

THE PARADOX VALLEY UNIT

A significant component of the Colorado River Basin Salinity Control Program

SUMMARY

The Paradox Valley Unit (PVU), a series of brine collection wells and a deep injection disposal well, is a critical component of the Colorado River Basin Salinity Control Program (Program). The PVU prevents approximately 100,000 tons of salt from entering the waters of the Colorado River Basin each year, providing just under 10 percent of the total salinity control implemented in the Colorado River Basin. It is estimated that the PVU's injection well could have as few as three to five years of operating life left due to increasing wellhead pressure. Additionally, injection-induced seismic events could further shorten the operational life of the PVU injection well. Failure of the existing PVU is projected to increase salinity levels in the Colorado River by 9-10 mg/L at Hoover Dam during periods of average hydrology and could be as high as 15 mg/L during drought conditions. This would increase economic damages to agricultural, municipal, and industrial entities by approximately \$24 million annually during average hydrology. Failure of the PVU would also increase the likelihood of exceeding water quality standards. Even if there is not "failure" of the injection well, concerns with induced seismicity have led to reductions in the effectiveness of the project. The Bureau of Reclamation (Reclamation) is currently working on an Environmental Impact Statement (EIS) that evaluates long-term solutions to the current PVU. Unfortunately, under the current NEPA schedule, the final Finding of No Significant Impact (FONSI) or Record of Decision (ROD) will not be published until 2018. This time frame may surpass the life of the existing PVU injection well. Accordingly, the Colorado River Basin Salinity Control Forum (Forum) members are very concerned and support additional congressional funding for Reclamation to expedite the EIS process as quickly as possible.

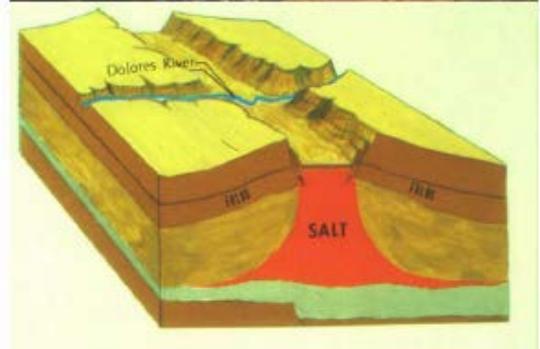


Paradox Valley, Colorado. View looking northwesterly towards the La Sal Mountains, Utah. The Dolores River cuts across (perpendicular to) the valley near its middle. The brine collection wells are along the Dolores River in the center of the valley. The deep well injection facility is behind the cliff in the Dolores River canyon on the center left of the photo.

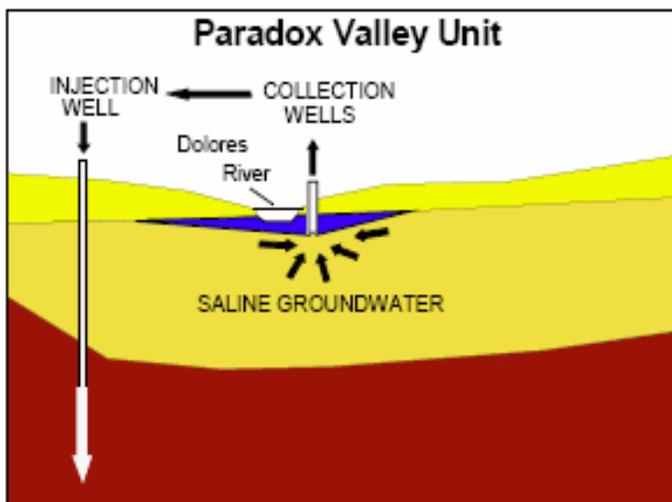
BACKGROUND

The PVU, which is operated by Reclamation, is an integral component of the Program. The PVU is located along the Dolores River (a tributary to the Colorado River) in the Paradox Valley in Montrose County, Colorado. The Paradox Valley is a collapsed salt anticline which developed as deeply buried salts flowed upward, doming up the valley. These salts were then partially dissolved and the overlying bedrock collapsed, forming the valley.

The PVU is an original unit authorized by Congress as part of the Colorado River Basin Salinity Control Act (P.L. 93-320) in 1974. It was constructed as part of the Program's effort to meet federal water quality standards under the Federal Water Pollution Control Act, as amended. Shallow groundwater in the Paradox Valley is one of the most concentrated sources of salinity (approximately 260,000 mg/L) in the Upper Basin. The PVU was designed to intercept shallow saline groundwater (brine) before it discharges to the Dolores River. Constructed in the late 1980s and early 1990s, the PVU is comprised of a brine collection well field, a brine treatment facility, and a 16,000-foot deep injection well, along with associated roads, pipelines and electrical facilities.



Aerial photo and schematic showing the collapsed salt anticlinal structure which created the Paradox Valley and its salt issues.



Schematic of PVU operations including shallow collection wells and deep well injection.

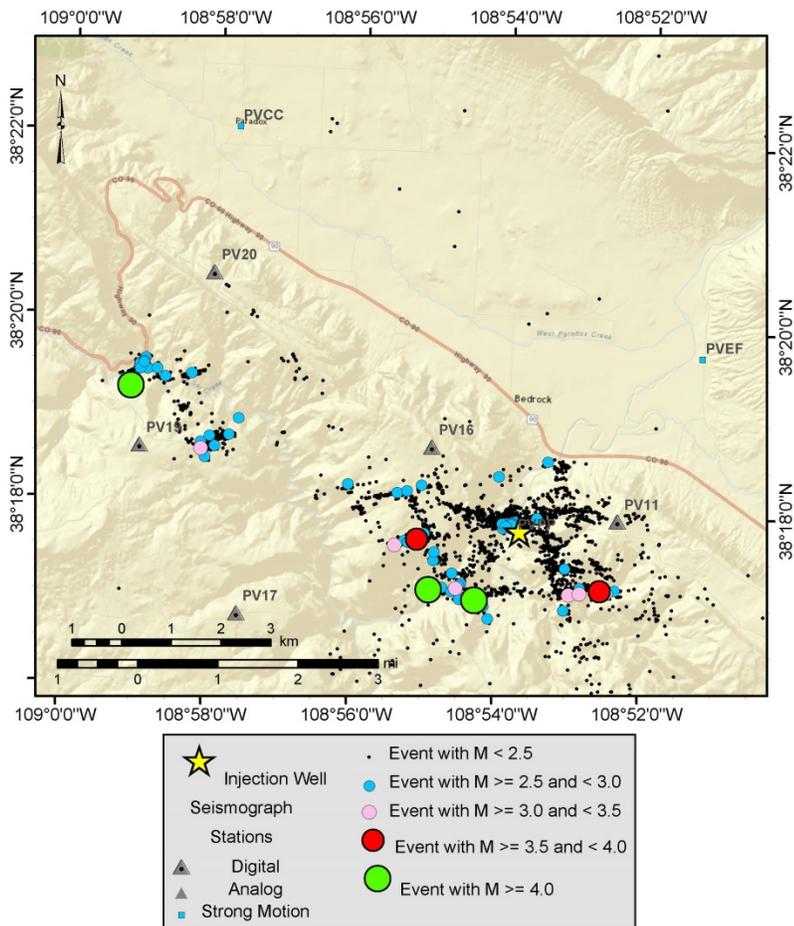
Under normal operations, the PVU injects about nine to ten million gallons of brine per month, or about 100,000 tons of salt per year. To put that number in perspective, 100,000 tons of dried salt would fill a football field about 40 feet high. Absent the PVU, the brine would otherwise enter the Dolores River and then the main stem of the Colorado River, significantly degrading its water quality. The PVU currently provides about 10 percent of the total salinity control on the Colorado River at a cost of approximately \$60 per ton.

CONCERN

The PVU's existing deep injection well is nearing the end of its viability. The wellhead injection pressure has been increasing steadily towards the maximum permitted injection pressure of 5,350 psi. The permitted pressure was increased from 5,000 psi in 2006 when Reclamation was given approval from EPA to modify the Underground Injection Control permit. In 2010, it was estimated that this could be exceeded in three to five years, reducing the efficacy of the injection well. In 2013, the injection rate was reduced from 230 gpm to 200 gpm, which reduced the wellhead injection pressure. Not considering other factors that could affect the life of the well, this decrease in pressure will extend the projected utility of the well to some degree. The other remaining features of the PVU, which constitute about half of the overall investment, are not affected by the wellhead injection pressure and are projected to be operable for many years.

An additional concern that has become critical to continued operations is the increased seismic activity caused by years of long-term fluid injection into the underlying formation. Prior to the construction of PVU, the Paradox Valley was fairly aseismic. Since initiation of operations, the valley has experienced thousands of earthquakes, with an average of more than 100 earthquakes each year. Most of these are small. In recent years, Reclamation scientists have been particularly concerned about the rate and magnitude of seismic activity occurring farther away from the well and toward the community of Paradox, Colorado.

On January 24, 2013, an M_L 4.4 earthquake struck near Paradox, Colorado causing minor damages. Consistent with its Emergency Action Plan, Reclamation immediately shut down PVU. Reclamation's Emergency Action Plan identifies contacts, responsibilities, and actions to be taken should there be an emergency.



Location and magnitude of Paradox seismic events. Modified from Reclamation's Draft Technical Memorandum TM-86-68330-2013-12 dated March 2013.

During this shutdown, Reclamation evaluated the seismic event and studied operational options. After three months it was determined to reinstate operations with the following two major changes: 1) shutdown periods would change from bi-annual to weekly, and 2) the injection rate would change from approximately 230 gpm to 200 gpm. These operational changes have decreased the rate of pressure buildup and likely reduced the short-term potential for further earthquakes, but have also reduced the amount of salt removed each year. As long-term injection continues, pressures will again rise, eventually requiring further reductions to avoid the risk of damaging earthquakes. A long-term replacement disposal alternative is urgently needed.

IMPACT OF FAILURE

Salinity in the Colorado River causes economic damages to water users in the Lower Colorado River Basin. Economic modeling shows several hundred million dollars per year of economic damages to agricultural crops, water utilities and municipal water suppliers, the commercial and industrial sectors, and residential household appliances

which use Colorado River water. If the PVU were to become inoperable, absent the development of another alternative to remove the salt load, salinity levels in the Dolores River would increase by more than 700 mg/L. In the Lower Basin, the TDS of the Colorado River would increase by 9-10 mg/L in just a few years during average hydrological conditions, causing damages to increase by approximately \$24 million annually. Even more severe, during periods of drought the increase in downstream salinity could exceed 15 mg/L. Moreover, the loss of the PVU injection well will increase the probability of exceeding water quality standards.

DEVELOPMENT OF ALTERNATIVES

To address the crucial need to develop a long-term replacement solution to the PVU injection well, Reclamation is preparing an EIS under which it is currently evaluating: 1) the siting and construction of a second deep-injection well, 2) creation of evaporation ponds, or 3) other new technology alternatives (so far unidentified). Reclamation published its EIS Scoping Report in January 2013 after several years of conducting preliminary studies with experts in geology, exploration, geophysics, drilling, seismicity, injection wells and operational activities. As part of the EIS process, further analysis is being conducted and Reclamation is working closely with the U.S. Fish & Wildlife Service, U.S. Bureau of Land Management, State of Colorado, Montrose County, Colorado, and the Paradox Valley community to evaluate the potential of a pilot evaporation pond. The pilot evaporation pond project is described in Reclamation's 2013 EIS Scoping Report.

Reclamation does not anticipate completing alternative impact analyses before July of 2016, nor having a final NEPA document before the fall of 2017. This means a final FONSI or ROD will not likely be published before 2018. The most significant hindrance to its completion is the availability of sufficient funding for each of the identified alternatives to be appropriately analyzed.

FORUM'S POSITION

Loss of the Paradox Valley Unit's injection well presents real concerns to the Colorado River Basin Salinity Control Program. Due to seismic activity, the efficacy of the unit has already been reduced. The Colorado River Basin Salinity Control Forum members, comprised of representatives from the Colorado River Basin States, feel strongly that this unit must remain operational in order for the States to meet their water quality obligations and avert economic damages in areas like Las Vegas, Los Angeles, San Diego, Phoenix, Tucson, Yuma and the Imperial and Coachella Valleys. The Forum members, Reclamation, other federal agencies, scientists, and consultants are all in agreement that an alternative to the existing deep-well injection unit is needed to ensure that its failure does not cause salinity levels to increase in the Colorado River, leading to unacceptable increases in economic and physical damages. The analysis and construction of alternatives is essential to avoid the risk of increased seismic activity at or near the town of Paradox. While the EIS is currently underway, the time frame for its completion may surpass the life of the injection well. Furthermore, no contingency or emergency plan or alternative is in place outside of the current EIS process to replace this essential facility. For these reasons, the Forum members would like Reclamation 1) to complete the EIS process as soon as possible (sooner than the current schedule) and 2) to maintain a viable Emergency Action Plan. The Forum Members support Reclamation's efforts and pledge their assistance to ensure sufficient funding exists for Reclamation to accomplish these paramount tasks.

COLORADO RIVER BASIN SALINITY CONTROL FORUM

The Colorado River Basin Salinity Control Forum was created by the seven Colorado River Basin states in 1973 to act as a common voice for the states on salinity matters and to coordinate with federal agencies in the implementation of the Program. Forum membership consists of appointees from each of the governors of the Colorado River Basin states and includes water quantity and water quality agency leads and representatives from major water user organizations.

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