Hydrology and Groundwater Sources

Source: L. Martin, National Park Service, Water Resources Division

PROJECT SUMMARY

KRIS JOHNSON

Big Sandy Creek (background).

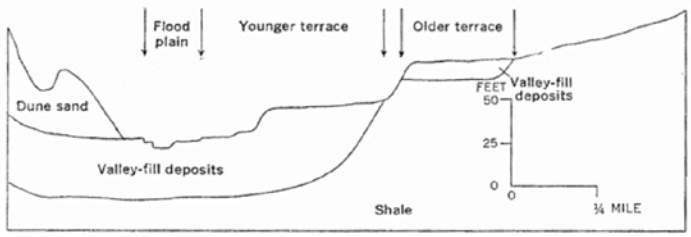
Introduction and Background

In 2006, the National Park Service Water Resources Division examined potential groundwater sources for the future Sand Creek Massacre National Historic Site (NHS) visitor center and administrative site. The study reviewed literature on the area's hydrogeology, or the relationship of geology to groundwater, and water quality. Literature included US Geological Survey water resources studies from the 1960s and 1980s, well records from the Colorado Division of Water Resources, and information from local well owners. The National Park Service is required to preserve the cultural landscape of Sand Creek Massacre NHS as closely as reasonable to its appearance at the time of the 1864 massacre. This assessment supports future management decisions and the site's purpose.

Hydrogeology

Most of the Sand Creek Massacre site area is covered by a thin layer of permeable Quaternary sediments, or rock formations from the last 1.6 million years comprised of sand, gravel, silt, and clay that have been deposited by wind and streams. Under the Quaternary deposits lie Late Cretaceous bedrock formations (80-85 million years ago) that measure several thousand feet thick. Precipitation trickles through permeable Quaternary deposits and accumulates above the impermeable Cretaceous bedrock. This bedrock forms a barrier which prevents downward percolation and creates a shallow aquifer. Groundwater in the Quaternary formations is recharged by rainfall.

The Late Cretaceous formations, including Pierre Shale, Niobrara Formation, and Carlile Shale, contain a few thin limestone beds but are primarily shale. The Smoky Hill Member of the Niobrara Formation is approximately 700 feet thick and provides small quantities of poor quality water in some areas. The Dakota Sandstone, approximately 1,000 feet below the surface, is the first dependable bedrock aquifer but probably contains poor quality water. Because of the limited supply and water quality available in the Late Cretaceous formations, the shallow but major aquifer in the Quaternary formation is the recommended source for potable water in the area.The Quaternary formation consists of terrace deposits, valley-fill deposits along streams, and dune sand, generally occurring west of Big Sandy Creek. These are comprised of sand, gravel, silt, and clay. The sediments range from very-fine-to-fine gravel and sand near the base and clay or very-fine-to-fine sand near the top. Deposits in the Big Sandy Creek valley are primarily alluvial, or accumulated by erosional processes such as streams, and are approximately 25 feet thick. Dune sand covering the area west of Big Sandy Creek is comprised of very-fine to very-course sand and ranges from 10 to 12 feet thick. A very thin aquifer forms at the base of the dune sand above the water table. However, because the layer is thin, reliable groundwater supplies do not develop in most of these areas and wells in dune sand may become dry during droughts.

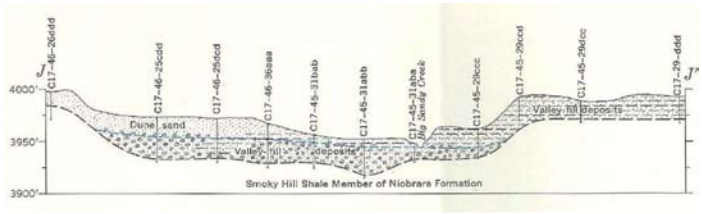


D. COFFIN

Cross-section diagram of the hydrogeology of Sand Creek Massacre NHS.

Water levels in the southern area of the Sand Creek Massacre site were monitored from 1959 to 1986. Water levels were fairly constant 5-7 feet below surface and had no significant trend during the monitoring period. These results indicate groundwater supply in the alluvium is continually recharged at least on an annual basis and should be a reliable source for at least small-scale development. Based on the hydrogeology of the area, the best location for a well is in the deepest part of

the valley where alluvial deposits are thickest and a significant aquifer could form. Well location should be somewhat distant from the creek so water supply is not drawn from the surface and high enough to prevent flooding of the well.



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West to east cross-section through the Big Sandy Creek valley.

Water Quality

Groundwater flows slowly north-south to the Arkansas River at approximately two feet per day. As it flows, the water reacts with the sedimentary rock and gradually becomes more mineralized. Water quality progressively decreases the longer it is in contact with the minerals in the rock. Existing wells in the Quaternary deposits associated with Big Sandy Creek produce poor quality groundwater. Deep wells in Dakota Sandstone would likely produce small amounts of poor quality water. Water from both shallow and deep wells in Sand Creek Massacre NHS would require treatment to meet public health standards.

Recommendations

The report recommended constructing a shallow well in the valley-fill deposits associated with Big Sandy Creek to supply water to a future visitor center and administrative site. Sufficient groundwater supplies are present throughout the site, though all would be poor quality and require treatment. A shallow well in the southeastern area of the Sand Creek Massacre NHS would not produce water that could be classified as being under direct influence of surface water. Construction of a deep well not recommended because there was no advantage and water would still need to be treated.

NPS

Run-off from Big Sandy Creek, 2007.

NPS/HEIDI SOSINSKI

Cottonwood trees along Big Sandy Creek.

Several existing wells are present at the site that likely have poor surface seals which can cause surface water to flow down the outside of the well and contaminate the aquifer. The report recommended an inspection of wells that are no longer in use and could potentially contaminate the aquifer to repair those with problems.

Literature Cited

Martin, L. 2006. Potential Groundwater Sources for a Potable Water Supply: Sand Creek Massacre Site, Kiowa County, Colorado. Report. Fort Collins, CO: National Park Service, Water Resources Division.

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