



Science Goals and Programs in the Water Resources Mission Area

The WMA Science Goals

The United States faces growing challenges to its water supply, infrastructure, and aquatic ecosystems due to population growth, climate change, floods, and droughts. The U.S. Geological Survey Water Resources Mission Area [science strategy](#) from 2013 lays out long-term goals that position the WMA to meet the water resource challenges of today and the future (figure 1):

1. **OBSERVE:** Provide society the information it needs regarding the amount and quality of water in all components of the water cycle at high temporal and spatial resolution, nationwide.
2. **UNDERSTAND:** Advance understanding of processes that determine water availability.
3. **PREDICT:** Predict future changes in the amount and quality of water in response to changing climate, population, land use, and water management.
4. **SUPPORT:** Anticipate and respond to water-related emergencies and conflicts
5. **DELIVER:** Deliver timely hydrologic data, analysis, and decision-support tools seamlessly across the nation to support water-resource decisions

As further stated in the science strategy, these goals help the WMA provide unbiased knowledge of the Nation's water resources to support human well-being, healthy ecosystems, economic prosperity, and anticipate and help resolve impending water-resources conflicts and emergencies. Ultimately, the WMA, through integrated activities with other USGS Mission areas and partners, will serve society through water-resource monitoring, assessment, modeling, and research to provide tools that managers and policymakers can use.

WMA efforts to meet these goals are guided by broader Department of Interior and USGS goals, Presidential directives, Congressional mandates, and performance measures.



Figure 1. Water Resources Mission Area science strategy goals.

DOI and USGS Goals

The WMA goals are aligned with two goals in the [Department of the Interior Strategic Plan for 2018-2022](#):

1. Mission Area 1, "Conserving Our Land and Water"; Goal 1, "Utilize science in land, water, species, and habitat management supporting decisions and activities"; Strategy 1, "Apply science to land, water, and species management.": This goal includes understanding and predicting changes in the quality and quantity of water to support land use and management decision making.
2. Mission Area 5, "Protecting Our People and the Border"; Goal 4, "Provide science to safeguard communities from natural hazards"; Strategy 1, "Monitor and assess natural hazards risk and response planning": This goal includes providing support to emergency managers, response officials, the media, and the public before, during, and after natural hazards.

Within the broad context of the DOI goals, the WMA goals are also aligned with the USGS 21st Century initiative, which has two key parts:

1. Accelerate delivery of actionable information: This part of the initiative stresses timely availability of USGS information. We can have the best information in the world, but if we don't get it to decision makers in time, then they'll make the best decision they can without it. This information should also be actionable; that is, processed to the point of being ready to use for decision making.
2. EarthMAP (Earth Monitoring, Analyses and Projections): This part of the initiative focuses on integrated, cross-mission area modeling, simulation, and prediction of the nation's earth and environmental systems. It marks a shift from thinking about what has happened to thinking about what is likely to happen, to help resource managers make more informed decisions about the future.

Presidential Directives

The WMA goals are aligned with directives in two recent Presidential memoranda:

1. [Promoting the Reliable Supply and Delivery of Water in the West](#): This memorandum directs DOI to improve the information and modeling capabilities related to water availability and water infrastructure projects in the western United States to help reduce flood risks; provide reliable water supplies for farms, families, businesses, and fish and wildlife; and generate dependable hydropower.
2. [Administration Research and Development Budget Priorities](#): This memorandum directs federal agencies to coordinate on five research priorities. The WMA is represented in the priority "American Energy and Environmental Leadership -- Earth System Predictability", which emphasizes coordination of research and modeling efforts that help quantify Earth system predictability across multiple phenomena, time, and space scales.

Congressional Mandates

The WMA goals reflect mandates from Congress in various pieces of authorizing legislation. For example, this includes:

- [SECURE Water Act of 2009](#), which authorizes USGS to perform an assessment of national water availability and use and to implement national streamflow and groundwater monitoring networks
- [Water Resources Development Act of 1986](#), which authorizes and directs the USGS, in cooperation with the States of the High Plains region, to monitor the levels of the Ogallala aquifer.
- [Klamath Basin Water Supply Enhancement Act of 2000](#), which authorizes the Secretary of the Interior to complete ongoing hydrologic surveys in the Klamath River Basin; these are currently being conducted by the USGS.

There are many other pieces of authorizing legislation for WMA, and you can learn more about them in detail from the following websites:

- <https://www.usgs.gov/water-resources/groundwater-and-streamflow-information/authorizations>
- <https://www.usgs.gov/water-resources/water-availability-and-use-science-program/authorizations>
- <https://www.usgs.gov/water-resources/national-water-quality-program/authorizations>
- <https://www.usgs.gov/water-resources/water-resources-research-act-program/authorizations>

Performance Measures

The WMA goals incorporate performance measures that all Federal agencies are required to establish. Progress on performance measures is tracked and [published annually by DOI](#) to increase government accountability to the public. Current (2019) WMA performance measures are:

1. Percent of the National Streamflow Network that is fully operational ([Goal](#): 8,230 operational streamgages)
2. Percent completion of next generation National Water Data Infrastructure strategy ([Goal](#): 100% completion of strategy)
3. Percent completion of the USGS National Water Census baseline ([Goal](#): Baseline daily estimates available for 9 water budget components across the Nation)
4. Percent completion of U.S. aquifer groundwater availability baseline studies ([Goal](#): 100% completion of groundwater availability assessments for the Nation's 40 principal aquifers)
5. Percent of water withdrawals from public supply, thermoelectric, and irrigation reported to USGS from our partners of a defined quality level ([Goal](#): 25% of withdrawals reported at defined quality level)
6. Percent completion of water quality sampling and studies for the Nation's groundwater, streams, and rivers ([Goal](#): 100% completion of planned sampling and studies)
7. Percentage of people living in targeted watersheds covered by completed water quality models ([Goal](#): 307 million people covered by models)

We accomplish these goals through Portfolios, Programs, and Projects

The WMA will address its long-term goals through strategically planned programs that make it clear to cooperators, internal partners, and Congress how these goals are being met and what the outcomes will be. WMA programs are compelling, timely, large, multi-year efforts that are made up of related projects and functions, and they are directed by the two major WMA portfolios (figure 2). They are coordinated across the mission areas; science centers; and federal, state, tribal, local, and academic partners. The specific programs supported by the WMA will evolve over time as new science priorities or operational challenges are identified. The current (2019) programs are listed below, organized under the two major WMA portfolios.



Figure 2. Funding for the WMA comes in through two major portfolios—the Water Observing Systems Portfolio (WOSP) and the Water Resources Availability Portfolio (WRAP). Each portfolio is comprised of related programs, which are large, multi-year efforts with clear requirements and outcomes. Each program is made up of related projects and functions.

Water Observing Systems Portfolio

The Water Observing Systems Portfolio (WOSP) encompasses the Water Resources Mission Area's objectives to collect, manage, and disseminate consistently high-quality and reliable water information in real-time and over the long term, both of which are critical for managing the Nation's water resources and anticipating and responding to water hazards that can result in loss of life and property. WOSP includes five programs that together encompass the WMA goals related to collecting, managing, and disseminating high-quality and reliable water information in real-time and over the long term (figure 3).

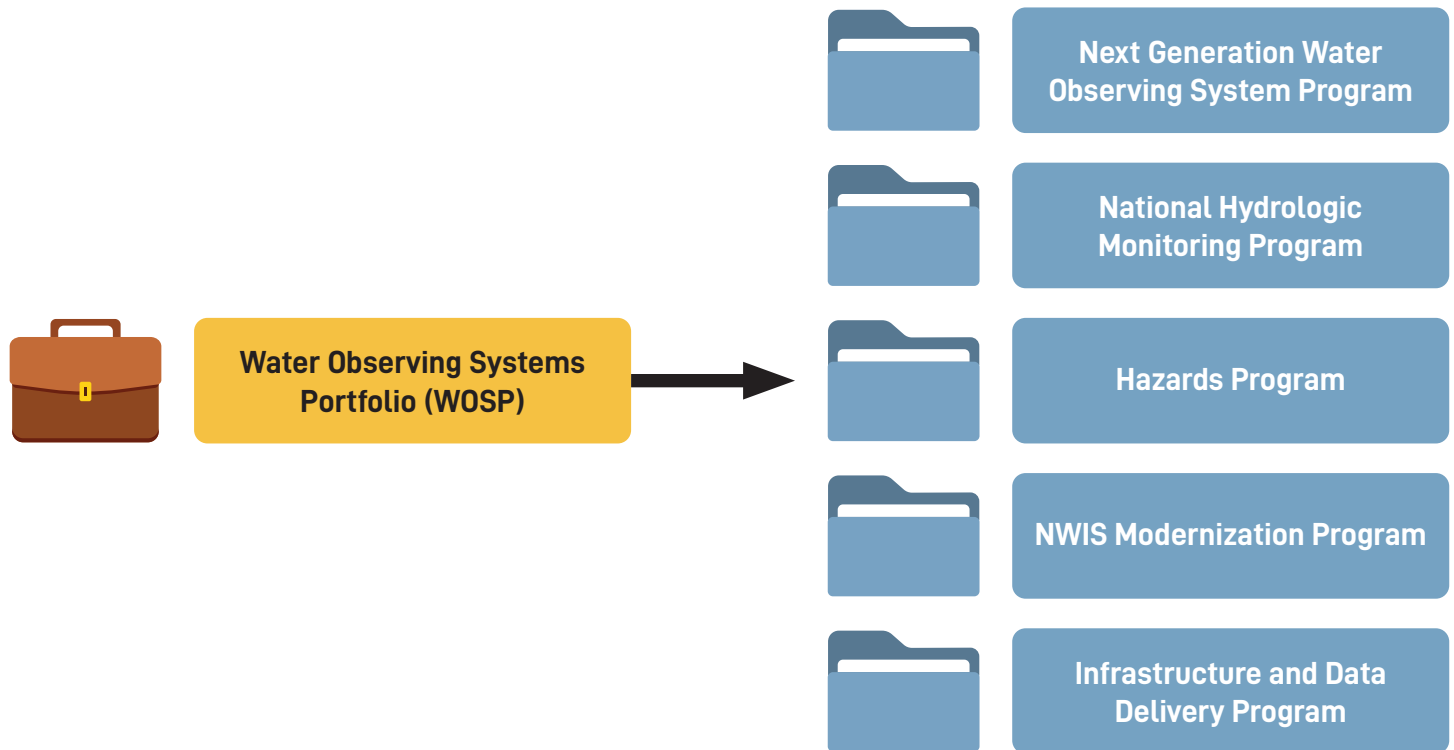


Figure 3. Programs directed under the Water Observing Systems Portfolio.

Next Generation Water Observing System (NGWOS) Program: Develops a next-generation integrated water observing system that ensures the USGS provides high-fidelity, real-time data on water quantity, quality, and use necessary to support a National modern water resource availability prediction and decision support system, and rapid and informed hazards response.

National Hydrologic Monitoring Program: Manages the highest quality and largest streamflow, groundwater and water-quality enterprise in the world. The program provides impartial, timely, rigorous, and relevant data for short- and long-term water decisions by stakeholders across the United States, as well as quality hydrologic equipment and instrumentation support, including testing, evaluation, repair, and development of new and existing hydrologic instrumentation.

Hazards Program: Ensures that response agencies are provided with the real-time hydrologic data, predictions, science, and tools needed to effectively respond to water-hazard events and mitigate the long-term risks water hazards pose to vulnerable people, property, or environments.

National Water Information System (NWIS) Program: Provides necessary improvements to NWIS, the world's largest authoritative enterprise water information system, which is foundational to advancing Water Mission Area priorities and meeting the needs of USGS and WMA stakeholders. This Program is supported by both WOSP and WRAP.

Infrastructure and Data Delivery Program: Assures successful execution of the data telemetry, storage and delivery aspects of the USGS Water Enterprise mission "to provide reliable, impartial, timely information needed to understand the nation's water resources". This program ensures that water information and associated tools are delivered in a way that meets the ever-evolving needs of our users and cooperators to make informed water-resource decisions.

Water Resources Availability Portfolio

The USGS Water Resources Availability Portfolio (WRAP) fulfills the goals established by Congress in the SECURE Water Act by investing in research and assessments that improve the Nation's understanding of water availability. WRAP includes twelve programs that collectively support our objectives to systematically provide information that will allow resource managers to assess the supply, use, quality, and availability of the Nation's water. WRAP includes twelve programs that collectively support our objectives to systematically provide information that will allow resource managers to assess the supply, use, quality, and availability of the Nation's water (figure 4).

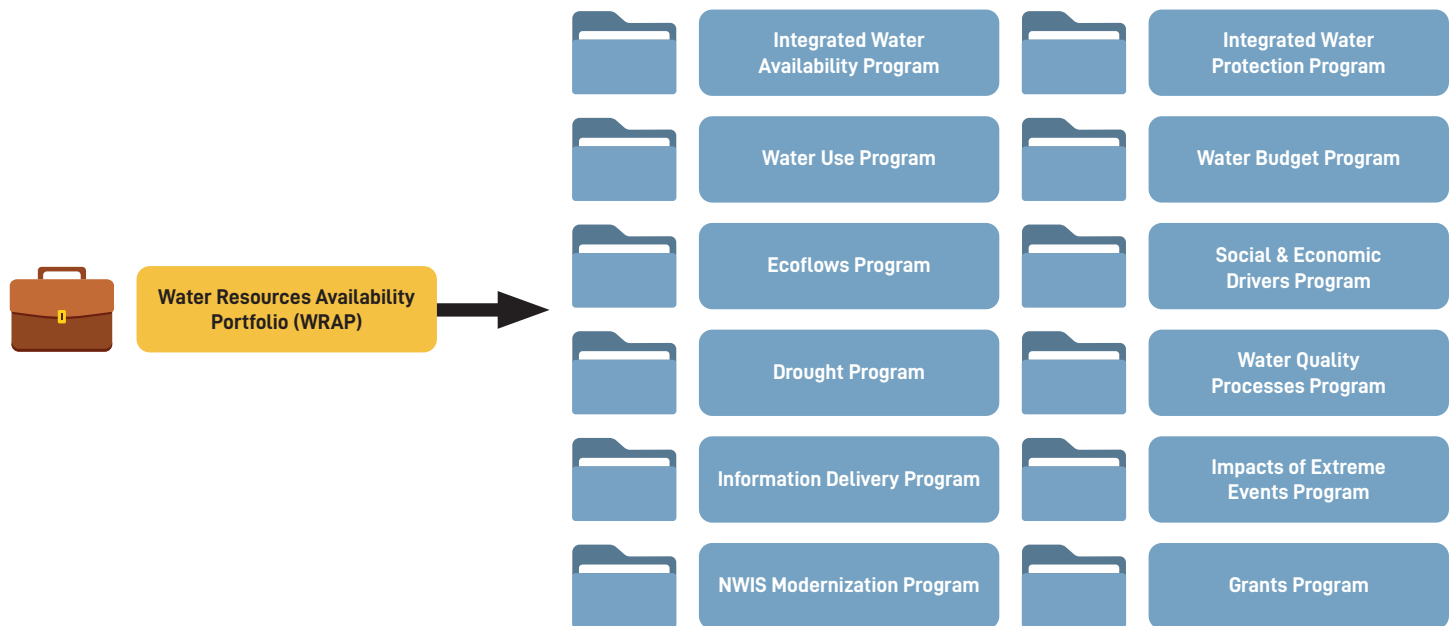


Figure 4. Programs directed under the Water Resources Availability Portfolio.

Integrated Water Availability Assessments (IWAAs) Program: Provides nationally consistent assessments of water availability for human and ecological needs and identifies factors that limit water availability toward improved forecasting, at multiple temporal and spatial scales, to inform water policy and management actions.

Water Use Program: Supports activities related to data collection, methods development, and application of water use models to improve reporting of water withdrawal and use information for 8 categories of use. This includes improving our understanding of the socioeconomic influence on water demand, use, and movement.

Ecoflows Program: Provides collaborative data and science needed to develop and quantify relations between hydrology and biological responses of fish and invertebrate communities.

Drought Program: Improves assessments and predictions of multi-scale drought risk relative to droughts of defined historical magnitudes including potential impacts to different components of water availability, including ecological flows most vulnerable to drought.

Information Delivery Program: Focuses on activities that improve data accessibility, web design, data dissemination, and cyberinfrastructure in support of WMA priorities. Initial focus will be on data-driven user experience testing, analysis, and design through testing and tracking user interactions quantitatively to improve the delivery of WMA priority products, like the National Water Census.

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Integrated Water Prediction (IWP) Program: Uses an open-science approach to advance predictive understanding of hydro-terrestrial system structure, function and evolution, across a broad range of spatial and temporal scales, and in response to diverse system drivers and stakeholder needs. Predictive and multiscale understanding of coupled natural and human system components of the integrated water cycle is codified into a modern enterprise architecture, which is modular, interoperable, extensible, portable, and scalable from PCs to HPC and the cloud. This predictive capacity is tested and further advanced through an iterative cycle of model-driven experimentation and observation utilizing a network of observational testbeds extending from local to national scales.

Water Budget Program: Provides science to understand and quantify the inputs, outputs, and changes in the water budget. Use of advanced techniques or accounting methods to quantify water budget components at consistent spatial and temporal scales provide a means for decision makers to evaluate the water available for human and ecological needs as well as where stresses to the budget exist or may develop.

Social and Economic Drivers Program: Provides improved understanding of the impacts of socioeconomics on water availability. Research will be focused on improved understanding around basin specific drivers for regional assessments as well as National drivers to improve the ability of the National Water Census to forecast availability under a variety of conditions.

Water Quality Processes Program: Provides an improved understanding of how water quality influences water availability. Initial focus of research activities will be on constituent fate and transport, improved understanding of bio-geochemical systems and contaminants, and water-quality methods development

Hydrologic Impacts of Extreme Events Program: Focuses on improved understanding of how extreme events impact water availability. Initial focus of research activities will be in the hydrologic impacts of floods, subsidence, and wildfire.

Grants Program: Manages WMA grant programs that provide financial assistance through cooperative agreements with State water resource agencies to improve water-use data and through collaboration with the National Park Service to assist them in addressing high-priority water-quality issues of concern.

How It All Fits Together

While each of the WMA programs has a different focus, their activities will be coordinated and aligned to produce integrated science to meet the WMA goals. Water-quantity and quality data from our monitoring networks will be served through a modernized NWIS and will be used in advanced modeling tools to provide state-of-the-art predictions of water quantity and quality. The enhanced observational data and model predictions will support assessments of past, current, and future water availability and near-real time forecasting of extreme events; these efforts will in turn will inform water resource management decisions.

For example, on a regional level, both IWP and IWAAs activities will be carried out in watersheds selected as part of the NGWOS program. NGWOS and National Hydrologic Monitoring data collection will be designed to meet IWP modeling needs, which in turn will be planned around IWAAs assessment priorities as defined together by the WMA, science centers, and stakeholders in the watershed. Each step in this process will leverage the world-class research and development capabilities within the WMA and the science centers.

The collective goal of the new programs is to provide comprehensive and timely water information to ensure the availability of safe, high-quality, sustainable water supplies and support improved response to water-related hazards in the United States. Substantial advances in water science, together with emerging breakthroughs in technological and computational capabilities, have resulted in sophisticated new monitoring and modeling capabilities that position the WMA to provide our stakeholders with improved information, data, and tools needed to address today's water challenges at the national, regional, and local scale.

