

*Surprise Creek Ranch Colony*

*Source Water Delineation and Assessment Report*

11/99

*Surprise Creek Ranch Colony*

Public Water System

**PWSID # MT0000391**

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## **List of Acronyms**

BMP - Best Management Practices

CAFO - Confined Animal Feeding Operation

CECRA - Comprehensive Environmental Cleanup and Responsibility Act

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

LUST - Leaking Underground Storage Tank

MCL - Maximum Contaminant Level

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

MPDES - Montana Pollutant Discharge Elimination System

NPDES - National Pollutant Discharge Elimination System

PWS - Public Water System.

RCRA - Resource Conservation and Recovery Act

SMCL - Secondary Maximum Contaminant Levels

SWDAR - Source Water Delineation and Assessment Report.

SWPP - Source Water Protection Plan

SWL - Static Water Level

SOC - Synthetic Organic Compounds

TMDL - Total Maximum Daily Load

UST - Underground Storage Tank

VOC - Volatile Organic Compounds

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

## 1.0 INTRODUCTION

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

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

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

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

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

human error. Although voluntary, source water protection plans are the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate Surprise Creek Ranch Colony in developing a source water protection plans that meets their specific needs.

### **Scope and Purpose**

This report presents the source water delineation and assessments for the municipal public water supply for the Surprise Creek Ranch Colony public water supply. James Swierc, Hydrogeologist with the Montana Department of Environmental Quality, prepared this report. Assistance was provided by Sam Hofer, operator of the public water supply for the colony.

The Surprise Creek Ranch Colony is located in the northern part of Judith Basin County in central Montana. This report is intended to meet the technical requirements for the completion of the delineation and assessment report for this PWS, as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

### **Limitations**

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

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

## 2.0 BACKGROUND

### **The Community**

The Surprise Creek Ranch Hutterite Colony is located in Judith Basin County, in central Montana, as shown in [Figure 1](#). There are approximately 115 residents at the colony. The nearest town is Stanford (population 454), located approximately 5 miles east of the colony. The economy of the colony relies on the production of a variety of agricultural products.

The Colony complex comprises several residential buildings, a kitchen building, and several other facilities that support the agricultural activities at the colony. A map showing the layout of the colony is included with Appendix A. The colony PWS obtains water from a small spring located approximately 1.5 miles south of the colony. Two artesian wells located within the main colony complex are used for livestock, and reported in DEQ files as backup wells to the main spring source. Wastewater is treated in a lagoon located north of the main colony buildings, downgradient from all wells. Animal waste from the barns is stored in concrete pits, and is disposed by land application to cropland.

### **Geographic Setting**

Surprise Creek Ranch Colony is located in the foothills northeast of the Little Belt Mountains, on the southern edge of the Judith Basin. The mountains in this area represent a significant feature with peaks that rise over 4,000 feet above the plains. The Surprise Creek watershed is part of the Arrow Creek watershed (HUC #10040102) of the Lower Missouri River system in Montana. The Surprise Creek Watershed is classified as HUC #10040102020.

The climate is typical of central Montana, with precipitation averaging 16.74 inches a year as measured at the Stanford. The wettest months are May and June averaging 2.93 and 3.03 inches a monthly, respectively. The driest months are November through February, with monthly averages ranging from 0.45 to 0.68 inches per month. The temperature ranges from an average high of 80.8°F in August (minimum August average of 49.3°F) to an average of 35.6°F in January (minimum January average of 12.1°F).

### **General Description of the Source Water**

The Surprise Creek Ranch Colony water system obtains water from a spring source located approximately 1.5 miles south of the main colony complex. The hydrogeology of the system was recently summarized in Rose (2000). The source aquifer is interpreted to be the Cutbank Sandstone at the base of the Cretaceous Kootenai Formation. The aquifer is recharged in the area south of the spring where the sandstone is exposed to surface water infiltration from precipitation and stream loss. Ground water generally flows to the north, following topography away from the Little Belt Mountains.

### **The Public Water Supply**

The spring source for the PWS (Source 002) is located south of the main colony complex as shown in [Figure 1](#). Information on the PWS for Surprise Creek Ranch Colony is reviewed in a sanitary survey completed for the colony in September 1993. The information reported on the PWS is obtained from this report, DEQ records, and from information gathered during a site visit by the author. A copy of the sanitary survey is included in Appendix A. The water system for Surprise Creek Ranch Colony serves the resident population of 115 people through 14 active service connections located in the colony residential and other buildings. The general layout of the colony buildings and distribution system is depicted in Appendix A

[Figure 1](#) – *Location Map*

The following description is adapted from Rose (2000). The source spring is present on the southern side of the Surprise Creek drainage. A ranch access gravel road follows the south side of Surprise Creek at this location, uphill from the spring source. The spring discharge was estimated at approximately 10 gallons per minute (gpm) on February 18, 1998 when the system was visited by a representative of the Montana Bureau of Mines and Geology. Water flows from the spring into a four-foot diameter culvert set approximately five feet into the ground. The bottom two feet of the culvert are perforated for water to flow into the culvert, which then flows into a two-inch diameter PVC collection pipe.

The collected water from the culvert flows by gravity to a small building for chlorination, located approximately 1,500 feet from the spring source. Water is chlorinated for disinfection using a sodium-hypochlorite dispensing system. After chlorination, water flows by gravity to a 10,000 gallon concrete storage tank at the colony. Water from the storage tank is provided to the colony buildings using a 5 horsepower pump. Pressure is maintained in the system using four 50-gallon hydropneumatic pressure tanks.

**Water Quality**

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliforms (as an indicator of pathogenic organism), nitrates, metals and for multiple chemicals. The monitoring schedule depends on many factors such as the size and source water for a PWS, the number of sources (e.g. wells), and the population served. Each PWS has a specific monitoring program tailored to their system that follows the general protocols for operation of a PWS defined by DEQ. A review of the DEQ PWS database indicates that monitoring results for the Surprise Creek Ranch Colony PWS indicate problems with coliform contamination of the water supply (Appendix D). The most recent occurrence, in June 2000, resulted in a boil order for the use of the water by colony residents. Compliance with state and federal regulations was achieved on September 18, 2000.

There were no other violations or exceedences of drinking water quality standards. The only additional detected compound that is regulated is nitrate, which can occur naturally or from agricultural, human and animal waste. The health standard for nitrates, the MCL, is 10 mg/L. The monitoring results for the potable water supply indicate nitrate levels consistently less than 1.00 mg/L over the last five years.

The MBMG-GWIC database includes water quality data several wells around the Surprise Creek Colony Ranch. Three sets of data are from an artesian well at the Surprise Creek Ranch Colony. This well draws water from the Kootenai Formation, the same unit that is the source for the PWS spring (Rose, 2000). There is no published data available for the spring source. The data, summarized in Table 1, is considered representative of background concentrations of dissolved constituents in ground water in the area. Copies of the data sheets from MBMG-GWIC, which includes the results of trace element analyses, are included with Appendix C.

**Table 1 – Background Water Quality in Kootenai Formation, Surprise Creek Ranch Colony Area**

Sample Date	Ca	Mg	Na	K	Fe	Mn	SiO <sub>2</sub>	HCO <sub>3</sub>	CO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	OPO <sub>4</sub>	TDS	Hardness as CaCO <sub>3</sub>
8/4/2000	78.70	25.40	8.79	2.82	0.10	0.03	6.08	232.3	0	2.50	120.0	< 5.0	0.47	< 5.0	359.32	301.06
1995	77.20	25.40	7.30	2.90	0.02	0.02	6.50	217.6	0	3.00	112.5	< 0.25	0.61	< 0.1	342.65	297.31
6/24/80	55.20	16.60	6.10	1.90	0.31	0.06	6.80	199.0	0	3.50	53.80	0.02	0.50	--	242.82	206.16

All results listed in mg/L.

The well is located at T16N, R11E, Section 4 cddc, based on BLM Township-Range-Section system

NL – Not Listed. Data extracted from MBMG-GWIC internet database.

Analytes are: Ca – Calcium; Mg – Magnesium; Na – Sodium; K – Potassium; Fe – Iron, Mn – Manganese; SiO<sub>2</sub> – Silica

HCO<sub>3</sub> – Bicarbonate; CO<sub>3</sub> – Carbonate; Cl – Chloride; SO<sub>4</sub> – Sulfate; NO<sub>3</sub> – Nitrate; F – Fluoride; OPO<sub>4</sub> - Orthophosphate

TDS – Total Dissolved Solids

### 3.0 DELINEATION

The source water protection area, the land area that contributes water to Surprise Creek Ranch Colony PWS is identified in this chapter. Three management areas are identified within the source water protection area. These three regions, the control zone, inventory region, and recharge region, are delineated for the spring. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around the spring source collection box. The inventory region for the source aquifer is defined as the area within a 1,000 foot radius of the spring. The recharge region represents the area where the source aquifer for the Surprise Creek Ranch Colony water system source is replenished.

#### Hydrogeologic Studies

Communities within the Judith Basin typically obtain their water from surface flowing artesian wells from deep bedrock aquifers. Due to this condition, there have been several studies of the regional hydrogeology of the area. These can be summarized as follows:

- Perry, E.S., 1932. Ground-Water Resources of the Judith Basin, Montana. Montana Bureau of Mines and Geology Memoir 7
- Vine, J.D., 1956. Geology of the Stanford-Hobson Area, Central Montana. United States Geological Survey Bulletin 1027-J, p. 405-465.
- Zimmerman, E.A., 1966. Geology and Ground Water Resources of Western and Southern Parts of Judith Basin, Montana. Montana Bureau of Mines and Geology Bulletin 50-A.

More recently, the spring source for the PWS was evaluated by the Montana Bureau of Mines and Geology for a determination of the effects of surface water on the spring. A copy of this study is included in Appendix D. This study is summarized in:

- Rose, J., 2000. Hydrogeologic Assessment of the Surprise Creek Ranch Colony Water Supply for Ground Water Under the Direct Influence of Surface Water. Montana Bureau of Mines and Geology Open File Report MBMG 401-O.

The following discussion of the hydrogeology of the area is based primarily on information presented by Rose (2000), which included a review of conclusions derived by other geologic investigations in the area. A generalized geologic map of the area is included in [Figure 2](#).

#### Hydrogeologic Conditions

The Surprise Creek Ranch Colony is located in the foothills north of the Little Belt Mountains. Sedimentary Formations around the mountains, including those south of the colony, were tilted upwards by the mountains. As a result, older rock formations are present in the central part of the mountains with progressively younger rocks present moving away from the core. The rocks on the northern flank of the mountains in the area near Surprise Creek Ranch Colony all dip north under the Judith Basin. The Madison limestone, an important regional aquifer in central Montana, receives recharge where the rocks are exposed in the core of the Little Belt Mountains. Ground water in all of the aquifers in the area are interpreted to flow generally to the north into the Judith Basin. With recharge in the mountains, the major aquifers yield surface flowing artesian wells to communities in the Judith Basin.

The Kootenai Formation is the primary geologic unit exposed at the surface in the area near the Surprise Creek Colony. The spring source for the Surprise Creek Ranch Colony PWS yields water from the Cutbank Sandstone Member of the Kootenai Formation, a thick sandstone bed present at the base of the Kootenai Formation in the Judith Basin area. The wells at the Surprise Creek Ranch Colony are surface flowing artesian wells, believed to be screened in the same water bearing interval that is the source for the spring. While the

aquifer is regionally confined, the discharge from the spring results in unconfined conditions in the area proximal to the PWS source. Recharge to the Kootenai Formation is interpreted to occur from surface water infiltration and stream loss where the sandstone aquifers are exposed at the surface. The general dip of the rocks to the north results in the flowing artesian conditions, since the aquifer is at a lower elevation than where it is recharged. Ground water is interpreted to flow in a general northward direction within the Kootenai, similar to the regional system in the Madison Limestone. For a more thorough discussion of the local hydrogeology, the reader is referred to Rose (2000), located in Appendix D.

[Figure 2](#) – *Geologic Map of Study Area*

### Conceptual Model and Assumptions

A conceptual hydrogeologic model is a simplified representation of the hydrogeologic system. For the Surprise Creek Ranch Colony, water is derived from a spring that discharges from a locally confined aquifer. The aquifer is recharged to the south of the Colony where the Cutbank Sandstone Member of the Kootenai Formation is exposed at the surface. Ground water flows in a general northward direction following topography.

Based on the hydrogeologic setting, the Surprise Creek Ranch Colony water source is a spring source from a confined aquifer in sandstone bedrock. Since the source is a spring which has been classified as ground water under the direct influence of surface water (see Appendix B), the water source is considered to have a *high* source water sensitivity to contamination.

### Spring Information

The location of the spring source for the Surprise Creek Ranch Colony is depicted in [Figure 1](#). Information on this source is summarized in Table 2.

*Table 2 - Source Information for Surprise Creek Ranch Colony.*

Information	Spring Source
PWS Source Code	002
Spring Location (T, R, Sec)	T16N, R11E Sec 17 ABBA
Spring Location (lat, long)	47.1150°N Lat -110.3560°W Long
MBMG #	179775
Water Right #	<i>Not Reported</i>
Yield	10 gpm *

\* Yield estimated by MBMG in February 1999

### Delineation Methods and Criteria

The source water protection management zones for the spring source are delineated based on the criteria for

springs from confined aquifers outlined in the DEQ Source Water Protection program document (DEQ, 1999). This includes identification of a control zone, inventory zone and the recharge area for the spring.

### **Source Water Protection Management Zones**

The delineated management zones for the spring is depicted in [Figure 3](#). The control zone is established as the area within a 100 foot radius of the spring source. The inventory zone is delineated as the area within a 1,000 foot radius of the spring source. The recharge area is identified as the watershed areas for Surprise Creek, Sun Creek and Wolf Creek south of Surprise Creek Ranch Colony towards the Little Belt Mountains to the area where the Kootenai Formation is exposed within these watersheds. The watersheds are identified since the streams lose water to the Kootenai Formation aquifer when they flow over permeable bed.

### **Limiting Factors**

The nature of ground water flow within bedrock aquifers in a mountain setting limits the accuracy of any hydrogeologic assessment under these conditions. As a result, the ground water system is evaluated based on known and standardized principles of hydrogeology. The assessment presented in this document is based on published works; however, the actual ground water flow system may be significantly more complicated than presented here. Communication between the deeper regional Madison Limestone aquifer to shallower beds may occur along unmapped fault planes or other geologic structures. The delineations presented in this report are considered accurate and protective of the drinking water source by using conservative assumptions for interpretations regarding the nature of the hydrologic system.

[Figure 3](#) – *Source Water Protection Management Zones*

## 4.0 INVENTORY

An inventory of potential sources of contamination was conducted for the Surprise Creek Ranch Colony PWS within the delineated source water protection management regions. Potential sources of all primary drinking water contaminants and *Cryptosporidium* were identified, however, only significant potential contaminant sources were selected for detailed inventory. The significant potential contaminants in the Surprise Creek Ranch Colony PWS management regions are nitrates, pathogens, herbicides/pesticides and fertilizer from agricultural land. The ranch road near the spring source represents a potential hazard to potential spills or accidents above the spring.

### **Inventory Method**

The inventory for Surprise Creek Ranch Colony was obtained by visiting the colony, and discussing colony activities with representatives from the colony. Information on the PWS, land use, agricultural chemical storage and application, and waste disposal practices were identified at this time.

Urban and agricultural land uses were identified from the United State Geological Survey land use classification project (USGS, 2000). Major transportation routes through the area, including railroad lines, were also identified. This information is depicted in [Figure 4](#).

As part of the standard inventory process, the information in available databases on environmental sites was reviewed. EPA's Envirofacts System was queried to identify EPA regulated facilities located in the Inventory Region. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), Permit Compliance System (PCS) and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). DEQ Databases were queried to identify the following in the inventory region: Underground Storage Tanks (UST), hazardous waste contaminated sites (DEQ Hazardous Waste Cleanup Bureau), landfills, abandoned mines, and active mines including gravel pits. Any information on past releases and present compliance status was noted.

No facilities meeting these criteria were identified within any of the identified source water protection management zones.

### **Inventory Results/Inventory and Control Zones**

The potential contaminant sources identified for the control and inventory zones for the PWS spring are agricultural land use and the ranch access road. The significant potential contaminant sources are summarized in Table 3. The potential contaminant sources in the inventory zone include spilled fuels and other farm chemicals, and crop fertilizers and herbicides. The primary hazards are spills of chemicals or other wastes during transportation on the ranch road. Agricultural related hazards reflect accidental spills or releases of farm chemicals during transportation to the field for application and excess application of herbicides and runoff from the cropped areas,

The control zones around the spring source is partially fenced and protected representing a control measure to help prevent any contamination from livestock waste from infiltrating into the spring collection system.

### **Inventory Results/Recharge Region**

The recharge region is comprised of agricultural cropland, with some areas used for open range cattle grazing. Fertilizers, weed control herbicides and fuels for farm machinery are the primary contaminants of concern in the recharge region. An additional concern noted during the site visit was a controlled access facility of unknown type, perhaps a military or telecommunications installation, on top of the butte to the south overlooking the spring facility. There is a potential that fuels or other chemicals may be used or stored at this facility, which

may impact the spring source due to any accidental release. The potential impact may occur through infiltration into the spring aquifer, or due to surface runoff onto the spring site. The location of this potential source is depicted in [Figure 4](#).

***Table 3 - Significant Potential Contaminant Sources.***

Source	Hazard
<b><i>Control and Inventory Zones</i></b>	
Cropped Agricultural Land	Land application of animal waste spills and excess application of herbicides
Ranch Access Road	Accidental release of chemicals transported on the road.
<b><i>Recharge Area</i></b>	
Cropped Agricultural Land	Land Application of animal waste spills and excess application of herbicide
Unknown Controlled Access Facility	Accidental release of stored chemicals or fuels.

### **Inventory Update**

The certified operator should update the inventory every year for his records. Changes in land uses or potential contaminant sources should be noted and additions made as needed. The complete inventory should be submitted to DEQ every five years.

### **Inventory Limitations**

The potential sources of contaminants for Surprise Creek Ranch Colony are taken from data and reports that are readily available. Consequently, unregulated activities or unreported contaminant releases may have been missed. The use of multiple sources of data, however, should help assure that contaminant sources that are identified represent the major threats to the source water for Surprise Creek Ranch Colony.

***[Figure 4](#) – Land Use Classification and Inventory Results***

## 5.0 SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case the Surprise Creek Ranch Colony PWS.

The goal of Source Water Management is to protect 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 land use activities in the Recharge Region pose minimal threat to the source water.

Management priorities in the Inventory Region are determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches are recommended as methods Surprise Creek Ranch Colony can implement to reduce susceptibility of the PWS to contamination.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the Surprise Creek Ranch Colony spring (Table 4). Hazard is rated by the proximity of the potential contaminant sources to the wells. Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant. The susceptibility of the spring to each potential contaminant source is assessed separately.

*Table 4 - Relative Susceptibility Based on Hazards and Barriers*

Presence Of Barriers	Hazard		
	High	Moderate	Low
<b>No Barriers</b>	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
<b>One Barrier</b>	High Susceptibility	Moderate Susceptibility	Low Susceptibility
<b>Multiple Barriers</b>	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

For confined aquifers, hazards for point sources are assigned based on the presence of wells in the inventory zone, and how they are constructed. If the spring source is not adequately protected it the source from infiltration of surface water, the relative hazard for any potential contaminant source within the 1,000-foot inventory area is assigned a relative hazard of high, and those within the recharge area are assigned a relative hazard of moderate. If the spring is protected, but other wells are present in the 1,000-foot inventory zone that do not have a seal, then the relative hazard is moderate for point sources in this area and low for potential sources within the recharge zone. If all wells in the inventory region have effective seals through the confining layer, then the relative hazard is considered low for point sources within the 1,000-foot inventory area, and very low for other sources within the recharge zone.

For the spring source at Surprise Creek Ranch Colony, the recent detection of coliforms within the public water supply (Appendix B) suggests that the collection box is not adequately sealed to surface water mixing. As a

result, point sources of potential contamination are given a hazard rating of high.

For non-point sources, hazard levels are assigned based the following table:

**Table 5 - Non-Point Source Hazard Table**

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

For the Surprise Creek Ranch Colony PWS, there are no barriers identified for the significant potential contaminant sources activities that can reduce the susceptibility of the PWS spring to contamination under “worst-case” conditions. Implementation of best management practices, including fencing and adequately protecting a larger part of the control zone, can reduce the relative susceptibility of the system to contamination.

The results of the susceptibility assessment indicate that agricultural activities represent the only significant potential threat identified for the source water for the Surprise Creek Ranch Colony PWS. The results are listed in Table 6.

**Table 6 - Susceptibility Assessment of Significant Potential Contaminant Sources.**

<b>Source</b>	<b>Contaminant</b>	<b>Hazard</b>	<b>Hazard Rating</b>	<b>Barriers</b>	<b>Susceptibility</b>	<b>Management</b>
<b>Inventory Zone</b>						
Cropped Agricultural Land	SOCs/Nitrates	Leaching and Runoff	Low	None	Moderate	Protect area upgradient from spring from livestock; develop best management practices for agricultural land use including the application of chemicals according to label instructions
Ranch Access Road	Various	Spills	High	None	Very High	Develop emergency response plan for PWS system
<b>Watershed Recharge Region</b>						
Cropped Agricultural Land	SOCs/Nitrates	Leaching and Runoff	Very Low	None	Low	Protect watershed area from livestock; develop best management practices for agricultural land use including the application of chemicals according to label instructions
Unknown Controlled Access Facility	Unknown	Spills, Infiltration and Runoff	Moderate	None	High	Communicate with upgradient landowner, develop best management practices for agricultural land use including the application of chemicals according to label instructions

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