Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Shepherd of the Hills Lutheran Church Public Drinking Water System, Anchorage, Alaska PWSID # 218739.001

DRINKING WATER PROTECTION REPORT 1621

Alaska Department of Environmental Conservation

December, 2008

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The Drinking Water Protection (DWP) section of the Drinking Water Program is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (DEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the DWP staff at the following number: 1-866-956-7656.

December, 2008

CONTENTS

TABLES

APPENDICES

Source Water Assessment for Shepherd of the Hills Lutheran Church Source of Public Drinking Water, Anchorage, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Shepherd of the Hills Lutheran Church is a Class B (transient/non-community) water system consisting of one well on the corner of Klatt Road and Elmore Road in south Anchorage, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Shepherd of the Hills Lutheran Church public drinking water source include: residential septic systems, paved roads, and an oil or gas pipeline. 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 Shepherd of the Hills Lutheran Church received a vulnerability rating of **Very High** for bacteria and viruses, **Medium** for nitrates and 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 Shepherd of the Hills Lutheran Church to protect public health.

SHEPHERD OF THE HILLS LUTHERAN CHURCH PUBLIC DRINKING WATER SYSTEM

Shepherd of the Hills Lutheran Church public water system is a Class B (transient/non-community) water system. The system consists of one well on the corner of Klatt Road and Elmore Road in south Anchorage, Alaska (See Map A of Appendix A). Anchorage and its surrounding communities are located in southcentral Alaska at the head of Cook Inlet (Please see the inset of Map A in Appendix A for location). The municipality's current population is 283,938 making it the most populated city in the state (ADCED, 2008). Communities located within the municipality include: Anchorage, Eagle River, Chugiak, Eklutna, and Girdwood.

The majority of homes in Anchorage are connected to Anchorage Water and Wastewater Utility, providing water and sewerage (ADCED, 2008). Natural gas is available to most homes through ENSTAR Natural Gas Company. Refuse is transported to the Anchorage Regional Landfill on Hiland Road (ADCED, 2008).

According to the sanitary survey (11/19/2006) for this system, the depth of the well is unknown. No well log is available. This system operates continuously and serves approximately 3 residents and 75 non-residents through two service connections.

SHEPHERD OF THE HILLS LUTHERAN CHURCH DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the drinking water protection area. The drinking water protection area is the area circling the well (the area influenced by pumping) and also the area upgradient of the well, usually forming a parabola shape. Because releases of contaminants within the protection area are most likely to impact the well, this area will serve as the focus for voluntary protection efforts.

There are many different methods for calculating the size of protection areas. Drinking Water Protection (DWP) uses a combination of two simple groundwater flow equations, the Thiem and uniform flow equations for all groundwater wells screened in unconsolidated material. The orientation of the protection zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The protection zone calculated by the DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone. Because of uncertainties and changing site conditions, a factor of safety is added to the protection zone to form the drinking water protection area for the well.

The parameters used to calculate the shape of this protection zone are general for the whole alluvial plain and were obtained from various United States Geological Survey (USGS) reports, area well logs, and

the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

The protection areas established for wells by the DEC are usually separated into two zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. An analytical calculation was used to determine the size and shape of the protection area. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (Patrick, Brabets, and Glass, 1989).

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 Shepherd of the Hills Lutheran Church 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 Shepherd of the Hills Lutheran Church 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 SHEPHERD OF THE HILLS LUTHERAN CHURCH 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 Shepherd of the Hills Lutheran Church received a **Low** susceptibility rating. The sanitary survey for this system indicates the land

surface is appropriately sloped away from the well and a sanitary seal is installed. However, according to the survey, the well is not grouted as required by DEC regulations. A sanitary seal prevents potential contaminant 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 wells and bore holes are penetrating the aquifer and, if applicable, the confining layer.

The Shepherd of the Hills Lutheran Church system is assumed to draw water from an unconfinedaquifer, based in nearby public water systems. The aquifer received a **Very High** susceptibility rating because of the lack of a confining layer and the presence of boreholes and wells in the protection area. In addition, the highly transmissive aquifer material and the moderately high water table in the area (31 feet bgs) can allow contaminants to travel downward from the surface with the precipitation and surface water runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Shepherd of the Hills Lutheran Church system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	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 Shepherd of the Hills Lutheran Church system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	14	Low
Volatile Organic Chemicals	22	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 Shepherd of the Hills Lutheran Church system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	80	Very High
Nitrates and/or Nitrites	45	Medium
Volatile Organic Chemicals	50	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with the residential septic systems and roads contributing to the risk to the drinking water well.

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

Only a small amount of bacteria and viruses are required to endanger public health. Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination. Bacteria and viruses have been detected during recent water sampling of the system at Shepherd of the Hills Lutheran Church (data was 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 **Low** with with the residential septics and roads contributing to the risk to this source of public drinking water. Nitrates are very mobile, moving at approximately the same rate as water.

The sampling history for Shepherd of the Hills Lutheran Church well indicates that nitrates have been detected in the water (the highest detected level within the last 5 years of sampling was 0.398 mg/l on 12/20/2006, data was 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 **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Medium** with the residential septics, roads, and pipeline contributing to the risk to the drinking water well.

The drinking water at Shepherd of the Hills Lutheran Church has not recently been sampled for volatile organic chemicals.

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 Shepherd of the Hills Lutheran Church 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 Shepherd of the Hills Lutheran Church drinking water source.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), Accessed 2008 [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.

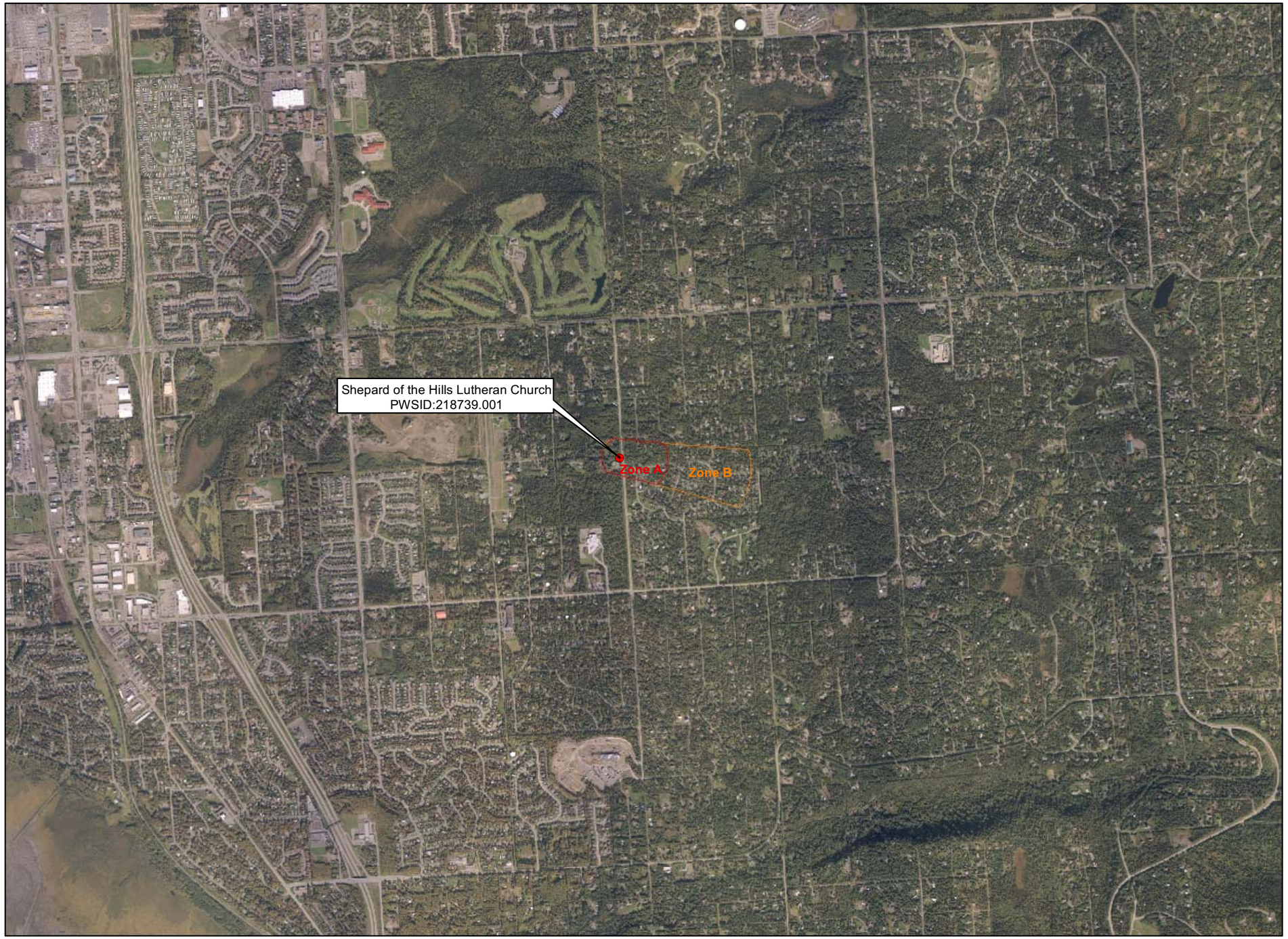
Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

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

APPENDIX A

Shepherd of the Hills Lutheran Church
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #218739.001 Shepard of the Hills Lutheran Church



Legend

Class B Public Water System

Groundwater Protection Zones

Zone A Protection Area - Several Months Travel Time

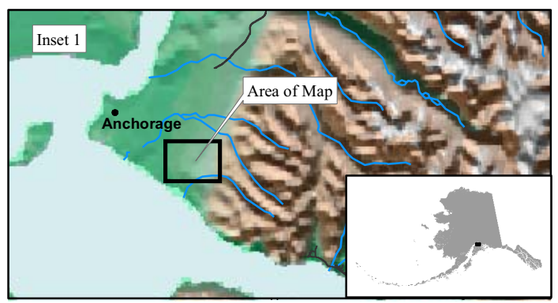
Zone B Protection Area - 2 Years Travel Time

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.



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Shepard of the Hills Lutheran Church
PWS 218739.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Shepherd of the Hills Lutheran Church (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 218739.001***

SHEPHERD OF THE HILLS LUTHERAN CHURCH

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Residential Septics	R02	R02	A	C	4 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	A	C	2 Roads
Residential Septics	R02	R02	B	C	55 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	B	C	1 Road
Pipelines (oil and gas)	X28	X28-01	B	C	

Table 2

Contaminant Source Inventory and Risk Ranking for SHEPHERD OF THE HILLS LUTHERAN CHURCH

Sources of Bacteria and Viruses

PWSID 218739.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Septics	R02	R02	A	Low	C	4 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 Roads
Residential Septics	R02	R02	B	Low	C	55 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 Road

Table 3

Contaminant Source Inventory and Risk Ranking for SHEPHERD OF THE HILLS LUTHERAN CHURCH

Sources of Nitrates/Nitrites

PWSID 218739.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Septics	R02	R02	A	Low	C	4 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 Roads
Residential Septics	R02	R02	B	Low	C	55 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 Road

Table 4

Contaminant Source Inventory and Risk Ranking for SHEPHERD OF THE HILLS LUTHERAN CHURCH Sources of Volatile Organic Chemicals

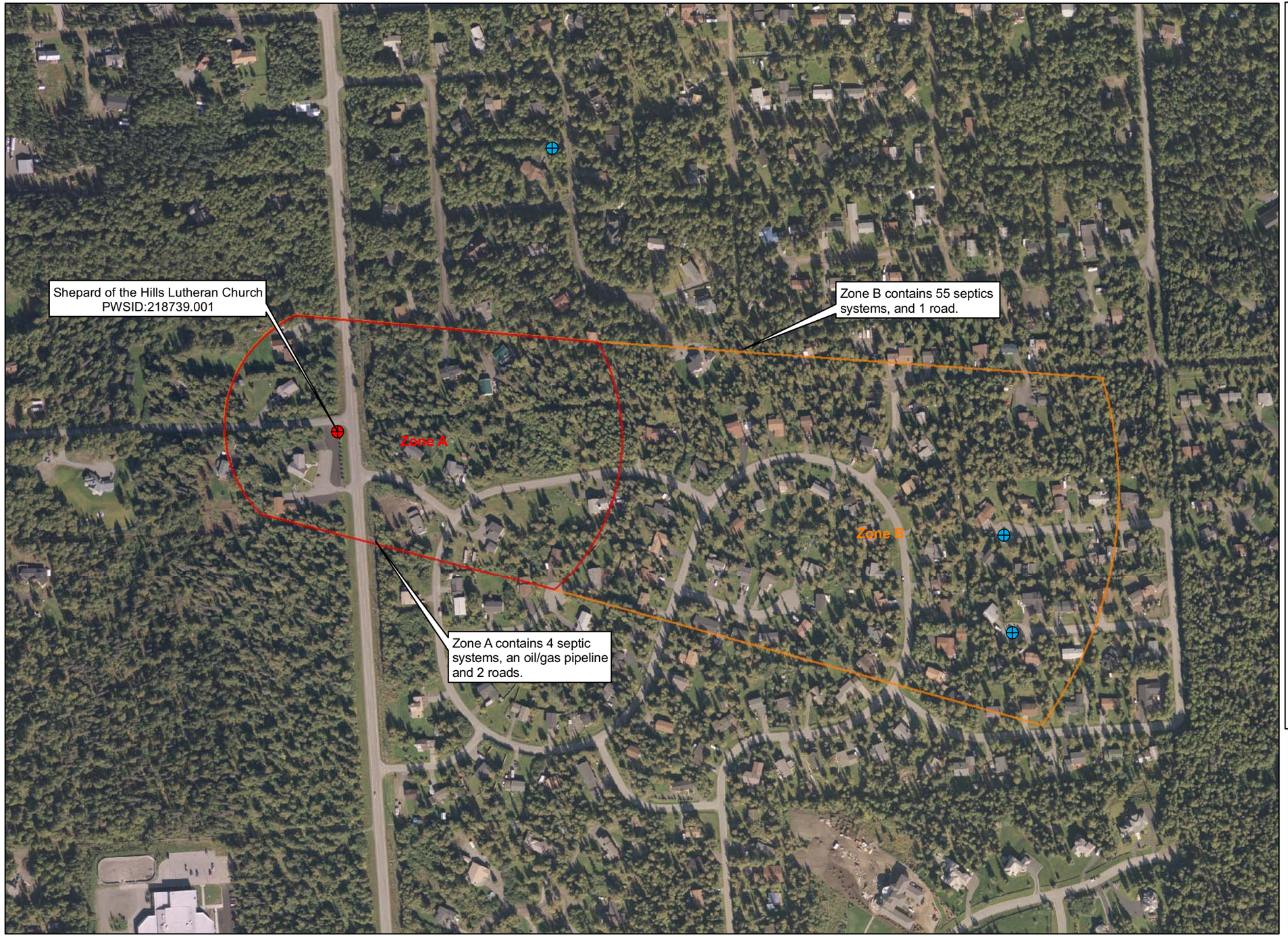
PWSID 218739.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Septics	R02	R02	A	Low	C	4 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 Roads
Residential Septics	R02	R02	B	Low	C	55 Septic systems
Highways and Roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 Road
Pipelines (oil and gas)	X28	X28-01	B	Medium	C	

APPENDIX C

Shepherd of the Hills Lutheran Church
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS #218739.001 Shepard of the Hills Lutheran Church
Showing Potential and Existing Sources of Contamination



Legend

- Class A Public Water System
- 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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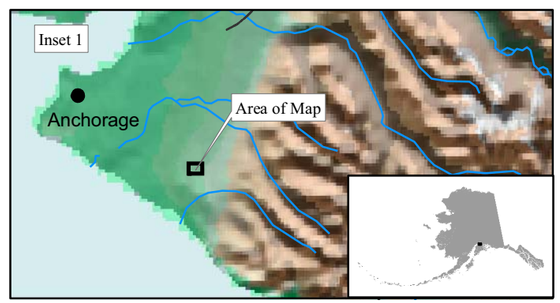

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Shepard of the Hills Lutheran Church
PWS 218739.001

Appendix C Map C