BUDGET JUSTIFICATIONS

The United States Department of the Interior

and Performance Information
Fiscal Year 2021

U.S. GEOLOGICAL SURVEY

NOTICE: These budget justifications are prepared for the Interior, Environment and Related Agencies Appropriations Subcommittees. Approval for release of the justifications prior to their printing in the public record of the Subcommittee hearings may be obtained through the Office of Budget of the Department of the Interior.

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Overview and Executive Summary

Budget Highlights

The United States Geological Survey (USGS) is the Nation's largest water, earth, and biological science and civilian mapping agency. The USGS is the primary Federal source of science-based information on ecosystem science, land resources, energy and mineral resources, natural hazards, water use and availability, and updated maps and images for the Earth's features available to the public. The USGS works in partnership with the Interior bureaus, other Federal agencies, Tribes, States, local jurisdictions, and others to provide the best available science to provide scientific information to resource managers and planners, emergency response officials, and the public.

The 2021 budget request for the USGS is $971.2 million. The budget focuses on bringing science, facilities, and infrastructure into the 21st Century. The 2021 budget allows the USGS to expand the Next Generation Water Observation System into the headwaters of the Upper Colorado and Gunnison Rivers; provide tenant improvements to new laboratory space at the Colorado School of Mines; and modernize information management and technology (IMT) throughout the USGS.

Overall, the budget provides funding for scientific monitoring, research, and mapping to support management strategies for land, water, and species. It funds energy and mineral assessments to identify the location of resources, applies science to safeguard communities against natural hazards, and provides services and infrastructure that make it possible to conduct USGS science.

USGS budget highlights for 2021 include:

Ecosystems

- Conducting research and developing decision-support tools that address the science needs of the Fish and Wildlife Service (FWS) 7-Year Listing Workplan to support listing, delisting, downlisting and recovery decisions.
- Developing information, technologies, and monitoring protocols used by Federal and State agencies in the design and siting of energy, transportation, and other infrastructure projects to reduce conflict with wildlife, streamline development, and comply with applicable laws and regulations.
- Conducting science to manage invasive species and fish and wildlife diseases that pose significant ecological, human health, or economic threats to the resources of the United States.

Energy and Minerals

- Continuing the Earth Mapping Resources Initiative (Earth MRI), a program for prioritized topographic, geologic, and geophysical mapping to enhance understanding of the Nation's mineral resource potential.
- Maintaining and continuing the development of the laboratory quality management system (QMS), including a laboratory information management system (LIMS) in each Program to

incorporate data management best practices and capabilities to collect, store, manage, process, document, validate, and archive laboratory information assets from laboratories.
- Assessing undiscovered, technically recoverable energy resources (including oil and gas, methane hydrates, coal, uranium, and geothermal) in priority basins in the United States and globally; and continue the underlying geological, geophysical, and geochemical research that underpins these assessments.

Natural Hazards
- Monitoring the Nation's earthquakes via the Advanced National Seismic System (ANSS) and through support of several regional seismic networks operated by university partners; providing 24x7 reporting on domestic and global earthquakes; delivering rapid earthquake impact and situational awareness products to support emergency response; and developing improved methods for continued improvement in the quality and timeliness of real-time earthquake information.
- Continuing the second year of a three-year effort to complete the magnetotelluric survey of the contiguous 48-states, providing data for a national geoelectric hazard map.
- Providing post-wildfire debris-flow hazard assessments for major wildfires to Burned Area Emergency Response (BAER) teams, State geological surveys, Federal, State, and local emergency management, and the public.

Water Resources
- Continuing operation of the highest-priority sites of the Next-Generation Water Observing System (NGWOS) in the Delaware River Basin and initiating implementation of NGWOS in the headwaters of the Colorado and Gunnison River Basin.
- Developing and delivering of the National Integrated Water Availability Assessment (IWAA), a near-real time census of water resources that will evaluate water availability for human and ecological use, infrastructure, security, and economic optimization.
- Utilizing and advancing USGS observational networks to guide the development of water prediction capabilities through the Integrated Water Prediction program.

Core Science Systems
- Continuing the collection of high-resolution light detection and ranging (lidar) elevation data, to achieve the first-ever baseline of national coverage with high quality data by 2025.
- Coordinating interagency elevation data collection through the 3D Elevation Program.
- Developing Landsat 9 ground systems in collaboration with NASA for overall mission integration in support of a fiscal year 2021 launch and developing recommendations for follow-on systems to Landsat 9 to affordably meet the needs of future Landsat users.

Science Support

- Providing access to advanced technologies such as artificial intelligence and high-performance computing and developing convergent IMT architecture by providing cloud hosting solution advancements.
- Making continuous improvements on Quality Management System (QMS) policy for USGS laboratories.
- Continuing to develop programs to prevent and eliminate harassing conduct within USGS.

Facilities

- Continuing the cost-saving USGS consolidation at Moffett Field, Mountain View, CA to improve collaboration with other research entities and modernize a primary campus of the USGS.
- Continuing an effective maintenance program at each owned facility to meet industry best practices.

The following three tables highlight the USGS FY 2021 budget request.

Budget Authority	2019	2020	2021 Request
Current	1,160,596	1,270,957	971,185
Supplemental	98,500	0	0
Total Current	***1,259,096***	***1,270,957***	***971,185***
Permanent	1,374	1,144	1,144
Total Current and Permanent	**1,260,470**	**1,272,101**	**972,329**
Direct FTEs	*4,531*	*4,581*	*3,754*

Mission Area/Subactivity/Programs (Dollars in Thousands)	2019	2020	2021	
	Enacted	Enacted	Request	Change from 2020 Enacted
Ecosystems	**229,190**	**251,527**	**127,337**	**-124,190**
Energy and Minerals Resources	**88,941**	**90,041**	**91,181**	**1,140**
Natural Hazards	**166,258**	**170,870**	**137,999**	**-32,871**
Water Resources	**226,308**	**234,120**	**180,809**	**-53,311**
Core Science Systems	**226,688**	**246,688**	**212,049**	**-34,639**
Science Support	**102,828**	**96,828**	**94,173**	**-2,655**
Facilities	**120,383**	**180,883**	**127,637**	**-53,246**
Grand Total	**1,160,596**	**1,270,957**	**971,185**	**-299,772**

FTE	2019	2020	2021 Request
Direct	*4,531*	*4,581*	*3,754*
Reimbursable	*2,891*	*2,891*	*2,891*
Working Capital Fund	*112*	*112*	*112*
Allocations	*20*	*20*	*20*
Contributed Funds	*2*	*2*	*2*
Total	*7,556*	*7,606*	*6,779*

Science for the 21st Century

The Nation faces many challenges: increasing demand for energy and mineral resources, vulnerability to natural hazards and land changes, water security and availability, emerging diseases affecting wildlife, and stresses on critical and unique ecosystems. While there are many factors that guide the direction of USGS science, these increasing demands on natural resources, the increased pace of information and rapid environmental change will require greater integration of scientific capabilities.

Enhanced integrative predictive capabilities and technology will be necessary to answer the increasingly complex, interconnected, interdisciplinary, and computationally intensive scientific questions that are most important to the Nation and the world. Recognizing and embracing this new paradigm presents tremendous opportunities for USGS to lead the Natural and Earth Science communities in the decades to come. In the 21st Century, the USGS will maintain its commitment to unbiased and impartial scientific understanding of the Earth and its systems, while leveraging new technologies in the pursuit of these enhanced predictive capabilities.

The USGS has begun a multi-year effort to design and build an integrated predictive science capability that, when fully implemented, will link USGS's capabilities in earth system characterization science and rich data sets with advanced integrated predictive models that are enhanced through the use of artificial intelligence, machine learning, cloud storage, and high-performance computing. This will allow the USGS to deliver actionable intelligence in the form of integrated observations and predictions of the future state of Earth systems – at the scales needed to inform decisions. These predictions will be usable in myriad ways to further our Nation's prosperity, ensure our citizen's safety, and support the long-term sustainability of the Earth. At all scales, these predictions will account for complex system interactions, anticipate the likelihood and consequences of evolving threats and hazards, and help guide resilient adaptation and mitigation efforts.

All USGS programs will contribute towards delivering this integrated predictive science capability for water, ecosystems, energy, minerals, and hazards. Examples of several ongoing and planned activities are described below.

Next Generation Water Observing System

An important component of building an integrated predictive science capability is the Next Generation Water Observing System (NGWOS). NGWOS, which the USGS has been piloting in the Delaware River Basin since 2018, establishes an enhanced monitoring network integrated with other relevant data sets. This provides a dense network of high-fidelity, real-time data on water-quantity, quality and use necessary to support advanced models, modern water predictions, and decision support for daily water operations or water emergencies.

Advanced water models can integrate observed water data with physical process understanding, socioeconomic risk, and policy information to optimize water usage, help meet water quality needs and instream flow requirements, reduce costs, and provide forecasts to inform long-term strategies to minimize risk and impacts from water hazards and to meet water needs. Advanced computational methods can mine existing water data to learn patterns that can then help fill in gaps in data that is collected. These modern models and tools would require more extensive observational data than the existing hydrologic monitoring networks provide.

This system will provide information on streamflow, evapotranspiration, snowpack, soil moisture, water quality, groundwater conditions, connections between the groundwater and surface water, and water usage. It will be used to provide flood and drought forecasts, and emergency- and water-management decision support. NGWOS will also provide a foundational dataset as the USGS develops Integrated Water Predictions and Integrated Water Availability Assessments (IWAAs).

In 2021, the USGS plans to maintain the highest-priority sites of the NGWOS in the Delaware River Basin and initiate implementation of NGWOS in the headwaters of the upper Colorado and Gunnison River Basin.

21st Century Information Management and Technology

The USGS has embarked on a multi-faceted enterprise information management and technology (IMT) infrastructure modernization to increase scientific capacity, communications, and support the bureau's efforts toward integrative predictive science capabilities. The 2021 Budget includes $2.5 million to improve communications within the USGS by providing improved IMT solutions across the USGS. This effort will better support timely communication, collaboration, and a common operational picture (COP), particularly during times of emergency need due to both natural or man-made hazards and disasters with potential impacts to life and property. Additionally, in order to support data-driven and analytical modeling, forecasts, and the production of actionable intelligence, in 2021 USGS will continue to adopt state-of-the-art technologies that expand and leverage cloud services, artificial intelligence/machine learning (Internet of things, devices and sensors), and advanced application development. These services also incorporate many Administration and Department of the Interior (DOI) technology requirements that have emerged

since the signing of the Federal Information Technology Acquisition and Reform Act (FITARA), such as the Data Center Optimization Initiative, application modernization, and shared services.

The modernization of the USGS IMT infrastructure is a parallel effort that supports the larger vision of integrative predictive science capacity. USGS is embarking on these technology upgrades to ensure that the science community has the best tools, data, and forecasts available to meet the questions most important to the Nation and the world.

Innovative Facilities Solutions

USGS considers one of its most important assets to be the facilities that support its mission. This includes a mix of larger campuses and smaller field stations with office and conference space, laboratories (including research vessels), and storage and warehouse space. Nationwide, the USGS has 723 buildings, both leased and owned. At the end of fiscal year 2019, the USGS had a deferred maintenance backlog of $148.3 million for both owned assets and assets for which the USGS pays operations and maintenance in lieu of rent.

The 2021 budget continues to propel USGS forward with innovative facilities solutions to bring our facilities into the 21st Century. This includes implementing co-location opportunities within USGS, DOI and other Federal agencies, and with universities when it makes sense to help manage growing lease costs and other maintenance issues.

The 2021 budget proposes $3.6 million to support the relocation of certain USGS Mineral Resources Program research labs and personnel into a newly constructed facility on the campus of the Colorado School of Mines (CSM) in Golden, Colorado by funding specific tenant improvements required for these highly specialized geochemical laboratories. This will allow USGS to vacate a GSA-owned building at the Denver Federal Center that has experienced significant building systems failures that hinder ongoing research, have damaged irreplaceable mineral samples, and continue to affect and hinder USGS operations. GSA supports the relocation to CSM as the optimal solution for USGS.

To better manage the increasing costs of leases and locate USGS employees near to agencies with related missions to improve customer service and collaboration, USGS is working to co-locate other USGS programs and other agencies onto the USGS campus in Boise, Idaho. Currently, the USGS Idaho Water Science Center and the U.S. Bureau of Reclamation (USBR) occupy space on the campus. In 2021, USGS will complete the first of three phases that will allow the USGS Snake River Field Station to move onto the campus. At full build-out, it is estimated that the campus could provide office and laboratory space to house an additional 250 employees.

The Menlo to Moffett relocation and modernization will continue in 2021. Phase 1 relocating about 200+ people into new offices, was completed in 2019. Phase 2 is primarily the construction of analytical labs and refurbishment of additional office space for the remaining 250+ employees. A recent feasibility study indicates that a 40 percent smaller lab footprint at Moffett Field than Menlo Park will retain essential USGS capabilities into the future. As currently planned, the relocation saves nearly $300 million in facilities costs over the next 20 years versus remaining at Menlo Park.

USGS also is working with USBR to co-locate the USGS Western Ecological Research Center and Nevada Water Science Center facilities from Henderson, NV at the USBR-owned facility in Boulder City, NV. Renovation for office and construction of laboratory space is estimated for completion in 2020, with an expected occupancy during 2021. This move and consolidation project will result in a cost avoidance of $16 million in GSA rent costs and improve the usage of USGS, USBR and DOI space holdings.

Management Reforms

The budget request supports the President's Management Agenda Workforce Cross-Agency Priority Goal #3, Developing a Workforce for the 21st Century. The Department will support strategic recognition throughout the year, address workforce challenges, and recognize high performing employees and those employees with talent critical to mission achievement. The budget assumes agency pay for performance efforts increase one percentage point for non-Senior Executive Service (SES)/Senior Leader (SL)/Scientific or Professional (ST) salary spending.

The budget request supports the allocated share of operating costs for the GrantSolutions enterprise system to improve the processing and transparency of grants and cooperative agreements across Interior. Cost allocations are based on an algorithm of use factors.

The 2021 budget supports needed reforms to strengthen the culture of ethics within Interior. Over the last two years, Interior has taken several steps to enhance the emphasis on ethics in the Department, including increasing the number of ethics officers and increased vigilance regarding the Department's leaders and employee's obligation to hold themselves and their colleagues accountable for ethical conduct. Ethics is a top priority in all decision making and operations.

This past summer, Secretary Bernhardt continued this commitment to transform Interior's ethics program by signing Secretarial Order 3375, which restructures the ethics program by unifying disparate bureau ethics programs into a centrally-managed office under the Solicitor. The Order streamlines the reporting structure for ethics personnel, establishes the Departmental Ethics Office, and clarifies roles and responsibilities for the Department's employees.

The FY 2021 budget implements this reorganization to restructure the ethics program by transferring bureaus' ethics funding and FTEs to the Departmental Ethics Office in the Office of the Solicitor budget. The 2021 budget request for the USGS therefore transfers $1.1 million to the Office of the Solicitor.

The Good Accounting Obligation in Government Act (GAO-IG Act, P.L. 115-414) enacted January 3, 2019, requires that Agencies report the status of each open audit recommendation issued more than one year prior to the submission of the Agency's annual budget justification to Congress. The Act requires Agencies to include the current target completion date, implementation status, and any discrepancies on closure determinations.

The Department of the Interior leadership takes audit follow-up very seriously and considers our external auditors, to include the Government Accountability Office (GAO) and Office of the Inspector General, valued partners in not only improving the Department's management and compliance obligations but also

enhancing its programmatic and administrative operations. As stewards of taxpayer resources, the Department applies cost-benefit analysis and enterprise risk management principles in recommendation implementation decisions. The Department's GAO-IG Act Report is available at the following link: https://www.doi.gov/cj.

Technical Adjustments

The 2021 President's budget proposes:

- Organizational changes to improve integration of USGS scientific programs and align resources more effectively to achieve mission goals and objectives.
- A budget restructure aligning the programs of two smaller mission areas, Land Resources and Environmental Health, with associated programs in other existing mission areas to strengthen integrated research and collaboration, and rationalize the structure of the Ecosystems, Water Resources and Core Science Systems.

The budget proposes the following organizational restructure:

Updating the Structure of the USGS Director's Office – The USGS is working to become a nimbler organization that is more effective and efficient dealing with the strategic, tactical, and administrative components of the work. Restructuring the Director's immediate office will provide the appropriate oversight and reporting structure to do the following:

- Splitting the portfolio of the current Deputy Director between two positions: a Deputy Director—Operations and a Deputy Director—Administration and Policy

  - The Deputy Director—Operations, a Senior Executive Service (SES) position, will report to the USGS Director and will serve as the Chief Operating Officer of the USGS. The Deputy Director—Operations will oversee USGS regional operations, which are managed by the seven USGS Regional Directors covering Interior's 12 regions. Collectively, this position will oversee approximately 6,000 employees and 68 science centers. The Deputy Director—Operations will provide direct line supervision to the seven Regional Directors and will lead planning and operations for the day-to-day activities of regional programs to ensure that the USGS stays at the forefront of science initiatives. Responsibilities will include implementing process improvements; monitoring internal controls to manage risks; ensuring that science quality, integrity, ethics, and diversity policies are followed; resolving resource-allocation issues; and empowering the field to make strategic decisions and investments.

  - The Deputy Director—Administration and Policy, an SES position, will report to the USGS Director and will provide executive-level leadership to the USGS science support programs, which have approximately 760 employees, and include the Office of Administration; Office of Budget, Planning, and Integration; Office of Communications and Publishing; Office of Science Quality and Integrity; Office of International Programs; Office of Diversity and Equal Opportunity; and the Office of Associate Chief Information Officer. The Deputy Director—Administration and

- Policy will implement the Director's policy and program objectives and provide direct line supervision over bureau-level science support activities.

- Establish a Chief Scientist position

  - The Chief Scientist, an SL position, will report to the USGS Director and will provide strategic scientific counsel (including analysis, planning, and coordination) to the USGS Director and the USGS Executive Leadership Team on scientific research and applications programs and projects that cross multiple USGS mission areas. The Chief Scientist will also serve as the USGS Executive Science Liaison within the Department of the Interior and with other Federal agencies.

- Change the name of the Office of Enterprise Information, within Science Support, to the Office of the Associate Chief Information Officer.

Consolidating Mission Areas – The budget proposes to realign USGS mission areas to ensure that programs of related focus and practice are managed within the same mission area, including aligning land imaging programs with other mapping programs, and integrating adaptation and landscape science into the biological science programs of the USGS.

The shift consolidates seven mission areas into five, which allows the USGS to eliminate several vacant positions and realign programs to leverage existing support staff. This reduces the number of USGS Associate Director positions from seven to five. This reduction of mission areas aligns with government-wide goals to improve efficiency and utilize resources and expertise that is readily available.

The budget proposes the following budget restructure:

Consolidation of the Land Resources and Environmental Health budget activities – The organizational restructure of the Land Resources and Environmental Health mission areas is proposed alongside the consolidation of the budget for these functions into programs where similar work is conducted. This includes aligning land imaging programs with other mapping programs, bringing together the two Environmental Health programs addressing contaminants and toxics with the existing contaminants-related team in Ecosystems, and consolidating adaptation and landscape science into the biological science programs of the USGS.

Restructure of the Water Resources Mission Area – This restructure aligns program operations into Water Resources Availability and Water Observing Systems programs to achieve integrated observation, understanding, prediction, and delivery of water science and information to the Nation.

The **Water Resources Availability Program** consolidates research and assessment activities from the existing Water Availability and Use Science, Groundwater and Streamflow Information, and National Water Quality programs. This subactivity would conduct integrated assessments, interpretive studies, and research to better understand the quantity, quality, and use components of water availability. In addition, this subactivity

would measure and estimate water budgets and develop models that decisionmakers can use as they manage the Nation's water resources.

The **Water Observing Systems Program** consolidates the data collection and monitoring activities of the existing Groundwater and Streamflow Information program, which is the funding source for the streamgage network, and the National Water Quality program. This subactivity would focus on enhancing and supporting observational networks that monitor water quantity and would also support monitoring of sediment, nutrients, and other contaminants that contribute to water quality.

Restructure of the Ecosystems Mission Area – This focuses USGS biological and ecological capabilities on providing science for natural resource management decisions by Federal, State, and Tribal agencies, with emphasis on Department of the Interior trust responsibilities for lands, species, and priority ecosystems to meet the needs for science in resource management decisions. The budget proposes a structure for the Ecosystems Mission Area to conduct work through four independent, yet integrated programs:

The **Species Management Research Program** conducts science to protect, conserve, and enhance species of fish and wildlife under trust responsibility of Interior bureaus and their partners. This subactivity would include funding from the following subactivities in the former structure: Status and Trends Program; Fisheries Program; Wildlife Program; and Environments Program. Additionally, activities of the Contaminant Biology and Toxic Substance Hydrology Program would be conducted in this subactivity.

The **Land Management Research Program** conducts science to effectively manage lands, waters, and ecosystems under trust responsibility of Interior bureaus and their partners. This subactivity would include funding from the following subactivities in the former structure: Status and Trends Program; Fisheries Program; Wildlife Program; and Environments Program. Additionally, any activities related to Biologic Carbon, formerly in the Land Change Science subactivity, would be in this new subactivity.

The **Biological Threats Research Program** conducts science to manage invasive species and wildlife diseases that pose significant ecologic, or economic threat to the resources of the United States. This subactivity would include funding from the following subactivities in the former structure: Fisheries Program; Wildlife Program; and Invasive Species Program.

The **Climate Adaptation Science Center** conducts science to understand climate and other stressors to the Nation's natural resources. It has two components: the National Climate Adaptation Science Center and Climate Research and Development. The work of Climate Adaptation Science Centers along with the Climate Research and Development Program and landscape science components of the Land Change Science program would be a part of this new subactivity. The subactivity would be integrated as both a program

and a science center and would continue to work directly with partners and stakeholders on issues of local concern.

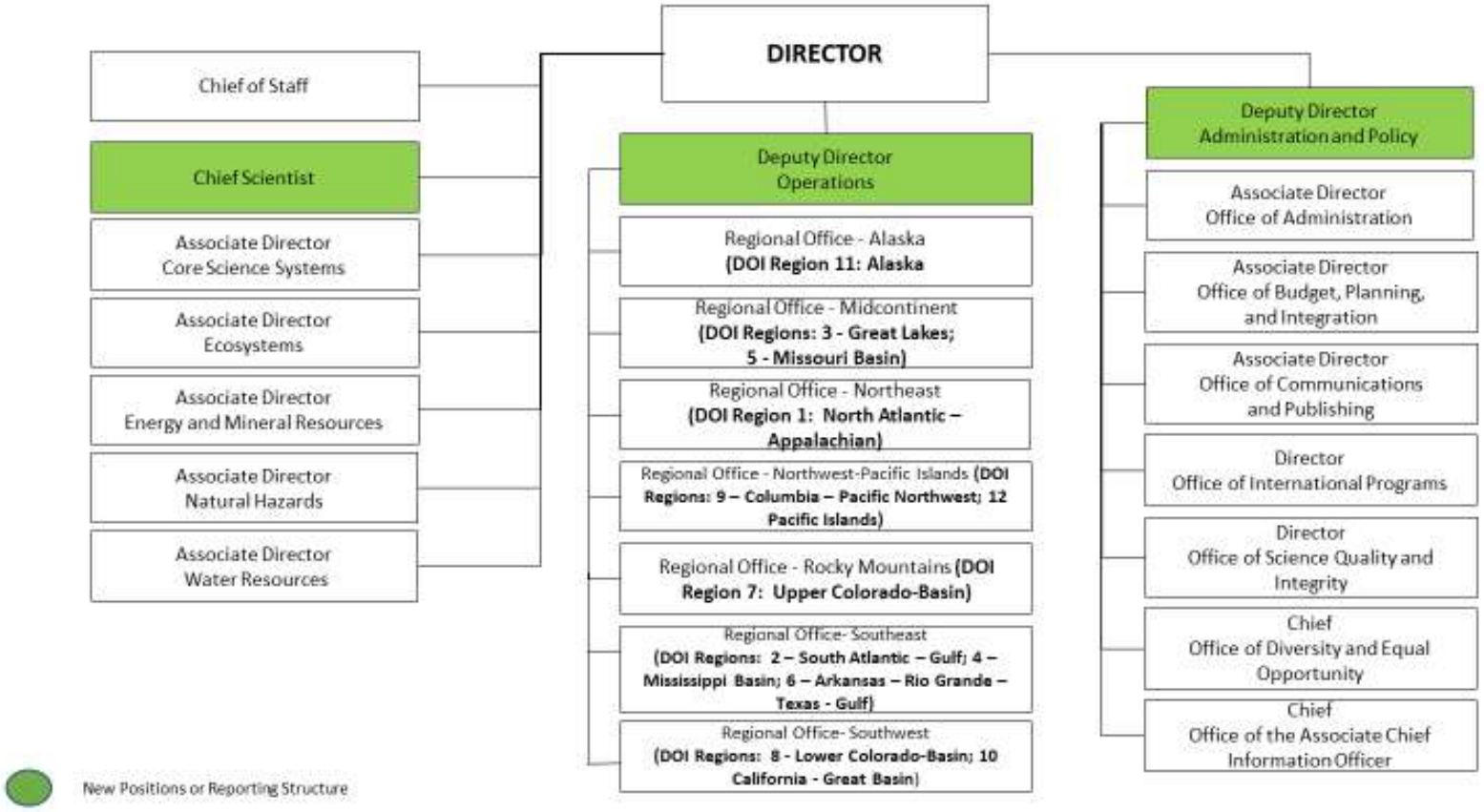
Consolidating research spread across five existing Ecosystem programs and similar activities from outside of the Ecosystems mission area will improve communication and provide clarity for project and program outcomes on the most pressing resource management issues of the Department and other Federal, State, and Tribal resource management agencies.

Restructure of the Core Science Systems Mission Area – To integrate the existing topographic, geologic, and biogeographic mapping and core science analysis and synthesis activities with the remote sensing and land change science assessment capabilities of the USGS, the restructure aligns the National Land Imaging Program and related elements of the Land Resources Mission Area into the Core Science Systems Mission Area.

The **National Land Imaging Program (NLI)**, including satellite operations and ground systems, integrates with the mapping and analytic activities of the National Geospatial Program (NGP). Combining NLI with NGP will support mapping accuracy enabled by cutting-edge technologies for land use planning, collaborative conservation, and hazard event risk characterization for communities and ecosystems. It includes the National Civil Applications Center and the Earth Resources Observation Science Center. Additionally, land cover monitoring and assessment activities are transferred into the National Land Imaging subactivity.

The **Science Synthesis, Analysis, and Research Program** integrates the risk and vulnerability assessments. This supports precise planning for recreational use on public lands; collaborative conservation with Interior partners; and hazard event risk characterization for communities and ecosystems.

The tables on the following pages show the program crosswalks from the existing mission areas into the new mission areas, including the mission area restructures proposed in the sections above.

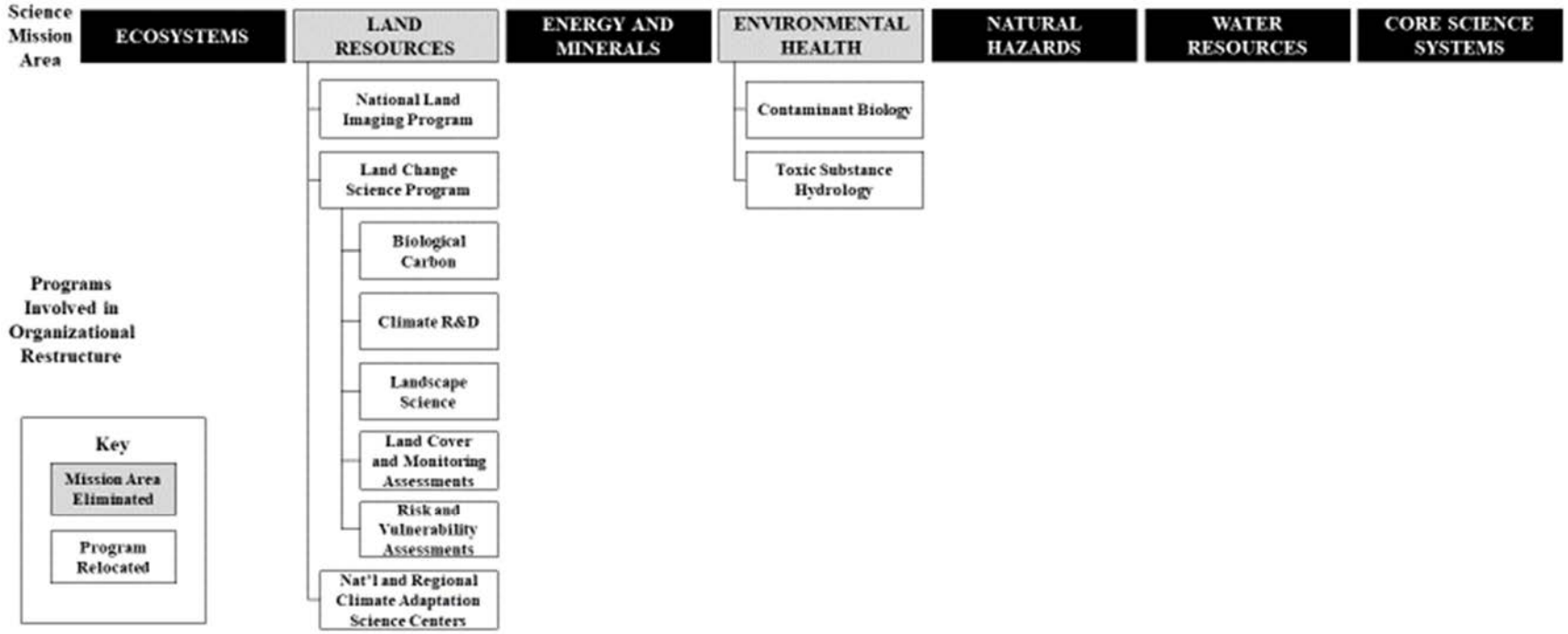

DIRECTOR
Chief of Staff
Chief Scientist
Associate Director Core Science Systems
Associate Director Ecosystems
Associate Director Energy and Mineral Resources
Associate Director Natural Hazards
Associate Director Water Resources
Deputy Director Operations
Regional Office - Alaska (DOI Region 11: Alaska
Regional Office - Midcontinent (DOI Regions: 3 - Great Lakes; 5 - Missouri Basin)
Regional Office - Northeast (DOI Region 1: North Atlantic – Appalachian)
Regional Office - Northwest-Pacific Islands (DOI Regions: 9 – Columbia – Pacific Northwest; 12 Pacific Islands)
Regional Office - Rocky Mountains (DOI Region 7: Upper Colorado-Basin)
Regional Office- Southeast (DOI Regions: 2 – South Atlantic – Gulf; 4 – Mississippi Basin; 6 – Arkansas – Rio Grande – Texas - Gulf)
Regional Office- Southwest (DOI Regions: 8 - Lower Colorado-Basin; 10 California - Great Basin)
Deputy Director Administration and Policy
Associate Director Office of Administration
Associate Director Office of Budget, Planning, and Integration
Associate Director Office of Communications and Publishing
Director Office of International Programs
Director Office of Science Quality and Integrity
Chief Office of Diversity and Equal Opportunity
Chief Office of the Associate Chief Information Officer
New Positions or Reporting Structure

2021 President's Budget Request Former Budget Subactivities Surveys, Investigations and Research $000s	Species Management Research Program	Land Management Research Program	Biological Threats Research Program	Climate Adaptation Science Center	Cooperative Research Units Program	Water Resources Availability Program	Water Observing Systems Program	Water Resources Research Act Program	National Land Imaging Program	National Geospatial Program	National Cooperative Geologic Mapping Program	Science Synthesis, Analysis and Research Program
	New Ecosystems Subactivities					New Water Resources Subactivities			New Core Science Systems Subactivities			
Ecosystems												
Status and Trends Program	9,093	5,580										
Fisheries Program	10,504	5,722	3,518									
Wildlife Program	14,976	8,336	8,341									
Environments Program	5,420	18,299										
Invasive Species Program			16,682									
Cooperative Research Units					0							
Land Resources												
National Land Imaging Program									79,571			
Land Change Science Program				11,090					6,342			1,921
National and Regional Climate Adaptation Science Centers				9,776								
Environmental Health												
Contaminant Biology Program												
Toxic Substances Hydrology Program												
Water Resources												
Water Availability and Use Science Program						33,433						
Groundwater and Streamflow Information Program							73,247					
National Water Quality Program						38,424	35,705					
Water Resources Research Act Program								0				
Core Science Systems												
National Geospatial Program										80,115		
National Cooperative Geological Mapping Program											21,757	
Science Synthesis, Analysis and Research Program												22,343
Total: USGS Realigned Programs	**39,993**	**37,937**	**28,541**	**20,866**	**0**	**71,857**	**108,952**		**85,913**	**80,115**	**21,757**	**24,264**

2020 Enacted Former Budget Subactivities Surveys, Investigations and Research $000s	Species Management Research Program	Land Management Research Program	Biological Threats Research Program	Climate Adaptation Science Center	Cooperative Research Units Program	Water Resources Availability Program	Water Observing Systems Program	Water Resources Research Act Program	National Land Imaging Program	National Geospatial Program	National Cooperative Geologic Mapping Program	Science Synthesis, Analysis and Research Program
	New Ecosystems Subactivities					New Water Resources Subactivities			New Core Science Systems Subactivities			
Ecosystems												
Status and Trends Program	11,090	5,616										
Fisheries Program	13,250	5,540	3,346									
Wildlife Program	24,208	12,276	9,473									
Environments Program	5,166	33,249										
Invasive Species Program			23,330									
Cooperative Research Units					24,000							
Land Resources												
National Land Imaging Program									98,894			
Land Change Science Program				19,153					7,971			1,921
National and Regional Climate Adaptation Science Centers				38,335								
Environmental Health												
Contaminant Biology Program	10,897											
Toxic Substances Hydrology Program	12,598											
Water Resources												
Water Availability and Use Science Program						47,487						
Groundwater and Streamflow Information Program						1,500	82,673					
National Water Quality Program						53,805	38,655					
Water Resources Research Act Program								10,000				
Core Science Systems												
National Geospatial Program										79,454		
National Cooperative Geological Mapping Program											34,397	
Science Synthesis, Analysis and Research Program												24,051
Total: USGS Realigned Programs	**77,209**	**56,681**	**36,149**	**57,488**	**24,000**	**102,792**	**121,328**	**10,000**	**106,865**	**79,454**	**34,397**	**25,972**

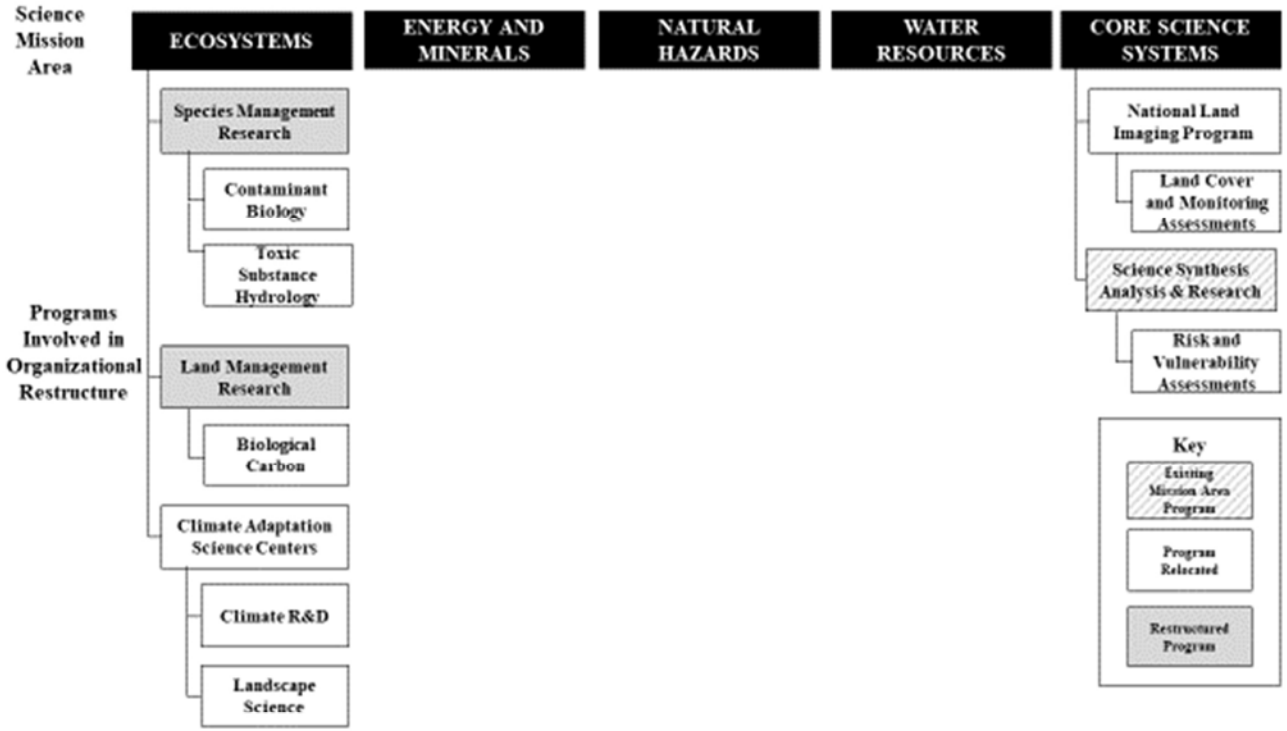
2019 Enacted Former Budget Subactivities Surveys, Investigations and Research $000s	Species Management Research Program	Land Management Research Program	Biological Threats Research Program	Climate Adaptation Science Center	Cooperative Research Units Program	Water Resources Availability Program	Water Observing Systems Program	Water Resources Research Act Program	National Land Imaging Program	National Geospatial Program	National Cooperative Geologic Mapping Program	Science Synthesis, Analysis and Research Program
	New Ecosystems Subactivities					New Water Resources Subactivities			New Core Science Systems Subactivities			
Ecosystems												
Status and Trends Program	11,990	6,383										
Fisheries Program	10,250	5,540	3,346									
Wildlife Program	24,208	12,276	8,773									
Environments Program	5,166	31,249										
Invasive Species Program			19,330									
Cooperative Research Units					18,371							
Land Resources												
National Land Imaging Program									98,894			
Land Change Science Program		5,025		44,488					7,971			1,921
National and Regional Climate Adaptation Science Centers				25,335								
Environmental Health												
Contaminant Biology Program	10,197											
Toxic Substances Hydrology Program	12,598											
Water Resources												
Water Availability and Use Science Program						45,487	0					
Groundwater and Streamflow Information Program						0	82,673					
National Water Quality Program						53,276	38,372					
Water Resources Research Act Program								6,500				
Core Science Systems												
National Geospatial Program										69,454		
National Cooperative Geological Mapping Program											24,397	
Science Synthesis, Analysis and Research Program												24,051
Total: USGS Realigned Programs	**74,409**	**60,473**	**31,449**	**44,488**	**18,371**	**98,763**	**121,045**	**6,500**	**106,865**	**69,454**	**24,397**	**25,972**

Current USGS Structure



Note: For simplicity of presentation, this exhibit only displays the programs involved in the organization restructure.

Proposed USGS Structure



Budget at a Glance (Dollars in Thousands)	2019 Actual	2020 Enacted	2021 Fixed Costs	2021 Internal Transfers	2021 Program Changes	2021 Request
Species Management Research	**[74,409]**	**[77,209]**	**1,015**	**77,209**	**-38,231**	**39,993**
Transfer from Status and Trends Program				*11,090*		
Transfer from Fisheries Program				*13,250*		
Transfer from Wildlife Program				*24,208*		
Transfer from Environments Program				*5,166*		
Transfer from Environmental Health Programs				*23,495*		
Museum Collections					*-500*	
Species-Specific Projects					*-5,886*	
Integrated Sensor Grants					*-250*	
Environmental Health Programs					*-23,295*	
Great Lakes Assessment Tools and Technology					*-3,000*	
Great Lakes Deepwater Monitoring					*-2,200*	
Changing Artic Ecosystems					*-3.600*	
Harmful Algal Blooms					*500*	
Land Management Research	**[60,473]**	**[56,681]**	**727**	**56,681**	**-19,471**	**37,937**
Transfer from Status and Trends Program				*5,616*		
Transfer from Fisheries Program				*5,540*		
Transfer from Wildlife Program				*12,276*		
Transfer from Environments Program				*33,249*		
Land and Water Management Projects					*-1,695*	
Contaminants					*-1,316*	
Habitat Projects					*-1,329*	
Chesapeake Bay					*-5,700*	
Everglades					*-5,850*	
Wyoming Landscape Conservation Initiative					*-1,297*	
Colorado Plateau					*-406*	
California Bay Delta					*-1,679*	
Platte River					*-199*	

Budget at a Glance (Dollars in Thousands)	2019 Actual	2020 Enacted	2021 Fixed Costs	2021 Internal Transfers	2021 Program Changes	2021 Request
Biological Threats Research	**[31,449]**	**[36,149]**	**517**	**36,149**	**-8,125**	**28,541**
Transfer from Fisheries Program				*3,346*		
Transfer from Wildlife Program				*9,473*		
Transfer from Invasive Species Program				*23,330*		
White Nose Syndrome					*-904*	
Coral Disease					*-400*	
Asian Carp					*-5,000*	
Chronic Wasting Disease					*-1,000*	
Greater Everglades Invasive Species					*-821*	
Climate Adaptation Science Center	**[44,488]**	**[57,488]**	**550**	**57,488**	**-37,172**	**20,866**
Transfer from Land Resources, Land Change Science Program (LR)				*19,153*		
Transfer from Land Resources, National & Regional Climate Adaptation Ctrs				*38,335*		
Landscape Science					*-2,213*	
Climate Research and Development					*-6,125*	
Arctic					*-528*	
Tribal Climate Adaptation Science					*-500*	
Realign Climate Adaptation Science Centers					*-23,806*	
Midwest Climate Science Center					*-4,000*	
Cooperative Research Units	**18,371**	**24,000**	**0**	**0**	**-24,000**	**0**
Transfer from CRU						
Cooperative Research Units					*-24,000*	
Status and Trends	**18,373**	**16,706**		**(16,706)**		
Transfer to Species Management Research Program				*(10,940)*		
Transfer to Land Management Research Program				*(5,766)*		
Fisheries Program	**19,136**	**22,136**		**(22,136)**		
Transfer to Species Management Research Program				*(13,250)*		
Transfer to Land Management Research Program				*(5,540)*		
Transfer to Biological Threats Research Program				*(3,346)*		
Wildlife Program	**45,257**	**45,957**		**(45,957)**		
Transfer to Species Management Research Program				*(24,208)*		
Transfer to Land Management Research Program				*(12,276)*		
Transfer to Biological Threats Research Program				*(9,473)*		

Budget at a Glance (Dollars in Thousands)	2019 Actual	2020 Enacted	2021 Fixed Costs	2021 Internal Transfers	2021 Program Changes	2021 Request
Environments Program	**36,415**	**38,415**		**(38,415)**		
Transfer to Species Management Research Program				*(5,166)*		
Transfer to Land Management Research Program				*(33,249)*		
Invasive Species	**19,330**	**23,330**		**(23,330)**		
Transfer to Biological Threats Research Program				*(23,330)*		
Total, Ecosystems	**156,882**	**170,544**	**2,809**	**80,983**	**-126,999**	**127,337**
National Land Imaging Program	**98,894**	**98,894**	**0**	**(98,894)**		
Transfer to Core Science Systems, National Land Imaging Program				*(98,894)*		
Land Change Science	**34,070**	**29,045**		**(29,045)**		
Transfer to Ecosystems, Climate Adaptation Science Center Program				*(19,153)*		
Transfer to Core Science Systems, Science Synthesis, Analysis and Research				*(1,921)*		
Transfer to Core Science Systems, National Land Imaging Program				*(7,971)*		
National Regional Climate Adaptation Science Centers	**25,335**	**38,335**		**(38,335)**		
Transfer to Ecosystems, Climate Adaptation Science Center Program				*(38,335)*		
Total, Land Resources	**158,299**	**166,274**		**(166,274)**	**0**	**0**
Mineral Resources Program	**58,969**	**59,869**	**795**	**0**	**0**	**60,664**
Energy Resources Program	**29,972**	**30,172**	**345**	**0**	**0**	**30,517**
Contaminant Biology Program	**10,197**	**10,397**	**0**	**(10,397)**		
Transfer to Ecosystems, Species Management Research Program				*(10,397)*		
Toxic Substances Hydrology Program	**12,598**	**13,098**	**0**	**(13,098)**		
Transfer to Ecosystems, Species Management Research Program				*(13,098)*		
Total, Energy and Mineral Resources, and Environmental Health	**111,736**	**113,536**	**1,140**	**(23,495)**	**0**	**91,181**
Earthquake Hazards	**83,403**	**84,903**	**636**	**0**	**-25,229**	**60,310**
Seismic Network					*-1,800*	
ShakeAlert Capital Investment, Operations, and Maintenance					*-17,229*	
ANSS Deferred Maintenance and Modernization					*-2,000*	
ANSS Regional Network Support					*-1,200*	
Earthscope Stations					*-3,000*	

Budget at a Glance (Dollars in Thousands)	2019 Actual	2020 Enacted	2021 Fixed Costs	2021 Internal Transfers	2021 Program Changes	2021 Request
Volcano Hazards	**30,266**	**30,266**	**429**	**0**	**-3,084**	**27,611**
Cooperative Agreement Awards					*-479*	
Next-Generation Lahar Detection System					*-2,145*	
Volcanic Ash Models					*-463*	
Landslide Hazards	**3,538**	**4,038**	**53**		**-484**	**3,607**
Hazards Assessment					*-484*	
Global Seismographic Network	**6,653**	**7,153**	**36**	**0**	**-1,792**	**5,397**
Stations Upgrades					*-1,792*	
Geomagnetism	**1,888**	**4,000**	**25**	**0**	**114**	**4,139**
Observatories Operations					*114*	
Coastal/Marine Hazards and Resources Program	**40,510**	**40,510**	**539**	**0**	**-4,114**	**36,935**
Characterizing Marine Hazards and Resources					*-1,967*	
Data Delivery					*-490*	
Coastal & Marine Ecosystem Health and Sustainability Assessment					*-1,657*	
Total, Natural Hazards	**166,258**	**170,870**	**1,718**	**0**	**-34,589**	**137,999**
Water Resources Availability Program	**[98,763]**	**[102,792]**	**1,291**	**102,792**	**-32,226**	**71,857**
Transfer from Water Availability and Use Science Program				*47,487*		
Transfer from Groundwater and Streamflow Information Program				*1,500*		
Transfer from National Water Quality Program				*53,805*		
Mississippi Alluvial Plain Aquifer Assessment					*-6,000*	
U.S.-Mexico Transboundary Aquifer Assessment					*-1,000*	
Water Use Data and Research					*-1,500*	
Cooperative Matching Funds - Water Use Research					*-1,000*	
Regional Water-Quality Assessments					*-4,100*	
Water-Quality Trends					*-458*	
Harmful Algal Blooms					*-1,348*	
National Park Service Water-Quality Partnership					*-1,743*	
Shallow and Fractured Bedrock Groundwater Research					*-300*	
Water Science Research and Development					*-12,368*	
Base Cooperative Matching Funds					*-606*	
Baseline Water-Quality Assessments of Transboundary Rivers					*-1,500*	
Regional Groundwater Evaluations					*-303*	

Budget at a Glance (Dollars in Thousands)	2019 Actual	2020 Enacted	2021 Fixed Costs	2021 Internal Transfers	2021 Program Changes	2021 Request
Water Observing Systems Program	**[121,045]**	**[121,328]**	**1,532**	**121,328**	**-13,908**	**108,952**
Transfer from Groundwater and Streamflow Information Program				*82,673*		
Transfer from National Water Quality Program				*38,655*		
Water Science Research and Development					*-2,102*	
Cooperative Matching Funds					*-2,365*	
National Groundwater Monitoring Network					*-2,395*	
Groundwater Quality Monitoring Networks					*-930*	
National Atmospheric Deposition Program					*-1,576*	
U.S.-Canada Transboundary Streamgages - Other Rivers					*-1,500*	
Next Generation Water Observing System					*-2,960*	
High Plains Aquifer Assessment					*-80*	
Water Resources Research Act Program	**6,500**	**10,000**	**0**	**0**	**-10,000**	**0**
Water Resources Research Act					*-10,00*	
Water Availability and Use Science Program	**45,487**	**47,487**		**(47,487)**		
Transfer to Water Resources Availability Program				*(47,487)*		
Groundwater and Streamflow Information Program	**82,673**	**84,173**		**(84,173)**		
Transfer to Water Resource Availability Program				*[1,500]*		
Transfer to Water Observing Systems Program				*(82,673)*		
National Water Quality Program	**91,648**	**92,460**		**(92,460)**		
Transfer to Water Resources Availability Program				*(53,805)*		
Transfer to Water Observing Systems Program				*(38,655)*		
Total, Water Resources	**226,308**	**234,120**	**2,823**	**0**	**-56,134**	**180,809**
National Geospatial Program	**69,454**	**79,454**	**661**	**0**	**0**	**80.115**
National Cooperative Geologic Mapping Program	**24,397**	**34,397**	**288**	**0**	**-12,928**	**21,757**
National Cooperative Geologic Mapping Program Projects					*-2,928*	
Phase 3 of National Geologic Map Database					*-10,000*	
Science Synthesis, Analysis and Research Program	**24,051**	**24,051**	**222**	**1,921**	**-1,930**	**24,264**
Transfer from Land Resource, Land Change Science Program				*1,921*		
USGS Library					*-1,930*	

Budget at a Glance (Dollars in Thousands)	2019 Actual	2020 Enacted	2021 Fixed Costs	2021 Internal Transfers	2021 Program Changes	2021 Request
National Land Imaging Program	**[98,894]**	**[98,894]**	**353**	**106,865**	**-21,305**	**85,913**
Transfer from Land Resources, National Land Imaging Program				*98,894*		
Transfer from Land Resources, Land Change Science Program				*7,971*		
Research and Investigations					*-7,556*	
Remote Sensing State Grants					*-1,215*	
Satellite Operations					*-10,905*	
Land Cover Monitoring Assessment Projects					*-1,629*	
Total, Core Science Systems	**117,902**	**137,902**	**1,524**	**108,786**	**-36,163**	**212,049**
Administration and Management	**80,881**	**74,881**	**1,341**	**0**	**-6,666**	**69,556**
Transfer of Ethics Office to Solicitor					*-1,094*	
Program Operations					*-5,572*	
Information Services	**21,947**	**21,947**	**170**	**0**	**2,500**	**24,617**
Virtual Communications Modernization (VTC)					*2,500*	
Total, Science Support	**102,828**	**96,828**	**1,511**	**0**	**-4,166**	**94,173**
Rental Payments and Operations & Maintenance	**105,219**	**104,719**	**2,741**	**0**	**8,602**	**116,062**
Realign Rent Costs					*8,602*	
Deferred Maintenance and Capital Improvement	**15,164**	**76,164**	**0**	**0**	**-64,589**	**11,575**
Facilities Modernization and Recapitalization					*-64,500*	
Space Consolidation and Modernization at the Colorado School of Mines					*3,600*	
Total, Facilities	**120,383**	**180,883**	**2,741**	**0**	**-55,987**	**127,637**
Total, Surveys, Investigations and Research	**1,160,596**	**1,270,957**	**14,266**	**0**	**-314,038**	**971,185**

Ecosystems

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[1]	Program Changes	Request	Change from 2020
Ecosystem	**229,190**	**251,527**	**2,809**	**-**	**(126,999)**	**127,337**	**(124,190)**
FTE	*1,153*	*[1,202]*	*-*	*-*	*(488)*	*714*	*(488)*
Species Management Research Program	**[74,409]**	**[77,209]**	**1,015**	**77,209**	**(38,231)**	**39,993**	**(37,216)**
FTE	*[394]*	*[395]*	*-*	*395*	*(161)*	*234*	*(161)*
Land Management Research Program	**[60,473]**	**[56,681]**	**727**	**56,681**	**(19,471)**	**37,937**	**(18,744)**
FTE	*[283]*	*[278]*	*-*	*278*	*(69)*	*209*	*(69)*
Biological Threats Research Program	**[31,449]**	**[36,149]**	**517**	**36,149**	**(8,125)**	**28,541**	**(7,608)**
FTE	*[165]*	*[192]*	*-*	*192*	*(31)*	*161*	*(31)*
Climate Adaptation Science Center	**[44,488]**	**[57,488]**	**550**	**57,488**	**(37,172)**	**20,866**	**(36,622)**
FTE	*[190]*	*[202]*	*-*	*202*	*(92)*	*110*	*(92)*
Cooperative Research Units	**18,371**	**24,000**	**0**	**0**	**(24,000)**	**[0]**	**(24,000)**
FTE	*121*	*135*	*-*	*135*	*(135)*	*0*	*(135)*
Status and Trends Research Program	**18,373**	**16,706**	**-**	**(16,706)**	**-**	**-**	**-**
FTE	*90*	*79*	*-*	*79*			
Fisheries Program	**19,136**	**22,136**	**-**	**(22,136)**	**-**	**-**	**-**
FTE	*116*	*124*	*-*	*124*			
Wildlife Program	**45,257**	**45,957**	**-**	**(45,957)**	**-**	**-**	**-**
FTE	*224*	*246*	*-*	*246*			
Environments Program	**36,415**	**38,415**	**-**	**(38,415)**	**-**	**-**	**-**
FTE	*170*	*183*	*-*	*183*			
Invasive Species Program	**19,330**	**23,330**	**-**	**(23,330)**	**-**	**-**	**-**
FTE	*97*	*122*	*-*	*122*			

The 2021 budget request for Ecosystems is $127,337,000 and 714 FTE. The budget does not request funding for projects that have provided sufficient scientific information to meet Interior land and species management responsibilities.

[1] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

The Ecosystems Mission Area provides science and decision support for land and species management; development of energy and mineral resources on Interior-managed lands; reducing risks from hazards; and adaptation to changing environments.

The USGS provides high-quality science to inform management for harvested species, threatened and endangered species, at-risk species and species of management concern, and their habitats. The USGS works with many Federal, State, local, and Tribal partners to sustain hunting, fishing, and wildlife-related recreational activities. USGS provides information to resource managers to make better decisions for lands and waters and manage habitats and associated species. The program uses advanced technologies and methods such as remote sensing, machine learning and artificial intelligence, data visualization, and crowdsourcing, to produce actionable information for stakeholders.

The four programs of the Ecosystems Mission Area support 16 Ecological Science Centers, a national Climate Adaptation Science Center, and 50 Biological Field Stations where USGS scientists work directly with resource managers to address high priority management questions.

Species Management Research Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[2]	Program Changes	Request	Change from 2020
Species Management Research Program	**[74,409]**	**[77,209]**	**1,015**	**77,209**	**(38,231)**	**39,993**	**(37,216)**
Museum Collections	*[500]*	*[500]*			*(500)*	*[0]*	
Species-Specific Projects	*[15,165]*	*[14,015]*			*(5,886)*	*[8,129]*	
Integrated Sensor Grants	*[0]*	*[250]*			*(250)*	*[0]*	
Environmental Health Research	*[22,595]*	*[23,295]*			*(23,295)*	*[0]*	
Great Lakes Fisheries Assessment Tools and Technology	*[0]*	*[3,000]*			*(3,000)*	*[0]*	
Great Lakes Deepwater Monitoring	*[4,100]*	*[4,100]*			*(2,200)*	*[1,900]*	
Changing Arctic Ecosystems	*[3,600]*	*[3,600]*			*(3,600)*	*[0]*	
Harmful Algal Blooms	*[200]*	*[200]*			*500*	*[700]*	
FTE	**[394]**	**[395]**			**(161)**	**234**	**(161)**

Program Description

The Species Management Research Program provides science to protect and conserve species that are important to the American public, with a particular focus on Interior trust responsibilities. This science improves conservation actions, can reduce the need for more restrictive protections of species and habitat, and supports population recovery and sustainability. There are two components within the Species Management Research Program:

- ***Species Biology*** is science to protect, conserve, and enhance species under trust responsibility of Interior and its partners.
- ***Species Stressors*** is research into the cause and mitigation of environmental and anthropogenic stressors that may affect the health and sustainability of species of management concern. Species stressors include development, fire, drought, extreme storms, invasive species and disease, contaminants, and land use change.

[2] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

2021 Activities

The 2021 budget supports:

- Research and decision-support tools that address the science needs of the Fish and Wildlife Service (FWS) 7-Year Listing Workplan to support listing, delisting, downlisting and recovery decisions.

- Establishing linkages among environmental and ecological drivers of algal blooms and toxin release, quantifying the health risks to fish and wildlife due to algal toxin exposures, and monitoring and assessing bloom extent and toxin occurrence.

- Species biology and stressors research to address the specific science needs of resource managers at Interior bureaus including FWS, National Park Service (NPS), and Bureau of Ocean Energy Management (BOEM). This includes continuing research related to spotted owl recovery, including the effectiveness of barred owl removal.

- Developing information, technologies, and monitoring protocols to reduce conflict with wildlife, streamline development, and comply with applicable laws and regulations when designing energy and infrastructure projects.

2021 Program Change Summary

The 2021 budget request for the Species Management Research Program is $39,993,000 and 234 FTE, which includes:

- Museum Collections (-$500,000 and -4 FTE)
- Species-Specific Projects (-$5,886,000 and -7 FTE)
- Integrated Sensor Grants (-$250,000 and 0 FTE)
- Environmental Health Programs (-$23,295,000 and -121 FTE)
- Great Lakes Fisheries Assessment Tools and Technology (-$3,000,000 and -8 FTE)
- Great Lakes Deepwater Monitoring (-$2,200,000 and -15 FTE)
- Changing Arctic Ecosystems (-$3,600,000 and -24 FTE)

The budget does not request funding for these activities in order to address other priorities.

- Harmful Algal Blooms (+$500,000 and +4 FTE)

Program Overview

The program produces research that improves the ability of managers to anticipate, adapt to, and alleviate the impacts of natural stressors to make better decisions about hunting and fishing regulations, land use, and water allocation. In support of the FWS workplan for Endangered Species Act (ESA) listing decisions, USGS conducts research to address key uncertainties in aquatic and terrestrial species population status to inform management decisions. This work will facilitate proactive and collaborative conservation between Interior and State fish and wildlife management agencies and other stakeholders and partners.

The USGS maintains robust research portfolios on manatees, sea otters, walrus, and polar bears in support of Interior's management responsibility for these species. USGS science informed recent U.S. Fish and Wildlife Service (FWS) Endangered Species Act determinations not to list walrus and to down-list manatees from Endangered to Threatened.

The USGS provides the management-relevant scientific information on migratory bird populations and trends used by Flyway Councils to develop recommendations on waterfowl harvest.

In fulfillment of Interior's responsibility under the 1954 Convention on Great Lakes Fisheries for technical support for multi-jurisdictional fisheries, harvest, and allocation, the USGS maintains a fleet of modern research vessels in the Great Lakes and conducts fish population surveys and fisheries research including the development and application of advanced technologies such as remote sensing and molecular genetics to assess population status and health.

Land Management Research Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[3]	Program Changes	Request	Change from 2020
Land Management	**[60,473]**	**[56,681]**	**727**	**56,681**	**(19,471)**	**37,937**	**(18,744)**
Land and Water Management Projects	*[8,423]*	*[7,656]*			*(1,695)*	*5,961*	
Contaminants	*[2,000]*	*[2,000]*			*(1,316)*	*684*	
Habitat Projects	*[2,788]*	*[2,788]*			*(1,329)*	*1,459*	
Chesapeake Bay	*[3,700]*	*[5,700]*			*(5,700)*	*[0]*	
Everglades	*[5,850]*	*[5,580]*			*(5,850)*	*[0]*	
Wyoming Landscape Conservation Initiative	*[1,297]*	*[1,297]*			*(1,297)*	*[0]*	
Colorado Plateau	*[406]*	*[406]*			*(406)*	*[0]*	
California Bay-Delta	*[1,679]*	*[1,679]*			*(1,679)*	*[0]*	
Platte River	*[199]*	*[199]*			*(199)*	*[0]*	
FTE	**[283]**	**[278]**		**278**	**(69)**	**209**	**(69)**

Program Description

The Land Management Research Program provides science to understand natural and human influences on lands, waters, and ecosystems to help resource managers balance land uses, resolve and avoid resource management conflicts, enhance and maintain trust lands, and keep communities safe. There are two components within the Land Management Research Program:

- ***Priority Landscapes*** – Current areas of focus include Interior-managed lands, and priority ecosystems, including the Great Lakes and Sage-Steppe.
- ***Management and Restoration*** – This information supports adaptive management and maximizes returns on restoration and conservation investments.

2021 Activities

The 2021 budget request supports:

- Providing science to understand critical migratory corridors and habitats for big game species in the West.

[3] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

- Developing a set of tools that will reduce the spread of invasive annual grasses, thereby helping manage the risk of wildfire, and improve restoration of sagebrush ecosystems.
- Developing datasets and tools used by fire and land management agencies to predict and suppress fire and to restore fire-damaged lands.
- Developing science and tools to inform energy development strategies that will help guide domestic energy development to areas of high resource potential and low environmental concern.
- Providing science to understand the most cost-effective and successful land and water conservation and reclamation practices.

2021 Program Change Summary

The 2021 budget request for the Land Management Research Program is $37,937,000 and 209 FTE, which includes:

- Land and Water Management Projects (-$1,695,000 and -15 FTE)
- Contaminants (-$1,316,000 and -2 FTE)
- Habitat Projects (-$1,329,000 and -10 FTE)
- Chesapeake Bay (-$5,700,000 and -7 FTE)
- Everglades (-$5,850,000 and -11 FTE)
- Wyoming Landscape Conservation Initiative (-$1,297,000 and -9 FTE)
- Colorado Plateau (-$406,000 and -3 FTE)
- California Bay-Delta (-$1,679,000 and -11 FTE)
- Platte River (-$199,000 and -1 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The Land Management Research informs how land and water management activities on Interior lands influence terrestrial, aquatic, coastal and estuarine habitats. The program develops decision-support tools to reduce economic and environmental impacts of hazards, with a particular emphasis on decision-support for Interior-managed lands that improves landscapes resistance to and recovery from fire. The program also provides science to improve coastal resilience and recovery after major storms.

The Land Management Research Program continues to solve challenges in ecologically sensitive areas, including the Great Lakes, Sage Steppe, and Southwest deserts. The USGS is facilitating adaptive management and increasing the cost effectiveness of future management actions.

The program supports energy development across the Nation, including providing science that reduces conflict around oil and gas, solar, wind, and hydropower development and operation. USGS-led collaborative activities such as those in the American Southwest provide science on effective strategies to support restoration and rehabilitation planning and implementation by Interior and other agencies in sensitive dryland ecosystems.

The USGS is working with Interior bureaus and Western States to develop maps and analyze datasets to improve understanding of how large game animals such as elk and mule deer use winter and summer habitats and migrate seasonally across the landscape. Federal and State land managers are using this information to preserve wildlife corridors that effectively conserve and protect these animals during migrations and reduce the incidence of vehicle collisions that pose economic and public safety concerns.

The program funds research, decision science, and adaptive management support to Interior bureaus to identify, maintain, and improve habitat to reach species management goals for federally-listed species as well as species of management responsibility including migratory birds and fish. The program also provides research to support decision-making designed to prevent the need for species to be listed, and to better provide recreational hunting and fishing opportunities to the American public.

Biological Threats Research Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[4]	Program Changes	Request	Change from 2020
Biological Threats Research Program	**[31,449]**	**[36,149]**	**517**	**36,149**	**(8,125)**	**28,541**	**(7,608)**
White Nose Syndrome	*[3,284]*	*[3,784]*			*(904)*	*[2,880]*	
Coral Disease	*[200]*	*[400]*			*(400)*	*[0]*	
Asian Carp	*[7,620]*	*[10,620]*			*(5,000)*	*[5,620]*	
Chronic Wasting Disease	*[720]*	*[1,720]*			*(1,000)*	*[720]*	
Greater Everglades Invasive Species	*[1,978]*	*[1,978]*			*(821)*	*[1,157]*	
FTE	**[165]**	**[192]**		**192**	**(31)**	**161**	**(31)**

Program Description

The Biological Threats Research Program provides essential research, data, detection and management methods, and decision-support tools to help resource managers reduce the threat of invasive species and fish and wildlife disease. The USGS works closely with Interior and other Federal, State, local, and Tribal management partners to provide actionable science to prevent, identify, detect, contain, manage, or eradicate invasive species, and fish and wildlife diseases that pose significant economic or ecological threats to the resources of the United States. There are two components within the Biological Threats Research Program:

- ***Invasive Species*** – Research, monitoring, and technology development to detect, contain, or eradicate invasive species with potential to cause significant ecological or economic damage.
- ***Fish and Wildlife Disease*** – Investigations into national and regional fish and wildlife mortality events and research on disease ecology, risk assessment, surveillance, impacts, control, and decision support to Federal, State, and Tribal wildlife management agencies.

[4] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

There is strong concern among States that invasive Asian carp will continue to spread in the Upper Mississippi River, Tennessee and Cumberland River basins and into the Great Lakes where they could pose a serious threat to the $7.0 billion recreational and commercial Great Lakes fishery, and potentially waterfowl populations in the region.

2021 Activities

The 2021 budget request supports:

- Conducting science to manage invasive species and fish and wildlife diseases that pose significant ecological, human health, or economic threats to the resources of the United States.
- Providing biosurveillance of wildlife diseases and aquatic invasive species by improving information and data delivery on monitoring and species occurrences through online databases and information systems.
- Use of the Nonindigenous Aquatic Species database to track the distribution and spread of new and existing aquatic invaders, continue to add information, and make this information available to the public.
- Advancement and implementation of USGS Asian carp science to create a robust set of tools for early detection, risk assessment, and containment of Asian carp.
- Research on White Nose Syndrome (WNS) and susceptible hibernating bat species to support implementation of the WNS National Plan, including pilot field trials of a potential WNS vaccine.
- Strengthening of national wildlife disease management strategies and outcomes by advancing knowledge, best-practices, and management tools to promote adaptive management for diseases that pose significant ecological or economic harm to the United States.

2021 Program Change Summary

The 2021 budget request for the Biological Threats Research Program is $28,541,000 and 161 FTE, which includes:

- White Nose Syndrome (-$904,000 and -1 FTE)
- Coral Disease (-$400,000 and -2 FTE)
- Asian Carp (-5,000,000 and -17 FTE)
- Chronic Wasting Disease (-$1,000,000 and -5 FTE)
- Greater Everglades Invasive Species (-$821,000 and -6 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The Biological Threats Program develops decision-support tools and technologies to detect, monitor, assess risk, and control nationally significant invasive species and fish and wildlife diseases. Research and technology development focus on species that have potential to cause significant economic or ecologic, concerns. A strong emphasis of the program is technology transfer to management agencies.

The USGS optimizes traditional monitoring and develops new tools, such as molecular markers, for early detection to reduce the damage and spread of invasive species. A focus of USGS research is to integrate control strategies to empower land and water managers to respond quickly and effectively to a wide variety of new invasions.

In response to the continued threat Asian carp pose in the Mississippi, Tennessee and Cumberland River basins, as well as the Great Lakes, the USGS is developing and refining genetic tools for detection and containment and control tools. A priority of the work is combined implementation of tools to decrease cost and increase potential for success.

The program conducts multi-scale, integrated assessments to map and monitor infestations of invasive plants in the West to predict areas most vulnerable to invasive species. In addition, the program examines the effects of management practices and natural disturbances on invasive species and evaluates how invasive plants alter the frequency and intensity of wildfires. Results will allow managers to reduce the risks posed by wildfire.

The program also assesses mass mortalities and develops fish and wildlife disease management tools for species, such as salmon, sturgeon, trout, whitefish, and mussels. This work enhances biosurveillance of aquatic diseases by improving information and data delivery on monitoring and species occurrences through field and lab research, online databases, and information systems to advance our understanding of the complex interactions that influence disease outbreaks. The USGS investigations into marine diseases impacting sea turtles, and other organisms support FWS, NPS and National Oceanic and Atmospheric Administration (NOAA) species management. By understanding disease patterns and processes, the science is being used by managers to take actions to improve the health of threatened or endangered fish populations.

The USGS is investigating vector-borne diseases of concern to Interior and other Federal agencies. Plague was one of eight zoonotic diseases prioritized by Centers for Disease Control and Prevention (CDC), US Department of Agriculture (USDA), and Interior that need to be addressed by the Federal government with a One Health approach. Endangered black-footed ferrets, prairie dogs, domestic and wild cats, as well as humans, can die from sylvatic plague, a flea-borne bacterial disease. The USGS is investigating the ecology of the plague and harnessing that information to develop and adapt integrated pest management tools, such as a novel vaccine, for natural resource managers for this and other wildlife diseases.

The technology behind the plague vaccine is being used by the USGS to develop a White Nose Syndrome (WNS) vaccine for bats. WNS has killed millions of bats across the United States causing significant negative effects on agriculture and potentially increasing the spread of insect-borne diseases.

Climate Adaptation Science Center

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[5]	Program Changes	Request	Change from 2020
Climate Adaptation Science Center	**[44,488]**	**[57,488]**	**550**	**57,488**	**(37,172)**	**20,866**	**(36,622)**
Landscape Science	*[2,213]*	*[2,213]*			*(2,213)*	*[0]*	
Climate Research and Development	*[16,940]*	*[16,940]*			*(6,125)*	*[10,815]*	
Arctic	*[3,647]*	*[3,647]*			*(528)*	*[3,119]*	
Tribal Climate Adaptation Science	*[500]*	*[500]*			*(500)*	*[0]*	
Realign Climate Adaptation Science Centers	*[21,188]*	*[30,188]*			*(23,806)*	*[6,382]*	
Midwest Climate Science Center	*[0]*	*[4,000]*			*(4,000)*	*[0]*	
FTE	**[190]**	**[202]**		**202**	**(92)**	**110**	**(92)**

Program Description

The Climate Adaptation Science Center delivers science to support the development of adaptive management plans that incorporate environmental changes and their impacts on fish, wildlife, water, land, and people. It provides knowledge for resource managers addressing challenges threatening natural resources and determining land use decisions. The program's science helps safeguard the health of fish, wildlife, and lands for the benefit of current and future generations.

There are two components within the Climate Adaptation Science Center Subactivity:

- The ***Climate Adaptation Science Center*** focuses on understanding the effects of changing climate on natural resources, reducing uncertainty about those effects, and improving adaptation strategies.
- The ***Climate Research and Development*** component generates long-term data and interpretations on the impacts of changing climate and land use on critical habitats and combines USGS expertise in multiple disciplines to document patterns of change over a range of timescales.

[5] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

2021 Activities

The 2021 budget request supports:

- Conducting science to understand and manage impacts of climate, land use, and other environmental stressors to the Nation's natural resources.
- Providing national syntheses on climate-related priority topics, such as sea level rise and coastal inundation, wildfires, wildlife disease, transformational drought, and climate impacts on federally-listed species or critical habitat.

2021 Program Change Summary

The 2021 combined budget request for the program is $20,866,000 and 110 FTE, which includes:

- Landscape Science (-$2,213,000 and -4 FTE)
- Climate Research and Development (-$6,125,000 and -44 FTE)
- Arctic (-$528,000 and -4 FTE)
- Tribal Climate Adaptation Science (-$500,000 and -4 FTE)
- Realign Climate Adaptation Science Centers (-$23,806,000 and -32 FTE)
- Midwest Climate Science Center (-$4,000,000 and -4 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The program provides information, tools, and applications to meet current and emerging challenges that threaten the sustainability of natural resources. The program serves as an interface between Federal researchers, land managers, and front-line stewards of natural and cultural resources.

The scientific work conducted is responsive to the following guiding principles:

- Meets the needs of resource managers.
- Prioritizes evaluation, translation, and synthesis of climate-impact research findings.
- Promotes rigorous and integrated research to advance fundamental understanding of climate impacts to fish and wildlife resources.
- Develops approaches to ensure broad dissemination of results to the public and foster professional scrutiny, critique, and learning.
- Promotes institutional efficiencies through partnerships to avoid duplication of effort and leverage opportunities in climate-impact research.

The program synthesizes and analyzes the effects of a changing climate on terrestrial and aquatic communities and natural resources at regional to national scales. The program focuses on the highest priorities of Interior, such as wildfires, wildlife disease, drought, and their effects on federally-listed species or critical habitat, recreational fisheries, migratory corridors, and Tribal lands and waters.

The Climate Research and Development program provides core data to understand and forecast how ecosystems and key habitats respond to a range of climate and environmental changes. The program

conducts research to advance the understanding of the physical, chemical, and biological components of the Earth system, the rates, causes, and consequences of climate and land use change, and the vulnerability and resilience of critical habitats to such changes. Climate Research and Development program researchers draw on expertise in past and present geology, biology, hydrology, and geography to document patterns of change on daily and longer timescales. These data are used to assess and better anticipate impacts of a range of changes over local, regional, and national scales. These efforts provide land managers and policy makers with real-world data on the response of critical ecosystems to a variety of changes.

The science in the Climate Research and Development program covers changes in land use, environment, and precipitation and temperatures that can have significant impacts on our Nation's natural resources, infrastructure, and water, energy, and food security. The program currently focuses on: long-term patterns and impacts of droughts and floods; response of coastal regions to changing land use, water management, and sea level; patterns and impacts of drought, fire, and other stressors on mountain ecosystems; and patterns and impacts of change on Arctic habitats. These efforts provide data to better understand how different forces shape the landscape, distinguish between changes resulting from natural forces from those associated with land management, and provide the scientific basis for land use decisions that affect the safety and prosperity of communities and our Nation's natural resources.

Energy and Mineral Resources

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Energy and Minerals Resources	**88,941**	**90,041**	**1,140**	**-**	**-**	**91,181**	**1,140**
FTE	*417*	*417*	-	-	-	*417*	-
Minerals Resources Program	**58,969**	**59,869**	**795**	**-**	**-**	**60,664**	**795**
FTE	*291*	*291*	-	-	-	*291*	-
Energy Resources Program	**29,972**	**30,172**	**345**	**-**	**-**	**30,517**	**345**
FTE	*126*	*126*	-	-	-	*126*	-

The 2021 budget request for the Energy and Mineral Resources Mission Area is $91,181,000 and 417 FTE. The Energy and Mineral Resources Mission Area conducts scientific research, completes energy and mineral resource assessments, and compiles information and statistics on the worldwide supply and flow of minerals, including critical minerals, and materials essential to our economy and national security.

Energy and mineral resources are vital components of the Nation's economy. The United States is currently 100 percent dependent on foreign nations for 16 different mineral commodities, including multiple minerals that are critical for national security and economic growth. The Nation depends on energy to power homes and businesses, as well as minerals to manufacture products such as cell phones, laptops, cars and renewable energy technologies such as electric vehicles and wind turbines. As demands for energy and mineral resources grow, the USGS research and assessments become increasingly critical for understanding the occurrence, quality, supply, and use of national and global resources. The in-depth science provided by the USGS Energy and Mineral Resources Mission Area informs strategic, evidence-based economic and geopolitical decisions and facilitates responsible natural resource development.

In 2021, the Energy and Mineral Resources Mission Area will build on its partnership with the U.S. Department of Energy for new research and development into geologic energy resources such as gas hydrates and geothermal energy, and to modernize the Nation's understanding of the subsurface through acquisition of new foundational geoscience data and new data science approaches to quantify the domestic critical mineral base. These collaborations bring together the two agencies' expertise in geoscience and technology in support of direction on energy, minerals, data, and innovation provided in the White House Office of Management Budget (OMB) and Office of Science and Technology Policy (OSTP) "Fiscal Year 2021 Administration Research and Development Budget Priorities" (OMB Management Memo M-19-25, August 30, 2019), Executive Order 13859, Executive Order 13783, Executive Order 13817, Secretarial Order 3352, and Secretarial Order 3359.

Minerals Resources Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Minerals Resources Program	58,969	59,869	795	-	-	60,664	795
FTE	291	291	-	-	-	291	-

Program Description

The Mineral Resources Program (MRP) is the sole Federal source of scientific information and research on nonfuel mineral potential, production, consumption, and interaction with the environment. The MRP supports data collection and research on a wide variety of nonfuel mineral resources that are critical to the economic stability and national security of the United States.

2021 Activities

The 2021 budget request supports:

- Collection, analysis, and dissemination of minerals information and materials flow studies.
- Research on new sources of critical minerals and on the lifecycles of critical minerals.
- Research to understand the genesis and distribution of critical mineral resources throughout the Nation by collecting, preserving and disseminating geological, geochemical, and geophysical data and initiating qualitative and quantitative mineral assessments.
- A nationwide program (Earth Mapping Resources Initiative; Earth MRI) of prioritized topographic, geologic, and geophysical mapping to enhance understanding of the Nation's mineral resource potential.
- Ongoing investments to revitalize the workforce, including a training program to update early- and mid-career USGS scientists' skills in mineral resource assessment techniques, and establish a mechanism to continuously update those techniques to incorporate new data and methods.
- A review and update, as necessary, of the May 2018 Critical Minerals List.
- Maintaining and continuing the development of the laboratory quality management system (QMS) implemented across the Energy and Mineral Resources Mission Area.

2021 Program Change Summary

The 2021 budget request for the Mineral Resources Program is $60,664,000 and 291 FTE.

There are no program changes for the Mineral Resources Program.

Program Overview

The USGS MRP identifies and characterizes non-fuel mineral resources important to our Nation's economy, security and way of life. Through the Earth Mapping Resources Initiative (MRI), the program and its Federal and State partners are working to modernize the Nation's understanding of the subsurface, using geologic, geochemical, geophysical, and remote sensing surveys, in conjunction with the program's many existing databases of minerals-related information, to characterize the mineral resources of the United States. These data will also be highly beneficial for infrastructure, transportation, and land-use planning; hazard assessments for landslides, volcanoes, and floods; water resources management; emergency response, and more.

The program also has unique expertise in the flow of resources through the global economy as both commodity and waste and has committed under Executive Order 13817 (December 2017) and the Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals (June 2019) to improve the Nation's understanding of the potential for deriving value from mineral wastes.

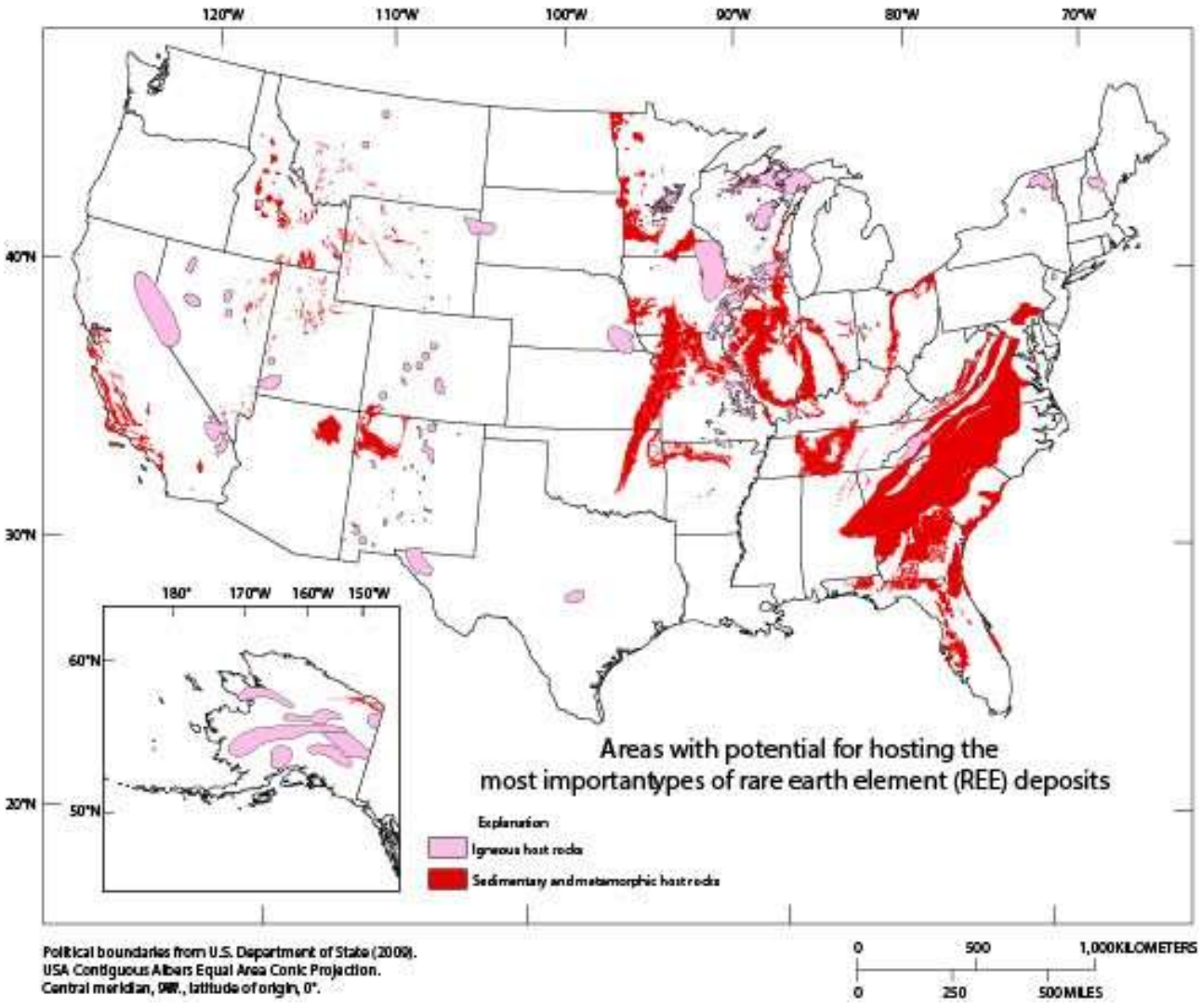
At the end of 2019, the United States was 100 percent reliant on foreign imports for 16 minerals, and at least 50 percent reliant on foreign imports for another 32 minerals. Research by the USGS helps to define and forecast these dependencies and to inform Federal decision makers about how to address them. Furthermore, a scientific understanding of how minerals interact with the environment informs the management of our public lands and resources and is used for protecting and improving public health and safety.

Much of the MRP's work currently focuses on critical minerals research and surveys to better inform the public, industry, land managers and policy makers about domestic critical mineral resources. This includes $10.6 million for Earth MRI which delivers on the USGS responsibility to improve the topographic, geological, and geophysical mapping of the United States, and make the resulting data and metadata electronically accessible. Pursuant to E.O. 13817 "*A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals*", the Department of the Interior published a list of 35 critical minerals in the Federal Register (83 FR 23295) in May 2018, based on a methodology developed by the USGS. Collectively, the MRP's proposed 2021 work on critical minerals totals about $31.4 million.

MRP's National Minerals Information Center (NMIC) collects, analyzes, and disseminates data that document production and consumption for about 100 mineral commodities, both domestically and internationally, for 180 countries. The data provide decision makers with information to ensure that the Nation has an adequate and dependable supply of minerals and mineral materials to meet its defense and economic needs at acceptable costs. The public and private sectors use this information to understand the use and ultimate disposition of materials in the economy and to forecast supply and demand. These data are used to formulate plans to address shortages and interruptions in minerals supplies, and to develop strategies for maintenance of a competitive position in the global economy. The NMIC will continue to annually provide hundreds of reports such as the

Minerals Commodity Summaries, the Minerals Yearbook, the Mineral Industry Surveys, Metal Industry Indicators, and the Nonmetallic Mineral Products Industry Indexes. These and other MRP informational products, along with sound analysis from minerals and materials analysis specialists and program scientists, allow for decision makers and stakeholders to understand the changes and importance of mineral resource production, consumption, and use. The NMIC will continue to provide high quality information and analyses that inform Federal critical minerals policy and are of paramount importance to U.S. national security and trade interests.

MRP, in conjunction with the National Science and Technology Council's Critical Minerals Subcommittee, was instrumental in developing a tool for assessing the criticality of mineral commodities that informed the development of the list of 35 critical minerals. In accordance with the interagency "Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals" (June, 2019), the NMIC will continue to refine its criticality assessment methodologies and revisit and update, as necessary, the May, 2018 Critical Minerals List in 2021.



Earth MRI focus areas for nonfuel, Rare Earth Element-bearing mineral deposit types. Modified from Dicken and others (2019)

USGS efforts through Earth MRI are improving the topographic, geological, and geophysical mapping of the United States. At the launch of Earth MRI in 2019, only about 5 percent had been covered by aeromagnetic surveys, and currently 20 percent of the United States had been geologically mapped at a detailed (1:24,000, i.e., 1 inch = 2,000 feet) scale, of an appropriate quality for mineral and energy exploration or for land-use planning. USGS geologic, geophysical, and geochemical research is enabling and improving the assessment of undiscovered mineral resources, most of which are not easily identified at the Earth's surface because they are hidden by non-mineral bearing rocks, soils, or dense vegetation. Geophysical techniques allow geologic units and structures beneath the Earth's surface to be mapped and provide data that can be used to develop three-dimensional models to understand how mineral resources are distributed. Innovative new geochemical tools and methods also are being developed by MRP to reduce uncertainty in mineral resource assessments. Earth MRI efforts in 2019 focused on areas with potential for rare earth elements. New mapping in both 2020 and 2021 will continue to focus on rare earth elements, along with ten additional critical minerals.

USGS mineral assessments enable land managers and decision makers to make more informed decisions for land use planning and management of mineral resources. Under the interagency "Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals" (June, 2019), the USGS will deliver at least one national or regional domestic multi-commodity critical mineral resource assessment every two years, starting in 2021.

The USGS supports development of tools and techniques designed to understand what happens when mineral deposits are weathered or mined. Mineral environmental assessments use knowledge of mineral deposits to anticipate environmental challenges associated with legacy mines and the effects of developing new mineral deposits, providing specific information on the potential release of contaminants into the environment.

The MRP supports research on how and where mineral deposits form and develops methods to detect potential mineral resources. This research, which employs a wide spectrum of geochemical, analytical and geophysical techniques, has produced many innovations in mineral resource science. Recent advancements in incorporating the latest space-based and airborne Earth observation instruments and the big data analytical techniques are promising to provide new insights into minerals-related science.

With the funding proposed in 2021, the USGS will continue to conduct field- and laboratory-based research and literature review on critical minerals, especially in Alaska, the midcontinent, and the Southeastern United States, and will collaborate with NMIC economists and commodity experts to determine which mineral commodities are most critical to our national economy and security, and should be prioritized for future assessments.

Both E.O. 13817 and the accompanying Secretarial Order 3359 "*Critical Mineral Independence and Security*" emphasized increasing access to minerals-related data. The MRP continues to collaborate with the Bureau of Land Management (BLM) and State Geological Surveys to grow a geospatial minerals information database (USMIN) that captures historic mine features from topographic maps and links those sites to a tabular database of minerals information. Knowledge of the location and character of these historic mine features is important because it can inform land management decisions, the exploration for new mineral discoveries, and because the sites may include mine wastes containing critical minerals that were not recovered when the sites were originally mined. The USMIN mine features project has been progressing eastward from the west coast and

as of December 2019 had captured 524,000+ points and 112,000+ polygons from over 88,000 topographic maps. Data for Tennessee, Kentucky, Ohio, Alabama, Mississippi, Florida, Georgia, North Carolina and South Carolina were released in 2019, and data capture for New England States, New York, New Jersey, Delaware, Pennsylvania, Maryland, Virginia and West Virginia is in progress. In 2020, data capture will be completed for Virginia, Maryland, Delaware, New Jersey, Connecticut, Rhode Island, Massachusetts, and New Hampshire. Data capture for the remaining States, West Virginia, Pennsylvania, New York, Vermont and Maine, will be completed by the end of 2021. In 2019, USMIN also issued individual data releases for lithium, tellurium, and an update on rare earth element occurrences in the United States. These data releases add to our understanding of the Nation's critical mineral resources and help to guide future Earth MRI surveys, mineral resource assessments and other MRP research. USMIN is a 'living' database project that will continue to incorporate mineral data nationwide as they become available.

The USGS continues research into the interactions of mineral resources with the environment, both natural and because of resource extraction, to understand emerging challenges and opportunities for future mining and new uses of previously mined materials. For example, a recent study concluded that steel slag, a waste product of steelmaking, has the potential to remove phosphate from water, which could help reduce agricultural and municipal water quality problems from excessive nutrients.

Geological mapping continues in Alaska's Yukon-Tanana terrane. In addition to contributing to understanding the bedrock geology, this mapping will help determine the source of known placer gold deposits in the region and aid in determining the area's potential to host critical minerals deposits.

Energy Resources Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Energy Resources Program	29,972	30,172	345	-	-	30,517	345
FTE	126	126	-	-	-	126	-

Program Description

The USGS Energy Resources Program (ERP) is the sole provider of publicly available estimates of geological energy resources for the United States (exclusive of the U.S. Outer Continental Shelf) and provides publicly available estimates related to global oil and gas resources. The geologic energy resources that the ERP studies are: oil (including shale and heavy oil), natural gas, coal, coalbed methane, gas hydrates, geothermal resources, and uranium. ERP science informs decision-making related to domestic and foreign energy resources, as well as the management of energy resources on Federal lands. In 2021, ERP proposes to build on its partnership with the U.S. Department of Energy for innovative new research and development in emerging energy fields such as gas hydrates and geothermal energy. ERP will also build on the Mineral Resources Program's (MRP) relationships with State Geological Surveys to better leverage both Federal and State data on the subsurface, including investments in data innovations such as machine learning tools to better characterize uncertainty in energy resource assessments.

2021 Activities

The 2021 budget request supports:

- Releasing additional USGS assessments of undiscovered, technically recoverable oil and gas resources in U.S. and non-U.S. basins.
- Continuing the underlying geological, geophysical, and geochemical research that underpins the assessments.
- Publishing assessments of conventional and unconventional oil and gas resources from regions around the world.
- Continuing research into geothermal resources aimed at improving the viability of Enhanced Geothermal Systems and studying environmental impacts of geothermal energy development on Federal lands.
- Expanding unconventional oil and gas research efforts that began in 2016 on the geologic causes of variability in the recovery of petroleum and water, and studies of baseline water quality.
- Supporting USGS gas hydrate studies with the USGS Coastal/Marine Hazards and Resources

Program and contribute to DOE- and industry-sponsored cooperative gas hydrate projects.

- Releasing an updating assessment of global petroleum resources. Global assessments will include multiple basins in western Canada and the Surat and Galilee Basins in Australia.
- Supporting domestic petroleum research and assessments of:
    - Section 1002 area of the Alaska North Slope coastal plain based on new three-dimensional seismic data acquired by an industry consortium, pursuant to Secretarial Order 3352.
    - Anadarko Basin (midcontinent).
    - Sacramento Basin (California).
    - Denver Basin (Colorado and Wyoming).
    - Montana Thrust Belt (Montana).
    - Powder River Basin (Wyoming and Montana).
    - Raton Basin (Colorado and New Mexico).
    - Williston Basin (North and South Dakota; southern Saskatchewan).
- Providing personnel and resources to conduct field and laboratory analyses of material recovered by conventional and pressure core systems, and partnering in the synthesis of data from logging, direct sampling, and geophysical and geologic characterization studies in support of an Alaska gas hydrate production test well project.
- Continuing to contribute to developing the operational plan in support of the International Ocean Discovery Program sponsored Expedition 386, which consists of a program of five drilling locations in the northern Gulf of Mexico, scheduled for the spring of 2021, whereby the physical and engineering properties of gas hydrates will be further studied to better evaluate scalability and commerciality.
- Continuing studies into the application of economics to resource assessments to understand the economic dynamics of shale gas and oil plays in order to model resource costs and evaluate future potential domestic supplies.
- Continuing to modernize energy resource assessments by developing tools and techniques for multi-resource assessments that combine energy resources assessments with information about the quantity and quality of other natural resources.
- Maintaining and continuing the development of the laboratory quality management system (QMS) implemented across the Energy and Mineral Resources Mission Area, and of a program-wide laboratory information management system (LIMS) for incorporating data management best practices and capabilities to collect, store, manage, process, document, validate, and archive laboratory information assets from ERP laboratories.
- Continuing to maintain and serve data previously provided to the National Coal Resources Data System (NCRDS) from State Cooperators and other ERP-funded efforts.
- Updating data management plans as needed to support of Federal data management policies and Departmental and bureau guidance.

2021 Program Change Summary

The 2021 budget request for the Energy Resources Program is $30,517,000 and 126 FTE.

There are no program changes for the Energy Resources Program.

Program Overview

The Energy Resources Program (ERP) provides the geoscience, publicly available data, and tools to inform all-of-the-above energy policy discussions and to support science-based decisions on energy development and the responsible use of resources. The ERP also invests in innovative research to enable and improve assessments of current energy resources and better understand and assess the potential for transformative new energy resources.

The ERP assesses oil and gas resource potential through in-depth studies of geology and resources in various petroleum provinces throughout the United States. Studies of the geologic, geophysical, and geochemical framework of these areas allows for better understanding of the resource potential and environmental impacts of oil and gas development. The USGS considers the following factors in prioritizing future oil and gas resource assessments: technological changes that enable access to additional resources (e.g., hydraulic fracturing, directional drilling, etc.); additional data that become available (e.g., wells, seismic, production data); history of completed USGS conventional and unconventional resource assessments; and specific requests from other Federal agencies aligned with their priority needs.

The USGS assessments of oil and gas resources are highly relevant to energy policy, especially as recovery processes such as directional drilling and hydraulic fracturing have become widespread in the United States. ERP resource assessments are widely used by a variety of stakeholders, including local, State and Federal governments, land resource managers, and the public. ERP products are also utilized by the U.S. Energy Information Administration (EIA) as the basis for computing reserve estimates for various basins in the United States and globally.

In light of recent significant industry discoveries on the Alaska North Slope (ANS) and in response to Secretarial Order 3352, the USGS initiated a multi-bureau effort (with the Bureau of Land Management and the Bureau of Ocean Energy Management) to assess ANS energy resource potential. The USGS continues to collaborate with Natural Resources Canada to improve the understanding of the geologic framework from eastern Arctic Alaska through the Mackenzie Delta and into the southern passive margin of the Canadian Arctic Islands (including petroleum systems elements).

The USGS conducts early-stage research on the geologic processes forming energy resources and the geologic setting of these resources to enable and improve assessments of current national and global coal, oil, and gas resources. Accurate and scientifically based assessments of coal, oil, and gas resources of the Nation and world are dependent upon this geologic information.

The work of the USGS in geologic process and resource characterization also provides a scientific basis upon which to evaluate the potential contributions to future energy supplies from currently used energy

resources and from emerging resources such as gas hydrates. The USGS geologic process and resource characterization research also provides a fundamental understanding of the economic viability and potential environmental factors associated with resource development and use. For example, geochemical research helps to explain how oil and gas are generated, how they migrate out of source rocks, and how they accumulate and are preserved in reservoir rocks. Predictive models developed from this research aid in predicting the type, timing, and migration patterns of hydrocarbon generated.

Understanding the potential for further diversifying the U.S. energy portfolio by harnessing our Nation's renewable and alternative energy potential is important for informed decision-making that takes into account the resulting effects on our economy and environment. In 2021, the ERP will support studies to develop, test, and deploy miniature unmanned aerial systems to perform future thermal infrared (or "heat mapping") studies to monitor changes associated with a potential expansion in geothermal production. In addition, the ERP will publish an assessment of resources associated with Enhanced Geothermal Systems located in the Great Basin of Nevada and western Utah.

The USGS Science and Decisions Center (SDC), as part of the ERP, conducts research to increase the use and value of science in decision-making. The SDC's multidisciplinary efforts focus on improved decision-making throughout a variety of natural resource science disciplines. SDC economists and physical, biological, and social scientists work with partners in Interior and other government agencies, academia, and nongovernmental organizations to develop innovative methods, analytical tools, and institutional structures to integrate science more effectively with natural resource management. The SDC advances systematic decision-making approaches including assessment of management outcomes and lessons learned in order to help decision makers and improve natural resource management outcomes.

Natural Hazards

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Natural Hazards	**166,258**	**170,870**	**1,718**	**-**	**(34,589)**	**137,999**	**(32,871)**
FTE	*612*	*612*	*-*	*-*	*(33)*	*579*	*(33)*
Earthquake Hazards	**83,403**	**84,903**	**636**	**-**	**(25,229)**	**60,310**	**(24,593)**
FTE	*227*	*227*	*-*	*-*	*(12)*	*215*	*(12)*
Volcano Hazards	**30,266**	**30,266**	**429**	**-**	**(3,084)**	**27,611**	**(2,655)**
FTE	*153*	*153*	*-*	*-*	*(1)*	*152*	*(1)*
Landslide Hazards	**3,538**	**4,038**	**53**	**-**	**(484)**	**3,607**	**(431)**
FTE	*19*	*19*	*-*	*-*	*(2)*	*17*	*(2)*
Global Seismographic Network	**6,653**	**7,153**	**36**	**-**	**(1,792)**	**5,397**	**(1,756)**
FTE	*13*	*13*	*-*	*-*	*(1)*	*12*	*(1)*
Geomagnetism	**1,888**	**4,000**	**25**	**-**	**114**	**4,139**	**139**
	8	*8*	*-*	*-*	*1*	*9*	*1*
Coastal/Marine Hazards and Resources	**40,510**	**40,510**	**539**	**-**	**(4,114)**	**36,935**	**(3,575)**
FTE	*192*	*192*	*-*	*-*	*(18)*	*174*	*(18)*

The 2021 budget request for Natural Hazards is $137,999,000 and 579 FTE.

The USGS provides scientific information to emergency responders, policy makers, and the public to reduce losses from a wide range of natural hazards, including earthquakes, floods, hurricanes, landslides, tsunamis, volcanic eruptions, wildfires, and geomagnetic storms. Working with its partners, cooperators, and customers, the USGS delivers actionable assessments of these hazards and helps to develop effective strategies for achieving more-resilient communities. The USGS is the Federal agency responsible for monitoring and notification of earthquakes, volcanic activity, and landslides and coastal erosion in the United States. For many other hazards, the USGS directly supports the warning responsibility of the National Oceanic and Atmospheric Administration (NOAA).

To achieve its primary mission, and to fulfill its responsibilities for loss and risk reduction, the USGS Natural Hazards Mission Area develops, delivers, and applies several components of hazard science: observations and targeted research underpin assessments, forecasts, warnings, and crisis and disaster response. The research, data, products, and detailed information that the USGS provides enables Federal, State, Tribal, local, and private-sector end-users to better understand, anticipate and reduce their risks associated with natural, technological, and environmental hazards, and enables science-based decisions that effectively enhance resilience and reduce impacts from those threats.

Earthquake Hazards Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Earthquake Hazards	**83,403**	**84,903**	**636**	**-**	**(25,229)**	**60,310**	**(24,593)**
Seismic Network	*[1,800]*	*[1,800]*			*(1,800)*	*[0]*	
ShakeAlert Capital Investment, Operations, and Maintenance	*[21,100]*	*[25,700]*			*(17,229)*	*[8,471]*	
Advanced National Seismic System Deferred Maintenance	*[5,000]*	*[2,000]*			*(2,000)*	*[0]*	
Advanced National Seismic System Regional Network Support	*[1,200]*	*[1,200]*			*(1,200)*	*[0]*	
Earthscope Stations	*[2,000]*	*[3,000]*			*(3,000)*	*[0]*	
FTE	**227**	**227**			**(12)**	**215**	**(12)**

Program Description

The Earthquake Hazards program provides the scientific information, situational awareness, and knowledge necessary to reduce deaths, injuries, and economic losses from earthquakes and earthquake-induced tsunamis, landslides, and soil liquefaction.

2021 Activities

The 2021 budget request supports:

- Monitoring the Nation's earthquakes via the Advanced National Seismic System (ANSS) and through support of several regional seismic networks operated by university partners; providing 24x7 reporting on domestic and global earthquakes; delivering rapid earthquake impact and situational awareness products to support emergency response; and developing improved methods for continued improvement in the quality and timeliness of real-time earthquake information.
- Delivering real-time earthquake data to NOAA, supporting tsunami monitoring in the Pacific Rim and disaster alerting in Alaska, Hawaii, Washington, California, and U.S. Territories in the Western Pacific and Caribbean.
- Improving the USGS National Seismic Hazard Model, which describes the likelihood and potential impacts of earthquakes nationwide, and which serves as the basis for seismic provisions in building codes; revising as needed a model update with input from the Building Seismic Safety Council, which develops building code updates; and maintaining associated databases and tools that are widely used by engineers for site-specific engineering design and seismic risk analysis.

- Conducting applied field, laboratory and theoretical research on the causes, characteristics, and effects of earthquakes, including investigations of earthquakes related to wastewater disposal and other industrial activities; and supporting relevant research by expert partners in academia, State agencies and the private sector via competitive grants and cooperative agreements.
- Communicating earthquake information to the public and to key stakeholders, including Federal and State emergency response agencies, disaster relief organizations, operators of utilities and lifelines, and communities at risk.

2021 Program Change Summary

The 2021 budget request for the Earthquake Hazards Program is $60,310,000 and 215 FTE, which includes:

- Seismic Network (-$1,800,000 and 0 FTE)
- ShakeAlert Capital Investment, Operations, and Maintenance (-$17,229,000 and -12 FTE)
- ANSS Deferred Maintenance and Modernization (-$2,000,000 and 0 FTE)
- ANSS Regional Network Support (-$1,200,000 and 0 FTE)
- Earthscope Stations (-$3,000,000 and 0 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

Nearly half of the U.S. population is at risk from earthquakes and annualized earthquake losses to the United States infrastructure are estimated at $6.1 billion per year. The USGS provides the scientific information, situational awareness, and knowledge necessary to reduce deaths, injuries, and economic losses from earthquakes and earthquake-induced tsunamis, landslides, and soil liquefaction.

The USGS Earthquake Hazards Program (EHP) is the applied Earth science component of the four-Agency National Earthquake Hazards Reduction Program (NEHRP, reauthorized by the National Earthquake Hazards Reduction Program Reauthorization Act of 2018, P.L. 115-307). Through NEHRP, the USGS partners with the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST) to reduce earthquake losses in the United States.

To effect loss reduction, the EHP supports a highly coordinated set of monitoring, hazards assessment, applied research, and risk translation and communication activities in at-risk regions nationwide. Through the National Earthquake Information Center (NEIC), the USGS is the only U.S. agency that continuously reports on current domestic and worldwide earthquake activity. Through the Advanced National Seismic System (ANSS), the USGS and its State and university partners monitor and report on earthquakes nationwide. Through the USGS National Seismic Hazard Maps, the EHP provides the basis for seismic

provisions in the Nation's building codes, which affect one trillion dollars' worth of new construction annually in the United States.

The USGS issues timely aftershock forecasts following potentially damaging earthquakes within the entire United States and provides aftershock forecasts following significant global earthquakes when called upon by other Federal agencies or international partners.

In 2021, the USGS will continue, in cooperation with States and other partners, to operate and maintain the extant ShakeAlert system based on the ShakeAlert Earthquake Early Warning Implementation Plan for the West Coast, which was revised in 2018.

In 2021, the USGS expects to provide universities, State geological surveys, and private institutions with over $12.5 million in earthquake hazards applied research grants and cooperative agreements. In recent years, more than 40 entities have been the recipients of this funding that supports earthquake research in high risk areas nationwide, contributes to the maintenance and operation of the USGS Advanced National Seismic System (ANSS), and supports the ShakeAlert West Coast earthquake early warning system.

Volcano Hazards Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Volcano Hazards Program	**30,266**	**30,266**	**429**	**-**	**(3,084)**	**27,611**	**(2,655)**
Cooperative Agreement Awards	*[3,896]*	*[3,896]*			*(476)*	*[3,420]*	
Next Generation Lahar Detection System	*[4,145]*	*[4,145]*			*(2,145)*	*[2,000]*	
Volcanic Ash Models	*[463]*	*[463]*			*(463)*	*[0]*	
FTE	**153**	**153**			**(1)**	**152**	**(1)**

Program Description

The mission of the USGS Volcano Hazards Program is to enhance public safety and minimize social and economic disruption from eruptions through delivery of effective forecasts, warnings, and information on volcano hazards based on scientific understanding of volcanic processes. The objectives of the program are: 1) to respond to volcanic crises and 2) to build capacity that makes such responses more timely, accurate, and effective. The Volcano Hazards program is organized by five volcano observatories, each with distinct areas of responsibility over the Nation's 161 volcanic centers. The program is managed with recognition of the importance of local knowledge and close ties with local officials and emergency managers to develop community preparedness and manage volcanic crises, but it also relies on interoperability among the five USGS volcano observatories, including use of common tools and standards. Interoperability supports a surge capability that is used to augment response capacity of a single observatory to a volcanic crisis, such as the 2018 eruption of Kilauea Volcano in Hawaii.

2021 Activities

The 2021 budget request supports:

- Continuing operation of monitoring networks on the most threatening volcanoes.
- Continuing field investigations into past eruptive histories of select volcanoes, to support the publication of hazard assessments.
- Ongoing research into the physical processes that drive volcanic eruptions, to improve future forecasts and warnings.

- Continuing work with local emergency management officials to prepare communities for future volcanic activity.
- Complete compliance of monitoring networks with the National Telecommunications and Information Administration (NTIA) authorizations on radio frequency utilization.
- Leveraging the USGS National Geospatial Program expertise and partnering with other Federal and State agencies to leverage resources toward acquiring high-resolution light distance and ranging (lidar) data over Very-High-Threat and High-Threat volcanoes.
- Continuing the development and testing of cloud computing and machine learning techniques to enhance volcano monitoring and warning capabilities through innovation.
- Engaging in efforts to sustain critical observatory capabilities while managing the relocation of laboratory, field support, and other operational functions into new consolidated facilities in California (Moffett Field) and Hawaii.

2021 Program Change Summary

The 2021 budget request for the Volcano Hazards Program is $27,611,000 and 152 FTE, which includes:

- Cooperative Agreement Awards (-$476,000 and 0 FTE)
- Next Generation Lahar Detection System (-$2,145,000 and -1 FTE)
- Volcanic Ash Models **(**-$463,000 and 0 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

Volcanic eruptions are among the most destructive phenomena of nature and can have significant social and economic impacts. However, volcanic eruptions are usually predictable well in advance of their occurrence if adequate in-ground instrumentation is in place that can provide the time needed to avoid loss of life and reduce other effects. The USGS VHP monitors and studies active and potentially active volcanoes, assesses their hazards, and conducts research on how volcanoes work in order for the USGS to issue timely warnings of potential volcanic hazards to emergency-management professionals and the public. In addition to collecting and interpreting the best possible scientific information, the program works to effectively communicate its scientific findings and volcanic activity alerts to authorities and the public. These warnings and forecasts enable the public to take appropriate actions to mitigate the risk to life and property.

The VHP has evaluated all of the Nation's volcanoes to determine the monitoring levels needed commensurate with the threat they pose. This national threat level assessment was first completed in 2005 and was updated in 2018 (USGS SIR 2018-5140) based on new data. The USGS and affiliated partners used this threat assessment to design a national-scale plan, the National Volcano Early Warning System (NVEWS), to improve monitoring networks so that unrest can be detected at the earliest stages using in-ground monitoring instrumentation deployed on the Nation's most threatening volcanoes and to prioritize

targets for scientific investigations and other work. A congressional report on the NVEWS 5-Year implementation plan is currently in development.

The VHP is built upon a structure of five volcano observatories that organize the Nation's volcanoes into distinct areas of responsibility:

- Hawaiian Volcano Observatory – Hawaii
- Cascades Volcano Observatory – Idaho, Oregon, and Washington
- Alaska Volcano Observatory – Alaska and the Commonwealth of the Northern Mariana Islands
- California Volcano Observatory – California and Nevada
- Yellowstone Volcano Observatory – Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming

In 2021, the VHP will continue development and testing of the Mt. Rainier Lahar Detection System (RLDS) and perform maintenance as needed on current stations. Lahar detection algorithm development will continue to be conducted via a new cooperative agreement with the University of Oregon. FY 2021 will be the biggest year to date for new instrument installations, pending permitting, with 14 new stations.

In 2021, the VHP will continue to repair and replace monitoring equipment damaged or lost during the Kilauea 2018 eruption and continue developing options for addressing new Hawaiian Volcano Observatory facilities and science infrastructure needs for comprehensive monitoring of all Hawaiian volcanoes. Significant progress is also anticipated in preparation of moving and consolidating the VHP's laboratory capabilities in California commensurate with the Menlo to Moffett Field transition.

Landslide Hazards Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Landslide Hazards Program	3,538	4,038	53	-	(484)	3,607	(431)
FTE	19	19			(2)	17	(2)

Program Description

The USGS assists Federal, State, and local agencies through landslide site evaluations and provides strategies for reducing ongoing and future impacts from landslides. The Landslide Hazards program deploys near-real-time monitoring systems at active landslide sites to gather continuous movement, rainfall, and hydrologic data needed to understand the mechanisms of landslide occurrence and mobility and forecast future behavior. Such data and understanding form the scientific underpinnings for early warning of conditions that may trigger landslides.

2021 Activities

The 2021 budget request supports:

- Conducting field, laboratory, and modeling studies of landslide initiation and mobility processes in cooperation with Federal, State, academic, and private sector partners to develop, test, and advance tools and methods for landslide monitoring, hazard assessment, and forecasting.
- Providing post-wildfire debris-flow hazard assessments for major wildfires to Burned Area Emergency Response (BAER) teams, State geological surveys, Federal, State, and local emergency management, and the public.
- Collecting observations, conducting studies, and testing methods and models to expand the NOAA-USGS partnership for post-wildfire debris-flow early warning beyond the prototype area in southern California to other parts of the Western United States.

2021 Program Change Summary

The 2021 budget request for the Landslide Hazards Program is $3,607,000 and 17 FTE, which includes:

- Landslide Hazard Assessments (-$484,000 and -2 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

Landslides occur in all 50 States, and where landslides impact human activities, lives may be lost and property and infrastructure damaged. Widespread landslides can accompany big storms, such as hurricanes, or earthquakes impacting broad areas hindering rescue and recovery efforts. In 2017, Hurricane Maria generated more than 40,000 landslides across Puerto Rico, impacting transportation and other lifelines.

The USGS Landslide Hazards Program (LHP) is the only Federal program dedicated to landslide science. It conducts targeted studies to understand landslide initiation and mobility processes. This understanding is used to develop methods and models for landslide hazard assessment, develop and deploy systems to monitor threatening landslides, and develop methods and tools for landslide early warning and situational awareness. Program activities are targeted toward the types of landslides that result in human and economic losses in the United States, such as those with long travel distances, those initiated by heavy rainfall, and those exacerbated by the effects of wildfire.

The LHP began cooperative work with the National Weather Service in 2005, to deliver alerts for debris flows from recently burned areas in southern California. This limited-scale project has provided essential guidance to emergency and land managers for many burned areas in the region, including the 2018 Thomas and Woolsey Fires. In FY 2021, the LHP will continue to build on recent scientific advances to expand the project to other parts of California and the Western United States.

Global Seismographic Network

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Global Seismographic Network	**6,653**	**7,153**	**36**	**-**	**(1,792)**	**5,397**	**(1,756)**
Station Upgrades	*[6,653]*	*[7,153]*	*36*		*(1,792)*	*5,397*	
FTE	**13**	**13**			**(1)**	**12**	**(1)**

Program Description

The Global Seismographic Network (GSN) consists of more than 150 globally distributed stations. It provides the high-quality seismic data needed for earthquake alerts and situational awareness products, tsunami warnings, national security (through nuclear test treaty monitoring and research), seismic hazard assessments and earthquake loss reduction, as well as research on earthquake sources and the structure and dynamics of the Earth.

2021 Activities

The 2021 budget request supports:

- Focusing efforts on the core priority of operating the network in its current state to provide seismic data needed for earthquake alerts and situational awareness products, tsunami warnings, national security, hazard assessments, and research.
- Continuing a multiyear effort to address the deferred maintenance needs of the GSN in order to refresh, support, and maintain the network at a high level of quality and reliability. These network infrastructure needs include installing the new Department of Energy-funded borehole sensors, improving the physical infrastructure of GSN sites, and replacing aged vault sensors.

2021 Program Change Summary

The 2021 Budget Request for the GSN is $5,397,000 and 12 FTE, which includes:

- Station Upgrades (-$1,792,000 and -1 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

Because of its real-time data delivery, the GSN is a critical element of USGS hazard alerting activities, as well as supporting activities of other Federal agencies, including the National Oceanic and Atmospheric Administration (NOAA) tsunami warning; National Science Foundation (NSF) basic research; and the Department of Energy (DOE) and the Department of Defense (DOD) nuclear test treaty monitoring and research. GSN stations transmit real-time data continuously to the USGS National Earthquake Information Center in Golden, CO, where they are used to rapidly determine the locations, depths, magnitudes, and other parameters of earthquakes worldwide, in conjunction with data from other networks. GSN data allows for the rapid determination of the location and orientation of the fault that caused the earthquake and provides an estimate of the length of the fault that ruptured during the earthquake, which are both essential for modeling earthquake effects. An additional important aspect of GSN activities is evaluating, developing, and advancing new technologies for seismic instrumentation, sensor installation, and seismic data acquisition and management.

The USGS and the Incorporated Research Institutions for Seismology are in the process of installing the new high-quality Very Broad Band (VBB) seismic sensors and improving the physical infrastructure of select GSN sites. In 2021, 4 VBB sensors will be installed**.**

Geomagnetism Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Geomagnetism Program	1,888	4,000	25	-	114	4,139	139
FTE	8	8			1	9	1

Program Description

The Geomagnetism Program is part of the U.S. National Space Weather Program (NSWP), an interagency collaboration that includes programs in the National Aeronautics and Space Administration (NASA), the Department of Defense (DOD), the National Oceanic and Atmospheric Administration (NOAA), and the National Science Foundation (NSF). The Geomagnetism Program provides data to the NSWP agencies, oil drilling services companies, geophysical surveying companies, and several international agencies. Data, products, and services from the USGS are also used by the electric-power industry to evaluate geomagnetic storm risk. The Geomagnetism Program contributes to interagency efforts to protect national security, homeland security, and commercial assets and operations against the effects of space weather.

2021 Activities

The 2021 budget request supports:

- Continuing to focus on core priorities for operating magnetic observatories and providing the real-time geomagnetic data that are needed for issuing warnings and forecasts of geomagnetic storms.
- Continuing to develop geoelectric hazard maps, develop existing data sets needed to estimate Earth surface impedance, and develop computer-based tools need for real-time mapping of geomagnetic and geoelectric field variation, all of which are needed to help mitigate hazards for the electric-power grid industry and other national critical infrastructure.
- Continuing the second year of a three-year effort to complete the magnetotelluric survey of the contiguous 48-States, providing data for a national geoelectric hazard map.

2021 Program Change Summary

The 2021 budget request for the Geomagnetism Program is $4,139,000 and 9 FTE, which includes:

- Observatories Operations (+$114,000 and +1 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

Magnetic storms are caused by the dynamic interaction of the Earth's magnetic field with the Sun. While magnetic storms often produce beautiful aurora lights that can be seen at high latitude, they can also wreak havoc on the infrastructure and activities of our modern, technologically based society. Large storms can induce voltage surges in electric-power grids, causing blackouts and the loss of radio communication, reduce GPS accuracy, damage satellite electronics, and affect satellite operations, enhance radiation levels for astronauts and high-altitude pilots, and interfere with directional drilling for oil and gas.

In order to understand and mitigate geomagnetic hazards, the USGS Geomagnetism Program monitors and analyzes the Earth's dynamic magnetic field. The Program is part of the U.S. National Space Weather Program (NSWP), an interagency collaboration that includes programs in the National Aeronautics and Space Administration (NASA), DOD, NOAA, and NSF. The Geomagnetism Program provides data to the NSWP agencies, oil drilling services companies, geophysical surveying companies, and several international agencies. Data, products, and services from the USGS are also used by the electric-power industry to evaluate geomagnetic storm risk.

Domestically, the USGS works cooperatively with NOAA, the Air Force 557th Weather Wing, and other Federal agencies. For example, USGS observatory data are used by NOAA's Space Weather Prediction Center, and by the U.S. Air Force, for issuing geomagnetic warnings and forecasts. The USGS magnetic observatory network is part of the global INTERMAGNET network. The USGS research is conducted in collaboration with the Colorado School of Mines, the USGS Crustal Geophysics and Geochemistry Science Center, the NOAA Space Weather Prediction Center and the NASA Community Coordinated Modeling Center.

The USGS also works with private entities that are affected by space weather and geomagnetic activity, including electric-power grid companies and the oil and gas drilling industries. In the oil and gas industry, for example, drill operators need to know the exact direction that their drill bits are going to maximize oil production and avoid collisions with other wells. One way to accomplish this is to install a magnetometer—a sort of modern-day "compass"—in a drill-string instrument package that follows the drill bit. Simultaneous measurements of the magnetic field in the drill hole are combined with those monitored by the USGS to produce a highly accurate estimate of the drill bit position and direction.

The USGS will improve previously completed preliminary models of the induced electric field in the crust due to geomagnetic storms. This work is part of a National Science and Technology Council's working group for coordinating Space Weather Operations Research and Mitigation (SWORM) across multiple Federal agencies. These results will help power-grid companies improve the resilience of their systems to magnetic storms, as required by the Federal Energy Regulatory Commission. Power grid operators will use these results to design mitigation strategies for geomagnetic storms, and the space weather alerting

agencies will use the resulting electric field model to issue improved forecasts and nowcasts for space weather alerts.

In 2021, the USGS will continue to operate 14 geomagnetic observatories, delivering data to the NOAA Space Weather Prediction Center, the US Air Force 557th Weather Wing, and numerous other customers, and will develop geoelectric hazard maps, develop existing data sets needed to estimate Earth surface impedance, and develop computer-based tools need for real-time mapping of geomagnetic and geoelectric field variation.

In 2021, USGS will continue the magnetotelluric (MT) survey of the U.S. to improve U.S. electrical grid resilience, improve forecast models for geomagnetic storms, and aid in mineral resource assessments. Collection of MT data on a national scale is a basis for modeling the Earth's electric field, which can be used to assess the impact of electrical storms. This survey is responsive to priorities established in the *National Space Weather Strategy*, as well as related international initiatives for pursuing induction hazard research. This broad collaboration includes scientists from NASA, NOAA, the Institute for Defense Analyses, the Federal Energy Regulatory Commission, the Federal Emergency Management Agency, and NSF.

Coastal/Marine Hazards and Resources Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Coastal/Marine Hazards and Resources Program	**40,510**	**40,510**	**539**	**-**	**(4,114)**	**36,935**	**(3,575)**
Characterizing Marine Hazards and Resources	*[16,000]*	*[16,000]*			*(1,967)*	*[14,033]*	
Data Delivery	*[4,100]*	*[4,100]*			*(490)*	*[3,610]*	
Coastal and Marine Ecosystems Health and Sustainability Assessment	*[9,736]*	*[9,736]*			*(1,657)*	*[8,079]*	
FTE	**192**	**192**			**(18)**	**174**	**18**

Program Description

The Coastal/Marine Hazards and Resources Program (CMHRP) is the sole Federal research program providing expertise and products on marine geology and geologic processes. CMHRP provides geologic characterization and understanding of processes that form and alter coastal and marine landscapes in support of the USGS mission to assess the resource and hazard potential of public lands including the Outer Continental Shelf, EEZ, and ECS. CMHRP works closely with NOAA to ensure that these geophysical tools and knowledge support NOAA, other Federal agency, and State agency objectives to delimit and manage marine protected areas; to effectively manage marine fisheries, energy, and mineral resources; and to model oceanographic processes including hurricane and tsunami hazards.

2021 Activities

The 2021 budget request supports:

- Conducting marine geological and geophysical investigations to provide Federal, State, and local users with improved assessments of hazard sources (earthquakes, tsunami, and submarine landslides) and their potential impacts on offshore operations, coastal communities, and infrastructure.

- Conducting field and laboratory studies with other Federal and academic partners to characterize marine methane systems and sea-bed processes to understand their energy resource potential; the hazard they represent to offshore operations; and their role in carbon storage and cycling including within organism communities around marine seeps.
- Contributing analyses and expertise to delineate the U.S. Extended Continental Shelf consistent with international law and applying unique USGS expertise to understanding the occurrence and potential of deep-sea mineral resources.
- Providing regional real-time forecasts of erosion and inundation due to coastal storms, including hurricanes; and long-term forecasts of the likelihood of future coastal change and inundation due to storms, erosion, and sea-level rise.
- Developing and delivering data and knowledge on physical setting and processes that inform local, State, and Federal coastal management, planning, and public safety efforts to design and assess strategies for regional restoration, risk reduction, and coastal management for priority coastal locations.
- Applying available resources to engage partners and key stakeholders and users in evaluating and improving the delivery of coastal change hazard products. Existing and potential new products and delivery services will be evaluated to increase program responsiveness to user needs; to enhance application of information and research products by users; and to more effectively translate USGS science through capacity sharing with other agencies.

2021 Program Change Summary

The 2021 budget request for the CMHRP is $36,935,000 and 174 FTE, which includes:

- Characterizing Marine Hazards and Resources (-$1,967,000 and -8 FTE)
- Data Delivery (-$490,000 and -2 FTE)
- Coastal & Marine Ecosystem Health and Sustainability Assessments (-$1,657,000 and -8 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The CMHRP characterizes the hazard and resource potential of the Nation's offshore and coastal landscapes. CMHRP information and tools help public trust managers anticipate and reduce risks from natural hazards and coastal change, and to responsibly manage marine and coastal resources. As the only Federal science program focused on the geology and processes of coastal and marine landscapes, the CMHRP investigates a wide range of issues, in locations ranging from shallow waters of estuaries to the deep sea.

The CMHRP responds to immediate local and regional priorities across these environments, while addressing the Nation's needs for coastal and marine science-based products on a national scale. The

unique capabilities and expertise of the CMHRP are applied in support of the mission objectives of Interior and other Federal, State, and local agencies; non-governmental organizations; and, ultimately, the public.

The CMHRP serves Federal, State, and local users with assessments of hazard sources (earthquakes, tsunami, submarine landslides) and their potential impacts on offshore operations, coastal communities, and infrastructure, to improve bureau-wide hazard assessments reliant upon, for example, marine investigations of subduction zone processes and hazards. The CMHRP characterizes marine methane systems and associated seabed processes to enhance understanding of their substantial energy resource potential, the risk they represent to offshore operations, and their role in the global carbon system and marine ecological productivity.

The CMHRP contributes analyses and expertise to delineate the U.S. Extended Continental Shelf consistent with international law, an effort led by the U.S. Department of State that expands U.S. sovereignty over resources on and beneath the seafloor. The CMHRP provides unique Federal expertise on deep-sea mineral resources, including rare-earth and other critical minerals, in support of the broad natural resource mission of the USGS.

The CMHRP provides real-time forecasts of erosion and inundation due to coastal storms, including hurricanes. CMHRP long-term forecasts allow coastal communities and resource managers to anticipate the likelihood of future coastal change due to storms, erosion, and sea-level rise. The CMHRP is the recognized Federal provider of tools to anticipate and respond to physical change along our Nation's coasts and the consequences of coastal change on communities, infrastructure, and resources.

In 2021, the CMHRP will conduct exploration and analysis of seafloor massive-sulfide deposit in the US Exclusive Economic Zone (EEZ), a subject that has been the subject of industry interest in past years and responds to Executive Order 13817 to secure reliable sources of critical minerals. This effort will explore mineralogy and composition of enriched crusts and conduct multibeam mapping and measurements of environmental conditions along the Southern Gorda Ridge of the Escanaba Trough. The effort will expand our knowledge of the extent, geologic setting, types and grades of mineralization, as well as the local geochemistry contributing to and resulting from the presence of deep-ocean minerals.

In 2021, the CMHRP will continue to aid the response to incoming major hurricanes and their aftermaths along the Atlantic and Gulf of Mexico coasts, providing forecasts of coastal erosion and elevated water levels. Storm forecasts, as well as data characterizing protective dunes and beaches, are delivered through the USGS Coastal Change Portal and the USGS/NOAA experimental Total Water Level and Coastal Change Viewer covering more than 3,000 km of the Nation's coast, allowing early responders to better understand flooding and erosion risks.

In 2021, the CMHRP will conduct field collection activities and research focused on storm-induced processes that pose hazards to lives, property, and habitat in coastal systems. CMHRP will support development and delivery of nationally consistent tools to forecast and plan for coastal change hazards due to extreme events and long-term erosion and sea-level rise. Activities in 2021 will include development of forecasting and decision support tools - including aerial imagery, digital elevation models, stereo-camera stations, bathymetry, and structure-for-motion - to protect communities and resources along the coast as

well as the development of novel techniques for collecting and processing data, including rapid response capabilities. Leveraging those data resources and through enhancement of existing models, the CMHRP will extend forecasts and projections of shoreline position to span time scales from single storms to the end of the current century across diverse coastal settings.

Water Resources

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[1]	Program Changes	Request	Change from 2020
Water Resources	**226,308**	**234,120**	**2,823**	**-**	**(56,134)**	**180,809**	**(53,311)**
FTE	*1,249*	*1,279*	*-*	*-*	*(245)*	*1,034*	*(245)*
Water Resources Availability Program	**[98,763]**	**[102,792]**	**1,291**	**102,792**	**(32,226)**	**71,857**	**(30,935)**
FTE	*[566]*	*[592]*	*-*	*592*	*(189)*	*403*	*(189)*
Water Observing Systems Program	**[121,045]**	**[121,328]**	**1,532**	**121,328**	**(13,908)**	**108,952**	**(12,376)**
FTE	*[682]*	*[685]*	*-*	*685*	*(54)*	*631*	*(54)*
Water Resources Research Act Program	**6,500**	**10,000**	**-**	**-**	**(10,000)**	**-**	**(10,000)**
FTE	*1*	*2*	*-*	*-*	*(2)*	*-*	*(2)*
Water Availability and Use Science Program	**45,487**	**47,487**	**-**	**(47,487)**	**-**	**-**	**-**
FTE	*298*	*312*	*-*	*-312*	*-*	*-*	*-*
Groundwater and Streamflow Information Program	**82,673**	**84,173**	**-**	**(84,173)**	**-**	**-**	**-**
FTE	*432*	*433*	*-*	*-433*	*-*	*-*	*-*
National Water Quality Program	**91,648**	**92,460**	**-**	**(92,460)**	**-**	**-**	**-**
FTE	*518*	*524*	*-*	*-524*	*-*	*-*	*-*

The 2021 budget request for the Water Resources Mission Area is $180,809,000 and 1,034 FTE.

The USGS monitors and assesses the amount and characteristics of the Nation's water resources, assesses sources and behavior of contaminants in the water environment, and develops tools to improve management and understanding of water resources. The information and tools provided by the USGS allow first responders, the public, water managers and planners, policy makers, and other decision makers to:

- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, landslides, and chemical spills.
- Manage freshwater, both above and below the land surface, for domestic, public, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.

[1] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

- Contribute to the effective development and conservation of the Nation's water resources for the benefit of present and future generations.

The 2021 budget makes targeted enhancements to the USGS water observing systems and strategic investments in modeling and assessments that support the advancement of the Nation's water prediction capabilities. Further, the budget maintains strategic activities that support the *Federal Action Plan for Improving Forecasts of Water Availability.* Released in October 2019, this plan outlines the actions and outcomes to be achieved by the Department of the Interior, Department of Commerce, and several partners to improve the modeling and forecasting capabilities related to water availability and water infrastructure projects. The Water Resources Mission Area will focus on the following science priorities:

- ***Delivering integrated water availability assessments (IWAAs).*** These multi-extent, stakeholder-driven assessments are designed to provide information to meet the goals of the National Water Census as established through the SECURE Water Act. When fully implemented, IWAAs will: evaluate current water supply and demand, quality, and use; evaluate long-term trends in water availability; provide seasonal to decadal forecasts of availability; and inform water resource decisions through development of socioeconomic tools.
- ***Upgrading USGS water observing systems.*** The USGS will implement dense networks of high-fidelity, real-time data on water-quantity, quality and use necessary to support advanced models, modern water predictions, and decision support for daily water operations or water emergencies.
- ***Modernizing the National Water Information System (NWIS).*** The USGS is the authoritative source for consistent, reliable, and timely water information for the Nation. To ensure the NWIS continues to meet the needs of water science priorities, the NWIS data systems that house the water information will continue to be modernized to upgrade to the newest technology. NWIS modernization will maximize data integrity, reliability, accessibility while simplifying data delivery to the general public.
- ***Building integrated water prediction capabilities.*** The USGS will use and advance the USGS observational networks to guide the development of integrated water prediction capabilities. Work will be accomplished through collaborations with Federal partners and academia and will advance the prediction of temperature, surficial and in-channel transport processes. In addition, efforts will improve existing hydrological process predictions from the National Water Model, a robust modelling framework that is maintained by NOAA's Office of Water Prediction and supported by several academic and federal research partners.

To address higher priorities, the USGS is not requesting funds for the Water Resources Research Act Program.

Cooperative Matching Funds

The cooperative matching funds (CMF) program provides funding to partner with nearly 1,600 local, State regional, and Tribal agencies to monitor and assess water in every State, protectorate, and territory. The 2021 request includes a total of $58,210,000 of these funds across the mission area.

Water Resources Availability Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[2]	Program Changes	Request	Change from 2020
Water Resources Availability Program	**[98,763]**	**[102,792]**	**1,291**	**102,792**	**(32,226)**	**71,857**	**(30,935)**
Mississippi Alluvial Plain Aquifer Assessment	*[4,000]*	*[6,000]*			*(6,000)*	*[0]*	
U.S.-Mexico Transboundary Aquifer Assessment	*[1,000]*	*[1,000]*			*(1,000)*	*[0]*	
Water Use Data and Research	*[1,500]*	*[1,500]*			*(1,500)*	*[0]*	
Cooperative Matching Funds – Water Use Research	*[2,000]*	*[2,000]*			*(1,000)*	*[1,000]*	
Base Cooperative Matching Funds	*[18,881]*	*[19,487]*			*(606)*	*[18,881]*	
Regional Water-Quality Assessments[3]	*[4,100]*	*[4,100]*			*(4,100)*	*[0]*	
Water-Quality Trends	*[9,404]*	*[9,404]*			*(458)*	*[8,946]*	
Baseline Water-Quality Assessments of Transboundary Rivers	*[0]*	*[1,500]*			*(1,500)*	*[0]*	
Regional Groundwater Evaluations	*[2,272]*	*[2,272]*			*(303)*	*[1,969]*	
Harmful Algal Blooms	*[4,461]*	*[4,990]*			*(1,348)*	*[3,642]*	
National Park Service Water-Quality Partnership	*[1,743]*	*[1,743]*			*(1,743)*	*[0]*	
Shallow and Fractured Bedrock Groundwater Research	*[300]*	*[300]*			*(300)*	*[0]*	
Water Science Research and Development	*[16,889]*	*[16,283]*			*(12,368)*	*[3,915]*	
Cooperative Matching Funds[4]	***[23,216]***	***[24,351]***			***[-2,954]***	***[21,397]***	***[-2,954]***
FTE	**[560]**	**[592]**		**592**	**(189)**	**403**	**(189)**

Program Description

The USGS Water Resources Availability Program (WRAP) fulfills the goals established by Congress in the SECURE Water Act (Public Law (P.L.) 111-11, Section 9508) by investing in research and assessments that improve the Nation's understanding of water availability. Specifically, the WRAP supports the National Water Census, a USGS activity designed to systematically provide information that will allow resource managers to assess the supply, use, quality, and availability of the Nation's water. The WRAP will focus on conducting national and regional water availability assessments, inclusive of quantity and quality, for both human and ecological uses; developing methods to estimate water budgets, including water withdrawals and consumptive uses; evaluating trends in water availability; and, developing new techniques

[2] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.
[3] Formerly referred to as Regional Stream Quality Assessments
[4] Cooperative Matching Funds are used to support research, data collection, and assessments activities across the Water Resources programs, and therefore are shown as a non-add component within the Mission Area.

to evaluate factors that limit water availability, the models and infrastructure that support assessments, and the tools that resource managers use to support resource planning activities.

2021 Activities

The 2021 budget supports:

- Research on water availability; synthesis, prediction, and reporting of information at regional and national scales; enhancements to the Nation's water modeling and prediction capability; and the compilation and reporting of water information in ways that are useful to States.
- Development and delivery of the National Integrated Water Availability Assessment (IWAA), a near-real time census of water resources that will evaluate water availability for human and ecological use, infrastructure, security, and economic optimization.
- Work on a pilot Regional IWAA in the Delaware River Basin focused on the impacts of severe drought on water availability for human and ecological uses.
- Implementing the first full Regional IWAA in the headwaters of the Colorado and Gunnison River Basin in collaboration and coordination with the Next-Generation Water Observing System (NGWOS) and the Integrated Water Prediction (IWP) program.
- Completion of National Water Census baseline estimates for nine water budget components by 2022.
- Integration of water quality models, such as those that look at changes in nutrients, water reuse, sediment, pesticides, and emerging toxins like those produced by harmful algal blooms (HABs), into national and regional IWAAs.
- Evaluation of water availability indicators and trends, inclusive of both quantity and quality, and the factors driving observed trends in water availability.
- Development and application of models that estimate withdrawal related to water use.
- Efforts to operationalize field-scale evapotranspiration (ET) estimation techniques; develop new techniques to evaluate ecological flows in headwater streams; and conduct drought research.
- Development and application of field and modeling tools to better understand groundwater and surface-water interactions and support evaluations of their conjunctive management.
- Cooperative studies at Water Science Centers across the Nation in cooperation with State, local, regional, and Tribal partners that provide the data and tools necessary for resource managers to make decisions regarding water availability now and into the future.

2021 Program Change Summary

The 2021 budget request for the Water Resources Availability Program (WRAP) is $71,857,000 and 403 FTE, which includes:

- Mississippi Alluvial Plain Aquifer Assessment (-$6,000,000 and -31 FTE)
- U.S.-Mexico Transboundary Aquifer Assessment (-$1,000,000 and -4 FTE)

- Regional Water-Quality Assessments (-$4,100,000 and -28 FTE)
- Cooperative Matching Funds - Water Use Research (-$1,000,000 and 0 FTE)
- Base Cooperative Matching Funds (-$606,000 and -5 FTE)
- Water Use Data and Research (-$1,500,000 and -1 FTE)
- Regional Groundwater Evaluations (-$303,000 and -2 FTE)
- Water-Quality Trends Assessments (-$458,000 and -4 FTE)
- National Park Service Water-Quality Partnership (-$1,743,000 and -12 FTE)
- Shallow and Fractured Bedrock Groundwater Research (-$300,000 and -2 FTE)
- Water Science Research and Development (-$12,368,000 and -82 FTE)
- Harmful Algal Blooms (-$1,348,000 and -10 FTE)
- Baseline Water-Quality Assessments of Transboundary Rivers (-$1,500,000 and -8 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The National Water Census (NWC): The USGS NWC is designed to systematically provide information on water availability that allows resource managers to assess the supply, use, and quality of the Nation's water resources. Through development of advanced techniques and new accounting methods, the WRAP will provide resource managers with more accurate and finer scale information to support near real-time management decisions related to water availability.

In efforts to further fulfill the requirements of the SECURE Water Act (P.L. 111-11, Section 9508), the USGS is focusing NWC activities toward the delivery of National and Regional Integrated Water Availability Assessments (IWAAs). An IWAA is a multi-extent, stakeholder driven, near real time census and seasonal prediction of water availability for both human and ecological uses. When fully implemented, IWAAs will: (1) evaluate current water supply and demand, quality, and use; (2) evaluate long-term trends in water availability, inclusive of water quantity and quality; (3) provide seasonal to decadal forecasts of availability; and (4) inform water resource decisions through development of socioeconomic tools. These National and Regional IWAAs, in conjunction with efforts to provide Water Resources Trends and Forecasts, will make up the major lines of work within the NWC.

National Integrated Water Availability Assessment: The WRAP supports the NWC through activities that improve our understanding of the quantity and quality of water resources in the United States. Through the National IWAA, the USGS will deliver an integrated assessment of water availability that is inclusive of quantity, quality, and use. By conveying current conditions and national trends of the quantity and quality of water, the National IWAA will provide a basis to evaluate where limits to availability exist or may develop for human and ecological uses. The National IWAA will assimilate the water availability components above at national scales with data and information gained from Regional IWAAs (see below).

The National IWAA is designed to provide daily snapshots of water availability across the U.S. To do this, the USGS is using the water budget to quantify how much water is available. By modeling components of the water budget, the USGS can better understand the processes that change the water budget and eventually predict future scenarios. As of 2019, the USGS has completed work to provide daily estimates for four of nine targeted water budget components: precipitation, streamflow, soil moisture, and recharge. In 2020 and 2021, the USGS will continue this work with the goal of providing daily estimates for all nine water budget components by 2022. These estimates can then be used to provide indicators of water availability in the National IWAA.

In December 2019, the WRAP delivered the first map of the National IWAA representing a near-real time census of water availability for quantity. This map uses water storage as an indicator of water availability showing how current water storage compares to historical storage for any place in the U.S. In 2021, the USGS will continue to enhance the National IWAA by adding additional water availability indicators for quantity and will implement models for the inclusion of quality through development of a national water temperature model.

Regional Integrated Water Availability Assessments: The USGS conducts assessment activities focused on the individual factors – quantity, quality, and use – that impact regional water availability. In 2021, work will continue to complete ongoing, discipline-specific assessment activities. As these assessments are completed, the USGS is integrating these activities into regionally integrated studies, referred to as Regional IWAAs, that will address water availability using a suite of integrated predictive and modeling tools. In addition to being stakeholder-driven and informative at the local and regional levels, data and information from these Regional IWAAs will be assimilated into national-scale products of the National IWAA.

The USGS has initiated a pilot Regional IWAA in the Delaware River Basin (DRB) with the goal of evaluating the impact of severe drought under current water supply and demand restrictions. This pilot will serve as a proof of concept and will inform next-generation data collection, integrated model development, and the Regional IWAA framework for future pilot basins. To supplement these efforts, the USGS has provided Cooperative Matching Funds to six additional projects outside the DRB that are designed to improve the technical data and information needed to provide National and Regional IWAAs. These cooperative projects have the added benefit of working directly with State and local partners to leverage skills and ensure Regional IWAAs will provide the data, tools, and information that stakeholders need to make water-resource management decisions. In 2020, the USGS is continuing work on the DRB pilot and supporting cooperative projects but will also begin efforts for the first full-scale Regional IWAA in the headwaters of the Colorado and Gunnison River Basin. The 2021 budget supports the continuation of all these Regional IWAAs activities.

Water Resources Trends and Forecasting: The USGS monitors, collects, and estimates a wide array of surface water, groundwater, water quality, and water use data. The WRAP then uses these data to map and better understand how changes in water withdrawal, land use, climate, management actions, infrastructure, and economics have impacted and may potentially impact water availability, for both quantity and quality. The 2021 budget maintains support for many of these activities. For example, the USGS will complete 3-D maps that show the concentrations of selected drinking water contaminants, such as nitrate, arsenic, and

uranium, in four of the Nation's critical water-supply aquifers: the Central Valley, North Atlantic Coastal Plain, Lower Mississippi Embayment, and Glacial. In addition, the WRAP will focus on evaluating trends in water availability driven by human activities and water use needs and exploring techniques to conduct integrated trend evaluations as part of IWAAs.

Factors that Influence Water Availability: Water availability is influenced by a number of factors that can limit both the quantity and quality of water available for human and ecological uses. Drought reduces baseflow and recharge, and groundwater level declines can be exacerbated by increased withdrawal for use. Water resources affected by extreme drought may take decades to recover. Water resources throughout the Nation are subject to impaired water quality conditions caused by natural processes and human activities on the landscape. Nutrients, sediment, pesticides, and emerging contaminants, such as algal toxins associated with harmful algal blooms (HABs) and per- and polyfluoroalkyl substances (PFAS), can pose a risk to human and ecosystem health and treatment, if possible, can be costly. Understanding how to detect and characterize these contaminants and how they might limit water availability will be critical to evaluating the availability of existing resources for human and ecological use, infrastructure, security, and economic optimization through National and Regional IWAAs.

The USGS addresses these information needs by investing in research that is focused on developing methods to detect emerging contaminants such as PFAS in water resources. In 2020, the USGS is operationalizing an analytical method designed to detect 34 of the most common PFAS compounds in the environment. In 2021, the USGS will continue efforts to assess PFAS and potential impacts to water availability. In 2021, the USGS will continue to conduct monitoring, modeling, and forecasting studies across the country, including an additional year of data collection for a large-river HABs pilot project started in 2017. In 2021, drought research will focus on developing the capacity to predict drought onset and forecast extent and persistence considering the entire water budget. Additionally, the Colorado and Gunnison River Basin Regional IWAA will evaluate impacts of wildfire to both short-term and long-term water availability for both human and ecological uses.

Model Development, Infrastructure, and Information Delivery: The USGS has been a leader in the development of coordinated, comprehensive, and consistent hydrologic modeling frameworks for the conterminous United States. Through research and studies, the USGS develops and applies surface-water, groundwater, and water-quality modeling software. These modeling frameworks support the evaluation of water availability nationally, but also reduce the initial costs for regional and local studies that use the infrastructure to build more refined models.

In 2021, the USGS will continue collaborations with partners like the National Weather Service and National Center for Atmospheric Research to develop and improve national-scale prediction for surface water-groundwater interaction, stream water temperature, erosion and sediment transport, and selected water-quality constituents. The USGS will also continue collaborations with NOAA to add a shallow aquifer/groundwater module to the National Water Model. In tandem with these efforts, USGS will focus on integrating disparate modeling systems into one National Hydrologic prediction framework. For example, by 2021 the USGS will complete regional SPARROW models for the conterminous U.S. that support an understanding of the impacts of water quality on water availability for over 307 million people. Integrating models such as these will be an important component of providing IWAAs.

The National Water Information System (NWIS): The NWIS is a delivery system that is funded through both the WRAP and the Water Observing Systems Program. As a part of overall model development, infrastructure, and information delivery activities, the WRAP supports modernization, development, implementation, and maintenance of reliable systems that deliver real-time and historic information. The NWIS is the central USGS water information system, providing current conditions related to streamflow, floods, drought, water-quality conditions, and water-use data. In 2021, the USGS will continue to upgrade its information technology resources to ensure computing capacity and data services can support integrated model performance and IWAAs.

Water Observing Systems Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[5]	Program Changes	Request	Change from 2020
Water Observing Systems Program	**[121,045]**	**[121,328]**	**1,532**	**121,328**	**(13,908)**	**108,952**	**(12,376)**
Transfer from Groundwater and Streamflow Information Program	*[82,673]*	*[82,673]*		*82,673*			
Transfer from National Water Quality Program	*[38,372]*	*[38,655]*		*38,655*			
Water Science Research and Development	*[2,467]*	*[2,102]*			*(2,102)*	*[0]*	
High Plains Aquifer Assessment	*[80]*	*[80]*			*(80)*	*[0]*	
Cooperative Matching Funds	*[38,530]*	*[39,178]*			*(2,365)*	*[36,813]*	
National Groundwater Monitoring Network	*[3,929]*	*[3,929]*			*(2,395)*	*[1,534]*	
Next-Generation Water Observing System	*[8,500]*	*[8,500]*			*(2,960)*	*[5,540]*	
U.S.-Canada Transboundary Streamgages	*[1,500]*	*[1,500]*			*(1,500)*	*[0]*	
Groundwater Quality Monitoring Networks	*[5,231]*	*[5,231]*			*(930)*	*[4,301]*	
National Atmospheric Deposition Program	*[1,576]*	*[1,576]*			*(1,576)*	*[0]*	
Cooperative Matching Funds[6]	***[38,530]***	***[39,178]***			***[-2,365]***	***[36,813]***	***[-2,365]***
FTE	**[682]**	**[685]**		**685**	**(54)**	**631**	**(54)**

Program Description

Monitoring networks that generate data on the quantity and quality of the Nation's water resources are the foundation for situational awareness and understanding the Nation's water resources. The Water Observing Systems Program (WOSP) encompasses the Water Resources Mission Area's objectives to collect, manage, and disseminate consistently high-quality and reliable water information in real-time and over the long-term, both of which are critical for managing the Nation's water resources and anticipating and responding to water hazards that can result in loss of life and property. Serving as the largest water data holder in the world, the USGS partners with more than 1,600 Federal, regional, State, Tribal, and local agencies to maintain and manage its water monitoring networks. Furthermore, the WOSP is increasingly using integrated monitoring for multiple parameters at a single location, providing continuous real-time water data used for decisions such as emergency response, flood forecasting, reservoir management, water-use restrictions, drinking water deliveries, permit compliance, water-quality studies, and recreational safety.

The long-term data supplied by the program are a critical component to sustaining the viability of activities such as agriculture, fishing, and recreation and are used for decisions related to water-supply planning, aquifer storage and recovery, infrastructure design, floodplain and ecosystem management, energy

[5] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

[6] Cooperative Matching Funds are used to support research, data collection, and assessments activities across the WOSP, and therefore are shown as a non-add component within the Program

development, and resolution of water disputes. In addition, the WOSP promotes the development and application of information and tools to minimize the loss of life and property due to hazards, including support for flood forecasting, informing drought and post-fire conditions, and monitoring debris flows and storm surge during floods and hurricanes.

2021 Activities

The 2021 budget request supports:

- Collection, management, and dissemination of high quality and reliable integrated hydrologic information in real time and over the long term for flood and drought planning, warnings, and forecasting; designing water infrastructure; operating waterways for power production and navigation; managing water rights issues; and assessing safety conditions for recreational activities.
- A unified National Streamflow Network of more than 8,400 real-time streamgages operated year-round, including 3,470 Federal Priority Streamgages that support strategic Federal responsibilities.
- Long-term, nationally consistent monitoring of sediment, nutrients, and pesticides at 113 sites located on large inland and coastal rivers, as well as small agricultural, urban, and minimally disturbed reference watersheds.
- A nationwide Climate Response Network of nearly 690 groundwater monitoring sites to understand the effects of drought and other climate variability on the Nation's groundwater levels and an enterprise of approximately 100 groundwater-quality monitoring networks to understand the status of the Nation's groundwater quality.
- Continued operation of the highest-priority sites of the Next-Generation Water Observing System (NGWOS) in the Delaware River Basin and initial implementation of NGWOS in the headwaters of the Colorado and Gunnison River Basin.
- Modernization of the National Water Information System (NWIS) data storage and delivery system with efforts focused on moving off of aging legacy systems.
- Work to develop, refine, and apply hazard information to minimize loss of life and property, such as Rapidly Deployable Gages (RDGs), Storm-Tide Sensors, and Wave-Height Sensors.
- Data collection and dissemination during hydrologic hazards (floods, droughts, hurricanes) and deployment of information tools for water managers to minimize loss of life and property.
- Monitoring activities to improve flood forecast predictions, and drought management, and inform development of National water prediction capabilities.

2021 Program Change Summary

The 2021 budget request for the Water Observing Systems Program (WOSP) is $108,952,000 and 631 FTE, which includes:

- Water Science Research and Development (-$2,102,000 and -14 FTE)
- High Plains Aquifer Assessment (-$80,000 and -1 FTE)

- U.S.-Canada Transboundary Streamgages (-$1,500,000 and -5 FTE)
- Cooperative Matching Funds (-$2,365,000 and -17 FTE)
- National Groundwater Monitoring Network (-$2,395,000 and -2 FTE)
- Next-Generation Water Observing System (-$2,960,000 and 0 FTE)
- Groundwater Quality Monitoring Networks (-$930,000 and -5 FTE)
- National Atmospheric Deposition Program (-$1,576,000 and -10 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The USGS Streamgaging Network: The USGS Streamgaging Network is comprised of more than 10,000 streamgages across the Nation. Of these sites, streamflows are monitored year-round at over 8,400 sites, which are considered part of a National Streamflow Network (NSN) that is used in countless ways by governmental organizations, private industries, and the general public. Information provided through the NSN forms the scientific basis for decisions related to protecting life and property from water-related hazards, such as: flood response and drought planning; designing bridges, roads, and water-treatment plants; efficiently managing freshwater for drinking, irrigation, energy, industry, recreation, and ecosystem health; and promoting National, State, Tribal, and local economic well-being. The USGS makes approximately 80,000 streamflow measurements each year to ensure the accuracy of the streamflow data. The latest streamgage data is readily available through the National Water Information System: Web Interface (NWISWeb). Data can also be provided as alerts to users (*http://water.usgs.gov/waternow/*) by e-mail or text message and as real-time stream conditions (*http://waterdata.usgs.gov/nwis/rt*) updated at intervals of one hour or less.

Approximately 70 percent of the funding for the NSN is reimbursable funding from local, State, and Tribal cooperators through jointly funded agreements (approximately 50 percent) and reimbursable funding from other Federal agencies (approximately 20 percent). The partnerships with over 1,400 Federal, State, local, and Tribal stakeholders reflect widespread recognition of the Network's critical role and the USGS's responsibility for collecting, analyzing, managing, and delivering streamflow information for the Nation.

An important component of building an integrated predictive science capability is the Next Generation Water Observing System (NGWOS). NGWOS, which the USGS has been piloting in the Delaware River Basin since 2018, establishes an enhanced monitoring network integrated with other relevant data sets. This provides a dense network of high-fidelity, real-time data on water-quantity, quality and use necessary to support advanced models, modern water predictions, and decision support for daily water operations or water emergencies. The USGS has selected the headwaters of the Colorado and Gunnison as the next basin for deployment. Selected watersheds are representative of the Nation's larger water-resource regions and instrumented to monitor a water quantity, quality, and use. These data will be coupled with the National Water Model and other modeling tools to improve prediction, and address a variety of other difficult water-resource questions in a given region. Further, the NGWOS will provide a foundational dataset as the USGS develops Integrated Water Availability Assessments (IWAAs).

Since 2018, the USGS has been piloting the NGWOS in the Delaware River Basin (DRB). In 2021, the USGS will focus monitoring efforts on a strategic set of sites that address the most critical water resource issues in the DRB. In addition, planning for implementing the NGWOS in the next watershed, the headwaters of the Colorado and Gunnison River Basin, will continue in 2021.

The Streamgaging Network and Federal Priority Streamgages: One of the highest priorities of the USGS is to maintain long-term stability of a "Federal needs backbone network" for long-term tracking and forecasting/modeling of streamflow conditions in response to changes in land use, water use, and climate. Specifically, consistent and systematically-collected information is paramount to meet the full gamut of Federal water priorities and responsibilities over the long term related to: forecasting extreme hydrologic events (floods and droughts); interstate agreements, compacts, court decrees and other legal obligations; streamflow tracking in major river basins and across borders; long-term streamflow forecasts that account for changes in population, land use, water use, and climate; and water-quality assessments on sources, transport, and fate of contaminants in rivers and estuaries. To meet these strategic Federal priorities and responsibilities, the USGS has identified 4,760 sites for a "Federal Priority Streamgage" (FPS) network. In 2021, the USGS will work with partners to support approximately 3,470 of these streamgages.

The Streamgaging Network and Cooperative Matching Funds (CMF): The remaining streamgages in the Network also support the USGS mission and national water priorities and is used to facilitate management decisions, operations, and responsibilities by other Federal agencies, States, localities, Tribes, regional commissions, industry, and non-governmental organizations. Most streamgages provide information to stakeholders serving more than one use, related to, for example:

- Water resource appraisals, allocations, and diversions (water supply/water use/water budgeting).
- Infrastructure planning and design for reservoirs, bridges, roads, culverts, and treatment plants.
- Operation of reservoirs, power plants, flood-control systems, and navigation locks and dams.
- Instream flow requirements for ecosystems and habitat.
- Management of groundwater pumping and depletion.
- Floodplain mapping and planning.
- Tide monitoring and prediction.
- Recreational safety and enjoyment.

Federal agencies rely on streamflow information to meet their obligations. This includes the National Weather Service using information from more than 3,600 streamgages to predict floods; the Federal Emergency Management Agency identifying flood-prone areas; the Bureau of Reclamation operating dam and water conveyance systems; the National Park Service and Fish and Wildlife Service managing water resources and ecosystems; and the U.S. Army Corps of Engineers operating locks and dams.

Water Monitoring Capabilities for Hazards Response: A critical application of Network data is its use in safeguarding communities from natural hazards. The WOSP promotes the development and application of information and tools to minimize the loss of life and property from hazards, including support for flood

forecasting, storm surge monitoring during hurricanes and floods (using storm tide sensors and Rapidly Deployable Streamgages, known as RDGs), drought, debris flows, and fires. The USGS Flood Event Viewer (https://water.usgs.gov/floods/FEV/) provides a one-stop application to view flood data for current and past events, including USGS flood response, streamflow information, and high-water marks. A Floods Web page (http://water.usgs.gov/floods/) also provides access to a range of tools and data for flood events.

The WOSP continues to expand the use of storm-tide sensors and RDGs to prepare for and respond to floods and hurricanes. These sensors are part of a mobile network of rapidly deployable instruments that are used to observe and document the timing, extent, and magnitude of hurricane-induced storm-surge, waves, and tides. This network, known as the SWATH (http://water.usgs.gov/floods/swath/), consists of water-level and meteorological monitoring devices that are set up in the days and hours prior to a potential storm-surge event, and then retrieved shortly after. High-water marks collected after flood events, and data from storm-tide sensors and RDGs are used by emergency managers, first responders, NWS forecasters, and others as they make decisions related to flood response and public safety, determine flood insurance maps and building codes, and to calibrate hurricane inundation models. To enable the USGS to more quickly deploy sensors in advance of future storm events, the USGS is installing storm tide sensor housings along U.S. coastlines. In 2021, this work will continue with the goal of providing national coverage of sites along coastlines with capacity to temporarily install sensors and RDGs prior to major storms or tsunamis by 2022.

Water Data for Hazards Planning: At the opposite end of the hydrologic spectrum, information from over 5,000 long-term record streamgages is used by the USGS and partners to determine the extent, duration, and severity of droughts and to allocate water for critical uses. As the USGS strives to provide the data and science needed by communities to plan for, rather than react to, hydrological droughts, this information is necessary for decision makers to manage and mitigate the effects of drought. In addition, the USGS, in collaboration with Federal agencies, consulting firms, and universities, has developed new national flood flow frequency guidelines. Flood-frequency analysis provides quantitative, scientific information about the magnitude and frequency of flood discharges, which is used by water resource planners in the planning, design, and management of infrastructure along river corridors.

National Water Quality Network (NWQN) for Streams and Rivers: The NWQN is the only nationally designed network for tracking the quality of the Nation's rivers and streams with consistent and comparable methods at all sites. In 2021, the USGS would operate 113 NWQN sites located on large inland and coastal rivers, as well as in small agricultural, urban, and minimally disturbed reference watersheds. The USGS also augments its existing streamgage infrastructure with multi-sensor "Super Gages," which can deliver near-real-time data on flow, basic water-quality properties, and an increasing number of water-quality constituents. This information can be used to identify sources of contaminants; understand how contaminant concentrations and loads are changing over time; monitor the effects of floods and other hydrologic events on water quality; and forecast harmful algal blooms and episodes of hypoxia in receiving waters.

Groundwater Data Collection: The quantity and quality of groundwater in an aquifer are important factors in determining water availability. The USGS works in collaboration with States, Tribes, universities, and localities to provide groundwater quality and level data through the National Groundwater Monitoring Network Data Portal. The Data Portal provides a valuable resource to water resource managers and other

decision makers across the Nation as they plan, manage, and develop groundwater resources by providing access to historical groundwater well data. In 2021, the WOSP will maintain a nationwide network of approximately 690 groundwater monitoring sites called the Climate Response Network (CRN). These sites are used to understand the effects of drought and other climate variability on long-term trends in groundwater levels across the Nation. In addition, the USGS will continue to support an enterprise of approximately 100 groundwater-quality monitoring networks in strategically selected aquifers across the Nation to provide the data needed to understand the status of the Nation's groundwater quality, and whether it is getting better or worse.

The National Water Information System (NWIS): At the center of the USGS water data products lies the NWIS, providing current conditions related to streamflow, flood and high flow, drought, and groundwater levels, in addition to water-quality and water-use data. The NWIS is funded through the WOSP and the Water Resources Availability Program. Funds support the development and maintenance of reliable systems that deliver real-time and historic information to stakeholders. This is particularly critical during hazard events and the USGS ensures this system functions at peak efficiency and effectiveness. The current version of NWIS is inflexible, suffers from extensive technological obsolescence and is at increased risk of system failure because of aging infrastructure. As a part of NGWOS, the USGS is transitioning from existing legacy systems to a robust, scalable water information infrastructure to enable management of new data and sensor networks, support integration of water data from multiple agencies and sectors, and feed data and analytical products into the National Water Model and other hydrologic models. In 2021, the USGS will continue to enhance and modernize its water data management and delivery infrastructure. Further, efforts will continue to provide capabilities for managing real-time streamflow, water level and other data with a centralized platform meeting the Federal Cloud First Computing Strategy.

Core Science Systems

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[1]	Program Changes	Request	Change from 2020
Core Science Systems	**226,688**	**246,688**	**1,524**	**-**	**(36,163)**	**212,049**	**(34,639)**
FTE	*560*	*570*	*-*	*-*	*-*	*513*	*(57)*
National Geospatial Program	**69,454**	**79,454**	**661**	**-**	**-**	**80,115**	**661**
FTE	*247*	*247*	*-*	*-*	*0*	*247*	*0*
National Cooperative Geologic Mapping Program	**24,397**	**34,397**	**288**	**-**	**(12,928)**	**21,757**	**(12,640)**
FTE	*98*	*108*	*-*	*-*	*(17)*	*91*	*(17)*
Science Synthesis, Analysis and Research Program	**24,051**	**24,051**	**222**	**1,921**	**(1,903)**	**24,264**	**(1,708)**
FTE	*68*	*68*	*-*	*15*	*(15)*	*68*	*(15)*
National Land Imaging	**106,865**	**106,865**	**353**	**106,865**	**(21,305)**	**85,913**	**(20,952)**
FTE	*132*	*132*	*-*	*-*	*(25)*	*107*	*(25)*
Land Change Science Program	**1,921**	**1,921**	**-**	**(1,921)**	**-**	**-**	**-**
FTE	*15*	*15*	*-*	*(15)*	*-*	*-*	*-*

The 2021 budget request for the Core Science Systems Mission Area is $212,049,000 and 513 FTE.

The 2021 President's budget request for the Core Science Systems (CSS) Mission Area funds priority high-resolution elevation, hydrographic, geologic, and biogeographic mapping activities; remote sensing satellite operations; remote sensing imagery availability; land cover change and classification applications; high performance computing and modeling activities; science data analysis and synthesis; and geoscientific asset preservation (e.g., drilling cores and rock samples).

With the proposed budget, these programs would continue to leverage Federal funds with matching partner funds while coordinating geospatial data requirements to eliminate duplication (i.e., pay to collect data once and use the results many times over for multiple applications). The USGS would also continue to develop the Landsat 9 ground and flight systems in collaboration with the National Aeronautics and Space Administration (NASA) to meet a planned launch date in fiscal year 2021.

[1] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

The 2021 President's budget request ensures that the USGS continues to provide:

- Light detection and ranging (lidar), and interferometric synthetic aperture radar (IfSAR) in Alaska, elevation data for critical minerals assessments, infrastructure management, flood risk determination, land navigation safety, and precision farming.
- Up-to-date topographic and hydrographic maps for Alaska and the rest of the United States in support of recreation, critical minerals assessments, and emergency response to natural disasters.
- Landsat 9 ground systems development to meet a scheduled launch date by fiscal year 2021, ensuring that the USGS will sustain a heavily-used, long-term imagery record that supports land cover change analyses, drought and water use assessments, and agricultural research.
- Operation of Landsat 7 and 8 flight operation and data systems, and other satellite-related operations support including coordinating the acquisition of remotely-sensed data and distributing images and geospatial products to aid in disaster response operations.
- The National Hydrography Dataset Plus High Resolution (NHDPlus HR), a nationwide, scalable hydrographic referencing system (i.e., an "address system" for America's inland waterways and catchment areas that drain into streams) to enable flood forecasting at the local, neighborhood level.
- Detailed geologic maps to assess the availability of critical minerals in Alaska and the rest of the United States; aid in locating commercial sand and gravel, crushed stone, and clay for infrastructure; assess energy and groundwater resources accurately; and provide information on the safest and most economical locations to build new bridges, roads, and dams.
- High-performance computing for data-intensive model processing for applications such as airborne electromagnetic surveys for critical mineral resource assessments, earthquake early warning systems, and daily models to predict coastal erosion and forecast hazards.
- Continued support to the National Land Cover Database, which serves as the definitive Landsat-based, high-resolution, land cover database for the Nation.
- Data science, information delivery, and biodiversity analytics for identifying low-conflict habitat areas for energy exploration, hazard mitigation, and urban planning. Assessments and decision-support tools characterizing risk levels for communities and ecosystems to hazard events.
- Preservation of geoscientific assets (e.g., drilling cores and rock and sediment samples) that provide foundational information to industry for discovering or rediscovering valuable natural resource deposits.
- Continued expansion of the online USGS Library through optimized technology and processes, and consolidation of the physical collections to a single location/storage facility.
- Continued support for Federal Geographic Data Committee (FGDC) and activities of the FGDC Office of the Secretariat, which supports: the development of the Nation's geospatial data and infrastructure; the implementation of the Geospatial Data Act of 2018; and the delivery of GeoPlatform Shared Services in support of the President's Management Agenda and the Federal Data Strategy.

- Research to study the spatial patterns, processes, relationships, and consequences of changes in climate, land uses and land cover, and research to contribute to the science basis needed to develop sustainable resource management strategies.

All these activities support Interior's coordinated mission functions of recreation, collaborative conservation, land and natural resource management, and permitting to better serve the American public; as well as the Administration's goals for critical minerals and energy assessments, economic development, public safety, and emergency preparedness.

National Geospatial Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
National Geospatial Program	69,454	79,454	661	0	0	80,115	661
FTE	247	247	-	-	-	247	-

Program Description

The National Geospatial Program (NGP) organizes, updates, and publishes the baseline for nationwide topography, natural landscape and built environment through The National Map—a compilation of the foundational geospatial data layers for the entire Nation, maintained in the public domain. The USGS supports Interior's responsibilities for national geospatial coordination and carries out the USGS's governmentwide leadership responsibilities for elevation, hydrography and watershed boundaries, and geographic names. As one of the cornerstones of the USGS, The National Map is readily accessible for display on the Web, as products and services, and as downloadable data for use in recreation, scientific analysis, and emergency response. The American people rely on USGS's publicly available enhanced data and mapping to remain informed and to stay healthy and safe.

2021 Activities

The 2021 budget request:

- Continues the collection of high-resolution light detection and ranging (lidar) elevation data, to achieve the first-ever baseline of national coverage with high quality data by 2025. Coordinates interagency elevation data collection through the 3D Elevation Program.
- Supports the objectives of Secretarial Order 3359 (Critical Mineral Independence and Security) and Executive Order 13817 (A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals) by providing advanced topographic data needed to locate U.S. critical mineral resources to inform management of private-sector domestic mineral resource development, reduce dependence on foreign sources of critical minerals, and support job creation and technological innovation.
- Revises 96 percent of topographic maps for Alaska by the end of 2021 using updated elevation and hydrography data. These new maps and data are used in infrastructure planning, recreation, navigation safety, hazards mitigation, and Arctic wildlife assessments.
- Completes 86 percent of the Nation's National Hydrography Dataset Plus High Resolution (NHDPlus HR) data by the end of 2021, to deliver a networked hydrography framework to improve stream network analysis and support water modeling and assessments for emergency responders.
- Provides foundational geospatial data supporting The National Map, topographic mapping,

emergency response and mitigation efforts to support public safety after major natural disasters.

- Continues supporting Interior's leadership role in advancing the next National Spatial Data Infrastructure (NSDI) Strategic Plan and supporting efforts under the Geospatial Data Act of 2018.

2021 Program Change Summary

The 2021 budget request for the **National Geospatial Program** is $80,115,000 and 247 FTE.

There are no program changes for the National Geospatial Program.

Program Overview

The USGS 3D Elevation Program (3DEP) acquires high-resolution elevation data for the Nation, including high-resolution IfSAR elevation data for Alaska. Geospatial liaisons distributed across the United States help to coordinate data acquisition requirements with Federal, State, local, and Tribal governments, and private industry. The NGP's annual Broad Agency Announcement process effectively leverages funds appropriated to the USGS with matching partner funds to accelerate completion of nationwide elevation data collection in support of energy resources management, critical minerals assessments, natural resources conservation, public safety, and job creation.

The NHDPlus HR will provide a single, scalable hydrography framework for the Nation that contains 10 times more detail than currently available. This new framework is a step forward in providing the next generation of hydrography data and will underpin a host of national applications including flood prediction and chemical spill response. Federal, State, Tribal, and local partners use the NHDPlus HR to perform water quantity and quality mapping; reference hydrologic features and observations for more accurate flood risk management; develop infrastructure; and report on surface water conditions.

The US Topo map product is a georeferenced digital map produced from The National Map data. The American public can use US Topo maps like the traditional 7.5-minute quadrangle paper topographic maps for which the USGS is well known. US Topo maps now provide modern technological advantages that support faster, wider public distribution and basic, onscreen geospatial analysis.

The Federal Geographic Data Committee (FGDC) is an interagency coordinating committee focused on implementing cross-government geospatial initiatives, including the Geospatial Platform and the National Spatial Data Infrastructure (NSDI). The FGDC Office of the Secretariat provides executive, strategic planning, administrative, and technical support to the Committee. The FGDC coordinates implementation of the Geospatial Data Act of 2018, OMB Circular A-16, the NSDI Strategic Plan, and integrates geospatial data, shared services, and portfolio management practices into the Federal Data Strategy as identified in the President's Management Agenda.

National Cooperative Geologic Mapping Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
National Cooperative Geological Mapping Program	**24,397**	**34,397**	**288**	**0**	**(12,928)**	**21,757**	**(12,640)**
National Cooperative Geologic Mapping Program Projects	*[24,397]*	*[24,397]*			*(2,928)*	*[21,469]*	
Phase 3 of the National Geologic Map Database	*[0]*	*[10,000]*			*(10,000)*	*[0]*	
FTE	**98**	**108**			**(17)**	**91**	**(17)**

Program Description

The National Cooperative Geologic Mapping Program conducts scientific (geologic) investigations and produces geologic maps through collaboration with State Geological Surveys and university partners. The resultant digital geologic maps and three-dimensional geologic framework models and visualizations are used by Federal and State decision-makers to help mitigate natural hazards, conduct energy and mineral resource assessments at county and regional scales, and assess hydrogeology and groundwater availability, all of which sustain and improve the quality of life and economic vitality of the Nation.

2021 Activities

The 2021 budget request:

- Makes detailed geologic maps publicly available for approximately 55 percent of the U.S. through the National Geologic Map Database by optimizing the use of geological and geophysical surveys and national digital geospatial datasets for the public and private sector.
- Continues efforts to design, build, and interpret an integrated three-dimensional geologic framework for the Nation based on new and prior geologic mapping at regional to local scales to improve mineral and energy resource assessments, earthquake and landslide hazards assessments, groundwater analyses, and infrastructure development.
- Continues efforts supporting the Earth Mapping Resources Initiative (Earth MRI) to improve knowledge of the geologic framework of the United States and to identify areas that have the potential to contain undiscovered critical mineral resources. Currently, 20 percent of the land area of the United States has geologic maps at an appropriate level of quality and detail for mineral and energy exploration or land use planning, to advance the objectives of Secretarial Order 3359 Critical Mineral Independence and Security) and Executive Order 13817 (A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals).
- Makes available, through the National Geologic Map Database (NGMDB), new detailed geologic

maps covering 20,000 square miles of the continental United States to support energy and mineral resource development as well as other applications.

2021 Program Change Summary

The 2021 budget request for the National Cooperative Geologic Mapping Program is $21,757,000 and 91 FTE, which includes:

- National Cooperative Geologic Mapping (-$2,928,000 and -7 FTE)
- Phase 3 – National Geologic Map Database (-$10,000,000 and -10 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The program represents nearly three decades of successful cooperation among Federal (FEDMAP), State (STATEMAP), and university (EDMAP) partners to deliver digital geologic maps for a wide range of public and private sector customers. Each of these three components has a unique role, yet all work cooperatively to select and map high-priority areas for new geologic maps.

The USGS characterizes, interprets, and distributes the geologic framework model of the Nation through geologic mapping and derivative research. The national geologic framework model is a three-dimensional visualization of surface and subsurface rock, soil, and sediment layers. This model is used to inform the responsible use of land, water, energy, and mineral resources and address the Nation's rapidly changing natural resource needs.

The National Geologic Map Database is a hallmark collaborative effort with the Association of American State Geologists. This national database provides rapid access for the public, scientists, and decision makers to well-documented and standardized Federal and State geoscience information to support research, understanding, and decisions in response to societal needs. The USGS's National Geologic Map Database leads national-level information exchanges and the development of more efficient methods for digital mapping, cartography, geographic information system analysis, and information management.

The FEDMAP component provides oversight for 18 regional geologic mapping and synthesis projects that cross jurisdictional boundaries. Through FEDMAP projects, the program has accelerated research in geologic specialties, including subsurface geophysical methodology and modeling, three-dimensional geologic modeling, age-dating, petrology and geochemistry, hydrogeology, and paleo-environmental study while still maintaining core geologic mapping expertise.

The STATEMAP component oversees the geologic mapping studies conducted by approximately 44 State Geological Surveys through a competitive cooperative agreement program that matches every Federal dollar with a State dollar. This program effectively leverages Federal funds with State partners and balances the diverse needs of the Nation with those of individual States. The State-matched grants to State Geological Surveys focus on producing new geologic maps that address societally relevant issues identified by the States, including: water, mineral, and energy resources; earthquake, flood, sinkhole, volcanic, and landslide hazards; soil conditions; coastal erosion and flooding; and urban and infrastructure development.

The EDMAP component provides oversight for competitive grants to universities and colleges for undergraduate and graduate students to conduct geologic mapping across the Nation. The objective of the program is to mentor the next generation of geoscientists in the science of modern geologic mapping and its application to field and laboratory based geologic problems. EDMAP projects typically involve one season of fieldwork and require a one-to-one match of Federal dollars from the university.

To the extent practicable, in 2021 selected FEDMAP projects will focus on increasing the area of the United States mapped at an appropriate level of detail and quality to support mineral and energy exploration and land use planning, in support of Secretarial Order 3359 and Executive Order 13817. Currently, only 20 percent of the United States is mapped to this level of detail. The USGS will prioritize 3 FEDMAP projects to collect data that will contribute to mapping at the appropriate level over high priority critical mineral areas.

Science Synthesis, Analysis, and Research Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers[2]	Program Changes	Request	Change from 2020
Science Synthesis, Analysis, and Research Program[3]	**[25,972]**	**[25,972]**	**222**	**1,921**	**(1,930)**	**24,264**	**(1,708)**
USGS Library	*[5,817]*	*[5,817]*	-	-	*(1,930)*	*[3,887]*	
FTE	**83**	**83**			**(15)**	**68**	**(15)**

Program Description

The Science Synthesis, Analysis, and Research Program provides analysis and synthesis of scientific data and information, and long-term preservation of scientific data and library collections. This program strives to accelerate research and decision making through data science, information delivery, advanced computing, biodiversity analytics, and preservation of geoscientific assets.

2021 Activities

The 2021 budget request:

- Enhances the USGS's high performance computing capabilities to support Interior's computational and management challenges, and enable more timely data transfer, analysis, and delivery of completed research results to support smart decisions on Secretarial priorities related to natural resource assessment and use.
- Reaches the goal of having 840 total scientists using the USGS high performance computing capability through intensive outreach and training.
- Maintains the Hazard Exposure Reporting and Analytics (HERA) dynamic Web application, a platform that makes research on community exposure to coastal-flooding hazards influenced by sea-level rise accessible to planners, decision makers, and the public.
- Supports Interior priorities by maintaining biogeographic science activities (e.g., species occurrence and distributions) to inform decisions on critical habitat conservation (e.g. sagebrush), hunting and fishing, invasive species, recreation, energy siting, and fire management.
- Supports the development of the USGS's National Biogeographic Map to provide analytical tools for the examination of selected species, habitats, protections, and habitat conditions.
- Continues to increase access, discovery, understanding and reuse of the USGS science data and information to improve the USGS ability to process and produce new science.

[2] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.
[3] Enacted amount in 2019 and 2020 was $24,051. Amounts shown are in the structure proposed for 2021.

- Continues to expand the online USGS Library through optimized technology and processes; and consolidates the physical collections to a single location/storage facility.
- Continues to preserve, expose, and provide access to valuable physical geoscience samples (e.g., drilling cores and rock and sediment samples) and data (e.g., borehole logs, GIS databases, and maps) for industry, academia, and the public.
- Provides support for approximately 30 State data preservation projects through the National Geological and Geophysical Data Preservation Program including grants to state geological surveys for a variety of critical minerals data preservation activities for Earth MRI efforts.
- Continues to support risk analysis as a part of the Science Application for Risk Reduction (SAFRR) project that is focused on earthquake analysis, including scenario assessments, damage estimation, early warning, and protective actions.
- Expands how the USGS characterizes societal impacts of coastal hazards, specifically communicating the influence of a changing world (e.g., sea level rise, urbanization).
- Expands the role of land-change modeling into projecting future societal vulnerability to natural hazards.

2021 Program Change Summary

The 2021 budget request for the Science Synthesis, Analysis, and Research Program is $24,264,000 and 68 FTE, which includes:

- USGS Library (-$1,930,000 and -15 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The program includes the Science Analytics and Synthesis Program (SAS); the National Geological and Geophysical Data Preservation Program; the Core Research Center (CRC); the USGS Library; and the J.W. Powell Center for Analysis and Synthesis (Powell Center). The USGS also develops quantitative, qualitative, and geospatial methods and decision-support tools characterizing the Nation's vulnerability to hazard events and assessing the impacts of land cover change on ecosystem services. These activities provide an integrated suite of essential data, services, and applications to empower the USGS and its collaborators to effectively manage, steward and analyze key scientific data and materials.

The USGS strives to accelerate research and decision-making through data science, information delivery, high performance computing, and biodiversity analytics. The USGS also maintains an Advanced Research Computing Framework to execute complex computational models required to quickly and efficiently process large quantities of data, including high-resolution elevation datasets, integrating elevation and hydrography data, and three-dimensional geologic datasets.

The USGS provides technical and financial assistance to State geological surveys and Interior bureaus to support preservation, exposure, and reuse of valuable physical geoscience samples (e.g., drilling cores and

rock and sediment samples) and data (e.g., borehole logs, GIS databases, maps, field notebooks, etc.). Preserving endangered and unique geological and geophysical collections reduces duplicative collection costs and can unearth natural resources that may have been previously unknown.

The Core Research Center (CRC) is an archive for the preservation of rock cores for use by scientists and educators from government, industry, and academia. Since the establishment of the CRC, billions of dollars have been saved through new discoveries, and by not re-drilling and replicating collections.

National Land Imaging Program

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers [4]	Program Changes	Request	Change from 2020
National Land Imaging Program	**[106,865]**	**[106,865]**	**353**	**106,865**	**(21,305)**	**85,913**	**(20,952)**
Research and Investigations	*[8,495]*	*[8,495]*	-	-	*(7,556)*	*[939]*	
Remote Sensing State Grants	*[1,215]*	*[1,215]*	-	-	*(1,215)*	*[0]*	
Satellite Operations	*[84,337]*	*[84,337]*	-	-	*(10,905)*	*[73,432]*	
Land Cover Monitoring Assessment Projects	*[7,971]*	*[7,971]*	-	-	*(1,629)*	*[6,342]*	
FTE	**[132]**	**[132]**	**-**	**[132]**	**(25)**	**107**	**(25)**

Program Description

The National Land Imaging Program delivers remote sensing observation capacity, data, and research to inform land and resource managers and advance understanding of how landscapes and associated natural resources are changing at local, regional, and global scales. The USGS plays a leading role in land surface observations through its Landsat satellite missions that are designed and implemented in collaboration with NASA. Through the Earth Resources Observation and Science (EROS) Center, the USGS ensures the efficient archiving, processing, and distribution of a wide range of land-imaging data and derived products to users across the Nation, enabling the advancement of world-class land science research and applications.

2021 Activities

The 2021 budget request:

- Develops Landsat 9 systems in collaboration with NASA for overall mission integration in support of a fiscal year 2021 launch.
- Operates the Landsat 7 and Landsat 8 satellites and the EROS National Archive to deliver high-quality data to government, commercial, and academic users.
- Advances Landsat-Next mission formulation and related system development activities in joint effort with NASA and develops ground system requirements and acquisition strategies specific to operations and data processing/distribution.
- Continues the production of Landsat Analysis Ready Data (ARD) to provide scientists greater access

[4] Internal transfers are crosswalked from the old structure to this new structure in the Technical Adjustments section of this budget justification.

to pre-packaged and pre-processed Landsat data products, which are more accessible, easier to analyze, and quicker to integrate into time-series investigative analyses for natural hazards and land change detection.

- Maintains progress on full deployment and enhancement of the Land Change Monitoring, Assessment, and Projection (LCMAP) suite of land cover change and classification image products and services.
- Leverages cloud and machine learning (ML) services and technologies to advance operational efficiencies in Landsat data processing, distribution, archiving, product development, and data science.
- Continues National Civil Applications Center (NCAC) and unmanned aircraft systems operations for disaster risk reduction and environmental monitoring, in close collaboration with government and industry stakeholders.
- Supports innovative land remote sensing applications to advance the Nation's economic, environmental, and scientific interests.
- Continues updates of the National Land Cover Database (NLCD) with an emphasis on reducing the refresh schedule from five years to one year and reducing the lag time to one year.

2021 Program Change Summary

The 2021 budget request for the National Land Imaging Program is $85,913,000 and 107 FTE, which includes:

- Research and Investigations (-$7,556,000 and -8 FTE)
- Satellite Operations (-$10,905,000 and -11 FTE)
- Land Cover Monitoring and Assessment Projects (-$1,629,000 and -6 FTE)
- Remote Sensing State Grants (-$1,215,000 and 0 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Overview

The USGS delivers remote sensing observation capacity, data, and research to inform the Nation's land and resource managers and improve understanding of how landscapes and associated natural resources are changing at local, regional, and global scales. The USGS operates satellites and Unmanned Aircraft Systems (UAS) and collects, archives, processes and distributes a broad array of data from its own and partners' remote sensing systems. The USGS also manages a partnership with NASA for the Sustainable Land Imaging (SLI) program, ensuring that both agencies work together to maintain the Nation's long-term moderate-resolution land remote sensing capabilities.

The USGS operates Landsat 7 and Landsat 8 satellites, the only operational civil satellite program with both thermal and short-wave infrared sensors. These sensors are used extensively in water resource and agricultural management; they allow users to discriminate moisture content of soils and vegetation and

estimate heat temperatures in urban areas. Landsat operates with a free and open data policy that allows users to access imagery at no cost, providing domestic and international users an estimated $3.45 billion in annual economic benefits in 2017, with U.S. users accounting for $2.06 billion of those benefits (Straub et al., 2019).

Landsat 9 is the direct replacement for Landsat 7 and will extend the long-term Landsat observational record to more than five decades of coverage. Together with Landsat 8, it will continue to support a near-weekly Landsat revisit for hundreds of land cover applications, supporting tens of thousands of government, commercial, and academic users across the Nation. As with previous missions, Landsat 9 is being developed and operated through a longstanding partnership between NASA and the USGS.

As the Landsat 9 launch nears, work has already begun on the follow-on mission. USGS and NASA will continue to initiate Landsat-Next mission formulation and related system development, including development of a concept of operations, a formal program-level requirements document, and an acquisition strategy. Both agencies anticipate leveraging rapidly-advancing technologies for space systems development, launch and operations, data communications, and cloud-based data management services. The resulting next-generation land-observing capabilities will continue to support advanced, integrated and predictive science by USGS and its partners.

In 2018, the USGS and NASA chartered an architecture study team to assess options for assessing and implementing the follow-on mission to Landsat 9, which is scheduled to launch in fiscal year 2021. The study will inform the design and implementation approach for the next phase of developing a sustainable, space-based system that will provide high-quality, global land-imaging measurements. NASA and USGS are currently reviewing the findings from the study.

The USGS's EROS Center performs the Landsat satellite operations and image data collection, archiving, processing, and distribution. In its National Satellite Land Remote Sensing Data Archive, EROS houses more than 8 million Landsat satellite scenes acquired globally since 1972. In its Long-Term Archive for aerial photos and geospatial data, EROS houses over 6.5 million high-definition aerial mapping photos of U.S. sites, some dating to 1937.

The USGS's LCMAP will meet growing demands for temporally specific information on land surface change. Based upon Landsat ARD, LCMAP employs a machine learning-based approach to integrative data science that can enhance landscape change analysis; provide input into a wide range of environmental modeling studies; and provide more timely information for land managers.

The USGS National Civil Applications Program serves Federal civil agencies by providing for the acquisition, dissemination, and exploitation of classified remote sensing systems and data in support of mission responsibilities for disaster response, public safety and scientific research. The USGS National Civil Applications Center supports the USGS Volcano Hazards Program to improve volcano monitoring and the National Interagency Fire Center and other partners to improve wildland fire detection. The USGS manages the Global Fiducial Library, a long-term Earth surface monitoring project using U.S. National System data. The USGS would expand this resource to include declassified satellite imagery from the 1960's to 1980's and updated unclassified, publicly releasable data.

The Land Change Science Program provides land and natural resource managers with data, tools, and scientific products that inform decisions relevant to the safety of communities, economic prosperity, and condition of natural resources across the Nation. USGS research provides critical data needed to understand how natural disturbances (e.g., droughts, fire, flooding, and sea level change) and land use decisions (e.g., urbanization, agriculture, ecosystem stewardship, and water management) affect the composition, distribution, and functioning of land and natural resources. The USGS produces research products and technical methods to help decision makers apply the knowledge and data, gained from on-the-ground and remote sensing observation systems, to land use planning, natural resource management, and adaptation planning decisions and help forecast future resource conditions and availability.

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Science Support

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Science Support	**102,828**	**96,828**	**1,511**	**-**	**(4,166)**	**94,173**	**(2,655)**
FTE	*466*	*427*	*-*	*-*	*(4)*	*423*	*(4)*
Administration and Management	**80,881**	**74,881**	**1,341**	**-**	**(6,666)**	**69,556**	**247**
FTE	*402*	*363*	*-*	*-*	*(7)*	*356*	*(7)*
Information Services	**21,947**	**21,947**	**170**	**-**	**2,500**	**24,617**	**2,670**
FTE	*64*	*64*	*-*	*-*	*3*	*67*	*3*

The 2021 budget request for Science Support is $94,173,000 and 423 FTE.

The Science Support Activity provides the core functions that make it possible for the USGS to conduct science. These business and information services and systems include acquisitions and grants, finance, internal controls, communications, budget and performance, monitoring and evaluation of science quality and integrity, information assurance, information management and technology services, and human capital.

The 2021 request continues support for Departmental priorities and improve operations through the use of technology, automation, and efficient business practices. Activities include:

- Advancing Information Management Technology by establishing Artificial Intelligence and Machine Learning services.
- Continuously improving on Quality Management System (QMS) policy for USGS laboratories.
- Preventing and eliminating harassing conduct within USGS.

Administration and Management

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Administration and Management	**80,881**	**74,881**	**1,341**	**-**	**(6,666)**	**69,556**	**-5,325**
Transfer of Ethics Office to Office of the Solicitor	*[1,094]*	*[1,094]*			*(1,094)*	-	*(1,094)*
Program Operations					*(5,572)*	-	*(5,572)*
FTE	**402**	**363**			**(7)**	**356**	**(7)**

Program Overview

The offices and personnel in this subactivity are comprised of the Office of the Director; the Office of Budget, Planning, and Integration; the Office of Communications and Publishing; the Office of Science Quality and Integrity; the Office of International Programs; the Office of Diversity and Equal Opportunity; and the Office of Administration.

Program Activities

The 2021 budget supports 356 FTE to:

- Uphold the Bureau's Fundamental Science Practices to ensure reliable science.
- Deliver high quality scientific products and services addressing life, safety, natural resource decisions, and community planning efforts.
- Provide continuous improvements on the USGS laboratory Quality Management Systems.
- Champion the implementation of and communicate the efforts of the Workplace Culture Transformation activity by funding the Peer Support Worker Network.
- Support initiatives funded through the Interior Working Capital Fund Central and Direct Bills.
- Provide the business and administrative functions necessary to support science, such as budget, finance, procurement, contract and grant management, and public and legislative affairs.

2021 Program Change Summary

The 2021 budget request for the Administration and Management subactivity is $69,556,000 and 356 FTE, which includes:

- Transfer of Ethics Functions to the Office of the Solicitor (-$1,094,000/-7 FTE)
- Program Operations (-$5,572,000/0 FTE)

The budget does not request funding for these activities in order to address other priorities.

Program Description

Administration and Management, within Science Support, provides bureau-wide leadership and direction; establishes organizational vision, mission, goals and scientific priorities; develops and enforces standards for scientific rigor and integrity; plans, obtains and manages necessary resources, including people, budget authority, facilities and equipment; provides resource management systems; implements statutory and regulatory requirements and monitors and enforces compliance; and communicates the USGS mission and science to Congress and the public.

Funding supports the allocated share of operating costs for the GrantSolutions enterprise system to improve the processing and transparency of grants and cooperative agreements across Interior. Cost allocations are based on an algorithm of use factors.

Information Services

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Information Services	**21,947**	**21,947**	**170**	**-**	**2,500**	**24,617**	**2,670**
Communication Infrastructure		*[0]*			*2,500*	*2,500*	*2,500*
FTE	**64**	**64**			**3**	**67**	**3**

Program Description

The offices and personnel in this subactivity include the Office of the Associate Chief Information Officer, Chief Technology Officer, Information Management Technology (IMT) Strategic Planning, Information Security, Enterprise Services, End User Services, and Information Management and Delivery.

2021 Activities

The 2021 budget supports 67 FTE to:

- Provide access to advanced technologies such as artificial intelligence, and high-performance computing to enable science.
- Develop convergent IMT architecture by providing cloud hosting solution advancements that move information technology infrastructure into the cloud.
- Provide bandwidth capabilities to meet expanding Federal scientific technological needs.
- Provide the critical IMT foundation for the USGS science mission through IMT operations, FITARA compliance, records management, and IT applications development.
- Support IMT initiatives funded through the Interior Working Capital Fund Central and Direct Bills.

2021 Program Change Summary

The 2021 budget request for the Information Services subactivity is $24,617,000 and 67 FTE, which includes:

- Communication Infrastructure (+2,500,000/+3 FTE): In an effort to ensure the USGS delivers the Nation cost-effective, responsive, and flexible science, the USGS will improve communications across the bureau by providing improved solutions, including video telecommunication. This effort supports timely communication, collaboration, and a common operational picture, particularly during times of emergency need due to both natural or man-made hazards and disasters with

potential impacts to life and property. The request would provide a video telecommunication solution in the major hubs of Reston, Virginia, Denver, Colorado, and Moffett Field, California, as well as regional offices.

Program Description

Information Services, within Science Support, provides the critical Information Management and Technology (IMT) foundation for the USGS science mission by implementing advances in IMT in order to facilitate research, data gathering, analysis and modeling, scientific collaboration, knowledge management and work processes. Information Services supports numerous IMT services, such as the USGS information assurance program; infrastructure and cloud services; applications and customer support; information investment, management, and delivery programs; and supports the Interior IMT activities through the DOI Working Capital Fund Central and Direct bills.

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Facilities

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Facilities	**120,383**	**180,883**	**2,741**	**-**	**(55,987)**	**127,637**	**(53,246)**
FTE	*74*	*74*	-	-	-	*74*	-
Rental Payments and Operations & Maintenance	**105,219**	**104,719**	**2,741**	**-**	**8,602**	**116,062**	**11,343**
FTE	*74*	*74*	-	-	-	*74*	-
Deferred Maintenance and Capital Improvement	**15,164**	**76,164**	**-**	**-**	**(64,589)**	**11,575**	**(64,589)**
FTE	-	-	-	-	-	-	-

The 2021 budget request for Facilities is $127,637,000 and 74 FTE.

The USGS Facilities Activity provides safe, functional workspace to accomplish the bureau's scientific mission with an emphasis on the mission driving facility needs. Funds support rent; basic facility operations; security; facility maintenance, in compliance with Federal, State, and local standards; and provide a safe, sustainable working environment for employees, visiting partners, and customers.

Rental Payments and Operations and Maintenance

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Rental Payments and Operations & Maintenance	**105,219**	**104,719**	**2,741**	**-**	**8,602**	**116,062**	**11,343**
Realign Rent Costs					*8,602*		
FTE	**74**	**74**			**-**	**74**	**-**

Program Overview

This program provides the USGS with funding needed to pay for annual recurring rent and operations and maintenance. Rental payments are to the General Services Administration (GSA), other Federal sources, private lessors, and cooperators for space occupied by the USGS. The USGS has unique facility requirements for supporting science functions and relies heavily on the GSA to meet those needs, including modern laboratory space.

2021 Activities

The 2021 budget supports 74 FTE to:

- Continue the USGS move from Menlo Park, CA, to NASA Ames, Moffett Field, Mountain View, CA.
- Coordinate facility planning with science planning to provide safe, high-quality workspace aligned with science needs.
- Continue supporting the USGS scientific mission by providing facilities with unique space requirements.
- Reduce energy intensity by 2.5 percent annually.
- Implement cost savings initiatives through space consolidations.

2021 Program Change Summary

The 2021 budget request for the Rental Payments and Operations and Maintenance subactivity is $116,062,000 and 74 FTE, which includes:

- Realign Rent Costs ($8,602,000 / 0 FTE) – This addresses rent increases for GSA and non-GSA facilities, including increases at the National Center in Reston ($1,600,000), the Denver Federal

Center ($332,000), and Menlo Park ($326,000), to level set the subactivity and enable future rent changes to be addressed through fixed costs. Without this program increase, funding will be diverted from important science work, hindering the performance of the bureau.

Program Description

The Rental Payments component provides rental payments for space occupied by the USGS to the GSA, other Federal sources, private lessors, and cooperators. The USGS has unique facility requirements for supporting science functions and relies primarily on GSA to meet those needs, including modern laboratory space. Operations and Maintenance funding provides for basic facility operations, security, and facility maintenance. Maintenance involves the upkeep of USGS-owned facilities, structures, and capitalized equipment necessary to maintain the useful life of the assets.

The USGS occupies approximately 3.84 million square feet of rentable space in about 161 GSA buildings nationwide, making the USGS one of the largest users of GSA space within Interior. Approximately 21 percent of the USGS space is owned; the remaining 79 percent of the USGS space is provided through GSA, direct leases with the private sector, and cooperative and interagency agreements with State and local governments, universities, and other Federal agencies.

In the Operations and Maintenance component, maintenance involves the upkeep of the USGS owned facilities, structures, and capitalized equipment, necessary to maintain the useful life of the asset. To protect important resources, ongoing investments in annual and cyclic maintenance, repair, revitalization, and disposal of assets must be considered as part of a long-term operations and maintenance program. Operations of the USGS owned facilities include costs such as utilities, janitorial and pest services, waste management, and salaries for staff responsible for the day-to-day operations of the facility.

Deferred Maintenance and Capital Improvement

Dollars in Thousands	2019	2020	2021				
	Actual	Enacted	Fixed Costs	Internal Transfers	Program Changes	Request	Change from 2020
Deferred Maintenance and Capital Improvement	**15,164**	**76,164**	**-**	**-**	**(64,589)**	**11,575**	**(64,589)**
Projects	*[15,164]*	*[11,664]*			*(3,689)*	*[7,975]*	*(3,689)*
Space Consolidation and Modernization at Colorado School of Mines	*-*	*-*			*3,600*	*[3,600]*	*3,600*
Facilities Replacement and Recapitalization	*-*	*[64,500]*			*(64,500)*	*-*	*(64,500)*
FTE	**-**	**-**			**-**	**-**	**-**

Program Description

This program provides the USGS with funding for deferred maintenance and repair activities on USGS-owned assets and assets where the USGS has deferred maintenance responsibility (buildings, structures, and equipment). Funding is provided to the highest priority facility and equipment requirements, including stewardship responsibilities for unique mission equipment such as: hazard warning networks, river cableways, and stream gaging stations, all of which require maintenance and capital investments to preserve their functionality.

The 2021 budget supports:

- Slowing the growth of the deferred maintenance backlog by renovating and constructing buildings and other facilities to replace assets that are no longer cost effective to operate.
- Continuing an effective maintenance program at each owned facility to meet industry best practices.
- Increasing co-location and consolidation consistent with science program objectives.
- Achieving Departmental for sustainability, energy, and water reduction.

2021 Program Change Summary

The 2021 budget request for the Deferred Maintenance and Capital Improvement subactivity is $11,575,000 and 0 FTE, which includes:

- Space Consolidation and Modernization at Colorado School of Mines ($3,600,000/0 FTE): The additional funds support the relocation of USGS Mineral Resources Program research labs and

personnel into a newly constructed facility on the campus of the Colorado School of Mines in Golden, Colorado, increasing collaborative opportunities and vacating current labs that are no longer suitable for the program's research purposes. This move will save $3.0 million over 20 years.

- Facilities Replacement and Recapitalization (-$64,500,000/0 FTE)

- Projects (-$3,689,000/0 FTE)

Program Overview

The Deferred Maintenance and Capital Improvements subactivity enables the USGS to address critical facility needs, helping to slow the growth in the USGS deferred maintenance backlog. At the end of fiscal year 2019, the USGS had a deferred maintenance backlog of $148.3 million for both owned assets and assets for which the USGS pays operations and maintenance in lieu of rent.

Facilities projects reflect comprehensive evaluations conducted by independent architectural and engineering firms. These installation-wide assessments help establish core data on the condition of the USGS constructed assets. Additionally, knowing the estimated cost of deferred maintenance and the replacement value of constructed assets allows the USGS to use the industry standard Facility Condition Index as a method of measuring facility condition and condition changes. The condition assessment process also identifies, reports, and tracks asbestos, environmental, and disposal liabilities of the USGS. Through the asset management planning process, the USGS identifies real property assets that are candidates for disposal. Any asset that is no longer critical to the mission, in poor condition, or no longer cost effective to maintain is a candidate for possible disposal.

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Working Capital Fund

The Working Capital Fund (WCF) was made available for expenses necessary for furnishing materials, supplies, equipment, work, and services in support of the USGS programs, and as authorized by law, to agencies of the Federal Government and others.

The WCF consists of:

- The WCF Investment Component provides a mechanism to assist the USGS managers in planning for and acquiring goods and services that are too costly to acquire in a single fiscal year or that, due to the nature of services provided, must operate in a multi- as opposed to a single-year basis of funding. Investments are supported by documented investment plans that include estimated acquisition/replacement costs, a schedule of deposits, and approval of the plans, deposits, and expenditures by designated USGS officials.
- The WCF Fee-for-Service Component provides a continuous cycle of client services for fees established in a rate-setting process. Fees are predicated upon both direct and indirect costs associated with providing the services, including amortization of equipment required to provide the services.
- The GSA buildings delegation component is used to manage funds received under the delegated authority for the J.W. Powell Building and Advanced Systems Center in Reston, VA, as provided by 40 U.S.C. 121 (d) and (e) (formerly subsections 205 (d) and (e) of the Federal Property and Administrative Services Act of 1949, as amended, and 40 U.S.C. 486 (d) and (e), respectively). Delegated functions include building operations, maintenance, cleaning, overseeing fire and life safety, maintaining high voltage switchgear and fire alarms, recurring repairs, minor alterations, historic preservation, concessions, and energy management. Because of the size and deferred maintenance issues of the Reston buildings and the need to expend the facility funds in a manner corresponding to GSA's no-year funding (Federal Buildings Fund) mechanisms and the GSA National Capital Region long-range capital improvement plan, no-year funding is a prerequisite to administering the delegation. Public Law 104–208, Section 611, provides that, for the fiscal year ending September 30, 1997, and thereafter, any department or agency that has delegated authority shall retain that portion of the GSA rental payment available for operation, maintenance, and repair of the building and the funds shall remain available until expended. This component was established in 2004 to provide the USGS with this no-year flexibility.

Appropriation Language and Citations

P.L. 101-512 Department of the Interior and Related Agencies Appropriations Act, 1991. This authority established a Working Capital Fund account in 1991. The Telecommunications Amortization Fund was included as part of the WCF and all balances of the Telecommunications Amortization Fund existing at the end of 1990 were transferred to the WCF. These balances were to be used for the same purposes as originally authorized.

P.L. 103-332 Department of the Interior and Related Agencies Appropriations Act, 1995. This authority expanded the use to partially fund laboratory operations and facilities improvements and to acquire and replace publication and scientific instrumentation and laboratory equipment.

WORKING CAPITAL FUND

Employment Summary

Identification Code 14-4556-0-4-306		2019 Actual	2020 Enacted	2021 Request
	Reimbursable:			
2001	Civilian full-time equivalent employment	112	112	112

USGS Accounts

Appropriations Language

SURVEYS, INVESTIGATIONS, AND RESEARCH

For expenses necessary for the United States Geological Survey to perform surveys, investigations, and research covering topography, geology, hydrology, biology, and the mineral and water resources of the United States, its territories and possessions, and other areas as authorized by 43 U.S.C. 31, 1332, and 1340; classify lands as to their mineral and water resources; give engineering supervision to power permittees and Federal Energy Regulatory Commission licensees; administer the minerals exploration program (30 U.S.C. 641); conduct inquiries into the economic conditions affecting mining and materials processing industries (30 U.S.C. 3, 21a, and 1603; 50 U.S.C. 98g(1)) and related purposes as authorized by law; and to publish and disseminate data relative to the foregoing activities; [$1,270,957,000] *$971,185,000*, to remain available until September 30, [2021] *2022*; of which [$84,337,000] *$73,432,000* shall remain available until expended for satellite operations; and of which [$76,164,000] *$11,575,000* shall be available until expended for deferred maintenance and capital improvement projects that exceed $100,000 in cost: *Provided,* That none of the funds provided for the ecosystem research activity shall be used to conduct new surveys on private property, unless specifically authorized in writing by the property owner: *Provided further*, That no part of this appropriation shall be used to pay more than one-half the cost of topographic mapping or water resources data collection and investigations carried on in cooperation with States and municipalities. *(Department of the Interior, Environment, and Related Agencies Appropriations Act, 2020.)*

ADMINISTRATIVE PROVISIONS

From within the amount appropriated for activities of the United States Geological Survey such sums as are necessary shall be available for contracting for the furnishing of topographic maps and for the making of geophysical or other specialized surveys when it is administratively determined that such procedures are in the public interest; construction and maintenance of necessary buildings and appurtenant facilities; acquisition of lands for gauging stations, observations wells, and seismic equipment; expenses of the United States National Committee for Geological Sciences; and payment of compensation and expenses of persons employed by the Survey duly appointed to represent the United States in the negotiation and administration of interstate compacts: *Provided*, That activities funded by appropriations herein made may be accomplished through the use of contracts, grants, or cooperative agreements as defined in section 6302 of title 31, United States Code: *Provided further*, That the United States Geological Survey may enter into contracts or cooperative agreements directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. 6101, for the temporary or intermittent services of students or recent graduates, who shall be considered employees for the purpose of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and

work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, but shall not be considered to be Federal employees for any other purposes. *(Department of the Interior, Environment, and Related Agencies Appropriations Act, 2020.)*

Authorizations

A full listing of USGS authorizations is available at the USGS Office of Budget, Planning, and Integration Web site.

Web site:

https://www.usgs.gov/about/organization/science-support/budget/authorizations

Expiring Authorizations

Expiring Authorization Citation	
Bureau/Office Name	USGS/Water Resources Mission Area
Program Name	National Streamflow Information Program (included in the Groundwater and Streamflow Information Program)
Citation	P.L. 111-11 42 USC 10367
Title of Legislation	Omnibus Public Land Bill of 2009
Last Year of Authorization	2019
BY Budget Request ($000)	$ 10,000
Explanation of Authorization Requirement for BY	No individual programmatic authorization is necessary for the USGS to continue this effort.
Program Description	As a subset of the National Streamgaging Network, the Federal Priority Streamgages (FPS) Network (previously known as the National Streamflow Information Program) is designed to address long-term Federal information needs (such as supporting National Weather Service flood forecasts, or interstate and international compacts and decrees). Currently about 3,600 of more than 4,700 qualified FPS locations are active. These streamgages are supported through a combination of Federal and partner funding—less than one-quarter are fully funded by the USGS. Information provided through the network forms the scientific basis for decision-making related to the protection of life and property from water-related hazards, such as floods; cost-effective management of freshwater that is safe and available for drinking, irrigation, energy, industry, recreation, and ecosystem health; and national, State, tribal, and local economic well-being. The latest streamflow information is available as alerts to users by email or text message and as real-time stream conditions change, updated at intervals of one hour or less.

Summary of Requirements

Activity/ Subactivity/ Program Element	2019	2020 Enacted		Fixed Costs	Internal Transfers		Program Changes		2021 Request		Change from 2020	
	Amount	FTE	Amount		FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
Species Management Research Program				+1,015	+234	+77,209		-38,231	234	39,993	+234	+39,993
Land Management Research Program				+727	+209	+56,681		-19,471	209	37,937	+209	+37,937
Biological Threats Research Program				+517	+161	+36,149		-8,125	161	28,541	+161	+28,541
Climate Adaptation Science Center				+550	+110	+57,488		-37,172	110	20,866	+110	+20,866
Cooperative Research Units Program	18,371	135	24,000		-135	+0		-24,000	0	0	-135	-24,000
Status and Trends	18,373	79	16,706		-79	-16,706			0	0	-79	-16,706
Fisheries Program	19,136	124	22,136		-124	-22,136			0	0	-124	-22,136
Wildlife Program	45,257	246	45,957		-246	-45,957			0	0	-246	-45,957
Environments Program	36,415	183	38,415		-183	-38,415			0	0	-183	-38,415
Invasive Species	19,330	122	23,330		-122	-23,330			0	0	-122	-23,330
Ecosystems Total	**156,882**	**889**	**170,544**	**+2,809**	**-175**	**+80,983**	**+0**	**-126,999**	**714**	**127,337**	**-175**	**-43,207**
National Land Imaging Program	98,894	121	98,894		-121	-98,894			0	0	-121	-98,894
Land Change Science Program	34,070	133	29,045		-133	-29,045			0	0	-133	-29,045
National and Regional Climate Adaptation Science Centers	25,335	70	38,335		-70	-38,335			0	0	-70	-38,335
Land Resources Total	**158,299**	**324**	**166,274**	**+0**	**-324**	**-166,274**	**+0**	**+0**	**0**	**0**	**-324**	**-166,274**
Mineral Resources Program	58,969	291	59,869	+795				+0	291	60,664	+0	+795
Energy Resources Program	29,972	126	30,172	+345				+0	126	30,517	+0	+345
Contaminant Biology Program	10,197	63	10,397		-63	-10,397			0	0	-63	-10,397
Toxic Substance Hydrology Program	12,598	58	13,098		-58	-13,098			0	0	-58	-13,098
Energy and Mineral Resources, and Environmental Health Total / Energy and Mineral Resources Total	**111,736**	**538**	**113,536**	**+1,140**	**-121**	**-23,495**	**+0**	**+0**	**417**	**91,181**	**-121**	**-22,355**
Earthquake Hazards Program	83,403	227	84,903	+636			-12	-25,229	215	60,310	-12	-24,593
Volcano Hazards Program	30,266	153	30,266	+429			-1	-3,084	152	27,611	-1	-2,655
Landslide Hazards Program	3,538	19	4,038	+53			-2	-484	17	3,607	-2	-431
Global Seismographic Network	6,653	13	7,153	+36			-1	-1,792	12	5,397	-1	-1,756
Geomagnetism Program	1,888	8	4,000	+25			+1	+114	9	4,139	+1	+139
Coastal-Marine Hazards and Resources Program	40,510	192	40,510	+539			-18	-4,114	174	36,935	-18	-3,575
Natural Hazards Total	**166,258**	**612**	**170,870**	**+1,718**	**+0**	**+0**	**-33**	**-34,589**	**579**	**137,999**	**-33**	**-32,871**
Water Resources Availability Program				+1,291	+592	+102,792	-189	-32,226	403	71,857	+403	+71,857
Water Observing Systems Program				+1,532	+685	+121,328	-54	-13,908	631	108,952	+631	+108,952
Water Resources Research Act Program	6,500	2	10,000	+0	+0	+0	-2	-10,000	0	0	-2	-10,000
Water Availability and Use Science Program	45,487	312	47,487		-312	-47,487			0	0	-312	-47,487
Groundwater and Streamflow Information Program	82,673	441	84,173		-441	-84,173			0	0	-441	-84,173
National Water Quality Program	91,648	524	92,460		-524	-92,460			0	0	-524	-92,460
Water Resources Total	**226,308**	**1,279**	**234,120**	**+2,823**	**+0**	**+0**	**-245**	**-56,134**	**1,034**	**180,809**	**-245**	**-53,311**

National Geospatial Program	69,454	247	79,454	+661		+0		+0	247	80,115	+0	+661
National Cooperative Geologic Mapping Program	24,397	108	34,397	+288		+0	-17	-12,928	91	21,757	-17	-12,640
Science Synthesis, Analysis and Research Program	24,051	83	24,051	+222		+1,921	-15	-1,930	68	24,264	-15	+213
National Land Imaging Program				+353	+132	+106,865	-25	-21,305	107	85,913	+107	+85,913
Core Science Systems Total	**117,902**	**438**	**137,902**	**+1,524**	**+132**	**+108,786**	**-57**	**-36,163**	**513**	**212,049**	**+75**	**+74,147**
Administration and Management	80,881	363	74,881	+1,341			-7	-6,666	356	69,556	-7	-5,325
Information Services	21,947	64	21,947	+170			+3	+2,500	67	24,617	+3	+2,670
Science Support Total	**102,828**	**427**	**96,828**	**+1,511**	**+0**	**+0**	**-4**	**-4,166**	**423**	**94,173**	**(4)**	**-2,655**
Rental Payments and Operations & Maintenance	105,219	74	104,719	+2,741				+8,602	74	116,062	+0	+11,343
Deferred Maintenance and Capital Improvement	15,164	0	76,164	+0				-64,589	0	11,575	+0	-64,589
Facilities Total	**120,383**	**74**	**180,883**	**+2,741**	**+0**	**+0**	**+0**	**-55,987**	**74**	**127,637**	**+0**	**-53,246**
Total, USGS	**1,160,596**	**4,581**	**1,270,957**	**+14,266**	**-488**	**+0**	**-339**	**-314,038**	**3,754**	**971,185**	**-827**	**-299,772**

Fixed Costs

Justification of Fixed Costs and Internal Realignments
(Dollars In Thousands)

Fixed Cost Changes and Projections	2020 Change	2020 to 2021 Change
Change in Number of Paid Days This column reflects changes in pay associated with the change in the number of paid days (-1 day) between 2020 and 2021, from 2,096 hours in the 2020 to 2,088 hours in the 2021.	+1,832	-2,071
Pay Raise The President's Budget for FY2021 includes one quarter of a planned 3.1% pay raise and three quarters of a planned 1% pay raise for the 2021.	+0	+8,334
Employer Share of Federal Employee Retirement System The change reflects the directed 1.3% increase in the employer contribution to the Federal Employee Retirement System.	+1,147	+5,053
Departmental Working Capital Fund The change reflects the final 2021 Central Bill approved by the Working Capital Fund Consortium.	+418	+158
Worker's Compensation Payments The amounts reflects final chargeback costs of compensating injured employees and dependents of employees who suffer accidental deaths while on duty. Costs for the 2021 will reimburse the Department of Labor, Federal Employees Compensation Fund, pursuant to 5 U.S.C. 8147(b) as amended by Public Law 94-273.	-180	+280
Unemployment Compensation Payments The amounts reflect projected changes in the costs of unemployment compensation claims to be paid to the Department of Labor, Federal Employees Compensation Account, in the Unemployment Trust Fund, pursuant to Public Law 96-499.	+22	-72
Rental Payments The amounts reflect changes in the costs payable to General Services Administration (GSA) and others for office and non-office space as estimated by GSA, as well as the rental costs of other currently occupied space. These costs include building security; in the case of GSA space, these are paid to Department of Homeland Security (DHS). Costs of mandatory office relocations, i.e. relocations in cases where due to external events there is no alternative but to vacate the currently occupied space, are also included.	+8,562	+2,584
Baseline Adjustments for O&M Increases In accordance with space maximization efforts across the Federal Government, this adjustment captures the associated increase to baseline operations and maintenance requirements resulting from movement out of GSA or direct-leased (commercial) space and into Bureau-owned space. While the GSA portion of fixed costs will go down as a result of these moves, Bureaus often encounter an increase to baseline O&M costs not otherwise captured in fixed costs. This category of funding properly adjusts the baseline fixed cost amount to maintain steady-state funding for these requirements.	+0	+0

Account and Sundry Exhibits

Employment Summary

SURVEYS, INVESTIGATIONS, AND RESEARCH

Identification Code 14-0804-0-1-306		2019 Actual	2020 Estimate	2021 Estimate
	Direct:			
1001	Civilian full-time equivalent employment	4,531	4,581	3,754
	Reimbursable:			
2001	Civilian full-time equivalent employment	2,891	2,891	2,891
	Allocation account:			
3001	Civilian full-time equivalent employment	20	20	20

Employment Summary
CONTRIBUTED FUNDS

Identification Code 14-8562-0-7-306		2019 Actual	2020 Estimate	2021 Estimate
	Direct:			
1001	Civilian full-time equivalent employment	2	2	2

Employee Count by Grade
(Total Employment)

		2019 Actual	2020 Estimate	2021 Estimate
Executive Level V		1	1	1
SES		15	19	19
	Subtotal	16	20	20
SL – 00		8	10	12
ST – 00		34	37	40
	Subtotal	42	47	52
GS/GM – 15		446	444	398
GS/GM – 14		704	701	629
GS/GM – 13		1,132	1,129	1,012
GS – 12		1,405	1,401	1,256
GS – 11		1,274	1,270	1,138
GS – 10		15	15	13
GS – 9		917	915	820
GS – 8		222	221	198
GS – 7		599	597	535
GS – 6		260	259	232
GS – 5		327	326	293
GS – 4		129	129	116
GS – 3		56	56	50
GS – 2		13	13	12
GS – 1		2	2	2
	Subtotal	7,501	7,478	6,704
Other Pay Schedule Systems		276	276	276
Total employment (actual/estimate)		**7,835**	**7,820**	**7,052**

Section 403 Compliance

This section describes details related to any assessments to, or within, the USGS to support bureau-wide services and functions. Details regarding the USGS's payments to the Department of the Interior's Working Capital Fund, and payments to other Federal Agencies are included in the External Administrative Costs subsection. Additional information on internal assessments and cost allocation methodologies can be found in the Bureau Administrative Costs subsection.

External Administrative Costs	2021 Estimate ($000)
Department of the Interior Working Capital Fund	
WCF Centralized Billings	*$18,302*
WCF Direct Billings	*$14,618*
Payments to Other Federal Agencies	
Worker's Compensation Payments	*$2,152*
Unemployment Compensation Payments	*$442*
GSA Rental Payments	*$109,997*
Bureau Administrative Costs	
Shared Program Costs	*$40,000*
Internal Bureau Overhead	*$43,000*

External Administrative Costs

The Department's Working Capital Fund was established pursuant to 43 U.S.C. 1467, to provide common administrative and support services efficiently and economically at cost. The Fund is a revolving fund, whereby capital is expended to provide services for customers who pay for the services. Customers consist of the Department's bureaus and offices, as well as other Federal agencies. Through the use of centrally provided services, the Department standardized key administrative areas such as commonly used administrative systems, support services for those located in and around the Main Interior building complex, and centrally managed departmental operations that are beneficial to the bureaus and offices.

Centralized billing is used whenever the product or service being provided is not severable or it is inefficient to bill for the exact amount of product or service being procured. Customers are billed each year using a pre-established basis that is adjusted annually to reflect change over time. These bills are paid for by both the Administrative & Management and the Information Services subactivities within Science Support, and payment may be adjusted accordingly between these lines during the year of execution based on the enacted appropriation.

Direct billing is used whenever the product or service provided is again severable but is sold through a time and materials reimbursable support agreement or similar contractual arrangement.

Bureau Administrative Costs

Shared Program Costs

The USGS employs an estimated four percent of its budget for bureau-wide support and science-related activities. These funds are used for initiatives which are crosscutting in nature, respond to emerging responsibilities, or respond to new bureau priorities.

The funding for the initiatives in the Shared Program Costs are assessed at the budget activity level, based upon one of two methodologies: proportionately based on total appropriated funds for the mission area; or proportionately based on total funds for the mission area, including reimbursable funding sources, and are distributed to the initiatives efficiently. The methodology used is tied to the nature of the initiative. For instance, an initiative that is crosscutting to all the mission areas but is purely an Interior priority (one in which an external partner is not a stakeholder, nor receives direct benefit of the service) would receive its funding based upon a calculation on appropriated funds only. Conversely, an initiative where all customers of the USGS either directly or indirectly receive benefit, such as the aforementioned information technology compliance and security upgrades, would be calculated to each of the mission areas based upon all funding sources, both appropriated and reimbursable. The initiatives on the Shared Program Cost Chart are vetted each year with the Executive Leadership Team of the USGS and are decided upon in a voting process to ensure bureauwide concurrence.

Internal Bureau Overhead Cost Allocation Methodology

The USGS manages overhead costs at two levels—the bureau and science center. Bureau level costs include headquarters and area executive, managerial, supervisory, administrative, and financial functions and bureauwide systems. At the bureau level, funding appropriated to the Science Support budget activity pays the bureau-wide overhead costs in the same proportion as appropriated funding is to total funding. For this reason, bureau-wide overhead costs collected on reimbursable support agreements are deposited within Science Support program areas, as well.

The USGS assesses a bureau overhead rate, estimated to remain at 12 percent, on reimbursable work from non-Interior customers to recoup their share of bureau-level costs. In some cases, the USGS assesses a special or reduced rate when it can be demonstrated that indirect costs are substantially and consistently less than the norm and the amount collected covers the full costs, such as with pass-through funding where the USGS does not perform any of the actual work.

At the science center level, because there generally is not a direct appropriated funding source to pay the local overhead (common services) costs, both the direct appropriated and reimbursable funding are assessed a percentage to cover their share of science center-level costs. Science center common services costs include center costs that are not directly attributable to a specific activity or project, such as managerial, supervisory, administrative, and financial functions and related systems, as well as costs incidental to providing services and products, such as postage, training, miscellaneous supplies and materials. The cost during 2019, for the local overhead, totaled $130 million from direct appropriated funds.

In recognition of the USGS role as the science bureau for the Department of the Interior, the USGS is continuing to give Interior bureaus and offices a "preferred" customer rate on overhead charges for a significant portion of reimbursable work, to the extent that matching funds are available within the USGS budget. The maximum rate that cost centers may charge other Interior bureaus for common services and bureau costs combined remains 15 percent net. In 2019, of the 15 percent, 7.5 percent is applied to bureau costs, and the remaining 7.5 percent is applied to common services costs. Cost centers must fund the common services costs not recovered (e.g., the difference between the cost center's standard common

services costs and the 7.5 percent) from USGS appropriated funds. In this way, the USGS is partnering on the science needs of Interior from both the bureau and cost centers.

The Associate Director for Administration establishes the USGS bureau special rate for each fiscal year. The special rate for 2021 is estimated to remain at three percent. Cost centers do not charge more than the bureau special rate for facilities-related costs or their standard common services rate when funding is approved for a bureau-level special rate. Special rates are applied under the following circumstances:

- When the USGS receives funds from a non-USGS organization and awards a grant to a third-party entity.

- When the USGS receives funds from one or more non-USGS organizations to support, under USGS leadership, a strategic science objective that includes the USGS passing through funds to one or more third-party entities.

- When the USGS receives funds from a non-USGS organization for the purpose of the customer acquiring services through the Cartographic Services or the Remotely Sensed Data Contracts. The special rate helps encourage other Federal agencies to use these contracts for cartographic services and remotely sensed data, rather than establishing and managing their own contracts, and ensures greater data consistency through the use of common service providers.

- When the USGS receives funds from a non-USGS organization for the purpose of passing through the customer's funds to State and local governments for the direct purchase of geospatial data.