



NM WATER DATA INITIATIVE: IMPROVING WATER DATA ACCESS FOR MODELING IN THE MIDDLE RIO GRANDE

Applicant: Stacy Timmons
Stacy.Timmons@nmt.edu ; 575-835-6951
NM Bureau of Geology and Mineral Resources
NM Institute of Mining and Technology
801 Leroy Place, Socorro, NM 87801

Project Manager: Laila Sturgis
Laila.Sturgis@nmt.edu ; 575-835-5327
NM Bureau of Geology and Mineral Resources
NM Institute of Mining and Technology
801 Leroy Place, Socorro, NM 87801

Stacy Timmons

NM BUREAU OF GEOLOGY AND MINERAL RESOURCES

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Technical Proposal and Evaluation Criteria

Executive Summary

This proposal, submitted by Stacy Timmons in Socorro, New Mexico, on April 19, 2021 is in response to the Bureau of Reclamation's Notice of Funding Opportunity No. R21AS00289 – WaterSMART – Applied Science Grant for 2021. The applicant fits in Category B at the New Mexico Bureau of Geology and Mineral Resources (NMBGMR), under the New Mexico Institute of Mining and Technology (a university). Of note, the NMBGMR is the convener of the New Mexico Water Data Initiative (WDI), an effort to organize, modernize and integrate the state's water data. This project is proposed in partnership with the New Mexico Interstate Stream Commission (NMISC), a Category A partner (letter included). The NMISC is a state agency with a role of investigation, protection, conservation, and decision support for development of New Mexico's waters including both interstate and intrastate stream systems.

The work proposed will build improvements to water data access in the middle Rio Grande region of New Mexico. This project aims to improve data "pipelines," using modern technology in the form of Application Programming Interfaces (APIs) as the input from various federal, state and local data providers to the end-point users in water modeling and decision support tools. Current practices in water modeling can be dramatically improved and streamlined by making real-time, near-real time, and historical data accessible in modern, machine-readable formats. Through collaboration with the data providers at the NMBGMR and others, and with direct support from the WDI, numerous existing water data features will be made more open and accessible to the NMISC (or others). Funding will be used to improve data sharing options and practices directly at the NMBGMR in the region of study, as well as to technology improvements in the form of APIs, support development costs, and provide training and implementation of data uses with models.

The project length of time is estimated at two years, with a completion date of October 31, 2024, assuming that project begins in October of 2022. The project will not be located on a Federal facility.

Technical Project Description

Water management in New Mexico relies heavily on modeling efforts and robust datasets to help inform these models. The project proposed here can enhance modeling capabilities for the NMISC (and others) and provide more reliable and direct access to real-time, near real-time, and historical water data. This project will improve access to and use of water resources data by connecting information from numerous federal, state and local agencies into "pipelines" of machine-readable, ready access, key water data. The end products of this proposed work are robust water data APIs, with additional descriptive metadata.

This project aims to improve access to and use of water resources data and enhance modeling capabilities specifically with the NM Interstate Stream Commission, our partner agency. 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 (Table 1).

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: New Mexico Interstate Stream Commission	A - State Agency

Numerous datasets to describe specific water conditions, such as streamflow, groundwater level measurements, precipitation or climate data, reservoir levels, and irrigation diversion amounts, are monitored at different locations, time intervals, and from different agencies (Table 2). Unfortunately, these data are shared in a wide range of formats and are often difficult to access and work with outside of the originating agency. Occasionally some of these datasets are difficult to access even within the agency providing them.

Data collected from federal agencies are becoming increasingly accessible (i.e. machine readable formats), but state and local data sources are often funding limited and lagging behind, making them not as readily interoperable with federal data. The applicant, NMBGMR, as one of these state agencies also working to make improvements to external and internal data accessibility – is providing essential groundwater data for the state of New Mexico, including the Rio Grande watershed. Additionally, the NMBGMR is also leading the state effort to make water data more easily shared, accessible and interoperable.

Table 2. Datasets of interest in the Rio Grande location may include (but not limited to) those listed here.

Agency / Data Provider	Data Type
United States Geological Survey (USGS)	Stream gages (river flow); groundwater level measurements; water quality
New Mexico Bureau of Geology and Mineral Resources (NMBGMR)	Groundwater level measurements; water quality
United States Bureau of Reclamation (USBOR)	Reservoir levels / data (in RISE)
US Fish and Wildlife Service (USFWS)	Water quality and aquatic species data
New Mexico Interstate Stream Commission (ISC) and Office of the State Engineer (OSE)	Real-time monitoring of streams and ditches; groundwater level monitoring; water rights / permits
Bosque Ecosystem Monitoring Program (BEMP) at University of New Mexico (UNM)	Groundwater and surface water data

Community Collaborative Rain, Hail & Snow Network (CoCoRAHS)	Precipitation monitoring
Middle Rio Grande Conservancy District (MRGCD)	Irrigation data
City of Albuquerque (CABQ)	Return flow and storm water flow data; groundwater level measurements; water quality
Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA)	Storm water flow data; water quality
Bernalillo County / Sandoval County	Storm water flow data; water quality
Natural Resources Conservation Service (under United States Department of Agriculture)	Snow / precipitation data
National Oceanic and Atmospheric Administration (NOAA)	Weather / Climate data

New Mexico, along with other states and the nation, are moving toward the concept of open water data that is findable, accessible, interoperable, and reusable (FAIR). This movement, managed under NMBGMR as the NM Water Data Initiative (WDI), is directed by legislation and statute in New Mexico (from NM 2019 House Bill 651) that requires state agencies to improve data sharing, management and integration.

Water Data Initiative Schematic IT Infrastructure DRAFT April 2021

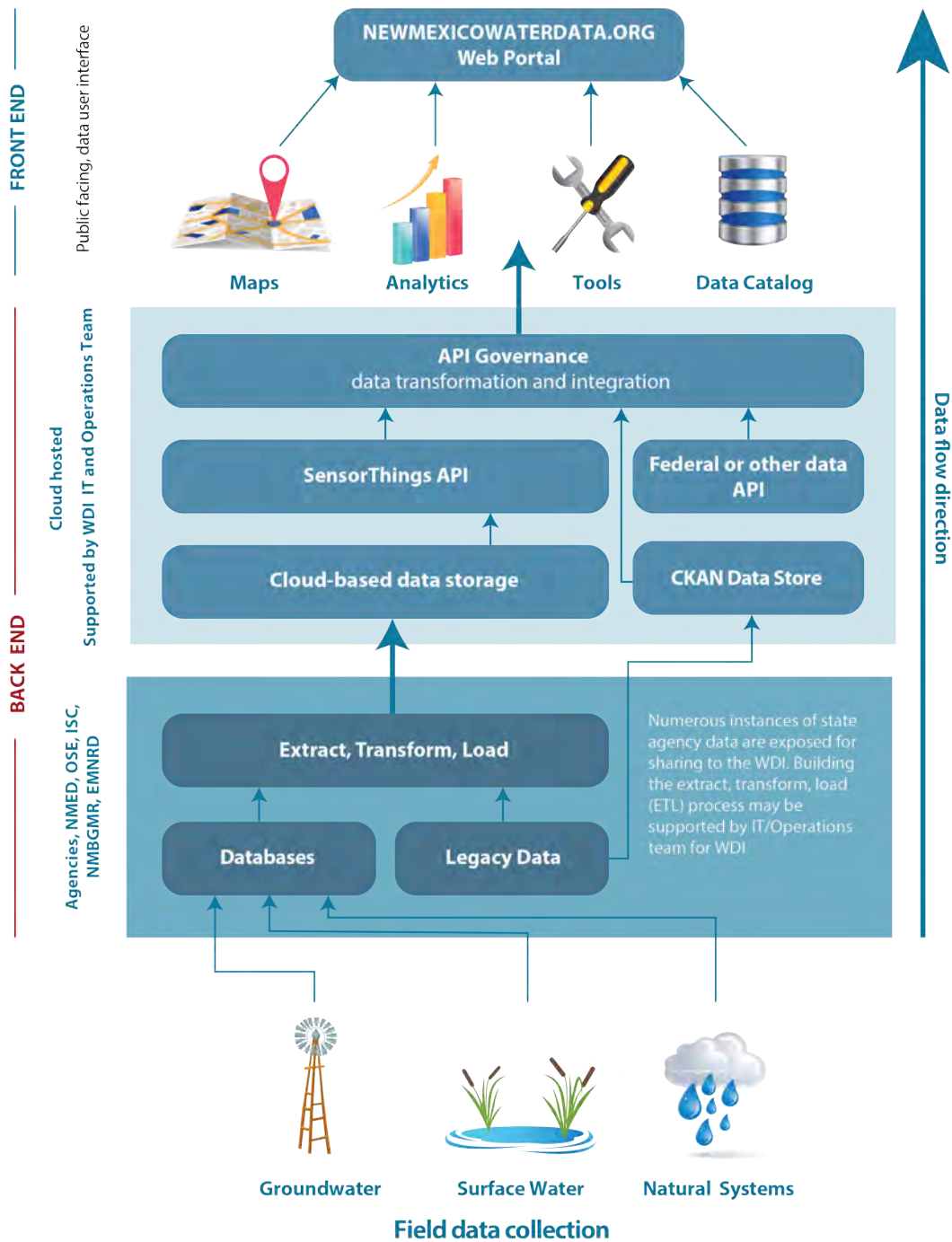


Figure 1. Working model for data flow in the New Mexico Water Data Initiative, where numerous agencies collect and provide data through various databases, loaded or exposed for further sharing, and integrated using the SensorThings API data format. As all of these machine readable, formatted data APIs are developed, they can be utilized for model development or applications like maps, graphs or charts in more human-readable uses.

The concept of “open water data” employed in the WDI is essentially building a federated data model, where data providers such as state agencies, host their water data that is ready for public consumption in a machine readable, common data format. To accomplish this for New Mexico, the WDI team is working to set up modern data sharing using Application Programming Interfaces (APIs), specifically working with Open Geospatial Consortium’s (OGC) internationally accepted SensorThings standard data format (see Figure 1). This API data standard provides a location-based, geospatially-enabled connection to unified water data that is especially helpful with time series data. Working with open-source tools and technology to build a long-term sustainable data platform which accommodates numerous data providers and data users requires many man-hours to help build.

At least three modeling projects are underway with the NMISC which can benefit from improved data access. One of these models relates to a 2019 WaterSMART Applied Science Project titled “Developing a Projection Tool for Otowi Index Supply and Elephant Butte Effective Index Supply.” This two year research project currently underway, which is designed to improve the forecasting and projection capability of the agency, will benefit from direct, API access to the most current data. This access will allow staff to run the model more quickly by reducing data compilation and manipulation time and improve confidence in model projections. Other modeling efforts in the NMISC include improving a groundwater – surface water model specific to a region of the Rio Grande (the San Acacia reach) included in this study. This model would directly benefit from incorporating data collected by NMBGMR, which includes numerous continuous monitoring stations for groundwater. Additionally, work on a new model application for integrated groundwater and surface water modeling (called “MIKE SHE”) is just beginning with the agency to address compliance with Endangered Species Act in the Rio Grande. This model can also benefit by having more direct access to both current and historical surface water, groundwater and precipitation data.

Model calibration and the accuracy of model predictions can be dramatically improved and streamlined by making real-time, near-real time, and historical data accessible in modern, machine-readable formats. Through collaboration with the data providers at the NMBGMR with direct support from the WDI, numerous existing water data features will be made more open and accessible to the NMISC (or others) for enhancing modeling capabilities and reducing staff time spent on data compilation, thereby improving water management decision-making and increasing flexible water operation options. Additionally, all modeling efforts can benefit from more access to water data for development, calibration / validation, and running model updates.

The idea behind this proposal is to improve several of the data “pipelines,” especially those in the state or local agency realm, to help make modeling work performed at the NMISC and water management decision making more efficient.

Objective 1 – Improve applicant data provision. Working with an existing data source at the NMBGMR, this project will work to build a robust agency internal data connection to the SensorThings API endpoint. Through this project the NMBGMR data collection team, internal data users and IT developer will provide QA/QC’ed groundwater data, improve sustainability of the API connection to the internal NMBGMR SQL database, and automate the dataflow to the fullest extent possible. Current practices involve manually running a set of Python scripts in a specific order to extract, transfer and load (ETL) into the API service

format and database. This fragile system will be replaced with a modern data orchestration platform to improve the existing connections and ease the additional of new data pipelines. The NMBGMR team can also help identify and evaluate other locally relevant data sources, review data and prepare for alignment with the preferred data model.

Objective 2 – Build data pipelines. Under this objective, discussions with staff at NMISC will refine the specific data needs and detail the current modeling and data management practices. These data will likely include the OSE / ISC Real Time monitoring data and other key data identified at the onset of this project as highest priority data needs for models in progress. Working with a contracted or hired developer or postdoc, with familiarity on water data and the WDI data format, additional data “pipelines” will be established to build additional APIs in the common (SensorThings) data format focusing on state or local datasets primarily. Similar to objective 1, support and guidance will likely be needed at agency or data provider level in order to prepare data for API connection. Developer support and funding proposed here will be used in this effort. Data will be hosted and integrated into the cloud-based New Mexico WDI platform, built on open source technology, described in Figure 1 above.

Objective 3 – Training and outreach. To enhance the accessibility and usability of open water data at the user endpoint of the data “pipeline,” we propose to provide support to the NMISC modeling staff on how to use and implement these modern API data streams into their models. Additionally, developer support may be needed to help build model and data integrations in a robust manner, providing a fairly automated process to quickly upload and connect models to the most current data features.

Outreach at the end of this project is intended to help provide information about successes and challenges faced in the process of creating more open water data for New Mexico. The NMBGMR and WDI team will provide several opportunities at webinars or conferences to share ideas on how this can be accomplished in other agencies, other regions, or other states. A periodic blog post and summary report of this work will be listed on the New Mexico Water Data website as well.

Funding provided in this opportunity will be used to:

- Improve data sharing options and practices directly at the NMBGMR in the region of study (Objective 1),
- Build new or improve existing data sharing practices for other data providers in NM (Objective 2)
- Support development costs either as a term-hired or contract developer or as a post-doc (Objective 2), and
- Provide training and implementation of data uses with models, with outreach and education on this project to other data users in NM or the West (Objective 3).

Project Location

The work proposed will build improvements to water data access in the middle Rio Grande region of New Mexico. Specifically, the region of interest for the NMISC and NMBGMR is the section of the Rio Grande from approximately the Otowi Bridge gage south of Espanola, NM to the Elephant Butte Reservoir (See Project Location, Figure 2). Datasets collected in this region are distributed in the region and collected over

various frequencies (minutes, hourly, daily, monthly, annually or less), hosted at a range of organizations, some of which are listed in Table 2.

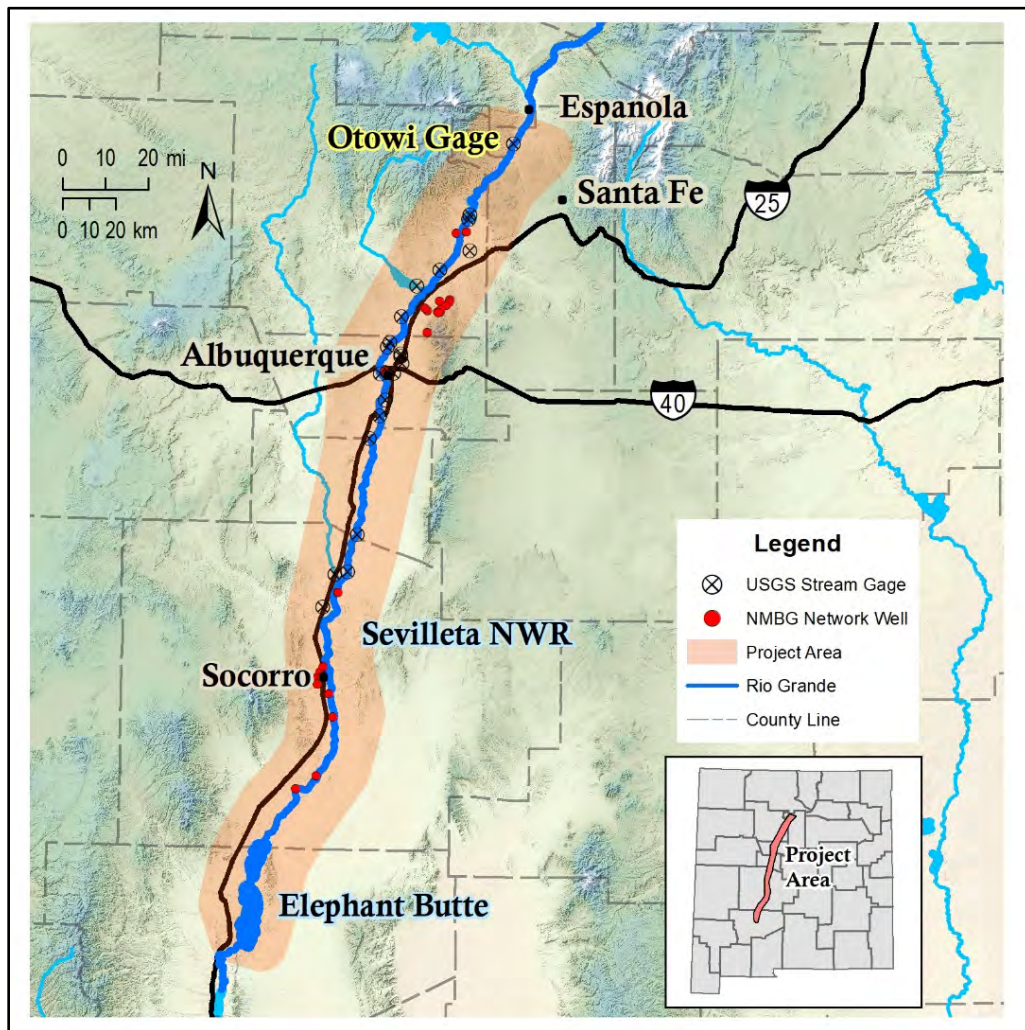


Figure 2. Approximate project location in New Mexico along the Rio Grande, from Otowi gage to Elephant Butte. Some potential data of interest show on this map are also listed in Table 2.

Data Management Practice

For this project, the data is expected to be cloud-hosted in a federated data model using open source technology to the fullest extent possible. This means that the agencies/entities collecting the data will share and expose data for their agency, and that they will use their own internal best management practices for data management.

To accomplish this for New Mexico and for the middle Rio Grande region, the WDI team is setting up modernized data sharing services using Application Programming Interfaces (APIs), specifically working with Open Geospatial Consortium's (OGC) internationally accepted SensorThings standard data format (Figure 1, <https://www.ogc.org/standards/sensorthings>). This API data standard provides a location-based,

geospatially-enabled connections to unified water data that is especially helpful with time series data. This project would work on building the data API “pipelines” that bring data from agency or cloud hosted datasets, into the SensorThings data model, and then to the NMISC data modeling needs. This project will work in a secure, cloud-based server environment, using open-source tools and technology to build a long-term sustainable data platform which accommodates numerous data providers and data users.

Because data can be extracted and filtered from the API platform in common machine-readable formats, with associated location information, the data will work readily in any geospatial platform or GIS software, as the project requires.

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.

Evaluation Criteria

Evaluation Criterion A — Benefits to Water Supply Reliability

Water management issues addressed

Building improvements to data connections to support modeling efforts in the NMISC can have multiple benefits related to water supply and **building increased reliability** along the middle Rio Grande. The area of focus for data on this project is approximately from Otowi gage to the Elephant Butte reservoir, particularly related to data associated with Rio Grande flow and irrigation management. Management and operations of water in this region is one of the most challenging endeavors for the state of New Mexico (and its federal partners), as it impacts some of the largest population centers of the state, a large irrigation district (Middle Rio Grande Conservation District), several tribal partners, municipalities, and an increasingly fragile river ecosystem / habitat.

In recent years, drought, along with increasing aridity and climate change, has made water management in this region even more challenging (See Figure 3). Water managers must become more prepared for quick

analysis and decision making, where they need to pivot to alternative water management strategies. Having quick, ready access to quality data and more efficient modeling tools is foundational in this challenge.

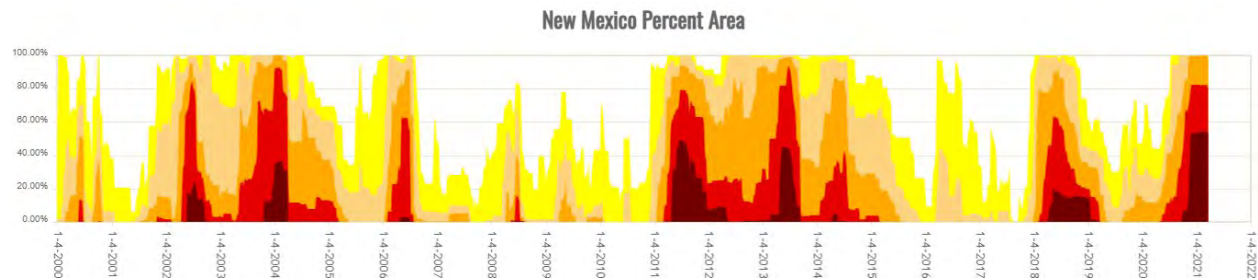


Figure 3: This graph illustrates the percent area of New Mexico in drought since 2000, with worst level of drought (D4) as darkest color red, ranging to less severe drought area as lightest yellow shade (D0).

Related to conflicts over water in this region, as data are standardized from the numerous sources, the various water management entities in the region (state, local, federal, and tribal) can all access and see the same datasets, which can also help **reduce conflict** around water. Also, a substantial number of staff hours are spent in several water management agencies attempting to compile and work with water data. By providing water data in a common format, in a machine-readable data “pipeline”- staff hours can instead be used to address the issues and communicate with stakeholders, thereby reducing potential conflict.

How project will address water management issues

In most years, New Mexico’s water is limited by climate and drought conditions, and little can be done to increase the overall natural supply. However, having ready access to the data describing how exactly water is changing in the region can help provide more **reliability** and consistency in decision making. Data of interest in this region, and for the overall WDI, relate to all aspects of water data, including groundwater, surface water, water quantity, water rights, water quality, and biological / aquatic life indicators. By providing several of these data through this data “pipeline” process, the NMISC as a participant in this project can demonstrate usability and improved efficiency of modeling.

There are numerous other “downstream” impacts of building these data “pipelines” and improving the access points for data. In addition to the NMISC, other water management agencies in the middle Rio Grande, can also access these open data to **help improve water management and deliveries**. Models utilized from other federal organizations, from tribal water authorities, or from a municipal water management perspective – all can be improved with access to modern open data sources. Developers and researchers anywhere in the world can also access these data, providing a “crowd sourced” opportunity to highlight the WaterSMART grant program as well as the success in this region of New Mexico.

Opportunities to actively manage water rights, permits, diversions or depletions along a dynamic and complex river system like the Rio Grande, with highly interconnected groundwater and surface water, requires great detail and data all along the river corridor and irrigated regions. Unfortunately, there are some significant data gaps, but by bringing multiple large (federal or state) datasets together with other smaller (community, municipality, or citizen science) datasets, we can begin to see where the real data collection gaps exist. Understanding the nuances of the water budget, through improved modeling with

machine-readable data access and more complete, interactive datasets, can enable dynamic water management decisions, such as **water marketing** or water banking, **drought management**, and **conjunctive management** of all water along the Rio Grande and in the watershed.

In New Mexico, the Office of the State Engineer is charged with addressing **water rights priorities and administration**, having more of the data required to establish water markets or water banking, will potentially improve ecosystem support for endangered species. Ideally, with improvements to water data access and use in models at the NMISC, processing and evaluation of water transfers can happen more efficiently. For example, in drought years such as 2021, with API access to real time data on surface water and groundwater, models can be with the most up-to-date data available. Irrigators or water managers can then quickly evaluate their options to transfer water from irrigation to support **endangered species**, such as the Rio Grande silvery minnow, Southwestern willow flycatcher, and the New Mexico meadow jumping mouse.

Extent of benefit

The largest benefit of this project, in which water data access is improved, is in building greater modeling and water management efficiency, reliability, and helping water managers be more agile in times of drought. The desire for improved access to water data has echoed throughout the state of New Mexico, as reflected in the 2018 State Water Plan (<https://www.ose.state.nm.us/Planning/index.php>). Our partner in this project, the NM Interstate Stream Commission, can directly benefit from having ready access to API endpoint water data, set in a common format – but so can numerous other agencies and developers interested in working with water data. Through the lens of open water data - new and creative ideas for increasing water reliability, improving water deliveries, water marketing or banking related to water rights or actual water, agile management of water during drought conditions, or providing water for ecosystem and watershed management – all come into focus. In a modern data realm, coordination of agencies and water managers can be improved, thereby making opportunity for more creative approaches and ideas.

Complementary projects

This proposed work is directly complementary to a 2019 WaterSMART Applied Science Project underway currently at the NMISC related to “Developing a Projection Tool for Otowi Index Supply and Elephant Butte Effective Index Supply.” This two year research project is designed to improve the forecasting and projection capability of the agency, and will directly benefit from the improved access to data provided in this project. The model under development will benefit from direct, API access to the most current data, allowing staff to run model projections without the need to compile and manipulate data into models manually.

Numerous other state and federal agencies work with water data for modeling needs, such as the models in development or in use at the NMISC. A model specifically focused on water management and delivery challenges in the San Acacia reach of the Rio Grande is under development. The model aims to address daily time-scale impacts of overbank flows on groundwater and flow into the Low Flow Conveyance Channel (LFCC). This model couples FLO-2D with MODFLOW and would benefit from having more with direct access to real-time and near real-time data. A new model process, called MIKE SHE, at the NMISC is also beginning, which is supporting management of endangered species and compliance with the

Endangered Species Act. Any of these modeling efforts can benefit from more access to water data for development, calibration / validation, and running model updates.

The current hydrologic model of use in this region of the Rio Grande is the Upper Rio Grande Water Operations Model (URGWOM), managed by the US Army Corps of Engineers (<https://www.spa.usace.army.mil/Missions/Civil-Works/URGWOM/>). This model, based in RiverWare software, utilizes data from many of the same agencies listed as data providers in this proposal. However, the data are imported into the URGWOM model using their data management interface. It is expected that some of the data, especially state datasets from NMISC and OSE, made available through the APIs in this proposal can also improve efficiency of model operations with the URGWOM model.

Work on this project is also directly complementary of NMBGMR's 2019 WaterSMART Applied Science Grant, A Water Data Pilot Project: Building Improved Data Management and Decision Support Tools for the Lower Pecos Valley. This project is a 3 year project, currently underway, which focuses on the Pecos River watershed and making data accessible specifically at the Pecos Valley Artesian Conservancy District and combining it with other regional datasets to build visualizations to support decision making. There are similar datasets of interest in the Pecos project as for the Rio Grande, and this is an excellent opportunity in this proposal to keep momentum going toward more open data for New Mexico, with learning opportunities applicable across the West.

The New Mexico WDI is complementary to national efforts (i.e. data.gov) to make data open and interoperable. The WDI was created in part because New Mexico has no other related ongoing projects to integrate water management data in one location. Many states face this same situation, and this proposal provides an exciting opportunity for USBOR to provide support to help other states learn more modern tools to share and access data.

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

Data access by a standardized API format is perhaps one of the most high impact applied science tools currently being used to modernize water data. 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 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 ideas and tools developed through this pilot project can easily be repurposed.

The need for increased accessibility of state level water data has been identified by regional and federal organizations such as the Water Foundation and the Internet of Water (<https://waterfdn.org/get-to-know-6-programs-driving-open-water-data/>, <https://internetofwater.org/resources/learning-center/>). Specific to New Mexico, in the recently completed (2018) State Water Plan, access to data was identified as one of eight top priorities for the state. This is in part why New Mexico enacted the Water Data Act, NMSA 1978, §72-4B, after the 2019 House Bill 651 was passed.

Our partner on this project, the NMISC, has also recognized the need for improved access to water data for their modeling needs. This improved access will help eliminate some of the key challenges the NMISC faces when working integrated water data, especially from state agencies. Additionally, staff at NMISC (and with other state agencies) can benefit from training on how to use more modern data APIs in their model

development, which is proposed in this project as well. With the NMISC's current WaterSMART project, as mentioned above, there is also direct and immediate benefits to developing several of these state water data "pipelines" or APIs.

Making New Mexico water data more accessible to anyone in the world, including federal agency partners in water management or neighboring states, is a tremendous learning opportunity. Using open source software tools or modern development practices makes it easier for other states to adopt and adapt the concepts developed in this project. Currently, WDI is using a wide range of open source products such as CKAN (a data sharing catalog), FROST (a SensorThings API implementation), and GitHub for sharing and review. Data platforms, web applications, and media reports will be shared publicly. 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.

Evaluation Criterion C — Project Implementation

Project implementation plans

See Figure 4 for timeline of objectives listed below, starting approximately fall of 2022 and ending in fall of 2024.

Objective 1 – Improve applicant data provision. NMBGMR team will provide QA/QC'ed groundwater data to an internal SQL database, improve sustainability of the API connection to the internal NMBGMR SQL database, and automate the dataflow to the extent possible using a modern workflow orchestration tool such as Airflow. The current practice involves manually running a set of Python scripts in a specific order to extract, transfer and load (ETL) data into the SensorThings database. These existing scripts will be modified to work in a workflow tool so that the process is fully automated and monitored. Small improvements to the NMBGMR internal data collection workflow will also be implemented, for example improvements to the existing data entry and data review applications. The NMBGMR team can also help identify and evaluate other locally relevant data sources, review data and prepare for alignment with the preferred data model.

Timeline for this work is expected to occur in year 1, with completed and revamped SensorThings API endpoint for NMBGMR water data provided by end of year as deliverable. Staff involved include field data collectors to help collect and compile data, hydrogeologists to review data from NMBGMR and other data sources, data managers and developers/ IT support to create and document process for a robust API endpoint.

Objective 2 – Build data pipelines. Phase 1 of this objective will be completed within 2 months of project initiation, where we will complete discussions with modeling staff at NMISC and other staff to refine the specific data needs and current modeling and data management practices.

Phase 2 of this objective begins with developing a detailed scope of work for a contracted, term-hired, or post-doc developer with familiarity on water data and the WDI data format. During Phase 2, additional data "pipelines" will be established to build and provide full documentation of additional APIs in the common

(SensorThings) data format focusing on state or local datasets primarily. Similar to objective 1, support and guidance will likely be needed at agency or data provider level in order to prepare data for API connection.

Timeline for completion of Objective 2 is 1.5 years, with Phase 1 complete in 2 months, and Phase 2 concurrent with Phase 1 and completed in 18 months.

Objective 3 – Training and outreach. Addressing the need for the user endpoint of the data “pipeline,” Objective 3 will be addressed in the final six months of this project by providing training to NMISC staff to support use and implementation of these modern API state or local datasets, in addition to federal API datasets. As needed, developer support can help build model and data integrations in a robust manner, providing a fairly automated process to quickly upload and connect models to the most current data features. With new access to several state datasets, including some from NMBGMR, OSE, and NMISC and others identified in Objective 1, the NMBGMR and WDI team will provide at least 2 opportunities at open webinars to share ideas on how this data can be accessed and how open data can be accomplished in other agencies, other regions, or other states. Outreach at the end of this project is intended to help provide information about successes and challenges faced in this process of creating more open water data for New Mexico. A periodic blog post and summary report of this work will be listed on the New Mexico Water Data website as well.

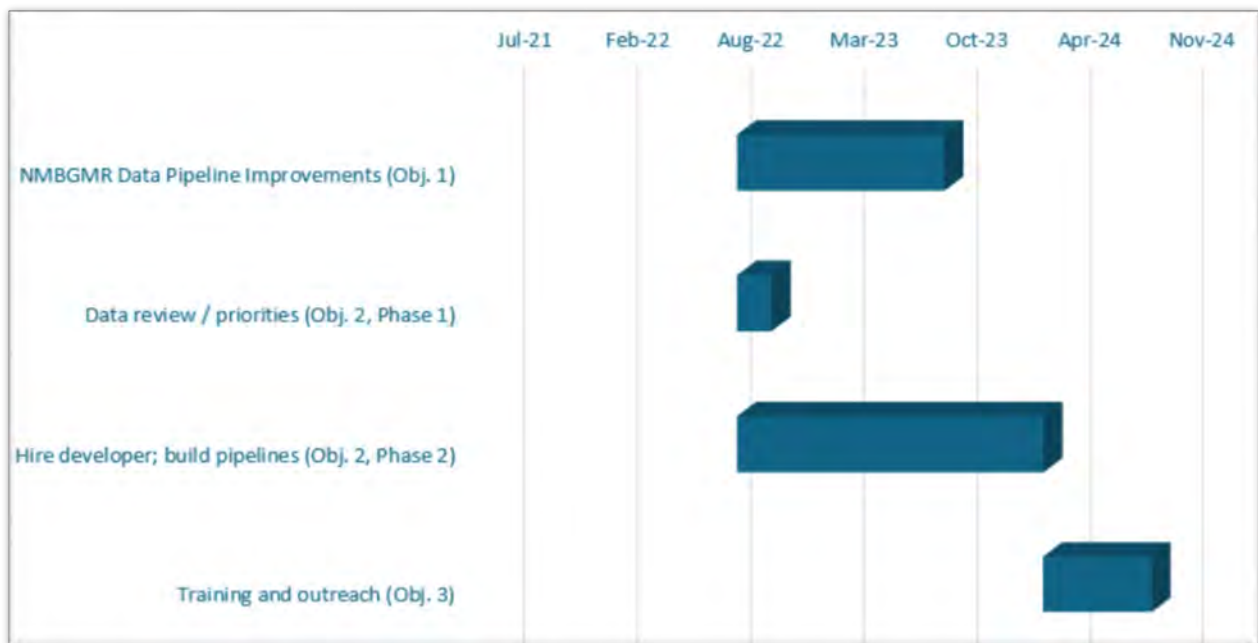


Figure 4. Approximate Gantt chart for timeline of three objectives for this 2 year project.

Staff credentials

Staff members working on this project, on behalf of NMBGMR, include the full spectrum of impact for a data “pipeline.” From data collection, data management and compilation, to full-stack developer support – the team is described in Table 3. As the agency named in New Mexico statute as the convener of the Water Data Act NMSA 1978, §72-4B, the team listed in this project are capable of supporting this project. Through

this project, we would seek to bring in an additional developer to help establish several new data “pipelines” for state and local datasets in the preferred API data format. Qualifications for this team member who would support this project for approximately 18 months would be evaluated in the hiring process (as a contractor, term-hire, or post-doc).

Table 3. Potential staff / roles to work on this proposed project.

Staff	Project Role	Credentials	Years of Experience	Area of Expertise
Stacy Timmons	Project Lead	MS Geology	18	WDI Project Leader
Laila Sturgis	Project Manager	MS Hydrology	17	Water Resource Management and Planning
Dave Kasefang	Database IT Manager	MBA	35	Network System Administrator
Cathryn Pokorny	Data Manager	MS Natural Science	18	Data Management
Ethan Mamer	Hydrogeologist	MS Hydrogeology	8	Data Collection and QA/QC
Jake Ross	Developer	PhD Geochronology	12	Technical Lead WDI, Full stack developer
TO BE HIRED or contracted	Developer(s)	PhD, experienced developer hire or contractor		API development and support

The Applicant is the project lead for the statewide Water Data Initiative (<https://newmexicowaterdata.org/>). Additionally, this staff team has worked on several data assimilation and data sharing projects over the years, including establishing a water data interactive map service supporting the New Mexico Environment Department (i.e. <https://maps.nmt.edu/>). Working with the IT staff and NMBGMR-WDI Lead Developer, the skills to build a robust internal and support external data “pipeline” connections is covered.

Under Objective 1, for data collection, assimilation, processing and data management, the team members listed on this project have years of experience working through water data, as part of the Aquifer Mapping Program and the state’s Collaborative Groundwater Monitoring Network. Following protocols comparable to USGS for field data collection, data processing and management in an enterprise SQL database, this team is well equipped to help bring additional data resources to the Rio Grande region.

If selected for this project, no delays in participation are expected.

Evaluation Criterion D — Dissemination of Results

The end products of this proposed work are robust water data APIs, with additional descriptive metadata. All water data for this project and the New Mexico WDI will be listed on the open source platform CKAN (<https://catalog.newmexicowaterdata.org/>), making sharing of project results straightforward and beneficial to the community in New Mexico and beyond. In addition to our website (<https://newmexicowaterdata.org/>)

and our newsletter mailing list, numerous services have also been set up through the WDI for sharing, including cloud-based servers, social media outlets (Facebook, Instagram, Twitter, YouTube, Slack, and LinkedIn) and a GitHub repository (<https://github.com/NMWDI>). All products developed through this project can be made available through any of these outlets, useful to water managers and data users, and to the broader New Mexico WDI collaboration and the public.

Water data “pipelines” will be made directly accessible for the NMISC modeling team as the primary beneficiary and through this project, training will be provided to help them quickly and efficiently access any of the data resources developed through this project.

For this project, and in alignment with goals of the WDI, the NMBGMR and WDI team will provide opportunities at open webinars to share information on how data can be accessed and how open data can be accomplished in other agencies, other regions, or other states. Outreach at the end of this project is intended to help provide information about successes and challenges faced in this process of creating more open water data for New Mexico. A periodic blog post and summary report of this work will be listed on the New Mexico Water Data website as well.

Project Budget

Funding Plan

The New Mexico Bureau of Geology and Mineral Resources (NMBMGR) serves as the state geologic survey and is a research division of New Mexico Institute of Mining and Technology (NMIMT). Our agency has existed since 1927, and has been part of the state's annual budget under the Higher Education apportionment. The NMBGMR staff time on this project, working toward improvements of data delivery internally and supporting other external data sources will be provided as cost match derived from the NMBGMR portion of the NMIMT annual budget. This proposal is reviewed internally at NMIMT prior to submittal, therefore, submission of this proposal is commitment to the cost-match funding. The NMISC is not contributing funding to this project, but is a partner under the Category A description in the associated NOFO.

Budget Proposal

The budget proposed here is for a 2 year timeline with a 50% match from NM State Funding at NMIMT – NMBMGR.

SOURCE	AMOUNT
Costs to be reimbursed by Federal funding	\$195,050
Cost to be paid by applicant	\$196,660
Third party contributions	0
TOTAL PROJECT COST	\$391,710

BUDGET ITEM DESCRIPTION	COMPUTATION		Quantity Type	Total Cost
	\$/Unit	Quantity		
Salaries and Wages				
Project Lead/WDI Liaison (ST)	\$40.25	625	Hourly wage	\$25,156
Project Manager (LS)	\$32.05	625	Hourly wage	\$20,031
Database/IT Manager (DK)	\$34.00	325	Hourly wage	\$11,050
Data Manager (KP)	\$25.18	625	Hourly wage	\$15,738
Hydrogeologist (EM)	\$25.66	625	Hourly wage	\$16,038
Developer (JR)	\$28.06	700	Hourly wage	\$19,642
Fringe Benefits				
NMBGMR employees (average rate 55.47%)				\$59,716
Equipment (none)				
Supplies and Materials				
Other (Travel)				
Contractual/Construction				
Developer (contract/ term hire/ post doc(s))	\$100	1500	Hourly wage	\$150,000
Training (contract/ term hire/ post doc(s))	\$100	160	Hourly wage	\$16,000
TOTAL DIRECT COSTS				\$333,370
Indirect Costs				
CESU Rate NM Institute of Mining and Technology	17.5%	\$333,370		\$58,340
TOTAL ESTIMATED PROJECT COSTS				\$391,710

Budget Narrative

The budget proposed here is for a 2 year timeline with a 50% match from NM State Funding at NMIMT – NMBMGR. The indirect rate used falls under the national network - Cooperative Ecosystems Studies Units (CESU) Rate, for which NMIMT is a participant. For proposal purposes, we use the Average Fringe Benefit rate for full-time employees at NMBMGR, which is 55.47% at this time (<https://www.nmt.edu/finance/spa/docs/Fringe%20Benefits%20Rates%20July%202020.pdf>).

No travel, equipment, material/ supplies or environmental/regulatory compliance costs are expected for this proposed work. For estimates of the Developer costs, we listed the expense under Contracts for planning purposes at \$100/hour, however, this may be feasible/ preferable as a part time staff hire or post doc. Developer costs can range from \$40/hr to upwards of \$200/hr. Assuming this work will be completed within approximately 18 months, at a part-time estimate of about 1660 hours for Development and Training, we expect this work of establishing several new SensorThings API data “pipelines” can be accomplished within the funding proposed here. We have used a conservative estimate, at \$100/hr for this proposal and it is

expected this would be sufficient funding for a contractor, a temporary staff hire, or a post-doctoral student hire.

Environmental and Cultural Resource 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.

Letters of Support

See attachments in Grant.gov submittal for letters of participation and support.

Official Resolution

See attachments in Grant.gov submittal for Official Resolution letter.

NEW MEXICO INTERSTATE STREAM COMMISSION

COMMISSION MEMBERS

MARK SANCHEZ, Chair
BIDTAH BECKER, Vice-Chair
JOHN R. D'ANTONIO JR., P.E., Secretary
ARON BALOK, Commissioner
GREGORY CARRASCO, Commissioner
PAULA GARCIA, Commissioner
MIKE HAMMAN, Commissioner
STACY TIMMONS, Commissioner



BATAAN MEMORIAL BUILDING
ROOM 101
P.O. BOX 25102
SANTA FE, NEW MEXICO 87504-5102
(505) 827-6160
FAX: (505) 827-6188

April 6, 2021

U.S Bureau of Reclamation
Water Resources and Planning Division
Attn: Ms. Avra Morgan,
P.O. Box 25007, MS 84-51000
Denver, CO 80225
C/O Stacy Timmons, NM Bureau of Geology and Mineral Resources

RE: WaterSMART- Applied Science Grant (Opportunity No. R21AS00289) Partnership

Dear Ms. Morgan:

This letter is written on behalf of the New Mexico Interstate Stream Commission (NMISC), a state agency with the role of investigation, protection, conservation, and decision support for development of New Mexico's waters including both interstate and intrastate stream systems.

The New Mexico Bureau of Geology and Mineral Resources, along with the New Mexico Water Data Initiative, is submitting a proposal for the Bureau of Reclamation WaterSMART- Applied Science Grant for Fiscal Year 2021 (Opportunity No. R21AS00289) for a project relating to developing **improved data access in the Rio Grande Basin**. The NMISC intends to participate as a partner in this project by coordinating data access for multiple modeling efforts underway in our agency. One of those projects is a funded 2019 WaterSMART project our agency has been working on related to building an improved projection tool for Otowi Index Supply and Elephant Butte Effective Index Supply in the Middle Rio Grande Basin. The Bureau of Geology's project would support and improve upon our project and we would be pleased to coordinate on the effort.

With this letter, the NMISC agrees to participate in the project as a partner, especially by providing input and feedback on usability and access to key data needed for our modeling efforts. We hope to utilize data products developed through this Applied Science grant upon its completion in two years.

Please feel free to contact Dr. Shalamu Abudu at shalamu.abudu@state.nm.us if you need any additional information.

Sincerely,

Rolf Schmidt-Petersen, Director
NM Interstate Stream Commission

cc: Page Pegram, Rio Grande Basin Manager, NMISC
Shalamu Abudu, Chief Modeler, NMISC



**DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, ALBUQUERQUE DISTRICT
4101 JEFFERSON PLAZA NE
ALBUQUERQUE, NM 87109-3435**

SPA-ECH-W

13 April 2021

To: Ms. Avra Morgan,
Bureau of Reclamation
Water Resources and Planning Division

Subject: Letter of support for NMBG's WaterSMART Grant

Dear Ms. Morgan:

The US Army Corps of Engineers, Albuquerque district, Civil Works authorities include flood risk management, water supply monitoring and emergency response operations. Our water management mission is to maintain and operate several reservoirs, as well as hydraulic/hydrologic modeling efforts for major basins in New Mexico and Southern Colorado, including the Rio Grande basin. This letter relates to support of a proposal being submitted by the NM Bureau of Geology and Mineral Resources, and the NM Water Data Initiative, to the US Bureau of Reclamation WaterSMART- Applied Science Grant for Fiscal Year 2021 (Opportunity No. R21AS00289).

With this letter, we support the concepts and work in this proposal as it relates to developing improved state data access in the Rio Grande Basin. This work will improve the process of updating basin's hydrologic models such as the Upper Rio Grande Water Operations model (URGWOM). We are looking forward to utilizing data products developed through this Applied Science grant.

Sincerely,

Nabil Shafike, P.E., Ph.D.
Chief, Water Management Section

C/O Stacy Timmons
NM Bureau of Geology and Mineral Resources

Letter of Support - NMBGMR Applied Science Grant Proposal, Notice of Funding Opportunity No. R21AS00289

2 messages

McKenna, Yvette R <yrmckenna@usbr.gov>

Fri, Apr 16, 2021 at 1:19 PM

To: Stacy Timmons <stacy.timmons@nmt.edu>

Cc: "Llewellyn, Dagmar K" <dllewellyn@usbr.gov>, "Gelderloos, Andrew R" <agelderloos@usbr.gov>, "Donnelly, Carolyn E" <CDonnelly@usbr.gov>, "Barrett, Lucas J" <lbarrett@usbr.gov>, "Wilber, James P" <JWilber@usbr.gov>

Stacy Timmons
New Mexico Bureau of Geology and Mineral Resources
[801 Leroy Place](#)
[Socorro, NM 87801](#)

Subject: Letter of Support
New Mexico Bureau of Geology Applied Science Grant Proposal
Notice of Funding Opportunity No. R21AS00289

Dear Ms. Timmons,

On behalf of the Deputy Area Manager, James Wilber, and the Office of the Albuquerque Area Manager, this letter is provided in support of the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) proposal for funding to the Bureau of Reclamation's Notice of Funding Opportunity No. R21AS00289 – WaterSMART – Applied Science Grant for 2021. The NMBGMR fits in Category A, under the New Mexico Institute of Mining and Technology (a university). Of note, the NMBGMR is the convener of the New Mexico Water Data Initiative (WDI), an effort to organize, modernize and integrate the state's water data. This proposal builds on the New Mexico WDI's Reclamation-funded 2019 Applied Science Grant: New Mexico Water Data Initiative and Regional Pilot Project for Improved Data Management and Decision Support Tool in the Lower Pecos Valley. This project is proposed in partnership with the New Mexico Interstate Stream Commission (NMISC), a Category A partner. The NMISC is a state agency with a role of investigation, protection, conservation, and decision support for development of New Mexico's waters including both interstate and intrastate stream systems. This proposal also builds on the NMISC's Reclamation-funded 2019 Applied Science Grant: Developing a Projection Tool for Otowi Index Supply and Elephant Butte Effective Index Supply.

The work proposed will build improvements to water data access in the middle Rio Grande region of New Mexico. This project aims to improve the flow of data from producer to consumer using modern software technologies, such as Application Programming Interfaces (APIs). These APIs allow various federal, state and local data providers to easily serve data to the end-point users for use in water modeling and decision support tools, for example. Current practices in water modeling can be dramatically improved and streamlined by making available data accessible in modern, machine-readable formats. Through collaboration with the data providers at the NMBGMR and others, and with direct support from the WDI, numerous existing water data features will be made more open and accessible to the NMISC (and others). Funding will be used to improve data sharing options and practices directly at the NMBGMR in the region of study, support development costs, and provide training and implementation of data uses with models.

Water management in New Mexico relies heavily on modeling efforts and robust datasets to help inform the models. The project proposed here can enhance modeling capabilities for the NMISC (and others) through more reliable and direct access to real-time, near real-time, and historical water data. This project will improve access to and use of water resources data, including Reclamation's, by building data "pipelines" for numerous federal, state and local water datasets, and improving the ease of moving data from producer to consumer. The end products of this proposed work are robust water data APIs, with additional descriptive metadata. Reclamation, and particularly the Albuquerque Area Office (AAO), Upper Colorado Basin Region, will also benefit from these improvements and enhancements through its various water operations, accounting, and planning activities.

If you have any questions or need additional information, please contact the AAO Applied Science Grants points of contact: Dagmar Llewellyn, at (505) 462-3594 (dllewellyn@usbr.gov) or Andrew Gelderloos, at (505) 462-3570 (agelderloos@usbr.gov).

Best wishes on your endeavors,

[Yvette](#)

Yvette Roybal McKenna

Water Management Division Manager

Albuquerque Area Office

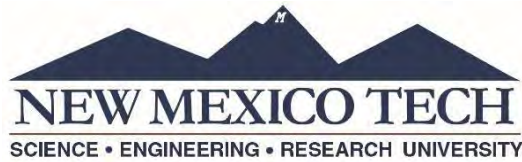
Bureau of Reclamation

Interior Region 7 - Upper CO Basin

O:505-462-3640 | C:505-414-3951

Timmons, Stacy <stacy.timmons@nmt.edu>
To: "McKenna, Yvette R" <yrmckenna@usbr.gov>

Fri, Apr 16, 2021 at 2:46 PM



Office of the Vice President for Administration and Finance

April 5, 2021

To: U.S. Department of the Interior (DOI)
Office of Bureau of Reclamation

Subject: Official Resolution for Notice of Funding Opportunity Number: R21AS00289


To Whom It May Concern:

This letter is to indicate New Mexico Institute of Mining & Technology's commitment on behalf of the New Mexico Bureau of Geology & Mineral Resources to entering into an agreement with the Bureau of Reclamation. New Mexico Institute of Mining & Technology will also commit to providing the required cost share of 50% of the total project costs for the proposal titled: NM Water Data Initiative: Improving Water Data Access for Modeling in the Middle Rio Grande. The Principal Investigator (PI) is Stacy Timmons, Associate Director of Hydrology Programs at the NM Bureau of Geology & Mineral Resources.

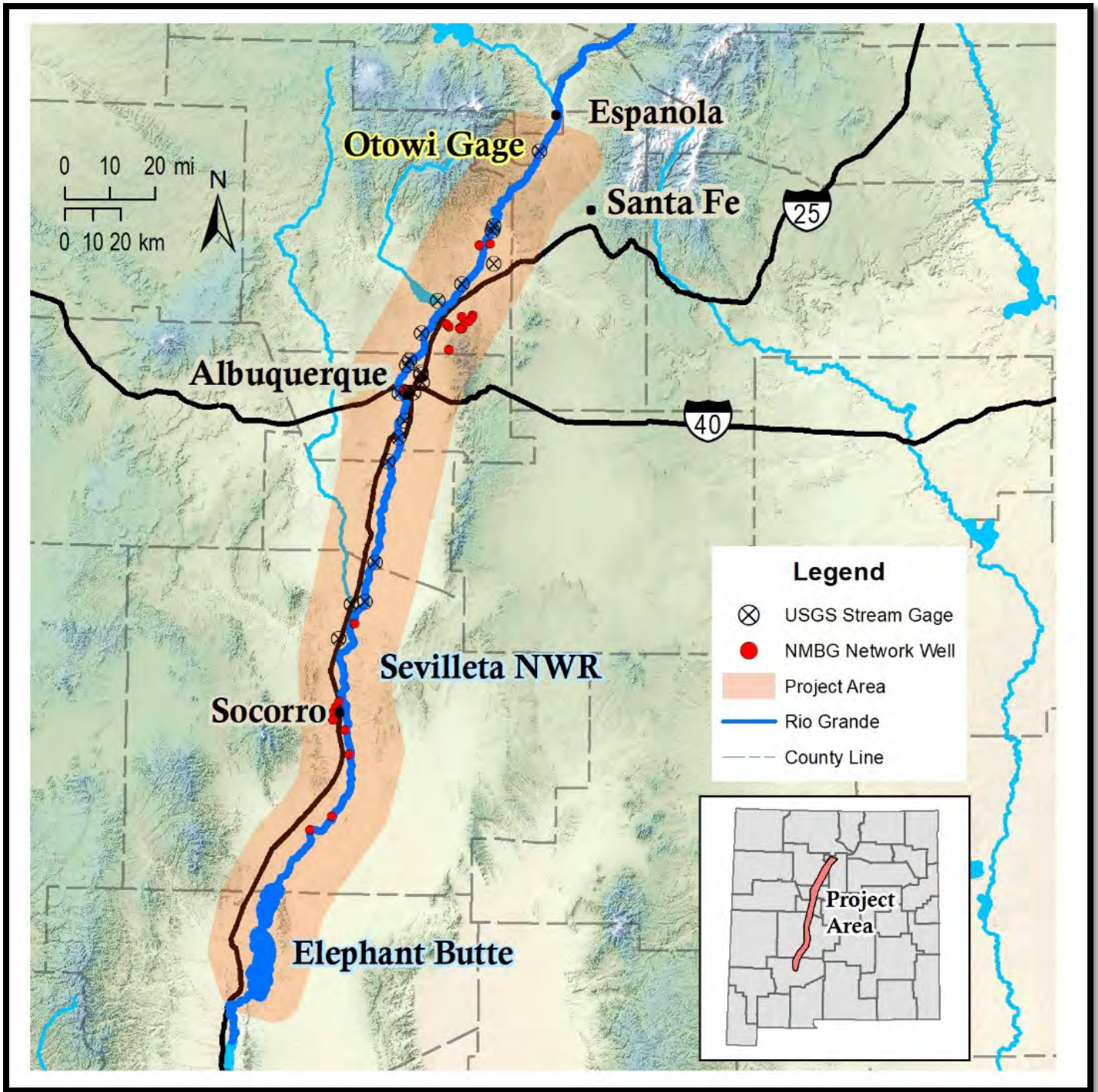
Federal funding in the amount of \$195,050 is requested from Bureau of Reclamation for this project. New Mexico Institute of Mining & Technology will contribute 50% of mandatory cost-share. The cost share in the amount of \$196,660 will be funded by state appropriations and will include salary, fringe benefits and applicable indirect costs.

New Mexico Institute of Mining and Technology is an Educational Institution and subject to and compliant with the requirements of 2 CFR 200 and New Mexico Tech's internal policies.

Sincerely,


Cleve McDaniel, PhD
Vice President for Administration and Finance

801 Leroy Place • Socorro • New Mexico • 87801 • www.nmt.edu
Telephone: 575.835.5606



Approximate project location, in New Mexico, along the Rio Grande from Otowi gage to Elephant Butte Reservoir.