Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Amore Mocha Public Drinking Water System, Kenai Area, Alaska PWSID # 249069.001

DRINKING WATER PROTECTION REPORT 1720

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

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Source Water Assessment for Amore Mocha Source of Public Drinking Water, Kenai Area, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Amore Mocha is a Class B (transient/non-community) water system consisting of one well on the east side of Kalifornsky Beach Road, about 5 miles south of Kenai, 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 **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Amore Mocha public drinking water source include: a gasoline station, motor vehicle dealership, motor vehicle waste injection wells, residential septic systems, large capacity septic systems, underground diesel storage tanks, water supply wells, roads, and a coal mining area. 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 Amore Mocha received a vulnerability rating of **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 Amore Mocha to protect public health.

AMORE MOCHA PUBLIC DRINKING WATER SYSTEM

Amore Mocha public water system is a Class B (transient/non-community) water system. The system consists of one well on the east side of Kalifornsky Beach Road, about 5 miles south of Kenai, Alaska. Kenai is part of the Kenai Peninsula Borough, which is located directly south of the city of Anchorage (Please see the inset of Map A in Appendix A for location). The borough encompasses 25,600 square miles, of which only 15,700 square miles is land.

The Kenai Peninsula is broken into two distinct geographic areas; the Kenai Mountains and the Kenai Lowlands. Kenai and its surrounding communities are located in the Kenai Lowlands. Communities located within the Kenai Lowlands include Sterling, Soldotna, Kenai, Nikiski, Clam Gulch, Ninilchik, and Homer.

The Kenai Peninsula area topography varies from about 3,000 feet to 5,000 feet above sea level in the Kenai Mountains, the highest point being about 6,400 feet above sea level. The Kenai Peninsula is dotted with many lakes and small streams, including three large lakes (Kenai Lake, Skilak Lake, and Tustemena Lake) and two substantial rivers (Kenai River, and Kasilof River) (USGS 1915).

The Amore Mocha water system is located within the Kenai Lowlands, which is a sub-province of the Cook Inlet-Susitna Lowland physiographic region. The Kenai Lowland is a glaciated coastal shelf situated west of the northeast-trending Kenai Mountains. Approximately 100 miles long, the coastal shelf is bordered on the west by Cook Inlet, on the east by Kenai Mountains, on the north by Turnagain Arm, and on the south by the Caribou Hills and Kachemak Bay. The following summary of regional geology and hydrogeology is based on studies by Bailey and Hogan (1995); Freethey and Scully (1980); Glass (1996); Hartman, et al. (1972); and Karlstrom (1964).

The Kenai Lowland is underlain by bedrock. Tertiary sedimentary bedrock is more than 500 feet below the city of Kenai airport, but is exposed along beach cliffs and road cuts near the southwest end of the lowland. Unconsolidated surficial deposits of Quaternary age include coastal deposits, glaciolacustrine deposits, glaciofluvial deposits, glacial moraine deposits, and periglacial wind deposits. Unconsolidated Quaternary cover on the lowlands generally thickens from south to North being thin or absent in the Homer area, and over 750 feet thick near Nikiski.

The most significant groundwater resources of the Kenai Lowlands are contained in Quarternary coarsegrained sands and gravels. Flood plain, river terrace and other alluvial deposits are common aquifer materials in the area, and are characterized by high rates of recharge, and large saturated thicknesses. Other favorable materials include a proglacial lake and two associated river deposits and glacial outwash deposits consisting of meltwater, sorted sand, and gravel material. Unsorted glacial moraine and drift deposits generally have poor groundwater yields, as do discontinuous layers of confining clays and silt that are common throughout the unconsolidated materials. The relatively thicker sequence of unconsolidated sediments in the northern portions of the Kenai Lowlands locally

hosts thicker, more extensive clay aquitards and multiple aquifers.

The Kenai Peninsula area has a central water system. However, many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are deep with depths between 50 and 200 feet. Static water levels in many of these wells are between 10 and 30 feet below the surface. Although groundwater quality can vary significantly in short distance, groundwater supplies are abundant in the area.

The Kenai River watershed covers over 2,200 square miles and runs over 80 miles in length. This watershed includes the towns of Cooper Landing, Sterling, Soldotna, and Kenai.

According to the well log, the well extends 83 feet below the ground surface, and is completed in an unconfined aquifer and screened in sand and gravel.

This system operates continuously and serves approximately 2 residents and 200 non-residents through one service connection.

AMORE MOCHA 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 Amore Mocha 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 Amore Mocha 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 AMORE MOCHA 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 AK Division of Parks received a **Low** susceptibility rating. The most recent sanitary survey (7/27/2005) for this system indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is 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.

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 Amore Mocha system draws water from an unconfined aquifer consisting of sand and gravel. The aquifer received a **Very High** susceptibility rating due to its unconfined nature and the presence of other wells penetrating the vadose zone of the protection area. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, it is susceptible to contamination from outside sources. Furthermore, the presence of other wells penetrating the vadose zone of the protection area can allow contaminants to travel into the shared aquifer with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Amore Mocha system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	25	Medium

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 Amore Mocha 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 Amore Mocha system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	75	High
Nitrates and/or Nitrites	75	High
Volatile Organic Chemicals	75	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with motor vehicle waste injection wells, residential septic systems, large capacity 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 not been detected during recent water sampling of the system at Amore Mocha (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 **High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High** with residential septic systems, large capacity septic systems, 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 the Amore Mocha well indicates that nitrates have been detected in the water (the highest detected level within the last 5 years of sampling was 0.102 mg/l on 12/7/2005, 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 **High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High** with a gasoline station, motor vehicle dealership, motor vehicle waste injection wells, residential septic systems, large capacity septic systems, underground diesel storage tanks, roads, and a coal mining area contributing to the risk to the drinking water well.

The drinking water at Amore Mocha has not recently been sampled for volatile organic chemicals (data was 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 **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 Amore Mocha 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 Amore Mocha drinking water source.

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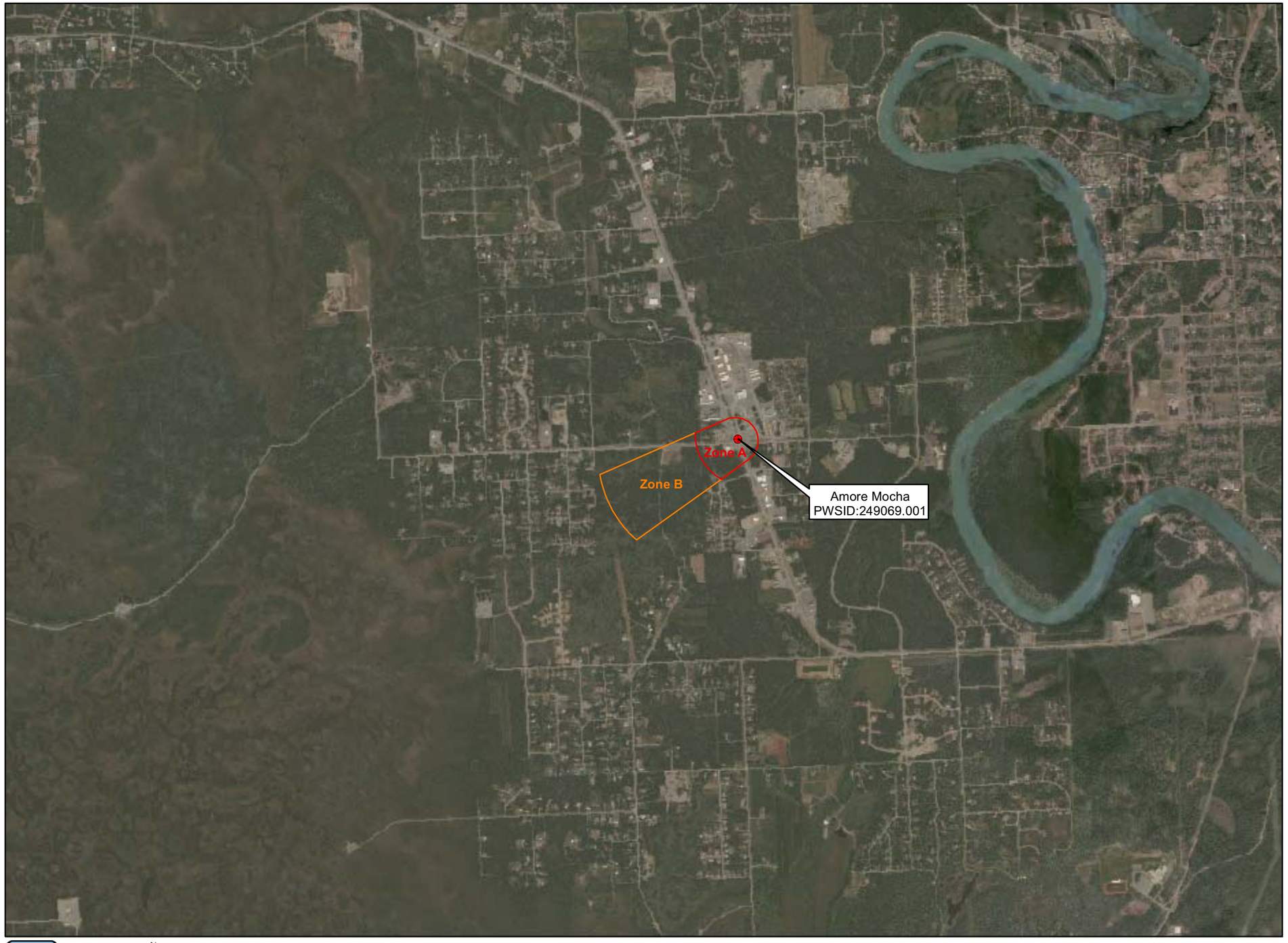
APPENDIX A

Amore Mocha
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #249069.001 Amore Mocha



Legend

Class B Public Water System

Groundwater Protection Zones

Zone A Protection Area - Several Months Travel Time

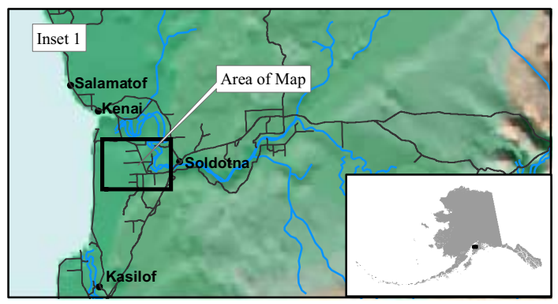
Zone B Protection Area - 2 Years Travel Time

Data Sources:
Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

All other data:
Kenai Borough Satellite Imagery (2003)

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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Amore Mocha
PWS 249069.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Amore Mocha (Tables 1-4)

Table 1

Contaminant Source Inventory for ***Amore Mocha***

PWSID 249069.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Gasoline Station (without repair shop)	C15	C15-01	A	C	
Motor Vehicle Dealership (with service department)	C27	C27-01	A	C	
Large Capacity Septic System	D10	D10-01	A	C	
Large Capacity Septic System	D10	D10-02	A	C	
Large Capacity Septic System	D10	D10-03	A	C	
Class V Motor Vehicle Waste Injection Well	D42	D42-01	A	C	
Class V Motor Vehicle Waste Injection Well	D42	D42-02	A	C	
Coal mining (active or inactive?)	E01	E01	A	C	
Residential Septic	R02	R02-01	A	C	
Residential Septic	R02	R02-02	A	C	
Residential Septic	R02	R02-03	A	C	
Residential Septic	R02	R02-04	A	C	
Residential Septic	R02	R02-05	A	C	
Residential Septic	R02	R02-06	A	C	
Residential Septic	R02	R02-07	A	C	
Underground Diesel Storage Tank	T08	T08-01	A	C	
Underground Diesel Storage Tank	T08	T08-02	A	C	
Water Supply Well	W09	W09-01	A	C	
Water Supply Well	W09	W09-02	A	C	
Road	X20	X20	A	C	
Road	X20	X20	A	C	
Residential Septic	R02	R02-08	B	C	
Water Supply Well	W09	W09-03	B	C	
Water Supply Well	W09	W09-04	B	C	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Road	X20	X20	B	C	

Table 2

Contaminant Source Inventory and Risk Ranking for Amore Mocha

Sources of Bacteria and Viruses

PWSID 249069.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Large Capacity Septic System	D10	D10-01	A	High	C	
Large Capacity Septic System	D10	D10-02	A	High	C	
Large Capacity Septic System	D10	D10-03	A	High	C	
Class V Motor Vehicle Waste Injection Well	D42	D42-01	A	Low	C	
Class V Motor Vehicle Waste Injection Well	D42	D42-02	A	Low	C	
Residential Septic	R02	R02-01	A	Low	C	
Residential Septic	R02	R02-02	A	Low	C	
Residential Septic	R02	R02-03	A	Low	C	
Residential Septic	R02	R02-04	A	Low	C	
Residential Septic	R02	R02-05	A	Low	C	
Residential Septic	R02	R02-06	A	Low	C	
Residential Septic	R02	R02-07	A	Low	C	
Road	X20	X20	A	Low	C	
Road	X20	X20	A	Low	C	
Residential Septic	R02	R02-08	B	Low	C	
Road	X20	X20	B	Low	C	

Table 3

Contaminant Source Inventory and Risk Ranking for Amore Mocha

Sources of Nitrates/Nitrites

PWSID 249069.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Large Capacity Septic System	D10	D10-01	A	High	C	
Large Capacity Septic System	D10	D10-02	A	High	C	
Large Capacity Septic System	D10	D10-03	A	High	C	
Residential Septic	R02	R02-01	A	Low	C	
Residential Septic	R02	R02-02	A	Low	C	
Residential Septic	R02	R02-03	A	Low	C	
Residential Septic	R02	R02-04	A	Low	C	
Residential Septic	R02	R02-05	A	Low	C	
Residential Septic	R02	R02-06	A	Low	C	
Residential Septic	R02	R02-07	A	Low	C	
Road	X20	X20	A	Low	C	
Road	X20	X20	A	Low	C	
Residential Septic	R02	R02-08	B	Low	C	
Road	X20	X20	B	Low	C	

Table 4

Contaminant Source Inventory and Risk Ranking for Amore Mocha
Sources of Volatile Organic Chemicals

PWSID 249069.001

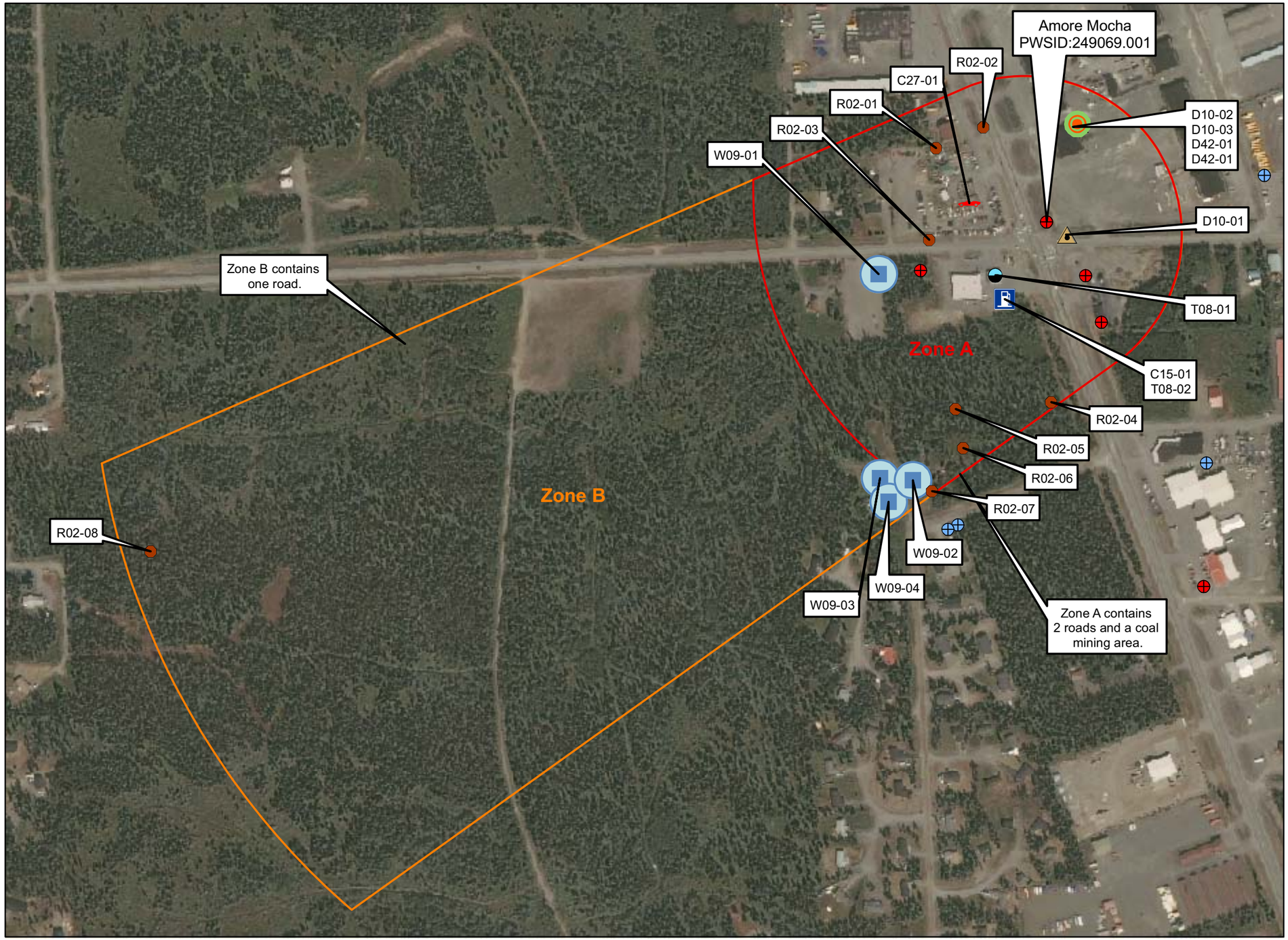
Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Gasoline Station (without repair shop)	C15	C15-01	A	High	C	
Motor Vehicle Dealership (with service department)	C27	C27-01	A	Medium	C	
Large Capacity Septic System	D10	D10-01	A	Low	C	
Large Capacity Septic System	D10	D10-02	A	Low	C	
Large Capacity Septic System	D10	D10-03	A	Low	C	
Class V Motor Vehicle Waste Injection Well	D42	D42-01	A	High	C	
Class V Motor Vehicle Waste Injection Well	D42	D42-02	A	High	C	
Coal mining (active or inactive?)	E01	E01	A	High	C	
Residential Septic	R02	R02-01	A	Low	C	
Residential Septic	R02	R02-02	A	Low	C	
Residential Septic	R02	R02-03	A	Low	C	
Residential Septic	R02	R02-04	A	Low	C	
Residential Septic	R02	R02-05	A	Low	C	
Residential Septic	R02	R02-06	A	Low	C	
Residential Septic	R02	R02-07	A	Low	C	
Underground Diesel Storage Tank	T08	T08-01	A	High	C	
Underground Diesel Storage Tank	T08	T08-02	A	High	C	
Road	X20	X20	A	Low	C	
Road	X20	X20	A	Low	C	
Residential Septic	R02	R02-08	B	Low	C	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Road	X20	X20	B	Low	C	

APPENDIX C

Amore Mocha
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS #249069.001 Amore Mocha
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

Existing or Potential Contaminant Sources

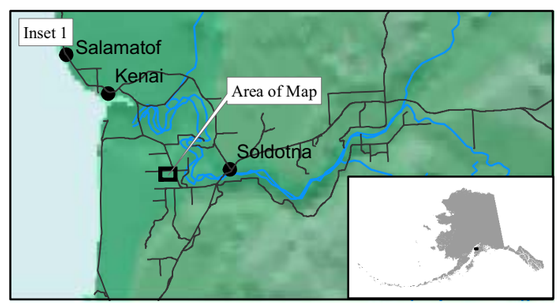
- Gasoline stations (without repair shop) (C15)
- Motor vehicle dealerships (with service department) C27)
- Tanks, diesel (underground) (T08)
- Water supply wells (W09)
- Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) (D10)
- Injection wells (Class V) Motor Vehicle Waste Disposal Well (D42)
- Residential Septics (R02)

Data Sources:
Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

All other data:
Kenai Borough Satellite Imagery (2003)

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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Amore Mocha
PWS 249069.001

Appendix C Map C