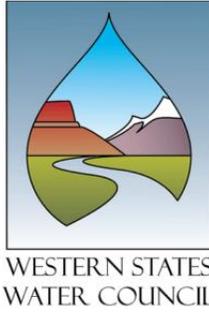


# Western State Water Program Capabilities Assessment Update Report

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## Western States Water Council

December 22, 2022



## 1. Introduction

The Western States Water Council (WSWC) is a government entity comprised of representatives appointed by the governors of eighteen Western states (i.e., Alaska, Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming).<sup>1</sup> Its mission is to advise western governors on policies and programs affecting water in the West and 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.

With ever-greater demands on the West's limited water resources, further complicated by a complex overlay of state and federal laws and regulations, cooperative efforts to exchange water data among the WSWC Member States and with federal agencies have become increasingly important. In response to this growing need, the WSWC launched a Water Data Exchange (WaDE) program in 2011.<sup>2</sup> WaDE's mission is to assist WSWC Member States to publicly share water data through a single platform that streamlines and standardizes the data across state boundaries. WaDE enables both state and regional analyses of water allocation, supply, and use to inform water resources planning and policies. In this report, the term water allocation has been used broadly and interchangeably to include water rights, water permits, water appropriations, and allotments. Domestic wells or groundwater managed under a correlative rights doctrine, as in many Western states, may not be included under allocation.

In June 2014, WSWC published a "Western State Water Program Capabilities Assessment Survey & Report," which was the culmination of extensive meetings, conversations, and written responses to a survey.<sup>3</sup> The survey sought to understand how the States collect, generate, manage, and share water data to inform building an effective WaDE framework for exchanging water data. Since then, the report and its findings have helped guide WaDE's efforts during the past decade. This 2022 update focuses on current state capabilities for sharing water rights and water use data, recognizing improvements over the past decade. The report is based on WSWC staff experiences working with state agency staff, a review of States' documents and webpages, presentations at a National Water Use Data Workshop hosted by the WSWC, together with the Internet of Water Coalition, Interstate Council on Water Policy, and U.S. Geological Survey (USGS) in Salt Lake City, Utah, in August 2022,<sup>4</sup> as well as direct state communications and feedback.

## 2. Changes to Western States' Water Data Sharing through WaDE

As the States' capacity to share data has improved, WaDE has similarly adapted its architecture in three phases. As illustrated in Figure 1 below, during the initial phase (2011-2018), each State hosted an independent copy of the WaDE database where they populated and maintained their respective state water data. Among the States, and even between water agencies in the same State, there were significant variations in the timing, instruments, units, and digital or paper filing systems used to collect and store water data. As each State's WaDE

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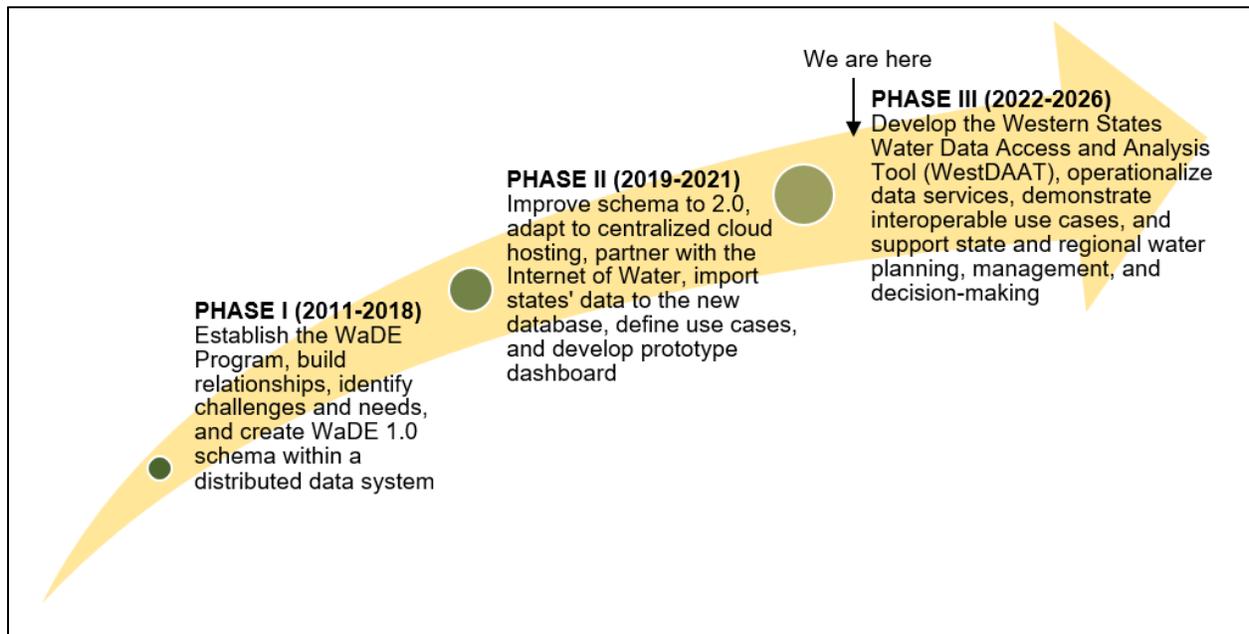
<sup>1</sup> Western States Water Council: <https://westernstateswater.org/>

<sup>2</sup> Water Data Exchange (WaDE) Program: <https://westernstateswater.org/wade>

<sup>3</sup> Western State Water Program Capabilities Assessment Report: <https://westernstateswater.org/publications/2014/western-state-water-program-capabilities-assessment-report>

<sup>4</sup> The 2022 National Water Use Data Workshop, Salt Lake City UT: <https://westernstateswater.org/events/2022-national-water-use-data-workshop/>

database was populated and connected to the central metadata catalog, some of the data were converted to be more regionally consistent while retaining the original metadata. Users could query information about data from a single starting point in WaDE and would be directed to each State's database.<sup>5</sup> However, this distributed data system approach proved to be cumbersome, and querying data was time-consuming. The WaDE team re-evaluated the database schema and data services and identified the need to use more modern methods.<sup>6</sup>



**Figure 1:** The Water Data Exchange (WaDE) past and current phases and key activities

In the second phase (2018-2021), the entire WaDE data system architecture evolved to enable streamlined access to water rights and water use data through standardized and machine-readable formats to support regional analyses. The WaDE 2.0 schema resolved issues presented in the first phase by developing a centralized and cloud-based platform.<sup>7</sup> As States shifted increasingly to cloud-hosting solutions for data sharing (e.g., ESRI ArcGIS Online), WaDE became a centralized database in the cloud that mirrored the state information, on a regional scale, without the need to maintain separate databases. As more States participated in sharing more of their data through WaDE, the ability to query the data to address regional questions grew.

As part of WaDE's third phase (2022-2026), the focus has been on developing a Western States Water Data Access and Analysis Tool (WestDAAT) and related use cases<sup>8</sup>. Use cases enable the programmers to anticipate potential data searches and describe how the data could

<sup>5</sup> WaDE: An Interoperable Data Exchange Network for Sharing Water Planning and Use Data <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1936-704X.2014.03177.x>

<sup>6</sup> Western State Water Resources Agency Use of Cloud Computing Technology & Platforms:

<https://www.westernstateswater.org/wp-content/uploads/2018/10/States-Use-of-the-Cloud-Final-October-2018.pdf>

<sup>7</sup> Celebrating Ten Years of Western Water Data Sharing <https://internetofwater.org/blog/wade-celebrating-ten-years-of-western-water-data-sharing/>

<sup>8</sup> WestDAAT Use Cases and Personas: <https://westernstateswater.org/wade-updates/2021/westdaat-use-cases-and-personas/>

be used by a different set of users (i.e., personas) to address water management challenges. WestDAAT is a dashboard that provides streamlined access to Western States' water data to support state and regional water planning, management, and decision-making. The current WestDAAT dashboard features focus on water rights data.<sup>9</sup>

The WaDE team has also created prototype tools for sharing three other data types for later expansion as part of the WestDAAT architecture: (1) site-specific reservoirs and observation sites with water data; (2) public-supply water use data; and (3) aggregate water budget data.<sup>10</sup> The States have different capabilities for sharing these data – either because they do not produce each data type or because the data are not publicly available or are not in a machine-readable format. Many States are working toward a greater capacity to share water data for transparency and compliance with new state legislative requirements. The current WaDE System architecture is designed to accommodate all these data types in different spatial and temporal scales with basic common metadata for all the Western States.

### 3. Status of States' Water Data Sharing through WaDE

Various States have made numerous water rights and water use datasets publicly available in a machine-readable format. WSWC has summarized the type of data shared across twelve datasets (see Table 1), as well as presented this information in an interactive Tableau dashboard (see Figure 2).<sup>11</sup> In general, California and Nebraska are sharing six datasets, while Nevada and Utah are sharing five datasets through WaDE. South Dakota is only sharing its Point of Diversion water rights dataset, and we are actively working on importing two datasets for Alaska. The following subsections describe each data type and which State has the capability to share it through WaDE.

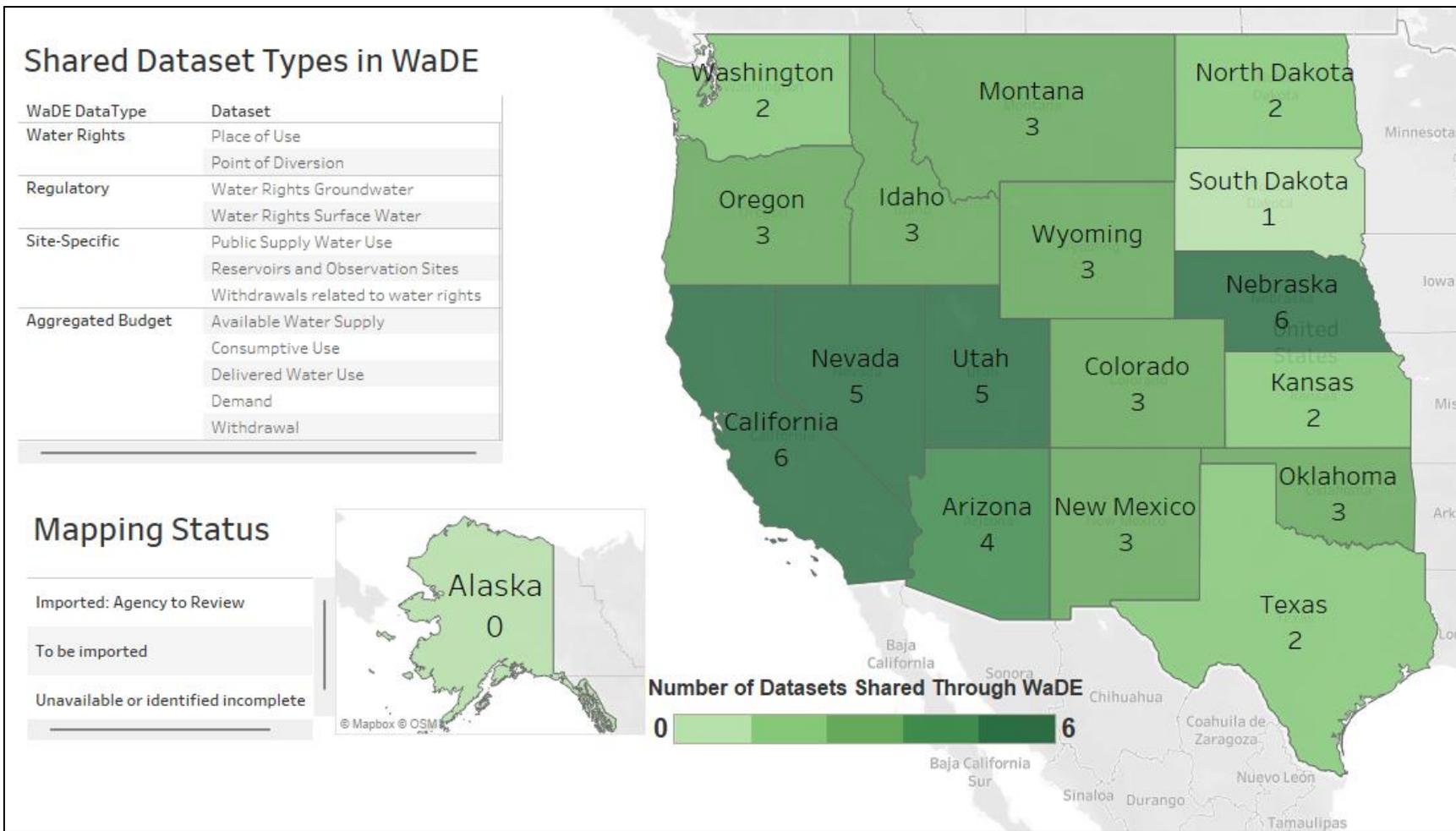
**Table 1:** Summary of Data Types and Datasets in WaDE (12 Datasets)

#	Data Type	Dataset
1	Water Rights	Point of Diversion
		Place of Use
2	Regulatory Overlays	Water Rights Surface Water
		Water Rights Groundwater
3	Site-Specific	Reservoirs and Observation Sites
		Public-Supply Water Use
		Withdrawals related to water rights
4	Aggregated Budget	Consumptive Use
		Delivered Water Use
		Demand
		Available Water Supply
		Withdrawal

<sup>9</sup> The Western Water Data Access and Analysis Tool WestDAAT: <https://westdaat.westernstateswater.org>

<sup>10</sup> WaDE Prototype Preview Page: <https://westernstateswater.org/wade-prototype-preview-page/>

<sup>11</sup> WaDE 2.0 State-By-State Data Sharing Status Dashboard [https://public.tableau.com/app/profile/wswc/viz/WaDE2\\_0\\_Shared\\_Datasets/Reports\\_snapshot?publish=yes](https://public.tableau.com/app/profile/wswc/viz/WaDE2_0_Shared_Datasets/Reports_snapshot?publish=yes)



**Figure 2:** Number of unique water datasets shared through WaDE across the WSWC States<sup>12</sup>

<sup>12</sup> Number of water datasets shared through WaDE across the WSWC States dashboard:  
[https://public.tableau.com/app/profile/wswc/viz/WaDE2\\_0\\_Shared\\_Datasets/NumberOfSharedDatasets?publish=yes](https://public.tableau.com/app/profile/wswc/viz/WaDE2_0_Shared_Datasets/NumberOfSharedDatasets?publish=yes)

### 3.1 Water Rights Data with Points of Diversions and Places of Use

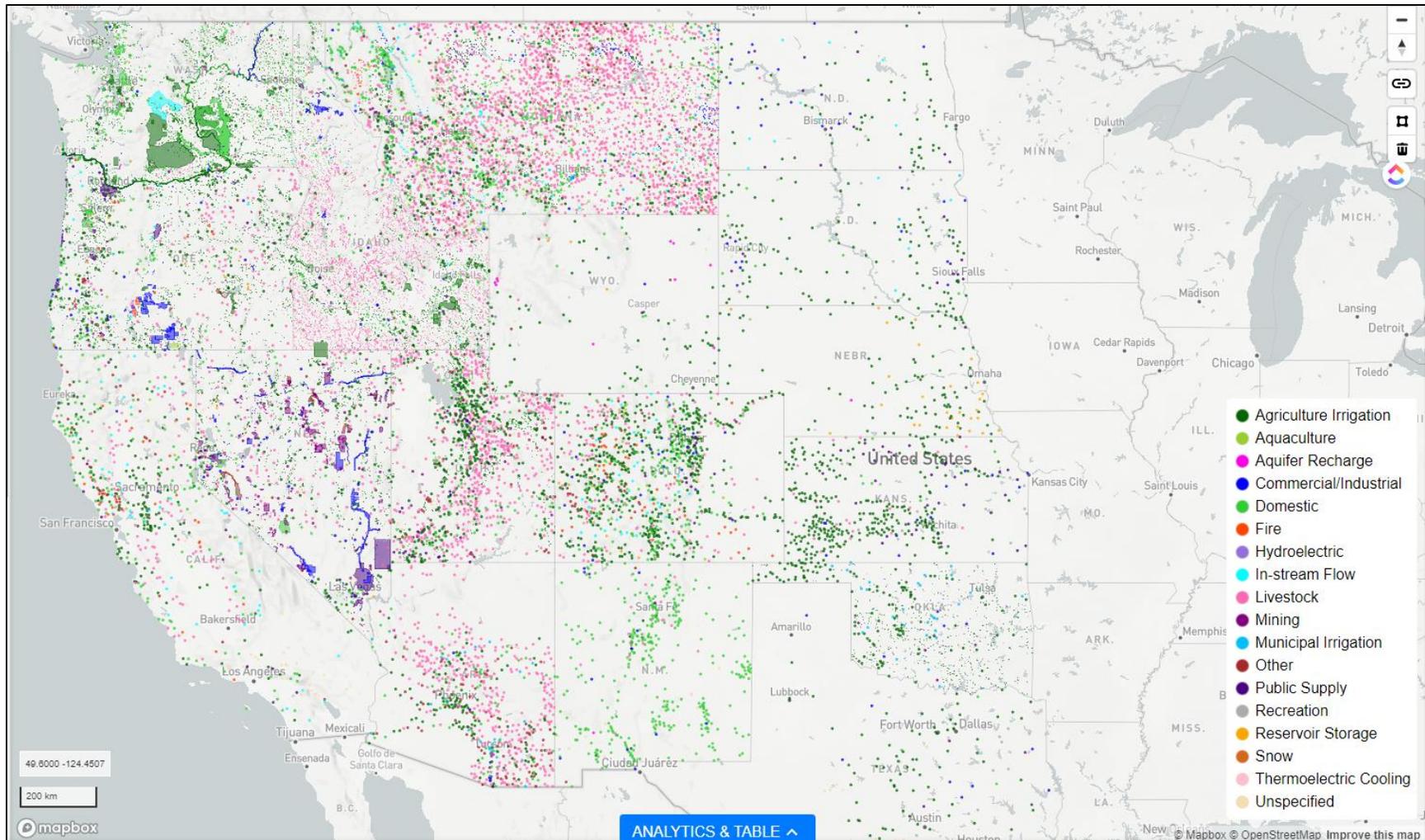
Seventeen States are able to share water rights with points of diversion (POD) data through WaDE (see Figure 3), which is available for interactive queries online through WestDAAT.<sup>13</sup> Alaska's water rights data are publicly available with key metadata such as priority date to be shared soon. New Mexico, Texas, and Wyoming datasets are still a work in progress, with more metadata pending. The Texas Commission on Environmental Quality is in the process of reviewing its water rights data especially in the Rio Grande River Basin. The New Mexico Office of State Engineer does not yet have a priority date and quantity associated with their machine-readable POD data layer. The Wyoming Office of State Engineer does not yet have water rights for livestock publicly available.

Nine States have shared digitized point-of-use (POU) geospatial layers through WaDE: Arizona, Idaho, Montana, Nevada, Oklahoma, Oregon, Utah, Washington, and Wyoming. The remaining States of California, Colorado, Kansas, Nebraska, North Dakota, South Dakota, New Mexico, and Texas do not yet have digitized POU geospatial layers available. The WaDE data system does not include water rights managed by Tribal water agencies, such as the reservations in the Four-Corners region.

The WaDE team continues to revise the metadata of water rights as more updates become available. For example, the WaDE team will add a weblink for each water right directing users to each States' online scanned document containing all information about the water right. Texas and Utah have such online documents, and the WaDE team will continue to review other States' capabilities in this regard.

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<sup>13</sup> Western States Water Data Access and Analysis Tool (WestDAAT): <https://westdaat.westernstateswater.org/>



**Figure 3:** Screenshot map showing water rights data shared through WaDE with Points of Diversion (POD) and Places of Use (POU) colored by beneficial uses category.<sup>14</sup> Dark green is for agriculture, while pink is for livestock.

<sup>14</sup> Western States Water Data Access and Analysis Tool (WestDAAT): <https://westdaat.westernstateswater.org/>

## 3.2 Regulatory Area Overlays

The WaDE System has imported publicly-available regulatory area overlays with geospatial boundaries and metadata that describe specific regulations applicable to either surface water or groundwater use for California, Kansas, Nebraska, Nevada, and Oklahoma. Additional publicly-available datasets have been identified for Arizona, New Mexico, Oregon, Texas, and Washington. The WaDE team will continue to work with other States to evaluate their data and import it into the WaDE database whenever available in machine-readable formats. Work to index these geospatial layers with PODs within the WaDE database is in progress. Such data indexing will allow querying water rights efficiently within any regulatory boundary, such as basins or aquifers closed to further allocations.

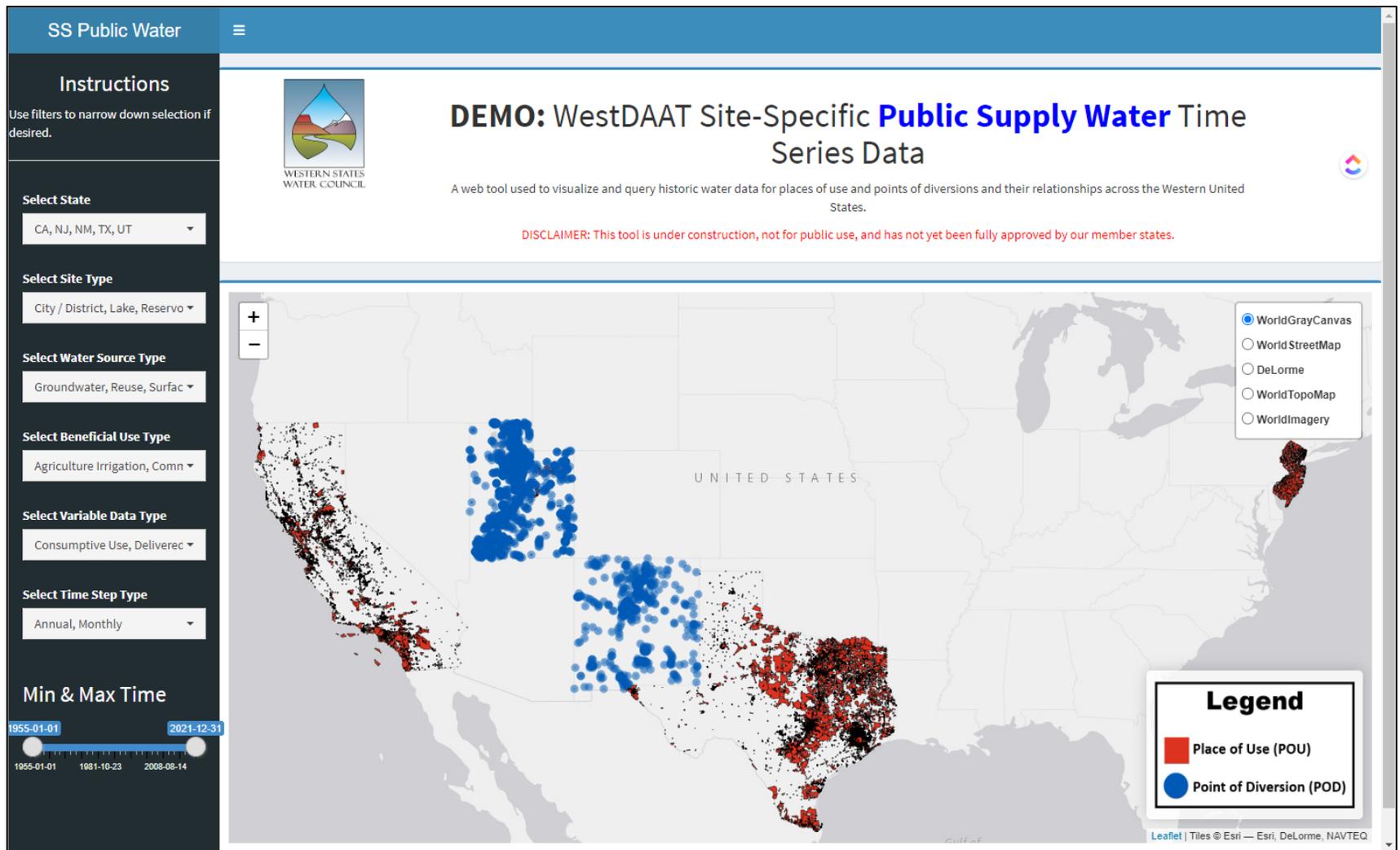
## 3.3 Site-Specific Time Series Data

Site-specific time series data have been grouped into the following three categories:

- Public Supply Water Use refers to the reported deliveries to urban water service areas (the POU) along with the water source (also known as intake) as PODs. Available "public supply" data have been imported for California, New Jersey (as other States share data using WaDE's architecture), New Mexico, Texas, and Utah. New Mexico and Utah have both POU and PODs, while California only has POU. Next, the WaDE team plans to revise Texas data by relating service areas with their intake locations, which were recently made publicly available (Figure 4). The WaDE team will continue to evaluate other states' capabilities in sharing this type of data. In the meantime, the WaDE team is collaborating with the U.S. Geological Survey (USGS) Water Availability and Use Science Program on a pilot water-use data-sharing project to share this data with their Program for the National Water Use Census.<sup>15</sup>

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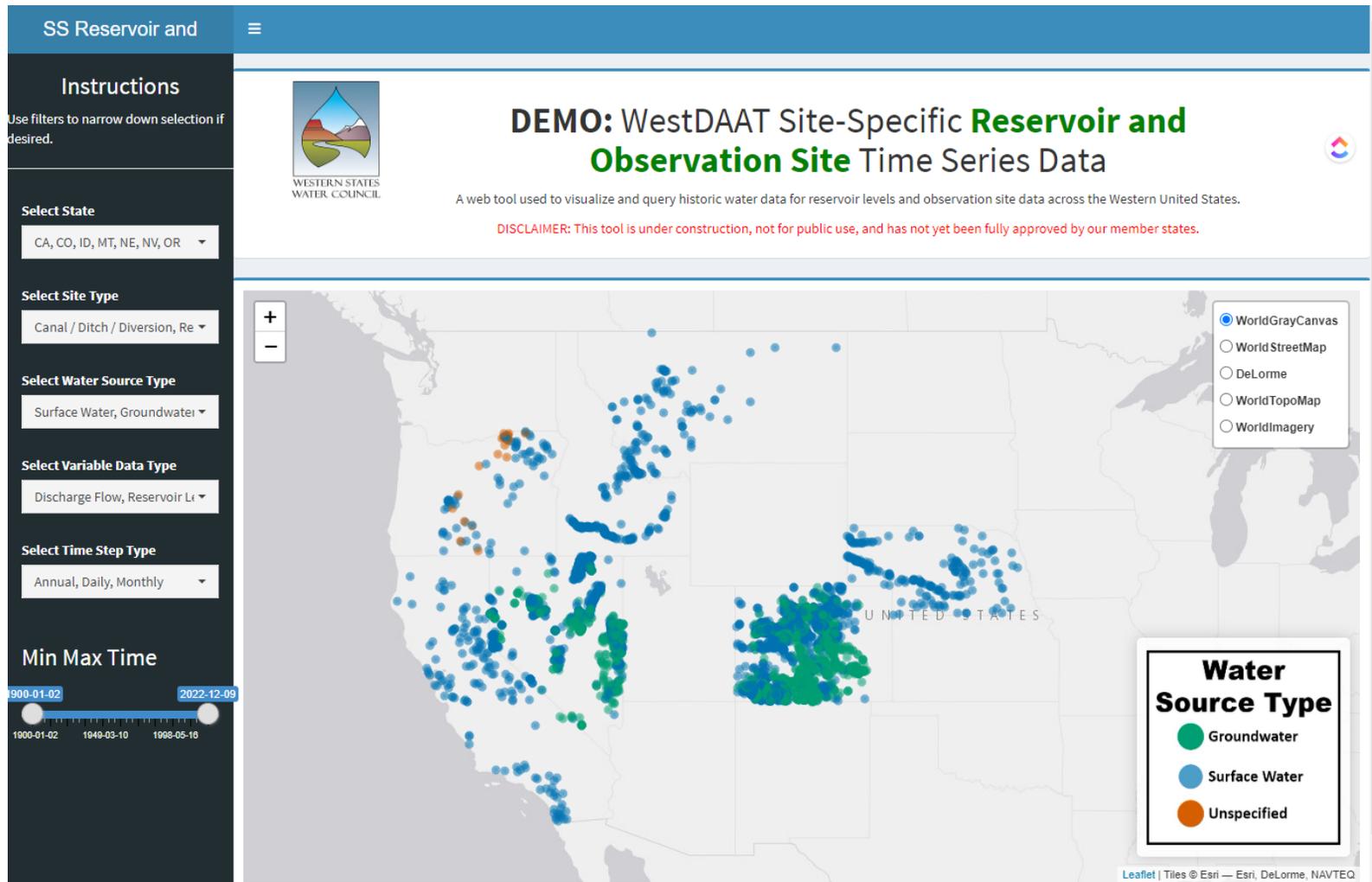
<sup>15</sup> WaDE Pilot Water Use Data Sharing Project with USGS: <https://westernstateswater.org/wade-updates/2022/wade-pilot-water-use-data-sharing-project-with-usgs/>



**Figure 4:** Prototype RShiny App showing imported site-specific time series water use data into WaDE with filters to query data on the left.<sup>16</sup> Each POD (blue) or POU (red) has a landing page with water use data and metadata. Both New Mexico and Utah have red POU areas that are covered over by PODs (blue)

<sup>16</sup> Prototype RShiny App for Site-Specific Public Supply Water Time Series Data:  
<https://waterdataexchangewsc.shinyapps.io/SiteSpecificPublicSupplyWaterDemo/>

- Reservoir and Streamgage Data refer to the historic water flows or volumes by gage stations that States operate year-round or seasonally. This data is separate from streamflow information gathered through federal agencies such as USGS or the U.S. Bureau of Reclamation. Publicly available state time series data have been imported for California, Colorado, Idaho, Montana, and Nevada (Figure 5). The WaDE team identified machine-readable datasets to be imported next for Utah and Wyoming. New Mexico has streamgage data to be offered in machine-readable formats. Texas has reservoir data available and is to be imported to the WaDE database. WSWC will continue working with the rest of its Member States to share their datasets through WaDE as they become publicly available.



**Figure 5:** Prototype RShiny App for showing imported site-specific reservoir and observation site time series data with filters on the left to query data.<sup>17</sup> Color circles in the legend indicate the water source type being measured. Unspecified site types indicate that the water source being measured was not provided.

<sup>17</sup> Prototype RShiny App Site-Specific Reservoir and Observation Site Time Series Data:  
<https://waterdataexchange.swc.shinyapps.io/SiteSpecificReservoirAndObservationSiteDemo>

- Withdrawals Related to Water Rights Data refer to the historic measurements made at the PODs or withdrawals linked to water rights data. WSWC is working on importing such data for California and North Dakota. WSWC will continue to work with other member States to evaluate their capability to share this data.

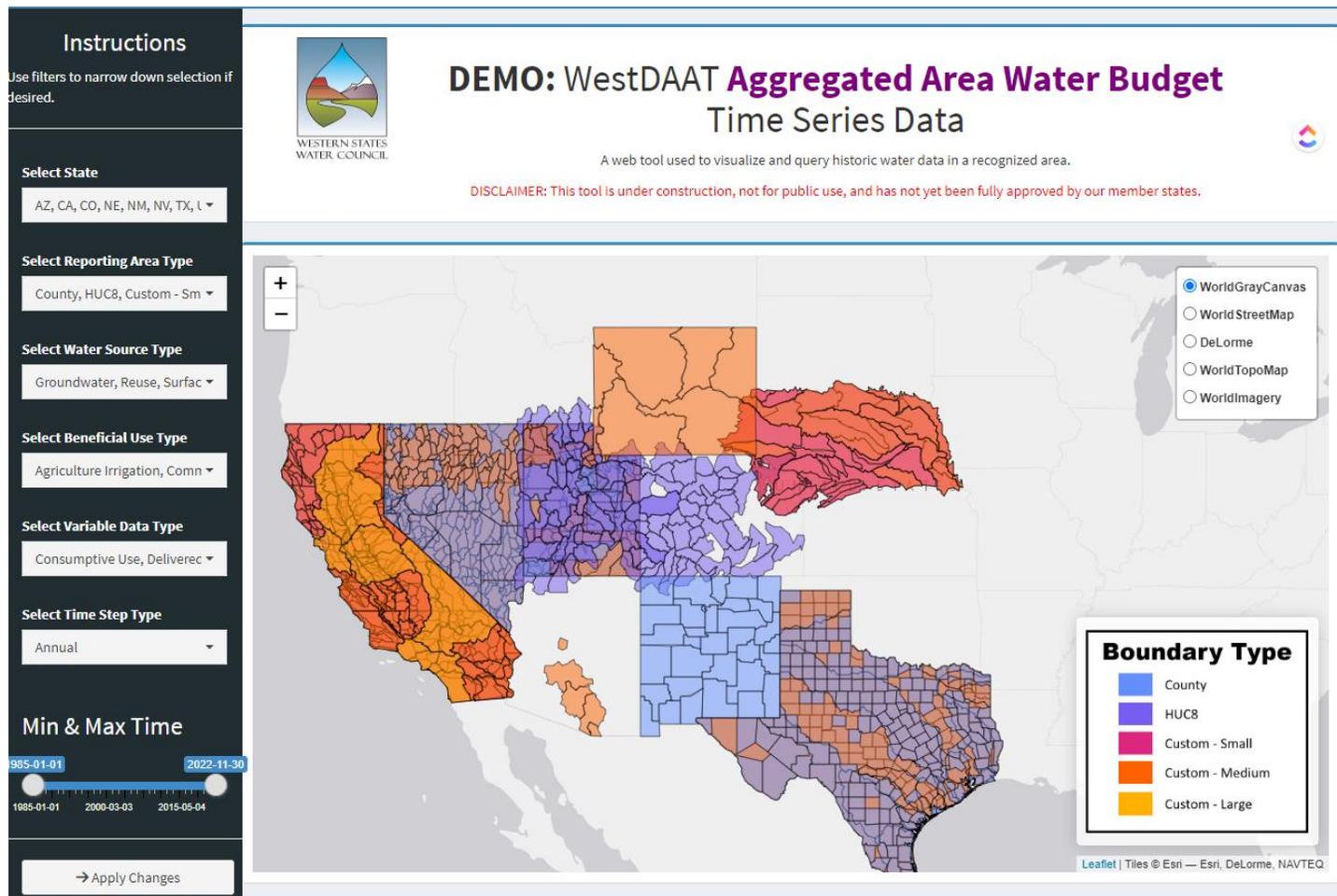
### 3.4 Aggregated Water Budget Data

Aggregated Water Budget Data is modeled and observed data that summarize inflows and outflows into the following five distinct components (i.e., categories) within a geospatial boundary such as county or watershed: available supply, demand, withdrawal, delivered water, and consumptive use. Publicly available data for one or many of these categories have been imported for: Arizona, California, Colorado, Nebraska, Nevada, New Mexico, Texas, Utah, and Wyoming (Figure 6).<sup>18</sup> Idaho, Montana, Oregon, and Washington do not have aggregate water budget data available. Next, WaDE will import North Dakota water budget data and continue to work with the rest of our Member States to share their data as it becomes available.

The most notable data gap in the aggregate water budget category is consumptive use which is an irrecoverable loss from water diverted or withdrawn and not returned to the hydrologic system. Consumptive use is often associated with irrigated agriculture, where water is lost via plant growth through evapotranspiration. Consumptive use for agriculture is often modeled using remote sensing and remains unavailable across most States. Available consumptive use data have only been imported for California, Nebraska, Utah, and Wyoming. States may have consumptive use data that is not publicly available either due to incompleteness, inaccuracy concerns, or sensitivity related to interstate compact administration.

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<sup>18</sup> Prototype Dashboard for Aggregated Area Water Budget Time Series Data  
<https://waterdataexchange.wswc.shinyapps.io/AggregatedBudgetWaterUseDemo/>



**Figure 6:** States sharing aggregate water budget data, which include one or many of the following components: supply, demand, withdrawal, delivered water, and consumptive use annual time series data.<sup>19</sup> The overlapping shapes or polygons are for different reporting boundaries within the same area. The left sidebar offers filters that narrow down the search by parameters such as water source type. Blank areas, such as in Arizona or Colorado do not have data.

<sup>19</sup> WaDE 2.0 State-By-State Data Sharing Status Dashboard  
[https://public.tableau.com/app/profile/wswc/viz/WaDE2\\_0\\_Shared\\_Datasets/DataSharingStatus?publish=yes](https://public.tableau.com/app/profile/wswc/viz/WaDE2_0_Shared_Datasets/DataSharingStatus?publish=yes)

## 4. Summary of Major State Capabilities – Updates/Changes

Summarized below are the following key findings for WSWC Member States' capabilities in sharing water data under four categories: (1) Information Technology; (2) Data Collection and Sharing; (3) State Legislation, Funding, and Initiatives; and (4) National and Regional Water Data Integration Efforts.

### 4.1 Information Technology

- The 2014 WSWC States Capabilities report was focused on Information Technology (IT) services, such as databases and programming languages that the States were using to manage their water data. Since then, cloud-based data management capabilities have emerged and improved significantly. As a result, the States' focus has shifted to data and metadata-sharing content through web services that work with a diverse set of existing back-end IT services.
- Geospatial data management technology and sharing have become relatively easier to use. ArcGIS Online "software-as-a-service" (SAAS) was first introduced in 2012 as a cloud solution to manage and share geospatial data.<sup>20</sup> A decade later, all WSWC Member States use ESRI ArcGIS Hub to share their datasets and maps online, except for Oregon and North Dakota, which use custom online services. In comparison, in 2014, only Idaho reported using the ESRI ArcGIS Hub to share its water data. ArcGIS Online appears to have overcome initial challenges related to security, cost, training, and States' policies, which were previously highlighted as barriers to cloud use adoption.
- In 2018 WSWC prepared a report on how WSWC States increasingly started using cloud services called: Western State Water Resources Agency Use of Cloud Computing Technology & Platforms.<sup>21</sup> The report findings informed the WaDE Program's second phase by updating its architecture to rely on States cloud-based data services.
- Almost all the WSWC States have dedicated webpages (data hubs or portals) that serve or catalog water data with missions that focus on "making informed decisions," "transparency," "public service," and "reliable data." However, when multiple agencies are the stewards of different water datasets, a data hub within a single agency does not include all state water data. For example, the "Utah's Open Water Data" hub is limited to datasets within the Division of Water Resources, while the Division of Water Rights maintains separate datasets. In contrast, the New Mexico Water Data Hub is an example of a collaborative effort to share and integrate water data across five agencies within the same State. The "Texas Water Data Hub" is under development to create an intuitive system to index, document, search and access Texas water data across State agencies. Likewise, the California Water Data Consortium is a partnership working on a centralized water data hub for all California agencies.<sup>22</sup> WSWC created a simple Tableau dashboard (Appendix A – Table 2) that provides access to these hubs and their mission statements where States can learn from others.<sup>23</sup>

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<sup>20</sup> The Indispensable Guide to ArcGIS Online Presented by SSP Innovations, LLC [https://sspinnovations.com/wp-content/uploads/2018/05/SSP\\_Innovations-ArcGIS\\_Online\\_eBook-FINAL.pdf](https://sspinnovations.com/wp-content/uploads/2018/05/SSP_Innovations-ArcGIS_Online_eBook-FINAL.pdf)

<sup>21</sup> Western State Water Resources Agency Use of Cloud Computing Technology & Platforms: <https://www.westernstateswater.org/wp-content/uploads/2018/10/States-Use-of-the-Cloud-Final-October-2018.pdf>

<sup>22</sup> California Water Data Consortium: <https://cawaterdata.org/>

<sup>23</sup> Western States Water Data Hubs Tableau Dashboard [https://public.tableau.com/app/profile/wswc/viz/States\\_Water\\_Data\\_Hubs/WaterDataHubs?publish=yes](https://public.tableau.com/app/profile/wswc/viz/States_Water_Data_Hubs/WaterDataHubs?publish=yes)

- The WSWC's 2014 report focused on water availability which was of interest to a Sandia National Lab study evaluating future energy and water use in the West.<sup>24</sup> Estimating regional water availability was challenging mainly due to the lack of consistent consumptive water use estimates.
- Nearly all WSWC member states have online water use reporting forms or tools. Oklahoma, Idaho, and Montana allow paper-based reporting only. Most of the online tools include login-based accounts with built-in quality assurance/quality control (QA/QC) checks that help verify reported numbers, flag possible incorrect reports and compare them to permitted water rights and previously reported use. The States continue to improve these tools by making them easier to use and better able to detect water use reporting errors. Table 3 (in Appendix A) provides links to these reporting tools and forms.<sup>25</sup>

#### 4.2 Data Collection and Sharing

- Geospatial data for withdrawal sites, gage stations, reservoirs, and municipal service area boundaries are more publicly available, but there is a gap in related time-series data and collection. While States have dedicated water data hubs, some States have not cataloged geospatial data files online within their hubs. Some States share duplicate files across two agencies, complicating the identification of the authoritative source. For example, there are two identical "culinary service areas" geospatial files at two agencies in the State of Utah.
- Consumptive use estimates and reporting remain a significant data gap for most States. The availability of satellite-based evapotranspiration (ET)<sup>26</sup> data for irrigated agriculture, forests, rangelands, and wetlands has been used extensively. The State of Idaho was a pioneer in the use of the National Atmospheric and Space Administration (NASA) thermal infrared (TIR) imagery from the Landsat program to measure ET and related consumptive use. The OpenET project<sup>27</sup> is expected to accelerate such remote sensing applications and help fill this consumptive use gap over the next decade. For example, Oregon is collaborating with the OpenET project to estimate the consumptive use of irrigated agriculture fields. While irrigation is the leading use of water (85%), the Oregon Water Resources Department does not have an operational method for estimating ET or consumptive use from irrigated agriculture. In addition, in June 2022, the four Upper Colorado River Basin States of Colorado, New Mexico, Utah, and Wyoming agreed to estimate consumptive water use with Google Earth Engine implementation of the automated Mapping Evapotranspiration at high Resolution using Internalized Calibration (eeMETRIC).<sup>28</sup> This landmark agreement may serve as an example for other interstate consumptive water use estimates in the West.
- Aggregate water budget data availability varies from state to state. While this data was the focus of the WaDE early on, there is a need for more site-specific time-series withdrawals and consumptive use data, together with more precise water supply data, to estimate aggregate water supply and use budget data at different spatial scales. Consumptive use again remains a significant gap in water budget models.

<sup>24</sup> Mapping water availability, projected use and cost in the western United States: <https://doi.org/10.1088/1748-9326/9/6/064009>

<sup>25</sup> See Appendix A

<sup>26</sup> What is Evapotranspiration? <https://openetdata.org/what-is-evapotranspiration/>

<sup>27</sup> OpenET- Filling the Biggest Data Gap in Water Management: <https://openetdata.org/>

<sup>28</sup> Resolution for Consumptive Use Measurement in the Upper Colorado River Basin – Adopted June 14th, 2022: <http://www.ucrcommission.com/consistent-consumptive-water-use-measurement-for-agricultural-irrigation-in-the-upper-colorado-river-basin/>

- Collecting and sharing site-specific time series water use or withdrawal, delivery, or diversion data has improved, but gaps remain in processing such data and sharing it online in machine-readable formats.<sup>29</sup> Similarly, only a few States' datasets relate site-specific diversion information with their water rights, such as California and North Dakota. In Colorado, data about the quantity of water diversions are not directly tied to water rights. More work remains to evaluate other States' datasets.

### 4.3 State Legislation, Funding, and Initiatives

- State legislative authorizations and requirements have improved States' capabilities in collecting and sharing water use data. Recent notable updates include the California Sustainable Groundwater Management Act (2014),<sup>30</sup> Utah Legislative Water Audit (2015),<sup>31</sup> California Open and Transparent Water Data Act (2016),<sup>32</sup> New Mexico Open Water Data Act (2019),<sup>33</sup> and Oregon Water Package Legislative funding (2021).<sup>34</sup> The WSWC WaDE Program (2011) has been assisting WSWC member States in publicly sharing water rights, allocation, supply, and use data through a common streamlined and standardized service to enable regional analyses to inform water resources planning and policies.
- The States of California,<sup>35</sup> New Mexico,<sup>36</sup> and Texas<sup>37</sup> have organized statewide stakeholder workshops to discuss their water data needs and inform planning and decision-making. The workshops resulted in reports documenting use cases that summarize the context of data needs and how users wanted to use such data. Use cases are very effective in communicating those needs to technical developers. In 2018, WSWC created a use case repository through a Tableau dashboard that summarizes and categorizes the identified use cases for California and Texas.<sup>38</sup> These use cases helped inform WaDE's 2.0 use case development with a focus on data integration across States agencies within each State.
- The 2014 WSWC report highlighted that "*one of the most fundamental issues needing to be addressed is simply to find a common set of definitions, terms, and methods for water planning program tasks that should be included in WaDE.*" Since then, the WSWC States have made significant progress in publicly documenting and sharing their glossaries. In 2020, the WSWC and the Internet of Water (IoW) collaborated on a glossaries project called "Coming to Terms" as part of the IoW's Water Terminology Collection.<sup>39</sup> The project developed a tool that tracks definitions, synonyms, and homonyms of water-related terms used by public agencies.

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<sup>29</sup> See Appendix A.

<sup>30</sup> Cal. Water Code § 10720 et seq.

<sup>31</sup> A Performance Audit of Projections of Utah's Water Needs: [https://water.utah.gov/wp-content/uploads/2019/01/2015\\_01\\_Report\\_A-Performance-Audit-of-Projections-of-Utahs-Water-Needs.pdf](https://water.utah.gov/wp-content/uploads/2019/01/2015_01_Report_A-Performance-Audit-of-Projections-of-Utahs-Water-Needs.pdf)

<sup>32</sup> Cal. Water Code § 12400 et seq.

<sup>33</sup> N.M. Stat. § 72-4B-1 et seq.

<sup>34</sup> Oregon Legislature Passes Landmark Water Package:

<https://www.oregonlegislature.gov/courtney/Documents/2021-Water-Package-Release.pdf>

<sup>35</sup> Data for Water Decision Making Informing the Implementation of California's Open and Transparent Water Data Act through Research and Engagement Download PDF Data for Water Decision Making. January 2018

<https://www.law.berkeley.edu/wp-content/uploads/2018/01/DataForWaterDecisionMaking.pdf>

<sup>36</sup> A Summary of Stakeholder Perspectives on New Mexico's Water Resources and Data Needs. August 2021

[https://newmexicowaterdata.org/wp-content/uploads/2021/08/StakeholderPerspectives\\_August2021.pdf](https://newmexicowaterdata.org/wp-content/uploads/2021/08/StakeholderPerspectives_August2021.pdf)

<sup>37</sup> Connecting Texas Water Data Workshop: Building an Internet for Water. April 2018

[https://libguides.tamusa.edu/ld.php?content\\_id=42020932](https://libguides.tamusa.edu/ld.php?content_id=42020932)

<sup>38</sup> WSWC Use Case Repository Dashboard

[https://public.tableau.com/app/profile/wswc/viz/UseCaseRepoDashboard\\_Google\\_0/SearchUseCasesByCategories](https://public.tableau.com/app/profile/wswc/viz/UseCaseRepoDashboard_Google_0/SearchUseCasesByCategories)

<sup>39</sup> Coming To Terms: <https://internetofwater.org/resources/coming-to-terms/>

WSWC identified, summarized, and categorized glossaries for its member States.<sup>40</sup> One WSWC-identified challenge is that glossaries are often scattered across several agencies and web pages within a single State.<sup>41</sup>

#### 4.4 National and Regional Water Data Integration Efforts

- The USGS Water Use Data and Research Program (WUDR)<sup>42</sup> was established in the Fiscal Year 2015 with appropriations funding authorized by Section 9508 of the 2009 SECURE Water Act.<sup>43</sup> The WUDR program established general guidelines for site-specific water use data collection and sharing priorities and authorized financial assistance to state water resource agencies to develop plans to reduce water use data gaps.<sup>44</sup> Since then, WUDR has funded 16 WSWC States for developing work plans using the non-competitive \$26,000 grants. Additionally, 13 of those States received funding out of the competitive grants (maximum of \$250,000 per state for a 1-2 year work deadline) to improve the availability, quality, compatibility, and delivery of water-use data. Staffing shortages or time-consuming grant administration were reported as major challenges. Colorado and South Dakota have not applied for WUDR grants. Arizona, California, and Wyoming only received a small portion of the grant limit per state due to the same challenges. Kansas, Montana, New Mexico, North Dakota, Oregon, and Texas have used their grant limit. In general, the States with dedicated staff and greater capacity to administer grants in their water use program were in the best position to take advantage of the WUDR grants. In general, the WUDR Program has had a very positive impact on improving states' capabilities to: (1) develop tools that process and perform QA/QC of water-use data; (2) conduct studies that develop data collection methods and coefficients for water use; (3) report site-specific water-use data for public supply, irrigation or industrial use categories.<sup>45</sup>
- An Aspen Institute Dialogue Series and 2017 Report on Sharing and Integrating Water Data for Sustainability invited and involved State representatives from Arizona, Colorado, and Texas, as well as the WSWC's WaDE Program Manager, together with federal agencies, academics, and private and non-governmental agencies. The dialogue led to the further development of an Internet of Water (IoW). The report called for actions to "address one of the country's most pressing challenges: how to improve our water data infrastructure to enable us to more sustainably manage our water resource."<sup>46</sup> The report represents findings and recommendations developed over the course of three scoping sessions and two roundtable

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<sup>40</sup> Western States Water Glossaries Dashboard:

[https://public.tableau.com/app/profile/wswc/viz/IOWStateProgress\\_15783291315810/Snapshot\\_report](https://public.tableau.com/app/profile/wswc/viz/IOWStateProgress_15783291315810/Snapshot_report)

<sup>41</sup> For example, there are water-related glossaries across five Texas agencies and four each in Arizona and Colorado. A shared glossary hub within each state still is needed for consistency in interpreting water data, especially when multiple agencies collect the data. Additionally, the size of the glossaries varies, with a short list of water-related terms in some States **Error! Main Document Only.**– Alaska (100), Kansas (95), Washington (54), while others have more extensive indexes **Error! Main Document Only.**– Texas (688), Utah (488), and Wyoming (1,071). Nevada is exceptional with 6,078 terms that cover all aspects of water planning, chemistry, biology, and law, among others.

<sup>42</sup> Water-Use Data and Research (WUDR) program: <https://www.usgs.gov/mission-areas/water-resources/science/water-use-data-and-research-wudr-program>

<sup>43</sup> Public Law 111–11, Mar. 30, 2009: <https://www.congress.gov/111/plaws/publ11/PLAW-111publ11.pdf>

<sup>44</sup> USGS WUDR Summary of baseline standards for water-use data: <https://www.usgs.gov/mission-areas/water-resources/science/summary-baseline-standards-water-use-data>

<sup>45</sup> WUDR overview and status, with summaries of completed projects [https://water.usgs.gov/wausp/wudr-files/WUDR\\_ProgramOverview\\_20220331.pdf](https://water.usgs.gov/wausp/wudr-files/WUDR_ProgramOverview_20220331.pdf)

<sup>46</sup> Internet of Water: Sharing and Integrating Water Data for Sustainability, The Aspen Institute, 2017. <https://www.aspeninstitute.org/wp-content/uploads/2017/05/Internet-of-Water-Report-May-2017.pdf>

dialogs convened in 2016-2017. Thereafter, the Nicholas Institute at Duke University was tasked with implementing an Internet of Water. As an initial step, the Nicholas Institute convened a series of further conversations through five regional roundtables in California, the Great Lakes Region, the Midwest, Texas, and the Colorado River Basin. A 2019 report, *Internet of Water Revisited*,<sup>47</sup> highlighted the use cases for states, the challenges they face, and opportunities for building an Internet of Water.

- The USGS Water Mission Area and the Internet of Water Coalition have created a water data system that is the backbone of relating and discovering water data across state and federal data providers called Geoconnex. The Geoconnex<sup>48</sup> project provides the technical infrastructure and guidance to create an open, community-contribution model for linking hydrologic features in the United States. When water data are published in accordance with best metadata practices, they can be automatically harvested and indexed to spatial data. Under the Internet of Water principles, those best practices include metadata that are findable, accessible, interoperable, and reusable (FAIR) for public use or authorized users.<sup>49</sup> In Geoconnex, each water feature, such as a point of diversion or place of use, has a permanent unique digital identifier linked to other water features, such as the water source (e.g., river or reservoir, etc.). Thus, Geoconnex is a system for connecting water data from different data providers and displaying it via geographic location. All water features are indexed in the National Hydrography Dataset (NHD) and can be discovered and searched upstream or downstream along the U.S. river network through the Hydro-Network Linked Data Index tool (NLDI).<sup>50</sup> In short, Geoconnex aims to make water data as easily discoverable, accessible, and usable across data providers as much as possible. WSWC is collaborating with the USGS and IoW on this project, and WaDE data is being used as a pioneering data provider on behalf of the Western States. All States' data shared through WaDE are indexed into the Geoconnex project and are discoverable through Geoconnex and the NLDI search tool. Thus, WaDE and the Geoconnex project are enhancing States' data capabilities by linking their data across state and federal agencies (Figure 6).
- The Water Data Act of 2022 (H.R. 7792), introduced in the 117<sup>th</sup> Congress, has the potential to accelerate water use data collection and reporting by improving states' capabilities and investments in dedicated staff and software. The proposed Act would also form a Water Data Council to establish a framework for standardizing water data across federal agencies, so the federal data can be interoperable and easily accessible to States, water managers, and communities.<sup>51</sup> The bill passed the House on July 29, 2022, as Title VI of HR 5118 and was sent to the Senate on August 2, but no further actions were scheduled.

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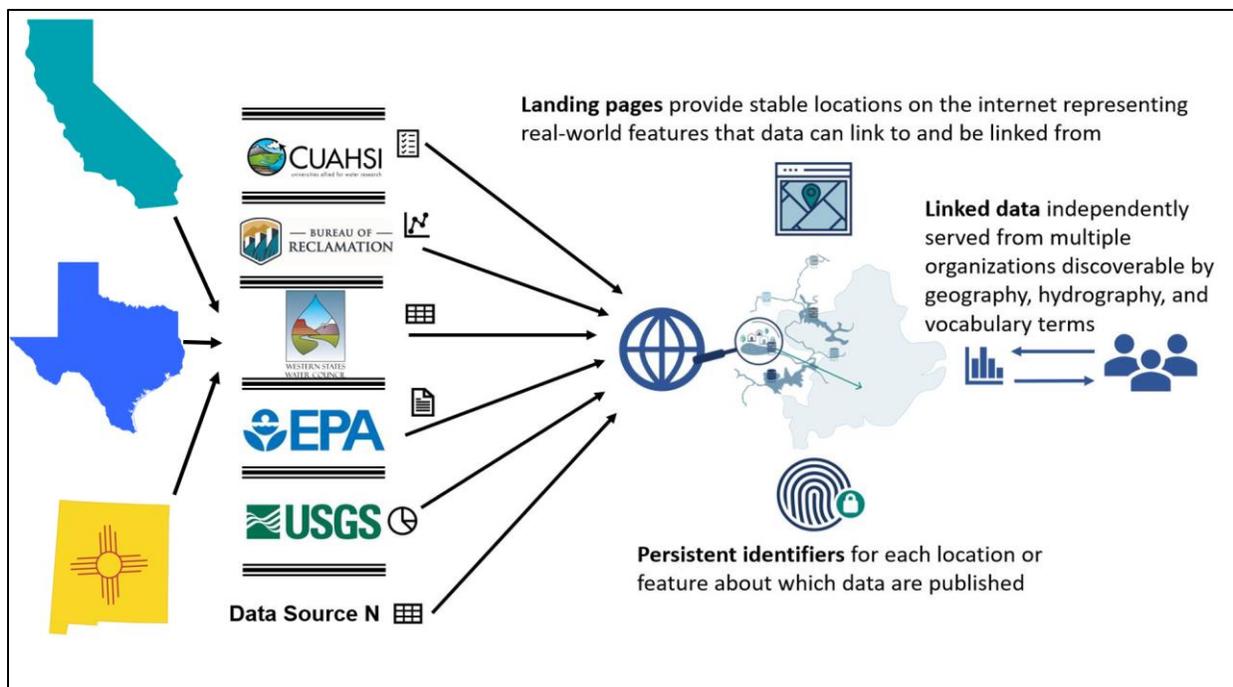
<sup>47</sup> *Internet of Water Revisited: Building an Internet of Water*: <https://www.aspeninstitute.org/publications/internet-of-water-revisited/>

<sup>48</sup> Geoconnex: <https://internetofwater.org/geoconnex/>

<sup>49</sup> Internet of Water Principles <https://internetofwater.org/internet-of-water-principles/>

<sup>50</sup> Hydro-Network Linked Data Index <https://labs.waterdata.usgs.gov/about-nldi/index.html>

<sup>51</sup> WSWC Support for the Introduction of the Water Data Act: <https://westernstateswater.org/wp-content/uploads/2022/08/May-2022-WSWC-Support-Introduction-of-Water-Data-Act.pdf>



**Figure 6:** WaDE is enhancing states' capabilities to connect their data with other providers through the Geoconex Project

# Appendix A: Tables 2 and 3

**Table 2:** Summary of WSWC States' Capabilities in Collecting Water Withdrawal Data from Users. Also accessible through this online interactive dashboard [https://public.tableau.com/app/profile/wswc/viz/States\\_Water\\_Data\\_Hubs/WaterDataHubs?publish=yes](https://public.tableau.com/app/profile/wswc/viz/States_Water_Data_Hubs/WaterDataHubs?publish=yes)

<u>State</u>	<u>Agency</u>	<u>Hub Name</u>	<u>Data or web-service technologies</u>	<u>Mission/statement</u>
Alaska	Alaska Department of Natural Resources	<a href="#">Alaska Department of Natural Resources Open Data</a>	ArcGIS Hub	This is Alaska Department of Natural Resources public platform for exploring and downloading open data, discovering and building apps, and engaging to solve important local issues. Analyze and combine Open Datasets using maps, as well as develop new web and mobile applications.
Alaska	Alaska Department of Natural Resources	<a href="#">Alaska Department of Natural Resources Open Data</a>	Excel	AKWUDS allows water right/authorization holders to submit monthly water use data online and to download data entered into AKWUDS
Arizona	Arizona Department of Water Resources	<a href="#">Interactive Maps and Data</a>	ArcGIS Hub	To give the public access to the Department's vast store of GIS and tabular data.
California	California State Water Resources Control Board	<a href="#">State of California's Open Data Portal</a>	CKAN, OpenGov	The Government Operations Agency sponsors data.ca.gov, a statewide open data portal created to improve collaboration, expand transparency and lead to innovation and increased effectiveness.
California	California Department of Water Resources	<a href="#">California Data Exchange Center</a>	CKAN, Custom Service, REST API, ArcGIS Hub	CDEC provides users access to hydrologic and climate information used to support real-time flood management and water supply needs in California.
Colorado	Colorado Division of Water Resources	<a href="#">Colorado's Decision Support Systems (CDSS)</a>	ArcGIS Hub, REST API	The goal of this system is to assist in making informed decisions regarding the historical and future use of water. Both DWR and CWCB have a hand in developing, managing, and enhancing CDSS tools and models for the major river basins in Colorado. CDSS data is pulled from DWR's HydroBase database.
Idaho	Idaho Department of Water Resources	<a href="#">IDWR GIS Data</a>	ArcGIS Hub	The Idaho Department of Water Resources makes this data available as a public service. The Idaho Department of Water Resources strives to ensure that all technical data and other information made available to the public is accurate, complete, and in compliance with the Idaho Public Records Act.
Kansas	The Kansas Department of Agriculture, Division of Water Resources	<a href="#">Water Information Management and Analysis System (WIMAS)</a>	ArcGIS Hub + Custom Service	The Kansas Department of Agriculture, Division of Water Resources (DWR), and Kansas Geological Survey (KGS) exercises great care in the creation of its Water Information Management and Analysis System (WIMAS) program. However, the DWR or KGS offers no warranty or guarantee of the accuracy or completeness of the WIMAS program and the data contained therein; the DWR or KGS assumes no liability for errors in, interpretation of, or use of these data. Water rights are dynamic and often complex entities. The water rights data used in WIMAS represents the water rights files as of 08/28/2022 and should not be viewed as current. A new water rights data set for the WIMAS program is generated weekly.
Montana	The Montana Department of Natural Resources and Conservation	<a href="#">Open Data Hub from Montana Department of Natural Resources &amp; Conservation</a>	ArcGIS Hub	To help ensure that Montana's land and water resources provide benefits for present and future generations.
Nebraska	Nebraska Department of Natural Resources	<a href="#">The Natural Resources Data Bank</a>	ArcGIS Hub, REST API	The Natural Resources Data Bank, statutorily created in 1969, is administered by the Department of Natural Resources. The purpose of the Data Bank is to develop, store, process, and manage natural resources data

				relating to land and water resources of the State and make the information available to government agencies and the general public in a user-friendly and timely manner.
Nevada	Nevada Division of Water Resources	<a href="#">Nevada Division of Water Resources Open Data</a>	ArcGIS Hub	Connecting people to the environment with data
New Mexico	New Mexico Bureau of Geology and Mineral Resources	<a href="#">New Mexico Water Data</a>	CKAN	A collaborative effort to share and integrate New Mexico's water data for effective water management and planning.
North Dakota	North Dakota Department of Water Resources	<a href="#">ND Department of Water Resources Map Service</a>	Custom Service	variety of different map services
Oklahoma	Oklahoma Water Resources Board	<a href="#">OWRB Open Data</a>	ArcGIS Hub	The OWRB produces and maintains many GIS datasets relating to Oklahoma's water resources. Each dataset contains descriptive metadata documentation and usage limitations.
Oregon	Oregon Water Resources Department	<a href="#">Access Data and Maps</a>	Custom Service	Not available
South Dakota	South Dakota Department of Environment and Natural Resources	<a href="#">Searchable Databases &amp; Lists Directory</a>	ArcGIS Hub + Custom Service	One-stop Shop for DANR Data
Texas	Texas Commission on Environmental Quality	<a href="#">TCEQ GIS Data Hub</a>	ArcGIS Hub	Connecting people to the environment with data
Texas	Texas Water Development Board	<a href="#">Texas Water Data Hub</a>	ArcGIS Hub	The GIS datasets listed below are related to various types of natural features. Although TWDB utilizes this data in our most commonly used maps, some of the datasets were created and are maintained by other state and federal agencies.
Utah	Utah Division of Water Resources	<a href="#">Utah's Open Water Data</a>	ArcGIS Hub	Publicly available data provided by the Utah Division of Water Resources
Utah	Utah Division of Water Rights	<a href="#">GIS Information</a>	Custom Service +ArcGIS Hub	The Division of Water Rights uses Geographic Information System (GIS) technology to manage water right information. Specifically the Division uses ArcGIS software. Links available from this page allow downloading of GIS data and/or output products for use on your own system. In general you must have some type of GIS software to use this information.
Washington	Washington State Department of Ecology	<a href="#">Environmental Information Management System (EIM)</a>	ArcGIS Hub+Custom Service	Our Environmental Information Management System (EIM) contains environmental monitoring data collected by our scientists and partners.
Washington	Washington Office of the Chief Information Officer	<a href="#">Washington Geospatial Open Data</a>	ArcGIS Hub	We will provide efficiency, effectiveness and transparency.
Wyoming	Wyoming Water Development Office	<a href="#">Wyoming Geospatial Hub</a>	ArcGIS Hub	The Wyoming Geospatial Hub aims to serve as the premier web portal to publicly accessible, reliable geospatial and non-geospatial data for the State of Wyoming.

**Table 3:** Summary of WSWC States' Capabilities in Collecting Water Withdrawal Data from Users. Credit to the USGS Water-Use Data and Research (WUDR) coordinator for sharing most of this information.

State	Water sources that the state collects water withdrawal information	Reporting Criteria	Does the state require direct measuring/metering for any sectors?	Time step of data reported Monthly, Annually, quarterly	User account/login-based tool?	Online tools or paper forms
Alaska	SW, GW, Glaciers	Water use reporting is case-by-case; 20 tons of glacier ice in a single day with additional caveats. <sup>1</sup>	PS, TE, MI, HY.	Primarily Monthly, but it can vary	Yes	<a href="#">Online</a>
Arizona	SW, GW, Effluent	15 connections used by year-round residents of the area served or that regularly serve at least 25 people; TE designed to produce 25 megawatts of electricity or more; IR and IN with their own wells	No	Annual	Yes	<a href="#">Online</a> but more complex forms have not been added yet
California	SW, GW, Treated Wastewater, and Ocean water desalination	>15 connections and/or 25 people, surface water reported to SWRCB; For groundwater, Sustainable Groundwater Management Act (SGMA) establishes groundwater service areas (GSA) to determine regulations on reporting. Tribal lands have voluntary reporting.	PS, IR-GC, TE, HY, WW.	Monthly, Water rights report monthly data annually. Meters collect daily data.	Yes	<a href="#">Online</a>
Colorado	SW, GW.	NA	IR, TE, IN, MI, LV, AQ.	Some sites have daily; most have monthly or annual	Yes	<a href="#">Online</a>
Idaho	SW, GW.	Survey sent to PS, CO; IR-CR in Eastern Snake River	All non-domestic groundwater users in the Eastern Snake River Plain Aquifer and all surface-water diversions	GW-annual; SW-daily	No	<a href="#">Paper</a>
Kansas	SW, GW, Treated WW.	All uses excluding non-primary municipal users and Domestic wells are required to report water use, see KSA 82a-701; Livestock and poultry production using 15 acre-feet or more per year.	PS, IN, IR-CR, IR-GC, LI, TE, DO, MI, AQ, CO, WW2, Contamination, Remediation, Thermal Exchange, Hydraulic Dredging, Fire Protection, Recreational, Artificial Recharge, and Dewatering	Annually, Industrial, Public Supply, and Livestock are monthly; site-specific data is at an annual amount; entity/system data are at a monthly amount	Yes	<a href="#">Online</a> ; users can submit their annual water-use report by completing an online or paper form.
Montana	SW, GW.	Reporting requirements fluctuate based on location (basin) and permit	PS, IR-CR, IR-GC, TE, MI, AQ	Varies	No	<a href="#">Paper</a>
Nebraska	SW, GW.	Required for over-appropriated areas, voluntary in others	No	Annually, some monthly	Yes	<a href="#">Online</a>
Nevada	SW, GW, Treated wastewater	Varies	PS, IN, IR-CR, IR-GC, TE, MI, CO, WW.	Monthly	No	<a href="#">Online &amp; Paper</a>
New Mexico	SW, GW.	Permit by permit basis with some standards	No	Annually and sometimes quarterly	Yes	<a href="#">Online</a>
North Dakota	SW, GW	DO/LI: 12.5 acre-feet annually Other categories: all water users	PS, IN, IR-CR, IR-GC	Annually with some monthly for PS, IN	Yes	<a href="#">Online and Paper</a>
Oklahoma	SW, GW.	Water use permitting is required for non-domestic and Non-short-term Use of the state's freshwater sources. <sup>7</sup>	No	Annual	No	<a href="#">Paper only</a>
Oregon	SW, GW.	Either water user is a governmental entity (all must report), or for water rights issued after ~1990 for >0.5 CFS diversion rate, or storage of >=9.2 AF.	PS, IN, IR-CR, IR-GC, TE, CO	Monthly	Yes	<a href="#">Online &amp; Paper</a>

South Dakota	SW, GW	Not clear but irrigators are required to report water usage and, to a lesser extent, usage by municipal and rural water systems.	Monthly	Online	No	<a href="#">Online</a>
Texas	Self-Supplied and Purchased volumes for SW, GW, and Reuse	All permitted surface water diversions are reported to TCEQ. For the Water use survey: 1) active community public water systems, 2) power generating plants, and 3) manufacturing and mining water users that annually use more than 10 million gallons of water or use a significant volume of water for the industrial sector for a particular area of the State.	No, but water uses other than agriculture and self-supplied domestic are largely metered. The TCEQ may require metering under drinking water regulations <sup>9</sup>	Monthly	Yes	<a href="#">Online &amp; Paper</a>
Utah	SW, GW.	Public suppliers, commercial and industrial users statewide; Secondary Water in most populous counties	PS.	Annually	Yes	<a href="#">Online</a>
Washington	SW, GW.	Varies by time period <sup>13</sup>	Variable	Variable	Yes	<a href="#">Online</a>
Wyoming	SW, GW.	Reporting requirements fluctuate based on location (basin) and type of water permit	Some diversions are metered	Varies	Yes	<a href="#">Online</a>

Key: SW, Surface water; GW, Groundwater; PS, Public supply; IN, Industrial; IR-CR, Irrigation-Crop; IR-GC, Irrigation-Golf course; LI, Livestock; TE, Thermoelectric; MI, Mining; AQ, Aquaculture; CO, Commercial; HY, Hydroelectric; WW, Wastewater returns; CCPCUA, Central Coastal Plain Capacity Area; SDWIS, Safe Drinking Water Information System; AFY, acre-feet per year; AF, acre-feet; CFS, cubic feet per second