Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Denali Backcountry Lodge Public Drinking Water System, Denali National Park, Alaska PWSID # 391249.001

DRINKING WATER PROTECTION REPORT 1843

Alaska Department of Environmental Conservation

February, 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.

February, 2009

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Source Water Assessment for Denali Backcountry Lodge Source of Public Drinking Water, Denali National Park, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Denali Backcountry Lodge is a Class B (transient/non-community) water system consisting of one well and a surface water intake located in the Kantisha Hills in Denali National Park, Alaska. This report applies only to the well, PWSID 391249.001. DEC records indicate this system is classified as groundwater under the direct influence of surface water (GWUDISW). The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **High**. An aquifer susceptibility rating of high to very high is typical for all systems that receive a component of surface water, or are classified as GWUDISW. Combining these two ratings produces a **High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Denali Backcountry Lodge public drinking water source include: multiple placer mines, quarries, a septic system, diesel tanks, a gasoline tank, and a road. 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 Denali Backcountry Lodge received a vulnerability rating of **Very High** for bacteria and viruses, **Medium** for nitrates and nitrites, and **Medium** 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 Denali Backcountry Lodge to protect public health.

DENALI BACKCOUNTRY LODGE PUBLIC DRINKING WATER SYSTEM

Denali Backcountry Lodge public water system is a Class B (transient/non-community) water system. The system consists of one well and a surface water intake located within the Kantisha Hills, near the confluence of Eureka Creek and Moose Creek, in Denali National Park (See Map A of Appendix A). This report applies only to the well, PWSID 391249.001.

The nearest community is McKinley Park, located just north of the entrance to Denali National Park at approximately Mile 238 of the Parks Highway. It is primarily a seasonal community, and is home to an estimated 149 residents (ADCCED, 2009).

Average annual precipitation in the area is approximately 11.3 inches. McKinley Park lies in the Nenana River valley, which cuts through the steeply rising peaks of the Alaska Range. Most of the businesses are located along the river or on the gentler slopes at the base of the mountains.

Residences and businesses in the area either haul water and use outhouses, or have private septic systems and wells. Refuse is hauled to the Denali Borough landfill south of Anderson (ADCCED, 2009).

The geology of the McKinley Park area is characterized by glacial sediments overlying bedrock. The glacial till has been reworked by rivers in some areas, and may consist of well-rounded to angular rock fragments mixed with sand and silt. Local fractures in the bedrock can provide pathways for the migration of groundwater (Lanning, 1994).

According to the previous Source Water Assessment report for this system (8/2002), the depth of the well is approximately 20 feet below the ground surface and it is completed in an unconfined aquifer. The Sanitary Survey (6/17/2003) for the water system indicates that a sanitary seal is installed, the land surface is appropriately sloped away from the well, and the well is grouted according to DEC regulations.

The well characteristics in combination with the characteristics of the unconfined aquifer at this location indicate that this well is GWUDISW.

This system operates from June to September and serves approximately 90 non-residents through 23 service connections.

DENALI BACKCOUNTRY LODGE DRINKING WATER PROTECTION AREA

Determining the risk for groundwater wells that are under the influence of surface water bodies necessitates an evaluation of both groundwater and surface water contamination pathways. The pathways most likely for surface contamination to reach the groundwater are determined by looking at the characteristics of the soil, groundwater, aquifer, and well. The pathways most likely for surface contamination to reach water intake

areas are initially determined by looking at the drainage area contributing overland water flow to a surface water source intake.

The most probable area for contamination to reach the drinking water well is the drinking water protection area. For groundwater sources, 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. For surface water sources, the drinking water protection area is the entire drainage area. Because releases of contaminants within these combined protection areas are most likely to impact the well, these areas will serve as the focus for voluntary protection efforts.

There are many different methods for calculating the size of protection areas for groundwater sources. 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 groundwater wells by the DEC are usually separated into two zones (A and B), 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 protection area established for surface water sources by the DEC is usually separated into three zones (E, F, and G), limited by the watershed boundary. These zones correspond to the overland-flow distance that water travels to get to the source. The DEC Drinking Water Protection Technical Advisory Committee developed guidelines for derivation of these zones in 1998.

The following is a summary of the five protection area zones for groundwater wells that are under the influence of surface water bodies and the calculated time-of-travel or distance from the water body for each:

Table 1. Definition of Zones

Zone	Definition
A	Several months time-of-travel
B	Less than the 2 year time-of-travel
E	Areas within 1000 feet of the water body, including areas within 1000 feet of all lakes/ streams up to a stream order of 2 below the stream order at the source
F	Areas within 1 mile of water body, including areas within 1 mile of all lakes/ streams up to a stream order of 2 below the stream order at the source
G	Entire watershed

The drinking water protection area for Denali Backcountry Lodge was determined using an analytical calculation and includes Zones A, E, F, and G (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 Denali Backcountry 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.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and viruses are only inventoried in Zones A and B because of their short life span. 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 DENALI BACKCOUNTRY 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 in place, protection from flooding, and if the well casing is properly grouted.

The wellhead for the Denali Backcountry Lodge received a **Very High** susceptibility rating. The most recent sanitary survey (6/17/2003) indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is grouted. A sanitary seal prevents potential contaminants 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. However, the well is located within a floodplain, thereby increasing the susceptibility of the wellhead to contamination.

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 Denali Backcountry Lodge system draws water from an unconfined aquifer consisting of sand and gravel. It received a **High** susceptibility rating because of its unconfined and relatively shallow 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. Shallow aquifers provide less protection from this downward migration.

Table 2 summarizes the Susceptibility scores and ratings for Denali Backcountry Lodge system.

Table 2: Susceptibility

	Score	**Rating**
Susceptibility of the Wellhead	20	Very High
Susceptibility of the Aquifer	18	High
Natural Susceptibility	38	High

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 Denali Backcountry Lodge system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	13	Low
Volatile Organic Chemicals	12	Low

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 Denali Backcountry Lodge system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	90	Very High
Nitrates and/or Nitrites	50	Medium
Volatile Organic Chemicals	50	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**, primarily due to previous records of bacteria in the water. A septic system and road also contribute to the risk to the drinking water well.

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

Samples testing positive for bacteria and viruses increase the overall vulnerability of the drinking water source by indicating that the source is susceptible to bacteria and virus contamination. Only a small number of bacteria and viruses are required to endanger public health. Bacteria and viruses have been detected during recent water sampling of the system at Denali Backcountry Lodge. Total coliforms were detected on 8/27/2005 and 8/30/2005 (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 **Very High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Low** with quarries, a septic system, and road contributing to the risk to the drinking water well.

Sampling history for Denali Backcountry Lodge well indicates that nitrates have been detected in the water within the last 5 years of sampling, with the highest level of 0.165 mg/l detected on 9/8/2004 (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 **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Low** with quarries, a septic system, diesel tanks, gasoline tank, and road contributing to the risk to the drinking water well.

The drinking water at Denali Backcountry Lodge has not recently been 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 **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 Denali Backcountry 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 Denali Backcountry Lodge drinking water source.

REFERENCES

Alaska Department of Commerce, Community and Economic Development (ADCCED), Accessed 2009 [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.

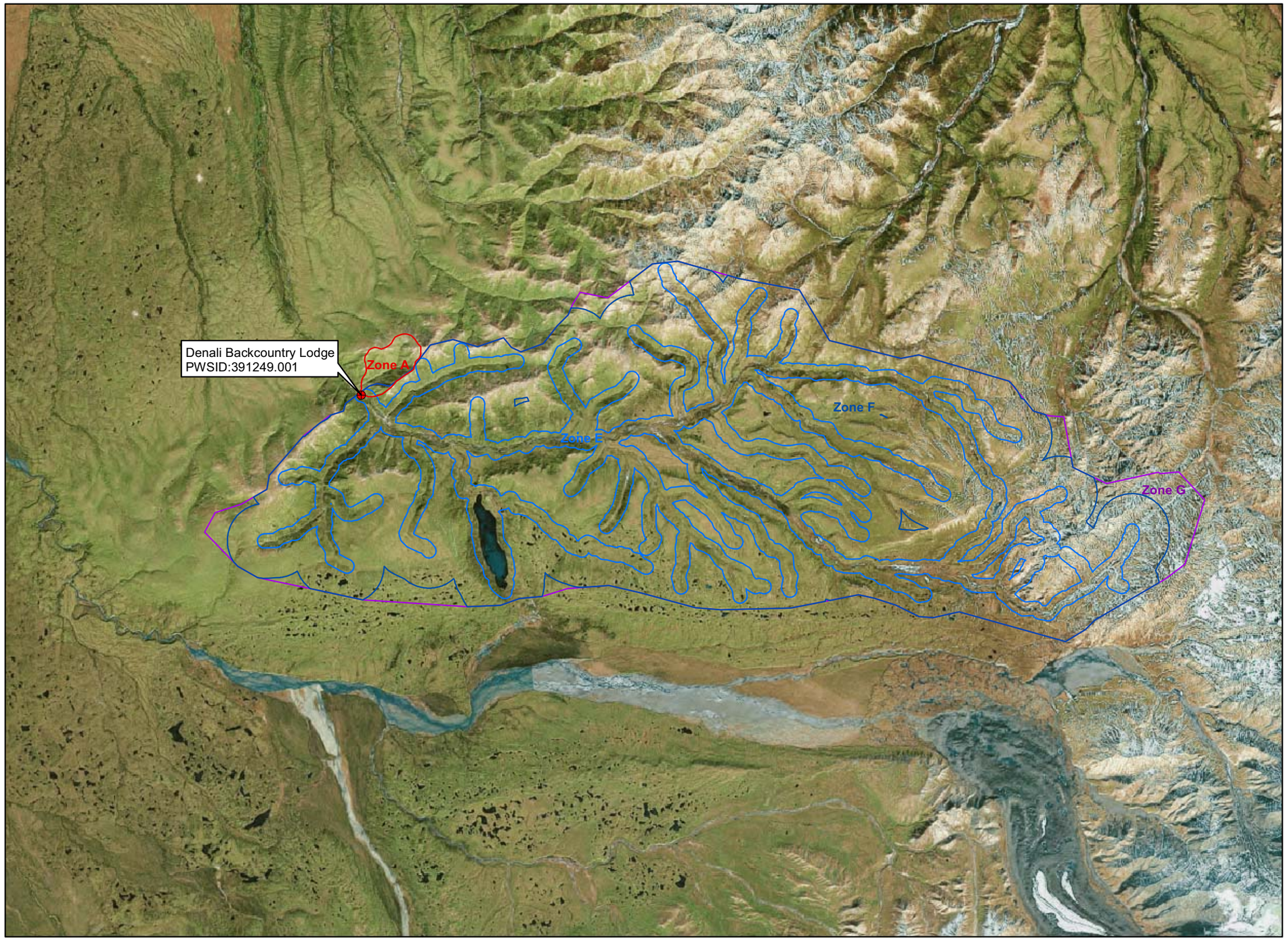
Lanning, David, 1994, Re: Request for Approval of a New Class B Well at Grizzly Bear Campground, Denali National Park, Alaska. Letter to the Alaska Department of Environmental Conservation dated May 11, 1994, Fairbanks, Alaska.

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

APPENDIX A

Denali Backcountry Lodge
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #391249.001 Denali Backcountry Lodge



Legend

- Class B Public Water System Well

Groundwater Protection Zones

- Zone A Protection Area - Several Months Travel Time
- Zone E Protection Area - Up to 1,000 Feet from Surface Water Body
- Zone F Protection Area - Up to 1 Mile from Surface Water Body
- Zone G Protection Area - Remainder of Watershed (Up to 10 Miles Upstream of Intake)

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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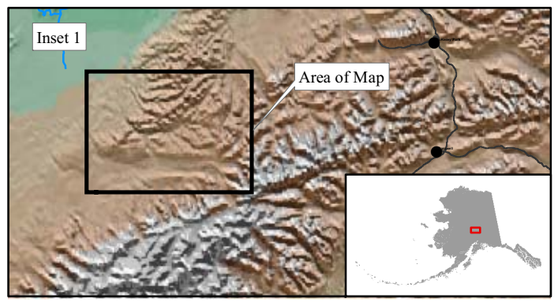

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Denali Backcountry Lodge
PWS 391249.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory And Risk Ranking for Denali Backcountry Lodge (Tables 1-4)

Table 1

Contaminant Source Inventory for ***Denali Backcountry Lodge***

PWSID 391249.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Metals mining, placer (active or inactive?)	E04	E04-11	A	C	
Quarries (sand, gravel, rock, other?)	E10	E10	A	C	6 quarries
Metals mining, placer (active or inactive?)	E04	E04-01	E	C	
Metals mining, placer (active or inactive?)	E04	E04-02	E	C	
Metals mining, placer (active or inactive?)	E04	E04-03	E	C	
Metals mining, placer (active or inactive?)	E04	E04-04	E	C	
Metals mining, placer (active or inactive?)	E04	E04-05	E	C	
Metals mining, placer (active or inactive?)	E04	E04-06	E	C	
Metals mining, placer (active or inactive?)	E04	E04-07	E	C	
Metals mining, placer (active or inactive?)	E04	E04-08	E	C	
Metals mining, placer (active or inactive?)	E04	E04-09	E	C	
Metals mining, placer (active or inactive?)	E04	E04-10	E	C	
Quarries (sand, gravel, rock, other?)	E10	E10	E	C	20 quarries
Septic systems (serves one single-family home)	R02	R02-01	E	C	
Tanks, diesel (above ground)	T06	T06-01	E	C	
Tanks, diesel (above ground)	T06	T06-02	E	C	
Tanks, diesel (above ground)	T06	T06-03	E	C	
Tanks, diesel (above ground)	T06	T06-04	E	C	
Tanks, gasoline (above ground)	T10	T10-01	E	C	
Highways and roads, dirt/gravel	X24	X24	E	C	1 road
Metals mining, placer (active or inactive?)	E04	E04-12	F	C	
Quarries (sand, gravel, rock, other?)	E10	E10	F	C	35 quarries
Highways and roads, dirt/gravel	X24	X24	F	C	1 road
Quarries (sand, gravel, rock, other?)	E10	E10	G	C	1 quarry

Table 2

Contaminant Source Inventory and Risk Ranking for Denali Backcountry Lodge Sources of Bacteria and Viruses

PWSID 391249.001

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	R02-01	E	Low	C	
Highways and roads, dirt/gravel	X24	X24	E	Low	C	1 road
Highways and roads, dirt/gravel	X24	X24	F	Low	C	1 road

Table 3

Contaminant Source Inventory and Risk Ranking for Denali Backcountry Lodge Sources of Nitrates/Nitrites

PWSID 391249.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Quarries (sand, gravel, rock, other?)	E10	E10	A	Low	C	6 quarries
Quarries (sand, gravel, rock, other?)	E10	E10	E	Low	C	20 quarries
Septic systems (serves one single-family home)	R02	R02-01	E	Low	C	
Highways and roads, dirt/gravel	X24	X24	E	Low	C	1 road
Quarries (sand, gravel, rock, other?)	E10	E10	F	Low	C	35 quarries
Highways and roads, dirt/gravel	X24	X24	F	Low	C	1 road
Quarries (sand, gravel, rock, other?)	E10	E10	G	Low	C	1 quarry

Table 4

Contaminant Source Inventory and Risk Ranking for Denali Backcountry Lodge
Sources of Volatile Organic Chemicals

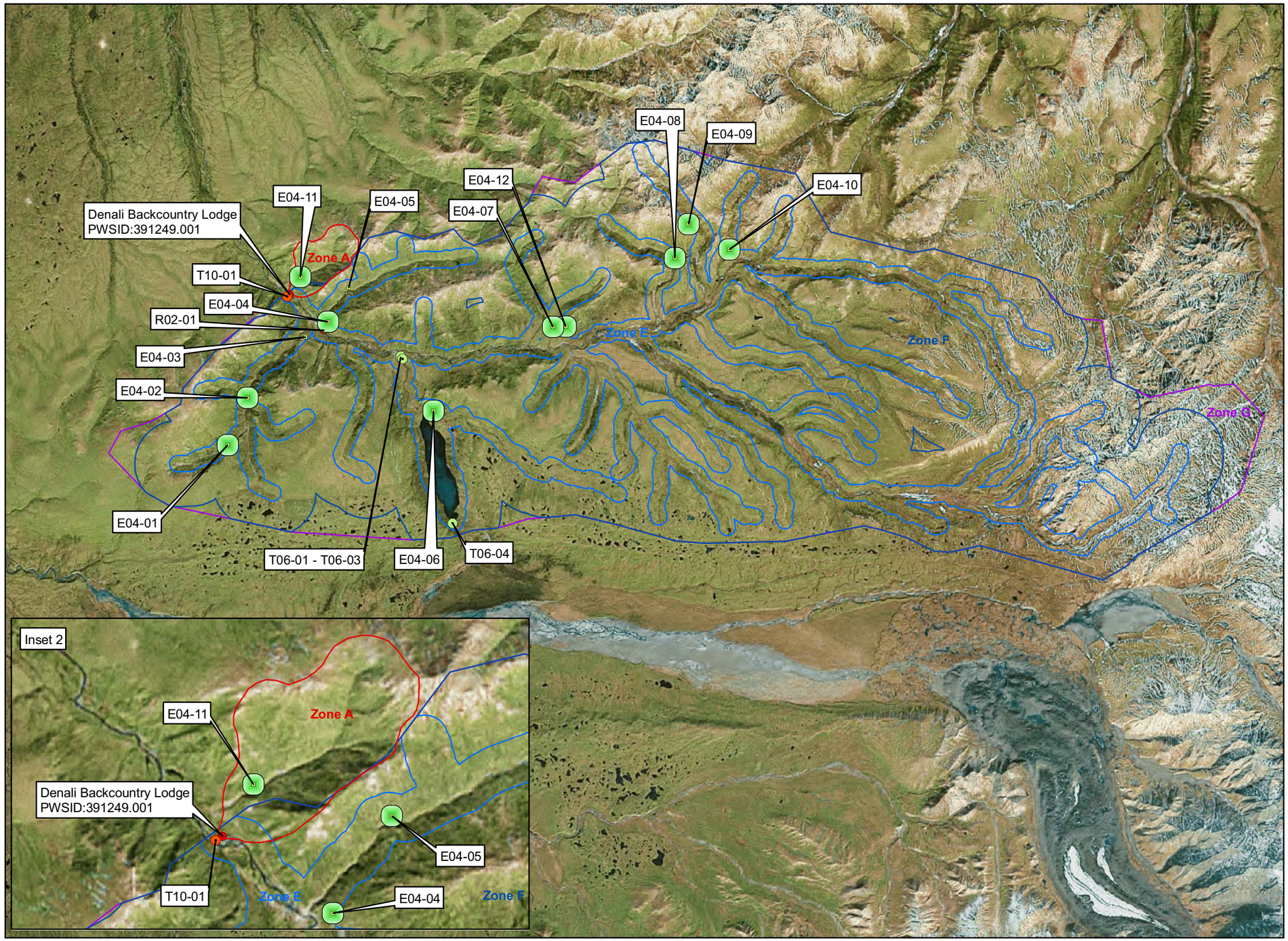
PWSID 391249.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Quarries (sand, gravel, rock, other?)	E10	E10	A	Low	C	6 quarries
Quarries (sand, gravel, rock, other?)	E10	E10	E	Low	C	20 quarries
Septic systems (serves one single-family home)	R02	R02-01	E	Low	C	
Tanks, diesel (above ground)	T06	T06-01	E	Medium	C	
Tanks, diesel (above ground)	T06	T06-02	E	Medium	C	
Tanks, diesel (above ground)	T06	T06-03	E	Medium	C	
Tanks, diesel (above ground)	T06	T06-04	E	Medium	C	
Tanks, gasoline (above ground)	T10	T10-01	E	Medium	C	
Highways and roads, dirt/gravel	X24	X24	E	Low	C	1 road
Quarries (sand, gravel, rock, other?)	E10	E10	F	Low	C	35 quarries
Highways and roads, dirt/gravel	X24	X24	F	Low	C	1 road
Quarries (sand, gravel, rock, other?)	E10	E10	G	Low	C	1 quarry

APPENDIX C

Denali Backcountry Lodge
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS # 391249.001 Denali Backcountry 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
- Zone E Protection Area - Up to 1,000 Feet from Surface Water Body
- Zone F Protection Area - Up to 1 Mile from Surface Water Body
- Zone G Protection Area - Remainder of Watershed (Up to 10 Miles Upstream of Intake)

Potential or Existing Contaminant Sources

- Metals mning, placer (active/inactive) (E04)
- Residential Septics (R02)
- Tanks, diesel (above ground) (T06)
- Tanks, gasoline (above ground) (T10)

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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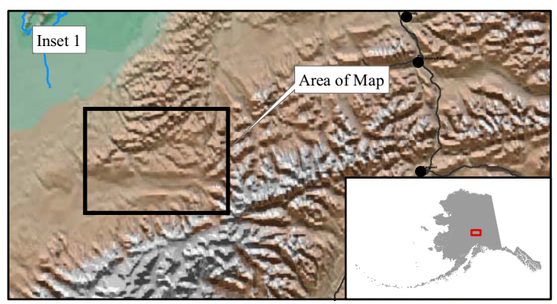

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Denali Backcountry Lodge
PWS 391249.001

Appendix C Map C