Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for FNSD Birch Hill Ski Lodge Public Drinking Water System, Fairbanks, Alaska PWSID # 315049.001

DRINKING WATER PROTECTION REPORT 1794

Alaska Department of Environmental Conservation

January, 2009

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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.

January, 2009

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Drinking Water Protection
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EXECUTIVE SUMMARY

The public water system for Birch Hill Ski Lodge is a Class B (transient/non-community) water system consisting of one well in Fairbanks, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for FNSD Birch Hill Ski Lodge public drinking water source include: a road, an assumed residential septic system, and an assumed heating oil tank. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Birch Hill Ski Lodge received a vulnerability rating of **Low** for bacteria and viruses, a rating of **High** for nitrates and/or nitrites, and a rating of **Low** for volatile organic chemicals. 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 Birch Hill Ski Lodge to protect public health.

FNSD BIRCH HILL SKI LODGE PUBLIC DRINKING WATER SYSTEM

The Birch Hill Ski Lodge public water system is a Class B (transient/non-community) water system. The system consists of one well located in Fairbanks, Alaska (see Map A of Appendix A). Fairbanks and its surrounding communities are part of the Fairbanks North Star Borough which is near the center of Alaska. The Borough's current population is 96,888 making it the second-largest population center in the state (ADCCED, 2008). Communities located within the Borough include: College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

The Fairbanks area experiences extreme weather variations according to the season. Temperatures in January vary from –19 to –2 degrees Fahrenheit and from 53 to 72 degrees in July. Average annual precipitation in the area is 11.5 inches, and ice fog is common during the winter (ADCCED, 2008).

Sewage and treated water facilities are provided by a private company within Fairbanks. Fifteen circulating pump stations distribute treated water. Wells and septic systems are also used within and outside Fairbanks. Heating oil (stored in both above- and below-ground tanks) is used for heating homes and buildings. Refuse is transported to the Fairbanks North Star Borough landfill (ADCCED, 2008).

According to the well log, the well extends 503 feet below the ground surface and is completed in an unconfined aquifer. The sanitary survey for this system (08/24/2005) indicates that the well is capped with a sanitary seal, the land surface is appropriately sloped away from the well, and the well is grouted according to DEC regulations.

This system has one service connection and serves approximately 400 non-residents year-round.

FNSD BIRCH HILL SKI LODGE 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 the 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 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 FNSD Birch Hill Ski Lodge was determined using an analytical calculation and includes Zone A (see Map A of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

DWP has completed an inventory of potential and existing sources of contamination within the FNSD Birch Hill Ski Lodge drinking 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 FNSD BIRCH HILL SKI LODGE 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 FNSD Birch Hill Ski Lodge received a **Low** susceptibility rating. The most recent sanitary survey (08/24/2005) indicates that the well is capped with a sanitary seal, the land surface is appropriately sloped away from the well, and the well is grouted according to DEC regulations. Sanitary seals prevent potential contaminants from entering the well, while sloping of the land surface away from the wellhead provides adequate surface water drainage, and concrete or grouting around the wellhead helps 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 FNSD Birch Hill Ski Lodge system draws water from an unconfined aquifer and consists mostly of schist and fractured rock. It received a **Medium** susceptibility rating because of its deep, unconfined nature. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, it is susceptible to contamination from outside sources. However, deeper aquifers provide greater protection from this downward migration.

Table 2 summarizes the Susceptibility scores and ratings for the FNSD Birch Hill Ski Lodge system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	12	Medium
Natural Susceptibility	12	Low

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 FNSD Birch Hill Ski Lodge system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
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 FNSD Birch Hill Ski Lodge system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	25	Low
Nitrates and/or Nitrites	60	High
Volatile Organic Chemicals	35	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Low** with a septic system and a road 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 sampling at FNSD Birch Hill Ski Lodge (data reviewed in April, 2008).

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 **Low**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High** mainly due to a high concentration of nitrates detected during sampling. A septic system and a road contribute further to the risk to this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. The Maximum Contaminant Level (MCL) is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects (EPA, 2008). The MCL for nitrates is 10 milligrams per liter (mg/L). The sampling history for FNSD Birch Hill Ski Lodge indicates that nitrates have been detected in the water at levels reaching 121% of the MCL, with the highest concentration of 12.1 mg/l detected on 3/19/2008 (data 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 septic system, a road, and a heating oil tank contributing to the risk to the drinking water well.

The drinking water at FNSD Birch Hill Ski Lodge has not been recently sampled for volatile organic chemicals (data reviewed in April, 2008).

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 **Low**.

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 FNSD Birch Hill Ski Lodge 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 FNSD Birch Hill Ski Lodge 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

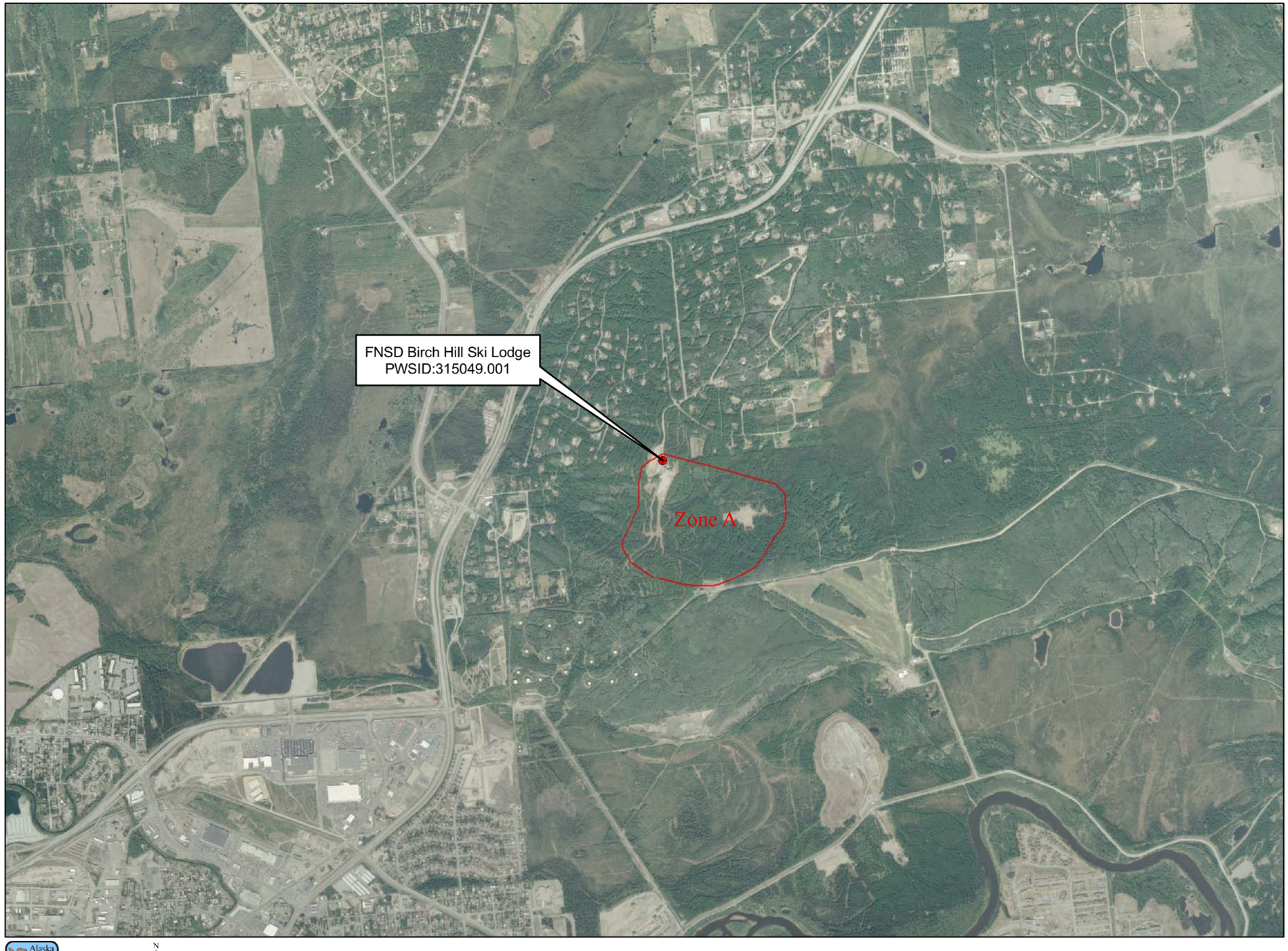
Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

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

APPENDIX A

FNSD Birch Hill Ski Lodge
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #315049.001 FNSD Birch Hill Ski Lodge



Legend

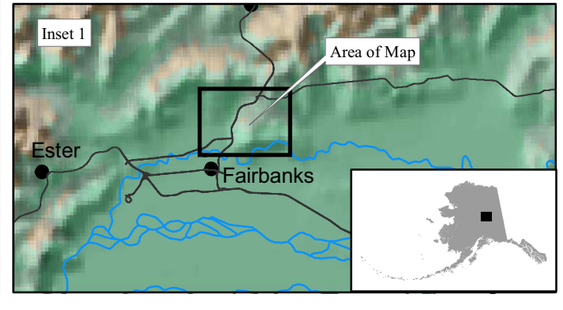
- Class B Public Water System Well
- Zone A Protection Area - Several Months Travel Time

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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FNSD Birch Hill Ski Lodge
PWS 315049.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for FNSD Birch Hill Ski Lodge (Tables 1-4)

Table 1

Contaminant Source Inventory for
FNSD Birch Hill Ski Lodge

PWSID 315049.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	C	1 Assumed septic
Tanks, heating oil, residential (above ground)	R08	R08	A	C	1 Assumed heating oil tank
Highways and roads, dirt/gravel	X24	X24	A	C	1 Road

Table 2

Contaminant Source Inventory and Risk Ranking for FNSD Birch Hill Ski Lodge Sources of Bacteria and Viruses

PWSID 315049.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 Assumed septic
Highways and roads, dirt/gravel	X24	X24	A	Low	C	1 Road

Table 3

Contaminant Source Inventory and Risk Ranking for FNSD Birch Hill Ski Lodge Sources of Nitrates/Nitrites

PWSID 315049.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 Assumed septic
Highways and roads, dirt/gravel	X24	X24	A	Low	C	1 Road

Table 4

Contaminant Source Inventory and Risk Ranking for FNSD Birch Hill Ski Lodge Sources of Volatile Organic Chemicals

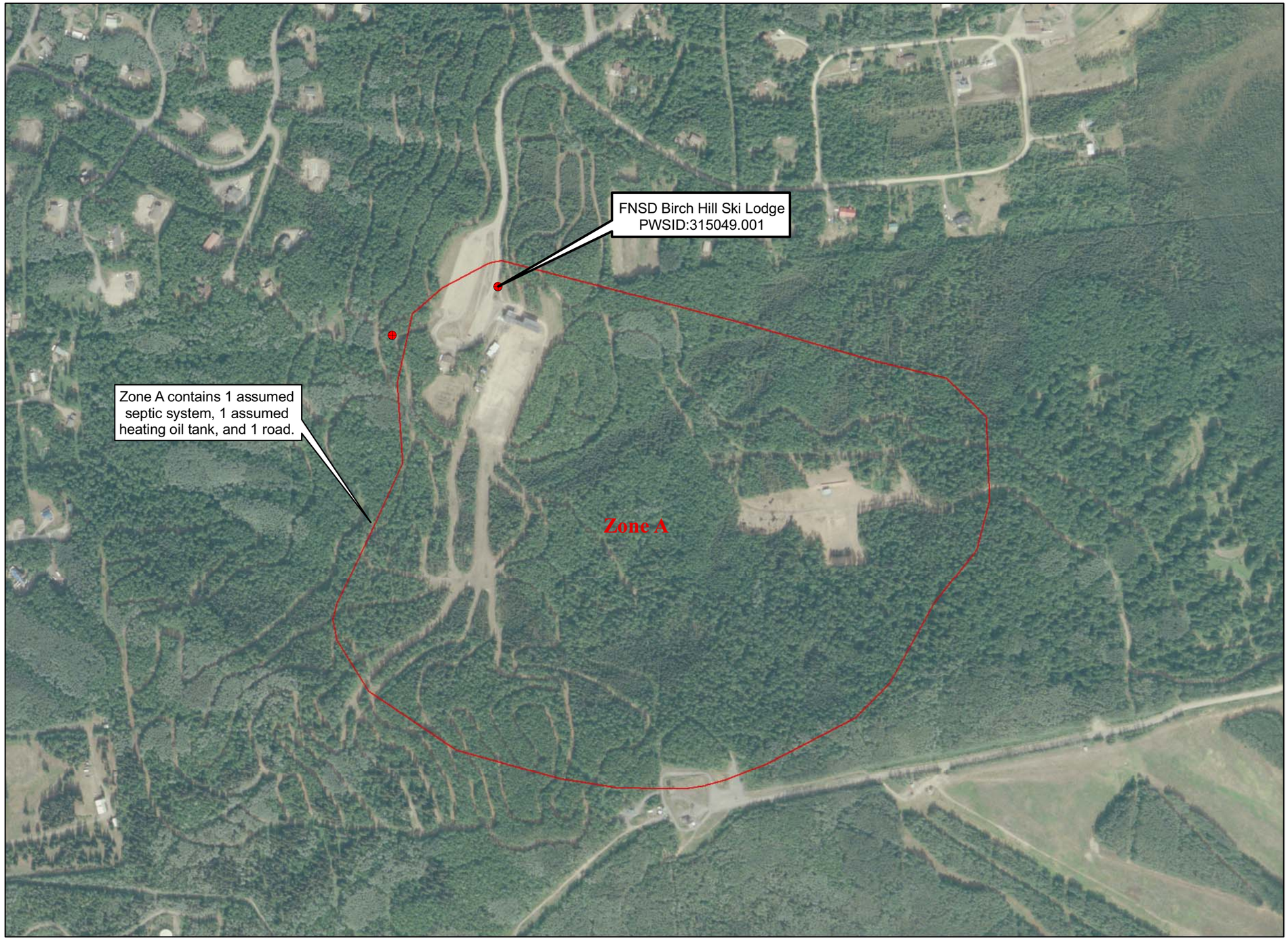
PWSID 315049.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 Assumed septic
Tanks, heating oil, residential (above ground)	R08	R08	A	Medium	C	1 Assumed heating oil tank
Highways and roads, dirt/gravel	X24	X24	A	Low	C	1 Road

APPENDIX C

FNSD Birch Hill Ski Lodge
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS #315049.001 FNSD Birch Hill Ski Lodge
Showing Potential and Existing Sources of Contamination



Legend

Class B Public Water System Well

Groundwater Protection Zones

Zone A Protection Area - Several Months 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

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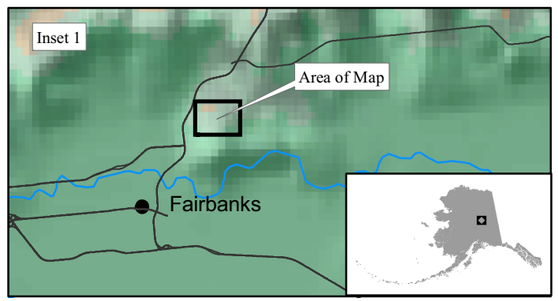

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FNSD Birch Hill Ski Lodge
PWS 315049.001

Appendix C Map C