

Building a Landscape Level Understanding of Our Resources



Interior is leading the way to apply science and technology to create a better understanding of landscapes than ever before—to advance important conservation goals and steward the public’s resources. This science based approach allows us to make well-informed decisions on behalf of the American people.

*Sally Jewell, Secretary of the Interior
February 9, 2016*

To effectively carry out its mission and priorities, the Department of the Interior recognizes the need to consider resource management decisions and resilience across large landscapes. Interior analyzes the effects of management decisions across broad scales and multiple jurisdictions and balances development with conservation to enhance ecosystems and improve community resilience. This approach requires strong applied and basic scientific research, data collection and monitoring systems, and shared information and tools to bolster partnership efforts. Interior’s premier science agency, the U.S. Geological Survey, and the scientific capabilities across Interior bureaus provide the expertise needed to support this landscape level strategy.

A significant example of Interior’s landscape level capabilities is represented by the Department’s coastal resilience effort in the aftermath of Hurricane Sandy. At the core of Interior’s Hurricane Sandy recovery and resilience work are landscape level collaborative partnerships. On the ground progress is underway to restore and strengthen coastal ecosystems which provide fish and wildlife habitat, storm risk reduction, and economic opportunities. Interior is currently applying lessons learned from these efforts to date in order to improve future resilience efforts.

In addition, the Department has a central role in increasing the understanding of natural threats including those posed by earthquakes, landslides, tsunamis, drought, flooding, wildfire, and volcanoes and is increasingly called upon to assist in early warning and response. Recognizing the importance of this work, Interior is strengthening its capabilities to harness new technology and promoting

partnerships to provide rapid, robust information sharing in response to natural disasters to proactively help increase resilience to these events.

APPLYING SCIENCE AND ANALYSIS AT THE LANDSCAPE LEVEL

Interior develops the tools to analyze, visualize, translate, and extrapolate science and is leading efforts to apply science at multiple scales and across numerous landscapes to inform land and resource planning, policy, mitigation, and management. Interior employs some of the Nation’s premier scientists. The USGS and the scientists of the Department’s land and resource management agencies provide baseline information regarding the health of ecosystems and environments, natural hazards, and the impacts of rapidly changing climate.

With multiple science programs across the Department’s bureaus and offices, science coordination remains a critical component in the process of effective science application. Interior is well served by the deployment of science advisors in each bureau. These advisors serve critical roles within the organizations and across the Department by sharing information concerning new research efforts, identifying and evaluating emerging science needs, and ensuring effective science delivery and application. The Interior 2017 budget reflects high priority needs identified for scientific research across the Department.

Interior’s science programs provide an array of tools to analyze and understand the impacts of management decisions across broad landscapes. The Department is incorporating tools such as

**PRIORITY GOAL
CLIMATE CHANGE ADAPTATION**

GOAL: Understand, communicate, and respond to diversity of impacts associated with climate change to improve the resilience of the Nation’s communities, natural resources, and safeguard our cultural heritage sites.

METRIC: By September 30, 2017, the Department of the Interior will mainstream climate change adaptation and resilience into program and regional planning, capacity building, training, infrastructure, and external programs, as measured by scoring at least 300 of 400 points using the Strategic Sustainability Performance Plan scorecard.

geospatial technologies, remote sensing, predictive modeling, scenario development, forecasting, and simulation into land management activities and ecosystem services that protect communities and natural resources.

The 2017 budget includes \$1.0 billion for research and development activities throughout the Department, an increase of \$84.5 million from the 2016 enacted level. Activities supported include scientific analysis of natural systems and applied field research to address specific problems, such as thawing permafrost, invasive species, and flooding. The Department’s scientific research is used by land managers, for example, to support conservation efforts on the front lines of a changing climate and to confront the unpredictable nature of its impacts.

**UNDERSTANDING AND DEVELOPING
RESILIENT COMMUNITIES**

The Nation is facing a rising number of extreme natural events—including severe storms, wildfires, and drought—which are expected to increase in both frequency and intensity in the future. In the past months, Americans have battled high intensity wildfires in the West and Pacific Northwest, floods in the Midwest, mudslides in California, and intense tornadoes in the South. As the population grows in coastal areas, major cities, and the wildland-urban interface, Americans are more vulnerable to these severe events, as well as other natural hazards, such as earthquakes and storm surges. Coastal erosion in the Arctic and other sensitive areas is also putting communities and infrastructure at-risk.

While striving to minimize and manage impacts from these events, the Department is taking action to build up the resilience of natural and cultural resources and communities to these threats. Interior’s role in response to a changing climate and increasing concerns for resilience is two-fold. As a principal land and resource manager, the Department must understand and mitigate these changes to properly steward America’s resources. As a Federal agency, Interior shares and exchanges resource information, research, and best practices with other land managers and communities addressing these same problems.

The 2017 budget applies the insights gained during extreme events of the past year, including the historic western drought, wildfires, and severe flooding in the Southeast. It reflects the importance

**RESEARCH AND DEVELOPMENT
(dollars in thousands)**

	2016 Enacted	2017 Request	Change
Bureau of Land Management.....	23,536	30,452	+6,916
Bureau of Ocean Energy Management.....	72,826	73,293	+467
Bureau of Safety and Environmental Enforcement.....	26,703	26,703	0
Office of Surface Mining Reclamation and Enforcement.....	0	5,023	+5,023
Bureau of Reclamation.....	88,585	91,909	+3,324
U.S. Geological Survey.....	676,914	736,323	+59,409
Fish and Wildlife Service.....	32,476	38,622	+6,146
National Park Service.....	26,992	28,702	+1,710
Bureau of Indian Affairs.....	9,500	10,957	+1,457
Wildland Fire Management.....	5,990	5,990	0
TOTAL, DEPARTMENT OF THE INTERIOR.....	963,522	1,047,974	+84,452

of building resilient landscapes and communities, and proposes wise investments that help address vulnerabilities. The 2017 budget also proposes investments throughout the Department to improve scientific understanding related to resource management and expands access to and benefits from this important information.

This budget includes a suite of investments intended to build on areas where the Department has a natural leadership role and is positioned to reduce the impact of natural hazards on life and property and increase resilience in the long term. The 2017 request for the USGS includes \$149.7 million for Natural Hazards activities, an increase of \$10.7 million from the 2016 enacted level. Within this request are funds to deploy an Early Earthquake Warning system and maintain the volcano monitoring network. The request includes increases to expand coastal resilience, landslide response, seismic network activities in the central and eastern portions of the U.S., and scenarios to address imminent coastal impacts in the Arctic.

The 2017 budget request also includes a mandatory proposal for a ten-year, \$2.0 billion Coastal Climate Resilience program which will provide resources for at-risk coastal States, local governments, and their communities to prepare and adapt to climate change.

LANDSCAPE LEVEL APPROACH TO BUILDING RESILIENCE

Large geographic regions are increasingly stressed by natural and man-made factors, while demands for ecosystem services increase. As a source of reliable scientific information to describe and understand the earth, Interior's scientists add to the understanding of natural processes and ecosystems to support resource decisions. Good science supports cost-effective outcomes, resolves and avoids conflicts, and strengthens Interior's public trust stewardship of the Nation's lands and waters.

The USGS provides Interior with the basic science needed at the landscape level by building a detailed understanding of resources, quantifying threats and stressors to resources, and delivering decision support tools to assist land managers and the public. The Department's land management bureaus also conduct applied scientific research to evaluate the efficacy of various resource management actions. The outcome of this work protects ecological diversity, maximizes the benefits of resources, maintains key ecosystem services, focuses development activities, and creates opportunities to build resilience.

Department-wide efforts to apply science to better understand and address threats to the sage steppe landscape are an excellent example of the type of basic and applied research collaboration Interior undertakes to address resource challenges and build resilience.

Across the vast sage steppe landscape of 11 States of the Intermountain West, new fire regimes, driven by drought, climate change, the spread of invasive species, and development have fragmented what was once known as the sagebrush ocean. The Department and other Federal and State agencies worked cooperatively to produce a decision support tool that combines the ecological requirements of greater sage grouse with factors that contribute to a productive sage steppe ecosystem. This tool helps land managers determine appropriate strategies for restoring or maintaining sage steppe habitats. Efforts in 2016 and beyond will evaluate whether current seeding and planting strategies can be improved to ultimately create higher quality sage steppe habitat. The sage steppe work is important as Interior bureaus and the U.S. Forest Service evaluate management and restoration scenarios to implement land use plans that support Greater sage grouse habitat. The USGS budget includes a \$3.0 million increase for science to support the sage steppe landscape and \$500,000 to develop rapid science response capacity for wildfire.

Science from across the Department informed the development of the Greater Sage Grouse Conservation Strategy which involves landscape level planning to foster balanced development, while ensuring conservation, adaptation, and restoration of the interior West's sage steppe ecosystem. The Greater Sage Grouse Conservation Strategy reached a significant milestone in September 2015, when the Fish and Wildlife Service determined the Greater sage grouse does not warrant protection under the Endangered Species Act. This achievement was only possible through close collaboration among western States, the Department and other Federal agencies, and more than 1,100 ranchers. The FWS decision was based, in large part, on the anticipated habitat and species conservation benefits of the 98 revised Federal land use plans that comprise roughly two-thirds of the remaining Greater sage grouse habitat. Much work remains to be done to fully implement the land use plans. The 2017 budget request includes an increase of \$14.2 million to fund vegetative treatments to protect, improve, or restore sage steppe habitat and assist States in implementing Greater sage grouse conservation plans.

SUPERSTORM SANDY SPURS RESILIENT RESTORATION EFFORTS

In the dark of October 29, 2012, Superstorm Sandy slammed the shores of the Atlantic coast, bringing massive amounts of rain, high winds, and a record setting storm surge. Barrier islands were washed over, new inlets formed, and coastal communities were devastated. At the Prime Hook National Wildlife Refuge in New Smyrna, Delaware, the storm tore through decades old coastal levees that had separated freshwater impoundments which provided food and safety for thousands of migratory birds from the salty waters of the Atlantic. The impoundments were quickly converted to the natural brackish state.



Prime Hook, managed by FWS, is a 10,000-acre refuge that is an important stopover site for migratory birds that travel up and down the Atlantic Flyway and provides protected breeding habitat for federally and State listed threatened and endangered species. Prime Hook's habitat features include salt marsh, freshwater marsh, ponds and impoundments, wooded swamps, and upland grasslands and forest supporting hundreds of plant and animal species.

The levees had been damaged before. Storms in 2006, 2009, and 2011 overwashed dunes and levees and created breaches that exacerbated flooding in and around the refuge. After Superstorm Sandy, four major breaches destroyed artificial freshwater marshes, damaging habitat for migratory birds and other wildlife.

The refuge embarked on a large scale tidal marsh restoration project in the wetlands previously managed as freshwater impoundments. A fundamental consideration to design the project is to obtain an understanding of how fresh and salt water circulate within the existing refuge impoundments, and how water flow and salinity will change in various marsh restoration scenarios. The engineering firm Atkins Global completed a model that evaluated existing hydrological conditions in the impoundments as well as two additional alternatives—maintaining one open breach or filling all breaches. The model showed maintaining an open breach to the bay will result in the same high water levels and salinity that occur in the impoundments today as a result of multiple breaches. Atkins found several restoration benefits will result if all breaches are closed and natural marsh hydrology is restored, including lower water levels resulting from an enhanced water exchange rate and reduction in storm surge.

It is one of the largest marsh restoration projects ever undertaken in the eastern United States. Restoration from degraded open water conditions to back-barrier salt marsh habitats will involve rebuilding dunes, closing breaches, and restoring tidal channels throughout the marsh. The restored hydrological and salinity regimes will support the natural recolonization of salt marsh grasses within the refuge; and FWS will apply the lessons learned from this effort to restore wetlands along the Gulf Coast and across the Country.

This project restores a highly damaged tidal marsh/barrier beach ecosystem covering nearly 4,000 acres of marsh within the former impounded wetland system. This coastal wetland restoration enhances the resilience of refuge marshes facing future storms and sea level rise. The project also provides natural and economic benefits to several adjacent and nearby communities in Delaware, such as enhanced natural storm barriers, improved wildlife habitat, and increased tourism.

RANGELAND FIRE

Rangeland fire is widely recognized as the greatest threat to Greater sage grouse survival in the Great Basin States, and Interior is taking steps to help reduce this threat. The Department continues to implement the Integrated Rangeland Fire Management Strategy, which identifies a comprehensive set of enhanced strategies, policies, and practices for preventing and suppressing rangeland fire and restoring western sagebrush landscapes damaged by fire. The Strategy's goal is to reduce the likelihood, size, and severity of rangeland fires, address the spread of cheatgrass and other invasive species, and commit wildland fire management resources and assets to prepare for and respond to rangeland fires. Integral to the Rangeland Fire Management Strategy is effective implementation of a National Seed Strategy. As part of a comprehensive, science based strategy to address the threat of wildfires damaging landscapes across the West, Interior works closely with many local, State, and Federal partners, as well as private groups to develop the National Seed Strategy for rehabilitation and restoration to help foster resilient and healthy landscapes. The National Seed Strategy—which also supports the Administration's efforts to protect the sagebrush ecosystem—was published in August 2015, and its implementation is being led by the Bureau of Land Management. The 2017 BLM budget includes a \$5.0 million increase to more aggressively implement the new National Seed Strategy developed in partnership with the Plant Conservation Alliance and the U.S. Department of Agriculture.

Full implementation of the National Seed Strategy will result in nationwide networks of native seed collectors, researchers developing wildland seed into commercial crops, farmers and growers increasing native seed supplies, nurseries and storage facilities providing sufficient amounts of appropriate seed, and restoration ecologists identifying the appropriate timing and placement for seed and plant material to optimize treatment results. The seed materials and knowledge gained from the BLM investment in the National Seed Strategy will focus on restoring the sage steppe landscape in the near term, complementing the Greater Sage Grouse Conservation Strategy, and benefiting all BLM land rehabilitation and restoration efforts over time.

The 2017 Wildland Fire Management request provides \$30.0 million for Resilient Landscapes projects, which will allow the Wildland Fire Management

program to address shared goals of bureau resource management programs to treat large landscapes to reduce the threat of catastrophic wildfire and achieve restoration. The budget also includes an increase of \$2.8 million to strengthen the initial attack capacity of rural fire departments and rangeland fire protection associations. The request acknowledges that in some cases the most cost-effective and efficient means of quickly suppressing fires is to enhance the firefighting capacity and capability of remote communities and ranchers closest to the fire.

The Integrated Rangeland Fire Management Strategy targets high-priority areas for preventing and suppressing fire and restoring fire-impacted lands; and monitoring changing resource conditions to further improve the efficacy and efficiency of management practices. The USGS is developing geospatial tools to identify and describe areas of concern, while establishing a new framework to monitor the condition of landscapes and the effectiveness of the Strategy. The USGS is leading the implementation of a multi-year plan for identifying, prioritizing, and funding science and research activities that will promote comprehensive, landscape level understanding, and be useful at all management levels. The USGS is also providing scientific support to enhance ecosystem function and resilience by improving fuel treatments, conducting large scale removal of cheatgrass and other invasive plants, improving post-fire restoration, and increasing restoration effectiveness by selecting and seeding plants that are locally adapted and genetically appropriate for shifting climates.

LANDSCAPE CONSERVATION COOPERATIVES AND CLIMATE SCIENCE CENTERS

The Interior Department is applying approaches to address broad conservation challenges across the Country. An important tool in that effort is the Department's network of Landscape Conservation Cooperatives, launched in 2009 to improve science integration and application to address natural hazards and other landscape scale issues. The 22 LCCs form a network of resource managers and scientists dedicated to specific landscape areas that take a holistic, collaborative, adaptive, and science based approach to ensure the sustainability of the economy, land, water, wildlife, and cultural resources.

Each LCC brings together Federal, State, tribal, and local governments along with non-governmental organizations, universities, and interested public

and private organizations. The LCC partners work collaboratively to identify best practices, connect efforts, identify science gaps, and avoid duplication through conservation planning and design. The LCC network harnesses the capacities and abilities of all partners in support of common conservation outcomes and serves as a strategic forum for collegial collaboration, coordination, and integration—a vital role the LCCs provide according to a recent report by the National Academy of Sciences.

In 2015, at the request of Congress, the National Academy of Sciences evaluated the scientific merits and impacts of the LCC Network five years after it was created. The Academy found LCCs “address landscape conservation needs at a national scale, for all natural and cultural resources, in a way that bridges research and management efforts” and “create opportunities for identifying common conservation goals and leveraging efforts of diverse partners at a much greater scale than any one entity could achieve alone.” As the LCC network matures, more public and private decision makers are using the tools and information LCCs generate to promote adaptive management of fish and wildlife. The FWS budget includes \$17.1 million, an increase of \$4.8 million, for continued engagement of LCCs with partners to leverage base program efforts and generate more information to help the Department and stakeholders adaptively manage habitat and wildlife across the landscape.

Interior’s Climate Science Centers operated by USGS provide essential scientific support to the LCCs. The CSCs are built on partnerships with universities and perform cutting-edge research at the local, regional, and national scale to produce innovative products that model ecosystems; collect geospatial, habitat, and species data; and engage with a community of regional stakeholders to define priorities and initiatives. The CSCs provide meaningful linkages between research and specific decisions that Federal, State, tribal, and local agencies make at a landscape scale. New projects started in 2016 include estimating total glacier loss in Alaska and potential changes in freshwater input, and understanding of the interconnected icefield, stream, and ocean systems that are such a dominant feature of coastal Alaska.

The CSCs are also building on relationships with the Bureau of Indian Affairs by co-locating tribal liaisons with four CSCs to help Tribes develop the capacity to adapt to climate change impacts. The Northwest CSC will assess which ecosystem components and

ecological processes are most vulnerable to pronounced water deficiencies and test or demonstrate new methods or technologies intended to lessen or adapt to the ecological impacts of drought.

LANDSAT AND THE GEOSPATIAL PLATFORM

The Landsat program is a four-decade Federal investment that improved data quality for resource management, particularly for snow and ice covered land surfaces and water resources. Landsat 9 is a follow-on mission to the successful Landsat 8 program and a direct replacement for Landsat 7, which is reaching the end of its usable life. The investment in Landsat 9 will ensure the continuation of the collection of specialized land use and land change imagery across the Earth’s land surfaces that supports a myriad of scientific applications. It will serve as a fundamental data source to address basic science questions as well as a valuable resource for decision makers in agriculture, forestry, land use, water resources, and natural resource exploration.

The USGS budget includes \$75.2 million, an increase of \$17.6 million, for Landsat 9 and Sentinel-2 data acquisition, to support development of the ground system to deliver the completed system in 2021, two years ahead of the original planned completion date. The 2021 launch date is necessary to replace Landsat 7 and prevent a break in the eight-day revisit data collection.

Landsat is a joint mission with NASA which builds, launches and conducts on-orbit testing of the satellite. The USGS develops the ground system, data collection, and mission flight operations. The increased funding will support three principal development activities: systems engineering of the Landsat 9 instruments, the Operational Land Imager and the Thermal Infrared Sensor; instrument calibration and validation; and support, evaluation, and award of spacecraft competitive studies and contracts. The increase also supports system design and mission operations center software and hardware.

The USGS budget proposes an increase of \$3.0 million to increase the usefulness and value of Landsat information by providing data tools for land managers and the public. By accelerating the development of a set of Landsat-based science products that will improve applications used by natural resource managers, Interior will provide an authoritative basis for regional- to continental-scale identification

of change, monitoring of current conditions, and predicting future scenarios.

The USGS budget also includes \$2.2 million to acquire, store, and disseminate data from the European Space Agency Sentinel-2 satellite. Providing Sentinel-2 data will enable the routine use of the dataset most like Landsat for tens of thousands of U.S. users, augmenting land observations over any one spot on the Earth's surface to just three days, as long as two Sentinel-2s and two Landsats are operating. Sentinel-2 may also partially mitigate any gap in data that could occur between the decommissioning of Landsat 7 and the launch and operations of Landsat 9.

Reliable information is the foundation for landscape level understanding of resources. The data and tools of the national geospatial platform and other investments in map data and information assist land and resource managers to make informed decisions across the landscape and provide data and information to the public for use in a wide variety of applications. The USGS budget requests program increases totaling \$5.5 million for expanded collection through the 3D Elevation Program and for the Big Earth Data Initiative. The USGS investment in 3DEP responds to growing needs for high quality and high resolution data to improve aviation safety, understand and mitigate the negative effects of coastal erosion and storm surges, provide infrastruc-

ture for Arctic shipping and resource extraction, identify landslide hazard areas, protect biodiversity and habitats, and support hundreds of other critical activities within Interior and other Federal, State, and tribal partners. The 3DEP initiative collects and provides publicly-accessible data using LIDAR—a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light—over the contiguous U.S. and Interferometric Synthetic Aperture Radar data for Alaska.

The geospatial platform integrates data from Federal agencies and partners—such as universities, private organizations, and tribal, State, and local governments—and turns raw data on landscapes and resources into useful, understandable knowledge to inform increasingly complex land use decisions. The geospatial platform leverages geographic information system tools to help all stakeholders understand and make decisions about how to balance resource uses, make informed development choices, and minimize unnecessary effects on an increasingly interconnected, changing landscape.

This open data effort is a tool for smart planning. By identifying potential land use challenges earlier, all stakeholders save time, resources, and costs. It has the potential to reduce litigation costs and help communities, civic planners, residents, and others evaluate risks from climate change as they plan for resilient communities.

ARCTIC COLLABORATIONS

Interior is leading a range of Arctic Council initiatives under the U.S. chairmanship that focus on Arctic science, conservation, climate resilience, and ocean safety and stewardship. The Arctic Council is an intergovernmental forum that promotes cooperation on Arctic issues, especially relating to environmental protection and sustainable development. The Arctic Council has a two-year rotating chairmanship among the eight member nations, and the United States holds the chairmanship through April 2017. The Department's leadership on U.S. chairmanship initiatives will result in a better understanding of climate resilience in the region, a circumpolar plan for the prevention and management of invasive species, and a pan-Arctic digital elevation model that will improve the quality of regional topographic information.

The critical Arctic ecosystem is experiencing rapid natural change and increasing worldwide attention for its tremendous natural resources. Recognizing the importance of this landscape, Interior's 2017 budget requests \$160.6 million for activities related to the Arctic region, including an increase of \$9.8 million in USGS to support communities and resource managers in the Arctic. Melting glaciers and thawing permafrost are changing the landscapes of the Arctic coasts, inland forests, and tundra. Communities and land managers are seeking actionable science about how these changes affect the broader physical environment—altering stream flows, disrupting ocean currents and the fisheries that depend on them, and changing ecosystems and the availability of resources.

Federal, State, and tribal managers need to understand how climate change impacts identified resources and what management actions are warranted. Equally important, managers must have good information about the effectiveness of these actions. The USGS is requesting a \$1.0 million increase to analyze changes in the distribution and condition of fish and wildlife. Declines in sea ice alter habitats for iconic Arctic animals, such as polar bears, seals, and walrus. These species rely on sea ice as a platform for resting and hunting, and the decline in sea ice forces them to move onshore. As the climate warms, shrubs grow in areas previously dominated by tundra vegetation, such as lichens. Lichens are an important food source for caribou and the displacement of lichen by shrubs may reduce caribou herds, which harms subsistence hunters from indigenous communities as well as predator species, such as bears and wolves.

Permafrost thaw can significantly affect the landscape's ecosystem, hydrology, and infrastructure. The effects of changes in permafrost are complex because each area has a unique geological, chemical, atmospheric, and biological composition. Thawing of permafrost beneath lakes and ponds that provide drinking water for villages creates water security challenges, while thawing induces deterioration of water and sewage systems, thereby increasing health risks. These changes are particularly challenging for Native communities where the subsistence way of life is a cornerstone of cultural traditions spanning many generations. Thawing of permafrost also releases pollutants, including mercury and organic pesticides that harm fragile Arctic ecosystems and threaten public health. The USGS requests a \$1.9 million increase to accelerate development of predictive models to evaluate the changes from permafrost thaw and glacier melt.

Across Alaska, the Department plays a pivotal role in collaborative research efforts that address key priorities such as conservation, sustainable land management and resource stewardship, and adapting to a changing climate. Following Secretary Jewell's visit to the Native Village of Kivalina, Alaska in February 2015, the White House established an interagency group co-chaired by the Department to coordinate the Federal response to the threats facing Alaska Native villages due to coastal erosion. The State of Alaska, using a grant from FWS, established Village Planning Groups to plan relocation or other responses for three of the most acutely threatened villages, including Kivalina. The Department is coordinating Federal participation in these groups.

