Golden Valley Colony

The attached Source Water Delineation and Assessment Report (SWDAR) for Golden Valley Colony was completed by Bill O'Connell of Montana Rural Water Systems, Inc. and Lisa O'Connell of Montana Tech as part of a June, 2003 report entitled "Hydrogeologic Assessment of the Principal Aquifers in the Upper Musselshell River Basin, Montana in Support of Source Water Assessment and Delineation Reports for Public Water Systems". Additional regional background information and assessment methodology for the Musselshell Project area from the Hydrogeologic Assessment is available at

Regional Background Information and Assessment Methodology

The primary intent of a Source Water Delineation and Assessment Report is to provide the background information for the community to use in developing local drinking water protection strategies. The attached report for Golden Valley Colony incorporates delineation and assessment components and includes a limited management and emergency response plan. ***DEQ has not reviewed the report or plan to confirm that it meets the requirements of Montana's Source Water Protection Program or that it is protective of your drinking water supply.***

It is highly recommended that the water system and community:

- Review the delineation of the inventory region to ensure it is protective of the long-term water quality;
- "Enhance" or refine the identification of the potential contamination sources and susceptibility analysis through further research and local input;
- Ensure that the management plan adequately identifies and reduces the risks of groundwater contamination from all potential contaminant sources (existing and future) that may affect the drinking water supply; and
- Ensure that the emergency plan identifies the potential threats to the drinking water supply and provides the detail necessary to implement a response to contamination or disruption of the public water system.

Technical assistance is available through DEQ for communities that choose to move beyond the assessments and voluntarily develop a Drinking Water Protection Plan. Clean safe drinking water is fundamental to the viability of any community. Protecting the drinking water source is a wise and relatively inexpensive investment in the community's future.

For technical assistance with review of this assessment or in developing plans to protect your public water system contact:

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MONTANA RURAL WATER

WELLHEAD/ SOURCE WATER PROTECTION PLAN
GOLDEN VALLEY COLONY,
RYEGATE, MONTANA

WELLHEAD/ SOURCE WATER PROTECTION PLAN

GOLDEN VALLEY COLONY
RYEGATE, MONTANA

Public Water System

PWSID # MT0001580

Report Date: June 30, 2003

Contact Person:

Paul Wipf

Certified Operator:

Paul Wipf

Route 1

Ryegate, MT 59074

phone: (406) 568-2210

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GLOSSARY*

Acute Health Effect. An adverse 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.
Best Management Practices (BMPs). Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.
Coliform Bacteria. Bacteria found in the intestinal tracts of animals. Their presence in water is an indicator of pollution and possible contamination by pathogens.
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 that inhibits the flow of water.
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.
Delineation. A process of mapping source water management areas.
Hardness. Characteristic of water caused by presence of various salts. Hard water may interfere with some industrial processes and prevent soap from lathering.
Hazard. A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.
Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through an aquifer.
Inventory Region. A source water management area that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified groundwater travel time.
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.
Nitrate. An important plant nutrient and type of inorganic fertilizer. In water the major sources of nitrates are 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.
Pathogens. A bacterial organism typically found in the intestinal tracts of mammals, capable of producing disease.
Point-Source. A stationary location or fixed facility from which pollutants are discharged.
Public Water System. A system that provides piped water for human consumption to 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. A source water management region that is generally 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.

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 Protection Area. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply.

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

Susceptibility (of a PWS). The 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.

Transmissivity. The ability of an aquifer to transmit water.

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.

Volatile Organic Compounds (VOC). Any organic compound which evaporates readily to the atmosphere.

* Definitions taken from EPA’s Glossary of Selected Terms and Abbreviations (http://www.epa.gov/ceisweb1/ceishome/ceisdocs/glossary/glossary.html)

INTRODUCTION

This Report was completed by Bill O'Connell, Groundwater Technician with Montana Rural Water Systems inc. (MRWS), Lisa O'Connell with the Montana Bureau of Mines and Geology, and Paul Wipf, the licensed operator for Golden Valley Colony's Public Water System (PWS).

Purpose

This report uses the Source Water Assessment Program (SWAP) to meet the technical requirements for the completion of the Wellhead/Source Water Protection Plan (SWPP) for Golden Valley Colony combined with a watershed evaluation of the Upper Musselshell River drainage. A Source Water Assessment is required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996.

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is "delineation and assessment." Delineation is a process of mapping source water protection areas that contribute water used for drinking. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. The purpose of the source water protection plan is to provide information to a PWS helping them protect their drinking water source.

Limitations

This report was prepared to assess threats to Golden Valley'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 community's public water supply and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the Colony area are identified. Only potential sources of contamination in areas that contribute water to its drinking water source are considered.

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 certain constituents that do not have MCLs but are considered to be significant health threats.

CHAPTER 1
BACKGROUND

The Community

Golden Valley Colony is located in central Montana, 5 miles south of Ryegate. The colony is a Hutterite religious community with approximately 100 residents. The Colony operates a large agricultural operation. The Public Water System (PWS) has 15 hook-ups and provides some water to their agricultural operation. See the vicinity map in figure 1.

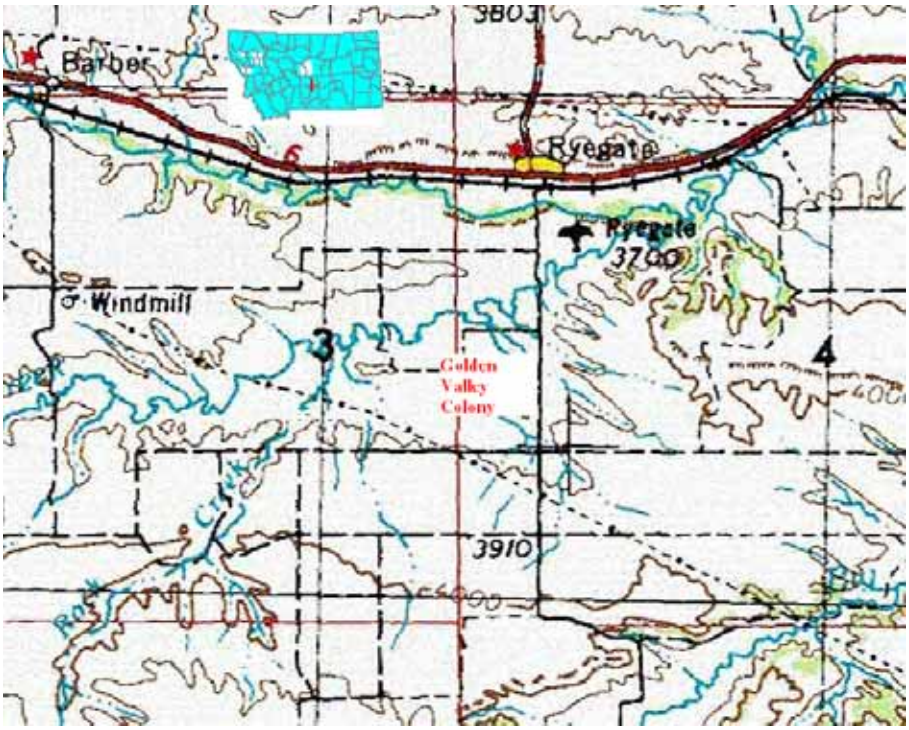


Figure 1. Golden Valley Vicinity Map

Geographic setting

Golden Valley Colony is located in the Un-Glaciated Missouri Plateau of the Great Plains Physiographic Province of central Montana. The Lake Basin Fault Zone has lifted the land surface to the south of the Colony. The topography is a series of rolling plains with deeply cut stream channels. The Musselshell River is located 5 miles north of the Colony in this region.

The average annual temperature in the region is 44.2^{o} F and the average annual precipitation is 14 to 18 inches (National Water and Climate Center).

General Description of the Source Water

Golden Valley Colony uses groundwater supplied by one well (figure 3) as its' drinking water source. The Well is located ¼ mile west of the colony in a field and is 140 feet deep and completed in the Eagle Sandstone formation aquifer. The Eagle is recharged where the formation is exposed south of the colony. The well will flow at the surface after 3 to 4 days of no pumping. See the well location on the map in Figure 2.

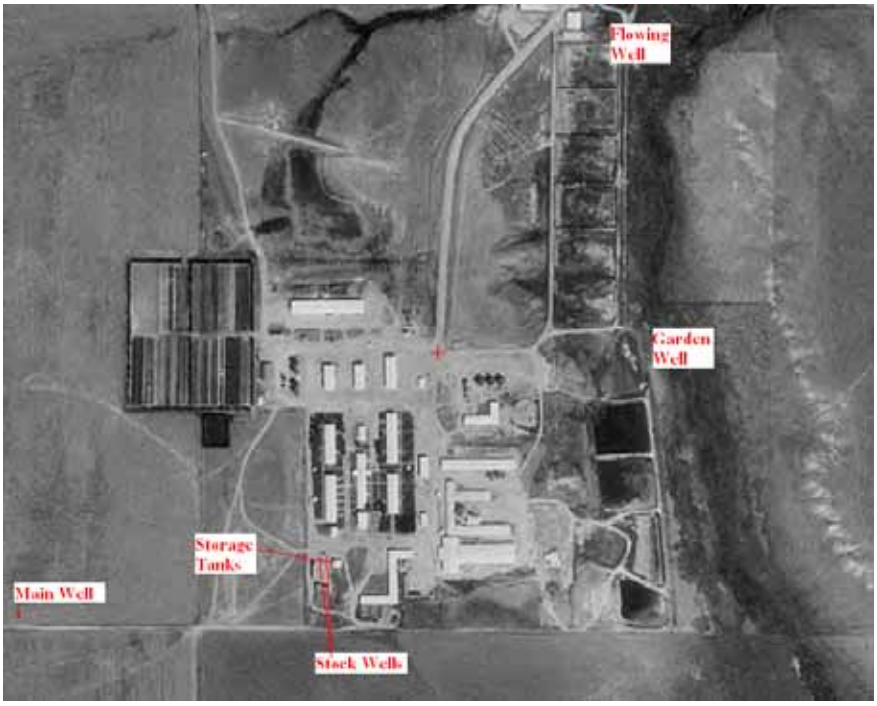


Figure 2. Well Locations for Golden Valley Colony

Table 1. List of geologic or hydrogeologic maps available for the Ryegate, Montana area.

Title or Description	Scale	Area Covered	Reference
Topographical	1:24,000	Ryegate	NRIS, map finder
Geological	Various	Montana	Taylor and Ashley
Geological	1:100,00	30'x60' Quadrangle	Wilde and Porter

The Public Water Supply

The Public Water Supply consists of 1 well, the date drilled is unreported (GWIC 1444). The well is ½ mile west of the colony and is pumped to the storage tank and then pumped to the

distribution system. The well is 140 feet deep and produces 55 gpm The distribution system consists of 2 inch pvc pipe and has 15 hookups and serves 100 people.

Water Quality

Golden Valley Colony is routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly. Compliance with other drinking water standards is based on additional sampling on a variety of schedules. The water is a sodium/bicarbonate type with a total dissolved solid (TDS) content of 772 parts per million. The water quality of this well is excellent for this region.

Influencing Factors

The Source Water Protection Plan (SWAP) was started as part of a program to combine a watershed evaluation of the Upper Musselshell basin completed by the MBMG with the SWPP for the public water systems, including the Golden Valley Colony completed by MRWS.

Source Water Protection Management

Paul Wipf, the colony's licensed operator and plumber will oversee implementation of the SWPP.

CHAPTER 2
DELINEATION

The portion of the aquifer that contributes water to the Colony's well is identified in this chapter. Three management regions (the control zone, inventory region, and recharge region) are mapped for the well. The goal of management in the control zone is to protect against direct introduction of contaminants into the well or the immediate surrounding area.

Management in the inventory region should focus on pollution prevention activities where water is likely to flow to the wells within a relatively short time period. The goal of management in the recharge region is to maintain and improve the quality of groundwater that could reach the well over longer times or with increasing water usage.

Geologic Conditions and Aquifer Characteristics

Golden Valley sits on the south side of the Mussellshell River Basin. Golden Valley uses groundwater supplied by one well to meet its' drinking water requirements. The well is 140 feet deep and produces 35 gpm. The water chemistry indicates the water is Sodium/bicarbonate and has a total dissolved solid concentration of 772 parts per million. This water chemistry identifies the aquifer as Eagle. See Figure 1, Golden Valley Vicinity Map.

The hydrogeology in this area is controlled by the Lake Basin Fault Zone located several miles south of the colony. The topography rises several hundred feet from the Musselshell River to the fault zone and the Lake Basin Fault Zone forms the hydrologic divide between the Musselshell River and the Yellowstone River Basins. The Eagle Sandstone Formation is widely exposed just south of the colony. In the draws and gullies throughout the colony the resistant Eagle Sandstone is easily recognized and has been mapped.

The Eagle Sandstone Formation is approximately 200 feet thick and has three units. The upper unit is a gray sandstone, the middle unit is a salt and pepper sandstone and the lower unit is a massive white sandstone also called the Virgelle. Shale layers and lenses can be found throughout the formation. The portion of the Eagle aquifer used by the colony is confined and the well will flow at the surface if not pumped. The Eagle has a shallow dip in this region and the area where the aquifer is recharge is located far enough south of the colony so that the elevation will pressurize the aquifer.

Well

The Golden Valley Colony's public water system is supplied by one well. The date the well was drilled is unreported, but the well was drilled to a depth of 140 feet. An 8 inch diameter PVC casing is completed from 80 to 140 feet with slots cut by a circular saw. The well has a reported yield of 55 gpm but additional information on the pumping water level and static water level was not reported in the drillers log. The well pumps into a storage tank located at the colony ¼ mile to the east. See the well logs and water chemistry results in appendix IV for additional

information. The well is pumped at 35 gpm with a 50 foot drawdown (Paul Wipf, 7-30-03).

Table 2. **Well information for Golden Valley Colony.**

Golden Valley Colony Well	
MBMG #	1444
Water Right #	
Latitude / Longitude	46.2536/-109.2844
Date Completed	Unreported
Depth	140 feet
Perforated Interval	80 feet to 140 feet
SWL Depth	Unreported
PWL Depth	Unreported
Drawdown	Unreported
Test Pumping Rate	55 gpm
Specific Capacity	.7 gpm/ft
Pumping Rate	35 gpm
Source Type	Groundwater Eagle Sandstone

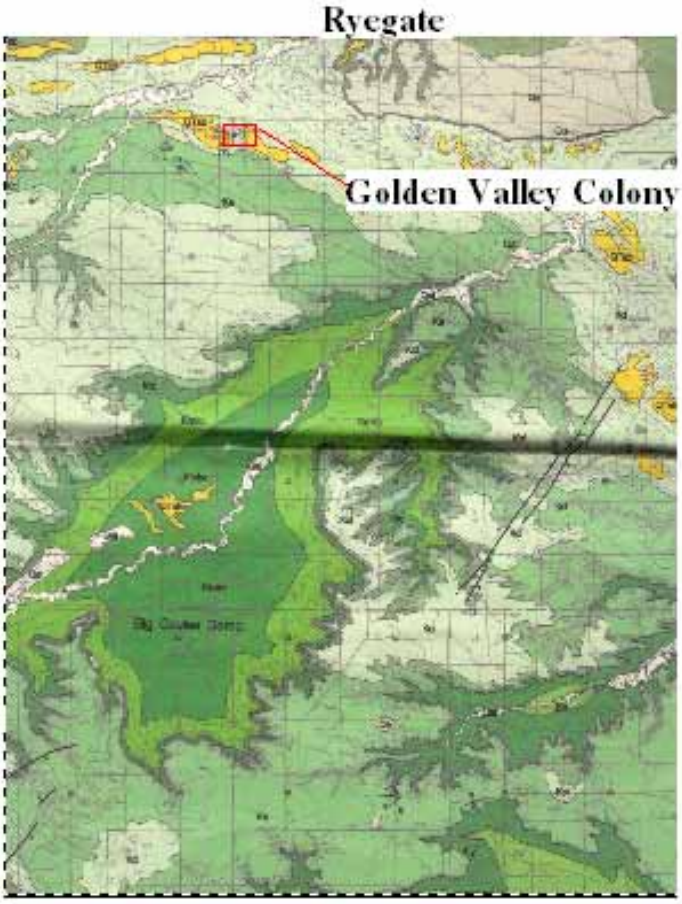


Figure 3. Geologic Map

Conceptual Model and Assumptions

The aquifer is recharged from infiltrating surface water where the Eagle Sandstone Formations are exposed south of the Colony. The Eagle is exposed throughout the area south of the colony but the unit that contains the aquifer is far enough south to have the elevation needed to pressurize the aquifer. The aquifer is confined and the well will flow at the surface if not pumped. The recharge is south where the Virgelle unit is exposed. The area was uplifted along the trend of the Lake Basin Fault Zone.

Additional regional geologic activities have created a buried basin in the sedimentary formations, including the Eagle Formation. The basin is centered about 3 miles southwest of Ryegate. The location of the Colony is on the south flank of the basin. The good water quality is the result of nearby exposures of the Eagle Formation.

Methods and Criteria

DEQ's Source Water Protection Program specifies methods and criteria used to delineate subregions of the source water protection areas for Golden Valley. A one-hundred-foot radius

Control Zone was delineated for each source. This is in accordance with DEQ 1, regulations for construction of water and wastewater systems.

The **Inventory Region** is delineated using the Uniform Flow Equations. The Uniform Flow Equations are used to determine the extent of the capture zone for a well. The Equations are an analytical solution to groundwater flow using measured and calculated aquifer characteristics. The Equations use the following simplifying assumptions:

1. The aquifer is homogeneous and infinite in extent. This condition is not found in nature but because of the moderate production rates of the wells and the volume of water in the aquifer, this condition is met to the accuracy the delineations require.

2. The groundwater flow is uniform in all directions. Groundwater flows along the path of least resistance and at the local level is rarely uniform. However, due to the size of the aquifer in relation to the well and the low groundwater flow velocities, this assumption is met to the accuracy the delineation requires.

The Uniform Flow Equations are used to calculate the **down-gradient and lateral extent of the capture zone** under steady state conditions (equilibrium)**.** The **Capture Zone** is the calculated area from which groundwater could be drawn into the well. The **Capture Zone** is calculated using the well's pumping rate and the aquifer characteristics.

The **up-gradient extent** of the capture zone uses a **time-of-travel** equation based on the wells production and aquifer (parameters) characteristics (the hydraulic gradient(i), aquifer porosity, hydraulic conductivity(K))

Aquifer Parameters:

Hydraulic gradient (i)=(change in contour elevation)/(map distance change in contour elevation occurred in). **200 ft/ 26400 ft=** .0074

Transmissivity (T)=2000*Q/s = 2000*35gpm/50ft. **T= 1400 ft^2/day**

Where: Q-flow from the well in gallons per minute
s-drawdown of the well in feet

Hydraulic conductivity(K)=T/b. From well log b=60 ft, so **K=1400/60= 23.3 ft/day**

Where: b-saturated thickness of the aquifer in feet

Uniform Flow Equations:

Down Gradient in feet (-X_L)=((1440/7.48)*Q)/(2BTi). Q= 6738 ft^3/day so, **-X= 103.5 ft**

Lateral Limits in feet (Y_L)= -X_L*B. **Y= 325.5ft/2 = 162.2 ft**

Time of Travel Calculation:

Upgradient Extent (X)=Kit/0. **X= 6293 ft**
Where: t-time in days: t=5 years for an unconfined aquifer, t=10 years for a confined aquifer

0-% porosity. =.1

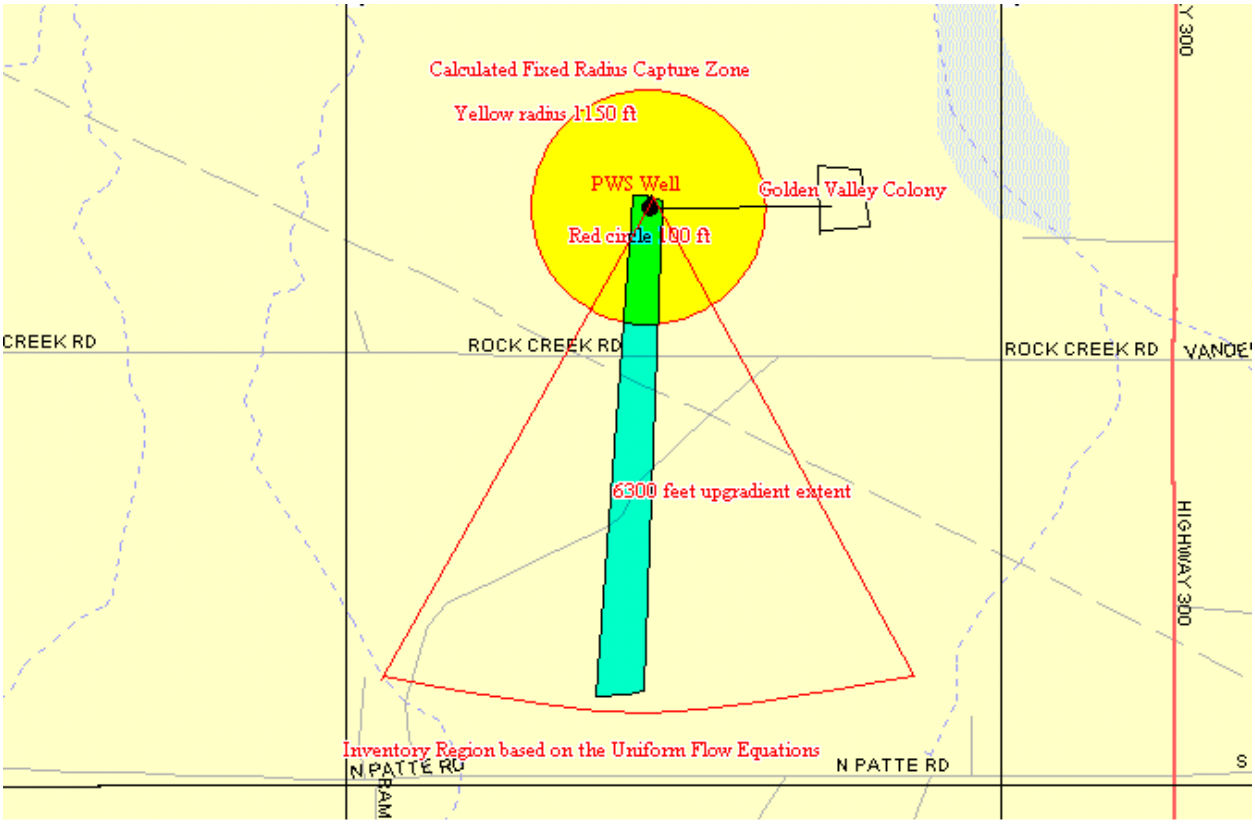


Figure 4. Inventory Region

CHAPTER 3
INVENTORY

Potential sources of contamination were inventoried to assess the susceptibility of the Golden Valley Colony's drinking water sources to contamination. Potential sources of all contaminants with primary drinking water standards and cryptosporidium were identified but a detailed inventory was conducted only for potential sources of contaminants that are the greatest threat to health. The contaminants of greatest concern to the Colony are nitrates from agricultural activities.

The inventory focuses on all activities in the control zone, major facilities in the inventory region, and general land uses in the recharge region.

Inventory Method

Databases were searched to identify businesses and land uses that are potential sources of regulated contaminants in the inventory region. The following steps were followed:
Step 1: Major road and rail transportation routes were identified throughout the inventory region.
Step 2. All land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the recharge region and identified on the base map.

Potential contaminant sources are designated as significant if they fall into one of the following categories:

1.Large quantity hazardous waste generators
2) Landfills
3. Hazardous waste contaminated sites
4) Underground storage tanks
5. Major roads or rail transportation routes
6).Cultivated cropland
7. Animal feeding operations
8) Wastewater treatment or spray irrigation
9. Septic systems, Sewered residential areas
10) Storm sewer outflows

Inventory Results/Control Zone

The control zone is the 100 foot radius around the well. Within the control zone for the existing well, the main potential contaminant is from agricultural activities near the wellhead.

Inventory Results/Inventory Region

The Inventory Region is strictly agricultural operations. See figure 4.

Table 4, Results for Golden Valley Colony's Inventory Region

map ID	contaminant source	description
	Agriculture	nitrates and chemicals

Inventory Results/Recharge Region

The Recharge Region for the well outside the inventory region is agricultural land.
See figure 3.

Inventory Update

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

Inventory Limitations

The potential sources of contaminants for Golden Valley Colony are determined from readily available data and reports. Unregulated activities or unreported contaminant releases may have been missed. The use of multiple sources of data, however, should ensure the major threats to the source water for the Colony.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

The susceptibility of Golden Valley Colony's well to significant potential contaminant sources is assessed in this chapter to rank threats to the drinking water source. The degree of susceptibiltiy is determined by the hazard associated with a source and the existence of barriers to contamination (Table 5). The proximity of point contaminant sources to the colony's well or the density of non-point sources in the inventory region determines hazard (Table 6). Barriers can be anything that decreases the likelihood that contaminated water will flow to the colony's 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 clayey soils, a deep water table, or a thick saturated zone above the well intake can be natural barriers.

Susceptibility ratings are presented individually for each significant potential contaminant source in the inventory region. Golden Valley is not considered susceptible to individual point sources in the recharge region because dispersion and dilution of contaminants should reduce concentrations of contaminants below levels associated with adverse health affects.

Table 5. Susceptibility to specific contaminant sources as determined by hazard and the presence of barriers.

	High Hazard	**Moderate Hazard**	**Low Hazard**
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

Table 6. Hazard rating of potential contaminant sources for Golden Valley Colony.

	High Hazard	Moderate Hazard	Low Hazard
Point Sources of All Contaminants	Within one-year TOT	one to three years TOT	Over three years TOT
Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Municipal Sanitary Sewer (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
Cropped Agricultural Land (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

The results of the susceptibility assessment for Golden Valley Colony are summarized in Table 7. The following are brief descriptions of the susceptibility assessments for each significant potential contaminant source.

Table 7. Susceptibility assessment for the Golden Valley Colony Inventory region.

Source	Contaminant	Hazard	Rating	Barriers	Susceptibility	Management
Agricultural land	pathogens, nitrates chemicals	Infiltration	high	:well intake below 80 feet :well grouted to bedrock	moderate	routine monitoring

CHAPTER 5
MANAGEMENT

The goal of the Source Water Protection Program is to prevent Golden Valley Colony's drinking water source from being contaminated. All land uses have been inventoried and the potential for these activities to contaminate the drinking water have been ranked. Management activities can be considered as another barrier developed to reduce the susceptibility of a specific contaminant from entering the Colony's water.

Control Zone Management

No chemicals will be used, stored or transported within the 100 foot radius of the well.

Inventory Region Management

Management of this region for Golden Valley colony is based on the well's depth and location away from most land use activities. The drillers logs for nearby wells show shale layers with some bentonite, this will inhibit surface water infiltration in the immediate area. The Colony will control the land use near the wells.

Recharge Region Management

The recharge region for Golden Valley Colony's well is due south of the Colony in rangeland.

Management Implementation

The management strategies have been in use as part of the Public Water Systems operation.

CHAPTER 6
EMERGENCY PLAN

Procedures for responding to emergencies are described and an emergency coordinator is designated in this chapter. The equipment and materials needed to respond to an emergency and the source of a temporary water supply are also described.

Possible Disruption Threats

The main threat to the PWS has been identified as casing failure or line breaks. A failure of the casing could allow contaminated surface water or poorer quality water from a different aquifer to enter the well.

Emergency Coordinator

The emergency coordinator for Golden Valley Colony is Paul Wipf.

Equipment and Material Resources

A catastrophic loss of water will require the services of an engineer and a well driller. Minor disruptions to the public water system will be handled by the colony.

Procedures to Shut Down the Well

The well can be isolated from the water distribution system by using the valves at the well site. The well can be turned off at the pump house but requires a key for access. The keys are located with the operator.

Table 8. Emergency Contacts

Contact Name	Title	Phone	Responsibility
Paul Wipf	operator	(406) 568-2210	All PWS
DES	Golden Valley county		Disaster & Emergency Services
24 hour Spill Hotline		(406) 444-5400	All spills
	Dept of Agriculture	(406) 444-5400	Ag chemicals
DEQ Enforcement		(406) 444-0379	

CHAPTER 7
ALTERNATE WATER SOURCES

Golden Valley Colony has sufficient water to meet the Colony's requirements and no new drinking water wells are planned at this time. The Colony has several wells including a flowing artesian well located near the northwest side of the compound that could be used in an emergency.

REFERENCES

1. Alt, David, A., and Hyndman, Donald, W., 1992, Roadside Geology of Montana

2. Levens, Russell, L.,1999, DEQ, Source Water Protection Plan, Sage Creek Hutterite Colony

3. Groff. S., L., 1962, Reconnaissance Ground-Water Studies, Wheatland, Eastern Meagher, and Northern Sweet Grass Counties, Montana

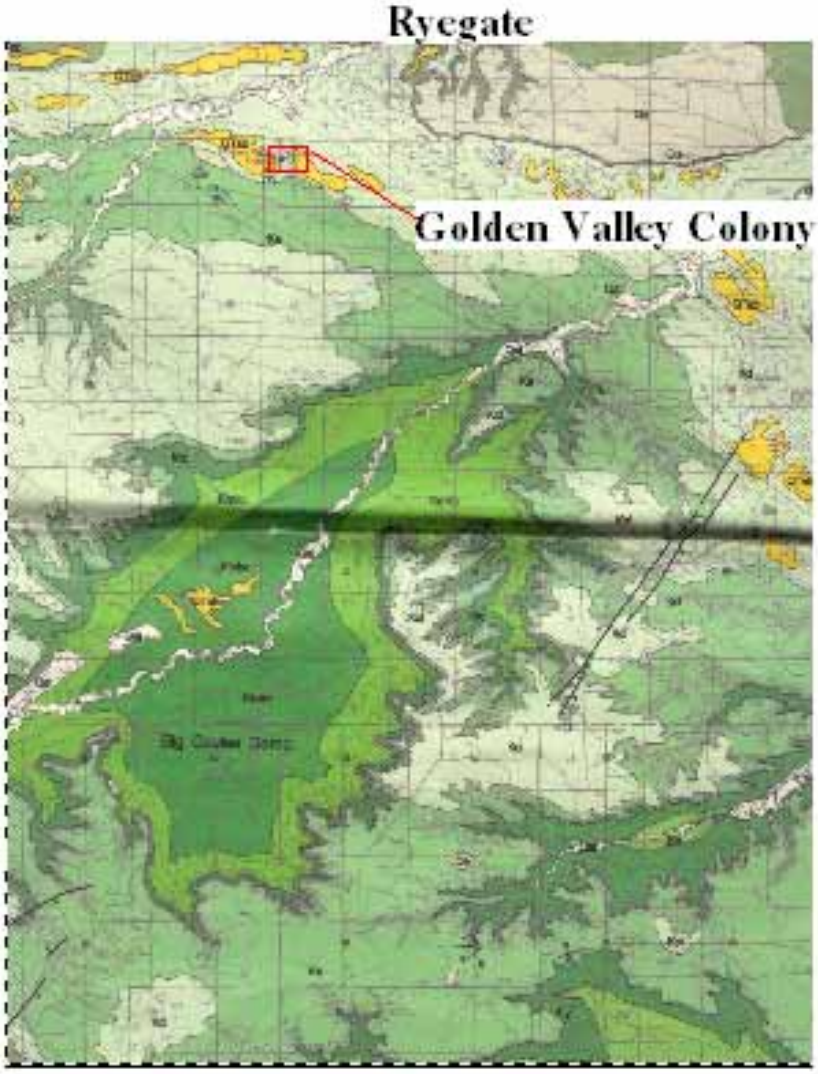
Appendix I
Glossary

Appendix II
Water Chemistry

Appendix III

Well Log

Appendix IV
Geologic Map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