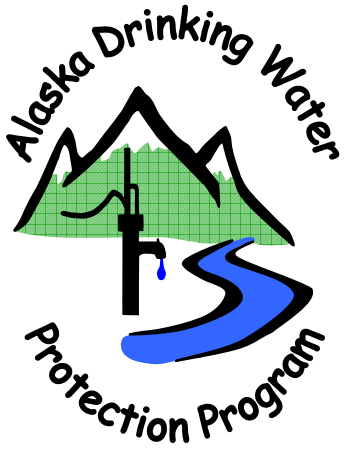

Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Alyeska PS 5 Drinking Water System, MP 137 Dalton Hwy, Alaska PWSID 350023

June 2006

DRINKING WATER PROTECTION REPORT Report 1579
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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TABLES

APPENDICES

Source Water Assessment for Alyeska PS 5 Source of Public Drinking Water, MP 137 Dalton Hwy, 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 5 to potential contamination. This Class A (community) water system consists of one well off of the Dalton Hwy approximately 165 air miles northwest of Fairbanks, Alaska. 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 **High** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Alyeska PS 5 public water system include: pipelines, roads and an airport. 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 5 received an overall vulnerability rating of a **Medium** for VOCs and OOCs, and a **Low** for bacteria and viruses, nitrates and/or nitrites, and heavy metals, cyanide, and other inorganic chemicals and SOCs.

ALYESKA PS 5 PUBLIC DRINKING WATER SYSTEM

Alyeska PS 5 public water system is a Class A water system. The system consists of one well at milepost 137 of the Dalton Highway.

According to a recent sanitary survey (3/9/99) for this water system, the depth of the well is 50 feet below the ground surface. The well is screened from 45 to 48 feet in unconsolidated material. Due to the depth of the well and high water table, the aquifer is assumed unconfined. Unconfined aquifers are more susceptible to groundwater impacts resulting from the downward migration of surface contaminants.

The Alyeska PS 5 public water system serves 50-60 non-residents through 7 service connections.

ALYESKA PS 5 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 5 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 5 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 5 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 5 received a **Low** susceptibility rating. A recent sanitary survey (3/9/99) 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.

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 5 well is completed in received a **High** susceptibility rating. The transmissive aquifer material and the high water table in the area allow contaminants to travel downward from the surface with the precipitation and surface water runoff. Table 2 summarizes the Susceptibility scores and ratings for Alyeska PS 5.

Table 2: Susceptibility

	Rating
Susceptibility of the Wellhead	Low
Susceptibility of the Aquifer	High
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	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Low
Synthetic Organic Chemicals	Medium
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	Low
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Medium

Bacteria and Viruses

The highway in the protection area represents 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. 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, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). No samples in recent 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

The highway and airport in the protection area also represent the greatest risk to to nitrates and nitrites for 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 (8/22/2004) for the Alyeska PS 5 well, at levels below the Maximum Contaminant Level (MCL=10 mg/L).

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 pipelines, highway and airport represent the greatest identified risk for volatile organic chemical contamination to the well.

Volatile Organic Chemicals in the form of Total Trihalomethanes (TTHMs) have been detected in samples from 8/22/2004. The detected levels are 14%

of the MCL for TTHMs (0.08 mg/L). The potential effects of ingesting large quantities of TTHMs are an increased risk of cancer, liver, kidney, or central nervous system problems.

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 airport, pipelines, and highway represent the greatest risk for inorganic chemicals to the well.

Inorganic chemicals were sampled on 6/23/2003. Barium was detected at levels 3% of the maximum contaminant level (MCL). In greater quantities, barium has been known to cause an increase in blood pressure (EPA, 2002).

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 airport represents the greatest risk for synthetic organic chemicals to the well.

Synthetic organic chemicals have not been sampled for in this water system.

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

The airport, pipelines, and highway represent the greatest risk for other organic chemicals to the well.

Other organic chemicals have not been sampled for in this water system.

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

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

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

APPENDIX A

Alyeska PS 5
Drinking Water Protection Area Location Map
(Map 1)

Map 1- Alyeska PS 5 and Surrounding Water Systems

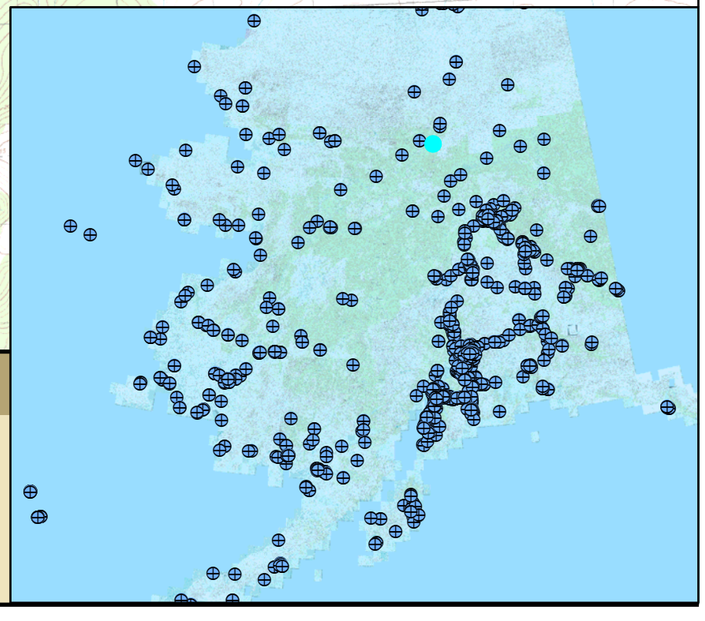
PWSID: 350023.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:96,523 Feet 20,000

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



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Alyeska PS 5 (Tables 1-7)

Table 1

Contaminant Source Inventory for

Alyeska PS 5 Perm

PWSID 350023.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	A		
Pipelines (oil and gas)	X28	X28-1	A		
Airports	X14	X14-1	B		

Table 2

Contaminant Source Inventory and Risk Ranking for Alyeska PS 5 Perm Sources of Bacteria and Viruses

PWSID 350023.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		

Table 3

Contaminant Source Inventory and Risk Ranking for Alyeska PS 5 Perm Sources of Nitrates/Nitrites

PWSID 350023.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		
Airports	X14	X14-1	B	Low		

Table 4

Contaminant Source Inventory and Risk Ranking for Alyeska PS 5 Perm
Sources of Volatile Organic Chemicals

PWSID 350023.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		
Pipelines (oil and gas)	X28	X28-1	A	Medium		
Airports	X14	X14-1	B	High		

Table 5

Contaminant Source Inventory and Risk Ranking for Alyeska PS 5 Perm

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 350023.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		
Pipelines (oil and gas)	X28	X28-1	A	Low		
Airports	X14	X14-1	B	Low		

Table 6

Contaminant Source Inventory and Risk Ranking for Alyeska PS 5 Perm

Sources of Synthetic Organic Chemicals

PWSID 350023.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Airports	X14	X14-1	B	Medium		

Table 7

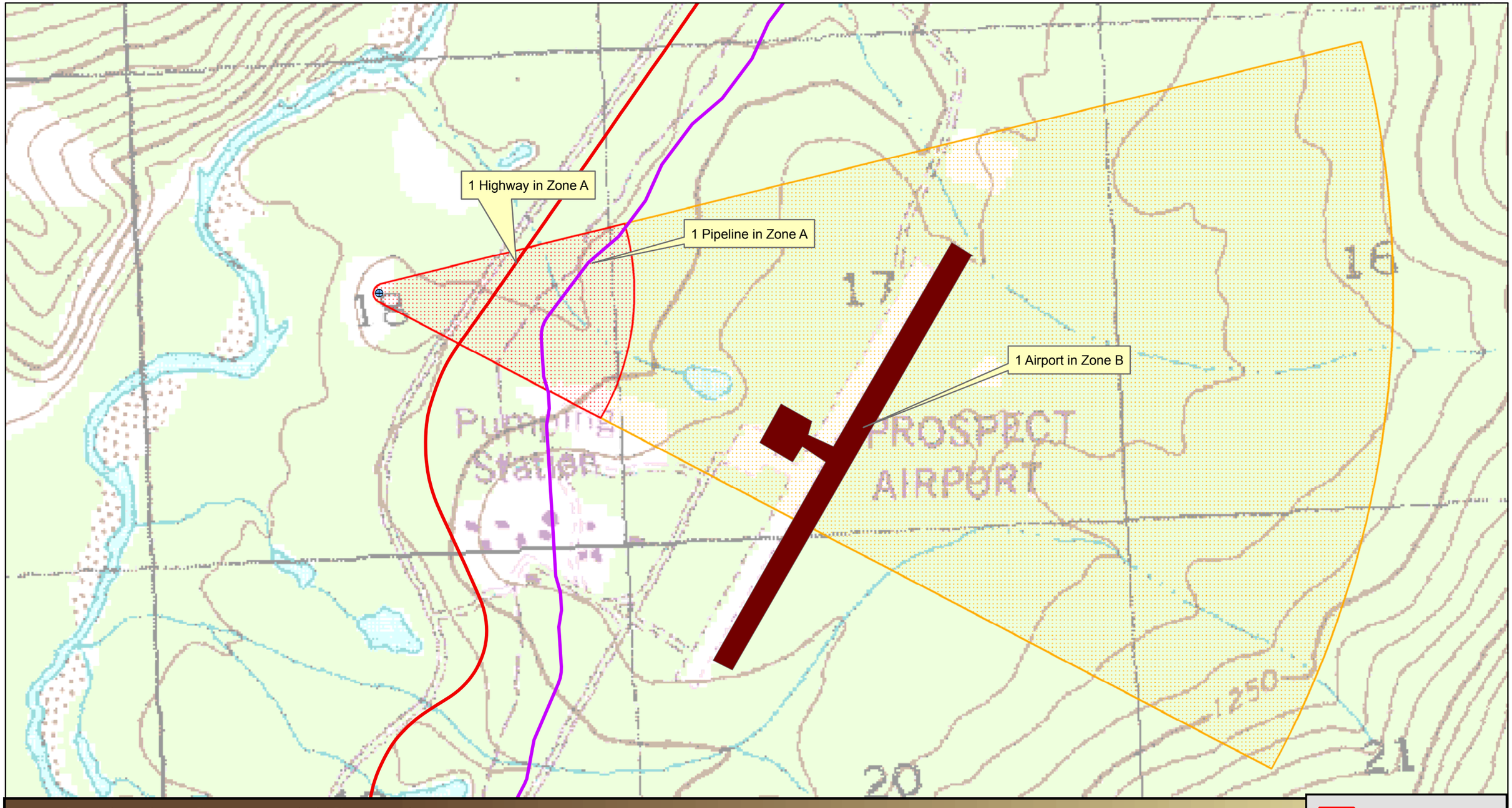
Contaminant Source Inventory and Risk Ranking for Alyeska PS 5 Perm
Sources of Other Organic Chemicals

PWSID 350023.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		
Pipelines (oil and gas)	X28	X28-1	A	High		
Airports	X14	X14-1	B	Medium		

APPENDIX C

Alyeska PS 5
Drinking Water Protection Area
Potential and Existing Contaminant Sources
(Map 2)



Map 2- Alyeska PS 5 Potential Contaminants

PWSID: 350023.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:12,032 Feet 2,500

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
- Airport
- Pipeline
- Roads
- Public Water Sources