



Hydrologic Monitoring in Salinas Pueblo Missions National Monument

Water Years 2012 through 2014

Natural Resource Data Series NPS/SCPN/NRDS—2015/966



ON THE COVER

Riparian area near the Quarai Mission in Salinas Pueblo Missions National Monument's Quarai Unit. NPS photo.

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This report is available from the Southern Colorado Plateau Network website (<http://science.nature.nps.gov/im/units/scpn/>), and the Natural Resource Publications Management Web site (<http://www.nature.nps.gov/publications/nrpm/>) on the Internet. To receive this report in a format optimized for screen readers, please email irma@nps.gov.

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1 Introduction

Salinas Pueblo Missions National Monument in central New Mexico preserves the architectural history of the Spanish and Pueblo people who once lived in the area. Patches of high biodiversity occur in the monument where intermittent streamflow and a spring-fed pool surface along Cañon Sapato in the Quarai Unit.

The Southern Colorado Plateau Network (SCPN) monitors hydrologic conditions in Cañon Sapato to document water levels in spring-fed pools and surface water runoff in Cañon Sapato. The specific objectives of this project are to determine the status of surface and groundwater levels through varying seasons and climatic conditions within Cañon Sapato, and any effects of substantial floods on the channel and associated wetland and riparian areas. This information will help park managers better understand the interaction between surface water and ground water in the stream.

2 Methods

SCPN has been monitoring hydrologic conditions in Cañon Sapato since 2010. Following methods described in the network's integrated riparian monitoring protocol (Monroe et al. in review), this project documents the timing, duration, and magnitude of surface water flow events, as well as changes in shallow ground water at four sites in Cañon Sapato.

In Cañon Sapato, surface water emerges at a spring-fed pool approximately 30 meters upstream from the pedestrian bridge, and 0.5 kilometers upstream from

the monument boundary. The reach between the pool and the downstream monument boundary supports dense wetland and riparian vegetation, providing habitat to numerous plant and animal species (NPS 1997). SCPN monitors hydrology at three sites in the upper portion of this reach (Table 1, Figure 1).

At two of the sites (QUA01b and QUA01c), 1.25-inch steel pipes with screened openings were installed to function as piezometers, measuring groundwater levels. Suspended inside each piezometer, a pressure transducer records water level data and water temperature at 15-minute intervals. A steel pipe (QUA01a) installed near the water's edge at the spring pool site enables direct measurement to the water's surface as a quality control check against transducer data. At QUA01RSG a recording stage gage (RSG) was installed to monitor surface flow. The RSG is instrumented with a pressure transducer that records air temperature and absolute pressure during periods of no flow, and water temperature and water levels when flow is present. A fourth transducer, known as a Barologger (Solinst Corp.), is a barometric pressure sensor suspended from a tree on channel left upstream from QUA01RSG that records air temperature and absolute pressure. These data are used to compensate raw transducer data for fluctuations due to atmospheric pressure.

Data in this report are presented for time periods known as Water Years (WY), which begin October 1 (of the previous year) and end September 30. This is the time period commonly used in hydrologic studies because it best delineates seasonal precipitation

Table 1. Hydrologic and climate monitoring sites used by SCPN at Salinas Pueblo Missions National Monument, New Mexico.

Location	Elevation ^a (m)	Coordinates ^a	Data type
Measuring point near upstream end of Cañon Sapato Spring pool (QUA01a) ^b	2016.96	381203.03 E 3828859.38 N	pool water level, measured manually
Cañon Sapato Spring (QUA01b) ^b	2017.32	381209.82 E 3828862.56 N	pool water level and water temperature, recorded by pressure transducer
Cañon Sapato upstream from pedestrian bridge (QUA01RSG) ^b	2017.88	381225.73 E 3828873.88 N	surface water level and air temperature, recorded by pressure transducer
Cañon Sapato downstream from bed-rock ledges (QUA01c) ^b	2012.82	381272.35 E 3828900.79 N	ground water levels and water temperature, recorded by pressure transducer
Mountainair climate station (GHCND:USC00295968) ^c	2033.6	379917.4 E 3833938.6 N	precipitation

^a Horizontal coordinates are reported in Universal Transverse Mercator (UTM) Projection, Zone 13, North American Datum of 1983 (NAD 83). Vertical heights are referenced to the North American Vertical Datum of 1988 (NAVD 88).

^b Surveyed with Total Station and GPS.

^c NOAA climate station data (ncdc.noaa.gov)

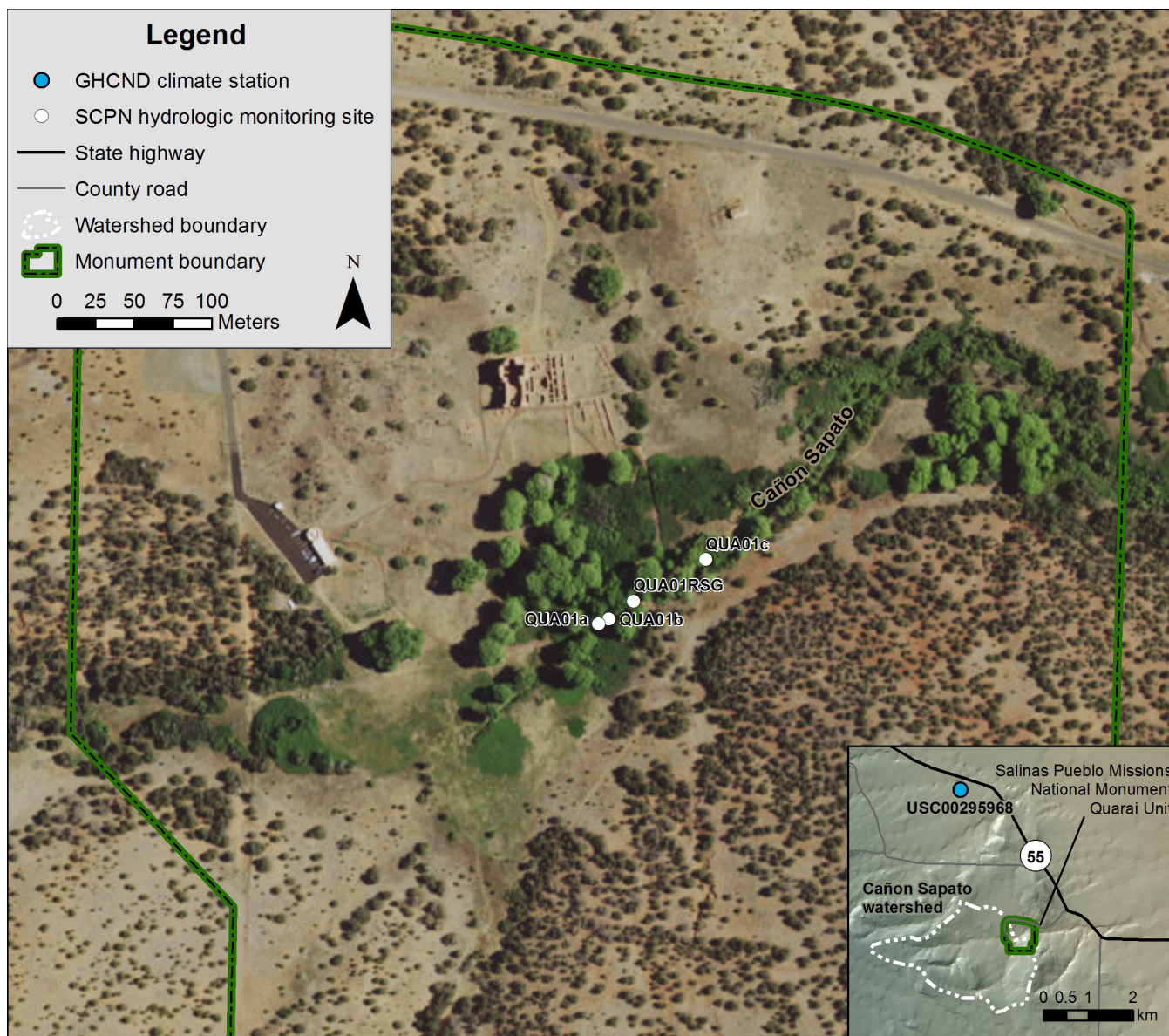


Figure 1. SCPN hydrologic monitoring sites in Cañon Sapato, Quarai Unit of Salinas Pueblo Missions NM, New Mexico.

patterns. SCPN staff visited sites at SAPU four times during WY 2012 and WY 2013, and twice in WY 2014 to download instrument data. In addition to the air and water temperatures collected by SCPN instruments, in this report we include local precipitation data from the Mountainair Global Historical Climatology Network (GHCND) climate station GHCND:USC00295968 (National Climatic Data Center, Climate Data Online n.d.) located 3.2 km from the Quarai Unit. During each site visit SCPN staff measured depth to water at each piezometer, manually measured the spring pool's water surface, and downloaded data from the data loggers. During initial site visits, the locations of all equipment, control points, and important channel features were

accurately surveyed using a total station survey instrument. The survey data were transformed from the initial arbitrary grid coordinates and datum using data collected by high-accuracy GPS equipment at survey controls in May 2012. Repeat total station surveys were completed in May 2012, and December 2014.

Accuracy for SCPN's total station surveys is ± 0.02 meters over a 500 m distance for vertical and horizontal. Accuracies for SCPN's GPS survey is ± 0.045 meters.

3 Results and Summary

Water levels and precipitation

Throughout WYs 2012–2014, water levels at QUA01b varied seasonally by just under 1 m, except during flood events (Figure 2). Seasonally, water in the spring pool typically rose to its highest and most stable level between January and early April each year, and fell to the lowest levels by late July. The smallest annual winter rise in pool water levels occurred in January–March of 2013, perhaps reflecting a lack of local recharge during the very dry preceding year.

All of the floods recorded at QUA01RSG during WYs 2012–2014 occurred during summer monsoon periods. In years with substantial monsoon precipitation, the initial monsoon period flood each year typically raised the spring pool water level from its seasonal low in late July. Local runoff generated floods recorded at QUA01RSG when water levels in the spring pool raised

high enough to overtop the downstream end of the spring pool, at an elevation of approximately 2018.0 m. No surface flow was recorded at QUA01RSG from August 2011 until August 2013. A closely spaced series of precipitation events preceded two floods in August 2013, and a flood on 11 September 2013 corresponded with the single greatest daily rainfall recorded during the period, more than 5 cm. Another series of floods occurred during the late summer monsoon period of 2014. Two of these (4 August and 25 August) were very large floods, each peaking at more than 1.1 m above the channel bottom at QUA01RSG. During the larger flood events, spring pool water levels rapidly rose about 2 meters.

Water levels in QUA01c typically reflected a subdued version of those in QUA01b, rising and falling in the same seasonal pattern. The early summer decline in water levels usually occurred slightly later, and was less steep in QUA01c than in QUA01b. Surface flows

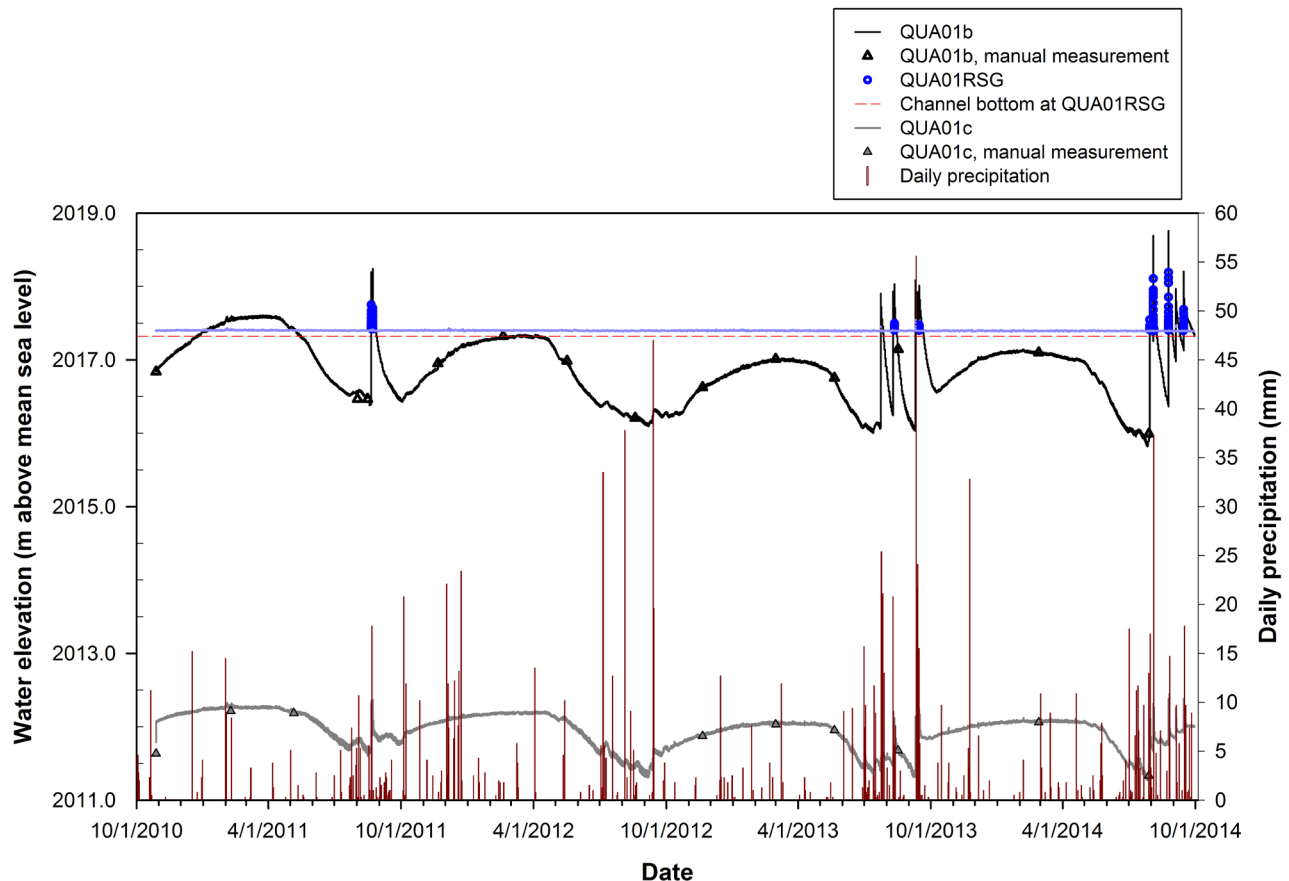


Figure 2. Manual and recorded water levels in the piezometers at QUA01b and QUA01c and the QUA01RSG 1 October 2010 through 30 September 2014, in Cañon Sapato, Salinas Pueblo Missions NM. The blue line for QUA01RSG designates periods of no flow. Daily precipitation recorded at the Mountainair climate station (GHCND:USC00295968) near Quarai from 1 October 2010 through 30 September 2014 is plotted relative to the right axis.

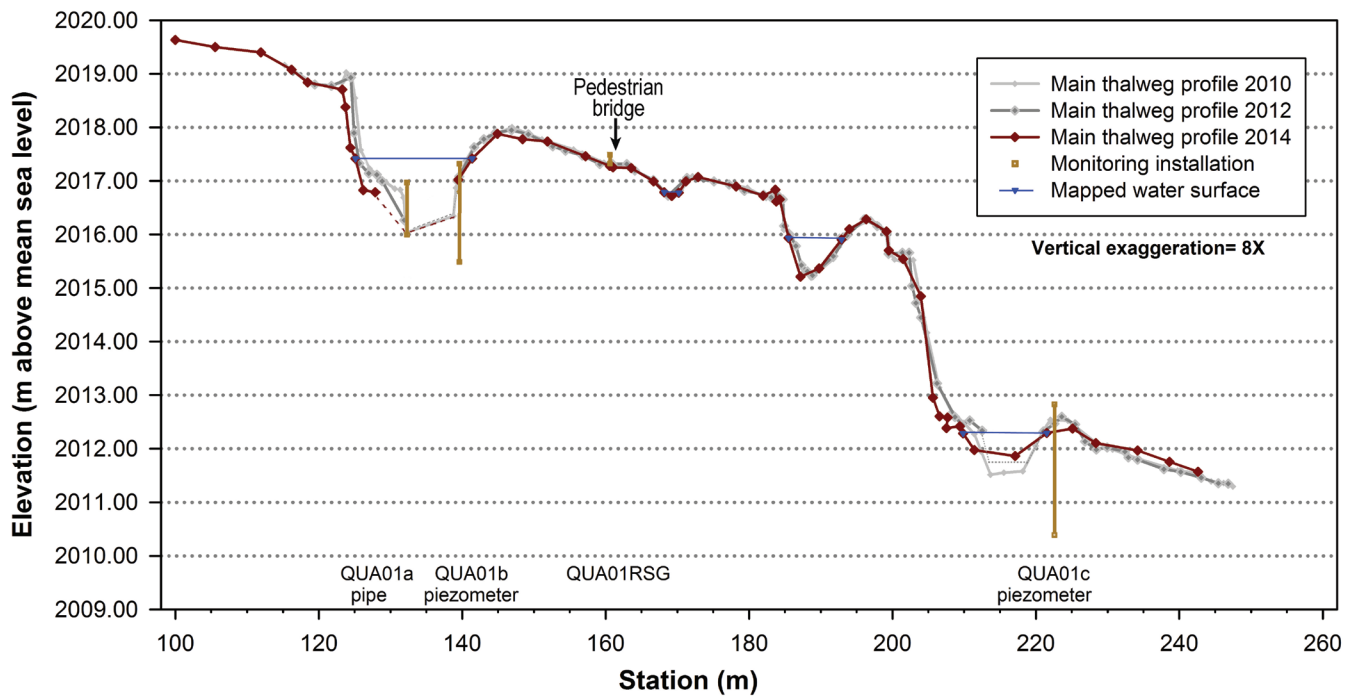


Figure 3. Changes in the profile view of the Cañon Sapato thalweg through the surveyed reach from 2010 to 2014 in Salinas Pueblo Missions NM. Locations and relative elevations of the hydrologic monitoring equipment are shown and labeled above the X axis. The pedestrian bridge's position is also shown for reference. Water surfaces are as mapped on 9 December 2014. X axis stationing is distance from the profile origin (arbitrarily set to 100.00 m); Y axis scaling is exaggerated 8 times relative to the X axis to show vertical detail.

recorded at QUA01RSG traveled downstream to enter the downstream wetland pool, but pool water levels there rose less than in the spring pool. The largest single rise in QUA01c water levels during a flood event was about 0.9 m, on 4 August 2014.

upstream end of the pool at QUA01C retreated nearly 2 m from 2010–2014, and was also much steeper in 2014 than in 2010.

Topographic mapping

Repeat surveys of a transect established across Cañon Sapato immediately upstream of the pedestrian bridge document that the channel at this location was generally stable, both laterally and vertically. The channel thalweg deepened slightly from 2010 to 2014 by about 10 cm total. Otherwise there was virtually no change on the transect. Remapping of the Cañon Sapato thalweg profile, from upstream of QUA01a past QUA01c, shows that vertical stability is also present through most, but not all, of the monitored reach (Figure 3). Pool bottom surfaces were not completely mapped in 2012 or 2014, and dashed lines show bottom topography extrapolated from the survey data. The greatest changes were seen at the upstream ends of both pools, where steep drops occur. The channel at the upstream end of the spring pool retreated approximately 1.4 m from 2010–2014, and the upstream bank steepened considerably. The channel bed at the

4 More Information

More detailed information about hydrologic monitoring at Salinas Pueblo Missions NM is presented in the report for the first year of monitoring at the site, available from SCPN (<http://science.nature.nps.gov/im/units/scpn/>), or the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>):

Contact Stephen Monroe for more information about water resources monitoring in SCPN parks, stephen_monroe@nps.gov.

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