

*New Mexico Water Data Initiative and Regional Pilot Project for
Improved Data Management and Decision Support Tool in the
Lower Pecos Valley*

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Table of Contents

Attachment 1	
TECHNICAL PROPOSAL	1
Executive Summary	1
Technical project description and milestones	1
Introduction	2
Part 1. Water Data Initiative.....	3
Part 2. Pilot project - Improved Data Management and Decision Support Tool for the Lower Pecos Valley	7
Project location	9
Data management practices.....	11
EVALUATION CRITERIA	11
Evaluation Criterion A — Benefits to Water Supply Reliability	11
Evaluation Criterion B — Need for Project and Applicability of Project Results	13
Evaluation Criterion C — Project Implementation	14
Evaluation Criterion D — Dissemination of Results.....	18
Evaluation Criterion E — Department of the Interior Priorities	19

Project Budget – Attachment 2

Letters of Participation – Attachment 3

Staff expertise (resumes) – Attachment 4

TECHNICAL PROPOSAL

Executive Summary

This proposal for a pilot water data delivery project in the Pecos Valley of New Mexico is submitted under the WaterSMART proposal under Project Category 4, in support of the Bureau of Reclamation goal of improving “access to and use of water resources data.” This application for funding is submitted on October 29, 2019 by Stacy Timmons, project manager and Associate Director, Hydrogeology Programs at the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) at New Mexico Institute of Mining and Technology (NMT or NM Tech) in Socorro County, Socorro, New Mexico. The NMBGMR and its partners propose to develop a federated water data delivery service for New Mexico, known as the Water Data Initiative (WDI), in accordance with the New Mexico Water Data Act. The NMBGMR is applying for this grant to leverage non-federal funding and concurrent activities to build a water data pilot project and decision support tools. Grant funds requested in this proposal will build from the WDI and support the development and implementation of a pilot project for improving management of local groundwater and surface water data in the lower Pecos Valley. Datasets will be obtained from multiple sources including partner groups on this proposal. The pilot project will then become a model for regional data integration and tool development for other regions of New Mexico (supporting the statewide WDI), and the West, for improved water resource management and decision making. The Water Data Initiative with the proposed pilot project will improve accessibility of hydrologic information and provide improved water management tools by creating more efficient data collection, data ingestion, and data management processes, as well as providing usability of these data for the regional water managers and state managers through application of open data principles. By improving access to and use of water supply data, this applied science proposal is in support of water supply reliability, improved management of water deliveries, drought management activities, water rights administration, and conservation and efficiency of water supply goals for the state and the proposed pilot project region. The project time length will be three years from the date of funds award. For planning purposes, the estimated completion date is March 31, 2023. The project will not be located on a Federal facility.

Technical project description and milestones

This project in Category 4, aims to improve access to and use of water resources data, or to develop new types of data to inform water management decisions. The applicant, the New Mexico Bureau of Geology and Mineral Resources (a division of New Mexico Institute of Mining and Technology), is a category B applicant, as a university/ non-regulatory state agency. As required for category B applicants, there are numerous partners in this application who are category A, as described in Table 1, below.

Table 1. Applicant and Partner Categories.

Applicant or Partner	Category
Applicant: New Mexico Bureau of Geology and Mineral Resources at New Mexico Tech	B - University/Non-regulatory State Agency
Partner: Pecos Valley Artesian Conservancy District	A - Irrigation District
Partner: New Mexico Office of the State Engineer	A - State Agency
Partner: New Mexico Interstate Stream Commission	A - State Agency
Partner: Sandia National Laboratory	B – Federal / research
Partner: Internet of Water	B - University/Non-Profit
Partner: University of New Mexico - Earth Data Analysis Center	B - University/Non-Profit

Introduction

The work is proposed in two parts. The first part consists of the existing, ongoing statewide activity of the New Mexico Water Data Initiative (WDI). New Mexico is building a water data service from which to host regional and state-level water data, including federal water data. The purpose of the WDI is to make state data findable, accessible, interoperable, and reusable (FAIR). The data service is intended to provide a mechanism for a federation of independently hosted water data. This is a necessary framework that will support pilot data accessibility projects, and will meet the non-federal cost match requirement of the grant, as described below and in the budget section.

The second part will build a pilot project, leveraging the framework of the WDI (which includes a Water Data Service (WDS)), to address specific regional water management challenges. This pilot project will develop water-data tools needed in the region of the lower Pecos River, with the partnership of the Pecos Valley Artesian Conservancy District, the Interstate Stream Commission, the Office of the State Engineer, and other interested parties in the local area. The purpose of these tools will be to enhance short- and long-term water management for irrigation, river flow for endangered species, interstate compact compliance, and other uses within the Conservancy District. In order to develop decision-support tools, a necessary first step is to bring interested groups together to discuss and agree on the data needs. The known data needs are diverse and include more efficient basic data collection, improving the current data management practices and platforms, streamlining data ingestion, and creating visual tools that can better inform decisions in the district. The pilot project will then feed knowledge and information to the broader WDI, providing a road map that can be modified and applied for other regional challenges in New Mexico.

These two parts of this proposal are described in further detail below.

Part 1. Water Data Initiative

In New Mexico, the ability to grow our economy and to support our citizens and our environment rests on a fundamental issue: water availability. As the most drought-vulnerable state in the nation according to World Resources Institute¹, New Mexicans are acutely aware of the need to account for every drop of usable water. As in many states, however, our water systems have developed in a haphazard way, with no strong central mechanism for accounting for or understanding the extent and quality of our water resources. The Water Data Initiative (WDI) described below is intended to create an environment supporting open, accessible, understandable, and useful water data for New Mexicans and others.

In response to the need to improve our water resource management systems, the New Mexico Legislature passed House Bill 651, the Water Data Act, in 2019. As signed by the Governor, the act designates the Bureau of Geology and Mineral Resources (NMBGMR) of the New Mexico Institute of Mining and Technology (NM Tech or NMT) to convene the effort, with partnership from the Interstate Stream Commission (ISC), the Office of the State Engineer (OSE), the Department of the Environment (NMED), and the Energy, Minerals, and Natural Resources Department (EMNRD). The legislation specifically requires this group to: (1) identify key water data, information, and tools needed to support water management and planning; (2) develop common water data standards for data collection; (3) develop an integrated water data and information platform, and (4) identify available and unavailable water data.

A statewide Water Data Service (WDS) developed through this act will, at a minimum, (1) integrate water data managed by state and local entities using consistent and standardized formats; and (2) integrate state and local government water data on streamflow, precipitation, reservoir and irrigation system operations, groundwater use and levels, municipal and industrial water use and land uses, data on water rights, diversions, and quality, data on fish, aquatic and riparian systems, and ecological data. The agencies as convened by the NMBGMR are directed to use common water data standards and best practices developed by the agencies; and to collaborate with regional and national efforts to share, integrate, and manage water data.

The NMBGMR is applying for this Bureau of Reclamation WaterSMART grant to leverage non-federal funding and concurrent activities to build a water data pilot project and decision support toolset linked with the WDS. These datasets will support the development of tools that will improve the ability of water resource managing agencies and the public to access and use data available through the WDS. Strong feedback loops within the pilot project development process will improve the system in support of the vision of the WDI. Ultimately, the WDI is intended to create an environment supporting open, accessible, understandable, and useful water data for New Mexicans and others.

WDI goals, vision, and FAIR data principles

The goal of the WDI is to build a functional water data service that federates numerous water datasets, making them easier to find, more accessible, with improved interoperability, and, therefore, more useful. Through the activities of the WDI, collaborating agencies and groups in the state will identify key data and fulfill a vision that *"New Mexico will have accessible and useful data for water management and planning."*

¹ <https://www.wri.org/publication/aqueduct-30>; Model and Blog post August, 2019.

The New Mexico WDI embraces the FAIR data principles for scientific data. FAIR stands for:

1. Findable
2. Accessible
3. Interoperable
4. Reusable

Essentially, the principles are indications of functionality of the data (#1-3), and how well the data can be put to immediate use for various purposes (#4).

WDI Management Structure

The WDI is managed by the NMBGMR (Figure 1), in cooperation with and contracting support from a number of groups and agencies, including the Internet of Water (at Duke University), Sandia National Laboratories, and the Earth Data Analysis Center at the University of New Mexico. The WDI is also supported by multiple working groups including a Directing Agencies Team, incorporating the key water resource managing agencies mentioned in the Act; a Technical Team, led by Sandia National Laboratories staff and including other technical support personnel from state and federal agencies; and a User Group, composed of a broad range of data users. Data users include representatives from any group that uses water data for resource decisions or analysis, including NGOs, environmental groups, water resource consultants, state and federal agencies, irrigation districts, and other water resource management entities.

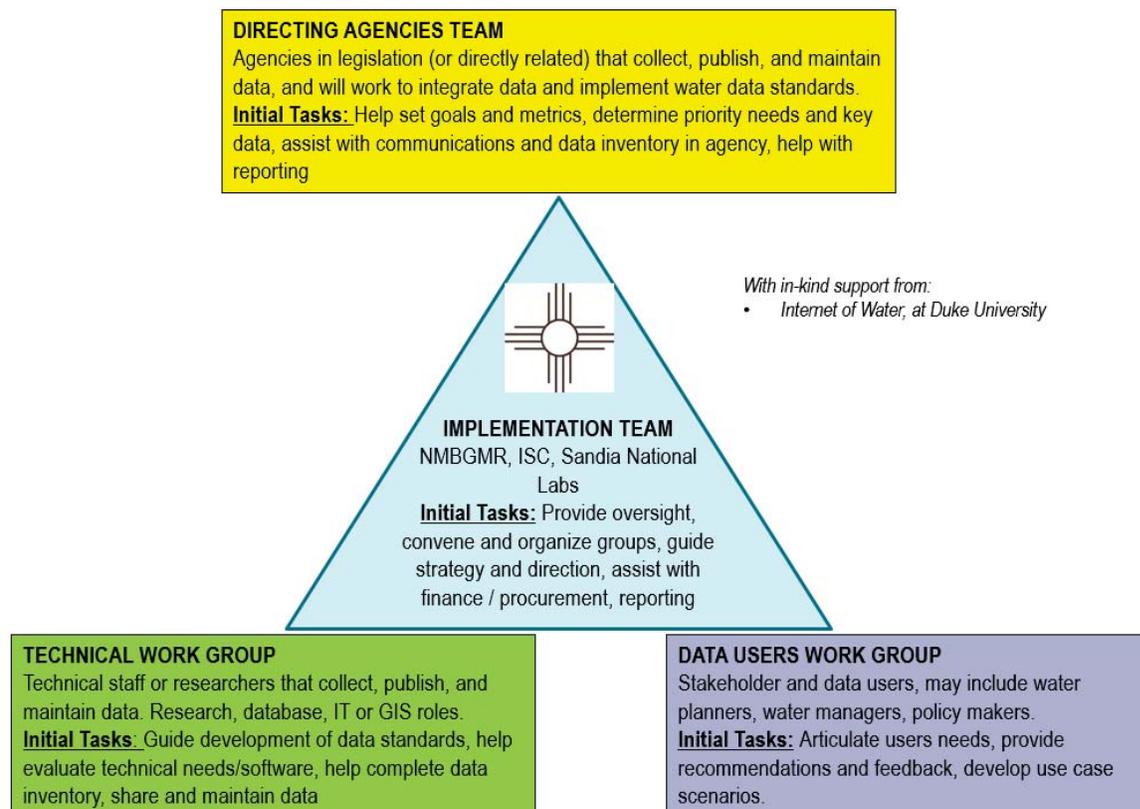


Figure 1. Water Data Initiative governance structure as of 2019.

WDI Preliminary Schedule

The process and major tasks of the WDI are summarized in Figure 2.



Figure 2. The process and major tasks of the WDI.

The preliminary schedule for the WDI, the main tasks and timeline includes:

1. *Data collection* - underway in fall 2019. This will be on-going, with a first iteration complete by winter 2020, where available and unavailable data are inventoried.
2. *Data ingestion* - beginning in fall 2019. This will be an on-going process for years to come.
3. *Data federation* - While datasets will remain under the control of the contributing agencies or groups, they will be *federated* within the WDS as a common platform. CKAN, a popular software used for data management, including CA water initiative and data.gov, was selected for the NM WDI. It is our goal to have 5-15 water datasets federated on the data service by January 2020. This will be an on-going process for years to come. Federated data will be made available through the WDS.
4. *Tools* - Initial tools will be provided in winter 2020, but this will also be an on-going effort to improve the usability of the water data, especially through pilot projects, such as the one proposed here. Tools will be made available through the WDS.

Data collection

A statewide data inventory has been initiated for the WDI. Over 50 data sets from state and federal agencies have been identified, both available (through an application programming interface, known as API) and unavailable (in other formats, not online) that will support improved water resource management in New Mexico. Data categories that describe the source (agency or other institution) and the type of data itself have been developed.

A more detailed water data inventory on an individual dataset basis, versus a platform basis, is being performed as a part of the WDI. Quantitative methods to evaluate the FAIR standards will be used as an annual check on progress. A critical component of the inventory will be the identification of unavailable data so that it can be integrated into the WDS. The pilot project provided in this proposal is an example of currently unavailable data, and will be an example for other regions on how to move it into the findable and interoperable available category.

The data are federated through APIs or direct links to data files, metadata describing those data are applied or confirmed, and then data are organized in a data catalog. In the initial phase, the data catalog will be hosted on an open source platform called CKAN (Figure 3), and will have a website with preliminary data available by January 2020.

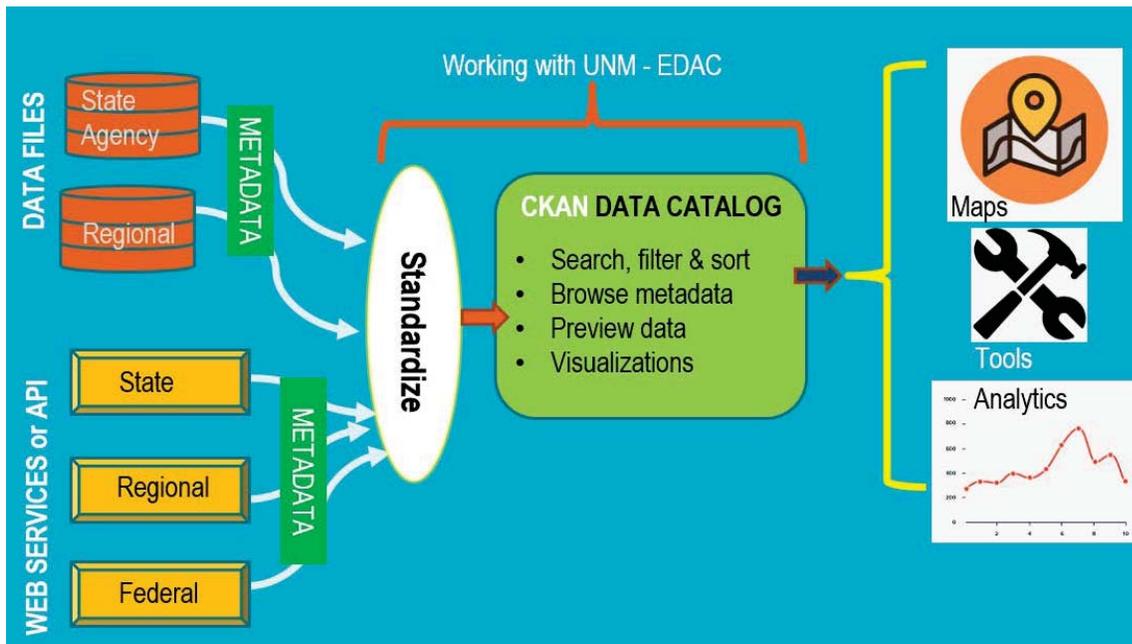


Figure 3. Schematic work plan for New Mexico's water data platform in CKAN.

Data Ingestion

Bringing multiple agency datasets together requires the data be ready for open sharing. Once data are complete as machine-readable data, with complete metadata and compliant to data standards, it can be standardized and ingested to the data platform. This will be an on-going process for New Mexico's WDI, but there is an initial timeline of creation of a data platform with key data available through it, by January 2020. From there, the process will continue, be refined, and improved. This process will also be used for the pilot test data.

Data Federation

The process of bringing together multiple independent datasets is called federation, and for New Mexico's WDI, we are calling this the Water Data Service (WDS). Oftentimes, there may be necessary steps of data cleaning or transformations required as data are ingested into the data platform. This process will continue

to occur as we build a data catalog to inform users about available datasets, navigate among data sets, and direct links to data.

Tools

From the data catalog described above, the data will then be accessed and made available to users through web services. Tools to allow easier interpretation and access to several interoperable datasets will be developed through use cases. This will be an ongoing process, but we expect basic map and graph tools to be available once the data catalog is set up in early 2020. Other tools may include different data visualizations, data download and use tools, or displays of various time-series data.

Use cases that are anticipated to be particularly useful for the PVACD include recharge estimations and real-time groundwater quantity estimations. Associated tools will have a direct and important influence on future water management in the Pecos Valley, helping to refine crop selection and planting locations on PVACD acreage and reducing the uncertainty and risk of planting less-viable crops. In the future, the wells monitored in the region may be added to the USGS National Groundwater Monitoring Network (the NMBGMR is a data sharer to this network) to enable interoperability with national water level data.

Part 2. Pilot project - Improved Data Management and Decision Support Tool for the Lower Pecos Valley

The pilot project location (Figure 4) proposed here will ensure that the FAIR data principles and the mission of the WDI are met. It is proposed as one branch of the broader WDI.

The Pecos Valley Artesian Conservation District (PVACD), within the Roswell Artesian Basin, includes 110,000 acres of irrigated farmland and is a major agricultural region encompassing the Pecos River Valley, one of the seven major river basins in the state. Water supplied from groundwater and surface water sources contributes to over \$1B of economic activity through agriculture, oil and gas, manufacturing, small and large businesses, and municipalities². Regionally, the Roswell Artesian Basin supports over 600 farms, comprising nearly 2 million acres, earning a net annual income exceeding \$245M, and with predominant crops of alfalfa, corn, dairy cows, and beef cattle³. Since the 1950s, water stress and over appropriation of the artesian aquifer has led to major changes in water management, including the retirement of 1529 wells and removal of over 33,000 irrigated acres from production. These measures have stabilized aquifer levels, but water-supply challenges related to regional aridification remain.

At this time in the PVACD, there are 10 artesian monitoring wells that are used for groundwater data measurement and long-term water management decision making. Roswell Artesian Basin farms and ranches rely heavily on this decision-making process and are impacted economically if inaccurate decisions are made about the quantities of water withdrawn, and the crops that are chosen depending upon the available water for irrigation in a given year. Manual water level measurements are tabulated on paper and brought back to the PVACD office where they are entered into a spreadsheet format. Data is disseminated by phone, email, or personal request to the office and presented in graphical format by the staff. In addition to this purpose, the well data is used for decision making surrounding river compact water deliveries,

² <https://pvacd.com>

³ 2017 New Mexico Agricultural Statistics Bulletin, https://www.nass.usda.gov/Statistics_by_State/New_Mexico/Publications/Annual_Statistical_Bulletin/2017/2017-NM-AG-Statistics.pdf

municipal and industrial supplies, and endangered species protection. At this time, the ten wells are not included in statewide water data information systems and thus are not easily included in statewide decision processes. The data are not easily discoverable and only rudimentary data are available online, thus not meeting the FAIR data principles. In addition, the analysis tools available (graphs, spreadsheets) are not integrated with other available tools (i.e. streamflow measurements from USGS), nor are they available in time-series format or in map format for users.

Funding of a pilot project by the WaterSMART program will provide a necessary step forward for the WDI and the WDS by providing realistic data management options, with improved data collection and responsive tools to address regional challenges. If successful, the project will likely lead to further investment by the PVACD to improve both data collection and data management. While the WDI and the WDS progresses to unify the multiple state datasets under one platform, the pilot project will ensure that the data are *useful* and *used* per the WDI mission. In addition, a critical purpose of the pilot project will be to train-the-trainers (or a beta test) for the processes underlying WDS development, streamlining future use case development and implementation.

Proposed Preliminary Schedule

Objectives for the pilot case regional users will support water management co-objectives for both the WDI and the WaterSMART program, including:

- water supply reliability,
- improved management of water deliveries,
- drought management activities,
- water rights administration, and
- conservation and efficiency

The NMBGMR will coordinate the pilot project with PVACD as a data contributor. The project will make PVACD data compatible with other regional data, and will allow the data to coexist on the WDS for users to access.

Year 1. The first phase of the pilot project will be focused on consensus building on the local priority data needs, while understanding the existing data collection and data management challenges. From this information, the project management team will then evaluate and propose realistic solutions, and the local water managers will be able to make informed decisions about solution selection.

Major tasks of year 1 include convening meetings to discover the local water data priorities, and data collection. The purpose of these meetings is to establish a local stakeholder coalition including partners identified on this proposal. This coalition will be responsible for guiding the development of the pilot, defining the terms and metrics of success, and making final decisions regarding resourcing and direction. The coalition will determine whether and how the anticipated data visualization tools should be operated, maintained, funded, and upgraded over time.

The milestones of the year 1 are achievement of 2 coalition meetings to identify relevant data priorities and tool needs, and completion of a data inventory for regional water data which includes available and unavailable data.

Year 2. The next phase includes implementation of improved data collection tools and data management solutions which align with FAIR data principles and will integrate water data into the broader WDS for the state. The improved data collection tools will be web-based and have interactive user interfaces. Web applications will be developed to facilitate data management. These web applications will enable: (1) cross-platform (e.g., Windows, Mac OS, Linux, Android, etc.) frontend user interfaces; (2) web accessible; (3) scalable backend databases; (4) easier data ingestion, data federation, data discovery, data sharing, and archive. This regional pilot will be integrated with the broader WDI for better interaction with other datasets and will aid the development of new data visuals and tools to inform decisions on water management. This phase creates a deliverable of initial data management tools for the local decision makers to provide feedback as an iteration process. Links to other datasets will be evaluated and tested. Use cases and data decision tools will be evaluated in context with the pilot project and other WDS cases. Milestones for the year are one or more use cases developed and evaluated, requirements created, data management tools delivered, and data collection tools evaluated and selected.

Year 3. The final phase of this project is intended to fine-tune the workflow of data collection, data ingestion and management of the data. Workflow feedback will be established to improve all stages of the system, including presentations and workshops to “train the trainers”. Also during this final year, work will continue to improve the decision support tools and data visualizations. Finally, the results will be disseminated to other users and groups within the WDI through informational workshops, meetings, and presentations, and interacting with the WDS, including the BoR.

Project location

The New Mexico Water Data Initiative includes water data for the entire state, which is housed and collected from many locations and agencies. The proposed pilot project proposed is located along the lower Pecos River watershed (also known as the Roswell Artesian Basin) in southeastern New Mexico. Expected datasets for this project are shown in Figure 4, including the 10 dedicated water level monitoring sites maintained by PVACD, wells in the USGS groundwater monitoring network, locations monitored by Office of the State Engineer (OSE), and sites with stream gauge data from the USGS.

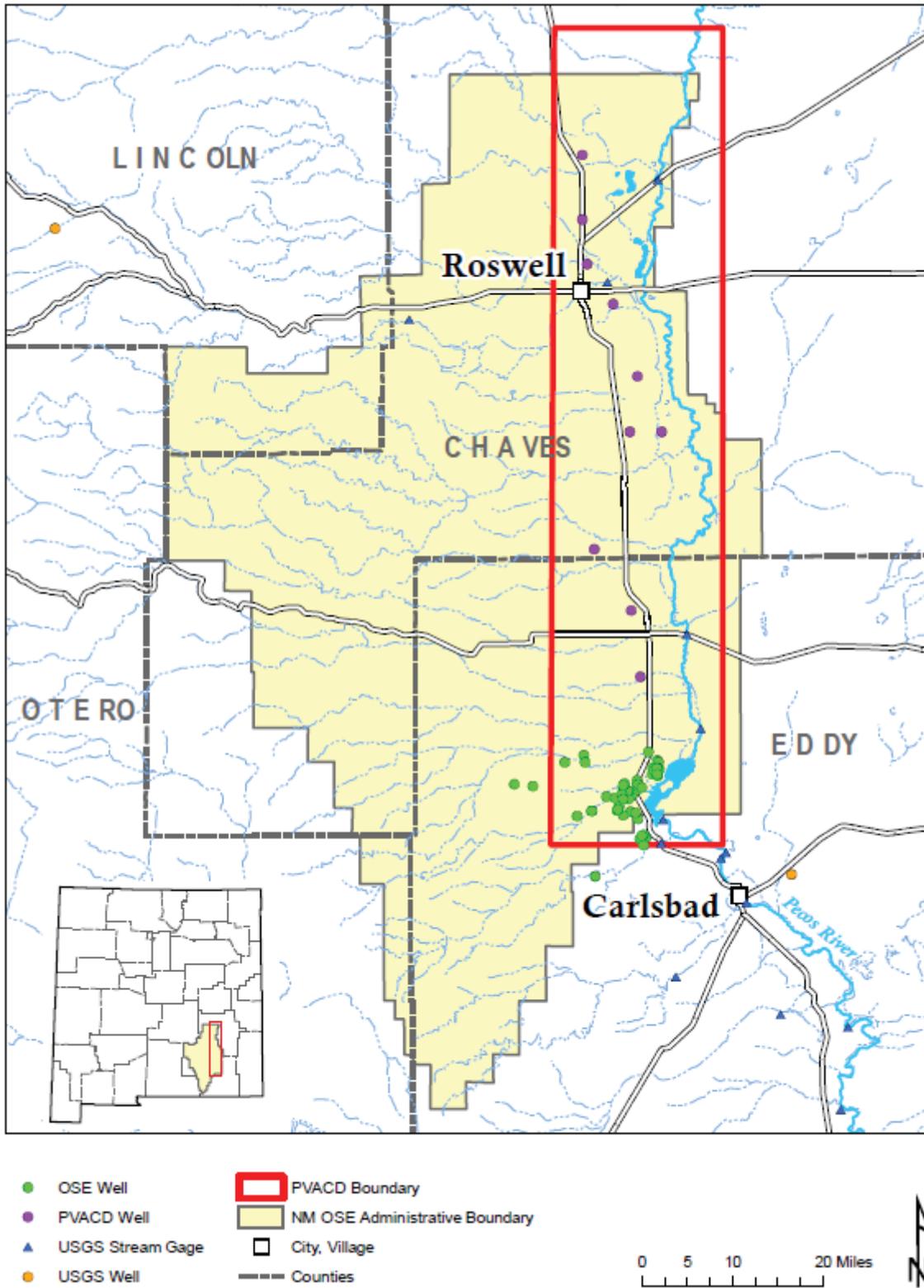


Figure 4. Map of the study area includes the entire state of New Mexico and the proposed pilot test region is southeast NM, along the lower Pecos River. The PVACD boundary is approximate.

Data management practices

For this project, in both the WDI and the pilot project, the data is expected to be hosted by the agencies/entities collecting the data and that the host agency will use best management practices. As multiple agency data are integrated through the data ingestion and federation step, the following data management strategies are applied:

1. Establish common water data terms and definitions
2. Select and define water data standards to be used
3. Establish common data models and essential metadata descriptions
4. Establish approach to data catalog(s)
5. Define access levels and approaches to ensure data privacy and security as appropriate while increasing overall openness and accessibility
6. Start with a smaller subset of the overall data to test management concepts
7. Focus on data quality at the data source by cleaning up inaccurate, duplicate, outdated, or poor quality data before entering into a larger database
8. Reduce duplicates and redundant data - use mapping to identify duplicate features based on location, while databases can query data for similar attributes such as well name
9. Establish a strong data backup and recovery processes
10. Establish a clear plan for data ownership and upkeep, including long-term operations and maintenance of an accessible, cloud-based architecture for data storage and delivery.

Feedback loops and training events to help support the agencies and contributors in managing and structuring their data for inclusion in the WDS is envisioned as a critical part of the WDI and pilot projects.

Evaluation criteria

Evaluation Criterion A — Benefits to Water Supply Reliability

This WDI and the pilot project will address several water uncertainties which ultimately affect water supply reliability. For example, in many parts of the West, and New Mexico, the quantity of groundwater available is poorly understood or unknown. The southeast region of the state has been prone to severe drought, and is a region where groundwater (the Roswell Artesian Basin) and surface water (the Pecos River) are intimately connected. In previous drought years, water shortages have created conflict with neighboring irrigation districts and states, and have made interstate compact compliance difficult. In the PVACD region, water managers respond to groundwater level changes as quickly as possible currently using data collected by hand. Providing findable and accessible data on groundwater level trends and relevant surface water measurements, in conjunction with simple visual tools, will allow for more timely and better informed water management decisions.

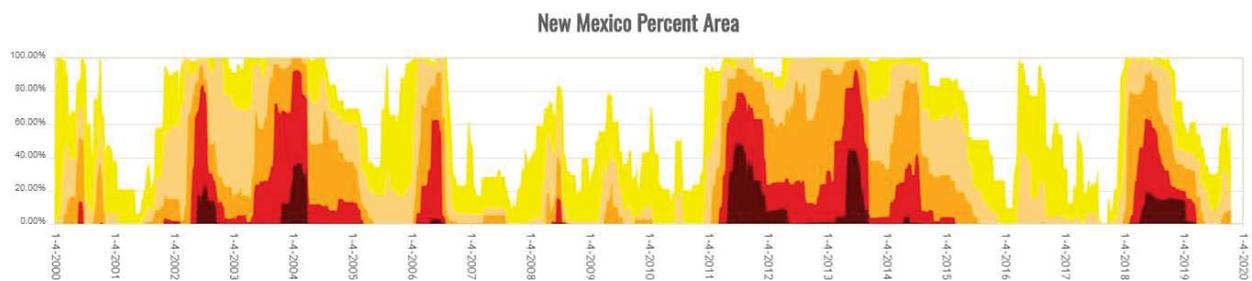
By building decision support tools, such as map visualizations or charts, water managers in the pilot project area and in other regions can begin to realize the greater benefit of the WDI. Having a more direct access to key datasets will enable water resource managing agencies and the public to have necessary information to aid in decision making, which can lead to increased water reliability. For the pilot project, specific benefits and expectations would be refined during the first year of this project through discussions with multiple water management stakeholders in the PVACD region. By adding efficiencies to data

collection and data management, with key visualizations of these data, we can improve the responsiveness of the PVACD and other water management entities, such as the OSE and ISC.

Water management issues

The pilot project in the Pecos Valley region and for the state can certainly improve *water supply reliability*, *drought management support*, and the potential to improve *water rights administration*. New Mexico WDI aligns with these topics and considers *conjunctive management of ground and surface water* as well, as it pertains directly to data describing groundwater and surface water. This project also supports the state's ability to meet *endangered species requirements* as ecological and water quality data are specifically listed in the directing legislation, and are of particular importance in the Pecos Valley. Figure 5 below illustrates the severity and repetitiveness of drought in New Mexico and in the Lower Pecos region since 2000⁴. Large-scale aridification over New Mexico and the southwestern U.S. has been identified as a long-term challenge for water managers⁵.

A



B

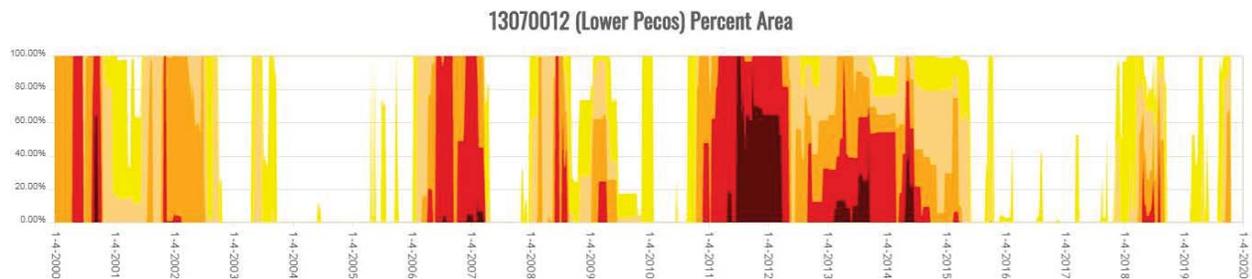


Figure 5. A) This graph illustrates the percent area of New Mexico in drought since 2000, with worst level of drought (D4) as darkest color red, ranging to less severe drought area as lightest yellow shade (D0). B) Percent area of the HUC8 for the lower Pecos River region, with similar trends as for the entire state of NM. Data source: <https://droughtmonitor.unl.edu/Data/Timeseries.aspx>

⁴ <https://droughtmonitor.unl.edu/Data/Timeseries.aspx>

⁵ <https://statesummaries.ncics.org/chapter/nm/>

How water management issues will be addressed

The pilot project in the Pecos Valley region can improve *water supply reliability*, particularly in *drought* times, by providing quicker, more efficient access to data, such as groundwater level measurements. *Drought management* requires tools and all water data available to support proactive and reactive decision-making. The potential for improving *water rights administration*, such as the exchange of water rights, can be more easily facilitated when all data are findable to the parties involved. In a region such as the Pecos Valley, where the river in some sections is fed by artesian groundwater, having readily accessible data on regional trends can help managers address water needs of the endangered species, such as the Pecos Bluntnose Shiner, which requires year-round water supply. Simple tools that help visualize groundwater trends alongside surface water flows can help managers adjust to potential impacts to river flows from groundwater diversions (*conjunctive use of ground and surface water*). By building decision support tools, such as map visualizations or charts, water managers in the pilot project area and in other regions can begin to realize the greater benefit of the WDI. Having a more direct access to key datasets will enable water resource managing agencies and the public to have the necessary information to aid in decision making, which can lead to increased water reliability.

Extent of project benefit

The extent that this project in the Pecos Valley can impact water supply reliability can be realized when water managers experience and use visual tools developed with their input and guidance. These managers know the region and know what their challenges are better than anyone. They can participate in discussions to guide the tools that seem most relevant to their local challenges. The benefit of pursuing this pilot project in this region also relates to water supply reliability in other regions of New Mexico. The proposed pilot project will add value to the limited data and tools currently available to PVACD decision makers. If successful, the project will likely lead to further investment by the PVACD to improve both data collection and data management.

Complementary projects

The New Mexico WDI is complementary to other national efforts (i.e. data.gov) to make data open and interoperable. The WDI was created as New Mexico has no other related ongoing projects to integrate water management data in one location. Upon completion of this 3-year pilot project, and showing actual use of data visualizations and improved management experiences, other regions can begin to utilize similar processes and access public data available through the WDS.

Evaluation Criterion B — Need for Project and Applicability of Project Results

This project, as the New Mexico WDI and the pilot project in the Pecos Valley, meet the clear and specific needs of water resource managers in the western 17 states, as identified by the Western States Water Council through WaDE⁶, the Aspen Institute Report on the Internet of Water⁷, and through the New Mexico State Water Plan as well as the 16 Regional Water Plans for the state⁸. Express interest in this New Mexico specific project has been provided and documented by letters of participation included with the

⁶ <http://wade.westernstateswater.org/>

⁷ <https://www.aspeninstitute.org/publications/internet-of-water/>

⁸ <https://www.ose.state.nm.us/Planning/>

proposal. This project has support from local and state agencies, such as the NM Interstate Stream Commission, Pecos Valley Artesian Conservancy District, NM Office of the State Engineer, Sandia National Laboratories, Duke University's Internet of Water Project, and University of New Mexico (Earth Data Analysis Center).

New Mexico, through the Water Data Act, is the second state in the country to adopt legislation to require that water data become more open and accessible. While most states in the West currently practice data sharing upon request, many of the practices developed through the WDI and in the development of the WDS will serve as resources for other states to utilize. With water challenges only growing in western states, it is highly likely that the other states will continue to move toward open and accessible data options, and that the tools developed through this pilot project can easily be repurposed.

The pilot project in the Pecos Valley will provide a workflow and process for other regions to implement within New Mexico, and can be translated to other states wishing to build open data platforms. The project results will be carefully documented, and made available through publication from the NMBGMR and communications with BoR.

With the WDS on the open source platform CKAN, sharing project results will be accessible to open source communities, using tools such as GitHub and BitBucket. Data platforms, web applications, and media reports will be shared. The applicant will also share project results through local, regional and national presentations, posters, social media posts and webinars as part of the usual education and outreach of the NMBGMR. The WDI website will also be used as a resource to provide news and updates, as well as tips and tools for water data management and pilot project experiences.

[Applicability of tools for water resource managers](#)

Project results will immediately inform water resource management actions in the Pecos Valley because they will be developed based on specific user requests and needs. The pilot project is designed to gather information through several meetings with key stakeholders in the first year, to get their input on the data and tools needed to answer their biggest challenges. While the tools developed for this region will be specific to the local needs, they will directly apply and be transferred to other regions which collect groundwater level measurements from aquifers in direct connection to a river (of which there are many).

Results from this pilot project work are directly applicable to several participants, especially the PVACD and the ISC Pecos Bureau, who can use the tools and open, accessible data for their water management practices. These users will also benefit by having their data more accessible and useful to others beyond their agencies. The applicant is charged with developing the WDS to create tools that are directly applicable to the participants. Therefore benefits will flow through the project directly to the project participants and to future system users.

[Evaluation Criterion C — Project Implementation](#)

Objectives for the pilot case regional users will support water management co-objectives for both the WDI and the WaterSMART program, including:

- water supply reliability,
- improved management of water deliveries,
- drought management activities,

- water rights administration, and
- conservation and efficiency

The NMBGMR will coordinate the pilot project with Pecos Valley Artesian Conservancy District as a data contributor. The project will make PVACD data compatible with regional data, and will allow the data to coexist on the WDS for users to access. **The first objective** is to build a data service (WDS) from which to host and federate state and regional water data, as well as to link to federal water data relevant to the pilot project. The WDS is designed to make water data findable, accessible, interoperable, and reusable (FAIR).

Approach for Objective 1: The first step is to bring interested groups together to discuss and agree on the data and tool needs. This step follows the approach taken in other federal efforts and states (California, IOW, Western States Water Council). The second step will be to aggregate currently “available” and “unavailable” data together in a federated platform, so that the data meet the FAIR standards, and to identify barriers to obtaining data. The second step is to use the pilot project that leverages the framework of the WDS to address regional water management challenges to support agriculture and other water uses including compact deliveries and endangered species support.

Approach for Objective 2: This step develops the data federation architecture and associated databases. The known data needs are diverse and will require more efficient basic data collection, improving the current data management practices and platforms, streamlining data ingestion, and creating visual tools that can better inform decisions in the district. Use case cases that describe resource management problems in the Lower Pecos Valley will be developed here. Contractors will work with the stakeholder group to develop water-data tools needed in the region, with the partnership of the Pecos Valley Artesian Conservancy District, the Interstate Stream Commission, and the Office of the State Engineer. The purpose of these tools will be to enhance short- and long-term water management for irrigation, river flow for endangered species, interstate compact compliance, and other uses within the Conservancy District. Input from the stakeholders, including these agencies, will be used to develop a list of tools that will support the resource management objectives developed by the stakeholders. Figure 6 shows a set of steps envisioned both for the WDI process and the pilot test.

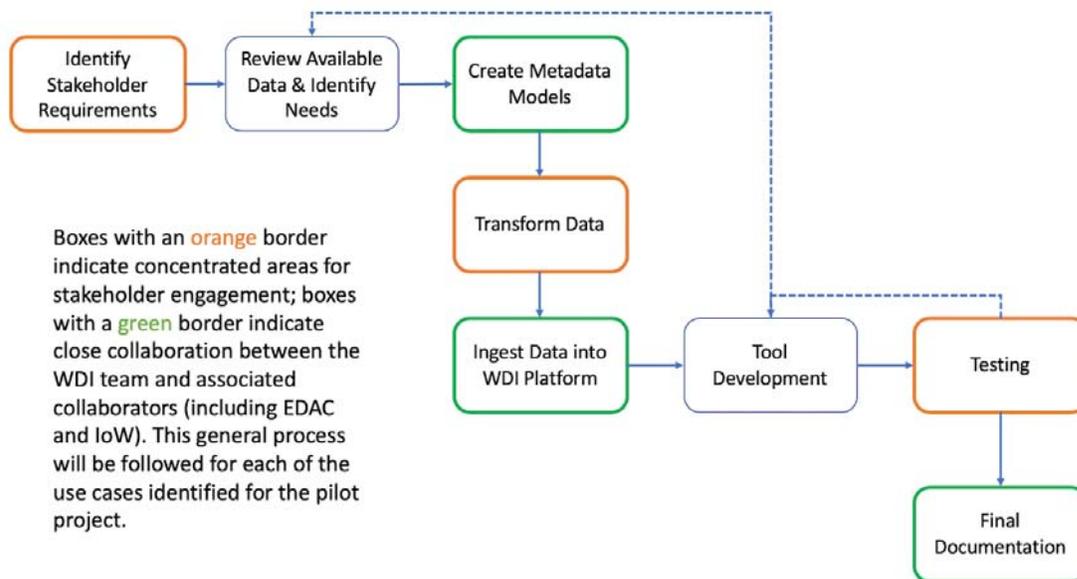


Figure 6. Project Activities flowchart for statewide NM WDI and pilot project in Pecos Valley.

Approach for Objective 3:

The team will use the pilot project as a learning tool and model for water data discovery, federation, and management projects across New Mexico. The process will identify data management tools that will be applied to better management of other data, such as meter information used by the OSE, PVACD, and the water producers. All of these exercises will feed information to the broader WDI, providing a road map that can be modified and applied for other regional challenges in New Mexico and the 17 Western States.

Work Plan and Project Schedule

Year 1. Consensus Building and Data collection

Major tasks of year 1 include convening meetings to discover the local water data priorities and data. The coalition will guide pilot development, define the terms and metrics of success, and make final decisions regarding resourcing and direction. The coalition will determine whether and how the anticipated data visualization tools should be operated, maintained, funded, and upgraded over time.

The milestones of the year 1 are achievement of 1-2 coalition meetings with actionable outcomes, and a data inventory for regional water data which includes available and unavailable data and metadata verification.

Year 2. Implementation of Coalition Priorities.

Major tasks include improved data collection tools development, ingestion of data to the management platform; and development of 1 or more use cases to tackle resource management problems. Databases

and data federation architecture will be established. Data ingestion and federation metrics will be applied, including QA/QC, speed, volume, categories, and target completeness. This phase creates a deliverable of initial data management tools for the local decision makers to provide feedback as an iterative process. Links to other datasets will be evaluated and tested. Metrics for data use will also be evaluated, including

1) data use statistics - how many downloads (in terms of data volume or data file amount) in one day; how many users visit the data portal;

(2) data use purposes - research, engineering, industry, other

(3) data use spatial distribution - New Mexico initially, other states later

(4) data use feedback - how many users contact us regarding the data availability, data platform functionality, how to make the data platform more user-friendly

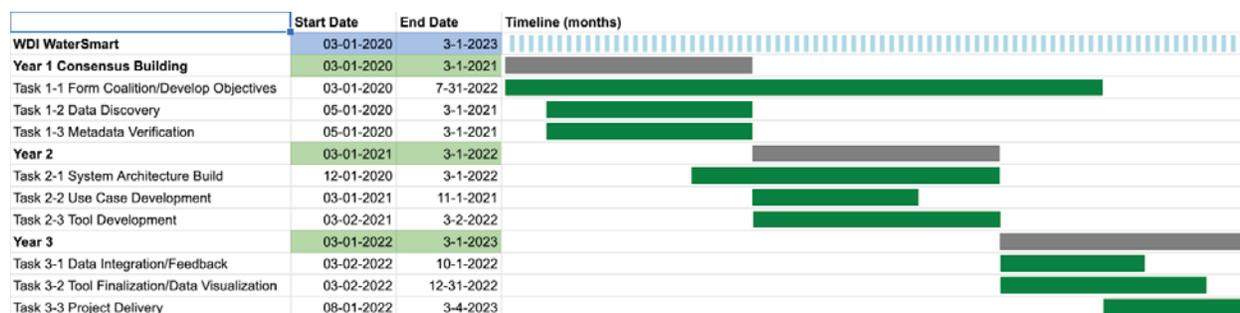
Milestones for the year are data management architecture put in place, 1 or more use cases developed and evaluated, requirements created, data management tools created, and data collection tools evaluated and selected.

Year 3. Fine-tuning Workflow and Getting Feedback.

Major tasks include workflow feedback established to improve all stages of the system. Use cases and data decision tools will be evaluated in context with the pilot project and other WDS cases. Workflow of data collection, data ingestion and management of the data will be fine-tuned. Also during this final year, work will continue to improve the decision support tools and data visualizations.

Milestones include mapping the project results to the WDI processes; disseminating results to the BoR and to other users and groups within the WDI through informational workshops, meetings, and presentations.

Estimated Project Schedule – Gantt Chart



Data availability

At this time in the PVACD, there are 10 artesian monitoring wells that are used for groundwater data measurement and decision making for long-term adjustments to depletions. Manual water level measurements are tabulated on paper and brought back to the PVACD office where they are entered into a spreadsheet format. Data is disseminated by request to the office and presented in graphical format by the staff. At this time, the ten wells are not included in statewide water data information systems and thus are not easily included in statewide or other local decision processes. The data are not easily discoverable and

only rudimentary data are available online, thus not meeting the FAIR data principles. Data from OSE and ISC, as well as federal agencies (i.e. USGS) are also available in this region describing groundwater and surface water quantity and quality. In addition, the analysis tools available (graphs, spreadsheets) are not integrated with other available tools, nor are they available in time-series format or in map format for users. Ultimately, the goal is to make the data used for annual decisions about depletions through a potential water banking process.

Staffing needs

Staff already affiliated with the WDI will also be assigned to the pilot project. Staff resumes are attached in appendix with this proposal. These include:

- Stacy Timmons, Associate Director Hydrology at NMBGMR
- Jeri Sullivan Graham, PhD, Water Data Specialist, NMBGMR
- Laila Sturgis, Hydrogeologist/ Technical Manager, NMBGMR
- Collaborator: Thushara Gunda, PhD, Senior Technical Staff, Sandia National Laboratories

There are no plans to request technical assistance from Reclamation, but there are numerous tasks expected to be accomplished through contracts as described in the budget section of this proposal.

All of the project team members, as well as project partners, who have written letters of participation, have extensive experience working with complex projects of this size and scope in one or more of the project areas of hydrology, geology, environmental science, data collection, data maintenance, data science, and data system development.

The project team is already in place and is currently working on the WDI for New Mexico. The addition of the pilot study will be a seamless addition to the WDI work plan, as pilot studies are already part of the strategic plan for WDS development.

No delays are anticipated to project commencement upon entering into the financial assistance agreement.

Products description

Data accessed for this WDS pilot is already public, and will continue to be made available through the federated platform, including metadata. Electronic products will include a website that will direct users to the data and to any tools developed. Reports found during data collection will also be cataloged and included on the website. Any reports or publications resulting from the pilot study will be made public through the WDS website, and through the NMBGMR publications link.

Evaluation Criterion D — Dissemination of Results

The WDS will be hosted on the open source platform CKAN, making sharing of project results straightforward and beneficial to the open source community using this platform. Sharing will also include open source communities such as GitHub and BitBucket. NMBGMR will direct contractors to make all products, including databases, tools, and websites of the pilot project available to the Pecos Valley water managers and data users, and to the broader New Mexico WDI collaboration and the public. Data platforms, web applications, and media reports will be shared.

Similar data management tools and visualization techniques can be reproduced from this pilot for other regions in the state, and other regions directly involved with the WDI. The applicant will also share project results through local, regional and national presentations, posters and webinars as part of the usual education and outreach of the NMBGMR.

Outreach to the local coalition developed in the first year of the pilot project is the most effective means to reach out to the local community, and ensure applicability and use of these data and tools. Broader outreach by the applicant through presentations and conferences, as well as shared tools in the open source data community, will ensure that regions beyond NM can benefit from this project.

Evaluation Criterion E — Department of the Interior Priorities

Fundamental to water management and adaptability is direct access to essential, high quality water data. Working to improve access to water data in a desert state like New Mexico, through the Water Data Initiative, and specifically in the Pecos Valley region through the pilot project proposed here, provides these regions with science and tools to better adapt to changes in the environment related to water - an important priority of the Department of the Interior.

Restoring trust with local communities

This funding opportunity through the WaterSMART Applied Science grant provides a unique opportunity to leverage the New Mexico Water Data Initiative, and its state funding, to have much greater impact by leveraging federal funding as well. The NM WDI already has great support and cooperation among state agencies the support of the Governor Michelle Lujan Grisham. The Department of Interior, through this opportunity can clearly and directly have an impact to improve communications with New Mexico agencies, and grow trust and collaboration with a rural community in the Pecos Valley.

Modernizing our infrastructure

In the most basic ways, this project, through the NM WDI and the Pecos Valley pilot project, the data infrastructure and data management for New Mexico and perhaps other states will be modernized. New Mexico, and many states, face tremendous challenges to keep up with data management and data collection at the same time, all while often dealing with backlog data from past years of data management failures. Processes developed through this project will provide guidance on how this basic “infrastructure” can be improved. Having water data more accessible and findable can have numerous side-benefits to infrastructure projects, as well.

Environmental or Cultural Resources Compliance

The work proposed in this application is not anticipated to require any NEPA, ESA or NHPA resource evaluations. This project is entirely focused on data management and improving current management plans. It does not include federal facilities.

Permits or Approvals

As stated above, the work proposed in this application is not anticipated to require resource evaluations, and therefore, should not require additional permits or approvals.

PROJECT BUDGET

Funding Plan

The non-Federal share of this project will be obtained from NM legislative funding supporting the Water Data Act. This Act directing the development of a data service is intended to provide a mechanism for a federation of independently hosted water data. This is a necessary framework from which to build the proposed pilot project. This funding is appropriated annually, currently set at \$110,000, from the NM legislature to the NMBGMR, as administered by the NM Tech Board of Regents in a Water Data Account established in the Water Data Act. This funding began in July 2019, and is expected to recur annually as established by NM HB 548 in 2019 (as junior bill funding). For this proposal, we suggest applying 3 years at \$100,000 annually toward the required cost match. This funding will go toward development of the WDS including salaries, wages, fringe benefits, and contract services.

Budget Proposal

Table 1. - Total Project Cost Table

SOURCE	AMOUNT
Costs to be reimbursed with the Federal funding	\$300,000
Costs to be paid by the applicant	\$300,000
Value of third party contributions	\$0
TOTAL PROJECT COST	\$600,000

Table 2. - Budget Proposal Table

BUDGET ITEM DESCRIPTION	COMPUTATION		Quantity Type	Total Cost
	\$/Unit	Quantity		
Salaries and Wages				
Project Manager	\$40.25	549	Hourly wage	\$22,077
Sr. Hydrologist/Technical Lead	\$33.00	1420	Hourly wage	\$46,860
Water Data Specialist	\$33.00	1202	Hourly wage	\$39,666
Fringe Benefits				
NMBGMR employees (average rate)				\$65,010
Equipment (none)				
Supplies and Materials				
Meeting hosting	10000	3	Annual event	30000
Other (Travel)				
Annual meetings to present findings; travel to Roswell	\$5,000	3		\$15,000
Contractual/Construction				
Contractor A - Consulting Services for Pilot Technical Design and Stakeholder Engagement	\$50,000	2	Annual task order	\$100,000
Contractor B - Consulting Services for Data Curation, Data Management, and Data Visualization	\$40,000	2	Annual task order	\$80,000
Contractor C - Consulting Services for Improvements in Data Collection Protocols, Software and Equipment	\$20,014	2	Annual task order	\$40,027
Professional services at UNM (EDAC) Portal and Data Input Development	\$20,000	3	Annual task order	\$60,000
Professional services at UNM (EDAC) Platform Hosting	\$4,000	3	Annual task order	\$12,000
TOTAL DIRECT COSTS				\$510,640
Indirect Costs				
CESU Rate NM Institute of Mining and Technology	17.5%	\$510,640		\$89,360
TOTAL PROJECT COSTS				\$600,000

Budget Narrative

The budget proposed here shows expenses covered 50% by matching funds and 50% by WaterSMART grant funds. Expenses are discussed below.

Salaries and Wages

Project manager (Stacy Timmons) will provide oversight and reporting requirements for this project, both for WDI and the proposed pilot project. The senior hydrogeologist and technical manager will provide support for day to day operations and meetings with local area leaders (the coalition), while the Water Data Specialist will provide support through the data inventory and data curation for the broader WDI and the pilot project, and engage with stakeholders at meetings. Hours provided in this budget are considered for three years.

Fringe Benefits

The fringe rate used in this category is 59.86%, which is the average rate provided by New Mexico Institute of Mining and Technology (NM Tech, or NMT) for salaried staff at the NMBGMR. For reimbursement, this rate may be adjusted specific to each employee. Rates are reviewed and adjusted periodically based on NMT benefit changes and or changed in state/federal regulations. The fringe rate is intended to cover the costs including FICA, Medicare, unemployment compensation, worker's compensation, NM Education Retirement Plan, life insurance, health insurance and compensated absences. More information can be found at: <https://nmt.edu/finance/spa/docs/Fringe%20Benefits%20Rates%20July%202019.pdf> .

Travel

Travel costs in this budget were estimated, and would be expected to be covered in the non-federal portion of this project. These expenses would cover mileage for travel to meetings (i.e. Santa Fe, Albuquerque, or Roswell for this project) at a rate of \$0.58 per mile. For overnight travel over 24 hours, per diem is charged at a rate of \$135 per day to include lodging and food costs. It is expected that this project will have several 1-2 day trips for 2-3 team members to attend in Roswell, NM. One or two team members may also travel locally to conferences to present results and share findings. Details on NMT travel policy can be found at: https://www.nmt.edu/finance/docs/travel/Travel_Procedures_7-15-15_updated_4-05-17.pdf

Equipment

No equipment is expected to be purchased using these funds.

Materials and Supplies

This budget item was estimated, and would be expected to be covered in the non-federal portion of this project. The only expense required under materials and supplies would be related to expenses involved with periodic meetings, including food, venue rental fees, and IT services to make webinars possible. This is part of the broader WDI and expense is estimated at \$5000 annually based on previous experience. In smaller meetings, venue rental is waived. For a larger annual meeting as part of the WDI, to gain data user input, a larger venues may be rented, and would be sought to fit within the available budget.

Contractual

To implement the pilot project, NM Tech will create external consulting contracts compliant with purchasing rules required of NM Tech. The first, Contractor A, will be with a national organization to provide technical design and consulting services for the pilot, including stakeholder engagement and technical design services. The second contract will be with a New Mexico-based organization, Contractor B, for gathering requirements, engaging data management, and creating data visualizations, in collaboration with Contractor A. A third contract will be created with another New Mexico-based organization, Contractor C, to manage improvements to monitoring and data collection.

For stakeholder engagement, Contractor A, will hold an initial consultation with local partners (i.e. PVACD, ISC, OSE, local water managers) to build a coalition of 5 to 6 individuals representing a broad cross section of stakeholders affected by the water sustainability question being addressed by the pilot. This coalition will be responsible for guiding the development of the pilot, defining the terms and metrics of success, and making final decisions regarding resourcing and direction. The coalition will determine whether and how the anticipated data visualization tools should be operated, maintained, funded, and upgraded over time.

Contractors A and B will work with the coalition to develop requirements for a data visualization tool aimed at translating newly discovered data into a usable and functional format for users. During a one day workshop, the contractors will discuss best practices for data visualization and user needs, which will serve as the basis for the data visualization tool. Users will share potential questions to be addressed through data visualization, such as learning specific numbers regarding trends in a particular water resource. This phase will include orientation to data literacy for participants less familiar with data science and data management terminology and concepts.

Contractors A and B will then work with the regional data providers to identify all sources of data relevant for the pilot, assembled from members of stakeholder coalition and external sources (Federal, State, Tribal, Local, and NGO). The group will work to arrive at common water data terms, definitions, standards, and metadata descriptions that will serve as agreed upon foundation for a data catalog.

Contractor C will be retained to purchase or acquire through donation, tablets and other equipment to make improvements to data collection techniques, protocols, apps, and data management activities by the local partner (PVACD).

Each contractor will provide quarterly email updates to the NM Tech project management team, and at the end of the contract term will provide a summary report. The intention of the reports is to provide feedback on the success or challenges of the contractor activities and interaction with local stakeholders. The final report will include a summary of the success of each activity including feedback from the local stakeholder coalition. The intent of these reports is to also provide a written guideline for future regional pilot projects to review and incorporate in their data management plans.

Tasks for each contractor role described here will be selected based on a procurement method, with tasks outlined as described above, compliant with federal and state of New Mexico Procurement guidelines. Procurements under \$20,000 will require one written quote; the next level \$20,000 - \$60,000 will require three written quotes; above \$60,000 will require a bid or Request for Proposal (RFP). However, if any of the contractors are other universities, city or state government, those are exempt from competition under NMSA 13-1-98. Additionally, if the contractor has a current GSA, state, or other competed contract for the

goods and services required under the contract, then NMT can contract directly at any cost per NMSA 13-1-129. Contractors are not restricted to private companies, but may include universities or agencies with appropriate skills applicable toward these proposed tasks. Any awards with universities or agencies where indirect costs are applied must comply with the CESU rate (17.5%) as applied to award managing agency, as proposed here at NM Tech. Further information is available here:

<https://www.nmt.edu/finance/purchasing/Purchasing%20Manual%20Updated%203-19-18.pdf>

Third-Party In-Kind Contributions

This proposal does not have third-party in-kind contributions.

Environmental and Regulatory Compliance

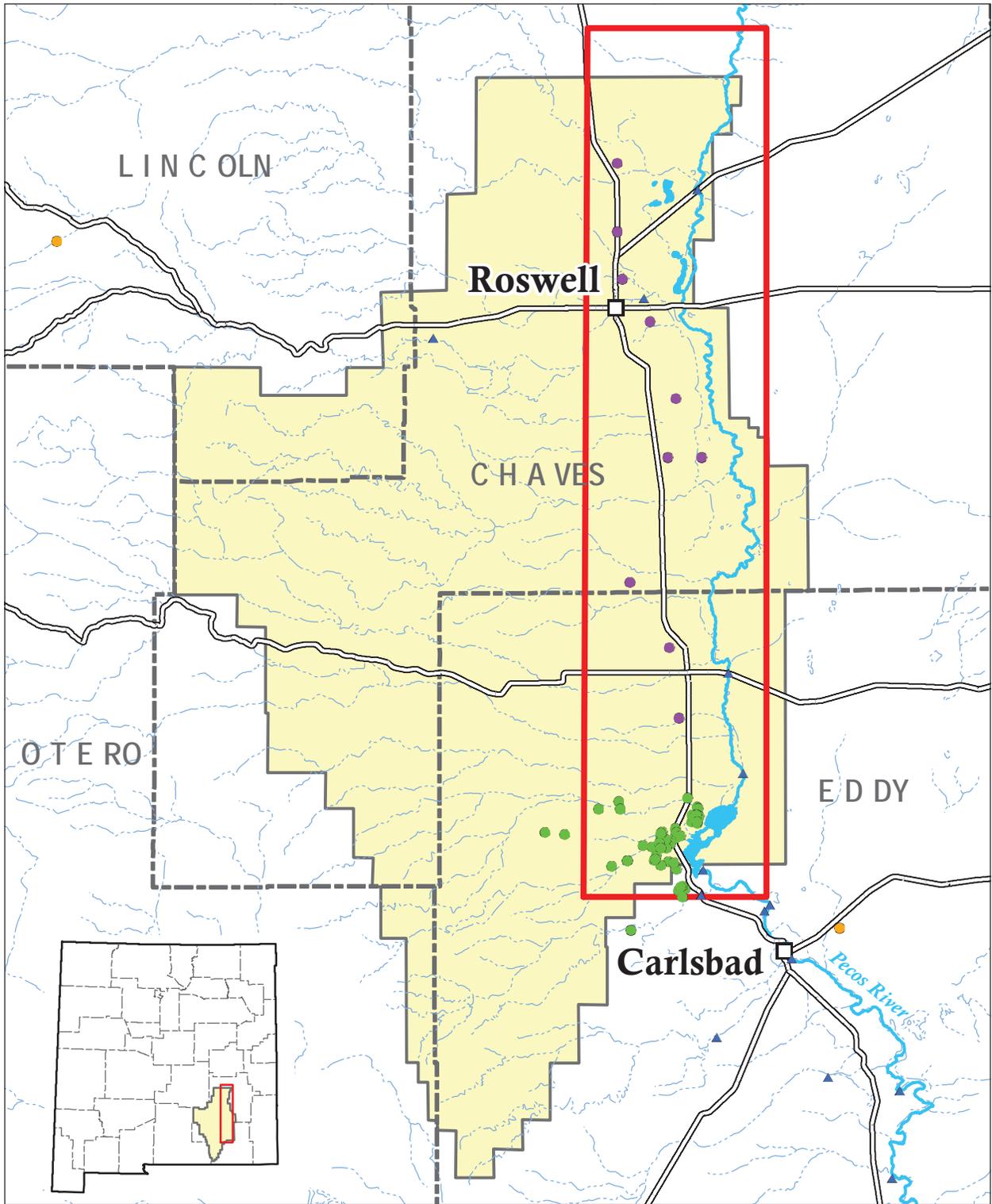
This project utilizes data from other data providers, such as existing monitoring wells in the Pecos Valley region monitored by staff of the PVACD. No installations or environmental excursions are anticipated for this project. Most work will be accomplished in existing office space at New Mexico Tech and contractor offices. No permits, approvals, or environmental compliance documents are anticipated for this project, including ESA, NHPA, NEPA, CWA, or state requirements. No costs are anticipated for the BoR to evaluate compliance.

Other Expenses

No other expenses are anticipated for this project. No profits or fees are included.

Indirect Costs

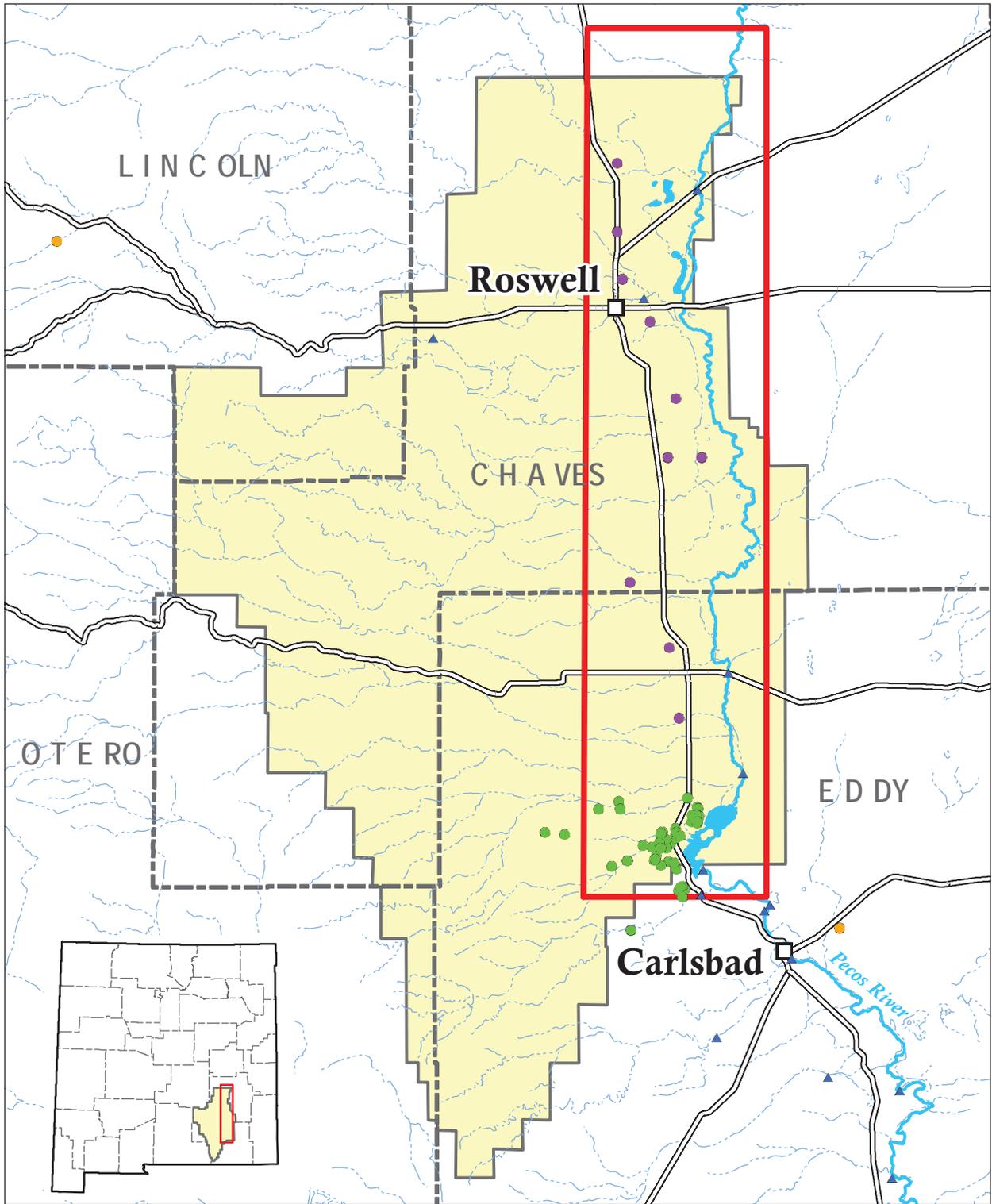
New Mexico Tech is in the Cooperative Ecosystem Studies Unit (CESU) with a federally approved indirect cost rate agreement of 17.5%. This indirect cost rate would be included in the award amount with this proposed work, up to \$300,000 for three years. The maximum amount of indirect costs would be \$44,680, as listed in the budget table. This indirect cost rate would also be applied to the non-federal match for the project, for a total of \$89,360 in total indirect costs, with \$510,641 for direct costs.



- OSE Well
- PVACD Well
- ▲ USGS Stream Gage
- USGS Well
- PVACD Boundary
- NM OSE Administrative Boundary
- City, Village
- Counties

0 5 10 20 Miles





- OSE Well
- PVACD Well
- ▲ USGS Stream Gage
- USGS Well
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- NM OSE Administrative Boundary
- City, Village
- Counties

0 5 10 20 Miles

