

Water Supply Wells At Park Headquarters, Organ Pipe Cactus National Park

The following information comes from WRD files in Fort Collins, supplemented with information and clarification from Rich Johns, Utilities Operator, at ORPI.

The aquifer supplying water to wells in the Headquarters area is a permeable zone in volcanic rocks and sediments filling the valleys. The mountains to the west of the Headquarters area are unlikely to yield much water to wells, as evidenced by the dry well (No. 2) that was drilled north of the campground.

Well No. 1 has been replaced by Well No. 5. Well No. 5 is known as the “North Well”. Well No. 1 was drilled in 1941 to a depth of 348 feet. It was 8-inches in diameter and had torch-cut perforations from 328-348 feet. Depth to water was reportedly 306 feet when drilled. A sample of the fine sand from 300-348 feet in the well was assayed and found to be 50% iron. In 1961 it was cleaned and repaired by lining it with a 5-5/8 inch casing. By December 1973, the well yield had decreased greatly. In an attempt to restore yield, the pump was removed and an attempt made to swab the well. The swab got stuck in the well and the cable was tied off at ground level. In June 1974, construction started on a new well (Well No. 5) adjacent to Well No. 1. The driller tied on to the swab cable and attempted to pull the swab free, but the cable broke and fell down the well. The casing was covered with a metal plate.

Well No. 5, known as the “**North Well**”, was drilled 8 feet north of Well No. 1 in 1974 to a depth of 420 feet and had a water level 308 feet below ground surface. The well was completed with 12-inch steel casing from surface to 420 feet with two sections of Johnson stainless steel screen (0.10” slot) from 350-360 and 400-410 feet. The well had a drilled diameter of 14 inches and was gravel packed with 3/8” washed gravel. After completion in August 1974, the well was test pumped at 114 gpm for 15½ hours resulting in 6¾ feet of water level drawdown. This small amount of drawdown indicates the well is capable of producing a larger quantity of water than 114 gpm. Water level drawdown in Well No. 4 (323 feet south of the pumped well) was less than 0.2 feet during the test

Well No. 2 was drilled north of the campground. It went to a depth of 305 feet without encountering water. The driller’s log indicates this well penetrated mostly granitic and schist rocks. Apparently the well was backfilled and abandoned.

Well No. 3 was drilled in May 1954 to a depth of 291 feet. It is 1886 feet south of Well No. 4 and 200 feet east of the paved road to the campground. The well was completed with 6-inch steel casing from surface to 290 feet. The well completion report states that there were no perforations in the steel casing. Water levels were reported at 279 feet when drilled in 1954 and 287 feet below ground surface in March 1956. It was reportedly dry in October 1962 and again in May 1976. This would probably have been a useable well if it had been drilled to a depth of about 350 feet.

Well No. 4, also known as the “**South Well**”, was constructed in Oct-Nov. 1957 to a depth of 430 feet and had 12-inch steel casing to a depth of 428 feet. The casing has torch-cut perforations from 365-425 feet. The water level was reportedly 310 feet below ground surface in November 1957. The well was reportedly pumped at 30 gpm for 24 hours resulting in no water level drawdown.

South Well

The South Well (Well No. 4) was the primary water supply well for the Headquarters area. Recently maintenance staff noticed sediment in the traps in the water line. Approximately a tablespoon of sediment is removed each time the traps are checked. Production from the well has dropped from about 45-50 gpm to about 20 gpm.

(January, 2004. I (L.Martin) made a site visit to the park and tested the wells. The South Well did not have enough thrust to lift water to the storage tank. It would pump 15 gpm with open discharge at the wellhead. The North Well has been the only source of water for several months.)

The pump and motor and some of the drop pipe in the South well were replaced about 3 years ago.

Maintenance staff also report that the well is about 395-400 feet deep and that the water level is about 337 feet below ground surface. The well was originally completed to 430 feet deep and had a water level about 310 feet below land surface. These data indicate that the bottom 30 feet of the well has filled with sediment in the past 45 years, effectively reducing the length of the open interval of the well by about half. It also appears that the static water level has decreased, but not enough to have significantly affected the production capability of the well.

The presence of sediment in the well and the water lines is not surprising. Wells that have been constructed with torch-cut perforated casing are notorious for eventually developing sediment problems. Part of the problem might also be related to corrosion of the well casing. Ordinarily, the magnetism of the sediments found in the water lines would indicate the problem was corrosion of the well casing. However, there are notes in WRD files that indicate the sediments contain a significant amount of magnetite and iron. Also the apparent filling of the bottom 30 feet of the well with sediment shows that movement of sediment into the well is at least part of the problem.

Suggested Solutions

South Well –

1. Disconnect the well from the distribution system and test pump the well to determine if the problem is with the well/pump or if it is a blockage in the water distribution line. Check the screen at the pump meter to see if it is partially plugged. If the pump will produce 50 gpm when disconnected from the system, then you know you have problems with sediment plugging the distribution line.

2. Pull the pump from the well and examine the drop pipe, check valves, pump, and particularly the intake screen on the pump.
3. Clean the well by bailing to remove the accumulated sediment. Continue bailing until the original depth of the well (430 feet) has been recovered. The surging action of bailing will help flush sediment from the perforations.
4. Install PVC well screen and casing as a liner. Make certain that casing centralizers are used in the screened section. The well screen should be factory slotted, not some cheap, homemade variation. Backfill the annular space between the steel casing and PVC liner with coarse sand to create a filter within the well.

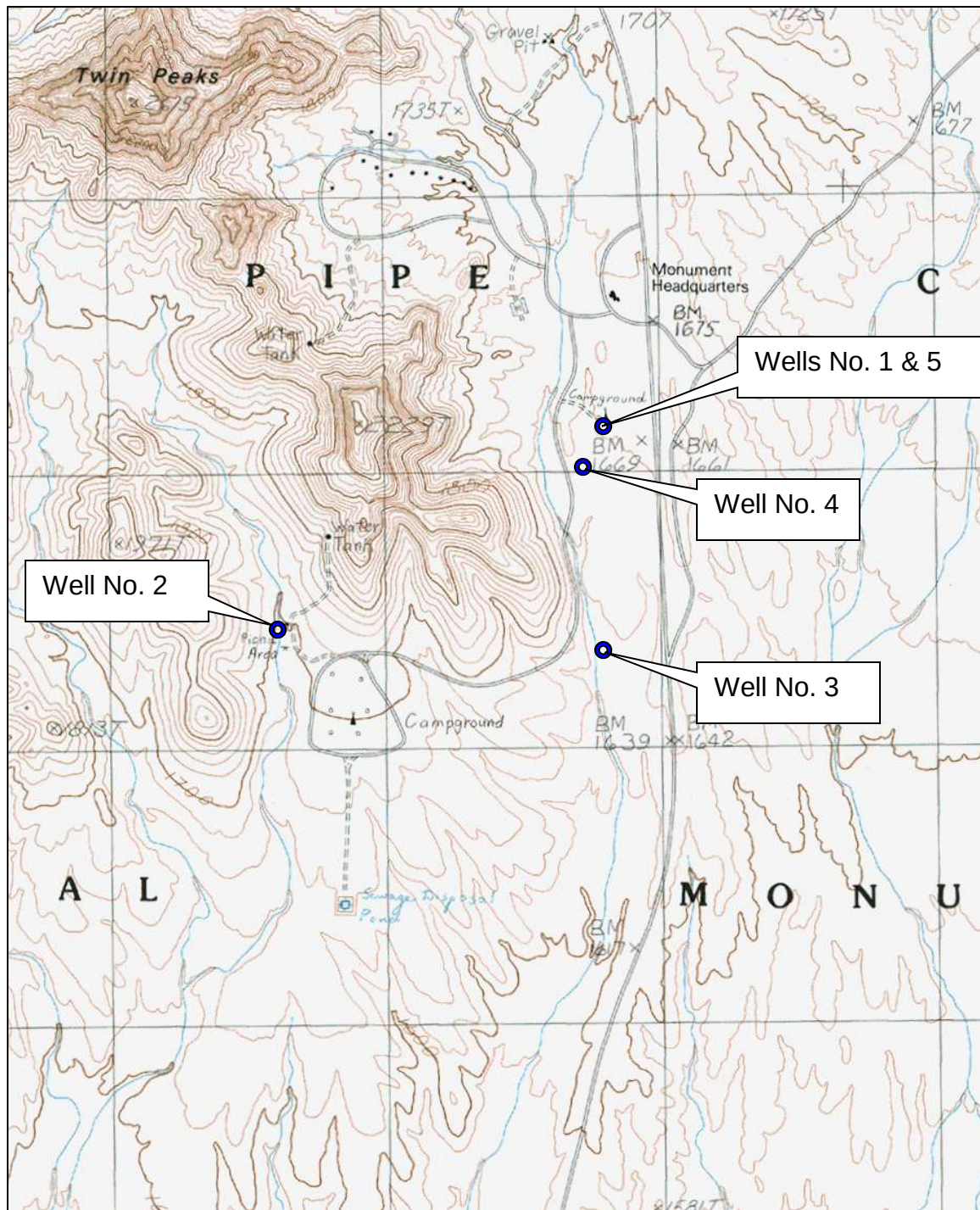
The result of these actions should be restoration of a functioning well, or at least as close as we can get without starting over and drilling a new well. It is not necessary to run a video log of the well or to conduct the sonar-jet cleaning of the well. Those items would add a lot to the total cost of the project and produce very little incremental increase in the results. We know from our records that the bottom 30 feet of the well has filled with sediment. Correcting that deficiency will go a long way toward restoring the yield of the well. We have enough room inside the 12-inch casing to place a PVC liner and sand filter. Installing the liner and sand filter should eliminate the sediment problem.

North Well –

This well reportedly can easily produce more than 100 gpm. If it produces less than that, we should determine why. Perhaps it is a limitation of the pump size. Water levels in the well should be measured to determine both the static and pumping water levels. That will allow us to determine whether the low yield from the North Well is a function of pump size or if there is some other problem preventing the full utilization of this well.

Please consider these comments as preliminary and subject to revision if more information becomes available or if I have misunderstood some part of the explanation of the problem. Please feel free to call me at (970)-225-3515 or send an email to larry_martin@nps.gov.

Larry Martin
NPS- Water Resources Division
Fort Collins, CO
November 28, 2003



Approximate locations of Wells in the Headquarters area at
Organ Pipe Cactus National Park

Well No. 5 is the “**North Well**”. Well No. 4 is the “**South Well**”. Well No. 3 was apparently never used for water supplies. Well No. 2 was dry and was backfilled and abandoned immediately after drilling. Well No. 1 was replaced by Well No. 5 in 1974.

February 3, 2004

Memorandum

To: Rich Johns, Utilities Operator, ORPI
Bill Mikus, Facility Manager, ORPI

From: Larry Martin, Hydrogeologist, Water Resources Division

Subject: Repair/Rehab of wells in Headquarters Area

This memo summarizes the information I obtained regarding the water supply wells in the headquarters area and our discussions regarding corrective actions to eliminate sediment production from the wells.

The South well was pumped for about an hour with the water discharging onto the ground. The pump in the South Well is no longer capable of pushing water all the way up the hill to the storage tank. The impellers in the pump have probably been worn by pumping sediment from the well. After pumping the well at 15 gpm for an hour, the water level had been drawn down only about a foot. This indicates that there is not a problem with the flow of water from the aquifer into the well. The well could probably produce 100 gpm or more, however the condition of the transmission line from the wells to the storage tank limits pumping rates from the wells to about 40-50 gpm. The South Well should easily produce the desired 40-50 gpm with only a few feet of drawdown.

The water pumped from the South Well remained dirty for the duration of pumping. This is likely a residual effect of not using the well regularly for the past several months. This situation can be corrected by bailing, air-lifting, or jetting the well after the old pump has been removed. The action of a bailer moving up and down the well while removing the sediment that has accumulated in the bottom of the well should knock loose most of the rust and sediment that may have accumulated in the well. It would probably take several hours of pumping before the water from the well was clear after bailing was completed. Air lifting involves running a small diameter pipe to the bottom of the well and then blowing large volumes of air at high pressure into the well. This causes water and sediment in the well to be blown to the surface. Continuing to blow air into the well for about an hour while moving the pipe up and down in the perforated zone of the well casing should be sufficient to clean up the well. Jetting is similar to air-lifting except that the flow is directed radially outward rather than through the bottom of a pipe. Jetting can be conducted with air or water. The effect is similar to sandblasting the interior of the well casing. Any of these methods are acceptable, depending on the equipment available from the pump service company.

The North Well was pumped at an average rate of 37 gpm for an hour resulting in 3 feet of drawdown. This indicates that the well can produce water at a much higher rate, but

again limitations of the transmission line dictate that the well be operated in the 40-50 gpm range. A decision as to whether to bail the North Well to remove accumulated sediment from the bottom of the well can wait until the pump has been pulled and the depth of the well is measured. If the bottom of the well is 400 feet or deeper, it probably doesn't need to be bailed. (The North Well is covered by a small building housing the electrical controls and chlorination equipment making access for bailing, air lifting, or jetting of the well more difficult.)

At both wells, the check valves in the drop pipe were not working properly. Water in the drop pipes would drain into the well when the pumps were turned off. This creates conditions where the inside of the drop pipe is alternately wet and then exposed to air; perfect conditions for corrosion of the pipe. Much of the sediment material that has been collected from the wells appears to be rust, most likely from the inside of the drop pipes.

Both wells should have new drop pipe and check valves installed. The South Well needs a new pump, but the motor might still be useable. The condition of the pump and motor in the North Well should be assessed after it is pulled from the well. The electrical cable should be replaced if necessary. Installation of Lakos sand separators should eliminate or greatly reduce sediment pumped from the wells, prolonging the life of pumps and valves.

Torque arrestors should be installed in both wells when the pumps are replaced. Torque arrestors reduce the torque and strain on the drop pipe when the pump starts and stops. It will also help to hold the pump and drop pipe stable in the center of the well. The number and spacing of the torque arrestors is dependent on the size of the pump and motor and the depth at which the pump is set in the well. The pump service company should be able to provide specs for the number and spacing of torque arrestors.

After torque arrestors are installed in the well, it will be nearly impossible to measure water levels in the well without getting the water level measuring probes hopelessly entangled in the torque arrestors. If we are ever going to measure the water levels, it will be necessary to install polyethylene tubing to allow passage of the monitoring probe. The tubing should be 1" diameter and can be taped to the drop pipe. The bottom of the tubing should be a few feet above the top of the pump. The tubing would need to extend through the well seal. If there is an extra hole in the well seal, the tubing can be run through it. Otherwise it will need to come through the air vent hole and some modification made to allow the same access hole to function as the air vent and monitoring access. The minimum diameter needed for a probe is $\frac{3}{4}$ inch.

In summary, the following actions are needed to repair/rehab the wells at Organ Pipe.

South Well

1. Remove the old pump. Assess the condition of the motor.
2. Clean the well and remove accumulated sediment by bailing, air lifting, jetting, or some combination of these.
3. Install a new pump, drop pipe, check valves, and a sand separator.
4. Install new electrical cable if needed.
5. Install polyethylene tubing to facilitate water level measurements.
6. Test pump the well until the water consistently runs clear.
7. Chlorinate the well and return it to service.

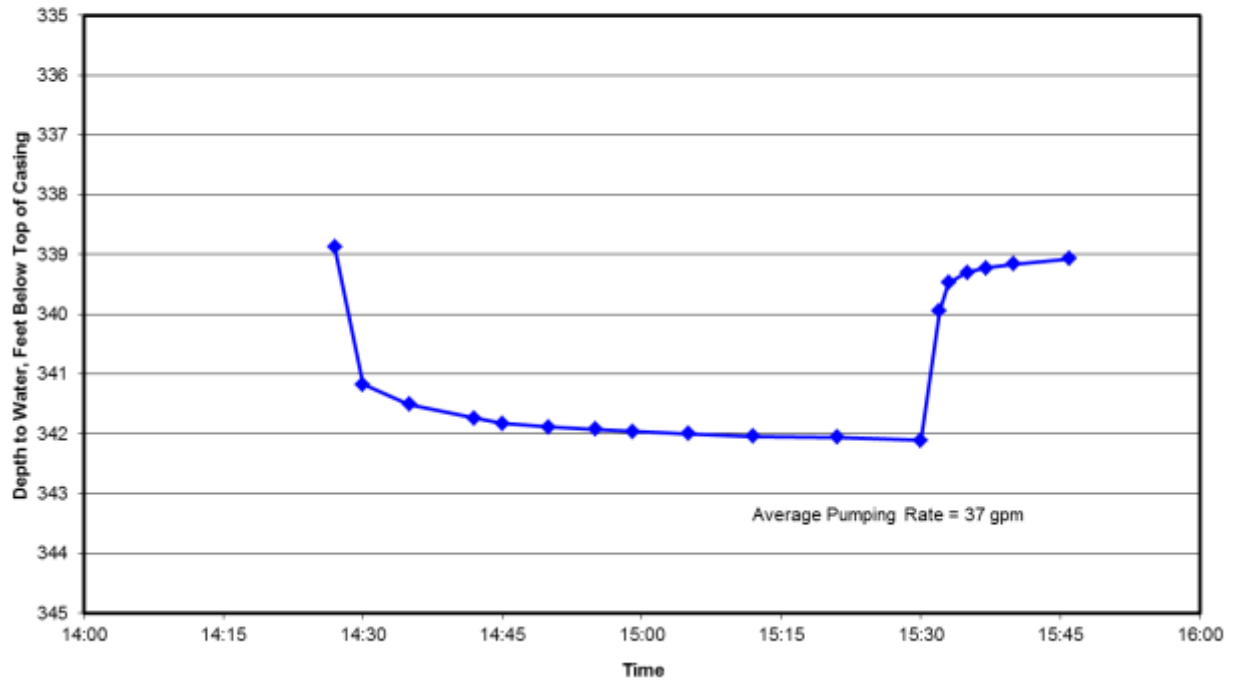
North Well

1. Remove the old pump. Assess the condition of the pump and motor.
2. Note whether there is evidence of degraded green electrical tape that might have been used to fasten the electrical cable to the drop pipe. If so, use another type of tape when installing the new pump.
3. Check the depth of the well and if necessary remove accumulated sediment by bailing, air lifting, jetting, or some combination of these.
4. Install a new pump, drop pipe, check valves, and a sand separator. (The existing pump and motor can be reused if they are still in good shape.)
5. Install new electrical cable if needed.
6. Install polyethylene tubing to facilitate water level measurements.
7. Test pump the well until the water consistently runs clear.
8. Chlorinate the well and return it to service.

The cost of a water level meter to make regular measurements of water levels in the wells is about \$500. Resource management staff (Amy Pate) volunteered to make regular water level measurements if Maintenance will buy the meter.

cc: Dan Overzet, DSC
Colleen Filippone, Tucson

Organ Pipe Cactus National Park
North Well, aka Well No. 5
January 26, 2004



Wednesday, March 31, 2004

Update on well at ORPI

Only the South Well has been rehabbed. They will do the North well in the near future, but only wanted to work on one well at a time and make sure they had one working well at all times.

After they pulled the pump, they did a video of the well, then cleaned it by sonar jetting, then let it settle for about a week and ran another video. Rich Johns is working on getting me copies of the videos.

The drop pipe from above the water table was in good shape, both inside and out. The pipe from below the water table had a lot of encrustation on the outside. The pump intake was nearly plugged with rust particles and fragments of green electrical tape. The worn ring and hole in the nipple above the pump was thought to be caused by vibration and rubbing of the attachment of the pump shroud at that location.

They installed new drop pipe, new wire, check valves, and added a sand separator to the bottom of the pump. Not sure if the pump was replaced.

Rich pumped water onto the ground for several hours. Produced 45-50 gpm. Water was dirty for about an hour and then cleared up. When he turned the pump on the next day, the water was clear from the very start. All is good.

His only concern now is that the well produces too much water, causing high pressure in the pipeline to the storage tank. The pressure on the water line varies from 195-205 psi. The pipeline is 2-inch schedule 40 PVC, the rating is about 125 psi. Rich fears that when the temperature drops next winter he will start to get leaks and bursts in the pipeline. I told him to partially close the valve at the wellhead to reduce the flow rate from the well, resulting in lower pressure in the pipeline. Folks from Gilbert Pumps had given him the same advice.

ORPI – SOUTH WELL

Tuesday 2/17/04 Gilbert Pump pulled the south well.

Gilbert and Mark started @ 9:45 am and finished at 12:11pm.

(Gilbert and Mark are employees of Gilbert Pump.)

Their job today was to pull the pump and pipe.

I have attached some pictures of what was found.

The green particle found in samples that I had in my shop are green plastic tape that held the electrical wire to the two inch drop tube.

s/Rich Johns



MVC-007L shows Holes in two inch by six inch nipple above pump.



MVC-008L shows corrosion on pipe and amount of pipe pulled. if you look closely at the pipe near the middle you will see a check valve.



MVC-009L shows plugged intake.



MVC-010L shows different view of the plugged intake and a piece of plastic tape that was removed from the intake