
# Source Water Assessment

## A Hydrogeologic Susceptibility and Vulnerability Assessment for Club Soda Public Drinking Water System, Fairbanks, Alaska PWSID # 313267.001

DRINKING WATER PROTECTION REPORT 1787

Alaska Department of Environmental Conservation

January, 2009

# Source Water Assessment for
# Club Soda
# Public Drinking Water System
# Fairbanks, Alaska
# PWSID# 313267.001

DRINKING WATER PROTECTION REPORT 1787

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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# APPENDICES

# Source Water Assessment for Club Soda Source of Public Drinking Water, Fairbanks, Alaska

**Drinking Water Protection**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The public water system for Club Soda is a Class B (transient/non-community) water system consisting of one well located approximately a half mile south of the intersection of Mitchell Expressway and Lathrop Street in Fairbanks, Alaska. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Very High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Club Soda public drinking water source include: septic systems, heating oil tanks, roads, quarries, a landfill, construction trade areas, heavy equipment storage, motor vehicle dealerships and supply stores, a large capacity septic system, machine shops, organic chemicals manufacturing, underground petroleum tanks, leaking underground fuel tanks, and a storage facility. 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 Club Soda received a vulnerability rating of **Very High** 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 Club Soda to protect public health.

## CLUB SODA PUBLIC DRINKING WATER SYSTEM

Club Soda public water system is a Class B (transient/non-community) water system. The system consists of one well located approximately a half mile south of the intersection of the Mitchell Expressway and Lathrop Street in Fairbanks, Alaska (see Map A of Appendix A). The City of Fairbanks (population 31,639) lies on the Chena River, in the Tanana Valley. It is part of the Fairbanks North Star Borough, which has a population of 96,888 and covers an area of more than 7,400 square miles (ADCCED, 2009).

The area receives 67.8 inches of snowfall a year, and a total of 11.5 inches of precipitation annually. Average January temperatures range from -19 to -2 degrees Fahrenheit, while average July temperatures range from 53 to 72 degrees Fahrenheit (ADCCED, 2009).

The City of Fairbanks operates a treated water distribution system that delivers water throughout the community. A piped sewage system is also in operation. Electricity is provided by Golden Valley Electric Association (ADCCED, 2009).

The Fairbanks – North Pole area is divided into two distinctive topographic regions: an alluvial plain spanning the area between the Tanana and Chena Rivers, and the uplands extending to the north. The alluvial plain, containing the communities of Fairbanks and North Pole, consists of alternating layers of silt, sand and gravel that can be more than 500 feet thick, and which are sometimes overlain by 1 to 10 feet of silt, sandy silt, or a thin layer of peat (Glass, 1996). Discontinuous permafrost (perennially frozen soil) is also common in the alluvial plain. The depth to permafrost in these areas ranges from 2 to 45 feet below the ground surface, with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, 1958).

The alluvial aquifer in this area is recharged primarily by the Tanana River, although the Chena River also contributes water, typically when its stage is high and the Tanana River is running low (Nelson, 1978).

As no well log is available and the sanitary survey is incomplete, the well is assumed to extend 140 feet below the ground surface and to be completed in an unconfined aquifer, based on data from an nearby public water system. This system operates year-round and serves approximately 44 non-residents through one service connection.

## CLUB SODA 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 Club Soda 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 Club Soda 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 CLUB SODA 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 Club Soda received a **Very High** susceptibility rating. The most recent sanitary survey (08/04/2006) does not indicate the status of the ground slope around the well or the presence or absence of grouting. However, it is noted that the well lacks a sanitary seal. 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.

As no well log is available for the well at Club Soda, it is assumed to be completed in an unconfined aquifer based on information from nearby public water systems. The aquifer received a **Very High** susceptibility rating because of its unconfined status and the presence of another well within 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 Club Soda system.

**Table 2. Susceptibility**

| | Score | Rating |
|---|---|---|
| Susceptibility of the Wellhead | 25 | Very High |
| Susceptibility of the Aquifer | 25 | Very High |
| Natural Susceptibility | 50 | Very High |

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 Club Soda system.

**Table 3. Contaminant Risks**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 50 | Very High |
| Nitrates and/or Nitrites | 42 | Very High |
| Volatile Organic Chemicals | 50 | 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:

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 Club Soda system. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 100 | Very High |
| Nitrates and/or Nitrites | 90 | Very High |
| Volatile Organic Chemicals | 100 | Very High |

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Very High** with risk resulting primarily from positive sampling results for bacteria and viruses. A large-capacity septic system, residential septic systems, and roads further contribute 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 were detected during recent water sampling of the system at Club Soda, with positive samples obtained on 07/03/2006, 07/06/2006, and 10/02/2006 (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 **Very High**.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Very High** with the large-capacity septic system, residential septic systems, roads, and quarries contributing to the risk to this source of public drinking water.

The sampling history for the Club Soda well indicates that nitrates have been detected in the water, with the highest concentration of 0.370 mg/l detected on 03/22/2002 (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 **Very High**.

**Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Very High** with septic systems, heating oil tanks, roads, quarries, construction trade areas, heavy equipment storage, motor vehicle dealerships and supply stores, a large capacity septic system, machine shops, and organic chemicals manufacturing contributing to the risk to the drinking water well.

The drinking water at Club Soda has not recently been 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 **Very 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 Club Soda 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 Club Soda drinking water source.

# REFERENCES


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# APPENDIX A

## Club Soda
## Drinking Water Protection Area Location Map
## (Map A)

# Public Water Well System for PWS #313267.001 Club Soda


## 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**

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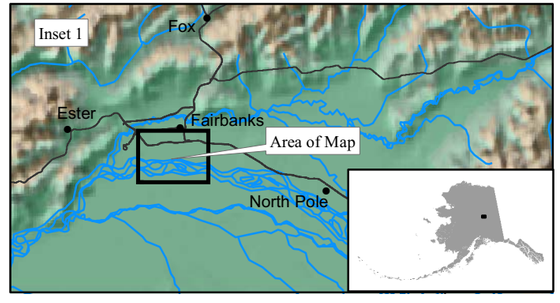


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Club Soda
PWS 313267.001

**Appendix A Map A**

# APPENDIX B

## Contaminant Source Inventory and Risk Ranking for Club Soda (Tables 1-4)

***Table 1***

# *Contaminant Source Inventory for* ***CLUB SODA***

***PWSID 313267.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Heavy equipment rental/storage | C18 | C18-01 | A | C | |
| Motor vehicle dealerships - cars, trucks, motor cycles, ATV's, snow machines, boats (with service department) | C27 | C27-01 | A | C | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | C | |
| Landfills (industrial; type of industrial waste?) | D52 | D52 | A | C | |
| Machine and metal work shops | I23 | I23-01 | A | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | C | 1 assumed |
| Tanks, heating oil, residential (above ground) | R08 | R08 | A | C | 1assumed |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | C | 2 roads |
| Construction trade areas and materials | C09 | C09-01 | B | C | |
| Heavy equipment rental/storage | C18 | C18-01 | B | C | |
| Motor/motor vehicle supplies stores | C28 | C28-01 | B | C | |
| Motor/motor vehicle supplies stores | C28 | C28-02 | B | C | |
| Quarries (sand, gravel, rock, other?) | E10 | E10 | B | C | |
| Quarries (sand, gravel, rock, other?) | E10 | E10-01 | B | C | |
| Organic chemicals manufacturing | I29 | I29-01 | B | C | |
| Septic systems (serves one single-family home) | R02 | R02 | B | C | 14 assumed |
| Tanks, heating oil, residential (above ground) | R08 | R08 | B | C | 14 assumed |
| Closed tanks, lubricants or other petroleum products (underground) | T21 | T21-01 | B | C | |
| Open Leaking Underground Fuel Storage Tank (LUST) Sites | U07 | U07-01 | B | C | |
| Closed Leaking Underground Fuel Storage Tank (LUST) Sites | U08 | U08-01 | B | C | |
| Closed Leaking Underground Fuel Storage Tank (LUST) Sites | U08 | U08-02 | B | C | |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | C | 4 roads |
| Motor vehicle/general storage yards/facilities | X27 | X27-01 | B | C | |

***Table 2***

# *Contaminant Source Inventory and Risk Ranking for CLUB SODA*

## *Sources of Bacteria and Viruses*

***PWSID 313267.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | Low | C | 1 assumed |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 2 roads |
| Septic systems (serves one single-family home) | R02 | R02 | B | Low | C | 14 assumed |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | Low | C | 4 roads |

***Table 3***

# *Contaminant Source Inventory and Risk Ranking for CLUB SODA*

## *Sources of Nitrates/Nitrites*

***PWSID 313267.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | Low | C | 1 assumed |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 2 roads |
| Quarries (sand, gravel, rock, other?) | E10 | E10 | B | Low | C | |
| Quarries (sand, gravel, rock, other?) | E10 | E10-01 | B | Low | C | |
| Septic systems (serves one single-family home) | R02 | R02 | B | Low | C | 14 assumed |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | Low | C | 4 roads |

**Table 4**

# *Contaminant Source Inventory and Risk Ranking for CLUB SODA*

## *Sources of Volatile Organic Chemicals*

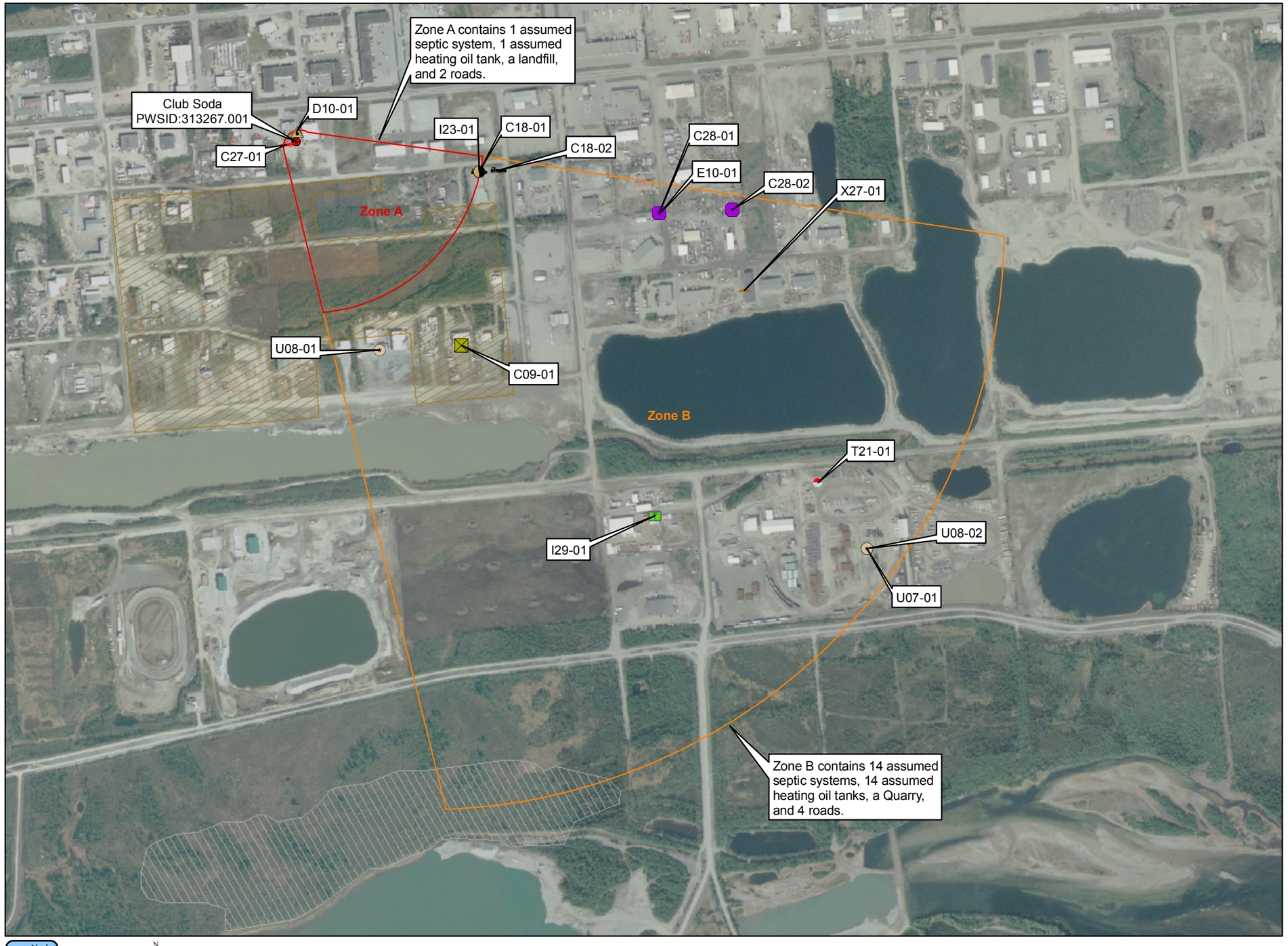
**PWSID 313267.001**

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Heavy equipment rental/storage | C18 | C18-01 | A | Medium | C | |
| Motor vehicle dealerships - cars, trucks, motor cycles, ATV's, snow machines, boats (with service department) | C27 | C27-01 | A | Medium | C | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | Low | C | |
| Machine and metal work shops | I23 | I23-01 | A | High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | Low | C | 1 assumed |
| Tanks, heating oil, residential (above ground) | R08 | R08 | A | Medium | C | 1assumed |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 2 roads |
| Construction trade areas and materials | C09 | C09-01 | B | Low | C | |
| Heavy equipment rental/storage | C18 | C18-01 | B | Medium | C | |
| Motor/motor vehicle supplies stores | C28 | C28-01 | B | Low | C | |
| Motor/motor vehicle supplies stores | C28 | C28-02 | B | Low | C | |
| Quarries (sand, gravel, rock, other?) | E10 | E10 | B | Low | C | |
| Quarries (sand, gravel, rock, other?) | E10 | E10-01 | B | Low | C | |
| Organic chemicals manufacturing | I29 | I29-01 | B | Very High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | B | Low | C | 14 assumed |
| Tanks, heating oil, residential (above ground) | R08 | R08 | B | Medium | C | 14 assumed |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | Low | C | 4 roads |
| Motor vehicle/general storage yards/facilities | X27 | X27-01 | B | Low | C | |

# APPENDIX C

## Club Soda
## Drinking Water Protection Area
## and Potential and Existing Contaminant Sources
## (Map C)

# Public Water Well System for PWS #313267.001 Club Soda
# 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**

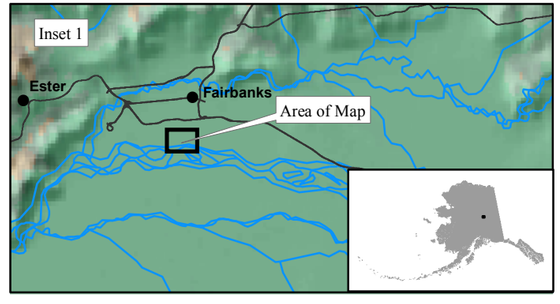
- Construction trade areas and materials (C09)
- Heavy equipment rental/storage (C18)
- Motor vehicle dealerships (with service department) C27)
- Motor/motor vehicle supplies stores (C28)
- Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) (D10)
- Quarries (sand, gravel, rock, other) (E10)
- Machine and metal work shops (I23)
- Organic chemicals manufacturing (I29)
- Closed tanks, lubricants or other petroleum products (underground) (T21)
- Open Leaking Underground Fuel Storage Tank (LUST) Sites (U07)
- Closed Leaking Underground Fuel Storage Tank (LUST) Sites (U08)
- Motor vehicle/general storage yards/facilities (X27)
- Landfills (Industrial) (D52)
- Quarries (sand, gravel, rock, other) (E10)

**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**

**Apparent misalignment between geographic features and aerial imagery may be present due to differences in source data. URS Corporation does not guarantee the accuracy or validity of the data provided.**

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Club Soda
PWS 313267.001

**Appendix C Map C**