Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Napakiak Washeteria Public Drinking Water System, Napakiak, Alaska PWSID # 262301.001

DRINKING WATER PROTECTION REPORT 1757

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 toll-free number 1-866-956-7656.

January, 2009

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EXECUTIVE SUMMARY

The public water system for Napakiak Washeteria is a Class B (transient/non-community) water system consisting of one well located in Napakiak, Alaska. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **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 Napakiak Washeteria public drinking water source include: a laundromat, a motor vehicle repair shop, a cemetery, a firehouse, a diesel tank, a generator, an airport, roads, nonresidential heating oil tanks, wastewater ponds, and petroleum bulk stations. 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 Napakiak Washeteria 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 Napakiak Washeteria to protect public health.

NAPAKIAK WASHETERIA PUBLIC DRINKING WATER SYSTEM

Napakiak Washeteria public water system is a Class B (transient/non-community) water system. The system consists of one well located in Napakiak, Alaska (see Map A in Appendix A). Napakiak is located on the north bank of the Kuskokwim River, about 15 miles southwest of Bethel. The area receives about 16 inches of precipitation, including about 50 inches of snowfall annually. Temperatures in Napakiak can range from 59 to 62 degrees Fahrenheit in the summer and from 11 to 19 in the winter (ADCCED, 2009).

Many residents in Napakiak use a flush/haul system, including plumbing and low-flush toilets. Treated water is provided by a community well. Electricity is provided by Ircinraq Power Company, who purchases it from Bethel Utilities (ADCCED, 2009).

According to the sanitary survey (06/24/1997), the depth of the well is approximately 230 feet below the ground surface and is completed in an unconfined aquifer. This system operates continuously and serves 330 non-residents through one service connection.

NAPAKIAK WASHETERIA 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 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 Napakiak Washeteria was determined using an analytical calculation and includes Zones A and B (see Map A in Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

DWP has completed an inventory of potential and existing sources of contamination within the Napakiak Washeteria 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 NAPAKIAK WASHETERIA 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 Napakiak Washeteria received a **Very High** susceptibility rating, due to its location within a floodplain. The most recent sanitary survey (06/24/1997) indicates that a sanitary seal is installed on the well and land surface is sloped away from the well. However, a note on the survey states that drainage is marginal. Also, the well is not 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. Additionally, the wellhead lies within a floodplain, which is the main contributing factor to the susceptibility rating for this system.

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 this system, the Napakiak Washeteria is assumed to draw water from an unconfined aquifer consisting of sand, based on information from a nearby public water system. The aquifer received a **High** susceptibility rating because of its relatively shallow, unconfined nature. 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. Shallow aquifers provide less protection from this downward migration.

Table 2 summarizes the Susceptibility scores and ratings for the Napakiak Washeteria system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	17	High
Natural Susceptibility	42	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 Napakiak Washeteria system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	50	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 Napakiak Washeteria system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

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

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with a laundromat, roads, and wastewater ponds contributing to the risk to the drinking water well.

Coliforms (a bacteria) are found naturally in the environment and while not necessarily a direct health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically fecal coliforms and E. coli. These bacteria only come from human and animal fecal waste and can cause diarrhea, cramps, nausea, headaches, and other symptoms (EPA, 2008).

Only a small number of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected in the water within the last 5 years of water sampling of the Napakiak Washeteria system (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 a laundromat, a cemetery, an airport, roads, and wastewater ponds contributing to the risk to the drinking water well.

Sampling history for Napakiak Washeteria well indicates that nitrates have not been detected in the water within the last 5 years of sampling (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 a laundromat, a motor vehicle repair shop, a firehouse, a diesel tank, a generator, an airport, roads, nonresidential heating oil tanks, wastewater ponds, and petroleum bulk stations contributing to the risk to the drinking water well.

The drinking water at Napakiak Washeteria 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 Napakiak Washeteria 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 Napakiak Washeteria drinking water source.

REFERENCES

Alaska Department of Commerce, Community and Economic Development (ADCCED), Accessed 2009 [WWW document]. URL: http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm

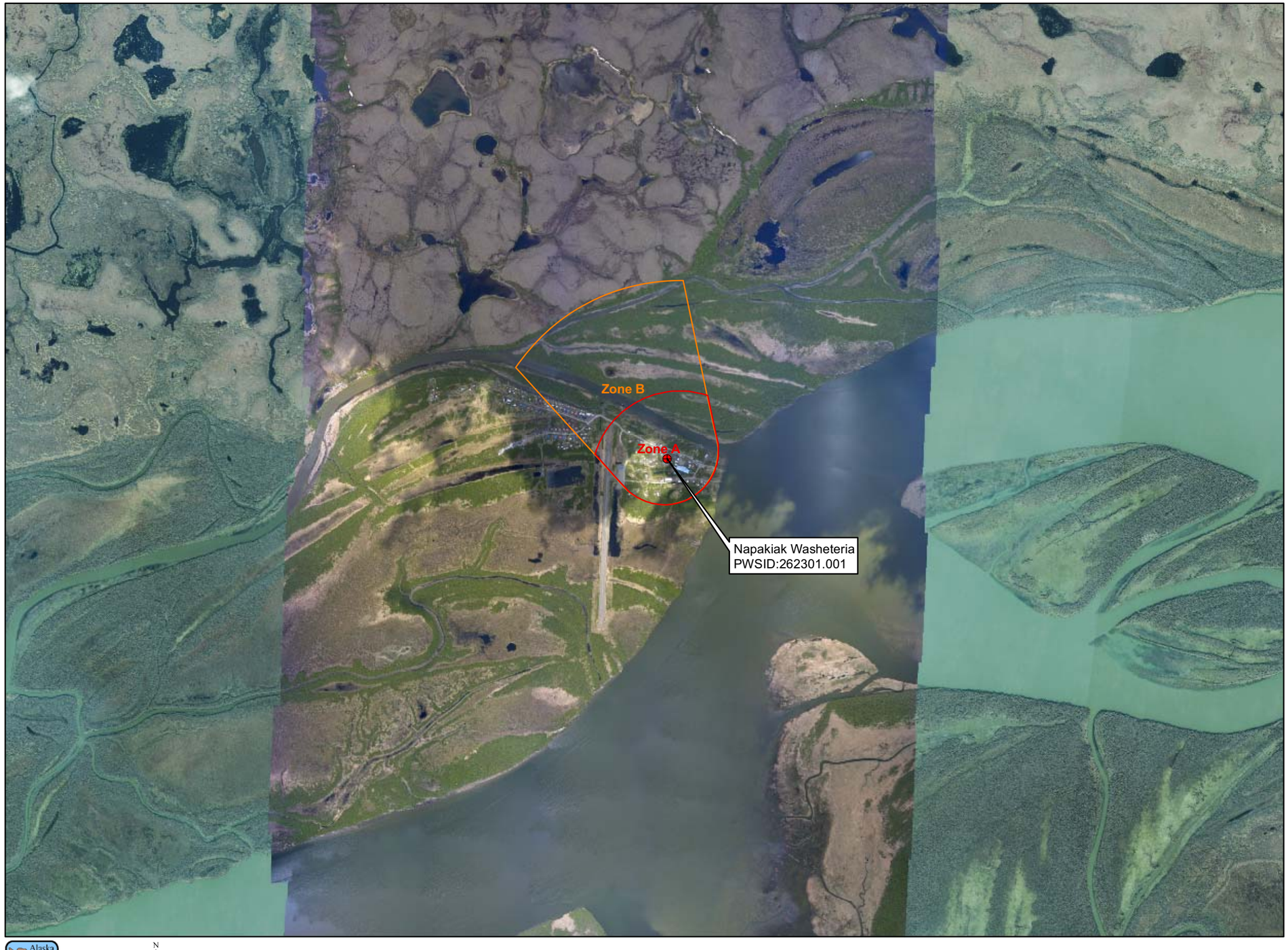
Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

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

APPENDIX A

Napakiak Washeteria
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #262301.001 Napakiak Washeteria



Legend

Class B Public Water System Well

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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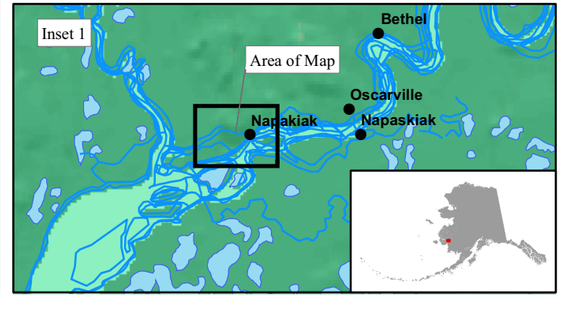

Alaska DEC

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Napakiak Washeteria
PWS 262301.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Napakiak Washeteria (Tables 1-4)

Table 1

Contaminant Source Inventory for ***NAPAKIAK WASHETERIA***

PWSID 262301.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	C	
Motor /motor vehicle repair shops	C31	C31-01	A	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	C	
Tanks, diesel (above ground)	T06	T06-01	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	C	
Cemeteries	X01	X01-01	A	C	
Petroleum product bulk station/terminals	X11	X11-01	A	C	
Petroleum product bulk station/terminals	X11	X11-02	A	C	
Airports	X14	X14	A	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	2 roads
Electric power generation (fossil fuels)	X36	X36-01	A	C	
Firehouses	X38	X38-01	A	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	C	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	B	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	B	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	B	C	
Highways and roads, paved (cement or asphalt)	X20	X20	B	C	1 road

Table 2

Contaminant Source Inventory and Risk Ranking for NAPAKIAK WASHETERIA

Sources of Bacteria and Viruses

PWSID 262301.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	High	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	High	C	
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

Table 3

Contaminant Source Inventory and Risk Ranking for NAPAKIAK WASHETERIA

Sources of Nitrates/Nitrites

PWSID 262301.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	High	C	
Cemeteries	X01	X01-01	A	Medium	C	
Airports	X14	X14	A	Low	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	High	C	
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

Table 4

Contaminant Source Inventory and Risk Ranking for NAPAKIAK WASHETERIA

Sources of Volatile Organic Chemicals

PWSID 262301.001

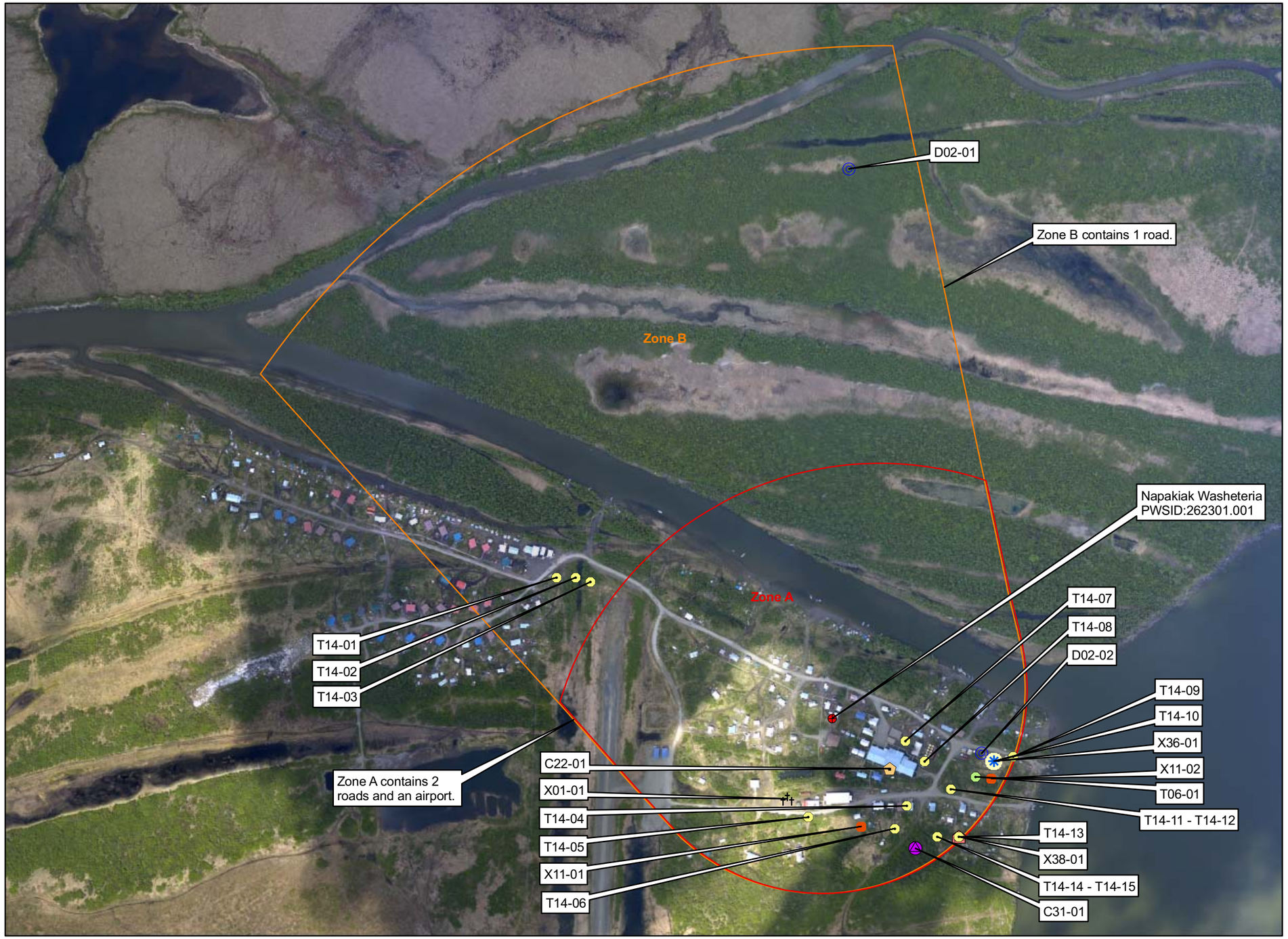
Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	Low	C	
Tanks, diesel (above ground)	T06	T06-01	A	Medium	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	
Petroleum product bulk station/terminals	X11	X11-02	A	Very High	C	
Airports	X14	X14	A	High	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	
Firehouses	X38	X38-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	B	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	B	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	B	Low	C	
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

APPENDIX C

Napakiak Washeteria
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS # 262301.001 Napakiak Washeteria
Showing Potential and Existing Sources of Contamination



Legend

- Class B Public Water System Well

Groundwater Protection Zones

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

Potential and Existing Contaminant Sources

- Laundromats without dry cleaning (C22)
- Motor /motor vehicle repair shops (C31)
- Domestic wastewater collection systems (sewer lines or lift stations) (D02)
- Tanks, diesel (above ground) (T06)
- Tanks, heating oil, nonresidential (aboveground) (T14)
- Cemeteries (X01)
- Petroleum product bulk station/terminals (X11)
- Electric power generation (fossil fuels) (X36)
- Firehouses (X38)

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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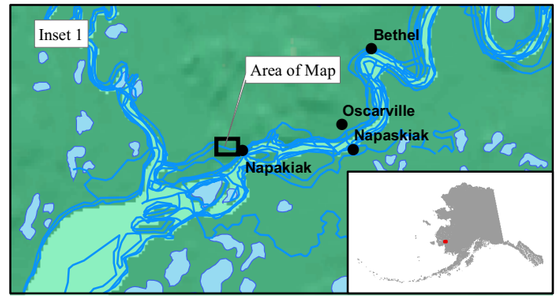

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0 500 1,000 2,000 Feet

Napakiak Washeteria
PWS 262301.001

Appendix C Map C