

# **Summary of well drilling and hydrogeology at Wolverton, Sequoia National Park**

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Prepared by Larry Martin, Hydrogeologist  
NPS Water Resources Division

## Introduction

Several water-supply wells and test holes have been constructed at Wolverton, primarily in the Long Meadow area. This report is being prepared to summarize the results of previous well drilling. Every effort was made to correctly identify the wells, but some of the documentation is confusing. For example, the two wells drilled in 1967 were named Well No. 1 and No. 2, but two wells drilled in 1984 were also named No. 1 and No. 2. Additionally, at some point the numbers for the 1984 wells were switched, with Well No. 1 now called No. 2 and No. 2 becoming No. 1. It is sometimes difficult to determine which documents and notes correspond to which well.

Groundwater exploration was originally undertaken in this area to provide a more reliable source of water and reduce treatment costs associated with a surface water source. Diversion of water from Wolverton Creek, especially late in the summer, was not always sufficient to meet existing or projected future demand. Anecdotal information indicates that the wells were only used as water supply sources for a few years. There was much concern about the potential impact of groundwater pumping on the ecology of the wet meadow. Water table decline could cause a drying of the meadow. The primary water source was changed back to a diversion from Wolverton Creek. One well is still maintained as a backup and emergency supply source.

## Hydrogeology

There are three geologic units of interest in the Wolverton area (Figure 1). Croft (1968) refers to these as: (1) basement complex of pre-Tertiary age, (2) glacial till of Pleistocene age, and (3) alluvium of Recent age.

The basement complex is granitic bedrock that is essentially impermeable (except where fractured). The granite outcrops on the hillslopes and is buried beneath the glacial till and alluvium in the valleys.

Glacial till occurs as an east-west ridge on the north side of Wolverton Creek. The ridge is part of a lateral moraine from a glacier that flowed down the Tokopah Valley (now occupied by the Marble Fork Kaweah River). Wolverton Creek formerly flowed northwestward into the Tokopah Valley, but was forced into its current path during the last glaciation. The till is probably several hundred feet thick and consists of poorly sorted sand, silt, clay, gravel, and boulders. Till has low permeability because it has not been sorted or reworked by running water.

Alluvium has filled the Long Meadow and Wolverton Creek valleys during the time since the retreat of the last glaciation. The alluvium consists primarily of medium-to-coarse sand and is

very permeable. The alluvium ranges from a few tens of feet to more than 100 feet thick. Logs of test wells indicate that the alluvial sand interfingers with finer-grained sediments from the glacial till.

### 1967 Well Drilling

In July and August 1967, two wells were drilled in the meadow about 500 feet southwest of the ski lodge (Figure 1). Well No. 1 was drilled to 121 feet through alternating layers of clay and sand. Well No. 2 was drilled about 50 feet southwest from Well No. 1 and was also drilled through alternating layers of sand and clay. In some documents, Well No. 1 is referred to as the “observation well” and Well No. 2 is the “production well”.

Well No. 1 was cased from 2 feet above land surface to 36 feet with 7-inch plain casing. Six-inch perforated casing was inserted inside the 7-inch casing and driven as drilling progressed to prevent the borehole from collapsing. The 6-inch perforated casing extends to 115 feet. The well was tested by bailing at a rate of about 20 gpm, resulting in about 40 feet of drawdown.

Well No. 2 was drilled and cased with 14-inch casing from 1 foot above ground surface to a depth of 120 feet. The 14-inch casing was perforated through the sand and gravel layers from 38-87 and 107-117 feet. A 6-inch casing and well screen were inserted inside the 14-inch casing and the annular space between the two casing strings was backfilled with gravel. The 6-inch well screen was “25 mesh” and was placed from 100-120 feet.

A step-drawdown test was conducted at Well No. 2 in August 1967 and again in September 1968. Water was pumped at various rates and the drawdown was measured at each pumping rate. The drawdown was greater during the 1968 test, suggesting that fine-grained sediments were plugging the perforated openings in the well casing. The well was poorly designed for its geologic environment.

### **1967 Well No. 2 (28-E2)**

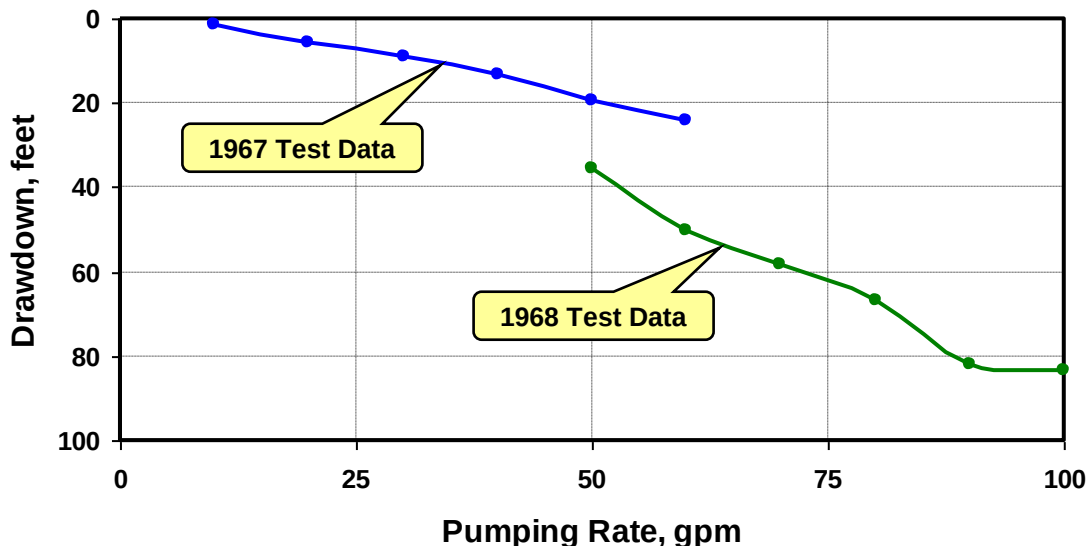


Figure 2. Results of step-drawdown test of Well No. 2 in 1967 and 1968.

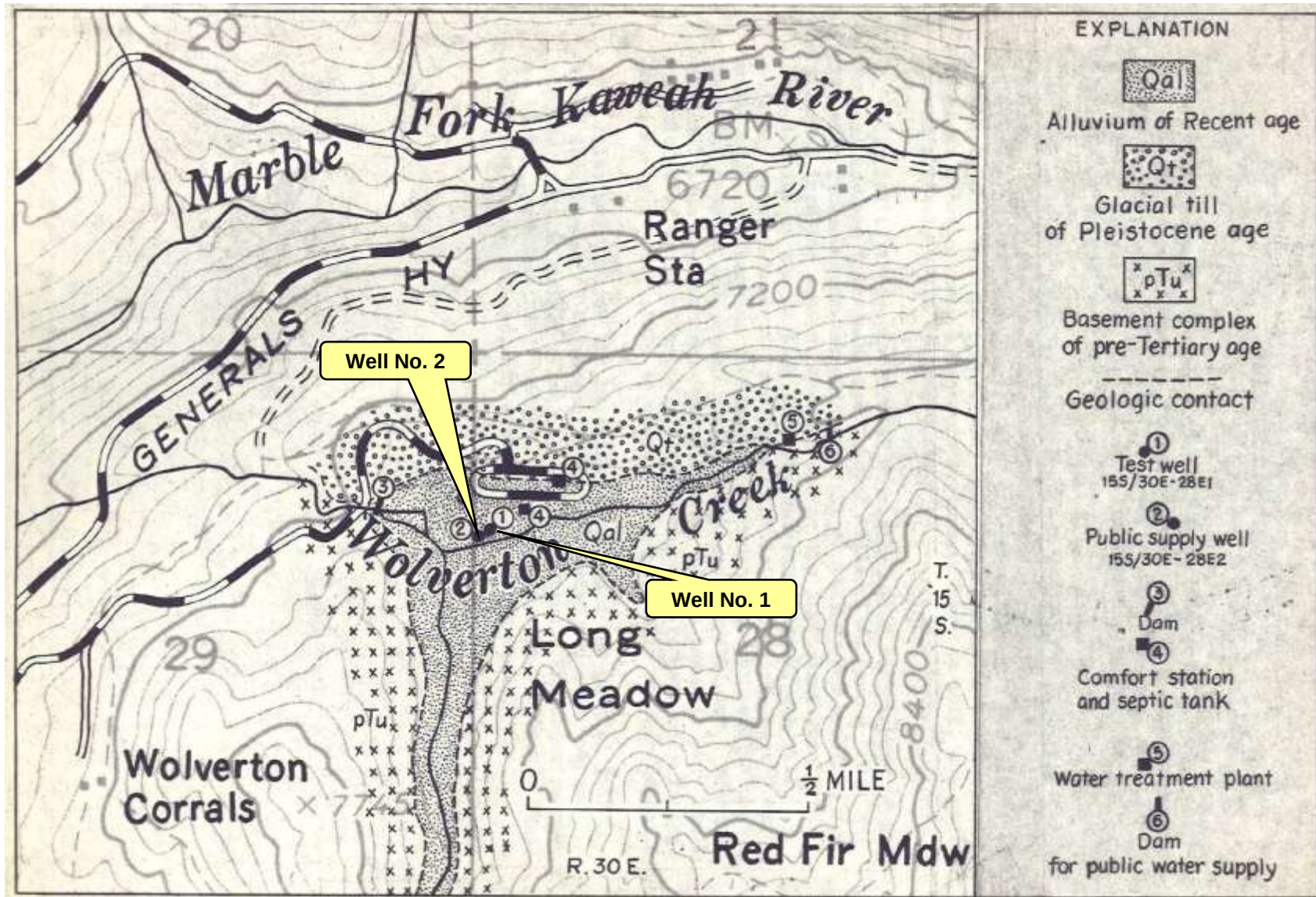


Figure 1. Location of 1967 wells and geology of the Wolverton area, from Croft (1968)

A trip report by Bill Werrell in 1982 stated that the two existing wells (the 1967 wells) had never been in service. No pumps were present.

### Geophysical Investigation

Bertoldi and Miller (1969) conducted a geophysical investigation of the Wolverton Creek Valley and Long Meadow to determine the thickness of alluvial sediments overlying the granitic bedrock. Their data showed that the bedrock valley underlying Long Meadow trended toward the north-northeast and has been filled with up to 100 feet of alluvial sediments. The east-west trending Wolverton Creek Valley has been filled with up to 130 feet of alluvial sediments. The data were used to identify optimal locations for future test wells. They also conducted a step-drawdown test of Well No. 2 and showed that the poor design of the well was causing excessive drawdown at high pumping rates. (Figure 2).

### 1984 Well Drilling

In August, September, and October 1984, two wells were constructed in the meadow south of the ski lodge. There is some confusion in the documents in the files regarding which well is which. At some point, the names (numbers) of the two wells were reversed, with Well No. 1 becoming Well No. 2 and No. 2 becoming No. 1. To avoid further confusion, I will refer to them as the “Iron Well” for the well that produces water with a high iron and manganese concentration, and the “Good Well” for the well that produces good-quality water. The Good Well is occasionally used as a backup supply for the Wolverton water supply system. The Good Well is located southeast of the ski lodge near the creek, very close to the 1967 wells. Well locations are shown in Figure 3.

The Iron Well is 101 feet deep and has well screen opposite the sandy intervals encountered during drilling, from 40-60, 70-75, and 85-90 feet below ground surface. Well screen was not placed opposite the clay and silt strata. The well was test pumped at 50 gpm for 24 hours, resulting in about 6½ feet of drawdown. Water from the well had 3.7 ppm iron and 0.82 ppm manganese, which exceed the secondary standards of 0.3 and 0.05 ppm.

The Good Well is 150 feet deep and has well screen at 45-60, 70-80, 100-115, and 135-140 feet below ground surface, opposite the sandy strata encountered during drilling. The well was test pumped at 50 gpm for 24 hours. Water level was not measured in the pumped well, but was measured in Well No. 1 and an observation well which were 370 and 350 feet away. Drawdown at those wells was about 4 feet. Concentrations of all water quality parameters were well below recommended limits.

Public Health Service inspections of the water system in 1978 and 1984 stated that the source of water was diversion from Wolverton Creek. The 1989 inspection report stated that the surface water diversion had been discontinued, the surface water treatment plant was physically disconnected from the distribution system, and the source of water was two wells in the meadow. A new surface water treatment plant was constructed ca. 1992-93. Presumably, the source was changed back to diversion from Wolverton Creek at that time. One of the wells in the meadow (the Good Well) is maintained as a supplemental/backup source. It is occasionally pumped to insure that it remains operational in case it's needed.

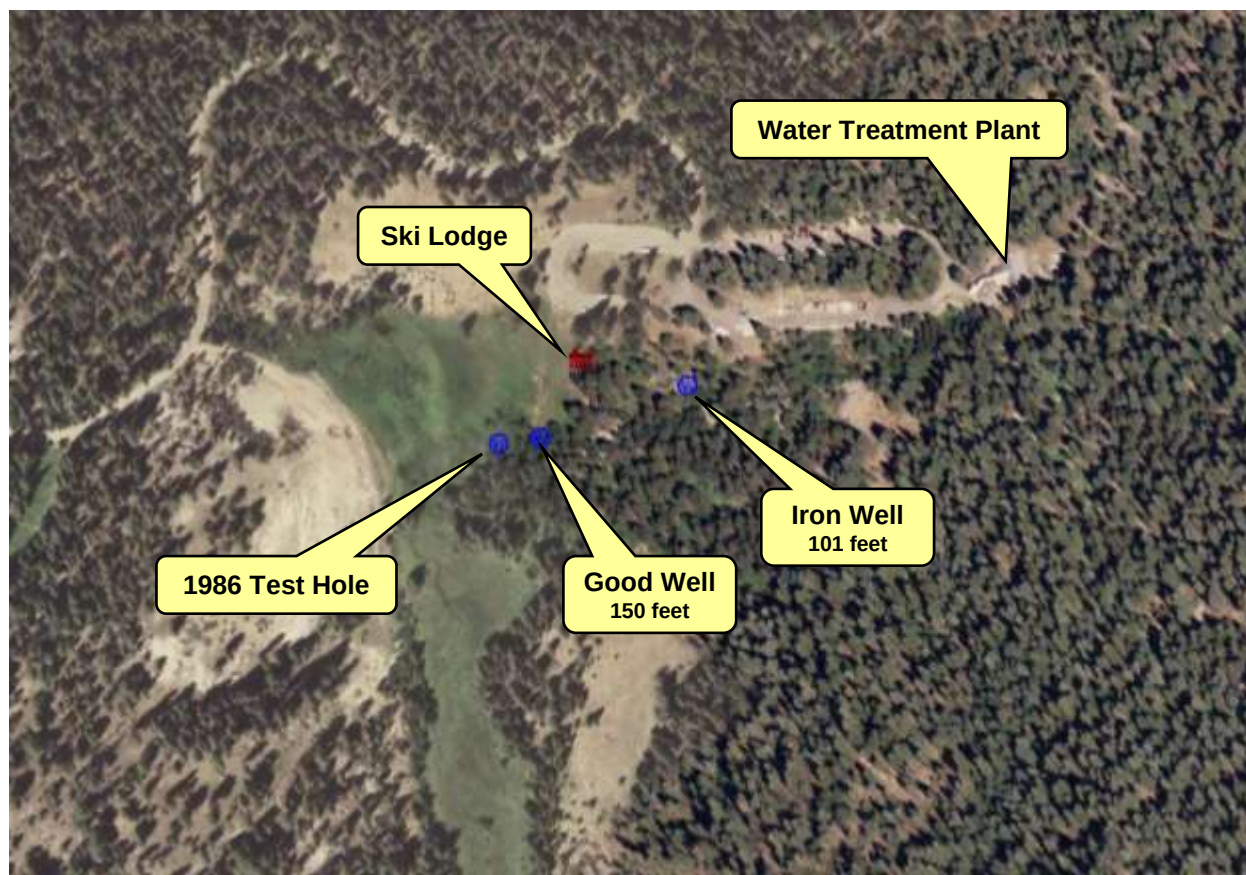


Figure 3. Water supply features in the Wolverton – Long Meadow area.

#### Potential Impacts of Groundwater Pumping

In 1983-84, the USGS investigated the potential impacts of groundwater pumping from wells in Long Meadow (Akers, 1986). In particular, there was concern that pumping groundwater from the wells in the meadow would capture and divert groundwater that otherwise might flow southwestward to sustain trees in the General Sherman Tree area. There was also concern that groundwater pumping might lower the water table in the wet meadow areas at Wolverton.

Several test holes were drilled in the granite ridge on the west side of Long Meadow. Water level measurements and testing suggest that the granite is essentially impermeable below the top 40 feet. The low permeability precludes the possibility of a significant amount of groundwater flowing from Long Meadow through the granite ridge to the General Sherman Tree area (Akers, 1986). Geologic mapping by Sisson and Moore (1984) showed an absence of fractures or joint systems through the granite ridge that might have acted as a conduit for groundwater to flow from the meadow toward the General Sherman Tree area. Shallow groundwater in the granite generally follows the same flow paths as surface water.

Test drilling showed that the ridge to the north of the Wolverton parking lot is glacial till. Although the till is saturated, the large clay content precludes significant groundwater flow through the sediments. Glacial till will not yield significant quantities of water to wells.

Test holes were augured at eight sites to determine the areal distribution of clay layers in the valley (Akers, 1986). The test-hole data indicate that the clay beds underlying the valley are lenticular and are distributed irregularly both horizontally and vertically. The erratic distribution and occurrence of the clay beds might inhibit percolation of streamflow and shallow groundwater at some locales, but it does not form a continuous confining layer throughout the valley. Thus, pumping groundwater from wells screened in the deeper sand layers will cause lowering of the water table throughout the valley and have adverse impacts on flora and fauna that are dependent on saturated conditions all the way to land surface.

Groundwater in the Long Meadow and General Sherman Tree areas was sampled and analyzed for stable isotopes. Analysis of the data suggests that little, if any, of the groundwater in the General Sherman Tree area travels there from Long Meadow (Akers, 1986).

#### 1986-87 Wells (Akers, 1987a)

A well was drilled in the meadow in 1986. The well was located 120 feet east of the Good Well that was constructed in 1984 (Figure 3). The well was drilled to 140 feet and completed with 0.45" well screen from 109-129 feet. The well was test pumped at 8-9 gpm for 7 hours, resulting in 105 feet of drawdown. The yield was not adequate for development as a water-supply source. The fate of the well is unknown; whether it was plugged, abandoned, and the casing removed, or if it's still there.

The well log of the 1986 Well No. 3 showed several tens of feet of coarse sand and gravel from 5-85 feet below ground surface. Yet the well produced less than 10 gpm. It was thought that the low yield was due to the construction of the well, with well screen only in the bottom 20 feet of the well. A new well was attempted 10 feet from Well No. 3 in 1987. It quickly became apparent that the new well was being drilled through glacial till (even though the well was in the middle of the meadow) and drilling was halted at 62 feet. The hole was backfilled and abandoned. It was concluded that the well log on the drillers report for the 1986 Well No. 3 was not accurate.

Since there was a drill rig on site, it was decided to clean and test the production well that had been constructed in 1967 (Well No. 2, Figure 1). The well was bailed and then cleaned, developed, and tested by airlifting. It was estimated that the well would produce 25 gpm.

#### Test wells south of Wolverton Creek (Akers, 1987b)

In October and November 1987, three test holes were drilled in the meadow south of Wolverton Creek. Sites were selected in areas where geophysical investigations predicted the maximum thickness of unconsolidated sediments overlying the granitic bedrock. The methods used in the geophysical investigations could not distinguish between permeable alluvium and impermeable glacial till.

The thickness of alluvium penetrated by these test wells ranged from 19-30 feet. The test wells then penetrated several tens of feet of impermeable glacial till before being finished in weathered granite. The alluvial groundwater was known to have high concentrations of iron from previous testing. Also, California regulations require sealing wells to a depth of 50 feet, effectively eliminating the alluvium as a potential groundwater source.

The test wells were temporarily cased to prevent the holes from collapsing and to allow testing of the water potential from the weathered granite underlying the alluvial and glacial till sediments in the meadow. Testing showed that the wells would produce a few tens of gpm, but that the iron concentration was about 1 ppm; approximately 3 times higher than the drinking water standard. The wells were plugged and abandoned.

#### Additional info regarding well locations

A new water treatment plant was constructed at Wolverton in the early 1990s. The “As-Constructed” drawings for the project provide some insight into the well locations in the meadow. Figure 4 is a reproduction of a portion of Sub-Sheet C3 (Drawing No. 102-41111C, Sheet 7 of 104, July 1992). The drawing shows Well No. 1 and Well No. 2. These are the wells constructed in 1984. It also shows that Well No. 2 was to be disconnected from the system. Well No. 2, as labeled on this drawing, is the “Iron Well”. It would make sense to disconnect it to eliminate the source of poor quality water. The drawing also shows Well No. 1 as remaining connected to the system (for use as a supplemental/backup source). The disconnection of the waterline from Well No. 2 was to occur at an existing valve chamber. This is the concrete vault with a metal-plate cover in the grassy meadow to the west of the ski lodge. Additionally, two small circles are shown near (to the east) of Well No. 1. These are likely the locations of the two wells constructed in 1967. The crosses on the drawing are 100-foot grid spacing.

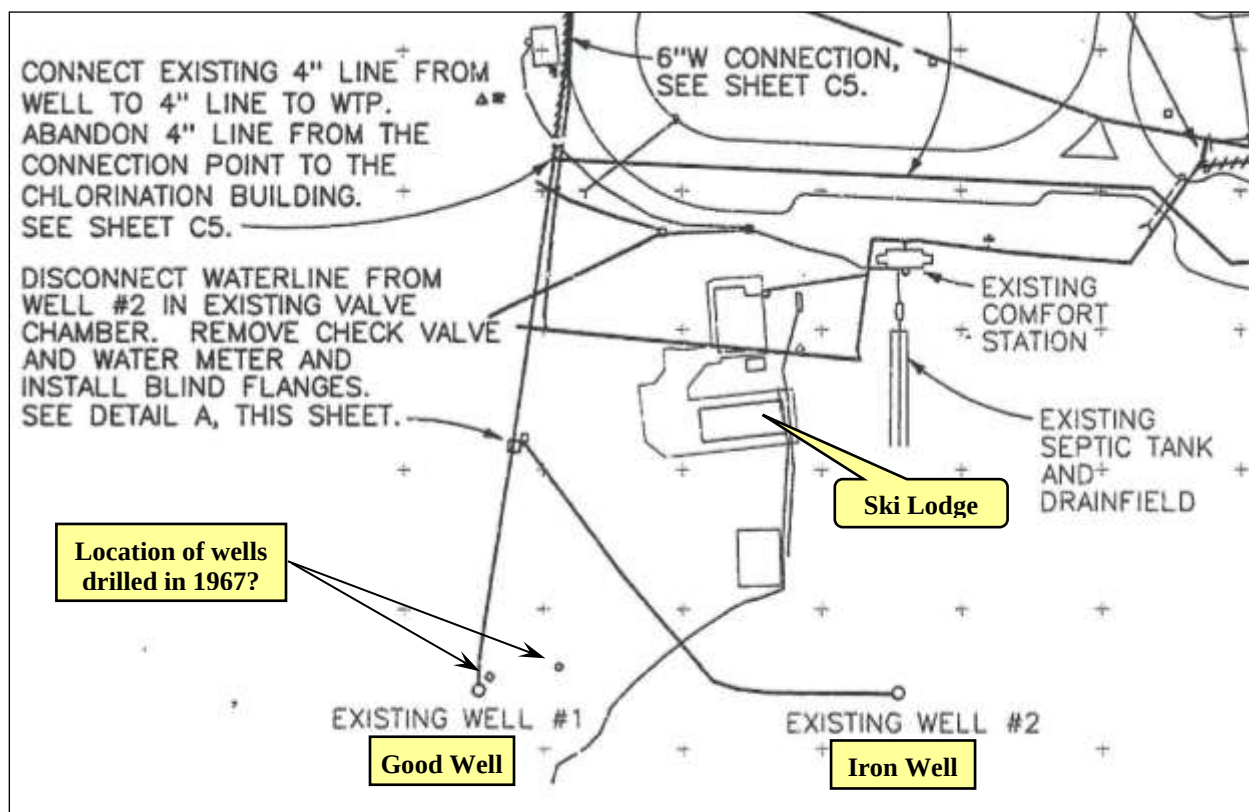


Figure 4. Well locations at Wolverton as shown on the construction drawings for the water treatment plant construction project.

#### Conclusions and Recommendations

1. The quantity and quality of groundwater underlying Long Meadow at Wolverton is probably not adequate to meet the full demand for water in the Wolverton water system.
2. Groundwater pumping from wells in the meadow will NOT affect the water regime at the sequoia grove in the vicinity of the General Sherman Tree.
3. Groundwater underlying the meadow flows toward, and discharges to, Wolverton Creek as it flows across the meadow. This inflow of groundwater mitigates (at least to some extent) the upstream diversion of water for the potable water supply of the area.
4. Continuous pumping of groundwater from wells in the meadow would lower the water table and cause an adverse impact on the wetland attributes of the meadow.

### References

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