

The WSWC Water Data Exchange (WaDE) Program: Architecture 2.0

The Second Roundtable on Colorado River
Basin Data and Modeling
May 27, 2020

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WESTERN STATES
WATER COUNCIL



Outline

- Why WaDE?
- How can WaDE help your state agency?
- Why WaDE 2.0? An overview of its design
- Portal Development and Demo
- Next Steps

Why WaDE?

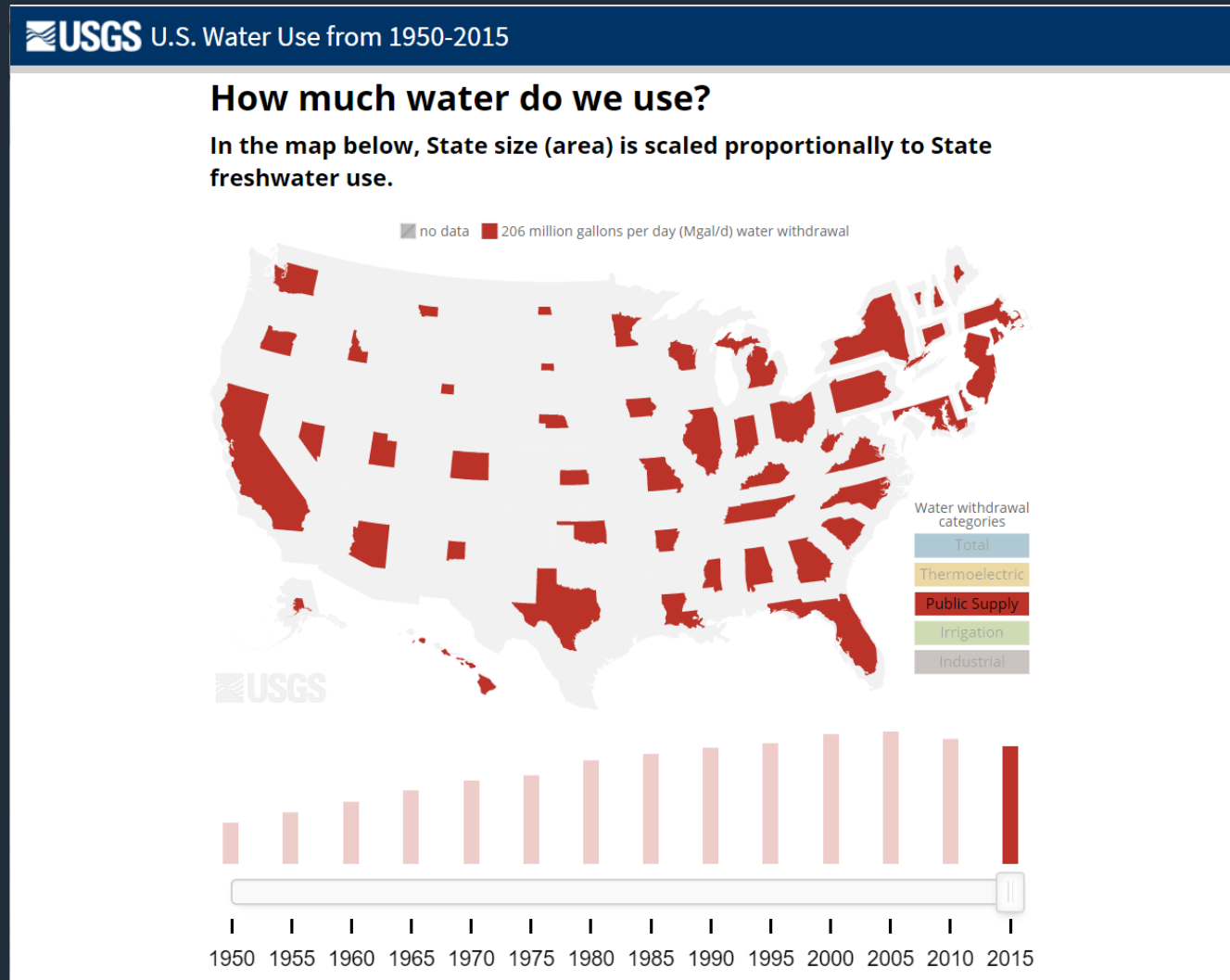
How much water is there? What is its quality? How is it currently being used?

“State primacy is fundamental to a sustainable water future”

“to formulate a strategy and to develop a framework for its member states to begin to **share important water supply, water use, and water administration datasets** with each other, with federal partners, and with the **public**”



USGS National Water Use Estimates



<https://owi.usgs.gov/vizlab/water-use/>

How can WaDE help your state agency?

- A **resource** to learn from what other states are doing on water data and sharing
- Potential **funding** to western states' agencies
- **Technical support** to help you share your data/metadata for WUDR grants



United States Geological Survey Water Availability and Use Science Program

Water Use Data and Research (WUDR) Data Transfer Guidance

The USGS National Water Information System (NWIS) is in the process of a complete modernization, using a combination of contracts for commercial software such as Aquatic Informatics' Aquarius data management system, and some software developed by USGS. The two water-use subsystems of NWIS, SWUDS (Site-Specific Water-Use Data System) and AWUDS (Aggregate Water-Use Data System), will be redeveloped into a single Water-Use Data System as part of this process. The current structures and input systems are expected to change significantly in the move to a combined database with a more modern architecture. Until this modernization effort is complete, USGS will continue to store water-use data in SWUDS and AWUDS.

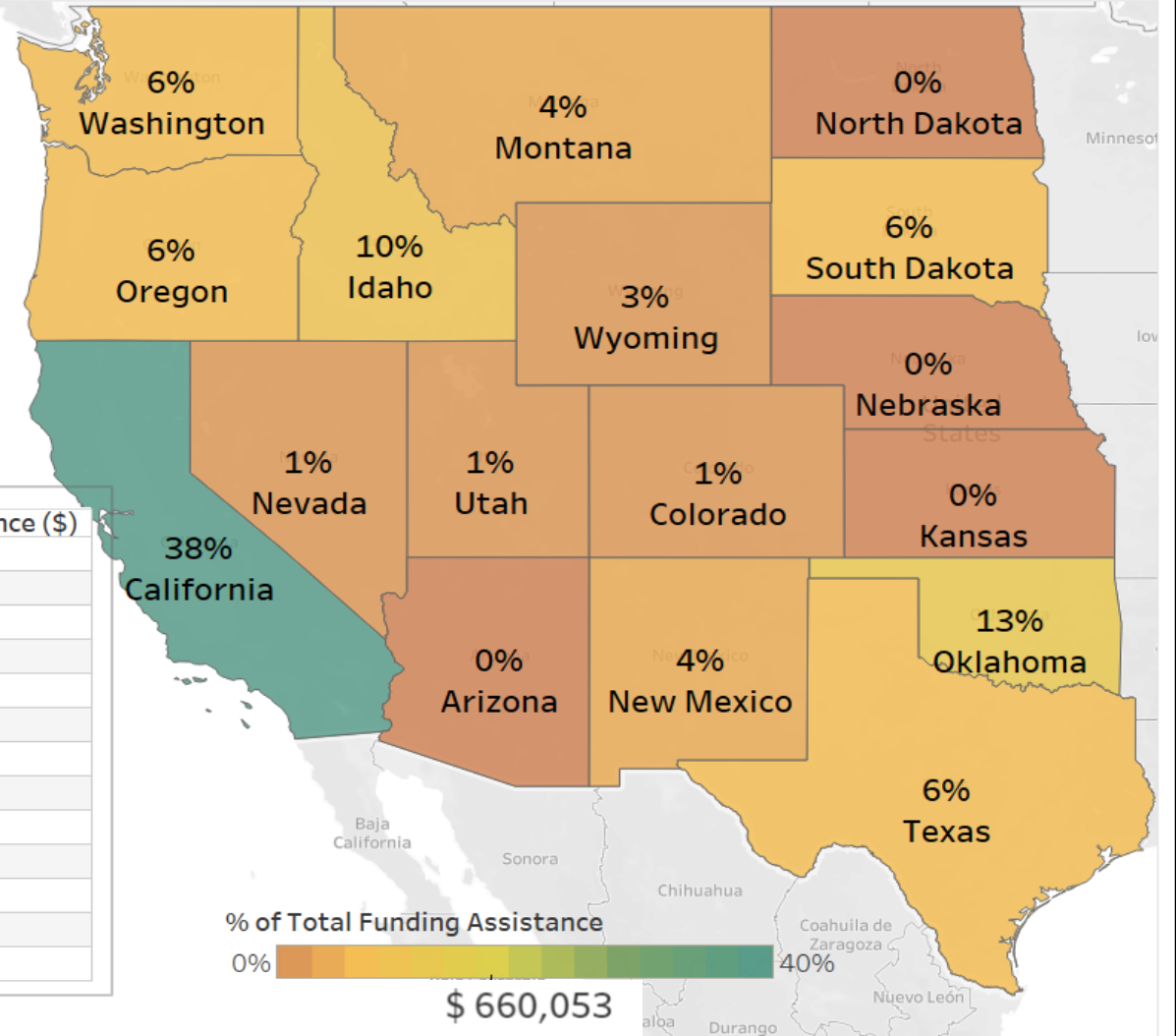
The Water-Use Data and Research (WUDR) program encourages the development of data services to more efficiently share data with the USGS, and with other stakeholders the grantee identifies. WUDR applicants and grant funding recipients have requested guidance on what to provide if they are seeking to use a data services approach for delivery of their water use information. Until the NWIS modernization effort has defined formats for USGS-specific water-use data services, the **USGS WUDR program recommends that grantees use the WaDE data schema (that is, the data dictionary) developed by the Western States Water Council's (WSWC) [Water Data Exchange](#) (WaDE) Program to provide data services that can be accessed by SWUDS and AWUDS.** USGS will work with States that have existing data services using other schemas and those already in the process of developing a custom schema to be able to process their data as well. States whose grant proposals did not include the development of data services may, of course, share data as described in their proposals.

More on WaDE: WaDE was developed to help the member States of the Western States Water Council share water use and water supply data in a common framework. Data that the States choose to share are then made available through a portal. Although initially developed for western States, the WaDE schema supports water-use data concepts for the rest of the U.S. as well. For WUDR grantees, WaDE schema data services may be implemented independently of the WaDE portal—that is, there is no need to engage with the WaDE program in order to utilize the WaDE schema to provide data. Grantees which are not in WSWC member States should contact [Adel Abdallah](#) if interested in participating as data providers in the WaDE portal.

The WaDE schema and API documentation is currently under redesign with an expected completion date of August 2019. USGS is providing input to this effort to make the data more easily integrated with NWIS and to ensure the schema covers USGS data requirements. When complete, the schema, related database components, and API documentation will be made available on the WaDE web site. A draft version can be viewed [here](#).

<https://water.usgs.gov/wausp/wudr/files/WUDR-USGS-data-transfer-guidance.pdf>

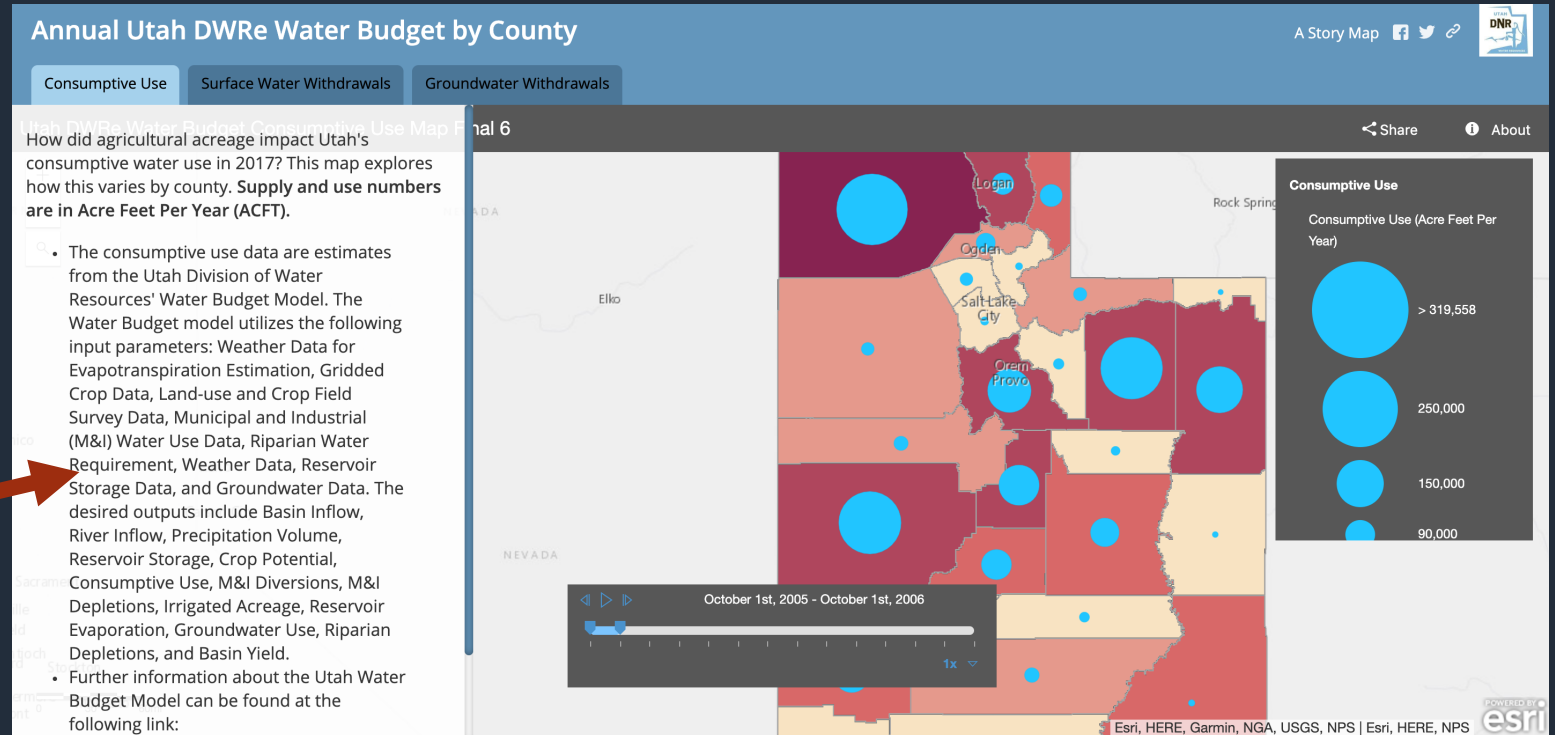
Assistance to Secure **Funding** to Member States



State	Funding Source	Funding Assistance (\$)
California	FY2015 EN Grant (Lead)	250,060
Oklahoma	FY2013 EN Grant	87,342
Idaho	FY2013 EN Grant	64,212
Texas	FY2013 EN Grant (Lead)	42,291
South Dakota	FY2015 EN Grant	41,344
Washington	FY2013 EN Grant	40,023
Oregon	FY2013 EN Grant	38,532
New Mexico	Internet of Water Grant	28,677
Montana	Internet of Water Grant	25,674
Wyoming	Water Foundation Grant (Interns)	17,000
Utah	Water Foundation Grant (Interns)	9,722
Nevada	FY2015 EN Grant	9,636
Colorado	WIDS	5,540

Technical Assistance to Member States

Utah



Wade 2.0



Open Data

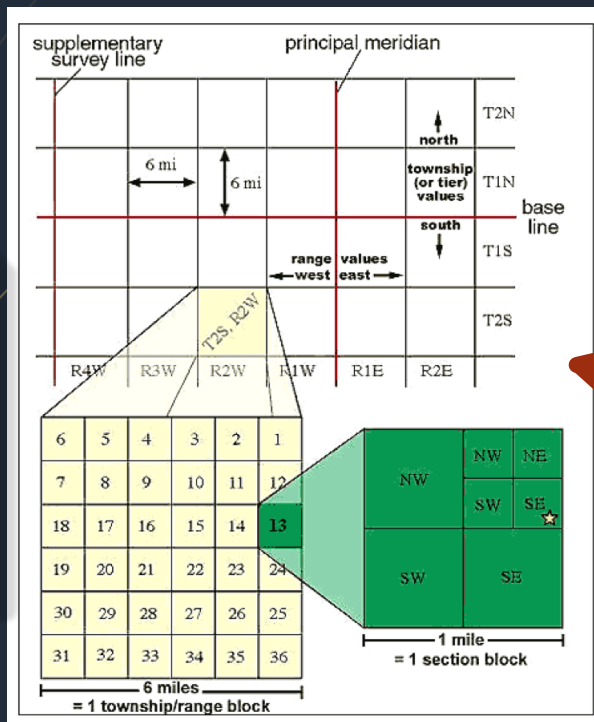


esri

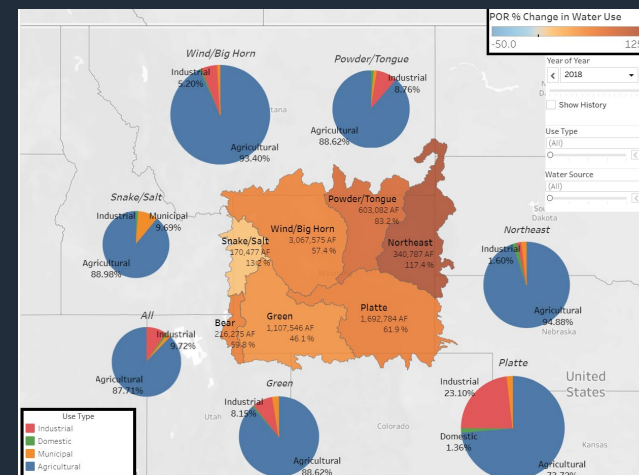
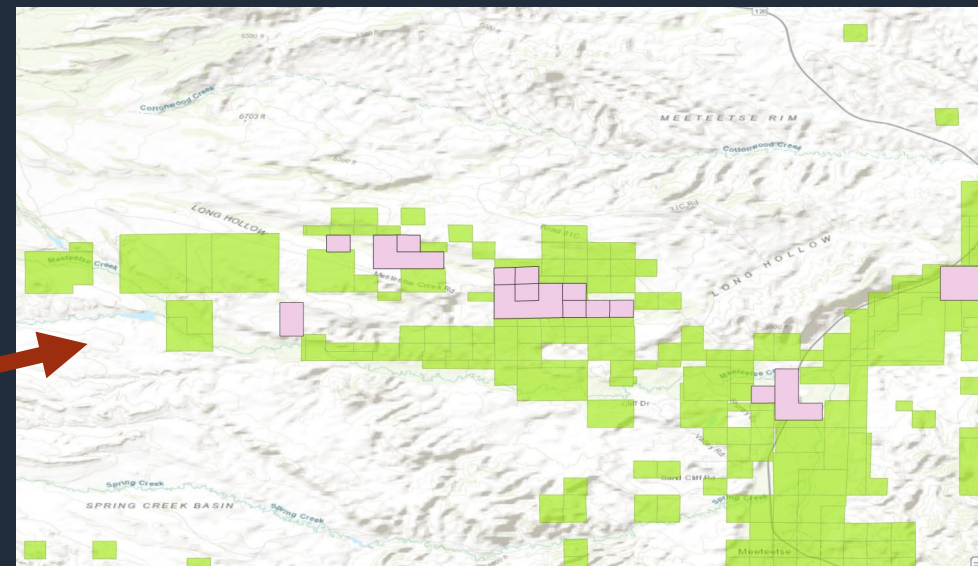
Technical Assistance to Member States

Wyoming

SHP



Linen Plat scans



WaDE 2.0



Financial Assistance to Member States

New Mexico

- Georeference about 1,600 hydrographic survey and water right filling Maps
- Enhance NM Office of State Engineer's water rights administering and adjudication process using the digitized maps
- Share water rights data through WaDE



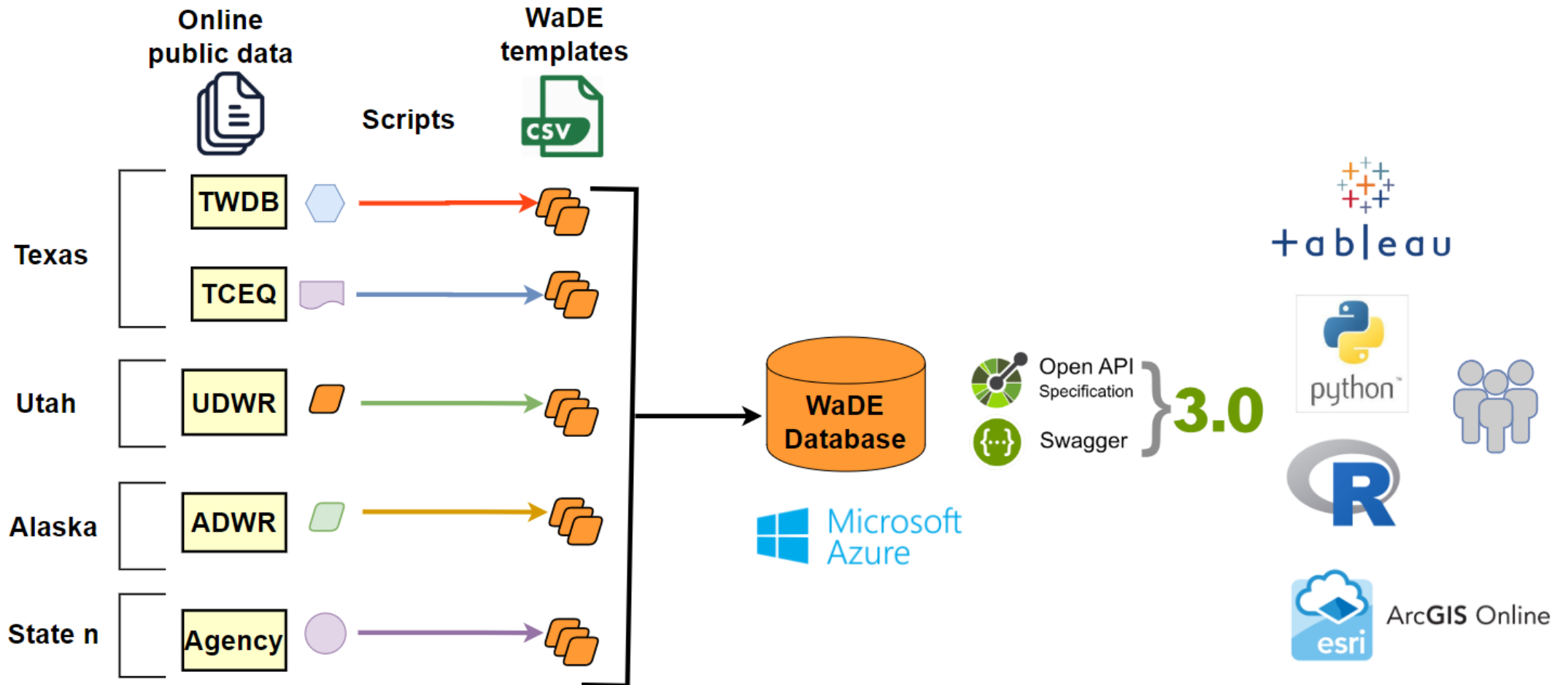
Why WaDE 2.0?

- Improve **scalability**, monitoring, updates, and efficiency
- Support **geospatial and time series** water use data in a centralized system
- Agreed-upon metadata and vocabularies across the Councils' members and with **USGS**

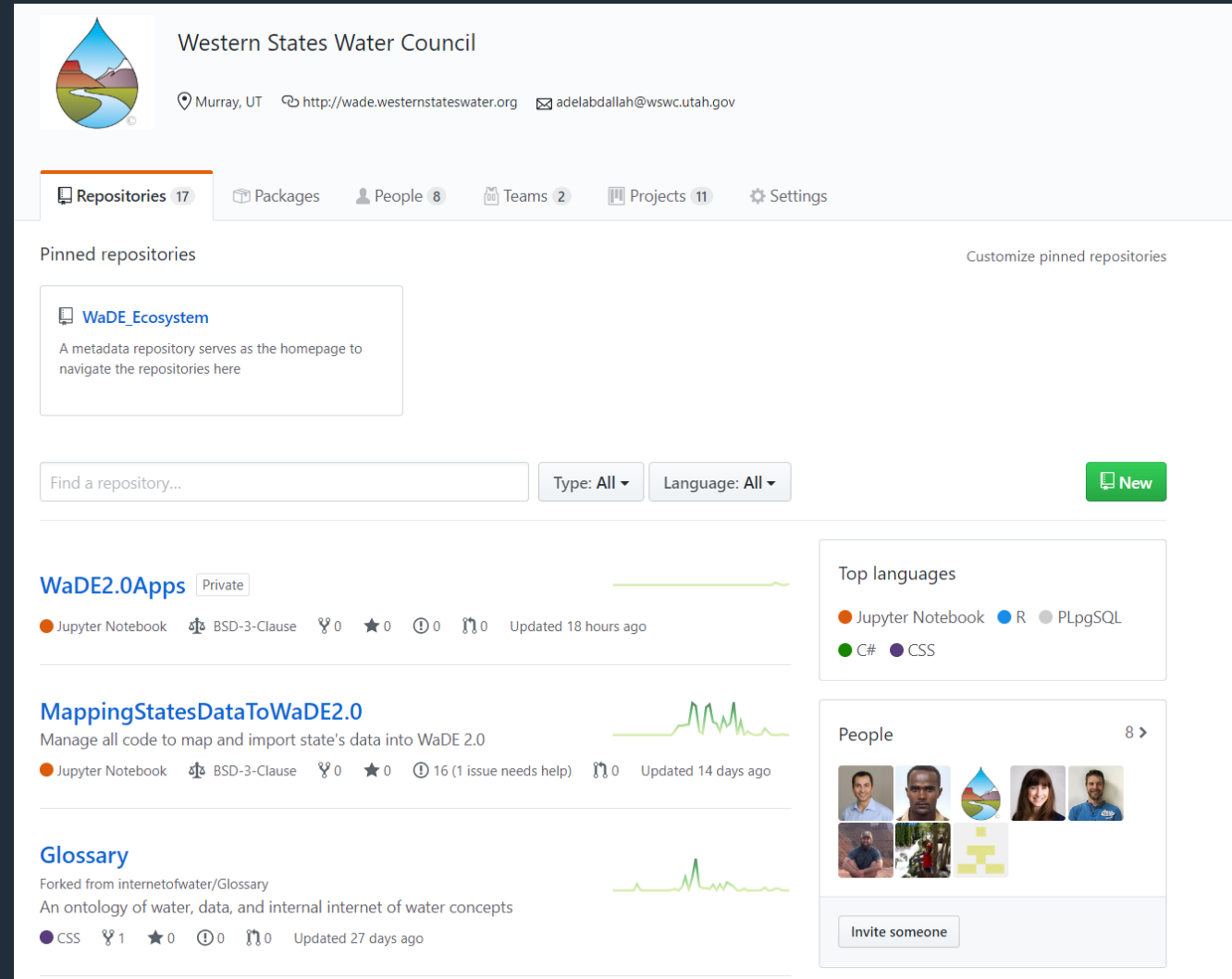
Questions WaDE 2.0 is designed to answer

- What are the appropriated **water rights** in an area sorted by date?
List their beneficial use (s)
- What is the annual **water budget** in a watershed over time?
- How much water is being **used in a location** over time and for what purpose?
- What are the **regulatory** constraints in a watershed?

WaDE 2.0 Architecture



Track WaDE Progress on GitHub



The screenshot shows the GitHub profile of the Western States Water Council. The profile header includes the organization's logo, name, location (Murray, UT), website (http://wade.westernstateswater.org), and email (adelabdallah@wswc.utah.gov). Below the header is a navigation bar with links to Repositories (17), Packages, People (8), Teams (2), Projects (11), and Settings. The main content area features a 'Pinned repositories' section with a single repository, 'WaDE_Ecosystem', described as a metadata repository. Below this is a search bar and filters for repository type and language. The repository list shows three items: 'WaDE2.0Apps' (Private, updated 18 hours ago), 'MappingStatesDataToWaDE2.0' (updated 14 days ago), and 'Glossary' (updated 27 days ago). Each repository entry includes icons for Jupyter Notebook, BSD-3-Clause license, forks, stars, issues, and pull requests. On the right side, there are sections for 'Top languages' (Jupyter Notebook, R, PLpgSQL, C#, CSS) and 'People' (8 members, with a grid of profile pictures and an 'Invite someone' button).

Western States Water Council

Murray, UT <http://wade.westernstateswater.org> adelabdallah@wswc.utah.gov

Repositories 17 Packages People 8 Teams 2 Projects 11 Settings

Pinned repositories [Customize pinned repositories](#)

[WaDE_Ecosystem](#)

A metadata repository serves as the homepage to navigate the repositories here

Find a repository... Type: All Language: All [New](#)

WaDE2.0Apps Private

Jupyter Notebook BSD-3-Clause 0 ★ 0 ⓘ 0 Updated 18 hours ago

MappingStatesDataToWaDE2.0

Manage all code to map and import state's data into WaDE 2.0

Jupyter Notebook BSD-3-Clause 0 ★ 0 ⓘ 16 (1 issue needs help) ⓘ 0 Updated 14 days ago

Glossary

Forked from internetofwater/Glossary

An ontology of water, data, and internal internet of water concepts

CSS 1 ★ 0 ⓘ 0 ⓘ 0 Updated 27 days ago

Top languages

Jupyter Notebook R PLpgSQL C# CSS

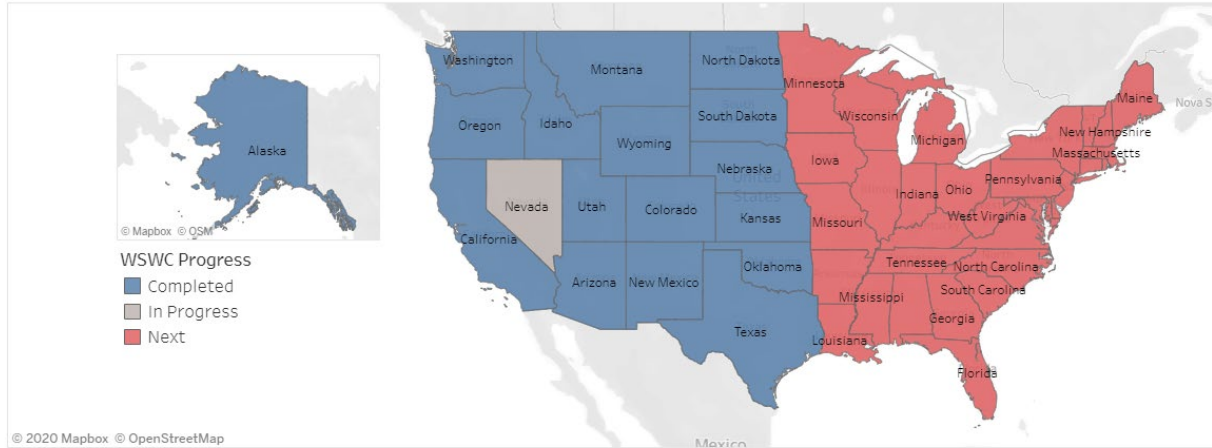
People 8 >

[Invite someone](#)

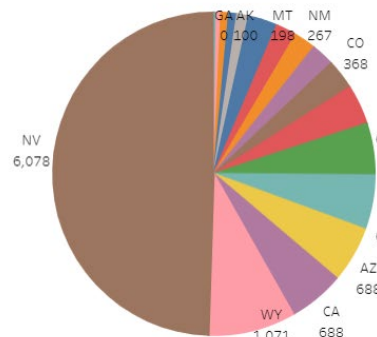
<https://github.com/WSWCWaterDataExchange/>

WaDE 2.0 Controlled Vocabulary

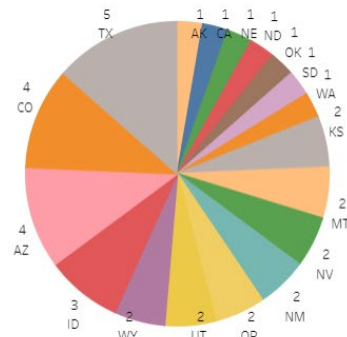
Vocabulary Fetch Progress Map



Number of Vocabulary Per State



Number of Agencies with Vocabulary



westernstateswater.org

work... What is Normalizati... jfleck at inkstain - A... Scrum Alliance Off... USGS Water Data f... Whitewash KML Interactive Sa... Avaya Aura® Confe... Aggimail - Calend...

WaDE Controlled Vocabularies wade.westernstateswater.org Admin Login

Master Controlled Vocabularies Registry for the Water Data Exchange(WaDE)

This online moderated registry aims to promote consistent use of terminology (i.e., Controlled Vocabularies) to describe attributes of the Water Data Exchange(WaDE) project across the seventeen Western US States while they still retain the use of their native terms. The use of these controlled vocabularies allow interoperable data query across states and regional analysis. Click at the tables below to view their vocabularies. You may suggest edits to the existing vocabularies or suggest new ones to be added. Scroll to the bottom for more info on how to the registry works.

Click on a collection of terms, then click New in the top left to suggest a new term. Once submitted, we will receive an email of the submission and decide to accept and add as a new vocabulary, or reject it in case it is similar to an existing one. Scroll to the bottom for more info on how to the registry works. The terms are hosted on [Google Sheets](#) and deployed to this registry.

Sara Larsen, PE
Water Data Exchange Senior Program Manager
Western States Water Council
[@wsdc.utah.gov](mailto:saralarsen)

Adel Abdallah, PhD
Senior Hydroinformatics Specialist
Western States Water Council
[@wsdc.utah.gov](mailto:adelabdallah)

Controlled Vocabularies

Aggregation Statistic

A term for describing the statistical action used to calculate over recorded time series values within a time interval. For example, 100 cfs of delivery target to a demand site is a "cumulative" aggregation statistic calculated over a time interval like a month.

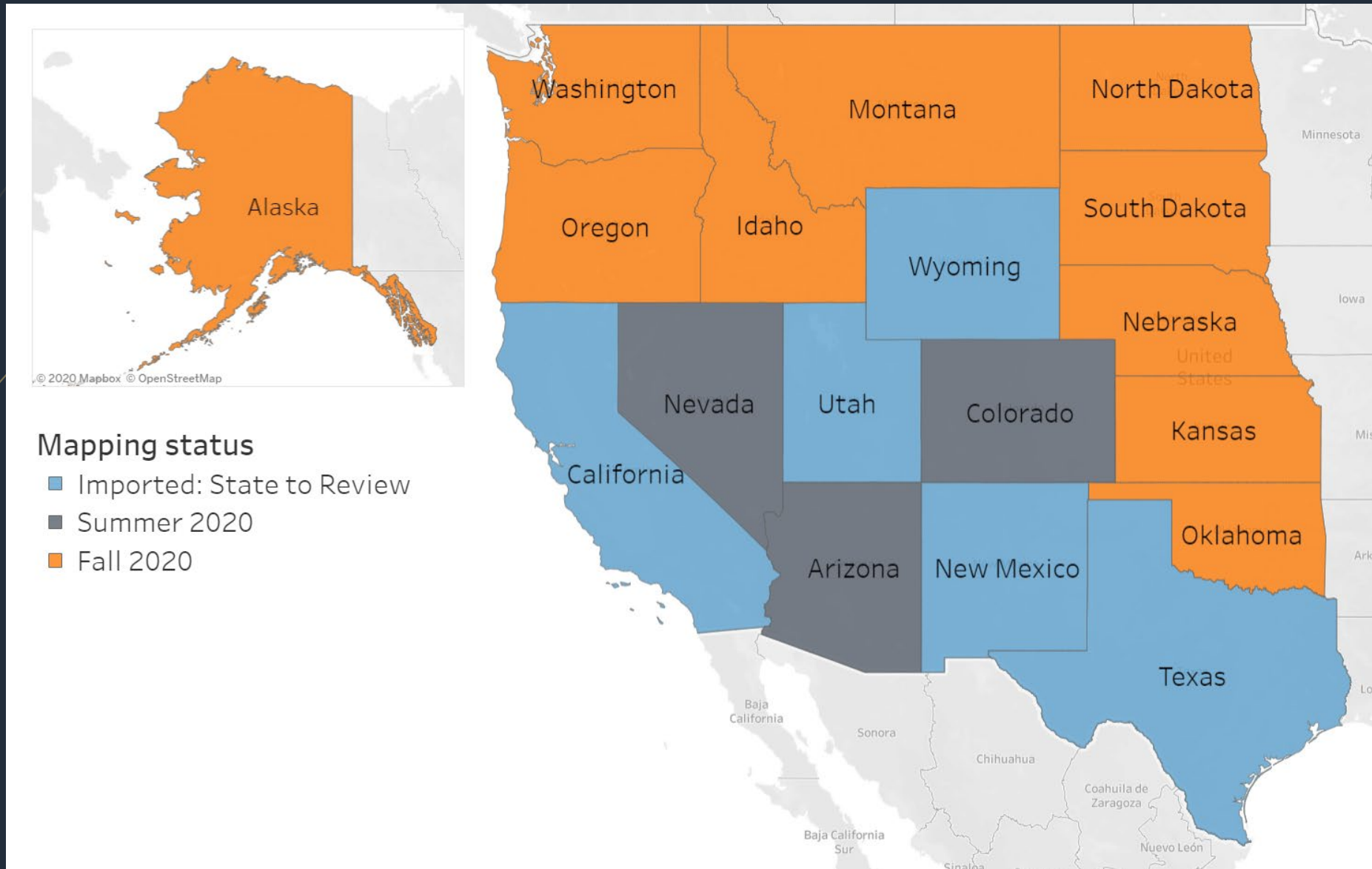
Applicable Resource Type

A term that indicates the types of water supply or water use for which the method is used (e.g. surface water, groundwater, storage).

<https://internetofwater.shinyapps.io/Glossary/#section-help-identify-synonyms3>

<http://vocabulary.westernstateswater.org/>

Aggregate Water Use Data Mapping Status

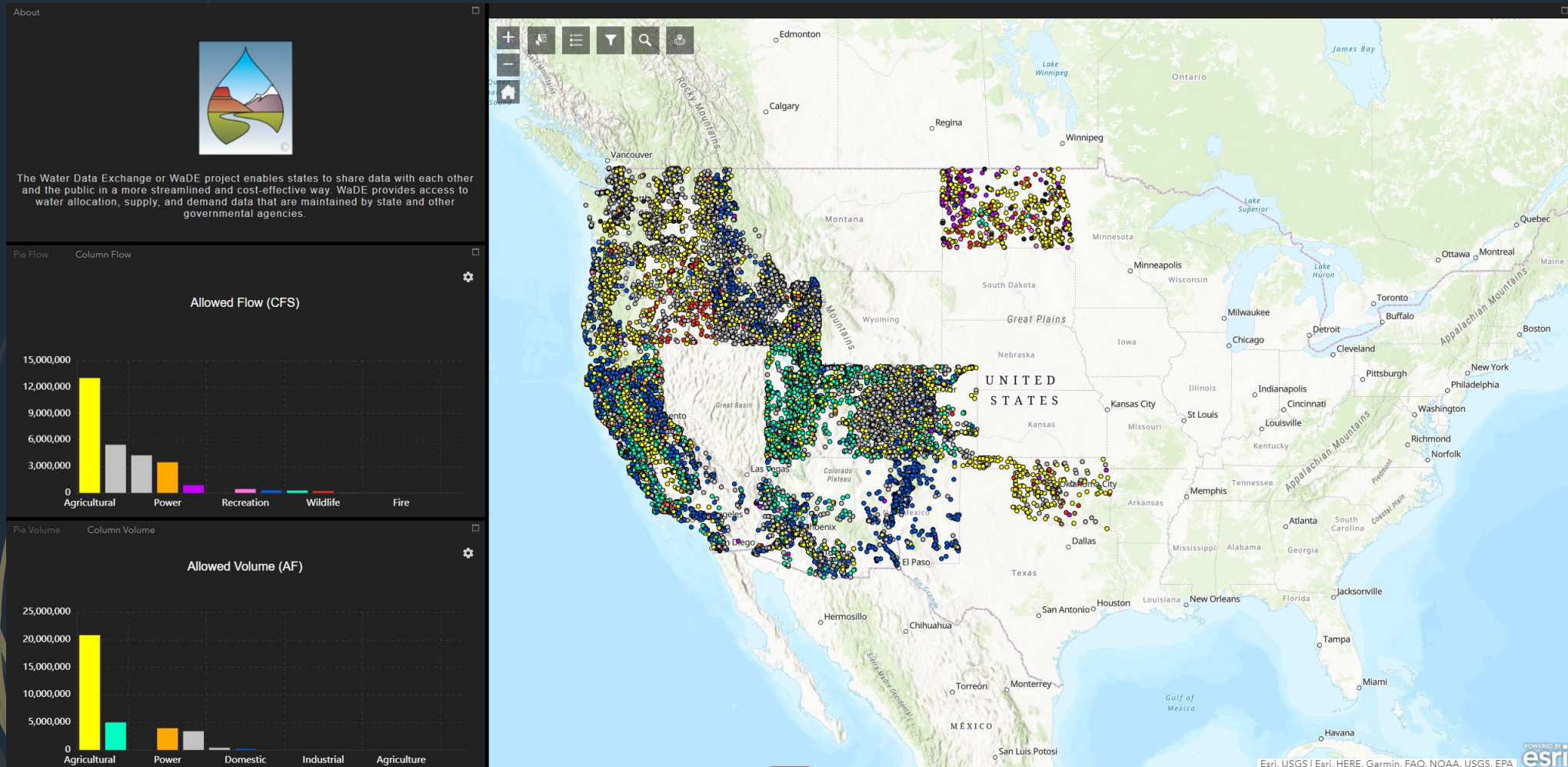


Web Tool and Portal Development for WaDE 2.0

- Explored Platforms: **ESRI, Tableau, Power-BI, CARTO, R Shiny**
- Each Platform has strengths but cannot support our full uses cases (i.e., issues of optimization, budget constraints, hosting services, UI development)
- Exploring the option to outsource to an IT contractor for the custom development of WaDE 2.0 Portal
- Today's demo on R Shiny (Demo Purposes Only)

Web Tool #1: Allocation (Water Rights) Point of Diversion Site Information

DEMO: Find all Water Rights near Starvation Reservoir, UT, that are associated with Agricultural for beneficial use and have priority date of 1920 or earlier.



Web Tool #1: Demo Step 1

Filter Options

1) Filter out sites based on 1) Priority Date, 2) State, 3) Beneficial Use, and 4) minimum and maximum Flow (CFS & AF).

Example

- State: Utah
- Beneficial Use: Agricultural
- Priority Date: 1920 – 05 – 15 (yyyy-mm-dd)

Western States Allocation Site Information

Filter Data:

Priority Date (yyyy-mm-dd)

1849-12-31 1920-05-15 2016-09-01

Text Input SiteUUID

AZ_10_AZ_10005,AZ_10008

Select State

- ☐ AZ
- ☐ CA
- ☐ CO
- ☐ NM
- ☒ UT

Select Beneficial Use

- ☒ Agricultural
- ☐ Commercial
- ☐ Domestic
- ☐ Fire
- ☐ Industrial
- ☐ Mining
- ☐ Municipal
- ☐ Power
- ☐ Recreation
- ☐ Snow Making
- ☐ StockWatering
- ☐ Wildlife
- ☐ Other

Allocation Flow

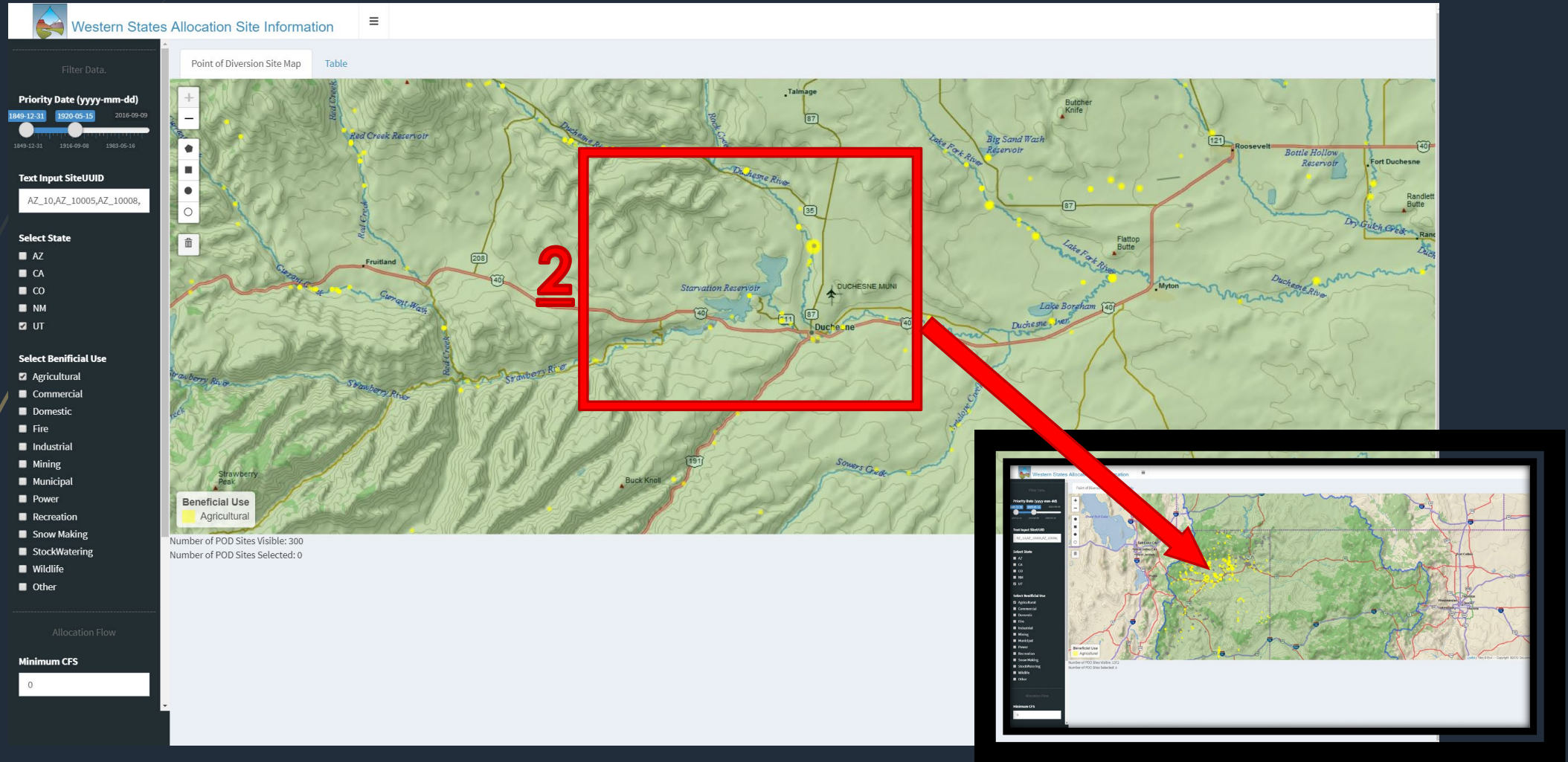
Minimum CFS

0

Point of Diversion Site Map Table

Number of POD Sites Visible: 1372
Number of POD Sites Selected: 0

- Location of Interest: Starvation Reservoir, UT.



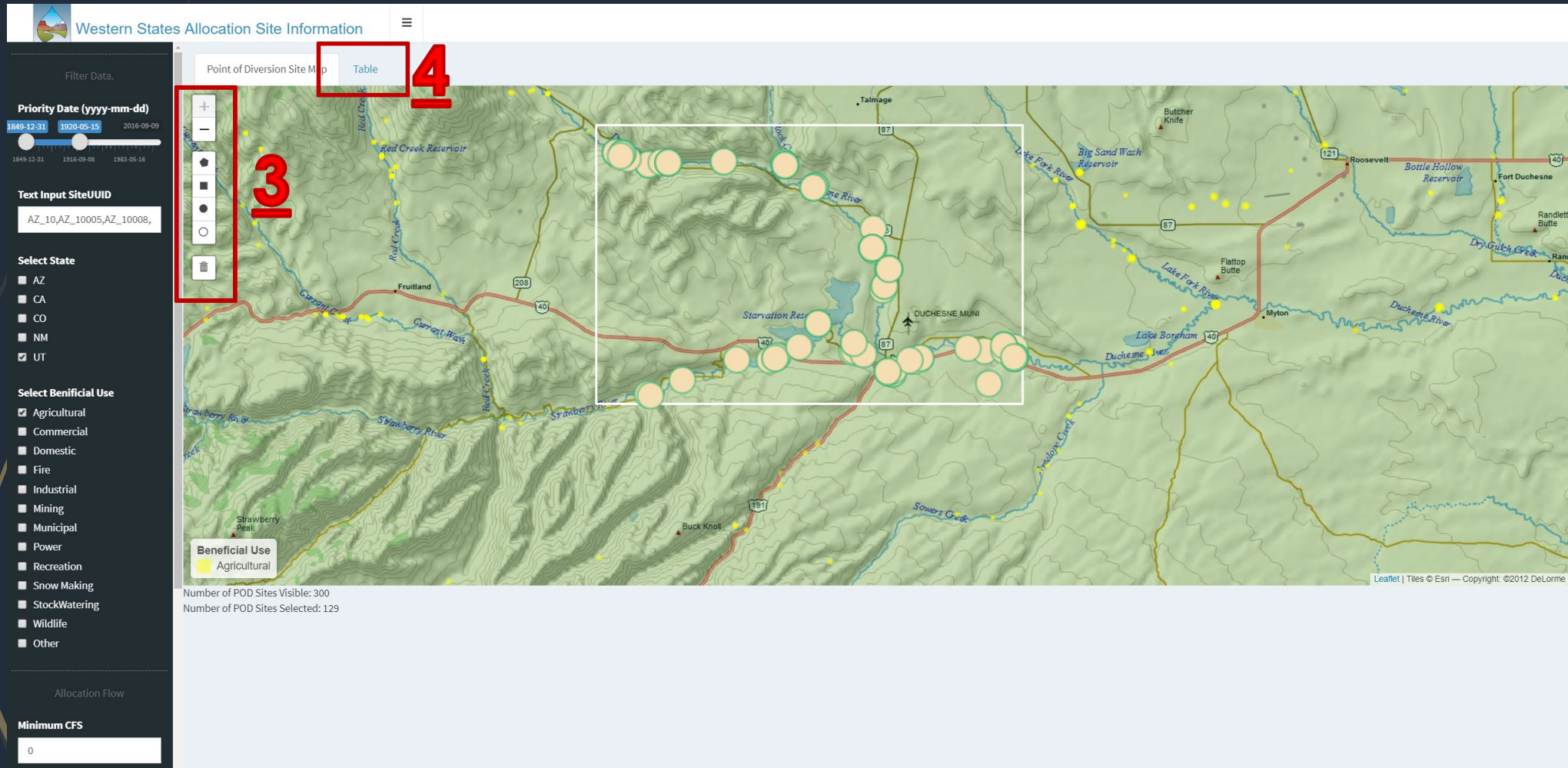
Web Tool #1: Demo Step 3

Draw Tools Selection

- 3) Select sites using draw tools.
- 4) View select sites.

Example

- Draw Tools: Draw rectangle around sites of interest



Web Tool #1: Demo Step 4

Download Sites to Excel

5) Download select sites to excel.

Example

 Western States Allocation Site Information

Filter Data.

Priority Date (yyyy-mm-dd)
1849-12-31 1920-05-15 2016-09-09

Text Input SiteUUID
AZ_10,AZ_10005,AZ_10008,

Select State
☐ AZ
☐ CA
☐ CO
☐ NM
☒ UT

Select Beneficial Use
☒ Agricultural
☐ Commercial
☐ Domestic
☐ Fire
☐ Industrial
☐ Mining
☐ Municipal
☐ Power
☐ Recreation
☐ Snow Making
☐ StockWatering
☐ Wildlife
☐ Other

Allocation Flow

Minimum CFS
0

Point of Diversion Site Map Table

Show 10 entries

	OBJECTID	SiteUUID	Lat	Long	SN_ID	State	AA_CFS	AA_AF	AAM_AF	PD	WSN	WBenUse	secondLocationID
1	75175	UT_57318	40.1741840376525	-110.285724198003		UT	0	73	156.8	6/16/1910 0:00:00	Duchesne River	Agricultural	UT_57318_selectedLayer
2	75366	UT_57507	40.1756347366367	-110.295551589802		UT	0.029	2	0	8/28/1905 0:00:00	Duchesne River	Agricultural	UT_57507_selectedLayer
3	75425	UT_57566	40.2832400863171	-110.465662019514		UT	1.26	78.1	312.4	9/29/1906 0:00:00	Duchesne River	Agricultural	UT_57566_selectedLayer
4	75426	UT_57567	40.2832400863171	-110.465662019514		UT	0.291	20	80	3/22/1911 0:00:00	Duchesne River	Agricultural	UT_57567_selectedLayer
5	75751	UT_57891	40.2276741991242	-110.397990223164		UT	0.45	31.59	126.36	11/18/1907 0:00:00	Duchesne River	Agricultural	UT_57891_selectedLayer
6	75794	UT_57934	40.1756347366367	-110.295551589802		UT	0.146	10	0	8/28/1905 0:00:00	Duchesne River	Agricultural	UT_57934_selectedLayer
7	75991	UT_58131	40.255231190527	-110.412069718086		UT	0.0725	5	0	4/21/1911 0:00:00	Duchesne River	Agricultural	UT_58131_selectedLayer
8	76137	UT_58276	40.1670866925077	-110.285739421677		UT	0.8027	58.49	233.96	7/14/1906 0:00:00	Duchesne River	Agricultural	UT_58276_selectedLayer
9	76483	UT_58619	40.1719754149644	-110.429281921332		UT	0.0853	0	23.64	4/22/1907 0:00:00	Strawberry River	Agricultural	UT_58619_selectedLayer
10	76707	UT_58843	40.19061432103	-110.461352265039		UT	0.83	58.02	0	12/14/1905 0:00:00	Strawberry River	Agricultural	UT_58843_selectedLayer

Showing 1 to 10 of 129 entries

[Download the data to csv](#)

Previous 1 2 3 4 5 ... 13 Next

Web Tool #1: Demo Step 5

Additional Info

6) Click site of interest. Select 'Link' on Additional Info

Example

• Site of Interest: SiteUUID: UT_60441

Western States Allocation Site Information

Filter Data.

Priority Date (yyyy-mm-dd)

49-12-31 1920-05-15 2016-09-09

Text Input SiteUUID

AZ_10,AZ_10005,AZ_10008,

Select State

☐ AZ

☐ CA

☐ CO

☐ NM

☒ UT

Select Beneficial Use

☒ Agricultural

☐ Commercial

☐ Domestic

☐ Fire

☐ Industrial

☐ Mining

☐ Municipal

☐ Power

☐ Recreation

☐ Snow Making

☐ StockWatering

☐ Wildlife

☐ Other

Allocation Flow

Minimum CFS

0

Point of Diversion Site Map Table

Additional Info: Link
SiteUUID: UT_60441
SN_ID: NA
State: UT
AA_CFS: 14.6
AA_AF: 1021.7
PD: 11/30/1908 0 00:00
WSN: Duchesne River
WBenUse: Agricultural

Number of POD Sites Visible: 305
Number of POD Sites Selected: 0

Web Tool #1: Demo Step 6

Download Additnal Site Info to Excel

7) Click site of interest. Select 'Link' on Additional Info

Example

• Site of Interest: SiteUUID: UT_60441

WaDE 2.0 QA Database Site Data

Query Parameter (SiteUUID)

SQPinput

UT_60441

Download Tables to Excel Workbook

downloadExcel

7

Organizations

Show 10 entries

OrganizationName	OrganizationPurview	OrganizationWebsite	OrganizationPhoneNumber	OrganizationContactName	OrganizationContactEmail	OrganizationState	
1	Utah Division of Water Resources	Water Planning	https://water.utah.gov/	801-538-7280	Craig Miller	craigmiller@utah.gov	UT

Showing 1 to 1 of 1 entries

Previous 1 Next

WaterSources

Show 10 entries

WaterSourceName	WaterSourceNativeID	WaterSourceUUID	WaterSourceTypeCV	FreshSalineIndicatorCV	WaterSourceGeometry
1	Duchesne River	UT_6098	Point of Rediversion	Fresh	

Showing 1 to 1 of 1 entries

Previous 1 Next

VariableSpecifics

Show 10 entries

VariableSpecificTypeCV	VariableCV	AmountUnitCV	AggregationStatisticCV	AggregationInterval	AggregationIntervalUnitCV	ReportYearStartMonth	ReportYearTypeCV	MaximumAmountUnitCV	
1	Allocation All	Allocation	CFS	Average	1.0	Year	10	WaterYear	AFY

Showing 1 to 1 of 1 entries

Previous 1 Next

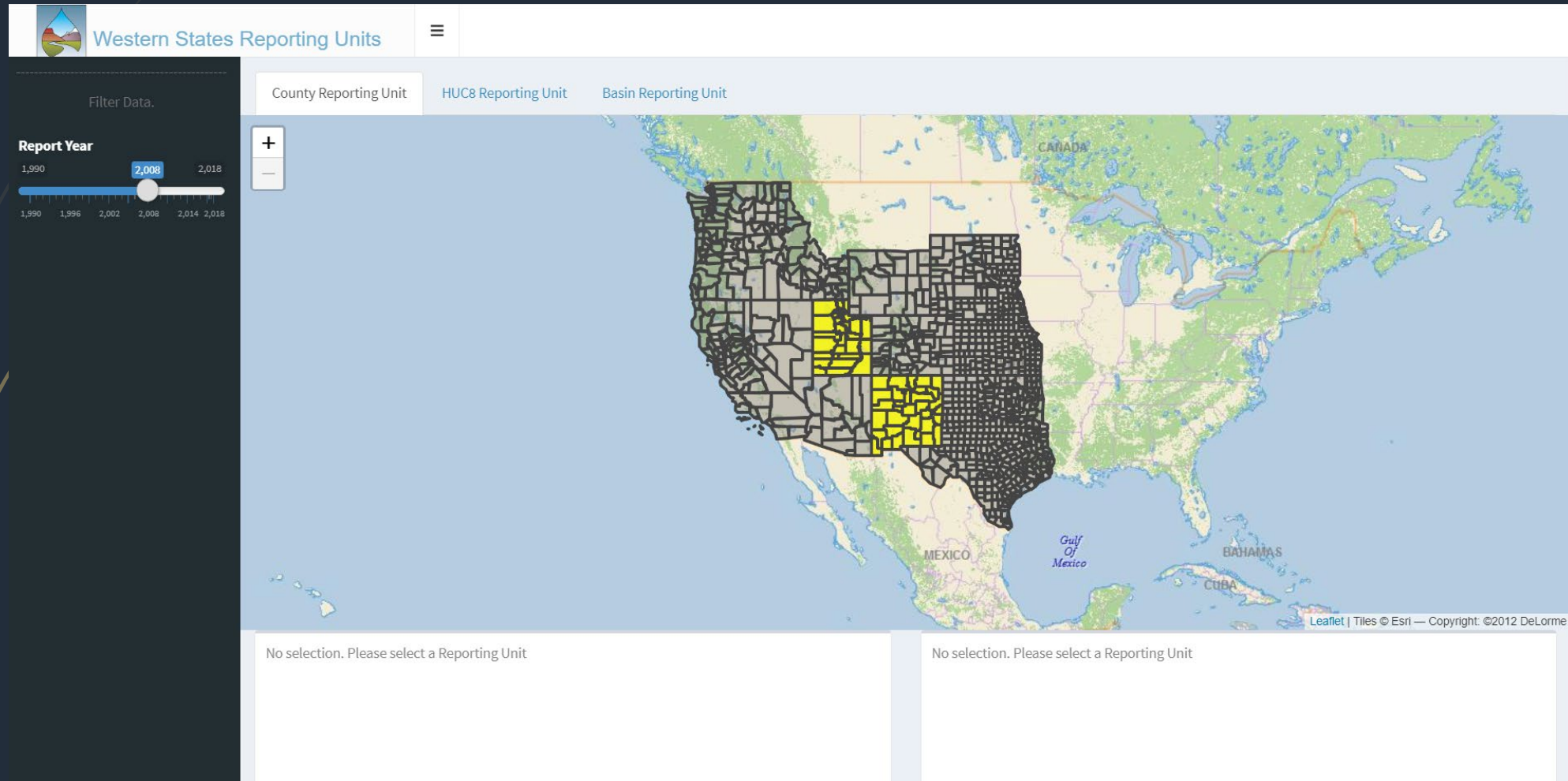
Methods

Show 10 entries

MethodUUID	MethodName	MethodDescription	MethodNEMILink	ApplicableResourceType	MethodTypeCV	DataCoverageValue	DataQualityValue	DataConfidenceValue
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Web Tool #2: Aggerated Reporting Unit (Polygon) Water Use Information Over Time

- **DEMO:** Find all Water Usage in San Juan County, ,UT, over a 10 years period.



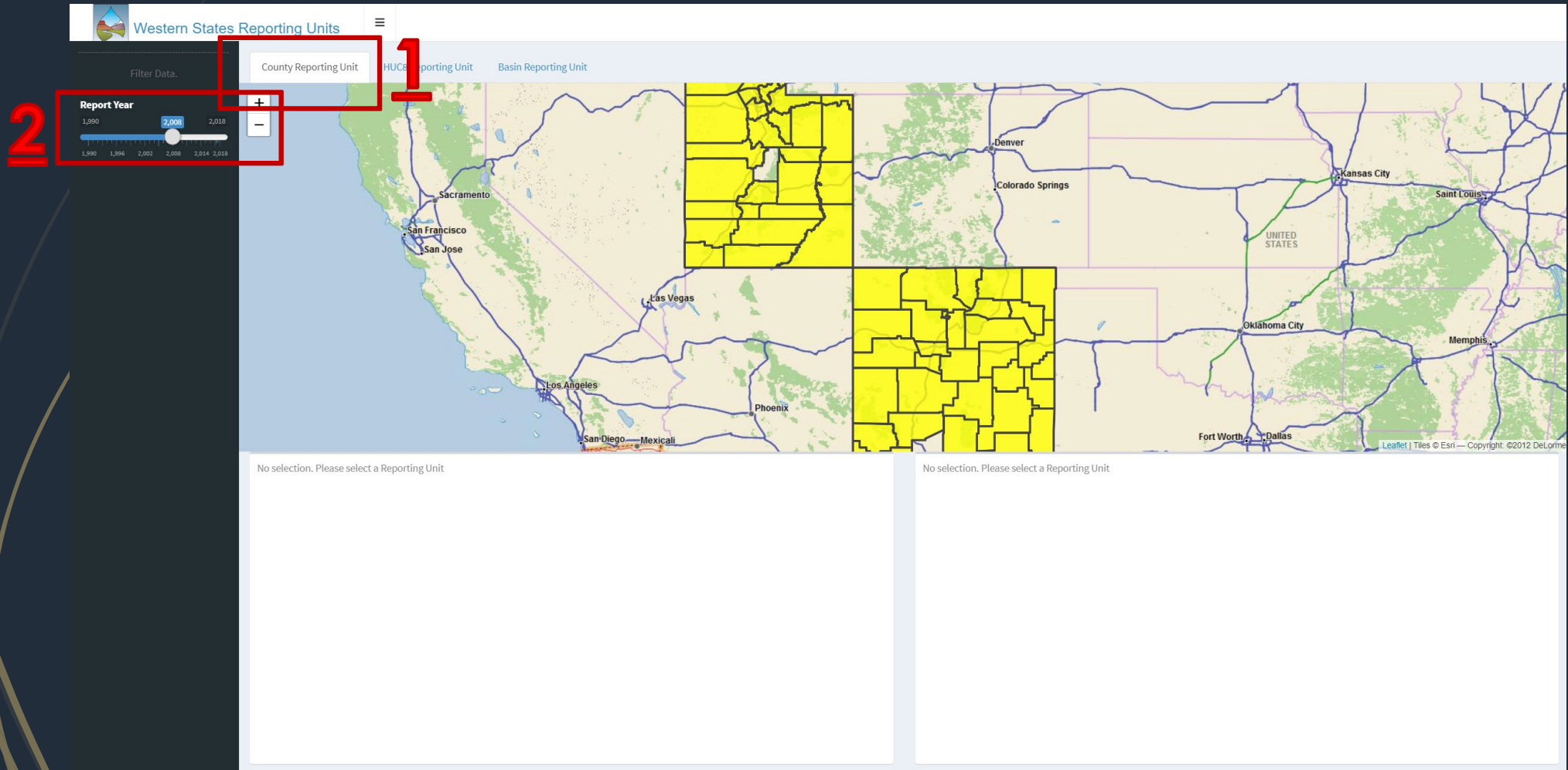
Web Tool #2: Demo Step 1

Filter Options

- 1) Select Reporting Unit Type of interest.
- 2) Filter available Aggregated Data based on Reporting Year of interest.

Example

- Reporting Unit Type: County
- Reporting Unit of Interest: 49307, San Juan County, UT
- _60441



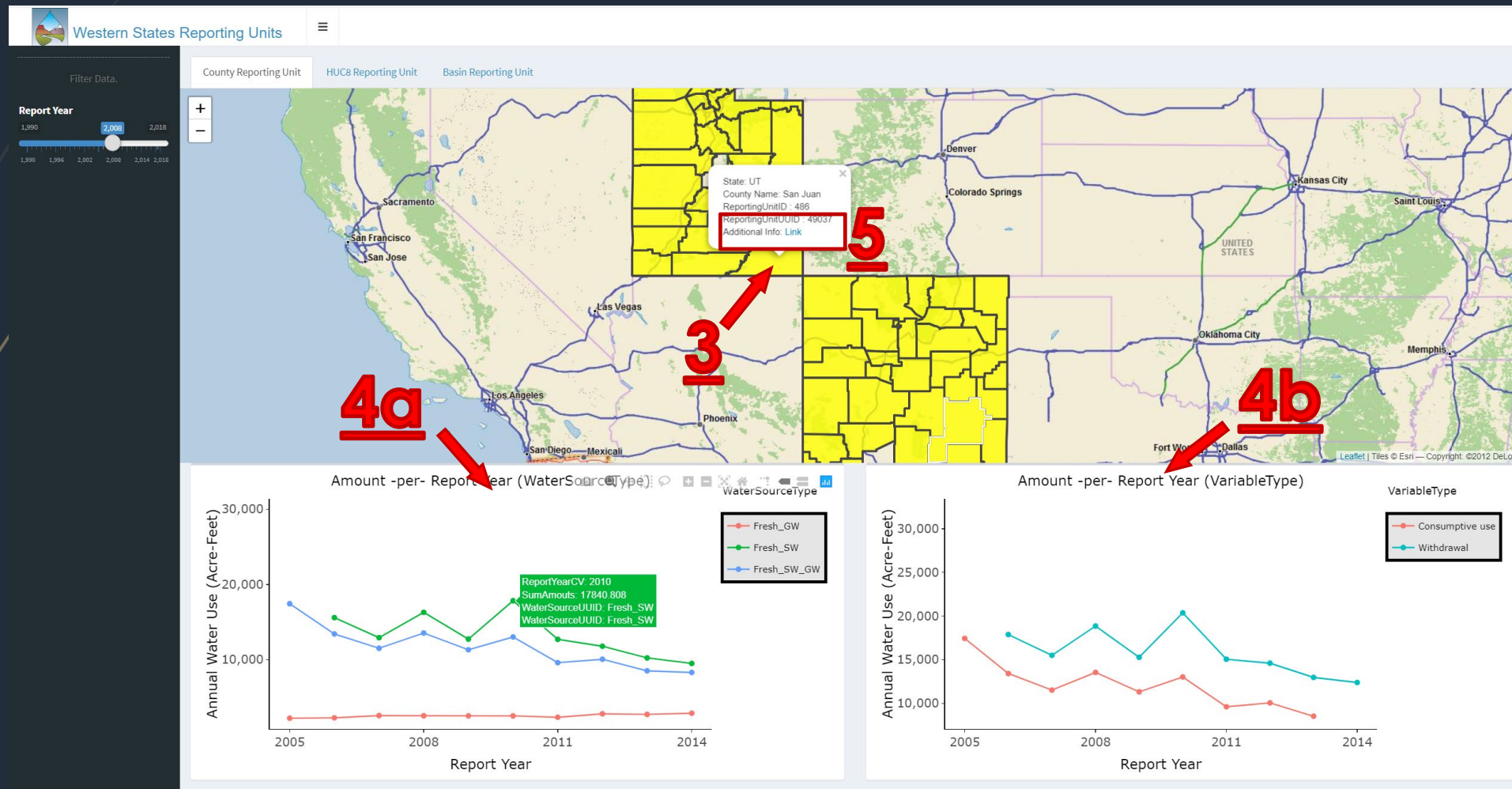
Web Tool #2: Demo Step 2

Water Usage Over Time

- 3) Click on Reporting Unit Polygon
- 4) Resulting Collected Water Use by a) Water Source Type & b) Variable Type.
- 5) For more Reporting Unit Information, Select 'Link' on Additional Info.

Example

- Reporting Unit of Interest: 49307, San Juan County, UT



Web Tool #2: Demo Step 3

Download Additional Reporting Unit Info to Excel

6) Download additional info from the WaDE 2.0 Database to Excel.

 WaDE 2.0 QA Database Site Data

Query Parameter (SiteUUID)

SQPinput
UT_60441

downloadExcel

6

Download Tables to Excel Workbook

Organizations

Show 10 ▼ entries

OrganizationName	OrganizationPurview	OrganizationWebsite	OrganizationPhoneNumber	OrganizationContactName	OrganizationContactEmail	OrganizationState	
1	Utah Division of Water Resources	Water Planning	https://water.utah.gov/	801-538-7280	Craig Miller	craigmiller@utah.gov	UT

Showing 1 to 1 of 1 entries

Previous 1 Next

WaterSources

Show 10 ▼ entries

WaterSourceName	WaterSourceNativeID	WaterSourceUUID	WaterSourceTypeCV	FreshSalineIndicatorCV	WaterSourceGeometry
1	Duchesne River	UT_6098	Point of Rediversion	Fresh	

Showing 1 to 1 of 1 entries

Previous 1 Next

VariableSpecifics

Show 10 ▼ entries

VariableSpecificTypeCV	VariableCV	AmountUnitCV	AggregationStatisticCV	AggregationInterval	AggregationIntervalUnitCV	ReportYearStartMonth	ReportYearTypeCV	MaximumAmountUnitCV	
1	Allocation All	Allocation	CFS	Average	1.0	Year	10	WaterYear	AFY

Showing 1 to 1 of 1 entries

Previous 1 Next

Methods

Show 10 ▼ entries

MethodUUID	MethodName	MethodDescription	MethodNEMILink	ApplicableResourceType	MethodTypeCV	DataCoverageValue	DataQualityValue	DataConfidenceValue
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Next steps

- Continue **connecting** member states data into WaDE
- Work with our IT Contractor on designing **WaDE Portal 2.0**
- Support WaDE data interoperability with USGS and IOW Geoconnex U.S. Hydrologic Features
- Contribute to the Water Budget Navigator for the Upper Colorado Basin
- **Beta release** WaDE 2.0 system to our partners and then the public in Summer and Fall 2020

Strategic Partnerships



CUAHSI
Universities Allied for Water Research



Internet of Water

Connecting Water Data to Enhance Decision-Making



WSWC Fall 2019 and Spring 2020 Interns



Ryan James
Utah State Univ.



Tseganeh Gichamo
Utah State Univ.



Joseph Brewer
Utah State Univ.

Thank you

Water Foundation

Mitchell Foundation

MOORE Foundation

EPA Exchange Network Grant Program



WESTERN STATES
WATER COUNCIL

Questions?

adelabdallah@wswc.utah.gov

<https://www.wade.westernstateswater.org/>