Case Study: Bear Canyon Recharge Project

Incentivizing Groundwater Recharge

Case Study #2

Working Draft

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Center for Law, Energy, and the Environment
UC Berkeley School of Law

This case study is part of a series focusing on incentives for Managed Aquifer Recharge, and the institutional context in which MAR projects are conducted. The series is being produced as part of a larger project examining this topic. A symposium on September 10, 2019 will highlight these and other projects. More information is available at law.berkeley.edu/recharge2019.

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Bear Canyon Recharge Project

Incentivizing Groundwater Recharge – Case Study #2

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Overview

Location: Albuquerque, NM
Motivation for MAR: Drought reserve; store unused shares of Colorado River for future use
Groundwater Challenges: Declining groundwater levels
MAR Challenges: Lengthy and new permitting process; tracking infiltration and demonstrating proof of concept
Project Goals: Develop a drought reserve for municipal use
Key Actor(s): Albuquerque Bernalillo County Water Utility Authority (Water Authority)
Water Source: Surface water imported from the Colorado River Basin
Start Date: 2008-2009 (demonstration project); 2014 (full-scale)
Current Status: Fully implemented
Project Results: 3,000 AFY (permitted); 600 AF, every other year (actual)
Cost: $1.5M (estimated, initial permitting and construction); $60,000 (estimated yearly cost)

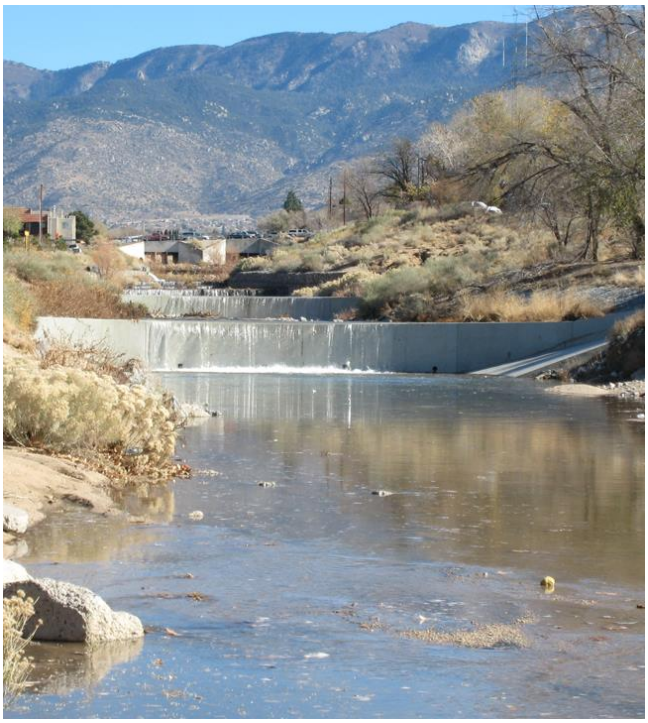

Figure 1 Bear Canyon Recharge Project. ABCWUA.

1. Motivation and Goals

The Bear Canyon Recharge Project was developed by the Albuquerque Bernalillo County Water Utility Authority (Water Authority) in order to create a drought reserve for future municipal use. The project utilizes portions of the Water Authority's Colorado River water that are unneeded in a given year, delivering them to an arroyo channel where they infiltrate into the aquifer.

2. Geographic and Historical Context

Bernalillo County, home to Albuquerque, is the most populous county in New Mexico. It varies in elevation from approximately 4,500 feet in the Rio Grande River Valley to 6,500 feet in the foothills of the nearby Sandia Mountains.[1] The county's climate is classified as cold semi-arid, with its inhabitants experiencing four distinct seasons and approximately 3,415 sunshine hours per year.[2] The summer months, from July to September, are characterized by afternoon

thunderstorms, with monsoon season falling mainly in July and August. The area receives varied levels of rainfall, ranging from an average of less than 9 inches annually in Albuquerque to nearly 15 inches in the Sandia Mountain foothills.[3] The area sits over the Santa Fe Group aquifer system. Up until 2008, the aquifer served as the region's sole source of water supply.[4]

The Albuquerque Bernalillo County Water Utility Authority (Water Authority) manages water in Albuquerque and the surrounding Bernalillo County area. The Water Authority provides water for approximately 678,000 municipal customers.[5,6] The Water Authority calculates the area's current water usage rate at 125 gallons per capita per day (GPCD), with a goal of reducing usage to 110 GPCD by 2037.[7] Currently, the Water Authority draws its water from two sources: surface water from the Colorado River water delivered by interbasin transfer to the Rio Grande, and groundwater from the underlying Santa Fe Group aquifer.[8]

Before 2008, Albuquerque relied solely on groundwater for its water supplies. As Albuquerque's population grew and demand for water increased, groundwater levels across Bernalillo County dropped between 40-120 feet.[9] The potential for land subsidence as a result of dropping water levels raised concerns about the unsustainability of relying solely on groundwater.[10] Furthermore, scientific studies throughout the 1990s demonstrated that pumping of the local aquifer was occurring at rates twice as high as natural replenishment.[11] The studies also revealed the aquifer to be smaller than previously believed.[12]

In light of these studies, the city leaders of Albuquerque began to plan and implement a strategy for both groundwater recharge and diversification of the city's water supplies. The main components of the strategy included reducing reliance on the aquifer by promoting conservation, developing groundwater recharge projects, and using alternative water sources.[13] The Water Authority succeeded the City of Albuquerque's Public Works Department and expanded the utility's jurisdiction to include Bernalillo County as a whole in 2003. [14]

In 1999, the State of New Mexico recognized the importance of strengthening its groundwater resources through the passage of the New Mexico Groundwater Storage and Recovery Act (the Act). Influenced in part by lobbying from representatives of the Water Authority, the Act authorized recharge projects with the potential to improve water and environment quality, reduce groundwater level declines, reduce operations and management costs, promote water conservation, serve the public welfare of the state, and lead to more effective use of New Mexico's water resources.[15] Under the Act, only governmental entities are able to obtain a permit for a groundwater recharge project.[16] In 2005, the state identified four potential groundwater recharge projects across the state. Bear Canyon was identified as a possible candidate by the report, citing Albuquerque's ready supply of water for the project, favorable hydrogeology, and existing infrastructure.[17]

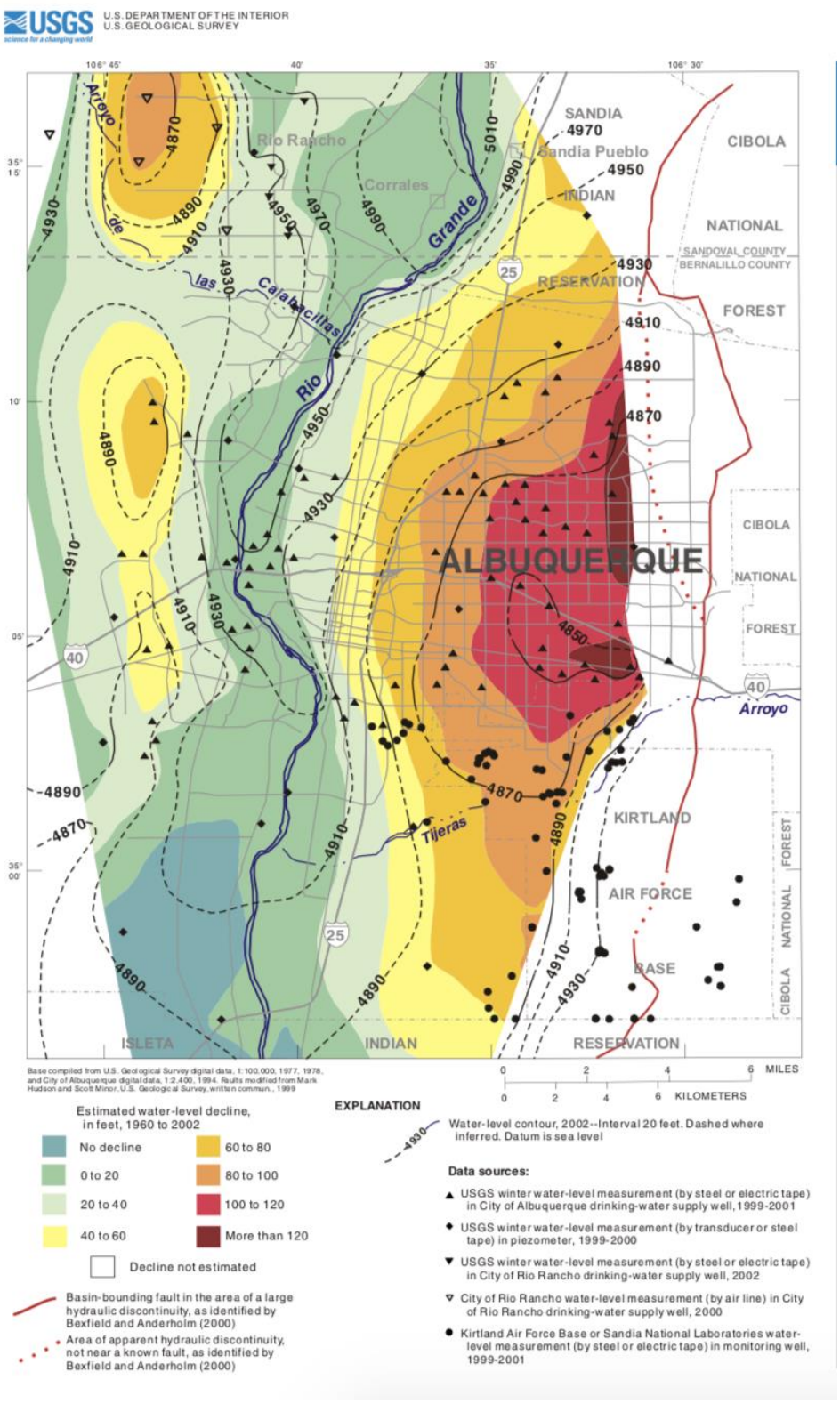

Figure 2 Estimated Water Level Declines in the Sante Fe Group Aquifer System, Predevelopment to 2002 (Bexfield and Anderholm, 2002)

In 2008, the Water Authority received a demonstration permit from the New Mexico Office of the State Engineer (OSE) for the Bear Canyon Recharge Project. The purpose of the Bear Canyon Demonstration Recharge Project was to "(1) use surface water to recharge the aquifer via an in-stream infiltration system, (2) use the aquifer to store surface water and establish a drought reserve, and (3) establish the right to recover the recharged water."[18] The demonstration project released diverted water from the San Juan-Chama Project into an arroyo to infiltrate into the aquifer during the winter months. Following the successful completion of the demonstration project, the Water Authority received a permit for full-scale operation of the Bear Canyon Recharge Project, which allowed them to recharge up to 3,000 AFY beginning in November 2014.

3. Regulatory Setting - ***Groundwater Storage and Recovery in New Mexico***

Operation of Groundwater Storage and Recovery facilities in New Mexico requires two permits: an underground storage and recovery permit (USR permit) from the OSE[19] and a discharge permit from the New Mexico Environment Department (NMED). USR permits include a recoverable amount for each recharge project. The "recoverable amount" is the "amount of water, as determined by the state engineer, that has reached the aquifer, remained within the area of hydrologic effect and is conducive to recovery without impairment to existing users."[20] Discharge permits identifies applicable quality standards with which the project must comply.[21]

An application for a USR permit costs $5,000, plus $5.00 per acre-foot of the annual capacity of the proposed project, with a cap at $50,000.[22] Additionally, an annual fee of $0.50 per acre-foot of water stored is owed each year. When applying for a permit, the governmental entity submitting the application must provide evidence of, among other things, financial and technical capability, the source and quality of the source water, the quality of the water in the receiving aquifer, evidence the applicant holds a valid water right, and a project plan.[23] The project plan must:

(a) Show that the project will not cause harm to users of land and water within the area of hydrologic effect;
(b) Demonstrate that the project is hydrologically feasible;
(c) Demonstrate that the project will not impair existing water rights or the state's interstate obligations;
(d) Demonstrate that the project will not be contrary to the conservation of water within the state;
(e) Demonstrate that the project will not be detrimental to the public welfare of the state.[24]

USR permits are not considered effective until an applicant obtains all other necessary permits from other state and federal agencies.[25] The OSE may also permanently revoke or suspend a USR permit if the permit holder fails to follow the permit terms and conditions.[26]

In order to receive a full-scale permit from the OSE, each underground storage and recovery project must first receive a demonstration project permit and operate a demonstration project for a period of time specified by the OSE. The demonstration tests the operational performance

of the project prior to full implementation. If the project meets the requirements set by the OSE (i.e., demonstrates enough water is being recharged), it can be considered for a full-scale operations permit.

Once water is recharged to an aquifer, it is considered the property of the project owner and is not considered public water.[27] Recharged water is not subject to the state forfeiture provision, which normally holds that water unused for four years is forfeited if not used within that time period.[28] Water recovered from storage can only be used for the purposes for which it was authorized to be used for prior to storage, unless the applicant applies for a change in the purpose of use.[29] Illegal recovery or use of stored water is punishable by a fine of $10,000 per day.[30] Other violations of permit conditions – those not related to the illegal recovery or use of stored water – are punishable by a fine of $100 per day of violation.[31]

4. Managed Aquifer Recharge Through the Bear Canyon Recharge Project

The Bear Canyon Recharge Project recharges chlorinated San Juan-Chama Project water diverted from the Rio Grande using an arroyo channel.[32]

Figure 1 Interbasin transfer of Colorado River water via the San Juan-Chama Project. ABCWUA.

4.1 Recharge

New Mexico holds an allotment of 11.25% of the water from the Upper Colorado Basin states' annual allocation of 7.5 MAF under the Colorado River Compact.[33] This allotment is equal to roughly 843,750 AFY. In order to access its share of the Colorado River, New Mexico transfers the water over the Continental Divide through the San Juan-Chama Project. The water then flows into the Rio Grande, where it is diverted by the Water Authority. The Water Authority holds a perpetual contract for 48,200 AFY from the San Juan-Chama Project.[34]

Notably, the source water for recharge is similar in quality to native groundwater. Bear Canyon Arroyo overlies portions of the ancestral Rio Grande – thus, the groundwater located beneath the recharge site is the result of alluvial groundwater recharge which occurred thousands of years ago, before the river shifted to the west.[35]

Instream infiltration used in the project takes advantage of favorable hydrogeologic conditions along Bear Canyon.[36] Water for

recharge is pulled from the Rio Grande through Ranney wells located about 60 feet below the riverbed. This water is chlorinated at the point of diversion and is then delivered by the existing North I-25 Reclamation and Reuse System to a non-potable reservoir tank located at the top of the existing Arroyo del Oso Reservoir.[37] To conduct recharge, water is released from the reservoir tank through an outfall pipe into a half-mile long unlined segment of an arroyo. As water flows through the arroyo channel it infiltrates into the streambed sediments. A flow meter measures the amount of water released from the outfall into the arroyo. From the streambed, the water flows through the unsaturated zone between the land surface and groundwater table (the vadose zone) and into the underlying aquifer. Because water is not directly injected (as is the case with ASR wells), the Water Authority is not required to treat the water to drinking water standards before infiltration.[38]

The Bear Canyon Project is permitted to release a maximum of 5.6 MGD from the outfall pipe for recharge, with a maximum of 3,000 AFY.[39] Currently, the Bear Canyon Project operates every other year so that it can recharge the water stored in the reservoir from two calendar years during one recharge event. Each recharge event recharges 600 AF.[40]

Recharge can anytime during a maximum period of six months (October through March) and only when the arroyo is dry. The Water Authority must immediately halt use of the project for 24 hours if "surface water flow is detected" in the channel used for recharge, for two reasons. First, in the event of native surface flow during a storm event, water intended for recharge would flow past the infiltration reach, rather than being recharged. The second reason for this requirement pertains to liability. Although the project is operated in the cold and dry winter months, precipitation during the recharge period is still possible, and, when present, recharge could exacerbate the risk that stormwater flows through the arroyo could overflow a paved pathway and form an icing hazard.

4.2 Accounting

The Water Authority developed a robust accounting system in order to demonstrate to both the public and regulators that i) the water being released into the arroyo channel would infiltrate into the aquifer rather than evaporate and ii) the water being recharged would meet quality standards.[41] To monitor instream infiltration during the demonstration phase, water was tracked at various points along its flow path from the arroyo bed, through the vadose zone, and into the underlying aquifer.[42] Temperature sensors, heat dissipation sensors, lysimeters, and neutron logging are used to track water and the rate of infiltration as it moves to the water table.[43] Lysimeters were also installed at various depths to monitor the quality of water as it moves towards the aquifer.[44] Results from the project's demonstration phase showed little water was lost through evapotranspiration in the vadose zone or during storage.[45]

Based on extensive monitoring during the demonstration phase 97% of the water discharged to the instream reach is considered to reach storage. This estimate accounts for 1% loss of water to evaporation, 1.5% attributed to vadose zone storage, and 0.5% attributed to meter uncertainty. The Bear Canyon project overall has a storage limit of 10,000 AF.[46] Currently, 1,405 AF are in storage.[47]

The amount of recoverable water is calculated every year, based on the net amount of recharged water remaining in storage after accounting for all recharge inflows and recovery outflows for the year. Throughout the year, the Water Authority submits monthly reports of daily discharge amounts to OSE. No later than June 30th each year, the Water Authority is required to submit an annual report for the preceding recharge period. This report much include:

(1) the total quantity of stored and recovered water
(2) the water quality of the stored water, the receiving aquifer and the recovered water; and
(3) a measurement of the static level of the water table.[48]

The USR permit for the Bear Canyon Recharge Project also requires the Water Authority to inform the OSE of its conservation efforts and an estimate of both its monthly and annual per capita water use.[49] After the report is filed, but before the start of each recharge season, the Water Authority and OSE meet and use this reported information to review the recharge, operating plan, and modeling of the project and to update the calculated amount of recharge credits.

Additionally, the project is subject to the terms of a discharge permit issued by the New Mexico Environment Department (NMED) Ground Water Quality Bureau. The discharge permit determines applicable water quality standards for the project and monitoring terms.[50] Water quality standards are set by the New Mexico Water Quality Control Commission. The project must meet all New Mexico primary drinking water maximum contaminant levels, and cannot exceed total nitrogen of 10 mg/l. If an exceedance occurs, the Water Authority must immediately cease discharging water into the arroyo, notify NMED, and create a corrective action plan to remedy the exceedance.[51] Groundwater is sampled at least three times each year – once before the recharge period begins, one month after it begins, and one month before it ends.[52] Water held for recharge in the storage tank is similarly tested one month before recharge operations begin and again one month before recharge operations stop.[53] Similar to the OSE permit, the Water Authority submits yearly water quality reports to NMED for the project, due August 1st of each year.[54] If the Water Authority plans not to operate the project in a given year, it must give notice to NMED prior to the recharge operation season.

4.3 Recovery

Recharged water is recovered through the Water Authority's existing groundwater well network. As of 2019, the Water Authority has not needed to recover a significant amount water as part of this project as water supplies from the Drinking Water Treatment Project and other sources have been sufficient to supply ABCWUA customers' needs. About 300 AF was recovered to demonstrate the ability to recover water and to establish the procedure and accounting method for doing so with the Office of the State Engineer.[55]

5. Management of the Bear Canyon Project

5.1 Institutional Structure

The Water Authority makes all technical decisions regarding day-to-day operations of the Bear Canyon Recharge Project.[56] The Water Authority consists of an eight member Governing Board of elected officials in the county.[57] The Governing Board oversees the actions of the approximately 600 employees. The Water Authority also retains an engineering and consulting firm to assist on the operation of the Bear Canyon Recharge Project and provide expertise as needed.[58]

There are opportunities for public engagement with Water Authority projects through public meetings[59] and other oversight groups. Citizens may participate in the Technical Customer Advisory Committee (TCAC) and the Water Protection Advisory Board (WPAB). The TCAC is made up of Water Authority customers and gives advice to the Governing Board regarding their "policies, programs and projects."[60] Members must be ratepayers of the Water Authority.[61] The WPAB addresses concerns about surface and groundwater quality and advocates for protection of water sources.[62] The WPAB consists of nine members, two who are appointed by the Water Authority, three who are appointed by the mayor, and another three who are appointed by the county, and one member who is jointly appointed by the mayor and the county.

5.2 Costs and Financing

The Bear Canyon Recharge Project was originally funded by New Mexico's $10 million Water Innovation Fund (WIF). Spearheaded by former New Mexico Governor Bill Richardson, the New Mexico Department of Finance and Administration identified potential groundwater recharge projects. The WIF provided initial funding for the identified projects, including the Bear Canyon demonstration project.[63] The Water Authority received $500,000 from the WIF for the initial demonstration phase.[64] Expansion to the full-scale project was funded by ratepayers. The total cost of the project during the first four years, including drilling costs, equipment installation, and permitting was approximately $1.5 million.[65] Currently, ongoing costs are paid for by ratepayers as part of the Water Authority's charges for water and wastewater services. The estimated cost for the project is $60,000 per year.[66]

6. Analysis and Summary

The Bear Canyon Recharge Project uses excess surface water supplies to recharge the regional aquifer through in-stream infiltration. The stored water serves as a drought supply for Albuquerque and the surrounding area. As the first operating recharge project in New Mexico, the Bear Canyon project serves as a groundbreaking example for other entities in the state that may be interested in conducting recharge.

6.1 Key Elements

New Mexico has specific legal requirements for recharge projects. The law facilitates development of MAR by creating a relatively clear process for obtaining proper permits and agency approval. However, as the first recharge project in New Mexico, obtaining the permits

for the Bear Canyon Recharge Project took a significant amount of time. Not including a few years during which the project was stalled, the total time from pursuing the demonstration project and receiving the final full-scale permit took approximately six years of cumulative work.[67] This long timeframe indicates that although legal affirmation of the right to recharge and a clearly defined process of how to do so are important for enabling MAR, a burdensome and lengthy permitting process can slow the development of MAR projects in spite of apparent legal clarity, at least for first movers. As more recharge projects are implemented in New Mexico, permit applicants and state agencies overseeing the process will likely iron out the permitting requirements and the times required for permitting may decrease.

Similarly, the OSE requirement that groundwater recharge and recovery projects complete a demonstration phase has both positive and negative sides. On one hand, requiring a demonstration phase guarantees that projects will work as designed, and prevents the potential waste of water and money to inefficient projects. On the other hand, requiring a demonstration phase may lead to higher costs of a project and a greater investment of time.

In this regard, the Water Authority is an ideal candidate for taking on recharge projects, as it is an agency with numerous financial and institutional resources. As the largest water utility in New Mexico, the Water Authority possesses an operation budget of well over $170 million, and can afford to take on innovative projects. Since a majority of the water infrastructure in Albuquerque belongs to the Water Authority, the infrastructure was already in place and available to transport water to the recharge site. The ability to retain outside consultants and engineers also provided the Water Authority with valuable ongoing technical support in design and maintenance of the project. Due to its progressive development of the Bear Canyon Recharge Project, the Water Authority may serve as a pathfinder for other agencies, ultimately making the process of creating recharge projects easier for everyone.

6.2 Incentives and Benefits

Implementation of the Bear Canyon Recharge Project was motivated by local climatic conditions and water availability. Given Albuquerque's historically declining aquifer rates and exposure to drought risk, creating a new drought supply of water was prudent. State support helped enable the recharge project, including a state-funded study identifying the Bear Canyon site as ideal for recharge and a state grant for the initial stages of the project. The creation of the recharge project was further enabled by the passage of comprehensive and specific recharge and recovery legislation.

6.3 Challenges and Future Considerations

While the Bear Canyon Recharge Project has been successful, the project is permitted to store only a relatively small amount of water compared to the needs of Albuquerque. Although recovery operations have been developed in a pilot, the project has not yet fully proven itself by operation during a drought. The Water Authority is developing an additional recharge facility, which is currently in the demonstration phase of permitting. This project, called the Drinking Water Treatment Plant Large-Scale Recharge Project, will use injection wells to store up to 5,000 AFY of potable San Juan-Chama water.[68]

Ultimately, the Bear Canyon Project is just one resource in the Water Authority's water supply portfolio, yet as the first recharge project in New Mexico, it is a pathbreaking one. It has proved the feasibility of developing such a project in the state, leading the utility to develop further groundwater recharge and recovery operations and paving the way for other agencies to do the same.

Acknowledgements

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