Water Resources

Water Resources

Dollars in Thousands	2017	2018	2019				
	Actual	Full Year CR	Fixed Costs	Internal Transfer	Program Changes	Request	Change from 2018
Water Resources	**214,754**	**213,296**	**1,188**	**200**	**(49,762)**	**164,922**	**(48,374)**
FTE	*1,287*	*1,287*	-	-	*(241)*	*1,046*	*(241)*
Water Availability and Use Science Program	**45,052**	**44,746**	**287**	**-**	**(14,682)**	**30,351**	**(14,395)**
FTE	*320*	*320*	-	-	*(71)*	*249*	*(71)*
Groundwater and Streamflow Information Program	**72,673**	**72,179**	**332**	**-**	**(7,596)**	**64,915**	**(7,264)**
FTE	*331*	*331*	-	-	*(31)*	*300*	*(31)*
National Water Quality Program	**90,529**	**89,915**	**569**	**200**	**(21,028)**	**69,656**	**(20,259)**
FTE	*635*	*635*	-	-	*(138)*	*497*	*(138)*
Water Resources Research Act Program	**6,500**	**6,456**	**-**	**-**	**(6,456)**	**-**	**(6,456)**
FTE	*1*	*1*	-	-	*(1)*	-	*(1)*
Cooperative Matching Funds[4]	**[59,927]**	**[59,927]**	**-**	**-**	**[-2,717]**	**[57,210]**	**[-2,717]**

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

- Minimize loss of life and property because of water-related natural hazards.
- Manage freshwater, both above and below the land surface, for domestic, public, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water for human health, aquatic health, and environmental quality.
- Contribute to wise use, development, and conservation of water resources.

The Water Resources Mission Area carries out its programs through the USGS Water Science Centers covering all 50 States and Puerto Rico.

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

[4] Cooperative Matching Funds are used to support research, data collection, and assessment activities throughout the Water Resources programs, and are therefore shown as a non-add component within the Mission Area.

Cooperative Matching Funds

The cooperative matching funds program provides funding to partner with nearly 1,600 local, State regional and tribal agencies to monitor and assess water in every State, protectorate, and territory. The 2019 request includes $57,210,000 across the three sub-activities of the mission area.

Water Availability and Use Science Program

	2017	2018	2019				
	Actual	Full Year CR	Fixed Costs	Internal Transfer	Program Changes	Request	Change from 2018
Water Availability and Use Science Program	**45,052**	**44,746**	**287**	**-**	**(14,682)**	**30,351**	**(14,395)**
Research and Development to Advance Water Science[5]					*(4,325)*		
Groundwater Models					*(869)*		
Mississippi Alluvial Plain Aquifer Assessment					*(3,000)*		
U.S.-Mexico Transboundary Aquifer Assessment					*(1,000)*		
Regional Groundwater Evaluations					*(789)*		
Water Use – Cooperative Matching Funds					*(1,000)*		
Water Use – Data and Research					*(1,500)*		
Water Use – Unconventional Oil and Gas					*(250)*		
Focus Area Studies					*(1,600)*		
Administrative Savings					*(349)*		
Cooperative Matching Funds[6]	**[12,397]**	**[12,397]**	**-**	**-**	**[-1,000]**	**[11,397]**	**[-1,000]**
FTE	*320*	*320*	*-*	*-*	*(71)*	*249*	*(71)*

The Water Availability and Use Science Program (WAUSP) supports research and projects that advance the goal of improving our understanding water budget components at the national and regional level.

The 2019 request supports:

- Collaborating with State partners to improve collection and reporting of water use data.
- Developing new techniques and methods to estimate water use and invest in new technologies to measure water use.
- Supporting the enhancement of tools to understand groundwater and surface-water interactions, sediment transport processes, and support evaluations of conjunctive management of these resources.
- Engaging and collaborate with stakeholders to ensure data and products meet the needs of local, regional, and national resource managers.

[5] Formerly the National Research Program

[6] Cooperative Matching Funds are used to support research, data collection, and assessment activities across the Water Availability and Use Science Program, and therefore shown as a non-add component within the Program.

- Researching the effect of drought on water availability for human and ecological uses.
- Enhancing regional water availability studies to provide information and tools for future management decisions.
- Conducting research on water-budget components; synthesize, predict and report information at regional and national scales, enhance water modeling and prediction capability, and compile and report water information in ways that are useful to States.

Justification of Program Changes

The request proposes the following to address higher priorities:

- Research and Development to Advance Water Science (-$4,325,000 and -28 FTE)
- Groundwater Models (-$869,000 and -7 FTE)
- Regional Groundwater Evaluations (-$789,000 and -4 FTE)
- Mississippi Alluvial Plain Aquifer Assessment (-$3,000,000 and -18 FTE)
- U.S.-Mexico Transboundary Aquifer Assessment (-$1,000,000 and -4 FTE)
- Focus Area Studies (-$1,600,000 and -8 FTE)
- Water Use – Cooperative Matching Funds (-$1,000,000/0 FTE)
- Water Use – Data and Research (-$1,500,000 and -1 FTE)
- Water Use – Unconventional Oil and Gas (-$250,000 and -1 FTE)

The USGS plans to achieve $349,000 of administrative savings within the program.

Program Overview

The WAUSP supports research and projects that advance the goal of improving our understanding water budget components at the national and regional level, as well as through the National Water Census (NWC). With the NWC, the USGS works with partners and stakeholders to improve our understanding of water budget components in the face of increasing demand and competition for limited regional water resources to ensure adequate water availability for both human and ecological needs now and into the future.

The USGS has begun development of a National Hydrologic Model (NHM) to support a coordinated, comprehensive, and consistent hydrologic modeling at multiple scales for the conterminous United States. The NHM provides baseline estimates of total water availability, changes in the timing and source of streamflow, and measures of the uncertainty of these estimates. In 2017, USGS researchers developed baseline datasets for all components of the water budget with estimates of error; added a stream temperature module to the NHM capabilities allowing for simulation of stream temperature; developed a tool to improve NHM model accessibility for local applications; improved representation of surface storage (water stored in ponds, lakes, and reservoirs) within the NHM; improved representation of snowmelt processes; and began work to improve streamflow routing algorithms in collaboration with the National Center for Atmospheric Research (NCAR). In 2018 and 2019, USGS researchers will continue collaboration with partners and stakeholders like the National Weather Service (NWS) and NCAR to improve national

prediction capabilities of surface water-groundwater interaction, stream water temperature, erosion and sediment transport, and water-quality.

The USGS has begun work to construct a national model of the shallow groundwater system that covers the contiguous United States; this model will help advance national water availability prediction capabilities. In 2017, the USGS developed baseline estimates of evapotranspiration, runoff to streams, and recharge to shallow groundwater. Maps at a 1-km resolution across the contiguous United States were published in 2017. Notably, the recharge map is the first "wall-to-wall" estimate of long-term average recharge values based on water balance calculations of this water budget component. In 2018 and 2019, the USGS will work with partners and stakeholders to provide input into future directions of the National Groundwater Model. This collaboration is critical to ensuring that groundwater is accounted for accurately in water budgets, as well as Earth system prediction models of water availability.

With issues like drought, groundwater depletion, shifting weather patterns, and demand for groundwater expected to continue to rise, understanding brackish groundwater supplies can help determine whether they can supplement or replace taxed freshwater sources in water-stressed areas. Specifically, as the Bureau of Reclamation works to promote sustainable water treatment for brackish aquifers, information on the chemical composition of the water and well yields is important to understanding the needs of water treatment. In 2017, the USGS released the first national assessment of brackish groundwater resources in more than 50 years. The study found that the amount of brackish groundwater underlying the Country is more than 35 times the amount of fresh groundwater, as well as 800 times the amount of brackish groundwater, currently used each year. By incorporating new data from more than 380,000 sites, the 2017 assessment provides comprehensive national dataset on the quantity and quality of brackish groundwater. This information provides a foundation to inform decision and policy makers about the potential for expanding brackish groundwater development. In 2018, the USGS will work closely with the Bureau of Reclamation to develop a Web service that will allow resource managers and other users to discover and download the brackish water data for their area of interest. In 2019, additional enhancements to this Web service, such as geochemical modeling capabilities, have been identified for development.

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Groundwater and Streamflow Information Program

	2017	2018	2019				
	Actual	Full Year CR	Fixed Costs	Internal Transfer	Program Changes	Request	Change from 2018
Groundwater and Streamflow Information Program	**72,673**	**72,179**	**332**	**-**	**(7,596)**	**64,915**	**(7,264)**
Cooperative Matching Funds – Tribal Waters					*(1,000)*		
Water Tools					*(363)*		
Research and Development to Advance Water Science[7]					*(1,540)*		
U.S.-Canada Transboundary Streamgages					*(160)*		
Groundwater Activities					*(3,752)*		
Administrative Savings					*(781)*		
Cooperative Matching Funds[8]	**[30,299]**	**[30,299]**	**-**	**-**	**[-1,000]**	**[29,299]**	**[-1,000]**
FTE	*331*	*331*	-	-	*(31)*	*300*	*(31)*

The Groundwater and Streamflow Information Program (GWSIP) encompasses the Water Resources Mission Area's objectives to collect, manage, and disseminate consistently high-quality and reliable hydrologic information in real-time and over the long-term, which are both critical for managing our Nation's water resources and anticipating and responding to water hazards that can result in loss of life and property.

The 2019 request supports:

- Maintaining a national streamgage network of more than 8,200 real-time streamgages.
- Continuing the collection and dissemination of high quality hydrologic information in real time and over the long term.
- Engaging and collaborating with our stakeholders to ensure data and products meet the needs of local, regional, and national resource managers.
- Developing next generation data collection tools and techniques, including improved data collection and dissemination during hazards (floods, droughts, hurricanes).
- Supporting improvement of flood forecast predictions, drought management, and development of national water prediction capabilities.

[7] Formerly the National Research Program

[8] Cooperative Matching Funds are used to support research, data collection, and assessment activities across the Groundwater and Streamflow Information Program, and therefore shown as a non-add component within the Program.

Justification of Program Changes

The request proposes the following to address higher priorities:

- Cooperative Matching Funds – Tribal Waters (-$1,000,000 and -6 FTE)
- Water Tools (-$363,000 and -2 FTE)
- Research and Development to Advance Water Science (-$1,540,000 and -10 FTE)
- U.S. Canada Transboundary Streamgages (-$160,000 and -0 FTE)
- Groundwater Activities (-$3,752,000 and -13 FTE)

The USGS plans to achieve $781,000 of administrative savings within the program.

Program Overview

The Groundwater and Streamflow Information Program (GWSIP) encompasses the Water Resources Mission Area's objectives to collect, manage, and disseminate consistently high-quality and reliable hydrologic information in real-time and over the long-term, which are both critical for managing our Nation's water resources and anticipating and responding to water hazards that can result in loss of life and property. The program serves as the national source of timely, quality-assured, and relevant data for short- and long-term water decisions by local, State, tribal, regional, and national stakeholders.

The USGS is increasingly using integrated monitoring for multiple parameters at a single location providing continuous real-time water data used for decisions such as emergency response, flood forecasting, reservoir management, water use restrictions, drinking water deliveries, permit compliance, water-quality studies, and recreational safety.

The long-term data supplied by the program are used for decisions such as water supply planning; aquifer storage and recovery; infrastructure design; floodplain and ecosystem management; energy development; and resolution of water disputes. Access to water information is increasingly more critical as climate patterns, land use, and population change, increase the challenges of managing competing water priorities.

Serving as the largest water data holder in the world, the USGS works in partnership with more than 1,000 Federal, regional, State, tribal, and local agencies to maintain and manage the National Streamflow Network. The network comprises more than 8,200 streamgages across the Nation and provides a continuous source of streamflow information. Information provided through the network forms the scientific basis for decision-making related to protection of life and property from water-related hazards, such as floods; cost-effective management of freshwater that is safe and available for drinking, irrigation, energy, industry, recreation, and ecosystem health; and national, State, tribal, and local economic well-being. The latest streamflow information is available as alerts to users by email or text message and as real-time stream conditions change, updated at intervals of one hour or less.

The USGS places the utmost importance on high quality, accessible, and consistent streamflow measurements over the full range of streamflow conditions to reduce uncertainty and to position the United States for a future that may hold unanticipated challenges, such as related to bigger and (or) more frequent floods, more sustained droughts, and changes in snowpack regimes. In addition, the USGS prioritizes the robustness of more than 8,200 streamgages in order to cover a broad range of watersheds and streamflow conditions across the Nation. A robust network is vital to support the hydrologic research needed to

characterize local and regional streamflow, especially at ungaged locations. Given that it is not economically feasible to measure all rivers and streams at all the important locations, a robust network enables the USGS to provide streamflow estimates at ungaged locations. For example, Federal and State transportation agencies annually estimate flood-frequencies for designing and upgrading thousands of culverts and bridges at ungaged locations across the Nation.

One of the highest goals of the USGS is to maintain long-term stability of a critical, high-priority streamgages for long-term tracking and forecasting/modeling of streamflow conditions in response to changes in land use, water use, and climate. Specifically, consistent and systematically-collected information is paramount to meet the full gamut of Federal water priorities and responsibilities over the long term related to:

- Forecasting extreme hydrologic events (floods and droughts).
- Interstate agreements, compacts, court decrees, and other legal obligations.
- Streamflow tracking in major river basins and across borders.
- Long-term streamflow forecasts due to population growth and changes in land use, water use, and climate.
- Water-quality assessments on sources, transport, and fate of contaminants in major rivers and estuaries.

To meet these strategic long-term Federal priorities and responsibilities, the USGS has identified a network of 4,760 "Federal Priority Streamgages" (FPS), roughly half of the total streamgage network. In 2017, approximately 3,460 of these streamgages were operational, including 1,176 fully funded by the USGS and the other 2,284 streamgages were jointly funded by the USGS and partners.

The remaining streamgages in the Network are also integral to the USGS mission and national water priorities related to hazard mitigation and water availability for human and ecosystem health. These approximate 4,800 streamgages were supported by Cooperative Matching Funds, in concert with cooperators and other USGS partners.

Most streamgages provide information to stakeholders serving more than one use, related to, for example:

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

- Indian Water Rights settlements.

Other Federal agencies continued to rely on streamflow information to meet their respective obligations. This includes:

- The National Weather Service flood prediction using information from over 2,500 streamgages at River Forecast Points.
- The Federal Emergency Management Agency (FEMA) for identifying flood prone areas.
- The U.S. Army Corps of Engineers (USACE) for operation of locks and dams.
- The Bureau of Reclamation for dam and water conveyance systems operations.
- The National Park Service (NPS) and the U.S. Fish and Wildlife Service (FWS) for managing water resources and ecosystems.

In addition to streamgages, the USGS continues to expand the use of storm tide sensors that measure tidal fluctuations and height of the tide relative to land surface. These sensors are part of a relatively new USGS mobile network of rapidly deployable, experimental instruments that are used to observe and document hurricane-induced storm-surge, waves, and tides as they make landfall and interact with coastal features.

In 2017, the USGS tested a new rapidly deployable streamgage (RDG). These new RDGs are less expensive, easier to install, and accommodate a variety of new sensors.

The USGS continues to enhance flood inundation mapping capabilities in order to provide emergency managers and the public with ready access to flood inundation information. The USGS, in concert with the NOAA, USACE, and local and State agencies, continue to enhance standardized geospatial flood inundation models and maps indexed to real-time streamgages that show floodwater extent and depth on the land surface. These flood forecasting tools are used for flood response and mitigation, and enable emergency management officials at local, State, tribal, and Federal levels to assess flood threats and to see, along with the general public, on a street-by-street basis, the expected extent of a flood hours, or even days, before it occurs.

The GWSIP supports the development, implementation, and maintenance of reliable systems for real-time and historic information delivery to all stakeholders that include data processing, quality assurance, storage, and readily available access. At the center of USGS water data products lies the National Water Information System (NWIS), which provides current conditions related to streamflow, flood and high flow, drought, and groundwater levels, in addition to water-quality and water-use data. The USGS ensures this system functions at peak efficiency and effectiveness, especially during hazard events. Hurricanes Harvey, Irma, and Maria resulted in record levels of requests for real-time stream and reservoir water level measurements and August 2017 was the busiest month on record, serving over 128 million requests for water information, due to Hurricane Harvey.

National Water Quality Program

	2017	2018	2019				
	Actual	Full Year CR	Fixed Costs	Internal Transfer	Program Changes	Request	Change from 2018
National Water Quality Program	**90,529**	**89,915**	**569**	**200**	**(21,028)**	**69,656**	**(20,259)**
Transfer from Environmental Health				*200*			
NAWQA Status and Trends Assessments					*(5,600)*		
NAWQA Lower Mississippi Stream Quality Assessment					*(4,000)*		
Enhanced Cooperative Activities and Urban Waters					*(717)*		
National Park Service Water-Quality Partnership					*(1,743)*		
Research and Development to Advance Water Science[9]					*(6,549)*		
National Atmospheric Deposition Program					*(1,565)*		
Administrative Savings					*(854)*		
Cooperative Matching Funds[10]	**[17,231]**	**[17,231]**	**-**	**-**	**[-717]**	**[16,514]**	**[-717]**
FTE	*635*	*635*	-	-	*(138)*	*497*	*(138)*

The National Water Quality Program (NWQP) encompasses the USGS water-quality monitoring, assessment, and research activities.

The 2019 request supports**:**

- Long-term, nationally consistent monitoring of sediment, nutrients, and pesticides at 104 stream monitoring sites that include large coastal and inland rivers and small (generally less than 100 mi^2) agricultural and minimally disturbed reference watersheds.
- Continued upgrades to the NWIS water-quality system.
- Continued long-term monitoring and modeling studies of nutrients, pesticides, sediment and other important water-quality constituents to provide information for water managers, policy makers and the public about current water-quality conditions, how they are changing through time, and the major factors that influence observed conditions and trends.

[9] Formerly the National Research Program.

[10] Cooperative Matching Funds are used to support research, data collection, and assessment activities across the National Water Quality Program, and therefore shown as a non-add component within the Program.

- Continued regional-scale modeling of current and projected surface-water and groundwater quality in selected major river basins and important principal aquifers.

- Continued efforts to develop state-of-the-science sensor technology to monitor and forecast changes on a near real-time basis for key water-quality constituents or their surrogates—such as salinity, sediment, algal toxins (HABs), and other contaminants—that can impair water quality and adversely affect the health of humans and aquatic ecosystems.

- Conducting research on water quality processes to enhance the Nation's water modeling and prediction capability.

Justification of Program Changes

The request proposes the following to address higher priorities:

- NAWQA Project Status and Trends Assessments (-$5,600,000 and -39 FTE)

- NAWQA Project Lower Mississippi Stream Quality Assessment (-$4,000,000 and -28 FTE)

- Enhanced Cooperative Activities and Urban Waters (-$717,000 and -6 FTE)

- National Park Service Water-Quality Partnership (-$1,743,000 and -12 FTE)

- Research and Development to Advance Water Science (-$6,549,000 and -44 FTE)

- National Atmospheric Deposition Program (-$1,565,000 and -10 FTE)

The budget includes an internal transfer from Environmental Health to Water Resource, National Water Quality Program of $200,000 and one FTE supporting research on harmful algal blooms and harmful algal toxin issues in water bodies throughout the Nation.

The USGS plans to achieve $854,000 of administrative savings within the program.

Program Overview

The NWQP encompasses the Water Resources Mission Area's water-quality monitoring, assessment, and research activities.

Primary goals of the NWQP are to:

- Assess the current quality of the Nation's freshwater resources and how it is changing over time.

- Explain how human activities and natural factors (e.g., land use, water use, and meteorological variability) affect the quality of surface water and groundwater.

- Determine the relative effects of important sources of water-quality impairment, including contaminants, excess nutrients and sediment, and altered streamflow in aquatic ecosystems.

- Predict the effects of human activities, meteorological variability, and management strategies on future water-quality and ecosystem conditions.

Water-quality challenges are increasing in number and complexity, and solutions are becoming more challenging and costly. The U.S. population in 2017 is over 325 million people, representing an increase of 24 million people in the last decade. This increasing population—accompanied by increased development and use of fertilizers and pesticides for food production—increases pressure on existing resources for supply water of suitable quality for irrigation, drinking water, energy development, and healthy ecosystems. NWQP investments in monitoring, assessments, modeling, and research provide the data and scientific information needed to address current and future water-quality challenges.

Long-term monitoring of water quality is used to track how changes in land use, climate, and water-quality management actions are affecting streams and rivers and associated commercial and recreational fisheries in estuaries across the Nation.

Many water bodies throughout the Nation experience chronic harmful algal bloom (HAB) issues, and toxic blooms have occurred in every State in the Nation. USGS HAB science is focused on developing analytical laboratory and field methods to detect and quantify blooms and associated toxins and taste-and-odor compounds, understanding causal factors, environmental fate and transport, ecological processes, effects of environmental exposure, and developing early warning systems for potentially harmful blooms. In 2019, the NWQP will continue this HAB research.

The USGS National Water Quality Laboratory (NWQL) is a state-of-the-art, nationally accredited laboratory providing high quality, reproducible data from the chemical analysis of water, sediment, and tissue samples, and the taxonomic identification of aquatic insects and other invertebrate organisms.

The NWQL is a leader in the research and development of new analytical methods to improve detection of contaminants at trace and ultra-trace levels, and in the detection of new and emerging contaminants. In 2019, the NWQL will continue to analyze about 40,000 water-quality samples collected annually by USGS national programs and science centers, and other Federal, State, and local customers, and work collaboratively on developing priorities for future analytical needs.

The primary models used by the USGS to develop national and regional assessments of water-quality conditions from monitoring data for the Nation’s streams and rivers are the Spatially Referenced Regressions On Watershed attributes (SPARROW) (model for sediment, nutrients, and dissolved solids), and the Watershed Regressions for Pesticides (WARP) model. Results of a new pesticide method that analyzes for 225 pesticides, including 47 parent compounds not included in previous analytical methods for stream samples collected between 2013 and 2017, will be incorporated into revised WARP models starting in 2019.

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