

July 11, 2003

L54(2380)
PARA/General

Memorandum

To: Superintendent, Grand Canyon – Parashant National Monument

Through: Chief, Water Resources Division
Chief, Water Operations Branch

From: Larry Martin, Hydrogeologist, Water Operations Branch, WRD

Subject: Trip Report for travel to Shivwits Fire Camp at Parashant National Monument on June 24, 2003.

Summary: Reconstruction of the large diameter well 1¼ miles north of the Shivwits Fire Camp is the best solution for providing a local water source for the Shivwits Fire Camp. There are no springs within a reasonable distance of the camp. Previous test well drilling at the camp failed to locate groundwater. Additional test drilling in the area would incur considerable cost and have a large risk of failure. The existing well can be reconstructed at a low cost and the work could be performed by park staff.

Discussion: The Shivwits Fire Camp is located on the Shivwits Plateau about 70 miles southeast of St. George, Utah. It is at the base of the north slope of Mount Dellenbaugh. Access to the camp is by dirt and gravel roads. The camp is primarily used by seasonal work crews and researchers. The camp contains two two-bedroom, two bathroom cabins.

In the past, the camp obtained water by pumping water from a well located about 1¼ miles north of the camp. The well was constructed in 1963 and consists of four-foot diameter corrugated steel culvert to a depth of 66 feet. Although information regarding construction of this well is scarce, it was reportedly constructed through alternating layers of clay and lava. When the well was used as the water supply for the camp, the pump was powered by a diesel generator. Water was pumped into a 50-gallon tank and transported to the camp. (Campbell, 1990)

There were concerns about the quality of water obtained from the well because the cover did not form a tight seal on the well. The well was in an area used for cattle grazing which created an additional risk for contamination from livestock.

In 1991, the National Park Service constructed a test well near the fence marking the north boundary of the fire camp. The well was drilled to a depth of 190 feet and was dry. It was backfilled and plugged with cement.

Currently (2003) water is hauled by tanker truck from town to an underground storage tank at the camp. Because the tanker truck is not rated for potable water and the underground tank is not completely sealed, all water at the camp is treated as if it were non-potable. Monument staff would like to obtain a local water source for the camp so that water would not need to be hauled from town. Bringing the water system into compliance with potable standards would be an added bonus.

There are only a few wells in the area. Records for wells registered with the Arizona Department of Water Resources were obtained from the ADWR website and are summarized in Table 1. The four wells within 6 miles of the camp are all shallow, large-diameter, dug wells that obtain water from perched aquifers in alluvium. Locations of these wells are shown on Figure 1.

Table 1. Water wells within 6 miles of the Shivwits Fire Camp

Name	Distance from Shivwits Fire Camp	Depth	Reported Yield, gpm	ADWR Reg. #
NPS Well	1¼ miles NW	66	<35	55-629132
BLM Well	3 miles West	24	1	55-806280
Snyder Well	4 miles North	30	15	55-601444
Pine Well	1¾ miles North	--	--	--

There are no springs on the plateau in the immediate vicinity of the camp. A few springs occur in the head of canyons at the edge of the plateau. These springs are probably the discharge points for local perched aquifers at the edge of the plateau. Springs in Twin Spring Canyon are about 4 miles southwest of the camp, but there are no roads to the springs and the springs are below the rim of the canyon. Development of these springs for a water supply would be problematic due to their inaccessibility and difficulty in transporting water from the springs to the camp. Also, development of water from these springs would reduce water availability for flora and fauna at the spring. Green Spring is about 4½ miles southeast of the camp at the head of Green Spring Canyon, a tributary to Surprise Canyon. This potential water source was not investigated due to the distance from the camp and the potential for natural resource impacts if water was withdrawn from the spring area. Locations of springs are shown on Figure 1.

Geologically, the Shivwits Fire Camp is a very poor site for construction of a water-supply well. Lava from Mount Dellenbaugh is at the surface throughout the area. Underlying the lava is the Kaibab Limestone, which tends to be fractured. Most rainfall and snowmelt in the area percolates through the lava and limestone and continues percolating down to the Redwall Limestone, about 3000 feet below ground surface. The general lack of surface water on the plateau is indicative of the porosity of geologic formations at land surface in the area.

In a few areas, there is alluvium (sand, silt, and clay) beneath the lava and on top the Kaibab Limestone that might act as a barrier to percolation of groundwater and cause formation of small locally perched water tables. These local, perched aquifers are the only reliable source of

groundwater within a reasonable depth on this part of the Shivwits Plateau. The large open area north of the camp (labeled Lake Flat on the topo map) is an area where there is a sufficient thickness of alluvium overlying the Kaibab Limestone to form a local, perched water table. The 4-foot diameter well 1¼ miles north of the camp is completed in this perched aquifer. Figure 2 shows a schematic cross-section through the area to illustrate hydrogeologic conditions.

At some time in the past, when Mount Dellenbaugh was an active volcano, lava flows from the volcano created a dam which acted as a sediment trap on streams north of the volcano. Subsequent lava flows and deposition of sediments between eruptions resulted in a stratigraphic sequence of alternating sediments and lava. The thickness of these deposits in the area north of the Shivwits Fire Camp is unknown as the only well in the area is only 66 feet deep. The sediments are sufficiently thick to form a perched aquifer that has been shown to be a reliable source of water for the NPS Well.

There may be areas in Lake Flat where the sedimentary sequence is thicker and more groundwater is available. It may be possible to construct a new well closer to the fire camp, but the previous test drilling clearly showed that there no alluvial sediments underlying the camp area, and therefore no groundwater available at the fire camp. Additional test well drilling might locate groundwater in sediments closer to the fire camp than the existing NPS Well, but drilling would be expensive (perhaps in the range of \$100/foot) and there would be no guarantee of finding a suitable source of water much closer than the existing well. If a new well was constructed, it would still be necessary to run a water line, or transport water by some sort of tanker, from the well to the camp. The best case scenario might put this distance at about half a mile. Geophysical investigations would probably not be useful in attempting to identify target drilling sites in the Lake Flat area because the interlayering of lava flows and sediments would tend to disrupt the reflection from the layers. Geophysical exploration works best where individual layers are thick and continuous over larger areas.

My recommendation for a water supply for the Shivwits fire camp is to reconstruct the NPS Well 1¼ miles north of the camp. This recommendation is based on; unfavorable hydrogeologic conditions at the camp, distance to and difficulty in obtaining water from springs, and the high cost and risk of failure for drilling new wells closer to the camp. After reconstructing the well, it could be equipped with a solar-powered pump. Water could be pumped from the well to the camp through black polyethylene tubing installed in a shallow trench or transported by a trailer-mounted tank unit to the 10,000 gallon underground storage tank at the camp.

Prior to spending money on reconstruction of the well, it should be tested to determine that it will produce enough water to supply the camp. I believe there is a pump in the well. A portable generator would need to be taken out to the well to supply power for pumping. During the test pumping both the pumping rate and water level in the well should be monitored. Water should be pumped through pipes or fire hoses to discharge a couple hundred feet from the well at a location where water will flow away from the well. The pumping rate can be adjusted by placing a valve in the discharge line at the well. If it is determined that the well will produce sufficient water, then reconstruction can proceed.

The well was constructed in 1963. The well was registered with Arizona Department of Water Resources in 1982 (see attached registration form). Depth to water in the well was reported to be 53 feet below land surface. It isn't clear if that refers to 1963 when the well was constructed or 1982 when it was registered. On June 24, 2003, I measured the water level at 48 feet below ground surface, 5 feet higher than previously reported. That there was still 18 feet of water in the well following a very dry period the preceding winter and summer is an indication that this aquifer is a fairly reliable source of water.

The first step in reconstruction of the NPS Well is to remove as much debris from the well as possible. Then pump the well repeatedly to allow water to surge in and out of the well to agitate sediments that have collected in the bottom of the well and remove them by pumping. The goal in reconstruction of the well is to replace the large diameter open well with a small diameter pipe to eliminate pathways for contaminants to reach the groundwater reservoir. A diagram of the reconstructed well is attached as Figure 3. Reconstruction should proceed as follows:

1. Place 1 foot of pea gravel or crushed rock in the bottom of the well.
2. Place the well screen and casing in the well. Four-inch PVC slotted well screen and casing should be readily available from a local well driller or supply house. Ten feet of slotted screen will be sufficient.
3. Backfill the area between the 4-inch PVC screen and casing and the 4-foot casing with pea gravel or crushed rock to about 45 feet below ground surface. The top of the coarse rock should be a few feet higher than the water level in the well and will provide a porous underground reservoir of water for pumping.
4. Backfill the well with lava rock and sediments from the pile created when the well was constructed. This backfill material can come to within 2 feet of ground surface.
5. The area from the top of the 4-foot casing to a depth of 2 feet should be backfilled with concrete to form a water tight seal to prevent infiltration of water from land surface into the well. Alternatively, a steel plate could be welded across the 4-foot opening, leaving the 4-inch PVC casing protruding from the steel plate. The opening between the steel plate and 4-inch PVC should have a water tight seal.
6. The immediate vicinity of the well should be graded to cause the surface to slope away from the well so water will not pond in the area, but will flow away from the well
7. Fence the area to keep cattle and wildlife 100 feet from the well.
8. Disinfect the well with chlorine when restarting the water system each spring.

Materials that would be required for reconstruction of the well are;

1. Ten feet of slotted 4-inch PVC well screen.
2. Sixty feet of 4-inch PVC well casing.
3. Well cap.
4. Ten cubic yards pea gravel or crushed rock.
5. Two cubic yards concrete.

If these procedures for reconstruction of the well are followed, the well should provide a safe, reliable source of potable water that should meet the needs for the Shivwits Fire Camp.

If there are any questions regarding this trip report, please call me at (970)-225-3515.

References

Billingsley, George H., 2003, USGS Geologist, Flagstaff Arizona, Personal communication.

Billingsley, G.H., Hamblin, W.K., Wellmeyer, J.L., and Dudash, S.L., 2001, Geologic map of part of the Uinkaret volcanic field, Mohave County, northwestern Arizona: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2368, scale 1:31680.

Billingsley, G.H., Wellmeyer, J.L., Harr, M.L., and Priest, S.S., 2002, Geologic map of the Hidden Hills and vicinity, Mohave County, northwestern Arizona: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2387, scale 1:31680.

Billingsley, G.R., Harr, Michelle, and Wellmeyer, J.L., 2000, Geologic map of the upper Parashant Canyon and vicinity, Mojave County, northwestern Arizona: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2343, scale 1:31680.

Campbell, Debra, 1990, Lake Mead Water and Sewer Systems Study, NPS Denver Service Center, Package 587.

Huntoon, P.W. and Billingsley, G.H., Jr., 1977, Geological map of western Grand Canyon, Arizona: Grand Canyon Association, scale 1:48000.

Levings, Gary W., and C.D. Farrar, 1979, Map Showing Ground-Water Conditions in the Virgin River, Grand Wash, and Shivwits Areas, Mohave County, Arizona -1976, USGS Water Resources Investigations 79-57 Open File Report, 1 map sheet.

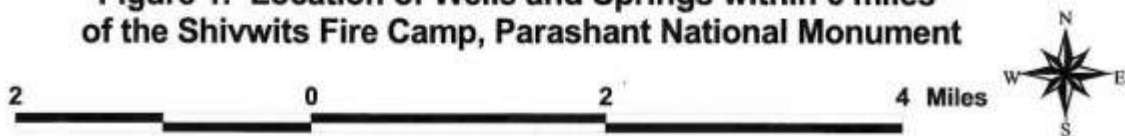
Wenrich, K.J., Billingsley, G.H., and Huntoon, P.W., 1996, Breccia-pipe and geologic map of the northwestern part of the Hualapai Indian Reservation and vicinity, Arizona: U.S. Geological Survey, Miscellaneous Investigations Series Map I-2522, scale 1:48000.

cc:

PARA – Darla Sidles, Ray Klein
1211 – Reber
2380 – Kimball
ZION – Sharrow



Figure 1. Location of Wells and Springs within 6 miles of the Shivwits Fire Camp, Parashant National Monument



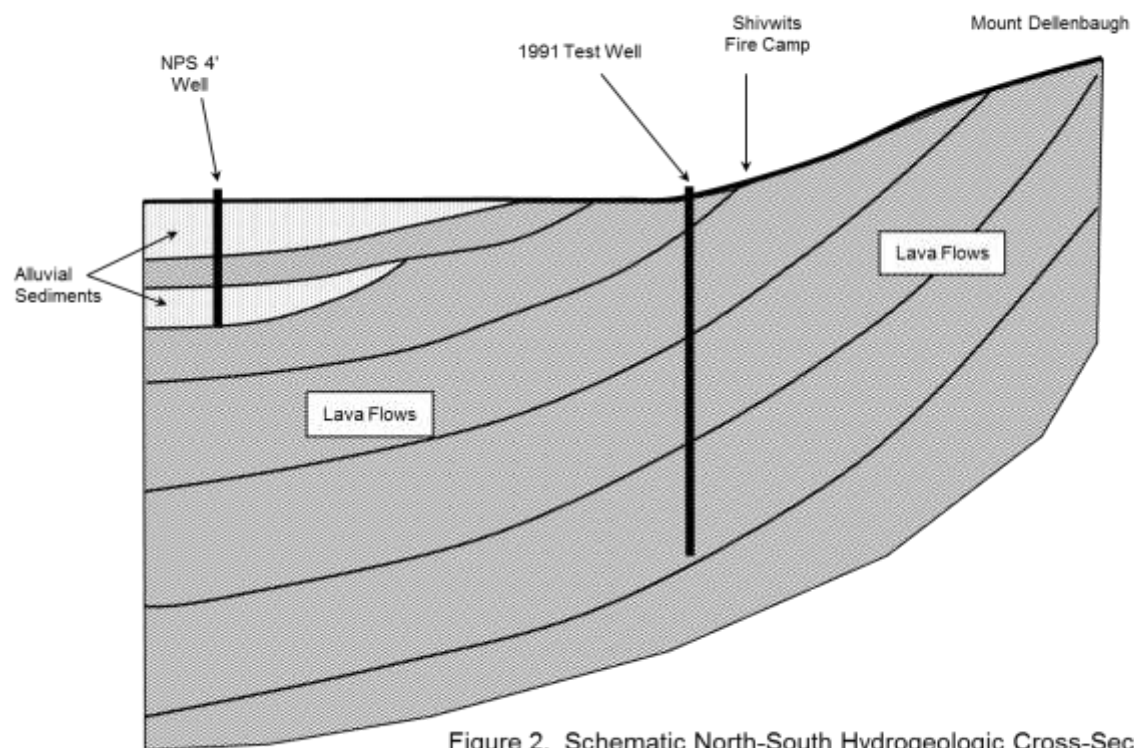


Figure 2. Schematic North-South Hydrogeologic Cross-Section

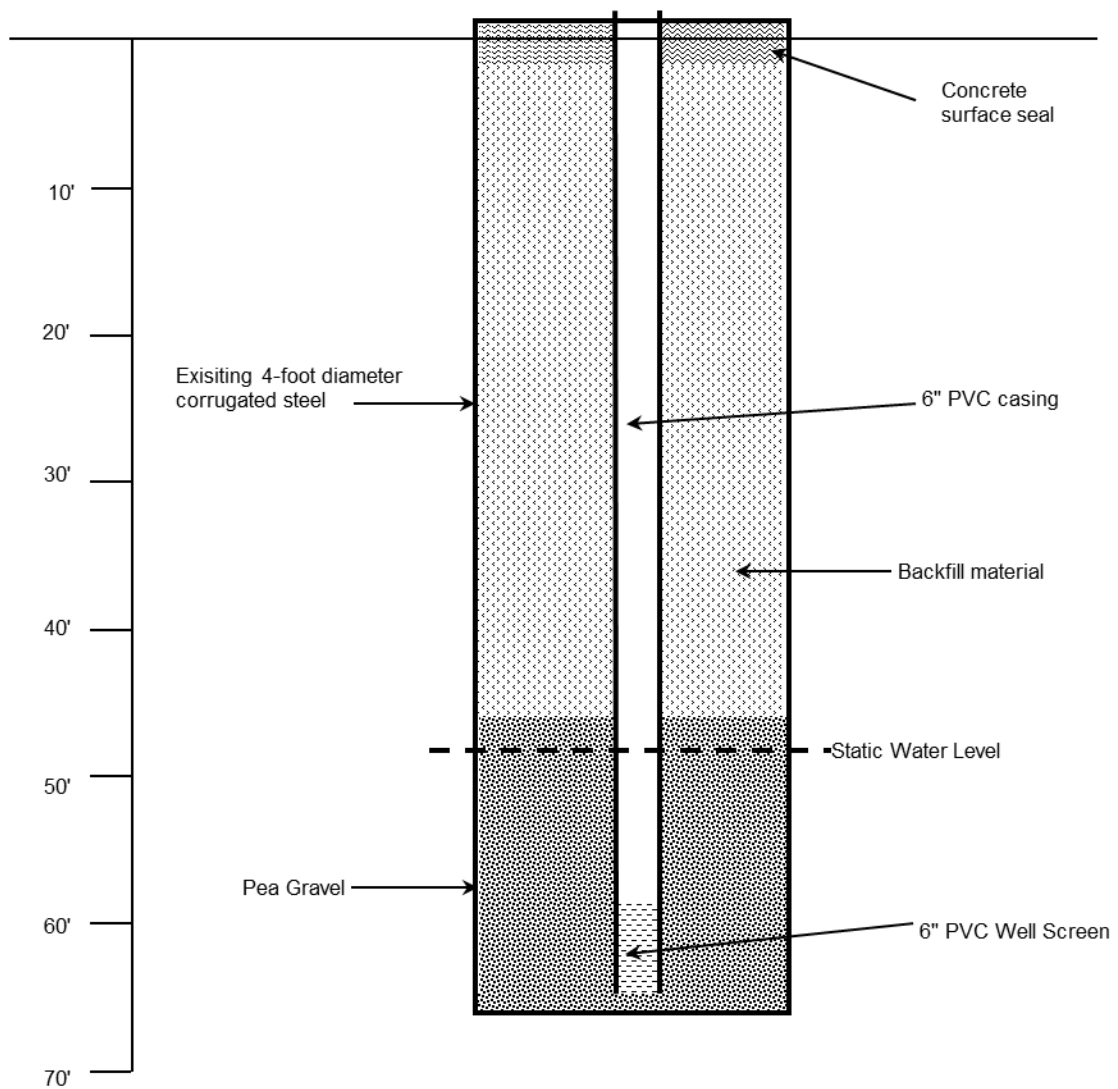


**Figure 3. Schematic of reconstructed well
1¼ miles NW of Shivwits Fire Camp,
Parashant National Monument**

DEPARTMENT OF WATER RESOURCES
89 EAST VIRGINIA AVENUE
PHOENIX, ARIZONA 85004



REGISTRATION OF EXISTING WELLS

READ INSTRUCTIONS ON BACK OF THIS FORM BEFORE COMPLETING
PRINT OR TYPE - FILE IN DUPLICATE

Declaration: The United States gives the
State the right to regulate the use of water of
the United States to the use of water of
the State, and does not concede that the
State has power to regulate the rights of
the United States to the use of water of
the State.

NPS
4-foot diameter well

02

REGISTRATION FEE (CHECK ONE)
EXEMPT WELL (NO CHARGE) ☒
NON-EXEMPT WELL - \$10.00 ☐

FOR OFFICE USE ONLY
REGISTRATION NO. 629137
FILE NO. 8(32-12)23-111
FILED 6-9-82 AT 1:30
(DATE) (TIME)
INA
AMA

1. Name of Registrant:
National Park Service, Western Region, Division of Water Resources
450 Golden Gate Ave., Box 36063, San Francisco CA 94102
(Address) (City) (State) (Zip)
2. File and/or Control Number under previous groundwater law:
(File Number) 35 (Control Number)
3. a. The well is located within the SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$, Section 23
of Township 32 N N/S, Range 12 W E/W, G & SRB & M, in the
County of Mohave.
b. If in a subdivision: Name of subdivision _____
Lot No. _____, Address _____
4. The principal use(s) of water (Examples: irrigation - stockwater - domestic - municipal - industrial)
Domestic, public supply, fire protection
5. If for irrigation use, number of acres irrigated from well _____
6. Owner of land on which well is located. If same as Item 1, check this box ☒

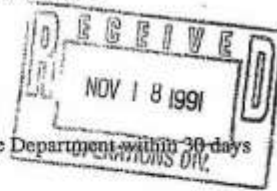
(Address) (City) (State) (Zip)
7. Well data (If data not available, write N/A)
a. Depth of Well 66 feet
b. Diameter of casing 4 (feet) ~~inches~~
c. Depth of casing 48 feet
d. Type of casing steel
e. Maximum pump capacity not more than 35 gallons per minute
f. Depth to water 53 feet below land surface.
g. Date well completed July 1963
(Month) (Day) (Year)
8. The place(s) of use of water. If same as Item 3, check this box ☒
SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$, Section _____ Township _____ Range _____
SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$, Section _____ Township _____ Range _____
Lake Mead National Recreation Area - Shivwits Area Well
Attach additional sheet if necessary.
9. DATE JUN 3 1982 SIGNATURE OF REGISTRANT Gerard R. Witucki
GERARD R. WITUCKI
CHIEF, DIVISION OF WATER RESOURCES

ARIZONA DEPARTMENT OF WATER RESOURCES

15 South 15th Avenue
Phoenix, Arizona 85007

WELL DRILLER REPORT

This report should be prepared by the driller in all detail and filed with the Department within 30 days following completion of the well.



1. Owner Name: National Park Service
Address: 601 Nevada Highway Boulder city nev. 89005
Street City State Zip
2. Driller Name: Ballard Drilling Co.
Address: 242 W. 300 S 95-7 Hurricane, Utah 84737
Street City State Zip
3. Location: 32 N 8 W 36 NW 1/4 NE 1/4 NE 1/4
Township Range Section 10-acre 40-acre 160-acre
4. Well Registration No. 55- 533440 (Required)
5. Permit No. _____ (If issued)

DESCRIPTION OF WELL

*Test hole at
Shivwitz Fire Camp*

6. Total depth of hole 190 ft.
7. Type of casing drilled open hole
8. Diameter and length of casing 0 in. from _____ to _____, _____ in from _____ to _____
9. Method of sealing at reduction points _____
10. Perforated from _____ to _____, from _____ to _____, from _____ to _____
11. Size of cuts _____ Number of cuts per foot _____
12. If screen was installed: Length _____ ft. Diam _____ in. Type _____
13. Method of construction _____
(drilled, dug, driven, bored, jetted, etc)
14. Date started Nov 8 91
Month Day Year
15. Date completed Nov 8 91
Month Day Year
16. Depth to water dry hole ft. (If flowing well, so state)
17. Describe point from which depth measurements were made, and give sea-level elevation if available _____

18. If flowing well, state method of flow regulation: _____

19. Remarks: dry hole

Filled bore hole
Cemented plug & marker
at the top.

DWR-55-55-701 (Rev.)

ENTERED NOV 19 1991

DO NOT WRITE IN THIS SPACE

55-533440
B(32-12)36BAB
Registr
File N
Receiv
Entero

LOG OF WELL

Indicate depth at which water was first encountered, and the depth and thickness of water bearing beds. If water is artesian, indicate depth at which encountered, and depth to which it rose in well.

[illegible]

I hereby certify that this well was drilled by me (or under my supervision), and that each and all statements herein contained are true to the best of my knowledge and belief.

Driller Name:

Devin Ballard
Ballard Drilling Co.

243 W 800 S. 95-7
Street

Street