BUDGET JUSTIFICATIONS

The United States Department of the Interior

and Performance Information
Fiscal Year 2023

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

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Overview and Executive Summary

Bureau Overview

The U. S. Geological Survey (USGS) was established in 1879 (43 U.S.C. 31) for "the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain." In 1962, Congress amended the USGS Organic Act to include examinations outside the national domain. The USGS is the Nation's largest water, earth, and biological science and civilian mapping agency, and it is the primary Federal source of science-based information on ecosystems, land use, energy and mineral resources, natural hazards, water use and availability, and updated maps and images for the Earth's features available to the public. As the science arm of the Department of the Interior, the USGS mission is to monitor, analyze, and predict current and evolving dynamics of complex human and natural Earth-system interactions and to deliver actionable information at scales and timeframes relevant to decision makers. The USGS works in partnership with Interior bureaus, Federal agencies, Tribes, States, local jurisdictions, universities, and the private sector to provide the best available science to resource managers and planners, emergency response officials, and the public.

The USGS provides science for a changing world that reflects and responds to society's continuously evolving needs. USGS scientific information forms a basis for important plans and decisions about resource management, emergency management, and public health. The USGS strives to address the science needs of decision makers, planners, and the public by delivering products and tools that are useful, relevant, and accessible. To better meet these demands and have a greater impact, USGS is strengthening its engagement with underserved communities and enhancing efforts in diversity, equity, inclusion, and accessibility in its workforce.

For more than a century, the USGS has served an essential role in understanding the Earth's past, present, and future climate. USGS science addresses the local to global implications of climate change on our lands, waters, wildlife, and the lives and livelihoods of all people—including underserved and marginalized populations—helping understand, adapt, and mitigate the impacts. Through monitoring, measuring, and observing changes to our climate, as well as modeling the impacts of past change and plausible futures, the USGS's multi-disciplinary approach brings together a broad range of capabilities and partnerships to address this urgent environmental crisis.

Budget Highlights

The 2023 budget request for the USGS is $1.7 billion, an increase of $395.8 million from the 2022 Annualized Continuing Resolution (CR) budget. The USGS estimates that staffing is 8,344 full-time equivalents (FTEs), an increase of 584 FTEs from 2022.

The following three tables highlight the USGS FY 2023 budget request.

Budget Authority (Dollars in Thousands)	2021 Enacted	2022 Annualized CR	2023 Request
Current	1,315,527	1,315,527	1,711,344
Supplemental	19,547	265,952	69,000
Other Transfer	0	-1,198	-345
Total Current	***1,315,527***	***1,580,281***	***1,779,999***
Permanent	739	1,921	628
Total Current and Permanent	**1,316,266**	**1,582,202**	**1,780,627**
Direct FTEs	*4,574*	*4,619*	*5,208*

Mission Area/Subactivity/Programs (Dollars in Thousands)	2021 Enacted	2022 Annualized CR	2023	
			Request	Changes from 2022 Annualized CR
Ecosystems	**259,077**	**259,077**	**375,692**	**+116,615**
Energy and Minerals Resources	**90,041**	**90,041**	**147,010**	**+56,969**
Natural Hazards	**175,484**	**175,484**	**219,827**	**+44,343**
Water Resources	**263,120**	**263,120**	**302,741**	**+39,621**
Core Science Systems	**252,688**	**252,688**	**348,798**	**+96,110**
Science Support	**95,734**	**95,734**	**129,197**	**+33,463**
Facilities	**179,383**	**179,383**	**188,079**	**+8,696**
Grand Total	**1,315,527**	**1,315,527**	**1,711,344**	**+395,817**

FTE	2021 Enacted	2022 Annualized CR	2023 Request
Direct	4,571	4,619	5,203
Reimbursable	3,008	3,008	3,008
Working Capital Fund	105	105	105
Allocations	47	24	24
Contributed Funds	4	4	4
Total	**7,735**	**7,760**	**8,344**

Administration Priorities

The 2023 budget reflects the USGS's enduring responsibilities as it continues to advance the priorities of the Administration. The 2023 budget both builds upon and expands the areas of advancement in the 2022 budget request, making critical investments in climate science, conservation, and wildland fire science; enhancing efforts to inform the transition to clean energy and reduce greenhouse gas emissions; and advancing science that underpins mitigation of natural hazards and strengthens community resilience. The request continues to strengthen partnerships with Native American Tribes, enhance science, technology, engineering, and math (STEM) youth education with a focus on underserved communities, and bolster the information systems and other enterprise capabilities that are foundational to research and development activities. The 2023 budget leverages investments made in the Bipartisan Infrastructure Law (P.L. 117-58) to support integrated mapping and interpretation of mineral resources data, the preservation and digital accessibility of geological and geophysical datasets— including those pertaining to critical minerals— and the design and construction of a new energy and minerals research facility.

Climate Science, Conservation, and Wildland Fire

In line with President Biden's Executive Order 14008 on *Tackling the Climate Crisis at Home and Abroad*, the 2023 budget continues investments to address climate change while laying the foundation for economic growth, creation of good-paying jobs, and ensuring that those benefits accrue to marginalized and underserved communities. The 2023 budget expands the ability of the USGS to conduct science to understand and manage impacts of climate, wildland fire, and other environmental stressors to the Nation's natural resources.

With funds in 2023, the USGS can provide critical science on climate change impacts to ecosystems, species (including species at-risk of needing protection under the Endangered Species Act of 1973), and biodiversity. Coastal wetland ecosystems are a focus of the 2023 investment: in particular, the impacts of sea level rise and extreme storm events on those ecosystems. With the 2023 request, the USGS can expand decision support tools for conserving biodiversity in the face of climate-related impacts and can develop tools and models for predicting the impacts of a changing climate on water availability and ecosystem health. The Landsat satellites provide foundational data and science for climate resilience initiatives through their long-term, continuous imaging of the Earth's surface, and the 2023 budget supports satellite operations for Landsat 7, Landsat 8, and Landsat 9, as well as the development of future Landsat missions in close partnership with NASA. The 2023 budget also invests in the expansion and continued operations and maintenance of the USGS Federal Priority Streamgage Network, which supports approximately 30 additional streamgage sites in 2023, providing data to decisionmakers as they prepare for and respond to flood events, manage water allocations for interstate and international compacts and other border water agreements, and plan for water needs in the face of climate change.

This budget includes funding for the creation of the American Conservation and Stewardship Atlas to deliver science to inform conservation for the America the Beautiful initiative, a key part of the Administration's vision of conserving 30 percent of America's lands and waters by 2030. The Atlas would provide information needed to track progress towards the initiative's conservation goals. The USGS would lead the development of the Atlas—which has extensive information technology and data curation requirements identified by Federal, State, Tribes, and non-governmental organizations (NGOs)—to support conservation tracking efforts in several settings, from protected lands to working lands.

Climate science and research will continue to prepare the Nation to better understand and respond to the impacts of climate change. The 2023 budget for the USGS supports the goals of Executive Order 14008 by developing and maintaining a national climate portal. The USGS, via the Federal Geographic Data Committee (FGDC), would work with Federal partners to produce a public portal that would integrate climate-relevant data, tools, and information to help Tribal, State, and local governments, communities, and industry understand their exposure to climate-related hazards and to guide efforts to build national resilience to extreme events equitably and inclusively.

With the 2023 request, the USGS continues climate research efforts proposed in 2022 to deliver the science needed to achieve transformational advancement in climate adaptation and resilience. The USGS continues to support research activities and upgrades to IT infrastructure for advanced research on habitat and biodiversity, fire and post-fire risk management, disaster response, and assessment models for the geologic storage of hydrogen.

Wildfires in the U.S. can be devastating, and the last several years have resulted in major impacts to people living in the American West, their livelihoods and homes, and western ecosystems. The economic burden alone is estimated to cost between $71 - $350 billion per year.[1] The worsening wildfire problem in the U.S. is a result of many causes, with complex fire effects not reflected in the data and tools that are currently available to fire, land, emergency and community managers to use before, during and after fires. In the 2023 budget, the requested investment in wildfire science sustains the USGS' capability to deliver actionable, integrated wildfire science and assessments to a range of stakeholders, communities, and partners at all levels of government.

Clean Energy, Emissions Mitigation, and Carbon Management

As the Nation transitions to a clean energy economy, the 2023 budget advances priorities in clean energy research as well as new science and tools for emissions mitigation and carbon management. The 2023 budget supports the mandates of the Energy Act of 2020 by funding research on wind, solar, and geologic energy sources, including geothermal, which has the potential to source a large proportion of the baseload electric power for the entire U.S. The 2023 request enables the USGS to accelerate progress toward understanding geothermal potential in the central and eastern U.S., as well as Alaska, Hawaii, and Puerto Rico. Funding for the Earth Mapping Resources Initiative (Earth MRI) in the Bipartisan Infrastructure Law also advances efforts to understand geothermal resource potential across the U.S. These efforts will help better quantify geothermal energy potential to serve communities with high heating costs, the energy needs of the manufacturing and other industries, and communities in remote or extreme weather areas with poor grid access and reliability.

Natural Hazards Risk Mitigation and Community Resilience

The 2023 budget strengthens USGS efforts to deliver the science that communities need to become more resilient to the most devastating natural hazard events. Subduction zones, where one of the Earth's tectonic plates is thrust over another, generate the world's largest earthquakes, volcanic eruptions, landslides, and tsunamis. Subduction zones generate hazards onshore and offshore in the Pacific Northwest (Cascadia subduction zone), southern Alaska (Alaska-Aleutians subduction zone), the Caribbean, and Pacific Island

[1] https://www.nist.gov/publications/costs-and-losses-wildfires

Territories, and tsunami hazards extend to Hawaii, California, and East Coast States. Subduction zones remain poorly understood because the processes that drive the hazard lie beneath the ocean floor. With funding in 2023 for Subduction Zone Science, the USGS would launch a partner-driven virtual research center on subduction zone hazards to help minimize the risks to vulnerable communities and to provide information and data to emergency responders to assist in preparing for and responding to hazardous events generated by subduction zones.

The 2023 budget also proposes to establish a capacity to build and strengthen relationships with external partners for delivering actionable information for risk reduction and improving community resilience efforts related to natural hazards, with a focus on science aimed at risk reduction for and communication with underserved communities. Successful development and delivery of actionable information requires translating, visualizing, and communicating scientific findings where the needs of diverse users are incorporated into final products to increase the usability and impacts of science products. Efforts proposed in the 2023 request include providing needs assessments, developing risk reduction and risk communication products, and language translation to ensure that science is accessible, relevant, and actionable for a diverse set of stakeholders.

Science Education in Underserved Communities and Partnerships with Native American Tribes

With the 2023 request, the USGS improves agency capacity to meet goals in diversity, equity, inclusion, and accessibility reflected in Executive Order 13985: *Advancing Racial Equity*. With the proposed investments in the 2023 budget, the USGS improves resources for underserved communities in youth and STEM education around USGS science topics. The USGS strengthens Tribal partnerships through technical and scientific collaborations with Native American Tribes and Alaska Native communities. The USGS accomplishes these goals by promoting innovative partnerships through the scientific community, including working to understand the needs of underserved communities and Tribes, and partnering with communities to provide technical training for staff of Tribal governments or organizations, leveraging USGS expertise to grow the most needed scientific skills.

Leveraging Investments in the Bipartisan Infrastructure Law

President Biden signed the Bipartisan Infrastructure Law (P.L. 117-58) on November 15, 2021, making this once-in-a-generation investment in the Nation's infrastructure and economic competitiveness a reality. This landmark investment rebuilds America's critical infrastructure, tackles the climate crisis, advances environmental justice, and drives the creation of good-paying union jobs. By addressing long overdue improvements and strengthening our resilience to the changing climate, this investment in our communities across the country grows the economy sustainably and equitably so that everyone gets ahead for decades to come.

The Bipartisan Infrastructure Law provided a total of $511 million directly to the USGS to support integrated mapping and interpretation of mineral resources data, the preservation of data from geochemical samples from the Earth MRI, and a replacement facility for the USGS energy and minerals research center in Golden, Colorado. Collectively, these investments deliver science information and data that are essential to the design, development, and management of the Nation's infrastructure.

In the 2023 request, and with the Bipartisan Infrastructure Law funds, the USGS builds upon the foundation laid by its work completed to date on Earth MRI and in the National Geological and Geophysical Data

Preservation Program to develop a robust scientific capacity for mineral resources research and geological and geophysical data preservation. Together, these investments are transformative for national capabilities for critical minerals research, directly supporting the growth of the U.S. economy. For the USGS FY 2023 Spend Plan, please see the Accounts and Sundry Exhibits section.

Department of the Interior Field Communication Modernization Initiative

The 2023 request also includes $176,000 for the USGS as part of a coordinated $28.6 million investment across BIA, NPS, FWS, USGS, and the Office of the Chief Information Officer (OCIO) for field communication modernization. This investment will enhance communications management in emergency situations, land and resource management, scientific studies, emergency management, wildland fire, and law enforcement mission areas. Where agency policy permits, and technology aligns these mission areas will have access to capabilities such as local control over the network to assign users and create talk groups and determine who can access or manage mobile devices and platform applications. This investment will also deploy mobile broadband connectivity and provide employees working in the field with voice, video, and data capabilities for all missions. In many locations, the deployment of these capabilities will enhance or replace a voice-only, mid-20th century land mobile radio technology with technology that is cheaper to operate and maintain.

The 2023 request will focus on field operations and users in the Great Lakes (Region 3), Mississippi Basin (Region 4), the U.S. Virgin Islands, and Puerto Rico. The modernization will leverage ongoing deployment of public safety broadband, such as FirstNet and satellite devices, where terrestrial broadband is not available. Nationwide, the USGS has an estimated $2.6 million in deferred maintenance backlog to bring related voice-only capability to acceptable condition; this solution will seek to replace that radio infrastructure where it makes sense, eliminating backlog in retained communication assets and reducing future operations and maintenance costs for field communications.

The USGS is an integral part of DOI-wide field communication governance, along with other bureaus and offices. The USGS will execute projects coordinated by the DOI governance body with project management, engineering support, and IT security requirements managed by OCIO.

Zero Emission Vehicle Fleet Conversions (+$6,131,000/+0 FTE) – In support of the President's goal of transitioning to a fully Zero Emission Vehicle Federal fleet, the USGS budget includes $6.1 million for zero emission vehicle (ZEV - battery electric, plug-in electric hybrid, and hydrogen fuel cell vehicles) acquisitions and deploying necessary vehicle charging and refueling infrastructure. These acquisitions are a significant step towards eliminating tailpipe emissions of greenhouse gases (GHG) from the USGS fleet and aligning the USGS fleet operations with the goal of achieving a fully ZEV Federal fleet. This action is important because tailpipe emissions are currently the leading source of GHG emissions that threaten the planet and harm U.S. communities.

The USGS ZEV acquisitions may include vehicles for both its agency-owned and GSA-leased segments of its vehicle fleet, including incremental costs of leased vehicles and lease payments to GSA for conversion of agency-owned vehicles to GSA's leased fleet where appropriate. To ensure effective and efficient deployment of ZEVs, the USGS will undertake preparation and planning for arriving ZEVs at its facilities, properly prioritizing transition to ZEVs where it is simplest and allow time for additional planning where mission demands pose a challenge to transitioning based on current technologies. Integral to this

preparation is growth in the number of agency-accessible re-fueling points (vehicle charging stations). In installing this infrastructure on-site to support acquired ZEVs, the USGS will take the long-term view to ensure efficiencies and thereby ensure wise infrastructure decisions that limit total expenditures. Using its experienced personnel and lessons learned in the fleet arena, the USGS will undertake a process that relies on a cross-functional team of staff from fleets, operations, facilities, finance, and acquisition departments with executive leadership support. The collaboration will not stop with initial deployment, as the USGS fleet and facility managers will work closely and employ existing training and tools to control utility costs by managing the overall charging load and thereby ensuring a seamless operation that now will involve building systems and vehicles together. Further, the USGS will ensure proper training of personnel to address any initial shortcomings in terms of any necessary ZEV knowledge and operations as the advanced vehicle technologies roll into the USGS fleet.

Additional Information

The USGS is always working to expand the information it has available about our programs and our science. For additional information about USGS programs, please visit the Program Book on the USGS website (www.usgs.gov).

Good Accounting Obligation in Government Act Report

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 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 implementing recommendation decisions.

The Department's GAO-IG Act Report will be available at the following link: https://www.doi.gov/cj

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Budget at a Glance

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	2021 Enacted	2022 Annualized CR	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes (+/-)	2023 Request
Appropriation: Surveys, Investigations, and Research						
Ecosystems	**259,077**	**259,077**	**+6,975**	**0**	**+109,640**	**375,692**
Environmental Health Program	**24,745**	**24,745**	**+1,070**	**+500**	**+1,494**	**27,809**
Contaminant Biology	***10,397***	***10,397***	***+482***	***+500***	***+1,203***	***12,582***
Mitigation of Contaminant Exposures & Recycling of Mining Waste	[0]	[0]	0	0	+1,000	[1,000]
Integrated Sensor Grants	[0]	[0]	0	+500	0	[0]
Contaminants Baseline Capacity	[0]	[0]	0	0	+203	[203]
Toxic Substances Hydrology	***14,348***	***14,348***	***+588***	***0***	***+291***	***15,227***
Toxic Substances Baseline Capacity	[0]	[0]	0	0	+291	[291]
Species Management Research Program	**53,914**	**53,914**	**+441**	**+4,587**	**+15,504**	**74,446**
Integrated Science - Multi-use Watershed Management, Forecasting of Coastal Ecosystems and Biodiversity Conservation	[0]	[0]	0	0	+2,000	[2,000]
Applied Science in Support of Bureau Conservation and Adaptation	[25,000]	[25,000]	0	0	+7,500	[32,500]
Decision Support for Clean Energy Development on Federal Lands and Waters	[3,816]	[3,816]	0	0	+5,000	[8,816]
Rebaseline of Priority Activities (Species Management Research)	[0]	[0]	0	+5,087	0	[0]
Integrated Sensor Grants	[500]	[500]	0	-500	0	[500]
Species Management Research Baseline Capacity	[0]	[0]	0	0	+1,004	[1,004]
Land Management Research Program	**56,681**	**56,681**	**+1,559**	**-7,707**	**+22,122**	**72,655**
Energy Transition, Conservation, and Carbon Management on Federal Lands	[0]	[0]	0	0	+1,500	[1,500]

	2021 Enacted	2022 Annualized CR	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes (+/-)	2023 Request
Understanding and Quantifying Ecosystem Services	[1,100]	[1,100]	0	0	+10,000	[11,100]
Applied Science and Support of Bureau Conservation and Adaptation	[28,340]	[28,340]	0	0	+7,500	[35,840]
Science Supporting Fire Management Before, During and After Fires	[0]	[0]	0	0	+2,000	[2,000]
Rebaseline of Priority Activities (Land Management Research)	[7,707]	[7,707]	0	-7,707	0	[7,707]
Land Management Research Baseline Capacity	[0]	[0]	0	0	+1,122	[1,122]
Biological Threats and Invasive Species Research Program	**38,249**	**38,249**	**+1,349**	**+2,620**	**+5,702**	**47,920**
Reducing Threats of Invasive Species and Wildlife Disease in a Changing Climate	[190]	[190]	0	0	+5,000	[5,190]
Rebaseline of Priority Activities (Biological Threats and Invasive Species Research)	[0]	[0]	0	+2,620	0	[0]
Biological Threats and Invasive Species Baseline Capacity	[0]	[0]	0	0	+702	[702]
Cooperative Research Units Program	**25,000**	**25,000**	**+644**	**0**	**+2,506**	**28,150**
Management of Cooperative Research Units	[25,000]	[25,000]	0	0	+2,000	[27,000]
CRU Baseline Capacity	[0]	[0]	0	0	+506	[506]
Climate Adaptation Science Center and Land Change Science Program	**60,488**	**60,488**	**+1,912**	**0**	**+62,312**	**124,712**
Land Change Science	***19,153***	***19,153***	***+574***	***0***	***+19,244***	***38,971***
Climate Impacts on Physical and Biological Systems	[15,168]	[15,168]	0	0	+10,000	[25,168]
Biologic Carbon Sequestration	[0]	[0]	0	0	+2,000	[2,000]
Monitoring Greenhouse Gas Reduction Process	[0]	[0]	0	0	+5,000	[5,000]
Developing a Climate Risk Framework to Inform Management Options	[0]	[0]	0	0	+2,000	[2,000]

	2021 Enacted	2022 Annualized CR	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes (+/-)	2023 Request
Land Change Science Baseline Capacity	[0]	[0]	0	0	+244	[244]
National and Regional Climate Adaptation Science Centers	***41,335***	***41,335***	***+1,338***	***0***	***+43,068***	***85,741***
Facilitate Synthesis of Regional Findings to a National Level	[500]	[500]	0	0	+5,000	[5,500]
Assessment of Biodiversity	[0]	[0]	0	0	+2,500	[2,500]
Support for Climate Adaptation Science Centers	[36,335]	[36,355]	0	0	+25,000	[61,355]
Tribal Climate Adaptation Science	[500]	[500]	0	0	+10,000	[10,500]
NRCASC Baseline Capacity	[0]	[0]	0	0	+568	[568]
Energy and Mineral Resources	**90,041**	**90,041**	**+3,037**	**0**	**+53,932**	**147,010**
Mineral Resources Program	**59,869**	**59,869**	**+2,065**	**0**	**+28,368**	**90,302**
Supply Chain Research for Green Technologies	[1,670]	[1,670]	0	0	+5,000	[6,670]
Mine Waste Research and Assessments in Support of Reclamation	[1,274]	[1,274]	0	0	+15,000	[16,274]
Mineral Systems	[4,376]	[4,376]	0	0	+2,000	[6,376]
Critical Minerals (Location, Forecasting)	[1,991]	[1,991]	0	0	+5,000	[6,991]
Mineral Resources Baseline Capacity	[0]	[0]	0	0	+1,368	[1,368]
Energy Resources Program	**30,172**	**30,172**	**+972**	**0**	**+25,564**	**56,708**
Geothermal Energy	[1,552]	[1,552]	0	0	+2,000	[3,552]
Inventory of Greenhouse Gas Emissions and Sinks on Federal Lands	[50]	[50]	0	0	+10,000	[10,050]
Scenario Analysis Tools for Greenhouse Gas Reduction on Federal Lands	[250]	[250]	0	0	+5,000	[5,250]
Geophysical Data Acquisition in Areas with Potential for Geologic Carbon Sequestration	[75]	[75]	0	0	+3,500	[3,575]
Geologic Carbon Sequestration	[1,477]	[1,477]	0	0	+4,500	[5,977]
Energy Resources Baseline Capacity	[0]	[0]	0	0	+564	[564]

	2021 Enacted	2022 Annualized CR	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes (+/-)	2023 Request
Natural Hazards	**175,484**	**175,484**	**+4,579**	**0**	**+39,764**	**219,827**
Earthquake Hazards Program	**85,403**	**85,403**	**+1,783**	**0**	**+12,734**	**99,920**
Subduction Zone Science	[2,700]	[2,700]	0	0	+7,500	[10,200]
Induced Seismicity	[1,100]	[1,100]	0	0	+2,000	[3,100]
Modernization/Hardening of Infrastructure in Support of Earthquake Analysis	[2,000]	[2,000]	0	0	+2,000	[4,000]
Earthquake Hazards Baseline Capacity	[0]	[0]	0	0	+1,234	[1,234]
Volcano Hazards Program	**30,266**	**30,266**	**+968**	**0**	**+3,266**	**34,500**
Next Generation Volcanic Hazard Assessments	[520]	[520]	0	0	+1,000	[1,520]
National Volcano Early Warning System: National Volcano Data Center Improvements	[300]	[300]	0	0	+1,500	[1,800]
Volcano Hazards Baseline Capacity	[0]	[0]	0	0	+766	[766]
Landslide Hazards Program	**8,038**	**8,038**	**+253**	**0**	**+3,141**	**11,432**
Actionable Landslide Hazard Data and Science	[0]	[0]	0	0	+3,000	[3,000]
Landslide Hazards Baseline Capacity	[0]	[0]	0	0	+141	[141]
Global Seismographic Network Program	**7,153**	**7,153**	**+68**	**0**	**+59**	**7,280**
GSN Baseline Capacity	[0]	[0]	0	0	+59	[59]
Geomagnetism Program	**4,114**	**4,114**	**+87**	**0**	**+1,559**	**5,760**
Expansion of Magnetometer Observatories	[2,388]	[2,388]	0	0	+1,500	[3,888]
Geomagnetism Baseline Capacity	[0]	[0]	0	0	+59	[59]
Coastal/Marine Hazards and Resources Program	**40,510**	**40,510**	**+1,420**	**0**	**+19,005**	**60,935**
Risk Reduction and Community Resilience	[800]	[800]	0	0	+4,000	[4,800]
Modeling and Forecasting Coastal Hazards	[10,674]	[10,674]	0	0	+10,000	[20,674]
Coastal Blue Carbon	[1,000]	[1,000]	0	0	+4,000	[5,000]
Coastal/Marine Hazards and Resources Baseline Capacity	[0]	[0]	0	0	+1,005	[1,005]

	2021 Enacted	2022 Annualized CR	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes (+/-)	2023 Request
Water Resources	**263,120**	**263,120**	**+5,847**	**0**	**+33,774**	**302,741**
Water Availability and Use Science Program	**57,987**	**57,987**	**+1,432**	**0**	**+13,014**	**72,433**
Water Use Withdrawal Models	[1,800]	[2,500]	0	0	+1,500	[4,000]
Integrated Water Prediction	[9,500]	[9,500]	0	0	+4,000	[13,500]
Integrated Water Availability Assessments	[3,725]	[3,979]	0	0	+6,000	[9,979]
Water Availability and Use Science Baseline Capacity	[0]	[0]	0	0	+1,514	[1,514]
Groundwater and Streamflow Information Program	**100,673**	**100,673**	**+2,384**	**0**	**+13,978**	**117,035**
Federal Priority Streamgages	[24,715]	[24,715]	0	0	+5,600	[30,315]
Next-Generation Water Observing System	[24,500]	[24,500]	0	0	+6,400	[30,900]
Groundwater and Streamflow Information Baseline Capacity	[0]	[0]	0	0	+1,978	[1,978]
National Water Quality Program	**93,460**	**93,460**	**+2,031**	**0**	**+2,782**	**98,273**
Prediction of Water Availability Impacts on Ecosystems	[250]	[315]	0	0	+1,000	[1,315]
National Water Quality Baseline Capacity	[0]	[0]	0	0	+1,782	[1,782]
Water Resources Research Act Program	**11,000**	**11,000**	**0**	**0**	**+4,000**	**15,000**
Water Resources Research Institute Grants	[11,000]	[11,000]	0	0	+4,000	[15,000]
Core Science Systems	**252,688**	**252,688**	**+3,878**	**0**	**+92,232**	**348,798**
National Geospatial Program	**79,454**	**79,454**	**+1,408**	**0**	**+17,644**	**98,506**
3D National Topography Model (3DNTM)	[0]	[0]	0	0	+1,500	[1,500]
Federal Climate Data Portal	[0]	[0]	0	0	+10,000	[10,000]
Geospatial, 3DEP, and Geologic Research and Collection on Tribal Lands	[0]	[0]	0	0	+5,000	[5,000]
NGP Baseline Capacity	[0]	[0]	0	0	+1,144	[1,144]

	2021 Enacted	2022 Annualized CR	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes (+/-)	2023 Request
National Cooperative Geologic Mapping Program	**40,397**	**40,397**	**+690**	**-350**	**+534**	**41,271**
National Cooperative Geologic Mapping Program Projects and 3D Geologic Mapping	[40,397]	[40,397]	0	-350	0	[40,397]
National Cooperative Geologic Mapping Baseline Capacity	[0]	[0]	0	0	+534	[534]
Science Synthesis, Analysis and Research Program	**25,972**	**25,972**	**+527**	**+350**	**57,481**	**84,330**
Collaborative Climate Innovation Response and Resilience Framework	[0]	[0]	0	0	+30,000	[30,000]
Tools Supporting Conservation Planning, Monitoring and Projection	[900]	[900]	0	0	+24,600	[25,500]
Assessment of Biodiversity	[0]	[0]	0	0	+2,500	[2,500]
NGGDPP Internal Transfer	[0]	[0]	0	+350	0	[350]
Science Synthesis, Analysis and Research Baseline Capacity	[0]	[0]	0	0	+381	[381]
National Land Imaging Program	**106,865**	**106,865**	**+1,253**	**0**	**+16,573**	**124,691**
Science Research and Investigations	***14,557***	***14,557***	***+37***	***0***	***+75***	***14,669***
Science Research and Investigations Baseline Capacity	[0]	[0]	+0	0	+75	[75]
Satellite Operations	***84,337***	***84,337***	***+940***	***0***	***+6,997***	***92,274***
Satellite Operations	[84,337]	[84,337]	0	0	+6,546	[90,883]
Satellite Operations Baseline Capacity	[0]	[0]	0	0	+451	[451]
Land Cover Monitoring and Assessments	***7,971***	***7,971***	***+276***	***0***	***+9,501***	***17,748***
Tools Supporting Conservation Planning, Monitoring and Projection	[3,858]	[3,858]	0	0	+5,400	[9,258]
Biologic Carbon Sequestration	[0]	[0]	0	0	+4,000	[4,000]

	2021 Enacted	2022 Annualized CR	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes (+/-)	2023 Request
Land Cover Monitoring and Assessments Baseline Capacity	[0]	[0]	0	0	+101	[101]
Science Support	**95,734**	**95,734**	**+4,118**	**0**	**+29,345**	**129,197**
Administration and Management Program	**73,787**	**73,787**	**+3,666**	**0**	**+18,584**	**96,037**
Scientific Integrity, Diversity, Partnerships with Tribes, and Support for Enterprise Science	[1,628]	[1,628]	0	0	+8,800	[10,428]
Federal Electric Fleet (ZEV)	[0]	[0]	0	0	+6,131	[6,131]
Justice40 Initiative	[0]	[0]	0	0	+225	[225]
HR Support	[0]	[0]	0	0	+160	[160]
DOI Diversity, Equity, Inclusion, and Accessibility Initiatives	[0]	[0]	0	0	+800	[800]
Administration and Management Baseline Capacity	[0]	[0]	0	0	+2,468	[2,468]
Information Services Program	**21,947**	**21,947**	**+452**	**0**	**+10,761**	**33,160**
Integration of Standard Cybersecurity Architecture	[0]	[0]	0	0	+2,492	[2,492]
IT Support for R&D, including Cloud and High-Performance Computing	[2,500]	[2,500]	0	0	+8,000	[10,500]
Information Services Baseline Capacity	[0]	[0]	0	0	+269	[269]
Facilities	**179,383**	**179,383**	**+3,093**	**0**	**+5,603**	**188,079**
Rental Payments and Operations & Maintenance Program	**104,719**	**104,719**	**+3,093**	**0**	**+5,427**	**113,239**
Rental Payment Baseline Capacity	[0]	[0]	0	0	+5,427	[5,427]
Deferred Maintenance and Capital Improvement Program	**74,664**	**74,664**	**0**	**0**	**+176**	**74,840**
Department of the Interior Field Communications Modernization (DIFCOM)	[0]	[0]	0	0	+176	[176]
TOTAL, Surveys, Investigations, and Research	**1,315,527**	**1,315,527**	**+31,527**	**0**	**+364,290**	**1,711,344**

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Ecosystems

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Ecosystems

Ecosystems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Environmental Health Program	**24,745**	**24,745**	**1,070**	**500**	**1,494**	**27,809**
FTE	***192***	***192***	***0***	***0***	***6***	***198***
Species Management Research Program	**53,914**	**53,914**	**441**	**4,587**	**15,504**	**74,446**
FTE	***61***	***61***	***0***	***0***	***26***	***87***
Land Management Research Program	**56,681**	**56,681**	**1,559**	**-7,707**	**22,122**	**72,655**
FTE	***263***	***263***	***0***	***0***	***37***	***302***
Biological Threats and Invasive Species Research Program	**38,249**	**38,249**	**1,349**	**2,620**	**5,702**	**47,920**
FTE	***256***	***256***	***0***	***0***	***10***	***266***
Cooperative Research Units Program	**25,000**	**25,000**	**644**	**0**	**2,506**	**28,150**
FTE	***121***	***121***	***0***	***0***	***6***	***127***
Climate Adaptation Science Center and Land Change Science Program	**60,488**	**60,488**	**1,912**	**0**	**62,312**	**124,712**
FTE	***272***	***272***	***0***	***0***	***115***	***387***
Ecosystems Total	**259,077**	**259,077**	**6,975**	**0**	**109,640**	**375,692**
FTE	***1,165***	***1,165***	***0***	***0***	***200***	***1,365***

The 2023 budget request for the Ecosystems Mission Area is $375,692,000 and 1,365 FTE, a program change of +$109,640,000, and +200 FTE from the 2022 CR Annual Rate level and +$6,975,000 in fixed costs.

Mission Area Overview

The Ecosystems Mission Area provides the science needed to ensure America's ecosystems are managed sustainably and biological resources in wild and urban spaces are conserved now and into the future. This work is done by Mission Area scientists who examine the consequences of climate and environmental

change; effects of management actions on communities, lands, and species; and risks of and solutions to harmful invasive species, wildlife diseases, and contaminants in the environment.

The Ecosystems Mission Area works with many partners to sustain the outdoor-related recreation needs of the public by providing data, research, and monitoring that informs and supports outdoor recreation in the United States, a $459.8 billion industry in 2019[1]. In 2020, 53 percent of Americans ages six and over enjoyed participating in outdoor recreation activities such as hunting, hiking, camping, fishing, canoeing, bird watching, among others at least once, the highest participation rate on record. Remarkably, 7.1 million more Americans participated in outdoor recreation in 2020 than in the year prior (Outdoor Industry Association, 2021).

Ecosystems Mission Area science is essential for resource management decisions that protect and conserve the lands and waters enjoyed by communities across the Nation and that provide critical habitat for fish, wildlife, and plant species. Ecosystems Mission Area scientists provide innovative and forward-thinking science and develop new management tools and techniques using remote sensing, artificial intelligence/machine learning, data visualization, and crowdsourcing, to produce timely information to meet diverse stakeholder needs.

The quality of life and economic strength of the United States hinges on healthy ecosystems that support living things and natural processes, and the Ecosystems Mission Area helps protect these vital interests as the principal science organization of the Department of the Interior. The lands managed by Interior and the ecosystems within them are a significant National asset, and the Ecosystems Mission Area provides the impartial tools, science, and decision support to the resource managers entrusted with the stewardship of those lands. In addition, because of the Mission Area's research capacity and the quality of science delivered, the Mission Area is sought out by partners across the United States for its expertise in sustainable management and conservation of biological resources.

The work of the Mission Area ranges from molecular-level to ecosystem-scale studies, but the common thread across the Mission Area programs is science to advance the understanding of biological resources. The Ecosystems Mission Area funds a wide variety of USGS capabilities and consists of six national programs that conduct research through 16 Ecological Science Centers, a national Climate Adaptation Science Center and nine regional Climate Adaptation Science Centers, 41 Cooperative Research Units, and 50 Biological Field Stations where USGS scientists work directly with resource managers to address high priority management questions.

FY 2021 Selected Mission Area Accomplishments

- Building on existing laboratory and field capacities and expertise, the USGS is partnering with the Centers for Disease Control (CDC) and municipal wastewater facilities in 25 locations across the U.S. to sample, analyze, and deliver community-level COVID-19 data to public health agencies. The work demonstrated a unique role for USGS in the National Wastewater Surveillance System

[1] 2021 Outdoor Participation Trends Report - Outdoor Industry Association

(NWSS) recently developed by CDC to coordinate and build the Nation's capacity to track the presence of SARS-CoV-2, the virus that causes COVID-19, in wastewater samples collected across the country.

- The USGS and partners released a study that summarizes eight years of tracking data maintained by Canada's Yukon Territorial Government and uses the data to evaluate locations of Porcupine Herd Caribou, habitat selection, and the role of spring phenology in determining calving and post-calving distributions in the U.S. and Canada from 2012 to 2018 and into the future. The findings highlight the influence of earlier spring phenology in shifting caribou distribution further west into northern Alaska. Future climate conditions were projected to advance spring phenology, shifting caribou calving and post-calving distributions deeper west into Alaska.
- The USGS published its first Landscape Science Strategy in 2021. This Strategy was developed in response to partner needs for landscape science to manage complex interacting natural and human systems across changing American landscapes and help conserve and restore lands, waters, and biodiversity. The Strategy presents an integrated approach for addressing complex natural resource issues emphasizing coproduction and delivery of actionable science with and for our partners.
- After the emergence of COVID-19, the USGS worked with other Federal agencies to support a One Health approach to the national COVID-19 response. Bolstered with funds from the CARES Act, USGS scientists began conducting wildlife coronavirus surveillance across the Nation, investigating the effect of the virus on bats, and conducting mathematical modeling to support public health decision-making. Collaborating with USDA, CDC, and State wildlife agencies, USGS continues to conduct coronavirus surveillance in wildlife at risk of harboring SARS-CoV-2 such as rodents, raccoons, skunks, and mink.
- USGS established a new Cooperative Fish and Wildlife Research Unit in the State of Nevada. The Unit will focus on water scarcity and other natural resource science needs of State and Federal cooperators. The unit is a partnership among the USGS, the University of Nevada Reno, the Nevada Division of Wildlife, the Wildlife Management Institute, and the U.S. Fish and Wildlife Service. This is the first new unit in the Cooperative Research Units Program in over 15 years.
- The recently-established Midwest Climate Adaptation Science Center (CASC) is the ninth member of the CASC network. In FY 2021, the University of Minnesota Twin Cities was selected as host institution for the Midwest CASC, after a competitive request for proposals. The Midwest CASC will support management and protection of land, water and natural resources with actionable climate science, innovation and decision support tools. It will pay special attention to Tribal concerns and build off the unique and robust experience of Midwest Tribes with adaptation science and practice.
- Release of the Greater Yellowstone Climate Assessment Report that provides an in-depth summary of past, historical, and projected future changes to temperature, precipitation, and water in the Greater Yellowstone Area.

For additional information about these programs, please visit the USGS website (www.usgs.gov).

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Ecosystems
Environmental Health

Ecosystems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Environmental Health Program	**24,745**	**24,745**	**1,070**	**500**	**1,494**	**27,809**
Contaminant Biology	**10,397**	**10,397**	**482**	**500**	**1,203**	**12,582**
Integrated Sensor Grants [1/]	[0]	[0]	0	500	0	[0]
Mitigation of Contaminant Exposures & Recycling of Mining Waste	[0]	[0]	0	0	1,000	[1,000]
Contaminants Biology Baseline Capacity	[0]	[0]	0	0	203	[203]
Toxic Substances Hydrology	**14,348**	**14,348**	**588**	**0**	**291**	**15,227**
Toxic Substances Baseline Capacity	[0]	[0]	0	0	291	[291]
FTE	***192***	***192***	***0***	***0***	***6***	***198***

1/ Funds transferred from Ecosystems-Species Management Research Program

2023 Program Changes

The 2023 budget request for Environmental Health is $27,809,000 and 198 FTE, a program change of +$1,494,000, and +6 FTE from the 2022 CR Annual Rate level and +$1,070,000 in fixed costs.

Mitigation of Contaminant Exposures & Recycling of Mining Waste (+$1,000,000/ +6 FTE) – The USGS would provide support for science needed to mitigate and prevent toxic and radiological contaminant hazard exposures to underserved communities and ecosystems at selected locations near mill tailings, abandoned mines, unused ore piles, deep well injection sites, and other locations where mine wastes may be found in the environment. Hazards to biological resources, drinking water, and other natural resources that these communities rely on for sustenance, cultural, and economic well-being will be considered. With a focus in areas where communities may be disproportionately impacted such as Tribal and other underserved communities, this approach would provide science for the safe management and mitigation of hazards associated with mining waste, the reclamation of abandoned mine lands, and recycling of mine wastes as a potential resource for rare-earth and other critical minerals.

Baseline Capacity (+$494,000/ 0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $494,000 in this program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The health of our land, water, and living resources can be affected by environmental exposures to toxicological or pathogenic disease agents (collectively referred to as "environmental contaminants"). The Environmental Health Program uses a "One Health" approach to deliver science for resource managers and other stakeholders to sustainably protect, balance and optimize the health of people, animals and ecosystems. The Program brings together interdisciplinary teams of science expertise and laboratory capabilities (hydrologists; geologists; chemists; toxicologists; biologists, ecologists; microbiologists; and geospatial, process, and statistical modelers) who advance our scientific understandings of environmental contaminant exposures and hazard mitigation.

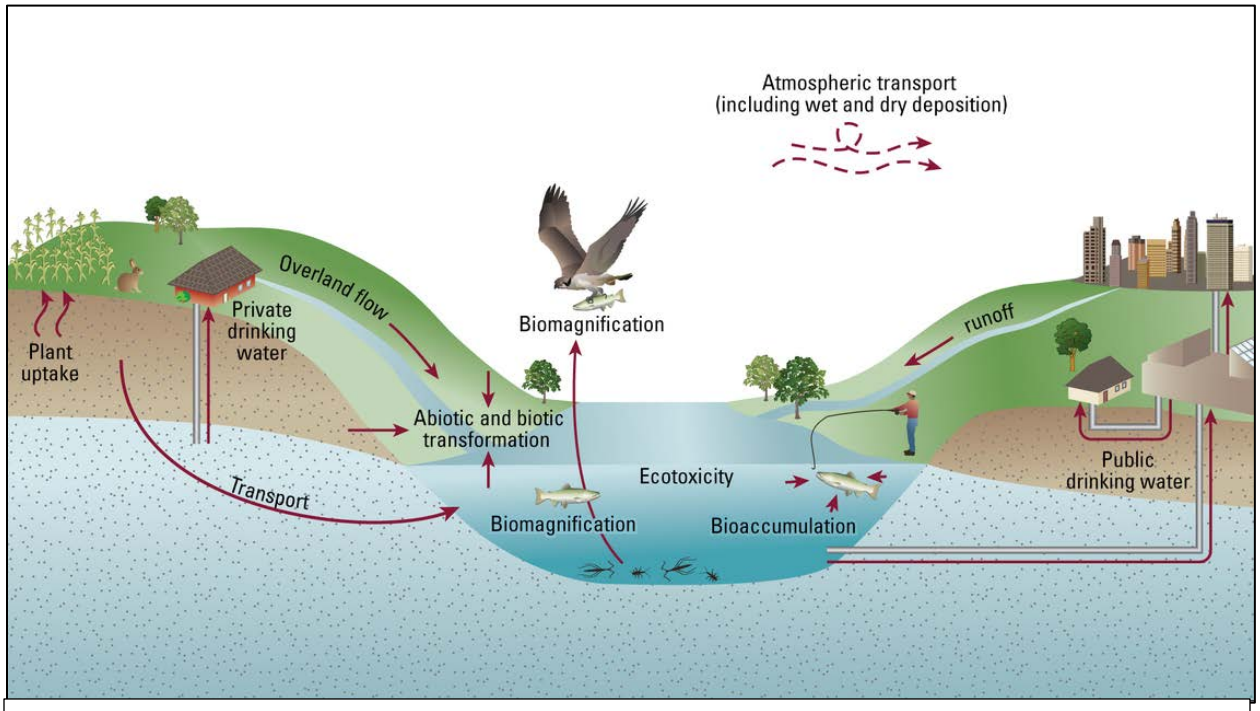
Scientists prepare municipal wastewater samples for SARS-CoV-2 testing at the Eastern Ecological Science Center in collaboration with the Centers for Disease Control. (Source: USGS)

Environmental exposures to a range of naturally occurring and human-sourced contaminants are investigated including mercury, lead, arsenic, natural and synthetic hormones and pharmaceuticals, per- and polyfluoroalkyl substances (PFAS), and pesticides; pathogens such as avian influenza, viruses, and antibiotic-resistant bacteria and genes; and a variety of algal toxins. The integration of natural-science disciplines produces extensive, comprehensive, peer-reviewed science and actionable data and related decision tools for situational awareness, planning, and forecasting.

Working with partners in academia and other science and health agencies the program contributes to a foundation of knowledge for a range of land and other resource management and related economic decisions such as maintaining the safety of harvested fish and wildlife species; the re-use of solid and liquid wastes from municipal, energy, and mineral activities; and protection of recreational and drinking water resources.

The Environmental Health Program supports integrated natural science expertise and capabilities across the USGS related to environmental contaminants and pathogens. The Program supports science to address the full range of questions related to contaminant and pathogen sources, environmental transport, exposure/transmission pathways, uptake, biological effects, and human health implications. This science informs stakeholder decisions to manage fish and wildlife health and provides environmental exposure information to partners in public health.

Mechanisms of PFAS Fate Transport and Exposure in the Environment



Conceptual diagram of per- and polyfluoroalkyl substance (PFAS) sources, movement, and exposures in a watershed. (Source: USGS)

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Ecosystems
Species Management Research

Ecosystems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Species Management Research Program	**53,914**	**53,914**	**441**	**4,587**	**15,504**	**74,446**
Rebaseline of Priority Activities (Species Management Research) 1/	[0]	[0]	0	5,087	0	[0]
Integrated Sensor Grants 2/	[500]	[500]	0	-500	0	[0]
Integrated Science - Multi-use Watershed Management, Forecasting of Coastal Ecosystems and Biodiversity Conservation	[0]	[0]	0	0	2,000	[2,000]
Applied Science in Support of Bureau Conservation and Adaptation	[25,000]	[25,000]	0	0	7,500	[32,500]
Decision Support for Clean Energy Development on Public Lands and Waters	[3,816]	[3,816]	0	0	5,000	[8,816]
Species Management Research Baseline Capacity	[0]	[0]	0	0	1,004	[1,004]
FTE	***61***	***61***	***0***	***0***	***26***	***87***

1/ Funds transferred from Ecosystems-Land Management Research Program
2/ Funds transferred to Ecosystems-Environmental Health Program

2023 Program Changes

The 2023 budget request for Species Management Research is $74,446,000 and 87 FTE, a program change of +$15,504,000, and +26 FTE from the 2022 CR Annual Rate level and +$441,000 in fixed costs.

Integrated Science - Multi-use Watershed Management, Forecasting of Coastal Ecosystems and Biodiversity Conservation (+$2,000,000/ +4 FTE) – The USGS would support integrated, multi-Mission Area science to increase Interior's abilities to make science-informed multi-use watershed management

decisions and advance understanding of the capacity of coastal wetlands, estuarine shorelines and wetland-dependent fish and wildlife to adapt to climate change, including extreme storm events and sea level rise.

On multi-use watershed management, the USGS would contribute technological advances for conducting monitoring, modeling, and ecosystems assessments of our Nation's aquatic species resources to forecast future conditions and strategically plan to manage for species sustainability. This would include: applied climate change research to document and understand species and population responses to physical changes and interactions in the aquatic environment; research addressing culturally significant aquatic species that provide services to impoverished and vulnerable communities; and development of genetic and genomic capabilities, remote sensing capabilities, risk assessment and decision support tools to manage for species biodiversity. Increased resources would also expand efforts to understand the response of at-risk species to stressors such as climate and land use change, energy development, and land and water management, and result in decision support tools for conserving biodiversity to support resilient ecosystems and prevent species from needing protection under the Endangered Species Act (ESA). One focus will be on providing information for Species Status Assessments for species listed under the ESA.

Regarding wetlands/estuarine environments and climate change, the USGS would develop predictive models to forecast coastal ecosystem response to future extreme storm or sea-rise level rise events and the anticipated changes in species distributions. This would enable resource managers to anticipate fish and wildlife response and future needs to sustain coastal systems, their biodiversity, and the ecosystem services they provide to communities.

Applied Science in Support of Interior Bureau Species Conservation and Adaptation (+$7,500,000 / +12 FTE) – The Species Management Research Program (SMRP) will expand work on threats to fish and wildlife like climate change, drought, extreme storm events, and invasive species and disease. The program will develop new tools and technologies to help managers consider species responses to alternative management scenarios and incorporate uncertainty about outcomes into decision-making at broad scales. For example, the SMRP will provide science to inform efforts to address priorities identified in the Conserving and Restoring America the Beautiful report, including the goal of conserving 30 percent of the America's landscape by 2030. Decades of thoughtful stewardship by ranchers, farmers, and property owners have demonstrated that the most effective and enduring conservation strategy is one that reflects the priorities, needs and perspectives of the communities that know, live, work, and care for the lands and water. Science can provide those communities sound information about important habitats to sustain at-risk, commercially, and recreationally important fish and wildlife. Species and their habitats are interdependent and complex in their relationships; the SMRP will work in tandem with the Land Management Research Program to direct resources to participatory science supporting the full spectrum of management information needs for species and their habitats, including, climate change, climate change adaptation, and species and ecosystem response to land use, land change, and resource management. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$7,500,000).

Decision Support Science for Clean Energy Development on Federal Lands and Waters (+$5,000,000 /+10 FTE) – Accelerating deployment of clean energy facilities while ensuring robust protection of sensitive species, habitat, and biodiversity will require science that informs strategies to avoid or reduce

harmful impacts to fish and wildlife and their habitats and incorporates climate change and clean energy needs and considerations.

With these funds, USGS fish and wildlife biologists and ecologists will work with regulatory agencies and the clean energy industry to produce science-based tools and strategies that will help decision-makers determine optimal placement of clean energy infrastructure on lands and in waters where risks and harmful impacts to protected species and habitats can be minimized or mitigated, helping to streamline siting and permitting of clean energy projects. Expected products include maps of desert tortoise connectivity for guiding solar energy development in the southwest and novel high-resolution models and GIS tools identifying high and low risk areas for protected species, developed in collaboration with Federal research laboratories such as the Department of Energy labs (e.g. National Renewable Energy Laboratory and others). The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$5,000,000).

Baseline Capacity (+$1,004,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $1.0 million in this program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

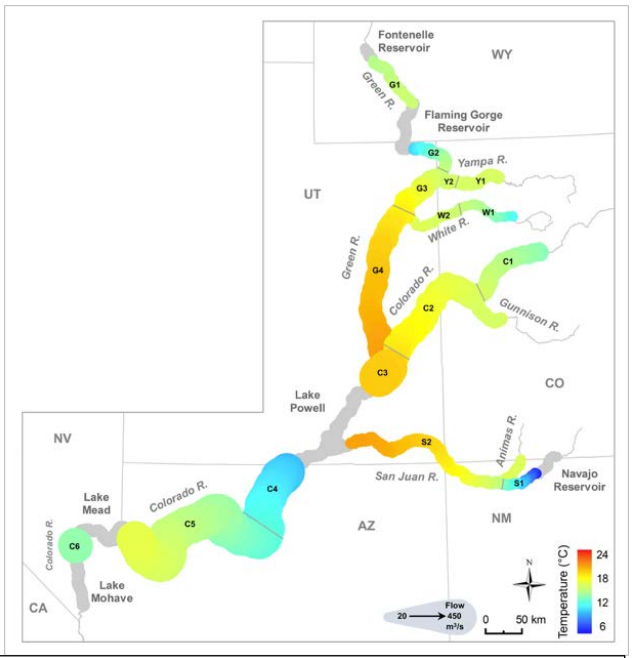
A peregrine falcon on the coast of Oregon, re-sighted seven years after she was first banded only a dozen miles away. The USGS Bird Banding Laboratory manages the permits and bands as well as the resulting data, enabling a wide range of professional researchers to conduct studies - and making it easier for the public to help by report a sighting via www.reportband.gov. (Source: Owen L. Schmidt, Coastal Raptors)

Biodiversity is declining at significant rates, both nationally and on a global scale. Climate change and other natural and manmade stressors are exacerbating species diversity declines and leading to uncertainty about the resilience and sustainability of species and whole ecosystems. Moreover, species distributions are changing with consequences for a wide range of decisions. Now, more than ever, land and water resource managers need targeted science to make strategic and informed decisions about species and ecosystems management. The SMRP approaches stressors like climate change from the perspective of resource management agency science needs and responsibilities for the conservation of species and biodiversity. Federal and State resource management agencies, Tribes, non-governmental organizations, industry and the public rely on the SMRP for information to guide a range of on the ground programs and activities related to meeting statutory requirements, permitting, habitat conservation planning, mitigation practices, ESA compliance, restoration best practices, and more.

This information is essential for agencies to meet societal needs and expectations in the face of a complex array of species stressors and projected changes in environmental conditions and improve science-based relationships with communities of color, low-income families, and rural and Indigenous communities.

The SMRP produces accessible and usable information that improves the ability of managers to anticipate, adapt, and alleviate negative impacts to species, and to make decisions with more certainty, credibility and reduced risk about species management, hunting and fishing regulations, land use, and water allocation. The SMRP conducts research to address key uncertainties in aquatic and terrestrial species biology and population status. This work often involves co-production of scientific information with Department of the Interior and other Federal and State fish and wildlife management agencies, Tribal entities, and other stakeholders. Currently, the SMRP is conducting research on over 160 at-risk species to identify and address stressors and threats, preserve biodiversity, support Species Status Assessments to inform listing and recovery, conduct species risk and vulnerability assessments, predict species adaptations to climate change, and prioritize lands and waters for protection, conservation and restoration actions.

The SMRP maintains robust research portfolios on numerous species in support of Department of the Interior's management responsibility and concerns related to climate change and other species stressors. Research includes birds, amphibians, salmon, bats, pollinators, insects, manatees, sea otters, mollusks, walrus, and polar bears. For example, SMRP science was used in support of species status assessments (pre-listing) for U.S. Fish and Wildlife Service for three bat species (little brown bats, northern long-eared bats and tricolored bats) and for migrating whooping cranes. Long-standing SMRP initiatives such as the Breeding Bird Survey and the Bird Banding Laboratory provide the primary long-term data on the abundance and distribution of avian species in North America.



To help understand the challenges to recovering species, the USGS studies the effects of hydrologic alteration on species and food-webs associated with changes in stream temperatures and nutrient cycles. For example, projected changes in water flow cycles and temperatures in the Colorado River may favor non-native species that compete with the pikeminnow and the endangered humpback chub. Source: USGS.

The SMRP provides the science to support management of harvested species, including migratory bird population models used by Flyway Councils to develop recommendations on waterfowl harvest, to accelerate responsible development of renewable energy on public lands and waters, and to provide technical support for multi-jurisdictional fisheries, harvest, and allocation. The SMRP develops advanced technologies such as remote sensing and genetic tools to improve our ability to assess species population status and health, and models that incorporate stressors such as climate change to predict biodiversity response. These tools are helping managers develop a more accurate and comprehensive understanding of species population trajectories and distribution shifts in the coming decades.

Ecosystems
Land Management Research

Ecosystems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Land Management Research Program	**56,681**	**56,681**	**1,559**	**-7,707**	**22,122**	**72,655**
Rebaseline of Priority Activities (Land Management Research) 1/	[7,707]	[7,707]	0	-7,707	0	[7,707]
Energy Transition, Conservation, and Carbon Management on Federal Lands	[0]	[0]	0	0	1,500	[1,500]
Understanding and Quantifying Ecosystem Services	[1,100]	[1,100]	0	0	10,000	[11,100]
Applied Science and Support of Bureau Conservation and Adaptation	[28,340]	[28,340]	0	0	7,500	[35,840]
Science Supporting Fire Management Before, During and After Fires	[0]	[0]	0	0	2,000	[2,000]
Land Management Research Baseline Capacity	[0]	[0]	0	0	1,122	[1,122]
FTE	***263***	***263***	***0***	***0***	***37***	***300***

1/ Funds transferred to Ecosystems-Species Management Research Program, Land Management Research Program & Biological Threats and Invasives Species Research Program

2023 Program Changes

The 2023 budget request for Land Management Research is $72,655,000 and 300 FTE, a program change of $22,122,000, and +37 FTE from the 2022 CR Annual Rate level and +$1,559,000 in fixed costs.

Energy Transition, Conservation, and Carbon Management on Federal Lands (+$1,500,000/ +3 FTE) – The USGS would work with resource managers to co-produce new science and tools that support the transition to renewable energy and other Administration priorities, including conserving biodiversity, recycling and managing mine wastes, reducing greenhouse gas emissions, and managing carbon. This

research would allow the USGS to inform and improve decision making related to NEPA planning, siting, prescriptions, restoration, and monitoring at both site and regional-cumulative scales. The USGS would continue to work with stakeholders, science providers, and industry to develop a scenario modeling framework that allows users to integrate local, regional, and national scale data for multiple resources and incorporate uncertainty into decisions.

Understanding and Quantifying Ecosystem Services (+$10,000,000 / +18 FTE) – Science has made remarkable gains in understanding the complicated natural systems that support human communities, particularly in the face of climate change. This investment would build a stronger understanding of the benefits that ecosystems offer and what ecosystem services are most beneficial to communities, with quantitative analysis of benefits and trade-offs across the range of land management alternatives. This would help to better measure the value of green infrastructure – using nature as part of our infrastructure system (e.g., natural wetlands for purifying water) – which can be incorporated into a portfolio of solutions to increase water storage capacity, flood risk mitigation, coastal storm protection, carbon sequestration, and climate change adaptation. This would allow the USGS to provide better information to land managers and decision makers to achieve conservation and restoration goals, such as the America the Beautiful initiative.

New USGS research on ecosystem services will support NEPA planning and empower all stakeholders with the unbiased information to prioritize and achieve multiple conservation outcomes and integrate land and species conservation research into adaptive management. The USGS ecosystem services research will also inform the development of public-private partnerships and investment in green infrastructure to enhance ecosystem services. This will also assist communities and land managers who face a growing threat from wildfire, drought, climate change impacts on biodiversity and the ongoing socio-economic transition to sustainable energy, manage lands and natural resources for multiple uses. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$10,000,000).

Applied Science in Support of Interior Bureau Conservation and Adaptation (+$7,500,000 /+12 FTE) – The USGS would expand work on science to support understanding of climate adaptation, mitigation, and impacts to natural resources to provide actionable science in support of policy and management decisions to assist natural resource managers, particularly at Interior bureaus, adapt to future climate related changes. This work will be conducted in partnership with the Species Management Program and focus effort on better understanding the complex linkages among ecosystems, land and resource management, climate change, and habitats for fish and wildlife.

The USGS would also build capacity to expand work with decision makers within the DOI land management bureaus and create targeted adaptation planning frameworks linked to explicit conservation goals and outcomes. The USGS will use targeted monitoring as a critical adaptive management approach to land and waters with complex, interacting, and dynamic challenges. This work will assist decision makers as they choose among possible actions, maximizing the likelihood of achieving the stated goals and allowing resource management to target scarce resources to actions with the highest probability of success. It will also enable the USGS to produce the biodiversity and ecosystem components of the National Climate Assessment, explicitly assessing linkages between climate and biodiversity to identify effective mechanisms to support conservation. This will also improve integration of climate change effects in environmental planning and will benefit Federal and State agencies, the public, and industry through

improved program efficiencies and reduced costs. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$7,500,000).

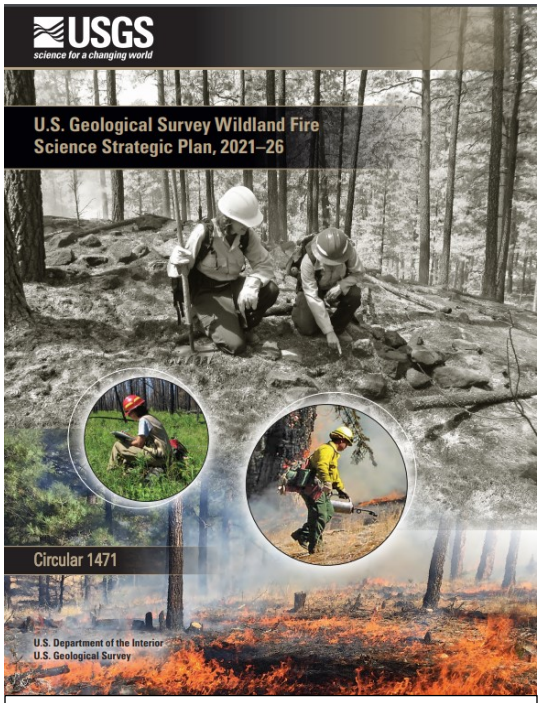
Science Supporting Fire Management Before, During and After Fires (+$2,000,000/ +4 FTE) – The USGS released its first Wildland Fire Science Strategic Plan in FY 2021, which emphasizes working with stakeholders to identify, develop, and share essential information, data and tools that support critical decision-making by fire, resource and emergency managers. The USGS is poised to provide critical science support for mitigating and responding to fire/post-fire risk and recovery at local to national scales. The USGS would fund advanced integrated fire research focused on the complicated, interacting, and dynamic fire/post-fire challenges to produce answers where there is uncertainty. For example, the USGS would identify how pre-fire fuel conditions affect fire behavior and how burn severity will improve fuel treatments to reduce direct fire effects and cascading post-fire impacts from debris flows, flooding, water quality and sedimentation. Integrated research approaches with advanced sensors, satellite data, analytics (artificial intelligence) and models would also provide managers better understanding and decision support to address such factors as climate change, invasive species, drought and human development, which all interact to affect fire behavior and fire risk to society and ecosystems. Land, fire, and community managers working with scientists would be better able to plan and implement actions that reduce wildfire and post-fire risk to people, wildlife habitat, water supply, land uses and other ecosystem services.

Baseline Capacity (+$1,122,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $1.1 million in this program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Land Management Research Program (LMRP) provides science for understanding natural and human influences on lands, waters, and ecosystems under management responsibility of Interior bureaus and other Federal, State, and Tribal partners. This information is indispensable for achieving the goal of the America the Beautiful initiative and for managing carbon sequestration on public lands. The program supports research to identify, reduce or avoid resource management conflicts, support the transition to sustainable energy, enhance and maintain public lands for future generations, and keep U.S. communities safe.

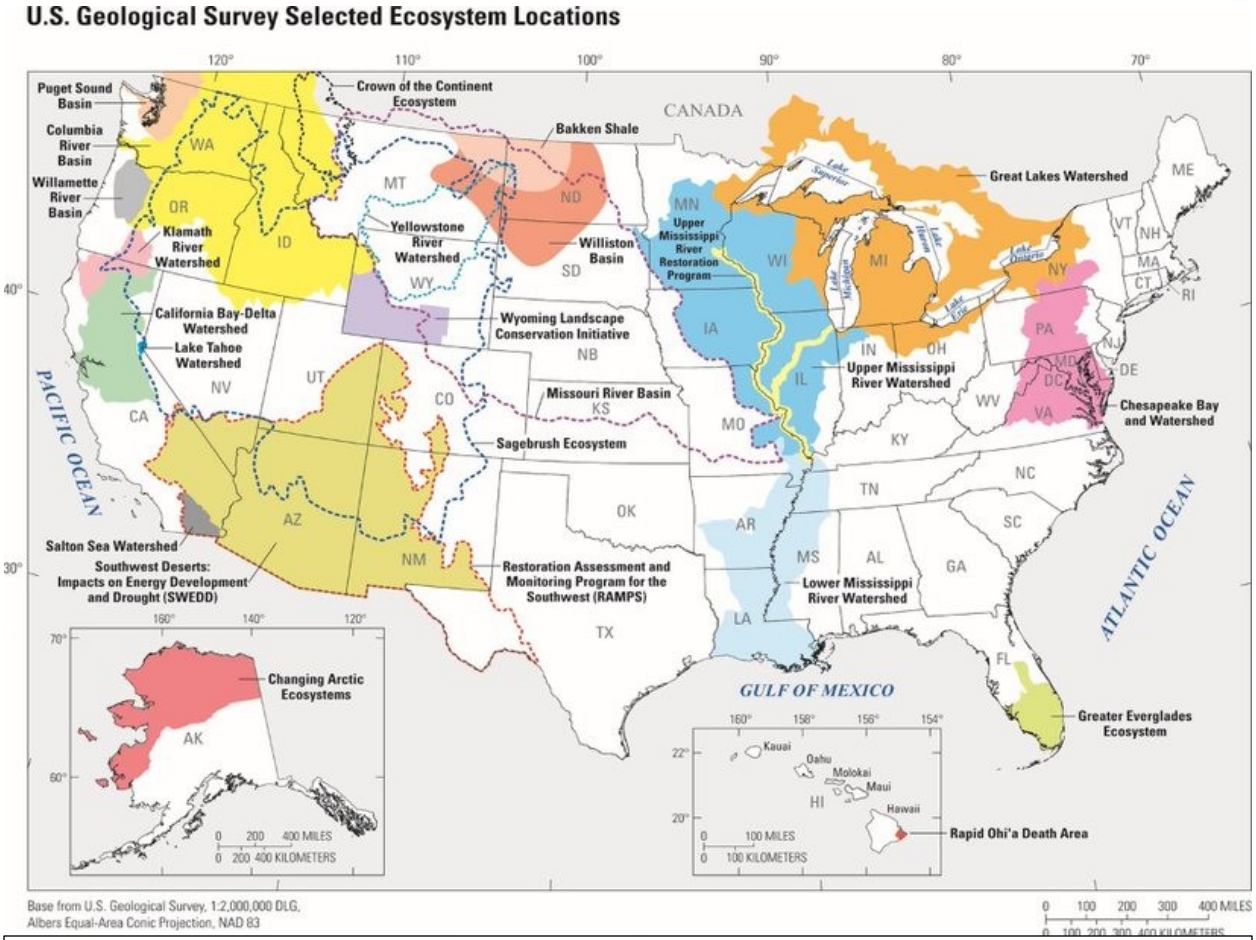
The USGS works with land managers to identify priority information needs and conducts research to predict and assess the potential effects of current and future land uses. Scientific assessment and prediction are the foundation for decision support tools that help managers understand risk and make cost-effective resource



The USGS Wildland Fire Strategic Plan, pictured above, represents the most integrated and detailed plan for fire research to date in Federal government. It combines the extraordinary breadth of the USGS Fire Science activities into a coherent vision for how integrated, actionable fire science can help address the nation's wildfire problems, working closely with stakeholders. Source: USGS.

management decisions. The USGS develops methods to improve degraded lands, identify and mitigate threats to people and ecosystems, and provide needed information on the benefits and potential liabilities of management actions. Information and tools resulting from studies help streamline permitting decisions by Interior bureaus by helping managers identify potential effects of climate change, invasive species, insect and disease outbreaks, drought, and development and evaluate management alternatives.

Looking to the future, the LMRP is working to transform the ability of Tribal Nations, land-management agencies, landowner organizations, and local communities to plan and make informed decisions by co-producing integrated, scenario-based modeling and monitoring approaches. Land management science brings together the information resulting from ecosystem, socio-economic, remote-sensing, and management research. Using new state-of-the-art integrated data and models, the effort improves the quality and timeliness of current estimates of carbon sequestration, land change, fire, hydrology, and other ecosystem services to provide consistent, cross-disciplinary science products that can project the impact of resource management decisions that are of importance to land managers.



USGS Ecosystems Research Priorities (Source: USGS)

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Ecosystems
Biological Threats & Invasive Species Research

Ecosystems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Biological Threats and Invasive Species Research Program	**38,249**	**38,249**	**1,349**	**2,620**	**5,702**	**47,920**
Rebaseline of Priority Activities (Biological Threats and Invasive Species Research) 1/	[0]	[0]	0	2,620	0	[0]
Reducing Threats of Invasive Species and Wildlife Disease in a Changing Climate	[190]	[190]	0	0	5,000	[5,190]
Biological Threats and Invasive Species Baseline Capacity	[0]	[0]	0	0	702	[702]
FTE	***256***	***256***	***0***	***0***	***10***	***266***

1/ Funds transferred from Ecosystems-Land Management Research Program

2023 Program Changes

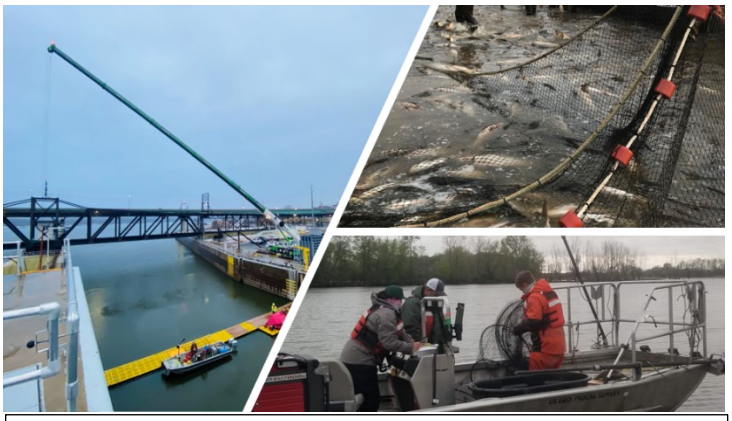
The 2023 budget request for Biological Threats and Invasive Species Research is $47,920,000 and 266 FTE, a program change of $5,702,000 and +10 FTE from the 2022 CR Annual Rate level and +$1,349,000 in fixed costs.

Reducing Threats of Invasive Species and Wildlife Disease in a Changing Climate (+$5,000,000 / +10 FTE) – The USGS would address the interacting effects of climate change and biological threats using a systematic risk-based approach to surveillance, risk reduction, and mitigation of these threats. A changing climate brings additional pathways for the introduction and spread of invasive species and wildlife diseases; range shifts for native and invasive species; and phenological mismatches between species' needs and habitat (e.g., critical food resources being too large to consume or no longer available when needed because of warming temperatures). This effort will initially focus on three regions that are expected to be disproportionately affected by climate change (Alaska, Hawaii and U.S. insular territories in the Pacific, and the Northeast) and that support critical habitat and species of conservation concern. In these locations, the USGS will connect biosurveillance, risk reduction, and mitigation tools with key stakeholders in Tribal

Nations and other underserved communities in addition to traditional Federal and State partners. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$5,000,000).

Baseline Capacity (+$702,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $702,000 in this program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview



USGS researchers lead efforts to develop and test the effectiveness of sound deterrents at Lock and Dam 19 (Illinois and Iowa) on the Mississippi River (left), mass capture methods in Kentucky Lake (top right) for bighead carp and silver carp and using baits and attractants to increase removal of grass carp in Lake Erie (bottom right). Source: USGS.

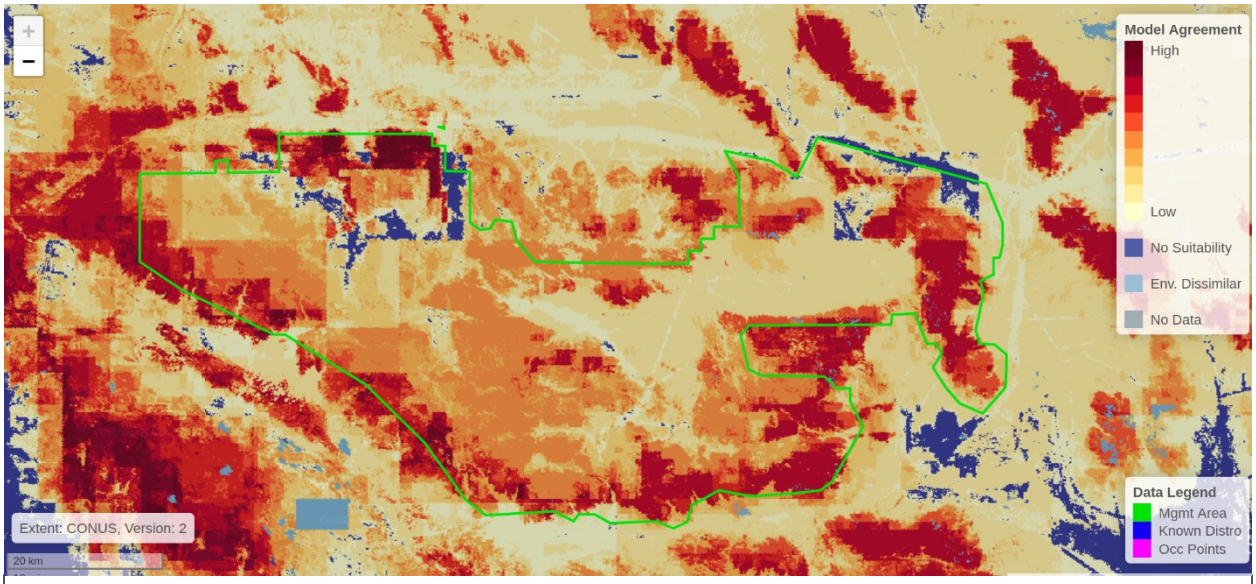
The harm done by biological threats such as invasive species and wildlife disease affects every State in the country, including urban centers and wilderness areas. Approximately 60 percent of emerging human infectious pathogens like SARS-CoV-2 are zoonotic (transmitted between animals and humans). Over 70 percent of these zoonoses originate in wildlife. The effects of emerging wildlife diseases are global and profound, often resulting in economic and agricultural impacts, declines in wildlife populations, and ecological disturbance. 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 ecological concerns. A strong emphasis of the program is technology transfer to management agencies.

The USGS optimizes traditional monitoring and develops new tools for early detection to reduce the damage and spread of invasive species. A focus of USGS research is to integrate mitigation and control strategies to empower land and water managers to respond quickly and effectively to a wide variety of new invasions. An example of the types of tools developed by USGS scientists to deter further spread of invasive carps (bighead, black, grass, and silver carps) is seen above.

Controlling the Spread of Invasive Carps

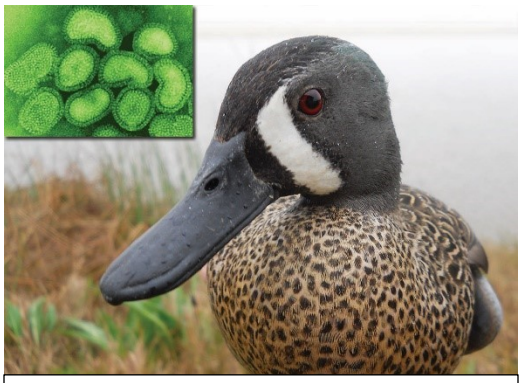
Research on invasive carps support early detection, risk assessment, and development and assessment of control tools. Removal efforts using a USGS-developed method in Barkley Lake, Kentucky removed tens of thousands of pounds of invasive silver and bighead carp. Similar efforts in the upper Mississippi River along the Minnesota/Wisconsin border removed a small number and demonstrated the value of the method as an early detection tool in new environments. Research testing the effectiveness of an acoustic deterrent system at Lock and Dam 19 on the Mississippi River will support stopping upstream expansion of invasive carps. Research on other deterrents, such as carbon dioxide, have proven effective in laboratory tests against grass carp.

The program conducts multi-scale, integrated assessments to aid managers, such as mapping, monitoring and predicting infestations of invasive plants to guide early detection and rapid response efforts (shown below). INHABIT (Invasive Species Habitat Tool; http://gis.usgs.gov/inhabit) is a web-based invasive plant species prediction tool that models habitat suitability at 90-m resolution for the continental U.S. to global at 1-km resolution to identify where species may establish. Models use various predictor layers that can include current and future climate layers (near- and long-term projections), remote-sensing derivatives (such as Moderate Resolution Imaging, MODIS, phenology metrics), land cover, topography, and anthropogenic features. USGS developed INHABIT in partnership with Federal, State and local invasive species managers to deliver species models for priority invasive terrestrial plant species for the contiguous U.S. An upcoming article in PLOS ONE describes two case studies demonstrating adaptions of the tool based on end user feedback. INHABIT was requested by NPS and USFWS, and developed in partnership with NPS, USFWS, BLM, and Colorado State University.



Visualization of model output from INHABIT displaying relative suitable habitat for Fountain grass (Pennisetum setaceum) in Joshua Tree National Park based on known distribution and point occurrence for the species. Managers use maps such as this to identify areas to monitor for new populations. Source: USGS.

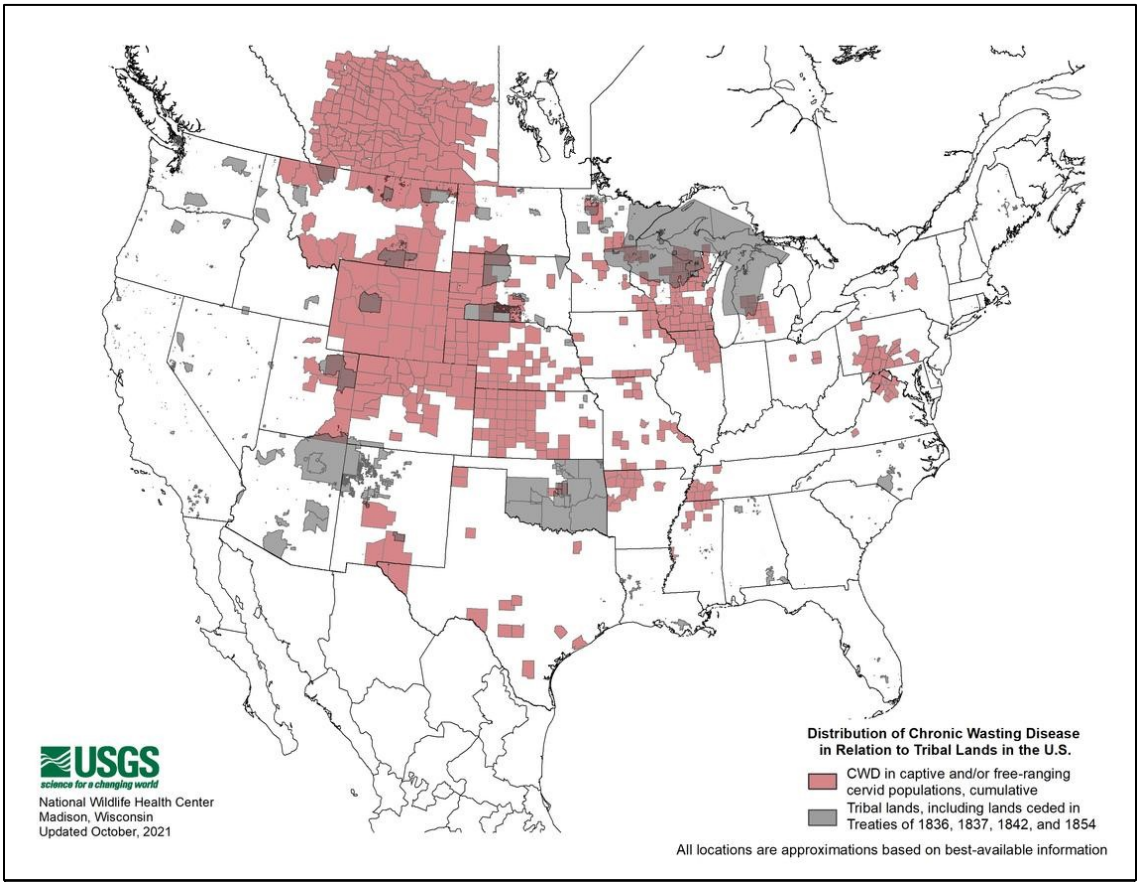
The program assesses fish and aquatic organism mass mortalities, developing disease surveillance and management tools for salmonid fish, coral, and shellfish (freshwater mussels, razor clams). The USGS marine disease investigations support USFWS, NPS and National Oceanic and Atmospheric Administration (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 wild aquatic organisms. Through the American Rescue Plan Act, the USGS is collaborating with USFWS and others to develop an Aquatic Disease and Pathogen database that leverages the infrastructure of the Nonindigenous Aquatic Species database to enhance situational awareness and biosurveillance of aquatic diseases.



To understand the dynamics of avian influenza viruses (inset), the USGS is collaborating with the USDA to characterize the spatial-temporal relationship between migratory birds (including the blue-winged teal shown here) and poultry across the US. (Source: USGS)

The USGS is investigating the dynamics of avian influenza (AI) in wild birds and the environment to support risk assessments, poultry outbreak tracebacks, and management actions (shown left). As the climate changes, the USGS is collaborating with U.S. Department of Agriculture (USDA) and other partners across the US to underpin AI surveillance and response with avian ecology and influenza genomic data. Similarly, USGS is supporting surveillance and the response to White Nose Syndrome, which has killed millions of bats across the US. USGS is facilitating an adaptive management approach and assessing the efficacy of a vaccine. USGS is partnering with USFWS and others to understand the ecological implications by monitoring bats (North American Bat Monitoring Program) in addition to tracking disease spread and characterizing persistent populations. USGS is modernizing the diagnostic laboratories and high-containment research facilities of the National Wildlife Health Center, established in 1975, along with its curated biosurveillance database (https://whispers.usgs.gov), which is the foundation for the ARPA National Wildlife Disease Database, to enhance situational awareness for wildlife diseases.

Chronic Wasting Disease (CWD) is a fatal, contagious neurological disease affecting deer, elk, and moose in more than half of the US. The USGS is not only mapping the spread (shown below) but also optimizing early detection tools, investigating the implications of cervid ecology and migration on CWD dynamics and risk, facilitating a structured-decision making approach, and incorporating human dimensions into the response.



USGS is collaborating with States and Tribes to develop and refine tools to improve situational awareness (e.g., this map), early detection, and management of chronic wasting disease. (Source: USGS)

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Ecosystems
Cooperative Research Units

Ecosystems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Cooperative Research Units Program	**25,000**	**25,000**	**644**	**0**	**2,506**	**28,150**
Management of Cooperative Research Units	[25,000]	[25,000]	0	0	2,000	[27,000]
CRU Baseline Capacity	[0]	[0]	0	0	506	[506]
FTE	***121***	***121***	***0***	***0***	***6***	***127***

2023 Program Changes

The 2023 budget request for Cooperative Research Units is $28,150,000 and 127 FTE, a program change of +$2,506,000 and +6 FTE from the 2022 CR Annual Rate level and +$644,000 in fixed costs.

Management of Cooperative Research Units (+$2,000,000 / +6 FTE) - The USGS would establish and staff up to two new Cooperative Research Units. New units would meet the research and training needs of program cooperators at host universities and State and Federal natural resource management agencies. The USGS would continue to leverage available resources for the benefit of all cooperators, as every federally-allocated dollar is levered on a 1:3 basis by State and host university contributions and grant funds.

Baseline Capacity (+$506,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $506,000 in this program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Cooperative Research Units (CRU) program is a unique cooperative relationship between the USGS, State fish and wildlife agencies, host universities, and the Wildlife Management Institute, a non-profit that works to improve the professional foundation of wildlife management. The USFWS is also a formal cooperator at most of the individual Units. Since 1935, this cooperative relationship has provided a strong

List of cooperators the CRU program partners with for research, both internal and external partners. (Source: USGS)

connection between the USGS, State and Federal fish and wildlife management agencies, and the national university community. The individual resources of each cooperator are leveraged to deliver program outcomes that far exceed what any one cooperator could achieve alone.

The goals of the CRU program are to sustain and maintain:

- A cost-effective, national network of Federal, State, and university partnerships pursuant to the Cooperative Research and Training Units Act of 1960 (P.L. 86-686), with a legislated mission of research, education, and technical assistance focused on fish, wildlife, ecology, and natural resources.
- A customer-oriented network of expertise for actionable science, research, teaching, and technical assistance that is responsive to information needs of State and Federal resource agency decision makers.
- Science capabilities responsive to resource management needs of Interior bureaus.
- A premier program for graduate education, mentoring, and training of future natural resources professionals from diverse backgrounds having skills to serve the broad natural resource management community successfully.

Graphic displays the research funding for Federal and State projects, the number of students and university staff member supported and the amount of support for tuition and reduced overhead. (Source: USGS)

The CRU program is composed of 41 cooperative units located at universities in 39 States. The program is designed to leverage cooperative partnerships with Federal and State agencies to address mutual needs of all partners in a cost-effective manner. The USGS stations Federal scientists at universities to help identify and respond to natural resource information needs through pooling of resources among agencies; participate in advanced scientific training and mentoring of university graduate students to represent the various agencies workforce of the future; and provide Federal and other natural resource managers' access to university expertise and facilities. Federal support of the CRUs is multiplied by State and university cooperator contributions of expertise, equipment, facilities, and project funding, thereby enhancing the program's cost- effectiveness. The program's appropriated dollars continue to be leveraged by Federal, State, university, and other entities' contributions

at a ratio of three matching dollars to each appropriated dollar. Through university affiliations, CRU scientists train a diverse group of future natural resource professionals and provide opportunities through graduate education to diversify the Federal workforce.

Each CRU is directed by a Coordinating Committee composed of Federal, State, university, and Wildlife Management Institute representatives. Each Coordinating Committee establishes goals and expectations for its unit within the program's mission of research, education, and technical assistance. The mix of priorities is established locally and is updated annually based on the needs of cooperators and available funding. Program accountability measures and standards, and oversight of Federal scientists are used to ensure research and the resulting scientific information products support the goals of the USGS and Interior.

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Ecosystems
Climate Adaptation Science Centers & Land Change Science

Ecosystems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Climate Adaptation Science Center and Land Change Science Program	**60,488**	**60,488**	**1,912**	**0**	**62,312**	**124,712**
Land Change Science	**19,153**	**19,153**	**574**	**0**	**19,244**	**38,971**
Climate Impacts on Physical and Biological Systems	[15,168]	[15,168]	0	0	10,000	[25,168]
Biologic Carbon Sequestration	[0]	[0]	0	0	2,000	[2,000]
Monitoring Greenhouse Gas Reduction Process	[0]	[0]	0	0	5,000	[5,000]
Developing a Climate Risk Framework to Inform Management Options	[0]	[0]	0	0	2,000	[2,000]
Land Change Science Baseline Capacity	[0]	[0]	0	0	244	[244]
National and Regional Climate Adaptation Science Centers	**41,335**	**41,335**	**1,338**	**0**	**43,068**	**85,741**
Facilitate Synthesis of Regional Findings to a National Level	[500]	[500]	0	0	5,000	[5,500]
Assessment of Biodiversity	[0]	[0]	0	0	2,500	[2,500]
Support for Climate Adaptation Science Centers	[36,335]	[36,355]	0	0	25,000	[61,355]
Tribal Climate Adaptation Science	[500]	[500]	0	0	10,000	[10,500]
NRCASC Baseline Capacity	[0]	[0]	0	0	568	[568]
FTE	***272***	***272***	***0***	***0***	***115***	***387***

2023 Program Changes

The 2023 budget request for Climate Adaptation Science Centers & Land Change Science is $124,712,000 and 387 FTE, a program change of +$62,312,000 and +115 FTE, from the 2022 CR Annual Rate level and +$1,912,000 in fixed costs.

Land Chance Science

Climate Impacts on Physical and Biological Systems (+$10,000,000 / +50 FTE) – In support of DOI bureaus and other partners, the USGS would expand and accelerate research that integrates coupled physical and biological observations over multiple temporal and spatial scales, conduct targeted experiments to determine the changing controls over systems, and modeling activities to better anticipate the impacts of a range of climate and land management scenarios.

Specifically, the USGS would lead regional- to national-scale research efforts to understand and forecast responses of coastal, wetland, dryland, forest, Arctic, and aquatic ecosystems to changing climates and environments. These activities would combine long-standing USGS expertise in geology, hydrology, ecology, biogeochemistry, and geography to provide high-resolution records of past and on-going changes over regional to national scales. The proposed increase would facilitate the integration of historic, instrumental, experimental, and monitoring records with land-cover and climate modeling activities to improve capabilities that project potential impacts of different management and climate scenarios. By providing decision makers the information needed to evaluate the impacts of various management plans, USGS research would help decrease the vulnerability and increase the resilience of critical ecosystems throughout the Nation. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$10,000,000).

Biologic Carbon Sequestration (+$2,000,000 / +10 FTE) – The USGS would use this funding to improve the understanding of how changing climate and resource management activities influence the sequestration of carbon. Biologic carbon storage and fluxes are central controls over the Earth’s climate and are highly susceptible to environmental factors such as increasing temperatures, fire, drought, and a broad range of climate and land use stressors. New research by the USGS would address the significant needs of resource managers to understand ways to sustain carbon sequestration in the face of change, and to increase carbon storage under different climate and management scenarios. An improved understanding of carbon management challenges and opportunities would provide the Nation powerful options for addressing the climate crisis, both now and into the future.

New studies would expand research to provide actionable information on how physical, biological, and ecological processes interact to control carbon sequestration and to improve models used to anticipate changes in carbon based on various resource management scenarios. These studies include: development of spatially-explicit, landscape-scale models of wetland vegetation and biogeochemical processes; comparison of carbon storage and flux rates in wetlands throughout the Nation, including coastal, inland, and permafrost sites; development of a novel approach to determine how climate change affects the cycling of carbon in dryland soils of the Southwest; analyses of impacts of droughts, floods, and land management on aquatic export of carbon from terrestrial systems through rivers to estuaries and oceans; and the impacts of changing climate and receding glaciers on the transport of carbon and nutrients to downstream

ecosystems and oceans. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$2,000,000).

Monitoring Greenhouse Gas Reduction Process (+$5,000,000 / +25 FTE) – The USGS would provide biologic information to further the Federal lands greenhouse gas (GHG) emissions inventory and sequestration assessment. Specifically, the activities would include development of a methodology to measure, monitor, report, and verify carbon sequestration and greenhouse gas reductions to monitor progress in meeting goals on Federal lands. The U.S. Federal Lands GHG Emissions and Sequestration Assessment would be updated to include an inventory of greenhouse gases on Federal lands. A geographic information system (GIS) database of identified geologic sources of GHG (e.g. CO_2 and methane seeps) would be compiled, and tools would be developed for Interior bureaus and other Federal agencies to identify restoration targets and methods that could optimize the protection of carbon resources and sequestration rates. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$5,000,000).

Developing a Climate Risk Framework to Inform Management Options (+$2,000,000) – In support of Interior bureaus, other partners, and stakeholders, the USGS would develop a climate risk assessment by enhancing ongoing scientific investigations that focus on understanding natural resources and human systems affected by climate change across a range of temporal and spatial scales. The USGS would conduct a national and regional synthesis that assesses ecosystem transformations due to climate and land use change, assesses changes in species and habitat distributions, places those changes in an historic context, and elucidates the drivers and mechanisms responsible for the changes. Activities such as remotely-sensed and ground-based data collection, modeling, and integration of habitat and species information would produce regional- to continental-scale syntheses and analyses of modern and paleoclimate relationships to fire, water resources, and, initially, forested and aquatic ecosystems and species. Outcomes would include identification of critical data gaps, advancement of integrated physical and biological watershed-scale research on drivers and understanding of the risks associated with climate and land use changes on species and habitat distributions at regional- to national-scales for use by natural resource decision makers. For example, research on near-term forecasting and climate risk responses of both "natural" and managed forest and aquatic systems and their anticipated influence on species distributions would result in products that inform local and regional management of climate-related impacts to water, fish, and wildlife and support management decisions for ecosystems throughout the Nation.

Baseline Capacity (+$244,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $244,000 in this program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

National & Regional Climate Adaptation Science Center

Facilitate Synthesis of Regional Findings to National Level (+$5,000,000 / +2 FTE) – The CASCs provide valuable adaptation science at a regional level, but leveraging that information at a national level

improves the quality of science and decision support in multiple ecoregions. Synthesizing a series of national science projects allows a broader understanding of the potential impacts and adaptation measures that will work across a variety of different geographies, thus sharing best practices from the work of the regional CASCs. The goal of this effort will be twofold, (1) directly support managers by providing a broader understanding of how climate impacts and adaptation can be used in a risk management framework for Federal, State, and Tribal partners decision processes, and (2) develop further understanding of broad climate driven impacts such as fire, drought, and sea level rise, and integrating that with a variety of fish and wildlife management "on the ground" projects to increase knowledge of management actions that may help us adapt to or mitigate climate impacts.

Among the various products will be a guidebook on (1) how managers incorporate aspects of risk of management choice associated with climate driven changes into adaptation and mitigation efforts, and (2) a series of reference case-studies focused on ecological transformation and ways for managers to effectively incorporate risk from climate into management strategies for underlying biodiversity and services that nature provides. Another outcome is the development of models that combine landscape properties (for example, land use, land cover, condition), climate, hydrology, biogeochemistry, and ecology to forecast change for specific ecosystems across different scales. Additionally, the USGS intends to produce a series of assessments focused on synthesizing findings of the climate impacts to fire, drought, ecological flows and other high priority topics identified by resource managers. These syntheses will include policy relevant options for various management agencies to consider when planning activities and regulatory approaches. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$5,000,000).

Assessment of Biodiversity (+$2,500,000 / +2 FTE) – Biodiversity provides the underlying support for nature's contributions to people, providing, for example, food and water security, hazard protection, and serves as an important component of cultural identity. Understanding the key linkages between climate and biodiversity, and how climate may impact future contributions to people will be critical to help mitigate or adapt to climate driven change. The USGS has extensive expertise in leading the National Climate Assessments chapters on biodiversity, ecosystems, and ecosystems services over the last 10 years. These extensive capabilities will be used to develop science to allow us to understand the key linkages between climate change and biodiversity. The primary focus of this work will focus on understanding the linkages between biodiversity and climate change, development of scientific approaches to help reverse the decline of biodiversity and perform the first National Assessment of Biodiversity and Ecosystems, modeled after the recently completed global assessment of biodiversity and ecosystem services. The final products will include an assessment in the U.S. of the linkages between Climate and Biodiversity and identify policy support mechanisms to conserve biodiversity. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$2,500,000).

Support for Climate Adaptation Science Centers (+$25,000,000 / +15 FTE) – With this increase, the USGS would accelerate the work conducted by the network of university-based CASCs. The effort would be along two complementary approaches: development of climate adaptation services and furthering ongoing work in support of the climate science needs identified in the DOI Climate Action plan; and ramping up efforts by our regional CASCs' stakeholder advisory committees to support DOI and their partners' science priorities. Specifically, the USGS would develop new scientific approaches to use and integrate climate information and model output into management and planning efforts, furthering our ability to provide actionable science to help natural resource managers adapt to future climate related changes. The USGS would focus basic scientific efforts on regional partner priorities, such as climate change in the Arctic, climate driven changes in wildfire and drought, understanding how the loss of winter impacts natural resources in northern climates and how coastal and nearshore resources will be impacted by climate change. Additionally, the USGS would expand our efforts to provide support in the intersection between climate science and natural and cultural resource management through development of climate adaptation services. This service would, for example, provide single points of contact to identify appropriate climate science for use in natural and cultural resources management planning and management, develop training for individuals in management communities to assure that best practices are used to incorporate climate in plausible futures, and develop broad approaches to integrating climate science in management actions. Once implemented, these services would ensure management agencies could integrate the best available climate science into everyday activities. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$25,000,000).

Water cascades down Gibbon Falls in Yellowstone National Park, where resource managers use decision making frameworks such as Resist-Accept-Direct (RAD) to incorporate climate data into their management strategies. (Source: Alan Cressler, USGS)

Tribal Climate Adaptation Science (+$10,000,000 / +1 FTE) – The USGS would build upon existing partnerships with Tribal and indigenous communities to integrate traditional knowledge into climate research, and expand capacity building efforts so that Tribal communities, including remote communities such as those in Alaska and the western Pacific, can more easily participate in research endeavors and access needed information.

The USGS is uniquely positioned to develop and manage the leading edge of institutional mechanisms to promote co-production of knowledge processes while ensuring that agencies maintain appropriate validation standards for data quality and dissemination. The USGS is currently collaborating with the Bureau of Indian Affairs to host Tribal Resilience Liaisons at the regional CASCs; these liaisons work across the boundary between the USGS and American Indian Tribes and Alaska Native villages. USGS scientists have established relationships with many American Indian and Alaska Native Tribes and indigenous communities in the Pacific islands and would use this increase to build a science portfolio that

provides information directly responsive to their needs. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$10,000,000).

Baseline Capacity (+$568,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $568,000 in this program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Climate Adaptation Science Center and Land Change Science 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, academic partners, land managers, and front-line stewards of natural and cultural resources.

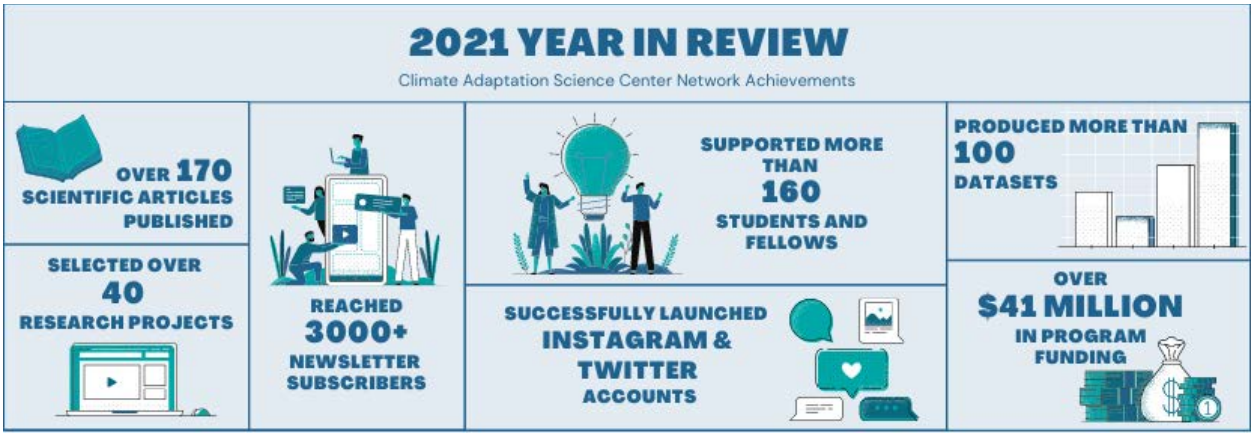
The scientific work conducted is responsive to the following guiding principles:

- 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; and
- Promotes institutional efficiencies through partnerships to avoid duplication of effort and leverage opportunities in climate-impact research.

A mangrove forest and adjacent mudflat near Big Sable Creek in Everglades National Park (Florida, USA). In this area, mangrove forest mortality and peat collapse due to a powerful tropical cyclone in 1935 led to the conversion of mangrove forests to mudflats. This area was once covered by more extensive mangrove forests but is now a mosaic of mangrove forest and mudflats. Source: USGS.

The CASCs synthesize and analyze the effects of a changing climate on terrestrial and aquatic communities and natural resources at regional to national scales. The CASC's focus 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 CASCs work collaboratively with scientific expertise

found throughout the Ecosystems Mission Area and in other programs within the USGS, along with scientific expertise available within University partners. The CASC includes a network of a national CASC and nine regional CASCs covering the continental U.S., Alaska, Hawai'i, the U.S. Affiliated Pacific Islands, and the U.S. Caribbean.



The Land Change Science program studies the 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's focus includes: long-term patterns and impacts of droughts and floods; response of coastal regions to changing land use, water management, and sea level rise; 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 and the difference between changes resulting from natural forces from those associated with land management. These efforts also provide the scientific basis for land use decisions that affect the safety and prosperity of communities and our Nation's natural resources.

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Energy and Mineral Resources

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Energy and Mineral Resources

Energy and Minerals Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Energy Resources Program	**30,172**	**30,172**	**972**	**0**	**25,564**	**56,708**
FTE	***135***	***135***	***0***	***0***	***25***	***160***
Mineral Resources Program	**59,869**	**59,869**	**2,065**	**0**	**28,368**	**90,302**
FTE	***289***	***289***	***0***	***0***	***51***	***340***
Energy and Mineral Resources Total	**90,041**	**90,041**	**3,037**	**0**	**53,932**	**147,010**
FTE	***424***	***424***	***0***	***0***	***76***	***500***

The 2023 budget request for the Energy and Mineral Resources Mission Area is $147,010,000 and 500 FTE, with a program change of +$53,932,000 and +76 FTE above the 2022 CR Annual Rate level, and +$3,037,000 in fixed costs.

Mission Area Overview

The USGS Energy and Mineral Resources Mission Area is the Nation's primary source of impartial scientific information on domestic and global geologic resources and their supply chains, including the location, quantity, and quality of the resources. The Nation relies on a variety of energy and mineral resources to power homes and businesses and to manufacture products and technologies, from phones to vehicles. The USGS conducts research on the full life cycle of these resources, including the Nation's domestic resources and global trade relationships; carbon storage potential and critical mineral supply chains essential to sustainable energy transitions; environmental and socioeconomic effects of geologic resource occurrence, extraction, use, wastes, and demands on water supplies; and supply, demand, and trade of mineral commodities. The USGS provides science to inform economic, technological, national security, and geopolitical strategies and decisions, as well as sustainable natural resource management and the development of infrastructure and new technologies.

Resource Assessments: The USGS is the primary provider of unbiased, publicly available estimates of geological resources for the United States; the USGS also provides publicly available estimates of global resource potential. These assessments describe the potential for undiscovered geologic resources, including

nonfuel mineral resources, oil, natural gas, coal, and uranium. In addition, the USGS assesses unconventional resources, such as gas hydrates and helium, renewable resources, such as geothermal energy, and carbon capture, utilization, and storage potential. The USGS also studies the environmental impacts of resource extraction, including the quality and quantity of water and wastes associated with development. This USGS science helps inform strategic decision-making regarding the Nation's reliance on domestic versus foreign resources and supports the management of geologic resources; in particular, those on Federal lands. USGS science also helps decision makers evaluate the potential to reclaim legacy mine sites and/or reprocess legacy wastes for critical minerals and supports policies and Federal investments to strengthen critical mineral supply chains.

Research for Decision Support: The USGS develops tools to make information on energy and mineral resources more useful for decisions impacting water supplies, climate, ecosystems, underserved communities, and the economy. This research includes methods for multi-resource assessments that combine energy and mineral resource assessments with information about those resources' effects on the quantity and quality of other natural resources, such as water. Recent USGS research spanning the Energy and Mineral Resources Programs has highlighted the importance of mineral supplies and wastes in the energy technology transition and identified opportunities to use geologic formations and mine wastes for carbon dioxide mineralization (i.e., turning carbon dioxide into a solid mineral to prevent escape of gases). The Mission Area also collaborates with other USGS mission areas to produce science and tools that span science disciplines. For example, the Mission Area coordinated with the Ecosystems Mission Area on the Wind Energy Impact Assessment Methodology to assess population-level impacts of wind energy development on birds and bats, helping inform decisions on the placement of wind turbines and related environmental considerations.

Data Quality, Data Delivery, and Workforce: The USGS is investing in data quality and data delivery to ensure seamless public access to the results of ongoing largescale data collection and interpretation. This effort ensures that foundational data sets are transparent and traceable and that historical data sets are accessible into the future. The Earth Mapping Resources Initiative (Earth MRI) is collecting an unprecedented volume of foundational data to transform and modernize the Nation's mapping of the surface and subsurface.

The USGS is leveraging these new data assets, legacy data, and data rescue efforts to support Interior in identifying candidate sites for remediation under the Bipartisan Infrastructure Law. Examples include the oil and gas wells database first developed for Energy Resources Program work on the Greenhouse Gas Emissions and Sequestration Inventory for Federal Lands and the U.S. Mineral Deposit (USMIN) database first developed by the Mineral Resources Program in concert with the Bureau of Land Management as the authoritative database of historical and present-day mining sites.

The USGS is also investing significantly in rebuilding its own, and the Nation's, geoscience workforce. This workforce is essential to address future challenges posed by the energy transition and the economy's vulnerability to mineral supply chain weaknesses. The Mineral Resources Program is providing technical assistance to support sister agencies, States, and universities in their efforts rebuild and update expertise in every aspect of the mineral life cycle, from the evolution of ore deposits through extraction and processing to waste management. Recently, the Program developed a course on ore deposits and economic geology for the Bureau of Land Management and the Department of Agriculture's U.S. Forest Service. The Program

will be developing a continuing education course for both agencies that includes field trips illustrating the state of the art in secondary processing to recover critical minerals from mine wastes. In addition, the Mission Area has launched a series of USGS cross-disciplinary workshops and joint USGS and State geological surveys workshops on waste as a resource, which initiated new methods to assess potential mineral resources in mine wastes.

FY 2021 Selected Mission Area Accomplishments

- The Mineral Resources Program published a report titled, "Methodology and Technical Input for the 2021 Review and Revision of the U.S. Critical Minerals List." The Energy Act of 2020 directed the Secretary of the Interior, acting through the USGS Director, to regularly update the whole-of-government critical minerals list, and this report provided the basis to do so in 2021. The methodology reflected interagency input through the National Science and Technology Council and leveraged USGS analysis of vulnerabilities in global supply chains for technologies ranging from consumer electronics and aerospace to renewable energy generation and storage.

- Under the Energy Act of 2020, the Energy Resources Program is to update the USGS 2008 assessment of geothermal resources in the western U.S. In 2021, the program completed a report titled, "National-scale Preassessment of Reservoir Thermal Energy Storage," which provides a basis for not only updating but also expanding the 2008 assessment of geothermal energy resources to include geothermal heating and cooling resources, which are likely available in much larger areas across the Nation than conventional geothermal resources.

For additional information about these programs, please see the Program Book on the USGS website (www.usgs.gov).

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Energy and Mineral Resources
Energy Resources Program

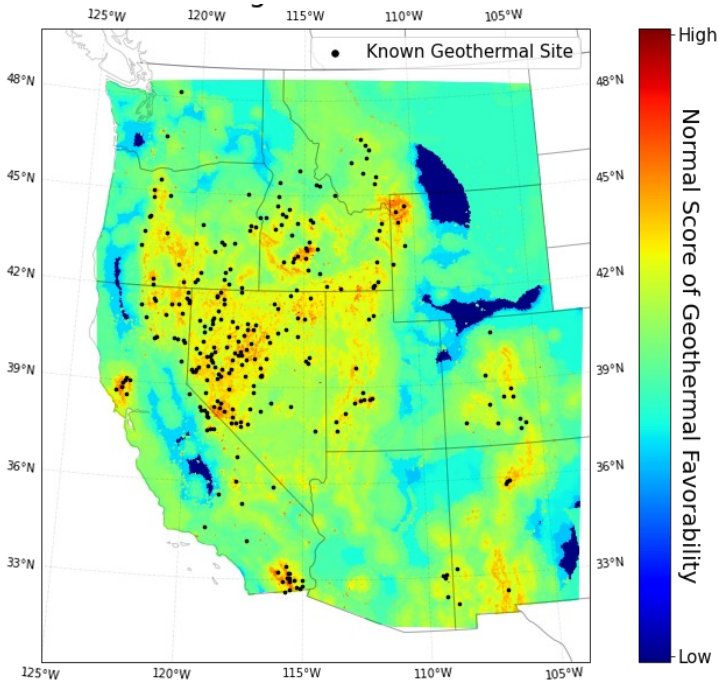
Energy and Minerals Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Energy Resources Program	**30,172**	**30,172**	**972**	**0**	**25,564**	**56,708**
Geothermal Energy	[1,552]	[1,552]	0	0	2,000	[3,552]
Inventory of Greenhouse Gas Emissions and Sinks on Federal Lands	[50]	[50]	0	0	10,000	[10,050]
Scenario Analysis Tools for Greenhouse Gas Reduction on Federal Lands	[250]	[250]	0	0	5,000	[5,250]
Geophysical Data Acquisition in Areas with Potential for Geologic Carbon Sequestration	[75]	[75]	0	0	3,500	[3,575]
Geologic Carbon Sequestration	[1,477]	[1,477]	0	0	4,500	[5,977]
Energy Resources Baseline Capacity	[0]	[0]	0	0]	564	[564]
FTE	***135***	***135***	***0***	***0***	***25***	***160***

2023 Program Changes

The 2023 budget request for the Energy Resources Program is $56,708,000 and 160 FTE, with a program change of +$25,564,000 and +25 FTE above the 2022 CR Annual Rate level, and +$972,000 in fixed costs.

Geothermal Energy (+$2,000,000/ +4 FTE) – The USGS would advance geothermal research through an updated and expanded assessment of geothermal energy resources, including low temperature resources. This new national geothermal assessment would identify the potential for geothermal resources across the United States. Geothermal energy is a significant source of renewable electric power in the western United States and, with advances in exploration and development technologies, a potential source of a large fraction of baseload electric power, as well as district heating and cooling, for the entire country.

The Energy Act of 2020 directed the USGS to develop a national geothermal assessment that would update the assessment published in 2008. The USGS would accelerate progress toward understanding geothermal potential in the central and eastern U.S., as well as Alaska, Hawaii, and Puerto Rico, to support a clean energy economy and communities' heating and cooling needs across the Nation. This effort is critical to meeting the mandates of the Energy Act of 2020, Executive Order 14008–*Tackling the Climate Crisis at Home and Abroad*, and Executive Order 13985–*Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*. In addition to identifying geothermal resources available to remote and underserved communities, the USGS would work cooperatively with Tribal scientists to ensure that funded data collection would benefit Tribal energy choices and facilitate improved understanding of other natural resources (e.g., groundwater).



The Energy Act of 2020 directed the USGS to update the 2008 assessment of geothermal resources, which highlighted high temperature geothermal resources suitable for power production in the Western U.S. (shown on map). The new assessment would incorporate low temperature geothermal resources suitable for heating and cooling. Source: USGS.

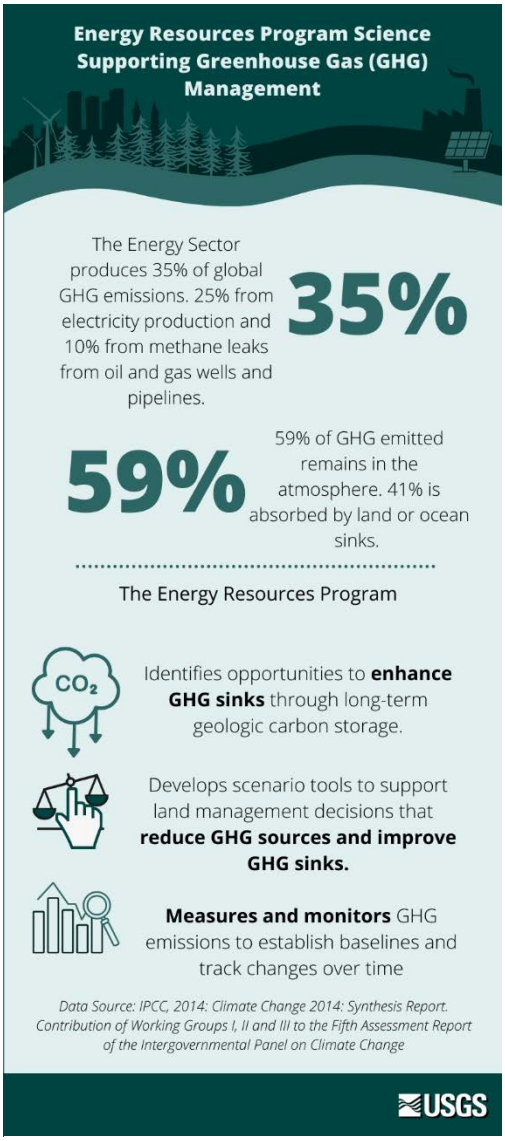
Inventory of Greenhouse Gas Emissions and Sinks on Federal Lands (+$10,000,000 / +8 FTE) – The USGS would foster collaboration with other Interior bureaus and Federal agencies on a system to measure, monitor, report, and verify carbon sequestration and greenhouse gas reductions in the lands and energy sectors, ranging from extractive activity to wetland and vegetation management on Federal lands. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$10,000,000).

Scenario Analysis Tools for Greenhouse Gas Reduction on Federal Lands (+$5,000,000 / +6 FTE) – The USGS would support sustainable uses of Federal lands by providing Federal decision-makers, local communities, and land managers with the tools to analyze tradeoffs among various energy development scenarios. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$5,000,000).

Geophysical Data Acquisition in Areas with Potential for Geologic Carbon Sequestration (+$3,500,000 / +3 FTE) – The USGS would identify areas that should be prioritized for geophysical data collection, thus providing high resolution data that will be analyzed jointly with the USGS Earthquake Hazards Program to determine the potential for induced seismicity. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$3,500,000).

Geologic Carbon Sequestration (+$4,500,000 / +4 FTE) – The USGS would scale up existing research on geologic carbon sequestration, which allows for the capture and storage of carbon in geologic formations, and has the potential, in some cases, for use in recovery of oil and gas resources while balancing greenhouse gases created by consumption of those resources. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$4,500,000).

Baseline Capacity (+$564,000 / +0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $564,000 in the Energy Resources Program, which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.



The Energy Sector produces 35% of global greenhouse gas emissions. This graphic shows how the USGS Energy Resources Program monitors those emissions and identifies opportunities to improve greenhouse gas sinks. Source: USGS

Program Overview

The Energy Resources Program is the sole provider of unbiased, publicly available estimates of undiscovered, technically recoverable energy resources for the United States (exclusive of the U.S. Outer Continental Shelf). The USGS addresses the challenge of increasing demand for energy resources by conducting basic and applied research on geologic energy resources and the environmental and economic impacts of their use. The USGS studies both emerging and renewable (e.g., geothermal, wind, solar, hydrogen) and traditional geologic energy resources (e.g., oil, natural gas), as well as the carbon, water, and waste implications of energy development. This USGS science informs strategic decision-making on the Nation's reliance on domestic versus foreign resources and the management of energy resources on Federal

and State land. This information is critical in efforts to meet increased energy demands while simultaneously mitigating climate change and increasing the sustainability of energy development.

Energy Resource Assessments and Methods Development: The USGS conducts assessments that include many types of traditional, renewable, and emerging energy resources, as well as carbon dioxide storage resources and the effects of energy development on other natural resources. The USGS' focus on traditional energy resources includes assessment of oil and gas resource potential through in-depth studies of geology and geochemistry in various petroleum provinces throughout the United States. Studies of the geologic, geophysical, and geochemical framework of these areas allow for better understanding of the resource potential and environmental impacts of oil and gas development. These USGS resource assessments are widely used by a variety of stakeholders including local, State, and Federal governments, land resource managers, and the public.

The USGS also studies and quantifies the Nation's renewable and emerging energy resources, including geothermal energy resources, gas hydrate resources, and hydrogen resources, which have the potential to further diversify the U.S. energy portfolio. Quantifying the Nation's renewable and emerging energy potential is important input to decision-making on the Nation's energy futures and potential effects on the economy and environment.

Part of the USGS' focus includes pioneering the development of tools and techniques for multi-resource assessments that combine energy resource assessments with assessments of other co-located natural resources that quantify potential trade-offs in resource availability and use. These multi-resource assessments, such as the relationship between energy development and water quality and availability, will help natural resource managers better balance development of interdependent resources and better adapt to changing natural conditions, such as drought and fluxes in societal demand for energy and water resources.

Energy Resources Research: The USGS conducts research on the geologic processes and settings that form energy resources. This fundamental geologic research enables probabilistic geology-based assessments of domestic and global traditional energy resources, such as coal, oil, and gas, and renewable and emerging resources, such as geothermal energy for heating, and cooling, energy gases such as carbon dioxide and hydrogen, and gas hydrates.

The USGS' research addresses the complete life cycle of energy resources from how and where resources form and accumulate prior to resource extraction by industry to reclamation, recycling, and disposal once extraction activities are complete. This research is used by a variety of decision-makers, including by industry to identify best practices to limit adverse environmental impacts and for other purposes, and by land use managers and regulators to enhance stewardship of public lands for multiple uses and for national energy and economic security.

The USGS continues to invest in data delivery to ensure that research on resources and on the effects of resource development is accessible and usable to a variety of decision-makers. Products include the Geologic Carbon Sequestration interactive map, U.S. Wind Turbine Database, National Produced Waters Geochemical Database, and National and Global Oil and Gas Assessment website.

Energy and Mineral Resources
Mineral Resources Program

Energy and Minerals Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Mineral Resources Program	**59,869**	**59,869**	**2,065**	**0**	**28,368**	**90,302**
Supply Chain Research for Green Technologies	[1,670]	[1,670]	0	0	5,000	[6,670]
Mine Waste Research and Assessments in Support of Reclamation	[1,274]	[1,274]	0	0	15,000	[16,274]
Mineral Systems	[4,376]	[4,376]	0	0	2,000	[6,376]
Critical Minerals (Location, Forecasting)	[1,991]	[1,991]	0	0	5,000	[6,991]
Mineral Resources Baseline Capacity	[0]	[0]	0	0	1,368	[1,368]
FTE	***289***	***289***	***0***	***0***	***51***	***340***

2023 Program Changes

The 2023 budget request for the Minerals Resources Program is $90,302,000 and 340 FTE, with a program change of +$28,368,000 and +51 FTE above the 2022 CR Annual Rate level, and +$2,065,000 in fixed costs.

Supply Chain Research for Green Technologies (+$5,000,000 / +6 FTE) – The proposed increase would help USGS build on recently published analyses of the mineral dependencies of current and emerging energy generation and storage technologies to increase the provision of data and technical assistance to other Federal agencies, including the interagency Federal Consortium on Advanced Batteries under Executive Order 14017, America's Supply Chains (2021). The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$5,000,000).

Mine Waste Research and Assessments in Support of Reclamation (+$15,000,000 / +25 FTE) – The proposed increase would allow USGS to collaborate with other Interior bureaus and Federal and State agencies to support development of a unified national strategy to accelerate and coordinate efforts on mine waste issues and to include the evaluation of mine waste as a resource for critical minerals. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$15,000,000).

Mineral Systems (+$2,000,000 / +5 FTE) – The USGS would increase the scope and scale of mineral systems activities to accelerate the pace of assessments by roughly 50 percent and expedite development of the national mine waste inventory and Earth MRI mapping efforts.

The USGS conducts fundamental research on processes that form mineral deposits, including those that host critical minerals. The USGS uses a mineral systems approach to provide a framework to evaluate multiple mineral commodities simultaneously, leading to a more robust understanding of the distribution, geologic setting, and geochemistry of mineral deposits. With these advances in mineral systems science, the USGS would further its work with State partners to synthesize data and science on mineral systems and abandoned mine lands reclamation. The USGS would expedite implementation of Executive Order 14017, which outlines the Administration's plan for resilient, diverse, and secure supply chains, by improving understanding and forecasting of reliable sources and supply chains of critical minerals needed for the Nation's infrastructure, economy, and transition to renewable sources of energy.

Critical Minerals (Location, Forecasting) (+$5,000,000 / +15 FTE) – The proposed increase would see USGS leverage its experience providing interagency technical assistance to launch development of an automated analytical capability for supply risk and economic impact forecasting. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$5,000,000).

Baseline Capacity (+$1,368,000 / 0 FTE)— The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $1.4 million in the Mineral Resources Program, which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Mineral Resources Program provides the Nation science and data on onshore nonfuel mineral potential, production, consumption, recycling, disposal, and interaction with the environment. The Program maps, studies, and analyzes the supply, demand, and trade of a wide variety of nonfuel mineral resources that are critical to the economy and national security of the United States. USGS researchers define and forecast domestic, foreign, and sectoral dependencies on mineral commodities, and develop methodologies to quantify the Nation's mineral resources both "still in the ground" and in mine wastes. They also provide scientific data to support Federal and private sector decision-making, for example informing Federal investments in economically significant supply chains and trade negotiations for critical minerals needed for renewable energy and emerging technologies. The USGS researches how minerals and mine wastes interact with the environment, to better understand wastes as potential resources, inform the management of public lands and resources, and protect and improve public and environmental health and safety.

Critical Mineral Resources: The Mineral Resources Program includes a focus on critical mineral resources that draws on data, science, and expertise from every component of the Program. Critical minerals, as defined by the Energy Act of 2020, are those mineral commodities which are essential to the economic or national security of the United States and which have a supply chain vulnerable to disruption. Critical minerals also serve an essential function in the manufacturing of a product, the absence of which would have significant consequences for the economic or national security of the United States. Many critical minerals are central to the ongoing energy transition. For example, minerals necessary to the rapidly

growing high-tech and renewable energy sectors include the rare earth elements used in wind turbines, electric vehicles, and consumer electronics. Following the Energy Act of 2020, the USGS has updated the methodology for determining mineral criticality and applied it to the 2022 Final List of Critical Minerals, published in the Federal Register on February 24, 2022. The USGS developed and continues to refine a "criticality tool," which can be used to identify emerging supply risks and evaluate the impact of commodity supply restrictions.

Mineral Information: The USGS analyzes mineral production, consumption, sustainability, materials flow, availability, and the economic health of the U.S. minerals industry. The USGS collects data on about 100 mineral commodities for 180 countries, produces about 700 mineral reports annually (see *http://minerals.usgs.gov/minerals*), and answers more than 2,000 mineral resources inquiries monthly. These data provide decision makers information essential to foresee supply chain disruptions and ensure adequate and dependable supplies of minerals and mineral materials to meet economic and defense needs. The public and private sectors use this information extensively to understand the use of mineral materials in the economy, and to inform investments in all aspects of supply chains. The USGS is developing its capability to forecast supply chain vulnerabilities in accordance with the Energy Act of 2020. Key stakeholders include Federal agencies, such as the Departments of Commerce, Defense, Energy, and State, intelligence agencies, the Federal Reserve Board, foreign investment and credit agencies, including the U.S. International Development Finance Corporation and Export-Import Bank, and the Office of the U.S. Trade Representative. State agencies, private sector minerals and manufacturing decision-makers, Wall Street market analysts, and foreign trade partners similarly rely on USGS data. As an example, USGS information helps the U.S. Environmental Protection Agency quantify material flows in annual solid waste reporting.

The USGS tracks global mineral supply chains and identifies their risks across various economic sectors. This graphic shows how specific minerals, including lithium, niobium, and copper, are used in manufacturing, aerospace, electronics, and more. Source: USGS

Mineral Resources Research: The USGS conducts innovative research on the potential for reprocessing mineral resources from mine wastes while also supporting legacy mine site remediation. It also develops analytical tools and databases to support mineral research and assessments. The USGS conducts geologic framework research on how and where mineral deposits form and develops methods to detect potential mineral resources. This research has resulted in the recognition of new types of mineral deposits, new understanding of the mineral systems that form mineral deposits, and new methods to characterize undiscovered resources. USGS mineral resources research is used by Federal and State agencies, academia, and the private sector.

The USGS also conducts research into the interactions of mineral resources with the environment, including the effects of naturally occurring mineralization and mineral resource extraction. This research identifies emerging challenges and opportunities for future sustainable mining, as well as new uses of previously mined materials. The USGS has unique expertise in the flow of resources through the global economy, including the commodity value of waste, and works to improve the Nation's understanding of the potential for deriving value from unconventional or above-ground mineral resources such as waste streams from manufacturing and mining.

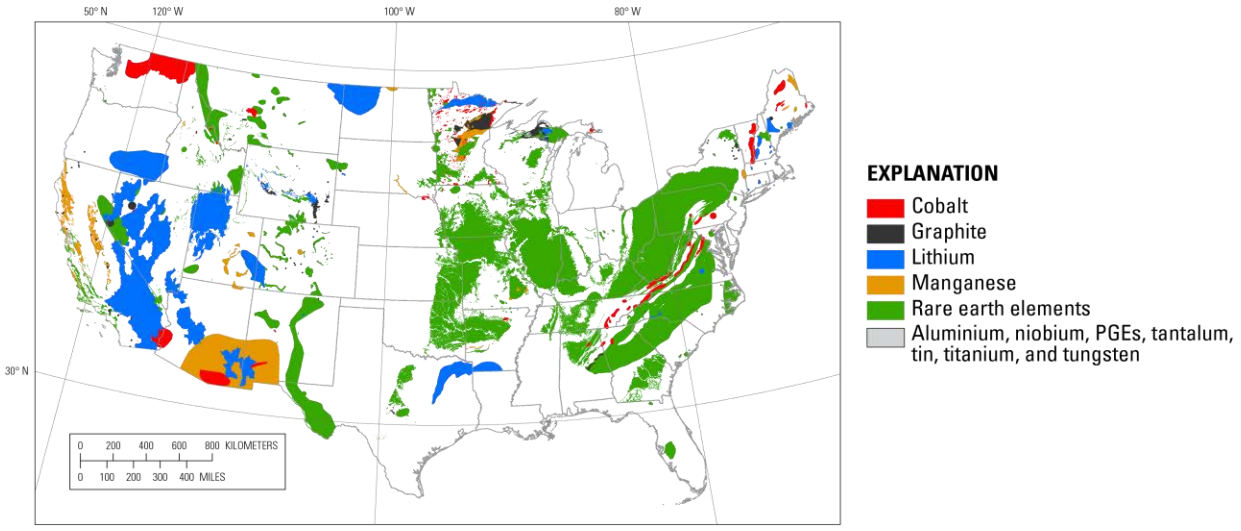
Mine dumps, ore stockpile and storage sites, slag piles, and mine tailings disposal sites in the lower 48 states (USGS USMIN Database). As part of its mine waste research effort, the USGS is developing a national mine waste inventory, which will include the number and location of legacy mine waste sites as well as information on their critical mineral resources. Source: USGS

Mineral Resource Assessments and Methods Development: USGS mineral resource assessments evaluate the potential for domestic and global mineral resources ranging from major metals (e.g., copper) to industrial minerals (e.g., construction materials) to rare earth elements. These assessments are informed by a diverse array of data types and sources, including space-based and airborne Earth observation instruments, aeromagnetic and radiometric geophysical surveys, hyperspectral remote sensing data, and geochemical tools and methods. The Energy Act of 2020 directed the USGS to carry out comprehensive national assessments of critical mineral resources. In response to the Energy Act and following consultation with National Science and Technology Council's interagency Critical Minerals Subcommittee, the USGS will focus its next assessments on critical battery minerals needed for electric vehicle and grid energy

storage applications. These assessments will help policymakers and land managers foresee needs for increased investments in sustainable domestic production, mine waste reprocessing and other forms of secondary production, and new trade agreements with other nations producing critical battery minerals.

Data Acquisition, Interpretation, and Delivery: The Nation is under-mapped relative to other developed nations. In 2019, the USGS launched the Earth Mapping Resources Initiative (Earth MRI) to modernize the Nation's mapping of geology and geologic resources, with an initial focus on critical minerals essential to the Nation's economy. Earth MRI collaborates across USGS programs, State Geological Surveys, other Federal agencies, and Tribal governments to plan, fund, acquire, and analyze geological, geophysical, geochemical, and topographic datasets. Earth MRI data are foundational geoscience information useful for many purposes. These data are essential for delineating areas with critical mineral potential, as well as for science and decisions on infrastructure, transportation, and land-use planning, hazard assessments for earthquakes, landslides, volcanoes, and floods, water resources management, geothermal resources and geologic carbon storage, and emergency response.

With the addition of $320 million over five years from the Bipartisan Infrastructure Law, Earth MRI will significantly expand and accelerate its acquisition of new airborne geophysical and lidar surveys, and on-the-ground geologic mapping and geochemistry. In addition, Earth MRI will supplement this significant increase in existing data collection activities with new types of surveys, such as hyperspectral surveys, which can be used for a variety of applications.



First national map of areas with the potential for advanced battery minerals. The colored areas were identified using a mineral systems approach. Earth MRI is prioritizing data acquisition in these areas and areas with the potential for other critical minerals. Source: USGS.

The USGS will also invest in new capacities to store, analyze, and share the unprecedented volume of data being collected through Earth MRI to maximize the accessibility and utility of these transformative datasets. In tandem, the USGS has launched efforts to modernize complementary research databases and digitize legacy mining and minerals information. These include USMIN, a national-scale geospatial database developed in collaboration with the BLM and State geological surveys, which is the authoritative data

source on the most significant mines, mineral deposits, and mineral districts of the United States, including digitized mine features from historical paper topographic maps. These datasets will inform USGS assessments of domestic mineral resources, both still in the ground and in mine wastes, and will also support other DOI efforts under the Bipartisan Infrastructure Law.

Natural Hazards

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Natural Hazards

Natural Hazards $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Earthquake Hazards Program	**85,403**	**85,403**	**1,783**	**0**	**12,734**	**99,920**
FTE	***268***	***268***	***0***	***0***	***21***	***289***
Volcano Hazards Program	**30,266**	**30,266**	**968**	**0**	**3,266**	**34,500**
FTE	***148***	***148***	***0***	***0***	***9***	***157***
Landslide Hazards Program	**8,038**	**8,038**	**253**	**0**	**3,141**	**11,432**
FTE	***35***	***35***	***0***	***0***	***6***	***41***
Global Seismographic Network Program	**7,153**	**7,153**	**68**	**0**	**59**	**7,280**
FTE	***11***	***11***	***0***	***0***	***0***	***11***
Geomagnetism Program	**4,114**	**4,114**	**87**	**0**	**1,559**	**5,760**
FTE	***12***	***12***	***0***	***0***	***2***	***14***
Coastal/Marine Hazards and Resources Program	**40,510**	**40,510**	**1,420**	**0**	**19,005**	**60,935**
FTE	***220***	***220***	***0***	***0***	***33***	***253***
Natural Hazards Total	**175,484**	**175,484**	**4,579**	**0**	**39,764**	**219,827**
FTE	***694***	***694***	***0***	***0***	***71***	***765***

The 2023 budget request for the Natural Hazards Mission Area is $219,827,000 and 765 FTE, a program change of $39,764,000 and 71 FTE above the 2022 CR Annual Rate level, and +$4,579,000 in fixed costs.

Mission Area Overview

The Natural Hazards Mission Area provides scientific information to emergency responders, policy makers, and the public to reduce losses from a wide array of natural hazards, including earthquakes, hurricanes, landslides, tsunamis, volcanic eruptions, and geomagnetic storms, as well as longer-term climate change-driven impacts such as sea level rise, coastal erosion, and intense wildfires. 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, 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), and other Federal or State agencies.

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, both of which 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.

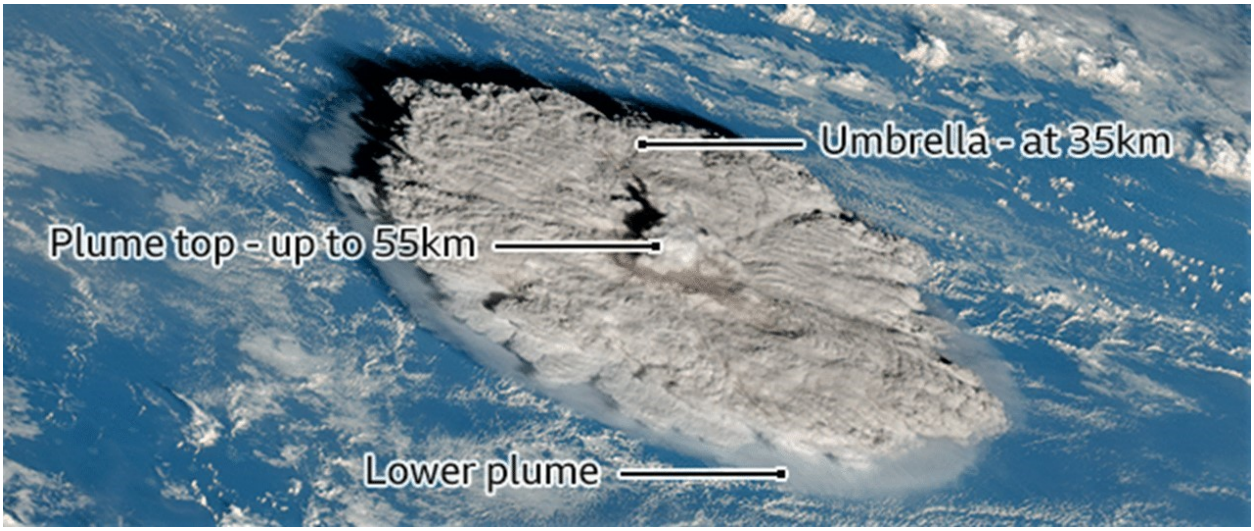
FY 2021 Selected Mission Area Accomplishments

- Rolled out ShakeAlert earthquake early warning (EEW) public alerting in Oregon in March 2021 and in Washington in May 2021. ShakeAlert public alerting has also been operational in California since October 2019.
- Alaska Volcano Observatory (AVO) converted, upgraded, and expanded operational capabilities at 27 locations including monitoring sites, repeaters, and receive facilities.
- Data collection, studies, and model results to assess the wave generating potential from landslides at Barry Arm, Prince William Sound, Alaska.
- Installed three new broadband primary sensors in the Global Seismographic Network (GSN), and completed infrastructure upgrades at several sites.
- Awarded second year of the cooperative agreement with Oregon State University for completion of the magnetotelluric (MT) survey of the southern one-third of the U.S.
- USGS expanded forecasts in cooperation with NOAA/NWS for the Atlantic Hurricane season, augmented storm-response forecasting along the U.S. West Coast, and provided follow-up assessments of storm impacts and readiness for the next storm and storm season.

For additional information about these programs, please see the Program Book on the USGS website (www.usgs.gov).

USGS Highlight: Working Together in Partnership – A Coordinated Response to Hunga Tonga-Hunga Ha'apai Eruption

On January 15, 2022, Hunga Tonga- Hunga Ha'apai volcano erupted, generating an ash plume that reached over 100,000 feet, forming an umbrella cloud over 250 miles wide, and resulting in ashfall on the major populated Tongan islands 40-80 miles to the southeast. The eruption created a tsunami that first reached the Tongan islands with a height of nearly 5 feet, making landfall in 11 countries around the Pacific Basin. Impacts from even distant undersea volcanic eruptions can extend to U.S. coasts and disrupt global air traffic. Similar volcanic threats exist along the island arcs of the Aleutians in Alaska and the Commonwealth of the Northern Mariana Islands.



Satellite imagery of the Tonga-Hunga Ha'apai volcanic eruption plume taken from the Japanese weather satellite Himawari-8 (Source: Japan Meteorological Agency)

The USGS responded to the Hunga Tonga-Hunga Ha'apai event with an "all-of-USGS" mobilization, serving the Pacific Island and other communities impacted directly while exercising the capabilities required to respond to cascading natural hazard events domestically. The resulting data, evaluations, and models will improve USGS' capacity to assess the Nation's risk from future events and to respond more effectively when they occur.

The USGS-USAID Volcano Disaster Assistance Program (VDAP) tracked the eruptive activity, leveraging data from the USGS Global Seismographic Network (GSN) that was monitored by the USGS National Earthquake Information Center (NEIC). Earthquake monitoring at the NEIC is performed in partnership with NOAA's Tsunami Warning Centers, which use seismic information to develop tsunami forecasts and issue warnings for the U.S. and the Pacific. The USGS analyzed the ash cloud and gas emissions, examined the resulting tsunami recordings, applied tsunami-physics models to understand the tsunami source, and supported NOAA's forecasts of tsunami impact on coastal communities. The USGS modeled the eruption plume and worked with U.S. and international partners to provide information on the impacts of volcanic ash to human health and agriculture. USGS seismologists provided information on the location of post-eruption earthquakes in Tonga. VDAP used USGS National Civil Applications Center and partner data to

perform evaluations of ash fall, tsunami hazards, and continuing volcanic activity, which allowed VDAP to provide guidance to Tonga Geological Services. VDAP also donated seismic and infrasound sensors that will allow for ground-based monitoring of future events in Tonga.

Natural Hazards
Earthquake Hazards Program

Natural Hazards $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Earthquake Hazards Program	**85,403**	**85,403**	**1,783**	**0**	**12,734**	**99,920**
Subduction Zone Science	[2,700]	[2,700]	0	0	7,500	[10,200]
Induced Seismicity	[1,100]	[1,100]	0	0	2,000	[3,100]
Modernization/Hardening of Infrastructure in Support of Earthquake Analysis	[2,000]	[2,000]	0	0	2,000	[4,000]
Earthquake Hazards Baseline Capacity	[0]	[0]	0	0	1,234	[1,234]
FTE	***268***	***268***	***0***	***0***	***21***	***289***

2023 Program Changes

The 2023 budget request for the Earthquake Hazards Program is $99,920,000 and 289 FTE, a program change of $12,734,000 and 21 FTE above the 2022 CR Annual Rate level, and +$1,783,000 in fixed costs.

Subduction Zone Science (+$7,500,000 / +11 FTE) – The proposed increase includes funding requested that would improve the understanding of risks posed to vulnerable communities in subduction zone environments and deliver scientific information and tools for disaster risk reduction. The additional funding) will also broaden these efforts while launching a virtual subduction zone hazards research center.

The USGS would accelerate the implementation of the USGS Subduction Zone Science Plan, *Reducing Risk Where Tectonic Plates Collide* (USGS Circular 1428) (https://pubs.usgs.gov/circ/1428/cir1428.pdf), in FY 2022 and FY 2023. This plan describes work necessary to support targeted multi-hazards subduction zone science investment across USGS Mission Areas and Programs. Subduction zones, where one tectonic plate is thrust over another, generate the world's largest earthquakes, volcanic eruptions, landslides, and tsunamis. Subduction zones generate hazards onshore and offshore in the Pacific Northwest (Cascadia subduction zone), southern Alaska (Alaska-Aleutians subduction zone), the Caribbean, and Pacific Island Territories, and tsunami hazards extend to Hawaii, California, and East Coast States. Subduction zones remain poorly understood because the processes that drive the hazard lie offshore. Future disastrous events in these regions are inevitable and require investment in subduction zone science that will inform decisions at all levels of society.

The USGS would improve the understanding of risks posed to vulnerable communities in subduction zone environments and deliver scientific information and tools for disaster risk reduction. Requested funding in FY 2022 would support targeted efforts, including seafloor geodetic monitoring and lake paleoseismology, (research at sites along sections of a fault to estimate the timeline of earthquakes at each location in the

past) aimed at improving our ability to detect the build-up of stresses leading to future earthquakes, and our understanding of past subduction zone events. These efforts would continue into FY 2023. In FY 2023, funding would also be used to plan for and launch a virtual subduction zone hazards research center (similar in concept to the USGS- and NSF-funded Southern California Earthquake Center). This center and associated efforts would focus on hazard and risk reduction, conducting research on subduction zone processes, and improving onshore monitoring of major subduction zone hazards, while exploring and investing in new technologies for monitoring and performing research in offshore environments. Efforts would target minimizing community vulnerability, including underserved communities, via the delivery of data and products that improve our understanding of hazard and risk, and make emergency response and recovery activities more effective, which would ultimately help citizens prepare for, react to, and recover from subduction zone hazards.

Induced Seismicity (+$2,000,000 / +6 FTE) – The Induced Seismicity Project would be expanded to assess increased seismic hazard (earthquakes) associated with clean energy, including geothermal energy and carbon sequestration. Work undertaken as part of this effort includes significant expansion of current induced seismicity projects, which are mostly focused on the impacts of oil and gas production. New research would focus on the effects of geothermal production and injection (including Enhanced Geothermal Systems) and carbon sequestration on induced earthquakes and Earth surface changes, and involves partnerships with the Department of Energy, State geological surveys, and universities. Funding would also support development of continuously refined hazard maps associated with induced seismicity, which will evolve with time as new clean energy facilities are developed, operated, and monitored over the long term. This project would complement a request of $3,500,000 included in the Energy Resources Program for **"**Geophysical Data Acquisition in Areas with Potential for Geologic Carbon Sequestration". The proposed increase includes funding requested in FY 2022 President's Budget Request (+$2,000,000).

Modernization/Hardening of IT Infrastructure in Support of Earthquake Analysis (+$2,000,000/ +4 FTE) – The USGS would modernize and harden IT infrastructure to ensure robust delivery of enhanced multi-hazards products such as ShakeMap and PAGER to decision makers, emergency managers, and the general public for risk mitigation, disaster planning, and situational awareness following major disasters. The USGS provides critical and rapid information to decision makers through some of the most heavily trafficked Web pages in the Federal government. This funding would ensure national interests are supported by a robust, modern, cloud-based infrastructure.

Work undertaken would focus on cloud-based infrastructure supporting data delivery and use of artificial intelligence and machine learning for earthquake detection. Currently, highly complex computational systems which manage data flow, processing, and product delivery, are being reconfigured around a cloud-based operational environment. This requested funding will accelerate these system reconfiguration efforts. Additionally, this requested funding will allow work to begin on streamlining national seismic monitoring systems to keep pace with modern research and innovation, including further incorporation of artificial intelligence and machine learning capabilities into earthquake detection, characterization, and alerting capacities. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$2,000,000).

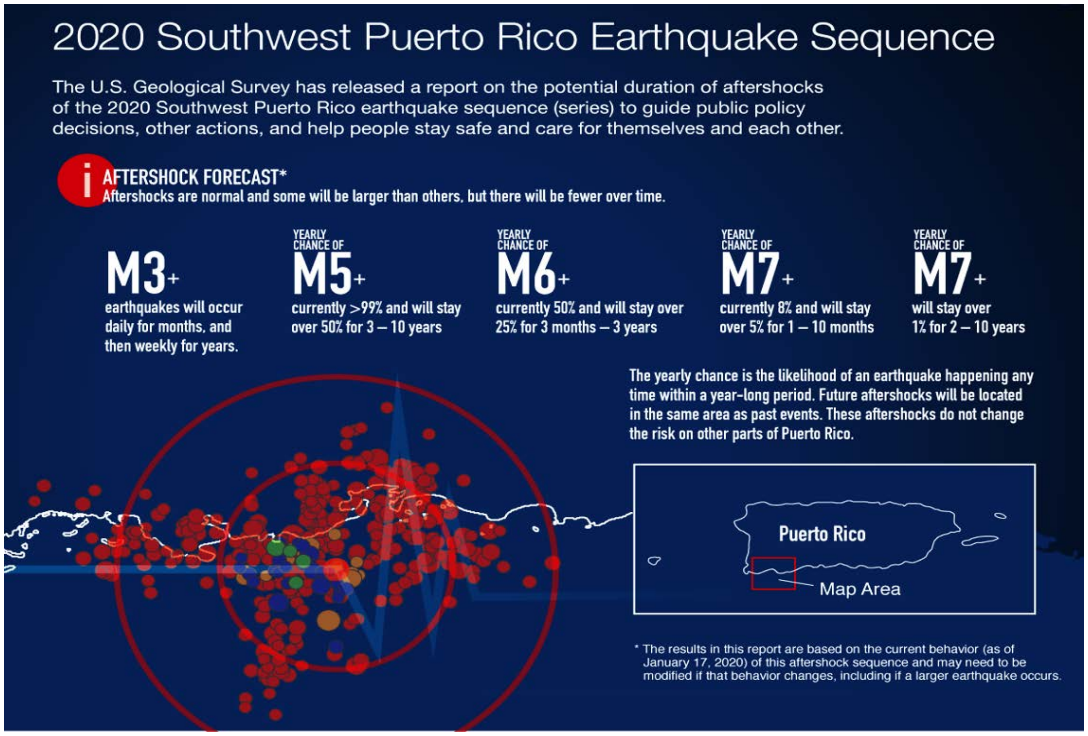
Baseline Capacity (+$1,234,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements

needed to continue to fulfill the USGS mission. The budget includes $1.2 million in the Earthquake Hazards Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

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



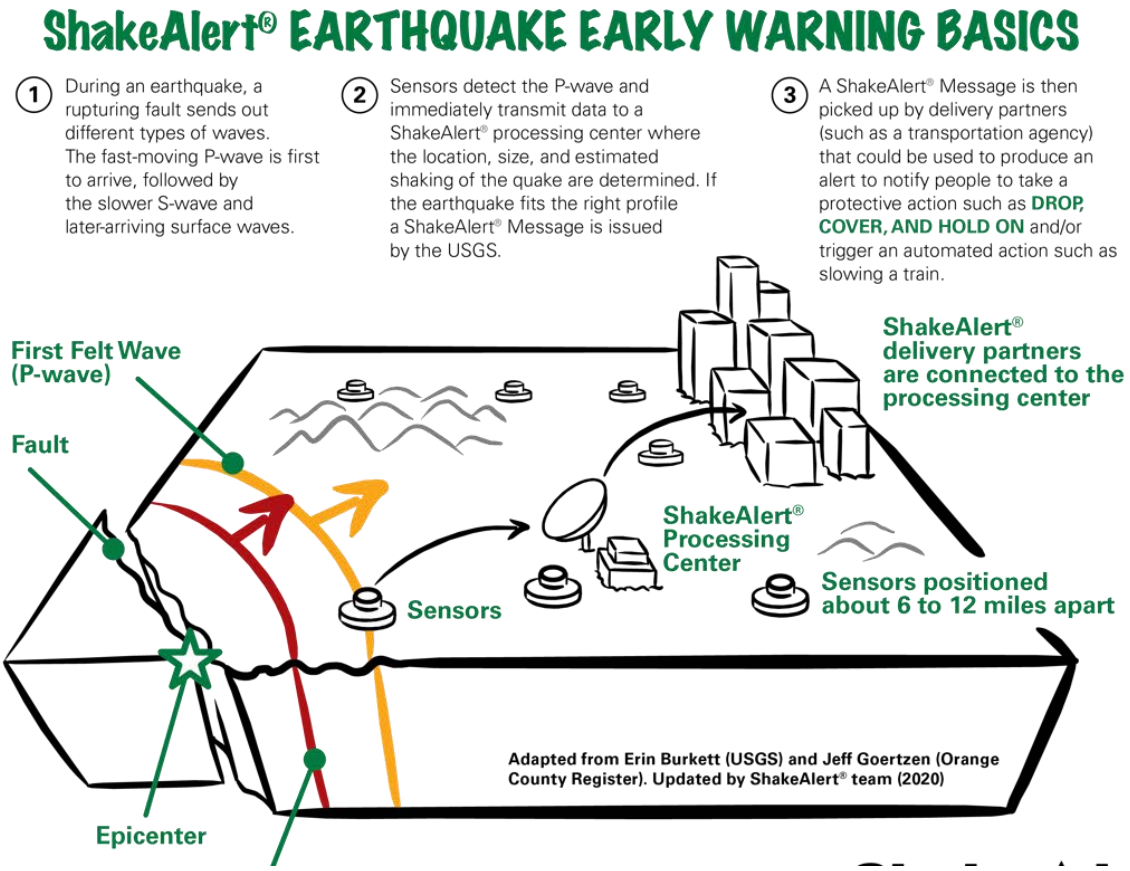
earthquake losses in the United States. To effect loss reduction, the EHP supports a highly coordinated set of monitoring, hazards assessment, applied research, and risk translation and communication activities in at-risk regions nationwide. Through the National Earthquake Information Center (NEIC), the USGS is the only U.S. agency that continuously reports on current domestic and worldwide earthquake activity. Through

The USGS has released Open-File Report 2020-1009 (release date 1/29/2020) describing the potential duration of aftershocks of the 2020 Southwest Puerto Rico earthquake sequence to guide public policy decisions, and other actions. Source: USGS.

the Advanced National Seismic System (ANSS), the USGS and its State and university partners monitor and report on earthquakes nationwide. *ShakeAlert*, a west coast earthquake early warning system built upon ANSS, offers new capabilities for seconds of advanced warning to people and systems ahead of earthquake shaking. Through the USGS National Seismic Hazard Model, 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 also issues timely aftershock forecasts following potentially damaging earthquakes within the United States and its Territories and provides aftershock forecasts following significant global earthquakes when called upon by other Federal agencies or international partners.

The USGS will continue, in cooperation with States and other partners, to finalize build out, operate, and maintain the *ShakeAlert* Earthquake Early Warning system based on the Technical Implementation Plan for the west coast, which was revised in 2018 (https://pubs.er.usgs.gov/publication/ofr20181155).

The EHP provides universities, State geological surveys, and private institutions with earthquake hazards applied research grants and cooperative agreements. Last year, more than 40 entities have been the recipients of approximately $28 million of funding and equipment that supports earthquake research in



The graphic above describes the basics of how the *ShakeAlert* earthquake early warning system operates during an earthquake. Source: USGS.

high-risk areas nationwide, contributes to the maintenance and operation of the ANSS, and supports the *ShakeAlert* west coast earthquake early warning system.

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Natural Hazards
Volcano Hazards Program

Natural Hazards $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Volcano Hazards Program	**30,266**	**30,266**	**968**	**0**	**3,266**	**34,500**
Next Generation Volcanic Hazard Assessments	[520]	[520]	0	0	1,000	[1,520]
National Volcano Early Warning System: National Volcano Data Center Improvements	[300]	[300]	0	0	1,500	[1,800]
Volcano Hazards Baseline Capacity	[0]	[0]	0	0	766	[766]
FTE	***148***	***148***	***0***	***0***	***9***	***157***

2023 Program Changes

The 2023 budget request for the Volcano Hazards Program is $34,500,000 and 157 FTE, a program change of $3,266,000 and 9 FTE above the 2022 CR Annual Rate level, and +$968,000 in fixed costs.

Next Generation Volcanic Hazard Assessments (+$1,000,000 / +6 FTE) – The USGS would accelerate work already begun and would improve the characterization of two active volcanic systems that are current or potential geothermal resources and that pose potential threats to surrounding communities: Clear Lake Volcanic Field and Sonoma Volcanic Field in California; and Makushin Volcano, Alaska. Both of these volcanoes lie under heavily travelled air traffic routes; therefore, the Federal Aviation Administration and the National Weather Service Volcanic Ash Advisory Centers, and the Department of Defense (particularly the U.S. Air Force 557th Weather Wing) would also benefit from these assessments.

Makushin has been targeted for geothermal exploration since 1981, and the location is currently being planned for clean energy development. The volcano is also near Dutch Harbor, Alaska, one of the world's busiest fishing ports. Clear Lake Volcanic Field is home to the Geysers Geothermal Field that generates 22 percent of California's renewable power. The project would generate data to aid in constructing accurate eruption histories and characterization of the internal structures beneath the volcanic centers. This work is important to address volcanic hazards for optimal siting of critical energy infrastructure or protecting other existing critical infrastructure. Hazard assessments are delivered to end users as a portfolio of products that delineate hazard zones as well as ash fall. These assessments identify the vulnerability of nearby populations and critical infrastructure to volcano hazards. The next generation volcanic hazard assessments delivered at the end of five years would ensure that all volcanic hazards and their respective impact zones

are clearly delineated; critical geothermal infrastructure is adequately protected with a monitoring network; and potential geothermal development is sited out of high hazard zones. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$1,000,000).

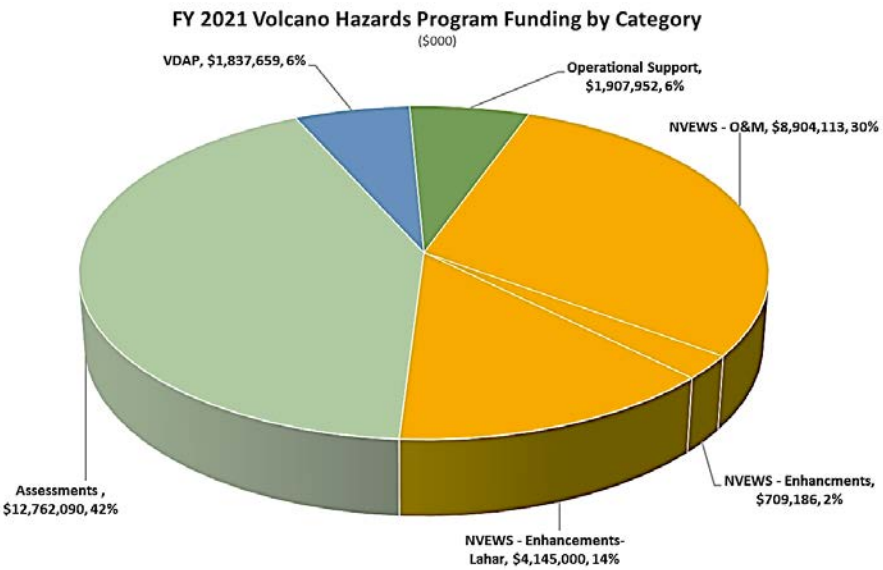
National Volcano Early Warning System: National Volcano Data Center Improvements +($1,500,000 / +3 FTE) – A National Volcano Data Center (NVDC) is a key component of the National Volcano Early Warning System (NVEWS). The investment in the NVDC would build a modern and scalable cloud-based processing, analysis, and storage capability. These capabilities would create a fully functioning NVDC with a capacity to accommodate anticipated growth of volcano monitoring data over the next 5-10 years. The USGS would establish the NVDC component called for in Public Law 116-9 that authorized the establishment of the NVEWS. The NVDC is critical to merging the U.S. volcano observatories into an integrated, interoperable system. The majority of the work would be done at the Volcano Science Center in Anchorage, AK, but would also involve the four other volcano observatories. USGS volcano observatories will need an easily accessible and cloud-hosted capability to analyze, store, and disseminate real time and near real time data from multiple types of ground sensors in addition to satellite based remote sensing imagery. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$1,500,000).

Baseline Capacity (+$766,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $766,000 in the Volcano Hazards Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities

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 so that the USGS can issue timely warnings of potential volcanic hazards to emergency management professionals and the public. In addition to collecting and interpreting 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 emergency responders, land managers and the public to take appropriate actions to mitigate the risk to life and property. The VHP has evaluated all the Nation's volcanoes to determine the monitoring levels needed commensurate with the threat they pose. This national threat level assessment was first completed

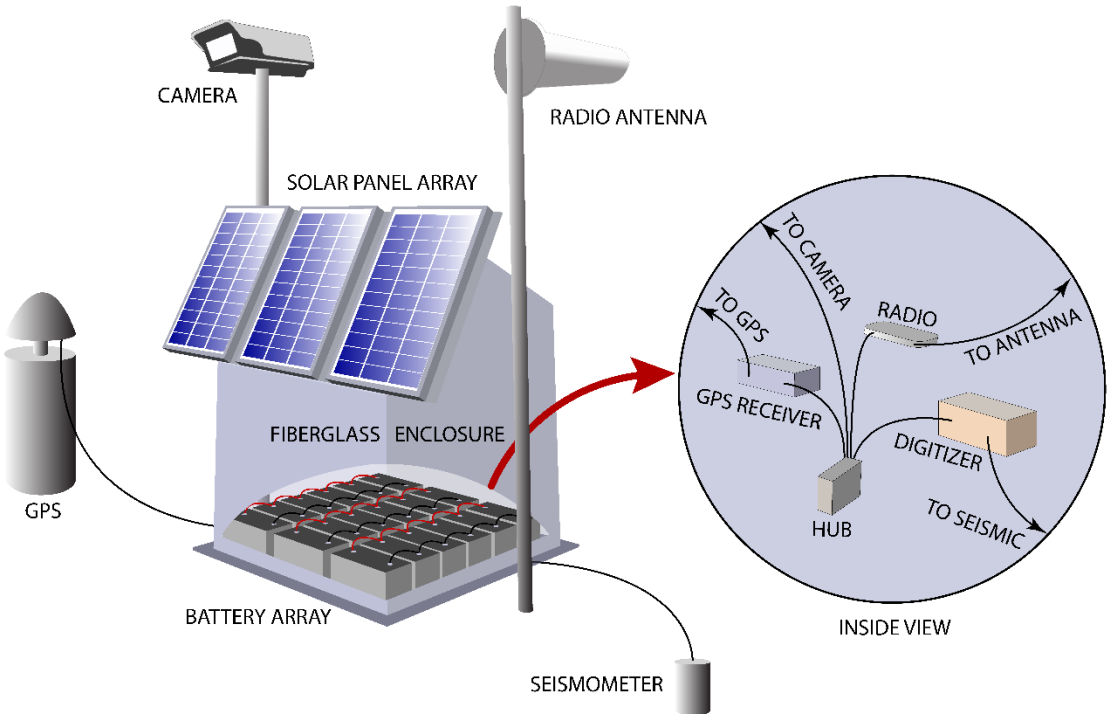
in 2005 and was updated in 2018, based on new data. In 2019, a bill authorizing the USGS to establish a National Volcano Early Warning System (NVEWS) (Pub. L. 116-9, title V, §5001) was signed into law.



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

Each observatory is responsible for volcano monitoring, community preparedness (including development and regular practice of volcano hazard emergency response plans), managing volcanic crises, and coordinating research in their areas of responsibility.



In Alaska, USGS is in the process of completing an effort to convert volcano monitoring stations from analog stations to digital stations. Conversion of analog radio telemetered monitoring stations is essential for NVEWS expansion because only stations with digital telemetry will have sufficient bandwidth to transmit data from additional ground-based sensor types. Conversion to all digital telemetry will allow for NVEWS expansion of networks and augmenting what were previously largely seismic-only monitoring stations. Source: USGS.

Natural Hazards
Landslide Hazards Program

Natural Hazards $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Landslide Hazards Program	**8,038**	**8,038**	**253**	**0**	**3,141**	**11,432**
Actionable Landslide Hazard Data and Science	[0]	[0]	0	0	3,000	[3,000]
Landslide Hazards Baseline Capacity	[0]	[0]	0	0	141	[141]
FTE	***35***	***35***	***0***	***0***	***6***	***41***

2023 Program Changes

The 2023 budget request for the Landslide Hazards Program is $11,432,000 and 41 FTE, a program change of $3,141,000 and 6 FTE above the 2022 CR Annual Rate level, and +$253,000 in fixed costs.

Actionable Landslide Hazard Data and Science (+$3,000,000 / +6 FTE) – Increasing wildfire severity and extent (megafires), along with growing population and changing land-use and land cover, increase the risk from post-fire debris flows and flooding. Shifting precipitation patterns also drive consequent changes in landslide frequency and distribution. The USGS would develop and deliver actionable landslide hazard and risk modeling for vulnerable populations and high-risk settings with an emphasis on areas recently burned by wildfire. The request would build on advances in landslide hazard assessment and data collection funded through recent appropriations, including supplemental appropriations. Data collection and research efforts would be targeted toward reducing uncertainty in hazard and risk forecasts over timescales ranging from weeks to decades. The USGS would also begin meeting requirements set out in Public Law 116-323 (National Landslide Preparedness Act) to develop and maintain Federal capacity to deploy scientists and assets to assist emergency response to landslide events.

A sustained increase in capacity to deliver enhanced landslide hazard and risk assessments, and to provide situational awareness and technical assistance to emergency response would support Interior, the U.S. Forest Service, the Federal Emergency Management Agency, State geological surveys, and State and emergency management. Work would be conducted in partnership with technical expertise from State, academic, and private sectors and data and products would benefit land and emergency managers at all levels as well as the general public across the western United States and other States and Territories with landslide risk. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$3,000,000).

Baseline Capacity (+$141,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These

investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $141,000 in the Landslide Hazards Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

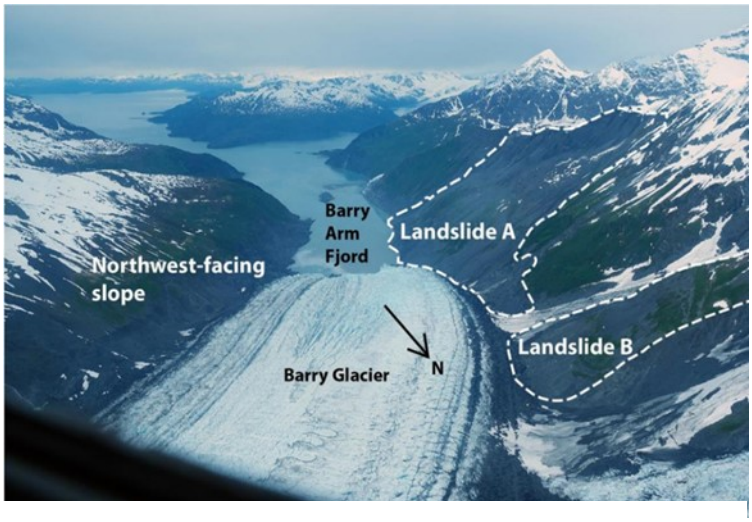
Program Overview

Landslides occur in all 50 States and many Territories, and where landslides impact human activities, lives may be lost and property and infrastructure damaged. Widespread landslides can accompany big storms or earthquakes, impacting broad areas and hindering rescue and recovery efforts. In 2017, Hurricane Maria generated more than 70,000 landslides across Puerto Rico, impacting transportation and other lifelines, hampering response, recovery, and rebuilding.

Interstate 70 closed by debris flows on July 27, 2021. Highway was closed multiple times this summer forcing 100-mile detour. Source: Glenwood Springs Fire Department.

The USGS Landslide Hazards Program (LHP) is the only Federal program dedicated to landslide hazard science and conducts targeted studies to understand landslide initiation and mobility processes. This understanding is used to (1) develop methods and models for landslide hazard assessment, (2) develop and deploy systems to monitor threatening landslides, and (3) to 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 USGS assists Federal, State, and local agencies through landslide site evaluations and provides strategies for reducing ongoing and future impacts from landslides. The LHP 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.

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, land, and transportation managers for many burned areas in the western U.S., including the 2020 Grizzly Creek Fire in central Colorado, and the 2021 Dixie and North Complex Fires in the central Sierra Nevada of California. The Landslide Program and National Weather Service will continue to build on recent scientific advances to expand the project to other parts of California and the western U.S. to meet the intent of the National Landslide Preparedness Act. The LHP is also leading efforts with Federal and State partners, to collect data and conduct analyses to assess the hazard from landslides with the potential to generate tsunami in Prince William Sound, AK. The LHP is surveilling landslide movement of the unstable slopes at the terminus of the Barry Glacier using satellite radar and other methods to inform the National Tsunami Warning Center and land and emergency managers of potential hazards.



The USGS is working with Federal and State partners to assess the risk of a catastrophic landslide and tsunami at the terminus of a retreating glacier in Prince William Sound, Alaska. This photo shows the Barry Arm Fjord of Prince William Sound, the area of potential landslides outlined, and the retreating Barry glacier in the middle foreground. Photo taken by Gabe Wolken, June 2020 Source: Public domain.

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Natural Hazards
Global Seismographic Network

Natural Hazards $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Global Seismographic Network Program	**7,153**	**7,153**	**68**	**0**	**59**	**7,280**
GSN Baseline Capacity	[0]	[0]	0	0	59	[59]
FTE	***11***	***11***	***0***	***0***	***0***	***11***

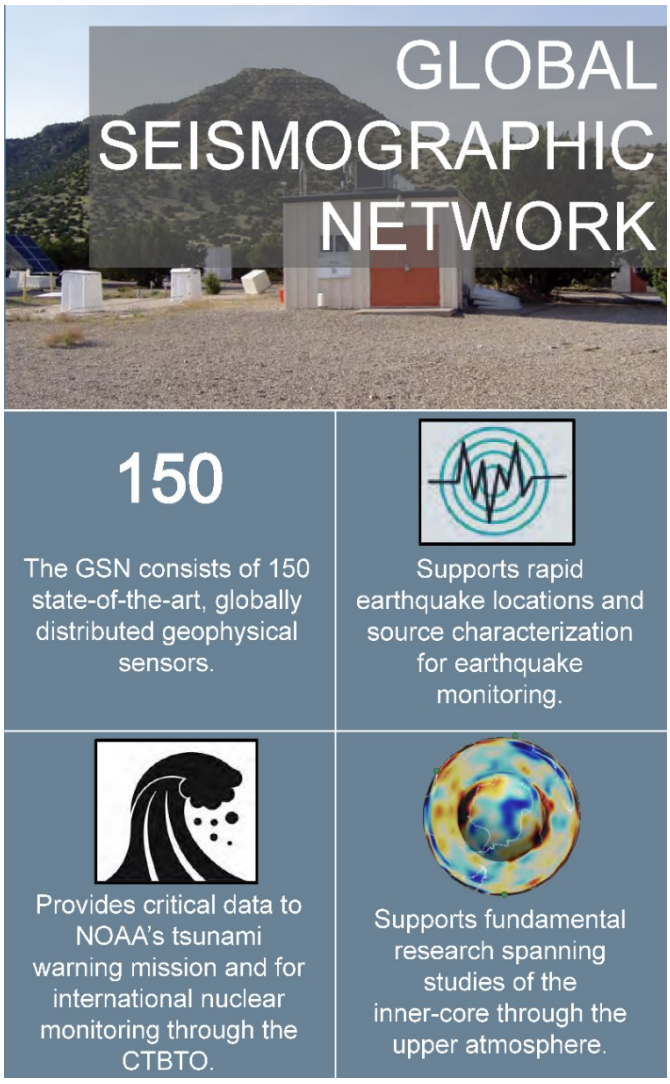
2023 Program Changes

The 2023 budget request for the Global Seismographic Network is $7,280,000 and 11 FTE, with a program change of +$59,000 above the 2022 CR Annual Rate level, no change in FTE, and +$68,000 in fixed costs.

Baseline Capacity (+$59,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $59,000 in the Global Seismographic Network which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Global Seismographic Network (GSN) consists of more than 150 globally distributed stations, 100 of which are operated by the USGS. The GSN is a partnership between the USGS and the National Science Foundation (NSF) and is implemented in partnership with the Incorporated Research Institutions for Seismology (IRIS) university consortium and many other entities. It provides the high-quality seismic data needed for global 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.

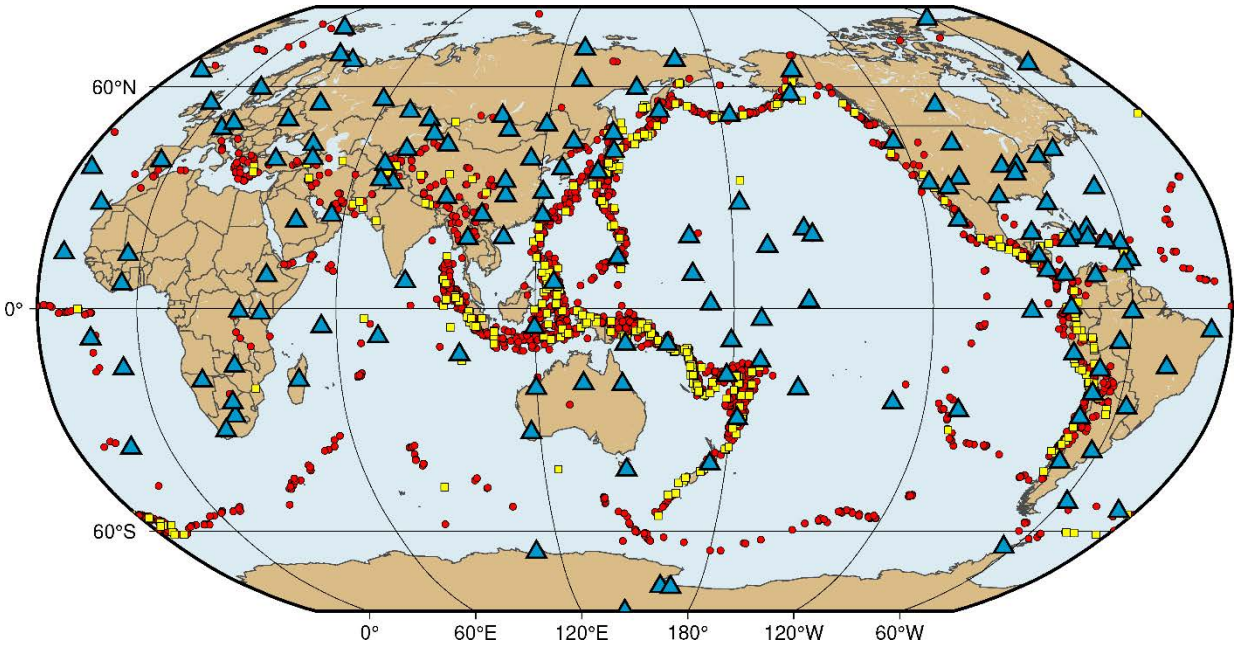


The graphic above describes the role of the Global Seismic Network (GSN). Source: USGS.

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 tsunami warning; NSF basic research; and the Department of Energy and the Department of Defense 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.

GSN operation is accomplished in cooperation with international partners who, in most cases, provide facilities to shelter the instruments and personnel to oversee the security and operation of each station. USGS responsibilities include station maintenance and upgrades, overseeing telecommunications, troubleshooting problems and providing major repairs, conducting routine service visits, training station

operators, providing limited financial aid in support of station operations at sites lacking a host organization, and ensuring data quality and completeness.



GSN stations (triangles) are shown against a backdrop of large earthquakes from 2000 to 2021 (red circles – magnitude 6-6.9, yellow squares – magnitude 7 and larger earthquakes). Source: USGS

In order to continue to receive high-quality seismic data needed, the USGS and the Incorporated Research Institutions for Seismology have recently installed new high-quality Very Broadband (VBB) seismic sensors and have been improving the physical infrastructure of select GSN sites.

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Natural Hazards
Geomagnetism Program

Natural Hazards $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Geomagnetism Program	**4,114**	**4,114**	**87**	**0**	**1,559**	**5,760**
Expansion of Magnetometer Observatories	[2,388]	[2,388]	0	0	1,500	[3,888]
Geomagnetism Baseline Capacity	[0]	[0]	0	0	59	[59]
FTE	***12***	***12***	***0***	***0***	***2***	***14***

2023 Program Changes

The 2023 budget request for the Geomagnetism Program is $5,760,000 and 14 FTE, with a program change of +$1,559,000 and +2 FTE above the 2022 CR Annual Rate level, and +$87,000 in fixed costs.

Expansion of Magnetometer Observatories (+$1,500,000 / +2 FTE) - The USGS would enhance monitoring and evaluation of space-weather hazards via a significant expansion of operational ground-based magnetometer stations. In coordination with the NOAA Space Weather Prediction Center, this expansion would enable delivery of accurate geoelectric hazard maps by reducing uncertainties that are primarily associated with the limited number of current observatories. This expansion is necessary for national electric grid resilience and is responsive to the interagency Space Weather Action Plan, which calls for an enhanced geomagnetic monitoring network that will deliver data to operational centers in real time. The Space Weather Action Plan is being executed by the Space Weather Operations, Research, and Mitigation Interagency Working Group, involving Interior, Department of Energy (DOE), Department of Commerce, Department of Defense (DOD), Department of Homeland Security, Department of Justice, Department of State, and Department of Transportation. Funding will begin the addition of the first of three planned new permanent observatory sites, adding to the six existing sites within the conterminous United States (CONUS), and will facilitate beginning the addition of roughly a dozen new low-cost variometer stations. As the three new observatories are completed, they will be targeted to cover regions of high hazard and fill in the geographic footprint of the current observatory network. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$1,500,000).

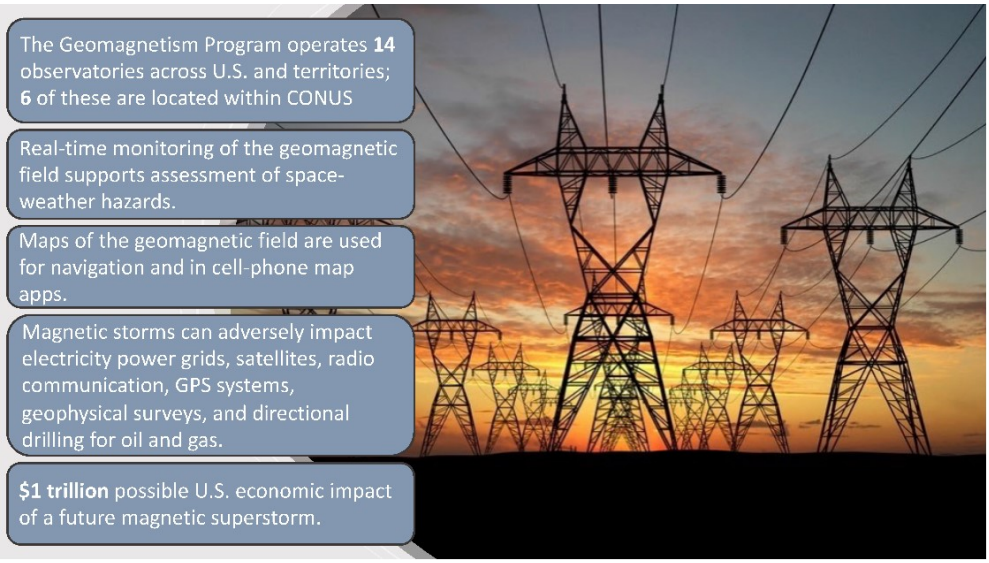
Baseline Capacity (+$59,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $59,000 in the Geomagnetism Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations

in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Geomagnetism Program provides data and information on short-term and long-term variations in the strength and direction of the Earth's magnetic field, including the intensity of magnetic storms, through operation of a network of geomagnetic observatories and supporting research, and analyzes related geomagnetic hazards that threaten the economy and national security. 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.

The Geomagnetism Program is part of the U.S. National Space Weather Program (NSWP), an interagency collaboration that includes NASA, DOD, NOAA, the National Science Foundation (NSF), and DOE. The Geomagnetism Program provides data to the NSWP agencies, oil drilling services companies, geophysical surveying companies, and several international agencies, including INTERMAGNET, an organization with a worldwide membership drawn from institutes operating geomagnetic observatories who coordinate geomagnetic monitoring around the world. Data, products, and services from the USGS are also used by the electric-power industry to evaluate geomagnetic storm risk.



The graphic above describes the role of the Geomagnetism Program. Source: USGS.

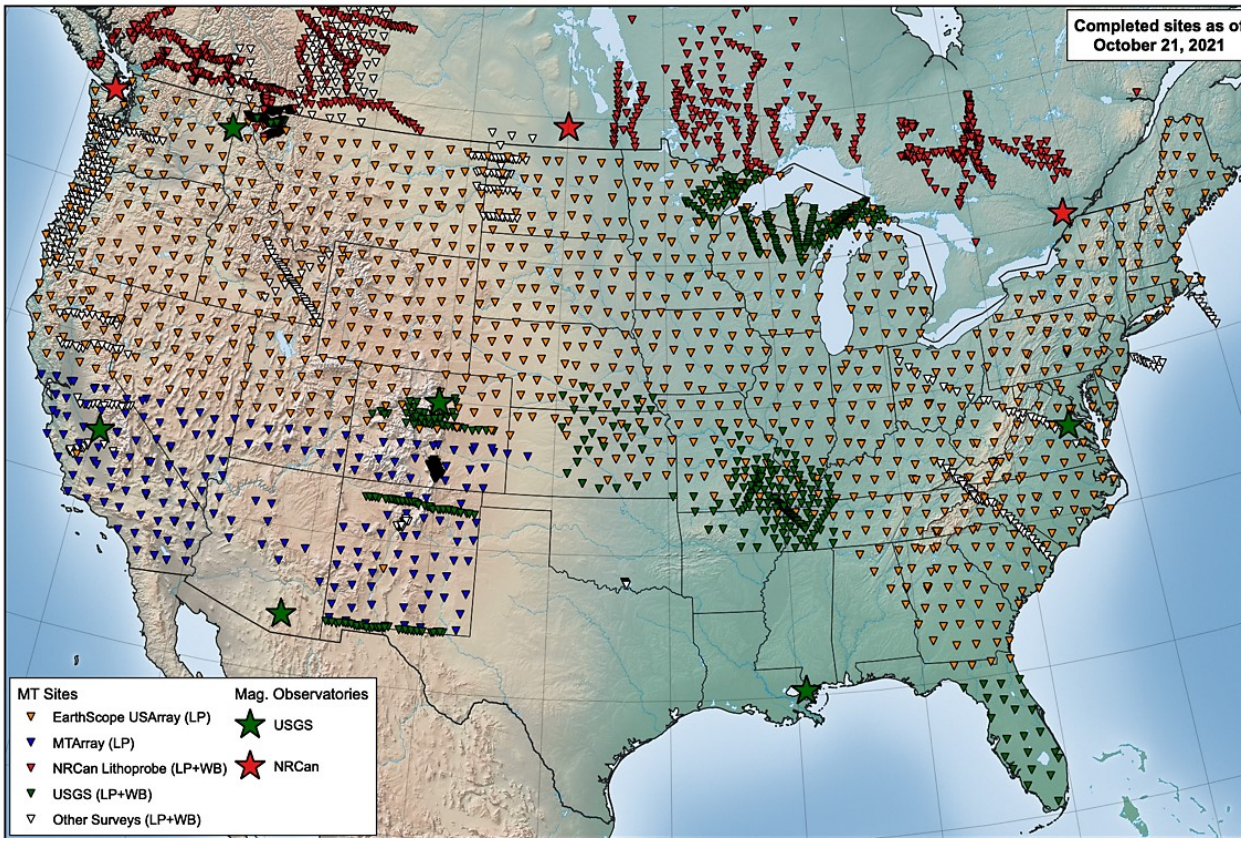
Domestically, the USGS continues to operate 14 geomagnetic observatories (six within CONUS), delivering data and working cooperatively with the NOAA Space Weather Prediction Center (SWPC), the U.S. Air Force 557th Weather Wing, and numerous other customers and Federal agencies. For example, USGS observatory data are used by NOAA's SWPC, and by the U.S. Air Force, for issuing geomagnetic warnings and forecasts. USGS geomagnetism research is conducted in collaboration with the Colorado School of Mines, the USGS Crustal Geophysics and Geochemistry Science Center, the NOAA SWPC, and the NASA Community Coordinated Modeling Center.

Global USGS Magnetic Observatory locations. Source: USGS

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 works with NOAA SWPC to produce hazard maps of the induced electric field in the crust due to geomagnetic storms. This work is part of a National Science and Technology Council's interagency working group for coordinating Space Weather Operations Research and Mitigation (SWORM). These results, now incorporated into a real time product, 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.

The Geomagnetism Program will continue the magnetotelluric (MT) survey of the United States to improve U.S. electrical grid resilience, improve forecast models for geomagnetic storms, and aid in mineral resource



The USGS Geomagnetism Program awarded a Cooperative Agreement with Oregon State University (OSU) on April 1, 2020 for the first two years of a project to survey a large, contiguous sector of the southern conterminous U.S. Once finished, this project will complete the MT survey across the contiguous United States. The upper two thirds of the CONUS MT Survey were completed through the NSF-funded IRIS Earthscope project from 2006-2018. Source: USGS

assessments. Collection of MT data on a national scale is a basis for modeling the Earth's electric field, 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 the NSF.

Natural Hazards
Coastal/Marine Hazards and Resources Program

Natural Hazards $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Coastal/Marine Hazards and Resources Program	**40,510**	**40,510**	**1,420**	**0**	**19,005**	**60,935**
Risk Reduction and Community Resilience	[800]	[800]	0	0	4,000	[4,800]
Modeling and Forecasting Coastal Hazards	[10,674]	[10,674]	0	0	10,000	[20,674]
Coastal Blue Carbon	[1,000]	[1,000]	0	0	4,000	[5,000]
Coastal/Marine Hazards and Resources Baseline Capacity	[0]	[0]	0	0	1,005	[1,005]
FTE	***220***	***220***	***0***	***0***	***33***	***253***

2023 Program Changes

The 2023 budget request for the Coastal/Marine Hazards and Resources Program (CMHRP) is $60,935,000 and 253 FTE, a program change of +$19,005,000 and +33 FTE above the 2022 CR Annual Rate level, and +$1,420,000 in fixed costs.

Risk Reduction and Community Resilience (FY 2023 Request: +$4,000,000 / +10 FTE) – The proposed increase, which includes funding requested in FY 2022 (+$2,000,000 / +5 FTE), would strengthen staff capabilities in the areas of risk reduction and community resilience, including support for underserved communities, as well as establish an internship program to advance that effort. The additional funding requested in FY 2023 (+$2,000,000 / +5 FTE) builds on capabilities developed in FY 2022 to enable increased support for advancing stakeholder communication, coordination, and engagement in the areas of risk reduction and community resilience.

In FY 2022, this proposed increase would strengthen critical personnel capacities in social science, equity, risk communication, and monitoring and evaluation. The new personnel would support USGS scientists in strategically identifying stakeholders, building partner coalitions, facilitating stakeholder meetings, and collaborating with underserved communities. In addition, at the requested level, a Hazards, Risk, and Social Equity Internship Program would be established for undergraduate and graduate students. This program

will focus on developing USGS hazard research and applications to meet the needs of underserved communities.

In FY 2023, building on capabilities strengthened in FY 2022, the proposed increase would provide support for advancing stakeholder engagement through participatory research and coalition building; developing hazard scenarios; and establishing partnerships for reducing risk in underserved communities with the goal of increasing long-term coordination, communication, and engagement. Efforts will include needs assessments, co-developing risk reduction and risk communication products, and language translation to ensure that science is accessible, relevant, and actionable for a diverse set of stakeholders.

Modeling and Forecasting Coastal Hazards (+$10,000,000 / +15 FTE) – The USGS would accelerate implementation of a national coastal change hazards strategy to develop and deliver understanding, modeling and forecasting of the coastal response to climate change, natural processes, and management actions across diverse landscapes and communities. Models of the response of natural landscapes, resources, and infrastructure to coastal inundation and erosion from future storms and sea-level rise would enable coastal land and resource managers to evaluate the sustained benefits of alternative adaptation and restoration strategies in increasing resilience and reducing risk. This would enable co-development of science and applications to meet site- and decision-specific requirements of resource managers (i.e., U.S. Fish and Wildlife Service and National Park Service), installation operators (i.e., Department of Defense), and designers and developers of nature-based solutions (i.e., U.S. Army Corps of Engineers, States) to reduce risk, enhance resilience, and pursue adaptation strategies in a variety of coastal settings. The USGS would also support development and application of observational (land cover/elevation characterization and change) and modeling capacities required to deliver actionable forecasts at regional and national scales. Furthermore, the USGS would increase the technical and operational capacities required to sustain rapid translation of new knowledge and methods to application by diverse users. The USGS would implement a strategy for multidisciplinary risk science and applications related to coastal change, including capacities to effectively engage stakeholders in coastal change hazards product design and evaluation. As a result of these investments, coastal resource and emergency managers would have the ability to anticipate the consequences of climate change, future storms, and coastal policies and projects on public safety, infrastructure performance, and community and ecosystem health and resilience. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$10,000,000).

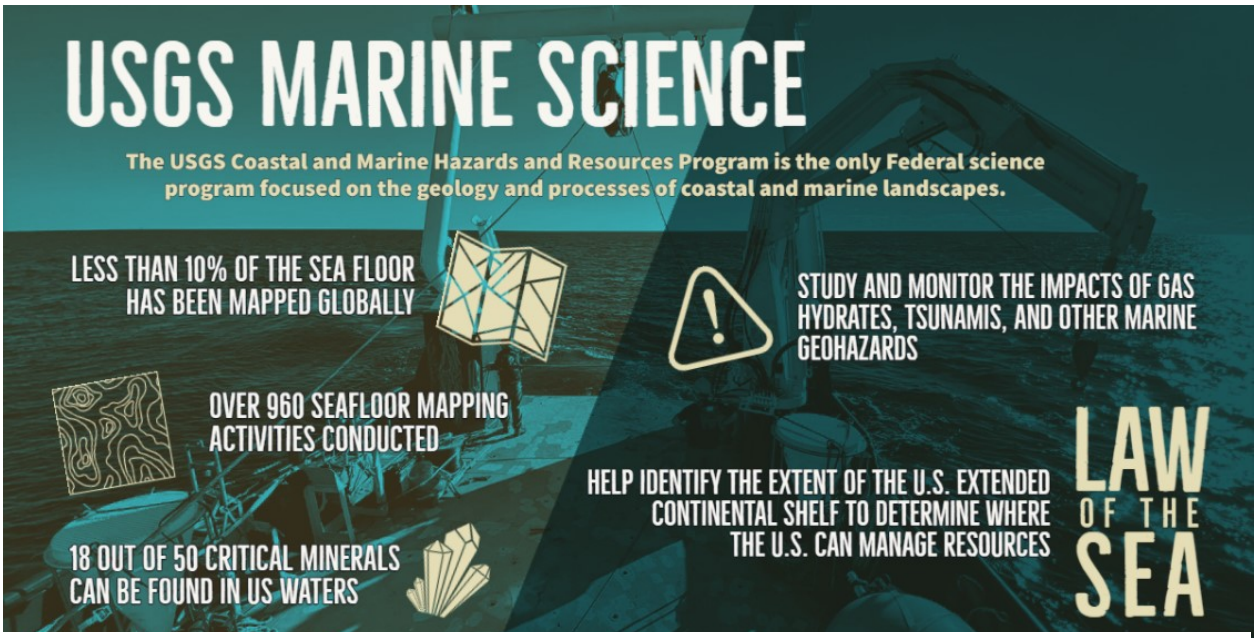
Coastal Blue Carbon (+$4,000,000 / +8 FTE) – Coastal marshes and wetland sediments are a natural sink for atmospheric carbon, with the rates of carbon capture dependent on the extent, health, and expansion of the marsh complex. The USGS would increase national and local scale evaluations of carbon sequestration potential in coastal salt marsh, mangrove, and associated environments. This includes field observations, development of new models leading to improved assessments and forecasts, and geospatial products to support decisions and policy within land management agencies. The USGS would quantify the consequences of management decisions in terms of enhanced carbon sequestration and reduced wetland methane emissions and integrate emissions benefits into tools to forecast the trajectories of natural, managed, and restored wetlands. This will allow marsh restoration and management decisions to include evaluation of carbon capture and emission reduction values in the prioritization and planning of coastal ecosystem protection and restoration projects. With an initial focus on the almost 1.2 million acres of

wetlands and impoundments in FWS refuges, and the approximately 3.2 million acres of wetlands managed by the NPS; the USGS and partners would develop and deliver tools that enable stakeholders to quantify and compare long-term benefits of alternative management strategies in terms of varied restoration, conservation, and risk reduction objectives, including reductions in greenhouse gas emissions. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$4,000,000).

Baseline Capacity (+$1,005,000 / 0 FTE) - The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $1.0 million in the Coastal/Marine Hazards and Resources Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

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.

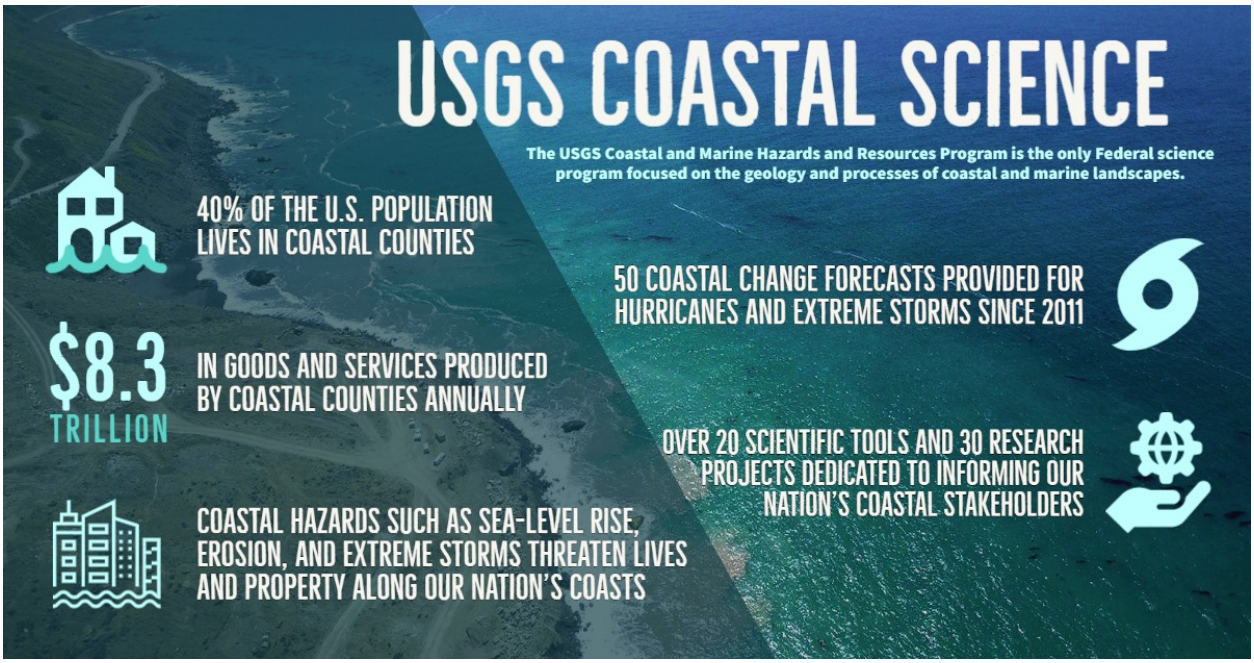


The graphic above describes the role of the Coastal/Marine Hazards and Resources Program as it relates to marine science. Program. Source: USGS.

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. The CMHRP characterizes marine methane systems and associated seabed processes to enhance understanding of their role in the global carbon system and marine ecological productivity and biodiversity; the risk they represent to offshore operations and infrastructure, including that associated with renewable energy; and their domestic and international potential as an energy resource.

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 establishes 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 graphic above describes the role of the Coastal/Marine Hazards and Resources Program as it relates to the science of coastal hazards and change. Program. Source: 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 and climate change. 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 climate and coastal change on communities, infrastructure, and resources.

Water Resources

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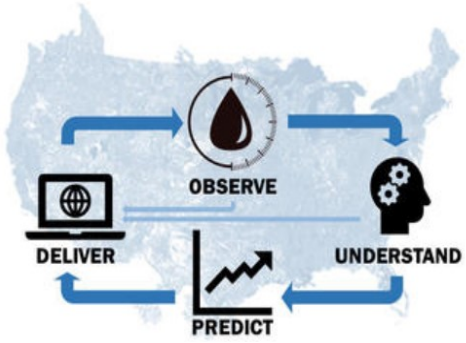
Water Resources

Water Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal transfers	2023 Program Changes	2023 Request
Water Availability and Use Science Program	**57,987**	**57,987**	**1,432**	**0**	**13,014**	**72,433**
FTE	***298***	***298***	***0***	***0***	***77***	***375***
Groundwater and Streamflow Information Program	**100,673**	**100,673**	**2,384**	**0**	**13,978**	**117,035**
FTE	***470***	***470***	***0***	***0***	***43***	***513***
National Water Quality Program	**93,460**	**93,460**	**2,031**	**0**	**2,782**	**98,273**
FTE	***430***	***430***	***0***	***0***	***7***	***437***
Water Resources Research Act Program	**11,000**	**11,000**	**0**	**0**	**4,000**	**15,000**
FTE	***2***	***2***	***0***	***0***	***0***	***2***
Water Resources Total	**263,120**	**263,120**	**5,847**	**0**	**33,774**	**302,741**
FTE	***1,200***	***1,200***	***0***	***0***	***127***	***1,327***

The 2023 budget request for the Water Resources Mission Area is $302,741,000 and 1,327 FTE, an increase of +$33,774,000 in program changes, +$5,847,000 in fixed costs, and +127 FTE from the 2022 CR Annual Rate level.



The above science processes (observe, understand, predict, and deliver) are necessary for acquiring reliable and actionable information about water availability. If one is overlooked, the others are limited. For example, if observing systems are not advanced, understanding is limited as is the ability to build better models for prediction. This is why science integration is critical and why it is a priority at the USGS.

Mission Area Overview

Beginning in 1888 with the National Streamgaging Program on the Rio Grande River under the direction of John Wesley Powell, the USGS has become one of the largest providers of in situ water data in the world. The Water Resources Mission Area (WMA) works with partners to monitor, assess, conduct targeted research, and deliver information on a wide range of water resources and conditions including streamflow, groundwater, water quality, and water use and availability. These activities support an overarching science strategy to observe, understand, predict, and deliver water science to the Nation.

As the Nation moves forward in the 21st Century, the USGS is integrating its water science activities to better address the greatest water resource challenges. In addition to continuing work nationwide, the USGS is working to intensively monitor

and study select Integrated Water Science (IWS) basins. These IWS basins will become focus areas for bringing a complete science capability together through multiple water science efforts including the Next Generation Water Observing System (NGWOS), Integrated Water Prediction (IWP) and Integrated Water Availability Assessments (IWAAs). Three basins have already been selected – the Delaware River Basin (DRB), the Upper Colorado River Basin (UCOL), and the Illinois River Basin (ILRB). The Willamette River Basin was recently selected as the fourth basin and a fifth basin will be selected in FY 2022.

IWS basins are medium-sized watersheds (10,000-20,000 square miles) that represent a wide range of environmental, hydrologic, and landscape settings and human stressors of water resources to improve understanding of water availability across the Nation. In each basin, the USGS will be developing the assessment and predictive methodologies and tools that can be expanded from the basin to the larger surrounding region and ultimately the Nation. The USGS will deploy water science efforts like the NGWOS, IWP, and IWAAs to better understand and predict water challenges. For example, in the DRB, the USGS is studying issues such as the impact of the drought of record under current water supply and demand restrictions. In the UCOL, cold-region processes of snow, ice and frozen soils are some of the priority issues being studied. In the ILRB, the relation between an overabundance of nutrients (primarily nitrogen and phosphorus) and associated harmful algal blooms (HABs) will be a focus of integrated water science efforts. Through integrated activities funded through the four WMA budget programs, the USGS will continue to serve society by providing tools that managers and policymakers can use to manage water resources so they meet both human and environmental needs.

The FY 2023 budget makes targeted investments in these integrated activities. The Water Resources Mission Area will focus on the following science priorities:

- ***Delivering IWAAs.*** These multi-extent, stakeholder-driven assessments support the delivery of the National Water Census (NWC), a near-real time census and prediction of water availability integrating water quantity, quality, and use; indicators of socioeconomic demand; and impacts of climate-related stressors to forecast water availability for human and ecological needs. At the national scale, the USGS will improve predictions of water quantity and quality; enhance models of water use for all 8 categories of use reported by USGS; and work to integrate these components with indicators of socioeconomic demand and impacts of drought and wildfire to forecast water availability at various steps. Regionally, the USGS will continue IWAA activities in the DRB and UCOL, with a focus on an improved understanding of impacts related to drought and wildfire and begin a water-quality focused assessment in the ILRB, in coordination with the NGWOS and IWP.
- ***Advancing USGS water observing systems.*** The USGS will complete 100 percent of the NGWOS initial implementation in ILRB, approximately 25 percent of initial implementation in the Willamette River Basin and will begin planning for NGWOS implementation in a fifth basin (to be selected in FY 2022). In addition, the USGS will continue to operate its National Streamgaging Network in cooperation with over 1,400 partners. As part of the Streamgaging Network, the USGS will support approximately 3,500 locations in the Federal Priority Streamgage Network, which provide long-term, real-time data at locations that serve strategic responsibility of various Federal agencies. The USGS will advance its water observing systems with the construction of a new Hydrologic Instrumentation Facility (HIF) on the University of Alabama campus. The HIF is expected to be completed in FY 2024. Once constructed, USGS HIF functions will be relocated from the current Mississippi location to the University of Alabama. All HIF employees located in Mississippi will be given the opportunity to relocate with their positions.

- ***Building integrated water prediction capabilities.*** The USGS is developing a new water prediction framework that, using advanced science and technology, will integrate state-of-the art climate, weather, water observations, and models to assess and simulate the underlying factors that limit water availability for both human and ecological uses. Using traditional observational networks, as well as targeted NGWOS data collection efforts, the USGS will evaluate and co-design data collection strategies to support model improvement and advance multi-scale modeling capabilities that support delivery of integrated water availability assessments. To ensure models effectively represent ecosystem demands, prediction capacity will be expanded to account for the impacts of hydrologic change on ecosystem vulnerability and resilience, including on culturally significant aquatic species that provide ecosystem services to impoverished and vulnerable communities. Work will be accomplished through collaborations with Federal and local partners and academia.
- ***Modernizing USGS water data infrastructure***. The National Water Information System (NWIS) is the USGS enterprise system supporting the storage, processing, and delivery of real-time and historic water data. To ensure NWIS can manage the data and new data types produced through all WMA activities into the future, integrate water data from multiple agencies and sectors, and continue to deliver data and model results to the public, funding from across the WMA programs is used to support activities to modernize NWIS IT infrastructure and data systems. In 2023, efforts will be focused on completing a new delivery system for groundwater data; transmission, storage and processing of imagery and videos from monitoring stations; automated records processing; and enhancing user-centered data delivery.

Cooperative Matching Funds

Much of WMA work with partners is supported by a unique subset of funds referred to as Cooperative Matching Funds (CMF). Required by law to be matched at least 50:50 by State, local, or Tribal partners, CMF is matched by over 1,600 of these partners to monitor and assess water resources in every State, and U.S. protectorate and territory. CMF are found in three of the four budget programs: Water Availability and Use Science; Groundwater and Streamflow Information; and National Water Quality. The FY 2023 budget requests $64,529,000 for CMF across these three programs, continuing funding at the FY 2022 CR level.

FY 2021 Selected Mission Area Accomplishments

- USGS collected hydrologic data in partnership with over 1,400 Federal, State, Tribal and local agencies at approximately 19,200 groundwater wells and 11,350 streamgages. Water-quality data were also collected at over 2,100 locations. These data are used for varied activities, such as managing flood or water scarcity risk to humans, designing bridges and water-treatment plants, and supporting freshwater biodiversity conservation. USGS data are provided to the public via the National Water Information System: Web Interface. To enhance the delivery of these data, the USGS released its National Water Dashboard (NWD). The NWD provides an intuitive interface for the public to access USGS water data as well as water data from other government agencies (e.g. live weather radar) that will help the public understand the water situation in their area.
- USGS continued IWAAs at both regional and national scales to provide consistent assessments of water available for human and ecological needs. A regional IWAA in the DRB continued evaluation of water quality trends, algal assessment, and groundwater modeling. Similar regional activities in the ILRB and UCOL were initiated that include data and model compilation and integration to efficiently identify water availability trends and additional data needs. Nationally, models, tools, and data collection strategies have been integrated to ingest the refined information

compiled at the regional scale with focus on understanding factors that contribute to priority water availability concerns like harmful algal blooms and the complexity of urban water supply and use.

- The NGWOS continued operation and maintenance of new or reactivated streamgages, water quality monitoring, water temperature sites, meteorological monitoring, water budget monitoring (evapotranspiration, water use, snow monitoring), cameras, and other technologies at fixed and mobile sites in the DRB. The USGS also expanded new monitoring investments into the UCOL and ILRB. The NGWOS provides enhanced monitoring data to support integrated water availability assessments and predictions while also providing an innovation incubator for transitioning new monitoring instrumentation and methods from research to national operations in order to improve the spatial and temporal scales of data.

For additional information about these programs, please see the Program Book on the USGS website (www.usgs.gov).

Water Resources
Water Availability and Use Science Program

Water Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Water Availability and Use Science Program	**57,987**	**57,987**	**1,432**	**0**	**13,014**	**72,433**
Water Use Withdrawal Models	[1,800]	[2,500]	0	0	1,500	[4,000]
Integrated Water Prediction	[9,500]	[9,500]	0	0	4,000	[13,500]
Integrated Water Availability Assessments	[3,725]	[3,979]	0	0	6,000	[9,979]
Water Availability and Use Science Baseline Capacity	[0]	[0]	0	0	1,514	[1,514]
FTE	***298***	***298***	***0***	***0***	***77***	***375***

2023 Program Changes

The 2023 budget request for the Water Availability and Use Science Program is $72,433,000 and 375 FTE, with a program change of +$13,014,000 and +77 FTE above the 2022 CR Annual Rate, and +$1,432,000 in fixed costs.

Water Use Withdrawal Models (+$1,500,000 / +10 FTE) – The USGS has been working to develop models that provide estimates for the eight major categories of water use. By the end of FY 2022, the USGS will have developed operational models for the three primary categories that make up approximately 90 percent of annual water use in the U.S. (public supply, thermoelectric, and irrigation). With additional funds in 2023, the USGS would further refine these primary models using methods such as artificial intelligence and machine learning to drive predictions of water use based on changes in climate, land use, and populations. In addition, the USGS would accelerate the development of models for the remaining five water use categories (industrial, domestic self-supplied, mining, aquaculture, livestock). Once complete, the USGS will have operational models available to the public that account for 100% of USGS historically reported water use.

Integrated Water Prediction (IWP) (+$4,000,000 / +27 FTE) – Through the IWP, the USGS will transform hydrologic modeling software to a scale that has never been feasible before. These efforts will support water resource managers who are increasingly faced with new challenges that require tighter integration of hydrologic models with other components of the earth system (e.g., weather, climate, ecosystems, and species). In addition, these activities will modernize the water prediction capabilities needed to fully realize the deliverables envisioned through IWAAs. In FY 2023 the USGS would design and develop an integrated hydrologic modeling software framework that will support an ecosystem of model codes that represent both natural and human system processes. The USGS would test and evaluate this framework at national, regional, and local scales in coordination with other integrated water science

activities such as IWAAs. WAUSP efforts would focus on incorporating climate change and variability, land-use land-cover change, and socio-economic drivers into USGS water budget prediction. The USGS would also enhance prediction capabilities related to the water availability impacts from climate-driven extreme events such as drought, wildfire, and hurricanes for incorporation into IWAAs and the National Water Census. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$4,000,000).

Integrated Water Availability Assessments (IWAAs) (+$6,000,000 / +40 FTE) – The USGS would expand USGS capacity to conduct IWAA activities across the USGS IWS basins. Regional IWAAs are planned, coordinated, and conducted with Next Generation Water Observing System (NGWOS) and Integrated Water Prediction activities in each basin and will provide enhanced assessments of the selected region's water availability that incorporate predictions and forecasts of water availability components, and the factors influencing both. Each Regional IWAA would gather and provide a common set of products to allow consistent information transfer to stakeholders and integration into National IWAA activities and products. Regional IWAAs would also have the flexibility to go beyond core requirements and prepare study designs that address regionally important science gaps that improve national assessment capacity and meet stakeholder information needs. Assessment periods for Regional IWAAs may vary, but would generally consist of three phases totaling about 10 years of activity:

- Phase 1 – Discovery and Evaluation (1-2 years)
- Phase 2 – Availability Assessment (5-years)
- Phase 3 – Operational Linkages (3-4 years)

With additional funds, the USGS would advance phase 2 IWAAs activities in the DRB and initiate phase 2 activities in the Upper Colorado River Basin. In addition, the USGS would begin phase 1 implementation in the Illinois River Basin and engage with stakeholders in the Willamette River Basin. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$6,000,000).

Baseline Capacity (+$1,514,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the Water Resources mission. The budget includes $1.5 million in Water Availability and Use Science Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

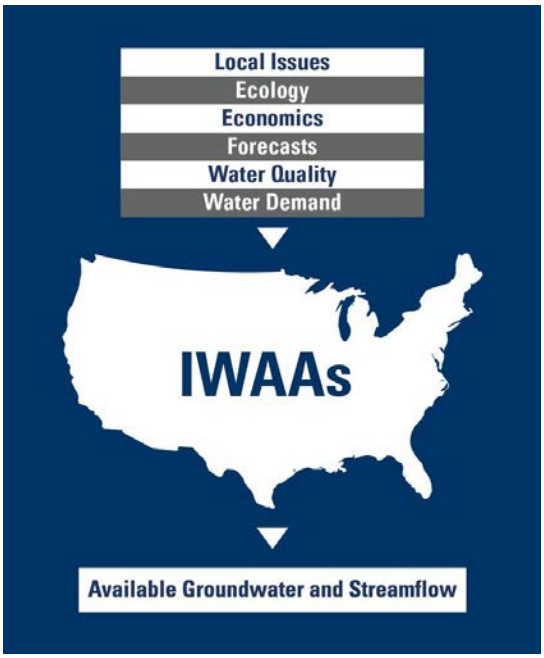
Program Overview

The Water Availability and Use Science Program (WAUSP) fulfills the goals established by Congress in the SECURE Water Act (Public Law 111-11, Section 9508) by investing in research and assessments that improve the Nation's understanding of water availability. Specifically, the WAUSP supports the National Water Census, a USGS activity designed to systematically provide information that will allow resource managers to assess the quantity, quality, and use of the Nation's water. The WAUSP focuses on conducting national and regional water availability assessments; developing methods to estimate water budgets; and evaluating trends in water availability. In addition, the WAUSP supports efforts to develop techniques to evaluate water availability, advance the models and infrastructure that support assessments, and deliver tools that resource managers can use to support resource planning.

The National Water Census (NWC)

The goal of the USGS NWC is to provide nationally consistent, well-documented information on water quantity, quality, and use that will allow resource managers to assess the Nation's water availability. The USGS supports this goal by investing in efforts to assess and provide information on the inputs, the outputs, and changes in the water budget. Furthermore, the USGS is examining the dynamic interactions and complex roles that major factors (i.e., water quality, drought, ecological flows, and water use) can have in water availability. Estimates of water budget components, as well as an understanding of how various factors can impact water availability, provide a means for the USGS to assess water availability.

Integrated Water Availability Assessments (IWAAs): Critical to the development and delivery of the NWC are multi-extent stakeholder-driven assessments, referred to as IWAAs, that will provide a near real-time census and seasonal prediction of water availability for both human and ecological uses. At a national scale, the USGS is working to deliver a web-based map that conveys daily snapshots of various water conditions and trends across the U.S. The WAUSP supports this effort by developing and refining models to simulate water budget components and factors that influence water availability. The USGS is providing daily estimates for eight of nine targeted water budget components: precipitation, streamflow, soil moisture, groundwater recharge, evapotranspiration, snowpack, snowmelt, and total runoff. These water budget components will provide a foundation of data for the NWC.



When fully implemented, IWAAs will evaluate current water supply and demand, long-term trends in water availability, provide seasonal to decadal forecasts of availability, and inform water resource decisions through development of socioeconomic tools. The IWAAs are designed to meet the goals of the National Water Census as established through the SECURE Water Act. Source: USGS.

IWAA activities are also at work in each of the USGS IWS basins and in other targeted regions across the U.S. The USGS is developing Regional IWAAs in partnership with stakeholders to ensure they are timely and informative at the local and regional level but can also be assimilated into national-scale products. The USGS has conducted a successful pilot for Regional IWAAs through its Mississippi Alluvial Plain Assessment (MAP) project. Initiated in 2016, the project was developed and conducted in close cooperation with local, State, and regional stakeholders to ensure it met both USGS and stakeholder needs. While it has improved the data and developed key tools and information to support the MAP's water resource managers, it has also had national benefits by laying the groundwork for a unified approach for evaluating and predicting water availability in other regions across the U.S. Lessons learned from the MAP will improve the ability of USGS to assess and forecast water availability at the national scale in terms of quantity, quality, and use.

In 2023, Regional IWAAs will be ongoing in the DRB, UCOL, ILRB basins and will begin in the Willamette River Basin. In the DRB, the USGS will continue phase 2 of the Regional IWAA with a focus on understanding the impacts of drought on water availability and issues related to water temperature, salinity, and coastal hydrology (including coastal inundation). The USGS will also begin full implementation of phase 2 in the UCOL with a focus on improving water resource planning with advancements to overall understanding and prediction of the processes that influence the magnitude and

timing of snowmelt. In the ILRB, the USGS will complete phase 1 of the Regional IWAAs and begin phase 1 of the regional IWAAs in the Willamette River Basin. These activities will support the design and implementation of projects aimed at better understanding how the timing, magnitude, and variation in water budget components influence water quantity and quality conditions, with a particular focus on nutrients and HABs in the ILRB and ecosystem demand in the Willamette River Basin.

In addition to the Regional IWAAs conducted in each IWS basin, moving forward, Regional IWAAs will be conducted in other regions of the U.S. For example, following the completion of the MAP project in FY 2022, the USGS will begin planning for IWAA activities in the Gulf of Mexico Coastal Plain (covering from Houston, TX, through Louisiana and Mississippi, to Mobile, AL) and the Klamath Basin.

Water Use, Ecological Flows, and Drought: In order to fully deliver the NWC, the USGS must develop the capacity to assess and understand not only the traditional hydrologic components of the water budget but also human and ecological supply and demand. Through incorporation of research and technical evolution, the USGS is focused on model development that will improve water use reporting from 5-year annual reports (how USGS currently reports on water use) to daily estimates modeled on a national scale, including uncertainty. The USGS will also identify, evaluate, and predict potential ecological responses to alterations in water availability and forecast the onset, severity, and duration of hydrologic drought.

Better Tools for the Public
The USGS National Integrated Water Availability Assessment Report

The SECURE Water Act (P.L. 111-11) recognized the need to improve our understanding of water availability for both human and ecological needs, across multiple sectors critical for economic growth and ecosystem sustainability. The ability to understand past and current water availability, as well as predict future water demands compared to available supplies is critical in the identification of emerging water issues, understanding the causes, and preparing for the future water availability. Integrating human water use and decision-making into models of the natural hydrologic system increases the ability of USGS to provide science-based information, including forecasts of water supply and suitability for use, to water resource managers, allowing them to make more informed management decisions. In 2023, the USGS will develop a draft of the first ever National Integrated Water Availability Assessment report, a periodic interpretive report on the state of the Nation's water resources—past, current, and future; quantity, quality, and use as well as the drivers of change including extreme events. This report will serve as a regular assessment of water availability for the Nation integrating the evaluation and prediction of water quantity, quality, and use, including ecosystem needs, into the assessment and communication of water availability.

In 2023, the USGS will begin working to develop water use withdrawal models for industrial, domestic self-supplied, mining, aquaculture, and livestock uses accounting for the remaining 10% of water use nationally not already covered by USGS models, which allows USGS to report water use for all 8 categories of use; conducting ecological flow assessments and model development in the UCOL, ILRB, and the Willamette River Basin; and, finalizing data-driven methods to prototype early warning of drought conditions including potential impacts to different components of water availability, including agricultural areas and ecological flows most vulnerable to drought.

Model Development, Infrastructure, and Information Delivery

Integrated Water Prediction (IWP): The USGS is participating in an ambitious Federal partnership with agencies like the National Oceanic and Atmospheric Administration, Bureau of Reclamation, and the U.S. Army Corps of Engineers, to develop a new national, interagency capacity for water prediction. Working

as part of this Federal community, the USGS is fostering a formalized, transparent, and adaptive governance process to integrate the modeling and computational strengths of multiple organizations.

Through identification of the science and technological needs that will serve the Nation's long-term hydrologic prediction capacity at the national, regional, watershed, and local scale, the USGS is developing the integrated modeling framework, software architecture, and standards needed to support the robust, efficient, and sustainable development of integrated water prediction capabilities. In 2023, the USGS will continue working through an IWP program to develop nationally consistent approaches for predicting and forecasting water quantity and quality conditions, changes, and outcomes for water availability. Leveraging modeling approaches designed to consider water quantity, quality, and use together in an integrated water availability model framework, IWP tools will be used to support broader USGS goals such as delivery of the National Water Census and National Integrated Water Availability Assessment report.

High-Impact Hydrologic Research

Research and development are critical foundations to the effective management of the Nation's water challenges, providing a foundation for understanding how the hydrologic process works and impacts water availability. To this end, the WAUSP supports research to better understand how factors like socioeconomics and extreme events can impact water budgets, and at a broader level, water availability. Through these efforts, the USGS strives to provide water resource managers with high-impact data, tools, and information that support management decisions.

Social and Economic Drivers: The USGS is working to better understand the impacts of and interactions between socioeconomics and water availability. A comprehensive understanding of the social and economic factors that drive water demand and alter water supply is needed to assess water availability in a predictive framework. Assessments and model development will identify the economic sectors, ecosystem goods and services, and other social, cultural, and economic factors that affect, or are affected by, water availability. In 2023, the USGS will begin incorporating socioeconomic drivers into water prediction and assessment capacity to better evaluate the impact of water demand, water management, and ecosystem services into national assessments. These efforts will improve the ability of the NWC to forecast availability under a variety of conditions.

Water Budget Research: This research is focused on improving water availability prediction through efforts to better quantify the hydrologic cycle. Activities at a range of spatial and temporal scales aim to improve the USGS ability to evaluate all components of the water budget, including groundwater-surface water interactions, recharge, evapotranspiration, snowpack, soil moisture, and streamflow and how changes to these components impact water availability. In 2023, the USGS will focus hydrologic process research on improving model representation of IWAAs core water budget components to reduce model uncertainty. This includes incorporation of process representation improvements based on assessment and prediction of snowpack as a driver of water availability in the UCOL.

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Water Resources
Groundwater and Streamflow Information Program

Water Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Groundwater and Streamflow Information Program	**100,673**	**100,673**	**2,384**	**0**	**13,978**	**117,035**
Federal Priority Streamgages	[24,715]	[24,715]	0	0	5,600	[30,315]
Next-Generation Water Observing System	[24,500]	[24,500]	0	0	6,400	[30,900]
Groundwater and Streamflow Information Baseline Capacity	[0]	[0]	0	0	1,978	[1,978]
FTE	***470***	***470***	***0***	***0***	***43***	***513***

2023 Program Changes

The 2023 budget request for the Groundwater and Streamflow Information Program is $117,035,000 and 513 FTE, with a program change of +$13,978,000 and +43 FTE above the 2022 CR Annual Rate, and +$2,384,000 in fixed costs.

Federal Priority Streamgages (FPS) (+$5,600,000 / +20 FTE) – Each year, floods, droughts, and water quality issues remind us of the vulnerability of our physical and socioeconomic well-being and the importance of monitoring our Nation's water. The FPS network was designed at Congress' request (per House Report 105-609) to support long-term Federal information needs such as National Weather Service flood forecasting, reservoir management, and interstate and international compacts and decrees. In addition, the FPS network is intended to serve as a backbone within the USGS Streamgaging Network that is not vulnerable to changing local priorities and resources and 'hardened' against extreme events.

The proposed increase includes funding requested in 2022 to support the continued operation of approximately 3,470 streamgages in the FPS Network. In addition, the USGS would be able to support an additional 30 flood-hardened streamgages that are fully funded by the USGS to the FPS network at key locations to fill gaps and support data needs of water model predictions. Furthermore, the USGS would implement enhancements that increase the resiliency of the FPS network (e.g., flood-hardening existing sites) and ensure sites meet requirements for successful data collection and transmission (e.g., cyclical equipment upgrades for monitoring, telecommunication, and data transmission).

Next Generation Water Observing System (NGWOS) (+$6,400,000 / +23 FTE) – At this funding level, USGS would operate and maintain the fully-deployed NGWOS in the Delaware River Basin and complete full implementation of the NGWOS in the Upper Colorado River Basin and Illinois River Basin and begin implementation in the fourth basin, which was recently selected to be the Willamette River Basin. The USGS would complete approximately one-quarter of NGWOS implementation in the Willamette River Basin (for more information on IWS basins, see the Mission Area Overview section.) The USGS would also support hydrologic instrumentation research and development aimed at pushing the state of monitoring technology forward in each IWS basin, which would ultimately improve USGS national observing

networks at large. As innovative data collection techniques and technologies are tested in each IWS basin, those that prove effective and beneficial could be rolled out to the national USGS observing networks.

Beyond these efforts, at the requested level, the USGS anticipates completing NWIS Modernization efforts by the end of FY 2024. The proposed increase includes funding requested in the FY 2022 President's Budget Request (+$6,400,000).

Baseline Capacity (+$1,978,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the Water Resources mission. The budget includes $2.0 million in Groundwater and Streamflow Information Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Groundwater and Streamflow Information Program (GWSIP) focuses on the collection, management, and dissemination of 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 one of the largest water data holders in the world, the USGS partners with more than 1,400 Federal, regional, State, Tribal, and local agencies to maintain and manage its water monitoring networks. Furthermore, the GWSIP is increasingly targeting integrated monitoring for parameters of water-quality and quantity 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 industries such as agriculture, fishing, and outdoor recreation and are used for decisions related to water-supply planning, aquifer storage and recovery, infrastructure design, floodplain and ecosystem management, energy development, and resolution of water disputes.

National Water Census (NWC)

The goal of the USGS NWC is to provide nationally consistent, well-documented information on water availability that will allow resource managers to assess the quantity, quality, and use of the Nation's water resources. The GWSIP is supporting this goal collecting, analyzing, and assessing hydrologic data in transboundary rivers along the U.S-Canada border. Initiated in 2019, the USGS is currently supporting activities in Alaska, Washington, Idaho, and Montana that are aimed at documenting baseline conditions and assessing any potential impacts from mining activities in British Columbia. Work is being coordinated with various Federal, State, local, and Tribal agencies to ensure that USGS efforts will serve their data needs.

Observing Systems

Water monitoring networks are the foundation of understanding the Nation's hydrologic systems; they provide information that is critical for defining, using, and managing water resources. The USGS operates a suite of real-time surface water and groundwater networks that provide data on water levels, streamflow, and a variety of water-quality parameters. The GWSIP primarily supports the networks that provide data

on water quantity (water levels and streamflow), while also investing in next-generation water observing systems designed to integrate monitoring for water quantity, quality, and use.

National Streamgaging Network: The GWSIP supports the collection and (or) delivery of both streamflow and water-level information for more than 8,500 sites and water-level information alone for more than 2,900 additional sites. The data are served online—most in near real-time—and form the basis for decisions related to protection of life and property from 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.

Improving Program Performance
Advancing USGS Monitoring Capabilities in Remote Areas through Satellite Remote Sensing

USGS is continuing to deliver historic and operational real-time discharge data at 4 "virtual" stream monitoring stations in Alaska, on the Nanana, Yukon, and Susitna Rivers utilizing satellite remote sensing to measure river widths, slopes and altitudes at these locations and, using hydraulic equations, convert these to discharge measurements. These virtual streamgaging stations are demonstration and test sites for use of satellites to measure rivers in remote areas that are too difficult or expensive to measure with traditional methods. With these test sites, USGS is developing accurate and reliable methods that can expand coverage of the national stream monitoring network. This work will improve safety by keeping technicians out of dangerous waters and will lead to less expensive stream monitoring methods that can be used to expand the coverage of monitoring across the Nation.

Federal Priority Streamgage (FPS) Network: The FPS Network (previously known as the National Streamflow Information Program) is a subset of the National Streamgaging Network and was conceived in 1999 to be a core, federally-funded network. The original network design identified 4,300 sites that were strategically positioned across the country to address long-term Federal information needs, such as forecasting (primarily supporting National Weather Service flood forecasts and to trigger operational drought or emergency declarations), interstate and international water compacts and decrees, and tracking sentinel trends. These sites are supported through a combination of USGS and partner funding—approximately one-quarter are fully funded by the USGS. For information on how the GWSIP will support the FPS Network in FY 2023, see the Program Changes section.

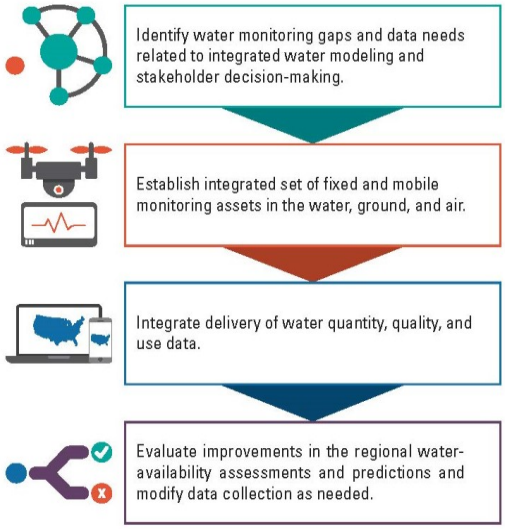
Improving Program Performance
Augmenting USGS Monitoring Capabilities during Flood Events

The USGS has developed a suite of tools that can be used to temporarily augment the monitoring capacity of the Streamgaging Network during flood response and fill data gaps. For example, Rapid Deployment Gages (RDGs) are temporary sensors that provide real-time water-level and meteorological data to communities lacking permanent streamgages, or where temporary stream or estuary information is needed. Storm-tide sensors are monitoring devices that observe and document storm-surge, waves and tides as coastal storms make landfall. Instruments like these can be deployed prior to a storm event and then retrieved shortly after. Data is useful for informing forecasts on potential coastal erosion and flooding hazards and helps public officials to assess storm damage, enhance flood forecasting models, and improve long-term planning for future coastal storms.

National Groundwater Monitoring Network (NGWMN): The NGWMN was designed in 2009 in response to the SECURE Water Act (P.L. 111-11). Authorized as a collaborative groundwater network among intergovernmental agency data providers, the NGWMN provides access to water-level and/or water-quality data from over 10,500 groundwater wells that are supported by over 30 Federal, State, local, and Tribal agencies. As part of the NGWMN, the USGS supports 695 Climate Response Network (CRN) sites, representing 292 of 370 Climate Divisions in the U.S. as outlined in P.L. 111-11. These sites are supported

by a combination of USGS and partner funding. The primary purpose of these data is to portray the response of groundwater systems to short- and long-term climate variations Nationwide. It serves as a critical measure of groundwater conditions during drought and provides long-term groundwater level data. In 2023, the USGS will continue to support the CRN.

Next Generation Water Observing System (NGWOS): In efforts to modernize observing networks, the USGS has developed a strategy for implementing a NGWOS. The USGS has begun establishing advanced, intensive monitoring networks in medium-sized watersheds across the U.S. referred to as Integrated Water Science (IWS) basins. Selected watersheds are being instrumented to monitor water quantity, quality, and use with a mixture of monitoring equipment in the water, ground, and air. When fully implemented, the NGWOS will provide high temporal and spatial resolution data on streamflow, evapotranspiration, snowpack, soil moisture, water quality, groundwater/surface-water connections, stream velocity distribution, sediment transport, and water use. These data are intended to be coupled with advanced models, such as the National Water Model, and other modern modeling tools to lower prediction uncertainty as well as provide flood and drought forecasts; drive emergency- and water-management decision support systems; and address a variety of other water-resource questions in a given region. Further, the NGWOS will provide a foundational dataset as the USGS develops Integrated Water Availability Assessments.



Infographic of the NGWOS implementation process. The NGWOS is integrating fixed and mobile monitoring assets in the water, ground, and air, including innovative webcams and new ground- and space-based sensors. Partner and stakeholder needs are informing NGWOS design so that data helps them anticipate water shortages more accurately and react to water hazards more quickly. Source: USGS.

Thus far, the USGS has selected three IWS basins (DRB, UCOL, and ILRB Basins) and NGWOS implementation is ongoing in all three. The initial investment of NGWOS instrumentation in the DRB is complete and has mainly focused on enhanced monitoring of streamflow, temperature and salinity to help address key water-resource issues such as: *interbasin transfers to New York City in the upper basin; maintaining ecological flows and stream temperatures adequate to support blue ribbon trout fisheries in the upper and middle part of the basin; and saltwater intrusion for cities like Philadelphia in the lower basin*. NGWOS implementation in the UCOL is focused on monitoring of snow to streamflow, groundwater to streams, and real-time water-quality and aims to help answer specific hydrologic questions important to stakeholders such as: *What are the near-term and long-term risks of floods and droughts, and what scenarios change these risks? How long will drought recovery take? How much water is stored in seasonal snowpacks, and how will changes affect water supplies? How much does groundwater contribute to streamflow, or vice-versa? What is the quality of water and how will it change during wet/dry periods?* In the ILRB, full implementation will focus on real-time monitoring of nutrient and sediment delivery, factors leading to the formation of harmful algal blooms (HABs), and urban flood hydrology and help to answer specific hydrologic questions important to stakeholders such as: *What are the near-term and long-term risks of floods and droughts, and what scenarios change these risks? What factors affect water availability in basins that possess a complex mixture of urban and agricultural land use? How do nutrient loads influence HABs? What are the best ways to monitor for water supply contaminants such as per- and poly-fluoroalkyl substances (PFAS)? What are the best practices to inform Federal State, local, and Tribal*

agencies about sediment loads in watersheds to facilitate planning of dredging operations that maintain navigable waters?

In 2023, initial implementation the Willamette River Basin will begin as well as planning for implementation in the fifth basin. Selection of the fifth IWS basin will occur in 2022.

At the foundation of USGS water observing systems is the Hydrologic Instrumentation Facility (HIF). The HIF provides quality-assured hydrologic instrumentation and data collection equipment, testing of in-service instruments, and evaluation of new technology and instrumentation which are foundational for a national, high quality water observing system. In 2020 and 2021, the USGS received appropriations to construct a new HIF co-located with complementary academic and federal partners. In 2023, the USGS will be constructing a new HIF on the University of Alabama campus. The HIF is expected to be completed in FY 2024. Once constructed, USGS HIF functions will be relocated from the current Mississippi location to the University of Alabama. All HIF employees located in Mississippi will be given the opportunity to relocate with their positions.

Data Systems

National Water Information System (NWIS) Modernization: As the USGS moves its monitoring networks forward through initiatives like NGWOS, it is modernizing the enterprise system that supports water data transmission, storage, processing and delivery: NWIS. These efforts will ensure that NWIS can efficiently manage new data and data types, incorporate automated processing of hydrologic data, integrate water data from multiple agencies and sectors, and continue to deliver data to the public, but in new and more user-friendly formats. In 2023, the USGS will continue to modernize data infrastructure and data delivery components of NWIS. Data delivery efforts will directly benefit data users by continued enhancement of the National Water Dashboard, adding new public search and data download functionality, and enhancing delivery of camera imagery and videos, geospatial information, and discrete groundwater data. In addition, the GWSIP is investing in activities to ensure that state-of-the-art tools are used to develop information and data visualizations that meet the decision-making needs of stakeholders.

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Water Resources
National Water Quality Program

Water Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
National Water Quality Program	**93,460**	**93,460**	**2,031**	**0**	**2,782**	**98,273**
Prediction of Water Availability Impacts on Ecosystems	[250]	[315]	0	0	1,000	[1,315]
National Water Quality Baseline Capacity	[0]	[0]	0	0	1,782	[1,782]
FTE	***430***	***430***	***0***	***0***	***7***	***437***

2023 Program Changes

The 2023 budget request for the National Water Quality Program is $98,273,000 and 437 FTE, with a program change of +$2,782,000 and +7 FTE above the 2022 CR Annual Rate, and +$2,031,000 in fixed costs.

Prediction of Water Availability Impacts on Ecosystems (+$1,000,000 / +7 FTE) – The USGS would support integrated, cross-mission area science that builds on recent advancements in monitoring, modeling, and multidisciplinary research to improve our capacity to forecast impacts of changing climate and land management on water availability and ecosystem health. Working collaboratively in Integrated Water Science basins, the USGS Water Resources and Ecosystems Mission Areas would develop methods, including genetic and genomic capabilities, and models to study continuing challenges related to water supply, infrastructure, land management, and aquatic ecosystems due to population growth, climate change, floods and droughts, and aging water delivery systems. Funding would support the integration of data from hydrologic, biogeochemical, and ecological studies to improve our capacity to model the impacts of hydrologic change on ecosystem vulnerability and resilience, including on culturally significant aquatic species that provide ecosystem services to disadvantaged and vulnerable communities.

Baseline Capacity (+$1,782,000 / 0 FTE) The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the Water Resources mission. The budget includes $1.8 million in the National Water Quality Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

To effectively manage the Nation's water resources, decisionmakers depend on understanding what resources are available for various purposes, and whether the quality of those resources is fit for purpose. The National Water Quality Program (NWQP) supports the data collection, assessments, modeling, and research needed to assess the quality of freshwater resources. In particular, activities are focused on understanding the role that water quality plays in water availability. The long-term data, assessments, and models supported by the program are a critical component to sustaining the viability of industries such as agriculture, fishing, and outdoor recreation, and are used for decisions related to water-supply planning, aquifer storage and recovery, infrastructure design, floodplain and ecosystem management, energy development, and resolution of water disputes. The multi-scale prediction of water quality and availability of freshwater resources are met through integrated capabilities across multiple programs. These programs include IWP to provide the computational framework for advanced models of quality and quantity, IWAAs to assess water availability within the context of competing demands, and research into water quality processes to identify and fill gaps models for more accurate predictions.

National Water Census (NWC)

The goal of the USGS NWC is to provide nationally consistent, well-documented information on water availability that will allow resource managers to assess the quantity, quality, and use of the Nation's water resources. The NWQP supports this goal by investing in efforts to evaluate the water-quality aspects of water availability. Given the cost of treating water for various uses (e.g. public supply, irrigation, energy development), water-quality is critical in the availability of water for human and ecological purposes.

Integrated Water Availability Assessments (IWAAs): IWAAs will provide a near real-time census and seasonal prediction of water availability for both human and ecological uses at regional and national extents. As part of this effort, the NWQP is working to analyze trends and develop advanced techniques to account for water quality. At a national scale, efforts are focused on developing water availability indicators related to water quality that will convey periodic snapshots of current conditions and national trends. Water-quality indicators will show water availability based on suitable uses and untreated quality (e.g., water may be available but must be treated before using in an industrial setting yet could be used untreated for mining). In addition, the USGS supports efforts to evaluate water-quality trends on a national scale. At regional scales, the NWQP is working to integrate water-quality assessment and evaluation capabilities into Regional IWAAs. These Regional IWAAs are being developed in partnership with stakeholders to ensure they are informative at local and regional levels but can also be assimilated into national-scale products as part of the National IWAA. In 2023, regional IWAAs will be ongoing in the Delaware River (DRB), Upper Colorado River (UCOL), Illinois River (ILRB) basins and the recently selected Willamette River Basin. The NWQP will be supporting those basins with efforts to assess water-quality factors such as salinity and temperature in the DRB, groundwater salinity and selenium in the UCOL, developing a framework for assessing the impacts of nutrients on water availability in the ILRB, and water-quality drivers impacting ecosystem needs in the Willamette River Basin.

Water availability reflects the quantity, timing, quality, and use of water resources and is driven by the interactions of various factors. The primary factors that can drive water availability are climate change, economics, water quality, and human and ecological demand.

Ecological Flows: The USGS is working to develop the data, tools, and information water resource managers need to protect and restore stream health as it is affected by alteration of flows for human water use, climate change, and anthropogenic changes to water quality. The results will be used to identify, evaluate, and predict potential ecological responses to alteration of water availability. In 2023, the USGS will begin to integrate data from hydrologic, biogeochemical, and ecological studies to improve our capacity to model the impacts of hydrologic change on ecosystem vulnerability and resilience, including on culturally significant aquatic species that provide ecosystem services to impoverished and vulnerable communities. Leveraging the multi-disciplinary nature of the USGS, this work is being conducted in collaboration with the USGS Ecosystems Mission Area. The USGS will also apply new technologies in genomic analyses, bioinformatics, and machine learning to improve the accuracy and interpretability of indicators of ecological wellbeing.

Water Prediction and Information Delivery/Data Systems

Integrated Water Prediction (IWP): As part of an ambitious federal partnership, agencies such as the National Oceanic and Atmospheric Administration, Bureau of Reclamation, U.S. Army Corps of Engineers, and USGS are developing a new national, interagency capacity for water prediction. As part of this effort, the USGS is working to advance its water modeling capabilities through an IWP program that is focused on developing nationally consistent approaches for predicting hydrologic conditions, changes, and outcomes for water availability. These approaches are being designed to consider water quantity, quality, and use together in an integrated water availability model. While these activities are supported by both the NWQP and the Water Availability and Use Science Program, NWQP funding supports activities that focus on incorporating water-quality processes into water prediction for a holistic view of water availability.

In 2023, the USGS will continue testing and evaluating methods to predict surface and groundwater quality nationally. NWQP efforts will focus on multi-scale testing and evaluation of this framework, specifically on improving the process representation and prediction of key water quality drivers such as surface water temperature, constituent transport, nutrients, and salinity. These activities will be coordinated with other integrated water science activities such as IWAAs.

High Impact Hydrologic Research

The USGS is investing in the research needed to better understand the water-quality factors that impact water availability. This work provides the foundation for providing models and tools for resource managers that can consider the quantity, quality, and use aspects of water availability as an interdependent system.

Water Quality Processes: These activities support the methods development and research that the USGS needs to quantify impacts of constituent fate and transport on changes in water-quality and how those changes impact water availability for both human and ecological uses. In 2023, the USGS is continuing efforts to understand the processes that influence both existing and emerging water-quality challenges such as harmful algal blooms (HABs) and per- and poly-fluorinated compounds (PFAS). Specifically, methods development activities will focus on the ability to detect and quantify contaminants of interest and to understand linkages between biogeochemistry and fate and transport. This is a critical foundation for understanding the potential impacts that contaminants like HABs and PFAS can have on water availability. Additional research will focus on improving prediction capabilities for the constituents identified as priority issues by stakeholders in IWS basins including sediment, salinity, selenium, carbon, and nutrient dynamics.

Social and Economic Drivers: These activities focus on a better understanding of the impacts of and interactions between socioeconomics and water availability. A comprehensive understanding of the social and economic factors that drive water demand and alter water supply is needed to assess water availability

in a predictive framework. Assessment and model development will identify the economic sectors, ecosystem goods and services, and other social, cultural, and economic factors that affect, or are affected by, water availability. When considering these factors, water quality is an integral driver in socioeconomic decisions related to water availability given its role in the suitability of water resources for use. For example, under drought conditions, water resources managers must weigh water demand with the intended uses (e.g., irrigation vs. public supply vs. mining) and the costs associated for the required treatment to meet those purposes when planning for water needs. In 2023, the USGS will continue studies aimed at understanding interactions such as these and ultimately how these interactions influence water demand, use, and movement regionally. These efforts will improve the ability of the National Water Census to forecast availability under a variety of conditions.

Water Availability Impacts of Extreme Events: The NWQP is working to understand how extreme events impact water availability through short-term changes in the quality of resources accessible for use. The initial focus of research activities will be on the water availability impacts of wildfire and hurricanes. In 2023, the USGS will continue development of the capacity to predict wildfire impacts on water availability using a strategic, nationally consistent, approach to quantify critical drivers of water-quality impairment. Improvements in measurement, assessment, and modeling techniques will allow USGS to produce near-real time predictions of wildfire impact for post-fire debris flows and water-availability impairment. These activities support the goals and strategies of the USGS Wildland Fire Strategic Plan released in February 2021. Additional efforts include developing a strategy for predicting short- and long-term water availability impacts of hurricanes.

Observing Systems

The USGS operates a suite of surface water and groundwater networks that provide real-time data on water levels, streamflow, and a variety of water-quality parameters such as dissolved oxygen, pH, specific conductance and temperature, as well as discrete water-quality data on contaminants. The NWQP primarily supports the networks that provide data on water quality, while also investing in next-generation water observing systems designed to enhance and integrate monitoring for water quantity, quality, and use. This integration is increasingly important as the WMA works to improve the prediction skill of complex hydrologic and water-quality models and ultimately improve understanding of water-availability and stakeholder decision making.

Improving Program Performance
Advancing USGS Monitoring Capabilities using Autonomous Underwater Vehicles (AUVs)

The USGS has begun combining traditional surface-water synoptic surveys with autonomous technology to produce integrated surveys of water quality, bottom shape, and velocity in rivers, lakes, and reservoirs. A synoptic survey produces a nearly instantaneous picture of a characteristic of interest over a broad area. Synoptic surveys of a water body often require many people and many hours to complete, depending on the extent of the survey and the purpose of the study. Typically, these surveys target a single characteristic, such as the extent of algal blooms. However, conducting these synoptic surveys simultaneously with a high-resolution three-dimensional survey of depth, water quality, velocity, and sonar imagery using an AUV can efficiently create an enhanced dataset that allows for a more holistic understanding of common environmental problems.

National Water Quality Network (NWQN) for Streams and Rivers: The NWQN is the only nationally designed, long-term monitoring network for tracking the quality of rivers and streams with consistent, comparable data collection and analytical methods at all sites. NWQN data is primarily collected through discrete sampling at sites; however, a growing number of sites have sensors that provide continuous, real-

time water-quality conditions. Through NGWOS, new sensors and instruments will be developed and implemented to measure more types of contaminants on a continuous basis and be delivered to users in real-time. In 2023, the USGS will continue monitoring at 106 sites in the NWQN covering important environmental settings (e.g., small agricultural and urban watersheds, large inland and coastal rivers, and minimally disturbed reference watersheds).

National Groundwater Quality Monitoring Networks (NGWQMN): The USGS monitors groundwater quality conditions through an enterprise of approximately 80 long-term networks across the U.S. These groundwater-quality monitoring networks track water quality conditions in principal aquifers across the U.S. Concentrations of constituents, such as arsenic, nitrate, metals, pesticides, volatile organic compounds, and per- and polyfluoroalkyl substances (PFAS) are compared to benchmarks established for the protection of human health. Users can access an online tool to see how concentrations of these constituents in groundwater are changing during decadal periods across the Nation. Currently, data is collected on a discrete basis where hydrologists must visit a groundwater site in-person to take water samples. Moving forward, emerging NGWOS sensor technologies may allow the USGS to advance continuous, real-time groundwater-quality monitoring and provide more safeguards for human health. In 2023, the USGS will continue sampling through these networks.

National Atmospheric Deposition Program (NADP): The USGS monitors wet atmospheric deposition (chemical constituents deposited via snow, sleet, rain) in the U.S. through the interagency NADP. The USGS supports sites in the National Trends, Mercury Deposition, and Mercury Litterfall networks, which provide long-term, high-quality data to support decisions related to sources of water-quality impairment, and watershed studies. In 2023, the USGS will continue to support monitoring through the NADP.

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Water Resources
Water Resources Research Act Program

Water Resources $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Water Resources Research Act Program	**11,000**	**11,000**	**0**	**0**	**4,000**	**15,000**
Water Resources Research Institute Grants	[11,000]	[11,000]	0	0	4,000	[15,000]
FTE	***2***	***2***	***0***	***0***	***0***	***2***

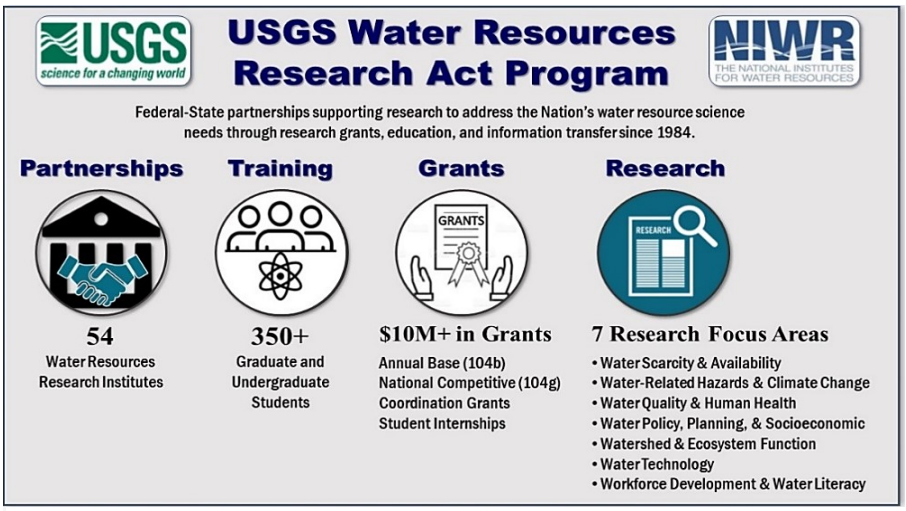
2023 Program Changes

The 2023 budget request for the Water Resources Research Act Program (WRRA) is $15,000,000 and 2 FTE, with a program change of +$4,000,000 and +0 FTE above the 2022 CR Annual Rate.

Water Resources Research Institute Grants (+$4,000,000 / +0 FTE) – The USGS would increase support for national competitive grants through the WRRA. These competitive grants allow the WRRA to focus the collaborative research between USGS and university scientists on significant national and regional water resource issues. The additional funds would support a variety of topics including how climate change influences water availability in the U.S.

Program Overview

The Water Resources Research Act, authorized by section 104 of the Water Resources Research Act (WRRA) of 1984, is a Federal–State partnership that plans, facilitates, and coordinates water resources research, education, and information transfer through a matching grant program.



FY 2021 Status of Water Resources Research Act Program. The WRRA Program provided over $10 million in grants to support water resources research within seven primary focus areas and promote the education and training of more than 350 students.

The WRRA authorized the establishment of State Water Resources Research Institutes (National Institutes for Water Resources; NIWR) at land grant universities across the Nation. There are currently 54 Institutes: one in each State, Puerto Rico, the District of Columbia, U.S. Virgin Islands, and Guam. The Institute in Guam serves the Federated States of Micronesia and the Commonwealth of the Northern Mariana Islands.

Annual Base Grants

Under the provisions of section 104 of the Water Resources Research Act of 1984, annual base grants (104b) are awarded to the Institutes or Centers that have been established in each of the 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. Annual base grants are required to have a 1:1 match by the Institute and are used to fund projects that are selected at the Institute level through a competitive selection process that is run by each Institute within their respective States. The annual base grants help each Institute or Center to plan and conduct applied and peer reviewed research on water resource issues that address State needs. Institutes also use their base grants to help train new scientists, disseminate research results to water managers and the public, and to cooperate with other colleges and universities in their respective States and with other institutes and other organizations in their regions to promote regional coordination. Through research projects, the WRRA program directly supports about 250 student undergraduate and graduate students each year. In addition, USGS grants help to support information transfer activities including an annual conference at every institute to facilitate the transfer of research progress and findings to the hydrologic research community as well as the public at large. In FY 2023, the USGS will continue to support base grants to all 54 Institutes.

National Competitive Grants

The WRRA program, in cooperation with the Institutes, supports an annual call for proposals to focus on priority water issues that are of a regional or interstate importance or relate to a specific priority topic identified annually by USGS, the Department, and the Institutes. These competitive grants (104g) allow the WRRA Program to focus the collaborative research between USGS and university scientists on significant national and regional water resource issues while promoting the dissemination and results and supporting the training of scientists in water resources. Any investigator at an accredited institution of higher learning in the U.S. is eligible to apply for a grant through an Institute or Center established under the provisions of the Water Resources Research Act of 1984. However, these grants must be matched with non-federal dollars on a 1:1 basis. Successful research topics have included research on improving and enhancing the nation's water supply, developing innovative approaches to water treatment, evaluation of the dynamics of extreme hydrological events and associated costs; development of methods for better estimation of the physical and economic supply of water; developing approaches for integrated management of ground and surface waters; and the evaluation and assessment of conservation practices. For more information on how the WRRA will support national competitive grants in 2023, see the Program Changes section.

A subset of these competitive grants is offered for specific priority research areas. One of those is aquatic invasive species and grants are selected to improve our understanding of the impacts of aquatic invasive species on lakes and rivers in the Upper Mississippi River basin, including on changes to water quantity, quality and the connected ecosystem dynamics. A second priority research topic is focused on improving our understanding of PFAS. Grants are selected based on how well they will improve understanding of the fate, persistence, and transport of PFAS as well as how PFAS may impact water quality and/or ecosystem dynamics in water resources.

Coordination Grants

These grants allow other Federal agencies, including those within the Department of the Interior, to use and take advantage of the expertise and capabilities that are available through the network of Institutes. The USGS may accept funds from other Federal departments or agencies for purposes of establishing a grant with an Institute to conduct hydrologic research with Federal programs concerned with water resources problems and issues. Historically, these grants have been used by several agencies include the Environmental Protection Agency and U.S. Army Corps of Engineers. The USGS fully supports and encourages other Federal programs concerned with water resources problems and issues to develop grants with the Water Resources Institutes in cooperation with the USGS.

Student Internships

The NIWR-USGS student internship program provides undergraduate and graduate students with career enhancing field, laboratory, and research experience through participation in USGS activities as interns. The program is a collaborative effort between the WRRA program and NIWR. On a need basis, the USGS through our Science Centers will fund interns hired by the Institute. These interns focus on various hydrologic topics including research to separate atmospheric sources of mercury from legacy mercury contained in sediments and peat, development of new numerical techniques for improving the predictability of temperature models, and improvements to data mining techniques for searching USGS hydrologic databases.

Interns are employees of participating universities and colleges and may be a student from any college or university in the Institute's State. Information about the availability of the Internship program in a State may be obtained by contacting the USGS representative or Institute Director in the State.

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Core Science Systems

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Core Science Systems

Core Science Systems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
National Geospatial Program	**79,454**	**79,454**	**1,408**	**0**	**17,644**	**98,506**
FTE	***234***	***234***	***0***	***0***	***7***	***241***
National Cooperative Geologic Mapping Program	**40,397**	**40,397**	**690**	**-350**	**534**	**41,271**
FTE	***118***	***118***	***0***	***0***	***0***	***118***
Science Synthesis, Analysis and Research Program	**25,972**	**25,972**	**527**	**350**	**57,481**	**84,330**
FTE	***86***	***86***	***0***	***0***	***9***	***95***
National Land Imaging Program	**106,865**	**106,865**	**1,253**	**0**	**16,573**	**124,691**
FTE	***169***	***169***	***0***	***0***	***45***	***214***
Core Science Systems Total	**252,688**	**252,688**	**3,878**	**0**	**92,232**	**348,798**
FTE	***607***	***607***	***0***	***0***	***61***	***668***

The 2023 budget request for the Core Science Systems Mission Area is $348,798,000 and 668 FTE, with a program change of +$92,232,000 and +61 FTE from the 2022 CR Annual Rate level, and +$3,878,000 in fixed costs.

Mission Area Overview

The USGS is the Federal agency responsible for mapping the geologic, geographic, and land features of the United States. The USGS conducts detailed surveys and distributes high-quality and highly accurate topographic, geologic, hydrographic, and biogeographic maps and remotely sensed data to the public. Mapping accuracy enabled by cutting-edge technologies allows precise planning for recreational use on public lands; collaborative conservation with Department of the Interior (Interior) partners; conservation and climate change; critical mineral resource assessments; renewable energy development; transportation and pipeline infrastructure projects; urban planning and development; land change and flood prediction at regional, local, and neighborhood scales; emergency response; and hazards mitigation.

The USGS Core Science Systems Mission Area fulfills the USGS' role as the National Civilian Mapping Agency, including topographic and geologic mapping in support of Federal and State requirements, national geospatial coordination in support of Interior and the Federal Geographic Data Committee, geospatial mapping and applications through the Civil Applications Committee, and satellite operations and remote sensing. In addition, the USGS provides: research, modeling, and analysis of land change science, biological occurrence data acquisition, biological taxonomic analysis and interpretation, computational analytics and synthesis; integration of USGS national data sets, data management, storage, accessibility and policy; preserving geological, geophysical, and paleontological data; managing the archive of geoscience samples, including rocks, fossils, sediments, and ice cores; and managing the network of libraries in support of USGS Earth science research.

The USGS manages the Nation's land imagery to support economic development, land use management, environmental protection, and climate change resilience. Additionally, the USGS Core Science Systems Mission Area houses the bureau's Associate Chief Data Officer with delegated authority from the Interior Chief Data Officer to support the lifecycle and manage the portfolio of data assets from their respective bureau or office, champion data inventory and dissemination, and engage with data users and evaluation units within the organization.

The USGS is the Federal steward of this high-quality geospatial data and provides access to the public through The National Map, the Federal GeoPlatform, the National Land Cover Database, the National Geologic Map Database, the USGS Earth Explorer, the National Biogeographic Map, and the Protected Areas Database of the United States. The USGS also operates Landsat satellites and data systems necessary to understand, monitor, and detect changes that affect the Nation's natural and agricultural resources, economy, public safety and national security, and historical heritage.

FY 2021 Selected Mission Area Accomplishments

- Completed all major Landsat 9 development milestones, including final observatory testing, flight operations system development and testing, ground system testing, and a successful launch from Vandenberg Space Force Base on September 27, 2021.

- Added 75,000 city parks and 4,903 local protected areas to the Protected Areas Database of the US (PAD-US) and updated Federal fee lands from the Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and USDA Forest Service, and State lands for California, Virginia, and West Virginia. The latest PAD-US assessment indicates 12.9 percent (an increase of 0.9 percent) of the Nation's lands and inland waters—equivalent to more than 316 million acres—are permanently protected and primarily managed for biodiversity conservation, making progress on the Administration's conservation goals.

- Completed once-over coverage of US Topo maps using USGS 3D Elevation Program (3DEP) data for the State of Alaska. The approximately 11,700 US Topo maps covering the State of Alaska represent a significant improvement over previously existing map coverage originally compiled in the 1950s and 1960s.

- Achieved 84 percent coverage of the Nation with high-quality elevation data available or in progress by the USGS 3DEP. Completed data collection for the 3D Nation Elevation Requirements and Benefits Study led by the National Oceanic and Atmospheric Administration and the USGS to help define the next generation of 3DEP data based on changing user needs for three-dimensional topographic and bathymetric mapping data.

- Worked with the Nevada Bureau of Mines and Geology, the Illinois State Geological Survey and others on a partnership designed to execute a National Assessment of Geologic Mapping Needs, Benefits and Return on Investment. This assessment, the largest and most comprehensive study of its kind, will better enable the use of geologic maps in planning for sustainable infrastructure and mitigation hazards.

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Core Science Systems
National Geospatial Program

Core Science Systems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
National Geospatial Program	**79,454**	**79,454**	**1,408**	**0**	**17,644**	**98,506**
3D National Topography Model (3DNTM)	[0]	[0]	0	0	1,500	[1,500]
Federal Climate Data Portal	[0]	[0]	0	0	10,000	[10,000]
Geospatial, 3DEP, and Geologic Research and Collection on Tribal Lands	[0]	[0]	0	0	5,000	[5,000]
NGP Baseline Capacity	[0]	[0]	0	0	1,144	[1,144]
FTE	***234***	***234***	***0***	***0***	***7***	***241***

2023 Program Changes

The 2023 budget request for the National Geospatial Program is $98,506,000 and 241 FTE, with a program change of +$17,644,000 and +7 FTE from the 2022 CR Annual Rate level, and +$1,408,000 in fixed costs.

3D National Topography Model (3DNTM) (+$1,500,000/+2 FTE) – The USGS and the National Oceanic and Atmospheric Administration (NOAA) are collaborating towards a "3D Nation vision" for a continuous three-dimensional (3D) elevation surface layer, from the peaks of our mountains to the depths of our waters. The 3D National Topography Model (3DNTM) is the terrestrial portion of the vision, which would integrate and model the Nation's elevation and hydrography in 3D. The 3D Hydrography Program (3DHP) and the next-generation 3D Elevation Program (3DEP) are key components of the 3DNTM vision. Building on the National Hydrography Datasets, in 2023, the USGS would implement the 3DHP to derive hydrography data from 3DEP lidar. Combining the hydrography and elevation data will improve the accessibility of water related data, improve geospatial analysis, and support critical applications. Building on the 3DEP national baseline data, the USGS would develop and implement the next generation of the 3DEP to include bathymetry of inland rivers and lakes and acquire new updated data in locations where wildland fire, hurricanes, anthropogenic, and other changes have altered the landscape.

The 3DNTM would continue the next phase of building a modern elevation foundation and would accelerate Federal, State, Tribal, and underserved community access to the next generation of topographic data, products, and services. The 3DNTM's state-of-the-art data and services would empower communities to plan for infrastructure projects and facilitate improvement of local economies. 3DNTM data would enable communities to effectively respond to climate challenges and natural hazards by providing foundational data to analyze flood risk; manage land and water resources; locate potential areas for clean

energy deployment; and support the mapping of broadband signal propagation to help improve access for underserved communities.

Implementing the 3DNTM requires additional data infrastructure and geospatial operational capacity to fully realize and deliver an integrated topographic foundation for the Nation. With this increase, the USGS would advance 3DHP by expanding the 3DEP Broad Agency Announcement to fund new Federal, State, and local partnerships to acquire high-accuracy hydrography data derived from 3DEP lidar. These foundational data would enable analysis, visualization, and data-driven decisions for the Administration's focus on climate science, infrastructure construction and management, hazards mitigation and response, and natural resources management.

Federal Climate Data Portal (+$10,000,000/+4 FTE) –The USGS would work with other agencies and partners to develop and maintain a Federal climate portal that consolidates and provides accessible climate information to users to respond to climate risks and improve climate resilience.

Serving as a public climate portal, this would integrate climate-relevant data, tools, and information to help Tribal, State and local governments, communities, and commercial entities understand potential climate-related hazards and to guide efforts to build resilience equitably and inclusively to climate impacts. The portal would be an online source of climate data, information, knowledge, and tools from across the Federal research enterprise, made freely accessible to the public. Potential applications for the climate portal by decision makers and the public could include uses such as: exploring the potential impact of climate hazards on human populations, economies, and built and natural environments; assessing vulnerability and risk and determining which risks require actions; evaluating and evolving building standards and designs to help ensure that new infrastructure and capital improvement projects are climate resilient; and preparing climate impact assessments which are required in Federal grant applications.

Funding would support development of a national portal and expand the Federal Geographic Data Committee's (FGDC) capacity. The FGDC would partner with climate portal leadership to define the geospatial data and services requirements and align FGDC services to support the implementation. The FGDC would coordinate and collaborate across Federal agencies to perform a gap-analysis of all available climate data that could be incorporated into a consolidated service hosted through the Federal Geospatial Platform (GeoPlatform). The FGDC would also assist in the development of geospatial standards and develop approaches for addressing federal-wide data-service challenges such as metadata compatibility, data cataloging, and geospatial services delivery.

Geospatial, 3DEP, and Geologic Research and Collection on Tribal Lands (+$5,000,000/+1 FTE) – The USGS would significantly improve the amount of, and access to, geospatial data and mapping information for underserved Tribal communities with availability of data through The National Map and other existing data portals. In coordination with Tribes, the USGS would expand elevation and hydrography data collection over Tribal lands, and geologic mapping information through detailed surveys of areas recognized to be vital to the economic, social, or scientific welfare of Tribes. Foundational elevation, hydrography, and geologic datasets, including acquisition of 3DEP high-resolution lidar data and curation of data and maps, would support a broad range of critical conservation and land management needs of

underserved tribal communities. The proposed increase includes funding requested in FY 2022 (+$5,000,000).

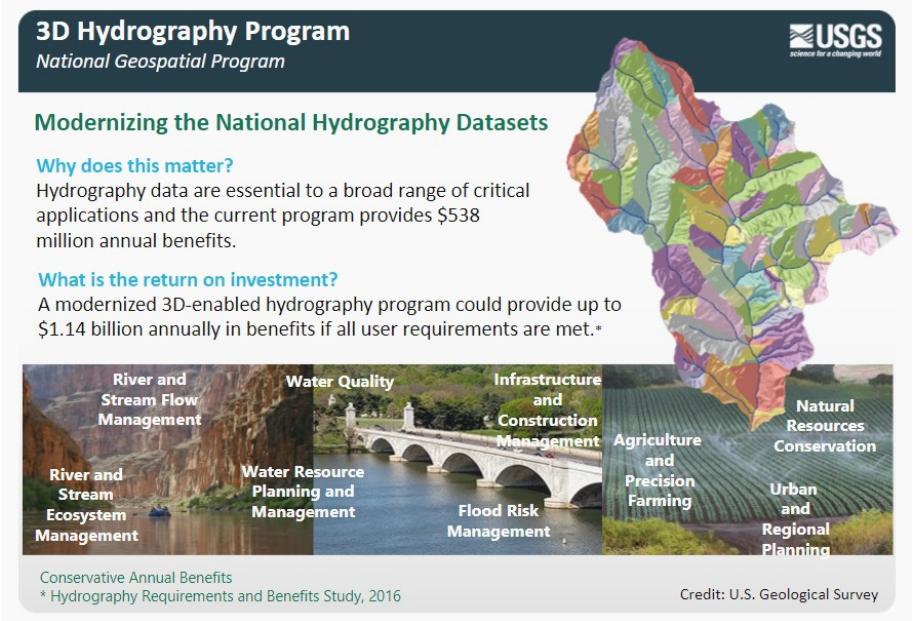
Baseline Capacity (+$1,144,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $1.1 million in the National Geospatial Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The National Geospatial Program (NGP) organizes, updates, and publishes the geospatial baseline of the Nation's topographic information, to advance science, enlighten citizens, and support decision-making through The National Map—a compilation of the foundational 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 government-wide leadership responsibilities for elevation, hydrography and watershed boundaries, and geographic names. As one of the cornerstones of the USGS, The National Map has many uses ranging from recreation to scientific analysis to emergency response. The National Map is easily accessible for display online, as products and services, and as downloadable data allowing the public to enhance their recreational experiences, make life-saving decisions, and support scientific missions. The American people rely on the USGS's publicly available data and mapping to remain informed and to stay healthy and safe.

The goal of the USGS 3D Elevation Program (3DEP) is to provide the first-ever national baseline of consistent high-resolution topographic elevation data, including both the bare Earth surface and 3D point clouds that map the Nation's natural and constructed features. The USGS 3DEP data directly support Departmental and Administration priorities, including climate resilience, conservation, Tribal programs, clean energy deployment, infrastructure, and identification of undiscovered critical minerals. High accuracy 3DEP data are essential to mapping broadband signal propagation to provide internet access to underserved communities, supporting racial and economic equity. Investments in 3DEP support the economy by creating jobs in the private mapping sector that acquire the data through contracts with the USGS, as well as providing high-quality elevation data to inform decisions.

The USGS produces and delivers the Nation's most comprehensive and up-to-date portfolio of surface waters datasets, including the National Hydrography Dataset, the Watershed Boundary Dataset, and the National Hydrography Dataset Plus High Resolution. With the 2023 proposal, the USGS would build on these baseline programs to develop the 3D National Topography Model, which integrates USGS elevation and hydrography datasets to model the Nation's topography in three dimensions (3D). In the future, the 3D National Topography Model would include the next generation of 3DEP data and a modernized 3D Hydrography Program (3DHP), which would completely refresh the Nation's hydrography data and improve discovery and sharing of water-related data. The 3DHP would significantly improve the level of detail and currency of data by deriving a 3D stream network and hydrologic units from accurate, high-quality 3DEP data, as well as hydrologically enforced digital elevation models to support applications like hydrologic and hydraulic modeling. 3DHP would improve information such as streamflow permanence and vastly improve the ability to account for the hydrologic cycle by connecting to wetland, engineered hydrologic systems, and groundwater data. 3DHP would also establish an information infrastructure to support sharing and discovering water-related information in the context of the improved stream network.



The USGS is the lead domestic civilian mapping agency, producing topographic maps for the Nation for more than 130 years. In addition to the standard digital US Topo map product, the USGS Published Maps, Products, and Services (PMPS) program has embarked on a new paradigm of topographic mapping generation and delivery. PMPS has invested in a new cloud-based platform which enables users to request and receive custom, on-demand topographic maps.

The Federal Geographic Data Committee (FGDC) is an interagency coordinating committee, which acts as the lead entity in the Executive Branch for the development, implementation, and review of policies, practices, and standards related to geospatial data. The FGDC is responsible for implementing the Geospatial Data Act (GDA) of 2018 and cross-government geospatial initiatives, including the Geospatial Platform (GeoPlatform), the National Spatial Data Infrastructure (NSDI), and Federal geospatial data portfolio management practices. The FGDC coordinates with other interagency working groups including the Chief Data Officers Council and is responsible for actions in the Federal Data Strategy. The FGDC Office of the Secretariat provides executive, administrative, strategic planning, and technical support to the Committee, and to the National Geospatial Advisory Committee of non-Federal geospatial sector representatives, as directed by the GDA. The FGDC leads the development of the NSDI Strategic Plan, in

accordance with OMB Circular A-16 (the Coordination of Geographic Information and Related Spatial Data Activities).

The Geospatial Data Act of 2018 (GDA; P.L. 115-254; 43 USC Ch. 46) directs covered agencies to include geospatial data in preparing the budget submission under sections 1105(a) and 1108 of Title 31 of the U.S. Code. The Department of the Interior is a covered agency under the GDA, and the Office of the Chief Information Officer (OCIO) provides vision and leadership to Departmental offices and bureaus in all areas of information management and technology. The OCIO's Information Resources Management Strategic Plan 2020-2025 (Plan) articulates a vision to guide and deliver technology and information resources to mission programs and the public. Consistent with the Plan, the OCIO provides oversight and governance across Interior for geospatial programs and submits an annual Joint Certification Statement on geospatial data assets and major geospatial information technology investments, including the GeoPlatform, as a part of the Department of the Interior's Federal IT Acquisition Reform Act Joint Certification Statement in the President's Budget Request.

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Core Science Systems
National Cooperative Geologic Mapping Program

Core Science Systems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
National Cooperative Geologic Mapping Program	**40,397**	**40,397**	**690**	**-350**	**534**	**41,271**
National Cooperative Geologic Mapping Program Projects and 3D Geologic Mapping	[40,397]	[40,397]	0	-350	0	[40,397]
National Cooperative Geologic Mapping Baseline Capacity	[0]	[0]	0	0	534	[534]
FTE	***118***	***118***	***0***	***0***	***0***	***118***

2023 Program Changes

The 2023 budget request for the USGS National Cooperative Geologic Mapping Program is $41,271,000 and 118 FTE, with a program change of +$534,000 and 0 FTE from the 2022 CR Annual Rate level, and +$690,000 in fixed costs. The request includes an internal transfer of -$350,000 and 0 FTE to the National Geological and Geophysical Data Preservation Program.

Baseline Capacity (+$534,000 / 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $534,000 in the National Cooperative Geologic Mapping Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The USGS National Cooperative Geologic Mapping Program conducts geologic investigations and produces geologic maps and three-dimensional geologic framework models in collaboration with State geological surveys and university partners.

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. Federal and State

decision-makers use the digital geologic maps and three-dimensional geologic framework models and visualizations 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.

The Federal mapping component, or FEDMAP, supports research on the Earth's surface and subsurface geologic framework to solve critical societal and scientific problems.

The State mapping component, or STATEMAP, funds the geologic mapping studies conducted by approximately 44 State Geological Surveys through a competitive cooperative agreement program that matches every federally-provided dollar with a State-provided dollar.

The educational mapping component, or EDMAP, funds fully-matched Cooperative Agreements to universities and colleges for undergraduate and graduate students to conduct geologic mapping across the Nation in support of the Administration's priority for educating and training a 21st century workforce under E.O. 14017 (America's Supply Chains).

The National Geologic Map Database (NGMDB) serves as the authoritative, comprehensive, and publicly available repository for the geologic maps and data produced by the NCGMP mapping components. The USGS manages the NGMDB in partnership with State geological surveys.

The USGS' substantial engagement with State governments supports mapping regions with high potential for strategic materials for the supply chain.

Core Science Systems
Science Synthesis, Analysis and Research Program

Core Science Systems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Science Synthesis, Analysis and Research Program	**25,972**	***25,972***	**527**	**350**	**57,481**	**84,330**
Collaborative Climate Innovation Response and Resilience Framework	[0]	[0]	0	0	30,000	[30,000]
Tools Supporting Conservation Planning, Monitoring and Projection	[900]	[900]	0	0	24,600	[25,500]
Assessment of Biodiversity	[0]	[0]	0	0	2,500	[2,500]
NGGDPP Internal Transfer	[0]	[0]	[0]	350	[0]	[350]
Science Synthesis, Analysis and Research Baseline Capacity	[0]	[0]	0	0	381	[381]
FTE	***86***	***86***	***0***	***0***	***9***	***95***

2023 Program Changes

The 2023 budget request for the USGS Science Synthesis, Analysis and Research Program is $84,330,000 and 95 FTE, with a program change of +$57,481,000 and +9 FTE from the 2022 CR Annual Rate level, and +$527,000 in fixed costs.

Collaborative Climate Innovation Response and Resilience Framework (+$30,000,000/ +5 FTE) – The USGS would support select activities on collaborative climate response and resilience that would accelerate the development and delivery of planning tools, models and forecasts for climate adaptation and resilience research. The Framework would provide decision support tools to evaluate the risks and tradeoffs from multiple-use land management decisions including energy development and carbon storage, the combined effects of climate scenarios, and land management and use alternatives on at-risk communities, species, habitats, and ecosystem processes. The USGS would focus on the following:

- Enhanced climate research data and models: Building landscape-scale data for climate research and response modeling; automating data analyses and integration and facilitating access for diverse research, models, and applications; and integrating models to forecast complex consequences of climate change and strategies for climate adaptation or mitigation.

- Mission-spanning research environment: Developing a shared, computational capacity including large-scale hybrid data storage, data discovery tools, and artificial intelligence systems that will integrate multiple existing data streams of variable scale and resolution and readily incorporate advances in sensors, computers, and networking, ultimately leading to accelerated scientific understanding of Earth systems climate responses and resiliency.
- Increased interdisciplinary scientific resources: Investing in open science and technology partnerships to leverage community-enabled climate science research, model development and computational capacity. Researchers will share critical data, co-develop frameworks, and apply models to provide new understanding and actionable science.

America the Beautiful and American Conservation and Stewardship Atlas (+$24,600,000/+4 FTE) – This request would fund the creation of the Administration's American Conservation and Stewardship Atlas (Atlas) and deliver science to inform conservation for the America the Beautiful initiative. The proposed increase includes funding requested in FY 2022 (+$9,600,000) for completing and modernizing the Protected Areas Database of the United States (PAD-US), America's official national inventory of U.S. terrestrial and marine protected areas. The Atlas would provide information needed to track progress towards Administration's goal of conserving 30 percent of America's lands and waters by 2030. The Atlas would also provide an integrated scenario analysis and visualization framework that allows Interior and the broader conservation community to co-produce scenarios and approaches specific to the issues of concern using the best available science. The USGS plans to modernize the PAD-US technology infrastructure to automate integration of partner data and provide national-scale analytics and data delivery in support of the Atlas.

The USGS would lead the development of the Atlas, which has extensive information technology and data curation requirements identified by Federal, State, Tribes, and non-governmental organizations (NGOs) to support conservation tracking efforts in several settings, from protected lands to working lands. This request is responsive to the outcomes of three national listening sessions with a variety of stakeholders, interest groups across the landscape, and the public accentuating the significant need for this Atlas.

This funding would enable the USGS to build the Atlas infrastructure using state-of-the-art technology solutions to integrate data from a variety of sources, develop map and analytical capabilities, partner with State, local, and Tribal organizations as well as NGOs to meet these requirements, and accelerate the delivery of the Atlas by 2025. The USGS would provide direct funding to Tribal Nation organizations, State organizations, NGOs, and other Federal agency data partners to update and collect data on conservation status; develop tracking mechanisms and user-interactive analytics to measure and assess progress towards the Administration's American Conservation and Stewardship Atlas goals; and implement automated data workflows to improve access, use, and availability of authoritative data would be accelerated to use science-based conservation actions.

Assessment of Biodiversity (+$2,500,000/+0 FTE) – The USGS proposes to deliver a National Biodiversity Assessment Dashboard to conduct an initial assessment that identifies nationwide biodiversity metrics; evaluates the role of protected areas; and projects vulnerabilities under future climate conditions. This assessment will allow USGS to provide vital information to help communities and Tribes to implement climate adaptation, resilience and clean energy strategies and assist in providing equitable access to

managed lands for underserved communities. The National Biodiversity Assessment Dashboard will be integrated with the Protected Areas Database of the United States (PAD-US) to facilitate on-demand biodiversity assessments and analysis on protected area lands. The proposed increase includes funding requested in FY 2022 (+$2,500,000).

Baseline Capacity (+$381,000/ 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $381,000 in the Science Synthesis, Analysis and Research Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Science Synthesis, Analysis, and Research Program (SSAR) provides analysis and synthesis of scientific data and information, interdisciplinary research to improve understanding of Earth system changes, and preservation of scientific data and samples and library collections. This program strives to accelerate research and decision-making through data science, information delivery, advanced computing, biodiversity analytics, multi-hazard risk assessments and preservation of geoscientific assets for reuse. SSAR ensures that data are strategically managed, integrated, and easily available to decision makers and others as they focus on issues associated with Earth and life science processes.

The program includes the Science Analytics and Synthesis Program; the National Geological and Geophysical Data Preservation Program; the Geologic Materials Repository; the J.W. Powell Center for Analysis and Synthesis; and the USGS Library. Answers to today's science challenges are complex, multi-disciplinary, and global in scope. Access to scientific data, samples and literary resources are the foundation of scientific discovery. These assets require preservation, modernization, and documentation so that they are available for future research. The Nation has invested heavily in the initial acquisition of these scientific resources and the USGS is making these data and unique historical assets Findable, Accessible, Interoperable, and Reusable.

The SSAR program, through interdisciplinary approaches, tools, and expertise, and strategic partnerships with the Earth science community, provides the long-term management and public distribution of scientific resources that are collected, processed, analyzed, and reused by researchers who conduct broad, complex analyses using the program's high-performance computing, enterprise data management, and historical research assets contained in the vast USGS scientific collections. USGS publications and science data are distributed and managed through a suite of enterprise data management applications such as the USGS Publications Warehouse and ScienceBase, a trusted digital repository; complex analysis is conducted using advanced research computing capacity including powerful supercomputers, large data transfer and storage, training, and expert consulting. Scientists, policymakers, and land conservation and resource management decision-makers rely on immediate access to this timely, well-curated, high-quality science to make well-informed decisions.

The USGS, other Interior bureaus, and State Geological Surveys manage a wealth of geological data and physical samples. The National Geological and Geophysical Data Preservation Program provides grants to State Geological Surveys, and funds projects in Interior bureaus, to document, modernize and archive these valuable assets and make them available to the public. The USGS Geological Materials Repository provides bureau-wide consultation, training, and repository services for USGS scientific working collections management. The USGS Library, authorized by Congress in 1879, is recognized as one of the world's largest Earth and natural science libraries. Each year, the USGS Library fills more than 2.3 million information requests (journal subscriptions, phone inquiries, online requests) and receives an estimated 10,000 visitors.

There is an imminent need to mitigate threats and foster resiliency to support conservation of America's lands, waters, and biodiversity. SSAR is engaged in interagency efforts, like those called for in a recent Administration report on "Conserving and Restoring America the Beautiful," to accelerate the application of scientific information in planning and decision-making. SSAR partners with natural resource managers to co-produce purpose-built tools such as the American Conservation and Stewardship Atlas, biogeographic data and science products, ensuring usefulness for science-based management decisions. Employing expertise and resources in data management, high-performance computing, and visualization, SSAR is working within USGS, Interior, and with external partners to compile, synthesize, and analyze data representing species, their habitats, threats and protections. The Protected Areas Database of the United States is America's official national inventory of U.S. terrestrial and marine protected areas that are dedicated to the preservation of biological diversity and to other natural, recreation, and cultural uses by Federal, State, Tribal, and local governments and non-governmental organizations manage these protected areas. Integration of these data provides the foundation for multi-hazard risk and vulnerability assessments and forecasting of ecological change.

USGS Contributions to America the Beautiful

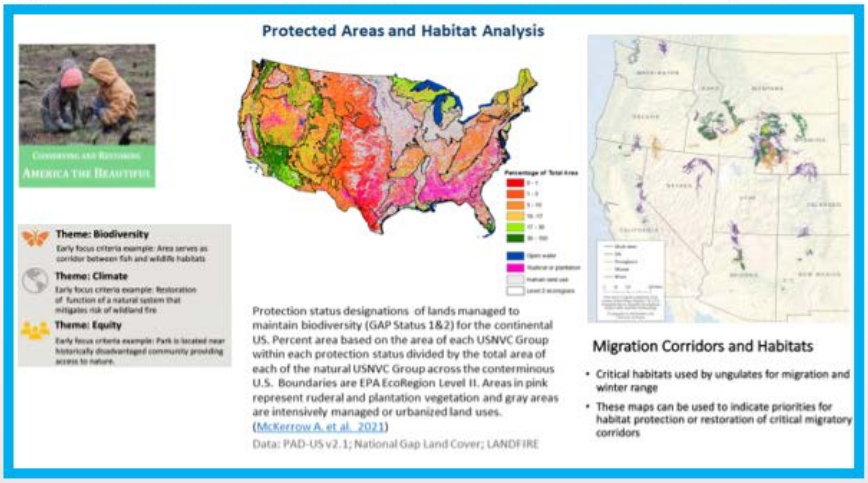
Science Synthesis, Analysis and Research

Why does this matter?

Three immediate problems threaten the lands, waters, and wildlife of the Nation: disappearance of nature, climate change, and inequitable access to the outdoors. America's economy, estimated at $460 billion in outdoor recreation, heavily depends on conserving natural places and wildlife.

What is the return on investment?

The USGS is leading interagency development of the American Conservation and Stewardship Atlas and several Committees to identify potential data contributions, broad engagement strategies, and effective science approaches to inform conservation, restoration, and stewardship status.



Credit: U.S. Geological Survey

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Core Science Systems
National Land Imaging Program

Core Science Systems $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
National Land Imaging Program	**106,865**	**106,865**	**1,253**	**0**	**16,573**	**124,691**
Science Research and Investigations	**14,557**	**14,557**	**37**	**0**	**75**	**14,669**
Science Research and Investigations Baseline Capacity	[0]	[0]	0	0	75	[75]
Satellite Operations	**84,337**	**84,337**	**940**	**0**	**6,997**	**92,274**
Satellite Operations	[84,337]	[84,337]	0	0	6,546	[90,883]
Satellite Operations Baseline Capacity	[0]	[0]	0	0	451	[451]
Land Cover Monitoring and Assessments	**7,971**	**7971**	**276**	**0**	**9,501**	**17,748**
Tools Supporting Conservation Planning, Monitoring and Projection	[3,858]	[3,858]	0	0	5,400	[9,258]
Biologic Carbon Sequestration	[0]	[0]	0	0	4,000	[4,000]
Land Cover Monitoring and Assessments Baseline Capacity	[0]	[0]	0	0	101	[101]
FTE	***169***	***169***	***0***	***0***	***45***	***214***

2023 Program Changes

The 2023 budget request for the National Land Imaging Program is $124,691,000 and 214 FTE, with a program change of +$16,573,000 and +45 FTE from the 2022 President's Budget level, and +$1,253,000 in fixed costs.

Satellite Operations (+$6,546,000/+15 FTE) – Earth observation data is the foundation of Earth and climate science and research. The USGS Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota collects, processes, archives and provides the Nation with digital land-surface images

acquired by satellite and airborne sensors. These data and research inform land and resource managers how landscapes and associated natural resources are changing at local, regional, and global scales.

This request would increase funding to hire needed expertise for ground operations and to replenish the ground and flight systems infrastructure for future Landsat missions. The USGS must maintain and replenish these systems with optimal technology to ensure that these billion-dollar space missions continue to be safely operated and fully productive for many years to come. FY 2023 is a critical year for the USGS and the National Aeronautics and Space Administration (NASA), given Landsat 9's recent launch and the need for continued operations of two other space missions—Landsat 7 and Landsat 8. With this increase, the USGS would ensure the optimal and continuous imaging of the Earth's surface and would ensure that government, academic, and private users receive high-quality and timely Landsat data and products.

Tools Supporting Conservation Planning, Monitoring and Projection (+$5,400,000/+20 FTE) – The USGS proposes to accelerate the delivery of land change monitoring assessment and projection (LCMAP) activities including expansion to Alaska, Hawaii, and the U.S. Territories. This would allow an analysis of rates and trends in land cover and condition from the past to the present; support linking the analyses to protection status and land ownership; and include an assessment of causes of landscape change, including land use, natural disturbance, and climatic factors. This information is important because monitoring and assessing changes in historic and current land cover—and their subsequent impacts on human and biological communities—help scientists better understand the drivers and impacts of these changes, including those from ecosystem disturbance, hazard events and surface water dynamics. The delivery will include modeling of climate scenarios, with national-scale maps of past, present, and potential future landscape conditions and development of conservation scenarios supporting the Administration's America the Beautiful initiative. The proposed increase includes funding requested in FY 2022 (+$5,400,000).

Biologic Carbon Sequestration (+$4,000,000/+10 FTE) – The USGS proposes to apply multi-sensor analysis and machine learning to enhance, streamline, and deliver improved assessment methodologies and produce regular assessments and monitoring of ecosystem carbon. The USGS would continue to develop land use change and economic scenarios of enhanced carbon management and avoided emissions in the public land management portfolio. The Survey would work with land management agencies to identify methods that could optimize the protection of carbon resources to serve stakeholders (e.g., forestry, biodiversity). This effort proposes to initiate studies on the feedback between climate change, wildfire, permafrost thaw, hydrologic change, carbon flux, infrastructure, and vulnerability of landscapes in Alaska, an area with rapid climate change. The proposed increase includes funding requested in FY 2022 (+$4,000,000).

Baseline Capacity (+$627,000/ 0 FTE) – The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $627,000 in the National Land Imaging Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

Our Nation's economic security, environmental vitality, and climate resiliency rely on the USGS's continuous monitoring of the Earth's continents, islands, and coastal regions. The USGS through the EROS Center in Sioux Falls, South Dakota, provides the world's largest civilian archive of remotely sensed digital land-surface images for land, inland water, and coastal resource management. This information empowers research and decision-making by land resource and environmental managers in all 50 States and 185 countries.

The USGS plays a leading role in land surface observations through its Landsat satellite missions that are designed, launched, and operated in collaboration with the National Aeronautics and Space Administration (NASA) under the agencies' Sustainable Land Imaging (SLI) partnership. This partnership ensures continued long-term operational provision of land remote sensing data to U.S. citizens on a full, free, and open basis. Through EROS, the USGS operates the Landsat 7, Landsat 8, and Landsat 9 satellites, the world's only operational civil satellites with both thermal and short-wave infrared sensors. These satellites provide near-weekly Landsat observations, supporting hundreds of thousands of government, commercial, and academic users across the Nation. Landsat's unique 50-plus year data record enables U.S. users to record, study, understand, and better manage landscape change at local, regional, and global scales. The USGS processes and distributes Landsat data and maintains the long-term Landsat data archive. Through its use of commercial cloud data services, the USGS is exponentially increasing the amount of Landsat data products provided to users at no cost: from tens of millions to hundreds of millions of products each year.

In FY 2023, USGS would continue its SLI partnership with NASA to develop Landsat Next, the successor to the Landsat 8 satellite, and to explore SLI international and commercial partnerships. USGS funding would focus on conducting ground system technical assessments; finalizing mission, spacecraft, instrument and ground system requirements; developing acquisition strategies for the USGS ground and flight operations procurements; and investigating ground network commercial capabilities. The USGS would also work closely with NASA to develop the Landsat Next operations concept and project management plans. The Administration will make key strategic decisions for Landsat Next in the upcoming FY 2024 Budget process.

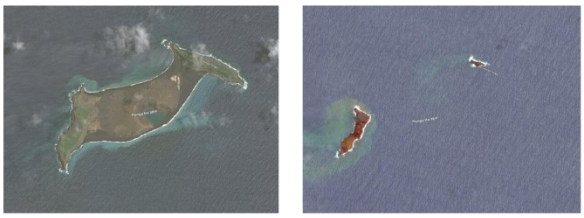
In addition to Landsat data, the USGS collects, processes, archives and provides the Nation with digital land-surface image data acquired by numerous other satellite and airborne sensors, including Uncrewed Aircraft Systems. These data meet a wider range of user needs than Landsat systems can provide for on their own. The USGS supports world-class remote sensing research and development, conducts land cover monitoring and assessments, and provides land and natural resource managers, policy makers, and other users with related data, tools, and information products. These activities include the innovative Land Change Monitoring, Assessment and Projection Project and authoritative National Land Cover Database. These and other USGS products are fundamental to well-informed local, Tribal, State, and Federal land use and management decisions that empower community safety, economic prosperity, sustainable development, and climate change adaptation. They also provide crucial support to the America the Beautiful initiative and related Interior land conservation activities.

The USGS National Civil Applications Center (Center) uses Earth observations from military and Intelligence Community sensors to detect wildland fires, compile Incident Commanders' wildfire response

maps, and to monitor global volcanos for aviation safety and local government information. The Center also manages the interagency Civil Applications Committee to oversee and facilitate appropriate Federal civil agency access to, and use of, military, intelligence, and commercial Earth observations. These observations are used extensively by Interior, the USGS, and numerous agencies for disaster response, environmental monitoring, and scientific research.

USGS Providing High-Resolution Data to Support Tonga Damage Assessments

The January 2022 eruption of the Hunga Tonga Hunga Ha'apai volcano was the world's largest volcanic blast since the 1991 eruption of Mount Pinatubo in the Philippines. The USGS, member of the International Charter Space and Major Disasters, acquired high resolution satellite to provide pre- and post-event imagery for damage assessments. The USGS Earth Resources Observation and Science Center also made this data available on its Hazard Data Distribution System (https://hddsexplorer.usgs.gov). High resolution satellite imagery was vital in helping scientists understand the impacts of this volcanic eruption and subsequent tsunami.



High-resolution satellite imagery captured Hunga Tonga-Hunga Ha'apai volcano before and after the January 15, 2022 eruption. Credit: © 2022 Maxar DigitalGlobe NextView License

The NLI program supports the requirements of the 1992 Land Remote Sensing Policy Act (P.L. 102-555).

Science Support

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Science Support

Science Support $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Administration and Management Program	**73,787**	**73,787**	**3,666**	**0**	**18,584**	**96,037**
FTE	***354***	***354***	***0***	***0***	***36***	***390***
Information Services Program	**21,947**	**21,947**	**452**	**0**	**10,761**	**33,160**
FTE	***59***	***59***	***0***	***0***	***18***	***77***
Science Support Total	**95,734**	**95,734**	**4,118**	**0**	**29,345**	**129,197**
FTE	***413***	***413***	***0***	***0***	***54***	***467***

The 2023 budget request for the Science Support Mission Area is $129,197,000 and 467 FTE, an increase of +$29,345,000 in program changes and +54 FTE from the 2022 CR Annual Rate level and +$4,118,000 in fixed costs.

Mission Area Overview

Science Support provides the executive leadership and business and information services within the USGS. The offices that comprise Science Support provide operational functions and services, including: acquisitions and grants; financial management; communications; budget, performance, and strategic planning; monitoring and evaluation of science quality and integrity; information management and technology services; technology transfer; international partnerships; intellectual property; directives management; human capital; diversity and equal opportunity; and the Freedom of Information Act. Each of these functions is crucial to providing the guidance, direction, support, and oversight as part of conducting USGS quality science.

FY 2021 Selected Mission Area Accomplishments

- Developed a Quality Management System (QMS) Manual comprised of requirements designed to meet the quality needs of 500 USGS laboratories across the Country. Through the implementation of the QMS, the resultant USGS laboratory data will be of known and documented quality, uphold the Bureau's scientific reputation and Fundamental Science Practices, and underscore its mandate to provide reliable science to address pressing societal issues.

- Supported all activities associated with response to the Solar Winds Cyber incident, including patching all systems within established timeframes and providing audit capabilities for incident analysis. This resulted in minimal disruption of services to the public for our scientific data.

- Enhanced Scientific Integrity at USGS by sustaining and fostering a culture of scientific integrity through employee engagement surveys and feedback reports to develop enhancements to the USGS Science Quality and Integrity Program. This engagement allows the USGS to continue to conduct its scientific mission and maintain data collection and publications that are free from falsification, fabrication, plagiarism, and censorship, as well as adhering to the Code of Scientific and Scholarly Conduct.

- The USGS collaborated with school districts and other educational institutions that have work transition programs for students (mostly ages 18–22) with cognitive and other disabilities. Known as STEP (Secondary Transition to Employment Program – USGS Partnership), students have training experiences with USGS to gain valuable job skills to support their goals of seeking employment and living independently.

- Supported Cloud Hosting Solutions for 27 projects leveraging artificial intelligence (AI) and machine learning (ML) models to enhance scientific investigations and develop applied algorithms, allowing the USGS to provide the critical information management and technology foundation to advance the mission of the USGS.

Science Support
Administration and Management

Science Support $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Administration and Management Program	**73,787**	**73,787**	**3,666**	**0**	**18,584**	**96,037**
Scientific Integrity, Diversity, Partnerships with Tribes, and Support for Enterprise Science	[1,628]	[1,628]	0	0	8,800	[10,428]
Federal Electric Fleet (ZEV)	[0]	[0]	0	0	6,131	[6,131]
Justice40 Initiative	[0]	[0]	0	0	225	[225]
HR Support	[0]	[0]	0	0	160	[160]
DOI Diversity, Equity, Inclusion, and Accessibility Initiatives	[0]	[0]	0	0	800	[800]
Administration and Management Baseline Capacity	[0]	[0]	0	0	2,468	[2,468]
FTE	***354***	***354***	***0***	***0***	***36***	***390***

2023 Program Changes

The 2023 budget request for Administration and Management Program is $96,037,000 and 390 FTE, with a program change of +$18,584,000 and +36 FTE from the 2022 CR Annual Rate level, and +$3,666,000 in fixed costs.

Scientific Integrity, Diversity, Partnerships with Tribes, and Support for Enterprise Science (+$8,800,000 / +33 FTE) – The proposed increase includes funding requested in FY 2022 (+$7,000,000 / +30 FTE) that would improve science support providing the essential resources for the USGS to perform its scientific mission goals. The FY 2023 request (+$1,800,000 / +3 FTE) broadens these efforts while increasing support for Tribes and enterprise science services.

The USGS would design tools and mechanisms to redress historic and current injustices in underserved communities. These tools would support effective equity measures, necessary to understand and address inequities while promoting innovative partnerships among the science community to participate in all aspects of USGS science benefits and opportunities.

The USGS would build scientific capacity in Tribal communities through enhancements to the USGS Technical Training in Support of Native American Relations program, which supports USGS employees to design and conduct technical training for staff of Tribal governments or organizations. The USGS would aid in building scientific capacity in Native communities by leveraging USGS expertise across all Mission Areas and Regions to grow the most needed scientific skills. Work would be done exclusively in collaboration with a Tribal entity to ensure that training successfully meets their needs. The USGS would also create science partnerships and internships for Tribal youth through work with Tribes and Native American organizations, emphasizing traditional ecological knowledge to acknowledge the understanding and wisdom of Tribal elders and respect Tribal teachings. This initiative will support a team of Tribal youth at the Native Youth Community Adaptation Leadership Congress and provide USGS internships for college students on the team.

Additionally, the USGS would enhance the core functions that make it possible to produce world-class science, including scientific integrity, diversity, and business services. The USGS would protect and enhance scientific integrity for the Department and within the USGS by implementing and maintaining key recommendations from a staff survey about scientific integrity, through the use of best practices from the Interior Scientific Integrity Officers Council, and through the use of Presidential Memoranda on scientific integrity. The recommendations include strengthening USGS scientific integrity policies, safeguarding protections against political interference, enhancing the culture of science quality and integrity, and providing opportunities for the professional development and advancement of USGS scientists.

The USGS would also develop a plan to build and sustain human capital pipelines for underserved communities and continue to develop a skilled and a high-performing workforce needed to meet the USGS 21st Century Science Strategy, serving the Nation and advancing diversity goals. These opportunities include engaging Tribal youth in USGS science to support scientific diversity in STEM education and underserved communities; financial assistance (grants and cooperative agreements), research, internships, scholarships, and fellowships to the Nation's Historically Black Colleges and Universities, Minority Serving Institutions, and eligible community colleges to encourage students to continue studies and pursue advanced degrees in natural science fields that are critical to the USGS.

Zero Emission Vehicle Fleet Conversions (+$6,131,000/+0 FTE) – The 2023 budget includes funding to accelerate the conversion of USGS's fleet to zero emission vehicles (ZEVs) and provide charging stations and hydrogen fueling stations to support those vehicles and future ZEVs. This conversion will immediately reduce the Interior's contributions to greenhouse gas emissions and dependence upon hydrocarbons. The investment in infrastructure will support these new vehicles and ensure charging infrastructure is available for subsequent ZEVs. This project is being coordinated across Interior and with other agencies to maximize utility of charging and hydrogen fueling stations in areas where multiple agencies operate. The funding also supports a small planning and coordination function to effectively deploy the fleet and charging infrastructure.

Justice40 Initiative (+$225,000/+1 FTE) – The 2023 budget includes $4.0 million Department-wide, including $250,000 for USGS, for dedicated staff resources to provide programmatic expertise, coordination, and outreach support to implement the Justice40 Initiative to increase environmental justice in Federal programs. Interior bureaus and offices are an important component of the Administration's objective for 40 percent of overall benefits of certain Federal investments that impact climate change and

generate clean energy to be directed to disadvantaged communities. Interior has identified more than 50 programs with a budget totaling over $3.0 billion that contribute to this forward-thinking initiative. Funding in 2023 will be used to develop methodologies to identify and quantify the benefits of Justice40 programs, demonstrate how and where covered programs distribute benefits, and pursue strategies for maximizing the benefits to vulnerable communities in the future. Agencies will also pursue and document stakeholder engagement in the initiative.

HR Support (+$160,000 / +1 FTE) - In line with the Administration's Human Resources recruitment and hiring efforts, the USGS would support rebuilding core functions and enhancing capacities to effectively manage resources within Science Support required to assist management with new major initiatives, including the Bipartisan Infrastructure Law priority to restore science and administration priorities identified in Executive Orders 14008 (*Tackling the Climate Crisis at Home and Abroad*) and 14017 (*America's Supply Chains*). These investments support the workforce that is vital for sustaining and advancing the scientific research mission.

DOI Diversity, Equity, Inclusion, and Accessibility Initiatives (+$800,000/+2 FTE) – The USGS budget includes $800,000 as part of a Departmentwide Diversity, Equity, Inclusion, and Accessibility budget initiative to address identified high-priority needs in support of Executive Order 13985, Advancing Racial Equity and Support for Underserved Communities Through the Federal Government, and Executive Order 13988, Preventing and Combating Discrimination on the Basis of Gender Identity and Sexual Orientation. As part of this initiative, the Department, bureaus, and offices will jointly conduct a review of the Diversity, Equity, Inclusion, and Accessibility program across Interior to identify gaps, challenges, and best practices and to examine Department and bureau roles, responsibilities, and governance.

Baseline Capacity (+$2,468,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $2.5 million in the Administration and Management Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

PROMOTING DIVERSITY IN THE FEDERAL WORKFORCE

Science Support

USGS

WHAT ARE WE DOING?

The USGS recognizes its talented and diverse workforce as a key asset. Our success as an agency reflects the quality and skill of our people. The USGS is committed to seeking out and retaining a highly skilled and diverse workforce to ensure we accomplish our mission in the most effective, efficient, and robust way possible.

WHY DOES THIS MATTER?

One of the core values of the USGS is the importance of diversity in our science and our workforce. The USGS is committed to creating opportunities for all.

The GeoGirls Visit a Volcano Monitoring Station at Mount St. Helens
Source: USGS

The offices and personnel that make up Administration and Management include the Director's Office and the Offices of: Administration; Budget, Planning, and Integration; Communications and Publishing; Science Quality and Integrity; International Programs; the Freedom of Information Act Officer; and Diversity and Equal Opportunity.

These activities, along with Information Services, have historically required approximately 12 percent of the total USGS budget to meet the statutory and regulatory requirements, as well as other standards that are the expected level of good business practice for any federal scientific agency and for the Department of the Interior. While funds directly appropriated to Science Support's two programs— Administration and Management, and Information Services— represent the largest share of bureau funds used for these necessary support activities, the balance of funding to sustain these programs comes from the science programs. Additional information can be found in the USGS Account and Sundry Exhibits chapter under Section 403 Compliance.

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.

SCIENTIFIC INTEGRITY AND FUNDAMENTAL SCIENCE PRACTICES

Science Support

WHAT ARE WE DOING?

The USGS is dedicated to preserving the integrity of the scientific activities it conducts and that are conducted on its behalf. The USGS will not tolerate loss of integrity in the performance, use, or communication of scientific activities and their results.

WHY DOES THIS MATTER?

The responsible planning, conduct, and communication of research is the bedrock of USGS science. Sustaining and fostering a culture of scientific integrity means conducting our work free from falsification, fabrication, plagiarism, and censorship, as well as adhering to the Code of Scientific and Scholarly Conduct.

Dr. Carol Meteyer at the National Wildlife Health Center applying knowledge and expertise in diverse scientific areas to study the most critically important diseases wildlife populations.
Source: USGS

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Science Support
Information Services

Science Support $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Information Services Program	**21,947**	**21,947**	**452**	**0**	**10,761**	**33,160**
Integration of Standard Cybersecurity Architecture	[0]	[0]	0	0	2,492	[2,492]
IT Support for R&D, including Cloud and High-Performance Computing	[2,500]	[2,500]	0	0	8,000	[10,500]
Information Services Baseline Capacity	[0]	[0]	0	0	269	[269]
FTE	***59***	***59***	***0***	***0***	***18***	***77***

2023 Program Changes

The 2023 budget request for Information Services Program is $33,160,000 and 77 FTE, with a program change of +$10,761,000 and +18 FTE from the 2022 CR Annual Rate level, and +$452,000 in fixed costs.

Integration of Standard Cybersecurity Architecture (+$2,492,000 / +5 FTE) – The Federal Information Security Modernization Act requires a comprehensive framework for ensuring the effectiveness of cybersecurity controls over information resources that support Federal operations and assets, as well as effective management and oversight of cybersecurity risks and Agency cybersecurity programs. The USGS would address critical gaps and requirements in accordance with administration cybersecurity requirements to keep the USGS systems secure and strengthen our security posture as we evolve to meet new challenges. The USGS would support transition to Internet Protocol version 6 in accordance with OMB M-21-07; planning and architecture support to migrate to a Zero-Trust Architecture Model in accordance with NIST Special Publication 800-207; and resources to improve cybersecurity assessment requirements for High Value Assets such as Security Architecture Reviews and Penetration Testing.

IT Support for R&D, including Cloud and High-Performance Computing (+$8,000,000; +13 FTE) The USGS would invest in breakthrough IT capabilities that strengthen mission capabilities and support forecasting and foundational predictive science. The continued advancement of USGS science and services depends on increasing computing networks' storage and capacity—fundamental IT requirements for the USGS that will allow for seamless integration across data, applications, and locations. The USGS would focus on infrastructure, security, and application components to a Cloud Smart architecture, which will

support the achievement of goals related to the USGS's 21st Century Science Mission and Vision, alongside 21st Century IT. The USGS would create an integrated, agile, and secure hosting environment that advances analytical and visualization capabilities, artificial intelligence, emerging machine-assisted processes, and service delivery models supporting mission requirements. The proposed increase includes funding requested in FY 2022 President's Budget Request (+$8,000,000).

Baseline Capacity (+$269,000 /0 FTE) — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $269,000 in the Information Services Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

Program Overview

The Information Services subactivity includes the Office of the Associate Chief Information Officer (ACIO). The Information Services subactivity provides the critical Information Management and Technology (IMT) foundation for the USGS science mission by implementing advances in IMT and using them to facilitate research, data gathering, analysis, modeling, scientific collaboration, knowledge management, and work processes. The Information Services subactivity supports numerous IMT services such as the USGS information assurance program; network capacity and cloud services; applications and customer support; information investment, management, and delivery programs; and supports the Department of the Interior's IMT activities through the Department of the Interior's Working Capital Fund.

INFORMATION MANAGEMENT AND TECHNOLOGY

Science Support

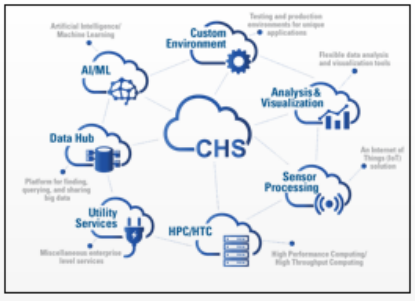
USGS

WHAT ARE WE DOING?

As the Nation's largest water, earth, and biological science and civilian mapping agency, the USGS works in cooperation with more than 2,000 organizations across the country to provide reliable, impartial scientific information to resource managers, planners, and other customers

WHY DOES THIS MATTER?

Services provide seamless access to USGS research and monitoring data from across the nation. Users have the ability to search, browse, or use a map-based interface to discover USGS data.



USGS services include high-performance computing, mapping, arc-gis, data visualization, sensor processing, artificial intelligence, machine learning, analytics, data storage, and much more.
Source: USGS

Facilities

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Facilities

Facilities $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Rental Payments and Operations & Maintenance Program	**104,719**	**104,719**	**3,093**	**0**	**5,427**	**113,239**
FTE	***66***	***66***	***0***	***0***	***0***	***66***
Deferred Maintenance and Capital Improvement Program	**74,664**	**74,664**	**0**	**0**	**176**	**74,840**
FTE	***2***	***2***	***0***	***0***	***0***	***2***
Facilities Total	**179,383**	**179,383**	**3,093**	**0**	**5,603**	**188,079**
FTE	***68***	***68***	***0***	***0***	***0***	***68***

The 2023 budget request for the Facilities Mission Area is $188,079,000 and 68 FTE, an increase of +$5,603,000 in program changes from the 2022 CR Annual Rate level and +$3,093,000 in fixed costs.

Mission Area Overview

The USGS Facilities provides safe, functional workspaces to accomplish the bureau's scientific mission, with an emphasis on the USGS mission driving facility needs. The Facilities Mission Area goal is to meet bureau science needs while optimizing facility locations, functionality of workspace, and lowering operating costs.

The USGS defines facilities to include all sites where USGS activities are housed, and mission related work is conducted. Facilities typically provide space for offices, laboratories, storage, parking, shared support for cafeterias, conference rooms, and other common space uses. The USGS also classifies its eight larger (greater than 45 feet in length) research vessels as laboratory facilities. Owned assets are usually part of a campus of buildings, for example, the Eastern Ecological Science Center includes all associated land, buildings, and other structures.

The USGS Facilities Activity funds rent; basic facility operations; security; facility maintenance, in compliance with Federal, State, and local standards; and provides a safe, sustainable working environment for employees, visiting partners, and customers.

The Facilities Program partners with other Federal agencies, State and local governments, universities, and the private sector. Collaboration with these partners supports the USGS's scientific work and facilitates communication of the results of this work to the public, emergency managers, and the scientific community. Partners generally have a mission similar to that of the USGS. In these instances, the USGS occupies space in return for science-related services or space is acquired as part of a larger cooperative agreement. Typically, the USGS pays a reduced rent rate or the cost of operations and maintenance. Co-locations with other bureaus, agencies, or universities is a space management strategy that advances science, creates partnerships, and facilitates recruitment of new talent.

FY 2021 Selected Mission Area Accomplishments

- Completed construction of office and joint USGS/Bureau of Reclamation (BOR) laboratory space at BOR Boulder City, NV campus in July 2021. This USGS project relocated two large USGS Science Centers (the Western Ecological Research Center and Nevada Water Science Center) from GSA-leased space to Interior/BOR-owned space, effective September 2021, resulting in an estimated $20 million rent savings over a 20-year period.
- The design for the new USGS laboratory at Moffett Field, CA was completed in August of 2021 and a construction contract has been awarded for the site work, concrete, and structural steel. The remaining bid packages will be evaluated and awarded in the coming months. The project broke ground in November of 2021 .
- The Forest and Rangeland Ecosystems Science Center (FRESC), Snake River Field Station (SRFS) and The Idaho Water Science Center (IDWSC) completed co-location in newly renovated facilities at the IDWSC in Boise, ID in August 2021. This consolidation resulted in vacating approximately 7,000 sf of space at Boise State University by moving staff and equipment into a new purpose-built facility and vacant USGS-owned space renovated to the tenant organization's specific needs. This consolidation will result in a savings of $4.4M over 20 years.
- The design for the new Hydrological Instrumentation Facility on the campus of the University of Alabama was completed in June of 2021. The Environmental Assessment and the land easement agreement with the University was completed at the same time.
- The USGS conceptual design and site plan for the Hawaii Volcano Observatory Field Station at the Volcanoes National Park was approved by the National Park Service in June 2021.

Facilities
Rental Payments and Operations and Maintenance

Facilities $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Rental Payments and Operations & Maintenance Program	**104,719**	**104,719**	**3,093**	**0**	**5,427**	**113,239**
Rental Payment BaselineCapacity	[0]	[0]	0	0	5,427	[5,427]
FTE	***66***	***66***	***0***	***0***	***0***	***66***

2023 Program Changes

The 2023 budget request for Rental Payments and Operations and Maintenance Program is $113,239,000 and 66 FTE, with a program change of +$5,427,000 and 0 FTE from the 2022 CR Annual Rate level, and +$3,093,000 in fixed costs.

Baseline Capacity — The 2023 budget includes important investments in programs needed to help strengthen America and be more competitive as the world continues to change. These investments include funding needed to maintain a strong, talented workforce and the must pay requirements needed to continue to fulfill the USGS mission. The budget includes $5.4 million in the Rental Payments and Operations and Maintenance Program which reflects the incremental amount needed to cover the fixed costs associated with mission operations in FY 2022. This request in combination with the FY 2023 fixed costs amounts will allow the program to meet must pay requirements without impacting program activities.

PROPERTY AND LABORATORY MANAGEMENT

Facilities

USGS

WHAT ARE WE DOING?

The USGS has more than 400 locations across the United States. Its mission is to collect, monitor, analyze, and provide scientific understanding about natural resource conditions, issues, and problems. To support these mission areas, the USGS occupies nearly 1,200 assets, including buildings, land, structures, and vessels.

WHY DOES THIS MATTER?

Priority of the program is to continue the important work of the Department of the Interior and the USGS, while also maintaining the health and safety of our employees and community.

The USGS National Center (105 acres) located in Reston, Virginia consolidates the agency's widespread activities for the 2,200 Survey employees located in the Washington, D.C, metropolitan area. The site also provides habitat for many native and migratory birds, insects, and large and small mammals.
Source: USGS.

The Rental Payments and Operations and Maintenance Program provides the USGS with funding needed to pay for annual rent and operations and maintenance costs. Rental payments are made to the General Services Administration (GSA), other Federal sources, private lessors, and cooperators for space occupied by the USGS. The USGS is continually working to enhance facilities efficiencies, in terms of both costs and mission needs.The USGS has unique facility requirements for supporting science functions and relies heavily on the GSA to meet those needs, including modern laboratory space.

Facilities
Deferred Maintenance and Capital Improvements

Facilities $ in thousands	2021 Enacted	2022 Annualized CR	2023 Fixed Costs	2023 Internal Transfers	2023 Program Changes	2023 Request
Deferred Maintenance and Capital Improvement Program	**74,664**	**74,664**	**0**	**0**	**176**	**74,840**
Department of the Interior Field Communications Modernization (DIFCOM)	[0]	[0]	0	0	176	[176]
FTE	***2***	***2***	***0***	***0***	***0***	***2***

2023 Program Changes

The 2023 budget request for Deferred Maintenance and Capital Improvement Program is $74,8400,000 and 2 FTE, with a program change of +$176,000 and 0 FTE from the 2022 CR Annual Rate level, and 0 in fixed costs.

Department of the Interior Field Communications Modernization (DIFCOM) (+$176,000 / +0 FTE) – USGS would deploy mobile broadband connectivity and provide employees working in the field with voice, video, and data capabilities across a broader set of missions. In many locations, this deployment will enhance or replace a voice-only, mid-20th century land mobile radio technology with technology that is cheaper to operate and maintain. As part of the broader modernization initiative across Interior in 2023, this funding will transition users in the Great Lakes (Region 3), Mississippi Basin (Region 4), the U.S. Virgin Islands, and Puerto Rico. USGS would execute projects coordinated by the DOI governance body with project management, engineering support and IT security requirements managed by OCIO.

Solutions will be enterprise in nature and focus on leveraging existing government systems supporting Federal, State, local, Tribal and territorial users, commercial services such as public safety broadband (e.g., FirstNet), and satellite capabilities while strategically reducing infrastructure and the operations and maintenance costs associated with that infrastructure. DOI has existing field communications contracts to quickly begin and successfully execute this project.

For USGS, improved field communications would support improved scientific communication more effectively across science disciplines to foster comprehensible collaboration and innovation. In addition, improvements would be made to help increase rural and Tribal broadband where feasible.

Program Overview

FACILITIES MODERNIZATION

Facilities

USGS

WHAT ARE WE DOING?

Prioritizing the construction of replacement facilities to address our most critical infrastructure needs and modernize our assets in support of USGS science.

Conceptual rendering of the new laboratory building at the National Wildlife Health Center
Source: USGS

WHY DOES THIS MATTER?

These infrastructure investments will help position the USGS to continue to provide world class science, facilitate partnerships, attract talent, reduce deferred maintenance, and support administration priorities for clean energy and sustainability.

Conceptual rendering of the new laboratory building at Moffett Field
Source: USGS

Deferred Maintenance and Capital Improvement (DMCI) funding provides for construction and major maintenance/repair projects on USGS-owned and maintained assets and infrastructure. Funding is provided to the highest priority facility requirements in support of USGS mission needs. Prioritization follows annual Interior budget guidelines and funding is primarily directed toward completion of ongoing major infrastructure projects and projects that restore, modernize, replace, or improve life-cycle performance of facilities assets that are mission critical or mission dependent. Projects that facilitate space consolidation, improve utilization, and reduce the bureau space footprint also receive DMCI funding, as do other facilities maintenance and management activities that identify, document, track, and remediate maintenance needs.

The FY 2023 budget requests $74.7 million to complete DMCI projects. The following table provides a description of how those funds will be used.

FY 2023 Requested Amount ($000)	Project Title	Description
$29,000	HVO Replacement Facilities at Hilo and Volcanoes National Park	Construction of laboratory at Hilo, HI and field station at Hawaii Volcanoes National Park.
$38,000	Replacement Facility for Denver Federal Center Based Labs	Construction of laboratory at the Colorado School of Mines to replace facilities at the Denver Federal Center. (This is in addition to the $167M provided in the BIL for these costs).
$2,434	Real Property Efficiency Plan	Consolidation of library holdings at the National Center, Reston, VA and relocation/space consolidation of the North Dakota Water Science Center.
$3,272	Other Deferred Maintenance Projects	Maintenance, repair, and modernization projects to address Americans with Disabilities Act compliance issues and deferred maintenance.
$1,958	Facilities Planning and Programs	Programs supporting facilities condition assessments, maintenance management system, and project planning and support.
(Total) $74,664		

Infrastructure Project Descriptions

1. $29,000,000: Hawaii Volcano Observatory (HVO) Replacement Facilities at Hilo and Volcanoes National Park

Additional funding for the construction of a laboratory/office building co-located on the University of Hawaii-Hilo campus and a field station within the Hawaii Volcanoes National Park to replace facilities damaged during the Kilauea volcanic eruption. Additional funding is needed above funds provided in 2019 and 2020 due to increased costs associated with factors outside USGS control. The Hawaii- Hilo location will house the USGS Hawaii Volcano Observatory, which monitors, investigates, and assesses hazards from active volcanoes and earthquakes in Hawaii, and communicates the results of this work to the public, emergency managers, and the scientific community. The co-location with the University of Hawaii will provide opportunities for science collaboration and support the development of talent by engaging students in USGS science. The field station location in Hawaii Volcanoes National Park will house the Pacific Islands Ecological Research Center and provide an onsite presence for active

field research. This additional funding will be used to fully fund the project at its current estimated cost of $108 milllion.

2. $38,000,000: Replacement Facility for Denver Federal Center Based Labs

Additional funding for construction of a new federally owned Geoscience Building for Energy and Mineral Science on the campus of the Colorado School of Mines (CSM). The new building will house the USGS Geology, Geophysics, and Geochemistry (G3) and Central Energy Resources (CER) Science Centers and will allow for co-location with CSM geoscience faculty, establishing a center of excellence in minerals and energy science and providing opportunities for science collaboration that will leverage USGS science, support the development of science, technology, engineering and mathematics (STEM) talent by engaging students in USGS science, and expanding the diversity of the USGS workforce.

Currently located on the Denver Federal Center (DFC), the science activities of G3-CER are increasingly hindered by the ongoing deterioration of DFC Building 20, which is past its useful life and does not support the existing science requirements of the USGS.

The design, construction, and tenant build-out of the new building and appurtenant associated structures will be accomplished through a cooperative agreement with the academic partner, CSM that is scheduled to be put into place May 2022. The USGS will retain ownership of the facility and associated structures.

The Bipartisan Infrastructure Law provided $167 million towards the funding of this new facility. The additional DMCI funding of $38 million in FY 2023 will be used to fund the project at its current estimated cost of $240 million. This project is estimated to be completed within five years.

USGS Working Capital Fund

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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 following components:

- 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 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		2021 Actual	2022 Estimate	2023 Estimate
	Reimbursable:			
2001	Civilian full-time equivalent employment	105	105	105

USGS Accounts

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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(a)(1)) and related purposes as authorized by law; and to publish and disseminate data relative to the foregoing activities; $1,711,344,000, to remain available until September 30, 2024; of which $92,274,000 shall remain available until expended for satellite operations; and of which $74,840,000 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.

Note.—A full-year 2022 appropriation for this account was not enacted at the time the budget was prepared; therefore, the budget assumes this account is operating under the Continuing Appropriations Act, 2022 (Division A of P.L. 117-43, as amended). The amounts included for 2022 reflect the annualized level provided by the continuing resolution.

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, observation 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: Provided further, That the United States Geological Survey is authorized to enter into a direct lease agreement for space as part of a Cooperative Science Agreement and to record such lease obligations on a year-by-year basis.

Note.—A full-year 2022 appropriation for this account was not enacted at the time the budget was prepared; therefore, the budget assumes this account is operating under the Continuing Appropriations Act, 2022 (Division A of P.L. 117-43, as amended). The amounts included for 2022 reflect the annualized level provided by the continuing resolution.

Authorizations

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

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

Expiring Authorizations

P.L. 111-11

- National Streamflow Information Program - Base Program (no specific dollar amount)
- National Groundwater Resources Monitoring (no specific dollar amount)
- Secure Water Act - Water Availability and Use Assessment Program - $300 million

P.L. 116-9

- National Volcano Early Warning System (NVEWS) ($55 million)

P.L. 115-307

- National Earthquake Hazards Reduction Program (NEHRP) ($83,403,000)

(Dollars in Thousands)

Surveys, Investigations, and Research	2021 Amount	2021 FTE	2022 Amount	2022 FTE	2023 Fixed Costs (+/-)	2023 Internal Transfers (+/-)	2023 Program Changes $ (+/-) Amount	2023 Amount	2023 FTE	Change from 2022 (+/-) FTE	Change from 2022 (+/-) $
Ecosystems											
Environmental Health Program	24,745	192	24,745	192	+1,070	+500	+1,494	27,809	198	+6	+3,064
Species Management Research Program	53,914	61	53,914	61	+441	+4,587	+15,504	74,446	87	+26	+20,532
Land Management Research Program	56,681	263	56,681	263	+1,559	-7,707	+22,122	72,655	300	+37	+15,974
Biological Threats and Invasive Species Research Program	38,249	256	38,249	256	+1,349	+2,620	+5,702	47,920	266	+10	+9,671
Cooperative Research Units Program	25,000	121	25,000	121	+644	-	+2,506	28,150	127	+6	+3,150
Climate Adaptation Science Center and Land Change Science Program	60,488	272	60,488	272	+1,912	-	+62,312	124,712	387	+115	+64,224
Total, Ecosystems	**259,077**	**1,165**	**259,077**	**1,165**	**+6,975**	**-**	**+109,640**	**375,692**	**1,365**	**+200**	**+116,615**
Energy and Mineral Resources											
Mineral Resources Program	59,869	289	59,869	289	+2,065	-	+28,368	90,302	340	+51	+30,433
Energy Resources Program	30,172	135	30,172	135	+972	-	+25,564	56,708	160	+25	+26,536
Total, Energy and Minerals Resources	**90,041**	**424**	**90,041**	**424**	**+3,037**	**-**	**+53,932**	**147,010**	**500**	**+76**	**+56,969**
Natural Hazards											
Earthquake Hazards Program	85,403	268	85,403	268	+1,783	-	+12,734	99,920	289	+21	+14,517
Volcano Hazards Program	30,266	148	30,266	148	+968	-	+3,266	34,500	157	+9	+4,234
Landslide Hazards Program	8,038	35	8,038	35	+253	-	+3,141	11,432	41	+6	+3,394
Global Seismographic Network Program	7,153	11	7,153	11	+68	-	+59	7,280	11	-	+127
Geomagnetism Program	4,114	12	4,114	12	+87	-	+1,559	5,760	14	+2	+1,646
Coastal/Marine Hazards and Resources Program	40,510	220	40,510	220	+1,420	-	+19,005	60,935	253	+33	+20,425
Total, Natural Hazards	**175,484**	**694**	**175,484**	**694**	**+4,579**	**-**	**+39,764**	**219,827**	**765**	**+71**	**+44,343**
Water Resources											
Water Availability and Use Science Program	57,987	298	57,987	298	+1,432	-	+13,014	72,433	375	+77	+14,446
Groundwater and Streamflow Information Program	100,673	470	100,673	470	+2,384	-	+13,978	117,035	513	+43	+16,362
National Water Quality Program	93,460	430	93,460	430	+2,031	-	+2,782	98,273	437	+7	+4,813
Water Resources Research Act Program	11,000	2	11,000	2	-	-	+4,000	15,000	2	-	4,000
Total, Water Resources	**263,120**	**1,200**	**263,120**	**1,200**	**+5,847**	**-**	**+33,774**	**302,741**	**1,327**	**+127**	**+39,621**
Core Science Systems											
National Geospatial Program	79,454	234	79,454	234	+1,408	-	+17,644	98,506	241	+7	+19,052
National Cooperative Geologic Mapping Program	40,397	118	40,397	118	+690	-350	+534	41,271	118	-	+874
Science Synthesis, Analysis and Research Program	25,972	86	25,972	86	+527	+350	+57,481	84,330	95	+9	+58,358
National Land Imaging Program	106,865	169	106,865	169	+1,253	-	+16,573	124,691	214	+45	+17,826
Total, Core Science Systems	**252,688**	**607**	**252,688**	**607**	**+3,878**	**-**	**+92,232**	**348,798**	**668**	**+61**	**+96,110**
Science Support											
Administration and Management Program	73,787	354	73,787	354	+3,666	-	+18,584	96,037	390	+36	+22,250
Information Services Program	21,947	59	21,947	59	+452	-	+10,761	33,160	77	+18	+11,213
Total, Science Support	**95,734**	**413**	**95,734**	**413**	**+4,118**	**-**	**+29,345**	**129,197**	**467**	**+54**	**+33,463**
Facilities											
Rental Payments and Operations & Maintenance Program	104,719	66	104,719	66	+3,093	-	+5,427	113,239	66	-	+8,520
Deferred Maintenance and Capital Improvement Program	74,664	2	74,664	2	-	-	+176	74,840	2	-	+176
Total, Facilities	**179,383**	**68**	**179,383**	**68**	**+3,093**	**-**	**+5,603**	**188,079**	**68**	**-**	**8,696**
Supplementals	**-**	**-**	**[264,754]**	**48**				**[68,655]**	**48**	-	**(196,099)**
TOTAL, ACCOUNT	**1,315,527**	**4,571**	**1,315,527**	**4,571**	**+31,527**	**-**	**+364,290**	**1,711,344**	**5,208**	**+589**	**+395,817**

United States Geological Survey
Justification of Fixed Costs
(Dollars In Thousands)

Fixed Cost Changes and Projections	2022 Change	2022 to 2023 Change	Description
Change in Number of Paid Days	+0	-2,912	This column reflects changes in pay associated with the change in the number of paid days between FY 2022 and FY 2023. The number of paid days in FY 2023 is one day less than FY 2022.
Pay Raise	+14,799	+30,273	The President's Budget for FY 2023 includes one quarter of a planned 2.7% pay raise for FY 2022 and three quarters of a planned 4.6% pay raise for FY 2023.
Employer Share of Federal Employee Retirement System	+5,153	+0	This column reflects no budgeted increase for the employer contribution to the Federal Employee Retirement System.
Departmental Working Capital Fund	+1,240	+1,187	The change reflects the final FY 2023 Central Bill approved by the Working Capital Fund Consortium.
Worker's Compensation Payments	-470	+184	The amounts reflects final chargeback costs of compensating injured employees and dependents of employees who suffer accidental deaths while on duty. Costs for FY 2023 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.
Unemployment Compensation Payments	+103	+0	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.
Rental Payments	+5,135	+2,795	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. 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.
Baseline Adjustments for O&M Increases	+0	+0	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.

United States Geological Survey
Justification of Internal Realignments
(Dollars In Thousands)

Internal Realignments and Non-Policy/Program Changes (Net-Zero)	2023 (+/-)	Description
Environmental Health Program -- Integrated Sensor Grants Species Management Research Program -- Integrated Sensor Grants	+500 -500	The USGS is proposing to transfer $500,000 from the Species Management Research Program to the Environmental Health Program. This transfer will shift the funding to the program, Environmental Health, where the work is conducted.
Land Management Research Program -- Rebaseline of Priority Activities Species Management Research Program -- Rebaseline of Priority Activities Biological Threats and Invasive Species Research Program -- Rebaseline of Priority Activities	-7,707 +5,087 +2,620	In FY 2021, the USGS, with Congressional approval, realigned its budget structure to focus 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. During the year, the USGS evaluated implementation of the restructure and identified areas where the funding and functions of the restructure were not aligned with scientific needs. This internal transfer would realign funding currently in the Land Management Research subactivity to the Species Management Research subactivity and the Biological Threats and Invasive Species subactivity to support studies such as species' responses to stressors, including climate change, and to support biosurveillance and invasive species studies, among other science needs.
National Cooperative Geologic Mapping Program -- National Cooperative Geologic Mapping Program Projects and 3D Geologic Mapping Science Synthesis, Analysis and Research Program -- NGGDPP Internal Transfer	-350 +350	The USGS proposes to transfer funds to the National Geological and Geophysical Data Preservation Program to support operational efficiencies and promote geoscience discovery for Administration priorities including climate and environmental research. The funds would support USGS scientific collections management to facilitate and promote the discovery and reuse of high-value physical samples and associated materials for new scientific discovery, model validation, data recovery and development of new technologies. This proposal would not affect distribution of National Geological Cooperative Mapping Program funds to the States and follows the intent of the National Geologic Mapping Act of 1992. The proposed internal transfer includes funding requested in FY 2022 (-$350,000).

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Account and Sundry Exhibits

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Account and Sundry Exhibits

Employment Summary

SURVEYS, INVESTIGATIONS, AND RESEARCH

Identification Code 14-0804-0-1-306		2021 Actual	2022 Estimate	2023 Estimate
	Direct:			
1001	Civilian full-time equivalent employment	4,571	4,619	5,208
	Reimbursable:			
2001	Civilian full-time equivalent employment	3,008	3,008	3,113
	Allocation account:			
3001	Civilian full-time equivalent employment	47	24	24

CONTRIBUTED FUNDS

Identification Code 14-8562-0-7-306		2021 Actual	2022 Estimate	2023 Estimate
	Direct:			
1001	Civilian full-time equivalent employment	4	4	4

Employee Count by Grade

(Total Employment)

		2021 Actual	2022 Estimate	2023 Estimate
Executive Level V		0	1	1
SES		16	19	19
	Subtotal	16	20	20
SL – 00		9	9	12
ST – 00		31	42	42
	Subtotal	40	51	54
GS/GM – 15		412	411	441
GS/GM – 14		709	707	760
GS/GM – 13		1,078	1,075	1,155
GS – 12		1,565	1,560	1,677
GS – 11		1,302	1,298	1,395
GS – 10		74	74	79
GS – 9		929	926	995
GS – 8		216	215	232
GS – 7		663	661	711
GS – 6		261	260	280
GS – 5		328	327	352
GS – 4		114	114	122
GS – 3		37	37	40
GS – 2		6	6	6
GS – 1		3	3	3
Subtotal		7,696	7,672	8,248
Other Pay Schedule Systems		273	273	273
Total employment (actual/estimate)		**8,025**	**8,016**	**8,595**

Section 403 Compliance

This section describes details related to any assessments to, or within, the USGS to support bureau-wide services and functions to support governmentwide, DOI-wide, bureau-wide and regional administrative functions, headquarters, and central operations.

External Administrative Costs	2023 Estimate ($000)
Department of the Interior Working Capital Fund and Payments to Other Federal Agencies	
WCF Centralized Billings	*$19,542*
WCF Direct Billings	*$15,191*
Worker's Compensation Payments	*$1,682*
Unemployment Compensation Payments	*$1,096*
GSA Rental Payments	*$118,000*
Bureau Administrative Costs	
Shared Program Costs	*$40,000*
Bureau-Level Costs	*$39,000*
Reimbursable Overhead	*$43,000*

Department of the Interior Working Capital Fund and Payments to Other Federal Agencies

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 using 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 and 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 severable but is executed through a time and materials reimbursable support agreement or similar contractual arrangement.

More information related to payments to other Federal agencies can be found in the USGS Account chapter under the fixed cost exhibit.

Bureau Administrative Costs

Shared Program Costs

The USGS maintains an estimated (up to) five percent of its budget submission for other bureau-wide support and science-related activities. These costs are in addition to what may be needed to adequately pay for science support. These funds are used for initiatives which may be unfunded mandates, are crosscutting in nature, or respond to new bureau priorities and emerging scientific issues.

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. 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 information technology compliance or 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 bureau-wide concurrence.

Bureau-Level Costs

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 bureau-wide systems. Funding appropriated to the Science Support budget subactivities pays much of the bureau-level costs. For this reason, bureau-level costs collected on reimbursable support agreements are deposited within Science Support program areas as well. Additionally, the USGS may allocate costs for these activities typically funded out of the Science Support program to the direct appropriation for those programs when those costs exceed amounts allocated to Science Support subactivities in the appropriation. At the 2023 request level, these costs are approximately three percent of the science program appropriations. Taken as a whole, costs to support science mission areas is estimated at about 12 percent of the USGS operating budget and up to 12 percent of appropriated programmatic funding could be used to adequately pay for science support costs. These costs may be considered shared program costs.

At the science center level, as 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 to cover 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. During 2021, the cost for the local overhead totaled $201 million; however, these costs are not included in Section 403 estimates.

Reimbursable Overhead

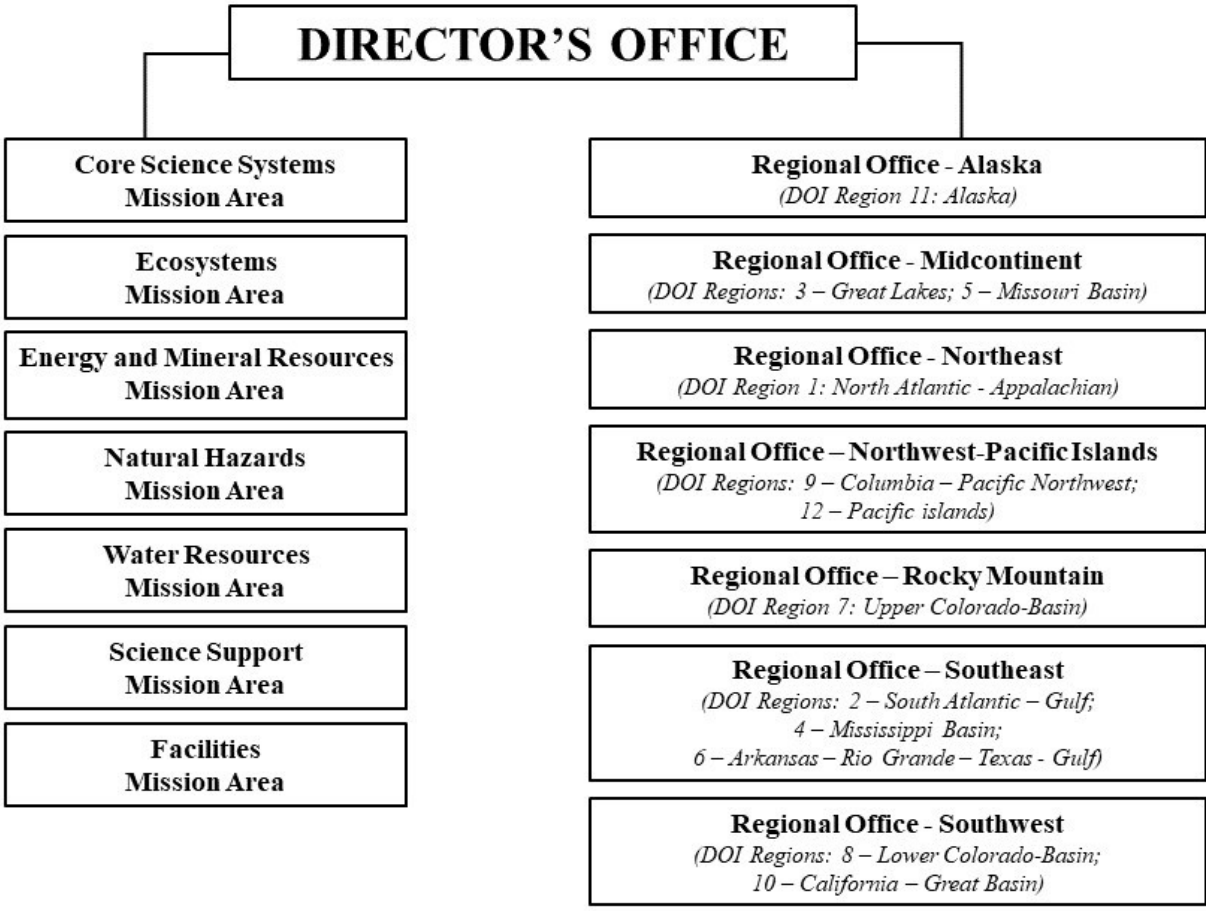
The USGS also assesses a bureau overhead rate, estimated to remain at 12 percent, on reimbursable work from non-Interior customers to recoup their share of bureau-level costs. In some cases, the USGS assesses a special or reduced rate when it can be demonstrated that indirect costs are substantially 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.

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 cost share funds are available within the USGS budget. The preferred rate that cost centers may charge other Interior bureaus for common services and bureau costs combined was 15 percent net in 2021 and 2022. 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 FY 2021, USGS covered $6.2 million of the costs to meet the DOI bureau preferred rate. In this way, the USGS is partnering on the science needs of Interior from both the bureau and cost centers. In 2023, USGS will analyze the preferred rate and coordinate with other DOI bureaus to revise the rate as appropriate.

The Associate Director for Administration establishes the USGS bureau special rate for each fiscal year. The special rate for 2023 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 using common service providers.
- Equipment purchase required for new project; cost of the equipment is a major portion of the total agreement funds; and equipment will be USGS property.
- Interagency detail work assignments of a USGS employee to a non-USGS agency when space and administrative support are provided at no charge.
- Funds received with specific legal authority to award a grant which will be transferred to a third-party entity.

USGS Organizational Chart



Bipartisan Infrastructure Law (BIL) FY 2023 Spend Plan

Introduction

President Biden signed the Bipartisan Infrastructure Law on November 15, 2021, making this once-in-a-generation investment in the Nation's infrastructure and economic competitiveness a reality. This landmark investment will rebuild America's critical infrastructure, tackle the climate crisis, advance environmental justice, and drive the creation of good-paying union jobs. By addressing long-overdue improvements and strengthening our resilience to the changing climate, this investment in our communities across the country will grow the economy sustainably and equitably so everyone gets ahead for decades to come.

Program Summary

The Bipartisan Infrastructure Law provides a total of $510.7 million directly to the USGS over a period of 5 years to support integrated mapping and interpretation of mineral resources data, the preservation of data from geochemical samples from the Earth Mapping Resource Initiative (Earth MRI), and a replacement facility for the USGS energy and minerals research center in the Denver, CO, area. Please refer to the USGS Spend Plan announcement for more information.

Funding is provided to USGS as emergency appropriations and is available for obligation with various spending availability terms depending on specific Congressional direction. The enacted amounts are shown in the following table.

USGS Bipartisan Infrastructure Funding

Enacted Amounts Available *(dollars in 000s)*

Program/Activity	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	Total
Program						
USGS Energy and Minerals Research Facility	167.0	0.0	0.0	0.0	0.0	167.0
National Geological and Geophysical Data Preservation Program	8.7	5.0	5.0	5.0	0.0	23.7
Earth Mapping Resources Initiative	64.0	64.0	64.0	64.0	64.0	320.0
Grand Total	**239.7**	**69.0**	**69.0**	**69.0**	**64.0**	**510.7**

USGS Energy and Minerals Research Facility

This project will support the construction of a new Federally-owned building for mineral and energy science on the Colorado School of Mines (CSM) campus. The new building is anticipated to be adjacent to the existing USGS Geologic Hazards Science Center (home to the National Earthquake Information Center), also on the CSM campus. The new building is intended to house the USGS Geology, Geophysics, and Geochemistry (G3) and Central Energy Resources (CER) Science Centers and allow for co-location with CSM geoscience faculty, establishing a center of excellence in minerals and energy science and providing

opportunities for science collaboration that leverages USGS science; supports the development of science, technology, engineering and mathematics (STEM) talent by engaging students in USGS science; and expands the diversity of the USGS workforce.

FY 2022 Accomplishments and Planned Activities

- In FY 2022, the BIL appropriates $167.0 million for the construction of the USGS Energy and Minerals Research Facility.
- The USGS formally announced a new state-of-the-art research and teaching facility will be built on the Colorado School of Mines campus in Golden, Colorado.
- The USGS anticipates awarding a Cooperative Agreement for the design and construction of the Energy and Minerals Research Facility in FY 2022.
- The bureau also anticipates awarding a contract for the preparation and delivery of the NEPA compliance including an Environmental Assessment for the research facility project in mid FY 2022.

FY 2023 Planned Activities and Milestones

- The USGS plans to utilize a cooperative agreement with the Colorado School of Mines to initiate the design, construction, and tenant build-out of the new building.

National Geological and Geophysical Data Preservation Program (NGGDPP)

The USGS plans to leverage the existing NGGDPP State grants program to provide competitive grants to States quickly and efficiently, to preserve and make publicly available historical geological and geophysical data and samples. The USGS provides competitive grants to State Geological Surveys and funds projects executed by USGS and other Department of the Interior bureaus, to preserve, modernize, and make publicly available, geological and geophysical data and assets.

FY 2022 Accomplishments and Planned Activities

- In FY 2022, the BIL appropriates $8.7 million for the National Geological and Geophysical Data Preservation Program project.
- The USGS anticipates awarding approximately 35 competitive grants to State Geological Surveys and funding approximately 25 DOI bureau projects for data preservation activities that will result in the public availability of historical data and physical samples.
- The USGS plans to award competitive grants by the end of FY 2022.
- The bureau also plans to release a Notice of Funding Opportunity for FY 2023 and 2024 State grant proposals.

FY 2023 Planned Activities and Milestones

- In FY 2023, the BIL appropriates $5.0 million for the National Geological and Geophysical Data Preservation Program project.
- The USGS plans to award competitive grants to State Geological Surveys and DOI bureau projects in early FY 2023.

Earth Mapping Resources Initiative (Earth MRI)

The BIL provides $64 million per year over the next 5 years for a total of $320 million for Earth MRI to identify areas with potential critical mineral resources. The BIL directs the USGS to accelerate efforts to carry out the fundamental resources and mapping mission of the USGS by (1) providing integrated topographic, geologic, geochemical, and geophysical mapping; (2) accelerating the integration and consolidation of geospatial and resource data; and (3) providing interpretation of mineral resources data on the subsurface and above ground.

FY 2022 Accomplishments and Planned Activities

- In FY 2022, the BIL appropriates $64.0 million for the Earth MRI program.
- The USGS published the 2022 List of Critical Minerals on February 22, 2022, as required by the Energy Act of 2020. This whole-of-government list identifies non-fuel minerals or mineral materials essential to the economic or national security of the U.S that have supply chains that are vulnerable to disruption.
- The USGS plans to establish funding agreements with State Geological Surveys for geologic mapping, acquire new geochemical data, and establish contracts for new geophysical surveys.

FY 2023 Planned Activities and Milestones

- In FY 2023, the BIL appropriates $64.0 million for the Earth MRI program.
- In addition to continuing contracts for geophysical surveys and new geochemical data, in FY 2023 the USGS will apply geologic mapping funding to State Geological Surveys with new agreements for sampling and characterization of legacy mine waste sites.

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