Horizontal Drilling Project Replaces Park Water Line

The completion of the longest horizontal drilling project of its kind will assure the water supply for Mesa Verde National Park, one of the country's most-visited historic resources.

Jerry Nelson

Containing more than 4,000 known archeological sites and an estimated 600 cliff dwellings, Mesa Verde National Park comprises more than 52,000 acres of high plateau and deep canyons that served as home to successive populations of Native Americans from 100 A.D. to 1300 A.D. Scholars have come to call these thriving generations of inhabitants the Ancestral Pueblo and believe that as many as 24 contemporary Native American tribes in the Southwest can trace ancestral affiliation back to the sites at Mesa Verde.

A certain amount of mystery attends the study of these settlements, since the Mesa Verde people managed not only to survive, but thrive in this location with no regular source of water, such as a major river or lake, relying instead on local springs and seasonal rainfall. This eventually led to their abandonment of the area because of a quarter-century drought at the end of the 13th century.

Pipeline Deterioration: Time and Money

A pipeline now supplies water to the park, with an intake at the West San Mancos River 16 miles to the northeast. It is not known exactly when the pipeline was constructed, but records indicate the U.S. Forest Service issued a special use permit in 1950 and much of the existing right-of-way was granted in the 1950s. Beginning in the 1960s, it is believed, the water line was cut open every 300 ft or so to line it with concrete as a way of sealing leaks. Unfortunately, the couplings required to reseal the waterline both reduced its interior diameter and began to corrode and leak themselves.

The park's only source of water presented other problems as well. Where the line crossed washes or arroyos, it was encased in sleeves and bridged over the arroyo bed with support from concrete abutments on either side. This left the exposed water line susceptible to freezing in winter and possibly breaking during floods. One portion of the waterline encased in reflective metal sheathing and running up a slope that is easily visible to park visitors also has required frequent maintenance resulting in soil erosion and environmental damage.

Other repairs have required unplanned spending and allocation of National Park Service resources. In June 1995, unusually high water on the West Mancos River damaged the existing intake facility. Emergency repair crews installed temporary rock gabions and rebuilt dams to restore the original intake ponds. The need to replace critical sections of the water line, which the National Park Service described as "extremely old and rapidly failing," was evident for some time. "It had gotten to the point where we had to spend considerable amounts of time and money repairing and maintaining the old water line, says Ron Shields, a project manager with the National Park Service. "We've been looking forward to this project for roughly the past decade."

In October 2003, the National Park Service completed a project to rebuild the line's raw water intake on the West Mancos River and replace four weakened sections of the 16-mile long water line. The Mesa Verde waterline project is among several infrastructure improvement and historical restoration projects being carried out by the National Park Service at remote locations around the country with construction management provided by PBS&J (www.pbsj.com).

Beginning with construction of the intake facility last November, work crews in the Colorado high country installed a total of 20 separate segments of pipe, each ranging in length from 650 ft to 1,900 ft. The horizontal drilling project, which finally replaced more than 23,000 ft of the park's existing pipe with newly installed 6-in, stainless steel pipe, is believed to be the longest directional drilling project of its kind.

The pipeline replacement is one of many projects the consultant manages under a contract with the National Park Service to complete infrastructure improvement and historical rehabilitation work at remote construction sites. These projects present unique challenges to communication, oversight, and inspection activities. It was a high-tech effort as well. Guided by the latest generation of laser-operated surveying stations, work crews downloaded readings to a program on a handheld computer and then used a laptop to calculate the drilling path.

Diverse Wildlife and Severe Conditions

Because the water line's right-of-way, which varies in width from 20 ft to 30

ft, would not easily provide access to individual drilling sites, work crews were forced to arrange a unique approach to each site, crossing over land owned by U.S. Forest Service, the U.S. Bureau of Land Management, the state of Colorado, the National Park Service, or one of many private landowners. Each point of entry required complex coordination among all parties, including the project's drilling contractor, Triad Western Construction Company.

Working at elevations ranging from 6,500 ft to 8,350 ft, the Mesa Verde water line project was carried out in wilderness surroundings more appropriate to a Hollywood movie than a construction site. Mesa Verde is less than 100 miles west of the Continental Divide, within easy sight of San Juan Mountain Range peaks reaching higher than 13,000 ft. Sparsely populated, the area also provides the opportunity for frequent sightings of wildlife, including herds of elk and deer as well as flocks of wild turkeys, in addition to footprints of bear and mountain lions.

Weather in that Colorado high country can present hardships, with winter temperatures barely exceeding 0° F and snowfall frequently accumulating to depths of 4 ft and more. The most challenging of all seasons is the spring melt, a virtual cascade of flooded rivers, pulsating arroyos, mud-laden slopes, and washed-out roads. The deeply riven mountain terrain is no help either, with elevations sometimes falling as fast as 100 ft over a 150-ft distance. All these conditions present obvious challenges to maintaining an efficient construction schedule.

For drilling crews, the greatest obstacle was dealing with what lay below the ground—where varying substrata of rock, shale, sandstone, clay, and cobble turned each drilling attempt into its own underground expedition. The drilling crews learned quickly what they were up against when one of the first lengths of pipe installed jammed as it was being pulled back through the bore. The protocol for the drilling crews called for working uphill whenever possible, bringing the drilling mud and bentonite reclaiming solution back to a collection pit. Rigs (Vermeer Manufacturing Company, www.vermeer.com) were fitted with 15- and 18-ft drilling clips, and each bore was opened with a 4-in. diameter hole that was back-reamed and then redrilled to widen its dimension.

Lengths of pipe were installed by hooking on to them from the drilling site and pulling them back through the hole. But crews quickly learned the hole that had been drilled could easily be disturbed, with clay soils absorbing fluid from the drilling operation and expanding, or cobbles collapsing and blocking the passage. After excavation to clear the first jam, crews readjusted their expectations of the clearance required for free passage of each length of newly installed pipe and were able to avoid another blocked installation attempt for the rest of the project.

They were not so lucky with the incidence of "frac-outs," unanticipated events that occurred when the drilling fluid and reclaiming solution manages to find an exit through the subsurface strata, flowing along a rock fracture or desiccation crack in the clay. With soil conditions such that three or four substrata might be encountered with a 1,000-ft bore—including chunks of coal occasionally surfacing in the reclaiming pit—crews were never certain when a sudden gushing of fluid would require the use of various methods to seal the path of the fracture and restore the integrity of the bore. The drilling crews eventually quickly became adept at responding to each frac-out incident and learned to take them in stride, maintaining steady progress in drilling for, then installing, new lengths of stainless pipe.

The wildfires that have plagued the Western states the past two years, forcing closure of parts of Mesa Verde National Park both last summer and this summer, fortunately had no effect on the water line replacement project. But project managers did make every effort to assure that the water supply to the park would continue without interruption. As soon as each of the four replacement segments was completed, it was subjected to prolonged pressure-testing and immediately called into service as part of the park's supply line.

By combining skilled construction management with the leading edge of technology in horizontal drilling techniques in this remote and primitive setting, the Mesa Verde water line replacement project will now make it possible to assure an uninterrupted supply of water for as many as 650,000 annual Mesa Verde National Park visitors, 500 annual park employees, and nearly 100 year-round park residents.

Drilling crews found that their greatest obstacles lay below ground, where each drill was its own expedition.

With the last segment completed in October, a project that has concerned park administrators for almost a decade will no longer require the allocation of resources that can now be spent on more pressing demands at Mesa Verde—including the continued archeological study of new and existing sites. "Until the 1950s, the water supply at Mesa Verde was dependent on a system of springs, reservoirs, and wells," says Shields. "Now we feel we've improved the condition of the water line substantially, giving us at least another 100 years of reliable water service for one of America's most beautiful, most educational, and most important natural resources." GE

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