Miller Colony

Public Water System

PWSID # 01649

Source Water Delineation and Assessment Report

and

Source Water Protection Plan

11/99

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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 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. 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.

Community. A town, neighborhood or area where people live and prosper.

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 does not allow the flow of water, maintaining the pressure of the ground water in the aquifer. The physical properties of a confining unit may range from a five-feet thick clay layer to a shale that is hundreds of feet thick.

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

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

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 ground water flow systems.

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

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 – Ground Water Information Center (MBMG/GWIC). The database of information on all wells drilled in Montana, including stratigraphic data and well construction data, when available.

Montana Pollutant Discharge Elimination System (MPDES). Database system to track entities that discharge wastewater of any type into waters of the State of Montana.

National Pollutant Discharge Elimination System (NPDES). A national database system to track entities that discharge wastewater.

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. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of chemicals into surface and/or ground waters at increased levels that may exceed MCLs.

Pathogens. A microorganism 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.

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. 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. 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. The Resource Conservation and Recovery Information System (RCRIS) 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 ground water source that provides water to a public water supply.

Source Water Assessment Report. A report for a public water supply that delineates source water protection areas, performs 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 ground water 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.

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.

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.

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 which evaporate readily to the atmosphere.

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

INTRODUCTION

This Delineation and Assessment Report was completed by James Swierc with the Source Water Protection Program at the Department of Environmental Quality with the assistance of David Hofer and John Waldner with Miller Colony. Montana Rural Water Water Systems, Inc performed preliminary work for completion of this report as part of the development of a Wellhead Protection Plan. This Source Water Delineation and Assessment Report was prepared for the Miller Hutterite Colony Public Water Supply, PWS ID# 1649, located in Teton County.

PURPOSE

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Miller Colony 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).

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, which 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 primary purpose of this source water delineation and assessment report is to provide information that helps the Miller Colony PWS complete a source water protection plan to protect its drinking water source.

Limitations

This report was prepared to assess threats to the Miller 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 the source of the Miller Colony 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 area of the Miller Colony public water supply are identified. Only potential sources of contamination in areas that contribute water to its drinking water source are considered.

The terms "contaminant" and "toxin" are 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.

CHAPTER 1

BACKGROUND

The Community

The Miller Hutterite Colony is located in Teton County, in north-central Montana, as shown in Figure 1. The nearest town with commercial services is Choteau (population 1802), located approximately 10 miles southeast of the colony. There are approximately 130 residents at the colony. The economy of the colony relies on the production of a variety of agricultural products.

The Colony complex comprises four 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. Domestic waste water is treated in a two-cell lagoon treatment system located northwest of the main colony buildings. Animal wastes are stored in a large above ground storage tank located on the east side of the colony. Wastewater and animal manure is disposed by land application to cropped areas.

Geographic setting

Miller Colony is located in the foothills to the east of the central part of the Rocky Mountain Front Range (see Figure 1). The mountains in this area represent a significant feature with peaks that rise over 4,000 feet above the plains. The colony is located on the western edge of the Burton Bench, an alluvial terrace of the ancestral Teton River which currently flows in an eastern direction several miles south of the colony. Bynum Reservoir, a flood control and irrigation reservoir, is located approximately 3 miles west of the colony.

The climate is typical of northern Montana, with a limited amount of precipitation averaging 11.7 inches at year as measured at the Choteau Airport. The wettest months are May and June averaging 2.0 and 2.8 inches monthly, respectively. The driest months are October through March, with monthly averages ranging from 0.3 to 0.5 inches per month. The temperature ranges from an average high of 82.2° F in July (minimum July average of 50.3° F) to an average of 33.5° F in January (minimum January average of 10.1° F).

General description of the Source Water

The Miller Hutterite Colony has two separate systems that serve their water needs, a potable water system that uses two wells, and a soft water system that comprises a shallow ground water collection system. These are located as shown in Figure 1. The potable water system represents the regulated PWS for this report. Both systems are piped into the colony, with potable water used for drinking and cooking, and the soft water used for other needs such as cleaning and laundry. The area is located within the

Teton River watershed (USGS Hydrologic Unit Code 10030205), located within the Upper Missouri River Watershed Management Region.

The potable water system draws water primarily from a single well, approximately 70 feet deep. A backup well which draws water from the same approximate depth is located approximately 100 feet south of the primary well. The source aquifer represents a fractured sandstone, the Virgelle Sandstone. The Sandstone is exposed in the hills immediately to the west of the colony, where it is recharged by infiltration of surface water and precipitation. Shallow ground water flow in the sandstone near the colony is considered likely to flow east from the recharge area, generally following topography, towards Miller Colony.

The soft water system obtains water from a shallow infiltration gallery located approximately one mile to the southeast of the colony. The soft water system source is located east of Ralston Gap, an erosional gap through the sandstone bedrock that is filled with alluvium. This collection system takes advantage of a very shallow depth to ground water in an unconsolidated alluvial aquifer. Ground water in the alluvial aquifer is considered likely to flow in a generally east to northeastward direction through Ralston Gap, with recharge from infiltration of surface water from irrigation ditches and precipitation.

The Public Water Supply

The configuration of the public water supply for Miller Colony is outlined in the sanitary inspection report completed by McNenny Environmental Engineering and Consulting on April 26, 1995. A copy of this report is included in Appendix A. The following discussion summarizes information obtained from this report.

The water system for Miller Colony serves the resident population of 130 people at 10 service connections located in the colony residential and other buildings. A map showing the general layout of the colony buildings and distribution system is included in Appendix A. Water for the potable system is obtained from the supply well (Source 002) and chlorinated in the building located over the wellhead, and then piped through a manhole to a 10,000 gallon glass lined storage tank. A backup well (Source 003) is piped into the system, and is connected in the manhole. There is currently no method to treat water from the backup well before it enters the distribution system. Water flows by gravity from the storage tank into the distribution system, where it is accessed at the colony buildings. The well lithology and construction logs for the main well and the backup well are included in Appendix B.

The soft water collection system is comprised of a trench, approximately 500 feet long with a perforated PVC pipe. The water is collected into a sump at the north end of the system, where a sump pump moves it into a 72,000 gallon storage reservoir. Overflow water from the storage tank feeds an irrigation ditch. Water from the storage tank flows by gravity to a distribution system in the colony, which has a layout similar to the potable

system (Appendix A). This water is softened by an ion-exchange system located in a small building within the colony, but is not disinfected for use as a potable water supply.

Water Quality

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliforms and other signs 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 Miller Colony PWS show no violations or exceedences of any drinking water quality standards. The only detected compound that is regulated is nitrate, which can occur naturally or from human and animal waste. The health standard for nitrates, the MCL, is 10 mg/L. The monitoring results for the potable water supply indicate varying nitrate concentrations, ranging from none detected up to a maximum of 2.39 mg/L detected on May 4, 1995. The results of two recent samples, from May 11, 1998 and March 2, 1999 indicate 1.37 and 1.48 mg/L, respectively. The soft water system is not regularly monitored.

A monitoring sample for VOCs from November 17, 1997 detected a trace concentration of 1.8 ug/L of 1,1,1-Trichloroethane from the potable supply. Subsequent confirmation sampling did not duplicate this result, and since there are no identifiable sources for the compound at Miller Colony, the result is not considered representative of any threat to the water supply.

There is no readily available published information on water quality from the fractured sandstone aquifer in the area. The shallow ground water in the Burton Bench area that supplies the soft water system is a calcium bicarbonate type, with generally low concentrations of dissolved constituents (Patton, 1991). This water is generally acceptable for all uses, including use as a drinking water supply source. The data listed in Table 1 are taken from three wells in the same area as the collection system for the soft water system, and is considered representative of background water quality in the area.

Table 1 – Background Water Quality in Burton Bench Aquifer

	Location	Cond	pH	TDS	Hardness	Ca	Mg	Na	K	Fe	Mn	HCO_3	CO_3	SO_4	Cl	F	SiO_2	NO_3
Sample	**(Section)**				**as $CaCO_3$**													
Date		**µ S/cm**	**SU**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**Mg/L**	**mg/L**	**mg/L**	**mg/L**
8/26/86	19bccc	454.0	7.63	271.83	248.32	52.8	28.3	3.7	1.3	< 0.002	< 0.001	248.4	0	48.1	0.4	0.6	14.2	0.07
6/17/85	20dbab	572.3	7.84	336.38	292.28	64.8	31.7	14.0	1.1	< 0.002	0.001	328.0	0	52.5	0.9	0.4	9.2	0.21
8/26/86	20dbac	575.0	7.52	337.30	296.65	68.2	30.7	14.2	0.9	0.010	< 0.001	326.0	0	52.3	0.8	0.4	8.8	0.10

Source wells listed are located in Township 25 North, Range 5 West Data from Patton (1991).

CHAPTER 2

DELINEATION

The source water protection area, the land area that contributes water to Miller Colony is identified in this chapter. Three management areas are identified within the source water protection area. These three regions are the control zone, inventory region, and recharge region. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around the well. The inventory region represents the zone of contribution of the well, which approximates a three-year groundwater time-of-travel. Analytical equations describing ground water flow using estimates of pumping and aquifer characteristics and simple hydrogeologic mapping are used to calculate groundwater time-of-travel distance. The recharge region represents the entire portion of the aquifer which contributes water to the Miller Colony water system.

Hydrogeologic Conditions

There are no published reports on the bedrock hydrogeology of the area around Miller Colony. The following discussion of the hydrogeologic setting of the area is based on Patton (1991) and interpretations from the geologic map for the area entitled "Geologic and Structure Map of the Choteau 1° x 2° Quadrangle, Western Montana" (Mudge et. al., 1982). A generalized geologic map of the area around Miller Colony, adapted from Mudge et. al. (1982), is depicted in Figure 2. Additional geologic information was obtained from well logs for the area from the Ground Water Information Center at the Montana Bureau of Mines.

The Miller Colony is located on an extensive gravel terrace system derived from the drainage of the Rocky Mountains before modern times. The terraces are comprised of coarse grained sand and gravels, with a total thickness up to 30 feet, and are located at elevations up to 800 feet above the modern stream alluvium. The gravel surface is present on Cretaceous bedrock comprised of interlayered sandstone and shale, with some areas of higher elevation not covered by the gravels. Miller Colony is located on the eastern edge of an area of bedrock exposed above the gravel plains. The bedrock in the area near Miller Colony has a slight general dip to the west, with younger Cretaceous Formations exposed immediately west of the colony.

The primary aquifer for the Miller Colony potable water system is comprised of fractured sandstone and shales of the Virgelle Sandstone Member of the Eagle Sandstone. Flow within the sandstone aquifer is considered likely to occur both within the primary porosity of the sandstone, and within a fracture flow system. According to the well logs for the Miller Colony wells (Appendix A), there is a shale layer overlying the sandstone source for the water, inferring that the aquifer is confined. However, the shallow depth to ground water and the uncertain nature of the aerial extent of the shale as a confining unit suggests that leakage may occur through the shale into the sandstone aquifer. The aquifer is considered to be semi-confined for this delineation, and with a High Source Water Sensitivity to contamination.

Ground water flow in the Virgelle Sandstone in the vicinity of Miller Colony is considered to be in a general northeastward direction generally following the topography.

The reservoirs located upgradient of the colony, Bynum and Farmers Reservoirs (see Figure 1), represent sources that feed the ground water system into the bedrock, as depicted in the generalized geologic cross section of the area in Figure 3. Ground water flow is relatively slow in the sandstone, and the actual flow system is likely more complex than described here.

The source of the soft water system at Miller Colony is the sand and gravel deposits of the terrace gravels. This unconfined alluvial aquifer is considered to have a High Source Water Sensitivity to contamination. Ground water in the unconsolidated sediments is considered likely to flow in a general direction that follows topography. Water in the shallow system may communicate with the underlying fractured bedrock system.

However, the alluvial deposits are more permeable and yield much greater quantities of water than the bedrock. An assessment performed by MBMG on the influence of surface water on this shallow ground water system, based on the information from Patton (1991), is included in Appendix D.

Conceptual Model and Assumptions

The ground water for the potable water system is recharged where the Virgelle Sandstone is exposed at the surface immediately west of Miller Colony. Recharge is comprised of infiltration of surface water from precipitation, and leakage from irrigation canals and the reservoirs (Bynum and Farmers) located on top of the bedrock bench. This water fills the sandstone bedrock aquifer, and flow is generally radially outward from areas of higher elevation to lower elevation. This relationship is depicted in Figure 3. In the area near Miller Colony, the flow direction is interpreted to be generally east, with a slight northward component. In areas where the bedrock is covered by alluvium, additional recharge to the bedrock may occur through infiltration of ground water through any fractures in the bedrock system.

The soft water system derives water from the porous terrace gravel deposits in an unconfined aquifer system. Recharge occurs as direct infiltration from precipitation, and from stream loss in irrigation ditches which cross the area. Flow in the area near the source for the Miller Colony soft system is generally northeast, following surface topography through Ralston Gap. This trend also follows the general direction of two irrigation ditches flowing in the area.

Well(s) Information

The primary well is approximately 70 feet deep, with a 20 foot long screened intake over predominantly sandstone. The backup well is completed to a depth of 54 feet, with a 30 foot screened intake over shale and sandstone. Both wells are constructed of PVC well materials, with the main well having a 6-inch inner diameter and the backup well having a 4-inch inner diameter. The main well yields approximately 10-15 gpm, and the yield for the backup well has not been reported and is considered to be less than 10 gpm. A third well was installed between the other two wells (Source 004); however, this well has never had sufficient yield for use with the water system. The well locations are shown in Figure 1, and the well logs are included in Appendix B.

Table 2. Source well information for Miller Colony.

Information	Well #1 "North Well"	Well #2 "South Well"	Spring Source* (Soft Water System)
PWS Source Code	002	003	005
Well Location	T25N, R5W, Sec 18abc	T25N, R5W, Sec 18abc	T25N, R5W, Sec 17ccd
MBMG #	*Not listed*	*Not listed*	*N/A*
Water Right #	W152648 MC	W152649 MC	P051285 CM
Date Well was Completed	July 1971	July 1971	1993
Total Depth	70 feet	54 feet	20 feet
Perforated Interval	50’ – 70’	24’ – 54’	*N/A*
Static Water Level	51 feet	*Not listed*	*N/A*
Pumping Water Level	56 feet	*Not listed*	*N/A*
Drawdown	5 feet	*Not listed*	*N/A*
Test Pumping Rate	11 gpm	*Not listed*	*N/A*
Specific Capacity	2.2 gpm/foot	*Not listed*	*N/A*

* The spring source is a ground water collection system that is not pumped. A sump pump moves water from one end of the collection system to a storage tank.

Methods and Criteria

The source water protection areas were delineated using the uniform flow equation listed in Appendix C. The lack of any specific data on hydrologic characteristics of the area limits the accuracy of the calculated estimates of hydrologic flow rates. The use of the uniform flow equation assumes that flow within the sandstone is uniform through primary porosity, and that the fracture system enhancing effective porosity is uniform through the aquifer. To address the uncertainties in the flow system, all estimated property values reflect conservative assumptions to ensure that proper management zones reflect all potential contaminant sources that may impact the Miller Colony water supply.

Model Input

The hydrologic parameter values used for the flow rate calculations are summarized in Table 3 and described in the following, with the criteria for selection of each value:

- ***Transmissivity***: The transmissivity of the bedrock aquifer for the potable water system was estimated from the initial pump test performed on the well after installation using the following equation from Driscoll (1986).

  $$T = [(Q / S) * 1500] / 7.48$$

  Where:

  T = transmissivity in ft^2/day

  Q = pumping rate in gallons per minute (gpm)

  S = drawdown in feet

  For the potable water source, using the values for the above parameters listed in Table 2, the transmissivity is estimated at 440 ft^2/day.

- ***Thickness***: The thickness of the aquifer for the potable water source was estimated as 20 feet, based on the length of the screened interval from the well construction log.

- ***Hydraulic Conductivity***: The hydraulic conductivity was estimated from the transmissivity using the relationship T = K * b, where K is the hydraulic conductivity, T is the transmissivity and b is the aquifer thickness. For the potable water source, the hydraulic conductivity is estimated at 22 feet/day

- ***Hydraulic Gradient***: The hydraulic gradient was estimated for the fractured bedrock system by measuring the change in elevation from the Farmers Reservoir surface located upgradient of Miller Colony, to the static water level for the primary source well. The gradient is estimated at 0.0085 feet/feet for the fractured bedrock system.

- ***Flow Direction***: The flow direction was estimated from the detailed topographic maps of the Miller Colony area. The flow is considered likely to follow the same direction as the topography, with an estimated northeastern flow direction (045°)

- ***Porosity***: The value for effective porosity is estimated from Heath (1989) at 20%.

- ***Pumping Rate***: The pumping rate was estimated at 11 gpm from the pump test after well installation.

An inventory zone for the soft water system was delineated using estimates of aquifer properties. While this system is not used as a potable water source, the inventory zone was delineated since it is included with the public water system. The estimated parameters used for the delineation are based on properties for similar hydrogeologic settings. These include a hydraulic conductivity (K) of 500 ft/day, an effective porosity of 25%, a hydraulic gradient of 0.007 feet/feet, an aquifer thickness of 25 feet, and a pumping rate of 500 gpm.

Table 3. Summary of source water protection area delineation parameters**.**

Input Parameter	-		
	North Well	**South Well**	**"Spring" Source**
PWS Source Code	002	003	005
Transmissivity	440 ft^2/day	440 ft^2/day	12,500 ft^2/day
Thickness	20 feet	20 feet	25 feet
Hydraulic Conductivity	22 ft/day	22 ft/day	500 ft/day
Hydraulic Gradient	0.0085	0.0085	0.007
Flow Direction	N 45° E	N 45° E	N 55° E
Effective Porosity	20%	20%	25%
Pumping Rate	11 gpm	11 gpm	500 gpm
1-Year TOT*	513 feet	513 feet	5730 feet
3-Year TOT*	1,270 feet	1,270 feet	16,150 feet

*Time of Travel

Delineation Results

The delineated management zones for both the potable and the soft water systems are depicted in Figure 4. For the potable system, the control zones comprise an area of a 100 foot radius around the wellhads. The inventory zone reflects an area with a 1,000 foot radius around the wellheads, with the upgradient distance modified to a distance of 1270 feet reflecting an estimated 3-year time of travel distance. The recharge area reflects the areas hydraulically upgradient where the sandstone bedrock aquifer is exposed at the surface.

The area upgradient of the soft water source shows the inventory zone based on an estimated 3-year time of travel. The recharge area comprises all exposed areas of the deposits upgradient from the soft water infiltration/collection system. A control zone for the soft water system has not been established since it is not used as a potable water source.

Limiting Factors

The lack of site and regional hydrogeologic data represent the greatest potential source of error to accurate delineations of the management zones for the water sources at Miller Colony. For the potable water source, the low yield of the well reflects a relatively slow ground water flow rate, with an estimated 3-year time of travel only slightly exceeding the 1,000 foot minimum distance. In addition, the inclusion of the 1,000 foot radius area around the wellheads in the inventory zone helps minimize the effects that variations in the ground water flow system may have on the dimensions of the calculated management zones.

CHAPTER 3

INVENTORY

An inventory of potential sources of contamination was conducted for the Miller Colony PWS within the control and inventory 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 Miller Colony PWS inventory region are nitrates and pathogens from the colony wastewater treatment systems and agricultural activities; and herbicides and pesticides from cropped agricultural land.

The inventory for the Miller Colony PWS focuses on all activities in the control zone, certain sites or land use activities in the inventory region, and general land uses and large facilities in the recharge region.

Inventory Method

The inventory for Miller 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. Specific locations of relevant facilities were identified on an engineering design map of the layout of the colony systems, provided to DEQ by the colony.

Urban and agricultural land uses were identified from the University of Montana GAP landuse analysis project (Redmond et. al., 1998). Major transportation routes through the area, including railroad lines, were also identified. This information is depicted in Figure 5.

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 site cleanup bureau), landfills , abandoned mines, and active mines including gravel pits. Any information on past releases and present compliance status was noted.

The only facility identified with these searches is an iron mine located in the recharge area for the potable wells. There is no information available regarding the size and years of operation for this mining facility. The location of this mine is depicted in Figure 6.

Inventory Results/Control Zone

The control zone for the PWS wells include the primary well house and surrounding area for the backup well located on the western side of the colony ranch complex. The control

zone for the wells is not fenced. The control zone for the soft water system is fenced and located in a grazing field. Chemical use in the control zones is limited to spot application of herbicides for weed control.

Inventory Results/Inventory Region

The inventory region for the PWS wells includes the dry pasture area west of the wells, and part of the farm complex located to the east of the wells. The farm complex is located at a lower elevation from the wells. The buildings included in the inventory zone include the school, slaughterhouse, and several cattle barns. Part of the colony garden is also within the inventory zone. The inventory region for the soft water system is comprised primarily of irrigated cropped agricultural land.

The location of the wells away from the central part of the colony, and at a higher elevation than the colony, results in the majority of the complex structures located outside of the inventory area. The only area of concern is a shelterbelt area planted to provide a protected area for sheep during lambing. The location of this area is identified in Figure 6.

Potential contaminants sources to the PWS wells, as identified in the inventory zone, include human and animal wastes, and herbicides. The primary hazards are chemical spills, excess application of herbicides, runoff from the slaughterhouse into the ground water system, and leakage from sewer mains. (Table 4). The primary potential hazards to the soft water system comprise herbicides and pesticides from the farming operations.

Inventory Results/Recharge Region

The recharge region for both the PWS wells and the soft water system is primarily used for open range cattle grazing and agriculture. Use of weed control herbicides and fuels for farm machinery are the contaminants of concern in the recharge region. The status of the iron mine located in the recharge region (Figure 6) is not known.

Table 4. Significant potential contaminant sources in the inventory regions of Miller Colony**.**

Source	Hazard
PWS Wells and Potable Water System	-
Housing	Leaking Sewer Lines
Barns	Leaking Sewer Lines or Collection System
Slaughterhouse	Leaching from Animal Wastes
Garden	Land Application of Animal Waste Spills and Excess Application of Herbicides
Shelterbelt Lambing Area	Leaching from Animal Wastes, flow of waste in stormwater to area around wellheads
Colonywide	Waste Chemical Spills
Soft Water System	-
Cropped Agricultural Land	Land Application of Animal Waste Spills and Excess Application of Herbicides

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 Miller 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 Miller Colony.

CHAPTER 4

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 Miller 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 that could be pursued by the Miller Colony PWS to reduce susceptibility are recommended.

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 Miller Colony PWS wells (Table 5). Hazard is rated by the proximity of a potential contaminant source to the well(s). Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 6).

Table 5. Relative susceptibility to specific contaminant sources 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

For point sources, the relative hazard of the significant potential contaminant sources listed in Table 6 reflects the location of the sites relative to the PWS Wells, and how long ground water would take to travel from that site to the wells. For sites located within a

time of travel distance of less than one year, the relative hazard is assigned as high. For sites within a one to three year time of travel, the relative hazard is moderate. For other sites, the relative hazard is low.

For non-point sources, the relative hazard is assigned based the following table:

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

The majority of the sites identified for the potable wells are located down gradient from the wells, and at a lower elevation, therefore the relative hazard assigned is low. The shelterbelt lambing area is located upgradient from the wells, within the inventory zone and is therefore asssigned a relative hazard of moderate. For the soft water system, the relative hazard for the cropped agricultural land is considered as high.

The primary barrier identified for all of the sites is clay-rich soils at the surface. Since the use of chemicals in the colony is limited, an additional barrier of using best management practices (BMPs) for chemical use is assigned.

Table 6. Susceptibility assessment of significant potential contaminant sources**.**

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Potable Wells	-	-	-	-	-	-
Housing and Domestic Sewer	Pathogens and Nitrate	Leaks	Low	Low Permeability Soils	Low	Leak Monitoring and Prompt Repair
Barns and Animal Waste Collection System	Pathogens and Nitrate	Leaks	Low	Low Permeability Soils	Low	Leak Monitoring and Prompt Repair
Slaughterhouse	Pathogens and Nitrate	Runoff	Low	Low Permeability Soils Low Permeability Soils	Low	Dispose of Wastes Outside Inventory Region
Garden	SOCs	Spills	Low	Low Permeability Soils	Low	Apply According to Label Instructions
Shelterbelt Lambing Area	Pathogens and Nitrate	Infiltration and Runoff	Moderate	Low Permeability Soils	Moderate	Dispose of Waste Outside Inventory Region, Maintain Stormwater Runoff From Area Away From Wellheads
Colonywide	VOCs, SOCs	Spills	Low	Low Permeability Soils, BMPs for handling	Very Low	Recycle / Dispose of Waste Chemicals Properly
Soft Water System	-	-	-	-	-	-
Cropped Agricultural Land	SOCs	Leaching	High	Low Permeability Soils	Moderate	Communicate with upgradient landowner, apply chemicals according to label instructions

The results of the susceptibility assessment indicate that the buildings and activities of the colony do not pose any significant threats to the potable water wells. The location of the wells on the hill at a position hydraulically upgradient from the colony provide a measure of protection to potential impacts to water quality in the wells. The shelterbelt lambing area is located at a position that may represent a threat to the wells when the area is used.

The most significant threat to the water quality in the soft water system is the use of herbicides and/or pesticides in the agricultural land present in the inventory zone for the water source.

CHAPTER 5

MANAGEMENT

The goal of this Source Water Protection Plan is to prevent Miller Colony's drinking water supply from being contaminated by keeping potentially polluting materials and activities out of the control zone, and by managing them in the inventory region. All land uses have been identified and inventory sheets have been completed for specific activities in the inventory region. Implementation of the management actions listed in Table 6 in the previous chapter is discussed in this chapter. Management actions described in this chapter can be considered additional barriers that will reduce the susceptibility of Miller Colony's source water to contamination.

Control Zone Management

No chemicals will be used, stored, or transported within 100 ft of the well enclosure. Information on the location of the control zone and restrictions on activities therein will be provided by announcements and posters to all colony residents.

Inventory Region Management

Management in the inventory region for the Miller Colony involves pollution prevention planning and education. Potential contaminants include pathogens and nitrates from human and animal wastes, and herbicides from the garden and other areas. The primary hazards are chemical spills, excess application of herbicides, runoff from the barns and slaughterhouse, and leakage from sewer mains. The goal of management is to ensure that wastes or chemicals are not released within the inventory region of the Miller Colony well or anywhere that could impact other water users in the watershed.

The potential contaminant sources identified at Miller Colony can be controlled through spill prevention and response, waste management, runoff control, preventive maintenance, and general good housekeeping.

Chemical Spills - Chemicals will be stored in their original containers in dry areas where damage by moving equipment is prevented. Waste chemicals will be collected and recycled or disposed of in a way that prevents groundwater or surface water contamination. Absorbent materials and 55-gallon drums will be available for cleaning up spills.

Table 7. Contacts for disposal of waste chemicals

Association	Contact Name	Phone	Resource
Waste Management	Harry Ellis Business Development	(406) 586-0606	Disposal of Waste from Herbicide Mixing
Oily Waste Processors	Roger Cathel Environmental Coordinator	(406) 761-3512	Disposal of Waste Oil
DEQ	Small Business Ombudsman	(406) 444-3937	Questions on Waste Handling

Runoff from the Barns - Manure and runoff from the stockyard and slaughterhouse waste is collected regularly and applied at agronomic rates to cropland outside the inventory region for the Colony's water systems.

Runoff from the Slaughterhouse - Dead animals are buried outside the inventory region for the Colony's water systems. Runoff to the surrounding ground will be minimized.

Application of Herbicides - Herbicides are applied following label instructions. Any spills will be promptly cleaned up.

Sewer Mains - Flow from sewer mains are monitored for signs of leaks. When leaks are suspected, repairs will be completed promptly.

Sheep Lambing Area – Manure is collected regularly and stored at a position where runoff will flow away from the wellheads. The waste is land applied at agronomic rates to cropland outside of the inventory region for the water system.

An inventory of all chemicals used or stored at Miller Colony and records of any spills or leaks will be maintained. Volumes of waste or spilled chemicals transported to recycling or disposal facilities will be recorded along with the date and destination of shipment.

All colony members will be informed about this plan through bulletins posted in the cafeteria and other frequented areas. Bulletins also will be posted where chemicals are stored or handled to remind people of proper procedures. Persons responsible for implementing specific provisions of this plan will read Miller Colony's Source Water Protection Plan and be able to carry out their responsibility. The colony members responsible for these activities are listed in Table 8.

Those directly responsible for chemical or waste handling also are responsible for implementing specific provisions of this plan. The **Farm Boss** has responsibility for implementing the overall plan.

Table 8. Potential sources of contamination, management controls, and responsible persons.

Source	Hazard	Control	Responsible Person
Housing	Leaking Sewer Lines	Leak Monitoring	Plumber
Barns	Leaking Sewer Lines or Collection System	Leak Monitoring	Plumber
Stockyard	Leaching from Animal Wastes	Waste Management	Plumber
Chemical Mixing	Spills and Runoff	Spill Cleanup and Runoff Prevention	Farm Boss
Cropland / Pasture	Land Application of Animal Waste	Prohibition Within 1000 ft of Well	Farm Boss
Cropland	Spills and Excess Application of Herbicides	Follow Label Instructions	Farm Boss
Lambing Area	Leaching from Animal Waste	Waste Collection, Management and Disposal	Sheep Boss
Colonywide	Waste Chemical Spills	Recycling and Disposal	Plumber
Garage	Chemical Spills	Proper Storage and Good Housekeeping	Plumber
Storage Tanks	Fuel Spills	Spill Cleanup and Containment	Colony Boss
Slaughterhouse	Leaching from Animal Wastes	Waste Collection and Disposal	Colony Boss

Recharge Region Management

The primary concern for the recharge regions is application of agricultural chemicals on cultivated cropland. For the potable system wells, the dry pastureland upgradient from the wells is the area of focus. This land is managed by limiting the use of chemicals and disposal of animal wastes in the area.

For the soft water system, Miller Colony will meet with the adjacent landowner to discuss this plan, and the need for protection of the water sources for Miller Colony. The appropriate use of fertilizers, herbicide and pesticides will be discussed to help ensure that use of these is done following appropriate label instructions and agronomic rates.

Management Implementation

Miller Colony will manage their source water protection area by implementing best management practices for chemicals and wastes on property owned or leased by the colony. Others who own land within the recharge region will be notified and encouraged to follow similar best management practices.

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 also are described.

Possible Disruption Threats

The principal threat to the PWS has been identified as the movement of contaminants that could flow to the wellhead and follow the well bore to the well intake. Included are spills from vehicles or chemical storage tanks, and surface runoff of waste from the lambing area upgradient from the wellhead.

Leaks from activities at the Colony may impact the source aquifer, however the location at a downgradient position minimizes the potential impacts. However, any impacts to the source aquifer may have long-term effects to water quality. The potential impacts may be derived from the use of any chemicals, the systems that carry waste in pipes such as sewers, and runoff from the barns, slaughterhouses, garages and chemical mixing areas. These should be monitored as disruption threats.

Emergency Coordinator

The emergency coordinator for Miller Colony is the **Colony Boss**. The contact telephone number is

(406) 464-2339. The backup emergency coordinator is **Plumber** at the same telephone number.

The emergency coordinator is familiar with county and state DES procedures and is responsible for contacting the appropriate officials should a spill or other threat to the source water occur. The Teton County DES coordinator 24-hour phone-number is (406) 466-5561. The State of Montana 24-hour Spill Hotline telephone number is (406) 444-6911.

Equipment and Material Resources

Heavy equipment for constructing berms or doing other excavation work is available if a spill occurs. The colony owns a backhoe, loader, bulldozer, scraper and two honey wagons that can be used to respond to any large spills. Absorbent materials and the honey wagon are available to handle any small chemical spills.

Should additional resources be needed due to the magnitude or chemical nature of a spill the Miller Colony will contract with a properly trained and equipped emergency response firm. A list of possible contractors is maintained and updated by the DEQ Enforcement Division (406) 444-0379.

A catastrophic loss of water may require the contracted services of a design engineer and a well driller.

Procedures to Shut the Well Down

The well can be turned off and isolated from the water supply system. Important valves are located as shown in appendix A. If each person uses 100 gal per day, the Colony can rely on water from the 10,000-gal storage tank for several days. Water from the soft water system provides an emergency backup source that will need to be tested, and potentially disinfected for use as a potable source. Well shut down is the responsibility of the certified operator or backup.

Coordination Procedures

The Source Water Protection Plan for Miller Colony has been made available to Teton County DES coordinator. Additionally, reportable spills will be handled according to reporting requirements as follows:

Agricultural chemical or fertilizer spills will be reported to the MT Department of Agriculture (406) 444-5400.

Any spills of refined petroleum product such as gasoline, diesel, asphalt, road oil, kerosene, fuel oil, and derivatives of mineral, animal, or vegetable oil in excess of 25 gallons will be reported to the DES hotline (406) 444-6911.

Procedures to communicate with water users

The well at Miller Colony can be isolated from the distribution system if a spill threatens the well. If the well becomes contaminated the well or intake will remain off line until an evaluation is done in cooperation with the MT DEQ, Public Water Supply Section.

All colony members will be notified if the well is contaminated.

Source of emergency water

The Colony can rely on water from the soft water system for an indefinite period if their well is out of service. Should this source be required, tests for nitrates and bacti in the source will be expedited to ensure that the water is safe for use as a potable water source. Until test confirmation is received, water from this source will be boiled as a disinfection method prior to use.

The services of a design engineer and well driller will be retained if the Colony develops a new source. Plans and specifications for the new source will be submitted to DEQ-PWS Section review and approval prior to construction.

Disinfection and Resumption of Water Service

The well, storage tank, or distribution system will be disinfected for bacteriological contamination as per the Miller Colony standard disinfection and tank cleaning procedures under the direction of the certified operator. Normal water service will resume

after sample results approved by DEQ-PWS Section and the certified operator indicate the supply is safe.

Table 9. Important emergency contacts and telephone numbers.

CONTACT NAME	TITLE	PHONE	RESPONSIBILITY
-	County DES Coordinator	(406) 466-5561	Coordinate Emergency Management
Montana 24 hr. Spill Hotline"	DEQ	(406) 444-6911	All Reportable Spills
Greg Murfitt	MT Dept of Agriculture	(406) 444-5400	Agricultural Chemical or Fertilizer Spills
DEQ Enforcement Division	Enforcement Officer	(406)444-0379	Any Event that May Pollute State Waters

CHAPTER 7

ALTERNATE WATER SOURCES

Miller Colony's potable water system supplies sufficient water to satisfy current demands. The soft water system serves as a backup system and provides sufficient quantity for all additional water needs.

The best location for an additional well or replacement well, if one becomes necessary, is the area near the current wells located west of the Colony away from potential contaminant sources. An additional source could be developed in conjunction with the source for the soft water system. A source water protection area will be delineated and a contaminant source inventory will be conducted in a similar fashion as the current one.

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