The Nature Conservancy

AECOM

# PROMOTING NATURE-BASED HAZARD MITIGATION THROUGH FEMA MITIGATION GRANTS

# ABBREVIATIONS

ADCIRC – Advanced Circulation Model

BCA – Benefit-Cost Analysis

BCR – Benefit-Cost Ratio

BRIC – Building Resilient Infrastructure and Communities

C&CB – Capability- and Capacity-Building

CDBG-DR – Community Development Block Grant-Disaster Recovery

CDBG-MIT – Community Development Block Grant-Mitigation

D.C. – District of Columbia

DEM – Department of Emergency Management

DOI – Department of the Interior

EDYS – Ecological Dynamics Simulation

EMA – Emergency Management Agency

EPA SWMM – Environmental Protection Agency Storm Water Management Model

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Map

FMA – Flood Mitigation Assistance

FMAG – Fire Management Assistance Grant

HAZUS – Hazards US

HEC-HMS – Hydrologic Engineering Center-Hydrologic Modeling System

HEC-RAS – Hydrologic Engineering Center-River Analysis System

HGM Approach – Hydrogeomorphic Approach

HMA – Hazard Mitigation Assistance

HMGP – Hazard Mitigation Grant Program

MSCP – Multiple Species Conservation Program

NBS – Nature-Based Solution

NFIP – National Flood Insurance Program

NFWF – National Fish and Wildlife Foundation

NOAA – National Oceanic and Atmospheric Administration

NOFO – Notice of Funding Opportunity

NPV – Net Present Value

SCC – State Coastal Conservancy

SDG&E – San Diego Gas & Electric

SFHA – Special Flood Hazard Area

SHMO – State Hazard Mitigation Officer

SLAMM – Sea Level Affecting Marshes Model

SRH-2D – Sedimentation and River Hydraulics – Two-Dimension

STWAVE – Steady-State Spectral Wave Model

TNC – The Nature Conservancy

USACE – U.S. Army Corps of Engineers

USFWS – U.S. Fish and Wildlife Service

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# GLOSSARY OF TERMS

Ancillary Benefits - Benefits generated by the project that are not directly related to the primary risk (riverine/urban flooding, coastal flooding, or wildfire).

Benefit Cost Analysis - An analysis of the risk reduction cost-savings provided by a hazard mitigation project compared to the present value of the costs. FEMA prescribes the use of a very specific approach to assess the benefits of a project.

Benefit Cost Ratio - The present value of benefits (including negative benefits) is placed in the numerator of the ratio and the present value of costs is placed in the denominator. A BCR >1 indicates that the benefits exceed the costs.

Capacity- and Capability-Building - Activities that enhance the knowledge, skills, and expertise to expand or improve the administration of mitigation assistance.

Community Lifelines – As established by FEMA, a lifeline enables the continuous operation of critical business and government functions and is essential to human health and safety or economic security.

Conservation Easement – Land is preserved from development, but the title remains with the original owner.

Ecosystem Services - The services provided by the Earth's ecological systems and resources to support human life. The benefits can be direct or indirect, small or large.

Engineering with Nature – Defined by USACE as, "the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaboration."

Fee Simple - Transition of the total suite of rights to a parcel of land.

Flood Mitigation – Implementation of actions to reduce or eliminate the long- term risk of flood-damage to buildings, other structures and infrastructure.

Grantee/Subgrantee - An applicant/subapplicant that has been awarded a funding grant.

Green-Gray Infrastructure- A mix of conservation and restoration of natural systems (e.g., mangroves, forests, floodplains) with conventional hard infrastructure (e.g., concrete seawalls, levee, roads).

Hazard Mitigation Assistance Grant - A suite of FEMA mitigation grant programs that offers pre- and post-disaster funding targeted at reduceing losses from natural hazards.

Living Shoreline - Living shoreline is a broad term that encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines, and tributaries. A living shoreline has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline structure (e.g. oyster reefs or rock sills) for added stability. Living shorelines maintain continuity of the natural land–water interface and reduce erosion while providing habitat value and enhancing coastal resilience.

**Natural Hazards** - Natural events that threaten lives, property, and other assets.

**Nature-Based Solutions** – Defined by TNC as: "project solutions that are motivated and supported by nature and that may also offer environmental, economic, and social benefits, while increasing resilience. Nature-based solutions include both green and natural infrastructure." Defined by FEMA as, "sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to build more resilient communities."

**Presidential Disaster Declaration** - The President can declare a Major Disaster Declaration for any event, including any natural disaster, such as a hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought, or, regardless of cause, fire, flood, or explosion, that the President believes has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond.

**Project Scoping** - Activities designed to develop mitigation strategies and obtain data to prioritize, select, and develop complete applications in a timely manner that result in either an improvement in the capability to identify appropriate mitigation projects or in the development of an application-ready mitigation project

**Resilience** – The capacity of individuals, communities, and natural systems to survive, adapt, and grow despite the natural hazards they experience.

**Setback Levee** - Earthen embankments that are located at a distance from a river or channel to allow the river to meander in a more natural manner and occupy some or all of its natural floodplain during high water events.

SECTION 1

# INTRODUCTION

Natural hazards of flooding and wildfires pose major threats to communities across the U.S. The frequency and intensity of these hazards is also likely to increase over the coming decades due to our evolving climate. Traditionally, "gray" or "hard" infrastructure solutions—engineering projects that use concrete and steel—have dominated efforts to manage risk and mitigate hazard impacts for communities. For example, seawalls and revetments have a long history of protecting coastal infrastructure. Similarly, preferred building materials in wildfire-prone areas has transitioned from wood to stone, steel, or composites. Although these approaches have been effective in providing site-specific hazard mitigation, the focus is shifting toward holistic solutions that have an eye towards natural processes to provide increased resilience.

Living shorelines integrate risk reduction while enhancing ecosystem services.

Combining gray infrastructure with nature-based approaches, often referred to as **a hybrid approach, can also provide an effective means for hazard mitigation that results in environmental, economic, and social co-benefits.** The Federal Emergency Management Agency (FEMA) is becoming aware of nature-based solutions as viable and preferred hazard mitigation solutions and has expressed a specific interest in funding them through Hazard Mitigation Assistance (HMA) grants. To support this momentum, The Nature Conservancy (TNC) has developed this guidebook to introduce these resources to its teams and partners and advance the use of FEMA HMA funds for a wide range of nature-based hazard mitigation and climate change resilience projects.

## DEFINING NATURE-BASED SOLUTIONS

Although nature-based solutions (NBS) are intended to enhance natural ecosystems to mitigate hazards, there is no universal definition and organizations frequently use differing terminologies specific to their sectors. Common definitions of nature-based solutions include:

- **TNC** defines nature-based solutions as, "project solutions that are motivated and supported by nature and that may also offer environmental, economic, and social benefits, while increasing resilience. Nature-based solutions include both green and natural infrastructure."
- **FEMA** defines nature-based solutions as "sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to build more resilient communities."[1]
- **The U.S. Army Corps of Engineers** (USACE) uses the term "**Engineering with Nature**," defined as, "the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaboration."[2]

A common thread among the definitions is that NBS provide a greater value than single-purpose gray infrastructure to yield community and ecosystem benefits and enhance the resilience of the site.

1 Federal Emergency Management Agency. (2020). Building Community Resilience with Nature-Based Solutions: A Guide for Local Communities. https://www.fema.gov/sites/default/files/2020-08/fema_riskmap_nature-based-solutions-guide_2020.pdf

2 U.S. Army Corps of Engineers. Engineering With Nature Initiative. https://ewn.el.erdc.dren.mil/. Accessed 16 February 2021.

# PURPOSE AND INTENDED USE

This guidance document is intended for stakeholders pursuing FEMA HMA grants for nature-based solutions to mitigate risks associated with flooding (riverine and coastal) and wildfire. **Many of the HMA grant programs can fund projects that mitigate other hazards, but this document is limited in discussion to flooding and wildfire.**

This document is designed to give users a better understanding for how HMA grants are a viable funding source for nature-based solutions to hazard mitigation. This includes an overview of selecting appropriate NBS for a given hazard and location, FEMA HMA requirments, and how to maximize benefits for a given project. Through this discussion, brief explanations of FEMA HMA funding pathways will be explored, but the discussion will not be exhaustive, as there are FEMA guidance documents that go into detail on the grant programs.

As introduced on the following page, there are three programs within HMA to fund mitigation projects, both pre- and post-disaster. There are many consistent elements across all programs, but there are also deviations in how grant funds are allocated and awarded across each program. To prevent confusion within this guidance document, the specific HMA program will be identified as appropriate within the content. **If not specifically identified, it can be assumed that the Building Resilient Infrastructure and Communities (BRIC) program is taking precedence**, as it serves as the most recently initiated by FEMA and takes an expanded focus on nature-based projects.

With these considerations in place, users of this guidance document should come away able to identify funding opportunities and how to best prepare project concepts to capture those funds. While the guidance document focuses on national HMA grant program requirements, it is important to understand that individual project eligibility and funding preferences are set at the state level. Because of this, it is important to have early communication with the **State Hazard Mitigation Officer**, and the state agency's grants team, to develop consensus on project approach.

## Nature-Based Terminology

There are many terms that refer to the idea of implementing and capturing benefits from natural systems. These terms include nature-based solutions, green infrastructure, ecosystem services, etc. Quick notes on these terms are below.

***Nature-Based Solutions*** - Project solutions that are motivated and supported by nature and that may also offer environmental, economic, and social benefits, while increasing resilience. This is an umbrella concept that covers a range of approaches, including restoration, management, conservation, and nature-based infrastructure (e.g., green infrastructure and low impact development). Many of these approaches share similarities in their interventions and, once implemented, ultimately perform the same ecosystem services.

***Green Infrastructure*** - Intentional or strategic preservation, enhancement, or restoration of a natural system or semi-natural systems to provide a desired benefit (e.g., flood protection, water purification, carbon sequestration, etc.)

***Low Impact Development*** - Systems and practices that use or mimic natural processes that result in a desired benefit. The practice is primarily used for capture and onsite treatment of stormwater runoff in urban areas to protect water quality and associated aquatic habitat.

***Ecosystem Services*** - The services provided by the Earth's ecological systems and resources to support human life.

# FEMA FUNDING OPPORTUNITIES FOR HAZARD MITIGATION

The Department of Homeland Security's FEMA HMA programs present a critical opportunity to reduce the risk to communities from natural hazards while simultaneously reducing reliance on Federal disaster recovery funds.

The HMA program includes three grant types for qualifying mitigation activities, especially those that mitigate flood risk in areas that previously experienced losses and help prevent future damages. All three HMA funding streams encourage the consideration of NBS as eligible project types that provide hazard mitigation while also supporting a community's environmental, social, and economic goals.

FEMA offers both pre- and post-disaster funding opportunities. **Pre-disaster mitigation opportunities** allow communities to plan for future disasters and enjoy the benefits of achieving a more resilent landscape before a natural disaster strikes. **Post-disaster mitigation opportunities** allow communities to take advantage of larger pots of funding that may become available in the aftermath of a federally-declared disaster. These opportunities allow communities to recover in a strategic and resilient manner.

| | | |
|---|---|---|
| PRE-DISASTER | BUILDING RESILIENT INFRASTRUCTURE AND COMMUNITIES | The Building Resilient Infrastructure and Communities (BRIC) program is a pre-disaster grant providing funds for hazard mitigation projects and capability- and capacity-building activities that expand or improve the administration of mitigation assistance. Funding from this grant reduces reliance on reactive spending and increases proactive investments in science-based community resilience projects. |
| | FLOOD MITIGATION ASSISTANCE | The Flood Mitigation Assistance (FMA) program provides pre-disaster funds for the reduction or elimination of long-term flood risk to buildings, manufactured homes, and other structures insured by the National Flood Insurance Program (NFIP). |
| POST-DISASTER | HAZARD MITIGATION GRANT PROGRAM | The Hazard Mitigation Grant Program (HMGP) provides post-disaster recovery funds to rebuild in a way that reduces future disaster losses in the community. HMGP is often open state-wide, and it can be used to rebuild in damaged areas and to mitigate in non-damaged areas. This grant funding is available after a presidentially declared disaster. |

# KEY STEPS FOR REALIZING A NATURE-BASED SOLUTION FOR HAZARD MITIGATION

This guidance document provides an overview of primary considerations to account for when pursuing FEMA HMA funding for NBS. Although nature-based solutions can mitigate many hazard types, linking the appropriate solution with the appropriate grant program depends on several variables. These include applying for the most appropriate HMA grant for the project site, selecting the most effective hazard mitigation technique, quantifying the benefits offered by the proposed NBS, and refining the project approach and strategy to maximize grant funding success.

| | |
|---|---|
| **FEMA HAZARD MITIGATION ASSISTANCE PROGRAMS** | Is the need for a mitigation project driven by pre-disaster preparation or an immediate post-disaster response? |
| **MITIGATION TECHNIQUES** | Is the primary hazard affecting the project site coastal flooding, urban flooding, or wildfire? Based on the project site characteristics, what is the most effective NBS? |
| **QUANTIFYING BENEFITS** | How to best quantify the benefits of nature-based solutions using the FEMA benefit-cost analysis (BCA) tool and capture additional ancillary benefits offered by a nature-based approach? |
| **APPROACH & STRATEGY** | How to maximize possible mitigation benefits, build consensus, gain stakeholders, or improve overall project impact? |

Dune restoration and planting on South Padre Island, Texas.

SECTION 2

# FEMA HAZARD MITIGATION ASSISTANCE PROGRAMS

The benefits of using nature-based solutions for hazard mitigation are increasingly clear. Projects that restore and/or emulate natural systems in order to increase human, ecosystem, and infrastructure resilience to natural hazards have been shown to reduce or prevent damages from natural hazards, are frequently cost-effective, and provide multiple benefits in addition to risk reduction.[3] Recognizing these benefits, FEMA's HMA grants offer federal funding to help states, local governments and agencies, and tribes to implement NBS for hazard mitigation assistance. These federal grants allow communities to develop projects that draw on multiple, interrelated benefits of nature-based solutions that increase preparedness for natural disasters while also investing in social, economic, and environmental benefits that can further strengthen community resilience.

3 Reguero, B. G. et al. (2018). Comparing the cost effectiveness of nature-based and coastal adaptation: A case study from the Gulf Coast of the United States. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5894966/pdf/pone.0192132.pdf

Volunteers from TNC plant trees as part of a reforestation project at the Conservancy's LaPlatte River Marsh Natural Area in Vermont.

***FEMA is increasing its focus on incorporating nature-based solutions into its programs***

*To do so, FEMA has developed targeted guidance documents that may be useful alongside this guide. Project proponents are strongly encouraged to review FEMA's reference materials, such as the* ***Building Community Resilience With Nature-Based Solutions*** *guide, that explain introductory concepts and nature-based solution project types. Many of the concepts within this guide are touched on in FEMA's as well, including collaboration, project scale, and co-benefits.*

## APPLICANT VS. SUBAPPLICANT ROLES

States, federally recognized tribes, and territories are designated as the HMA Applicant for FEMA HMA funding. State agencies, local governments, and tribal governments qualify as Subapplicants and must apply to the Applicant to be considered for FEMA funding. Once awarded, the subapplicant bears the responsibility of administering and managing the grant, but the applicant will oversee the grant requirements.

Individuals, businesses, and non-profits are not eligible to apply for HMA funds, but subapplicants can apply for funding on their behalf. For more information about applicant and subapplicant eligibility, refer to the FEMA **Hazard Mitigation Assistance Guidance**.

While the statutory origins of the FEMA HMA programs differ, **all HMA grants are nationally-competitive and share a common goal of reducing the loss of life and property due to natural hazards.**

# OVERVIEW OF FEMA HAZARD MITIGATION ASSISTANCE GRANTS AND ELIGIBILITY

Historically, post-disaster assistance (e.g., HMGP) has received significantly more resources than pre-disaster mitigation (e.g., FMA and BRIC). For example, in FY2019 FEMA provided $699.3M for HMGP, compared to $175M for FMA and $250M for pre-disaster mitigation funds.[4] However, funding for HMGP is available only after a major federal disaster declaration, meaning the President has determined the magnitude of the disaster has exceeded the state's capacity to effectively respond. Due to the episodic nature of disaster events, the amount awarded is highly variable each year. Historically, grants from the FMA and BRIC programs are awarded without a disaster declaration, and the BRIC program is intended to provide a more stable funding source.

FEMA's HMA grant programs also differ in the way they are designed and awarded:

- **HMGP** is authorized by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act). It provides post-disaster recovery funds to state and local governments for mitigation projects aimed at reducing future loss of life and property damage. The amount of funding a state receives for a declaration is 7.5 to 15 percent of the total disaster aid that FEMA grants the state for the disaster. **The maximum award increases to 20 percent for states with enhanced hazard mitigation plans.** The amount of disaster aid used to calculate the percentage is capped at $35.3 billion and states are obligated to pay a 25 percent cost share to receive the funding.
- **FMA** is authorized by the National Flood Insurance Act of 1968. It provides pre-disaster funds aimed to reduce or eliminate claims under the **National Flood Insurance Program**. Funds are administered through competitive grants to state and local governments to develop plans and complete projects to reduce identified flood risk. FEMA will generally cover up to 75 percent of eligible project costs but may contribute up to 90 percent for repetitive loss properties[5] or 100 percent for severe repetitive loss properties.
- The **BRIC** program was created as an amendment to the Stafford Act and authorizes FEMA to set aside up to 6 percent of Presidentially declared disaster expenses each year to provide pre-disaster funds. Project funding is intended for mitigation projects that reduce the risk of disasters and natural hazards. Like FMA, the funds are administered through competitive state and local government grants. FEMA will generally cover up to 75 percent of eligible project costs but may contribute up to 90 percent for small impoverished communities. The funding available for BRIC varies each year based on Presidential disaster declarations. FEMA announces the budget determination in the annual Notice of Funding Opportunity (NOFO), which is posted on their website prior to opening the application period.

Table 2-1 summarizes distinguishing factors and Table 2-2 lists key eligibility requirements to assist in appropriate grant selection.

4 HMA Annual Report: https://www.fema.gov/sites/default/files/2020-09/fema_hma-year-in-review-support-document_June2020.pdf. Prior to 2020, pre-disaster grants were distributed under the PDM program, not BRIC.

5 FEMA defines this as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978.

The flooded overflow banks from the Mississippi River in St. Francisville, LA.

## TABLE 2-1. DISTINGUISHING FACTORS FOR FEMA HAZARD MITIGATION GRANTS

| ***FMA*** <br> ***Flood Mitigation Assistance*** | ***BRIC*** <br> ***Building Resilient Infrastructure and Communities*** |
|---|---|
| • **Pre-disaster**<br>• Flood hazards only (no fire)<br>• Funding availability originates from annual appropriations<br>• Community must be in good standing with the NFIP and be located in a Special Flood Hazard Area (SFHA)<br>• Program has least flexibility and smallest funding cap ($200 million is available for 2021, but can vary annually)<br>• Cost share is typically 25 percent (zero to 10 percent for repetitive loss or severe loss properties)<br>• If possible, projects should benefit repetitive and severe repetitive loss properties<br>• **Funding Caps per project:**<br>  • Project Scoping - $600,000<br>  • Flood Mitigation Projects - $30 million<br>  • Technical Assistance - $50,000 | • **Pre-disaster**<br>• All hazards<br>• Funding availability originates from up to 6% set aside from federal post-disaster grant funding<br>• Program has the most incentives for NBS<br>• Program has more flexibility and more funding than FMA<br>• Cost share is typically 25 percent (10 percent for small impoverished communities)<br>• **Projects compete locally (State review) and nationally (FEMA competition):**<br>  • Capability- and capacity-building activities, such as project scoping, are only eligible under the State/Territory Allocation<br>  • Due to the funding caps, smaller mitigation projects (<$600,000) are eligible under State/Territory Allocation while larger projects (up to $50 million) are best suited for the National Competition<br>• An unlimited number of projects may be submitted for the National Competition<br>• **Funding Caps per funding type:**<br>  • State/Territory Allocation - $600,000 annually<br>  • National Competition - $50 million per project |
| ***HMGP*** <br> ***Hazard Mitigation Grant Program*** | ***HMGP Post-Fire*** <br> ***Hazard Mitigation Grant Program Post-Fire*** |
| • **Post-disaster**<br>• All hazards<br>• Funding availability originates from Presidentially declared disaster<br>• Project state/area recently (within 12 months) had a federal disaster declaration<br>• Program has the most flexibility for eligibility requirements<br>• Projects compete for funding on a local scale, which may improve the likelihood of award<br>• Projects must be able to be completed within 36 months<br>• Cost share is typically 25 percent | • **Post-disaster**<br>• Fire hazards only<br>• Funding availability originates from national aggregate for each Fire Management Assistance Grant Declaration Grant declaration<br>• State/tribe/territory recently (within 6 months of the close of the declaration fiscal year) had a Fire Management Assistance Grant Declaration to be eligible<br>• Cost share is typically 25 percent<br>• A separate BCA is not required for soil stabilization, flood diversion, or reforestation projects |

The **Hazard Mitigation Grant Program Post-Fire** (HMGP Post-Fire) is a **non-competitive grant** initiated in 2018 that provides mitigation assistance using HMGP funds for areas affected by and recovering from fire damages. HMGP Post-Fire funding focuses on reducing the risk of future damage and loss posed by wildfires. The funding is available following a Fire Management Assistance Grant (FMAG) declaration, rather than a major disaster declaration, making the funding more easily accessible than the other HMA opportunities aimed at fire damage mitigation.

## TABLE 2-2. MINIMUM REQUIREMENTS FOR FEMA HAZARD MITIGATION GRANTS

| Minimum Requirements | Grant Program | | | |
|---|---|---|---|---|
| | FMA | BRIC | HMGP | HMGP Post-Fire |
| ***Basic Eligibility*** | | | | |
| Applicant/Subapplicant part of approved Hazard Mitigation Plan | ■ | ■ | ■ | ■ |
| Project aligns with FEMA-approved Hazard Mitigation Plan | ■ | ■ | ☐ | ☐ |
| National Flood Insurance Program member in good standing if the mitigation project is located in the SFHA | ■ | ■ | ■ | ☐ |
| Communities with projects in SFHAs* | ■ | | | ■ |
| ***Hazard Type*** | | | | |
| Grant supports flood mitigation (riverine or coastal) | ■ | ■ | ■ | ■ |
| Grant supports fire mitigation | | ■ | ■ | ■ |
| ***Disaster Declaration*** | | | | |
| Requires major disaster declaration in the state within the past 12 months | | | ■ | |
| Requires major disaster declaration within past 7 years | | ■ | | |
| Requires fire management assistance grant declaration | | | | ■ |
| ***Federal Compliance*** | | | | |
| Environmental Planning and Historic Preservation Review & Compliance | ■ | ■ | ■ | ■ |
| Conformance with International Building Codes (ASCE/SEI 24-14 ) | ■ | ■ | ■ | |

☐ Exceptions may apply

*Communities that submit projects in the SFHA must participate in the NFIP

# TRENDS IN FEDERAL MITIGATION PRIORITIES

As the cost of natural disasters continues to increase, the breakdown of pre- vs. post-disaster grants awarded may begin to shift to favor an increase in mitigation project spending.[6] In response to growing federal disaster spending, **FEMA is considering several options to change the federal-state fiscal relationship, such as providing incentives for states to invest in more pre-disaster mitigation projects** that decrease the likelihood of damage to infrastructure. Mitigation projects have been shown to save an average of $6 in response and recovery for every $1 spent.[7] For example, FEMA launched the Mitigation Investment Moonshot mission in 2017 with the goal of quadrupling mitigation spending by federal, state, local, and tribal governments by 2023 and has published a National Mitigation Investment Strategy focused on building support for investments in pre- and post-disaster mitigation projects. Congress further strengthened this initiative by including a provision in the 2018 bipartisan budget agreement increasing the federal government's share of natural disaster recovery costs for states that have invested in pre-disaster mitigation efforts.

In addition to promoting an increase in pre-disaster mitigation investments, **FEMA has also taken a large step to encourage communities to use NBS for flood hazard protection.** The new policy (**FP-108-024-02**), released in September 2020, revises the benefit-cost analysis used to evaluate State-submitted HMA grant applications to allow all projects to include their environmental and social benefits, in addition to flood protection. The update acknowledges the important role that the natural environment plays in a community's resilience and allows applicants to demonstrate the effectiveness of nature-based approaches, such as floodplain restoration and expansion in flood protection.

6 NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2021). https://www.ncdc.noaa.gov/billions/, DOI: 10.25921/stkw-7w73

7 National Institute of Building Sciences Issues New Report on the Value of Mitigation (https://www.nibs.org/news/381874/National-Institute-of-Building-Sciences-Issues-New-Report-on-the-Value-of-Mitigation.htm)

***DID YOU KNOW:***

***HMA includes funds allocated to project scoping in addition to funding project implementation?***

***Project scoping funds can provide a community or individual initial funding to further study flood mitigation project opportunities*** *if a detailed analysis has not already been completed. While these funds may not be a strong focus of the HMA program, they can provide a path towards developing a thorough project application at a later date, with the necessary technical insights required to show NBS and their benefits.*

# THE STATE'S ROLE IN FEMA HAZARD MITIGATION FUNDING

Overall, these advances in FEMA's policies have expanded funding opportunities for projects that have overlapping conservation, recreation, and disaster mitigation benefits. This change will more accurately reflect the benefits of NBS and help these projects receive federal funding.

Although FEMA sets national funding priorities and application deadlines for both pre- and post-disaster mitigation programs, each state also plays a critical role, as they are tasked with administering FEMA-awarded funds. States are responsible for the review, prioritization, and funding recommendation of eligible projects to FEMA. Therefore, understanding the role and goals of the state are important to being competitive in the grant cycles. To assist local governments and tribes, state staff offer technical assistance and training for project identification and preparing applications. Coordination with your State Hazard Mitigation Officer and State Floodplain Coordinator is the first step to establishing this foundational knowledge (a table of contacts is included at the end of this section). Not all states manage HMGP, FMA, and BRIC out of the same agency, so coordination with multiple state agencies may be required. Some states might also have earlier deadlines (e.g., up to several months) for HMA funding consideration than the official federal program deadline. Therefore, **it is important to make sure communities are aware of both state and federal deadlines** when starting the application process.

# FEDERAL MITIGATION FUNDING CAN VARY FOR EACH STATE

The breakdown of funding received for each state is dependent on many factors, including: natural disasters experienced (HMGP); whether the president declared a major disaster (HMGP); and state and local decisions about which and how much federal mitigation assistance to pursue (Figure 2-1).

Studies of historical state disaster spending indicate that all 50 states and the District of Columbia (D.C.) received at least some financial support from FEMA's hazard mitigation programs from 2007 to 2016, but the amount and type of funding was highly variable. Funding amounts ranged from $6 million in D.C. to $1.4 billion in New York. Forty-three states received the largest share of their FEMA mitigation grants through the HMGP, while the remaining states (and D.C.) received most of their funding through pre-disaster mitigation funds.

FEMA publishes and maintains annual reports and data visualization products intended to provide documentation of the effectiveness of the program's performance and stewardship of resources. These products can be used to help subapplicants understand local historical risks and the evolution of mitigation priorities across the country.

**FEMA Data Visualization Tools: https://www.fema.gov/about/reports-and-data/data-visualizations**

**Full datasets for hazard mitigation are available here: https://www.fema.gov/about/openfema/data-sets#hazard**

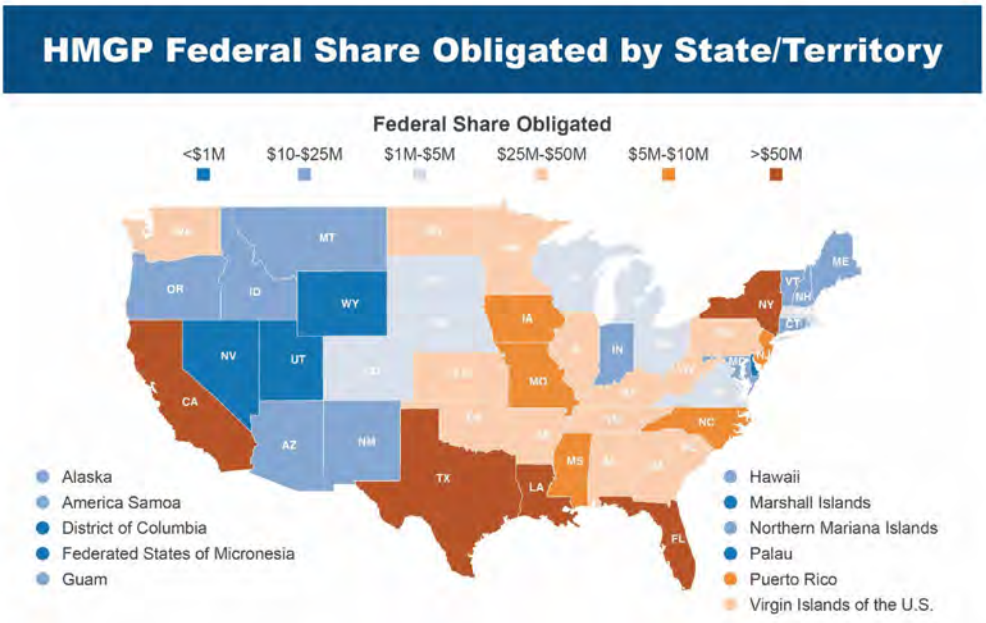



Figure 2-1. Example breakdown of FEMA-awarded HMGP grants described in the **Hazard Mitigation Assistance Division Year in Review** report

## *DID YOU KNOW*

*BRIC divides its annual funding among a set-aside for states and territories, tribes and a national competition. In FY2020, each state and territory was allocated $600,000 and these funds can be used for mitigation projects and Capability- and Capacity-Building (C&CB) activities. C&CB activities can be used to enhance the knowledge, skills, and expertise of the workforce to promote the use of NBS in future mitigation projects. In addition to the state/territory allocation and the national competition for funding mitigation projects, BRIC also provides opportunities to receive support through management costs and non-financial, direct technical assistance, but these are not covered in this guidance document.*

*Refer to the **BRIC Program Support Materials** about the C&CB activities, which provide additional detail about eligible efforts. Although eligible C&CB activities are designed to be flexible, there should be a clear connection to mitigation or resilience when determining preferred activities that could be selected for funding.*

# STATE HAZARD MITIGATION AGENCIES

States play a critical role in accessing FEMA hazard mitigation grant funding. In some cases, they directly select recipients of funding from their state allocations, such as with the BRIC program. Most states have their own priority and selection criteria for most HMA programs and recommend subapplications for FEMA HMA funding. In these scenarios, understanding the role and goals of the state are important to being selected for a grant. **Coordination with your SHMO is the first step to establishing this foundational knowledge**. State Hazard Mitigation Officers are also listed on FEMA's website. In some cases, the SHMO may not manage all of the FEMA mitigation grants, as not all states manage HMGP, FMA, and BRIC out of the same agency.

| State/Territory | Agency | Phone | Website |
|---|---|---|---|
| **Alabama** | Alabama Emergency Management Agency | 205-280-2312 | ema.alabama.gov |
| **Alaska** | Department of Military and Veterans Affairs | 907-428-7085 | ready.alaska.gov |
| **American Samoa** | Office of Disaster Assistance | 684-633-4116 | americansamoa.gov |
| **Arizona** | Arizona Department of Emergency and Military Affairs | 602-464-6539 | dem.azdema.gov/ |
| **Arkansas** | Department of Emergency Management | 501-683-6700 | adem.arkansas.gov |
| **California** | California Governor's Office of Emergency Services | 916-845-8510 | caloes.ca.gov |
| **Commonwealth of the Northern Mariana Islands** | Emergency Management Office | | cnmihsem.gov.mp |
| **Colorado** | Colorado Division of Homeland Security and Emergency Management | 720-852-6600 | dhsem.state.co.us |
| **Connecticut** | Connecticut Department of Emergency Services and Public Protection, Division of Emergency Management and Homeland Security | 860-685-8000 | ct.gov/despp/site/default.asp |
| **Delaware** | Delaware Emergency Management Agency | 302-659-6855 | dema.delaware.gov |
| **District of Columbia** | DC Homeland Security and Emergency Management Agency | 202-727-6161 | hsema.dc.gov |
| **Florida** | Florida Division of Emergency Management | 850-815-4000 | floridadisaster.org |
| **Georgia** | Georgia Emergency Management and Homeland Security Agency | 404-635-7000 | gema.ga.gov |
| **Guam** | Guam Homeland Security, Office of Civil Defense | 671-475-9600-2 | aahd.us/2012/03/guam-emergency-preparedness-resources/ |
| **Hawaii** | Hawaii Emergency Mangement Agency | 808-733-4300 | scd.hawaii.gov |
| **Idaho** | Idaho Office of Emergency Management | 208-258-6500 | BHS.idaho.gov |
| **Illinois** | Illinois Emergency Management Agency | 217-782-2700 | state.il.us |
| **Indiana** | Indiana Department of Homeland Security, Indiana Government Center South | 317-232-2222 | in.gov/dhs/ |
| **Iowa** | Iowa Homeland Security and Emergency Management Department | 515-725-3231 | homelandsecurity.iowa.gov/ |
| **Kansas** | Kansas Division of Emergency Management | 785-646-2000 | kansastag.gov/kdem |
| **Kentucky** | Kentucky Division of Emergency Management | 800-255-2587 | kyem.ky.gov |
| **Louisiana** | Louisiana Governor's Office of Homeland Security & Emergency Preparedness | 225-925-7500 | Gohsep.la.gov |
| **Maine** | Maine Emergency Mgmt. Agency | 207-624-4400 | Maine.gov |
| **Maryland** | Maryland Emergency Management Agency | 410-517-3600 | mema.maryland.gov |
| **Massachusetts** | Massachusetts Emergency Management Agency | 508-820-2001 | mass.gov/ |
| **Michigan** | Emergency Management and Homeland Security Division, Michigan State Police | 517-284-3745 | michigan.gov |

| State/Territory | Agency | Phone | Website |
|---|---|---|---|
| **Minnesota** | Minnesota Department of Public Safety, Homeland Security and Emergency Management | 651-201-7400 | Hsem.state.mn.us |
| **Mississippi** | Mississippi Emergency Management Agency | 866-519-6362 | Msema.org |
| **Missouri** | Missouri State Emergency Management Agency | 573-526-9100 | Sema.dps.mo.gov |
| **Montana** | Montana Department of Military Affairs Disaster & Emergency Services | 406-324-4777 | http://readyandsafe.mt.gov/Emergency |
| **Nebraska** | Nebraska Emergency Management Agency | 402-471-7421 | Nema.ne.gov |
| **Nevada** | Department of Public Safety, Division of Emergency Management | 775-687-0300 | Dem.nv.gov |
| **New Hampshire** | New Hampshire Homeland Security and Emergency Management | 603-271-2231 | nh.gov/safety/divisions/hsem |
| **New Jersey** | New Jersey Office of Emergency Management | | state.nj.us/njoem/ |
| **New Mexico** | CFM New Mexico Department of Homeland Security and Emergency Management | 505-476-9600 | nmdhsem.org |
| **New York** | New York State Division of Homeland Security and Emergency Services | 518-292-2275 | dhses.ny.gov/recovery |
| **North Carolina** | Division of Emergency Management, North Carolina Department of Public Safety | 919-825-2500 | ncdps.gov |
| **North Dakota** | Division of Homeland Security, N.D. Department of Emergency Services | 701-328-8100 | nd.gov/des/emergency |
| **Ohio** | Ohio Department of Public Safety | 614-889-7150 | ema.Ohio.gov |
| **Oklahoma** | Oklahoma Emergency Management Agency | 405-521-2481 | ok.gov/OEM/ |
| **Oregon** | Oregon Military Department, Office of Emergency Management | 503-378-2911 | Oregon.gov |
| **Pennsylvania** | Pennsylvania Emergency Management Agency | 717-651-2001 | pema.pa.gov |
| **Puerto Rico** | Central Recovery and Reconstruction Office | 787-273-8202 | https://recovery.pr/en |
| **Rhode Island** | Rhode Island Emergency Mgmt. Agency | 401-946-9996 | sos.ri.gov |
| **South Carolina** | South Carolina Emergency Management Division | | scemd.org |
| **South Dakota** | South Dakota Office of Emergency Management | 605-773-3231 | dps.sd.gov |
| **Tennessee** | Tennessee Emergency Management Agency | 615-741-0001 | tnema.org |
| **Texas (HMGP, BRIC)** | Texas Division of Emergency Management | 512-424-2208 | www.tdem.texas.gov |
| **Texas (FMA)** | Texas Water Development Board | 512-463-7847 | twdb.texas.gov/flood |
| **Utah** | Utah Division of Emergency Management | 801-538-3193 | https://dem.utah.gov/hazards-and-mitigation/ |
| **Vermont** | Vermont Emergency Management | 800-347-0488 | vem.vermont.gov |
| **Virginia** | Virginia Department of Emergency Management | | VAemergency.com |
| **Virgin Islands** | Virgin Islands Territorial Emergency Management Agency | 340-774-2244 | vitema.gov |
| **Washington** | Washington Emergency Management | 253-512-8000 | mil.wa.gov/emergency-management-division |
| **West Virginia** | WV Division of Homeland Security and Emergency Management | 304-558-5380 | dhsem.wv.gov/Grants/Pages/default.aspx |
| **Wisconsin** | Wisconsin Emergency Management | 608-242-3000 | Emergencymanagement.wi.gov/mitigation |
| **Wyoming** | Wyoming Office of Homeland Security | 307-777-4900 | wyohomelandsecurity.state.wy.us/grants/mitigation_grants.aspx |

SECTION 3

# MITIGATION TECHNIQUES

There are a wide range of NBS that can be used for hazard mitigation. Each option offers a variety of co-benefits and can be used in different physical settings and applied on a range of scales. Nature-based solutions can be utilized alone or combined with services offered by traditional or gray infrastructure for a hybridized approach. Once implemented, NBS are considered key assets of a resilient community and highly advantageous to relying solely on gray infrastructure because of their inherent capacity to provide important social, economic, and environmental benefits. However, as with gray infrastructure, matching the most effective solutions to offset the hazards experienced in a particular setting can be challenging, and one option may not be applicable everywhere. Properly framing the hazard to allow for a wider array of potential solutions while also considering the community and physical context of the site is vital when developing a FEMA HMA grant application. This section provides a breakdown of considerations to support communities applying for HMA funding, targeting nature-based approaches to hazard mitigation.

## STEPS FOR SELECTING A NATURE-BASED SOLUTION

Selecting a nature-based solution for hazard mitigation follows a five-step process, summarized in Figure 3-1. These steps provide a framework to assist the applicant or subapplicant in prioritizing for the project that meets the community's hazard mitigation needs and qualifies for funding through FEMA's HMA program. First, it is important to determine the hazard (or combination of hazards) that are affecting the area and posing a risk to the subapplicant.

**Although there are many natural hazards facing communities across the country, this guidance document focuses on three most common challenges that can be addressed with NBS: coastal flooding, inland flooding, and wildfires.**

During the feasibility phase of project development, the subapplicant should create a list of all nature-based solutions that could mitigate risk of the identified hazard. The *Nature-Based Solutions by Hazard Type* subsection, below, provides additional information and examples of nature-based hazard mitigation projects categorized by hazards that may be funded by HMA grants. Because not all NBS can be applied uniformly, screening the options for those that fit the local needs and site-specific characteristics is an important accompanying step to filter for strategy applicability. For example, although a living levee may provide flood protection for an urban waterfront, there may be a space limitation for the required footprint of the flood mitigation feature. This step may require the expertise of a consultant (e.g., certified engineer or landscape architect) to provide design drawings or model calculations of the effectiveness of the options based on existing conditions of the site.

Once a subset of site-suitable options is selected, each should be analyzed for their potential ancillary benefits. Projects providing significant ancillary benefits should be strongly considered, as they will increase the social and environmental well-being of the supported community. Refer to Section 4 (*Qualitative Benefits*) for a list of common community lifeline examples prioritized by FEMA's HMA programs. Lastly, the options should be compared with FEMA's eligibility criteria for suitability with the appropriate HMA Program. Chapter 2 (*Funding Nature-Based Solutions*) provides background on eligibility requirements.

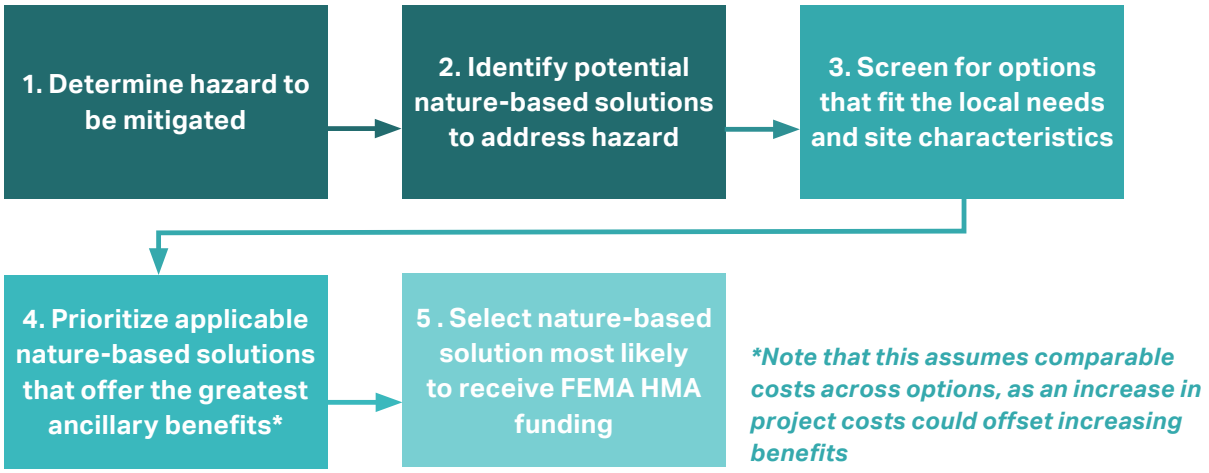



Figure 3-1. Steps in the nature-based solution selection process

## NATURE-BASED SOLUTIONS BY HAZARD TYPE

The BRIC program makes federal funds available for subapplicants to reduce the risks of hazard impacts with eligible activities generally categorized as **C&CB activities** and **mitigation projects**. Within the BRIC program, only mitigation projects are eligible to be funded under the national competition. C&CB activities include building codes, planning and partnership activities, and project scoping efforts. Project scoping activities are designed to gather data and information needed to prioritize, select, and develop complete applications for mitigation project funding opportunities. Funding for this project scoping serves as an important tool for the development of future mitigation projects, particularly for NBS, which are often large-scale efforts that require advanced feasibility studies and engagement of multiple stakeholders for project success. Table 3-1 lists example C&CB activities, which may be used to support NBS for hazard mitigation. FEMA has also developed program support materials to provide more detailed information about Project Scoping Activities specific to the BRIC, FMA, and HMGP programs, which should be referenced when developing an application for this project type.

Individual mitigation projects involve physical changes or improvements to a site to provide enhanced protection from hazards. Examples include restoring a floodplain to expand the natural retention of floodwaters and vegetation management to address wildland fire fuel hazards. **Projects are eligible if they reduce risk of loss of life and property and meet other FEMA eligibility requirements.** Table 3-2 lists examples of Individual Projects that may be designed, permitted, and constructed using nature-based approaches. Preference and eligibility of projects may vary by state. Therefore, before selecting a project, subapplicants are encouraged to reach out to and coordinate with their state hazard mitigation agency.

### *DID YOU KNOW*

*Non-financial Direct Technical Assistance is not a C&CB activity, but it is a BRIC program offering that can complement C&CB activities. Management costs can be requested by both applicants and subapplicants to manage their subawards.*

Chatsworth Park, Los Angeles using NBS, including drainage restoration and native vegetation.

## TABLE 3-1. EXAMPLE CAPABILITY- AND CAPACITY-BUILDING ACTIVITIES BY HAZARD TYPE

| Possible Activites | Riverine/Urban Flooding | Coastal Flooding | Wildfire |
|---|---|---|---|
| **Policy and Administration** | • Establish Zoning<br>• Revise Floodplain Development Codes | • Enact Setbacks<br>• Revise Building Codes | • Establish Zoning<br>• Revise Building Codes |
| **Data Collection and Studies** | • Data Collection<br>• Environmental Assessments<br>• Hydrologic and Hydraulic Analysis<br>• Floodplain Mapping | • Data Collection<br>• Environmental Assessments<br>• Coastal Analysis<br>• Floodplain Mapping | • Data Collection<br>• Environmental Assessments |
| **Applicant Capability and Capacity Building** | • Project Scoping<br>• Identify Match Funds<br>• Add Staff / Capacity | • Project Scoping<br>• Identify Match Funds<br>• Add Staff / Capacity | • Project Scoping<br>• Identify Match Funds<br>• Add Staff / Capacity |
| **Planning and Preliminary Design** | • Develop Hazard Mitigation Plan<br>• Feasibility Studies<br>• Alternatives Analysis<br>• Land Use Planning<br>• Preliminary Engineering | • Develop Hazard Mitigation Plan<br>• Feasibility Studies<br>• Alternatives Analysis<br>• Coastal Resilience Planning<br>• Preliminary Engineering | • Develop Hazard Mitigation Plan<br>• Feasibility Studies<br>• Alternatives Analysis<br>• Land Use Planning<br>• Preliminary Engineering |

***Nature-based solutions should be considered during all C&CB activities.***

### *DID YOU KNOW*

*C&CB activities "result in a resource, strategy, or tangible mitigation product that will reduce or eliminate risk and damage from future natural hazards." These activities can include Project Scoping that can later lead to an individual mitigation project.* ***Under the BRIC program, additional points are awarded under the national competition for projects that progress from Project Scoping/Advance Assistance to the individual project phase,*** *promoting a phased approach for stakeholders.*

| TABLE 3-2. EXAMPLE INDIVIDUAL MITIGATION PROJECTS BY HAZARD TYPE | | | | |
|---|---|---|---|---|
| **Scale** | **Setting** | **Riverine/Urban Flooding** | **Coastal Flooding** | **Wildfire** |
| ***Watershed/ Landscape*** | ***More Urban***  ***More Rural*** | • Greenways<br>• Culvert Upgrades<br>• Daylighting<br>• Low Impact Development<br>• Stormwater Parks<br>• Riparian Buffer<br>• Stream/River Restoration<br>• Horizontal Setback Levee<br>• Floodplain Restoration<br>• Dam Removal<br>• Land Conservation | • Culvert Upgrades<br>• Waterfront Parks<br>• Beach Parks*<br>• Tidal Circulation<br>• Living Shorelines<br>• Channel Restoration<br>• Beaches and Dunes*<br>• Coral Reef Restoration<br>• Coastal Wetlands Restoration (Marsh, Mangroves)<br>• Land Conservation | • Post-Fire Urban Debris Removal<br>• Post-Fire Hazard Tree Removal<br>• Vegetation Management<br>• Forest Thinning<br>• Forest Regeneration<br>• Forest Diversification |
| ***Neighborhood/ Site*** | ***More Urban***  ***More Rural*** | • Green Roofs<br>• Green Streets<br>• Permeable Pavers<br>• Vegetated Swales<br>• Rain Gardens<br>• Tree Canopy<br>• Rainwater Harvesting<br>• Land Acquisition | • Culvert Upgrades<br>• Waterfront Parks<br>• Stormwater Wetlands<br>• Living Shorelines<br>• Coastal Wetlands Restoration<br>• Shellfish Reef Restoration | • Fire- and Ignition-Resistant Roofing<br>• Retrofit for Ignition Resistant Building Materials<br>• Fire-Resistant Landscaping<br>• Pruning Requirements to Reduce Fuel Loads<br>• Post-Fire Soil Stabilization<br>• Establishing Defensible Space |

*Excludes beach nourishment or re-nourishment under FEMA guidance as of 2020

## PROJECT INELIGIBILITY

Projects that are ineligible are listed in FEMA's **Hazard Mitigation Assistance Guidance** under Sections E.1.2 (ineligible stand-alone activities), E.1.3.2 (ineligible planning-related activities) and E.2 (ineligible activities):

- Projects with the sole purpose of open space acquisition of unimproved land
- Projects located on Federal lands or associated with facilities owned by another Federal entity
- Projects related to beach nourishment or re-nourishment
- Projects that do not increase the level of protection
- Prescribed fire projects
- Projects for hazardous fuels reduction in excess of 2 miles from at-risk buildings and structures
- Creation and maintenance of fire breaks, access roads, or staging areas

# LESS COMMON APPLICATIONS OF FEMA-FUNDED NATURE-BASED SOLUTIONS

Some projects, such as those listed below, are project types not traditionally funded by FEMA HMA grants. They are more nuanced and require additional considerations and scoping related to eligibility and likelihood of award due to their unique complexities. Before pursuing a non-traditional nature-based project, it it recommended that the subapplicant contact and coordinate with their state hazard mitigation agency for eligibility and preference.

## Land Acquisition

Land acquisition of undeveloped open space is not currently eligible under HMA guidance. Land acquisitions are traditionally used to purchase property that repeatedly floods from homeowners. Non-traditional acquisitions may be able to be approved, in some cases, if:

- **Property to be acquired is undeveloped, at-risk land** adjacent to an eligible property with existing structures.
- **Property is upstream of or adjacent to substantial damage and repetitive loss properties,** particularly if the community has had difficulty enacting buyouts or if it can be demonstrated that acquisition provides more complete and permanent protection from future hazards than other alternatives.
- **Property acquisition of unimproved land is shown to be necessary** to enact a nature-based project, such as open space being acquired as a requisite subcomponent of a river restoration project.

Land can be purchased as a fee-simple (total transition of property title) or conservation easement (land is preserved from development, but the title remains with the original owner) transaction.

## Beaches and Dunes

Although beach nourishment and re-nourishment activities are ineligible under current FEMA guidance, some NBS for enhancing beach and dune areas, and the hazard mitigation services they offer, are eligible for funding. Some alternatives to direct sand placement could include:

- **Beach or dune planting** to reduce erosion, reduce wave height, and improve sand retention for the existing beach or dune areas.
- **Acquiring and restoring repetitive loss properties** near a beach or dune line to allow a dune system to rebuild naturally.
- **Adding scour protection** to an existing flood control structure, such as a seawall, as a first step to rebuilding a beach system in front of the engineered structure.

## Culvert Upgrades

Culvert upgrades, while typically perceived as an engineered or gray infrastructure solution, can nonetheless be designed to benefit nature. Upsizing, reconfiguring, or otherwise re-designing culverts can achieve benefits such as:

- **Restoring tidal circulation** when a culvert currently creates a choke point at a bridge or roadway near an estuary or tidal delta.
- **Improving fish migration** where undersized or outdated culverts do not allow sufficient clearance.
- **Meeting stream crossing standards,** guidance, or targets at federal, state, or local levels that have been developed since the original installation of the culvert. This guidance could include things like restoring stream bed material, preferred channel dimensions, instream habitat, recommendations to reduce habitat fragmentation, and climate change design considerations.

# TECHNICAL AND FEASIBILITY CONSIDERATIONS

In addition to identifying projects that mitigate hazard risks, FEMA encourages subapplicants to select measures that incorporate other key technical, financial, political, and environmental considerations. This ensures the project is feasible, has widespread support, and offers additional benefits, such as enhanced resilience (for example, a stormwater park can detain water in the middle of a highly urban area, redirecting it away from homes and businesses) and accessibility for the greater community. Considering these factors early in the project selection and scoping phase of the application process will allow the subapplicant to develop a viable project and plan that meets all HMA program requirements and increases the efficiency of the application review.

This section lists key considerations for project development—technical, financial, political, and environmental factors—that should be considered for nature-based solutions. The strategies and case studies linked in Table 3-1 and Table 3-2, above, may provide additional detailed information pertaining to the selected mitigation project.

In accordance with FEMA HMA program requirements, project applications should be able to demonstrate:

- Mitigation planning
- Climate change and resiliency considerations
- Universal accessibility and mitigation
- Technical feasibility and effectiveness
- Floodplain management and protection of wetlands (for FMA projects)
- Environmental and historic preservation requirement compliance and cultural resources review
- Cost-effectiveness

## GENERAL CONSIDERATIONS

| ***Opportunities*** | ***Challenges*** |
|---|---|
| • Nature-based solutions are typically more resilient to climate change, including more frequent and more intense storms and wildfires, because they allow natural processes (flooding, land or habitat migration) to occur.[8]<br>• Nature-based solutions have adaptive capacity (increased system capacity to mitigate losses, such as by adding vegetation or allowing natural migration of certain features) that can often be planned for and added post-construction, unlike traditional infrastructure. | • Overselling the value that nature-based solutions brings to the project should be avoided. Overselling the benefits of NBS could undermine the integrity of how they are perceived by decision makers and regulators.<br>• Substantiating the quantitative benefits provided by the NBS can be more challenging because of a lack of supporting environmental and economic models or studies.<br>• There are other challenges related to scale. For instance, NBS can be very expensive and might be harder to demonstrate a "complete" mitigation solution, especially if it is difficult to fund or isolate a discrete portion of a larger project.<br>• Large scale NBS are often looked at through multi-entity efforts, which can be challenging under FEMA programs, which require no duplication of programs or federal funding |

8 Seddon Nathalie, Chausson Alexandre, Berry Pam, Girardin Cécile A. J., Smith Alison and Turner Beth, 2020. Understanding the value and limits of nature-based solutions to climate change and other global challenges. Phil. Trans. R. Soc., B37520190120.

## FINANCIAL CONSIDERATIONS

| ***Opportunities*** | ***Challenges*** |
|---|---|
| Nature-based solutions are often applicable for funding opportunities that can be used as a match for federal hazard mitigation funding. Because they serve multiple goals, they can also attract multiple stakeholders and cost-sharing opportunities.<br>• Non-federal grant funds<br>• Private-public partnerships<br>• Donated or third-party in-kind services or materials<br>• Groups of repetitive loss or severe repetitive loss properties | • Nature-based solutions may have a greater initial cost than traditional engineering projects to acheive similar levels of risk reduction.<br>• If there is not enough information to generate a strong BCA for a nature-based project, it may be necessary to apply for C&CB funds (under the BRIC program) to further refine the project analysis before being considered in the national competition. |

## POLITICAL CONSIDERATIONS

| ***Opportunities*** | ***Challenges*** |
|---|---|
| • Nature-based solutions can add value to communities by creating recreational/cultural spaces that are designed to withstand natural hazards.<br>• Nature-based solutions that benefit repetitive loss areas, low-to-moderate income communities, or address other social vulnerabilities would likely contribute to points from BRIC qualitative evaluation criteria.<br>• Nature-based solutions offer benefits that infrastructure-only projects may not (recreational, cultural, environmental). | • Nature-based solutions should be aligned as closely as possible with State priorities, such as climate action plans and recommendations. Some states may have more guidance than others. |

## ENVIRONMENTAL CONSIDERATIONS

| ***Opportunities*** | ***Challenges*** |
|---|---|
| • Nature-based solutions offer multiple benefits that infrastructure-only projects cannot; for example, reducing urban heat stress, improving biodiversity, restoring lost habitat, and improving wildlife corridors.<br>• Nature-based solutions have great opportunity for community and resource agency buy-in. | • Nature-based solutions may require additional resource agency and regulatory coordination during permitting to gain consensus on the approach.<br>– Water quality<br>– Environmental |

## WHEN ARE ENGINEERING, ECONOMIC, OR ENVIRONMENTAL MODELS RECOMMENDED TO INCREASE THE LIKELIHOOD THAT A PROJECT WILL BE FUNDED?

| | ***Model Recommended*** | ***Model Likely Not Required*** |
|---|---|---|
| ENGINEERING | Engineering models will typically be required for large-scale, complex engineering projects or projects located in heavily urbanized areas and should be scoped to include NBS. The complexity of the model needed will depend on the nature-based project type and the site conditions. There may be existing models and studies that can be used in place of a new model. Any study or model used to justify the project should be certified by a licensed professional.<br>More Complex, 2D/3D Model<br>***Project examples:*** Setback levee, floodplain restoration, daylighting, tidal circulation, dam removal, river restoration.<br>• **Riverine/Urban:** HEC-RAS (2D), HEC-HMS, SRH-2D, MIKE suite<br>• **Coastal:** ADCIRC, STWAVE, XBEACH, MIKE21 (2D), Delft3D (3D)<br>• **Fire:** FlamMap<br>Less Complex, 1D/2D Model<br>***Project examples:*** Culvert upgrades, low impact development, greenways, riparian buffer, living shorelines, beaches and dunes, waterfront parks, stormwater parks.<br>• **Riverine/Urban:** 1D HEC-RAS, EPA SWMM, HY8<br>• **Coastal:** ADCIRC, STWAVE, XBEACH, MIKE21 (2D), Delft3D (3D)<br>• **Fire:** FlamMap | Engineering models are typically not required for small-scale projects that can use existing data or engineering calculations in a desktop analysis, administrative projects, or projects that use nature-based solutions that are well understood through pre-calculated benefits.<br>Desktop Assessment<br>***Project examples:*** Revised building codes, zoning, environmental assessments to support future project, forest diversification, forest thinning, debris removal, rainwater harvesting, permeable pavers, green roofs, green streets.<br>• Review effective FEMA Flood Insurance Rate Map(s) (FIRM) and locate NFIP properties<br>• Measure acreage of land by landcover type (riparian, open land, etc.) using Google Earth or ArcGIS<br>• Use existing literature sources to demonstrate expected benefits from implementing the NBS. Ideally, any academic studies used to validate results will be from the same geographical region as the proposed project |

### *Redman Point-Loosahatchie Bar Environmental Restoration Project*

*The landscape-scale Redman Point-Loosahatchie Bar Environmental Restoration project on the Mississippi River near Memphis, Tennessee included notching several existing rock dikes that were constructed in the 1960s to contain river flow to improve the biological function of least terns, riverine fish, river-connected wetlands, and other aquatic habitat.*

*To determine a nature-based approach for restoring the channel,* ***USACE developed a small-scale, physical, moveable-bed model to determine which project components would maximize environmental uplift and minimize impacts to navigation.*** *The improved habitat benefits three endangered species and other fish and migratory birds and provides nature-based recreational tourism.*

## WHEN ARE ENGINEERING, ECONOMIC, OR ENVIRONMENTAL MODELS RECOMMENDED TO INCREASE THE LIKELIHOOD THAT A PROJECT WILL BE FUNDED?

| | ***Model Recommended*** | ***Model Likely Not Required (Pre-Calculated Benefits)*** |
|---|---|---|
| **ECONOMIC** | An economic model is recommended if there are benefits for the project that are not included in the FEMA BCA toolkit (see Section 4) that the subapplicant would like to claim to augment a low BCR (lower than 1.0). If a different model than the BCA Toolkit is used, prior approval from FEMA is required.<br><br>Examples could include:<br>• Benefit transfers of ecosystem service study results to a subapplicant's project<br>• Damages avoided in the future from pending development<br><br>***Project examples:*** Flood reduction by beaches/ dunes, flood protection due to mangroves, erosion protection from coral reefs.<br><br>***Example economic models:*** HAZUS, BEACH-Fx, HEC-FDA | FEMA determines pre-calculated benefits for specific project types:<br>• Acquisitions and Elevations in the Special Flood Hazard Area<br>• Post-Wildfire – soil stabilization, flood diversion, and reforestation projects<br><br>If a separate model or study has already been completed showing greater benefits than FEMA predicts using pre-calculated benefits, the modeled benefits may be used in place of pre-calculated benefits. The model or study can also be provided as supplemental information. |

| | ***Model Recommended*** | ***Model Likely Not Required*** |
|---|---|---|
| **ENVIRONMENTAL** | If the project benefits being claimed depend on demonstrating significant prevention of a particular habitat loss, this could require a separate model.<br><br>***Project examples:*** Ecosystem services provided by a large area of stormwater wetlands that is being restored over the course of the project.<br><br>***Example environmental models:*** EDYS, HGM Approach, SLAMM | In most cases, a desktop analysis will be sufficient to provide qualitative data or as a baseline to develop quantitative justification for HMA projects. Use existing data sources, such as online data mappers, to identify coverage of wetlands, species corridors, and other habitats of interest.<br><br>***Examples include:***<br>• National Wetlands Inventory |

SECTION 4

# BENEFITS OF NATURE-BASED SOLUTIONS

Justifying federal investment for nature-based solutions is an important and often challenging step in the hazard mitigation funding application process. FEMA hazard mitigation funding is competitive, and the primary indicator for funding the most effective projects is relating investment dollars to the expected outcomes (i.e., reduced risk) and associated benefits (i.e., damages avoided) of the project. This section provides an overview of how to quantify benefits of NBS to meet FEMA requirements.

Community-focused floodplain restoration.


## BENEFIT-COST ANALYSIS

A benefit-cost analysis can be useful for evaluating costs and benefits of a proposed project over time. Completion of a BCA is required for all FEMA grant applications and can also be used to compare various alternatives during planning to support the selection of the best value alternative, given cost constraints. Since capital costs are typically incurred at the beginning of a project, but benefits may not begin accruing until after project completion (or once vegetation is well established for NBS), a BCA includes all costs and benefits over the analysis period. The costs and benefits of a project are the incremental difference between the project and the present and future conditions without the project (baseline).

Benefits and costs are evaluated for a period that includes the construction and the operations period. The analysis period should be commensurate with the expected life of project. The analysis period for infrastructure projects can range from 20 to 50 years. However, for some projects, a shorter period of analysis may be considered more appropriate. FEMA recommends the useful life for various project types (**BCA Reference Guide**, June 2009, Appendix D).

The benefits and costs, including maintenance costs, are valued in constant dollars, which avoids forecasting future inflation and escalating future values accordingly. The use of constant dollar values requires the use of a real discount rate for present value discounting. A real discount rate eliminates the effect of inflation when discounted future costs and benefits back to the present value. Discounting is used to address the time value of money concept, which represents a person's preference to consume money sooner rather than later, meaning the value of money in the future is considered to be less than the value of having the money today.

BCA can produce several useful metrics. The Net Present Value (NPV) is the present value of the benefits (sum of the discounted benefits) less the present value of costs (sum of discounted costs). The NPV can be used to compare multiple alternatives. Another key metric from BCA is the Benefit-Cost Ratio (BCR). The BCR is a ratio of the benefits to the costs over the lifecycle of the project. **FEMA requires a BCR of 1.0 or greater, which indicates that the project is cost-effective because the monetized benefits are equal to or greater than the costs.**

## COSTS OF NATURE-BASED SOLUTIONS

All HMA grant programs require a detailed budget beginning with design and extending through the post-construction analysis period. Some components of nature-based solutions may have higher upfront costs (e.g., design for nature-based features, increased permitting coordination, higher contingency). However, nature-based solutions are often preferred alternatives for the cost-savings that are typically seen when compared with solely gray infrastructure-based solutions over the long-term.

Nature-based features tend to appreciate in value over time as the ecosystems protected or created increase in functionality. This is an advantage over gray infrastructure, which tends to depreciate as the project ages and reaches the end of its useful life. **The additional upfront cost associated with nature-based solutions can make it challenging to achieve a BCR of greater than 1.0. Therefore, it is important to ensure project costs are offset by the benefits of the project.**

## BENEFITS OF NATURE-BASED SOLUTIONS

Benefits are calculated as the incremental difference between the existing and future conditions without the project compared to the conditions expected after the project is completed. If possible, the appreciative value of NBS should be included with the future conditions. The primary benefit categories for flood mitigation projects are avoided physical damages, avoided loss-of-function costs, avoided casualties and avoided emergency management costs. Some examples for each category are provided in Table 4-1.

Hazard mitigation using NBS can provide many economic, social and environmental benefits beyond the benefits from traditional flood mitigation projects. Examples of some of the potential benefits are provided in Table 4-2.

Considering ancillary benefits early in the application process can allow a subapplicant to pool resources by including other stakeholders and a diverse array of funding sources for a project that satisfies multiple goals. The BRIC application process requires a determination of which **Community Lifelines** have

Estuarine wetlands between Grand Isle and New Orleans, LA.

reduced risk as a result of the project, which is also one of the technical criteria that will be scored during subapplication review. In the qualitative narrative, subapplications can further describe how the nature-based solution mitigates risk to one or more Community Lifelines in relation to the Risk Reduction/ Resiliency Effectiveness criterion, which includes ancillary benefits as a component of the scoring rubric.

If available, models that simulate a reduction in losses to a lifeline from the NBS can support the claims made qualitatively. Studies from credible sources (e.g., federal, state, county, regional, and local government agencies or qualified professionals such as licensed architects, engineers, and surveyors) that can be used to substantiate any qualitative benefits and should be included as technical support data.

## TABLE 4-1. PRIMARY BENEFIT CATEGORIES EXAMPLES

| ***Avoided Physical Damage*** | ***Avoided Loss-of-Function Costs*** | ***Avoided Casualties*** | ***Avoided Emergency Management Costs*** |
|---|---|---|---|
| • Buildings and contents<br>• Infrastructure<br>• Bridges/Roads<br>• Site contamination<br>• Vehicles<br>• Equipment<br>• Utilities | • Displacement<br>• Loss of rental or business income<br>• Lost productivity<br>• Loss of public services<br>• Economic impact of road/bridge closures | • Deaths<br>• Injuries | • Evacuation/rescue costs<br>• Emergency operation center costs<br>• Debris removal and cleanup |

Note: FEMA only allows consideration of avoided casualties in very specific circumstances, such as flash flooding from a dam failure, hurricane safe rooms, and tornado shelters.

## TABLE 4-2. ECONOMIC, COMMUNITY, AND ENVIRONMENTAL BENEFITS OF NBS

| ***Economic Benefits*** | ***Community Benefits*** | ***Environmental Benefits*** |
|---|---|---|
| • Appreciating property values<br>• Energy conservation<br>• Increasing retail business<br>• Reduced stormwater treatment costs | • Recreation<br>• Aesthetics and placemaking<br>• Reduced urban heat-island effect<br>• Improved physical and mental health<br>• Greenhouse gas sequestration | • Air and water quality improvements<br>• Reduced nitrogen and phosphorus/ nutrient cycling<br>• Erosion control<br>• Pollination<br>• Habitat creation/ connection<br>• Groundwater recharge |

# QUANTIFYING BENEFITS

FEMA created software to ensure that the BCR is calculated in accordance with FEMA's standardized methodologies. Applicants and subapplicants are required to use FEMA-approved methodologies and tools—such as the BCA Toolkit, unless receiving prior authorization to use another methodology. The **Benefit-Cost Analysis Toolkit**, **guidance documents**, and **training** have been developed by FEMA to assist communities with preparing a BCA. FEMA also provides a Helpline that can be reached at 866-222-3580 or via email at **bchelpline@dhs.gov**.

Pre-calculated benefits are available for acquisitions and elevations in the SFHA, residential hurricane wind retrofits, non-residential hurricane wind retrofits, individual tornado safe rooms, and hazard mitigation grant program post wildfire. Use of pre-calculated benefits eliminates the requirement to conduct a separate BCA for these eligible project types.

Some benefits can be monetized within the BCA Toolkit, while other benefits may need to be quantified outside of the BCA Toolkit. Any benefits that cannot be quantified for the BCA should be captured in the application qualitatively. This section discusses each scenario in more detail.

## BENEFITS IN THE FEMA BCA TOOLKIT

Ecosystem service benefits should be included as part of providing a comprehensive estimate of the expected project benefits and cost to society. FEMA recognizes ecosystem service benefits as an important consideration that should be included in the BCA. Originally, FEMA required a BCR of 0.75 or greater before ecosystem service benefits could be included in the BCA, however a new FEMA policy (**FP 108-024-02**) removes the 0.75 BCR threshold that was previously required. Therefore, ecosystem service benefits can be used to justify nature-based mitigation projects regardless of the BCR.

The purpose of including ecosystem services should be to improve the cost-effectiveness of the project, but is not intended to affect the eligibility of the project for the HMA program—in other words, the ecosystem services should be an added benefit to the project, not the primary driver for why the project is eligible for FEMA HMA grants. FEMA is ultimately interested in funding projects that reduce risk to structures and people and reduce future costs to the Disaster Relief Fund or the National Flood Insurance Program.

Table 4-3 displays the inputs for NBS projects that FEMA's BCA Toolkit recognizes. Note that preserved space and habitat is not eligible, but rather, only new or restored habitat. Preserved space and habitat should be discussed qualitatively.

The ecosystem services valued in the FEMA BCA Toolkit are indicated in Table 4-4, below.

**TABLE 4-3. EXAMPLE NBS INPUTS IN FEMA BCA TOOLKIT BY PROJECT TYPE**

| ***Project Type*** | ***Riverine/Urban Flooding*** | ***Coastal Flooding*** | ***Wildfire*** |
|---|---|---|---|
| ***Traditional Benefits*** *recognized by BCA Tool* | • Riparian space created by acre<br>• Green open space acreage created by acre<br>• Riparian wetlands acreage restored or created by acre | • Coastal wetlands restored or created by acre<br>• Marine and estuarine spaces restored or conserved by acre<br>• Coastal forests restored or created by acre | • Forests restored by acre |

| TABLE 4-4. ECOSYSTEM SERVICES VALUED IN FEMA BCA TOOLKIT | | | | | |
|---|---|---|---|---|---|
| ***Ecosystem Service*** | ***Green Open Space*** | ***Riparian*** | ***Forest*** | ***Wetland*** | ***Marine and Estuary*** |
| *Aesthetic Value* | X | X | | X | |
| *Air Quality* | X | X | | | |
| *Biological Control* | | X | | | |
| *Climate Regulation* | X | X | X | X | X |
| *Erosion Control* | X | X | | | |
| *Flood Hazard Reduction* | | X | X | | |
| *Food Provisioning* | | X | | | |
| *Habitat* | | X | | | X |
| *Nutrient Cycling* | | | | X | X |
| *Pollination* | X | | | | |
| *Recreation/Tourism* | X | X | | | |
| *Storm Water Retention* | X | | | | |
| *Water Filtration* | | X | | X | |
| *Water Supply* | | X | X | X | |

## BENEFITS NOT INCLUDED IN THE FEMA BCA TOOLKIT

When possible, the benefits of NBS should be quantified in the BCA as they pertain to avoided losses or damages. Benefits that are not calculated within the FEMA BCA Toolkit can be calculated outside of the FEMA BCA Toolkit as a separate benefits analysis. Any benefits calculated outside of the FEMA BCA Toolkit must be based on credible sources (e.g., academic studies, engineering reports, published peer-reviewed journal articles) and backed up with supporting documentation.

If it is not possible to quantify some benefits or if enough supporting information is not available to transfer benefits from other studies to the context of the project, these benefits should be qualitatively discussed as part of the application narrative.

The BCA Toolkit allows users to account for anticipated Sea Level Rise but does not currently account for other effects of climate change or changing demographic conditions and land use patterns. Anticipated future conditions relevant to the project should be supported by data sources, assumptions and models, where possible. The following table provides examples of reliable national resources to support documentation of future climate conditions that may affect the proposed project site. Many state, regional, and city governments also provide more locally-relevant climate data and projections that may be consulted and used as supporting documentation.

## Accounting for Future Conditions

Accounting for and accommodating future conditions will increase the likelihood of project funding and longevity of the project lifespan. Documentation of future conditions is particularly important for the BRIC program, which currently allocates 15 points for projects that anticipate future conditions. The scoring is largely based on the qualitative discussion of the project benefits. Therefore, even if quantification of the benefits is not possible, it is important to document in the narrative.

Examples of future conditions that should be accounted for in the project include:

- Future population projections
- Changes in employment
- Changes in housing needs
- Climate change

## PRE-CALCULATED BENEFITS

To streamline the HMA grant application process, FEMA has released a list of pre-calculated benefits that provide pre-determined cost effectiveness values. Use of pre-calculated benefits eliminates the requirement to conduct a separate BCA for these eligible project types if the pre-calculated benefits exceed the project cost. If pre-calculated benefits for the proposed project are not greater than project costs, use the FEMA BCA Toolkit to perform a traditional BCA.

Table 4-5 lists FEMA-designated project types with pre-calculated benefits that may be coupled with nature-based solutions. FEMA does not allow the aggregation of pre-calculated benefits with a traditional BCA. For example, if only a subset of properties protected by the proposed project are applicable for pre-calculated benefits, only those structures may be included in the pre-calculated benefits, while the remaining properties will require a separate BCA. Additionally, ecosystem service benefits cannot be added to pre-calculated benefits.

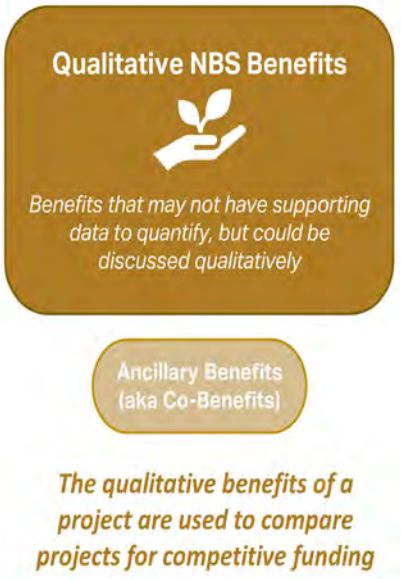
**TABLE 4-5. APPLICABILITY OF NATURE-BASED SOLUTIONS FOR PROJECT TYPES WITH PRE-CALCULATED BENEFITS[9]**

| ***Project Type*** | ***Example NBS*** |
|---|---|
| ***Acquisitions and Elevations in SFHA*** | • Acquired land can be converted to open space or a preferred ecosystem (forest, wetlands, etc.); any acquisition project requires open space dedication in perpetuity<br>• A program could be implemented to promote restoration of land beneath elevated homes with vegetation to allow increased infiltration of flood waters |
| ***Post-Wildfire***<br>*soil stabilization, flood diversion, reforestation* | • A soil stabilization project could prioritize plants that have a high moisture content to reduce landscape flammability while restoring wildlife habitat<br>• A flood diversion project could remove channelization on a river to restore inflows while improving riverine habitat |

9 Federal Emergency Management Agency. (2021). When You Apply for Building Resilient Infrastructure and Communities (BRIC) Funds. https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/when-apply#milestones-cost-effectiveness.

# QUALITATIVE BENEFITS

Qualitative benefits not included in the BCA because they are difficult or not possible to monetize should be discussed in the project narrative. A strong narrative describing qualitative benefits is recommended for all HMA applications, but particularly for the BRIC program, which includes evaluation scoring criteria used for the grant selection process, as described in the BRIC **Qualitative Criteria** and **Technical Criteria** Program Support Materials. The qualitative benefits can also be aligned with the FEMA community lifelines shown on the following page. Examples of qualitative benefits provided by NBS are described by project type in Table 4-6.




## TABLE 4-6. EXAMPLE NBS QUALITATIVE BENEFITS BY PROJECT TYPE

| Project Type | Riverine/Urban Flooding | Coastal Flooding | Wildfire |
|---|---|---|---|
| Qualitative Benefits | • Preventing development in flood-prone areas<br>• Climate change mitigation<br>• Soil and bank stabilization<br>• Preserving habitat and open space<br>• Sediment capture | • Wave and wind attenuation<br>• Sea level rise mitigation<br>• Improved evacuation/ supply access routes<br>• Soil and bank stabilization<br>• Preserving habitat and open space | • Landslide protection<br>• Improved evacuation/ supply access routes |

The subapplication should describe how the project aligns with any FEMA-approved, existing State Hazard Mitigation Plan or Local/Tribal Hazard Mitigation Plans. State priorities for Hazard Mitigation Funding will vary. Coordinate with the **State Hazard Mitigation Officer** (SHMO) and State Department of Emergency Management (DEM) for your state to determine and align with State priorities.

The State DEM or SHMO typically serves as the Applicant that submits all subapplications (i.e., the application being completed using this guidebook) to FEMA. The subapplication is more likely to be selected by the State DEM and submitted to FEMA if it aligns with DEM priorities.

Other plans to consider when aligning NBS with local priorities and future infrastructure include (this list is not comprehensive):

- Capital Improvement Plans
- Economic Development Plans
- Economic Recovery Plans
- Emergency Management Plans
- Long-Range Transportation Plans
- Parks, Open Space, Greenway or Recreation Plans
- Stormwater Management Plans
- State Flood, Coastal, and Wildfire Resiliency Plans

## Ancillary or Co-Benefits

Ancillary benefits, also known as co-benefits, are the positive side effects generated by the project that are not directly related to the project's primary function of hazard mitigation or risk reduction. Unlike gray infrastructure solutions to the same hazards, NBS (and hybrid approaches) often provide multiple ancillary benefits, spanning the social, economic, and environmental categories. For example, flood hazard mitigation actions designed with nature in mind are likely to increase flood resilience, but also expand species habitat, improve water quality, improve aesthetics of the area, and increase adjacent property values. Ancillary benefits should be discussed qualitatively within the grant application. They may also be included in the project BCA if there is credible documentation supporting the quantitative benefits provided by the NBS.

For the BRIC program, there are 35 points available for project Risk Reduction/Resiliency Effectiveness, which is scored largely based on the qualitative discussion of the project benefits.

In addition to the hazard type ancillary benefits noted in the table above, co-benefits to risk reduction and resiliency effectiveness can also include categories like:

- Economic opportunity
- Reduced social vulnerability
- Cultural resources
- Multi-hazard (e.g. wind/storm surge, wildfire/ mudslides)

# FEMA COMMUNITY LIFELINES


## RIVERINE FLOODING

- Open space preservation and stormwater parks can improve the **Safety and Security** lifeline by relocating recreation spaces to areas that flood easily and retaining floodwaters to reduce flooding likelihood to business and residential areas.
- Culvert upgrades and dam removals could lower the risk of road closure due to flood damage, providing benefits to evacuation, keeping supply chains open post-emergency, and reducing detour time, benefiting the **Transportation** lifeline.
- Bioretention features that filter floodwaters can improve **Food, Water, Shelter** lifeline by supporting wildlife, improving water quality, and lowering the risk of loss of community water supplies due to disasters.

## WILDFIRES

- Forest thinning near a hospital or other critical infrastructure could benefit the **Safety and Security** and **Health and Medical** lifelines.

## COASTAL FLOODING

- Improving the dune structure on a shoreline could benefit the **Safety and Security** lifeline by reducing the need for emergency repsonse personnel to respond to trapped or flooded homeowners and the **Transportation** lifeline by protecting coastal roadways functioning as evacuation routes.
- Improving tidal circulation under a coastal highway to reduce risk of overwash while restoring wetlands could benefit the **Food, Water, Shelter** lifeline by supporting habitat for early marine species and benthic organisms, such as oysters, shrimp, and fish, as well as the **Transportation** lifeline by allowing larger vessels to pass or widening lanes along portions of the roadway.

# ADDITIONAL RESOURCES

The following table provides examples of reliable national resources to support documentation of future climate conditions that may affect the proposed project site. Many state, regional, and city governments also provide more locally-relevant climate data and projections that may be consulted and used as supporting documentation.

| National Resources for Future Climate Conditions |
|---|
| **National Climate Assessment**<br>The National Climate Assessment provides a comprehensive and authoritative report on the state of the science on climate change, variability, and its impacts across the United States now and throughout the coming century. |
| **Global and Regional Sea Level Rise Scenarios for the United States**<br>This NOAA report provides updated scenarios of global mean sea level rise integrated with regional factors for local projections for the entire U.S. coastline. Projections include statistical probabilities, allowing for risk-based decision making through the coming century. |
| **NOAA Sea Level Rise Viewer**<br>Hosted by NOAA, this online mapping tool allows users to observe the potential effects of sea level rise on U.S. coasts. The visualization tool allows for up to 6 feet of sea level rise, models potential marsh migration, and includes accompanying data for uncertainty, flood frequency, impacts, and socio-economic factors. |
| **NOAA Sea Level Rise Trends**<br>NOAA maintains historical trends of locally-observed sea level rise and anomalies at many of their tide stations across the U.S. |
| **NOAA State of High Tide Flooding and Annual Outlook**<br>This report updates high tide flood (i.e., sunny day or nuisance flood) frequencies for the latest year at 98 NOAA tide stations and provides a statistical outlook for the coming year. |
| **The Climate Explorer Toolkit**<br>This tool provides access to historical and downscaled climate projections for every county in the contiguous U.S. Climate variables include changes in average and extreme temperature and precipitation, and high tide flooding. |
| **American Association of State Climatologists**<br>Forty-seven states and Puerto Rico have an official climatologist appointed by the state. They collaborate with state and local government agencies and academic institutions to monitor and disseminate information about historical and possible future impacts of the climate |

SECTION 5

# APPROACH & STRATEGY

This section focuses on potential enhancements the subapplicant should consider to maximize the likelihood for FEMA HMA funding success. It is important to remember that a given project will be competing with a large pool of applications, either at the state or national level. Most of the projects will be based on traditional gray infrastructure approaches to hazard mitigation, which have inherent advantages for satisfying grant requirements based on FEMA's existing scoring criteria. To promote competitive projects that emphasize NBS, their unique advantages need to be conveyed effectively in the subapplication.

**A well-thought-out strategy is crucial to acheiving the vision of a nature-based project. Often, it requires a hybrid solution that allows mutual benefits for multiple stakeholders to be realized.**

This section will focus on considerations such as project scale, stakeholders, and residual benefits, which can provide distinguishing features of NBS and give the project a winning edge not easily offered by traditional gray strategies. It concludes with how to overcome challenges and pitfalls common to the FEMA HMA application process.

The Sylvan Beach project in La Porte, TX is a hybrid solution that created a community beach park using sand as a nature-based feature held in place by engineered rock groins.

# PROJECT SCALE

The subapplicant should consider whether a small-scale or large-scale NBS is more appropriate or achievable for the community being protected. **Nature-based solutions often work best when they are applied at larger scales across whole landscapes, ecosystems, or communities.** However, application at a smaller scale can be useful to develop a robust understanding of the NBS and refine project design. Once a foundation has been created based on the success of the small-scale "pilot," these projects may be expanded to a broader scale that increases the benefits offered. Expanding the scale commonly involves multiple other project stakeholders and partners that have overlapping jurisdictions and interests in the project footprint. Engagement of potential stakeholders from the start of the application and project planning process offers the opportunity to pool resources and expertise to achieve multiple objectives, mutual benefits, and cost-sharing opportunities.

### *Small Scale Project with Regional Applications*

*The Palo Alto Horizontal Levee Pilot Project provides an example of a project currently implemented at a small scale with plans to expand for regional application. The City of Palo Alto, California is currently evaluating a horizontal levee pilot in the Palo Alto Baylands to provide flood protection for a wastewater treatment facility.* ***Because horizontal levees have gently sloping berm sides, they provide the opportunity for restoration of transitional habitats and further removal of nutrients from highly treated wastewater*** *before being released into the San Francisco Bay. The City has partnered with adjacent cities, county flood agencies, and the State of California to incorporate this nature-based solution design into the regional effort of future flood control levee improvements within Palo Alto and regionally along the South Bay.*

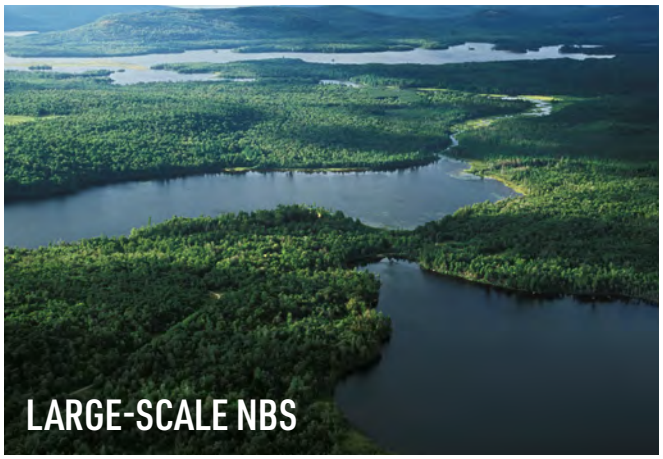
SMALL-SCALE NBS

**PROS**

- Less expensive and time-intensive to implement
- Smaller interventions across a broad geography can be very successful
- May require less coordination with external partners

**CONS**

- Protects fewer properties
- Even small-scale NBS can be very expensive
- May be more difficult to show project benefits in a BCA



LARGE-SCALE NBS

**PROS**

- Maximizes the project benefits and outputs
- More visible to communities and partners

**CONS**

- More expensive and time-intensive to implement
- Likely requires more coordination with external partners
- May have greater challenges during implementation

# STAKEHOLDERS

Following on the concept of increasing project scale is that of increasing project stakeholders. An increasing number of grant programs prefer to see stakeholder collaboration within a project application or concept. **It is especially valuable to engage stakeholders from a variety of backgrounds and expertise to maximize potential project benefits and buy-in.** This includes communities, environmental organizations, state or federal agencies, academia, and private companies. Often, other interested parties are willing to engage with a project as a technical resource when not obligated to provide financial investments in a project. Once project benefits are understood, stakeholders are more likely to become a project partner, providing the opportunity for cost and risk sharing.

By engaging multiple stakeholders, the subapplicant is providing FEMA with a blueprint to show the concept is vetted with multiple professionals and, at times, experts in the field. Expanding a project's pool of stakeholders often requires examining associated project benefits and identifying entities that may experience direct or indirect benefits from project implementation.

Due to their widespread benefits, NBS can be more readily acceptable by stakeholders. Traditional infrastructure projects are likely to have project opponents in many cases, but a well-developed NBS has the opportunity to unify a team of stakeholders around an approach to benefit both community infrastructure and the environment. Nature-based projects are more likely to provide social, recreational, and cultural benefits by improving quality of life. In addition to capturing additional NBS benefits as discussed in Section 4, use this information to incorporate communities, regional entities, state agencies, and others in the process. Broadening the group of stakeholders may also allow more partners to contribute to funding match requirements.

## An Unexpected Stakeholder

Forming unique coalitions of project stakeholders and supporters is invaluable for implementing broad-reaching nature-based solutions. As an example of an unexpected, non-traditional stakeholder, San Diego Gas & Electric (SDG&E) recently implemented their Wildfire Fuels Management Program in California, a pilot program that focuses on retaining and improving native habitat value while reducing wildfire risk near infrastructure. **What differentiates SDG&E's efforts from traditional methods in this program is that it prioritizes thinning vegetation rather than clear cutting or removing it completely.** The program focuses on elimination of ignition fuels, reducing vegetation density, and reducing ladder fuels by removing all non-native vegetation.

Maintaining native vegetation in the utility transmission corridor.

This example demonstrates that understanding the mutual benefits for nature-based solutions is critical to identifying potential stakeholders and future partners and for realizing nature-based solutions to mitigate hazards. Making a connection with a non-traditional stakeholder could allow for a stronger HMA application that offers broader nature-based benefits than what might have been otherwise identified. For example, **working with non-traditional stakeholders like SDG&E can help mitigate larger ecosystem challenges by re-envisioning designs for corridors or private properties that otherwise might result in habitat disconnects and limit their ultimate effectiveness.** Industrial partners can also help create new industry cultures that build sustainable environmental practices into otherwise typical project designs.

# RESIDUAL BENEFITS - ADDITIONAL HAZARDS

FEMA's HMA program includes funding for hazards that expand beyond the flooding and wildfire hazards discussed in this guidebook. In an ideal scenario, a project would address more than one hazard, which could result in increased benefits, more potential stakeholders, and an overall project result that is more compelling.

If multiple hazards are being addressed in a single grant application, a nature-based project that addresses or mitigates all of the identified hazards should be selected. In some cases, these connections are direct and apparent. For example, when considering wildfire mitigation projects, landslides are an additonal hazard that can be a direct result of the wildfire hazard itself. Landslides may be more likely to occur in areas where vegetation has been destroyed by wildfires and no longer provides the same degree of soil stabilization. Using preventitive measures that mitigate the risk of wildfires and other post-disaster ecosystem responses can also mitigate landslide risk. Similarly, some drought mitigation techniques could provide benefits for wildfire mitigation. In cases where mitigating for additional hazards is not possible, NBS could still be used to mitigate risk for listed hazards.

## *Downtown Miami Triple Bottom Line Cost-Benefit Analysis*

*The Miami Downtown Development Authority prepared a **Triple Bottom Line Cost-Benefit Analysis** to decide how to best protect more than 8 miles of coastal shorelines using traditional or nature-based infrastructure. Specifically, the analysis was used to determine if it would be more effective to raise an existing 5-foot seawall by approximately 2 feet using an infrastructure-only approach or by including a living shoreline with mangroves and seagrasses. The Triple Bottom Line analysis, which measures economic, social, and environmental benefits, indicated that the combined seawall and living shoreline design would return greater net benefits and co-benefits to the area, including natural flood attenuation from the mangroves and wastewater purification and carbon sequestration from the seagrasses.*

## *Springhouse Run Stream Restoration Project*

*The U.S. Fish and Wildlife Service completed the **Springhouse Run Stream Restoration** in Washington, D.C. The project was completed to filter pollutants and remove excess nutrients and sediments flowing from the region's drainage ditches and storm sewers using a series of ponds, pools, and riffles. Natural bed materials like native plants and trees, soil, stones, gravel, and wood chips help to clean the water as it flows through the U.S. National Arboretum. The restored stream reduces sediment pollution and excess nutrients from stormwater flows that would otherwise travel downstream and endanger the sensitive estuarine habitats of Chesapeake Bay.*

# APPLICATION CHALLENGES AND PITFALLS

As the FEMA HMA programs continue to evolve, they have trended towards being more inclusive of NBS, often introducing new considerations to make them more viable. Even with these enhancements, any major grant program will always have challenges for the applicant (or subapplicant, in this case).

1 **Quantified benefits of risk reduction are worth more than ancillary benefits.** The most common challenge for subapplicants is to provide sufficient justification to result in project investment, as described in Section 4. A major focus of Section 4 is identifying the right mitigation project generating the intended benefits, and then understanding what benefits are allowable and most meaningful. While there are many benefit categories, it is most important that the BCA is able to quantify the benefits of removing at-risk infrastructure from potential hazard exposure. These benefits will almost always be greater in magnitude than ancillary benefits offered by the program (e.g., enhanced recreational opportunities).

Kayakers at Lighthouse Lakes, a series of four designated paddling trails within Redfish Bay, Aransas Pass, TX. The trails provide paddlers with ample bird-watching and fishing opportunities.

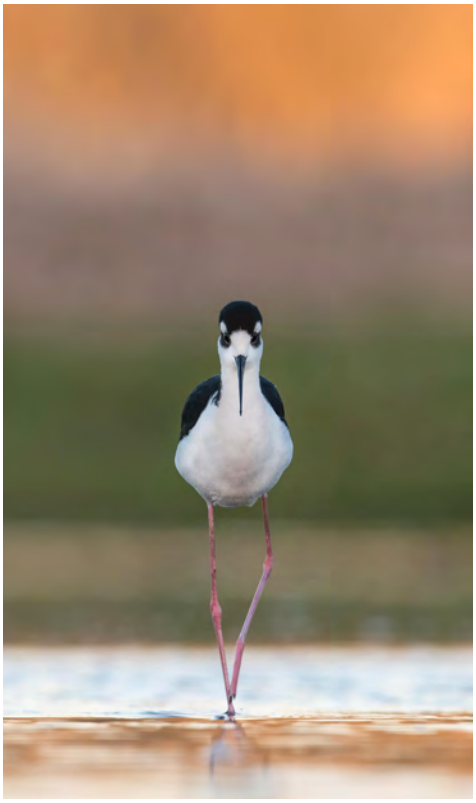
2 **Mitigating wildfire hazards is less understood than flood hazards.** For wildfire hazards, the mitigation project development process is not as refined as flood risk reduction. As a result, there is more flexibility in how to analyze project benefits, which could make it more challenging if the subapplicant is less experienced and needs more direction. However, it can also be less costly, as established standards are less strict and do not have as many requirements.

Niobrara Valley Preserve, NE just after the July 2012 wildfire.

3 **Large flood hazard mitigation projects may require complex modeling to quantify risk reduction.** Showing flood risk reduction benefits is accomplished through hydrologic and hydraulic modeling, and can be accomplished through a range of models and at varying levels of detail. A project concept can be developed with a desktop level analysis using data already available through FEMA or other state or federal public datasets. For the national competition, under BRIC or an application to FMA or HMGP, with- and without-project scenarios should be modeled by qualified engineers. Depending on the scale of the study, this could entail moderate- to high-level of effort. In many cases, simple studies are possible for an engineer when the watershed or study area is focused on a small area ($10,000-$50,000). Larger watersheds or regional analyses can become very costly, ranging from $100,000-$300,000 or more. Additionally, coastal analyses can be computationally intensive and result in high costs. In all cases, having a partner, such as USACE, who may already have models or analyses in the area, can be very valuable if previous efforts can serve as a starting point for the modeling.

Endangered Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) hatchling released at Padre Island National Sea Shore, TX.

4 **Project should provide both immediate and long-term hazard protection.** Another challenge for NBS, especially in HMA programs, is how future conditions are considered. Under BRIC, FEMA is working to better incorporate projected future benefits; even then, there are limitations that are primarily qualitative. More information is captured in Section 4 regarding accommodating future conditions in the benefit development process. Due to the replication of natural processes, NBS derive signficant value from the adaptability and longetivity, and some of these benefits can be captured by reduced project lifecycle costs. However, a project cannot be developed with its sole focus on future benefits. This may seem insignficant, but this is the reason it is so challenging to have an acquisition-based project funded under FEMA's HMA program. While it may be apparent that future damages are avoided by preserving an undeveloped site that is high risk to flood or wildfire, it is not a suitable approach for these funding sources. A more direct connection with stream or hydrologic restoration project could provide a viable path forward, while also preventing future development. Ultimately, a project under current conditions needs to be possible before future considerations but this may not always be achievable.



A black-necked stilt meanders along a shallow section of the Myakka River in Tampa, FL.

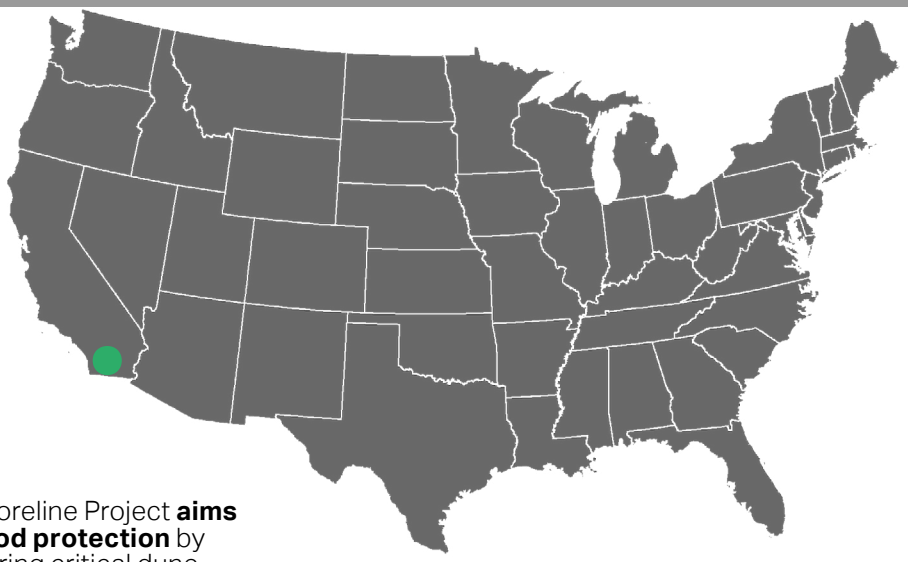
5 **Projects that overlap with federal project sites or offer enhancements to federal projects are not eligible for FEMA HMA funding.** Projects categorized as federal projects also pose a challenge to HMA funding. Existing federal projects are not eligible projects, which means many riverine and coastal levee systems cannot be modified or enhanced through FEMA HMA funding. In these scenarios, projects will need to progress through USACE planning requirements for project identification, which face strict criteria and standards for implementation. These projects can be very time consuming and progress slowly due to Congressional involvement, and the best course of action may be to identify complementary project components that can be separated from the primary flood risk reduction projects themselves.

An endangered house in wait of advancing sea level and coastal storms along the Gulf Coast near Freeport, TX.

# CASE STUDIES

# CARDIFF STATE BEACH LIVING SHORELINE PROJECT

SAN DIEGO COUNTY, CALIFORNIA



## COASTAL FLOODING

## PROJECT DESCRIPTION

The Cardiff State Beach Living Shoreline Project **aims to provide sea level rise and flood protection** by reducing beach erosion and restoring critical dune ecosystems that act as a natural buffer for coastal flooding and protect critical infrastructure assets, including Pacific Coast Highway 101.

Cardiff State Beach is a popular place for recreating in San Diego County, California. However, it is under constant threat of erosion and flooding in the surrounding areas. Highway 101, located in close proximity to Cardiff State Beach, has flooded at least 42 times since the 1980s.[1] The project enhanced preexisting rock riprap (approximately 0.5-mile of coastline [3 acres]) and restored it to a dune ecosystem to better protect coastal Highway 101 from current, episodic flood vulnerability. Public access points and interpretive signs explaining the functional role of the dune system were incorporated into the design. The American Shore and Beach Preservation Association awarded the project with the top honor of Best Restored Beach Award in 2020.[2] This project, completed in 2019, is the first nature-based solutions of its kind in southern California.

The project uses preexisting riprap and imported rock materials, locally sourced coastal plants, and dredged sand from the nearby San Elijio Lagoon. The project provides a nature-based solution to reduce future impacts from the increased frequency and severity of storm events and sea level rise. **Implementation of this type of project could be transferable to other coastal regions with preexisting riprap and revetment structures in place.** Nature-based solutions may benefit locations similar to Cardiff State Beach by transforming hardened, grey infrastructure into thriving dune ecosystems to receive flood hazard benefits, ecosystem services, and increase public outreach.

1 Sanchez, M. (2019). Living Shoreline Project holds ocean at bay. https://www.fws.gov/cno/newsroom/highlights/2019/cardiff_state_beach/?utm_medium=email&utm_source=govdelivery

2 Piatt, P. (2020). Encinitas Wins Best Beach Restoration for the Cardiff State Beach Living Shoreline Project. https://encinitasca.gov/Home/City-News/ArticleID/307

## NATURE-BASED SOLUTION

This project **exemplifies both a regional pilot example and multi-benefit model** for employing a nature-based solution that reduces coastal erosion and flood impacts, while simultaneously enhancing the native ecosystem and improving public accessibility and awareness. Dunes were dynamically engineered to withstand future change by using a buried revetment of preexisting riprap for reinforcement, and native species were planted on the top of the dunes to stabilize the sand against wind and wave impacts.[3] A project objective was to create dune ecosystems that will persist dynamically for approximately 50 years and will protect the coastline and its infrastructure.[4] A 5-year monitoring plan was implemented to evaluate pre-defined project success criteria: vegetation cover, invasive species removal, and the durability of the dunes over time. Future maintenance necessary for this site will be reviewed and permitted over time through an adaptive management process. Results from this project will help to inform other coastal resilience and nature-based solutions projects, as well as the viability of such projects for coastal protection.[1]

3 Potter, Chris. (2016). California Ocean Protection Council Staff Recommendation for the Cardiff State Beach Living Shoreline Project. http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20160629/4h_Cardiff_Beach/4h_Staff%20Rec%20for%20SCC%20Cardiff%20Beach_final.pdf

4 Milligan, P., Tirado, V., Leslie, B., and Duran, M. (2019). Abstract for FSBPA National Conference on Beach Preservation Technology. https://www.ghd.com/en/projects/resources/Documents/Maritime_Cardiff-Beach-Living-Shoreline-Project-Abstract.pdf

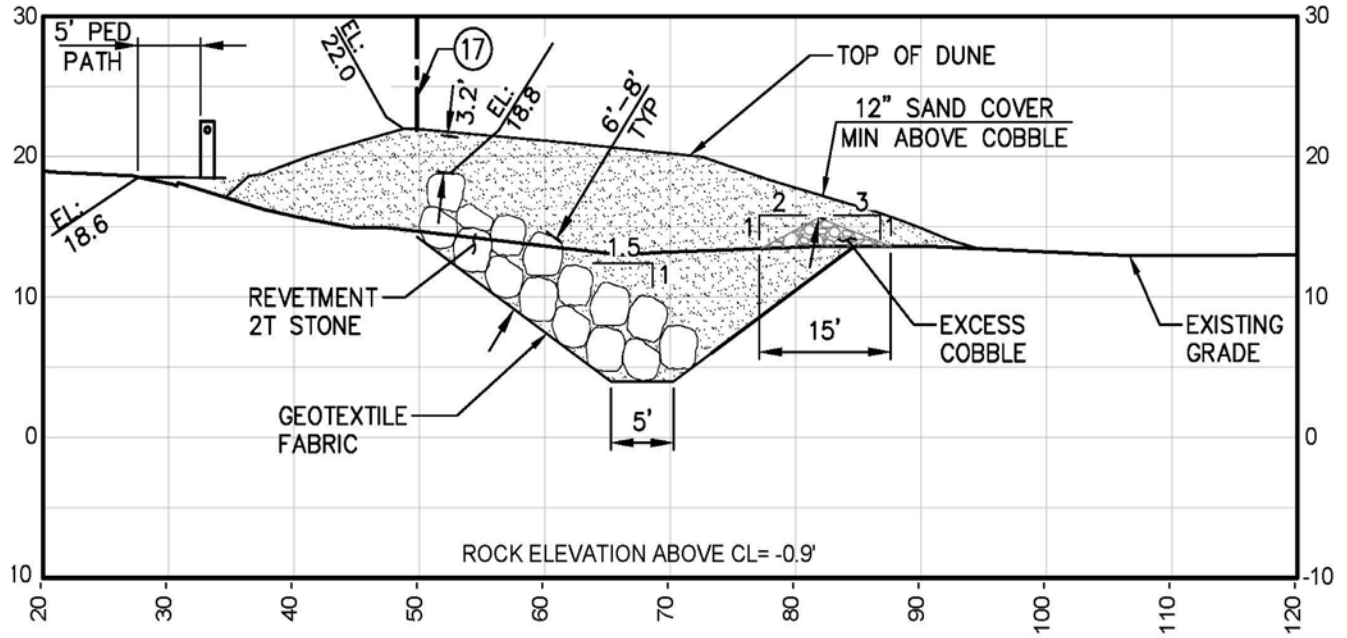



Figure 1: Engineered Sand Dune Using Pre-existing Riprap. *Credit: GHD*[4]

## PROJECT DEVELOPMENT AND APPLICATION

A grassroots community effort gathered historical information on dune ecosystems in this part of San Diego County and became the catalyst for the living shoreline project to enhance resiliency and protect the coastal highway. The City of Encinitas and the State Coastal Conservancy (SCC) undertook the planning, construction, and ongoing monitoring efforts for the project. Project design was completed by consultants GHD and Moffat & Nichol. Additional partnerships include the Nature Collective (formerly the San Elijo Lagoon Conservancy), University of California Los Angeles, California State Parks, United States Fish and Wildlife Service (USFWS), and the California Coastal Commission.[2]

The City of Encinitas received $2.5 million in funding from the Ocean Protection Council and SCC from the State of California's voter approved Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Prop 1).[3] Additional funding from the San Diego Association of Governments, USFWS, and Scripps Institution of Oceanography increased the total funding of this project to $3.6 million.[1] The aim of Prop 1 funding is to support critical infrastructure through a multi-benefit ecosystem and watershed protection and restoration approach.[5]

## RELEVANCE TO FEMA HMA

**Future projects with similar conditions to this could be eligible for FEMA BRIC funding.** The Cardiff State Beach Project provides an innovative example of applying nature-based solutions to existing grey infrastructure and could in turn be applied in other communities looking to pursue similar projects and apply for BRIC funding. In this case study, in addition to garnering points under the "incorporation of nature-based solutions" technical criterion, this project could also obtain points under the "mitigating risk to one or more lifelines" technical criterion, since it reduces risk to a transportation system.[6] If another community were to pursue a similar project, it could detail in its subapplication the extent to which it meets qualitative criteria such as "risk reduction/resiliency effectiveness," "population impacted," and "outreach activities." The Cardiff State Beach project demonstrates attention to sea level rise which could bolster the "future conditions" criterion score and illustrates strong partnerships which would increase its competitiveness under the "leveraging partners" criterion.[7]

Figure 2: Cardiff State Beach Living Shoreline. *Credit: Joanna Gilkeson/ USFWS*[1]

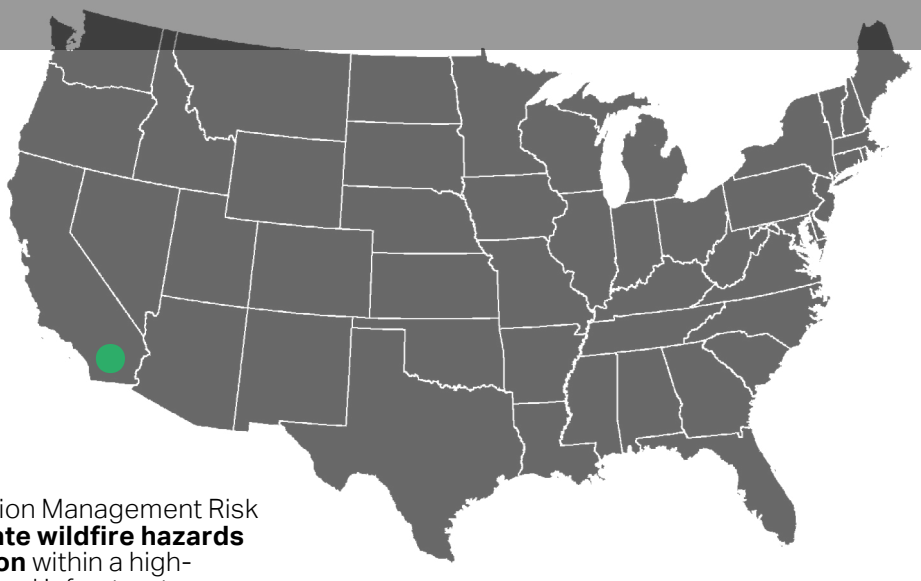
5 California Department of Water Resources. (2020). Proposition 1 Integrated Regional Water Management (IRWM) Grant Program. https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs/Proposition-1

6 FEMA. (2020). BRIC Technical Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-supportdocument_08-01-2020_0.PDF

7 FEMA. (2020). BRIC Qualitative Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-qualitative-criteria_support_document_08-2020.pdf

# RICE CANYON - CITY OF CHULA VISTA VEGETATION MANAGEMENT AND WILDLIFE RISK REDUCTION PROJECT

SAN DIEGO COUNTY, CALIFORNIA



WILDFIRE MITIGATION

## PROJECT DESCRIPTION

The City of Chula Vista's Vegetation Management Risk Reduction Project aims **to mitigate wildfire hazards by actively managing vegetation** within a high-risk fire prone area for residents and infrastructure, thereby reducing available wildfire fuel. Rice Canyon is Chula Vista's largest wildland-urban interface and is the city's greatest wildfire threat.[1]

As part of Chula Vista's Open Space Preserve, the canyon provides easy hiking, walking and running trails that are accessible to the public year-round. Vegetation communities comprise a mix of coastal sage scrub, chaparral, and riparian, in addition to a suite of non-native species. Rice Canyon has been characterized as a "high or very high" fire hazard due to its steep topography and density of wildfire fuels present. Urban development in the city's eastern and southern portions is relatively new; many of the structures have been built under strict fire codes that include ample defensible space (protective buffer zone between the edge of residential properties and areas with wildfire hazards). Conversely, along inner canyons of Rice Canyon, many of the homes were built before current fire codes were in place, and many structures do not have adequate defensible space. Approximately 1,900 homes and critical facilities, such as power, communications, medical care, and emergency facilities, are at risk of wildfire damage originating within Rice Canyon.[1]

This case study highlights current nature-based vegetation management techniques, including vegetation thinning, removal, and reseeding activities, to reduce wildfire risk at the wildland-urban interface. **The vegetation management protocol used in Rice Canyon can be implemented in other communities with similar environmental conditions and reoccurring high wildfire threats.**

1 Southwest San Diego Community Wildfire Protection Plan. http://firesafesdcounty.org/wp-content/uploads/2016/06/SWSD_CWPP_FINALwMaps.pdf

## NATURE-BASED SOLUTION

This case study provides a classic example of how nature-based solutions like **vegetation management can be implemented to reduce wildfire risk at wildland-urban interfaces.** The vegetation management technique follows specially developed protocols compiled by local fire departments in collaboration with the community, local municipalities, and natural resource agencies. Vegetation management activities for this project were created in coordination with the City's Multiple Species Conservation Program (MSCP) Subarea Plan, a robust and long-term habitat conservation plan for the region.[2] Seasonal restrictions for vegetation removal were put in place to minimize impacts to native species. Vegetation thinning and removal activities, under the direction of biologists, focused on decreasing the density of non-native plant species to reduce ladder fuels. Dead wood and underbrush removal methods minimized disturbance to native herbaceous and succulent vegetation within brush management areas.[2] Brush clearing was conducted by work crews using solely hand tools (i.e., loppers, chainsaws, and string trimmers), while disking and mowing activities were excluded from this project to minimize erosion. Rootballs were left in place to increase bank stabilization and diminish negative impacts.[2]

Once the vegetation was cleared, the area was then reseeded with native plant species to reduce erosion, stabilize slopes, and deter the growth of non-native species. The treated area (i.e., defensible space) was subsequently expanded from 80-ft to 120-ft to provide an enhanced buffer zone between residential structures and the canyon edge.[2] Upon project completion, the City began a long-term (5-years) maintenance treatment plan to continue the implementation of vegetation thinning and removal activities twice yearly to reduce fuel loads and the risk of wildfire outbreaks within the canyon.[2]

2 U.S. Department of Homeland Security and FEMA. (2016). Vegetation Management Risk Reduction Project ESA Consultation Letter. Retrieved January 21, 2021 from FEMA.

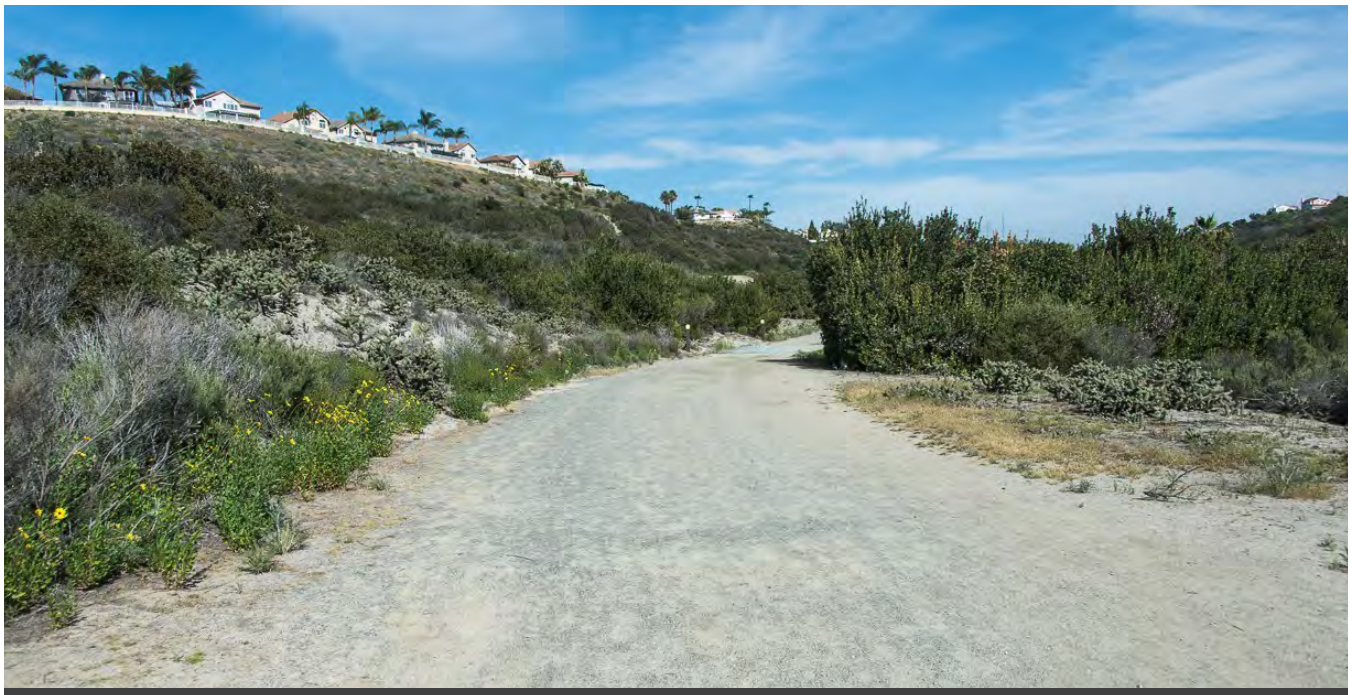


Figure 1: Rice Canyon Trails. *Credit: Hiking San Diego County*[5]

## PROJECT DEVELOPMENT AND APPLICATION

After experiencing multiple severe wildfires within Rice Canyon, local residents met with Chula Vista City officials and the local fire department to urge the City to implement wildfire risk reduction activities within the canyon.[1] Starting in 2009, FEMA awarded several rounds of funding to the City of Chula Vista through its Pre-Disaster Mitigation Program to actively manage vegetation along the canyon perimeter and increase the area of defensible space between structures and the canyon edge. In 2013, FEMA provided federal assistance through the California Emergency Management Agency to conduct wildfire risk reduction projects. In 2016, the City requested that FEMA funding be extended to conduct wildfire risk reduction vegetation management activities in additional areas of the canyon and to complete revegetation activities in both project areas.[2] These efforts aim to increase the area of defensible space around residential properties, thereby reducing wildfire risk and enhancing the resilience of the canyon to future hazards. In order to comply with federal environmental regulations and requirements to obtain FEMA funding, the project also had to comply with the City's MSCP.[2] This coordination highlights the benefits of using existing planning and consultation documents to establish funding for nature-based solutions to reduce hazard impacts while concurrently protecting special-status species.

## RELEVANCE TO FEMA HMA

**Future projects with similar conditions to Rice Canyon could be eligible for FEMA BRIC funding.** The City of Chula Vista's Vegetation Management Risk Reduction Project provides a good example of implementing nature-based solutions, such as vegetation management, to reduce wildfire risk within local communities. This case study project would currently score points under the "incorporation of nature-based solutions" as well as the "mitigating risk to one or more lifelines" technical criteria, since it reduces risk to critical infrastructure, such as power lines, communication, medical care, and emergency facilities.[3] Furthermore, if another community were to pursue a similar project, it could detail in its subapplication the extent to which it meets qualitative criteria such as "risk reduction/resiliency effectiveness," "future conditions," and "population impacted."[4]

Figure 2: View from the bottom of Rice Canyon looking up toward the project area. *Credit: FEMA, Chula Vista Consultation Letter*[2]

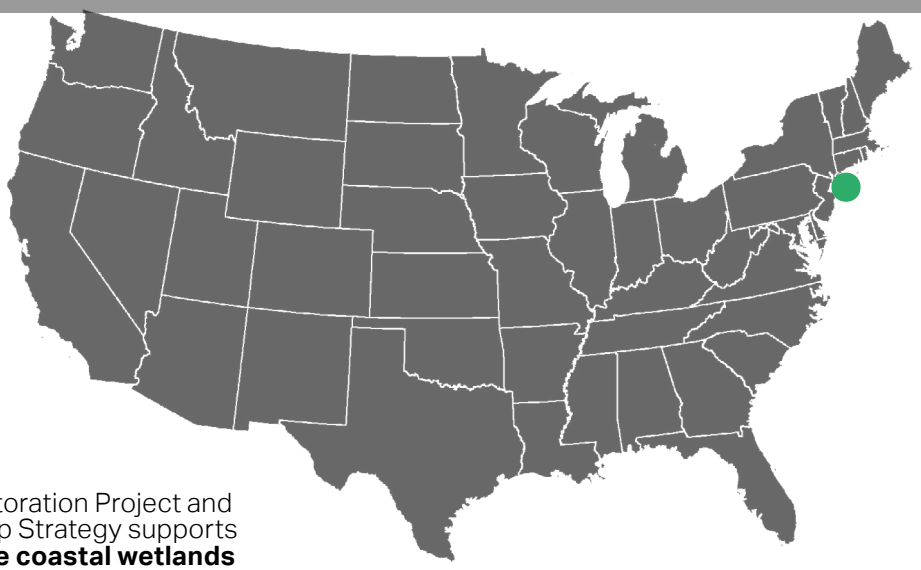
3 FEMA. (2020). BRIC Technical Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-supportdocument_08-01-2020_0.PDF

4 FEMA. (2020). BRIC Qualitative Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-qualitative-criteria_support_document_08-2020.pdf

5 Hiking San Diego County. (2016). Rice Canyon. http://hikingsdcounty.com/rice-canyon/

# SUFFOLK COUNTY WETLAND RESTORATION PROJECT

SUFFOLK COUNTY, NEW YORK



COASTAL FLOODING

## PROJECT DESCRIPTION

The Suffolk County Wetland Restoration Project and subsequent Wetland Stewardship Strategy supports the County's objective to **restore coastal wetlands damaged from Hurricane Sandy and enhance coastal resiliency via an Integrated Marsh Management Approach.** The purpose of this project is to provide long-term flood and storm surge risk protection from future extreme storm events and sea level rise through the use of nature-based solutions.

Suffolk County encompasses eastern Long Island, New York and has a population of greater than 1 million. In 2004, a U.S. Fish and Wildlife study of historical wetlands in Suffolk County indicated that approximately 39% of tidal wetlands and 51% of freshwater wetlands had been lost to development and impacts of increasingly frequent and severe storm events. It is likely that there have been additional losses of wetland habitat in the region since 2004.[1] Hurricane Sandy, a superstorm that hit Suffolk County in 2012, inflicted billions of dollars of damage spanning across eight countries from the Caribbean to Canada. Wetland restoration, expansion of protected areas (preserves and refuges), and establishment of conservation easements have become more prolific in Suffolk County, and other northeastern states, to combat negative impacts to both coastal wetlands and communities.

The project uses preexisting wetland footprints to restore and enhance coastal wetlands and salt marsh habitat via nature-based solutions to reinvigorate beneficial ecosystem services and coastal armoring. The County's long-term Wetlands Stewardship Strategy is anticipated to restore up to 2,500 acres of damaged wetlands.[2] **Implementation of wetland restoration projects and long-term strategies could be transferable to other high flood-risk coastal communities with adjacent wetland habitats.**

## NATURE-BASED SOLUTION

The Suffolk County Wetland Restoration Project **incorporates an ecosystem-based integrated marsh management approach to restore and enhance coastal wetlands.** This project is a distinctive nature based solution that aims to restore and improve degraded wetland habitats along the Suffolk County coastline to increase ecosystem services and lessen impacts from future and extreme weather events. Coastal wetlands are natural features that mitigate flood risk hazards and enhance economic and climate resilience. The habitat restoration and nature-based design implemented in Suffolk County enhanced and restored degraded and damaged salt marshes and wetlands to provide environmental and socio-economic services.[1] Restoration targeted invasive non-native species removal (namely Phragmites australis) and prevention of waterlogging, or dieback of marsh vegetation due to increased inundation, which transforms mudflats back to healthy marshes.[1] The effort focused on improving water circulation in marshes, enhancing vegetation and wildlife communities, and encouraging sediment accretion to allow marshes and wetlands to absorb wave energy. This decreased panne formations (shallow depressions that cause ponding and scour marsh vegetation), reduced shoreline erosion, and alleviated mosquito populations, thereby reducing the need for mosquito abatement.[1]

The project prompted further research and monitoring to evaluate the efficacy of coastal restoration and long-term ecological and socio-economic strategies employed through the Coastal Resiliency Grant Program, which will inform prioritization of future efforts and investments. Suffolk County officials have also developed long-range plans to protect, restore, and enhance all publicly owned wetlands (17,000 acres) to increase climate resilience against future extreme storms and sea level rise.[1]

1 North Shore Land Alliance. (2018). The Importance of Protecting Wetlands. Rhttps://northshorelandalliance.org/protecting-wetlands/

2 Suffolk County Government. (2021). Wetland Stewardship Program. https://www.suffolkcountyny.gov/Departments/Economic-Development-and-Planning/Planning-and-Environment/Water-Quality-Improvement/Wetland-Stewardship-Program

Figure 1: Suffolk County Department of Public Works removing Hurricane Sandy debris from the marsh and wetlands at Mastic Beach, New York. *Credit: Newsday and Thomas A. Ferrara*[4]

## PROJECT DEVELOPMENT AND APPLICATION

The catastrophic damage from Hurricane Sandy across the northeast and mid-Atlantic states prompted substantial investments in coastal resiliency efforts, including locations like Suffolk County. The Disaster Relief Appropriations Act of 2013 appropriated $829.2 million to the Department of the Interior (DOI) to restore and enhance coastal assets, build strategic investments, and design cost-effective plans for future coastal resilience initiatives.[3] The DOI partnered with the National Fish and Wildlife Foundation (NFWF) to administer Hurricane Sandy Coastal Resiliency Competitive Grant Program funds to support projects at various scales and jurisdictions. Suffolk County was awarded $1.31 million to restore 430 acres of coastal wetlands. Restoration sites were located at Gardiner County Park in West Bay Shore, Pepperidge Hall Tidal Wetland Area in Oakdale, Timber Point Tidal Wetlands in Great River, and Babylon barrier island marshes. This project leveraged a range of partners that included county, state, and federal entities, as well as several academic institutions. The Suffolk County Department of Economic Development and Planning provided $688,740 in matching funds to carry out this habitat restoration project. The DOI/NFWF funding stream addressed critical issues, such as reducing impacts to coastal communities, to strengthen ecological integrity and functionality and develop an improved understanding of storm impacts to identify cost-effective resilience efforts and tools to mitigate future impacts.

In addition to wetland restoration, the County used the Wetlands Stewardship Strategy to secure an increase of long-term federal and state aid for capacity-building and rehabilitation of more than 2,500 acres of damaged wetlands to reduce future costs from extreme storm events and rising sea levels.[4]

3 National Fish and Wildlife Foundation (NFWF). Hurricane Sandy Coastal Resiliency Competitive Grant Program. https://www.nfwf.org/programs/hurricane-sandy-coastal-resiliency-competitive-grant-program

4 Brand, R. (2015). Suffolk to repair 500 acres of tidal wetlands. https://www.newsday.com/long-island/suffolk/suffolk-county-to-repair-500-acres-of-tidal-wetlands-1.10642885#:~:text=Suffolk%20County%20will%20begin%20rehabilitating,by%20County%20Executive%20Steve%20Bellone

## RELEVANCE TO FEMA HMA

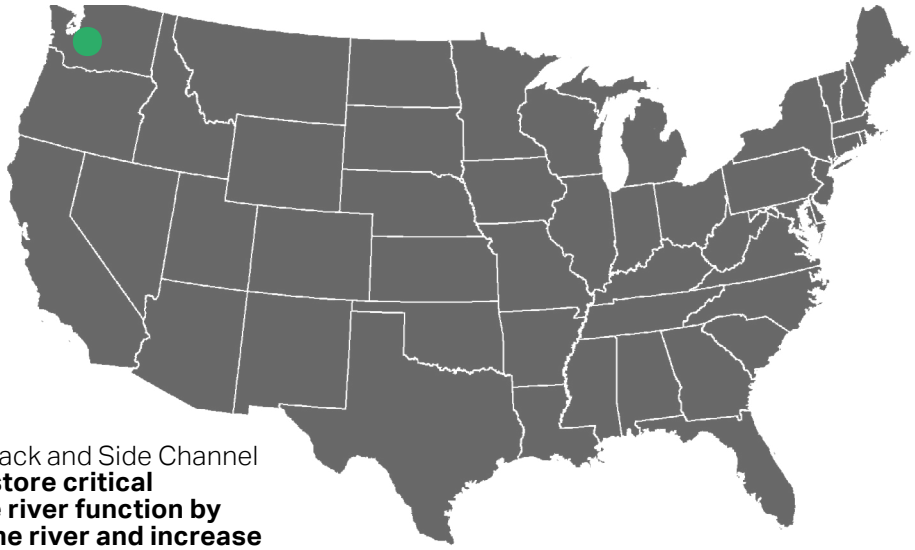
**Future projects designed to mitigate coastal flooding risks using nature-based solutions similar to those undertaken in Suffolk County after Hurricane Sandy could be eligible for FEMA BRIC funding.** Suffolk County's Wetland Restoration Initiative and Wetland Stewardship Strategy provide an ideal example of utilizing multiple rounds and sources of funding to enhance landscape level resilience to future hazardous flooding conditions for the surrounding infrastructure and communities, which could support the "leveraging partners" qualitative criterion. If another community were to pursue a similar project, it could detail in its subapplication the extent to which it meets qualitative criteria like "risk reduction/resiliency effectiveness," "future conditions," and "population impacted."[5] This project would currently score points under the "incorporation of nature-based solutions" technical criterion since it incorporates wetlands restoration and rehabilitation to address future extreme storms and sea level rise.[6] Critical to this is being able to clearly articulate the structures that will be protected by the wetland restoration and resulting mitigation of coastal flooding.

5 FEMA. (2020). BRIC Qualitative Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-qualitative-criteria_support_document_08-2020.pdf

6 FEMA. (2020). BRIC Technical Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-supportdocument_08-01-2020_0.PDF

# CALISTOGA REACH LEVEE SETBACK AND SIDE CHANNEL CONSTRUCTION PROJECT

PIERCE COUNTY, WASHINGTON



RIVERINE/URBAN FLOODING

## PROJECT DESCRIPTION

The Calistoga Reach Levee Setback and Side Channel Construction Project aims **to restore critical floodplain habitat and improve river function by setting back levees to widen the river and increase flood storage capacity,** thereby reducing the stage at which the river floods.

The City of Orting is a community located between the Calistoga Reach of the Puyallup River and the Carbon River. In the 1960s, large stretches of the Puyallup and Carbon Rivers were straightened, and flows were restricted by levees and revetments.[1] Large areas of floodplain farmland were converted to urban developments.[1] During large storm events, the Puyallup River often overtops levees, threatening homes, infrastructure, and businesses[2], along with important salmonid habitat. The project removed approximately 1 mile of existing levees and replaced them with 1.5 miles of setback levees that widened the river.[3] Dewatering wells were installed to reroute surface and groundwater back to the river.[3] A large-scale, 4,000-foot overbank side channel was constructed to provide added flood storage capacity by reconnecting 46 acres of floodplain habitat. It also created and restored 55 acres of streambed habitat for salmonids to the Calistoga Reach of the Puyallup River. This reduced flood risk by allowing river flows to spread out during extreme storm events. The International Right of Way Association awarded the project with the Project of the Year in 2015.[2]

Levee setbacks benefit surrounding areas by allowing flood surges to spread out across a wider plain, resulting in a more natural and wildlife-friendly ecosystem. The project provides a NBS to reduce future impacts from flooding hazards, which pose a threat to people, property, and habitat by widening the river two to four times its original size. **Implementation of this type of project could be transferable to other high flood-risk communities with older levees or narrow river channels.** Several communities have already reached out to the City of Orting to inquire about project development.[1]

## NATURE-BASED SOLUTION

This project **exemplifies a multi-benefit model** for using nature-based solutions to reduce flood impacts while simultaneously enhancing the native ecosystem. The levee setback and added side channel reduced the stage at which the river floods from 3,000 to 10,000 cubic feet per second. The project was completed in November 2014, and a week later prevented devastating flooding impacts to the City of Orting from an extreme storm event that was characterized as the fourth largest flow on the Puyallup River since 1962.[3] Additionally, the project entailed removing invasive, non-native vegetation, planting 38,000 native trees, shrubs, and other plant species, and preserving existing old growth trees along the original levee to enhance riparian habitat.[3] This increased natural cover and reduced water temperatures for federally listed and culturally important salmonid species. The new side channel connects the Puyallup River to existing wetlands, ponds, and low-lying riparian woodlands.[4] Engineered logjams in the side channel promoted the creation of gravel bars and sediment deposits that increase salmonid habitat quality.[5] A 10-year stewardship plan was put in place to ensure the success of the restoration activities.[4] **The project demonstrated the viability of ecologically designed levee setbacks and additional side channels for successful flood prevention.**

1 Floodplains for the Future. (2021). Puyallup Watershed. https://floodplainsforthefuture.org/

2 Parametrix. (2020). Implementing Comprehensive Flood Control Management Programs. https://www.parametrix.com/what-we-do/water-resources/flood-control/calistoga-setback-levee

3 Orting News. (2014). Calistoga Levee Setback. http://www.ortingnews.com/article/2014/5/CalistogaLeveeSetback.html

4 Washington State Recreation and Conservation Office. (2015). Calistoga Setback Levee – Construction. https://secure.rco.wa.gov/prism/search/projectsnapshot.aspx?ProjectNumber=10-1863

5 The Nature Conservancy. (2016). Floodplains: Revisited. In: Washington Nature. https://www.washingtonnature.org/fieldnotes/tag/orting

Figure 1: Calistoga Reach Levee Setback. *Credit: City of Orting.*[10]

## PROJECT DEVELOPMENT AND APPLICATION

Several federally declared flood disasters have impacted Orting since the early 1990s.[3] A major flood in 2006 prompted the City of Orting to begin the process of improving flood resilience.[1] The project design was completed by a consultant, Parametrix, who also assisted the City in obtaining additional funding and provided construction management services.[1] The project received $5.7 million in funding from the Washington Department of Ecology's Floodplain by Design program, which is jointly managed by TNC.[6] An additional $10.7 million in funding was secured through collaborating with a dozen different agencies, including the Pierce County Flood Control District and Washington State Salmon Recovery Funding Board.[4,7]

Figure 2: Engineered logjams on the Puyallup to generate suitable salmonid habitat. *Credit: The Nature Conservancy*[5]

## RELEVANCE TO FEMA HMA

**Future projects with similar, narrow or restricted floodplain conditions could be eligible for FEMA BRIC funding.** The Calistoga Reach Levee Setback and Side Channel Construction Project combines nature-based solutions with existing grey infrastructure in a restoration strategy that could be applied in other communities looking to pursue similar flood reduction projects and apply for BRIC funding. The project provides an example of utilizing multiple rounds and sources of funding to accomplish landscape-level resilience to prevent future hazardous flooding conditions for surrounding infrastructure and communities, which could support the "leveraging partners" qualitative criterion.[8] This case study would garner points under the "incorporation of nature-based solutions," and "mitigating risk to one or more lifelines" technical criteria, since it reduces risk to homes, infrastructure and businesses in Orting.[9] Furthermore, if another community were to pursue a similar project, it could detail in its subapplication the extent to which it meets qualitative criteria, such as "risk reduction/ resiliency effectiveness," "future conditions," and "population impacted."[8]

6 Floodplains by Design. (2021) Where We Work. http://www.floodplainsbydesign.org/work/

7 Pierce County Flood Control Zone District. (2013). 2014-2019 Capital Improvements. https://www.piercefloodcontrol.org/DocumentCenter/View/16/2014-2019-Capital-Improvement-Projects-Plan?bidId=

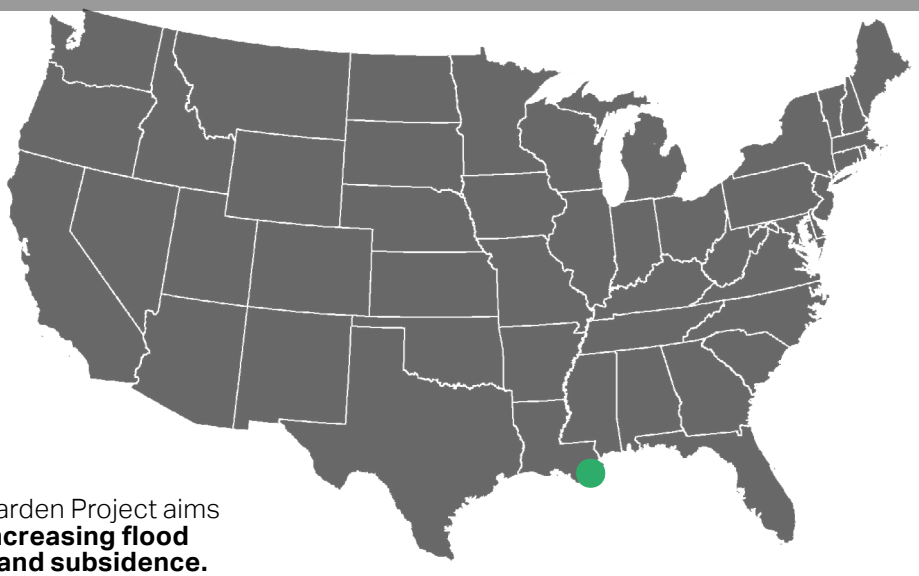
8 FEMA. (2020). BRIC Qualitative Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-qualitative-criteria_support_document_08-2020.pdf

9 FEMA. (2020). BRIC Technical Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-supportdocument_08-01-2020_0.PDF

10 City of Orting. (2014). Levee Updates. http://cityoforting.org/update-72114/

# MIRABEAU WATER GARDEN PROJECT

NEW ORLEANS, LOUISIANA



RIVERINE/URBAN FLOODING

## PROJECT DESCRIPTION

The proposed Mirabeau Water Garden Project aims to **reduce urban flood risk by increasing flood storage capacity and slowing land subsidence.** Other community benefits include the protection of critical infrastructure, improved economic benefits and public health quality, urban heat island reduction, and additional open space for recreational activities.

The City of New Orleans was built on coastal marshlands comprised of organic and highly porous soils that need water for stabilization.[1] City development was made possible by draining the marshlands of water to build in the lower-lying regions. The combination of frequent flooding events and pumping groundwater has contributed to a shrink-swell effect in the soils and land subsidence that causes severe damage to infrastructure over time.[1] The Mirabeau Water Garden Project aims to address urban flooding issues in the city's lowest-lying and most vulnerable neighborhood, the Gentilly District, which averages eight to nine feet below sea level. The objectives for this proposed project are fourfold: (1) divert and store stormwater into a newly configured detention pond to mitigate flooding risks; (2) reduce subsidence by infiltrating water back into the site's soils for stabilization; (3) filter captured storm water runoff through a series of wetlands to improve water quality; and (4) educate the local community about nature-based solutions for sustainable water management and flood reduction.[2]

The Mirabeau Water Garden Project is **meant to serve as a model for other communities facing similar subsidence and flood risks to reduce urban flooding hazards using innovative nature-based solutions** while providing additional community benefits. As a public asset, the Mirabeau Water Garden will function as an environmental classroom to foster a more positive relationship between the community and water, increase property values, and provide recreational space.[2]

## NATURE-BASED SOLUTION

The proposed project **aims to transform an empty urban parcel into an urban wetland** using NBS to reduce flood impacts. This project acts as a research site to demonstrate urban water management and flood mitigation best practices to provide resiliency against climate change, which is predicted to increase the frequency and intensity of extreme storms and sea level rise. Using methods pioneered in the Netherlands to address impacts from sea level rise, the project will welcome stormwater instead of fighting it by creating a series of lakes and reservoirs to absorb flood waters.[3] Up to 10 million gallons of stormwater will be collected into a slow-draining lake, rather than immediately shunted into the Gulf of Mexico.[4] This will slow the city's subsidence by recharging groundwater and infiltrating the site's sand sublayer to stabilize soils. Native grasses will be planted to provide vegetative cover that tolerates the variable hydric conditions, while wildflowers will provide aesthetics for community interest. The construction of the garden seeks to keep water in, utilizing natural processes to prevent against the magnitude of flooding hazards witnessed in the region while building resilience.[1]

1 Worby, R. (2018). Changing Tides; Mirabeau Water Garden in New Orleans part of a Sustainable Water Management System. Retrieved February 1, 2012 from Pacific Standard: https://psmag.com/news/changing-tides

2 City of New Orleans. (2018). Gentilly Resilience District; Mirabeau Water Garden Fact Sheet. Retrieved February 1, 2021 from the City of New Orleans: https://nola.gov/resilience-sustainability/resources/fact-sheets/mwg-fact-sheet-9-14-18/

3 Waggonner & Ball. Greater New Orleans Urban Water Plan. Retrieved February 1, 2021 from Waggonner & Ball: https://wbae.com/projects/greater_new_orleans_urban_water_plan

4 Teague, M. (2020). Flood and Sacrifice: How an Old Convent Could Help Save New Orleans. Retrieved February 1, 2021 from The New York Times: nytimes.com/2020/08/26/us/new-orleans-nuns-hurricane-laura-flood.html


Figure 1: Illustration of the Mirabeau Water Garden. *Credit: Waggonner & Ball*[8]

## PROJECT DEVELOPMENT AND APPLICATION

The Mirabeau Water Garden is part of Resilient New Orleans, a resilience initiative aimed at reducing flood risk, slowing land subsidence, improving energy reliability, and encouraging neighborhood revitalization. This project was proposed by Waggoner & Ball, an architecture and environmental firm in New Orleans, as part of the Greater New Orleans Urban Water Plan in the aftermath of Hurricane Katrina—the Plan was recently awarded the American Planning Association's National Planning Excellence Award.[1] The proposed project location was once home to the Congregation of the Sisters of St. Joseph, a 25-acre parcel in northern New Orleans that was destroyed during Hurricane Katrina and was donated to the City to enhance and protect the neighborhood and "evoke a huge systemic shift in the way humans relate with water and land."[5]

The City of New Orleans has secured $12.5 million dollars in FEMA Hazard Mitigation Grant Program funding. The proposed project will receive an additional $10.5 million dollars through the U.S. Department of Housing and Urban Development's (HUD) National Disaster Resilience Competition to implement nature-based solutions that reduce flood risks while creating beneficial community assets, making it the first Resilience District in Gentilly.[2] The HUD funds will enhance the landscape design of the water garden and promote both educational and recreational amenities for the local community.

## RELEVANCE TO FEMA HMA

Future projects with similar urban flooding conditions to those in New Orleans could be eligible for FEMA BRIC funding. **The Mirabeau Water Garden Project provides an innovative and educational example of nature-based designs in highly urbanized areas** that can guide communities as to the benefits of these practices and aid those looking to pursue similar urban flooding mitigation projects in the future. This case study warrants points under the "incorporation of nature-based solutions" and "mitigating risk to one or more lifelines" technical criteria, since it reduces risk to the city's drainage system using an urban wetland and in turn protects its road network, which is covered under the Transportation Community Lifeline.[6] If another community were to pursue a similar project, it could detail in its subapplication the extent to which it meets qualitative criteria such as "risk reduction/ resiliency effectiveness," "population impacted," and "outreach activities."[7] A project similar to the Mirabeau Water Garden Project could address climate change impacts (i.e., future extreme storms and sea level rise) in the planning and implementation phases to further bolster support for the "future conditions" criterion score.

Figure 2: Rendering of Mirabeau Water Garden. *Credit: Waggonner & Ball*[3]

5 Deltares. Sewage & Water Board of New Orleans "Integrated Master Planning: Request for Information;" Subsidence and Groundwater: Mirabeau Water Garden. https://www.swbno.org/documents/Projects/MasterPlan/RFI/Deltares.pdf

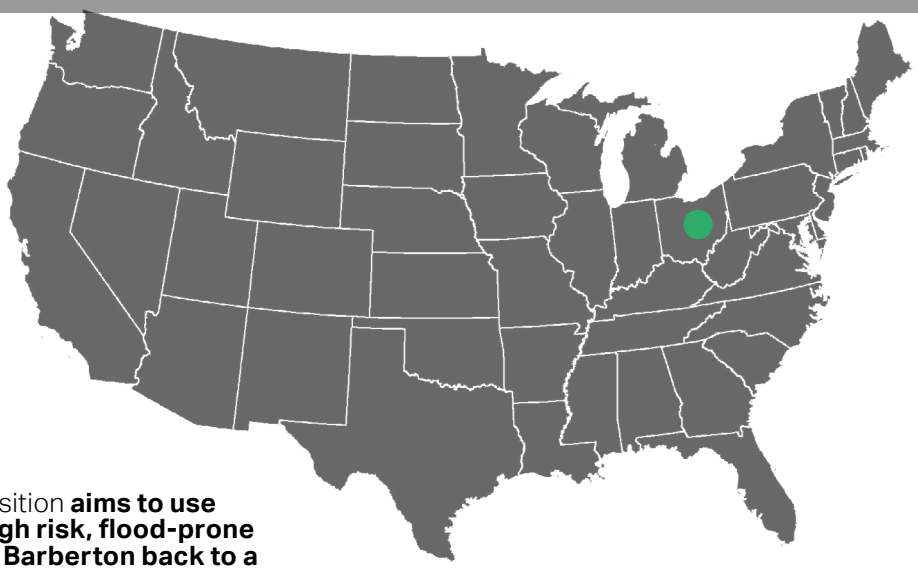
6 FEMA. (2020). BRIC TechnicalCriteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-supportdocument_08-01-2020_0.PDF

7 FEMA. (2020). BRIC Qualitative Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-qualitative-criteria_support_document_08-2020.pdf

8 Waggonner & Ball. Mirabeau Water Garden. https://wbae.com/projects/mirabeau_water_garden

# WOLF CREEK FLOODPLAIN ACQUISITION

BARBERTON, SUMMIT COUNTY, OHIO



RIVERINE/URBAN FLOODING

## PROJECT DESCRIPTION

The Wolf Creek Floodplain Acquisition **aims to use land acquisition to restore a high risk, flood-prone urban region within the City of Barberton back to a functional and resilient floodplain.**

The City of Barberton, Ohio was constructed on fertile floodplains within the Tuscarawas River Watershed which comprises numerous waterways, including Wolf Creek, that meander through the city. Wolf Creek experiences frequent urban flooding that negatively impacts surrounding residential infrastructure. In addition to Wolf Creek, the city has additional flood hazard areas within the 100-year floodplain that are highly susceptible to flooding events.[1] Wolf Creek flooding mechanisms can be attributed to the expansion of the waterway following precipitation events, increased drainage from neighboring towns, and overflow of storm sewers.[2] Regular urban flooding prompted Barberton to develop a flood risk and vulnerability assessment to better understand and minimize flooding impacts to the community and critical infrastructure. The city cataloged flood hazards and quantified flood-related losses to identify risks and prioritize mitigation strategies, which include removing flood-prone structures, flood-proofing structures within the floodplain, installing structural flood controls, reducing stormwater entering waterways, and increasing the storage capacity of drainage regions.[2]

In 2019 and 2020, the city of Barberton was awarded FEMA and the State of Ohio Emergency Management Agency (EMA) funds to acquire and demolish residential structures adjacent to Wolf Creek through the use of a nature-based design that would return the natural floodplain to a more resilient and historic state as a perpetual greenspace. **Implementation of this type of land conservation can be used to reduce urban flood impacts within high-risk communities and be transferred to other urban areas with community support and proper funding.** When land is aquired using FEMA HMA funds, it must be kept as open space (or for activities tied to open space) in perpetuity.

1 Pursley, R.L., 2013. Flood Risk and Vulnerability Assessment of Barberton, Ohio. https://nfa.usfa.fema.gov/pdf/efop/efo47446.pdf

2 Barberton Stormwater & Floodplain Administration *via* the Pursley, R.L., 2013 FEMA Assessment.

## NATURE-BASED SOLUTION

Floodplain acquisition is considered a step towards community resilience through nature-based solutions that reduce detrimental and recurring urban flooding impacts. The effects of riverine flooding are projected to worsen in the future due to more variable and extreme storm events, aging infrastructure, and increased urban development with little migration space for the river to naturally expand and contract.

Co-benefits of floodplain acquisition go beyond the inherent nature-based design. They also include flood risk reduction and floodplain enhancement, enabling beneficial flooding regimes. It can be a more economical option for the community when recurring flooding takes place by allowing the waterway to adapt and regenerate to its original state.[3] The Wolf Creek Floodplain Acquisition project aims to reduce further urban flood impacts to residents surrounding Wolf Creek and strives to restore the floodplain and associated waterway to a more resilient system.

3 Global Facility for Disaster Reduction and Recovery. Nature-based Solutions for Disaster Risk Management, River Flood Hazards. https://www.gfdrr.org/sites/default/files/NBS%20for%20River%20Flood%20Control.pdf

Figure 1: Street flooding near Wolf Creek in Barberton, Ohio. *Credit: Barberton Herald*[8]


Figure 2: Flooding of 14th Street N.W., Barberton, OH. *Credit: WKSU News*[9]

## PROJECT DEVELOPMENT AND APPLICATION

The City of Barberton's administrative officials and representatives from Summit County's Emergency Management Agency received a voluntary participation commitment from eligible property owners located on 14th Street N.W., 15th Street N.W., and Arthur Street adjacent to Wolf Creek. The collaboration of Summit County, the City of Barberton administration, agency support, other local municipalities, and affected property owners helped guarantee the successful awarding of funds to conduct the land acquisition and subsequent restoration projects. The funding was awarded in 2019 and 2020. In 2019, the City received $595,000 in competitive grant dollars from FEMA and Ohio EMA and contributed $84,938 in local matching funds for the acquisition and demolition of up to 15 residential structures on 14th Street N.W.[4] In 2020, the City received $1.246 million and contributed $177,986 in local matching funds for the acquisition and demolition of up to 18 residential properties on 15th Street N.W. and three residential properties on Arthur Street.[4,5] The residents were given the opportunity to relocate their homes and aid the city in improved flood mitigation for high-risk areas.

## RELEVANCE TO FEMA HMA

**Future projects with similar urban flooding conditions as those experienced in Barberton could be eligible for FEMA BRIC funding.** The proposed Wolf Creek Floodplain Acquisition provides an example of how beneficial NBS can be for both residents and communities looking to pursue similar projects. This case study highlights a unique representation of NBS in the face of climate change and increased extreme events, and warrants BRIC points under the "incorporation of nature-based solutions" technical criterion.[6] If another community were to pursue a similar project, it could detail in its subapplication the extent to which it meets qualitative criteria such as "risk reduction/resiliency effectiveness" and "population impacted." The Wolf Creek Flood Acquisition project demonstrates attention to the increased frequency and intensity of extreme flooding events over time and the updates necessary to storm water infrastructure that could bolster the "future conditions" criterion score. Maintaining strong partnerships between the community and various agencies that acted in collaboration would increase competitiveness under the "leveraging partners" criterion.[7]

4 Vinay, M., 2019. News Release. City of Barberton Receives Award of $595,000 Federal & State Emergency Management Agency Grant for 14th Street N.W. Hazard Mitigation Project. https://www.cityofbarberton.com/DocumentCenter/View/3997/PR-11-13-19-14th-St-FEMA-Grant---2019

5 Tracy, G., 2020. News Release. City of Barberton Receives Award of $1,245,908 Federal & State Emergency Management Agency Grant for 15th Street N.W. Hazard Mitigation Project. https://cityofbarberton.com/DocumentCenter/View/4801/PR---15TH-and-ARTHUR-ST-GRANT

6 FEMA. (2020). BRIC TechnicalCriteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-supportdocument_08-01-2020_0.PDF

7 FEMA. (2020). BRIC Qualitative Criteria. https://www.fema.gov/sites/default/files/2020-08/fema_bric-qualitative-criteria_support_document_08-2020.pdf

8 Muller, R. Flooding Closes Streets. Barberton Herald News Source. https://www.barbertonherald.com/2018/04/16/flooding-closes-streets/

9 Urycki, M., 2013. Floods in Barberton force evacuation of nearly two dozen elderly people. https://archive.wksu.org/news/story/36161