# Cherry Creek WUA
# Public Water System

**PWS ID # MT0000228**

# ***Source Water Delineation and Assessment Report***

**Date of Report: November 16, 2010**

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# EXECUTIVE SUMMARY

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

The Sunny Hills Suburban Subdivision (which is also a PWS) is located adjacent to Cherry Creek to the east. A separate Source Water Delineation and Assessment report will be prepared for Sunny Hills Suburban WUA and it is recommended that the two WUAs work together towards protection of the local drinking water.

Based on the sanitary surveys, well logs, and regional geology, alluvial sand and gravel channel material along Cherry Creek is providing water to the PWS wells. In accordance with the Montana Source Water Protection Program criteria (1999), the aquifer (source water) is considered to have a moderate to high sensitivity to potential contaminant sources because the aquifer is a semi-confined to unconfined alluvial aquifer. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

Three types of source water protection management regions for the Cherry Creek WUA public water system were mapped as part of this assessment. They are the control zone, inventory region and the recharge region. Potential sources of contamination were identified within each of these three regions and the results are as follows:

- The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's wells or immediate surrounding areas. The control zone is delineated as a 100-foot radius around the wells and all sources of potential contaminants should be excluded in this region. No sources of potential contamination were identified within the control zone.
- The inventory region should be managed to prevent contaminants from reaching the wells before natural processes reduce their concentrations. The inventory region includes the area of land overlying the aquifer upgradient (northeast) of the wells along Cherry Creek that is expected to supply groundwater recharge to the wells over the next three years. Significant potential contaminant sources identified within the inventory region include: the golf course, residential development on a sewer systems, a facultative sewage lagoon, and Highway 2.
- The goal of management in the recharge region is to maintain and improve water quality over long periods of time or increased usage. The recharge region for the Cherry Creek WUA wells includes the alluvial channel fill sediments upgradient (northeast) of the PWS wells along Cherry Creek for about 10 miles. Agricultural land use was the only significant potential contaminant sources identified in the recharge region.

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the public water supply well intakes. **The Cherry Creek WUA public water supply has a low to**

**very low susceptibility to the golf course and sewered residential area and a moderate susceptibility to the residential treatment system (lagoon), highway, and agricultural areas. The water system and community consider potential risks to the protection area if future land use changes are made.** This provides a quick look at the existing potential sources of contamination that could, if improperly managed or released, impact the source water for Cherry Creek WUA. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to focus resources for protection of this valuable drinking water resource.

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

# INTRODUCTION

This Source Water Delineation and Assessment Report (SWDAR) was prepared for the Cherry Creek Water Users Association (WUA) Public Water Supply, PWS ID# MT0000228, located in Valley County. It was completed by Julie Harvey with the Source Water Protection Program at the Department of Environmental Quality with the assistance of John Peterson, Cherry Creek WUA water system operator.

## PURPOSE

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Cherry Creek WUA Public Water System (PWS) as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (Public Law 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 Cherry Creek WUA protect its drinking water sources.

## LIMITATIONS

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

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

# CHAPTER 1
# BACKGROUND

## THE COMMUNITY

Cherry Creek WUA is located in Valley County approximately 1½ miles northwest of Glasgow on US Highway 2 (Figure 1). The U.S. Census Bureau estimates the 2000 population of Valley County at 7,675 people with about half (3,253) of these people residing in Glasgow (http://factfinder.census.gov).

Cherry Creek WUA serves 180 people through 59 service connections (lots/hook ups). Cherry Creek WUA's public water system (PWS) is classified as a Community PWS because it serves more than 25 residents. Drinking water to the WUA is supplied by three wells located between the creek and the highway southeast of the subdivision (Figure 1) and the subdivision is served by a community sewer system which discharges to a lagoon located west of Highway 2 (personal correspondence with the PWS operator, 6/22/2004). The Sunny Hills Suburban Subdivision (which is also a PWS) is located adjacent to Cherry Creek to the east. A separate Source Water Delineation and Assessment report will be prepared for Sunny Hills Suburban and it is recommended that the two WUAs work together towards protection of the local drinking water.

## GEOGRAPHIC SETTING

Glasgow is located in the glaciated central groundwater region of the United States (Heath, 1984). The elevation of Glasgow is approximately 2100 feet above mean sea level. The town is situated on the north bank of the Milk River floodplain, approximately 17 miles northwest of the Milk River confluence with the Missouri (Figure 1). The Milk River valley is approximately 1.5 miles wide in the vicinity of Glasgow.

The glaciated topography in the vicinity of town exhibits relatively low relief, typically less than 100 feet over several miles (Donovan, 1988). The City of Glasgow is built on the Milk River floodplain. The floodplain is bordered by poorly defined benches, which are capped by glacial deposits and dissected by numerous drainages. An extensive perennial Milk River tributary drainage, Cherry Creek, is located approximately one mile north of town (Figure 1). Cherry Creek WUA is located in the Cherry Creek watershed, U.S. Geological Survey (USGS) hydrologic unit code (HUC) Number 10050012, which is located within the Lower Missouri River Watershed Management Region for Montana. The Cherry Creek Watershed extends northward from the confluence of Cherry Creek with the Milk River to Cherry Creek's headwaters approximately 8 miles north of the Glasgow Air Force Base.

***Figure 1*. *Vicinity Map and Well Locations***

## CLIMATE

Information on climate in the Cherry Creek WUA area is based on the National Oceanic and Atmospheric Administration's (NOAA) Glasgow WSO Airport climate station located at an elevation of 2,280 feet above mean sea level (Western Regional Climate Station). Average temperatures and total precipitation for the period of record are shown in Table 1.

***Table 1. Period of Record Monthly Climate Summary Glasgow WSO Airport***

Station (243558) Period of Record: 11/1/1955 to 12/31/2003

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max. Temperature (F) | 20.4 | 27.5 | 39.9 | 56.0 | 67.9 | 76.8 | 84.5 | 83.8 | 71.0 | 58.0 | 38.7 | 26.3 | 54.2 |
| Average Min. Temperature (F) | 1.4 | 7.9 | 18.8 | 31.5 | 42.5 | 51.5 | 56.9 | 55.7 | 44.3 | 33.1 | 18.4 | 7.1 | 30.8 |
| Average Total Precipitation (in.) | 0.36 | 0.26 | 0.40 | 0.76 | 1.59 | 2.39 | 1.80 | 1.30 | 0.89 | 0.63 | 0.38 | 0.34 | 11.11 |
| Average Total SnowFall (in.) | 6.7 | 4.2 | 4.4 | 2.6 | 0.9 | 0.0 | 0.0 | 0.0 | 0.2 | 1.1 | 4.1 | 5.7 | 29.9 |
| Average Snow Depth (in.) | 4 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 |

## GENERAL DESCRIPTION OF THE SOURCE WATER

Cherry Creek WUA's drinking water is supplied by three wells located between the creek and the highway southeast of the subdivision. The wells were completed at a relatively shallow depth of about 65 feet deep and draw water from a gravel layer. The static water levels measured at the time of drilling ranged from 16 to 27 feet below surface. The drinking water source material is interpreted to be alluvial sand and gravel channel material that was deposited in the Cherry Creek channel. The aquifer is semi-confined to unconfined and the groundwater flow direction in the vicinity of the wells is towards the southwest along the Cherry Creek channel. Recharge to the wells is likely from infiltration of precipitation and surface water through the overlying alluvial materials. Additional detail on the geology and hydrogeology of the area is provided in Chapter 2.

## THE PUBLIC WATER SUPPLY

The Cherry Creek WUA is classified as a community public water system (PWS) since it serves at least 25 of the same people every day. Information on the water system was obtained from correspondence in the DEQ Public Water Supply Section files including the most recent sanitary surveys completed on April 10, 2001 (report dated May 5, 2001 included in Appendix A) and personal communication with the PWS operator.

Cherry Creek WUA serves 180 people through 59 service connections (lots/hook ups). The WUA uses three wells located between the creek and the highway southeast of the subdivision for its drinking water supply. The pump in each well delivers 80 to 90 gallons per minute. The distribution system includes two storage tanks on the hill to the northeast of the subdivision and plastic piping looping through the subdivision. A schematic map of the system is provided in the Sanitary Survey in Appendix A. The drinking water is not continuously treated at this time; however, the operator periodically chlorinates the storage tanks using solid chlorine tablets.

A preliminary assessment of groundwater sources under the direct influence of surface water (GWUDISW) was completed in 2001 and the water is classified as groundwater.

## WATER QUALITY

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliform and other signs of pathogenic organisms, nitrates, metals and multiple organic 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. PWS monitoring schedules are available at http://nris.state.mt.us/wis/swap/swapquery.asp. The Cherry Creek WUA PWS monitoring data from DEQ's PWS database for the past five years was reviewed and is summarized in this section.

The compounds detected in Cherry Creek WUA's source water monitoring over the past 5 years include nitrite + nitrate (0.81 to 1.98 mg/L), fluoride (0.46 to 0.5 mg/L), selenium (0.008 mg/L), and sulfate (450 mg/L). The compounds detected are all below EPA primary maximum contaminant levels (MCLs) where established. National secondary drinking water standards (SMCLs) are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as taste, odor, or color) and are generally not a health risk. The sulfate concentration detected in the drinking water (450 mg/L) exceeds the SMCLs for sulfate of 250 mg/L. Coliform has not been detected at confirmed levels in the source water.

# CHAPTER 2
# DELINEATION

The source water protection area, the land area that contributes water to the Cherry Creek WUA's PWS is identified in this chapter. Three management areas are identified for a PWS's source water protection area. These three regions, the control zone, inventory region, and recharge region, are delineated for the wells. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around each well. The inventory region represents the zone of contribution of the wells, which typically approximates a three-year groundwater time-of-travel. Analytical equations describing groundwater flow using estimates of pumping and aquifer characteristics and simple hydrogeologic mapping are used to calculate groundwater time-of-travel distance. The recharge region represents the area where the source aquifer for the Cherry Creek WUA water system wells are replenished.

## GENERAL GEOLOGIC AND HYDROGEOLOGIC SETTING

This section provides an overview of the geology and hydrology of the Cherry Creek WUA area and is based on a primarily on a geologic map of the area by Bergantino (1999) and the well logs for the Cherry Creek WUA PWS wells and regional well logs available from the Montana Bureau of Mines and Geology (MBMG) Ground-Water Information Center (GWIC). A regional geologic map is provided in Figure 2. 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 contaminant sources.

The stratigraphy in the Glasgow area generally consists of alluvial, terrace and glacial deposits which overly the bedrock of the Bearpaw Shale. The alluvium is primarily present at the surface in the larger stream valleys and consists of fine- to coarse-grained floodplain deposits of gravel, sand, silt and clay. Remnant terrace deposits consisting of alluvial and glacially-derived silt, sand and gravel are present on the hillsides and in the valleys.

The alluvial and terrace deposits (Qal and Qac on Figure 2) are underlain by the Bearpaw Shale which consists of dark gray shales with thin fine-grained sandstone and siltstone beds. In general, the shale layers do not yield water to wells but some of the thin sandstone beds may yield small quantities (usually less than 15 gallons per minute) of water to stock or domestic wells.

***Figure 2.*** ***Geology of the Area***

## PWS WELL INFORMATION

Cherry Creek WUA's drinking water is supplied by three wells located between the creek and the highway southeast of the subdivision. The wells were completed at a relatively shallow depth of about 65 feet deep and draw water from a gravel layer. The static water levels measured at the time of drilling ranged from 16 to 27 feet below surface. The drinking water source material is interpreted to be alluvial sand and gravel channel material that was deposited in the Cherry Creek channel. The aquifer is semi-confined to unconfined and the groundwater flow direction in the vicinity of the wells is towards the southwest along the Cherry Creek channel. Recharge to the wells is likely from infiltration of precipitation and surface water through the overlying alluvial materials.

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***Table 2. Summary of PWS Well Log Information***

| **Cherry Creek WUA Well Number** | **Well #2** | **Well #3** | **Well #4** |
|---|---|---|---|
| DEQ Well Name/ Source Code | Well #1<br>WL002 | Well #2<br>WL003 | Well #3<br>WL004 |
| GWIC ID | 39749 | 39734 | 39741 |
| DNRC Water Right | W013089-00 | P023059 | W013088-00 |
| Well Location | NE¼, NE¼, NW¼, Sec.2, T28N, R39E | NE¼, NE¼, NW¼, Sec.2, T28N, R39E | NE¼, NE¼, NW¼, Sec.2, T28N, R39E |
| Well Elevation | Approx. 2,100 feet | Approx. 2,100 feet | Approx. 2,100 feet |
| Date Completed | 4/26/1957 | 8/6/1978 | 7/19/1965 |
| Total Depth (bgs) | 65 feet | 68 feet | 65 feet |
| Well Completion: Casing | 5" casing from 0 to 60 feet below surface | 8" casing from 0 to 68 feet below surface | 8" casing from 0 to 65 feet below surface |
| Well Completion: Screen | Casing perforated from 55-60 feet in "coarse gravel" | Casing perforated from 53-63 feet in "gravel and water" | Open bottom at 65 feet in "coarse gravel" |
| Well Completion: Annular Seal | No seal records currently in GWIC. | No seal records currently in GWIC. "Heavy brown clay" encountered from 21 to 34 feet below surface | No seal records currently in GWIC. "clay" encountered from 0 to 31 feet below surface |
| Static Water Level (at time of drilling) | Not recorded | 27 feet | 23 feet |
| Well Pump Test Data | Pumping water level of 20 feet after 36 hours of pumping at 90 gpm | Pumping water level of 50 feet after 3 hours of pumping at 85 gpm | Pumping water level of 25 feet after 4 hours of pumping at 60 gpm |

## CONCEPTUAL MODEL AND ASSUMPTIONS

Cherry Creek WUA's production wells are located in the Cherry Creek watershed (USGS Hydrologic Unit Code 10050012) which is located within the Lower Missouri River Watershed Management Region for Montana. Cherry Creek WUA's drinking water source is interpreted to be alluvial sand and gravel channel material that was deposited by Cherry Creek or the Milk River. Groundwater flow direction is from the northeast towards the southwest along Cherry Creek. The aquifer is semi-confined to unconfined and recharge to the wells is primarily from infiltration of surface water and precipitation through the overlying sand and

gravel.

Using DEQ Source Water Protection Program criteria for ranking aquifer sensitivity (Table 3), the Cherry Creek WUA source water is considered as having **High to Moderate Source Water Sensitivity** to contamination because the aquifer is an unconfined to semi-confined unconsolidated alluvial aquifer. Sensitivity is defined as the relative ease that contaminants can migrate to source water.

***Table 3. Source Water (Aquifer) Sensitivity Criteria***

Based on DEQ Source Water Protection Program Criteria (DEQ, 1999)

| High | Moderate | Low |
|---|---|---|
| • Surface water and GWUDISW<br>• Unconsolidated Alluvium (unconfined)<br>• Fluvial-Glacial Gravel<br>• Terrace and Pediment Gravel<br>• Shallow Fractured or Carbonate Bedrock | • Semi-consolidated Valley Fill sediments (semi-confined)<br>• Unconsolidated Alluvium (semi-confined) | • Consolidated Sandstone Bedrock<br>• Deep Fractured or Carbonate Bedrock<br>• Semi-consolidated<br>• Confined Aquifers |

**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 the Cherry Creek WUA PWS include a control zone, an inventory region and a recharge region. The delineated management zones for the wells are shown on Figure 3.

*Control Zone* – A 100-foot radius control zone is delineated for Cherry Creek WUA's wells. All sources of potential contaminants should be excluded in this region.

*Inventory Region* - For the Cherry Creek WUA wells, the DEQ's Source Water Protection Program criteria for an unconfined aquifer system was followed. The inventory zone was delineated based on a groundwater time-of-travel (TOT) distance of three years. This distance was determined using a simple groundwater flow model using the uniform flow equation (EPA, 1991). Conservative estimates for aquifer properties were made using available data from published reports and the information on the well logs. A summary of the time of travel calculations is included in Appendix B and the results of the calculations indicate an estimated distance of approximately 1½ miles upgradient for a three-year TOT and ½ mile upgradient for a one-year TOT. The lateral extent of the inventory region was limited to the alluvial channel deposits as mapped by Bergantino (1999) and shown on Figure 2. All sources of potential contaminants are inventoried in this region.

*Recharge Region* –The recharge region for the Cherry Creek WUA wells includes the alluvial channel material upgradient (north and northeast) of the PWS wells. In general, the alluvial materials mapped by Bergantino (1999) (Figure 2) are about ½ mile wide so a buffer of ¼-mile was applied to the creek. The upgradient extent of the recharge region was limited to approximately ten miles along the creek upstream of the wells. The inventory for the recharge region focuses on general land uses and large industrial facilities. The goal of management in the recharge region is to maintain and improve the long-term quality of groundwater in the aquifer.

## LIMITING FACTORS

Delineation of the source water protection areas for the Cherry Creek WUA PWS wells is based on published reports and lithology indicated on the well logs. The interaction of surface water with the alluvial channel deposits is not completely understood and the changes in the flow regime under seasonal conditions are not

known. The delineation was completed using conservative assumptions to help ensure that the inventory zone reflects the actual area where contamination to the system may occur.

***Figure 3.*** ***Drinking Water Protection Areas and Potential Sources of Contamination***

# CHAPTER 3
# INVENTORY

## INVENTORY METHOD

An inventory of significant potential contaminant sources was conducted to assess the susceptibility of Cherry Creek WUA's wells to contamination and to provide a foundation for source water protection planning. The inventory for Cherry Creek WUA 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 pathogens are identified, although only potential sources of contaminants that are the greatest threat to human health were selected for detailed inventory.

It is important to remember that the sites and areas identified in this section are only potential sources of contamination to the drinking water. Contamination of the drinking water is not likely to occur when potential contaminants are properly used and managed. Not all of these inventoried activities pose actual high risks to your public water supply. The day-to-day operating practices and contamination awareness varies considerably from one facility or land use activity to another.

The inventory for the Cherry Creek WUA PWS focuses on all activities in the control zones for the wells; certain types of municipal and private facilities or land uses in the inventory region; potential sources of nitrates and pathogens in the surface water buffer; and general land uses and large facilities in the Recharge Region. Databases were searched to identify businesses and land uses that are potential sources of regulated contaminants. The process for completing the inventory included several steps, which are summarized as follows:

Step 1: Urban and agricultural land uses were identified from the U.S. Geological Survey's Geographic Information Retrieval and Analysis System (http://nris.state.mt.us/gis/datalist.html). Sewered and unsewered residential land uses were identified from boundaries of sewer coverage obtained from municipal wastewater utilities.

Step 2: EPA's Envirofacts System (http://www.epa.gov/enviro/) was queried to identify EPA regulated facilities located in the inventory region. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) and the Permit Compliance System (PCS - for Concentrated Animal Feeding Operations with MPDES permits). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.

Step 3: Databases were queried to identify the following in the inventory region:

- Underground Storage Tanks (UST) (http://www.deq.state.mt.us/UST/USTDownloads.asp)
- Hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau),
- Landfills (http://nris.state.mt.us/gis/datalist.html), and
- Abandoned and active mines including gravel pits (http://nris.state.mt.us/gis/datalist.html)

  Any information on past releases and present compliance status was noted.

Step 4: A business phone directory was queried to identify businesses that generate, use, or store chemicals in the inventory region. Equipment manufacturing and/or repair facilities, printing or photographic shops, dry

cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by Standard Industrial Classification (SIC) code.

Step 5: Major road and rail transportation routes were identified throughout the inventory region (http://nris.state.mt.us/gis/datalist.html).

Step 6: Public water system officials, or someone they designated as knowledgeable of the area, were interviewed to identify potential sources that are not listed in databases or on maps elsewhere (such as animal feeding operations that are not required to obtain a permit) and to assist in locating potential sources listed in the state and federal databases.

Step 7. Significant potential contaminant sources were identified in the control zone and inventory region and land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the recharge region

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

1. Large quantity hazardous waste generators.
2. Landfills.
3. 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 well.
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

## CONTROL ZONE INVENTORY RESULTS

The 100-foot control zone for the wells includes the well house and adjacent undeveloped land. The well casings all extend at least 18-inches above floor of the well house and are properly sealed. The PWS either has easements or leases the control zone area around the wells to ensure protection of this area (personal communication with PWS operator, 6/22/04).

No potential sources of contamination were identified within the control zones for the wells. No information was provided on the well logs to indicate that the wells are sealed or grouted between the borehole and the well casing which may indicate that the wells are highly susceptible to water and other contaminants reaching the water table along the well casing. The PWS should be vigilant to ensure that potential sources of contamination are excluded from the control zone and that positive drainage away from each well casing is maintained.

## INVENTORY REGION RESULTS

The inventory results for Cherry Creek WUA's source water are summarized in Table 4 and are shown on Figure 3 and Figure 4. Land uses within the inventory region include primarily undeveloped grasslands along the creek, the golf course, and some low intensity residential property located east of the creek. Other potential sources of contamination noted include a sewage treatment lagoon and Highway 2. Septic system density within the inventory region is low and is not considered a risk to the PWS drinking water. Additional point sources of potential pollutants (such as businesses or facilities listed on regulatory databases) were not identified in the inventory region. (Note: the railroad line identified on the topographic map is no longer active).

***Table 4. Summary of Potential Contaminant Sources in the Inventory Region***

| *Source Type* | *Potential Contaminants* | *Description/Concern* |
|---|---|---|
| **Land Use Cover (Step 1)** | | |
| Sunnyside Golf Course | Pathogens, nitrates, pesticides and herbicides | Over-application or improper handling of pesticides or fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants or sediments to groundwater |
| Residential Development with Sewer Lines | Pathogens and nitrates | If not properly designed, installed, and maintained, sewer lines can be a point source of residential and commercial effluent in groundwater. |
| **EPA Envirofacts Sites (Step 2)** | | |
| Valley County SID #2<br>Facultative Sewage Lagoon<br>NPDES Permit # MTG580027 | Pathogens and nitrates | Improper seepage or overflows of liquid wastes or management of wastewater, treatment chemicals, or equipment maintenance materials may impact drinking water supply. |
| **DEQ Databases (Step 3)** | | |
| None identified | | |
| **Business – SIC Code Sites (Step 4)** | | |
| None Identified | | |
| **Miscellaneous Others, including Step 5 and 6** | | |
| Transportation Corridor – Highway 2 | Nitrates, pesticides and herbicides, various others | Vehicle usage increases the risks for leaks or spills of fuels and other hazardous materials that may impact drinking water. Over-application or improper handling of pesticides or fertilizers may impact the drinking water supply. |

Notes: Individual sites identified are evaluated in Chapter 4.

***Figure 4. Land Use and Potential Sources of Contamination in the Protection Areas***

## RECHARGE REGION INVENTORY RESULTS

Land use in the recharge region is reported in the 1992 National Land Cover dataset (Figure 4) to be primarily grasslands and deciduous forests with agricultural land in the upper reaches. There are also several gravel pits identified, however, gravel pits are generally not considered a risk to the water supply unless there is significant illegal dumping or equipment operations. The percentage of agricultural land is considered a moderate risk to the drinking water supply. Grasslands or forests are not considered potential sources of contamination unless there are significant grazing operations in the area.

Septic system density within the watershed/recharge region is low and is not considered a risk to the PWS drinking water.

Additional point sources of potential pollutions (such as businesses or facilities listed on regulatory databases) were not identified in the recharge region.

## INVENTORY UPDATE

To make this SWDAR a useful document for the years to come, the certified water system operator should update the inventory for his records every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. The complete inventory should be submitted to DEQ every five years to ensure the source water delineation and assessment remains current.

## INVENTORY LIMITATIONS

The potential contaminant sources 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 Cherry Creek WUA's public water supply have been identified. The lack of identification of a potential contaminant source in the inventory or susceptibility assessment of this report does not mean that the potential for contamination does not exist or there is not a threat. It is highly recommended that the PWS and community "enhance" or refine the identification of the potential contamination sources through further research and local input.

# CHAPTER 4
# SUSCEPTIBILITY ASSESSMENT

## GENERAL DISCUSSION

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose a concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case the Cherry Creek WUA PWS managers and operators. The goal of Source Water Management is to protect the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources in the inventory region, and 3) ensuring that major land use activities or other significant activities in the recharge region pose minimal threat to the source water. Management priorities in the inventory region are determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches that could be pursued by the PWS managers and operators to reduce susceptibility are recommended in this chapter.

## HAZARD DETERMINATION

The proximity of a potential contaminant source to a spring or well intake, potential contaminant migration pathways, or the density of potential non-point contaminant sources determines the threat of contamination, referred to here as hazard (Table 5). Hazard and the existence of barriers to contamination determine susceptibility, which is described in Table 6. Table 5 below describes the criteria to determine hazard within the inventory region as it was delineated in this SWDAR. Note that this table is specific to PWSs that draw their water from unconfined aquifers. The determination of hazard is somewhat different for other types of water sources.

***Table 5. Hazard of Potential Contaminant Sources for Well Drawing Water from Unconfined Aquifers***

| Type of Potential Contaminant Source | High Hazard | Moderate Hazard | Low Hazard |
|---|---|---|---|
| **Septic System Density** (# per square mile) | More than 300 septic systems per sq. mile | Between 50 and 300 septic systems per sq. mile | Less than 50 septic systems per sq. mile |
| **Municipal or Community Sanitary Sewer** (% land use) | More than 50 percent of the inventory region | Between 20 and 50 percent of the inventory region | Less than 20 percent of the inventory region |
| **Agricultural** (% land use) | More than 50 percent of the inventory region | Between 20 and 50 percent of the inventory region | Less than 20 percent of the inventory region |
| **Point sources of all contaminants** | Within 1-year TOT | Between 1 to 3 years TOT | Over 3 years TOT |

Note: Highlighted areas are those relevant to the Cherry Creek WUA inventory region
TOT – Time of travel

## DISCUSSION OF SUSCEPTIBILITY

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 Cherry Creek WUA PWS well intakes (Table 6).

***Table 6. Susceptibility Based on Hazard and Barriers***

| 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 |

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

Two of the three well logs indicates that a significant (13 to 31-foot) layer of clay is present overlying the aquifer. Clay layers were also identified in other well logs in the area indicating that the layer is likely laterally extensive in the Cherry Creek valley. The clay serves as a natural barrier to the downward migration of potential contaminants from the surface.

A summary of the susceptibility assessment for Cherry Creek WUA PWS production wells is located in Table 7. Because a contaminant source has not been identified in the inventory or susceptibility assessment of this report, it doesn't mean that the potential for contamination does not exist or is not a threat. Table 7 only includes the potential contaminant sources identified in Chapter 3 that were determined to present a <u>significant</u> potential risk to the drinking water supply. It is highly recommended that the PWS operator and community members familiar with the nature of businesses and land use in the area enhance the inventory through further research and local input.

***Table 7. Susceptibility Assessment of Significant Potential Contaminant Sources***

| Potential Contaminant Source | Potential Contaminants | Hazard | Hazard Rating | Barriers | Susceptibility | Management Recommendations |
|---|---|---|---|---|---|---|
| ***Inventory Region*** | | | | | | |
| Transportation Corridor Highway 2 | Pesticides, fertilizers, VOCs, SOCs, other | Spills, routine spraying, storm water runoff, infiltration into groundwater | ***High*** | - Clay layers overly the aquifer<br>- County Emergency Response Plan, training and preparation of local response personnel | ***Moderate Susceptibility*** | Notify landowners of well and protection area locations. Encourage and support emergency planning, training of local emergency response personnel, use of levees and engineered storm drainage to carry any spills away and prevent infiltration into ground, cooperation with railroad managers or MDOT to reduce herbicide use. |
| Valley County SID #2 Facultative Sewage Lagoon | Pathogens, nitrates | Ongoing or catastrophic leakage of sewage into groundwater | ***High*** | - Clay layers overly the aquifer<br>- Located down gradient from the wells<br>- The creek is between the wells and the lagoon (dilution) | ***Moderate Susceptibility*** | Ongoing inspection and maintenance, rapid response planning for leaks and ruptures |
| Sunnyside Golf Course | Nitrate and SOCs from fertilizer, pesticides and herbicides. | Contaminants leaching into groundwater | ***Moderate*** | - Clay layers overly the aquifer<br>- The creek is between the wells and the golf course (dilution) | ***Low Susceptibility*** | Work with Golf Course owners/operators to encourage use of best management practices (BMPs) and the development of an integrated pest management plan that is protective of the drinking water. |
| Residential Sewer System | Pathogens, nitrates | Ongoing or catastrophic leakage of sewage into groundwater | ***Low*** | - Clay layers overly the aquifer<br>- The creek is between the wells and the residential area (dilution) | ***Very Low Susceptibility*** | Maintenance, rehabilitation, or replacement of existing sewer mains, use of sewer main liners, rapid response planning for leaks or ruptures. |
| ***Recharge Region*** | | | | | | |
| Agricultural Crop Land | Nitrate and SOCs from fertilizer, pesticides and herbicides. Pathogens (if grazing occurs) | Contaminants leaching into groundwater | ***Moderate*** | - Clay layers overly the aquifer | ***Moderate Susceptibility*** | Encourage use of agricultural best management practices (BMPs) in the recharge region |

**Notes:** VOCs - Volatile organic compounds (i.e. solvents, fuel components) SOCs - Synthetic Organic Compounds (i.e. pesticides, herbicides, plasticizers)

The susceptibility assessment results for each significant potential contaminant source identified within the Inventory Region are described below. Sources located outside the Inventory Region, but within the Recharge Region may still pose a threat over time, but are not discussed in detail.

***Highway 2***– The potential hazard imposed by spills and routine spraying from the highway is high. The clay layers and emergency response planning serve as a barriers so the overall susceptibility is ranked as moderate.

***Sunnyside Golf Course***– The potential hazard imposed by nitrates, pesticides and pathogens originating from the golf course is moderate based on the percent of the total land use in the inventory region. The clay layers serve as a barrier to downward migration and the creek serves as a barrier so the overall susceptibility is ranked as low.

***Residential Sewer System*** – Residential sewer mains are present in the development east of the wells within the 1-year TOT of the inventory region. The potential hazard imposed by pathogens and nitrate originating from municipal sewer system is moderate. The clay layers serve as a barrier and the creek serves as a barrier and the overall susceptibility is rated as low.

***Lagoon/Wastewater Treatment System*** – The Valley County SID #2 facultative sewage lagoon is present on the southern (down gradient) boundary of the inventory region. The potential hazard imposed by pathogens and nitrate originating from lagoon is high since it is a potential point-source of contamination in the 1-year TOT. The clay layers, creek, and the down gradient location serve as barriers and the overall susceptibility is rated as moderate.

## MANAGEMENT RECOMMENDATIONS

It should be noted that even small releases of some chemicals in close proximity to a public water supply well can have significant negative impact on water quality, and therefore are a significant threat to the public water supply. Steps can be taken to reduce the likelihood of releases in the source water for the PWS or in the vicinity of the sources. Some of these management recommendations are detailed in the susceptibility table for the Cherry Creek WUA PWS (Table 7). If these, and other, management recommendations are implemented; they may be considered additional barriers that will reduce the susceptibility of the intake to specific sources and contaminants.

***Restrict Chemical Handling, Use and Storage in Control Zones***– Cherry Creek WUA should restrict chemical handling, use and storage within the control zones for the production wells (including pesticides and herbicides for lawn care). Ongoing training to promote safe handling and proper storage, transport, use, and disposal of hazardous materials should be provided if these materials are used in the control zone.

***Golf Course/Agricultural Best Management Practices (BMPs)*** – The water system should encourage land users to utilize BMPs to limit the application of pesticides, herbicides, and fertilizers in the inventory and recharge region. If significant grazing occurs in the recharge region, land users should be encouraged to keep the concentration of livestock low and to keep livestock away from Cherry Creek immediately up gradient of the wells.

***Sewer/Wastewater Treatment System Maintenance and Leak Detection*** – Early warning of leaks and scheduled replacement of aging sewer lines and wastewater treatment systems may reduce the susceptibility of the PWS to contamination from septic wastes.

***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

The Cherry Creek WUA PWS has a waiver for Phase 2 inorganics (which includes barium, cadmium, chromium, fluoride, mercury and selenium). The waiver allows the WUA to collect one sample round for these constituents every 9-year cycle (the standard is one sample round per 3-year cycle). In addition, the WUA was grandfathered under the radionuclide rule and is only required to sample once every 9-years. Based on past monitoring results and the susceptibility assessment, the Cherry Creek WUA PWS may be eligible for other waivers as well including Phase 5 inorganics and volatile organic compounds. Information on susceptibility and use waivers is provided in this section to give the PWS operators an opportunity to consider if waivers may be feasible.

Before a susceptibility or use wavier is requested, 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 should submit a letter to DEQ requesting the specific monitoring waivers. The PWS must be in compliance with monitoring requirements to be considered. If requested by DEQ, the PWS may also need to provide additional information regarding chemical use in the area within the Inventory Region. Table 8 shows how identified potential contaminant sources affect the eligibility for monitoring waivers.

***Table 8. Susceptibility Assessment as it relates to Waiver Eligibility for Significant Potential Contaminant Sources in the Inventory Region***

| Source | Contaminant | Susceptibility | Waiver Eligibility |
|---|---|---|---|
| **Transportation Corridor** | VOCs, SOCs, petroleum products and other chemicals | **Moderate** | Chemical use in right-of-way may preclude waivers for some chemicals. PWS should confirm chemical use history along the right-of-way. Waivers might be rescinded if a spill occurred. |
| **Sewer System/ Wastewater Treatment** | Nitrates, pathogens | **Moderate to Very Low** | Waivers are not available for pathogens and nitrate. Sewer system integrity may preclude waivers. The PWS should provide information of sewer assessment and maintenance. |
| **Golf Course** | Nitrates and SOCs | **Low** | Chemical use may preclude waivers for some chemicals. The PWS should confirm chemical use/storage history by land parcel. |

## MONITORING WAIVER REQUIREMENTS

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

Use Waivers

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

Susceptibility Waivers

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

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

Susceptibility Waiver for 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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Western Regional Climate Center Montana Climate Summaries. wrcc@dri.edu

# GLOSSARY*

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

**Alkalinity.** The capacity of water to neutralize acids.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Hydrogeology.** The study of geologic formations and how they effect groundwater flow systems.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

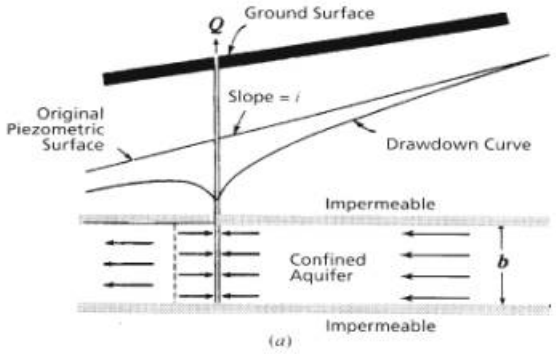
The definitions for Phase II and Phase V Rules were adapted from:

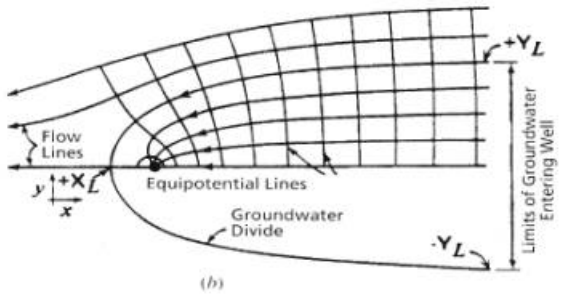
http://www.epa.gov/OGWDW/source/therule.html#PhaseII
http://www.epa.gov/OGWDW/source/therule.html#PhaseV

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

# Appendix A
# PWS Sanitary Survey and
# PWS Well Logs

# Appendix B
# Groundwater Time-of-Travel Calculations




$$-\frac{Y}{X} = \tan\left(\frac{2\pi Kbi}{Q}Y\right)$$

Uniform-Flow Equation

$$X_L = -\frac{Q}{2\pi Kbi}$$

Distance to Down-Gradient Null Point

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

Boundary Limit

**Legend:**

- Pumping Well

**Where:**

Q = Well Pumping Rate
K = Hydraulic Conductivity
b = Saturated Thickness
i = Hydraulic Gradient
π = 3.1416

## Model Input

The values selected for the calculation of time of travel represent conservative assumptions made to identify areas that may potentially impact the Cherry Creek WUA PWS. The criteria for selection of each value used for this delineation are as follows:

- ***Thickness***: The value for the thickness of the aquifer is estimated at 10 feet based on the estimated thickness of the aquifer from the well logs and the screened interval
- ***Hydraulic Conductivity***: A value for hydraulic conductivity (K) is estimated at 500 feet/day which is in accordance with the standard range of hydraulic conductivities for unconsolidated well-sorted gravel and sand (per Fetter) and is within the range of values calculated based on pumping test data (specific capacity) at the time of drilling which were 438 feet/day for Well #2, 274 feet/day for Well #3, and 1,113 feet/day for Well #4.
- ***Hydraulic Gradient***: The hydraulic gradient was estimated based on local topography. The estimated gradient is 20 feet per 5700 feet = 0.0035 feet/feet.
- ***Flow Direction***: The flow direction is to the southwest along the channel of Cherry Creek.
- ***Porosity***: The value for effective porosity is estimated from (Todd, 1980) at 25% which is typical for gravel and sand.
- ***Pumping Rate***: The pumping rate was estimated based on a conservative estimate of full time pumping at 90 gallons/minute. Divide by 7.48 gallons/ $ft^3$ = 17,326 $ft^3$/day.

**Delineation Results**

The results of the calculations are shown below.

| | | | 3-yr TOT | 1-year TOT |
|---|---|---|---|---|
| **Pumping Rate** | **Q** | **ft3/day** | 17326 | 17326 |
| **Hydraulic Conductivity** | **K** | **ft/day** | 500 | 500 |
| **Saturated Thickness** | **B** | **ft** | 10 | 10 |
| **Hydraulic Gradient** | **I** | **ft/ft** | 0.0035 | 0.0035 |
| **Effective Porosity** | **N** | **%** | 0.25 | 0.25 |
| **Time of Travel Limit** | **Tx** | **days** | **1095** | **365** |
| **Stagnation Point** | **-X** | **ft** | **-157** | **-157** |
| **Boundary Limit** | **½ (YL)** | **ft** | **3435** | **1255** |
| **TOT Distance Threshold** | **XL** | **ft** | **7292** | **3029** |
| **TOT Distance Threshold** | **XL** | **miles** | **1.57** | **0.57** |
| **Average Velocity** | **V** | **ft/day** | **7.57** | **8.30** |

Tx = travel time from point x to a pumping well (days)

K = hydraulic conductivity (ft/day)

b = aquifer thickness (ft)

I = hydraulic gradient (ft/ft)

Q = average production rate (ft3/day)

n = effective porosity (%)

X = distance from pumping well over which groundwater travels in Tx (ft)

Null Point = distance to down gradient null point (ft)

Boundary Limit = maximum distance from the center line to the boundary of the capture zone (ft) (i.e. half the maximum width of the capture zone

Time-of-travel Calculation Method: The Time of Travel for water to move along a line parallel to the hydraulic gradient form a point to a pumping well (EPA, 1991) is

$$T_X = \frac{n}{Ki}\left[X_L - \frac{Q}{2\pi Kbi}\ln\left(1 + \frac{2\pi kbi}{Q}X_L\right)\right]$$

# Appendix C
# Concurrence Letter