PWS-6 Report
Town of Sheridan
Final Version: July 16, 2001
Public Water Supply:
PWS ID: 00329
Town of Sheridan

INTRODUCTION AND PURPOSE

The purpose of this PWS-6 report is to assess threats to a new supply well for the Sheridan water supply system. The primary contact for this water supply is Mr. Kelly Elser, P.O. Box 78, Sheridan, Mt. 59749. Jim Stimson, Hydrogeologist with the Montana Department of Environmental Quality (DEQ) prepared the final report. Details on this water supply were obtained from a review of the Public Water Supply files, the most recent sanitary survey completed June 14, 1999, a draft preliminary ground-water report provided by the Ruby Valley Conservation District, memos and well test data from Damschen-Entranco, and other public sources of information.

LIMITATIONS

The terms "drinking water supply" or "drinking water source" refer specifically to the source of the Sheridan public water supply and not any other public or private water supply. Only significant potential sources of contamination in areas that contribute water to the drinking water source are considered in this report. A source is considered significant if substances that are used, generated or stored are highly hazardous to human health or if the volume on-site is relatively large. Some potential or existing sources of contamination may be unintentionally missed in the inventory. The report will be periodically updated when new information becomes available. The term "contaminant" is used in this report to refer to constituents for which maximum concentration levels (MCLs) have been specified under the national primary drinking water standards, and to certain constituents that do not have MCLs but are considered to be significant health threats.

PWS INFORMATION

Sheridan is located in lower Ruby Valley in Madison County along State Highway 287, about 36 miles northeast of Dillon (Figure 1A). DEQ public water supply records indicate the water system serves 723 residents and is classified as a community system because it serves at least 25 year-round residents. Public water and sewer services are provided within the city limits. A waste treatment lagoon is located about one-quarter mile northwest of town (Figure 1B).

The primary water supply consists of four wells located in a well field on the west-side of town (Figure 1B). Use of one of the wells is limited due to construction problems. Water from the well field is pumped to two storage reservoirs northeast of town near Nonpariel Creek and then re-routed through a variety of service connections to Sheridan residents.

Average water use is estimated at 183 gallons per minute (gpm), that is 263,520 gallons per day (gpd), with peak demand estimated at 329 gpm (473,760 gpd) during the summer. The water is not disinfected but the system is equipped to provide gas chlorination. Concerns over water supply shortages due to drought conditions during the summer of 2000 and chronic production problems with the number 4 well prompted efforts to drill the new supply well. The new well will be located near the existing well field and completed in a deeper aquifer that appears to be confined.

DELINEATION

Due to the fact that the new well has not been completed at the time of writing this report, two delineation alternatives are presented. The first alternative assumes: 1) the new well is completed in the deeper aquifer and this aquifer is confined, 2) the number 3 well is modified and tested to insure production is only from the deeper aquifer, and 3) the number 4 well is plugged and properly abandoned. Given these assumptions, option 1 considers the aquifer confined and delineation includes a 100-foot radius control zone, a

1000-ft fixed radius inventory region, and a recharge region (Figure 1). Note: Figure 1B shows the inventory zone.

The second delineation alternative is presented in the event that Sheridan continues to use both the shallow and deeper aquifer to supply water. Option 2 includes a 100-foot radius control zone, a 3-year Time-Of-Travel (TOT) inventory region, and a recharge region (Figure 2) Note: Figure 2B shows only the inventory zone.

Hydrologic Conditions

Hydrogeologic studies indicate that Quaternary and Tertiary sedimentary deposits are the source of Sheridan's water supply. The majority of the wells in the vicinity of Sheridan are between 15 and 60 feet deep. These wells tap a shallow water table aquifer within the Quaternary alluvium. The town's public supply wells are between 100 and 412 feet deep and production is from shallow Quaternary alluvium and deeper zones within the upper Tertiary sedimentary deposits. Geologic cross-sections from a preliminary ground-water study show confining clay layers are present but may not be laterally continuous. Therefore the aquifer used by the Sheridan water supply is interpreted to be semi-confined, and is assigned a rank of "moderate source water sensitivity" to potential contaminants, in accordance with Table 2 of the PWS-6 template for Community or Non-Community Non-Transient Public Water Supplies (DEQ PWS-6 Template, 2000).

Conceptual Model and Assumptions

Sheridan is located on an alluvial fan that originates at the Tobacco Root Mountain front and slopes southwest toward the Ruby River floodplain (Figure 1B and 2B). Ground-water flow is generally to the southwest away from the mountain front and toward the Ruby River. As a consequence, potential contaminant sources of concern for Sheridan's source water are those located to the northeast and up-gradient of the well field. Well logs indicate the presence of shallow and deeper production zones. Data from several aquifer tests suggest the deep aquifer is confined. However, some of the aquifer test data also suggests that there may be leakage between the shallow and deep aquifer. Additional aquifer tests should be conducted to determine if the deeper aquifer is truly confined or if it receives recharge from overlying confining beds and aquifers.

Well Information

Table 1 shows that Sheridan's public water supply wells range in depth from 100 to 412 feet. Two wells located in the well field west of Sheridan encountered 40 to 100 feet of "hard pan" or "clay" that can be interpreted as impermeable confining layers. The deeper wells are perforated below these "clay" layers. However, Well 4 is perforated in both the shallow and deeper aquifer, creating a connection between the two and compromising the confining layers. This well essentially provides a pathway from the shallow aquifer to the deeper aquifer for potential contaminants. This well will be plugged and abandoned as soon as the new well is brought on line (Kelly Elser, Personal Communication, 2-5-2001). This action will help reduce the threat from potential contaminant sources in the vicinity of the well field and within the inventory zone. Well 3 may also be facilitating leakage of water from the shallow aquifer into the deep aquifer (Damschen-Entranco, 1997), and needs to be addressed in the work to upgrade Sheridan's water supply system.

Aquifer Properties

Table 2 summarizes aquifer information for the Sheridan area. The table includes parameter values used in TOT calculations to delineate the inventory zone (Figures 2B and C).

Limitations

Values in Table 2 come from a limited number of studies conducted in the lower Ruby Valley. As a consequence, it is uncertain how accurately the values portray the aquifer's properties. The width of the 3-year TOT inventory zone was expanded to include a 45-degree arc to help compensate for uncertainties and seasonal variations in the ground-water flow direction. Calculated TOT distances are considered to be conservative estimates based on available data and the professional judgement of the analyst writing this report.

There are only 2 or 3 wells deeper than 80 feet in the Sheridan area. As a result, information on deeper aquifers is limited and work is needed to verify that deeper production zones are confined and less susceptible to contamination from potential sources at the land surface.

INVENTORY

Table 3A lists the significant potential contaminant sources for the control zone and a 1000-foot fixed radius inventory zone. This assumes that the deep aquifer is the source for Sheridan's water supply (Figure 1). Numbers in the source column of the table provide a cross-reference to maps shown in figures 1B and 1C. Hazard ratings for each significant potential contaminant source are derived from Table 10 of the PWS-6 template (Montana DEQ, 2000). If all of the deep wells within the inventory zone are properly constructed and sealed, and unused deep wells are properly abandoned, the hazard for all contaminant sources within the 1000-foot inventory zone is low (Table 10 PWS-6 template Montana DEQ, 2000).

Table 3B is included in the event that Sheridan continues to use shallow and deep aquifers for water supply (Figure 2). Table 3B list more potential contaminant sources because the 3-year TOT inventory zone extends almost one mile to the east of the proposed well site. Numbers in the source column of the table provide a cross-reference to maps shown in figures 2B and 2C. Hazard ratings for each significant potential contaminant source are derived from Table 9 of the template (Montana DEQ, 2000).

Two former fuel leak sites are included in the inventory, despite the fact they lie just outside the 3-year TOT inventory zone boundary. They are included because the inventory boundary is delineated based on incomplete and preliminary information on aquifer properties and ground-water flow direction. Modification of the inventory zone boundary to include both sites could be warranted if future studies indicate these areas contribute water to the Sheridan supply wells. The railway, which would normally be considered a significant potential contaminant source, is not included in the inventory and susceptibility analysis because it is abandoned.

SUSCEPTIBILITY

The susceptibility of the proposed well to contamination is assessed in this section. The proximity of a potential contaminant source to the well site or the density of non-point potential contaminant sources determines the threat of contamination. Hazard and the existence of barriers to contamination determine susceptibility, see Table 11 of the PWS-6 template (Montana DEQ, 2000).

Barriers can be anything that decreases the likelihood that contaminants will reach a well. Barriers can be engineered structures, management actions or natural conditions. Examples of engineered barriers are spill catchment structures for industrial facilities and leak detection for underground storage tanks. Emergency planning and best management practices can be considered management barriers. Thick clay-rich soils, a deep water table or a thick saturated zone above the well intake can be natural barriers.

Tables 3A and B also list results from the susceptibility analysis for significant potential contaminant sources. A segment of Highway 287 is within a one-year time of travel of the well field (Figure 1B) and is initially ranked as a very high hazard. However, Mill Creek can be considered as a natural barrier to spills on the highway within the inventory zone. In addition, Sheridan has an emergency response plan to facilitate rapid response to spills on the highway. With these multiple barriers, the final susceptibility rating is reduced to moderate.

REFERENCES

- DEQ Source Water Protection Program, 2000, PWS-6 Template for Community or Non-Community Non-Transient Public Water Supplies. Available from the DEQ web site: http://www.deq.mt.gov/wqinfo/SWP/Circulars.htm
- Damschen-Entranco, 1997, Memo summarizing Sheridan water supply.
- Hannaman, D. L. and Wideman, C. J., 1988, Sequence stratigraphy of Cenozoic rocks; Geologic Society of American V. 103, p. 1335-1345.
- Kuenzi, W.D. and Fields, R. W., 1971, Tertiary stratigraphy, structure, and geologic history of the Jefferson Basin, Montana; Geologic Society of American V. 82, p. 3374-3394.
- Rupple, E. T., 1993, Cenozoic tectonic evolution of South West Montana and East-Central Idaho, Montana Bureau of Mines and Geology (MBMG) Memoir 65.

- Ruby Valley Conservation District in association with the Ruby Valley Watershed Committee, 2000, Preliminary report on the ground-water resources of the Mill and Indian Creek subwatershed, lower Ruby Valley, Montana. Draft Hydrogeologic Report, Madison County Conservation District.
- U.S. Geological Survey, 2000. National Landcover Dataset, Montana. 30-meter electronic digital landcover dataset interpreted from satellite imagery.

TABLES

Table 1. Source well information for City of Sheridan. Source: MBMG GWIC. (Table 4 of template). NR = Not Reported

Well Information	Well # 1	Well # 2	Well # 3	Well #4	City Well	City Well (Tolson Well)
PWS Source Code	03	02	05	NR	NR	NR
Well Location (T, R, Sec or lat, long)	04S 05W 27 DB	04S 05W 26 CCDA	04S 05W 27 DB	04S 05W 27 DB	04S 05W 27 DA	04S 05W 26 CDA
MBMG #	107982	107951	107984	107983	107980	107954
Water Right #	NR	NR	NR	NR	NR	NR
Date Well was Completed	01/01/89	11/28/89	01/03/90	01/01/89	01/01/82	01/01/67
Total Depth	100	225	412	400	300	58
Perforated Interval	NR	81 - 225	250 -412	NR	NR	NR
Static Water Level	18	20	22	16	9	8
Pumping Water Level	NR	220	NR	NR	97	44
Drawdown	NR	200	NR	NR	88	36
Test Pumping Rate	50	30	300	500	80	125
Specific Capacity	NR	0.15	NR	NR	0.91	3.47

Table 2. Estimates of aquifer properties and pumping demand**.** (Table 5 of template)

Input Parameter	Values used for TOT Calculations	Range of Values from Sheridan wells	
		Well # 3	Well #3
PWS Source Code		05	02
Transmissivity	18,000	14,000 - 18,000 gpd/ft.	14,000 - 18,000 gpd/ft.
Thickness	103	62	144
Hydraulic Conductivity	175 gpd/ft^2	226 - 290 gpd/ft^2	97 - 125 gpd/ft^2
Hydraulic Gradient	0.02	NR	NR
Flow Direction	South-Southwest (S 70 - 75 W)	NR	NR
Effective Porosity	0.1	NR	NR
Pumping Rate	368,640 gpd Average of 263,520 and 473,760 reported in text.	300	30
Stagnation Point Distance	165 ft		
Lateral Boundary Limit	520 ft		
1-Year TOT Distance	1,679 ft		
3-Year TOT Distance	5,037 ft		

Table 3A. Significant potential contaminant sources for City of Sheridan Source Water. (Assumes water supply only from the deep confined aquifer)

Source	Contaminants	Description *(Location and nature of hazard)*	Hazard Rating	Barriers	Susceptibility
1. Dryland Agricultural Crop Lands and grazing	SOC, Nitrate	47% ag-land in the inventory zone	Low	None	Low
2. Sanitary Sewer Main	Pathogens & Nitrates	Inventory zone is about 66% sewered	Low	None	Low
5. Underground storage site (UST)	Gasoline	Bulk plant south of well field	Low	None	Low
6. Class V Injection Well	Various organic chemicals	Unverified	Unknown	Unknown	Not Determined

Table 3B. Significant potential contaminant sources for City of Sheridan Source Water. (Assumes water supply from shallow and deep aquifer)

Source	Contaminants	Description *(Location and nature of hazard)*	Hazard Rating	Barriers	Susceptibility
1. Dryland Agricultural Crop Lands and grazing	SOC, Nitrate	52% ag-land in the inventory zone	High	None	Very High
2. Sanitary Sewer Main	Pathogens & Nitrates	Inventory zone is about 50% sewered	Moderate	None	High
3. Leaking Underground storage site (LUST)	Gasoline	Just outside inventory zone	Moderate	None	High
4. Highway Crossing	Hazardous Materials (VOCs & SOCs)	About 700 feet is within 1-year TOT	High	-Mill Creek -Emergency Plan	Moderate
5. Underground storage site (UST)	Gasoline	Just outside inventory zone	Moderate	None	High
6. Class V Injection Well	Various organic chemicals	Unverified	Unknown	Unknown	Not Determined

Montana Bureau of Mines and Geology -- Ground-water Information Center
Site Report for TOWN OF SHERIDAN #1

Location Information

GWIC Id:107984
Location (TRS):04S 05W 27 DB
County (MT):MADISON
DNRC Water Right:Not Reported
PWS Id:
Block:Not Reported
Lot:Not Reported
Certificate of Survey:Not Reported

Source of Data:LOG
Latitude (dd):45.4563
Longitude (dd):-112.2028
Geomethod:TRS-TWN
Datum:1927
Addition:Not Reported
Subdivision:Not Reported
Type Of Site:WELL

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft):412.00
Static Water Level (ft):22.00
Pumping Water Level (ft):
Yield (gpm):300.00
Test Type:AIR/PUMP
Test Duration:9.00
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):

How Drilled:AIR ROTARY
Driller's Name:LINDSAY
Driller License:253
Completion Date:Jan 03, 1990
Special Conditions:None Reported
Is Well Flowing?:No
Shut-In Pressure:
Well/Water Use:PUBLIC WATER SUPPLY
Geology/Aquifer:120SDMS

Hole Diameter Information

No hole diameter records were found.

Casing Information

From	To	Dia	Description
0.0	2.0	13.0	STEEL

Annular Seal Information

From	To	Description
0.0	20.0	BENTONITE

Completion Information

From	To	Dia	Description
250.0	412.0	13.0	HOLE

Lithology Information

From	To	Description
0.0	20.0	TOP SOIL
2.0	40.0	BOULDERS GRAVEL FINES
40.0	89.0	GRAVEL SAND SILT (H2O)
89.0	185.0	CLAY
245.0	412.0	CEMENTED GRAVEL (CONGLOMERATE) H2O

Montana Bureau of Mines and Geology -- Ground-water Information Center
Site Report for TOWN OF SHERIDAN #2

Location Information

GWIC Id:107982
Location (TRS):04S 05W 27 DB
County (MT):MADISON
DNRC Water Right:Not Reported
PWS Id:
Block:Not Reported
Lot:Not Reported
Certificate of Survey:Not Reported
Source of Data:Not Reported
Latitude (dd):45.4563
Longitude (dd):-112.2028
Geomethod:TRS-TWN
Datum:1927
Addition:Not Reported
Subdivision:Not Reported
Type Of Site:WELL

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft):100.00
Static Water Level (ft):18.00
Pumping Water Level (ft):
Yield (gpm):150.00
Test Type:Not Reported
Test Duration:
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):
How Drilled:Not Reported
Driller's Name:Not Reported
Driller License:253
Completion Date:Jan 01, 1989
Special Conditions:None Reported
Is Well Flowing?:No
Shut-In Pressure:
Well/Water Use:PUBLIC WATER SUPPLY
Geology/Aquifer:Not Reported

Hole Diameter Information

No hole diameter records were found.

Casing Information

From	To	Dia	Description
0.0	0.0	12.0	

Annular Seal Information

No annular seal records were found.

Completion Information

No completion records were found.

Lithology Information

No lithologic records were found.

Montana Bureau of Mines and Geology -- Ground-water Information Center
Site Report for TOWN OF SHERIDAN #3

Location Information

GWIC Id:107951
Location (TRS):04S 05W 26 CCCDA
County (MT):MADISON
DNRC Water Right:Not Reported
PWS Id:
Block:Not Reported
Lot:Not Reported
Certificate of Survey:Not Reported

Source of Data:LOG
Latitude (dd):45.4522
Longitude (dd):-112.1913
Geomethod:MAP
Datum:1927
Addition:Not Reported
Subdivision:Not Reported
Type Of Site:WELL

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft):225.00
Static Water Level (ft):20.00
Pumping Water Level (ft):220.00
Yield (gpm):30.00
Test Type:AIRLIFT
Test Duration:2.00
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):

How Drilled:AIR ROTARY
Driller's Name:LINDSAY
Driller License:WWC253
Completion Date:Nov 28, 1989
Special Conditions:UNUSED
Is Well Flowing?:No
Shut-In Pressure:
Well/Water Use:PUBLIC WATER SUPPLY
Geology/Aquifer:120SDMS

Hole Diameter Information

No hole diameter records were found.

Casing Information

From	To	Dia	Description
-2.0	81.0	8.0	STEEL
0.0	20.0	12.0	STEEL

Annular Seal Information

From	To	Description
0.0	20.0	BENTONITE

Completion Information

From	To	Dia	Description
81.0	225.0	8.0	OPEN HOLE

Lithology Information

From	To	Description
0.0	3.0	TOPSOIL
3.0	21.0	BOULDERS
21.0	35.0	GRAVEL CLAY
35.0	39.0	GRAVEL BOULDERS; WATER
39.0	57.0	HARDPAN
57.0	58.0	GRAVEL (L. WATER)
58.0	80.0	HARDPAN
80.0	138.0	HARDPAN (V.L. WATER)
138.0	150.0	HARD CLAY
150.0	180.0	CLAY SAND & GRAVEL
180.0	194.0	HARD CLAY
194.0	196.0	GRAVEL LENSE (WATER)
196.0	205.0	CLAY
205.0	216.0	HARDPAN
216.0	225.0	HARD DARK CLAY

Montana Bureau of Mines and Geology -- Ground-water Information Center
Site Report for TOWN OF SHERIDAN #4

Location Information

GWIC Id:107983
Location (TRS):04S 05W 27 DB
County (MT):MADISON
DNRC Water Right:Not Reported
PWS Id:
Block:Not Reported
Lot:Not Reported
Certificate of Survey:Not Reported
Source of Data:Not Reported
Latitude (dd):45.4563
Longitude (dd):-112.2028
Geomethod:TRS-TWN
Datum:1927
Addition:Not Reported
Subdivision:Not Reported
Type Of Site:WELL

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft):400.00
Static Water Level (ft):16.00
Pumping Water Level (ft):
Yield (gpm):500.00
Test Type:Not Reported
Test Duration:
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):
How Drilled:Not Reported
Driller's Name:Not Reported
Driller License:253
Completion Date:Jan 01, 1989
Special Conditions:None Reported
Is Well Flowing?:No
Shut-In Pressure:
Well/Water Use:PUBLIC WATER SUPPLY
Geology/Aquifer:Not Reported

Hole Diameter Information

No hole diameter records were found.

Casing Information

From	To	Dia	Description
0.0	0.0	12.0	

Annular Seal Information

No annular seal records were found.

Completion Information

No completion records were found.

Lithology Information

No lithologic records were found

Water Quality Analyses

TABLE 6

SHERIDAN WATER CHEMICAL ANALYSIS SUMMARY[1]

PARAMETER	TEST SAMPLE LOCATION			
	TOWN HALL	WELL #3	TOWN HALL	STANDARD MAXIMUM CONTAMINANT LEVEL (MCL)
Sample Date	1/5/94	8/7/92	6/19/91	
Primary Constituents				
Fluoride (F)	<0.1	.2	<0.1	4.0
Arsenic (As)	<.001	<.001	<.001	0.05
Lead (Pb)	<.001	<.001	<.005	0.05
Barium (Ba)	.044	<.093	.057	1.
Chromium (Cr)	<.001	<.005	<.005	0.05
Cadmium (Cd)	<.001	<.005	<.001	0.010
Mercury (Hg)	<.001	<.0002	<.0002	0.002
NO3 + NO2 (Total as N)	.41	.6	.2	10.
Selenium (Se)	<.001	-	<.001	0.01
Silver (Ag)	<.001	<.002	<.001	0.05
Secondary & Unregulated				
Calcium (Ca)	33.8	22	28.1	
Magnesium (Mg)	10.1	5.1	8.5	
Sodium (Na)	6.7	3.9	6.1	
Potassium (K)	-	4.8	-	
Bicarbonate (HC03)	-	-	123.2	
Carbonate (C03)	-	-	0	
Chloride (Cl)	-	2.6	-	
Sulfate (S04)	17	11	13.5	
Phosphate (P04 As P)	-	-	-	
Iron (Fe)	<.01	<.01	<.01	
Manganese (Mn)	<.005	<.005	<.005	
Total Hardness (CaC03)	126	76	105	
Total Alkalinity (CaCO3)	127	81	101	
pH	8.09	8.1	7.65	
Conductivity - umhos/cm	284	181	237	
Total Dissolved Solids[2]	185	118	154	
Sodium Absorption Ratio	-	.2	.3	
Gross Alpha (pCi/l)	-	-	-	