Tracy
Water Users Corporation
Public Water System

PWSID # MT0000345

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

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INTRODUCTION

Russell Levens, Hydrogeologist with Montana Department of Environmental Quality (DEQ) completed this Source Water Delineation and Assessment Report. Randy Kerkes, certified operator for Tracy Water Users Corporation, reviewed the report for accuracy.

PURPOSE

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Tracy Water Users Corporation as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is "delineation and assessment." Delineation is a process of mapping source water protection areas, that contribute water used for drinking. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. The primary purpose of this source water delineation and assessment report is to provide information to help the Tracy Water Users Corporation complete a source water protection plan to protect its drinking water source.

Limitations

This report was prepared to assess threats to the Tracy Water Users Corporation public water supply and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to the source of Tracy's public water supply and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the area of the Tracy Water Users Corporation are identified. Only potential sources of contamination in areas that contribute water to its drinking water source are considered.

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

CHAPTER 1

BACKGROUND

The Community

Tracy Water Users Corporation was formed in August 1961 to supply water to residents of Tracy and the surrounding area. Tracy is a small, unincorporated community in Cascade County with approximately 150 residents (Figure 1). The population of Cascade County was estimated to be 78,282 in 1999, most of who live in nearby Great Falls. Two Hutterite colonies are within a short distance of Tracy. Sewage is treated in individual septic systems.

The basis of the economy around Tracy is small-grain farming and ranching. The only businesses in town are a taxidermy shop and two bars. Residents of Tracy either work in Great Falls or are retired.

Geographic Setting

Tracy is located along Sand Coulee Creek (HUC# 10030102120) between flat-topped benches that slope gently to the north away from the Little Belt Mountains (Figure 1). This tableland topography is dissected by generally north flowing tributaries of the Missouri River.

Tracy is at approximately 47.4° north-latitude and 111.1° west-longitude and 3,550 feet above sea level. The average high and low temperatures at the nearest weather station in Great Falls are 84.5° and 54.5° in July and 33.7° and 13.8° in January. The climate is semi-arid with precipitation averaging 14.73 inches per year concentrated in May and June. Snowfall averages 45.8 inches per year. Wind is a constant presence on the bench tops, quickly blowing snow into coulees or melting it during warm winds called chinooks that can raise the air temperature 50° in a few hours.

Land around Tracy is planted to small grains or hay, or grazed by cattle. Tracy is in a historical coal-mining district with many abandoned underground mines dating to the late 1800s underlying the benches south of town. The Old Anaconda Mine underlying the bench immediately to the east is the closest mine to Tracy.

General Description of the Source Water

The Tracy Water Users Corporation obtains its water from three wells from 160- to 200-feet deep completed in sandstone of the Swift Formation and limestone of the Madison Group. Water infiltrates the aquifer where it outcrops in the foothills of the Little Belt Mountains and where it underlies alluvium along Sand Coulee Creek south of Tracy.

Water from the aquifer flows north and discharges in part to the Missouri River at Giant Springs near Great Falls.

Table 1 List of geologic or hydrogeologic maps for the Tracy area.

Type Of Map & Features	Scale	Area Covered	Reference
Potentiometric surface map of water in the Madison Group, Montana	1:500,000	Western half of state	Feltis, 1980
Contours in feet on the top of the Madison Group	1:500,000	Western half of state	Feltis, 1980, (2)
Geologic Map of the Southeast Great Falls Quad.	1:24,000	7.5 Minute Quad.	Osborne et al., 1987

The Public Water Supply

The Tracy Water Users Corporation supplies water to 320 residents through 81 active service connections. Water is pumped directly to the distribution system or when not in demand to a 86,000-gallon storage tank on the bluff east of town. A separate tank is used to fill water trucks that transport water to outlying areas. Peak water demand results from summer irrigation. One-half cup of granular calcium hypochloride is added to the storage tank once a month for disinfection.

Water Quality

Tracy's water is routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly. Compliance with other drinking water standards is based on additional sampling on a variety of schedules. Nitrate and coliform bacteria were the only regulated contaminants detected in the last five years. Nitrate can come from human or animal wastes but also is naturally occurring. The highest level detected in Tracy's wells was 0.84 mg/L, considerably below the maximum contaminant level of 10 mg/L set by the U.S. Environmental Protection Agency (EPA). One water sample tested positive for coliform bacteria.

Analyses of groundwater and mine drainage near Tracy are available from a study conducted by the Montana Bureau of Mines and Geology (1987). The purpose of this study was to assess the impacts of mining on water quality in the Sand Coulee Creek drainage. Low pH and high sulfate concentrations resulting from oxidation of sulfide minerals contained in coal and adjacent rock characterize mine drainage (Table 2). Mine drainage that infiltrates shallow groundwater is neutralized as it contacts and reacts with soil and rock containing limestone or silicate minerals. Therefore, shallow groundwater impacted by mine drainage in the Tracy area has near neutral pH, high sulfate, higher concentrations of calcium and magnesium, and elevated total dissolved solids (TDS) (Table 2). Deeper wells in the Madison formation, including Tracy's wells, do not exhibit obvious signs of contamination by mine drainage. However, evidence presented in the Montana Bureau of Mines and Geology indicate that mine drainage south of Tracy has reached the Madison Aquifer.

Table 2. Laboratory analyses of water samples collected from wells in the Tracy area during 1982 and 1983 (MBMG, 1983).

GWIC #	Depth ft	pH	Sc : S/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Fe mg/L	Mn mg/L	SiO_2 mg/L	HCO_3 mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	TDS
2288 Alluvium	41.8	7.3	2655	334	207	71.1	3.4	0.35	0.023	30.2	627	33.2	1280	5.81	2274
2289*	200	7.6	624	82.2	29.1	12.4	2.3	0.02	11.8	236	0	145	0.69	-	527.3
2244*	158	7.6	617	75.8	26.5	11.8	2.5	0.01	11.8	234	0	133	0.88	-	506.0
2285	220	7.6	1115	97.3	89.4	22	8	0	8.7	234	0	428	1.83	-	903.4
2241	136	7.3	2094	319	119	41.2	4.3	0.02	0.004	27.2	483	28.7	924	15.9	1718
2242	70	7.8	930	66.3	75.6	15.9	2.7	0	9.7	452	0	84.4	11.1	-	731.8
2243	131	7.6	2172	354	115	27.7	5.5	0.02	0.004	25.3	507	18.9	937	3.67	1737
145504 Mine Drain**	-	3.03	1790	82.2	72.6	23.1	2.7	7.4	0.643	51.8	1.25	7	801	1.25	1090

* Madison Aquifer

** Sample collected 5/27/94

CHAPTER 2

DELINEATION

The area that contributes water to Tracy's wells is identified in this chapter. Four management regions are mapped (control zone, inventory region, surface water buffer, and recharge region). The goal of management in the control zone is to protect against direct introduction of contaminants into Tracy's wells or the immediate surrounding area. The inventory region and surface water buffer should be managed to prevent release of contaminants that could flow to Tracy's wells within three years. The goal of management in the recharge region is to maintain and improve water quality over long periods of time or increased usage.

Geologic Conditions and Aquifer Characteristics

Most of the following description of geologic conditions near Tracy is summarized from a report published by the Montana Bureau of Mines and Geology (MBMG) (Osborne et al., 1987). Bedrock in the vicinity of Tracy ranges from Mississippian age Madison Group to Cretaceous age Blackleaf Formation (Figure 2). The basal sandstone layer of the Blackleaf Formation and mudstone and sandstone layers of the Kootenai Formation top the benches around Tracy. Mudstone with minor sandstone layers and coal beds of the Morrison Formation outcrop along coulee walls. Coal in the area mines comes from seams at the top of the Morrison. Sandstone of the Swift Formation and limestone of the Madison Group outcrop along the base of coulees in the Stockett area and in the foothills of the Little Belt Mountains and underlie alluvium along Sand Coulee Creek at Tracy.

Important aquifers near Tracy include sandstone layers in the Kootenai, Morrison, and Swift formations and limestone in the Mission Canyon Member of the Madison Group. Alluvium filling coulee bottoms yields abundant water to wells but is contaminated by mine drainage and has generally been abandoned as a water source. Kootenai and Morrison aquifers mostly receive recharge from bench tops and discharge to underground mines or outcrops along coulees. The Madison Group and Swift Formation behave as a single aquifer unit that is the source of water for the Town of Tracy. The Swift ranges form 4 to 40 feet of fine- to coarse-grained sandstone containing interbeds of shale and conglomerate. The top of the Madison Group is the Mission Canyon Formation consisting of gray limestone containing large voids that are intercepted by wells drilled in the Stockett area. Water recharges the Swift/Madison aquifer where it outcrops near Stockett and in the foothills of the Little Belt Mountains and where it subcrops beneath alluvium along coulees. Water from the Swift/Madison aquifer upwells through overlying formations to feed Giant Springs along the Missouri River at Great Falls.

Geologic structure near Tracy is characterized by a broad arch gently dipping toward the northwest from the Little Belt Mountains (Wilke, 1983). The regional bedrock dip near Tracy is 1.5° , N35° W (Daniel and others, 1986). Average orientations of near vertical fracture pairs that extend through the Kootenai, Morrison, and Swift formations as measured by Osborne, et al. (1987) were N35° E and N56° W at one location and N44° E and N50° W at another location. Orientations of Walker Coulee, Sand Coulee, and many lesser, unnamed coulees generally parallel the northeast trending fracture set.

Osborne et al. (1987) believes groundwater flow in the Kootenai follows the regional fracture trend to the northeast. In contrast, a map of the potentiometric surface of the Madison prepared by Feltis (1980) indicates regional groundwater flow is parallel to the regional bedrock dip with a hydraulic gradient of approximately 0.005. Static water levels in wells measured by Osborne, et al. (1987) indicate that vertical groundwater flow is downward from bedrock and alluvium overlying the Swift/Madison aquifer.

Table 3. List of Geologic or hydrogeologic research activities in the Tracy area.

Title Of Project	Period Of Project	Location Or Area Covered	Project Objectives
Interaction Between Ground Water and Surface Water Regimes and Mining-induced Acid Mine Drainage (AMD) in the Stockett-sand Coulee Coal Field	1980-1983	Sand Coulee Creek Watershed	To formulate acid mine drainage mitigation techniques
Appraisal of Water in Bedrock Aquifers, Northern Cascade County, Montana	1979-1983	Northern Cascade County (780 sq. mi.)	To describe the occurrence and chemical quality of water in bedrock aquifers
Acid Mine Drainage Control in the Sand Coulee Creek and Belt Creek Watersheds, Montana 1983-1987; V.1 and V.2	1983-1987	Sand Coulee Creek and Belt Creek Watersheds	To test hydrogeologic techniques of acid mine drainage control

Conceptual Model

The source of Tracy's drinking water is sandstone of the Swift Formation and limestone of the Mission Canyon Member of the Madison Group (see cross-section in Figure 3). Recharge is from precipitation and losses from streams at outcrops near Stockett and in the foothills of the Little Belt Mountains. Downward leakage from alluvium and fractured bedrock that overlies the Swift/Madison aquifer is a source of recharge closer to Tracy. Groundwater flow direction is uncertain, but probably is between N45° E and N45° W. Because younger mudstone layers have been removed by erosion, the Swift/Madison aquifer probably is unconfined. Consequently, the aquifer is classified as shallow fractured or carbonate bedrock and is designated as high sensitivity.

Source-Wells

Tracy Water Users Corporation has three wells located at the south edge of town (see map in Appendix A and well logs in Appendix D). The primary well (well #3) was drilled in October 1985 to 160 ft in fractured sandstone of the Swift Formation. Water enters the well through torch-cut perforations between 132 and 154 ft depth. The well yielded 50 gpm when pumped during completion, but DEQ public water supply records indicate it is capable of producing 100 gpm. The other two wells are 191 ft and 200 ft deep and are probably completed in the Mission Canyon Limestone of the Madison Group. DEQ records indicate Well #2 yields 25 gpm. Well #1 is privately owned and is only used for emergency backup (see Table 4 for well completion details).

Aquifer Properties

Estimates including aquifer flow properties, well discharge rate, groundwater gradient, and ambient groundwater flow direction are used to estimate one-year and three-year times-of-travel in order to define boundaries of the inventory region and to determine susceptibility (Table 5). Aquifer flow properties estimated are transmissivity, hydraulic conductivity, thickness, and effective porosity. Flow test data from well logs or representative published values were used to estimate transmissivity and hydraulic conductivity. Lithology descriptions from well logs and published data were used to estimate effective porosity and thickness. Maps of geologic structure and groundwater elevations were used to estimate groundwater gradient and flow direction.

Properties of the Swift/Madison aquifer are naturally variable and there is limited data on them. Hydraulic conductivity estimates cover two orders of magnitude (high estimate = 100 X low estimate) and estimates of thickness and effective porosity cover one order of magnitude (high estimate = 10 X low estimate). Groundwater gradient could be in error by a factor of four and groundwater flow direction could fall within a 90° range. The accuracy of hydraulic conductivity estimates affects the accuracy of time-of-travel estimates the most because hydraulic conductivity values are highly uncertain and because time-of-travel calculations are highly sensitive to different hydraulic conductivity values. Time-of-travel calculations also are highly sensitivity to different values of effective porosity and groundwater gradient, however, the values of these properties are known more accurately than hydraulic conductivity. In the case of the Swift/Madison aquifer at Tracy, aquifer thickness and well yield have the least affect on the accuracy of time-of-travel estimates.

Table 4 Source well information for the Tracy Water Users Corporation.

	Source #002 (Well #1)	Source #003 (Well #2)	Source #004 (Well #3)
MBMG #	None	2289	31920
Water Right #	200210	C049982	C058838
Latitude / Longitude	47.4117° / -111.1546°	47.4120° / -111.1545°	47.4121° / -111.1539°
Date Completed	1926	1982	1985
Depth	191	200	160
Perforated Interval	Unknown	Unknown	132 – 154 ft
SWL Depth	Unknown	90 ft	125 ft
PWL Depth	Unknown	Unknown	135 ft
Drawdown	Unknown	Unknown	10 ft
Test Pumping Rate	Unknown	Unknown	50 gpm
Specific Capacity	Unknown	Unknown	5 gpm/ft
Source Type	Shallow Fractured or Carbonate Bedrock	Shallow Fractured or Carbonate Bedrock	Shallow Fractured or Carbonate Bedrock

Hydraulic Conductivity and Transmissivity – Hydraulic conductivity is a measure of the ease at which water flows through porous materials such as rock or soil and transmissivity is a measure of the ease at which water flows through the full thickness of an aquifer. Estimates of hydraulic conductivity and transmissivity are based on well yield data reported on well logs and data for similar rocks published in texts and literature. Hydraulic conductivity estimates ranged from five- to 500-ft/day and transmissivity estimates ranged from 100- to 10,000-ft^2/day. Representative estimates of 50 ft/day and 2,500 ft^2/day were used in calculations.

Thickness – There are not enough well logs available to accurately estimate the aquifer thickness. Therefore, the estimate is based on the thickness of sandstone and limestone intercepted by Tracy's wells (approximately 100 feet), the total thickness of the Swift/Madison aquifer (probably several hundred feet), and the thickness of screened intervals for individual wells (20 to 50 feet). A representative estimate of 50 feet was used in calculations.

Effective Porosity - Total porosity is the percent of a rock occupied by voids. For sandstone and limestone, total porosity typically varies from 2 - 30 percent depending on the porosity of the original sediment and subsequent cementing or dissolution (Freeze and Cherry, 1979). Effective porosity or the porosity that water actually flows through will be less than total porosity. An effective porosity of five percent is used in calculations.

Groundwater Gradient and Flow Direction – A range of groundwater flow directions is estimated from the regional dip of the Swift/Madison aquifer and the strike of steep dipping fractures in the vicinity of Tracy (Osborne et al., 1987). Groundwater gradient is estimated from the regional dip of the Swift/Madison aquifer (0.015) and a potentiometric map (0.005) (Feltis, 1965). To account for uncertainty in groundwater flow direction a 45-degree range of groundwater flow directions was used to define the the inventory region.

Well Production – Well production is estimated from published water use information and information in public water supply files at DEQ. Average usage for single family households obtained from the Manual of Small Public Water Supply Systems (EPA, 1991) is 50 to 75 gallons per day per resident or 16,000 to 24,000 gallons per day for the Town of Tracy. DEQ records indicate Tracy's total average daily production is 40,000 gallons per day with a maximum daily production of 144,000 gallons per day. Seasonal irrigation use is not considered in the published information so 40,000 gallons per day is used for final calculations.

Table 5. Estimates of input parameters used to delineate the source water protection area.

Input Parameter	Range	Value Used
Hydraulic Conductivity	5 - 500 ft/day	50 ft/day
Thickness	20 - 200 ft.	50 ft.
Transmissivity	100 – 10,000 ft^2/day	2,500 ft^2/day
Effective Porosity	1-20 %	5 %
Gradient	0.005 - .-0.015	0.01
Well Production	16,000 – 144,000 gal/day	40,000 gal/day
Flow Direction	N35ºW - N40ºE	N45ºW - N45ºE
One-Year Time-of-Travel Distance	950 – 5,700 ft	4,400 ft
Three-Year Time-of-Travel Distance	2,000 – 55,000 ft	12,000 ft

Delineation Results

DEQ's Source Water Protection Program (DEQ, 1999) specifies methods and criteria used to delineate subregions of the source water protection area for Tracy. Following this guidance, the control region for the Tracy Water User Corporation encompasses a radius of 100-ft around each well. A three-year time-of-travel and outcrops of the Swift/Madison aquifer along Sand Coulee Creek near Stockett delineate the inventory region (Figure 4). Outcrops of the Swift/Madison aquifer along Sand Coulee Creek are included in the inventory region because time-of-travel estimates are highly uncertain in aquifers, such as the Swift/Madison aquifer, where large voids are encountered. Time-of-travel is difficult to estimate under these conditions because water can flow much faster than normal where voids provide an interconnected path for water to follow. Outcrops are areas where water can infiltrate directly to the aquifer and potentially follow interconnected flowpaths to

Tracy's wells. Further, the distance from outcrops of the Swift/Madison aquifer to Tracy's wells is within the range of three-year time-of-travel distances shown in Table 5.

The surface water buffer includes all land and water between benches for ten miles upstream from Tracy. A fixed 1,000-ft buffer delineates the surface water buffer when coulees are less than 1,000 feet wide (Figure 4). Outcrops in the foothills of the Little Belt Mountains delineate the recharge region.

Limitations

The reader should keep in mind that this delineation is based on estimated properties and groundwater flow conditions. Conclusions based on this interpretation are uncertain because the extent and properties of the aquifer, and the direction and rate of groundwater flow are not known precisely. Nonetheless, conservative selection of parameters for time-of-travel calculations should assure that Tracy's source water protection areas include all significant potential contaminant sources.

CHAPTER 3

INVENTORY

Potential sources of contamination were inventoried to assess the susceptibility of Tracy's drinking water sources to contamination. Potential sources of all contaminants with primary drinking water standards, and cryptosporidium, were identified. A detailed inventory was conducted only for potential sources of contaminants that are the greatest threat to health. Nitrate, pathogens, and pesticides were the most common potential contaminants identified in Tracy's source water protection area.

The inventory for the Tracy Water Users Corporation focuses on all activities in the control zone, municipal and private facilities in the inventory region, potential sources of nitrate and microbial contaminants in the surface water buffer, and general land uses and large facilities in the recharge region.

Inventory Method

Databases were searched to identify businesses and land uses that are potential sources of regulated contaminants. The following steps were followed:

Step 1: Urban and agricultural land uses were identified from landcover data collected by the Montana Gap Analysis project (Redmond et al., 1998).

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 on the basis of SIC code.

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, or use 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

Inventory Results/Control Zone

Four residential septic systems are located within 100 ft of one or more of Tracy's wells. Small quantities of pesticides, fuels, and solvents are stored at residences in the control zone and pesticides are used for weed and insect control. The Montana Bureau of Mines and Geology, Ground-Water Information Center (GWIC) database was searched to identify wells in the control zone besides the Tracy Water Users Corporation wells. None were identified.

Inventory Results/Inventory Region-Surface Water Buffer

Landcover in the inventory region and surface water buffer are predominantly range with scattered dryland crops and small, developed communities (Figure 5). Mixing, handling, and application of herbicides are potential contaminant sources from dryland crops. Other significant potential contaminant sources include septic systems, abandoned mines, underground storage tanks, and the sanitary sewer and wastewater lagoon for Stockett (Table 6). Forty wells ranging from 23 to 430 feet deep are located in Tracy's inventory region according to GWIC; however, only one is within 1,000-feet of Tracy's wells.

Inventory Results/Recharge Region

Agriculture is the only significant land use in the recharge region (Figure 6). Of the recharge region, 38 percent is grassland, irrigated crops cover 21 percent, shrubs cover 21 percent, and dryland crops cover eight percent.

Application of herbicides on the cropland, land application of animal waste, and a sewage treatment lagoon at Big Stone Colony are potential contaminant sources.

Table 6. Significant potential contaminant sources in the inventory region and surface water buffer.

Source	Hazard
Cultivated Cropland	Spills and excess application of herbicides and fertilizer
Septic Systems	Infiltration of untreated sewage
Stockett Wastewater Lagoons	Leaks
Stockett Sanitary Sewer	Leaks
Underground Storage Tanks	Leaks
Abandoned Coal Mines	Drainage containing high total dissolved solids and metals infiltrating the aquifer

Inventory Update

The certified operator should update the inventory for his records every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. A complete inventory should be submitted to DEQ every five years.

Inventory Limitations

The potential sources of contaminants for the Town of Tracy were determined from readily available data and reports. Unregulated activities or unreported contaminant releases may have been missed. The use of multiple sources of data, however, should ensure the major threats to the source water for the Town of Tracy are identified.

CHAPTER 4

SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a well to be contaminated by one of the sources inventoried in the previous chapter. Hazard ratings and the presence of barriers determine susceptibility (Table 7). Hazard ratings are determined by the proximity of a potential contaminant source to the well. Point contaminant sources within a one-year time-of-travel of Tracy's wells are given a high hazard rating and all other point sources in the inventory region are given a moderate hazard rating. Hazard for cropland is based on the percent of the inventory region or surface water buffer cultivated for dryland or irrigated crops. Hazard for septic systems is based on their density as estimated by population density. Barriers can be engineered structures, management actions, and/or natural conditions. Examples of engineered barriers are liners in wastewater treatment lagoons and double-walled underground fuel storage tanks. Chemical management plans and procedures for safe mixing and application of agricultural chemicals are considered management barriers. Finally, thick clay soils, a thick zone above the water table, and a deep well can be natural barriers.

Table 7 Susceptibility to specific contaminant sources as determined by hazard and the presence of barriers

	High Hazard	**Moderate Hazard**	**Low Hazard**
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

The following are brief descriptions of the susceptibility assessments for each source included in Table 8.

Septic Systems –Population and septic density is generally low around Tracy, but the presence of septic systems within the control zone is a concern. Consequently, hazard for septic systems is rated high for the control zone and low for the inventory region and surface water buffer. Susceptibility is rated very high because there are no barriers. Well construction can be a barrier in the control zone but is not included here because there is limited information on construction of wells #1 and #2.

Abandoned Mines – Hazard is rated moderate because the most significant sources of mine drainage are between one- and three-year times-of-travel. One small mine is located within a one-year time-of-travel but it does not produce significant drainage. Susceptibility is rated moderate because the combination of thick unsaturated zone and depth of intake is a barrier.

Cultivated Cropland **–** Hazard is rated low because less than 20 percent of the inventory region or surface water buffer is dryland crops. Susceptibility is rated low because a combination of a thick unsaturated zone and depth of well intakes below the water table should act as a barrier.

Stockett Sanitary Sewer – Hazard is rated low because the sewered area is a small percent of the inventory region or surface water buffer. Susceptibility is rated low because a combination of a thick unsaturated zone and depth of well intakes below the water table should act as a barrier.

Stockett Wastwater Lagoon – Hazard is rated moderate because the lagoon is located near an outcrop of the Swift/Madison aquifer but outside the one-year time-of-travel distance. Susceptibility is rated low because there are multiple barriers provided by the lagoon liner and the combination of a thick unsaturated zone and depth of well intakes below the water table.

Underground Storage Tank – Hazard for the 10,000 gallon heating oil tank in Centerville is moderate because it lies between the one- and three-year time-of-travel distances from the Tracy wells. Susceptibility is rated low because spill prevention and/or leak detection, and the combination of a thick unsaturated zone and depth of well intakes below the water table provide multiple barriers

Table 8 Susceptibility of Tracy's wells to significant potential contaminant sources in the inventory region and surface water buffer.

Source	Contaminant	Contaminant Origin	Hazard Rating	Barriers	Susceptibility	Management
Septic Systems (conrol zone)	Nitrate and Microbial Contaminants	Drain field leachate	High	None	Very High	Inspect for proper operation
Abandoned Mines	Metals	Infiltration of mine drainage	Moderate	Thick unsaturated zone and deep intake	Moderate	Monitoring
Cultivated Cropland	Pesticides and Fertilizer	Spills or excessive application	Low	Thick unsaturated zone and deep intake	Low	Provide information to land owners on proper chemical use
Sanitary Sewer	Nitrate and Microbial Contaminants	Leaks from sewer lines	Low	Thick unsaturated zone and deep intake	Low	Monitor for leaks
Wastwater Lagoon	Nitrate and Microbial Contaminants	Leaks through liner	Moderate	Thick unsaturated zone and deep intake, Lagoon liner	Low	Monitor for leaks
Underground Storage Tank	Heating Oil	Leaks or spills during filling	Moderate	Thick unsaturated zone and deep intake, Leak detection/leak prevention	Low	Monitor for leaks

REFERENCES

Daniel, J.A., M.J. Bartholomew, and R.C. Murray, 1986. Geological characteristics of the Great Falls coal field, Montana: Geological Society of America, Abstract with Programs, v. 18, no. 5, 349 p.

DEQ, 1999, Montana source water protection program.

Feltis, R.D., 1980, Potentiometric surface map of water in the Madison Group, Montana. Montana Bureau of Mines and Geology Hydrogeologic Map 2.

Feltis, R.D., 1980 (2), Contours in feet on the top of the Madison Group, Montana. Montana Bureau of Mines and Geology, compiled from Geologic Maps GM9, 10, 11, 12, 15, 16, 17, 18, 20, 21, and 22 and Miscellaneous Investigations Map I-847-C.

Osborne, T.J., J.J. Donovan, and J.L. Sonderegger, 1983. Interaction between groundwater and surface water regimes and mining-induced acid mine drainage in the Stockett-Sand Coulee coal field, Volume 1. Montana Bureau of Mines and Geology Open-File Report 109, 54 p.

Osborne, T.J., M.H. Zaluski, B.J. Harrison, and J.L. Sonderegger, 1987. Acid mine drainage control in the Sand Coulee Creek and Belt Creek watersheds, Montana. Montana Bureau of Mines and Geology Open File Report 197, 113 p.

Redmond, R.L., M.M Hart, J.C. Winne, W.A. Williams, P.C. Thornton, Z. Ma, C.M. Tobalske, M.M. Thornton, K.P. McLaughlin, T.P. Tady, F.B. Fisher, S.W. Running. 1998. The Montana Gap Analysis Project: final report. Unpublished report. Montana Cooperative Wildlife Research Unit, The University of Montana, Missoula. Xiii + 136 pp. + appendices.

Todd, D. K., 1980. Groundwater Hydrology, second edition: John Wiley and Sons, 535 p.

U.S. EPA, Office of Water, 1991. Manual of small public water supply systems, EPA 570/9-91-003, 211 p.

Wilke, K.R., 1983. Appraisal of water in bedrock aquifers, northern Cascade County, Montana. Montana Bureau of Mines and Geology Open-File Report 82-1025, 29 p.

GLOSSARY*

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

Alkalinity. The capacity of water to neutralize acids.

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

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

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

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

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

Delineation. A process of mapping source water management areas.

Hardness. Characteristic of water caused by presence of various chemical compounds. 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.

Hydrologic Unit Codes (HUC). Uniform, nationally consistent map codes for river basins.

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

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

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

Nonpoint-Source Pollution. Pollution sources such as stormwater runoff 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. Bacterial organisms typically found in the intestinal tracts of mammals, capable of producing disease.

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

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

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

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

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

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

Susceptibility (of a PWS). The potential for a public water supply to draw water with contamination that would pose concern

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

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

Transmissivity. The ability of an aquifer to transmit water.

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

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

Volatile Organic Compounds (VOC). Organic compounds that evaporate readily to the atmosphere.

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