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Groundwater Supplies in the Two Medicine Area, Glacier National Park

Problem

There are two existing wells that provide potable water for the Two Medicine Area at Glacier National Park. The wells are in close proximity to one another near the water storage tanks about 400 feet southeast of the paved Two Medicine Road. Current production capacity of the wells is barely able to meet the average daily demand of about 20,000 gallons per day. Additional water is needed to meet current demand in the Two Medicine area and to provide a backup supply.

Hydrogeology

The Two Medicine developed area is at the northeast end of Two Medicine Lake. The mountains surrounding the area are composed of PreCambrian argillite. The argillite has low permeability and is not likely to yield significant quantities of groundwater to wells. Drilling into the argillite bedrock is not recommended. If solid argillitic bedrock is encountered during the drilling of test wells, drilling should be stopped and the water-producing capability of the test wells should be evaluated at that depth. There is no point in continuing to drill into unbroken argillitic bedrock. In some of the previous test holes, the drillers log describes the first 5-10 feet of bedrock as being "broken". In situations where broken rock is encountered, drilling should proceed until more solid bedrock is encountered. The broken bedrock may be a very permeable source of groundwater and add significantly to the production capability of a well.

A blanket of glacial till overlies the granitic bedrock in most of the area adjacent to Two Medicine Lake. Till is a mixture of sediments ranging in size from boulders, gravel, and sand, to silt and clay. The till will probably contain groundwater, but will not readily yield water to a well. The fine-grained portion of the till (silt and clay) fill the pore spaces between the sand- and gravel-size sediments and impedes the flow of groundwater through the sediments. Wells completed in glacial till may produce a few gpm, but are unlikely to produce much more than that.

There are alluvial sediments along the Appistoki Creek and at the flat fan area where the creek enters Two Medicine Lake. These alluvial sediments were reworked by flowing water from the creek, resulting in washing away most of the fine-grained sediments and leaving the larger sand- and gravel-size sediments behind. The flat area including the boat dock and chalet is a delta of alluvial sediments that were deposited by Appistoki Creek as it flowed into Two Medicine Lake. These alluvial sediments are the only permeable geologic

formation in the area and should be the target aquifer for drilling any future wells in the Two Medicine area.

The alluvium along Appistoki Creek is probably not very thick as it is in a steep and narrow part of the valley; most of the alluvium would have been flushed downstream to be deposited at the delta where the creek flows into the lake. Drilling additional wells along Appistoki Creek is not recommended because a well in that area will only encounter a small amount of alluvium before entering the underlying glacial till. The till is less permeable than alluvium because it contains a significant amount of clay.

The existing wells at Two Medicine are located along Appistoki Creek and probably are completed in glacial till; explaining their low yield.

Historical Development of water at Two Medicine

About 1913, the Great Northern Railway Company constructed a diversion from Appistoki Creek to provide water for visitor services at the chalets and other facilities at Two Medicine Lake.

The collection and distribution system was reconstructed in 1963. The system included a concrete intake structure with sand-gravel filtration to collect water from the creek. Water flowed by gravity to the pump house where it was treated by chlorination and then pumped to a storage tank on the hillside.

The USGS conducted an evaluation of the groundwater supply at 8 sites in Glacier National Park in 1971-72 (Boettcher, 1973). At Two Medicine, a well was drilled about 200 feet southwest of the entrance to the campground and west of the road to the boat dock. The well was drilled to a depth of 32 feet and completed by perforating the casing opposite highly permeable alluvium from 18-28 feet below ground surface. The well was developed by bailing at about 25 gpm for more than 2 hours. The well was test pumped at a rate of 13 gpm (pumping rate was probably limited by the size of the pump) for 200 minutes resulting in 0.18 feet of drawdown. Clearly this well could have produced much more water with a larger pump. Depth to water in this well was about 18 feet below ground surface. This well was located across the road (west) from the current ranger station. There is no record of the test well ever being connected to the water supply system at Two Medicine.

The Montana Bureau of Mines and Geology Ground-Water Information Center website (<http://mbmgwic.mtech.edu/>) contains records for 2 water wells at Two Medicine. Both wells are in close proximity of the storage tanks on Appistoki Creek, about 400 feet southeast of the Two Medicine Road. One well was completed in 1981 to a depth of 60 feet and reportedly yielded 25 gpm. The other well was completed in 1984 to a depth of 72 feet and reportedly yielded 12 gpm.

There were three other test holes constructed in 1983 that did not produce enough water to warrant completing them as wells. These test holes were backfilled and abandoned. Their locations are unknown.

Discussion

Options for increasing the water supply for the Two Medicine area include;

1. Redevelopment of the 2 existing wells near the storage tanks.
2. Redevelopment and reconnection of the USGS well to the water system.
3. Construct a new well on the delta of Appistoki Creek at Two Medicine Lake.

Current production rates from the two wells are close to the production rates determined by test pumping when the wells were originally constructed. Thus it would appear that there has been no drop off of the production rate and it is unlikely that anything would be gained by redeveloping the wells. Their low production rate is primarily a function of their hydrogeologic setting; obtaining groundwater primarily from glacial till rather than alluvium.

The USGS well that was constructed in 1971 or 1972 provides a good indication that large amounts of groundwater could be obtained from a well completed in the alluvium of the Appistoki Creek delta. The old well was probably not constructed to current standards for a public water-supply well; it should be plugged and abandoned to prevent contamination of the aquifer.

Constructing a new well on the delta is the most likely solution to increasing the water supply at Two Medicine. The optimal location for a new well is on the distal part of the fan or delta formed where Appistoki Creek enters Two Medicine Lake. Alluvial sediments in this area will be thicker and more extensive than at alternative locations further up the creek. Production capability of a well in this area is likely to be larger than for a well further up the creek. This area is generally bounded on the east by the road to the campground, on the north by the picnic area, and on the south by the creek. A well located anywhere in this area is likely to be capable of producing large quantities of good-quality water. The well location should include;

1. Consideration of proximity to the creek and lake. If the well is too close to the creek or lake it might be “under the influence of surface water.”
2. Location of existing utilities, water lines, sewer, electricity, and potential contaminant sources.
3. Land use in the area.

Avoiding classification of a new well as “under the influence of surface water”

We would like to avoid having a new well fall under the classification of “groundwater under the direct influence of surface water” (GUDISW). Although a new well on the delta near the lake or creek could probably pass the tests for GUDISW, it’s probably better to avoid it if at all possible. This would save the time and money involved with testing and protect against future revisions to interpretation of the rule or treatment of GUDISW sources.

Montana assesses GUDISW on a point scale. A certain number of points are assessed based on distance from the surface water source, depth of the well screen or perforations, depth to water table, and other factors. If the total is 40 or more points, additional testing is required; generally water quality monitoring and a microparticulate analysis (MPA). If the total is less

than 40 points, then the source is presumed to be groundwater and no further testing is required. The preliminary assessment worksheet is attached to this report.

The depth to the water table in the recommended area is almost certainly less than 25 feet, so the well will be assessed 15 points on that factor.

The top of the well screen will likely be in the range of 25-49 feet below ground surface; giving another 10 points. It might be possible to place the screen deeper than 50 feet if the alluvial sediments are that deep, but I wouldn't bank on it. The deeper screen assessment would reduce the assessment on this factor to 5 points.

The point assessment for depth to water table and depth to the top of the well screen will most likely be $(15+10) = 25$ points. The remaining factor that we have control over is the distance to the surface water bodies. This must be 10 points or less to keep the total below 40 points, so the distance from the well to either the lake or the creek must be at least 175 feet. Maybe we should look at a setback of 200 feet to provide a little cushion.

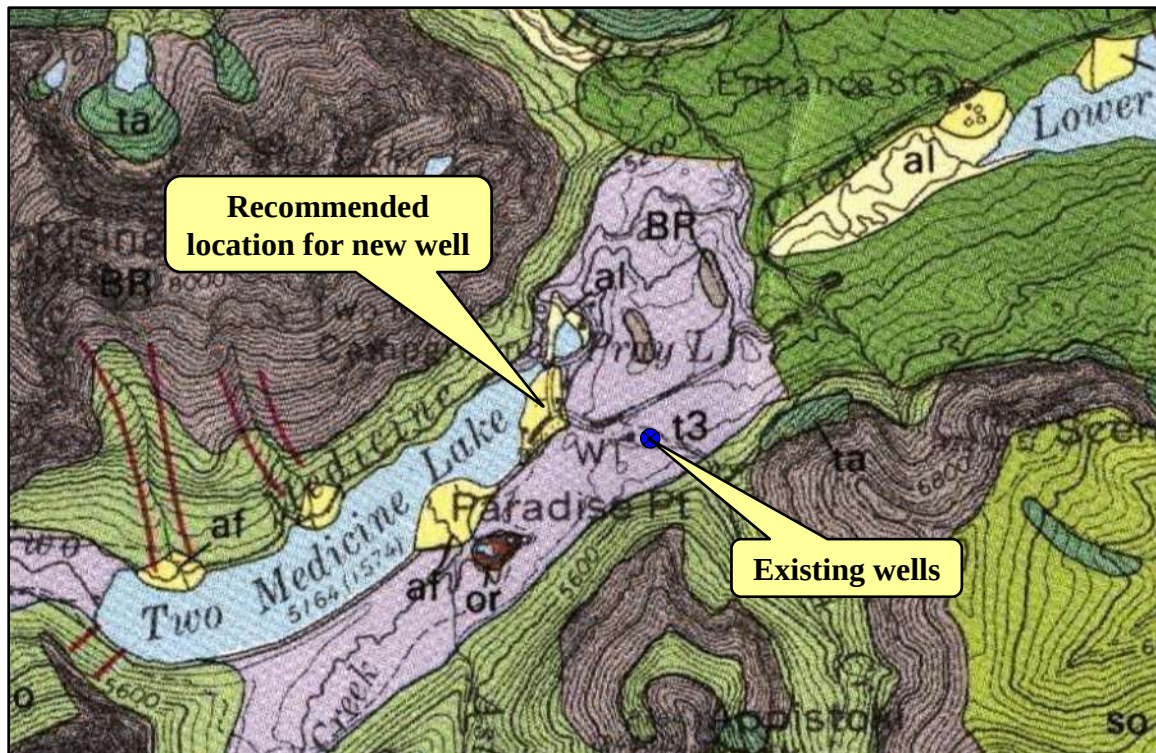
Summary

The most favorable location for constructing a new well at Two Medicine is on the alluvial fan (or delta) formed where Appistoki Creek enters Two Medicine Lake. There should be a substantial thickness of very permeable sand and gravel sediments in this area. A test well constructed in this area by USGS confirms this hypothesis. In addition to the usual considerations of setbacks from roads, leachfields, and other potential contaminant sources, the well should be located more than 200 feet from the lake or the creek to minimize the potential for classification of under the influence of surface water.

References

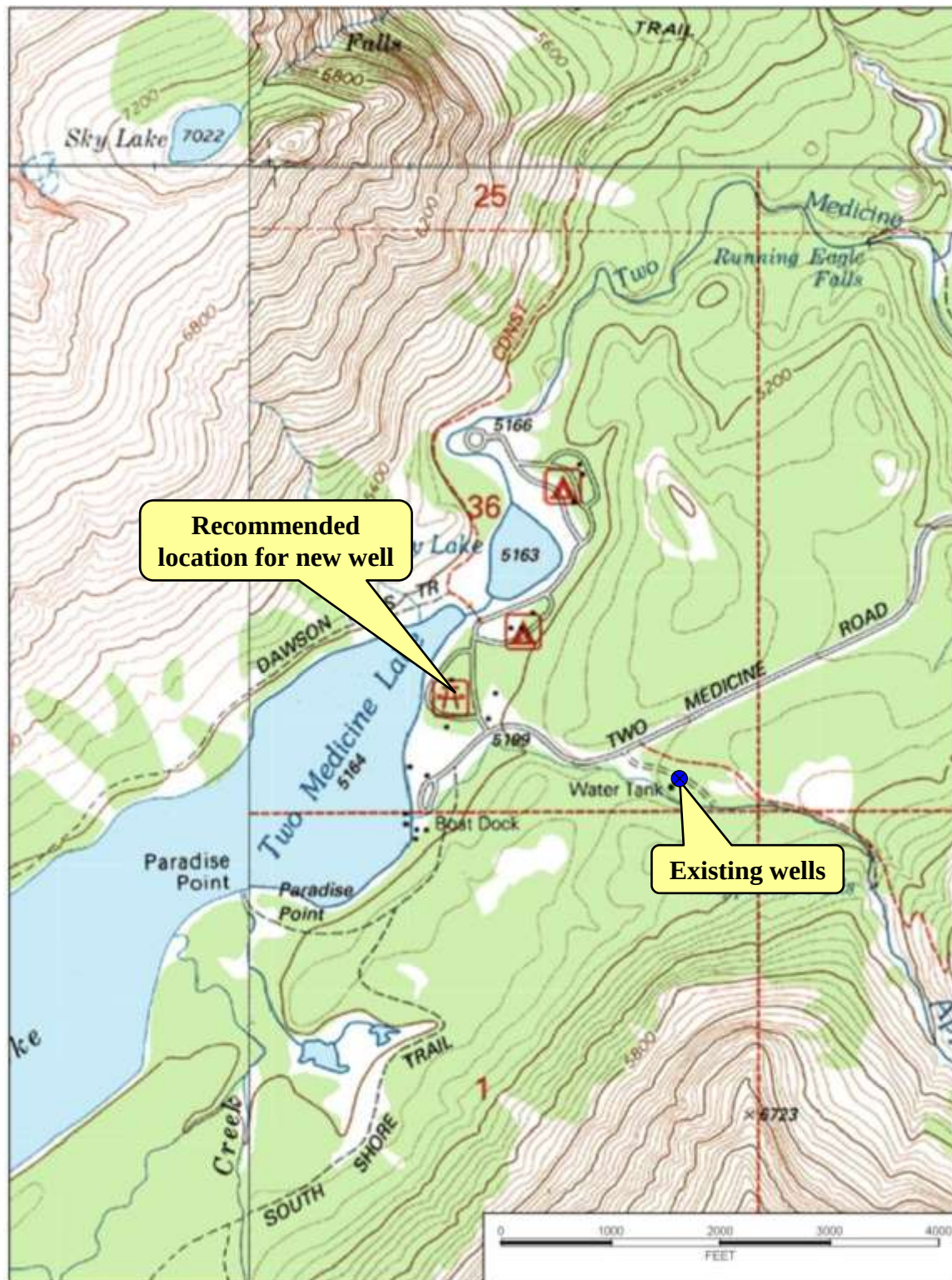
Boettcher, A.J., 1973, *Evaluation of the Ground-Water Supply at Eight Sites in Glacier National Park, Northwestern Montana*, USGS Open-File Report, 30 pp.

Carrara, P.E., 1990, *Surficial geologic map of Glacier National Park, Montana*: U.S. Geological Survey, Miscellaneous Investigations Series Map I-1508-D, scale 1:100000.

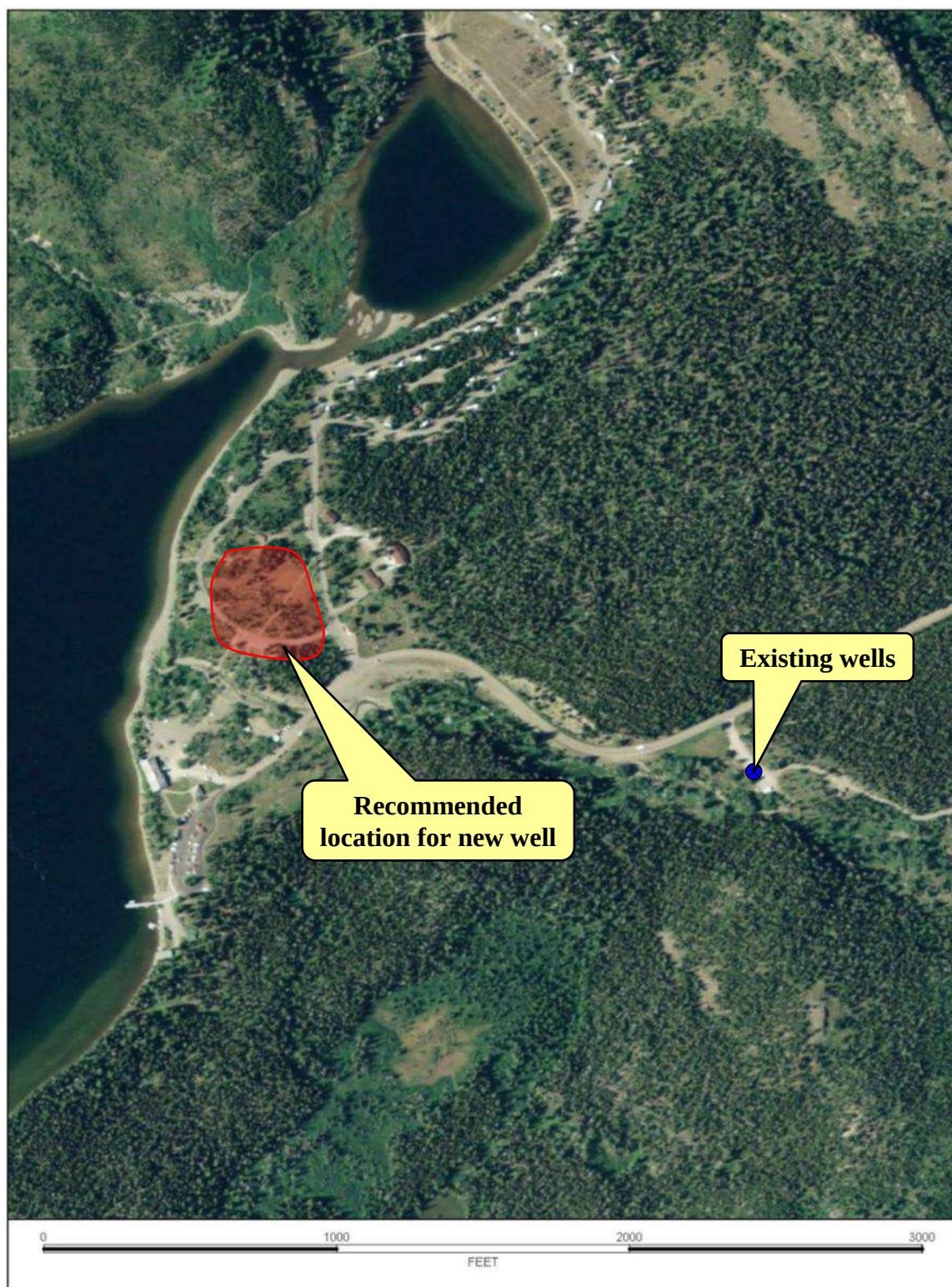


Geologic Map of the Two Medicine area (from Carrara, 1990).

- af** **Alluvial-fan deposit (Holocene and late Pleistocene)**—Fan-shaped deposits of fluvial sand and gravel. In places unit contains thin lenses of silt. Unit consists chiefly of rounded and subrounded clasts of Belt Supergroup rocks. Locally includes debris-flow deposits. Thickness 2-50 m
- 13** **Till (late Pleistocene)**—Unsorted subrounded to subangular bouldery rubble, consisting mainly of Belt Supergroup rocks, and minor amounts of sand, silt, and clay. Striated rocks are common. Found on valley floors within mountainous areas where it was deposited as ground moraine by local mountain glaciers; here, its thickness is usually 1-3 m. Also found in the valleys of the North and Middle Forks Flathead River where it was deposited as a thick blanket of ground moraine by the large trunk glaciers that filled these valleys; here, its thickness exceeds 30 m in places. Locally includes small areas of bedrock and colluvium. This unit is in places also overlain by the Glacier Peak G ash



Locations of existing and proposed wells at Two Medicine.



Locations of existing and proposed wells at Two Medicine.

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Metcalf Building - 1520 East Sixth Avenue P.O. Box 200901 Helena, MT 59620-0901

PRELIMINARY ASSESSMENT WORKSHEET

Preliminary Assessment of Ground Water Sources that may be Under the Direct Influence of Surface Water

PWS System and Source Facility Information			
PWS Name: GLAC TWO MEDICINE - NEW WELL NEAR THE LAKE			PWS ID#: (MT9000000)
Type (C, NTNC, NC):	County:		Population Served:
Source Facility Name:	SDWIS Facility ID: (W1000,SP000,IG000)	Date: (m/d/yyyy)	

COMPUTE PA SCORE Mark (X) ONE option that applies and enter option index pts at right				Points
A. TYPE OF STRUCTURE				
Spring (40) ____	Horizontal Well (40) ____	Well (0) <u>X</u>	<u>0</u>	
B. HISTORICAL PATHOGENIC ORGANISM CONTAMINATION: History or suspected outbreak of Giardia, or other pathogenic organisms associated with surface water, with current system configuration.				
Yes (40) ____			No (0) <u>X</u>	
C. HISTORICAL MICROBIOLOGICAL CONTAMINATION:				
I) Record of acute (boil order or fecal positive sample) MCL violations of the Total Coliform Rule during the last 3 years. Number of violations:				
None (0) <u>X</u>	One (5) ____	Two (10) ____	Three (15) ____	<u>0</u>
II) Record of non-acute (two coliform positive samples in one month) MCL violations of the Total Coliform Rule during the last 3 years. Number of violations:				
None or One (0) <u>X</u>	Two (5) ____	Three (10) ____	Turbidity Complaints (DEQ verified) (5) ____	<u>0</u>
D. HYDROLOGICAL FEATURES: Horizontal distance between surface water & source.				
> 250 ft (0) ____	175 - 250 ft (10) <u>X</u>	100 - 174 ft (20) ____	< 100 ft (40) ____	<u>10</u>
E. WELL SEAL: Poorly constructed well (uncased, or annular space not sealed to depth of at least 18 feet below land surface), or casing construction is unknown.				
Yes (15) ____			No (0) <u>X</u>	
F. WELL INTAKE CONSTRUCTION: In wells tapping unconfined or semi-confined aquifers, the depth below land surface to top of perforated interval or screen is:				
>100 ft (0) ____	50-100 ft (5) ____	25-49 ft (10) <u>X</u>	0-24 ft (15) ____	Unkn (15) ____
G. STATIC WATER LEVEL: In wells tapping unconfined or semi-confined aquifers, the depth to static water level below land surface is:				
>100 ft (0) ____	50-100 ft (5) ____	25-49 ft (10) ____	0-24 ft (15) <u>X</u>	Unkn (15) ____
H. WELL CAP CONSTRUCTION: Poor sanitary seal, or seal without acceptable material.				
Yes (15) ____			No (0) <u>X</u>	
TOTAL PA SCORE (Right click in cell to right and select Update Field.)				<u>35</u>

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PRELIMINARY ASSESSMENT WORKSHEET (continued)

1. PRELIMINARY ASSESSMENT DETERMINATION	Mark (X) ONE
1. PASS: Source is not under the direct influence of surface water.	___
2. FAIL: Well must undergo further GWUDISW analysis.	___
3. FAIL: Spring, must undergo further GWUDISW analysis.	___
4. FAIL: Well or horizontal well less than 100 feet from surface water, must undergo further GWUDISW analysis.	___
5. FAIL: Well will PASS if well construction deficiencies (section E or F) are repaired.	___
6. FAIL: Well may PASS if well construction details (section E, F, or G) become available.	___

ANALYST INFORMATION AND COMMENTS	
NAME:	LARRY MARTIN
AFFILIATION:	NATIONAL PARK SERVICE
COMMENTS	
PRELIMINARY ASSESSMENT BASED ON EXPECTED CONDITIONS. ASSESSMENT SHOULD BE REDONE AFTER A WELL IS LOCATED, CONSTRUCTED, AND TESTED.	

Electronic Entry Instructions: Open the WORD document template (DOT) as a WORD document (DOC) with an appropriate name and location. The document is protected from all edits other than form entry. Enter the requested information in the form fields and tab forward between fields. All character entries will be converted to upper case. In the Compute PA Score table for questions A through H, mark with an X the one option which applies to each, then enter the score corresponding to that option in the field to the right under the Points column. When scores A-H have been entered right click on the Total PA Score field and select Update Field. The total score will be computed. Select the PA Determination option by marking with an X. Fill out the Analyst Information and Comments table. Save the document with your entries.