Building Resilience through Natural Infrastructure:

Barriers and Opportunities within FEMA Hazard Mitigation and HUD Community Development Block Grant Programs

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Section 1: Introduction

The United States has faced increasingly frequent, severe, and costly weather- and climate-related disasters ranging from unprecedented wildfires to extreme storms and floods, all while combating a global pandemic. In 2020 alone, there were a record setting 22 separate weather- and climate-related billion-dollar disaster events - the most to date - totaling $95 billion in damages.[1] These major disasters, along with smaller hazard events, cause severe physical, psychological, emotional, and economic disruptions to communities.

Physically, disaster impacts have been catastrophic nationwide. Communities are stuck in repetitive disaster event cycles; rebuilding to the same pre-disaster conditions simply to replace what was lost, and then suffer the same impacts again in the future. Disaster recovery is currently a very costly and reactive effort. The U.S. has a 5 year-total of $642.5 billion in costs from billion-dollar disasters alone.[1] This value does not incorporate costs from smaller disasters, which are also numerous and frequent across the US, and can still have major localized impacts on communities. About half of the total costs related to billion-dollar disasters since 1980, $1.9 trillion, has been incurred since 2010, marking a significant increase in damages and costs related to disasters.[2]

Disasters like flooding and wildfires can create additional burdens for the most vulnerable community members, while also exacerbating existing socioeconomic problems. Disasters can increase financial strain for all families, with the most extreme impacts felt in the poorest communities. The costs of evacuating – including gas, hotels, and meals away from home - may be out of reach for many people, forcing them to choose between moving to safety in a local congregate shelter or staying home and risking their lives. Many disasters increase the risk of exposure to animal-borne and communicable diseases, pollutants from flood waters, mold or smoke damage exposure post-disaster, or particulate matter from wildfires causing or exacerbating health issues like asthma, fungal infections, and chronic obstructive pulmonary disease (COPD).[3] Disaster-related stress, anxiety, and trauma can also exacerbate pre-existing health conditions and long-term health impacts like heart disease and Post Traumatic Stress Disorder (PTSD).[4] Disasters also lead to disruption of treatments, lack of access to healthcare facilities and providers, and emotional trauma from the severing of community and family support networks.[5]

In order to combat and minimize the impacts of natural hazards on communities, mitigation and adaptation techniques are key investments for protecting people, property, and the environment. The federal government is increasingly placing greater value on investing in hazard mitigation solutions, which prevent similar damages from happening in the future, quickening recovery time and reducing the

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[1] NOAA National Centers for Environmental Information (NCEI). U.S. Billion-Dollar Weather and Climate Disasters (2021). https://www.ncdc.noaa.gov/billions/

[2] NOAA National Centers for Environmental Information (NCEI). (2021).

[3] NIH. Health and Disasters: Understanding the International Context, Section 2: The Health Impacts of Disasters (2020). https://www.nlm.nih.gov/dis_courses/international/02-000.html#One

[4] Tulane University. A Closer Look at the Long-Term Health Consequences of Natural Disasters (2018). https://socialwork.tulane.edu/blog/health-consequences-natural-disasters

[5] Prohaska, T.R.,K.E. Peters. Impact of Natural Disasters on Health Outcomes and Cancer Among Older Adults, *The Gerontologist*, (2019). https://doi.org/10.1093/geront/gnz018

financial and emotional impacts in the post-disaster recovery and rebuilding phase. Investment in hazard mitigation is a smart financial decision, saving up to $13 for every $1 invested.[6]

Historically, federal mitigation investment has relied on costly grey infrastructure solutions like constructing hardened erosion and flood control structures such as seawalls and levees. These mitigation measures can be effective at reducing flood risk, but only to their designed standard and with proper maintenance. Many structural solutions were designed without the realities of climate change in mind and have not been maintained. As a result, they are prone to catastrophic failure, as we see with increasing examples of dam failures and levee breaches. These hardened structures can also exacerbate harm in the surrounding environment. With increasingly extreme storms, irregular precipitation and weather patterns, and extreme drought and fire conditions, taking future conditions like climate change, new development, and changes in land use into account when designing mitigation measures is key. Natural and nature-based solutions are adaptive mitigation solutions which effectively reduce risk, are cost-effective, and provide additional year-round recreational and environmental co-benefits to the community. Natural solutions will be a critical technique to expand the nation's portfolio of hazard mitigation solutions to build truly resilient communities in the face of natural hazards.

Various federal agencies across the US government play a major role in building our nation's resilience and investing in mitigation activities. For example, the National Oceanic and Atmospheric Administration (NOAA), the Natural Resources Conservation Service (NRCS), and the U.S. Fish and Wildlife Service (USFWS) administer various grant programs that support resilience through ecosystem restoration. Other agencies, including the U.S. Army Corps of Engineers (USACE) and the Department of Transportation (DOT), have a major role to play in shoring up the resilience of our public infrastructure. Additionally, the Small Business Administration (SBA) and Economic Development Administration (EDA) invest in the economic resilience of communities and businesses in pre- and post-disaster environments. The Federal Emergency Management Agency (FEMA) and the Department of Housing and Urban Development (HUD), however, are two of the major agencies that have significant funding available that communities can more directly access in order to invest in resilience projects that are informed by local and state needs. This paper will examine FEMA and HUD's role in resilience investments, as well as barriers and opportunities at each agency to utilizing nature-based solutions for hazard mitigation.

The time to increase our national investment in natural and nature-based hazard mitigation and resilience solutions is now. The Biden-Harris Administration's recent Executive Order on Tackling the Climate Crisis at Home and Abroad speaks specifically to the pursuit of a green recovery effort by utilizing nature-based solutions to address our climate-related challenges.[7] Additionally, President Biden has also called for a doubling of the funding available through FEMA's pre-disaster mitigation Building Resilient Infrastructure and Communities (BRIC) grant program, with an emphasis on projects utilizing

[6] National Institute of Building Sciences. Mitigation Saves Fact Sheet (2020). http://2021.nibs.org/files/pdfs/ms_v4_overview.pdf

[7] Exec. Order 14008 of January 27, 2021, Tackling the Climate Crisis at Home and Abroad, *Federal Register* vol. 86 no. 7619: 7619-7633. https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad

nature-based solutions, and a significant portion of funding directed to disadvantaged communities.[8] With bipartisan support, members of Congress are also currently working to advance legislation to permanently authorize HUD's Community Development Block Grant-Disaster Recovery (CDBG-DR) Program to expedite community-scale recovery and mitigation assistance post-disaster for those communities most in need.[9] Additionally, President Biden has called for the re-evaluation of longstanding policies to ensure future federal actions and investments are equitable, and employ the best available science to incorporate climate change and future conditions considerations into project design for smart, sustainable investments.[10]

Ultimately, even with robust support from Congress and the Administration, policy barriers to accessing federal funding for natural and nature-based hazard mitigation projects still exist, particularly for disadvantaged and under-resourced communities. With the Biden Administration's whole-of-government approach to addressing climate change, investing in resilient infrastructure, and examining the equity of new and existing programs, there is a near-term opportunity to address many of these policy roadblocks. Many federal agencies, including FEMA and HUD, are actively examining and reforming program delivery and policies, providing a key opening to engage and promote utilization of climate-smart nature-based hazard mitigation techniques and equitable changes to federal programs.

What is Natural Infrastructure and Why is it Important?

Natural and nature-based solutions, also known as natural infrastructure or green infrastructure, refer broadly to natural systems - such as wetlands, forests, and floodplains - which provide essential services and benefits to society like flood protection, erosion control, and water purification. These solutions capitalize on the ecosystem service functions, like flood water absorption, that natural systems inherently provide. By harnessing these ecosystem services, communities can implement natural infrastructure solutions to address specific resilience problems.[11]

Natural and nature-based solutions can provide a multitude of risk-reduction services, often referred to as natural defenses, to reduce risks to lives, property, and communities overall.[12] These approaches utilize existing or restored natural systems for their risk reduction benefits. An example of a natural solution would be a wetland conservation project which preserves an existing wetland that provides natural flood control for a surrounding neighborhood. In addition to accomplishing the goal of

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[8]Reforming Disaster Recovery Act, S. 2301, 116th Cong. (2019). https://www.congress.gov/bill/116th-congress/senate-bill/2301?q=%7B%22search%22%3A%5B%22S+2301%22%5D%7D&s=2&r=1

[9]Executive Office of the President. Press Release May 24, 2021, FACT SHEET: Biden Administration Invests $1 Billion To Protect Communities, Families, and Businesses Before Disaster Strikes. https://www.whitehouse.gov/briefing-room/statements-releases/2021/05/24/fact-sheet-biden-administration-invests-1-billion-to-protect-communities-families-and-businesses-before-disaster-strikes/

[10] Executive Office of the President. Memorandum January 26, 2021, Modernizing Regulatory Review, *Federal Register* vol. 86 no. 7223: 7223-7224. https://www.federalregister.gov/documents/2021/01/26/2021-01866/modernizing-regulatory-review

[11] Glick, P., E. Powell, S. Schlesinger, J. Ritter, B.A. Stein, A. Fuller. The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction (2020): 3. https://www.nwf.org/-/media/Documents/PDFs/NWF-Reports/2020/The-Protective-Value-of-Nature.ashx?la=en&hash=A75F59611475502BEE58723F8B3C58423417E579

[12] Small-Lorenz, S.L., B. A. Stein, K. Schrass, D.N. Holstein, A.V. Mehta. Natural Defenses in Action: Harnessing Nature to Protect Our Communities (2016): 3. https://www.nwf.org/-/media/Documents/PDFs/NWF-Reports/2016/NWF_Natural-Defenses-in-Action_Report.ashx

reducing flood risk, this project would also provide co-benefits like additional wildlife and fish habitat, carbon sequestration services, recreational opportunities for the community, and improved water quality. Alternately, nature-based approaches mimic the risk reduction function of a natural system but are designed and constructed by people, and can utilize natural or manmade materials. An example of a nature-based solution project would be an engineered stream stabilization with aquifer recharge elements, which may utilize a combination of cement, rebar, railroad ties, rocks, native plantings, and fallen trees to primarily reduce erosion and flooding to surrounding areas, increase aquifer recharge, and reduce drought. It would also provide co-benefits of new wildlife and fish habitat, enhanced water quality, reduced sedimentation, and support new recreation and education opportunities.

Additionally, natural and nature-based solutions can be effective when combined with traditional hazard mitigation techniques. For example, a series of voluntary buyout property acquisitions of repetitively flooded structures along a river could be paired with a floodplain restoration project to maximize benefits. A project like this can completely eliminate flood risk to the acquired structures, while also reducing the risk to the surrounding community by restoring and managing a natural floodplain, providing greater flood storage and water absorption capabilities. Another example would be restoring a wetland between the river and the levee to provide additional flood storage capacity, further reducing flood risk to neighboring communities.

With a vulnerable environment due to climate change, shifts in baseline conditions, and more frequent and severe storms, the need for adaptable hazard mitigation and resilience solutions will only grow. Traditional grey solutions, such as a cement retaining wall, are designed to a specific level of protection, and require costly maintenance to remain effective. Once conditions exceed that grey structure's mitigation capabilities, it may no longer be effective or may require a costly redesign to remain effective under new conditions. Grey infrastructure can also exacerbate erosion and further degrade the nearby environment. A more adaptable alternative could be a natural stream bank stabilization technique that could incorporate natural plantings, downed trees, and rocks to naturally stabilize the bank to reduce risk, increase groundwater recharge, provide increased ecologically valuable habitat, and increase aesthetic and recreation values of the river. A natural stream bank stabilization can also be designed to have multiple layers of protection that can adapt and grow, continuing to function and reduce risk with future varied changes in water levels. In general, natural and nature-based solutions can be designed to fit local risk reduction needs, adapt to future conditions, and enhance the environment based on site specific requirements and local ecosystems.

Table 1. Examples of natural infrastructure for hazard risk reduction.[13]

Natural hazard	Conventional approaches	Natural or nature-based approaches	Examples
Inland flooding and erosion	Dams, dikes, levees, stream channelization, stormwater sewers, combined sewers, pumps	• Floodplain and watershed restoration • Green stormwater management • Protecting floodplains from development	• Levee setbacks • Wetland, forest and watershed restorations • Rain gardens and natural infiltration systems • Minimizing stream alterations • Permeable pavement • Voluntary buyouts • Avoiding new development in floodplains • Open space acquisition and protection
Coastal flooding and erosion	Seawalls, bulkheads, dikes, breakwaters, levees	• Coastal habitat protection and restoration • Living shorelines • Protecting sensitive coastal areas from development	• Intact or restored shoreline systems (e.g., wetlands, mangroves, beaches, dunes, and barrier islands) • Coral and oyster reefs • Restored/constructed marsh with sills or breakwater structures • Constructed oyster reefs • Voluntary buyouts • Coastal land acquisition and easements
Extreme heat and drought	Dams and reservoirs, air conditioning	• Watershed protection and restoration • Urban green infrastructure • Water conservation	• Forest and watershed restoration • Beaver restoration • Urban trees and other vegetation • Green roofs and cool pavement • Rain barrels • Xeriscaping
Wildfire	Wholesale suppression of wildfires, clearing firebreaks	• Ecological forest management • Helping communities live with fire • Managing wildfires (when possible) to benefit ecosystems	• Combined fuel reduction treatments • Prescribed fire • Post-fire restoration • Fire-adapted communities, such as through Firewise USA® neighborhood mitigation • Collaborative risk management • Avoiding new development in high-fire-risk areas

[13] Glick et al. (2020): 6.

Western Watersheds: Hazards and Nature-Based Solutions[14]

Although there are somewhat limited examples of FEMA and HUD-funded natural solutions for hazard resilience, there are well established natural and nature-based techniques used to address many of the most pressing issues in western watersheds. Detailed below are some of the most pressing hazards encountered across western states, along with examples of natural and nature-based solutions that can be effective to combat and mitigate these hazards.

Inland Flooding and Erosion

Floods are known to be one of the most frequent and expensive natural hazards in the U.S., often reaching upward of billions of dollars per year in damages.[15] [16] [17] [18] Flooding is a natural process that is beneficial for some natural ecosystems. However, floods become a hazard or even a disaster when they have adverse or catastrophic effects on people and the environment. Floods can have a wide range of impacts, including loss of life, bodily harm, destruction of homes and infrastructure, spread of pollutants, distress and trauma, and disruption to agriculture and other sources of livelihood.

In order to reduce flood risks, it is key to identify the type of flooding – such as riverine or surface flooding – that impacts a community. Riverine or fluvial floods occur when the water in rivers, streams, or lakes overflows and/or erodes its banks. Surface or pluvial floods occur away from existing water bodies. Surface floods occur when heavy rainfall volumes exceed the ability of drainage systems, such as urban stormwater infrastructure. Human impacts on floodplains and wild landscapes – through development, increases in impervious pavement, changes to elevation impacting water flow and sediment type, channelization of streams, destruction of forests, and filling of wetlands – can quickly alter water flow and absorption rates leading to flooding.[19] [20] These types of changes can modify an area with little to no history of flood risk to become an area that can experience severe flooding under moderate rainfall. Additionally, these types of development changes in upstream communities can lead to severe increases in downstream flood risk.[21]

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[14] The following sections on hazard risks and natural solutions to address them are adapted from: Glick, P., E. Powell, S. Schlesinger, J. Ritter, B.A. Stein, A. Fuller. The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction (2020): 8-27. https://www.nwf.org/-/media/Documents/PDFs/NWF-Reports/2020/The-Protective-Value-of-Nature.ashx?la=en&hash=A75F59611475502BEE58723F8B3C58423417E579

[15] Kousky, C. Learning from extreme events: Risk perceptions after the flood (2010) *Land Economics* 86: 395–422.

[16] Michel-Kerjan, E., H. Kunreuther. Redesigning flood insurance. (2011) *Science* 333: 408–409.

[17] Pralle, S. Drawing lines: FEMA and the politics of mapping flood zones. (2019) *Climatic Change* 152: 227–237.

[18] Truhlar, A.M., C. Bergstrom. Surging Waters: Science Empowering Communities in the Face of Flooding. (2019) *Washington, DC: American Geophysical Union*.

[19] Ogden, F.L., N. Raj Pradhan, C.W. Downer, J.A. Zahner. Relative importance of impervious surface area, drainage density, width function, and subsurface storm drainage on flood runoff from an urbanized catchment (2011) *Water Resources Research* 47: W12503.

[20] ASFPM Riverine Erosion Hazards Workgroup. ASFPM Riverine Erosion Hazards White Paper (2016)

[21] Heine, R.A., N. Pinter. Levee effects upon flood levels: An empirical assessment (2011) *Hydrological Processes* 26: 3225–3240.

Natural Defenses for Inland Flooding

Evidence suggests that utilizing natural infrastructure to reduce flood risks makes economic sense.[22] [23] [24] [25] Natural and nature-based solutions are highly effective resilience solutions to address inland flooding as they take advantage of natural systems' abilities to absorb and store floodwaters. They also can provide multiple additional benefits during "sunny days" such as increasing wildlife and fish habitat, improving water and air quality, acting as carbon sequestration sites, and providing educational and recreational opportunities for communities.

Often one of the most effective ways to reduce flood risk is to enhance or restore natural qualities of floodplains, wetlands, and watersheds. This technique is beginning to be used more widely across the west to restore streams and rivers that pose significant flood risk to communities; however, it is not always referred to as natural infrastructure or a nature-based solution. Often, floodplain or stream restoration and stabilization projects are combined with other measures, such as voluntary property buyouts, to further reduce or eliminate risk (discussed further below).

Boulder Creek Recovery and Restoration

In 2013, catastrophic floods drastically impacted Boulder County, Colorado, causing erosion, debris accumulation, sedimentation, and degradation of the natural and built environment. Following the retreat of the flood, the county's eight subwatersheds and creek systems were severely impacted, increasing the susceptibility of the county to future severe flood events.

Boulder County quickly worked to engage stakeholders and form public and private partnerships to create the Comprehensive Creek Planning Initiative to develop a post-flood watershed-wide master plan.[26] [27] [28] Funding for stream restoration was provided by the Boulder County recovery tax, Natural Resources Conservation Service Emergency Watershed Protection program, Colorado Water Conservation Board, and HUD's Community Development Block Grant-Disaster Recovery (CDBG-DR) Program.

Stream and floodplain restorations were unique to each area, but often included elements like restoring stable and sustainable channel configuration to slow water flow, restoring natural riparian and aquatic habitats, utilizing natural materials to stabilize in-stream habitat features and channel banks, restoring floodplains for lateral connectivity, and improving sediment transport, all while protecting private and public infrastructure.

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[22] Baumgärtner, S., S. Strunz. The economic insurance value of ecosystem resilience (2014) *Ecological Economics* 101: 21–32.
[23] Denjean, B., M.A. Altamirano, N. Graveline, et al. Natural Assurance Scheme: A level playing field framework for Green-Grey infrastructure development (2017) *Environmental Research* 159: 24–38.
[24] Green, T.L., J. Kronenberg, E. Andersson, T. Elmqvist, E. Gomez-Baggethun. Insurance value of green infrastructure in and around cities (2016) *Ecosystems* 19: 1051–1063.
[25] Martín, E.G., M.M. Costa, K.S. Máñez. An operationalized classification of Nature Based Solutions for water-related hazards: From theory to practice (2020) *Ecological Economics* 167: 106460.
[26] Boulder County. Comprehensive Creek Planning (accessed June 2021). https://www.bouldercounty.org/disasters/flood/creek-restoration/history-and-background/
[27] Boulder County. Boulder Creek Master Plan (2015). https://www.bouldercounty.org/transportation/plans-and-projects/boulder-creek-restoration-master-plan/
[28] Colorado Water Conservation Board, Colorado Department of Local Affairs, USDA. Colorado Watershed Flood Recovery 2013-2018 (2018). https://indd.adobe.com/view/7f7c3eb4-9779-403c-997e-4341091a4c93

Wetlands act as natural sponges, storing and slowly releasing floodwaters, with research suggesting that a single acre of wetlands can store up to 1.5 million gallons of floodwaters.[29] [30] A global study suggests that wetlands in agricultural areas provide an estimated $2,802 per acre per year in flood control services.[31] The flood reduction potential of wetlands in the Eagle Creek watershed of central Indiana was found to reduce peak flows from rainfall by up to 42%, flood area by 55%, and maximum stream velocities by 15%.[32] Restoring, enhancing, or protecting wetlands can be one of the most valuable investments communities make in reducing flood risk.

Forest and other wildland management practices may also reduce risks to nearby communities from flooding and debris flows following high-severity wildfires, which can burn away much of the vegetation that holds soil in place and slows runoff.[33] Ecological forest management, including targeted thinning, prescribed fire, and long-term rehabilitation and restoration activities can reduce the severity of future wildfires and help minimize associated post-fire flood risks to communities.

Post-fire treatments such as the application of mulch, erosion barriers, and aerial seeding with native grasses and other plants may be necessary to mitigate flood runoff and erosion.[34] [35] However, tradeoffs may exist between the use of seeding to reduce erosion and the recovery of natural plant diversity.

Natural Solutions for Flooding in an Urban Environment

Often referred to as green infrastructure or green stormwater management, natural solutions to reduce flooding in the urban environment often look to mimic ecosystem services from natural systems, such as floodwater absorption. Integrated approaches to stormwater management use natural features such as rain gardens, green roofs, bioswales, vegetated trenches, and permeable pavement in strategic areas to capture stormwater runoff as close as possible to the source. Traditional stormwater management approaches focus on quickly directing water downstream, which can result in flooding when systems are overwhelmed, and degraded water quality. In contrast, green infrastructure specifically is designed to slow down the flow of runoff to facilitate absorption in soils and vegetation, relieving pressure on over-capacity sewage treatment plants and stormwater infrastructure. Green infrastructure can be particularly important in cities that have older combined sewer systems, in which one piping system conveys both sanitary sewage and stormwater. Not only does green infrastructure

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[29] Antolini, F., E. Tate, B. Dalzell. Flood risk reduction from agricultural Best Management Practices (2019) *JAWRA Journal of the American Water Resources Association* 56: 161–179.

[30] Krasowski, M. Continuous watershed-scale hydrologic modeling of conservation practices for peak flow reduction (2019) Master of Science thesis, University of Iowa.

[31] Brander, L., R. Brouwer, A. Wagtendonk. Economic valuation of regulating services provided by wetlands in agricultural landscapes: A meta-analysis (2013) *Ecological Engineering* 56: 89–96.

[32] Javaheri, A., M. Babbar-Sebens. On comparison of peak flow reductions, flood inundation maps, and velocity maps in evaluating effects of restored wetlands on channel flooding (2014) *Ecological Engineering* 73: 132–145.

[33] Garfin, G., S. LeRoy, D. Martin. Managing for Future Risks of Fire, Extreme Precipitation, and Post-fire Flooding. Report to the U.S. Bureau of Reclamation, from the project Enhancing Water Supply Reliability. (2016) *Institute of the Environment.*

[34] Napper, C, USDA/USFS. Burned Area Emergency Response Treatments Catalog (2006). https://www.fs.fed.us/eng/pubs/pdf/BAERCAT/lo_res/06251801L.pdf

[35] Robichaud, P.R., S.A. Lewis, J.W. Wagenbrenner, R.E. Brown, F.B. Pierson. Quantifying long-term post-fire sediment delivery and erosion mitigation effectiveness (2020) *Earth Surface Processes and Landforms* 45: 771–782.

help improve water quality through the diversion and filtration of pollutants, it also can help reduce surface flooding during storms.

Utilizing systems like rain gardens, which are planted depressions designed to allow runoff from nearby impervious areas to soak into the ground, has been shown to significantly reduce runoff into storm drains, thereby increasing the capacity of existing drainage systems to handle higher rainfall volumes.[36] Ramsey County, Minnesota installed a suite of green infrastructure projects like rain gardens, underground infiltration trenches, and a stormwater retention pond to address localized flooding and polluted runoff into nearby waterways. The implemented green infrastructure measures capture more than 10% of the total stormwater runoff in the watershed area and can filter an estimated 94% of stormwater volume from the sub-watershed.[37] [38] Green roofs and permeable pavers are also a good way to reduce localized flooding as rainwater can be absorbed directly, instead of flowing off impervious surfaces further contributing to flooding. Green roofs can also be combined with stormwater catch systems to harvest water for later use. Additionally, all of these techniques can contribute to reducing urban heat island effects, discussed further below.

Levee and Dam Failure Risk and Nature-Based Alternatives

Dams and levees are often used to control and divert floodwater through grey infrastructure structures. These types of projects may give communities a false sense of security, as water is typically stored or held behind large structures until storm events cause water to overtop or breach the designed capacity. With changes in development and increasingly severe and unpredictable storm events, we may begin to see more catastrophic failures of these types of flood control structures. Many of these structures nationwide have been neglected or not properly maintained, posing an extreme potential risk to communities. According to the American Society of Civil Engineers (ASCE), dams and levees separately received a "D rating" on ASCE's 2021 Infrastructure Report Card. The U.S. has 15,600 high-hazard dams, meaning failure would likely result in loss of life, and 11,343 significant-hazard potential dams meaning failure would likely cause significant economic damage but no loss of life. This accounts for almost 30% of the dams in the US.[39] 30% of levees accredited by the USACE are characterized as moderate, high, or very high risk. These levee systems have about 3.6 million people living or working behind them and protect $400 billion of property.[40] Additionally, there are an unknown but significant number of miles of levees nationwide built and maintained by non-USACE groups, and there are significant risks associated with the aging of these levees. A small portion of levees in the US are accredited by FEMA, meaning a professional engineer certifies that the levee meets the National Flood

[36] Mahler, R.I., R. Simmons, M.E. Barber. Problems, perceptions, and solutions to increased flooding threats in urban areas of the Pacific Northwest, USA. (2019) *International Journal of Environmental Impacts* 2: 107–116.
[37] CRWD (Capitol Region Water District). Capitol Region Watershed District BMP Performance and Cost-Benefit Analysis: Arlington Pascal Project 2007–2010. (2012).
[38] Small, G.E., E.Q. Niederluecke, P. Shrestha, B.D. Janke, J.C. Finlay. The effects of infiltration-based stormwater best management practices on the hydrology and phosphorus budget of a eutrophic urban lake (2019) *Lake and Reservoir Management* 35: 38–50.
[39] ASCE. Dam Infrastructure Report Card (2021). https://infrastructurereportcard.org/cat-item/dams/
[40] ASCE. Levee Infrastructure Report Card (2021). https://infrastructurereportcard.org/cat-item/levees/

Insurance Program's minimum design, maintenance, and operations criteria and is expected to provide a 1% annual chance of flood risk.

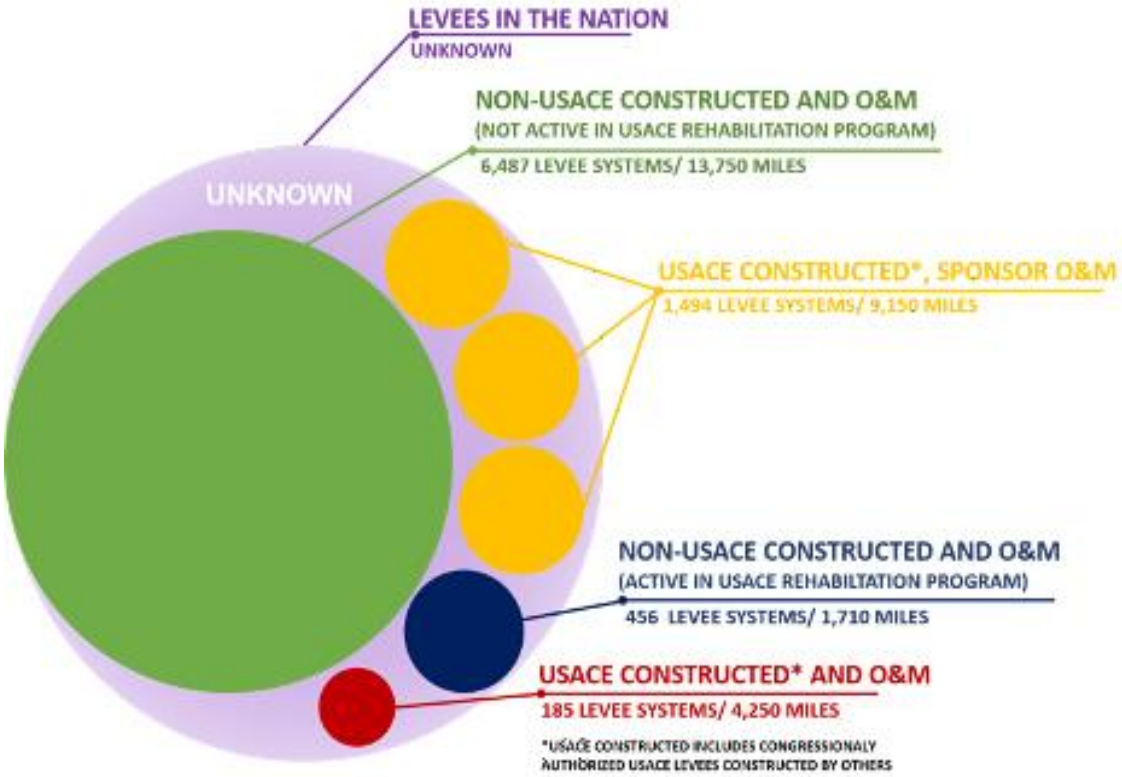

Figure 1. Diagram depicting the operation and maintenance status and construction of levees nationwide.[41]

In response to disastrous floods and infrastructure failures nationwide, many communities across the country have invested in efforts to make room for natural river level fluctuations through levee setbacks, dam removal, and floodplain restoration. Additional floodplain storage provided by levee setbacks reduces flood height and slows peak flows, while also providing additional ecosystem and recreation benefits.[42]

By removing dams, particularly those that are aged and poorly maintained, and restoring natural floodplain and river function, hazardous dam failure risk can be removed and additional flood storage capacity can be maintained, while also restoring fish passages and creating valuable wildlife and fish habitat.

[41] ASCE. Levee Infrastructure Report Card (2021). https://infrastructurereportcard.org/cat-item/levees/
[42] Dahl, T.A., C.H. Theiling, and W. Echevarria, U.S. Army Engineer Research and Development Center. Overview of Levee Setback Projects and Benefits (2017): 2-4.
https://www.researchgate.net/publication/322131431_Overview_of_Levee_Setback_Projects_and_Benefits

Puyallup River Levee Setback Project[43]

Levees were built gradually along the Puyallup River in Washington State from the early 1900s up until the 1950s, originally to control flooding on agricultural fields. These levees enabled human development behind them. As the floodplain was further developed, many sections of the levees were left unmaintained, eroded, or destroyed.

In 1996, a flood damaged the levee and many homes behind it, increasing threats for many more homes as well as a major nearby roadway. These events triggered a coordinated planning effort to reduce levee risk with the USACE, the county, the Washington Department of Fish and Wildlife, and the Puyallup Tribe of Indians. The plan included 10,000 feet of levee setbacks and levee removal as well as floodplain restoration.

Levee setbacks and levee removals required some property acquisitions, funded by FEMA's Hazard Mitigation Grant Program as well as the Washington State Flood Control Assistance Account Program. Levee removal reconnected the Puyallup River with 125 acres of natural floodplains, further reducing flood severity, while also restoring natural habitat and river connection through 2,000 feet of stream restoration for critical salmon populations, allowing fish access for the first time in almost a century.

[43] FEMA. Puyallup River Levee Rehabilitation Project (2021). https://www.fema.gov/case-study/puyallup-river-levee-rehabilitation-project

Rattlesnake Creek Dam Removal

In 2020, the City of Missoula, Montana began to remove a dam on Rattlesnake Creek, which was built over 100 years ago, to reconnect portions of the river and restore the floodplain's natural function. Removal of the dam, which was no longer being maintained, greatly reduced risk to the community and the environment. The dam removal was estimated to avoid $6 million in losses, while also restoring natural function to the watershed. The City of Missoula formed a partnership with Missoula Water, Trout Unlimited, the Watershed Education Network, and the Montana Department of Fish, Wildlife and Parks. The partners collaborated starting in 2017 to prepare for dam removal, and the public-private partnership successfully applied for several grants, receiving substantial funding from the Montana Department of Natural Resources and Conservation's Renewable Resource Grant and Loan Program, FEMA's Hazard Mitigation Grant Program, and the Open Rivers Fund, a program of the Resources Legacy Fund supported by the William and Flora Hewlett Foundation.[44]

Figure 2. Before and after the dam removal and restoration project. Source: FEMA. 2020 HMA Division Year in Review.

Wildfire Risk Intensifies

The 2020 wildfire season was historic and devastating, with the hottest October on record, 10.27 million acres burned, $16.5 billion in damages, 43 direct deaths and an estimated 3,000 indirect deaths from impacts of stress and smoke inhalation.[45] As of June 2021, wildfires in 2021 have already been recorded across 13 states with almost 2 million acres burned, and the National Preparedness Level is set at a 4, a level not typically seen this early in the season. Extreme drought combined with record

[44] Missoula. Rattlesnake Dam Removal Project (2021). https://www.engagemissoula.com/rattlesnake-reservoir-restoration
[45] Masters, J. Reviewing the horrid global 2020 wildfire season (2021). https://yaleclimateconnections.org/2021/01/reviewing-the-horrid-global-2020-wildfire-season/

high temperatures (discussed below), high winds, and dry lightning activity are some of the factors leading to an already active wildfire season.

Although wildfires are a natural and integral part of many forest ecosystems, humans contribute to an increased severe fire risk by changing forest compositions and suppressing natural fires that manage fuel loads and promote growth.[46] [47]Over the past few decades, the severity and extent of wildfires have grown considerably, as have the impacts to human communities and to natural ecosystems.[48] This can be attributed to many factors including overly dense forests due to historical and present-day fire suppression, the expansion of highly flammable invasive species, and changing climatic conditions and human development that lead to intense droughts and altered hydrology.[49] A major concern is the significant increase in people living in the Wildland–Urban Interface (WUI), which is an area where houses are in or near wildland vegetation.[50] The number of homes in the WUI of the conterminous United States increased 41% from 1990 to 2010 to 44 million houses, with the highest concentrations in California, Texas, and Florida.[51] These WUI areas are at higher wildfire risk because the structures are scattered within flammable vegetation, increasing the potential for human-caused ignitions.

Natural Mitigation Solutions for Wildfire

Responsible wildland fire management in the face of climate change is ever more necessary to reduce risks to people and property while enhancing the health and resilience of ecosystems. Typically, in areas where the risks to public safety, property, and natural resources are particularly high, management options selected skew toward fire prevention (e.g., reducing ignitions) and suppression (e.g., incident response), in addition to fuels management (e.g., mechanical thinning and prescribed fire). Yet, management efforts must also account for the effects of more frequent and severe wildfires on forest ecosystems more broadly. Natural and nature-based approaches for wildfire risk reduction range from ecological forest management practices, such as restoring natural fire regimes (including letting fires burn where safely possible), thinning, prescribed fire, and postfire restoration, to policies and programs that help communities adapt to a fire-prone landscape. Additionally, homes in the WUI can implement a number of natural landscaping and xeriscaping designs to create effective fire risk reduction buffers around homes.

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[46] Thom, D., R. Seidl. Natural disturbance impacts on ecosystem services and biodiversity in temperate and boreal forests (2016) *Biological Reviews* 91: 760–781.

[47] Brown, J.K., J.K. Smith, eds., USDA/USFS. Wildland Fire in Ecosystems: Effects of Fire on Flora. General Technical Report (2000) RMRS-GTR-42-vol. 2.

[48] Seidl, R., D. Thom, M. Kautz. Forest disturbances under climate change (2017) *Nature Climate Change* 7: 395–402.

[49] Millar, C.I., N.L. Stephenson. Temperate forest health in an era of emerging megadisturbance (2015) *Science* 349: 823–826.

[50] Radeloff, V.C., D.P. Helmers, H.A. Kramer. Rapid growth of the US wildland-urban interface raises wildfire risk (2018) *Proceedings of the National Academy of Sciences* 115: 3314–3319.

[51] Martinuzzi, S., S.I. Steward, D.P. Helmers. The 2010 Wildland-Urban Interface of the Conterminous United States (2015) Research Map NRS-8. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

Wildfire Mitigation Opportunities

Typically, wildfire mitigation through forest management is implemented primarily by five agencies: The Department of Agriculture's Forest Service (USFS) and the Department of the Interior's Bureau of Indian Affairs, Bureau of Land Management, Fish and Wildlife Service, and National Park Service. FEMA's role and authority are to assist survivors with post-fire impacts and execute recovery efforts, primarily for the built environment.

Forest management and wildfire mitigation is conducted primarily by the agency responsible for the land on which the forests are located. With more private homes interspersed in the WUI, comprehensive management falls on multiple private property owners. Historically, local and state governments have had challenges getting funding for this type of comprehensive wildfire mitigation when it is needed across a matrix of public and private lands.

FEMA has recently (in the wake of multiple catastrophic wildfire seasons and the Disaster Recovery Reform Act of 2018 revisions) committed dedicated post-disaster mitigation funding for wildfire mitigation and recovery, beyond the human and built environment. FEMA is currently administering the Hazard Mitigation Grant Program Post Fire Assistance program.[52] Assistance is available through this program for projects which substantially reduce the risk of future damage, hardship, loss, or suffering in any area affected by a major disaster, or any area affected by a fire for which assistance was provided under Section 420 Fire Management Assistance Grant (FMAG).[53] Common project types include soil stabilization, flood diversion, and reforestation. This funding is unique as it can be used on private land and may be able to be used to complement USFS funding.

Extreme Heat and Drought

Extreme heat and drought conditions are historically one of the deadliest disaster types in the U.S., accounting for almost 20% of disaster related deaths since 1970.[54] From 1980 to 2019, economic losses from drought amounted to nearly $250 billion, compared with just under $147 billion from inland flooding events.[55] Climate change is contributing to an increase in both extreme heat and drought conditions across much of the United States.[56] Heat waves are occurring more often than they used to in major cities across the United States, from an average of two heat waves per year during the 1960s to more than six per year during the 2010s. In addition, the average heat wave season across 50 major cities is 47 days longer than it was in the 1960s.[57] June 2021 set record temperatures across much of the Pacific Northwest, with record all-time highs recorded (>110°F) in early summer for Idaho, Washington,

[52] FEMA. Post-Fire Hazard Mitigation Grant Program (2021). https://www.fema.gov/grants/mitigation/post-fire
[53] FEMA. FEMA POLICY: Hazard Mitigation Grant Program - Post Fire Policy #207-088-2 (2019). https://www.fema.gov/sites/default/files/2020-07/fema_DRRA-1204-policy.pdf
[54] Pollard, K. Which Types of Disasters Are the Deadliest in the U.S.? The Answer Is Surprising (2011). https://www.prb.org/resources/which-types-of-disasters-are-the-deadliest-in-the-u-s-the-answer-is-surprising/
[55] NOAA. 2010–2019: A landmark decade of U.S. billion-dollar weather and climate disasters (2020). https://www.climate.gov/newsfeatures/blogs/beyond-data/2010-2019-landmark-decade-usbillion-dollar-weather-and-climate
[56] USGCRP. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, vol. II. (D.R. Reidmiller et al., eds.) (2018): 71. https://nca2018.globalchange.gov/downloads/NCA4_Report-in-Brief.pdf
[57] USGCRP. USGCRP indicators catalog: Heat waves (accessed June 2021). https://www.globalchange.gov/browse/indicators/us-heat-waves

and Oregon.[58] If climate change continues unabated, scientists project two times as many days per year with a heat index over 100°F, and four times as many days with a heat index above 105°F by the 2050s.[59] In addition, a combination of higher air temperatures and altered precipitation patterns are likely to cause increased drought and increased demand on limited water supplies. Coupling all the factors together, extreme heat and drought contribute to water shortages, crop losses, public health risks, damage to aquatic and terrestrial habitats, and severe wildfires.

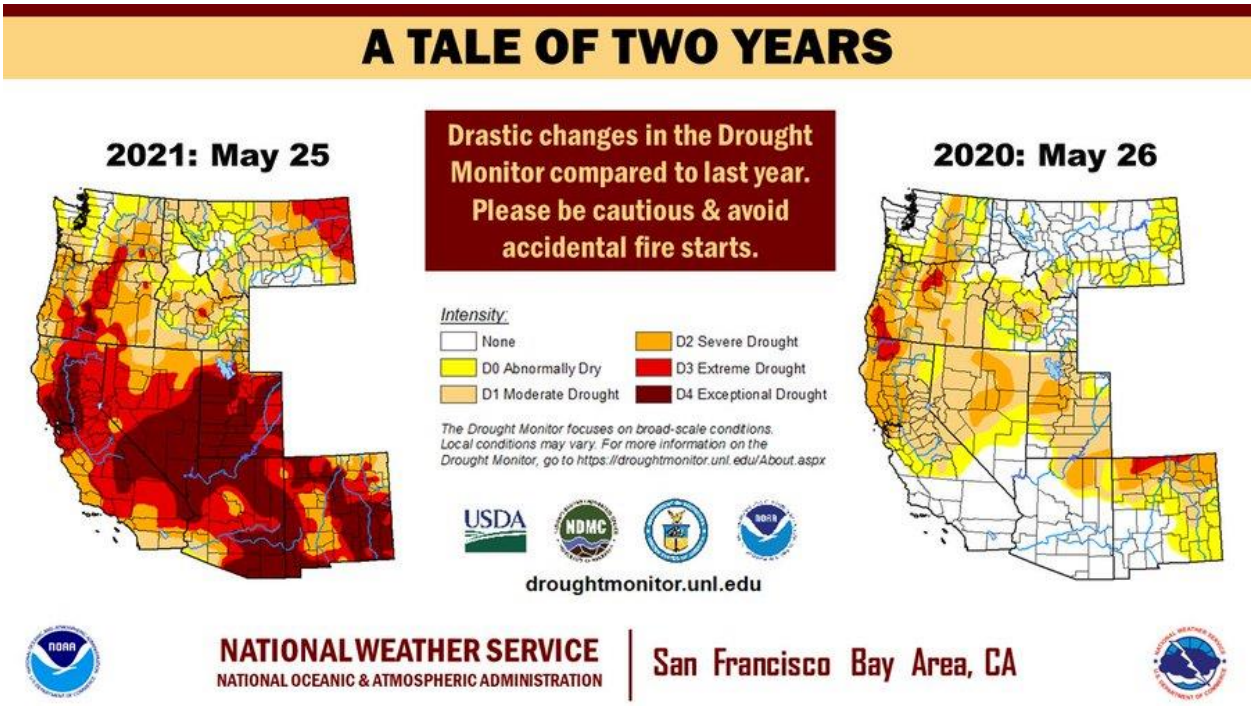

Figure 3. NOAA Bay Area National Weather Service alert demonstrating the significant pre-summer (pre-fire season) drought conditions in 2021 vs. 2020 across portions of the American west.[60]

Nature-Based Approaches to Mitigating Extreme Heat and Drought

Many natural infrastructure approaches are effective in mitigating extreme heat and drought, sometimes achieving both goals simultaneously. Strategies range from watershed protection and restoration and urban green infrastructure to a wide variety of water conservation techniques at differing scales. In urban environments, for instance, increasing pervious surfaces and vegetation cover, including through parks and green roofs, can reduce localized air and surface temperatures and help replenish groundwater by capturing and filtering rainfall. Additionally, adding urban forest canopies can keep localized temperatures lower through shading and evaporative cooling, reducing the urban heat

[58] Freedman, A. Pacific Northwest soon to be ground zero for record-shattering heat (2021). https://www.axios.com/pacific-northwest-heat-wave-all-time-records-17b55cac-7049-4583-86f0-4296093d5691.html

[59] UCS (Union of Concerned Scientists). Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days (2019). https://www.ucsusa.org/resources/killer-heat-united-states-0

[60] NWS Bay Area. A Tale of Two Years (2021). https://twitter.com/NWSBayArea/status/1398474379214802951/photo/1

island effect. In more rural areas, strategies such as beaver restoration and riparian vegetation restoration can help store water and keep nearby streams cooler. When combined with forest restoration efforts, results can lead to safeguarding water resources for people and wildlife alike.

Reducing water consumption is also an important element to improve water security in communities faced with frequent drought. Reducing urban outdoor water use, like that used for lawns and landscaping, can help communities meet their water consumption goals. To achieve this goal municipalities can conserve water by capturing rainfall for reuse, using less water in landscape management, trapping and storing non-potable water, and encouraging landowners to replace lawns with native, drought-resistant plants. In more extreme drought-prone areas, encouraging the use of xeriscaping, which utilizes a mix of highly drought-tolerant native plants and rocks, requiring little to no supplementary watering, can be an effective way to further reduce drought and create fire buffers when managed correctly. In addition, farmers across the country have found that certain practices, such as no-till farming and use of cover crops, can reduce their annual water requirements.

Section 2: Background on Federal Hazard Mitigation and Disaster Recovery Programs

With ever increasing natural hazards, aging crumbling infrastructure, and continued development, many communities are scrambling to use limited funds to protect lives and property, while also maintaining continuity of service for essential lifelines like hospitals, water and sewer systems, and roadways. Limited local resources are always a constraint for communities under the best of conditions, but disaster events exacerbate existing resource constraints and social and physical vulnerabilities.

What Mitigation Programs Exist at FEMA?

FEMA administers many programs that have a history of investing in hazard mitigation and recovery efforts, and are well poised to incorporate climate change and future conditions into current mitigation practices to ensure a resilient nation for years to come:

Public Assistance Mitigation. In a post-disaster environment, Public Assistance Mitigation (PA Mitigation) can be used to fund mitigation and resilience investments for public facilities and some private nonprofit facilities where damages resulted from a presidentially-declared disaster event. These mitigation funds are available to eligible damaged facilities through a non-competitive process and funding amounts are determined by demonstrable cost-effectiveness with no cap on amounts.[61] Post-disaster recovery is a great opportunity to take advantage of the large amounts of available disaster funding to cover the bulk of public infrastructure mitigation costs. PA Mitigation provides opportunities for public facilities and communities to build back better and ensure continuity of services during future disaster events, increasing long-term resilience.[62]

Hazard Mitigation Grant Program. The Hazard Mitigation Grant Program (HMGP) provides funds directly to states after a presidentially-declared disaster, in order to allow states to rebuild in a way that they direct to promote resilience and reduce risk, in accordance with state hazard mitigation plans. HMGP can fund mitigation projects anywhere in the state post-disaster declaration, and can fund projects for undamaged public facilities and private nonprofits, as well as for individual homes and businesses. HMGP has historically been FEMA's largest mitigation program, but that could change with greater investment in pre-disaster mitigation programs like BRIC.[63]

Building Resilient Infrastructure and Communities. FEMA's new BRIC program awards pre-disaster hazard mitigation funding through an annual competitive grant cycle. The program provides funding for a variety of activities beyond mitigation project implementation, such as capability- and capacity-building funding, and mitigation planning. In 2021, BRIC will make $1 billion available through grants,

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[61] FEMA. Mitigate Disaster Damage with FEMA Public Assistance (2019). phttps://www.fema.gov/sites/default/files/2020-06/fema-pa406-mitigation-brochure.pdf

[62] Coastal State Organization. FEMA's Public Assistance Mitigation (2021). https://www.coastalstates.org/wp-content/uploads/2021/01/PA-Mitigation-Fact-Sheet.pdf

[63] FEMA. Hazard Mitigation Grant Program (2021). https://www.fema.gov/grants/mitigation/hazard-mitigation

which presents a great opportunity to fund innovative and large mitigation projects in a pre-disaster or "blue skies" environment.[64] BRIC awards grants through a multi-stage competitive process that includes eligibility determination, technical panel review, and Qualitative Panel evaluations. The BRIC program awards points to projects based on various factors like incorporation of nature-based solutions, consideration of future conditions, existing state and local building codes, outreach and partnership utilization, and projects benefiting small and impoverished communities.[65]

Flood Mitigation Assistance. The Flood Mitigation Assistance (FMA) program, much like BRIC, is a pre-disaster grant program appropriated and awarded on a yearly cycle. This program's goal is to specifically reduce damages and protect people and communities from flood hazards. FMA provides funds for mitigation projects on structures insured under the National Flood Insurance Program, with a special emphasis on repetitive loss structures. FMA can also fund community scale projects that reduce flood risk and flood mitigation planning.[66]

The remainder of this white paper will focus primarily on the BRIC program; however, it is worth noting that many pre-disaster flood mitigation projects that are submitted under BRIC would also be eligible for consideration under FMA if they incorporate flood risk reduction. Additionally, HMGP and PA Mitigation are also high value funds that can be utilized in a post-disaster environment for undamaged and damaged areas.

What's the big deal about BRIC?

FEMA's BRIC program launched in 2020, replacing the longstanding Pre-Disaster Mitigation (PDM) Program, based on authorization under Section 1234 of the Disaster Recovery Reform Act of 2018 (DRRA).[67] BRIC is funded through a six percent set aside from the Disaster Relief Fund, which aggregates the funds available under seven different Stafford Act FEMA major disaster programs. This funding mechanism supports FEMA's ability to provide more consistent large-scale funding for pre-disaster mitigation that is not tied to congressional appropriations. Under the Stafford Act, funding for BRIC is intended to support technical and financial assistance to:

- implement pre-disaster hazard mitigation projects,
- support effective public-private partnerships furthering mitigation investment,
- improve vulnerability assessments of natural hazards,
- establish hazard mitigation priorities or hazard mitigation plans, or
- establish and carry out enforcement activities relevant to the most recent consensus-based building codes and standards.

Additionally, as further defined by the FEMA BRIC program, funds may be used for:

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[64] Executive Office of the President. Press Release May 24, 2021, FACT SHEET: Biden Administration Invests $1 Billion To Protect Communities, Families, and Businesses Before Disaster Strikes. https://www.whitehouse.gov/briefing-room/statements-releases/2021/05/24/fact-sheet-biden-administration-invests-1-billion-to-protect-communities-families-and-businesses-before-disaster-strikes/

[65] FEMA. Building Resilient Infrastructure and Communities (2021). https://www.fema.gov/grants/mitigation/hazard-mitigation

[66] FEMA. Flood Mitigation Assistance (2021). https://www.fema.gov/grants/mitigation/floods

[67] FEMA. Disaster Recovery Reform Act of 2018 (2020). https://www.fema.gov/disasters/disaster-recovery-reform-act-2018

- Capability- and Capacity-Building Activities (C&CB)[68]
    - Building Code Activities[69]
    - Project Scoping[70]
    - Mitigation Planning[71]
    - Partnership Building[72]
- Mitigation Projects
- Direct Technical Assistance[73]
- Management Costs

A sample of eligible project types is available through FEMA's Mitigation Action Portfolio.[74] BRIC is noted as being different from the past pre-disaster mitigation program by encouraging large and innovative projects, allowing flexibility when possible, while also promoting public-private partnerships and supporting capability- and capacity-building.

Additionally, projects must meet basic eligibility requirements where they must:

- Be cost-effective,
- Reduce or eliminate risk and damage from future natural hazards,
- Meet either of the latest two International Building Codes (2015 or 2018),
- Align with local and state hazard mitigation plans as appropriate, and
- Meet all national, state, and local environmental and historic preservation requirements.

Eligible applicants include states, territories, and federally recognized Tribal governments, which are responsible for compiling, prioritizing, and submitting all sub-applicant projects in their jurisdiction. Typically, this responsibility is held by the State Hazard Mitigation Officer (SHMO). SHMOs are typically based out of the state, territory, or Tribal Emergency Management Agencies (EMA). Local governments, other non-EMA state agencies, and federally or non-federally recognized Tribes can function as sub-applicants writing grant applications for individual projects. Sub-applicants should coordinate with state EMAs (the applicant) for state specific guidelines, internal deadlines, and technical assistance that can greatly assist in the production of successful applications. Homeowners, businesses, and nonprofits can work with their local government sub-applicant to apply for BRIC funding for private property.[75]

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[68] FEMA. Capability- and Capacity- Building Activities (2021). https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/before-apply#c&cb

[69] FEMA. BRIC Building Code Activities (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-building-code-activities_support_document_august_2020.pdf

[70] FEMA. BRIC Project Scoping Activities (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-protect-scoping-activities_support_document_08-2020.pdf

[71] FEMA. BRIC Mitigation Planning Activities (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-mitigation-planning-activities_support_document_08-2020.pdf

[72] FEMA. BRIC Partnership Activities (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-partnership-activities_support_document_08-2020.pdf

[73] FEMA. BRIC Direct Technical Assistance (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-direct-techinical-assistance_support_document_08-2020.pdf

[74] FEMA. Mitigation Action Portfolio (2020). https://www.fema.gov/sites/default/files/2020-08/fema_mitigation-action-portfolio-support-document_08-01-2020_0.pdf

[75] FEMA. Funding & Eligibility (2021). https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/before-apply#funding

BRIC Funds and Project Evaluation

After being assessed to meet the basic eligibility requirements listed above, state, Tribal, or territory applicants will rank, in order of priority, projects for submission into different tracks for project consideration outlined below. Funding amounts listed in Table 2 indicate what was offered for Fiscal Year (FY) 2020. FY21 is expected to total $1 billion (doubling amounts available from FY20). Allocation weight for each category may shift in future years, with more information available for the next cycle when the FY21 notice of funding opportunity is released in August 2021.

After BRIC project applications are ranked by EMAs and submitted to FEMA, projects are reviewed for initial eligibility and completeness by FEMA Regional Staff. The mitigation projects in the national competition pool then go through a Technical Criteria evaluation, and then the top projects also go through a Qualitative Criteria evaluation to select the final grant recipients.[76] [77] In FY20 (the first year of the program) $500 million was available for funding and FEMA received requests for $3.6 billion worth of projects, indicating the competitive nature and oversubscription of this program. As seen in the graphics below, a widely touted element of BRIC is the support for implementing nature-based solutions as a hazard mitigation technique; however, as discussed further in this report, significant roadblocks still exist to widespread nature-based solution project funding through FEMA's BRIC program and other federal hazard mitigation programs.

[76] FEMA. BRIC Technical Criteria (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-support-document_08-01-2020_0.PDF

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

Table 2. Further details about BRIC's four funding tracks available for FY20.[78]

Project Tracks Available Under BRIC	FY20 Amount of Funding Available*	Project Type Explanation	Requirements
National Mitigation Project Competition	$446,400,000	Shovel in the ground/physical mitigation projects	-Benefit-Cost Analysis Required -FEMA-approved State and Local Mitigation Plan Required
Tribal Set-Aside (federally-recognized Tribes)	$20,000,000 ($600,000 per applicant available total for all 4 project types)	1. Building Code Activities 2. Mitigation Planning 3. Project Scoping 4. Partnership Building	-No Benefit-Cost Analysis Required -FEMA-approved State and Local Mitigation Plan Required (except mitigation planning projects) -Narrative description of benefits, resources required, and product that will be produced
State/Territory Allocation	$33,600,000 ($600,000 per state or territory available total for all 4 project types)	1. Building Code Activities 2. Mitigation Planning 3. Project Scoping 4. Partnership Building	-No Benefit-Cost Analysis Required -FEMA-approved State and Local Mitigation Plan Required (except mitigation planning projects) -Narrative description of benefits, resources required, and product that will be produced
Direct Non-Financial Technical Assistance	10 Requests Fulfilled in 2020 (1 per FEMA Region); one request may be put forward from each state, territory, or federally-recognized Tribe	Direct technical assistance that will help improve ability of applicant to produce a successful future BRIC Application	-No Benefit-Cost Analysis Required -Letter of interest (<2 pages) outlining the communities' challenges and need for technical assistance, and current staff capacity to participate
TOTAL	$500 million + 10 non-financial technical assistance		

[78] FEMA. The Department of Homeland Security (DHS) Notice of Funding Opportunity (NOFO) FY 2020 Building Resilient Infrastructure and Communities (2020). https://www.fema.gov/sites/default/files/2020-08/fema_fy20-bric-notice-of-funding-opportunity_federal-register_August-2020.pdf

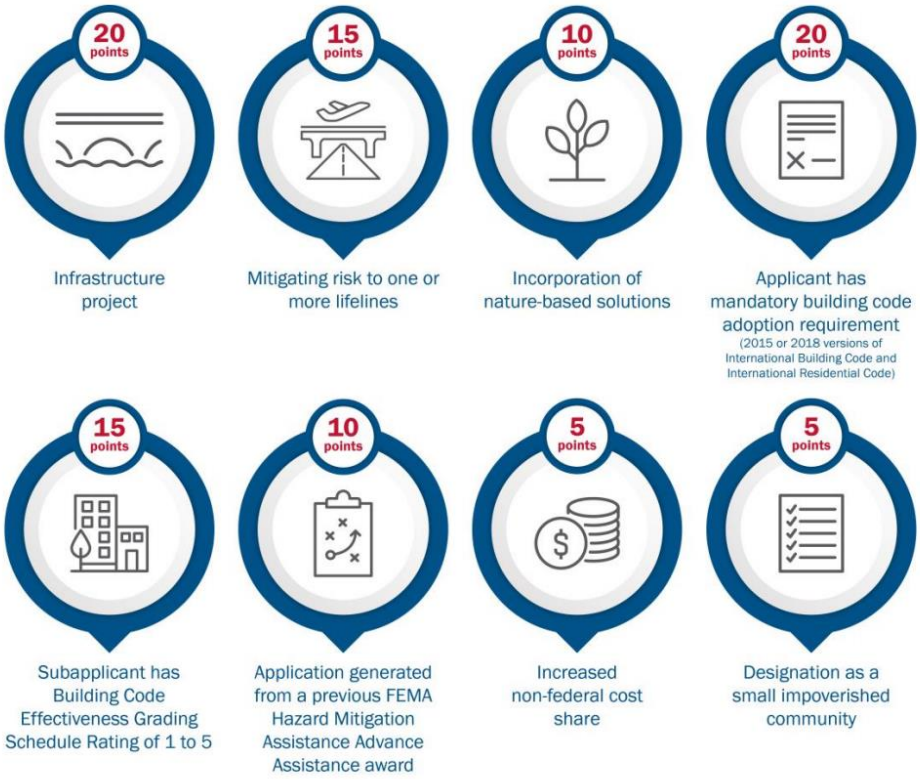

Figure 4. BRIC National Competition Technical Criteria are awarded binarily, either receiving full points or zero points for each category.[79]

Figure 5. BRIC National Competition Qualitative Criteria are awarded weighted points via a rubric evaluating to what degree the project meets each separate Qualitative Criteria ranging from "not at all" to "exceeds."[80]

What Mitigation Funding Opportunities Exist at HUD?

HUD has a program that is sometimes authorized and appropriated by Congress after disaster events called Community Development Block Grant-Disaster Recovery (CDBG-DR) Program. CDBG-DR is

[79] FEMA. BRIC Technical Criteria (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-technical-criteria-support-document_08-01-2020_0.PDF

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

a supplemental appropriation for disaster recovery. Conventional (non-supplemental) CDBG funds can be used for disaster recovery purposes, but the CDBG-DR Program specifically was developed to appropriate significant funding to the most at need communities for long-term disaster recovery, addressing needs which are left unmet by other federal sources. These funds typically follow the statutory authority of the broader CDBG program; however, there can be implementation and allocation-specific directions provided by Congress for each individual supplemental appropriation dependent on the type of disaster event, the community affected, and the unmet needs. The CDBG-DR Program has been authorized as needed over the past 15 years, but the lack of permanent authorization for the CDBG-DR Program continues to create roadblocks to speedy disaster recovery assistance.

CDBG-DR funds are appropriated at the discretion of Congress, and the executive branch occasionally. CDBG-MIT (mitigation) or CDBG-CV (COVID-19) - newer designations made by Congress in recent years - are also considered under the larger umbrella of special CDBG-DR appropriations as they are all supplemental appropriations related to the larger CDBG program.

HUD CDBG-MIT Program

In 2018 Congress appropriated $12 billion specifically for mitigation efforts from qualifying disasters from 2015, 2016, and 2017. HUD was able to bring $3.9 billion of existing general CDBG funds to the program as well. This created a unique opportunity for communities in disaster impacted areas to conduct high impact mitigation and resilience projects to prevent similar future disasters, transforming resilience investments during the recovery phase.[81] In 2021, Congress also appropriated $186 million for eligible 2018 disasters.[82] CDBG-MIT encouraged the use of green techniques and building standards, and consideration of changes in future conditions that should be incorporated to create green resilient designs.

All CDBG funds are flexible in nature, which is one of the best aspects of this program highlighted by communities. Generally, all CDBG funds must be utilized for activities that meet one of the following objectives:

- To benefit low- and moderate-income people,
- To aid in the prevention or elimination of slums or blight, or
- To meet an urgent need for the purposes of health or safety.[83]

Additionally, localities that receive CDBG-DR funds may also utilize any previously awarded unspent general CDBG grants for disaster recovery. CDBG-DR specific appropriations may be used for a variety of purposes such as:

- FEMA non-federal cost share requirements,
- Long-term recovery, rather than immediate disaster recovery needs, or
- "Unmet needs" not addressed by FEMA, EDA, or SBA.

CDBG-DR funds are typically last to be appropriated as they are considered a last resort type of funding for communities that are still heavily impacted by disasters. These funds are typically considered as a

[81] HUD. CDBG-MIT Overview (accessed June 2021). https://www.hudexchange.info/programs/cdbg-mit/overview/
[82] HUD. CDBG-MIT Overview (accessed June 2021). https://www.hudexchange.info/programs/cdbg-mit/overview/
[83] 42 U.S.C. §5301 et seq. as interpreted by HUD at 24 C.F.R. §570.200 and the HUD Guide to National Objectives and Eligible Activities for CDBG Entitlement Communities.

solution to address the gap that exists between typical disaster funding and complete recovery that cannot be covered by local or state resources.

CDBG-DR Funding Cycle

As there is no permanent authorization, the CDBG-DR appropriations and implementation cycle can vary. Generally, CDBG-DR funding generally follows this process:

1. Congress appropriates CDBG-DR through supplemental guidelines;
2. HUD sets rules (as guided by any specifics from Congress) and allocations for how the funds are to be utilized for each individual CDBG-DR allocation;
3. Communities work to develop CDBG-DR action plans and begin engaging in public participation;
4. HUD approves action plans, negotiates grant agreements with locals, and obligates funds;
5. Communities implement action plans and utilize funds; and
6. HUD monitors program activities and expenditures of local grantees.

As this process has many moving pieces that can be subject to congressional direction, associated timelines, steps, and requirements can vary from grant to grant.

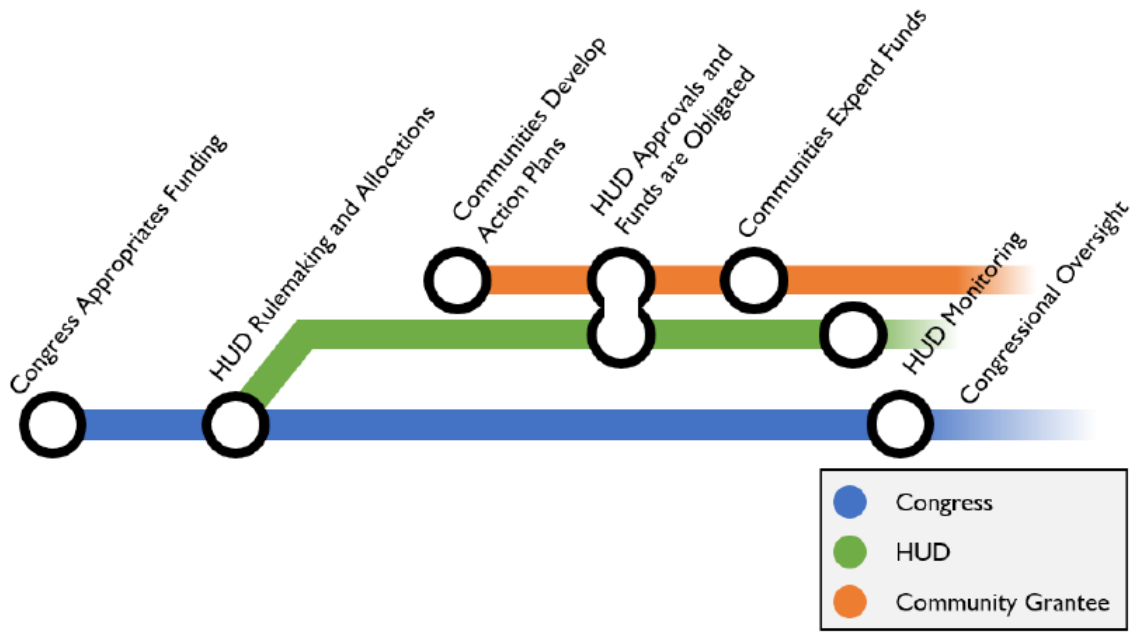

Figure 6. Generalized view of CDBG-DR funding and disbursement process. Exceptions to this process exist as each individual authorization is unique with no permanent authorization.[84]

[84] Cercire, M.H., J.V. Jaroscak, CRS. The Community Development Block Grant's Disaster Recovery (CDBG-DR) Component: Background and Issues (2020): 5. https://www.everycrsreport.com/reports/R46475.html

Sandy CDBG-DR "Rebuild by Design" Recovery

The Obama Administration issued an Executive Order to establish the Hurricane Sandy Rebuilding Task Force, which was to coordinate with affected communities in rebuilding and recovering from the disaster.[85] The Sandy Rebuilding Task Force, which was led by the HUD Secretary, developed a comprehensive strategy for incorporating resiliency in the long-term recovery from Hurricane Sandy's impacts. As part of its efforts, the Task Force administered Rebuild by Design, under the authority of the America COMPETES Reauthorization Act of 2010.[86] Rebuild by Design was a multi-staged resiliency planning and design competition, funded by CDBG-DR funds, focused on areas affected by Hurricane Sandy. The competition had two stated goals: "to promote innovation by developing regionally-scalable but locally contextual solutions that increase resilience in the region," and "to implement selected proposals with both public and private funding dedicated to this effort." HUD developed specific objectives, categories, stages, timelines, eligibility, and registration processes.[87]

Ten final projects were chosen and seven are currently funded through this process and under construction, ranging from Living Breakwaters along Staten Island to The Big U - a hybrid green/gray system of salt-tolerant parks, educational elements, and deployable flood barriers surrounding Manhattan to mitigate and adapt to sea-level rise and storm surge.[88]

The success of the Rebuild by Design collaboration between private and public programs, like The Rockefeller Foundation and CDBG-DR, inspired future similar programs nationwide like HUD's CDBG-Disaster Resilience Competition (CDBG-DRC). In 2014, CDBG-DRC funded eight states and five cities with over $1 billion for disaster recovery and long-term resilience projects nationwide.[89]

[85] Exec. Order 13632 of December 14, 2012, Establishing the Hurricane Sandy Rebuilding Task Force, *Federal Register* vol. 77 no. 74341, 74341`-74344 https://www.federalregister.gov/documents/2012/12/14/2012-30310/establishing-the-hurricane-sandy-rebuilding-task-force

[86] 15 U.S.C. §3719, U.S. Department of Housing and Urban Development, "Third Allocation, Waivers, and Alternative Requirements for Grantees Receiving Community Development Block Grant (CDBG) Disaster Recovery Funds in Response to Hurricane Sandy," *Federal Register* vol.79 no. 62182, October 16, 2014. https://www.govinfo.gov/content/pkg/FR-2014-10-16/pdf/2014-24662.pdf

[87] U.S. Department of Housing and Urban Development. Rebuild by Design—Competition and Registration. *Federal Register* vol. 78 no. 45551, July 29, 2013. https://www.govinfo.gov/content/pkg/FR-2013-07-29/pdf/2013-18163.pdf

[88] Rebuild by Design. Funded Projects (2020). http://www.rebuildbydesign.org/our-work/sandy-projects

[89] HUD. National Disaster Resilience (2017). https://www.hudexchange.info/programs/cdbg-dr/resilient-recovery/

Section 3: Barriers to and Opportunities for Federal Funding and Implementation of Nature-Based Solutions

Nature-based solutions, although widely utilized nationwide for decades to restore ecological function, are a relatively new concept for the hazard mitigation and emergency management community. FEMA, and the wider emergency management community, does not have an extensive history utilizing nature-based solutions for resilience, but has recognized the ability of natural techniques to reduce natural hazard risks to communities while also providing extensive additional benefits year-round to communities.

Because nature-based solutions are fairly novel to the emergency management community, there are a relatively limited number of projects implemented by hazard mitigation professionals with long-term monitoring for specific hazard risk reduction metrics to point to as examples. Nevertheless, there are many examples of nature-based solutions, implemented for a diversity of reasons and by a wide range of agencies and stakeholders, which demonstrate effective hazard mitigation. The National Wildlife Federation cataloged much of the latest science and research regarding the performance of natural infrastructure for hazard risk reduction in our 2020 report, the Protective Value of Nature.[90]

Although there is currently demonstrated support from Congress and the Administration, barriers still exist to implementing and funding nature-based solutions through existing federal grant programs at FEMA and HUD. In the sections that follow we detail and explore these barriers further, and identify opportunities to improve policies and programs to better utilize nature-based solutions for federal hazard mitigation and resilience investment.[91]

[90] Glick, P., E. Powell, S. Schlesinger, J. Ritter, B.A. Stein, A. Fuller, The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction (2020): 28. https://www.nwf.org/-/media/Documents/PDFs/NWF-Reports/2020/The-Protective-Value-of-Nature.ashx?la=en&hash=A75F59611475502BEE58723F8B3C58423417E579

[91] The Nature Conservancy. Promoting Nature-Based Hazard Mitigation Through FEMA Mitigation Grants (2021): 22-30. https://www.nature.org/content/dam/tnc/nature/en/documents/Promoting-Nature-Based-Hazard-Mitigation-Through-FEMA-Mitigation-Grants-05-10-2021-LR.pdf

Montana Abandoned Mine Restoration for Drought Reduction

The Clark Fork and its related tributaries have become seriously degraded by clear-cut logging and hard rock and placer mining over the past 150 years. Ninemile Creek, located near Missoula, Montana, is one of the most important native trout tributaries that has been highly degraded by mining impacts. Large-scale dredging operations have resulted in impassable streams, disconnected stagnant water in dredge pools, and large piles of mining discards 15-20 feet high that dominate the stream corridor. Many of the streams that used to feed Ninemile Creek no longer connect, merely flowing into dredge ponds that line the floodplain.

Abandoned placer mines are responsible for the dewatering of soil leading to drought conditions, flow alterations, channel and floodplain confinement, habitat alteration, fish passage barriers, and sedimentation of waterways to significant bank erosion. The goal of the Clark Fork Restoration Program included rehabilitating streams, floodplains, and hillslope processes impaired by mining operations, restoring aquatic habitat conditions that support all life stages of native fish, and preparing a restoration design that is cost-efficient and incorporates the desires and needs of multiple stakeholders.

Starting in 2014, the Ninemile Creek watershed restoration has been a cooperative effort by the local, state, and federal government, as well as nonprofit groups like Trout Unlimited. This collaborative process has yielded significant progress towards watershed restoration and fisheries health.
In 2020, Missoula County was awarded a $1.2 million federal-share grant through the previous version of the BRIC program (Pre-Disaster Mitigation). This project benefits community members by decreasing peak runoff, providing floodplain storage and increasing drought resilience. Agricultural landowners downstream will also receive benefits associated with aquifer storage and increased late season flow.[92] [93]

[92] FEMA. FEMA Awards $1.2 Million for Ninemile Creek Mitigation Project (2020). https://www.fema.gov/press-release/20210318/fema-awards-12-million-ninemile-creek-mitigation-project

[93] Trout Unlimited. Ninemile Valley Abandoned Mine Restoration (2021). https://www.tu.org/project/ninemile-valley-abandoned-mine-restoration/

FEMA Barriers and Opportunities for Nature-Based Solutions

Increasing State and Local Applicant Uptake of Nature-Based Solutions

Barrier: Under the BRIC program, local municipalities are considered to be sub-applicants for BRIC grants, with state EMAs acting as the official applicant. The state EMA typically reviews, pools, and ranks all local sub-applicant project proposal packages determining the priority ranking for all proposals for their individual state. State EMAs typically are less familiar, or not at all familiar, with nature-based solutions in comparison to grey mitigation techniques. Some state EMAs have never utilized nature-based techniques in pursuit of FEMA funded mitigation grants and may be resistant to put forward a novel type of mitigation project as a priority, or at all. States typically will not receive funding for all their submitted projects, so by ranking and selecting priority projects they ensure their most critical needs are met. Every state has slightly different internal processes and levels of comfort, knowledge, and capacity to support new and innovative projects, as well as provide technical assistance. Without state EMA support for and comfort with nature-based solutions, communities - no matter how capable - may be barred, or poorly ranked by their state EMA when submitting nature-based proposals to FEMA's national competition. Additionally, technical reviewers on FEMA's panel evaluating the projects for awards may not have experience or expertise in reviewing and evaluating nature-based solutions, particularly when comparing them to traditional grey mitigation solutions.

Opportunity: More can be done to advance the acceptance and working knowledge of the emergency management and hazard mitigation community around nature-based solutions. By increasing familiarity with nature-based solutions in the emergency management community and within FEMA, nature-based solutions will become more commonly accepted techniques to address resilience issues nationwide.

> **Congressional Action:** One way of increasing the familiarity of the emergency management community with nature-based solutions is to ensure a portion of funding is dedicated to their implementation. This could be achieved through the authorization of a portion of BRIC funding to be administered by the National Fish and Wildlife Foundation (NFWF) as a multi-year demonstration project for nature-based solutions.[94] NFWF has a history of successfully partnering with federal agencies to administer competitive grant cycles, and demonstrated experience with nature-based solution projects.[95] NFWF currently partners with agencies like NOAA, Environmental Protection Agency (EPA), and the Department of Defense (DoD) to administer the National Coastal Resilience Fund, as well as multiple other grants. NFWF also has a large network of private partners that typically provide a 1:1 match to federal dollars - higher than that required by FEMA. By monitoring the success of implemented projects through this program, NFWF could help advise FEMA on ways to ensure the application process, technical feasibility/effectiveness requirements, and economic metrics used to evaluate projects in the benefit-cost analysis and project review do not disadvantage nature-based projects, and instead incentivize nature-based solutions where appropriate for hazard risk reduction.

[94] National Fish and Wildlife Foundation. https://www.nfwf.org/
[95] National Fish and Wildlife Federation. National Coastal Resilience Fund (2020). https://www.nfwf.org/programs/national-coastal-resilience-fund

An alternative approach would be to authorize a 15% minimum set-aside of BRIC funding to support nature-based projects. Such an approach has been successfully applied to drive nature-based approaches through other federal programs like the Clean Water State Revolving Funds. By setting aside 15% of the funds that FEMA administers through the BRIC national competition specifically for nature-based projects, Congress can help build the capacity of state, local and federal decision-makers, and get demonstration projects in the ground to show the effectiveness of natural infrastructure approaches for enhancing community resilience.

These specific nature-based allocations could help FEMA and the larger EMA community grow a portfolio of natural project types for resilience, gain experience in the implementation and review of projects, and build community trust and interest in such approaches.

Education: With the introduction of a new program like BRIC, there is a learning curve for all involved, particularly when supporting less-familiar techniques like nature-based solutions. Increasing the available opportunities for training, education, and resources which communicate best practices and potential benefits of nature-based solutions is critical to educate the SHMOs, state EMA mitigation program officials, local emergency and floodplain managers, and local elected officials, among others. The more these individuals' working knowledge about nature-based techniques increases, the more likely they are to pursue and support nature-based projects for BRIC funding.

Outreach and Partnerships: An important, but sometimes overlooked, element to a successful FEMA mitigation sub-application centers around the support and relationship between local governments and state EMAs. Although non-governmental organizations cannot act as the sub-applicant for funding, there is ample opportunity to form public-private partnerships with communities. Non-governmental organizations can assist in facilitating a successful working relationship between communities and state EMAs around nature-based solutions.[96] They can provide workshops and trainings that convene and connect local officials and state agencies, while providing expertise on nature-based solutions. Additionally, the leveraging of public-private partnerships is a criterion considered as part of BRIC applications.

[96] FEMA. Building Private-Public Partnerships (2021) https://www.fema.gov/sites/default/files/documents/fema_building-private-public-partnerships.pdf

Non-Governmental Organization Building Connections

Prior to the first BRIC round, the Coastal Management Program within the Illinois Department of Natural Resources had some knowledge about FEMA's Hazard Mitigation Program, but the launch of BRIC motivated staff to pay close attention to the new funding program and eligibility. They were particularly interested in the component of the funding that would allow private property owners to work with their local government to apply on their behalf.

Figure 7. *Unrestored Lake Michigan Shoreline. Source: IL Coastal Management Program*

Coastal States Organization (CSO), a non-governmental nonprofit association, alerted the Illinois Coastal Management Program early on to opportunities related to BRIC through outreach and communication. Following that, CSO's frequent workgroup calls centering BRIC and providing a forum for state coastal management agencies to connect on the utilization of BRIC funding kept this topic front of mind. This motivated managers to proactively conduct outreach to coastal communities in Illinois on the benefits that this funding opportunity could provide.

CSO's communications and education on BRIC provided the Illinois Coastal Management Program an opportunity to get in touch with their SHMO. As a result of this connection, the Illinois Coastal Management Program and Illinois SHMO co-hosted a webinar for local coastal communities to answer questions about their eligibility for BRIC. Because of these timely connections and support, a local neighborhood in the South Shore was able to work with a local governmental entity to seek funding for emergency shoreline restoration that would also protect community lifelines such as critical roads in their neighborhoods. CSO's involvement fostered new relationships and facilitated connections amongst their coastal stakeholders.

Inclusion of Nature-Based Solutions in Hazard Mitigation Plans

Barrier: A statutory requirement of the BRIC program is the consistency of project proposals with state, local, or Tribal FEMA-approved hazard mitigation plans.[97] Many hazard mitigation plans do not consider, or only consider in the abstract, the potential of nature-based solutions as a tool to accomplish their mitigation goals. The plans are typically developed by state and local EMAs, some of whom lack familiarity with nature-based solutions and typically rely on grey infrastructure. BRIC applications must

[97] 42 U.S.C. § 5133 (g)(7)

refer specifically (by page number, section title, etc.) to where the proposed project type is referenced in a state or Tribal hazard mitigation plan in order to be considered for funding.[98]

As outlined in a 2021 report by the Environmental Law Institute (ELI), most states have some reference to natural or nature-based solutions incorporated into their state hazard mitigation plan.[99] However, these goals were not always well developed or fully integrated for implementation. Specific actions are outlined in Table 3.

Table 3. ELI's 2021 report examined the FEMA-approved state hazard mitigation plans for the incorporation of environmental, natural, and nature-based solutions. The report identified relevant nature-based elements in hazard mitigation plans and classified them within the following action categories, indicating the number of times actions were listed across all plans and the state plans in which the actions were present.[100]

Action Category	Number of Actions*	Number of States
Agency Coordination	3	**3 states** (CA, MA, MN)
Conservation/ Preservation/ Management	21	**17 states** (CO, DE, KY, MD, MA, MN, MS, MT, NV, NY, RI, SC, TX, VT, WA, WI, WY)
Education and Awareness	9	**7 states** (AL, CO, IN, MI, NY, NC, MD)
Funding and Programmatic	38	**16 states** (AL, CA, CT, MA, NE, NV, NH, NJ, NC, OH, OR, PA, SC, VT, WA, WI)
Green Infrastructure	13	**12 states** (AR, HI, IN, IA, KY, MD, MA, MN, NY, OH, RI, UT)
Land Use	8	**8 states** (AK, AL, DE, GA, IA, MT, NH, TX)
Partnerships	8	**8 states** (HI, MA, MI, MT, TN, TX, VT, WA)
Policy and Law	12	**9 states** (AK, AL, DE, GA, MA, MN, MT, WA, WI)
Restoration	39	**19 states** (AK, CO, CT, IA, KY, MD, MA, MN, MS, MT, NV, NM, NY, SC, TX, UT, WA, WI, WY)
Technical and Information	37	**11 states** (CT, GA, HI, IL, KS, MA, NH, NY, RI, VT, WA)
No Actions Included	--	**11 states** (AZ, FL, ID, LA**, ME, MO, ND, OK, SD, VA, WV)

*Notes: * 11 actions were included in more than 1 category. ** The Louisiana plan does not include actions like other states, but has a technical appendix with possible mitigation actions.*

Opportunity: By more fully integrating consideration of nature-based solutions into hazard mitigation plans, states can ensure that such projects are better positioned for future funding decisions which are by law required to be aligned with these plans. Additionally, by increasing the working knowledge of the emergency management community regarding nature-based solutions during the hazard mitigation plan update process, emergency managers will be more inclined to select such solutions when resources become available. State hazard mitigation plans are required to be updated every 5 years, and with 33 states currently updating plans for renewal in 2023, there is a near-term opportunity to engage and advocate for the inclusion of nature-based solutions in hazard mitigation plans.

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[98] Kihslinger, R., Avi Li, Heather Luedke. Nature-Based Mitigation Goals and Actions in State and Tribal Hazard Mitigation Plans (2021): 12. https://www.eli.org/sites/default/files/eli-pubs/nature-based-mitigation-goals-and-actions-final.pdf
[99] Kihslinger, R., Avi Li, Heather Luedke. Nature-Based Mitigation Goals and Actions in State and Tribal Hazard Mitigation Plans (2021): 12. https://www.eli.org/sites/default/files/eli-pubs/nature-based-mitigation-goals-and-actions-final.pdf
[100] Kihslinger et al. (2021): 5.

Congressional Action: The Stafford Act requires various elements to be included in hazard mitigation plans.[101] To encourage states and local and Tribal governments to consider nature-based approaches as part of their resilience portfolio, Congress could amend the Act to require future plan updates to consider nature-based solutions as a potential mitigation technique. This requirement could apply to all plan updates, or could be an added criterion for enhanced state mitigation plans. A State with a FEMA-approved enhanced state mitigation plan at the time of a disaster declaration is eligible to receive increased funds under the HMGP.

Agency Action: FEMA has also undertaken an initiative to revise and update the state and local hazard mitigation plan policy guidance.[102] [103] State and local guidance has not been updated since 2015 and 2011, respectively. These agency-level policy guidance documents – which drive FEMA's approval of mitigation plans – have no mention of natural or green infrastructure or natural or nature-based solutions. They also broadly state that climate change considerations should be accounted for, but give litter further specific guidance of how to account for such changes. FEMA should update this guidance to require states to consider nature-based solutions as a hazard mitigation technique, and should provide resources to assist states in integrating nature-based solutions into their hazard mitigation plans.

Education and Outreach: As mentioned above, there is ample opportunity for additional training, education, and resource communication efforts centered on nature-based solutions geared towards government agencies in the hazard mitigation planning process. During hazard mitigation plan development cycles (every 5 years), there is an opportunity for public comment, engagement, and review. Different states approach this outreach and engagement process differently, but community feedback is critical. External partners can help promote public participation in hazard mitigation plan development, encouraging consideration of nature-based solutions in general or for specific nature-based projects which may address specific community needs.

Property Buyouts and Floodplain Restoration

Barrier: FEMA administers a voluntary buyout program for flood prone properties, with required conversion of acquired properties to open space through deed restrictions, maintained in perpetuity. This can benefit communities by helping them avoiding repeat damages. As homeowners are impacted by more frequent and severe flooding, voluntary property buyouts may become a more frequent request. However, the process can be lengthy and difficult to navigate. A common complaint is the length of time it takes from the decision of the property owner to sell, which is typically spurred by flood damage, to the time of receipt of award. This period usually spans from one to three years, depending

[101] 42 U.S.C. § 5165
[102] FEMA. State Mitigation Plan Review Guide (2015). https://www.fema.gov/sites/default/files/2020-06/fema-state-mitigation-plan-review-guide_03-09-2015.pdf
[103] FEMA. Local Hazard mitigation Plan Review Guide (2011). https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-plan-review-guide_09_30_2011.pdf

on local governments' familiarity with the process and many other factors affecting coordination of the purchase and property transfer.[104] This delay can mean repeated damages to the property, where the residents either have to live with damages or fund repairs personally, as federal assistance would not be available for a property slated for buyout and demolition. Additionally, towns and cities may not have expertise or resources available to manage the land post-acquisition, which can result in a patchwork of vacant lots throughout flood-prone neighborhoods. Furthermore, organizations better suited to manage these open spaces, like land trusts or wetland organizations, are not able to directly acquire land through the FEMA BRIC program.

Furthermore, although buyouts provide the only form of complete flood risk elimination for structures, utilization of voluntary buyouts has historically been delivered inequitably, with communities of color that are within whiter, wealthier counties found to be the most likely to accept buyout aid.[105] [106] Inequitable delivery of buyout assistance, without proper planning and community engagement, can greatly exacerbate the displacement and marginalization of low-income populations and communities of color.[107] Socially vulnerable and marginalized communities often suffer from increased risk of flooding due to many long-standing inequalities and discriminatory practices in residential land use and development.

Opportunity: Buyouts are an important tool to eliminate risk to the most flood prone structures, moving people out of harm's way. Such acquisitions also can protect surrounding communities when combined with restoring natural floodplain functions, which may further reduce flood risk by increasing natural flood absorption and protection. Communities are increasingly turning to buyout programs to manage the most severely flood-impacted areas.[108] Through proper planning and policy changes, and appropriate engagement with communities, buyouts can be used more effectively for the most at-risk properties.

> **Planning and Education:** Buyout programs should be managed proactively, not reactionarily to flood events. Through comprehensive planning, buyouts can be used as a tool to manage retreat from floods in a pre-disaster environment, with the goal of minimizing economic, environmental, and social impacts of relocations.[109] A major contributor to the buyout process's length is often town and local municipalities' lack of experience with FEMA buyout programs. By

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[104]Keith Mulvihill, NRDC. How Long Does It Take to Get a FEMA Buyout for a Flooded Home? (2019). https://www.nrdc.org/stories/how-long-does-it-take-get-fema-buyout-flooded-home

[105] Elliott, J.R., P.L Brown, K. Loughran. (2020) Racial inequities in the federal buyout of flood-prone homes: a nationwide assessment of environmental adaptation. *Socius*: *6*. https://doi.org/10.1177/2378023120905439

[106] Mach, K.J., Kraan, C.M., Hino, M., Siders, A.R., Johnston, E.M. and Field, C.B., 2019. Managed retreat through voluntary buyouts of flood-prone properties. *Science* Advances: 5(10). DOI: 10.1126/sciadv.aax8995

[107] Lipuma, S. Building Social Equity into Floodplain Buyouts. (2021) Duke University and Southeast Climate Adaptation Science Center. https://storymaps.arcgis.com/stories/e211f523cb194f7a95ae893014ff8dd8

[108] Urban Land Institute. On Safer Ground: Floodplain Buyouts and Community Resilience (2021): 3. https://knowledge.uli.org/-/media/files/research-reports/2021/onsaferground_final_june14.pdf?rev=03d9b2a7fb1c44b587ef2e6f873290c5&hash=9300A91155C8BD9417058ACB97D64BD2

[109] Georgetown Climate Center. (2020) Managed Retreat Toolkit: Social/Equity: Community Engagement and Equity https://www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/social-equity-community-engagement-and-equity.html#ref-back-10

incorporating buyout planning, or managed retreat considerations, into larger floodplain, mitigation, and community planning efforts, municipalities can be better prepared to utilize this mitigation option when the opportunity arises. Additionally, advance planning for the use or restoration of properties post-buyout is key to making the most of the flood risk reduction benefits of property buyouts.

Communities that may be good candidates for buyouts due to repeated flooding impacts should be consulted early and often to create equitable discussion about what managed retreat might look like for their community. Additional information on future conditions and adaptation alternatives should also be provided, allowing communities full information on options that may be available, promoting informed decision making.[110] Governments must commit to building trust with communities and community-based organizations by providing tools and resources to aid in the decision-making process, but ultimately letting community members drive outcomes. Additionally, transparency throughout the planning and buyout process and clearly communicated timelines are key factors to building greater trust with communities. Receiving communities - the areas buyout recipients may eventually reside- should also be included in the engagement and planning process, to ensure equitable outcomes and a high quality of life for both new and existing residents.[111]

Agency Action: FEMA grants for a property buyout do not include funds for any restoration or floodplain management post-demolition. Properties are demolished and sites are leveled, with any further actions requiring funding from other sources. A municipality may have to submit separate applications for floodplain restoration dollars after the completion of the home buyout, or opt to fund the restoration and maintenance of the parcel itself. FEMA has extensive guidance on property buyouts, but could create simpler and easier-to-follow guidance to potentially increase the number of communities using the buyout program. Additionally, FEMA should create an allowable project type that couples property buyouts with floodplain or wetland restoration, or with construction of a natural stormwater collection or management site, which could reduce risks to surrounding communities and restore ecological functions.[112]

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[110] Kraan, C.M., M. Hino, J, Niemann, A.R. Siders, K.J. Mach. (2021) Promoting equity in retreat through voluntary property buyout programs. *Journal of Environmental Studies and Sciences*, pp.1-12. https://link.springer.com/article/10.1007/s13412-021-00688-z

[111] Georgetown Climate Center. (2020) Managed Retreat Toolkit: Social/Equity: Receiving Communities https://www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/social-equity-receiving-communities.html

[112] Environmental Law Institute & University of North Carolina Chapel Hill. Floodplain Buyouts: An Action Guide for Local Governments on How to Maximize Community Benefits, Habitat Connectivity, and Resilience (2017): 14. https://www.eli.org/sites/default/files/eli-pubs/actionguide-web.pdf

Community Group Advocacy for Buyouts and Federal Support

In 2015, the community of Rosewood, South Carolina – having no known history of flooding – experienced over five feet of standing water during Hurricane Matthew. This neighborhood is not in a FEMA-designated Special Flood Hazard Area or near an ocean or river. The community then continued to experience regular significant flooding events for the next five years. The community received little to no help from FEMA or local officials, which prompted community members to form Rosewood Strong, a grassroots organization to advocate for buyouts and elevation funding for repeatedly impacted homes in their community. Rosewood Strong members educated local and county leaders about the impacts they were facing from floods, as well as potential solutions, like federal buyouts, that would work for them and their neighbors. In 2021, Rosewood Strong saw success with their advocacy efforts when a $13 million CDBG-MIT grant was allocated to the county to fund 60 property buyouts throughout the impacted neighborhood.[113]

Similarly, in De Soto, Missouri, residents experienced four severe floods in less than five years after the Missouri Department of Transportation built a bridge nearby that impacted river conditions and exacerbated flooding. Citizens' Committee for Flood Relief (CCFR) is a citizen-led group established to work alongside the city, county, state and federal governments to implement solutions and adopt a methodology to reduce the impact of flood damage though structural and non-structural measures. CCFR also has a state representative that advocates for them formally. Through the American Geophysical Union's Thriving Earth Exchange, CCFR was able to work with researchers at the US Geological Service (USGS) and St. Louis University to receive expert advice and assistance in planning for implementation of recommendations they had received from USACE and USGS studies.[114] *CCFR members continue to use this experience and knowledge to advocate for community needs related to flood mitigation such as buyouts and floodplain restoration.*

Grassroots and citizen-led groups like CCFR and Rosewood Strong often know the needs of their community better than anyone else, but may lack the funding, technical expertise, and decision-making power to implement these changes. Through nonprofit coalitions like the Anthropocene Alliance, such grassroots groups are connecting and sharing best practices with similar groups across the country.[115]

Agency Action: Currently, post-acquisition property maintenance is left up to the municipality to manage and fund. A non-governmental group, such as a wildlife or wetland conservancy or land trust, cannot be a direct recipient for a property acquisition. Many creative solutions exist to transfer land from local municipalities to land trusts such as through conservation easements, property leases, or title transfers. Non-governmental organizations like Wetlands Watch and Living River Trust are working with FEMA to begin to develop pathways for land trusts to become stewards and more formalized partners in pursuit of buyouts and long-term

[113] Anthropocene Alliance. Rosewood Strong (2021). https://anthropocenealliance.org/rosewood-strong/
[114] AGU. Thriving Earth Exchange, Assessing Flooding and Hydrodynamics for Community Preparedness and Revitalization City of De Soto, Missouri (2019). https://thrivingearthexchange.org/project/cityofdesoto-mo/
[115] Anthropocene Alliance (2021). https://anthropocenealliance.org/

management of properties.[116] [117] If successful, voluntary property buyouts will more consistently lead to responsible land management post-acquisition that includes environmental restoration, producing multiple risk reduction benefits and associated co-benefits for healthier more resilient communities. Often nonprofits and conservation partners may be the best practitioners to manage these properties long term, and pathways for their involvement need to be included in FEMA programs for more effective solutions.

FEMA's Benefit-Cost Analysis (BCA)

Barrier: FEMA requires the demonstration of cost-effectiveness as an eligibility metric.[118] For the BRIC program, the only way to demonstrate cost-effectiveness is to use FEMA's BCA Toolkit and receive a benefit-cost ratio of 1.0 or greater. FEMA's BCA Toolkit is primarily designed to calculate benefits related directly to risk reduction, and is less fitted for cataloging benefits such as ecosystem services or social services benefits. As a result, completing a BCA for a traditional structural solution– which are typically designed to provide one static benefit (risk reduction) – is fairly straightforward. These projects are at their strongest on the day that construction is completed, with decreasing effectiveness over time due to wear and tear.

Alternately, nature-based solutions are dynamic systems that provide a multitude of benefits in addition to hazard risk reduction, including values like recreation, wildlife habitat, carbon sequestration, and water quality improvement, which may be more difficult to quantify. Nature-based solutions also grow and adapt, providing more benefits as time goes on, with the ability to self-repair and adapt to climate stress – qualities that are not currently able to be captured by FEMA's BCA Toolkit calculations. Additionally, FEMA's BCA Toolkit is guided by policies like the Office of Management and Budget (OMB) Circular A-94, which prescribes a 7% discount rate for projects. FEMA often cites this OMB policy as a hindrance to approval of nature-based projects, as it artificially discounts nature-based project benefits by 7% every year based on the time value of money, rather than more accurately reflecting the continued and expanding services that nature-based solutions provide over time.

Opportunity: There are numerous small- and large-scale changes that can be made to the BCA process, through FEMA policies and tool design and by OMB, that will deliver better outcomes for nature-based solutions.

Agency Action: FEMA currently has pre-calculated benefits for certain project types that, if below a certain cost, are categorically considered to be cost effective and therefore do not require a BCA. An example of one of these project types is a property acquisition in a Special

[116] Kodis, M., Bortman, M. & Newkirk, S. Strategic retreat for resilient and equitable climate adaptation: the roles for conservation organizations. J Environ Stud Sci (2021). https://doi.org/10.1007/s13412-021-00692-3
[117] Dietrich, T. Virginia City Seeks Conservation Solution for Flood Prone Properties (2020). https://www.bayjournal.com/news/climate_change/virginia-city-seeks-conservation-solution-for-flood-prone-properties/article_bc5a701a-ec62-11ea-8c53-ebba58aa49dd.html
[118] 42 U.S.C. § 5133 (b)

Flood Hazard Area valued under $276,000.[119] [120] FEMA has historically conducted and funded loss-avoidance studies to inform pre-calculated benefits and best practices across many types of mitigation techniques. FEMA could apply this approach to add additional pre-calculated benefit project types featuring nature-based solutions. For instance, a pre-calculated benefit was created for the Post-Fire HMGP: pre-calculated benefits of $5,250 per acre are assumed for the post-wildfire mitigation project types including soil stabilization, flood diversion, and reforestation projects. [121]

Agency Action: FEMA recently updated its BCA Policy to allow ecosystem service benefits to count from the start of the BCA calculation, rather than having to demonstrate a benefit-cost ratio threshold of at least 0.75 before being able to incorporate ecosystem service benefits.[122] [123] Though this was a positive and important step, FEMA currently has a limited list of ecosystem service benefits available to utilize in their BCA Toolkit (Table 4). FEMA has an opportunity to update and expand these values with best available science, through existing partnerships with NOAA and other environmental economic experts. Additionally, advocating for the inclusion of a "write your own" option for ecosystem service benefits – which would allow applicants to use and fill in their own values, supported by demonstrated evidence – would help accommodate regional differences in ecosystems that are not accounted for under the current toolkit. This option for "write your own" is available in other benefit-calculation areas of the toolkit already, but is not available for capturing ecosystem or social service benefits.

Table 4. FEMA's current Ecosystem Service Values in their BCA Toolkit.[124]

Type of Space	Value
Green open space	$8,308/acre/year
Riparian	$39,545/acre/year
Wetlands	$6,010/acre/year
Forest	$554/acre/year
Marine & estuary	$1,799/acre/year

Agency Action: OMB's Circular A-94, a policy that directs federal agencies' benefit-cost analysis methodologies, is frequently cited as a major barrier to approval of more nature-based solution

[119] FEMA. Pre-Calculated Benefits (2021). https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis
[120] FEMA. Acquisitions and Elevations in the Special Flood Hazard Area (2013). https://www.fema.gov/sites/default/files/2020-04/fema_bca_pre-calculated_special-flood-hazard-area.pdf
[121] FEMA. Hazard Mitigation Grant Program Post Fire (2021) https://www.fema.gov/grants/mitigation/post-fire
[122] FEMA. Using Ecosystem Service Benefits in the Benefit-Cost Analysis Policy Fact Sheet (2020). https://www.fema.gov/sites/default/files/documents/fema_hma-ecosystem-service-benefits_fact-sheet_january-2021.pdf
[123] FEMA. Ecosystem Service Benefits in Benefit-Cost Analysis for FEMA's Mitigation Programs Policy FEMA Policy FP-108-024-02 (2020). https://www.fema.gov/sites/default/files/2020-09/fema_ecosystem-service-benefits_policy_september-2020.pdf
[124] FEMA. BCA Training Unit 3 (2020): 23. https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis/training

projects.[125] Specifically, the 7% discount rate contained in OMB Circular A-94 is particularly harmful to the evaluation of benefits related to nature-based solutions. In 2019, FEMA's National Advisory Council, composed of senior officials from major disaster recovery efforts, cited the outdated 7% discount rate as a major barrier to truly cost-effective and beneficial mitigation projects. They recommended that development of a reassessed benefit-cost analysis methodology with a lower discount rate of 1-3% be considered for FEMA mitigation projects.[126] Under the Obama Administration, the President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience Report recommended consideration of lowered discount rates for long-term investments where benefits are expected to accrue over a long period of time, particularly for benefits like those from natural infrastructure that increase long-term climate resilience.[127] Leading economists have also provided a theoretical justification for lower discount rates for projects with long lifespans in consideration of uncertain economic conditions.[128] [129] Many groups, including the Association of State Floodplain Managers, Georgetown Climate Center, and the Congressional Research Service, have raised concerns over the current applicability of the outdated 7% discount rate for long-term investments, particularly for resilience projects that are effective at reducing future risks caused by climate change and climate-exacerbated natural hazards.[130] [131] [132] With the opportunity of a new Administration and new political leadership, OMB should reevaluate the appropriateness of OMB Circular A-94 as it applies to nature-based solutions, which have long-lasting intergenerational benefits and provide climate mitigation services.

Agency Action: Existing interagency collaborations, including FEMA's collaboration with NOAA, could be expanded to provide additional expertise in nature-based approaches. NOAA has extensive resources on nature-based solutions, climate change, and a variety of other relevant topics through their Digital Coast Library and internal expertise.[133] NOAA's existing resources should be fully leveraged by FEMA to help inform the expansion of the ecosystem service values of the BCA Toolkit. Collaboration with other agencies that have significant expertise in nature-based solutions, like the Forest Service and the U.S. Fish and Wildlife Service, would be highly beneficial in this work.

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[125] OMB. Circular A-94 (1992). https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/a94/a094.pdf
[126] National Advisory Council, Report to the FEMA Administrator (2019): 45. https://www.fema.gov/sites/default/files/2020-08/fema_nac-report_11-2019.pdf
[127] President's State, Local, and Tribal Task Force On Climate Preparedness and Resilience. Recommendations to the President Report (2014): 39-40. https://obamawhitehouse.archives.gov/sites/default/files/docs/task_force_report_0.pdf
[128] Weitzman, M. L. Why the far-distant future should be discounted at its lowest possible rate. *Journal of environmental economics and management* (1998) *36*(3): 201-208.
[129] Newell, R. G., W.A. Pizer. Discounting the distant future: how much do uncertain rates increase valuations?. *Journal of environmental economics and management* (2003) *46*(1): 52-71.
[130] Georgetown Climate Center. Preparing Our Communities for Climate Impacts (2014): 26-27. https://www.georgetownclimate.org/files/report/GCC%20-%20Recommendations%20for%20Federal%20Action%20-%20September%202014.pdf
[131] ASFPM, Discount Rate Position Paper (2008): 1-6. https://asfpm-library.s3-us-west-2.amazonaws.com/ASFPM_Pubs/ASFPM_Discount_+Rate_Whitepaper_2008.pdf
[132] Leggett, J.A., CRS. Climate Change: Conceptual Approaches and Policy Tools (2011). http://www.fas.org/sgp/crs/misc/R41973.pdf
[133] NOAA, Office for Coastal Management. Digital Coast Data (2021) https://coast.noaa.gov/digitalcoast/data/home.html

Barrier: In addition to having a cost-benefit ratio greater than 1.0, to be eligible for FEMA funding hazard mitigation projects are required to demonstrate feasibility and effectiveness in reducing risk as part of a technical review. This is often achieved through engineering designs from a registered Professional Engineer or via compliance with accepted Building Codes and Standards.[134]. Demonstrating the effectiveness of nature-based solutions for FEMA typically entails complicated and expensive Hydrology and Hydraulic modeling (H&H) – studies that are time-consuming and inaccessible for many communities. Providing this documentation is currently one of the largest barriers for communities in implementing nature-based solutions through FEMA programs. FEMA also does not give explicit guidance on how to demonstrate effectiveness and feasibility, beyond stating that it should be demonstrated "through conformance with accepted engineering practices, established codes, standards, modeling techniques, or best practices."[135]

Opportunity: Additional guidance for applicants on how to document feasibility and effectiveness for nature-based projects will improve the quality and competitiveness of applications received. Furthermore, outcomes from feasibility and effectiveness studies are critical to informing benefit values and updates to FEMA's BCA Toolkit.

> **Agency Action:** FEMA should provide more explicit guidance on how feasibility and effectiveness can be demonstrated for different types of nature-based solutions. This can be accomplished through updates to the Hazard Mitigation Assistance Guidance.
>
> Additional technical policy guidance can be difficult for inexperienced applicants and sub-applicants to translate into effective mitigation project applications and apply to real life circumstances. FEMA should strive to ensure the guidance itself, and the project documentation required, is as simple as possible, while still ensuring project applications demonstrate both feasibility and effectiveness. FEMA should also create and generate a portfolio of fully accessible example project applications for nature-based projects, including effectiveness and feasibility documentation studies, BCAs, and details on how data and project information was sourced and compiled. The ability to examine a variety of successful project applications would aid applicants as they generate their own proposals. Although FEMA has produced the Mitigation Action Portfolio which contains project examples, this document provides little technical information on application components that would inform communities planning applications for similar projects.[136]

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[134] FEMA. Hazard Mitigation Assistance Guidance (2015): 70. https://www.fema.gov/sites/default/files/2020-07/fy15_HMA_Guidance.pdf

[135] FEMA. Hazard Mitigation Assistance Guidance (2015): 17. https://www.fema.gov/sites/default/files/2020-07/fy15_HMA_Guidance.pdf

[136] FEMA. Mitigation Action Portfolio (2020). https://www.fema.gov/sites/default/files/2020-08/fema_mitigation-action-portfolio-support-document_08-01-2020_0.pdf

Increasing Access to Non-Federal Match Assistance

Barriers: Stafford Act Section 203 provides a statutory definition of "small and impoverished" communities.[137] This definition determines which communities receive a non-federal cost-share reduction (90% federal / 10% non-federal) under the FEMA BRIC Program, making FEMA programs "more accessible" to these communities. Under the BRIC program, communities meeting this definition also receive additional points in the Technical Criteria scoring process for projects which serve or engage these small and impoverished communities. Though well-intentioned, this definition encompasses a very limited number of communities. Small communities and impoverished communities are not necessarily the same, and larger impoverished communities may need consideration for a reduced cost-share as well. There may also be subset populations inside a larger community that are capacity- and funding- limited and deserving of additional assistance, even if the larger community itself wouldn't qualify. Additionally, Tribes are often grouped and evaluated as one Tribal population, thereby not qualifying under the definition due to overall size, even when individual towns or subsets of populations within the Tribal community are geographically separated. Notably, the definition for this program differs widely from definitions used by other federal agencies.

Adding to the challenge, communities are required to provide funding upfront for all project costs for many recovery and mitigation efforts across FEMA, with funds reimbursed after project completion. For large municipalities and wealthy areas this is feasible, but many rural, low population density, and low-income counties and towns have extreme difficulty fronting project dollars because they do not have surplus funds or flexible budgets, even with a grant award guaranteed at completion.

Opportunities: Congress and FEMA can take corrective action to ensure that mitigation dollars and cost-share assistance is appropriately targeted to all communities in need. This will expand participation in FEMA mitigation programs, improving resilience and opening new opportunities to pursue nature-based approaches for hazard risk reduction and the multiple co-benefits they provide to nearby communities.

> **Congressional Action:** To equitably deliver a program for hazard mitigation, the barrier for entry for the communities most at need should be lowered. A reduced non-federal match amount is one way to reduce burden on low-income communities. Congress should modify the statutory definition of small and impoverished communities, to ensure that FEMA can deliver additional aid to communities most in need of a reduced cost-share.
>
> **Congressional Action:** For some communities, even a 10% non-federal match may be more than they can afford. Additional considerations of need should be evaluated when determining match funding to allow applicants to request a full match waiver or reduction. Other FEMA mitigation programs like the Public Assistance program have flexible cost-share language in their authorizing language, requiring a minimum 75% federal cost-share with the ability of the President or FEMA to authorize or suggest a reduced non-federal cost share, such as in the case

[137] 42 U.S.C. § 5133 (a)

of COVID-19 assistance (100% federal cost-share) or Hurricane Maria assistance (90% federal cost-share) when a federal cost threshold is surpassed.[138]

Outreach: Through the FEMA BRIC program, sub-applicants can fulfill non-federal match requirements through the documentation of volunteer time or donated resources.[139] [140] Local governments can work closely with non-governmental organizations to coordinate and source volunteers and specific services to meet the non-federal match requirements in lieu of financial contributions. This can be a great opportunity to gather public support for projects, as well as to foster stewardship and educational engagement among community members.

Enhancing Community Engagement

Barrier: In many circumstances, public engagement is often a "check the box" exercise during the hazard mitigation planning process. BRIC has taken small steps to support and encourage community engagement, like providing points for stakeholder engagement under the Qualitative Criteria for demonstrated "Outreach Activities". However, this is one of the lowest point categories, and FEMA does not provide available funding for this type of activities under the capability- and capacity-building project type. FEMA does provide some funding for "Partnership Building" under the capability- and capacity-building category of state/territory allocations and Tribal set-asides within the BRIC program, but this is geared towards supporting engagement of more formalized private actors in mitigation project implementation, rather than for equitable participatory planning and inclusive community engagement.

Opportunity: Multiple strategies at the legislative, agency, and community level could improve effective public engagement.

Agency Action: FEMA currently lists a suite of activities that are eligible under their partnership activities funding program; however, these mostly reflect formal partnerships with actors who already typically have a role in local or state mitigation planning and mitigation project development processes, such as utility operators.[141] Inclusion of a community engagement funding allowance tied to planning grants provided under BRIC would support the participation of a variety of community organizations and community members in future mitigation project development, resulting in a more representative community perspective on future mitigation goals. Expenses such as stipends, childcare, and meals for community participants should be allowable. This will enable more engagement from all members of the public, not just those in positions of power or privilege.

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[138] 44 C.F.R. §206.47(b)
[139] FEMA. Hazard Mitigation Assistance Cost Share Guide (2016). https://www.fema.gov/sites/default/files/2020-08/fema_hma_cost-share-guide.pdf
[140] FEMA. Hazard Mitigation Assistance Cost Share Webinar (2020). https://www.youtube.com/watch?v=lISxKRE05UE
[141] FEMA. BRIC Partnership Activities (2020). https://www.fema.gov/sites/default/files/2020-08/fema_bric-partnership-activities_support_document_08-2020.pdf

Congressional Action: Legislative changes to the Stafford Act Section 322 to include requirements for participatory planning in hazard mitigation plan development would help to ensure greater public engagement.[142] Additionally, Congress should include specific language that requires state and local hazard mitigation plans to consider physical and socioeconomic vulnerability when directing resources to communities, prioritizing resources for those communities most at risk and which are the least resilient by utilizing decision making tools like FEMA's National Risk Index.[143]

HUD CDBG-DR Barriers and Opportunities

The long-standing CDBG-DR Program has no permanent authorization, which leads to multiple related issues including the uncertain and prolonged timeline of assistance delivery to local communities. Often it takes anywhere from months to multiple years for CDBG-DR regulations to be published before allocations can be made or funds can be obligated. Although CDBG funds are intended to address longer-term recovery needs and not immediate post-disaster needs, the unpredictable nature of timing for funding, and the potentially multi-year process can hinder the ability of communities to be able to leverage multiple funding sources or plan for a coordinated and efficient recovery. The unpredictable and potentially mismatched funding timeline also creates many administrative burdens for local communities. In addition, varying requirements and eligibility across FEMA and HUD disaster relief funding streams can confuse local municipalities, creating challenges to accessing these funds to benefit citizens and provide timely response and recovery assistance.

There is ample of opportunity to enhance climate resilience through HUD's CDBG-DR program for the most vulnerable communities. By aligning the administration of this program with other disaster resources, permanently authorizing the program to create more predictable funding sources, and encouraging the use of more nature-based solutions, CDBG-DR assistance can enhance climate resilience while delivering multiple environmental and social co-benefits to communities that are most in need.

Permanent Authorization of CDBG-DR

Barrier: As discussed above, CDBG-DR funds are only available post-disaster as a "last resort" for community recovery. The timing and size of funding assistance that flows through this program to communities can be unpredictable. Communities are sometimes unsure whether or not they are eligible for CDBG-DR funding or when they can expect to receive these resources. This unpredictability makes it extremely difficult to integrate various funding sources or plan for use of the funds before a disaster. CDBG-DR is meant to provide larger, flexible sums to rebuild disadvantaged communities more fully as a supplement to funding from FEMA and other more immediate disaster recovery resources. With no permanent authorization for the program, each CDBG-DR authorization is subject to a time-consuming rulemaking process requiring individual Federal Register notices. These Federal Register notices contain varying rules, conditions, and timelines, which introduce additional administrative complexity.

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[142] 42 U.S.C. § 5165

[143] FEMA. National Risk Index (2020). https://www.fema.gov/flood-maps/products-tools/national-risk-index

Additionally, when multiple allocations are made to one area, each allocation may have different rules and guidance, often causing administrative and technical burdens for municipalities.

Opportunity: Permanent authorization of the CDBG-DR Program would provide an opportunity to reassess and revise the administration and direction of the program, and critically would enable funds to flow more quickly post-disaster to provide more reliable and predictable disaster relief.

Congressional Action: Many organizations and members of Congress are working to advance permanent authorization of the CDBG-DR program. Permanent authorization could lead to a clearer and more consistent path to access, rather than relying upon individual Congressional emergency authorizations. Communities would not have to await the Federal Register rulemaking process and navigate new and potentially difficult guidelines and requirements. Permanent authorization would allow communities to integrate a predictable and more reliable source of post-disaster funding into their disaster preparedness and hazard mitigation planning processes.

Permanently authorizing the CDBG-DR Program also provides an opportunity to reassess the direction and priorities of the program. This allows authorizers the ability to direct a program that incorporates modern, common-sense priorities such as nature-based solutions for hazard resilience, climate change considerations and adaptations, and green building practices. In any permanent CDBG-DR authorization legislation, however, it is important that local municipalities and states retain flexibility in the use of funds. This flexibility is one of the main points highlighted by cities and towns as a major success of the program, generally allowing the funds to be used in a less prescriptive way than with most federal funding sources to address each area's most pressing needs.

Through this permanent authorization process, it also would be extremely beneficial to consider how FEMA and HUD can better coordinate their programs as complements in the disaster recovery space. When looking at alignment, it is important to consider eligibility, timing, funding uses, and grant requirements. Disasters can cause vast amounts of harm to communities and particularly to the most vulnerable individuals. They also can be extremely taxing for overburdened and under resourced community governments. Through the alignment of FEMA and HUD grant requirements, applications, and reports, post-disaster aid can be delivered with less waste, more efficiently and effectively helping those most in need.

Modernizing Integrated Action Plans and CDBG Priorities

Barrier: A key component of the CDBG-DR program is the development by communities of Integrated Action Plans (IAPs). This is a helpful process for communities, providing an avenue to refine their priorities for use of CDBG-DR funding to address long-term disaster recovery needs.[144] [145] Many areas have received some version of CDBG funding over time, and have likely gone through the process of

[144] HUD. Community Development Block Grant Disaster Recovery Policy Guide for Grantees (2019) https://files.hudexchange.info/resources/documents/CDBG-DR-Policy-Guide.pdf

[145] HUD. Disaster Impact and Unmet Needs Assessment Kit (2013). https://files.hudexchange.info/resources/documents/Disaster_Recovery_Disaster_Impact_Needs_Assessment_Kit.pdf

developing an IAP. Under current requirements, municipalities must complete new IAPs for each allocation, and cannot amend or update existing IAPs.

Opportunity: As part of a permanent program authorization for CDBG-DR, Congress should amend the IAP process to relieve applicant burden and encourage greater integration with other hazard planning.

> **Congressional Action:** Development of IAPs help to ensure alignment of intended community actions with program goals, but repeating this planning process for every disbursement of CDBG funds can be burdensome. Future CDBG-DR legislation should direct HUD to modify the IAP system to allow for greater longevity and continuity of IAPs, while still requiring regular updates and reevaluation. Congress should also require that IAPs be coordinated with other relevant state planning activities, including emergency management and hazard mitigation plans, as well as coastal zone management plans to align and coordinate all community planning efforts.
>
> **Agency Action**: Within the CDBG program, HUD outlines 26 eligible activities for funding, which need to be identified in IAPs.[146] These priorities were written and developed in the 1970s to address challenges that urban centers in America were facing when CDBG grants were established. An update of these 26 eligible activities - and of the 2001 overall CDBG program guidance - is needed. Such an update should better integrate the concepts of hazard mitigation, resilience, natural features, and climate change, and more explicitly include nature-based solutions as eligible activities for resilience and climate mitigation.

Section 4: Summary and Conclusion

There are numerous near-term avenues and opportunities available to advance the use of nature-based solutions in FEMA and HUD programs. Table 5 below summarizes the opportunities and pathways for change that were explored in this white paper.

With the first cycle of FEMA's BRIC program wrapping up, and increased focus from the Administration and Congress on resilience and pre-disaster mitigation investment, opportunities may exist to amend agency-level policies, particularly surrounding newer focus areas within FEMA's portfolio, like nature-based solutions. Many of the changes required are technical amendments to existing tools and guidance, as well as the creation of user-directed resources, to remove barriers and advance nature-based projects and more equitable program delivery.

Congressional interest in nature-based solutions is also growing, and there is wide bipartisan support for increased investment in pre-disaster hazard mitigation in general. Through legislative changes to the Stafford Act and permanent reauthorization of HUD's CDBG-DR Program, Congress can make great strides toward creating a more resilient nation capable of adapting to climate change.

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[146] HUD. CDBG Guide to National Objectives and Eligible Activities Chapter 2: Eligible Activities (2001): 3-83. https://www.hudexchange.info/sites/onecpd/assets/File/CDBG-National-Objectives-Eligible-Activities-Chapter-2.pdf

Table 5. Summary of identified barriers and solutions to federal funding of nature-based solutions. *

	Pathway		
Opportunity	**Congressional Action**	**Agency Action**	**Partnerships, Planning, Education, & Outreach**
Increasing State and Local Applicant Uptake of Nature-Based Solutions	X		X
Inclusion of Nature-Based Solutions in Hazard Mitigation Plans	X	X	X
Property Buyouts and Floodplain Restoration		X	X
FEMA's Benefit-Cost Analysis		X (both within FEMA and OMB)	
Increasing Non-Federal Match Assistance	X		X
Enhancing Community Engagement	X	X	
Permanent Authorization of CDBG-DR	X		
Modernizing Integrated Action Plans and CDBG Priorities	X	X	

**Some of the above opportunities may have solutions across additional pathways that were not fully evaluated in this white paper.*