SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Birch Creek Colony
Public Water System

PWSID # MT0001781

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INTRODUCTION

This Delineation and Assessment Report was originally completed in 2000 by James Swierc with the Source Water Protection Program at the Department of Environmental Quality with the assistance of George Waldner with Birch Creek Colony for Public Water Supply, PWS MT0001781, located in Pondera County. The report was updated in 2013 by DEQ to include two production wells that were added as approved drinking water sources in the previous decade.

PURPOSE

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Birch Creek 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 Birch Creek Colony PWS complete a source water protection plan to protect its drinking water source.

LIMITATIONS

This report was prepared to assess threats to the Birch Creek 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 Birch Creek 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 Birch Creek 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.

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CHAPTER 1: BACKGROUND

THE COMMUNITY

The Birch Creek Hutterite Colony is located in Pondera County, in north-central Montana, as shown in **Figure 1**. The nearest town with commercial services is Valier (population 519), located approximately 12 miles northeast of the colony. There are around 130 residents at 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 agricultural activities. Domestic wastewater is treated in a lagoon treatment system located north of the main colony buildings. Hog waste is discharged to a lagoon east of the central part of the colony. These lagoons both have several monitoring wells to monitor down gradient water quality.

GEOGRAPHIC SETTING

Birch Creek 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 a bedrock bench away from any major drainage. An eastward flowing irrigation canal is present south of the colony. The colony is located in the unglaciated region between the recent continental glaciers to the east, and mountain glaciers to the west.

The climate is typical of northern Montana, with a limited amount of precipitation averaging 12.02 inches a year as measured at the weather station at the Conrad Airport. The wettest months are May and June, averaging 1.88 and 2.69 inches monthly, respectively. The

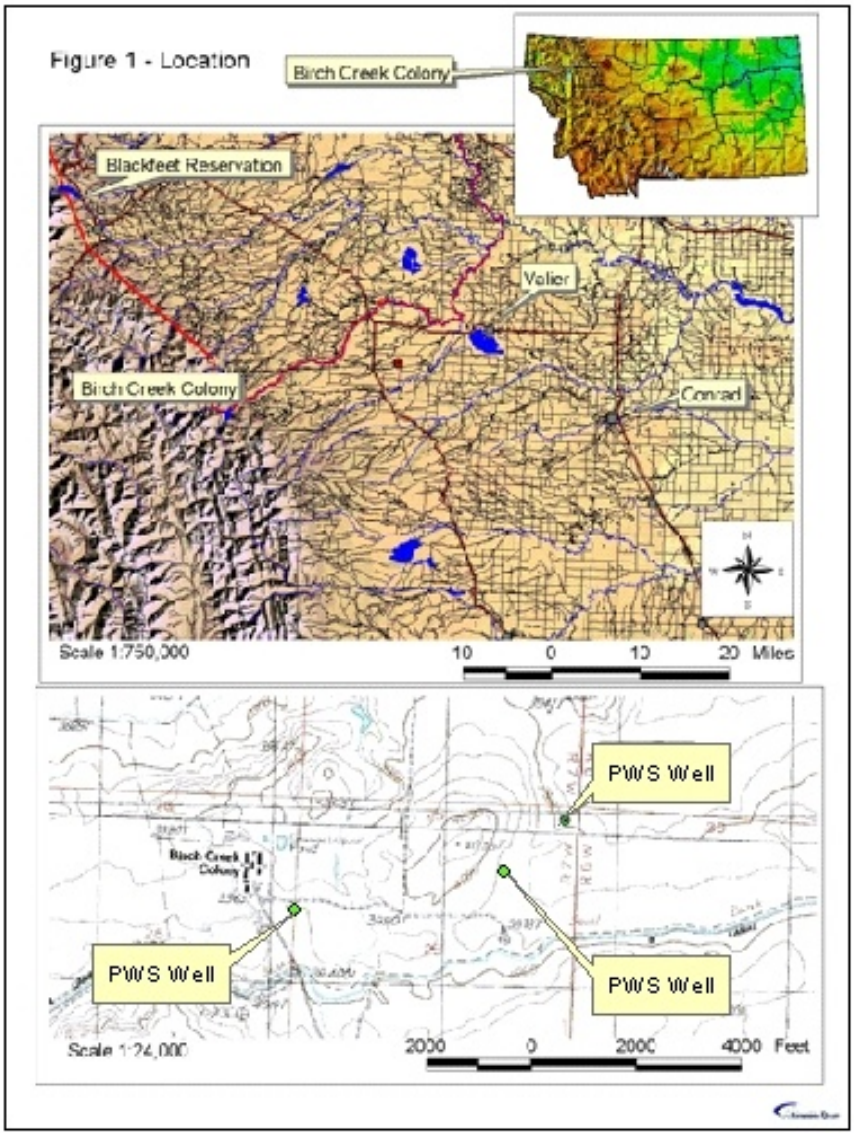

Figure 1. Location Map

driest months are October through March, with monthly averages ranging from 0.32 to 0.61 inch per month. The temperature ranges from an average high of 82.5 °F in July (minimum July average of 49.6 °F) to an average of 30.9 °F in January (minimum January average of 5.8 °F).

GENERAL DESCRIPTION OF THE SOURCE WATER

The general area is located within the Two Medicine River watershed (USGS Hydrologic Unit Code 10030201), located within the Lower Missouri River Watershed Management Region for Montana.

There are no detailed published reports on groundwater hydrology in the vicinity of Birch Creek Colony. The PWS wells range between 80 to 140 feet deep. Based on the lithology from the well logs (**Appendix A**) and regional geology, the source is interpreted to be sandstones in the Two Medicine formation. The aquifer is interpreted to be confined. Static water levels in wells tapping the Two Medicine formation are reported at 1 to 10 feet below the ground surface. The formation dips slightly to the west though groundwater flow in the aquifer near the colony is considered likely to flow generally to the northeast and east following topography. It should be noted that the ungrouted well bore at Well 1 wl002 can be a conduit to the producing zone(s) and renders groundwater in the Two Medicine formation in the immediate area to be vulnerable to contamination. Soils data suggest the depth to a local perched water table is between three to 6 feet in some areas in the vicinity of the colony. Some protection to the deeper producing zones is afforded by the tight nature of the silty clay loam soils that mantle the Two Medicine formation and clay or mudstones layers between water-bearing sandstones, however, several very high nitrate values measured in the drinking water supply (around 40 mg/L) in the mid-1980s indicate the vulnerable nature of the aquifer in this area.

THE PUBLIC WATER SUPPLY

The three supply wells are located southeast and east of the main colony complex (**Figure 3**). Well wl002 was the only source in use when the original source water assessment was completed in 2000. Wells wl003 and wl004 were added as drinking water sources in the subsequent decade.

The water system for Birch Creek Colony serves the resident population of 130 people through 7 service connections. The general layout of the colony buildings can be seen on **Figure 3**. Water from the supply wells is pumped into a common header, to treatment (disinfection, cartridge filter, arsenic removal) and then into an underground 50,000 gallon concrete tank located south of the main part of the colony, or, water can bypass the tank to go directly to distribution.

The system operator estimates water usage averages approximately 12,000 gallons per day.

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 organisms, nitrates, and 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. The colony has experienced elevated arsenic and nitrate in the past. The addition two new wells were, in part, an attempt to find water with lower arsenic where blending could be used as

the treatment method. Ultimately, blending was not deemed not to be an options and an absorbent media type arsenic treatment system was installed.

The other detected compound of concern is nitrate, which can occur naturally or from human and animal waste. The drinking water standard for nitrates is 10 mg/L. The highest reported value at the colony was 64 mg/L in 1981. A couple of subsequent values around 40 mg/L were reported in the mid-1980s. The more recent monitoring results indicate nitrate levels average 1.5 mg/L over the last 5 years. The reduction over time may be a function of blending with water from wells away from the compound, away from the ungrouted borehole at Well 1 wl002.

CHAPTER 2: DELINEATION

The source water protection area, the land area that contributes water to Birch Creek 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 within a 100-foot radius of the well. The inventory region for the confined aquifer is defined as an area within a 1,000-foot radius around the wellhead. The recharge region represents the area where the source aquifer for the Birch Creek Colony water system is replenished.

HYDROGEOLOGIC CONDITIONS

There are no detailed published reports on the hydrogeology of the immediate area around Birch Creek Colony. The following discussion of the hydrogeologic setting of the area is based on available information on the area, and assumptions based on basic principles of hydrogeology. The assumptions are discussed in the following. A generalized geologic map of the area around Birch Creek Colony, adapted from Ross et al. (1955) is depicted in **Figure 2**.

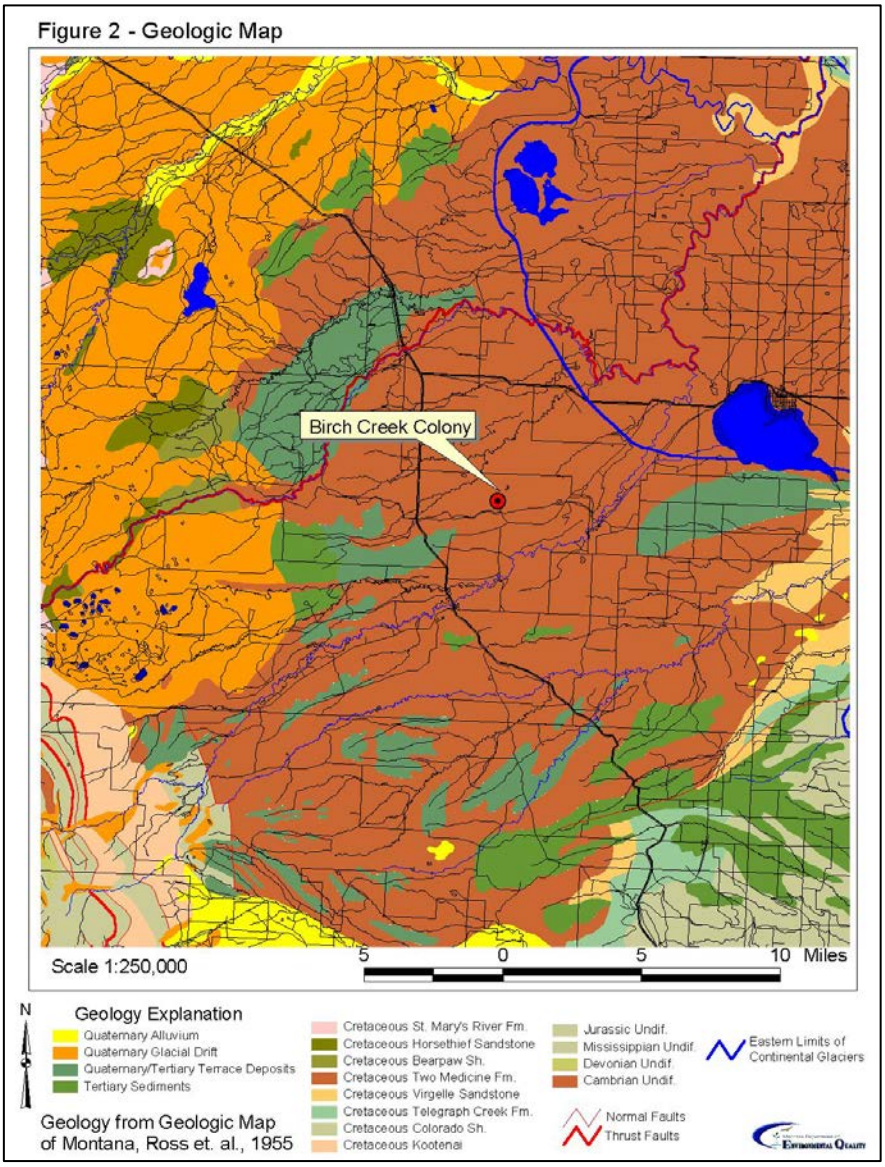

Figure 2. Geologic Map

The Birch Creek Colony is located on a bedrock plain above the valleys of any of the major drainages that have incised into the bedrock surface of the area. Birch Creek is located to the north of the main colony area, and Dupuyer Creek is located to the south. The colony and PWS wells are located near the local watershed boundary between the two drainages. The aquifer is present in sandstones of the Two Medicine Creek Formation (see attached well logs). The Two Medicine is exposed at the surface or has a very thin soil mantle in this area. Fracture flow may represent the primary porosity for the aquifer, especially in more fine-grained layers. The primary aquifer for the Birch Creek

Colony is considered confined to in consolidated sandstone bedrock but compromised by the ungrouted well wl002.

Groundwater flow in the vicinity of Birch Creek Colony is considered to be generally to the northeast and east, following topography. The source wells do not have a high continuous yield, suggesting that groundwater flow in the aquifer is relatively slow. The aquifer is recharged by infiltration of surface water and precipitation into the subsurface in the upgradient area west of the well. Groundwater flow in the aquifer occurs in the primary porosity of the sandstone, and in fractures in the bedrock which provide secondary porosity. A perched water table may exist locally in some areas.

CONCEPTUAL MODEL AND ASSUMPTIONS

Groundwater is recharged from infiltration of surface water and precipitation into the subsurface in the area around and west of the Birch Creek Colony. Groundwater flow in the area generally follows the topographic gradient to the northeast and east.

WELL(S) INFORMATION

The well logs for the Birch Creek PWS are included in **Appendix A**. The wells range between 80 feet and 140 feet deep. A general description of well construction information based on well wl003 is summarized in **Table 1**.

Table 1. Source Well Information

Information	Well
PWS Source Code	wl003
Well Location	T29N, R7W, Sec 24 ddd
MBMG #	83380
Water Right #	58251
Date Well Was Completed	April 3, 1986
Total Depth	140 feet
Perforated Interval	40 to 140 feet
Static Water Level	1 foot
Pumping Water Level	25 feet
Drawdown	24 feet
Test Pumping Rate	60 gpm
Specific Capacity	2.5 gpm/foot drawdown

METHODS AND CRITERIA

In order to support source water protection planning efforts, an informal recharge zone is delineated based on a 1-mile radius around the PWS well, biased towards the area hydrologically upgradient from the well. The complete recharge area is considered to be the Birch Creek and Dupuyer Creek watershed areas to the west of Birch Creek Colony.

DELINEATION RESULTS

The delineated management zones for the wells are depicted in **Figure 3**. The control zones comprise an area of a 100-foot radius around each wellhead. The inventory zones reflect areas with a 1,000-foot

radius around the individual wellheads. The recharge area reflects the area to the east, including the main colony complex, with a 1-mile radius area (**Figure 4**) to help with assessing susceptibility and management options.

As a tool to support source water protection planning for Birch Creek Colony, groundwater flow rates are conservatively estimated using the uniform flow equation and data in **Table 1**. The data used for the assessment, assumptions and calculation summaries are available from DEQ. Based on these estimates, groundwater flow rates are an estimated 363 feet (0.07 mile) for a 1-year time of travel, and 820 feet (0.16 mile) for a 3-year time of travel.

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 Birch Creek Colony. The inventory zone of a 1-mile radius provides a conservative approach that helps to minimize the potential effects from the lack of hydrologic data for the area.

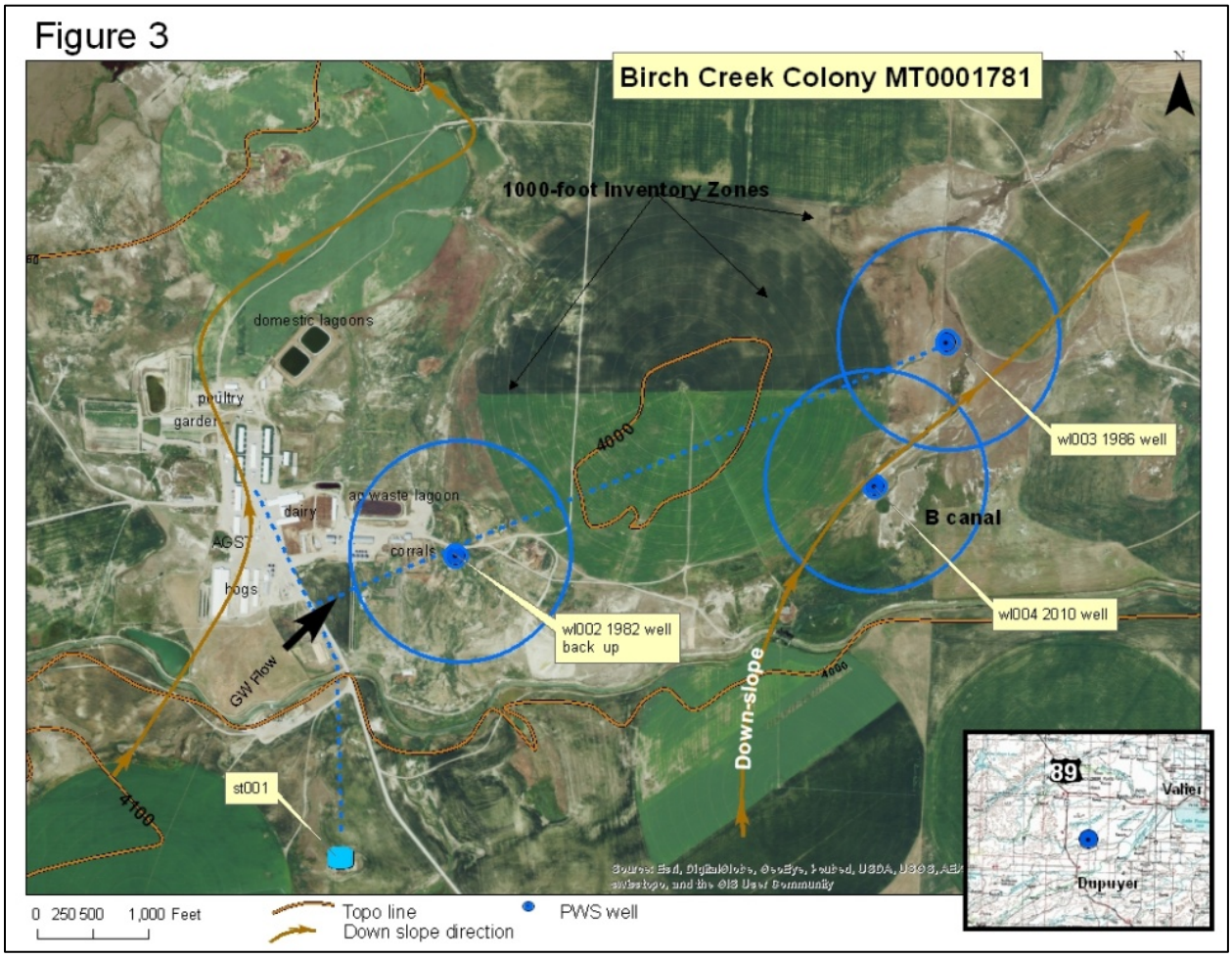

Figure 3. Map of Delineated Management Zones

CHAPTER 3: INVENTORY

An inventory of potential sources of contamination was conducted for the Birch Creek Colony PWS within the control and inventory regions. Potential sources of all primary drinking water contaminants were identified; however, only significant potential contaminant sources were selected for detailed inventory. The significant potential contaminants in the Birch Creek Colony PWS inventory region are nitrates and pathogens from waste management including land application of waste from the colony, and herbicides/pesticides and fertilizer from cropped agricultural land.

The inventory for the Birch Creek 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 Birch Creek 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 University of Montana GAP land use analysis project (Redmond et al., 1998). 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 site cleanup bureau), landfills, abandoned mines, and active mines including gravel pits. Any information on past releases and present compliance status was noted.

No facilities were identified with this search.

Inventory Results/Control Zone

The control zone for the wl002 includes livestock corrals (**Figure 3**). The control zones for wl003 and wl004 is pasture. The control zones should be fenced to keep livestock away from the wellheads.

Inventory Results/Inventory Region

The 1,000-foot inventory region for the wl002 includes hog waste lagoons and livestock holding corrals. The primary hazards are infiltration or run-off from animal waste contaminated areas and leakage from the waste holding lagoon. The inventory regions for wells wl003 and wl004 are cropland and pasture areas. Potential contaminants sources here include land applies animal wastes, crop fertilizers and herbicides. The primary hazards are shown on **Table 2**.

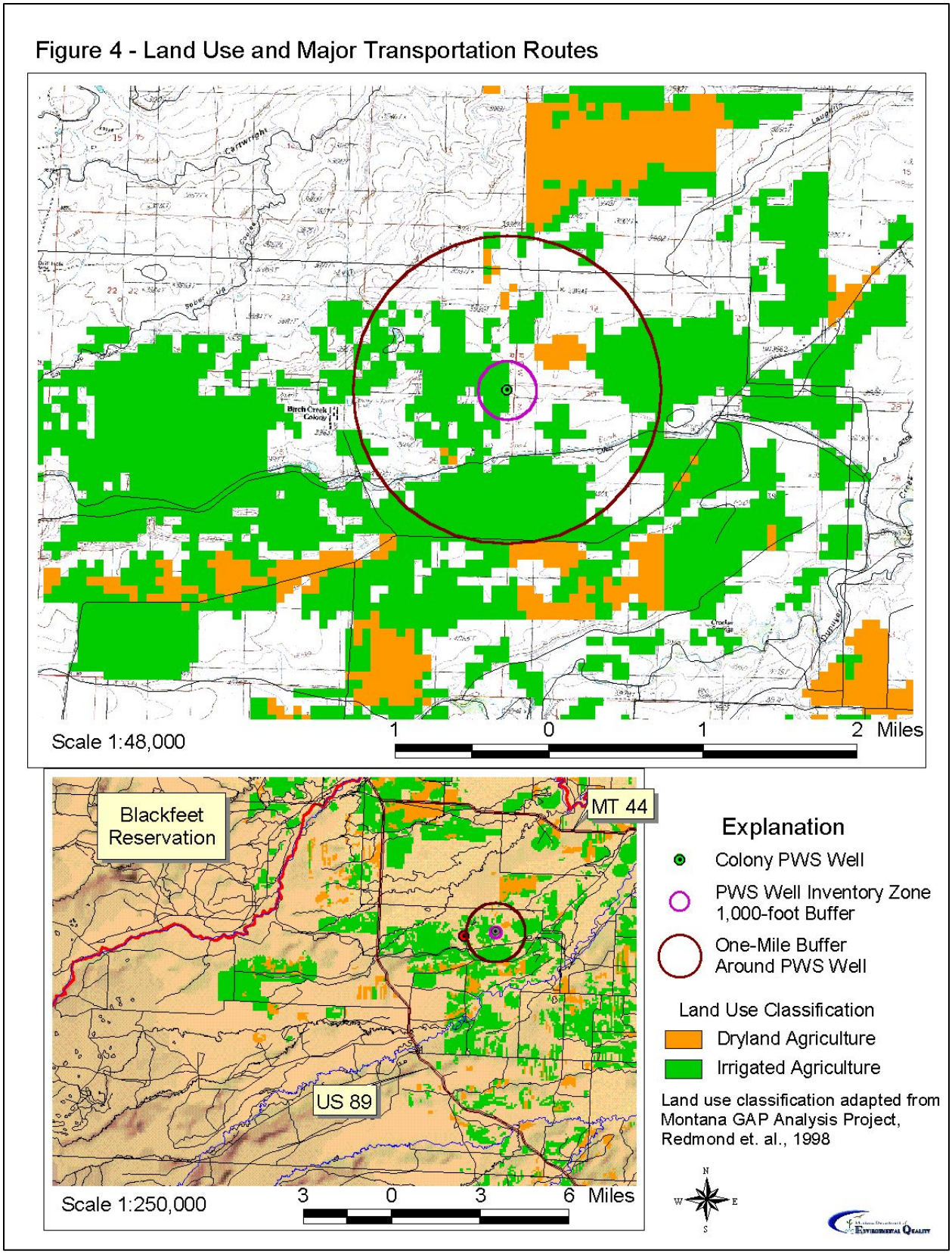

Figure 4. Land Use and Major Transportation Routes Map

Inventory Results/Recharge Region

The recharge region for the PWS wells includes the main colony building area, and the surrounding area comprised primarily of agricultural cropland, with some areas used for open range cattle grazing. Use of weed control herbicides and fuels for farm machinery are the contaminants of concern in the recharge region. Additionally, the colony buildings and animal process areas are considered to be located in within the recharge area. The colony buildings and process areas are depicted in **Figure 3**, with their location relative to the PWS wells and the inventory zones.

Table 2. Significant Potential Contaminant Sources

Source	Hazard
Control and Inventory Zones	
Cropped Agricultural Land	Land Application of Animal Waste Spills and Excess Application of Herbicides
Livestock areas	Infiltration of run-off from animal waste areas
Animal Waste Lagoon	Leakage
Recharge Area	
Barns	Leaking Sewer Lines or Collection System
Slaughterhouse	Leaching from Animal Wastes
Housing	Leaking Sewer Lines
Wastewater Treatment Lagoons	Leakage from lagoons
Fuel/Chemical Storage	Spills
County Roads	Spill or Accident from Transported Chemicals or Fuels
Colonywide	Waste Chemical Spills
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 5 years.

Inventory Limitations

The potential sources of contaminants for Birch Creek 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 Birch Creek 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 Birch Creek 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 Birch Creek 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 Birch Creek Colony PWS wells (**Table 3**). 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 4**).

Table 3. 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 confined aquifers, hazards for point sources are assigned based on the presence of other wells in the inventory zone, and how the PWS well and other wells in the area are constructed. If the PWS well is not sealed through the confining layer, than 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 1-mile inventory zone are assigned a relative hazard of moderate. If the PWS well has a seal through the confining layer, 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 remainder of the inventory 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 inventory zone.

When the location of septic systems is known, they are treated as point sources, with hazards assigned based on the above criteria. For non-point sources, the relative hazard is assigned the same for both confined and unconfined aquifers. For residential areas with multiple septic systems with only estimated locations and thus an estimated density, they are treated as non-point sources with hazards assessed following non-point source criteria. For non-point sources, primary hazard levels are assigned based on the relative concentration of the sources within the inventory zone, based on **Table 5**.

Table 4. Susceptibility Assessment of Significant Potential Contaminant Sources

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Control and Inventory Zone wl003 and wl004						
Cropped Agricultural Land	SOCs/Nitrates	Leaching and Runoff	High	Low Permeability Soils; BMPs for Handling	Moderate	Apply Chemicals According to Label Instructions
Control and Inventory Zone wl002						
Livestock Management and Water Areas in Main Colony	Nitrate, bacteria, SOCs	Leaching and Runoff	High	None	Very High	Ensure Drainage Is Away from the Wellhead. Consider Grouting wl002 Casing or Abandoning the Well.
Recharge Area (Colony Complex)						
Barns	Pathogens and Nitrate	Infiltration and Runoff	Low	Low Permeability Soils,	Low	Dispose of Waste Outside Inventory Region
Slaughterhouse	Pathogens and Nitrate	Infiltration and Runoff	Low	Low Permeability Soils,	Low	Dispose of Waste Outside Inventory Region
Housing	Pathogens and Nitrate	Leakage from Sewage Lines	Low	Low Permeability Soils	Low	Monitor Integrity of Sewer Lines
Human and Animal Waste Lagoons	Pathogens and Nitrate	Leakage	Low	Low Permeability Soils	Low	Monitor Operation and Performance of Lagoons
Fuel/Chemical Storage	VOCs, SOCs	Spills	Low	Low Permeability Soils, BMPs for Handling	Very Low	Recycle / Dispose of Waste Chemicals Properly
County and Colony Access Roads	VOCs, Pathogens, and Nitrate	Spills	Low	Low Permeability Soils	Low	Develop Emergency Response Plan
Colonywide	VOCs, SOCs	Spills	Low	Low Permeability Soils, BMPs for handling	Very Low	Recycle / Dispose of Waste Chemicals Properly
Cropped Agricultural Land	SOCs, Nitrates	Infiltration and Runoff	Moderate	Low Permeability Soils; BMPs for handling	Low	Communicate with Upgradient Landowner, Apply Chemicals According to Label Instructions

Table 5. Non-Point Source Primary Hazard Level Assignments

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 well construction information the Birch Creek Colony PWS well indicates that a proper seal was installed around the wellhead as "puddled clay." According to records from MBMG-GWIC, the only other wells within a 1-mile radius are four shallow monitoring wells from the Montana Salinity Control Project (**Appendix B**). None of these wells are installed to the aquifer depth of the Birch Creek Colony PWS Well. Based on this criterion, any point potential contaminant sources within the inventory zone would be assigned a relative susceptibility hazard of low. However, there were no point potential contaminant sources identified with this assessment since the well is located more than a mile away from the main colony complex. The hazard from cropped agricultural land is rated as high, since the majority of the inventory region is active agricultural land.

The primary barrier for the PWS well from agriculture is clay-rich soils that may adsorb and attenuate any excess fertilizer or herbicides applied to the cropland. Well logs for the PWS well (**Appendix B**) indicate topsoil over 30 feet of yellow clay. In addition, since the use of chemicals in the colony is limited, an additional barrier of using best management practices (BMPs) for chemical use is assigned.

The results of the susceptibility assessment are summarized in **Table 4**, with recommended management actions. The results indicate that multiple barriers are present to mitigate the effects of any potential contamination from the buildings and activities of the colony. The location of the well away from the central part of the colony provides a measure of protection to potential impacts to water quality in the wells.

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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 groundwater in the aquifer. The physical properties of a confining unit may range from a 5-foot 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 affect groundwater flow systems.

Inventory Region. A source water management area for groundwater systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified 3-year groundwater 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 – Groundwater 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 groundwaters 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 groundwater 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 groundwater sources, the area within a fixed radius or 3-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 evaporates 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)

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APPENDIX A – WELL LOGS

MONTANA WELL LOG REPORT | **Other Options**

Plot this site on a topographic map
View scanned well log (5/31/2006 12:24:25 PM)

Site Name: BIRCH CREEK COLONY
GWIC Id: 83381 wl002 well 1

Section 1: Well Owner

Owner Name
BIRCH CREEK COLONY
Mailing Address

City	State	Zip Code
VALIER	MT	59486

Section 2: Location

Township	Range	Section	Quarter Sections
29N	07W	25	SE¼ SW¼ NW¼

County | **Geocode**
PONDERA

Latitude	Longitude	Geomethod	Datum
48.244634	112.463014	TRS-SEC	NAD83

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water
UNKNOWN (1)

Section 4: Type of Work
Drilling Method: CABLE

Section 5: Well Completion Date
Date well completed: Thursday, October 14, 1982

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1	9	6				STEEL
5	80	4		160.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
65	80	4			1/4 HOLE

Annular Space (Seal/Grout/Packer)

not grouted

Section 7: Well Test Data

Total Depth: 80
Static Water Level: 6
Water Temperature:

Bailer Test *

30 gpm with _ feet of drawdown after 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 15 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	6	TOPSOIL
6	80	LAYERS - SANDSTONE AND SHALE

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: POVERTY DRILLING
License No: WWC-302
Date Completed: 10/14/1982

MONTANA WELL LOG REPORT

Other Options
Plot this site on a topographic map
View scanned well log (5/31/2006 12:24:11 PM)

Site Name: BIRCH CREEK COLONY wl003
GWIC Id: 83380
DNRC Water Right: C058251-00

Section 1: Well Owner

Owner Name
BIRCH CREEK COLONY
Mailing Address
712 DUPUYER CUTOFF

City	State	Zip Code
VALIER	MT	59486

Section 2: Location

Township	Range	Section	Quarter Sections
29N	07W	24	SE¼ SE¼ SE¼

County
PONDERA

Latitude	Longitude	Geomethod	Datum
48.251828	112.446684	TRS-SEC	NAD83

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

Section 4: Type of Work

Drilling Method: FORWARD ROTARY

Section 5: Well Completion Date

Date well completed: Thursday, April 03, 1986

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	140	8

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	12	6	0.280			STEEL
12	140	6		160.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
40	140	6			HAND SLOTTED

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	40	PUDDLED CLAY	

Section 7: Well Test Data

Total Depth: 140
Static Water Level: 1
Water Temperature:

Pump Test *

Depth pump set for test _ feet.
60 gpm pump rate with _ feet of drawdown after 1 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 25 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	1	TOPSOIL
1	30	YELLOW CLAY
30	76	SANDSTONE
76	78	CLAY
78	96	SANDSTONE
96	97	CLAY
97	140	SANDSTONE

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: J & T DRILLING
License No: WWC-475
Date Completed: 4/3/1986

MONTANA WELL LOG REPORT

Other Options
Plot this site on a topographic map

Site Name: BIRCH CREEK COLONY wl004
GWIC Id: 255103

Section 1: Well Owner

Owner Name
WALDNER, GEORGE
Mailing Address
712 DUPUYER- VALIER CUTOFF

City	State	Zip Code
VALIER	MT	59486

Section 2: Location

Township	Range	Section	Quarter Sections
29N	07W	24	NW¼ SE¼

County	Geocode
PONDERA	

Latitude	Longitude	Geomethod	Datum
48.256385	112.453476	TRS-SEC	NAD83

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Sunday, April 04, 2010

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	40	12.5
40	120	8

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
2	40	8	0.322		WELDED	A53B STEEL
20	120	6		240.0	SOLVENT WELD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
40	60	6		.030	FACTORY SLOTTED
100	120	6		.030	FACTORY SLOTTED

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	40	PORTLAND CEMENT	

Section 7: Well Test Data

Total Depth: 120
Static Water Level: 4
Water Temperature: 10

Air Test *

15 gpm with drill stem set at 120 feet for 2 hours.
Time of recovery 4 hours.
Recovery water level 4 feet.
Pumping water level _ feet.

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	3	TOPSOIL
3	25	GREEN SHALE
25	40	MUDSTONE
40	65	MUDSTONE WITH SAND LENSES (WATER) (SCREENED)
65	91	SHALES
91	117	SANDSTONE WITH MUDSTONE LENSES (SCREENED)
117	120	GRAY SHALE

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: TIM HLAVNICKA
Company: AQUASOURCE DRILLING LLC
License No: WWC-475
Date Completed: 4/4/2010

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APPENDIX B – GROUNDWATER FLOW ESTIMATES

METHODS AND CRITERIA

The source water protection areas were delineated using the uniform flow equation. 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 Birch Creek 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 value is calculated from the specific yield of the PWS well using the method described in Driscoll (1980) for confined aquifers, where:
  Q/s = T/2000; or T = 2000 Q/s
  Q = pumping rate, gpm – 60 gpm
  s = drawdown, in feet – 24 feet note: Q/s = specific capacity
  T = Transmissivity, in gpd/ft
  The estimated value for Transmissivity is 5,000 gpd/ft, which equals 668 ft^2/day
- **Thickness:** The thickness of the aquifer for the water source was estimated as 43 feet, based on the thickness of the lowest sandstone screened for the PWS well.
- **Hydraulic Conductivity:** A value for hydraulic conductivity is estimated using the basic relationship
  T = Kb, where T = transmissivity – 668 ft^2/day
  b = aquifer thickness – 100 feet
  The estimated value for the hydraulic conductivity (K) is 6.68 ft/day. A rounded value of 10 ft/day is used as a conservative estimate for this assessment.
- **Hydraulic Gradient:** The hydraulic gradient was estimated at 50 feet/mile, or 0.01 feet/feet.
- **Porosity:** The value for effective porosity is estimated from Heath (1989) at 20%.
- **Pumping Rate:** The pumping rate was estimated at 20 gpm, based on estimated well use.

RESULTS

Groundwater flow in the PWS aquifer, based on the above assumptions, travels an estimated distance of 3,150 feet (0.6 mile) in a 1-year period. The 3-year time of travel distance is estimated at 9,250 feet (1.75 miles).

Table B1. Birch Creek Public Water Supply - Summary of Time of Travel Calculations

Property		Units	
Porosity	n	percent	0.2
Hyd Cond	K	ft/day	10
Hyd Grad	I	ft/ft	0.01
Pumping Rate	Q	gpm	20
		ft^3/day	3850
Aquifer Thickness	b	ft	43
Distance Upgradient to Null Point			
Null Distance	Xl	ft	142
		miles	0.03
Lateral limits of Zone of Contribution			
Boundary Limits	Y	ft	448
		miles	0.08

Table B2. Time of Travel Calculations

Distance Traveled			Time of Travel	
Feet	**Miles**		**Days**	**Years**
1,000	0.19		1,406.74	3.85
100	0.02		48.48	0.13
500	0.09		570.78	1.56
1,000	0.19		1,406.74	3.85
2,500	0.47		4,167.76	11.41
5,000	0.95		8,978.01	24.58
5,280	1.00		9,522.90	26.07
7,500	1.42		13,865.10	37.96
10,000	1.89		18,784.44	51.43
10,560	2.00		19,889.12	54.45
15,000	2.84		28,670.22	78.49
15,840	3.00		30,334.83	83.05
21,120	4.00		40,813.48	111.74
31,680	6.00		61,818.56	169.25
363	0.07		365.13	1.00
820	0.16		1,095.60	3.00
2,227	0.42		3,652.84	10.00