

THE NATIONAL ECOLOGICAL OBSERVATORY NETWORK (NEON)

\$70,000,000
+\$5,000,000 / 7.7%

The National Ecological Observatory Network Funding
(Dollars in Millions)

| FY 2021 Actual | FY 2022 (TBD) | FY 2023 Request | Change over FY 2021 Actual | |
|-------------------|------------------|--------------------|-------------------------------|---------|
| | | | Amount | Percent |
| \$65.00 | - | \$70.00 | \$5.00 | 7.7% |

Brief Description

Funded and overseen in the Directorate for Biological Sciences, NEON is the first observatory of its kind, designed to foster and enable advances in the basic understanding of the complexities of life on earth, from organisms and populations to the biosphere and from seconds to decades. Construction of the observatory was completed in 2019, and it is designed to operate for 30 years. The NEON infrastructure is distributed across the United States (including Alaska, Hawaii, and Puerto Rico), and includes 20 regional eco-climatic domains. NEON collects standardized observations on plants, animals, and biogeochemistry in air, land, and water at 81 sites across these domains using three types of approaches: on-the-ground organismal sampling by trained professionals, automated instrument measurements in the environment, and airborne remote sensing surveys. After the collection and processing of data from instrument and observational systems, NEON makes 181 data products available on a centralized data portal that is free for all to access and use; it also makes available open access data tutorials, code packages, and other resources that enable use of NEON data by scientists and the community at large throughout the U.S. and the world.

Scientific Purpose

NEON is designed to detect, and enable forecasting of, ecological change at continental scales over multiple decades. NEON enables research by the nation's scientists on the impacts of climate and land use change, water use, and invasive species on the Nation's living ecosystems at temporal and spatial scales that are relevant to human well-being. NEON allows researchers to explore large-scale dynamics affecting ecosystems by collecting consistent and standardized environmental and biological measurements across multiple sites nationwide. NEON's unique statistically determined design supports research on the dynamics of complex coupled systems needed for modeling and understanding rates of change on regional and continental scales. NEON's cyberinfrastructure gateway provides resources to support a wide range of scientists at any institution to conduct research at these important scales using its open access data.

Status of the Facility

Prior to March 2020, data were being collected as planned at all the terrestrial and aquatic sites across the 20 eco-climatic domains. Data collection in the ensuing year was somewhat compromised, as described below. The overall trend in use of NEON data from the data portal shows a significant increase in the number of users and data downloads, with an even greater increase in use of the Application Programming Interface (API) to access NEON data. In the year prior to the onset of COVID-19, NEON staff supported 304 engagement events reaching over 8,400 individuals. Events

included presentations, site tours, conference attendance, trainings and outreach through social media, and in-person and virtual workshops targeting a wide range of public and STEM audiences. The groups engaged during these events are from different educational and/or career stages (e.g., high school, undergraduate, graduate student, postdoctoral fellows, scientists in academia, agencies), diverse geographic areas within the U.S., and multiple demographic groups including underrepresented groups and Minority Serving Institutions.

The COVID-19 pandemic had a significant impact on NEON operations during Calendar Year 2020. Operational sampling at all NEON sites was halted near the end of March and began resuming gradually in the second half of May. Since mid-June of 2020, the 81 NEON field sites and 18 Domain Support Facilities (DSFs) have cycled among three states—fully open, limited operation, or closed—depending on local governmental restrictions and safety assessments by Battelle, the current managing organization for NEON. As of November 30, 2021, all 18 DSFs were fully open; 73 field sites were fully open, 8 field sites were in limited operations, and none were closed. The NEON Headquarters in Boulder, Colorado is under restrictions with most employees working from home. The changing states had significant impacts on regular maintenance and data continuity, especially in the gathering of biological samples, an important component of the Observational Systems data. Closed sites continued to stream automated data that did not require human presence (e.g., atmospheric sampling), while biological sampling was suspended.

Meeting Intellectual Community Needs

Use of NEON data and assets is growing as more data become available. Research use of site data, soil and other samples, and remote sensing data continues to expand; data are streaming to the NEON Data Portal from tower sensors, aquatic sensors, and observational systems from all sites. Research has been supported through early exploration of NEON data via 15 Early-concept Grants for Exploratory Research (EAGER), standard awards through the Macrosystems Biology and NEON Enabled Science Programs and core research programs across the Agency, and multiple workshops awards. The EAGERs were intended to catalyze the use of NEON data and they have started yielding the types of publications that NEON is intended to inform. The NEON Airborne Observation Platform (AOP) has been used to assess major fires and, in partnership with the National Aeronautics and Space Administration (NASA), participated in the science development of the Hyperspectral Infrared Imager (HyspIRI) mission. Multiple NEON science presentations by funded researchers formed the corpus of continental-scale sessions at the 2021 Ecological Society of America meetings in addition to presentations at several other venues, such as the 2021 American Geophysical Union Fall Meeting. The number of presentations using Remote Sensing data continue to increase compared to previous years, spurred in large part by data from the three AOPs.

Governance Structure and Partnerships

NSF Governance Structure

The NEON program is managed in BIO, with the Office of the Assistant Director providing overall policy guidance and programmatic oversight. Direct oversight currently resides within the Division of Biological Infrastructure (DBI) allowing for enhanced long-term programmatic oversight of the project within the context of project management and infrastructure support. Within DBI, the Division Director and Deputy Division Director provide overall oversight of the project as a component of BIO's Centers, Facilities, and Additional Research Infrastructure Cluster.

Major Facilities

Programmatically, the NEON project is managed by a cognizant program officer in DBI who oversees the operations award. Another program officer in DBI and program officers in the Division of Environmental Biology (DEB) assist with oversight for science implementation. In addition, the program is supported by a project manager with experience in the management of large research infrastructure projects. A NEON Environmental Assessment Team that includes the project manager and colleagues from the Office of the General Counsel provides ongoing technical advice on National Environmental Policy Act compliance and NSF's compliance with other relevant policies.

An integrated project team (IPT) has been established and is chaired by the NEON cognizant program officer. The IPT includes representatives from the Office of Legislative and Public Affairs, BFA's Large Facility Office (LFO), BFA's Division of Acquisition and Cooperative Support (DACS), BFA's Division of Institution and Award Support - Cost Analysis and Pre-Award Branch, the Office of the General Counsel, and as needed, the Office of the Director.

Additional strengthening of the BIO NEON program and NEON Project Oversight is ongoing and includes visits in coordination with LFO and DACS to assist with strategic coordination of project activities and understanding NSF review and reporting requirements.

External Governance Structure

Management of the NEON project was transferred to Battelle in the spring of 2016 when the existing NEON, Inc. Board of Directors was replaced by Battelle employees. Within Battelle, the NEON Chief Scientist provides overall scientific leadership and serves as the Principal Investigator for the award. The NEON Chief Scientist is supported by a Project Operations Manager. A Science, Technology, and Education Advisory Committee (STEAC), composed of members of the NEON user community, provides strategic guidance and advice to Battelle, and helps ensure that NEON will enable frontier research and education. The work of the STEAC is complemented by several Technical Working Groups, comprising over 170 science, education, and engineering experts, that advise Battelle on technical aspects of the project and other issues that have scientific, educational, engineering, or operational implications.

Partnerships and Other Funding Sources

The NEON project is funded through an award to Battelle. While NSF funds provide the operations costs, several federal agencies (NASA, the National Oceanic and Atmospheric Administration, the Department of Energy, the United States Forest Service, the Environmental Protection Agency, the United States Department of Agriculture, the National Park Service, the Bureau of Land Management, the United States Geological Survey) provide significant in-kind services, including sites for deployment of NEON infrastructure. Funding for research using NEON is provided through a special program and in other BIO core programs across its divisions, as well as by programs in GEO and CISE. Formal agreements have been signed with the European Union, including the Integrated Carbon Observing System Ecosystem Thematic Center, Infrastructure for Analysis and Experimentation on Ecosystems, and Czech Climate Change Research Center, and Australia's Terrestrial Ecosystem Research Network. Areas of coordination with the above include planning, design, construction, deployment, environmental assessment, data management, geospatial data exchange, cyberinfrastructure, research, and modeling. Several of the 81 NEON field sites are located on land administered or owned by other federal agencies and private organizations, providing opportunities for partnering around common research interests. Private organizations, including the Heinz Center,

National Geographic Society, NatureServe, the Ecological Society of America, and the American Geophysical Union, are assisting to broaden the impact of NEON science and education to the next generation of scientists and educators.

Funding

Total Obligations for NEON
(Dollars in Millions)

| | FY 2021 | FY 2022 | FY 2023 | ESTIMATES ¹ | | | | |
|--------------------------|---------|---------|---------|------------------------|---------|---------|---------|---------|
| | Actual | TBD | Request | FY 2024 | FY 2025 | FY 2026 | FY 2027 | FY 2028 |
| Operations & Maintenance | \$65.00 | - | \$70.00 | \$70.00 | \$70.00 | \$70.00 | \$70.00 | \$70.00 |

¹ Outyear estimates are for planning purposes only. The current cooperative agreement ends in October 2023.

The NEON program in BIO provides all support for operations, which are estimated at approximately \$70.0 million in FY 2022. Operations and maintenance support began in FY 2014. In August of 2017, a supplemental operations award was authorized. For planning purposes, costs are held constant by BIO at the projected annual operations ceiling of \$70.0 million.

Reviews

The construction close-out review in April 2019 documented the completion of NEON construction scope and transition to operations. External evaluators were tasked with reviewing project documentation and confirmed delivery of observatory capacity. Reviews of full O&M are held annually. The 2020 review of O&M emphasized evaluation of data availability, accessibility, and quality; impacts of and responses to natural disasters and the pandemic; Battelle’s cost performance; and the facility’s cyberinfrastructure. The 2021 annual review was substituted by a review of a supplemental proposal to extend Battelle’s period of performance through October 31, 2023. The supplemental proposal review was completed by an external panel of experts and focused on science outcomes enabled by the facility, responses to the pandemic, Battelle’s cost performance, and the facility’s cyberinfrastructure, resulting in an NSB-approved two-year extension to the active O&M award and facilitating the ongoing competition that was delayed by the pandemic (see below). Progress against the annual program plan and towards implementation of review recommendations is also monitored by BIO via biweekly teleconferences, bimonthly operations reports, and site visits as needed. In addition to these scientific and technical reviews, there are periodic reviews by organizations within BFA. To evaluate the suite of business systems that support the management of NEON, a Business Systems Review was conducted in FY 2019 and included desk reviews of Battelle’s policies, procedures, and technologies as well as site visits to Battelle Headquarters in Columbus, Ohio and NEON Headquarters in Boulder, Colorado.

Renewal/Recompetition/Termination

Construction was completed in May 2019 after delays caused by ongoing permitting and compliance issues, natural disasters, and other external factors.

The initial operations period of the NEON observatory was extended to allow time for Battelle to optimize operations and maintenance activities and to identify operational efficiencies and cost-saving opportunities. Funding of operations and maintenance was approved (August 2017) for three

Major Facilities

years, beginning on November 1, 2017 (costs not-to-exceed \$192.50 million), with an option for the director to issue a fourth year of funding (costs not-to-exceed \$70.0 million). This operations and maintenance phase allowed Battelle to develop a firm cost baseline for funding full operations over the long-term. In July 2019, the NSF Director alerted the National Science Board of her intention to exercise the option for a fourth year of funding. A Dear Colleague Letter (DCL) was released (July 26, 2019) announcing NSF's intention to compete the management of NEON operations and maintenance and encouraging organizations to submit requests for information. At the issuance of the DCL, BIO anticipated the timeline of the competition to be approximately 2 years. The COVID-19 pandemic has delayed implementation of some activities in the competition timeline, resulting in the postponement of proposal submission by 2 years. Thus, NSF, based on positive annual reviews of operations by panels of external experts and other data, has asked Battelle to operate NEON through October 2023, allowing the Agency time to execute a robust competition. NSF aims to have a new CA for NEON O&M in place by November 1, 2023. The anticipated lifetime of the NEON project is thirty years.