

**Roy Water and Sewer District
Public Water System**

PWS ID # MT0002395

***Source Water Delineation
and Assessment Report***

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Table of Contents

EXECUTIVE SUMMARY	i
INTRODUCTION	1
Purpose	1
Limitations	1
BACKGROUND	2
The Community.....	2
Geographic Setting.....	2
Geologic and Hydrogeologic Setting	2
Climate	3
General Description of the Source Water	3
The Public Water Supply	3
PWS Well Information.....	4
Water Quality	4
CHAPTER 2	7
DELINEATION.....	7
Conceptual Model and Assumptions.....	7
Delineation	7
Limiting Factors	8
INVENTORY	9
Inventory Method.....	9
Control Zone Inventory Results	10
Inventory Region Results	10
Recharge Region Inventory Results.....	12
Inventory Update.....	12
Inventory Limitations.....	12
SUSCEPTIBILITY ASSESSMENT	13
Hazard Determination	13
Discussion of Susceptibility	13
Management Recommendations	14
Conclusions.....	17
REFERENCES	19
GLOSSARY	20

Tables

Table 1. Monthly Climate Summary: Roy Climate Station.....	3
Table 2. Summary of PWS Well Information	4
Table 3. Background Water Quality Results	5
Table 4. Summary of Potential Contaminant Sources in the Inventory Region.....	11
Table 5. Susceptibility Based on Hazard and Barriers	13
Table 6. Susceptibility Assessment of Significant Potential Contaminant Sources	15

Figures

Figure 1. Vicinity Map and Well Locations 2
Figure 2. Geology of the Area 2
Figure 3. Source Water Management Areas and Potential Sources of Contamination 8
Figure 4. Land Use and Potential Sources of Contamination in the Protection Areas 11

Appendices

APPENDIX A – PWS PWS – 6 Report
APPENDIX B – Roy School Well Log and Water Quality
APPENDIX C – Roy Sewer Map
APPENDIX D – List of Potential Contaminant Sources
APPENDIX E – Monitoring Waivers
APPENDIX F – Concurrence Letter

EXECUTIVE SUMMARY

This Source Water Delineation and Assessment Report (SWDAR) was prepared under the requirements and guidance of the Federal Safe Drinking Water Act and the US Environmental Protection Agency, as well as a detailed Source Water Assessment Plan developed by a statewide citizen's advisory committee here in Montana. The Department of Environmental Quality (DEQ) is conducting these assessments for all public water systems in Montana. The purpose is to provide information so that the public water system staff/operator, consumers, and community citizens can begin developing strategies to protect your source of drinking water. The information that is provided includes the identification of the area most critical to maintaining safe drinking water, i.e., the Inventory Region, an inventory of potential sources of contamination within this area, and an assessment of the relative threat that these potential sources pose to the water system.

The drinking water for Roy Water and Sewer District is supplied by two wells. A shallow well (with horizontal collectors) is located northwest area of the Town of Roy along Box Elder Creek. A deep well is located by the well house and chlorination system. Based on the PWS-6 Report, and the depth of the wells, it appears that the soil, loam, clay for the shallow well and the shale, sandstone for the deep well are components of the Eagle Formation is providing water to the PWS's wells. In accordance with the Montana Source Water Protection Program criteria (1999), the aquifer (source water) for the shallow well is considered to have a high sensitivity to potential contaminant sources since it is surface water and GWUDISW, unconfined unconsolidated alluvium, fluvial-glacial gravel, terrace and pediment gravel, shallow fractured or carbonate bedrock. The deep well's aquifer (source water) is considered to have a low sensitivity to potential contaminant sources since it is consolidated sandstone bedrock, deep fractured or carbonate bedrock, confined semi-consolidated valley fill sediments, a confined aquifer. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

As part of this assessment, three types of source water protection management areas were mapped for the Roy Water and Sewer District public water system. They are: the control zone, the inventory region, and the recharge region. Potential sources of contamination were identified within each of these three regions and the results are as follows:

- Potential contaminant sources identified within the control zones include grazing and pasture land. The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's well or immediate surrounding areas. The control zone is delineated as a 100-foot radius around the wells and all sources of potential contaminants should be excluded in this region.
- Significant potential contaminant sources identified within the inventory region include: pasture land, sewer residential area, Highway 191, and private septic systems. The inventory region should be managed to prevent contaminants from reaching the well before natural processes reduce their concentrations. Since the source water from the new well is confined, the inventory region for the well consists of a 1000-foot radius circle around the well. The inventory region includes the area of land overlying the aquifer upgradient northwest of the well that is expected to supply groundwater recharge to the well over the next three years.
- Potential contaminant sources identified within the recharge region include: agricultural land and underground storage tanks. The goal of management in the recharge region is to maintain and

improve water quality over long periods of time or increased usage. Recharge to the wells is likely from infiltration of precipitation and surface water into the Eagle Formation where this formation outcrops upgradient southwest of the wells.

The Roy Water and Sewer District public water supply shallow well has a high susceptibility to the following potential contaminant sources: pasture land and a moderate susceptibility to sewerage area, and private septic systems. The hazard rating of the deep new well for all of the potential contaminant sources identified is low because the PWS source water well is confined and potential contaminant source migration pathways through the confining layer (i.e. poorly sealed wells) were not identified in the inventory region. With the natural barrier of the thick impermeable layer, the susceptibility of the Roy Water and Sewer District deep well to potential contaminant sources is low to very low. Low risk potential sources and potential sources located outside the Inventory Region, but within the Recharge Region may still pose a threat over time, but are not discussed in detail in this assessment. This provides a quick look at the existing potential sources of contamination that could, if improperly managed or released, impact the source water for Roy Water and Sewer District. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to focus resources for protection of this valuable drinking water resource.

The costs associated with contaminated drinking water are high, and prevention is preferable to treatment. Public awareness is a powerful tool for protecting drinking water. The information in this report will help increase public awareness about the relationship between land use activities and drinking water quality.

INTRODUCTION

This Source Water Delineation and Assessment Report (SWDAR) was prepared for the Roy Water and Sewer District Public Water Supply (PWS), PWS ID No. MT0002395, located in Fergus County. It was completed by Joe Meek of the Source Water Protection Program at the Department of Environmental Quality (DEQ) with assistance from intern Bethany Haines.

PURPOSE

The primary purpose of this source water delineation and assessment report is to provide information that helps the Roy Water and Sewer District protect its drinking water sources. A major component of the Montana Source Water Protection Program is '*delineation and assessment*'. Delineation is the process of identifying areas that contribute water to aquifers or surface water bodies used as drinking water supplies. The delineated areas are referred to as source water protection areas. Assessment involves identifying and inventorying potential sources of contamination within the source water protection areas, and then determining the potential for contamination of drinking water by these sources. This report is intended to meet the technical requirements for the completion of a source water delineation and assessment report for the Roy Water and Sewer District public water system, as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (Public Law 104-182). The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination.

LIMITATIONS

This report was prepared to assess threats to Roy Water and Sewer District's 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 the source of the Roy Water and Sewer District public water supply, and not to any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the vicinity of the Roy Water and Sewer District public water supply are identified. Potential sources of contamination are considered only in areas that contribute water to the source of the public water supply.

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 potentially represent health threats.

CHAPTER 1

BACKGROUND

THE COMMUNITY

The Town of Roy is located in Fergus County, in central Montana, as shown in [Figure 1](#). The nearest town is Lewistown located approximately 35 miles southwest of Roy. Roy Water and Sewer District serves 110 people through 54 service connections (lots/hook ups). Roy Water and Sewer District's public water system (PWS) is classified as a Community PWS because it serves more than 25 residents. Human waste and animal processing wastes are treated in wastewater treatment sewage lagoons located over a half mile northeast of the well site.

GEOGRAPHIC SETTING

The Town of Roy is located just south of Box Elder Creek and approximately 35 miles south of the Missouri River (see [Figure 1](#)). Roy Water and Sewer District is located in the Box Elder Watershed, U.S. Geological Survey (USGS) hydrologic unit code (HUC) No. 10040204, which is located within the Lower Missouri River Watershed Management Region for Montana. The Box Elder Watershed extends south of South Fork Bear Creek to North of Box Elder Creek.

[Figure 1](#). Vicinity Map and Well Locations

GEOLOGIC AND HYDROGEOLOGIC SETTING

This section provides an overview of the geology and hydrology of the Roy Water and Sewer District area and is based on a primarily on the Porter, D.W, Wilde, E.M geologic map, the PWS-6 Report, the well log for the Roy School District # 74 PWS well and regional well logs available from the Montana Bureau of Mines and Geology (MBMG) Ground-Water Information Center (GWIC). A regional geologic map is provided in [Figure 2](#). The geology of the area can be used to determine the locations, boundaries, and hydraulic properties of local aquifers. An understanding of hydrogeologic conditions also provides an explanation for the sensitivity of local aquifers to potential contaminant sources.

The stratigraphy in the Roy area generally consists of alluvial, terrace and glacial deposits which overly the bedrock of the Eagle Formation. The alluvium is primarily present at the surface in the larger stream valleys and consists of fine- to coarse-grained floodplain deposits of gravel, sand, silt and clay. The alluvial and terrace deposits (Qal and Qao on [Figure 2](#)) are underlain by the Bearpaw Shale which consists of dark gray shales with thin fine-grained sandstone and siltstone beds. In general, the shale layers do not yield water to wells but some of the thin sandstone beds may yield small quantities (usually less than 15 gallons per minute) of water to stock or domestic wells.

Information obtained from the MBMG indicate the Eagle sandstone dips to the north/northeast and generally follows the topography of the area. The lithology shown on the well log for the deep well tapping the Eagle formation is soil, loam, clay, gravel, shale/coal, rock/sandstone shale, and shale with streaks of bentonite (hot water). Water quality of the Eagle-sandstone formation is generally good.

[Figure 2](#). Geology of the Area

CLIMATE

Information on climate in the Roy Water and Sewer District area is based on the National Oceanic and Atmospheric Administration's (NOAA) Roy climate station located at an elevation of 3,450 feet above mean sea level (Western Regional Climate Station). Average temperatures and total precipitation for the period of record are shown in Table 1.

Table 1. Monthly Climate Summary: Roy Climate Station

Station 243558 Period of Record: 7/1/1948 to 6/30/2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	30.2	36.8	44.4	57.0	67.2	76.0	85.2	84.9	72.9	61.3	44.8	34.8	58.0
Average Min. Temperature (F)	6.2	12.5	19.8	30.4	40.2	48.2	53.4	52.0	42.0	32.3	20.0	10.9	30.7
Average Total Precipitation (in.)	0.49	0.37	0.65	1.15	2.65	2.55	1.82	1.38	1.13	0.73	0.44	0.47	13.83
Average Total SnowFall (in.)	8.8	6.1	7.3	5.6	1.0	0.1	0.0	0.0	0.2	2.2	5.1	7.8	44.2
Average Snow Depth (in.)	6	5	3	1	0	0	0	0	0	0	1	3	2

Percent of possible observations for period of record.

Max. Temp.: 99.9% Min. Temp.: 99.8% Precipitation: 100% Snowfall: 100% Snow Depth: 99.9%

GENERAL DESCRIPTION OF THE SOURCE WATER

The source aquifer for the shallow well is unconfined alluvium and the aquifer for the deep wells is confined bedrock. Recharge to the shallow well is likely from infiltration of precipitation and surface water through the overlying alluvial materials. Recharge to the deep aquifer occurs where the formation outcrops in the adjacent uplands and mountains to the southeast.

THE PUBLIC WATER SUPPLY

Roy Water and Sewer District serves 110 people through 54 service connections (hook ups). The Roy Water and Sewer District is classified as a community public water system (PWS) since it serves at least 25 of the same residents every day. Information on the water system was obtained from correspondence in the DEQ Public Water Supply Section files, including the PWS-6 Report completed on May 15, 2002 (attached as Appendix A).

The old well is a shallow (21ft) infiltration gallery spring type collection system. The new well is estimated 1,417 feet below ground surface. The wells come to a common entry point in the well house where the water is chlorinated and stored in a 30,000 gallon above ground steel storage tank. There is a 50/50 mix of water from the deep and shallow well.

A preliminary assessment of groundwater sources under the direct influence of surface water (GWUDISW) has not been conducted by DEQ. However the well would likely be classified as groundwater based on the distance to surface water (greater than 250 feet), well construction, and other assessment criteria.

PWS WELL INFORMATION

Roy Water and Sewer District’s drinking water is supplied by two wells located northwest of the Town of Roy. The shallow well is 21 feet deep and located about 50 feet from Box Elder Creek. The well was originally hand dug and improved in 1979 by installing a casing and backfilling the annulus between the casing and the dug well with gravel. The wellhead has a concrete sanitary seal. The static water level is 13 feet below ground surface. The new deep well was drilled on August 23, 2002 to a depth of 1,417 feet with a casing to the depth of the well. The static water level is 93 feet below ground level. The well is screened 1377 feet to 1417 feet with stainless steel. The grout depth is 1200 feet.

Table 2. Summary of PWS Well Information

Well ID	Shallow Well	Deep Well
DEQ Well Name/ Source Code	Well #1 WL002	Well #2 WL003
GWIC ID		
DNRC Water Right	050637	
Well Location	SW¼, SW¼, NE¼, Sec.2, T18N, R22E	SW¼, SW¼, NE¼, Sec.2, T18N, R22E
Well Elevation	Approx. 3,490 feet	Approx. 3,490 feet
Date Completed	1979	8/23/02
Total Depth (bgs)	21 feet	1417 feet
Well Completion: Casing	No records on casing.	Casing to 1417 feet below surface
Well Completion: Screen	No completion records.	Casing perforated from 1377 to 1417 feet in “shale”
Well Completion: Annular Seal	Sealed with concrete	No seal records.
Static Water Level (at time of drilling)	13 feet	93 feet
Well Pump Test Data	No records.	Pumping water level of 705 feet after pumping at 22 gpm

WATER QUALITY

Every PWS is required to perform regular sampling of their water supply to detect any contamination. The analytical parameters include: coliform bacteria and other pathogenic organisms, nitrates, metals, petroleum hydrocarbons, and other organic chemicals. The monitoring schedule depends on factors such as the size and source water of a PWS, the number of supplies (e.g. wells), and the population served. Each PWS has a specific monitoring program tailored to their system that follows the general protocols defined by DEQ for operation of a PWS. PWS monitoring schedules are available at: <http://nris.state.mt.us/wis/swap/swapquery.asp>. The Roy Water and Sewer District PWS monitoring data from DEQ’s database for the past five years was reviewed and is summarized in this section. There have been no confirmed coliform detections in the past five years.

Compounds detected during Roy Water and Sewer District’s water sampling over the past five years include nitrite + nitrate (0.09 to 0.16 mg/L (milligrams per liter, or ppm)), selenium (0.005 mg/L), and sulfate (178 mg/L). The compounds detected are all below established EPA primary maximum contaminant levels (MCLs). National secondary drinking water standards (SMCLs) are non-enforceable guidelines that may affect the aesthetic quality of water (i.e. odor, color, etc.) and are not health standards.

Background Water Quality Monitoring Results

Groundwater analytical data characterizing untreated groundwater quality not identified for Roy Water and Sewer District deep or shallow well. Water quality analytical results were identified for other wells in the area, including: several private wells, and a Montana Bureau of Mines and Geology (MBMG) test well. Background water quality sampling typically includes some general water quality parameters including major dissolved ions (calcium, magnesium, sodium, potassium, iron, manganese, silica, bicarbonate, carbonate, chloride, sulfate, nitrate, fluoride and orthophosphate), trace elements, and metals. Copies of the well logs, the water quality results from the GWIC database, and a comparison of the results to maximum contaminant levels for three of the wells located closest to Roy Water and Sewer District's current well field is provided in the PWS -6 Report (Appendix A).

Elevated sulfates, iron and manganese appear to be typical of this water source. These compounds generally exceed the SMCLs. Although the sodium concentrations detected in regional water (107 to 366 mg/L) does exceed the SMCL of 250 mg/L, water systems having greater than 20 mg/L of sodium in their drinking water source are encouraged to inform their customers of the presence of this constituent so that those individuals on a physician-prescribed low-sodium diet can inform their doctors of this source of sodium in their diet.

Table 3. Background Water Quality Results

Constituent	Bowser Jim* 4 MI SE Roy MT (GWIC ID 2190)	Horyna James*6 MI E Roy Mt (GWIC ID 2189)	Roy City Park (GWIC ID 149779)	Drinking Water Standard
Sample Date	08/16/1979	8/19/1979	6/16/2004	
Total Dissolved Solids	1974.76	1039.58	1650.21	
Hardness as CaCO3	1289.37	6.39	923.680	
Alkalinity	338.23	384.14	360.22	
Calcium (Ca)	279 mg/L	1.90 mg/L	1182 mg/L	---
Magnesium (Mg)	144 mg/L	0.04 mg/L	114 mg/L	---
Sodium (Na)	107 mg/L	366 mg/L	177 mg/L	250 mg/L [smcl]
Potassium (K)	10 mg/L	1.20 mg/L	5.10 mg/L	---
Iron (Fe)	14.60 mg/L	0.13 mg/L	9.06 mg/L	0.3 mg/L [smcl]
Manganese (Mn)	0.08 mg/L	<.01 mg/L	0.621 mg/L	0.05 mg/L [smcl]
Silica (SiO2)	10.30 mg/L	16.6 mg/L	6.27 mg/L	---
Bicarbonate (HCO3)	389 mg/L	398 mg/L	439.2 mg/L	---
Carbonate (CO3)	11.50 mg/L	34.6 mg/L	0.00 mg/L	---
Chloride (Cl)	6.20 mg/L	4.30 mg/L	22.1 mg/L	250 mg/L [smcl]
Sulfate (SO4)	1200 mg/L	415 mg/L	900 mg/L	250 mg/L [smcl]
Nitrate (NO3 as N)	<0.23 mg/L	0.03 mg/L	< 0.50 mg/L	10 mg/L [mcl]
Fluoride (F)	0.45 mg/L	0.36 mg/L	0.876 mg/L	4 mg/L [mcl]
Ortho-Phosphate (as P)	NR	NR	< 0.50 mg/L	500 mg/L [smcl]
Aluminum (Al)	NR	NR	32 ug/L	50-200 ug/L [smcl]
Antimony (Sb)	NR	NR	< 10 ug/L	6 ug/L [mcl]
Arsenic (As)	NR	NR	< 5 ug/L	10 ug/L [mcl]
Barium (Ba)	90 ug/L	70 ug/L	29.9 ug/L	2,000 ug/L [mcl]
Boron (B)	110 ug/L	140 ug/L	241 ug/L	---
Cadmium (Cd)	NR	NR	<1 ug/L	5 ug/L [mcl]
Chromium (Cr)	NR	NR	<10 ug/L	100 ug/L [mcl]

Cobalt (Co)	NR	NR	5.12 ug/L	---
Copper (Cu)	NR	NR	< 5 ug/L	1,300 ug/L [mcl]
Lead (Pb)	NR	NR	<10 ug/L	15 ug/L [mcl]
Lithium (Li)	170 ug/L	54 ug/L	161 ug/L	---
Molybdenum (Mo)	NR	NR	<50 ug/L	---
Nickel (Ni)	NR	NR	20.7 ug/L	---
Phosphate (P)	NR	NR	NR ug/L	---
Selenium (Se)	< 0.1 ug/L	< 0.1 ug/L	< 5 ug/L	50 ug/L [mcl]
Silver (Ag)	NR	NR	< 5 ug/L	100 ug/L [smcl]
Strontium (Sr)	1800 ug/L	160 ug/L	3,358 ug/L	---
Titanium (Ti)	NR	NR	<1ug/L	---
Vanadium (V)	NR	NR	< 25 ug/L	---
Zinc (Zn)	NR	NR	16,801 ug/L	5,000 ug/L [smcl]
Zirconium (Zr)	NR	NR	<10 ug/L	---

Key:

NR = No reading in GWIC

mg/L = milligrams per Liter

ug/L = micrograms per Liter

--- = Currently no standard for this constituent

[mcl] = U.S. Environmental Protection Agency maximum contaminant level or action level: revised October 13, 1999

[smcl] = U.S. Environmental Protection Agency maximum contaminant level or action level: revised October 13, 1999. This standard is based on aesthetic quality of water (i.e. odor, color, etc.) and is not a health standard

CHAPTER 2

DELINEATION

This report delineates three source water management areas. The goal of source water management is protecting the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources in the inventory region, and 3) ensuring that major land use activities or other significant activities in the recharge region pose minimal threat to the source water.

CONCEPTUAL MODEL AND ASSUMPTIONS

Roy Water and Sewer District's production wells are located in the Box Elder watershed (USGS Hydrologic Unit Code 10040204), which is located within Montana's Lower Missouri River watershed (Heath, 1984). Roy Water and Sewer District's deep drinking water source is interpreted to be the Eagle Formation. The direction of deep groundwater flow beneath the site is presumed to be from the southwest towards the northeast correlation with the Eagle Formation. Water tapped by the shallow well comes from the alluvial aquifer where flow direction is assumed to be toward the stream and down the stream valley with recharge coming primarily from infiltration of surface water and precipitation through the overlying sand and gravel. The aquifer is unconfined for the shallow well.

The unconfined aquifer is considered to have a **High Source Water Sensitivity** to contamination, and the deep confined aquifer is considered to have a **Low Source Water Sensitivity** to contamination. Sensitivity is defined as the degree of ease with which contaminants may migrate to the source water aquifer. This determination is according to the DEQ Source Water Protection Program criteria for ranking aquifer sensitivity (DEQ 1999).

DELINEATION

Methods and criteria for delineating source water protection areas are specified in the Montana Source Water Protection Program (DEQ, 1999). The delineated management zones for the wells are shown on [Figure 3](#).

Control Zone – A 100-foot radius control zone is delineated for Roy Water and Sewer District's wells. All sources of potential contaminants should be excluded in this region.

Inventory Region – According to the DEQ's Source Water Protection Program criteria for an unconfined aquifer (DEQ, 1999), the inventory zone for the shallow well was delineated based on a 1-mile up the Box Elder Creek recharge area. The inventory zones for the wells were broadened to reflect potential changes in the groundwater flow system during seasonal periods of high and/or low flow. The lateral extent of the inventory region was limited to the alluvial channel deposits as mapped by Porter, Wilde (1999) and shown on [Figure 2](#). All sources of potential contaminants are inventoried in this region. The inventory zone for the deep well was established within a 1,000-foot radius, based on the DEQ's Source Water Protection Program criteria for a confined aquifer system. Conservative estimates for aquifer properties were made using available data from published reports and the information on the well logs. All sources of potential contaminants are inventoried in this region.

Recharge Region –The recharge region for the Roy Water and Sewer District shallow well includes the alluvial channel material upgradient (south and southwest) of the PWS wells. The recharge region for the

Roy Water and Sewer District deep well includes the edge of the nearby Judith Mountains, where precipitation runoff recharges the sandstones aquifer. The inventory for the recharge region focuses on general land uses and large industrial facilities. The goal of management in the recharge region is to maintain and improve the long-term quality of groundwater in the aquifer.

LIMITING FACTORS

Delineation of the source water protection areas for the Roy Water and Sewer District PWS wells is based on published reports and lithology indicated on the well logs. The interaction of surface water with the alluvial channel deposits is not completely understood and the changes in the flow regime under seasonal conditions are not known. The delineation was completed using conservative assumptions to help ensure that the inventory zone reflects the actual area where contamination to the system may occur.

[Figure 3.](#) Source Water Management Areas and Potential Sources of Contamination

CHAPTER 3 INVENTORY

INVENTORY METHOD

Significant potential contaminant sources in the source water management areas were inventoried to assess the susceptibility of Roy Water and Sewer District's wells to contamination, and to provide a foundation for source water protection planning. The inventory for Roy Water and Sewer District focuses on facilities or features that generate, use, store, or transport potential contaminants, as well as certain land uses in the inventory and recharge regions. It is important to remember that the sites and areas identified in this section are only potential sources of contamination to the drinking water. Contamination of drinking water sources is less likely when potential contaminants are properly used and managed.

The inventory focus is slightly different in each of the delineated management areas. The inventory for Roy Water and Sewer District focuses on all activities in the control zones for the wells; certain types of facilities and land uses in the inventory region and general land uses and large facilities in the Recharge Region. Information on facilities and land uses that are potential sources of regulated contaminants was obtained from a number of databases, described below. The process for completing the inventory included several steps, which are summarized as follows:

Step 1: Urban and agricultural land uses were identified from the U.S. Geological Survey's (USGS) Geographic Information Retrieval and Analysis System <<http://nris.state.mt.us/gis/datalist.html>>. Sewered and unsewered residential land uses were identified from boundaries of sewer coverage obtained from municipal wastewater utilities.

Step 2: The US Environmental Protection Agency's (EPA) Envirofacts System <<http://www.epa.gov/enviro/>> was queried to identify EPA-regulated facilities located in the management areas. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) and the Permit Compliance System (PCS - for Concentrated Animal Feeding Operations with MPDES permits). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.

Step 3: Montana DEQ databases were queried to identify any of the following in the management areas:

- Underground storage tanks (USTs) <<http://www.deq.state.mt.us/UST/USTDownloads.asp>>
- Hazardous waste contaminated sites, above ground storage tanks (ASTs), landfills, and abandoned and active mines, including gravel pits <<http://nris.state.mt.us/gis/bundler/>>

Any information on past releases and present compliance status was noted.

Step 4: A business phone directory was queried by Standard Industrial Classification (SIC) code to identify businesses that generate, use, or store chemicals in the management areas. Particular attention was paid to equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers.

Step 5: Major road and rail transportation routes were identified throughout the inventory region: <http://nris.state.mt.us/gis/gisdata/lib/gisDataList.aspx>.

Step 6: The public water system operator was asked to identify potential sources that are not listed in databases or on maps elsewhere (such as animal feeding operations that are not required to obtain a permit) and to assist in locating potential sources listed in the state and federal databases.

Potential contaminant sources are designated to be significant if they fall into one or more of the following categories:

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

CONTROL ZONE INVENTORY RESULTS

The 100-foot control zone for the wells includes the well house and grazing/pasture land. Improper storage and management of animal wastes may impact drinking water supply especially if the animals have access to the control zone.

INVENTORY REGION RESULTS

The inventory results for Roy Water and Sewer District's source water are summarized in Table 4 and are shown on [Figure 3](#) and [Figure 4](#). The inventory region includes dryland pasture, private septic systems, Highway 191, and sewer mains underlying the town. Potential contaminants for Roy are human and animal wastes, and solvents and fuels. The primary hazards are chemical or fuel spills from the Highway, runoff, and leakage from sewer mains and septic tank discharges (Table 4).

Land uses within the inventory region include primarily undeveloped grasslands along the creek, pasture/grazing land, and some low intensity residential property located southeast of wells. Septic system density within the inventory region is low and is not considered a risk to the PWS drinking water. Additional point sources of potential pollutants (such as businesses or facilities listed on regulatory databases) were not identified in the inventory region. (Note: the railroad line identified on the topographic map is no longer active).

Table 4. Summary of Potential Contaminant Sources in the Inventory Region

<i>Source Type</i>	<i>Potential Contaminants</i>	<i>Description/Concern</i>
Land Use Cover (Step 1)		
Grazing/Pasture Land	Pathogens and nitrates	Improper storage and management of animal wastes may impact drinking water supply.
Residential Development with Sewer Lines	Pathogens and nitrates	If not properly designed, installed, and maintained, sewer lines can be a point source of residential and commercial effluent in groundwater.
EPA Envirofacts Sites (Step 2)		
None Identified		
DEQ Databases (Step 3)		
None Identified		
Business – SIC Code Sites (Step 4)		
None Identified		
Miscellaneous Others, including Step 5 and 6		
Transportation Corridors	Pesticides, fertilizers, VOCs, SOCs, other	Spills, routine spraying, storm water runoff, infiltration into groundwater
Domestic Septic Systems	Nitrates, Pathogens	Ongoing discharge sewage effluent into groundwater

Notes: Individual sites identified are evaluated in Chapter 4.

Figure 4. Land Use and Potential Sources of Contamination in the Protection Areas

RECHARGE REGION INVENTORY RESULTS

According to the 1992 National Land Cover dataset, the primary land uses in the recharge region are grasslands, with agricultural land in the lower reaches. The percentage of agricultural land is very low and not considered a risk to the drinking water supply. Grasslands are not considered potential sources of contamination unless there are significant grazing operations in the area.

Septic system density within the watershed/recharge region is low and is not considered a risk to the PWS drinking water.

Additional sources of potential pollutions (such as businesses or facilities listed on regulatory databases) were not identified in the recharge region.

INVENTORY UPDATE

To make this SWDAR a useful document for the years to come, the certified water system operator should review the inventory every year. Changes in land uses or potential contaminant sources should be noted and additions made as appropriate. The complete inventory should be submitted to DEQ every five years to ensure the source water delineation and assessment remains current.

INVENTORY LIMITATIONS

The potential contaminant sources described above are identified from readily available information. Consequently, unregulated activities or unreported contaminant releases may have been overlooked. The use of multiple sources of information, however, should ensure that the major threats to the source water for Roy Water and Sewer District's public water supply have been identified. The lack of identification of a potential contaminant source in the inventory or susceptibility assessment of this report does not mean that the potential for contamination does not exist or there is not a threat. It is highly recommended that the PWS and community "enhance" or refine the identification of the potential contamination sources through further research and local input.

CHAPTER 4

SUSCEPTIBILITY ASSESSMENT

HAZARD DETERMINATION

The threat of contamination is referred to as *hazard*. The degree of hazard is determined either by the proximity of a potential contaminant source to a spring or well intake, potential contaminant migration pathways, or by the density of potential non-point contaminant sources.

DISCUSSION OF SUSCEPTIBILITY

Susceptibility is the relative degree of likelihood for a public water supply to be impacted by inventoried contaminant sources, at concentrations that would pose a concern. Susceptibility is assessed to prioritize potential pollutant sources for local management, in this case the Roy Water and Sewer District PWS operator. Alternative management approaches that could be used by the PWS managers and operators to reduce susceptibility are recommended in this chapter.

Susceptibility is determined by considering the hazard rating for each potential contaminant source relative to any contaminant barriers (Table 4). Barriers to contamination are anything that decreases the likelihood that contaminants will reach a spring or well. Barriers can be engineered structures, management actions, or natural conditions. Examples of engineered barriers include spill catchment structures and leak detection for underground storage tanks. Emergency planning and best management practices (BMPs) are considered management barriers. Thick clay-rich soils, a deep water table or a thick unsaturated zone above the well intake are examples of natural barriers.

Table 5. Susceptibility Based on Hazard 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

Clay layers were identified in other well logs in the area indicating that the layer is likely laterally extensive in the Roy. The clay serves as a natural barrier for the deep well to the downward migration of potential contaminants from the surface.

A summary of the susceptibility assessment for Roy Water and Sewer District production well is provided in Table 6. This table only includes the potential contaminant sources (identified in Chapter 3) that were determined to present a significant potential risk to the drinking water supply. Therefore, this list is not exhaustive, and it is highly recommended that the PWS operator and community members

familiar with the nature of businesses and land use in the area enhance the inventory through further research and local input.

MANAGEMENT RECOMMENDATIONS

It should be noted that even small releases of some chemicals in close proximity to a public water supply well can have significant negative impact on water quality, and therefore are a significant threat to the public water supply. Steps can be taken to reduce the likelihood of releases in the source water for the PWS or in the vicinity of the sources. Management recommendations for protecting the Roy Water and Sewer District drinking water supply are detailed in the susceptibility table (Table 6). If these, and other, management recommendations are implemented; they may be considered additional barriers that will reduce the susceptibility of the intake to specific sources and contaminants.

Table 6. Susceptibility Assessment of Significant Potential Contaminant Sources

Potential Contaminant Source	Potential Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
<i>Inventory Region for Old Shallow Well</i>						
Septic Systems (2% of Inventory Region)	Nitrates, Pathogens	Ongoing or catastrophic leakage of sewage into groundwater	<i>Low</i>	-None	<i>Moderate Susceptibility</i>	Encourage and support city and county efforts to extend city sewer or to promote installation of community or advanced treatment septic systems and regular maintenance of septic tanks and distribution lines.
Sewer Lines (15% of Inventory Region)	VOCs, SOCs, metals, pathogens, nitrates, others	Ongoing or catastrophic leakage of sewage into groundwater	<i>Low</i>	-None	<i>Moderate Susceptibility</i>	Support maintenance, rehabilitation, or replacement of existing sewer mains; use of sewer main liners; and rapid response planning for leaks or ruptures.
US Highway 191 (5% of Inventory Region)	Pesticides, fertilizers, VOCs, SOCs, other	Spills, storm water runoff, infiltration into groundwater	<i>Low</i>	-None	<i>Moderate Susceptibility</i>	Encourage and support emergency planning, training of local emergency response personnel, use of levees and engineered storm drainage to carry any spills away and prevent infiltration into ground, cooperation with railroad managers or MDOT to reduce herbicide use.

Inventory Region for New Deep Well						
Septic Systems (2% of Inventory Region)	Nitrates, Pathogens	Ongoing or catastrophic leakage of sewage into groundwater	Low	- Clay layers overlie the aquifer	Low Susceptibility	Encourage and support city and county efforts to extend city sewer or to promote installation of community or advanced treatment septic systems and regular maintenance of septic tanks and distribution lines.
Sewer Lines (15% of Inventory Region)	VOCs, SOCs, metals, pathogens, nitrates, others	Ongoing or catastrophic leakage of sewage into groundwater	Low	- Clay layers overlie the aquifer	Low Susceptibility	Support maintenance, rehabilitation, or replacement of existing sewer mains; use of sewer main liners; and rapid response planning for leaks or ruptures.
Heavily Grazed Area (77% of Inventory Region)	Nitrates, Pathogens	Improper storage and management of animal wastes may impact drinking water supply.	Low	- Clay layers overlie the aquifer	Low Susceptibility	Notify landowners of well and protection area locations. Encourage use of agricultural best management practices (BMPs) in the watershed to keep cattle away from the wells and stream especially directly upstream of the well locations.
US Highway 191 (5% of Inventory Region)	Pesticides, fertilizers, VOCs, SOCs, other	Spills, routine spraying, storm water runoff, infiltration into groundwater	Low	- Clay layers overlie the aquifer	Low Susceptibility	Encourage and support emergency planning, training of local emergency response personnel, use of levees and engineered storm drainage to carry any spills away and prevent infiltration into ground, cooperation with railroad managers or MDOT to reduce herbicide use.
Recharge Region						
Underground Storage Tanks	VOCs, petroleum hydrocarbons	Contaminants leaching into groundwater	Low		Not Rated: Outside Inventory Region	Review permit status and ensure proper operation and maintenance, emergency planning, training of local emergency response personnel, groundwater monitoring, spill prevention, and BMPs.
Agricultural Crop Land	Nitrate and SOCs from fertilizer, pesticides and herbicides. Pathogens (if grazing occurs)	Contaminants leaching into groundwater	Low		Not Rated: Outside Inventory Region	Encourage use of agricultural best management practices (BMPs) in the recharge region

Notes: VOCs - Volatile organic compounds (i.e. solvents, fuel components) SOCs - Synthetic Organic Compounds (i.e. pesticides, herbicides, plasticizers)
 UST - Underground Storage Tank LUST - Leaking Underground Storage Tank
 BMPs - Best Management Practices DEQ- Montana Department of Environmental Quality
 RR - Recharge Region SIC - Standard Industrial Code

CONCLUSIONS

This Source Water Delineation and Assessment Report (SWDAR) was prepared under the requirements and guidance of the Federal Safe Drinking Water Act and the US Environmental Protection Agency, as well as a detailed Source Water Assessment Plan developed by a statewide citizen's advisory committee here in Montana. The Department of Environmental Quality (DEQ) is conducting these assessments for all public water systems in Montana. The purpose is to provide information so that the public water system staff/operator, consumers, and community citizens can begin developing strategies to protect your source of drinking water. The information that is provided includes the identification of the area most critical to maintaining safe drinking water, i.e., the Inventory Region, an inventory of potential sources of contamination within this area, and an assessment of the relative threat that these potential sources pose to the water system.

The drinking water for Roy Water and Sewer District is supplied by two wells. A shallow well is located northwest area of the Town of Roy by Box Elder Creek. A deep well is located by the well house. In accordance with the Montana Source Water Protection Program criteria (1999), the aquifer (source water) for the shallow well is considered to have a high sensitivity to potential contaminant sources since it is unconfined unconsolidated alluvium. The deep well's aquifer (source water) is considered to have a low sensitivity to potential contaminant sources since it is in consolidated sandstone bedrock overlain by clays. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

As part of this assessment, three types of source water protection management areas were mapped for the Roy Water and Sewer District public water system. They are: the control zone, the inventory region, and the recharge region. Potential sources of contamination were identified within each of these three regions and the results are as follows:

- Potential contaminant sources identified within the control zones include grazing and pasture land. The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's well or immediate surrounding areas. The control zone is delineated as a 100-foot radius around the wells and all sources of potential contaminants should be excluded in this region.
- Significant potential contaminant sources identified within the inventory region include: sewer residential area, Highway 191, and domestic septic systems. The inventory region should be managed to prevent contaminants from reaching the well before natural processes reduce their concentrations. Since the source water from the new well is confined, the inventory region for the well consists of a 1000-foot radius circle around the well. The inventory region includes the area of land overlying the aquifer upgradient northwest of the well that is expected to supply groundwater recharge to the well over the next three years.
- Potential contaminant sources identified within the recharge region include: agricultural land and underground storage tanks. The goal of management in the

recharge region is to maintain and improve water quality over long periods of time or increased usage. Recharge to the wells is likely from infiltration of precipitation and surface water into the Eagle Formation where this formation outcrops upgradient southwest of the wells.

The Roy Water and Sewer District public water supply shallow well has a high susceptibility to the following potential contaminant sources: none; moderate susceptibility to sewerage area, domestic septic systems, and potential spills along the highway. For the deep well, the hazard ratings for all of the potential contaminant sources identified are low because the PWS source water well is confined and potential contaminant source migration pathways through the confining layer (i.e. poorly sealed wells) were not identified in the inventory region. With the natural barrier of the thick impermeable layer, the susceptibility of the Roy Water and Sewer District deep well to potential contaminant sources is low to very low. Low risk potential sources and potential sources located outside the Inventory Region, but within the Recharge Region may still pose a threat over time, but are not discussed in detail in this assessment. This provides a quick look at the existing potential sources of contamination that could, if improperly managed or released, impact the source water for Roy Water and Sewer District. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to focus resources for protection of this valuable drinking water resource.

The costs associated with contaminated drinking water are high, and prevention is preferable to treatment. Public awareness is a powerful tool for protecting drinking water. The information in this report will help increase public awareness about the relationship between land use activities and drinking water quality.

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GLOSSARY

Acute Health Effect. A negative health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

Aquifer. A water-bearing layer of rock or sediment that will yield water in usable quantity to a well or spring.

Barrier. A physical feature or management plan that reduces the likelihood of contamination of a water source from a potential contaminant source

Best Management Practices (BMPs). Methods for various activities that have been determined to be the most effective, practical means of preventing or reducing non-point source pollution.

Biennial Reporting System (BRS). An EPA database that contains information on hazardous waste sites. The data can be accessed through the EPA Envirofacts website.

Chronic Health Effect. A negative health effect in which symptoms develop over an extended period of time.

Class V Injection Well. Any pit or conduit into the subsurface for disposal of waste waters (e.g. dry well). The receiving unit for an injection well typically represents the aquifer, or water-bearing interval.

Coliform Bacteria. A general type of bacteria found in the intestinal tracts of animals and humans, and also in soils, vegetation and water. Their presence in water is used as an indicator of pollution and possible contamination by pathogens.

Comprehensive Environmental Cleanup and Responsibility Act (CECRA). Passed in 1989 by the Montana State Legislature, CECRA provides the mechanism and responsibility to clean up hazardous waste sites in Montana.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Enacted in 1980. CERCLA provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). A database that provides information about specific sites through the EPA Envirofacts website.

Confined Animal Feeding Operation (CAFO). Any agricultural operation that feeds animals within specific areas, not on rangeland. Certain CAFOs require permits for operation.

Confined Aquifer. A fully saturated aquifer overlain by a confining unit such as a clay layer. The static water level in a well in a confined aquifer is at an elevation that is equal to or higher than the base of the overlying confining unit.

Confining Unit. A geologic formation present above a confined aquifer that inhibits the flow of water and maintains the pressure of the groundwater in the aquifer. The physical properties of a confining unit may range from a five-foot thick clay layer to shale that is hundreds of feet thick.

Delineation. The process of determining and mapping source water protection areas.

Glacial. Of or relating to the presence and activities of ice or glaciers. Also, pertaining to distinctive features and materials produced by or derived from glaciers.

Geographic Information Systems (GIS). A computerized database management and mapping system that allows for analysis and presentation of geographic data.

Hardness. Characteristic of water caused by presence of various calcium and magnesium salts. Hard water may interfere with some industrial processes and prevent soap from lathering.

Hazard. A relative measure of the potential of a contaminant from a facility or associated with a land use to reach the water source for a public water supply. The location, quantity and toxicity of significant potential contaminant sources determine hazard.

Hydraulic Conductivity. A constant number or coefficient of proportionality that describes the rate water can move through an aquifer material.

Hydrology. The study of water and how it flows in the ground and on the surface.

Hydrogeology. The study of geologic formations and how they effect groundwater flow systems.

Inventory Region. A source water management area for groundwater systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified three year groundwater travel time.

Lacustrine. Pertaining to, produced by, or formed in a lake or lakes.

Large Capacity Septic System. Defined by Underground Injection Control regulations as an on-site septic system serving 20 or more persons.

Leaking Underground Storage Tank (LUST). A release from a UST and/or associated piping into the subsurface.

Maximum Contaminant Level (MCL). Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act to establish concentrations of contaminants in drinking water that are protective of human health.

Montana Bureau of Mines and Geology – Groundwater Information Center (MBMG/GWIC). The database of information on all well drilled in Montana, including stratigraphic data and well construction data, when available.

Montana Pollutant Discharge Elimination System (MPDES). A permitting system that utilizes a database to track entities that discharge wastewater of any type into waters of the State of Montana.

National Pollutant Discharge Elimination System (NPDES). A national permitting system that utilizes a database to track entities that discharge wastewater into waters of the United States.

Nitrate. An important plant nutrient and type of inorganic fertilizer that can be a potential contaminant in water at high concentrations. In water the major sources of nitrates are wastewater treatment effluent, septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of these chemicals into surface and/or groundwaters at increased levels that may exceed MCLs.

Pathogens. A microorganism typically found in the intestinal tracts of mammals, capable of producing disease.

Phase II (and IIb) Rules. EPA updated or created legal limits on 38 contaminants. The rules became effective July 30, 1992 and January 1, 1993. Some of these contaminants are frequently-applied agricultural chemicals such as nitrate and others are industrial solvents.

Phase V Rule. EPA set standards for 23 contaminants in addition to those addressed by the Phase II Rules. The Phase V Rule became effective January 17, 1994. Some of these contaminants include inorganic chemicals such as cyanide and other Phase V contaminants are pesticides that enter water supplies through run-off from fields where farmers have applied them or by leaching through the soil into groundwater. Six are probable cancer-causing agents. Others can cause liver and kidney damage, or problems of the nervous system and brain.

Point Source. A stationary location or a fixed facility from which pollutants are discharged. This includes any single identifiable source of pollution, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fracture, container, rolling stock (tanker truck), or vessel or other floating craft, from which pollutants are or may be discharged.

Pollutant. Generally, any substance introduced into the environment that adversely affects the usefulness of a resource (e.g. groundwater used for drinking water).

Permit Compliance System (PCS). An EPA database that provides information on the status of required permits for specific activities for specific facilities. The data can be accessed through the EPA Envirofacts website.

Public Water System (PWS). A system that provides water for human consumption through at least 15 service connections or regularly serves 25 individuals.

Pumping Water Level. Water level elevation in a well when the pump is operating.

Recharge Region. An area in which water is absorbed that eventually reaches the zone of saturation in one or more aquifers. As a source water management region, the term generally describes the entire area that could contribute water to an aquifer used by a public water supply. Includes areas that could contribute water over long time periods or under different water usage patterns.

Resource Conservation and Recovery Act (RCRA). Enacted by Congress in 1976. RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner.

Resource Conservation and Recovery Information System (RCRIS). Is a database that provides information about specific sites through the EPA Envirofacts website.

Secondary Maximum Contaminant Levels (SMCL). The maximum concentration of a substance in water that is recommended to be delivered to users of a public water supply based on aesthetic qualities. SMCLs are non-enforceable guidelines for public water supplies, set by EPA under authority of the Safe Drinking Water Act. Compounds with SMCLs may occur naturally in certain areas, limiting the ability of the public water supply to treat for them.

Section Seven Tracking System (SSTS). SSTS is an automated system EPA uses to track pesticide producing establishments and the amount of pesticides they produce.

Source Water. Any surface water, spring, or groundwater source that provides water to a public water supply.

Source Water Delineation and Assessment Report (SWDAR). A report for a public water supply that delineates source water protection areas, provides an inventory of potential contaminant sources within the delineated areas, and evaluates the relative susceptibility of the source water to contamination from the potential contaminant sources under “worst-case” conditions.

Source Water Protection Areas. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply. For groundwater sources, the area within a fixed radius or three-year travel time from a well, and the land area where the aquifer is recharged.

Spill Response Region. A source water management area for surface water systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified four-hour water travel time in a stream or river.

Standard Industrial Classification (SIC) Code. A method of grouping industries with similar products or services and assigning codes to these groups.

Static Water Level (SWL). Water level elevation in a well when the pump is not operating.

Susceptibility (of a PWS). The relative potential for a PWS to draw water contaminated at concentrations that would pose concern. Susceptibility is evaluated at the point immediately preceding treatment or, if no treatment is provided, at the entry point to the distribution system.

Synthetic Organic Compounds (SOC). Man made organic chemical compounds (e.g. herbicides and pesticides).

Total Dissolved Solids (TDS). The dissolved solids collected after a sample of a known volume of water is passed through a very fine mesh filter.

Total Maximum Daily Load (TMDL). The total pollutant load to a surface water body from point, nonpoint, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

Toxicity. The quality or degree of being poisonous or harmful to plants, animals, or humans.

Toxicity Characteristic Leachate Procedure. A test designed to determine whether a waste is hazardous or requires treatment to become less hazardous.

Toxic Release Inventory (TRI). An EPA database that compiles information about permitted industrial releases of chemicals to air and water. Information about specific sites can be obtained through the EPA Envirofacts website.

Transmissivity. A number that describes the ability of an aquifer to transmit water. The transmissivity is determined by multiplying the hydraulic conductivity time the aquifer thickness.

Turbidity. The cloudy appearance of water caused by the presence of suspended matter.

Unconfined Aquifer. An aquifer containing water that is not under pressure. The water table is the top surface of an unconfined aquifer.

Underground Storage Tanks (UST). A tank located at least partially underground and designed to hold gasoline or other petroleum products or chemicals, and the associated plumbing system.

Volatile Organic Compounds (VOC). Chemicals such as petroleum hydrocarbons and solvents or other organic chemicals that evaporate readily to the atmosphere.

Watershed. The region drained by, or contributing water to, a stream, lake, or other water body of water.

* With the exception of the definitions for Lacustrine, Phase II and Phase V Rules, and Standard Industrial Classification Code, definitions were adapted from EPA's Term References System (formerly known as Glossary of Selected Terms and Abbreviations) which can be found at: <http://www.epa.gov/trs/index.htm> . The definitions of glacial and lacustrine were taken from the Glossary of Geology by Robert L. Bates and Julia A. Jackson.

The definitions for Phase II and Phase V Rules were adapted from:

<http://www.epa.gov/OGWDW/source/therule.html#PhaseII>

<http://www.epa.gov/OGWDW/source/therule.html#PhaseV>

The definition for Standard Industrial Classification Code was adapted from:

EPA/Office of Enforcement and Compliance Assurance: Guide to Environmental Issues: Glossary of Terms & Acronyms *Term Detail*

Appendix A
PWS – 6 Report

Town of Roy

May 15, 2002

Public Water Supply: PWS ID: 02395
Town of Roy

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INTRODUCTION AND PURPOSE

The purpose of this PWS-6 report is to assess threats to a new public water supply for the Town of Roy water supply system. The existing PWS well is a shallow (21 ft) infiltration gallery spring type collection system which has been unable to produce the adequate volume of water to meet the demand.

The primary contact for the Town of Roy is Mr. Tom Byrne, P.O. Box 51, Roy, MT 59471, telephone (406) 464-2161. The Engineering Report for the Roy well was prepared by Neil Consultants, Inc.

Information on this water supply were obtained from a review of the Public Water Supply files, well data from the Roy School well, and other public sources of information.

LIMITATIONS

The terms "drinking water supply" or "drinking water source" refer specifically to the source of the Roy 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

Roy is located just south of Box Elder Creek, approximately 35 miles south of the Missouri River and 35 miles northeast of Lewistown on US Highway 191. The existing PWS well is located in the SW $\frac{1}{4}$ NE $\frac{1}{4}$ of Section 7, Township 18 N, Range 22 E, and north of US Highway 191.

Average water use is approximately 23,000 (gpd) for the months of January through March. Maximum day demand is estimated at 57,500 gallons per day using a maximum day factor of 2.5 times average day demand. Water demands are based on interpretation of pump output on pump curves and are considered good estimates but are not metered data. Currently the output is not metered. There are a total of 54 users on the water system. With an average of 2.7 persons per household, demand equates to 144 gallons per capita per day. However, without meter readings, per capita demand may be meaningless as agricultural and commercial demand may have a significant impact.

With the 30,000 gallon water storage available, it is anticipated that 30 gpm from the new PWS will meet the current demand with a future demand requirement of approximately 35 gpm.

The new well will be located in essentially the same location as the existing well house and chlorination system. Information from existing wells in the vicinity in the Eagle Formation was used as well as the public information to estimate aquifer properties.

The proposed PWS well is anticipated to be between 1400 and 1450 feet in depth based on the Roy School well in the same aquifer. The proposed PWS will be cased full depth from the land surface to the water bearing zone. The annulus between the main well casing and the borehole will be cemented by positive placement of neat grout from the bottom of the well casing to the land surface to seal the well from potential contaminants from other aquifers and hazardous material spills in the vicinity of the well head. The well will be screened at the bottom of the well casing with a Johnson or equal stainless steel well screen.

The Town of Roy is serviced by a community sewer system with sewage lagoons located over $\frac{1}{2}$ mile northeast of the well site and the spray irrigation system located over $\frac{3}{4}$ mile east of the well site.

DELINEATION

Three source water protection zones are delineated for the Roy water supply well. They include a 100-foot fixed radius control zone, a 1000 foot radius Inventory Zone, and hydrologic flow boundaries of the Eagle Aquifer.

Hydrologic Conditions

Geologic conditions were taken from the school's deep well completed in 1965 and consist of the following:

0 to 8 feet below surface	soil, loam and clay
16-30 feet below surface	gravel
60-530 feet below surface	shale/coal/shale some rock
530-1217 feet below surface	rock/sandstone shale
1217-1574 feet below surface	shale w/ streak of bentonite (hot water)

Sources obtained from the MBMG indicate the Eagle sandstone dips to the north/northeast and generally follows the topography of the area.

Existing wells in the area tapping the local shallow gravels are typically less than 20 feet deep and yield 10 gpm +/- and are typically used for domestic and livestock purposes. A well log of the Roy School well located to the southeast of the existing PWS well is included in the Attachments. Also included is water quality from the existing Roy PWS well and two other wells east and southeast of Roy in the same aquifer.

Water quality in the Eagle-Sandstone formation is generally fair to good with some locations having relatively high total dissolved solids and turbidity. However, the water is typically very soft making it beneficial for washing, but has high PH possibly causing a scale buildup in piping.

Discussion was completed with the District Board regarding investigation for the use of a deep well in the Eagle formation for domestic use. Although the water quality of the shallow well is generally good, the water is considered hard (300 to 400 grains hardness) making it unsuitable for washing. The Town of Roy is planning on mixing the harder shallow well with the future soft deep well. The town proposes to mix the shallow hard water of neutral PH with the deep well softwater with a high PH. The PH of the proposed deep well is anticipated to be between 8.0-9.0.

The Eagle Sandstone Aquifer is considered a confined aquifer and is assigned a "Low Source Water Sensitivity" in accordance with Table 2 of PWS-6 template for Community or Non-Community Non-Transient Public Water Supplies.

Well Information

Table 1 shows that wells in the Eagle Aquifer in the area of Roy vary from a depth of 690 feet to a depth of 2005 feet at a well 6 miles east of Roy. Both deep wells located to the east and southeast of Roy are not considered a potential threat since they are located a significant distance downgradient in the aquifer.

Aquifer Properties

Table 2 summarizes aquifer information for the Roy area.

Limitations

Values in Table 2 are from a limited number of deep wells in the Roy area. Water quality varies between wells which is possibly due to influence from wells in the area penetrating other aquifers.

INVENTORY

Table 3 lists the potential contaminant sources for the control and inventory zones. Items in the source column of Table 3 are shown on the attached Exhibit 1. Dryland pasture is the primary land use near the well although a house with a septic system is located within 300 feet of the well site. Land use within the 1000 feet inventory zone is approximately 77% pasture land, 15% sewered residential, 5% roads (public), and 2% unsewered residential. There are two residences within the inventory zone which have septic tanks and drainfields. Land use in the inventory zone is predominantly pasture land.

No former or existing underground fuel tank sites are known to exist within the inventory zone.

An abandoned shallow well is located approximately 50 feet west of the existing PWS well. Contact was made with the property owner through Tom Byrnes regarding status of the well. The well was originally dug with a backhoe approximately 20 years ago to a depth of 10-15 feet. The well consisted of a vertical pipe and horizontal collection pipe. The well was abandoned several years ago due to lack of water. The method of well abandonment is not known. It is assumed that the well was not formally abandoned but just taken out of service. No well logs were available for the well. Due to the shallow depth of the well, no further consideration was given as a potential contaminant source.

The railway which would normally be considered a significant potential contaminant source is not included in the inventory since the railroad has been abandoned for over 20 years.

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; the density of non-point potential contaminant sources; and the presence and adequacy of well seals through the confining layer determines the threat of contamination. Hazard and the existence of barriers to contamination determine susceptibility; see Table 7 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.

Table 3 lists results from the susceptibility analysis for significant potential contaminant sources. The hazard rating and susceptibility assessment is based on criteria in Table 9c of the PWS-6 template (DEQ, 2000). Agricultural (pasture) lands in the inventory zone around Roy make up about 77% of the inventory zone and are assigned a low hazard rank. Municipal sewer lines within the Town of Roy are ranked as a low hazard since they underlie approximately 15% of the inventory zone. The Roy school well is sealed through the confining layer which contributes to the low hazard ranking. No other deep wells are noted in the inventory region which could contribute to contamination of the aquifer.

A segment of US Highway 191 is within the inventory zone and is initially ranked as a low hazard. US 191 poses a low hazard to the proposed Roy PWS well due to the absence of inadequately sealed wells finished in the Eagle sandstone within the inventory region.

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

Well Information *	Well # 1	Well # 2	Well # 3
PWS Source Code			
Well Location (T, R, Sec or lat, long)	18N 22E 07 DD	18N 22E 27 BBD	18N 22E 01 AAC
MBMG #	179757	2190	2189
Water Right #	NR	NR	NR
Date Well was Completed	4/22/65	6/05/65	3/04/74
Total Depth (ft)	1411	690	2005
Perforated Interval (ft)	NR	None	1860-2005
Static Water Level**	0	12	120
Pumping Water Level **	160	150	200
Drawdown (ft)	160	138	80
Test Pumping Rate (gpm)	15	20	55
Specific Capacity	NR	NR	NR

* see attached well logs
 ** feet below land surface

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

Input Parameter	Range of Values and Units	Values Used (for each well if more than one)		
		Well # 1	Well # 2	Well #3
PWS Source Code				
Transmissivity		NR	NR	NR
Thickness	Ft	157	240	135
Hydraulic Conductivity	gpd/ft ²	NR	NR	NR
Hydraulic Gradient		NR	NR	NR
Flow Direction		East/ Northeast	East/ Northeast	East/ Northeast
Effective Porosity		NR	NR	NR
Pumping Rate	Gpm	15	20	55

Table 3. (MT SWPP Table 5). Significant potential contaminant sources for Town of Roy Source Water.

Source	Contaminants	Description (Location and nature of hazard)	Hazard Rating	Barriers	Susceptibility
1. Dryland grazing	SOC, Nitrate	77% ag-land in the inventory zone	Low	Upward Vertical Gradient	Low
2. Sanitary Sewer Main	Pathogens & Nitrates	Inventory zone is about 15% sewerred	Low	Upward Vertical Gradient	Low
3. Sanitary Sewer Main	Pathogens & Nitrates	15% of the inventory zone	Low	Upward Vertical Gradient	Low
4. Septic Systems	Pathogens & Nitrates	2 septic systems in inventory zone	Low	Upward Vertical Gradient	Low
5. US Highway 191	Hazardous Materials (VOC's & SOC's)	5% of inventory zone	Low	Upward Vertical Gradient	Low

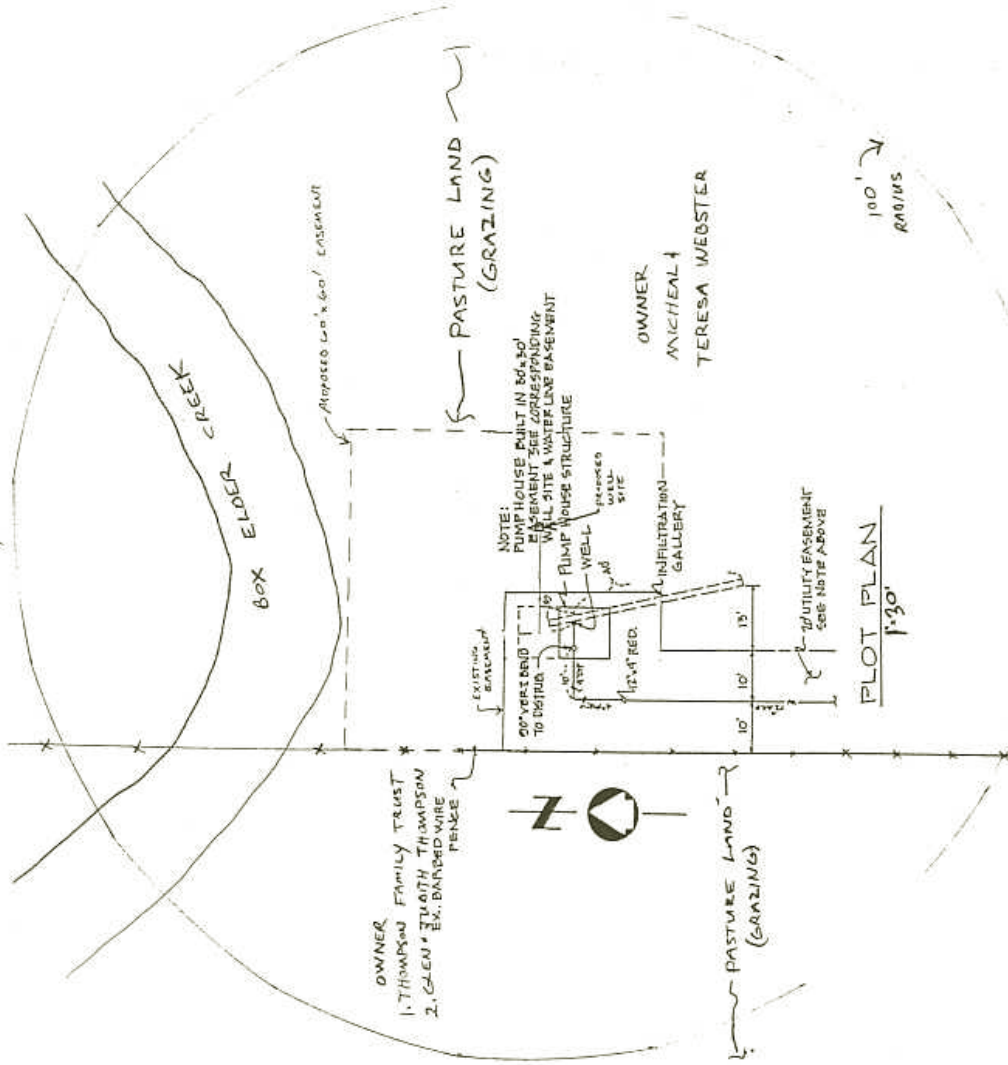
REFERENCES

- 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.state.mt.us/wqinfo/SWP/Circulars.htm>
- Montana Bureau of Mines and Geology
 - Open File Report: MBMG 99 TF 211.41E (Eagle Thickness)
 - Open File Report: MBMG 99 AT 211.39E (Eagle Top Elevations)
 - Open File Report: MBMG 99 DS 211.39E (Eagle TDS)
 - Open File Report: MBMG Report #265
 - MBMG 99, Volume 1, 1982 – Occurrence and Characteristics of Ground Water in Montana
- Montana Natural Resource Information System Website <http://www.nris.state.mt.us/>

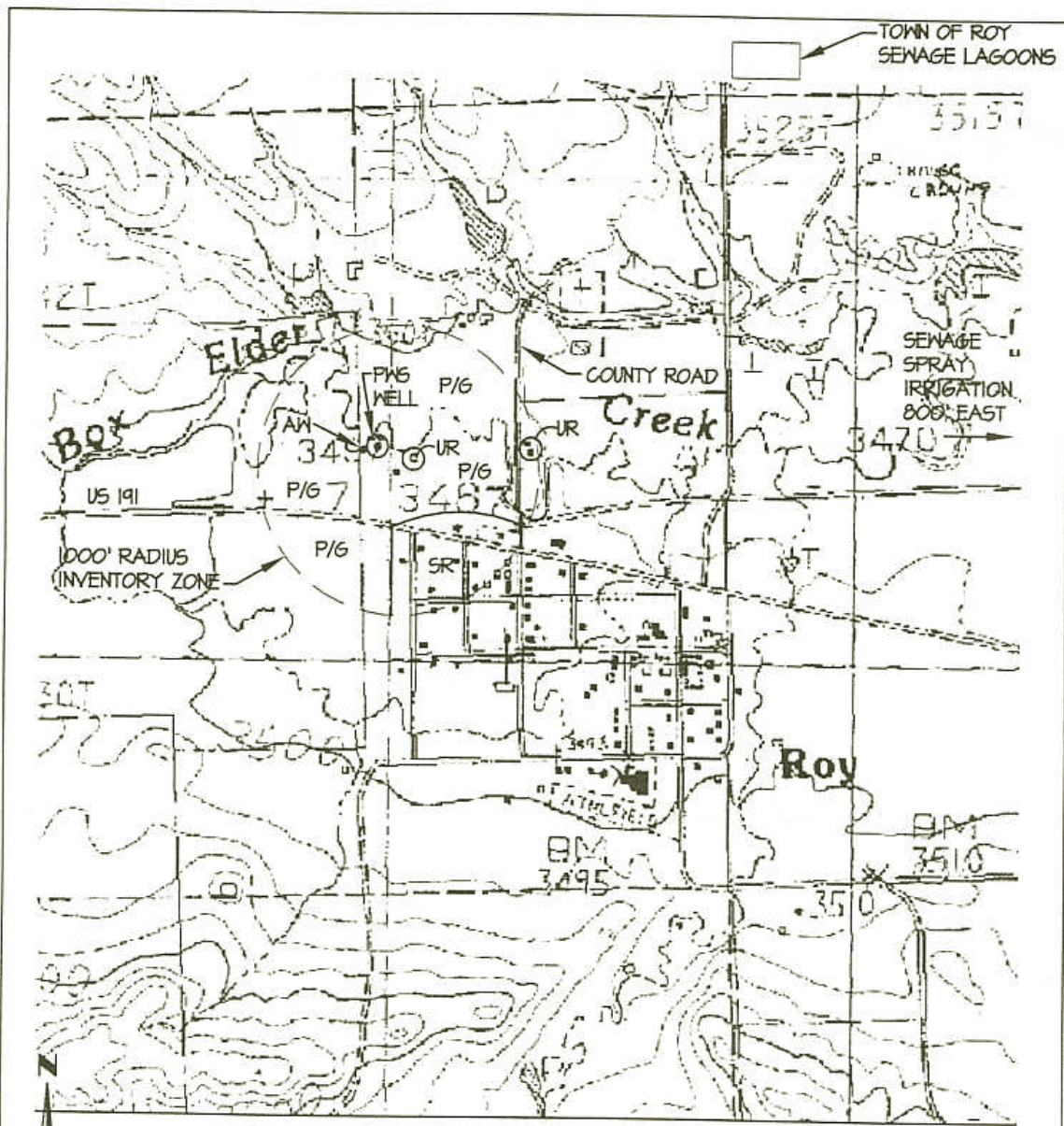
APPENDIX

- Roy Well PWS Plan
- Roy Well Inventory Zone
- Groundwater Top of Eagle Formation and Direction Flow Map
- Well Logs
 - ❖ Roy School District No. 74, GWIC ID: 179757
 - ❖ Bowser Jim, 4 MI SE Roy MT, GWIC ID: 2190
 - ❖ Horyna James, 6 MI E Roy MT, GWIC ID: 2189

TOWN OF ROY WELL SITE



NOTE: ALL BUILDINGS, STRUCTURES ETC. SHOWN



LEGEND

- UR UNSEWERED RESIDENCE (SEPTIC/DRAINFIELD)
- SR SEWERED RESIDENCE (COMMUNITY SYSTEM)
- P/G PASTURE & GRAZING
- ⊙ NEW & EXISTING PWS WELL
- ◻ ABANDONED WELL (SHALLOW)
- (---) INVENTORY ZONE

ENGINEERS
PLANNERS
DESIGNERS



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ROY WELL
INVENTORY ZONE

DRAWING #
EXHIBIT I

**Montana Bureau of Mines and Geology
Ground-water Information Center Site Report
ROY SCHOOL DISTRICT NO. 74**

Plot this site on a topographic map

Location Information

GWIC Id: 179757	Source of Data: LOG
Location (TRS): 18N 22E 07 DD	Latitude (dd): 47.3307
County (MT): FERGUS	Longitude (dd): -108.9546
DNRC Water Right: Not Reported	Geomethod: TRS-TWN
PWS Id:	Datum: 1927
Block: Not Reported	Addition: Not Reported
Lot: Not Reported	Type of Site: WELL
Certificate of Survey: Not Reported	

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

Total Depth (ft): 1411.00	How Drilled: ROTARY
Static Water Level (ft): .00	Driller's Name: SINGLEY
Pumping Water Level (ft): 160.00	Driller License: WWC019
Yield (gpm): 15.00	Completion Date: Apr 22, 1965
Test Type: PUMPING	Special Conditions: DEEPENED
Test Duration: 24.00	Is Well Flowing?: No
Drill Stem Setting (ft):	Shut-In Pressure:
Recovery Water Level (ft):	Well/Water Use: PUBLIC WATER SUPPLY
Recovery Time (hrs): .00	Geology/Aquifer: Not Reported

Hole Diameter Information

From (ft)	To (ft)	Dia (in)
0.0	505.0	5.5
505.0	1010.0	5.0
1010.0	1411.0	4.0

Casing Information

From (ft)	To (ft)	Dia (in)	Description
-1.0	510.0	4.5	6.7 LB STEEL
470.0	1288.0	2.0	GALV. PIPE

Annular Seal Information

From (ft)	To (ft)	Description
0.0	510.0	CEMENT

Completion Information

From (ft)	To (ft)	Dia (in)	Description
1288.0	1411.0	4.0	OPEN HOLE

Lithology Information

From (ft)	To (ft)	Description
0.0	2.0	TOPSOIL
2.0	6.0	YELLOW CLAY
6.0	16.0	GRAVEL
16.0	30.0	LIGHT BLUE SHALE AND CLAY
30.0	60.0	LAYERS OF SANDY ROCK AND SHALE. SMALL AMOUNT OF WATER.
60.0	90.0	LIGHT BLUE SHALE AND CLAY
90.0	130.0	LIGHT GRAY SHALE. BROWN TINT
130.0	180.0	ROCK AND SANDSTONE. SMALL AMOUNT OF WATER AT 130-140 AND AT 170-180.

180.0 182.0 WELL DEEPENED - SHALE
182.0 199.0 COAL AND SHALE
199.0 206.0 HARD SANDSTONE
206.0 207.0 COAL
207.0 270.0 SANDSTONE
270.0 275.0 COAL AND SANDSTONE
275.0 295.0 WHITE SANDSTONE
295.0 318.0 SHALE
318.0 320.0 COAL
320.0 330.0 SHALE
330.0 360.0 SANDY SHALE AND ROCK
360.0 385.0 SAND ROCK
385.0 470.0 SHALE - BROWN AND WHITE SPECKED
470.0 475.0 SANDSTONE - CLAY
475.0 530.0 BROWN AND WHITE GRAY SHALES
530.0 537.0 HARD ROCK
537.0 540.0 BROWN SHALE
540.0 541.0 ROCK
541.0 630.0 SHALE
630.0 647.0 LIGHT BLUE SANDSTONE
647.0 695.0 SHALE
695.0 700.0 BENTONITE AND SHALE
700.0 872.0 SHALE
872.0 873.0 HARD ROCK
873.0 900.0 SHALE AND BENTONITE
900.0 901.0 ROCK
901.0 950.0 SHALE
950.0 951.0 ROCK
951.0 986.0 SHALE
986.0 987.0 ROCK
987.0 1010.0 SHALE
1010.0 1013.0 ROCK
1013.0 1063.0 SANDY SHALE
1063.0 1064.0 ROCK
1064.0 1106.0 SANDY SHALE
1106.0 1111.0 BENTONITE
1111.0 1145.0 SANDY SHALE
1145.0 1170.0 SHOW OF GAS - SANDY SHALE
1170.0 1171.0 HARD SILICATE SAND
1171.0 1217.0 ROCK
1217.0 1374.0 SAND ROCK AND WATER
1374.0 1411.0 SHALE AND STREAKS BENTONITE

Site Notes

WELL FOR TEACHERAGES

Well Notes

WELL ORIGINALLY DRILLED IN 1954. CASING DRIVEN TO 130 FEET. WELL DEEPENED TO 1411 FEET IN 1965

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180.0 182.0 WELL DEEPENED - SHALE
182.0 199.0 COAL AND SHALE
199.0 206.0 HARD SANDSTONE
206.0 207.0 COAL
207.0 270.0 SANDSTONE
270.0 275.0 COAL AND SANDSTONE
275.0 295.0 WHITE SANDSTONE
295.0 318.0 SHALE
318.0 320.0 COAL
320.0 330.0 SHALE
330.0 360.0 SANDY SHALE AND ROCK
360.0 385.0 SAND ROCK
385.0 470.0 SHALE - BROWN AND WHITE SPECKED
470.0 475.0 SANDSTONE - CLAY
475.0 530.0 BROWN AND WHITE GRAY SHALES
530.0 537.0 HARD ROCK
537.0 540.0 BROWN SHALE
540.0 541.0 ROCK
541.0 630.0 SHALE
630.0 647.0 LIGHT BLUE SANDSTONE
647.0 695.0 SHALE
695.0 700.0 BENTONITE AND SHALE
700.0 872.0 SHALE
872.0 873.0 HARD ROCK
873.0 900.0 SHALE AND BENTONITE
900.0 901.0 ROCK
901.0 950.0 SHALE
950.0 951.0 ROCK
951.0 986.0 SHALE
986.0 987.0 ROCK
987.0 1010.0 SHALE
1010.0 1013.0 ROCK
1013.0 1063.0 SANDY SHALE
1063.0 1064.0 ROCK
1064.0 1106.0 SANDY SHALE
1106.0 1111.0 BENTONITE
1111.0 1145.0 SANDY SHALE
1145.0 1170.0 SHOW OF GAS - SANDY SHALE
1170.0 1171.0 HARD SILICATE SAND
1171.0 1217.0 ROCK
1217.0 1374.0 SAND ROCK AND WATER
1374.0 1411.0 SHALE AND STREAKS BENTONITE

Site Notes

WELL FOR TEACHERAGES

Well Notes

WELL ORIGINALLY DRILLED IN 1954. CASING DRIVEN TO 130 FEET. WELL DEEPENED TO 1411 FEET IN 1965

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is retransmitted. Note: non-reported casing, completion, and lithologic records may exist in paper files at GWIC.

**Ground-Water Information Center
Internet Information Services Water Quality Report
BOWSER JIM * 4 MI SE ROY MT.**

Compare to water-quality standards

Sample Id / Site Id:1979Q3276 / 2190
Location (TRS):18N 22E 27 BBD
Latitude/Longitude:47° 17' 48" N 108° 54' 24" W
Datum:NAD27
Altitude:3475.00
County/State:FERGUS / MT
Site Type:WELL
Geology:211EGLE
USGS 7.5' Quad:LEWISTOWN
Project Code(s):NR
Drainage Basin:ED

Sample Date:08/16/1979
Agency/Sampler:USGS / LMU
Field Number:
Lab Date:04/18/1980
Lab/Analyst:MBMG / FNA
Sample Method/Handling:FLOW COMPOSITE / 5230
Procedure Type:DISSOLVED
PWS Id:
Total Depth (ft):690.00
Depth Water Enters:447.0 ft BGS
SWL (ft below MP):

Cations mg/L meq/L		Anions mg/L meq/L	
Calcium (Ca)	279.00 13.92	Bicarbonate (HCO ₃)	389.00 6.38
Magnesium (Mg)	144.00 11.85	Carbonate (CO ₃)	11.50 0.38
Sodium (Na)	107.00 4.65	Chloride (Cl)	6.20 0.17
Potassium (K)	10.00 0.26	Sulfate (SO ₄)	1200.00 25.00
Iron (Fe)	14.60 0.78	Nitrate (as N)	<.023 0.00
Manganese (Mn)	0.08 0.00	Fluoride (F)	0.45 0.02
Silica (SiO ₂)	10.30	Ortho-Phosphate (OPO ₄)	NR 0.00
Total Cations	31.52	Total Anions	31.95

Trace Element Results (µg/L)

Aluminum (Al):	NR	Cadmium (Cd):	NR	Mercury (Hg):	NR	Tin (Sn):	NR
Antimony (Sb):	NR	Chromium (Cr):	NR	Molybdenum (Mo):	NR	Titanium (Ti):	NR
Arsenic (As):	NR	Cobalt (Co):	NR	Nickel (Ni):	NR	Thallium (Tl):	NR
Barium (Ba):	90.00	Copper (Cu):	NR	Silver (Ag):	NR	Uranium (U):	NR
Beryllium (Be):	NR	Lead (Pb):	NR	Selenium (Se):	<.1	Vanadium (V):	NR
Boron (B):	110.00	Lithium (Li):	170.00	Strontium (Sr):	1800.00	Zinc (Zn):	NR
Bromide (Br):	NR					Zirconium (Zr):	NR

Field Chemistry and Other Analytical Results

**Total Dissolved Solids:	1974.76	Field Alkalinity as CaCO ₃ :	NR	Langlier Saturation Index:	1.83
**Sum of Diss. Constituents:	2172.13	Alkalinity as CaCO ₃ :	338.23	Ammonia (mg/L):	NR
Field Conductivity (µmhos):	2500.00	Field Nitrate (mg/L):	NR	T.P. Hydrocarbons (µg/L):	NR
Lab Conductivity (µmhos):	2198.00	Nitrite (mg/L as N):	NR	Field Dissolved O ₂ (mg/L):	NR
Field pH:	7.00	Water Temp (°C):	NR	PCP (µg/L):	NR
Lab pH:	8.36	Air Temp (°C):	NR	Phosphate, TD (mg/L as P):	NR
Field Hardness as CaCO ₃ :	NR	Ryznar Stability Index:	4.69	Field Chloride (mg/L):	NR
Hardness as CaCO ₃ :	1289.37	Sodium Adsorption Ratio:	1.30	Field Redox (mV):	NR

Sample Condition: NONE.

Field Remarks: BUREAU FUND NO. 115 * NGP * FILTERED/ACIDIFIED FOR CATIONS * SULFIDE TEST *

Lab Remarks: NONE.

Explanation: mg/L = milligrams per Liter; µg/L = micrograms per Liter; meq/L = milliequivalents per Liter; ft = feet; NR = No Reading in GWIC

Qualifiers: A = Hydride atomic absorption; E = Estimated due to interference; H = Exceeded holding time; K = Na+K combined; N = Spiked sample recovery not within control limits; P = Preserved sample; S = Method of standard additions; * = Duplicate analysis not within control limits; ** = Sum of Dissolved Constituents is the sum of major cations (Na, Ca, K, Mg, Mn, Fe) and anions (HCO₃, CO₃, SO₄, Cl, SiO₃, NO₃, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

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**Montana Bureau of Mines and Geology
Ground-water Information Center Site Report
HORYNA JAMES * 6 MI E ROY MT**

[Plot this site on a topographic map](#)
[View Water Quality for this Site](#)

Location Information

GWIC Id: 2189	Source of Data: LOG
Location (TRS): 18N 22E 01 AAC	Latitude (dd): 47.3533
County (MT): FERGUS	Longitude (dd): -108.8513
DNRC Water Right: Not Reported	Geomethod: Not Reported
PWS Id:	Datum: 1927
Block: Not Reported	Addition: Not Reported
Lot: Not Reported	Type of Site: WELL
Certificate of Survey: Not Reported	

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

Total Depth (ft): 2005.00	How Drilled: FORWARD ROTARY
Static Water Level (ft): 120.00	Driller's Name: SINGLEY
Pumping Water Level (ft): 200.00	Driller License: 19
Yield (gpm): 55.00	Completion Date: Mar 04, 1974
Test Type: AIR	Special Conditions: None Reported
Test Duration: 2.00	Is Well Flowing?: No
Drill Stem Setting (ft):	Shut-In Pressure:
Recovery Water Level (ft):	Well/Water Use: DOMESTIC
Recovery Time (hrs):	Geology/Aquifer: 211EGLE

Hole Diameter Information

No hole diameter records were found.

Casing Information**From (ft) To (ft) Dia (in) Description**

-1.0	1308.0	4.0	STEEL
1280.0	2005.0	2.0	STEEL

Annular Seal Information**From (ft) To (ft) Description**

0.0	140.0	CEMENT
-----	-------	--------

Completion Information**From (ft) To (ft) Dia (in) Description**

1860.0	2005.0	0.0	PERFORATED CASING
--------	--------	-----	-------------------

Lithology Information

From (ft)	To (ft)	Description
0.0	6.0	GRAVEL
6.0	60.0	SURFACE DRIFT CLAY ROCKS
60.0	778.0	BEAR PAW SHALE
778.0	1300.0	JUDITH RIVER FORMATION
1300.0	1860.0	CLAGGETT SHALE
1860.0	1995.0	EAGLE SANDSTONE WATER
1995.0	2005.0	COLORADO SHALE

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**Ground-Water Information Center
Internet Information Services Water Quality Report
HORYNA JAMES * 6 MI E ROY MT**

Compare to water-quality standards

Sample Id / Site Id: 1979Q3225 / 2189
Location (TRS): 18N 22E 01 AAC
Latitude/Longitude: 47° 21' 12" N 108° 51' 05" W
Datum: NAD27
Altitude: 3420.00
County/State: FERGUS / MT
Site Type: WELL
Geology: 211EGLE
USGS 7.5' Quad: LEWISTOWN
Project Code(s): NR
Drainage Basin: ED

Sample Date: 08/19/1979
Agency/Sampler: USGS / PMD
Field Number:
Lab Date: 02/27/1980
Lab/Analyst: MBMG / FNA
Sample Method/Handling: GRAB / 523
Procedure Type: DISSOLVED
PWS Id:
Total Depth (ft): 2005.00
Depth Water Enters: 1860.0 ft BGS
SWL (ft below MP):

Cations mg/L meq/L			Anions mg/L meq/L		
Calcium (Ca)	1.90	0.09	Bicarbonate (HCO ₃)	398.00	6.52
Magnesium (Mg)	0.40	0.03	Carbonate (CO ₃)	34.60	1.15
Sodium (Na)	366.00	15.92	Chloride (Cl)	4.30	0.12
Potassium (K)	1.20	0.03	Sulfate (SO ₄)	415.00	8.64
Iron (Fe)	0.13	0.01	Nitrate (as N)	0.03	0.00
Manganese (Mn)	<.01	0.00	Fluoride (F)	0.36	0.02
Silica (SiO ₂)	16.60		Ortho-Phosphate (OPO ₄)	NR	0.00
Total Cations	16.10		Total Anions	16.46	

Trace Element Results (µg/L)

Aluminum (Al):	NR	Cadmium (Cd):	NR	Mercury (Hg):	NR	Tin (Sn):	NR
Antimony (Sb):	NR	Chromium (Cr):	NR	Molybdenum (Mo):	NR	Titanium (Ti):	NR
Arsenic (As):	NR	Cobalt (Co):	NR	Nickel (Ni):	NR	Thallium (Tl):	NR
Barium (Ba):	70.00	Copper (Cu):	NR	Silver (Ag):	NR	Uranium (U):	NR
Beryllium (Be):	NR	Lead (Pb):	NR	Selenium (Se):	<.1	Vanadium (V):	NR
Boron (B):	140.00	Lithium (Li):	54.00	Strontium (Sr):	160.00	Zinc (Zn):	NR
Bromide (Br):	NR					Zirconium (Zr):	NR

Field Chemistry and Other Analytical Results

**Total Dissolved Solids:	1036.58	Field Alkalinity as CaCO ₃ :	NR	Langlier Saturation Index:	0.54
**Sum of Diss. Constituents:	1238.52	Alkalinity as CaCO ₃ :	384.14	Ammonia (mg/L):	NR
Field Conductivity (µmhos):	1600.00	Field Nitrate (mg/L):	NR	T.P. Hydrocarbons (µg/L):	NR
Lab Conductivity (µmhos):	1586.00	Nitrite (mg/L as N):	NR	Field Dissolved O ₂ (mg/L):	NR
Field pH:	9.42	Water Temp (°C):	18.40	PCP (µg/L):	NR
Lab pH:	9.18	Air Temp (°C):	NR	Phosphate, TD (mg/L as P):	NR
Field Hardness as CaCO ₃ :	NR	Ryznar Stability Index:	8.09	Field Chloride (mg/L):	NR
Hardness as CaCO ₃ :	6.39	Sodium Adsorption Ratio:	63.00	Field Redox (mV):	NR

Sample Condition: NONE.

Field Remarks: BUREAU FUND NO. 115 * NGP * FILTERED/ACIDIFIED FOR CATIONS *

Lab Remarks: NO RA SAMPLE FOR FETRM * SE RUN ON FILTERED SAMPLE *

Explanation: **mg/L** = milligrams per Liter; **µg/L** = micrograms per Liter; **meq/L** = milliequivalents per Liter; **ft** = feet; **NR** = No Reading in GWIC

Qualifiers: **A** = Hydride atomic absorption; **E** = Estimated due to interference; **H** = Exceeded holding time; **K** = Na+K combined; **N** = Spiked sample recovery not within control limits; **P** = Preserved sample; **S** = Method of standard additions; * = Duplicate analysis not within control limits; ** = Sum of Dissolved Constituents is the sum of major cations (Na, Ca, K, Mg, Mn, Fe) and anions (HCO₃, CO₃, SO₄, Cl, SiO₃, NO₃, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

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Appendix B
Roy School Well Logs and Water Quality

**Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
ROY CITY PARK**

Location Information

GWIC Id: 149779	Source of Data: INV
Location (TRS): 18N 22E 07 DBAA	Latitude (dd): 47.3355
County (MT): FERGUS	Longitude (dd): -108.9583
DNRC Water Right:	Geomethod: MAP
PWS Id:	Datum: NAD27
Block:	Altitude (feet): 3487.00
Lot:	Certificate of Survey:
Addition:	Type of Site: WELL

Well Construction and Performance Data

Total Depth (ft): 5.30	How Drilled:
Static Water Level (ft): 3.03	Driller's Name:
Pumping Water Level (ft):	Driller License:
Yield (gpm):	Completion Date (m/d/y):
Test Type:	Special Conditions: UNUSED
Test Duration:	Is Well Flowing?:
Drill Stem Setting (ft):	Shut-In Pressure:
Recovery Water Level (ft):	Geology/Aquifer: 110ALVM
Recovery Time (hrs):	Well/Water Use: Not Reported
Well Notes:	

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information¹

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
-2.1	5.3	8.0				CULVERT

Annular Seal Information

No Seal Records currently in GWIC.

Completion Information¹

No Completion Records currently in GWIC.

Lithology Information

No Lithology Records currently in GWIC.

¹ - All diameters reported are **inside** diameter of the casing.

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Location Information

Sample Id/Site Id: 2004Q0598 / 149779
Location (TRS): 18N 22E 07 DBAA
Latitude/Longitude: 47° 20' 7" N 108° 57' 29" W
Datum: NAD27
Altitude: 3487.00
County/State: FERGUS / MT
Site Type: WELL
Geology: 110ALVM
USGS 7.5' Quad: ROY 7 1/2'
PWS Id:
Project: GWAAMON

Sample Date: 6/16/2004 4:20:00 PM
Agency/Sampler: MBMG / CWS
Field Number:
Lab Date: 8/30/2004
Lab/Analyst: MBMG / WO
Sample Method/Handling: / 5230
Procedure Type: DISSOLVED
Total Depth (ft): 5.300
SWL-MP (ft): NR
Depth Water Enters (ft): NR

Major Ion Results

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	182.000	9.082	Bicarbonate (HCO3)	439.200	7.198
Magnesium (Mg)	114.000	9.381	Carbonate (CO3)	0.000	0.000
Sodium (Na)	177.000	7.700	Chloride (Cl)	22.100	0.623
Potassium (K)	5.100	0.130	Sulfate (SO4)	900.000	18.747
Iron (Fe)	9.060	0.487	Nitrate (as N)	<0.50 P	0.000
Manganese (Mn)	0.621	0.023	Fluoride (F)	0.876	0.046
Silica (SiO2)	6.270		Orthophosphate (OPO4)	<0.50	0.000
Total Cations		27.419	Total Anions		26.615

Trace Element Results (µg/L)

Aluminum (Al):	32.000	Cadmium (Cd):	<1	Mercury (Hg):	NR	Tin (Sn):	NR
Antimony (Sb):	<10	Chromium (Cr):	<10	Molybdenum (Mo):	<50	Titanium (Ti):	<1
Arsenic (As):	<5	Cobalt (Co):	5.120	Nickel (Ni):	20.700	Thallium (Tl):	<25
Barium (Ba):	29.900	Copper (Cu):	<5	Silver (Ag):	<5	Uranium (U):	6.510
Beryllium (Be):	<2	Lead (Pb):	<10	Selenium (Se):	<5	Vanadium (V):	<25
Boron (B):	241.000	Lithium (Li):	161.000	Strontium (Sr):	3,358.000	Zinc (Zn):	16,801.000
Bromide (Br):	<500					Zirconium (Zr):	<10

Field Chemistry and Other Analytical Results

**Total Dissolved Solids:	1,650.210	Field Hardness as CaCO3:	NR	Ammonia (mg/L):	N
**Sum of Diss. Constituents:	1,873.060	Hardness as CaCO3:	923.680	T.P. Hydrocarbons (µg/L):	N
Field Conductivity (µmhos):	2,040.000	Field Alkalinity as CaCO3:	NR	PCP (µg/L):	N
Lab Conductivity (µmhos):	2,020.000	Akalinity as CaCO3:	360.220	Phosphate, TD (mg/L as P):	<0.0
Field pH:	7.610	Ryznar Stability Index:	5.587	Field Nitrate (mg/L):	1.00
Lab pH:	7.780	Sodium Adsorption Ratio:	2.530	Field Dissolved O2 (mg/L):	N
Water Temp (°C):	11.100	Langlier Saturation Index:	1.097	Field Chloride (mg/L):	N
Air Temp (°C):	24.000	Nitrite (mg/L as N):	NR	Field Redox (mV):	N

Notes

Explanation: mg/L = milligrams per Liter; µg/L = micrograms per Liter; ft = feet; NR = No Reading in GWIC

Qualifiers: A = Hydride atomic absorption; E = Estimated due to interference; H = Exceeded holding time; K = Na+K combined; N = Spiked sample recovery not within control limits; P = Preserved sample; S = Method of standard additions; * = Duplicate analysis not within control limits; ** = Sum of Dissolved Constituents is the sum of major cations (Na, Ca, K, Mg, Mn, Fe) and anions (HCO3, CO3, SO4, Cl, SiO2, NO3, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

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Appendix C
The Town of Roy's Sewer Map

Appendix D
List of Potential Contaminant Sources

DEQ UST List

<http://www.deq.state.mt.us/UST/USTDownloads.asp>

Notes:

Active USTs have usually been upgraded to 1998 standards (which includes leak detection and monitoring) Spills or improper handling during tank filling or product distribution at these facilities may impact the drinking water supply.

DEQ classifies inactive USTs as temporarily out of service and requires that the product in the tank be removed. However, testing of the tanks, distribution lines or soils around the tank is not required to evaluate the potential for historic leaks or spills that may impact subsurface soils and groundwater.

Alt Facility ID	Facility Name	Facility Location Address	City	County	Active Tanks	Non-active Tanks
14-07569	Bohemian Corner	SR-19 & US-191	Roy	Fergus		5
14-02512	Bowser Grain & Livestock Inc	6 1/4 miles SE of Roy 34-18-22	Roy	Fergus		6
14-08123	Box Elder Ranch	10 miles SW of Roy	Roy	Fergus		5
14-12716	G S Oil Co	Block Butte Rd PO Box 149	Roy	Fergus		3
14-09129	Malmstrom AFB 0 1	US-191	Roy	Fergus	1	
14-09131	Malmstrom AFB 0 3	US-191	Roy	Fergus	1	1
14-09133	Malmstrom AFB 0 5	SR-19	Roy	Fergus	1	1
14-09135	Malmstrom AFB 0 7	US-191	Roy	Fergus	1	1
14-09138	Malmstrom AFB O 10	US-191	Roy	Fergus	1	1
14-09139	Malmstrom AFB O 11	US-191	Roy	Fergus	1	1
14-09130	Malmstrom AFB O 2	US-191	Roy	Fergus	1	1
14-09132	Malmstrom AFB O 4	SR-19	Roy	Fergus	1	1
14-09134	Malmstrom AFB O 6	SR-19	Roy	Fergus	1	1
14-04064	MDOT Roy Mobridge Site	MP 86.8 on US-191 RR 61	Roy	Fergus		5
14-04063	MDOT Roy Section	MP 35.6 on US-191 RR 43	Roy	Fergus		3
14-08360	Puckett Ranch	2 miles SW of Roy	Roy	Fergus		1
14-09397	Ralph Willmore	River Rte	Roy	Fergus		2
14-05110	Rindal Oil Co Roy	5 miles W of Roy US-191	Roy	Fergus		2
14-03082	Roy Public School	PO Box 9	Roy	Fergus		3
14-02305	Sand Creek Wildlife Station	US-191 By Fred Robinson Brdg	Roy	Fergus		5
14-06761	Wytana Livestock Co	PO Box 88	Roy	Fergus		4

DEQ LUST List

<http://www.deq.state.mt.us/UST/USTDownloads.asp>

City	Site Name	Location	AltEventID	Date	Confirmed Release Date	Project Officer	Active
Roy	Bohemian Corner	SR-19 & US-191	1407569*4203	26-Apr-99	26-Apr-99		No
Roy	Box Elder Ranch		1408123*1847	16-Sep-93	16-Sep-93		No
Roy	G S Oil Co	Cowan St	1412716*3981	24-Dec-90	24-Dec-90	William Hammer	Yes
Roy	MDOT Mobridge Site	MP 86.8 on US-191	1404064*323	09-May-90	09-May-90		No
Roy	Roy	Roy	3737	24-Dec-90	24-Dec-90		No
Roy	Sand Creek Wildlife Station	US-191 By Fred Robinson Brdg	1402305*2356	04-Oct-94	04-Oct-94		No
Roy	USAF Lcf 0 1	US-191	1409129*660	22-Mar-91	21-Mar-91		No

Appendix E
Monitoring Waivers

MONITORING WAIVERS

Waiver Recommendation

The Roy Water and Sewer District PWS has a waiver for Phase 2 inorganics (which includes barium, cadmium, chromium, fluoride, mercury and selenium). The waiver allows the PWS to collect one sample round for these constituents every 9-year cycle (the standard is one sample round per 3-year cycle). Based on past monitoring results and the susceptibility assessment, the Roy Water and Sewer District PWS may be eligible for other waivers as well, including Phase 5 inorganics and volatile organic compounds. Information on susceptibility and use waivers is provided in this section to give the PWS operators an opportunity to consider if waivers may be feasible.

Before a susceptibility or use waiver is requested, the PWS Operators are encouraged to carefully review the Monitoring Waiver Requirements, described below. If after reviewing this section it is determined that an additional waivers are feasible, the PWS should submit a letter to DEQ requesting the specific monitoring waivers. The PWS must be in compliance with monitoring requirements to be considered. If requested by DEQ, the PWS may also need to provide additional information regarding chemical use in the area within the Inventory Region. The table below shows how identified potential contaminant sources affect the eligibility for monitoring waivers.

Susceptibility Assessment as it relates to Waiver Eligibility

Source	Contaminant	Susceptibility	Waiver Eligibility
Transportation Corridors	VOCs, SOCs, petroleum products and other chemicals	Low to Moderate	Chemical use in right-of-way may preclude waivers for some chemicals. PWS should confirm chemical use history along the right-of-way. Waivers might be rescinded if a spill occurred.
Sewer System/ Septic System	Nitrates, pathogens	Low to Moderate	Waivers are not available for pathogens and nitrate.
Grazing/Pasture Land	Nitrates, pathogens	Low to Moderate	.Waivers are not available for pathogens and nitrate.

Monitoring Waiver Requirements

The 1986 Amendments to the Safe Drinking Water Act require that community and non-community PWSs sample drinking water sources for the presence of volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). The US EPA has authorized states to issue monitoring waivers for organic chemicals to systems that have completed an approved waiver application and review process. All PWSs in the State of Montana are eligible for consideration of monitoring waivers for several organic chemicals. The chemicals diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB), dibromochloropropane (DBCP), and polychlorinated biphenyls (PCBs) are excluded from monitoring requirements by statewide waivers.

Use Waivers

A Use Waiver can be allowed if through a vulnerability assessment, it is determined that specific organic chemicals were not used, manufactured, or stored in the area of a water source (or source area). If certain organic chemicals have been used, or if the use is unknown, the system would be determined to be vulnerable to organic chemical contamination and ineligible for a Use Waiver for those particular contaminants.

Susceptibility Waivers

If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a vulnerability assessment it is demonstrated that the water source would not be susceptible to contamination. The purpose of the vulnerability assessment procedures outlined in this section is to determine which of the organic chemical contaminants are in the area of investigation. The vulnerability assessment of a surface water source must consider the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the surface water intake. PWSs developed in unconfined aquifers should use a minimum fixed radius of one mile as an area of investigation for the use of organic chemicals. Vulnerability assessment of spring water sources should use a minimum fixed radius of one mile as an area of investigation for the use of organic chemicals. Surface water and shallow groundwater sources under the direct influence of surface water (GWUDISW) should assess the watershed area above the source, or a minimum fixed radius of one and one-half miles upgradient.

Given the wide range of landforms, land uses, and the diversity of groundwater and surface water sources across the state, additional information is often required during the review of a waiver application. Additional information may include well logs, pump test data, water quality monitoring data from surrounding public water systems, delineation of zones of influence and contribution to a well; time-of-travel or attenuation studies; vulnerability mapping; and the use of computerized groundwater flow and transport models. DEQ's PWS Section and DEQ's Source Water Protection Program will conduct review of an organic chemical monitoring waiver application. Other state agencies may be asked for assistance.

Susceptibility Waiver for Unconfined Aquifers

Unconfined aquifers are the most common source of usable groundwater. Unconfined aquifers are not contained within impervious geologic strata. As a result, the upper groundwater surface, or water table, in an unconfined aquifer is not under the pressure that produces hydrostatic head common to confined aquifers.

Unconfined aquifers are usually locally recharged from surface water or precipitation. In general, groundwater flow gradients in unconfined aquifers reflect surface topography, and the residence time of water in the aquifer is generally shorter than for water in confined aquifers. Similar water chemistry often exists between unconfined groundwater and area surface water, and physical parameters and dissolved constituents can be an indicator of the hydraulic connection between groundwater and surface water. Consequently, unconfined aquifers can be susceptible to contamination by organic chemicals migrating from the ground surface to groundwater.

Properly assessing a susceptibility waiver application for an unconfined source aquifer requires: site-specific information pertaining to the location and construction of the source development, monitoring history of the source, geologic characteristics of the unsaturated soil and vadose zones, and chemical characteristics of the organic chemicals pertaining to their mobility and persistence in the environment. The zone of contribution of the unconfined groundwater source must be defined and plotted. This should describe the groundwater flow directions, gradients, and a 3-year time-of-travel. All surface water bodies within 1,000 feet of the PWS well(s) must be plotted. Analytical monitoring history of the PWS well and those nearby should be provided as well.

Susceptibility Waiver for Confined Aquifers

Confined groundwater is isolated from overlying material by relatively impermeable geologic units. A confined aquifer is generally subject to pressures greater than atmospheric pressure. A well that is screened in a confined aquifer will have a static water level that determined by the pressure (hydrostatic head) at the top of the aquifer.

The susceptibility of a confined aquifer relates to the probability of an introduced contaminant to travel from the source of contamination to the aquifer. Important hydrogeologic controls include the depth of the aquifer, the permeability of the soil and vadose zones, the thickness and uniformity of low permeability and confining layers between the surface and the aquifer, and hydrostatic head of the aquifer.

A confined aquifer may eventually be affected by contaminated groundwater from elsewhere in the recharge area. Improper well construction or abandonment can act as a hydraulic connection to the confined aquifer. The extent of confinement of an aquifer is critical to limiting susceptibility to organic chemical contamination. The extent of confinement must be demonstrated by the PWS in order to be considered for a confined aquifer susceptibility waiver. Typical information includes: pump test data (storage coefficient), geologic mapping, well logs, water quality history, and available information related to any other wells, active or abandoned, in the recharge region.

Appendix F
Concurrence Letter