

2022–2026

National Integrated Drought Information System (NIDIS) Strategic Plan

Advancing Drought Science and
Preparedness Across the Nation

August 2022



Document prepared by the National Integrated Drought Information System (NIDIS) in partnership with key stakeholders.

On the cover: View of Lake Powell from Wahweap lookout near Page, Arizona. Credit: Ravi Natarajan

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FOREWORD

We are pleased to share with you the *2022–2026 National Integrated Drought Information System (NIDIS) Strategic Plan*. This plan outlines and advances NIDIS’s approach to building a national drought early warning system (DEWS). NIDIS provides credible, timely, relevant, and usable drought information services across timescales. The plan incorporates the thoughtful feedback and participation of NIDIS’s partners across sectors and levels of government. We are grateful for the individuals, including the NIDIS Executive Council, who contributed to this plan and whose dedication to collaborative partnership on drought issues has helped provide earlier drought warnings and strengthen drought-related resilience across the country. NIDIS draws from existing capacity in states, universities, and multiple federal agencies, as called for in NIDIS’s 2006 authorizing legislation. NIDIS has been recognized as a model for a whole-of-government approach and federal–state collaboration in developing and delivering shared climate services. It is through partnerships such as those with the Western Governors Association, Mississippi River Cities and Towns Initiative (MRCTI) U.S. Geological Survey (USGS), the U.S. Department of Agriculture (USDA), the U.S. Chamber of Commerce, the National Drought Mitigation Center (NDMC), state agencies, and others, that NIDIS is delivering the best available information and resources to leaders, decision-makers, businesses, and the public.

Since the NIDIS Public Law was reauthorized in 2019, the Western United States has been hit particularly hard by persistent, severe drought, during a time in which the COVID-19 pandemic has also wreaked havoc on communities and economies. Drought, along with devastating wildfires, record-breaking heat, and other hazards have illuminated the urgency to address multiple impacts to vulnerable populations, businesses, and ecosystems. The U.S. Southwest continues to confront the challenges of drought response and forward-looking management under potentially increasing aridification in the region.

NIDIS’s greatest impact lies in making the Nation more resilient to drought and is realized through support for drought monitoring, prediction, planning, communication, and research across eight regional DEWS, and through its partnerships with Federal, State, Tribal, and local communities and the private sector. Over the past five years, there have been many successes across these areas. NIDIS led the development of a strategy for building the first *National Coordinated Soil Moisture Monitoring Network*, widely recognized as a key opportunity to improve response times to the interconnected hazards of drought, flood, and fire. It launched a redesigned *U.S. Drought Portal* to deliver actionable drought information by city, county, state, zip code, and at watershed to global scales, leveraging innovative technologies like cloud computing through Climate Engine. Improved

interagency coordination led to timely co-developed drought status updates and webinars which resulted in consistent communication and messaging in regions entering drought. A *Tribal Drought Engagement Strategy* was launched in 2020, after rich engagement with tribal nations in the Missouri River Basin and Midwest DEWS. These and many other milestones mark a new phase in the growth of NIDIS; what started as a small program with burgeoning regional pilots in 2006 is now maturing into a fully national drought early warning information system.

This Plan presents an expanded set of priorities for the next five years, identified through consultative engagement with Federal, tribal, state, and local partners. It reflects the need to better understand drought impacts to the economy, ecosystems, public health, and the interactions of drought and wildland fire in specific locations and how these may be connected across regions. The Plan creates a process to expand regional DEWS coverage into areas such as Alaska, Hawaii and the U.S. Affiliated Pacific Islands, Puerto Rico and the U.S. Virgin Islands, and on Tribal lands to ensure equitable access to localized drought information services. It advances the 2019 NIDIS reauthorization mandate to focus on advancing subseasonal to seasonal (S2S) forecasting, through continued investments in partnerships such as with the National Weather Service’s Climate Prediction Center (CPC) and the USGS. Finally, the Plan includes an emphasis on implementation of the National Coordinated Soil Moisture Monitoring Network Strategy.

From New Hampshire to New Mexico, drought’s impacts can be diverse and devastating, made worse by a changing climate. Water users, agricultural producers, natural resource managers, planners, and others must be able to assess the risks of drought before its onset and during its evolution to make informed decisions and implement effective mitigation measures. It is imperative that we support the research and advancements needed to build more resilient communities.

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Introduction

The National Integrated Drought Information System (NIDIS) Act of 2006 (*P.L. 109-430*), reauthorized in 2014 (*P.L.113-86*) and 2019 (*P.L. 115-423*) with strong bipartisan support, prescribed a comprehensive, interagency approach for drought monitoring, forecasting, and early warning planning and preparedness to help states and local communities cope with the impacts of drought. The NIDIS Public Law authorizes \$13.5 million in annual appropriations towards the NIDIS Program, and the 2019 reauthorization authorized a gradual increase in appropriations, from \$13.5M for FY2019 up to \$14.5M in FY2023.

To fulfill its mission under the Public Law, NIDIS focuses on three critical areas:

1. Improving drought observations, prediction, planning, and communication to strengthen early warning across the nation
2. Delivering the best-available drought information for informed decision-making and public awareness
3. Coordinating and leading research initiatives that address key scientific and societal needs in different regions

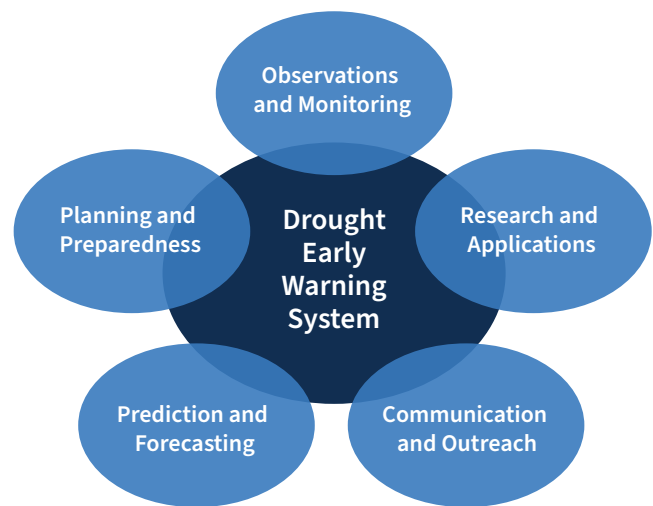


Figure 1: Five components of a Drought Early Warning System. Credit: NOAA NIDIS, Fiona Martin

Given the diversity of drought impacts, predictability, and stakeholder needs across the nation, and the need to leverage the capabilities of partner agencies on the ground, NIDIS, since its inception, has taken a regional approach. Eight regional DEWS support rich networks of researchers, academics, resource managers, and decision-makers who share information and actions that help communities cope with drought. Each of the regional DEWS integrates five key components of a drought early warning information system: interdisciplinary research and applications; predictions and forecasting; observations and monitoring; planning and preparedness; and communication and outreach (*Figure 1*). Each DEWS advances the provision of drought early warning information and science-based drought decision support tailored to the region's unique characteristics and needs. Over the past five years, each regional system has been supported by a multi-year strategic plan

that identifies how the DEWS can further facilitate not only drought information delivery but also action to reduce the impacts of drought.

As these regional networks have grown and trusted partnerships have deepened, common stakeholder priorities and best practices have emerged, which have informed the launching of several national-level initiatives that cross boundaries, hazards, and disciplines. In the last five years, several programs and key activities have been designed to build out the national DEWS, including:

- *The NIDIS Drought and Wildland Fire Nexus Strategy*
- *The National Coordinated Soil Moisture Monitoring Network Strategy*
- *The NIDIS Tribal Drought Engagement Strategy*
- Flash Drought Initiative: 2017 Northern Plains Drought Assessment, 2020 Flash Drought Workshop
- Megadrought: 2021 Southwest Drought Forum, 2021 NOAA Modeling, Analysis, Predictions, and Projections (MAPP) Drought Task Force
- Drought and Private Sector Engagement: 2019 National Drought Forum, Southwest Drought Forum
- Public–Private Partnerships: Climate Engine, a partnership between the Desert Research Institute, University of Idaho, and Google, with support from NIDIS since 2016
- Drought and Human Health Initiative
- The Coping with Drought Grant Applied Research Competitions
- A Redesigned U.S. Drought Portal ([Drought.gov](https://drought.gov))

These programs and activities are highlighted throughout this Plan, as examples of progress made as well as areas of future growth.

MISSION

NIDIS’s mission is to maximize the nation’s ability to proactively manage drought-related risks, by providing those affected with the best available information and resources to assess the potential for drought and to better prepare for, mitigate, and respond to the effects of drought. Toward that end, NIDIS will create a drought early warning system for the nation.

NIDIS is led by the National Oceanic and Atmospheric Administration (NOAA), and is housed within the Office of Oceanic and Atmospheric Research’s Climate Program Office.

VISION

The NIDIS vision is a dynamic integrated drought information system that provides users with the ability to determine the potential impacts of drought and its associated risks, and the decision support tools needed to better prepare for and mitigate the effects of drought.

CONSULTATION

The NIDIS Public Law calls for consultation and coordination with “relevant federal, regional, state, tribal, and local government agencies and leaders (e.g., mayors), research institutions, and the private sector” in the development of NIDIS. NIDIS supports a NIDIS Executive Council and several technical Working Groups around this mandate, to encourage regular consultation, quality assurance, and information-sharing with a wide variety of stakeholders. Over the years, Working Groups have evolved from a model broadly aligned with the components of a drought early warning system, to include a more flexible and targeted focus group model that informs NIDIS on specific and/or cross-cutting drought-related topics.

Through the Executive Council, technical Working Groups, and other coordinating mechanisms, NIDIS shares information about its current priorities and gathers individual feedback on NIDIS challenges and priorities, and how they relate to the organizations and agencies represented among Council and Working Group participants. Collectively, the information and individual feedback received from and shared with the Executive Council and Working Groups supports the development of the regional DEWS.

FEDERAL INTERAGENCY COLLABORATION

Early warning and improved drought monitoring are critical aspects of building long-term drought resilience, and they inform policy, infrastructure, and investment decisions to

mitigate drought impacts and respond to drought. NIDIS collaborates across NOAA line offices, including within the Office of Oceanic and Atmospheric Research, the National Weather Service (NWS), and the National Environmental Satellite, Data, and Information Service (NESDIS), partnering on research, webinars, and the development of resources to support drought risk management. New opportunities for policy-level interagency coordination on drought action have also emerged since NIDIS was first authorized, offering the promise of heightened levels of resilience to long-term drought, such as the National Drought Resilience Partnership (NDRP), which complements the aims of NIDIS. The NDRP has been working since 2013 to coordinate drought resilience efforts across Federal departments and agencies, focusing on mid- to long-term strategies to build drought resilience into all economic sectors and in natural and built infrastructure design. Other Federal interagency and partner-led collaborative efforts include: the Water Subcabinet; the Interagency Council for Advancing Meteorological Services (ICAMS); the Western States Federal Agency Support Team (WestFAST); the USDA’s Climate Hubs; and the Department of the Interior’s Climate Adaptation Science Centers (CASCs). NIDIS continues to support Federal agency partners working across water management disciplines, including the U.S. Bureau of Reclamation, the Environmental Protection Agency, and the U.S. Army Corps of Engineers, in connecting science with policy and decision-making and ensuring greater cross-cutting efficiencies.

ORGANIZATIONAL MODEL FOR NIDIS PARTNERSHIP



Figure 2: The organizational approach to building partnerships across NIDIS. The Program Office facilitates activities with the Regional DEWS, and consults with the Executive Council, Working Groups and Advisory Teams, as well as interagency and partner-led efforts, on NIDIS priorities and direction. Credit: NOAA NIDIS, Fiona Martin

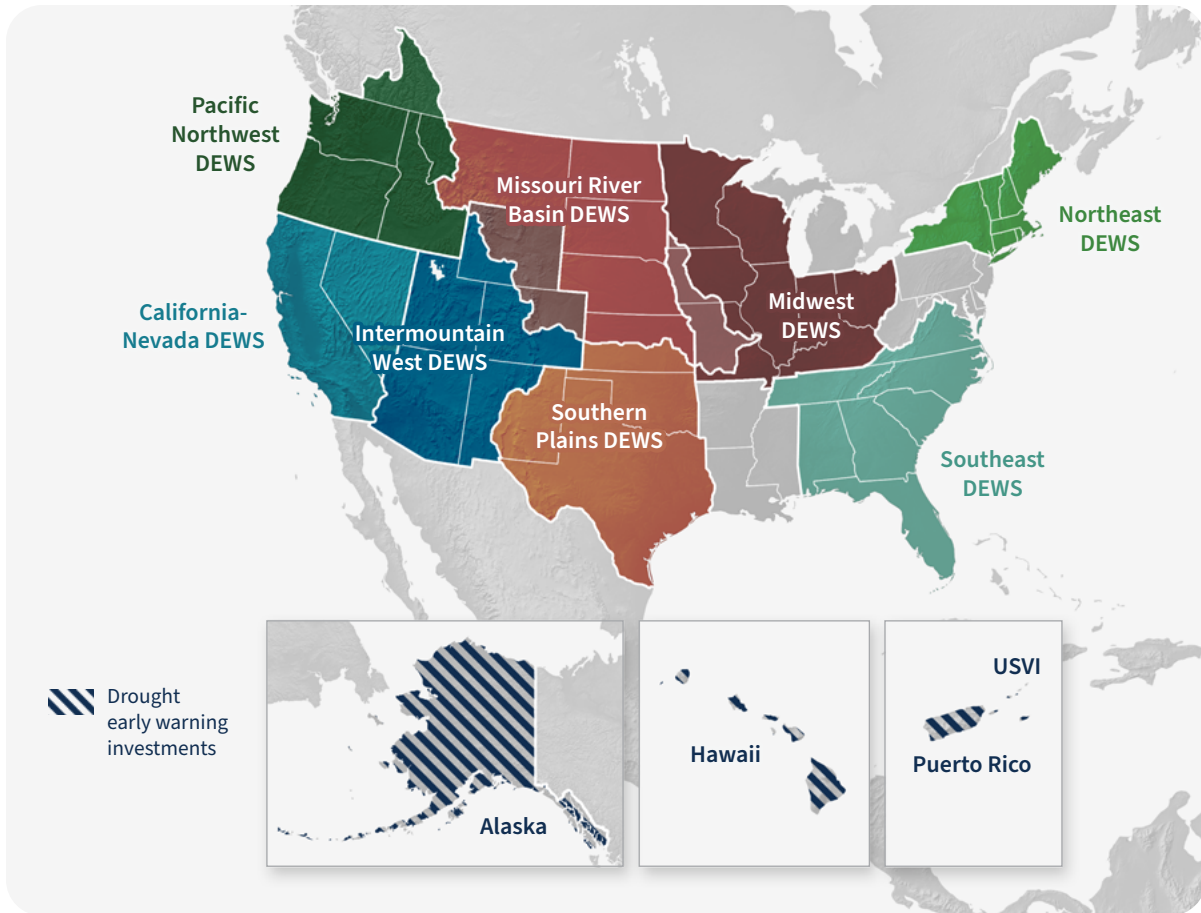


Building the 2022–2026 NIDIS Strategic Plan

The plan builds upon the *2016 NIDIS Implementation Plan Update*, and incorporates many of the priorities and themes captured in the *Regional DEWS Strategic Plans*, as well as the strategic documents that accompany National-level NIDIS initiatives (such as the *NDAWN Strategy*). As was the case with each of these guiding documents, the *2022–2026 NIDIS Strategic Plan* was produced with significant input from partners and stakeholders around the country throughout 2021–2022.

Glen Canyon Dam forms Lake Powell in Arizona, and helps ensure equitable water distribution throughout the arid Colorado River basin.

Credit: KaryB



Implementation of the 2022–2026 NIDIS Strategic Plan

Implementation of the 2022–2026 *NIDIS Strategic Plan* will happen through a combination of targeted investments at national and regional levels, leveraging of existing efforts, and strong collaboration with existing and new partners.

REGIONAL APPROACH

Recognizing that drought characteristics and impacts vary across the country, the NIDIS regional DEWS provide a foundation on which a national early warning system rests (*Figure 3*) and are the central implementation mechanism for the Strategic Plan. The regional DEWS utilize existing networks to make climate and drought science readily available, easily understandable, and usable; and to improve regional capacity to respond to and cope with

drought. Each regional DEWS has its own multi-year *Strategic Action Plan* that includes the same strategic goals of this *NIDIS Strategic Plan*, and provides additional details on proposed implementation activities to meet those strategic goals.

NATIONAL APPROACH

Initiatives that cross the regional DEWS boundaries, or are larger than any single regional DEWS, are elevated to be addressed holistically by NIDIS and partners at a national scale. These complex issues often require larger investments in research and targeted decision support tools. In this *Strategic Plan* cycle, the NIDIS program will actively leverage, invest and/or coordinate several topical national-level and cross-DEWS issues that include:

- Partner Engagement and Support
 - Tribal Engagement
 - Public–Private Partnerships
 - State and Local Governments
 - Citizen Science
 - Drought Planning and Response
- Monitoring and Prediction
 - National Coordinated Soil Moisture Monitoring Network (*NCSMMN*)
 - Drought Indicators
 - Subseasonal to Seasonal (S2S) Drought Forecasting
 - Flash Drought
- Sector-Based and Issue-Specific Information
 - Drought and Wildfire (NIDIS Drought and Wildland Fire Nexus, *NDAWN*)
 - Drought and Public Health
 - Drought and Agriculture
 - Drought and Ecosystem Services
 - Drought and the Private Sector
 - Regional Drought Economic Impact Assessments

National efforts, products, and learning can be assessed for relevance, validated, tailored, and then incorporated into the regional DEWS. It is this cross-scale exchange of information and learning, realized through partnerships, that helps to maximize capacity for early warning across diverse sectors of the economy.

NIDIS 2022–2026 Strategic Goals, Objectives, & Outcomes

The Strategic Goals of this *Plan* are tied to the NIDIS Public Law, the national DEWS that it calls for, and the NOAA Mission. In order for these early warning systems to be successful, they must support efforts to understand past, present, and future drought conditions, and to plan proactively and respond using an adaptive management process that improves future outcomes. These systems must also support decisions across a range of time scales, sectors, and issues (*Table 1*).

| Table 1: Examples of How Drought Information is Utilized for Different Decisions | | | |
|---|---|---|---|
| Sector | Weekly | Subseasonal to seasonal (monthly, water year) | Climate (years, decades) |
| State Planning and Response | State monitoring and drought declarations | State response actions such as restrictions | State drought planning |
| Agriculture | Irrigation timing and amount | Planting; seed purchases; livestock selling; land fallowing | Business planning |
| Wildfire | Fire response and suppression activities | Staff and resource allocation | Preventive actions/ long-term planning |
| Water Resources | Reservoir management; water permitting | Utility allocation during drought; allocating backup drinking water supplies | Infrastructure planning; updating water plans |
| Ecosystems and Tourism | Snow making; river and lake access | Staff and resource allocation | Restoration site selection |
| Public Health | Heat, smoke, and dust event monitoring | Preparedness for increased illness and disease | Preventative actions for mental health |
| Transportation/ Manufacturing | Waterway access; cargo capacity | Port access and supply chains; water for goods production | Navigation planning |
| Energy | Electricity generation; heat wave monitoring; water quality | Power and energy shortage planning; alternative water supply decisions; pricing | Infrastructure planning |

The Strategic Goals of this *2022–2026 NIDIS Strategic Plan* are organized around the five components of a DEWS, in addition to the unique and essential NIDIS role to integrate these components with the support of Coordinators in each regional DEWS. Some of these Goals are core NIDIS activities to enhance over the next several years, and others are new. The Goals are not independent; activities and actions in one Goal inform those in other Goals, and in the early warning system itself. There is feedback and learning that informs and improves the system over time and is embedded in each of the Goals.

STRATEGIC GOALS will guide NIDIS activities over the next five years, in alignment with the NIDIS Public Law.

OUTCOMES for each Goal will describe the expected long-term change that the NIDIS program plans to achieve over the next 10 years in accomplishing the Strategic Goals, and are what will be used as the basis for evaluation.

OBJECTIVES for each Goal are specific results that NIDIS intends to accomplish over the next five years to achieve each Strategic Goal. They are intended to be exemplary and not exhaustive.

Performance indicators used to track progress toward achieving the NIDIS Outcomes will be implemented through a supplemental monitoring and evaluation document (see *Appendix B*).

| Table 2: Overview of 2022–2026 Strategic Goals | |
|--|--|
| Goal 1 | Support and facilitate improvements to drought forecasts and predictions across all time scales to provide the best early warning information for a wide range of decision-makers and audiences. |
| Goal 2 | Strengthen observational networks and drought indicators to improve the monitoring of drought conditions across a variety of spatial and temporal scales. |
| Goal 3 | Strengthen the quality and use of information to improve drought planning and preparedness. |
| Goal 4 | Communicate and deliver the best available science and information to increase drought awareness and catalyze action. |
| Goal 5 | Advance and integrate interdisciplinary research to improve risk assessments, decision-based applications and actions. |
| Goal 6 | Coordinate and bolster collaborations that foster the exchange of information, practices, and lessons to improve drought early warning. |

GOAL 1

Support and facilitate improvements to drought forecasts and predictions across all time scales to provide the best early warning information for a wide range of decision-makers and audiences.

Long-Term Outcomes Expected for Goal 1:

- Improved drought forecasts and prediction products provide more meaningful and reliable information to manage risk at different scales and sectors.
- Improved understanding of future drought trends and climate change helps with decision-making at longer planning scales.

Objectives to Achieve Goal 1:

- Identify and support research targeted towards improved accuracy, reliability, timeliness, and/or local relevance of prediction products to provide earlier detection of drought risk at multiple time scales.
- Improve understanding of long-term drought trends, including drought and aridification in the Southwestern U.S., through model advancements in partnership with NOAA’s MAPP Program and the NOAA Drought Task Forces.
- Advance forecasting capabilities using new technology that includes artificial intelligence, machine learning, and cloud technology.
- Improve seasonal and sub-seasonal forecasting, including migrating existing products to probabilistic forecasts and incorporating new and improved dynamical and statistical forecast modeling tools, in partnership with the National Weather Service’s Climate Prediction Center.
- Improve the reliability of national-level predictions and forecasting at regional scales through the incorporation of regional information and assessment input.
- Assess current operational drought forecast system capabilities and develop partnerships to improve NOAA’s official monthly and seasonal drought outlooks as well as develop new flash drought outlooks.
- Better incorporate low-flow information into federal operational water prediction resources including those at NOAA and the USGS.
- Deliver actionable drought prediction and forecast maps at different geographic scales (e.g., city, county, state, watershed) through the U.S. Drought Portal.
- Deliver tailored drought prediction and forecast tools to diverse sectors and partners, including tribal nations, drought-vulnerable communities, and the private sector.

- Improve the visualization and understanding of drought forecast products through research that incorporates multidisciplinary approaches, including social science methods.
- Increase the understanding and communication of uncertainty in drought forecasts and products, including improved characterization and communication of forecast uncertainty and drought-related projections, on the U.S. Drought Portal (*Drought.gov*).

GOAL 2

Strengthen observational networks and drought indicators to improve the **monitoring of drought conditions across a variety of spatial and temporal scales.**

Long-Term Outcomes Expected for Goal 2:

- Improved relevance, timeliness, density, distribution, and interoperability of observational/monitoring data provide greater understanding of current drought conditions.
- New and improved products are deployed to meet end-user needs and improve accessibility, leading to greater incorporation of monitoring information into their decision-making process.
- The development of monitoring resources is tailored for specific drought-vulnerable populations, allowing them to be better prepared for future droughts.

Objectives to Achieve Goal 2:

- Investigate gaps in snowpack monitoring and how expected future changes in snowpack may impact streamflow and water supply forecasting.
- Address gaps with in-situ soil moisture monitoring for areas where monitoring is lacking such as tribal lands, rangelands, and forested areas, and deliver improved data access systems including a soil moisture product clearinghouse through the NCSMMN.
- Develop and deliver monitoring information for rapid intensification events (i.e., flash droughts), and tailor this information to region, season, and sector.
- Advance the use of drought indicators and/or indices to address specificities of regional drought conditions, including at the watershed level.
- Strengthen integration of groundwater data into drought monitoring and decision making.

- Improve the ability of drought indicators and/or indices to address sector needs, such as wildfire management, public health, and natural resource management.
- Strengthen and implement observation and monitoring activities that build drought resilience among tribal nations, and provide drought monitoring data at tribal land and territory scales on the U.S. Drought Portal.
- Apply cloud technologies, such as Climate Engine, to make data (i.e., gridded, in-situ, remotely sensed) more readily available for analysis and place-based decision support.
- Improve the collection and use of citizen science monitoring data and information.
- Strengthen drought impact data collection and analysis to better understand drought's economic, wildfire, public health, infrastructure, and ecological impacts.
- Ensure support for key drought monitoring tools, like the U.S. Drought Monitor, and refine to strengthen decision-making across sectors.

GOAL 3

Strengthen the quality and use of information to improve drought **planning and preparedness**.

Long-Term Outcomes Expected for Goal 3:

- An increased number of drought-related plans, activities, and investments are based upon actionable, localized drought information that informs near and long-term planning and maximizes drought resilience.

Objectives to Achieve Goal 3:

- Support state and local-level efforts to conduct post-drought assessments, and communicate opportunities to incorporate results into future planning activities.
- Integrate risk and vulnerability assessments for diverse populations, sectors (such as small agriculture and outdoor recreation), and ecosystems into the drought planning process.
- Develop an online interactive and engaging drought planning platform that optimizes data and resources from across the federal family and supports planners to develop and improve drought plans at all spatial scales.
- Account for drought events of different time scales in the planning process, from shorter-lived episodic droughts, to longer, more chronic droughts (e.g., multi-year and decadal), as well as rapid intensification events (i.e., flash drought).

- Support integration of drought information into planning for nature-based approaches to drought risk management.
- Incorporate multi-hazard integration, cascading impacts, cost-benefit analysis, and evolving drought risks into the planning process.
- Foster federal-level interagency exchanges to expand drought planning guidance and the identification of populations most at risk to drought impacts.
- Improve the dissemination of drought research, tools, and planning information in formats that are timely, accessible, and useful for public and private sector drought management and planning purposes.

GOAL 4

Communicate and deliver the best available science and information to increase drought awareness and catalyze action.

Long-Term Outcomes Expected for Goal 4:

- Dialogue between partners on drought issues are improved through the convening of diverse stakeholders and partners to share information and practices.
- Accessibility and utilization of drought information by the public are increased through the direct expansion of the U.S. Drought Portal ([Drought.gov](https://www.drought.gov)), media outreach, educational initiatives, and other NIDIS and partner communication tools.

Objectives to Achieve Goal 4:

- Improve the U.S. Drought Portal ([Drought.gov](https://www.drought.gov)) by assessing visitor analytics and incorporating user feedback into site enhancements.
- Enhance efforts to leverage data, decision support products and resources from federal agency partners.
- Strengthen the relationship and trust between NIDIS and partners with external stakeholders through customized and improved email communication technologies, social media, news media, and outreach activities such as national webinars and forums.
- Continue to develop and disseminate collaborative regional Drought Status Updates and webinars in coordination with partners such as NWS, RISA, and the USDA Climate Hubs, to further foster awareness of drought conditions with consistent messaging.

- Maintain regular dialogue with the NIDIS Executive Council as well as Federal partners.
- Hold regular dialogues with tribal partners to ensure that their needs are articulated and information is communicated, including through the Regional Tribal Drought Action Plan discussions.
- Communicate research findings through multiple channels including the U.S. Drought Portal, NIDIS newsletters, and the regional DEWS networks.
- Continue to convene regular national, regional and state workshops to communicate new information on drought topics as appropriate and deemed important by partners.

GOAL 5

Coordinate and integrate interdisciplinary research to improve risk assessments, decision-based applications and actions.

Long-Term Outcomes Expected for Goal 5:

- Drought plans and response actions to build resilience at different scales and sectors are improved with the integration of tailored research and information.
- Applied research projects sponsored by NIDIS are incorporated into or used to inform management and planning activities.

Objectives to Achieve Goal 5:

- Conduct research that improves understanding of which indicators are best suited to specific management decision points in the regional context, including an emphasis on indicators tailored for flash drought.
- Conduct research that improves understanding of drought characteristics and regional distinctions, including flash drought and snow drought.
- Advance applied research to investigate how seasonal to decadal climate variability is impacting the Southwestern U.S. climate and society.
- Conduct research that improves understanding of the far-reaching nature of drought into diverse sectors, such as public health interconnections and economies.
- Conduct research that improves understanding of the actions to prepare for and respond to droughts and that reduce impacts and/or increase resilience over the long term.

- Conduct research to better understand secondary and tertiary impacts or effects of drought to inform drought planning, including wildland fire management.
- Explore research that improves understanding of the impacts of drought on critical infrastructure.
- Plan projects that integrate social science to understand societal factors that interact with response to drought events.

GOAL 6

Coordinate and bolster collaborations that foster the exchange of information, practices, and lessons to improve drought preparedness and early warning.

Long-Term Outcomes Expected for Goal 6:

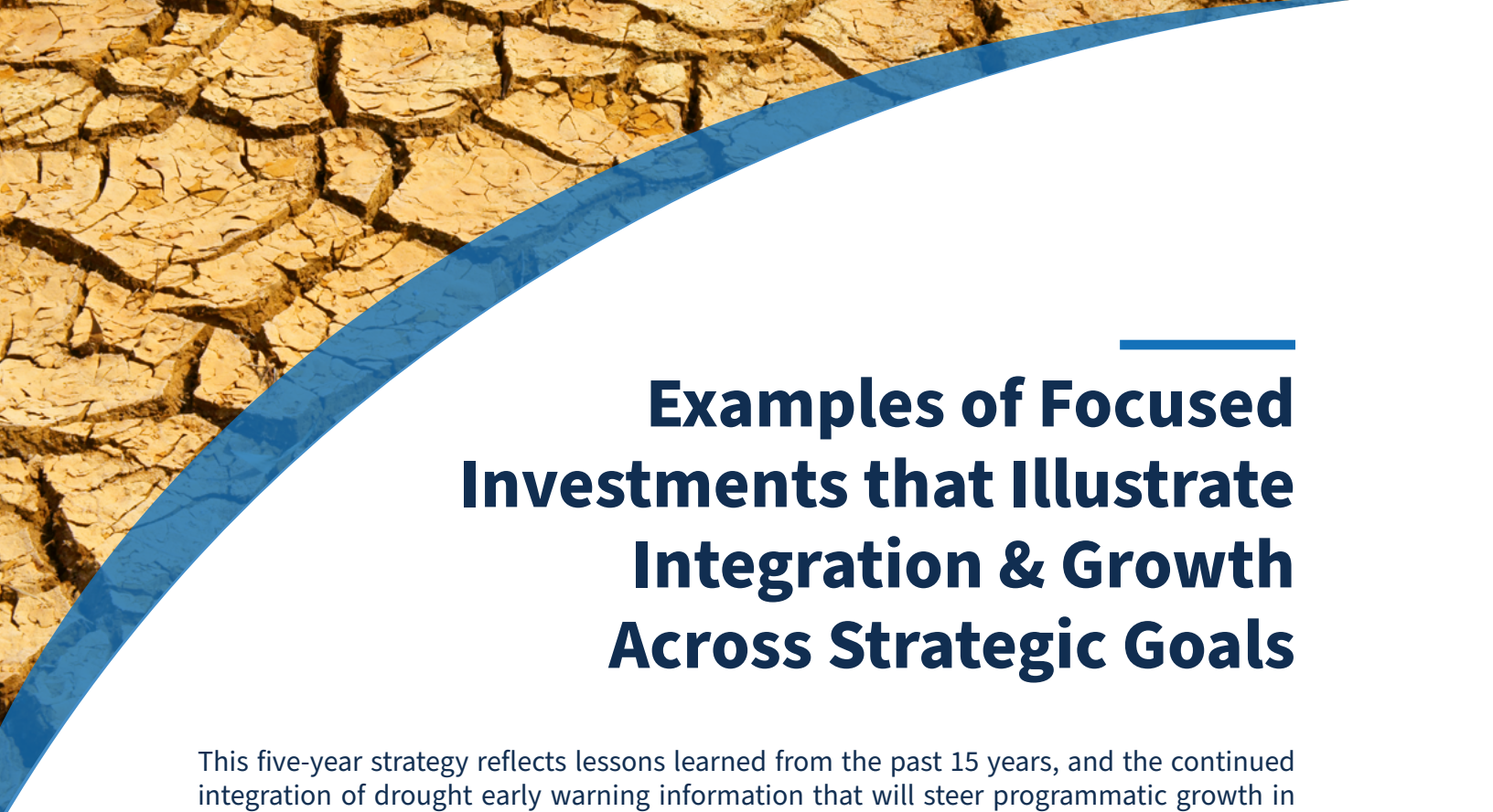
- Regional DEWS networks become more diverse (multi-sector, interdisciplinary) and more inclusive of vulnerable and underserved populations, including rural communities, as well as ecosystems.
- Engagement in NIDIS-led network activities by partners is increased and provides useful and actionable results.
- NIDIS engagement in partner-led drought activities is increased and provides useful and actionable results.
- Drought communication and learning across scales and sectors are sustained and expanded.

Objectives to Achieve Goal 6:

- Identify populations at risk due to drought, assess their information needs, and work to support those needs.
- Implement updated *Strategic Action Plans* in all of the NIDIS regional DEWS.
- Continue to hold partner meetings in each of the regional DEWS, and expand these DEWS networks to include new partners in sectors impacted by drought.
- Utilize topical cross-DEWS dialogues to more efficiently develop and deliver a consistent suite of services that can contribute to a national DEWS and foster cross-DEWS exchanges.
- Strengthen the exchange of knowledge both within and across DEWS through various methods including the sharing of case studies and best practices, and

participation in partner-led drought-related learning networks, such as those within the USDA Climate Hubs.

- Promote justice, equity, diversity, and inclusion through deliberate outreach and engagement via the regional DEWS networks and other networks, and work to make funding opportunities and research activities more equitable.
- Engage in NOAA-relevant structures to strengthen cross-agency collaboration related to weather, water, and climate.
- Share lessons in post-drought assessment with regional decision-makers to inform future public and private sector planning and adaptation measures.
- Continue to lead the coordination of national-level initiatives such as the NCSMMN and the NIDIS Drought and Wildland Fire Nexus.
- Continue to support and participate in partner-led dialogues and initiatives such as the NACo's Resilient Counties Initiative, the American Water Works Association's Water 2050 initiative, the work of the Mississippi River Cities and Towns Initiative, and others.
- Develop, expand, and coordinate the use of flexible ad-hoc focus groups to support cross-disciplinary drought challenges as identified by NIDIS partners, including on the topics of drought indicators and blends; drought and wildfire; drought and public health; seasonal to sub-seasonal forecasting; and flash drought.



Examples of Focused Investments that Illustrate Integration & Growth Across Strategic Goals

This five-year strategy reflects lessons learned from the past 15 years, and the continued integration of drought early warning information that will steer programmatic growth in the future. The NIDIS program is uniquely situated to foster, catalyze, and often lead this essential need for integration across the strategic goals. Tangible examples of NIDIS-led integration in action and opportunities for expansion are described below, pending availability of resources. These examples are accompanied by anticipated actions and deliverables over the course of this plan, presented in [Table 3](#).

| Focused Investment Areas | 2022–2024 | 2025–2026 | Deliverables |
|--|---|--|---|
| Supporting Drought Prediction Across Timescales | Determine snow hydrology required for wildfire forecasts and water supply management; improve useability of operational drought outlooks, including for flash drought | Strengthen forecast skill for reservoir operations and water management | Improved operational drought outlook products at different geographic scales (e.g., city, county, state, watershed) through partners like the National Weather Service and the U.S. Drought Portal. |
| Expanding the Regional DEWS Footprint and Reach | Increase support for states and territories not covered under a regional DEWS; expand network partnerships and collaboration | Incorporate the remaining CONUS states into a formal DEWS network; expand network partnerships | Full coverage of the United States and territories under a regional DEWS or similar regional network |

Table 3: Anticipated Actions and Deliverables for NIDIS Initiatives Across Goals

| Focused Investment Areas | 2022–2024 | 2025–2026 | Deliverables |
|--|--|--|---|
| Understanding the Impacts of Drought | Fund and complete a 2-year research competition program on ecological drought; develop a Drought and Public Health Strategy | Create resources leveraging big data, artificial intelligence, and analytics to better understand drought’s socio-economic impacts | Value-added products for drought impact indicators and triggers to inform drought planning and response |
| Tribal Engagement | Conduct Regional Tribal Drought Action Plan Dialogues; fund and complete a 2-yr research competition program on drought resilience; expand tribal partnerships | Expand drought monitoring and observation networks on tribal lands; expand tribal partnerships | Expanded access and utilization of tailored tools on drought.gov in response to tribal nation needs |
| Expanding Decision-Support Resources for Drought Planning | Develop a prototype for a new Drought Planning Platform in collaboration with key planning agencies that includes tailored decision support resources | Refine and expand the Drought Planning Platform to influence more decision makers and planners. | A Drought Planning Platform on drought.gov to support drought plans at all scales |
| U.S. Drought Portal (Drought.gov) | Increase drought.gov usability and interactivity for users; improve communication of forecast uncertainty | Continue to address gaps in monitoring and prediction on drought.gov for specific sectors | An expanded drought.gov with tailored, cutting-edge resources for drought early warning, planning, and response |
| Implementing the National Coordinated Soil Moisture Monitoring Network (NCSMMN) | Conduct a Data Value Study for the Upper Missouri River Basin Soil Moisture and Snowpack Pilot Project | Create near real-time, gridded, user-friendly soil moisture maps and associated tools | A national “network of networks” that effectively demonstrates data and operational coordination of in-situ networks and addresses gaps in coverage |
| Drought and Wildfire Management | Improve soil moisture modeling to inform the update of a key tool used in wildland fire management (Keetch-Byram Drought Index/KBDI-ET); Better understanding drought’s role in the threat of post-fire debris flows | Improve understanding and application of how antecedent conditions, including recent droughts, impact the fire season and fire behavior | Assess progress on the NDAWN strategy and improvements to fire decision making and engage partners to update goals and priorities. |
| Drought and Climate Change (or Megadrought) | Support research on Western Drought through MAPP Competition | Improve Drought Portal resources to include historical drought information that addresses observed climate change and megadrought conditions | Research strengthens planners’ capacity to distinguish between short-term drought, multi-decadal megadrought, and permanent change in the local climate |

Flash drought conditions stress a sugar beet field. Credit: rsoll



IMPROVING DROUGHT OBSERVATIONS, PREDICTION, PLANNING, AND COMMUNICATION TO STRENGTHEN EARLY WARNING TO EARLY ACTION ACROSS THE NATION

Supporting Drought Prediction Across Timescales

The NIDIS Reauthorization Act of 2019 (P.L. 115-423) called on NIDIS to “utilize... improvements in subseasonal to seasonal precipitation and temperature and low flow water prediction”; Congress also recognized the need to improve S2S in the Weather Research and Forecasting Innovation Act of 2017 (P.L. 115-25). Increased support to improve S2S forecasting is essential for the nation to be able to predict and adapt to precipitation variability within the timescales of most operational decisions. NIDIS partners continually call for prioritized investments in research required to improve prediction accuracy, and to lengthen forecasting lead time, as well as improve under stability and useability of forecast information. For example, a top finding of several service assessments, including the [2014 NOAA California Drought Service Assessment](#), the 2019 National Drought Forum, and the 2021 Southwest Drought Forum, emphasized the need for seasonal prediction capability in California and the Colorado River Basin: “Even a low confidence forecast for the total precipitation in those areas could go a long way in answering the most enduring question: ‘How much water will we get this year?’”

Key initiatives that NIDIS and core partners lead that will benefit from improved S2S forecasts include: understanding and predicting flash drought; strengthening forecast-informed reservoir operations (FIRO) to more effectively operate the nation’s water infrastructure for both drought and flood extremes; determining snow hydrology required for wildfire forecasts; and water supply planning and management, especially in the western U.S. where snowpack sustains water supplies.

Predicting flash drought is another area of keen interest for stakeholders. These rapid onset drought events are currently poorly forecasted, and often catch farmers and other land and water managers off-guard and unable to effectively respond in a timely manner. Significant negative impacts of flash drought to the agricultural sector have been well documented, and it is likely there are also serious impacts to other economic sectors as well as environmental services.

NIDIS responded to the need identified by flash drought researchers that increased coordination on this phenomenon was needed in order to advance flash drought early warning. NIDIS held a comprehensive *Flash Drought Workshop* in December 2020, which was a multi-day virtual event that brought together researchers and practitioners from across the U.S. (and internationally) to discuss key research issues, and to identify opportunities to translate research into practical applications of value to end users. Over the coming years, NIDIS will implement a series of priority actions as laid out in the *2020 Flash Drought Workshop Report*. For example, NIDIS published a *literature review of flash drought research* in 2021, and contributed to a research prospectus in 2022 intended to focus the research community on solvable and impactful problems and inform future research investments. With this strategy in place, NIDIS is paving the way for meaningful engagement with practitioners and improved capacity in flash drought monitoring, prediction, and planning and response.

Key Strategic Goals Addressed: See Goal 1 (Forecasts and Prediction, page 15) and Goal 2 (Monitoring, page 16).

Expanding the Regional DEWS Footprint

In recent years, numerous requests have been made to scale the successful DEWS model across the CONUS, Alaska, Hawaii and the U.S. Affiliated Pacific Islands (USAPI), Puerto Rico and the U.S. Virgin Islands, and in tribal lands.

The 2017–2019 extreme drought in southeast Alaska prompted calls to better understand and prepare for current and future drought scenarios in the different climate zones of Alaska. Regional listening sessions and partner-led workshops with Federal, tribal, state governments, and local universities prioritized the following DEWS objectives: understanding drought impacts in Alaska’s regions and to indigenous and underserved communities; extension of drought monitoring indices and forecasts developed for the contiguous U.S. to Alaska; and guidance to support planning for drought resilience.

Hawaii, the USAPI, and the U.S. Caribbean are extremely vulnerable to drought events. Many Pacific island communities rely on rainwater for drinking water supplies, and drought may reduce or degrade these supplies, affecting public health. Drought also impacts island

farming, ranching, and sensitive ecosystems. The remoteness of many islands is an obstacle to timely relief during drought, emphasizing the importance of improving early warning and local drought resilience. Drought early warning activities in the region will amplify and extend climate-related research, products, and training built by regional partnerships and networks such as the Pacific Drought Knowledge Exchange, tailoring those to the unique needs of different regional climate zones, and will address major monitoring gaps, including a lack of in-situ observing sites. In Puerto Rico and the U.S. Virgin Islands, drought early warning activities will similarly build upon the Caribbean Drought Knowledge Network and other regional partnerships.

Improved Drought Early Warning at Regional Scales

A robust network of regional DEWS allows for responsiveness to particular geographic and hydrologic circumstances, as well as value-added information needs specific to stakeholders in the respective areas. Regional DEWS Coordinators in each region provide critical support to developing, sustaining, and expanding the regional and local partnerships that make these systems responsive and inclusive.

An illustrative example of the services provided by a regional DEWS came during a 2017 flash drought in the Northern Plains of the U.S. and the prairies of central Canada that took many by surprise. While the impacts were severe, costing over \$2.8 billion (*NOAA NCEI U.S. Billion-Dollar Weather and Climate Disasters*), an opportunity was created to improve how states prepare for, monitor, and respond to drought. The State of Montana and the Montana Climate Office (MCO) used this opportunity to improve drought early warning not only for the state, but for the region.

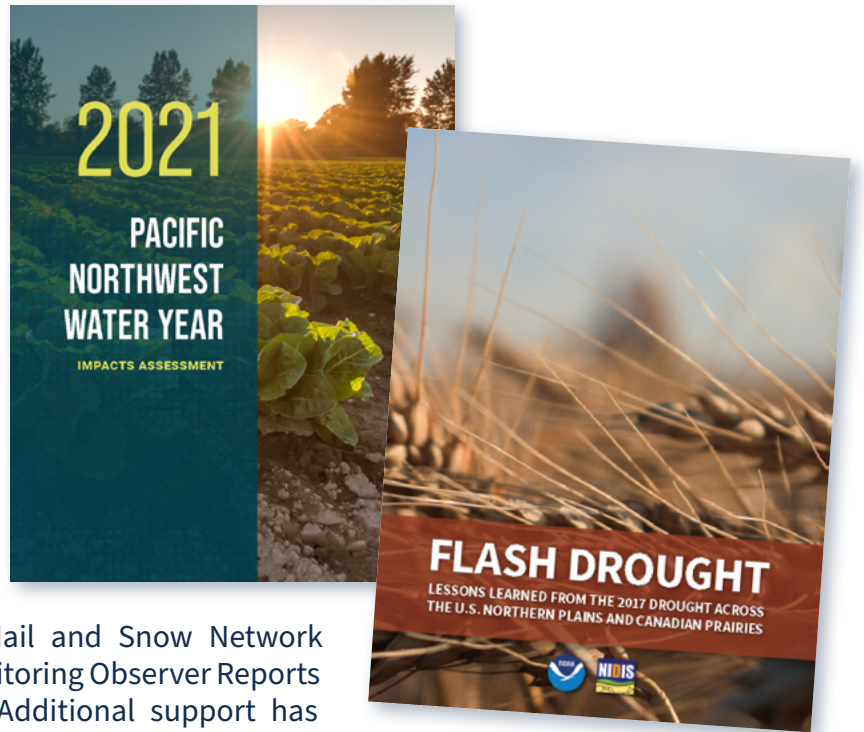
Through the Missouri River Basin DEWS, partners came together to develop a post-drought assessment, *Flash Drought: Lessons Learned From the 2017 Drought Across the U.S. Northern Plains and Canadian Prairies*, which identified the need for improved monitoring infrastructure, indicators, drought plans, impact reporting and increased technical capacity of state drought task forces. NIDIS funded a project with the Montana Climate Office to develop an open-source *Upper Missouri River Basin Drought Indicators Dashboard*, and validate drought metrics using soil moisture datasets to evaluate the most appropriate usage geographically, spatially and temporally. The work leveraged funds from the state to tie these efforts directly to updates to the Montana State Drought Plan. Federal agencies such as the U.S. Army Corps of Engineers and the U.S. Forest Service also provided investments that significantly increased monitoring sites in the region for soil moisture and other key parameters such as snowpack, providing key data streams to the monitoring effort. Key to the success of these efforts has been NIDIS's investments in the region, along with the willingness of entities to work together, leverage funds and capacity, align goals, and share data and knowledge. Future work will include a NIDIS-led research study of the value of soil moisture data from the expanded monitoring networks to support key applications such as river forecasting, drought and climate modeling, and snowpack estimation.

Key Strategic Goals Addressed: See Goal 5 (Interdisciplinary Research, page 19) and Goal 6 (Coordination and Collaboration, page 20).

DELIVERING THE BEST-AVAILABLE DROUGHT INFORMATION FOR PUBLIC AWARENESS AND INFORMED DECISION-MAKING

Understanding the Impacts of Drought

NIDIS has helped establish the nation’s foundation for drought impact data collection and analysis through support for the citizen-science initiative Community Collaborative Rain, Hail and Snow Network (*CoCoRaHS*) and the Condition Monitoring Observer Reports (*CMOR*) on Drought with NDMC. Additional support has gone to states, including the States of Montana and Kentucky, to develop drought impact reporting and visualization platforms; and support for in-depth drought impact assessments, including *Flash Drought: Lessons Learned From the 2017 Drought Across the U.S. Northern Plains and Canadian Prairies* and the annual *Pacific Northwest Water Year Impact Assessment*. This foundation provides the basis for tackling crucial remaining unknowns, such as how, when, and why physical drought hazards (e.g., precipitation deficits) translate into climate vulnerabilities and impacts that damage the nation’s economy, health and safety, and the resilience of natural systems.



A critical piece of drought early warning is the ability to quantify, monetize, and predict drought’s impacts on drought-vulnerable sectors that drive the U.S. economy. However, challenges exist. For example, there is minimal data on drought’s economic impacts to the key economic sectors of recreation and tourism, energy, and manufacturing. While direct impacts are mostly tangible and can be evaluated in economic terms, many indirect impacts are intangible and not straightforward or even unsuitable for economic valuation. Examples are the loss of biodiversity because of the reduction or drying out of wetlands, increasing poverty among the affected population, ecosystem degradation and the loss of ecosystem services. Beyond direct crop losses, estimates of economic damage should be interpreted with care – there is a significant gap between reported and real, direct and indirect impacts, and systematic quantification is extremely challenging. This is an area in need of research.

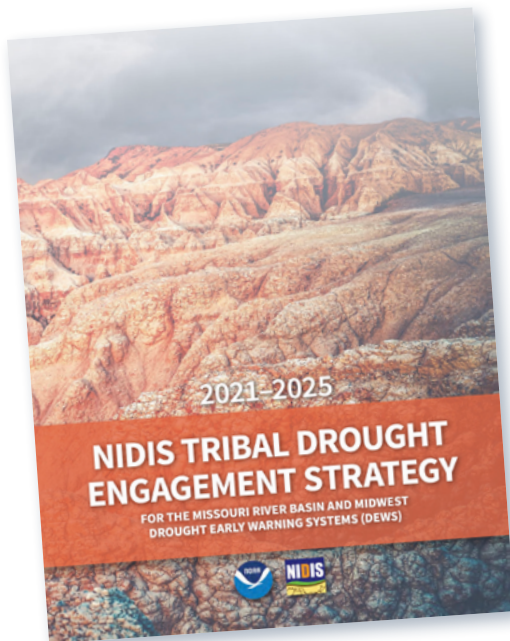
NIDIS and partners will continue to address this gap by leveraging advances in big data, artificial intelligence, and analytics to create resources that enable decision makers to better quantify, stratify, and insure economic risks of drought; rapidly pivot decision trade-offs as impacts evolve; and build resilience after drought events.

Key Strategic Goals Addressed: See Goal 2 (Monitoring, page 16) and Goal 5 (Interdisciplinary Research, page 19).

Tribal Engagement

In partnership with tribal natural resource managers and leaders across the Midwest and Missouri River Basin DEWS in 2018 and 2019, NIDIS developed a *Tribal Drought Engagement Strategy* for 2021–2025 to ensure that indigenous perspectives are integrated into NIDIS’s

work and that tribal nations are equal partners in preparing for and responding to drought. A foundational element of the *Tribal Strategy* are three principles of engagement that guide NIDIS and partners in work with tribal nations. These include: (1) respecting tribal sovereignty; (2) ensuring trust and reciprocity; and (3) ensuring DEWS are culturally appropriate and useful for tribal nations



The *Strategy* also outlines key priorities for tribal engagement around the five components of a DEWS. To help implement the *Strategy*, NIDIS hired a full-time tribal engagement coordinator in summer 2021.

Conversations with tribal natural resource managers while developing the *Strategy* revealed several barriers to drought resilience that NIDIS intends to address during the *2022–2026 Strategic Plan*. One of the biggest barriers for tribal nations is not having the resources to implement actions in their drought plans. In response, NIDIS allocated

\$2.4 million to a two-year competitive funding opportunity in FY22 that requested proposals for projects specifically focused on funding the implementation of drought management actions on tribal lands. Another need identified is the lack of reservation-scale data to assess local drought conditions. As a result, NIDIS is seeking to expand its tools and resources relevant to tribal nations on the U.S. Drought Portal ([Drought.gov](https://www.drought.gov)). In order to further gather needs and build relationships with tribal partners across the country, NIDIS plans to host tribal drought action plan dialogues. These dialogues will be conducted in partnership with others within NOAA and other federal agencies, such as the EPA and DOI. NIDIS has also committed to supporting improved drought monitoring on tribal lands, including enhancing existing networks such as the USDA/NRCS’s Tribal Soil Climate Analysis Network (T-SCAN), NOAA’s Climate Reference Network (CRN), and the National Mesonet Program.

Key Strategic Goals Addressed: See Goal 3 (Planning and Preparedness, page 17) and Goal 4 (Communication, page 18).

Expanding Decision-Support Resources for Drought Planning

Stakeholders in regional DEWS require expanded decision-support tools that support multi-hazard risk assessment and planning in a changing climate. NIDIS’s diverse partnerships with federal, tribal, state, local, and cross-sector entities engaged in planning are leading efforts to coordinate across regional DEWS in support of drought planning activities. Critical to this aim is a centralized resource that helps planners take a proactive approach to the

development, evaluation, and improvement of drought plans at all scales, from city to state, tribal, economic sectors, and watershed levels. Decision-support resources will include those that help public and private sector planners assess interdependent societal, climate hazard, sector and ecological risks, and vulnerabilities; and select optimal adaptation and mitigation actions.

Key Strategic Goals Addressed: See [Goal 3 \(Planning and Preparedness, page 17\)](#) and [Goal 4 \(Communication, page 18\)](#).

The U.S. Drought Portal ([Drought.gov](#))

NIDIS has been delivering resources, maps, and tools for drought decision makers through the interagency U.S. Drought Portal ([Drought.gov](#)) since 2008. In January 2021, NIDIS worked with the NOAA National Centers for Environmental Information (NCEI) to launch a major redesign of the U.S. Drought Portal that would better serve decision makers across all levels of government, private industry, and the public. The new website features updated content and new interactive maps designed to provide actionable, shareable information on current drought conditions, forecasts, and planning resources from the city and county level to state, watershed, and global scales. The U.S. Drought Portal also aggregates and presents drought impact data for economic sectors such as agriculture, water utilities, public health, and wildfire management. By providing centralized access to key decision support resources, the new website helps to increase individuals' and communities' capacity for mitigating the impacts of drought. Since the launch, NIDIS has continued to improve the U.S. Drought Portal. For example, by expanding watershed-specific resources for the [Colorado River Basin](#) and the [Apalachicola-Chattahoochee-Flint River Basin](#), improving access to National Weather Service drought information statements through an [interactive map](#), and providing local [drought alert emails](#), where users can receive customized email updates when U.S. Drought Monitor conditions change for their location or when a new drought outlook is released.

Over the past five years, NIDIS has relied on user research, usability testing, and feedback from the NIDIS Executive Council, technical Working Groups, stakeholders, and the public to improve the data resources on the U.S. Drought Portal. In the next five years, NIDIS will continue to engage with these groups to increase usability and interactivity, while consistently improving user experience. NIDIS plans to develop an interactive Drought Planning Platform that supports planners to develop and improve drought plans at all scales, from city to state to regional. In addition, NIDIS will work closely with partners to address gaps in monitoring and prediction resources on the U.S. Drought Portal (e.g., for tribal nations), improve communication of forecast uncertainty, and continue to integrate sponsored research throughout the website, which will give stakeholders and leaders the tools to make better and more timely decisions and, ultimately, improve the nation's capacity to proactively manage drought-related risks.

Key Strategic Goals Addressed: See [Goal 1 \(Forecasts and Predictions, page 15\)](#), [Goal 2 \(Monitoring, page 16\)](#), and [Goal 4 \(Communication, page 18\)](#).

Burmester, Great Salt Lake, Utah. Source: Scott Stringham



COORDINATING AND LEADING RESEARCH INITIATIVES THAT ADDRESS KEY SCIENTIFIC AND SOCIETAL NEEDS

Implementing the National Coordinated Soil Moisture Monitoring Network (NCSMMN)

Soil moisture has been widely recognized as a critical land surface variable, impacting a wide variety of climatological, agricultural, and hydrological processes. It has also been identified as a key drought early warning indicator. However, developing accurate depictions of soil moisture conditions continues to be a serious challenge. In response to this need, NIDIS is leading the *National Coordinated Soil Moisture Monitoring Network* (NCSMMN), a collaborative effort among federal agencies, soil moisture scientists, state mesonet operators, and others to plan for and support nationally-coordinated soil moisture monitoring, data assimilation, and product development for drought and flood early warning and other applications.

The NIDIS-led *Strategy for a NCSMMN* is a detailed plan to build a multi-agency, cross-cutting initiative to integrate soil moisture data from around the country and to capitalize on its transformative potential for a wide range of applications across sectors of the economy, including not only drought, but also flooding, wildfire risk assessment, agricultural monitoring, and other natural resource needs. Key goals of the initiative include:

- Establishing a national “network of networks” that effectively demonstrates data and operational coordination of in-situ networks and addresses gaps in coverage
- Supporting R&D on innovative techniques to merge in-situ soil moisture data with remotely-sensed and modeled hydrologic data to create near real-time, gridded, user-friendly soil moisture maps and associated tools
- Building a community of practice, learning, and expertise around soil moisture measurement and interpretation—a “sustained network of people” that links data providers, researchers, and the user community

In addition, NIDIS has sponsored research on *proof-of-concept gridded national soil moisture maps* that blend multiple data sources (in-situ, satellite, modeled), led efforts to build partnerships with state mesonets, supported NOAA-wide efforts to increase soil moisture monitoring with a *buildout in the Southeastern U.S.*, and engaged in a range of targeted outreach activities with mesonet data providers, researchers and end users.

Resources to fully implement the strategy will enable rapid development of near real-time products that reduce drought risks and improve response times. The NCSMMN will strengthen drought monitoring and hazard early warning systems, improve characterization of national water budgets that are key for flood and drought forecasts, and strengthen climate models.

Key Strategic Goals Addressed: See Goal 2 (Monitoring, page 16) and Goal 6 (Coordination and Collaboration, page 20).



Extreme heat in the Southwest U.S. Source: canadastock

Climate-Driven Megadrought

In February 2022, a UCLA-led study found that the 22-year-long Southwest North American megadrought is the region’s driest in at least 1,200 years. Studying the area from southern Montana to northern Mexico, and from the Pacific Ocean to the Rocky Mountains, researchers discovered that human-caused climate change is responsible for about 42% of the soil moisture deficit since 2000, the paper found. One of the primary reasons climate change is

causing more severe droughts is that warmer temperatures are increasing evaporative demands. Higher evaporative demands mean that, for every drop of precipitation that falls, less water is likely to drain into streams, wetlands, and aquifers across the region. Soils and vegetation spend more time in drier conditions, increasing potential for forest fire, tree mortality, and tree regeneration failure.

NIDIS is taking a leadership role in alerting the nation to this megadrought as well as supporting the development of mitigation measures. NIDIS hosted two webinars in 2020 focusing on the megadrought: *Impact of Anthropogenic Warming on an Emerging North American Megadrought*; and *Coping With Megadrought in the Colorado River Basin*. In 2021, NIDIS also hosted a Southwest Drought Virtual Forum, assembling stakeholders, decision makers, and drought experts for a cross-cutting dialogue on worsening drought conditions in the Southwestern United States, and response and relief efforts across levels of government and sectors. Finally, in 2021, the NOAA Drought Task Force, which is a collaboration between NIDIS, the NOAA Climate Program Office, and leading scientists, released the study *Exceptional Southwest Drought Exacerbated by Human-Caused Warming*. The report found that while precipitation was exceptionally low in the Southwest from 2020–2021, temperatures over the same period were exceptionally warm. These warm temperatures caused both a shortened snow season and the record high vapor pressure deficit (VPD), a measure of how thirsty the atmosphere is, observed between January 2020 to August 2021. Additional increases in VPD from human-caused warming helped make drought more likely.

Improvements in drought early warning will be achieved through continued investment in research on drought and aridification in the Southwestern U.S., including social science research to investigate how seasonal to decadal climate variability is impacting the Southwest U.S. climate and society.

Key Strategic Goals Addressed: See [Goal 3 \(Planning and Preparedness, page 17\)](#) and [Goal 5 \(Interdisciplinary Research, page 19\)](#).



The Dixie Fire destroyed numerous homes and displaced thousands of residents. Plume of smoke seen from Deer Creek, Plumas County, California; July 22, 2021. Credit: Michael Lee

Drought and Wildfire Management

The *NIDIS Drought and Wildland Fire Nexus* (NDAWN) is rooted in developing partnerships and collaboration with the wildland fire management community. It was launched to address the challenges fire managers face related to drought and to establish a robust drought and wildland fire decision-support information network. NDAWN functions as a network at multiple scales, from subregional to national. This engagement informs a comprehensive applied research program

aimed to better understand the consequences of drought at every point of the fire management continuum from prediction and pre-ignition, to active fire management including prescribed fire, and post-fire recovery. The network also creates a mechanism for sustained

engagement with wildland fire managers and practitioners and enables co-production throughout the process to meet those needs together.

Challenges identified to-date include drought amplifying safety concerns for firefighters and communities, drought increasing the potential for large wildfires, resource demands and cost, management uncertainty, and the likelihood for post-fire vegetation shifts. A lack of flexibility in planning processes to manage the impacts of drought to fire management was also identified. Efforts to address these challenges are underway and will continue over the next five years to answer applied research questions and incorporate better information into operational decision support systems. Example areas of work, which touch on all five components of drought early warning, include:

- The development of an automated system for subseasonal forecasts for fire danger indices and relative fire risk metrics and improving soil moisture modeling to inform the development of an updated Keetch-Byram Drought Index (KDBI).
- Work to better understand regional differences in how compounding antecedent conditions (e.g., long-term climate patterns, recent seasonal conditions, and acute critical fire weather events) impact the fire season and fire behavior will inform what should be monitored and incorporated into wildfire management decisions.
- A focus on relating atmospheric and plant health indicators to plant water potential to improve current operational models and that do not adequately capture plant flammability potential. This effort is nested in a larger effort to understand atmospheric–terrestrial interactions that cause sudden increases in highly flammable fuel conditions.
- Once wildland fires are extinguished, drought conditions can inhibit recovery of soils and vegetation contributing to post-fire debris flows and landslides and impacting the success of restoration projects. Research on the long-term vulnerability of communities near burn scars and how to adjust techniques and approaches to improve restoration success in drought prone areas is key to public safety post-fire.

The ultimate goal of NDAWN is to benefit both wildland firefighters and public health and safety across the United States.

Key Strategic Goals Addressed: See [Goal 1 \(Forecast and Predictions, page 15\)](#) and [Goal 5 \(Interdisciplinary Research, page 19\)](#).



Conclusion

The completion of a fully operational national DEWS is fundamental to creating a more drought resilient nation. As the foremost Federal agency drought program, NIDIS is well positioned to deliver that system to the Nation, by directing efforts toward reducing risk in drought sensitive sectors and regions and engendering awareness of the drought hazard, its links to vulnerability, and opportunities for action. Through a robust consultative process over the course of 15 years, NIDIS has matured and expanded its reach and services. The future growth identified through consultation and captured in this plan is vital to meet the nation's goals for a drought and climate ready nation. Resources to support this growth will result in transformational improvements that reduce drought's catastrophic economic, wildfire, health, and environmental impacts across the country. By building upon existing programs and partnerships to create an effective national drought early warning system, NIDIS will continue to advance proactive responses to drought-related risk, and strengthen preparedness strategies and plans that increase our country's resilience in the face of drought.

APPENDIX A: KEY DRIVERS

Key Drivers for the 2022–2026 NIDIS Strategic Plan:

- NIDIS Public Law and Reauthorizations
 - *NIDIS Act of 2006, Public Law 109–430*
 - *NIDIS Reauthorization Act of 2014, Public Law 113–86*
 - *NIDIS Reauthorization Act of 2018, Public Law 115–423*
- Department of Commerce 2022–2026 *Strategic Plan*
- NOAA’s *Mission and Vision*
- NOAA 2022–2026 Research and Development *Vision*
- NOAA Oceanic and Atmospheric Research (OAR) 2020–2026 *Strategy*
- The *Weather Research and Forecasting Innovation Act of 2017*
- National Weather Service Weather Ready Nation *Strategic Plan* 2019–2022
- NOAA *Service Delivery Framework*
- USDA 2021 *Action Plan for Climate Adaptation and Resilience*
- NOAA 2014 *California Drought Service Assessment*

APPENDIX B: PERFORMANCE MEASURES

NIDIS will measure its progress in meeting the Strategic Goals and the long-term Outcomes identified in this *Strategic Plan* by monitoring the specific outputs from implementation activities in 2022–2026, and their impact on drought early warning and preparedness. This includes both regional and national activities. The following are examples of performance measures that NIDIS may track and measure, and will be refined through a supplemental monitoring and evaluation document.

U.S. Drought Portal Utilization

- Unique and returning visits to the U.S. Drought Portal (drought.gov)
- Bounce rate (rate of users immediately leaving a web page) for the U.S. Drought Portal
- Media referencing the U.S. Drought Portal content

Research Impacts

- Number of Publications by PIs supported by NIDIS
- Number of Publications using NIDIS data or products
- Number of Scientific Assessments
- NIDIS-supported data or products used to inform science and management
- Improvements of new technologies or methodologies for drought monitoring and prediction
- NIDIS-supported research to improve operational product delivery
- NIDIS PIs, personnel, and/or key partners in critical national and regional leadership roles related to drought

Planning Impacts

- Use of Drought Planning Platform
- State or other plans informed by NIDIS-supported research and information

Information Dissemination

- Drought updates produced and disseminated
- Drought information webinars led
- Convening of stakeholders for individual consultation

Partnership Reach, Network Building and Justice, Equity, Diversity, and Inclusion (JEDI)

- Number of tribal nations that are supported by NIDIS drought
- Number of states and territories supported by NIDIS
- Number of partners convened under regional and national drought dialogues
- Implement updated *Strategic Action Plans* (SAPs) in all 8 NIDIS regional DEWS
- Number of students at all levels and early career professionals involved in NIDIS supported activities

ACKNOWLEDGEMENTS

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Document prepared by NIDIS
in partnership with key
stakeholders in
the region.

