Churchill Retirement Home

Public Water System

PWSID # MT0001375

Source Water Delineation and Assessment Report

11/99

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INTRODUCTION

The Safe Drinking Water Act (SDWA) Amendments of 1996 requires states to develop and implement Source Water Assessment Programs (SWAP) to analyze existing and potential threats to the quality of the public drinking water supplies throughout the state. The Montana SWAP was formally approved by the US Environmental Protection Agency (EPA) in November 1999. The Montana SWAP was developed from the former Wellhead Protection Program, but includes surface water sources and requires a more rigorous inventory of potential contaminant sources. For communities that have already developed wellhead protection plans, SWAP revises these plans to meet the expanded requirements. DEQ also works with other groups such as Montana Rural Water Systems, Inc., and Midwest Assistance Programs to implement the program.

SWAP addresses only public water systems (PWS) regulated according to the Federal Safe Drinking Water Act. A public water supply system is defined, according to Federal and Montana regulations, as a system that supplies water for human consumption. A public water supply system has at least 15 service connections or regularly provides water to at least 25 persons daily for a minimum of 60 days in a calendar year. There are three types of public water supply systems:

- Community water systems provide water on a year-round basis, and have a minimum of 15 service connections or regularly serve at least 25 residents. In addition to incorporated towns, community systems may serve smaller areas such as housing subdivisions or trailer courts.

- Non-transient non-community systems do not serve communities, but provide water regularly to a minimum of 25 of the same people for at least 6 months of a year. These systems serve public buildings such as schools and hospitals, where people are employed but do not reside.

- Transient non-community systems do not serve communities, and do not regularly serve a minimum of 25 of the same people for at least 6 months of the year. These systems are usually seasonal, and are located in areas such as campgrounds and parks.

Source water protection is a common sense approach to guarding public health by protecting drinking water supplies. In the past, water suppliers have used most of their resources to treat water from rivers, lakes, and underground sources before supplying it to the public as drinking water. Source water protection means preventing contamination and reducing the need for treatment of drinking water supplies. Source water protection also means taking positive steps to manage potential sources of contaminants and contingency planning for the future by determining alternate sources of drinking water. Protecting source water is an active step towards safe drinking water; a source water protection program (along with treatment, if necessary) is important for a community's drinking water supply. A community may decide to develop a source water protection

program based on the results of a source water assessment, which includes the delineation of the area to be protected and an inventory of the potential contaminants within that area.

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to help public drinking water supplies protect their water source from contamination. The Montana Source Water Protection Program is responsible for completing delineation and assessment reports for all public water supplies in Montana. The Source Water Delineation and Assessment Report (SWDAR) compiles the appropriate data and other technical information about an area to allow communities to develop source water protection plans. Delineation is a process whereby areas that contribute water to aquifers or surface waters used for drinking water, called source water protection areas, are identified on a map. Geologic and hydrologic conditions are evaluated in order to delineate source water protection areas. Assessment involves identifying potential contaminant sources in delineated source water protection areas, and evaluating the potential for contamination of drinking water from these sources under "worst-case" conditions such as a flood, fire or human error. Although voluntary, source water protection plans are the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate the Churchill area communities and public water supply operators develop source water protection plans that meets their specific needs.

Scope and Purpose

This report presents the source water delineation and assessment for the community public water supply for the Churchill Retirement Home located the unincorporated Town of Churchill, in the western part of the Gallatin Valley in Gallatin County, Montana. This report is intended to meet the technical requirements for the completion of the delineation and assessment report for this PWS, as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

This report was prepared by James Swierc, Water Quality Specialist with the Montana Department of Environmental Quality with the assistance of Donald R. Heys with the Churchill Retirement Home.

Limitations

This report was prepared to assess threats to the Churchill Retirement Home public water supply, and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to sources for regulated public water supplies, and not any other type of water supply. The inventory of potential contaminant sources focuses on the management areas delineated for the public water supplies in this report. As a result, other potential sources of contamination to surface and ground water in the area may not be identified.

The term "contaminant" is used in this report to refer to any chemical or biologic constituent in water that are listed as regulated under state and federal regulations. Water constituents are generally regulated based on health effects that may occur when ingested at certain levels. Water quality standards are based on maximum contaminant level goals (MCLGs) for a compound, which represents a concentration where adverse health effects are not considered likely to occur when ingested. However, as natural waters contain many dissolved constituents and MCLGs are frequently not attainable with economically viable water treatment alternative, maximum concentration levels (MCLs) are used. MCLs represent concentrations that may result in chronic or acute health problems when ingested. MCLs are based on the relative risk, or likelihood that health problems may occur, and economics associated with a treatment technology for a specific constituent of water. In some cases, sources for constituents with Secondary MCLs are also evaluated in this report. Secondary MCLs are non-regulatory guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.

BACKGROUND

Study Area

Churchill is located in the Camp Creek Hills west of the Gallatin Valley, in the western part of Gallatin County (Figure 1). The area is comprised primarily of farm and ranchland. Bozeman is the largest city in the area, located approximately 15 miles east of Churchill. Belgrade is the largest community with commercial services in the area. The economy of the Churchill area includes agriculture and small businesses in the area. Many area residents work in the larger communities in the valley as the population of the county grows.

Figure 1 – Churchill Retirement Home Location

The Community

Churchill is an unincorporated community of approximately 650 persons. It is bisected by Highway 288 (Churchill Rd.) which runs through town. Interstate 90 runs east to west about 8 miles north of the community. The surrounding area is agricultural, growing primarily small grains, alfalfa and potatoes. Several dairy and beef cattle operations are also present in the area. An implement dealer and auto dealer are two other large businesses in the area both lying on the northern outskirts of the community. Two subdivisions, one completed with another in development, are present on the outskirts of Churchill. The community also includes two churches, and a combined elementary and high school – the Manhattan Christian School with approximately 360 students from the surrounding area.

The primary water users are residential area, and agricultural irrigation systems. Domestic water in the area is obtained from private wells. Agricultural irrigation water is derived from wells and from the Low-line canal and its offshoot ditches, which brings water from the Gallatin River to the area. The entire community, including the neighboring unincorporated community of Amsterdam, are served by a single sewer system with settling ponds approximately three miles away.

Geographic Setting

The community of Churchill is located on the Madison plateau, located in the Camp Creek Hills above the Gallatin River valley to the east. Churchill is geographically located at 45° 75' N latitude and 111° 28' W longitude. The legal description for the location of the Churchill Retirement Home is N½ SW¼ Sec 13 T1S R4E Twilight Court Subdivision, Lot 10.

This area is located in the western part of the Gallatin Valley approximately 15 miles west of Bozeman. Godfrey Creek flows north along the floor of a drainage between hills on the eastern edge of Churchill. The Godfrey Creek Watershed is a tributary from the Camp Creek Hills to part of the Gallatin River Watershed. The United States Geological Survey Hydrologic Unit Code (HUC) for the Lower Gallatin River system, which includes the Godfrey Creek Watershed, is 10020008120. Camp Creek flows north in a drainage parallel to Godfrey Creek, located approximately one mile west of Godfrey Creek. The Gallatin River flows north about 8 miles to the east of the Retirement Home.

The soil, locally known as Badger silt, is composed of a deep sandy loam varying from a few feet to 30 or 40 feet deep. There are some thick, continuous, relatively shallow gravels in the area that are largely unsaturated and have a potential to serve as a conduit for recharge of the underlying aquifer from surface water. Precipitation measures from 10 to 15 inches.

The Madison Plateau is part of the Camp Creek Hills representing a broad set of small hills that separate the Madison and Gallatin River valleys. The elevation at Churchill is approximately 4,550 feet above mean sea level (MSL), with the higher elevations of the Camp Creek Hills at over 5,500 feet MSL. The Camp Creek Hills and Gallatin Valley are surrounded by mountains on three sides. The Bridger Mountains lie approximately 20 miles to the east, the Gallatin Range about the same distance to the south and the Tobacco Roots a little farther away to the west. To the north are the Horseshoe Hills.

Climate

The climate is typical of southwestern Montana. Precipitation averages 14.28 inches a year as measured at the weather station at the Belgrade. The wettest months are May and June averaging 2.25 and 2.51 inches monthly, respectively. The driest months are December and February, with averages of 0.57 and 0.47 inches per month. The temperature ranges from an average high of 83.9 ° F in July (minimum July average of 48.7 ° F) to an average of 29.3 ° F in January (minimum January average of 5.1 ° F).

General Description of the PWS Source Waters

The Churchill Retirement Home public water supply source is a well located on the south side of the property, as depicted in Figure 2. The Churchill Retirement Home PWS obtains water from a confined aquifer in a sandstone in the Camp Creek Hills approximately 230 feet below the ground surface. The aquifer is recharged from infiltration in the higher elevations of the Camp Creek Hills and Godfrey Creek Watershed south and southwest of Churchill.

Public Water Supply

The Churchill Retirement Home public water supply serves a resident population of approximately 45 people with 5 total service connections. The water users include the residents of the retirement home, and eight condominiums located adjacent to the facility.

The primary water source is a well (source 003) installed to a depth of 230 feet into a sandstone in the Tertiary beds of the Camp Creek Hills. A well that serves as a backup supply source for the system (source 002) is installed to an approximate depth of 310 feet deep. Information about the system is documented in a sanitary survey completed for the system by Gallatin County in 1994. The following description of the PWS is based on information from this report, included in Appendix A.

Water from the primary and backup wells is pumped into a storage shed adjacent to the retirement home, where it is run through a water softener prior to entering the pressurized storage tanks. The pressure tanks are 300 gallons and 50 gallons, respectively. A booster pump aids in pressurizing both hot and cold water for distribution through the system.

Figure 2 – PWS Source Locations

Wastewater Treatment

Wastewater from the entire area around Churchill, including the Churchill Retirement Home is collected through a community sewer system, with the treatment lagoons located approximately three 3 miles northwest of the facility, north of Amsterdam

Water Quality Monitoring

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliforms and other signs of pathogenic organisms, nitrates, metals and for multiple chemicals. The monitoring schedule depends on many factors such as the size and source water for a PWS, the number of sources (e.g. wells), and the population served. Each PWS has a specific monitoring program tailored to their system that follows the general protocols for operation of a PWS defined by DEQ. A review of the DEQ PWS database indicates that monitoring results for the Churchill Retirement Home PWS show no violations or exceedences of any drinking water quality standards. The only detected compound that is regulated is nitrate, which can occur naturally or from human and animal waste. The health standard for nitrates, the MCL, is 10 mg/L. The monitoring results for the last five years indicate nitrate levels ranging from 2.96 mg/L to 3.12 mg/L.

DELINEATION

The source water protection areas, the land area that contributes water to the Churchill Retirement Home PWS source is identified in this chapter. Delineation of management areas for source water protection are based on the hydrogeologic setting of the water source, in accordance with the requirements outlined in the Montana Source Water Protection Program (DEQ, 1999). For ground water systems in general, there are three regions referred to as the control zone, inventory region, and recharge region. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around the well. The inventory region for confined aquifers represents the area within a 1,000 foot radius around the well. The recharge region represents the area where the source aquifer for a water system is replenished.

Regional Geology

While several geologic studies have published information on the hydrogeology of the Gallatin Valley, little information is included on the water resources of the confined aquifers in the Camp Creek Hills. The following discussion of the geology and hydrogeology of the area is based on information included in these studies which make references to the Camp Creek Hills, an evaluation of well logs for the area obtained from the Montana Bureau of Mines and Geology Ground Water Information Center (MBMG-GWIC), and application of the general principles of hydrogeology. Summary tables of well logs from MBMG-GWIC are included in Appendix C. The studies of the area are listed with the references at the end of this document. A generalized geologic map of the area is included with Figure 3.

The Tertiary sediments that are the source aquifer for the Churchill Retirement Home PWS are part of a thick sequence of material that fills both the Gallatin and Madison River Valleys as a single structural basin, the Three Forks Basin (see Figure 3). The Tertiary sediments fill the Three Forks basin as a continuous sequence, with pre-Tertiary bedrock present at the basin boundaries. The Camp Creek Hills that separate the two valleys represent the surface of the modern drainage system incised into the older basin fill material, the Tertiary beds. The Tertiary beds have an estimated thickness up to 5,000 feet in the central part of the Basin near Belgrade and Churchill (Davis et. al., 1965). The drainage system and the hills separating them do not reflect the deeper bedrock geology of the area. The Tertiary beds represent deposits of wind blow (eolian) sediments, river (fluvial) sediments, and lacustrine sediments with large quantities of volcanic materials such as tuffs intermixed with some material eroded from older rocks in the area. These deposits are generally semi-consolidated as rocks, but are not as hard or coherent as Pre-Tertiary bedrock located outside of the valley).

The source aquifer for the Churchill Retirement Home PWS is characterized as a consolidated bedrock under confined conditions. The clay-rich lenses that separate coarser grained water-bearing layers within the Tertiary sediments provide a natural protective barrier to contamination from the surface (see well logs in Appendix B). Based on this criteria, the aquifer is classified as having a ***low*** source water sensitivity to

contamination. Additional well logs obtained from the MBMG-GWIC for the area are included in Appendix C.

The intake for the PWS wells are located at depths of 310 and 230 feet below ground surface (Table 1). The well logs for the area (Appendix C) indicate that clays and claybound gravels predominate to an approximate depth of 100 feet in the area. The first water bearing interval is at this depth; however, a consistent low yield from this unit results in many of the area wells drilled to deeper water bearing layers.

Figure 3 – Generalized Geologic Map

Regional Hydrogeology

Ground water flow in the Camp Creek Hills is interpreted to generally follow topography from the higher elevations towards the major rivers in the valleys below. Recharge to the water bearing layers occurs from infiltration of precipitation, and potentially from stream loss where streams draining the higher elevations cross over the coarser grained strata. For purposes of this assessment, the Godfrey Creek watershed is considered to represent the limits of the recharge area for ground water in the alluvium.

Conceptual Model and Assumptions

A conceptual hydrogeologic model is a simplified representation of the hydrogeologic system. For the Churchill Retirement Home PWS, ground water occurs in confined aquifers in coarse grained sedimentary layers in the Camp Creek Hills. Ground water generally flows parallel to the major streams following the general topographic gradient of the hills. Recharge to the aquifer occurs from infiltration of precipitation and from stream loss where they flow from over coarser grained water bearing units.

Public Water Supply Well Information

The location of the primary and backup wells are depicted in Figure 2. Information on these sources is summarized in Table 1. Copies of the driller construction logs for the wells are included with Appendix A.

Table 1. Source well information for Churchill Retirement Home.

Information	**Well #1** (Backup Well)	**Well #2** (Primary Well)
PWS Source Code	002	003
Well Location (T, R, Sec)	T1S, R3E Sec 13 CBDA	T1S, R3E Sec 13 CBDA
Well Location (lat, long)	45.7488° N Lat -111.3043° W Long	45.7483° N Lat -111.3043° W Long
MBMG #	90781	90740
Water Right #	Not Listed	15799
Date Well was Completed	Original 140 feet, 1974; Deepened 8/5/79	6/23/77
Total Depth	320 feet	230 feet
Perforated Interval	310-320 feet	214-230 feet
Static Water Level	25 feet	118 feet
Pumping Water Level	150 feet	180 feet
Drawdown	125 feet	62 feet
Test Pumping Rate	70 gpm	15 gpm
Specific Capacity	0.56 gpm/ft	6.1 gpm/ft
Yield	70 gpm	Not listed

The original PWS source for Churchill Retirement Home is the current emergency backup well (DEQ PWS Source 002). The backup well was installed in 1974 to a depth of 140 feet, and deepened in 1979 to a depth of 320 feet. The well is constructed with 6-inch diameter steel casing to a depth of 310 feet, with a slotted screen from 310 to 320 feet. The yield of the well is listed at 70 gpm. This source is currently classified as inactive, but is maintained by the operator as an backup supply source. To use the well, the operator needs to active the circuit breaker to provide electricity for the pump. The main PWS source for Churchill Retirement Home is Well #2 (DEQ PWS Source 003). The well was installed in 1977 to a depth of 230 feet. The well is constructed with 6-inch diameter steel casing to a depth of 214 feet, with perforated plastic screen from 206 to 230 feet. The yield of the well is not known.

Delineation Methods and Criteria

The source water protection management areas were defined for a confined aquifer in accordance with the requirements of the DEQ Source Water Protection program (DEQ, 1999). The control zone around the wells comprises a distance of 100 feet radius around each wellhead. The Inventory Region for the wells is defined as an area of a 1,000-foot radius around the wellheads. The method used to estimate the ground water flow velocity is described in the following section. The recharge area is informally delineated as the Godfrey Creek Watershed upstream from the drinking water sources; however, the actual recharge zone may include areas in the Camp Creek Hills at higher elevations outside of this watershed.

Ground Water Flow Rate Estimates

The results of the ground water flow rate calculations are summarized in Appendix C. The calculations provide a rough estimate of ground water flow velocities to support Source Water Protection planning for the area. Assuming that the ground water flow direction is coincident with topography at the same gradient, ground water flows approximately 1,200 feet (0.25 miles) in a year, and 2,630 feet (0.5 miles) in three years.

Source Water Protection Management Zones

The management areas delineated for the Churchill Retirement Home PWS are depicted in Figure 4. The inventory zone is the area within a 1,000-foot radius around the facility. The recharge area includes the area the Camp Creek Hills south to southwest of Churchill; and includes the Godfrey Creek watershed shown in Figure 3 and Figure 5.

Limiting Factors

The hydrogeologic assessment presented in this section is based on the available information on the area. The approach reflects uncertainties in the available data used to estimate the time of travel distances. Limitations in the time of travel calculations result from the use of the Uniform Flow Equation for analysis of flow rates, which reflects assumed values for hydrologic properties where no data is available.

Figure 4 – Inventory Zone

INVENTORY

An inventory of potential sources of water contamination was conducted for delineated source water management zones for the Churchill Retirement Home PWS. The inventory focuses on potential sources of regulated drinking water contaminants including pathogens such as Cryptosporidium. For the SWDAR for a specific PWS, the inventory evaluates activities in the control zone, certain sites as potential contaminant source and land use activities in the inventory region, and general land uses and large facilities in the recharge region. The inventory was performed consistent with the requirements of the Montana Source Water Assessment Program (1999).

While the inventory focuses on many potential sources, only significant potential contaminant sources (DEQ, 1999) were selected for detailed inventory for each system. The significant potential contaminants in the study area include petroleum from underground storage tanks, nitrates and pathogens from sanitary sewers, septic systems and agriculture; and herbicides and pesticides from cropped agricultural land.

Inventory Method

The initial inventory steps comprise querying existing state and federal electronic databases for regulated facilities that use, store or release regulated chemicals. The steps to the database searches, and the results from each step are listed in Appendix D. The assessment of agriculture land use and urban areas, and major transportation routes through the area are shown on Figure 5. The limits of the municipal sewer system and relative density of septic systems in the area are shown on Figure 6. The database search is supplemented and verified with a "windshield survey" and a business directory search of the delineated inventory zones for each PWS in the study area. The results of the business directory search are included in Appendix D. This method helps ensure that the inventory is complete as a data collection exercise to identify all potential contaminant sources.

The results of the inventory process are summarized in Table 2, which summarizes the properties or sites within the study area. The potential contaminants are listed, with a description of the potential release mechanism for the site. In all cases, releases may occur due to unavoidable conditions such as flooding, lightning or fire. The sites where this is the primary potential release mechanism are identified as concerns resulting from such a disaster. For other sites where other release mechanisms may be more common, the potential for a release from such a disaster is assumed.

The Montana Source Water Protection Program identifies specific types of potential contaminant sources as significant, for further evaluation of the susceptibility of the water

source to these sources. The following categories of potential contaminant sources are considered significant:

1. Large quantity hazardous waste generators.
2. Landfills.
3. Underground storage tanks.
4. Known groundwater contamination (including open or closed hazardous waste sites, state or federal superfund sites, and UST leak sites).
5. Underground injection wells.
6. Major roads or rail transportation routes.
7. Cultivated cropland greater than 20 % of the inventory region.
8. Animal feeding operations.
9. Wastewater treatment facilities, sludge handling sites, or land application areas.
10. Septic systems.
11. Sewer mains.
12. Storm sewer outflows.
13. Abandoned or active mines, including gravel pits.

Figure 5 – Land Use Classification

Table 2 - Summary of Inventory Results for Churchill Retirement Home

-	Source Type	Potential Contaminants	Description/Concern
Step 1 Results			
	Agricultural Land Use	*Pathogens and Nitrates; Pesticides and Herbicides*	*Non-point source pollution, concentration of fertilizers/chemicals in surface/ground water*
	Urban Land Use	*Spills of various chemicals*	*Non-point source pollution, small spills of household chemicals*
	Sanitary Sewer System	*Pathogens and Nitrates*	*Leakage from sewer lines*
	Septic Systems	*Pathogens and Nitrates*	*Non-point source pollution, loading o f ground water system with effluent*
EPA Envirofacts Sites (Step 2)		*No sites identified*	
EPA-PCSs Sites (Step 3)		*No sites identified*	
DEQ Database (Step 4)			
	Active USTs – 1 Sites	*Petroleum Hydrocarbons*	*Spill or leak from USTs and piping*

	LUST Sites	*No sites identified*	
	CECRA Sites	*No sites identified*	
Business SIC Code Search Results* (Step 5)			
		No sites identified	
Miscellaneous Others, including Step 6			
	Abandoned Residential USTs	*Petroleum Hydrocarbons*	*Spill or leak from residual hydrocarbons in UST*
	Major Roads	*Spills of various chemicals*	*Disaster – spill/release of chemicals and fuels transported on Highway*
	Cattle Farm Operations in Godfrey Creek Watershed	*Pathogens and Nitrates from animal waste*	*Located directly adjacent to Godfrey Creek*
	Class V Injection Wells	*Various chemicals*	*Direct discharge of chemical to shallow ground water system*

* Note: Sites identified from multiple search queries are listed with the first step that identified the specific site. The results of the business SIC code search reflect types of facilities, with the number of facilities indicated in parentheses. Individual sites identified as significant potential contaminant sources are evaluated in Chapter 5.

The potential contaminant sources classified as significant are summarized in Table 3, and located in Figure 7. While other potential sources may be present within the delineated management regions, the significant sources are identified as a subset of the potential sources that are considered more likely to contaminate the PWS source aquifer under "worst-case" conditions. The following discussions identify the results of the inventory for significant potential contaminant sources within the delineated management regions for the PWS sources.

Inventory Results – Inventory Region

The inventory region is delineated as the area within a 1,000-foot radius of the Churchill Retirement Home. The primary identified threats to the PWS are summarized as follows:

- Agricultural use in the watershed, comprising cultivated lands and livestock grazing. Potential contamination from this source can infiltrate into the ground water in the alluvium, where it may be collected with the PWS source pumping from the aquifer.

- The Sanitary Sewer system may provide a conduit for contaminated waters to migrate to a position where they may infiltrate into the aquifer for the PWS. A resident of the Churchill Retirement Home indicated a location where the sewer system may be leaking to the surface. While this is a potential point source of contamination, the assessment of this point is included with the hazard ranking for the entire sewer system, which assumes that leakage occurs across the system.

- Septic System failure may result in the infiltration of contaminated waters into the source aquifer.

- Two abandoned underground storage tanks used for heating oil are still present. Closed tanks frequently have a small amount of residual fuels remaining after closure, which may leak.

- The primary route through the area represents a threat from a highway accident. Chemicals and fuels may be transported along the highway, and an accidental spill may spread contaminants around the area.

Figure 6 – Limits of Sewer System

Inventory Update

The certified operator for the Churchill Retirement Home PWS will update the inventory 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 to ensure re-certification of the source water delineation and assessment report.

Inventory Limitations

The inventory is limited by the accuracy of information in databases used for the assessment. The windshield survey provides a level of quality assurance that the information presented reflects current conditions at the time of preparation of this report. The location of Class V injection wells is not complete at this time, and is currently being compiled by EPA for the area.

Table 3. Significant potential contaminant sources for Churchill Retirement Home PWS.

	Source	Contaminants	Description
	Agricultural Land Use	*Pathogens and Nitrate; Pesticide/Herbicides (SOCs)*	*Primary concern is cultivated and grazing lands in Camp Creek Hills upstream from Churchill*
	Urban Land Use	*Various*	*The majority of the area is downgradient from the PWS sources within the city limits*
	Sanitary Sewer Main	*Pathogens and Nitrate*	*The area around PWS source is sewered. Concern from leaks and backfill around sewers providing a preferred conduit for other contaminants to migrate*
	Septic Systems	*Pathogens and Nitrate*	*Area southwest of wells and sewered area with moderate density, outside well inventory zone*
	Active UST Sites	*Petroleum Hydrocarbons*	*At location adjacent to inventory zones*
	Abandoned USTs	*Petroleum Hydrocarbons*	*Within inventory zone*
	Major Roads	*Various Chemicals*	*Transportation corridors through town, concern over an accident and spill of any transported chemicals*
	Class V Injection Wells	*Various organic chemicals*	*Not inventoried at this time (EPA responsibility); may provide conduits for chemicals into subsurface*

Figure 7 – Inventory Results

SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by an inventoried potential contaminant source. Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the PWS wells. Hazard is rated by the proximity of a potential contaminant source to the PWS source. Susceptibility ratings are presented individually for each significant potential contaminant source and each related contaminant when multiple types of potential contaminants may be present. The susceptibility of each PWS source to each potential contaminant source is assessed separately. Susceptibility for community PWS is assessed in order to prioritize potential pollutant sources for management actions by local groups that may be concerned with protecting drinking water quality.

The susceptibility assessment is designed to serve as a tool to aid in Source Water Protection Planning. The goal of Source Water Planning and Management is to protect the source water by 1) limiting and controlling certain activities in the control zone; 2) managing significant potential contaminant sources in the Inventory Region; and 3) ensuring that land use activities in the Recharge Region pose minimal threat to the source water. Management priorities in the Inventory Region are determined by ranking the significant potential contaminant sources according to susceptibility. For each identified potential contaminant source, management approaches are recommended that can reduce the relative susceptibility of each PWS source to the specific potential contaminant source, as an additional barrier.

Hazard Ratings

For confined aquifers, hazards for point sources are assigned based on the presence of other wells in the inventory zone, and how the PWS well and other wells in the area are constructed. If the PWS well does not have a proper seal through the confining layer, than the relative hazard for any potential contaminant source within the 1,000-foot inventory area is assigned a relative hazard of high, and those outside the inventory zone are assigned a relative hazard of moderate. If the PWS well has a seal through the confining layer, but other wells are present in the 1,000-foot inventory zone that do not have a seal, then the relative hazard is moderate for point sources in this area and low for other potential sources outside of the inventory zone. If all wells in the inventory region have effective seals through the confining layer, then the relative hazard is considered low for point sources within the 1,000-foot inventory area, and very low for other sources within the inventory zone.

For the two wells for the Churchill Retirement Home, there are no proper sanitary seals indicated on the well logs. The seal is indicated to comprise gravel and well cuttings on the original well logs, which does not meet the current standards for PWS. This results in a classification of all potential point sources of contamination within the inventory zone with a relative hazard ranking of high. There are many additional wells in the area, as depicted in Figure 7 and listed in Appendix C. While the hazard assessment is based on the construction criteria for the PWS wells, additional threats and hazards may be associated with poor sanitary seals due to improper construction of additional wells in the area.

When the location of septic systems are known, they are treated as point sources, with hazards assigned based on the above criteria. When this information is not available or not known, septic systems are assessed based on the relative density of septic systems in the inventory zones, treated as a non-point pollution source similar to the percent of cropped agricultural land. For non-point sources, primary hazard levels are assigned based on the relative concentration of the sources within the inventory zone, as listed in Table 4.

After the relative hazard of a potential contaminant source is assigned, the relative susceptibility is determined based on the presence of barriers that may mitigate the potential for a contaminant source to impact a water source. Barriers may represent natural conditions, engineered barriers or management actions. Natural barriers include anything that can be demonstrated as effective in mitigating the migration of any chemicals released at the surface, such as thick clay-rich soils or surface flowing artesian conditions. Engineered barriers represent man-made structure to contain chemicals if they are released, such as spill containment for underground storage tanks. Management barriers are plans that prohibit or control potentially polluting activities, but only if there if a plan or approach that has been formally implemented.

Table 4 - Non-Point Source Hazard Table

Source Type	*High Hazard*	*Moderate Hazard*	*Low Hazard*
Septic Systems	> 300 per sq. mi.	50 – 300 per sq. mi.	< 50 per sq. mi.
Municipal Sanitary Sewer (% Land Use)	> 50% of region	20% – 50% of region	< 20% of region
Cropped Agricultural Land(% Land Use)	> 50% of region	20% – 50% of region	< 20% of region

For the Churchill Retirement Home PWS sources, the only identified barrier is clay-rich soils to absorb and retard migration of any potential contaminants spilled onto the ground. This applies to all of the identified potential contaminant sources. An additional barrier for operating USTs is compliance with the 1998 EPA regulations for containment and spill prevention.

The relative susceptibility of a potential contaminant source is based on the hazard, and the number of barriers present, as described in the following table:

Table 5 - Relative Susceptibility Table.

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

The results of the susceptibility assessment for the Churchill Retirement Home PWS are listed in Table 6. The assessment is completed for the main well, but also applies to the backup well currently classified as an inactive source. However, the location of the backup well on the property grounds drawing water from a similar aquifer source results in the same potential hazards being present for the backup well. In particular, the relative

hazard is determined by the well construction information and the presence of additional wells within the inventory zone.

Susceptibility Assessment Results

For the Churchill Retirement Home PWS, the primary threats are identified as agricultural land use in the area, and the potential for leakage from sanitary sewer lines in the area.

Table 6. Susceptibility assessment of significant potential contaminant sources**.**

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Inventory Zone	-	-	-	-	-	-
Agricultural Land	Pesticides/ Herbicides/ Nitrates and Pathogens	Infiltration and Runoff	High	Clay-rich soils	High	Promote the use and development of agricultural BMPs for the area
Sanitary Sewer Main	Pathogens and Nitrate	Infiltration and Runoff	High	Clay-rich soils	High	Monitor integrity of sewer lines
Active USTs	Petroleum Hydrocarbons	Leakage, Infiltration and Runoff	High	Clay-rich soils; Compliance with 1998 EPA upgrade regulations	Moderate	Monitor operating compliance results
Abandoned USTs	Petroleum Hydrocarbons	Leakage from Residual Fuels	High	Clay-rich soils	High	Remove tanks from ground and properly dispose
Highways	Various Chemicals	Spills	High	Clay-rich soils	High	Develop emergency response plan
Recharge Area	-	-	-	-	-	-
Agricultural Land	Pesticides/ Herbicides/ Nitrates and Pathogens	Infiltration and Runoff	Moderate	Clay-rich soils	Moderate	Promote the use and development of agricultural BMPs for the area

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