

**Fort Benton  
Public Water System**

**PWSID # MT0000216**

**SOURCE WATER DELINEATION AND  
ASSESSMENT REPORT**

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## Fort Benton Executive Summary

The drinking water for Fort Benton is supplied by one Ranney Collector well located along the north bank of the Missouri River at Fort Benton. This Source Water Delineation and Assessment Report was prepared under the requirements and guidance of the Federal Safe Drinking Water Act and the US Environmental Protection Agency, as well as a detailed Source Water Assessment Plan developed by a statewide citizen's advisory committee here in Montana. The Department of Environmental Quality (DEQ) is conducting these assessments for all public water systems in Montana. The purpose is to provide information so that the public water system staff/operator, consumers, and community citizens can begin developing strategies to protect your source of drinking water. The information that is provided includes the identification of the area most critical to maintaining safe drinking water, i.e., the Inventory Region, an inventory of potential sources of contamination within this area, and an assessment of the relative threat that these potential sources pose to the water system.

Based on the sanitary survey, well log, and the depth of the well, it appears that Quaternary alluvium is providing water to the PWS's well. In accordance with the Montana Source Water Protection Program criteria (1999), the aquifer (source water) is considered to have a high sensitivity to potential contaminant sources since it is unconfined unconsolidated alluvium. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

Four source water protection management regions for the Fort Benton public water system were mapped as part of this assessment. They are the control zone, inventory region, surface water buffer, and the recharge region. Potential sources of contamination were identified within each of these three regions and the results are as follows:

- The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's well or immediate surrounding areas. The control zone is delineated as a 100-foot radius around the well and all sources of potential contaminants should be excluded in this region. Potential contaminant sources identified within the control zone include municipal sewer mains.
- The inventory region should be managed to prevent contaminants from reaching the well before natural processes reduce their concentrations. Since the source water is unconfined, the inventory region includes the area of land overlying the aquifer that is expected to supply groundwater recharge to the well over the next three years. Significant potential contaminant sources identified within the inventory region include: municipal sewer mains, underground storage tanks (USTs) and leaking underground storage tanks (LUSTs), and underground injection control wells.
- The goal of management in the recharge region is to maintain and improve water quality over long periods of time or increased usage. Recharge to the wells is likely from infiltration of precipitation and surface water into the Quaternary alluvium. The topographic divide that represents the watershed boundary (based on the 11-digit USGS hydrologic unit) is used as the recharge region for the PWS well. Potential contaminant sources identified within the recharge region include: cultivated cropland and the Towns of Floweree and Carter.
- The goal of management in the surface water buffer is to avoid introducing nitrates and microbial contaminants into surface waters that are hydraulically connected to aquifers that are the source of drinking water. The surface water buffer will include ½-mile buffers around the surface waters that are within the three year time-of-travel of a public water supply well and will extend 10 miles upstream from the groundwater zone of contribution or to the watershed limits, whichever distance is shorter. Potential contaminant sources identified in the surface water buffer include: those sources identified in the inventory region, cultivated cropland, and Montana Rail Link railroad.

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. 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 public water supply well intake. The Fort Benton public water supply has a high to very high susceptibility to MT Highway 80 and the municipal sewer mains, and a moderate susceptibility to the USTs/LUSTs. Low risk potential sources and potential sources located outside the Inventory Region, but within the Recharge Region may still pose a threat over time, but are not discussed in detail in this assessment. This provides a quick look at the existing potential sources of contamination that could, if improperly managed or released, impact the source water for Fort Benton. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to focus resources for protection of this valuable drinking water resource.

The costs associated with contaminated drinking water are high. Developing and approach to protect that resource will reduce the risks of a contamination event occurring. In this report, we have summarized the local geology and well construction issued as they pertain to the quality of your drinking water source. We have identified the area we believe to be most critical to preserving your water quality (the Inventory Region) and have identified potential sources of contamination within that area. Additionally, we provide you with recommendations, i.e., Best Management Practices, regarding the proper use and practices associated with some common potential contamination sources. We believe public awareness is a powerful tool for protecting drinking water. The information in this report will help you increase public awareness about the relationship between land use activities and drinking water quality.

## INTRODUCTION

Carolyn DeMartino, a Water Quality Specialist with the Montana Department of Environmental Quality, completed this Delineation and Assessment Report. Special thanks goes to Timothy Farwick, of the Fort Benton Public Water System (PWS) for his assistance to make this a complete and accurate report.

### **Purpose**

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

### **Limitations**

This report was prepared to assess threats to the Fort Benton 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 Fort Benton public water supply and not any other public or private water supply. Also, not every potential or existing source of groundwater or surface water contamination in the area of the Fort Benton has been identified. Only potential sources of contamination in areas that contribute water to its drinking water source are considered.

The term “contaminant” is used in this report to refer to constituents for which maximum concentration levels (MCLs) have been specified under the national primary drinking water standards, and to certain constituents that do not have MCLs but are considered to be significant health threats.

# CHAPTER 1

## BACKGROUND

### The Community

The City of Fort Benton is located along the Missouri River in north central Montana in Chouteau County, approximately 40 miles North of Great Falls ([Figure 1](#)). According to the Census Bureau the population of Chouteau County in 2000 was 5,970 with the population of Fort Benton at 1,594.

Fort Benton, named after Senator Thomas Hart Benton, is one of the most historically significant sites in Montana and is recognized as the “Birth Place of Montana. Fort Benton played a prominent role in the opening of the Northwestern United States and Canada. First established in 1846, Fort Benton was as a fur and buffalo robe trading post. Later, Fort Benton became the hub for trade and travel for all of Montana and Western Canada. Fur traders, gold seekers, and homesteaders came via steamboats to Fort Benton, the “Head of Navigation” on the Missouri River. Lewis and Clark, Jim Bridger, Kit Carson, and John Colter explored the area.

Today, Fort Benton is listed as a National Historic Landmark and it is the only trading post that was built in the 19<sup>th</sup> century that still serves as a town. Fort Benton is also known as the gateway to Lewis and Clark’s “Scenes of Visionary Enchantment”; the Wild and Scenic Upper Missouri River; and The Upper Missouri River Breaks National Monument.

Fort Benton’s current economy is based primarily on agriculture. Tourism, area businesses, and the medical center also contribute to the local economy. The major transportation routes in the Fort Benton area include U.S. Highway 87, U.S. Highway 89, and Montana State Highway 200. Montana Rail Link Railroad provides railway service to Fort Benton.

Fort Benton is served by a municipal sanitary sewer system. The sewage wastewater treatment plant is located east of Fort Benton on the north bank of the Missouri River ([Figure 2](#)). The plant has three lined, aerated treatment lagoons. Wastewater is then discharged either into a fourth unlined infiltration lagoon or discharged directly into the Missouri River. Wastewater effluent discharges to both the infiltration lagoon and the Missouri River and must meet national secondary treatment standards. Septic system use continues in some portions of Fort Benton.

### Geographic Setting

Fort Benton is located in the Glaciated Missouri Plateau Region of the Northern Great Plains physiographic province. Beginning about five million years ago, regional uplift of the western part of the North American continent forced streams, which for 30 million years had been depositing sediment nearly continuously on the Great Plains, to change their course and begin to cut into the layers of sediment they had been so long depositing (D. Trimble, 1980). The predecessor of the Missouri River cut headward into the northern Great Plains and developed a tributary system that excavated deeply into the accumulated deposits near the mountain front and carried away huge volumes of sediment from the Great Plains to Hudson Bay. By two million years ago, the streams had cut downward to within a few hundred feet of their present level.

About 2 million years ago, after much down-cutting had already taken place and river channels had been firmly established, continental glaciers advanced southward from Canada into the United States. When the continental glaciers spread southward into northern Montana and the Dakotas, a few areas in Montana, such

as the Sweetgrass Hills, stood above the surrounding plain and became islands surrounded by the advancing

**glaciers. The glaciers advanced southward up against the Highwood Mountains to the south of Fort Benton, and the Bears Paw Mountains to the northeast. Much of the northern portion of Montana is a plain of little relief that is the surface of a nearly continuous cover of glacial deposits, generally less than 50 feet thick.**

The major drainages in the Fort Benton area include the Missouri, Teton, and Marias Rivers ([Figure 1](#)). These rivers have cut down into the sandstone, siltstone, and shale layers underlying the land surface. Inter-stream areas are broad, relatively flat areas covered by the glacial sediments. The headwaters of the Missouri River are located near Three Forks, Montana where the Jefferson, Madison, and Gallatin rivers meet. The Missouri River enters the Fort Benton vicinity from the southwest, and flows to the northeast. East of Fort Benton is the White Cliffs area which was formed by the Missouri River cutting a narrow canyon through light-colored Eagle Sandstone and forming the massive cliffs along this segment of the river. Approximately six lakes and one reservoir are located south and east of Fort Benton. They include, Harwood Lake, White Lake, Shonkin Lake, Lost Lake, Big Lake, Kingsbury Lake, and Dammel Reservoir ([Figure 1](#)).

The climate in the Fort Benton area is considered semi-arid. Average daily maximum and minimum temperatures in Fort Benton are 85.5° F and 52.6° F in July and 32.1° F and 8.1° F in January. Annual average precipitation is 14.07 inches with the wettest months being May and June. An annual average of 59.1 inches of snow is received in the Fort Benton area mainly November to April (Table 1)

**Table 1.** Fort Benton, Montana(243113)

Period of Record Monthly Climate Summary

Period of Record : 7/ 1/1948 to 7/31/2003

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	32.1	39.8	47.6	60.2	70.1	77.9	85.9	85.0	74.2	62.9	46.5	36.3	59.9
Average Min. Temperature (F)	8.1	14.3	21.0	31.4	41.0	48.6	52.6	51.1	41.5	31.9	21.1	12.6	31.3
Average Total Precipitation (in.)	0.66	0.51	0.83	1.20	2.33	2.69	1.36	1.32	1.11	0.81	0.59	0.61	14.01
Average Total SnowFall (in.)	13.6	10.0	9.3	4.6	0.4	0.0	0.0	0.0	0.2	1.8	7.6	11.7	59.1
Average Snow Depth (in.)	3	2	1	0	0	0	0	0	0	0	1	2	1

Percent of possible observations for period of record.

Max. Temp.: 99.5% Min. Temp.: 99.2% Precipitation: 99.5% Snowfall: 97.9% Snow Depth: 94.7%

Check [Station Metadata](#) or [Metadata graphics](#) for more detail about data completeness.

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Western Regional Climate Center, [wrcc@dri.edu](mailto:wrcc@dri.edu)

### General description of the Source Water

“The City of Fort Benton is supplied water from a unique water well source called a Ranney Collector, the only one in the state of Montana.” (E. Minneti, December 1999). The Ranney Collector well has five lateral pipes that extend underneath the Missouri River sediments approximately 125 feet and collect groundwater from the Quaternary Alluvium ([Figure 3](#) and [Figure 4](#)). Lateral #4 is not used to supply drinking water to the system as it collects groundwater that is much harder than Missouri River water. Lateral #4 is pumped continuously to remove hardness from the water and to capture most of the groundwater in this area.

Groundwater and surface water in the vicinity of the Fort Benton Ranney Collector Well appear to be in hydraulic connection with one another. Based on the design of the Ranney system however the source of water to the well has been classified as groundwater.

## **The Public Water Supply**

The Fort Benton PWS is classified as a community PWS because it serves a total resident population of 1,600 persons through 748 active connections (DEQ SDWIS Database). Fort Benton obtains its drinking water from a Ranney Collector well (Source WL002) located along the Missouri River in unconfined Quaternary alluvium. The Ranney Collector well consists of a 20-foot diameter casing 40 feet deep with lateral piping that extends underneath the Missouri River approximately 125 feet. Drinking water is pumped from four of the five active lateral pipes by two large turbine pumps and brought into the plant for treatment. Water from Lateral #4 is pumped continuously to remove hardness from the water and to prevent petroleum contamination from a nearby leaking UST site from entering the PWS. The non-consumptive treated water from Lateral #4 is then discharged either into a trench or directly into the Missouri River.

The Fort Benton PWS provides three forms of treatment to the water from the Ranney Collector. The water is dosed with polyphosphate chemical to sequester iron and manganese. The water is then run through an ultraviolet light system for immediate disinfection. Chlorine gas is also added after ultraviolet radiation to maintain the disinfection residual throughout the distribution system.

Water storage for the Fort Benton PWS consists of three ground level storage tanks, with a combined storage volume of over one million gallons.

A site layout map for the Fort Benton PWS has not been included in this report. Additional information about the water system is available upon request from the City of Fort Benton or DEQ.

## **Water Quality**

Fort Benton is classified as a community PWS and the city is required to conduct routine monitoring of the drinking water for contaminants in accordance with the Federal Safe Drinking Water Act. Parameters such as coliform bacteria, lead, copper, nitrate, nitrite, volatile organic chemicals (VOCs) including hydrocarbons and chlorinated solvents, inorganic chemicals including metals, synthetic organic chemicals including pesticides, and radiological contaminants must be monitored in accordance with schedules specified in the Administrative Rules of Montana. All contaminant concentrations detected in the required samples must comply with numeric maximum contaminant levels (MCLs) specified in the Federal Safe Drinking Water Act.

Within the past five years, there have been detections of coliform bacteria but follow-up monitoring indicated the absence of the bacteria. Within the past five years the concentration of nitrate detected in the drinking water ranged from 0.06 mg/L to 0.22 mg/L, well below the MCL of 10 mg/L (DEQ SDWIS).

Known sources of groundwater contamination in the Fort Benton Ranney Collector well vicinity include leaking underground fuel storage tank releases. Lateral #4 is pumped continuously for non-consumptive purposes to capture area groundwater in the vicinity of the Ranney Well to prevent petroleum contamination from entering the Fort Benton PWS.

## CHAPTER 2 DELINEATION

The source water protection area, the land area that contributes water to the Fort Benton PWS wells, is identified in this chapter. The management areas identified within the source water protection area included the control zone, inventory region, surface water buffer, and recharge region. The control zone is an area at least 100-foot radius around the well. The management goal of the control zone, also known as the exclusion zone, is to protect against the direct introduction of contaminants into the wells or in the immediate area surrounding each well. The inventory region represents the zone of contribution of the well, which approximates a three-year groundwater time-of-travel. Analytical equations describing ground water flow using the calculated fixed radius approach are located in Appendix A. and hydrogeologic mapping are used to calculate groundwater time-of-travel distance (Appendix A). The management goal of the inventory region is to focus on pollution prevention activities at potential contaminant sources where it is likely that contaminated water would flow into the wells within a relatively short time frame. A surface water buffer zone has been delineated around the Missouri River to account for the interaction of surface water and groundwater. The surface water buffer includes ½-mile buffers around associated surface waters for 10 miles upstream of the groundwater zone of contributions or to watershed limits, whichever distance is shorter. The management goal of the surface water buffer is to protect against the introduction of pathogens and nitrates into the wells through surface water-groundwater interaction. The recharge region represents the entire portion of the aquifer that contributes water to the Fort Benton PWS. Management in the recharge region should focus on maintaining and improving the quality of groundwater that could reach each well over longer timeframes or with increased water usage.

### Hydrogeologic Conditions

Fort Benton is located in the Missouri River Valley where a narrow trench was cut into the Colorado Shale (Perry, 1933). Valley-fill consists of more recent Quaternary alluvium. Colorado Shale underlies the valley-fill and underlying the Colorado Shale is the Kootenai Formation. These formations slope north towards the Missouri River (Figure 5). Because Fort Benton obtains its drinking water from unconfined, Quaternary alluvium, the source water sensitivity is classified as highly sensitive to contamination, in accordance with Montana Source Water Protection Program aquifer sensitivity criteria (Table 2).

**Table 2.** Source sensitivity criteria (DEQ, 1999)

Source Water Sensitivity
<b>High Source Water Sensitivity</b> Surface water and GWUDISW <b>Unconsolidated Alluvium (unconfined)</b> Fluvial-Glacial Gravel Terrace and Pediment Gravel Shallow Fractured or Carbonate Bedrock
<b>Moderate Source Water Sensitivity</b> Semi-consolidated Valley Fill sediments Unconsolidated Alluvium (semi-confined)
<b>Low Source Water Sensitivity</b> Consolidated Sandstone Bedrock Deep Fractured or Carbonate Bedrock Semi-consolidated Valley Fill Sediments (confined)

Regional groundwater flow appears to be northeast. However, groundwater elevation data gathered as part of the quarterly monitoring for a nearby leaking UST remediation site indicate that groundwater has a southerly flow direction. “This flow direction was likely greatly influenced by the Ranney System Pump Station which can create an artificial southerly flow direction when the pumps are operating” (R. Brown, January 2003).

Recharge to the alluvial aquifer is from precipitation falling directly on and percolating into the alluvium, and leakage from the Missouri River and its tributaries into the alluvium.

### Conceptual Model and Assumptions

Fort Benton is located in the Missouri River Valley where a narrow trench was cut into the Colorado Shale (Perry, 1933). Valley-fill consisting of more recent Quaternary alluvium was deposited in the valley. Colorado Shale underlies the alluvial valley-fill and the Kootenai Formation underlies the Colorado Shale. These formations slope north towards the Missouri River ([Figure 5](#)).

Groundwater located in more recent Quaternary alluvium supplies drinking water to the City of Fort Benton via a Ranney Collector well. The Ranney Collector well consists of a 20-foot diameter casing 40 feet deep with lateral piping extending underneath the Missouri River approximately 125 feet. Drinking water is pumped from the four of the five active lateral pipes by two large turbine pumps and brought into the plant for treatment. Non-consumptive water is pumped continuously from lateral #4, treated and discharged into either a trench or directly into the Missouri River.

While regional groundwater flow in the Fort Benton area is northeast, the Ranney well, when pumping, shifts the groundwater flow direction in a more southerly direction. Groundwater in the vicinity of the Ranney Collector Well is recharged by precipitation falling directly on and percolating into the alluvium, and leakage from the Missouri River and its tributaries into the alluvium.

### Well Information

Data for the Fort Benton Ranney Collector Well (WL002) is summarized in Table 3.

**Table 3.** Fort Benton PWS Well Information

Well Information	Ranney Collector Well
PWS Source Code	WL002
Well Location (T, R, Sec)	Sec. 23, T. 24 N., R. 8 E.
Latitude/ Longitude	47.8165/ -110.6678
MBMG #	NA
Water Right #	71889-00
Well Completion Date	7/1/1985
Total Depth (feet)	40
Perforated Interval (feet)	NA
Static Water Level (feet)	12

**Table 3.** Fort Benton PWS Well Information

Well Information	Ranney Collector Well
Pumping Water Level (feet)	NA
Drawdown (feet)	NA
Test Pumping Rate (gpm)	300 – 400
Specific Capacity (gpm/ft)	NA

\* Not Available

## Methods and Criteria

DEQ’s Source Water Protection Program specifies methods and criteria used to delineate subregions of the source water protection area for the Fort Benton PWS Ranney Collector Well. Because Fort Benton obtains its drinking water from groundwater in alluvial sands and gravels a one hundred-foot radius control zone was delineated around the well. The calculated fixed radius equation describing uniform groundwater flow was used to delineate the inventory regions for the Fort Benton Ranney Well (Appendix A). The inventory region boundary delineates the distance in the aquifer that would be traveled by water or contaminants in approximately three years. A surface water buffer for the Missouri River and its major tributaries was also delineated. The topographic divide that represents the watershed boundary (based on the 11-digit USGS hydrologic unit) was used as the recharge region for the PWS well.

## Time-of-Travel Model Input

Estimates of the input parameters for the Fort Benton Ranney Collector well were obtained from personal communication with the Fort Benton PWS operator, area well logs, leaking UST groundwater monitoring reports, and other hydrogeology texts. Estimates of these parameters are summarized in Table 4. The selection criteria for the parameters are described in the text following Table 4.

**Table 4.** Estimates of input parameters used to delineate the inventory region

Input Parameter	Range of Values/ Units	Values Used
		Ranney Collector Well
PWS Source Code	N/A	WL002
Pumping Rate	400- 500 gpm	500 gpm
Thickness	25 -30	28
Flow Direction	NE-SE	SE
Porosity	10-25	20
1-Year TOT*	--	748 feet
3-Year TOT*	--	1,295 feet

\*Time of Travel

**PWS Source Code** - is the specific identification code for each Whitehall PWS well. The code is obtained from the DEQ Public Water Supply Section SDWIS database.

**Pumping Rate** - is the pumping rate of the Fort Benton Well. This information was obtained from the water operator.

**Thickness** - denotes the estimated aquifer thickness.

**Flow Direction** - is the direction that ground water is flowing. This information was obtained from Leaking Underground Storage Tank (LUST) remediation site files on file at the DEQ Petroleum Release Section.

**Porosity** - as applied to aquifer materials it is the ratio of the volume of water, which after being saturated, the aquifer will yield by gravity to its own volume. The value was obtained from Driscoll (1986).

**1-Year TOT** - is calculated. See TOT Calculation Table in Appendix A.

**3-Year TOT** - is also calculated. See TOT Calculation Table in Appendix A.

### **Delineation Results**

The Fort Benton PWS inventory region was delineated using the fixed radius calculation equation. The 1-year TOT distance is approximately 748 feet and the 3-year TOT distance is approximately 1,295 feet ([Figure 6](#)).

### **Limiting Factors**

This delineation is based on estimated groundwater flow and pumping conditions. The calculated fixed radius equation assumes that groundwater is being pumped into the well from all directions. Also, the total amount of recharge to the system is unknown and can vary seasonally.

Time of travel distances represent the time required for ground water to travel through a specified aquifer to the public water supply well. These distances do not represent the time required for contaminants to reach a public water supply well. Travel times for the migration of free phase contaminants that are not dissolved in the ground water vary tremendously from ground-water travel times. Free-phase contamination migration rates are influenced by the characteristics of the vadose zone, contaminant density, the slope of the water table, the slope of the base of the aquifer, aquifer porosity, lithologic heterogeneities, and the extent and duration of contamination.

Travel times for dissolved contaminant migration also differ from ground-water travel times. Dissolved contaminants are affected by advection, or the component of solute movement attributed to transport by flowing ground water (Freeze and Cherry, 1979). However, the migration of dissolved contaminant plumes is also affected by many additional factors, including the characteristics of the vadose zone, the extent and duration of contamination, contaminant solution density, mechanical dispersion, biological transformation, dilution, molecular diffusion, adsorption, precipitation, oxidation, complexation, volatilization, radioactive decay, lithologic heterogeneities, and water extraction.

Inventory regions delineated using time-of-travel calculations should be used as a planning tool to identify areas within which the potential for contaminants to reach a public water supply source is highest. Ground-water time-of-travel calculations should not be used to estimate contaminant migration rates.

## **CHAPTER 3 INVENTORY**

An inventory of potential contaminant sources was conducted to assess the susceptibility of the Fort Benton PWS to contamination, and to identify priorities for source water protection planning. These inventories were conducted within the spill response and watershed regions. The inventory for Fort Benton focuses on facilities that generate, use, store, transport, or dispose potential contaminants, and on certain land types on which potential contaminants are generated, used, stored, transported or disposed. Additionally, the inventory process identifies potential sources of all regulated primary drinking water contaminants and pathogens. Only those potential contaminant sources that pose the most significant threat to human health were selected for detailed inventory. The most significant potential contaminants in the Fort Benton Inventory Region include nitrate, pathogens, fuels, solvents, herbicides, pesticides, and metals. The inventory for the Fort Benton PWS also focuses on all activities in the inventory region, those activities in the surface water buffer that may be the sources of nitrates and pathogens, as well as general land uses and large potential contaminant sources in the recharge region.

### **Inventory Method**

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 landcover data collected by the USGS.

Step 2: EPA's Envirofacts System was queried to identify EPA regulated facilities. This system accesses 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). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility is a significant potential contaminant source.

Step 3: DEQ databases were queried to identify Underground Storage Tanks (UST), hazardous waste contaminated sites, landfills, and abandoned mines.

Step 4: A business phone directory was consulted to identify businesses that generate, use, or store chemicals in the inventory region. Equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by SIC code.

Step 5: Major road and rail transportation routes were identified.

Step 6. All significant potential contaminant sources were identified in the spill response region, and land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the watershed region.

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

- Large quantity hazardous waste generators
- Landfills

- Hazardous waste contaminated sites
- Underground storage tanks
- Major roads or rail transportation route
- Cultivated cropland
- Animal feeding operations
- Wastewater lagoons or spray irrigation
- Septic systems
- Sewered residential areas
- Storm sewer outflows
- Floor drains, sumps, or dry wells
- Abandoned or active mines

**Inventory Results/ Control Zone**

The City of Fort Benton owns the land within the control zone for the Fort Benton Ranney Collector Well. The most significant potential contaminant source in the control zone is the municipal sewer mains in the vicinity of the well.

**Inventory Results/Inventory Region**

Land cover within the Fort Benton Inventory Region includes mainly grassland at 24%, open water at 22%, and residential land at 13% (Figure 7). Additional types and percentages of land cover/use are also presented on Figure 7. Municipal sewer mains underlie approximately 50% of the inventory region. Overall, the septic density in the inventory region is low (Figure 8).

Significant potential contaminant sources in the inventory region are identified in Table 5 and indicated on Figure 7, Figure 8, and Figure 9. Other potential contaminant sources in the Fort Benton vicinity are identified in Appendix B.

<b>Table 5. Significant potential contaminant sources in the Fort Benton Inventory Region</b>			
<b>Significant Potential Contaminant Sources</b>	<b>Figure / Map ID#</b>	<b>Contaminants</b>	<b>Hazard</b>
<b>Municipal Sewer Mains</b>	<a href="#">Figure 7</a>	Nitrates and pathogens	Failure of older clay sewer lines contaminated water discharging directly to the river or via contaminated groundwater
<b>USTs/LUSTs:</b>	<a href="#">Figure 9</a> 1,2,3	VOCs	Existing contamination from spills, leaks, or improper handling of stored materials may impact the drinking water supply
<b>Cultivated Cropland</b>	<a href="#">Figure 5</a>	Nitrates, pathogens, SOCs	Enter river via surface water runoff or irrigation return flows
<b>Class V Injection Wells</b>	Locations currently unknown	VOCs, SOCs, metals	Discharges into the river via contaminated groundwater

**Municipal sewer mains** - are within the inventory region and may constitute preferred contaminant migration pathways that allow contaminants to enter area groundwater that supplies water to the Fort Benton PWS.

**Underground storage tanks (USTs) and leaking underground storage tanks (LUSTs)** - are located within the inventory region upgradient of the Fort Benton PWS well. USTs may release VOCs to area groundwater that supplies the PWS. Leaking USTs are also in the inventory region upgradient of the PWS well.

**Cultivated Cropland** - nitrates and pathogens or other agricultural chemicals used on cultivated cropland may leach into groundwater that supplies the Fort Benton PWS.

**Class V Injection wells** - may be located within the inventory region; however, their locations are unknown at this time.

### **Inventory Results/ Surface Water Buffer**

[Figure 10](#) identifies the Missouri River Surface Water Buffer delineated for the Fort Benton PWS. Land cover in the surface water buffer consists primarily of grasslands at 45% and cultivated cropland at 19% ([Figure 11](#)). Additional land cover/ use types and percentages are also identified on [Figure 11](#). Overall, the septic density is low. The only additional significant potential contaminant source in addition to those already identified in the inventory region is the Montana Rail Link Railroad.

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

Land use within the Fort Benton PWS Recharge Region ([Figure 12](#)) consists mainly of cultivated cropland at 65% ([Figure 13](#)). Overall, septic density in the recharge region is low. The towns of Floweree and Carter are located in the Fort Benton PWS Recharge Region; however, potential contaminant sources have been or will be addressed in the individual SWDARs for these towns.

### **Inventory Update**

The Fort Benton PWS certified operators should update the inventory every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. The complete inventory should be sent to DEQ every five years to ensure re-certification of the source water delineation and assessment report.

### **Inventory Limitations**

The potential contaminant inventory was conducted using various databases to acquire readily available information. Information was also obtained where possible, from individuals familiar with Fort Benton. Consequently, unregulated activities or unreported contaminant releases may have been overlooked. The use of multiple sources of information, however, should ensure that the major threats to the Fort Benton Ranney well have been identified.

## 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 Fort Benton.

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 within 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 Fort Benton to reduce susceptibility are recommended.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers (Table 6). Barriers can be anything that decrease the likelihood that contaminated water will flow into the Fort Benton PWS Ranney Well..

**Table 6.** Susceptibility to specific contaminant sources as determined by hazard and the presence of barriers

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

The hazard presented by point source contaminants in the Fort Benton Inventory Region depends on whether contaminants can discharge directly to segments of the Missouri River and Sand Coulee Creek located in the spill response region. Point source hazard is also dependent on the health affects associated with potential contaminants (Table 7).

**Table 7.** Hazard of potential contaminant sources associated with proximity to a PWS well or intake or density within a PWS inventory or spill response region.

<b>Type of Contaminant Source</b>		<b>High Hazard</b>	<b>Moderate Hazard</b>	<b>Low Hazard</b>
<b>S U R F A C E</b>	Point Sources of Nitrate or Microbes	Potential for direct discharge to source water	Potential for discharge to groundwater hydraulically connected to source water	Potential contaminant sources in the watershed region
<b>W A T E R</b>	Point Sources of VOCs, SOCs, or Metals	Potential for direct discharge of large quantities from roads, rails, or pipelines	Potential for direct discharge of small quantities to source water	Potential for discharge to groundwater hydraulically connected to source water

**Table 7.** Hazard of potential contaminant sources associated with proximity to a PWS well or intake or density within a PWS inventory or spill response region.

Type of Contaminant Source		High Hazard	Moderate Hazard	Low Hazard
W E L L S	Point Sources of All Contaminants (Unconfined)	Within 1-year TOT	1 to 3 years TOT	Over 3 years TOT
	Point Sources of All Contaminants (Confined)	PWS well is not sealed through the confining layer	Well(s) in the inventory region other than the PWS well are not sealed through the confining layer	All wells in the inventory region are sealed through the confining layer
A L L	Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
	Municipal Sanitary Sewer (% land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
	Cropped Agricultural Land (% land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Hazard ratings for non-point sources are assigned based on criteria listed in Table 7 for septic systems, sanitary sewers, and cropped agricultural land. Hazard ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 8).

Significant Potential Contaminant Sources	Figure / Map ID#	Contaminants	Hazard	Hazard Rating
Sanitary Sewer Main	<a href="#">Figure 8</a>	Nitrates and pathogens	Failure of older clay sewer lines contaminated water discharging directly to the river or via contaminated groundwater	High
USTs/LUSTs	<a href="#">Figure 7</a>	VOCs	Existing contamination from spills, leaks, or improper handling of stored materials may impact the drinking water supply	High
Class V Injection Wells	Locations currently unknown	VOCs, SOCs, metals	Not Evaluated	Unknown at this time

Table 9 displays the susceptibility assessment results for each significant potential contaminant source in the Fort Benton PWS Inventory Region.

<b>Table 9.</b> Susceptibility assessment for significant potential contaminant sources in the Inventory Region						
<b>Contaminant Source</b>	<b>Contaminant</b>	<b>Hazard</b>	<b>Hazard Rating</b>	<b>Barriers</b>	<b>Susceptibility</b>	<b>Management Recommendations</b>
<b>Sanitary Sewer Main</b>	Nitrates and pathogens	Failure of older clay sewer lines contaminated water discharging directly to the river or via contaminated groundwater	High	None	Very High	Periodically inspect older sewer mains and implement upgrades where necessary
<b>USTs/ LUSTs</b>	VOCs	Existing contamination from spills, leaks, or improper handling of stored materials may impact the drinking water supply	High	Secondary containment	High	Continue monitoring VOC concentration results to ensure drinking water standards are met and the water is safe
<b>Class V Injection Well</b>	VOCs, SOCs, metals	Discharge into the river via contaminated groundwater	Unknown at this time	Not evaluated	Unknown at this time	Work with EPA to identify locations and appropriate response

The susceptibility results for each significant potential contaminant source and their associated contaminants are identified as follows:

**Sanitary sewer mains** – Hazard is ranked high for potential contamination from sewer main failure, however, the overall susceptibility is very high, as no barriers to contamination were identified.

**USTs/LUSTs** – Hazard is ranked high as petroleum spills from USTs have the potential to enter into area groundwater in the vicinity of the Ranney Well. A VOC plume is currently in the immediate vicinity of the Ranney well. The overall susceptibility to contamination from these significant potential contaminant sources is high because currently, only secondary containment was identified as a barrier to contamination.

**Class V Injection Wells** – Hazard has not been ranked because the location and quantity of Class V Injection Wells in Fort Benton is unknown. They have been identified in this report because they have the potential to either discharge directly into the river or via groundwater surface water interaction. The susceptibility is also unknown at this time.

### **Management Recommendations**

The Fort Benton PWS Source Water Delineation and Assessment Report was prepared to assist the Fort Benton PWS operator. The report provides information concerning the Ranney Collector Well that supplies water to Fort Benton, identifies the control zone, inventory region surface water buffer, and the recharge region, and within each of these protection areas identifies the significant potential contaminants that may impact the source of water drinking water to Fort Benton. Also provided in the table are recommendations regarding how the potential contaminant could be better managed to prevent impacts in the vicinity of the Fort Benton well. If these management recommendations are implemented, they may be considered

additional barriers that will reduce the susceptibility of Fort Benton's PWS well to specific sources and contaminants.

Management recommendations fall into the following categories:

**Sewer maintenance and leak detection.** Early leak detection and scheduled replacement of older sewer lines will reduce the susceptibility of the Fort Benton Ranney Collector Well to contamination from sanitary wastes.

**Sewer extension.** Annexation and extension of sewers is the only way to reduce contamination from existing unsewered developments.

**Agricultural Best Management Practices.** BMPs that address application and mixing of fertilizers and pesticides are a viable alternative to prohibition of their use. BMPs are voluntary but their implementation can be encouraged through education and technical assistance. BMPs may also be utilized to minimize surface runoff and soil erosion on cultivated fields

**Stormwater Management.** Stormwater planning should address source and drainage control. Source control can be accomplished through educational programs focussing on residential and commercial chemical use, disposal, and recycling. Drainage control and pollutant removal can be accomplished through the use of vegetated retention basins at outfall locations.

**Education.** Educational workshops provided to the general public by the city, county, or state promote safe handling and proper storage, transport, use, and disposal of hazardous materials. Ongoing training provided to designated emergency personnel would promote the efficiency and effectiveness of emergency responses to hazardous material spills. Educational workshops provided to rural homeowners will promote the proper maintenance and replacement of residential septic systems. Educational materials covering these topics are available to the public and can be obtained from the US EPA and the State of Montana.

**Emergency Spill Response Plan.** If one does not already exist, the City of Fort Benton should develop an emergency response plan that can be implemented in the event that there is an imminent threat contaminants would reach the Fort Benton Ranney Well. Currently, a VOC plume is in the vicinity of the Ranney Well. Fort Benton PWS water operators need to continue reviewing VOC concentration monitoring results to ensure drinking water standards are met and the drinking water is safe. Coordination with state, county, and local emergency response personnel would greatly benefit a Fort Benton Emergency Spill Response Plan. The plan should identify the procedures that the water operators and other emergency personnel should follow if a contamination event were to occur and contaminants begin migrating towards the Fort Benton Ranney Well. The emergency response plan should be updated annually to reflect changes in emergency contacts, phone numbers, and resources available within the city and county to respond to an emergency situation that may impact the drinking water supply.

## **CHAPTER 5**

### **Monitoring Waivers**

#### **Monitoring Waiver Requirements**

The 1986 Amendments to the Safe Drinking Water Act require that community and non-community PWSs sample drinking water sources for the presence of volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). The US EPA has authorized states to issue monitoring waivers for the organic chemicals to systems that have completed an approved waiver application and review process. All PWSs in the State of Montana are eligible for consideration of monitoring waivers for several organic chemicals. The chemicals diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB), dibromochloropropane (DBCP), and polychlorinated biphenyls are excluded from monitoring requirements by statewide waivers. Following are descriptions of the different types of waivers. Monitoring waiver recommendations for the City of Fort Benton follow these descriptions.

#### **Use Waivers**

A Use Waiver can be allowed if through a vulnerability assessment, it is determined that specific organic chemicals were not used, manufactured, or stored in the area of a water source (or source area). If certain organic chemicals have been used, or if the use is unknown, the system would be determined to be vulnerable to organic chemical contamination and ineligible for a Use Waiver for those particular contaminants.

#### **Susceptibility Waivers**

If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a vulnerability assessment it is demonstrated that the water source would not be susceptible to contamination. Susceptibility is based on prior analytical or vulnerability assessment results, environmental persistence, and transport of the contaminants, natural protection of the source, wellhead protection program efforts, and the level of susceptibility indicators (such as nitrate and coliform bacteria). The vulnerability assessment of a surface water source must consider the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the surface water intake. PWSs developed in unconfined aquifers should use a minimum fixed radius of 1.0 mile as an area of investigation for the use of organic chemicals. Vulnerability assessment of spring water sources should use a minimum fixed radius of 1.0 mile as an area of investigation for the use of organic chemicals. Shallow groundwater sources under the direct influence of surface water (GWUDISW) should use the same area of investigation as surface water systems; that is, the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the point of diversion. The purpose of the vulnerability assessment procedures outlined in this section is to determine which of the organic chemical contaminants are in the area of investigation.

Given the wide range of landforms, land uses, and the diversity of groundwater and surface water sources across the state, additional information is often required during the review of a waiver application. Additional information may include well logs, pump test data, or water quality monitoring data from surrounding public water systems; delineation of zones of influence and contribution to a well; Time-of-Travel or attenuation studies; vulnerability mapping; and the use of computerized groundwater flow and transport models. Review of an organic chemical monitoring waiver application will be conducted by DEQ's PWS Section and DEQ's Source Water Protection Program. Other state agencies may be asked for assistance.

## **Susceptibility Waiver for Confined Aquifers**

Confined groundwater is isolated from overlying material by relatively impermeable geologic formations. A confined aquifer is subject to pressures higher than atmospheric pressure that would exist at the top of the aquifer if the aquifer were not geologically confined. A well that is drilled through the impervious layer into a confined aquifer will enable the water to rise in the borehole to a level that is proportional to the water pressure (hydrostatic head) that exists at the top of a confined aquifer.

The susceptibility of a confined aquifer relates to the probability of an introduced contaminant to travel from the source of contamination to the aquifer. Susceptibility of an aquifer to contamination will be influenced by the hydrogeologic characteristics of the soil, vadose zone (the unsaturated geologic materials between the ground surface and the aquifer), and confining layers. Important hydrogeologic controls include the thickness of the soil, the depth of the aquifer, the permeability of the soil and vadose zones, the thickness and uniformity of low permeability and confining layers between the surface and the aquifer, and hydrostatic head of the aquifer. These factors will control how readily a contaminant will infiltrate and percolate toward the groundwater.

The Susceptibility waiver has the objective of assessing the potential of contaminants reaching the groundwater used by the PWS. A groundwater source that appears to be confined from surface infiltration in the immediate area of the wellhead may eventually be affected by contaminated groundwater flow from elsewhere in the recharge area. Contaminants could also enter the confined aquifer through improper well construction or abandonment where the well provides a hydraulic connection from the surface to the confined aquifer. The extent of confinement of an aquifer is critical to limiting susceptibility to organic chemical contamination. Regional conditions that define the confinement of a groundwater source must be demonstrated by the PWS in order to be considered for a confined aquifer susceptibility waiver. Confinement of an aquifer can be demonstrated by pump test data (storage coefficient), geologic mapping, and well logs. Site specific information is required to sufficiently represent the recharge area of the aquifer and the zone of contribution to the PWS well. The following information should be provided:

- Abandoned wells in the region (zone of contribution to the well),
- Other wells in the region (zone of contribution to the well),
- Nitrate/Coliform bacteria analytical history of the PWS well,
- Organic chemical analytical history of the PWS well,

## **Susceptibility Waiver for Unconfined Aquifers**

Unconfined aquifers are the most common source of usable groundwater. Unconfined aquifers differ from confined aquifers in that the groundwater is not regionally contained within relatively impervious geologic strata. As a result, the upper groundwater surface or water table in an unconfined aquifer is not under pressure that produces hydrostatic head common to confined aquifers.

Unconfined aquifers are usually locally recharged from surface water or precipitation. In general, groundwater flow gradients in unconfined aquifers reflect surface topography, and the residence time of water in the aquifer is comparatively shorter than for water in confined aquifers. Similar water chemistry often exists between unconfined groundwater and area surface water, and physical parameters and dissolved constituents can be an indicator of the hydraulic connection between groundwater and surface water. Consequently, unconfined aquifers can be susceptible to contamination by organic chemicals migrating from the ground surface to groundwater.

The objective of the susceptibility waiver application is to assess the potential of organic chemical migration from the surface to the unconfined aquifer. The general procedures make use of a combination of site specific information pertaining to the location and construction of the source development, monitoring history of the source, geologic characteristics of the unsaturated soil and vadose zones, and chemical characteristics of the organic chemicals pertaining to their mobility and persistence in the environment. The zone of contribution of the unconfined groundwater source must be defined and plotted. This should describe the groundwater flow directions, gradients, and a 3-year time-of-travel. All surface bodies within 1,000 feet of the PWS well(s) must be plotted. Analytical monitoring history of the PWS well and those nearby should be provided as well.

### **Waiver Recommendation**

Currently, the Fort Benton PWS has no waivers. For waiver consideration, based on monitoring history or a demonstration that certain chemicals were/ are not used in the inventory region, the Fort Benton PWS will need to send a letter to the DEQ Public Water Supply Section requesting monitoring waivers. Additional information regarding chemical use on adjacent properties in the inventory region must accompany the waiver request letter.

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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 non-point source 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.

**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.

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

**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 inhibits the flow of water and maintains the pressure of the ground water in the aquifer. The physical properties of a confining unit may range from a five-foot thick clay layer to shale that is hundreds of feet thick.

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

**Glacial.** Of or relating to the presence and activities of ice or glaciers. Also, pertaining to distinctive features and materials produced by or derived from glaciers.

**Geographic Information Systems (GIS).** A computerized database management and mapping system that allows for analysis and presentation of geographic data.

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

**Hazard.** A relative measure of the potential of a contaminant from a facility or associated with a land use to reach the water source for a public water supply. The location, quantity and toxicity of significant potential contaminant sources determine hazard.

**Hydraulic Conductivity.** A constant number or coefficient of proportionality that describes the rate water can move through an aquifer material.

**Hydrology.** The study of water and how it flows in the ground and on the surface.

**Hydrogeology.** The study of geologic formations and how they effect ground water flow systems.

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

**Lacustrine.** Pertaining to, produced by, or formed in a lake or lakes.

**Leaking Underground Storage Tank (LUST).** A release from a UST and/or associated piping into the subsurface.

**Maximum Contaminant Level (MCL).** Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act to establish concentrations of contaminants in drinking water that are protective of human health.

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

**Montana Pollutant Discharge Elimination System (MPDES).** A permitting system that utilizes a database to track entities that discharge wastewater of any type into waters of the State of Montana.

**National Pollutant Discharge Elimination System (NPDES).** A national permitting system that utilizes a

database to track entities that discharge wastewater into waters of the United States.

**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. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of these chemicals into surface and/or ground waters at increased levels that may exceed MCLs.

**Pathogens.** A microorganism typically found in the intestinal tracts of mammals, capable of producing disease.

**Phase II (and IIIb) Rules.** EPA updated or created legal limits on 38 contaminants. The rules became effective July 30, 1992 and January 1, 1993. Some of these contaminants are frequently-applied agricultural chemicals such as nitrate and others are industrial solvents.

**Phase V Rule.** EPA set standards for 23 contaminants in addition to those addressed by the Phase II Rules. The Phase V Rule became effective January 17, 1994. Some of these contaminants include inorganic chemicals such as cyanide and other Phase V contaminants are pesticides that enter water supplies through run-off from fields where farmers have applied them or by leaching through the soil into ground water. Six are probable cancer-causing agents. Others can cause liver and kidney damage, or problems of the nervous system and brain.

**Point Source.** A stationary location or a fixed facility from which pollutants are discharged. This includes any single identifiable source of pollution, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fracture, container, rolling stock (tanker truck), or vessel or other floating craft, from which pollutants are or may be discharged.

**Pollutant.** Generally, any substance introduced into the environment that adversely affects the usefulness of a resource (e.g. groundwater used for drinking water).

**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 (PWS).** 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.

**Resource Conservation and Recovery Information System (RCRIS).** Is a database that provides information about specific sites through the EPA Envirofacts website.

**Secondary Maximum Contaminant Levels (SMCL).** The maximum concentration of a substance in water that is recommended to be delivered to users of a public water supply based on aesthetic qualities. SMCLs are non-enforceable guidelines for public water supplies, set by EPA under authority of the Safe Drinking Water Act. Compounds with SMCLs may occur naturally in certain areas, limiting the ability of the public water supply to treat for them.

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

**Source Water.** Any surface water, spring, or ground water source that provides water to a public water supply.

**Source Water Delineation and Assessment Report (SWDAR).** A report for a public water supply that delineates source water protection areas, provides an inventory of potential contaminant sources within the delineated areas, and evaluates the relative susceptibility of the source water to contamination from the potential contaminant sources under “worst-case” conditions.

**Source Water Protection Areas.** For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply. For ground water sources, the area within a fixed radius or three-year travel time from a well, and the land area where the aquifer is recharged.

**Spill Response Region.** A source water management area for surface water systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified four-hour water travel time in a stream or river.

**Standard Industrial Classification (SIC) Code.** A method of grouping industries with similar products or services and assigning codes to these groups.

**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.

**Total Maximum Daily Load (TMDL).** The total pollutant load to a surface water body from point, nonpoint, and natural sources. The TMDL program was established by section 303(d) of the Clean Water

Act to help states implement water quality standards.

**Toxicity.** The quality or degree of being poisonous or harmful to plants, animals, or humans.

**Toxicity Characteristic Leachate Procedure.** A test designed to determine whether a waste is hazardous or requires treatment to become less hazardous.

**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.

**Turbidity.** The cloudy appearance of water caused by the presence of suspended matter.

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

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

**Volatile Organic Compounds (VOC).** Chemicals such as petroleum hydrocarbons and solvents or other organic chemicals which evaporate readily to the atmosphere.

**Watershed.** The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common delivery point.

\* With the exception of the definitions for Lacustrine, Phase II and Phase V Rules, and Standard Industrial Classification Code, definitions were adapted from EPA's Term References System (formerly known as Glossary of Selected Terms and Abbreviations) which can be found at:

<http://www.epa.gov/trs/index.htm>

The definitions of glacial and lacustrine were taken from the Glossary of Geology by Robert L. Bates and Julia A. Jackson.

The definitions for Phase II and Phase V Rules were adapted from:

<http://www.epa.gov/OGWDW/source/therule.html#PhaseII>

<http://www.epa.gov/OGWDW/source/therule.html#PhaseV>

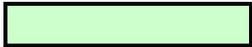
The definition for Standard Industrial Classification Code was adapted from:

[EPA/Office of Enforcement and Compliance Assurance: Guide to Environmental Issues: Glossary of Terms & Acronyms \*Term Detail\*](#)

## **Appendices**

## **APPENDIX A: Calculated Fixed Radius Equations**

**Fort Benton Calculated Fixed Radius-1 YR TOT**



Green color indicates you can edit content of this cell



Blue color cells cannot be edited, they are calculated fields

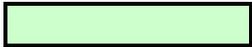
**Cylinder Method**

Equation:  $R = ((Q * t) / (\pi * n * H))^{1/2}$

$$R \approx \sqrt{\frac{Qt}{n\pi H}}$$

Input Values		
<b>Q =</b>	26952	ft <sup>3</sup> /day
<b>t =</b>	365.00	days
<b>n =</b>	0.2%	
<b>H =</b>	28	ft
<b>R =</b>	748	ft
<b>Volume Pumped</b>	9,837,480	ft <sup>3</sup> Pumped in this time frame
<b>Volume Pumped</b>	73,584,350	Gallons pumped in this time frame

**Fort Benton Calculated Fixed Radius-3YR TOT**



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Blue color cells cannot be edited, they are calculated fields

**Cylinder Method**

Equation:  $R = ((Q * t) / (\pi * n * H))^{1/2}$

$$R \approx \sqrt{\frac{Qt}{n\pi H}}$$

Input Values		
<b>Q =</b>	26952	ft <sup>3</sup> /day Pumping Rate or Discharge
<b>t =</b>	1095.00	days Time Of Travel Period Used or Time that pumping rate is sustained
<b>n =</b>	0.2%	Porosity
<b>H =</b>	28	ft Screened Interval
<b>R =</b>	129	ft Radius of cylinder needed to provide Q
<b>Volume Pumped</b>	29,512,440	ft <sup>3</sup> Pumped in this time frame
<b>Volume Pumped</b>	220,753,051	Gallons pumped in this time frame

## **APPENDIX B: Other Potential Contaminant Sources In The Fort Benton Vicinity**

**Note:** The listing of businesses came from telephone directories/ databases and other public sources. It does not indicate that these businesses are current polluters, but is simply listing them as potential contaminant sources based on experience with and the chemicals handled by similar types of businesses. These businesses were identified based on the Standard Industrial Classification Code associated with the business.

**APPENDIX B. Other Potential Contaminant Sources In The Fort Benton Vicinity**

<b>NAME</b>	<b>ADDRESS</b>	<b>CITY</b>	<b>STATE</b>	<b>ZIP CODE</b>	<b>LATITUDE</b>	<b>LONGITUDE</b>
2 & 4 Cycle Sales & Svc	1209 26th St	Fort Benton	MT	59442	47.830020	-110.66112
Ayers Limited Inc	2220 River St	Fort Benton	MT	59442	47.824260	-110.65824
B D Scott Construction	1210 Chouteau St	Fort Benton	MT	59442	47.817300	-110.67444
Benton Funeral Home	1201 Front St	Fort Benton	MT	59442	47.815020	-110.67006
Farmer's Union Oil Co	1820 Saint Charles St	Fort Benton	MT	59442	47.822940	-110.67030
Farmers Union Oil Co	1418 Main St	Fort Benton	MT	59442	47.817300	-110.66928
Fertilizer Bulk Plant	1820 St Charles St	Fort Benton	MT	59442	47.822940	-110.67030
Fort Benton Airport		Fort Benton	MT	59442	47.793960	-110.60934
Fort Benton Motor Co	1207 Front St	Fort Benton	MT	59442	47.815080	-110.67006
Fort Benton Taxidermy	2305 Saint Charles St	Fort Benton	MT	59442	47.793960	-110.60934
General Mills Inc	3011 High St	Fort Benton	MT	59442	47.793960	-110.60934
H-O Parts Supply Co	811 14th St	Fort Benton	MT	59442	47.817360	-110.67012
Harvest States Cooperative	Highway 87	Fort Benton	MT	59442	47.793960	-110.60934
Jim Taylor Chev-Olds-Pontiac	2520 Saint Charles St	Fort Benton	MT	59442	47.829720	-110.66274
Karen's Insta-Print Svc	1402 Front St	Fort Benton	MT	59442	47.816700	-110.66838
L & R Meat Co	1310 Front St	Fort Benton	MT	59442	47.816160	-110.66898
Leatherworks	1510 Front St	Fort Benton	MT	59442	47.817660	-110.66736
Missouri River Medical Ctr	1501 Saint Charles St	Fort Benton	MT	59442	47.820360	-110.67300
Naeseth Ready Mix	43261 US Highway 87	Fort Benton	MT	59442	47.793960	-110.60934
Noon's Convenience Store	1221 Main St	Fort Benton	MT	59442	47.815740	-110.67096
Power Motors	2410 St Charles St	Fort Benton	MT	59442	47.829540	-110.66292
Signal Point Golf Club	PO BOX 1134	Fort Benton	MT	59442-1134	47.793960	-110.60934
Taylor Aviation Inc	149 Signal Point Rd	Fort Benton	MT	59442	47.793960	-110.60934
Tgf Napa Parts Stop	1622 Main St	Fort Benton	MT	59442	47.819160	-110.66736
Tire Rama	810 15th St	Fort Benton	MT	59442	47.818080	-110.66862
United Agri Products Co	1108 14th St	Fort Benton	MT	59442	47.818260	-110.67204