

**COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY  
SUBCOMMITTEE ON ENVIRONMENT  
U.S. HOUSE OF REPRESENTATIVES**

**HEARING CHARTER**

***FROM GRAY TO GREEN: ADVANCING THE SCIENCE OF NATURE-BASED  
INFRASTRUCTURE***

Wednesday, March 2, 2022

12:00 p.m. ET

Online via Zoom

**Purpose**

This hearing will provide an opportunity to discuss the state of the science related to nature-based infrastructure. The Subcommittee will consider the environmental, economic, and social co-benefits of nature-based infrastructure and its contribution to resilient communities. Members would have the opportunity to discuss the co-benefits of nature-based infrastructure and the research, development, and long-term monitoring needed to quantify these co-benefits. Finally, the Subcommittee will examine research gaps and additional federal coordination, investment, and engagement needed to support the implementation of nature-based infrastructure.

**Witnesses**

- **Dr. Steven Thur**, Director, National Centers for Coastal Ocean Science, National Oceanic and Atmospheric Administration
- **Dr. Sherry Hunt**, Supervisory Civil Engineer, Agriculture Research Service, U.S. Department of Agriculture
- **Dr. Todd Bridges**, Senior Research Scientist, Environmental Science, U.S. Army Corps of Engineers

**Overarching Questions**

- What knowledge gaps exist that hinder wide-scale implementation of nature-based infrastructure?
- What type of data gaps exist in this field? What types of federal investments in R&D and environmental and social impact monitoring can help to close these gaps?
- What methods or parameters need to be standardized to assist valuation and implementation of nature-based infrastructure?
- What is the state of the science of quantifying the co-benefits of nature-based infrastructure?
- Why is the importance of nature-based solutions increasing as we see greater effects from climate change?
- How can implementation of nature-based infrastructure support social equity?

## **Background**

Nature-based infrastructure or similar terms, like “natural infrastructure” or “green infrastructure,” generally refers to natural or engineered systems that mimic natural processes. It is used to mitigate the effects of natural hazards to protect against coastal and inland flooding, minimize erosion, and improve runoff management, for example. It is also used to increase resilience in the face of climate change.

There are numerous types of nature-based infrastructure used in various settings. Some examples include green roofs, rain gardens, permeable pavements, beach dunes and dune vegetation, salt marshes and coastal wetlands, and submerged aquatic vegetation like mangroves or seagrass. Nature-based infrastructure may be used on its own or in combination with traditional “hard” or “gray” infrastructure.

In the context of the federal government, there is no consistent definition of nature-based infrastructure or similar terms. The National Oceanic and Atmospheric Administration (NOAA) has different definitions for natural infrastructure and nature-based infrastructure. In NOAA Administrative Order 216-117: NOAA National Habitat Policy,<sup>1</sup> NOAA defines natural infrastructure as “healthy ecosystems, including forests, wetlands, floodplains, dune systems, and reefs, which provide multiple benefits to communities, including storm protection through wave attenuation or flood storage capacity and enhanced water services and security.” The Administrative Order also defines nature-based infrastructure as “engineered systems where natural features are combined with more hard or structural engineering approaches to create a hybrid system.” Neither definition is codified in statute.

33 U.S.C. §2289a, which pertains to the U.S. Army Corps of Engineers, defines “nature-based features” as something that is “created by human design, engineering, and construction to provide risk reduction in coastal areas by acting in concert with natural processes.” 33 U.S.C. §1362(27), which pertains to the Environmental Protection Agency (EPA), defines “green infrastructure” as “the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspire stormwater and reduce flows to sewer systems or to surface waters.”

In addition to the primary benefits of nature-based infrastructure, these features can also have numerous co-benefits. They can improve water quality by providing natural filtration, support biodiversity by providing habitat for wildlife, and reduce the urban heat island effect with increased tree cover and greenery in urban areas. Some nature-based infrastructure features can also improve the physical health of residents, as well as helping their mental health. Certain features can also sequester carbon, whether its increased greenery on land or thriving seagrass beds.<sup>2</sup>

## **Federal Agencies Involved with Nature-Based Infrastructure**

Several federal departments and agencies are engaged in the implementation of nature-based infrastructure and the underlying science. This includes federal science agencies, like NOAA, the

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<sup>1</sup> <https://www.noaa.gov/organization/administration/nao-216-17-noaa-national-habitat-policy>

<sup>2</sup> <https://www.nwf.org/-/media/Documents/PDFs/NWF-Reports/2020/The-Protective-Value-of-Nature.aspx?la=en&hash=A75F59611475502BEE58723F8B3C58423417E579>

National Science Foundation, the National Institute for Standards and Technology, and the U.S. Geological Survey, and land management agencies, such as the Forest Service and agencies within the Department of the Interior, as well as the EPA, the U.S. Department of Transportation, the U.S. Army Corps of Engineers (USACE), the Federal Emergency Management Agency (FEMA) and the U.S. Department of Agriculture (USDA). This charter provides examples of a few agencies' nature-based infrastructure research and development activities.

### **National Oceanic and Atmospheric Administration**

NOAA supports a wide-range of nature-based infrastructure activities primarily through three of its line offices: the National Ocean Service (NOS), the National Marine Fisheries Service (NMFS), and the Office of Oceanic and Atmospheric Research (OAR). Numerous NOS programs and offices support nature-based infrastructure work. Programs including the Coral Reef Conservation Program, the National Coastal Zone Management Program, and the National Estuarine Research Reserve System (NERRS) work directly with end users, including academia, non-profits, and local, state, and tribal governments, to provide technical assistance and administer competitive grant programs to support nature-based infrastructure activities.<sup>3</sup> NOS's Office of Coastal Management hosts the agency's Digital Coast Partnership which provides data, tools, and training to coastal management communities.<sup>4</sup> NOAA's National Centers for Coastal Ocean Science (NCCOS) provides coastal managers with scientific information to help protect environmental resources, preserve valued habitats, and improve community interactions with coastal ecosystems.<sup>5</sup>

NMFS supports nature-based infrastructure activities through multiple programs and offices including its Office of Habitat Conservation, its Office of Protected Resources, and its Restoration Center. These activities include support for design and implementation of natural infrastructure features, reviewing nature-based infrastructure features that may impact protected species, and providing community-based restoration grants for nature-based infrastructure activities. OAR supports research and implementation of nature-based infrastructure through its Climate Program Office (CPO) and the National Sea Grant College Program (Sea Grant). CPO awards grants to academic institutions and state government agencies to "support the development and application of methodologies to value nature-based infrastructure." NOAA Sea Grant consists of 34 different federal and university partnerships on the coasts and Great lakes and provides grants to support coastal research and initiatives to maintain healthy coasts.<sup>6</sup> The Sea Grant program provides a variety of opportunities for local communities to receive support for nature-based infrastructure initiatives include support for research and technical assistance.<sup>7</sup>

### **Environmental Protection Agency**

The EPA funds and conducts interagency collaborative research that addresses a variety of challenges in the natural infrastructure developmental space, including improving stormwater retention, reducing carbon in the atmosphere while improving air quality, and building resilient

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<sup>3</sup> U.S. Congressional Research Service. Nature-Based Infrastructure: NOAA's Role (R46145; January 2, 2020), by Eva Lipiec. <https://sgp.fas.org/crs/misc/R46145.pdf>

<sup>4</sup> <https://coast.noaa.gov/digitalcoast/about/>

<sup>5</sup> <https://coastalscience.noaa.gov/about/>

<sup>6</sup> <https://www.seagrant.noaa.gov/About>

<sup>7</sup> Ibid

inland and coastal communities. Examples of this work include monitoring and modeling of the impact of green infrastructure on urban air quality.<sup>8</sup> The EPA helps fund natural infrastructure projects through the Clean Water Act Nonpoint Source Grant (Sec. 319), the Clean Water State Revolving Fund (CWSRF), the Great Lakes Restoration Initiative (GLRI), and the Superfund Redevelopment Initiative (SRI).<sup>9</sup> The agency has developed a green infrastructure modeling toolkit, which allows users to find resources for incorporating green infrastructure into their practices.<sup>10</sup> The EPA also launched the Green Infrastructure Federal Collaborative which fosters collaboration between federal agencies to support the implementation of nature-based infrastructure through the sharing of knowledge and resources.<sup>11</sup>

### **U.S. Army Corps of Engineers**

Since 2010, USACE has been working on its Engineering With Nature (EWN) initiative.<sup>12</sup> EWN is the “intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaboration.” USACE partners with government agencies at the federal and state level to advance nature-based solutions. USACE’s Engineer Research and Development Center (ERDC) conducts research to provide decision makers with tools to help determine the best options given their needs. USACE’s Coastal Storm Modeling System enables decision makers to see how utilizing nature-based infrastructure may help with flood risk management.<sup>13</sup> USACE has also convened the Systems Approach to Geomorphic Engineering (SAGE) initiative, which partners with several federal agencies, academic and research institutions, non-governmental organizations and the private sector, to support the integration of nature-based solutions.<sup>14</sup>

### **U.S. Department of Agriculture**

The Natural Resources Conservation Service (NCRS) at the USDA provides conservation programs and funding opportunities to agricultural producers and landowners.<sup>15</sup> NCRS assists these groups through its Conservation Technical Assistance Program (CTA), which provides locally based technical assistance to aid in the development of conservation plans by region.<sup>16</sup> NCRS’s programs include natural infrastructure related goals of reducing soil erosion and maintaining water quality. The Urban and Community Forestry (UCF) program provides research and technical assistance services as related to urban forests, including stormwater management.<sup>17</sup> The Agricultural Research Service (ARS) research initiative provides further assistance through research that focuses on sustaining natural resources.<sup>18</sup>

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<sup>8</sup> <https://www.epa.gov/air-research/recommendations-constructing-roadside-vegetation-barriers-improve-near-road-air-quality>

<sup>9</sup> <https://www.eesi.org/papers/view/fact-sheet-federal-resources-for-nature-based-solutions-to-climate-change>

<sup>10</sup> <https://www.epa.gov/sustainability/giwiz>

<sup>11</sup> <https://www.epa.gov/green-infrastructure/green-infrastructure-federal-collaborative>

<sup>12</sup> [https://ewn.erd.dren.mil/?page\\_id=7](https://ewn.erd.dren.mil/?page_id=7)

<sup>13</sup> <https://www.erd.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/476697/coastal-storm-modeling-system/>

<sup>14</sup> <http://sagecoast.org/>

<sup>15</sup> <https://www.ncrs.usda.gov/wps/portal/ncrs/main/national/programs/>

<sup>16</sup> [http://forest.mtu.edu/niacs/Climate%20Hub\\_images/NRCS-Infrastructure-Hubs.pdf](http://forest.mtu.edu/niacs/Climate%20Hub_images/NRCS-Infrastructure-Hubs.pdf)

<sup>17</sup> <https://www.fs.usda.gov/managing-land/urban-forests/ucf/program>

<sup>18</sup> <https://www.ars.usda.gov/about-ars/>

## **Opportunities for Additional Research and Development**

There are several outstanding questions and opportunities for further research and development for nature-based infrastructure. This includes improving data to be used in cost-benefit analyses, standardizing data, developing better metrics of ecosystem services provided by nature-based infrastructure, and incorporating social science and equity considerations.<sup>19</sup>

Nature-based infrastructure or a hybrid of nature-based and traditional infrastructure can be more cost-effective and provide greater benefits than traditional gray infrastructure on its own. However, a lack of data required to quantify all the benefits and co-benefits can make such a comparison difficult.<sup>20</sup> More data to establish a baseline for observations and long-term monitoring of projects can shed more light on the effectiveness of these projects. Additionally, developing more quantifiable data, and the most comprehensive cost-benefit analysis that considers all aspects of both nature-based infrastructure and traditional gray infrastructure, could provide communities with more actionable information, thereby enabling them to make the best decisions.

There is also a role for greater coordination and collaboration between the federal government and external stakeholders. Providing local, state, and tribal governments with robust technical assistance could not only inform infrastructure-related decisions but could also inform decision making for permitting and zoning codes. Incorporating perspectives from diverse communities in the research, development, and implementation of nature-based infrastructure could help respond to the climate crisis in a more comprehensive and equitable way. There remains a gap in the needed social science for recognizing and communicating the importance of nature-based infrastructure in an inclusive manner to all.<sup>21</sup>

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<sup>19</sup> [https://www.fema.gov/sites/default/files/documents/fema\\_riskmap-nature-based-solutions-guide\\_2021.pdf](https://www.fema.gov/sites/default/files/documents/fema_riskmap-nature-based-solutions-guide_2021.pdf)

<sup>20</sup> <https://www.nwf.org/-/media/Documents/PDFs/NWF-Reports/2020/The-Protective-Value-of-Nature.aspx?la=en&hash=A75F59611475502BEE58723F8B3C58423417E579>

<sup>21</sup> Ibid.