Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Alyeska Creekside Apartments Well 1 Public Drinking Water System, Girdwood, Alaska PWSID# 218653.001

DRINKING WATER PROTECTION REPORT 1858

Alaska Department of Environmental Conservation

February, 2011

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The Drinking Water Protection (DWP) team 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 (ADEC), 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 DWP staff at #1-866-956-7656.

February, 2011

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Source Water Assessment for Alyeska Creekside Apartments Well 1 Source of Public Drinking Water, Girdwood, Alaska

Drinking Water Protection

Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Alyeska Creekside Apartments Well 1 is a Community Water System (CWS) consisting of one well located at 351 Hightower Rd., Girdwood, Alaska. An assessment of the susceptibility of the wellhead and aquifer to contamination, and the vulnerability of the public water system to potential and existing contamination were evaluated as of January 2011. The wellhead received a susceptibility rating of **High** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and existing sources of contamination for the Alyeska Creekside Apartments Well 1 public drinking water system include inundation of California Creek, placer mining, residential areas, park and roads. These are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals (VOCs), heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals (SOCs), and other organic chemicals (OOCs). Additionally, presumably natural sources of barium and nitrates are also present.

Combining the natural susceptibility of the well with the six (6) contaminant risk categories, the public water system for Alyeska Creekside Apartments Well 1 received an overall vulnerability rating of **Medium** for bacteria and viruses**, Medium** for nitrates and/or nitrites, **Medium** for VOCs, **Low** for heavy metals, cyanide, and other inorganic chemicals, **Low** for SOCs, and **Low** for OOCs.

ALYESKA CREEKSIDE APARTMENTS WELL 1 PUBLIC DRINKING WATER SYSTEM

Alyeska Creekside Apartments Well 1 public water system is a community water system. The system consists of one well at 351 Hightower Road (Girdwood Elementary School, Tract A2), Girdwood, Alaska (See Map 1 of Appendix A). Girdwood is located on Turnagain Arm in the Municipality of Anchorage, 35 miles southeast of downtown Anchorage. (Please see the inset of Map 1 in Appendix A for location). The Municipality of Anchorage's current population is approximately 290,588, and Girdwood's current population is at approximately 2,000 to 3,000. Communities located within the municipality include Anchorage, Eagle River, Chugiak, and Girdwood. The majority of homes in the municipality are connected to Anchoarage Water and Wastewater Utility, providing water and sewerage. Natural gas is available to most homes through ENSTAR Natural Gas Company. A refuse transfer site is provided by the municipality (ADCCED 2009).

The floor of the Girdwood Valley is covered primarily by coniferous forests. Bedrock also outcrops at elevation in the mountains. Glacier Creek originates in uplands at the head of the valley, drains an area of approximately 58.2 square miles and is roughly centrally located. A mean annual discharge of 265 cubic feet per second was recorded in Glacier Creek (USGS gaging station near the mouth) from 1965 to 1978. California Creek and Alyeska Creek flow into Glacier Creek. California Creek drains an area of roughly 6.96 square miles. Virgin Creek flows directly into the Turnagain Arm and drains an area of about 3.5 suqare miles in the valley [*Glass and Brabets, 1988*].

According to the most recent sanitary survey (06/12/2006) for this water system, the depth of the well is estimated at 80 feet below land surface (bls). The well is completed in bedrock overlain by loose alluvium and is screened in the alluvium and left open in the bedrock, thus, making this well a bedrock well. Other wells in the area do not appear to be finished in the bedrock, so this one is unique to its neighbors. Geologic maps confirm that the entire watershed is composed of the same bedrock unit (*Combellick, R.A., 1984*).

The Alyeska Creekside Apartments Well 1 public water system serves approximately sixty (60) residents through two (2) approved service connections, per the latest sanitary survey (06/12/2006).

ALYESKA CREEKSIDE APARTMENTS WELL 1 DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. 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 area are were obtained from various United States Geological Survey (USGS) reports, area well logs, and the Groundwater textbook by Freeze and Cherry (1979).

The drinking water protection areas (DWPAs) 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 Alaska Division of Geological & Geophysical Surveys (*Combellick, R.A., 1984*).

Groundwater in the Glacier Creek Valley generally flows from bedrock highlands, including steep valley walls, toward sediments in the center of the valley. Flow through valley sediments, or unconsolidated deposits, is generally to the south toward Turnagain Arm. The entire immediate watershed was delineated as Protection Area for Alyeska Creekside Apartments Well 1 to take into account contaminants that may flow overland and enter valley sediments.

Because of uncertainties and changing site conditions, a factor of safety is added to the drinking water protection area for the well.

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

Zone A for this well is the immediate watershed. Zone B was not delineated. The DWPA for the Alyeska Creekside Apartments Well 1 found on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

Drinking Water Protection (DWP) has completed an inventory of potential and existing sources of contamination within the Alyeska Creekside Apartments Well 1 DWPA. 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 Community public water system assessments, the following six categories of drinking water contaminants were inventoried:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other organic chemicals.

The sources are displayed on Map 2 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 each 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 combination of toxicity and volume associated with that source. Rankings include:

- Low
- Medium
- High
- Very High

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant.

Tables 2 through 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals and other organic chemical

VULNERABILITY OF ALYESKA CREEKSIDE APARTMENTS WELL 1 PUBLIC DRINKING WATER SYSTEM

The vulnerability of public drinking water systems to regulated contaminants is determined by assessing the susceptibility of the wellhead, the susceptibility of the aquifer and the potential contaminant sources identified within the DWPA.

Drinking Water Protection staff developed a vulnerability assessment tool that assigns a vulnerability risk ranking based upon various factors associated with the well, aquifer and potential and existing contaminants identified within the DWPA.

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 Alyeska Creekside Apartments Well 1 received a **High** susceptibility rating. The most recent sanitary survey (completed 06/12/2006) indicates that the well is capped with a sanitary seal, the well is grouted, but the land surface is not sloped away from the well. Adding fill to slope the land away from the well is recommended to provide adequate surface water drainage. A sanitary seal prevents potential contaminants from entering the well and grouting help to prevent potential contaminants from traveling down the outside of the well casing. However, the well is located within an area with insufficient drainage and is 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 other wells and bore holes are penetrating the aquifer and, if applicable, and the characteristics of the confining layer.

The aquifer that the Alyeska Creekside Apartments Well 1 well is completed in received a **Medium** susceptibility rating. The aquifer is semi-confined and overlain by 51 feet of silty sand and gravel. The aquifer is relatively shallow and has a modest confining layer. Deeper aquifers are more protected from surface contaminants while more impermeable confining layers provide greater protection from any contamination that does manage to penetrate to that depth.

Table 2 summarizes the susceptibility scores and ratings for Alyeska Creekside Apartments Well 1.

Table 2. Susceptibility

	Rating
Susceptibility of the Wellhead	High
Susceptibility of the Aquifer	Medium
Natural Susceptibility	Medium

The Contaminant Risk was 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.

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	**Rating**
Bacteria and Viruses	Medium
Nitrates and/or Nitrites	Medium
Volatile Organic Chemicals	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Low
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Low

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

Natural Susceptibility
+
Contaminant Risks
=
Vulnerability of the
Drinking Water Source to Contamination

Table 4 contains the overall ratings for each of the six categories of drinking water contaminants.

Table 4. Overall Vulnerability

Category	Rating
Bacteria and Viruses	Medium
Nitrates and Nitrites	Medium
Volatile Organic Chemicals	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Low
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Low

Bacteria and Viruses

The inundation of California Creek and park in the protection area represent the greatest risk for bacteria and viruses to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coliform bacteria are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliform bacteria and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). No total coliform or fecal coliform have been detected for this well. 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 park in the protection area represents the greatest risk for nitrates and nitrites to this source of public drinking water. Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history of the Alyeska Creekside Apartments Well 1 indicates that low concentrations of nitrate have been detected. On 01/10/2010, 0.663 mg/L of nitrate and/or nitrite was detected. This is 7% of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed. Nitrate concentrations in uncontaminated groundwater are typically less than 2 milligrams per liter (mg/L) and are derived primarily from the decomposition of organic matter in soils (Wang, Strelakos, Jokela, 2000). The levels detected in source waters are low and are considered safe to drink.

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 inundation of California Creek represents the greatest risk for volatile organic chemicals (VOCs) to the well.

VOCs have not been detected within source waters. 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**.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The inundation of California Creek, residential areas, park and roads in the protection area and natural sources represent the greatest risk for inorganic chemicals to the well.

Heavy metals and other inorganic chemicals were collected on several occasions back to 2003. Barium and thallium were detected well below their respective maximum contaminant levels (MCLs). Barium and thallium has no man-made source in this area and is presumed to be naturally occurring.

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Low**.

Synthetic Organic Chemicals

The residential areas and park represent the greatest risk for synthetic organic chemicals (SOCs) to the well.

SOCs have not been sampled from this well. After combining the contaminant risk for SOCs with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Low**.

Other Organic Chemicals

The residential areas and roads represent the greatest risk for other organic chemicals (OOCs) to the well.

OOCs have not been sampled from this well. After combining the contaminant risk for OOCs 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 Alyeska Creekside Apartments Well 1 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 Alyeska Creekside Apartments Well 1 drinking water source.

REFERENCES

Alaska Department of Commerce, Community and Economic Development (DCCED), 2008 [WWW document], http://www.commerce.state.ak.us/dca/commdb/CIS.cfm (URL)

Glass, R.L., and Brabets, T.P., 1988, Summary of water resources data for the Girdwood-Alyeska area, Alaska: U.S. Geological Survey Open-File Report 87-678, 24 p.

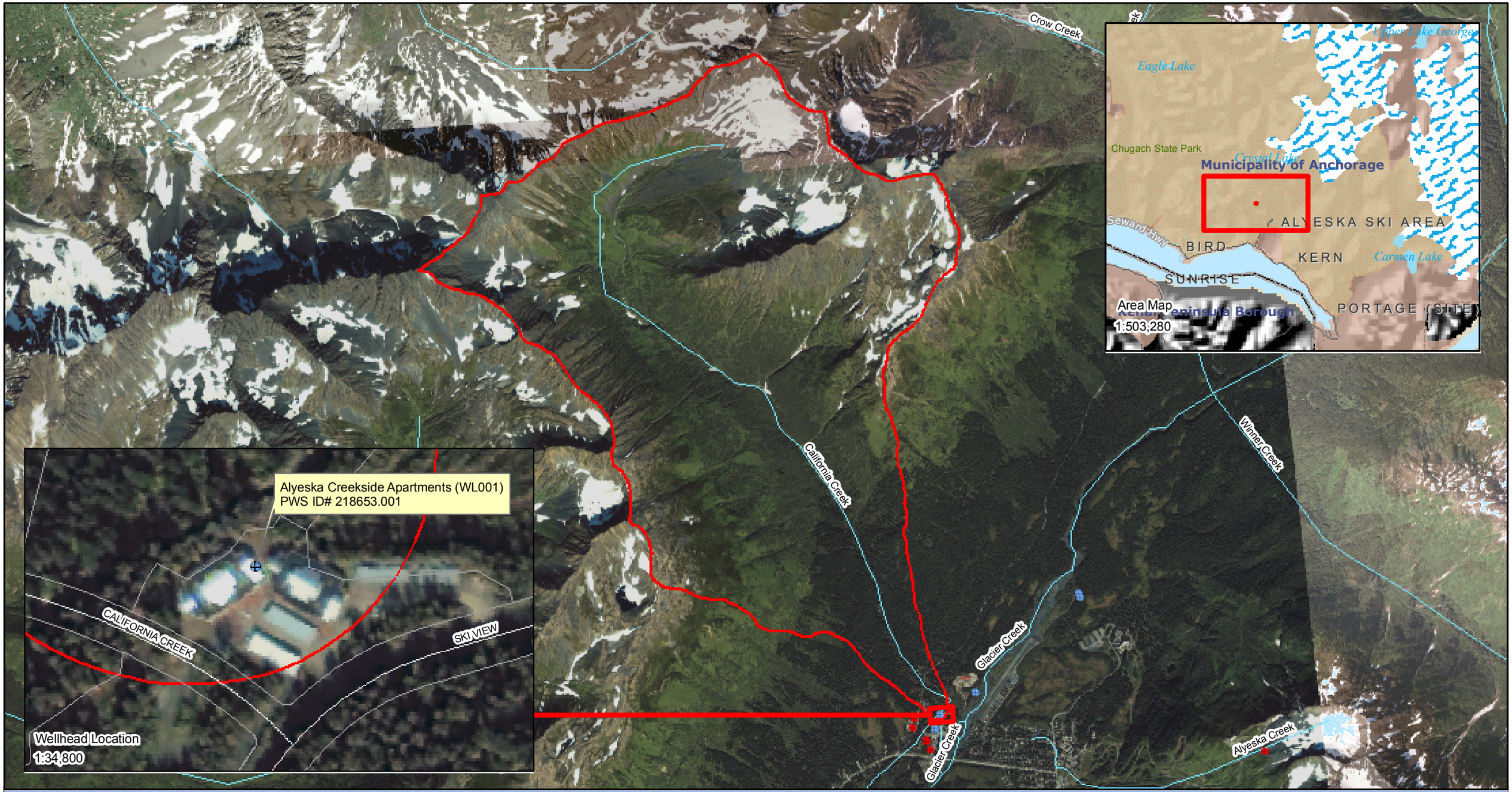
Combellick, R.A., 1984, Surficial-geologic map of the Seward D-7 Quadrangle, Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation 84-22, 1 sheet, 1:63,360

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

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

APPENDIX A

Alyeska Creekside Apartments Well 1
Drinking Water Protection Area Location Map
(Map 1)



Map 1 - Alyeska Creekside Apartments

PWS ID# 218653.001

Alaska Department of Environmental Conservation

1 0.5 0 1 Miles

1:34,800

N W E S

Public Water Systems

- Class A Water Systems (C/NTNC)
- Class B Water Systems (TNC)

Drinking Water Protections Areas

- Zone A: Several-month time-of-travel for groundwater sources.

Anne Gleason 09/23/2010

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Alyeska Creekside Apartments Well 1 (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Alyeska Creekside Apartments***

PWSID 218653.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Inundation (break-up or other seasonal events)	B04	B04-01	A	2	Flooding of California Creek. California Creek has been nominated to be listed as an impaired waterbody (303(d)) with flow alterations, oil and grease, habitat alterations, and siltation/sedimentation as water quality concerns.
Metals mining, placer (active or inactive?)	E04	E04-01	A	2	California Creek (Magnetite, Pyrite, Scheelite and Zircon)
Residential Areas	R01	R01-01	A	2	Approximately 12 Acres identified
Municipal or city parks (with green areas)	X04	X04-01	A	2	Chugach State Park
Highways and roads, paved (cement or asphalt)	X20	X20-01-03	A	2	Crow Creek Rd., Snowmass Cir., and California Creek Wy.

Table 2

Contaminant Source Inventory and Risk Ranking for Alyeska Creekside Apartments Sources of Bacteria and Viruses

PWSID 218653.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Inundation (break-up or other seasonal events)	B04	B04-01	A	Medium	2	Flooding of California Creek. California Creek has been nominated to be listed as an impaired waterbody (303(d)) with flow alterations, oil and grease, habitat alterations, and siltation/sedimentation as water quality concerns.
Residential Areas	R01	R01-01	A	Low	2	Approximately 12 Acres identified
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	2	Chugach State Park
Highways and roads, paved (cement or asphalt)	X20	X20-01-03	A	Low	2	Crow Creek Rd., Snowmass Cir., and California Creek Wy.

Table 3

Contaminant Source Inventory and Risk Ranking for Alyeska Creekside Apartments Sources of Nitrates/Nitrites

PWSID 218653.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	2	Approximately 12 Acres identified
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	2	Chugach State Park
Highways and roads, paved (cement or asphalt)	X20	X20-01-03	A	Low	2	Crow Creek Rd., Snowmass Cir., and California Creek Wy.

Table 4

Contaminant Source Inventory and Risk Ranking for Alyeska Creekside Apartments Sources of Volatile Organic Chemicals

PWSID 218653.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Inundation (break-up or other seasonal events)	B04	B04-01	A	Medium	2	Flooding of California Creek. California Creek has been nominated to be listed as an impaired waterbody (303(d)) with flow alterations, oil and grease, habitat alterations, and siltation/sedimentation as water quality concerns.
Residential Areas	R01	R01-01	A	Low	2	Approximately 12 Acres identified
Highways and roads, paved (cement or asphalt)	X20	X20-01-03	A	Low	2	Crow Creek Rd., Snowmass Cir., and California Creek Wy.

Table 5

Contaminant Source Inventory and Risk Ranking for Alyeska Creekside Apartments

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 218653.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Metals mining, placer (active or inactive?)	E04	E04-01	A	Low	2	California Creek (Magnetite, Pyrite, Scheelite and Zircon)
Residential Areas	R01	R01-01	A	Low	2	Approximately 12 Acres identified
Municipal or city parks (with green areas)	X04	X04-01	A	Low	2	Chugach State Park
Highways and roads, paved (cement or asphalt)	X20	X20-01-03	A	Low	2	Crow Creek Rd., Snowmass Cir., and California Creek Wy.

Table 6

Contaminant Source Inventory and Risk Ranking for Alyeska Creekside Apartments Sources of Synthetic Organic Chemicals

PWSID 218653.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	2	Approximately 12 Acres identified
Municipal or city parks (with green areas)	X04	X04-01	A	Low	2	Chugach State Park

Table 7

Contaminant Source Inventory and Risk Ranking for Alyeska Creekside Apartments Sources of Other Organic Chemicals

PWSID 218653.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Residential Areas	R01	R01-01	A	Low	2	Approximately 12 Acres identified
Highways and roads, paved (cement or asphalt)	X20	X20-01-03	A	Low	2	Crow Creek Rd., Snowmass Cir., and California Creek Wy.

APPENDIX C

Alyeska Creekside Apartments Well 1
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Zone A Contaminant Sources:
1 source of Inundation (B04)
1 Metals, mining, placer (E04)
12 acres of Resdiential Areas (R01)
1 State Park (X04)
3 Roads (X20)

X04

California Creek

B04

Glacier Creek

E04

Alyeska Creekside Apartments (WL001)
PWS ID# 218653.001

1:73,118

Penguin Creek

Map 2 - Alyeska Creekside Apartments

PWS ID# 218653.001

Alaska Department of Environmental Conservation

0 0.125 0.25 0.5 Miles

N W E S

1:15,600

Public Water Systems
- Class A Water Systems (C/NTNC)
- Class B Water Systems (TNC)

Drinking Water Protections Areas
- Zone A: Several-month time-of-travel for groundwater sources.

Potential Sources of Contamination
- E04, Metals Mining, placer (active/inactive)
- B04, Inundation (break-up or other seasonal events)
- X20, Highways and roads, paved (cement or asphalt)
- R01, Residential Areas
- X04, Parks (with green areas)

DATA SOURCES:

Aerial Imagery: A WMS-compliant map server provided by the Alaska Mapped program (http://www.alaskamapped.org) and UAF-GINA (http://www.gina.alaska.edu).

Public Drinking Water Sources, Drinking Water Protection Areas and Potential Sources of Contamination: Alaska Department of Environmental Conservation

Anne Gleason 01/14/2011