



# **Overview of recent USGS-NAS Report, Internet of Water, and a slide on new priorities for the USGS Water Mission Area**

**Gary Rowe**

**USGS Co-Chair National Water Quality Monitoring Council Program  
Coordinator, USGS National Water Quality Program**

**National Water Quality Monitoring Council meeting,  
Boise Idaho, November 8, 2018**

# Future Water Priorities for the Nation: Directions for the U.S. Geological Survey Water Mission Area

Briefing to USGS

George Hornberger, Committee Chair

<https://www.nap.edu/catalog/25134/future-water-priorities-for-the-nation-directions-for-the-us>

# Statement of Task

The committee will address the most compelling national water resource and science needs during the next several decades. In particular, the study will:

1. Identify the nation's highest-priority water science and resources challenges over the next 25 years,
2. Summarize WMA's current water science and research portfolio, and
3. Provide recommendations on the strategic water science and research opportunities for WMA that would address the highest-priority national water challenges.

# Questions Most Relevant to USGS

1. What is the **quality** and quantity of atmospheric, surface, and subsurface water, and how do these vary spatially and temporally?
2. How do human activities affect water quantity and **quality**?
3. How can water accounting be done more effectively and comprehensively to provide data for water availability and use?
4. How does changing climate affect water **quality**, quantity, and reliability, as well as water-related hazards and extreme events?
5. How can long-term water-related risk management be improved?

# Additional Questions

6. How does the hydrologic cycle respond to changes in the atmosphere, the lithosphere, and the biosphere through Earth's history and in the near future? And how do the hydrologic responses feed back to and hence accelerate or dampen the changes in the atmosphere, the lithosphere, and the biosphere?
7. How can short-term forecasting for climate, hydrology, [water quality](#), and associated social systems be improved?
8. How do institutions and governance and institutional resilience impact the quantity and [quality](#) of water?
9. How can understanding of the connections between water-related hazards and [human health](#) be improved?
10. How can competing uses for water resources be managed and maintained to [sustain healthy communities and ecosystems](#) in a changing world?

# Recommendations

1. What is the **quality** and quantity of atmospheric, surface, and subsurface water, and how do these vary spatially and temporally?

**Recommendation 1.1: Enhance data collection, include citizen science, and develop Web-based analytical tools.**

WMA should... co-develop accessible, open, and codified data formats, protocols, interoperability, and software tools...

**Recommendation 1.2: Coordinate with agencies and organizations on data delivery.**

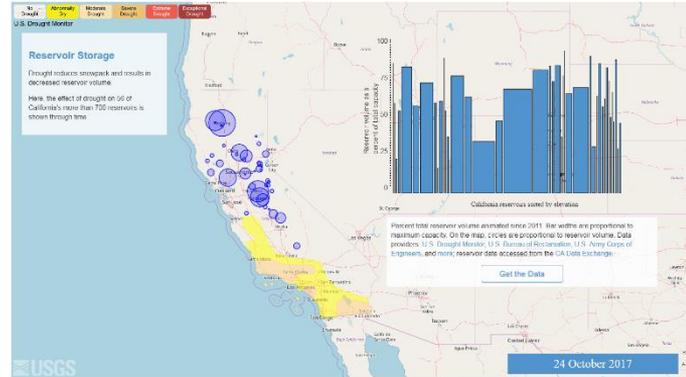
2. How do human activities affect water quantity and **quality**?

**Recommendation 2.1: Increase focus on the relationships between human activities and water.**

WMA should prioritize... a careful synthesis of observations and coupled natural-human systems models.



Source: Wikipedia



# Recommendations (cont'd)

3. How can water accounting be done more effectively and comprehensively to provide data for water availability and use?

**Recommendation 3.1: Develop a robust water accounting system.**

**Recommendation 3.2: Collaborate with agencies and organizations on water-data standards and categories of use.**

4. How does changing climate affect water **quality**, quantity, and reliability, as well as water-related hazards and extreme events?

**Recommendation 4.1: Ensure that monitoring networks provide adequate information to assess changing conditions.**



Source: USGS



# Recommendations (cont'd)

5. How can long-term water-related risk management be improved?

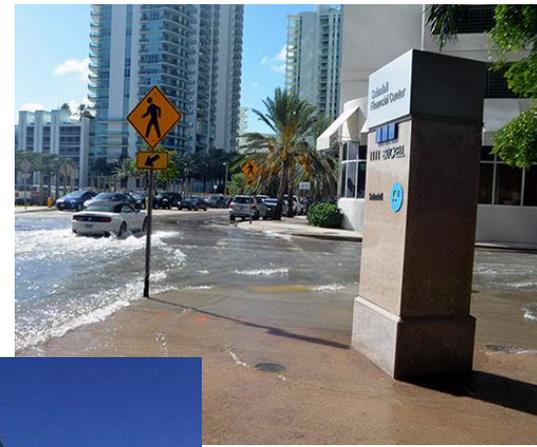
**Recommendation 5.1: Focus on long-term prediction and risk assessment of extreme water conditions.**

Additional Recommendations

**Recommendation 6: Develop multiscale, integrated, dynamic models that encompass the full water cycle.**

**Recommendation 7: Collaborate as appropriate both within and outside of USGS, including agencies and the private sector.**

**Recommendation 8: Build a workforce who are ready to take on new water challenges.**



Source: Wikipedia

*The Internet of Water*

**Dr. Emily K. Read**

**Chief, Web Communications**

**Water Resources Mission Area**

**U.S. Geological Survey**



# USGS Water

*Observe, understand, predict, and deliver timely water information*

Water information is fundamental to national and local economic well-being, protection of life and property, and effective management of the Nation's water resources.

*USGS Water works with partners to monitor, assess, conduct targeted research, and deliver information on a wide range of water resources and conditions including*

- Streamflow
- Groundwater
- Water quality
- Water use and availability

*Image credit: NASA*

# Water issues abound

*as society puts increasing pressure on limited freshwater resources*



*Image credit, left to right: Time Magazine (left and center images) and National Geographic Magazine*

# USGS Water Information Delivery

*Making water data discoverable and accessible*

USGS is the largest provider of in-situ water data in the world.

*Every year, USGS Water delivers*

> 1 billion successful data requests per year

> 10 terabytes of data

> 700k publication downloads

<https://waterdata.usgs.gov>



# Where can you find water data?

*What's the best source?*

**Finding relevant water data can be challenging.**

*Hundreds of federal, state, local, tribal and other monitoring organizations collect water data*

- Different delivery media (websites, web services, by email, through the mail, and more)
- Different delivery format (PDF, CSV, JSON, scanned documents, and more)
- Different data and metadata formats (units, geospatial references, time/date, and more)
- Different measurement methods (discrete, continuous, analytical, remotely sensed, and more)

# The Federal Open Data Movement

## *Implications for Water Data*

### Timeline

2013 Presidential Open Data Policy



THE DIRECTOR

EXECUTIVE OFFICE OF THE PRESIDENT  
OFFICE OF MANAGEMENT AND BUDGET  
WASHINGTON, D.C. 20503

May 9, 2013

M-13-13

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM:

Sylvia M. Burwell  
Director

Handwritten signature of Sylvia M. Burwell in blue ink.

Steven VanRoekel  
Federal Chief Information Officer

Handwritten signature of Steven VanRoekel in black ink.

Todd Park  
U.S. Chief Technology Officer

Handwritten signature of Todd Park in black ink.

Dominic J. Mancini  
Acting Administrator, Office of Information and Regulatory Affairs

Handwritten signature of Dominic J. Mancini in black ink.

SUBJECT: Open Data Policy—Managing Information as an Asset

Information is a valuable national resource and a strategic asset to the Federal Government, its partners, and the public. In order to ensure that the Federal Government is taking full advantage of its information resources, executive departments and agencies (hereafter referred to as “agencies”) must manage information as an asset throughout its life cycle to promote openness and interoperability, and properly safeguard systems and information. Managing government information as an asset will increase operational efficiencies, reduce costs, improve services, support mission needs, safeguard personal information, and increase public access to valuable government information.

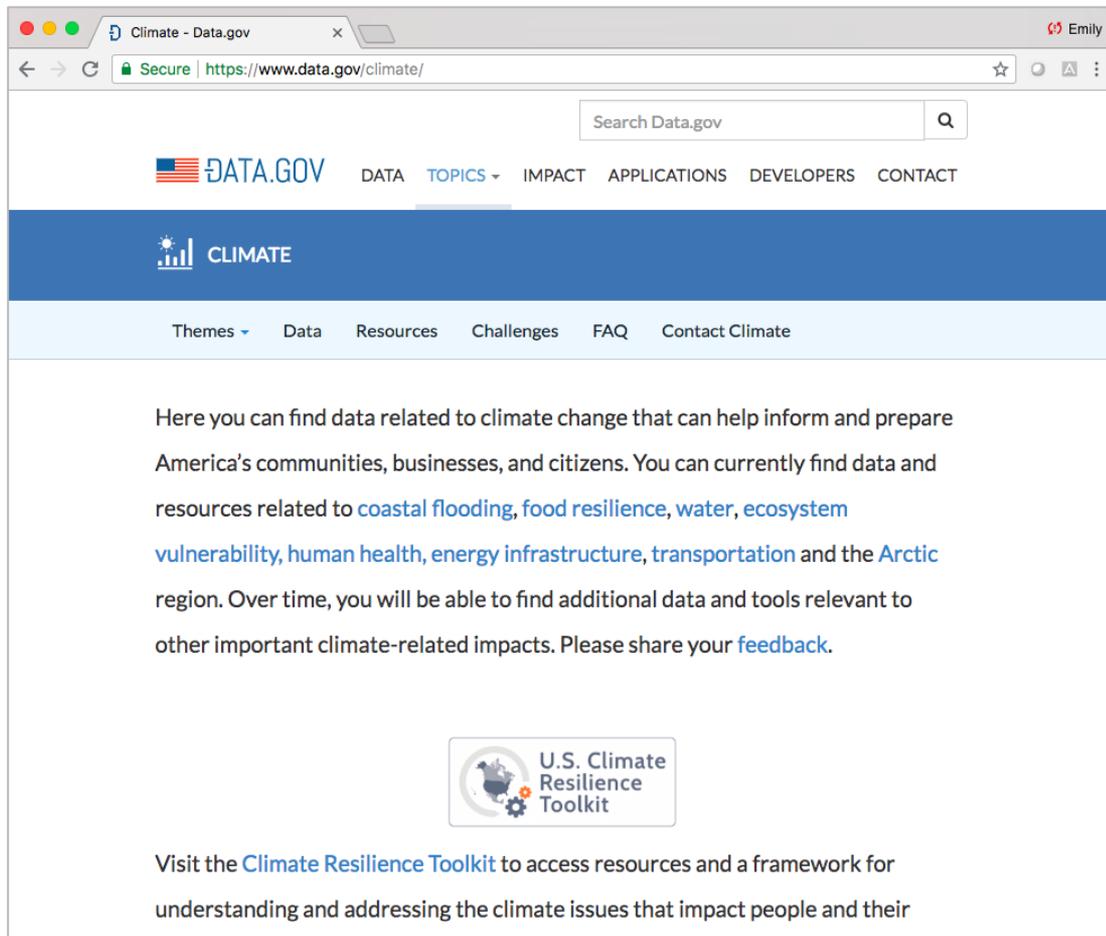
# The Federal Open Data Movement

## *Implications for Water Data*

### Timeline

2013 Presidential Open Data Policy

2014 Federal Climate Data Initiative

A screenshot of a web browser displaying the Data.gov Climate page. The browser's address bar shows the URL "https://www.data.gov/climate/". The page features a search bar at the top right with the text "Search Data.gov". Below the search bar is the Data.gov logo and a navigation menu with links for "DATA", "TOPICS", "IMPACT", "APPLICATIONS", "DEVELOPERS", and "CONTACT". A blue banner below the navigation menu contains the word "CLIMATE" next to a bar chart icon. Underneath the banner is a secondary navigation menu with links for "Themes", "Data", "Resources", "Challenges", "FAQ", and "Contact Climate". The main content area contains a paragraph of text: "Here you can find data related to climate change that can help inform and prepare America's communities, businesses, and citizens. You can currently find data and resources related to [coastal flooding](#), [food resilience](#), [water](#), [ecosystem vulnerability](#), [human health](#), [energy infrastructure](#), [transportation](#) and the [Arctic region](#). Over time, you will be able to find additional data and tools relevant to other important climate-related impacts. Please share your [feedback](#)." Below this text is a box for the "U.S. Climate Resilience Toolkit" which includes a map of the United States and a gear icon. At the bottom of the page, there is a call to action: "Visit the [Climate Resilience Toolkit](#) to access resources and a framework for understanding and addressing the climate issues that impact people and their".

# The Federal Open Data Movement

## *Implications for Water Data*

### Timeline

2013 Presidential Open Data Policy

2014 Federal Climate Data Initiative

2015 Federal Open Water Data Initiative



The screenshot shows a web browser window with the URL <https://acwi.gov/spatial/owdi/>. The page header includes logos for WICP (Water Information Coordination Program), OWDI (Open Water Data Initiative), and ACWI (Advisory Committee on Water Information). A navigation menu contains links for About Us, Members, Meetings, Contacts, Products, Old Features, Full Report, and News Feed. The main content area is titled "Open Water Data Initiative Overview" and contains a paragraph of text. Below the text is a diagram titled "Open Water Web" with four columns representing different data services and their associated actions.

**Open Water Data Initiative Overview**

Quantifying the availability, use, and risks to our national water resources is an effort of national importance for the present and the foreseeable future. Improving access to data and enabling open exchange of water information is foundational to identifying and understanding existing water resources issues and developing sustainable future solutions particularly in the face of climate change and unprecedented drought. To address this challenge, we are proposing a new Open Water Data Initiative that will integrate currently fragmented water information into a connected, national water data framework and leverage existing systems, infrastructure and tools to underpin innovation, modeling, data sharing, and solution development.

<b>Open Water Web</b>			
<b>water data Catalog</b>	<b>water data <i>As a Service</i></b>	<b>Enriching Water Data</b>	<b>water data and tools <i>Marketplace</i></b>
Find source data	Consensus standards	Include routing	Community exercise of tools & data
Create water & climate themes	Visualization and delivery	Coupling with models	Data usage tracking
Recruit/engage partners	Catalog and serve	Grounded to geofabric	Community-built extensions (eg map)

# The Federal Open Data Movement

## *Implications for Water Data*

### Timeline

2013 Presidential Open Data Policy

2014 Federal Climate Data Initiative

2015 Federal Open Water Data Initiative

2017 Internet of Water Report



## INTERNET OF WATER: SHARING AND INTEGRATING WATER DATA FOR SUSTAINABILITY

A REPORT FROM THE ASPEN INSTITUTE  
DIALOGUE SERIES ON WATER DATA

*Credit: <https://www.aspeninstitute.org/publications/internet-of-water/>*

# Internet of Water

*A report from the Aspen Institute*

## Findings:

1. The value of open, shared, and integrated water data has not been widely quantified, documented or communicated.
2. Making existing public water data open is a priority.
3. The appropriate architecture for an “Internet of Water” is a federation of data producers, hubs, and users.



WATER DATA

# INTERNET OF WATER

A network of interconnected data shared between different water sectors and regions will enable the real-time transmission of water-related data and information to more efficiently and sustainably manage water resources.

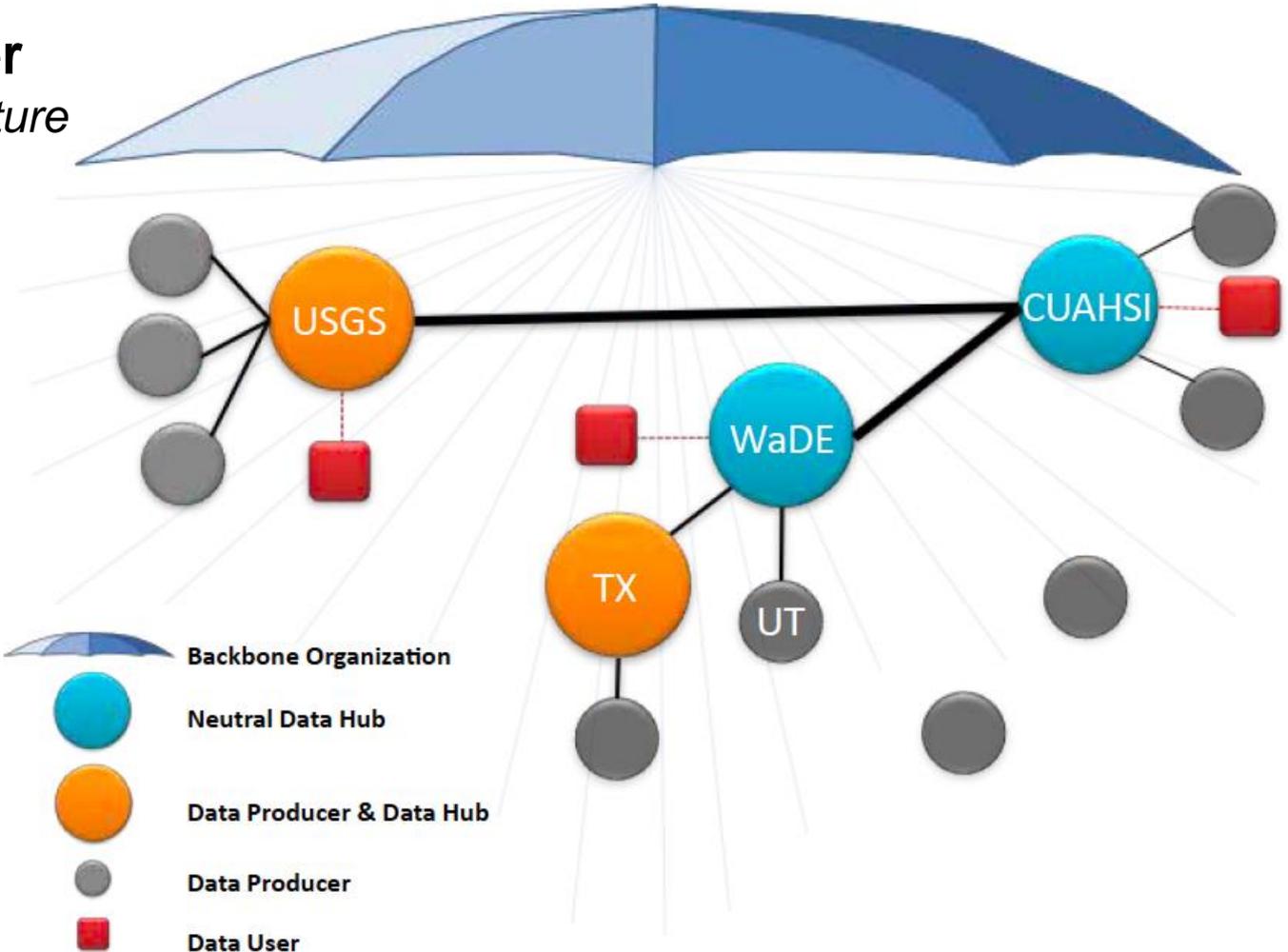
## KEY FINDINGS FROM THE ASPEN WATER DATA DIALOGUE SERIES

- 1**  
Water is under-valued, water data even more so.
- 2**  
Prior to sharing water data for sustainability, public water data must be made open by default, discoverable, and digitally accessible.
- 3**  
An Internet of Water is the most efficient means to share and integrate water data.

*Credit: <https://www.aspeninstitute.org/publications/internet-of-water/>*

# Internet of Water

*Appropriate architecture*



Credit: <https://www.aspeninstitute.org/publications/internet-of-water/>

# Internet of Water

*A report from the Aspen Institute*

## Recommendations:

1. Articulate a vision
2. Enable open water data
3. Create an Internet of Water



WATER DATA

# INTERNET OF WATER

## ACTION PRIORITIES

- ENABLE OPEN WATER**  
Quantify, document and communicate the value of open, shared and integrated water data to build the business case for investing in making water data open and shareable.
- INTEGRATE EXISTING PUBLIC WATER DATA**  
There are already some water data sharing communities integrating existing public water data; these efforts should be further supported with lessons and tools shared between these (and new) communities.
- CONNECT REGIONAL DATA SHARING COMMUNITIES**  
Similar to the Internet, the IOW will also require the development of a governance structure to connect regional data sharing communities, reducing redundancy and gaining efficiencies.

THE ASPEN INSTITUTE

#InternetofWater

f /AspenInstitute  
t @AIEnvironment

The graphic is a dark-themed cover for a report titled "Internet of Water". At the top, it says "WATER DATA" in a small font. Below that, the main title "INTERNET OF WATER" is written in large, bold, white capital letters. Underneath the title is the section "ACTION PRIORITIES". There are three items listed, each preceded by a teal water drop icon. The first item is "ENABLE OPEN WATER" with a brief description. The second is "INTEGRATE EXISTING PUBLIC WATER DATA" with a brief description. The third is "CONNECT REGIONAL DATA SHARING COMMUNITIES" with a brief description. At the bottom of the graphic, there is the Aspen Institute logo (a white water drop above the text "THE ASPEN INSTITUTE"), the hashtag "#InternetofWater", and social media icons for Facebook and Twitter with their respective handles: "/AspenInstitute" and "@AIEnvironment".

*Credit: <https://www.aspeninstitute.org/publications/internet-of-water/>*

# Internet of Water

## *Action 1: Articulate a vision*

Recommendation 1.1: Articulate a vision of sustainable water resource management and stewardship enabled by open, shared, and integrated public water data.



### INTERNET OF WATER: SHARING AND INTEGRATING WATER DATA FOR SUSTAINABILITY

A REPORT FROM THE ASPEN INSTITUTE  
DIALOGUE SERIES ON WATER DATA

# Internet of Water

## *Action 1: Articulate a vision*

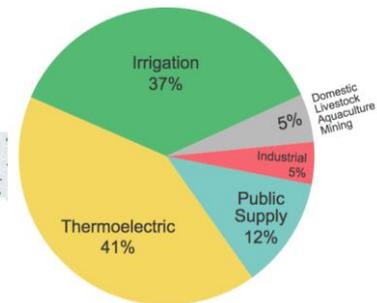
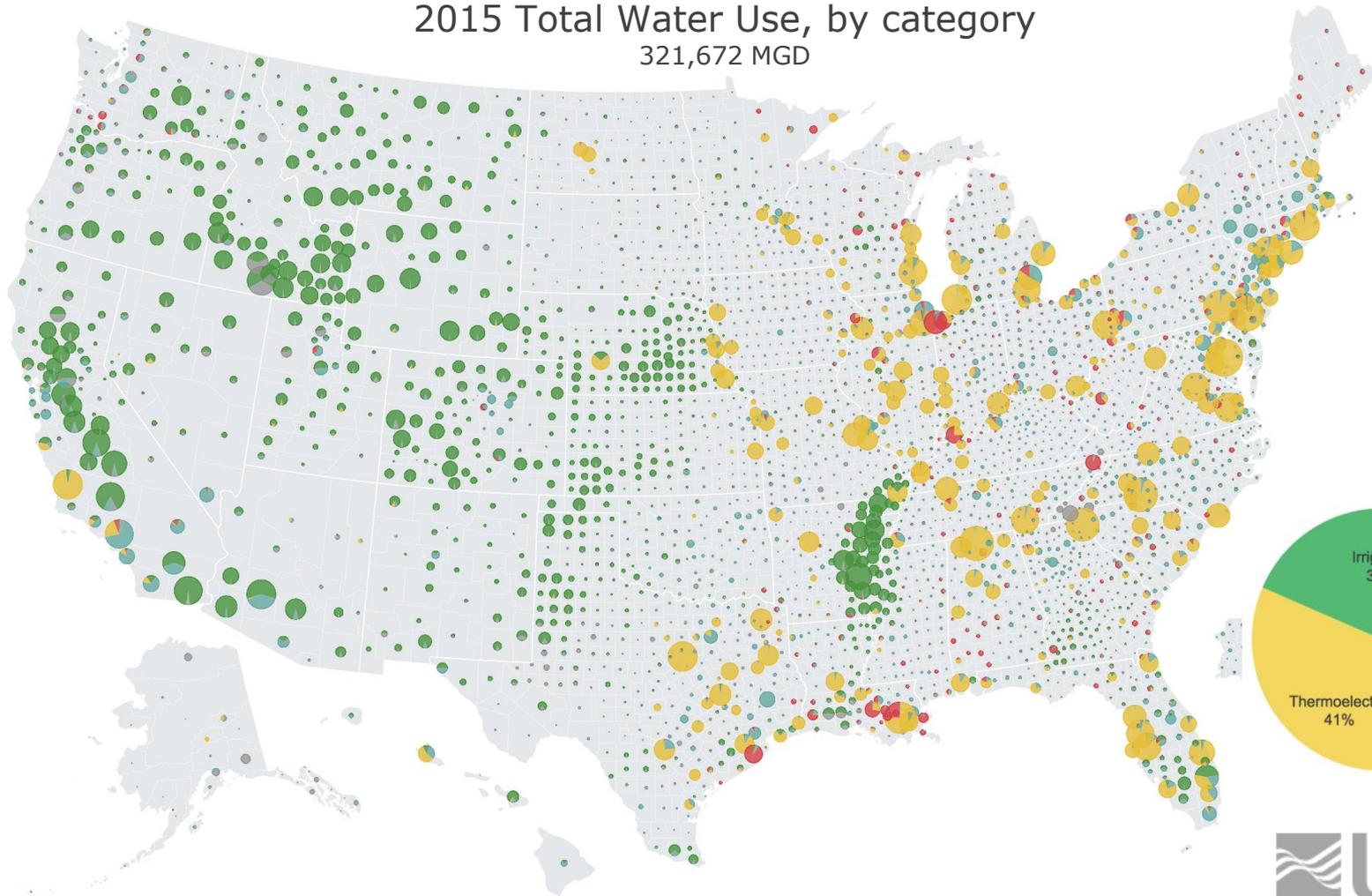
Recommendation 1.2: Initiate an Internet of Water (IoW) through regional pilots that solve near-term water management problems for key stakeholders through shared and integrated water data.

### *Water Use Data Collaboration*



# 2015 Total Water Use, by category

321,672 MGD



# Internet of Water

## *Action 1: Articulate a vision*

Recommendation 1.2: Initiate an Internet of Water (IoW) through regional pilots that solve near-term water management problems for key stakeholders through shared and integrated water data.

### **Water Use Data Collaboration**

- Who: Western States Water Council Water Data Exchange (WaDE), USGS, ACWI, and IoW
- Desired outcome: Water use data shared through trusted brokers for consistent, national, timely water information
- USGS Water Use Science Program pivot to estimating water use at higher spatial and temporal scales



*Credit: US EPA*

# Internet of Water

## *Action 2: Enable Open Water Data*

Recommendation 2.1: Develop water data catalogs that identify all existing public water data maintained by states.

# Internet of Water

## Action 2: Enable Open Water Data

Recommendation 2.1: Develop water data catalogs that identify all existing public water data maintained by states.

### The Water Quality Portal

- Who: EPA, USGS, USDA, ACWI
- What: Multi-agency water quality data portal
- Hundreds of millions of WQ records, millions of sites, shared data model.
- Big-tent model

A screenshot of a web browser displaying the National Water Quality Monitoring Council (NWQMC) Water Quality Data Portal. The browser's address bar shows the URL "https://www.waterqualitydata.us/portal/". The page header includes the NWQMC logo and the tagline "Working Together for Clean Water". Below the header is a navigation menu with links for "WQP Home", "Download Data", "How to use the WQP", "National Results Coverage", and "About the WQP". The main content area is a search form with a "Reset form" button at the top left. The form is divided into several sections: "LOCATION" with fields for "Place:" (Country, State, County), "Point Location: ?" (Within, North, South, East, West), and "Bounding Box: ?" (Lat, Long); "SITE PARAMETERS" with fields for "Site Type:", "Organization ID:", "Site ID:", "HUC:", and "Minimum sampling activities per site:"; "SAMPLING PARAMETERS" with fields for "Sample Media:", "Characteristic Group:", "Characteristics:", "Project ID:", "Parameter Code: (NWS ONLY)", "Minimum results per site:", and "Date range - from:" and "to:"; and "Biological sampling parameters: ?" with fields for "Assemblage:" and "Taxonomic Name:". A map of the United States is located at the bottom left of the search form, with a "Search Upstream and Downstream (BETA) ?" label above it. The map includes navigation controls (refresh, zoom in, zoom out) and a "Leaflet | Powered by Esri | HERE, DeLorme, Mapm..." footer.

The Water Quality Portal. <https://waterqualitydata.us>

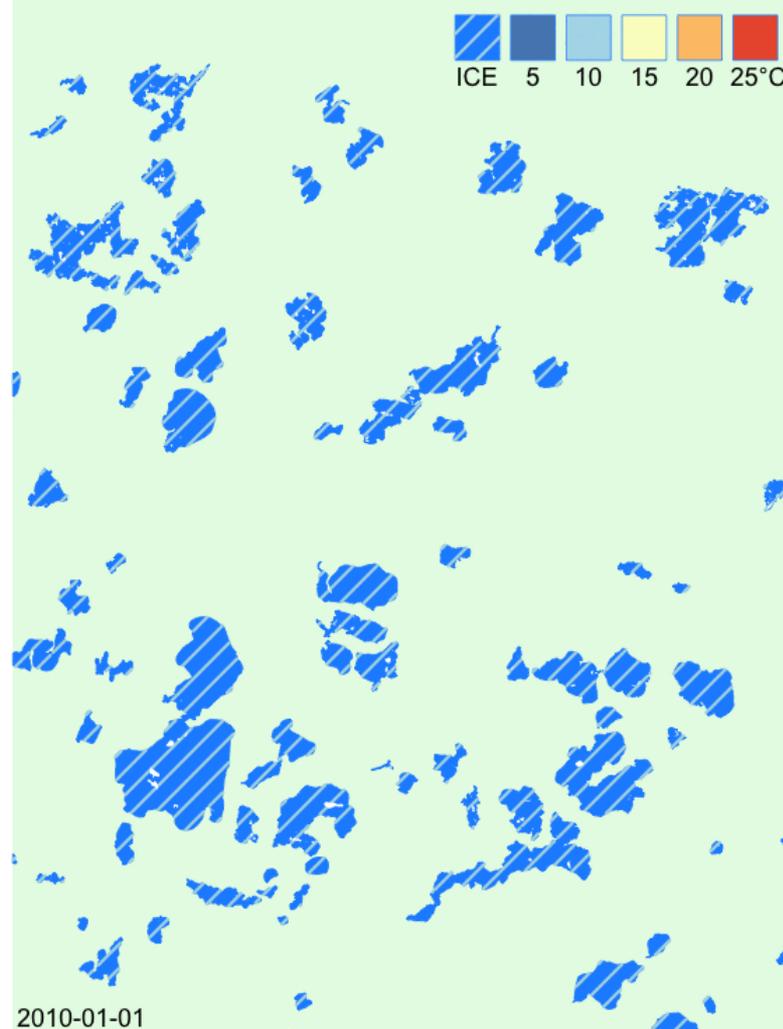
# Internet of Water

## *Action 2: Enable Open Water Data*

Recommendation 2.2: Develop tools for opening existing, public water data and enable the use of those tools by producers and users.

### **Predicting shifts in fish habitat under change climate**

- Who: MN, WI, and MI DNRs; USGS; University of Wisconsin
- What: 10k+ lake temperature forecasts
- Why: Fisheries managers can make informed decisions about stocking in particular systems that may



Credit: J. Read, USGS

# Internet of Water

## *Action 3: Create an Internet of Water*

Recommendation 3.1: Existing water data hubs should be stabilized and further resourced.

### **USGS Water Budget Outlook**

- Modest increase from Congress in FY18
- \$13.5M + in House mark for FY19 for *Water Observing System Modernization* and the Cooperative Matching Fund



**INTERNET OF WATER:  
SHARING AND INTEGRATING  
WATER DATA FOR SUSTAINABILITY**

A REPORT FROM THE ASPEN INSTITUTE  
DIALOGUE SERIES ON WATER DATA

# Internet of Water

## *Action 3: Create an Internet of Water*

Recommendation 3.2: A backbone organization should be formed to structure and enable a system of federated data.

Recommendation 3.3: The backbone organization should be a non-profit organization but with a cooperative agreement with a federal, non-regulatory agency.

### **Duke Nicholas Institute for Environmental Policy Solutions**

- Secured funding to stand up backbone IoW organization
- Cooperative Agreement with USGS in development



*Martin Doyle (top) and  
Lauren Patterson,  
Internet of Water backbone;  
Duke Nicholas Institute for  
Environmental Policy Solutions*



Emily K Read, U.S. Geological Survey  
[eread@usgs.gov](mailto:eread@usgs.gov) (608)-821-3851  
League of Women Voters Water Forum  
June 27, 2018

## INTERNET OF WATER

Duke Nicholas Institute Internet of Water  
<https://nicholasinstitute.duke.edu/internet-of-water>

## MULTI-AGENCY WATER DATA HUBS

Water Quality Portal (WQP)  
<https://www.waterqualitydata.us/portal/>

Nat'l Groundwater Monitoring Network (NGMWN)  
<https://cida.usgs.gov/ngwmn/index.jsp>

Western States Water Council Water Data Exchange (WaDE)  
<http://wade.westernstateswater.org/>

## USGS WATER DATA HUBS & INFORMATION

USGS Nat'l Water Information System (NWISWeb)  
<https://waterdata.usgs.gov/>

USGS Publications Warehouse  
<https://pubs.er.usgs.gov/>

USGS Surface Water Quality Trends  
<https://nawqatrends.wim.usgs.gov/swtrends/>

USGS Groundwater Quality Trends  
<https://nawqatrends.wim.usgs.gov/Decadal/>

USGS Water Data Visualizations  
<https://owi.usgs.gov/vizlab/>

USGS 2015 County-Scale Water Use Data Visualization  
<https://owi.usgs.gov/vizlab/water-use-15/>



# **New Directions for USGS Water Mission Area**

- **Modernize NWIS and related enterprise IT infrastructure to support NGWOS and water prediction (includes Internet of Water)**
- **Start building Next-Gen Water Observing System (NGWOS)**
- **Use Integrated Models to forecast future Water conditions over short, medium and long-term (Water Prediction Work Program)**
- **Produce Integrated Water Availability Assessments at Regional and National scales to meet Secure Water Act requirements**
- **Planning for all 4 areas started, more details to come**