Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for MSBSD Shaw Elementary Public Drinking Water System, Wasilla, Alaska PWSID# 220230.001

DRINKING WATER PROTECTION REPORT 1848

Alaska Department of Environmental Conservation

October, 2008

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The Drinking Water Protection (DWP) team 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 (ADEC), 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 DWP staff at #1-866/956-7656.

October, 2008

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Drinking Water Protection

Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for MSBSD Shaw Elementary is a Non-Transient Non-Community (NTNC) water system consisting of one well located at Mile 4.5 Wasilla Fishhook Road, Wasilla, Alaska. An assessment of the susceptibility of the wellhead and aquifer to contamination, and the vulnerability of the public water system to potential and existing contamination were evaluated as of March 2008, and updated October 2008. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Low**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential sources of contamination for the MSBSD Shaw Elementary public drinking water system include one minor road, agricultural croplands, and livestock pastures. These are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals (VOCs), heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals (SOCs), and other organic chemicals (OOCs).

Combining the natural susceptibility of the well with the six (6) contaminant risk categories, the public water system for MSBSD Shaw Elementary received an overall vulnerability rating of **Low** for bacteria and viruses**, Medium** for nitrates and/or nitrites, **Medium** for VOCs, **Low** for heavy metals, cyanide, and other inorganic chemicals, **Medium** for SOCs, and **Low** for OOCs.

MSBSD Shaw Elementary PUBLIC DRINKING WATER SYSTEM

MSBSD Shaw Elementary public water system is a Non-Transient Non-Community (NTNC) water system. The system consists of one well located at Mile 4.5 Wasilla Fishhook Road, Wasilla, Alaska (See Map 1 of Appendix A). Wasilla is located north of Anchorage in the Matanuska-Susitna Borough which is in Southcentral Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is approximately 80,088, and Wasilla's current population is approximately 7,028 (ADCCED 2008). Communities located within the Borough include: Big Lake, Buffalo Soapstone, Butte, Chase, Chickaloon, Farm Loop, Fishhook, Gateway, Glacier View, Houston, Knik River, Knik-Fairview, Lake Louise, Lakes, Lazy Mountain, Meadow Lakes, Palmer, Petersville, Point MacKenzie, Skwentna, Susitna, Sutton-Alpine, Talkeetna, Tanaina, Trapper Creek, Wasilla, Willow and Y (ADCCED 2008. The majority of homes use individual water wells and septic systems, although the City operates a piped water and sewer system (ADCCED 2008). Refuse collection is provided by a private company, for disposal in the Mat-Su Borough landfill. Residents also drop refuse at the Borough landfill in Palmer (ADCCED 2008).

A lake covered the Susitna River valley lowland during glacial times. The deposition of glacial silts and clays played an important part in the makeup of the soils of the area.

Most of the soils in the area provide good sources of sand, gravel and topsoil. The deposition of silt, clay and organic "muck" in old lakes and depressions means that some areas have soil conditions that vary over relatively short distances. The U.S. Soil Conservation Service has mapped seven soil associations in and around Wasilla.

The Homestead and Knik soil types predominate the Wasilla area, with smaller areas of Coal Creek, Jacobsen, Kalambach, Salamatof, and Slikok soil types. MSBSD Shaw Elementary is located within the Knik Silt Loam soil type.

According to the most recent sanitary survey (2/10/2007) for this water system, the depth of the well is estimated at 305 feet below land surface (bls) and is screened in sandstone. The well penetrates about twenty (20) cumulative feet of shale and coal confining layers. Based on this information, the well is assumed to be completed in a confined aquifer, or an aquifer that is under hydrostatic pressure.

The MSBSD Shaw Elementary public water system serves approximately three-hundred (300) non-transient residents through one (1) approved service connection, per the latest sanitary survey (2/10/2007).

MSBSD Shaw Elementary DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in

determining a drinking water system's risk. 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 area are general for the Matanuska-Susitna lowlands and were obtained from various Alaska Department of Natural Resources (DNR) reports, various United States Geological Survey (USGS) reports, area well logs, and the textbook *Groundwater* by Freeze and Cherry (1979).

The drinking water protection areas (DWPAs) 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 confined aquifer levels in the area of the MSBSD Shaw Elementary water system are not well documented, but are primarily influenced by recharge from the Talkeetna Mountains and Matanuska River valley. The protection areas were drawn based on these regional assumptions combined with topographic contours. Groundwater in the confined aquifer of this area generally flows west to south.

Because of uncertainties and changing site conditions, a factor of safety is added to the drinking water protection area for the well.

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 DWPA for the MSBSD Shaw Elementary found on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

Drinking Water Protection (DWP) has completed an inventory of potential and existing sources of contamination within the MSBSD Shaw Elementary 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 NTNC public water system assessments, the following six categories of drinking water contaminants were inventoried:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other organic chemicals.

The sources are displayed on Map 2 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 each 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 combination of toxicity and volume associated with that source. Rankings include:

- Low
- Medium
- High
- Very High

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant.

Tables 2 through 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals and other organic chemical

VULNERABILITY OF MSBSD Shaw Elementary PUBLIC DRINKING WATER SYSTEM

The vulnerability of public drinking water systems to regulated contaminants is determined by assessing the susceptibility of the wellhead, the susceptibility of the aquifer and the potential contaminant sources identified within the DWPA.

Drinking Water Protection staff developed a vulnerability assessment tool that assigns a vulnerability risk ranking based upon various factors associated with the well, aquifer and potential and existing contaminants identified within the DWPA.

Factors contributing to the susceptibility of the wellhead are: whether the sanitary seal in place, protection from flooding, and if the well casing is properly grouted.

The wellhead for the MSBSD Shaw Elementary received a **Low** susceptibility rating. The most recent sanitary survey (completed 2/10/2007) indicates that the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is properly grouted. A sanitary seal prevents potential contaminants from entering the well while sloping of the land surface and grouting help 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 other wells and bore holes are penetrating the aquifer and, if applicable, and the characteristics of the confining layer.

The aquifer that the MSBSD Shaw Elementary well is completed in received a **Low** susceptibility rating. The aquifer is confined, deep, and composed of consolidated material (sandstone).

Table 2 summarizes the susceptibility scores and ratings for MSBSD Shaw Elementary.

Table 2. Susceptibility

	Rating
Susceptibility of the Wellhead	Low
Susceptibility of the Aquifer	Low
Natural Susceptibility	Low

The Contaminant Risk was 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.

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	**Rating**
Bacteria and Viruses	Medium
Nitrates and/or Nitrites	Very High
Volatile Organic Chemicals	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Medium
Synthetic Organic Chemicals	Very High
Other Organic Chemicals	Low

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

Natural Susceptibility
+
Contaminant Risks
=
Vulnerability of the
Drinking Water Source to Contamination

Table 4 contains the overall ratings for each of the six categories of drinking water contaminants.

Table 4. Overall Vulnerability

Category	Rating
Bacteria and Viruses	Low
Nitrates and Nitrites	Medium
Volatile Organic Chemicals	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Low
Synthetic Organic Chemicals	Medium
Other Organic Chemicals	Low

Bacteria and Viruses

The livestock pastures in the protection area represent the greatest risk for bacteria and viruses to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coliform bacteria are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliform bacteria and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). No total coliform or fecal coliform have been detected for this well. 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 agricultural croplands and livestock pastures in the protection area represent the greatest risk for nitrates and nitrites to this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have been detected within source waters within the last five years, but the most recent analysis did not detect nitrates.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Medium**.

Volatile Organic Chemicals

A minor road in the protection area represents the greatest risk for volatile organic chemicals (VOCs) to the well.

VOCs have occasionally been detected in the source waters. 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**.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

Agricultural cropland in the protection area represents the greatest risk for inorganic chemicals to the well.

Heavy metals and other inorganic chemicals have been detected in the source waters. Barium and chromium were detected below their respective maximum contaminant levels (MCLs).

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Low**.

Synthetic Organic Chemicals

Agricultural cropland in the protection area represents the greatest risk for synthetic organic chemicals (SOCs) to the well.

The source water has not been analyzed for SOCs. After combining the contaminant risk for SOCs with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Medium**.

Other Organic Chemicals

One minor road in the protection area represents the greatest risk for other organic chemicals (OOCs) to the well.

The source water has not been analyzed for OOCs. After combining the contaminant risk for OOCs 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 MSBSD Shaw Elementary 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 the MSBSD Shaw Elementary drinking water source.

REFERENCES

Alaska Department of Commerce, Community and Economic Development (DCCED), 2008 [WWW document]. URL http://www.commerce.state.ak.us/dca/commdb/CF_BLOCK.cfm.

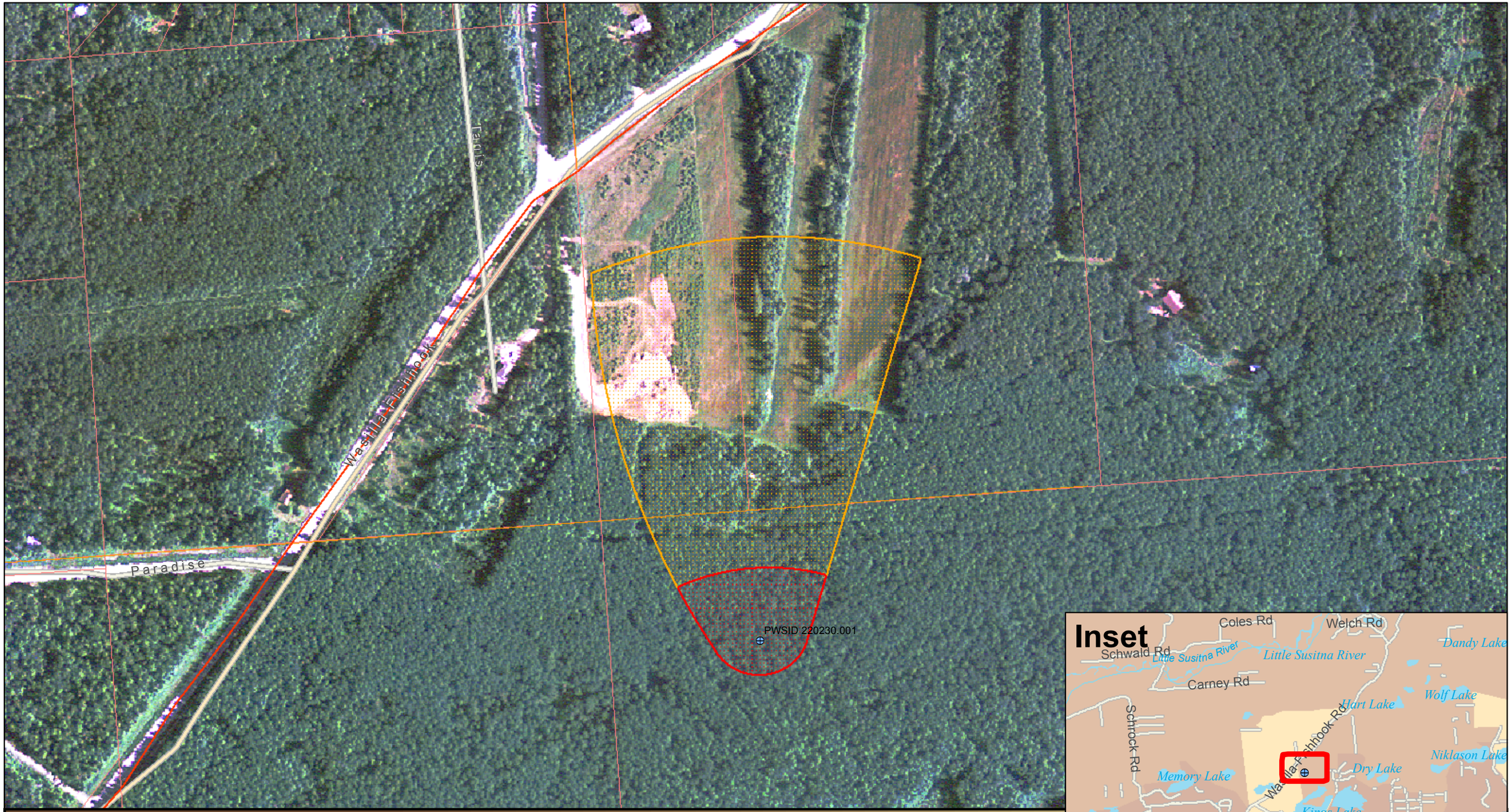
Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

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

Western Regional Climate Center, 2008, September 8th, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://climate.uaa.alaska.edu/.

APPENDIX A

MSBSD Shaw Elementary
Drinking Water Protection Area Location Map
(Map 1)



Map 1- MSBSD Shaw Elementary

PWSID: 220230.001

Alaska DEC

0 — 900 Feet

1 inch equals 250 feet

Data Sources:
Boroughs: Roads and parcels (data shifted slightly)
Public Water Systems: DEC
Potential Sources of Contamination: DEC
Map Date: October 9, 2008

Identified Public Water Sources

- Class A (Federal Classification: Community (C), or Non-Transient Non-Community (NTNC))
- Class B (Federal Classification: Non-Community (NC), or Transient Non-Community (TNC))

Drinking Water Protection Areas

- Zone A (Several Months Time of Travel)
- Zone B (2 Year Time of Travel)
- Parcels (Outline Only)

APPENDIX B

Contaminant Source Inventory and
Risk Ranking for **MSBSD Shaw Elementary**
(Tables 1-7)

Table 1

Contaminant Source Inventory for ***MSBSD Shaw Elementary***

PWSID 220230.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	2	One (1) minor road.
Cropland	A02	A02-1	B	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-2	B	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-3	B	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Livestock pastures	A08	A08-1	B	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	2	5-10 horses; 15-20 acres; 50 years.
Water supply wells	W09	W09-1	B	2	Private.

Table 2

Contaminant Source Inventory and Risk Ranking for MSBSD Shaw Elementary Sources of Bacteria and Viruses

PWSID 220230.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	One (1) minor road.
Livestock pastures	A08	A08-1	B	Medium	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	Medium	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	Medium	2	5-10 horses; 15-20 acres; 50 years.

Table 3

Contaminant Source Inventory and Risk Ranking for MSBSD Shaw Elementary Sources of Nitrates/Nitrites

PWSID 220230.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	One (1) minor road.
Cropland	A02	A02-1	B	High	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-2	B	High	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-3	B	High	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Livestock pastures	A08	A08-1	B	Medium	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	Medium	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	Medium	2	5-10 horses; 15-20 acres; 50 years.

Table 4

Contaminant Source Inventory and Risk Ranking for MSBSD Shaw Elementary Sources of Volatile Organic Chemicals

PWSID 220230.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	One (1) minor road.

Table 5

Contaminant Source Inventory and Risk Ranking for MSBSD Shaw Elementary

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 220230.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	One (1) minor road.
Cropland	A02	A02-1	B	Medium	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-2	B	Medium	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-3	B	Medium	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.

Table 6

Contaminant Source Inventory and Risk Ranking for MSBSD Shaw Elementary

Sources of Synthetic Organic Chemicals

PWSID 220230.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Cropland	A02	A02-1	B	High	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-2	B	High	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Cropland	A02	A02-3	B	High	2	Hay; 15-20 acres; 50 years; Use 2,4-D annually with spreader (qty unk) - no on-site storage or disposal.
Livestock pastures	A08	A08-1	B	Low	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	Low	2	5-10 horses; 15-20 acres; 50 years.
Livestock pastures	A08	A08-1	B	Low	2	5-10 horses; 15-20 acres; 50 years.

Table 7

Contaminant Source Inventory and Risk Ranking for MSBSD Shaw Elementary
Sources of Other Organic Chemicals

PWSID 220230.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	One (1) minor road.

APPENDIX C

MSBSD Shaw Elementary
Drinking Water Protection Area
with Potential and Existing Contaminant Sources
(Map 2)

A02 A08

A02 A08

A02
A08

Zone B
One minor road identified.

PWSID 220230.001

Map 2- MSBSD Shaw Elementary

PWSID: 220230.001

Alaska DEC

0 500 1,000 Feet

1 inch equals 250 feet

N W E S

Data Sources:
Boroughs: Roads and parcels (data slightly shifted)
Public Water Systems: DEC
Potential Sources of Contamination: DEC
Map Date: October 22, 2008

Legend

Identified Public Water Systems

- Class A Water Systems (Community, or Non-transient non-community)
- Class B Water Systems (Non-community, or Transient non-community)

Drinking Water Protection Area

- Zone A (Several Months Time of Travel)
- Zone B (2 Year Time of Travel)

Identified Potential and Existing Sources of Contamination

- A02, Cropland
- A08, Livestock pastures