Fairfield
Public Water System
PWSID # MT0000212

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

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Fairfield Executive Summary

The majority of the Fairfield Public Water System (PWS) Source Water Delineation and Assessment Report (SWDAR) has been completed using data from the "Town of Fairfield Demonstration of Source Water Protection For A Public Water Supply Using Ground Water" report completed in 1996 by Montana Bureau of Mines and Geology (MBMG) staff. Montana Department of Environmental Quality (DEQ) Source Water Protection staff completed additional sections for the SWDAR including the Executive Summary, an updated significant potential contaminant source inventory including potential contaminant source mapping, and a susceptibility assessment.

The Town of Fairfield is located approximately 35 miles west of Great Falls on the Third Bench of the Greenfields Bench area. Agriculture is the basis for Fairfield's economy. An extensive network of irrigation canals is used to supply water to area cropland. The Sun River is the source of area irrigation water.

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

Based on the well logs and previous hydrogeologic studies the seven Fairfield PWS wells are completed in terrace gravels of the Third Bench of the Fairfield Bench Aquifer. In accordance with the Montana Source Water Protection Program criteria (1999), the aquifer (source water) is considered to have a high sensitivity to potential contaminant sources since they are completed in terrace gravels. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

Previous groundwater investigations in the Fairfield area indicate that water levels in the Fairfield PWS wells vary seasonally in direct relation to when the main irrigation canals are "turned on" and then shut down for the winter. Water quality monitoring data indicates that groundwater in the terrace gravels supplying drinking water to the Fairfield PWS has been impacted by land use activities.

Recharge to the terrace gravels is predominantly from leakage from area irrigation canals and infiltration of irrigation water. Precipitation falling directly on and percolating into the terrace gravels may also provide some recharge to the aquifer. The Town of Fairfield utilizes a portion of land near Well #2 that serves as a snow dumping area. Melting snow in this area may also provide some localized recharge to the nearby PWS wells.

Three source water protection management regions for the Fairfield Public Water System were mapped as part of this assessment. They include the control zones, inventory region, and surface water buffer. In 1996, the previously completed MBMG report delineated 1000-foot special protection regions for each well and a protection region for the Fairfield PWS. In 1999, the DEQ Source Water Protection Program was re-developed, and the terms "inventory region" and "recharge region" replaced "special protection region" and "protection region", respectively. Time-of-travel criteria for the delineation of the inventory regions also changed. For the purposes of the current DEQ Source Water Delineation and Assessment Report the special protection regions delineated in the MBMG report were incorporated into the protection region boundary to delineate the current inventory region.

Potential sources of contamination have been identified within each of the three source water protection management regions and the results are as follows:

- The goal of management in the control zones of each well is to avoid introducing contaminants directly into the water supply's well(s) or immediate surrounding areas. The control zone is delineated as a 100-foot radius around each well and all sources of potential contaminants should be excluded in this region. Potential contaminant sources identified within the control zones include: municipal sewer mains, residential land, agricultural land, State Highway 408, and U.S. Highway 89.

- The inventory region should be managed to prevent contaminants from reaching the wells before natural processes reduce their concentrations. Since the source water is unconfined, the inventory region includes the area of land overlying the aquifer that is expected to supply groundwater recharge to the well over the next three years. Significant potential contaminant sources identified within the inventory region for the Fairfield wells include: municipal sewer mains, cultivated cropland, U.S. Highway 89, MT Highway 408, Burlington Northern Railroad, underground storage tanks (USTs) and leaking underground storage tanks (LUSTs), a closed landfill, and underground injection control wells.

- The goal of management in the surface water buffer is to avoid introducing nitrates and microbial contaminants into surface waters that are hydraulically connected to aquifers that are the source of drinking water. The surface water buffer will include a ½-mile buffer around the Spring Valley Canal and the Greenfields Main Canal that are within the inventory region and will extend 10 miles upstream from the groundwater zone of contribution or to the watershed limits, whichever distance is shorter. No additional significant potential contaminant sources were identified in the surface water buffer.

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the public water supply well intake. The Fairfield public water system has a very high to high susceptibility to cultivated cropland, U.S. Highway 89 and MT Highway 408, a trucking company, the golf course, and the BNSF Railroad; and a moderate susceptibility to municipal sewer mains and other area septic systems. Low risk potential sources and potential sources located outside the Inventory Region, but within the Recharge Region may still pose a threat over time, but are not discussed in detail in this assessment. This provides a quick look at the existing potential sources of contamination that could, if improperly managed or released, impact the source water for Fairfield. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to focus resources for protection of this valuable drinking water resource.

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

CHAPTER 1
INTRODUCTION

The majority of information for the Fairfield Public Water System (PWS) Source Water Delineation and Assessment Report (SWDAR) was taken from the Montana Bureau of Mines and Geology report, "Town of Fairfield Demonstration of Source Water Protection For A Public Water Supply Using Ground Water" completed by Kathleen J. Miller and Lillian Alfson, former Mayor of the Town of Fairfield. Carolyn DeMartino, a Water Quality Specialist with the Montana DEQ completed additional sections into the SWDAR including the Executive Summary, an updated the significant potential contaminant source inventory including potential contaminant source mapping, and a susceptibility assessment.

Purpose

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

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

Limitations

This report was prepared to assess impacts to the Fairfield PWS, and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to the source of the Fairfield public water supply and not any other public or private water supply. Also, not every potential or existing source of groundwater or surface water contamination in the area of the Fairfield has been identified. Only potential sources of contamination in areas that contribute water to its drinking water source are considered.

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

Chapter 1
BACKGROUND

The Community

Farming and ranching provide the basis of Fairfield's economy. The town is located in the heart of an 83,000-acre irrigation project. In a 3.5-mile radius around Fairfield, there is a trucking company, an automotive repair shop, a small livestock yard, and a nine-hole golf course with clubhouse. The town has approximately 45 small businesses of various types, including:

- a large barley malting operation and seed processing plant,
- grain elevators,
- gas stations and garages,
- car wash,
- grocery stores,
- a lumber company,
- hardware stores,
- drug store,
- shoe shop,
- restaurants and bars,
- main business offices for an electric cooperative,
- telephone cooperative, and,
- the headquarters for the irrigation project.

The community has no major industry that manufactures a product that is subsequently shipped elsewhere.

The major transportation routes are Highway # 89 (Figure 1), which bisects the town on the west end of main street and runs approximately southeast to northwest, and Secondary Highway # 408, which borders the south edge of town for approximately two and one-half blocks. A short spur of the Burlington Northern Railroad parallels Highway #89 to approximately one-half mile southeast of town and approximately one block of old Highway #89 runs east of town along the south edge of Fairfield. Highway #89, Secondary Highway #408 and the Burlington Northern Railroad run past the town's # 2, #4, #5, #6 and #7 wells (Figure 1). Secondary highway #408 also passes the # 1 well. The old portion of Highway #89 passes Fairfield's # 3 well.

Geographic setting

Fairfield is located in Teton County, approximately 30 miles northwest of the City of Great Falls. The town is situated on the southwest edge of the Fairfield Bench (also known as the Greenfields Bench) at an elevation of 3,980 feet above sea level. Average annual precipitation is 12 to 13 inches (Osborne 1983).

General description of the aquifer

The Fairfield Bench Aquifer comprises three gravel terraces of Quaternary/ Tertiary? age. The wells serving Fairfield are completed in gravels of the Third Bench, which is the lowest in elevation of the three gravel terraces. Well depths near Fairfield range from 15 to 200 ft., with most wells 40 ft. or less in depth. Reported yields range from 5 to 500 gallons per minute (gpm)(Ground-Water Information Center, 1997). A geologic map, compiled by the U.S. Geological Survey (Nimick et al. 1996), has been modified for use in this report (Figure 2).

The public water supply

Fairfield utilizes seven wells to provide water to approximately 660 residents (Census Bureau, 2000) through 377 service connections (DEQ SDWIS Database). Site plans for the wells are located in Appendix A. Well logs for each well are located in Appendix B.

The town's major water users are:

- The Fairfield High School and Elementary School District # 21
- Teton Apartments,
- Motel Apartments,
- Greenfields Irrigation District headquarters, which includes their office, a large shop and one private residence
- The Store and Car Wash,
- a convenience store,
- a gas station,
- a car wash unit
- 3 Rivers Telephone Cooperative's headquarters office building, and,
- one large shop

Influencing factors

Councilman Jim Lear, former Councilman Terry Aubrey, Councilman Brad Bauman, Councilman Ellis Misner, Councilman Kris Ingenthron, Mayor Lillian I. Alfson, Water Superintendent C. Leo Mueller, and Town Engineer Jim Cummings were the people that made the decision to pursue a Source Water Protection Plan. One of the major factors in deciding on a Source Water Protection Plan was that the Town of Fairfield has an old water system dating back to 1945; the newest wells went into service in 1980. The town's wells are shallow with depths ranging from 22 to 30 feet below ground surface and appear to be vulnerable to contamination. Fairfield residents feel a commitment to protecting their water supply by implementing a source water protection plan.

CHAPTER 2
DELINEATION

Previous investigation

The Montana Bureau of Mines and Geology (Osborne et al. 1983) characterized the ground-water contribution to Muddy Creek from the Greenfields Bench. The open-file report describes a monitoring well network, aquifer characteristics, and general direction of ground-water flow across the bench.

Method

Three source water protection management regions for the Fairfield Public Water System were mapped as part of this assessment. They include the control zones, inventory region, and surface water buffer. In 1998, the previously completed MBMG report delineated 1000-foot special protection regions for each well and a protection region for the Fairfield PWS. In 1999, the DEQ Source Water Protection Program was re-developed, and the terms “inventory region” and “recharge region” replaced “special protection region” and “protection region”, respectively. Time-of-travel criteria for the delineation of the inventory region also changed. For the purposes of the current DEQ Source Water Delineation and Assessment Report the special protection regions delineated in the MBMG report were incorporated into the protection region boundary to delineate the current inventory region. The following text from the MBMG report describes how the Fairfield source water protection areas were delineated.

Water-level information was collected from 24 existing wells from September 1995 through August 1996. Figure 1 shows the locations of the wells. Because some wells were being pumped, data for static water levels were not available at all times. Table 1 presents information on static water levels from 15 wells and shows hydrographs from 2 wells where continuous data collection was possible. Samples of water to be analyzed for inorganic constituents were collected from 12 wells, one spring, and one surface-water source, Greenfields Main Canal. The analytical results are presented in Appendix Fairfield-2 and can be obtained upon request from either the MBMG or DEQ. Samples for pesticide analysis were collected from 12 wells.

Control zones and the initial Special Protection Regions were determined using analytical methods described in "EPA Seminar Publication -Wellhead Protection for Small Communities." Stagnation points, boundary limits, and times of travel were calculated for each well using the Uniform Flow Equation and Darcy's Law. As shown in Figure 3, control zones were delineated as circles of 100-ft. radius around each well. Based on data collected from a 21-hour aquifer test (measuring drawdown and recovery) on well #6, transmissivity was estimated using the Jacob straight-line method. Hydraulic conductivity, K, was estimated using K=T/b, where T= transmissivity and b= aquifer thickness (18 ft.). Special Protection Regions are defined by areas upgradient from the well that represent a 3-year time of travel or 1,000 ft., whichever is less. Because the upgradient distance of a three-year time of travel exceeds the aerial extent of the aquifer, Special Protection Regions with an upgradient distance of 1,000 feet were drawn for each well (see Figure 4). The delineated Special Protection Regions include stagnation points and boundary limits. A one-year time of travel exceeds the upgradient aerial extent of the aquifer for all of the Fairfield wells. The Protection Region represents the entire recharge area and extends upgradient to the terminus of the aquifer (Figure 5).

Geologic conditions and aquifer characteristics

As shown on Figure 8, the aquifer serving the public water supply for Fairfield is composed of terrace gravel deposits that overlie the Cretaceous Colorado Group (Lower Cretaceous Blackleaf Formation and Upper Cretaceous Marias River Formation). The lateral extent of the aquifer is essentially equal to the aerial extent of the Fairfield Bench. The thickness of the terrace deposits on the Fairfield Bench ranges from 4 to 32 feet (Osborne, 1983). The total combined thickness of the Colorado Group is about 1,500 feet. Rocks younger than the Colorado Group were removed by pre-Pleistocene erosion, leaving a gently eastward sloping erosional surface. An ancestral Sun River cut terraces into the shale in down-to-north steps and deposited the gravels directly onto the weathered shale surface. As a result, surface topography generally mirrors the underlying bedrock contours. Figure 6 depicts contours of the top of the bedrock (basal confining units). The oldest and highest terrace is locally called the First Bench and has an average gradient of 24 ft./mile. The Second Bench lies 120 ft; below the First Bench and has an average gradient of 19 ft./mile. The Third Bench (on which the Fairfield wells are located) lies about 75 ft. beneath the Second Bench and also has an average gradient of about 19 ft./mile (Osborne, 1983).

Water levels near Fairfield demonstrate a direct hydraulic connection to surface water in the irrigation distribution and drainage canals that surround and bisect the Town. Potentiometric contour maps presented in Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, and Figure 14 show changes in water levels and ground-water flow direction from September 29, 1995 through August 8, 1996. Flow to the irrigation system was turned off on September 22, 1995 and subsequently restored on May 10, 1996.
The potentiometric contour maps from September 29, 1995, through May 10, 1996, show that water levels gradually declined after flow to the irrigation system was shut off. Figure 10 shows that for the period from September 1995 to May 10, 1996, the water-level decline was greater than 14 feet near wells # 4, 5, 6, and 7.

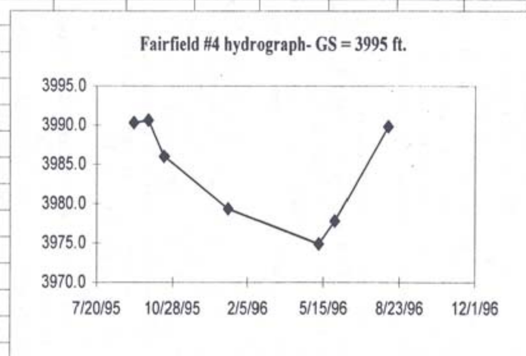
Conversely, when flow to the irrigation system was restored on May 10, 1996, water levels rapidly rose. As shown in Figure 10, Figure 11, Figure 12, and Figure 13, water levels rose more than 4 feet in the twenty-day period from May 10 to May 30, 1996. This is the period of time when the maximum gradient exists.

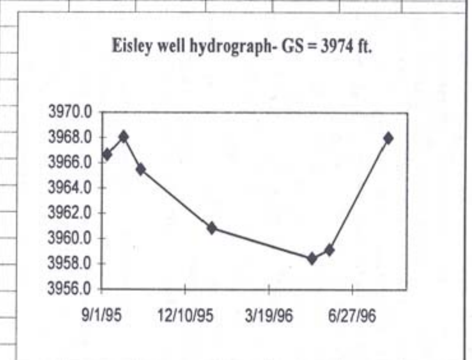
Figure 7 (September 1995) and Figure 14 (August 1996) illustrate maximum water-level conditions in late summer and early fall.

Table 1. Hydrographs and static water levels for the Fairfield area

Table 4. Hydrographs and static water levels for the Fairfield area (values in feet above mean sea level [MSL])

DATE	FF #1	FF #2	FF #3	FF #4	FF #5	FF #6	FF #7	Kind #1	Krause	Greenflds	Watson	Eisley	Diedrich	LDS	Schenk
9/7/95		3981.6		3990.3	3984.1					3979.4	3994.0	3966.6	3966.9	3972.2	
9/26/95	3983.9	3982.0	3970.9	3990.6	3981.7	3982.9		3984.9	3996.1	3979.0	3993.4	3968.0	3966.7	3971.9	3982.3
10/17/95	3983.5	3977.0	3970.4	3986.0		3980.3		3981.7	3995.0	3978.6	3989.0	3965.5	3965.3	3971.4	3979.2
1/10/96	3981.6	3976.0	3969.0	3979.3		3976.5		3975.4	3991.5	3977.3	3984.2	3960.8	3962.4	3970.3	3976.2
5/9/96		3973.0		3974.9				3972.9	3989.9	3977.3	3979.3	3958.4	3961.1		
5/30/96		3974.3		3977.8		3974.2	3976.9	3976.6	3992.0	3977.4	3983.8	3959.1	3963.0	3969.2	
8/8/96		3976.9		3989.8				3986.5	3997.8	3979.6	3993.5	3968.0	3967.3	3971.4	
MIN	3981.6	3973.0	3969.0	3974.9	3981.7	3974.2	3976.9	3972.9	3989.9	3977.3	3979.3	3958.4	3961.1	3969.2	3976.2
MAX	3983.9	3982.0	3970.9	3990.6	3984.1	3982.9	3976.9	3986.5	3997.8	3979.6	3994.0	3968.0	3967.3	3972.2	3982.3
CHANGE	2.3	9.0	1.9	15.7	2.4	8.6	0.0	13.6	7.8	2.3	14.8	9.6	6.2	2.9	6.1
GS elev.	3991.0	3986.0	3978.0	3995.0	3988.0	3989.0	3993.0	3995.0	4002.0	3986.0	4003.0	3974.0	3973.0	3979.0	3987.0





Estimates of aquifer characteristics were based on a long-term aquifer test of Fairfield well #6. Both drawdown and recovery were measured. An estimate of 20% porosity was used to calculate flow velocities. Aquifer thickness varies throughout the bench, but 18 feet was used for calculating hydraulic conductivity, K; Transmissivity, T, was estimated at 28,460 feet2/ day; and hydraulic conductivity was calculated at 1,580 feet/ day.

The hydraulic conditions governing aquifer sensitivity are conceptually illustrated in Figure 15. Setting 1 depicts maximum gradient conditions that are experienced when the irrigation canals are first filled in late spring. High water-level conditions, normally experienced in summer and early fall, are illustrated in Setting 2. And low water level conditions, which occur in late winter and early spring, are conceptualized as Setting 3. In terms of contaminant transport, the conditions that represent the greatest aquifer vulnerability are probably Setting 1 and Setting 2. High flow velocities, up to 158 feet per day for wells 4, 5, 6, and 7 and 32 feet per day for wells 1, 2, and 3, are associated with maximum gradient conditions (Setting 1), causing rapid contaminant transport. And during high water-level conditions (Setting 2), ground water may rise to less than four feet below ground surface, bringing ground water into direct contact with contaminants that may have migrated through the root zone and have not yet been photo-oxidized or biodegraded.

Time-of-travel estimates for the PWS wells were performed for each of Settings 1, 2, and 3. Darcy's Law was used in the calculations, and the results are presented graphically in figure 16, figure 17, and figure 18. Feet upgradient from the well is presented on the y-axis and the corresponding time of travel is read on the x-axis. Wells # 1, 2, and 3 were grouped because they responded similarly to gradient fluctuations. Likewise wells # 4, 5, 6, and 7 were grouped because measured gradients were identical for the four wells. Hydraulic gradients were determined from potentiometric contours and from known elevation differences between the main irrigation canals and the wells. Under maximum gradients and high water-level conditions, wells 4, 5, 6,and 7 demonstrate higher gradients and higher flow velocities than wells 1, 2, and 3, probably because of their close proximity to the Main Canal. During low water-level conditions all 7 wells experience similar hydraulic gradients and flow velocities, hence time-of-travel estimates are identical under Setting 3.

Estimates for down gradient stagnation points, and lateral boundary limits were performed using the Uniform Flow Equation,

$$-Y/X = \tan \left\{ \frac{27\pi Kbi}{Q} \right\} Y$$

re-arranging for stagnation point, XL,

$$XL = -\frac{Q}{27\pi Kbi}$$

and for the boundary limit, Y L.

$$YL = \pm \frac{Q}{2Kbi}$$

Figure 10 shows down-gradient stagnation points and lateral boundary limits for the wells and includes a table of calculated results for each of the wells.

Source well(s)

The Town of Fairfield uses water from 7 wells (Figure 1). Well-construction details are presented in table 5. Well logs are included in Appendix A.

Possible alternative sources

Drilling deeper for a different ground-water source is not a practical option for Fairfield because of the very poor water quality (high TDS) and low transmissivities usually associated with the underlying Cretaceous sediment. The only other possible aquifer, the Mississippian- age Madison Group, occurs at even greater depths than the Cretaceous (drilling depths from 1500 to 2200 feet [Feltis, 1980]). The Madison Formation is an aquifer in many regions of Montana, but its water here also contains very high levels of total dissolved solids. An alternative source of ground water would probably have to be imported from another watershed.

Surface water, possibly from the Sun River or Missouri River, may be a viable alternative for Fairfield. But because surface water usually requires extensive treatment, such as sedimentation, flocculation, filtration, and disinfection, the construction and operational costs are usually much higher than for ground water. A feasibility analysis, evaluating all possible alternative sources, should probably be performed for the Town.

The most practical option is the protection of the existing supply through source water protection and by management of the Protection Regions.

Table 2. **Well construction details for Fairfield public water supply wells**

Well	**Location**	**tract**	**GWIC#**	**drill date**	**TD bgs (MSL), ft.**	**Casing diam.**	**Top of p.i., ft MSL**	**Bottom Of p.i. ft. MSL**
#1	21N 03W 04	AADAA	M:75576	1945	22R (3969)	12'xI2' caisson, infilt. gallery	NA	NA
#2	21N 03W 03	BBAAB	M:76705	1951	22R (3964)	2 caissons @ 12'xI2'	3974	3964
#3	21N 03W 03	BAAA	M:6125	1962	32R (3946)	18" galv.	3968	3946
#4	21N 03W 03	CAAAA		?	24.8 (3970.2)	8' culvert	NA	NA
#5	21N 03W 03	BDBAD	M:75567	1980	39 (3948.6)	10"	3969	3964
#6	21N 03W 03	BDACD	M:75566	1980	40 (3948.9)	10"	3969	3964
#7	21N 03W 03	BDDDB	M:75565	1980	26.5 (3966)	10"	3971	3966

Note: R = reported value from well logs
TD = total depth in feet
bgs = below ground surface
MSL = mean sea level elevation
p.i. = perforated interval

Model or equation input parameters

The delineation methods reflect a combination of analytical methods and hydrogeologic mapping. Input parameters (table 3) were estimated from data derived during a long-term aquifer test (21 hrs.) on Fairfield well #6.

Table 3. **Equation input parameters / aquifer test data for Fairfield.**

PARAMETER	VALUE	UNITS	HOW DETERMINED
Porosity, (n)	20	%	estimated from well logs and Fetter, p. 68
Max. pumping rate, (Q)		gpm	
Well #1	350	(gal/min)	well log
Wel1 #2	100		well log
Well #3	85		well log
Well #4	190		well log
Well #5	85		well log
Well #6	105		measured during long-term pumping test
Well #7	100		well log
Aquifer thickness, (b)	18	ft.	estimated from well logs
Transmissivity, (T)	28, 460	ft^2/day	$T=\frac{2.30}{4\pi(h_o - h)}$ (Jacob Straight-Line Method, Fetter, p. 170)
Hydraulic Conductivity, (K)	1,580	ft./ day	K=T/b

Base map

The base maps were developed from scanned images of the 7.5-minute USGS topographic maps for the Fairfield quadrangle (1983), the Cleiv quadrangle (1983), and the Freezeout Lake quadrangle (1987).

Assumptions

It is assumed that estimated values for transmissivity, hydraulic conductivity, and porosity derived from a pump test on well #6, are similar for wells #1, #2, #3, #4, #5, and #7. Other assumptions include steady-state radial flow, aquifer homogeneity and isotropy, and constant withdrawals at maximum pumping rates.

Limiting factors

Specific limitations to this delineation include spatial variability in aquifer properties and possible errors in estimates of parameters, such as porosity. Variability in lithology and aquifer thickness also exists. Therefore, the aquifer is not homogenous or isotropic, and withdrawals vary over time.

Ground water under the direct influence of surface water (GUDISW)

Surface-water seepage from the irrigation canals is the major source of recharge to the terrace gravels. Of the total irrigation water input to the bench, about 40% is lost to canal seepage or wasted to drains. Fifty-two percent of on-farm irrigation water is lost to ground-water recharge (Osborne, 1983, p. 136).

The Department of Environmental Quality Preliminary Assessment of Ground Water Sources that may be under the Direct Influence of Surface Water (GUDISW) was used to evaluate the Fairfield municipal wells. All seven wells failed the preliminary assessment (40 points), indicating the possibility that the wells are under the direct influence of surface water. The reasons for failure were: poor well construction (e.g., grouting depths), shallow perforated intervals, shallow static water levels, or unknown well construction details. One well is an infiltration gallery, so 40 points are automatically assigned to the source.

The Montana Department of Environmental Quality (DEQ) performed microscopic particulate analyses on well #5 on May 28, 1996 and on well #2 on September 30, 1996. Microscopic particulate analyses (MPA) indicate the presence or absence of microorganisms (such as Crvptospiridium and Giardia lamblia) that may be found in ground water that is under the influence of surface water. The DEQ interpretation of the MPA results indicate that wells #5 and #2 are under extreme low risk of the introduction of microbes to ground water from surface water.

Inorganic water-quality data (Appendix Fairfield –2, available upon request) suggests that the relative proportion of dissolved constituents in the terrace gravels is virtually identical to that of water in the Greenfields Main Canal. The Stiff diagrams presented in Figure 19 show the relative proportions of major ions, such as sodium, calcium, magnesium, chloride, bicarbonate/carbonate, and sulfate. The shape of Stiff diagrams for water influenced by
Cretaceous sediments is distinctly different from the shape of Stiff diagrams of water from the terrace gravels and from the Greenfields Main Canal. Water in the terrace deposits and in the Greenfields Main Canal was a magnesium/calcium bicarbonate type. Water from Cretaceous or from mixed Cretaceous / terrace deposits was primarily a magnesium/ sodium bicarbonate type. The evidence suggests that water quality in the terrace gravels is strongly influenced by surface water.

Land-use activities appear to affect ground-water quality. The Water Center's Drinking Water Assistance Program sponsored Montana Department of Agriculture (MDA) sampling and analysis of herbicides commonly used on the Bench. MDA personnel performed sampling and analyses using MDA and EPA QA/QC protocol. The following analytical methods were used:

- EPA Method Number 515.2" Methods for the Determination of Organic Compounds in Drinking Water; Determination of Chlorinated Acids in Water

Using Liquid-Solid Extraction and Gas Chromatoeraphv with an Electron Capture Detector. Revision No. 1.0.

Analytes are:
Clopyralid, 5-Hydroxy-dicamba. 2,4,5-T,2,4-DB, Dinoseb, Picloram, Diclofop
Methyl, Dicamba, MCPP, MCPA, 2,4-DP, 2,4-D, Triclopyr, PCP, Silvex

- EPA Method Number 507 AMethods for the Determination of Organic Compounds in Drinking Water=: Determination of Nitrogen and Phosphorous - Containing Pesticides in Ground Water bv Gas Chromatographv with a Nitrogen-Phosphorous Detector, Revision No.2.

  Analytes are:
  EPTC, Metribuzin, Alachlor, Bromacil, Metolachlor, Carboxin, Hexazinon,
  Propachlor, Acetochlor, Tebuthiuron, Cycloate, Simazine, Prometon, Atrazine,
  Pronamide, Terbacil, Triallate, Chlorpyrifos, Dichlovos, Ethyl Parathion, Disuloton
  Sulfone, Disulfoton Sulfoxide, Oxydemeton Methyl, Demeton-S, Terbufos, Diazinon,
  Disulfoton, Methyl Parathion, Malathion
- American Cyanamid Co.=s AImazamethabenz-methvl Herbicide (CL 222.2931: HPLC Method for the Determination of CL 222.293 and CL 263.840 (acid metabolite}Residues in Soi1=. Report No. M-2159, 7/ 3/ 91 with in-house modifications for water residue analysis).
  Analytes are:
  Imazamethabenz-methyl (Assert) and Imazamethabenz-methyl (Assert acid metabolite).

Twelve wells were sampled for pesticides in May, July, and November 1996. Figure 20, Figure 21, Figure 22, and Figure 23 show the pesticide-sampling locations and table 7 summarizes the analytical results. Only those analytes that were detected in ground water are reported in the table. Pesticide concentrations were low and did not exceed Maximum Contaminant Levels (MCLs), Health Advisory Levels, or Interim Health Standards (listed below). Picloram is the only chemical with an MCL regulated through the Safe Drinking Water Act; Well #1 contained 0.36 µg/L of picloram. Well # 1 also contained Assert and Assert metabolite each time it was sampled.

- Interim Health Standards:
  Assert: 400 µg/L
  Clopyralid: 1,000 µg/L
- Health Advisory Level:
  Prometon: 100 f.1gj L
- Maximum Contaminant Level:
  Picloram: 500 µg/L

Inorganic water-quality data, pesticide monitoring data, and hydrogeologic evidence indicate that the Fairfield Bench Aquifer bears a direct hydraulic connection to surface water in the irrigation system. Although a direct hydraulic connection exists between surface water and ground water, results of the MPA suggest that natural flltration through the terrace deposits is sufficient to exclude the entry of some micro-organisms (especially protozoans commonly associated with surface water) to wells #2 and #5. But dissolved constituents in surface water are entering the ground-water flow system. Land-use activities in the recharge area for the Fairfield wells are affecting ground-water quality. The town is exploring the possibility of implementing land-use agreements or conservation easements in the management of the recharge area.

Table 4. Summary of Fairfield area pesticide sampling results, 1996, results in μg/ L (parts per billion)

Table 7. *Summary of Fairfield area pesticide sampling results, 1996,* results in μg/L (parts per billion)

Well	Assert				Assert Metabolite				Picloram				Prometon				Clopyralid			
date:	5/6	5/29	7/22	11/13	5/6	5/29	7/22	11/13	5/6	5/29	7/22	11/13	5/6	5/29	7/22	11/13	5/6	5/29	7/22	11/13
pws-1	0.86	0.87	3.3	1.1	5.0	4.2	7.5	2.2	0.36	nd	nd	nd	bdl	nd	nd	nd	nd	bdl	1.3	bdl
pws-2	ns	1.1	ns	ns	ns	5.0	ns	ns	ns	bdl	ns	ns	ns	0.40	ns	ns	ns	bdl	ns	ns
pws-3	bdl	bdl	nd	nd	bdl	bdl	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
pws-4	ns	nd	nd	nd	ns	nd	nd	nd	ns	nd	nd	nd	ns	nd	nd	nd	ns	nd	nd	nd
pws-5	bdl	nd	1.8	nd	bdl	nd	4.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
pws-6	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns
pws-7	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns
gf	0.80	1.1	1.8	nd	4.2	4.9	4.5	2.1	0.36	nd	nd	nd	0.47	bdl	0.34	bdl	bdl	nd	nd	nd
i	bdl	bdl	nd	nd	0.61	0.56	0.92	0.71	nd	nd	nd	nd	bdl	bdl	bdl	bdl	nd	nd	nd	nd
d.	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns
s	bdl	ns	ns	ns	bdl	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns	nd	ns	ns	ns
k 2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Note: **Sampling locations are within a one mile radius of the Town of Fairfield**

Explanation:

pws - Town of Fairfield public wells numerical designations
gf, i, d, s, k-2 - private wells
ns - not sampled
nd - no detections
bdl - detected below method detection (quantification) limits

CHAPTER 3
INVENTORY

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

Inventory Method

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

Step 1: Urban and agricultural land uses were identified from landcover data collected by the USGS.

Step 2: EPA's Envirofacts System was queried to identify EPA regulated facilities. This system accesses the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), Permit Compliance System (PCS), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility is a significant potential contaminant source.

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

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

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

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

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

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

Potential contaminant sources identified during the previous Fairfield SWP demonstration project to be considered in the inventory process included:

- Sunset Hills Cemetery
- Oakley Brothers trucking operation
- 3 Rivers Telephone warehouse
- Allen=s feedlot
- Roberts Brothers operation
- golf course area
- golf course grain field
- power poles w / transformers
- old dry cleaners
- Cenex warehouse
- houses in the Watson subdivision
- private septic systems
- buried drain ditches
- private residences

Inventory Results/ Control Zone

The most significant potential contaminant source in the control zones for wells 1, 2, and 3 are municipal sewer mains. The most significant potential contaminant source in the control zones for wells 4, 5, 6, and 7 is U.S. Highway 89.

Inventory Results/Inventory Region

Land cover within the Fairfield Inventory Region is predominantly cultivated cropland (Figure 24). Additional types and percentages of land cover/use are also presented on Figure 24. Municipal sewer mains underlie approximately 3% of the inventory region. Overall, the septic density in the inventory region is low at (Figure 25).

Significant potential contaminant sources in the inventory region are identified in Table 5 and indicated on Figure 24, Figure 25, Figure 26, and Figure 27. Other potential contaminant sources in the Fairfield vicinity are identified in Appendix C.

Table 5. Significant potential contaminant sources in the Fairfield Inventory Region

Significant Potential Contaminant Sources	Figure / Map ID#	Contaminants	Hazard
Cultivated Cropland	Figure 24	Nitrates, pathogens, SOCs	Contaminants could leach into area groundwater
U.S. Highway 89 **MT Highway 408**	Figure 26 #1 #2	VOCs, SOCs, and nitrates	Accidental spills in the vicinity of the wells could allow contaminants to leach into area groundwater serving the wells
Trucking Company	Figure 27	VOCs, metals	Contaminants could leach into area groundwater supplying
Golf Course	Figure 27	Nitrates, pathogens, herbicides, pesticides	Contaminants could leach into area groundwater serving the wells
Burlington Northern Santa Fe Railroad	Figure 26 #3	VOCs, SOCs, and nitrates	Accidental spills in the vicinity of the wells could allow contaminants to enter area groundwater
Municipal Sewer Mains	Figure 25	Nitrates and pathogens	Failure of older sewer lines or improperly designed, installed, and maintained sewer lines can impact area groundwater
Other Area Septic Systems	Figure 25	Nitrates and pathogens	Untreated effluent from malfunctioning tanks, piping, or drainfields, leaching into area groundwater may impact drinking water.
Closed Landfill	Figure 26 #4	VOCs, SOCs, metals, nitrates and pathogens	Contaminants could leach into area groundwater
USTs/LUSTs:	Figure 26 #5	VOCs	Existing contamination from spills, leaks, or improper handling of stored materials may impact the drinking water supply
Class V Injection Wells	Locations currently unknown	VOCs, SOCs, metals	Contaminants could leach into area groundwater

Cultivated Cropland – cultivated cropland including row crops, small grains, and fallow cropland cover approximately 72% of the inventory region. Nitrates, pathogens, and agricultural chemicals used on cultivated cropland may leach into area groundwater that supplies the Fairfield PWS.

U.S. Highway 89 and MT Highway 408 – these transportation routes are within the Fairfield well control zones and inventory region. Spills of fertilizers, pesticides, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs), could leach into area groundwater that supplies drinking water to the Fairfield PWS.

Trucking Company - this facility is located in the vicinity of Well #1. Accidental petroleum spills or other automotive fluids may leach into the groundwater supplying water to the well.

Golf Course – the golf course is located immediately upgradient of Wells #4, 5, 6, and 7. Nitrates in fertilizers and SOCs in pesticides and herbicides could leach into area ground water if over application occurs.

Burlington Northern Railroad Spur – an active portion of the railroad is located in the inventory region and runs past Fairfield wells #2, #4, #5, #6, and #7. Accidental spills could leach contaminants into groundwater that is utilized by these wells.

Municipal sewer mains – underlie approximately 3% of the inventory region. The sewer mains may constitute preferred contaminant migration pathways that allow contaminants to enter area groundwater that supplies drinking water to the Fairfield PWS.

Septic System Density – individual homes outside of Fairfield but within the inventory utilize on-site septic systems. If improperly maintained nitrates and pathogens could leach into area groundwater and impact drinking water.

Closed landfill - a closed landfill is located in the inventory region. Over time, contaminants may leach into area groundwater.

Underground storage tanks (USTs) and leaking underground storage tanks (LUSTs) - are located along the northern boundary of the inventory region. Spills or leaks from these USTs/ LUSTs may release contaminants to area groundwater that supplies drinking water to the PWS wells.

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

Inventory Results/ Surface Water Buffer

Figure 28 depicts the surface water buffer delineated for the Fairfield PWS. Land cover in the surface water buffer consists primarily of grasslands at 50% and cultivated cropland at 36% (Figure 29). Additional land use types and percentages are also identified on Figure 29. Overall, septic system density in the surface water buffer is low. No significant potential contaminant sources have been identified in the surface water buffer in addition to those already identified in the inventory region.

Inventory Results/Recharge Region

Land use within the Fairfield PWS Recharge Region consists mainly of grasslands and and agricultural land. Overall, septic density in the recharge region is low. No other significant potential contaminant sources were identified in addition to those in the inventory region.

Inventory Limitations

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

Inventory Update

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

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CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case Fairfield.

The goal of source water management is to protect the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources within the Inventory Region and 3) ensuring that land use activities in the Recharge Region pose minimal threat to the source water. Management priorities in the Inventory Region are determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches that could be pursued by Fairfield to reduce susceptibility are recommended.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers (Table 6). Barriers can be anything that decreases the likelihood that contaminated water will flow to the Fairfield wells.

Table 6. 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

Proximity or density of significant potential contaminant sources and the nature of contaminants determines hazard (Table 7). Point source hazard is also dependent on the health affects associated with potential contaminants. Hazard ratings for non-point sources are assigned based on criteria listed in Table 7 for septic systems, sanitary sewers, and cropped agricultural land.

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

Contaminant Source Type		High Hazard	Moderate Hazard	Low Hazard
SURFACE WATER	Point Sources of Nitrate or Microbes	Potential for direct discharge to source water	Potential for discharge to groundwater hydraulically connected to source water	Potential contaminant sources in the watershed region
SURFACE WATER	Point Sources of VOCs, SOCs, or Metals	Potential for direct discharge of large quantities from roads, rails, or pipelines	Potential for direct discharge of small quantities to source water	Potential for discharge to groundwater hydraulically connected to source water
WELLS	Point Sources of All Contaminants (Unconfined)	Within 1-year TOT	1 to 3 years TOT	Over 3 years TOT
WELLS	Point Sources of All Contaminants (Confined)	PWS well is not sealed through the confining layer	Well(s) in the inventory region other than the PWS well are not sealed through the confining layer	All wells in the inventory region are sealed through the confining layer
ALL	Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
ALL	Municipal Sanitary Sewer (% land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
ALL	Cropped Agricultural Land (% land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Table 8 identifies the individual hazard ratings for significant potential contaminant sources and each associated contaminant in the Fairfield Inventory Region.

Table 8. Hazard of significant potential contaminant sources for the Fairfield PWS Inventory Region

Significant Potential Contaminant Sources	Figure / Map ID#	Contaminants	Hazard	Hazard Rating
Cultivated Cropland	Figure 24	Agricultural chemicals, nitrates, and pathogens	Over-application or improper handling of agricultural chemicals; excessive irrigation causing transport of contaminants or sediments to groundwater/ surface water through runoff	High
U.S. Highway 89 **MT Highway 408**	Figure 26 #1 #2	VOCs, SOCs, nitrates, pathogens	Vehicle usage increases the risk for leaks or spills of fuels and other hazardous materials that may impact drinking water.	High

Significant Potential Contaminant Sources	Figure / Map ID#	Contaminants	Hazard	Hazard Rating
Trucking Company	Figure 26	VOCs, SOCs, metals	Spills, leaks, or improper handling of automotive fluids, solvents, and repair materials during transportation, use, storage and disposal may impact area groundwater	High
Golf Course	Figure 27	SOCs, nitrates and pathogens	Over-application or improper handling of pesticides or fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants to groundwater or surface water through surface runoff	High
Burlington Northern Railroad	Figure 26 #3	VOCs, SOCs, nitrates	Rail transport increases the risks for leaks or spills of fuels and other hazardous materials that may impact drinking water. Over application or improper handling of pesticides adjacent to tracks may impact drinking water	High
Municipal Sewer Main	Figure 8	Nitrates and pathogens	Failure of older sewer lines or improperly designed, installed, and maintained, sewer lines can impact drinking water.	Low
Other Area Septic Systems	Figure 25	Nitrates and pathogens	Untreated effluent from malfunctioning tanks, piping, or drain field leaching into area groundwater	Low
Closed Landfill	Figure 26 #4	VOCs, SOCs, metals, nitrates, and pathogens	Contaminants may leach into groundwater over time and impact area groundwater	Low
USTs/LUSTs	Figure 26 #5	VOCs	Spills, leaks, or improper handling of stored fuel may impact drinking water	Low
Class V Injection Wells	Locations are currently unknown	VOCs, SOCs, metals	Not Evaluated	Unknown at this time

Table 8. Hazard of significant potential contaminant sources for the Fairfield PWS Inventory Region

Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant. The susceptibility of each well to each potential contaminant source is assessed separately. Table 9 displays the susceptibility assessment results for each significant potential contaminant source in the Fairfield PWS Inventory Region.

Table 9. Susceptibility assessment for significant potential contaminant sources in the Inventory Region						
Contaminant Source	**Contaminant**	**Hazard**	**Hazard Rating**	**Barriers**	**Susceptibility**	**Management Recommendations**
Cultivated Cropland	Agricultural chemicals, Nitrates, and pathogens	Over-application or improper handling of agricultural chemicals; excessive irrigation causing transport of contaminants or sediments to groundwater/ surface water through runoff	High	None	Very High	Encourage area producers to use Best Management Practices (BMPs).
U.S. Highway 89 and MT Highway 408	VOCs, SOCs, nitrates, pathogens	Vehicle usage increases the risk for leaks or spills of fuels and other hazardous materials that may impact drinking water.	High	None	Very High	Emergency planning, training of local emergency response personnel, use of levees and engineered storm drainage to carry any spills away and prevent infiltration into ground, cooperation with railroad managers or MDOT to reduce herbicide use.
Trucking Company	VOCs, metals	Spills, leaks, or improper handling of automotive fluids, solvents, and repair materials during transportation, use, storage and disposal may impact area groundwater	High	None	Very High	Encourage pollution prevention education; training in waste reduction, handling, and recycling; promote good housekeeping. Schedule days for the collection of hazardous wastes from the public.
Golf Course	SOCs, nitrates and pathogens	Over-application or improper handling of pesticides or fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants to groundwater or surface	High	None	Very High	Encourage golf course operators to use BMPs

Table 9. Susceptibility assessment for significant potential contaminant sources in the Inventory Region						
Contaminant Source	**Contaminant**	**Hazard**	**Hazard Rating**	**Barriers**	**Susceptibility**	**Management Recommendations**
		water through surface runoff				
Burlington Northern/ Santa Fe Railroad	VOCs, SOCs, nitrates	Rail transport increases the risks for leaks or spills of fuels and other hazardous materials that may impact drinking water. Over application or improper handling of pesticides adjacent to tracks may impact drinking water	High	Company emergency spill response plan	High	Contact the railroad company to determine the emergency spill response procedures that will be conducted in the event a railroad accident occurs. Implement an emergency spill response plan for Fairfield to follow in the event the drinking water becomes threatened.
Municipal Sewer Mains	Nitrates and pathogens	Failure of older sewer lines or improperly designed, installed, and maintained, sewer lines can impact area drinking	Low	None	Moderate	Maintenance, rehabilitation, or replacement of existing sewer mains, use of sewer main liners, rapid response planning for leaks or ruptures.
Area Septic Systems	Nitrates and pathogens	Untreated effluent from malfunctioning tanks, piping, or drain field leaching into area groundwater	Low	None	Moderate	Encourage area septic tank owners to periodically inspect their septic systems and conduct regular maintenance
Closed Landfill	VOCs, SOCs, nitrates, pathogens	Contaminants leaching into groundwater	Low	Properly closed in 1992; covered with 2 feet of clay soil and revegetated	Very Low	Periodically inspect the site to ensure that the clay soil cover is in tact.
USTs/ LUSTs	VOCs	Spills, leaks, or improper handling of stored fuel may impact drinking water	Low	Secondary containment, leak detection, spill site	Very Low	Review permit status, encourage operators to properly operate and maintain tanks, implement emergency planning , training of

Table 9. Susceptibility assessment for significant potential contaminant sources in the Inventory Region						
Contaminant Source	**Contaminant**	**Hazard**	**Hazard Rating**	**Barriers**	**Susceptibility**	**Management Recommendations**
				remediation		local emergency response personnel, groundwater monitoring, spill prevention, and BMPs
Class V Injection Well	VOCs, SOCs, metals	Discharge contaminants into area groundwater	Unknown at this time	Not evaluated	Unknown at this time	Work with EPA to identify locations and appropriate response

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

Cultivated Cropland - Hazard is ranked high for potential contamination from cultivated cropland as it covers approximately 72% of the inventory region. The overall susceptibility is very high, as no barriers to contamination were identified.

U.S. Highway 89 and MT Highway 408 - Hazard is ranked high due to the proximity of these transportation routes to the wells. Overall, the susceptibility is very high no barriers to contamination were identified.

Trucking Company – Hazard is rank high, especially due to the company's proximity to Well #1. Overall, the susceptibility is very high as no barriers to contamination were identified.

Golf Course – Hazard is ranked high, as the golf course is located in the inventory region upgradient of the PWS wells. Overall, the susceptibility is very high as no barriers to contamination were identified.

Burlington Northern/ Santa Fe Railroad – Hazard is ranked high due to the proximity of the active portion to the PWS wells. Overall, the susceptibility is very high as no barriers to contamination were identified.

Municipal sewer mains – Hazard is ranked low because sewer mains underlie only 3% of the inventory region. Overall, the susceptibility is moderate, as no barriers to contamination were identified.

Area Septic Systems - Hazard is ranked low for potential contamination from area septic systems. The overall susceptibility is moderate, as no barriers to contamination were identified.

Closed Landfill – Hazard is ranked low to this potential contaminant source. Overall the susceptibility is very low as multiple barriers to contamination were identified. The landfill was closed according to DEQ specifications in 1992. The site was covered with two feet of clay soil and was re-vegetated.

USTs/LUSTs – Hazard is ranked low from USTs/LUSTs. Overall, the susceptibility is very low, as multiple barriers to contamination including secondary containment, leak detection, and site remediation were identified.

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

Management Recommendations

The Fairfield PWS Source Water Delineation and Assessment Report was prepared to assist the Fairfield PWS. The report provides information concerning the seven wells that supply water to Fairfield, identifies the control zones, inventory region, surface water buffer, and the recharge region, and within each of these protection areas identifies the significant potential contaminants that may impact the source of water drinking water to Fairfield. Also provided in the table are recommendations regarding how the potential contaminants could be better managed to prevent impacts in the vicinity of the Fairfield wells. If these management recommendations are implemented, they may be considered additional barriers that will reduce the susceptibility of Fairfield's PWS wells to specific sources and contaminants.

Management recommendations fall into the following categories:

Municipal Sewer maintenance and leak detection. Early leak detection and scheduled replacement of older sewer lines will reduce the susceptibility of the wells to contamination from sanitary wastes.

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

Sewage disposal system maintenance and leak detection – Proper maintenance of septic tanks and pipes leading to the drain fields will reduce the susceptibility of the Fairfield PWS wells to contamination from sanitary wastes. Installation of advanced treatment septic systems such as sand filters can limit contamination from new rural residential development.

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

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

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

Emergency Response Plan. If one does not already exist, Fairfield should develop and implement an emergency response plan. Coordination with county and state emergency response personnel would greatly benefit the plan. The plan should identify the procedures the water operators and other emergency personnel should follow in the event that there is an imminent threat that the contaminated water would reach the PWS wells. The emergency response plan should be updated annually to reflect changes in emergency contacts, phone numbers, and resources available within the city and county to respond to an emergency situation that may impact the drinking water supply.

CHAPTER 5
Monitoring Waivers

Monitoring Waiver Requirements

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

Use Waivers

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

Susceptibility Waivers

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

Given the wide range of landforms, land uses, and the diversity of groundwater and surface water sources across the state, additional information is often required during the review of a waiver application. Additional information may include 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. Review of an organic chemical monitoring waiver application will be conducted by DEQ’s PWS Section and DEQ’s Source Water Protection Program. Other state agencies may be asked for assistance.

Susceptibility Waiver for Confined Aquifers

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

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

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

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

Susceptibility Waiver for Unconfined Aquifers

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

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

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

Waiver Recommendation

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

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GLOSSARY*

Acute Health Effect. A negative health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

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

Barrier. A physical feature or management plan that reduces the likelihood of contamination of a water source from a potential contaminant source

Best Management Practices (BMPs). Methods for various activities that have been determined to be the most effective, practical means of preventing or reducing non-point source pollution.

Biennial Reporting System (BRS). An EPA database that contains information on hazardous waste sites. The data can be accessed through the EPA Envirofacts website.

Chronic Health Effect. A negative health effect in which symptoms develop over an extended period of time.

Class V Injection Well. Any pit or conduit into the subsurface for disposal of waste waters. The receiving unit for an injection well typically represents the aquifer, or water-bearing interval.

Coliform Bacteria. A general type of bacteria found in the intestinal tracts of animals and humans, and also in soils, vegetation and water. Their presence in water is used as an indicator of pollution and possible contamination by pathogens.

Community. A town, neighborhood or area where people live and prosper.

Comprehensive Environmental Cleanup and Responsibility Act (CECRA). Passed in 1989 by the Montana State Legislature, CECRA provides the mechanism and responsibility to clean up hazardous waste sites in Montana.

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

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

Confined Animal Feeding Operation (CAFO). Any agricultural operation that feeds animals within specific areas, not on rangeland. Certain CAFOs require permits for operation.

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

Confining Unit. A geologic formation present above a confined aquifer that inhibits the flow of water and maintains the pressure of the ground water in the aquifer. The physical properties of a confining unit may range from a five-foot thick clay layer to shale that is hundreds of feet thick.

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

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

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

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

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

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

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

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

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

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

Large Capacity Septic System. Defined by Underground Injection Control regulations as an on-site septic system serving 20 or more persons.

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

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

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

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

National Pollutant Discharge Elimination System (NPDES). A national permitting system that utilizes a database to track entities that discharge wastewater into waters of the United States.

Nitrate. An important plant nutrient and type of inorganic fertilizer that can be a potential contaminant in water at high concentrations. In water the major sources of nitrates are wastewater treatment effluent, septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of these chemicals into surface and/or ground waters at increased levels that may exceed MCLs.

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

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

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

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

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

Permit Compliance System (PCS). An EPA database that provides information on the status of required permits for specific activities for specific facilities. The data can be accessed through the EPA Envirofacts website.

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

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

Recharge Region. An area in which water is absorbed that eventually reaches the zone of saturation in one or more aquifers. As a source water management region, the term generally describes the entire area that could contribute water to an aquifer used by a public water supply. Includes areas that could contribute water over long time periods or under different water usage patterns.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Toxic Release Inventory (TRI). An EPA database that compiles information about permitted industrial releases of chemicals to air and water. Information about specific sites can be obtained through the EPA Envirofacts website.

Transmissivity. A number that describes the ability of an aquifer to transmit water. The transmissivity is determined by multiplying the hydraulic conductivity time the aquifer thickness.

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

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

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

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

Watershed. The region drained by, or contributing water to, a stream, lake, or other water body of water.

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

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

The definitions for Phase II and Phase V Rules were adapted from:
http://www.epa.gov/OGWDW/source/therule.html#PhaseII
http://www.epa.gov/OGWDW/source/therule.html#PhaseV

The definition for Standard Industrial Classification Code was adapted from:
EPA/Office of Enforcement and Compliance Assurance: Guide to Environmental Issues: Glossary of Terms & Acronyms *Term Detail*

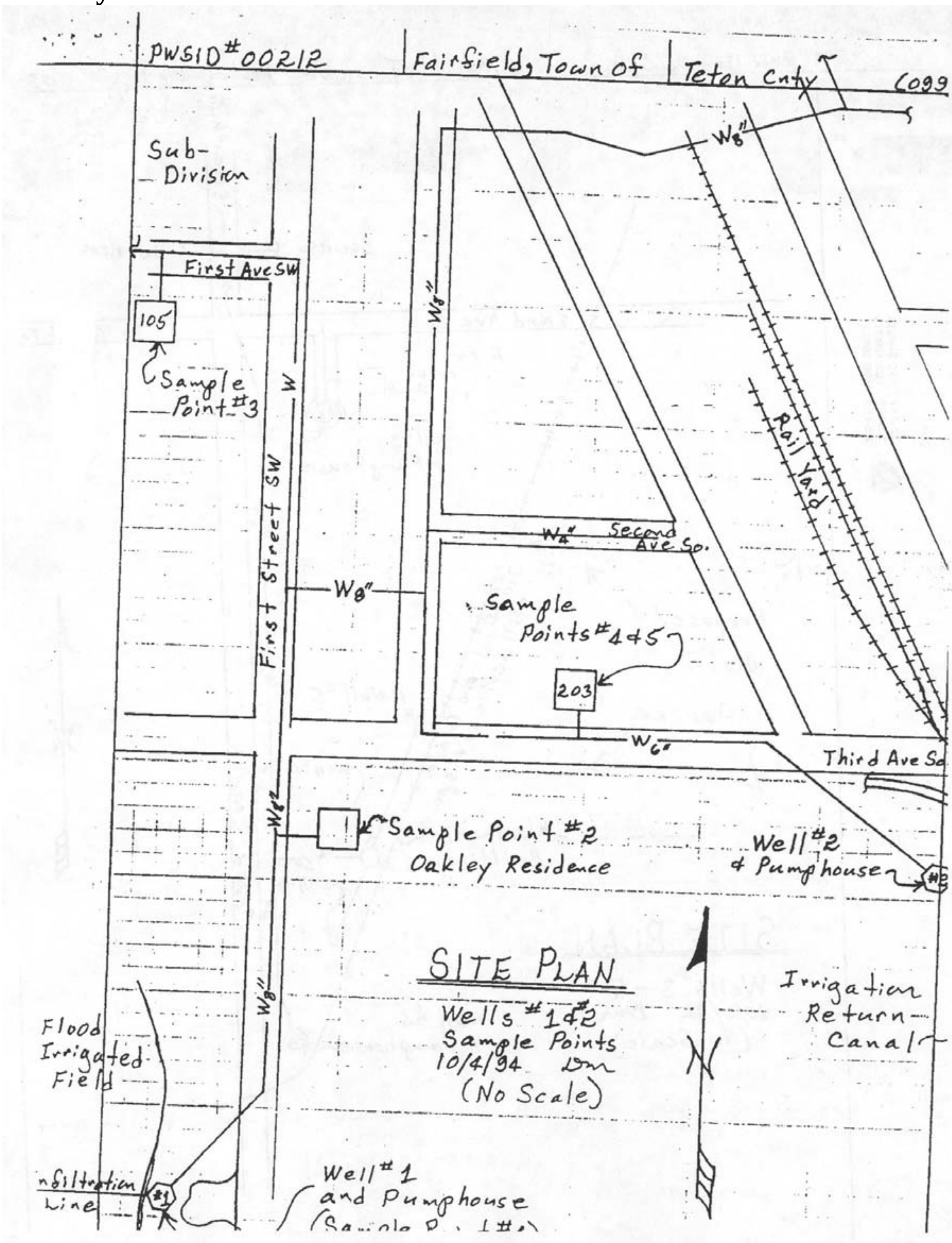
APPENDICES

Appendix A: Well Site Plans
Appendix B: Well Logs
Appendix C: Other Potential Contaminant Sources
Appendix D: Concurrence Letter

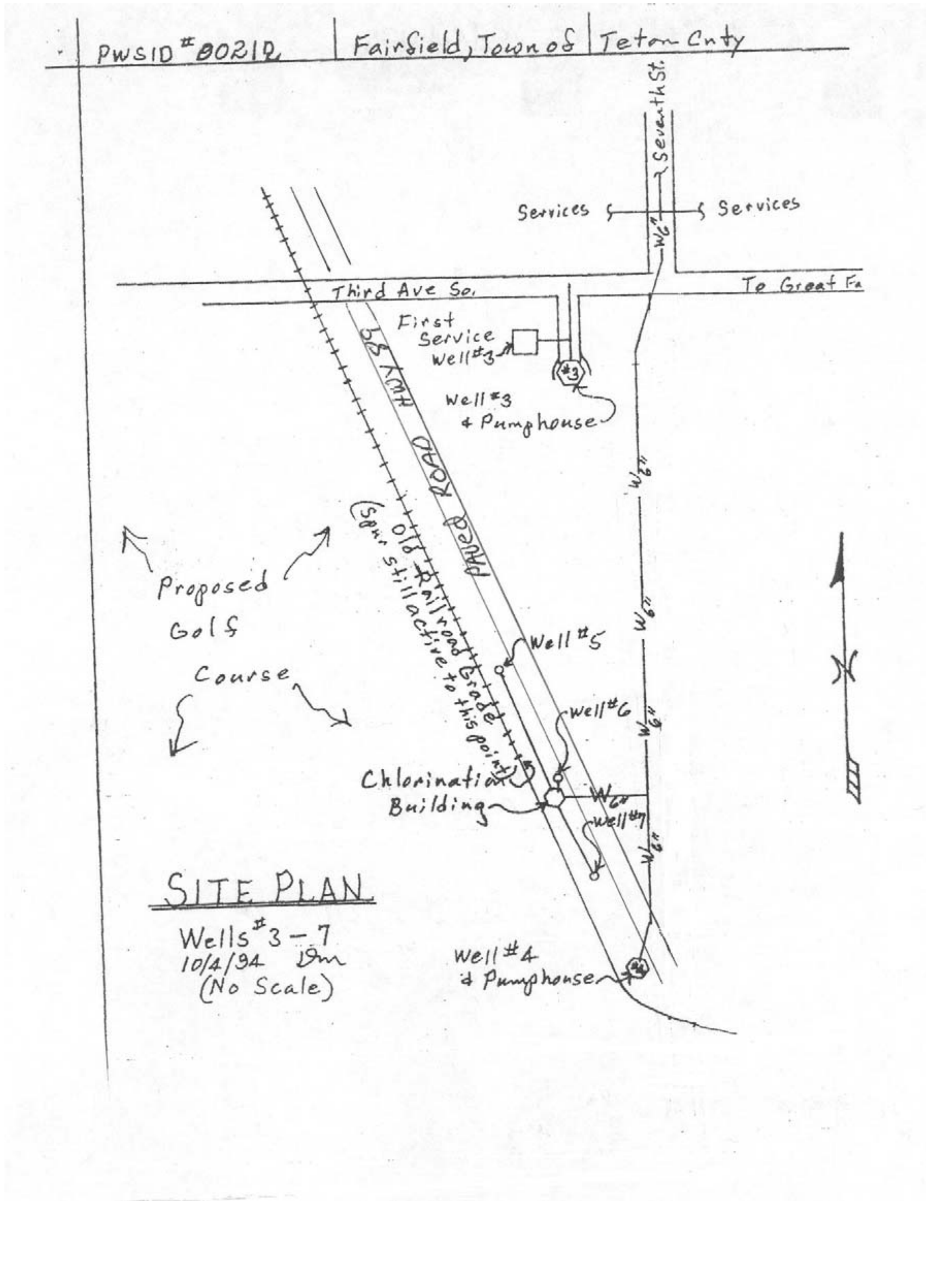
APPENDIX A

WELL SITE PLANS

Site Layout Wells 1 & 2



Site Layout Wells 3 -7



APPENDIX B

WELL LOGS

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

Plot this site on a topographic map

Location Information

GWIC Id:	75576	Source of Data:	COMBO
Location (TRS):	21N 03W 04 AADC	Latitude (dd):	47.6099
County (MT):	TETON	Longitude (dd):	-111.9877
DNRC Water Right:	W001976-00	Geomethod:	MAP
PWS Id:	00212002	Datum:	NAD27
Block:		Altitude (feet):	3095.00
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	22.00	How Drilled:	DRAGLINE
Static Water Level (ft):	12.00	Driller's Name:	UNKNOWN
Pumping Water Level (ft):		Driller License:	
Yield (gpm):	500.00	Completion Date (m/d/y):	1/1/1945
Test Type:		Special Conditions:	
Test Duration:		Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	Not Reported
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY
Well Notes:			

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	22.0	14.0				CONCRETE

Annular Seal Information

No Seal Records currently in GWIC.

Completion Information[1]

No Completion Records currently in GWIC.

Lithology Information

No Lithology Records currently in GWIC.

1- All diameters reported are **inside** diameter of the casing.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
CITY OF FAIRFIELD – WELL 2

Plot this site on a topographic map
View Water Quality for this Site

Location Information

GWIC Id:	76705	Source of Data:	GW4/QW
Location (TRS):	21N 03W 03 BBAA	Latitude (dd):	47.6106
County (MT):	TETON	Longitude (dd):	-111.9795
DNRC Water Right:	W001977-00	Geomethod:	TRS-TWN
PWS Id:	00212003	Datum:	NAD27
Block:		Altitude (feet):	3975.00
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	22.00	How Drilled:	
Static Water Level (ft):	12.00	Driller's Name:	
Pumping Water Level (ft):		Driller License:	
Yield (gpm):	350.00	Completion Date (m/d/y):	6/15/1951
Test Type:	PUMP	Special Conditions:	
Test Duration:		Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	110ALVM
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY
Well Notes:			

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	22.0	0.0				CONCRETE

Annular Seal Information

No Seal Records currently in GWIC.

Completion Information[1]

From	To	Dia	# of Openings	Size of Openings	Description
12.0	22.0	0.0			CONCRETE PERFS

Lithology Information

From	To	Description
0.0	2.0	LOAM
2.0	2.5	CEMENTED GRAVEL
2.5	20.0	FINE GRAINED WATER BEARING GRAVEL
20.0	38.0	YELLOW SHALE
38.0	60.0	GRAY SHALE

1- All diameters reported are **inside** diameter of the casing.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
TOWN OF FAIRFIELD WELL 03

Plot this site on a topographic map
View Water Quality for this Site

Location Information

GWIC Id:	6125	Source of Data:	LOG
Location (TRS):	21N 03W 03 BBAA	Latitude (dd):	47.6110
County (MT):	TETON	Longitude (dd):	-111.9828
DNRC Water Right:	W001978-00	Geomethod:	MAP
PWS Id:	00212004	Datum:	NAD27
Block:		Altitude (feet):	3979.00
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	32.00	How Drilled:	ROTARY
Static Water Level (ft):	8.00	Driller's Name:	COLQUITT
Pumping Water Level (ft):	12.00	Driller License:	WWC131
Yield (gpm):	330.00	Completion Date (m/d/y):	5/1/1962
Test Type:	PUMP	Special Conditions:	
Test Duration:	48.00	Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	110TRRC
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY
Well Notes:			

Hole Diameter Information

From	To	Diameter
0.0	32.0	24.0

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	32.0	18.0				STEEL

Annular Seal Information

No Seal Records currently in GWIC.

Completion Information[1]

From	To	Dia	# of Openings	Size of Openings	Description
10.0	32.0	18.0			1IN SLIT PERFS

Lithology Information

From	To	Description
0.0	4.0	TOP SOIL
4.0	9.0	BOULDERS AND GRAVEL
9.0	21.0	GRAVEL
21.0	32.0	YELLOW CLAY

1 – All diameters reported are **inside** diameter of the casing.

These data represent the contents of the GWIC databases at the Montana Bureau of Mines and Geology at the time and date of the retrieval. The information is considered unpublished and is subject to correction and review on a daily basis. The Bureau warrants the accurate transmission of the data to the original end user. Retransmission of the data to other users is discouraged and the Bureau claims no responsibility if the material is retransmitted. Note: non-reported casing, completion, and lithologic records may exist in paper files at GWIC.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
CITY OF FAIRFIELD – WELL 4

[Plot this site on a topographic map]

Location Information

GWIC Id:	171379	Source of Data:	COMBO
Location (TRS):	21N 03W 03 CAAA	Latitude (dd):	47.6037
County (MT):	TETON	Longitude (dd):	-111.9966
DNRC Water Right:	W001979-00	Geomethod:	UNKNOWN
PWS Id:	00212005	Datum:	NAD27
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	25.00	How Drilled:	
Static Water Level (ft):		Driller's Name:	
Pumping Water Level (ft):		Driller License:	
Yield (gpm):	200.00	Completion Date (m/d/y):	5/9/1967
Test Type:		Special Conditions:	
Test Duration:		Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	Not Reported
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY

Well Notes: DATA FROM DEQ REPORT AND DNRC

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	25.0	8.0				

Annular Seal Information

No Seal Records currently in GWIC.

Completion Information[1]

No Completion Records currently in GWIC.

Lithology Information

No Lithology Records currently in GWIC.

1- All diameters reported are **inside** diameter of the casing.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
CITY OF FAIRFIELD – WELL 5

Plot this site on a topographic map
View Water Quality for this Site

Location Information

GWIC Id:	75567	Source of Data:	LOG
Location (TRS):	21N 03W 03 BCBA	Latitude (dd):	47.6074
County (MT):	TETON	Longitude (dd):	-111.9791
DNRC Water Right:	K027211-00	Geomethod:	MAP
PWS Id:	00212006	Datum:	NAD27
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	40.00	How Drilled:	FORWARD ROTARY
Static Water Level (ft):	10.00	Driller's Name:	BILLMAYER
Pumping Water Level (ft):	17.00	Driller License:	WWC335
Yield (gpm):	200.00	Completion Date (m/d/y):	9/3/1980
Test Type:	PUMP	Special Conditions:	
Test Duration:	24.00	Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	110ALVM
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY
Well Notes:			

Hole Diameter Information

From	To	Diameter
0.0	40.0	10.0

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	19.0	10.0				STEEL
0.0	40.0	10.0				STEEL
24.0	39.0	9.0				STEEL

Annular Seal Information

From	To	Description
0.0	1.0	CEMENT

Completion Information[1]

From	To	Dia	# of Openings	Size of Openings	Description
19.0	24.0	9.0			SCREEN

Lithology Information

From	To	Description
0.0	4.0	TOPSOIL
4.0	12.0	CLAY AND GRAVEL
12.0	24.0	SAND- GRAVEL- WATER
24.0	39.0	BROWN CLAY AND SILT
39.0	40.0	SHALE

1- All diameters reported are **inside** diameter of the casing.

These data represent the contents of the GWIC databases at the Montana Bureau of Mines and Geology at the time and date of the retrieval. The information is considered unpublished and is subject to correction and review on a daily basis. The Bureau warrants the accurate transmission of the data to the original end user. Retransmission of the data to other users is discouraged and the Bureau claims no responsibility if the material is retransmitted. Note: non-reported casing, completion, and lithologic records may exist in paper files at GWIC.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
CITY OF FAIRFIELD – WELL 6

[Plot this site on a topographic map]

Location Information

GWIC Id:	75566	Source of Data:	LOG
Location (TRS):	21N 03W 03 BCCA	Latitude (dd):	47.6062
County (MT):	TETON	Longitude (dd):	-111.9781
DNRC Water Right:	K027211-00	Geomethod:	MAP
PWS Id:	00212007	Datum:	NAD27
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	40.00	How Drilled:	FORWARD ROTARY
Static Water Level (ft):	11.00	Driller's Name:	BILLMAYER
Pumping Water Level (ft):	13.00	Driller License:	WWC335
Yield (gpm):	190.00	Completion Date (m/d/y):	9/4/1980
Test Type:	PUMP	Special Conditions:	
Test Duration:	8.00	Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	Not Reported
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY
Well Notes:			

Hole Diameter Information

From	To	Diameter
0.0	40.0	10.0

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	40.0	10.0				
25.0	40.0	9.0				

Annular Seal Information

From	To	Description
0.0	1.0	CEMENT

Completion Information[1]

From	To	Dia	# of Openings	Size of Openings	Description
20.0	25.0	9.0			SCREEN

Lithology Information

From	To	Description
0.0	5.0	TOPSOIL
5.0	15.0	SAND- GRAVEL AND CLAY
15.0	20.0	SAND- GRAVEL- WATER
20.0	24.0	SAND- GRAVEL- WATER
24.0	39.0	BROWN CLAY
39.0	40.0	SHALE

1- All diameters reported are **inside** diameter of the casing.

These data represent the contents of the GWIC databases at the Montana Bureau of Mines and Geology at the time and date of the retrieval. The information is considered unpublished and is subject to correction and review on a daily basis. The Bureau warrants the accurate transmission of the data to the original end user. Retransmission of the data to other users is discouraged and the Bureau claims no responsibility if the material is retransmitted. Note: non-reported casing, completion, and lithologic records may exist in paper files at GWIC.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
CITY OF FAIRFIELD – WELL 7

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

Location Information

GWIC Id:	75565	Source of Data:	LOG
Location (TRS):	21N 03W 03 BCDC	Latitude (dd):	47.6050
County (MT):	TETON	Longitude (dd):	-111.9774
DNRC Water Right:	K027211-00	Geomethod:	MAP
PWS Id:	00212008	Datum:	NAD27
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	43.00	How Drilled:	FORWARD ROTARY
Static Water Level (ft):	9.00	Driller's Name:	BILLMAYER
Pumping Water Level (ft):	12.00	Driller License:	WWC335
Yield (gpm):	180.00	Completion Date (m/d/y):	9/5/1980
Test Type:	PUMP	Special Conditions:	
Test Duration:	9.00	Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	110ALVM
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY
Well Notes:			

Hole Diameter Information

From	To	Diameter
0.0	43.0	10.0

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	43.0	10.0				STEEL
14.6	26.5	9.0				STEEL

Annular Seal Information

From	To	Description
0.0	1.0	CEMENT

Completion Information[1]

From	To	Dia	# of Openings	Size of Openings	Description
21.5	26.5	9.0			SCREEN

Lithology Information

From	To	Description
0.0	4.0	TOPSOIL
4.0	14.0	GRAVEL AND GRAY CLAY
14.0	18.0	SAND- GRAVEL- WATER
18.0	26.0	SAND- GRAVEL- WATER
26.0	41.0	BROWN CLAY
41.0	43.0	SHALE

1- All diameters reported are **inside** diameter of the casing.

Appendix C

Other Potential Contaminant Sources

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

Other Potential Contaminant Sources In Fairfield

NAME	ADDRESS	CITY	STATE	ZIP	LATITUDE	LONGITUDE
A M Construction Llc	2144 US Highway 89	Fairfield	MT	59436-9341	47.663640	-112.00728
A W Trucking	291 8th Ln SW	Fairfield	MT	59436-9430	47.581080	-112.15680
Allen's Feedlot	631 Rust Allen	Fairfield	MT	59436	47.663220	-111.92346
Anderson Taxidermy	31 5th Ln NE	Fairfield	MT	59436-9223	47.628720	-111.88038
B & D Construction	636 1st Rd NE	Fairfield	MT	59436-9135	47.625360	-111.83562
Baer's Construction	35 W Division	Fairfield	MT	59436-9302	47.611560	-111.99258
Batson Photography		Fairfield	MT	59436	47.663220	-111.92346
Busch Agricultural Resources	223 W Main St	Fairfield	MT	59436	47.663220	-111.92346
Dirkes Chevrolet Pontiac Olds	503 Central Ave	Fairfield	MT	59436	47.614920	-111.98016
Ervin A Baeth Construction	671 1st Rd NE	Fairfield	MT	59436-9135	47.625420	-111.83562
Fairfield Airport		Fairfield	MT	59436	47.663220	-111.92346
Fairfield Fire Dept		Fairfield	MT	59436	47.663220	-111.92346
Fairfield Mini Storage		Fairfield	MT	59436	47.663220	-111.92346
Hager's Cremation & Memorial		Fairfield	MT	59436	47.663220	-111.92346
Harvest Hills Golf Course	US HIGHWAY 89	Fairfield	MT	59436	47.663220	-111.92346
K's Auto Parts	414 Central Ave	Fairfield	MT	59436	47.614920	-111.98118
L A Auction Co	86 S Division	Fairfield	MT	59436-9361	47.640660	-111.95556
Meyer Ditcher Mfg	10 1st Rd NW	Fairfield	MT	59436-9305	47.640660	-111.95556
Meyer Ditcher Mfg	90 W Division	Fairfield	MT	59436	47.611500	-111.99864
Mills Motor Co	302 Central Ave	Fairfield	MT	59436	47.614920	-111.98280
Mountain View Soil Svc Ctr	PO BOX 271	Fairfield	MT	59436-0271	47.663220	-111.92346
Mountian View Co-Op	Main St & US Hwy 89	Fairfield	MT	59436	47.663220	-111.92346
Oakley Brothers Trucking	10 S Division	Fairfield	MT	59436	47.663220	-111.92346
Swimming Pool		Fairfield	MT	59436	47.663220	-111.92346
Teton County Road Dept		Fairfield	MT	59436	47.663220	-111.92346
Treasure State Seed Co	6 1st St SW	Fairfield	MT	59436	47.640660	-111.95556

Appendix D

Concurrence Letter

RECEIVED
JUN 1 0 2004
D.E.Q.

Source Water Protection Section
Department of Environmental Quality
P.O. Box 200901
Helena, MT 59602-0901

RE: Source Water Delineation & Assessment Report

Dear Carolyn:

The Fairfield Public Water System (PWS) has reviewed the Source Water Delineation and Assessment Report (SWDAR) dated June 3, 2004. We concur that the delineation component appears to describe current conditions at the water system based on reasonably available information and that the susceptibility assessment identifies the origins of regulated contaminants to the extent practical.

We understand that the Fairfield PWS SWDAR will be made available to the public by DEQ as described in the Montana Source Water Protection Program. Also, we will make a copy of the report available for the public to view during our normal office hours and describe the results in subsequent releases of our consumer confidence report.

Signed,
Robert L. Stewart

Superintendent 6/8/04 ←Title Date

Lillian I. Alfson Mayor 6/08/04 ←Title Date