



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Shoreside Petroleum Texaco
Public Drinking Water System,
Bird Creek, Alaska
PWSID # 213352.002

DRINKING WATER PROTECTION REPORT 1609

Alaska Department of Environmental Conservation

December, 2008

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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 number: 1-866-956-7656.

December, 2008

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Source Water Assessment for Shoreside Petroleum Texaco Source of Public Drinking Water, Bird Creek, Alaska

Drinking Water Protection Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Shoreside Petroleum Texaco is a Class B (transient/non-community) water system consisting of one new well replacing an older abandoned well, located at milepost 101 on the Seward Highway in Bird Creek, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Shoreside Petroleum Texaco public drinking water source include: a park, septic systems, heating oil tanks, roads, an underground gasoline tank, and a pipeline. 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 sources for Shoreside Petroleum Texaco received a vulnerability rating of **Medium** for bacteria and viruses, **Medium** for nitrates and nitrites, and **High** 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 Shoreside Petroleum Texaco to protect public health.

SHORESIDE PETROLEUM TEXACO PUBLIC DRINKING WATER SYSTEM

Shoreside Petroleum Texaco public water system is a Class B (transient/non-community) water system. The system consists of one new well replacing an older abandoned well, located at milepost 101 on the Seward Highway in Bird Creek, Alaska. Bird Creek, located on Turnagain Arm, is within the Municipality of Anchorage. Turnagain Arm is an estuary, which begins where Cook Inlet divides near Anchorage and extends southeast to the junction of the Kenai Peninsula. The Seward Highway travels along the coast of the arm, connecting Anchorage with the communities of Indian, Bird Creek, Girdwood, and Portage.

The topography in the site vicinity is typical of valleys formed by glaciation, with a relatively flat to gently sloping valley bottom and steep sidewalls. Relatively steep mountainous terrain comprises more than 90% of

the watershed. Elevations range from sea level to just over 5,000 feet.

According to the Major Ecosystems of Alaska map, this area lies within the southcentral hydrologic region and the Cook Inlet sub-region. Surface water and groundwater flow is abundant in this area. Based on the USGS, Water Resources Division, groundwater database, groundwater in this area is designated as having existing beneficial uses for domestic and commercial applications.

Although the quality can vary significantly in a short distance, groundwater supplies are abundant in the area. Many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are deep with depths of more than 100 feet up to 390 feet. Static water levels in many of these wells are between 20 feet to 130 feet below the surface.

Various Quaternary-age surficial deposits are found in the general area. The origin of these deposits is predominantly glacial, with components of alluvial, colluvial, and lacustrine deposition (Winkler, 1992). The glacier ice mass deposited silt, sand, gravel, cobbles and boulders during multiple glacial advancements and recessions. The soils deposited during the glacial advancements were consolidated by the weight of the ice. During the recessional phase of glaciation, soils consolidated by the ice mass were probably eroded to some degree by melt water, and unconsolidated alluvial materials were deposited.

Based on previous geotechnical investigations in the surrounding area, it is believed the area is underlain by rock of Tertiary age which rests on Mesozoic rocks about 30,000 feet thick. Bedrock in the area is covered by unconsolidated glaciolacustrine and alluvial deposits remaining after Pleistocene glaciers moved through the valley.

According to the well log (10/09/05), the well extends 117 feet and is completed in an unconfined aquifer. The well has a static water level 34 feet below ground level. This system operates year-round and serves 25 non-residents through one service connection.

SHORESIDE PETROLEUM TEXACO 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 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 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 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 Shoreside Petroleum Texaco was determined using an analytical calculation and includes Zones A and B (see Map A of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

DWP has completed an inventory of potential and existing sources of contamination within the Shoreside Petroleum Texaco 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 SHORESIDE PETROLEUM TEXACO 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.

$$\begin{aligned} &\text{Susceptibility of the Wellhead (0-25 Points)} \\ &+ \\ &\text{Susceptibility of the Aquifer (0-25 Points)} \\ &= \\ &\text{Natural Susceptibility of the Well (0-50 Points)} \end{aligned}$$

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 for the Shoreside Petroleum Texaco received a **Low** susceptibility rating. The most recent sanitary survey for this system indicates that the well is properly grouted and fixed with a sanitary seal, but the land surface is not sloped away from the well. 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, and the confining layer.

The Shoreside Petroleum Texaco system draws water from an unconfined aquifer. The aquifer received a **Very High** susceptibility rating because of its unconfined nature and the presence of boreholes and wells in the protection area. In addition, the highly

transmissive aquifer materials can allow contaminants to travel downward from the surface with precipitation and surface water runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Shoreside Petroleum Texaco system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	16	High
Natural Susceptibility	21	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 Shoreside Petroleum Texaco system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	22	Medium
Nitrates and/or Nitrites	26	Medium
Volatile Organic Chemicals	40	Very High

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

$$\begin{array}{r}
 \text{Natural Susceptibility (0-50 Points)} \\
 + \\
 \text{Contaminant Risks (0-50 Points)} \\
 = \\
 \text{Vulnerability of the Drinking Water Source to} \\
 \text{Contamination (0-100 Points)}
 \end{array}$$

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 Shoreside Petroleum Texaco system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	45	Medium
Nitrates and/or Nitrites	45	Medium
Volatile Organic Chemicals	60	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Medium** with the park, septic systems, and roads contributing to the risk to the drinking water well.

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are 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. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2008). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination.

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system at Shoreside Petroleum Texaco (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 **Medium**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Medium** with the park, septic systems, and roads contributing to the risk to the drinking water well.

The sampling history for Shoreside Petroleum Texaco well indicates that nitrates have been detected in the water (the highest detected level within the last 5 years of sampling was 0.690 mg/l on 12/22/06, data was 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 **Very High** with the septic systems, heating oil tanks, underground gasoline tank, pipeline, and roads contributing to the risk to the drinking water well.

The drinking water at Shoreside Petroleum Texaco has not been sampled for volatile organic chemicals recently.

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**.

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 Shoreside Petroleum Texaco 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 Shoreside Petroleum Texaco drinking water source.

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APPENDIX A

Shoreside Petroleum Texaco Drinking Water Protection Area Location Map (Map A)

Public Water Well System for PWS #213352.002 Shoreside Petroleum Texaco



Legend

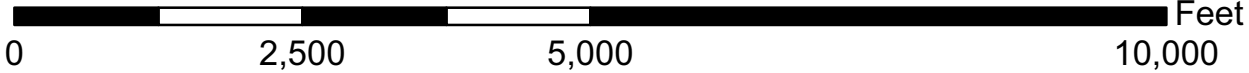
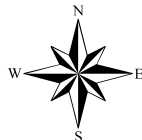
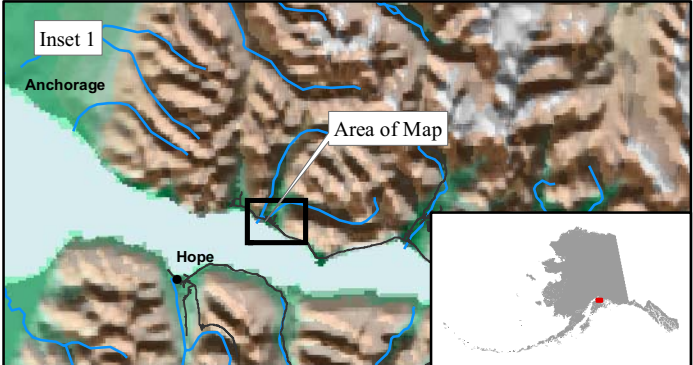
-  Class B Public Water System
- Groundwater Protection Zones**
-  Zone A Protection Area - Several Months Travel Time
-  Zone B Protection Area - 2 Years Travel Time

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.



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Shoreside Petroleum Texaco (Tables 1-4)

Table 1

**Contaminant Source Inventory for
SHORESIDE PETROLEUM TEXACO**

PWSID 213352.002

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Septic systems (serves one single-family home)	R02	R02	A	C	4 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	C	4 assumed
Tanks, gasoline (underground)	T12	T12-01	A	C	
Highways and roads, dirt/gravel	X24	X24	A	C	1 road
Pipelines (oil and gas)	X28	X28	A	C	
Septic systems (serves one single-family home)	R02	R02	B	C	1 assumed
Tanks, heating oil, residential (above ground)	R08	R08	B	C	1 assumed
Municipal or city parks (with green areas)	X04	X04	B	C	Chugach State Park

Table 2

*Contaminant Source Inventory and Risk Ranking for
SHORESIDE PETROLEUM TEXACO
Sources of Bacteria and Viruses*

PWSID 213352.002

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one single-family home)	R02	R02	A	Low	C	4 assumed
Highways and roads, dirt/gravel	X24	X24	A	Low	C	1 road
Septic systems (serves one single-family home)	R02	R02	B	Low	C	1 assumed
Municipal or city parks (with green areas)	X04	X04	B	Medium	C	Chugach State Park

Table 3

*Contaminant Source Inventory and Risk Ranking for
SHORESIDE PETROLEUM TEXACO
Sources of Nitrates/Nitrites*

PWSID 213352.002

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one single-family home)	R02	R02	A	Low	C	4 assumed
Highways and roads, dirt/gravel	X24	X24	A	Low	C	1 road
Septic systems (serves one single-family home)	R02	R02	B	Low	C	1 assumed
Municipal or city parks (with green areas)	X04	X04	B	Medium	C	Chugach State Park

Table 4

*Contaminant Source Inventory and Risk Ranking for
SHORESIDE PETROLEUM TEXACO
Sources of Volatile Organic Chemicals*

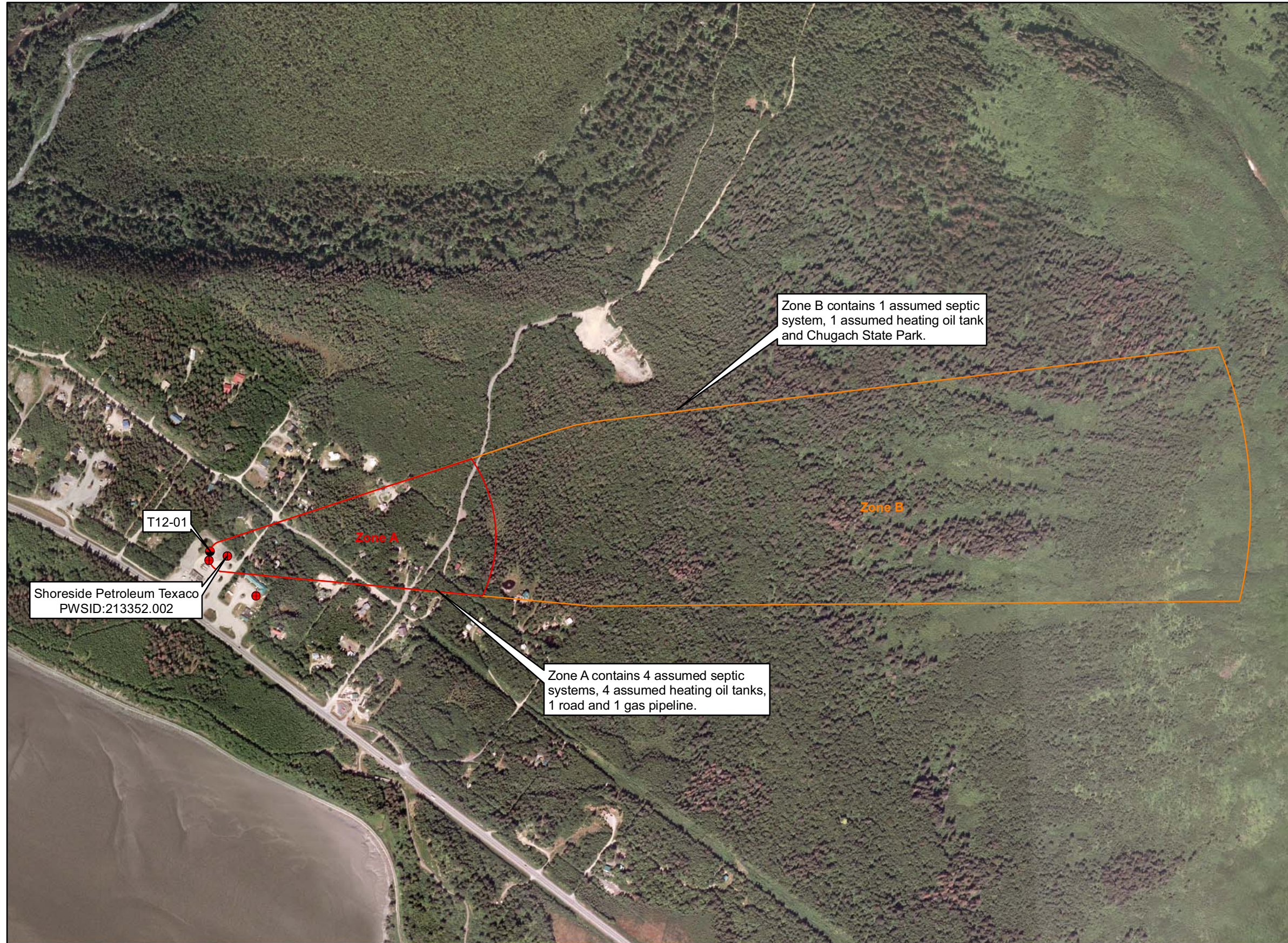
PWSID 213352.002

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one single-family home)	R02	R02	A	Low	C	4 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	Medium	C	4 assumed
Tanks, gasoline (underground)	T12	T12-01	A	High	C	
Highways and roads, dirt/gravel	X24	X24	A	Low	C	1 road
Pipelines (oil and gas)	X28	X28	A	Medium	C	
Septic systems (serves one single-family home)	R02	R02	B	Low	C	1 assumed
Tanks, heating oil, residential (above ground)	R08	R08	B	Medium	C	1 assumed

APPENDIX C

Shoreside Petroleum Texaco Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)

**Public Water Well System for PWS #213352.002 Shoreside Petroleum Texaco
Showing Potential and Existing Sources of Contamination**



Legend

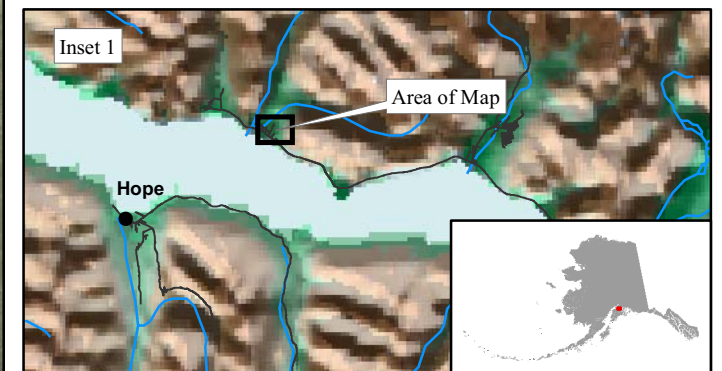
- Class B Public Water System
- Groundwater Protection Zones**
- Zone A Protection Area - Several Months Travel Time
- Zone B Protection Area - 2 Years Travel Time
- Existing or Potential Contaminant Sources**
- Tanks, gasoline (underground) (T12)

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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0 1,000 2,000 4,000 Feet