

# National Drought Resilience Partnership (NDRP)

## Priority Actions Supporting Long-Term Drought Resilience

2019

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## MISSION STATEMENT

The Federal Government supports States, Tribes, Territories, local communities, and public- and private-sector interests in preparing for, mitigating, responding to, and recovering from drought. The National Drought Resilience Partnership (NDRP) leverages technical and financial Federal resources, strengthens communication, and fosters collaboration among its members to productively support State, tribal, and local efforts to build, protect, and sustain drought resilience capacity at regional and basin scales.

In addition to meeting the expressed goal of building toward a drought resilient Nation, activities of the NDRP also support related overarching Administration goals, including those expressed in the October 19, 2018, *Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West*, where the importance of improving forecasts of water availability (under the Weather Research and Forecasting Innovation Act of 2017<sup>1</sup>) and the use of technology to increase that water availability (under the Reclamation Wastewater and Groundwater Study and Facilities Act<sup>2</sup> and the Water Desalination Act of 1996<sup>3</sup>) are outlined.

## INTRODUCTION

Drought poses a serious threat to the resilience and security of the Nation and impacts the lives of millions of Americans. Extreme, widespread drought challenges the security of the Nation's food supply, the integrity of critical infrastructure, the resilience of the economy, and the health and safety of our people and ecosystems. Meteorological trends indicate that the United States can expect droughts to become more frequent, longer, and more severe. Persistent drought eventually forces foundational changes in the way communities use and live on the land. The regional economic impacts of drought force water-intensive industries to relocate, threaten agricultural production, heighten wildfire and land subsidence risk, and reduce tourism. The potential human impacts of drought are far reaching to the extent drought reduces both water quantity and water quality, contributes to poor air quality, and exposes populations to increased incidence of illness and disease.

While authority lies with the States to manage water resources, Federal agencies play a key role in supporting States, Tribes, Territories, communities, and private-sector owners and operators of critical national infrastructure to prepare for, mitigate against, respond to, and recover from drought.

The interagency NDRP Member Agencies and offices include the Department of Defense (DOD); Department of the Interior (DOI); Department of Agriculture (USDA); Department of Commerce

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<sup>1</sup> Pub. L. No. 115-25, 131 Stat. 91, 15 U.S.C. § 8501 *et seq.*

<sup>2</sup> Pub. L. No. 102-575, tit. XVI, 106 Stat. 4663, 43 U.S.C. § 390h *et seq.*

<sup>3</sup> Pub. L. No. 104-298, 110 Stat. 3622, 42 U.S.C. § 10301 note.

(DOC); Department of Energy (DOE); Department of Homeland Security (DHS); Environmental Protection Agency (EPA); Office of the Assistant Secretary of the Army for Civil Works (Army Civil Works); Office of Management and Budget (OMB); Office of Science and Technology Policy (OSTP); National Economic Council (NEC); Council on Environmental Quality (CEQ); National Security Council (NSC) staff; and such other agencies or offices as the agencies set forth above, by consensus, deem appropriate,<sup>4</sup> currently including the: National Oceanic and Atmospheric Administration (NOAA), its National Weather Service (NWS), National Integrated Drought Information System (NIDIS), and Office of Water Prediction (all within DOC); Bureau of Reclamation (BOR) and United States Geological Survey (USGS) within the DOI; National Aeronautics and Space Administration (NASA); DHS Cybersecurity and Infrastructure Security Agency – National Risk Management Center; Federal Emergency Management Agency (FEMA); and Centers for Disease Control and Prevention (CDC).<sup>5</sup> These Member Agencies work with each other, as well as with State, regional, tribal, and local partners, to build long-term drought resilience to ensure successful outcomes with maximum efficiency and minimal duplication.

The NDRP Member Agencies recognize that the efforts of these diverse agencies are greater than the sum of their constituent parts. By building relationships and informing Agency policymakers about cross-Agency opportunities to enhance, invigorate, and support individual Agency goals and performance, more can be achieved. To that end, key Administration goals of enhancing Federal coordination and integration of resource planning help minimize regulatory burdens and assure that, as much as possible, communities affected by drought avoid economic hardships.

This document provides background on the capabilities, ongoing activities, and opportunities of the NDRP. The document categorizes the NDRP's drought resilience efforts along the six drought resilience policy goals established in the NDRP Charter:<sup>6</sup>

1. Data Collection and Integration
2. Communicating Drought Risk to Critical Infrastructure
3. Drought Planning and Capacity Building
4. Coordination of Drought Activity
5. Market-based Approaches for Infrastructure and Efficiency
6. Innovative Water Use, Efficiency, and Technology

These goal areas provide a framework to systematically address how the Federal Government supports building long-term drought resilience. The document summarizes current and planned work by NDRP Member Agencies to promote drought resilience. The document does not provide a complete catalog of NDRP Member Agency accomplishments or capabilities, but is intended to continue a national dialogue regarding how the NDRP Member Agencies can continue to facilitate

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<sup>4</sup> Presidential Memorandum: Building National Capabilities for Long-Term Drought Resilience, § 5(c)(i)-(xiv) (Mar. 21, 2016).

<sup>5</sup> National Drought Resilience Partnership, 2016 End of Year Report, January 2017, Appendix B: National Drought Resilience Partnership Leadership.

<sup>6</sup> National Drought Resilience Partnership: CHARTER (June 27, 2016).

a more drought-resilient Nation, in partnership with and in support of States, Tribes, Territories, and other stakeholders.

## CURRENT AND PLANNED ACTIONS

**Goal 1: Data Collection and Integration.** Agencies shall share data and information related to drought, water use, and water availability, including data on snowpack, groundwater, stream flow, population health, and soil moisture with State, regional, tribal, and local officials to strengthen decision making to support more adaptive responses to drought and drought risk.

### **National Soil Moisture Network**

Operators of Federal soil moisture networks are partnering with the public sector to coordinate activities around the collection and dissemination of soil moisture information. Activities to date have included NIDIS sponsored workshops, discussions with State-run networks, and attempts to establish metrics for station siting and data collection. Several discreet actions are underway in an effort to establish pilots for products designed for use in the *United States Drought Monitor*.

*Lead Agencies: NOAA, USGS, USDA, NASA*

*Underway; Ongoing Program*

### **Create a Next-Generation Water Observations System for the Nation**<sup>7</sup>

USGS, BOR, and NOAA are collaborating to develop the Next Generation Water Observation System (NGWOS) to provide real-time data on water quantity and quality necessary to support modern water prediction and decision support systems for water emergencies and to better understand drought impacts on water availability. When fully implemented, the NGWOS will provide quantitative information on streamflow, evapotranspiration, snowpack, soil moisture, a broad suite of water quality constituents (nutrients, salinity, turbidity, and wastewater indicators), sediment transport, connections between groundwater and surface water, and water use in watersheds that are representative of the primary principal aquifers and major river basins of the United States.

*Lead Agency: USGS*

*Underway; Ongoing Program*

### **Improve Continental Scale Hydrologic Modeling**<sup>8</sup>

NOAA and USGS are developing a pilot program to evaluate probabilistic water information and forecasts at high-spatial resolutions in western watersheds. These services will incorporate high resolution from additional data sources, such as NGWOS, and will be deployed on multiple spatial and temporal scales to provide predictive capabilities on key water budgeting components such as snow states, soil moisture, evapotranspiration, runoff, and streamflow.

*Lead Agencies: NOAA & USGS*

*Underway; Ongoing Program*

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<sup>7</sup> *Id.*

<sup>8</sup> *Id.*

### **Improving Seasonal and Sub-Seasonal Forecasting**

The NDRP Member Agencies are assisting NOAA in the congressionally mandated effort to improve the accuracy and usefulness of sub-seasonal (two weeks to three months) and seasonal (three months to two years) outlooks.

*Lead Agency: NOAA*

*Underway; Ongoing Program*

### **Strengthen Linked Data Observation Networks to Broaden Their Spatial and Temporal Extents**

To better understand how drought affects biota across aquatic environments, the NDRP Member Agencies are assisting the USGS in efforts to improve eco-hydrological data observation networks by linking hydrological and biological data. To address drought vulnerability across riverscapes, the USGS will develop and implement integrated ecological drought monitoring and research networks in several focal basins across the United States, with focal points in the Flathead River, Yellowstone River, and Snake River basins in the Northern Rocky Mountains ecoregion, Shenandoah National Park watersheds, West Brook in the northeastern United States, and the Blitzen River in the Great Basin.

*Lead Agency: USGS*

*Underway; Ongoing Program*

### **Expansion of United States Drought Monitor to the United States Virgin Islands and United States-Affiliated Pacific Islands**

The *United States Drought Monitor* is being expanded to cover previously unrepresented United States territories to assess drought severity for program eligibility. Sample products have been approved and partner Agencies are clear to make datasets and procedures operational to bring maps online for the drought monitoring community.

*Lead Agencies: USDA & NOAA*

*Completed June 2019*

### **New Weather and Climate Sensors in Tribal Areas for Management Decisions and Science, Technology, Engineering, and Mathematics (STEM) Education**

Partner agencies are working with tribal leaders to increase the amount of rainfall sensors available for monitoring and assessing drought. Non-Federal partners include Colorado State University and the operators of the Community Collaborative Rain, Hail, and Snow (CoCoRaHS) Network. Data from these locations (mainly precipitation, but also solar radiation, air temperature, wind speed and direction, soil temperature and moisture, and leaf wetness where possible) will be worked into existing databases available to authors of the *United States Drought Monitor*.

One such project is Tribal Soil Climate Analysis Network (TSCAN), which focuses on strengthening tribal outreach to support production management and STEM education. The National Water and Climate Center of USDA's Natural Resources Conservation Service (NRCS), in partnership with the Bureau of Indian Affairs (BIA), is in the process of distributing multi-variable weather and climate monitoring units to select tribal groups. NRCS is also working with NOAA's Northeast Regional Climate Center at Cornell University to develop an online platform to improve utility of the TSCAN data by linking it to graphical tools useful for agricultural production, food sovereignty, and to support STEM education.

*Lead Agencies: USDA, NOAA, BIA*

*Underway; Ongoing Program*

### **High Resolution Satellite-Based Soil Moisture for Improved Drought Monitoring**

Generally, drought develops when the precipitation amount received by an area drops below its long-term average. This causes insufficient plant water availability and reduced water storage. Soil moisture is a key hydrologic variable that controls the local water and energy balance and is a critical measure of agricultural drought. To this end, soil moisture information is critical for crop yield forecasting, early warning of floods and droughts, irrigation scheduling, and reservoir management. However, the availability of soil moisture estimates from satellites can provide reliable estimates at a range of spatial scales. The NASA Western Water Applications Office (WWAO) is supporting the development of a customized, downscaled product at 1km spatial resolution that can provide detailed information for research and applications in hydrology and other related fields. Once NASA-Indian Space Research Organisation (ISRO) Synthetic Aperture Radar (SAR) Mission (NISAR) launches, NASA will be able to provide 200m spatial resolution over agricultural areas.

*Lead Agency: NASA*

*Underway; Expected Completion 2020*

### **Conduct Survey on Irrigation Organizations**

The Irrigation Organizations Survey will be conducted in early 2020 referencing 2019 as the target year. The work supports the call for Federal research and data on drought resiliency under the NDRP initiative, providing valuable input to Federal agencies and other stakeholders involved in resource assessment, conservation, and analysis. This survey will be conducted through a cooperative agreement between the USDA National Agricultural Statistics Service (NASS) and the Economic Research Service (ERS) also within USDA. The development of this important economic agricultural database serves the best interest of USDA, the agricultural community, and the Nation. On April 11, 2019, the NASS at USDA published a Notice of Intent to Seek Approval to Create a New Information Collection in the *Federal Register* with a deadline for comments of June 10, 2019.

*Lead Agency: USDA*

*Underway; Expected Completion 2020*

### **Improved Monitoring of Drought Impacts on Fallowing of Agricultural Lands**

During drought events, reductions in surface water deliveries to agricultural users often result in increases in the extent of agricultural lands that are fallowed and left unplanted for one or more seasons. This impact of drought is difficult to quantify in real-time without the use of remote sensing. The NASA WWAO is supporting partnerships between NASA scientists and State agencies to implement tools that support the integration of satellite data in the operational monitoring of fallowed agricultural acreage in regions impacted by drought events.

*Lead Agency: NASA*

*Underway; Expected Completion 2022*

### **Improved Water Supply Forecasts and Streamflow Predictions**

Thorough assessment of basin-level water supply forecasts and streamflow predictions requires careful integration of ground- and satellite-based observations with calibrated hydrologic models at the proper temporal and spatial scale. The NASA WWAO is supporting the development of a multi-hydrologic model-based data assimilation system, the Western Land Data Assimilation System, to enable a robust historic hydrologic assessment capability for the western United States. The system will provide long-term climatology with which current conditions can be compared

through the integration of the best available parameter and meteorological forcing inputs and observations of terrestrial water storage, soil moisture, vegetation, and snow data.

*Lead Agency: NASA*

*Launched January 2019; Expected Completion 2022*

### **Support State, Tribal, Local, and Territorial Health Departments**

The CDC support a previously distributed drought-resource guide for health departments that focuses on planning for, and responding to, the health effects of drought, and provide updates as appropriate. CDC is expanding existing work with State, local, tribal, and territorial health departments to identify the health effects of drought, identify at-risk populations in those communities, and develop and implement activities to decrease the risk of those health effects.

*Lead Agency: CDC*

*Expected Launch Date: September 2019*

### **Improved Forecast Integration in Water Management Decision-Making<sup>9</sup>**

DOC and DOI expect to collaborate to improve and expand water forecasting tools and their use in water management operations. NOAA's Hydrologic Ensemble Forecast Service (HEFS) provides forecasts of multiple factors important to water management decisions and verification products at specific river locations that can be tailored to user needs at forecast horizons ranging from six hours to one year. The HEFS model allows for the incorporation of multiple weather and physical inputs to produce an expected range of outcomes. The ensemble forecasts provided by HEFS help water managers understand the range of possibilities that should be considered when planning reservoir and other water operations. Expanding the deployment of HEFS to new river systems is expected to allow for further refinement of the models to better inform reservoir operations and decision-making.

*Lead Agencies: NOAA & BOR*

*Underway; Expected Completion December 2019*

### **Operation of Statistical Water Supply Forecast Tool<sup>10</sup>**

BOR's Great Plains Region (Missouri-Basin Region) is developing a statistical modeling tool to improve seasonal water supply forecasting in snow-dominated basins. The software allows users to analyze multiple forecasts to provide a better picture of future reservoir inflows. The tool has a user-friendly interface that allows water managers to build data sets from a wide range of online sources to meet specific needs.

*Lead Agency: BOR*

*Underway; Expected Completion FY 2021*

### **BOR WaterSMART Reservoir Operations Pilot Studies<sup>11</sup>**

BOR is conducting pilot studies to identify possible improvements to reservoir operations by incorporating improved scientific information and enhancing operational flexibility to maximize benefits from the existing system. BOR's reservoirs are operated using criteria to meet several different water management priorities, including reliable water deliveries, power generation, environmental requirements, navigation, and flood control management. Reservoir management

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<sup>9</sup> Action implementing *Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West* (Oct. 19, 2018).

<sup>10</sup> *Id.*

<sup>11</sup> *Id.*



practices are being evaluated to determine if there are opportunities to update these criteria to optimize reservoir operations. BOR recently completed five pilot studies in Oklahoma, Oregon, Arizona and the Upper Colorado River. In FY 2019, BOR is compiling key takeaways from the completed pilots for use in framing a request for proposals for new reservoir operations pilots.

*Lead Agency: BOR*

*Underway; Expected Completion September 2019*

### **Improved Forecasts of Low-Elevation Snowmelt Runoff<sup>12</sup>**

BOR and the National Center for Atmospheric Research (NCAR) expect to collaborate to improve forecasting of low-elevation snowmelt runoff. The outcome will directly address needs for improved forecasts to support reservoir operations. Some statistical forecast methods do not represent low elevation snowpack, which can result in under-forecasting reservoir inflows and the potential for insufficient drawdown. Better forecasts provide operators the ability to mitigate runoff due to low elevation snowpack through reservoir drawdown actions. This potentially avoids damaging high releases and spill, which reduce hydropower generation.

*Lead Agency: BOR*

*Underway; Expected Completion FY 2020*

### **Application of National Water Model for Drought Monitoring and Nowcasting**

NOAA will advance drought monitoring using analyses and predictions of land surface and hydrologic process outputs from the state-of-the-art National Weather Monitor (NWM) to calculate soil moisture, evapotranspiration, and runoff. First applications will inform and enhance NOAA/NWS Climate Prediction Center drought monitoring and outlooks.

*Lead Agency: NOAA*

*Expected Launch Date: FY 2019*

### **Evaporative Demand Drought Index**

NOAA will complete transition and demonstrate operational deployment of the Evaporative Demand Drought Index (EDDI), which has proven potential applicability in monitoring agricultural and hydrological drought and in fire-weather risk assessment.

*Lead Agency: NOAA*

*Underway; Expected Completion 2019*

## **Goal 2: Communicating Drought Risk to Critical Infrastructure.**

Agencies shall communicate with State, Territorial, regional, tribal, local, and critical infrastructure officials, targeted information about drought risks, including specific risks to critical infrastructure.

### **Disseminate and Implement the Recently Developed Critical Infrastructure Security and Resilience Planning Guide**

The DHS-National Protection and Programs Directorate (DHS-CISA) will work through its regional offices to disseminate the Regional Drought Primer developed by DHS and NDRP Member Agencies in 2017 and 2018. The Primer synthesized information on drought hazard and potential

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<sup>12</sup> *Id.*

impacts to infrastructure services across multiple sectors and will point infrastructure planners toward multiple Agency adaptation and planning resources.

*Lead Agency: DHS*

*Expected Launch Date: FY 2019*

**Goal 3: Drought Planning and Capacity Building.** Agencies shall assist State, Territorial, regional, tribal, and local officials in building local planning capacity for drought preparedness and resilience.

### **National Drought Forum**

NIDIS, along with the NDRP, is co-hosting the 2<sup>nd</sup> National Drought Forum in Washington, D.C., from July 30-31, 2019. The National Integrated Drought Information System Act of 2006<sup>13</sup> ordered the establishment of NIDIS within DOC, with an interagency mandate to coordinate and integrate drought research, building upon existing federal, tribal, state, and local partnerships to create “an effective drought early warning system”<sup>14</sup> (DEWS) for the Nation. NIDIS’s general goal is to improve the Nation’s capacity to manage drought-related risks by providing the best available information and tools to assess the potential impacts of drought, and to prepare for and mitigate the effects of drought. The DEWS utilizes new and existing partner networks to optimize the expertise of a wide range of Federal, State, Tribal, Territorial, local, and academic partners to make climate and drought science readily available, easily understandable, and usable for decision makers; and to improve the capacity of stakeholders to better monitor, forecast, plan for, and cope with the impacts of drought.

*Lead Agency: NIDIS*

*Underway; Ongoing Program*

### **Western Water Applications Office (WWAO)**

NASA’s Earth Science Division, Applied Sciences Program has established a local western office at NASA’s Jet Propulsion Laboratory to support western United States water managers in putting NASA data to work. WWAO connects stakeholders with NASA scientists, technology, tools, and data, including development of custom solutions through application projects. WWAO also will assist with the transition of applications into an operational state. NASA has a remarkable constellation of Earth observing satellites, much of which target freshwater information. This capability has also driven science, technology, and applied research using these observations for better information about water resources. WWAO is charged with leveraging decades’ worth of capabilities and teaming with water resource stakeholders to target our water management challenges, especially in the western United States.

*Lead Agency: NASA*

*Underway; Ongoing Program*

### **New Study Examining the Ecological Impacts of Drought Across the United States**

USGS is leading a study with Federal, academic, and non-profit ecological-sciences experts to synthesize the current understanding of drought impacts on ecosystems and to enable better-

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<sup>13</sup> Pub. L. No. 109-430, 120 Stat. 2918.

<sup>14</sup> 15 U.S.C. § 313(b).

informed decision-making with respect to the regional effects of drought on wildlife and ecosystems.

*Lead Agencies: USGS & Forest Service (USFS)*

*Underway; Ongoing Program*

### **Delivering Water Availability Assessments at National and Regional Extents**<sup>15</sup>

Water resource managers need tools and information that support decision-making with regard to water availability for both human and ecological uses. USGS is developing a framework that will provide data, tools, and information through Integrated Water Availability Assessments (IWAAs). IWAAs will: (1) evaluate current water supply and demand; (2) evaluate long-term trends in water availability; (3) provide seasonal to decadal forecasts of availability; and (4) inform water resource decisions through development of socioeconomic tools. National IWAAs will deliver daily operational assessments of availability for quantity by the end of 2019, and quality and use by the end of 2020. Regional IWAAs will be piloted in the Delaware River Basin with implementation in a Western Basin to follow, coordinated with NGWOS.

*Lead Agency: USGS*

*Underway; Expected Completion 2020*

### **Quantification of Evapotranspiration and Agricultural Water Use**

The ability to rapidly and consistently quantify agricultural water use and identify water shortages can provide State agencies with critical information that can be applied to quantify drought impacts on agriculture, identify areas with particularly acute drought impacts, and ensure compliance with actions taken in response to water shortages. NASA is supporting the development of software tools that allow State water management agencies to create statewide water maps of evapotranspiration at the scale of individual fields through integration of satellite and weather data. NASA is also supporting a series of training workshops for personnel at State water agencies to ensure ongoing, operational use of these tools in State water planning and drought response activities.

*Lead Agency: NASA*

*Underway; Expected Completion 2022*

### **Satellite-Based Drought Reports for the Navajo Nation**

To determine how best to deploy drought relief resources and develop drought relief strategies, the Navajo Nation has requested support from NASA to develop satellite-based tools and data to help augment sparse rain gauge data. The NASA WWAO is supporting applied research to develop software tools that combine precipitation data from NASA satellites, drought indices and on-the-ground rain measurements within a user-friendly web interface. The “Drought Severity Evaluation Tool” will enable water managers to quickly calculate precipitation on the Navajo Nation for all chapters, agencies, grazing districts, watersheds, or ecoregions, over any historical time period in recent decades, and in near-real-time. This tool is being developed to support decision-making about allocation of drought emergency funds to impacted regions, and could be extended to other regions in partnership with tribal governments.

*Lead Agency: NASA*

*Underway; Expected Completion 2022*

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<sup>15</sup> Action implementing *Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West* (Oct. 19, 2018).

### **Develop Municipal Water Recycling Technical Assistance**

Building upon recently awarded research grant funding, NDRP partners are planning to develop a series of technical assistance documents that assist States, Tribes, regions, and localities as they plan for future water reuse and recycling projects, with the goal of including information on:

- regulated or unregulated contaminants and expected presence in treated water;
- evaluation of common drinking-water treatment processes and their inactivation/removal efficiency;
- microbial, chemical, radiological, and emerging contaminants;
- recommended monitoring of influent and effluent for water treatment plants; and
- recommended monitoring of finished water.

*Lead Agency: EPA*

*Expected Launch Date 2020*

**Goal 4: Coordination of Federal Drought Activity.** Agencies shall improve the coordination and integration of drought-related activities to enhance the collective benefits of Federal programs and investments.

### **Development and Application of DOE Water-Energy Model Capabilities in Conjunction with Partner Agencies' Programmatic Drought Mitigation Efforts**

To enable the identification of potential risk areas in the event of reliable water supply disruptions for which the resilience and reliability of the power generation infrastructure could be compromised, DOE is leveraging its modeling capabilities forecasting the interaction between energy and water ecosystems under simulated drought conditions with forecasts from diverse end users. This information will be utilized by Agencies with mission areas in other water use sectors, such as the NRCS, to help focus water conservation resources to mitigate these risks, with the goal of ultimately enhancing energy, economic, and environmental security.

*Lead Agencies: DOE & USDA*

*Underway; Expected Completion 2019*

### **Improved Regional Collaboration to Better Manage Water Resources<sup>16</sup>**

NOAA will strengthen regional collaboration between BOR, USDA, and NOAA by identifying opportunities to better apply water forecast services for precipitation, snowpack, water quantity, and water quality to improve resource management. BOR will evaluate the quality of existing data and services as resources to guide resource management decisions and operation of water infrastructure projects.

*Lead Agency: NOAA*

*Expected Launch Date: FY 2019*

### **Launch the New BOR Information Sharing Environment**

Building on the 2017 release of the BOR Water Information System (water.usbr.gov), this new information management system will provide public and private sectors easier access to information on reservoir water conditions, environmental compliance activities, hydropower, infrastructure assets, and other water-related information. The system will serve a mix of data

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<sup>16</sup> *Id.*

types (e.g., time series, spatial, documents) and offer modern features such as machine-readable data formats and web-services.

*Lead Agency: BOR*

*Expected Launch Date: FY 2019*

### **Coordinate Planning and Capacity-Building Programs**

Multiple Federal agencies, including EPA, USDA, and DOI, have programs to facilitate or support locally led watershed level drought planning. This activity focuses on enhancing the existing National Drought Mitigation Center (NDMC) Drought Planning Database with additional sub-State analysis capabilities and increased geospatial capabilities to enable more effective coordination on State, regional, tribal, and local drought planning efforts. This activity also involves increased coordination of drought planning in hazard mitigation strategies.

*Lead Agencies: NOAA, NIDIS, USDA*

*Expected Launch Date: FY 2020*

### **Local Hazard Mitigation Plan Guidebook**

Drought mitigation strategies are included in many State, Local, Tribal, and Territorial (SLTT) *hazard mitigation plans*. FEMA's regional mitigation planners review and approve plans and provide mitigation planning technical assistance to all SLTTs, through FEMA's National Mitigation Planning Program. Through a FEMA Cooperating Technical Partnership (CTP) program, the American Planning Association and the NDMC are developing a Guidebook for planners and allied professionals that will include available tools, resources, and State and Federal programs for drought planning in a multi-hazard context. The Guidebook will be informed by a recent survey of the APA membership on planning and drought as well an interdisciplinary drought summit that was held in 2018. Planned release of the Guidebook is scheduled for September 2019.

*Lead Agency: FEMA*

*Underway; Expected Completion 2019*

## **Goal 5: Market-Based Approaches for Infrastructure and Efficiency.** Agencies shall support the advancement of innovative investment models and market-based approaches to increase resilience, flexibility, and efficiency of water use and water-supply systems.

### **Leveraging WaterSMART to Support Water Supply Reliability and Drought Resilience**

The BOR supports the development of new strategies to increase water supply reliability through several different WaterSMART activities, including Water and Energy Efficiency Grants, Water Marketing Strategy Grants and the Drought Response Program. New near-term actions include extending ongoing collaboration between BOR and the NRCS to align water conservation funding to maximize conservation benefits, increasing awareness of water marketing as a tool to improve water management through the development of case studies, and increased collaboration with other Agencies and partners (e.g., NIDIS, USGS, and NDMC) to improve access to drought planning tools and data needed by BOR stakeholders engaged in drought planning.

*Lead Agencies: BOR & NRCS*

*Underway; Expected Completion 2019*

## Develop and Promote Innovative Technologies Through Prize Competitions and Challenges

The NDRP Member Agencies are leading major efforts to promote innovative technologies through prize competitions and challenges. Currently identified competitions and challenges include:

- DOE recently launched the Water Security Grand Challenge to advance transformational technology and innovation to meet the global need for safe, secure, and affordable water. The Grand Challenge aligns well with NDRP priorities and is being implemented in collaboration with EPA. Using a coordinated suite of prizes, competitions, early-stage research and development, and other programs, the Grand Challenge has set the following goals for the United States to reach by 2030: (1) Launch desalination technologies that deliver cost-competitive clean water; (2) Transform the energy sector’s produced water from a waste to a resource; (3) Achieve near-zero water impact for new thermoelectric power plants, and significantly lower freshwater use intensity within the existing fleet; (4) Double resource recovery from municipal wastewater; and (5) Develop small, modular energy-water systems for urban, rural, tribal, national security, and disaster response settings.
- BOR will partner with other Federal and non-Federal agencies to launch a reduction-to-practice prize competition “More Water Less Concentrate – Stage 2.” This will be a multi-phase competition that ultimately asks competitors to build and demonstrate novel technologies for more efficiently managing concentrate streams produced during desalination. This competition is intended to demonstrate increased desalination water recovery, increased water supplies, and improved cost viability of desalination as a drought-resilient water supply option.
- BOR continues to lead a Water Prize Competition Center with multiple Agencies to help incentivize new technologies and scale up existing methods of water-use innovation through prize competitions. These efforts are focused on complex and pressing water-related problems in infrastructure, water availability, and environmental compliance.
- BOR will launch the second edition of the “Sub-Seasonal Climate Forecast Rodeo” prize competition, a yearlong real-time competition where participants are asked to predict, out to three to six weeks, the precipitation and temperature over the western United States. Compared to the first competition, the second edition will feature more challenging benchmarks and a solver community expanded from the United States only to an international pool. Partners include NOAA and other Federal and non-Federal organizations. The forecast rodeo helps accomplish section 3 of the October 2018 Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West.<sup>17</sup>
- The USDA’s NRCS encourages innovative technologies with [Conservation Innovation Grants](#) (CIG), which are competitive grants that drive public- and private-sector innovation in

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<sup>17</sup> *Id.*

resource conservation focused on resilience of agricultural operations. Public and private grantees develop the tools, technologies, and strategies to support next-generation conservation efforts on working lands and develop market-based solutions to resource challenges. Grantees leverage the Federal investment by at least matching it.

*Lead Agencies: DOE, BOR, NRCS*

*Expected Launch Date: 2019*

### **Water Infrastructure and Resiliency Finance Center (WIRFC) Support**

The EPA's Water Finance Center is working with NDRP partners to promote better stakeholder understanding of Federal funding programs, identify and disseminate knowledge concerning scalable funding/financing innovations for the benefit of all NDRP partners and stakeholders, and collaborate on innovative development projects, as appropriate. Some of those innovative development projects include adding additional drought resilient investment resources to the Water Finance Clearinghouse, the repository that warehouses information on state-of-the-art financing methods and available funding sources.

*Lead Agency: EPA*

*Expected Launch Date: FY 2020*

**Goal 6: Innovate Water Use, Efficiency and Technology.** Agencies shall support efforts to conserve and make efficient use of water by carrying out relevant research, innovation, and international engagements.

### **Water Reuse and Recycling Action Plan**

The EPA is leading the development of a National Water Reuse Action Plan to enable water reuse as part of an integrated water resources management approach developed at the State, basin, watershed, and/or local level. The plan will identify specific actions that Federal, State, tribal, local agencies, and other stakeholders could take to better enable, finance, communicate the benefits of, and remove barriers to water reuse and recycling.

*Lead Agency: EPA*

*Underway; Expected Completion 2020*

### **Improvements to Water Use Reporting**<sup>18</sup>

Understanding the human component of the water budget is a key factor in fully evaluating water resources at both the national and regional scale that is currently lacking. The USGS is developing daily modeled water use estimates of withdrawal for public supply, thermoelectric, and irrigation water use. The intent is to develop modeled water use at the sub-watershed extent nationally (these sub-watersheds are approximately 30 square miles in size and are referred to as HUC12 basins). Together, these three categories represent 90 percent of all water used in the United States. Accounting for these categories within an integrated hydrologic model is critical to ensuring a complete evaluation of water availability. Currently, water use data are reported every five years at the county level. These models will allow reporting to occur within a time frame necessary to meet water resource decision making needs and represents an important step

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<sup>18</sup> *Id.*

forward in our ability to model and predict water resources at both the national and regional extent.

*Lead Agency: USGS*

*Underway; Expected Completion 2022*

### **Development of Software Tools for Irrigation and Nutrient Management**

During drought events, and in regions working to mitigate groundwater overdraft, agricultural producers need tools that can assist them in matching irrigation to crop water requirements. NASA is supporting joint work between NASA, USDA, and the Cooperative Extension to develop desktop and mobile software tools that provide accurate information on crop water and nutrient requirements. These tools are designed to support growers in optimizing the use of water for irrigation and minimize both unintentional deficit irrigation and leaching of irrigation below the root zone. The tools being developed use satellite data to track crop canopy development, quantify evapotranspiration, and integrate this information with crop canopy growth and nutrient uptake models to provide data-driven guidance on irrigation and nutrient applications. Use of satellite data is also facilitating expansion of these tools to support a wider range of perennial crops.

*Lead Agency: NASA*

*Underway; Expected Completion 2022*

### **Identify Science and Technology Gaps Inhibiting Greater Consideration of the Reuse of Oil and Gas Produced Water**

In 2018, the EPA entered into a Memorandum of Understanding (MOU) with the State of New Mexico that created a work group that is developing a white paper related to renewable water opportunities under State and Federal law in New Mexico. The parties produced a white paper that highlighted challenges and opportunities for making available renewable water supplies. EPA also produced a draft study (public comment ended July 1, 2019) on the opportunities for the discharge of treated waters from oil and gas activities, currently being deep injected underground, back into surface waters or usable aquifers, therefore returning those waters to the normal water cycle and available for use.

*Lead Agency: EPA*

*Underway; Expected Completion 2020*

### **Identify and Break Down Technical Barriers to the Reuse of Oil and Gas Produced Water**

DOE is conducting extensive efforts to relieve water scarcity issues within the water-energy nexus. One of the goals of the Water Security Grand Challenge, led by DOE, is transforming the energy sector's produced water from a waste to a resource. As part of this effort, DOE and Chevron Technology Ventures partnered on the Chevron Tech Challenge to identify cost-effective produced water management solutions applicable to United States oil and gas extraction. DOE is also supporting research and development projects to accelerate the development and commercialization of treatment technologies that reduce waste water and increase fresh water supplies, as demonstrated by a \$5 million funding announcement in May 2019, and ongoing work at the National Energy Technology Laboratory.

*Lead Agencies: DOE & EPA*

*Underway; Expected Completion 2022*



### **Support Water Technology Utilization**

EPA will assess water technology utilization nationwide and develop recommendations for coordinated Federal and NDRP stakeholder action to incentivize public and private sector water technology investment, including new delivery frameworks that can address regulatory concerns and lower adaptation/commercialization barriers.

*Lead Agency: EPA*

*Expected Launch Date: FY 2019*

## **NDRP PROGRESS REPORT (2017-2019)**

The NDRP Member Agencies plan to provide a progress report that summarizes accomplishments on agency actions from 2017 through 2019, updates on regional scale collaborations, and recommendations on priorities for 2020 and beyond. Recommendations will be formulated among the NDRP Member Agencies with input from stakeholders, shaped by direct engagement and feedback collected at the National Drought Forum scheduled for July 2019.

*Lead Agencies: EPA & USDA*

*Expected Completion Date: February 2020*

### **NDRP Drought Resources Website**

The NDRP Member Agencies will develop a publicly available website to serve as a “one-stop shop” of Federal drought resources, including NDRP reports, publications, activities, events, and links to Member Agencies’ drought resources and services.

*Lead Agencies: EPA & USDA*

*Expected Completion Date: February 2020*