

**Angel Island Subdivision  
Public Water Supply**

**PWS ID #MT0000582**

***SOURCE WATER DELINEATION  
AND ASSESSMENT REPORT***

**Date of Report: July 30, 2004**

**Report Prepared For:**

**Angel Island Subdivision**

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## **Introduction**

This Delineation and Assessment Report was completed by Erin M. Carlson, an intern with Montana Department of Environmental Quality (DEQ) Source Water Protection Program (SWPP) and was reviewed by Jeffrey Frank Herrick, a hydrogeologist also with DEQ SWPP. This report was prepared for:

**Angel Island Association, Owner**  
**Mary Beth Harvey, Administrative Contact**  
**Harold Lewis, Financial Contact**  
**George Cochran, Patrick Vinion, Harvey Zucker, Garry Hoadley, and Dale Myers, Operators**  
**c/o P.O. Box 595**  
**Troy, MT 59935**  
**(406) 295-5259**

## **Purpose**

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Angel Island Subdivision 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).

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

## **Limitations**

This report was prepared to assess threats to the Angel Island Subdivision PWS public water supply, and is based on published information and information obtained from persons familiar with the community. The terms “drinking water supply” or “drinking water source” refer specifically to the source of the Angel Island Subdivision public water supply and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the area of the PWS are identified. Only potential sources of contamination in areas estimated to contribute water to its drinking water source are considered.

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

## Chapter 1 BACKGROUND

### The Community

The Angel Island Subdivision, which will often be referred to as Angel Island in this report, is located in northwestern Montana’s Lincoln County. The subdivision is located on Bull Lake’s Angel Island, which is approximately 16 miles south of the intersection of Montana Highway 56 and U.S. Highway 2. The nearest town to Angel Island Subdivision is Troy, which is approximately 18 miles to the north. Libby, the county seat of Lincoln County, is located about 30 miles northeast of Angel Island, and Noxon, in Sanders County, is located approximately 40 miles to the south ([Figure 1](#)- [Figure 2](#)). According to 2000 United States Census data, Troy is home to 957 people. Libby and Noxon have 2,626 people and 230 people respectively. According to U.S. Census data, major industries in Lincoln County include educational, health, and social services, retail trade, and manufacturing. Median household income for the county is \$26,754.

### Geographic Setting

Angel Island Subdivision is found in extreme northwestern Montana. The subdivision is on Angel Island (also known as Callows Island), which is located on Bull Lake. Bull Lake is approximately 1163 acres in size and is about 2,400 feet above mean sea level. Waters from Ross Creek flow into the lake from the south, and Lake Creek leaves the lake at its northern end. Lake Creek flows northward and eventually converges with the Kootenai River. The Cabinet Mountains surround the area, and the Montana-Idaho state border is approximately 15 miles west of the subdivision. Evergreen forest covers most of the area, as is common in western Montana.

The main transportation route in the Angel Island area is Montana Highway 56. MT 56 converges with U.S. Highway 2, an east-west route, approximately 16 miles north of the subdivision. Highway 56 also links up with Montana Highway 200 south of Angel Island, near the town of Noxon. Numerous out-of-service railroad lines are found in the area.

The climate in the Bull Lake area is typical of other lower elevation intermontane basins in the northern Rocky Mountains west of the continental divide. As is shown in Table 1, high and low temperatures average 32.7° and 19.8° F in January and 86.0° and 47.8° F in July. The area receives 24.59 inches of precipitation annually, and the average snowfall is 31.5 inches yearly. Snow falls mostly in November, December, January, and February.

**Table 1. Table of Climatic Data**

Troy, Montana (248390), Period of Record: 9/1/1960 to 3/31/2004 (from wrcc@dri.edu)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	32.7	40.2	49.8	59.9	68.9	76.8	86.0	85.7	74.0	57.8	41.2	32.6	58.8
Average Min. Temperature (F)	19.8	23.0	26.9	32.3	39.2	45.1	47.8	47.2	40.6	33.5	28.9	21.8	33.9
Average Total Precipitation (in.)	3.08	2.18	1.85	1.57	1.94	1.83	0.99	1.19	1.32	1.91	3.54	3.19	24.59
Average Total Snow Fall (in.)	9.8	4.4	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	5.2	10.6	31.5

**Table 1. Table of Climatic Data**

Troy, Montana (248390), Period of Record: 9/1/1960 to 3/31/2004 (from wrcc@dri.edu)

Average Snow Depth (in.)	6	4	1	0	0	0	0	0	0	0	0	3	1
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### **General Description of the Source Water**

The four Angel Island wells draw water from the sands and gravels of glaciolacustrine deposits in the Lake Creek Valley. The silts and clays associated with sand and gravel layers described by area well logs may prevent some vertical movement of water within the aquifer, however for the purposes of this report, the local aquifer is considered to be unconfined. Groundwater flow is described as toward Bull Lake in the Angel Island area, with recharge occurring from infiltration of precipitation.

Some water quality data have been collected in the area by the DEQ TMDL program to determine classification of local major streams and the need for inclusion in the listing of impaired waterways. While Bull Lake is not on this list, Lake Creek, which flows out of Bull Lake and continues north to the Kootenai River, is included. Lake Creek has received B-1 classification under the Administrative Rules of Montana (17.30.623). According to B-1 classification standards, water from Lake Creek is suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

It does not appear that there is any community sewer system servicing Angel Island. As such, residences in the Angel Island Subdivision are likely serviced by private onsite septic systems. The density of these private onsite systems is addressed in the inventory section of this SWDAR.

### **The Public Water Supply**

The Angel Island Subdivision public water supply serves a resident population of 150 people in the summer and 120 people in the winter. There are 172 total service connections, and 135 of these connections are active. None of the connections are metered. According to the most recent sanitary survey, four wells provide water to the system. Well #1 is located approximately 50 feet from the west edge of Angel Island and 75 feet north of the Angel Island boat ramp. This well was drilled on July 14, 1970 and extends to 84 feet below ground surface (bgs). Well #1 is screened from 72 to 82 feet bgs. The static water level is 13 feet bgs and the pumping water level is 60 feet bgs. Drawdown was reported as 47 feet bgs at 25 gallons per minute (gpm) for 45 minutes. Well #2 is in the Quonset with the system's storage tank, and it was drilled on July 18, 1972. Well #2 extends to 310 feet bgs, and it is screened from 290 to 300 feet bgs. Static and pumping water levels are 50 feet bgs and 275 feet bgs, respectively. Drawdown for this well is 225 feet bgs at 53 gpm for 10 hours. Well #3 is approximately 40 feet from the west edge of Angel Island and 30 feet north of the Angel Island boat ramp. This well was drilled on September 16, 1983 and is 110 feet deep. The well is screened from 90 to 100 feet bgs, and the static water level is 9 feet bgs. Pumping water level for this well is 48 feet bgs, and drawdown was reported as 39 feet bgs at 118 gpm for 6 hours. Well #4 is located approximately 25 feet from the west shore of Angel Island and 100 feet north of the Angel Island boat ramp. This well was drilled on July 10, 1998 and is 165 feet deep. Well #4 is screened from 145 to 165 feet bgs, and the static water level is 13 feet bgs. Pumping water level is 135 feet, and drawdown was reported at 122 feet bgs at 77 gpm for 45 minutes. Logs for wells #1 and #2 do not contain any information about grouting, but well #3 is grouted to 21 feet bgs and well #4 is grouted continuously.

Well #1 is equipped with a 1-hp submersible pump; well #2 has a ½-hp submersible pump; well #3 is outfitted with a 5-hp submersible pump; and well #4 has a 7 ½-hp submersible pump. Some discussion is found in previous sanitary surveys regarding the pump for well #4. It is noted that this pump is oversized for the well, but it is recommended in the 2003 sanitary survey that this pump not be replaced until it fails. At that time, it should be replaced with a 5-hp pump.

The system’s pressure control assembly is found immediately after the storage tank, and it consists of a 2-hp centrifugal pump, which operates fulltime, and a 7.5-hp centrifugal pump that provides added capacity in periods of high demand. These two pumps are used simply to supply distribution pressure. One 13,000-gallon storage tank is found in the Quonset building with well #2. This tank stores a volume of water equivalent to one day’s supply for the subdivision. At this time, no treatment of Angel Island’s water is noted.

**Table 2. PWS Facilities and Well Information**

Angel Island Subdivision Public Water Supply (#MT0000582)

<b>Contact Information</b>	Angel Island Subdivision Mary Beth Harvey P.O. Box 595 Troy, MT 59935 (406) 295-5259			
<b>PWS Class</b>	Community			
<b>Well/Intake Source Code</b>	WL002 with EP502	WL003 with EP502	WL004 with EP502	WL005 with EP502
<b>Well/Intake Name</b>	Well 1 1970	Well 2 1972	Well 3 1983	Well 4 1998
<b>Status</b>	Active	Active	Active	Active
<b>Latitude and Longitude</b>	48.2558 -115.8563	48.2558 -115.8507	48.2558 -115.8507	48.2549 -115.8549
<b>Treatment System</b>	None			
<b>Pressure Control Assembly</b>	PC 001 Pressure Control Active			
<b>Distribution System</b>	DS001 Distribution System Active			
<b>Storage Tanks</b>	ST001 Storage Facility 1 Active			

Note: A common header, CH001, joins wells 1, 3, and 4.

**Water Quality**

No coliform bacteria has been detected during routine samplings of water from Angel Island wells during the past five years. Nitrate levels have been well below DEQ’s maximum regulatory limit of 10 mg/L. No other analytes have been detected in noteworthy levels over the past five years, except a sulfate level of 5 mg/L in 2002.

## **Chapter 2 DELINEATION**

### **Delineation Process**

The source water protection regions are identified in this chapter. They are the delineated land areas that contribute water to the sources at Angel Island Subdivision PWS. Three management or source water protection regions are usually identified. These three regions are 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 PWS wellhead, spring collection box, or surface water intake. Human activity in this area can have an immediate impact on water quality by introducing contaminants into the area directly above a well screen or other intake structure. As such, management of this control zone is critical to protect a PWS. For groundwater sources the inventory region usually represents the zone of contribution of the well, which can approximate a three-year groundwater time-of-travel or a 1-mile radius around a wellhead. The inventory region comprising a 1-mile radius circle around a well is often a conservative value that is used either for convenience or when insufficient geologic or hydrogeologic information is available about an area or details are lacking on the construction of a production well. In certain circumstances where a PWS well taps into an aquifer that has been characterized as being confined, the inventory region can be limited to an approximate 1,000-foot radius around the wellhead, and the inventory of potential contaminant sources is only completed for those sources within 1,000-feet of the well. Activities or contaminant releases within the inventory region have the potential to reach a PWS well in a period approximating less than 3 years. The recharge region represents the entire portion of the aquifer or an area that contributes water to the local aquifer and over time supplies water to a well. This extended region of groundwater recharge is often, but not always, inclusive of the limits of a watershed. At times an entire watershed is too large to be realistically manageable by a PWS or community, so a subsection of that watershed is delineated as the recharge region. Long-term water quality at a PWS can be affected by contaminant releases or certain land use activities in the recharge region. Table 3 summarizes how these source water protection regions are determined.

**Table 3. Methods and Criteria for Delineating Source Water Protection Regions**

If Your Source of Water Is	Delineate These Water Protection Regions	Method For Each Region	Minimum Distance Values & Type of Inventory Required
<p><b>Ground Water that is:</b></p> <ul style="list-style-type: none"> <li><b>Unconfined or Semi-confined*</b></li> <li><b>Confined</b></li> </ul> <p>*Ground Water that is hydraulically Connected to Surface Water also needs the following -----&gt;&gt;&gt;</p>	<p>Control Zone Inventory Region Recharge Region</p> <p>Control Zone Inventory Region Recharge Region</p> <p>Surface Water Buffer Zone</p>	<p>Fixed radius Fixed radius Topography</p> <p>Fixed radius Fixed radius Topography</p> <p>Fixed Distance</p>	<p>Distance - 100 feet Distance - 1 mile or 3 year groundwater TOT Limits of the watershed</p> <p>Distance - 100 feet Distance - 1000 feet Limits of the watershed</p> <p>In addition to the Inventory Region, a one-half mile surface water buffer will extend upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. The buffer will not exceed the extent of the watershed. Inventory is limited to pathogens and nitrate sources.</p>
<p><b>Surface water*</b></p>	<p>Spill Response Region</p> <p>Watershed Region</p>	<p>Fixed Distance</p> <p>Topography</p>	<p>One-half mile buffer extending upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. Buffer will not exceed the extent of the watershed. Inventory is for all regulated contaminants for that PWS. Limits of the watershed</p>

**Hydrogeologic Conditions**

The following is a description of the sediments, bedrock, and groundwater in the Lake Creek Valley and surrounding area. This information is relevant because the rock units and sediments comprise the aquifer(s) (the water bearing formations) into which the Angel Island Subdivision PWS wells are installed. The hydrogeology is a description of the presence and movement of groundwater in the bedrock and within the valley. This discussion is intended to help the reader understand where the PWS wells are obtaining their groundwater and the vulnerability of that source of water to potential contamination. DEQ Source Water Protection Section personnel compiled most of the information contained in this section during previous assessments. See [Figure 3](#) for a surficial geologic map of the area.

*Geology*

The Lake Creek Valley, in which the Angel Island Subdivision PWS is located, is in a graben modified by glacial and fluvial processes. Two major faults underlie the valley. The Lenia Fault generally runs down the central part of the valley, while the Bull Lake Fault is on the eastern edge of the valley and likely creates a hydrologic boundary, as it is the point where bedrock and unconsolidated sediments interface. Sedimentary rocks with glaciolacustrine deposits and alluvium above underlie the valley.

Unconsolidated deposits of silt, clay, sand, gravel, and cobbles were put down as sediments during periods of glaciation and are generally believed to be discontinuous in the area. The maximum thickness of the glaciolacustrine deposits is unknown but probably exceeds 400 feet. For the purposes of this report though, the saturated thickness was estimated to be 200 feet.

*Hydrogeology*

The Angel Island wells draw water from the sand and gravel of the glaciolacustrine deposits in the Lake Creek Valley. The silt and clay associated with sand and gravel layers described by the well logs may prevent some vertical movement of water within the aquifer, however the aquifer is assumed to be unconfined for the purposes of this SWDAR. Groundwater flow is likely toward Bull Lake in the Angel Island area, with recharge occurring from infiltration of precipitation. Bull Lake and Lake Creek are the discharge points for groundwater in the area. The lateral extend of the aquifer is likely the Bull Lake Fault on the east and Bull Lake on the west. Measurements of pH and calcium in the Angel Island well water are higher than that of Bull Lake. This is likely due to aquifer water residence time in contact with subsurface materials and supports the notion that groundwater flow is from the aquifer toward the lake.

Based upon the hydrogeologic setting, the wells for this system are classified as having high source water sensitivity to contamination, as shown by highlighting below.

**Table 4. Source Water (Aquifer) Sensitivity**

High Source Water Sensitivity	Moderate Source Water Sensitivity	Low Source Water Sensitivity
<ul style="list-style-type: none"> <li>• Surface water and GWUDISW</li> <li>• <b>Unconsolidated Alluvium (unconfined)</b></li> <li>• Fluvial-Glacial Gravel</li> <li>• Terrace and Pediment Gravel</li> <li>• Shallow Fractured or Carbonate Bedrock</li> </ul>	<ul style="list-style-type: none"> <li>• Semi-consolidated Valley Fill sediments (semi-confined)</li> <li>• Unconsolidated Alluvium (semi-confined)</li> </ul>	<ul style="list-style-type: none"> <li>• Consolidated Sandstone Bedrock</li> <li>• Deep Fractured or Carbonate Bedrock</li> <li>• Semi-consolidated</li> <li>• Confined Aquifers</li> </ul>

**Public Water Supply Source/Well Information**

Included in Appendix B are the well logs for many of the wells found in proximity to the PWS wells. Information regarding the sources at Angel Island is summarized in Table 5 below.

**Table 5. PWS Source/Well Information**

Angel Island Subdivision PWS (#MT0000582)

Source Name	Well 1 1970	Well 2 1972	Well 3 1983	Well 4 1998
Source Code	WL002	WL003	WL004	WL005
Status	Active	Active	Active	Active
Latitude and Longitude	48.2558 -115.8563	48.2558 -115.8507	48.2558 -115.8507	48.2549 -115.8549
MBMG GWIC #	84928	84929	84930	168367
Water Right #	P065039-00	C055827-00	C055827-00	None

**Table 5. PWS Source/Well Information**

Angel Island Subdivision PWS (#MT000582)

Source Name	Well 1 1970	Well 2 1972	Well 3 1983	Well 4 1998
<b>Date completed</b>	July 14, 1970	July 18, 1972	September 16, 1983	July 10, 1998
<b>Total Depth (feet bgs)</b>	84	310	110	165
<b>Perforated Interval (ft bgs)</b>	72-84	290-300	90-100	145-165
<b>Static Water Level (ft bgs)</b>	13	50	9	13
<b>Pumping Water Level (ft bgs)</b>	60	275	48	135
<b>Draw Down (ft)</b>	47	225	39	122
<b>Test Pumping Rate (gpm)</b>	25	53	118	77
<b>Yield (gpm)</b>	25	53	110	77

**Delineation Results**

In all instances, a 100-foot radius control zone is delineated around the wellhead. This is done in order to ensure that the area immediately surrounding the wells remains free of contamination. Thus 100-foot radius control zones have been delineated and inventoried around the wells at Angel Island.

A one-mile fixed radius inventory region was delineated around each of the four wells, and the resulting inventory region is shown in [Figure 4](#). This inventory region includes most of Bull Lake and a portion of Montana Highway 56. The inventory region may have been modified to include only the eastern portion of the lake, but since behavior of groundwater in the area is not understood exactly, the full one-mile fixed radius inventory region was likely the best option.

The recharge region is shown in [Figure 5](#). It encompasses Ross Creek, which eventually flows into Bull Lake on its southern end. The recharge region extends nearly to the Montana-Idaho border but encompasses relatively few potential contaminant sources.

**Limiting Factors**

Groundwater behavior in general terms is reasonably well understood in the Lake Creek Valley, but is not easily predictable beneath specific locations and especially around a certain well that is drawing water from a specific depth. Groundwater flow direction fluctuates seasonally and from year to year. Here, several conservative assumptions were made in the delineation of the source water protection areas and the development of this report. Also, reliance on some basic hydrogeologic principals to define the aquifer boundaries and groundwater movement was employed. The SWDAR, however, can and should be revised if more data becomes available that alters the assumed groundwater flow direction(s).

## Chapter 3 INVENTORY

### Inventory Method

An inventory of potential sources of contamination was conducted for the Angel Island Subdivision PWS within the control zone, inventory region, and recharge region. Potential sources of all primary drinking water contaminants and *Cryptosporidium* were also identified and noted, however, only significant potential contaminant sources were selected for detailed inventory and the susceptibility evaluation that occurs in Chapter 4 of this SWDAR. It should be noted that the inventory emphasizes potential contaminant sources. Inclusion of a facility or business in the inventory does not indicate that it is an actual polluter, with the exceptions of known hazardous waste sites where past releases have occurred, areas with known onsite contamination, locations with leaking underground storage tanks (LUSTs), or wastewater dischargers.

The inventory for the Angel Island PWS focuses on all activities in the control zone around the well, certain types of municipal and private facilities in the inventory region, and general land uses and large facilities in the recharge region. The following databases have been searched in an effort to identify generators, storage facilities, and land uses that could be potential generators of contamination in the inventory region.

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. Septic density (the density of private onsite septic systems) was determined based on the 2000 US Census and obtained from the Montana State Library's Natural Resource Information System (NRIS) Thematic Mapper (<http://nris.state.mt.us/mapper/>) and (<http://nris.state.mt.us/wis/swap/swapquery.asp>)

Step 2: As appropriate, 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). 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: The Permit Compliance System (PCS) was queried using Envirofacts (<http://www.epa.gov/enviro/>) to identify Concentrated Animal Feeding Operations with MPDES permits. The PWS system operator and/or system managers are familiar with the area included in the Inventory Region will have identified animal feeding operations that are not required to obtain a permit.

Step 4: Databases were queried to identify the following in the Inventory Region: Underground Storage Tanks (UST) (<http://webdev.deq.state.mt.us/UST/>), hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau), landfills (<http://nris.state.mt.us/gis/datalist.html>), abandoned mines (<http://nris.state.mt.us/gis/datalist.html>) and active mines including gravel pits. Any information on past releases and present compliance status was noted.

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

Step 6: All land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the Recharge Region and identified on the base map.

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 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.

## **Inventory Results**

Results of inventory for each of the three protection regions are presented below. A tabular summary is presented in Table 6 at the end of the section.

### *Inventory Results/Control Zone*

Bull Lake appears to be within the control zone for wells #1, #3, and #4, but not for well #2. Flooding of Bull Lake or other related problems could cause contamination of some of the Angel Island PWS wells. Also, the locations of drain fields for septic systems on Angel Island is unknown, so it is possible that these drain fields and associated tanks and sewer mains are within the control zone and could result in contamination of some or all of the wells.

### *Inventory Results/Inventory Region*

As is seen in [Figure 4](#), a localized area of increased septic density is found on Angel Island, directly around well #2 and very near the other PWS wells. This area of high and moderate density of private septic systems has the potential to contaminate any or all of the public water supply wells at Angel Island, as wastewater discharged to drain fields may contain improperly disposed chemicals or nitrate and pathogens that may not have been completely eliminated from the effluent.

Montana Highway 56 crosses the eastern portion of the inventory region, running in a direction generally parallel to Bull Lake. This route appears to be up-gradient of the wells at Angel Island, so accidents or spills along the highway, though infrequent, could prove catastrophic to the PWS wells.

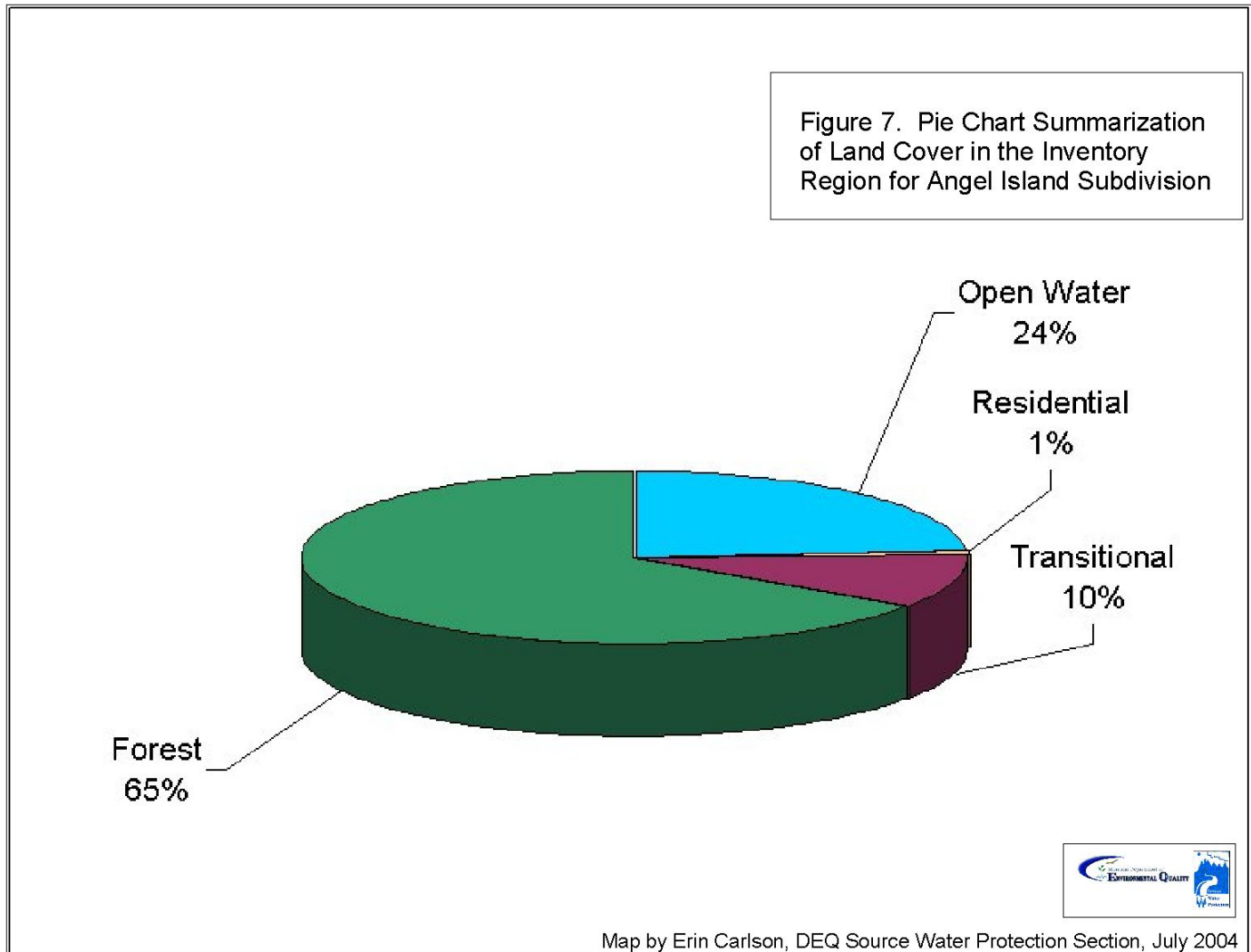
Trio Mine is found in Emma Gulch in the western part of the inventory region. Contaminants from the mine could contaminate groundwater, but it is unlikely that this contamination would have any effect on the wells at Angel Island, as the mine appears to be down-gradient of the wells. Further, Bull Lake would most likely dilute any contaminants before they reached well.

Analysis of land in the inventory region for Angel Island Subdivision shows that the area is primarily forest (65%) ([Figure 6](#) and [Figure 7](#)). Open water accounts for 24% of the land in the inventory region, and transitional use (10%) and residential use (1%) make up the remainder of the inventory region. None of these land uses are considered possible contaminant sources for the PWS wells at Angel Island Subdivision.

### *Inventory Results/Recharge Region*

The recharge region, as shown in [Figure 5](#), contains relatively few potential contaminant sources. Three mines, the Trio Mine, Troy Unit Mine, and Bull Lake Prospect Mine, are found within the recharge region. Of the three, the Bull Lake Prospect Mine is the only one that appears to be up-gradient of the PWS wells, and it is therefore the most critical potential contaminant source of the group.

**Figure 7. Pie Chart Summarization of Land Cover in the Inventory Region for Angel Island Subdivision**



Montana Highway 56 runs through the eastern part of the recharge region. As in the inventory region, spills or accidents along this route, though rare, could be disastrous for the PWS wells at Angel Island Subdivision.

Land in the recharge region appears to be primarily forest, and this is not a contamination threat to the Angel Island PWS wells.

**Table 6. Noteworthy Potential Contaminant Sources**

Angel Island Subdivision PWS—Control Zone (CZ), Inventory Region (IR), and Recharge Region (RR)

Source	Contaminants	Description
Septic Systems (localized areas high and moderate density of private systems in the IR)	Pathogens, nitrates, other organic and inorganic chemicals	Wastewater discharged to drain fields may contain improperly disposed chemicals or may not completely eliminate nitrate and pathogens from the effluent.
MT Highway 56 (IR & RR)	Hazardous materials (VOCs, SOCs, metals, other)	Large scale spills of hazardous or other materials could occur.
Mines (Trio Mine in IR and Troy Unit Mine and Bull Lake Prospect Mine in RR)	Acid mine drainage or metal-rich water discharge, metals	Contaminants could be conveyed to the PWS wells.

**Inventory Update**

To make this SWDAR a useful document in the years to come, the owners, manager, or the water system operators for the Angel Island public water supply should update the inventory for their records every year. Changes in land uses or the presence of new potential contaminant sources should be noted and additions made as needed. This updated inventory should be submitted to DEQ at least every 5 years to ensure that this report/plan stays current in the public record.

**Inventory Limitations**

The extent of the potential contaminant source inventory is limited in several respects. The inventory is based on data that is readily available through state documents, published maps and reports, GIS data, and discussions with people that are familiar with the area. Also, documentation may not be readily available on some potential sources. This is the case with large capacity septic systems that are present in the inventory and recharge regions. As a result, all potential contaminant sources may not have been identified or recognized as being significant potential contaminant sources. The author of this SWDAR is depending on local PWS owners and/or operators for site-specific knowledge. Their initial review of this document is sought and their comments will be incorporated.

## 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 concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case Angel Island PWS owners and operator(s). 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 owners and the operator to reduce susceptibility are recommended in this chapter.

### Hazard Determination

The susceptibility of the Angel Island Subdivision PWS water sources to various types of contamination is assessed in the following paragraphs. 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 7). Hazard and the existence of barriers to contamination determine susceptibility, which is described in Table 8. Table 7 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.

**Table 7. Hazard of Potential Contaminant Sources**

For Wells Drawing Water From Unconfined Aquifers

Potential Contaminant Source	High Hazard	Moderate Hazard	Low Hazard
<b>Point Sources</b>	Within 1 year TOT	Between 1 to 3 years TOT	Over 3 years TOT
<b>Density of Private Septic Systems</b> (# per square mile)	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
<b>Municipal Sanitary Sewer</b> (Percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
<b>Cropped Agricultural Land</b> (Percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

### Susceptibility Determination

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 source intake. First, hazard is rated by the proximity of a potential contaminant source to the water source or based on the percentage of the inventory region occupied by a

certain type of contaminant source (from Table 7). Then the presence of barriers is used to determine susceptibility. Susceptibility ratings are determined individually for each significant potential contaminant source and/or contaminant based on Table 7. These susceptibility ratings are the evaluation of the vulnerability of wells to the more significant potential contaminant sources and are presented on Table 9.

**Table 8. Susceptibility, Based on Hazard and Barriers**

Presence Of Barriers	Hazard		
	High	Moderate	Low
<b>No Barriers</b>	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
<b>One Barrier</b>	High Susceptibility	Moderate Susceptibility	Low Susceptibility
<b>Multiple Barriers</b>	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

**Discussion of Susceptibility**

A summary of the susceptibility assessment for the Angel Island PWS water sources is located in Table 9. Below is a brief discussion of the susceptibility assessment for the significant potential contaminant sources. Other sources of contamination may also exist and may pose threats to the public water supply at Angel Island Subdivision. It is prudent to make further attempts to identify these sources, especially if they are up-gradient from the PWS, and to understand the treats they pose.

**Table 9. Susceptibility Assessment**

Assessment of Hazards in Inventory Region (IR) only—Angel Island Subdivision PWS (#MT0000582)

Source	Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Localized Areas of High and Moderate Septic Density	Pathogens, nitrates, other organic and inorganic chemicals	Waste water discharged to drain fields that may contain chemicals, nitrates, and pathogens	<b>High Hazard</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<b>Very High Susceptibility</b>	Promote the design and installation of advanced septic systems in the area, education (including posters and placards) to reduce improper disposal of chemicals, and possible creation of a community sewer district and the development of a wastewater treatment plant for Angel Island. Involvement of PWS managers/operators in this process is critical.
MT Highway 56	Hazardous materials (VOCs, SOCs, metals, other)	Large scale spills of hazardous or other materials	<b>High Hazard</b>	<ul style="list-style-type: none"> <li>Local and regional emergency response measures including training of responders and resources for spill cleanup in the area</li> </ul>	<b>Moderate Susceptibility</b>	Emergency planning, training of local emergency response personnel, and allocation of resources/funding for emergency response

**Table 9. Susceptibility Assessment**

Assessment of Hazards in Inventory Region (IR) only—Angel Island Subdivision PWS (#MT0000582)

Source	Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management
				<ul style="list-style-type: none"> <li>Presence of wetland area between road and wells</li> </ul>		
Trio Mine	Acid mine drainage, metal-rich water discharge, metals	Discharge of contaminated materials from site	<b>High Hazard</b>	<ul style="list-style-type: none"> <li>Bull Lake between mine and wells, will act to dilute contaminants</li> <li>Mine appears to be down-gradient of wells</li> </ul>	<b>Moderate Susceptibility</b>	Careful monitoring of mine's activities, especially regarding spills or groundwater contamination events

*Septic Systems*

A localized area of high and moderate density of private septic systems on Angel Island is rated as a high hazard to the PWS wells there. No barriers to contamination could be identified at this time, so the wells have very high susceptibility to contamination from this source.

*Montana Highway 56*

This transportation route is rated as a high hazard to the public water supply wells at Angel Island Subdivision. The presence of emergency response measures and the allocation of funds for these activities is considered one barrier to contamination. Another barrier is the presence of a wetland between the highway and the Angel Island wells. With multiple barriers, the wells have moderate susceptibility to contamination from this source.

*Trio Mine*

The Trio Mine is rated as a high hazard to the public water supply wells at Angel Island Subdivision because it is within one-year groundwater time-of-travel of them. Bull Lake is, however, between the well and mine, so it will act as a barrier by diluting contaminants before they reach the wells. Further, the mine appears to be down-gradient of the wells, minimizing the threat. Therefore, the wells have moderate susceptibility to contamination from this source.

**Summary of Susceptibility Assessment**

The Angel Island Subdivision PWS uses four wells that are installed into what is assumed to be an unconfined aquifer. The recharge region for this aquifer is the area shown in [Figure 5](#). Groundwater beneath the area is believed to flow toward Bull Lake. The inventory region was established as seen in [Figure 4](#), and it contains potential contaminant sources as seen in Table 6.

The public water supply wells at Angel Island have very high susceptibility to contamination from its own private onsite septic systems and moderate susceptibility to contamination from MT Highway 56 and the Trio Mine.

### **Waiver Recommendation**

This section addresses the Angel Island Subdivision public water supply that DEQ has classified as a community (C) system. Recommendations are based on the susceptibility assessment above.

#### *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 up-gradient of the surface water intake. PWSs developed in unconfined aquifers should use a minimum fixed radius of 1.0 miles 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 up-gradient of the point of diversion. The purpose of the vulnerability assessment procedures outlined in this section is to determine which of the organic chemical contaminants are in the area of investigation.

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

### *Susceptibility Waiver for 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 overlain by 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 often locally recharged from surface water or precipitation. In general, groundwater flow gradients in unconfined aquifers may reflect surface topography, and the residence time of water in the aquifer is typically comparatively shorter than for water in confined aquifers. Similar water chemistry may often exist between unconfined groundwater and area surface water, and physical parameters and dissolved constituents can be indicators 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 or surface water 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, monitoring history of the source, geologic characteristics of the vadose zones, and mobility and persistence characteristics of the organic chemicals. The zone of contribution of the unconfined groundwater source must be defined and plotted. Groundwater flow directions, gradients, and a 3-year time-of-travel should be described. All surface bodies within 1,000 feet of the PWS well(s) must be plotted. Analytical monitoring history of the PWS well and nearby wells should also be provided.

### *Waiver Recommendations*

Based on the monitoring history for the well, the results of the inventory, the susceptibility assessment of this SWDAR, the geology of the area, the nature of the aquifer from which the well draws water, the Angel Island PWS production well may be eligible for volatile organics (VOCs), synthetic organic chemicals (SOCs), and some inorganic chemical (IOCs) waivers. For monitoring waiver consideration, the PWS should submit a letter to DEQ requesting the specific monitoring waivers. If requested by DEQ, the PWS may also need to provide additional information.



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Angel Island Subdivision  
#MT0000582  
SWDAR

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## GLOSSARY

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

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

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

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

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

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

**Delineation.** A process of mapping source water management areas.

**Effective Porosity.** The percent of soil, sediment, or rock through which fluids, such as air or water, can pass. Effective porosity is always less than total porosity because fluids cannot pass through all openings.

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

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

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

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

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

**Nitrate.** An important plant nutrient and type of inorganic fertilizer. In water the major sources of nitrates are 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.

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

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

**Porosity.** The percent of soil, sediment, or rock filled by air, water, or other fluid.

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

**SIC Code.** The U.S. Standard Industrial Classification (SIC) Codes classify categories of businesses. SIC Codes cover the entire range of business categories that exist within the economy.

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

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

**Synthetic Organic Compounds (SOC).** Man made organic chemical compounds (e.g. 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, non-point, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

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

**Transmissivity.** The ability of an aquifer to transmit water.

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

**Volatile Organic Compounds (VOC).** Any organic compound that evaporates readily to the atmosphere (e.g. fuels and solvents).

**Recharge Region / Watershed.** The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common delivery point.

\*\*Definitions taken from EPA's Glossary of Selected Terms and Abbreviations and other sources.

## APPENDICES

### Appendix A

*DEQ PWS's Database Output*

*Water Quality Data*



**Appendix B**

*Sanitary Surveys*

*Well Log Information*

*Other Relevant Well Information*

*Lithologic and Construction Logs (GWIC Well Information) for Other Area Wells*



**Appendix C**

*Concurrence Letter*