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# Source Water Assessment

A Hydrogeologic Susceptibility and  
Vulnerability Assessment for  
Peters Creek Terrace Drinking Water  
System,  
Chugiak, Alaska  
PWSID # 211473.001

DRINKING WATER PROTECTION PROGRAM REPORT #984

Alaska Department of Environmental Conservation

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By Suzan J. Hill

DRINKING WATER PROTECTION PROGRAM REPORT 984

The Drinking Water Protection 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. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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# Source Water Assessment for Peters Creek Terrace Source of Public Drinking Water, Chugiak, Alaska

By Suzan J. Hill

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## Drinking Water Protection Program Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The public water system for Peters Creek Terrace is a Class A (community) water system consisting of one well in the Chugiak, Alaska area. Identified potential and current sources of contaminants for Peters Creek Terrace public drinking water source include large capacity and residential septic systems, a machine and metal shop, a heavy equipment rental facility, construction trade areas, roads, and approximately 122 acres of residential area. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals. Overall, the public water source for Peters Creek Terrace received a vulnerability rating of **High** for bacteria and viruses; nitrates and nitrites; volatile organic chemicals; and other organic chemicals, and **Medium** for heavy metals and synthetic organic chemicals.

### INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide public water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

### DESCRIPTION OF THE CHUGACH MOUNTAIN FRONT EAST OF ANCHORAGE

#### Location

Between the Chugach Mountain Front east of Anchorage and Knik Arm lie the communities of Eagle River, Chugiak, Peters Creek, and Eklutna. The Eagle River Valley is one of the largest valleys in the western Chugach Mountains. Eagle River and the neighboring communities are located in the Municipality of Anchorage Borough.

Glacial and alluvial forces have shaped the Eagle River Valley and Chugach Mountain front in this area. These forces have resulted in the U-shaped river valleys and moraine-mantled mountain flanks of the mountain front and lakes, streams and undulating ridges and hills of the glaciated lowlands extending to Knik Arm.

#### Precipitation

Eagle River averages between 20 and 25 inches of precipitation per year, including about 68 inches of snowfall.

#### Topography and Drainage

The area topography varies from sea level to about 400 feet in the area surrounding Knik Arm to several thousand feet on the surrounding ridges and mountain flanks.

#### Groundwater

Although the quality can vary significantly in a short distance, groundwater supplies are generally abundant in the area, except for some reported well failures that have occurred within the city limits of Eagle River. Groundwater occurs within both confined and unconfined aquifers and from both unconsolidated and bedrock aquifers. Many homes and businesses in the area rely on individual wells for their water supply.

Most of these wells are shallow with depths of less than 100 feet to 200 feet. Static water levels in many of these wells are less than 15 feet below the surface.

**Geology and Soils**

Most of the soils in the area provide good sources of sand, gravel and topsoil. The deposition of silt, clay and organic muck in old lakes, oxbows and depressions means that some areas have soil conditions that vary over relatively short distances.

**PETERS CREEK TERRACE PUBLIC DRINKING WATER SYSTEM**

Peters Creek Terrace is a Class A (community) water system. The system consists of one well and is located at Lot 11, Sheets Subdivision on Songbird Road. (See Map 1 of Appendix A). This area is at an elevation of approximately 425 feet above sea level.

According to the Well Log, there is sand and gravel from 0 to 28 feet; brown shale with boulders from 28 to 52 feet; gravel and red clay from 52 to 70 feet; sand from 70 to 83 feet; and water and gravel from 83 feet to a total well depth of 86 feet. The well was drilled on 9/7/77 and had a static water level of 74 feet. The Sanitary Survey (2/14/97) indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is also appropriately sloped away from the well providing adequate surface water drainage. The well is not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year-round and serves 70 residents through 5 service connections.

**PETERS CREEK TERRACE WELL 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. Some areas are more likely to allow contamination to reach the well than others. 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 recharge area. This area is

designated as the Drinking Water Protection Area (DWPA). Because releases of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts. (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The DWPA's established for wells by the ADEC are separated into four zones. 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 DWPA. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (Patrick, Brabets, and Glass, 1989), and State of Alaska Department of Water Resources (Jokela et. al., 1991).

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 four DWPA zones and the calculated time-of-travel for each:

**Table 1. Definition of Zones**

<b>Zone</b>	<b>Definition</b>
A	¼ the distance for the 2-yr. TOT
B	Less than the 2 year TOT
C	Less Than the 5 year TOT
D	Less than the 10 year TOT

As an example, water moving through the aquifer in Zone B will reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area down-gradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

The DWPA for the Peters Creek Terrace contain three zones: Zone A, Zone B, and Zone C (see Map 1 in Appendix A).

**INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES**

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Peters Creek Terrace 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 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 Maps 2 and 3 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.

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

### VULNERABILITY OF PETERS CREEK TERRACE DRINKING WATER SOURCE

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and
- Contaminant risks.

Each of the six categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

$$\begin{array}{r}
 \text{Natural Susceptibility (0 – 50 points)} \\
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the}
 \end{array}$$

Drinking Water Source to Contamination (0 – 100). A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

$$\begin{array}{r}
 \text{Susceptibility of the Wellhead (0 – 25 Points)} \\
 + \\
 \text{Susceptibility of the Aquifer (0 – 25 Points)} \\
 = \\
 \text{Natural Susceptibility (Susceptibility of the Well)} \\
 \text{(0 – 50 Points)}
 \end{array}$$

The well for Peters Creek Terrace is completed in a confined aquifer setting. The aquifer that is utilized by the well is protected from surface contamination by approximately 18 feet of relatively impermeable clay. Table 2 shows the Susceptibility scores and ratings for Peters Creek Terrace.

**Table 2. Susceptibility**

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	20	Very High
Natural Susceptibility	25	Medium

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

**Table 3. Contaminant Risks**

Category	Score	Rating
Bacteria and Viruses	45	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	35	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	32	High
Synthetic Organic Chemicals	25	Medium
Other Organic Chemicals	35	High

Appendix D contains fourteen charts, which together form the ‘Vulnerability Analysis’ for a source water

assessment for a public drinking water source. Chart 1 analyzes the ‘Susceptibility of the Wellhead’ to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the ‘Susceptibility of the Aquifer’ to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes ‘Contaminant Risks’ for the drinking water source with respect to bacteria and viruses. The ‘Contaminant Risks’ portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the ‘Vulnerability Analysis for Bacteria and Viruses’. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability**

Category	Score	Rating
Bacteria and Viruses	70	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	60	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	55	Medium
Synthetic Organic Chemicals	50	Medium
Other Organic Chemicals	60	High

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is very high with large capacity septic systems in Zones B presenting the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Recent sampling of Peters Creek Terrace shows no detection of Bacteria and Viruses. 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 High.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is very high with large capacity septic systems in Zones B posing the most significant contaminant risk to this source of public drinking water (See Chart 5 -

Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history for Peters Creek Terrace well indicates that low concentrations of nitrate have been detected. At the latest sampling period, a low concentration of nitrate and/or nitrite was detected at 6.300 mg/L or 63% of the Maximum Contaminant Level (MCL) of 10mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects.

It is unknown how much of the existing nitrate concentration can be attributed to natural or human-made sources. 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].

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 High.

**Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is high with a machine and metal shop in Zone B presenting the most significant risk to the drinking water well (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D). Recent sampling history of Peters Creek Terrace did not detect any chemicals in the Volatile Organic Chemicals category. 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 High.

**Heavy Metals, Cyanide, and Other Inorganic Chemicals**

The contaminant risk for heavy metals is high with a machine metal shop in Zone B posing the most significant risk to the drinking water well (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). Monitoring samples analyzing chemicals within the Heavy Metals, Cyanide and Other Inorganic Chemicals collected on 8/22/01 showed very small amounts of Barium, well below the MCL.

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 contaminant risk for synthetic organic chemicals is medium with a furniture manufacturing shop in Zone A posing some risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to synthetic organic chemicals of the well is Medium.

### **Other Organic Chemicals**

The contaminant risk for other organic chemicals is high with a machine metal shop in Zone B and a furniture manufacturing shop in Zone A posing the most significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals of the well is High.

There is no recent sampling history for contaminants within the synthetic organic chemicals or other organic chemicals categories for Peters Creek Terrace' drinking water (See Charts 11 and 13 – Contaminant Risks for Synthetic Organic Chemicals and Other Organic Chemicals in Appendix D, respectively).

### **SUMMARY**

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 Peters Creek Terrace 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 Peters Creek Terrace public drinking water source.



## REFERENCES CITED

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Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

Wang, B., Strelakos, P.M., and Jokela, J.B., 2000, Nitrate source indicators in ground water of the scimitar subdivision, Peters Creek Area, Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 00-4137.

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## **APPENDIX A**

### **Peters Creek Terrace Drinking Water Protection Area Location Map (Map 1)**

## **APPENDIX B**

### **Contaminant Source Inventory and Risk Ranking for Peters Creek Terrace (Tables 1-7)**

## **APPENDIX C**

### **Peters Creek Terrace Drinking Water Protection Area and Potential and Existing Contaminant Sources (Maps 2-3)**

## **APPENDIX D**

### **Vulnerability Analysis for Peters Creek Terrace Public Drinking Water Source (Charts 1-14)**