



## **Source Water Assessment**

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
LKSD Nightmute High School & Elementary
Drinking Water System,
Nightmute, Alaska

PWSID # 271261.001

April 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1129 Alaska Department of Environmental Conservation

# Source Water Assessment for LKSD Nightmute High School & Elementary Drinking Water System Nightmute, Alaska

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### DRINKING WATER PROTECTION PROGRAM REPORT 1129

The Drinking Water Protection Program (DWPP) 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 DWPP, (907) 269-7521.

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## Source Water Assessment for LKSD Nightmute High School & Elementary Source of Public Drinking Water, Nightmute, Alaska

## **Drinking Water Protection Program Alaska Department of Environmental Conservation**

### **EXECUTIVE SUMMARY**

The LKSD Nightmute High School & Elementary has one Public Water System (PWS) well. The well (PWS No. 271261.001) has been used as a drinking water source since it was drilled in 1966.

The well is a Class A (community and non-transient non-community) water system located approximately 1,000 feet northeast of the Toksook River in Nightmute, Alaska. Available records indicate that there is secondary storage of drinking water, with a combined capacity of 1,000-gallons, and that the untreated drinking water source is derived directly from the wellhead. This system operates year round and serves approximately 69 residents and 146 non-residents through two service connections. The wellhead received a susceptibility rating of **High** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produce a **Medium** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: Laundromats, domestic wastewater treatment plant disposal ponds/lagoons, landfills, aboveground fuel tanks, an ADEC recognized contaminated site, petroleum product bulk stations/terminals, electric power generation, and a medical/veterinary facility. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

Overall, the water well received a vulnerability rating of **Medium** for bacteria and viruses, nitrates and nitrites, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, and a vulnerability rating of **High** for the volatile organic chemicals contaminant categories.

#### PUBLIC DRINKING WATER SYSTEM

The LKSD Nightmute High School & Elementary well is a Class A (community/non-transient/non-community) public water system. The system is located approximately 1,000 feet northeast of the Toksook River in Nightmute, Alaska (Sec. 33, T5N, R88W, Seward Meridian; see Map A of Appendix A). Nightmute is located on Nelson Island, in western Alaska. It is 18 miles upriver from Toksook Bay, and 100 miles west of Bethel. The community has a population of 228 (ADCED, 2003). Average annual precipitation in Nightmute is 22 inches, including approximately 43 inches of snowfall. Temperatures range from 41 to 57°F in summer and 6 to 24°F in winter.

The community of Nightmute obtains most of their water supply from a community well. The City of Nightmute provides water and sewer haul service (ADCED, 2003). Nightmute receives electrical power from AVEC, a REA Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by individuals and transported to the landfill (ADCED, 2003).

According to information supplied by ADEC for the LKSD Nightmute High School & Elementary PWS, the depth of the primary water well is 56 feet below the ground surface and is screened in a confined aquifer based on available construction details. The well is suspected of being located within a floodplain, due to its proximity to the Toksook River.

Information acquired from a September 1997 sanitary survey for the public water system indicated that the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. The sanitary survey indicates that the well is not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

Nightmute is within the Bering Shelf physiographic province of southwestern Alaska. The Yukon-Kuskokwim Coastal Lowland, a section of the physiographic province, is a delta complex consisting of a lake-dotted marshy plain rising from the sea level. The largest geologic unit is the delta itself. The delta consists of three very similar units that chiefly consist of silt, sands, silty sands, and organic soils (peat bogs). The sediments of these units are a complex of river deposits, marine deposits, swamp deposits, and wind deposits. Nightmute lies within the discontinuous permafrost region of Alaska (R&M Consultants, Inc., 1979).

#### 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 area that contributes water to the well, the groundwater recharge area. This area is designated as the drinking water protection area (DWPA). Because releases of contaminants within the protection area are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts. An analytical calculation was used to determine the size and shape of the DWPA for the LKSD Nightmute High School & Elementary PWS. The input parameters describing the attributes of the aguifer in this calculation were adopted from Groundwater (Freeze and Cherry, 1979). Available geology and groundwater contours were also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

The protection areas established for wells by the ADEC are usually separated into four 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 (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

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 four protection area zones for wells and the calculated time -of-travel for each:

**Table 1. Definition of Zones** 

Zone	Definition
A	<sup>1</sup> / <sub>4</sub> the distance for the 2-yr. time -of-travel
В	Less than the 2 year time-of-travel
C	Less Than the 5 year time -of-travel
D	Less than the 10 year time -of-travel
	•

The DWPA for the LKSD Nightmute High School & Elementary PWS was determined using an analytical calculation and includes Zones A, B, C, and D (See Map A of Appendix A).

## INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the LKSD Nightmute High School & 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 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,
- Other 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.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well. 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, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

## VULNERABILITY OF THE DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility, and
- Contaminant risks.

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals. synthetic organic chemicals, and other organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points) (Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points) (Chart 2 of Appendix D)

=

Natural Susceptibility (Susceptibility of the Well) (0-50 Points)

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings						
40 to 50 pts	Very High					
30 to < 40 pts	High					
20 to < 30 pts	Medium					
< 20 pts	Low					

The LKSD Nightmute High School & Elementary's water well is in a confined aquifer. Confined aquifers are less susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the susceptibility scores and ratings for this PWS.

Table 2. Susceptibility

Score	Rating
15	High
13	Medium
28	Medium
	15

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. 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 to 50 pts	Very High						
30 to < 40 pts	High						
20 to < 30 pts	Medium						
< 20 pts	Low						

Category	Score	Rating
Bacteria and Viruses	25	Medium
Nitrates and/or Nitrites	30	High
Volatile Organic Chemical	s 41	Very High
Heavy Metals, Cyanide an	d	
Other Inorganic Chemicals	12	Low
Synthetic Organic Chemica	als 15	Low
Other Organic Chemicals	18	Low

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).

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings							
80 to 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 six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability** 

Category	Score	Rating
Bacteria and Viruses	50	Medium
Nitrates and Nitrites	55	Medium
Volatile Organic Chemicals	70	High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	40	Medium
Synthetic Organic Chemicals	45	Medium

Other Organic Chemicals

Medium

### **Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Medium**. The risk is primarily attributed to the presence of a domestic wastewater treatment plant disposal pond/lagoon and landfills in Zone D (see Table 2 – Appendix B).

45

No positive bacteria counts have been reported in recent (within five years) sampling events (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Only a small amount of bacteria and viruses are required to endanger public health.

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 **Medium**.

### Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **High**. The risk to this source of public drinking water is primarily attributed to the presence of a domestic wastewater treatment plant disposal pond/lagoon and landfills in Zone D (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that low levels of nitrates have been detected in recent sampling events. However, the reported concentrations of nitrates do not exceed the maximum contaminant level (MCL) of 10 mg/L. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L; therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils. Although the nitrate source is unknown, such occurrences may be attributed to septic systems or other sources. After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is **Medium**.

### **Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of landfills, an ADEC recognized contaminated site, and petroleum product bulk stations in Zone D (see Table 4 – Appendix B).

No recent sampling data was available in ADEC records for LKSD Nightmute High School & Elementary (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

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**.

### **Heavy Metals, Cyanide and Other Inorganic** Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Low**. The risk is primarily attributed to the presence of landfills located in Zone D (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, moderate levels of copper and lead have been detected in recent sampling history, but have not exceeded their respective MCLs of 1.3 mg/L and 0.015 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentrations of copper and lead in recent sampling events are not likely to be representative of source water conditions. These two analytes are likely attributed to either the water treatment process or water distribution network; therefore, no risk points were assigned based on the presence of these analytes.

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**

The contaminant risk for synthetic organic chemicals is **Low**. The risk is primarily attributed to the presence of landfills in Zone D (see Table6 - Appendix B).

No recent sampling data was available in ADEC records for the LKSD Nightmute High School & Elementary (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

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

### **Other Organic Chemicals**

The contaminant risk for other organic chemicals is **Low**. The risk is primarily attributed to the presence of landfills, electric power generation, and petroleum product bulk stations/terminals located in Zone D (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the LKSD Nightmute High School & Elementary (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

After combining the contaminant risk for other 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 the LKSD Nightmute High School & Elementary and the community of Nightmute 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 drinking water source.

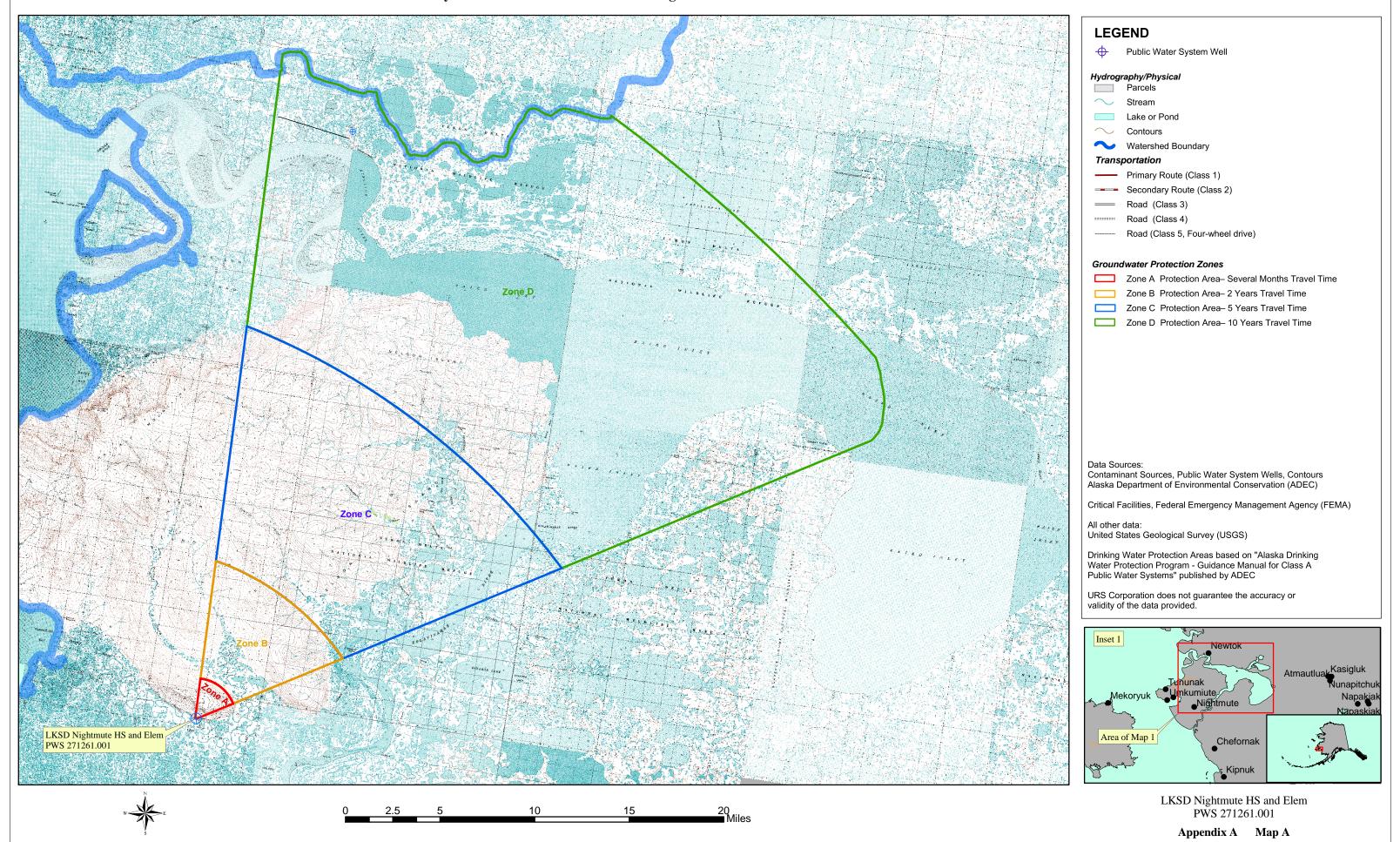
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## **APPENDIX A**

# Drinking Water Protection Area Location Map (Map A)

### Public Water Well System for PWS #271261.001 LKSD Nightmute HS and Elem



## **APPENDIX B**

# Contaminant Source Inventory and Risk Ranking (Tables 1-7)

# Contaminant Source Inventory for LKSD Nightmute HS & Elem

### PWSID 271261.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Laundromats without dry cleaning	C22	C22-01	D	С	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	D	С	
Landfills (municipal; Class III)	D51	D51-01	D	С	
Landfills (municipal; Class III)	D51	D51-02	D	С	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	D	С	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	D	С	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	D	С	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	D	С	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	D	С	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	D	С	
Petroleum product bulk station/terminals	X11	X11-01	D	С	
Petroleum product bulk station/terminals	X11	X11-02	D	С	
Petroleum product bulk station/terminals	X11	X11-03	D	С	
Petroleum product bulk station/terminals	X11	X11-04	D	С	
Petroleum product bulk station/terminals	X11	X11-05	D	С	
Petroleum product bulk station/terminals	X11	X11-06	D	С	
Electric power generation (fossil fuels)	X36	X36-01	D	С	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	D	С	

## Contaminant Source Inventory and Risk Ranking for LKSD Nightmute HS & Elem Sources of Bacteria and Viruses

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	D	High	С	
Landfills (municipal; Class III)	D51	D51-01	D	High	С	
Landfills (municipal; Class III)	D51	D51-02	D	High	С	

## Contaminant Source Inventory and Risk Ranking for LKSD Nightmute HS & Elem Sources of Nitrates/Nitrites

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	D	High	С	
Landfills (municipal; Class III)	D51	D51-01	D	Very High	C	
Landfills (municipal; Class III)	D51	D51-02	D	Very High	С	

## Contaminant Source Inventory and Risk Ranking for LKSD Nightmute HS & Elem Sources of Volatile Organic Chemicals

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Landfills (municipal; Class III)	D51	D51-01	D	High	С	
Landfills (municipal; Class III)	D51	D51-02	D	High	C	
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	D	High	С	
Petroleum product bulk station/terminals	X11	X11-01	D	Very High	C	
Petroleum product bulk station/terminals	X11	X11-02	D	Very High	C	
Petroleum product bulk station/terminals	X11	X11-03	D	Very High	C	
Petroleum product bulk station/terminals	X11	X11-04	D	Very High	С	
Petroleum product bulk station/terminals	X11	X11-05	D	Very High	С	
Petroleum product bulk station/terminals	X11	X11-06	D	Very High	С	

# Contaminant Source Inventory and Risk Ranking for LKSD Nightmute HS & Elem

## Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Landfills (municipal; Class III)	D51	D51-01	D	High	С	
Landfills (municipal; Class III)	D51	D51-02	D	High	С	

## Contaminant Source Inventory and Risk Ranking for LKSD Nightmute HS & Elem Sources of Synthetic Organic Chemicals

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Landfills (municipal; Class III)	D51	D51-01	D	Very High	С	
Landfills (municipal; Class III)	D51	D51-02	D	Very High	C	

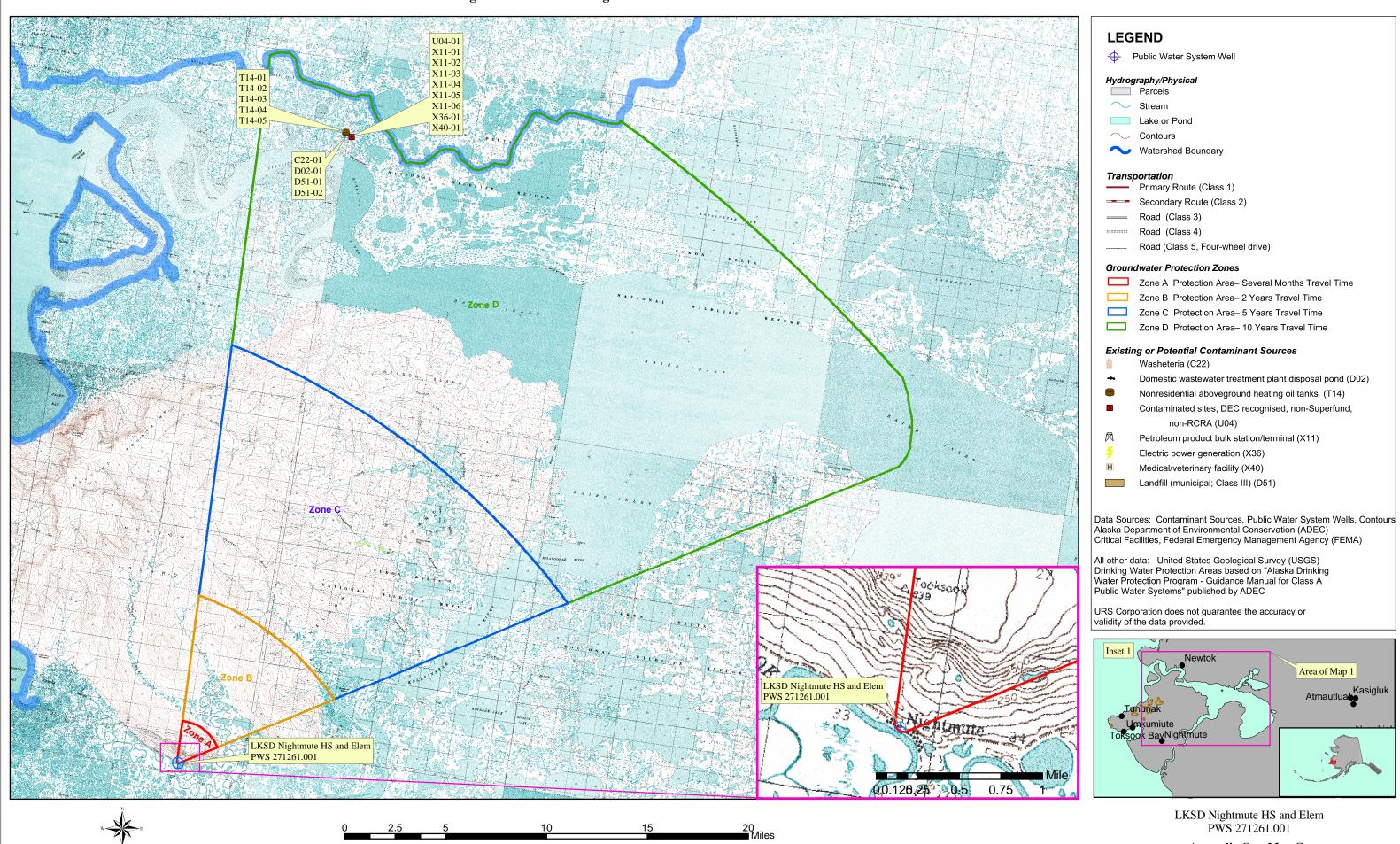
## Contaminant Source Inventory and Risk Ranking for LKSD Nightmute HS & Elem Sources of Other Organic Chemicals

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Landfills (municipal; Class III)	D51	D51-01	D	Very High	С	
Landfills (municipal; Class III)	D51	D51-02	D	Very High	C	
Petroleum product bulk station/terminals	X11	X11-02	D	High	С	
Petroleum product bulk station/terminals	X11	X11-03	D	High	С	
Petroleum product bulk station/terminals	X11	X11-04	D	High	С	
Petroleum product bulk station/terminals	X11	X11-05	D	High	С	
Petroleum product bulk station/terminals	X11	X11-06	D	High	С	
Electric power generation (fossil fuels)	X36	X36-01	D	High	С	

## **APPENDIX C**

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

### Public Water Well System for PWS #271261.001 LKSD Nightmute HS and Elem Showing Potential and Existing Sources of Contamination



Appendix C Map C

## **APPENDIX D**

Vulnerability Analysis for Public Drinking Water Source (Charts 1-14)

Susceptibility initially assumed to be low. Susceptibility of wellhead = 0 pts Is the well Increase susceptibility 5 pts + 5 pts properly grouted? Is the well Increase susceptibility 20 pts 0 pts capped? YES Based on the proximity of the well to Toksook River, it is suspected YES that the well may be located in a High Susceptibility of wellhead floodplain. 15 pts Increase susceptibility: YES Is the well 10 pts: suspected floodplain + 10 pts within a Wellhead Susceptibility Ratings 20 pts: known floodplain floodplain? 20 to 25 pts very high 15 to < 20 pts 10 to < 15 pts medium NO < 10 pts low Is the land surface sloped Increase susceptibility 5 pts 0 pts away from the

Chart 1. Susceptibility of the wellhead - LKSD Nightmute HS & Elem. (PWS No. 271261.001)

Chart 2. Susceptibility of the aquifer LKSD Nightmute HS & Elem. (PWS No. 271261.001)

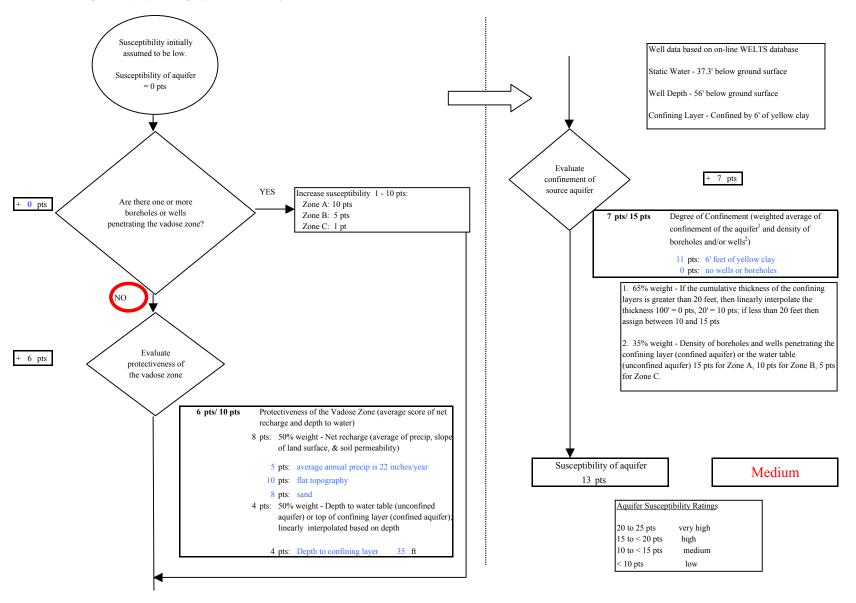


Chart 3. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Bacteria & Viruses

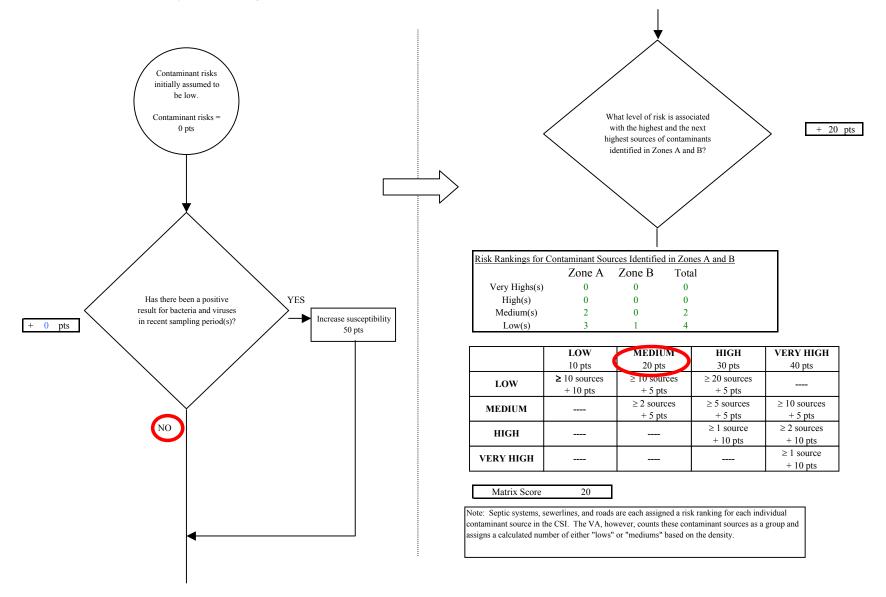


Chart 3. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Bacteria & Viruses NO Are there sufficient Initial assessment of risk posed by Risk unchanged controls, conditions, or potential sources of contamination monitoring to warrant = 20 pts downgrading risk? Are any YES significant Risk unchanged contaminant Reduce risk 1 - 10 pts sources within - 0 pts Zone A? The number and magnitude of Risk posed by potential sources of contaminant sources in YES contamination with controls Zone A determines a risk increase. See Table 2 for 25 5 pts Increase risk 1 - 10 pts inventory. Existing Risk due to existing 0 pts contamination Are there any conditions that Risk unchanged Risk posed by potential sources warrant upgrading Potential of contamination with controls risk? 25 pts Contaminant risks Contaminant Risk YES 25 pts Increase risk 1 - 10 pts + 0 pts Contaminant risks\* \* Truncate risk at 50 pts 25 Contaminant Risk Ratings Risk posed by potential sources of contamination 40 to 50 pts very high 30 to < 40 pts high Medium  $20 \text{ to} \le 30 \text{ pts}$ 

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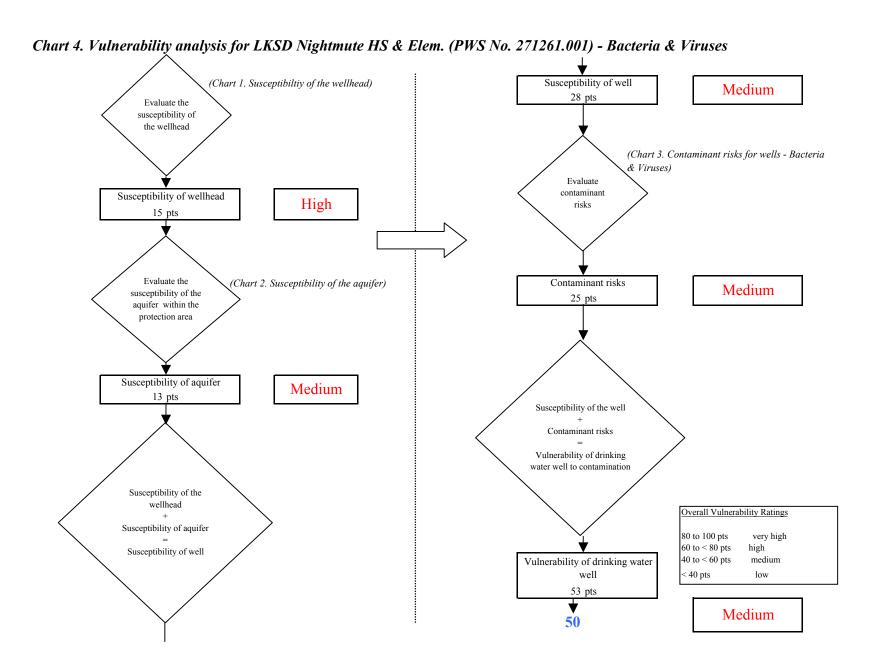
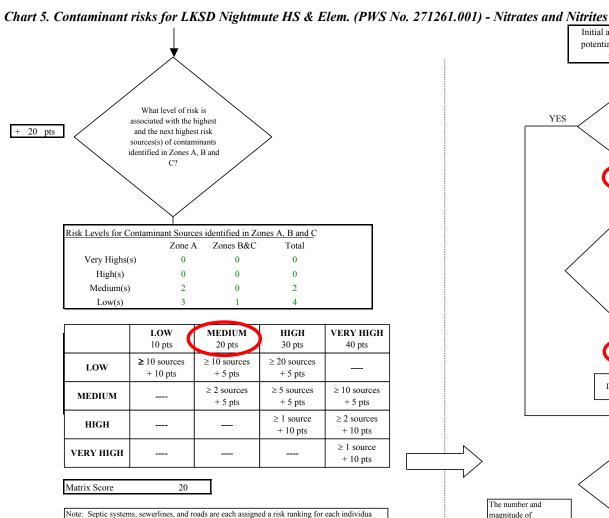


Chart 5. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Nitrates and Nitrites Contaminant risks initially assumed to be low. Current level of Evaluate the level of Contaminant risks background contamination due to man-= 0 pts contamination from made source(s) natural sources 0 pts Is the concentration of Has nitrates and/or NO the contaminant nitrites been detected in increasing, decreasing, the source waters in or staying the same? recent sampling period(s)? Recent Nitrate Sampling Results (mg/L) 7/7/2000 0.16 12/7/1998 ND The nitrate concentration is assumed to be natural if less than 2 mg/L (20%), or Increasing: risk up 1 - 10 pts YES attributed to man made Decreasing: risk down 1 - 5 pts sources if greater than 2 + 0 pts Same: risk unchanged mg/L. Maximum Contaminant Level (MCL) = 10 mg/LDetected Nitrate Level = Existing contamination points based on Risk due to existing man-Risk due to natural linear interpolation of most recent detect sources made sources [MCL = 50 pts; detect = 0 pts]1 pts 0 pts Risk due to existing contamination 1 pts Was the source of Evaluate the level of NO. contamination contamination from natural? man-made sources YES

Initial assessment of risk posed by



contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and

assigns a calculated number of either "lows" or "mediums" based on the density.

potential sources of contamination 20 Is the source YES aquifer fractured rock or karst? NO Are all of the higher risk sources beyond Risk unchanged Zones A and B? YES - 1 pts Decrease risk 1 - 10 pts Are any significant NO Risk unchanged sources within Zone A? magnitude of contaminant sources in Zone A determines a risk increase. See Table 3 for inventory. + 5 pts Increase risk 1 - 10 pts

Chart 5. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Nitrates and Nitrites Existing Are there conditions NO 1 pts Risk unchanged that warrant upgrading risk? Risk due to existing Potential contamination 29 pts The number and magnitude of Risk posed by potential sources contaminant sources in of contamination with controls Contaminant Risk Zone D determines a risk YES 30 pts increase. See Table 3 for Contaminant risks inventory. 5 pts Increase risk 1 - 10 pts Risk posed by potential sources of contamination 29 pts \*Truncate risk at 50 pts Contaminant risks\* 30 Are there sufficient Contaminant Risk Ratings High controls, conditions, NO. Risk unchanged or monitoring to 40 to 50 pts very high warrant downgrading 30 to < 40 pts high 20 to < 30 pts risk? medium < 20 pts low YES 0 pts Decrease risk 1 - 10 pts Risk posed by potential sources of contamination with controls

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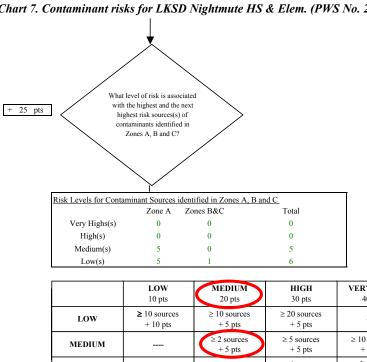
Chart 6. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Nitrates and Nitrites (Chart 1. Susceptibiltiy of the wellhead) Susceptibility of well Medium 28 pts Evaluate the susceptibility of the wellhead (Chart 5. Contaminant risks for wells - Nitrates and Nitrites) Evaluate Susceptibility of wellhead contaminant risks High 15 pts Evaluate the (Chart 2. Susceptibility of the aquifer) Contaminant risks High susceptibility of the 30 pts aquifer within the protection area Susceptibility of aquifer Medium 13 pts Susceptibility of the well Contaminant risks Vulnerability of drinking water well to contamination Susceptibility of the wellhead Overall Vulnerability Ratings Susceptibility of aquifer 80 to 100 pts very high Susceptibility of well 60 to < 80 pts high 40 to < 60 pts medium Vulnerability of drinking water well < 40 pts 58 pts Medium **55** 

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Chart 7. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Volatile Organic Chemicals Contaminant risks initially assumed to be Current level of Evaluate the level of Contaminant risks contamination due to manbackground =0 pts contamination from made source(s) natural sources 0 pts Is the concentration of the NO contaminant increasing, Have volatile organic decreasing, or staying the chemicals been detected ir same? the source waters in recent sampling period(s)? Recent VOC Sampling Results (mg/L) No recent VOC sampling data was available in ADEC records for this PWSID Increasing: risk up 1 - 10 pts YES Decreasing: risk down 1 - 5 pts + 0 pts Same: risk unchanged Existing contamination points based on linear interpolation of most recent detect [MCL = 50 pts; detect = 0 pts] Risk due to existing man-Risk due to natural sources made sources 0 pts 0 pts Risk due to existing contamination 0 pts Was the source of Evaluate the level of contamination contamination from mannatural? made sources YES

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	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	
MEDIUM		≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH			≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH				≥ 1 source + 10 pts

Matrix Score 25

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in tl CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

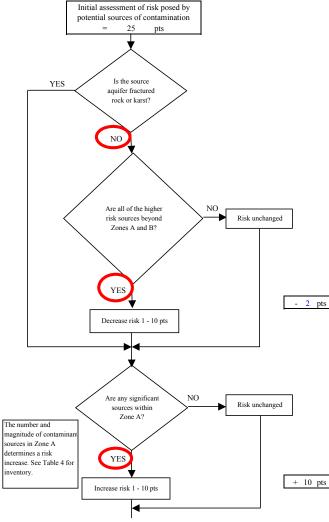


Chart 7. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Volatile Organic Chemicals Existing NO Are there conditions 0 pts Risk unchanged that warrant upgrading Risk due to existing risk? Potential contamination 41 pts The number and magnitude of Risk posed by potential sources contaminant sources in of contamination with controls Contaminant Risk Zone D determines a risk YES increase. See Table 4 for 41 pts Contaminant risks inventory. + 8 pts Increase risk 1 - 10 pts Risk posed by potential sources of contamination 41 pts \*Truncate risk at 50 pts Contaminant risks\* Contaminant Risk Ratings Very High Are there sufficient NO , controls, conditions, or Risk unchanged 40 to 50 pts very high monitoring to warrant 30 to < 40 pts high downgrading risk? 20 to < 30 pts medium < 20 pts YES 0 pts Decrease risk 1 - 10 pts Risk posed by potential sources of contamination with controls

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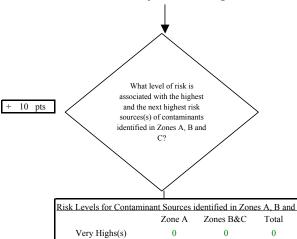
Chart 8. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Volatile Organic Chemicals Susceptibility of well (Chart 1. Susceptibiltiy of the wellhead) Medium 28 pts Evaluate the susceptibility of the wellhead (Chart 7. Contaminant risks for wells - Volatile Organic Chemicals) Evaluate Susceptibility of wellhead contaminant risks High 15 pts Evaluate the (Chart 2. Susceptibility of the aquifer) Contaminant risks Very High susceptibility of the 41 pts aquifer within the protection area Susceptibility of aquifer Medium 13 pts Susceptibility of the well Contaminant risks Vulnerability of drinking water well to contamination Susceptibility of the wellhead Overall Vulnerability Ratings Susceptibility of aquifer 80 to 100 pts very high Susceptibility of well 60 to < 80 pts high 40 to < 60 pts medium Vulnerability of drinking water well < 40 pts 69 pts High **70** 

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Chart 9. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals Contaminant risks initially assumed to be low. Current level of Evaluate the level of Contaminant risks contamination due to manbackground = 0 ptscontamination from made source(s) natural sources 43 pts The reported concentrations of lead and copper are likely attributed NO or Is the concentration of Have heavy metals, UNKNOWN to the water the contaminant cyanide or other inorganic treatment/conveyance increasing, decreasing, chemicals been detected system. No risk points or staying the same? in the source waters in assigned since neither recent sampling period(s)? analyte exceeded 100% of Recent Metals Sampling Results (mg/L the MCL in most recent sampling event. 12/31/2004 0.762 6/30/2001 1.03 12/31/2004 0.0013 Lead YES 6/30/2001 0.0037 Increasing: risk up 1 - 10 pts Decreasing: risk down 1 - 5 pts + -43 pts Same: risk unchanged Maximum Contaminant Although other inorganic compounds have Level (MCL) (mg/L) % of MCI been detected in previous sampling events, Copper= 1.3 86% lead and copper have reported the highest percent MCL values in the past 5 years. 0.015 9% Lead = Risk due to existing man-Risk due to natural Existing contamination points based on linear sources made sources interpolation of most recent detect [MCL = 50 pts; 0 pts 0 pts detect = 0 pts] Risk due to existing contamination 0 pts Evaluate the level Was the source of NO. of contamination contamination from man-made natural? sources YES

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Chart 9. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



isk Levels for Contaminant Sources identified in Zones A, B and C							
	Zone A	Zones B&C	Total				
Very Highs(s)	0	0	0				
High(s)	0	0	0				
Medium(s)	0	0	0				
Low(s)	5	1	6				

	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	
MEDIUM		≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH			≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH				≥ 1 source + 10 pts

Matrix Score 10

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

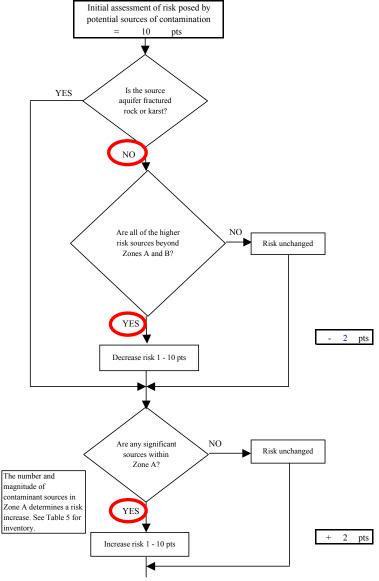
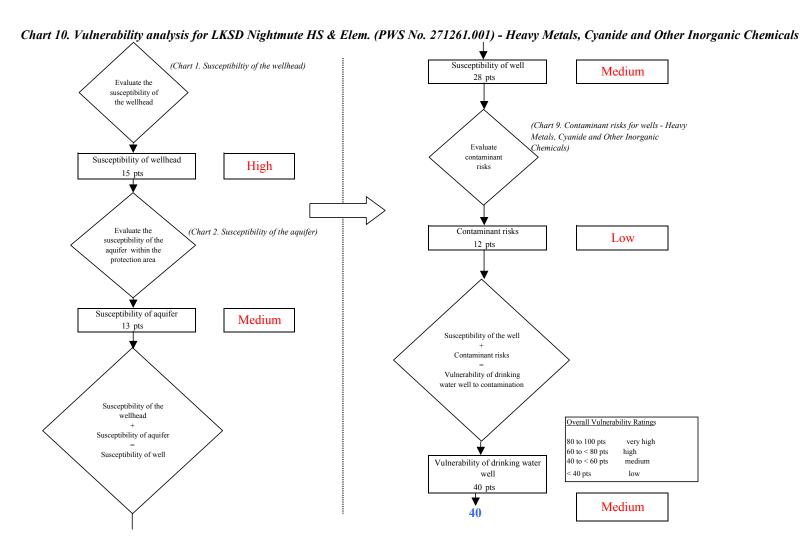


Chart 9. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals Existing Are there conditions 0 pts Risk unchanged upgrading risk? Risk due to existing Potential contamination 12 pts The number and magnitude of Risk posed by potential sources contaminant sources in of contamination with controls Contaminant Risk Zone D determines a YES 12 pts risk increase. See Table Contaminant risks 5 for inventory. 2 pts Increase risk 1 - 10 pts Risk posed by potential sources of contamination 12 pts Contaminant risks\* \*Truncate risk at 50 pts 12 Contaminant Risk Ratings Are there sufficient Low NQ controls, conditions, Risk unchanged 40 to 50 pts very high or monitoring to 30 to < 40 pts warrant downgrading high risk? 20 to < 30 pts medium < 20 pts low YES 0 pts Decrease risk 1 - 10 pts Risk posed by potential sources of contamination with controls 12 pts



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Chart 11. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Synthetic Organic Chemicals Contaminant risks initially assumed to be low. Current level of Evaluate the level of Contaminant risks background contamination due to man-= 0 ptscontamination from made source(s) natural sources 0 pts NO or Is the concentration of Have synthetic organic UNKNOWN the contaminant chemicals been detected increasing, decreasing, in the source waters in or staying the same? recent sampling period(s)? Recent SOC Sampling Results (mg/L) No recent SOC sampling data was available in ADEC records for this PWSID Increasing: risk up 1 - 10 pts YES Decreasing: risk down 1 - 5 pts + 0 pts Same: risk unchanged Existing contamination points based on linear interpolation of most recent detect [MCL = 50 pts; detect = 0 pts]Risk due to natural Risk due to existing mansources made sources 0 pts 0 pts Risk due to existing contamination 0 pts Was the source of Evaluate the level of NO. contamination contamination from man-made sources YES

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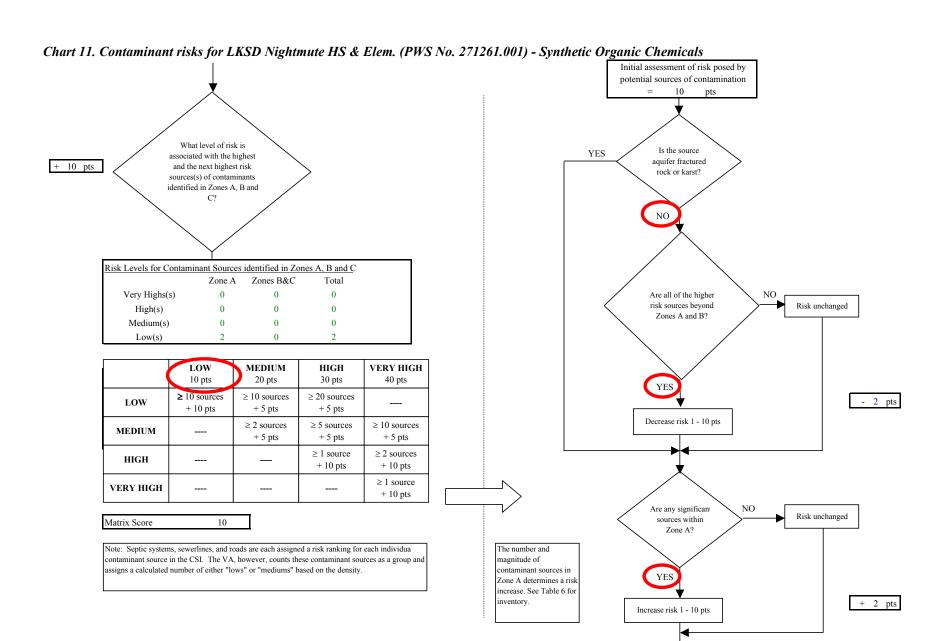


Chart 11. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Synthetic Organic Chemicals Existing NO Are there conditions 0 pts Risk unchanged that warrant upgrading risk? Risk due to existing Potential contamination 15 pts The number and magnitude of Risk posed by potential sources contaminant sources in of contamination with controls Contaminant Risk Zone D determines a risk YES 15 pts increase. See Table 6 for Contaminant risks inventory. 5 pts Increase risk 1 - 10 pts Risk posed by potential sources of contamination 15 pts \*Truncate risk at 50 pts Contaminant risks\* 15 Contaminant Risk Ratings Are there sufficient Low controls, conditions, NO. Risk unchanged or monitoring to 40 to 50 pts very high warrant downgrading 30 to < 40 pts high 20 to < 30 pts risk? medium < 20 pts low YES 0 pts Decrease risk 1 - 10 pts Risk posed by potential sources of contamination with controls

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Chart 12. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Synthetic Organic Chemicals (Chart 1. Susceptibiltiy of the wellhead) Susceptibility of well Medium 28 pts Evaluate the susceptibility of the wellhead (Chart 11. Contaminant risks for wells -Evaluate Synthetic Organic Chemicals) contaminant Susceptibility of wellhead High risks 15 pts Evaluate the (Chart 2. Susceptibility of the aquifer) Contaminant risks Low susceptibility of the 15 pts aquifer within the protection area Susceptibility of aquifer Medium 13 pts Susceptibility of the well Contaminant risks Vulnerability of drinking water well to contamination Susceptibility of the wellhead Overall Vulnerability Ratings Susceptibility of aquifer 80 to 100 pts very high 60 to < 80 pts high Susceptibility of well 40 to < 60 pts Vulnerability of drinking water medium < 40 pts low 43 pts Medium 45

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Chart 13. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Other Organic Chemicals Contaminant risks initially assumed to be low. Current level of Evaluate the level of Contaminant risks background contamination due to man-= 0 ptscontamination from made source(s) natural sources NO or Is the concentration of Have other organic UNKNOWN the contaminant chemicals been detected increasing, decreasing, in the source waters in or staying the same? recent sampling period(s)? Recent OOC Sampling Results (mg/L) No recent OOC sampling data was available in ADEC records for this PWSID Increasing: risk up 1 - 10 pts YES Decreasing: risk down 1 - 5 pts + 0 pts Same: risk unchanged Existing contamination points based on linear interpolation of most recent detect [MCL = 50 pts; detect = 0 pts]Risk due to natural Risk due to existing mansources made sources 0 pts 0 pts Risk due to existing contamination 0 pts Was the source of Evaluate the level of NO. contamination contamination from natural? man-made sources YES

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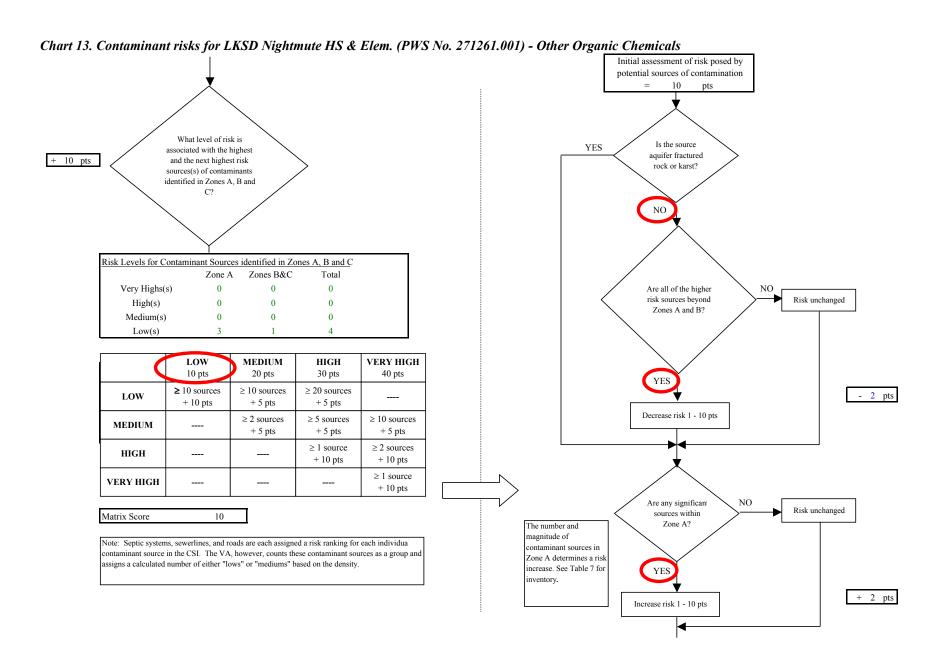


Chart 13. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Other Organic Chemicals Existing NO Are there conditions 0 pts Risk unchanged that warrant upgrading risk? Risk due to existing Potential contamination 18 pts The number and magnitude of Risk posed by potential sources contaminant sources in of contamination with controls Contaminant Risk Zone D determines a risk YES 18 pts increase. See Table 7 for Contaminant risks inventory. 8 pts Increase risk 1 - 10 pts Risk posed by potential sources of contamination 18 pts \*Truncate risk at 50 pts Contaminant risks\* 18 Contaminant Risk Ratings Are there sufficient Low controls, conditions, NO. Risk unchanged or monitoring to 40 to 50 pts very high warrant downgrading 30 to < 40 pts high 20 to < 30 pts risk? medium < 20 pts low YES 0 pts Decrease risk 1 - 10 pts Risk posed by potential sources of contamination with controls

