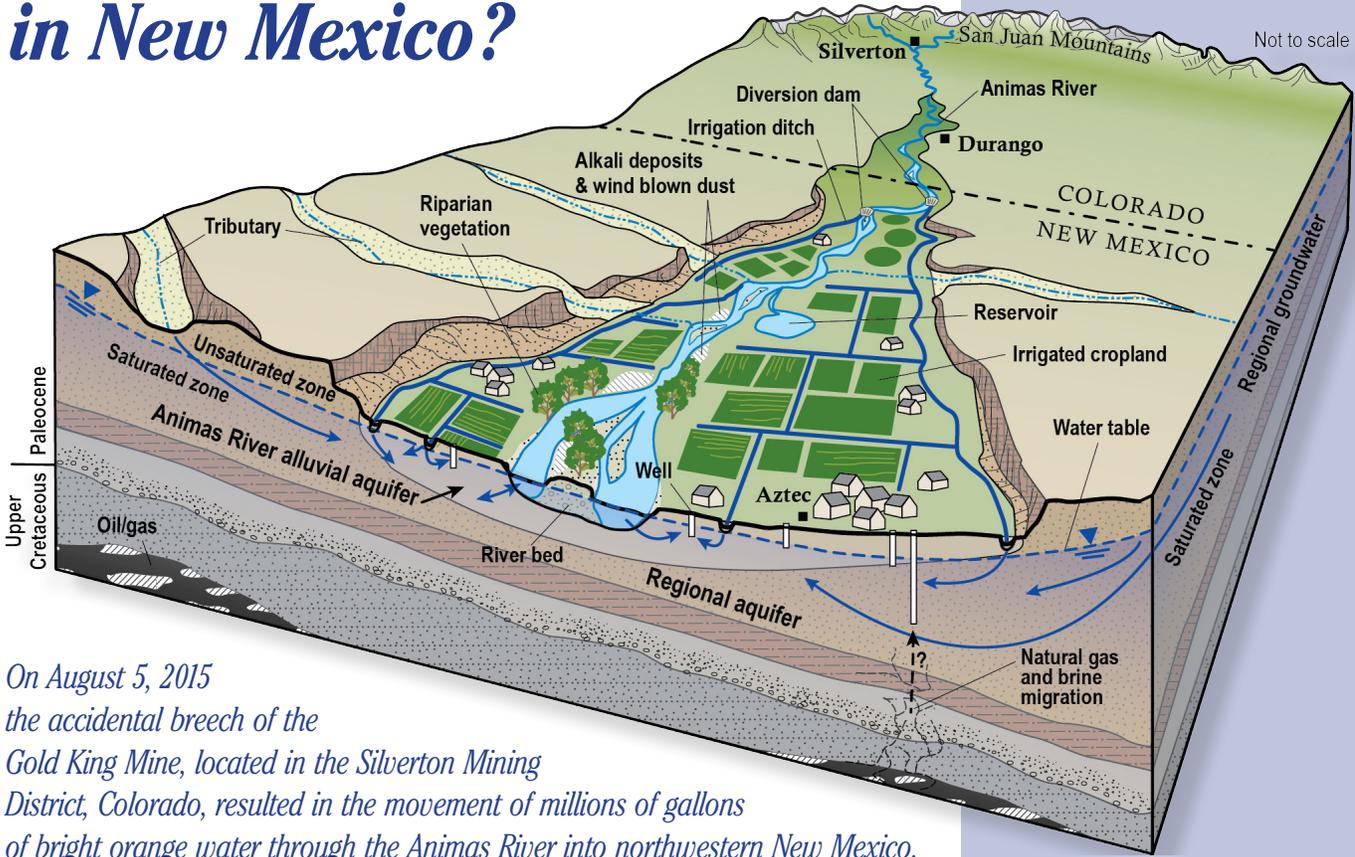


Did the Gold King Mine Spill Impact Groundwater in New Mexico?



On August 5, 2015 the accidental breach of the Gold King Mine, located in the Silverton Mining District, Colorado, resulted in the movement of millions of gallons of bright orange water through the Animas River into northwestern New Mexico. The water was loaded with dissolved metals and contaminated sediments, which posed a possible risk to people and the environment downstream. As part of a collaborative effort by multiple federal and state agencies to assess potential downstream impacts by the spill, researchers from the New Mexico Bureau of Geology & Mineral Resources conducted a study that focused on the shallow alluvial aquifer in the Animas Valley, New Mexico. A large network of domestic wells was utilized to assess groundwater levels and water chemistry in 2016–2017.

This conceptual model of the hydrogeologic system in the Animas Valley shows the various processes and interactions that may affect groundwater quality in the shallow aquifer.

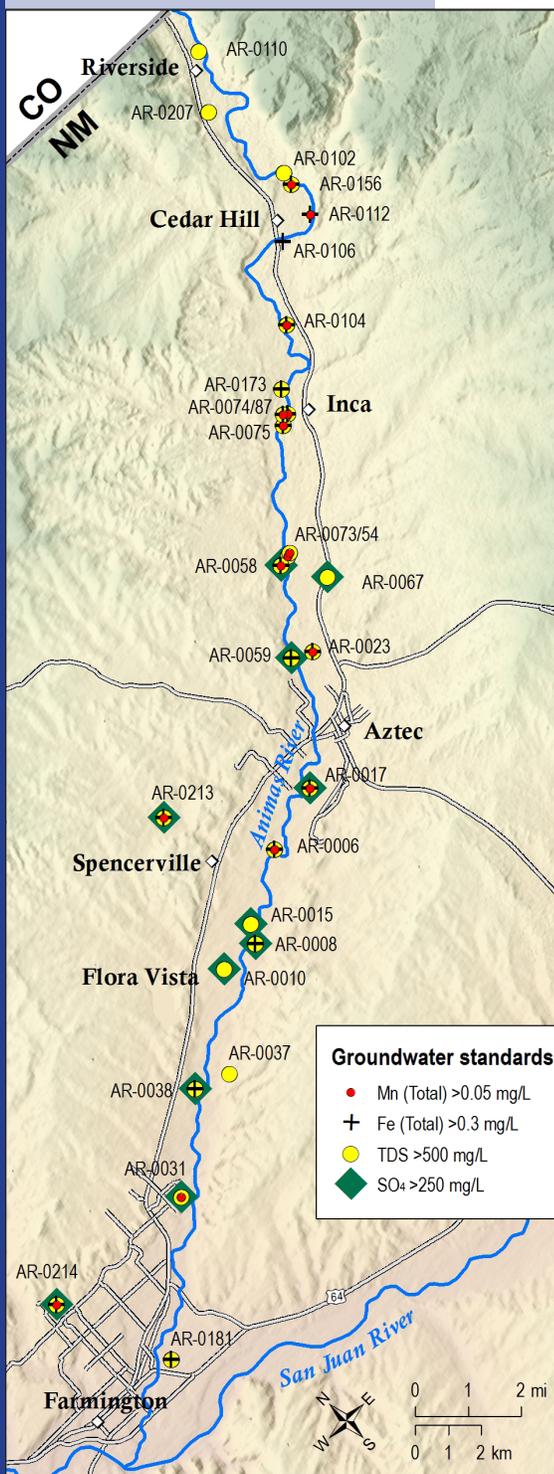
The objectives of this study were to:

- Characterize the hydrogeologic system, which includes the determination of groundwater flow directions, hydraulic gradients, recharge sources, and the assessment of groundwater/surface water interactions
- Identify areas along the river where the river may be losing water to the shallow aquifer
- Assess the possible impacts of the Gold King Mine spill to shallow groundwater quality in New Mexico



A view of the Animas River in northern San Juan County.

The Animas River flows from the headwaters in the San Juan Mountains, near Silverton, CO to Farmington, NM, where it feeds into the San Juan River. In New Mexico, the river flows through sand, clay, and gravel deposits that are largely made up of sediment eroded from older rocks from the surrounding mesas and hills in the area. While municipal or regional drinking water is largely sourced from the Animas River, most private domestic wells in the valley rely on the shallow aquifer along the river, with well depths of about 30 to 60 feet.



Location of wells that produce water with concentrations of manganese (Mn), iron (Fe), total dissolved solids (TDS), and sulfate (SO₄) that exceed the U.S. EPA Secondary MCLs.

RESULTS

Using groundwater level measurements, we found that in most areas, the Animas River in NM is a gaining river, where groundwater from the surrounding valley flows downhill, and into the river. We found that during irrigation season, the infiltration of water through the bottoms of ditches and into fields causes groundwater levels to rise in most of the valley. When irrigation ends in the fall, groundwater levels begin to drop again.

Irrigation water, which is diverted from the river, is the primary recharge source to the aquifer and the most direct potential pathway for contaminants from the river to enter the groundwater system. Groundwater quality was assessed by examining concentrations of major ions and trace metals. Major ion concentrations are controlled by the dissolution of minerals in the aquifer and largely determine the total dissolved solids (TDS) content. Groundwater chemistry in the shallow aquifer along the river is mainly controlled by the mixing of low TDS (<500 mg/L) irrigation/river water and high TDS (>10,000 mg/L) groundwater from the underlying regional aquifer. While irrigation/river water is the dominant recharge source, the input of regional groundwater significantly affects water quality by increasing total dissolved solids and sulfate concentrations to values that exceed the U.S. Environmental Protection Agency (EPA) Secondary MCL*.

The data and analyses from this study show no direct evidence of adverse effects on groundwater quality related to the Gold King Mine spill from 2015. Potential groundwater contaminants identified in water and sediments associated with the Gold King Mine spill include iron, aluminum, manganese, lead, copper, arsenic, zinc, cadmium, and mercury. With the exception of iron and manganese, all of these metals were below EPA MCLs**. Several wells in the shallow aquifer produced water that exceeds EPA Secondary MCLs for dissolved iron and manganese. High manganese and iron concentrations in this aquifer were recognized before the spill, and the source of these metals is unclear. While geochemical conditions in the aquifer do not favor the dissolution of most metals associated with the Gold King Mine spill, continued research and basic groundwater quality monitoring is recommended.

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We are a non-regulatory governmental agency (the state's geological survey) that conducts scientific investigations leading to responsible development of the state's mineral, water, and energy resources.

*U.S. EPA Secondary MCL – secondary drinking water regulation, nonenforceable guideline regarding cosmetic or aesthetic effects.

**U.S. EPA MCL – maximum contaminant level, an enforceable standard for the highest level of a contaminant allowed in drinking water.