Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Chena Lake Recreation Area - Well 2 Public Drinking Water System, North Pole, Alaska PWSID # 371825.001

DRINKING WATER PROTECTION REPORT 1816

Alaska Department of Environmental Conservation

January, 2009

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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.

January, 2009

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Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Chena Lake Recreation Area - Well 2 is a Class B (transient/non-community) water system consisting of one well located a few miles to the northeast of North Pole, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Chena Lake Recreation Area - Well 2 public drinking water source include: campgrounds and RV parks, septic systems, and a heating oil tank. 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 Chena Lake Recreation Area - Well 2 received a vulnerability rating of **Low** for bacteria and viruses, **Low** for nitrates and/or nitrites, and **Medium** 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 Chena Lake Recreation Area - Well 2 to protect public health.

CHENA LAKE RECREATION AREA - WELL 2 PUBLIC DRINKING WATER SYSTEM

Chena Lake Recreation Area - Well 2 public water system is a Class B (transient/non-community) water system. The system consists of one well located a few miles northeast of North Pole, Alaska (see Map A in Appendix A). The Chena Lakes Recreation Area covers over 2,100 acres with campsites, RV parks, day use areas, swimming areas, and boat docks (FNSB, 2008). North Pole and its surrounding communities are located in the Fairbanks North Star Borough which is near the center of Alaska. Communities located within the Borough include: College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers (ADCCED, 2008).

The Fairbanks area includes two distinct topographic areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north of this alluvial plain. The Chena Lakes Recreation Area - Well 2 water system is located in the alluvial plain at an elevation of approximately 500 feet above sea level.

According to operator of this water system, the depths of the Chena Lake Recreation Area wells are between 28 and 35 feet below the ground surface. Other wells in this area are screened in a combination of sand and gravel and it is assumed that this one is also. The alluvial plain consists of alternating layers of silt, sand and gravel up to over 500 feet thick, in some locations overlain by 1 to 10 feet of silt or sandy silt or a few feet of peat (Glass and others, 1996). Discontinuous permafrost (perennially frozen areas) is also common in the alluvial plain. The depth to permafrost in these areas ranges between 2 and 45 feet below the ground surface with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, 1958). Areas with discontinuous permafrost may locally affect the ground water flow directions.

The Tanana River is the primary water contributor to this alluvial aquifer but the Chena River also contributes at times, typically only when its stage is high and the Tanana River is low (Nelson, 1978). The Tanana River gets approximately 85% of its water from snowmelt of the Alaska Range and 15% from the Yukon-Tanana uplands (Anderson, 1970).

The most recent sanitary survey for this system (09/08/04) indicates that the land surface is appropriately sloped away from the well, the well is grouted according to DEC regulations, and the well is properly capped.

This system operates from May to September and is one of 13 active wells that serve a total of 200 non-residents through one service connection each.

CHENA LAKE RECREATION AREA - WELL 2 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 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 Chena Lake Recreation Area - Well 2 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 Chena Lake Recreation Area - Well 2 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 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 CHENA LAKE RECREATION AREA - WELL 2 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.

Susceptibility of the Wellhead (0-25 Points)
+
Susceptibility of the Aquifer (0-25 Points)
=
Natural Susceptibility of the Well (0-50 Points)

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 Chena Lake Recreation Area - Well 2 received a **Low** susceptibility rating. The sanitary survey indicates that the well is operated and sealed by a hand pump, the land surface is appropriately sloped away from the well providing adequate surface water drainage, and the well is grouted according to DEC regulations. Sanitary seals (provided by the hand pump) 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.

As no well log is available for the Chena Lake Recreation Area system, Well 2 is assumed to draw water from an unconfined aquifer consisting of combination of sand and gravel. The aquifer received a **High** susceptibility rating because of its unconfined nature and the presence of other wells penetrating the vadose zone of the protection area. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, it is susceptible to contamination from outside sources. Furthermore, the presence of other wells penetrating the vadose zone of the protection area can allow contaminants to travel into the shared aquifer with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Chena Lake Recreation Area - Well 2 system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	18	High
Natural Susceptibility	18	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:

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 Chena Lake Recreation Area - Well 2 system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	10	Low
Nitrates and/or Nitrites	10	Low
Volatile Organic Chemicals	25	Medium

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

Natural Susceptibility (0-50 Points)
+
Contaminant Risks (0-50 Points)
=
Vulnerability of the Drinking Water Source to Contamination (0-100 Points)

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 Chena Lake Recreation Area - Well 2 system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	30	Low
Nitrates and/or Nitrites	30	Low
Volatile Organic Chemicals	45	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Low** with septic systems, campgrounds, and RV parks contributing 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 Chena Lake Recreation Area - Well 2 (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 septic systems, campgrounds, and RV parks contributing the risk to the drinking water well.

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for Chena Lake Recreation Area - Well 2 indicates that nitrates have not been detected in the water in the last five years (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 **Medium** with campgrounds, RV parks, septic systems, and a heating oil tank contributing the risk to the drinking water well.

The drinking water at Chena Lake Recreation Area - Well 2 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 **Medium**.

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 Chena Lake Recreation Area - Well 2 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 Chena Lake Recreation Area - Well 2 drinking water source.

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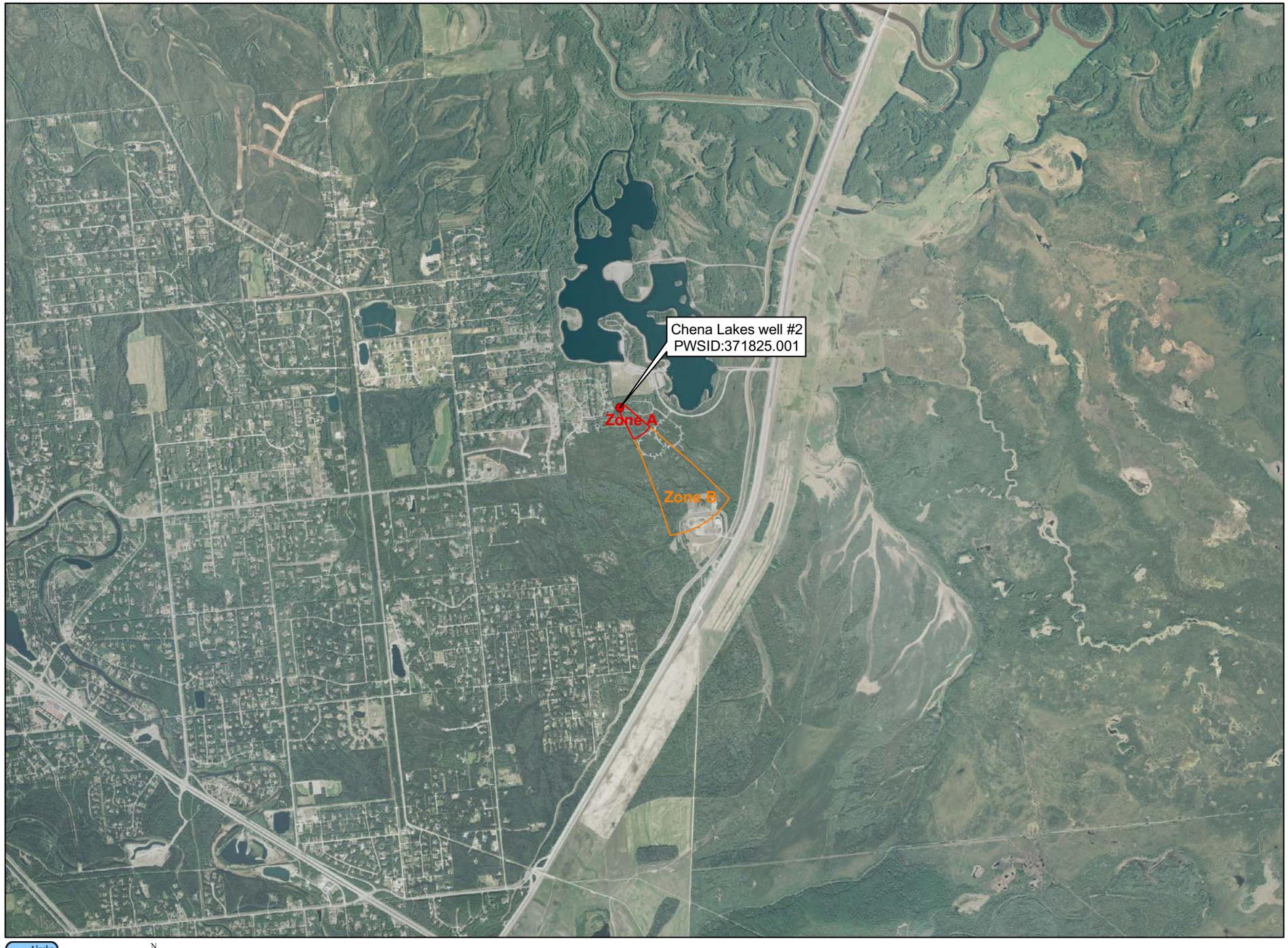
APPENDIX A

Chena Lake Recreation Area - Well 2
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #371825.001 Chena Lakes well #2



Legend

- Class B Public Water System

Groundwater Protection Zones

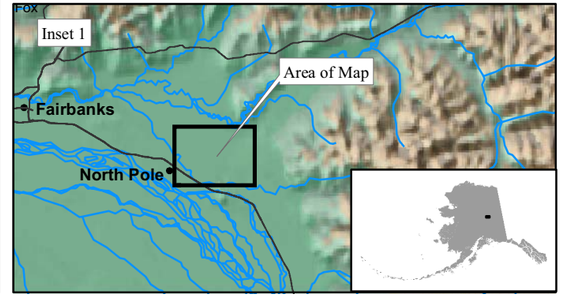
- Zone A Protection Area - Several Months Travel Time
- Zone B Protection Area - 2 Years Travel Time

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.



N
W E
S

0 4,000 8,000 16,000 Feet

Chena Lakes well #2
PWS 371825.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Chena Lake Recreation Area - Well 2 (Tables 1-4)

Table 1

Contaminant Source Inventory for

Chena Lakes well #2

PWSID 371825.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	
Septic systems (serves one single-family home)	R02	R02	B	C	
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	B	C	
Campgrounds and RV Parks	X35	X35	B	C	

Table 2

Contaminant Source Inventory and Risk Ranking for Chena Lakes well #2

Sources of Bacteria and Viruses

PWSID 371825.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Septic systems (serves one single-family home)	R02	R02	B	Low	C	
Campgrounds and RV Parks	X35	X35	B	Low	C	

Table 3

Contaminant Source Inventory and Risk Ranking for Chena Lakes well #2 Sources of Nitrates/Nitrites

PWSID 371825.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Septic systems (serves one single-family home)	R02	R02	B	Low	C	
Campgrounds and RV Parks	X35	X35	B	Low	C	

Table 4

Contaminant Source Inventory and Risk Ranking for Chena Lakes well #2

Sources of Volatile Organic Chemicals

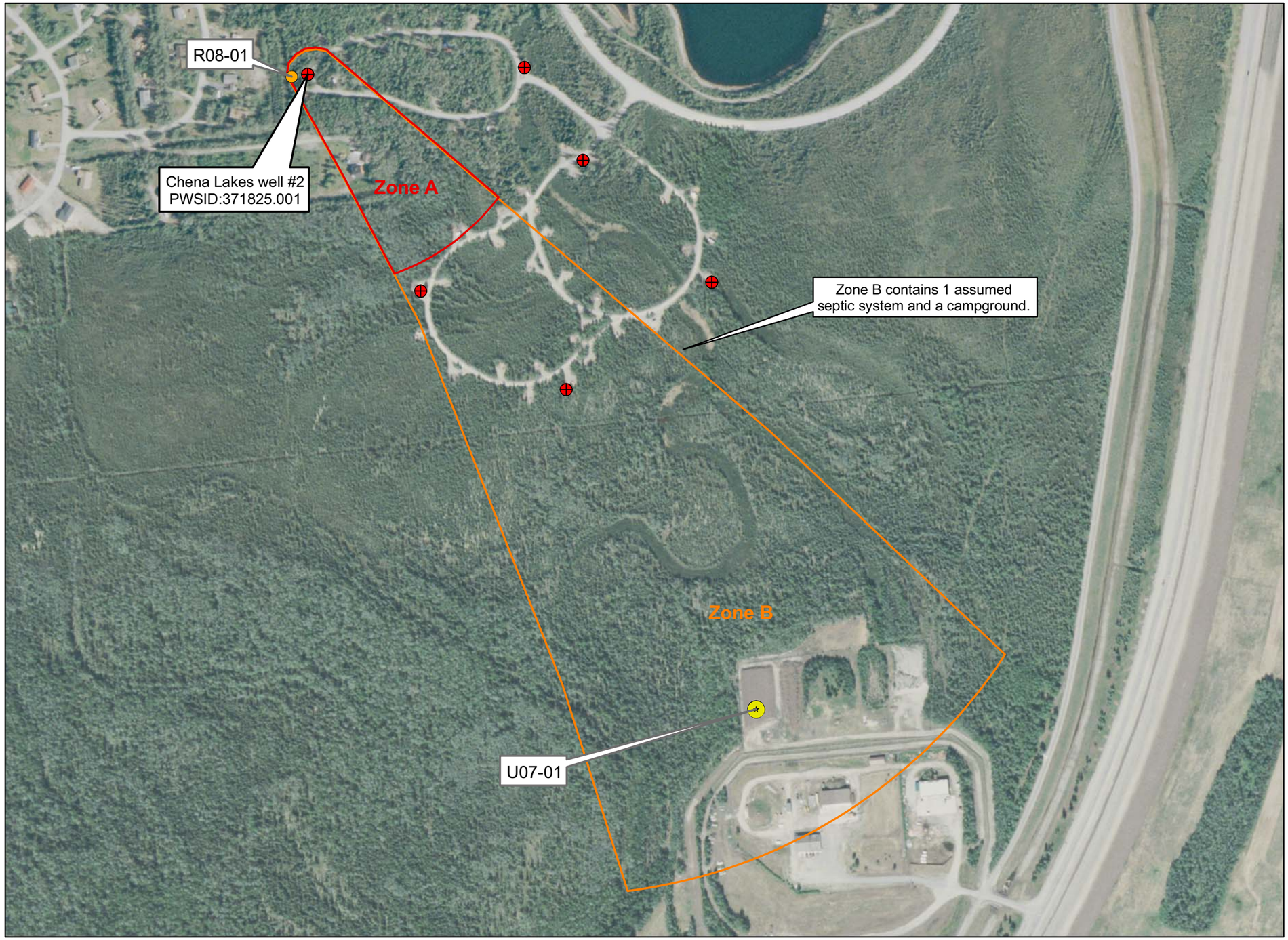
PWSID 371825.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	
Septic systems (serves one single-family home)	R02	R02	B	Low	C	
Campgrounds and RV Parks	X35	X35	B	Low	C	

APPENDIX C

Chena Lake Recreation Area - Well 2
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS #371825.001 Chena Lakes well #2
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

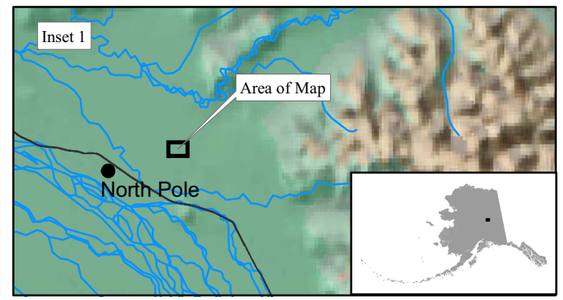
- Open Leaking Underground Fuel Storage Tank (LUST) Sites (U07)
- Tanks, heating oil, residential (above ground) (R08)

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.



N W E S

0 625 1,250 2,500 Feet

Chena Lakes well #2
PWS 371825.001

Appendix C Map C