
# Source Water Assessment

## A Hydrogeologic Susceptibility and Vulnerability Assessment for Hilltop Ski Area Chalet Public Drinking Water System, Anchorage, Alaska PWSID # 218641.001

DRINKING WATER PROTECTION REPORT 1631

Alaska Department of Environmental Conservation

December, 2008

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The Drinking Water Protection (DWP) section of the Drinking Water Program is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (DEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the DWP staff at the following number: 1-866-956-7656.

December, 2008

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# APPENDICES

# Source Water Assessment for Hilltop Ski Area Chalet Source of Public Drinking Water, Anchorage, Alaska

**Drinking Water Protection**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The public water system for Hilltop Ski Area Chalet is a Class B (transient/non-community) water system consisting of one well off Abbott Road in east Anchorage, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the Hilltop Ski Area Chalet public drinking water source include: a municipal park, one paved road, a pipeline, a construction trade area, and residential septic systems. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Hilltop Ski Area Chalet received a vulnerability rating of **Medium** for bacteria and viruses, as well as volatile organic chemicals. This system received a rating of **High** in the nitrates and nitrites contaminant category. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Hilltop Ski Area Chalet to protect public health.

## HILLTOP SKI AREA CHALET PUBLIC DRINKING WATER SYSTEM

Hilltop Ski Area Chalet public water system is a Class B (transient/non-community) water system. The system consists of one well less than a mile east of Abbott Road in east Anchorage, Alaska (See Map A of Appendix A). Anchorage and its surrounding communities are located in southcentral Alaska at the head of Cook Inlet (Please see the inset of Map A in Appendix A for location). The municipality's current population is 283,938 making it the most populated city in the state (ADCED, 2008). Communities located within the municipality include: Anchorage, Eagle River, Chugiak, Eklutna, and Girdwood.

The majority of homes in Anchorage are connected to Anchorage Water and Wastewater Utility, providing water and sewerage (ADCED, 2008). Natural gas is available to most homes through ENSTAR Natural Gas Company. Refuse is transported to the Anchorage Regional Landfill on Hiland Road.

According to the well log, the depth of the well is 65 feet below the ground surface, and is screened in gravel. This system serves approximately 101 non-residents through one service connection.

## HILLTOP SKI AREA CHALET DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the drinking water protection area. The drinking water protection area is the area circling the well (the area influenced by pumping) and also the area upgradient of the well, usually forming a parabola shape. Because releases of contaminants within the protection area are most likely to impact the well, this area will serve as the focus for voluntary protection efforts.

There are many different methods for calculating the size of protection areas. Drinking Water Protection (DWP) uses a combination of two simple groundwater flow equations, the Thiem and uniform flow equations for all groundwater wells screened in unconsolidated material. The orientation of the protection zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The protection zone calculated by DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone. Because of uncertainties and changing site conditions, a factor of safety is added to the protection zone to form the drinking water protection area for the well.

The parameters used to calculate the shape of this protection zone are general for the whole alluvial plain and were obtained from various United States Geological Survey (USGS) reports, area well logs, and the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

The protection areas established for wells by the DEC are usually separated into two zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. An analytical calculation was used to determine the size and shape of the protection area. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (Patrick, Brabets, and Glass, 1989).

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the two protection area zones for wells and the calculated time-of-travel for each:

**Table 1. Definition of Zones**

| Zone | Definition |
|---|---|
| A | Several months time-of-travel |
| B | Less than the 2 year time-of-travel |

The drinking water protection area for Hilltop Ski Area Chalet was determined using an analytical calculation and includes Zones A and B (See Map A of Appendix A).

## INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

Drinking Water Protection has completed an inventory of potential and existing sources of contamination within the Hilltop Ski Area Chaletdrinking water protection area. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class B public water system assessments, the following three categories of drinking water contaminants were inventoried:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals

The sources are displayed on Map C of Appendix C and summarized in Table 1 of Appendix B.

## RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

## VULNERABILITY OF HILLTOP SKI AREA CHALET DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural Susceptibility; and
- Contaminant Risks.

A score for the Natural Susceptibility of the well is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0-25 Points)
+
Susceptibility of the Aquifer (0-25 Points)
=
Natural Susceptibility of the Well (0-50 Points)

A ranking is assigned for the Natural Susceptibility according to the point score:

| Natural Susceptibility Ratings | |
|---|---|
| 40-50 pts | Very High |
| 30 to < 40 pts | High |
| 20 to < 30 pts | Medium |
| < 20 pts | Low |

Factors contributing to the susceptibility of the wellhead are: whether the sanitary seal is in place, protection from flooding, and if the well casing is properly grouted.

The wellhead for the Hilltop Ski Area Chalet received a **Low** susceptibility rating. The most recent sanitary survey (12/14/2007) indicates the well is capped with a sanitary seal, the well is grouted, but the land surface is not sloped away from the well. Recommendations for adding fill to slope the land away from the well have been made. A sanitary seal prevents potential contaminant from entering the well while sloping of the land surface and grouting help to prevent potential

contaminants from traveling down the outside of the well casing.

Factors contributing to the susceptibility of the aquifer are: whether the aquifer is confined or unconfined, whether the well is completed in unconsolidated or fractured bedrock, whether wells and bore holes are penetrating the aquifer and, if applicable, the confining layer.

The aquifer that the Hilltop Ski Area Chalet system is in is unconfined and consists of layers of gravel and hardpan. It has received a **High** susceptibility rating because of the existence of private wells within the protection area. The high water table in the area may also allow contaminants to travel downward from the surface with precipitation and surface water runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Hilltop Ski Area Chalet system.

**Table 2. Susceptibility**

| | Score | Rating |
|---|---|---|
| Susceptibility of the Wellhead | 5 | Low |
| Susceptibility of the Aquifer | 18 | High |
| Natural Susceptibility | 23 | Medium |

Contaminant risks are derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

| Contaminant Risk Ratings | |
|---|---|
| 40-50 pts | Very High |
| 30 to < 40 pts | High |
| 20 to < 30 pts | Medium |
| < 20 pts | Low |

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants for the Hilltop Ski Area Chalet system.

**Table 3. Contaminant Risks**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 25 | Medium |
| Nitrates and/or Nitrites | 50 | Very High |
| Volatile Organic Chemicals | 25 | Medium |

Finally, an overall vulnerability score is assigned for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

Natural Susceptibility (0-50 Points)
+
Contaminant Risks (0-50 Points)
=
Vulnerability of the Drinking Water Source to Contamination (0-100 Points)

Again, rankings are assigned according to a point score:

| Overall Vulnerability Ratings | |
|---|---|
| 80-100 pts | Very High |
| 60 to < 80 pts | High |
| 40 to < 60 pts | Medium |
| < 40 pts | Low |

Table 4 contains the overall vulnerability scores (0-100) and ratings for each of the three categories of drinking water contaminants for the Hilltop Ski Area Chalet system. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 50 | Medium |
| Nitrates and/or Nitrites | 75 | High |
| Volatile Organic Chemicals | 50 | Medium |

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Medium** with a municipal park, paved road, and residential septics contributing to the risk to the drinking water well.

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli, which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2008).

Only a small amount of bacteria and viruses are required to endanger public health. Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination. Bacteria and viruses have not been detected during recent water sampling of the system at Hilltop Ski Area Chalet.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Medium**.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Very High** with a municipal park, paved road, and residential septics contributing to the risk to this source of public drinking water. Nitrates are very mobile, moving at approximately the same rate as water.

The sampling history for Hilltop Ski Area Chalet well indicates that nitrates have been detected in the water (the highest detected level within the last 5 years of sampling was 5.42 mg/l on 2/9/2004, data was reviewed in April, 2008).

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **High**.

**Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Medium** with a municipal park, paved road, pipeline, and residential septics contributing to the risk to the drinking water well.

The drinking water at Hilltop Ski Area Chalet has not recently been sampled for volatile organic chemicals.

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Medium**.

**Using the Source Water Assessment**

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Hilltop Ski Area Chalet to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of Hilltop Ski Area Chalet drinking water source.

# REFERENCES

Alaska Department of Community and Economic Development (ADCED), Accessed 2008 [WWW document]. URL: http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm

Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

United States Environmental Protection Agency (EPA), Accessed 2008 [WWW document]. URL: http://www.epa.gov/safewater/contaminants/index.html.

# APPENDIX A

## Hilltop Ski Area Chalet
## Drinking Water Protection Area Location Map
## (Map A)

# Public Water Well System for PWS #218641.001 Hilltop Ski Area - Chalet


## Legend

Class B Public Water System

**Groundwater Protection Zones**

Zone A Protection Area - Several Months Travel Time

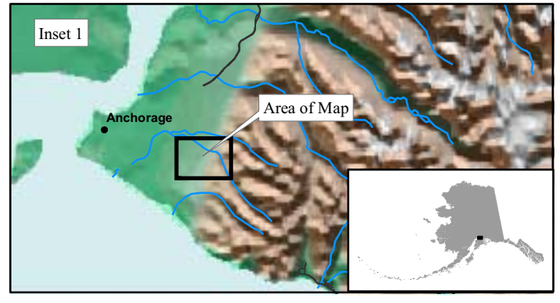
Zone B Protection Area - 2 Years Travel Time

**Data Sources:**
**Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)**

**All other data:**
**Alaska Statewide Digital Mapping Initiative (SDMI)**

**Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC**

**URS Corporation does not guarantee the accuracy or validity of the data provided.**

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Hilltop Ski Area - Chalet
PWS 218641.001

**Appendix A Map A**

# APPENDIX B

## Contaminant Source Inventory and Risk Ranking for Hilltop Ski Area Chalet (Tables 1-4)

***Table 1***

# *Contaminant Source Inventory for*
# ***Hilltop Ski Area - Chalet***

***PWSID 218641.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Municipal or city parks (with green areas) | X04 | X04 | A | C | Far North Bicentenial Park |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | C | 1 Road |
| Pipelines (oil and gas) | X28 | X28-01 | A | C | |
| Construction trade areas and materials | C09 | C09-01 | B | C | |
| Residential Septics | R02 | R02 | B | C | 35 Septic Systems |

***Table 2***

# *Contaminant Source Inventory and Risk Ranking for Hilltop Ski Area - Chalet Sources of Bacteria and Viruses*

***PWSID 218641.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Municipal or city parks (with green areas) | X04 | X04 | A | Medium | C | Far North Bicentenial Park |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 1 Road |
| Residential Septics | R02 | R02 | B | Low | C | 35 Septic Systems |

***Table 3***

# *Contaminant Source Inventory and Risk Ranking for Hilltop Ski Area - Chalet Sources of Nitrates/Nitrites*

***PWSID 218641.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Municipal or city parks (with green areas) | X04 | X04 | A | Medium | C | Far North Bicentenial Park |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 1 Road |
| Residential Septics | R02 | R02 | B | Low | C | 35 Septic Systems |

***Table 4***

# *Contaminant Source Inventory and Risk Ranking for Hilltop Ski Area - Chalet*
## *Sources of Volatile Organic Chemicals*

***PWSID 218641.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 1 Road |
| Pipelines (oil and gas) | X28 | X28-01 | A | Medium | C | |
| Construction trade areas and materials | C09 | C09-01 | B | Low | C | |
| Residential Septics | R02 | R02 | B | Low | C | 35 Septic Systems |

# APPENDIX C

## Hilltop Ski Area Chalet
## Drinking Water Protection Area
## and Potential and Existing Contaminant Sources
## (Map C)

# Public Water Well System for PWS #218641.001 Hilltop Ski Area - Chalet
# Showing Potential and Existing Sources of Contamination


## Legend

- Class B Public Water System

**Groundwater Protection Zones**

- Zone A Protection Area - Several Months Travel Time
- Zone B Protection Area - 2 Years Travel Time

**Existing or Potential Contaminant Sources**

- Construction trade areas and materials (C09)

**Data Sources:**
**Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)**

**All other data:**
**Alaska Statewide Digital Mapping Initiative (SDMI)**

**Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC**

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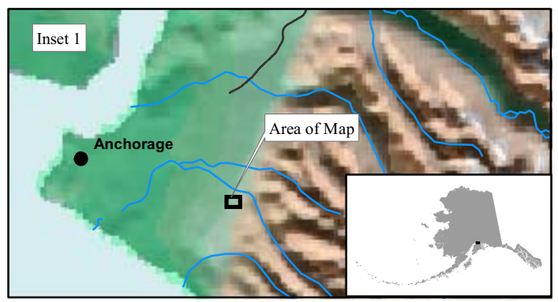


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Hilltop Ski Area - Chalet
PWS 218641.001

**Appendix C Map C**