

Palisades Apartments

PWSID # MT0000145

Source Water Delineation and Assessment Report

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INTRODUCTION

This Source Water Delineation and Assessment Report, also known as a SWDAR, was completed by Jim Stimson, Hydrogeologist with Montana Department of Environmental Quality (DEQ) and by intern Shonna Jorgensen.

Purpose

This report is intended to meet the technical requirements for completion of the delineation and assessment report 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 whereby areas that contribute water to aquifers or surface water bodies that are used to supply drinking water are identified on a map. These areas are called source water protection areas. Assessment involves identifying locations in the delineated 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 Palisades Apartments protect its drinking water sources.

Limitations

This report was prepared to assess threats to the Palisades Apartments public water system 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 Palisades Apartments public water system and not any other public or private water system. Also, not all of the potential or existing sources of ground water or surface water contamination in the area are identified. Only potential sources of contamination in areas that contribute water to Palisades Apartments public water system wells are considered.

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

CHAPTER 1 - BACKGROUND

The Community

Approximately 60 people reside year-round in a single apartment building consisting of 40 apartments. There is one active service connection. Palisades Apartments are located near Miles City, across the Yellowstone River and downstream approximately $\frac{3}{4}$ of a mile (Figure 1). The U.S. Census Bureau estimates the 2000 population of Custer County at 11,372 people, 8,698 of whom reside in Miles City. Custer County's population, as well as Miles City's, has increased by about 1%, since 1990.

There are 15 other public water supplies in the area of which 4 are community systems and the remaining 10 are non-community (Table 1). Five of the 15 public water supplies purchase water from Miles City and the remainder, like the Palisades Apartments, use groundwater as their source of water.

Table 1. Public Water Supplies in the Miles City area.

PWSID	CLASS	SOURCETYPE	PRIMRYNAME
03041	C	Purchased	Custer Co Water and Sewer District
00291	C	Surface Water	Miles City, City of
00145	C	Groundwater	Palisades Apartments
00292	C	Purchased	Pine Hills Youth Correct Facil
00139	C	Groundwater	Valley Drive Mobile Home Park
01187	N	Groundwater	Airport Inn
03382	N	Purchased	Albertsons #2039
01186	N	Groundwater	Alta Club
02918	N	Groundwater	Big Sky Camp and RV Park
03819	N	Purchased	Cascade Pure Water Service
03739	N	Purchased	County Market
01192	N	Groundwater	Flying J Restaurant
01193	N	Groundwater	Gingham Lady Motel
01196	N	Groundwater	Star Motel
03802	N	Groundwater	Yellowstone Tavern Inc
03178	P	Groundwater	Kircher School District #03

Climate

Based on Western Regional Climatic Center data for the period of record, annual precipitation averages 13.52 inches. Monthly average precipitation ranges from 0.41 inches in February to 2.87 inches in June. Summer thunderstorms and winter snows provide a majority of the precipitation in the area. The annual mean snowfall in Miles City is 30.0 inches. A summary of the available climatic data for the Miles City area is presented in Table 1 below.

Figure 2. Miles City Average Temperatures and Precipitation

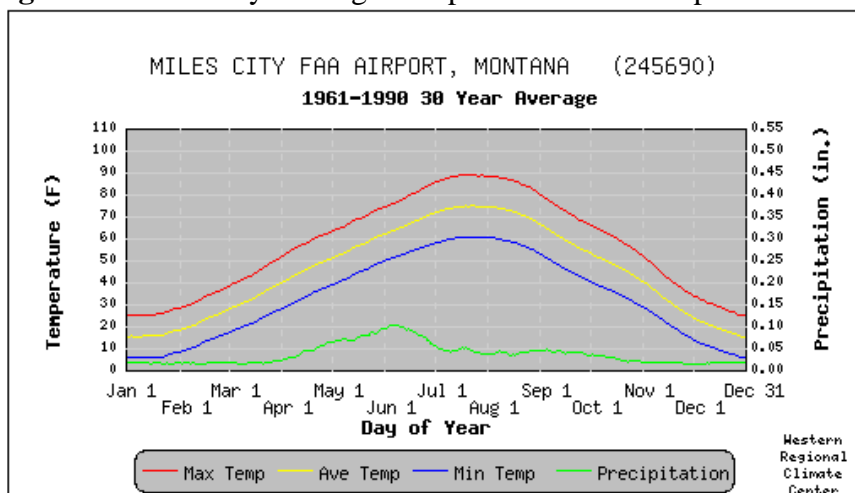


Table 2. Climate Summary for the Miles City Airport.

MILES CITY FAA AIRPORT, MONTANA (245690)													
1961-1990 Monthly Climate Summary													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	26.2	33.3	44.8	58.2	69	79.9	88.3	86	73.2	60.1	41.5	29.2	57.7
Average Min. Temperature (F)	6.7	12.9	22.7	33.8	44.5	54.1	60.2	58.1	46.8	35.3	21	9.7	33.9
Average Total Precipitation (in.)	0.56	0.53	0.59	1.32	2.4	2.66	1.45	1.29	1.29	0.86	0.56	0.58	14.09

Western Regional Climate Center, wrcc@dri.edu

Geographic Setting

Miles City is located in the non-glaciated portion of the Great Plains physiographic province of North America (Rocky Mountain Association of Geologists, 1972). This area is also designated as the non-glaciated central ground-water region of the United States (Heath, 1984). The elevation at Miles City is approximately 2,358 feet above mean sea level and the town is located immediately next to the Yellowstone River (Figure 1). The Yellowstone River valley is about 2 to 2.5 mile wide in the vicinity of Miles City. Topographic relief in the area is low with highlands rising about 200 to 300 feet above the river valley. Many of the creeks and tributaries to the Yellowstone have moderately incised channels.

General Aquifer Setting

Ground water in the Miles City area generally comes from one of four aquifers. Shallow wells near the Yellowstone River obtain water from unconsolidated alluvium deposited by the river. Siltsonte and sandstone beds within the Fort Union Formation are also tapped by wells to provide water and represent a shallow aquifer system. A deeper aquifer in the lower part of the Fort Union Formation is also a frequent target for drillers in the area. This aquifer consists of consolidated sandstone beds that lie above wide spread clay and shale beds of the upper Hell Creek Formation. The fourth aquifer utilized in the area is the Colgate Sandstone that marks the upper part of the Fox Hills Formation. Although no well logs are available for the Palisades’ wells, based on logs from near by wells; it appears the backup well is completed in the lower Fort Union Formation and the primary well is completed in the Fox Hills-Hell Creek formations. Both aquifers are interpreted here as deep confined sandstone aquifers. This type of aquifer is classified as having a low sensitivity to potential contamination sources (Montana DEQ, 1999). A well log from the Miles City Airport is included in Appendix A and illustrates the kind of completion information that would be useful for the Palisades’ wells. It is important to note that because there are no well logs available for either well, it cannot be determined if the wells have been constructed properly to prevent mixing of water from shallow and deeper aquifers. The lack of well logs causes the susceptibility analysis to be more conservative.

Public Water Supply

Palisades Apartments is obtains water from two wells. One is located within the apartment building and the other is in a detached building near the outside pool. The well inside the building is considered the primary

well and is a 4-inch steel cased well drilled to approximately 670 feet. There is an old steel pressure tank and two captive air tanks located in the same room as the well. The second well is also a 4-inch steel cased well drilled to about 380 feet and has a single captive air tank to control pump cycling. The second shallower well is used as a backup well. Both wells are tied into the same plumbing system and provide adequate water and pressure to the apartment building (Sanitary Survey, 2002).

Water Quality

Ambient water quality in the area around the Palisades Apartment wells is not available. In general, water quality in the Fox Hills-Hell Creek aquifer tends to be relatively high and the Colgate member of the Fox Hills Formation is often a drilling target due to the water quality and quantity available.

Monitoring and Enforcement Actions

Palisades Apartments supply wells are routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly. Compliance with other drinking water standards is based on additional sampling on a variety of schedules depending on system classification and population served. Nitrate can come from human or animal wastes but also occurs naturally. The highest level detected in the apartment's wells in the last five years was 2.53 mg/l, considerably below the maximum concentration level of 10 mg/l set by the U.S. Environmental Protection Agency (EPA). Palisades Apartments has had one bacterial detect in June of 2002, which tested positive for total coliform, however, tested negative for E. coli. A subsequent sample was taken the same day, which came back negative for total coliform bacteria.

CHAPTER 2 - DELINEATION

The source water protection areas for Palisades Apartments public water system are delineated in this chapter. The purpose of delineation is to map the source of the water supply's drinking water and to define areas within which to prioritize source water protection efforts. Four types of management regions are identified; they are the control zone, one-mile fixed radius inventory zone, the recharge region, and the surface water buffer zone.

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

General Geology

This section provides an overview of the geology and hydrology of the vicinity of Miles City. Reports used for this section include Lewis and Roberts (1978), Slagle, 1983, Slagle, et al., 1983, Smith, et al., (2000), Stoner and Lewis, (1980), Torrey and Swenson (1951), and Vuke et al., (2001). The geology of the area can be used to determine the locations, boundaries, and hydraulic properties of local aquifers. An understanding of hydrogeologic conditions also provides an explanation for the sensitivity of local aquifers to potential contamination sources. Geology is not just important for understanding the hydrologic conditions related to ground water but it is also valuable for public water supplies that use surface water. For example, the timing and runoff patterns of streams are influenced in part by the geology within a watershed. Watersheds with large areas of low hydraulic conductivity bedrock tend to respond quickly to precipitation and snowmelt events. Hydrographs from streams within such a watershed show numerous high flow peaks or spikes. On the other hand, streams within watersheds underlain by bedrock that has high hydraulic conductivity tend to have more subdued hydrographs, that is, fewer and more rounded high flow peaks. Infiltration of precipitation and snowmelt waters makes the high flow events rise more gradually and have more rounded peaks. Surface water quality can also be affected by the geology within a watershed and information in this section can be useful for gaining a better understanding of factors that control erosion and sedimentation.

Unconsolidated alluvium is present in the Yellowstone River valley and in many of the tributaries to the Yellowstone ([Figure 3](#)). The alluvium consists of lenses of unconsolidated clay, sand, and gravel. As much as 50 feet of alluvium is present in the Yellowstone and Tongue river valleys and up to 25 feet is present in some of the tributaries (Vuke et al (2001)). The Yellowstone River alluvium yields economic quantities of water to wells and in most places represents an unconfined aquifer. Terrace deposits are also present within the main river valley and the tributaries. Some of the terraces are between 2 and 260 ft. above the streams and are considered to be Quaternary age, ranging from Pleistocene to Recent (Vuke et al (2001)). These terrace deposits consist of gravel, sand, silt, and clay and range in thickness up to as much as 50 ft. in some places.

Bedrock exposed at the land surface in the vicinity of Miles City ranges in age from Upper Cretaceous to Recent (Vuke et al (2001)). Around Miles City, the Fort Union Formation dominates the landscape ([Figure 3](#)). The Fort Union can be on the order of 1,000 feet thick and can be divided into three members in descending order: the Tullock, Lebo Shale, and Tongue River. There are outcrops of red metamorphosed sedimentary rocks within the Fort Union Formation southeast of town. These beds are referred to as "clinker" and formed when underlying coal beds were ignited and baked the sandstone, siltstone, and shale beds. In some places the heat was so intense that the overlying rocks were metamorphosed into rock resembling volcanic rocks known as scoria. The Hell Creek Formation (Upper Cretaceous) is below the

Fort Union, is about 160 feet thick, and contains beds of silty shale, mudstone, sandstone, and coal. The Hell Creek is not exposed at the land surface near Miles City. Generally, the Hell Creek is more fine grained and contains less coal than the overlying Fort Union. Sandstone beds are more abundant in the lower part of the Hell Creek Formation. Beneath the Hell Creek Formation is a series of fine to medium grained sandstone and shale beds that make up the Fox Hills Formation. The upper part of the Fox Hills consists of a pervasive light colored sandstone bed known as the Colgate Member of the Fox Hills. Below the Fox Hills Formation is the Pierre Shale, also known as the Bearpaw Shale in some parts of the state. The Pierre Shale is substantially thick ranging between 1,300 and 3,000 feet.

General Hydrogeologic Setting

Aquifers within the geologic formations described above are often grouped together based on their depth from the land surface. The groups are referred to as hydrologic units. The shallow hydrologic unit represents aquifers within 200 feet of the land surface (Slagle et al. 1983, Smith et al. 2000). In most places this includes aquifers within the alluvium and terrace deposits and sandstones in the upper part of the Fort Union Formation. Ground-water flow within this shallow hydrologic unit is generally from upland areas toward local stream tributaries and major streams. Recharge to the shallow hydrologic unit comes primarily from infiltration of precipitation; to a lesser extent recharge also comes from water losses from some stream channels, irrigation ditches, and return flows from irrigated fields (Smith et al. 2000). Below 200 feet a deeper hydrologic unit is present above the pervasive claystone and shale beds in the upper Hell Creek Formation. Ground-water flow within the deep hydrologic unit is from upland areas toward major streams and is generally thought to bypass or flow beneath local tributary valleys. Recharge areas for the deep hydrologic unit comes from more distal highland areas to the north and south of Miles City (Slagle et al., 1983). Sandstones in the lower Hell Creek - upper Fox Hills represent a third hydrologic unit in this region. The Colgate Member of the Fox Hills is an important drilling target in this hydrologic unit (Smith et al, 2000). Ground-water flow in the lower Hell Creek - upper Fox Hills is generally toward major stream including the Yellowstone and Missouri rivers. Recharge appears to come some distance from upland areas to the north and south of the Miles City area (Slagle et al., 1983). The Pierre Shale lies below the Fox Hills formation and is generally not considered a viable drilling target to obtain ground water.

Conceptual Model

The Palisade wells are completed in relatively deep and consolidated sandstone aquifers that are interpreted here as confined. [Figure 4](#) is a generalized geologic cross section of the Miles City area showing the conceptual ground-water flow model for the area. Recharge for the aquifers is interpreted to originate from upland areas to the north. Due to the fact that no well logs are available for the either of the Palisade wells, it can not be determined if the Palisade wells are properly constructed or sealed to prevent commingling of water from shallower aquifers that could be more vulnerable to contaminant sources at the land surface. As a consequence, the inventory region for the Palisade wells is fixed at a one-mile radius.

Source Wells

Palisades Apartments have two wells, one located within the apartment building and the other in a detached building near the outside pool. The 4-inch steel cased well inside the building, drilled in 1964 to a depth of 670 feet, is the primary well. The second well is also a 4-inch steel cased well, drilled in 1980 to a depth of approximately 380 feet. The system provides water to about 40 apartments. Pressure problems existed at the time of Darryl McNenny's inspection in 1995. Since then, the pump in the primary well was changed out and the connection between the building and the secondary well has been opened. These actions seem to have taken care of the pressure and quantity problems (Sanitary Survey, 2002).

Table 3. Information from drillers logs from wells near the Palisades Apartments.

MBMG #	Primary Well #1	Well #2
Location	-	-
Date Completed	1964	1980
Depth	670	380
Screened Interval	-	-
SWL Depth - ft. below ground surface (ft. bgs)	-	-
PWL Depth - ft. bgs	-	-
Drawdown - ft.	-	-
Test Pumping Rate	-	-
Specific Capacity	-	-

Delineation

Methods and criteria for delineating source water protection areas are specified in the Montana Source Water Protection Program (DEQ, 1999). Source water protection areas delineated for Palisades Apartments include controls zones for each well and common inventory and recharge regions (Figure 1, 5, and 6).

Control Zones - 100-foot radius control zones are delineated for the apartment's wells; all sources of potential contaminants should be excluded in this region.

One-mile Fixed Radius Inventory Zone – The inventory zone is delineated as a modified one-mile fixed radius circle. The aquifer receives recharge water through both the Yellowstone River alluvium to the south and through the older bedrock to the west. All sources of potential contaminants are inventoried in this region.

Recharge Region - On a broad scale, the entire Paradise Valley provides recharge to the alluvial aquifer used by the Palisades Apartments public water supply. Efforts to maintain and improve water quality within the valley will benefit the apartment and other public water supplies within the valley. Watersheds included in the recharge region consist of hydrologic units 10100001230, 10100001240, 10100001250, 10100001260, 10100001270, and 10100001280. The inventory for the recharge region includes both the smaller and larger watershed regions and focuses on potential sources of nitrate and pathogens. The goal of management in the recharge region is to maintain and improve the long-term quality of ground water in the alluvial aquifer.

Table 4. Note: Table 4 is omitted because time-of-travel calculations were not used to establish the inventory regions.

CHAPTER 3 - INVENTORY

An inventory of potential contaminant sources was conducted to assess the susceptibility of Palisades Apartment's wells to contamination and to provide a foundation for source water protection planning. The inventory for the apartment focuses on facilities that generate, use, or store potential contaminants and certain land uses in the inventory region delineated in the previous section. Sources of all primary drinking water contaminants and cryptosporidium are identified, although only potential sources of contaminants that are the greatest threat to human health were selected for detailed inventory. The contaminants of greatest concern to Palisades Apartments are nitrate, microbial contaminants, and agricultural chemicals including fertilizers and pesticides.

Inventory Method

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

Step 1: Land cover is identified from the National Land Cover Dataset compiled by the U.S. Geological Survey and U.S. Environmental Protection Agency (USGS, 2000). Land cover types in this dataset were mapped from satellite imagery at 30-meter resolution using a variety of supporting information.

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

Step 3: DEQ databases were queried to identify underground storage tanks (UST), hazardous waste contaminated sites, landfills, and abandoned mines.

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

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

Step 6: All significant potential contaminant sources were identified in the inventory region, sources of nitrate and microbial contaminants were identified in the surface water buffer, and land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the recharge region.

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

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

Inventory Results/Control Zones

The control zones for the two wells include portions of the apartment building, lawns, pool, and parking lot. The parking lot could be a source of VOCs (fuels and oil) from parked or stored vehicles. Use of fertilizers, herbicides, and pesticides related to lawn care could be sources of SOCs. Chemicals used for the pool could also represent a potential threat to the wells, particularly the back up well.

Based on photos in the most recent sanitary survey, the back up well near the pool is located in a room that appears to be used for storage of a variety of material, some of which may be chemicals related to pool and yard maintenance. Storage of chemicals and/or herbicides and pesticides in this room is not advised. The room should be kept free of materials or chemicals that could contaminate water entering the distribution system.

Without well logs for either of the wells, it is not possible to determine if the apartment's wells are properly completed and constructed. Contaminants entering the shallow aquifer system may be allowed to enter the deeper aquifer under certain conditions if the apartment's wells or other wells in the area tapping the deeper confined aquifers are not constructed properly. Providing well logs would make it possible to more accurately assess the hazard the potential contaminants mentioned above represent and to determine how susceptible the Palisades Apartment's source water is to each of these potential contaminant sources. As a result, the potential contaminant sources mentioned above are considered significant.

Inventory Results/One-mile Fixed Radius Inventory Zone

Land cover in the inventory region of Palisades Apartments is 42 percent grassland, 31 percent ag-land, 16 percent shrubland, and 7 percent open water ([Figure 6](#)). Grassland, shrubland, and forest are not considered potential sources of contamination, and the percentage of ag-land present poses a moderate hazard to Palisades Apartments' source water. The concern here is the potential for mismanagement or over-application of fertilizers and/or pesticides on the agricultural lands that could result in SOCs entering surface- and ground-water.

There is a toxic release site located on the top of Yellowstone Hill approximately ½ mile from the apartment's wells. The company is ICI Explosives USA Inc., Miles City Plant. ICI Explosives is permitted for processing ammonia and ammonium nitrate solution and according to the permit is allowed to release 40 pounds per year through non-air emissions and 106 pounds per year via air emissions (EPA Toxic Release Inventory). Reporting was current up to 1993 on the EPA TRI system and it is not clear if the facility is still operational. Because of the distance from the water supply wells, and the relatively small volumes released annually, this site likely does not pose a threat to the source water used by Palisades Apartments.

A mine is also located in the inventory region about ½ mile from the apartments. The site is known as the Yellowstone Hill Pit and Plant is a past producer, meaning that it is not operational at this time. It appears that the operation was small and due to the distance from the apartments it is not likely a threat to the source water.

Highway 22 also runs through the one-mile fixed radius inventory region. It is located up-gradient of Palisades Apartments. There is a potential for spills along the highway and also the spraying of pesticides and herbicides. Spills along this section of highway would not likely threaten the apartment's wells because it is separated from the apartments by a topographic ridge, which would contain the spills away from the wells.

Septic systems are considered potential sources of pathogens. The Palisade Apartment septic system is located within the inventory region and is considered large capacity system because it serves 20 or more people per day. Large capacity septic systems are considered point sources of potential contaminants when they are located within the inventory region.

No additional businesses that use or generate hazardous chemicals were identified in the inventory region. The most likely contaminants in the inventory region are VOCs (fuels and petroleum products), SOCs (fertilizers, pesticides, and herbicides), microbial contaminants, and nitrate.

As mentioned above, having well logs would make it possible to determine how susceptible the Palisades Apartment’s source water is to each potential contaminant source located within the inventory region. As a result, the potential contaminant sources mentioned above are considered significant.

Table 5. Significant potential contaminant sources in the inventory region of Palisades Apartments public water system wells.

Source	Contaminants of Concern
Large capacity septic system	Pathogens and nitrate
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate
Toxic Release Site	Explosives and/or fertilizers
Mining Operations	Metals
Highway	Pesticides, fertilizers, VOCs, other hazardous materials
Spills and leaks from the parking lot	VOCs (fuels and oil)

Inventory Result/Recharge Region

Land use in the recharge region is 75 percent grassland, 19% ag-land, and 4% shrubland ([Figure 7](#)). Septic density near Palisades Apartments is low. As mentioned above, grasslands and shrubland are not considered potential contaminant sources. The percentage of ag-land in the recharge region is interpreted to represent a low hazard. The concern is the potential for mismanagement or over- application of fertilizers and/or pesticides on the agricultural lands that could result in SOCs entering surface- and ground-water.

Inventory Update

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

Inventory Limitations

The potential sources of contaminants described above are identified from readily available information. Consequently, unregulated activities or unreported contaminant releases may have been overlooked. The use of multiple sources of information, however, should ensure that the major threats to the source water for Palisades Apartments public water supply have been identified.

CHAPTER 4 - SUSCEPTIBILITY ASSESSMENT

The susceptibility of Palisades Apartments' wells to contamination is assessed in this chapter. The proximity of a potential contaminant source to a well or the density of non-point potential contaminant sources determines the threat of contamination, referred to here as hazard (Table 6). For Palisades Apartments, a one-mile fixed radius inventory zone in conjunction with hydrogeologic mapping of the alluvial aquifer were used to identify areas from where possible contaminants could enter the apartment's water supply. High hazard is assigned to significant potential contaminant sources within the one-mile fixed radius of the Palisades Apartments wells, moderate and low hazard were assigned to potential sources outside the one-mile fixed radius inventory zone depending on distance and number of barriers. Hazard and the existence of barriers to contamination determine susceptibility (Table 7).

Barriers can be anything that decrease the likelihood that contaminants will reach a well. Barriers can be engineered structures, management actions or natural conditions. Examples of engineered barriers are spill catchment structures for industrial facilities and leak detection for underground storage tanks. Emergency planning and best management practices can be considered management barriers. Thick clay-rich soils, a deep water table or a thick saturated zone above the well intake can be natural barriers.

Table 6. Hazard of potential contaminant sources for Palisades Apartments public water system.

	High Hazard	Moderate Hazard	Low Hazard
Point Sources of Contaminants	Within one-half mile of a well	From one-half to one mile (the limit of the inventory region)	Beyond the inventory region
Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Cropland (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Table 7. Susceptibility to potential contaminant sources based on 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

Susceptibility ratings are presented individually for each significant potential contaminant source in the inventory region (Table 8). In addition, Palisades Apartments' wells may be susceptible to contamination from Class V injection wells that have not been identified. If well logs were available, it would be possible to determine if the wells are properly constructed and sealed. If properly constructed, the hazard level for all of the potential contaminants sources could be reduced to moderate to low. The susceptibility could also be reduced accordingly.

Source water for this public water supply has a high susceptibility to the large capacity septic system and is moderately susceptible to the agricultural land within the inventory region. These potential contaminant sources are of concern because they may contribute SOCs, nitrate, and pathogens into surface- and ground-water.

Table 8. Susceptibility assessment for Palisades Apartments' wells.

Source	Contaminant	Hazard Rating	Barriers	Susceptibility	Management
Large capacity septic system	Pathogens, nitrate	High*	-Depth to intake exceeds 100 ft.	High	Maintain septic tank and distribution lines.
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Moderate*	-Depth to intake exceeds 100 ft.	Moderate	Encourage and support city and county efforts to provide educational information, materials and resources to land owners on the proper application and storage of pesticide and fertilizers; implement agricultural BMPs
Toxic Release Site	Ammonia, Ammonium Nitrate	Low	-Depth to intake exceeds 100 ft.	Low	Be vigilant concerning current operations at the site. Encourage state and local officials to enforce violations and proceed to have sites mitigated when violation occur.
Mining Operations	Metals	Low	-No longer producing -Depth to intake exceeds 100 ft.	Very Low to Low	Be vigilant concerning current operations at the site. Encourage state and local officials to enforce violations and proceed to have sites mitigated when violation occur.
Highway	Variety of hazardous materials	High*	-Distance form wells -Depth to intake exceeds 100 ft. -County Emergency Response	Low	Stay current and informed of accidents and spills on the highway within the inventory region.
Spills and leaks from the parking lot	VOCs	Low	-Depth to intake exceeds 100 ft	Low	Be vigilant and require leaking vehicles to be removed, and spills cleaned up.
Class V Injection Wells	VOCs, SOCs, pathogens, nitrate	Unknown	-Unknown	Unknown	Encourage city and county efforts to inventory Class V wells, to provide educational information, materials and resources to business owners and the public on proper waste disposal and recycling

***Note: If well logs were available it would be possible to determine if the wells are properly constructed and sealed. If properly constructed, the hazard level for all of the potential contaminants sources could be reduced to moderate to low.**

Large Capacity Septic System – The Palisades’ septic system is assigned a high hazard because it serves more than 20 persons per day and it is located within the inventory region. With the depth to the well intake assumed to be below multiple clay layers and considered a barrier; susceptibility is rated as high.

Cultivated Cropland – Thirty-one percent agricultural land within the inventory region requires a moderate hazard rating (Table 6, bottom row, middle column). With the depth to the well intake counted as a barrier, susceptibility is ranked as moderate.

Toxic Release Site – Hazard is rated as low for the ICI Explosives facility and susceptibility is also low with the depth to the well's intakes counted as a barrier.

Mining Operations – Hazard for this site is low and susceptibility is also low with the depth to the well's intakes counted as a barrier.

Highway – A high hazard rating is assigned to the highway but with multiple barriers identified, the susceptibility is ranked as low (Table 8).

Parking Lot – Hazard posed by leaks from vehicles and spills in the lot is considered low due to the small volumes that would routinely be encountered. With the depth to the well's intakes counted as a barrier, susceptibility is considered low.

Class V Injection Wells – The potential hazard imposed by VOCs, SOCs, pathogens, nitrate, and other contaminants originating from the class V injection wells cannot be determined due to the fact that no inventory of Class V well is complete for most of Montana or the current inventory is inadequate. The susceptibility of the intake to contaminants originating from this source is unknown.

Management Recommendations

Management recommendations are listed along with the susceptibility analysis in Table 8. Some of the recommendations in Table 8 and most of those below are beyond Palisades Apartments' control and are intended for governmental entities such as the City of Miles City or Custer County that have the authority or ability to implement them. If implemented, these recommendations can be considered additional barriers that will reduce the susceptibility of Palisades Apartments' wells to specific sources and contaminants.

Management recommendations fall into the following categories:

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

Sewer Maintenance and leak detection – Early warning of leaks and scheduled replacement of aging sewer lines may reduce the susceptibility of the City's PWS to contamination from municipal septic wastes, and could also benefit other public water supplies in the Miles City area.

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

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

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

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

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

CHAPTER 5 - Monitoring Waivers

Waiver Recommendation

Palisades Apartments does not appear to have any monitoring waivers at this time. Based on past monitoring results or the susceptibility assessment of the intake, the public water supply may not be eligible for additional monitoring waivers. However, to be sure that eligibility for all available waivers is considered, the PWS Operators are encouraged to carefully review the following section on Monitoring Waiver Requirements. If after reviewing this section it is determined that an additional waivers are feasible, the PWS Operators should submit a letter with the proper documentation to DEQ requesting monitoring waivers. Table 9 shows how identified potential contaminant sources affect the eligibility for monitoring waivers.

Table 9. Susceptibility Assessment as it relates to waiver eligibility for significant potential contaminant sources in the Spill Response Region Glendive PWS surface water intakes.

Source	Contaminant	Susceptibility	Waiver Eligibility
Large Capacity Septic System	Pathogens, nitrate	High	Waivers are not available for pathogens and nitrate
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Moderate	Chemical use likely precludes waivers for some chemicals
Toxic Release Site	Ammonia, Ammonium Nitrate	Low	Use and contributions from this and other sources likely preclude waivers.
Mining Operations	Metals	Low to Very Low	Extensive mining within the Yellowstone River watershed likely precludes waivers
Highway	Pesticides, fertilizers, VOCs, other	Low	Volume and type chemicals and materials transported likely precludes waivers for some chemicals
Spills and leaks from the parking lot	VOCs	Low*	Use and contributions from this and other sources likely preclude waivers.
Class V Injection Wells	VOCs, SOCs, pathogens, nitrate	Unknown	Waivers are not available for pathogens and nitrate

Monitoring Waiver Requirements

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

Use Waivers

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

Susceptibility Waivers

If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a

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

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

Susceptibility Waiver for Confined Aquifers

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

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

The Susceptibility waiver has the objective of assessing the potential of contaminants reaching the groundwater used by the PWS. A groundwater source that appears to be confined from surface infiltration in the immediate area of the wellhead may eventually be affected by contaminated groundwater flow from elsewhere in the recharge area. Contaminants could also enter the confined aquifer through improper well construction or abandonment where the well provides a hydraulic connection from the surface to the confined aquifer. The extent of confinement of an aquifer is critical to limiting susceptibility to organic chemical contamination. Regional conditions that define the confinement of a groundwater source must be demonstrated by the PWS in order to be considered for a confined aquifer susceptibility waiver.

Confinement of an aquifer can be demonstrated by pump test data (storage coefficient), geologic mapping, and well logs. Site specific information is required to sufficiently represent the recharge area of the aquifer and the zone of contribution to the PWS well. The following information should be provided:

- Abandoned wells in the region (zone of contribution to the well),

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

Susceptibility Waiver for Unconfined Aquifers

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

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

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

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Figures

[Figure 1 – General Location Map](#)

[Figure 2 - Average Temperatures and Precipitation](#)

[Figure 3 – General Geology Map](#)

[Figure 4 – Conceptual Ground-Water Flow Model](#)

[Figure 5 – Inventory Region Map](#)

[Figure 6- – Land Cover / Land Use Map For The Inventory Region](#)

[Figure 7 – Land Cover / Land Use Map For The Recharge Region](#)

DEQ PWS's Database Output

Inorganic Water Quality Sampling Results – Palisades Apartments

PWS NUMBER	PWS NAME	WATER TYPE	WATER SOURCE NAME	SAMPLE POINT LOCATION	ANALYTE NAME	CONCENTRATION	UNITS	COLLECTION END DATE
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	1,1,1-TRICHLOROETHANE	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	1,1,1-TRICHLOROETHANE	0		06-May-98
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	1,1,1-TRICHLOROETHANE	0		16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	1,1,1-TRICHLOROETHANE	0		18-Dec-96
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	1,1,1-TRICHLOROETHANE	0		30-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	ANTIMONY	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	ANTIMONY	0		16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	ANTIMONY	0		25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	ARSENIC	0		16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	ARSENIC	0		16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	ARSENIC	0.003	MGL	25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0		15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0		28-Nov-84
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0		22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0.001	MGL	11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	BARIUM	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	BARIUM	0.035	MGL	25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.04	MGL	15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.06	MGL	28-Nov-84
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	BARIUM	0		22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	BARIUM	0		11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	BERYLLIUM	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	BERYLLIUM	0		16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	BERYLLIUM	0		25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	CADMIUM	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	CADMIUM	0		25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CADMIUM	0.002	MGL	15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CADMIUM	0		28-Nov-84
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CADMIUM	0		22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CADMIUM	0		11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	CHROMIUM	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	CHROMIUM	0		25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CHROMIUM	0		15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CHROMIUM	0		28-Nov-84
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CHROMIUM	0		22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	CHROMIUM	0		11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	DINOSIB	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	DINOSIB	0		06-May-98
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	DINOSIB	0		30-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	FLUORIDE	2.53	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	FLUORIDE	2.64	MGL	29-Oct-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	FLUORIDE	10.1	MGL	16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	FLUORIDE	0.8	MGL	25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	2.4	MGL	15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	1.5	MGL	28-Nov-84
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	2.43	MGL	28-Sep-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	2.55	MGL	22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	2.3	MGL	11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	MERCURY	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	MERCURY	0		25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	MERCURY	0		15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	MERCURY	0		28-Nov-84
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	MERCURY	0		22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	MERCURY	0		11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NICKEL	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NICKEL	0		16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NICKEL	0		25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		06-Jun-00
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		28-Jun-99
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0.04	MGL	18-Nov-88
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		19-Jul-95
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0.02	MGL	27-Feb-95
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		31-May-94
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		30-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	NITRATE+NITRITE (AS N)	0		25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.28	MGL	15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.01	MGL	28-Nov-84
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0		22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.1	MGL	19-Aug-80
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0		11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	OXAMYL (VYDATE)	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	OXAMYL (VYDATE)	0		06-May-98
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	OXAMYL (VYDATE)	0		30-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	POLYCHLORINATED BIPHENYL	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	POLYCHLORINATED BIPHENYL	0		06-May-98
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	POLYCHLORINATED BIPHENYL	0		30-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	SELENIUM	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	SELENIUM	0.001	MGL	25-Aug-93
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	SELENIUM	0.001	MGL	15-Nov-88
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	SELENIUM	0		22-May-81
MT0000145	PALISADES APARTMENTS	GW	DISTRIBUTION SYSTEM	SP001	SELENIUM	0		11-Apr-78
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	SIMAZINE	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	SIMAZINE	0		06-May-98
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	SIMAZINE	0		30-Aug-93
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	THALLIUM	0	MGL	16-Jan-01
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	THALLIUM	0		16-Jul-97
MT0000145	PALISADES APARTMENTS	GW	COMMON HEADER FOR WELLS 1 2	EP502	THALLIUM	0		25-Aug-93

Bacteriological Sampling Data – Palisades Apartments

PWS NUMBER	SYSTEM NAME	LAB ASSIGNED ID NUM	COLLECTION END DATE	SAMPLE TYPE CODE	PRESENCE INDICATOR CODE	CODE	ANALYTE NAME
MT0000145	PALISADES APARTMEN	B02110208-001	11/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02100220-001	10/2/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02090136-001	9/3/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02080301-001	8/5/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02070889-001	7/16/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02070889-002	7/16/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02070505-001	7/9/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02061574-001	6/25/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02061574-002	6/25/2002	RT	A	3014	COLIFORM, E. COLI
MT0000145	PALISADES APARTMEN	B02061574-002	6/25/2002	RT	P	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02060155-001	6/3/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02050295-001	5/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02040552-001	4/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02030119-001	3/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	B02020100-001	2/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-02-50173	1/7/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-60890	12/10/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-60410	11/26/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-59216	10/16/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-57733	9/5/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-56720	8/6/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-55649	7/9/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-54427	6/6/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-53260	5/1/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-52549	4/4/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-51599	3/5/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-51027	2/12/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-01-50264	1/9/2001	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-60470	12/5/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-59640	11/7/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-58521	10/2/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-57531	9/5/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-56474	8/1/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-55668	7/10/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-54508	6/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-53397	5/1/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	001-00-52643	4/5/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	51742	3/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	51002	2/7/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	00241	1/10/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-09811	12/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-09255	11/8/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-08109	10/4/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-07214	9/7/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-06010	8/2/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-05241	7/21/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	9904001	6/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	9903210	5/3/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-02391	4/6/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-01569	3/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-01028	2/8/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	99-00853	2/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	W9900105	1/5/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	W9810896	12/1/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	98-10099	11/2/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	W9809513	10/13/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	98-08430	9/8/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	98-07137	8/3/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	W9806053	7/6/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	98-04906	6/1/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	98-03817	5/4/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	W8-03192	4/13/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	98-02972	4/6/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	W8-01882	3/2/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	00994	2/2/1998	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000145	PALISADES APARTMEN	W8-00056	1/5/1998	RT	A	3100	COLIFORM, TOTAL (TCR)

Appendix B

GWIC Well log for the Miles City Airport

**Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
MILES CITY AIRPORT COMMISSION**

Location Information

GWIC Id: 171183	Source of Data: LOG/INV
Location (TRS): 08N 47E 20 CDDD	Latitude (dd): 46.4265
County (MT): CUSTER	Longitude (dd): -105.8747
DNRC Water Right:	Geomethod: MAP
PWS Id:	Datum: 1927
Block:	Certificate of Survey:
Lot:	Type of Site: WELL
Addition:	
Site Notes:	

Well Construction and Performance Data

Total Depth (ft): 830.00	How Drilled: ROTARY
Static Water Level (ft): 265.00	Driller's Name: ASKIN
Pumping Water Level (ft):	Driller License: WWC183
Yield (gpm): 30.0	Completion Date (m/d/y): 6/5/1990
Test Type: PUMP/BAILER	Special Conditions:
Test Duration: 24.00	Is Well Flowing?:
Drill Stem Setting (ft):	Shut-In Pressure:
Recovery Water Level (ft):	Geology/Aquifer: 211FHHC
Recovery Time (hrs): 0.00	Well/Water Use: PUBLIC WATER SUPPLY
Well Notes:	

Hole Diameter Information

From	To	Diameter
0.0	59.0	16.0
59.0	660.0	9.0
660.0	830.0	6.0

Annular Seal Information

From	To	Description
0.0	660.0	CEMENT

Lithology Information

From	To	Description
0.0	58.0	GRAVEL
58.0	62.0	CLAY
62.0	90.0	SAND
90.0	205.0	CLAY
205.0	215.0	COAL
215.0	580.0	CLAY
580.0	600.0	SAND(10GPM)
600.0	620.0	CLAY
620.0	660.0	SAND(20GPM)
660.0	760.0	CLAY
760.0	830.0	SAND(30GPM)

Casing Information¹

From	To	Dia	Description
-2.0	660.0	6.0	STEEL
0.0	59.0	10.0	STEEL
660.0	830.0	4.5	YELLOWMINE PVC

Completion Information¹

From	To	Dia	Description
760.0	830.0	4.0	SLOTS

GLOSSARY*

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

Alkalinity. The capacity of water to neutralize acids.

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

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

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

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

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

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.

Delineation. A process of mapping source water management areas.

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

Hazard. A measure of the potential of a contaminant leaked from a facility to reach a public water system source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through an aquifer.

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

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

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

Nonpoint-Source. Pollution sources that are diffuse and do not have a single point of origin.

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

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

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

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

Recharge Region. A source water management region that is generally the entire area that could contribute water to an aquifer used by a public water system. 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.

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

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

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

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

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

Transmissivity. The ability of an aquifer to transmit water.

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

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

Volatile Organic Compounds (VOC). Any organic compound which evaporates readily to the atmosphere.

* Definitions taken from EPA's Glossary of Selected Terms and Abbreviations