Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Country Field Drinking Water System, Wasilla, Alaska PWSID 220029

November 2006

DRINKING WATER PROTECTION REPORT Report 1589
Alaska Department of Environmental Conservation

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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 (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 the Program Coordinator of DWP, (907) 269-7521.

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Source Water Assessment for Country Field Source of Public Drinking Water, Wasilla, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the Country Field to potential contamination. This Class A (community) water system consists of one well off of the Seward Meridian Pkwy in Wasilla. The well received a natural susceptibility rating of **Low**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **Low** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Country Field public water system include: residential areas, septic systems, and roads. These are considered as 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 contaminant risk, the public water system for Country Field received an overall vulnerability rating of **Medium** for nitrates and/or nitrites, heavy metals, cyanide, and other inorganic chemicals, **Low** for VOCs, OOCs, bacteria and viruses, and SOCs.

COUNTRY FIELD PUBLIC DRINKING WATER SYSTEM

Country Field public water system is a Class A (community) water system off of the Seward Meridian Parkway in Wasilla.

A lake covered the Susitna River valley lowland during glacial times. The deposition of glacial silts and clays played an important part in the make up 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, Salamatof, and Slikok soil types.

The ***Knik*** series is the other major soil type in the area. It includes most of the downtown area, north and south of Lake Lucille and Wasilla Lake.

Knik soils are shallow, well-drained and silty, overlaying coarse, gravelly material, although scattered areas of poorly drained soils are also included. The soils are extensive over a broad range of slopes from flat to steep escarpments.

The ***Coal Creek*** series consists of dark-colored, poorly drained soils that formed in moderately deep silty material over compacted, fine-textured sediments. These soils occur in nearly level to gently sloping stream valleys, on the border of muskegs, and in small depressions. They are sometimes characterized by hillside seeps. This soil unit is found in small areas north and west of the downtown area.

The ***Salamatof*** and ***Slikok*** series are found within low areas and consist of poorly drained, peat, muck, and silty sediments in shallow depressions throughout the eastern side of the city. High water tables, often at or just below the surface, are characteristics of these soils. The banks of Cottonwood Creek south of Wasilla Lake have the greatest concentrations of these soils.

A sanitary survey from 10/02/2003 for a now abandoned well once used by Country Field public water system shows the system serving approximately 35 non-residents through 2 service connections.

COUNTRY FIELD 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 area that contributes water to the well, the groundwater capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

There are many different methods for calculating the size of capture zones. 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 capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated by the DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture 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).

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

The protection areas established for wells are usually separated into two zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the two zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	Several months travel time
B	Less than 2 years time-of-travel

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Country Field 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 Country Field protection area. This inventory was completed through a search of agency records and other publicly available information. 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 A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- 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

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 COUNTRY FIELD 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 protection area.

The Drinking Water Protection 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 protection area.

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 Country Field received a **Low** susceptibility rating. Plan review information for the

new well from 2005 indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is grouted. 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, the confining layer, if applicable.

The aquifer the Country Field well is completed in received a **Low** susceptibility rating. The well is deep, and the aquifer is confined by about 97 feet of hardpan. The depth of the well combined with its confinement help keep contaminants from traveling down to the aquifer from the surface. Table 2 summarizes the Susceptibility scores and ratings for Country Field.

Table 2: Susceptibility

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

The Contaminant Risk has been 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	High
Volatile Organic Chemicals	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Very High
Synthetic Organic Chemicals	Low
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	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Medium
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Low

Bacteria and Viruses

Residential areas in the protection area represent the greatest risk for bacteria and viruses to the drinking water well. For a complete listing of potential sources for bacteria and virus contamination please see Table 2 in Appendix B.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms 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 coliforms and E. coli which only come from human and animal fecal waste (EPA, 2006). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2006). No

samples have tested positive for coliforms in recent history.

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

Septic systems in the protection area also represent the greatest risk to to nitrates and nitrites for this source of public drinking water. For a complete listing of potential sources for nitrate and nitrite contamination please see Table 3 in Appendix B.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have been detected in recent sampling history for the Country Field well at levels about 13% of the maximum contaminant level (MCL = 10mg/L). Levels of nitrates/nitrites exceeding the MCL have been known to cause 'blue baby syndrome' in infants.

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

Roads represent the greatest identified risk for volatile organic chemical contamination to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 4 in Appendix B.

Volatile Organic Chemicals have not been detected within 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 low.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

Roads represent the greatest risk for inorganic chemicals to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 5 in Appendix B.

Arsenic and barium have both been detected during recent sampling. Arsenic was detected in higher relative concentration at 138% of its MCL. The MCL for arsenic is 0.01 mg/L. In greater quantities, arsenic is known to cause skin damage, problems with circulatory systems, and may create an increased risk of developing cancer (EPA, 2006).

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 medium.

Synthetic Organic Chemicals

Residential areas represent the greatest risk for synthetic organic chemicals to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 6 in Appendix B.

Synthetic organic chemicals have not been sampled for in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Other Organic Chemicals

Septic systems represent the greatest risk for other organic chemicals to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 7 in Appendix B.

Other organic chemicals have not been sampled for in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

REFERENCES

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

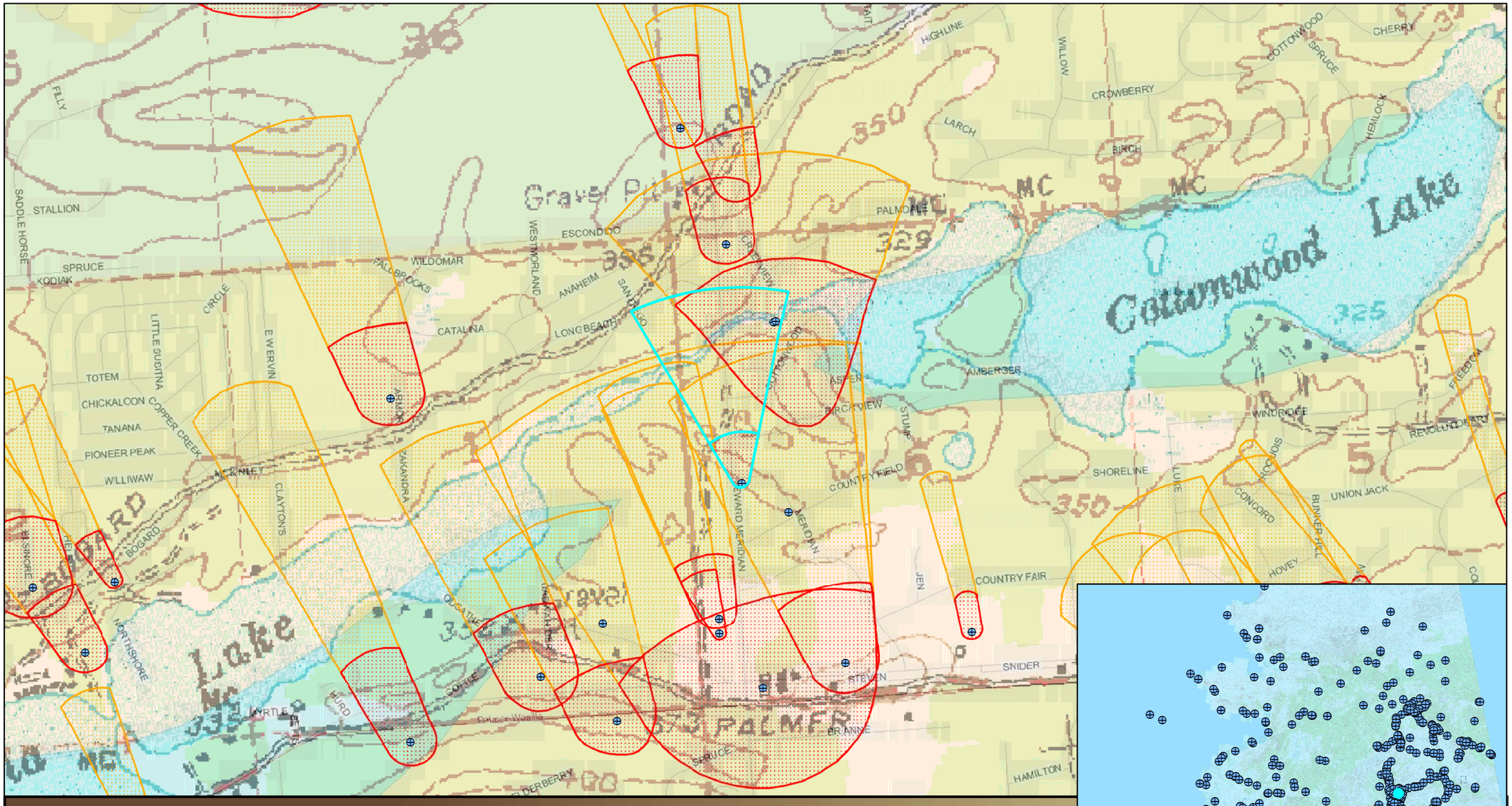
United States Environmental Protection Agency (EPA), 2006 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

Trainer, F.W., 1953, Preliminary report on the geology and groundwater resources of the Matanuska Valley agricultural area, Alaska, USGS Water Supply Paper 1494, U.S. Printing Office, Washington, D.C.

Jakola, J.B., Munter, J.A., and Evans, J.G., 1991, Ground-water resources of the Palmer-Big Lake area, Alaska: a conceptual model. Division of Geological and Geophysical Surveys Report of Investigations 90-4, State of Alaska Department of Natural Resources, Fairbanks, AK.

APPENDIX A

Country Field
Drinking Water Protection Area Location Map
(Map 1)



Map 1- Country Field Water Potential and Existing Source of Contamination

PWSID: 220029.003

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:13,181 Feet 2,600

Data Sources:
Mat-Su Borough: Roads and parcels
Potential Sources of Contamination: ADEC

- Public Water Sources
- Zone A Protection Area
- Zone B Protection Area

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Country Field (Tables 1-7)

Table 1

Contaminant Source Inventory for

Country Field Water Co.

PWSID 220029.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	A		
Residential Areas	R01	R01	B		30 residential acres
Septic systems (serves one single-family home)	R02	R02-1-21	B		21 septic systems
Highways and roads, paved (cement or asphalt)	X20	X20-2-6	B		

Table 2

Contaminant Source Inventory and Risk Ranking for Country Field Water Co. Sources of Bacteria and Viruses

PWSID 220029.001

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	A	Low		
Residential Areas	R01	R01	B	Low		30 residential acres
Septic systems (serves one single-family home)	R02	R02-1-21	B	Low		21 septic systems
Highways and roads, paved (cement or asphalt)	X20	X20-2-6	B	Low		

Table 3

Contaminant Source Inventory and Risk Ranking for Country Field Water Co. Sources of Nitrates/Nitrites

PWSID 220029.001

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	A	Low		
Residential Areas	R01	R01	B	Low		30 residential acres
Septic systems (serves one single-family home)	R02	R02-1-21	B	Low		21 septic systems
Highways and roads, paved (cement or asphalt)	X20	X20-2-6	B	Low		

Table 4

Contaminant Source Inventory and Risk Ranking for Country Field Water Co. Sources of Volatile Organic Chemicals

PWSID 220029.001

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	A	Low		
Residential Areas	R01	R01	B	Low		30 residential acres
Septic systems (serves one single-family home)	R02	R02-1-21	B	Low		21 septic systems
Highways and roads, paved (cement or asphalt)	X20	X20-2-6	B	Low		

Table 5

Contaminant Source Inventory and Risk Ranking for Country Field Water Co. Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 220029.001

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	A	Low		
Residential Areas	R01	R01	B	Low		30 residential acres
Septic systems (serves one single-family home)	R02	R02-1-21	B	Low		21 septic systems
Highways and roads, paved (cement or asphalt)	X20	X20-2-6	B	Low		

Table 6

Contaminant Source Inventory and Risk Ranking for Country Field Water Co. Sources of Synthetic Organic Chemicals

PWSID 220029.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01	B	Low		30 residential acres
Septic systems (serves one single-family home)	R02	R02-1-21	B	Low		21 septic systems

Table 7

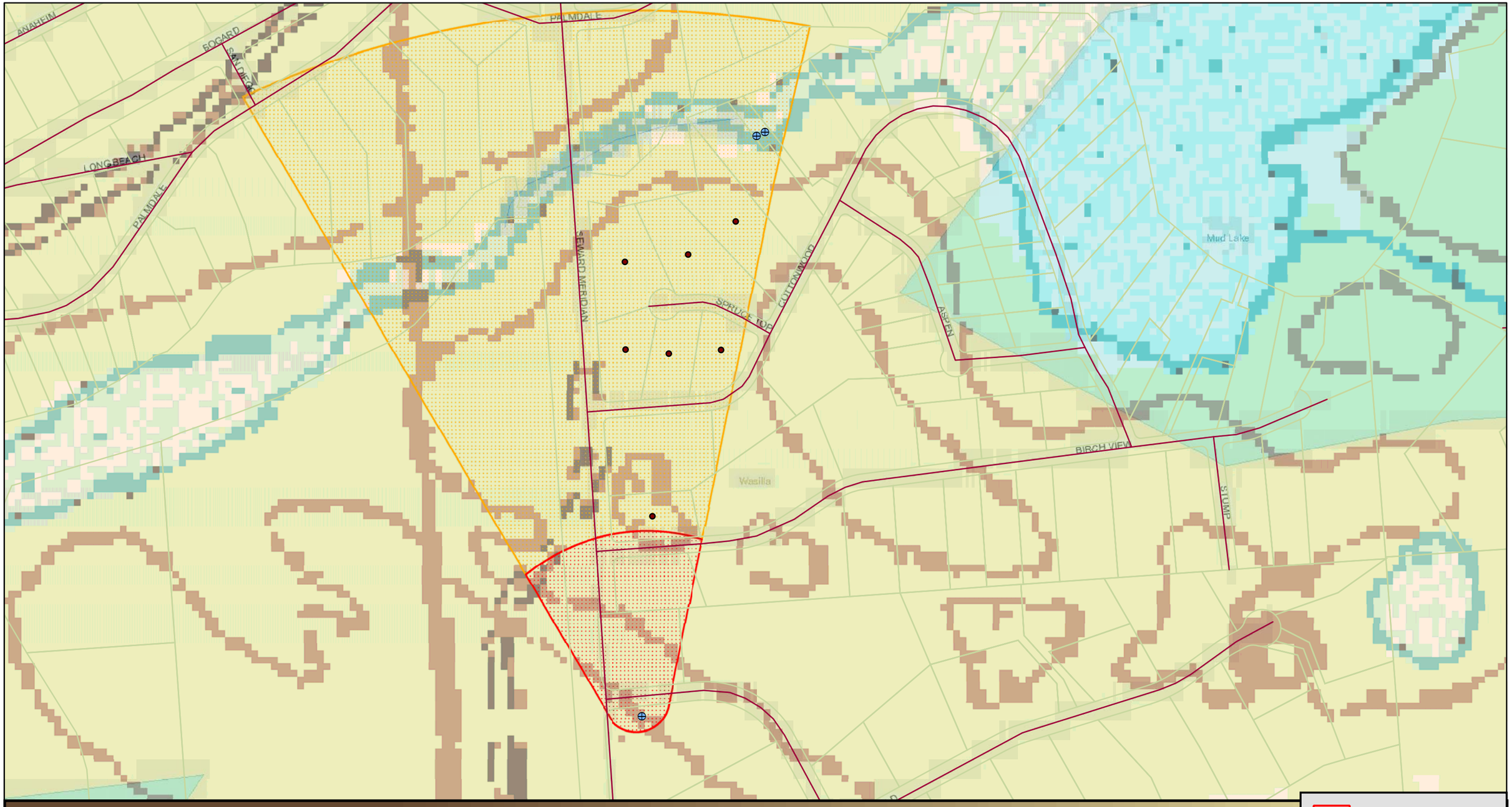
Contaminant Source Inventory and Risk Ranking for Country Field Water Co. Sources of Other Organic Chemicals

PWSID 220029.001

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	A	Low		
Residential Areas	R01	R01	B	Low		30 residential acres
Septic systems (serves one single-family home)	R02	R02-1-21	B	Low		21 septic systems
Highways and roads, paved (cement or asphalt)	X20	X20-2-6	B	Low		

APPENDIX C

Country Field
Drinking Water Protection Area and
Potential and Existing Contaminant Sources
(Map 2)



Map 2- Country Field Water Potential and Existing Source of Contamination

PWSID: 220029.003

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:3,652 Feet 720

Data Sources:
Mat-Su Borough: Roads and parcels
Potential Sources of Contamination: ADEC

- Zone A Protection Area
- Zone B Protection Area
- parcels
- Roads
- Public Water Sources
- Septics