

NEW MEXICO WATER DATA INITIATIVE WORKSHOP

Location: Macey Center at
New Mexico Tech

Convened By: New Mexico Bureau of Geology
and Mineral Resources

Date: May 4, 2023

Click on the presentation title to jump to the presenter's slide deck

9:00 – 9:40 am	Welcome to the NM Water Data Workshop – Stacy Timmons, NMBGMR	Auditorium
9:40 – 10:40 am	Panel: Updates from Water Data Act Directing Agencies, Progress and Challenges – OSE, ISC, NMED, EMNRD, and NMBGMR	Auditorium
11:00 am – 12:00 pm	Keynote presentation: The Water Walker – Eldrena Douma	Auditorium

Track 1	Location: Galena Room Session Chair: Amy Galanter
1:00 – 1:20 pm	USGS Water Data for the Nation: How We Work – Emily Read, USGS
1:20 – 1:40 pm	OpenET: Field-Scale ET for Water Resilience in the U.S. West – Maurice Hall, EDF
1:40 – 2:00 pm	Using Data Visualizations of the NM Dynamic Statewide Water Budget Tool to Address Community Water Issues – Austin Hanson, Intera, and Mark Sheely, NM WRI
2:00 – 2:20 pm	Rio Grande and Pecos River Water Operations Dashboard – Lucas Barrett, U.S. Bureau of Reclamation
2:40 – 3:10 pm	Update on the Internet of Water Coalition and Core Technology – Faith Sternlieb, Internet of Water
3:10 – 3:40 pm	Demo: The Western States Water Data Access and Analysis Tool (WestDAAT) – Adel Abdallah, Western States Water Council
3:40 – 4:10 pm	CUAHSI Data Infrastructure and Sharing Across the Data Lifecycle – Clara Cogswell, CUASHI

Track 2	Location: Auditorium Session Chair: Emily Geery
1:00 – 1:20 pm	Data and Water, Facts and Stories from a Storyteller – Harriet Cole
1:20 – 1:40 pm	The DRAFT 50-Year Water Plan – Sara Goldstein, ISC
1:40 – 2:00 pm	Communicating Climate Science, the New Mexico Climate Risk Tool and Future Data Needs – Robert Gomez, EMNRD
2:00 – 2:20 pm	Water Models and Data Needs at OSE – Katie Zemlick, OSE
2:40 – 3:10 pm	Using the NMWDI Data Catalog: What it CKAN and Can't Do – Cris Morton and Rachel Hobbs, NMBGMR
3:10 – 3:40 pm	NMWDI: The Modern Data Sharing Infrastructure – Jake Ross, NMBGMR
3:40 – 4:10 pm	How to Access USGS Water Data – Candice Hopkins, USGS
4:10 – 5:30 pm	Networking break and social hour



The New Mexico Water Data Act: Stories and our path ahead

May 2023

Stacy Timmons

Associate Director for Hydrogeology Programs



Why are we here today?

- To gain better understanding about how to find water data
- To network and connect with each other
- Free lunch?
- To learn more about what is going on with the NM Water Data Act implementation

FIND YOUR OWN PATH AND FOLLOW WHAT INTERESTS YOU MOST
THIS IS THE WAY!



Jump in - Let's go back 10 years



June 2013 - Magdalena, NM



June 2013 - Magdalena, NM



Village was operating on 1 well
It stopped producing water
Tanks were soon empty

2013 water outage

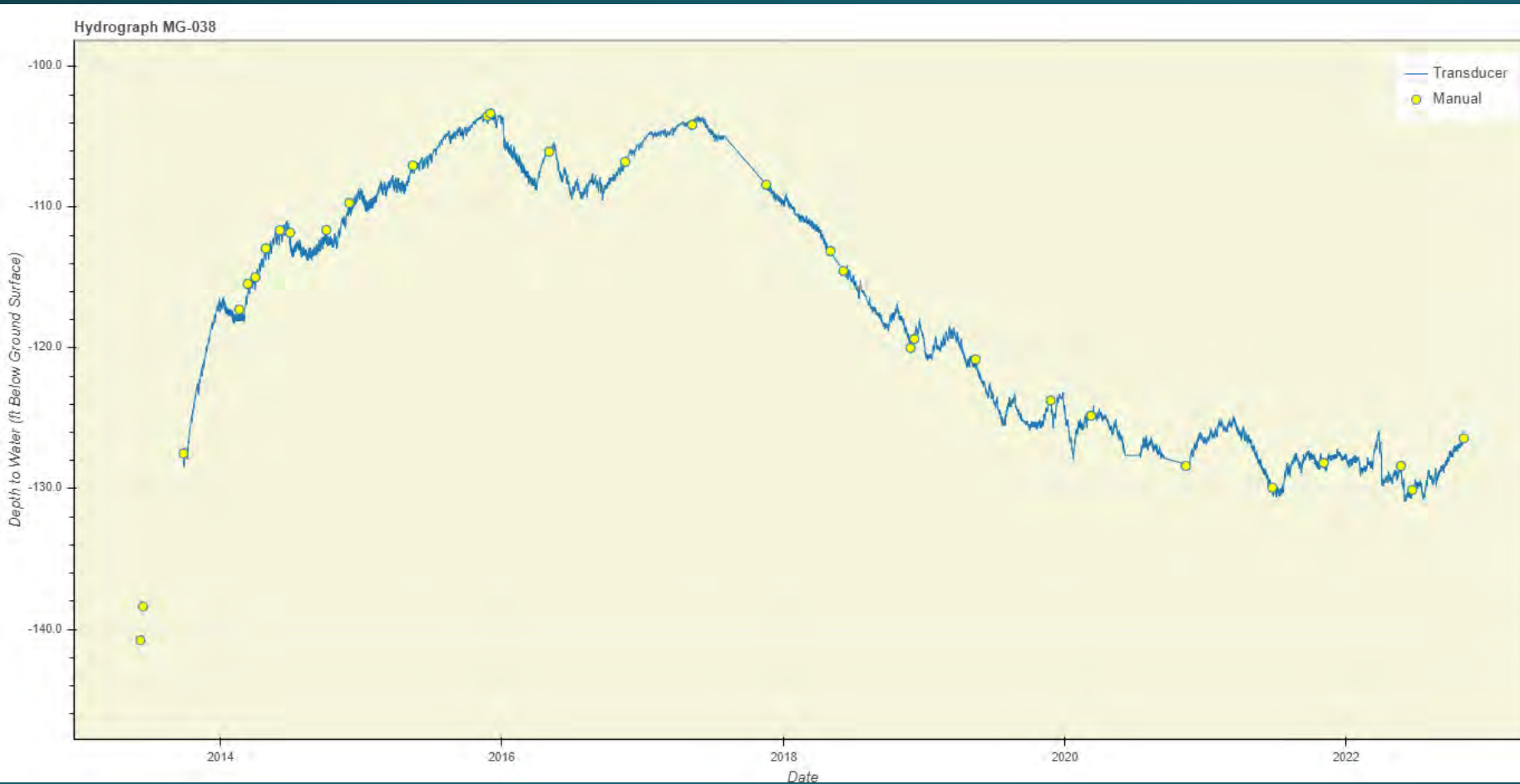


Quick access to data on local water was needed

- Numerous state agencies working together, with other collaborators, to find short term solutions
- So many questions, such as
 - What were the options for alternative sources?
 - **Was the aquifer “gone” or was this a one well situation?**
 - Was there something that could have been done to prevent this?
- Our role - evaluate other wells in the region to understand broader aquifer conditions



How did things turn out in Magdalena?

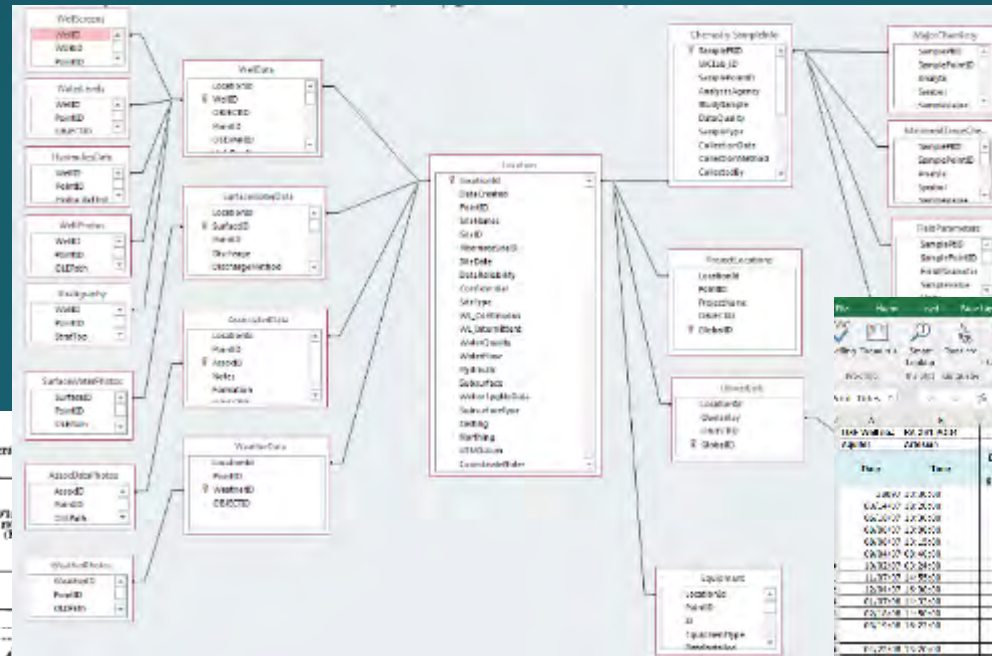


The problem: Water data in New Mexico is stored in a **wide range of disconnected “data systems”**



TABLE 1.—*Chemical analyses of saline ground water in New Mexico*
[Analyses in parts per million, except as indicated]

Well No.	County	W.D. (S. Or)	Iron	Cal. (S. Or)	Magn. (S. Or)	Sodium	Potash (S. Or)	Chlorine (S. Or)	Sulfate (S. Or)	Chlorine (S. Or)	Phosphorus (S. Or)
2.6.11.23.24	Terram	25		294	354	211		224		296	
2.6.11.23.25	Terram	25		279	350	125		260	1,360	283	
2.6.11.23.26	Terram	25		290	354	125		254	1,360	283	
2.6.11.23.27	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.28	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.29	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.30	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.31	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.32	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.33	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.34	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.35	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.36	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.37	Terram	25		279	354	125		254	1,360	283	
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2.6.11.23.43	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.44	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.45	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.46	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.47	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.48	Terram	25		279	354	125		254	1,360	283	
2.6.11.23.49	Terram	25		279	354	125		254	1,360	283	
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2.6.11.23.80	Terram	25		279	354	125		254	1,360	283	
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2.6.11.24.00	Terram	25		279	354	125		254	1,360	283	

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2017 - Water data themes emerge in NM and beyond

TOWN HALL FINAL REPORT



STATE WATER PLANNING TOWN HALL

Advancing New Mexico's Water Future

CONVENER

New Mexico Interstate Stream Commission

RESEARCHER AND FACILITATOR

New Mexico First

- Final town hall recommendations
- Details from the December 13-14, 2017 town hall

WATER



Internet of Water: Sharing and Integrating Water Data for Sustainability

MAY 10, 2017 • ENERGY AND ENVIRONMENT PROGRAM



2018 - Evaluating and documenting water data challenges in NM



Work Session

New Mexico Water Data Coordination Meeting: An open discussion about coordinating water data sources, collection, sharing, and access to meet New Mexico's future water challenges

Adrian Oglesby, Utton Transboundary Resources Center, UNM

Stacy Timmons, NM Bureau of Geology and Mineral Resources, NM Tech

Sam Fernald, NM Water Resources Research Institute, NMSU



2019 - NM Water Dialogue Conference (January)

The Future of Water in New Mexico

Emerging Policy Priorities

Melanie A. Stansbury

Presentation to the New Mexico Water Dialog

January 9, 2019

Albuquerque, New Mexico



Legislative Session 2019 - House Bill 651

Water Data Act: HB 651

sponsored by
Representatives Melanie Stansbury and Gail Armstrong



Water in New Mexico

New Mexico faces significant challenges in addressing its long term water security and water management needs. Numerous agencies and organizations collect water data around the state to help manage our water resources. These data, however, are often difficult to find, use and interpret. House Bill 651 will provide a much needed framework to bring New Mexico's water data experts together, to make water data more open and accessible. The main goal of this legislation is to coordinate and integrate relevant water data for the state.

Why HB651 is needed

To make informed water management decisions, we need quick and easy access to data and information on water resources. This bill will enable state agencies to collaborate on making water data more open and accessible. HB 651 establishes a council to develop data standards, develop a strategic plan for the state's water data and facilitate partnerships. The bill also establishes a fund to effectively leverage funding where needed to support data development, collection and delivery.

This legislation will

- Address the top issue identified in the State Water Plan - Improving water data and science
- Direct state agencies to make water data and information more accessible
- Identify data gaps, standardize data collection and support the development of more tools
- Foster partnerships between state, tribal, local, federal, irrigation, utility, industry, and NGO partners
- Leverage funding from federal, private and other partners

Organizations in support of the Water Data Act:



AN ACT

RELATING TO WATER; ENACTING THE WATER DATA ACT; DIRECTING AGENCIES TO IDENTIFY AND INTEGRATE KEY WATER DATA SETS; PROVIDING DUTIES; DIRECTING THE ESTABLISHMENT OF A WATER DATA ACCOUNT.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF NEW MEXICO:

SECTION 1. SHORT TITLE.--This act may be cited as the "Water Data Act".

SECTION 2. DEFINITIONS.--As used in the Water Data Act:

A. "agencies" means:

(1) the bureau of geology and mineral resources of the New Mexico institute of mining and technology;

(2) the interstate stream commission;

(3) the office of the state engineer;

(4) the department of environment; and

(5) the energy, minerals and natural resources department;

Statute provides guidance... and opportunities for growth!

Guidance from NM Water Data Act:

- Multi-agency collaboration
- Guides state to identify & inventory water data
- Establish common water data standards
- Develop an integrated data / information platform
- Collaborate with regional and national efforts
- Annual reporting to set goals, targets, metrics and establish budgetary needs for state agencies to accomplish the Act

Not included in the NM Water Data Act:

- There was no funding in the legislation for agencies directed to participate
- There was no specific use cases for **water data beyond “water management and planning”**
- No blueprint for how to actually accomplish this

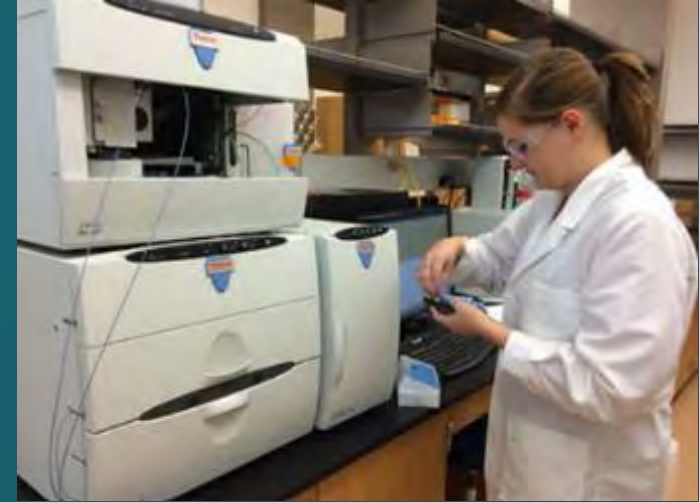
2019 Water Data Act legislation passes (NMSA 1978, §72-4B)

Among other things, state agencies will collaborate with regional and national efforts to improve how we **MANAGE**, **SHARE**, and **INTEGRATE**, water data.

- *Convener:* Bureau of Geology and Mineral Resources
- Office of State Engineer
- Interstate Stream Commission
- Environment Department
- Energy, Minerals and Natural Resources Department



Water Data Act includes a wide range of water data



DIRECTING AGENCIES TEAM

Agencies in legislation (or directly related) that collect, publish, and maintain data, and will work to integrate data and implement water data standards.

Tasks: Help set goals and metrics, determine priority needs and key data, assist with communications and data inventory in agency, help with reporting.

EXECUTIVE STEERING COMMITTEE

Cabinet secretaries & directors +/- CIOs or lead IT from directing agencies.

Tasks: Periodic check in on progress; set priorities; provide directives and agency budget.

Stacy Timmons
NMBGMR, ISC, SNL

Tasks: Provide oversight, convene and organize groups, guide strategy and direction, assist with finance/procurement, reporting.

IMPLEMENTATION TEAM

IT SUPPORT TEAM

Tasks: Provide technical support to data providers, help build the WDI infrastructure, and set up data integrations.

TECHNICAL WORKING GROUP

Technical staff or researchers that collect, publish, and maintain data. Research, database, IT or GIS roles.

Tasks: Guide development of data standards, help evaluate technical needs/software, help complete data inventory, share and maintain data.

DATA USERS WORKING GROUP

Stakeholder and data users, may include water planners, water managers, policy makers, and researchers.

Tasks: Articulate users needs, provide recommendations and feedback, develop use case scenarios.

Look for NM Water Data Act Implementation leaders



Thushara Gunda



Emily Geery



Andrew Padilla

Working Group leaders



Stacy Timmons



Rachel Hobbs



Jake Ross

Water Data Initiative leaders



Cris Morton



Magdalena Donahue



David Mattern



Chris Cox

IT Support Team

Directing Agency Points of Contact

- Stacy Timmons and Rachel Hobbs, NM Bureau of Geology & Mineral Resources
- Hannah Riseley-White, NM Interstate Stream Commission
- Rodney McKnight and Ed Rivera, NM Office of State Engineer
- John Rhoderick, NM Environment Department
- Kevin Myers, NM Energy Minerals and Natural Resources Dept.



We have two paths for data sharing and improving access

DATA CATALOG

Data are discoverable by listing data on our catalog

Starting point: open source and community driven



<https://catalog.newmexicowaterdata.org/>



FEDERATED DATA MODEL

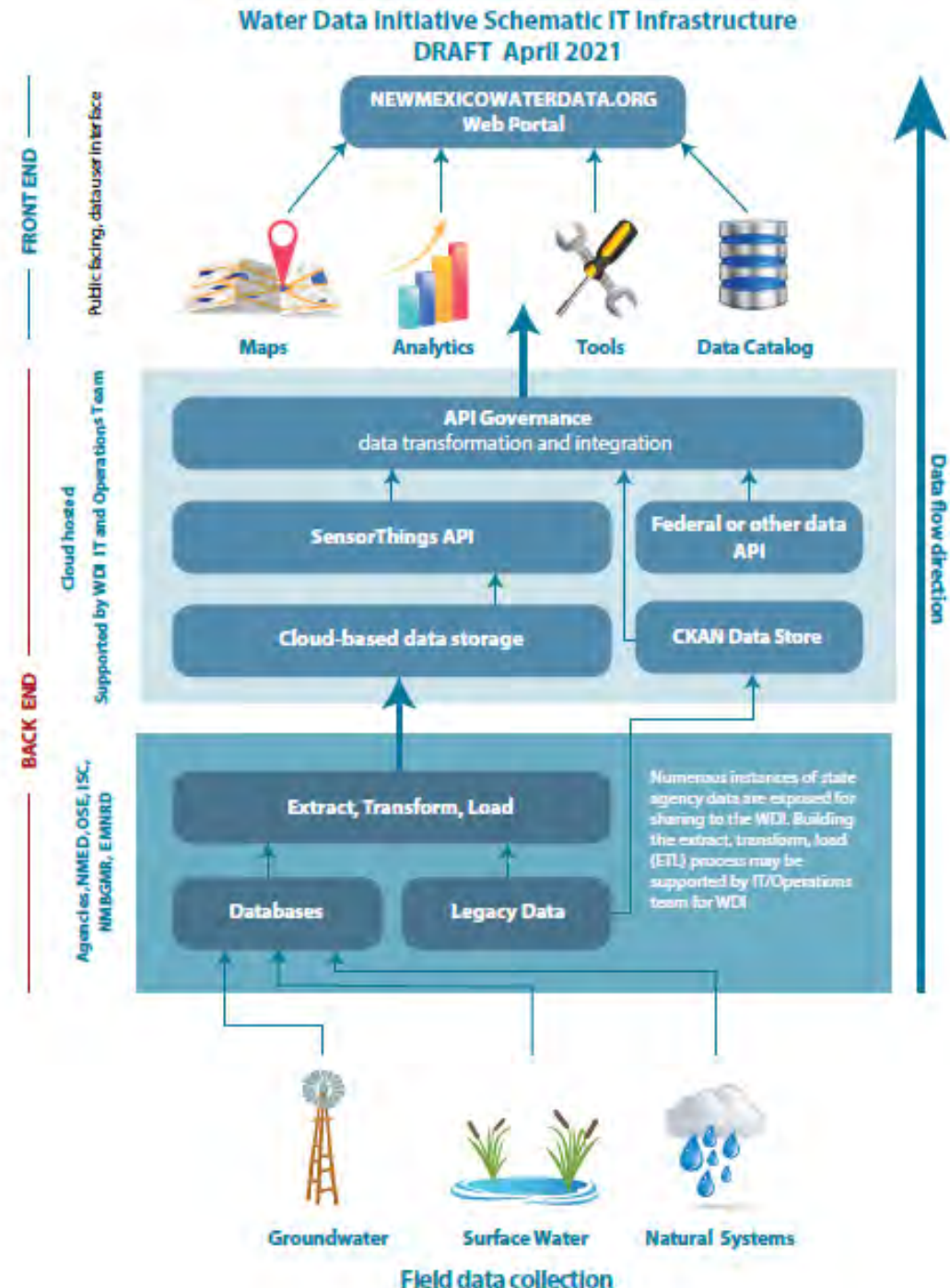
Each agency is responsible for sharing data by API, ideally following specific **data standard (OGC's SensorThings)** and NMWDI specifications

Applications developed using these robust and dynamic APIs

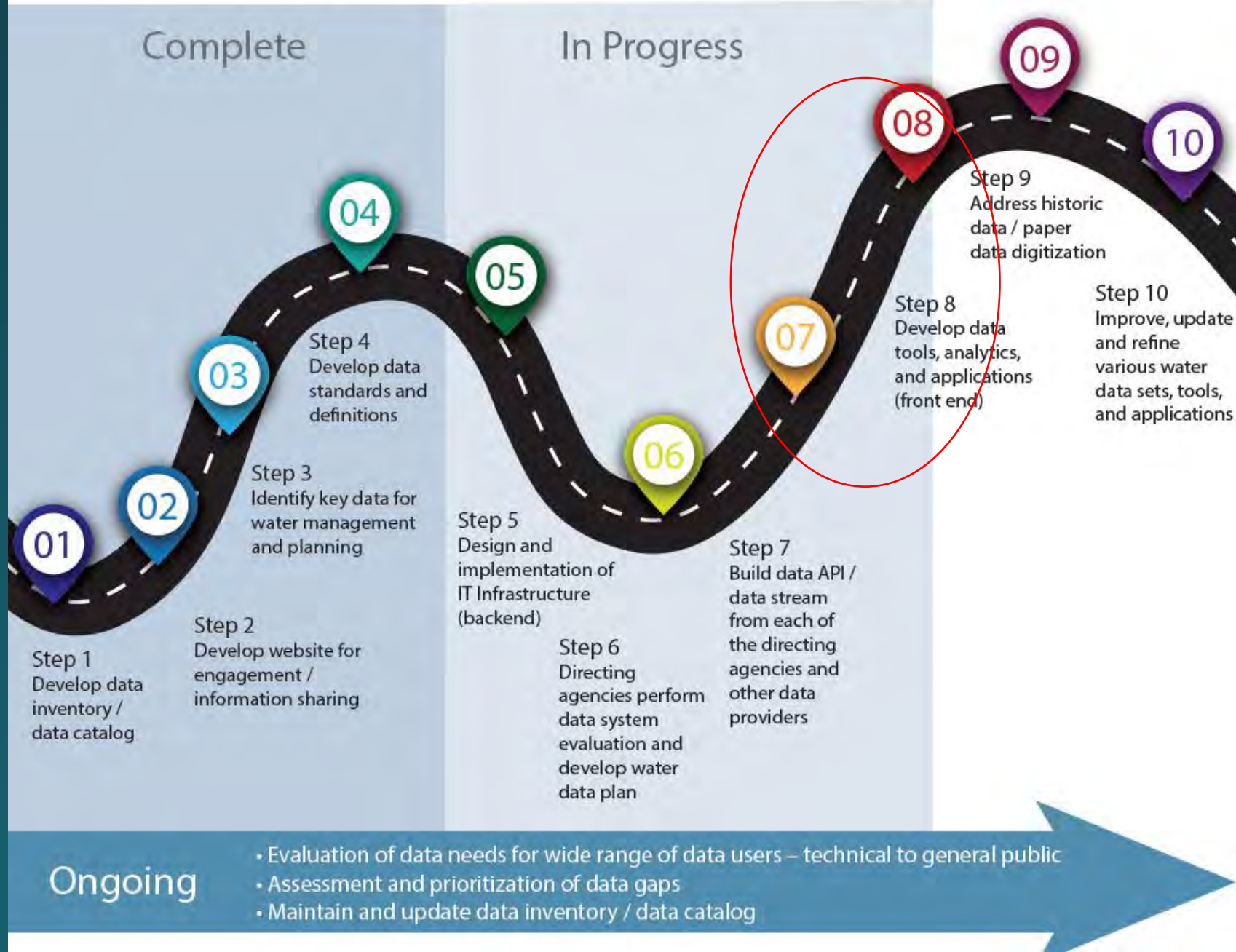
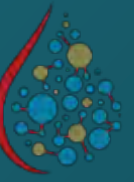


FEDERATING Water Data: Building toward integration

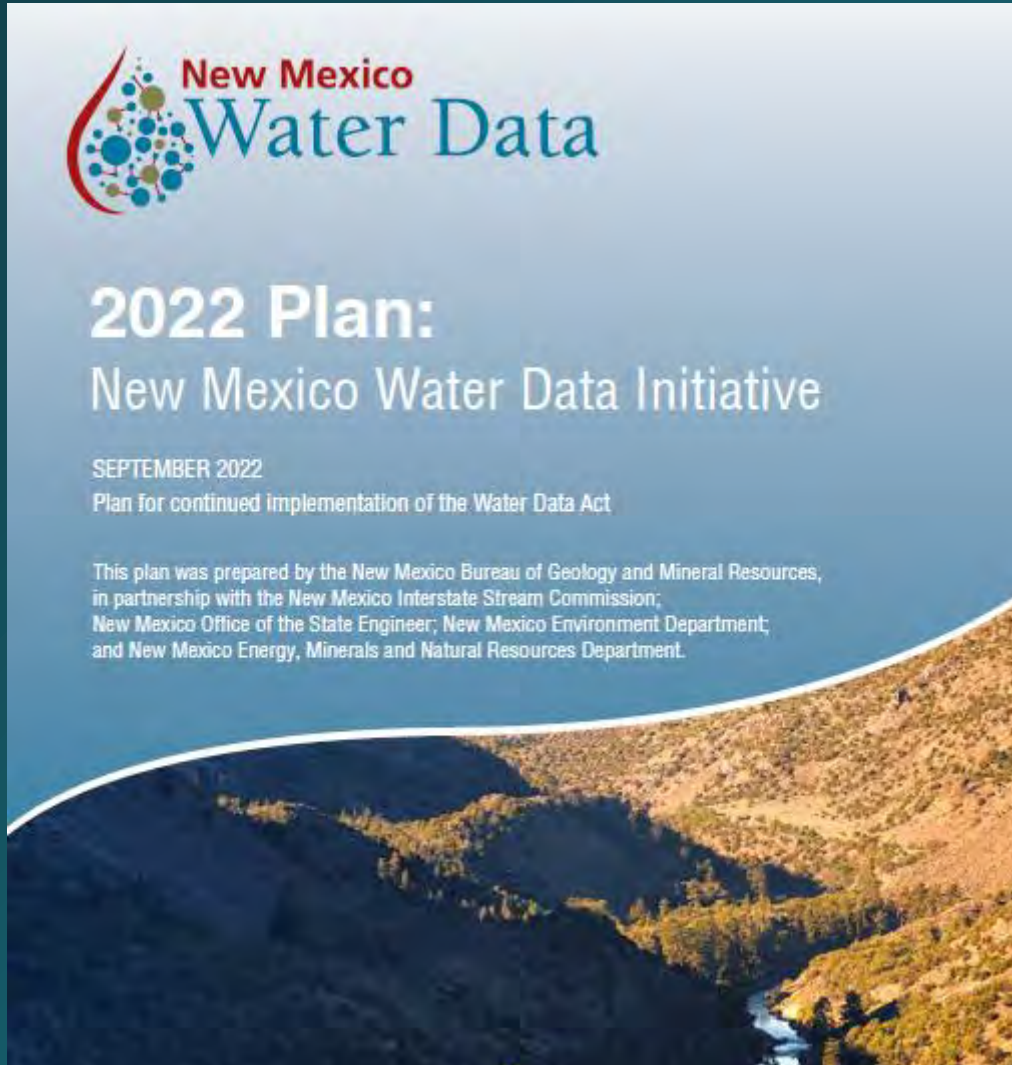
1. Data providers collect, maintain and host data
 - Only share data when ready & Qced
 - Internal data system improvements may be needed
2. Share data in modern, dynamic ways
 - SensorThings API or other rest APIs
3. Integrate data
 - Building transformations
4. Easy access to data
 - Data available to build tools, analytics, or download and use through web interface
 - Data available for research



Water Data Act Roadmap



Funding Goals for NM Water Data Initiative

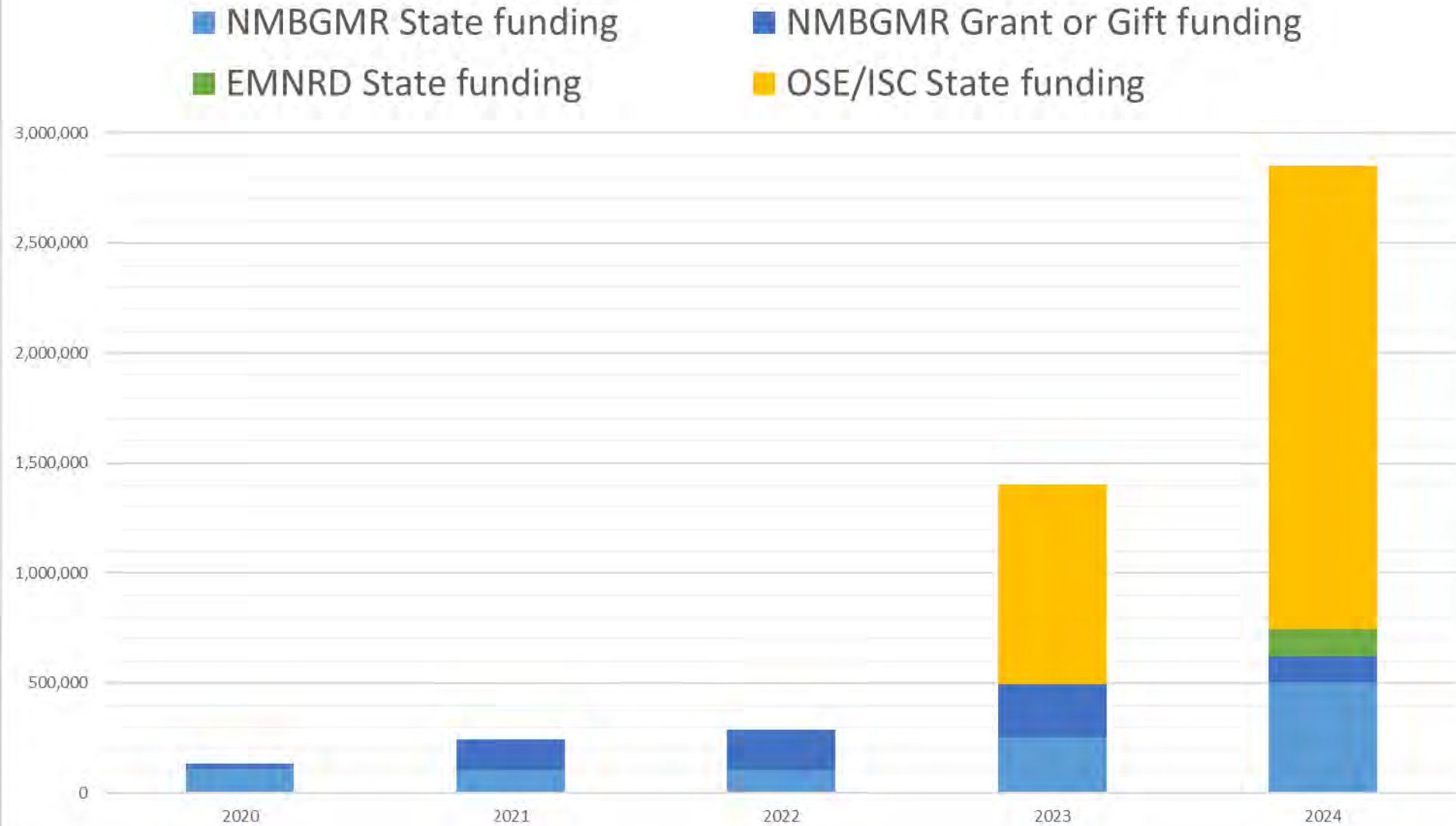


State Agency	Annually Recurring Funding Need	Non-Recurring Funding Need	Annually Recurring Funding Acquired	Non-Recurring Funding Acquired	Staffing Needs
NMED	\$725,000	\$1,000,000	None	None	5 FTEs <i>2 FTEs in IT section; 2 FTEs in Water Protection Division; 1 FTE in Resource Protection Division</i>
EMNRD	\$250,000	\$1,900,000	None	None	2 FTEs <i>In IT section, plus other contract or temporary staff</i>
OSE/ISC	\$1,175,000	\$3,300,000	\$410,000	State funding = \$500,000	10 FTEs <i>3 FTEs in IT section starting in FY23; 7 FTEs needed in management divisions</i>
NMBGMR (convening WDI)	\$500,000	\$300,000	\$250,000	Non-state grant funding = \$509,000	6 FTEs <i>2 FTEs starting in FY23; 4 FTEs in IT services, support, and management positions</i>
GRAND TOTAL	\$2,650,000	\$6,500,000	\$660,000	\$1,009,000	23 NEW state jobs

Note: FTE = Full-time equivalent

newmexicowaterdata.org/resources

Funding for Water Data Act



Several regional projects with NM Water Data at NMBGMR

GROUNDWATER MONITORING GAP ASSESSMENT

- Evaluate data gaps and build a plan to improve coverage of groundwater monitoring.
- Thornburg Foundation funding
- Project complete 2023



PECOS VALLEY PILOT PROJECT - WATERSMART

- Improve data collection, management and sharing with local irrigation district (PVACD) as a pilot for other regions of NM and the West
- Integrate state / federal data for Pecos Region
- Funding by cooperative agreement with US Bureau of Reclamation, Applied Science WaterSMART



RIO GRANDE WATER DATA - WATERSMART

- Improve data integration for modeling with NM Interstate Stream Commission
- Focus on building robust APIs for state and local datasets
- Funding by cooperative agreement with US Bureau of Reclamation, Applied Science WaterSMART



We're not done yet, this will be a long run!



It may never be this “easy” to find water data



- We all want different things, have different questions
- By building improved access and improved access, we build trust
- With quick access to data, we can make quicker, informed decisions
- With a solid foundation, we can build toward “easier” solutions for data access

Work ahead: Integrating data



A DATA PORTAL THAT PROVIDES

- Current groundwater levels
- Historic groundwater trends
- Surface water gaging data
- Weather data
- Water quality - surface water
- Water quality - groundwater

We're so not done yet

- Improving data collection practices to improve efficiency
 - Ways to improve data delivery from local/regional to state agencies
- Digitizing data currently in paper form and reducing paper workflow
- Working with academics to make sure data collection is accessible to state
- Collaborating with regional data providers to improve findability
- Improved monitoring programs that fill data gaps (i.e. groundwater, ET, weather monitoring)
- Build a better overall picture of where we have water challenges, and plan solutions for changes

Magdalena, NM - how it might have been...

If water data were more accessible

- Well would not have gone dry
 - Real time data could have provided warning
- Alternative water options more quickly located
- Perhaps they would not have been reliant on a single well
 - Increase data visibility - where are the approximately 250-300 small water systems in NM that are on a single water source?
 - Improve resiliency



Major work ahead for New Mexico

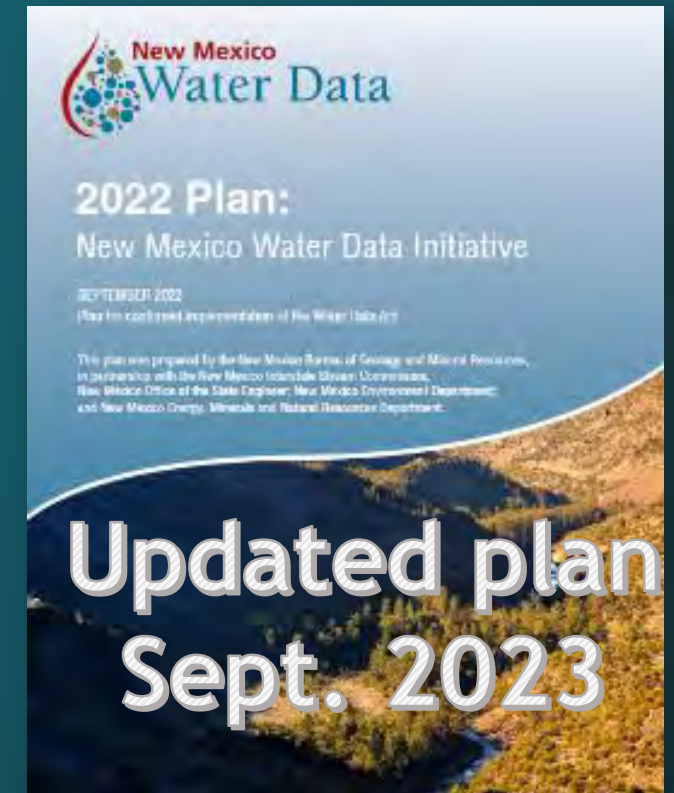
Build staff capacity at agencies charged with monitoring, managing or evaluating our water resources.



Improve monitoring efforts to measure water quantity and quality changes, and track water use better.

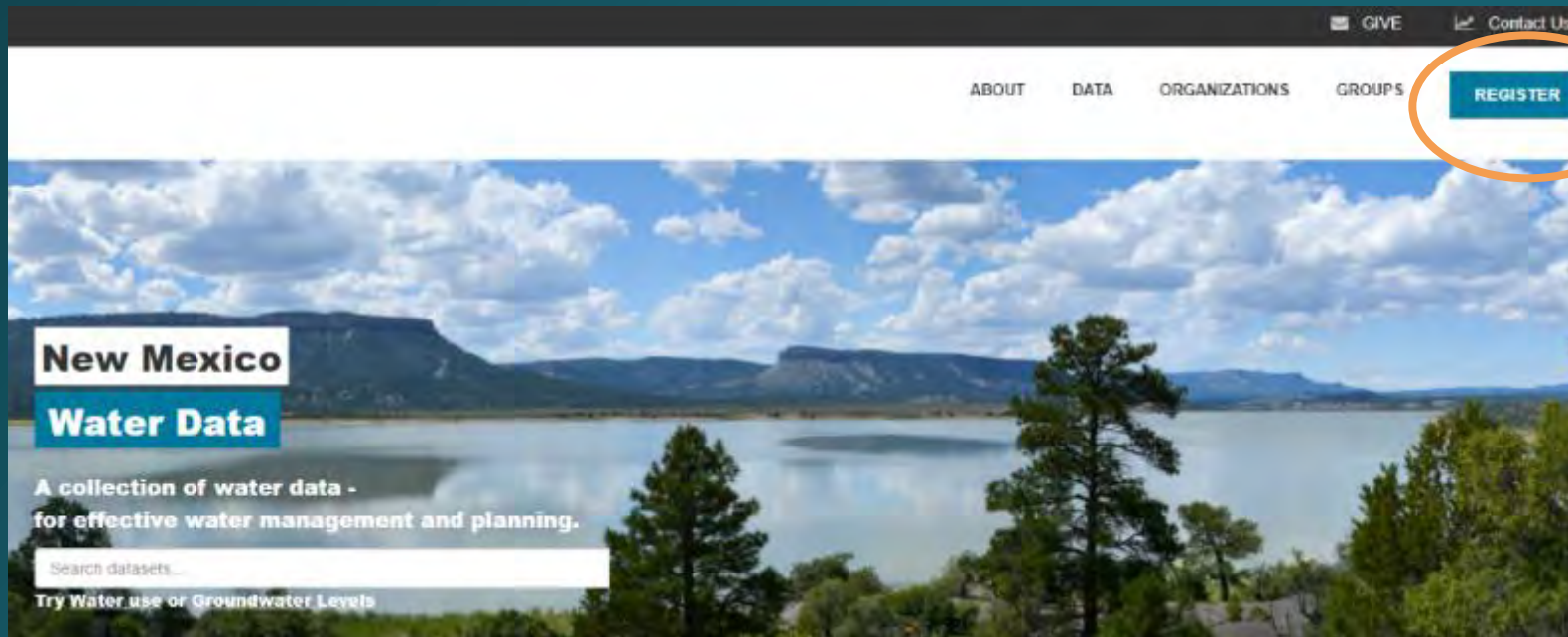


Enable state agencies to fully engage in the Water Data Act



Get involved and stay connected to New Mexico Water Data

If you have data you want to share -> Start by Registering and reaching out with an email!



<https://catalog.newmexicowaterdata.org/>

NewMexicoWaterData@nmt.edu

WAYS TO CONNECT

- Sign up for newsletters
- Follow us on social media or YouTube



- Join the Data Users Working Group (sign up at table today!)
- Tell us what data **you're most** interested in

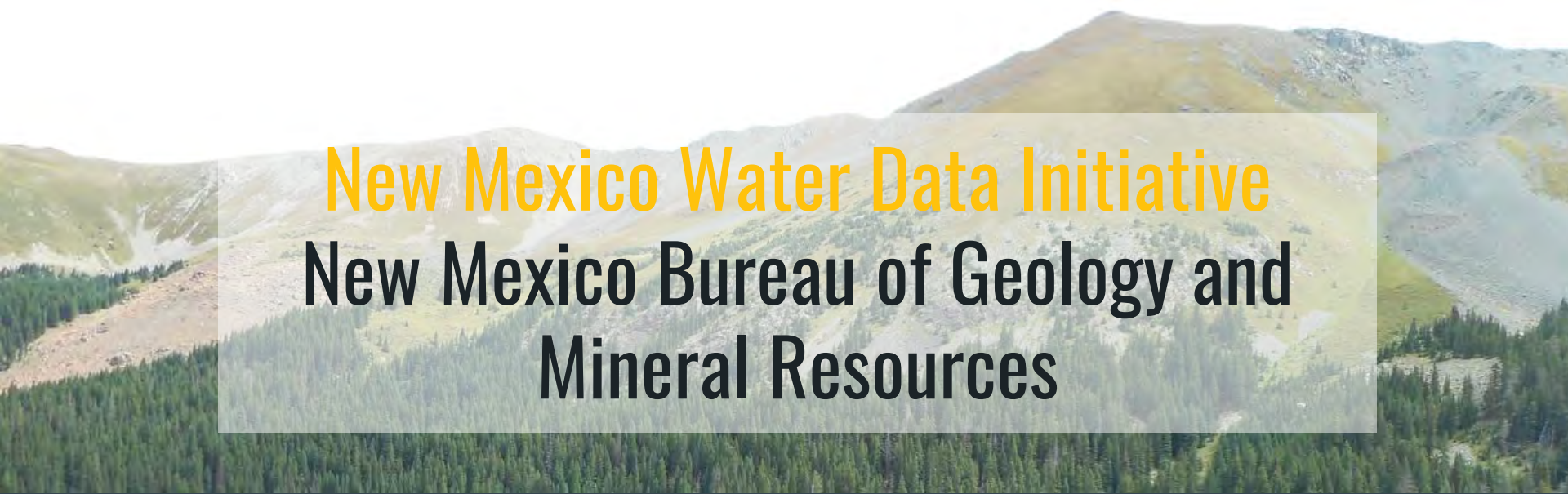
Thanks to our collaborators and supporters



- Staff contribution and management support at OSE, ISC, NMED, EMNRD, NMBGMR and NMT
- Funding from State of New Mexico, Healy Foundation, U.S. Bureau of Reclamation (WaterSMART), Thornburg Foundation
- Collaboration from Internet of Water Coalition, Sandia National Laboratories, Earth Data Analysis Center at UNM, Datacequia, Sol Web Solutions, RESPEC, and Moxiecran Media
- Tremendous support from federal and state legislators
- We appreciate our regional collaborators and advocates for water data!

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New Mexico Water Data Initiative

New Mexico Bureau of Geology and Mineral Resources



May 2023

Rachel Hobbs, Stacy Timmons, and Jake Ross

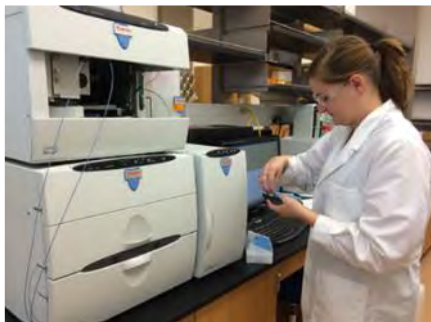
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New Mexico Bureau of Geology and Mineral Resources (NMBGMR)

- A research and service division of the New Mexico Institute of Mining and Technology (NM Tech).
- A non-regulatory agency that serves as the geological survey for the State of New Mexico.

Divisions:

- Energy
 - Oil/Gas
 - Geothermal
- Mineral/Economic
- Laboratories
- Outreach and Education
 - Publications
 - Archives and Collections
- Geologic Mapping and Hazards
- Hydrogeology
 - Aquifer Mapping
 - Water Data Initiative
 - Water Education Programs



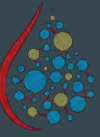
Water Data Collected by NMBGMR and the Aquifer Mapping Program

- Data to Support State Needs
 - Regional hydrologic studies
 - Long term monitoring
- Groundwater levels
- Groundwater quality
- Surface water flow
- Age data (isotopic dating)

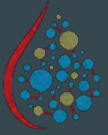
Ways to find data:

NMBGMR Data Catalog Page:
<https://catalog.newmexicowaterdata.org/organization/nmbgmr>

NMBGMR Interactive Resources Map:
<https://maps.nmt.edu/>



NMBGMR is a Water Data Producer and User



NMBGMR Common Water Data Requests (Examples)

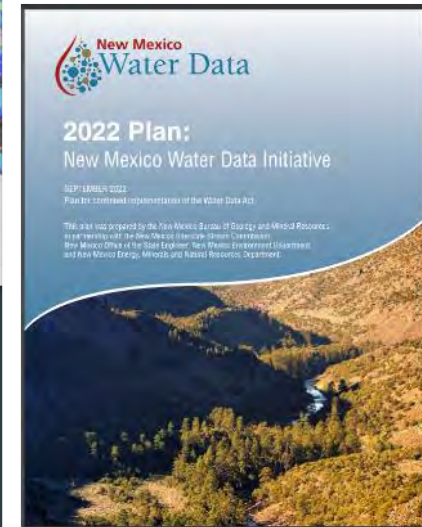
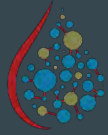
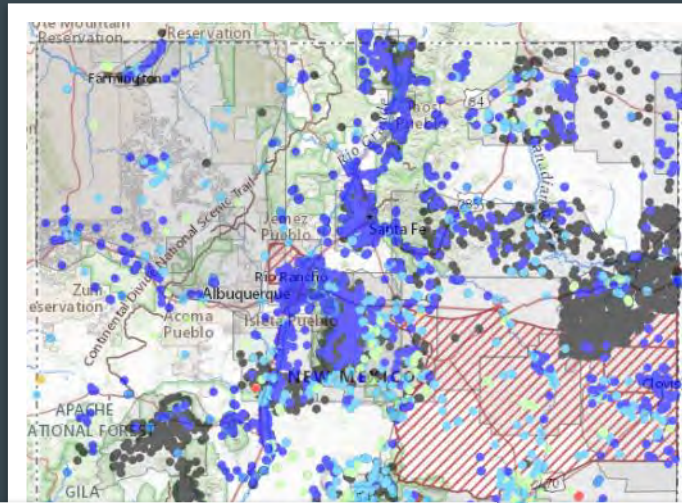
- How deep is the water table at the property I am buying, and how might that change in the future?
- How have water levels been changing in Roosevelt County?
- How large is the aquifer in Rio Arriba County?

NMBGMR Common Water Data Needs

- Water data needed for internal Bureau of Geology hydrologic studies (compiled from multiple agencies)
 - Water level data from multiple agencies to cover a specific basin
 - Water quality data for a specific geographic area

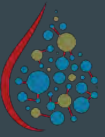
NMBGMR Participation in the Water Data Initiative

- Convening agency for WDI
 - Lead annual planning and reporting
 - Maintain and update data catalog
 - Coordinate working groups
- Enhance data management and sharing at the Bureau of Geology
- Develop additional projects supportive of WDI mission



NMBGMR Current Goals

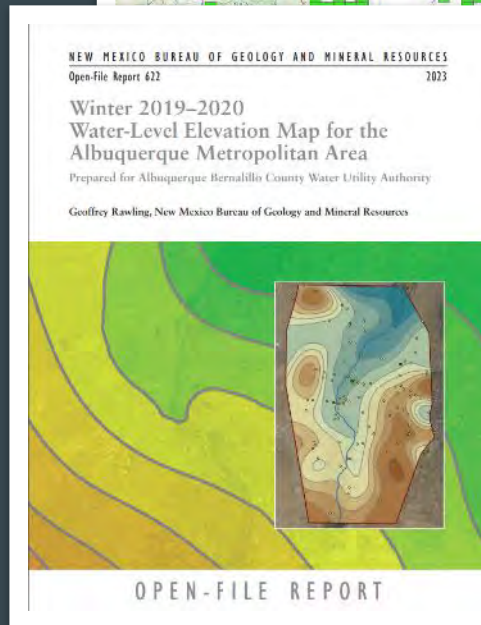
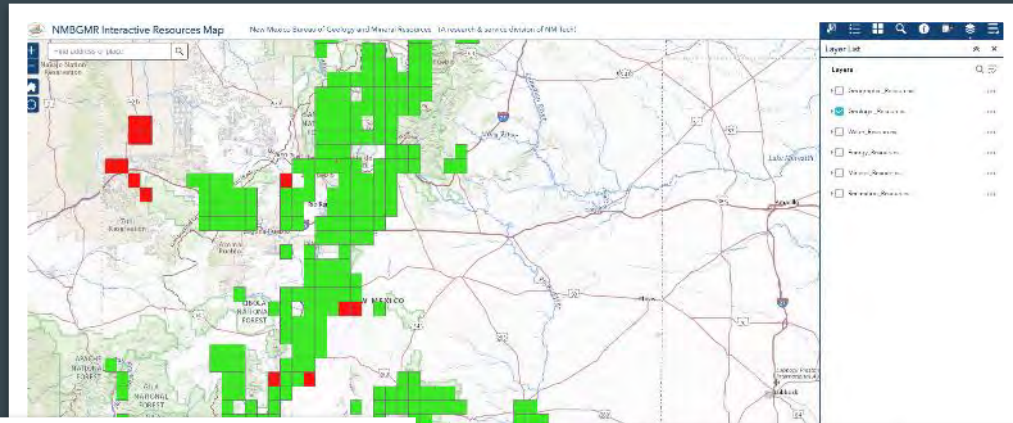
- Move away from paper records
- Improve internal data management system
- Improve FAIR data sharing



NMBGMR Data Challenges

- A lot of data are available in PDF reports and GIS files
- Humans still need to be heavily involved in responses to data requests
- Individual groups within NMBGMR with different data management systems

newmexicowaterdata.org



NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES
Open-File Report 622 2023

Winter 2019-2020
Water-Level Elevation Map for the
Albuquerque Metropolitan Area
Prepared for Albuquerque Bernalillo County Water Utility Authority

Geoffrey Rawling, New Mexico Bureau of Geology and Mineral Resources

newmexicowaterdata.org

OPEN-FILE REPORT

About Us | Maps & Publications | Geoscience | Natural Resources | Data & Collections

Home | Staff | Facilities & Services | News, Events, & Jobs | Site Overview | Search

W. Borch Bibliography

The Geologic Information Center at the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) maintains a bibliography of New Mexico geology, which contains all the information in the 12 published bibliographies of New Mexico through 1987. Bibliographic data from 1988 onwards has been compiled directly into this database and indexed by keywords, County, Formation, and Time Period. You can also search the bibliography specifically for *M.S. Theses* and *Ph.D. Dissertations*.

Inquiries about geologists, literature as well as suggestions for additions to the Bibliography may be directed to:
Alysa Trevelyan, Geospatial Archives Coordinator
(505) 835-5362

Title: [ANY] Author: [ANY] Publisher: [ANY]

County: [ANY] Formation: [ANY] Keyword: [ANY]

Specific Year: [] OR From Year: [] To Year: [] [Search] [Reset Form]

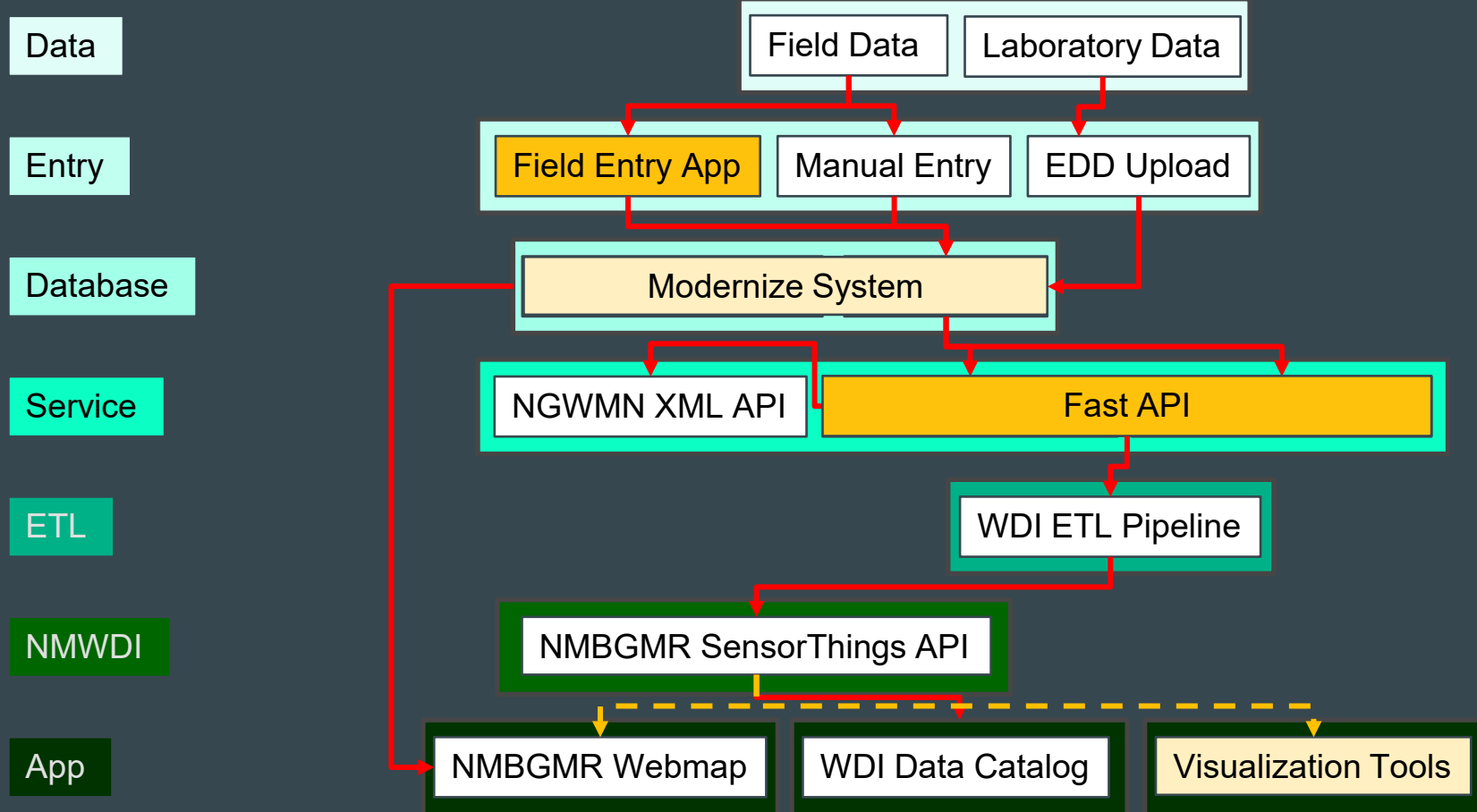
Your search returned 500 + publications.
Displaying results 1 - 50.

References showing 10,000 are available for review at our Geologic Information Center Library

Reference

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- 2021, 41st Annual New Mexico Mineral Symposium - The Smithsonian gem collection, unearthed: surprising stories behind the jewels, in: 41st Annual New Mexico Mineral Symposium, November 12-14, Socorro, NM, pp. 1. [Purchase](#)
- 2019, Welcome to the 40th Annual New Mexico Mineral Symposium - An overview of the ages of northern Mexico and western New Mexico, in: 40th Annual New Mexico Mineral Symposium, November 9-10, Socorro, NM, pp. 34. [Purchase](#)
- 2010, Symposium keynote speakers 1970-2010, in: 10th Annual New Mexico Mineral Symposium, November 5-10, Socorro, NM, pp. 6. [Purchase](#)
- 2010, Resolving time-space histories of Late Cenozoic tectonic incision along the Upper Colorado River, USA, Geomorphology.
- 2018, New Mexico graduate student abstracts, in: New Mexico Geology, v. 49, no. 1, pp. 27-33. [View Abstract](#)
- 2018, Welcome to 30th Annual New Mexico mineral symposium, in: 30th Annual New Mexico Mineral Symposium, November 10-11, 2018, Socorro NM, pp. 30.
- 1999, Yellen, A.; Murphy, Michael A.; van Vligt, Johannes; Koenig, Daniel J.; Smith, Elyse; Andrews, Steve A., 2019, Progressive opening of the northern Colorado oil basin on Gulf of Mexico and derivation of the Upper Miocene sequence in north central New Mexico, U.S., tectonophysics, v. 753, no. 15, pp. 15-35. <https://doi.org/10.1016/j.tecto.2019.05.049>
- Schultz, Jonathan D.; Lees, Jackie A., 2019, Marine Micropaleontology, v. 151.

Success Story: NMBGMR Data Pipeline Updates



Thank You!

newmexicowaterdata.org



Energy, Minerals and Natural Resources

OUR MISSION To position New Mexico as a national leader in energy and natural resource management.

WATER DATA WORKSHOP – MAY 4, 2023

KEVIN MYERS, HYDROLOGIST – MINING AND MINERALS DIVISION



MISSION-*Balance & Conservation*

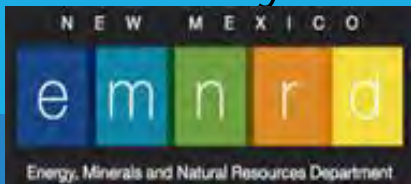
ENERGY CONSERVATION & MANAGEMENT ECMD develops and implements effective clean energy programs – renewable energy, energy efficiency and conservation, clean fuels and efficient transportation – to promote environmental and economic sustainability for New Mexico and its citizens.

OIL CONSERVATION regulates oil, gas, and geothermal activity in New Mexico, and collects well production data; permits new wells; enforces the division's rules and the state's oil and gas statutes; and ensures land is responsibly restored.

MINING AND MINERALS is to promote the public trust by ensuring the responsible utilization, conservation, reclamation, and safeguarding of land and resources affected by mining.

STATE FORESTRY retains lead responsibility for wildland fire management on all non-federal, non-tribal, and non-municipal lands, maintaining fire suppression capacities and emphasizing public and firefighters' safety. The Forestry Division promotes healthy, sustainable forests and watersheds in New Mexico for the benefit of current and future generations.

STATE PARKS New Mexico's 35 State Parks protect and enhance natural and cultural resources, provide first-class recreational and education facilities and opportunities, in a safe and family-friendly environment.

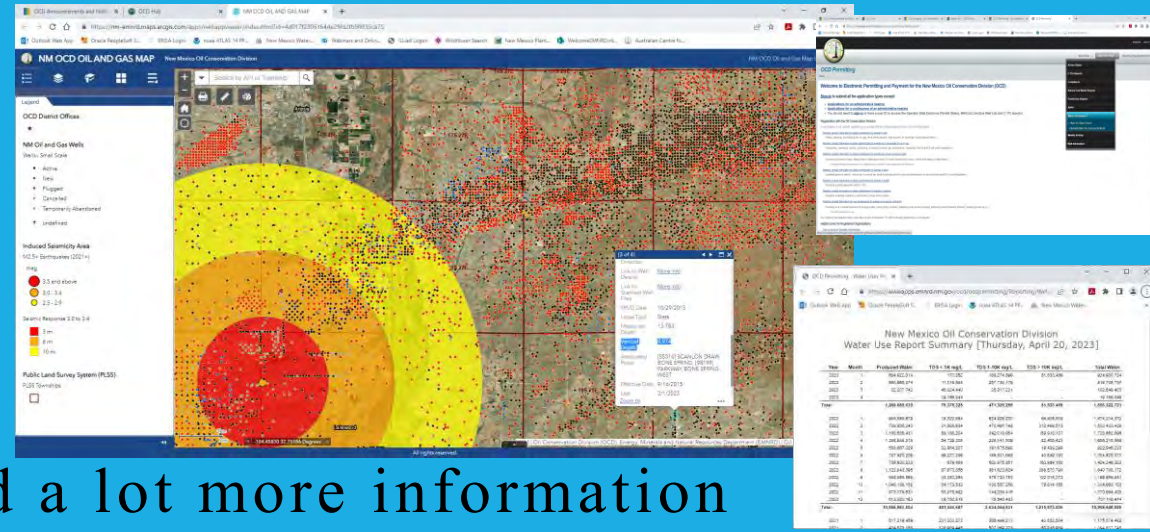




Water Data Examples

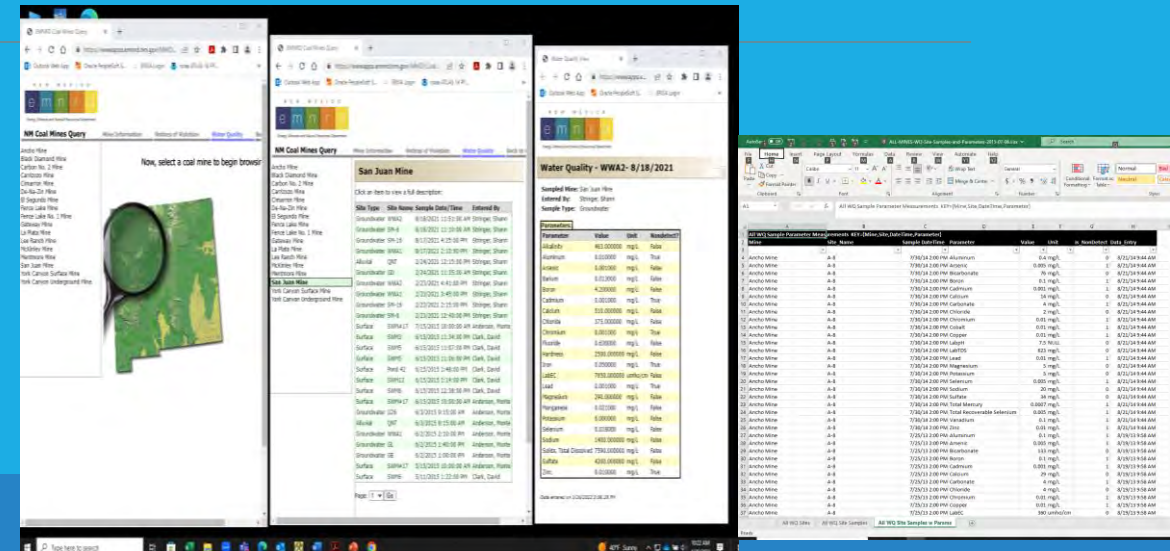
OCD

Oil Wells drilled, abandoned and a lot more information
Production Data (oil, gas, flaring, venting, produced water)
Water Use Report (2020 to present) \approx 16 bgy or 59,000 af/y
Geospatial Hub – Induced Seismicity (2022 to present)



MMD

Water Quality at Coal Mines



Data Requests



Data Mining
Permit Holders
Students
Researchers
NGO's
IPRA
Web Surfers

Water Data Initiative

- Participation Since July 2019
- All Divisions
- Planning and Learning
- Funding starts July 2023





FY24 Goals

- ☐ Hire Data Analyst
- ☐ Interagency Communication
- ☐ Coal Water Quality data more API-accessible

Our APIs will be public-facing and have geospatial capabilities.



Challenges

Improved water data access beneficial

- New
- Non WDI Demands
- Partial Funding
- Historic Data



EMNRD data feeds that may become part of our API implementation:

- Mining and Minerals Division
 - Coal Water Quality Data
- Oil Conservation Division
 - Produced Water Volumes
 - Injected & Disposed Water Volumes
 - Water Dispositions (related to oil and gas properties)
 - Recycled Water Volumes
 - Hydraulic Fracturing Volumes
 - Water Use Reports
 - Hydraulic Fracturing Chemical Disclosure
 - Daily Water Injection Reports for injection wells affected by induced seismicity
 - Remediation related Water Quality Test Reports (C-141)
 - Groundwater abatement plan associated water data
 - Discharge permit associated water data
- State Parks
 - Weekly Reservoir Water Level Data (from USACE and/or BOR)
- And more.



Success Story



- ☁ Induced Seismicity 2022
- ☁ Water Use 2020
- ☁ Automated Data Feeds OCD

THANK YOU



The Office of the State Engineer/ Interstate Stream Commission

2023 New Mexico Water Data Initiative (WDI) Workshop
Socorro, New Mexico May 4, 2023

OSE Website

[New Mexico Office of the State Engineer/Interstate Stream Commission](https://www.ose.state.nm.us/)

<https://www.ose.state.nm.us/>

About Me

- ❖ From Albuquerque New Mexico and living in Santa Fe since 1984
- ❖ Before working in information technology, I made a living as a general contractor
- ❖ Worked for NM Game and Fish as an IT business analyst, database administrator (DBA) modernizing Game and Fish applications like the online sales and internal applications
- ❖ Worked for NM Department of Human Services as a DBA, quality assurance analyst and a business analyst modernizing the Human Services online application website
- ❖ Began working for Office of the State Engineer (OSE) beginning February 2023 serving as the IT Water Data Liaison
- ❖ Contact information: Email EDWARD.RIVERA@OSE.NM.GOV Phone 505.946.7088

Outline

- ❖ Review The Office of the State Engineer mission and vision
- ❖ A brief explanation the current online water data that OSE provides
- ❖ Talk about the challenges and progress of the Water Data Initiative (WDI)

Office of the State Engineer (OSE)

Vision:

The Office of the State Engineer and the Interstate Stream Commission is the preeminent water management agency, which is trusted by the public to effectively and transparently manage, allocate and protect New Mexico's water resources.

OSE Mission

To actively protect and manage the water resources of New Mexico for beneficial uses by its people, in accordance with law:

- ❖ to investigate, measure, and distribute water in the most efficient manner in accordance with state laws, court adjudications, and State Engineer rules and regulations;
- ❖ to administer a water rights system that lawfully and effectively allocates and reallocates water and adjudicates water rights to meet the needs of New Mexico's growing population;
- ❖ to maximize use of New Mexico's renewable interstate stream apportionments in order to improve the sustainability of New Mexico's water supplies; and
- ❖ to plan for the future water needs of New Mexico's people.

Water Data Initiative Directing Agencies

- ❖ New Mexico Bureau of Geology and Mineral Resources (NMBGMR)
- ❖ **Office of State Engineer (OSE)**
- ❖ Interstate Stream Commission (ISC)
- ❖ Environment Department (NMED)
- ❖ Energy, Minerals and Natural Resources Department (EMNRD)

OSE and the WDI Moving Forward

❖ Current Online Data

- OSE Spatial Data <https://geospatialdata-ose.opendata.arcgis.com/>
- NMBGMR Water Data <https://catalog.newmexicowaterdata.org/>

❖ Staff Augmentation

- Three full time positions have been created for the WDI including two software engineers and one IT water data liaison with one software engineer position unfilled as of today. Click [HERE](#) to apply.

❖ System Modernization Projects

- Taxonomy Project...Water data terms
- Water Rights Adjudication Tracking System (WRATS)
- Water Right Technical Engineering System (WATERS)

Working Towards The Vision



“New Mexicans will have accessible and useful data for water management and planning”

OSE Challenges

The Water Data Initiative, the implementation of the Water Data Act is a big adjustment for the OSE.

- ❖ Data quality concerns
- ❖ Data sharing issues
- ❖ Increased workload
- ❖ Change management

WDI Progress

- ❖ Modernizing enterprise water data systems
- ❖ Increased communication and interaction with the directing agencies
- ❖ Identifying barriers to success
- ❖ Initialized a FROST-Server in a development environment

Questions?

Thank you!



New Mexico Environment Department

NMENV and the WDI

Zack Stauber, GIS Coordinator

May 4th, 2023





Agency Mission

- Our mission is to protect and restore the environment and to foster a healthy and prosperous New Mexico for present and future generations. We implement our mission guided by four tenets:
 - Innovation - Employing creative engineering and technological solutions to address environmental challenges.
 - Science - Using the best available science to inform our decision-making in protecting public health and the environment.
 - Collaboration - Engaging communities and interested stakeholders in environmental decision-making outcomes.
 - Compliance - Ensuring meaningful compliance with state regulations and permits; leveling the playing field through enforcement.



Agency Activities

- NMOSE vs. NMENV
 - ▣ Both employ engineers and hydrologists
 - ▣ Both track wells in various ways
 - ▣ NM Office of the State Engineer is primarily concerned with water quantity
 - ▣ NM Environment Department is primarily concerned with water quality
- NMENV is a regulatory agency
 - ▣ Monitoring of water quality
 - ▣ Permitting of discharge activities (polluting)
 - ▣ Oversight of remediation (cleanup) of excess releases (spills)



Four Bureaus Contribute to the WDI

- ❑ Surface Water Quality Bureau (SWQB)
- ❑ Ground Water Quality Bureau (GWQB)
- ❑ Drinking Water Bureau (DWB)
- ❑ Petroleum Storage Tank Bureau (PSTB)



Surface Water Quality Bureau

- Monitoring and assessment of streams and lakes for human and natural use (swimming, fishing, drinking, irrigation, etc.)
- Most data submitted to EPA is only required every 2 years under the Clean Water Act, and most reports only contain derived data such as final assessments.
- Our goal with respect to the Water Data Act is to publish sampling data as soon as it is vetted, rather than waiting up to 2 years.
- Tracks permits in the National Pollution Discharge Elimination System (NPDES), which are sources of pollution such as pipes or ditches
- Assesses watershed quality and doles out funding for watershed improvement



Ground Water Quality Burea

- Issues permits for discharging effluents that may or will impact groundwater
 - ▣ Wineries, slaughterhouses, cheese..ries?
 - ▣ Animal feed lots (dairies, feedlots)
 - ▣ Mines
 - ▣ Industrial plants
- Locations of potential sources are important for the public to be aware of. For example, fertilizer may cause E. coli to grow and contaminate nearby wells.
- Monitoring wells are proactive, to see that permittees are not releasing or contaminating more than anticipated, but well samples would be very useful to the public



Drinking Water Bureau

- Monitoring and permitting of operators at public water systems
- “A public water system is any water system that serves at least 15 service connections or 25 individuals at least 60 days out of the year.”
- Samples are taken regularly and when a problem is suspected
- Violations are issued for various analytes (chemicals) above set levels
- This data is already available for human browsing on Drinking Water Watch, but not in computer readable form
- Our goal is to publish all the same data through the WDI website



Petroleum Storage Tank Bureau

- ❑ Inspection of tanks in use and remediation of leaks
- ❑ Gas stations and privately held storage tanks such as tank batteries in oil pad country and fuel depots at airports
- ❑ So many leaks over time that PSTB has the most monitoring wells, which are only used in remediation
- ❑ Our goal is to publish this monitoring well data



Common Data Requests

- ❑ Researchers ask for bulk datasets of all kinds
- ❑ Real estate agents need letters of No Further Action (NFA) after remediation (cleanup) in order to transfer property
- ❑ Developers seek data on groundwater quality in small areas
- ❑ Private individuals would like to know about samples and violations for their public water system



How has NMENV been participating?

- ❑ The aforementioned bureaus have linked their digital data
- ❑ Several staff have participated regularly in the technical working group (TWG) offering input on standards
- ❑ GIS Section has added in a lot of sample data from Drinking Water Watch to the initiative's SensorThings API server
- ❑ NMENV has no FTE's working on it the Water Data Initiative, but on average there are about 5 people devoting a few hours a week to it



Challenges

□ Data Quality

- Several important bureaus have digital records but only in the most basic sense.
 - Data are in PDF tables
 - Data are in Excel workbooks but the data is dirty
- In some cases, longstanding practice or even statutes prevent us from asking for or requiring data to be submitted electronically

□ Staffing Power

- We are chronically short on labor, both in IT to publish APIs and in the water bureaus who do not have the time to digitize or clean up data
- People suggest unpaid interns could help to grunt work, but in terms of data quality, you get what you pay for, and it is not fair to interns who hope to learn a lot



Successes (Data and Otherwise)

- We have one workflow in production that brings all sample data from Drinking Water Watch into the SensorThings API servers.
- NPDES permits, ground water discharge permits, and public water system wells are all served up “live” (daily refresh) from ArcGIS Server and linked on the <https://newmexicowaterdata.org> website.
- While we have had a lot of turnover at NMENV, there is still at least one person from each relevant bureau who is attached to the Water Data Initiative and is happy to contribute if and how they can.



Q&A

- Questions?
 - ▣ Comments?
 - Complaints?



NM Interstate Stream Commission

WATER DATA INITIATIVE WORKSHOP – MAY 4, 2023

- HANNAH RISELEY-WHITE - DEPUTY DIRECTOR
- ANDREW ERDMANN – WATER PLANNING PROGRAM MANAGER

NMISC

Statutory Authorities

“To investigate water supply, to develop, to conserve, to protect and to do any and all other things necessary to protect, conserve and develop the waters and stream systems of this state, interstate or otherwise”

- NMSA 72-14-3

Including:

- Oversee Obligations and Entitlements Under 8 Interstate Stream Compacts
- Support and Conduct Regional & State Water Planning
- Implement Indian Water Rights Settlements
- Manage the State's Strategic Water Reserve



Gila River



Data

- ▶ NMISC collects some data through staff and contractors
 - ▶ Streamflow and groundwater data related to interstate compact compliance or endangered species efforts
 - ▶ Throughout New Mexico
- ▶ NMISC is a user of water data from many other sources
 - ▶ USGS, NRCS, NOAA, etc.

Water Data and Planning

- ▶ SB 337 / The Water Security Planning Act
 - ▶ Rulemaking to revisit regional water planning
 - ▶ Boundaries & number of regions
- ▶ State Water Plan
 - ▶ Water use categories
 - ▶ Climate change projections
- ▶ Data Visualization Tools
 - ▶ Water Use
 - ▶ Groundwater – everything!
 - ▶ Scenarios



A landscape photograph showing a body of water in the middle ground, with a vibrant rainbow arching across the sky above it. The foreground is filled with dry, yellowish-brown grass and shrubs. The sky is filled with large, white and grey clouds, with some blue visible. The overall scene is bright and hopeful.

Looking Ahead

- ▶ Participation in the WDI has been challenging due to limited staff capacity to engage
- ▶ Challenge in making OSE/ISC data more accessible for internal purposes, as well as to the public:
 - ▶ Data quality, meta-data, paper data, database creation, management, etc.
- ▶ Working with OSE to identify/prioritize WDI-related initiatives
 - ▶ ISC did not receive any funding for WDA implementation in the 2023 legislative session, however, other funding received could be used to support data-related work
- ▶ Looking forward to the continued partnerships with the directing agencies
 - ▶ Thank you to NM Bureau of Geology and Mineral Resources!



...

The Water Walker

By Eldrena Douma

Words can inspire

WARNING-DANGER

WALKING OR SWIMMING

PROHIBITED

WITHIN 25 FEET
OF THIS STRUCTURE

DEPT. OF PARKS

The message heard and the important word, “if”.

In 2000, Josephine was among a group that heard the words of a prophecy that was given to them by Grand Chief Eddie Benton-Banai. He told them, in “Thirty years from now, an ounce of drinking water will cost the same as an ounce of gold, If we humans continue with our negligence.”

He spoke with those gathered, especially the women, who are the keepers of the land and waters and the decision makers of the Nation. He asked the people what they planned to do about it?

Josephine felt like he was looking at her when he asked that question.



“If not me, who? If not now, when?”

“This journey with the pail of water that we carry is our way of Walking the Talk. We really don’t have to say anything. Just seeing us walk is enough to make a person realize that, yes, we are carriers of the water. We are carrying the water for the generations to come. Our great grandchildren and the next generation will be able to say, yes, our grandmothers and grandfathers kept this water for us!”

(Josephine Mandamin)



Interesting facts about the Mother Earth Water Walk:

- In 2005 Grandmother Josephine Mandamin, 63, wore out 6 pairs of shoes.
- The Walkers travel an average of 70 kilometres (43 miles) per day.
- The women carry a large copper bucket (8 litres) of water.
- The men carry a symbolic eagle staff to offer strength to the women.
- The Walkers stop to make an offering of tobacco at many streams, rivers and tributaries along the route.
- The Walkers rise before 5 in the morning, hold a morning ceremony and begin their walk before sunrise



Photo by Eldrena Douma



Photo by Eldrena Douma

According to the Global Great Lakes Organization, there is enough water in Lake Superior to cover the entire landmass of North and South America with a foot of water.



This is one of my favorite places I like to
walk beside in Pecos, NM

If given the opportunity, I ask myself, what
lengths would I go to protect this and other
water surfaces for the 7th generation?

This is one opportunity that I accepted!



NIBI SONG

This song was written by Doreen Day at the request of her grandson. She attended a conference about the water in which the internationally known speaker, Dr. Masaru Emoto said, the very least we should do every day, is to speak to the water:

Water, we love you.

We thank you.

We respect you.

Doreen and her grandson, Mashkoonce, give permission for everyone to share this song... sing it to the water every day.

Ne-be Gee Zah- gay- e- goo

Gee Me-gwetch -wayn ne- me – goo

Gee Zah Wayn ne- me- goo

The Water Walker

February 21, 1942 - February 22, 2019

Josephine Mandamin, known as “Grandmother Water Walker”.

Anishinaabemowin name is Biidaasige-ba
“The one who comes with the light”

Born on the Manitoulin Island, ON in
Wiikwemikoong Unceded Territory

Anishinaabe elder and water rights advocate. She walked around the Great Lakes from 2003 - 2017 to bring awareness to the problems of water pollution and environmental degradation on the Great lakes and on Indigenous reserves in Canada.



Canadian Encyclopedia, s.v. "Josephine Mandamin," by David Joseph Gallant, Accessed May 02, 2023, <https://www.thecanadianencyclopedia.ca/en/article/josephine-mandamin>

Thanks!

Contact information:

Eldrena Douma
1420 4th Avenue, Suite #20
Canyon, TX 79015

bluecorn_teller@hotmail.com
www.eldrenadouma.com

Photo of Qweshchi lake by Eldrena Douma



USGS Water Data for the Nation: How We Work

Emily Read

Web Communications Branch Chief for USGS Water Resources Mission Area

with contributions from Rachel Bryan, Mary Bucknell, Nicole Felts, James Kreft, Shawna Gregory, and Andrew Yan

May 4, 2023

New Mexico Water Data Initiative

New Mexico Bureau of Geology / New Mexico Tech



WDFN Team



- 👤 Software Developers
- 👤 Technologists
- 👤 Scientists
- 👤 Communications Staff
- 👤 Operation/ Infrastructure Experts
- 👤 Product Owners

Modernization Increases Visibility & Accessibility of All USGS Water Data

- Agile Approach to Modernization
- User Centered Design
- Tooling, Tech, and Architecture
- Staffing and Acquisitions



Water Data for the Nation

Modernizing how you access water data



@USGS_Water





These data are critical
for **water decisions**.

flood forecasting



water availability



recreation



power generation



emergency management

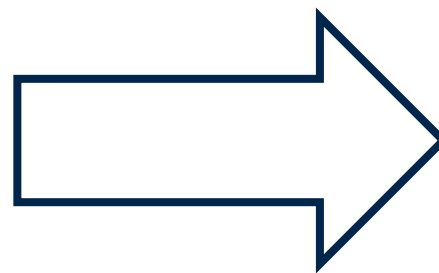




Water Data for the Nation makes high-quality water information **discoverable, accessible, and usable** for everyone.

NWIS Web

Legacy
Web Product Family



Water Data
For the
Nation

Next Generation
(Modernized)
Web Product Family





Pardon the dust!

We're remodeling,
one room at a time,
while still living in the house





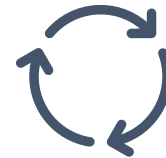
User-centered

We connect with people where they're at



Transparent

Our code and tools are open and reproducible



Dynamic

We create state-of-the-art products using Agile workflows



Agile Development Process



Agile Development Process



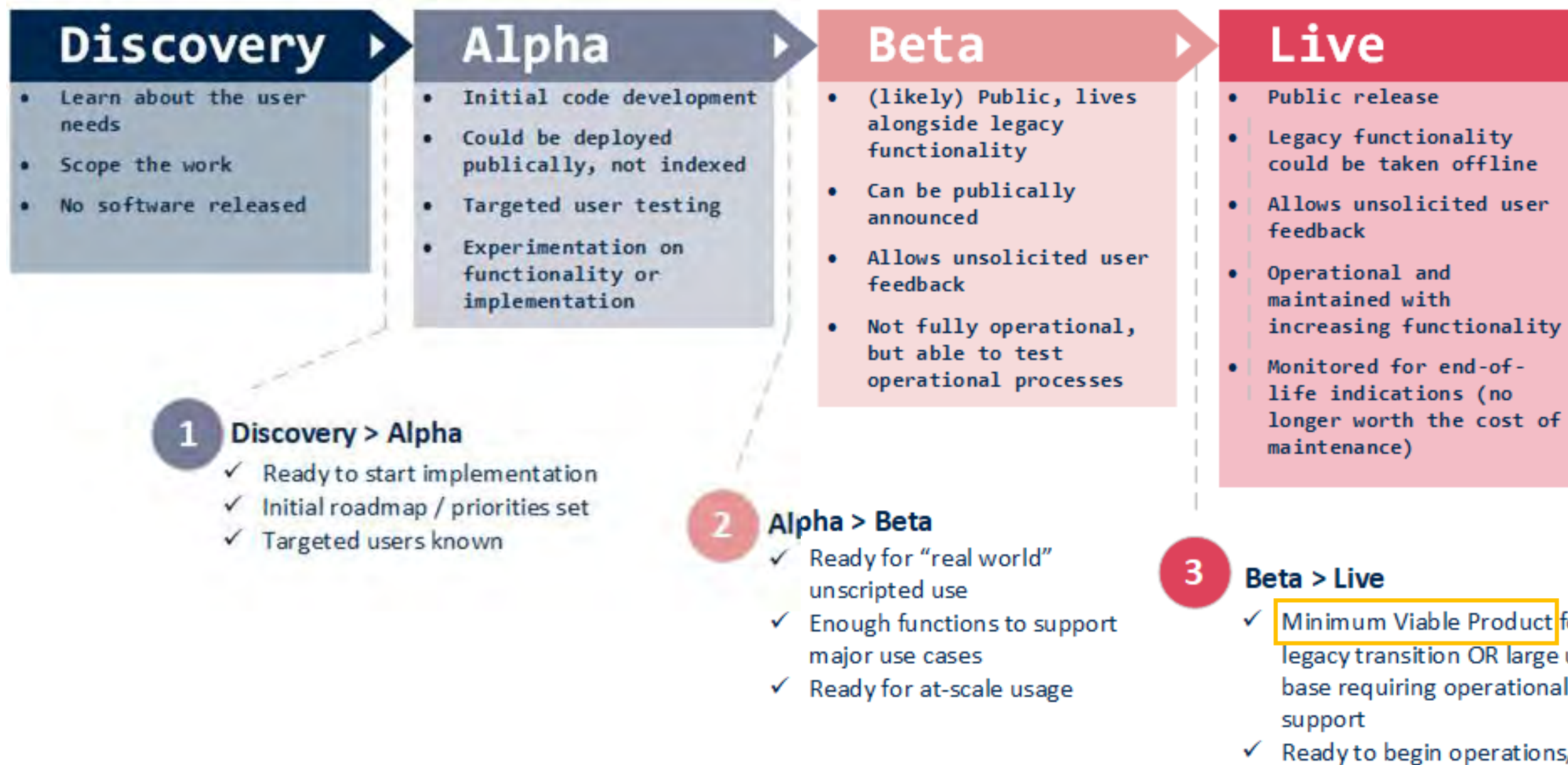
@USGS_Water

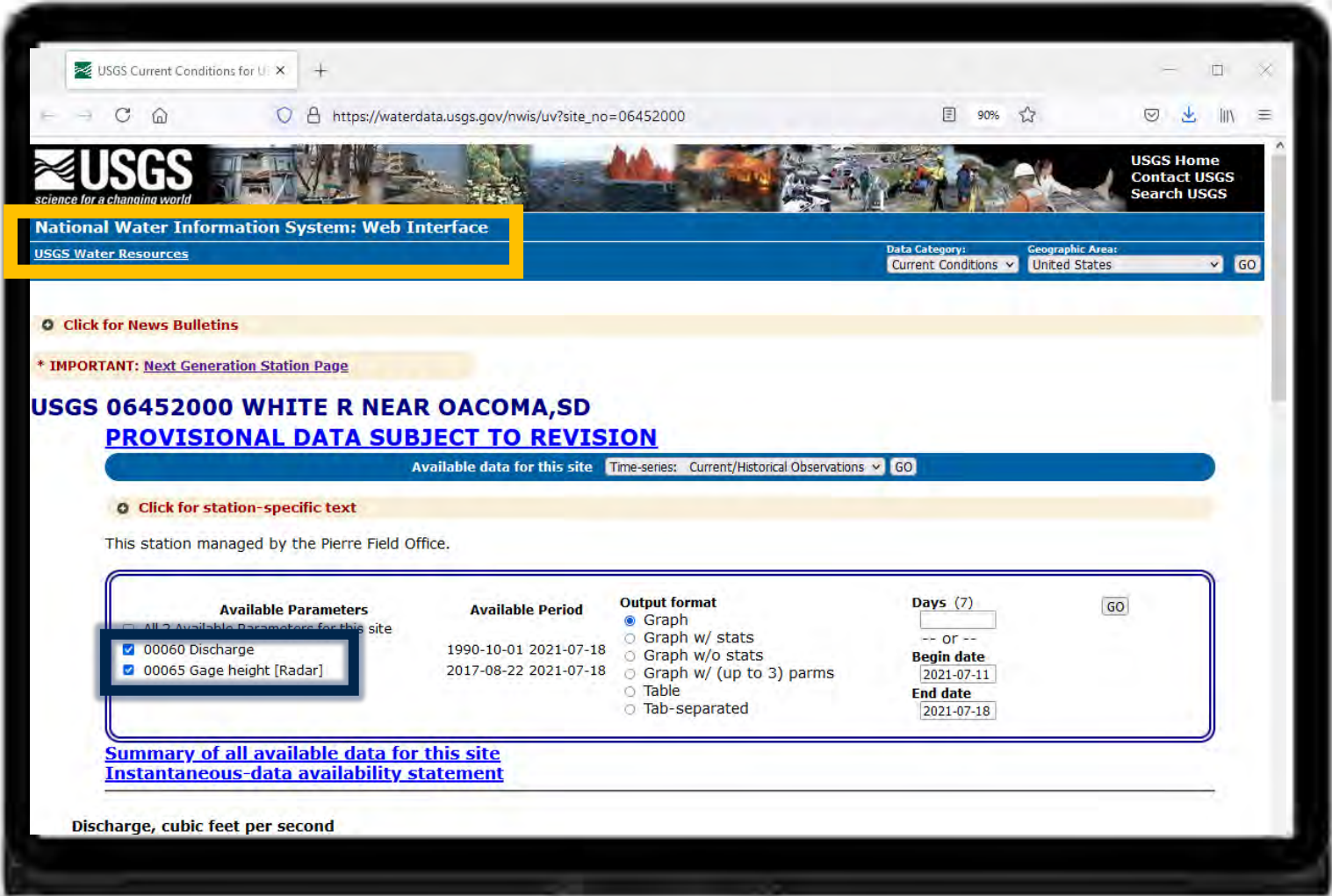


Agile Development Process



@USGS_Water







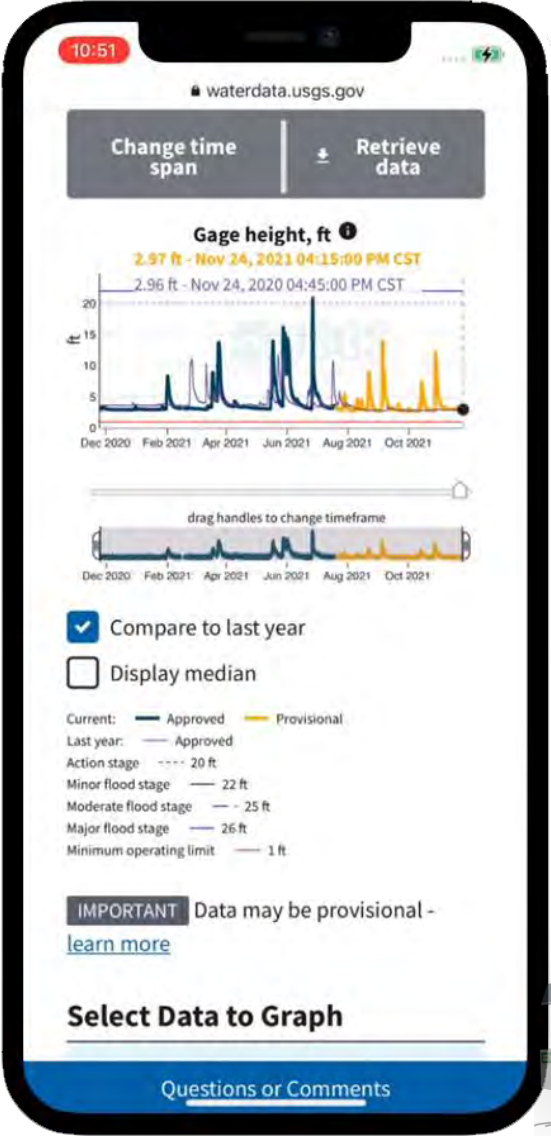
Legacy
Current-
Conditions
Real-Time
Pages

Legacy
Web Product



Next
Generation
Monitoring
Location
Pages

Modernized
Web Product



User Centered Design



USGS Water has a wide range of users, and we need to understand their needs and patterns of use to design solutions



A process for design based on the context and the needs of our users



Learn about our users and how they use our product(s)



Create solutions that support our users



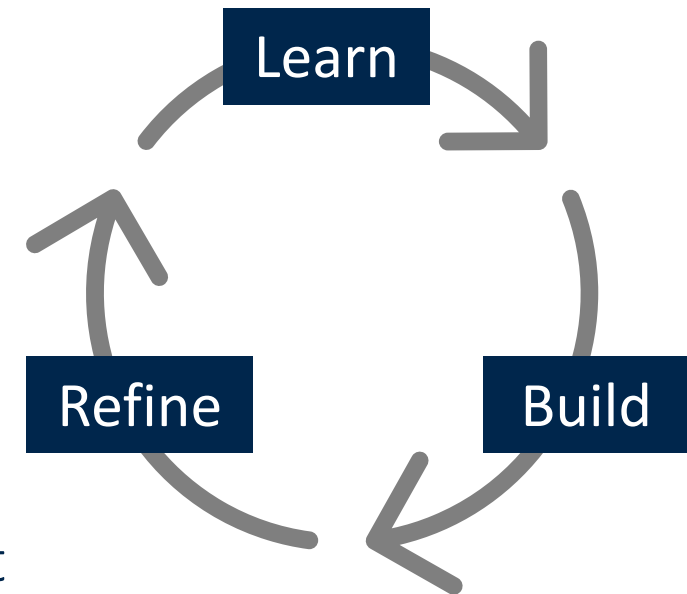
Ask users to test our designs



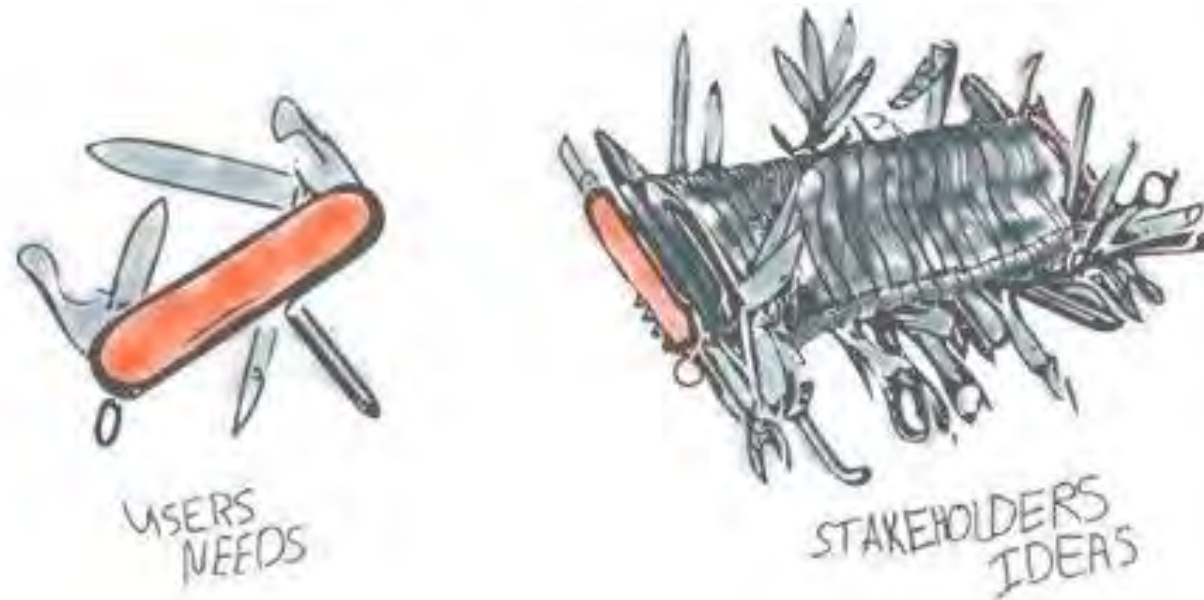
Incorporate user feedback into our designs



- Actively engage with users
- Increase usage and adoption of products and tools
- Reduce number of help requests
- Increase stakeholder buy-in of products and services
- Tends to be unbiased
- Demonstrate a commitment to continual improvement



We found that user needs often do not match stakeholder ideas



How can you balance user needs and stakeholder ideas?



Image from: <https://twitter.com/mathiasmenzl/status/862021586005741568>

Tech, Tools, and Architecture



Service Oriented Architecture

APIs and Services are the foundation of our products

We're maintaining legacy structures while modernizing to ensure ongoing sustainment

Developing new APIs to power products and services

New focus on developer experience (DX)

USGS Water Services

This site serves USGS water data via automated means using web services and extensible markup language (XML), as well as other popular media types. Services are invoked with the REST protocol. These services designed for high fault tolerance and very high availability.

Instantaneous Values Web Service

Retrieve current streamflow, gage height, and hundreds of other real-time data for one or multiple locations.

[Learn More](#)[Test the Service](#)

Statistics Web Service

Retrieve daily, monthly or annual statistics for sites. Statistics are provided on approved data only for time-series sites. Statistics are available for any parameter on these sites with approved data.

[Learn More](#)[Test the Service](#)

Groundwater Levels Web Service

Retrieve historical manually-recorded groundwater levels from hydrologic sites served by the USGS. (If you are looking to retrieve data for real-time or historical groundwater levels recorded on a regular basis using automated equipment, please use the instantaneous values web service.)

[Learn More](#)[Test the Service](#)

Site Service

The service allows searches for USGS sites and site information using a variety of flexible filters. Output formats include tab-delimited and KML formats (used with Google Earth and Google Maps).

[Learn More](#)[Test the Service](#)

Daily Values Service






Interested in historical summarized daily data about our nation's streams, lakes and wells? This service provides a wealth of historical water data. Daily data available for USGS water sites include mean, median, maximum, minimum, and/or other derived values.

[Learn More](#)[Test the Service](#)

Water Quality Web Services

The USGS and the U.S. Environmental Protection Agency (EPA) each collect vast amounts of water quality data. A jointly developed web service allows you to retrieve data for millions of quality checked water quality samples and results.

[Learn More](#)

[DOI Privacy Policy](#) | [Legal](#) | [Accessibility](#) | [Site Map](#) | [Contact USGS](#) | Follow     

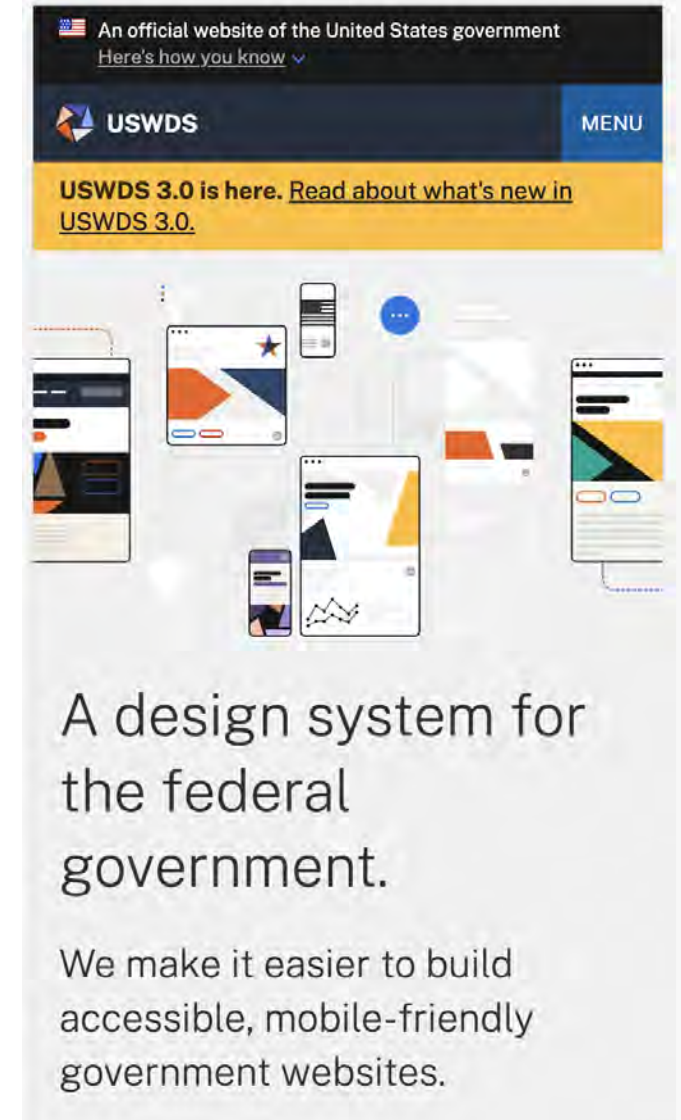
[U.S. Department of the Interior](#) | [DOI Inspector General](#) | [White House](#) | [E-gov](#) | [No Fear Act](#) | [FOIA](#)

Shared and accessible design builds trust in government

USWDS provides guidance to produce accessible, mobile friendly websites.

USWDS provides stylesheets, utility classes, icons, and Javascript which allow easy prototyping of websites without implementing an asset build process.

USWDS allows agencies to customize theme choices so that they can customize the look of their websites.



Data Applications in the Cloud



@USGS_Water

Implications

- New and legacy data flows must coexist for a time
- New data flow must have no deleterious impact on legacy

Considerations

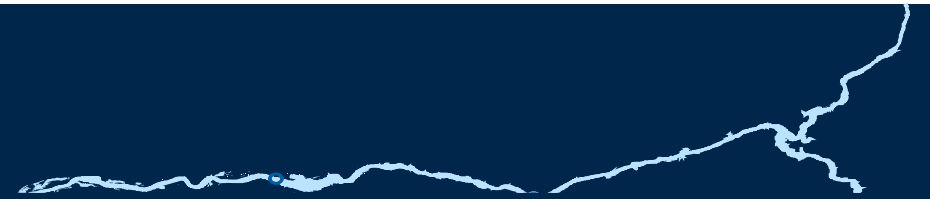
- Data must keep flowing
- Applications are robust and resilient
- Support event and scheduled based notifications

Lessons Learned

- Decouple appropriately – makes development and operations easier
- Failures need to be handled appropriately
- Flexibility is a double-edged sword



Staffing and Acquisitions



Key roles filled by Federal Staff

- Product Managers
- Technical Leads
- Usability Specialists
- Core Software Developer Roles
- DevOps

Use Direct Hire Authority when possible

Remote-first

Cast a wide net to garner lots of interest from qualified, diverse candidates

USGS Water is hiring Physical Scientists & Interdisciplinary Data Scientists

Cluster hire for multiple
permanent federal positions
in the USGS Water Mission Area
(GS11, 12, & 13)



Positions open **Tuesday, February 28th, 2023**

Apply online at **USAjobs.gov**



Smaller, modular contracts

Time and materials type contract

Short base periods of performance

Write a good QASP

Key personnel are named

Maintain a backlog

<https://derisking-guide.18f.gov/#guide-teasers>

De-risking Government Technology

Federal Agency Field Guide

September 2020



We want to hear from you!

Drop us a line



@USGS_Water



OPENET

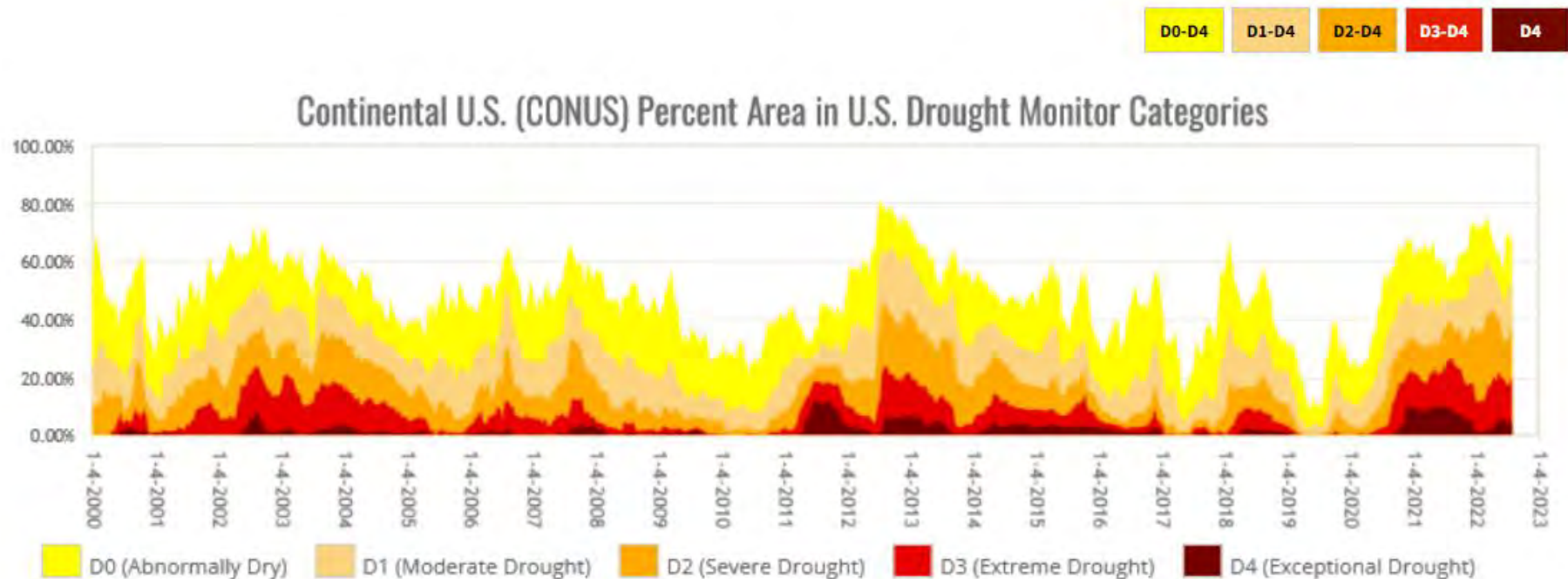
Filling the Biggest Data Gap in Water Management



Maurice Hall, PhD, PE
Vice President, Water
EDF



Managing water in the West



What is evapotranspiration (ET)?

Water applied to a field ultimately:

- ◆ Evaporates
- ◆ Transpires (after being used by plants to grow)
- ◆ Recharges underlying groundwater
- ◆ Runs off and returns to a local canal or river

OpenET uses data from a constellation of satellites



Image credit: NASA/Goddard Space Flight Center Conceptual Image Lab



OpenET: Reliable, accurate water data

OPENET

Filling the Biggest Data Gap
in Water Management

Methodology | API | Known Issues | FAQ | About

(Coming Soon)

Account Name



Home

Explore Data

Customize Data

(Coming Soon)

(Coming Soon)

Training

(Coming Soon)

Case Studies

Search



Select Year
2019

Select Variable
ET

Raster View

Field View

New Here? Take a Tour!

Cities

mm in

42 in

Cumulative Ensemble Evapotranspiration (in)

0 in

Create Custom Data
(Coming Soon)

2020 ET: 40 in

Crop: Alfalfa

8 in
6 in
4 in
2 in
0 in



5

+

OpenET can help:

- **Rural communities** to design locally driven water conservation and trading programs.
- **Local Groundwater managers** to develop more accurate water budgets, incentive programs and other innovative strategies.
- **Policymakers** to more accurately track water supplies and co-develop solutions with local communities.
- **Farmers** to improve irrigation practices for maximized “crop per drop” and reduce costs for fertilizer, water and energy



OpenET Uptake

- **Upper Colorado River Basin**

Local conservation in a critically overdrafted basin

- **Oregon**

Creating water budgets for groundwater basins; supporting conservation programs

- **Nebraska**

Integration of OpenET alongside Groundwater Evaluation Toolbox into Twin Platte NRD's Water Data Program

- **Arizona**

Guiding and evaluating Forest Treatments



Upper Colorado River Basin



Paul Bruchez

Rancher and Board Member, Colorado Water Conservation Board

Advancing groundwater management in Oregon

Statewide

- Groundwater basin budgets
- API access, outreach and training support, model refinement



Harney Basin

- Conservation program implementation
- Water use measurement



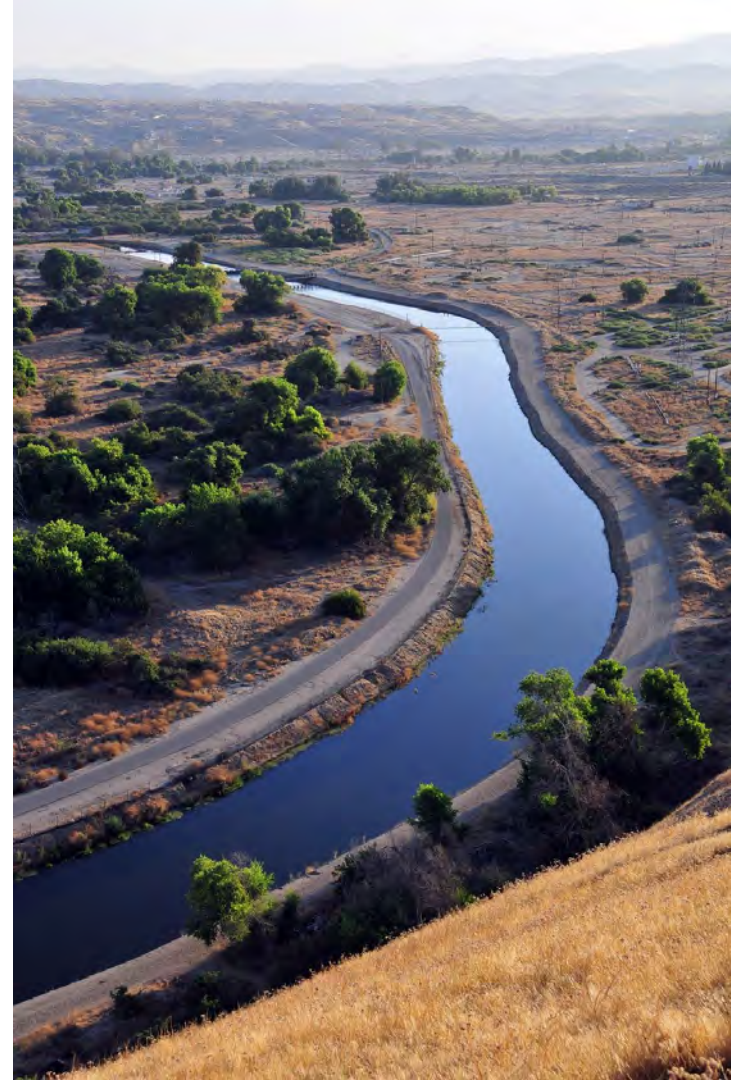
Irrigation Management



Mark Owens
Alfalfa Farmer
Harney County, Oregon

Forest & Rangeland Management

- **Identify ET signal** from various rangeland and forest practices
- **Develop basin-wide water budgets** in forested and rangeland watersheds
- **Integrate ET estimates with other high resolution drone and field data** to expedite labor intensive evaluations

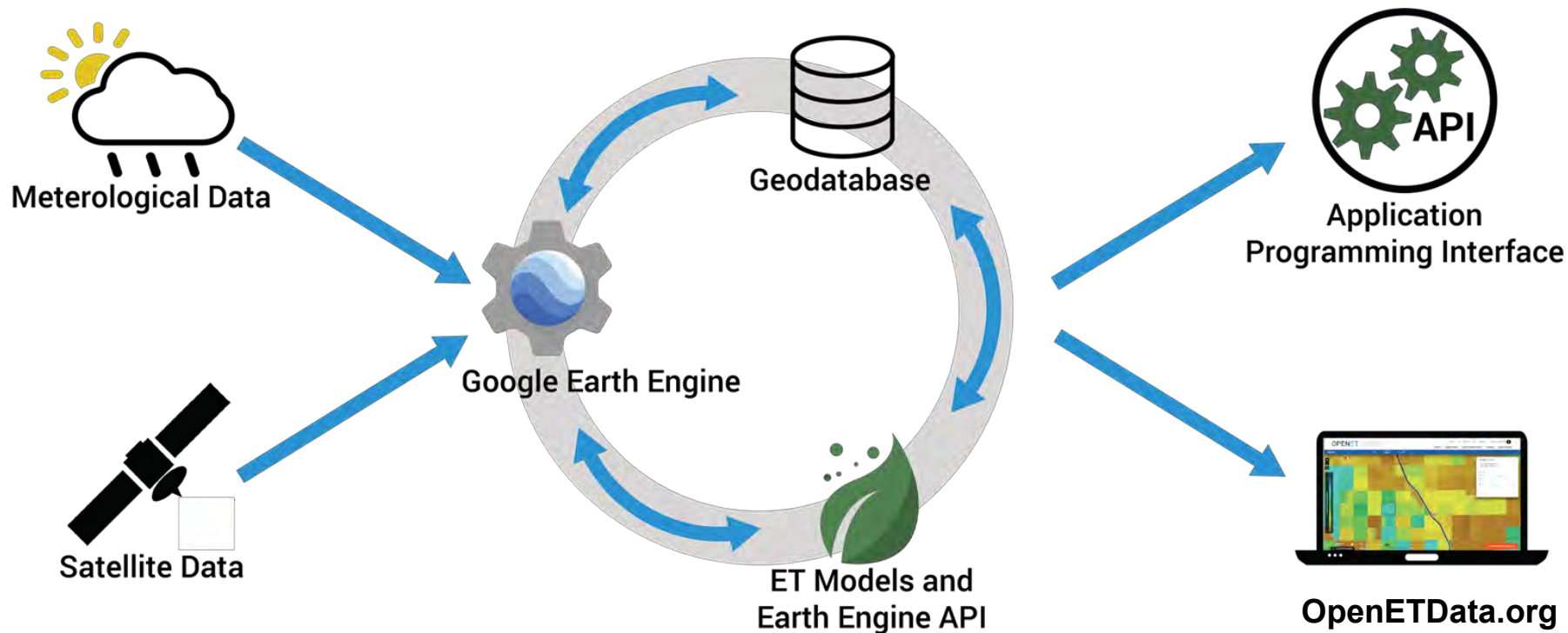


Watershed Health and Forest Management



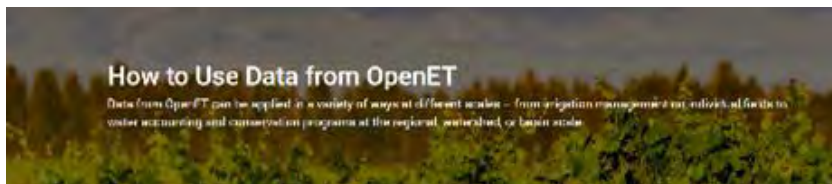
Elvy Barton
Senior Water Policy Analyst
Salt River Project

How OpenET works



Dedicated to Transparency and Equal Data Access

Available on www.openetdata.org:



(and more)



What's next?



- Public launch of API
- Effective precipitation
- Custom reporting
- Daily data
- Forecasting
- Geographic expansion



OPENET



Thank you!
Maurice Hall
mhall@edf.org
[916-208-1706](tel:916-208-1706)



Using Data Visualizations of the NM Dynamic Statewide Water Budget Tool to Address Community Water Issues



Team

Dr. Sam Fernald

*Professor of Watershed Management, NMSU
Director, NM WRI*

Austin Hanson

Geologist, INTERA

Mark Sheely

Program Specialist, NM WRI

Dr. Connie Maxwell

*Postdoctoral Researcher
NM WRI Water and Community Collaboration Lab
Leader*

Robert Sabie

Research Scientist, Assc., NM WRI

Outline

1. Our statewide water budget model
2. Our regional planning process
3. The need to create regionally specific models



NM WRRI New Mexico Dynamic Statewide Water Budget Model (NM DSWB) Funding & Goal

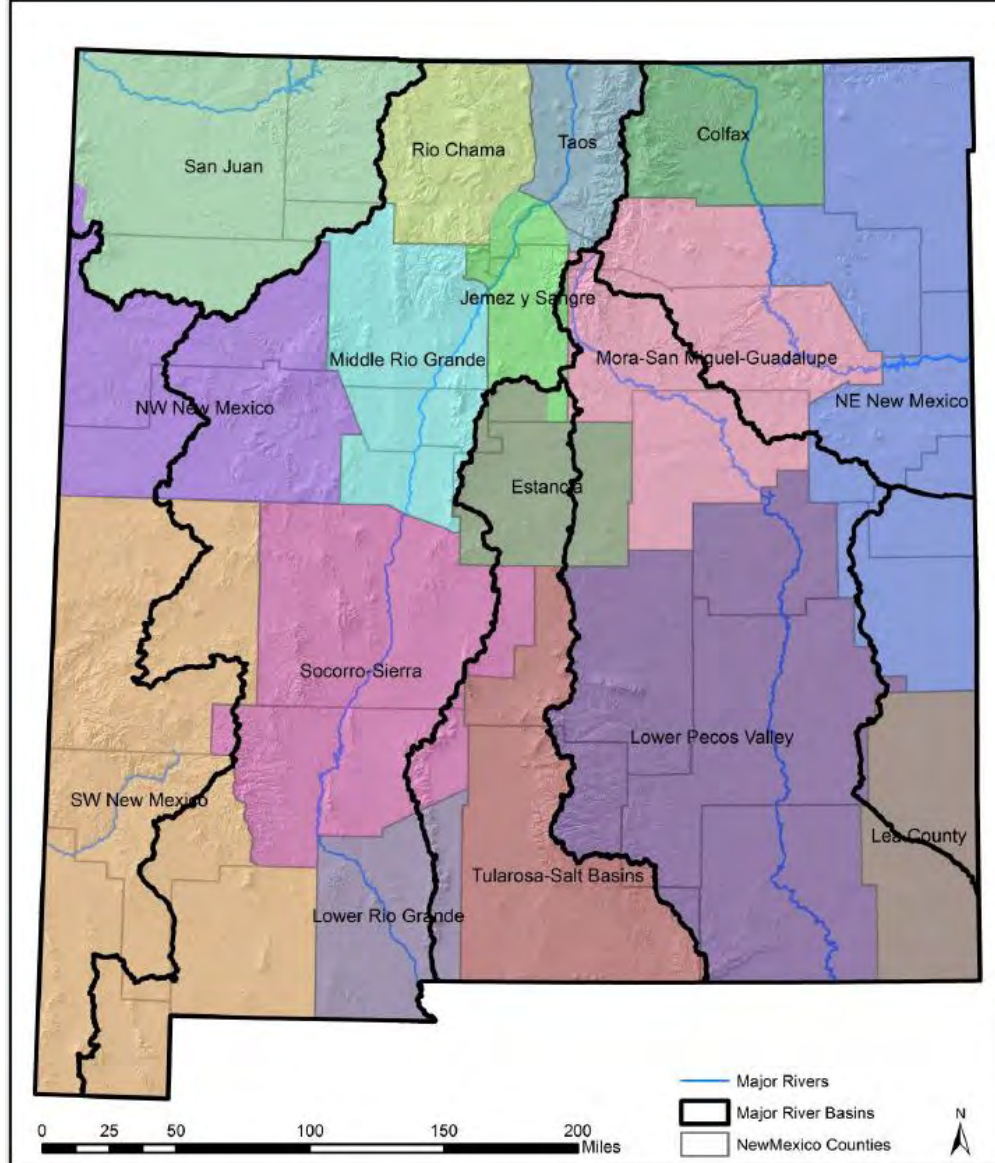
Funding

- Part of the Statewide Water Assessment
- Funds provided by NM Legislature and NM EPSCoR

Goals

- Advance conversations and inform water resource management strategies
- Provide quantitative assessments of water budgets for the entire state of NM
- Identify and improve on data/knowledge gaps
- Bring statewide water budget data and analyses to an open access and user-friendly tool that displays the information

NM DSWB Covers Multiple Spatial Scales



Spatial Scales

- Counties (33)
- Water Planning Regions (16)
- Major river basins (7)
- Statewide (1)

NM DSWB Stocks & Flows

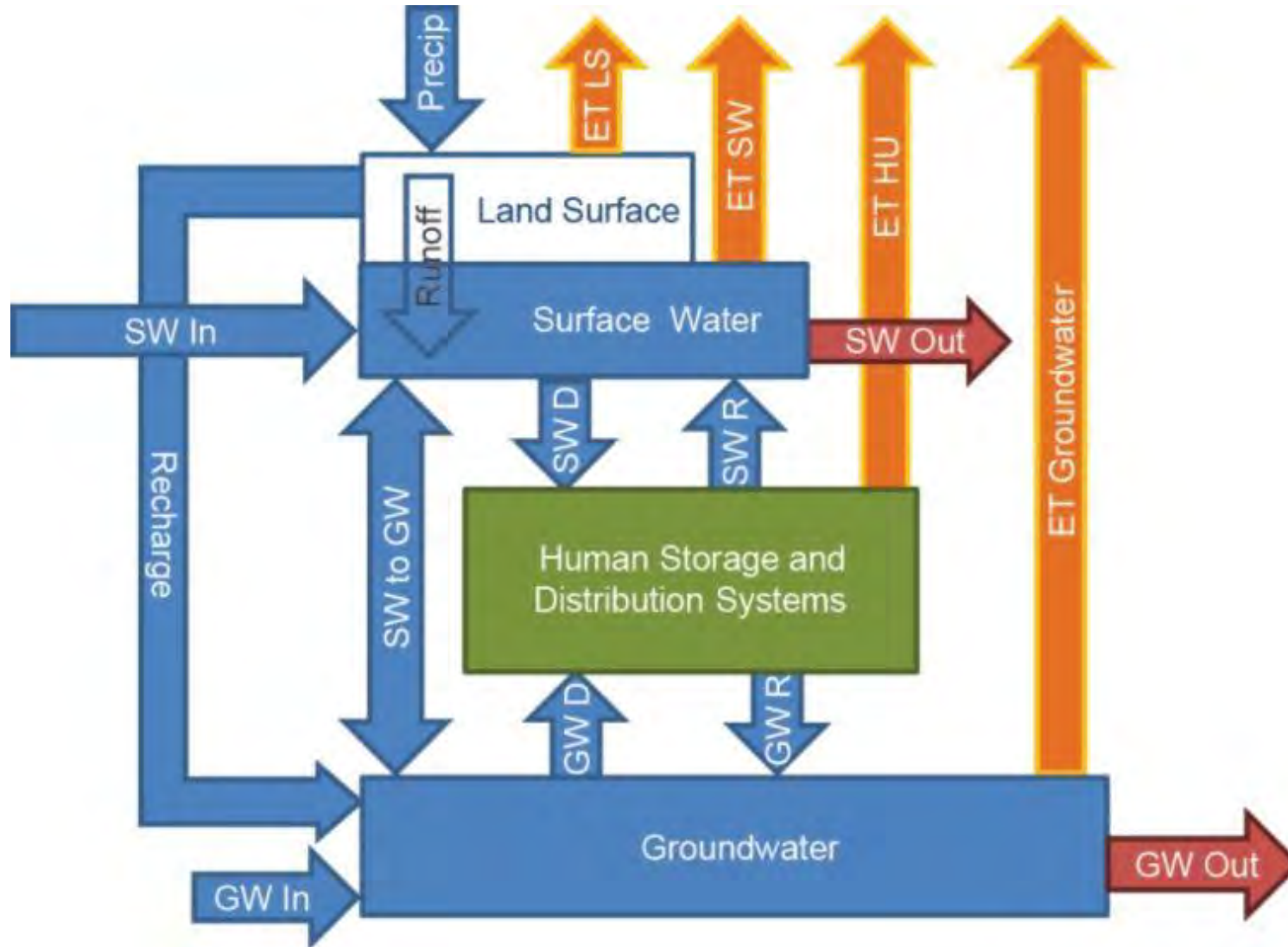


Diagram of the DSWB model

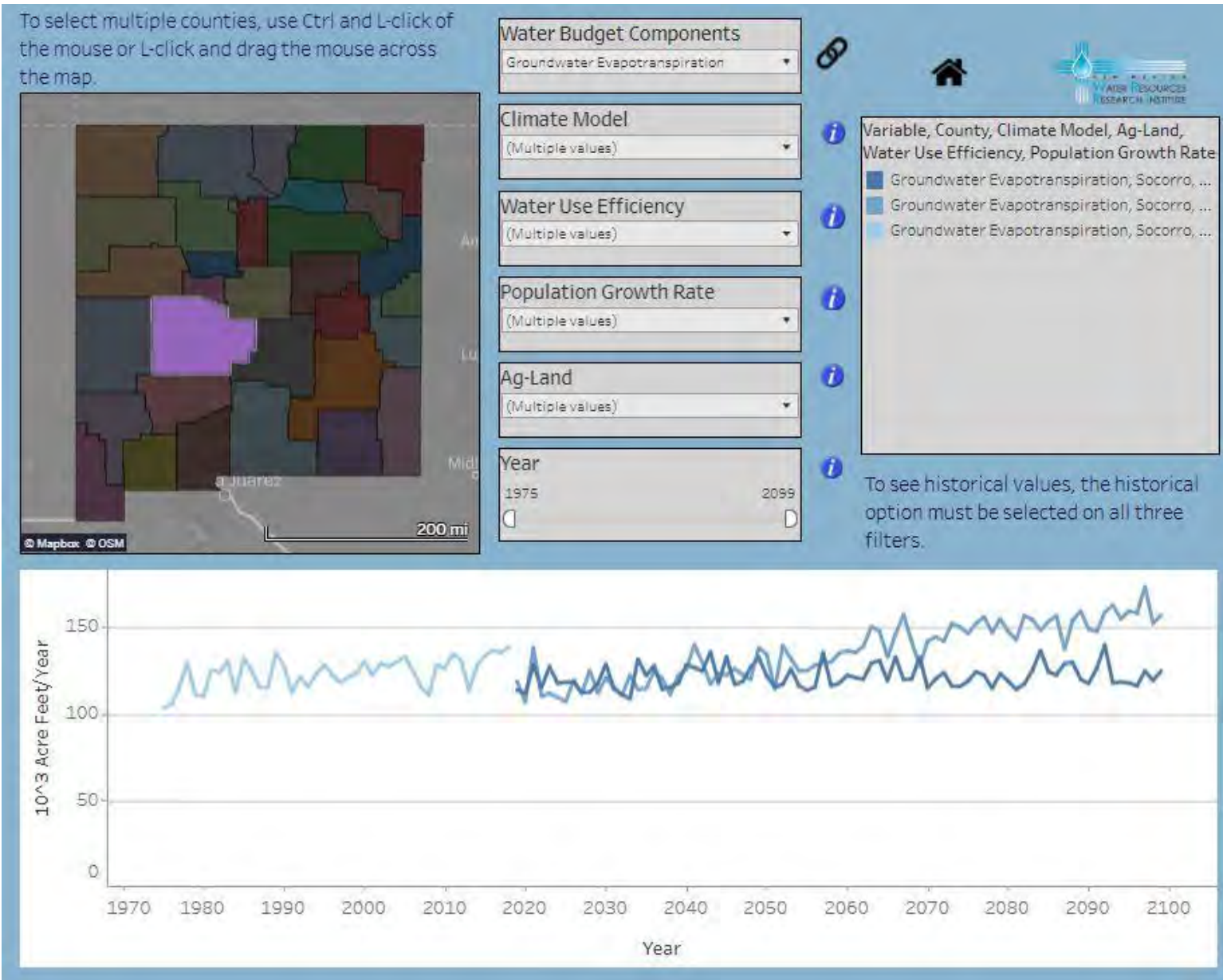
- Includes flows into region and the effects on the water volumes (stocks)
- Monthly timestep
- Historical (1975–2018)
- Future (2019–2099)
- > 30 million data points

NM DSWB Future Scenario Options

Climate Model
High Emissions (GFDL) ▼
Water Use Efficiency
Low ▼
Population Growth Rate
Historically Derived Projection ▼
Ag-Land
High ▼

- 4 General Circulation Models
 - Temperature, precipitation, & streamflow
- 3 options based on the 2015 OSE Water Use by Category Report (Magnuson et al., 2019)
 - Alters per-capita self-supplied domestic & public water use
- 3 options based on the UNM Bureau of Business and Economic Research population model (UNM BBER, 2014)
 - Domestic & public water use directly related to population
- 3 options based on the 2018 USDA CropScape Cropland Data layer (USDA, 2018)
 - Alters agricultural acreage → CIR

NM DSWB Data Visualization Tool – A Local Example



Estimates of Riparian ET in Socorro County

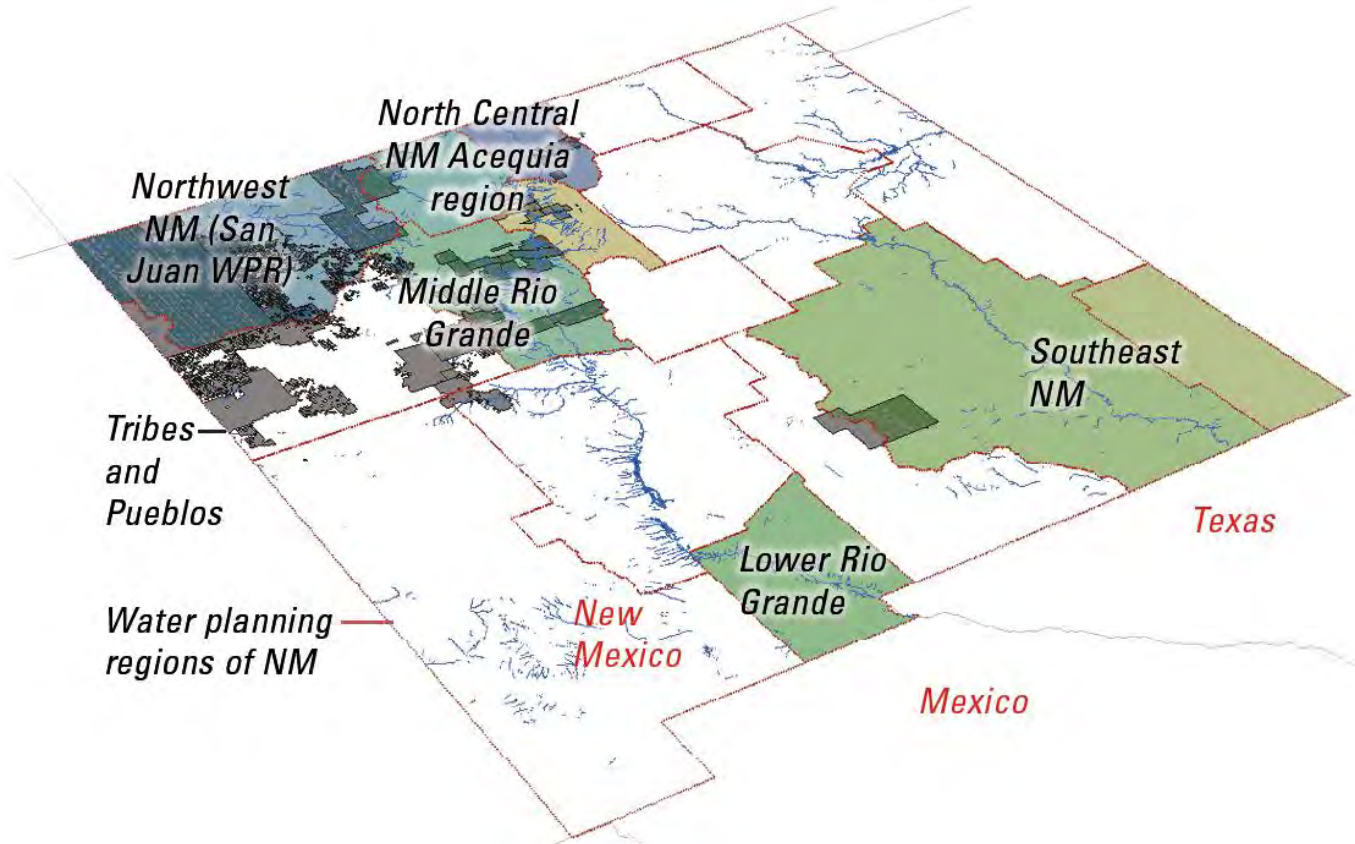
Historical estimate (1975-2018)

Two Future Scenarios (2019-2099)

- Dark Blue = Low emissions scenario (NCAR)
- Light Blue = High emissions scenario (GFDL)

Access to the NM DSWB Visualization Tool:
<https://nmwrri.nmsu.edu/new-mexico-dynamic-statewide-water-budget-beta-version-3-0/>

Community Conversations for the New Mexico 50-Year Water Plan: Managing Water for Future Resilience



- Regional knowledge networks are the key to water and community resilience planning.
- NM WRRRI conducted 12 Focus groups, workshops, and interviews with regional stakeholders throughout New Mexico utilizing NM DSWB visualizations.
- These conversations contributed to NM ISC 50-Year Water Plan process.

Data for Who and Why – Regional Planning Process for Water and Community Resilience



Maxwell, C.M., M. Sheely, L. Conrad, K. Perez, A. Hanson, S. Langarudi, A.G. Fernald. 2022. *Community Conversations for the NM 50-Year Water Plan: Managing Water for Future Resilience*. New Mexico Water Resources Research Institute. Miscellaneous Report No. 34

URL: <https://nmwrri.nmsu.edu/miscellaneous-reports-2/m34/>

Lower Rio Grande Stakeholder Visions for a Resilient Future

1) Visions of future resilience and goals built from what is valued, issues faced, and desired strategies to employ or test

2) Build collaborative network of partnerships across landscape

Values and visions for the future

- **Achieve economic and community resilience integrated with ecological resilience**, e.g., build healthy watersheds and significantly reduce sediment transport and recurring maintenance issues
- **Address challenges of climate change by rethinking the system, how to deal with floods, and restore the Rio Grande** with the prospect of more intense storms, plus aging infrastructure
- **Retain flood flows with vegetation or aquifer recharge** instead of evaporating or flowing downstream
- **Build networking and working groups to achieve bigger goals**, on the scale of the region

Issues

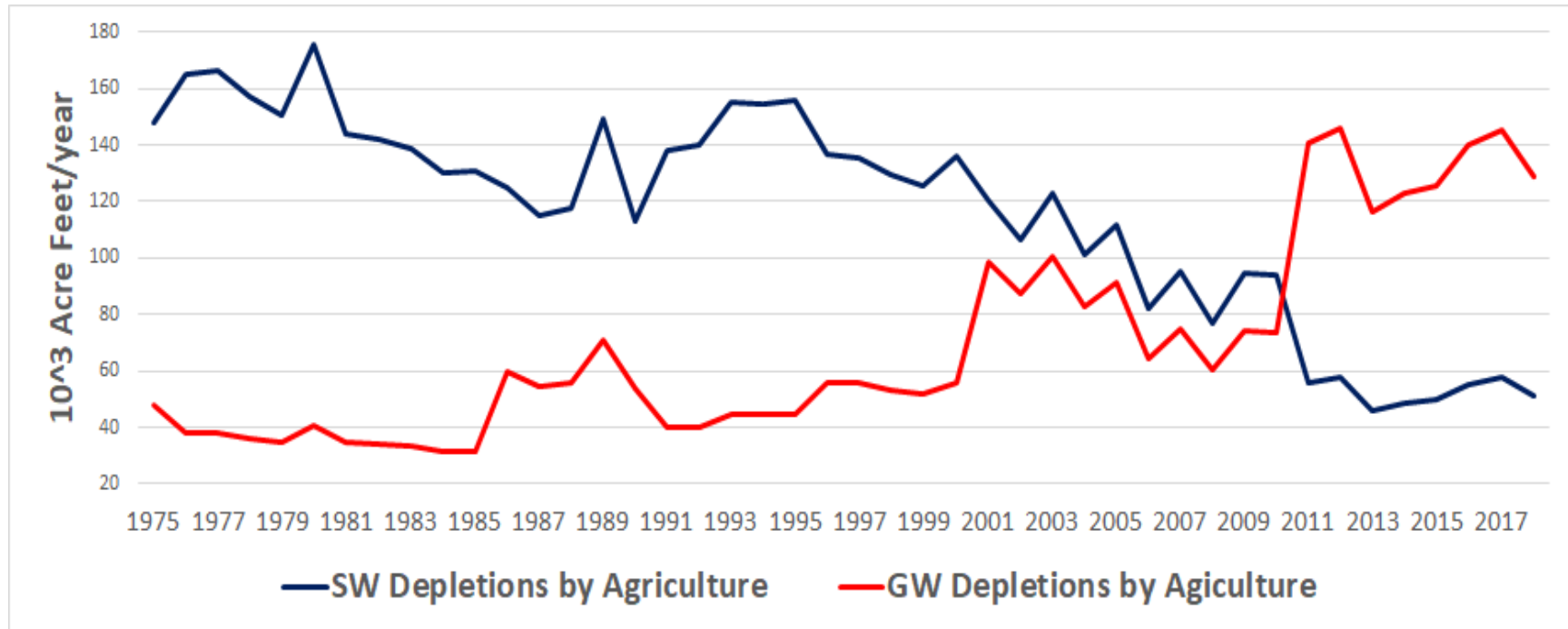
- **Upper watershed/ rangeland health** conditions
- **Resultant downstream flooding and sediment transport**
- **Riparian health**
- **Water supply and quality:** increased variability, shortfalls
- **Aquifer depletion**
- **Need for coordinated watershed planning efforts**, including in the Organ Peaks National Monument

Strategies

- **Expand aquifer recharge network**
- **Expand early warning and water data system**
- **Watershed planning and restoration**
- **Develop regional water budget decision-support tool**
- **Develop watershed educational and technical support programs**

3) Build mutual understandings of critical regional dynamics of the ecosystems and the communities that rely upon them

Lower Rio Grande Region WPR (Doña Ana County)

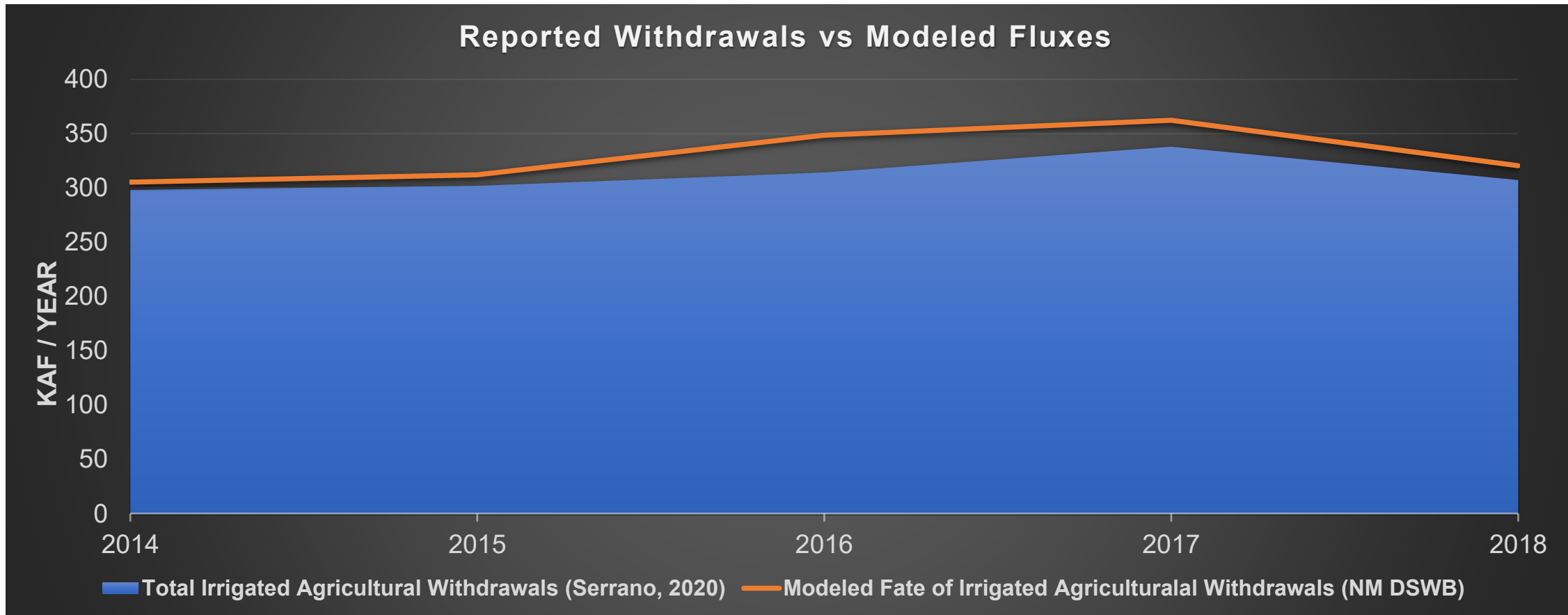


Lower Rio Grande
Water Planning
Region (WPR)
(Doña Ana County)

As Surface Water (SW) Availability Declines, Groundwater (GW) Depletions for Agriculture Increase

- Exemplifies dynamics of increasing reliance on GW globally

Lower Rio Grande Irrigation

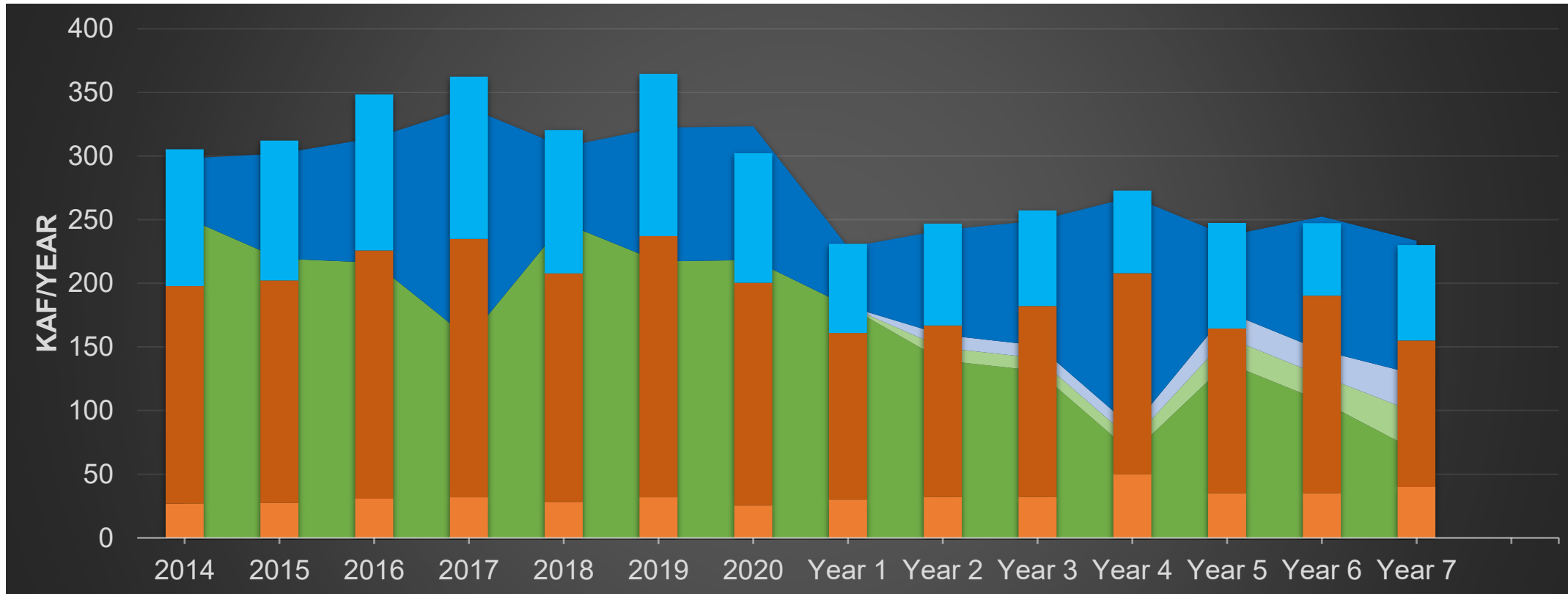


Modeled Fate = Irrigated Agriculture ET + Recharge + SW Returns

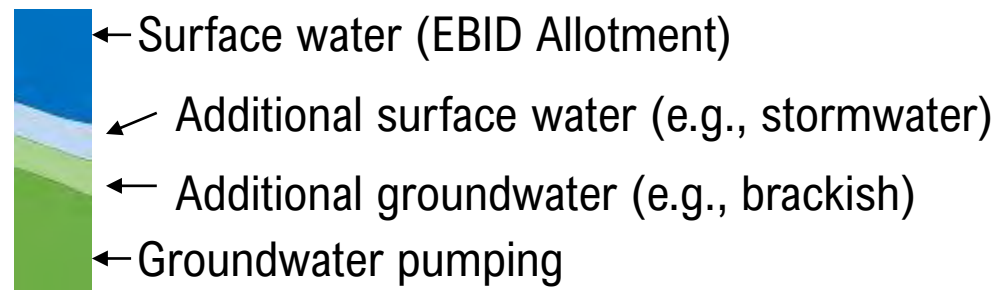
Total irrigated agriculture withdrawals sourced from the Lower Rio Grande
Water Master Annual Report 2020 Accounting Year (Serrano, 2020)

Lower Rio Grande Irrigation Possible Scenarios

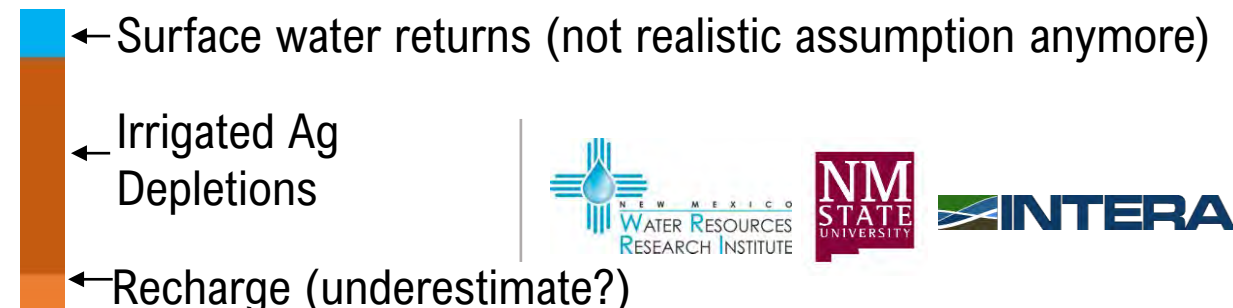
4) Identify potential pathways to resilience of combinations of strategies and triggers for action



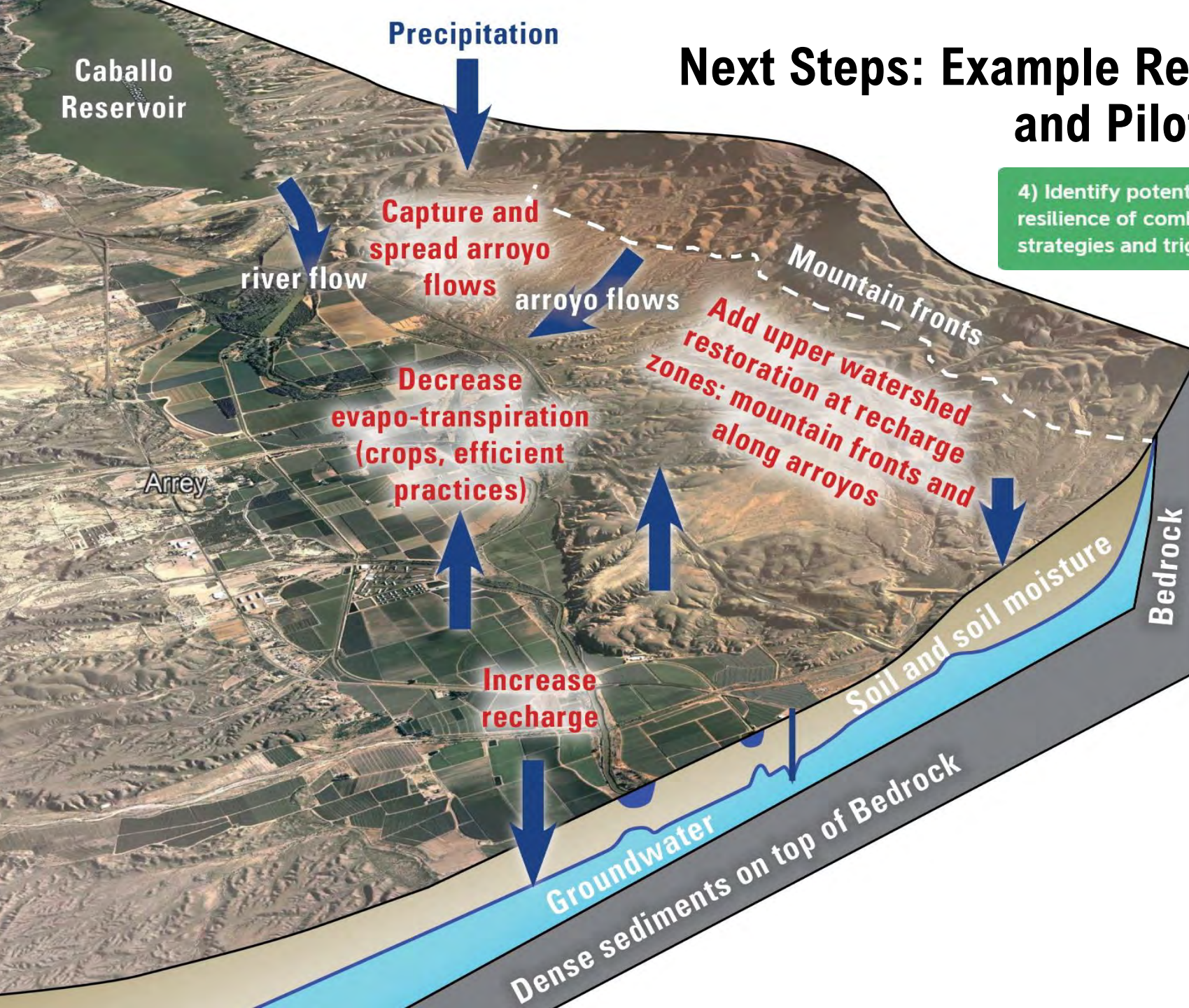
Supply (Serrano, 2020)



Fate of Supply (NM DSWB)



Next Steps: Example Regional Integrated Models and Pilot Projects

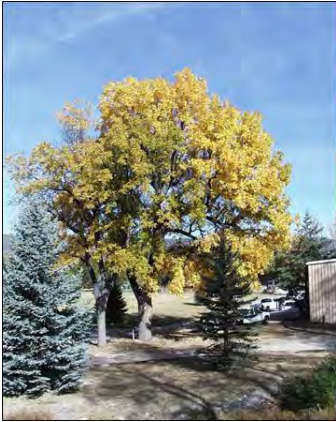


4) Identify potential pathways to resilience of combinations of strategies and triggers for action

5) Implement actions and monitor to assess ability to achieve visions

Testing and gaining evidence of effects of strategies for resilience

- Developing integrated water budget models to assess what is needed for regional resilience
- Community pilot projects that test, measure, and fit practices to local conditions:



THANK YOU!



An Incomplete List of NM DSWB Historical Data Sources

- Precipitation & temperature: PRISM & URGWOM Technical Team (2015)
- Surface water in & out: USGS gauge data
- Surface water/groundwater withdrawals & returns: OSE Water Use by Category Reports
- Human Use ET (i.e., consumptive use): Primarily based on OSE Water Use by Category Reports
 - Irrigated agriculture: Blaney-Criddle equation with surface and groundwater efficiencies, USGS NLCD, USDA CropScape Cropland Data Layer, PRISM, Soil Conservation Service (1970), NMSU Cooperative Extension Service's report (Longsfrod, 1997)
 - Livestock: USDA NASS Quick Stats Database, USDA NASS Annual Statistical Bulletins, USDA Census of Agriculture Reports
- Surface water ET: surface water area, USGS gauge data, Hargreaves-Samani reference ET, & open water evaporation coefficient
- Groundwater (i.e., riparian) ET: NLCD area, Hargreaves-Samani reference ET, & riparian vegetation crop coefficient
- Groundwater storage change: Calibrated by Rinehart et al. (2016)
- Reservoirs: USGS, USBR, USACE, and URGWOM Technical Team (2015)
- Population: UNM BBER (2014) model

NM DSWB Flux Closure Terms

Closure terms

- Runoff: For deficit in surface water system, gets split between Runoff and $SW \leftrightarrow GW$ (BFI 1-km grid)
- $SW \leftrightarrow GW$: For deficit &/or surplus in surface water system
- Landsurface $ET = P - (RO + R)$
- Recharge = baseflow + GW ET (assumes long-term, steady state of GW system)



— BUREAU OF —
RECLAMATION

Reclamation Power BI Water Ops Dashboard

Water Data Initiative Meeting

May 4, 2023

Water Ops Dashboard

- Reclamation recently developed a Water Ops Dashboard that is now available to the public.
- Provides current reservoir and stream data to assist with water operations.
- Utilizes Microsoft's Power BI software.
- Data is pulled from CDWR API, USGS API, and Reclamation's HDB.
- Data is pulled every hour on the half an hour (8:30, 9:30, etc.).
- All data is considered provisional unless states otherwise.



Water Ops Dashboard Demo

Link to AAO Water Ops Page:

<https://www.usbr.gov/uc/albuq/water/index.html>



Internet of Water (IoW)

Overview of IoW Coalition and Update on Core Technology

Faith Sternlieb, Associate Director of Engagement

Kyle Onda, Associate Director of Technology

Internet of Water Initiative

Center for Geospatial Solutions, Lincoln Institute of Land Policy



CENTER FOR
**GEOSPATIAL
SOLUTIONS**

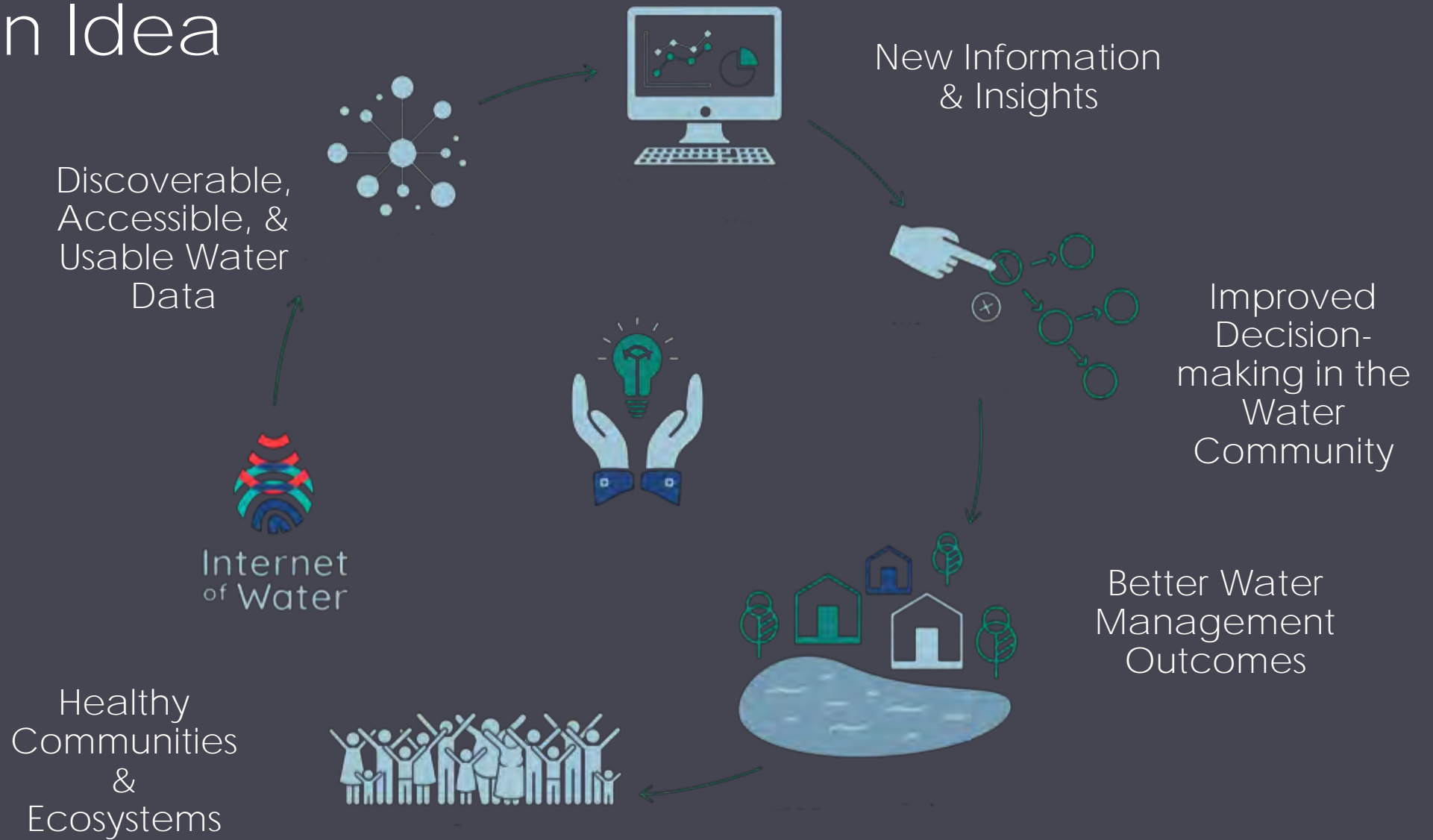


LINCOLN INSTITUTE
OF LAND POLICY

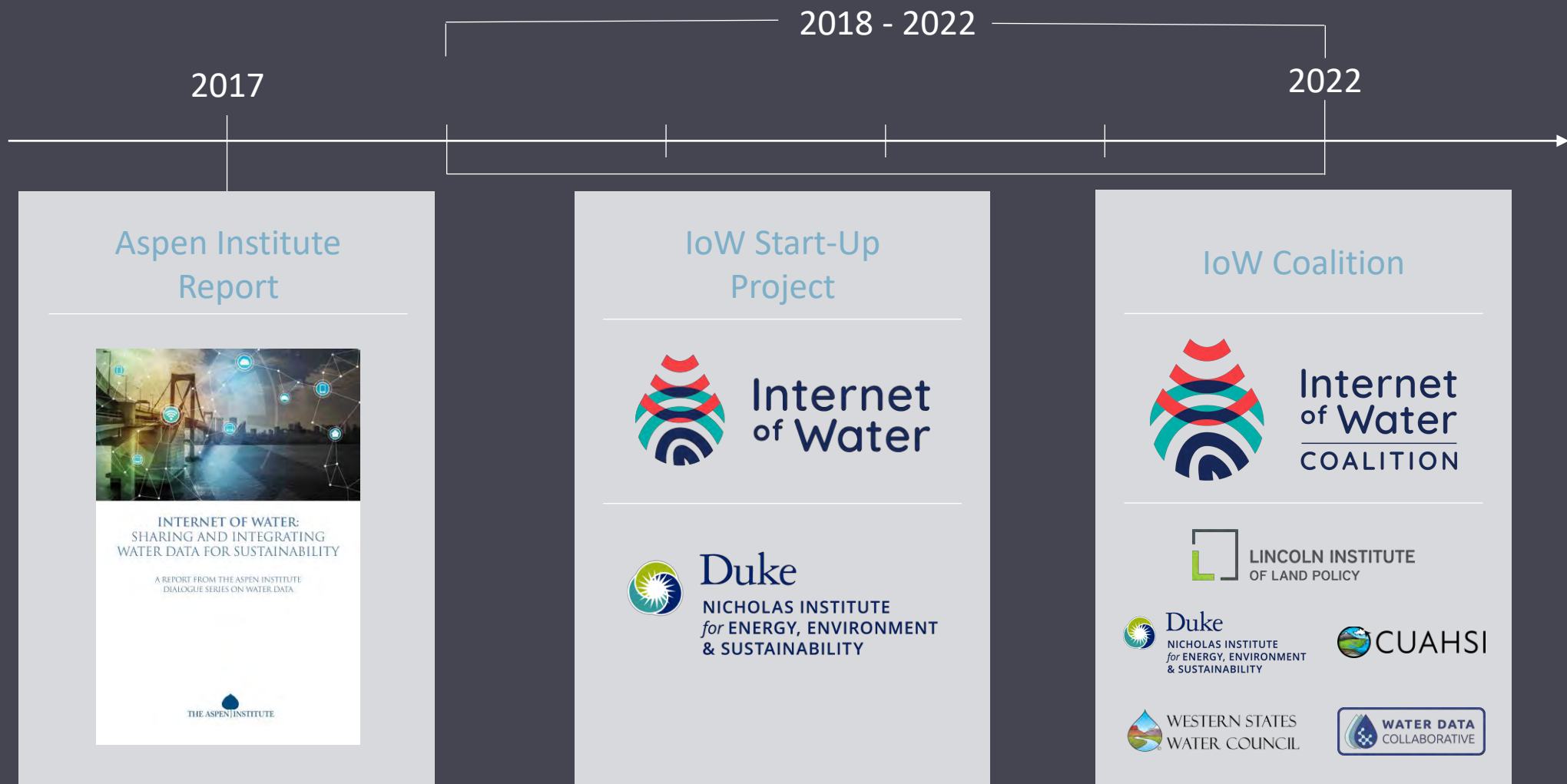


Internet
of Water
COALITION

The Main Idea



IoW - From Report to Project to Coalition



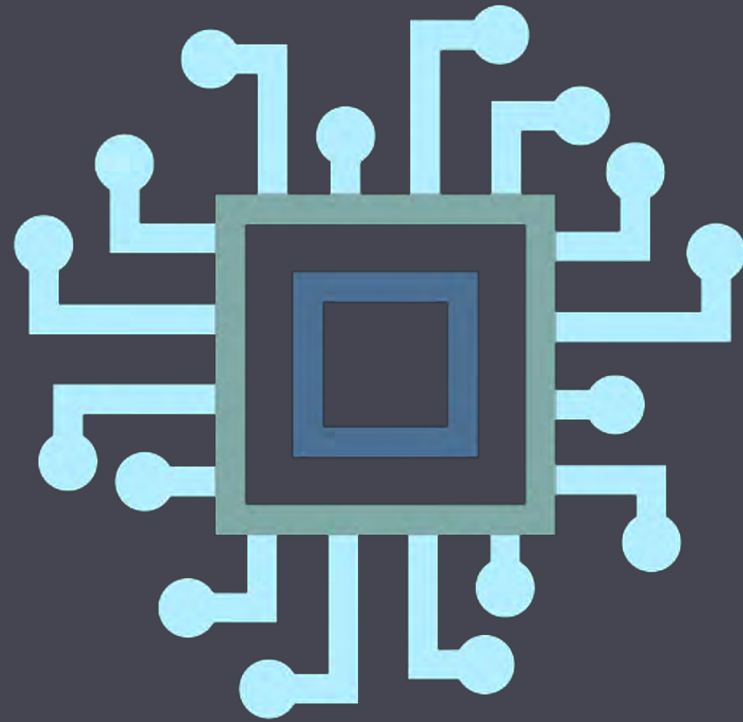
IoW at Lincoln Institute - Center for Geospatial Solutions

Acts as a service center for the IoW community, supporting the IoW Coalition of non-profits, states, and other organizations



Supports DOE, USGS, and other Federal agencies, as well as emerging Federal roundtable

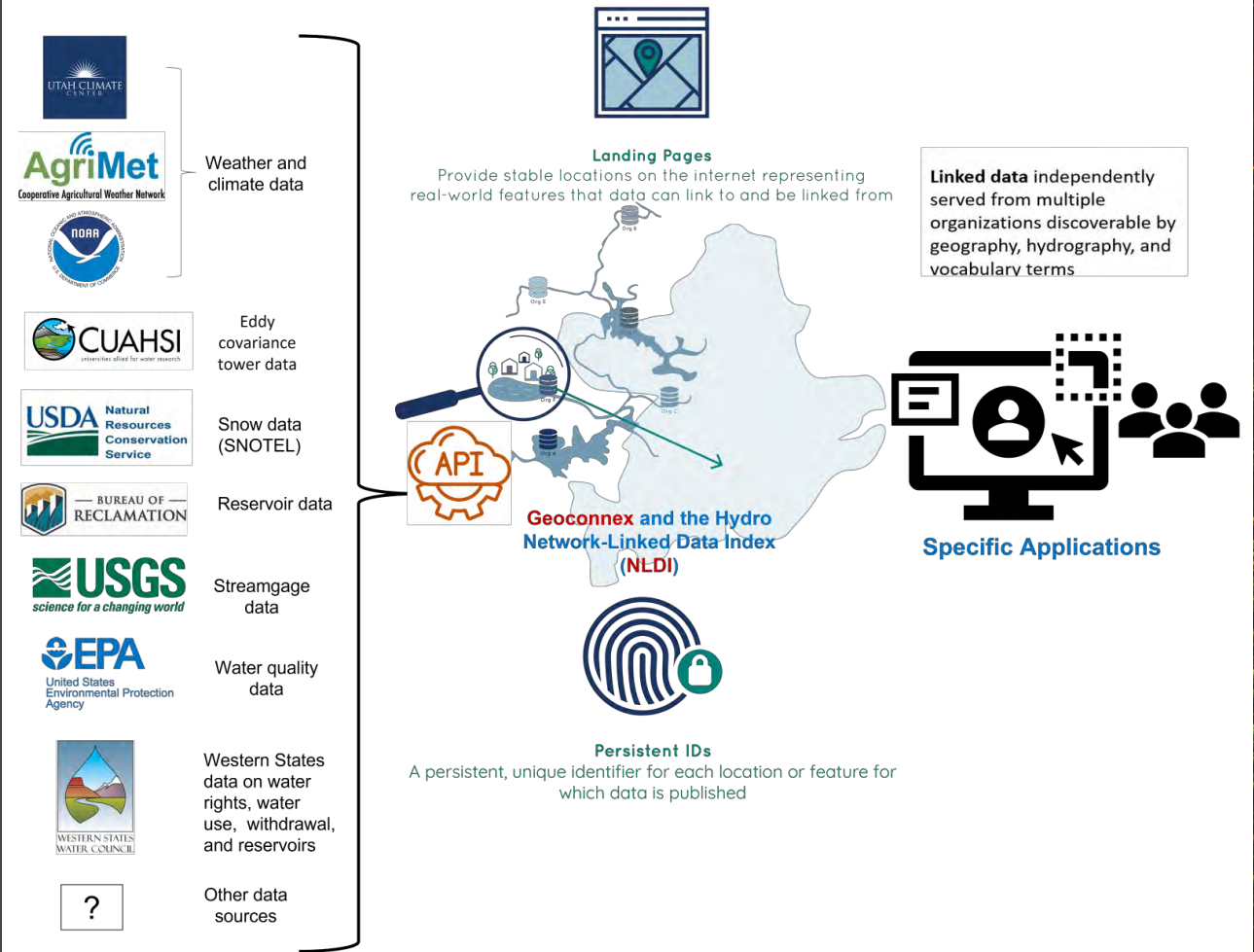
Provides support for long-term operations of IoW technologies



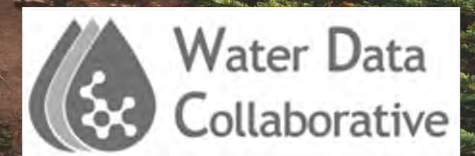
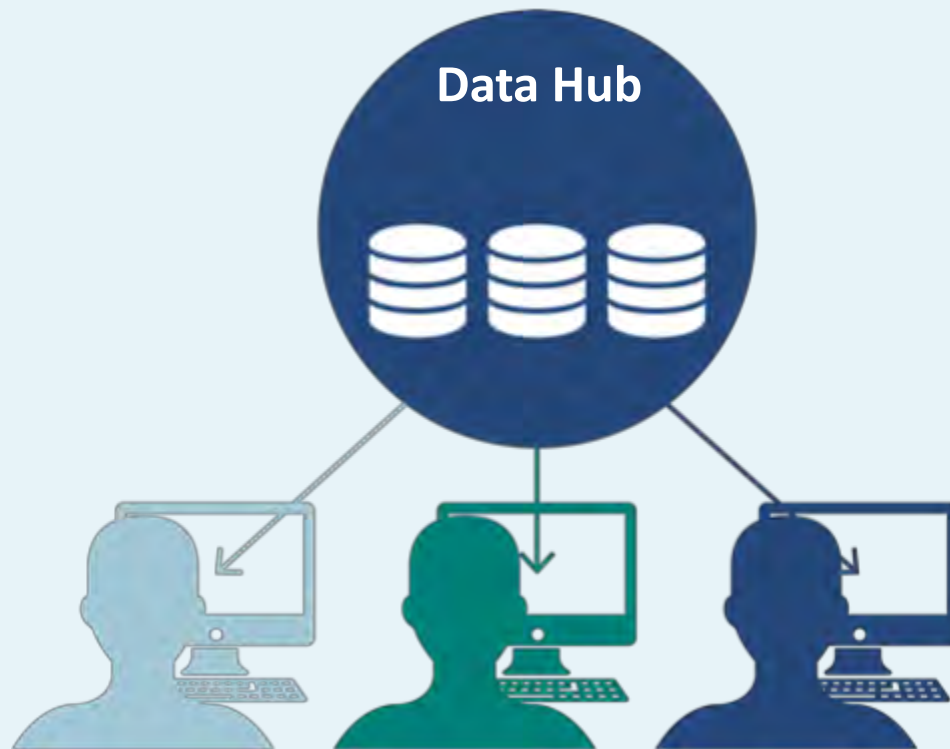
New Technologies

Why are new technologies needed?

At completion, users will have easy access to comprehensive water data for any specific query for a given location:



Geographic and Thematic Hubs



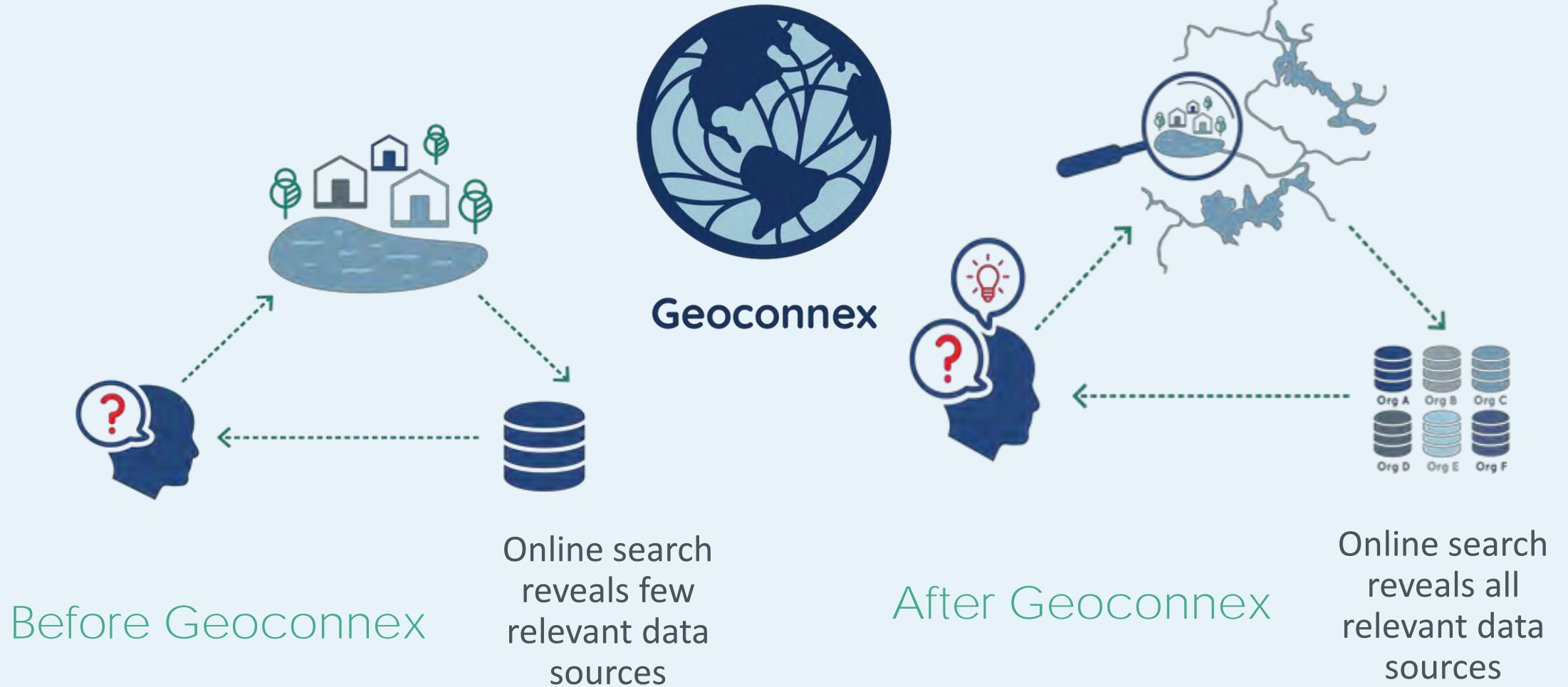
Approach: HubKit

- The Core Idea
- Open Source Software components that allow data providers to
 - Format their data according to loW standards
 - Publish data via loW standard APIs
 - Publish metadata to geoconnex

Hubkit

- Low-cost, versatile ‘toolkit’ with 4 data management components:
 1. Data ingestion
 2. Data standardization
 3. Data access automation (with an API)
 4. Data publication on the web

In 2020, IoW and USGS began developing a key concept, Geoconnex, based on earlier USGS research

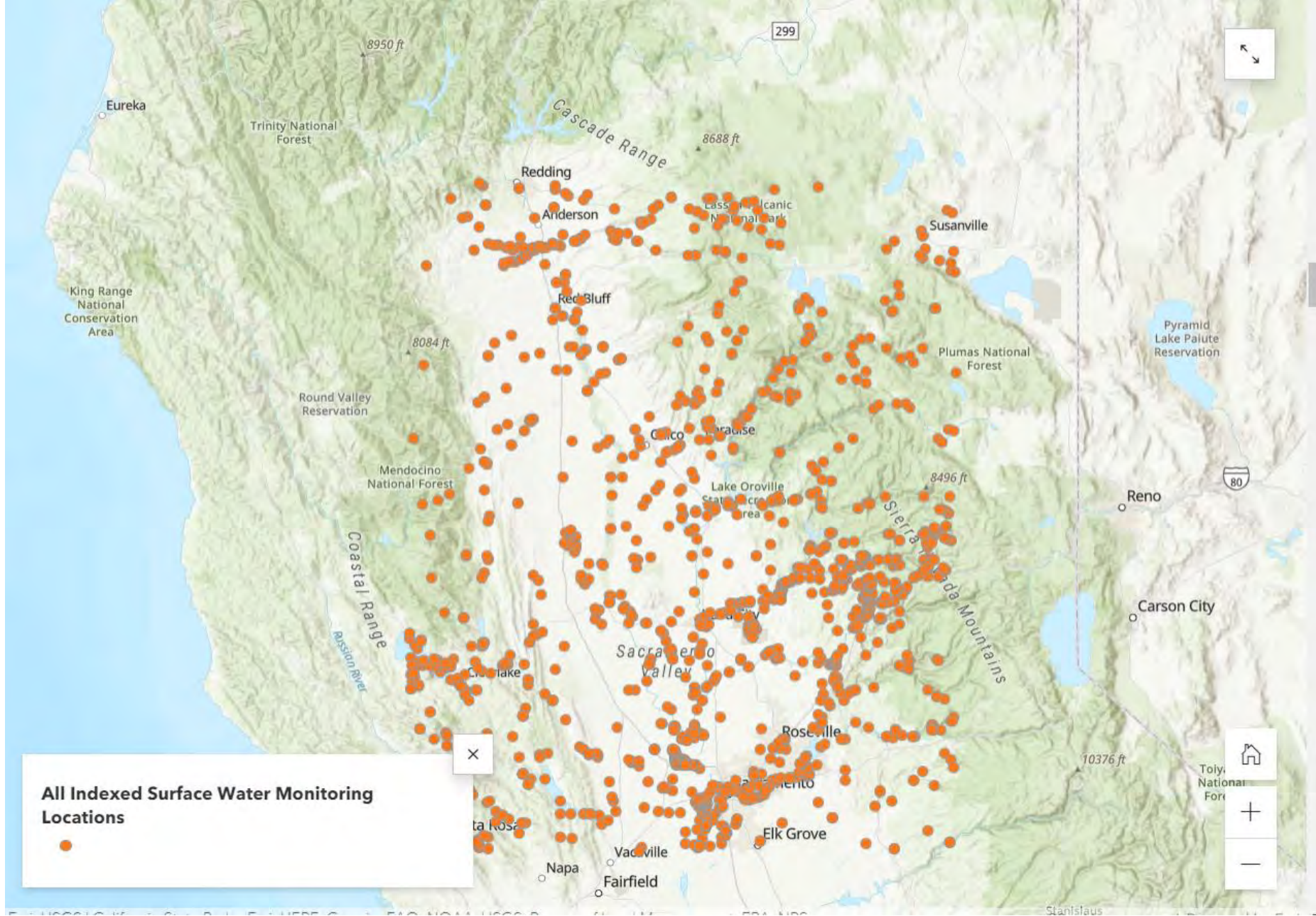


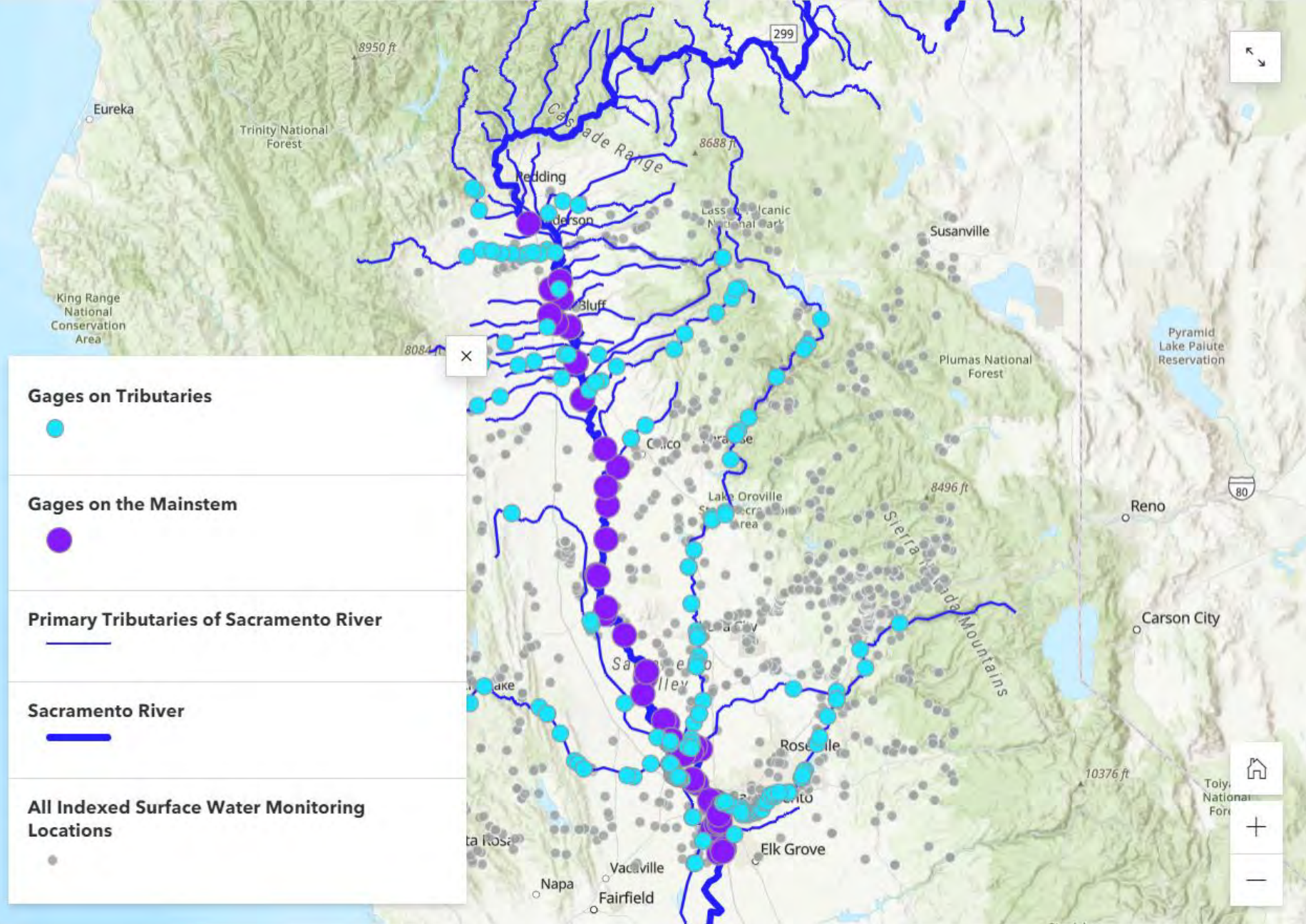
Approach: Geoconnex.us

The Core Idea: Metadata Management and Publication

Data providers should publish **metadata** that specifies in a standard format:

- What is the data about (e.g. a specific place, river, aquifer, piece of infrastructure, jurisdiction, etc)
- What variables does the data provider collect (e.g. water level, flow, temperature, salinity)
- The time period and frequency of data collection for each variable
- How that data was collected/modeled/forecasted and its quality
- Where to find the data
- How the data is formatted

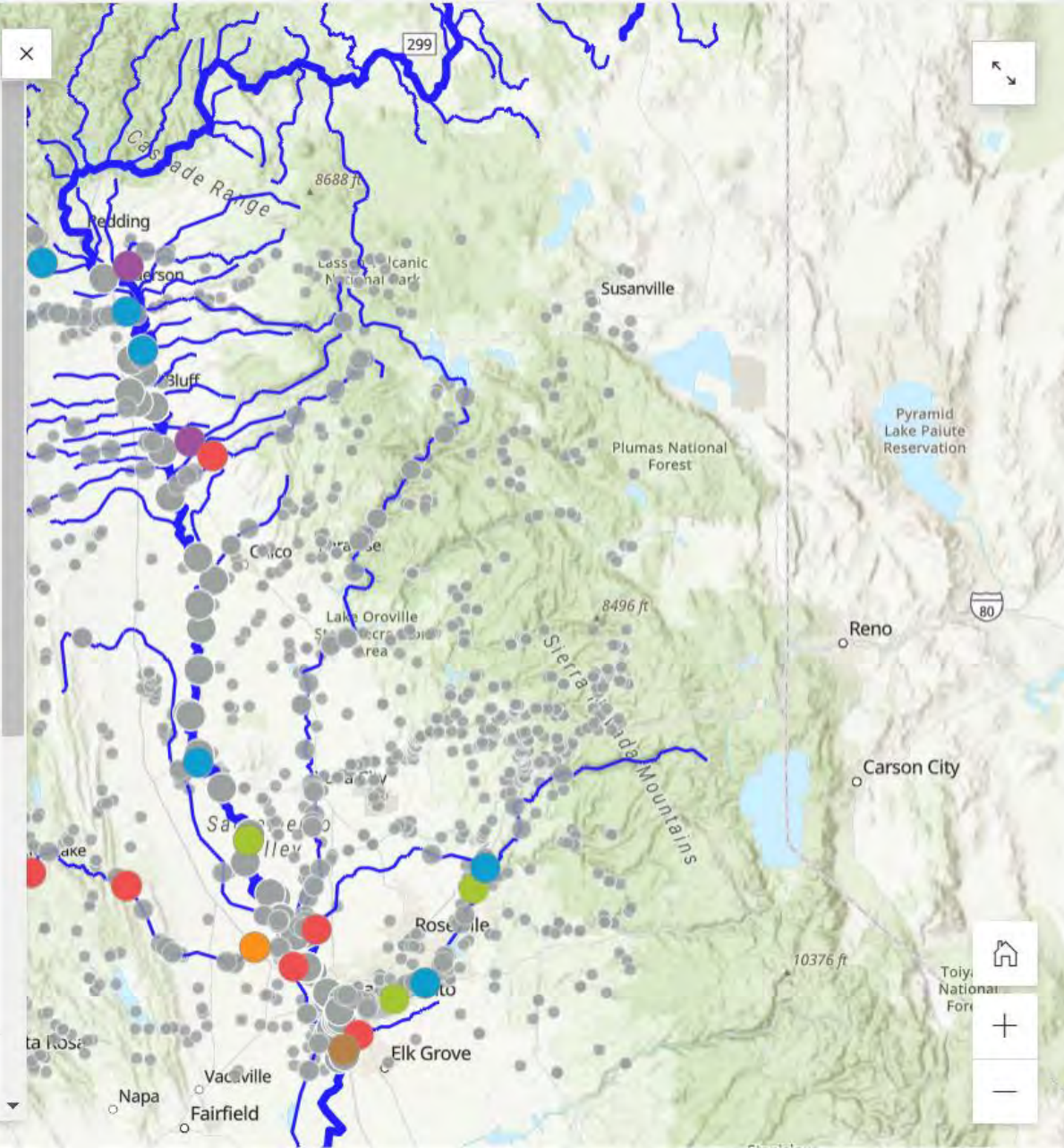




Gages on mainstem or tributaries with current data

- Gage height, feet
- Discharge, cubic feet per second
- Temperature, water, degrees Celsius
- Stream water level elevation above NAVD 1988, in feet
- Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +2.5 degrees, formazin nephelometric units (FNU)
- Chlorophyll fluorescence (fChl), water, in situ, concentration estimated from reference material, micrograms per liter as chlorophyll
- DCP battery voltage, volts
- Discharge, tide fltrd
- Dissolved organic matter fluorescence (fDOM), water, in situ, concentration estimated from reference material, micrograms per liter as quinine sulfate equivalents (QSE)
- Dissolved oxygen, water, unfiltered, milligrams per liter
- Other

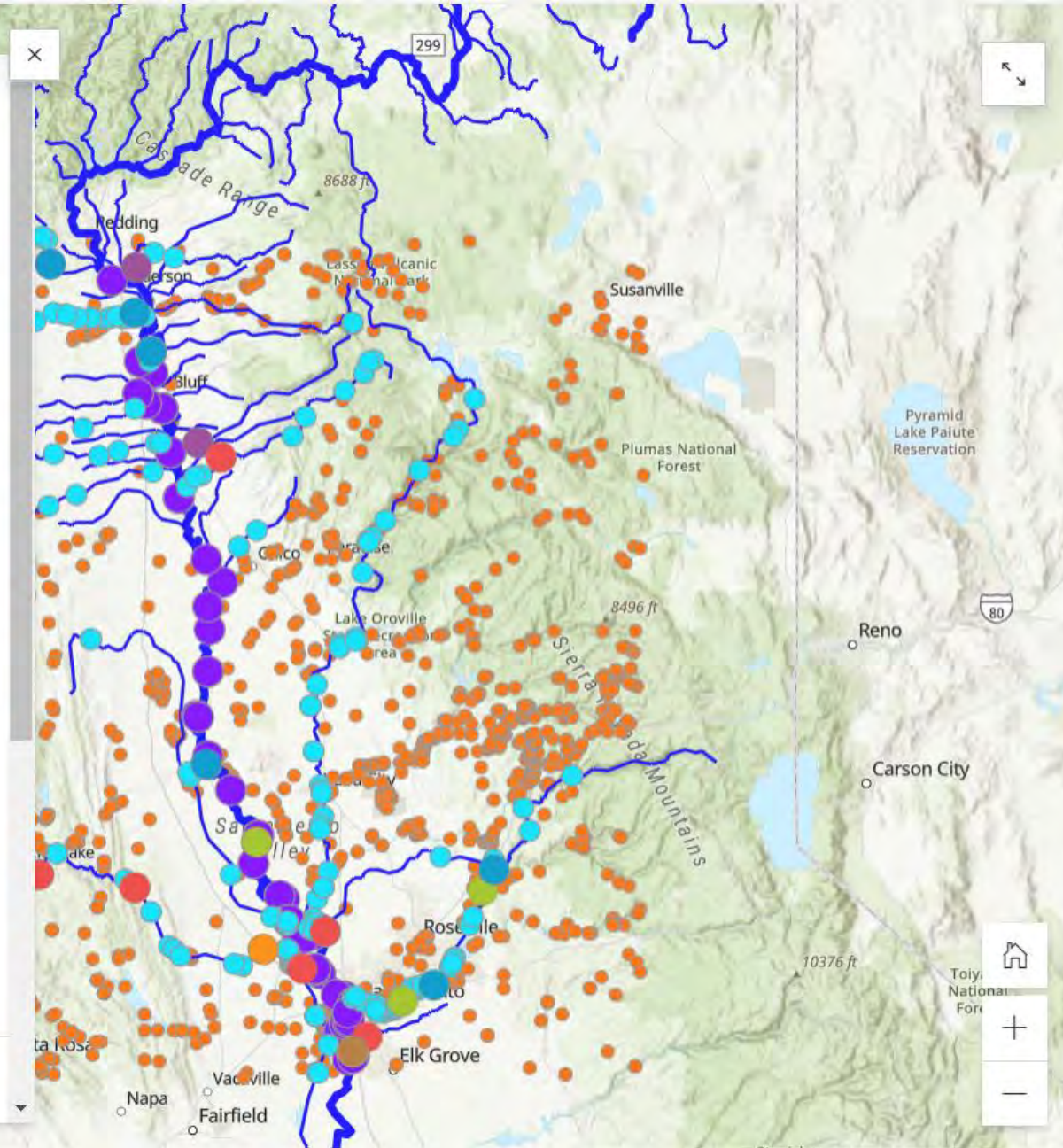
Gages on Tributaries



Gages on mainstem or tributaries with current data

- Gage height, feet
- Discharge, cubic feet per second
- Temperature, water, degrees Celsius
- Stream water level elevation above NAVD 1988, in feet
- Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 \pm 2.5 degrees, formazin nephelometric units (FNU)
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- Dissolved oxygen, water, unfiltered, milligrams per liter
- Other

Gages on Tributaries



Status of the Data

- Significant growth:
 - September 2021 - 1.1 million references
 - September 2022 - 3.3 million references
 - March 2023 – 5.8 million references!
- Utility and comprehensiveness enhance with more additions, providing greater value



Internet of Water COALITION

internetofwater.org

Faith Sternlieb

fsternlieb@lincolnst.edu

Demo: the Western States Water Data Access and Analysis Tool (WestDAAT)

2023 New Mexico Water Data Initiative Workshop
May 4, 2023

Adel Abdallah, PhD
WaDE Program Manager





Western States Water Council

- State government entity
- Advisory body to 18 Western Governors on water issues
- Works with the Western Governors' Association (WGA)
- Provides states collective voice
- Fosters state/state and federal/state collaboration
- Western Federal Agency Support Team (WestFAST)

Our mission is to ensure that the West has an adequate, secure, and sustainable supply of water of suitable quality to meet its diverse economic and environmental needs now and in the future.



New Mexico State Members

By virtue of position and pending Governor's appointment

MIKE HAMMAN

State Engineer

New Mexico Office of the State Engineer

Committees:

NATHANIEL CHAKERES

General Counsel

New Mexico Office of the State Engineer

Committees:

JOHN RHODERICK

Director, Water Protection Division

New Mexico Environment Department

Committees:

Former Members: John D'Antonio and Greg Ridgley

Credit

- **Julie M. Valdez**, Water Use & Conservation/Subdivision Review Bureau Chief, Office Of The State Engineer
- **Molly Magnuson** (retired)
- **David Hatchner**, GIS Manager, Information Technology Systems Bureau, Office Of The State Engineer
- **David Anderson**, Director, Water Rights Abstract Bureau. Office of the State Engineer
- **Stacy Timmons**, Associate Director, Hydrogeology Programs, New Mexico Bureau of Geology & Mineral Resources
- **Ed Rivera**, IT Water Data Business Liaison. Office of the State Engineer/Interstate Stream Commission | New Mexico
- **Matt Nelson**, Senior Water Resource Specialist. Water Use and Conservation Bureau
- **Daniel Estrada**, GIS Analyst. NM Office of the State Engineer
- **Rachel Hobbs**, Water Data Program Manager. New Mexico Bureau of Geology and Mineral Resources
- **Sandeep Patel**, Chief Information Officer. Office Of The State Engineer. (Left)
- **Emily Geery**, Planning; and Project Manager, SWCA Environmental Consultants
- **Jake Ross**, Lead Software Developer, New Mexico Water Data Initiative
- **Thushara Gunda**, Engineer/Data Scientist, Sandia National Laboratories

WESTERN GOVERNORS/WATER RESOURCES
WGA Annual Meeting/Water Data and Forecasting

June 21, 2019
Special Report #2353

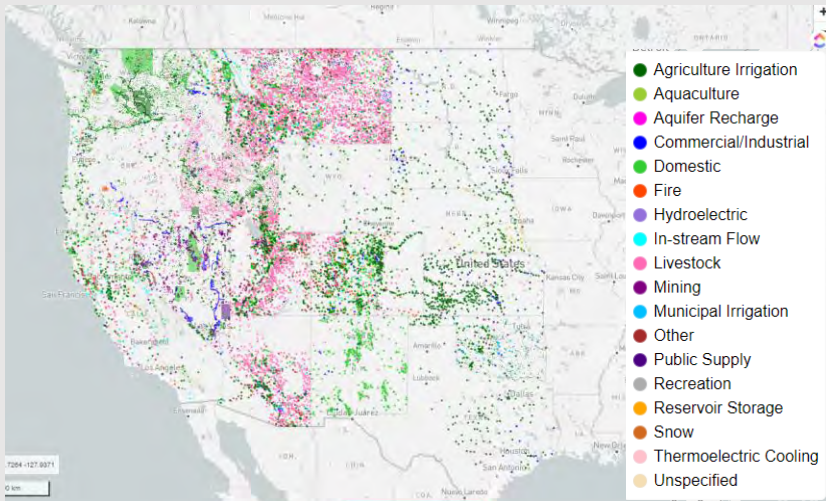
The Western Governors' Association (WGA) held its annual meeting on June 10-12, in Vail, Colorado. Twelve governors attended including Chairman David Ige (Hawaii), Vice Chair Doug Burgum (North Dakota), Jared Polis (Colorado), Brad Little (Idaho), Laura Kelly (Kansas), Steve Sisolak (Nevada), Michelle Lujan Grisham (New Mexico), Kate Brown (Oregon), Kristi Noem (South Dakota), Gary Herbert (Utah), Mark Gordon (Wyoming) and Lourdes Leon Guerro (Guam).

Secretary of the Interior David Bernhardt was the keynote speaker, addressing the governors in a question and answer session. He was introduced by Governor Polis as originally from Rifle, Colorado. Polis expressed thanks for

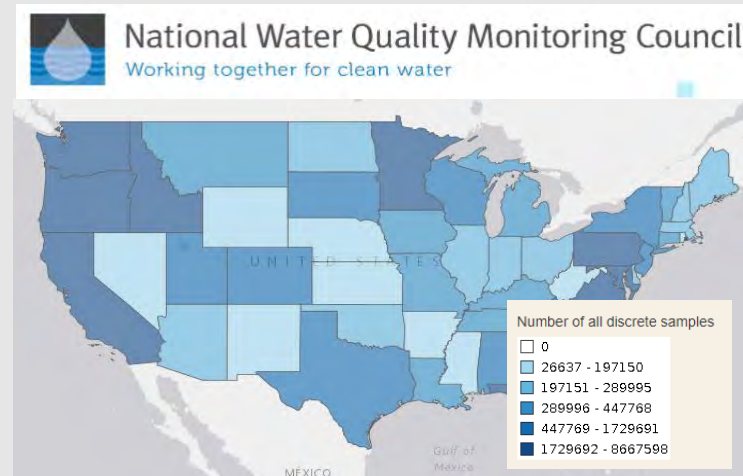
Governor Lujan Grisham declared that we don't effectively gather water data. She asked if WGA should be looking at regional data sets and techniques to provide data in real time to improve management and accuracy for making decisions. She also mentioned state aridification. Melton responded that state innovation is important and talked about the use of Landsat data sets by Idaho and Wyoming. He specifically referred to the WSWC WaDE and efforts to coordinate information. Grisham noted the need for data to help improve management of entire basins, including interstate river basins like the Upper Colorado River Basin. She added that it would help if all states used the same approach to gathering and presenting data. This would also have a significant benefit in communicating with the public. On February 14, Governor Lujan Grisham signed a bipartisan Water Data Act. [With Rep. Melanie Stansbury as the primary sponsor, the bill (HB651) ultimately passed the New Mexico House and Senate unanimously.]

Water Data Shared by WaDE

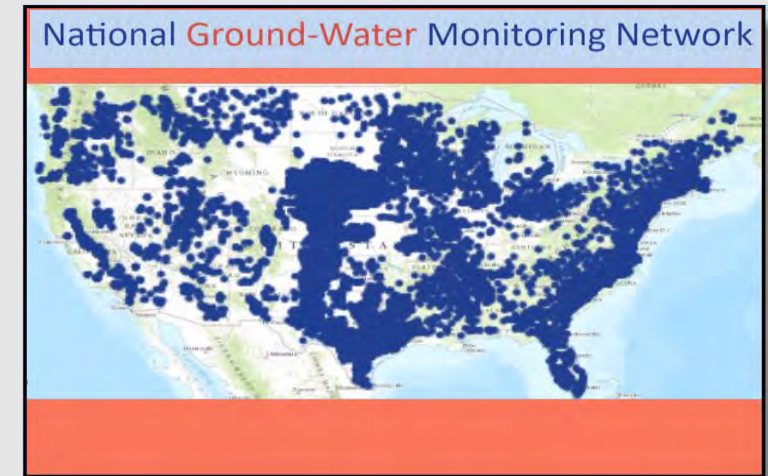
- ☐ Water rights
- ☐ Site-specific use and withdrawals
- ☐ Aggregated water budget estimates
- ☐ Regulatory overlays



Water Data Shared by Federal Agencies



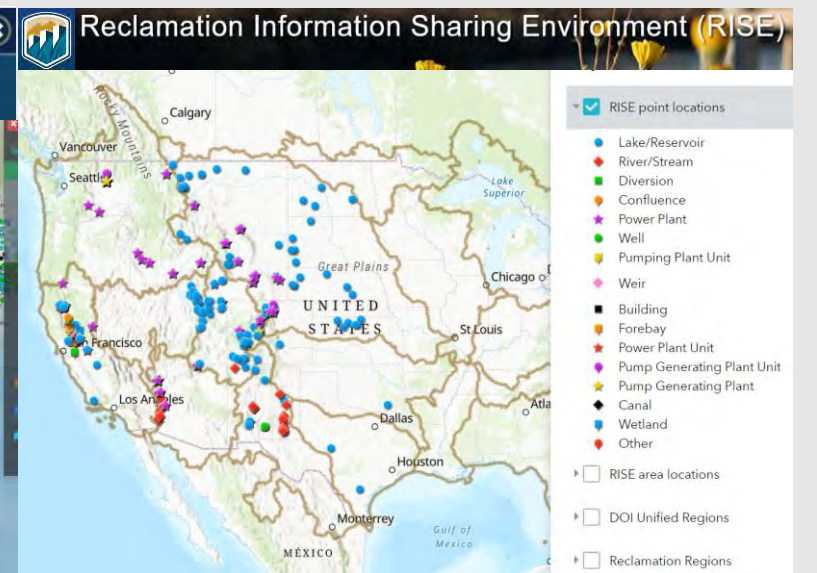
<https://www.waterqualitydata.us/coverage>



<https://cida.usgs.gov/ngwmn/index.jsp>



<https://dashboard.waterdata.usgs.gov>



<https://data.usbr.gov/rise-map>



Water Data Exchange (WaDE) Program

Transforming Western Water Planning, Management, and Policy by
Sharing States Water Data Since 2011

The WaDE Program is committed to assisting WSWC member states in publicly sharing water rights, allocation, supply, and use data through a common streamlined and standardized service that enables regional analyses to inform water resources planning and policies

WaDE Data is FAIR

Findable

Metadata and data should be findable for both humans and computers

Interoperable

Data needs to work with applications or workflows for analysis, storage and processing

F

A

I

R

Accessible

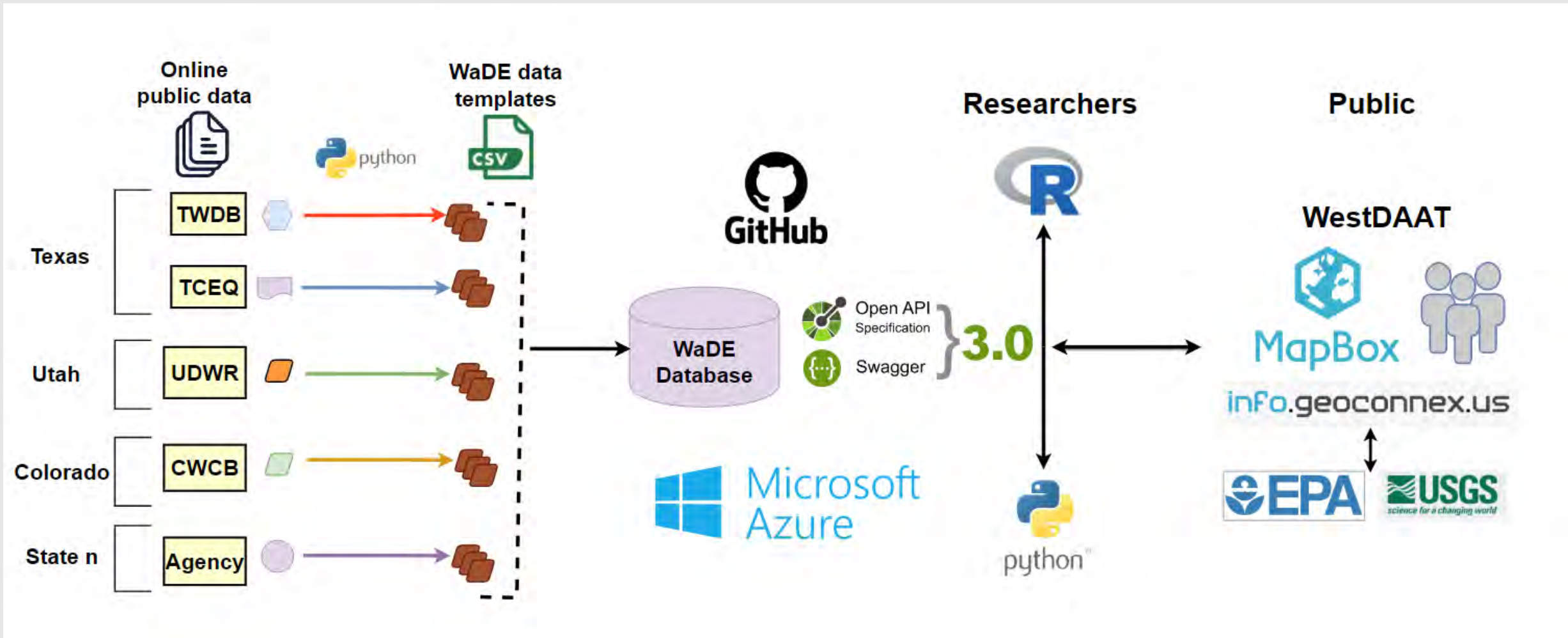
Once found, users need to know how the data can be accessed

Reusable

The goal of FAIR is to optimise data reuse via comprehensive well-described metadata

<https://www.scibite.com/solutions/enterprise-fair-data-mdm/>

WaDE 2.0 Architecture



WaDE Database and Water Data Shared through WestDAAT

	#	Data Type	Data	# States sharing	WaDE database	WestDAAT
Stage 1	1	Water Rights	Owner, point of diversion, purpose of use, permitted flow or volume, place of use, water source name and type, priority date	17	Yes	Yes
	2	State Regulatory Overlays	Basins closed to new surface water diversions, groundwater management areas, natural resources districts, interstate stream and river compacts, etc.	5	Yes	No
Stage 2	3	State Site-Specific time series	State reservoir and state streamgages or groundwater observation wells	10	Yes	No
			State public-supply water use	4	Yes	
			Historic withdrawals related to water rights (e.g. CA, ND).	2	No	
	4	Area Aggregated time series	Available water supply, withdrawal, demand and delivered water as well as consumption or consumptive use	9	Yes	No

WaDE 2.0 “Translates” Water Terminology

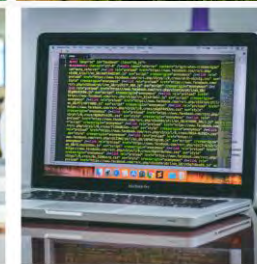
□32 + metadata terms

Irrigation Method, Customer Type, Crop Type, Site Type, Water Source Type, Water Allocation Type, Applicable Resource Type, Data Quality Value, Report Year Type, Water Quality Indicator, Water Allocation Basis, Method Type, Legal Status, Regulatory Status, Regulatory type

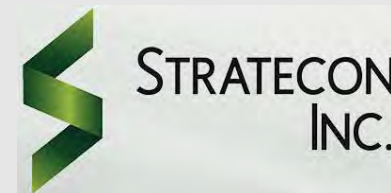
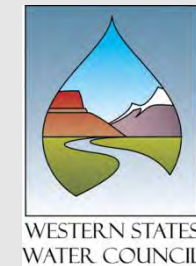
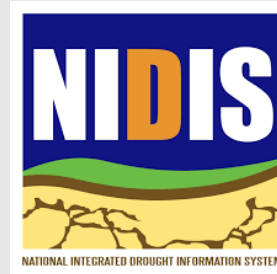
#	Key Term	# of States Unique Terms	# of WaDE Unique Terms
1	Beneficial Use Category	386	21
2	Water Source Type	56	7
3	Site Type	171	9
4	Legal Status	149	TBD

WestDAAT Use Cases and Personas

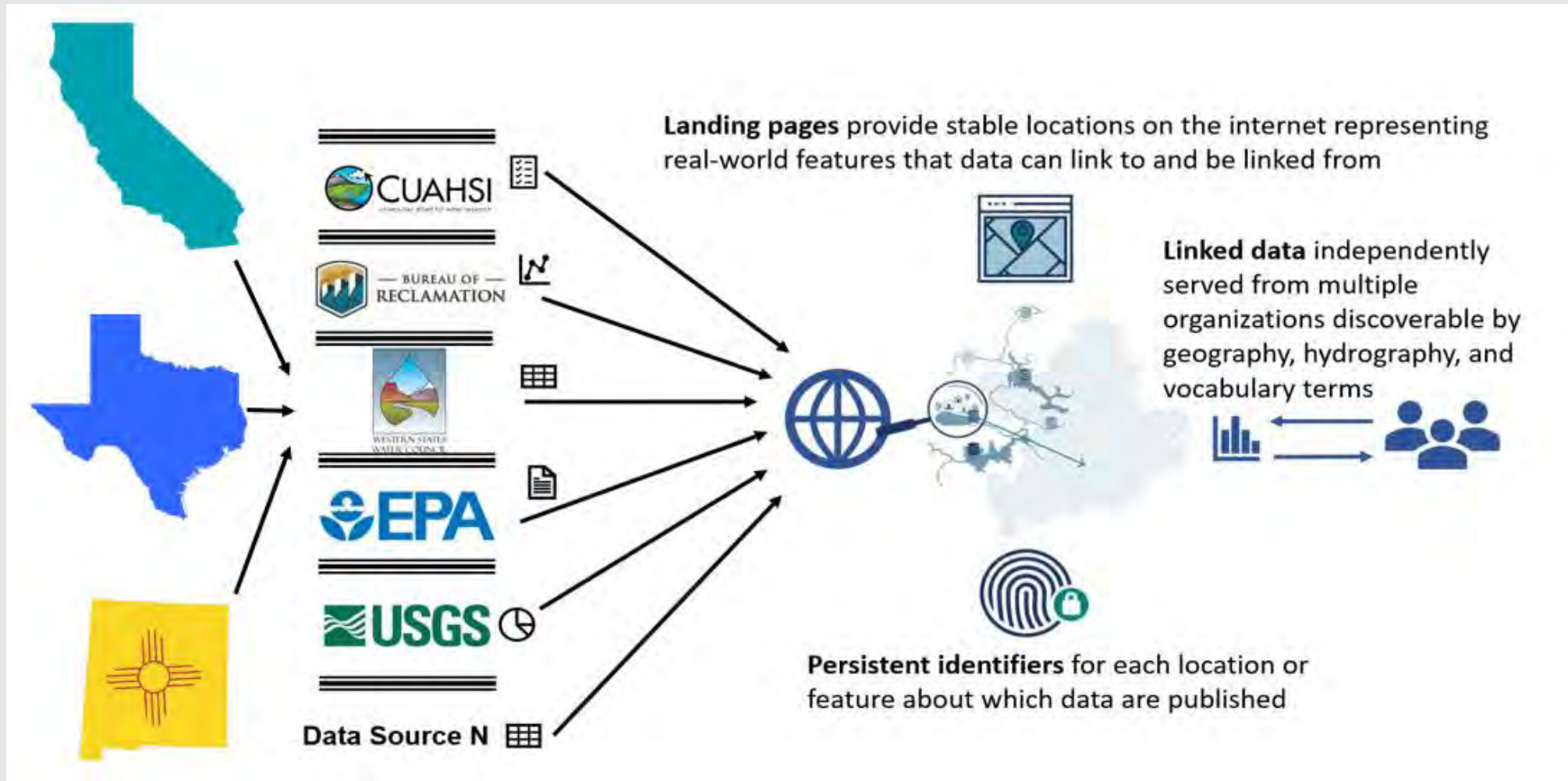
1. Gary the Governor
2. Stan the State Engineer
3. Maggie the River Basin Manager
4. Laila the Land Use Manager
5. Frank the Farmer
6. Ratibah the Researcher



<https://westernstateswater.org/wade-updates/2021/westdaat-use-cases-and-personas/>



WaDE Integration with Geoconnex and NLDI



Geoconnex <https://internetofwater.org/events/geoconnex-a-community-index-for-water-data/>

The Hydro Network-Linked Data Index (NLDI): <https://waterdata.usgs.gov/blog/nldi-intro/>

Funders, Collaborators & Partners



Water Foundation
Mitchell Foundation
BHP Foundation
MOORE Foundation
EPA Exchange Network

WSWC Member State Agencies



Support WaDE by Sharing Feedback

Water Data Exchange (WaDE) Data and Software Terms of Service

Water Data Exchange (WaDE) Program

Water Rights Data

Reset All Filters

COLOR AND SIZE TOOLS

Change Map Color Legend

Beneficial Use

Toggle Point Size

Default Flow Volume

Toggle View

Points of Diversion Places of Use Both

Map Layer

WATER RIGHT SELECTION FILTERS

Learn about WestDAAT filters

State

Select State(s)

Beneficial Use

Select Beneficial Use(s)

Water Source Type

Select Water Source Type(s)

Search Allocation Owner

34 3885 -81 8767

300 km

mapbox

WaDE | WSWC

Send Feedback

Please let us know your feedback about the Water Data Exchange Data (WaDE) Tool.

Contact us: <https://westernstateswater.org/wade/contact-us/>

First Name(Optional)

John

Last Name(Optional)

Doe

Email(Required)

email@domain.com

Comments(Optional)

Professional Organization(Optional)

Role(Optional)

How do you use the data?(Optional)

- ☐ Demand Management
- ☐ General Interest
- ☐ Planning
- ☐ Regulatory
- ☐ Research
- ☐ Reservoir Management
- ☐ Thermoelectric / Hydropower Management
- ☐ Water Markets
- ☐ Water Quality

Download Data

Agriculture Irrigation

Aquaculture

Aquifer Recharge

Commercial/Industrial

Domestic

Fire

Geothermal

Hydroelectric

In-stream Flow

Livestock

Mining

Municipal Irrigation

Other

Public Supply

Recreation

Reservoir Storage

Snow

Thermoelectric Cooling

Unspecified

Mapbox © OpenStreetMap. Improve this map

Feedback

<https://westernstateswater.org/wade/westdaat-terms-of-service>

Thank You!

WestDAAT is Public

<https://westdaat.westernstateswater.org/>



Adel Abdallah, WaDE Program Manager

Ryan James, WaDE Data Analyst

Western States Water Council

adelabdallah@wswc.utah.gov



Live Demo

WestDAAT

<https://westdaat.westernstateswater.org/>

Prototypes

1. Reservoir and Gage Data
<https://waterdataexchangewswc.shinyapps.io/SiteSpecificReservoirAndObservationSiteDemo/>
2. Aggregated Area Water Budget Data
<https://waterdataexchangewswc.shinyapps.io/AggregatedBudgetWaterUseDemo/>
3. Public Supply Water Data
<https://waterdataexchangewswc.shinyapps.io/SiteSpecificPublicSupplyWaterDemo/>

What is a State Water Right?

- The term is broadly applied to include state-granted rights to the use of public waters, via public and private appropriations, permits, allocations, allotments, and reservations.
- Attributes of a state water right usually include the owner, point of diversion or withdrawal, place of use, the purpose of use, a limit on the flow rate or total quantity consumptively used (sometimes including a customary water duty), and a priority date.
- State water rights in western states are predominantly administered under the Doctrine of Prior Appropriation, generally governed by priority date, “first in time, first in right,” and limited to reasonable beneficial use. Waste is prohibited, as is an injury to prior senior water rights, and water not “used” is subject to forfeiture, “use it or lose it.” The latter was by design intended to limit speculation, ensure applicants had the means to develop a water right and maximize the economic benefit to the state. Modern adjustments have been made to recognized instream flows and other environmental or recreational non-consumptive uses, as well as allow for water banking, leasing, and other water marketing mechanisms to be applied on a temporary basis.
- Consumptive water use is a component of reasonable beneficial use and generally refers to irrecoverable losses due to conveyance losses, evaporation, crop evapotranspiration, and other depletions.
- Of note, domestic wells may or may not require state water right though withdrawals may be limited; and groundwater use managed under correlative rights or proportionate use doctrine, as in some western states, limits landowners to a reasonable share of the total water supply.

Introduction to



CUAHSI

allied for water science

Data Infrastructure

CUAHSI

Allied for Water Science

CUAHSI is the Consortium of Universities for the Advancement of Hydrologic Sciences, Inc.

- We are a non-profit funded in part by the National Science Foundation
- CUAHSI offers both education and outreach services, and data services
- CUAHSI administers and maintains a variety of data resources for the water community



CUAHSI Services

CUAHSI has two branches, Data Services and Education and Outreach services.

CUAHSI Data Services Offers:

- **Two Repositories**
 - HydroShare –File agnostic
 - HIS-timeseries specific
- **Apps and Compute**
 - MATLAB online
 - CUAHSI JupyterHub
 - NWM Subsetter
- A well documented API
- A well documented HydroShare Python Client, HScient



CUAHSI Education and Outreach Offers:

- Grants and Fellowships
- Workshops and Trainings
- National Water Center Summer Institute
- Cyberseminar Series
- CUAHSI Virtual University

Overview

A quick look at information flow in this session

- HydroShare
 - How data is organized in HydroShare
 - Data access throughout the data lifecycle
 - Overview of HydroShare Features
- CUAHSI Compute services
 - MATLAB Online
 - CUAHSI Jupyterhub
 - CUAHSI Domain Subsetter
- Hydrologic information Systems (HIS)
 - Current functionality
 - Plans for HIS modernization



F.A.I.R. Data Standards

F.A.I.R.

F. -findable

F1: data are assigned a globally unique and persistent identifier

A. -accessible

A1: Metadata are retrievable by their identifier using a standardized communications protocol

I. -Interoperable

I1: Metadata use a formal, accessible, shared, and broadly applicable language for knowledge representation

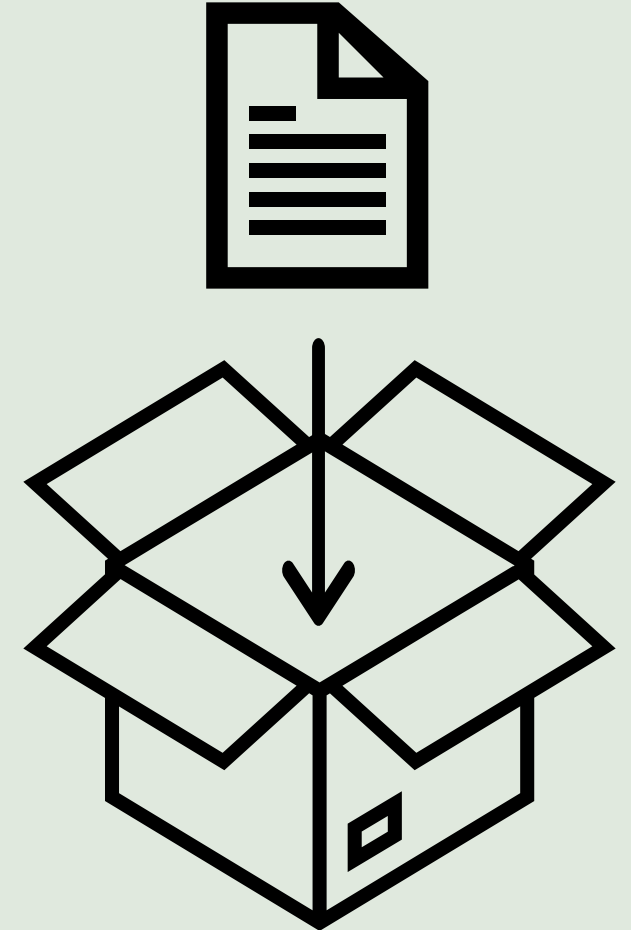
R. -reusable

R1: Metadata are richly described with a plurality of accurate and relevant attributes

HydroShare: data organization

In HydroShare, data is stored within “Resources”

- A resource is the primary unit of digital content, and discovery.
- **It is essentially a landing page for your data** that walks other users through the metadata and content in an understandable manner.
- **Data Access:** A resource can occupy one of several access levels depending on user needs
- At all stages, your resource has a persistent and globally unique URL



← → ↺


hydroshare.org/resource/2881f7ae08a34e66906a7bd1593fc838/

🏠 ☆ ⚙️ 📄 🗑️

Update

Adobe Acrobat All... HydroShare Supp... Find, Analyze and... HydroShare Pytho... FAIR Principles -... CUAHSI hscient · PyPI Issues · hydroshar... ADP Cluster Distributio... CZCN Cluster We...

»

HOMEMY RESOURCESDISCOVERCOLLABORATEAPPSHELP

Create👤🔔

Analyzing Air Temperature using Jupyter Notebooks

Open with...📺

📄📄

Authors:Anthony Michael Castronova ⓘ

Owners:Anthony M. Castronova

Type:Resource

Storage:The size of this resource is 2.4 MB

Created:Jul 24, 2020 at 4:29 p.m.

Last updated:Feb 22, 2021 at 5:29 p.m. Anthony M. Castronova

Citation:See how to cite this resource

Sharing Status:Public

Views:756

Downloads:102

+1 Votes:Be the first one to 🗳️ this.

Comments:No comments (yet)

Abstract

The purpose of this resource is to demonstrate how the CUAHSI JupyterHub platform can be used to perform basic hydrologic data analysis. Temperature data was collected from the NOAA Global Historical Climatology network for two sites in the greater Seattle area. These data are organized using Python classes, and plotted in various ways to demonstrate common data analysis steps.

For more information about the GHCN data included in this resource, see; <https://docs.opendata.aws/noaa-ghcn-pds/readme.html>

Subject Keywords

temperatureExampleJupyterHubGHCNjupyter

Coverage

What Type of Data Can be Uploaded

Any type of water data can be uploaded

- HydroShare will accept any type of file (any extension)
- Some file types will be automatically recognized (shape files, geoTIFF, netCDF)
- Each user is automatically allocated 20 GB of storage
- More storage is available upon request to help@cuahsi.org
- README.md or README.txt files will be recognized by HydroShare and displayed below the contents section.

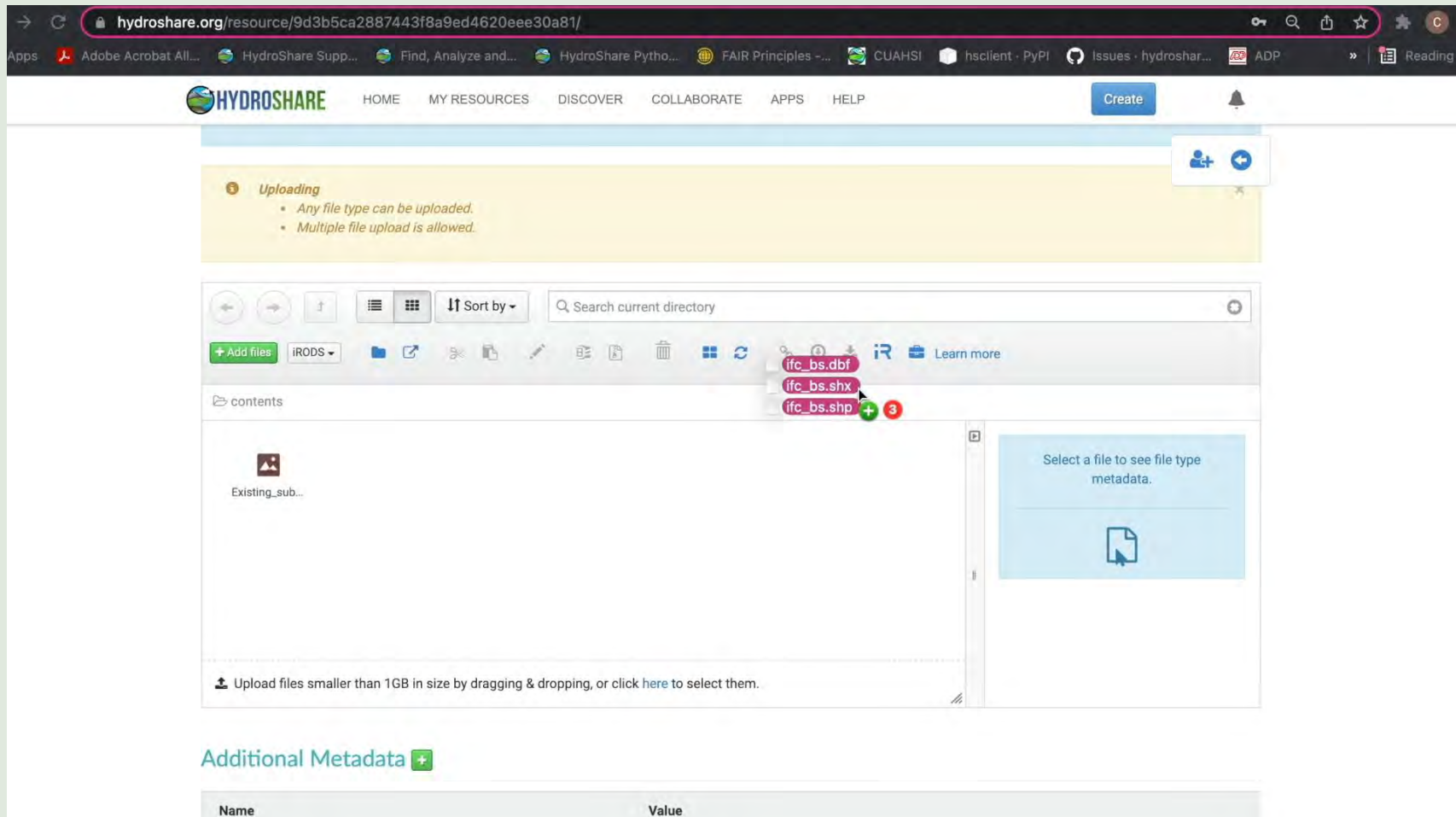


Uploading data, content types

Drag and drop data into the contents section, add links to external web resources, or upload large file using iRods

- **Geographic Features:** The Geographic Feature content type is a set of point, line, or polygon features stored in the ESRI shapefile format, which is comprised of multiple physical files. At minimum, the .dbf, .shp, and .shx files must be included.
- **Geographic Rasters:** Geographic raster data are commonly used for representing imagery, digital elevation, and other spatially distributed phenomena. A raster dataset can have a single or multiple bands (or layers) of data. A geotif file will be automatically recognized by HydroShare
- **Multidimensional Data:** HydroShare uses the Network Common Data Form (NetCDF) specification for multidimensional data. Multidimensional space-time data is commonly used for hydrological modeling (e.g., precipitation or surface air temperature that vary in space and time). HydroShare will automatically recognize netcdf file.
- **Timeseries Data:** Time series content (e.g., multiple observations made over time at a fixed monitoring point like a stream gage, water quality monitoring site, or weather station) can be stored in HydroShare using an Observations Data Model Version 2 (ODM2) format SQLite file.
- **Code:** With code include: Descriptions of the code's operations and functions (README file), Input files needed to run the code, Output files (if appropriate), Inputs and outputs should be described, including formatting.

Content Types Cont.



The screenshot displays the HydroShare web interface. At the top, the URL bar shows `hydroshare.org/resource/9d3b5ca2887443f8a9ed4620eee30a81/`. The navigation bar includes links for HOME, MY RESOURCES, DISCOVER, COLLABORATE, APPS, and HELP, along with a 'Create' button and a notification bell. A yellow banner with an 'i' icon contains the text 'Uploading' and two bullet points: 'Any file type can be uploaded.' and 'Multiple file upload is allowed.'

Below the banner is a file management toolbar with icons for navigation, file operations, and a search bar labeled 'Search current directory'. A green '+ Add files' button is visible. A dropdown menu is open, showing a list of files: `ifc_bs.dbf`, `ifc_bs.shx`, and `ifc_bs.shp`, with a red '3' indicating the total count. The main content area shows a folder named 'Existing_sub...' with a thumbnail icon. To the right, a blue box prompts the user to 'Select a file to see file type metadata.' with a document icon.

At the bottom, there is a section titled 'Additional Metadata' with a green '+' icon. Below this is a table with two columns: 'Name' and 'Value'.

Name	Value
------	-------

Data Access Levels in HydroShare

Sharing Status:

- **Private (default):** Only owners and added viewers can view
- **Discoverable:** Only metadata is viewable, can be found on discover page
- **Public:** All metadata and content viewable and downloadable.
- **Published:** Discoverable, has a DOI, content is immutable.



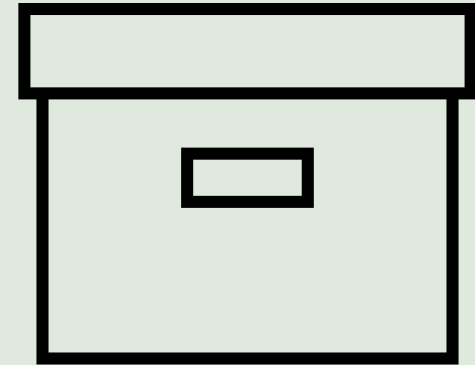
Users can add other users to their resources as:

- **Owners:** can take any action on a resource
- **Editors:** Can edit a resource
- **Viewers:** can view the resource but cannot make any changes
- **Another Status: quota holder**

Collections in HydroShare

In HydroShare, Resources can be grouped into collections

- Collections are another way to organize and link related resources
- A collection is a landing page for a list of resources with its own metadata template
- Collections have their own URLs, Identifiers, and sharing statuses
- Collections can be published if all resources within the collection are published.
- The contents of a collection can be gathered using our python client or API



Linked Data in HydroShare

Related Geospatial Features

The feature operates using the user defined spatial coverage of the resource, and allows users to search for related features within an existing library of features

The screenshot displays the 'Related Geospatial Features' interface in HydroShare. At the top, a header reads 'Related Geospatial Features' with a subtitle 'This HydroShare resource is linked to the following geospatial features'. Below this is an informational box explaining the 'Geoconnext, through the Internet of Water' field and its purpose for increasing data fairness and discoverability. The main interface is divided into two sections: '1. Choose a collection to search...' and '2. Select related features to add to resource metadata'. In the first section, a search box contains 'Four-digit Hydrologic Subregion (hu04)' and a dropdown menu lists several collections including 'Two-digit Hydrologic Regions (hu02)', 'Four-digit Hydrologic Subregion (hu04)', 'Six-digit Hydrologic Basins (hu06)', 'Eight-digit Hydrologic Subbasins (hu08)', 'Ten-digit Watersheds (hu10)', and 'National Aquifers of the United States from USGS National Water Information System National Aquifer code list. (nat_aq)'. A 'Hide Map' button is visible. The second section shows 'Mid Atlantic Region [hu02/02]' as the selected feature. To the right, a map of the United States is shown with a black outline highlighting the Mid Atlantic Region, which includes parts of New York, Pennsylvania, Delaware, Maryland, and Virginia. The map includes standard navigation controls like zoom in/out and a search bar at the top right that says 'Search using visible map bounds'. At the bottom, there is a footer for 'Leaflet | Map data © OpenStreetMap contributors' and a prompt to 'Select a feature for more information.'

Publishing

Data stored in HydroShare can receive a DOI

Within HydroShare, the terms “**Published**” and “**Public**” take on the following meanings:

Published: Has a digital object identifier (DOI) and an immutable set of content files which cannot be changed. Can be discovered on the discover page and Google dataset search. Viewers can download the contents of your resource from the resource landing page.

Public: Can be discovered on the HydroShare Discover page and Google dataset search, and viewers can download the contents of your resource from the resource landing page, but does not have a digital object identifier (DOI). It has a persistent URL and a globally unique alphanumeric ID.

HydroShare Communities and Groups

HydroShare has several methods of enable group collaboration

Groups

- Groups is a feature that allows users to more easily share resources with collaborators
- Creates a shared landing page for group resources
- Groups can be viewers and editors of resources, but not owners
- Anyone can create a group

Communities

- A group of groups
- A community can be created for you by the HydroShare team
- Allows groups to share resources to a larger organization while retaining ownership at the depositor level.

CUAHSI Computing

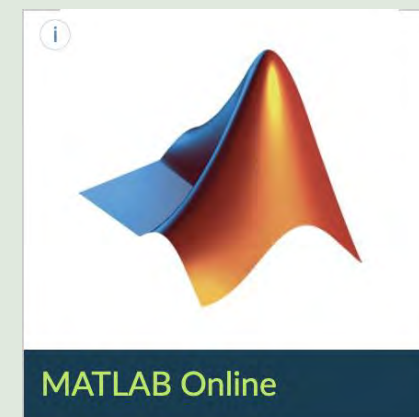
Join the [CUAHSI Cloud Computing Group](#) to use Compute services

Using CUAHSI Apps

- **MATLAB Online:** a MATLAB cloud computing environment
- **CUAHSI Jupyterhub:** a cloud computing environment with several server options
- **HydroShare on Jupyter:** Allows users to make changes to notebooks stored in HS
- **Model Domain Subsetter**
 - Allows users to subset the national water model easily and quickly


Server Options

- ☐ **Python - v3.8**
This is a general purpose scientific computing environment that is pre-configured with common scientific libraries such as scipy, pandas, geopandas, sympy, scikit-learn, matplotlib, ulmo, landlab, gdal, xarray, TauDEM, hscient, dataretrieval, etc.
- ☐ **R v3.6.1 - Lab Interface**
This is a general purpose scientific computing environment for the R programming language. It comes pre-configured with common tools and libraries jsonio, nscdf4, ggmap, grass, dataRetrieval, WaterML, and R Studio
- ☐ **RStudio - R v3.6.1**
This is a general purpose scientific computing environment for the R programming language. It comes pre-configured with common tools and libraries jsonio, nscdf4, ggmap, grass, dataRetrieval, WaterML, and R Studio
- ☐ **SUMMA Modeling**
This an environment built with the SUMMA model and supporting tools pre-installed. For more information on the SUMMA model, visit the project [webpage](#).
- ☐ **WRF-Hydro - NWM v2.0**
This is environment is configured for running the WRF-Hydro model.
- ☐ **CSDMS Workbench**
This environment includes libraries, models, and tools in the CSDMS Workbench, from the [Community Surface Dynamics Modeling System](#). Products include [Landlab](#), the Python Modeling Tool ([pymt](#)), and a collection of pymt-compatible numerical models, along with standard scientific libraries such as scipy, pandas, and matplotlib.
- ☐ **HydroLearn - Intelligent Earth**
This environment configured for the HydroLearn: Intelligent Earth course ([edx.hydrolearn.org](#)). This includes the Python and R programming languages along with a variety of machine learning and data science libraries.



Compute with HydroShare

CUAHSI JupyterHub and MATLAB Online are tightly integrated with HydroShare, and can be launched from the resources landing page of resources containing code



HYDROSHARE HOME MY RESOURCES DISCOVER COLLABORATE APPS HELP Create

Analyzing Air Temperature using Jupyter Notebooks

Authors: [Anthony Michael Castronova](#)
Owners: [Anthony M. Castronova](#)
Type: Resource
Storage: The size of this resource is 2.4 MB
Created: Jul 24, 2020 at 4:29 p.m.
Last updated: Feb 22, 2021 at 5:29 p.m. [Anthony M. Castronova](#)
Citation: [See how to cite this resource](#)

Sharing Status: Public
Views: 849
Downloads: 102
+1 Votes: Be the first one to [+1](#) this.
Comments: [No comments \(yet\)](#)

Open with...

- Data Series Viewer
- View in Model My Watershed
- MATLAB Online
- CyberGIS-Jupyter for Water
- CUAHSI JupyterHub**
- SWIM: Sustainable Water through Inte...
- THREDDS Data Server

Abstract

The purpose of this resource is to demonstrate how the CUAHSI JupyterHub platform can be used to perform basic hydrologic data analysis. Temperature data was collected from a network for two sites in the greater Seattle area. These data are organized using Python classes, and plotted in various ways to demonstrate common data analysis steps.

For more information about the GHCN data included in this resource, see: <https://docs.opendata.aws/noaa-ghcn-pds/readme.html>

Subject Keywords

temperature Example JupyterHub GHCN jupyter

The HydroShare RESTful API

What can the API be used for

- The API
 - Download data from a resource
 - Push data to a resource
 - Programmatically update ongoing datasets
 - Integrate external apps with HydroShare
 - Documentation:
<https://www.hydroshare.org/hsapi/>

The screenshot shows the Hydroshare API v1 documentation page. At the top, it says "Hydroshare API v1" with a small "v1" badge. Below this, it lists the base URL as "www.hydroshare.org/hsapi" and provides a link to "https://www.hydroshare.org/hsapi/?format=openapi". There are links for "Hydroshare Rest API", "Terms of service", and "Contact the developer".

On the right side, there are buttons for "Django", "ClaraCogswell", "Django Logout", and "Authorize".

Below the header, there is a "Schemes" dropdown menu set to "HTTPS".

The main content area is titled "Filter by tag" and lists two categories: "modelprogram" and "resource".

Under "modelprogram", there are two entries:

- GET /modelprogram/template/meta/schema/{schema_filename} modelprogram_template_meta_schema_read
- GET /modelprogram/template/meta/schemas/ modelprogram_template_meta_schemas_list

Under "resource", there are six entries:

- GET /resource/ resource_list
- POST /resource/ resource_create
- PUT /resource/accessRules/{id}/ resource_accessRules_update
- GET /resource/content_types/ resource_content_types_list
- POST /resource/data-store-add-reference/ resource_data-store-add-reference_create
- POST /resource/data_store_edit_reference_url/ resource_data_store_edit_reference_url_create

HSClient

```
!pip install hsclient
```

A python client for interacting with HydroShare in an object-oriented way.

Basic Operations

- Create a new resource
- Retrieve an existing resource
- Deleting a Resource
- Download an Entire Resource

File Operations

- Authenticating with HydroShare
- Create a New Empty Resource
- Resource File Handling
- Searching for Files within a Resource
- Downloading Files from a Resource

Metadata Operations

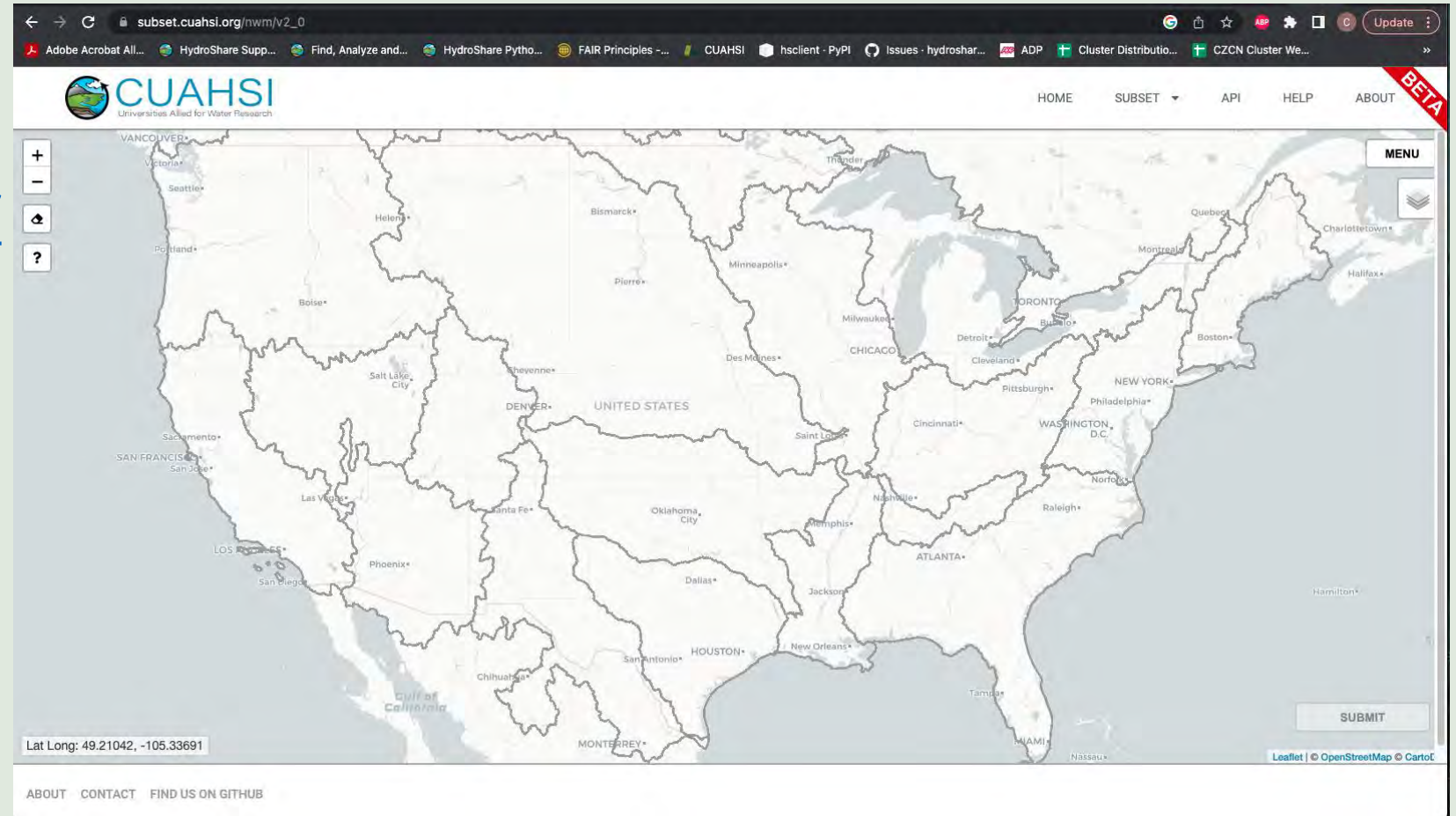
- Edit Title and Abstract
- Edit Subject Keywords
- Add and alter spatial and temporal coverage
- Add funding agencies

The CUAHSI Domain Subsetter

The purpose of this application is to introduce a collaborative effort for preparing, publishing, and sharing subsets of the National Water Model input data at watershed scales

Available at:

<https://subset.cuahsi.org/>



Hydrologic Information Systems

HIS, a data repository for timeseries data, is currently undergoing a modernization

- **HIS is for Timeseries data**
 - [HydroServer](#) (upload), [HydroClient](#) (discover)
- Data is uploaded as a CSV
- Upload templates can be downloaded from <https://hydroserver.cuahsi.org/>
- Controlled vocabularies in effect
- Public and published data is discoverable on HydroClient
- Data can be published (DOI)
- HIS remains available throughout the modernization
- NOTE: Currently HIS operates on ODM, but the new system will not rely on a strict database structure.



Standard Upload

Upload Sites, Variables, Methods, Sources, Quality Control Levels and Data Values

- 📄 [Formatting Template](#)
- 📄 [Formatting Guide](#)
- 📄 [Uploading Guide](#)

Advanced Upload

Upload Sites, Variables, Methods, Sources, Quality Control Levels, Data Values and additional optional metadata tables

- 📄 [Formatting Template](#)
- 📄 [Formatting Guide](#)
- 📄 [Uploading Guide](#)

Status

Last Modified: 01/26/22 11:36:50 +00:00 [i](#)

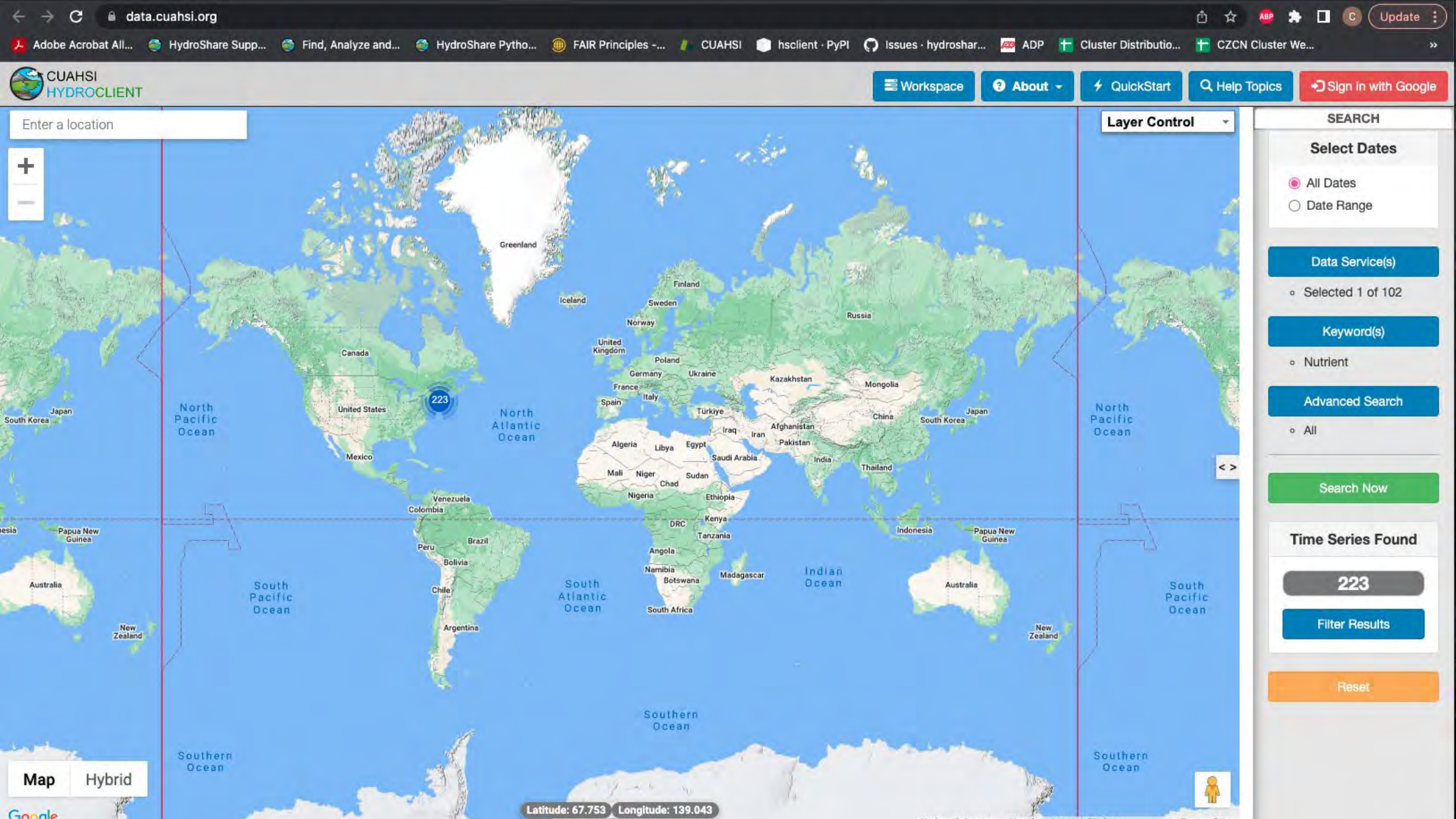
Last Published: unknown [i](#)

[Request First Time Publication](#) [i](#)

Number of values

Sites	0
Variables	0
Sources	1
Methods	1
Data Values	0
Timeseries	0

Offset Types	0
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More Information

There are many resources to help users navigate HydroShare

Written Documentation is available at <https://help.hydroshare.org/>

A series of short YouTube videos called HydroShare How To is available here:
[HydroShare How To](#)

If you would like an introduction to HydroShare Webinar or hands on workshop for your organization, feel free to reach out!

Questions/issues: Contact
help@cuahsi.org or
ccogswell@cuahsi.org

Water Planning: State, Regional & 50 Year

Sara Goldstein

sara.goldstein@ose.nm.gov

NM Interstate Stream Commission

Senior Water Planner

New Mexico Water Data Initiative Workshop

5/4/2023



**Smart Water Management –
Sustainability –
Equity –**

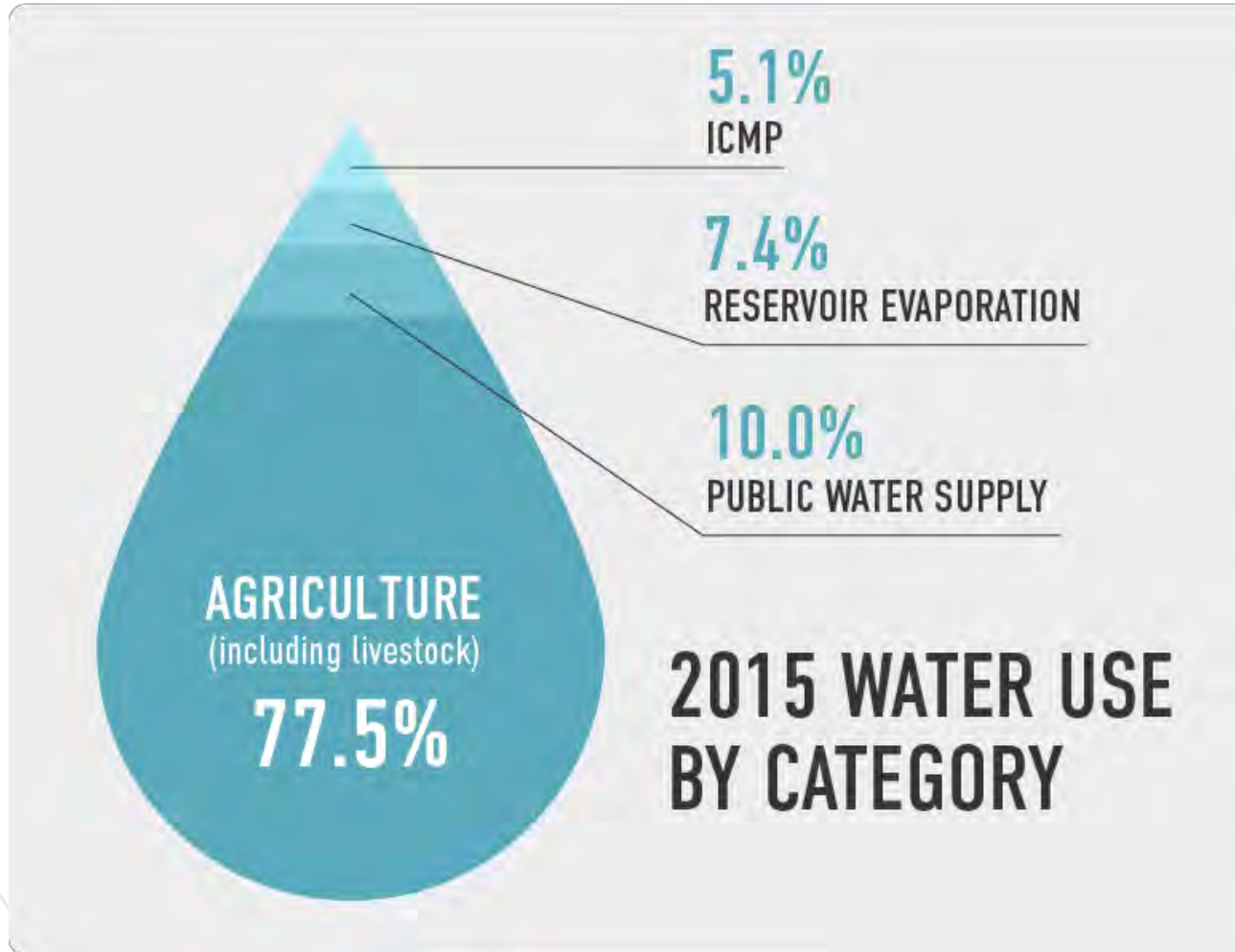


Water Planning in NM – Presentation Outline

- **Challenges**
 - The Status Quo
 - Climate Change
 - Water Data & Values
- **Planning Efforts**
 - The Interstate Stream Commission
 - 50-Year Water Planning
 - State Water Planning
 - Regional Water Planning



Water Planning Challenges: The Status Quo



- Agriculture is the largest water user in New Mexico
- Water Rights are administered based on priority dates
- Levels of groundwater use are not sustainable
- Interstate compacts and endangered species flow requirements exist

Climate Change: National Water Stress Index

- The eastern half of the country can expect more water,
- the west can expect more water stress.

Projected change in water stress by mid-century (2040-2061) compared to historical average (1900-2668 1970). Lindsey, 2013.

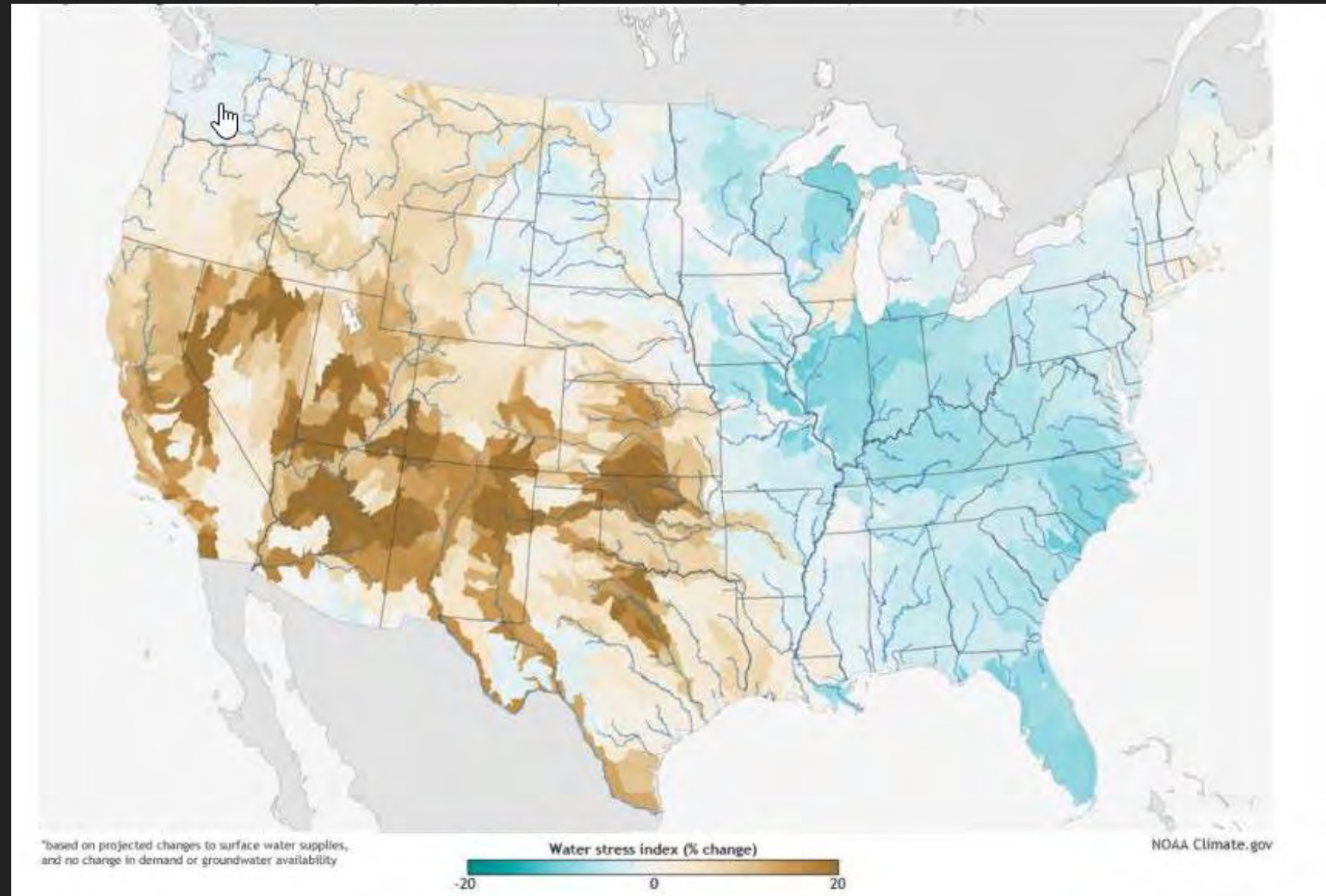


Image from Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources

NEW MEXICO'S WATER FUTURE = *DRIER / MORE VARIABLE*

- Anticipated continued changes in climate will mean *less water is available* while demands continue to increase.
- Given this new reality, we must plan ahead to ensure continuing economic development and the needs of all New Mexicans are met.

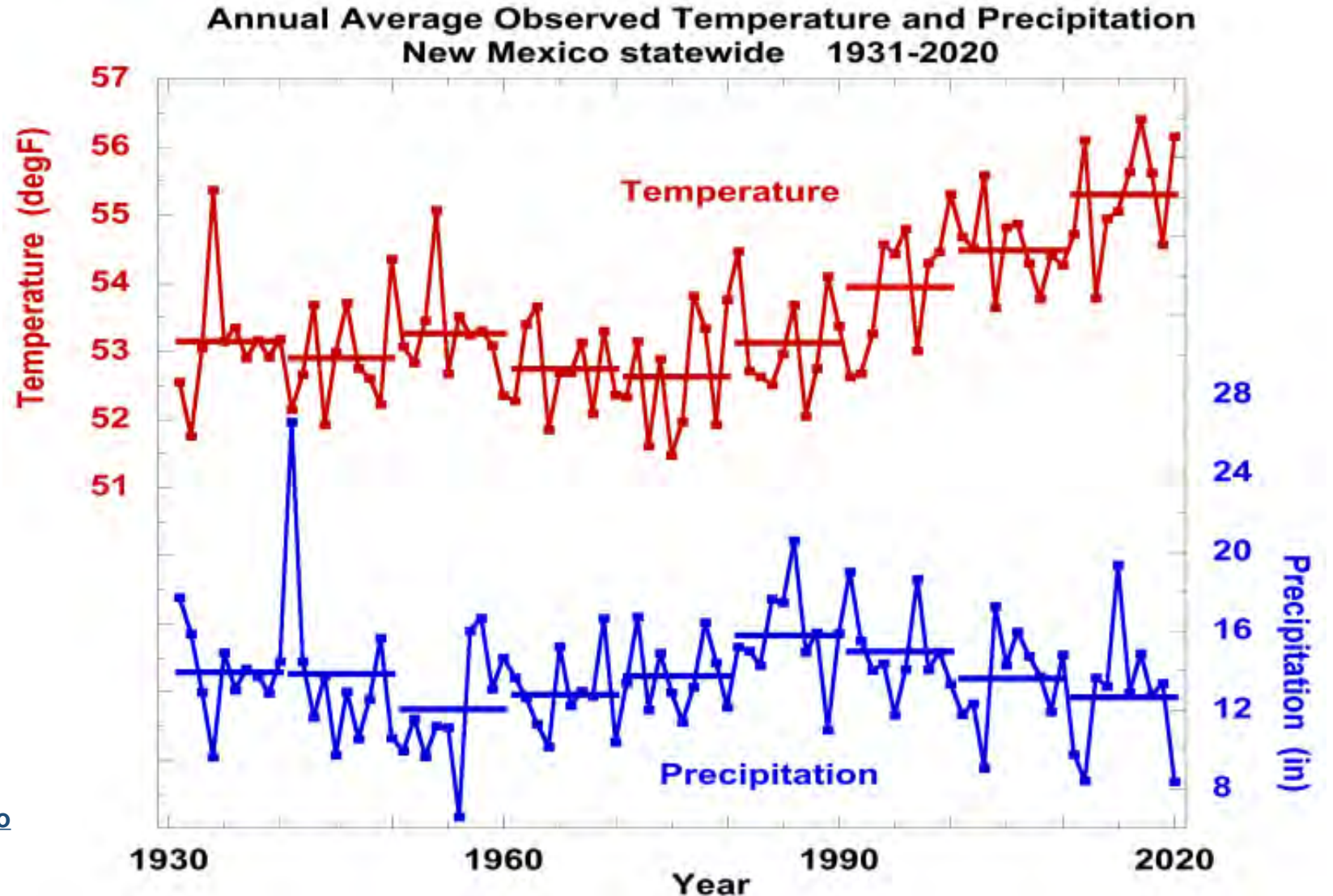


Image from [Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources](#)

Temperature Change in New Mexico

- Temperature increase will occur throughout the entire state.
- Especially high in the Northwest part of the state.

Annual average temperature simulated by 20 CMIP5 climate simulations by different models, spatially averaged over the state of New Mexico. Temperature change is defined as the difference between two thirty-year averages: (2040-2069) minus (1971-2000); the central years of these averaging periods are 70 years apart, so this plot represents 70-year temperature changes across the state.

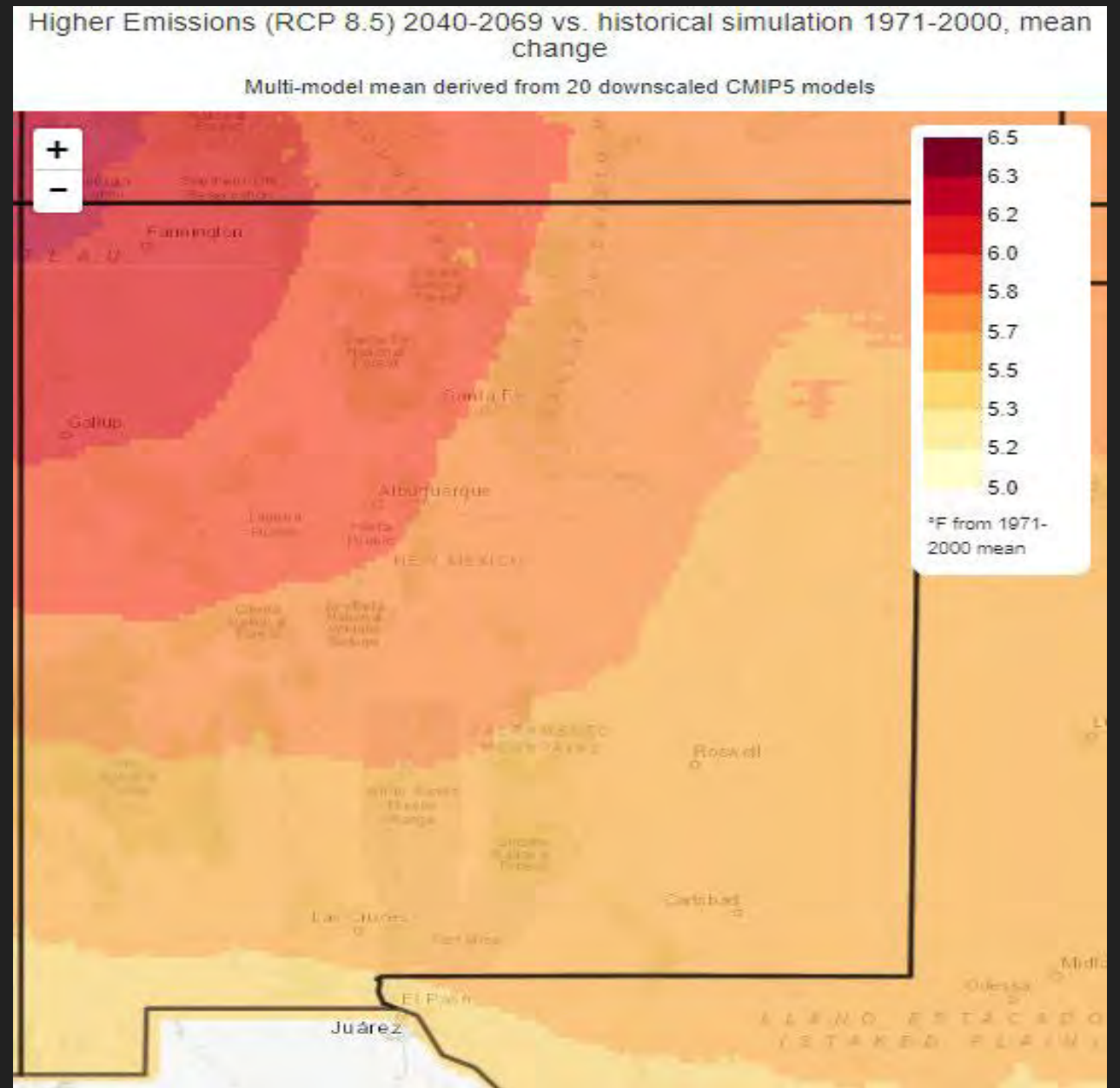
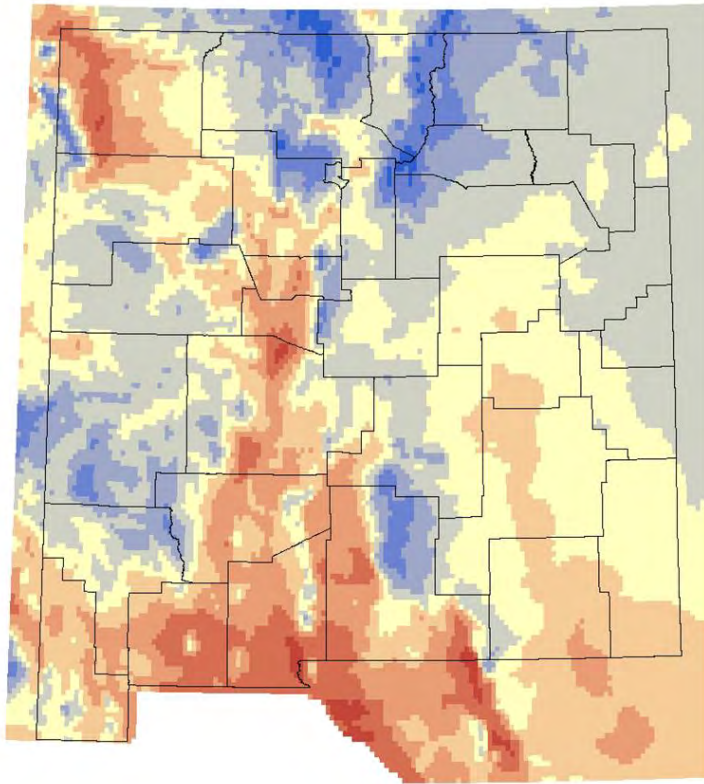


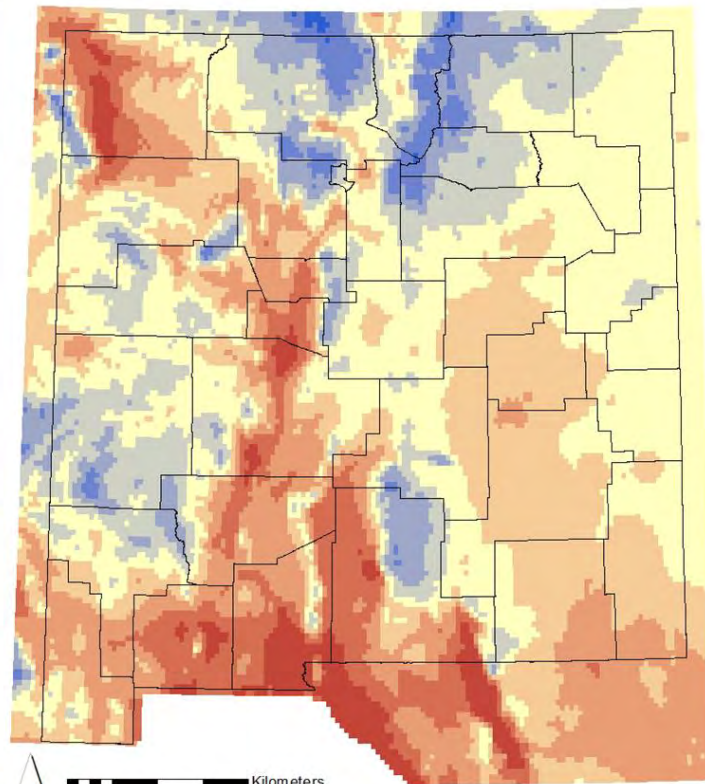
Image from Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources

Historical 1970-2020



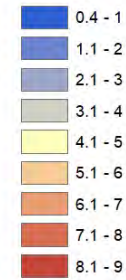
A

Future Projection 2040-2069



B

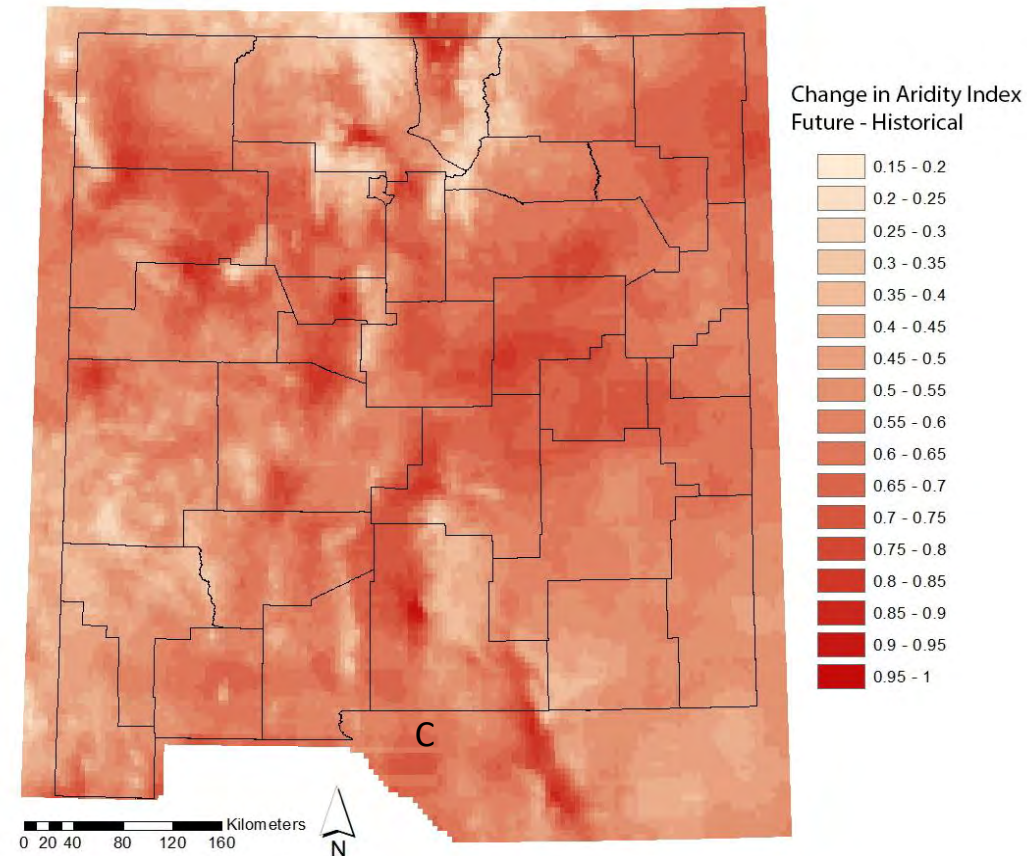
Aridity Index



Aridity in New Mexico

Projected change in the aridity index over New Mexico. (a) Average aridity index from 1970-2000 data, (b) Average aridity index from 2040-2069 projections, generated from 20-model ensemble RCP8.5. (c) Difference between 2040-2069 and 1970-2000 aridity indexes. Aridity index is defined as the ratio of average potential evapotranspiration to the average precipitation.

Image from [Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources](#)



Climate Change and Water in New Mexico: The Next 50 Years

- Average temperature rise of 5° to 7°F
- Lower streamflow and aquifer recharge
- Greater year-to-year variability in precipitation
- Hotter, more severe droughts
- Decreasing snowpack, earlier and diminishing runoff
- Greater demands on dwindling groundwater due to surface water shortfall
- Stress on natural vegetation caused by increasing temperature and decreased water availability
- Increasing catastrophic forest fire frequency resulting from heat and dryness
- Increasing flooding and sediment transport due to more intense storm events and fires
- Irreversible damage to soils through loss of vegetation and erosion
- Degraded quality of surface waters

Water Planning Challenges: Data & Values

- **Water Data**

- *Surface Water*
 - Surface Water Flows
 - Surface Water Diversions
 - Evaporation
 - Water Quality
- *Groundwater*
 - Water Levels
 - Infiltration Rates
 - Well Metering
 - Water Quality

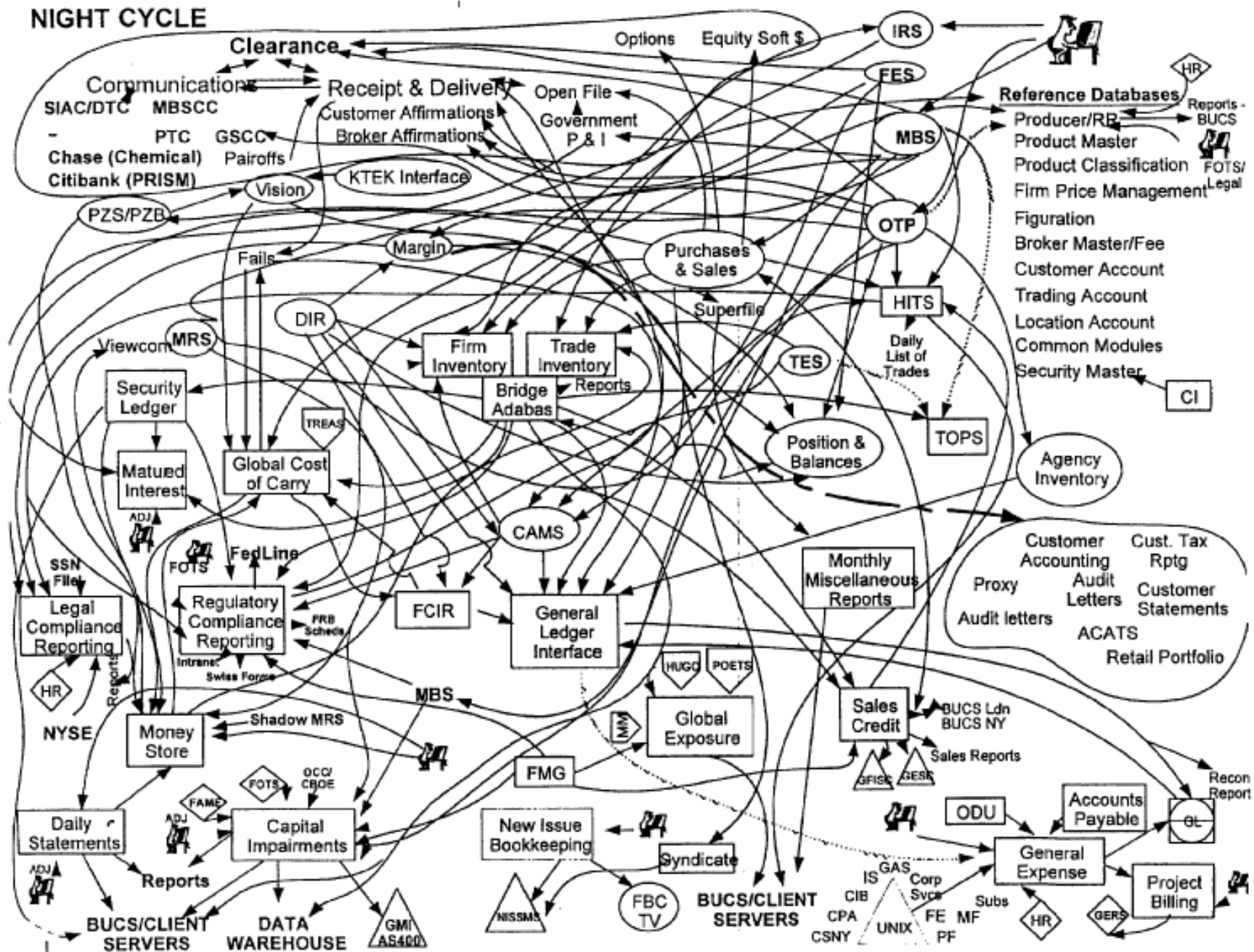
- **Diverse Values**

- *Planning Horizon*
 - Years
 - Decades
 - Long-Term Sustainability
- *Science*
 - Climate Change
 - Impacts
 - Causes
 - New Water Technology
 - Imported Water
 - Brackish Water
 - Deep Wells
- *Legal Issues*
 - Property Rights
 - Future Generations
 - Priority Enforcement
 - Rivers and Streams

PLANNING



NIGHT CYCLE



NMISC'S WATER PLANNING PROGRAM

- 50-Year Water Planning
- State Water Planning
- Regional Water Planning





What is the 50-Year Water Plan?

- **Governor's Initiative**
- **Purpose** – Help NM plan for climate change impacts to water supplies
- **Audience** – Decision-makers and the general public
- **Format** – Concise, bottom-line-up-front summary of needs and recommendations for improving water resilience

What the 50 Year Water Plan is **NOT**

- State Water Plan
- Regional Water Plans
- Technical Report
- All Gloom-and-Doom
- Able to Solve all the State's Water Problems
- Going to Just Sit on a Shelf



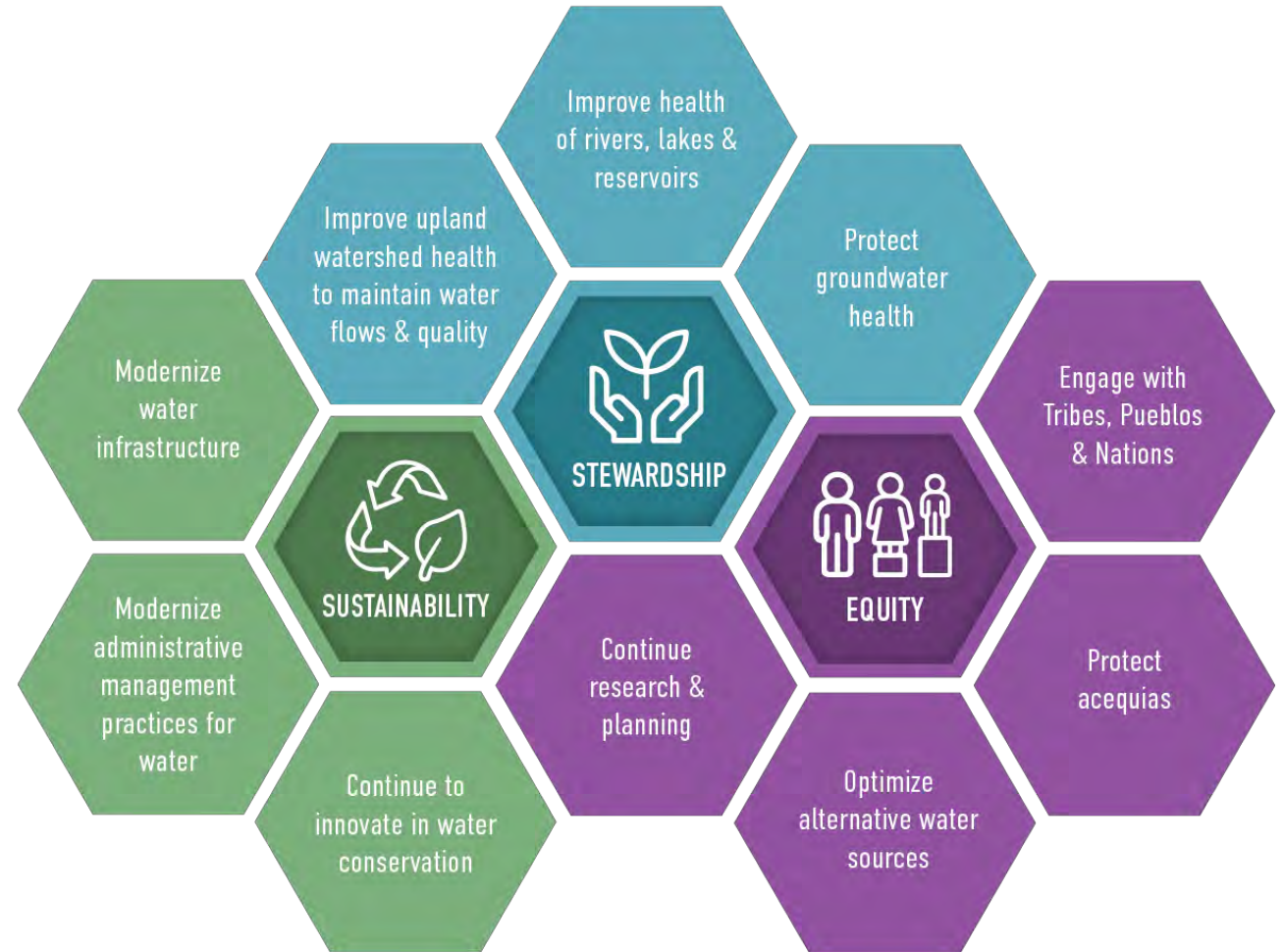
Partners



- NM Bureau of Geology & Mineral Resources
- Volunteer Research Experts
- New Mexico Indian Affairs Department
- Tribal Water Work Group Volunteers
- Other State Agencies – NMOSE, EMNRD, NMED, NMDA, DGF, DHSEM, EDD, DOH
- New Mexico Water Dialogue
- Water Resources Research Institute
- U.S. Army Corps of Engineers



50-YEAR WATER PLAN RECOMMENDATIONS



STATE WATER PLAN

- Last updated in 2018
- Review is required every 5 years at a minimum
- Extensive statutory requirements
- Update will be a review of statutory requirements and a timeline of how to address those given climate change projections

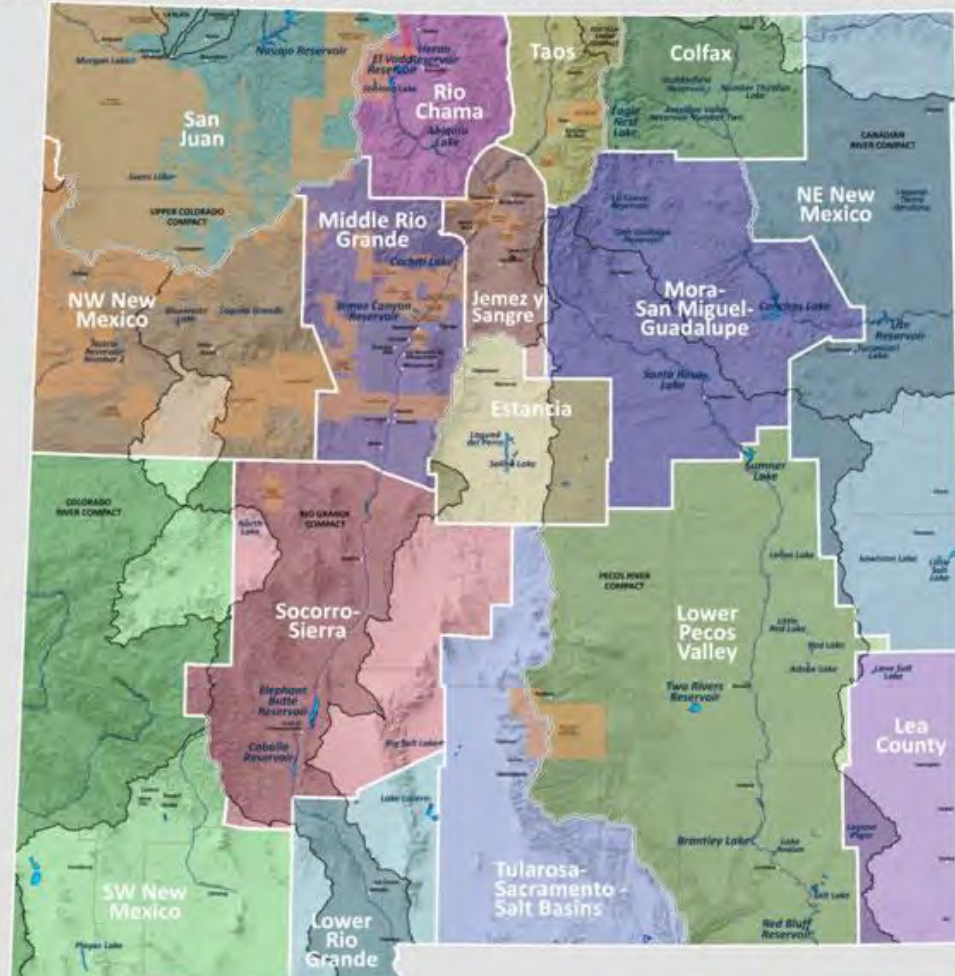


Adopted by the New Mexico Interstate Stream Commission
December 6, 2018



New Mexico Interstate Stream Commission WATER PLANNING REGIONS

with Native Nation Lands, Pueblos and Interstate Compact Boundaries



Regional Water Planning

- First began in 1987 in response to TX claims on NM water
- Two rounds of regional water planning have occurred throughout NM
- *SB 337 was just passed during the legislative session = Water Security Planning Act to reinvigorate regional water planning*

The Water Security Planning Act

- All actions called for are subject to available funding
- Development of an advisory council with IAD re: tribal sovereignty, water rights, and community needs
- Promulgation of rules to govern water security planning broadly
- Development of guidelines to address specific requirements for water security planning
- Requirements for engagement, particularly with TPN's, acequias, and rural communities
- Support for climate science and modelling will be ongoing and provide projections for future water
- Annual reporting to legislative committees by October 31
- ISC support for regional water security planning entities including:
 - Technical & local capacity development including commission staff and funding
 - Statewide objectives including interstate compact and endangered species act compliance
 - Supporting the implementation of Active Water Resource Management if prioritized by the region
- Regional Planning Entity Requirements:
 - Be composed of stakeholders identified in the entity's guidelines
 - Obtain public input in the development, vetting, and prioritization of projects
 - Ensure TPN participation within the region
 - Provide assistance to rural communities
 - Report to the ISC by June 30 of each year
 - Utilize existing water plans from entities within the region



Water Security Planning: What the rules will address

- The boundaries & number of regions
- Criteria for ISC approval of a regional security plan
- Procedure for regional water planning entities to develop and notify the ISC of regional public welfare issues
- Composition of regional water planning entities
- Procedure for regional water planning entities to consider public welfare values and the needs of future generations
- This list is a minimum only



THANK YOU QUESTIONS?

Sara Goldstein

NMISC Senior Water Planner
sara.goldstein@ose.nm.gov



Communicating Climate Science, the New Mexico Climate Risk Tool and Future Data Needs

New Mexico Water Data Workshop May 4, 2023

The New Mexico Climate Risk Map is a Cooperative Project of



Who we Are: Energy, Minerals and Natural Resources Department

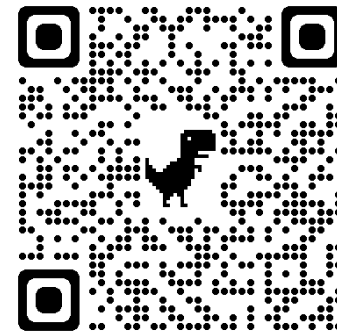
The mission of Energy, Minerals and Natural Resources Department (EMNRD) is to position New Mexico as a national leader in energy and natural resource management. This includes developing reliable supplies of energy and energy-efficient technologies with a balanced approach toward conserving renewable and nonrenewable resources; protecting the environment and ensuring responsible reclamation of land and resources affected by mineral extraction; growing and managing healthy, sustainable **forests; and improving the state park system that protects New Mexico's** natural, cultural, and recreational resources for posterity and contributes to a sustainable economy statewide.



Who We Are:

Energy Conservation and Management Division (ECMD) - Develops and implements effective clean energy programs renewable energy, energy efficiency, alternative fuels, and safe transportation of radioactive waste to promote economic growth, environmental sustainability, and wise stewardship of our natural resources while protecting public health and safety for New Mexico and its citizens.

The Climate Policy Bureau, is the newest Bureau with the EMNRD, and is a **part of ENMRD's Energy Conservation Management Division (ECMD). It will play an integral role in building New Mexico's capacity to adapt to climate change** by supporting interagency efforts to reduce greenhouse gas emissions, grow the state's green economy and develop and implement a statewide Climate Action Plan.



Summary of Climate Change Impacts to NM

- Lower streamflow and recharge because of increased aridity
- Greater inter annual variability in precipitation
- Hotter, more severe droughts
- Decreasing snowpack → earlier and diminishing snowmelt runoff
- Greater demands on groundwater
- Vegetation stress
- Increasing catastrophic forest fires and degraded air quality
- Increasing flooding/sediment transport
- Irreversible damage to soils through loss of vegetation and erosion
- Degraded quality of surface waters

<https://engagenmwater.org/hotter-drier-impacts-to-new-mexico-s-water-resources-from-climate-change-2020-2070>

N E W M E X I C O



Energy, Minerals and Natural Resources Department

Health Concerns with Changing Climate

- Heat waves - increased probabilities, higher overnight temperatures
- Most frequent weather- related cause of injury and death in the United States
- Allergens - earlier & longer frost-free season, longer allergy season
- Wildfires - frequency and size to increase; fine particulates or smoke to increase, impacts large areas & can be transported long distances.

Data and Information on NMTracking.doh.nm.gov



New Mexico Stats

- ▶ Population (2020) = 2.1 million with ~940,859 households
- ▶ Median Household income = \$51,243
- ▶ By 2030, New Mexico will have the 4th largest senior population in the Nation, resulting in the need for prioritized services and new funding mechanisms
- ▶ 966,000 individuals are on Medicaid
- ▶ 44,525 households have received **Low Income Home Energy Assistance Program (LIHEAP)** assistance in FY 22, down from 63,041 in FY 21 and 70,157 in FY 20
 - ▶ 2 x as many households receive heating assistance than cooling assistance



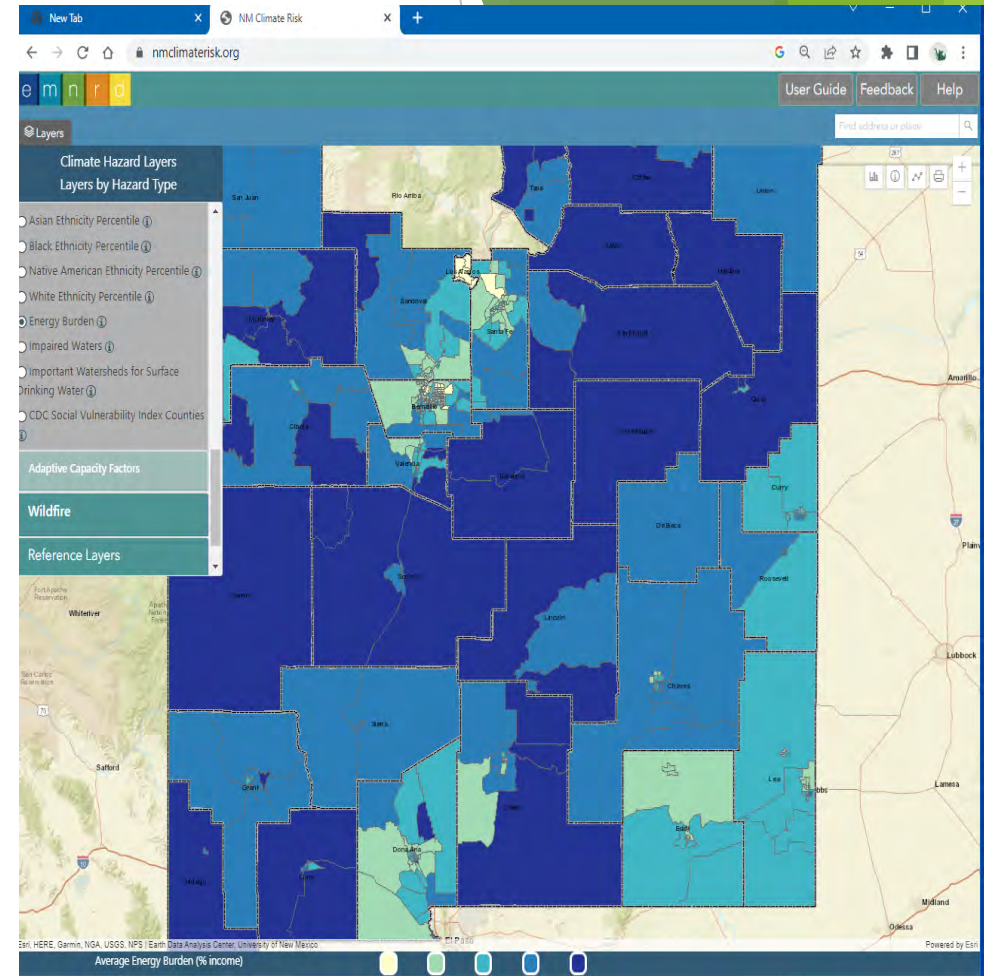
Energy, Minerals and Natural Resources Department

<https://www.census.gov/quickfacts/NM>
<https://www.hsd.state.nm.us/>

New Mexico Stats - Energy

- ▶ Rural electric cooperatives serve 80% of land mass in NM and have long distribution lines and dispersed customers; distribution expense translates to higher cost per kWh than in urban areas served by Investor-Owned Utilities
- ▶ State average cost per kWh is highest in mountain west
- ▶ Cascading impacts of COVID hit rural co-ops the hardest
- ▶ Access still very much an issue. Many communities are not connected by electric/gas/water infrastructure and even more do not have access to broadband.
- ▶ Energy burden is high for all energy sources in rural areas.

<https://www.emnrd.nm.gov/ecmd/state-energy-security-planning/>



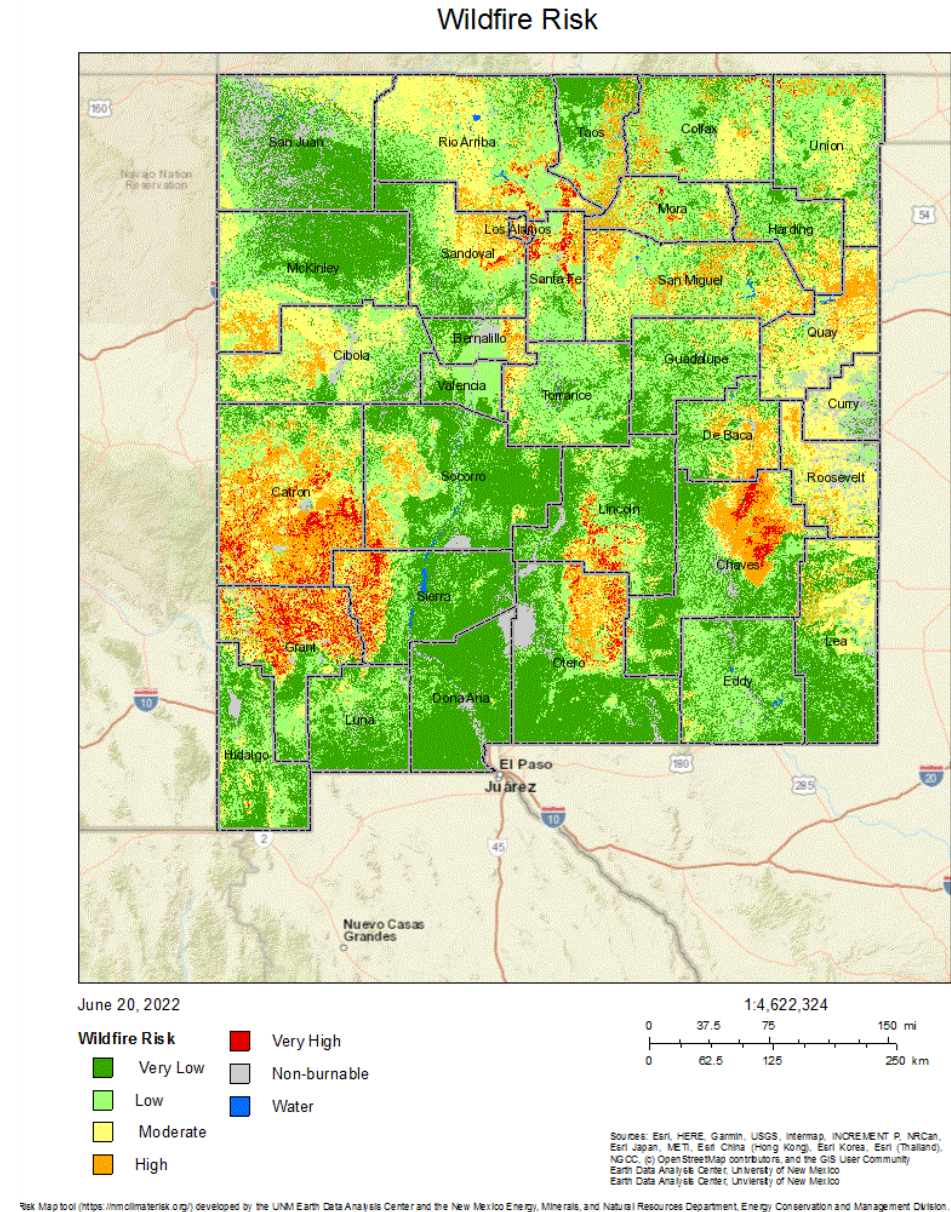
What is climate risk mapping?

A map of climate risks and vulnerabilities, identifying how and where climate hazards will affect the city, sectors and assets. Identification of priority risks, based on exposure, sensitivity, interdependencies and vulnerability.

Climate Risk Map users can assess vulnerability to natural hazards exacerbated by factors such as

- Chronic Illness,
- Linguistic isolation,
- Limited or no access to transportation,
- Distance to medical facilities.

Going forward we need to increase the capacity to link to real-time or near-real time information served by outside entities.



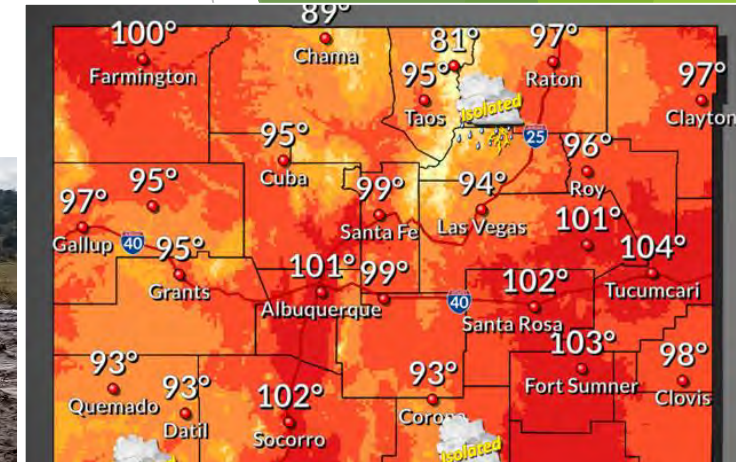
COMMUNICATING RISKS, ADAPTIVE CAPACITY, ENVIRONMENTAL EXPOSURE, AND SENSITIVITY

Three overarching data categories:

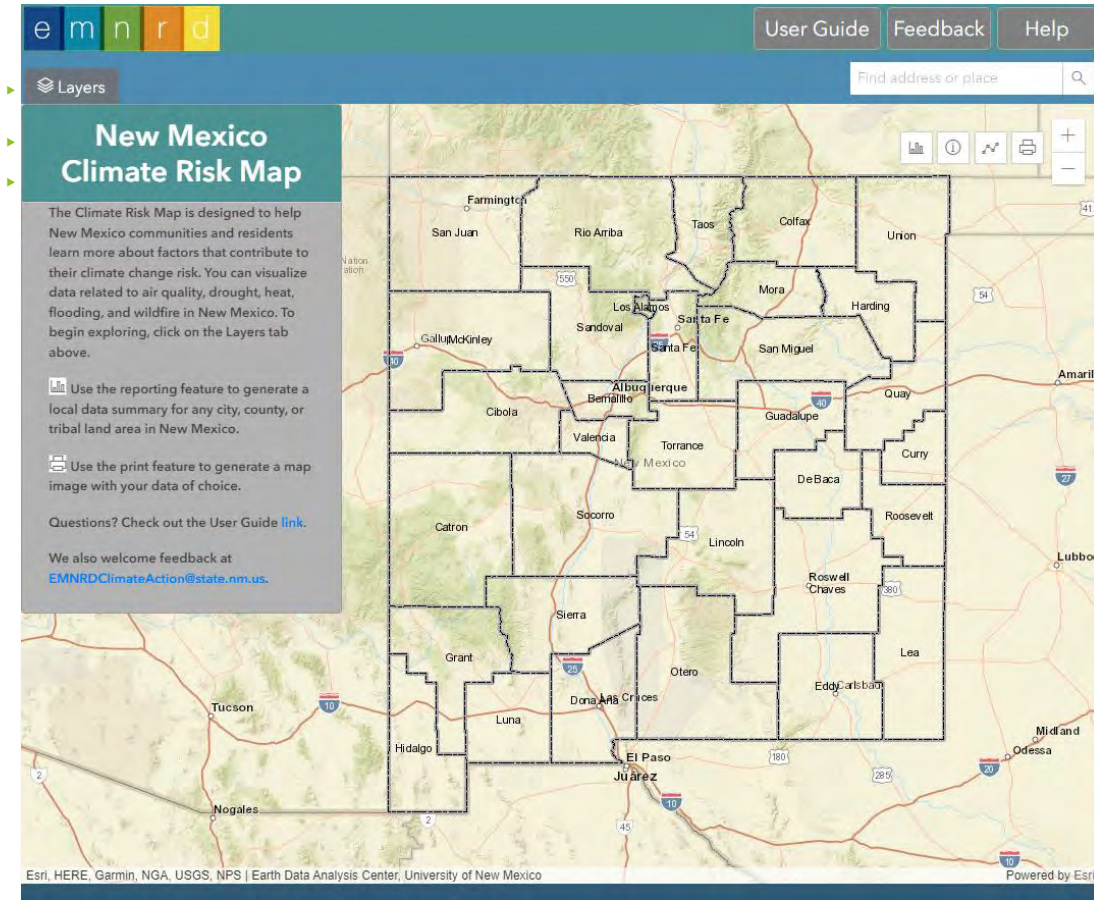
- Adaptive capacity
- Environmental exposure
- Sensitivity

Five natural hazard areas:

- Air Quality
- Drought
- Flood
- Heat
- Wildfire

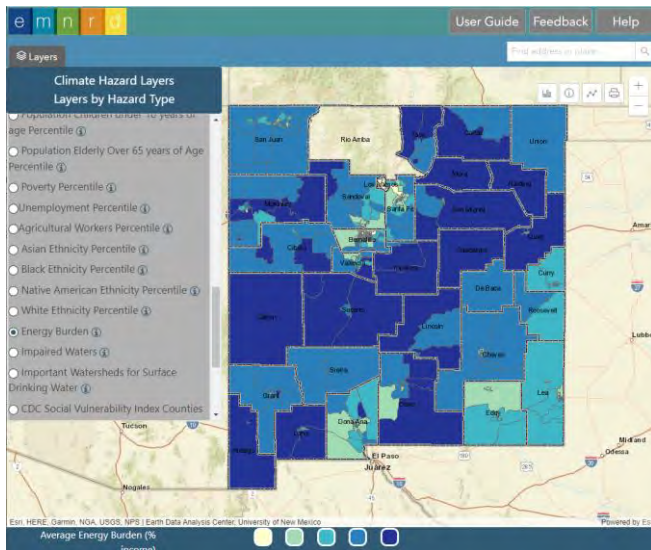


New Mexico Climate Risk Map



► The New Mexico Climate Risk Map project is part of an overall vision to communicate risk to the public and stakeholders in state and Tribal governments.

1. A mapping service which layers climate risk data from multiple state agencies and local governments.
2. A public-facing StoryMap of climate risk and climate work.
3. A mapping service which will allow state employees to use scenario modeling in conjunction with climate risk data and extant climate work data.



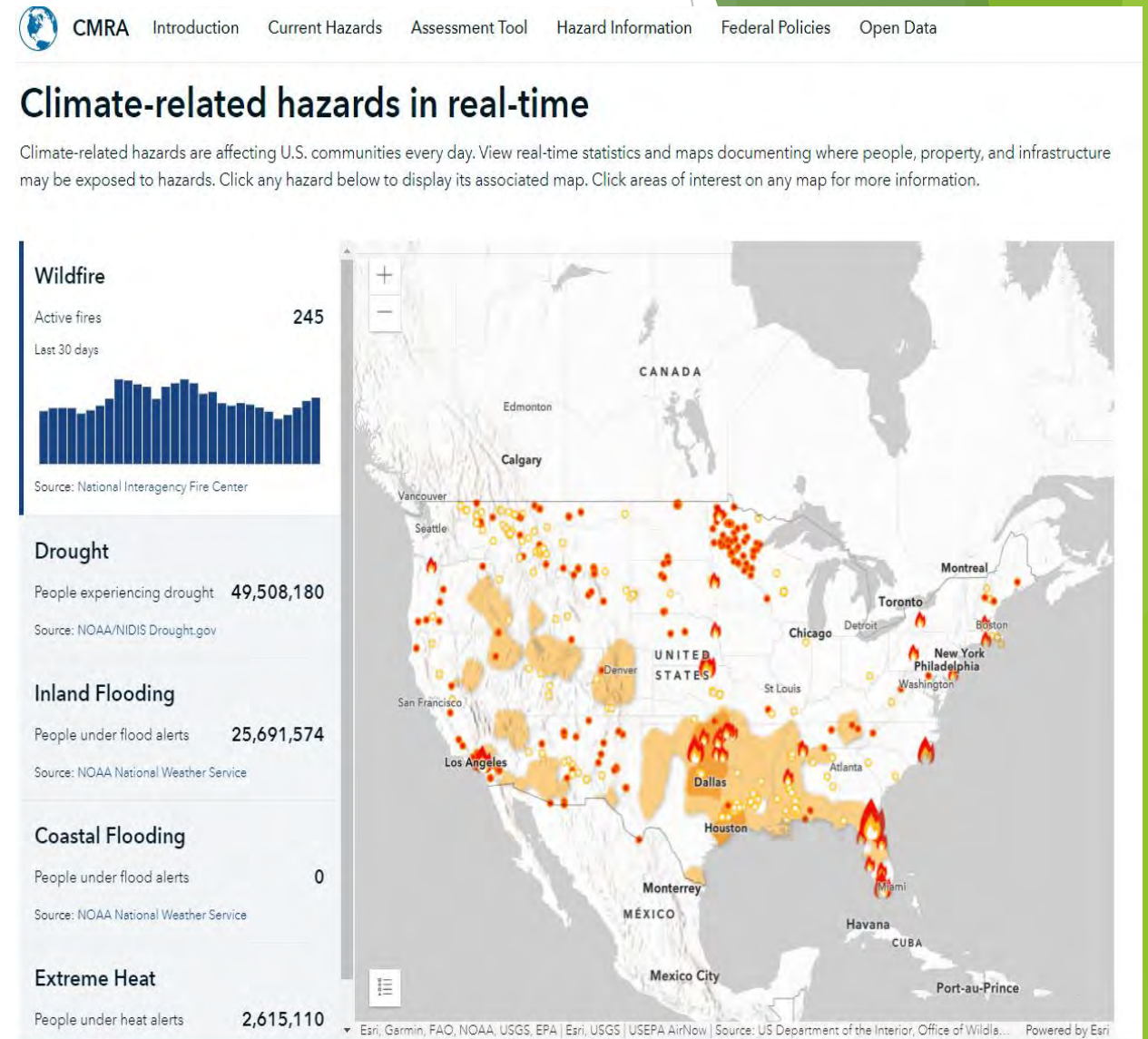
Addressing Climate and Environmental Justice

- ▶ The NM Climate Risk Map includes demographic factors, including race and poverty, because historic disinvestment and disenfranchisement have led to a status quo where climate change is expected to disproportionately impact poor, rural communities.
- ▶ These overburdened communities are not inherently vulnerable because of their demographics, but often experience greater risk from climate change and other hazards because of a history of structural racism and environmental discrimination.
- ▶ This tool can help the state, local, and tribal governments in NM identify and prioritize investments that counteract this inequity.



Establishing Effective Paths Forward

- ▶ Lack of New Mexico Specific Climate Data
 - ▶ No New Mexico Climate Study
 - ▶ Projections Utilize down scaled Global Studies
 - ▶ Data at variable scales
- ▶ Need Capacity to Display near real-time Climate-related hazards
 - ▶ Climate-related hazards are affecting U.S. communities every day. Viewing real-time statistics and maps documenting where people, property, and infrastructure may be exposed to hazards may spur actions.
 - ▶ Climate Risk Map Updates will need to mesh with planned EMNRD API development and implementation





NEW MEXICO CLIMATE CHANGE ACTION

Contact Us:

Rachel Finkelstein, Bureau Chief
Climate Policy Bureau
Rachel.Finkelstein@emnrd.nm.gov

Robert Gomez
Resilience Coordinator
Climate Policy Bureau
Robert.Gomez@emnrd.nm.gov

Maria Lohmann
Sustainability and Resilience Officer
Climate Policy Bureau
Maria.Lohmann@emnrd.nm.gov

Hydrologic Models and Data Needs at the New Mexico Office of the State Engineer

New Mexico Water Data Workshop

NM Bureau of Geology/NM Tech

Socorro, NM



Katie Zemlick, Ph.D., Hydrology Bureau Chief

May 4, 2023

Role of Hydrologic Models at the OSE

We need to understand local and regional hydrogeology and water availability spatially and temporally.

We need to understand the surface water flow regimes and historic supply.

We need to evaluate the effect of a change in groundwater use on other groundwater users.

We need to evaluate the effect of a change in groundwater use on streamflow, surface water supply, and our interstate stream deliveries.

Hydrologic Models

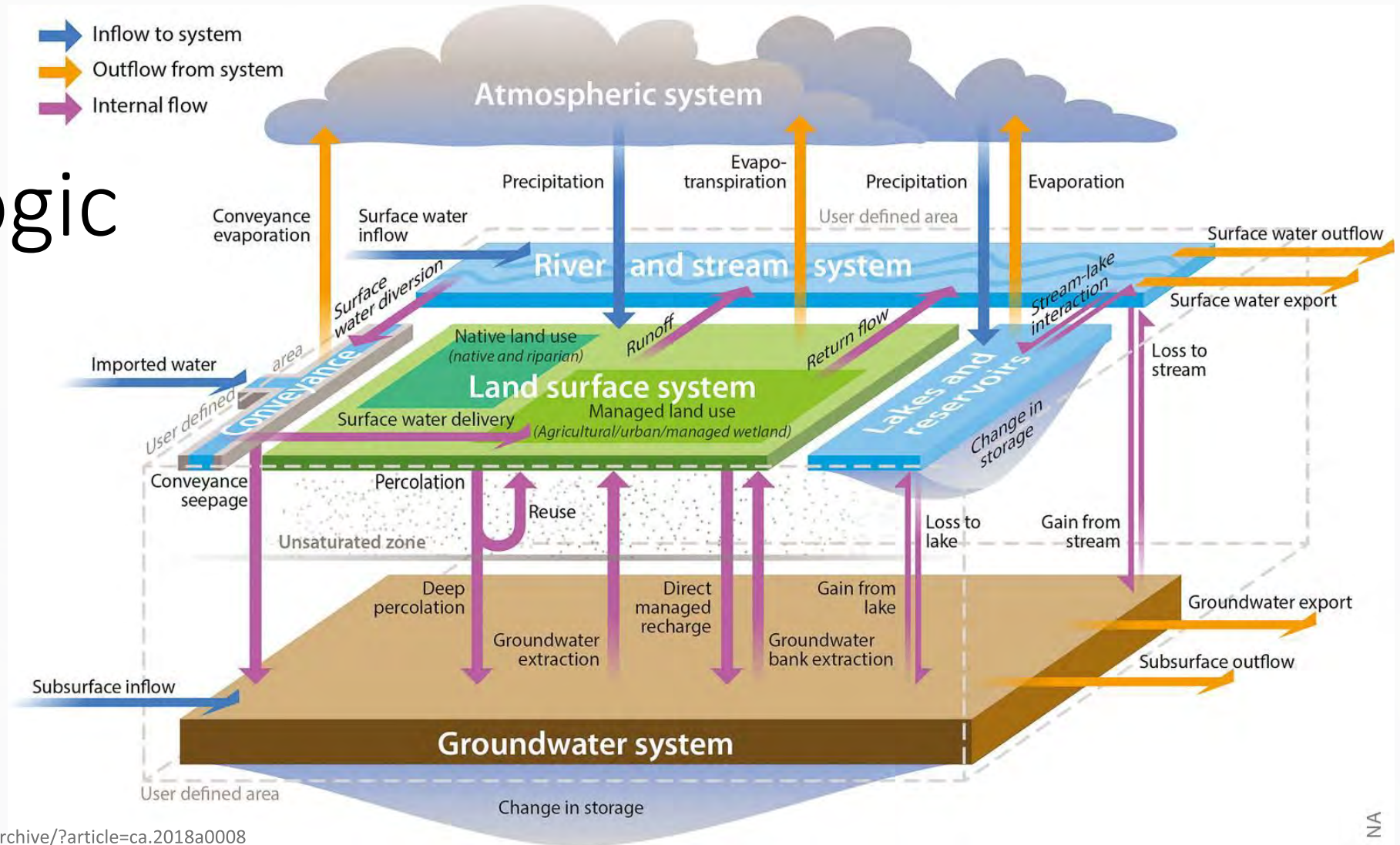
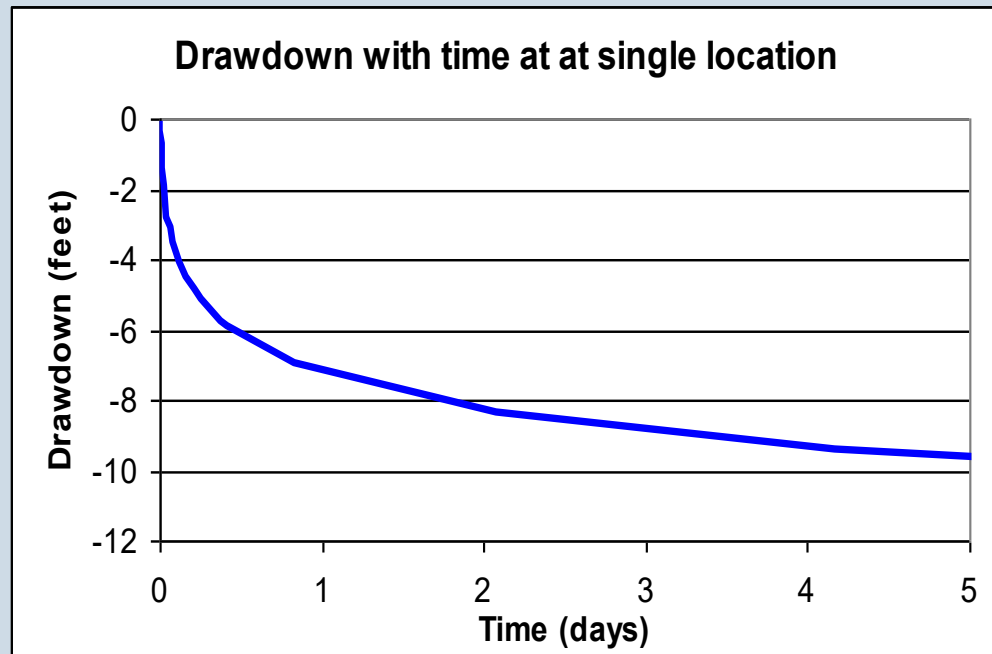


Image Source: <https://calag.ucanr.edu/Archive/?article=ca.2018a0008>

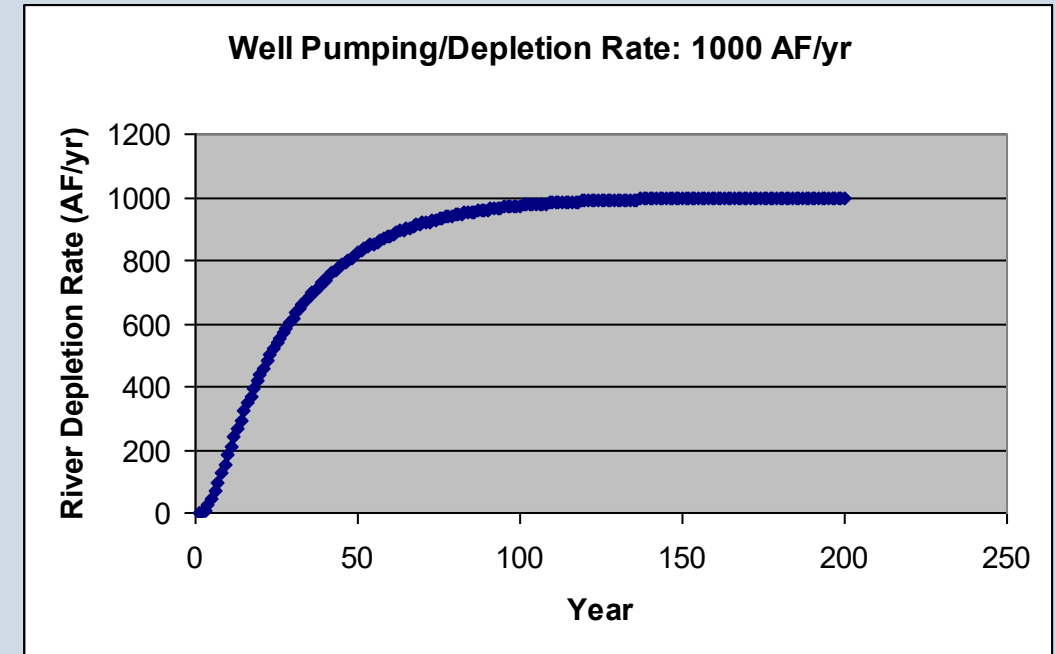
Analytical Tools

Many assumptions: single homogeneous confined aquifer, horizontal flow, fully penetrating stream, well fully penetrates aquifer and has constant pumping rate, etc.

Theis Equation



Glover Balmer Method



Solution can be found with single value for transmissivity, storage, pumping rate, time, distance or drawdown.



Application Analysis Spreadsheet

Aquifer Information

Applicant:	test
Application #:	1
DA - Drawdown Allowance (ft)*:	2
S - Storage Coefficient*:	0.15
Aquifer Type?*	Unconfined
Average Water Column of Existing Wells (ft)	122.33
Saturated Thickness (Unconfined Aquifer Only) (ft)*	120
T - Transmissivity (ft ² /d)*	300

* Required element

Boundary Information

Y = 0 Boundary Type	No Boundary
2nd Y Boundary Type	No Boundary
2nd Boundary at Y =	

Spreadsheet Checklist

Aquifer Information ready?	TRUE
Boundary Information ready?	TRUE
Application Well data ready?	TRUE
Existing Water Right data ready?	TRUE
Observation Well data ready?	TRUE
Pre-existing Application Wells included in Existing Water Right data?	TRUE

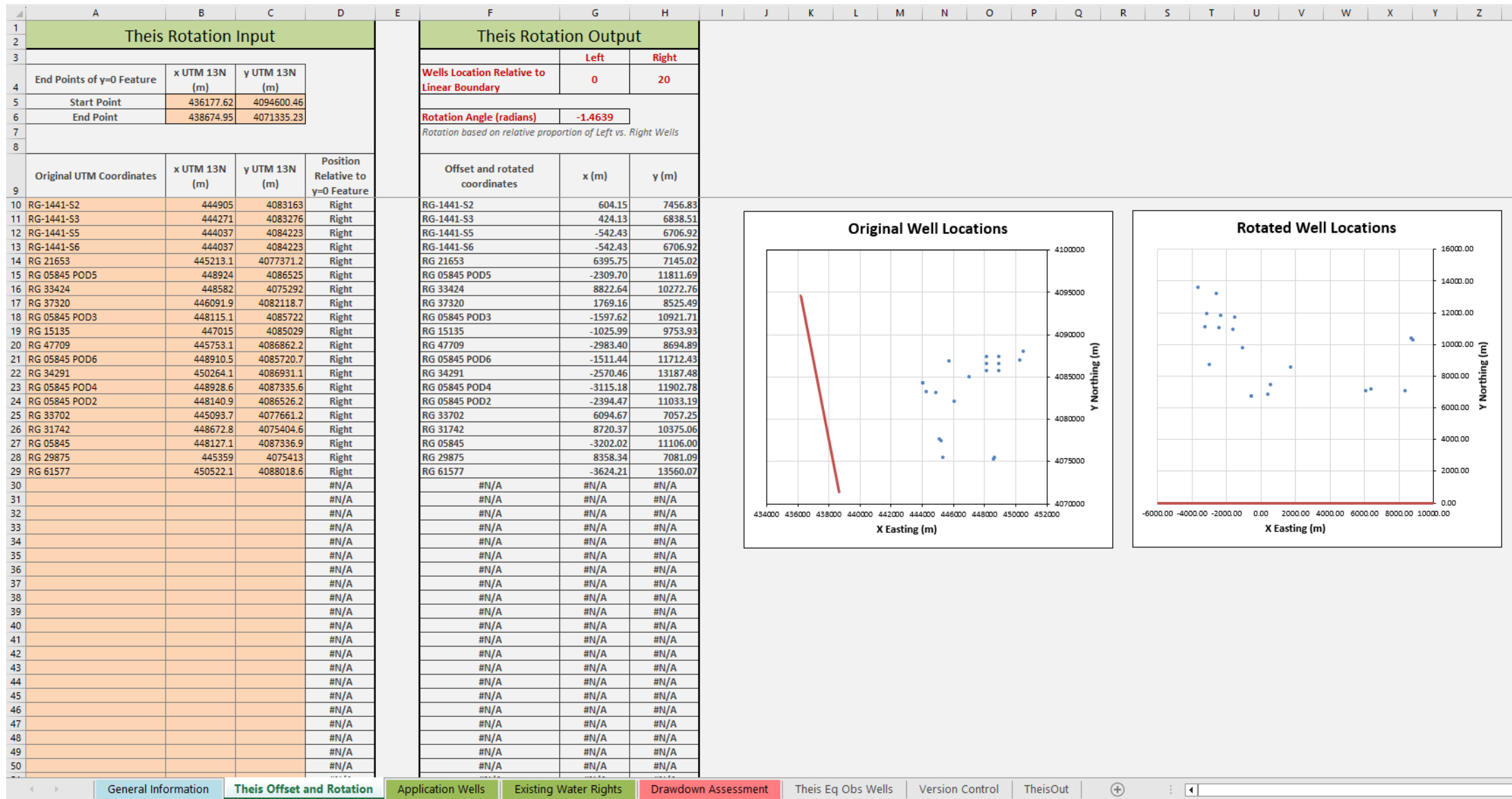
Run Theis Program

Steps:

- 1) Input **Basic Information** and **Boundary Information**
- 2a) If boundary conditions used -> Start at **Theis Offset and Rotation**
- 2b) If no boundary conditions -> Start at **Application Wells**
- 3) **Theis Offset and Rotation** - Input all well X, Y values to adjust location relative to boundary condition
- 4) **Application Wells** - Input application well data (Modified X, Y locations from Theis Offset and Rotation, if used)
- 5) **Existing Water Rights** - Input existing well data, including application wells if currently operating
MAKE SURE TO INCLUDE EXISTING APPLICATION WELLS IN EXISTING WATER RIGHTS SHEET
- 6) Verify **Spreadsheet Checklist** is ready
- 7) Click **Run Theis Program** button
- 8) Check **Drawdown Assessment** for Results

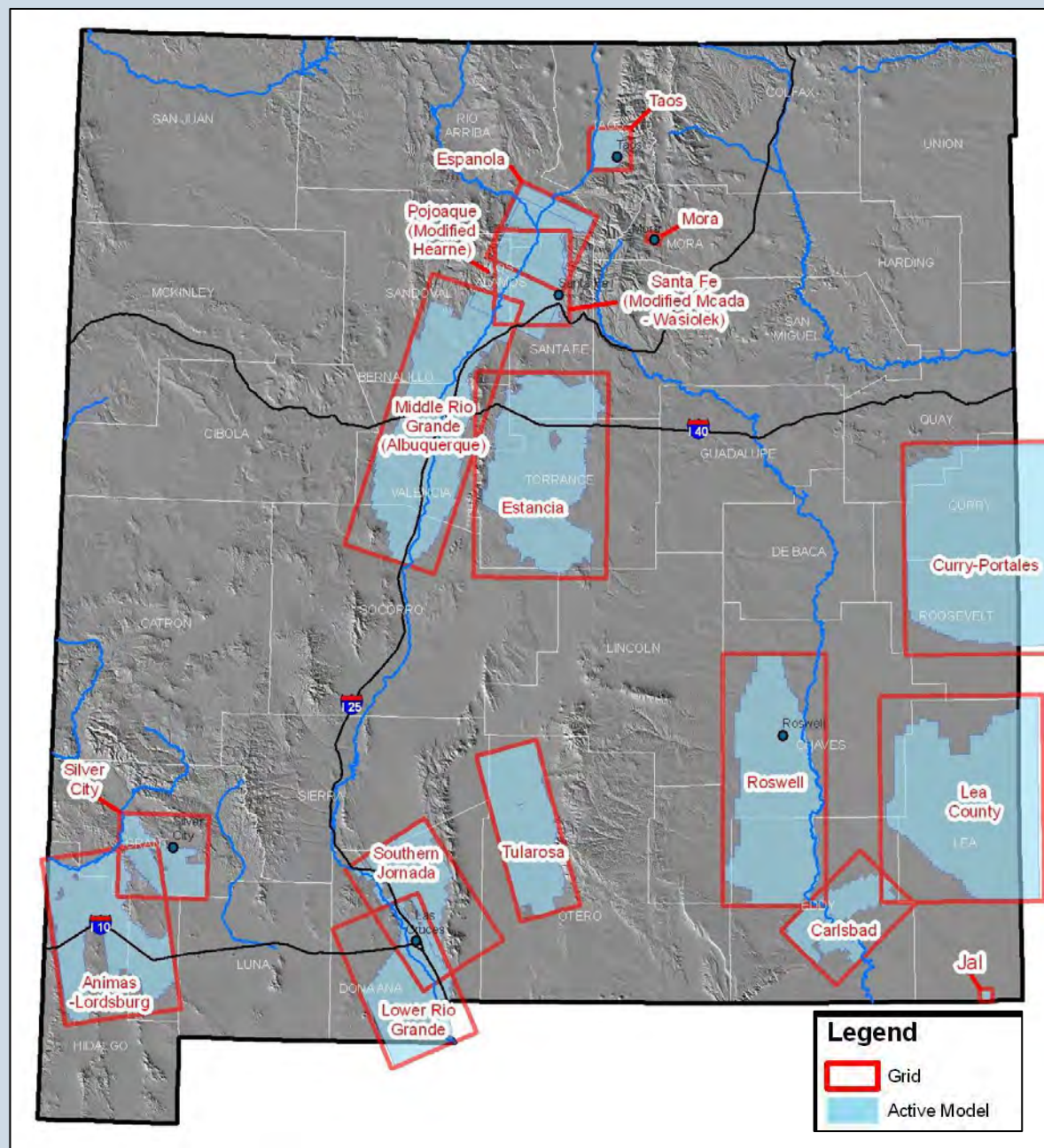
Notes:

- Fillable cells highlighted in **Orange**
- This template is **currently limited to 30 application wells** and **300 existing wells**
- Column headings containing "Theis" give needed text for Theis program input files. (Do not modify)
- The Theis program executable file must be in the same folder as this spreadsheet.
- The path to the folder containing this worksheet and Theis program executable cannot contain folder names with spaces
- If you have any problems with this spreadsheet, please contact the Hydrology Bureau



Administrative Models

- Calibration
- Basin specific guidelines
- Pumping
- Revision/Updates
- Aquifer Properties
 - Permeability/Transmissivity/
Hydraulic Conductivity of
aquifer
 - Storage



Data Needs

Geologic
information

Aquifer
properties
(aquifer tests)

Water Use

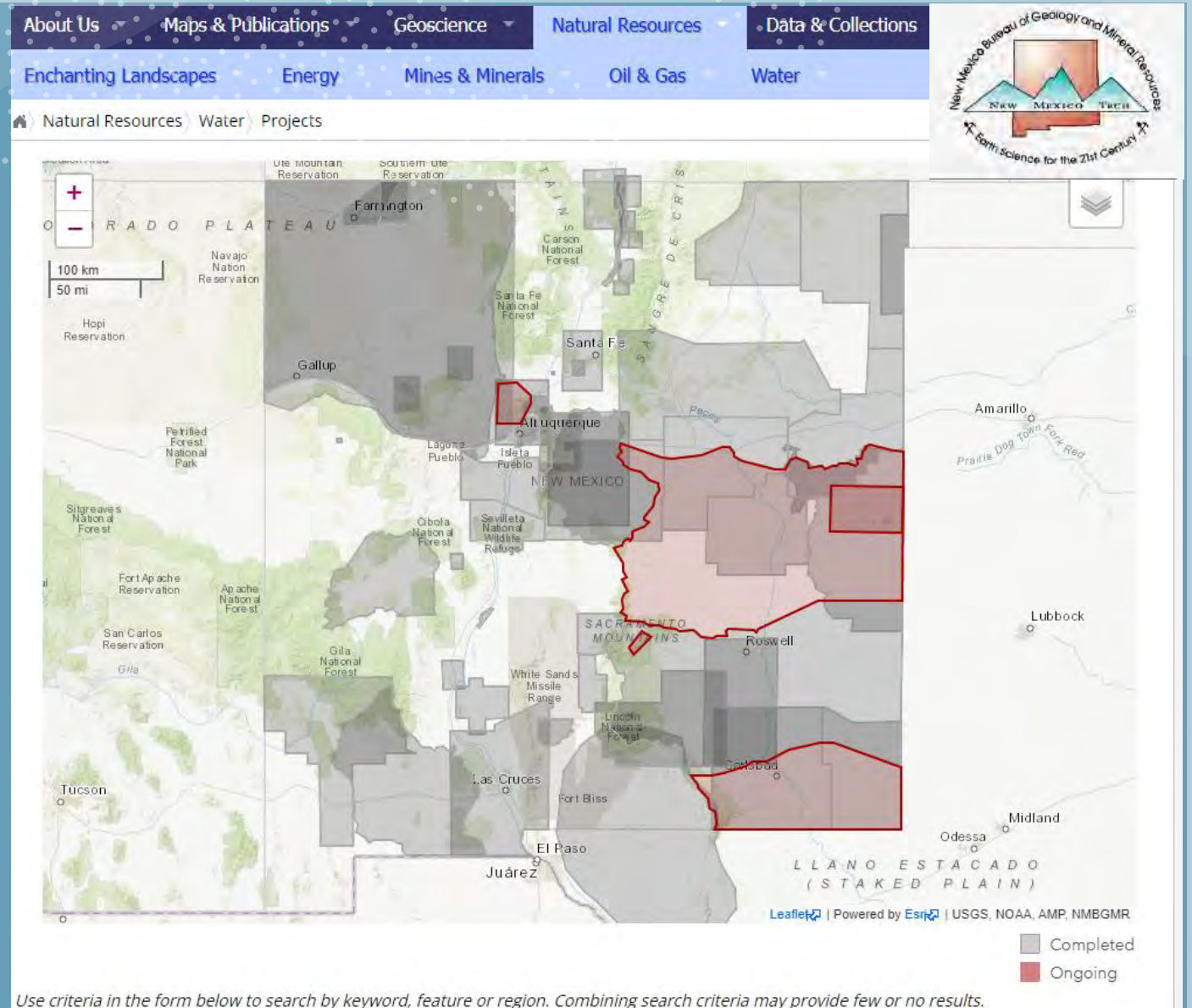
Water Levels

Recharge
estimates

Streamflow
measurements

Geologic Framework

- NM Bureau of Geology (NMBGMR)
- US Geological Survey (USGS)
- Texas Water Development Board (TWDB)
- Published reports
- Oil and Gas (API) Wells



Aquifer Properties

- Geology

Materials	Range of K (m day ⁻¹)
Clay soils (surface)	0.2
Deep clay beds	10 ⁻⁸ -10 ⁻²
Loam soils (surface)	0.1-1
Fine sand	1-5
Medium sand	5-20
Coarse sand	20-100
Gravel	100-1000
Sand and gravel mixes	5-100
Clay, sand and gravel mixes (till)	0.001- 0.1

- Aquifer test database
- Literature
- Other models

Hydrology Bureau

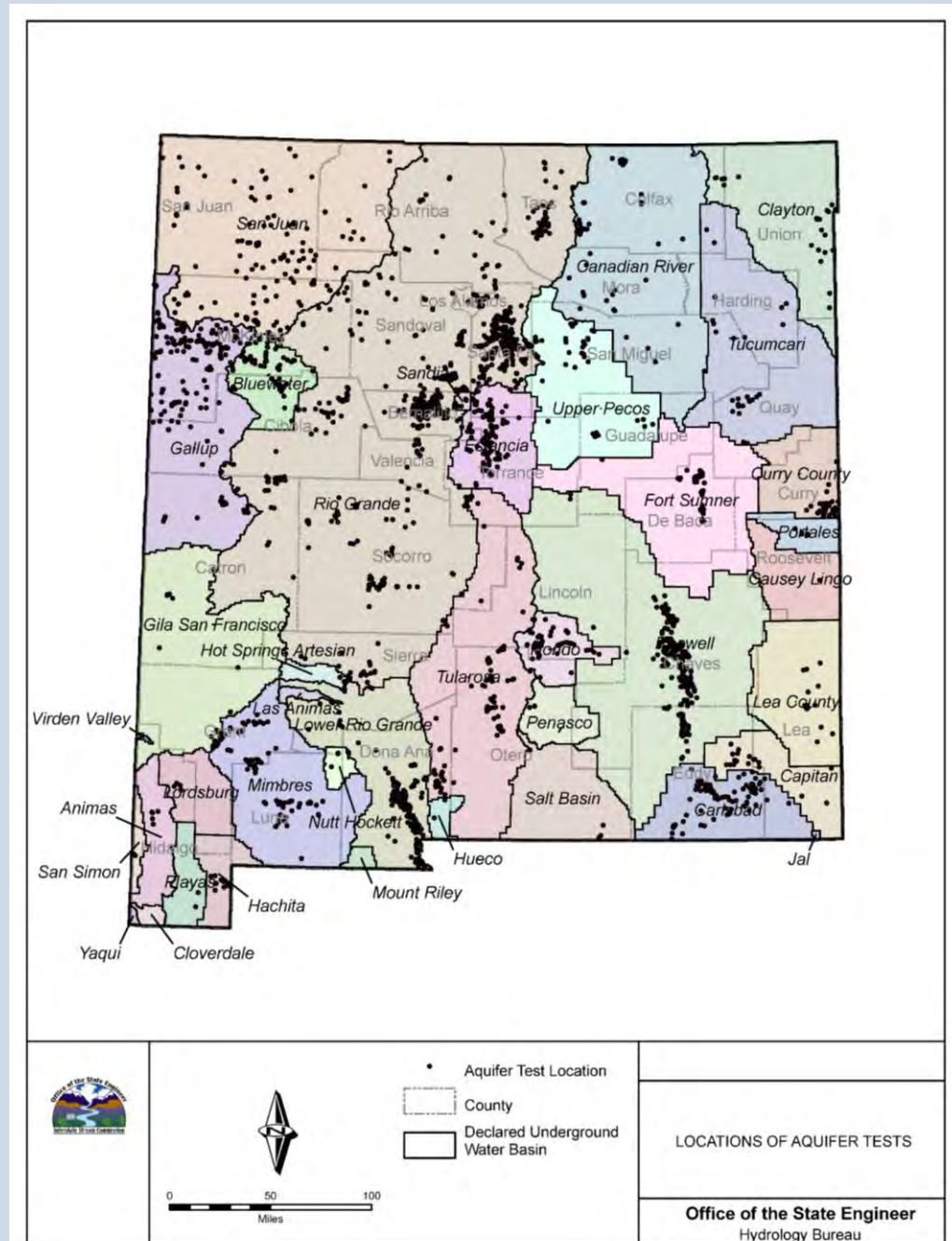
AQUIFER TEST INDEX - DECEMBER 2016

This index has been compiled from reports by consultants, the U.S. Geological Survey, the Office of the State Engineer, the New Mexico Bureau of Mines and Mineral Resources and other sources.

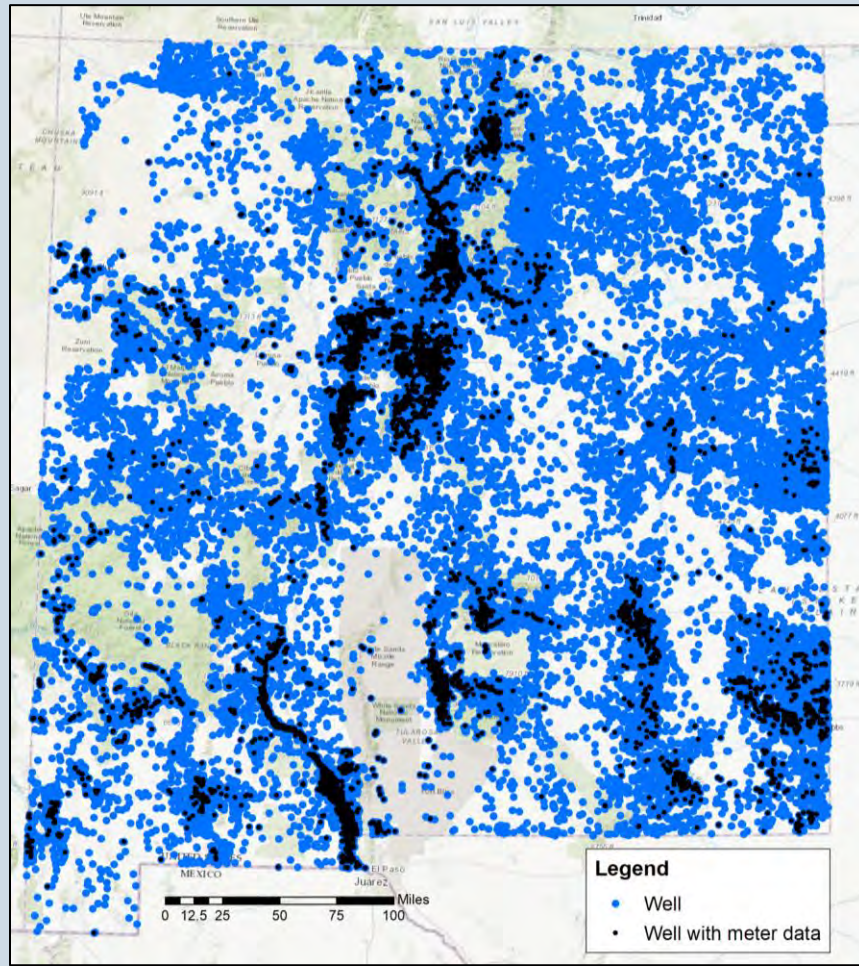
It is highly recommended that users of the Index check the data against the original publications. Interpreted results presented in the index are those provided by the authors of the test reports. Most references are available in the **Office of the State Engineer library**.

Search files: [Search](#)

Title	Open File
Aquifer Test Index - Maps	Open File
Aquifer Test Data	Open File



Water Use Data



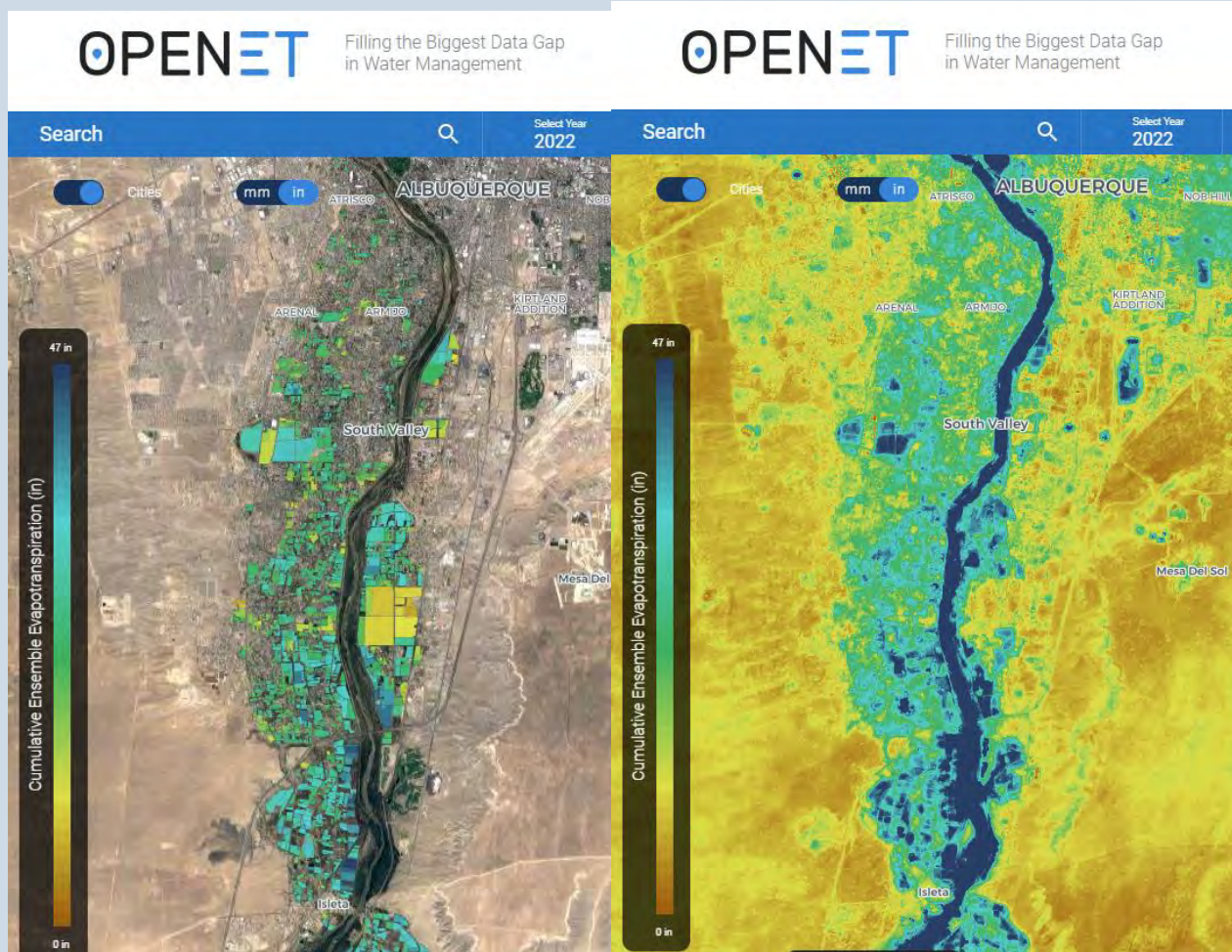
Pumping data is an important for models, but:

- < 10% of wells have meter records
- Some are incomplete or incorrect
- Water rights are both spread and stacked
- Program that can estimate the maximum potential pumping (also need actual)

Waters2Wells Program

WR File Number	Subbasin	Use	Diversion (AFY*)	POD Number
Z 00011 A	A	IRR	225.3	Z 00011 POD1
				Z 00011 POD2
Z 00012 A	A	IRR	77.1	Z 00011 POD1
				Z 00011 POD2
				Z 00012 POD1
Z 00012 B	A	IRR	177.6	Z 00011 POD1
				Z 00011 POD2
				Z 00012 POD1
				Z 00012 POD2

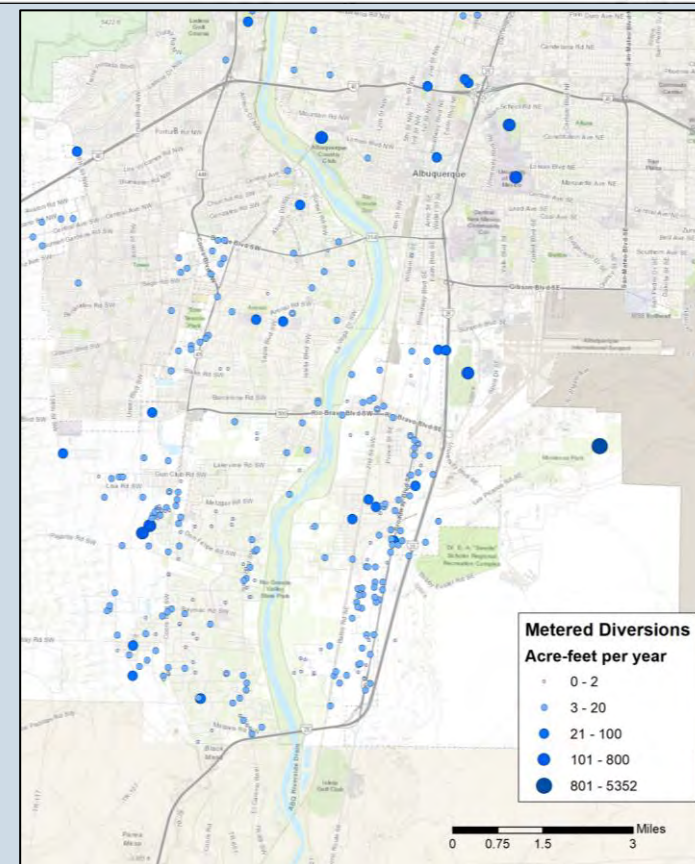
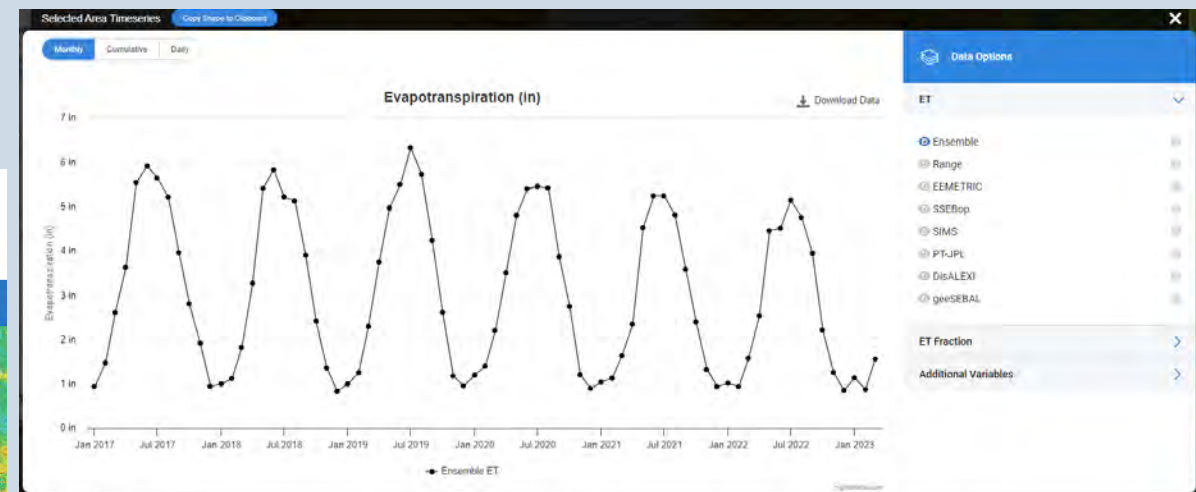
Water Use Data



Field View (OpenET)

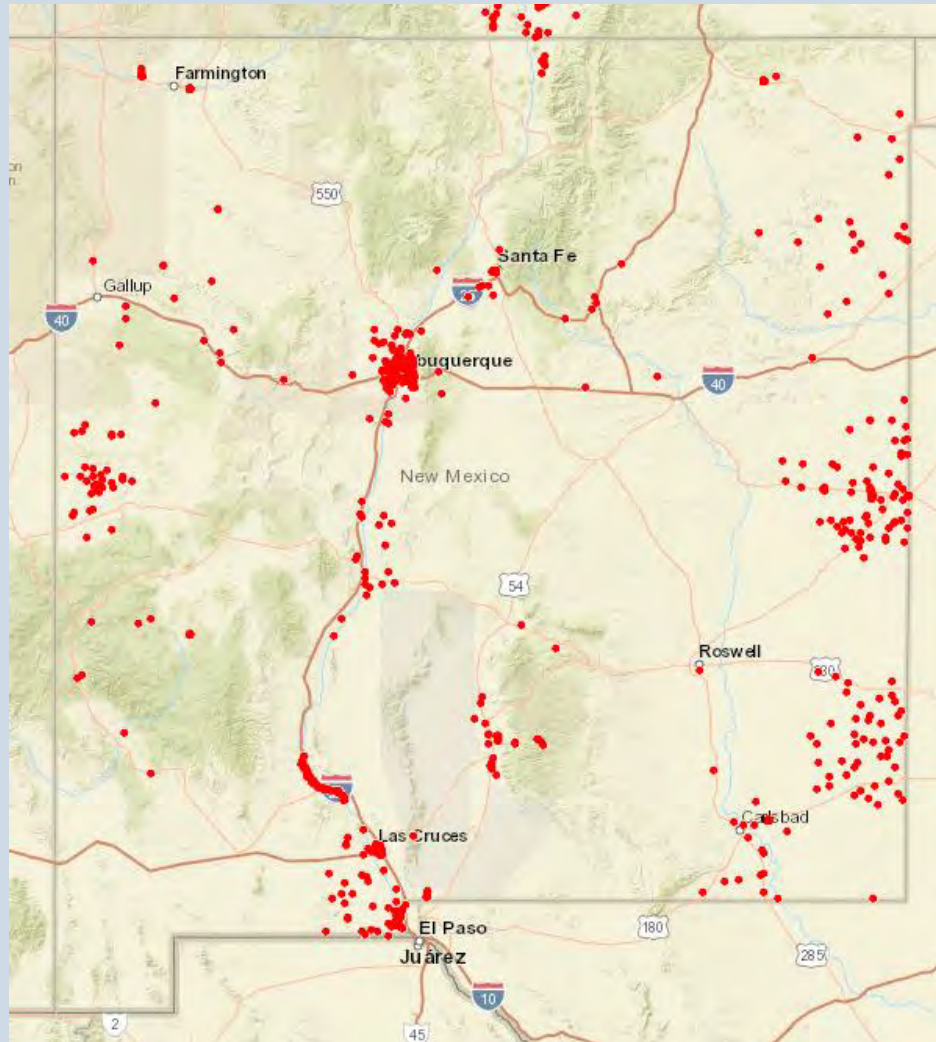
Field View (OpenET)

Well and surface diversions are not accounting for riparian and non-agricultural ET

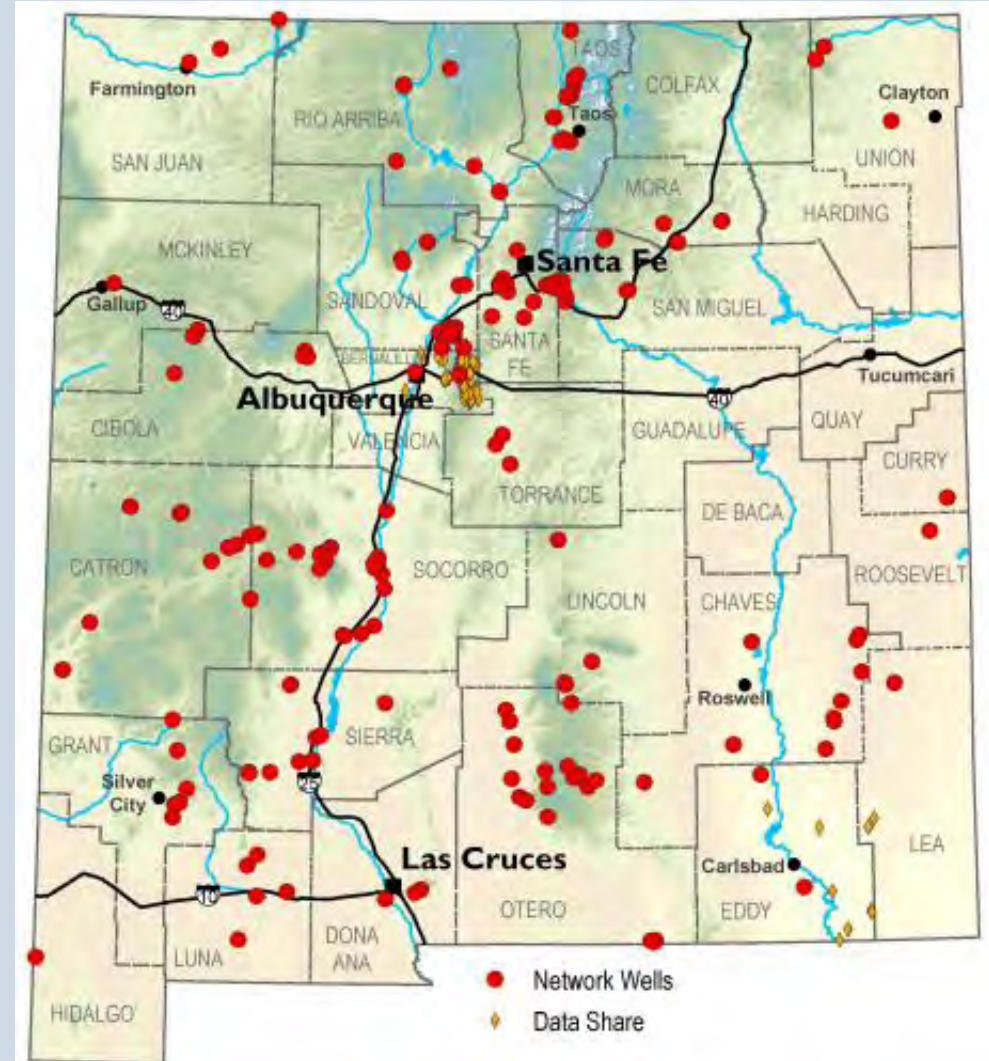


Water Level Data

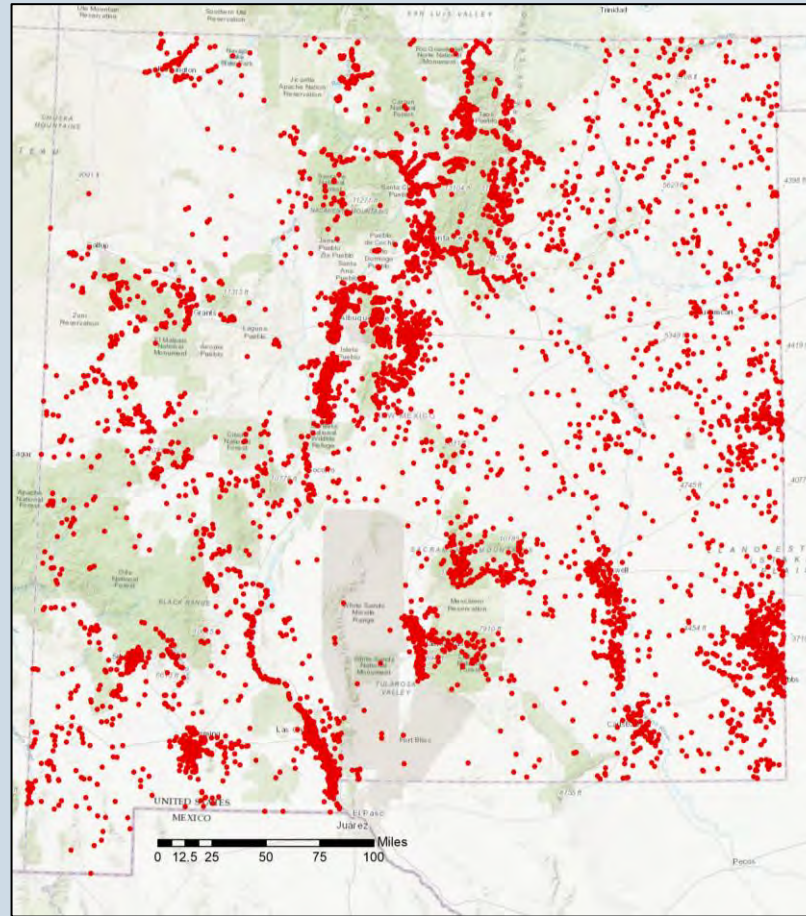
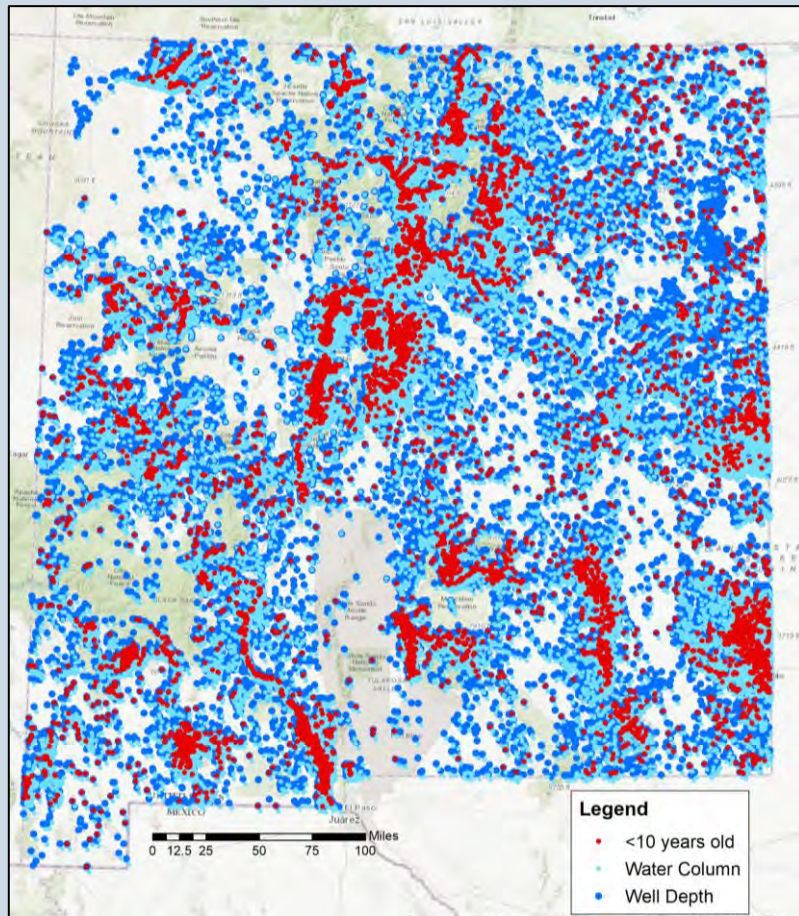
USGS Monitoring Wells



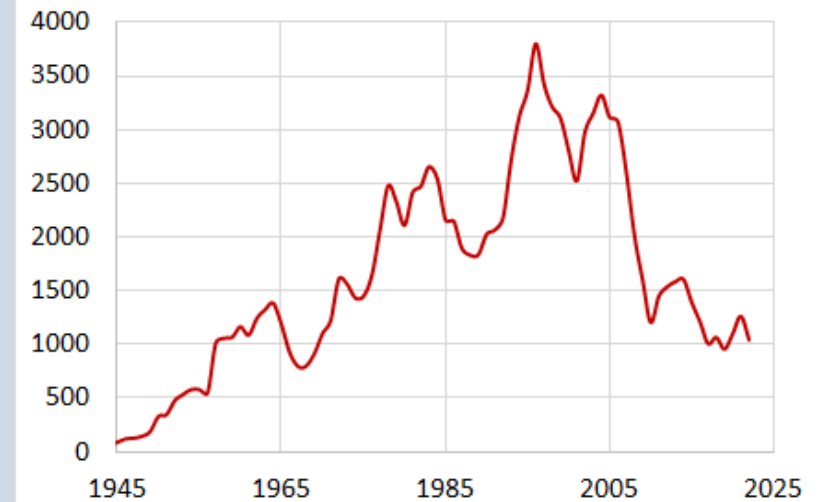
Healy Network (NMBGMR)



Water Level Data



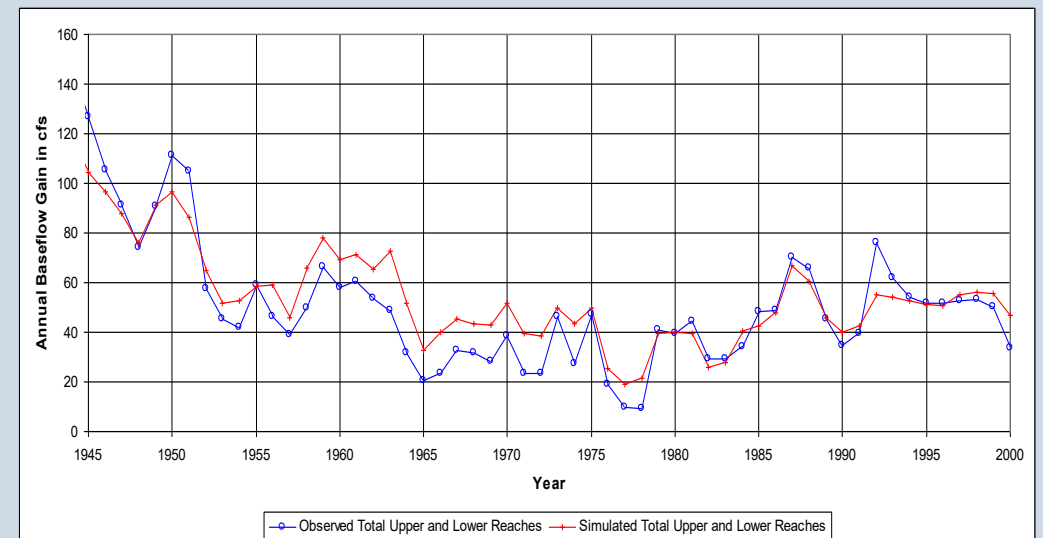
Number of water level measurements in new wells (NMWRRS)



- Measurements taken when well is drilled
- 25% of measurements are < 20 years old
- 8% of measurements are < 10 years old

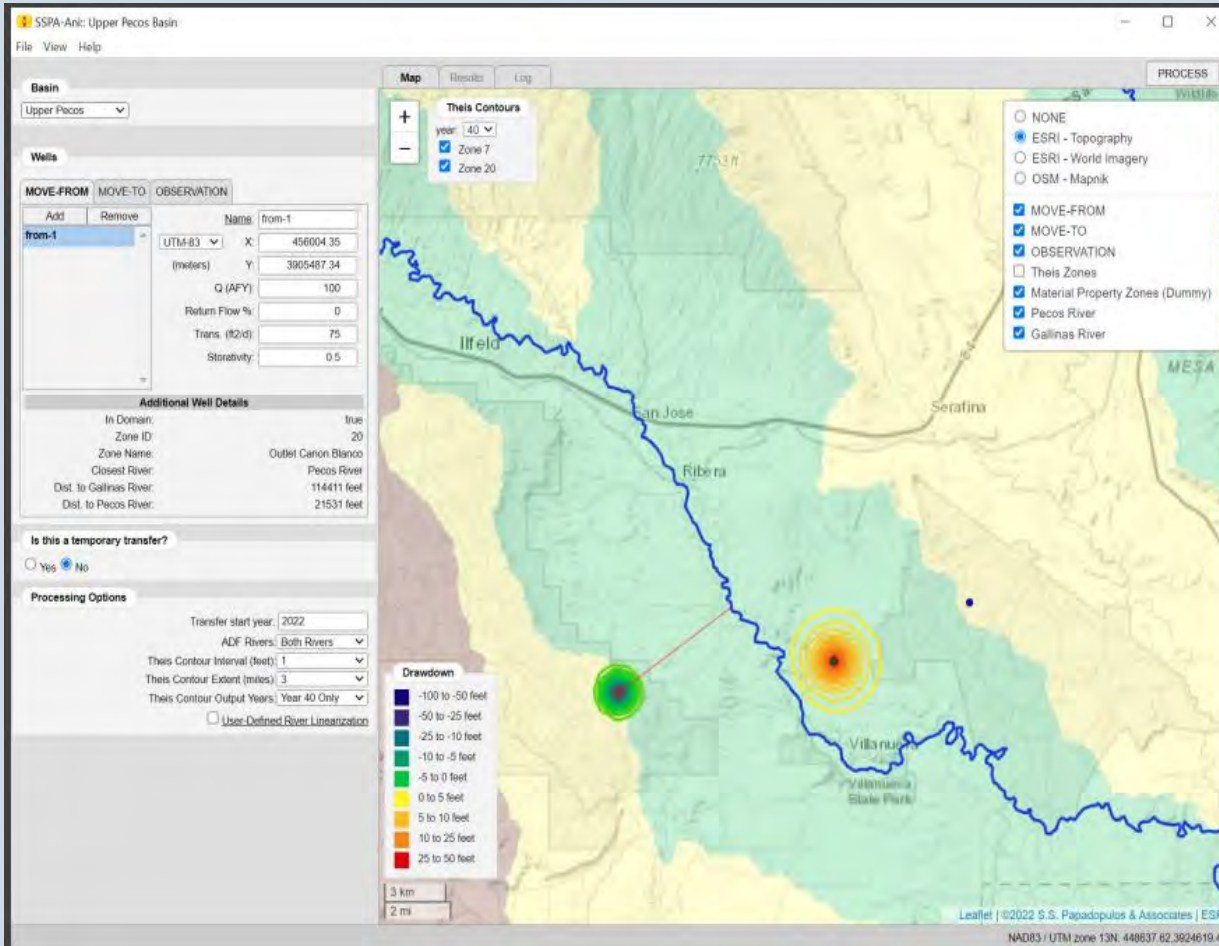
Data Needs

- Develop conceptual models (and revisit!)
- Construct geologic framework of physical system
- Accurately represent boundary conditions (fluxes)
- Model calibration
- Model verification
- Model updates and revisions

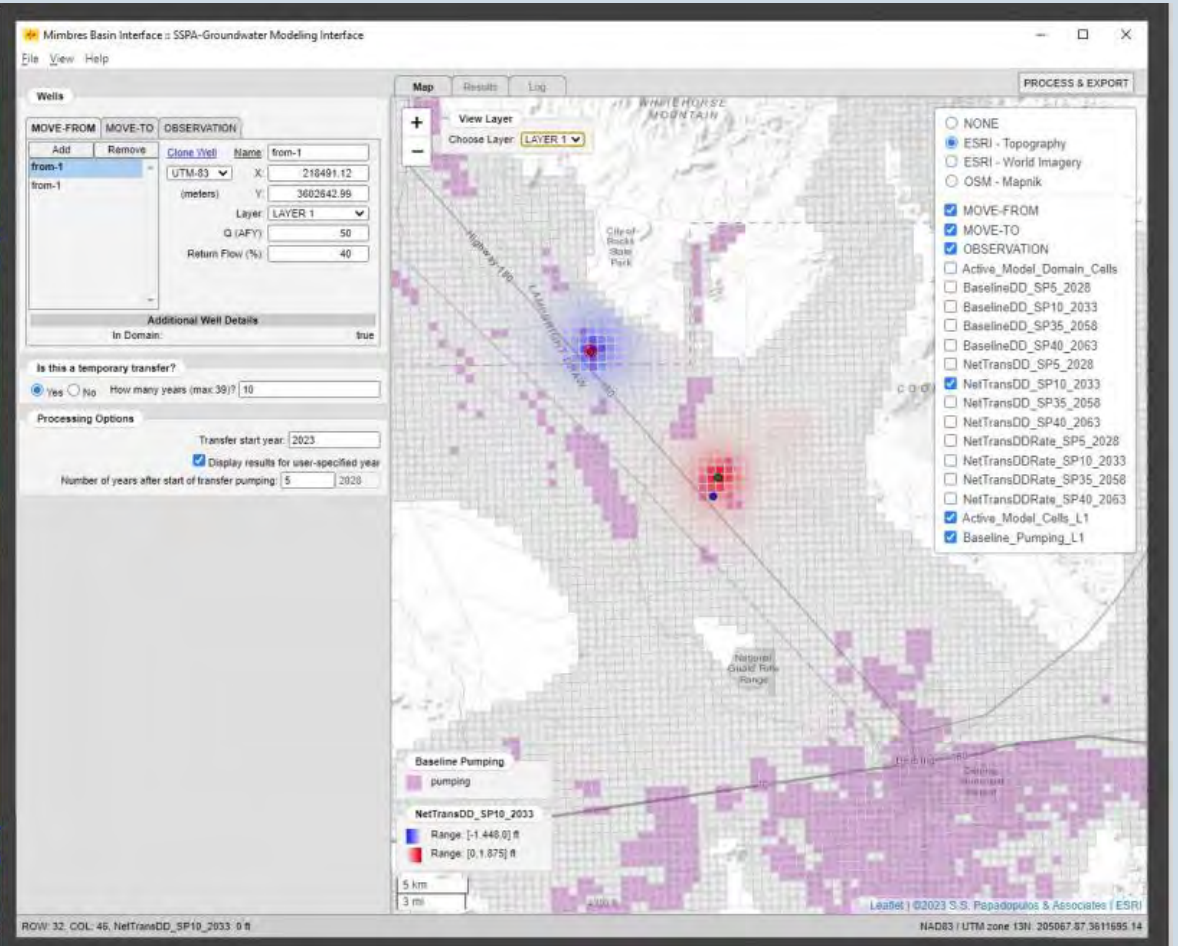


Interfaces in Development

Analytical Interface (AnI)



Mimbres Basin, Lea County, Estancia Basin



Thank You

*Bisti/De-Na-Zin Wilderness
San Juan Basin, New Mexico*

Image: <https://spotlightorigin.files.wordpress.com/2021/07/bisti-de-na-zin-wilderness-landscape.jpg?w=1568>

Katie Zemlick, Ph.D.
Hydrology Bureau Chief
New Mexico Office of the State Engineer
Katie.Zemlick@ose.nm.gov



New Mexico Water Data Initiative

Using the NMWDI Data Catalog: What it CKAN and Can't Do



May 2023
Cris Morton, Rachel Hobbs

newmexicowaterdata.org

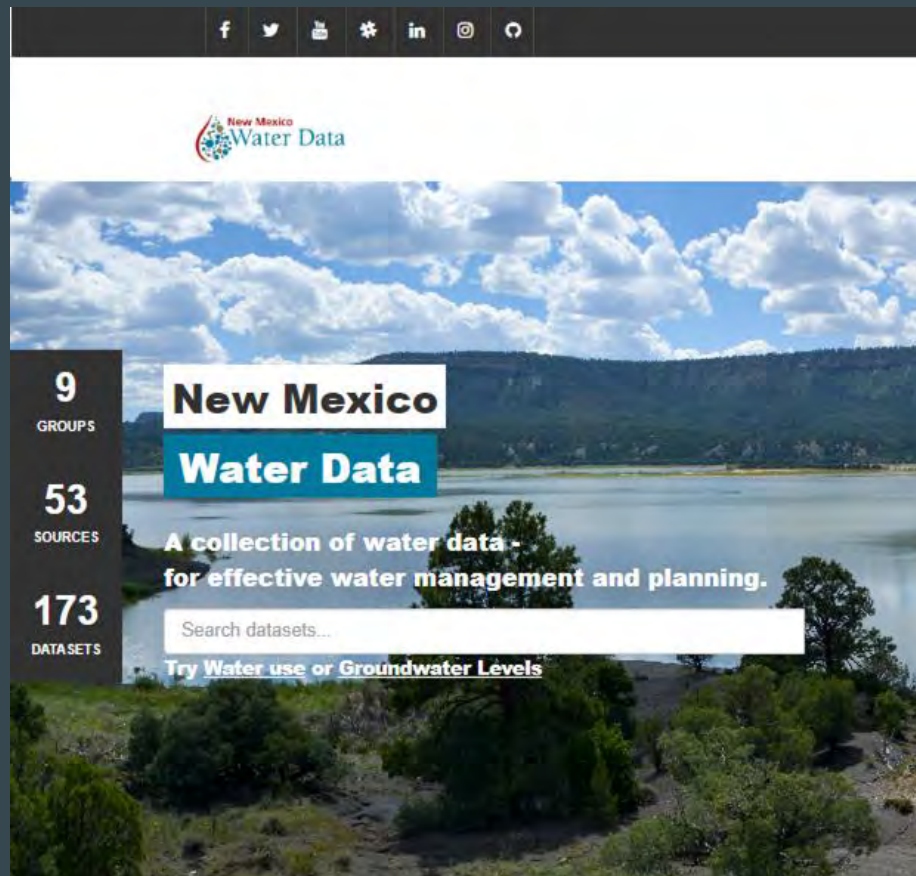
Overview

- New Mexico Water Data Catalog
- Creating a CKAN account
- Finding datasets
- Creating datasets
- Editing Datasets
- Challenges
- Future Work

New Mexico Water Data Catalog

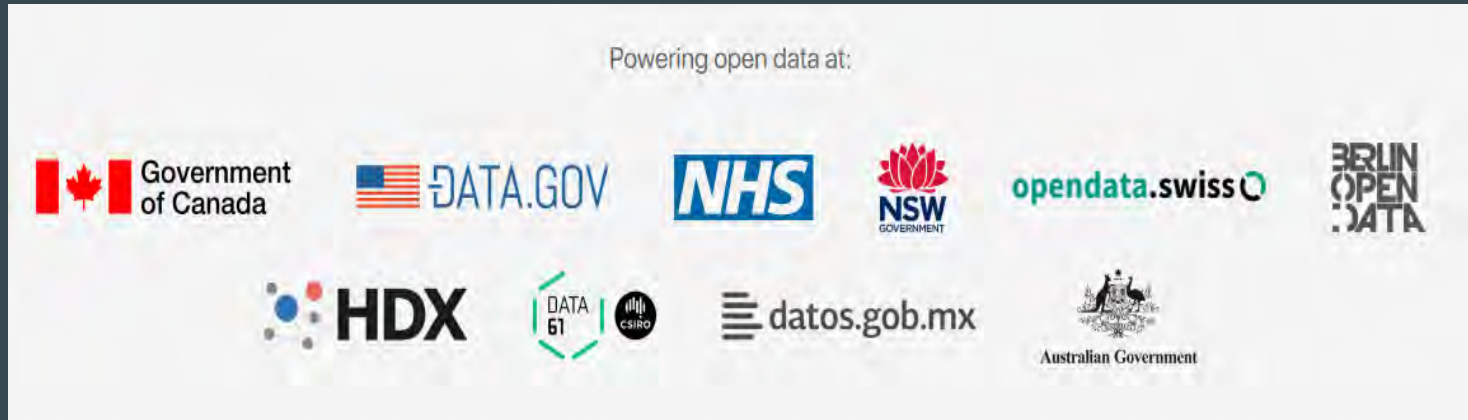
catalog.newmexicowaterdata.org

- A repository for New Mexico water data
- Over 170 datasets from 53 organizations
- New Mexico water data is findable, accessible, reusable
- The main way that users interact with water data



What is CKAN?

“An open source data management system for powering data hubs and data portals. CKAN makes it easy to publish, share, and use data. It powers hundreds of data portals worldwide” - Open Knowledge Foundation



CKAN = Comprehensive Knowledge Archive Network

<https://ckan.org/>

Who Can Use New Mexico Water Data?

- Who can view and download datasets?
- Who can become a registered user?
- Who can add new datasets, or update existing datasets?
- Anyone! You don't have to be a registered user to view or download datasets
- Anyone! Registering allows you to follow organizations or datasets, participate in discussions, and have a profile page
- Anyone who is associated with an organization

New Mexico Water Data Catalog

- Can search by
 - Keyword
 - Group
 - Organization
 - Can also filter datasets by format, tags, etc

The screenshot displays the New Mexico Water Data Catalog website. At the top, there are social media icons for Facebook and Twitter, and a blue button labeled "Add Organization". Below this is a navigation bar with a home icon and the text "Datasets".

The main content area is divided into two columns. The left column features a map titled "Filter by location" with a "Clear" link. The map shows the state of New Mexico with labels for "AZ", "Phoenix", "Albuquerque", "NM", and "Juarez". Below the map, it says "Map data © OpenStreetMap contributors" and "Tiles by Stamen Design (CC BY 3.0)". Underneath the map is a section titled "Organizations" with a list of organizations and their dataset counts:

- New Mexico Bureau o... 25
- New Mexico Environm... 19
- New Mexico Office o... 16
- EDAC 12
- US Geological Survey 10
- New Mexico Energy M... 9
- City of Albuquerque... 5
- Elephant Butte Irri... 5
- National Oceanic an... 5
- US Bureau of Reclam... 5

The right column has a blue button labeled "Add Dataset" and a search bar with the placeholder text "Search datasets...". Below the search bar, it says "177 datasets found" and "Order by: Relevance".

The right column also displays a list of datasets. The first dataset is "La Cienega Groundwater Level Monitoring, Santa Fe County, New Mexico: Summari...". Its description reads: "Beginning in 2003, the New Mexico Bureau of Geology began a hydrogeological investigation of the Española Basin, with a special focus on the wetlands at La Cienega, Santa Fe...". It has "HTML" and "PDF" format options.

The second dataset is "Persistent Effects of the Gold King Mine Spill on Biota: Animas and San Juan ...". Its description reads: "Three years following the Gold King Mine (GKM) spill that released approximately 11 million liters of metal-laden mine drainage into the Animas River, the scientific community...". It has "PDF" and "CSV" format options.

The third dataset is "EDI Data Portal". Its description reads: "The EDI Data Portal contains environmental and ecological data packages contributed by a number of participating organizations. Data providers make every effort to release data...". It has an "HTML" format option.

The fourth dataset is "OSE Points of Diversion". Its description reads: "The NM Office of the State Engineer (OSE) 'Point of Diversions' (POD) layer includes well locations, surface declarations, or surface permits updated on a monthly basis. These...". It has a "1 Dataset" count.

The fifth dataset is "Climate". Its description reads: "Data desc conditions drought or data...". It has a "1 Dataset" count.

Datasets are Comprised of Resources

Healy Collaborative Groundwater Monitoring Network

Followers 1

Follow

Organization

New Mexico Bureau of Geology and Mineral Resources

New Mexico Bureau of Geology and Mineral Resources - the state geologic survey - is a research and service division of the New Mexico Institute of Mining and Technology (NM Tech). [read more](#)

Social

Twitter

Facebook

License

License not specified

Dataset Groups Activity Stream Discussions Manage

Healy Collaborative Groundwater Monitoring Network

The Healy Collaborative Groundwater Monitoring Network is a statewide well measurement network, with wells measured in a variety of ways (i.e. pressure, acoustic, and manual measurements), as well as compiling data from various regional networks. This is an API link to these well locations and associated data.

Data and Resources

Healy Collaborative Groundwater Monitoring Network
The Aquifer Mapping Program is actively expanding the Healy Collaborative...

NMBGMR Historical Monitoring Well Locations
This is a list of coordinates for active and discontinued groundwater...

NMBGMR Active Monitoring Wells
This is a list of wells that are actively monitored by the New Mexico Bureau...

Documentation for the NMBGMR Hydrogeologic ...

[More information](#) [Go to resource](#)

[Preview](#) [Download](#)

[Preview](#) [Download](#)

[More information](#) [Download](#)

aquifer levels aquifer mapping aquifer storage aquifers groundwater groundwater level L...
groundwater levels groundwater monitoring monitoring monitoring network water levels
water quantity water wells wells

Additional Info

Field	Value
Division	Hydrogeology
Subdivision	Aquifer Mapping Program
Contact Name	Laila Sturgis
Contact Email	laila.sturgis@nmt.edu

Dataset

Resources

Takes you directly to the resource link

Allows you to preview the data

Downloads the data

Pulls up metadata page for the resource

Documentation for the NMBGMR Hydrogeologic ...

[Manage](#) [Download](#)

[URL: https://catalog.newmexicowaterdata.org/dataset/2c1b6c5d-0384-45d3-874b-350d22b65639/resource/7a568a7-a17b-406c-b6a0-425a317a2033/download/nmt_aquifer_08]

This includes detailed information about wells, aquifers, water chemistry, stratigraphy, as well as associated data and documentation such as owner information, equipment use, photos and hydrologic log files.

There are no views created for this resource yet.

Not seeing the views you were expecting? Click here for more information.

Resources

Healy Collaborative
NMBGMR Historical...
NMBGMR Active
Documentation for the

Additional Information

Field	Value
Division	Hydrogeology
Subdivision	Aquifer Mapping Program
Data Format	DOC
Contact Name	Laila Sturgis
Contact Email	laila.sturgis@nmt.edu
Data Collection Frequency	one-time
Version	1.0
License	Creative Commons Attribution

Social

Twitter

Facebook

Can view groups, activity stream, and discussions for datasets

Groups tab shows the groups the dataset is associated with

Activity stream shows when the dataset or resources have been updated

Discussions tab allow users to comment on the dataset. Users must be registered and logged in to participate in discussions

The image displays two screenshots of a dataset page for 'Healy Collaborative Groundwater Monitoring Network'.

Top Screenshot: The 'Activity Stream' tab is selected and highlighted with a red box. The page shows a list of updates, including a resource update by Cris Morton 3 days ago.

Bottom Screenshot: The 'Discussions' tab is selected and highlighted with a red box. The page shows a search bar, a 'New Discussion' button, and a message stating '0 discussions found'.

Steps for Adding Datasets to the NM Water Data Initiative's Data Catalog

1. Register as a user
2. Create a new dataset
3. Enter metadata
4. Upload or link resources
5. Create a data dictionary, or upload your existing data dictionary

New Mexico Water Data Initiative can help you with any of these steps! Contact Rachel Hobbs (rachel.hobbs@nmt.edu) or Cris Morton (Cristopher.Morton@nmt.edu) if you have questions.

CKAN Homepage - Register

f t y * in @

GIVE Contact Us Log in

New Mexico Water Data

ABOUT DATA ORGANIZATIONS GROUPS REGISTER

9 GROUPS

52 SOURCES

171 DATASETS

New Mexico Water Data

A collection of water data - for effective water management and planning.

Search datasets...

[Try Water use or Groundwater Levels](#)

Climate
Data describing long-term weather conditions such as precipitation, drought conditions, or evaporation data.

Ecosystems & Wildlife
Water data within the scope of ecosystems and wildlife, such as aquatic life, watershed health, or land use.

Energy
Data related to energy development, such as produced water, mining, water reuse, or hydroelectric power, for example.


Infrastructure
Data that helps to manage or describe various water management structures, such as dams and reservoirs, flood control structures, acequias and ditches, or pipelines.

Natural hazards
Data related to hazards like drought, flood, storm water and public health factors.

CKAN = the open-source data management system that powers the New Mexico Water Data catalog

Register - create a CKAN account at newmexicowaterdata.org

Setting up a CKAN account

 Registration

Why Sign Up?

Create datasets, groups and other exciting things

Register for an Account

* Username:

Full Name:

* Email:

* Password:

* Confirm:

* Required field

Create Account

After account registration
NMBGMR can give permission to
add/edit datasets.

Contact:
Rachel Hobbs
(rachel.hobbs@nmt.edu) or
Cris Morton
(Cristopher.Morton@nmt.edu)
to request permission

Set Up CKAN Profile

Users **Cris Morton**



Cris Morton

I am a hydrogeologist in the Aquifer Mapping Program at the New Mexico Bureau of Geology, working on 3-dimensional models of aquifers in the state as well collecting water related data in the field.

Followers

1

Datasets

47

Edits

823

Username

mortoncr

Datasets

Activity Stream

Manage

Add Dataset

EBID SensorThings API

Currently, users can either view this data directly in a web browser, though this can be confusing to users who do not understand the SensorThings API...

sensorthings api

HTML

CABQ Landfill and Groundwater Monitoring

Prior to the use of the Cerro Colorado Landfill, the City of Albuquerque, Bernalillo County and private landowners operated several other landfills in and around Albuquerque....

HTML

CABQ Groundwater Levels 1995-Present- Webmap

The Environmental Services Division conducts aquifer groundwater monitoring at approximately 130 selected wells within the Albuquerque city limits. Groundwater monitoring...

HTML

Hydrogeologic Framework of the Estancia Basin, New Mexico - Open-file Report 609

This dataset includes GeoJSON files which can be downloaded and dropped directly into open source GIS software such as QGIS. New Mexico relies heavily on groundwater, as it...

-Click on your name at the top of the page to get to user profile

-“Activity Stream” tab shows recent user activity

-Use “Manage” button to regenerate API key, change password, or edit name, email, and bio.

CKAN Homepage - Finding Datasets

f t d * in @

GIVE Contact Us Log in

ABOUT DATA ORGANIZATIONS GROUPS REGISTER

9 GROUPS

52 SOURCES

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Data that helps to manage or describe various water management structures, such as dams and reservoirs, flood control structures, acequias and ditches, or pipelines.

Natural hazards
Data related to hazards like drought, flood, storm water and public health factors.

-About- info about WDI

-Data- list of all datasets

-Organizations - list of contributing organizations

-Groups - datasets by category

-Search bar – Search datasets by tags, groups, organizations, file format, or name

Creating Datasets

- Datasets can include single or multiple files.
- Datasets can also be links to pages outside of the Water Data Catalogue

The screenshot shows the user profile for Cris Morton. The profile includes a bio, a list of datasets, and statistics. The 'Add Dataset' button is highlighted with a red box.

Users **Cris Morton**

Datasets **Activity Stream**

Add Dataset

EBID SensorThings API
Currently, users can either view this data directly in a web browser, though this can be confusing to users who do not understand the SensorThings API...

CABQ Landfill and Groundwater Monitoring
Prior to the use of the Cerro Colorado Landfill, the City of Albuquerque, Bernalillo County and private landowners operate several other landfills in and around Albuquerque...

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Followers **Datasets**
1 **47**

Edits
823

Username
mortonc

From user profile

The screenshot shows the 'Datasets' page. It includes a search bar, a map, and a list of datasets. The 'Add Dataset' button is highlighted with a red box.

New Mexico Water Data

ABOUT **DATA** **ORGANIZATIONS** **GROUPS**

Datasets

Filter by location **Clear**

Add Dataset

Search datasets...

175 datasets found

Order by: **Relevance**

Bernalillo County Water Levels
The county water level monitoring program was formally launched in February 2010. Based on data collected since that time, the Office of the State Engineer closed the Sandia...

EBID SensorThings API
Currently, users can either view this data directly in a web browser, though this can be confusing to users who do not understand the SensorThings API...

From "datasets"
page

Creating Datasets – Filling Out Metadata

Metadata describe information about data, including who, what, where, when, why, and how, so that it can be understood, re-used, and integrated with other data. Metadata records follow a standard format to enable interoperability.

Metadata are entered into CKAN in three ways:

- Manual metadata entry when creating a new dataset,
- Manually creating the data dictionary for an uploaded dataset, or
- Uploading a machine-readable data dictionary.

Title:

A good title includes 'what', 'where', and 'when' (Example: Point Locations of Wind Turbines in I

* URL: catalog.newmexicowaterdata.org/dataset/<dataset> [Edit](#)

* Description:

Details about the what, why, when, and how aspects pf the data. Please describe whether the data is used for operations, research, regulatory, or other decision purposes.

You can use [Markdown formatting](#) here

Keywords:

Words or phrases that help people find the data.

Source URL:

Associated website where the data, or information about the data, can be found.

Organization:

New Mexico Bureau of Geology and Mineral Resources

Visibility:

Public

Division:

Division, bureau, program, committee or commission, etc. within the organization. If applicable.

Subdivision:

Subdivision, bureau, program, committee or commission, etc. within the division. If applicable.

* Contact Name:

Point of contact name for data steward

* Contact Email:

Point of contact email for data steward

Contact Phone:

Point of contact phone for data steward

The data license you select above only applies to the contents of any resources

Creating Datasets – Filling Out Metadata

Robust and detailed metadata, including a data dictionary, are very important for the success of the Water Data Initiative.

Metadata are crucial for any use or reuse of data; no one can responsibly re-use or interpret data without metadata that explains how the data were created, why, where it is geographically located, and details about the structure of the data.

Only a few fields are required but the more information the better

Known Uses of Data:

If certain agencies are known downstream consumers of the data, please list brief details about who they are and what asp

Data Collection Procedures:

Please include brief details about how the data were collected. If certain protocols were followed, please include relevant d

* Data Collection Timeframe:

Describe the date range within which the data was collected, or if data collection is still ongoing

Data Collection Frequency:

one-time

Preparation Method:

How is the data extracted (if it is part of a larger dataset) and prepared for publication? If the method uses a calculation, inc

* Data Publishing Method:

How is the data published for use (website, print, API, etc.)?

Data Publishing Frequency:

Data Quality Procedures:

Please include brief details about how the data quality was reviewed. If certain protocols were followed, please include rele

Version:

1.0

License:

Creative Commons Attribution

 License definitions and additional information can be found at opendefinition.org

Geographic Location:

The name of the location, area, or region where the data was collected

Coordinate reference system:

Coordinate reference system if uploading spatial data such as GeoJSON (EPSG:26913 or NAD83 / UTM zone 13N).

Data Dictionary:

Data dictionary listing field names, human readable translation of the field name, descriptions of the field names, and field data types.

Creating Datasets – Add Data

Keywords:

Words or phrases that help people find the data.

Source URL:

Associated website where the data, or information about the data, can be found.

Organization:

Albuquerque Bernalillo County Water Utility Authority

Visibility:

Public

Division:

Division, bureau, program, committee or commission, etc. within the organization. If applicable.

Subdivision:

Subdivision, bureau, program, committee or commission, etc. within the division. If applicable.

* Contact Name:

Point of contact name for data steward

* Contact Email:

Point of contact email for data steward

Contact Phone:

Point of contact phone for data steward

The data license you select above only applies to the contents of any resource files that you add to this dataset. By submitting this form, you agree to release the metadata values that you enter into the form under the [Open Database License](#).

* Required field

Next: Add Data

Tagging helps users find what they are looking for

1 Create dataset

2 Add data

Data:

Upload

Link

* Name:

eg. January 2011 Gold Prices

* Description:

Details about the what, why, when, and how aspects of the data. Please describe whether the data is used for operations, research, regulatory, or other decision purposes.

You can use [Markdown formatting here](#)

Division:

Division, bureau, program, committee or commission, etc. within the organization. If applicable.

Subdivision:

Subdivision, bureau, program, committee or commission, etc. within the division. If applicable.

Data Source:

Original source of the data (e.g. USGS, OSE, etc.) if different from organization.

Format:

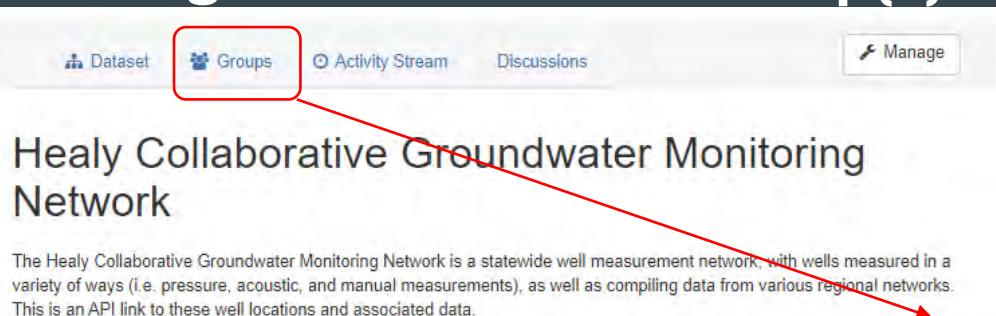
Describe the format of the data (PDF, CSV, etc.).

This will be guessed automatically. Leave blank if you wish

-Data resources can be files like CSV, XLS, PDF, JSON, SHP (zipped) etc, or HTML links

- Resources can be edited or added to after the dataset is created

Creating Datasets – Add Group(s)



[Dataset](#) **[Groups](#)** [Activity Stream](#) [Discussions](#) [Manage](#)

Healy Collaborative Groundwater Monitoring Network

The Healy Collaborative Groundwater Monitoring Network is a statewide well measurement network, with wells measured in a variety of ways (i.e. pressure, acoustic, and manual measurements), as well as compiling data from various regional networks. This is an API link to these well locations and associated data.

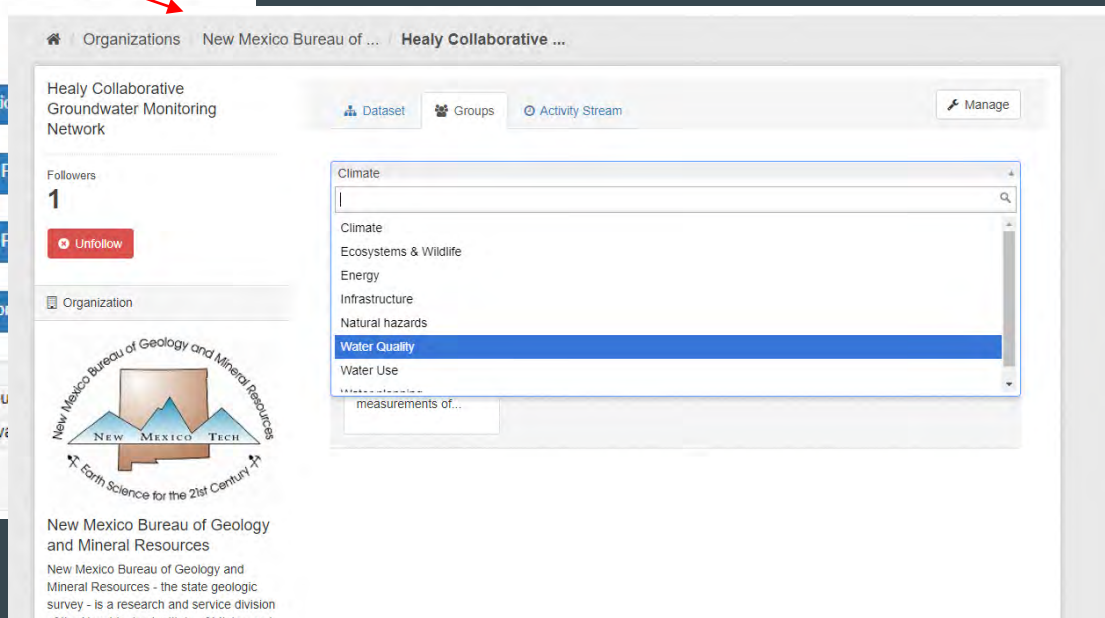
Data and Resources

Healy Collaborative Groundwater Monitoring Network
The Aquifer Mapping Program is actively expanding the Healy Collaborative...

NMBGMR Historical Monitoring Well Locations
This is a list of coordinates for active and discontinued groundwater...

Healy Collaborative Groundwater Monitoring ...
This is a list of wells that are actively monitored by the Healy...

Documentation for the NMBGMR Hydrogeologic ...
This includes detailed information about wells, aquifers, water chemistry...




[Organizations](#) [New Mexico Bureau of ...](#) **Healy Collaborative ...**

[Dataset](#) **[Groups](#)** [Activity Stream](#) [Manage](#)

Followers
1
[Unfollow](#)

Organization



New Mexico Bureau of Geology and Mineral Resources
New Mexico Bureau of Geology and Mineral Resources - the state geologic survey - is a research and service division of the New Mexico Institute of Mining and...

Climate
Climate
Ecosystems & Wildlife
Energy
Infrastructure
Natural hazards
Water Quality
Water Use
measurements of...

After the dataset has been created there will a “Groups” tab with a dropdown to select the relevant group(s) for the data


Editing Datasets

[Dataset](#) [Groups](#) [Activity Stream](#) [Discussions](#) [Manage](#)


Healy Collaborative Groundwater Monitoring Network

The Healy Collaborative Groundwater Monitoring Network is a statewide well measurement network, with wells measured in a variety of ways (i.e. pressure, acoustic, and manual measurements), as well as compiling data from various regional networks. This is an API link to these well locations and associated data.


Data and Resources

**Healy Collaborative Groundwater Monitoring Network**
The Aquifer Mapping Program is actively expanding the Healy Collaborative...


[More information](#) [Go to resource](#)

**NMBGMR Historical Monitoring Well Locations**
This is a list of coordinates for active and discontinued groundwater...

[Preview](#) [Download](#)

**Healy Collaborative Groundwater Monitoring ...**
This is a list of wells that are actively monitored by the Healy...

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This includes detailed information about wells, aquifers, water chemistry,...

[More information](#) [Download](#)

aquifer levels aquifer mapping aquifer storage aquifers groundwater groundwater level t...
groundwater levels groundwater monitoring monitoring monitoring network water levels
water quantity water wells wells

[Edit metadata](#) [Resources](#) [View dataset](#)

Title:
Healy Collaborative Groundwater Monitoring Network

URL: <catalog.newmexicowaterdata.org/dataset/collaborative-groundwater-monitoring-network> [Edit](#)

Description:
The Healy Collaborative Groundwater Monitoring Network is a statewide well measurement network, with wells measured in a variety of ways (i.e. pressure, acoustic, and manual measurements), as well as compiling data from various regional networks. This is an API link to these well locations and associated data.
You can use Markdown formatting here

Keywords:
aquifers groundwater groundwater monitoring monitoring monitoring network water levels
wells water wells water quantity aquifer levels aquifer mapping aquifer storage
groundwater levels groundwater level trends

Source URL:
Associated website where the data, or information about the data, can be found

Organization:
New Mexico Bureau of Geology and Mineral Resources

Visibility:
Public

Division:
Hydrogeology

Editing Datasets – Adding/Reordering Resources

Organizations New Mexico Bureau of ... Healy Collaborative ... Edit

Healy Collaborative Groundwater Monitoring Network

Followers 1

Edit metadata Resources View dataset

Title:

Healy Collaborative Groundwater Monitor

* URL: catalog.newmexicowaterdata.org/dataset/colla

* Description:

The Healy Collaborative Groundwater Monitoring Net
in a variety of ways (i.e. pressure, acoustic, and manu
networks. This is an API link to these well locations ar

You can use Markdown formatting here

New resource

All resources

Data:

Upload

Link

* Name:

eg. January 2011 Gold Prices

* Description:

Details about the what, why, when, and how aspects of the data. Please describe whether the data is used for operations, research, regulatory, or other decision purposes.

You can use Markdown formatting here

Division:

Organizations New Mexico Bureau of ... Healy Collaborative ... Edit

Healy Collaborative Groundwater Monitoring Network

Followers 1

Edit metadata

Resources

+ Add new resource

Reorder resources



Healy Collaborative Groundwater Monitoring Network

The Aquifer Mapping Program is actively expanding the Healy Collaborative...



NMBGMR Historical Monitoring Well Locations

This is a list of coordinates for active and discontinued groundwater...



Healy Collaborative Groundwater Monitoring ...

This is a list of wells that are actively monitored by the Healy...



Documentation for the NMBGMR Hydrogeologic ...

This includes detailed information about wells, aquifers, water chemistry,...

Datasets – Data Dictionaries

A Data Dictionary is a collection of names, definitions, and attributes about data elements that are being used or captured in a database, information system, or part of a research project.

Table	Column	Type	Size	Description
Location	PointID	nvarchar	10	Alpha-numeric identifier assigned by project personnel. Used to cross-relate in subordinate data tables
Location	Easting	int	4	UTM Easting of the Site in NAD83, Zone 13
Location	Northing	int	4	UTM Northing of the Site in NAD83, Zone 13
Location	UTMDatum	nvarchar	50	Indicates the datum of the Easting/Northing values; NAD83 – North American Datum of 1983
Location	Altitude	real	4	Altitude in feet above mean sea level of the land surface at the Site
Location	County	nvarchar	25	Name of County covering the data location
Location	State	nvarchar	2	The state in which the site is located.
WellData	HoleDepth	smallint	2	Depth to which the well hole was drilled in feet below land-surface datum.
WellData	WellDepth	smallint	2	Depth of the finished well in feet below land-surface datum.
WellData	DepthSource	nvarchar	5	Code indicating how the information about the depth of the well was obtained; A = Reported by another agency
WellData	CompletionDate	datetime	8	Date when the hole or well was completed.
WellData	CompletionSource	nvarchar	5	A code indicating how the information about the construction of the well was obtained; A = Reported by another agency
WellData	CasingDiameter	real	4	Diameter of the casing in feet.
WellData	CasingDepth	real	4	Total depth to which casing was installed in the hole, in feet below land-surface datum.
WellData	Status	nvarchar	2	Code describing the current status of the hole/well, as of the date of entry; A = Abandoned, C = Active pump
WaterLevel	DateMeasured	date	10	Date of water-level measurement.
WaterLevel	TimeMeasured	time	16	Time of water-level measurement.
WaterLevel	TimeDatum	nvarchar	100	Time zone where measurement was taken (EST, MST, etc)
WaterLevel	DepthToWaterBGS	real	4	Depth to water, in feet below ground surface. This is a calculated field.
WaterLevel	LevelStatus	nvarchar	2	Code indicating the status of the site at the time the water level was measured; see WaterLevels - Level Status Codes list
WaterLevel	DataQuality	nvarchar	2	Code indicating quality of measurement; 0 = None, 1 = good - clean line or E-probe, 2 = fair - somewhat reliable
WaterLevel	MeasurementMethod	nvarchar	2	Code indicating how the water level was measured; see WaterLevels - Measurement Methods Codes list
WaterLevel	DataSource	nvarchar	5	Code indicating the source of water-level data; A = Reported by another agency, D = From driller's log or well log
WaterLevel	MeasuringAgency	nvarchar	50	Code indicating the agency/organization/company that performed water level measurement; USGS = US Geological Survey

Data Dictionary

Column	Type	Label	Description
Well_ID	text		GUID and primary key for records in the WellData table
Managing_Agency	text	MeasuringAgency	Code indicating the agency/organization/company that performed the water level measurement
Type	text		Describes the type of site; SiteType CODE MEANING D Division of surface water, etc ES Ephemeral stream GW Groundwater other than spring (well) L Lake, pond or reservoir M Meteorological (rain, snow) O Outfall of wastewater or return flow OT Other PS Perennial stream R Rock sample location S Soil gas sample location SP Spring
Latitude	numeric		Latitude coordinate of the location in degrees, minutes, seconds as a consecutive string.
Longitude	numeric		Longitude coordinate of the location in degrees, minutes, seconds as a consecutive string.
Well_Depth	numeric		Depth of the finished/cased well, in feet below land surface.

Editing Datasets – Data Dictionaries

The screenshot displays a web interface for editing a dataset titled "Healy Collaborative Groundwater Monitoring Network". The interface is divided into two main sections: a left sidebar for editing the dataset's metadata and a right pane for editing the data dictionary.

Left Sidebar (Dataset Metadata):

- Dataset:** Healy Collaborative Groundwater Monitoring Network
- Navigation:** Edit resource, DataStore, Data Dictionary (selected), Views
- Field 1. PointID (text):**
 - Type Override: [Dropdown menu]
 - Label: [Text input field]
 - Description: Alpha-numeric identifier assigned by project personnel. Used on a more functional level to cross-relate to subordinate table data.

Right Pane (Data Dictionary):

- Dataset Title:** Healy Collaborative Groundwater Monitoring ...
- URL:** <https://catalog.newmexicowaterdata.org/dataset/2c186c58-0394-4583-87a0-358d22b56639/resource/757e7642-1e22-4f7d-ab8c-7bd549602b64/download/collab...>
- Description:** This is a list of wells that are actively monitored by the Healy Collaborative Monitoring Network at the New Mexico Bureau of Geology and Mineral Resources, including sites.
- Actions:** Manage, Download, Fullscreen, Embed, Data Ex
- Records:** 751 records
- Navigation:** Edit resource, DataStore, Data Dictionary (selected), Views
- File:** collaborative-water-level-network.csv (Remove)
- Name:** Healy Collaborative Groundwater Monitoring Network Wells
- Description:** This is a list of wells that are actively monitored by the Healy Collaborative Monitoring Network at the New Mexico Bureau of Geology and Mineral Resources, including data share sites.
- Division:**

Challenges: What We CKAN'T Do

- Interoperability of datasets
- Creating metadata schema
- Standardized tagging
- Organizing datasets with only two levels in the scheme (Dataset and Resource)
- Feedback from users

Future Work and Improvements

- Update version of CKAN
- Incorporate visualizations of Datasets/Resources
- Resource tagging
- Enhanced searching
- Adding a third level of classification
- Small UI changes like larger text boxes
- Data Requests/user feedback option

Thank You!
Questions?



Find Cris or Rachel during the social hour to talk
more, or email us

rachel.hobbs@nmt.edu

cristopher.morton@nmt.edu



newmexicowaterdata.org

Feedback?

Has anyone tried to find data in CKAN?

NMWDI Plumbing: the unseen infrastructure delivering water data



Jake Ross
NMWDI Implementation Team

5/4/2023
NMWDI
NMBGMR



newmexicowaterdata.org

Who Am I?

Jake Ross

- Technical Lead/principal software developer for NMWDI
- Background in Argon Geochronology
- Open source software for New Mexico Geochronology Research Laboratory
- Open source software for NMBG Aquifer Mapping Program

How do we “view” data?

Is it observable?

Is it measured?

Is it in electronic form?

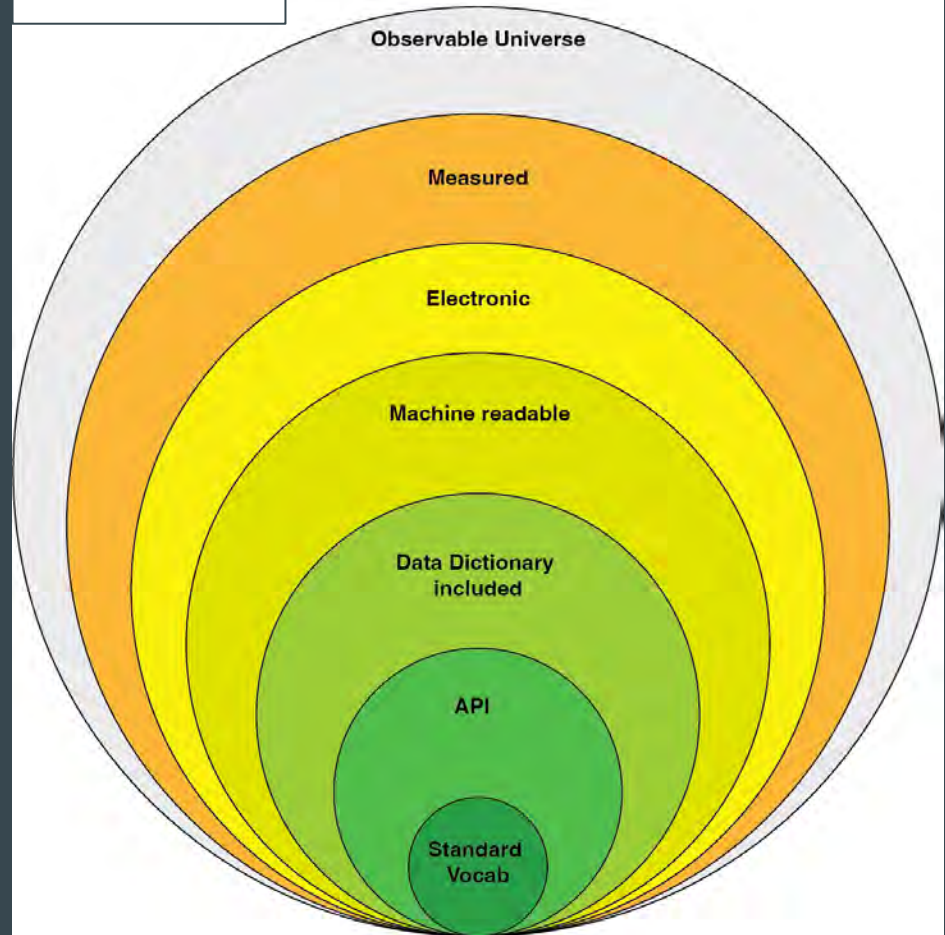
Is it machine readable (json, csv, xml)?

Is there a “data dictionary”?

Is it served via an API?

Does it follow a standard vocabulary?

Data Onion



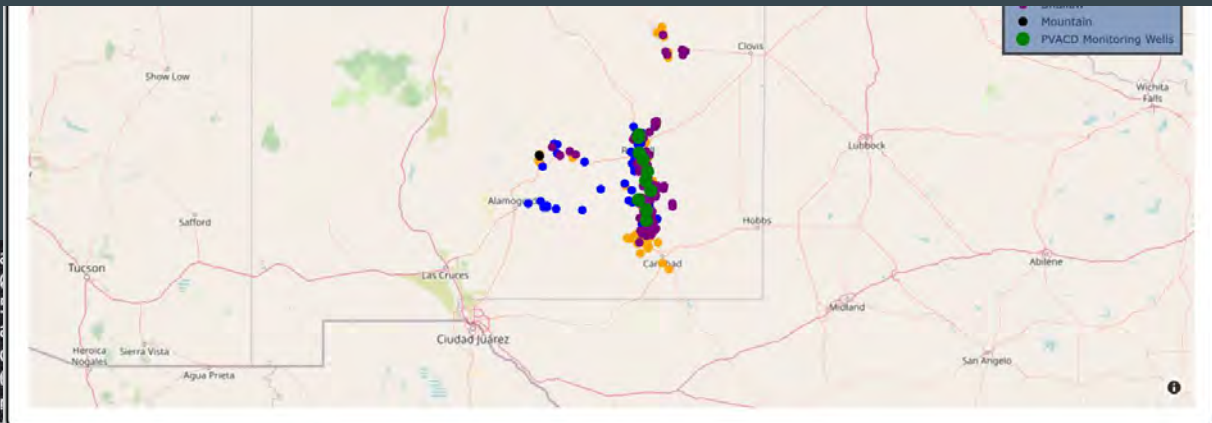
What Will I Talk About?

1. The Problem
2. SensorThings and FROST
3. New Mexico Water Data Initiative's ELT Pipeline
4. New Mexico Water Data Initiative's Schemas and Validation

The Problem

We want

```
{ "@iot.nextLink": "https://st2.newmexicowa",
  { "type": "Point", "coordinates": [-106.5218,
    0101", "AltDatum": "NGVD29", "Altitude": 5571,
    /v1.1/Locations(2527)", "Things@iot.naviga
    /HistoricalLocations"}, {"description": "L
    031", "properties": {"WellID": "6EFD2F4-BF
    /8212", "source_id": 37994.0}, "@iot.selfLi
    /Things", "HistoricalLocations@iot.naviga
    made", "encodingType": "application/vnd.ge
    AF21-9232753876FA", "agency": "NMBGMR", "Po
    /FR0ST-Server/v1.1/Locations(7444)", "Thi
    /v1.1/Locations(7444)/HistoricalLocations
    [-106.49013699971263, 35.23122608124462]}
    /st/locations/8032", "source_id": 37743.0}
    /Things", "HistoricalLocations@iot.naviga
    made", "encodingType": "application/vnd.ge
    B7FD-8893D678A58B", "agency": "NMBGMR", "Po
    /v1.1/Locations(4643)", "Things@iot.naviga
    /HistoricalLocations"}, {"description": "L
    108", "properties": {"WellID": "BDC84EE3-F0
    /8291", "source_id": 38078.0}, "@iot.selfLi
    /Things", "HistoricalLocations@iot.naviga
    made", "encodingType": "application/vnd.ge
    ADDA-735E97163CFA", "agency": "NMBGMR", "Po
    /v1.1/Locations(6673)", "Things@iot.naviga
    /HistoricalLocations"}, {"description": "location of well where measurements are made", "encodingType": "application/vnd.geo+json", "@iot.id": 4172,
```

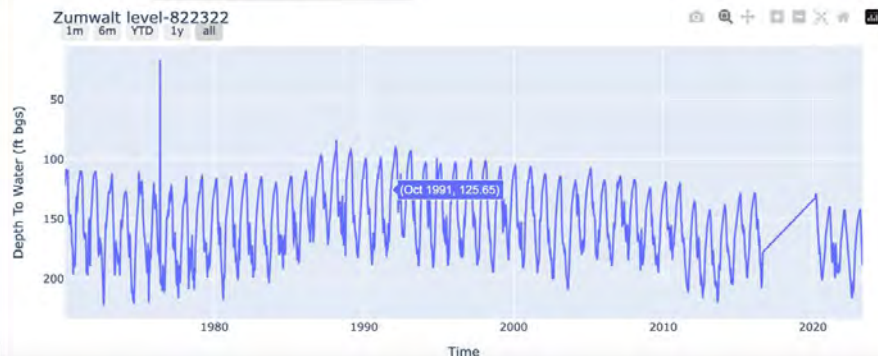


Selected Well

Name	Value
Location	Zumwalt level-822322
Lat/Lon	32.880, -104.430
Source	PVACD
PointID	NM-28258
Elevation (ft)	
Well Depth (ft)	
Aquifer (PVACD)	Artesian
Aquifer	Permian Aquifer System
Formation	
Model Formation	SanAndres
DepthToWater Min/Max	16.65/222.32 (ft bgs)

Download Selected

Start Date → End Date



```
{ "type": "Point", "coordinates": [-106.5218, 0101", "AltDatum": "NGVD29", "Altitude": 5571, /v1.1/Locations(2527)", "Things@iot.naviga /HistoricalLocations"}, {"description": "L 031", "properties": {"WellID": "6EFD2F4-BF /8212", "source_id": 37994.0}, "@iot.selfLi /Things", "HistoricalLocations@iot.naviga made", "encodingType": "application/vnd.ge AF21-9232753876FA", "agency": "NMBGMR", "Po /FR0ST-Server/v1.1/Locations(7444)", "Thi /v1.1/Locations(7444)/HistoricalLocations [-106.49013699971263, 35.23122608124462]} /st/locations/8032", "source_id": 37743.0} /Things", "HistoricalLocations@iot.naviga made", "encodingType": "application/vnd.ge B7FD-8893D678A58B", "agency": "NMBGMR", "Po /v1.1/Locations(4643)", "Things@iot.naviga /HistoricalLocations"}, {"description": "L 108", "properties": {"WellID": "BDC84EE3-F0 /8291", "source_id": 38078.0}, "@iot.selfLi /Things", "HistoricalLocations@iot.naviga made", "encodingType": "application/vnd.ge ADDA-735E97163CFA", "agency": "NMBGMR", "Po /v1.1/Locations(6673)", "Things@iot.naviga /HistoricalLocations"}, {"description": "location of well where measurements are made", "encodingType": "application/vnd.geo+json", "@iot.id": 4172,
```

API Challenges

Consistency

Proliferation non-interoperable RESTful Web APIs

Metadata

Data is accessible but deciphering it is untenable

Documentation

Custom APIs need not provide documentation by default

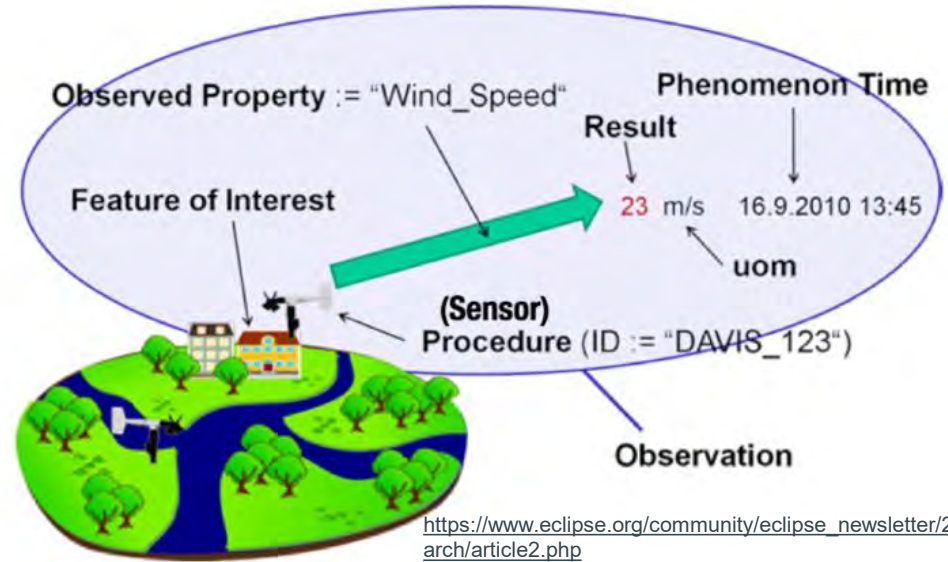
SensorThings and FROST

What is SensorThings?

Why SensorThings?

What is FROST?

Why FROST?



What Is SensorThings?

OGC SensorThings API

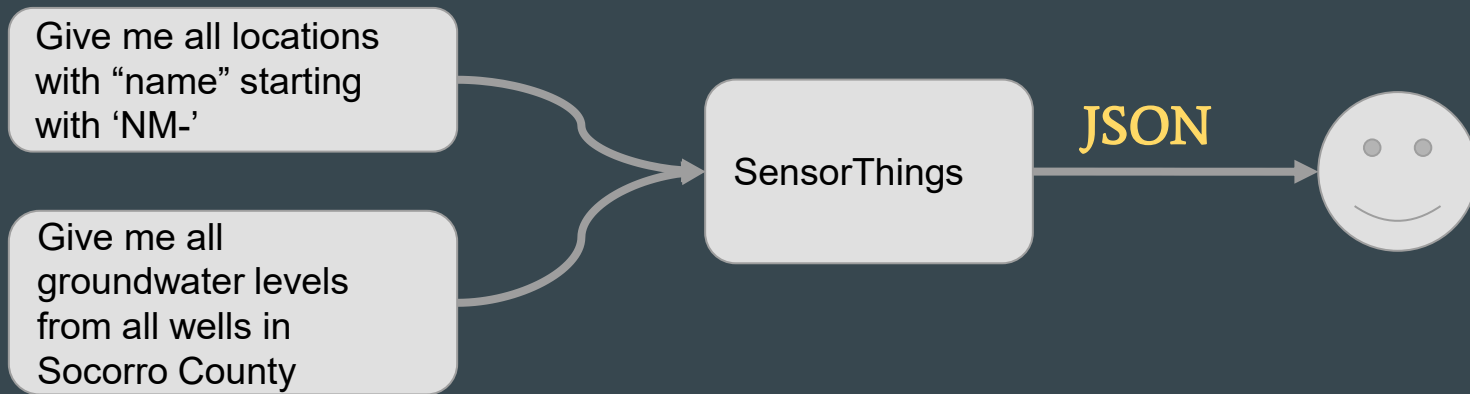
Open, geospatial-enabled and unified way to connect sensors, data and applications over the web

defined in a separate document as the Part II of the SensorThings API.

Why SensorThings?

- Open, Mature, Internationally used and supported
- Geospatial
- Flexible standard way to describe and model any sensing system

Excellent tool for sharing location based time series data



How SensorThings?

I want to share my data in the SensorThings format, what are my options?

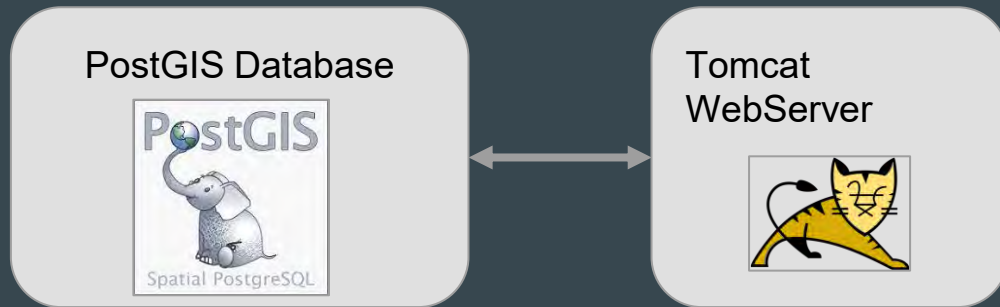
Implement our own
SensorThings compliant
API

Use an open source
implementation.
Setup server, upload
data

What is FROST and why do we use it?

“The **FR**aunhofer **O**pensource **S**ensor**T**hings-Server is the first complete, open-source official reference implementation”

<https://github.com/FraunhoferIOSB/FROST-Server>

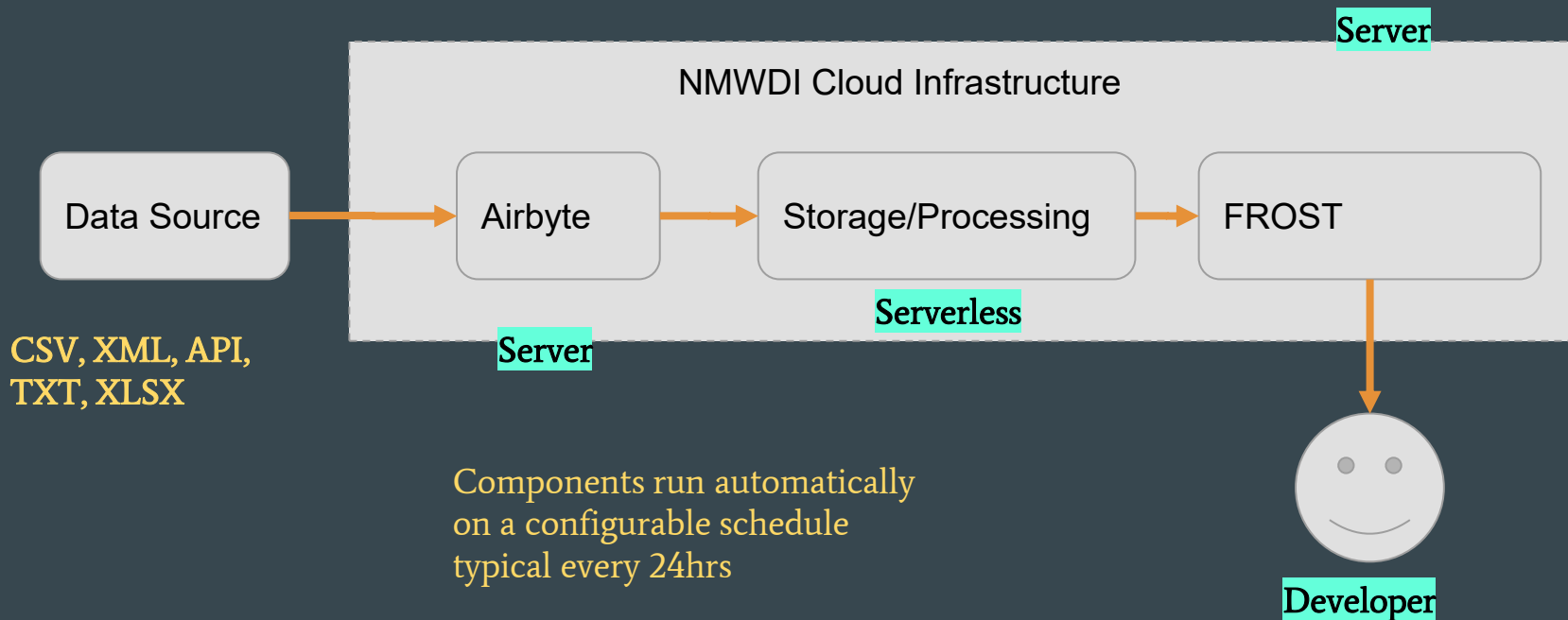


OK! I want to share my data in SensorThings format.
And I want to upload my data to a FROST Server.

How!?

New Mexico WDI Pipeline

Automated ELT Pipeline



What is Airbyte?

The open data movement platform

Airbyte **securely** extracts data from all your tools, and **reliably** loads it to your data warehouse, data lake or database.



Airbyte Connector Management

The screenshot displays the Airbyte web interface for managing connections. The left sidebar contains navigation links for Connections, Sources, Destinations, Update, and Resources. The main area is titled 'Connections' and features a '+ New connection' button. Below the header, a table lists the configured connections with columns for Name, Source Name, Destination Name, Frequency, Last Sync, and Enabled status.

NAME	SOURCE NAME	DESTINATION NAME	FREQUENCY	LAST SYNC	ENABLED
HydroVuPecos <> BQ Locations	hydrovu - HydroVuPecos	BigQuery - BQ Locations	24 hours	24 hours ago	<input checked="" type="checkbox"/>
HydroVuPecos <> BQ Levels	hydrovu - HydroVuPecos	BigQuery - BQ Levels	24 hours	24 hours ago	<input checked="" type="checkbox"/>
ISC Seven Rivers Monitoring Points <> BQ Locations	isc-seven-rivers - ISC Seven Rivers Monitoring Points	BigQuery - BQ Locations	24 hours	24 hours ago	<input checked="" type="checkbox"/>
ISCSevenRivers <> BQ Levels	isc-seven-rivers - ISC Seven Rivers Observations	BigQuery - BQ Levels	24 hours	24 hours ago	<input checked="" type="checkbox"/>
isc-seven-rivers-totalizers <> BQ Levels	isc-seven-rivers-totalizers - isc-seven-rivers-totalizers	BigQuery - BQ Levels	24 hours	23 hours ago	<input checked="" type="checkbox"/>
NMBGMR Well Screens <> BQ Locations	nmbgmr - NMBGMR	BigQuery - BQ Locations	Manual	39 days ago	<input checked="" type="checkbox"/> Launch
NMBGMR <> BQ Locations	nmbgmr - NMBGMR	BigQuery - BQ Locations	24 hours	18 hours ago	<input checked="" type="checkbox"/>
NMBGMR Acoustic <> BQ Levels	nmbgmr - NMBGMR Acoustic	BigQuery - BQ Levels	Cron	13 hours ago	<input checked="" type="checkbox"/>
NMBGMR Manual <> BQ Levels	nmbgmr - NMBGMR Manual	BigQuery - BQ Levels	24 hours	23 hours ago	<input checked="" type="checkbox"/>
NMBGMR Pressure <> BQ Levels	nmbgmr - NMBGMR Pressure	BigQuery - BQ Levels	24 hours	23 hours ago	<input checked="" type="checkbox"/>

Airbyte Logs

The screenshot displays the Airbyte web interface for a connection named "NMBGMR Manual <> BQ Levels". The interface is divided into a left sidebar with navigation options (Connections, Sources, Destinations, Update, Resources) and a main content area. The main content area shows the connection details, including the source (nmbgmr) and destination (BigQuery), and a "Sync History" section. The "Sync History" section lists two successful syncs, each with a timestamp of 4:34PM 04/27. Below the sync history, there is a log output showing the results of a sync operation, including the number of models found (4) and the number of threads used (8).

Connection

NMBGMR Manual <> BQ Levels

nmbgmr → BigQuery

Sync History

Sync Succeeded
30 MB | 45.534 record records | 19.534 record records | 1m, 3s

Sync Succeeded
30 MB | 45.534 record records | 19.534 record records | 1m, 3s

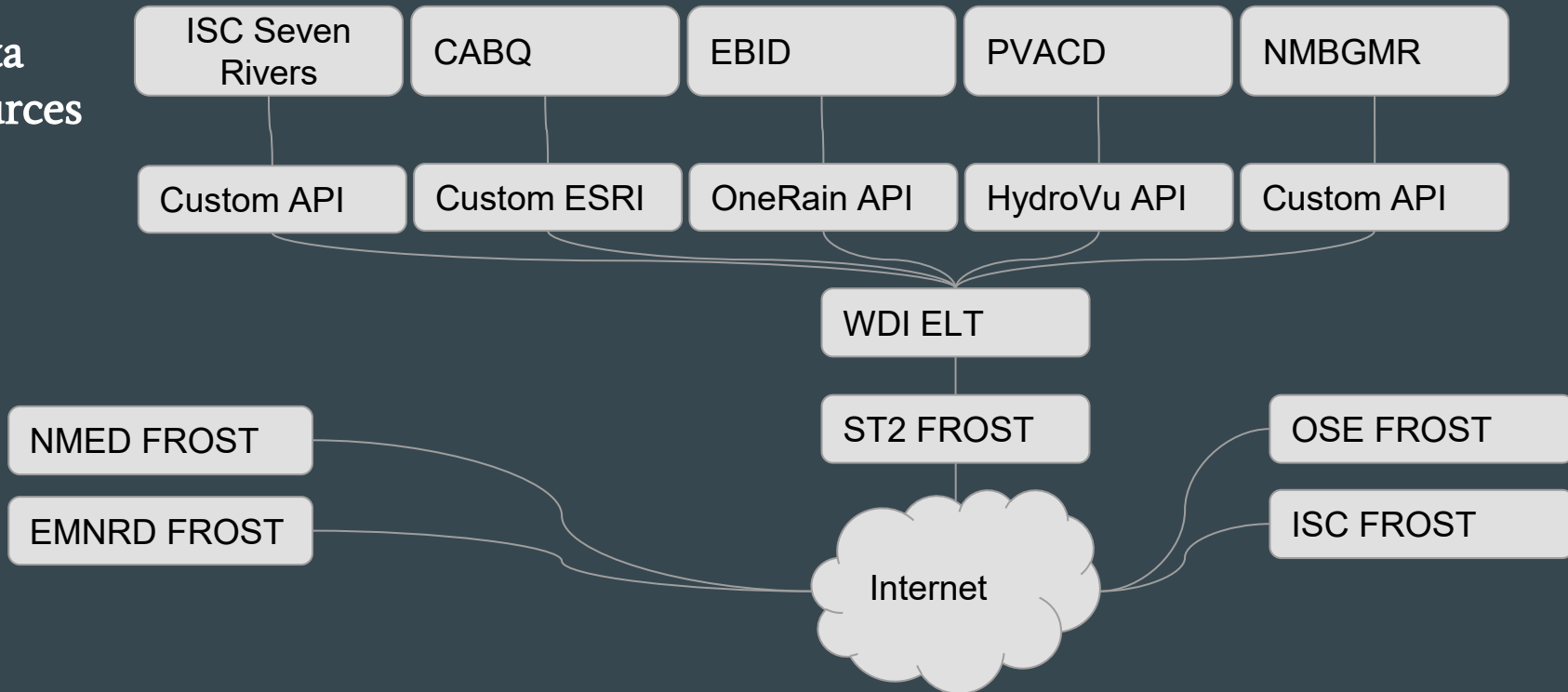
Log Output:

```
2023-04-26 22:35:43 [INFO] Found 4 models, 8 tests, 8 snapshots, 8 analyses, 602 macros, 8 operations, 8 seed files, 1 source, 8 exposures, 8 metrics
2023-04-26 22:35:43 [INFO] Concurrency: 8 threads (target='prod')
2023-04-26 22:35:43 [INFO] 1 of 1 STAR? table model levels.nmbgmr_manual_gvl... [RUN]
2023-04-26 22:35:55 [INFO] 1 of 1 DM created table model levels.nmbgmr_manual_gvl... [CREATE TABLE 148.4k rows, 33.8 MB processed] in 12.22s
2023-04-26 22:35:55 [INFO] Finished running 1 table model in 12.87s
```


Current State

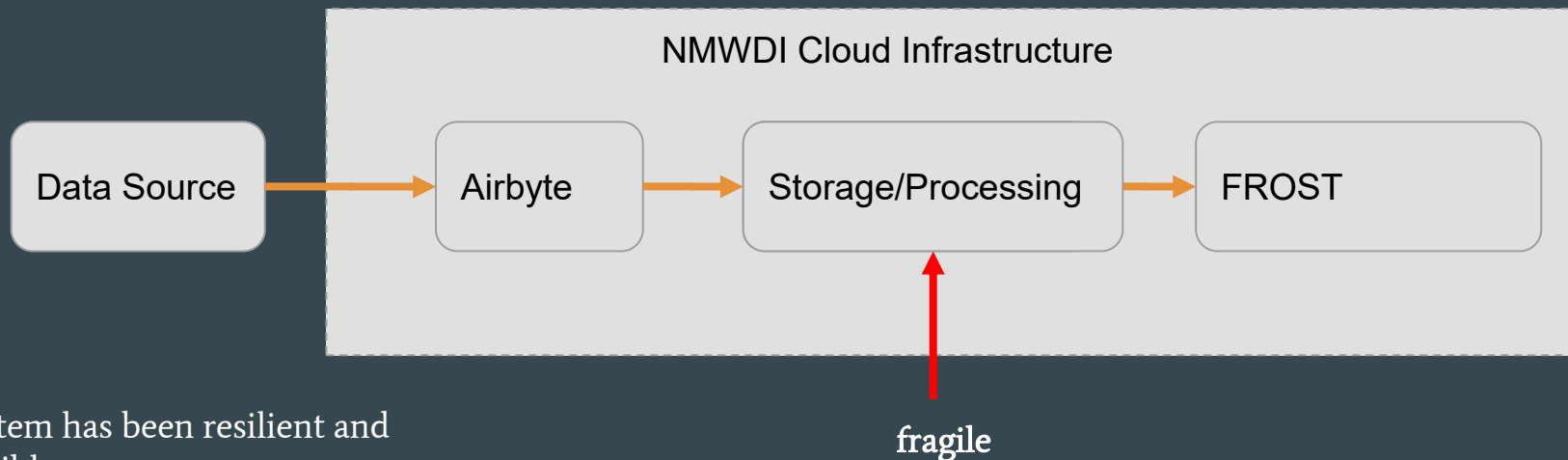
<https://st2.newmexicowaterdata.org/FROST-Server/v1.1>

Data Sources



New Mexico WDI Pipeline

Automated ELT Pipeline

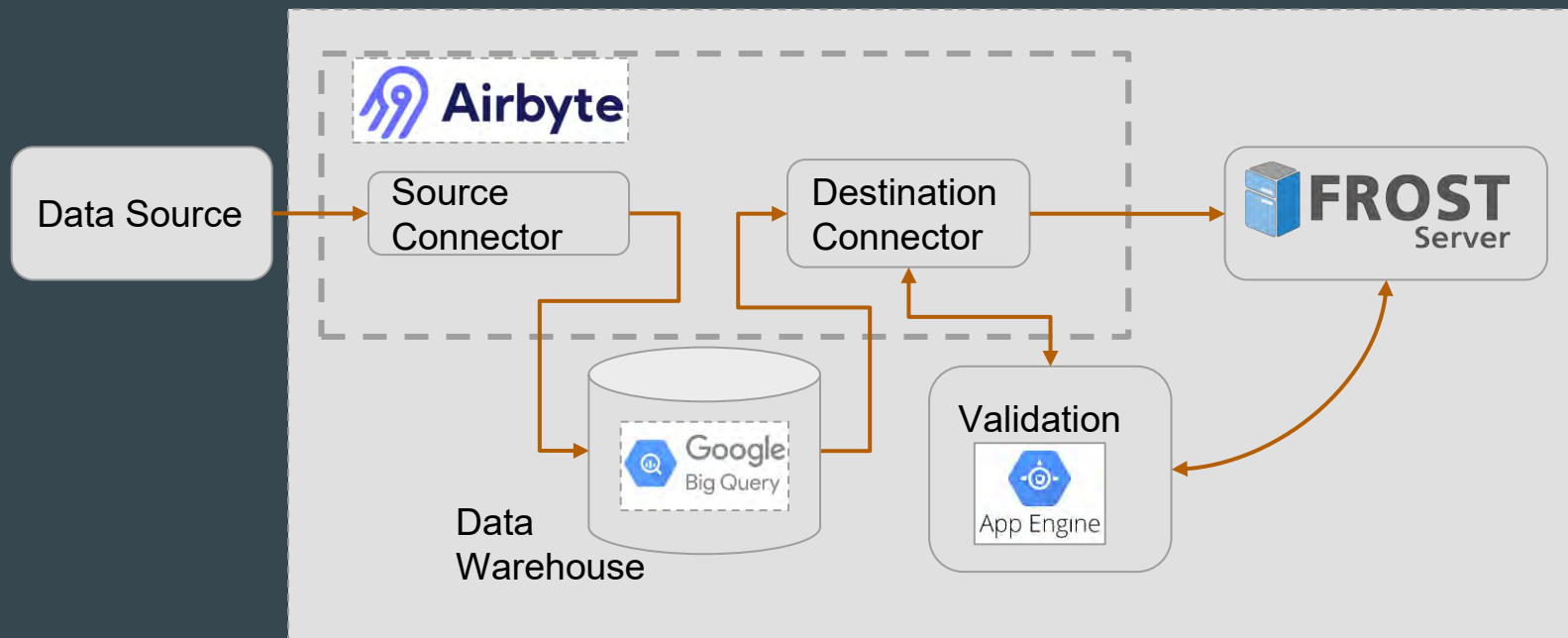


System has been resilient and flexible

Custom pipeline using Google BigQuery, Google Cloud Functions, Google Cloud Scheduler and Google Cloud Workflows

New Mexico WDI Pipeline 2.0

Automated ELT Pipeline



What About Consistency?

How can it be encouraged in a federated system?

What About Documentation?

NMWDI Schemas

The NM Water Data Technical Working Group is developing a Groundwater Level schema

Defines a minimum set of attributes and a large number of optional attributes.

Provides style and naming guidelines



JSON Schema

Specification

Learn

Implementations

Blog

Join our Slack

JSON Schema is a declarative language that allows you to **annotate** and **validate** JSON documents.

JSON Schema enables the confident and reliable use of the JSON data format.

Benefits

- Describes your existing data format(s).
- Provides clear human- and machine- readable documentation.
- Validates data which is useful for:
 - Automated testing.
 - Ensuring quality of client submitted data.

<https://json-schema.org/>

Validation Service

Our schemas are publicly available at <https://github.com/NMWDI>

We also have a web validation service for convenient/easy validation of your data

https://st2.newmexicowaterdata.org/FROST-Server/v1.1 10

Validate All Validate Locations Validate Things Validate Datastreams

Name	@iot.id	ValidationError	Instance
TO-0413	7275	'location_source' is a required property	<pre>{ "WellID": "EE8B926A-EAC9-4D5E-B99F-812DA0F27E56", "agency": "NMBCWR", "PointID": "TO-0413", "AltDatum": "NAVD88", "Altitude": 6219.06982421875, "geoconnex": "https://geoconnex.us/nmwdi/st/locations/7275", "source_id": 35791.0 }</pre>

Validation Service

- Add additional schemas
 - Surface water levels, water chemistry, etc
- Validation “Badges”
- Automate



6 datasets found Order by: Relevance

Formats: SensorThings API x

CABQ Groundwater SensorThings API

Currently, users can either view this data directly in a web browser, though this can be confusing to users who do not understand the SensorThings API...

SensorThings API HTML tests 477 passed, 2 failed

NMBGMR SensorThings API

Currently, users can either view this data directly in a web browser, though this can be confusing to users who do not understand the SensorThings API...

HTML SensorThings API passed tests 31

Documentation

SensorUp Developer site

The Location entity locates the Thing(s) it associated with. A Thing's Location entity is defined as the last known location of the Thing. A Thing can have multiple Locations if all Locations are different representations of same Location with different encodingType.

POST

Property	Required	Type
name	mandatory	String
description	mandatory	String
encodingType	mandatory	ValueCode
location	mandatory	Any (Depends on encodingType)

Related entities that are required when creating a Location:

Entity	Required
Things	optional
HistoricalLocations	optional

Example 1: POST

Create a Location.

HTTP JavaScript/jQuery cURL

```
{
  "name": "UoFC CCIT",
  "description": "University of Calgary, CCIT building",
  "encodingType": "application/vnd.geo+json",
  "location": {
    "type": "Point",
    "coordinates": [-114.133, 51.08]
  }
}
```

Home Tutorial Examples Scoreboard



Who

Welcome to the New Mexico Water Data Documentation site

What

This site contains information and links on the data services provided by New Mexico Water Data Initiative

Where

This site is maintained and hosted by the New Mexico Water Data Initiative

Why

The purpose of this site is to provide a comprehensive and sensible set of documentation to help guide users in accessing and finding water data

How

This site was developed by the NM WDI Implementation Team

Lets not mess around. Just show me how to retrieve data via the API

[Checkout Browser Examples](#)

The following snippet shows how to retrieve Locations associated with NMBGMR in the ST2 service.

```
import requests
url = "https://st2.newmexicowaterdata.org/FROST-Server/v1.1/Locations?filler=properties/agency eq 'NMBGMR'"
resp = requests.get(url)
if resp.status_code==200:
    print(resp.json())
```

[See the Tutorial for more info](#)

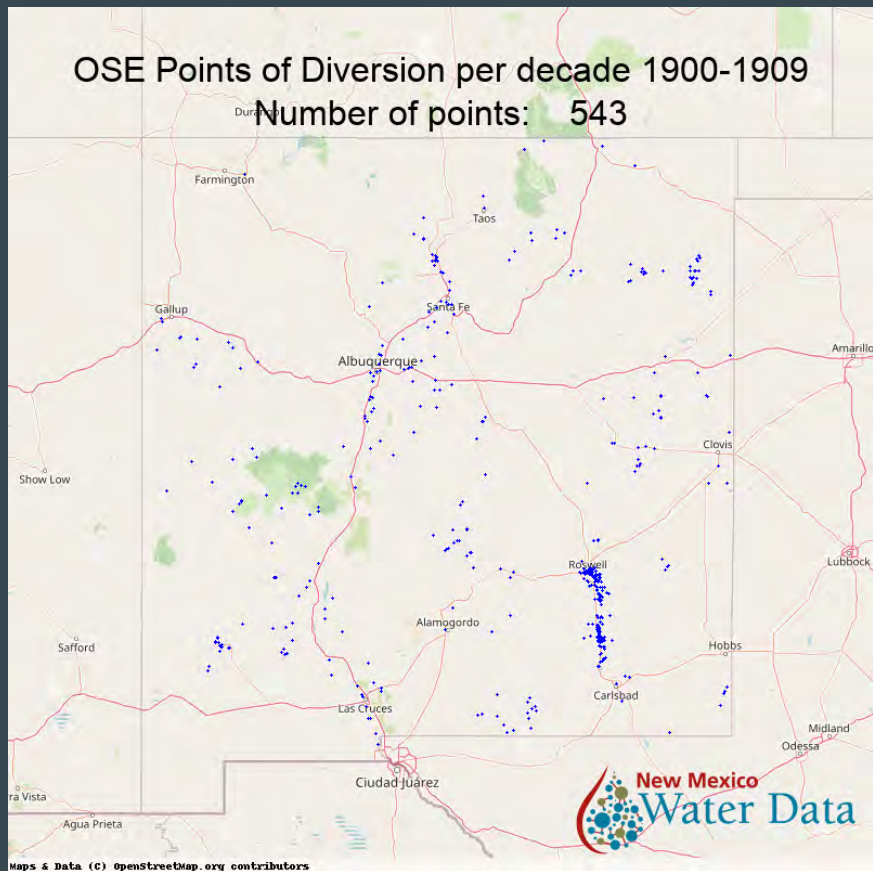
Links

API User

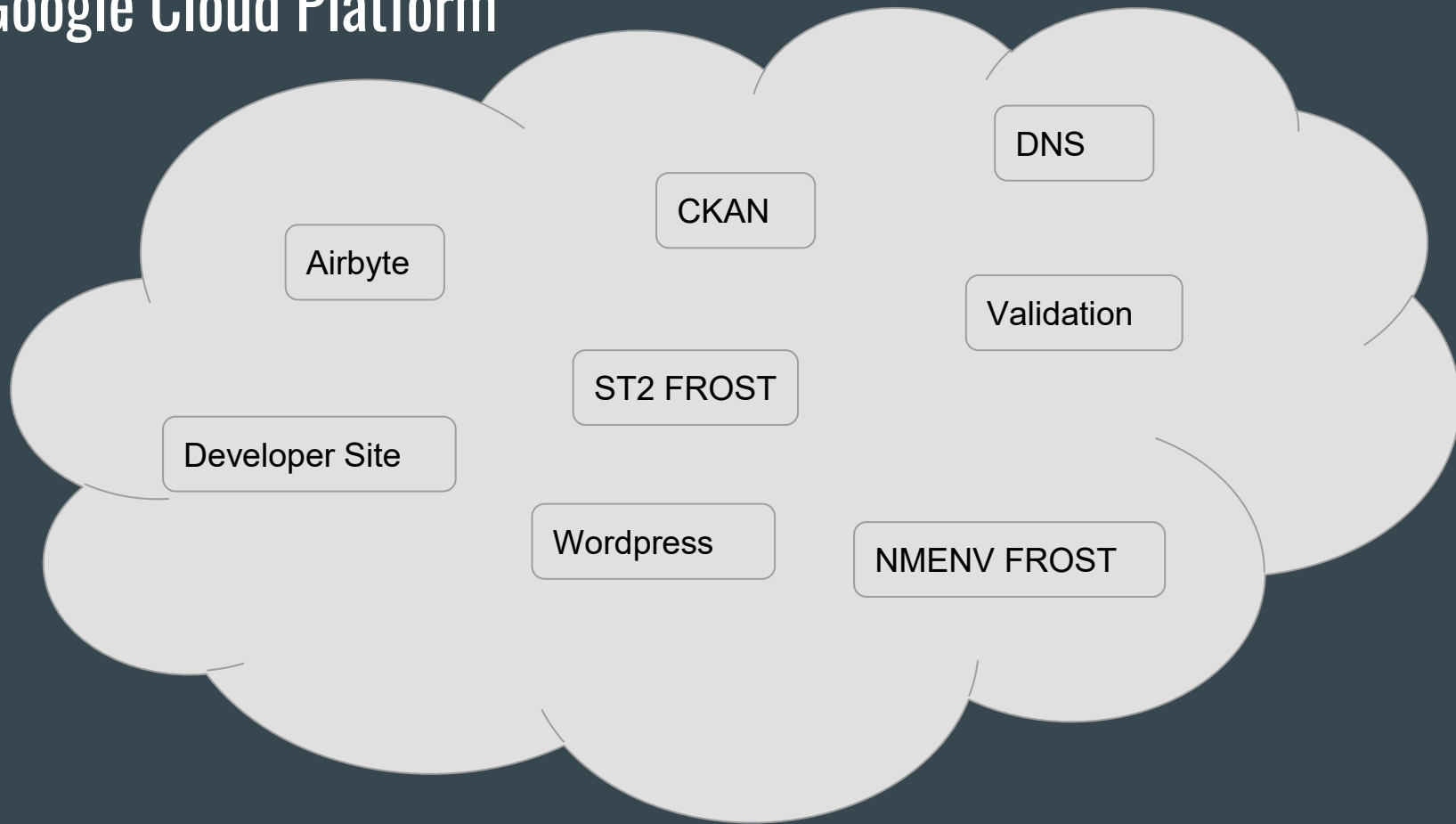
- [NMWDI Project](#) - Link to the NMWDI GitHub Organization page
- [Whats in ST2?](#)
- [Jupyter](#) - A set of interactive examples/templates and environment to execute them in. Examples include how to download a set of locations as a csv and find all locations for a given agency.
- [SensorThings Developer Center](#)
- [SensorThings Documentation](#)
- [FROST Server](#) - An implementation of the SensorThings specification
- [FROST Python Client](#) - A python client for interacting with a FROST server

NMWDI Developer site

Questions?



Google Cloud Platform

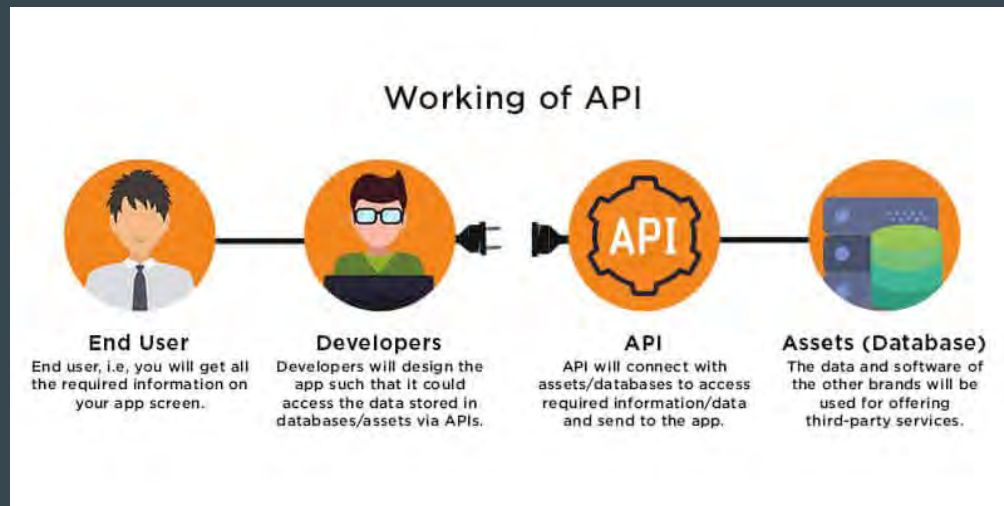


Applications vs APIs

APIs are for Developers to build Applications for End Users

Only sharing data via an Application makes automation difficult

Access to data is narrow and inflexible



<https://www.freecodecamp.org/news/design-an-api-application-program-interface/>



How to access USGS Water Data

Candice Hopkins
USGS Water Resources Mission Area
Web Communications Branch

 @USGS_Water

 @USGS_Water

waterdata.usgs.gov/blog/

New Mexico Water Data Initiative

May 4, 2023



The US Geological Survey

We monitor, assess, and conduct targeted and unbiased science research so that policy makers and the public have the understanding they need to enhance preparedness, response, and resilience.

Water Data for the Nation makes high-quality water information **discoverable, accessible, and usable** for everyone.



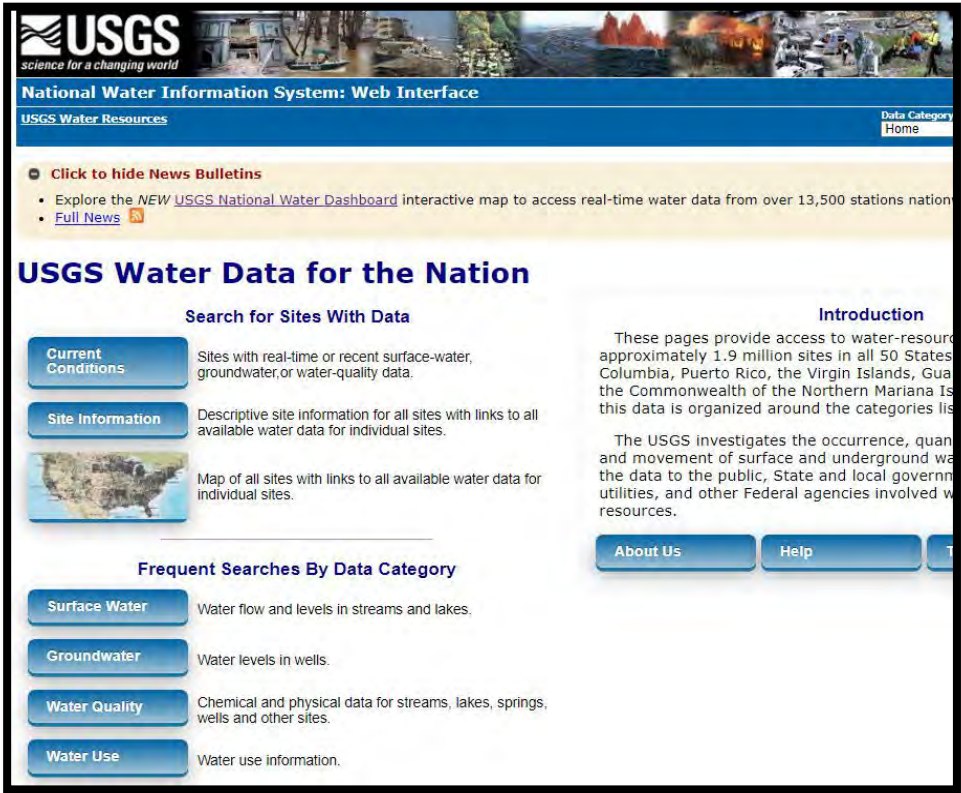
Back End



Front End

Tools and Products for USGS Data Access

NWISweb



WDFN

Top Level:
WDFN Home
*Handles traffic for all user journeys
Navigates to exploratory pages*



Second Level:
Exploratory Pages
Explores water data offerings. Facilitates access to network or specialty pages



National Water Dashboard



Explore USGS water data

Third Level:
Network Pages
Groups together data from multiple locations. Summarizes data, access to specialty pages



Custom Location Lists

Fourth Level:
Specialty Pages
*Data tools to support various use cases
Includes static and dynamic pages*



Water Services descriptions



WaterAlert



Monitoring Location pages



Monitoring Location pages: All Graphs



Combined Location Graph



Refine Download

Next Generation Water Alert



@USGS_Water

Next-Gen Enhancements

Redesigned User Interface
Streamlined Account Management
Enhanced email alerts
Short-code SMS messages
Quick settings and historic values
Easy pause and resume feature

USGS WaterAlert [version 2.36]

Subscription Form

The U.S. Geological Survey WaterAlert service sends e-mail or text (SMS) messages when certain parameters, as measured by a USGS real-time data-collection station, exceed user-definable thresholds. The development and maintenance of the WaterAlert system is supported by the USGS and its partners, including numerous federal, state, and local agencies.

Real-time data from USGS gages are transmitted via satellite or other telemetry to USGS offices at various intervals; in most cases, 1 to 4 times per hour. Emergency transmissions, such as during floods, may be more frequent. *Notifications will be based on the data received at these site-dependent intervals.*

Site Info:

Number: 01651770
Name: HICKEY RUN AT NATIONAL ARBORETUM AT WASHINGTON, DC
Agency: USGS
Transaction ID: HGBKC

Send Notification To: [about this...](#)

☐ My mobile phone
☐ My email address

Notification Frequency: [about this...](#)

Hourly ☐
Daily ☒

Streamflow Parameter(s): [about this...](#) Recent value:

Discharge, ft³/s ☒ 1.10 [\(real chart\)](#)
Gage height, ft ☐ 1.12 [\(real chart\)](#)

Alert Threshold Condition: [about this...](#)

☒ Greater than (>)
☐ Less than (<)
☐ Outside a range (< or >)
☐ Inside a range (> and <)

Real-time value is greater than: ft³/s

☐ I have read and acknowledge the [Provisional Data Statement](#) and [Privacy Statement](#).



10:51

waterdata.usgs.gov
you can get text message alerts! Add your phone number in [Settings](#)

Hanalei River nr Hanalei, Kauai, HI - 16103000

My Alerts
[This Location](#) | [All My Alerts](#)

☐ Gage height(High-flow backup abv 6.15 ft) is greater than 15.8 ft - daily

☒ Gage height is greater than 15.8 ft - daily

☐ Gage height is greater than 5 and less than 15.8 ft - daily

Create Alerts for This Location

Gage height, feet
Latest Value: 5.51 ft
on Tue, 22 Mar 2022 21:20:00 GMT UTC

What values have been seen in the past?

Send alert when current condition value is greater than ft less than ft

☐ I'd like to use a value range

Quick click to set options
Flood levels - ft
N/A 5 N/A 15.8

What do these colors mean?

While the alert conditions are true notify me
☒ Once per day
☐ Once per hour

Summary:

[Questions or Comments](#)



National Water Dashboard

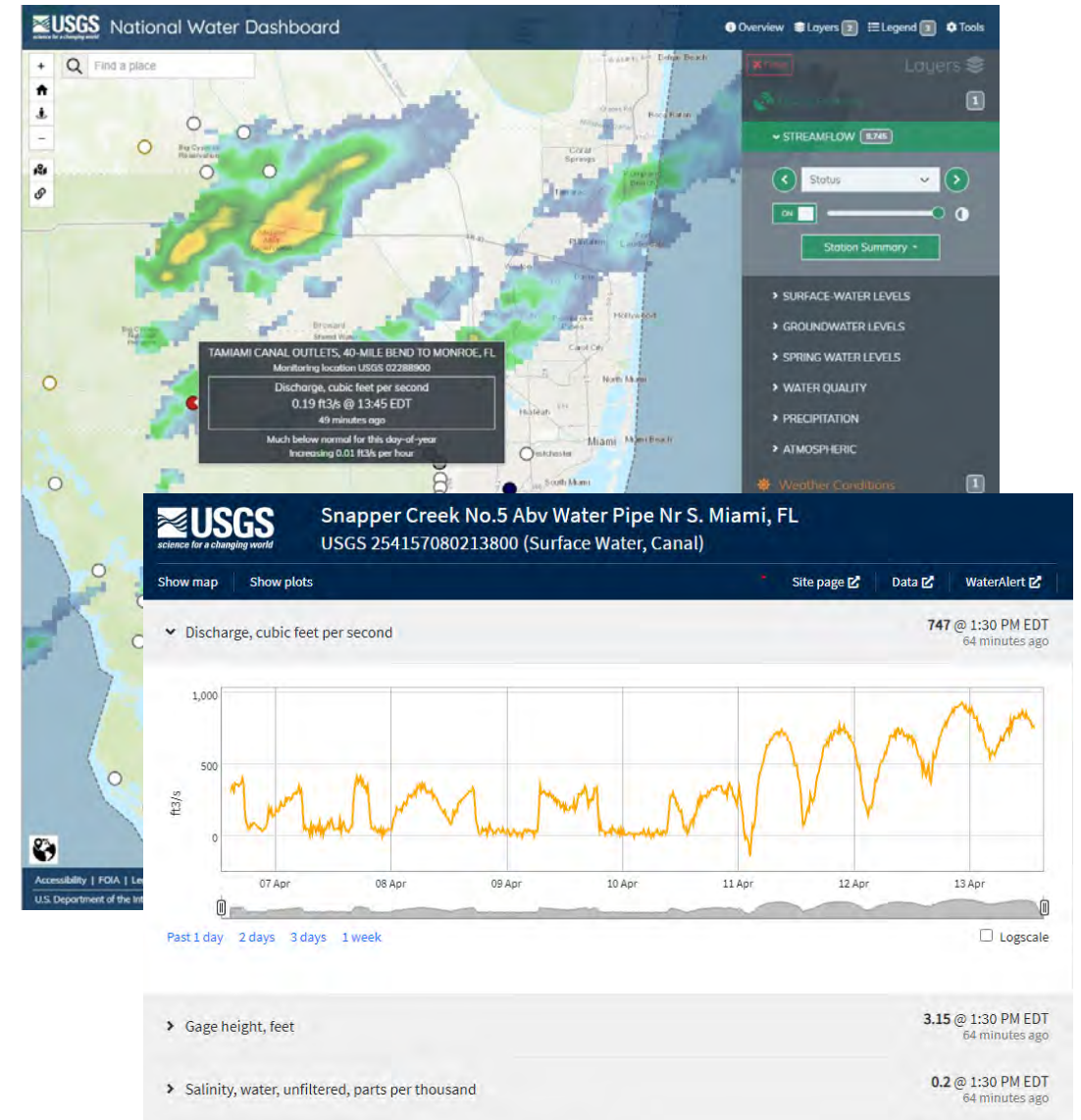


@USGS_Water

National Water Dashboard also has simple graphs of data

Map showing the latest weather radar, active flood forecasts.

Using easy-to-understand colors, track how the latest data compares to historical measurements.



The Watches and NWD Integration

Serve water professionals who want quick and easy visualizations of regional current conditions with historical context

Peer-reviewed, published APIs & R/Python packages to produce Watches graphs, plots and tables

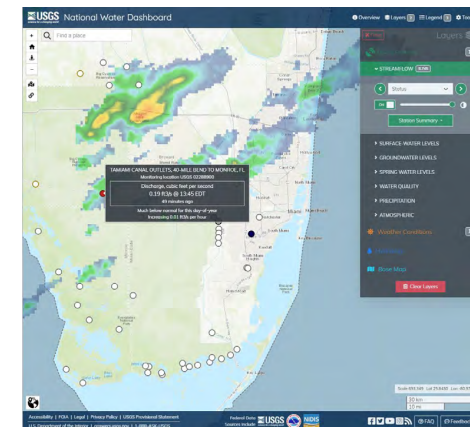
Watches dot-map logic encoded in the National Water Dashboard

Select Water Data for the Nation enhancements

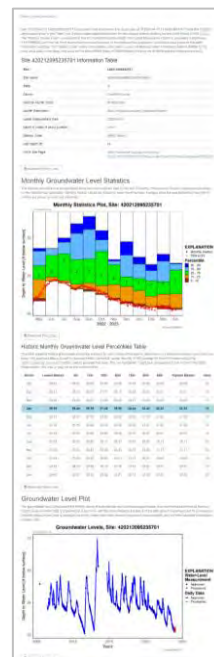
Legacy Water, GW, and WQ Watches



National Water Dashboard



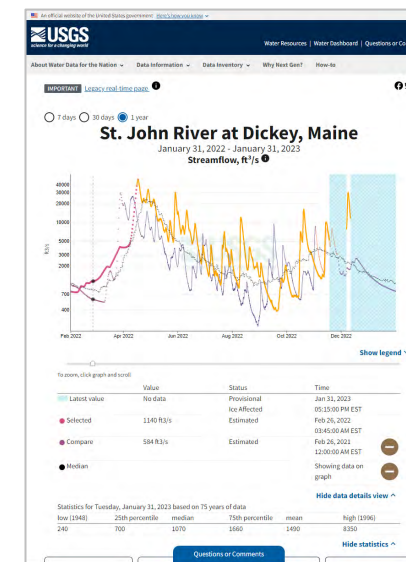
Computational Tools



APIs

```
"type": "Feature",
"id": "USGS-010471",
"geometry": {
  "type": "Point",
  "coordinates":
    [-69.886944,
     44.778888],
},
"properties": {
  "agency": "U.S.",
  "monitoringLoc": "St. John River at Dickey, Maine",
  "monitoringLoc": "St. John River at Dickey, Maine",
  "monitoringLoc": "St. John River at Dickey, Maine"
```

Water Data for the Nation



Monitoring location page



@USGS_Water

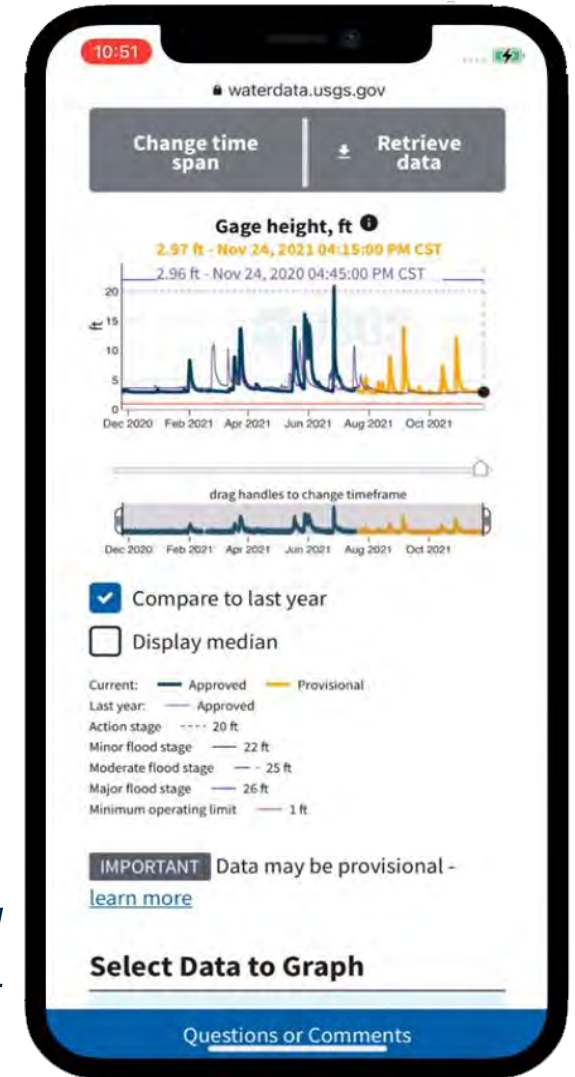


Legacy
Current-
Conditions
Real-Time
Pages

*Legacy
Web Product*

Next
Generation
Monitoring
Location
Pages

*Modernized
Web Product*



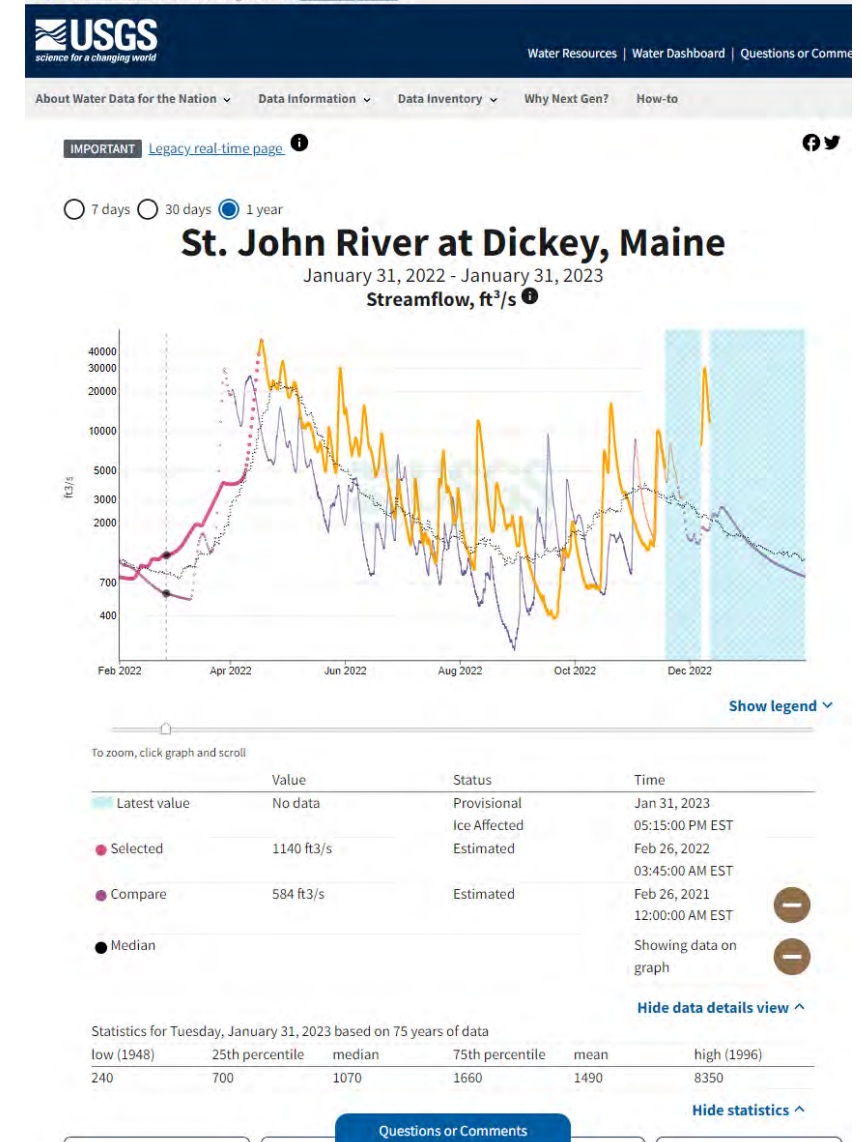
Monitoring location page



@USGS_Water

Upcoming features

- Field visits on the hydrograph
- Presentation-quality graphs
- Better consolidated download services
- Indications of revised data
- Ratings depot links



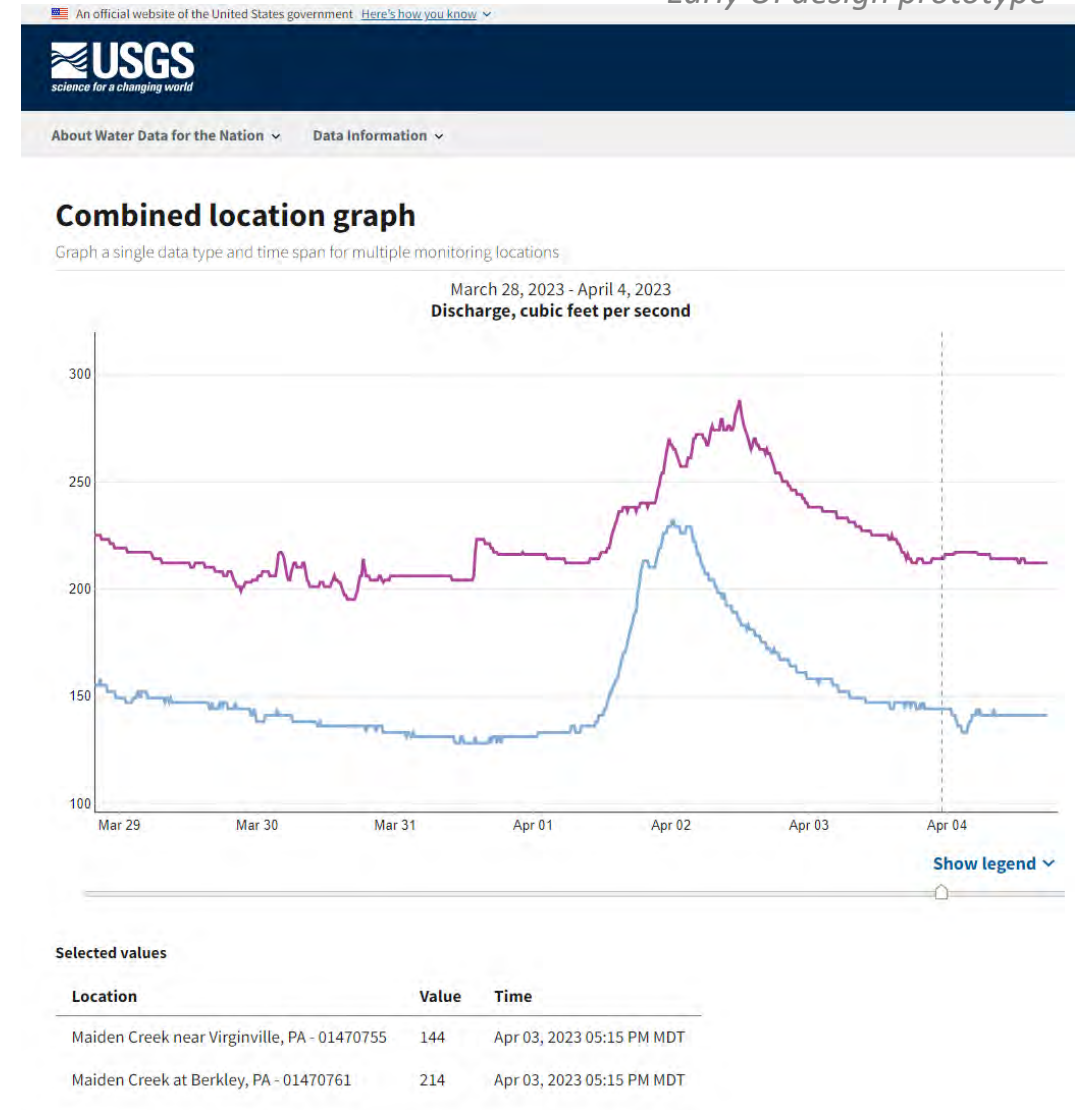
Combined location graph



@USGS_Water

Early UI design prototype

- Graph a single data type for 7 days for multiple USGS monitoring locations
- Launching in April/May



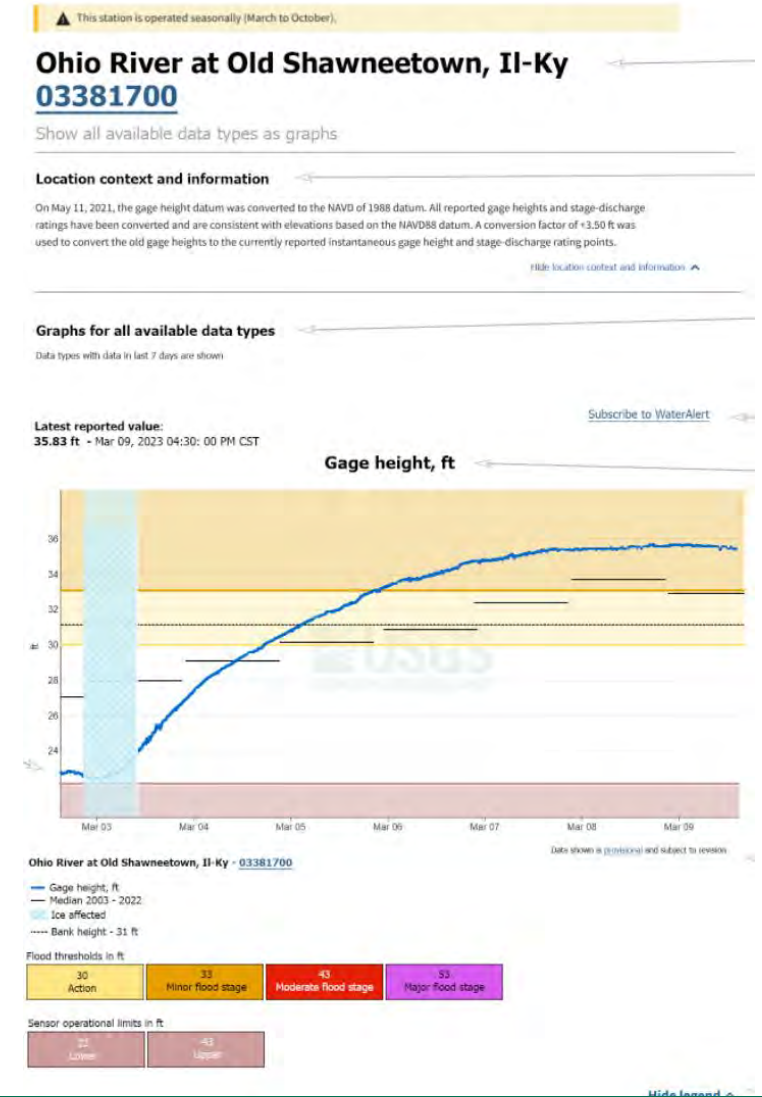
Monitoring location page – all graphs



@USGS_Water

Early UI design prototype




- Graph the last 7 days of data in a scrollable list of graphs
- See all the data at-a-glance
- Launching later this summer



Which page is right for you?



@USGS_Water

Types of data graphs available in WDFN	 Monitoring Location Pages	 Monitoring Location Pages: All Graphs	 Combined Location Graph
	Interactive graph with custom time periods for whole period of record	List of graphs with latest 7-days of data	Single graph showing data from multiple locations
1 data type 1 location	✓	✓	✓
2 data types 1 location	✓	✓*	✗
1 data type 5 locations	✗	✗	✓
2 data types 5 locations ^	✗	✗	✗

* 1 data type per graph, list of graphs on page for all recent data

^ Under consideration in the future


✓ Available ✗ Not available

For more details see: https://waterdata.usgs.gov/blog/legacy_current_to_WDFN



Access legacy pages

Legacy pages are no longer the default




science for a changing world

[Water Resources](#) | [Water Dashboard](#) | [Questions or Comments](#)

[About Water Data for the Nation](#) ▾ | [Data Information](#) ▾ | **Data Inventory** ▴ | [Why Next Gen?](#) | [How-to](#)

IMPORTANT


[Legacy real-time page](#) 

☒ 7 days ☐ 30 days ☐ 1 year

Long Green Creek at

April 16, 2023

1.2 ft - Apr 16, 2023 07:15:00 AM EDT



MD - 01584050

[Detailed Inventory](#)

[Daily Data](#)

[Daily Statistical Data](#)

[Monthly Statistical Data](#)

[Annual Statistical Data](#)

[Peak Streamflow](#)

[Field Measurements](#)

[Field/Lab Water Quality Samples](#)

[Water Year Summary](#)

[Revisions](#)



Groundwater data from Federal and state sources

National Groundwater Monitoring Network:

<https://cida.usgs.gov/ngwmn/>

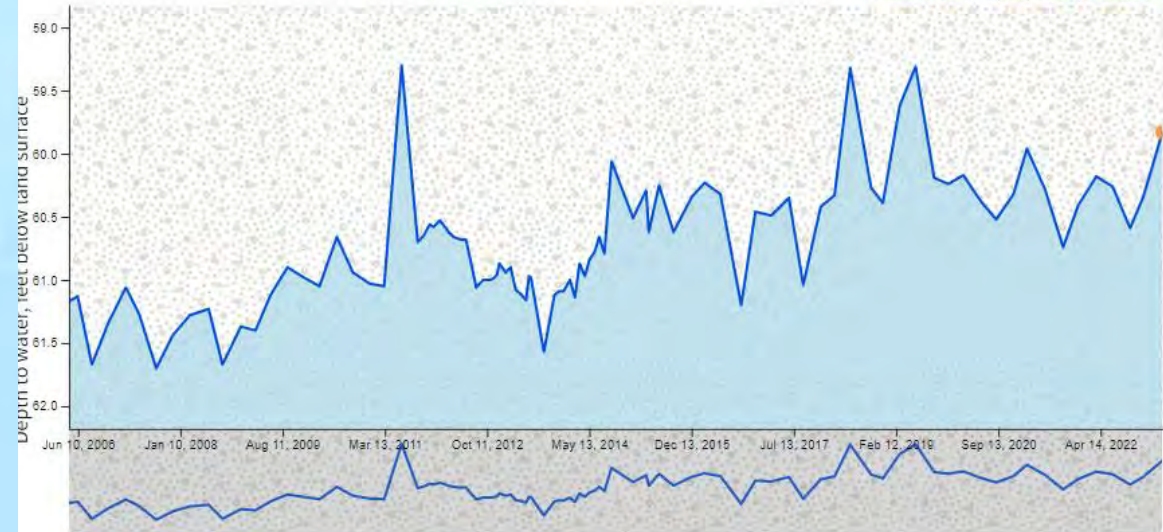
16,460 water-level wells
3,959 water-quality wells
10 subnetworks
37 contributing agencies
53 administrative units
65 principal aquifers



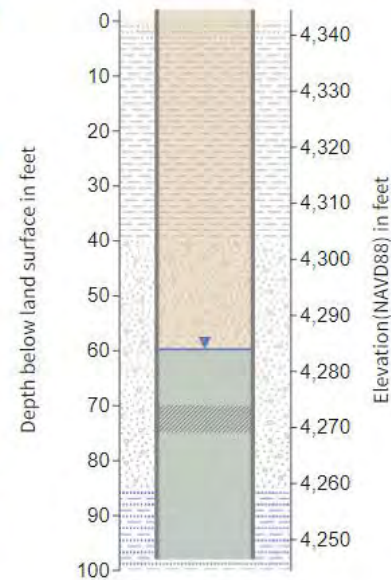
**MBMG-215992****Montana Bureau of Mines and Geology**

Water Levels, in feet below land surface

59.83 FEET - 3/31/2023, 1:00:00 AM

☒ Show lithology

Located in Jefferson County, Montana, this groundwater monitoring location is associated with a water well in the Northern Rocky Mountains Intermontane Basins aquifer systems.

**Well Construction****Detailed Lithology**

All

Screens

Casings

Depth

Description

-2.0-98.0 ft	6.0 in diameter steel casing
70.0-75.0 ft	6.0 in diameter perforated casing screen

Summary

Water Quality

Water Levels

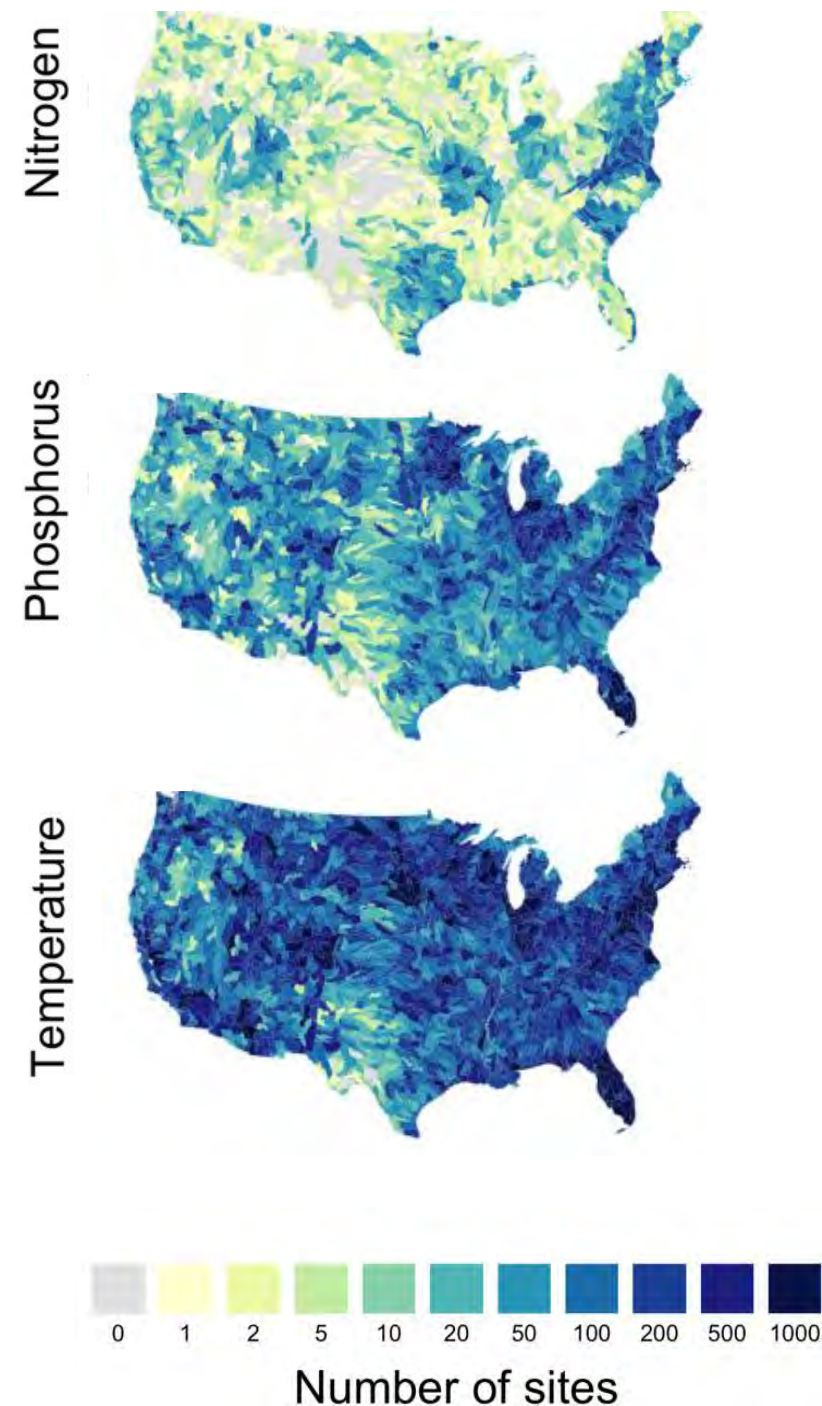
Water Level Statistics



Water quality data from Federal, State, Local, Tribal, and citizen sources

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

- > **400** data providers
- > **1,500,000** sites
- > **300,000,000** records





[WQP Home](#) > [Providers](#) > [STORET](#) > [11113300](#) > [11113300-MIRCAND](#)

MIRROR LAKE-DEEP SPOT (11113300-MIRCAND) site data in the Water Quality Portal

Data Provider: **STORET** ([Learn more about Water Quality Portal Data Providers](#))

This lake site, maintained by the New Hampshire Department Of Environmental Services (BEACH) (identifier 11113300), has the name "MIRROR LAKE-DEEP SPOT" and has the identifier 11113300-MIRCAND. This site is in the watershed defined by the 8 digit [Hydrologic Unit Code \(HUC\)](#) 01080106.

This site is located in Grafton County County, New Hampshire at 43.6386940000 degrees latitude and -71.9972780000 degrees longitude using the datum NAD83. No horizontal location accuracy metadata is available. This site is at an elevation of 948 ft No vertical location accuracy metadata is available.

To download the metadata about this site along with water quality data, go to the [Portal Page](#) and enter "11113300-MIRCAND" into the "Site ID" box under Site Parameters

What other monitoring locations are upstream or downstream from this one?

Upstream and downstream locations

This map shows all Water Quality Portal stations that are 10 miles upstream (dashed dark blue) and 10 miles downstream (solid light blue) of this monitoring location (indicated by the large blue circle). The upstream and downstream functionality is provided by the [Network Linked Data Index](#).



Downloading USGS water data



Transparent & FAIR

Findable

- Unique identifiers and metadata are used to allow data to be located quickly and efficiently



Accessible

- Data are free, open, and universally available for use
- Data are available for a variety of purposes



Interoperable

- Data use a formal, accessible, shared, and broadly applicable language
- Allows for use in a broad range of applications and research

Reusable

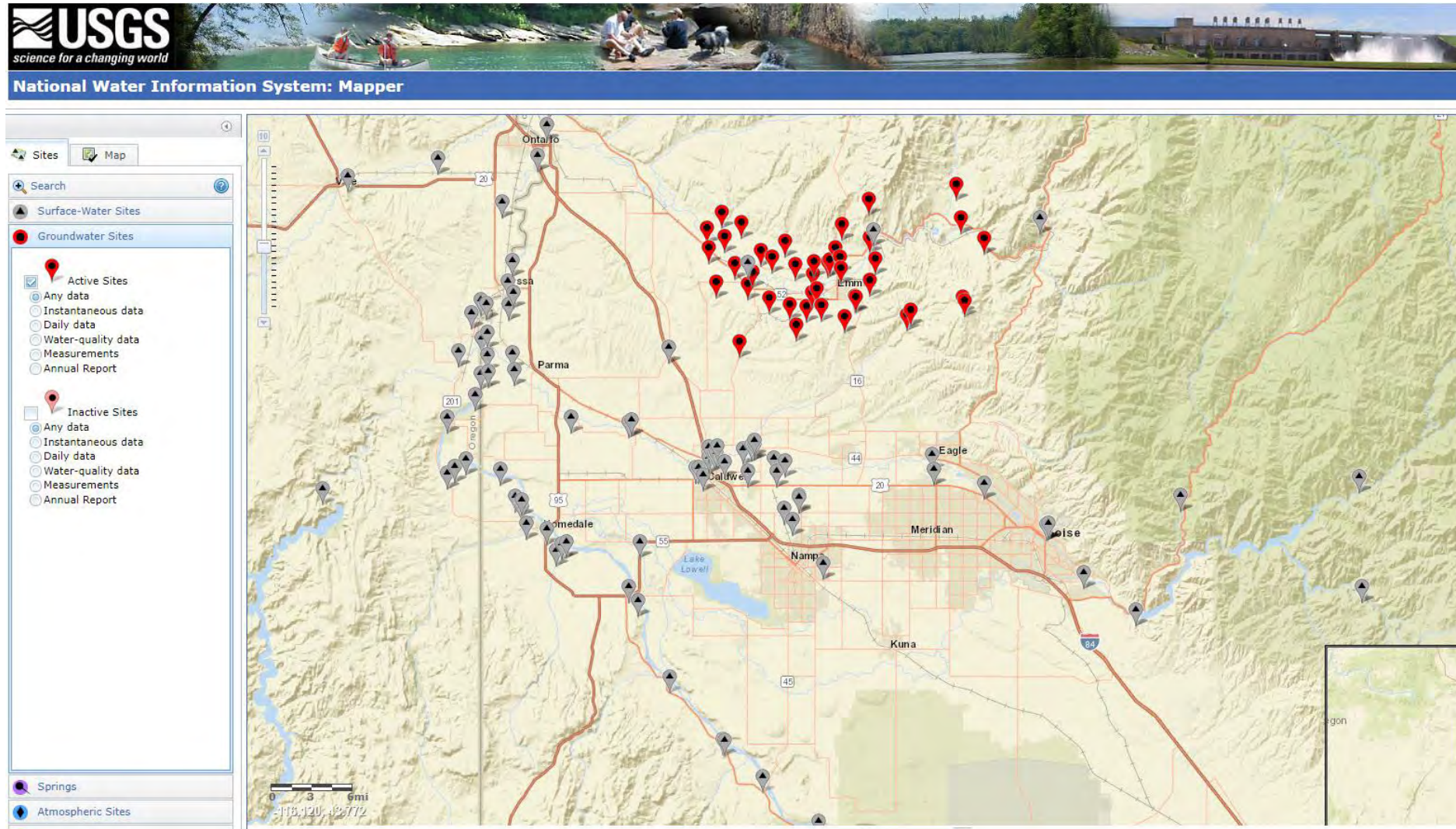
- Data are clearly described
- Data meet domain-relevant community standards



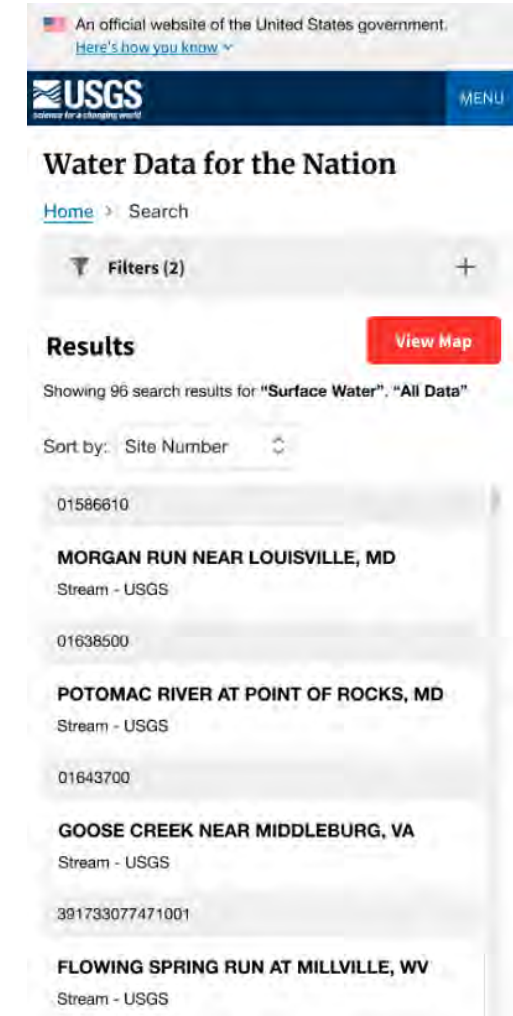
Search and Filter (in development)



@USGS_Water



@USGS_Water



Consolidated download (in development)



@USGS_Water

Download a set of data from **multiple** monitoring **locations**

Download **several types** of data simultaneously

Download from **large numbers** of locations simultaneously

Provides **translation into API calls** for easy reuse with access to our services

The image shows a web-based user interface for downloading data. At the top, it says "Prepare Download" and "Active Downloads: 0". Below this is a "Locations" section with a search bar and a table of locations. The table has columns for "Location Number", "Location Name", "Location Type", "Data Age", and "Parameters". There are five rows of data, each with a checkbox to select the location. Below the table is a "Specific Date Range" section with "Starting Date" and "Ending Date" fields. Below that is a "Select Data Type" section with a dropdown menu. Below that is an "Output Format" section with a dropdown menu. At the bottom is a large "Download Location Data Package" button. The footer says "Footer".

Prepare Download Active Downloads: 0

Locations

Search by Location Name/Number

Location Number	Location Name	Location Type	Data Age	Parameters	
<input type="checkbox"/>	Big river at this spot, in this state	2456789123	Surface Water	Last Year	2
Available Parameters:					
<input checked="" type="checkbox"/> Specific Conductance					
<input checked="" type="checkbox"/> Salinity					
<input type="checkbox"/> Specific Gravity (Unavailable)					
<input type="checkbox"/>	Big river at this spot, in this state	2456789123	Groundwater	Last Year	10
<input type="checkbox"/>	Big river at this spot, in this state	2456789123	Spring	Last Year	5
<input type="checkbox"/>	Big river at this spot, in this state	2456789123	Groundwater	Last Year	8
<input type="checkbox"/>	Big river at this spot, in this state	2456789123	Surface Water	Last Year	3

Specific Date Range

Note: Location data age. Not all sites may have data for the selected range.

Starting Date: to Ending Date:

Select Data Type

Select: Please select a data type and a download package size.

Output Format

Select: Estimated download size: 1 MB. Estimated number of records: 1000. Estimated time: 10 minutes.

Footer

Early UI design prototype

Why USGS APIs?

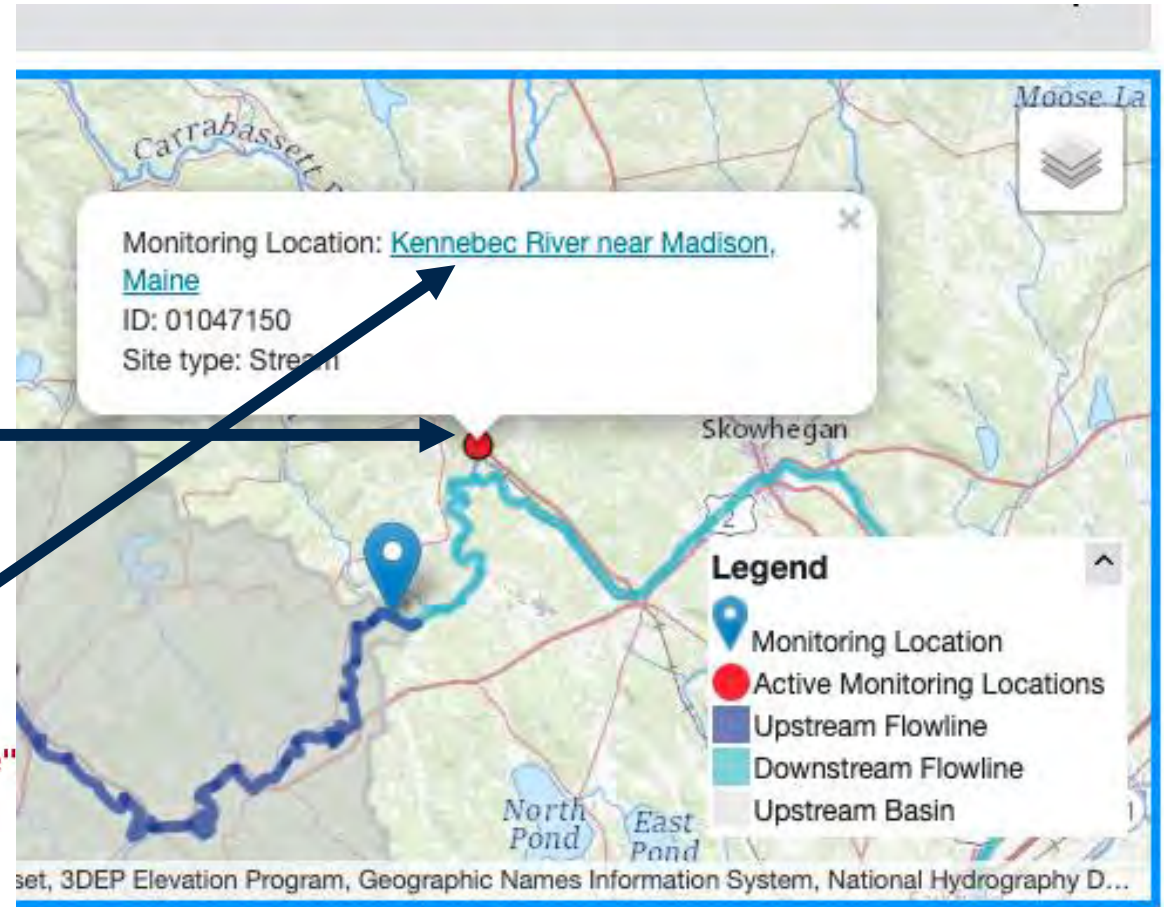
Interact with the data in the way that best serves you



@USGS_Water

```
"type": "Feature",
"id": "USGS-01047150",
"geometry": {
  "type": "Point",
  "coordinates": [
    -69.8869444,
    44.7788888
  ]
},
"properties": {
  "agency": "U.S. Geological Survey",
  "monitoringLocationNumber": "01047150",
  "monitoringLocationName": "Kennebec River near Madison, Maine",
  "monitoringLocationType": "Stream",
```

OGC API-Features Call for locations within a bounding box



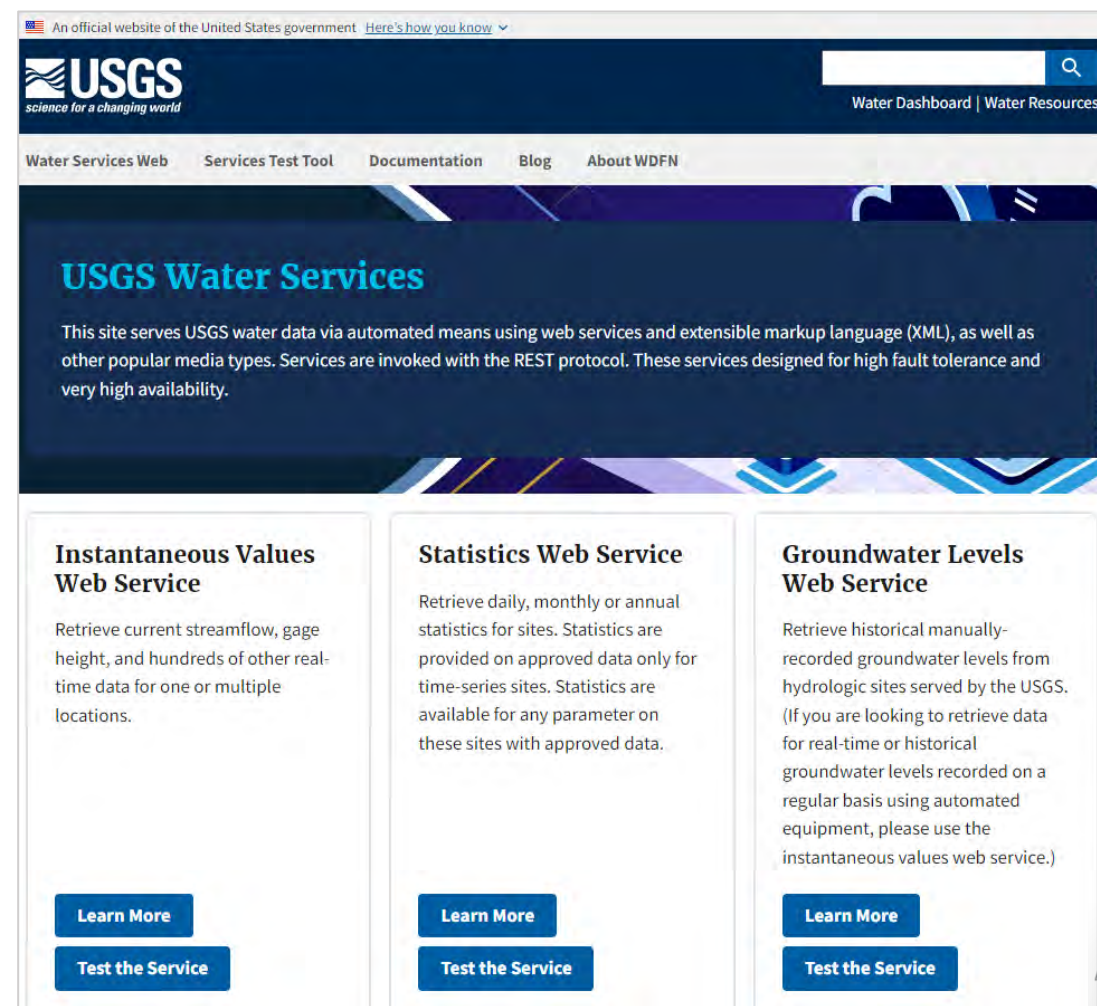
Map of nearby monitoring locations to Sandy River near Mercer, Maine



USGS water data services using the REST protocol:

- Instantaneous Values
- Statistics
- Groundwater Levels
- Site
- Daily Values
- Water Quality

Launching soon updated tools to test service calls



The screenshot shows the USGS Water Services website. At the top, there's a navigation bar with the USGS logo and tagline "science for a changing world". Below the navigation bar, there's a search bar and links to "Water Dashboard" and "Water Resources". The main content area features a large heading "USGS Water Services" followed by a paragraph explaining that the site serves USGS water data via automated means using web services and extensible markup language (XML), as well as other popular media types. Services are invoked with the REST protocol. These services are designed for high fault tolerance and very high availability. Below this, there are three columns, each representing a different service: "Instantaneous Values Web Service", "Statistics Web Service", and "Groundwater Levels Web Service". Each column contains a brief description of the service and two buttons: "Learn More" and "Test the Service".

Instantaneous Values Web Service
Retrieve current streamflow, gage height, and hundreds of other real-time data for one or multiple locations.

Statistics Web Service
Retrieve daily, monthly or annual statistics for sites. Statistics are provided on approved data only for time-series sites. Statistics are available for any parameter on these sites with approved data.

Groundwater Levels Web Service
Retrieve historical manually-recorded groundwater levels from hydrologic sites served by the USGS. (If you are looking to retrieve data for real-time or historical groundwater levels recorded on a regular basis using automated equipment, please use the instantaneous values web service.)

<https://waterservices.usgs.gov>

Open Geospatial Consortium standard
which can speed up your application
development, put data easily on a map

Events-driven JSON API

Real-time data access (data less than 120
days available)

Retrieve location metadata

[Water Data Labs API documentation](#) > [USGS Sensorthings Implementation](#) > SensorThings API - Quick Start

SensorThings API - Quick Start

SensorThings is a JSON API for better dashboard and device integration, real-time data access (less than 120 days old), and location metadata.

Use the SensorThings API to access national-scale data for quicker application development and the ability to map those results. This API provides users with a flexible way to interconnect data, devices, and applications over the Web.

Get Started

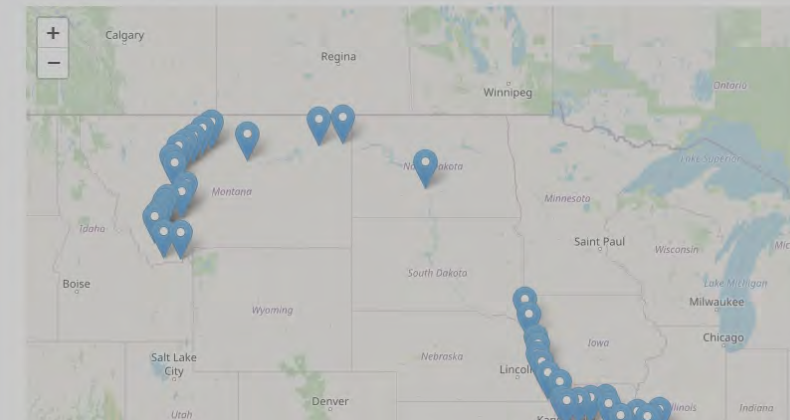
USGS created JSON sample APIs as a way to quickly access and use USGS available data.

What's New?

Plot my API results on a Map

- ESensorThings makes it easy to put information on a map by natively supporting a geoJSON output. To receive results in GeoJSON, add `&$resultFormat=GeoJSON` to the request.
- Establish links and integrate responses using the [Mainstems Dataset](#). Two ways to query locations include:
 - [GNIS Feature ID](#)
 - [geoconnex](#) url, such as <https://reference.geoconnex.us/collections/mainstems/items/312532>

This is a map making a live call showing the latest result for the observedProperty Discharge, cubic feet per second on the Missouri River. You can learn more about the hydrologic indexing in the Locations section.



What's on this page

What's New?

Plot my API results on a Map

Ready to Use APIs

Location Specific APIs

Open Source Deployed Instance

Sample Responses

Everything

All Things

Observed Properties for a Datastream

Two Most Recent Observations for a Datastream

One Thing with Location Information

All Data Streams at One Location

Data Model

API Development Standards

Additional Resources

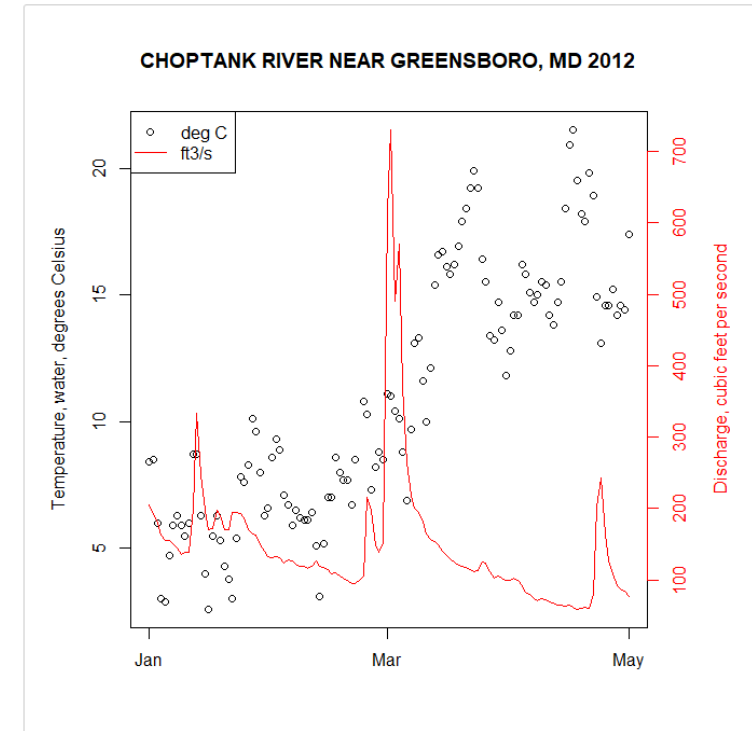


Access USGS water data in R, Python, or Julia language (in development)

Quickly pull in data to make custom visualizations

Access EPA data hosted in Water Quality Portal

Vision Statement: Make USGS water data easily **discoverable, accessible AND usable** by providing supported, robust, and dependable computational tools and code to enable responsible data use and meet *diverse* and *ever-changing* user needs.



We want to hear from you!

Drop us a line



@USGS_Water

