City of Colstrip
Public Water Supply
PWSID # MT0000180

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Date of Report: December 5, 2002

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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), and by intern Shonna Jorgensen. The City of Colstrip public water supply (PWS) is located in Rosebud County, Montana, about 40 miles south of Forsyth, along Highway 39 near the Northern Cheyenne Reservation (Figure 1a). The DEQ PWS identification number, operator name, and operator number for the Colstrip 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 City of Colstrip 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 City of Colstrip PWS operator in the identification of potential contaminant sources near and upstream from the city's surface water intake, and to encourage the development of a source water protection plan to protect the city'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 sources. 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.

Limitations

This report was prepared to assess threats to the City of Colstrip public water supply, and is based on published data 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 the public water supplies, and not any other public or private water supply. Also, not all of the potential or existing sources of groundwater or surface-water contamination in the area of the City of Colstrip 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

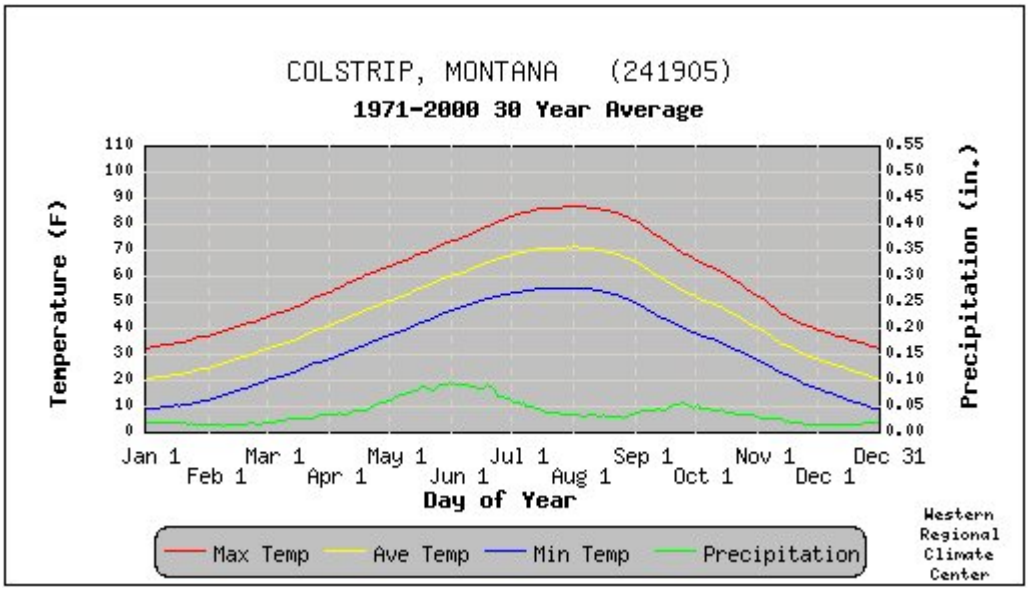
Colstrip is located in Rosebud County approximately 40 miles south of Forsyth along Highway 39, near the Northern Cheyenne Reservation (Figure 1a). The U.S. Census Bureau estimates the 2000 population of Rosebud County at 9,383 people, 2,346 of who reside in Colstrip. Rosebud County's population has decreased by about 11%, while Colstrip's population has decreased by about 23% since the1990 census.

Colstrip is known as the "energy capital of Montana" and came about in 1924 when the Northern Pacific Railroad started mining coal nearby in order to fuel their steam locomotives. Once the railroads switched from coal to diesel fuel, the mine closed. However, when the Montana Power Company (MPC) purchased the mine as well as the town site, Colstrip became the center of mining and energy generation. In 1968 Western Energy, a subsidiary of MPC, started to mine again. A few years later, construction of the power plant began. Colstrip became a city in 1999 and today is a quiet community consisting of approximately 2,000 people and 22 parks. Mining has also played an important role in the local and regional economy. The largest revenue-generating industries in Rosebud County in 2000 were transportation and public utilities, 28.7 percent of earnings; services, 20.7 percent; and mining, 19.0 percent (www.bea.doc.gov/bea/regional/bearfacts).

Within the city limits, residents obtain their drinking water from the municipal PWS. The municipal sewer district services all residents within town limits. Municipal wastewater discharges to a multi-cell infiltration pond are located about a quarter of a mile northeast of town. Residents in areas outlying town limits utilize on-site septic systems for waste disposal. Three other public water supplies are located in or near Colstrip including Big Sky Coal Company, Colstrip Moose Lodge, and Colstrip Super Stop. These three public supplies use ground water as their source water.

Climate

Figure 2. Colstrip Average Temperatures and Precipitation



Based on Western Regional Climatic Center data for the period of record, annual precipitation averages 14.26 inches. Monthly average precipitation ranges from 0.51 inches in February to 2.65 inches in June. Summer thunderstorms and winter snows provide a majority of

the precipitation in the area. The annual mean snowfall in Colstrip is 37.0 inches. A summary of the available climatic data for the Colstrip area is presented in Table 1 below.

Table 1. Climatic Summary
City of Colstrip, Montana (241905)
Period of Record Monthly Climate Summary
Period of Record : 7/2/1948 to 12/31/2001

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	33.9	40.4	47.1	58.8	69.0	78.4	87.3	86.6	75.0	62.3	46.4	37.2	60.2
Average Min. Temperature (F)	8.5	15.2	21.5	31.3	40.9	49.5	54.6	53.2	43.2	33.2	22.0	12.7	32.1
Average Total Precipitation (in.)	0.58	0.51	0.80	1.57	2.53	2.65	1.28	1.20	1.24	1.17	0.66	0.55	14.73
Average Total Snow Fall (in.)	6.5	5.6	6.0	4.9	0.6	0.3	0.0	0.0	0.5	1.5	4.6	6.5	37.0
Average Snow Depth (in.)	2	2	1	0	0	0	0	0	0	0	1	2	1

Percent of possible observations for period of record.
Max. Temp.: 94.3% Min. Temp.: 94.3% Precipitation 95.9% Snowfall: 87.5% Snow Depth: 87.7%
Source: Western Regional Climate Center, wrcc@dri.edu

Geographic Setting

Colstrip is located within the Power River Basin that is in the non-glaciated Missouri Plateau portion of the Great Plains physiographic province of North America (Rocky Mountain Association of Geologists, 1972). This area is also designated as the non-glaciated central ground-water region of the United States (Heath, 1984). The elevation at Colstrip is approximately 3,232 feet above mean sea level and the town is located immediately next State Highway 39 and the East Fork of Armells Creek (Figure 1a and 4). Topographic relief in the vicinity of Colstrip is low with highlands rising about 200 to 300 feet above the town location.

Geology

This section provides an overview of the geology and hydrology of the vicinity of Colstrip and near Forsyth where Colstrips surface water intake is located. Reports used for this section include Lewis and Roberts (1978), Slagel (1983), Slagel et al. (1983), Stoner and Lewis, 1980, and Vuke et al (2001). 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. Geology is not just important for understanding the hydrologic conditions related to ground water but it is also valuable for public water supplies that use surface water. For example, the timing and runoff patterns of streams are influenced in part by the geology within a watershed. Watersheds with large areas of low hydraulic conductivity bedrock tend to respond quickly to precipitation and snowmelt events. Hydrographs from streams within such a watershed show numerous high flow peaks or spikes. On the other hand, streams within watersheds underlain by

bedrock that has high hydraulic conductivity tend to have more subdued hydrographs, that is, fewer and more rounded high flow peaks. Infiltration of precipitation and snowmelt waters makes the high flow events rise more gradually and have more rounded peaks. Surface water quality can also be affected by the geology within a watershed and information in this section can be useful for gaining a better understanding of factors that control erosion and sedimentation.

Unconsolidated alluvium is present in the Yellowstone River valley and in many of the tributaries to the Yellowstone. The alluvium consists of lenses of unconsolidated clay, sand, and gravel. As much as 25 feet of alluvium is present in the Yellowstone River valley and up to 13 feet is present in some of the tributaries in the neighborhood of Forsyth (Vuke et al (2001). The Yellowstone River alluvium yields economic quantities of water to wells and in most places represents an unconfined aquifer. Terrace deposits are also present within the main river valley and the tributaries. Some of the terraces are between 2 and 350 ft. above the streams and are considered to be Quaternary age, ranging from Pleistocene to Recent (Vuke et al (2001). These terrace deposits consist of gravel, sand, silt, and clay and range in thickness from 15 ft., to as much as 50 ft. in some places. Other terrace deposits are present above the Quaternary terraces. The higher terraces are considered to be Tertiary in age, ranging between Pliocene to Pleistocene (Vuke et al, 2001). The older terrace deposits consist of up to 30 ft. of gray gravel and sand. As in other areas of Montana, the terrace deposits can yield water to wells, particularly if agricultural irrigation water is applied on the upper terrace.

Bedrock exposed at the land surface in the vicinity of Colstrip and Forsyth ranges in age from Upper Cretaceous to Recent (Vuke et al (2001). South and northeast of Forsyth, the Fort Union, Hell Creek, and Lance formations dominate the landscape. The Fort Union can be up to 1,000 feet thick in the area and can be divided into three members in descending order: the Tullock, Lebo Shale, and Tongue River. There are outcrops of red metamorphosed sedimentary rocks within the Fort Union Formation southeast of Forsyth. These beds are referred to as “clinker” and formed when underlying coal beds were ignited and baked the sandstone, siltstone, and shale beds. In some places the heat was so intense that the overlying rocks were metamorphosed into rock resembling volcanic rocks known as scoria. The Hell Creek Formation (Upper Cretaceous) is below the Fort Union, ranges between 200 and 300 feet thick, and contains beds of silty shale, mudstone, sandstone, and coal. Generally, the Hell Creek is more fine grained and contains less coal than the overlying Fort Union. Sandstone beds are more abundant in the lower part of the Hell Creek Formation. The Lance Formation lies between the Hell Creek and Fox Hills formations in this area. The Lance consists of medium grained sandstone lenses interbedded with shale. A conglomerate unit is located near the base of the Lance. The Lance can be up to 300 feet thick. The Fox Hills Formation (Upper Cretaceous) lies below the Lance and is marked by a light-colored sandstone bed ranging in thickness from 30 to 150 feet. The sandstone is known as the Colgate Member and is present over large areas in this region. The lower part of the Fox Hills is made up of sandstone, sandy shale, silty shale, and carbonaceous shale. Thickness of the entire Fox Hills is up to 200 feet thick in this area.

The Porcupine Dome is located north of Forsyth. Within the center and along the flanks of the Porcupine Dome there are older Cretaceous formations exposed at the surface including the Fox Hills Formation, Bearpaw Shale (also known as the Prairie Shale in some locations), Judith River Formation, Clagget Shale, and Gammon Shale. All of these bedrock formations consist of complex mixtures of sandstone, siltstone, shale, and coal. With the exception of the Porcupine Dome where bedrock formations dip between 4 to 6 degrees, bedrock is relatively flat-lying.

An examination of well logs in the area indicates that some wells are completed in the Cretaceous bedrock formations. These wells tend to be deep, greater than 100 feet, and yield smaller amounts of water than shallower wells completed in the alluvium. Generally, there are four primary aquifers in this area that include: 1) the alluvial and terrace deposits within stream valleys, 2) the upper 200 feet of the Fort Union Formation, 3) sandstone beds within the lower Fort Union Formation, and 4) the lower Hell Creek - upper Fox Hills Formation (Colgate Member). Sandstone beds within the Lance Formation would be included in group 4. Water from formations below the Bearpaw or Pierre Shale tend to have high total dissolved solids and are too saline for domestic and stock water use.

The Public Water Supply

The Colstrip 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 2,000 residents through approximately 973 active service connections.

Colstrip receives its water from Castle Rock Lake located on the edge of town. According to the sanitary survey, an intake structure is located about 100 yards from the eastern shoreline of the lake and supplies water directly to the treatment plant. The water is supplied to the lake through a 30-mile transmission line from the Yellowstone River. The river intake is located on the river's edge west of Forsyth (Figure 4A). The pumps and intakes on the river are owned and maintained by Pennsylvania Power and Light (PP&L) (DEQ Permitting and Compliance Division, 2001).

The treatment plant at Colstrip is a multi-media filtration plant that utilizes Castle Rock Lake for its supply. The lake also acts as a pre-settling area, which improves the efficiency of the water plant. There are six high service pumps that supply water to three different zones in the distribution system. These three zones supply four different reservoirs. Zone 1 consists of two 500,000-gallon steel tanks that are supplied by a 12-inch main from the treatment plant. A 14-inch main supplies a steel tank with the capacity of 2,000,000 gallons in zone 2, while zone 3 consists of a 12-inch main that supplies water from the plant to a steel tank with a capacity of 650,000 gallons. Adequate pressure is maintained throughout the system and very few or no leaks are detected throughout the year (DEQ Permitting and Compliance Division, 2000).

Disinfection is provided by two, in-line, 2000 lb chlorine cylinders with automatic switchover controls (DEQ Permitting and Compliance, 2000). A separate chlorine room exists in the treatment plant designed to store the chlorine cylinders and other equipment. The chlorine feed room is equipped with leak detection devices and a venting system for emergency. There is also an emergency response program in effect with the local fire department.

Due to the fact that Colstrip obtains its drinking water from a surface water supply, the source water is classified as highly sensitive to potential sources of contamination, in accordance with Montana Source Water Protection Program aquifer/source water sensitivity criteria (1999).

Water Quality

Public water systems must conduct routine monitoring for contaminants in accordance with Federal Safe Drinking Water Act requirements. A community public water supply, like Colstrip, 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.

The U. S. Geological Survey collects water quality data for the Yellowstone River at Forsyth. Table 2 summarizes this data for a 5-year period from 1996 to 2001.

The State of Montana classifies the Yellowstone River mainstem as B-3 surface water. According to the classification, the Yellowstone River is to be maintained suitable for drinking, culinary and food-processing purposes after conventional treatment for the removal of naturally present impurities. These waters must also be maintained as suitable for bathing, swimming, and recreation; growth and propagation of salmonoid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. These surface water classifications are pursuant to the Administrative Rules of Montana 17.30.600-625.

City of Colstrip PWS Water Quality

Within the past five years, no positive fecal coliform samples were collected during routine contaminant monitoring. The highest recorded nitrate level within the last five years was 1.27 mg/L in January of 1998 which is well below the MCL of 10 mg/L. No MCL exceedances were noted for any other constituents monitored over the past five years, this includes nitrate.

Table 2 – Water Quality Data summary for select parameters from USGS Station 0629500 at Forsyth. Period of summary is 1996 to 2001.

	TEMPERATURE, WATER (DEG. C)	DISCHARGE, INSTANTANEOUS, CUBIC FEET PER SECOND	TURBIDITY (NTU)	SPECIFIC CONDUCTANCE (MICROSIEMENS/CM AT 25 DEG. C)	OXYGEN DISSOLVED (MG/L)
Average	12.15	13313.96	43.69	518.68	10.24
Max	24.50	51800.00	340.00	805.00	17.40
Min	0.00	2420.00	3.00	182.00	1.40
	PH, WATER, WHOLE, LABORATORY, STANDARD UNITS	CARBONATE, WATER, DISSOLVED, INCREMENTAL TITRATION, FIELD, MG/L AS CO3	BICARBONATE, WATER, DISSOLVED, INCREMENTAL TITRATION, FIELD, MG/L AS HCO3	NITROGEN NITRITE PLUS NITRATE DISSOLVED (MG/L AS N)	PHOSPHORUS TOTAL (MG/L AS P)
Average	8.10	2.70	150.34	0.21	0.15
Max	8.60	24.00	235.00	0.48	0.74
Min	7.50	0.00	71.00	0.05	0.01
	CALCIUM DISSOLVED (MG/L AS CA)	MAGNESIUM DISSOLVED (MG/L AS MG)	SODIUM DISSOLVED (MG/L AS NA)	POTASSIUM DISSOLVED (MG/L AS K)	CHLORIDE DISSOLVED (MG/L AS CL)
Average	45.19	16.14	40.00	2.83	7.23
Max	66.60	26.40	73.00	4.40	13.20
Min	16.60	5.18	10.40	1.21	2.30
	SILICA DISSOLVED (MG/L AS SIO2)	ARSENIC DISSOLVED (UG/L AS AS)	BARIUM DISSOLVED (UG/L AS BA)	BERYLLIUM DISSOLVED (UG/L AS BE)	BORON DISSOLVED (UG/L AS B)
Average	9.50	5.93	41.57	-	137.52
Max	13.00	9.90	54.70	0.00	203.00
Min	2.70	3.40	18.70	0.00	36.00

Table 2 Continued:

	COBALT DISSOLVED (UG/L AS CO)	COPPER DISSOLVED (UG/L AS CU)	IRON DISSOLVED (UG/L AS FE)	LEAD DISSOLVED (UG/L AS PB)	MANGANESE DISSOLVED (UG/L AS MN)
Average	0.18	1.50	13.33	0.08	5.65
Max	0.25	2.60	30.00	0.08	13.80
Min	0.09	1.10	10.00	0.08	0.40
	NICKEL DISSOLVED (UG/L AS NI)	SILVER DISSOLVED (UG/L AS AG)	STRONTIUM DISSOLVED (UG/L AS SR)	VANADIUM DISSOLVED (UG/L AS V)	ZINC DISSOLVED (UG/L AS ZN)
Average	1.49	#DIV/0!	463.91	1.85	2.16
Max	4.47	0.00	667.00	2.50	8.00
Min	0.15	0.00	132.00	1.20	1.00
	LITHIUM DISSOLVED (UG/L AS LI)	SELENIUM DISSOLVED (UG/L AS SE)	URANIUM, NATURAL, WATER, DISSOLVED, UG/L	ALKALINITY, WATER, DISSOLVED, FIXED ENDPOINT TITRATION, LAB, AS CACO3, MG/L	FECAL COLIFORM .7 UM-MF (COL./ 100 ML)
Average	35.64	1.22	3.38	129.45	57.67
Max	50.00	1.70	4.99	185.00	150.00
Min	11.90	0.60	1.19	59.00	21.00
	ALACHLOR, WATER, DISSOLVED, RECOVERABLE, UG/L	ACETOCHLOR, WATER, FILTERED, RECOVERABLE, MICROGRAMS PER LITER	NITROGEN, PARTICULATE, WATER, FILTERED, SUSPENDED, MILLIGRAMS PER LITER	SEDIMENT, SUSPENDED CONCENTRATION (MG/L)	
Average	-	-	0.21	140.63	
Max	0.00	0.00	0.47	797.00	
Min	0.00	0.00	0.11	4.00	

CHAPTER 2
DELINEATION

The source water protection areas for the Colstrip public water system are delineated in this chapter. The purpose of delineation is to map the source of the water supply's drinking water and to define areas within which to prioritize source water protection efforts. Because Colstrip uses the Yellowstone River for its public water supply, two types of management regions are mapped; a spill response region and a watershed region.

The goal of management in the spill response region is to avoid introducing contaminants directly into the river upstream of the public water supply. In addition, this region should be managed to prevent contaminants from reaching the intake or infiltration lines before natural processes reduce their concentrations. The goal of management in the watershed region is to maintain and improve water quality over long periods of time or increased usage.

Hydrogeologic Conditions

The U.S. Geological Survey operates a stream gauging station near Forsyth MT (Station 06295000). The station has a period of record extending from July 1921 to present. The station lacks winter records from July 16, 1921 to September 30, 1923. Annual average flow for the Yellowstone River at this station is 10,300 cubic feet per second (cfs). Maximum and minimum annual discharge for the same period are 22,800 and 3,750 cfs (NWISWeb Data for the Nation). A hydrograph for the last 5 years of record is shown to the right (Figure 5). The hydrograph shows a pattern of low flows in the fall and winter months and high flows during the spring and early summer.

Figure 5. Peak Flow Levels for the Yellowstone River at Forsyth

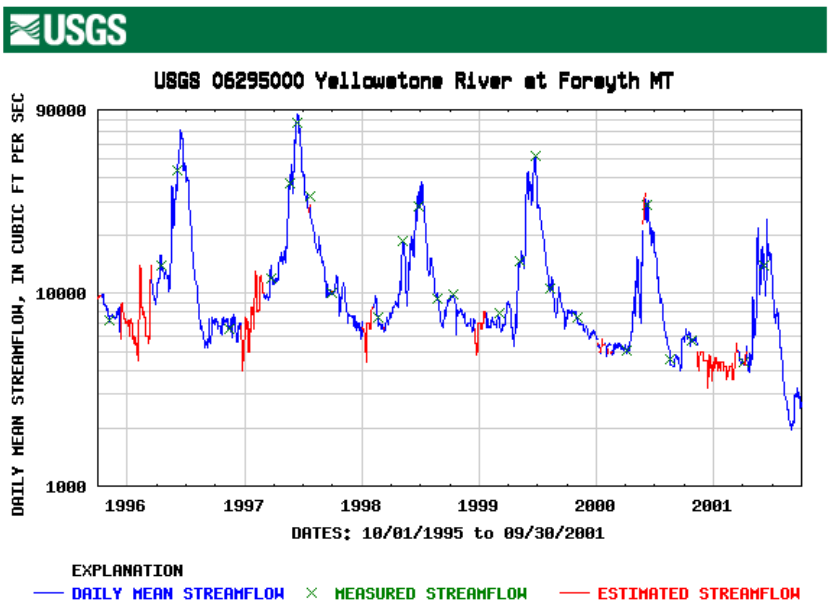


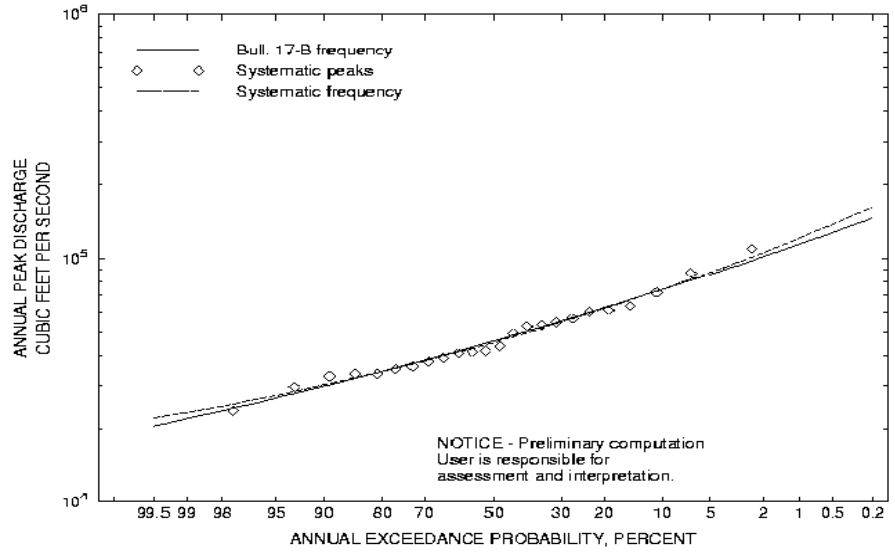
Table 3 summarizes the daily mean flow statistics for the USGS gauging station. In addition to maximum and minimum flows, Table 3 shows the percent of time the Yellowstone River flows at or above specific volumes. Figure 6 shows the flood frequency curve with exceedance flows probability shown as a percent.

Table 3 - Daily mean flow statistics for 8/2 based on 27 years of record in ft^3/sec

Minimum	Mean	Maximum	80 percent exceedence	50 percent exceedence	20 percent exceedence
3730	11,150	21,900	7,128	9,650	13,519

Figure 6. Flood Frequency Analysis for the Yellowstone River at Forsyth

20500	22000	26700	29900	34300	45700	62300	74100	89700	102000	115000	128000	147000
99.5	99	95	90	80	50	20	10	4	2	1	0.5	0.2



NOTE: Systematic peaks are those that are recorded within the period of gaged record. The computed systematic flood-frequency curve is based only on the systematic peaks. The computed Bulletin 17-B flood-frequency curve often is different from the systematic flood-frequency curve because of differences between station skew and regional skew, low- or high-outlier adjustments, or the presence of one or more historical peaks outside the systematic record. Historical peaks also result in historical adjusted plotting positions (exceedance probabilities) for all peaks.

Using DEQ Source Water Protection Program criteria for ranking aquifer/source water sensitivity (Table 4 below), the City of Colstrip PWS source water is considered highly sensitive to contamination. The sensitivity ranking is a result of the surface water source for the Colstrip PWS.

Table 4. Source water sensitivity criteria (DEQ, 1999).

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

Conceptual Model and Assumptions

The headwaters of the Yellowstone River and its tributaries originate in the mountain ranges to the west and southwest of Forsyth including: the Bridger Range, Crazy Mountains, Absaroka-Beartooth Range, Prior Mountains, and Bighorn Mountains (Figure 1b). Significant tributaries to the Yellowstone draining these land areas include the Shields River, Boulder River, Stillwater River, Clarks Fork of the Yellowstone, and the Bighorn River (Figure 4a).

Annual precipitation for the Colstrip area is about 14 inches, however, precipitation is much higher in the mountainous headwaters. Annual precipitation can range between 40 and 60 inches in the higher mountain ranges. A significant portion of that precipitation occurs as snow during the winter months and as spring rain, both of which contribute to high streamflow events (Figure 2). Peak flows for the Yellowstone River commonly occur in spring and early summer, and low flows are more common in late summer through the winter months.

Certain land uses and businesses located along the Yellowstone River and its tributaries upstream from Colstrip's intake near Forsyth represent potential contaminant sources for the public water supply. However, spills and leaks of contaminants are considered to represent a high hazard to the public water supply if they are located so that they result in direct discharge into Yellowstone River or into one of the its tributaries upstream in the vicinity of the surface water intake (Tables 6 and 9). The concern is that spills or leaks occurring in closer proximity to the intake could reach the intake before plant operators can close or isolate the line. Other contaminant sources may discharge to the river and its tributaries in a less direct manner. These contaminant sources are within the watershed but are farther from the river and contaminants can be flushed into the streams during spring snowmelt or storm events. Indirect discharge to streams can also come from contaminants that infiltrate into aquifers that then discharge to streams via hydraulic connections. Because these contaminants are not discharged directly into the river, they tend to pose a less immediate threat to the public water supply and are usually assigned a lower hazard rating.

Seasonal timing of direct contaminant discharges into rivers and streams can complicate the potential threat to the public water supply. Spills occurring during high water periods will tend to travel toward the

surface water intake faster than during low water conditions. However, dilution during high flows in the spring and early summer may help reduce the hazard posed to the public water supply. Direct discharges to the river during low flow conditions will have less chance to be diluted before reaching the surface water intake.

Delineation Results

Spill Response Region

The Spill Response Region for the City of Colstrip PWS actually consists of two areas; ½ mile downstream and approximately 10 miles upstream of the Yellowstone River intake and also a ½ mile buffer around the perimeter of Castle Rock Lake. This situation is due to the fact that Castle Rock Lake is supplied its water through a 30-mile transmission line from the Yellowstone River, therefore, delineation and assessment must include both spill response regions. The spill response region for the river encloses the shoreline of the Yellowstone River and also parts of Big Porcupine Creek and Armells Creek. Both tributaries join the Yellowstone River about 2 miles upstream from Colstrip's intake on the river. The Yellowstone Canal discharges into the river about 2 miles above the confluence of Armells Creek. The width of the spill response region extends 1/2 mile on either side of the water bodies mentioned above.

Watershed Region

The Watershed Region for the City of Colstrip PWS focuses mainly around the intake on the Yellowstone River and encompasses portions of two watersheds, including the area of the Lower Yellowstone Watershed located upstream of the surface water intake and the Big Porcupine Watershed (Figure 9). The watershed that contributes to Castle Rock Lake was also looked at, however, due to the absence of any significant potential contaminant sources, this area was not shown on a map, rather the focus remained on the Spill Response Region around the lake (Figure 4B, 8).

Limiting Factors

The delineations for the Colstrip PWS Spill Response Region and Watershed Region are based on fixed-distance and watershed mapping. The Spill Response Region represents an approximation of the distance required for contaminants released upstream to reach the surface water intake with relatively short lag time. Numerous assumptions are associated with these Source Water Protection Program (SWPP) criteria for Spill Response Region delineations. Contaminant transport rates and concentrations will vary depending on stream/river flow conditions, groundwater flux into the river, contributions from overland flow, soil types, slope, characteristics of riparian vegetation, the extent of riparian vegetation buffer zones, the extent and duration of contamination, contaminant solution density, adsorption, mechanical dispersion, biological transformation, dilution, molecular diffusion, precipitation, oxidation, complexation, and volatilization. As a result, some areas within the Spill Response Region may be more conducive to contaminant transport than others, and should be designated as higher priority areas for source water protection efforts.

CHAPTER 3
INVENTORY

An inventory of potential sources of contamination was conducted to assess the susceptibility of the City of Colstrip PWS to contamination, and to identify priorities for source water protection planning. Inventories were conducted within the delineated Spill Response and Watershed 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. The significant contaminants posing potential threats to the City of Colstrip PWS include nitrate, pathogens, herbicides, and pesticides. The inventory for the Colstrip PWS also focuses on all activities in the Spill Response Region, as well as general land uses and large potential contaminant sources in the Watershed 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: 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/Spill Response Region

Land areas within the spill response and watershed region are sparsely populated and fairly rural. The inventory results, with regard to the spill response region, will be addressed in two separate areas. These areas consist of the spill response region located around the intake on the Yellowstone River and also the area around Castle Rock Lake near Colstrip. The principal land cover in the Spill Response Region near the Yellowstone River intake is ag-land (42%) and grassland (28%). The remaining land cover includes shrubland (9%), fallow (7%), open water (6%), forest (4%), wetland (3%), and commercial/industrial (1%) (Figure 7). According to the Source Water Program criteria, the percentage of agricultural land in this region indicates that activities on agricultural land could pose a moderate potential threat to the City of Colstrip PWS. The concern here is the potential for mismanagement or over- application of fertilizers and/or pesticides on the agricultural lands, most of which are located adjacent the Yellowstone River and some of the larger tributaries. Interstate 94, Montana Highway 12, and the Burlington Northern Railroad tracks are also considered potential sources of contamination. While the interstate, Highway 12, and the railroads are located some distance from the river, accidents and spills on the Highway 12 bridge could also pose a threat to the water supply.

The principal land cover in the Spill Response Region surrounding Castle Rock Lake consists of grassland (36%), residential/commercial (20%), shrubland (18%), and open water (14%). The remaining land cover includes forest (7%), quarries/strip mines/gravel pits (4%), and transitional (1%) (Figure 8). The types of landcover or amount present do not pose a significant threat to Colstrip's PWS. Other businesses and land uses in the area are also considered as potential sources of contamination. A full listing of businesses in and around the City of Colstrip, based on the Standard Industrial Codes (SIC) codes and their potential to be contaminant sources and other types of facilities was compiled and is present in Appendix A.

Septic systems in areas outside the city's sewer service are considered potential contaminant sources if they are located in close proximity to source water intakes or wells and if the density of multiple septic systems is significantly high. However, in the Colstrip area, low septic densities occur over half of the spill response region (55.7% overall), while medium septic densities comprise 34.1% of the region. There appears to be a subdivision directly south of Castle Lake that is also shown as having medium septic density. From the topographic map of the area, it appears that the subdivision is separated from the lake by a local topographic divide that would prevent potential contaminants from the subdivision from moving toward the lake. The Colstrip municipal sewer system is located partially inside of the spill response region. Main breaks or leaking connections in the system likely pose a minimal threat to the PWS. No concentrated animal feeding operations are located in either spill response region (Figure 7).

Table 5. Significant potential contaminant sources in the Spill Response Regions City of Colstrip PWS (Yellowstone River Intake, Castle Rock Lake)

Potential Source	Potential Contaminants	Hazard
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff
Railroad	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
Highway	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
USTs/LUSTs	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and or reaching surface water
Landfills	Metals, Inorganics, VOCs, SOCs, pathogens, nitrate	Infiltration of leachate into shallow groundwater and subsequent discharging to the Yellowstone River; unauthorized dumping
Storm Water/Wastewater Discharges	VOCs, SOCs, pathogens, nitrate, TDS	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are released to systems that allow discharge of contaminants with wastewater to surface water
Class V Injection Wells (existence and locations are not known) where storm and/or wastewater is concentrated and recharges groundwater.	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

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 surface water intakes. Significant potential contaminant sources from the above list are discussed individually in the following section on susceptibility assessment and they are listed in Table 9.

Inventory Results/Watershed Region

The Watershed Region for the City of Colstrip PWS (around the Yellowstone River intake) encompasses the entire Big Porcupine Watershed and also the Lower Yellowstone Watershed located upstream of the PWS intake (Figure 9). Spills of fertilizers, pesticides, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs) could occur along the interstate and the railroad tracks within the Watershed Region (Figure 9). However, the highway is almost a half mile west and south of the intake, while the railroad tracks on the north side of the river appear to be more than a mile from the intake and the track on the south is over a half mile from the PWS intake. It is unlikely spills along these transportation routes would impact Colstrip's water supply unless spills took place relatively close to the intake. The Watershed Region encompasses a large portion of the City of Forsyth and the businesses located there, as well as Hysham. As such, it also encompasses a number of significant potential contaminant sources, such as storm and wastewater discharges, UST/LUST locations in and around town, and a crude oil pipeline. If spills or releases occur at these locations, it could result in contaminants being released into the shallow aquifer system that very likely is in hydraulic connection with the Yellowstone River. Under certain flow conditions, the contaminants could be discharged from the shallow aquifer system into the river. However, all of the potential contaminant sources in Forsyth are located in a downstream position relative

to the Colstrip PWS intake. As a result, if contaminants were discharged, they would most likely be released downstream from the intake and would not impact the Colstrip's water supply. In general, the potential contaminant sources in Forsyth are located over a mile from the intake (Figure 9). The businesses in and around Hysham most likely do not pose a threat to Colstrip's intake on the river. It is upstream, however, is located at least 30 miles away. Other public water supplies in the area that use ground water could be adversely affected by the release of contaminants to the shallow aquifer system. A full listing of businesses in the City of Forsyth (based on SIC codes) was compiled and is present in the Source Water Delineation and Assessment Report for Forsyth (see Appendix A of that report). Predominant land covers in the Watershed Region include grassland (76%), shrubland (9%), ag-land (6%), forest (5%), fallow (3%), and open water (1%) (see Figure 9). Almost all of the agricultural land cover is concentrated in the river and stream valleys (Figure 9). For this reason, activities on agricultural land are considered to pose a potential threat to the City of Colstrip's public water supply.

Low septic densities occur over the entire Watershed Region (99.8% overall). The Forsyth municipal sewage lagoon appears to be located over four miles downstream from the public water supply intake and does not pose a threat to the public water supply (Figure 4A). Table 6 below lists the significant potential contaminant sources identified in the Watershed Region.

Table 6. Significant potential contaminant sources in the Watershed Region
City of Forsyth PWS

Potential Source	Potential Contaminants	Hazard
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff
Railroad	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
Highways, roads, and pipelines	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
On-site residential septic systems	Nitrate, pathogens	Leaks in septic tanks, leaks in collection lines, system failure, infiltration of untreated effluent into shallow ground water, which may in turn reach surface water
Large capacity septic systems	Nitrate, pathogens	Leaks in septic tanks, leaks in collection lines, system failure, infiltration of untreated effluent into shallow ground water, which may in turn reach surface water
Municipal Sewer	Nitrate, pathogens	Leaks in mains/lines, system failure, infiltration of untreated effluent into shallow ground water, which may in turn reach surface water
USTs/LUSTs	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and or reaching surface water
Assorted businesses in town	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the river
Mining Operations	Metals	Erosion and mobilization of metals in sediment and/or leached into surface water and groundwater
Landfills	Metals, Inorganics, VOCs, SOCs, pathogens, nitrate	Infiltration of leachate into shallow groundwater and subsequent discharging to the Yellowstone River; unauthorized dumping
Gas and Oil Wells	Total Dissolved Solids, Petroleum Hydrocarbons	Migration of brine wastewater into shallow groundwater discharging to surface water, surface runoff to surface water
Class V Injection Wells (existence and locations are	VOCs, SOCs, petroleum hydrocarbons, metals,	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are

Table 6. Significant potential contaminant sources in the Watershed Region
City of Forsyth PWS

Potential Source	Potential Contaminants	Hazard
not known) where storm and/or wastewater are concentrated and recharges groundwater.	pathogens, nitrate	released to systems that allow infiltration of contaminants to the subsurface or to the storm water system
Storm Water / Wastewater Discharges	VOCs, SOCs, pathogens, nitrate, TDS	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are released to systems that allow discharge of contaminants with wastewater to surface water

From the above list of potential contaminant sources, some are considered significant based upon the following factors: 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 surface water intakes.

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 for the City of Colstrip 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 GIS data. 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 of the City of Colstrip PWS's source water is determined by two factors: the potential of a contaminant reaching the intake and the resulting health hazard. Susceptibility is assessed in order to prioritize potential pollutant sources in the Spill Response Region in order to guide management actions undertaken by local entities, in this case the City of Colstrip and Rosebud County.

The goal of source water management is to protect the source water, manage significant potential contaminant sources in the Spill Response Region, and ensure that land use activities in the Watershed Region pose minimal threats to the source water. Management priorities in the Spill Response 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 City of Colstrip PWS owners and operators to reduce susceptibility are also included in this section of the report.

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 reach the PWS intake. The hazard presented by point sources of contaminants in Colstrip's Spill Response Regions depends on whether contaminants can discharge directly into the Yellowstone River or into two of its joining tributaries, Big Porcupine Creek and Armells Creek, or into Castle Rock Lake. Point source hazard is also dependent on the health affects associated with potential contaminants. Hazard ratings for point and nonpoint sources are assigned based on criteria listed in Table 7. Barriers can be anything that decreases the likelihood that contaminated water will reach Colstrip's surface water intake (Table 8). Examples of barriers include: a vegetated riparian area, protective forest management practices, and dilution.

Table 7. Hazard of Potential Contaminant Sources, Determination of For Surface Water Sources

Potential Contaminant Sources	High Hazard Rating	Moderate Hazard Rating	Low Hazard Rating
Point Sources of Nitrates or Pathogens	Potential for direct discharge to surface water	Potential for discharge to groundwater hydraulically connected to surface water	Potential contaminant sources in the watershed region
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 surface water	Potential for discharge to groundwater hydraulically connected to surface water
Septic Systems (density)	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Municipal Sanitary Sewer (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
Cropped Agricultural Land (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Barriers to contamination can be anything that decreases the likelihood that contaminants will reach a spring or well. 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. Susceptibility of Source Water based on Hazard rating and the presence of Barriers

	High Hazard Rating	**Moderate Hazard Rating**	**Low Hazard Rating**
No Barriers	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
One Barrier	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Multiple Barriers	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 9, next page).

Susceptibility Assessment Results

Table 9. Susceptibility Assessment

Significant Potential Contaminant Sources in the Spill Response and Watershed Regions

City of Colstrip PWS surface water intakes

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff adjacent the Yellowstone River and larger tributaries	**Moderate**	-Dilution	**Moderate**	Provide educational information, materials and resources to land owners on the proper application and storage of pesticide and fertilizers; implement agricultural BMPs
Highway	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into groundwater	**High**	-Dilution; County Emergency Response Plan, training and preparation of local response personnel	**Moderate**	Maintain preparedness of local emergency personnel through active training, storm water diversion
Railroad	Pesticides, fertilizers, VOCs	Spills, storm water runoff, infiltration into ground water	**High**	-Both rail lines are over one mile from the river and partially down stream from the intake. -Dilution; County Emergency Response Plan, training and preparation of local response personnel.	**Moderate**	Maintain preparedness of local emergency personnel through active training, runoff diversion, continued remediation of former release sites
UST/LUSTs	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and/or reaching surface water	**Moderate**	-Spill prevention, dilution, ongoing monitoring of groundwater, monitoring for spills, ongoing remediation of spill sites -Located downstream of the PWS intake	**Very Low**	Spill response planning, tank and groundwater monitoring, spill catchment, active and ongoing remediation of spill sites
Assorted Businesses in Town	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the river	**Low**	-Located downstream of the PWS intake	**Low**	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. Scheduled days for the collection of hazardous wastes from the public
Mining Operations	Metals	Erosion and mobilization of metals in sediment and/or leached into surface water and groundwater	**Low**	- Small size - Most metal and coal mining in the watershed is a considerable distance from the intake (dilution)	**Low**	Continue monitoring for metals and participate in watershed-wide efforts to maintain water quality and clean up high priority abandoned mines.

Table 9. Susceptibility Assessment

Significant Potential Contaminant Sources in the Spill Response and Watershed Regions

City of Colstrip PWS surface water intakes

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Wastewater Discharges	VOCs, SOCs, pathogens, nitrate, TDS	System failure, exceeding effluent limits	**Moderate**	-Dilution -Discharge points are more than one mile distance upstream, the other is more than one mile downstream.	**Low**	Ensure proper maintenance and operation of system; monitor leaks in system; develop an alternative treatment plan in the event of system failure
Municipal Sewer System	Pathogens, nitrate	Leaks in sewer mains to groundwater, which may reach surface water	**Low**	-Low Septic density throughout the Spill Response and Watershed Regions.	**Low to Moderate (if close to intake location)**	Ongoing testing and maintenance of lines and system, replacement of old lines, compliance with current regulations for discharges
Class V Injection Wells	VOCs, SOCs, pathogens, nitrate	Infiltration of contaminants into aquifer	**Low**	-Spill prevention, dilution, ongoing monitoring of groundwater, monitoring for spills, ongoing remediation of spill sites	**Very Low**	Inventory; Provide educational information, materials and resources to business owners and the public on proper waste disposal and recycling

Table 9, above, displays the susceptibility assessment results for the City of Colstrip PWS surface water intakes. The town's intakes, located on the Yellowstone River and at Castle Rock Lake, are susceptible to a number of different contaminants, including pathogens, nitrates, fertilizers, pesticides, VOCs, and SOCs. The above assessment addresses the Spill Response Regions for the City of Colstrip PWS.

The susceptibility assessment results for each significant potential contaminant source identified is described below:

Agricultural lands – The potential hazard imposed by pathogens and nitrate originating from agricultural lands is moderate. Cropped agricultural lands occupy 42% of the spill response region around the Yellowstone River intake, falling between 20% and 50% of the total area of the region. The susceptibility of the intake to these agricultural sources of nitrate and pathogens is also moderate due to the presence of a single barrier. Adequate dilution is provided by the Yellowstone River to reduce water quality impacts to non-significant levels.

Highway- The potential hazard imposed by pesticides, fertilizers and other hazardous materials that could be accidentally spilled on or along the highway is high because the highway runs directly up-gradient of Colstrip's PWS surface water intake. Of particular concern is the bridge crossing the Yellowstone River west of Forsyth. Susceptibility is rated moderate because there are several barriers present including dilution, a county emergency response plan, and training and preparation of local response personnel.

Railroads – The potential hazard imposed by pesticides, fertilizers, VOCs and SOCs originating from the railway and former spills along the railway pose a moderate hazard. This is because tracks are located over a mile from the river but there is potential for a spill originating on or near the tracks in some locations to indirectly discharge into the Yellowstone River upstream from the City of Colstrip's surface water intake. The susceptibility of the Colstrip PWS, on the river, to contaminants originating from this source is considered to be low to moderate. Multiple barriers identified for this source include dilution in the river and use of a county emergency plan.

UST/LUSTs- The potential hazard imposed by VOCs and petroleum hydrocarbons is low. This is because of the potential for discharge into groundwater that is hydraulically connected to surface water. The susceptibility is rated very low due to the presence of several barriers including spill prevention, dilution, ongoing monitoring of groundwater and monitoring for spills. The UST/LUSTs are also located mainly downstream of the PWS intake.

Assorted Businesses in Town- Appendix A lists various businesses in town that are considered to represent potential contaminant sources based on the criteria within the Source Water Protection Guidelines (DEQ, 1999). Based on their location with respect to the public water supply intake, these businesses are not considered to pose a threat to the water supply. However, a simple proactive step to reducing the risk of unnecessary contamination in a community is to provide educational information and resources to business owners and the public on proper waste disposal and recycling.

Mining Operations- Due to their size and distance from the public water supply intake they are not considered to pose a threat to the water supply. The susceptibility is rated as low.

Wastewater Discharges- The potential hazard imposed by VOCs, SOCs, pathogens, and nitrate originating from wastewater discharges related to Colstrip's wastewater treatment operations is moderate. The susceptibility of the Colstrip PWS intake to contaminants originating from this source is low. The primary reason for the low rating is that the discharge point is downstream from the public water supply intake.

Municipal Sewer System – The potential hazard imposed by pathogens and nitrate originating from Colstrip's municipal sewer system is low to moderate depending on how close the sewer mains are located to the surface water intake on the lake. A relatively small part of Forsyth is located adjacent to the intake location. As a result, the number of sewer lines that could be considered a potential threat is small. The susceptibility of the intakes to nitrate and pathogens originating from this source is rated as low to moderate. Verifying that the mains are not located close to or upstream from the intake would set the susceptibility rating at low.

Class V Injection Wells – The potential hazard imposed by VOCs, SOCs, pathogens, nitrate, and other contaminants originating from the class V injection wells is considered low. The susceptibility of the intake to contaminants originating from this source is unknown due to the fact that no inventory of Class V well is complete or the current inventory is inadequate.

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

Management Recommendations

Management recommendations are included in the susceptibility table for the Colstrip PWS (Table 9). If these management recommendations are implemented, they may be considered additional barriers that will reduce the susceptibility of Colstrip's intakes to specific sources and contaminants.

Management recommendations fall into the following categories:

- Sewer maintenance and leak detection
- Municipal sewer extension
- Agricultural best management practices
- Stormwater management
- Proper disposal and monitoring of oil and gas production wastewater
- Education
- Emergency Response Planning

Sewer Maintenance and leak detection – Early warning of leaks and scheduled replacement of aging sewer lines will reduce the susceptibility of Forsyth's intake 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 city limits but indirectly affect the city PWS.

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 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.

Hazardous Materials Collection Days – Several counties in the state that have vulnerable water supplies have implemented scheduled days for the collection of hazardous wastes from the public. These vary in the inclusiveness of what materials are collected, how the materials are handled, and how they are disposed of, but they all act to reduce the amount of unauthorized or improper disposal of these wastes. Used motor oil collection station could be established and available to the public on a regular basis.

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.

The City of Colstrip PWS operator, the city administration, and the Rosebud County administration should consider these management recommendations. Should contamination reach the town's intake, the City and County will likely need to work cooperatively to address remediation or relocation of the Colstrip PWS source.

CHAPTER 5
MONITORING WAIVERS

Waiver Recommendation

Colstrip does not have any waivers at the present time. To be sure that eligibility for all available waivers is considered, the City of Colstrip PWS could submit a letter to DEQ requesting monitoring waivers. The PWS may also need to provide additional information to DEQ regarding chemical use within the Spill Response Region. Table 10 shows how the identified potential contaminant sources in the spill response and watershed regions could affect eligibility for monitoring waivers for the City of Colstrip. It should also be noted that it is not possible to receive monitoring waivers for pathogens, nitrate, or arsenic.

Before requesting DEQ to consider approving new or additional water quality monitoring waivers, it is strongly suggested that the PWS operators or others involved in the effort thoroughly read the Wavier Requirements section that follows Table 10. It is important to clearly understand the level of effort that will be required to support the waiver request.

Table 10. Susceptibility Assessment as it relates to waiver eligibility for significant potential contaminant sources in the Spill Response RegionCity of Colstrip PWS surface water intake.

Source	Contaminant	Susceptibility	Waiver Eligibility
Cultivated Cropland	Fertilizers, pesticides	Moderate	Chemical use likely precludes waivers for some chemicals
Railroads	Pesticides, fertilizers, VOCs	Low to Moderate	Tranportation of chemicals and hazardous materials along the Yellowstone River likely precludes waivers for some chemicals.
Highway	Pesticides, fertilizers, VOCs, other	Moderate	Tranportation of chemicals and hazardous materials along the Yellowstone River likely precludes waivers for some chemicals.
UST/LUSTs	VOCs, petroleum hydrocarbons	Very Low	Presence of sites with historic leaks within Hysham, Forsyth and Colstrip likely precludes waivers
Assorted Businesses in Town	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Low	-Chemical use likely precludes waivers for some chemicals -Waivers are not available for pathogens and nitrate
Mining Operations	Metals	Low	Extensive mining within the Yellowstone River watershed likely precludes waivers
Municipal Sewer System	Nitrate, pathogens	Low to Moderate	Waivers are not available for pathogens and nitrate
Wastewater Discharges	Pathogens, nitrate, VOCs, SOCs	Moderate	Waivers are not available for pathogens and nitrate
Class V Injection Wells	VOCs, SOCs, pathogens, nitrate	Very Low	Waivers are not available for pathogens and nitrate

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 will 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.

APPENDICES

APPENDIX A

Listing of Potential Contaminant Sources by SIC Code and Other Sources

NAME	ADDRESS	CITY	STATE	ZIP	PHONE	SIC1	SIC2	SIC3	SIC4	LATITUDE	LONGITUDE	COUNTYNAME
Animal House Veterinary Svc	100 Prospect	Forsyth	MT	59327	406-356-7731	074201	508746			46.596800	-106.90092	Rosebud
Art's Tires & Svc	1487 Main St	Forsyth	MT	59327	406-356-7718	553123	753903	753301		46.266640	-106.67208	Rosebud
Beals Furniture & Funeral Home	1055 Main St	Forsyth	MT	59327	406-356-2148	726103				46.266360	-106.67736	Rosebud
Best Western Inn	1018 Front St	Forsyth	MT	59327	406-356-2115	701101	738977			46.264200	-106.67604	Rosebud
Big Sky Svc	340 Front St	Forsyth	MT	59327	406-356-7231	554101				46.268520	-106.66326	Rosebud
Bootery	777 Main St	Forsyth	MT	59327	406-356-7594	725102	594120	566103		46.265100	-106.68036	Rosebud
Burlington Northern Santa Fe	800 Main St	Forsyth	MT	59327	406-356-3271	401101				46.265100	-106.68036	Rosebud
City Hall	247 N 9th Ave	Forsyth	MT	59327	406-356-2521	911104				46.263180	-106.67718	Rosebud
City Mayor	247 N 9th Ave	Forsyth	MT	59327	406-356-2521	911104				46.263180	-106.67718	Rosebud
Clifford Wright Ranch	PO Box 148	Forsyth	MT	59327-0148	406-347-5438	519112				46.596800	-106.90092	Rosebud
County Clerk & Recorder	1200 Main St	Forsyth	MT	59327	406-356-7318	911103				46.267140	-106.67544	Rosebud
D & K Automotive	115 S 16th St	Forsyth	MT	59327	406-356-2071	753801				46.269240	-106.67070	Rosebud
Diamond Willow Taxidermy	165 W Cedar St	Forsyth	MT	59327	406-356-2606	769904				46.262400	-106.68906	Rosebud
Flower Boutique	993 Main	Forsyth	MT	59327	406-356-2811	599201	599940			46.266000	-106.67826	Rosebud
Forsyth Country Club	2 1/2 Miles Of Forsyth W	Forsyth	MT	59327	406-356-7710	799201				46.596800	-106.90092	Rosebud
Forsyth Elementary School	425 N 10th Ave	Forsyth	MT	59327	406-356-2986	821103				46.263060	-106.67550	Rosebud
Forsyth Fire Hall	257 N 9th Ave	Forsyth	MT	59327	406-356-2521	922404				46.263120	-106.67712	Rosebud
Forsyth Hardware & Homecenter	200 N 9th Ave	Forsyth	MT	59327	406-356-2405	521142	526109	526132		46.263540	-106.67754	Rosebud
Forsyth High School	425 N 10th Ave	Forsyth	MT	59327	406-356-2705	821103				46.263060	-106.67550	Rosebud
Forsyth Middle School	1850 Cedar St	Forsyth	MT	59327	406-356-2791	821103				46.596800	-106.90092	Rosebud
Forsyth School District	425 N 10th Ave	Forsyth	MT	59327	406-356-2796	821103				46.263060	-106.67550	Rosebud
Forsyth Seed & Ag Supply	1210 Main St	Forsyth	MT	59327	406-356-7627	519112	072301	525101	561109	46.267200	-106.67532	Rosebud
Forsyth Welding & Machine	85 Main St	Forsyth	MT	59327	406-356-2465	769203	501321	359903	508435	46.261140	-106.68972	Rosebud
Greyhound Bus Lines	1017 Front	Forsyth	MT	59327	406-356-2885	413101	478977			46.264260	-106.67610	Rosebud
Haberle Ford	1825 Front St	Forsyth	MT	59327	406-356-2221	551102				46.267860	-106.66722	Rosebud
Home Oil Co	200 Main St	Forsyth	MT	59327	406-356-7815	517206	517208			46.261920	-106.68786	Rosebud
Hotel Howdy	807 Main St	Forsyth	MT	59327	406-356-2241	738977				46.265160	-106.68030	Rosebud
J T's Auto & Towing	1160 Main St	Forsyth	MT	59327	406-356-2581	753801	754901			46.266900	-106.67604	Rosebud
Jack's Iga	1026 Main St	Forsyth	MT	59327	406-356-7531	541105				46.266240	-106.67760	Rosebud
Kent Autobody	358 N 9th Ave	Forsyth	MT	59327	406-356-7828	753201	523110			46.262340	-106.67646	Rosebud
Kum & Go	1017 Front St	Forsyth	MT	59327	406-356-2885	541103				46.264260	-106.67610	Rosebud
Lasting Impressions	214 N 13th Ave	Forsyth	MT	59327	406-356-7066	722101				46.268520	-106.67520	Rosebud
Municipal Pool	630 N 11th Ave	Forsyth	MT	59327	406-356-2409	799999				46.596800	-106.90092	Rosebud
Napa Auto Parts	980 Main St	Forsyth	MT	59327	406-356-7878	553111				46.265940	-106.67832	Rosebud
Northern Glass	420 S 6th Ave	Forsyth	MT	59327	406-356-7270	753201	523110			46.260180	-106.67964	Rosebud
Precision Auto Body	117 Main	Forsyth	MT	59327	406-356-7144	753201	523110			46.261500	-106.68888	Rosebud
Prince Inc	1 Mile Of Forsyth W	Forsyth	MT	59327	406-356-2137	421306	503211	521128		46.596800	-106.90092	Rosebud
Rosebud County Appraiser	1200 Main St	Forsyth	MT	59327	406-356-7477	738913				46.267140	-106.67544	Rosebud
Rosebud County Supt Of Schools	Main St	Forsyth	MT	59327	406-356-2537	821103				46.596800	-106.90092	Rosebud
Rosebud Health Care Ctr	383 N 17th Ave	Forsyth	MT	59327	406-356-2161	805101	806202	839998		46.271160	-106.67064	Rosebud
Schenk Inc	S W Of Forsyth	Forsyth	MT	59327	406-356-2365	421307				46.596800	-106.90092	Rosebud
Spanwell Service	3072 W Highway 10	Forsyth	MT	59327	406-356-7653	769938				46.596800	-106.90092	Rosebud
Stevenson & Sons Funeral Homes	245 Westwind Ln	Forsyth	MT	59327	406-356-2311	726103				46.596800	-106.90092	Rosebud
Town Pump	974 Front St	Forsyth	MT	59327	406-356-7952	541103				46.264140	-106.67622	Rosebud
U-Haul Co	358 N 9th Ave	Forsyth	MT	59327	406-356-2276	751303	735934	751903		46.262340	-106.67646	Rosebud
V-1 Propane		Forsyth	MT	59327	406-356-2702	517208				46.596800	-106.90092	Rosebud
Valley Auto Supply Co	188 N 9th Ave	Forsyth	MT	59327	406-356-2141	553111				46.263540	-106.67754	Rosebud
Valley Music	188 N 9th Ave	Forsyth	MT	59327	406-356-2143	553114	573501			46.263540	-106.67754	Rosebud

APPENDIX B
DEQ PWS's Database Output

APPENDIX C
Sanitary Survey

APPENDIX D

Concurrence Letter & Other Correspondence