Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Alyeska PS 9 Drinking Water System, Richardson Hwy MP 258, Alaska PWSID 370691

September 2006

DRINKING WATER PROTECTION REPORT 1581
Alaska Department of Environmental Conservation

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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 (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 the Program Coordinator of DWP, (907) 269-7521.

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Source Water Assessment for Alyeska PS 9 Source of Public Drinking Water, Richardson Hwy MP 258, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the Alyeska PS 9 to potential contamination. This Class A (community) water system consists of one well off of the Richardson Highway near milepost 258. The well received a natural susceptibility rating of **Low**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **Medium** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Alyeska PS 9 public water system include: aboveground fuel storage tanks, pipelines, fuel transfer station, and other aboveground petroleum product storage tanks. These are considered as 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). Combining the natural susceptibility of the well with the contaminant risk, the public water system for Alyeska PS 9 received an overall vulnerability rating of **Medium** for VOCs, OOCs, and heavy metals, cyanide, and other inorganic chemicals; and, a **Low** for nitrates and/or nitrites, bacteria and viruses, and SOCs.

ALYESKA PS 9 PUBLIC DRINKING WATER SYSTEM

Alyeska PS 9 public water system is a Class A (community) water system. The system consists of one well off of the Richardson Highway at approximately milepost 258. This is just outside the Fort Greely Reservation area. Fort Greely operates a piped water and sewer system in the main installation area. Water is supplied by a number of wells. The Fort operates its own Class 3 landfill (ADCED 2003).

Alyeska PS 9 lies in the eastern part of the Tanana-Kuskokwim Lowlands. The geology of the Fort is composed of crystalline bedrock overlain by thick deposits of glacial sediments.

Groundwater in the main cantonment area flows in a northeasterly direction (DOWL 1997). Flow is expected to be off the hillsides towards the Delta River or other principal water bodies.

Permafrost is found discontinuously throughout the area; although the water table generally lies below permafrost, perched water zones have been reported (DOWL 1997).

The Alyeska PS 9 public water system serves approximately 25 non-residents through 3 service connections.

ALYESKA PS 9 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 area that contributes water to the well, the groundwater capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

There are many different methods for calculating the size of capture zones. 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 capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated by the DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture 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).

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

The protection areas established for wells are usually separated into two zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the two zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	Several months travel time
B	Less than 2 years time-of-travel

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Alyeska PS 9 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 PS 9 protection area. This inventory was completed through a search of agency records and other publicly available information. 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 A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- 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

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 PS 9 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 protection area.

The Drinking Water Protection 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 protection area.

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 PS 9 received a **Low** susceptibility rating. The most recent sanitary survey (8/16/2003) indicates the well is capped with a sanitary seal, the land surface is well drained, and the well is grouted. However, grout depth is unknown. A sanitary seal prevents potential contaminant from entering the well while sloping of the land surface and grouting help to prevent potential contaminants from traveling down the outside of the well casing.

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

The aquifer the Alyeska PS 9 well is completed in received a **Medium** susceptibility rating. While the aquifer material is highly transmissive, the water table is very deep. Transmissive aquifer materials aid contaminants in traveling downward from the surface with precipitation and surface water runoff, while deep

water tables help prevent it. Table 2 summarizes the Susceptibility scores and ratings for Alyeska PS 9.

Table 2: Susceptibility

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

The Contaminant Risk has been 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	Low
Nitrates and/or Nitrites	Low
Volatile Organic Chemicals	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Medium
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Very High

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	Low
Nitrates and Nitrites	Low
Volatile Organic Chemicals	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Medium
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Medium

Bacteria and Viruses

There are no potentail contaminant sources in the protection area that represent a serious risk for bacteria and viruses to contaminate the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms 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 coliforms and E. coli which only come from human and animal fecal waste (EPA, 2006). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2006). No samples in recent sample history have detected coliforms.

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

There are no potentail contaminant sources in the protection area that represent a serious risk for nitrates and nitrites to contaminate this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have been detected in recent sampling history for the Alyeska PS 9 well at levels 4% of the Maximum Contaminant Level (MCL=10mg/L). In quantities above the MCL nitrate can cause 'blue baby syndrome' in infants, and hemorrhaging of the spleen (EPA, 2006).

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 **low**.

Volatile Organic Chemicals

The fuel transfer area, aboveground fuel storage tank, and pipeline represent the greatest identified risk for volatile organic chemical contamination to the well.

Volatile Organic Chemicals have not been detected within source waters at appreciable levels. 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 fuel transfer area, aboveground fuel storage tank, pipeline, and aboveground crude oil tanks represent the greatest risk for inorganic chemicals to the well.

Barium was detected in recent sampling history at levels 2% of the MCL (MCL=2mg/L). In large amounts Barium can cause muscular weakness and high blood pressure (EPA, 2006).

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 **medium**.

Synthetic Organic Chemicals

The fuel transfer area and pipeline represent the greatest risk for synthetic organic chemicals to the well.

Synthetic organic chemicals have not been detected since sampling on 5/10/1995, where pentachlorophenol was detected at levels of 1% of the MCL (MCL=0.001mg/L). Subsequent samplings in 1995 and later have not yielded detections of SOCs.

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

Other Organic Chemicals

There are no potentail contaminant sources in the protection area that represent a serious risk for other organic chemicals to contaminate the well.

In sampling from 5/10/1995 DI(2-Ethylhexyl)-Phthalate was detected at levels of 30% of the MCL (MCL=0.006mg/L). Sampling on 9/6/1995 did not detect DI(2-Ethylhexyl)-Phthalate or any other SOC.

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

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2006 [WWW document]. URL http://www.dced.state.ak.us/mra/CF_BLOCK.cfm.

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

United States Environmental Protection Agency (EPA), 2006 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

DOWL/Ogden Joint Venture, 1997, *Draft Wellhead Protection Plan, Fort Greely, Alaska*, prepared for the U.S. Army Corps of Engineers, Anchorage, AK, February 1997.

APPENDIX A

Alyeska PS 9
Drinking Water Protection Area Location Map
(Map 1)

Beales South Base A
VABM
1392
Rifle Range
Pumping Station
No 9
Rifle
Range
HIGHWAY
PIPELINE
(UNDERGROUND)
TRANS-ALASKA
BOUNDARY
CREEK

Map 1- Alyeska PS 9 and Surrounding Water Systems

PWSID: 370691.001

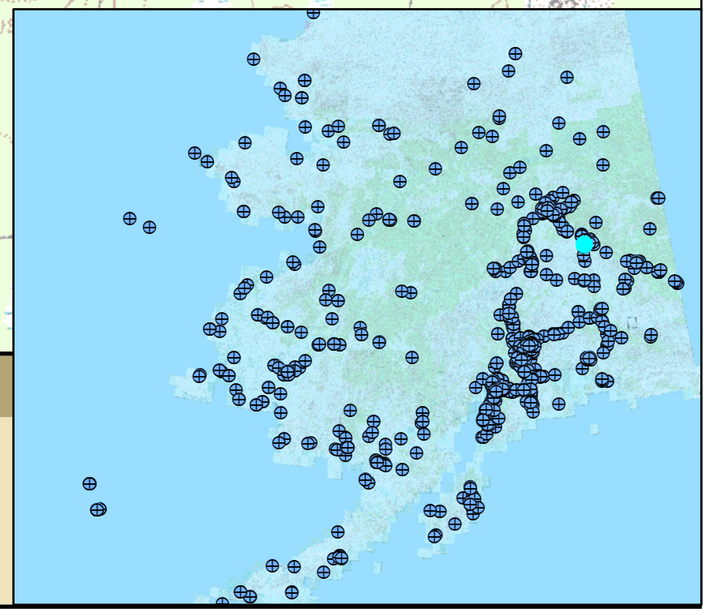
Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:30,615 Feet 7,200

Data Sources:
Kenai Borough: Roads and parcels
Aerial Photo: USGS and Microsoft Terraserver
Potential Sources of Contamination: ADEC

- Public Water Sources
- Zone A Protection Area
- Zone B Protection Area



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Alyeska PS 9 (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Alyeska PS 9 Perm***

PWSID 370691.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Truck stops/terminals	C42	C42-1	A		Transfer area for diesel from trucks to diesel tank. APSC Comments: Information appears correct.
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A		APSC Comments: The fuel supply for OSCP, oil spill and warm storage buildings. Tank is active, inside tank farm.
Tanks, lubricants or other petroleum products (aboveground)	T18	T18-1-3	A		APSC Comments: We assume these sources are the crude oil and turbine fuel. There are three large tanks within the tank farm: one crude oil, two turbine fuel, and are active at this time.
Pipelines (oil and gas)	X28	X28-1	A		APSC Comments: TAPS passes through western portion of Zone B, and along western edge of Zone A.
Tanks, lubricants or other petroleum products (aboveground)	T18	T18-4-6	B		APSC Comments: T19-6 is furthest from other tanks and represents several sumps and reservoirs in buildings w/in protection area. They hold Lube oil, Hydraulic fluid, etc. We are aware of two active sumps, but can't ID them with the info. provided.

Table 2

Contaminant Source Inventory and Risk Ranking for Alyeska PS 9 Perm
Sources of Volatile Organic Chemicals

PWSID 370691.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Truck stops/terminals	C42	C42-1	A	Medium		Transfer area for diesel from trucks to diesel tank. APSC Comments: Information appears correct.
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	Low		APSC Comments: The fuel supply for OSCP, oil spill and warm storage buildings. Tank is active, inside tank farm.
Pipelines (oil and gas)	X28	X28-1	A	Medium		APSC Comments: TAPS passes through western portion of Zone B, and along western edge of Zone A.

Table 3

Contaminant Source Inventory and Risk Ranking for Alyeska PS 9 Perm

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 370691.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Truck stops/terminals	C42	C42-1	A	Medium		Transfer area for diesel from trucks to diesel tank. APSC Comments: Information appears correct.
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	Low		APSC Comments: The fuel supply for OSCP, oil spill and warm storage buildings. Tank is active, inside tank farm.
Tanks, lubricants or other petroleum products (aboveground)	T18	T18-1-3	A	Low		APSC Comments: We assume these sources are the crude oil and turbine fuel. There are three large tanks within the tank farm: one crude oil, two turbine fuel, and are active at this time.
Pipelines (oil and gas)	X28	X28-1	A	Low		APSC Comments: TAPS passes through western portion of Zone B, and along western edge of Zone A.
Tanks, lubricants or other petroleum products (aboveground)	T18	T18-4-6	B	Low		APSC Comments: T19-6 is furthest from other tanks and represents several sumps and reservoirs in buildings w/in protection area. They hold Lube oil, Hydraulic fluid, etc. We are aware of two active sumps, but can't ID them with the info. provided.

Table 4

Contaminant Source Inventory and Risk Ranking for Alyeska PS 9 Perm
Sources of Other Organic Chemicals

PWSID 370691.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Truck stops/terminals	C42	C42-1	A	Medium		Transfer area for diesel from trucks to diesel tank. APSC Comments: Information appears correct.
Pipelines (oil and gas)	X28	X28-1	A	High		APSC Comments: TAPS passes through western portion of Zone B, and along western edge of Zone A.

APPENDIX C

Alyeska PS 9
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

8 Storage areas including several in-building sumps, and one fuel transfer area.
4 in Zone A
4 in Zone B

1 Pipeline through both Zones

Map 1- Alyeska PS 9 and Surrounding Water Systems

PWSID: 370691.001

0 1:3,130 Feet 750

Data Sources:
Kenai Borough: Roads and parcels
Aerial Photo: USGS and Microsoft Terraserver
Potential Sources of Contamination: ADEC

- Zone A Protection Area
- Zone B Protection Area
- Pipeline
- Public Water Sources
- Storage