



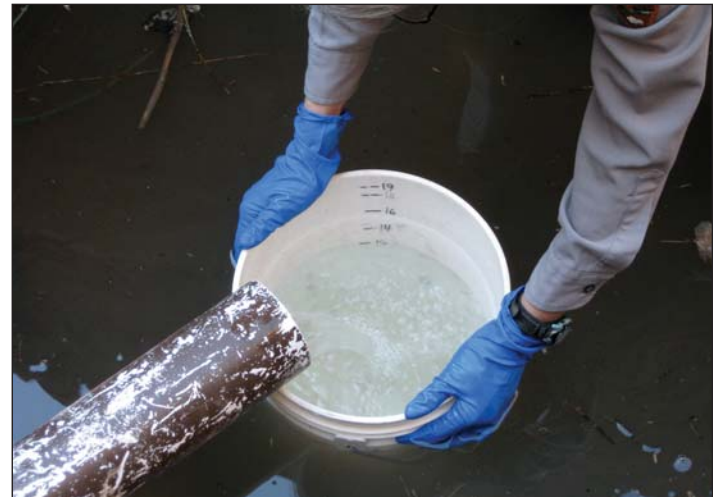
Water Quality Monitoring

Importance

Most Northern Colorado Plateau Network (NCPN) parks are located in semi-arid to arid environments where water is a major factor in determining the distribution of flora, fauna, and historic human habitation. Additionally, the abundance and quality of water resources reflect human activities and land use in and near parks, and are a primary factor influencing park visitation and recreational activities. Water bodies in national parks are protected by the Clean Water Act and other policies that prevent unacceptable levels of pollution and establish acceptable values for other water quality measures. Park managers need information on status and trends in surface-water quality and quantity to comply with the Clean Water Act and to mitigate historic and future impacts to park water resources that may have ecological and social significance.

Long-term Monitoring

Water quality monitoring sites are selected based on historic impacts, perceived threat, current monitoring by others, or to determine baseline status as a starting point for long-term trend detection. As many as 30 water quality parameters are measured at each site visit. At every site, portable sensors are used to measure core parameters (specific conductivity, flow, temperature, pH, and dissolved oxygen) as basic indicators of water quality. Field and laboratory measurements are then compared to state water quality standards to determine if acceptable concentrations are present and if, over time, conditions are changing beyond acceptable normal ranges. NCPN water quality monitoring is a coordinated effort between the network, individual park units, the U.S. Geological Survey, and the State of Utah.



Measuring flow at Sleepy Hollow Spring, Arches NP.

Status and Trends

Between January 2006 and December 2009, 1,267 site visits were conducted at 76 different locations on NCPN streams and rivers in or near 12 park units. The news was good: Results indicated that 24,878 (97.7%) of the 25,462 total designated beneficial-use evaluations completed during that period did not exceed state water quality standards. While some exceedances were reoccurring and may have been caused by human activities in the watersheds, many were due to naturally occurring conditions characteristic of the geographic setting. The most common exceedances or indications of impairment, in order of abundance, were due to elevated nutrients, elevated trace metals, elevated bacteria (*E. coli*), low dissolved oxygen, elevated pH, elevated total dissolved solids, and elevated temperature (Figure 1).

Contact

David Thoma, dave_thoma@nps.gov

Network park units where the NCPN monitors water quality

Arches NP	Dinosaur NM
Black Canyon of the Gunnison NP	Golden Spike NHS
Bryce Canyon NP	Hovenweep NM
Canyonlands NP	Natural Bridges NM
Capitol Reef NP	Timpanogos Cave NM
Curecanti NRA	Zion NP

NHS = National Historic Site; NP = National Park; NM = National Monument;
NRA = National Recreation Area

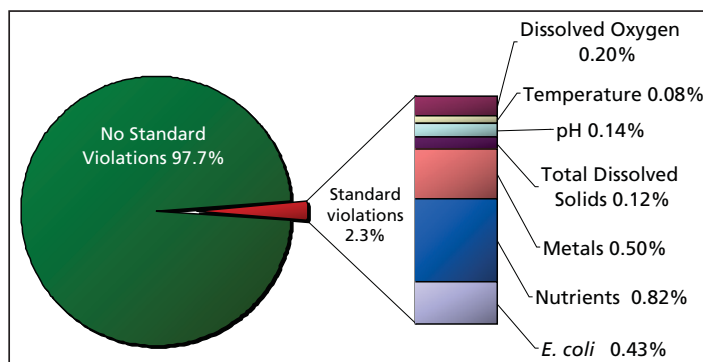


Figure 1. Percentage of use evaluations that exceeded standards, and the causes of exceedances at selected sites sampled in NCPN park units, 2006–2009.

Labor of Love: Water Quality Monitoring at Timpanogos Cave National Monument

At Timpanogos Cave National Monument, water quality monitoring is regular but anything but routine. Once each month, park resource chief Cami McKinney packs up her monitoring equipment—and, in the winter, her ice axes—and hikes 1.5 miles (and 1,100 vertical feet) up Mt. Timpanogos to the NCPN's two most unusual water quality monitoring sites, both located inside the cave system. Situated only about 10 feet off the visitor route through Timpanogos Cave, Hidden Lake is drip-fed. Here, surface water slowly filters hundreds of feet through mountain rock before reaching the pool, whose water levels are marked by their consistency. Conversely, at Hansen Cave Lake, surface rainstorms can be witnessed from within, as water pours in through the fault fracture that runs through the cave and shapes the cave system. At its peak, Hansen Cave Lake can reach 15 feet deep and 40 feet in diameter, draining to a depth of just a couple of feet later in the year. Here, the monitoring site is approximately 300 feet from the cave's visitor route.

Water—its quality, its quantity, its ability to sustain life—is a key influence on these isolated ecosystems, where both McKinney and NCPN staff have had to work through some of the peculiarities of monitoring water in caves. For example, if accidentally dropped on the cave floor, the glass bottles typically used to hold the chemicals needed for sampling would be more likely to break than if dropped on a riverbank—and the chemicals contained in those bottles would likely have greater impacts in a low-flow, limestone cave environment than in an

outdoor environment with greater buffering capacity. As such, otherwise-standard protocols for handling acid-preserved water samples and conducting other aspects of water quality monitoring had to be modified through a process of trial and error until they proved both reliable in terms of sound data collection and acceptable in the cave environment.

Why are park managers willing to go to extraordinary lengths to conduct water quality monitoring at Timpanogos Cave NM? The answers are simple. At just 101 hectares (250 acres), Timpanogos Cave NM is not a park that has substantial control over its own watershed. Changes in climate, upstream land uses, or surface ecology could impact park resources—for instance, if increased levels of contaminants or sediment began to filter into the caves. Such changes could affect cave ecosystems and visitor experience and, possibly, threaten cave-dwelling species. In the past, without either baseline data or any systematic process for knowing about the park's water quality, park managers were in the dark about one of the park's most important resources and ecosystem drivers—and were less well-positioned to contribute, as informed stakeholders, to discussions about the possible impacts of local land use policies or other potential drivers of change on park resources.

Now that light has been shed on water conditions in the caves, managers have their baseline: cave waters are pristine. In 2008 and 2009, of 12 NCPN parks where water quality is monitored, Timpanogos Cave NM was the only unit with zero exceedances of water quality standards or indications of impairment. If water quality changes in the future, park managers are now in a position to receive early warning and take appropriate actions to preserve the resources in their care.



Above, Cami McKinney and her hiking partner (behind the camera) near the entrance to Timpanogos Cave in winter.

Right, taking water quality measurements at Hansen Cave Lake.