SOURCE WATER DELINEATION AND ASSESSMENT REPORT

11/99

City of Ronan

Public Water System

PWSID # MT0000318

Date of Report: June 2000

Mark Clary
Kevin Templar,
Certified Operators

109 2nd Avenue SW
Ronan, Montana 59864

(406) 676-4231

Table of Contents

FIGURES

Tables

Appendices

GLOSSARY*

Acute Health Effect. An adverse health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

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

Best Management Practices (BMPs). Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

Coliform Bacteria. Bacteria found in the intestinal tracts of animals. Their presence in water is an indicator of pollution and possible contamination by pathogens.

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

Confining Unit. A geologic formation that inhibits the flow of water.

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

Delineation. A process of mapping source water management areas.

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

Hazard. A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through an aquifer.

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

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

Nitrate. An important plant nutrient and type of inorganic fertilizer. In water the major sources of nitrates are septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet.

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

Point-Source. A stationary location or fixed facility from which pollutants are discharged.

Public Water System. A system that provides piped water for human consumption to at least 15 service connections or regularly serves 25 individuals.

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

Recharge Region. A source water management region that is generally the entire area that could contribute water to an aquifer used by a public water supply. Includes areas that could contribute water over long time periods or under different water usage patterns.

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

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

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

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

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

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

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

Transmissivity. The ability of an aquifer to transmit water.

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

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

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

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

INTRODUCTION

This Delineation and Assessment Report was completed by James Swierc with the DEQ Source Water Protection Program, with assistance from Mark Clary, Operator for the Ronan PWS (ID# 318). Ronan is located in Lake County, on the Flathead Indian Reservation, home of the Confederated Salish and Kootenai Tribes (CSKT).

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Ronan PWS as required by the Montana Source Water Protection Program and the federal Safe Drinking Water Act (SDWA).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protecting public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is termed delineation and assessment. The emphasis of this delineation and assessment report is identifying significant potential contaminant threats to public drinking water sources and providing the information needed to develop a source water protection plan for Ronan.

Delineation is a process whereby areas that contribute water to aquifers or surface waters used for drinking water, called source water protection areas, are identified on a map. Geologic and hydrologic conditions are evaluated in order to delineate source water protection areas. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported and then determining the potential for contamination of drinking water by these sources.

Delineation and assessment is the foundation of source water protection plans, the mechanism Ronan can use to protect their drinking water source. Although voluntary, source water protection plans are the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate the Ronan operator and the local community to complete a source water protection plan that meets their specific needs.

Limitations

This report was prepared to assess threats to the Ronan 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 Ronan 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 Ronan 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 City of Ronan is located in the central part of the Mission Valley, within the boundaries of the Flathead Indian Reservation (Figure 1). Ronan has a population estimated at 1,939 people in 1990. The local economy relies on the agriculture and businesses in the area. The major highway in the area is U.S. Highway 93, which runs in a north-south direction through both the town and the Mission Valley, and connects Ronan with Saint Ignatius to the south and Pablo and Polson to the north.

Wastewater from the community is collected in a sanitary sewer system. The sewer system discharges to treatment ponds located southwest of the town (Figure 2).

Geographic setting

Ronan is located in the north-central part of the Mission Valley as depicted in Figure 2. The elevation of the town is approximately 3100 feet above sea level. The Mission Mountains, with peaks as high as 8,600 feet above sea level, represent the eastern boundary to the valley. The mountains that form the western valley boundary are as high as 7,400 feet above sea level. The Mission Valley is drained by the Flathead River, which flows generally southward from Flathead Lake to a position near Dixon, where the flow direction changes to west. Spring Creek flows south following a general north-south direction through town, and surface drainage in town is generally towards the creek. Further away from town, the general surface topography reflects a surface drainage pattern to the west, with streams following a general northeast to southwest trend (Figure 3). Several irrigation ditches that flow in a general northeast-southwest direction are also present in the area.

The climate in the area is typical for this part of Western Montana. Weather data is reported for Polson, a town located approximately 12 miles north of Ronan. Polson gets an average of 15.43 inches of precipitation annually, with the wettest months in May and June averaging 1.93 and 2.25 inches monthly, respectively. The driest months are February and March, with respective averages of 0.86 and 0.95 inches per month. The temperature ranges from an average high of 81.9°F in July (minimum July average of 52.9°F) to an average of 31.2°F in January (minimum January average of 18.9°F).

General description of the Source Water

The Ronan PWS obtains water primarily from a surface water source, Middle Crow Creek, draining from the Mission Mountains located west of Ronan. The intake is located at the approximate point where the stream leaves the mountains into the valley. The backup water supply comprises two wells installed into a relatively deep aquifer comprised of glacial outwash deposits covered by several hundred feet of clay-rich glacial tills. One well is located in the central part of town, and the second is located on the west side of town (Figure 2). The wells draw water from an approximate depth of 400 feet below the ground surface. Ground water in the source aquifer for the wells flows in an general westward direction in the Ronan area.

The Public Water Supply

The Ronan PWS currently serves an estimated population of 1630 with 863 active service connections. The surface water supply (Source 002) pipes water from the intake to a settling pond. The water is then disinfected with an ozone treatment system, followed by chlorination prior to entering the distribution system. The two backup supply wells are located as shown in Figure 2. The backup well supplies have capabilities for chlorination as a disinfection system. The Big Well (Source 003), located on the west side of town, was installed in 1974 to a depth of 453 feet and has a yield of up to 600 gpm. The Little Well (Source 004), located in the central part of Ronan in the City Park, was installed in 1961 to a depth of 346 feet, with an estimated yield of 150 gpm.

A general plan showing the layout of the distribution system is presented in Appendix A, with copies of the most recent sanitary survey and the drillers well logs.

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 Ronan PWS show no violations or exceedences of any drinking water quality standards.

There is no available documentation of surface water quality from the Middle Crow Creek source in the Mission Mountains. The results of system monitoring of the Ronan PWS do not indicate any elevated levels of any dissolved constituents. This is consistent with the recharge area for the watershed being located in a pristine mountain wilderness area, the Mission Mountain Tribal Wilderness area in the Mission Mountains.

The ground water in the Pablo area is a calcium bicarbonate type, with generally low concentrations of dissolved constituents (Slagle, 1988). 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 a well in the Ronan area, northeast of the area where the source wells for the Ronan PWS wells are located. This data is considered representative of background water quality for the local water source aquifer.

Table 1. Background Ground Water Quality in Ronan

Sample Date	Cond µS/cm	pH SU	Temp °C	TDS mg/L	Hardness As $CaCO_3$ Mg/L	Ca mg/L	Mg Mg/L	Na Mg/L	K mg/L	HCO_3 Mg/L	CO_3 mg/L	SO_4 Mg/L	Cl Mg/L	F mg/L	SiO_2 Mg/L	NO_3 Mg/L
Well1																
8/26/75	151	6.2	10.0	86	0	21	4.3	2.9	0.8	89	--	1.9	0.6	< 0.1	9.2	0.27
6/7/84	69	8.4	8.0	42	30	9.1	1.8	0.9	0.3	43	0	1.3	0.6	< 0.1	5.7	0.24
Well 2																
8/26/75	197	6.6	11.5	120	90	29	4.2	6.6	1.1	120	--	3.1	0.1	0.1	14	0.18

Source wells listed are both from Township 20 North, Range 20 West, Section 2, in the Ronan Town area.
Well 1 is from Section 2aac and Well 2 is from Section 2bab
Data from Slagle (1988).

CHAPTER 2
DELINEATION

The source water protection area, the land area that contributes water to the Ronan PWS, is identified in this chapter. For the surface water intake, the management area is delineated as the watershed area upstream from the intake. There are normally two surface water system management zones. This includes a spill response zone, that represents a distance upstream from the intake of a four-hour time of travel up to ten miles with a buffer zone of one-half mile on each side of the stream. The second surface water management zone is the watershed area, the area that comprises the headwaters for the surface water body. For the Middle Crow Creek surface water intake, the watershed is relatively small, and results in a combined spill response zone and recharge area.

For the backup wells for ground water, three management areas are identified within the source water protection area based on the criteria for wells installed into a confined aquifer. 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 for the confined aquifer represents an area of a 1,000 foot radius around each wellhead. The recharge region represents the area where the aquifer is replenished.

Surface Water Hydrologic Conditions

There are not any readily available published reports which assess the flow characteristics of the Middle Crow Creek watershed. The USGS maintains a water monitoring station on South Crow Creek; however the station is located several miles downstream from the surface water intake; after the confluence of North, Middle and South Crow Creeks several miles west of the Mission Mountain front. As a result, the information from this station is not considered representative of the flow from Middle Crow Creek in the Mission Mountains to the Ronan PWS intake.

The Middle Crow Creek Watershed is located within the Lower Flathead Watershed (USGS HUC 17010212), as part of the headwaters of the Columbia River Watershed. The limits of the Middle Crow Creek Watershed upstream from the surface water intake are shown in the map in Figure 3. The Middle Crow Creek watershed in the Mission Mountains upstream from the intake covers an estimated area of 3.25 square miles. Flow from the watershed is derived from meltwater from mountain glaciers in the upper elevations of the watershed; and from baseflow from the geologic materials filling the valley.

Hydrogeologic Conditions

Geologic and hydrogeologic studies of the Mission Valley and Ronan area are listed in Table 2, with a summary of maps listed in Table 3. The hydrogeologic system in the Mission Valley, including the Ronan area, is described in detail by Slagle (1988) and Boettcher (1983). The following description of the local hydrogeology is adapted from these sources. Within the Mission Valley, the major geologic units include a thick sequence of glacial deposits of clay-rich tills with small outwash seams overlying a thicker sequence of more continuous sand and gravel outwash deposits that can serve as productive local aquifers. These sediments were deposited by the advancing glacier over Tertiary basin-fill sediments as it advanced southward into the Mission Valley. Ronan is located at a general midpoint between glacial terminal moraine deposits near Polson and Charlo. The terminal moraine deposits are comprised of large amounts of sand and gravel deposited when the advancing glaciers stopped at this position. The surficial material near Ronan is primarily clay-rich strata with intermixed sand and gravel. Some alluvium comprising sand, gravel, boulders and some clay are present on the surface in some areas, with the thickest deposits of alluvium located adjacent to the Mission Mountains.

The aquifer material for the Ronan PWS is interpreted as comprised of glacial outwash sediments covered with

clay-rich glacial tills. The tills represent a confining layer for the coarser deposits of sand and gravel that produce water. Silt deposits of glacial Lake Missoula are present in some areas overlying the glacial tills. A limited number of thin, discontinuous sand and gravel outwash lenses in the till may produce small amounts of water, but none of these have been developed to supply any community systems. The glacial deposits cover the entire central part of the Mission Valley. A geologic map depicting the surface geology of the area around Ronan is present in Figure 4. A generalized ground water flow map for the glacial aquifer that is the source for the Ronan PWS is depicted in Figure 5.

The glacial outwash sediments representing the source aquifer for Ronan can be considered to have boundaries where PreCambrian Belt Supergroup rocks outcrop along the margins of the valley. Due to the depth of the outwash deposits below the surface, and the nature of glacial deposits in general, the exact configuration of the aquifer is not known. However, the aquifer does represent a water source developed by communities across the central part of the Mission Valley. Based on interpretation of the well logs for the PWS wells (Appendix B), the glacial outwash deposits comprising the aquifer for the Ronan PWS occur in discontinuous sand and/or gravel seems ranging in thickness from several feet up to 30 feet or more. These outwash seams cannot be correlated over large distances, as is common in glacial strata. However, the occurrence of these seams significantly increases at an approximate depth of 350 feet below the surface. In addition, the high density of these seams and consistent yield demonstrate that they are in communication, and can be considered as a single aquifer unit. This is supported by various studies mapping the potentiometric surface in them as a single unit (Table 3). The overlying clay-rich tills that represent the confining aquitard to the deeper outwash seams are generally present from an estimated depth of 50 feet to 350 feet below the surface. Small water bearing seams may be present within these tills; however, they occur as small discontinuous lenses that do not appear to be in hydraulic communication with other water bearing intervals. As a result, these seams do not provide sufficient yield for development as a water source with no PWS in the Mission Valley utilizing them as a source. The geologic cross-section in Figure 6 depicts the relationship of the different types of glacial deposits in the Ronan area to the margins of the Mission Valley.

The static water level of the deep glacial aquifer is near the surface, and may result in flowing artesian wells in parts of the Mission Valley west of Pablo. The Ronan PWS wells are classified as flowing artesian wells. However, an area of approximately 50 square miles located west of Ronan does not have any usable quantities of ground water, reflecting the variability of the type of deposits that represent the source for the glacial aquifer. Based on the hydrogeologic setting as a confined aquifer with a thick sequence of overlying clays, the aquifer is classified as having a low source water sensitivity to contamination.

Table 2. **List of geologic or hydrogeologic investigations near the Ronan and Mission Valley area.**

Title of Project	Reference Information	Area Covered	Project Purpose
Physiography and Glacial Geology of Western Montana and adjacent areas	Alden, W.C., 1953 U.S. Geological Survey Professional Paper 231	Western Montana including the Mission Valley, and the Idaho Panhandle	Document the regional glacial history and related deposits.
Ground-Water Resources in the Central Part of the Flathead Indian Reservation, Northwestern Montana	Boettcher, A.J., 1982 Montana Bureau of Mines and Geology Memoir 48	Mission Valley and Little Bitterroot Valley	Document hydrogeology, ground water quality, and potential for development of ground water in the study area
Geohydrology of the Flathead Indian Reservation, Northwestern Montana	Slagle, S.E., 1988 U.S. Geological Survey Water-Resources Investigations Report 88-4142	Flathead Indian Reservation, including Mission Valley	Update Boettcher with a more comprehensive study covering the entire Flathead Reservation

Table 3. **List of geologic or hydrogeologic maps available for the Ronan area.**

Title or Description	Date	Area Covered	Reference
Map showing generalized geology and depth to the top of Belt Supergroup; and Map showing altitude and configuration of the water surface of the valley-fill aquifers	1988	Flathead Reservation	Ground-Water Resources in the Central Part of the Flathead Indian Reservation, Northwestern Montana; Boettcher, A.J., 1982; Montana Bureau of Mines and Geology Memoir 48
Generalized geohydrologic map of the central part of he Flathead Indian Reservation; And Map showing potentiometric surface, well locations and low-flow measurement sites in the central part of the Flathead Indian Reservation	1982	Mission Valley and Little Bitterroot Valley	Geohydrology of the Flathead Indian Reservation, Northwestern Montana; Slagle, S.E., 1988; U.S. Geological Survey Water-Resources Investigations Report 88-4142

Hydrogeologic Conceptual Model and Assumptions

A conceptual hydrogeologic model is a simplified representation of the hydrogeologic system. For the Ronan area, ground water occurs in glacial outwash beds as the primary aquifer. These deposits are recharged by surface water infiltration into alluvium and other surficial material along the margins of the Mission Mountains. In this area, mountain glacial deposits are intermixed with the valley glaciers, and the tills are not present as a continuous confining layer. Additional recharge from infiltration of precipitation and stream loss may occur in limited quantities. Water flows from the recharge area vertically downwards to the aquifer beds, then horizontally towards the central part of the Mission Valley beneath the thick clay-rich tills. In the Ronan area, any flowpath for water from the surface to the deep glacial aquifer would be convoluted through any shallow water bearing seams in the surficial deposits. In addition, from its recharge area adjacent to the mountains, water flows in the deeper glacial aquifer in a general western and southwestern direction towards the Flathead River, which acts as a discharge point. This relationship is depicted in the cross-section in Figure 6.

In the area near Ronan, shallow ground water may be present at various locations in surface deposits of alluvium or other glacial deposits. Low yields from these units indicate that they do not represent a significant source of water. The confined nature of the lower aquifer, with wells flowing at the surface, demonstrates the separation of any shallow ground water with the deeper system.

Well(s) Information

The source wells for the Ronan PWS are located as shown in Figure 2. Copies of the drillers well logs are included in Appendix A. Well information is summarized in Table 4. The Big Shop Well (Well No. 1) has casing to 454 feet, with perforations from 382 to 383 feet, and from 402 to 419 feet. The well was drilled to a total depth of 490 feet. The second well, the Little Park Well (Well No. 2), has unperforated casing installed to the total depth of the well at 345 feet.

Methods and Criteria

The methods and criteria used to delineate the source water protection zones for the Ronan water system are specified in the Montana Department of Environmental Quality Source Water Protection Program (DEQ, 1999). For the surface water source, this includes an assessment of the watershed upstream from the intake. The spill response zone was delineated by mapping the area included within one-half mile from Middle Crow Creek

upstream from the surface water intake. The watershed recharge area for this drainage was mapped using USGS topographic maps at a 1:24,000 scale. Since the watershed limits are typically less than one-half mile from the stream, the spill response zone and watershed are outlined as a single area. This combined spill response and watershed zone is depicted in Figure 7. The Middle Crow Creek source for the Ronan PWS has the Water Right # W141909-00, according to the DNRC database.

For the backup wells for the Ronan system, the criterion for confined aquifer systems was followed. This incorporates using a fixed radius to identify the control and inventory zones around each well. The inventory zones for the Ronan wells defined by this criterion, a 100 foot radius for the control zone and a 1,000 foot radius for the inventory zone, are depicted in Figure 8. The recharge area was identified using available geologic maps (Boettcher, 1983; Slagle, 1988) and is shown in Figure 9.

Table 4. **Source well information for Ronan.**

Information	Well #1 Big Well – Shop	Well #2 Little Well - Park
PWS Source Code	003	004
Well Location (T, R, Sec or lat, long)	T20N, R20W, Section 2 BD	T20N, R20W, Section 2
MBMG #	74823	74822
Water Right #	P000073-00	W141908-00
Date Well Completed	11/28/73	9/23/61
Total Depth	490 feet	345 feet
Perforated Interval	382 – 383 feet; 402 – 419 feet; Casing to 453.8 feet	Casing to 346.8 feet
Static Water Level	--	--
Pumping Water Level	100 feet	--
Drawdown	--	--
Test Pumping Rate	600 gpm	150 gpm
Specific Capacity	--	--

Ground Water Flow Rates and Time of Travel

Time of travel calculations were completed using the uniform flow equation (EPA, 1993) for the glacial aquifer supplying the Ronan PWS. Conservative estimates for aquifer properties were made using available data from published reports. Since information on the aquifer in the Ronan area is limited, this assessment utilizes aquifer parameters determined for the Pablo area several miles north of Ronan. The flow rate estimates are made to evaluate the time of travel distance from the recharge area along the front of the Mission Mountains. The time of travel calculations are used to assess the impacts from potential contaminant sources in the inventory zone.

Model Input

The values selected for the calculation of time of travel represent conservative assumptions made to evaluate ground water flow rates upgradient from the Ronan area. The values for these estimates are based on criteria summarized on well tests in the area in Slagle (1988). The criteria for selection of each value used for the ground water flow estimatesis summarized as follows:

- ***Transmissivity***: The transmissivity value is calculated from the specific yield of the a 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 – 220 gpm

  s = drawdown, in feet - 199 feet note: Q/s = specific capacity

  T = Transmissivity, in gpd/ft

The estimated value for Transmissivity is 2,211 gpd/ft, which equals 296.3 ft^2/day

- ***Thickness***: The value for the thickness of the aquifer is estimated at 20 feet, which reflects the thickness of the water bearing intervals for the two PWS wells interpreted from the well logs (Appendix B)
- ***Hydraulic Conductivity***: A value for hydraulic conductivity is estimated using the basic relationship

  T = Kb, where T = transmissivity – 296.3 ft2/day
  b = aquifer thickness – 20 feet

  The estimated value for the hydraulic conductivity (K) is 14.8 ft/day. A rounded value of 15 ft/day is used for this assessment.
- ***Hydraulic Gradient***: The hydraulic gradient was measured from two potentiometric surface maps published in different studies. The local gradient calculated from a flow map in Slagle (1988) shows an approximate change of 100 feet over a distance of 5 miles, for an estimated gradient of 0.0037. A value of 0.004 was used for this study as the potentiometric surface in the Ronan area is relatively flat.
- ***Flow Direction***: The flow direction from Slagle (1988) indicates a generally western flow direction. The estimated flow direction for this study is considered as due west (270 degrees) to reflect the regional flow system.
- ***Porosity***: The value for effective porosity is estimated from (Todd, 1980) at 30%. The estimated value is considered representative of gravel intermixed with finer grained material, such as a glacial till.
- ***Pumping Rate***: The pumping rate for the wells was estimated at 200 gpm, reflecting the needs of the system.

Ground Water Flow Rate Calculation Results

Summary spreadsheets of the results of the time of travel calculations for the aquifer is included in Appendix D. The results of the calculations indicate an estimated distance of 915 feet for a one-year time of travel (TOT), and a distance of 1,645 feet for a three-year TOT. These results indicate that horizontal flow within the deep glacial aquifer is very slow, taking many years to flow from the recharge areas adjacent to the Mission Mountains.

Limiting Factors

The ground water flow rate calculations use values that are considered representative of actual conditions. This approach reflects the uncertainties in the data used in the modeling process, with estimates reflecting conservative, or worst-case conditions. The assumed values are consistent with published data on the ground water system in the Mission Valley and Ronan study area (Table 2). While the inventory zones are delineated using criteria for confined aquifers, ground water flow rates were estimated to demonstrate the general properties of the ground water flow system for assessments on a more regional scale. In addition, the assessment of flow conditions in the shallow aquifer primarily reflect assumed or estimated values as there is little available information on this unit. As a result, the calculations of flow rates for both the deep and shallow aquifers are considered as estimates. Further refinement of the hydrogeologic conceptual model and time of travel flow calculations would require collection of additional data.

Additional limitations result from the use of the Uniform Flow Equation for analysis of flow rates, which does not account for pumping from multiple wells. Uncertainty in flow conditions for the shallow unit reflect the relationship between surface water and the unit, and the density and frequency of pumping from wells installed at various locations across the study area. An additional limitation on this assessment reflects the nature of glacial strata, where deposit types reflect variable shapes, and can exhibit rapid changes in hydraulic properties over very short distances.

CHAPTER 3
INVENTORY

An inventory of potential sources of contamination was conducted for the Ronan PWS within the spill response and watershed regions for the surface water source; and within the control and inventory regions for the ground water sources. Potential sources of all primary drinking water contaminants, including pathogens, were identified. However, only significant potential contaminant sources were selected for detailed inventory. There are no significant potential contaminant sources identified within the delineated management zones for the surface water systems. For the ground water wells, the significant potential contaminants in the inventory region include nitrates and pathogens from sanitary sewers, septic systems and agriculture; and herbicides and pesticides from cropped agricultural land.

The inventory for the Ronan PWS focuses on all activities in the control zone, certain sites or land use activities in the inventory and special protection regions, and general land uses and large facilities in the recharge region. The inventory results for potential contaminant sources within the inventory zone for the wells, as listed in the following steps, are summarized in Table 5.

Inventory Method – Surface Water System

The spill response zone and watershed region for the surface water source are located within the Mission Mountain Tribal Wilderness Area, a wilderness area established and protected by the Confederated Salish and Kootanai Tribes of the Flathead Reservation. As a result, the watershed region represents a relatively pristine wilderness area with no impacts from anthropogenic activities. The results of the standard inventory procedures, as outlined in the following for the ground water system, did not indicate any potential sources in the watershed area for this source.

Inventory Method – Ground Water System

The primary inventory method represents a "windshield survey" and a business directory search of the delineated inventory zones in the Ronan area. This assessment was completed as a method of checking on the information provided from available databases, and to identify any sites, facilities or land uses that may not have been included with the database searches.

The available databases were initially searched to identify businesses and land uses that are potential sources of regulated contaminants in the inventory region. The following steps were followed:

Step 1: Urban and agricultural land uses were identified from the U.S. Geological Survey's Geographic Information Retrieval and Analysis System. Sewered and unsewered residential land use were identified from boundaries of sewer coverage obtained from municipal wastewater utilities. Storm water management and discharge points were identified with the help of the PWS Operator. Septic system density outside of the sewered area was evaluated using census block population data, reflecting a septic system density of 2.6 persons per septic system.

- This information is depicted in Figure 10 and Figure 11.

Step 2: 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), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.

- A total of ten facilities were identified using this query. The location of several of these facilities near the inventory zones for the wells is indicated in Figure 12.

Ronan Area Envirofacts Sites

Facility Name	*Address*	*EPA Facility ID*	*Comments*
(Former) Don Aadsen Ford	*5 3rd Ave NW*	MTD035284637	Hazardous waste handler, located just north of inventory zone for park well
Conoco Service Station	9 Hwy 93 S	7550654	Gasoline Service Station
Georges BP	1018 Hwy 93 S	MT0001887090	Gasoline Service Station
Jore Manufacturing	45000 Hwy 93 S	7550684	
Lake County Weed District	1210 Round Butte Rd. W	MTD981552276	
Ronan Auto Body	Old Hwy 93	7550673	
Ronan – City of	205 Mink Lane	MT0001691153	Wastewater Treatment Discharge
S&K Electronics, Inc.	53347 Hwy 93	MTD144179462	
Westland Seed Inc	1308 Round Butte Rd	MTD065662256	

Step 3: The Permit Compliance System (PCS) was queried using Envirofacts to identify Concentrated Animal Feeding Operations with MPDES permits. The water system operator or other local official familiar with the area included in the inventory region identified animal feeding operations that are not required to obtain a permit.

- No facilities in the Ronan area were identified with this query.

Step 4: Databases at DEQ were queried to identify the following in the inventory region: Underground Storage Tanks (UST), hazardous waste contaminated sites, landfills, abandoned mines and active mines including gravel pits. Any information on past releases and present compliance status was noted.

- The following UST Sites were identified. The location of the sites near the inventory zones for the wells is shown in Figure 12.

Ronan Area Active Underground Storage Tanks

Name	*Address*	*Facility ID*	*Number USTs*	*Comments*
Arnie's Gas and Tire Center, Inc	9 Hwy 93 S	24-05517	4	1 Diesel and 3 Gasoline USTs Active LUST Site
East of Ronan Middle School	500 Round Butte Road W	24-04824	1	Heating Oil UST
George's Exxon	1018 Hwy 93 S	24-07532	6	4 Diesel and 2 Gasoline USTs Active LUST Site
Kicking Horse Job Corps Center	2000 Mollman Pass Trail	24-10386	3	2 Diesel and 1 Gasoline USTs
John's Fuel Farm	308 Hwy 93 S	24-07437	6	3 Diesel and 3 Gasoline USTs
Ronan Town Pump	1213 29th Street	24-08718	4	1 Diesel and 3 Gasoline USTs
St. Luke Community Hospital	107 6th Ave SW	24-03736	1	Heating Oil UST
Dyno Mart (Midnite Market #31)	303 Hwy 93 N	24-05768	3	Gasoline USTs
Cenex Farm & Home Supply	1408 Hwy 93 S. East Side of Hwy	24-04530	5	2 Diesel and 3 Gasoline USTs Active LUST Site

- The following Leaking UST Sites were identified. Since these sites are located on the Flathead Reservation, CS&KT staff may monitor remediation and other clean-up activities. As a result, some of this information may not be present in the DEQ database. In some cases, sites may have been closed with no cleanup completion data noted. The location of the LUST sites within and near the inventory zones for the wells is shown in Figure 12.

Ronan Area Leaking Underground Storage Tank Sites

Name	*Address*	*Facility ID*	*Leak #*	*Confirmed Release Date*	*Cleanup Completion Date*	*Ground Water Impacts / Comments*
Arnie's Gas & Tire Center	9 Hwy 93 S	24-05517	482	11/9/90		Active Service Station; cleanup ongoing, impacts to shallow ground water detected
Cenex Bulk Plant	1407 Hwy 93 S West Side of Hwy	24-07909	1803	6/15/92	8/24/93	All storage tanks and piping above ground as of 7/3/96
Cenex Farm and Home Supply	1408 Hwy 93 S East Side of Hwy	24-04530	873	9/3/91		Active Service Station; impacts to shallow ground water, remediation ongoing
City of Ronan	109 2nd Ave SW	24-12053	1189	4/29/92		Heating Oil, shallow soils only
City of Ronan	2nd Ave SW and Main	24-13904	3550	8/26/98		No impacts to ground water
City of Ronan	1010 Main St. SW	24-08549	3201	7/24/97		No impacts to ground water
Consolidated Dairies	1317 Hwy 93 S	24-13400	2172 2448	4/12/94 11/4/94	4/12/94 5/9/96	No impacts to ground water
Don Aadsen Parts & Service	5 3rd Ave NW	24-13662	2680 3117	8/16/95 2/25/97		Waste oil leak, diesel spill with impacts to surface water
Don Aadsen Ford, Inc	Hwy 93 N	24-07355	2546	3/24/95		Heating oil, impacts to shallow ground water
George's Exxon (Atkinson)	1018 Hwy 93 S	24-07532	2183	4/25/94		Free product on top of shallow water table; remediation ongoing
Granly, Gary or Norma	207 Main St. SW	24-02705	2531	3/2/95	3/28/95	No impacts to ground water
Hofschulte, Dwaye and Daphne	*Not listed*	24-12596	927	9/5/91	11/5/93	Abandoned gas station, no impacts to ground water
Hoversland, Rueben Ranch	4160 Addy Lane	24-03410	1536	12/23/92	6/29/93	No impacts to ground water
Midnite Market #31 (Dyno Mart)	303 Hwy 93 N	24-05768	1180	4/29/92	11/10/92	No impacts to ground water
Mission Mountain Enterprise	330 Main St. SW	24-10595	3582	11/13/98		No impacts to ground water
Ronan Auto Body Sales and Service	703 Hwy 93	24-01551	3178	6/17/97	11/20/97	No impacts to ground water
Ronan Telephone	Round Butte Road Shop	24-09648	2283	7/11/94		No impacts to ground water
Ronan United Methodist Church	512 Buchanan SW	24-01794	2320	8/25/94	1/26/95	No impacts to ground water
St. Lukes Hospital	107 6th Ave SW	24-08307	3562	10/26/98	1/26/99	No impacts to ground water
Stephens, Maynard	133 Franklin St SW	24-01564	2246	7/5/94	7/21/94	No impacts to ground water
Stonehocker, George	Box 61, Star Route	24-07167	2089	2/3/94	3/4/94	No impacts to ground water
US Post Office	222 Adams St. SW	24-09908	1114	2/26/92	3/12/92	No impacts to ground water

- A single hazardous waste contaminated sites (CECRA Sites), the old community dump, is present in the DEQ database for the Ronan area. This site is listed at a medium priority site.

- There are landfills, either active or closed, in the DEQ database for the Ronan area.

- There are no inactive mines, including gravel pits, in the Ronan area.

Step 5: A business phone directory was queried to identify businesses that generate, use, or store chemicals in the inventory region. Businesses such as equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by SIC code.

- The SIC code search identified the following businesses for Ronan. The businesses in ***bold italic*** represent locations within or adjacent to the well inventory zones.

Ronan Area SIC Code Search Results

Name	*SIC Code*	*Business Type*	*Address*
Arnie's Gas & Tire Ctr	***5541***	***Gasoline Service Stations***	***9 US Highway 93 S***
Artisan Photography	7335	Commercial Photography	2218 Emory Rd
Baer's Flying Svc	4581	Airports and Aircraft Service and Maintenance	102 Mud Creek Ln
Benson Mechanic & Welding	7538	General Automotive Repair Shops	1097 Little Marten Rd
Big Sky Heating & Air Cond	1711	Heating and Air Conditioning Service	505 Main St SW
Canyon Mill Photo & Custom Lab	7221	Photography Studios	3385 Canyon Mill Rd
Catamount Veterinary Clinic	0742	Veterinarians	33 Timberlane Rd
Cenex Supply & Marketing Inc	5172	Petroleum Product Wholesalers, except Bulk Stations and Terminals	1408 US Highway 93 S
Circle J's Restaurant	5541	Gasoline Service Stations	303 US Highway 93 N
Collision Service	7532	Automobile Repair	90 Timberlane Rd
Creative Landscapes	0782	Agriculture – Landscaping	2380 Round Butte Rd W
Dads	7538	General Automotive Repair Shops	347 Clairmont Rd
Don Aadsen Ford	5531	Retail Automobile	107 US Highway 93 N
Edelman Enterprises	4971	Hydrogeologists	1050 Spring Creek Rd
Flathead/Mission Valley Dspsl	4953	Sanitary Services	45358 US Highway 93
Folkshop	***8399***	***Recycling Center***	***221 US Highway 93 S***
G & L Propane	5172	Petroleum Product Wholesalers, except Bulk Stations and Terminals	1018 US Highway 93 S
George's BP	5541	Gasoline Service Stations	1018 US Highway 93 S
H & L Auto Body & Dscnt Glass	7532	Automobile Body and Interior Repair and Paint Shop	185 Spud Ln
Hodge Radiator Repair	***7699***	***Equipment Repair Shop***	***103 Main St SW***
Hodges Welding Inc	7692	Welding	53032 US Highway 93
Image Quest	2759	Screen Printing	5266 Stipe Ln
Jerome's Repair	***7699***	***Equipment Repair Shop***	***336 Round Butte Rd W***
John's Fuel Farm	***5172***	***Petroleum Product Wholesalers, except Bulk Stations and Terminals***	***308 US Highway 93 S***
K C's Pump Svc	1781	Well Drilling	2059 Clairmont Rd
K-O Auto Specialist	7538	General Automotive Repair Shops	1408 US Highway 93 S
Lake County Leader/Advertiser	***2711***	***Newspaper Publishers***	***229 Main St SW***
Lake Seed Inc	0723	Agriculture Supplies	25 Spring Creek Rd
Mark's Machine Shop	***7538***	***General Automotive Repair Shops***	***224 US Highway 93 S***
Mission Mountain Country Club	7992	Golf Courses	640 Stagecoach Trl
Mission Mountain Landscaping	0782	Agriculture – Landscaping	2085 Clairmont Rd
Mission Mountain Medicine	8011	Small Medical Treatment Centers	108 6th Ave SW
Mission Transmissions	7537	Automobile Transmission Repair Shops	207 Clairmont Rd
Mission Valley Automotive	***7538***	***General Automotive Repair Shops***	***1000 Round Butte Rd W***
Mission Valley Power	***9199***	***Government Offices***	***122 Round Butte Rd W***
Mission Valley Printing	***2752***	***Printers***	***23 3rd Ave SW***
Mission Valley Veterinary Clnc	0742	Veterinary Services	424 Terrace Lake Rd

Ronan Area SIC Code Search Results, Continued

Name	*SIC Code*	*Business Type*	*Address*
News-Press	***2752***	***Printers***	***229 Main St SW***
Pablo Land & Cattle Inc	0751	Livestock Breeders	3155 Leighton Rd
Palmchuk Landscape & Nursery	0782	Landscape Contractors	1200 Highway 93
Palmchuk Landscape & Nursery	***0782***	***Landscape Contractors***	***411 Main St SW***
Paulson's Mini-Barns	4225	General Warehousing and Storage	1100 Timberlane Rd
Piedalue Livestock	5154	Livestock	927 Piedalue Ln
Ronan Airport	4581	Airports and Aircraft Service and Maintenance	Airport Rd
Ronan Auto Body-Chrysler Prods	7532	Automobile Body, Interior Repair and Paint Shop	607 3rd Ave NW
Ronan Mini Storage	4225	General Warehousing and Storage	347 3rd Ave NW
Ronan Power Products	***5261***	***Retail Nurseries, Lawn & Garden Supply Stores***	***111 Round Butte Rd W***
Round Butte Mini Storage	4225	General Warehousing and Storage	814 US Highway 93 S
Shop Specialties	5093	Scrap and Waste Materials	266 Glacier Lily Ln
Shrider's Mortuary	7261	Funeral Services and Crematories	419 Round Butte Rd W
Sparks Mechanical	7699	Equipment Repair Shop	1072 N Foothills Dr
St Luke Community Hospital	8062	Medical Facilities	107 6th Ave SW
Tracy's Auto	7538	General Automotive Repair Shops	367 Michel Rd
Veterinary Services	0742	Veterinary Services	50052 US Highway 93
Westland Seed Inc	***5191***	***Farm Supplies***	***1308 Round Butte Rd W***
White's Wholesale Meats	2011	Meat Packing Plants	1208 Terrace Lake Rd
Wood's Farm & Garden Ctr	5261	Retail Nurseries, Lawn and Garden Supply Stores	309 3rd Ave NW
Woodchuck Logging	2411	Logging	203 Michel Rd
Woody's Mechanic Shop	7538	General Automotive Repair Shops	5 8th Ave NW

Note – Some businesses may be identified by multiple SIC codes.

Step 6: Major road and rail transportation routes were identified throughout the inventory region (http://nris.state.mt.us/gis/datalist.html).

- The major transportation route is US 93, which runs in a north-south direction through Ronan. A secondary major transportation route, MT State Highway 211, runs east-west through Ronan. A railroad line is also present in a general parallel direction to US 93. The locations of these, and other minor transportation routes, are identified on Figure 10.

Step 7. All land uses and facilities that generate, store, or use large quantities of potentially hazardous materials were identified within the recharge region and identified on the base map. This information reflects the results of the inventory process outlined in the previous steps.

- All of the inventoried facilities classified as significant potential contaminant sources based on the criteria outlined in the Montana Source Water Protection Program are identified on the map in Figure 13.

Step 8: All wells located within the inventory region were identified and well logs were obtained when available.

- The well logs available from MBMG – GWIC are summarized in the Tables in Appendix C. The locations of the known wells are identified on the base map in Figure 13.
- There may be wells located in the Ronan area operated by the Confederated Salish and Kootenai Tribes, with no documentation of these wells available from MBMG-GWIC.

Ronan PWS Inventory Zone Area Deep Wells

GWIC Id	*DNRC Water Right*	*Site Name*	*Township*	*Range*	*Section*	*Tract*	*Total Depth*	*Completion Date*
6079		City of Ronan, Near Spring Creek	20N	20W	2	AAC	550	--
6080		City Park, Ronan	20N	20W	2	AAC	550	--
6081		City of Ronan, West of Town	20N	20W	2	BAB	540	--

The results of the "windshield survey" were generally consistent with the results from database searches. The only additional site observed is the City of Ronan Public Works Shop area. The Big Shop Well is located within this area. Several above ground fuel tanks were observed, and other small volumes of chemicals may be stored at the site. Another concern observed is above ground heating oil tanks present at residences and businesses in the area. However, these are not classified as signficant potential contaminant sources.

The following summarizes the results of the inventory for the Ronan area. For the surface water system, there are no potential contaminant sources identified within the Spill Response/Watershed zone. The potential contaminants are listed, with a description of the potential release mechanism for the site. In all cases, releases may occur due to unavoidable conditions such as flooding, lightning or fire. The sites where this is the primary potential release mechanism are identified as concerns resulting from such a disaster. For other sites where other release mechanisms may be more common, the potential for a release from such a disaster is assumed.

Table 5. **Summary of Inventory Results for Ronan PWS Well Inventory Zones and vicinity.**

ID#	*Source*	*Potential Contaminants*	*Description/Concern*
1	*Sanitary Sewer Systems*	*Pathogens and Nitrates*	*Leakage from sewer lines*
2	*Storm Water Discharge Points*	*Spills of Various chemicals*	*Point source to non-point source releases from urban land use*
3	*Septic Systems*	*Pathogens and Nitrates*	*Non-point source pollution, loading o f ground water system with effluent*
4	*(Former) Don Aadsen Ford*	*Petroleum Hydrocarbons*	*LUST Site, envirofacts site; concern over impacts of released hydrocarbons to ground water*
5	*Conoco Service Station/ Arnie's Gas and Tire Center, Inc*	*Petroleum Hydrocarbons*	*LUST Site, envirofacts site, active UST site; concern over impacts to shallow ground water*
6	*John's Fuel Farm*	*Petroleum Hydrocarbons*	*Leakage from tanks*
7	*City of Ronan LUST Sites*	*Petroleum Hydrocarbons*	*Three sites, closed with no impacts to ground water;*
8	*LUST – Granly Site*	*Petroleum Hydrocarbons*	*No impacts to ground water*
9	*LUST – Mission Mountain Enterprises*	*Petroleum Hydrocarbons*	*No impacts to ground water*
10	*LUST - Ronan Telephone*	*Petroleum Hydrocarbons*	*No impacts to ground water*
11	*LUST – US Post Office*	*Petroleum Hydrocarbons*	*No impacts to ground water*
12	*Folkshop Recycling Center*	*Small amounts of various chemicals*	*Natural Disaster - Spill of unknown chemicals stored at facility*
13	*Hodge Radiator Repair*	*Petroleum Hydrocarbons, Cleaning Solvents, Antifreeze*	*Natural Disaster – spill/release of chemicals and fuels stored on site*
14	*Jerome's Repair*	*Petroleum Hydrocarbons, Cleaning Solvents, Antifreeze*	*Natural Disaster – spill/release of chemicals and fuels stored on site*
15	*Lake County Leader/Advertiser*	*Inks (Volatile Organic Chemicals)*	*Natural Disaster – spill/release of inks*
16	*Mark's Machine Shop*	*Petroleum Hydrocarbons, Cleaning Solvents, Antifreeze*	*Natural Disaster – spill/release of chemicals and fuels stored on site*
17	*Mission Valley Automotive*	*Petroleum Hydrocarbons, Cleaning Solvents, Antifreeze*	*Natural Disaster – spill/release of chemicals and fuels stored on site*

18	*Mission Valley Power*	*Spills of small volumes of various chemicals*	*Natural Disaster – spill/release of chemicals and fuels stored on site*

Table 5 (continued). Summary of Inventory Results for Ronan PWS Well Inventory Zones and vicinity.

ID#	Source	Potential Contaminants	Description/Concern
19	*Mission Valley Printing*	*Inks (Volatile Organic Chemicals)*	*Natural Disaster – spill/release of inks*
20	*News-Press*	*Inks (Volatile Organic Chemicals)*	*Natural Disaster – spill/release of inks*
21	*Palmchuk Landscape & Nursery*	*Spills of small volumes of agricultural chemicals*	*Natural Disaster – spill/release of chemicals and fuels stored on site*
22	*Ronan Power Products*	*Spills of small volumes of various chemicals*	*Natural Disaster – spill/release of chemicals and fuels stored on site*
23	*Westland Seed, Inc*	*Spills of small volumes of agricultural chemicals*	*Natural Disaster – spill/release of chemicals and fuels stored on site*
24	*Lake County Weed District*	*Pesticides and Herbicides*	*Natural Disaster or accidental spill of agricultural chemicals*
25	*City of Ronan Public Works Shop Area*	*Petroleum Hydrocarbons, Spills of small volumes of various chemicals used on site*	*Natural Disaster – spill/release of chemicals and fuels stored on site*
26	*Major Roads (US Hwy 93 and MT Hwy 211)*	*Spills of various chemicals*	*Disaster – spill/release of chemicals and fuels transported on highway*
27	*Railroad Lines*	*Spills of various chemicals*	*Disaster – spill/release of chemicals and fuels transported on railroad line*
28	*Agricultural Land Use*	*Pathogens and Nitrates; Pesticides and Herbicides*	*Non-point source pollution, concentration of fertilizers/chemicals in surface/ground water*
29	*Urban Land Use*	*Spills of various chemicals*	*Non-point source pollution, small spills of household chemicals*
30	*Class V Injection Wells*	*Various organic chemicals*	*Direct discharge of chemical to shallow ground water system*
31	*Heating Oil Tanks*	*Petroleum Hydrocarbons*	*Disaster or accidental spill of fuels*

The Montana source water protection program identifies specific types of potential contaminant sources as significant, for further evaluation of the susceptibility of the water source to these sources (Chapter 4). In general, potential contaminant sources are designated as significant if they fall into one of the following categories:

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

Inventory Results/Surface Water Spill Response and Watershed Zones

The inventory for the surface water source did not yield any potential contaminant sources present in the Middle Crow Creek watershed upstream from the PWS intake. The area is included in the Mission Mountain Tribal Wilderness, designated by the Confederated Salish and Kootenai Tribes of the Flathead Reservation.

Land use around the area (Figure 10) does not include any agriculture or other uses that can represent significant potential contaminant sources to this water source.

Inventory Results/Backup Well Control Zones

The control zone represents the most critical point to protecting the integrity of the wellhead for ground water sources. The land around the control zone for the Big Shop Well is classified as urban, as the well is located within the City of Ronan public works shop area. The Little Park Well is located within the Ronan City Park, and the control zone comprises park land, which is classified as urban. Inventory sheets for the area in the Control Zones for the two wells are included in Appendix E.

Inventory Results/Inventory Region

The results of the inventory of significant potential contaminant sources for the inventory zones, based on criterion outlined in the Montana Source Water Protection Program (DEQ, 1999), are listed in Table 6. There are multiple potential sources within the inventory zones for both wells, with the majority located within the inventory zone for the Little Park Well. Inventory sheets for the properties within the inventory zones, and listed in Table 6, are included in Appendix F. The location of the facilities are shown in Figure 12 and Figure13.

Inventory Results/Recharge Region

The land use in the recharge region is comprised of irrigated agriculture and undeveloped areas. No significant potential contaminant sources are identified as present in the recharge area. General land use for the area is depicted in Figure 10.

Inventory Update

The certified operator for the Ronan PWS will update the inventory every year. Changes in land uses or potential contaminant sources will be noted and additions made as needed. The complete inventory will be submitted to DEQ every five years to ensure re-certification of the source water delineation and assessment report.

Inventory Limitations

The inventory is limited by the accuracy of information in databases used for the assessment. The windshield survey provides a level of quality assurance that the information presented reflects current conditions at the time of preparation of this report. The location of Class V injection wells is not complete at this time, and is currently being compiled by EPA for the area.

Table 6. **Significant potential contaminant sources for Ronan PWS Wells.**

ID#	*Source*	*Contaminants*	*Description*
1	*Sanitary Sewer System*	*Pathogens and Nitrates*	*Present throughout inventory zones for wells*
3	*Septic Systems (Big Shop Well)*	*Pathogens and Nitrates*	*Low density for area south of Big Shop Well*
5	*Conoco Service Station/ Arnie's Gas & Tire Center*	*Petroleum Hydrocarbons*	*In inventory zone for Little Park Well; LUST Site with ongoing remediation; active gasoline service station*
6	*John's Fuel Farm*	*Spills of various chemicals*	*In inventory zone for Little Park Well; active gasoline service station*
7	*City of Ronan LUST Sites*	*Petroleum Hydrocarbons*	*In inventory zones for both wells; no impacts to ground water, one site near Big Shop Well*
8	*Granly LUST Site*	*Petroleum Hydrocarbons*	*In inventory zone for Little Park Well; DEQ LUST file closed, no impact to ground water*
9	*Mission Mountain Enterprises LUST Site*	*Petroleum Hydrocarbons*	*In inventory zone for Little Park Well; No impact to ground water*
11	*US Post Office LUST Site*	*Petroleum Hydrocarbons*	*In inventory zone for Little Park Well; DEQ LUST file closed, no impact to ground water*
13	*Hodge Radiator Repair*	*Petroleum Hydrocarbons, Cleaning Solvents, Antifreeze*	*In inventory zone for Little Park Well; concern over chemicals used at facility*
16	*Mark's Machine Shop*	*Petroleum Hydrocarbons, Cleaning Solvents, Antifreeze*	*In inventory zone for Little Park Well; concern over chemicals used at facility*
17	*Mission Valley Automotive*	*Petroleum Hydrocarbons, Cleaning Solvents, Antifreeze*	*In inventory zone for Big Shop Well; concern over chemicals used at facility*
24	*Lake County Weed District*	*Pesticides and Herbicides*	*In inventory zone for Big Shop Well; concern over chemicals used or stored at facility*
25	*City of Ronan Public Works Shop Area*	*Petroleum Hydrocarbons, Spills of small volumes of various chemicals used on site*	*In inventory zone for Big Shop Well; concern over chemicals used at facility or release from above ground storage tanks*
26	*Major Roads*	*Spills of various chemicals*	*In inventory zones for both wells; concern over a chemical release due to an accident*
27	*Railroad Lines*	*Spills of various chemicals*	*Located west of inventory zone for Big Shop Well; concern over chemical release due to an accident*
28	*Agricultural Land Use*	*Pathogens and Nitrates; Pesticides and Herbicides*	*Area south of Big Shop Well classified as irrigated agriculture*
29	*Urban Land Use*	*Spills of various chemicals*	*Concern over small amounts of spilled chemicals concentrating in stormwater runoff*
30	*Class V Injection Well*	*Various organic chemicals*	*Not inventoried at this time (EPA responsibility); may provide conduits for chemicals into subsurface*

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 Ronan 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 and Spill Response Regions, and 3) ensuring that land use activities in the Recharge and Watershed Regions 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 Ronan PWS to reduce susceptibility are recommended.

Surface Water System Susceptibility

The susceptibility of the surface water system to contamination is considered minimal based on the existing level of protection afforded the watershed by the designation of the area as a Tribal Wilderness Area. As the watershed has historically been maintained, the lack of development has resulted in no significant potential contaminant sources being located within the headwaters region.

Ground Water System Susceptibility

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 Ronan PWS wells (Table 7). Hazard for confined aquifers is low if all wells in the inventory region are constructed to current state standards. Hazard is high if the PWS well is not sealed into the confining layer and moderate of only other wells are not properly constructed. Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 8). The susceptibility of each well to each potential contaminant source is assessed separately. 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 Ronan PWS wells (Table 8).

Table 7. **Relative susceptibility to specific contaminant sources as determined by hazard and the presence of 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

A query of the MBMG-GWIC database indicated a total of four wells installed to depths similar to the Ronan PWS wells potentially present in the inventory zone (Appendix C). All of these wells are owned by the City of Ronan. The location of these wells is depicted in Figure 13. For purposes of the susceptibility assessment, the PWS wells for the Ronan system are considered to be properly constructed with adequate seals, as they are

naturally flowing artesian wells. The additional wells in the inventory zone are also considered to be have proper seals. Based on this criterion, the relative hazard assigned for all of the potential contaminant sources in the inventory zone is ***low***. Any potential contaminant source located outside of the inventory zone can be assigned a relative hazard of ***very low***.

The natural setting of the aquifer around Ronan results in two natural barriers being present that would limit any impacts from a potential contaminant source to the source aquifer. The barriers comprise clay-rich soils and an upward vertical hydraulic gradient. The clay-rich soils can absorb any released contaminant and hinder downward migration. The upward gradient is reflected in the flowing artesian wells utilized by the PWS system. Since water from the source aquifer will flow at the surface, this demonstrates that the aquifer is well protected and that any released chemicals could not flow downward in the Ronan area.

Table 8. **Susceptibility assessment for significant potential contaminant sources in the Control Zone and Inventory Region for the PWS Wells**.

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Sanitary Sewer Main	Pathogens and Nitrates	Leak	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Monitor integrity of sewer lines
Septic Systems	Pathogens and Nitrates	Leak	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Connect to sanitary sewer system
UST Sites	Petroleum Hydrocarbons	Spill, leak	Low	Compliance with 1998 upgrades; clay rich soils; upward hydraulic gradient	Very Low	Monitor compliance results
LUST Sites	Petroleum Hydrocarbons	Ground water impacts	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Monitor status of remediation
Machine and Auto Repair Shops	Various Chemicals	Spills	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Educate shop owners and staff on BMPs in waste management and reduction
Lake County Weed District	Pesticides and Herbicides	Spills	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Work with staff for BMPs for chemical use and storage
Ronan Public Works Shop Area	Petroleum Hydrocarbons and other chemicals	Spills	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Work with staff for BMPs for chemical use and storage
US Highway 93 and MT Highway 211	Various	Spill	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Develop emergency response protocols
Railroad Lines	Various	Spill	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Develop emergency response protocols
Agricultural Land Use	Pesticides and herbicides; Nitrates	Non-point source, concentration	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Educate community on BMPs for agriculture
Stormwater/Urban Land Use	Various	Small spills	Low	Clay-rich soils; upward hydraulic gradient	Very Low	Develop stormwater management plan

The results of the susceptibility assessment indicate that both the Ronan surface water source and the PWS wells are generally well protected from contamination by the natural conditions.

REFERENCES

Alden, W.C., 1953. Physiography and Glacial Geology of Western Montana and Adjacent Areas; U.S. Geological Survey Professional Paper 231.

Boettcher, A.J., 1982. Ground-Water Resources in the Central Part of the Flathead Indian Reservation, Northwestern Montana; Montana Bureau of Mines and Geology Memoir 48.

Montana Department of Environmental Quality (DEQ), 1999. Montana Source Water Protection Program.

United States Environmental Protection Agency (EPA), 1993. Seminar Publication – Wellhead Protection: A Guide for Small Communities, EPA/625/R-93/002.

Fetter, C.W., 1994. Applied Hydrogeology, Macmillan College Publishing Co., New York, NY.

Heath, R., 1982. Basic Ground Water Hydrology, U.S. Geological Survey Water Supply Paper 2220.

Slagle, S.E., 1988. Geohydrology of the Flathead Indian Reservation, Northwestern Montana; U.S. Geological Survey Water Resources Investigations Report 88-4142.

Todd, D.K., 1980, Ground Water Hydrology, John Wiley and Sons, New York, NY.