Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Denali Mountain Morning Hostel Public Drinking Water System, McKinley Park, Alaska PWSID # 391804.001

DRINKING WATER PROTECTION REPORT 1836

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 toll-free number 1-866-956-7656.

February, 2009

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Drinking Water Protection
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EXECUTIVE SUMMARY

The public water system for Denali Mountain Morning Hostel is a Class B (transient/non-community) water system consisting of one well located at Mile 224 of the George Parks Highway, near McKinley Park, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and existing sources of contaminants for the Denali Mountain Morning Hostel public drinking water source include: assumed and confirmed septic systems, assumed and confirmed residential heating oil tanks, 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 source of the Denali Mountain Morning Hostel received a vulnerability rating of **Low** 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 Mountain Morning Hostel to protect public health.

DENALI MOUNTAIN MORNING HOSTEL PUBLIC DRINKING WATER SYSTEM

Denali Mountain Morning Hostel public water system is a Class B (transient/non-community) water system. The system consists of one well located at Mile 224 of the George Parks Highway (see Map A of Appendix A). The nearest community is McKinley Park, located 14 miles north at the entrance to Denali National Park. It sits in the Nenana River valley, which cuts through the steeply rising peaks of the Alaska Range. McKinley Park is primarily a seasonal community, with a population of 138 residents during the busy summer tourist season. The McKinley Park area lies in the Denali Borough (population 2,033), which encompasses more than 12,000 square miles and also includes the communities of Anderson, Cantwell, and Healy (ADCCED, 2009).

Most of the residents in the area operate businesses catering to the influx of park visitors, and the majority of the businesses are located along the river or on the gentler slopes at the base of the mountains. Average annual precipitation in the area is 11.3 inches, and average temperatures range from lows of -22 degrees Fahrenheit in January to highs of 72 degrees Fahrenheit in July (ADCCED, 2009).

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. This glacial till has been reworked by rivers in some areas, and often consists 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 well log (10/10/2000), the Denali Mountain Morning Hostel well extends approximately 50 feet below the ground surface and is completed in an unconfined aquifer. This system operates seasonally from June to September and serves five residents and twenty-five non-residents through three service connections.

DENALI MOUNTAIN MORNING HOSTEL 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 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 Denali Mountain Morning Hostel was limited by its immediate watershed and includes only Zone A (see Map A in Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

DWP has completed an inventory of potential and existing sources of contamination within the Denali Mountain Morning Hostel 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 DENALI MOUNTAIN MORNING HOSTEL 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 at Denali Mountain Morning Hostel received a **Low** susceptibility rating. The most recent sanitary survey (06/27/2003) indicates that a sanitary seal is installed on the well, the land surface is 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 depth and thickness of the confining layer.

According to the well log (10/10/2000), the Denali Mountain Morning Hostel system draws water from an unconfined aquifer consisting of silt, sand and gravel. It received a **Very High** susceptibility rating because of the shallow depth and highly permeable nature of the aquifer, combined with the presence of other wells penetrating the vadose zone within the protection area. 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. Highly permeable materials allow this migration to happen quickly, thereby increasing the susceptibility. Other wells penetrating the vadose zone can also allow contaminants to travel down to the shared aquifer with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Denali Mountain Morning Hostel system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	25	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 Denali Mountain Morning Hostel system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	15	Low
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 Denali Mountain Morning Hostel system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	35	Low
Nitrates and/or Nitrites	40	Medium
Volatile Organic Chemicals	50	Medium

Bacteria and Viruses

The contaminant risk to the drinking water well for bacteria and viruses is determined to be **Low** with assumed and confirmed septic systems and a road contributing 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).

Only a small number of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected in the water within the last 5 years of sampling at Denali Mountain Morning Hostel (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 for the East Well at the Denali Mountain Morning Hostel is determined to be **Low** with assumed and confirmed septic systems, and a road contributing to the risk to the drinking water well.

The sampling history for the Denali Mountain Morning Hostel system indicates that nitrates and nitrites have been detected several times within the last five years, with the highest concentration of 0.526 mg/L detected on 05/13/2004 (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 determined to be **Medium** with assumed and confirmed septic systems, assumed and confirmed residential heating oil tanks and a road contributing to the risk to the drinking water well.

The drinking water at the Denali Mountain Morning Hostel 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 Mountain Morning Hostel 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 the Denali Mountain Morning Hostel 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.

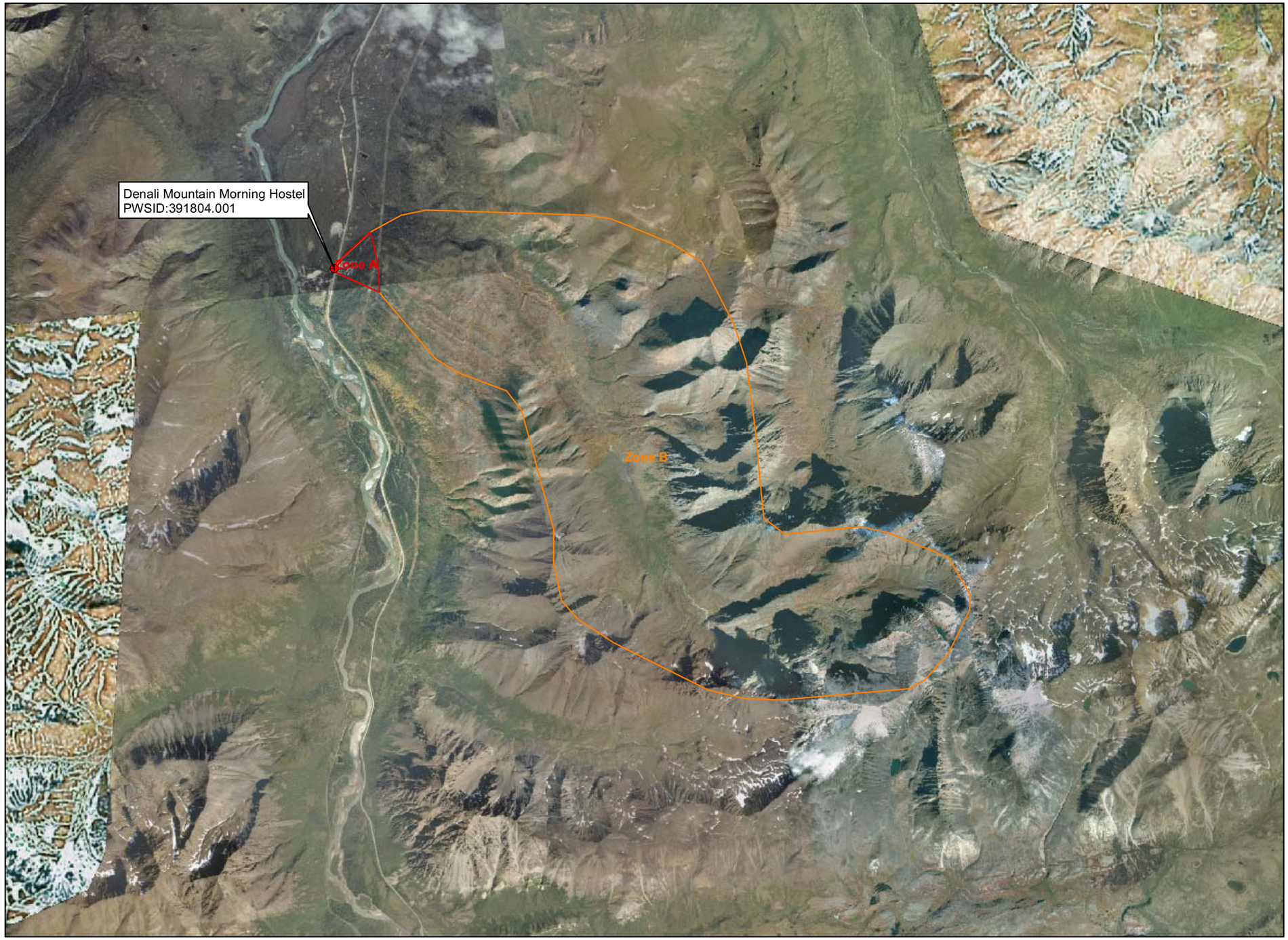
Lanning, David, 1994. Re: Request for Approval of a New Class B Well at Grizzly Bear Campground, Denali National Park, Alaska. Letter to the Alaska Department of Environmental Conservation dated May 11, 1994, Fairbanks, Alaska.

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

APPENDIX A

Denali Mountain Morning Hostel
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #391804.001 Denali Mountain Morning Hostel



Legend

Class B Public Water System Well

Groundwater Protection Zones

Zone A Protection Area - Several Months Travel Time

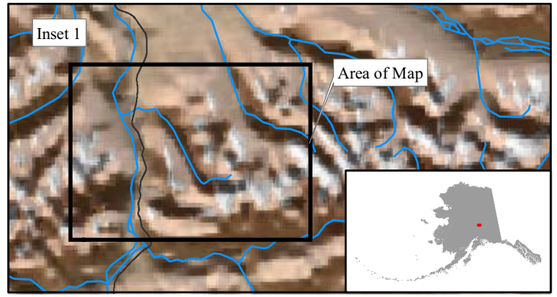
Zone B Protection Area - 2 Years Travel Time

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.



Alaska DEC

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Denali Mountain Morning Hostel
PWS 391804.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Denali Mountain Morning Hostel (Tables 1-4)

Table 1

Contaminant Source Inventory for ***Denali Mnt Morning Hostel***

PWSID 391804.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	C	3 assumed septic systems
Septic systems (serves one single-family home)	R02	R02-01	A	C	
Tanks, heating oil, residential (above ground)	R08	R08	A	C	3 assumed heating oil tanks
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	1 road

Table 2

Contaminant Source Inventory and Risk Ranking for Denali Mnt Morning Hostel Sources of Bacteria and Viruses

PWSID 391804.001

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	3 assumed septic systems
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

Table 3

Contaminant Source Inventory and Risk Ranking for Denali Mnt Morning Hostel Sources of Nitrates/Nitrites

PWSID 391804.001

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	3 assumed septic systems
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

Table 4

Contaminant Source Inventory and Risk Ranking for Denali Mnt Morning Hostel Sources of Volatile Organic Chemicals

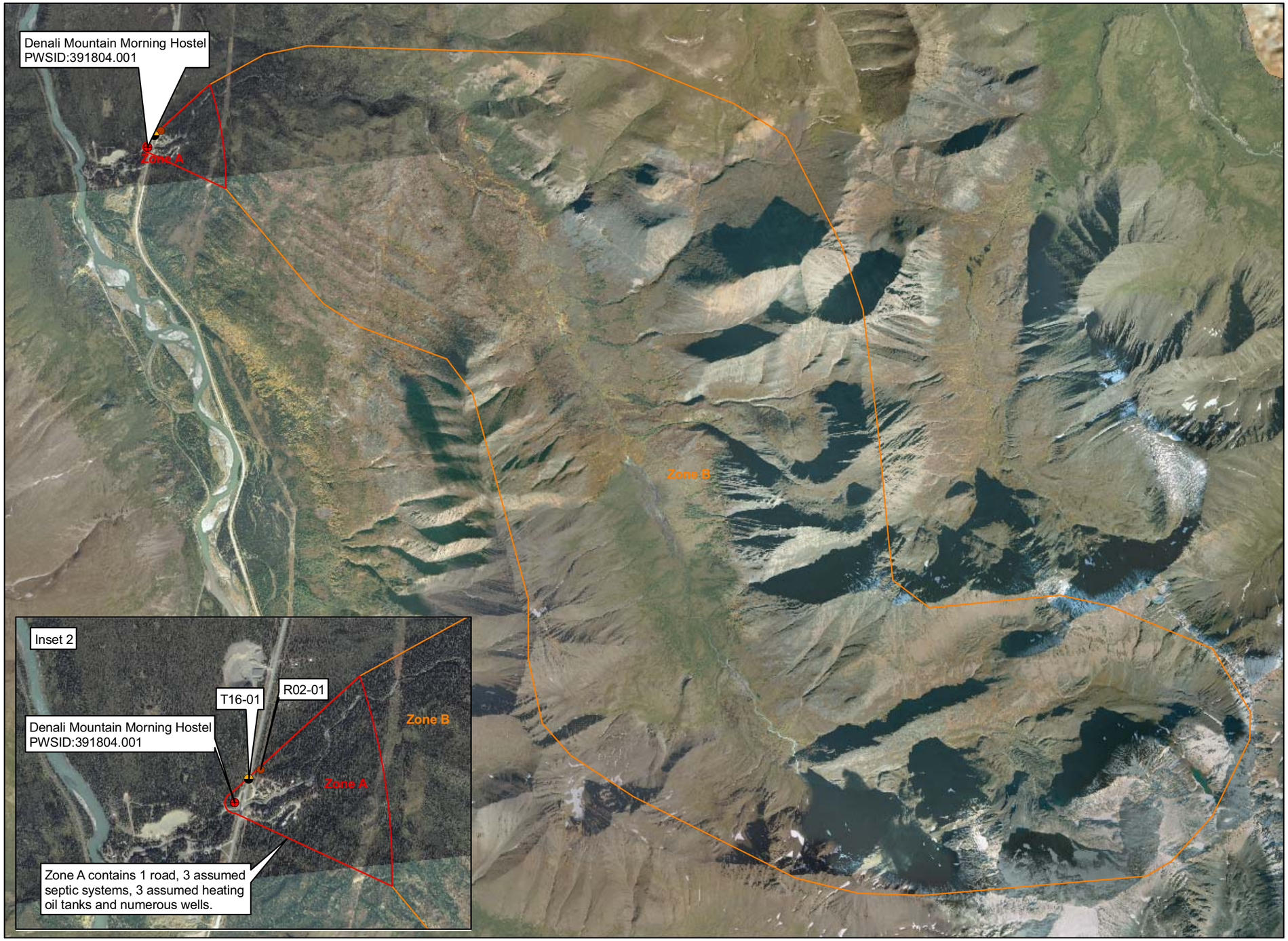
PWSID 391804.001

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	3 assumed septic systems
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	
Tanks, heating oil, residential (above ground)	R08	R08	A	Medium	C	3 assumed heating oil tanks
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

APPENDIX C

Denali Mountain Morning Hostel
Drinking Water Protection Area and
Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS # 391804.001 Denali Mountain Morning Hostel
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 B Protection Area - 2 Years Travel Time

Potential or Existing Contaminant Sources

- Residential Septics (R02)
- Tanks, heating oil, nonresidential (underground) (T16)

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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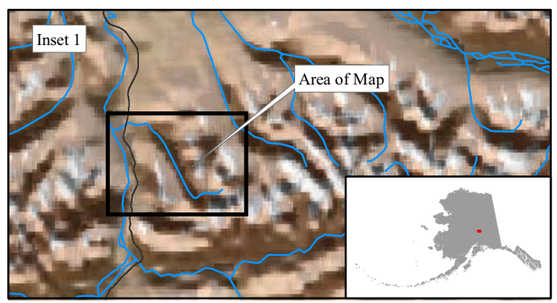

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Denali Mountain Morning Hostel
PWS 391804.001

Appendix C Map C