Program Changes

Program Changes – Priority Increases			
Component	**Subactivity/Program**	**2015 Program Change Amount ($000)**	**FTE Changes**
Meeting the Challenge: Climate Change Science for a Changing World		**18,150**	**25**
	National Climate Change and Wildlife Science Center/ DOI Climate Science Centers (CSCs)	[11,550]	[9]
	Climate Research & Development	[4,600]	[11]
	Carbon Sequestration	[2,000]	[5]
Ecosystem Priorities		**12,400**	**29**
	Environments Program	[3,500]	[8]
	Invasive Species	[4,500]	[12]
	Land Change Science	[500]	[2]
	Contaminant Biology	[200]	[0]
	National Water Quality Assessment	[1,700]	[5]
	Toxic Substances Hydrology	[200]	[1]
	Hydrologic Research & Development	[200]	[1]
	National Geospatial Program	[800]	[0]
	Science Synthesis, Analysis and Research Program	[800]	[0]
Hydraulic Fracturing		**8,336**	**20**
	Fisheries Program	[2,200]	[10]
	Energy Resources	[950]	[1]
	Contaminant Biology	[1,400]	[5]
	Earthquake Hazards	[700]	[2]
	Hydrologic Research & Development	[901]	[2]
	National Cooperative Geologic Mapping Program	[2,000]	[0]
	Science Synthesis, Analysis and Research Program	[185]	[0]
WaterSMART		**6,400**	**11**
	Groundwater Resources	[2,400]	[9]
	Hydrologic Networks & Analysis	[2,000]	[1]
	Cooperative Water Program	[2,000]	[1]
Data Innovation and Mapping		**5,236**	**0**
	National Geospatial Program	[5,236]	[0]
Environmental Impacts of Uranium Mining		**3,173**	**12**
	Contaminant Biology	[673]	[3]
	Toxic Substances Hydrology	[2,500]	[9]
Earth Scientists for Tomorrow		**2,700**	**8**
	Cooperative Research Units	[1,000]	[6]
	Administration and Management	[1,700]	[2]
Grand Total		**56,395**	**105**

Program Changes - USGS Increases			
Component	**Subactivity**	**2015 Program Change Amount ($000)**	**FTE Changes**
Pollinators		**300**	**1**
	Status and Trends	[300]	[1]
Wildlife Health		**200**	**1**
	Wildlife Program	[200]	[1]
Energy Future and Wildlife Sustainability		**1,000**	**1**
	Wildlife Program	[1,000]	[1]
Wildfire Restoration Ecology		**500**	**2**
	Environments Program	[500]	[2]
OCS Ecosystems Decisions		**300**	**2**
	Environments Program	[300]	[2]
Landsat Science Products for Climate and Natural Resources Assessments		**1,500**	**3**
	Land Remote Sensing	[1,000]	[0]
	Land Change Science	[500]	[3]
Alternative Energy Permitting on Federal Lands		**1,300**	**2**
	Energy Resources	[1,300]	[2]
Emerging Contaminants & Chemical Mixtures		**1,450**	**2**
	Toxic Substance Hydrology	[1,450]	[2]
Streamgages		**1,200**	**0**
	National Streamflow Information Program	[1,200]	[0]
Streamgage R&D		**700**	**1**
	Hydrologic Research & Development	[700]	[1]
National Hydrologic Modeling/Groundwater Sustainability		**750**	**3**
	Hydrologic Networks & Analysis	[750]	[3]
Tribes		**1,000**	**7**
	Cooperative Water Program	[1,000]	[7]
Big Earth Data Initiative		**2,000**	**0**
	Science Synthesis, Analysis and Research Program	[2,000]	[0]
National Map Modernization		**1,908**	**9**
	National Geospatial Program	[1,908]	[9]
Tribal Science Coordination		**300**	**0**
	Administration and Management	[300]	[0]
DOI Science Coordination		**200**	**1**
	Administration and Management	[200]	[1]
Reducing the Facilities Footprint - Cost Savings and Innovation Plan (CSIP)		**5,365**	**0**
	Rental Payments and Operations & Maintenance	[5,365]	[0]
Grand Total		**19,973**	**35**

Program Changes - USGS Decreases			
Component	**Subactivity**	**2015 Program Change Amount ($000)**	**FTE Changes**
Fisheries Program Research		**-1,000**	**-8**
	Fisheries Program	-[1,000]	-[8]
Wildlife Program Research		**-1,200**	**-7**
	Wildlife Program	-[1,200]	-[7]
Environments Program Research		**-3,220**	**-18**
	Environments Program	-[3,220]	-[18]
National Civil Applications Program/Civil Applications Committee		**-2,547**	**-12**
	Land Remote Sensing	-[2,547]	-[12]
Land Change Science Research		**-1,000**	**-7**
	Land Change Science	-[1,000]	-[7]
Energy Research		**-1,000**	**-2**
	Energy Resources	-[1,000]	-[2]
Oil, Oil Shale, and Gas Assessments		**-500**	**-1**
	Energy Resources	-[500]	-[1]
Contaminants in Wastewater Projects		**-369**	**-1**
	Toxic Substances Hydrology	-[369]	-[1]
Eliminate Geodetic Monitoring and Active-Source Seismic Profiling		**-700**	**-2**
	Earthquake Hazards	-[700]	-[2]
Coastal Vulnerability Studies		**-1,000**	**-1**
	Coastal & Marine Geology	-[1,000]	-[1]
Water Quality Monitoring		**-2,000**	**-8**
	National Water Quality Assessment	-[2,000]	-[8]
HR&D Monitoring and Assessments		**-1,500**	**-7**
	Hydrologic Research & Development	-[1,500]	-[7]
Watershed Support, Information Delivery, & Technical Support		**-1,500**	**-7**
	Hydrologic Networks & Analysis	-[1,500]	-[7]
Monitoring and Assessments		**-3,264**	**-9**
	Cooperative Water Program	-[3,264]	-[9]
Funding to State Institutes		**-3,000**	**0**
	Water Resources Research Act Program	-[3,000]	[0]
Bio-Science Data Synthesis		**-3,000**	**-4**
	Science Synthesis, Analysis and Research Program	-[3,000]	-[4]
Glacial Aquifers Project		**-2,000**	**0**
	National Cooperative Geologic Mapping Program	-[2,000]	[0]
Land Cover Data		**-422**	**-1**
	National Geospatial Program	-[422]	-[1]
Nation's 133 Largest Urban Areas		**-4,082**	**-25**
	National Geospatial Program	-[4,082]	-[25]
NGP Program Coordination and Partnership Development		**-822**	**-4**
	National Geospatial Program	-[822]	-[4]
The National Atlas		**-2,674**	**-18**
	National Geospatial Program	-[2,674]	-[18]
Reduction to Administrative Services		**-4,500**	**-16**
	Administration and Management	-[2,200]	-[14]
	Information Services	-[2,300]	-[2]
Grand Total		**-41,300**	**-158**

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Priority Increases

Meeting the Challenge: Climate Change Science for a Changing World

Meeting the Challenge: Climate Change Science for a Changing World						
		2013 Actual	2014 Enacted	Program Changes	2015 Request *	Change from 2014 Enacted (+/-)
National Climate Change and Wildlife Science Center/DOI Climate Science Centers (CSCs)		23,735	23,735	11,550	35,285	+11,550
	FTE	40	40	9	49	+9
Climate Research & Development		20,495	20,495	4,600	25,095	+4,600
	FTE	123	123	11	134	+11
Biological Carbon Sequestration		4,180	5,180	2,000	7,180	+2,000
	FTE	8	12	5	17	+5
Total Requirements ($000)		**48,410**	**49,410**	**18,150**	**67,560**	**+18,150**
	Total FTE	**171**	**175**	**25**	**200**	**+25**

* 2015 Request column does not include fixed costs.

Justification of 2015 Program Changes

The 2015 budget request for the U.S. Geological Survey's Meeting the Challenge: Climate Change Science for a Changing World initiative is $67,560,000 and 200 FTE, a program increase of +$18,150,000 and +25 FTE above the 2014 Enacted level.

Overview

Climate change requires that the Nation prepare for an increasingly wide range of temperature and precipitation patterns, including longer and more intense droughts, heat waves, and other climate-related environmental change. The USGS has conducted climate change research for more than 100 years, in an effort to understand the impact of climate change on humans, wildlife, and the environment. The Climate and Land Use Change (CLU) Mission Area conducts research and assessments to inform resource managers' strategies to mitigate and adapt to climate change, through the National Climate Change and Wildlife Science Center (NCCWSC)/Department of the Interior Climate Science Centers (CSC) Program, the Climate Research and Development (R&D) Program, and the biological carbon sequestration project based on Landsat satellite data and Landsat-based essential climate variables (ECVs) provided by the Land Remote Sensing Program. Continued research that leverages all of these programs' strengths is needed to better understand climate change impacts on natural resources and the infrastructure of the Nation.

Program Performance

Science for Adapting to a Changing Climate +11,550,000/+13 FTE

National Climate Change and Wildlife Science Center/Department of the Interior
Climate Science Centers (+8,550,000/+6 FTE)

Established in 2008, the NCCWSC has created eight regional CSCs to provide resource management agencies with science and technical support on the impacts of climate change on fish, wildlife, and ecological processes. In 2015, the NCCWSC/CSC Program requests an increase of $8.6 million to strengthen this work, focusing on interagency and regional coordination of climate science and adaptation planning activities; developing actionable science focused on decisionmakers' needs, including providing science to better integrate climate mitigation and adaptation planning; and addressing tribal needs for climate science.

In early 2013, Interior released a policy that requires Interior bureaus and offices to incorporate climate adaptation into policies, programs, planning, and operations. Identifying which species, ecosystems, and regions are likely to experience negative effects from climate change is a crucial initial step in building a climate adaptation program. Many Federal, State, tribal and other entities are conducting vulnerability assessments. These entities need to be able to easily access the findings of completed or ongoing assessments learn from existing methods and data to develop new studies, and combine results to provide larger and more meaningful conclusions. In 2015, the NCCWSC would work with an existing interagency/State coordination group and tribes to continue development of a public cross-agency database and field guide to vulnerability assessments. This project would support Interior and other agencies in establishing standards and best practices, tracking progress for such assessments, and strategically prioritizing adaptive management actions.

Assuring that Federal, State, and other scientific activities are efficiently and effectively devoted to high priority needs requires an increased level of coordination. In 2015, the NCCWSC would develop and implement the technical means to track relevant climate change adaptation-science across Federal agencies and ensure the availability of this information in a Web accessible format at the regional and national scale. Additionally, the CSCs would continue to work with regional partners to identify common priorities and develop multiagency strategies that ensure coordinated implementation of public science investments to target the most critical management needs. This cross-agency dialogue convened by the CSCs represents a critical component of an effective and efficient Federal response to the climate science needs of managers. Investment in better coordination allows the NCCWSC and CSCs to better leverage the capacity and expertise of existing institutions, eliminate redundancy, make maximum use of existing data, and better support the needs of decisionmakers.

Ensuring that scientific understanding translates into practical application-ready solutions is a major challenge for the scientific community. The NCCWSC and the CSCs are implementing multiple approaches to ensure that managers and scientists "co-develop" actionable scientific products. In 2015, all CSCs would significantly expand their activities that support adaptation planning, with a focus on meeting the needs of specific decisions and planning activities, and on delivering application-ready

scientific information. Building on existing CSC stakeholder interactions, the CSCs would work with regional managers to identify high priority policy management decisions that could be informed by research results, then ensure close working relationships between scientists, managers and decisionmakers to assure that science projects provide decision ready outcomes. This ongoing collaboration between research scientists and land managers is essential to the successful production of actionable science. The NCCWSC would work with the USGS biological carbon sequestration project to identify options for building climate mitigation into climate adaptation planning, in particular by developing decision tools to help natural resource managers account for the carbon impacts of routine management practices as well as future climate adaptations. The CSCs would pilot this effort through regional projects focused on migratory birds and on the impacts of extended drought on ecosystems.

Native American communities are increasingly engaging with the USGS and other partners to develop climate adaptation programs, and their needs for scientific and planning information are likewise increasing. In 2013, the NCCWSC/CSC Program established a Federal Advisory Committee: the Advisory Committee on Climate Change and Natural Resource Science (ACCCNRS). In early 2014, the ACCNRS recommended that the USGS convene tribal and indigenous partners from across the CSC network to identify common and high priority tribal needs. This recommendation would complement work at each of the CSCs, where scientists work with tribes to identify high priority tribal resource management concerns and build a science portfolio that provides information directly responsive to these needs. In 2015, the NCCWSC and the CSCs would help identify and implement best practices for the integration of traditional ecological knowledge into CSC science products. These efforts would be guided and supported by participation of tribal interests on CSC stakeholder committees and on the ACCCNRS as well as be coordinated with the Bureau of Indian Affairs climate programs, tribal governments, consortia, and organizations, and other Federal climate efforts in Indian Country. Finally, in 2015 the CSCs would build on existing training and educational efforts, working with tribes in the development of climate adaptation strategies. The CSCs would expand research on key climate concerns, such as identifying those “First Foods” and similar culturally valued interests (plants, animals) whose existence or access is threatened by climate change.

Climate Research and Development (+2,600,000/+7 FTE)

For more than 50 years, the Climate Research and Development (R&D) Program has supported fundamental multidisciplinary research needed to understand patterns of climate and land use change and their impacts on the Earth system. In 2015, the Climate R&D Program requests an increase of $2.6 million to focus efforts on emerging science needs. This research would improve understanding of regional responses to climate and land use stressors and forecasting of impacts of different climate and land use scenarios.

An important emerging science need is the identification and documentation of long-term patterns of drought and storms. Recent droughts and model projections of increased aridity in parts of the United States and elsewhere have raised concerns about the ability of society to respond to and mitigate impacts of altered water availability. Because instrumental monitoring of climate variables such as temperature and precipitation spans only the last century or so, it is critical to integrate them with fossil and chemical indicators of past climate to understand the magnitude, frequency, spatial impacts, and drivers of droughts

and megadroughts (events that lasted decades). In 2015, the Climate R&D Program plans to initiate a research effort to document historical baseline levels of variability in water resources across the United States, providing context and setting expectations for modern-day patterns of droughts, storms, and other hydrologic events that affect coasts, urban areas, agriculture, and other sectors in our Nation.

Because of the high concentration of the U.S. population along the Nation's coastline, rising sea level has significant impacts on society, infrastructure, and coastal habitats that serve as buffers from storm surges and severe weather events. An increasing science need is to improve the ability to accurately forecast rates and magnitudes of future sea level rise. In 2015, the Climate R&D Program would conduct research to develop consistent methods to measure the amount of water contained in alpine glaciers. This research would improve understanding of the potential contributions of melting glaciers and ice sheets to sea level. In addition, the Climate R&D Program would expand research on geologic records of past high sea levels.

Another emerging science need is the response of coastal habitats to combined effects of sea level rise and changing land use. Both stressors affect the distribution of plant communities and the ecosystem services that they provide. In 2015, the Climate R&D Program would expand efforts to integrate ecological research on existing plant communities with reconstructions of past vegetation and aquatic communities to improve understanding of how coastal habitats respond to specific changes. By designing projects in consultation with resource managers within national parks and U.S. Fish and Wildlife (FWS) Refuges, the results should facilitate development of sustainable resource management strategies for the Nation's coastlines.

Effective application of climate research to address resource management needs requires ongoing communication between USGS scientists and resource managers as well as an understanding of scientific capabilities and limitations. This requires Climate R&D Program scientists to work with stakeholders on public lands to identify their most pressing science needs and coordinate with researchers to develop projects to address those needs. In 2015, the Climate R&D Program and the NCCWSC propose cost-sharing of staff, with expertise in both natural resource management and research, to work with stakeholders and researchers to provide translational expertise and design research efforts to provide data on ecosystem response to climate and land use changes over appropriate temporal and regional scales that would facilitate development of sustainable management plans.

Grand Challenges +$7,000,000/+12 FTE

The Administration's grand challenges are ambitious but achievable goals that harness science, technology, and innovation to solve important national or global problems and that have the potential to capture the public's imagination. The three USGS proposed grand challenges focus on climate change and encourage collaboration between Federal, State, local and tribal governments, academia, non-governmental organizations, and the private sector.

Drought Impacts & Adaptive Management **(+3,000,000/+3 FTE*)***

National Climate Change and Wildlife Science Center/Department of the Interior
Climate Science Centers (+3,000,000/+3 FTE)

Given the persistent drought in the Central and Western United States, the NCCWSC proposes a grand challenge to harness the natural and social sciences for adaptive management of the complex consequences of severe and prolonged drought. Responding to drought patterns and managing the implications of limited water resources in the Central and Western United States are primary drivers for many land and water management agencies throughout the region. The grand challenge would be carried out by adapting the Natural Hazards Mission Area's approach for developing region-specific disaster scenarios (Science Applications for Risk Reduction), and updating the method with scenario modeling and visualization tools in development by the CSCs.

In 2015, the NCCWSC and the North Central and South Central CSCs would work with Actionable Science Working Groups for both CSCs and with the Water Resources Mission Area, regional stakeholder networks and multidisciplinary science groups to develop a science-based, shared understanding of future changes in water supply and consumptive water use; and to develop common, plausible scenarios for regional drought impacts across the midcontinent. The NCWSC/CSC Program would develop models on likely socio-ecological impacts from drought and create visualization tools or processes to address competing concerns and inform resource managers' decisionmaking. This effort would build on existing socio-ecological modeling capabilities in the Land Change Science (LCS) Program to incorporate management goals identified by the working groups, to enable resource managers to pose "what if" questions about potential responses to drought impacts, and to create a tool or process to address competing concerns and inform resource managers' decisionmaking. The North Central CSC's visualization tools would allow the Actionable Science Working Groups to evaluate potential impacts of decision regarding drought. Finally, the NCWSC/CSC Program would develop an online information management system for data, models, and tools that will allow managers to use the integrated modeling of drought to explore impacts of numerous decisions.

In summary, this "grand challenge" would provide actionable information on likely ecological impacts from drought, create a tool or process to address competing concerns, and inform resource managers' decisionmaking. By focusing on the ecological impacts of drought, this "grand challenge" complements ongoing activities focused on water availability/supply and the agricultural and municipal effects of drought such as those under the National Integrated Drought Information Systems, U.S. Bureau of Reclamation basin studies, and other partners. The USGS will develop an actionable science working group, consisting of scientists and managers from the Central United States, to identify science needs for decisions on drought. This effort will provide managers in the Central United States with a climate drought toolkit for adaptation planning. The toolkit will contain common plausible scenarios for projecting drought impacts, social-ecological models that can to be used to forecast the potential implications of drought, better access to climate and drought related data, and a tool that will allow managers to visualize the potential impacts of decisions.

Climate and Land Cover Change Effects **(+2,000,000/+4 FTE)**

Climate Research and Development (+2,000,000/+4 FTE)

Land use and land cover changes cause the boundaries between wet and dry regions to shift, altering regional climate patterns and vulnerability to droughts and floods. As regional resource managers plan future alterations or restorations of the landscape, those plans could be better supported by science that integrates long historical records of land change with modern Landsat satellite-based records of land change, and integrates these records into climate modeling efforts. For example, removal and drainage of hydrologic features early in the 20th century has had a significant impact on the timing and quantities of regional precipitation. Scientists and resource managers would benefit from a better representation of historical and modern-day water bodies, wetlands, and other hydrologic features in models. Auxiliary changes to such features (whether through artificial drainage or restoration of previous hydrology) would further affect regional climate, and the capability to incorporate such feedbacks into regional-scale climate and ecosystem models would improve the capability of policymakers and planners to forecast potential impacts of different land use scenarios. The Climate R&D Program plans to focus this "grand challenge" in two areas: (1) the Florida peninsula, including the Everglades and (2) the Upper Colorado Basin.

Hydrology is the primary driver of vegetation across much of the Florida peninsula, and most restoration efforts focus on achieving 'natural' quantity and quality of water. Previous regional climate simulations indicated that 20th century land-cover changes could have reduced regional precipitation by about 10 percent, consistent with historical evidence. These results suggest that restoration of more natural land cover and hydrology would have significant impacts on regional climate, and management actions should anticipate such changes in long-term ecosystem management planning. In 2015, the Climate R&D Program would conduct research to improve the resolution of land cover data for both pre-drainage and modern datasets. Land cover classes would be refined, and a more detailed analysis of historic and modern land cover would be conducted to derive datasets suitable for coupling regional climate, hydrologic, and ecologic models. These data would be used in an expanded set of sensitivity experiments, and the regional climate model outputs would be coupled with hydrologic and ecologic models to improve capabilities to model ecosystem responses to different climate and management scenarios. Coupling of the regional climate model outputs with hydrologic and ecologic models used by resource managers would allow them to run different management scenarios and see whether there were unanticipated feedbacks to the climate system (such as increased precipitation resulting from restoration of natural Everglades hydrology). An understanding of the possible feedbacks minimizes the likelihood of surprises and increases the chance of sustainable restoration outcomes.

Water supply, demand, and drought are important issues in the Colorado River Basin, and the relative controls of climate variability vs. human modification of the landscape on water availability are poorly known. Changes in fire frequency, arroyo cutting, and hydrology have been observed since the mid-19th century, and regional climate simulations that compare outcomes using pre-settlement and present-day land cover would clarify how such changes have influenced climate and the hydrologic system. In 2015, Climate R&D Program research would develop pre-settlement and modern land cover datasets in a consistent format for input to regional climate sensitivity experiments. Pre-settlement datasets will be

compiled from a combination of archival sources, such as Land Office Surveys and other historic datasets, and paleoecological evidence. Present-day datasets will be compiled from contemporary Landsat data with 30-meter resolution, as well as other remote sensing technology. Land cover types and other aspects of both datasets will be determined in the initial phases of the project. The datasets will be used in a regional climate model simulation to conduct paired pre-settlement and present-day simulations. Ultimately, researchers would work with resource managers to couple model outputs with hydrologic and ecological models to support management needs. The Integration of regional climate models with different ecosystem models allows identification of climate feedbacks from different management/land cover scenarios. This improves the likelihood of successful ecosystem management.

Carbon Inventory and Decision Support Tools **(+2,000,000/+5 FTE)**

Carbon Sequestration (+2,000,000/+5 FTE)

Biological carbon sequestration refers to both natural and deliberate processes by which carbon dioxide (CO_2) is removed from the atmosphere and stored as carbon in vegetation, soils and sediments. The biological carbon sequestration national assessment will be completed in 2015 for all 50 States. In 2015, the biological carbon sequestration project proposes a grand challenge leveraging this initial assessment to implement a carbon inventory and tracking system for carbon stocks and flows on all Interior lands, complete with online tools to support regional natural resource decisionmaking.

Interior can lead the Federal government in establishing a national carbon inventory and tracking system. Management of carbon stored in biological reservoirs has importance both for mitigation of climate change and for adaptation to such changes. Even though the USGS has developed methods for evaluating biological carbon storage at a regional scale, these methods were developed for a broad national assessment and need refinement to be applicable to a specific site or decision. The development of an approach that identifies the scientific basis for carbon management decisions (such as ecosystem restoration) and a process to incorporate science information directly in management planning will be critical to ensure effective use of scientific results. While management activities have implications for carbon management, informed decisions are often hampered by the lack of tools for understanding or incorporating science into decisionmaking. The USGS will work directly with decisionmakers to understand their needs and timelines, and develop and apply refined geospatial models and estimation techniques for biological carbon sequestration, as well as decision-support tools supporting carbon management objectives and the tradeoffs involved with other ecosystem services.

Ongoing use and relevance of the national biological carbon sequestration assessment results require that a continuing carbon monitoring effort, which will document the impact of management actions, as well as climate change, land use change, wildfire, and other environmental perturbations on carbon stocks, carbon sequestration and other ecosystem services. In 2015, the biological carbon sequestration project would develop methodologies for updating critical input data, streamline biogeochemical models for calculating carbon stocks and sequestration, and engage an interdisciplinary team of scientists for evaluating and documenting results.

Finally, the biological carbon sequestration project in 2015, would conduct research and development for reducing carbon stock and sequestration uncertainties. Further research into quantifying and reducing uncertainties in estimating carbon stocks and sequestration is needed to incorporate information on carbon stocks and sequestration into land management decisions. Inherent uncertainties in modeling, as well as in the quality of input data on fires, land use/land cover change, and aquatic measures would be investigated, along with incorporating the Land Remote Sensing Program's new Landsat-based essential climate variables (ECVs) such as burned area extent, surface water extent, and snow covered area. The ECVs help to provide an authoritative basis for regional- to continental-scale identification of historical change, monitoring of current conditions, and predicting future scenarios. The biological carbon sequestration project would also need to adapt the national assessment methodology to the same resolution as the Landsat satellites (30 meter (m) scale) so it can be used by land managers at a local scale. Beginning in 2015, the USGS would hold a set of workshops with management agencies (Federal agencies, States, tribes, and non-governmental organizations) to identify requirements and appropriate data inputs (such as possible management actions). Pilot projects with Interior land management agencies will be initiated. For example, in 2014, the U.S. Fish and Wildlife Service (FWS) is beginning work with the USGS to incorporate biological carbon sequestration into Refuge management. FWS pilot sites include the Great Dismal Swamp, Alligator River, and Pocosin Lakes National Wildlife Refuges. This work will be the basis for a refined approach in 2015.

Ecosystem Priorities – Landscape Priorities, Invasive Species and Restoration

Ecosystem Priorities		2013 Actual	2014 Enacted	Program Changes	2015 Request	Change from 2014 Enacted (+/-)
Landscape Priorities						
California Bay Delta		6,884	6,884	1,500	8,384	+1,500
	FTE	12	12	3	15	+3
Chesapeake Bay		7,058	8,057	1,500	9,557	+1,500
	FTE	29	29	5	34	+5
Columbia River		3,408	3,408	850	4,258	+850
	FTE	48	48	2	50	+2
Puget Sound		5,704	5,704	1,050	6,754	+1,050
	FTE	26	26	2	28	+2
Upper Mississippi River		4,608	4,608	200	4,808	+200
	FTE	23	23	2	25	+2
Invasives Species						
Brown Tree Snakes – Detection and Control		0	0	500	500	+500
	FTE	0	0	0	0	0
Everglades		6,525	6,525	1,000	7,525	+1,000
	FTE	30	30	2	32	+2
Great Lakes Asian Carp		2,478	3,464	1,000	4,464	+1,000
	FTE	6	6	4	10	+4
Upper Mississippi River Asian Carp		0	0	1,000	1,000	+1,000
	FTE	0	0	2	2	+2
New and Emerging Invasives of National Concern		0	0	1,000	1,000	+1,000
	FTE	0	0	4	4	+4
Ecosystem Services						
National Ecosystems Services Framework		0	0	1,000	1,000	+1,000
	FTE	0	0	1	1	+1
Sustaining Environmental Capital		0	0	1,000	1,000	+1,000
	FTE	0	0	2	2	+2
Eco INFORMA		0	0	800	800	+800
	FTE	0	0	0	0	0
Total Requirements ($000)		**36,665**	**38,650**	**12,400**	**51,050**	**+12,400**
	Total FTE	**174**	**174**	**29**	**203**	**+29**

Justification of 2015 Program Changes (+$12,400,000/+29 FTE)

The 2015 budget request for Ecosystem Priorities is $51,207,000 and 203 FTE, a program increase of +$12,400,000 and +29 FTE above the 2014 Enacted level.

Overview – Landscape Priorities

Knowledge of ecosystems is critical to the well-being of the Nation because ecosystems supply the natural resources and other goods and services that humans require. The scope of science needed to improve conservation and restoration of ecosystems is complex. In many ecosystems, regional environmental resource issues challenge decisionmakers and place them at a critical juncture to balance human needs with ecosystem health. The multidisciplinary approach applied by the USGS is necessary to develop an understanding of both individual ecosystem processes as well as holistic ecosystem level evaluations of responses to actual and proposed restoration alternatives and plans. Science enables

resource managers to make informed decisions, to help resolve and prevent resource management conflicts, and to support Interior's public trust stewardship responsibilities for the Nation's lands and waters.

Increases in 2015, support research and development efforts focused in the California Bay-Delta, the Chesapeake Bay, the Columbia River, Puget Sound and Upper Mississippi River. These multi-disciplinary projects are designed to serve local ecosystem management needs and provide knowledge and approaches transferable to similar ecosystems across the Nation.

Program Performance

California Bay-Delta **(+$1,500,000/+3 FTE)**

Environments	(+$500,000/+2 FTE)
National Water Quality Assessment	(+$1,000,000/+1 FTE)

The California Bay-Delta Ecosystem (Delta) is recognized as one of the world's threatened treasures of biodiversity, supporting unique native species and their critical tidal and wetland habitats. Like other urban estuaries, this system has a history of anthropogenic changes involving multiple stressors including altered hydrodynamics, environmental contaminants, and invasive species that have degraded the ecosystem. The native fish fauna has been much reduced and key species are now protected by the Endangered Species Act. Among these species, the threatened Delta smelt most prominently influences human decisions about the movement of water through the system. The recovery of this species requires an improved understanding of the changes that influence all stressors and parts of the system, including watersheds, rivers, deltas, bays, and the ocean. This initiative builds on ongoing monitoring and research by the USGS to understand how flow conditions, water quality, and fish behavior affect fish survival. The USGS would use additional resources to increase capacity to further understand biological elements of the Sacramento – San Joaquin – San Francisco system, specifically the role of invertebrates, fish, and birds and other organisms and how these organisms respond to managed and natural flow changes and agency habitat-restoration efforts. USGS biological scientists would build on existing datasets, some of which are multi-decadal time series, and evaluate existing and new biological observations in light of physical changes to the system, especially drought conditions, changing salinities, and potential pollutant increases. Increased understanding of the flows in the system is possible using the existing USGS CASCaDE I model software and the CASCaDE II model that is under development. This funding would also support expedited development of the CASCaDE II model toward a version that is well-suited to evaluating multiple scenarios under a range of flow (e.g., drought) conditions in an operational mode. This model would permit assessment of the effects of flow regime and in-Delta management responses on water levels, velocities, and distributions of critical water quality and habitat parameters such as salinity and temperature throughout the Delta, physical conditions that can have profound effects on vegetation and wildlife. The USGS would advance the capability to collect, store, and access, visualize, and share data and information about the Delta system, the vulnerabilities of Delta ecosystem components to change, and the potential responses to these vulnerabilities.

Chesapeake Bay **(+$1,500,000/+5 FTE)**

Environments	(+$300,000/+1 FTE)
Land Change Science	(+$500,000/+2 FTE)
Contaminant Biology	(+$100,000/ 0 FTE)
Toxic Substances Hydrology	(+$100,000/ 0 FTE)
National Water Quality Assessment	(+$500,000/+2 FTE)

The USGS provides science to restore the Nation's largest estuary and carry out the President's Chesapeake Bay Executive Order (EO) strategy and associated action plan. The Interior, through the USGS, the U.S. Fish and Wildlife Service (FWS), and the National Park Service (NPS), is providing leadership, expertise, and resources to meet the major goals of the Chesapeake Bay Program (CBP) partnership and the associated EO to restore water quality, recover habitat, sustain fish and wildlife, and conserve lands and increase public access. The USGS has lead responsibility under the EO (in collaboration with the National Oceanic and Atmospheric Administration's (NOAA)) to strengthen science to support all of these goals.

In 2014, the USGS had $8.1 million among multiple programs to conduct Chesapeake activities. In 2015, the requested $1.5 million increase would enhance activities to (1) restore brook trout and their habitats; (2) help identify contaminants affecting fish health; (3) forecast the effects of land change and sea-level rise on black ducks and their habitats; (4) forecast effects of land and climate change on habitat conditions; (5) explain water-quality change; and (6) use remote sensing to assess effectiveness of conservation practices. Planned activities led by the programs listed below include —

- Expand science to help restore brook trout and their habitats. The USGS worked with the FWS and partners to identify five research priorities to support brook trout conservation and restoration, which is an EO priority. Refining and developing patch-prioritization tools and assessing effects of shale-gas drilling would begin in 2015 (Environments Program in collaboration with Fisheries Program).
- Enhance science on multiple factors affecting fish health in the Bay watershed and the associated effects and sources of toxic contaminants and endocrine-disrupting compounds. The USGS activities are needed to address recommendations in the recent EO on the extent and severity of toxic substances and their biologic effects in the bay and its watershed (Environments, Toxic Substances Hydrology and Contaminant Biology Programs).
- Assess the combined effects of land change and sea-level rise on black duck habitats. Additional funding would be used to enhance science to improve energetics models for wintering black ducks within the Bay refuge system, begin new effort to couple the energetics models with new models of sea-level rise and land use change to predict future impacts on coastal wetland, and help identify the best areas for restoration of black duck habitats (Environments Program).
- Forecast the combined effects of land and climate change on habitat conditions. To support the brook trout, black duck, and water-quality studies, the USGS would enhance efforts to identify potential effects of land use and climate change by: (1) considering the potential effects of

hydraulic fracturing and land change on stream quality; and (2) assessing potential changes in land cover on black duck habitats. (Land Change Science Program and Environments Program).

- Further investigate the factors affecting water quality to enhance progress toward the Bay total maximum daily load (TMDL). The USGS would enhance the use of models, land use information, and other data to explain changes in nutrients and sediment at key areas in the Bay watershed. The USGS has been asked by U.S. Environmental Protection Agency (EPA) and six States to better assess trends and explain the effects of water quality management practices as the Bay TMDL is implemented. The USGS would also work with the U.S. Department of Agriculture (USDA) to evaluate the effect of agricultural practices to improve water quality. (National Water Quality Assessment (NAWQA), Environments, and Land Change Science Programs).
- Increase research on the effectiveness of winter cover crops in reducing both soil erosion and nitrogen runoff from agricultural fields into the Chesapeake Bay. This research would support water-quality studies and conducted in collaboration with the USDA Agricultural Resource Service, the Maryland Department of Agriculture, and local soil conservation districts. Project scientists would use satellite-based remote sensing data products with site specific, privacy-protected conservation program farm data records to measure cover crop success in preventing sediment and nutrients from reaching the Bay. (Land Change Science Program).

Columbia River (Salmon) **(+$850,000/+2 FTE)**

Environments	(+$300,000/+1 FTE)
Contaminant Biology	(+$100,000/0 FTE)
Toxic Substances Hydrology	(+$100,000/+1 FTE)
National Geospatial Program	(+$350,000/0 FTE)

The Columbia River is the largest river in the Pacific Northwest, and plays an important role in the region's culture and economy through tribal fisheries, irrigation, power production, and recreation, among other goods and services. This system has been affected by a number of anthropogenic changes, including altered flows, environmental contaminants, and invasive species that have degraded the ecosystem. Managers and policymakers require scientific information to prevent the decline of critical species such as salmon, which are a valued tribal trust species; to manage ecological flows in this engineered river system; and to reduce risks from habitat degradation, changes in species composition, and climate change. With the proposed increase, the USGS would enhance documentation of the life history, habitat requirement, and population status and trends of forage fish, critical as a food source to other species, supporting fish, bird and mammals. The USGS would address invasive species, related climate impacts, chemical and physical habitat degradation, and effects on economic and trust species. USGS scientists would conduct research on the effect of altered flow regimes due to climate change and dam operations on habitats. A new Columbia River Treaty with Canada, which would take effect in 2025, could potentially affect flow regimes. USGS researchers would characterize ecological tradeoffs related to alternative flow regimes, as they affect physical habitat features, food webs, and ecological interactions influencing the sustainability of salmon, sturgeon, and other key species populations. The research results would help decision makers address flow regimes as required by the treaty. The USGS

would combine data acquisition efforts with the Science Application for Risk Reduction (SAFRR) project to better leverage multiple science uses for high-resolution lidar data over ecosystem and natural hazard projects in the Columbia River area. The SAFRR develops natural hazard disaster scenarios as a strategy to increase community resilience or a community's ability to cope with the effects of a disaster.

Puget Sound **(+$1,050,000/+2 FTE)**

Environments	(+$400,000/+1 FTE)
Hydrologic Research and Development	(+$200,000/+1 FTE)
National Geospatial Program	(+$450,000/0 FTE)

Puget Sound, the second largest estuary in the United States, provides diverse benefits to a growing regional human population. It provides a home, recreation, and economic opportunity to millions of people. The Sound is a natural resource treasure, supporting hundreds of species of fish, sea birds, and marine mammals, many of which are of enormous economic and cultural importance to the region. Human development and land use changes will likely affect the future sustainability of the Sound, particularly watershed and shoreline alterations that are likely to reduce critical habitat for species and reduce water quality. More than 20 Native American tribes are protected in perpetuity in their uses of salmon. However, salmon are in decline due to reductions in habitat quantity and quality. The USGS is providing critical science to a major ecosystem restoration effort involving tribal, local, State, and Federal entities. The proposed increase in 2015 would support managers and decisionmakers by developing process-based monitoring and models at the ecosystem scale to identify and address risks to salmon. These models, based on current and historic monitoring, help decisionmakers identify the key species and processes in the ecosystem for appropriate protections, controls, and monitoring. In addition, the USGS would investigate the status of forage fish populations—some of which are in decline—and identify linkages between population dynamics, bioenergetics, predation, habitat alterations, disease, and food availability. In support of the restoration, this work would result in new molecular tools and sampling methods. The USGS would combine data acquisition efforts with the SAFRR project to better leverage multiple science uses for high-resolution lidar data over ecosystem and natural hazard project in the Puget Sound area. Finally, the recent removal of two major dams on the Elwha River is one of the largest river restoration projects in history, requiring active management of former submerged reservoir lands; use of hatcheries to supplement wild fish populations; and monitoring of specific aquatic, terrestrial, and near-shore marine responses of the ecosystem. USGS science would provide managers with information on ecosystem responses to specific post-removal restoration actions to ensure that restoration is effective.

Upper Mississippi River **(+$200,000/+2 FTE)**

National Water Quality Assessment

This initiative builds on ongoing USGS activities in the Upper Mississippi River Basin (Basin). With this increase, the USGS will be able to perform more data collection and interpretative studies on water quality in the Upper Mississippi Region. The Basin contains a wide diversity of landscape types that include major agricultural operations headwaters with major urban landscapes. Both landscape types can have negative impacts on aquatic ecosystem health of the Mississippi River and connecting rivers downstream resulting in maintaining or expanding hypoxia conditions in the Gulf of Mexico. Existing

USGS programs in this region are developing a better understanding of water resources through critical streamflow measurement stations that characterize water quality. The USGS has been collecting samples of contaminants of emerging concern and learning about the potential effects of these contaminants on aquatic organisms living in the streams and rivers. Data collections and interpretive studies addressing water quality concerns are shared with State and local partners in this five State region (Minnesota, Wisconsin, Illinois, Iowa and Missouri).

Overview – Invasive Species

Nonindigenous invasive plants and animals cause significant economic losses and diminishing opportunities for beneficial uses of forests, croplands, rangelands, and aquatic resources. Costly effects include clogging of water facilities and waterways, wildlife and human disease transmission, threats to commercial, native, and farmed fisheries and increased fire vulnerability and adverse effects for ranchers and farmers. Across the Nation, the USGS partners with States, tribes, other Federal agencies, businesses, agriculture, natural resource managers, and the private sector to help solve problems posed by all significant groups of invasive organisms in terrestrial and aquatic ecosystems.

Increases in 2015, support research and development efforts focused on the brown tree snakes in Guam, invasive plants and animals in the Everglades, Asian carp in the Great Lakes and Upper Mississippi, and new and emerging invasive species of national concern.

Program Performance

Brown Tree Snakes – Detection and Control

Invasive Species (+$500,000/0 FTE)

Shortly after World War II, the brown tree snake (BTS) was transported from its native range in the South Pacific to Guam accidentally. Because of abundant prey on Guam and the absence of natural predators and other population controls, BTS populations reached extraordinarily high numbers. Snakes have caused the extinction of most of the native forest vertebrate species; thousands of power outages affecting private, commercial, and military activities; and widespread loss of domestic birds and pets. The highest priority needs for control and management of BTS are the development of landscape-scale methods to suppress or eradicate snakes on Guam, and to detect and eradicate incipient populations of snakes accidentally transported to other islands such as Hawaii and the Northern Mariana Islands. The military expansion on Guam will raise the profile of these issues because military construction will result in mitigation actions that include snake suppression in areas of high ecological value, and because increased military cargo transport and off-Guam training exercises will increase the odds of transporting snakes to other islands, such as Hawaii. With the increased funding, the USGS would focus on high-priority research to validate the efficacy of aerially-delivered toxicants for snake control at landscape-scales; predict the results of snake suppression on Guam and the increase of potentially problematic species (such as non-native rats); increase the number of trained snake rapid responders in Hawaii and other islands at risk of receiving BTS transported from Guam; and conduct a thorough assessment of the possibility that

scattered reports of snakes sighted in the U.S. Commonwealth of the Northern Mariana Islands represent an established population.

Everglades **(+$1,000,000/+2 FTE)**

Invasive Species (+$1,000,000/+2 FTE)

The USGS conducts research to fill key science information gaps and to assist in the sustainable use, protection, and restoration of the South Florida ecosystem through partnering with the Comprehensive Everglades Restoration Plan (CERP) and the South Florida Ecosystem Restoration Task Force (SFERTF). South Florida is particularly vulnerable to the introduction and spread of invasive plants and animals and is highly colonized by a wide variety of exotic species such as water hyacinth, melaleuca, old world climbing fern, and the Burmese python. The SFERTF recognizes the challenges that invasive species pose to the success of overarching ecosystem restoration efforts. Funding will support high priority research needs identified by the interagency invasive species working group of the SFERTF including quantifying ecosystem effects of invasive species to assist partnering agencies in deciding where best to allocate management and control efforts; filling key biological and ecological information gaps of invasive species to better inform early detection efforts of partnering agencies; and to improve methods to better detect and control species such as Burmese pythons for which ecosystem effects have been documented. The results and methodologies would be provided to resource and land managers for use in controlling the spread of invasive species.

Great Lakes – Asian Carp **(+$1,000,000/+4 FTE)**

Invasive Species (+$1,000,000/+4 FTE)

In 2009, the Administration established the Asian Carp Regional Coordinating Committee (ACRCC), a group of Federal, State, and local agencies and other private stakeholder entities, to protect and maintain the integrity and safety of the Great Lakes ecosystem from an Asian carp invasion. As a charter member of this group, the USGS has been conducting research to provide critical information to the ACRCC since 2010. Funding would augment ongoing research described in the ACRCC's annual Asian Carp Control Strategy Framework. This research focuses on providing scientific information and methodologies to better prevent, detect, and control Asian carp. Specific research activities include developing methods for the oral delivery of registered fish toxicants; identifying and developing attractant pheromones and food lures to aid in targeted removal of Asian carp from infested waters; and testing seismic technology as a means to affect the distribution of Asian carp and to restrict their passage through lock and dam structures. The proposed increase would allow the USGS to broaden research capacity and accelerate from "proof of concept" stage to transferring technology to resource managers for field use, and address research needs identified for managing grass carp.

Upper Mississippi River – Asian Carp (+$1,000,000/+2 FTE)

Invasive Species (+$1,000,000/+2 FTE)

Funding would support new research addressing needs identified for the Upper Mississippi River System (UMRS) in the 2007 "Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States," in the "2011 Asian Carp Action Plan," developed by the Minnesota-Wisconsin Asian Carp Task Force, and the ACRCC's annual Asian Carp Control Strategy Framework. The increase would allow the USGS to increase research capacity, augment ongoing efforts initiated in 2013, and target high priority research gaps identified in these collaborative planning efforts, including improving methods to detect Asian carp at low population levels, identifying habitats and locations most vulnerable to colonization by these invasive fishes, and improving methods for containment and control of Asian carp in UMRS habitats.

New and Emerging Invasive Species of National Concern

Invasive Species (+$1,000,000/+4 FTE)

The introduction, establishment, and spread of invasive species will be important drivers of biodiversity loss over the next century and will pose substantial risks to native species, valued ecosystem services, and human and wildlife health. Ongoing global changes such as more-frequent transcontinental and transoceanic trade and tourism, land and water use changes, and climate change are facilitating ever-faster rates of establishment and spread of harmful, invasive plant and animal species around the world. Challenges for scientists will be to determine which newly established nonnative species might cause significant impacts and become high priority invaders, and accurately estimate their potential spread throughout the country. While many invaders come without noticeable impact, causing little or no observed change in the invaded ecosystem, a small percentage of species that become established alter ecosystem structure and function in detectible and deleterious ways. The USGS has gained an understanding of the qualities and characteristics to help identify the next generation of invaders—hopefully in time to take action to prevent large-scale landscape changes like those caused by invasive cheatgrass, which have changed fire dynamics in ecosystems in the Western United States. USGS research on current high priority invasive species such as tamarisk in the Southwest, nutria in the Gulf of Mexico, Burmese pythons in the Everglades, and Asian carp in the Mississippi River Basin provides information to identify the next generation of invaders and to forecast their impacts. Assessing the factors influencing known invasions improves the national ability to predict invasions and to take preventative measures early enough to better address new invasive species.

This increase would allow investigation of the relationship between landscape-scale alterations such as dams and canals, drought, climate change, hurricanes and invasive species, and enhance the ability to improve predictive tools. The USGS would develop models, decision tools, and other approaches to predict geographic distribution of invasive species based on parameters such as temperature, precipitation, elevation, and vegetation. These models would provide screening tools to focus early detection efforts by predicting potential range and resulting distribution. The USGS would also enhance efforts focused on the development, evaluation, and improvement of capabilities for early detection and control of existing

and emerging high profile invasive species. The USGS would utilize advanced molecular detection tools (such as eDNA) to detect invasive species at very low densities in the field. These USGS research endeavors would provide information for assessments of risk and predictions; determine effects of invasive species; develop tools and innovative methods for control and management; and deliver information management tools to more effectively integrate and utilize available data on invasive species. The end result is a greatly enhanced capability for early detection and control of currently established and emerging invasive species and to ensure that the Nation is better prepared for the next—yet unknown—generation of invasive species.

Overview – Ecosystem Services

Agencies have multiple sources of information from monitoring and assessment programs, but need a formal mechanism or capability to routinely integrate these sources of information into assessment products for land and resource management of environmental benefits. Land and resource management agencies are increasingly being called upon to understand the effects of their actions in an economic context, and the tools must be well developed to achieve a comprehensive understanding of the effects of their actions on the value of the environment. A better understanding is needed of the environment's ability to sustain the multiple requirements for resource development, extraction and use, and to assess the value of the tradeoffs that inevitably occur as decisions are made.

Program Performance

National Ecosystem Services Framework (+$1,000,000/+1 FTE)

Environments (+$1,000,000/+1 FTE)

As part of a multiagency assessment of biodiversity and ecosystem services trends, USGS would evaluate data, information, methods, and tools that could contribute to the identification, assessment, valuation and use of ecosystem services for particular policy and management scenarios. The 2015 increase will enable the USGS to assess gaps in information; develop and test protocols for integrating interagency information in assessment; develop interagency practices for implementation of this information in natural resource decision-making, and work in an interagency context to develop assessments. This activity contributes to the goals of the Committee on Environment, Natural Resources and Sustainability's Subcommittee on Ecological Systems and other cross-government efforts to develop policy-relevant information on ecosystem services for Federal decision-making.

Sustaining Environmental Capital (+$1,000,000/+2 FTE)

Environments (+$1,000,000/+2 FTE)

The USGS, working with management agencies on current management decisions, will develop, integrate and enhance tools to value environmental benefits and predict changes that result from management options. The increase will enable the USGS ultimately to build standard methods and a national capability

to value ecosystem services. The increase will enable the USGS to assess trends in ecosystem services, and provide ecosystem service information to a broad network of resource managers for decision-making. The USGS would determine the conditions under which these methods can be used as standard methods, and the applicability of these methods to various geographic areas.

EcoINFORMA **(+$800,000/0 FTE)**

Science Synthesis, Analysis, and Research (+$800,000/0 FTE)

The President's Council on Science and Technology Advisors (PCAST) report, "Sustaining Environmental Capital: Protecting Society and the Economy" recommended a series of Federal actions including the Econinformatics-based Open Resources and Machine Accessibility (EcoINFORMA) initiative to enable integration and use of current knowledge to inform decisions. EcoINFORMA improves and expands Federal and non-Federal biodiversity, ecosystem, and ecosystem-service information access, data exploration, availability, and interoperability for decisionmakers. EcoINFORMA facilitates cost savings by providing ready access to data, improved applications and availability, and useful tools to resource managers and decisionmakers. Integration of essential partner data in EcoINFORMA (e.g., NPS, BLM, EPA, VegBank, etc.), will substantially expand the amount of data available in EcoINFORMA to inform climate change and provide landscape understanding.

In 2013, the USGS implemented recommendations in the PCAST report, including the development of the EcoINFORMA Implementation Blueprint. The Blueprint calls for implementation of resource hubs supported by existing communities of practice that improve data standards, interoperability, and ecosystems data reuse. In 2013, two hubs were established and a third hub was proposed: (1) the biodiversity resources hub that leverages the USGS BISON program (Biodiversity Information Serving Our Nation); (2) the ecosystem hub that powers the Environmental Protection Agency's EnviroAtlas; and (3) the Multi-Resolution Land Characteristics Consortium that support the land cover dynamics resource hub.

In 2014, the USGS continues to implement the EcoINFORMA Implementation Blueprint by initiating Ecosystems.data.gov as the public presence for EcoINFORMA. To advance the EcoINFORMA biodiversity hub, the USGS is expanding the data fields, providing greater discoverability and documentation of the data; integrating the ability to overlay base layers to better understand occurrence data (e.g., why species may be present or absent in a particular location); and to develop application programming interfaces (APIs) that allow direct access to BISON data regardless of a user's technical knowledge.

In 2015, the USGS requests an additional $0.8 million to continue implementing the PCAST report recommendations. The USGS would advance implementation of the EcoINFORMA biodiversity hub and support priorities such as: Ecosystems.data.gov; building communities to support the EcoINFORMA hubs; and developing standards and policy to allow interoperability among hubs. For example, the USGS would partner with BioEco (a working group on biodiversity and ecosystem) informatics to formalize rules for provision of data among Federal agencies, allowing more data to be added to the EcoINFORMA hubs.

Hydraulic Fracturing

Hydraulic Fracturing		2013 Actual	2014 Enacted	Program Changes	2015 Request	Change from 2014 Enacted (+/-)
Fisheries Program		108	108	2,200	2,308	+2,200
	FTE	1	1	10	11	+10
Energy Resources		5,850	5,850	950	6,800	+950
	FTE	29	29	1	30	+1
Contaminant Biology		145	145	1,400	1,545	+1,400
	FTE	1	1	5	6	+5
Toxic Substances Hydrology		450	541	0	541	0
	FTE	2	3	0	3	0
Earthquake Hazards		800	1,800	700	2,500	+700
	FTE	2	4	2	6	+2
Groundwater Resources		520	520	0	520	0
	FTE	1	1	0	1	0
Hydrologic Research & Development		1,300	1,300	901	2,201	+901
	FTE	1	1	2	3	+2
Science Synthesis, Analysis and Research Program		0	0	185	185	+185
	FTE	0	0	0	0	0
National Cooperative Geologic Mapping Program		0	0	2,000	2,000	+2,000
	FTE	0	0	0	0	0
Total Requirements ($000)		**9,173**	**10,264**	**8,336**	**18,600**	**+8,336**
	Total FTE	**37**	**40**	**20**	**60**	**20**

Justification of 2015 Program Changes

The 2015 budget request for hydraulic fracturing research is $18,600,000 and 60 FTE, a program increase of +$8,336,000 and +20 FTE above the 2014 Enacted level.

Overview

In 2012, the President issued an Executive Order (EO), “Supporting Safe and Responsible Development of Unconventional Domestic Natural Gas Resources,” as a component of the energy strategy. The goal of the EO is to ensure coordination among Federal agencies regarding natural gas development activities. In support of this effort, the Interior, Department of Energy (DOE), and the Environmental Protection Agency (EPA) signed a Memorandum of Agreement (MOA) formalizing a Multiagency Collaboration on Unconventional Oil and Gas (UOG) Research. This collaboration is aimed at improving the ability to understand and address potential environmental, human health, and safety impacts of hydraulic fracturing and associated operational activities. The three agencies are working together to engage other organizations involved in research on hydraulic fracturing in the pursuit of collaborative research opportunities. Through the MOA, the USGS is applying and building its research strengths with focused studies on resource characterization and assessments, water quality and availability, ecological effects, effects on people, and induced seismicity. The interagency collaboration is intended to build on the core capabilities of each agency in synergistic ways that lead to complementary work. To accomplish this, Interior, the DOE, and the EPA are developing a multi-year National Research Strategy designed to address the highest priority research questions, new and innovative technological opportunities, and

community concerns associated with safely and prudently developing resources through hydraulic fracturing. These topics include scale and nature of U.S. unconventional oil and gas resources; water quality; water availability; air quality and greenhouse gas emissions; effects on human health; ecological effects; and induced seismicity. In addition, the National Research Strategy identifies a set of six multidisciplinary, collaborative "Flagship Projects" to provide examples of potential research and deliverables for the multiagency collaboration outlined in the MOA. While the National Research Strategy identifies the highest priority projects for research, all of the research efforts depend on available funding at the EPA, the DOE, and Interior.

The development of oil and gas resources through hydraulic fracturing is playing an important and rapidly growing role in the domestic energy portfolio of the United States. Shale and other unconventional oil and gas formations are found throughout the United States beneath Federal, State, tribal and private lands. The development and extraction of unconventional oil and gas resources are accomplished through hydraulic fracturing, a technique that entails horizontal drilling, perforation of steel casing and cement grout using explosive charges, and expansion of fractures using fluids and propellants under high pressure.

While there are economic benefits associated with oil and gas production and industry has developed best management practices for well site activities, concerns remain about potential environmental, health, and safety impacts of hydraulic fracturing. A comprehensive understanding of these potential impacts will require a significant research effort, including baseline data collection across various geologic settings. Potential effects of hydraulic fracturing may include: (1) impacts to water resources, including the contamination of aquifers and surface waters from drilling and hydraulic fracturing chemicals; the cross-contamination of aquifers through faulty well construction and casing installation; the release of methane and other greenhouse gases into aquifers and the atmosphere; contamination from radioactive elements and other toxic chemicals in waters recovered during gas production; and the reduced availability of water, particularly in water-scarce areas; (2) landscape changes including soil erosion and habitat fragmentation; (3) generation of airborne pollutants; and (4) unintended seismic events from the subsurface injection disposal of recovered hydraulic fracturing and rock formation fluids. Singly or in combination, these potential effects might result in harmful impacts on human health or on terrestrial and aquatic wildlife and ecosystems.

Program Performance

Hydraulic Fracturing	**(+$8,336,000/+20 FTE)**
Fisheries	(+$2,200,000/+10 FTE)
Energy Resources Program	(+$950,000/+1 FTE)
Contaminants Biology	(+$1,400,000/+5 FTE)
Earthquake Hazards Program	(+$700,000/+2 FTE)
Hydrologic Research and Development	(+$901,000/+2 FTE)
Science Synthesis, Analysis, and Research	(+$185,000/0 FTE)
National Cooperative Geological Mapping Program	(+$2,000,000/0 FTE)

The 2015 President's budget request supports this collaborative interagency research and development effort by the USGS, the DOE, and the EPA to conduct a national science, research, and development program aimed at understanding and reducing the potential environmental, health, and safety impacts of hydraulically fractured oil and gas resources and to address the most urgent questions and decision-support needs surrounding hydraulic fracturing. Through this effort, the three agencies are building upon current work and collaboratively identifying and coordinating new priority research and development activities that support sound management and policy decisions by Federal, State, tribal, and local entities. The goal is to produce decision-ready information to ensure the prudent development of energy resources and the protection of human health and the environment.

In 2014, USGS research efforts are focused on a number of activities including resource characterization and assessments, water quality and availability, ecological impacts, effects on people, and induced seismicity. The USGS conducted research and assessments of undiscovered, technically recoverable unconventional oil and gas resources for high-priority shale and tight gas basins. It is important to understand where these resources are located, and what their potential volumes and physical character are, so as to understand where production might occur, and to understand potential environmental impacts should development commence.

Also in 2014, the USGS will continue or initiate selected monitoring and research efforts directed toward understanding potential effects of unconventional oil and gas production on water resources. Baseline monitoring of groundwater was conducted in a number of States, notably in Arkansas, where hydraulic fracturing is underway, and in New York, where baseline studies are underway before drilling takes place to look at ambient groundwater conditions. Surface water monitoring will continue to be conducted in Pennsylvania, Utah and New York, among other areas. The USGS will continue to conduct studies of produced waters to characterize the geochemical nature of these fluids, including the occurrence of naturally occurring radioactive materials contained within the waters, which provides important baseline information as well as information for the proper disposal methods. The USGS will continue to work collaboratively with the EPA and others to develop appropriate groundwater sampling protocols in regions subject to hydraulic fracturing. New laboratory methods for analysis of flowback and produced waters were developed collaboratively with the EPA. A USGS-wide effort to compile water quality data extending back more than 60 years is scheduled to be completed in 2014, potentially leading to a better understanding of water quality trends in relation to unconventional oil and gas development. A compilation of national water quality databases associated with unconventional oil and gas production is continuing in 2014. In addition, the USGS has expanded seismic networks into areas of suspected induced seismicity and continues to publish studies on the occurrence of, and potential for, earthquakes triggered by the injection disposal of hydraulic fracturing flowback fluids and produced formation fluids into deep rock formations. A number of reports on the impact of shale gas development activities on land use change were published in 2013. In 2014, the USGS will collect seasonal baseline and post-development data to monitor and model the effects of shale gas development on wildlife and aquatic species and ecosystem integrity.

Resource assessments provide critical evaluations of where future energy development might take place, or equally important, where it is unlikely to take place. The USGS is the sole provider of publicly available estimates of undiscovered, technically recoverable unconventional oil and gas resources of

onshore lands and offshore State waters. In 2015, a portion of the requested new funding would allow the USGS to begin an assessment of the size and location of hydraulically fractured oil and gas resources in a new basin such as assessments underway in the Barnett Shale and Green River Shale. Geologic mapping conducted by the USGS would support research on the geological parameters of unconventional oil and gas basins under current or near-term development.

The development and extraction of shale gas and other unconventional oil and gas resources require large quantities of water for hydraulic fracturing and produce large volumes of fluids during flowback and production. In 2015, a portion of the requested funding increase would be used for water availability studies to: (1) assess the water needs associated with unconventional oil and gas development; (2) evaluate the volumes of water resources needed for use in tight oil development; and (3) characterize flowback fluids and brines from hydraulically fractured wells, which would be important to identify and track potential contamination. The USGS would also conduct studies that address the identification of alternative sources of water used for hydraulic fracturing to replace the use of scarce fresh water sources. In addition, the USGS would address water availability through the development of groundwater flow and transport models in selected case study areas. These models would be used to understand the effects of withdrawals whether water would be used for hydraulic fracturing operations or produced waters, on basinwide water availability.

In 2015, the USGS would use a portion of the requested funding to expand baseline surface water and groundwater quality monitoring. The USGS would support the continued development of analytical methods for the detection of contaminants associated with produced and flowback waters in the environment, including an enhancement of methods for sampling and measuring methane. This would include enhanced methods for monitoring and characterization of “stray gas.” The USGS would support research on the development of geochemical methods and groundwater flow models used to determine if hydrofracture fluids and other drilling materials are contaminating water supplies. These tools and monitoring data would enable assessments and prioritization of key human and ecological exposure pathways associated with natural or anthropogenic contaminants created and mobilized throughout the life cycle of hydraulic fracturing activities.

Additionally, the USGS would develop new methods to detect and understand the mobilization and occurrence of naturally-occurring contaminants resulting from hydraulic fracturing. The USGS will work with EPA and other partners at prospective sites as part of the EPA Drinking Water Program to assess potential groundwater and surface water contaminants associated with hydraulic fracturing operations. A new research project on environmental contaminants potentially associated with hydraulic fracturing has begun in 2014, and will continue in 2015. Specifically, the USGS will investigate the role of bacteria in natural attenuation of organic compounds in wastewaters from unconventional oil and gas (hydraulic fracturing flowback and produced waters) as well as the potential for adverse impacts on microbial communities. In addition, the USGS will assess soils and streambed sediments for contamination where UOG wastewaters are land applied and will begin working on new analytical methods to detect a range of chemicals known, or suspected to be, associated with these wastewaters.

In 2015, the USGS would support research that assesses potential ecological impacts associated with unconventional oil and gas development. The ecological effects research will continue to implement the

Flagship project outlined in the Federal Multiagency Collaboration on Unconventional Oil and Gas Research strategy. This flagship focuses on the assessment of potential ecological impacts of wastewater and water withdrawal associated with unconventional oil and gas development. This research includes acute and chronic toxicity impacts, toxicity mechanisms and pathways and the cumulative impacts and risks at the landscape scale. Coordinated efforts are being made with the DOE and the EPA to collect both ecological and human health data at selected monitoring sites when possible.

The USGS continues its research and assessments studies of injection-induced earthquakes and the risks are primarily associated with wastewater disposal using deep well injection. The work combines analysis of earthquake sources with related geologic data to determine those factors that affect induced seismicity from subsurface disposal of fluids. This information could be used to guide changes to disposal operations, such as by adding new wells or changing injection parameters. Cataloging the presence or absence of earthquakes induced by injection activities is already yielding critical information on the regions and conditions that are favorable for induced seismicity. This information is being combined with probabilistic seismic hazard analysis to assess the hazard and risk of damaging earthquakes.

In 2013 and 2014, the USGS has responded to significant increases in earthquake rates in Oklahoma, Kansas, and Texas, accompanied by moderate-magnitude, lightly damaging earthquakes. In the 2014 enacted appropriation, Congress included an additional $1.0 million for earthquake assessments. This funding is being used to develop methods to forecast whether or not a particular type of injection operation in a specified geologic setting would be likely to induce or trigger earthquakes, to perform comprehensive studies at two carefully selected field sites, and to establish procedures to adapt the USGS National Seismic Hazard Maps to take account of the additional hazard due to earthquakes associated with the production of oil and gas. In 2015, the proposed expansion of work on induced seismicity will allow the USGS to expand the number of sites that are monitored and assessed in detail. Because the phenomenon of earthquake triggering by fluid injection is relevant to several energy-sector technologies of national interest, such as enhanced geothermal and carbon sequestration, expanded USGS efforts could include targeted research at one or more injection sites in those technology areas.

The USGS would emphasize products that contain decision-ready information. Deliverables would include new assessments of undiscovered technically recoverable unconventional oil and gas resources to inform the public about the magnitude and location of potential future production and its associated impacts. These and other assessments would form a foundation for planning where and what kind of additional studies are needed, such as those involving water quality and quantity, potential ecological impacts, and induced seismicity. Three-dimensional geologic mapping and a better understanding of rock structures form the basis to characterize the hydro-geologic framework used to understand impacts. Results of water budget analyses and water requirements for unconventional oil and gas development would help water managers better utilize existing water resources and protect scarce potable resources. Maps and databases showing the occurrence and distribution of naturally occurring radioactive elements would be used to inform water disposal management in a way that reduces or eliminates the potential for buildup of radiation to dangerous levels. Data and reports that characterize baseline surface water and groundwater quantity and quality of selected sites would be produced. These assessments would provide the information needed to determine pathways of human and ecological exposures to natural and anthropogenic contaminants associated with hydraulic fracturing activities.

The USGS plans to release reports describing the factors controlling the occurrence of earthquakes due to fluid injection activities to inform both Federal and State agencies that permit the injections and the industry operators who wish to minimize the risk of damaging earthquakes. The USGS would produce updated probabilistic seismic hazard maps that incorporate the contribution from injection induced seismicity, so that building codes (which reflect long-term hazard) can appropriately account for the local or regional effects of induced earthquakes. Finally, the USGS would plan to release reports and other publications that outline effects of hydraulic fracturing and associated activities on terrestrial and aquatic species and create decision support systems that would help avoid or minimize ecological impacts associated with hydraulic fracturing.

Water Challenges: WaterSMART

WaterSMART		2013 Actual	2014 Enacted	Program Changes	2015 Request	Change from 2014 Enacted (+/-)
Fisheries Program		466	466	0	466	0
	FTE	0	0	0	0	0
Land Change Science		514	514	0	514	0
	FTE	0	0	0	0	0
Groundwater Resources		2,645	2,645	2,400	5,045	+2.400
	FTE	0	0	9	9	+9
Hydrologic Networks & Analysis		4,427	4,427	2,000	6,427	+2,000
	FTE	3	3	1	4	+1
Cooperative Water Program		0	0	2,000	2,000	+2,000
	FTE	0	0	1	1	+1
Total Requirements ($000)		**8,052**	**8,052**	**6,400**	**14,452**	**+6,400**
	Total FTE	**3**	**3**	**11**	**14**	**+11**

Justification of 2015 Program Changes

The 2015 budget request for the USGS's WaterSMART Availability and Use Assessment initiative is $14,452,000 and 14 FTE, a program increase of +$6,400,000 and +11 FTE above the 2014 Enacted level.

Overview

As competition for water resources grows for irrigation of crops, for serving cities and communities, for energy production, and for the environment, the need for information and tools to aid water and natural resource managers grows. WaterSMART is a Department of the Interior initiative that leverages and directs existing expertise and resources within the USGS and the Bureau of Reclamation toward addressing complex, national- and regional-scale water challenges. Primary focuses of the WaterSMART initiative include developing a national water census, better understanding water budgets, and supporting ecologically-sound water management. Leveraging expertise across multiple disciplines enables a broader focus to address these challenging issues in a time of growing competition for water resources. The USGS possesses both the skills and foundational resources to unlock this knowledge and provide water resource, ecosystem, and land use managers the decision support tools to make decisions that are more informed. The goal of this initiative is to improve the understanding of groundwater and human water use and the ways in which they influence water availability. USGS expertise in understanding the hydrologic cycle effects on water, human water use, and the ways in which water quality and quantity affect the natural environment is critical to addressing this issue. The Nation will be well served through this effort, by gaining the ability to balance water resource sustainability through consideration of water quantity, quality, and uses, including ecological uses.

Program Performance

National Groundwater Monitoring Network (+$2,400,000/+9 FTE)

Groundwater Resources (+$2,400,000/+9 FTE)

Current USGS water-level networks do not provide adequate spatial or temporal monitoring for all the Nation's major aquifers, which is critical information for determining availability. To address this national need, a framework was developed for a National Groundwater Monitoring Network (NGWMN) in response to the SECURE Water Act (P.L. 111-11) Section 9507(b) to provide a systematic groundwater monitoring program for each aquifer system in the United States. To date, the Advisory Committee on Water Information (ACWI) Subcommittee on Groundwater (SOGW), through a successful pilot program and a pilot information portal developed by the USGS Groundwater Resources Program, demonstrated that a collaborative NGWMN can be successfully implemented by taking advantage of existing monitoring done by Federal, State, tribal and local agencies *(http://acwi.gov/sogw/*). The DOI, in consultation with the ACWI, identified the USGS as the Federal agency needed to manage this collaborative NGWMN. In 2015, the USGS will begin implementation of the NGWMN as outlined in the SOGW report, "A National Framework for Ground-Water Monitoring in the United States" (*http://acwi.gov/sogw/ngwmn_framework_report_july2013.pdf*), which calls for selecting a NGWMN advisory group, soliciting additional Federal, State and local data providers, and funding operation of data portal and collection at NGWMN backbone sites managed by Federal and non-Federal NGWMN partners.

Water Use Research (+$2,000,000/+10 FTE)

Cooperative Water Program (+$2,000,000/+1 FTE)

Water use information that identifies the impacts of human water withdrawals and return-flows is critical for WaterSMART's water budget analysis. This information, which is mostly collected at State, tribal, regional, and local governmental levels, must be obtained on a site-specific scale in order to be fully useful in WaterSMART analyses. Directed work is required to develop better methods of sampling, estimating, aggregating, and presenting water use data. This includes research into new methods that use remote sensing and spatial datasets in water use estimation. The research and networks and analysis functions of the USGS would work together to advance the development of those methods for use within the WaterSMART initiative. In addition, the Cooperative Water Program would work directly with State, tribal, regional, and local cooperators to make maximum use of their water use datasets in the water availability and use assessment. The USGS would integrate this information with decision-support tools that facilitate use of that information in a manner that is relevant to water resource management decisionmaking.

Cooperative Water Program monitoring, assessments, and research will continue and expand related to WaterSMART and its efforts on water use. Additional focus will be placed on tracking site-specific, public-supply and other water use information; developing consumptive use measurements and methodology (particularly associated with irrigated agriculture); assessing watershed water budgets

(including developing estimates for streamflow at ungaged sites for more accurate water budgets); developing water use/budget models to track long-term patterns in groundwater and surface water flow; and advancing evapotranspiration measurements and assessment techniques.

As with all Cooperative Water Program efforts, appropriated funds could be leveraged by non-Federal partners who are interested in and willing to further these objectives.

State Water Use Grants **(+$2,000,000/+1 FTE)**

Hydrologic Networks and Analyses (+$2,000,000/+1 FTE)

Water managers across the United States require more complete, timely, and accurate water availability information to support decision making. Data concerning water withdrawals and consumptive use needs improvement, as decisionmakers require accurate water use data to establish local and regional water budgets. State water resource agencies are vital entities and primarily responsible for collecting data on water supplies, water allocations and water rights. Water budgets, which account for the water inputs, outputs and changes in storage within a watershed, have been widely referred to as the foundation for effective water resources management. This initiative will provide financial resources, through grants to State water resource agencies, to improve the availability and quality of water use data that they collect and will integrate that data with the USGS Water Census.

Currently, the only Federal agency that explicitly collects water use data as a part of its mission is the USGS, through its National Water Use Information Program (NWUIP). The NWUIP works with State, local, and Federal partners to consolidate dozens of disparate data sets in order to create comprehensive reports of water use in the United States every five years. Because of the large differences in methodology and quality control in State programs to collect water use data, these reports require significant effort to standardize (to the extent possible) such data between States. The NWUIP products largely form the basis of the water use portion of the Water Census as created by the SECURE Water Act. Recognizing the limitations of current water use data, the Act authorized a grants program to support State data collection to improve water use data sets and share them with NWUIP.

The initiative will provide the budget resources to implement this part of the Act. Funding provided to States through these grants would be targeted at improvements to water use data collection and integration that will be of the greatest benefit to a national assessment of water availability and use. The USGS will work with State stakeholders to develop and implement this grants program in a fashion easily accomplished through existing grant mechanisms and in a way that is most beneficial to the common goal of understanding water availability at the State and national scales.

Data Innovation and Mapping

Data Innovation and Mapping						
		2013 Actual	2014 Enacted	Program Changes	2015 Request	Change from 2014 Enacted (+/-)
National Geospatial Program		13,621	14,376	5,236	19,612	+5,236
	FTE	59	59	0	59	0
Total Requirements ($000)		**13,621**	**14,376**	**5,236**	**19,612**	**+5,236**
	Total FTE	**59**	**59**	**0**	**59**	**0**

Justification of 2015 Program Changes

The 2015 budget request for the Data Innovation and Mapping initiative is $19,612,000 and 59 FTE, a program increase of +$5,236,000 and 0 FTE above the 2014 Enacted level.

Overview

The 3D Elevation Program (3DEP) initiative responds to growing needs for high-quality and high resolution topographic data to capture change in the Nation's natural and constructed features. New and accurate data is constantly in demand to improve aviation safety; understand and mitigate the negative effects of coastal erosion and storm surges; provide infrastructure for Arctic shipping and resource extraction; and protect biodiversity and habitats. The 3DEP initiative will systematically collect enhanced elevation data using lidar (light detection and ranging) and other technologies over the United States. A 2012 study funded by the USGS and partners identified 602 mission-critical activities of 34 Federal agencies; the 50 States; and selected local and tribal government, private, and other organizations. A fully funded and implemented multiagency 3DEP will acquire national coverage during an eight-year period, and would provide more than $690 million annually in new benefits to the public and private sectors and citizens. The National Geospatial Advisory Committee, the National States Geographic Information Council, the Association of State Floodplain Managers, the Association of American State Geologists, and the Management Association for Private Photogrammetric Surveyors endorsed the 3DEP plan. Interior, staffed by the National Geospatial Program, is organizing an interagency 3DEP Executive Forum to identify interagency funding strategies and coordinate Federal activities.

The NGP is working with the State of Alaska and Federal partners to replace the more than half-century-old topographic maps for Alaska. The NGP and its partners have developed a five-year plan (2013-2018) to acquire data to remap the State, with an emphasis on replacing lower-quality elevation data for the State using newer interferometric synthetic aperture radar (ifsar) technology. Unlike conventional technology, ifsar allows elevation data to be collected in challenging conditions including cloud cover, which is common in Alaska. The Alaska Mapping initiative is a combined Federal, State, local, and tribal program to support and improve maps and digital map data for Alaska, bringing Alaska topographic maps and digital map data quality in line with the rest of the United States.

The USGS is currently inventorying lidar data that is now publicly available, developing a process for unified Federal and State partner data acquisition, refining data specifications, organizing executive- and operational-level governance, and publishing the 3DEP implementation plan.

The Alaska Mapping initiative is improving the currency and accuracy of topographic data including elevation and hydrography and other datasets. New 1:25,000-scale maps are being produced to replace the 1:63,000-scale maps which were as much as 50 years old. The USGS has generated the first 400 of 11,273 new US Topo maps for Alaska, and in 2014, the USGS will generate 718 more. In 2014, the USGS will increase ifsar acquisition by over 5,000 square miles.

Program Performance

3D Elevation Program

National Geospatial Program (+$5,000,000/0 FTE)

The USGS plans to finalize the 3DEP implementation plan by January 2015. The proposed funding would increase data acquisition by 15,000 square miles (approximately a tenth of the area of California) and would support development efforts to process and serve lidar and derived elevation data. The percentage of the Nation (excluding Alaska) published as enhanced elevation data would increase to seven percent, an increase of two percent to the 2014 coverage. (See “Alaska Mapping” for a discussion of coverage for that State.)

Alaska Mapping

National Geospatial Program (+$236,000/0 FTE)

In 2015, the proposed increase would boost ifsar acquisition by approximately 10,000 square miles annually. The percentage of Alaska published as high resolution elevation data would be 48 percent, an increase of five percent to 2014 coverage. Map production will increase 50 percent from 2014 levels to approximately 1,100 maps.

Environmental Impacts of Uranium Mining

Environmental Impacts of Uranium Mining		2013 Actual	2014 Enacted	Program Changes	2015 Request	Change from 2014 Enacted (+/-)
Contaminant Biology		50	50	673	723	+673
	FTE	0	0	3	3	+3
Toxic Substance Hydrology		100	100	2,500	2,600	+2,500
	FTE	0	0	9	9	+9
Total Requirements ($000)		**150**	**150**	**3,173**	**3,323**	**+3,173**
	Total FTE	**0**	**0**	**12**	**12**	**+12**

Justification of 2015 Program Changes

The 2015 budget request for the Environmental Impacts of Uranium Mining is $3,323,000 and 12 FTE, a program increase of $3,173,000 and 12 FTE above the 2014 Enacted level.

Overview

In January 2012, the Secretary of the Interior withdrew over one million acres of public lands in the Grand Canyon region from mining for 20 years under the Mining Law of 1872. However, even under the withdrawal, some mining will occur on valid existing claims. For example, the Canyon Mine (on U.S. Forest Service (USFS) lands south of the Grand Canyon) and the EZ Mine (on Bureau of Land Management (BLM) property north of the Grand Canyon) are expected to begin ore extraction in 2014 and 2016, respectively. A key factor in the Secretary's decision was a lack of scientific information. The USGS developed a 15-year science plan in collaboration with the BLM, National Park Service, U.S. Fish and Wildlife Service, and the USFS. The studies would provide critical information for future decisions on withdrawal of lands and help inform the development, mitigation, reclamation, and ecological restoration of mines on valid existing claims, as applicable.

Program Performance

Northern Arizona Uranium Mining Science +$3,173,000/+12 FTE

Toxic Substances Hydrology Program (+$2,500,000/+9 FTE)

The proposed increase would begin the implementation of the integrated 15-year science plan by collecting new baseline data, expanding smaller scale studies begun in previous years, and lay the foundation for future modeling and monitoring efforts. Work in 2015, would characterize the baseline conditions of soil, groundwater, and surface water at the Canyon and EZ Mine sites before ore extraction begins. This would be done in cooperation with agency partners and private mining companies, and would complement USGS work on Trust resources (animal and plant species) started at Canyon Mine in 2013. This baseline work is crucial for comparison after extraction occurs and enables understanding of

the extent of naturally occurring versus mine- related uranium and associated contaminants in soil, water, and biota.

In addition, work would begin to determine potential pathways of uranium exposure, such as movement through groundwater-flow paths, surface water, and wind dispersion. This includes continued and expanded monitoring of water quality and uranium levels in the Colorado River in the Grand Canyon, Kanab and Havasu Creeks, and other regional rivers, streams, intermittent washes, and springs. USGS researchers would analyze data continually in preparation for presenting an interim report at the end of the third year of the study that describes spatial and temporal patterns of uranium in soil and water samples, and includes regional exposure models that would shape subsequent research and monitoring components.

Contaminant Biology Program (+$673,000/+3 FTE)

The proposed increase would support characterization of baseline radiation and chemical concentrations in sentinel species (e.g., birds, mammals and reptiles) from samples obtained at targeted mine sites before ore extraction began. Biological surveys and samples were collected at the Kanab North Uranium Mine, Arizona Strip. Pre-mining species inventories (currently at 200 species) and sampling of those species was done in 2014. These foundational activities are necessary for measuring the environmental effects of mining uranium, and its associated release of radiation, beyond what is naturally occurring in this area of the country to determine whether those increases pose a risk to biota. In 2015, USGS would complete the uranium baseline assessment, analyzing the pre-mining background levels of uranium in dust water, and biota, and begin modeling the ‘natural’ transport and occurrence of uranium and radiation in native animals and plants. Post mining samples that parallel those collected pre-mining will be collected during uranium extraction at active mines. Results will be used to develop a modeling tool to assess ecosystem health before, during, and eventually after uranium extraction. The knowledge gained from these studies will be used for developing prevention and mitigation strategies to ensure that the health and sustainability of natural resources are balanced with economic development. This study will provide science needed by the Secretary of the Interior for making sound decisions regarding extraction activities on Federal lands.

Earth Scientists for Tomorrow

Justification of 2015 Program Changes

Earth Scientists for Tomorrow		2013 Actual	2014 Enacted	Program Changes	2015 Request	Change from 2014 Enacted (+/-)
Cooperative Research Units		0	0	1,000	1,000	+1,000
	FTE	0	0	6	6	+6
Administration and Management		1,602	1,602	1,700	3,302	+1,700
	FTE	0	0	2	2	+2
Total Requirements ($000)		**1,602**	**1,602**	**2,700**	**4,302**	**+2,700**
	Total FTE	**0**	**0**	**8**	**8**	**+8**

Justification of 2015 Program Changes

The 2015 budget request for the USGS's Earth Scientists for Tomorrow initiative is $4,302,000 and 8 FTE, a program increase of $2,700,000 and 8 FTE above the 2014 Enacted level.

Overview

The USGS has a proud history of mentoring and engaging the youth of our country. The USGS provides a broad array of research and learning experiences for young people in the Earth and biological sciences aimed at inspiring the pursuit of scientific careers and increasing science literacy. USGS engagement with youth covers a broad age range. Typically, outreach activities and science camps are aimed at elementary and secondary school students, while internship programs employ students in high school, undergraduate, and graduate school. The USGS engages and hires post graduate students that include 26-30 year old young scientists. A number of the youth employed by the USGS stay onboard while finishing their degrees.

The USGS's Youth Stewardship of Natural and Cultural Resources High Priority Performance Goal (HPPG) is an investment in the Nation's youth to develop the next generation of young scientists and Earth stewards, and provide opportunities to pass on institutional knowledge. Youth employment has proven to be an effective and economical means of helping accomplish the critical USGS science mission, and develop and mentor a cadre of young scientists through real-time work experiences. The USGS has expanded programs engaging youth in science, technology, engineering, and mathematics (STEM). In 2013 and 2014, USGS expanded education and internship programs for students underrepresented in STEM, tribal colleges, and veterans, as well as expanding partnerships in support of the 21st Century Conservation Service Corps (21CSC) in 2015. These examples highlight the USGS's unique role of working with a wide array of cooperators to bring world class Earth science to decisionmakers, communities, and schools.

As the Federal workforce faces the retirement eligibility of 53 percent of permanent full-time employees in 2014 (per OPM estimates), the USGS considers the development of a science workforce of tomorrow a

vital tool in succession planning, passing on institutional knowledge, and recruiting youth into federal services careers in earth sciences.

Program Performance

Cooperative Research Units Scientists for Tomorrow **(+$1,000,000/+6 FTE)**

Cooperative Research Units (+$1,000,000/+6 FTE)

The Cooperative Research Units (CRU) Program will use its existing cooperative network to work with Interior partners to improve and increase youth involvement in Interior science and resources management. The proposed increase would enhance opportunities to provide advanced scientific training and professional mentorship leading to Masters and PhD degrees to students underrepresented in the Nation's conservation workforce. Funding will focus on the training of students on contemporary research topics including the application of science and analytical tools for decisionmaking, energy development, fire ecology, ecosystem sustainability, threatened and endangered species, invasive species, and water quality and use. Funding also will assist in the career development of undergraduate students by providing additional experiential learning opportunities on research projects addressing priority information needs of State and Federal agencies. Student support includes safety training and equipment in addition to financial and research support. Implementation will be through enhancement of existing partnerships with universities and nongovernmental organizations (NGOs) serving Native American and Hispanic communities and other underrepresented groups. The Interior and other program partners will be fully engaged in this initiative, leveraging funding provided. The CRU has a record of accomplishment of approximately fivefold leveraging of each dollar appropriated to the program.

Youth and Education in Science **(+$1,000,000/+1 FTE)**

Administration and Management (+1,000,000/+1 FTE)

The program increases in 2015, would provide the USGS the opportunity to expand USGS education and internship programs for students underrepresented in STEM, tribal colleges, and veterans; and expand partnerships in support of the 21CSC, in line with the Youth Stewardship of Natural and Cultural Resources APG. The USGS would receive an increase of $1.0 million to establish the science component of the 21CSC. This science component, the 21st Century Conservation and Natural Resources Science Corps (Science Corps), would put young Americans to work for USGS science programs, providing science for decisionmaking in support of protecting, restoring, and enhancing public and tribal lands and waters. The USGS would engage other Interior bureaus, tribes, learning institutions and governmental and non-governmental organizations, to create partnerships and projects with the goal of developing the USGS's next generation of scientists. The USGS provides critical early science experiences through its education programs, resources for teachers, and research opportunities for students to work with USGS scientists.

Career pathways in conservation and natural resources science would be provided to 50 students from underrepresented groups, by coupling Science Corps internships with cooperative training programs at

two- and four-year colleges. This would help build upon and expand current hydrologic, biologic, and physical science technician programs with Gateway (Phoenix, AZ), Vermillion (Ely, MN), South Dakota, and Northern Virginia Community Colleges, and would be expanded to new minority-serving institutions and tribal colleges. The Science Corps would also provide internships, mentoring, and training in life skills, such as how to effectively apply to college, to approximately 50 urban high school youth by working with city governments, city schools, and inner city summer programs.

The development of a new general Science Corps program of approximately 100 undergraduate students would work with Interior bureaus and other partners, such as the National Science Foundation, University of Texas, and Environmental Stewards to create recruitment, hiring, and project placement processes that can be readily used by others. The students would work with USGS scientists and others on projects that support USGS mission goals. In addition, an effective, low cost evaluation methodology would be developed and implemented to ensure USGS youth programs are meeting goals, are based on best practices, and provide an evidence-based improvement process.

Mendenhall Research Fellowship Program **(+$500,000/+1 FTE)**

Administration and Management (+$500,000/+1 FTE)

The Mendenhall Research Fellowship Program is the flagship postdoctoral research program for the USGS. Established in 2001, this program has grown into one of the most prestigious and coveted postdoc programs in science. Through the Mendenhall Program, the USGS obtains the some of the best available new PhD talent to address the needs of its science mission. The increased funding will allow the USGS to increase the number of postdocs by a minimum of four, if only this funding is used, or perhaps as many as 8-10 if combined with a matching process with the science mission areas.

Outreach to Underserved Communities **(+$200,000/0 FTE)**

Administration and Management (+$200,000/0 FTE)

The USGS culture strongly supports mentoring students, promoting interest in science to a broad range of young people through varied experiences, and instilling a sense of stewardship for the Earth. These efforts are aligned with the performance of the Youth Stewardship of Natural and Cultural Resources APG, and reach out to underserved communities by creating meaningful educational experiences for youth and USGS employees. An increase of $0.2 million would continue and help grow the high quality and diverse programs highlighted below:

The USGS and the Denver Mayor’s Office initiated a collaborative employment partnership in 2011 aimed at promising inner-city, at-risk youth. Students were given exposure to diverse science activities and were provided life skills training, meaningful work assignments, a mentor and group counseling sessions. The initial 2011 cohort had fourteen students from either high school or beginning college. In 2012, the Partnership expanded to the Albuquerque Mayor’s Office, with a cohort of twenty-one students. The Partnership was suspended in 2013 due to Sequestration; it was restarted in 2014, but only in Denver. The proposed funding would allow the partnership to expand to Albuquerque and Flagstaff in 2015.

The USGS led and funded the development and delivery of the Native Youth in Science – Preserving Our Homelands summer science camp. The Woods Hole Coastal and Marine Science Center collaborated with the Mashpee Wampanoag Departments of Education and Natural Resources, the Bureau of Indian Affairs, and the Waquoit Bay Estuarine Research Reserve to organize a four-week summer science and Wampanoag cultural program for sixth-to-eighth graders from the Mashpee Wampanoag Tribe. To demonstrate how science topics learned in school relate to Wampanoag culture and the environmental health of local lands, lessons focused on addressing tribally important sites and topics through the perspectives of environmental science and Wampanoag culture. The proposed funding would allow outreach to additional tribes who have expressed interest in working with the USGS to bring the program to their communities.

GeoFORCE is a program of the Jackson School of Geosciences, University of Texas at Austin, designed to encourage students from minority serving high schools in rural South Texas and inner city Houston to take on the challenge of a rigorous math and science curriculum, to pursue higher education in these fields, and to enter the high tech workforce. Each summer GeoFORCE takes over 600 high school students on spectacular geologic field trips in Texas and throughout the United States. With a high school graduation rate of 100 percent and a college matriculation rate of over 95 percent, GeoFORCE has 439 college students currently enrolled in over 70 colleges and universities throughout Texas and across the United States. Nearly two-thirds of GeoFORCE college students are majoring in STEM fields. Over eighty percent of GeoFORCE students are from underrepresented groups. For the ninth year in a row, the USGS has provided financial support, mentoring, tours of USGS laboratories, and STEM related internship opportunities. Students can move on from GeoFORCE to the EdMAP program, a component of the National Cooperative Geologic Mapping Program (NCGMP), which trains the next generation of geologic mappers.

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Other Program Changes

This section addresses other program increases and decreases within each of the USGS Mission Areas.

Program Increases

Ecosystems

Status and Trends Program Change Items

Pollinators

Status and Trends (+$300,000/+1 FTE)

Insect pollination is a vital ecosystem service. Our Nation's agricultural systems rely on pollination for food production, and wild settings require pollination for promoting diversity among the trees, shrubs, and wildflowers that collectively make up the landscape. Honey bees, the Nation's most prominent and wide-spread pollinating species, have recently suffered from Colony Collapse Disorder (CCD), resulting in widespread loss of US honey bee colonies and heightened societal concern over honey bee health and pollination services. Continued declines in managed bee colonies are placing considerable pressure on agricultural productivity, global food supplies, and commercial beekeepers. Additionally, recent research indicates that diseases are being passed from honey bees to native bees, providing evidence of the complex interconnected nature of pollination systems.

The USGS has unique scientific capabilities to contribute to pollination research through our portfolio of interdisciplinary research on biological, hydrological, geological, and spatial sciences. The research is predominantly applied in nature, focusing on free-ranging animals and populations within the context of their habitats, and ultimately designed to inform management decisions for species of interest. The science links habitat and environmental factors to the condition of wildlife populations, determining not only which different land use conditions cause a population level response, but also why.

While the precise cause of CCD remains unclear to scientists and beekeepers, habitat loss and poor nutrition are proposed as important factors of honey bee declines. It is generally accepted that increases in forage plant abundance and diversity will do much to promote overall bee health and pollination service. Therefore a landscape scale research initiative is needed to understand how bee health is influenced by changing habitat conditions and resource availability throughout the country.

Working with U.S. Department of Agriculture (USDA) and other Federal agencies, the USGS would conduct focused assessments and research on the status and health of honey bees and other insect pollinators that contribute to the human food supply and the sustainability of wild lands, emphasizing options for monitoring and management actions by the public and private sectors to mitigate demonstrated or potential adverse impacts. Studies would include a range of objectives, such as foraging habitat quality, limiting nutritional factors, effects of pesticides, impacts and transmission of disease, and the ecological and economic value of pollination to the Nation. Efforts will be integrated with PCAST Assessment activities.

Wildlife

Wildlife Health

Wildlife Program (+$200,000/+1 FTE)

Emerging and resurging wildlife diseases such as West Nile virus, chronic wasting disease, white-nose syndrome, chytridiomycosis, and avian influenzas are having profound impacts on wildlife populations and also threatening human and domestic animal health. Consequently, there is increased need for sharing wildlife mortality information to improve situational awareness of these disease events and allow for more effective planning and response. The USGS plans to continue the development of an online national wildlife mortality event reporting system that will facilitate the sharing of disease event information, such as outbreak onset and ending date, location, species involved, numbers involved, diagnoses, laboratory, and contact names. The system will be Web-enabled allowing users to upload event information online as well as search, sort, and retrieve relevant information for downloading. The system will be populated initially with 30 years of data from the National Wildlife Health Center, allowing wildlife managers to understand the historical context of disease detection and therefore the significance of a disease event. The system will allow for tracking of diseases that spread over large geographical areas, enhance detection of novel or new diseases or known diseases in new geographic areas or species, allow for the generation of hypotheses regarding causes, relatedness and significance of disease events, and improve disease response planning and preparedness.

Energy Future and Wildlife Sustainability

Wildlife Program (+$1,000,000/+1 FTE)

Traditional and alternative energy innovation, development, production, and delivery will remain a national focus for decades. USGS ecosystems science is a key linkage between energy development and sustainability of the Nation's ecosystems, and is at the forefront of providing information for management decisions, particularly for renewable energy. The USGS is a leader in supplying science needed to solve the challenges of making progress in energy availability while maintaining functioning natural systems. New research would build on the past three years of focused work on impacts to bald and golden eagles, bats, condors, and desert wildlife from wind and solar energy development to meet new priorities. The USGS will collect critical biological data, particularly on demographics and habitat; focus on strengthening and developing advanced technologies, such as algorithms and advanced computing infrastructure to mine bird and bat information from existing weather data; and thermal imaging and infrared videography to allow observations of birds and bats at night. Offshore energy development and new solar technologies are emerging and the USGS is working with management bureaus to identify the highest priority research for seabirds, desert species, and Interior's trust marine mammals. Large tracts of the Arctic are now leased for oil and gas development and exploratory drilling, resulting in significant overlap between the leased areas and those used by the Pacific walrus. Research would add new knowledge on potential impacts of seismic activities and ship traffic for this declining species.

Environments

Outer Continental Shelf (OCS) Ecosystems Decisions

Environments Program (+$300,000/+2 FTE)

The coastal and offshore environment is increasingly being seen as an opportunity for renewable resource development, substantially ramping up the need for biological science to support decision needs of Interior bureaus. USGS Ecosystems research has a unique role in marine waters to support, in particular, Bureau of Ocean Energy Management's (BOEM) mission-critical research priorities focused on Interior trust resources (sea birds, marine mammals, aquatic ecosystems) and potential impacts of energy development on wildlife, their habitats, and the coastal ecosystem resilience. Continued long-term research, supported by short-term focused research, is needed across multiple disciplines. This includes investigations as diverse as predicting the response of polar bears and walrus to sea ice declines, mapping of seabird abundance and distribution, understanding benthic resources and microbial ecology, determining acoustic effects on marine animals, and charting deep sea coral distributions and function. This increase would provide the USGS with resources to develop a comprehensive geographic dataset on the pelagic distribution and movements of seabirds in the U.S. Pacific Ocean using methodology developed for the Atlantic, to design long-term research and monitoring strategies to understand ecosystem changes in relation to wildlife resources, and to expand investigations on offshore wind energy and wildlife on the Atlantic coast. Research will be coordinated closely with BOEM to identify the most effective science projects. This will result in improved study planning and implementation mechanisms to enhance the Outer Continental Shelf (OCS) program results overall.

Wildfire Restoration Ecology

Environments Program (+$500,000/+2 FTE)

Land management organizations make significant investments in restoration activities both before and after wildfires. The objectives of these activities are myriad and diverse and include reducing the risk of future wildfires; maximizing safety and suppression opportunities for wildfire responders; restoring and maintaining resilient landscapes, wildlife habitat, and native vegetation communities; limiting the spread of invasive species; and stabilizing hill slopes, restoring watersheds, and ensuring water quality and supply. Although many of these activities effectively meet their objectives, many (particularly on arid landscapes) fail to meet their stated objectives. Further, there is little information about how these combined activities contribute to resilient landscapes into the future. Despite the size of the investments, there is a lack of comprehensive, integrated, and accessible scientific information that evaluates the short- and long-term effectiveness of these activities (particularly on arid landscapes). Further, national capacity is needed for providing science information that may be used to support adaptive management approaches to managing hazardous fuels and establishing and promoting resilient landscapes.

This new effort consists of two main components. The first component will initially develop an integrated and accessible database of scientific information on fuel treatment, post-fire rehabilitation, and ecological restoration activities. Following this initial development, work will focus on new science

required to support effective establishment and maintenance of resilient landscapes. The second component will use the products of the first component to develop a national, multi-scale database that characterizes the effects of fuel treatment and ecological restoration activities on wildland fire risk and resilient landscapes. This database will draw heavily from land cover change products from Landsat, broad scale monitoring programs like the Bureau of Land Management (BLM) Assessment, Inventory, and Monitoring program, and integrated fire behavior and effects models used by wildland fire managers. Deliverables of this system will include metrics that define changed fire behavior and landscape condition. This system will support the performance monitoring metrics that are being developed in current revisions of the Interior fuels management programs.

Climate and Land Use Change

Landsat Science Products for Climate and Natural Resource Assessments (+$1,500,000/+3 FTE)

The Interior bureaus rely on Landsat as a data source on wildfires, consumptive water use, land cover change, rangeland status, wildlife habitat, and other Interior responsibilities. The 2015 increase would take advantage of new Landsat capabilities to support departmental and bureau priorities including climate, wildland fire, and WaterSMART. Landsat 8 (launched in February 2013) is a $1.0 billion Federal investment and has improved data quality, particularly for snow- and ice-covered land surfaces, and has a thermal sensor that provides new capabilities for water resources monitoring and management.

Land Remote Sensing (+$1,000,000/0 FTE)

In 2015, the Land Remote Sensing (LRS) Program proposes funding (along with the Land Change Science (LCS) Program) to accelerate the development of Landsat science and applications supporting natural resource management. The LRS Program has identified a set of Landsat-based science products that will improve applications used by natural resource managers, and will contribute to the international and interagency climate monitoring community's initiative to develop consistent Essential Climate Variables (ECVs) and related Climate Data Records (CDRs). The CDRs are long-term time-series measurements such as surface temperature that support a variety of ECVs, including measures of fire disturbance, snow cover, glaciers and ice caps, permafrost, surface water extent, land cover, and biomass. The CDRs and ECVs will provide an authoritative basis for regional- to continental-scale identification of historical change, monitoring of current conditions, and predicting future scenarios. This funding would provide the opportunity to create a standing process to detect land change as it is occurring, develop national-scale ECVs documenting land and water conditions, develop algorithms to automate the products, and provide updated interpretive products in near real time. The output will be a baseline set of science products that support a wide variety of further products. This effort leverages preparatory work started in 2012 and continuing through 2014.

Land Change Science (+$500,000/+3 FTE)

In 2015, the LCS Program proposes funding (along with the LRS Program) to accelerate the development of Landsat science and applications supporting natural resource management. Water availability information is a critical input to landscape science and decisionmaking. The LCS Program has developed a proof-of-concept geospatial analysis product that integrates the principal water balance components at a sub-basin scale. The product would combine long-term Landsat data with water use information dating back to the 1980s, taking advantage of the recent gridded USGS streamflow data, Landsat-based evapotranspiration estimates, and precipitation from the Parameter-elevation Regressions on Independent Slopes Model. The resultant products will not only provide water budget information but will also provide estimates of the relative impact of climate versus land use/land cover change on water budgets. Preliminary studies will focus on watersheds in California, the Great Plains, and the Southeastern United States. This work will leverage the WaterSMART National Water Census sub-basin-scale estimates of streamflow, which are in development through 2014, and scheduled for full implementation in 2015. In turn, the resultant online tool will directly support National Water Census goals by advancing the ability to produce landscape-scale water budgets—the building blocks of water availability.

Energy, Minerals, and Environmental Health

Alternative Energy Permitting on Federal Lands +$1,300,000/+2 FTE

Energy Resources Program (+$1,300,000/+2 FTE)

This proposed increase allows the Energy Resources Program (ERP) to provide science support to the agencies responsible for energy resource management on Federal Lands in several ways. There is substantial potential for unconventional geothermal resources (Enhanced Geothermal Systems) on Federal lands, but these resources have not been thoroughly evaluated. The USGS would use core capabilities in geothermal research to evaluate the geology and subsurface characteristics to identify likely areas of potential exploration and development of geothermal resources. The Bureau of Land Management (BLM) and other bureaus could use this information for land use planning and potentially a targeted environmental impact statement for high potential use areas. The proposed funding increase would allow a focused effort in targeted areas to survey and subsequently track the impacts of geothermal development over time, which have been poorly characterized to date. This effort would focus on key areas where there are, or may be, issues related to ongoing geothermal production. The increase would also allow for additional support for researching induced seismicity related to geothermal development on Federal lands, and help to determine the risks and potential mitigation plans should development be proposed.

Emerging Contaminants and Chemical Mixtures (+$1,450,000/+2 FTE)

Toxics Substances Hydrology Program (+$1,450,000/+2 FTE)

The proposed increase would support a national assessment of contaminant mixtures at stream locations affected by combinations of contaminant sources, including wastewater treatment plant discharges, industrial discharges, landfill leachate, crop agriculture, and animal agriculture. Samples of stream waters

and sediments would be analyzed using USGS analytical capabilities for approximately 800 common and emerging chemical contaminants. In addition, the USGS would employ extensive forensic analyses to identify unknown contaminants in these environmental samples. This project would be coordinated with the EPA and their capability to conduct *in vitro* bioassays of environmental samples. The information produced by these activities would provide a basis for toxicity testing for chemical mixtures and low-level exposures; help improve understanding groups of contaminant effects on organism health; and identify unidentified contaminants of emerging concern based their actual presence and their levels in the environment. A pilot project, currently ongoing in 2014, is testing chemical mixtures and forensic methods in stream waters at a limited number of stream sites; scientists from the EPA National Exposure Research Lab, National Risk Management Research Lab, and National Health and Environmental Effects Research Laboratory are testing the same water samples for biological activity using bioassays. The expanded effort would enable testing at additional sites for other contaminant source types and combinations, and would enable testing of contaminants in both stream water and sediments, providing a better estimate of total contaminant mass and exposure potential.

Water Resources

Streamgages and Streamgage R&D (+$1,900,000/+1 FTE)

The USGS streamgage network provides streamflow information and understanding for national, State, tribal, and local economic well-being, the protection of life and property, and efficient and effective water resource management. Research and development into complimentary methods of streamflow data collection is important to measure areas in which it is not practical or feasible to place a gage.

National Streamflow Information Program (+$1,200,000/0 FTE)

The increase proposed for the National Streamflow Information Program (NSIP) would enhance the stability of the national backbone of streamgages by retaining streamgages that would otherwise be discontinued. It is expected that the NSIP would be able to fully fund about 50 streamgages. With the proposed increase, the program would help support a highly reliable system for real-time and historic streamflow information delivery to customers that includes data processing, quality assurance, storage, and easy data access. These funds would help ensure that the National Water Information System (NWIS) database, critical to the success of the NSIP, is operated and maintained at peak efficiency and effectiveness. Additional efforts are needed to provide real-time data users information on the range of uncertainty of the streamflow information they use to make decisions on a regular basis. Proposed funding would support software upgrades for time series information. The proposed 2015 budget increase would allow continuation of efforts to characterize streamflow at ungaged locations started in 2014.

Hydrologic Research and Development (+$700,000/+1 FTE)

The USGS would continue to develop and improve hydro-acoustic measurement and monitoring techniques. These techniques have greatly improved the efficiency of the USGS streamgage network and offer additional opportunities to more efficiently collect and share streamflow information in the near

term. The USGS would also expand research and development on the next generation of streamflow and bathymetric measurement techniques, which could achieve cost efficiencies in existing monitoring networks and improve capabilities for measuring discharge and depth profiles at ungaged sites. High-speed infrared video and particle image velocimetry have demonstrated potential for generating accurate, spatially detailed measurements of water-surface velocities and channel bathymetry. Laboratory experiments and field tests of these techniques using data collected from aircraft and unmanned aerial vehicles (UAV's) will enhance current capabilities for measuring discharge in ungaged streams, and could produce methods that might eventually be applied to remote sensing data from satellite platforms that currently are in development and scheduled to become operational in a few years. This capability has applications that potentially could reduce loss of life and property damage during floods; other applications include hydrographic charting for navigation, ecological monitoring and restoration, water resource management, and contaminant transport.

National Hydrologic Modeling/Groundwater Sustainability (+$750,000/+3 FTE)

Hydrologic Networks and Analysis (+$750,000/+3 FTE)

National Hydrologic Modeling Framework –Multiple agencies are very concerned that U.S. modeling capacity is inadequate to meet the needs of water managers in a rapidly changing world. Existing hydrologic modeling challenges include difficulty incorporating climate change information, lack of interoperability and integration among models, difficulty incorporating new and improved datasets, and an inability to model certain critical hydrologic processes adequately. It is essential that water management decisions be made using the best available data and modeling tools, suggesting the need for a National Hydrologic Modeling Framework or community modeling system like that currently used by the international climate modeling community. Through a series of workshops and working groups, this initiative will assess the feasibility of a new framework or modeling community.

Targeted investments in Federal science and technology as well as identification of cost-effective policy options could enhance groundwater sustainability in regions where overdraft is already occurring or expected in the near future. Through a series of workshops and working groups, the USGS will identify and describe specific investments and strategies that will provide a path forward for significantly improving management of the Nation's important groundwater resources based on changes in existing Federal programs, partnerships, regulations, grants and management strategies.

Tribes (+$1,000,000/+7 FTE)

Cooperative Water Program (+$1,000,000/+7 FTE)

Cooperative Water Program monitoring, assessments, and research would continue and expand work related to water availability issues on tribal lands in order to address such topics as water rights, water use, hydrologic conditions, and water-quality issues. The CWP would continue development of quantitative models of water budgets, including groundwater and surface-water interactions, that provide information on how human and natural factors, such as groundwater pumping and climate change, affect streamflows so that tribal river managers can develop effective strategies to maintain water supplies and

restore critical habitats and healthy ecosystems. Funding for tribal cooperators, including an increase in the 2014 budget, will be allocated in coordination with the Secretary's Indian Water Rights Office and other bureaus (including Indian Affairs and Reclamation) that support the Federal trust responsibility for water in Indian Country.

Core Science Systems

Big Earth Data

Science Synthesis, Analysis, and Research (+$2,000,000/0 FTE)

The USGS and other Interior bureaus are home to high value Earth observations, satellite and other remote sensing technologies, that are critical to providing reliable scientific information to the Nation to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. USGS datasets are regularly recognized as a high priority from a Federal science perspective. These data are regularly used for science and decisionmaking, and this additional funding to enable data innovation would dramatically expand the utility of this information and the array of users that can tap into the resource.

In coordination with the National Science and Technology Council (NSTC)/ U.S. Group on Earth Observations (USGEO) led by the President's Office of Science and Technology Policy, the USGS will coordinate with Interior bureaus, other Federal agencies, Tribes, and States to develop a cohesive strategy that contributes to and follows guidelines for government wide interoperability improvements that focus on web service access layer development to deliver underlying Earth observations. For example, investments under this initiative would enable access and integration of data from State Wildlife Management Plans, the U.S. Fish and Wildlife Service Wetland Inventory and USGS habitat and water quality databases to inform management strategies needed to restore the Gulf Coast Ecosystem.

In 2014, the USGS is leading the USGEO Subcommittee of the NSTC Data Management Working Group, to further develop the implementation plan for the Big Earth Data Initiative (BEDI). This plan outlines an approach for collecting and managing high value Earth observations. Interior bureaus included in this plan are the USGS, the U.S. Fish and Wildlife Service, the National Park Service, and the Bureau of Land Management. Work is underway to define characteristics of discoverability, accessibility, and usability and apply them to Interior observational data products such as LANDSAT and USGS Water Data for the Nation, with the expectation of understanding the treatments needed. As defined in the Big Earth Data Strategy, treatments include policies, standards, services, and tools applied in the context of the data lifecycle to improve capabilities.

In 2015, an increase of $2.0 million is proposed to support BEDI and Interior-wide coordination efforts. The USGS will continue to lead the USGEO to advance the proposals of the Big Earth Data Strategy. To advance the strategy's proposals, the USGS would continue implementing the USGS Science Data Catalog to provide a portal for organized access to USGS science data, making data easier to find using common search engines (e.g., Google, etc.); improve discoverability, accessibility, and usability; develop

and apply USGS science data-management policies that address data release and approval, metadata, and data lifecycle; develop and execute tools to make it easier for scientists to document data; make available managed collections of Earth science data to Data.gov, the Geospatial Platform, and specialized collaborative portals (e.g., Ecosystems.data.gov); integrate individual datasets into larger portal platforms (e.g., Biodiversity Information Serving Our Nation, etc.), creating efficiencies by reducing the number of smaller data systems; support the development of Web services (Application Programming Interfaces) to improve the accessibility and usability of high-priority Big Earth Data systems and data supporting the Climate Data Initiative; begin defined Big Earth Data treatments for high-priority Big Earth Data systems defined in the USGS implementation strategy; and, establish processes to sustain the viability of the USGS's Earth science data by characterizing the Nation's natural systems in new ways that spurs economic development and informs landscape conservation decisionmaking.

National Map Modernization

National Geospatial Program (+$1,908,000/+9 FTE)

Funding for National Map modernization will support geospatial data acquisition for lidar and ifsar elevation data, revised and more detailed hydrography data for the Nation's surface water, and the integration of transportation, boundaries, structures, and geographic place names data into the online geospatial data access portals, including the National Map Viewer and Download Portal, and the Geospatial Platform. These data and their access are required to support Presidential and Secretarial priorities for Building a Landscape Level Understanding of Our Resources. The proposed funding allows the National Geospatial Program to address landscape level understanding by increasing the ability to accurately visualize the natural and built environment within a set of tools that support modeling and applications. These additional funds would also boost the NGP's research and development component to provide a systematic application of knowledge and understanding to develop and improve prototypes and new processes to better use NGP map data, products, and services.

Science Support

Administration and Management (+$500,000/+1 FTE)

The Science Support program funds the bureau and region leadership and management that provide guidance, direction, and oversight of all USGS science activities and resource management and business and information systems, which provide the framework for science activities.

DOI Science Coordination (+$200,000/+1 FTE)

As the primary science bureau for Interior, the Director serves as the Secretary's Science Advisor and the Deputy Director serves as Interior's Science Integrity Officer. Starting in 2013, the USGS worked with other Interior bureau's science integrity officers to facilitate a revision of Interior's science integrity policy (to be released in 2014) and the development of training on scientific integrity that will be available to all Interior employees. The USGS has also worked with other Interior bureau's science advisors to initiate better collaboration on science issues and activities common to Interior. Together,

these activities strengthen the research and application of science across Interior. In 2015, the USGS will provide a science position dedicated to science collaboration, internal to the USGS and external with other Interior bureaus, and assisting in the fulfilling the requirements of the science integrity process.

Tribal Science Coordination (+$300,000/0 FTE)

The USGS would make existing partnerships more robust and strengthen the ability to hire interns for the Students in Support of Native American Relations (SISNAR) program, which brings interns to work on USGS research studies, including climate studies, on tribal lands. The USGS would also increase tribal capacity building through the Technical training in Support of Native American Relations (TESNAR) program, which provides training to tribal employees on a variety of scientific data collection and analysis topics, including those associated with climate change impacts, mitigation and adaptation. This funding would also allow the USGS to increase its support for tribal colleges and universities (TCUs) by allowing increased collaboration with TCU staff working on curriculum development for science programs.

Facilities

Reduce Facilities Footprint – Cost Savings and Innovation Plan (CSIP)

Rental Payments and Operations and Maintenance (+$5,365,000/0 FTE)

The USGS produces space cost savings when locations are able to consolidate space or relocate to space with lower costs. With the proposed increase, Facilities, Rental Payments and Operations and Maintenance would have the ability to invest in Cost Savings and Innovation Plan (CSIP) projects, that allow the USGS to consolidate space, reduce the occupancy footprint, improve utilization and create real property cost savings and other efficiencies.

Because the USGS relies on the General Services Administration (GSA) owned and leased buildings for about 67 percent of the space it occupies, the USGS has no ability to reduce fixed rental rates at these sites and can only offset the higher facility costs by vacating space. Therefore, primary emphasis is placed on improving space utilization, consolidating operations within, and relinquishing space to GSA provided offices, laboratories, data centers, and warehouses.

In 2013 and 2014, the USGS made significant progress in CSIP consolidation projects, reducing the bureau's footprint by more than 400,000 square feet (SF) which represents approximately 10 percent of the USGS's GSA provided space holdings.

The proposed increase would fund the library consolidation projects at the Denver Federal Center and Menlo Park Campus reducing the library space by 29,400 SF; a 48 percent reduction. Completing the Menlo Park library project will also speed up the overall consolidation plan at the Menlo Park Campus, which will ultimately allow the USGS to release the remainder of Building 3; an additional reduction of 50,100 SF. The increase would also fund a co-location project with the Bureau of Reclamation in Boulder City, NV, significantly reducing the rent costs as well as lessening Interior's overall footprint. Ultimately, these projects will yield a $1.4 million annual rent savings with a 40,750 SF footprint

reduction. The USGS has also identified six additional CSIP projects located in Menlo Park, CA; Denver, CO; and Seattle and Spokane, WA. Once these projects are completed, they will yield a footprint reduction of over 70,000 SF and annual savings of $2.4 million. The USGS is beginning to accumulate a backlog of viable short payback CSIP projects.

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Program Decreases

In order to support national priorities in a constrained budget environment, difficult choices must be made to reduce other programmatic efforts. In making these tough choices, the USGS, wherever possible, made reductions to programs where activities were nearing completion, near the end of their life cycle, or of a lower priority. The following are descriptions of those activities and programs where reductions in funding were taken.

Ecosystems

Fisheries Program Research

Fisheries Program (-$1,000,000/-8 FTE)

This funding reduction within the Fisheries Program of the Ecosystem Mission Area will reduce the collection, analysis, and dissemination of fisheries research across four areas: (1) aquaculture and hatchery support; (2) contaminant research; (3) marine ecosystems and ecology; and (4) place-based research in support of individual States.

Wildlife Program Research

Wildlife Program (-$1,200,000/-7 FTE)

The USGS would reduce research involving captive wildlife and reduce the scope of long-term monitoring activities funded under the Wildlife Program, while retaining investments in the design of monitoring and surveys. The Wildlife Program will refocus efforts to a limited number of species and populations designated as priorities for Interior management bureaus, and reduce the overall breadth of the USGS portfolio by minimizing efforts on all but the most urgent research needs.

Environments Program Research

Environments Program (-$3,220,000/-18 FTE)

The USGS would reduce the collection, analysis, and dissemination of environmental information and products across three areas: (1) landscape level science support to States; (2) biogeochemical and hydrological cycles; and (3) contaminants, toxicology, and disease research.

Climate and Land Use Change

National Civil Applications Program (-$2,547,000/-12 FTE)

Land Remote Sensing Program (-$2,547,000/-12 FTE)

The National Civil Applications Program (NCAP) uses data from classified systems and commercial satellites to investigate climate change and other Earth dynamics, ecosystems, natural hazards, and manmade disasters (such as wildland fires), and improve land and resources management. In 2014 and 2015, the Land Remote Sensing Program will begin to decrease lower-priority, outdated, or duplicative functions of the NCAP. The USGS will maintain its civil science leadership of the Civil Applications Committee and assess ways to use classified assets for hazards, environmental, and natural resources applications strategically. The USGS would continue to scale back operations at the Advanced System Center (ASC) Sensitive Compartmented Information Facility (SCIF) in Reston and would discontinue funding research at the Special Applications Science Center (SASC) SCIF located in Denver. In addition, the ASC SCIF in Reston would release additional space in their building and vacant positions would not be filled. In addition, NCAP funding provided to the Eastern Geographic Science Center for the use of classified data at the ASC would be reduced. The acquisition, archive, and dissemination of classified remotely sensed data to support science programs of the USGS, Interior, and other Federal civil agencies would be continued.

Land Change Science (-$1,000,000/-7 FTE)

The Land Change Science (LCS) Program conducts research on land cover to provide a historical record of resource use; information on the availability and quality of natural resources; assessment of the impacts of land cover change; and tool development for decisionmakers to use for resource allocation. In 2015, the LCS Program is proposing a $1.0 million reduction. This reduction permits program prioritization of Landsat information products and research on the Chesapeake Bay but the reduction would result in the elimination of projects whose objectives are to use remotely sensed imagery to assess vegetation, ecosystems function, flood inundation, and historical land cover change.

Energy, Minerals, and Environmental Health

Energy Research (-$1,000,000/-2 FTE)

Energy Resources Program (-$1,000,000/-2 FTE)

This proposed reduction would reduce methanogensis (formation of methane) research and other environmental studies related to energy resources. At this level, contributions to the Energy Resources Program publications would only fund assessment fact sheets.

Activities related to Oil, Oil Shale and Gas Assessments (-$500,000/-1 FTE)

Energy Resources Program (-$500,000/-1 FTE)

This proposed reduction would reduce basic oil and gas resource research and assessment activities in the Energy Resources Program including research on domestic oil shale resources, and oil and gas activities in the U.S. Gulf Coast.

Discontinue Research on Contaminants in Wastewater Projects (-$369,000/-1 FTE)

Toxics Substances Hydrology (-$369,000/-1 FTE)

The proposed reduction would eliminate projects which enable scientists and decisionmakers to design monitoring strategies, predict how wastewater contaminants move in groundwater and surface water, and estimate how quickly contaminants in wastewater effluents released to the environment degrade to less toxic compounds at these targeted sites and other similar sites nationwide. Journal articles originally scheduled for publication this year would be delayed. These products are designed to inform wastewater managers working in municipal as well as military sectors about the balance between natural attenuation versus the longevity of wastewater contaminants released to surface water and groundwater in the years after cessation of these releases.

Natural Hazards

Eliminate Precision Geodetic Monitoring and Active-Source Profiling (-$700,000/-2 FTE)

Earthquake Hazards Program (-$700,000/-2 FTE)

Between the occurrences of large earthquakes, precision geodetic monitoring is used to track non-seismic fault movement. Data from this monitoring helps assess the buildup of energy along a fault, and can affect assessments of earthquake probabilities and large-earthquake recurrence times. Without these technologies, users will rely on less precise data, such as GPS, for fault-specific assessments. Fault slip and earthquake potential are also assessed through geophysical profiling, especially seismic profiling such as is used in the oil and gas industry. Such capabilities can also be used to determine site-specific earthquake risk. Without these data, USGS researchers will rely on geologic studies alone, significantly diminishing the understanding of individual fault geometry and slip history.

Coastal Vulnerability Studies (-$1,000,000/-1 FTE)

Coastal and Marine Geology Program (-$1,000,000/-1 FTE)

The Coastal and Marine Geology Program would reduce regional ecosystem and coastal change studies focused on estuarine and wetland vulnerability to coastal hazards (except within the areas impacted by

Hurricane Sandy), tsunami risk to coastal communities, ecological impacts of sea-level rise, and studies of coral reef health and resilience in Hawaii and Florida.

Water Resources

Water Quality Monitoring (-$2,000,000/-8 FTE)

National Water Quality Assessment Program (-$2,000,000/-8 FTE)

In order to fund work that is of a higher priority, the National Water Quality Assessment Program had to make some strategic reductions. The NAWQA program would reduce groundwater quality monitoring at about 150 of 750 wells in large aquifers across the Nation. The reduction would also decrease development of groundwater-quality models used by water-supply managers to assess the amount and quality of drinking water that is available and to forecast changes in water quality resulting from alternative management actions.

Monitoring and Assessments (-$1,500,000/-7 FTE)

Hydrologic Research and Development (-$1,500,000/-7 FTE)

As resources are refocused on high-priority research areas such as the Puget Sound Ecosystem, Hydraulic Fracturing, and Streamgaging R&D, there would be a $1.5 million decrease in base funding for Hydrologic Research and Development, resulting in reduced effort on long-term monitoring and assessments at research sites. This would slow progress on data collection and publication of information products in specific areas related to water availability, contaminants, ecosystem restoration, and others.

Watershed Support, Information Delivery, and Technical Support (-$1,500,000/-7 FTE)

Hydrologic Networks and Analysis (-$1,500,000/-7 FTE)

The Water Mission Area made strategic budget decisions that meant moving funds from lower priority projects to Administration and USGS priorities. The Hydrologic Networks and Analysis program would reduce watershed modeling within the Hydrologic Analysis component of the program and reduce its support for Information Delivery and Technical Support.

Monitoring and Assessments (-$3,264,000/-9 FTE)

Cooperative Water Program (-$3,264,000/-9 FTE)

Reductions redirect funding to other priorities under the Cooperative Water Program. Funding for a number of monitoring and assessment activities would be redirected to priority areas such as national water quality assessment, streamflow studies, and tribal water needs as discussed in the program increases section.

Water Resource Research Act Program **(-$3,000,000/0 FTE)**

Water Resources Research Act Program (-$3,000,000/0 FTE)

The proposed budget reduction would reduce funding of the annual base grants to the Institutes by approximately one-half of what was allocated to each Institute in 2014. The competitively awarded portion of the program would continue. The USGS is working with the Institutes in 2014 and will continue in 2015, to develop more rigorous oversight of the program and ensure that Federal investments at each of the Institutes effectively and consistently maximize national science goals and leverage all available resources, particularly in the areas of water availability, quality, and climate change.

Core Science Systems

Bio-Science Data Synthesis

Science Synthesis, Analysis, and Research **(-$3,000,000/-4 FTE)**

The USGS proposes to redirect funds from lower priority bio-scientific data and information such as vegetation characterization and oceans to advance implementation of higher priority data synthesis and analysis activities such as the Big Earth Data Initiative and EcoINFORMA.

Glacial Aquifers Project

National Cooperative Geologic Mapping Program **(-$2,000,000/0 FTE)**

The USGS would redirect funds to higher priority hydraulic fracturing research. The proposed reduction would discontinue mapping in support of the glacial aquifer project, which provides information about aquifer characterization in glaciated areas of the Northeast. Geologic mapping of glacial aquifers in the northern United States will be curtailed in order to redirect some expertise toward hydraulic fracturing research. This would end some collaborative work being conducted jointly with the States of Massachusetts, Michigan and New York.

Land Cover Data

National Geospatial Program **(-$422,000/-1 FTE)**

This reduction eliminates the support of USGS land cover data in the National Geospatial Program's (NGP's) maps, products, and services. NGP funding will be focused on higher priorities necessary to modernize the National Map.

Urban Area Imagery

National Geospatial Program **(-$4,082,000/-25 FTE)**

This reduction eliminates the USGS's participation to cooperatively acquire high-resolution imagery with the National Geospatial-Intelligence Agency's (NGA's) 133 urban areas program in support of homeland security and other national needs. The program has become a lower priority for the USGS and the NGA as other resources and technologies have become a higher priority.

NGP Program Coordination and Partnership Development

National Geospatial Program **(-$822,000/-4 FTE)**

The USGS would redirect funds to higher priority work. This component oversees external coordination and communications with partners, and NGP's geospatial liaison network. This program advances effectiveness in working with external organizations and partnership development, but would retain core data program investments.

The National Atlas of the United States of America®

National Geospatial Program **(-$2,674,000/-18 FTE)**

This reduction eliminates some lower priority activities of The National Atlas of the United States of America®. The National Atlas effort develops, integrates, and disseminates small-scale (national-, multi-State, and regional) base maps, geospatial data for download, thematic maps, articles, and interactive map viewer products and Web services. It is the only integrated and comprehensive national source for much of these small-scale base data. Some of these datasets will still be available through the National Map viewer or other accesses such as the National Cooperative Geologic Mapping Program's Tapestry of Time and Terrain, a union of two maps of the United States that depicts the geology and topography.

Science Support

To prioritize on-the-ground science activities funding would be redirected from Administration services to science.

Administrative Services **(-$4,500,000/-16 FTE)**

The Science Support Activity funds the bureau and regional leadership and management that provide guidance, direction and oversight of all USGS science activities and resource management, and business and information systems, which provide the framework for science activities.

Administration and Management (-$2,200,000/-14 FTE)

The Administration and Management subactivity includes science quality and integrity, communications, and bureau management activities, such as leadership and budget formulation and analysis. The proposed reduction could affect such Administrative services as acquisition and grant services, human capital, communications, financial and budget management, vehicle management, safety training, and hazardous waste management.

Information Services (-$2,300,000/-2 FTE)

Information Services facilitates science through technologies that enable collaboration and knowledge and information sharing between scientists across the landscape in addition to providing the communications and data management backbone. The proposed reduction could impact functions such as cyber security, records management (including the Data Rescue Program), maintenance and technology refresh for computing infrastructure hardware, and system software contracts and services.

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