

# Town of Bridger

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# Executive Summary

December 15, 2004

## Introduction and Background

Bridger is located in Carbon County just west of the Clarks Fork of the Yellowstone River. The town is about 30 miles south of Laurel (Figure 1). The U.S. Census Bureau estimates the 2000 population of Carbon County at 9,552 people, 759 reside in Bridger. Carbon County's population has increased about 18% and Bridger's has increased by almost 8%, since the 1990 census. Within the town limits, residents obtain their drinking water from the municipal public water supply.

The Bridger public water supply is classified as a community system under the Federal Safe Drinking Water Act, because the system serves at least 25 year-round residents through at least 15 service connections. The public water supply services about 759 residents with about 360 active service connections. Bridger's public water supply is served by ground water from three wells that were drilled between 1942 and 1953, according to the most recent sanitary survey. The wells draw water from shallow sand and gravel deposits that are part of an alluvial terrace that sits above the Clarks Fork River Valley (Figure 4).

Within the past five years, Bridger has not had any positive total coliform results from water quality samples submitted to the Department of Environmental Quality. The highest nitrate value recorded for water from all of the wells is 2.17 milligrams per liter (mg/l), and an average value of 1.8 mg/l, which is significantly below the Maximum Contaminant Level (MCL) of 10 mg/l set by the US EPA.

## Delineation of Source Water Protection Areas

The purpose of delineation is to map the source of drinking water for the public water supply and to define areas within which to prioritize source water protection efforts. Four source water protection areas are defined for Bridger (Figures 3A and B, 7, 8 and 9). They are 1) a 100-foot control zone around each of the wells, 2) an inventory region based on hydrogeologic mapping and 3-year Time-Of-Travel (TOT) calculations for ground water, 3) a recharge region corresponding to the watershed that surrounds the public water supply, and 4) a surface water buffer region extending ½ mile down-stream from the wells and 10 miles upstream. The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's wells. The inventory and surface water buffer regions should be managed to prevent contaminants from reaching the wells before natural processes reduce their concentrations. The goal of management in the recharge region is to maintain and improve water quality over long periods of time or increased usage.

Ground water in the vicinity of Bridger is present within the older bedrock formations, alluvial terrace deposits, and modern alluvium (Figures 4A and B). The most productive wells in the area are those completed in the modern alluvial deposits that flank the Clarks Fork River and its tributaries. Bridger's wells are completed in an alluvial terrace deposits west of the river. Recharge for the aquifers in the area comes from a combination of precipitation, snowmelt runoff, flood irrigation, and leakage from rivers, streams and irrigation canals. Ground water flow direction is interpreted to be primarily from upland areas toward the river (Figures 3A and B).

## **Inventory of Potential Contaminant Sources**

The inventory of potential contaminant sources is used to assess the susceptibility of the Bridger public water supply to contamination and to identify priorities for source water protection planning. The inventory focuses on facilities that generate, use, store, transport, or dispose of potential contaminants, and on land types where potential contaminants are present. Some potential contaminant sources are considered significant based upon 1) the volume of potential releases, 2) the volume of hazardous materials typically handled, 3) the potential of the released materials to impact nearby surface water or groundwater, and 4) the proximity of the potential contaminant sources to the source of water used by the public water supply. Maps showing the inventory results are shown in Figures 3A and B, 6, 7, 8 and 9.

Bridger has multiple businesses that could be considered potential contaminant sources but most of them are small and do not handle commercial volumes of hazardous materials. The businesses are not considered to pose a threat to the public water supply.

Potential contaminant sources that could pose a threat to the public water supply include: the railroad corridor, the town's municipal sewer system, and agricultural lands in the vicinity of Bridger. The hazard associated with the railroad comes from accidents that could result in spills and releases that would infiltrate into the aquifer used to provide water for Bridger. Rail cars can carry relatively large volumes of hazardous materials and the hazard rating is set at high. Susceptibility is also set at high with one barrier recognized (emergency response).

Municipal sewer mains and lines are present beneath about 47% of the inventory region and represent a moderate hazard. Leaks in the main and service lines or structural failure of the lines could pose a threat to the source water. The susceptibility of the water supply to the municipal sewer system is set at high with no barriers identified (Table 9).

The concern with agricultural lands is over-application or misuse of fertilizers and/or pesticides that can result in those ag-chemicals infiltrating into ground water and running off in to surface water bodies that may have hydraulic connection with aquifers that supply water. The hazard associated with the ag-land is set at low and the susceptibility of the water supply to the ag-land is set at moderate with no barriers identified (Table 9).

Table 9 lists all of the potential contaminant sources identified in this inventory and includes the hazard and final susceptibility ratings assigned to each potential source. Figures 3, 6, 7, 8 and 9 show the locations of potential contaminant sources in relation to the public water supply. All potential contaminant sources may not have been identified in this inventory. In some instances, inadequate location information precluded the inclusion of potential sources in the inventory.

## **Management Recommendations**

It should be noted that even small releases of some chemicals in close proximity to a well, spring, infiltration gallery, or surface water intake can have significant negative impact on water quality, and is therefore a significant threat to a public water supply. Steps can be taken to reduce the likelihood of releases to the source water for the public water supply or in the vicinity of the sources. Some of these steps are listed in Table 9 and under the Management Recommendations section on page 23.

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## INTRODUCTION

This Delineation and Assessment Report was prepared by Jim Stimson, a hydrogeologist with the Source Water Protection Program of the Montana Department of Environmental Quality (DEQ). Bridger Public Water Supply (PWS) is located in Carbon County, Montana, about 25 miles south of Laurel and about 30 miles north of the Montana – Wyoming border (Figure 1). The DEQ PWS identification number, operator name, and operator phone number for the Bridger PWS appear on the title page of this report.

### **Purpose**

This report is intended to meet the technical requirements for the completion of the source water delineation and assessment report for the Bridger PWS as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182). The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to the protection of public drinking water supplies from contamination. The primary purpose of this source water delineation and assessment report is to provide information to assist the Bridger PWS operator in the identification of potential contaminant sources near and upstream from the town's well infiltration galleries, and to encourage the development of a source water protection plan to help protect the town's drinking water for the long term.

Delineation and assessment constitute major components of the Montana Source Water Protection Program. Delineation entails mapping the boundaries of source water protection areas, which encompass ground water and/or surface waters contributing to public water supply. Assessment involves identifying locations or regions within source water protection areas where contaminants may be generated, stored, transported, or disposed, and determining the relative susceptibility of drinking water to contamination from these sources. In 1994, DeMartino completed a Wellhead Protection Report for Bridger that included ground-water flow modeling, delineation of an inventory region, and an inventory of potential contaminant sources (DeMartino, 1994). The current Source Water Delineation and Assessment Report compliments the earlier Wellhead Report by adding several other inventory regions required under the Source Water Protection Program and includes some data from the previous work.

### **Limitations**

This report was prepared to assess threats to the Bridger PWS and is based on published data including the most recent sanitary survey, and information obtained from local residents familiar with the community. The terms “drinking water supply” and “drinking water source” refer specifically to the sources of Bridger public water supply, and not any other public or private water supply. Also, not all of the potential or existing sources of ground water or surface-water contamination in the area of Bridger are identified. Only potential sources of contamination in areas that contribute water to the identified drinking water sources 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 carcinogenic or toxic constituents that do not have MCLs but are considered to be significant health threats.

# CHAPTER 1 BACKGROUND

## The Community

Bridger is located near the Clarks Fork of the Yellowstone River (Figures 1 and 3A and B). State Highway 72 / 310 passes directly through town and an active line of the Northern Pacific/Burlington Northern Railroad is adjacent the highway. The U.S. Census Bureau estimates the 2000 population of Carbon County at 9,552 people, 759 reside in Bridger. Carbon County’s population has increased about 18% and Bridger’s has increased by almost 8%, since the 2000 census.

Within the town limits, residents obtain their drinking water from the municipal public water supply. The municipal sewer district services all residents within town limits and some areas outside the limits. A wastewater treatment plant also serves the town with multicelled lagoons located about ½ mile west of town. Residents in areas outlying town limits where sewer services are not available utilize on-site septic systems for waste disposal. There are no other public water supplies located in Bridger.

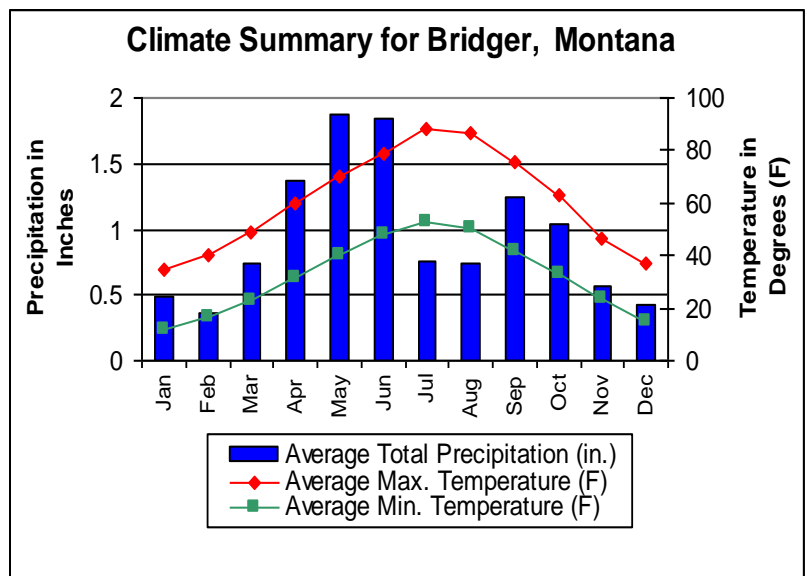
**Table 1. Public Water Supplies in the area. Not Used In This Report**

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## Climate

Climate data for Bridger is summarized in Figure 2. The average daily high and low temperatures at Bridger are 88 °F and 52.9°F in July, and 34.3 °F and 11.6 °F in January (Figure 2). Based on Western Regional Climatic Center data for the period of record, annual precipitation averages 11.48 inches. Monthly average precipitation ranges from 0.43 inches in December to 1.88 inches in May. Summer thunderstorms and winter snows provide a majority of the precipitation in the area. The annual mean snowfall in Bridger is 38.1 inches. A summary of the available climatic data for the Bridger area is presented in Table 2 below.

**Figure 2. Average Temperatures and Precipitation**



**Table 2. Climate Summary.**

**BRIDGER, MONTANA (241102)**

Period of Record Monthly Climate Summary

Period of Record : 8/23/1951 to 6/30/1974

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<b>Average Max. Temperature (F)</b>	34.3	40	48.6	59.8	69.9	78.9	88	86.7	75.3	62.8	46.6	36.8	60.7
<b>Average Min. Temperature (F)</b>	11.6	16.3	22.7	31.8	40.3	47.7	52.9	50.7	41.8	33.4	23.3	15.3	32.3
<b>Average Total Precipitation (in.)</b>	0.49	0.37	0.74	1.37	1.88	1.84	0.76	0.74	1.25	1.04	0.56	0.43	11.48
<b>Average Total SnowFall (in.)</b>	6.9	4.6	7.3	5.3	0.5	0	0	0	0.5	2.8	4.6	5.6	38.1
<b>Average Snow Depth (in.)</b>	2	1	1	0	0	0	0	0	0	0	1	1	1

Western Regional Climate Center, [wrc@dr.edu](mailto:wrc@dr.edu)

**Geographic Setting**

Bridger is located in the Non-Glaciated Central Region of the United States (Heath, 1984). The town is located on the western edge of the Clarks Fork of the Yellowstone River alluvial valley (Figure 1) and is about 30 miles south of Laurel. The Beartooth Mountain Front at Red Lodge is about 30 miles to the southwest of Bridger and the Prior Mountain uplift is about 6 miles southeast of Bridger. The Clarks Fork River Valley is about 1 ½ to 2 miles wide near Bridger. Topographic relief in the area is moderate with nearby up-land areas rising about 1,000 feet above the river valley. Many of the creeks and tributaries to the Clarks Fork have moderately incised channels.

**Geology**

This section provides an overview of the geology and hydrology of the vicinity of Bridger and Fromberg, Montana. The geologic quadrangle map is used to describe the general geology in the area (Lopez, 2000, Geologic Map of the Bridger Quadrangle, Montana Bureau of Mines and Geology Geologic Map Series Number 58). The geology of the area can be used to determine the locations, boundaries, and hydraulic properties of local aquifers. An understanding of hydrogeologic conditions also provides an explanation for the sensitivity of local aquifers to potential contamination sources.

Unconsolidated alluvium is present in the Clarks Fork Valley and in the local tributary valleys (Figure 4). The alluvium consists of lenses and beds of unconsolidated gravel, sand, silt, and clay. Alluvial deposits are thicker within the main river valley. The alluvium yields economic quantities of water to wells and in represents an important shallow source of ground water from an unconfined aquifer.

Alluvial terrace deposits are also present within the main river valley in the vicinity of Bridger and Fromberg (Figure 4). The terrace deposits represent older alluvium that was deposited by the ancestral Clarks Fork River over the last 10,000 years or so. Some of the terraces are between tens and hundreds of feet above the modern streams and are considered to be Quaternary age, ranging from Pleistocene to Recent. These terrace deposits consist of gravel, sand, silt, and clay. In some parts of Montana, the

terrace deposits can be mapped as three or four distinct geologic deposits distinguished by their elevations above the present-day river flood plains. However, in the Bridger – Fromberg area the terraces are not differentiated and they are mapped as a single unit that is present on either side of the river (Figure 4). An isolated outcrop of the Alluvial Terrace 4 is mapped just north of Fromberg. In some areas, the gravel deposits within the terraces provide ground water to wells where there is a source of recharge from leakage from tributary streams, irrigation canals, and flood irrigation.

Near Bridger, several alluvial fan deposits of unconsolidated gravel, sand, silt and clay are present at the valley margins and rest on top of the river valley alluvium. The fan deposits gradually “join” the alluvium in up-stream areas (Lopes, 2000). The fans can in some places act as confining layers above the alluvial gravel deposits that supply water to wells. Several well logs from wells north of the Bridger public water supply wells do record significant clay layers above the gravels. The Bridger public water supply well logs do not indicate the presence of the clays so the aquifer appears to be unconfined.

Bedrock exposed at the land surface in the vicinity of Bridger – Fromberg is dominated by about 10 formations that are Upper Cretaceous in age (Figure 4). The bedrock formations are dipping slightly to the west away from the Prior Mountain Uplift. The modern alluvium, alluvial terraces, and the alluvial fan deposits discussed above rest on top of the older bedrock (Figure 4B). East of Bridger – Fromberg, the landscape is dominated by outcrops of the Cretaceous age Mowry Shale and Belle Fourche Shale. Some of the formations have been broken into large blocks by numerous faults. Outcrops of the Frontier Formation are present in bands that form the flanks of hills just east of the two towns and adjacent the alluvial terrace surface (Figure 4). Near Bridger, alluvial fan deposits grade into the alluvial terrace deposits and rest on top of the Frontier Formation. West of the town sites, there are outcrops of the Telegraph Creek, Eagle Sandstone, Clagget Shale, and Judith River Formation that are all of Upper Cretaceous age.

From a water availability standpoint, aquifers within the modern alluvium are often the most reliable and consistent source of ground water and they are tapped for public and private water supply by numerous shallow wells. Terrace deposits can also be important aquifers in parts of the valley where there are sources of recharge like flood irrigation and leakage from streams and canals. Deeper wells are completed in the older bedrock formation in some areas around Bridger – Fromberg area. They target sandstone beds within the bedrock formations. While the older bedrock formations can be sources of ground water, they usually yield smaller volumes of water to wells than the younger alluvial deposits. Figure 4B represents a conceptual ground-water model for the Bridger – Fromberg areas and shows the general relationships between the younger alluvial deposits and the older bedrock formations. The figure is not drawn to scale and only represents an illustration of the conceptual model for the occurrence of ground water in the vicinity. The depth to bedrock is reported as ranging from 22 to 30 feet below land surface near Laurel but near the Montana – Wyoming border the depth to bedrock is reported to occur at more than 47 feet below land surface (Levings, 1986). From the report by Levings (1986), it appears that the Clarks Fork River Valley is underlain by a tilted bedrock contact that slopes downward to the south. This bedrock configuration is similar that present in the Paradise Valley and the Big Hole Valley.

### **The Public Water Supply**

The Bridger PWS is classified as a community system under the Federal Safe Drinking Water Act, because the system serves at least 25 year-round residents through at least 15 service connections. The PWS services about 759 residents with about 360 active service connections.

Bridger’s public water supply is served by ground water from three wells that were drilled between 1942 and 1953 according to the sanitary survey. The wells range in depth between 38 and 52 feet and are interpreted by the Montana Bureau of Mines and Geology (MBMG) as being completed in a alluvial terrace deposit. One of the wells (Well 1) is used as a backup to the other two sources. The water from all of the sources is treated with chlorine. Wells 2 and 3 have their own chlorinators and Well 1 water is chlorinated as it passes through a consecutive connection with Well 3. Water from the three wells is pumped to a 500,000-gallon storage tank located west of town. The wells draw water from shallow sand and gravel deposits that are part of an alluvial terrace that sits above the Clarks Fork River valley (Figures 1 and 3A). The terrace sands and gravel deposits represent a shallow and unconfined aquifer. Source water from the wells is classified as highly sensitive to contamination, in accordance with Montana Source Water Protection Program criteria (1999), also see Table 3 below.

Public water systems must conduct routine monitoring for contaminants in accordance with Federal Safe Drinking Water Act requirements. A community public water supply, like Bridger, must sample in accordance with schedules specified in the Administrative Rules of Montana (ARM). Monitoring includes coliform bacteria, lead, copper, nitrate, nitrite, volatile organic chemicals (including hydrocarbons and chlorinated solvents), inorganic chemicals (including metals), synthetic organic chemicals (including pesticides), and radiological contaminants. Transient, non-community PWSs are required to conduct routine monitoring only for pathogens (including coliform bacteria), nitrate, and nitrite. All contaminant concentrations detected in required samples must comply with numeric maximum contaminant levels (MCLs) specified in the Federal Safe Drinking Water Act.

**Table 3. Source water sensitivity criteria (DEO).**

Source Water Sensitivity
<b>High Source Water Sensitivity</b> <b>Surface water and GWUDISW</b> <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)

**Bridger PWS Water Quality**

Within the past five years, Bridger has not had any positive total coliform detections. No MCL exceedances were noted for any other constituents monitored over the past five years, this includes nitrate. The highest nitrate value recorded for water from all of the wells is 2.17 milligrams per liter (mg/l), and an average value of 1.8 mg/l, which is significantly below the MCL of 10 mg/l but is considered to be an elevated nitrate concentration compared to other ground-water sources in the state (Appendix B). Water quality data collected as part of the 1994 Wellhead Protection Project is included in Appendix C. This data set includes samples collected from surface-water and ground-water sites.

## **CHAPTER 2 DELINEATION**

The source water protection areas for the Bridger public water system are delineated in this chapter. The purpose of delineation is to map the source of drinking water for the public water supply and to define areas within which to prioritize source water protection efforts. Normally for a public water supply using ground water, three source water protection regions are delineated for each well. They include: 1) a 100-foot control zone, 2) a 3-year Time-Of-Travel (TOT) inventory region, or an inventory region based on hydrogeologic mapping, and 3) a recharge region corresponding to the watershed that surrounds the public water supply. For ground water sources that are located close to streams, a surface water buffer region is also routinely delineated.

For Bridger, the four source water protection regions mentioned above are delineated for each of the public water supply wells (Figures 1, 3, 7, and 8). The inventory region is based on general hydrogeologic mapping and estimates of 3-Year Time-Of-Travel. A surface water buffer region extends ½ mile downstream from the general location of the wells and 10 miles upstream. This surface water buffer region extends ½ mile from each bank of the river and extends up some major tributaries. The recharge region corresponds to the watershed surrounding the Clarks Fork River Valley.

The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's wells and infiltration lines or the immediate surrounding areas. The inventory and surface water buffer regions should be managed to prevent contaminants from reaching the well before natural processes reduce their concentrations. The goal of management in the recharge region is to maintain and improve water quality over long periods of time or increased usage.

### **General Hydrogeologic Setting**

#### *Geologic Setting:*

Ground water within the Clarks Fork River Valley can be found in several distinct aquifers or hydrologic units (groups of aquifers). Many of the wells near Bridger and Fromberg are completed in the alluvium of the Clarks Fork. The aquifer is relatively shallow and it is unconfined. In some areas there are clay or silty clay beds related to river over-bank flow (flood events) that rest on top of the alluvial gravels and create locally confined conditions. In other areas there are clay beds associated with alluvial fan deposits overlies the alluvium and confine the aquifer locally. However for the most part, the alluvial aquifer appears to be unconfined (Olson and Reiten, 2000). Alluvium beneath the flood plains of larger rivers like the Clarks Fork often functions as a highly productive aquifer. Water level in the area ranges from 50 feet below the land surface near the valley margins to less than 10 feet near the river (Levins, 1986, Olson and Reiten, 2000).

In some areas within the Yellowstone River Valley and some of its tributaries, there are up to five distinct alluvial terraces with varying thicknesses of unconsolidated gravel and sand. Some of the terraces are more extensive than others and can be distinguished from each other by their elevation above the modern river flood plain. Some of the gravel deposits within the terraces function as aquifers where they receive recharge from irrigation canals, streams, and flood irrigated fields. Aquifers within the terraces can also yield substantial volumes of water if reliable sources of recharge are present. However, the terraces are often eroded by streams (dissected) and this can lead to natural dewatering of the gravel and sand deposits.

The terraces are not reliable sources of ground water where recharge is inconsistent or absent, or where they are substantially dissected or reduced in area by erosion. In the Bridger and Fromberg areas, one primary terrace deposit is mapped and only small remnants of Terrace 4 are present at some locations (Figure 4). Some of the wells in the area appear to be located on the terrace surface but it is not clear whether the wells are producing from gravels and sands within the terrace, or from alluvial deposits or bedrock formations below the terraces. The Montana Bureau of Mines and Geology (MBMG) has interpreted the source of water for the Bridger wells as the lower terrace gravel deposit, as indicated from each well's log.

As mentioned above, bedrock formations are exposed at the land surface around Bridger and Fromberg. Most of the formations near the two towns are Upper Cretaceous in age and lie beneath the modern alluvium and the terraces. Bedrock formations are dipping (inclined) to the west at an angle ranging from 4 to 6 degrees (Olson and Reiten, 2000). Some wells in the area appear to tap aquifers within the older bedrock formations. Sandstone beds within the bedrock formations do in fact provide water to wells. While the older bedrock formations can be sources of ground water, they usually yield smaller volumes of water to wells than the younger alluvial deposits and sometimes the quality of water from bedrock is not as good as water from the alluvium.

Bridger's three public water supply wells are located within Memorial Park and appear to be completed in the shallow unconfined alluvium of the Clarks Fork. Well 1 is 38 feet deep and completed in a gravel deposit that is about 6 feet below the land surface and is about 32 feet thick. The well produced about 400 gallons per minute (gpm) during a pumping test conducted at the time of completion. The sanitary survey states that Well 1 is currently used as a backup source for the other wells and is pumped at about 250 gpm when it is used. Well 2 is 45 feet deep and encountered the gravel aquifer at 6 feet below the land surface. This well also produced on the order of 400 gpm at completion but is currently pumping about 500 gpm. Well 3 is 52 feet deep and currently pumped at about 520 gpm. According to the sanitary survey, the average daily production volume is 300,000 gallons. The maximum daily production is reported as 450,000 gallons per day (gpd).

### **Local Hydrogeologic Setting**

Ground water is present within the older bedrock formations, the terraces in some places, and the modern alluvium. As in many areas, the most productive wells are those completed in the modern alluvial deposits that flank and that are found beneath larger rivers and streams. Recharge for the aquifers in the area comes from a combination of precipitation, snowmelt runoff, irrigation return flows, and leakage from rivers, streams and irrigation canals. The MBMG well logs for the Bridger wells indicate that the wells are completed in terrace gravel deposits (see last 3 pages of sanitary survey).

Information for wells in the vicinity of Bridger was retrieved from the Montana Ground Water Information Center (GWIC) September 9, 2004. Figure 5 shows a frequency distribution of total depth of these wells. Figure 5 indicates that the majority of wells are relatively shallow. Eighty-four percent are less than 100 feet deep, and 61% are less than 50 feet deep. The average depth for all of the wells in the recharge region is 63 feet below land surface (ft. bls) and the maximum depth is 340 ft. bls. Average static water level for these wells is 31 ft. bls and the maximum is 210 feet. Pumping water level average is 23 ft. bls and average yield for wells in this area is 44 gallons per minute (gpm) with a maximum yield listed at 2000 gpm. Well logs show that the majority of the wells are completed in sand and gravel deposits with a smaller number completed in what appears to be sandstone associated with the bedrock formations. Levings (1986) reported specific yield values ranging from 1 to 1,000 gpm/ft. for wells

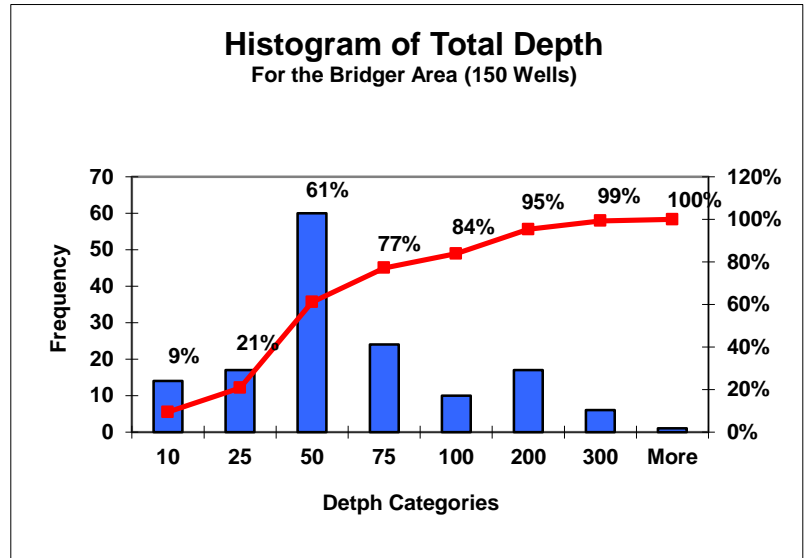
completed in the Clarks Fork alluvium and ranging from 0.02 to 2.4 gpm/ft. for wells completed in bedrock.

**Conceptual Model and Assumptions**

Source water for the Bridger public water supply comes from unconsolidated sands and gravels associated with a terrace deposit (Figures 4 and 4B). The aquifer is interpreted to be shallow unconfined aquifer.

Ground water flow direction is interpreted to be primarily from upland areas toward the river (Figures 3A and B). Close to the Clarks Fork River the ground water flow direction is interpreted to be approximately parallel to the river. Recharge is considered to come from a combination of precipitation, snowmelt runoff, irrigation return flows, and leakage from rivers, streams and irrigation canals.

**Figure 5. Well Depth Histogram For Wells In The Area.**



**Summary of Well Information**

**Table 4. Information from drillers log for the Bridger wells.**

Well Name: MBMG # DNRC WR#	Well 1 104035 -	Well 2 104036 -	Well 3 104037 -
Location	06S 23E 21 DBCD	06S 23E 21 DBCD	06S 23E 21 DBCD
Date Completed	05/01/1942	06/01/1945	06/01/1953
Depth (ft bgs*)	35	45	52
Screened Interval (ft**)	-	-	-
SWL Depth (ft bgs*)	25	25	25
PWL Depth (ft bgs*)	-	-	-
Drawdown (ft**)	-	-	-
Test Pumping Rate (gpm***)	400	400	400
Specific Capacity (gpm/ft****)	-	-	-

\*ft bgs = feet below ground surface, \*\*ft = feet, \*\*\*gpm = gallons per minute, \*\*\*\*gpm/ft = gallons per minute per foot of drawdown.

## Delineation Results

### Control Zones

The control zone for each well consists of a 100 foot fixed radius circle, in accordance with the criteria specified in the Source Water Protection Program Document (1999). All potential sources of contamination are inventoried within the control zones. The general location of the control zones are shown in Figures 3A and B but detailed maps of the control zones are not shown.

### Inventory Region

An single inventory region is delineated for the wells that includes land areas that contribute water to the aquifer tapped by the well (Figures 3A and 3B). The inventory region extends about 400 feet east of wells 1 and 3 to the western edge of the river valley, near the contact between river alluvial fan deposits and older bedrock formations (Figures 3A, 3B, and 4A). This represents a distance of about 3,700 to 3,800 feet from the wells (Figure 3A and 3B). Information obtained from three general studies on the ground water in the vicinity of Bridger was used to estimate ground-water time-of-travel distances. These distances were used to set the length of the inventory region. One and three year time-of-travel distances are estimated and the three-year distance is used to determine the total length of the inventory region. The length of the inventory region is estimated at 3,863 feet and the one-year distance is calculated at 1,619 feet (Table 5). The inventory region's western boundary is set at the valley margin near the contact between the alluvial deposits with the bedrock formation. This location is just under the calculated three-year time-of-travel distance. All potential sources of contamination are inventoried within the inventory region.

### Surface Water Buffer Region

The surface water buffer region extends ½ mile down stream from the general location of the wells and 10 miles upstream. The buffer region is ½ mile from each bank of the Clarks Fork River (Figures 7 and 8). Sources of pathogens and nitrate are inventoried within this region.

### Recharge Region

The Watershed Region for the Bridger well and infiltration lines encompasses the land area surrounding the river valley that includes the Fifth Code Hydrologic Unit: 10070006130 (Figures 8 and 9). The watershed has an area of about 283 square miles. General land uses and large potential contaminant sources are inventoried in this region.

### **Limiting Factors**

Only three general studies on the ground-water resources in the area that included Bridger were available for this report. Information on the hydraulic characteristics of the alluvial aquifer are based on general estimates of the parameters listed in Table 5 and are not the results of multiple aquifer tests. As a result, inventory region is delineated based on general hydrogeologic mapping, interpretations of the general

**Table 5 - Input parameters and calculated times-of-travel.**

Input Parameter	
PWS Source Code	MT0000165
Transmissivity	1005 (ft <sup>2</sup> /day)
Thickness	25 feet
Hydraulic Conductivity	40 (ft/day)
Hydraulic Gradient	0.02 to 0.003
Flow Direction	West to East South to North near the river
Effective Porosity	0.30
Pumping Rate	26 gallons/minute
1-Year TOT	1,619 ft.
3-Year TOT	3,863 ft.

ground-water flow direction, and on the estimated hydraulic parameters listed in Table 5. The time of travel distance estimates are considered reasonable but could be improved upon by additional information and aquifer test data. The conceptual model presented in this report is a simplification of the real ground-water flow system near Bridger but is considered to be sufficiently accurate to assess the susceptibility of the Bridger public water supply to potential sources of contamination in the area.

## **CHAPTER 3 INVENTORY**

An inventory of potential sources of contamination was conducted to assess the susceptibility of the Bridger public water supply to contamination, and to identify priorities for source water protection planning. Inventories were conducted within the control zone, and the inventory, surface water buffer, and recharge regions. The inventory focuses on facilities that generate, use, store, transport, or dispose of potential contaminants, and on land types on which potential contaminants are generated, used, stored, transported, or disposed. Additionally, the inventory identifies potential sources of all primary drinking water contaminants and *Cryptosporidium*. Only significant potential contaminant sources were selected for detailed inventory.

### **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: Land cover is identified from the National Land Cover Dataset compiled by the U.S. Geological Survey and U.S. Environmental Protection Agency (U.S.G.S., 2000). Land cover types in this dataset were mapped from satellite imagery at 30-meter resolution using a variety of supporting information.

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 Standard Industrial Codes.

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

Step 6. All significant potential contaminant sources were identified in the inventory region and land uses and facilities that generate, store, transport, or dispose large quantities of hazardous materials were identified within the recharge region.

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

- 1) Large quantity hazardous waste generators
- 2) Landfills
- 3) Hazardous waste contaminated sites
- 4) Underground storage tanks
- 5) Major roads or rail transportation routes
- 6) Cultivated cropland
- 7) Animal feeding operations
- 8) Wastewater lagoons or spray irrigation
- 9) Septic systems
- 10) Sewered residential areas
- 11) Storm sewer outflows
- 12) Floor drains, sumps, or dry wells
- 13) Abandoned or active mines

### **Inventory Results/Control Zones**

The control zones for all of the wells include portions of the Memorial Park, several streets, and developed lots that appear to be connected to the city sewer service (Figure 3A and B). Potential contaminants present in the control zone include yard and lawn chemicals, small volumes of fuel related to lawn care equipment, and town sewer lines servicing several houses. Potential contaminants just mentioned are not stored in commercial volumes and do not pose a threat to the well or the source water. It would be advisable for land owners and town personnel not to use fertilizers, pesticides, or herbicides near the well location. The sanitary survey mentioned that each well is housed in its own structure.

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

A short segment of State Highway 72 / 310 passes through the inventory region up-gradient from the wells (Figures 3A and B, and 10). The Northern Pacific Railroad line is shown as an active line and passes just east of the Bridger wells and the inventory region. The Chicago-Burlington Northern-Quincy Railroad line is also shown as active and is located on the east side of the Clarks Fork River. In multiple locations these transportation routes are close to the river. The hazard comes from accidents resulting in spills and releases that would infiltrate into the alluvial aquifer up-gradient from the public water supply wells. The highway is not a major truck route and truck traffic volume is not considered to be high. The railroad is considered to pose a greater potential threat to the source water than the highway because rail cars can carry relatively large volumes of hazardous materials. Rail lines and the highway within the one-year time-of-travel distance would represent the greatest threat to the source water.

There are about 14 underground storage tank sites listed for the Bridger area (Figures 3A and B). Some of the tank sites had multiple tanks and the total count of tanks present in the area is more than 30. However, of the 14 or so sites listed, only two sites are shown as still active with a total of 6 underground fuel tanks in operation. All of the other tanks are reported as out of service and permanently removed from the ground. In addition, only one tank site with a leak history, Montana Highway Department, is located within the inventory region. The leak is reported as occurring in 1992 and resolved in 1994. At present there are no tanks present at this location.

Municipal sewer mains are present within the inventory region. A significant portion of the sewer lines appear to be directly up-gradient from the town's wells (Figures 3A and B). That means that the ground water in this area is flowing towards the wells. The potential hazard from pathogens and nitrate coming from municipal sewer system is considered moderate to high.

Bridger's wastewater treatment lagoons are located about ½ mile east from the wells and near the river. This location puts the lagoons in a down-gradient position from the public water supply. Ground water beneath the lagoons is flowing away from the town's wells and as a consequence, the lagoons do not pose a threat to the source water or the public water supply.

Several town streets are located fairly close to the wells. However, these roads do not carry heavy traffic volume and they are not major truck routes. These roads are not considered to pose a threat to the source water.

The Sand Creek Canal also passes through town about 600 feet or so west and up-gradient from the public water supply wells (Figure 3A and B). Irrigation canals often lose water through their sides and base and this water provides recharge to shallow aquifers. If the canal water is of lower quality than the ground water, it can be considered a potential contamination source that could have a negative impact on the town's source water. However, the canal carries water diverted from the Clarks Fork about 4 miles upstream from Bridger. Appendix E includes water quality data collected as part of the 1994 Wellhead Protection Project and includes samples for the Clarks Fork, the town's wells, and the canal. The water quality of canal water is very similar to the Clarks Fork which is relatively high quality water that would not pose a threat to the town's ground water source.

Agricultural land use accounts for about 20% of the land area within the inventory region. From the aerial photo in Figure 3B, it appears that the percentage of ag-land within the inventory region is probably less than 20%. Agricultural land is considered to be a significant potential contaminant source. Over application of fertilizers and/or pesticides can result in those ag-chemicals infiltrating into ground water and running off in to surface water bodies that may have hydraulic connection with aquifers that supply water. The percentage of ag-land in the inventory region is assigned a low hazard rating in accordance with the Source Water Protection Program guidelines. Other landuse / landcover types in the inventory region are grassland at 33% and urban at 47%. Grassland is not considered to be a potential contaminant source. The percentage of urban land with the municipal sewer lines represents a moderate hazard to the public water supply.

The 1994 Wellhead Protection Project included an on-site inventory of businesses in Bridger. Businesses in town at that time included: vacated gas stations, active gas stations, automobile-related businesses, furniture manufacturing, a hardware store, beauty shop, a fur company, several agribusinesses, and an unused well (DeMartino, 1994). These businesses could be considered potential contaminant sources but most of them are small and do not handle commercial volumes of hazardous materials. The businesses are not considered to pose a threat to the Public Water Supply.

Other potential contaminant sources in the Bridger area possibly include Class V injection wells. The threat from Class V injection wells cannot be determined because an accurate inventory of these wells has not been completed for Montana.

From the above list of potential contaminant sources, some are considered significant based upon the following factors: the volume of potential releases, the volume of hazardous materials typically handled, the potential of the released materials to impact nearby surface water or groundwater, and the proximity of the sources to the PWS well and infiltration lines. Significant potential contaminant sources from the above section are summarized for each source of water in Table 6 below.

**Table 6 - Significant potential contaminant sources identified.**

<b>Inventory Region for Well 1 and the Infiltration Lines</b>			
<b>Source</b>	<b>ID Number on Maps</b>	<b>Contaminant</b>	<b>Hazard</b>
<b>Railroad Corridor</b>	Not Numbered	Variety of hazardous materials including VOCs and SOCs, others?	Spills and releases related to accidents
<b>State Highway 72</b>	Not Numbered on the map	Variety of hazardous materials including VOCs and SOCs, others?	Spills and releases related to accidents
<b>USTs/LUSTs</b>	Not Numbered	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and or reaching surface water
<b>Municipal Sewer Lines</b>	Not Numbered on the map	Pathogens and nitrate, household hazardous waste	Infiltration into shallow ground water that is hydraulically connected to surface water.
<b>Local road and streets</b>	Not Numbered	Variety of hazardous materials including VOCs and SOCs, others?	Spills and releases related to accidents
<b>Cultivated Cropland</b> (less than 20% in the inventory region)	Not Numbered	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff
<b>Assorted businesses in town</b>	Not Numbered	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the river
<b>Class V Injection Wells</b> (existence and locations are not known) where storm and/or wastewater is concentrated and recharges groundwater.	Not Numbered	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are released to systems that allow infiltration of contaminants to the subsurface or to the storm water system

**Inventory Results/Surface Water Buffer Region**

Potential sources of pathogens and nitrate are the focus of the inventory for this region. Land use represents 70% agricultural land, 19% grassland, and the remaining landuse consisting of forest, urban areas, open water, and wetlands.

The Town of Bridger wastewater treatment plant is located near the Clarks Fork River and within the surface water buffer region (Figure 9). This facility appears to be operating within its permit and is located a sufficient distance from the Bridger public water supply wells so as to not pose a threat to the source water.

A train derailment site near Bridger is listed as a hazardous spill response site (Figure 9). According to EPA’s records, some volume of Phenolic was spilled at the site and contaminated soil in 1974. From

readily available information sources, it is not apparent that the spill site was remediated. However, the spill site is in across the river from the Bridger wells and very likely poses no threat to the source water.

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

The inventory within the recharge region also focuses on potential sources of nitrate and pathogen. It is assumed that distance from the public water supply well and infiltration lines and dilution will reduce the hazard posed by potential contaminant sources identified in the source water protection region.

Land cover in the recharge or watershed region is 71 percent grassland, and 26% percent agricultural land (Figure 9). Forest, urban, and wetlands make up the remaining 3% of the landuse / landcover. As stated previously, grasslands are not considered potential contaminant sources. Agricultural land is considered a potential contaminant sources due to the use of fertilizers, pesticides and herbicides. As mentioned previously, the concern here is the potential for mismanagement or over- application of fertilizers and/or pesticides on the agricultural lands that could result in SOCs entering the river up-stream from the infiltration lines and well. The percent of agricultural land represents a moderate hazard to the source water.

A number of oil and gas exploration wells and mine sites are located within the recharge region (Figure 9). Several oil and gas fields are located in the including the Belfry, Clarks Fork, and Elk Basin fields. Oil and gas fields and mine sites are located in the southern distal part of the recharge region and they are not considered to pose a threat to the source water.

Figure 9 also shows several hazardous spill response sites in the recharge region. None of the sites involve nitrate or pathogen releases. The sites are number in Figure 9 and correspond to the following sites. Site 1 - Edgar School Caprolactum detection. Caprolactum is a petrochemical used in the manufacturing of man-made fibers like nylon. Site 2 - Burlington-Northern derailment site. In 1974 a train derailment released and unknown volume of phenol. Site Number 3 is a spill related to a truck roll over in 2002 that spilled 43,000 gallons of gasoline. Site 4 is the Dry Creek Gas Field site. Petroleum products were detected in ground-water samples in the field. All of the sites listed are far enough away from the Bridger water supply so as to not pose a threat to the town's source water.

### **Inventory Update**

To make this SWDAR a useful document in the years to come, the owners, manager, or the certified water system operator(s) for the public water supply should update the inventory for their records every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. The complete inventory should be submitted to DEQ at least every 5 years to ensure that this report/plan stays current in the public record.

**Inventory Limitations**

The extent of the potential contaminant source inventory is limited in several respects. The inventory is based on data readily available through state documents, published reports, and other public sources. Documentation may not be readily available on some potential sources. As a result, all potential contaminant sources may not have been identified. In some instances, inadequate location information precluded the inclusion of potential sources in the inventory.

## CHAPTER 4 SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources. Susceptibility is assessed in order to help prioritize management actions for each potential contaminant source.

The goal of source water management is to protect the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources in the inventory region, and 3) ensuring that land use activities in the recharge region pose minimal threats 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 are also recommended that could be pursued by the PWS operators, town, and county officials in order to reduce 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 PWS well and infiltration lines (Tables 7 and 8). For point sources, hazard is rated by the proximity of a potential contaminant source to the well and infiltration lines. A high hazard rating is assigned to point sources located within the 1-year time-of-travel distance to a well. A moderate hazard rating is assigned to point sources located between the 1-year time-of-travel distance and the 3-year time-of-travel distance to a well. A low hazard rating is assigned to point sources located farther than the 3-year time-of-travel distance to a well. Hazard ratings for nonpoint sources are assigned based on the following criteria in Table 7.

**Table 7. Hazard of potential contaminant sources for the public water system well and Infiltration lines.**

	High Hazard	Moderate Hazard	Low Hazard
<b>Point Sources of All Contaminants</b>	Within 1-year TOT	1- to 3-year TOT	Over 3-year TOT
<b>Septic Systems</b>	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
<b>Municipal Sanitary Sewer (% land use)</b>	More than 50 % of region	20 to 50 % of region	Less than 20 % of region
<b>Cropped Agricultural Land (% land use)</b>	More than 50 % of region	20 to 50 % of region	Less than 20 % of region

Barriers to contamination can be anything that decreases the likelihood that contaminants will reach a well or the infiltration gallery. Barriers can be engineered structures, management actions, or natural conditions. Examples of engineered barriers are spill catchment structures for industrial facilities and leak detection for underground storage tanks. Emergency planning and best management practices are considered management barriers. Thick clay-rich soils, a deep water table or a thick saturated zone above the well intake can be natural barriers. Table 8 shows how barriers are used to adjust the final susceptibility ratings.

**Table 8. Susceptibility of Source Water based on Hazard rating and the presence of Barriers**

	<b>High Hazard Rating</b>	<b>Moderate Hazard Rating</b>	<b>Low Hazard Rating</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

Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant on the following page (Table 9).

**Table 9. Susceptibility Assessment Significant Potential Contaminant Sources in the Inventory Region - Bridger Public Water Supply.**

Inventory Region							
Source	ID Number on Maps	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
<b>Railroad Corridor</b>	Not Numbered	Variety of hazardous materials including VOCs and SOCs, others?	Spills and releases related to accidents	<b>High</b>	-Emergency response	<b>High</b>	- Maintain preparedness of local emergency personnel through active training, storm water diversion and other measures
<b>Municipal Sewer</b>	Not Numbered on the map	Pathogens and nitrate, household hazardous waste	Infiltration into shallow ground water that is hydraulically connected to surface water.	<b>Moderate</b>	-None	<b>High</b>	-Conduct routine inspections to detect leaks and deteriorating lines. -Repair leaks and replace old lines. - Provide educational information, materials and resources to business owners and the public on proper waste disposal and recycling
<b>Cultivated Cropland (&lt;20% in the inventory region)</b>	Not Numbered	Fertilizers, pesticides, pathogens, nitrate	Spills, over-application, surface runoff	<b>Low</b>	-None	<b>Moderate</b>	Support the agricultural community's educational efforts to distribute materials and resources to land owners on the proper application and storage of pesticide and fertilizers; implement agricultural BMPs
<b>USTs/LUSTs 1 Tank Site In The Inventory Region</b>	Not Numbered	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and or reaching surface water	<b>High</b>	-All tanks are inactive and removed -Remediation in complete in 1994. -New tanks comply with current standards (Spill prevention, monitoring, and leak detection)	<b>Low</b>	-Verify that remediation is complete -Request and review monitoring well water quality data -Carry out periodic inspections
<b>State Highway 72 / 310</b>	Not Numbered on the map	Variety of hazardous materials including VOCs and SOCs, others?	Spills and releases related to accidents	<b>Low</b>	-Low traffic volume -Emergency response	<b>Low</b>	- Maintain preparedness of local emergency personnel through active training, storm water diversion and other measures

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<b>Wastewater Treatment Plant and Lagoons</b>	Not Numbered	Pathogens, nitrate, TDS	Spills, leaks, and releases	<b>Low</b>	-Located downstream -Regulated and monitored discharge - City / County Emergency Response	<b>Low</b>	-Ensure proper maintenance and operation of system; monitor leaks in system; develop an alternative treatment plan in the event of system failure
<b>Local road and streets</b>	Not Numbered	Variety of hazardous materials including VOCs and SOCs, others?	Spills and releases related to accidents	<b>Low</b>	-Low traffic volume -Emergency Response	<b>Low</b>	- Maintain preparedness of local emergency personnel through active training, storm water diversion and other measures
<b>Assorted businesses in town</b>	Not Numbered	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the river	<b>Low</b>	-Business district and most business locations are down gradient of the well field.	<b>Low</b>	Support efforts to provide educational workshops to the general public by the city, county, or state promote safe handling and proper storage, transport, use, and disposal of hazardous materials. Scheduled days for the collection of hazardous wastes from the public.
<b>Class V Injection Wells</b> (existence and locations are not known) where storm and/or wastewater is concentrated and recharges groundwater.	Not Numbered	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are released to systems that allow infiltration of contaminants to the subsurface or to the storm water system	<b>Unknown</b>	<b>Unknown</b>	<b>Unknown</b>	Inventory; Provide educational information, materials and resources to business owners and the public on proper waste disposal and recycling

### **Management Recommendations**

It should be noted that even small releases of some chemicals in close proximity to a well, spring, infiltration gallery, or surface water intake can have significant negative impact on water quality, and is therefore a significant threat to a public water supply. Steps can be taken to reduce the likelihood of releases to the source water for the PWS or in the vicinity of the sources. Some of these steps (considered management recommendations) are listed below.

Some management recommendations are also included in the susceptibility table (Table 9). If these, and other, management actions are implemented; they may be considered additional barriers that will reduce the susceptibility of the intake to specific sources and contaminants.

Specific management recommendations for the Bridger Public Water Supply:

The public water supply serving Bridger is highly susceptible to the railroad tracks located within the one-year time-of-travel distance and from the municipal sewer system (Figures 3A and B, and 6). The public water supply is moderately susceptible to agricultural land in the inventory region. Working with the agricultural community to increase awareness of the public water supply's location and encouraging the use of BMPs for fertilizer, pesticide, and herbicide application would help lower the hazard posed by agricultural chemicals. Working with county and regional emergency response personnel to make sure they are aware of the public water supply's location in relation to the railroad tracks will also help shorten response time and could lessen the hazard posed by the railroad. Systematically inspecting and replacing aging sewer mains and lines would reduce the hazard posed by the municipal sewer system.

Other general management recommendations fall into the following categories:

- Sewer maintenance and leak detection
- Municipal sewer extension
- Agricultural best management practices
- Education
- Emergency Response Planning

***Sewer Maintenance and leak detection*** – Early warning of leaks and scheduled replacement of aging sewer lines may reduce the susceptibility of the Bridger public water supply to contamination from municipal septic wastes.

***Sewer Extension*** – Installation of advanced septic treatment systems such as sand filters can limit contamination from new rural residential development, however, annexation and extension of sewers is the only way to reduce contamination from existing unsewered developments.

***Agricultural and silvicultural best management practices (BMPs)*** – BMPs that address application and mixing of fertilizer and pesticides are a viable alternative to prohibition of their use. BMPs may also be utilized to minimize surface runoff and soil erosion on cultivated fields. Erosion control, selective logging, and other silvicultural practices (essentially BMPs) should be considered on a county-wide basis. BMPs are generally voluntary but their implementation can be encouraged through education and technical assistance. County planning can help promote the implementation of BMP on lands that are outside the town limits but indirectly affect the city PWS.

***Education*** - Educational workshops provided to the general public by the county or state promote safe handling and proper storage, transport, use, and disposal of hazardous materials. Ongoing training provided to designated emergency personnel will promote the efficiency and effectiveness of emergency responses to hazardous material spills. Likewise, educational workshops provided to rural homeowners will promote the proper maintenance and replacement of residential septic systems. The EPA and the State of Montana can provide educational materials on these topics.

***Emergency Response Plan*** – Several counties have compiled Emergency Response Plans that were then adopted by the local communities. The usefulness and effectiveness of a response plan are maximized if it contains a clear listing of all emergency contacts, emergency numbers, and resources available within the county to respond to an emergency situation, such as a hazardous material spill. Emergency plans are not difficult to develop or distribute, but have a significant benefit to the citizens and municipalities within the county.

## CHAPTER 5 MONITORING WAIVERS

### **Waiver Recommendation**

It appears that Bridger does not have any water quality waivers. Based on the susceptibility assessment of the town's source water, the Source Water Protection Program would not recommend monitoring waivers. Water quality monitoring will act as a first defense to detect problems with water quality in the area. However, to be sure that eligibility for all available waivers is considered, the public water supply operators are encouraged to carefully review the following section on Monitoring Waiver Requirements. If after reviewing this section it is determined that an additional waivers are feasible, the PWS should submit a letter with the proper documentation to DEQ requesting monitoring waivers. Table 9 in the Susceptibility Chapter can be used as a guide to request 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.

### 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. DEQ's PWS Section and DEQ's Source Water Protection Program will conduct review of an organic chemical monitoring waiver application. 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.

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## GLOSSARY\*

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

**Alkalinity.** The capacity of water to neutralize acids.

**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.

**Delineation.** A process of mapping source water management areas.

**Effective Porosity.** The percent of soil, sediment, or rock through which fluids, such as air or water, can pass. Effective porosity is always less than total porosity because fluids can not pass through all openings.

**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 an area expected to contribute water to a public water supply well within a fixed distance or a specified groundwater time-of-travel distance.

**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 or virus 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.

**Porosity.** The percent of soil, sediment, or rock filled by air, water, or other fluid.

**Public Water Supply (PWS).** A system that provides piped water for human consumption to at least 15 service connections or regularly serves 25 individuals.

**SIC Code.** The U.S. Standard Industrial Classification (SIC) Codes classify categories of businesses. SIC Codes cover the entire range of business categories that exist within the economy.

**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.

**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. 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, non-point, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

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

**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.

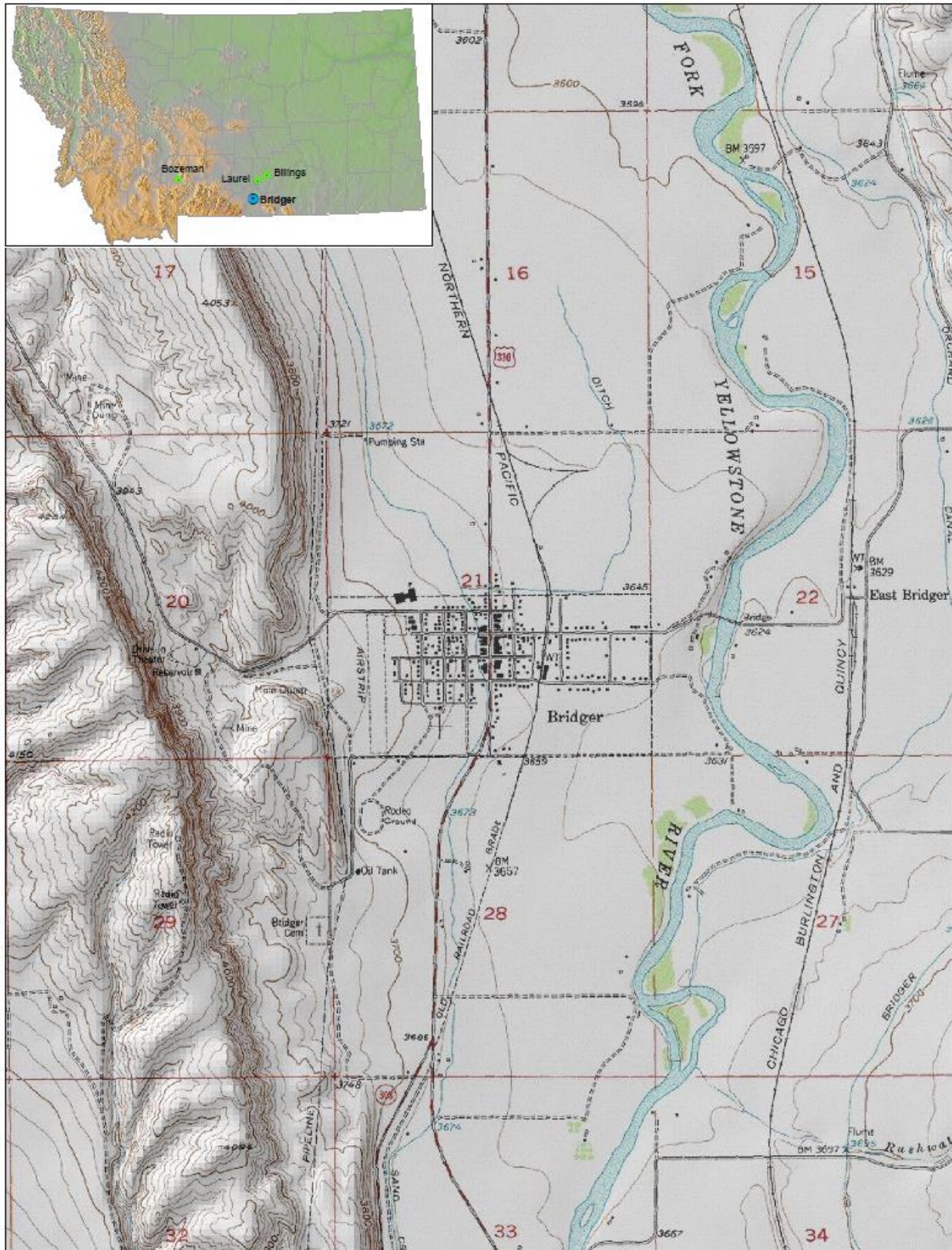
**Volatile Organic Compounds (VOC).** Any organic compound which evaporates readily to the atmosphere (e.g. fuels and solvents).

**Recharge Region / 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.

\* Definitions taken from EPA's Glossary of Selected Terms and Abbreviations and other sources.

## **FIGURES**

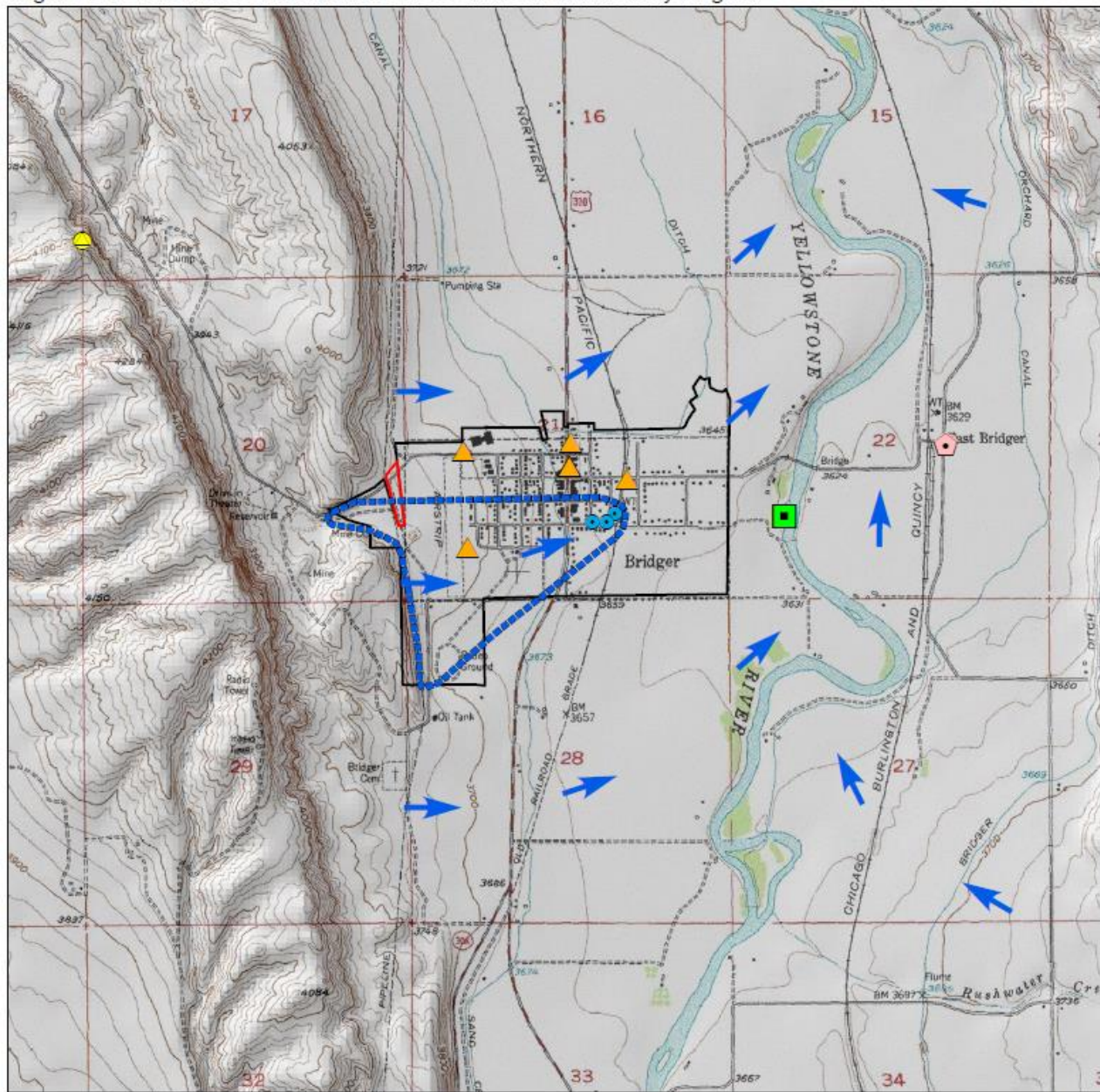
**Figure 1. General Location Map.**  
Figure 1 - General Location Map



**Figure 2. Climate Summary– Imbedded in text on page 4.**

**Figure 3A - Inventory of Potential Contaminant Sources.**

Figure 3A - Potential Contaminant Sources in the Well Inventory Region



**Legend**

Bridger PWS Wells

Bridger\_TOT\_Inventory\_Region

**Potential Contaminant Sources**

Wastewater Treatment Discharge Site

UST Site with Leak History

Landfill - Inactive

State Spill Response Site

0 0.25 0.5 1 Miles

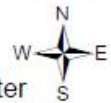
Scale

**Septic Density**

Municipal Sewer Service

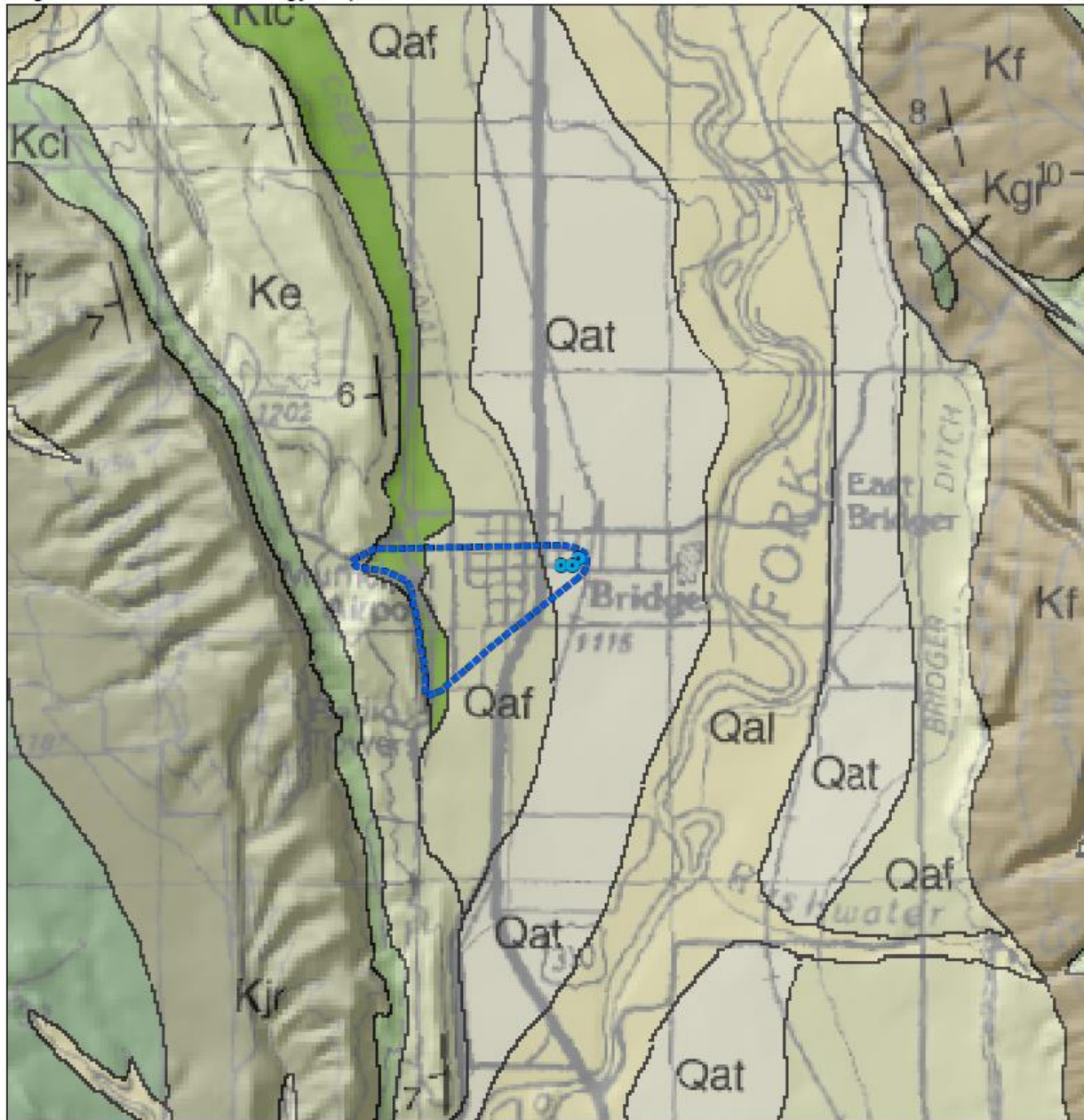
High

General Ground-Water Flow Direction



**Figure 4A. General Geology Map.**

Figure 4A - General Geology Map



<p>Geology Legend</p> <p>Formations appearing on map</p>		<p>0 0.25 0.5 1 Miles</p> <p>Scale</p>	<p>● Bridger Public Water Supply Wells</p>	
Qal - Quaternary Alluvium	Kcl - Cretaceous Clagget Shale			
Qat - Quaternary Alluvial Terrace Deposit	Ke - Cretaceous Eagle Sandstone			
Qaf - Quaternary Alluvial Fan Deposit	Ktc - Cretaceous Telegraph Creek			
Kb - Cretaceous Bearpaw Shale	Kf - Cretaceous Frontier Formation			
Kjr - Cretaceous Judith River Formation	Kbf - Cretaceous Belle Fourche Formation			
	Km - Cretaceous Mowery Shale			

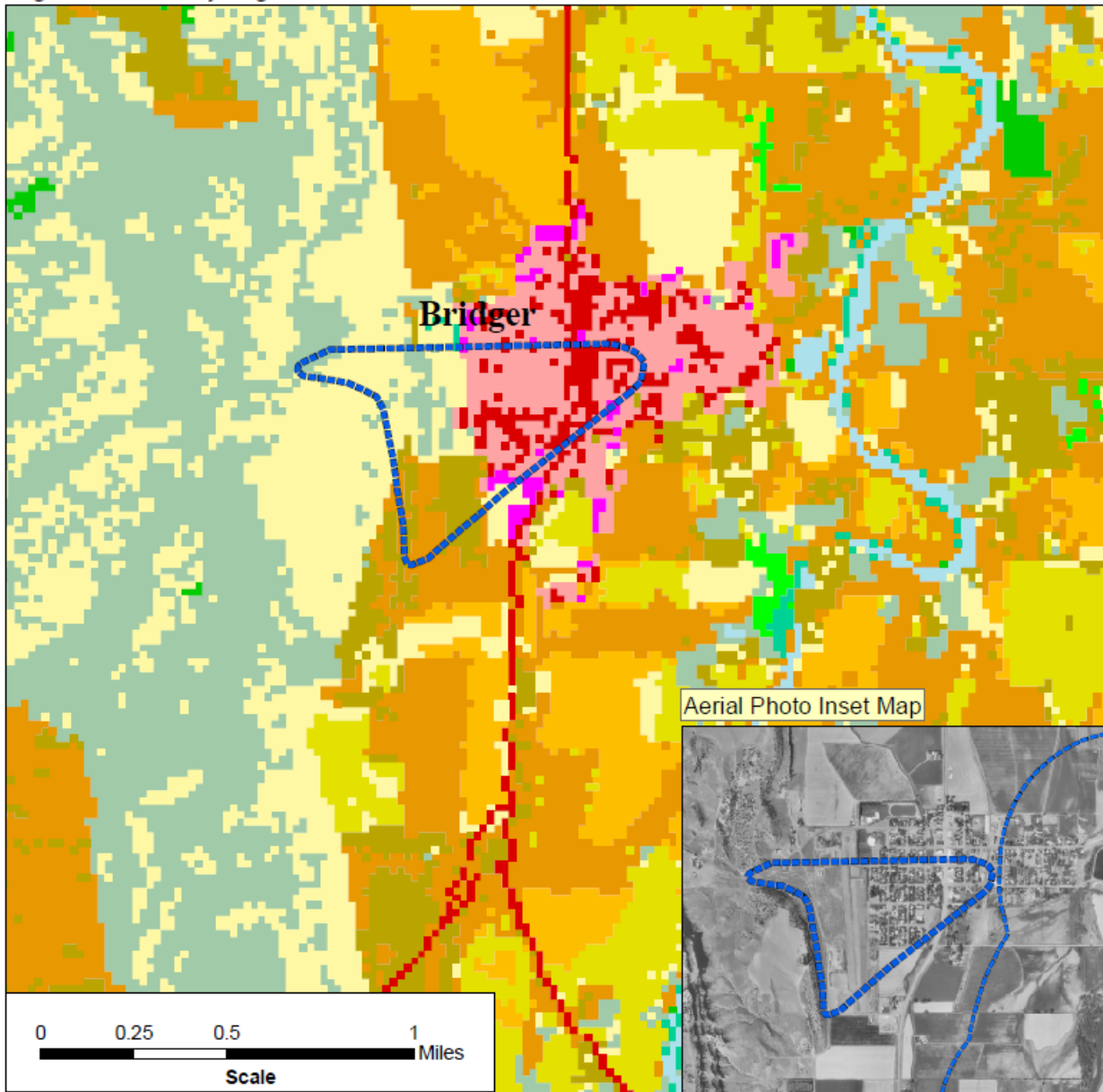
Modified from David A. Lopez, 2000, Geologic Map of the Bridger 30 X 60 Quadrangle, Montana: MBMG Geologic Map Series 58. [Note: The map on this page is for illustration purposes only and is not drawn to the original scale. The original scale for the map is 1:100,000.]

JRS - December 2004

**Figure 5. Well Depth Histogram – Imbedded in text on page 10**

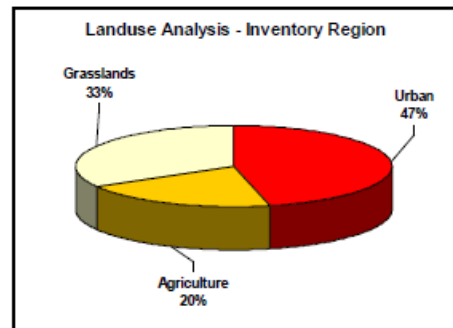
**Figure 6. Inventory Region Map with Landcover / Landuse.**

Figure 6 - Inventory Region and Landcover / Landuse



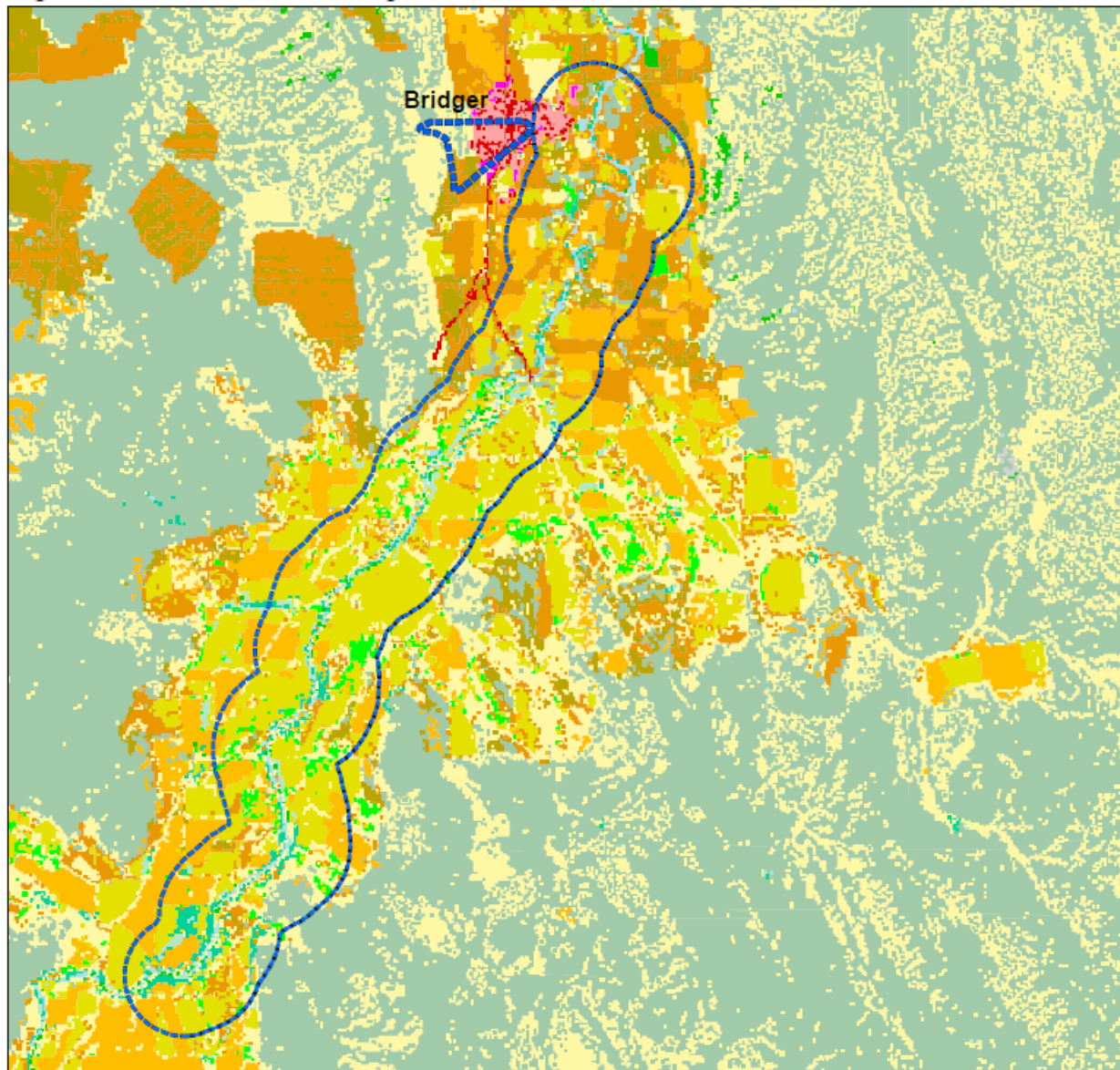
**Legend**

- Bridger Inventory\_Region
- Water
- Commercial & Roads
- Forest
- Shrubland and Grassland
- Pasture/Hay
- Agricultural Land
- Wetlands

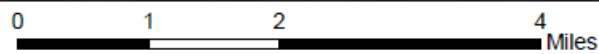


**Figure 7: Surface Water Buffer Region with Landcover / Landuse**

Figure 7 - Surface Water Buffer Region and Landcover / Landuse

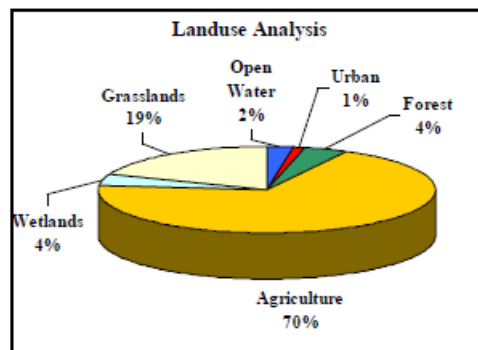


**Legend**



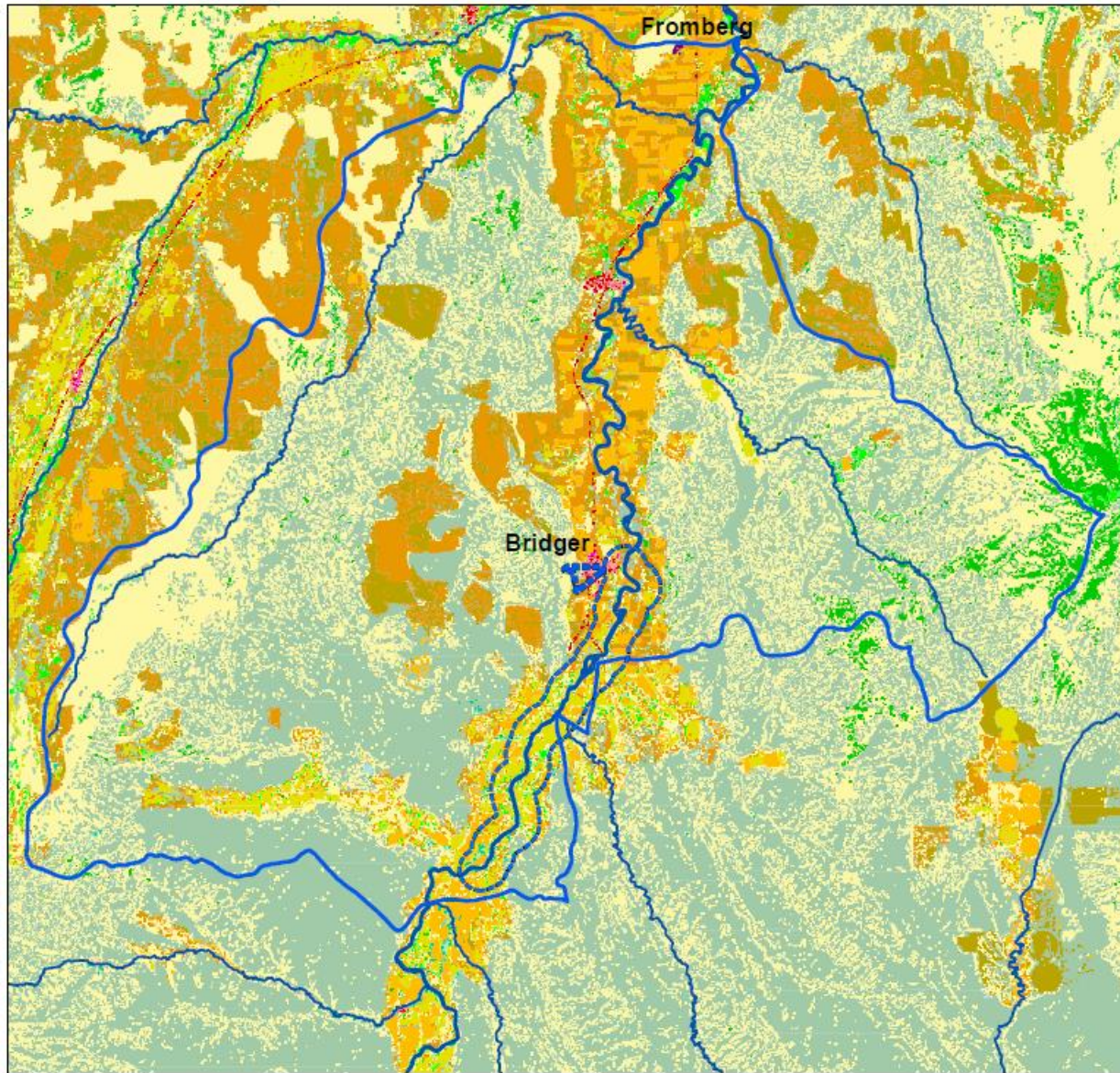
- Bridger\_TOT\_Inventory\_Region
- BR\_Surface Water Buffer Region
- Water
- Commercial & Roads
- Forest
- Shrubland and Grassland
- Pasture/Hay
- Agricultural Land
- Wetlands

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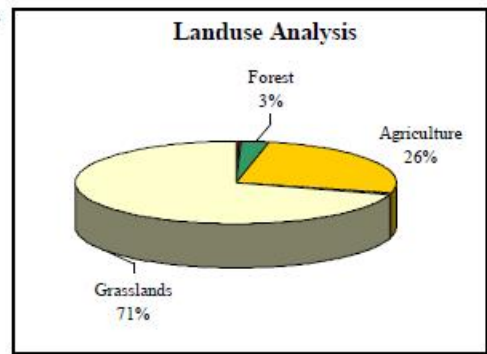
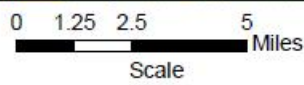
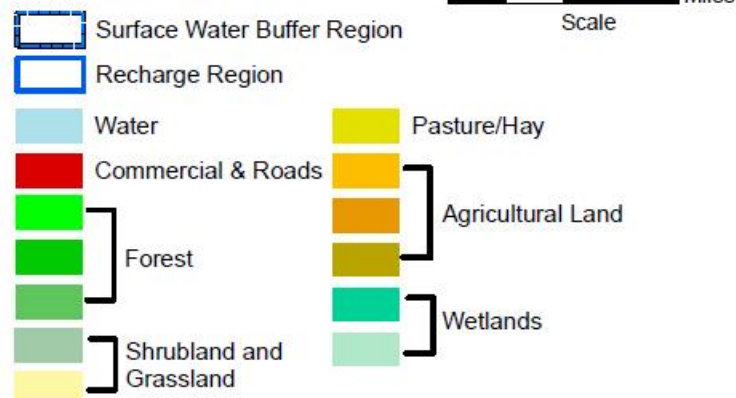


**Figure 8: Recharge Region with Landcover / Landuse**

Figure 8 - Recharge Region and Landcover / Landuse

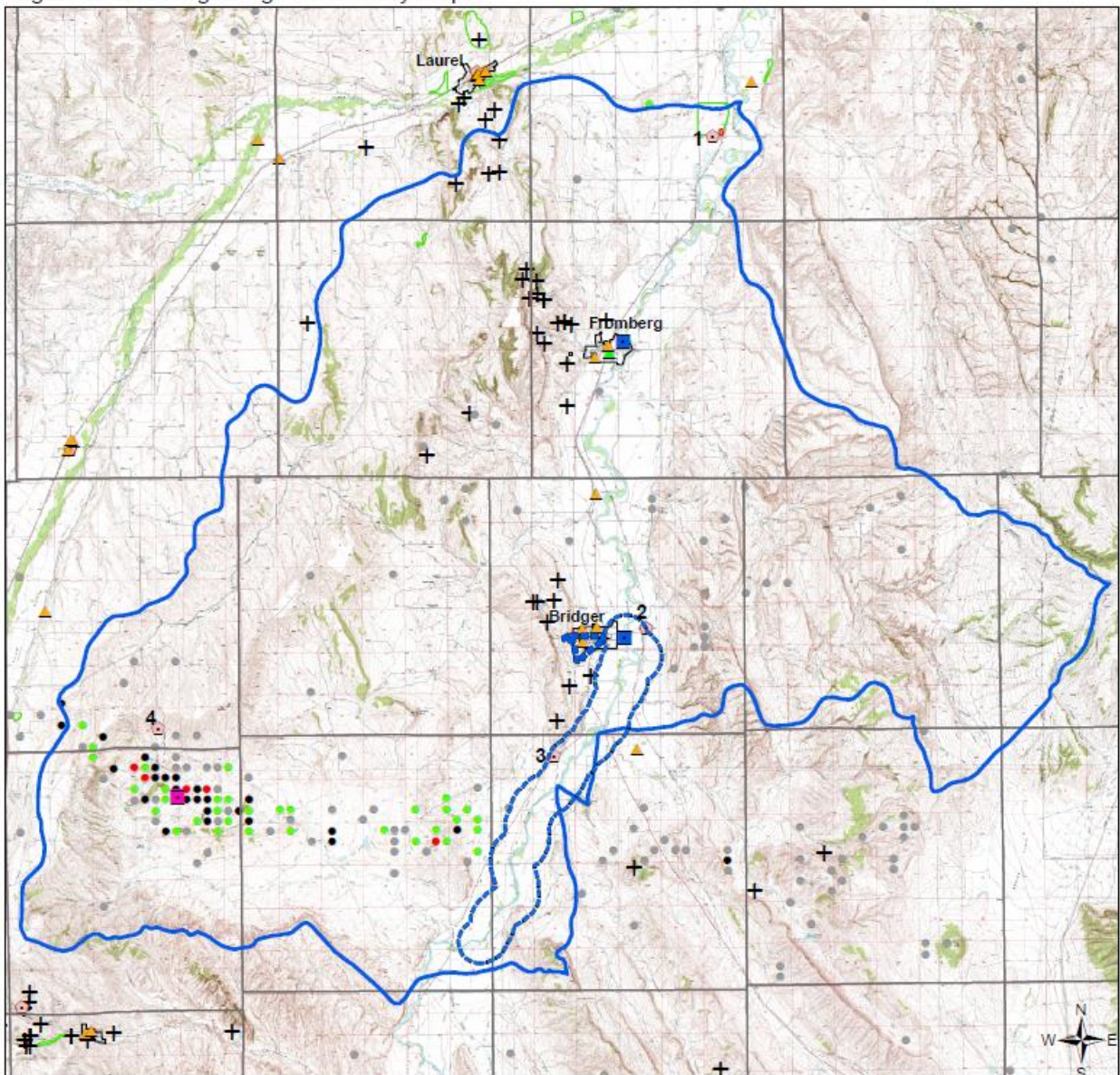


**Legend**



**Figure 9: Recharge Region Inventory Map**

Figure 9 - Recharge Region Inventory Map



**Legend**

0 1.25 2.5 5  
Scale  
Miles

Wyoming Department of Environmental Quality  
JRS - October 2004

**Septic Density**

- Municipal Sewer Service
- High
- Moderate

**Wastewater Treatment**

- Municipal
- Industrial

**Spill Response Sites**



**Underground Storage Tanks Abandoned Mine Sites**

- Tank Site with Leak History
- Tank Site - No Leak History
- Abandoned Mine Sites

**Oil and Gas Test Wells**

- Oil but no gas
- Gas but no oil
- Oil & Gas produced
- No Production

## **APPENDICES**

APPENDIX A – Well Logs for the Town of Bridger

**Montana Bureau of Mines and Geology  
Ground-Water Information Center Site Report  
TOWN OF BRIDGER WELL 1**

[Plot this site on a topographic map](#)

**Location Information**

GWIC Id: 104035	Source of Data: COMBO
Location (TRS): 06S 23E 21 DBCD	Latitude (dd): 45.2942
County (MT): CARBON	Longitude (dd): -108.9111
DNRC Water Right: W006177-00	Geomethod: UNKNOWN
PWS Id: 00165002	Datum: NAD27
Block:	Altitude (feet): 3617.90
Lot:	Certificate of Survey:
Addition:	Type of Site: WELL

**Well Construction and Performance Data**

Total Depth (ft): 38.00	How Drilled:
Static Water Level (ft): 25.00	Driller's Name:
Pumping Water Level (ft):	Driller License:
Yield (gpm): 400.00	Completion Date (m/d/y): 5/1/1942
Test Type:	Special Conditions:
Test Duration:	Is Well Flowing?:
Drill Stem Setting (ft):	Shut-In Pressure:
Recovery Water Level (ft):	Geology/Aquifer: 110TRRC
Recovery Time (hrs):	Well/Water Use: PUBLIC WATER SUPPLY
Well Notes:	

**Hole Diameter Information**

No Hole Diameter Records currently in GWIC.

**Casing Information<sup>1</sup>**

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	38.0	15.0				

**Annular Seal Information**

No Seal Records currently in GWIC.

**Completion Information<sup>1</sup>**

From	To	Dia	# of Openings	Size of Openings	Description
38.0	38.0	15.0			OPEN BOTTOM

**Lithology Information**

From	To	Description
0.0	6.0	TOPSOIL
6.0	38.0	SAND & GRAVEL

**Montana Bureau of Mines and Geology  
Ground-Water Information Center Site Report  
TOWN OF BRIDGER WELL 2**

[Plot this site on a topographic map](#)

**Location Information**

GWIC Id: 104036  
Location (TRS): 06S 23E 21 DBCD  
County (MT): CARBON  
DNRC Water Right: W006179-00  
PWS Id: 00165004  
Block:  
Lot:  
Addition:

Source of Data: COMBO  
Latitude (dd): 45.2938  
Longitude (dd): -108.9125  
Geomethod: UNKNOWN  
Datum: NAD27  
Altitude (feet): 3601.80  
Certificate of Survey:  
Type of Site: WELL

**Well Construction and Performance Data**

Total Depth (ft): 45.00  
Static Water Level (ft): 25.00  
Pumping Water Level (ft):  
Yield (gpm): 400.00  
Test Type:  
Test Duration:  
Drill Stem Setting (ft):  
Recovery Water Level (ft):  
Recovery Time (hrs):  
Well Notes:

How Drilled:  
Driller's Name:  
Driller License:  
Completion Date (m/d/y): 6/1/1945  
Special Conditions:  
Is Well Flowing?:  
Shut-In Pressure:  
Geology/Aquifer: 110TRRC  
Well/Water Use: PUBLIC WATER SUPPLY

**Hole Diameter Information**

No Hole Diameter Records currently in GWIC.

**Casing Information<sup>1</sup>**

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	45.0	15.0				

**Annular Seal Information**

No Seal Records currently in GWIC.

**Completion Information<sup>1</sup>**

From	To	Dia	# of Openings	Size of Openings	Description
45.0	45.0	15.0			OPEN BOTTOM

**Lithology Information**

From	To	Description
0.0	6.0	TOPSOIL
6.0	45.0	SAND & GRAVEL

**Montana Bureau of Mines and Geology  
Ground-Water Information Center Site Report  
TOWN OF BRIDGER WELL 3**

[Plot this site on a topographic map](#)  
[View Water Quality for this Site](#)

**Location Information**

GWIC Id: 104037  
Location (TRS): 06S 23E 21 DBCD  
County (MT): CARBON  
DNRC Water Right: W006178-00  
PWS Id: 00165003  
Block:  
Lot:  
Addition:

Source of Data: COMBO  
Latitude (dd): 45.2938  
Longitude (dd): -108.9116  
Geomethod: UNKNOWN  
Datum: NAD27  
Altitude (feet): 3613.90  
Certificate of Survey:  
Type of Site: WELL

**Well Construction and Performance Data**

Total Depth (ft): 52.00  
Static Water Level (ft): 25.00  
Pumping Water Level (ft):  
Yield (gpm): 400.00  
Test Type:  
Test Duration:  
Drill Stem Setting (ft):  
Recovery Water Level (ft):  
Recovery Time (hrs):  
Well Notes:

How Drilled:  
Driller's Name:  
Driller License:  
Completion Date (m/d/y): 6/1/1953  
Special Conditions:  
Is Well Flowing?:  
Shut-In Pressure:  
Geology/Aquifer: 110TRRC  
Well/Water Use: PUBLIC WATER SUPPLY

**Hole Diameter Information**

No Hole Diameter Records currently in GWIC.

**Casing Information<sup>1</sup>**

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	52.0	15.0				

**Annular Seal Information**

No Seal Records currently in GWIC.

**Completion Information<sup>1</sup>**

From	To	Dia	# of Openings	Size of Openings	Description
52.0	52.0	15.0			OPEN BOTTOM

**Lithology Information**

From	To	Description
0.0	6.0	TOPSOIL
6.0	52.0	SAND & GRAVEL

**APPENDIX B - DEQ PWS's Database Output  
Available Upon Request**

**APPENDIX C – Water Quality Tables 3 and 4 from the 1994 Wellhead Protection Project  
Available Upon Request**

**APPENDIX D - Sanitary Survey  
Available Upon Request**

**APPENDIX E - Concurrence Letter & Other Correspondence  
Available Upon Request**