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# Source Water Assessment

A Hydrogeologic Susceptibility and  
Vulnerability Assessment for  
Knik Caboose  
Public Drinking Water System,  
Butte Area, Alaska  
PWSID # 226036.001

DRINKING WATER PROTECTION REPORT 1689

Alaska Department of Environmental Conservation

December, 2008

Source Water Assessment for  
Knik Caboose  
Public Drinking Water System  
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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 Knik Caboose Source of Public Drinking Water, Butte Area, Alaska

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## Drinking Water Protection Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The public water system for Knik Caboose is a Class B (transient/non-community) water system consisting of one well located on the south shore of the Knik River near Butte, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. The only identified potential and current source of contaminants for Knik Caboose public drinking water source was a road. The identified potential and existing source of contamination is considered as a source of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Knik Caboose received a vulnerability rating of **Low** for all three contaminant categories. 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 Knik Caboose to protect public health.

### KNIK CABOOSE PUBLIC DRINKING WATER SYSTEM

The Knik Caboose public water system is a Class B (transient/non-community) water system. It consists of one well and is located on Knik River Road, approximately 6 miles east of Butte, Alaska, at the edge of Chugach State Park (see Map A in Appendix A). Butte (population 3,209) and its surrounding communities lie within the Matanuska-Susitna Borough, approximately 50 miles northeast of Anchorage (ADCCED, 2008)..

Most homes in the Butte area rely on individual water wells and septic systems, and are completely plumbed. Electricity is provided by Matanuska Electric Association, Inc. and Enstar services the Palmer area with its natural gas (ADCCED, 2008).

The temperature in the area ranges from -35 to 33 degrees Fahrenheit in January and from 42 to 85 degrees Fahrenheit in July. Annual precipitation is 16.5 inches, including 43 inches of snowfall (ADCCED, 2008).

According to the most recent sanitary survey for this system (07/30/07), the well extends approximately 60

feet below the ground surface and is completed in a confined aquifer. This system operates year-round and serves twenty-five non-residents through one service connection.

### KNIK CABOOSE 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 (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 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 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 Knik Caboose was determined using an analytical calculation and includes Zones A (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 Knik Caboose 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 KNIK CABOOSE 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.

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

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 Knik Caboose received a **Low** susceptibility rating. The sanitary survey indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is grouted according to DEC regulations. 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, the confining layer.

The Knik Caboose system draws water from a confined aquifer overlain by 30 feet of hardpan. The aquifer received a **Medium** susceptibility rating due to its moderately deep nature and relatively thick confining layer. Deeper aquifers are more protected from surface contaminants while thicker 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 the Knik Caboose system.

**Table 2. Susceptibility**

	<b>Score</b>	<b>Rating</b>
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	12	Medium
Natural Susceptibility	12	Low

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:

<b>Contaminant Risk Ratings</b>	
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 Knik Caboose system.

**Table 3. Contaminant Risks**

<b>Category</b>	<b>Score</b>	<b>Rating</b>
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	16	Low
Volatile Organic Chemicals	12	Low

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

$$\begin{aligned} &\text{Natural Susceptibility (0-50 Points)} \\ &+ \\ &\text{Contaminant Risks (0-50 Points)} \\ &= \end{aligned}$$

Vulnerability of the Drinking Water Source to Contamination (0-100 Points)

Again, rankings are assigned according to a point score:

<b>Overall Vulnerability Ratings</b>	
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 Knik Caboose system. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability**

<b>Category</b>	<b>Score</b>	<b>Rating</b>
Bacteria and Viruses	25	Low
Nitrates and/or Nitrites	30	Low
Volatile Organic Chemicals	25	Low

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Low** with a road 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).

Only a small amount of bacteria and viruses are required to endanger public health. Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination. Bacteria and viruses have not been detected during recent sampling at Knik Caboose (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 **Low**.

#### **Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Low** with a road contributing to the risk to the drinking water well.

The sampling history for Knik Caboose indicates that nitrates have been detected within the last five years of sampling, with the highest concentration of 0.739 mg/l detected on 08/29/2007 (data 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 **Low**.

#### **Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Low** with the road contributing to the risk to the drinking water well.

The drinking water at Knik Caboose has not been recently sampled for volatile organic chemicals (data reviewed in April, 2008).

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 **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 Knik Caboose 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 Knik Caboose drinking water source.

## REFERENCES

Alaska Department of Commerce, Community and Economic Development (ADCCED), Accessed 2008 [WWW document]. URL: [http://www.commerce.state.ak.us/dca/commdb/CF\\_COMDB.htm](http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm)

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

Jokela, J.B., Munter, J.A., and Evans, J.G., 1991, Ground-water resources of the Palmer-Big Lake area, Alaska: a conceptual model. Division of Geological & Geophysical Surveys Reports of Investigations 90-4, State of Alaska Department of Natural Resources, Fairbanks, AK.

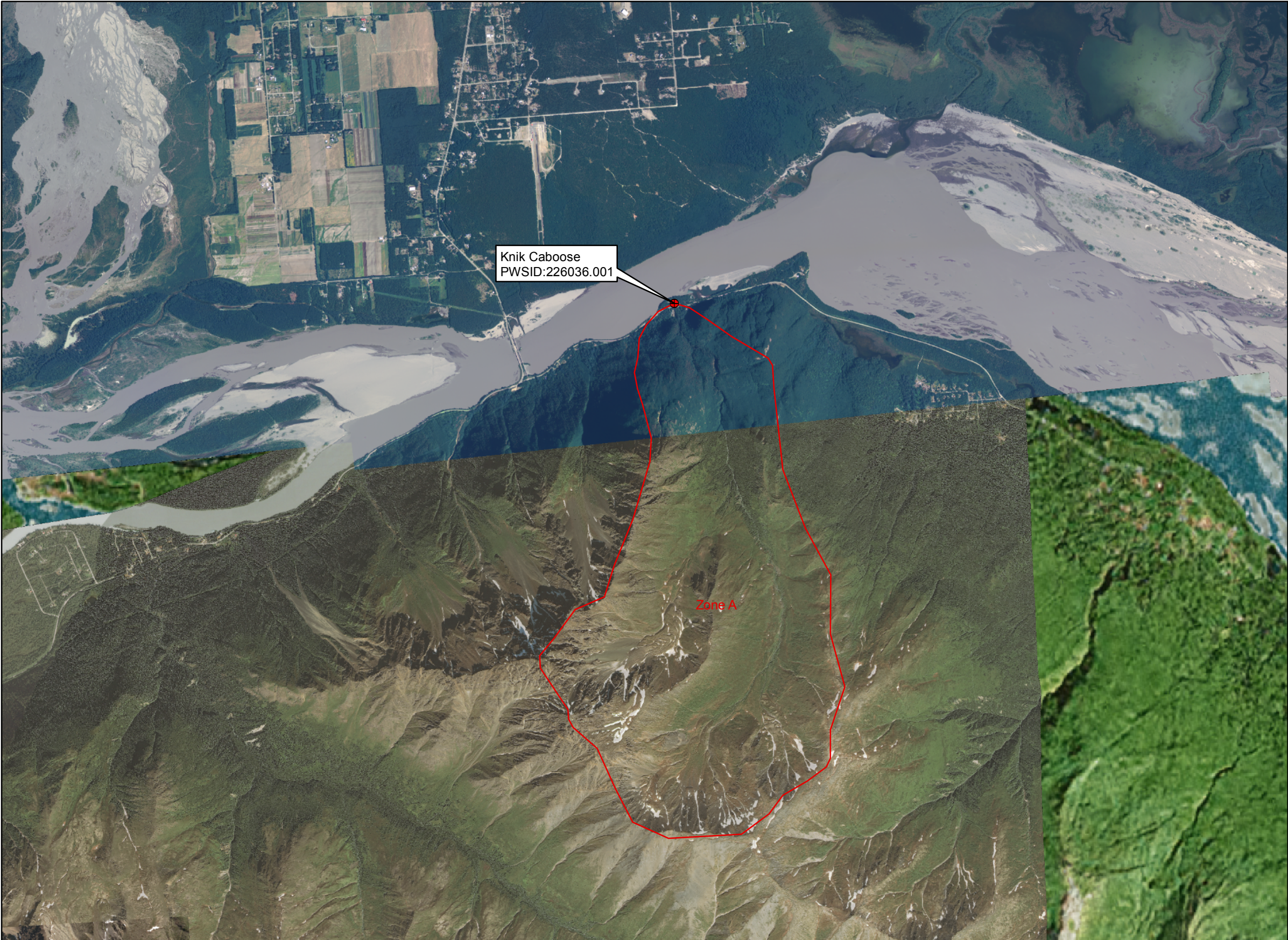
United States Environmental Protection Agency (EPA), Accessed 2008 [WWW document]. URL: <http://www.epa.gov/safewater/contaminants/index.html>.





## **APPENDIX A**

### **Knik Caboose Drinking Water Protection Area Location Map (Map A)**

Public Water Well System for PWS #226036.001 Knik Caboose



Legend

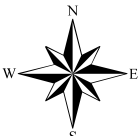
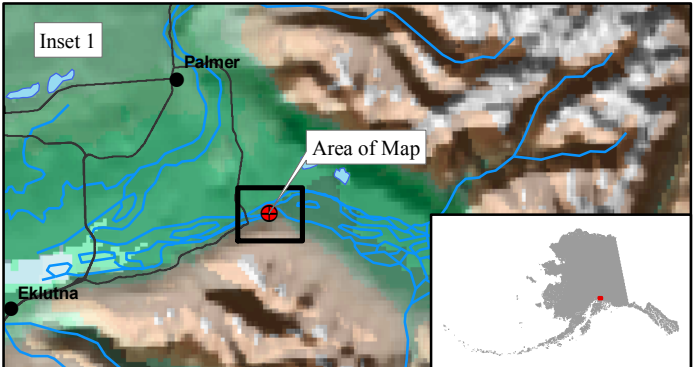
-  Class B Public Water System Well
-  Zone A Protection Area - Several Months Travel Time

Data Sources:  
 Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

All other data:  
 United States Geological Survey (USGS)

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.



Knik Caboose  
 PWS 226036.001  
 Appendix A Map A

## **APPENDIX B**

### **Contaminant Source Inventory and Risk Ranking for Knik Caboose (Tables 1-4)**

*Table 1*

*Contaminant Source Inventory for  
KNIK CABOOSE*

*PWSID 226036.001*

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	1 road

**Table 2**

*Contaminant Source Inventory and Risk Ranking for  
KNIK CABOOSE  
Sources of Bacteria and Viruses*

*PWSID 226036.001*

<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>
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

**Table 3**

*Contaminant Source Inventory and Risk Ranking for  
KNIK CABOOSE  
Sources of Nitrates/Nitrites*

*PWSID 226036.001*

<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>
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

**Table 4**

*Contaminant Source Inventory and Risk Ranking for  
KNIK CABOOSE  
Sources of Volatile Organic Chemicals*

*PWSID 226036.001*

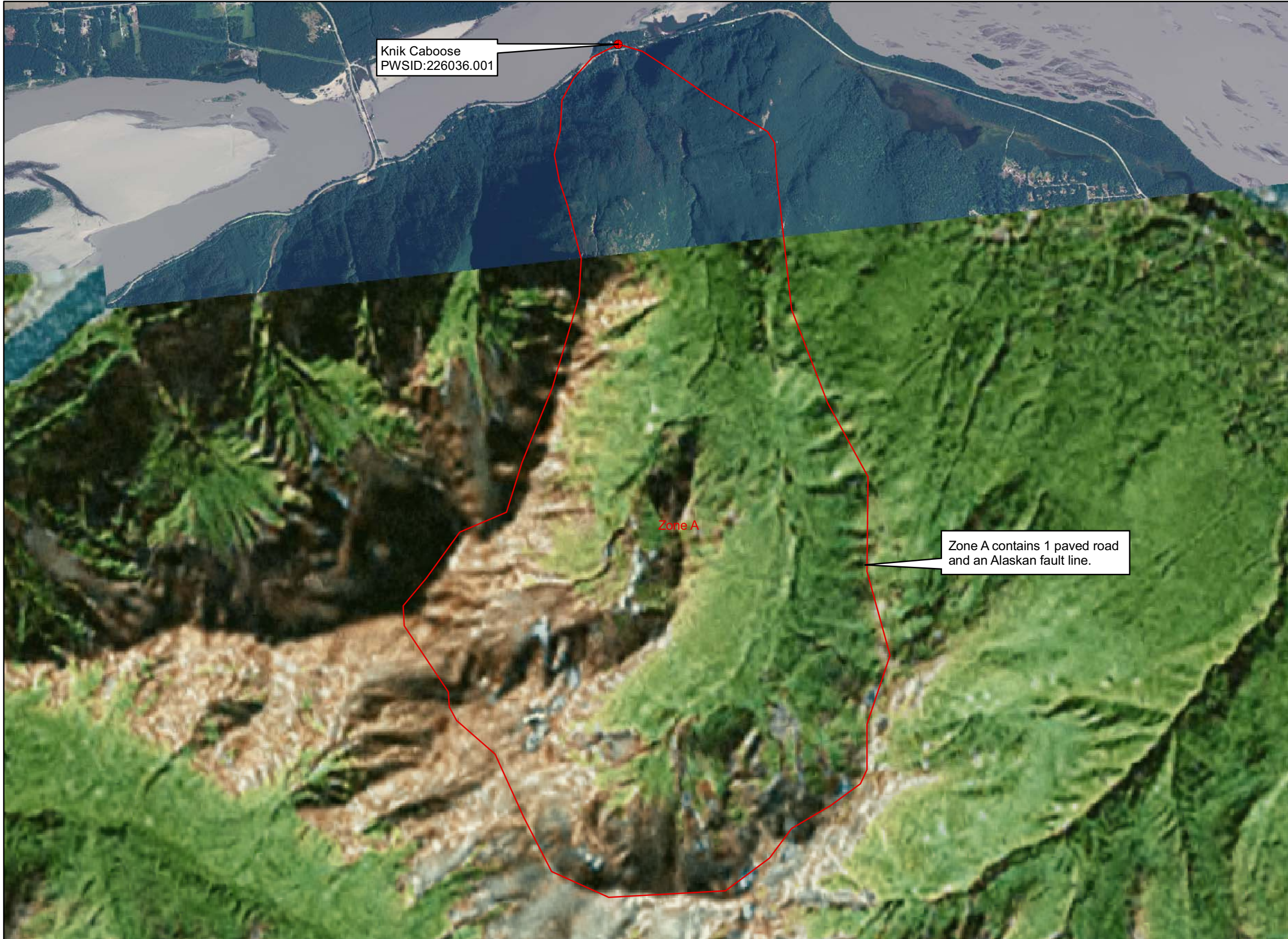
<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

## **APPENDIX C**

### **Knik Caboose Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)**



**Public Water Well System for PWS #226036.001 Knik Caboose  
Showing Potential and Existing Sources of Contamination**



**Legend**

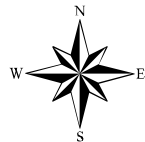
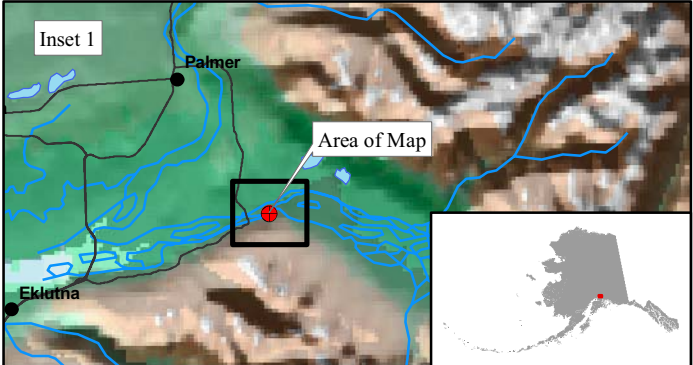
- Class B Public Water System
- Zone A Protection Area - Several Months Travel Time

**Data Sources:**  
Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

**All other data:**  
United States Geological Survey (USGS)

**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.**



Knik Caboose  
PWS 226036.001  
**Appendix C Map C**