Source Water Delineation and Assessment Report

11/99

Midvale Water Service, Inc

Public Water System

PWSID # MT0000211

Town of Eureka**,**

Certified Operators

Midvale Water and Sewer District.

Neil Tempel, Secretary

P.O. Box 1510

Eureka, Montana 59917

phone: (406) 296-3131

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Montana Department of Environmental Quality

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List of Acronyms

BMP - Best Management Practices

CAFO - Confined Animal Feeding Operation

CECRA - Comprehensive Environmental Cleanup and Responsibility Act

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

LUST - Leaking Underground Storage Tank

MCL - Maximum Contaminant Level

MBMG-GWIC - Montana Bureau of Mines and Geology – Ground Water Information Center

MPDES - Montana Pollutant Discharge Elimination System

NPDES - National Pollutant Discharge Elimination System

PWS - Public Water System.

RCRA - Resource Conservation and Recovery Act

SMCL - Secondary Maximum Contaminant Levels

SWDAR - Source Water Delineation and Assessment Report.

SWPP - Source Water Protection Plan

SWL - Static Water Level

SOC - Synthetic Organic Compounds

TMDL - Total Maximum Daily Load

UST - Underground Storage Tank

VOC - Volatile Organic Compounds

See glossary at end of text for definitions of acronyms and other terms used in this report

1.0 INTRODUCTION

The Safe Drinking Water Act (SDWA) Amendments of 1996 requires states to develop and implement Source Water Assessment Programs (SWAP) to analyze existing and potential threats to the quality of the public drinking water supplies throughout the state. The Montana SWAP was formally approved by the US Environmental Protection Agency (EPA) in November 1999. The Montana SWAP was developed from the former Wellhead Protection Program, but includes surface water sources and requires a more rigorous inventory of potential contaminant sources. For communities that have already developed wellhead protection plans, SWAP revises these plans to meet the expanded requirements. DEQ also works with other groups such as Montana Rural Water Systems, Inc., and Midwest Assistance Programs to implement the program.

SWAP addresses only public water systems (PWS) regulated according to the Federal Safe Drinking Water Act. A public water supply system is defined, according to Federal and Montana regulations, as a system that supplies water for human consumption. A public water supply system has at least 15 service connections or regularly provides water to at least 25 persons daily for a minimum of 60 days in a calendar year. There are three types of public water supply systems:

- Community water systems provide water on a year-round basis, and have a minimum of 15 service connections or regularly serve at least 25 residents. In addition to incorporated towns, community systems may serve smaller areas such as housing subdivisions or trailer courts.
- Non-transient non-community systems do not serve communities, but provide water regularly to a minimum of 25 of the same people for at least 6 months of a year. These systems serve public buildings such as schools and hospitals, where people are employed but do not reside.
- Transient non-community systems do not serve communities, and do not regularly serve a minimum of 25 of the same people for at least 6 months of the year. These systems are usually seasonal, and are located in areas such as campgrounds and parks.

Source water protection is a common sense approach to guarding public health by protecting drinking water supplies. In the past, water suppliers have used most of their resources to treat water from rivers, lakes, and underground sources before supplying it to the public as drinking water. Source water protection means preventing contamination and reducing the need for treatment of drinking water supplies. Source water protection also means taking positive steps to manage potential sources of contaminants and contingency planning for the future by determining alternate sources of drinking water. Protecting source water is an active step towards safe drinking water; a source water protection program (along with treatment, if necessary) is important for a community's drinking water supply. A community may decide to develop a source water protection program based on the results of a source water assessment, which includes the delineation of the area to be protected and an inventory of the potential contaminants within that area.

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to help public drinking water supplies protect their water source from contamination. The Montana Source Water Protection Program is responsible for completing delineation and assessment reports for all public water supplies in Montana. The Source Water Delineation and Assessment Report (SWDAR) compiles the appropriate data and other technical information about an area to allow communities to develop a source water protection plans. Delineation is a process whereby areas that contribute water to aquifers or surface waters used for drinking water, called source water protection areas, are identified on a map. Geologic and hydrologic conditions are evaluated in order to delineate source water protection areas. Assessment involves identifying potential contaminant sources in delineated source water protection areas, and evaluating the potential for contamination of drinking water from these sources under "worst-case" conditions such as a flood, fire or human error. Although voluntary, source water protection plans are the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate the Eureka and Tobacco Plains area communities and public water supply operators develop source water protection plans that meet their specific needs.

Scope and Purpose

This report presents the source water delineation and assessments for the municipal public water supply for the Midvale Water and Sewer District (Midvale WUA) public water supply. James Swierc, Hydrogeologist with the Montana Department of Environmental Quality, prepared this report. Assistance was provided by Joe Richard with the Town of Eureka, contracted to serve as operators for the Midvale WUA.

The Midvale WUA is located adjacent to the northern municipal boundary of the Town of Eureka in northeast Lincoln County, Montana. This report is intended to meet the technical requirements for the completion of the delineation and assessment report for this PWS, as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

This report addresses the study area with a watershed-type approach, recognizing that potential contaminant sources may threaten more than one public water supply. The report presents all of the information for the Eureka and Tobacco Plains area, and will be used as a basis to develop SWDAR for additional public water supply sources in the area that have overlapping source water protection areas with similar threats.

Limitations

This report was prepared to assess threats to the Midvale WUA public water supply, and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to sources for regulated public water supplies, and not any other type of water supply. The inventory of potential contaminant sources focuses on the management areas delineated for the public water supplies in this report. As a result, other potential sources of contamination to surface and ground water in the area may not be identified.

The term "contaminant" is used in this report to refer to any chemical or biologic constituent in water that are listed as regulated under state and federal regulations. Water constituents are generally regulated based on health effects that may occur when ingested at certain levels. Water quality standards are based on maximum contaminant level goals (MCLGs) for a compound, which represents a concentration where adverse health effects are not considered likely to occur when ingested. However, as natural waters contain many dissolved constituents and MCLGs are frequently not attainable with economically viable water treatment alternative, maximum concentration levels (MCLs) are used. MCLs represent concentrations that may result in chronic or acute health problems when ingested. MCLs are based on the relative risk, or likelihood that health problems may occur, and economics associated with a treatment technology for a specific constituent of water. In some cases, sources for constituents with Secondary MCLs are also evaluated in this report. Secondary MCLs are non-regulatory guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.

2.0 BACKGROUND

Study Area
Eureka and the Midvale WUA service area is located north of the Tobacco River Valley in the southern part of the Tobacco Plains area in northeastern Lincoln County (Figure 1). The area is relatively isolated by the mountains in the area, and is predominantly undeveloped at this time. The Tobacco Plains area is a broad glaciated plain that represents the northern limits of the Tobacco River watershed before it combines with the Kootenai River west of Eureka. The southern edge of the Tobacco Plains in Eureka is separated from the Tobacco River by several bedrock hills. For this report, the Tobacco Plains are treated as an individual watershed.

Eureka is the largest town in the area and is located approximately 8 miles south of the Canadian Border. Eureka and the Midvale WUA are located in Section 14 of Township 36 North, Range 27 west at approximately 48.88°N latitude and 115.05°W longitude. The Midvale WUA provides service to the area directly north of the Eureka town municipal boundary. Eureka is the largest community with commercial services in the predominantly rural area, and provides services to international transportation through the Roosville Port of Entry on US Highway 93 north of town. The population of Eureka is approximately 1,092, as estimated in 1998. The economy of the area includes agriculture, the timber industry, tourism, and a Burlington Northern – Santa Fe Railroad facility. Rexford is located west of Eureka at the confluence of the Tobacco River into Lake Koocanusa.

Figure 1 – Location

Geographic Setting
The Tobacco Plains study area is present in a northwest to southeast trending regional valley system, referred to as the Rocky Mountain Trench (Figure 2). The valley system is a long linear feature that continues for over 1,000 miles northwest of Montana into the Yukon Territory of Canada. In northern Montana, the trench is bounded to the east by the Whitefish Mountains. The western border comprises the Salish Mountains south of the Kootenai River, and the Purcell Mountains north of the Kootenai River. The Kootenai River flows southward from Canada along the western part of the valley, and flows westward out of the trench near Rexford. The Kootenai River valley in this area holds Lake Koocanusa, which fills the valley from near Libby northward into Canada. The area is located within the upper reaches of the Kootenai River watershed (USGS Hydrologic Unit Code 17010101), located within the Westslope, or Columbia River Watershed Management Region for Montana.

The Tobacco River is a northward flowing tributary of the Kootenai River, formed at the junction of Grave and Fortine Creeks southeast of Eureka. The Tobacco River watershed area covers approximately 450 square miles upstream from Rexford. Grave Creek flows southwest from the Whitefish Mountains to the east with a watershed area of approximately 76 square miles. Fortine Creek flows northeast from the Salish Mountains with a watershed area of approximately 261 square miles. The Tobacco River flows in a narrow valley to the north towards Eureka, where it begins to flow to the west south of the Tobacco Plains. The river discharges into Lake Koocanusa near Rexford. The lower Tobacco River watershed area downstream from the formation of the river covers approximately 113 square miles, and includes the southern part of the Tobacco Plains. Several southwestward flowing tributaries drain the Whitefish Mountains into the Tobacco River; including Sinclair Creek which joins the Tobacco River just south of Eureka, and Ksanka Creek which flows through Eureka.

The Tobacco Plains valley is a broad plain that fills the Rocky Mountain Trench north of Eureka. The principal stream across the northern part of the plain is Phillips Creek, which originates in Canada. Phillips Creek discharges into Sophie Lake, and the area represents a small, closed drainage basin. The topography of the Tobacco Plains reflects the history of glaciers that covered the area. The flat topography is interrupted by occasional drumlin hills and kettle lakes 20 to 100 feet deep. The mountains in the area are predominantly covered with evergreen forest, while the lower elevations are primarily open grassland.

Figure 2 – Eureka and Tobacco Plains Area

Climate

The climate is typical of northwestern Montana. Precipitation averages 14.7 inches a year as measured at the weather station at the Eureka Ranger Station. The mountains and higher elevation areas obtain more precipitation, which is not reflected in this weather data. The wettest months are May and June averaging 1.81 and 2.15 inches monthly, respectively. The driest months are February and March, with both averaging 0.8 inches per month. The temperature ranges from an average high of 84.5 °F in July (minimum July average of 49.4 °F) to an average of 29.6 °F in January (minimum January average of 15.0 °F).

General Description of the PWS Source Waters

The Midvale WUA public water supply source locations are located north of Eureka. The PWS obtains ground water from wells located in glacial deposits north of the Tobacco River. The glacial aquifer has widely variable properties over relative short distances, but can be characterized as generally confined with the depth to ground water varying across the area. As a result, the extent and productivity of the glacial source aquifers for the Midvale WUA is variable.

Public Water Supply

The Midvale WUA public water supply serves a resident population of approximately 270 people with 95 total service connections. At the time of preparation of this report, all 95 of these connections are classified as active. Information on the system was obtained primarily from a recent sanitary inspection of the system in October 1998. A copy of this report is included in Appendix A. The system has four wells installed to similar depths, summarized in the following.

- Well #1 (Source 002) was installed in September 1967 with five-inch casing to a depth of 141 feet bgs.
- Well #2 (Source 003) was incorporated into the system, and changed from an inactive source to an active source in 2001. This well was installed in August 1996 with six-inch casing to a depth of 123 feet bgs.
- Well #3 (Source 004) is located adjacent to Well #1. There is currently no well log or other record of well construction information available for this well at this time. Water from this well enters the PWS distribution system at the same entry point as water from Well #1.
- Well #4 (Source 005) was installed in April 1984 with six-inch casing to a depth of 126 feet bgs.

The location of the wells and the service area for the water system are depicted in Figure 3. Water from the wells is pumped into the distribution system, with overflow into a 110,000 gallon tank located on a hill west of the area. The storage tank is located primarily underground, with a gunnite top. The tank was built in 1978, with some improvements made in 1988. A booster pump adjacent to the storage tank provides water to eight service connections located above the tank. Water is pumped from the booster station through a two-inch main. There is currently no treatment or disinfection system applied to the water before distribution to consumers.

Wastewater Treatment

Domestic wastewater from municipal sewer systems and non-sewered areas with septic tanks represent a common threat to the majority of public water supply sources. The Midvale WUA service area utilizes septic systems for wastewater treatment and disposal, as does all areas outside of the Town of Eureka municipal boundary. Eureka is serviced by sanitary sewer system within the city limits, with treatment lagoons located southwest of town.

Water Quality Monitoring

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliforms and other signs of pathogenic organisms, nitrates, metals and for multiple chemicals. The monitoring schedule depends on many factors such as the size and source water for a PWS, the number of sources (e.g. wells), and the population served. Each PWS has a specific monitoring program tailored to their system that follows the general protocols for operation of a PWS defined by DEQ. A review of the DEQ PWS database indicates that monitoring results for the Midvale PWS show no violations or excesses of any drinking water quality standards. The only detected compound that is regulated is nitrate, which can occur naturally or from human and animal waste. The health standard for nitrates, the MCL, is 10 mg/L. The monitoring results for the last five years indicate nitrate levels ranging from 0.18 mg/L to 0.43 mg/L.

Figure 3 – Midvale WUA Service Area and Source Well Locations

Local Water Quality and the TMDL Process

Water quality in the Eureka and Tobacco Plains area is generally of good quality suitable for all uses. Table 1 lists the available water quality data from the area. The majority of samples were collected during the late 1960s. The recent data on ground water quality from the infiltration gallery was obtained from the facilities plan. The data includes sample results from both surface and ground water from locations near Eureka. The data indicates a relatively consistent water quality, with the exception of two samples that indicate high dissolved solids (one from a ground water source, and another from a surface water source). The data from these locations reflects the potential for localized hydrogeologic conditions to reduce water quality in some locations. The data in Table 1 is considered representative of background conditions for water quality in the Eureka and Midvale WUA service area.

All of the surface water streams in the study area, including the lower Tobacco River and tributaries, are classified as B-1 waters using the State of Montana stream classification system for beneficial uses. These types of waters are suitable for drinking, culinary and food processing purposes after conventional treatment. Additional uses include bathing, swimming and recreation, growth and propogation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and agricultural and industrial water supply. The Total Maximum Daily Loading (TMDL) assessment for the surface waters in the area will identify threats to the listed potential uses for the surface waters in the area. The TMDL assessment will evaluate the ability of the surface waters to buffer various types of discharges to the waters, including both natural and human caused sources, and the impact to the overall health of the water bodies. These include wastewater treatment plant discharges, surface water runoff and non-point source pollution. After the TMDL assessment is complete, the results will be presented to area and community leaders to help identify and plan methods to meet the goals of the TMDL assessment in preserving and improving surface water quality in the area. The Tobacco River watershed, with the exception of Grave Creek in the headwaters, is classified as a low priority watershed for TMDL development. Grave Creek is a high priority watershed for TMDL development. The Upper Kootenai River, including drainages such as Phillips Creek, is classified as a moderate priority watershed for TMDL development.

This report addresses threats to drinking water sources, and identifies many of the same threat that will be identified in the TMDL assessment. In this area, the SWDAR focuses on ground water quality. Communities and PWS operators are encouraged to use the results of the SWDAR to develop Source Water Protection Plans that outline steps to help preserve and protect the integrity of their water source. However, long-term planning to protect water resources across the watershed and study area should consider the results of both this SWDAR and the TMDL assessment for the area, when completed.

Table 1 – Background Water Quality in Tobacco Plains Area

Sample Date	Location	Ground Water Source	Fe mg/L	Ca mg/L	Mg Mg/L	Na+K mg/L	HCO_3 Mg/L	CO_3 mg/L	SO_4 mg/L	Cl mg/L	F Mg/L	NO_3 mg/L	TDS Mg/L	Hardness as $CaCO_3$ mg/L
9/26/67	36n26w27a	Glen Lake (*Surface Water*)	0.08	24	11	16	159	0	6	2	0	0	128	105
9/26/67	36n26w33dc	Alluvium	0	38	23	37	308	0	13	3	0	0	226	190
10/18/66	36n27w4dc	Deltaic Deposits	0	9	12	605	1338	605	3	143	5.2	0	1500	72
10/18/66	36n27w5bd	Deltaic Deposits	0	40	30	45	265	15	49	11	0.2	10.2	210	220
10/18/66	36n27w8ab	Lake-bottom Deposits	0	11	23	82	195	0	70	47	0.6	0	314	121
10/18/66	36n27w9d	Tobacco River (*Surface Water*)	0	46	8	30	250	0	0	4	0.1	0	180	149
9/26/67	36n27w14ba	Deltaic Deposits	0	40	23	51	296	18	16	10	0.2	8.1	280	195
10/15/68	36n27w26c	Thirsty Lake (*Surface Water*)	0	0	88	2112	2020	1510	91	450	0.76	1.6	5540	360
9/26/67	37n26w30d	Indian Creek (*Surface Water*)	0.08	30	12	14	177	0	5	3	0	0	136	125
9/26/67	37n27w1b	Phillips Creek (*Surface Water*)	0	24	11	24	165	0	15	5	0	0	120	105
5/29/68			0.1	19	20	0	97	0	8	4	0.44	0	110	129
9/26/67	37n27w6cb	Alluvium	0	50	15	24	177	0	84	5	0.4	0.5	250	185
9/26/67	37n27w14cb	Deltaic Deposits	0	28	15	20	195	0	9	3	0	0	142	130
9/26/67	37n27w17bd	Lake-bottom Deposits	0	30	13	22	201	0	7	4	0	0	150	130
5/29/68		*(Sophie Creek Spring)*	0.05	33	22	0	171	0	4	5	0.12	0	148	192
9/26/67	37n27w17cd	Lake-bottom Deposits	0.03	26	16	15	183	0	4	5	0	0	136	130
10/18/66	37n27w21cb	Sophie Lake (*Surface Water*)	0.12	24	9	31	190	0	3	3	0.1	0	114	99
11/9/67			0.03	16	10	18	134	0	7	2	0	0	90	80
5/29/68			0	46	4	0	127	0	0	5	0.28	0	132	134
10/14/68			0	30	9	0	122	0	1	0	0	0	100	110
9/26/67	37n27w28aa	Tetrault Lake (*Surface Water*)	0.08	18	16	24	183	0	8	3	0	0	134	110
5/29/68			0.05	37	21	0	181	0	4	4	0.2	0	152	178
10/14/68			0	20	22	0	158	0	2	3	0	0	120	140
10/18/66	37n27w29bb	Lake Bottom Deposits	0	31	13	21	177	12	5	4	0.1	0	140	132
9/26/67		*(Murray Creek Spring)*	0	24	13	23	189	0	4	2	0	0	150	115
12/19/67			0.01	30	15	4	170	0	4	0.2	0	0.1	146	136
5/29/68			0	38	22	0	116	0	0.4	4	0.6	0	110	187
10/14/68			0	30	18	2	183	0	1	1	0	0	136	150
10/18/66	37n27w35dd	Deltaic Deposits	0	42	17	15	220	12	2	3	0.1	1.2	194	176

Locations are listed with Township, Range and Section, with section location based on BLM system
Analytes are: Fe – Iron; Ca – Calcium; Mg – Magnesium; Na+K – Sodium and Potassium; HCO_3 – Bicarbonate; CO_3 – Carbonate; SO_4 – Sulfate; Cl – Chloride; F – Fluoride; NO_3 – Nitrate; TDS – Total Dissolved Solids
Data from Coffin et.al., 1971

3.0 DELINEATION

The source water protection areas, the land area that contributes water to the Midvale PWS sources are identified in this chapter. Delineation of management areas for source water protection are based on the hydrogeologic setting of the water source, in accordance with the requirements outlined in the Montana Source Water Protection Program (DEQ, 1999). For ground water systems in general, there are three regions referred to as the control zone, inventory region, and recharge region. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around the well. The area within a 1,000-foot radius of the well defines the inventory region for confined aquifers. The recharge region represents the area where the source aquifer for a water system is replenished.

Regional Geology
Several geologic studies have been published with information on the Eureka and Tobacco Plains areas;

however, information on the hydrogeology of the area from these reports is limited. The following discussion of the geology and hydrogeology of the area is based on these references, and an evaluation of well logs for the area obtained from the Montana Bureau of Mines and Geology Ground Water Information Center (MBMG-GWIC). Summary tables of well logs from MBMG-GWIC are included in Appendix B. The published studies of the area include:

- Alden (1953), "Physiography and Glacial Geology of Western Montana and Adjacent Areas." This report presents results of studies of glacial deposits in western Montana, including the Eureka area. The study includes maps of the location of glacial deposits.
- Johns (1970), "Geology and Mineral Deposits of Lincoln and Flathead Counties, Montana". This report evaluated existing mining operations and the viability of further mining in northwest Montana. This study includes geologic maps of Lincoln and Flathead Counties.
- Coffin et. al. (1971), "Surficial Geology and Water Resources of the Tobacco and Upper Stillwater River Valleys, Northwestern Montana." This report focuses on water resources in the area, and includes maps of local geology, estimated ground water flow directions, and the water table surface.
- Harrison et. al. (1992), "Geologic and Structure Maps of the Kalispell 1° x 2° Quadrangle, Montana, and Alberta and British Columbia." This document presents updated geologic maps of the area.

Eureka and the Tobacco Plains are present within the Rocky Mountain Trench, the major geologic feature in the area. The Rocky Mountain Trench is a long valley system present behind the Rocky Mountain Front Range from the Canadian Yukon Territory to the Flathead and Mission Valleys in Montana. Normal faults are present along the edges of the trench, and the valley is filled with alluvium eroded from the adjacent mountain ranges. A geologic map of the Eureka and Tobacco Plains area is included in Figure 4, with additional information included in Appendix B. In the Eureka area, bedrock comprised of PreCambrian Belt Supergroup rocks are present in the mountains west and east of the valley, with some small outcrops present in the hills and Tobacco River valley west of Eureka. The water storage tank for the Midvale WUA is located on the small bedrock outcrops west of Eureka.

The entire Rocky Mountain Trench valley was filled with glaciers during the geologically recent ice ages. The glaciers are believed to have advanced and retreated several times though the valley leaving various types of deposits. Generalized schematic drawings showing the glacial history of the area are shown in Figure 5 (Stage 1) (Stage 2) (Stage 3). The glacial deposits include tills, which represent a clay, sand and gravel mixture where clays are the matrix holding the larger grains. In many cases, tills may have a large percentage of sand and gravel similar to an aquifer; however, the clays present in the matrix prevent the development of any significant effective porosity resulting in a relatively impermeable layer. There are two general types of tills, depending on how they were deposited relative to the glacier. The most recognizable tills are typically deposited beneath a glacier as it advances, when it may forms a hard cement like material that may be informally referred to as "hardpan." This type of till is relatively impermeable to water flow, even with potentially large percentages of coarse grained material. A second type of till occurs from material melting from the glacier as it retreats, or melts away from an area. These tills are not as coherent as the hardpan tills, and may yield small amounts of water that can support household wells. The second type of till is difficult to identify in the field since the deposits resemble other types of glacio-fluvial facies.

Figure 4 – Geologic Map of Study Area

During certain intervals between glacial advances through the area, the glaciers damned the major drainage from the area to the south without being present over the Tobacco Plains. During these times, Glacial Lake Kootenai formed in the valley between the Whitefish Mountains to the east and the Purcell and Salish Mountains to the west. There are a variety of geologic deposits associated with glacial lakes in mountainous areas. In the central part of the lake, deposits are typically well sorted and laminated, with abundant clays and silts. However, when streams flow into glacial lakes, localized delta deposits may be present where coarse grained material washes into the lakes. In the Tobacco Plains area, the Whitefish Mountains to the east are at a higher elevation than the area west. Due to the higher elevation of the region, larger mountain glaciers were present, resulting in more erosion into the developing Glacial Lake Kootenai system. The erosional debris from the glaciers on land is deposited in high energy streams that carry fine grained material away from the area to be deposited downstream. This material, commonly referred to as glacial outwash, is typically comprised of sand and gravel material that that washes out from the front of a glacier.

Outwash deposits make good aquifers since fine-grained material such as clays and silts washes away from the coarser grained sands and gravels when they are deposited. This results in very permeable deposits with potentially high water yields, depending on the size and extent of the deposit. While lake deposits and tills typically cover relatively large areas, outwash deposits are highly variable in size. Outwash deposits may be present within hardpan tills deposited by meltwater in front of a glacier as it advances resulting in small, localized aquifers contained with tills. In other cases, outwash may fill an entire valley resulting in a single large, productive aquifer.

Figure 5 – Glacial History of the Tobacco Plains and the Kootenai River Valley

From Coffin et. al., 1971

Stage 1 **–** Maximum advance of glacial ice over the study area is depicted. The glacier is present filling the entire Kootenai River and Rocky Mountain Trench Valleys. The glacier moved southward, and carved the valley while depositing till beneath the ice.

Stage 1

Stage 2 **–** Glacial Lake Kootenai is present in the Kootenai River Valley, with the river being damned at an unknown location downstream. The glacial lake extended into the valleys of the tributaries, where lacustrine sediments were deposited. Delta deposits of stream gravel alluvium from the adjacent mountains formed where local streams drained into the lake.

Stage 2

Stage 3 **–** The modern Tobacco Plains and Kootenai River Valley is shown. The local drainage system has eroded into both tills and lacustrine strata, with several terraces visible. The topography of the area reflects the different types of glacial deposits.

Stage 3

Where the outwash streams entered Glacial Lake Kootenai, the change in the local surface water base level resulted in the formation of localized deltas near the shores of the lake. In the Tobacco Plains area, the deltas are comprised of coarser sands and gravels mixed with clays. The largest delta deposits are localized near where the mouths of where the former streams entered the glacial lake. The delta deposits are coarsest on the eastern part of the Tobacco Plains area, which was nearest to the shore. The coarse deposits are gradational into finer grained sand and silt dominated delta deposits to the west, nearer the central part of the lake. These deposits are then gradational into the laminated clays and silts present in the central part of the lake.

Regional Soils

The soils in the area are derived from glacial strata and the bedrock in the surrounding mountains. In places, soils developed over the clay-rich glacial till sequences may be thick, with soils derived from the underlying material. In other areas, the soils over coarse grained alluvium may be present only in thin layers. For a detailed review of soil properties in the area, the reader is referred to the Soil Survey of Kootenai National Forest Area, Montana and Idaho (USDA, USFS, and NRCS, 1996).

Regional Hydrogeology

After the glaciers retreated, the modern stream system of the Tobacco Plains developed. At places, the drainage system eroded into the glacial sediments, reworking some of the material into alluvium present within the modern riverbeds. The alluvium also contains material eroded from bedrock in the mountains adjacent to the area. Ground water within the alluvium is generally in communication with surface water, with streams capable of both losing water to alluvium and gaining water from alluvium during different conditions. Ground water within the glacial sediments is present in laterally discontinuous lenses of coarse grained outwash and deltaic sediments which grade from coarse grained on the east side of the Tobacco Plains to fine grained near Lake Koocanusa. Ground water flows through and between the lenses allowing the entire sequence to be considered as a single confined aquifer across the Tobacco Plains. The confined nature of the aquifer is evidenced by the depth to water and perforated interval in local wells typically present below the static water level in the wells (Appendix B). While the glacial strata is unconsolidated to semiconsolidated, the occurrence of clay-rich intervals that act as aquitards and confining layers allows classification of the system as confined, even though they occur in unconsolidated sediments. The Midvale WUA obtains water from wells in this glacial aquifer.

The bedrock geology of the Tobacco River Valley and the Rocky Mountain Trench helps isolate the ground water flow system in the Tobacco Plains from the Tobacco River and associated alluvium. Bedrock occurs at the surface immediately southwest of Eureka, and is present in a general southeast trending line away from Eureka in the Tobacco River Valley (Figure 4). The ground water system of the Tobacco Plains is present northeast of this bedrock surface. In the Eureka area, this surface exposure is interpreted to represent a local divide to the ground water system between the Tobacco Plains and the Tobacco River alluvium system. Ground water in Eureka typically flows north to northwest away from the Tobacco River, with flow in the area immediately adjacent to the Tobacco River to the south (towards the river). Ground water flowing north combines with the regional system within the glacial aquifer of the Tobacco Plains and flows generally west, towards Lake Koocanusa. Approximately one mile east of the location of the Kootenai River, a set of springs are present which provide outlets to ground water flowing in the Tobacco Plains. With the construction of the Libby Dam and Lake Koocanusa, the springs appear to be have been flooded by the lake, based on altitude and their location relative to the shoreline.

Locally, ground water flow in the glacial aquifer of the Tobacco Plains may be considered variable due to the different hydraulic properties of the glacial strata. A generalized ground water flow map for the Tobacco Plains area based on Coffin et. al. (1971) is shown in Figure 6. This map combines the results of an electric-analog flow model with a limited number of actual water surface elevation measurements. As a published study, this map is considered generally representative of ground water flow in the Tobacco Plains area, and is used to calculate hydraulic gradients and directions for estimates of ground water flow rates. While the aquifer is considered confined, this model predicts that Indian Creek and Ksanka Creek both discharge to ground water in the upper reaches of the watershed. Sinclair Creek is not included in the modeling area; however it is considered to interact with ground water in a similar manner to the other area streams. Recharge to the glacial aquifers occurs from direction infiltration of precipitation, and infiltration of surface water along the interface between bedrock units and the glacial sediments.

Based on the preceding discussion and the information presented in Figure 6, ground water flow immediately north of Eureka appears to be southwest. This local variance in the regional system results from the discharge of surface water in Ksanka Creek into the local ground water system more than a mile northwest of the Midvale WUA service area. Flow in the area immediately north of Eureka appears to be generally to the northwest, towards the Tobacco Plains.

Figure 6 – General Ground Water Potentiometric Surface (Coffin et.al, 1971)

Conceptual Model and Assumptions

A conceptual hydrogeologic model is a simplified representation of the hydrogeologic system. For the Midvale WUA public water supply, ground water occurs in confined lenses of glacial outwash sediments. Ground water generally flows locally towards town from the northeast, with general ground water flow in the area to the northwest, away from the Tobacco River and central Eureka, around the bedrock hills located west of town. Depending on seasonal conditions, however, the flow rate and direction will fluctuate depending on precipitation within the watershed. The aquifer boundaries are not known due to the nature of the glacial strata, but the aquifer is considered to be limited to the Tobacco Plains area. Recharge to the aquifer occurs from stream loss where tributaries flow from over the boundaries of the glacial strata with the bedrock in the area, and from direct infiltration of precipitation.

Based on the hydrogeologic setting, the Midvale WUA water source is a confined aquifer in semi-consolidated glacial strata, which is considered to have a ***low*** source water sensitivity to contamination.

Well Information

The locations of the wells for the Midvale WUA are depicted in Figure 3. Information on these sources is summarized in Table 2. Copies of the driller construction logs for Wells 1, 2 and 4 are included with Appendix A. Well 1 is the original well for the system, and is located in the northern part of the service area. This well was installed in 1967 with 5-inch steel casing. Well two was installed in 1996, and was recently incorporated into the system for use as an active source. There is no well log or record available for Well 3. The MBMG-GWIC database was queried for well logs in the area (Appendix B), including well information for the PWS wells. There is no information in this database on Well 3 or Well 4.

Table 2. Source Well Information for Midvale WUA.

Information	Well 1	Well 2	Well 3*	Well 4
PWS Source Code	002	003	004	005
Well Location (T, R, Sec)	T36N, R27W Sec 11 CDCB	T36N, R27W Sec 14 ABAB	T36N, R27W Sec 11 CDCB	T36N, R27W Sec 14 BBAB
Well Location (lat, long)	48.8922°N Lat -115.0568°W Long	48.8898°N Lat -115.0478°W Long	48.8922°N Lat -115.0568°W Long	48.8897°N Lat -115.0584°W Long
MBMG #	90228	159477	*Not Reported*	*Not Reported*
Water Right #	*Not Reported*	*Not Reported*	*Not Reported*	*Not Reported*
Date Well was Completed	9/3/67	8/2/96	*Not Reported*	4/15/84
Total Depth	141 feet	135 feet	*Not Reported*	126 feet
Perforated Interval	111 – 113 feet 131 – 141 feet	Casing to 123 feet Open Bottom	*Not Reported*	122 – 126 feet
Static Water Level	40 feet	41 feet	*Not Reported*	*Not Reported*
Pumping Water Level	45 feet	100 feet	*Not Reported*	*Not Reported*
Drawdown	5 feet	59 feet	*Not Reported*	*Not Reported*
Test Pumping Rate	*Not Reported*	*Not Reported*	*Not Reported*	*Not Reported*
Specific Capacity	--	--	--	--
Yield	25 gpm	75 gpm	*Not Reported*	80 gpm

* Well 3 is located adjacent to Well 1, and was installed following the same general construction criteria for this well.

Delineation Methods and Criteria

The source water protection management areas were defined for a confined aquifer in accordance with the requirements of the DEQ Source Water Protection program (DEQ, 1999). The control zone around the infiltration gallery comprises a distance of 100 feet from each wellhead. The Inventory Regions comprise the area within a 1,000-foot radius of each wellhead. The recharge area is delineated as the watershed area upgradient from the Tobacco Plains. Due to the complexity of the glacial source aquifer, the areas within a one-year and three-year time of travel distance hydraulically upgradient from the Midvale WUA sources are also delineated. The recharge areas are broadened to reflect the uncertainties in the local hydrogeology.

Ground Water Flow Rates and Time of Travel

Ground water flow rates are estimated to conservatively identify a recharge area for the susceptibility assessment, and to support management planning based on the results of this SWDAR. Time of travel calculations for ground water flow were completed using the uniform flow equation (EPA, 1993). Conservative estimates for aquifer properties are made using available data from published reports. The values for these estimates are generally based on the information reported for the area in Coffin et. al. (1971). The criteria for selection of each value used for the ground water flow estimates is summarized in the following discussions:

- ***Transmissivity***: The transmissivity value is estimated based on the value used by Coffin et. al. (1971) for their assessment of ground water flow within outwash and deltaic deposits in the area. An estimated value of 10,000 ft^2/day is used for this assessment

- ***Thickness***: The value for the thickness of the aquifer for the wells is estimated at 20 feet for this assessment. This thickness is an assumed average value, and recognizes that the aquifer thickness can vary considerably across the area. In addition, water may also potentially occur in two or more water bearing seams beneath the potentiometric surface. Well logs showing the variability in water bearing thickness for deposits in the area are included in Appendix B.
- ***Hydraulic Conductivity***: A value for hydraulic conductivity is estimated using the basic relationship Transmissivity (T) = Hydraulic Conductivity (K) x Aquifer Thickness (b). From this relationship, the estimated value for the hydraulic conductivity (K) is 500 ft/day for this assessment.
- ***Hydraulic Gradient***: The hydraulic gradient is estimated from the flow gradient of the modeled ground water potentiometric surface for the area in Figure 6. The flow direction near Eureka appears to be from Ksanka Creek to the southwest towards Eureka. The gradient is an estimated 40 feet of elevation for every mile, which equals a gradient of approximately 0.008.
- ***Flow Direction***: The flow direction is considered generally southwest into the northern Eureka area, against the general flow direction in the Tobacco Plains area.
- ***Porosity***: The value for effective porosity is estimated at 30% (Todd, 1980). The estimated value is considered representative of sand and gravel, which reflects glacial outwash deposits.
- ***Pumping Rate***: The pumping rate for the wells is estimated at 50 gpm for purposes of this assessment. .

Ground Water Flow Rates and Calculation Results

The results of the ground water flow rate calculations are summarized in Appendix C. A one year time of travel distance correspondes to 4,980 feet (0.94 miles) while a three year time of travel distance is estimated at 14,750 feet (2.79 miles). Ground water flow rates within the coarse grained glacial deposits may be relatively fast. The presented ground water flow rates represent an estimate for general planning purposes only. Ground water flow rates within the glacial system may vary considerably over short distances due to rapid facies changes, vertical gradients, pumping from local wells, and other factors. The mathematics and baseline data required for such an assessment are beyond the scope of the Source Water Protection Program.

Source Water Protection Management Zones

The management areas delineated for the Midvale PWS are depicted in Figure 7. The inventory zones cover portions of Eureka, and the developed area around US Highway 93 north of Eureka. The upgradient area identified based on the three-year time of travel distance represents the a part of the local recharge area, where contaminants introduced to the surface may migrate into the glacial aquifer. The upper watershed of the Tobacco River Tributaries and Tobacco Plains area is delineated as the recharge area for the local aquifer

Limiting Factors

The hydrogeologic assessment presented in this section is based on the published and available geologic information on the area. The approach reflects uncertainties in the available data used to estimate the time of travel distances. The nature of glacial strata and the lateral extent of source aquifers represents the greatest area of uncertainty in this assessment, which evaluates the hydrogeology as a single aquifer. The understanding of the aquifer geometry is partially based upon a depositional model. With further data collection and analysis in the area, the depositional model may be further refined or changed. Additional limitations in the time of travel calculations result from the use of the Uniform Flow Equation for analysis of flow rates, which does not reflect the variability in hydraulic properties for the glacial strata.

Figure 7 – Midvale WUA Source Water Protection Management Area

4.0 INVENTORY

An inventory of potential sources of water contamination was conducted for delineated source water management zones for the Midvale PWS, including the Tobacco Plains area. The inventory focuses on potential sources of regulated drinking water contaminants including pathogens such as Cryptosporidium. For the SWDAR for a specific PWS, the inventory process evaluates activities in the control zone, certain sites as potential contaminant source and land use activities in the inventory region, and general land uses and large facilities in the recharge region. The inventory was performed consistent with the requirements of the Montana Source Water Assessment Program (1999).

While the inventory focuses on many potential sources, only significant potential contaminant sources (DEQ, 1999) were selected for detailed inventory for each system. The significant potential contaminants in the study area include petroleum from underground storage tanks, nitrates and pathogens from sanitary sewers, septic systems and agriculture; and herbicides and pesticides from cropped agricultural land.

Inventory Method

The initial inventory steps comprise querying existing state and federal electronic databases for regulated facilities that use, store or release regulated chemicals. The steps to the database searches, and the results from each step are listed in Appendix D. The assessment of agriculture land use and urban areas are shown on Figure 8 with the location of major transportation routes. The limits of the Eureka municipal sewer area south of the Midvale area and the relative density of septic systems in the area are shown on Figure 9. The database search is supplemented and verified with a "windshield survey" and a business directory search of the delineated inventory zones for each PWS in the study area. The results of the business directory search are included in Appendix D. This method helps ensure that the inventory is complete as a data collection exercise to identify all potential contaminant sources.

The results of the inventory process are summarized in Table 3, which summarizes the properties or sites within the study area. The potential contaminants are listed, with a description of the potential release mechanism for the site. In all cases, releases may occur due to unavoidable conditions such as flooding, lightning or fire. The sites where this is the primary potential release mechanism are identified as concerns resulting from such a disaster. For other sites where other release mechanisms may be more common, the potential for a release from such a disaster is assumed.

The Montana Source Water Protection Program identifies specific types of potential contaminant sources as significant, for further evaluation of the susceptibility of the water source to these sources. The following categories of potential contaminant sources are considered significant:

1. Large quantity hazardous waste generators
2. Animal feeding operations
3. Landfills
4. Abandoned or active mines, including gravel pits
5. Underground storage tanks
6. Septic systems
7. Underground injection wells
8. Sewer mains
9. Major roads or rail transportation routes
10. Storm sewer outflows
11. Cultivated cropland greater than 20 % of the inventory region
12. Wastewater treatment facilities, sludge handling sites, or land application areas
13. Known groundwater contamination (including open or closed hazardous waste sites, state or federal superfund sites, and UST leak sites)

Figure 8 – Area Land Use Classification (USGS, 2000) and Major Transportation Routes

Table 3 - Summary of Inventory Results for Midvale WUA

Source Type	***Potential Contaminants***	***Description/Concern***
Step 1 Results		
Agricultural Land Use	*Pathogens and Nitrates; Pesticides and Herbicides*	*Non-point source pollution, concentration of fertilizers/chemicals in surface/ground water*
Urban Land Use, Storm Water Discharge Points	*Spills of various chemicals*	*Non-point source pollution, small spills of household chemicals concentrated to point source*
Sanitary Sewer System	*Pathogens and Nitrates*	*Eureka municipal system, concern from leakage from sewer lines*
Septic Systems	*Pathogens and Nitrates*	*Non-point source pollution, loading o f ground water system with effluent*
EPA Envirofacts Sites (Step 2)	*No sites identified*	
EPA-PCSs Sites (Step 3)	*No sites identified*	
DEQ Database (Step 4)		
Active USTs - 3 Sites	*Petroleum Hydrocarbons*	*Spill or leak from USTs and piping*
LUST Site – 3 Sites	*Petroleum Hydrocarbons*	*Existing contamination, or residual contamination*
CECRA Sites and Landfills	*No sites identified*	
Business SIC Code Search Results* (Step 5)		
Stores - Auto Parts (3), Auto Repair (1), Oil Change (1), Hardware (1) and Miscellaneous Businesses (1)	*Petroleum Hydrocarbon and other chemicals*	*Natural Disaster or accidental spill of small quantities of chemicals stored or used*
Storage Area (3)	*Various*	*Natural Disaster or accidental chemical spills*
Miscellaneous Others, including Step 6		
Above ground tanks (1)	*Petroleum Hydrocarbons*	*Spill or release of stored fuels*
Major Roads	*Spills of various chemicals*	*Disaster – spill/release of chemicals and fuels transported on Highway*
Class V Injection Wells	*Various chemicals*	*Conduit for direct discharge to ground water*

* Note: Sites identified from multiple search queries are listed with the first step that identified the specific site. The results of the business SIC code search reflect types of facilities, with the number of facilities indicated in parentheses. Individual sites identified as significant potential contaminant sources are evaluated in Chapter 5.

The potential contaminant sources classified as significant are summarized in Table 4 with location shown on Figure 10. While other potential sources may be present within the delineated management regions, the significant sources are identified as a subset of the potential sources that are considered more likely to contaminate the PWS source aquifer under "worst-case" conditions. The following identifies the results of the inventory for significant potential contaminant sources within the delineated management regions.

Inventory Results – Inventory Region

The inventory region encompasses the area around the wells, and includes part of the area within the Eureka municipal boundaries. The identified potential sources primarily reflect Wells 1, 3 and 4. Well 2 is located upgradient from all of the identified potential sources, at a position where threats the well are minimized. The primary identified potential contaminant sources are summarized as follows:

- The Town of Eureka Sanitary Sewer system may provide a conduit for contaminated waters to migrate to a position where they may infiltrate into the local ground water system.
- Septic System failure may result in the infiltration of contaminated waters into shallow ground water, that can migrate towards and impact the source aquifer.
- Active USTs and LUST sites represent potential sources of contamination to the glacial aquifer from migration of chemicals through the subsurface.
- The primary route through the area, US Highway 93. Chemicals and fuels may be transported along the

highway, and an accidental spill may spread contaminants around the area where they may infiltrate into the shallow ground water system.

Figure 9 – Septic System Density and Limits of Sewered Areas

Table 4. Significant Potential Contaminant Sources for Midvale WUA.

Source	*Contaminants*	*Description*
Agricultural Land Use	*Pathogens and Nitrate; Pesticide/Herbicides (SOCs)*	*Primary concern in cultivated and grazing lands in Tobacco Plains within Ksanka Creek watershed, and to a lesser extent, the Indian Creek and Sinclair Creek Watersheds*
Urban Land Use	*Various*	*The area around the PWS sources and adjacent to Hwy 93 has grown with multiple businesses and residential areas.*
Sanitary Sewer Main	*Pathogens and Nitrate*	*The Eureka Town sewer system is located in the southern part of the Inventory Zone. Concern from leakage from sewer lines, and that backfill around sewers provides a preferred conduit for contaminants to migrate*
Septic Systems	*Pathogens and Nitrate*	*The central part of the Midvale Service Area has a high density. The majority of the area within the one-year time of travel has a moderate density*
Storm Water Discharge Points	*Various organic chemicals*	*Not inventoried at this time*
Active UST Sites	*Petroleum Hydrocarbons*	*At several locations within inventory zone; predominantly located downstream from PWS sources*
Major Roads	*Various Chemicals*	*Transportation corridors through town, concern over an accident and spill of any transported chemicals*
Class V Injection Wells	*Various organic chemicals*	*Not inventoried at this time (EPA responsibility); may provide conduits for chemicals into subsurface*

Inventory Results – Recharge Region
The land use in the upper Tobacco Plains is primarily forested, with limited amounts of agriculture as shown in Figure 8 . The rural nature of the region encompassing the Midvale WUA service area provides a measure of protection to the recharge area to the source aquifer. This includes the area within a three year time of travel distance for ground water, and the entire watershed area upgradient from the system. The only potential contaminant sources identified is agricultural use in the watershed, comprising cultivated lands and livestock grazing. Potential contamination from this source can infiltrate into the ground water in the glacial aquifer, where it may migrate towards the PWS sources.

Inventory Update
The certified operator for the Eureka PWS will update the inventory every year. Changes in land uses or potential contaminant sources will be noted and additions made as needed. The complete inventory will be submitted to DEQ every five years to ensure re-certification of the SWDAR.

Inventory Limitations
The inventory is limited by the accuracy of information in databases used for the assessment. The windshield survey provides a level of quality assurance that the information presented reflects current conditions at the time of preparation of this report. The location of Class V injection wells is not complete at this time, and is currently being compiled by EPA for the area.

Figure 10 – Inventory Locations for Potential Non-Point Contaminant Sources

5.0 SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by an inventoried potential contaminant source. The susceptibility assessment assumes that any released contaminants can enter a shallow ground water system and migrate towards a PWS well. Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the PWS wells. Hazard is rated by the proximity of a potential contaminant source to the PWS source. Susceptibility ratings are presented individually for each significant potential contaminant source and each related contaminant when multiple types of potential contaminants may be present. The susceptibility of each PWS source to each potential contaminant source is assessed separately. Susceptibility for community PWS is assessed in order to prioritize potential pollutant sources for management actions by local groups that may be concerned with protecting drinking water quality.

The susceptibility assessment is designed to serve as a tool to aid in Source Water Protection Planning. The goal of Source Water Planning and Management is to protect the source water by 1) limiting and controlling certain activities in the control zone; 2) managing significant potential contaminant sources in the Inventory Region; and 3) ensuring that land use activities in the Recharge Region pose minimal threat to the source water. Management priorities in the Inventory Region are determined by ranking the significant potential contaminant sources according to susceptibility. For each identified potential contaminant source, management approaches are recommended that can reduce the relative susceptibility of each PWS source to the specific potential contaminant source, as an additional barrier.

Hazard Ratings

For the confined aquifer in the Tobacco Plains area, hazard for point sources of contamination are rated by the proximity of the potential contaminant sources to the well and the location and well construction criteria for the PWS wells and other wells in the area. Assigned hazards reflect "worst-case" conditions, where any released contaminants could impact shallow ground water, and migrate down a wellbore to the source aquifer in wells without properly constructed sanitary seals. If the PWS well is not properly constructed with a complete sanitary seal, all point sources of potential contamination within the inventory zone are assigned a relative hazard of high. If the PWS well is properly constructed, but other wells in the inventory zone are present without proper sanitary seals, then all point sources are assigned a relative hazard of moderate. If the PWS well and all other wells in the inventory zone have proper sanitary seals, then all point sources in the inventory zone are assigned a relative hazard of low. For the Midvale WUA, the PWS wells are assumed to be properly constructed, but lack of data for other wells in the area infers that some wells may be present without proper sanitary seals. The approximate location of wells in the area is shown in Figure 11.

When the location of septic systems are known, they are treated as point sources, with hazards assigned based on the above criteria. When this information is not available or not known, septic systems are assessed based on the relative density of septic systems in the inventory zones, treated as a non-point pollution source similar to the percent of cropped agricultural land. For non-point sources, primary hazard levels are assigned based on the relative concentration of the sources within the inventory zone, based on the following table:

Table 5 - Non-Point Source Hazard Table

Source Type	***High Hazard***	***Moderate Hazard***	***Low Hazard***
Septic Systems	> 300 per sq. mi.	50 – 300 per sq. mi.	< 50 per sq. mi.
Municipal Sanitary Sewer (% Land Use)	> 50% of region	20% – 50% of region	< 20% of region
Cropped Agricultural Land(% Land Use)	> 50% of region	20% – 50% of region	< 20% of region

Figure 11 – Well Locations within Inventory Zone

After the relative hazard of a potential contaminant source is assigned, the relative susceptibility is determined based on the presence of barriers that may mitigate the potential for a contaminant source to impact a water source. Barriers may represent natural conditions, engineered barriers or management actions. Natural barriers include anything that can be demonstrated as effective in mitigating the migration of any chemicals released at the surface, such as thick clay-rich soils or surface flowing artesian conditions. Engineered barriers represent man-made structure to contain chemicals if they are released, such as spill containment for underground storage tanks. Management barriers are plans that prohibit or control potentially polluting activities, but only if there is a plan or approach that has been formally implemented.

For the Midvale PWS sources, there are only a limited number of barriers present. In general, clay-rich glacial soils are considered a barrier for all of the potential contaminant sources identified. An additional barrier for operating USTs is compliance with the 1998 EPA regulations for containment and spill prevention. The relative susceptibility of a potential contaminant source is based on the hazard, and the number of barriers present, as described in table 6.

Table 6 - Relative Susceptibility Based on Hazards and Barriers

Presence Of Barriers	**Hazard**		
	High	**Moderate**	**Low**
No Barriers	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
One Barrier	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Multiple Barriers	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

Susceptibility Assessment Results

The results of the susceptibility assessment of significant potential contaminant sources are listed in Table 7. The non-point potential contaminant sources represent potential threats to all of the sources. The remaining potential sources represent threats to Wells 1, 3, and 4 as there are no point sources within the inventory zone for Well 2. The additional potential contaminant sources to these three wells include a gasoline service station and the location of the PWS wells near US Highway 93.

Table 7. Susceptibility assessment of significant potential contaminant sources.

Source	**Contaminant**	**Hazard**	**Hazard Rating**	**Barriers**	**Susceptibility**	**Management**
Inventory Zone – All Wells						
Agricultural Land	Pesticides/ Herbicides/ Nitrates and Pathogens	Infiltration and Runoff	Low	Clay-rich soils	Low	Promote the use and development of agricultural BMPs for the area

Septic Systems	Pathogens and Nitrate	Infiltration and Runoff	High	Clay-rich soils	High	Connect to Sanitary Sewer System; monitor septic system performance
Inventory Zone – Wells 1, 3, and 4						
Active USTs	Petroleum Hydrocarbons	Leakage, Infiltration and Runoff	High	Clay-rich soils; Compliance with 1998 EPA upgrade regulations	Moderate	Monitor operating compliance results
US Highway 93	Various Chemicals	Spills	High	None	High	Develop emergency response plan
Recharge Area						
Cropped Agricultural Land	Pesticides/ Herbicides/ Nitrates and Pathogens	Infiltration and Runoff	Low	Clay-rich soils	Low	Promote the use and development of agricultural BMPs for the area

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