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# 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

PWSID # 271261.001

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

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## 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 aquifer 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	¼ the distance for the 2-yr. time -of-travel
B	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
Susceptibility of the Wellhead	15	High
Susceptibility of the Aquifer	13	Medium
Natural Susceptibility	28	Medium

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

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

**Table 3. Contaminant Risks**

Category	Score	Rating
Bacteria and Viruses	25	Medium
Nitrates and/or Nitrites	30	High
Volatile Organic Chemicals	41	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	12	Low
Synthetic Organic Chemicals	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:

$$\begin{array}{r}
 \text{Natural Susceptibility (0 – 50 points)} \\
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the} \\
 \text{Drinking Water Source to Contamination (0 – 100).}
 \end{array}$$

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                      45                      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).

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 Table 6 - 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.



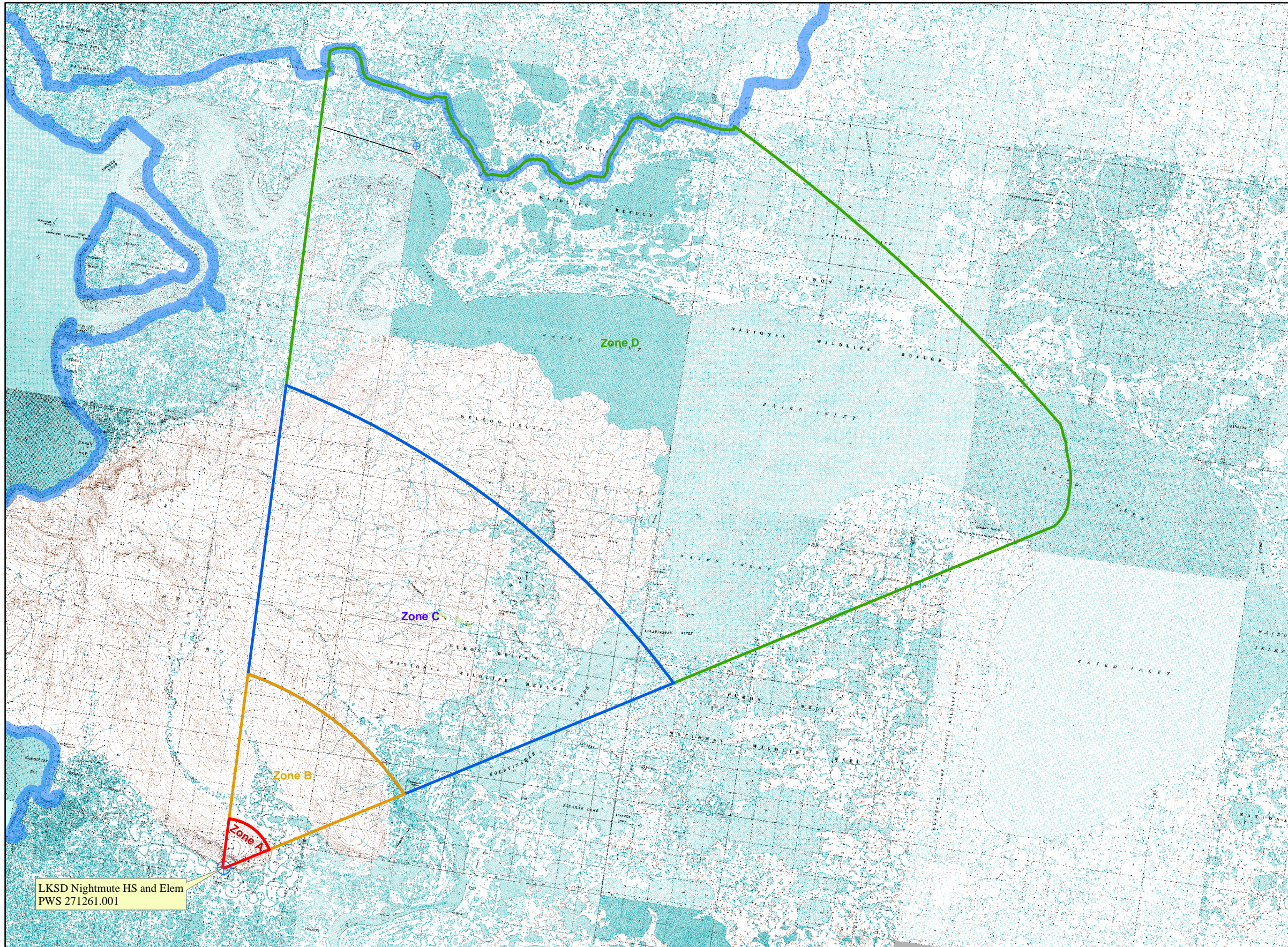
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# **APPENDIX A**

## **Drinking Water Protection Area Location Map (Map A)**

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



**LEGEND**

- Public Water System Well
- Hydrography/Physical**
  - Parcels
  - Stream
  - Lake or Pond
  - Contours
  - Watershed Boundary
- Transportation**
  - Primary Route (Class 1)
  - Secondary Route (Class 2)
  - Road (Class 3)
  - Road (Class 4)
  - Road (Class 5, Four-wheel drive)
- Groundwater Protection Zones**
  - Zone A Protection Area- Several Months Travel Time
  - Zone B Protection Area- 2 Years Travel Time
  - Zone C Protection Area- 5 Years Travel Time
  - Zone D Protection Area- 10 Years Travel Time

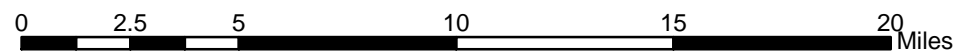
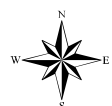
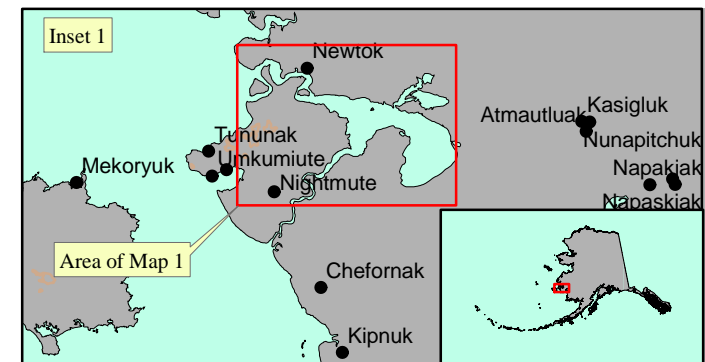
Data Sources:  
Contaminant Sources, Public Water System Wells, Contours  
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:  
United States Geological Survey (USGS)

Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



LKSD Nightmute HS and Elem  
PWS 271261.001

## **APPENDIX B**

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

**Table 1****Contaminant Source Inventory for  
LKSD Nightmute HS & Elem****PWSID 271261.001**

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

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

*PWSID 271261.001*

*Table 2*

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

Table 3

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

PWSID 271261.001

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

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

*PWSID 271261.001*

*Table 4*

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



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

*PWSID 271261.001*

*Table 5*

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

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

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

*PWSID 271261.001*

**Table 6**

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

*PWSID 271261.001*

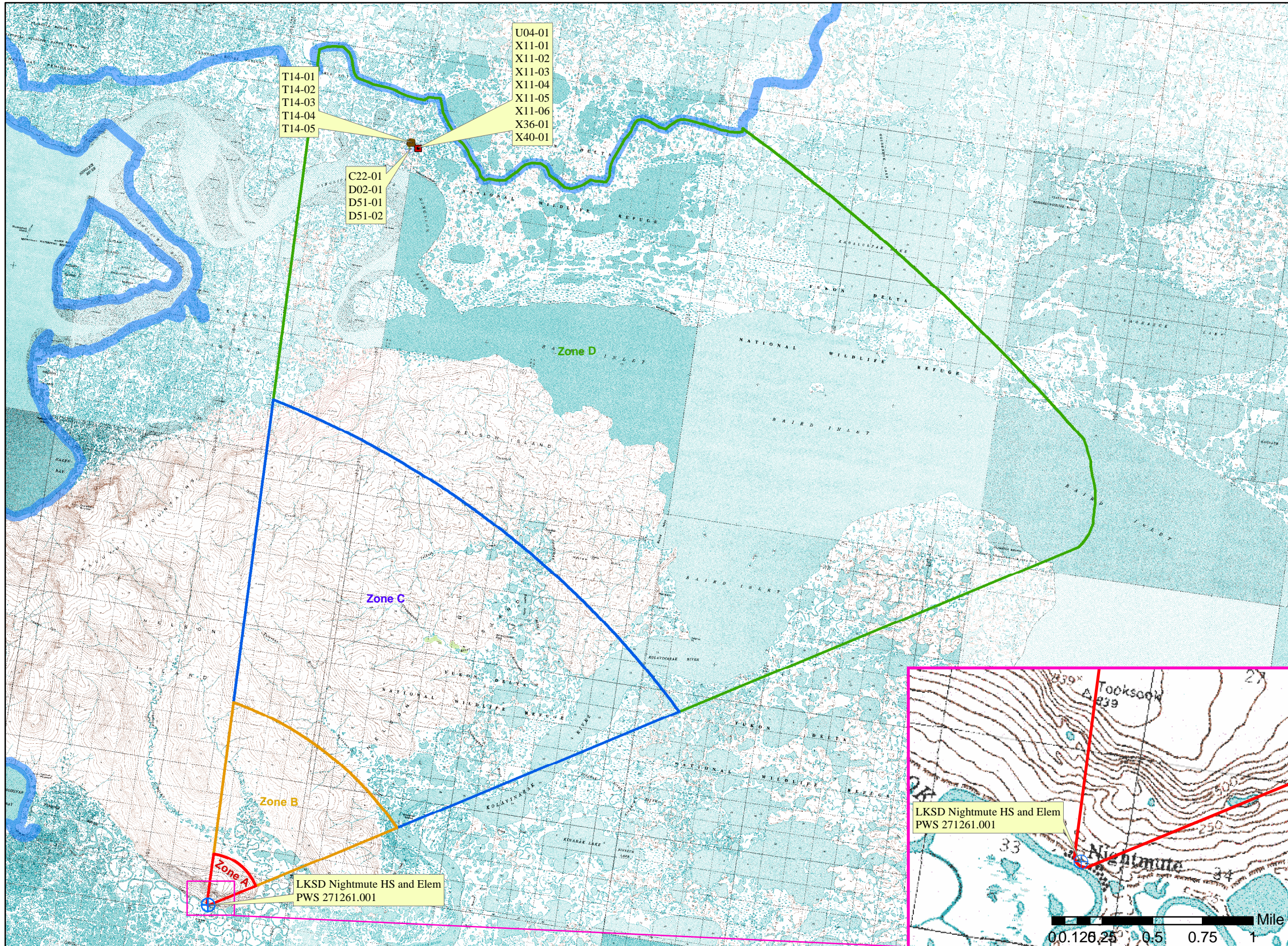
*Table 7*

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

## **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**



**LEGEND**

- Public Water System Well

**Hydrography/Physical**

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

**Transportation**

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

**Groundwater Protection Zones**

- Zone A Protection Area- Several Months Travel Time
- Zone B Protection Area- 2 Years Travel Time
- Zone C Protection Area- 5 Years Travel Time
- Zone D Protection Area- 10 Years Travel Time

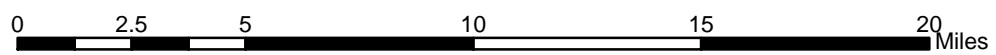
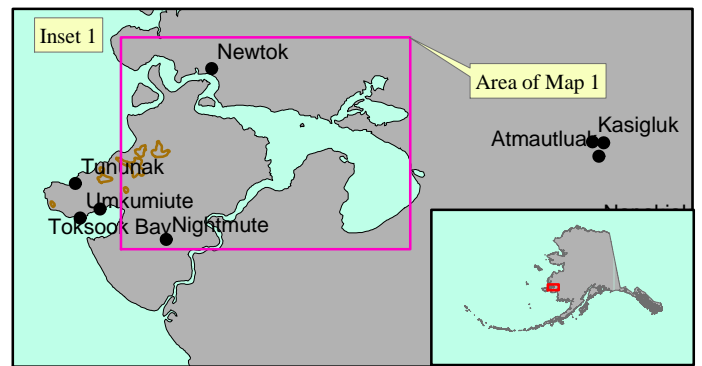
**Existing or Potential Contaminant Sources**

- Washeteria (C22)
- Domestic wastewater treatment plant disposal pond (D02)
- Nonresidential aboveground heating oil tanks (T14)
- Contaminated sites, DEC recognised, non-Superfund, non-RCRA (U04)
- Petroleum product bulk station/terminal (X11)
- Electric power generation (X36)
- Medical/veterinary facility (X40)
- Landfill (municipal; Class III) (D51)

Data Sources: Contaminant Sources, Public Water System Wells, Contours Alaska Department of Environmental Conservation (ADEC)  
Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data: United States Geological Survey (USGS)  
Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

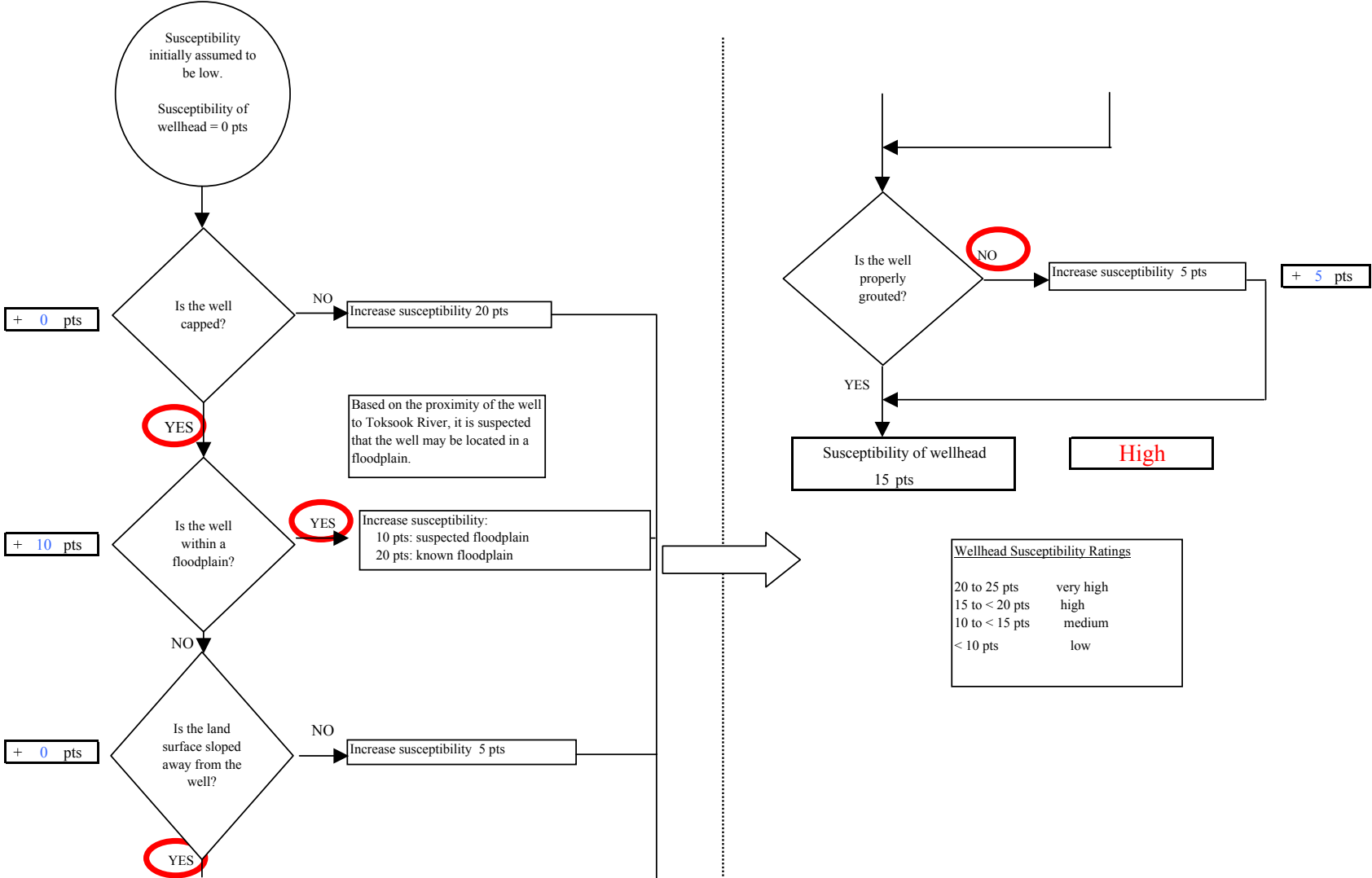
URS Corporation does not guarantee the accuracy or validity of the data provided.



## **APPENDIX D**

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

**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)**

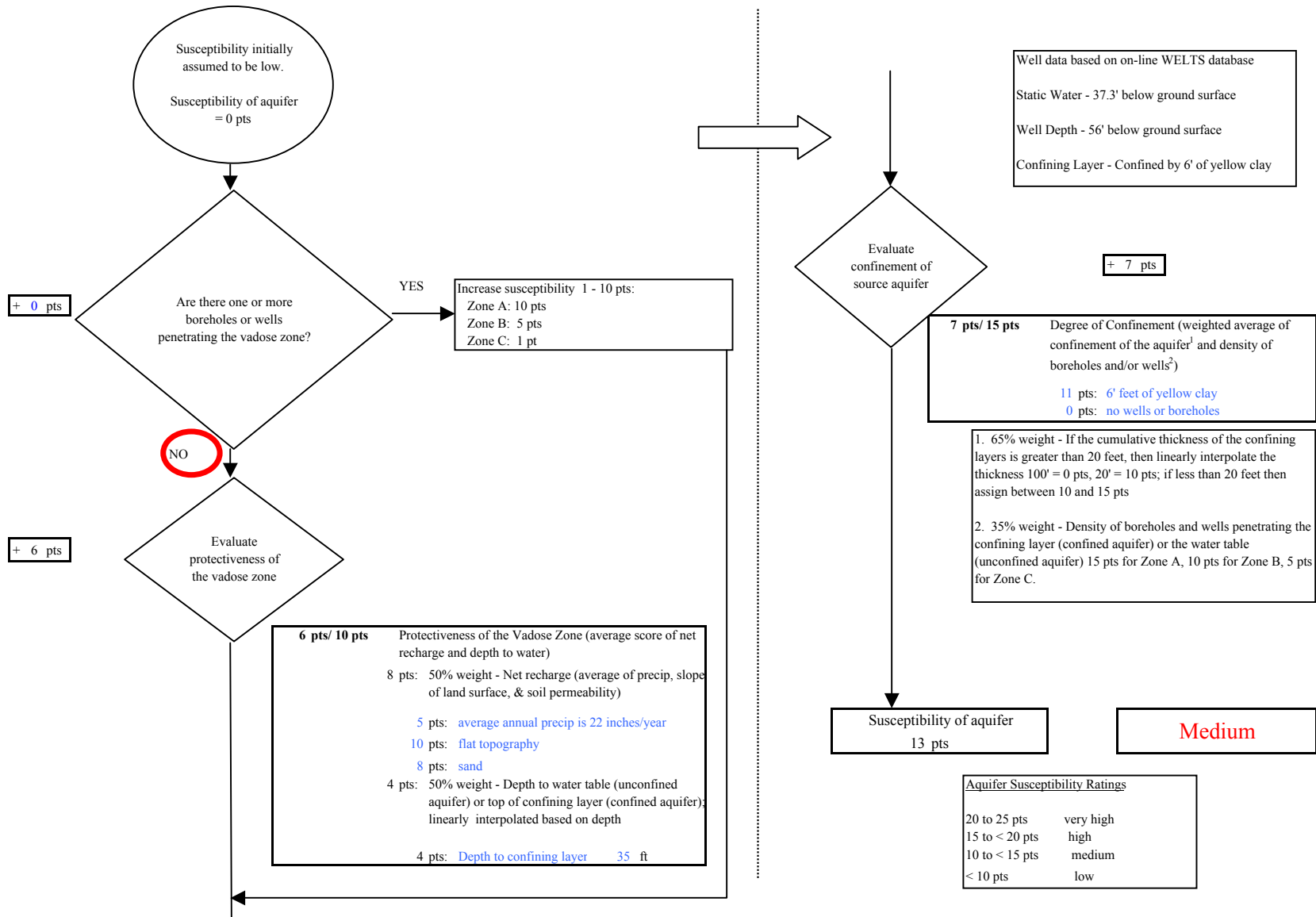




Chart 3. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Bacteria & Viruses

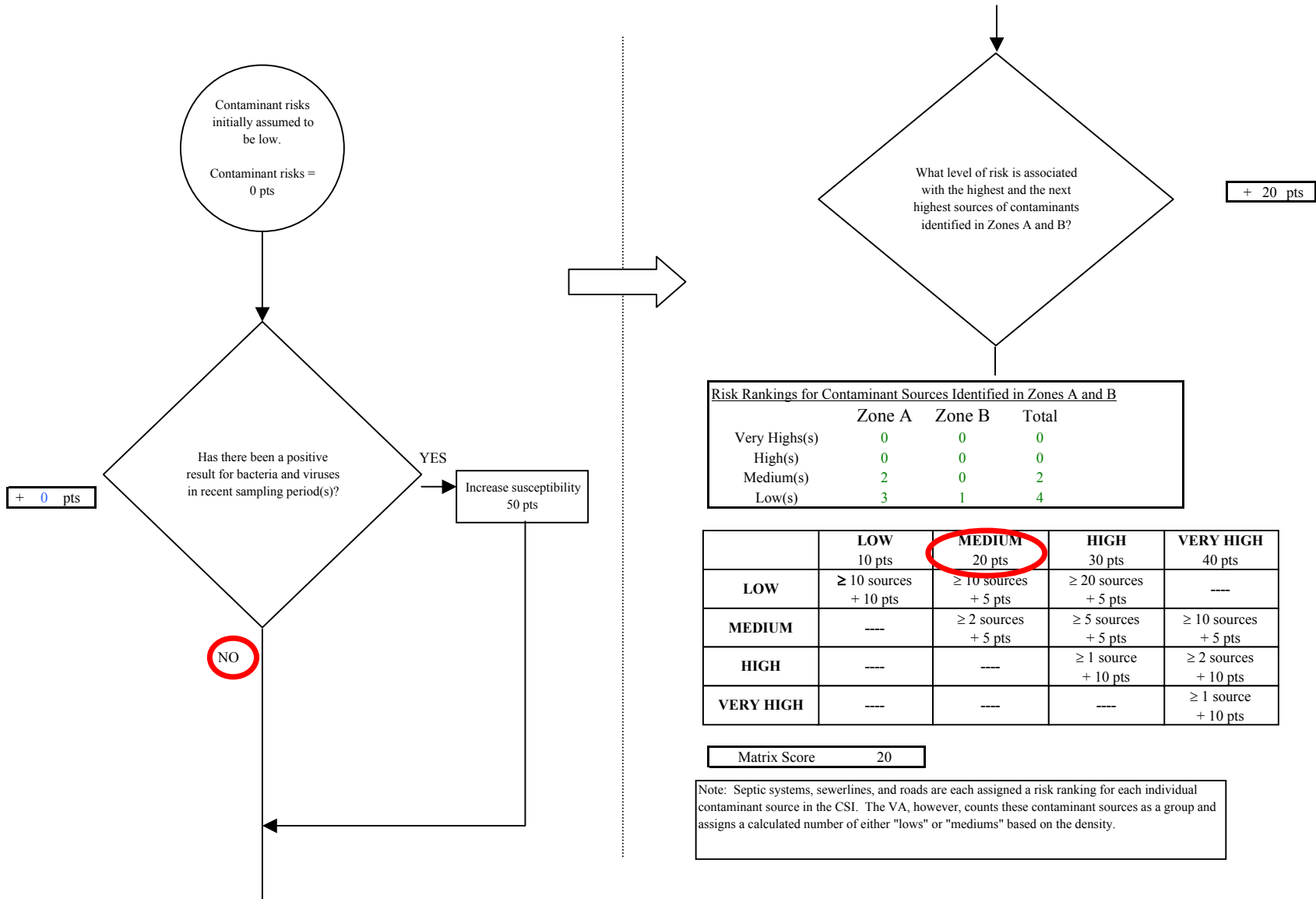
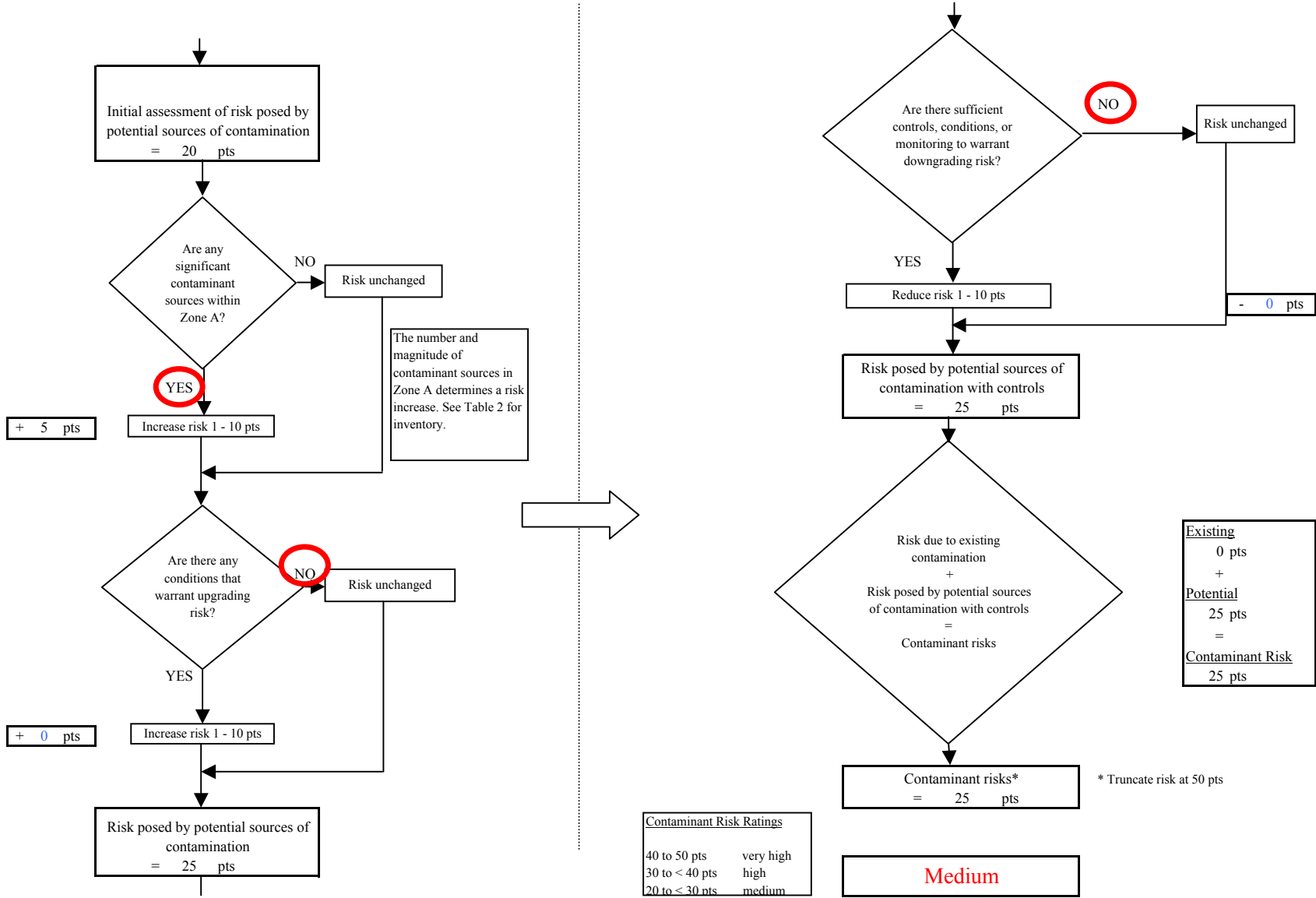


Chart 3. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Bacteria & Viruses



**Chart 4. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Bacteria & Viruses**

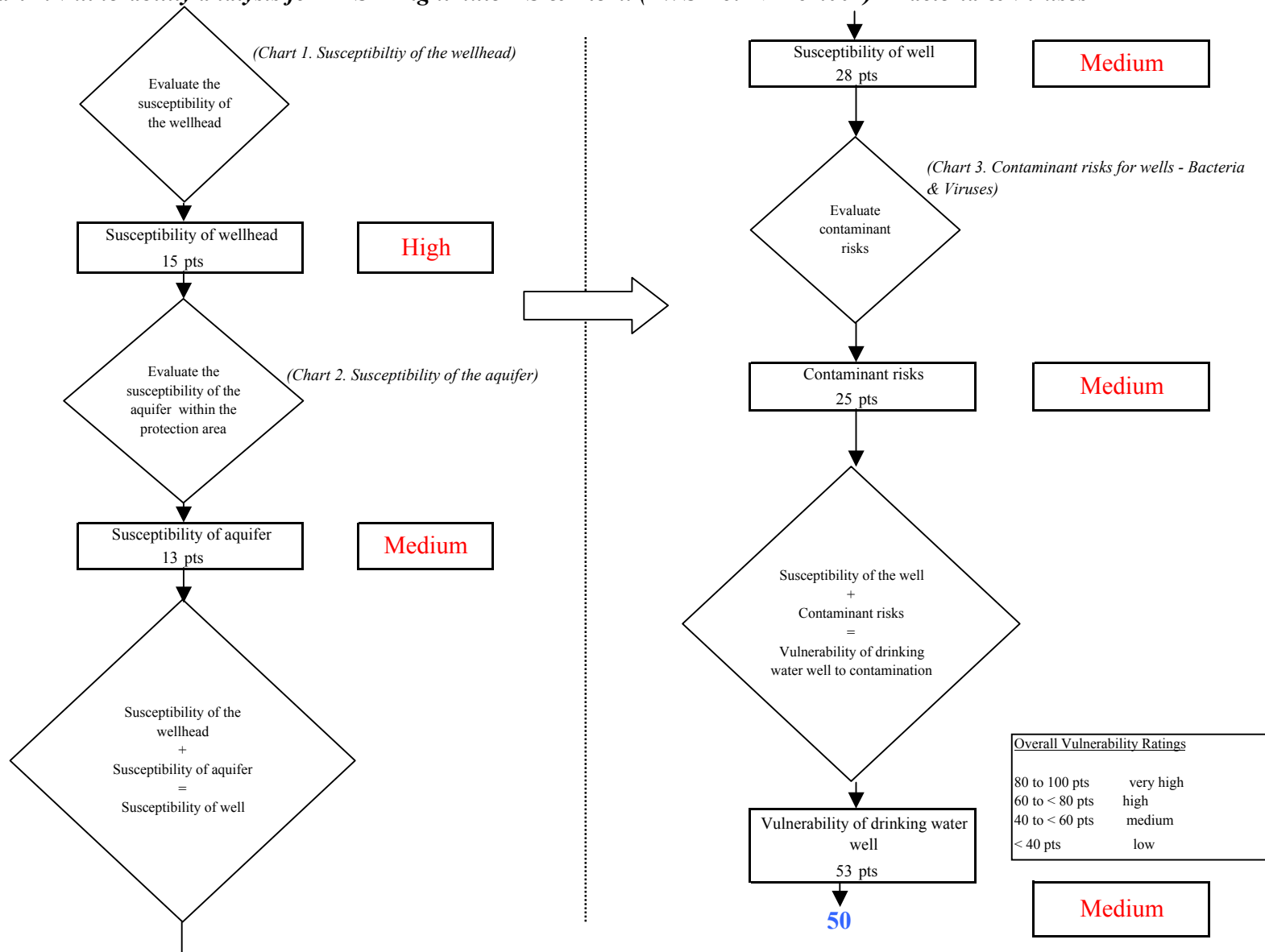


Chart 5. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Nitrates and Nitrites

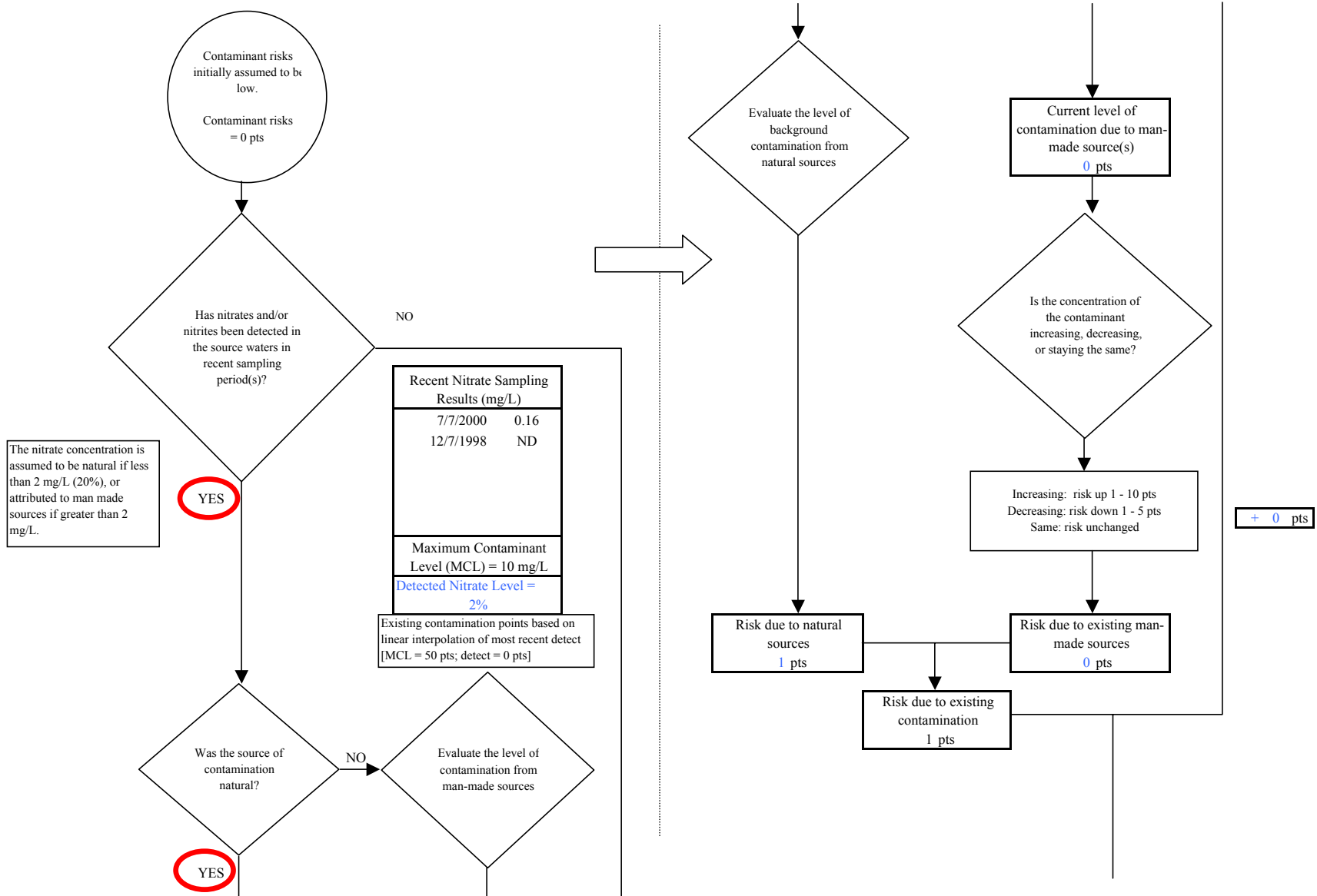
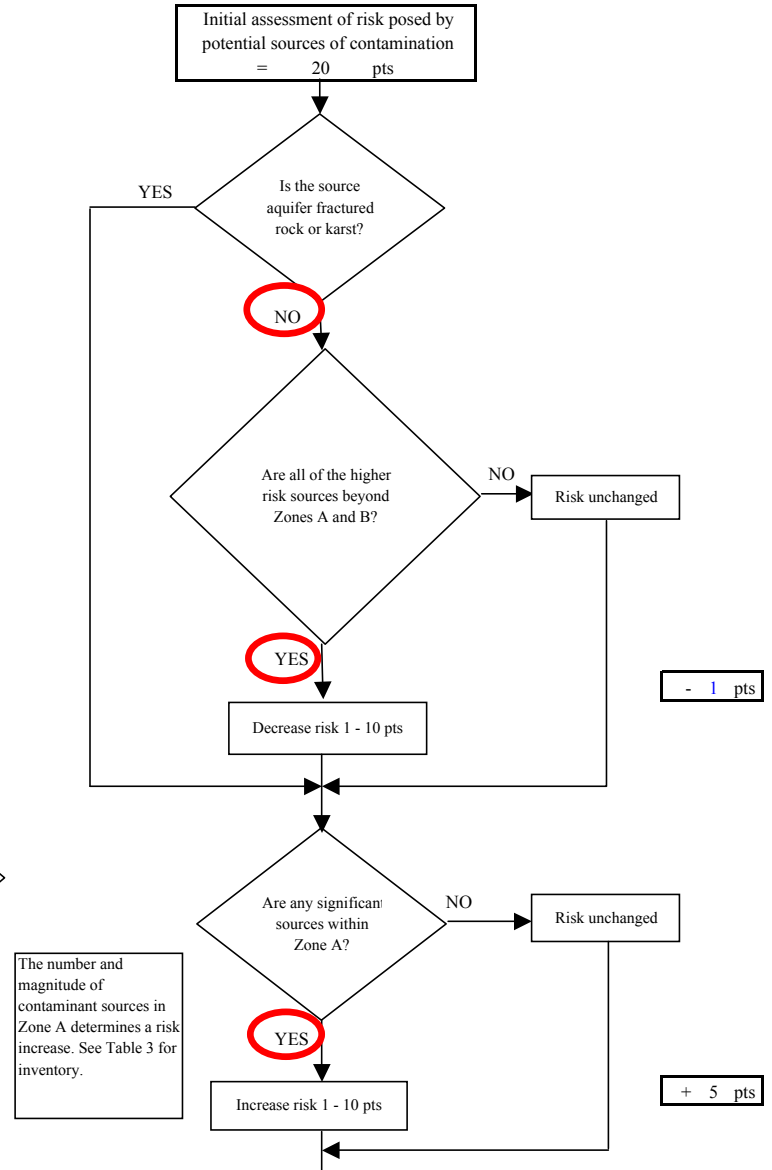
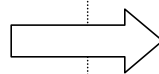
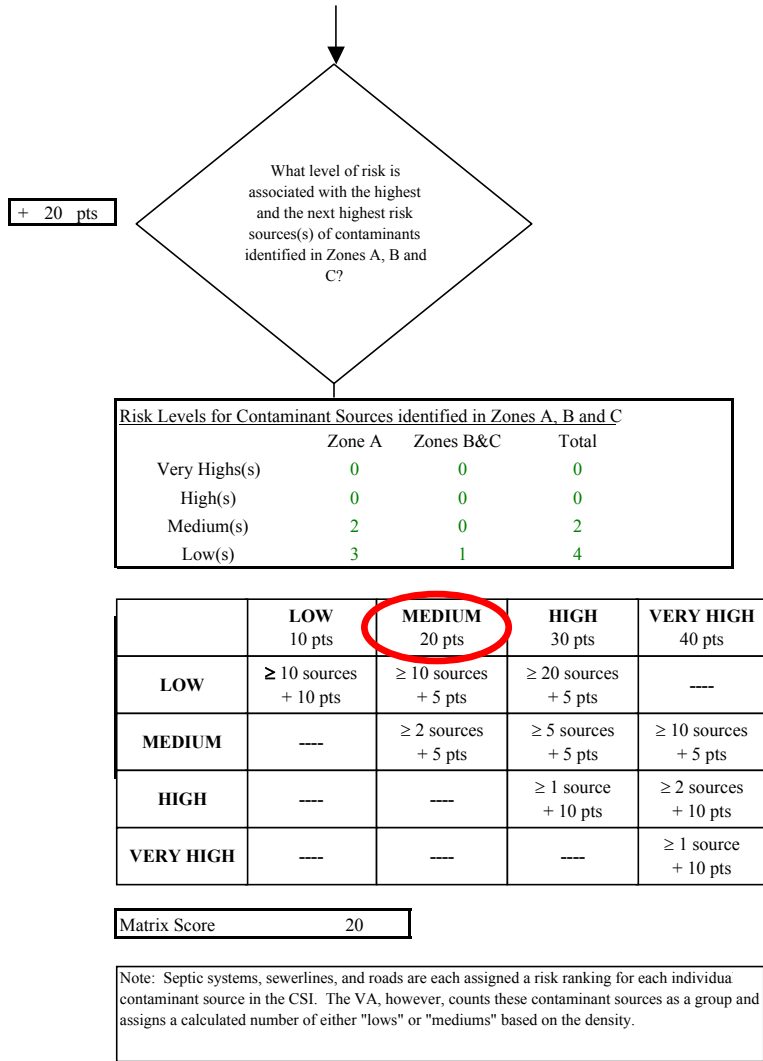
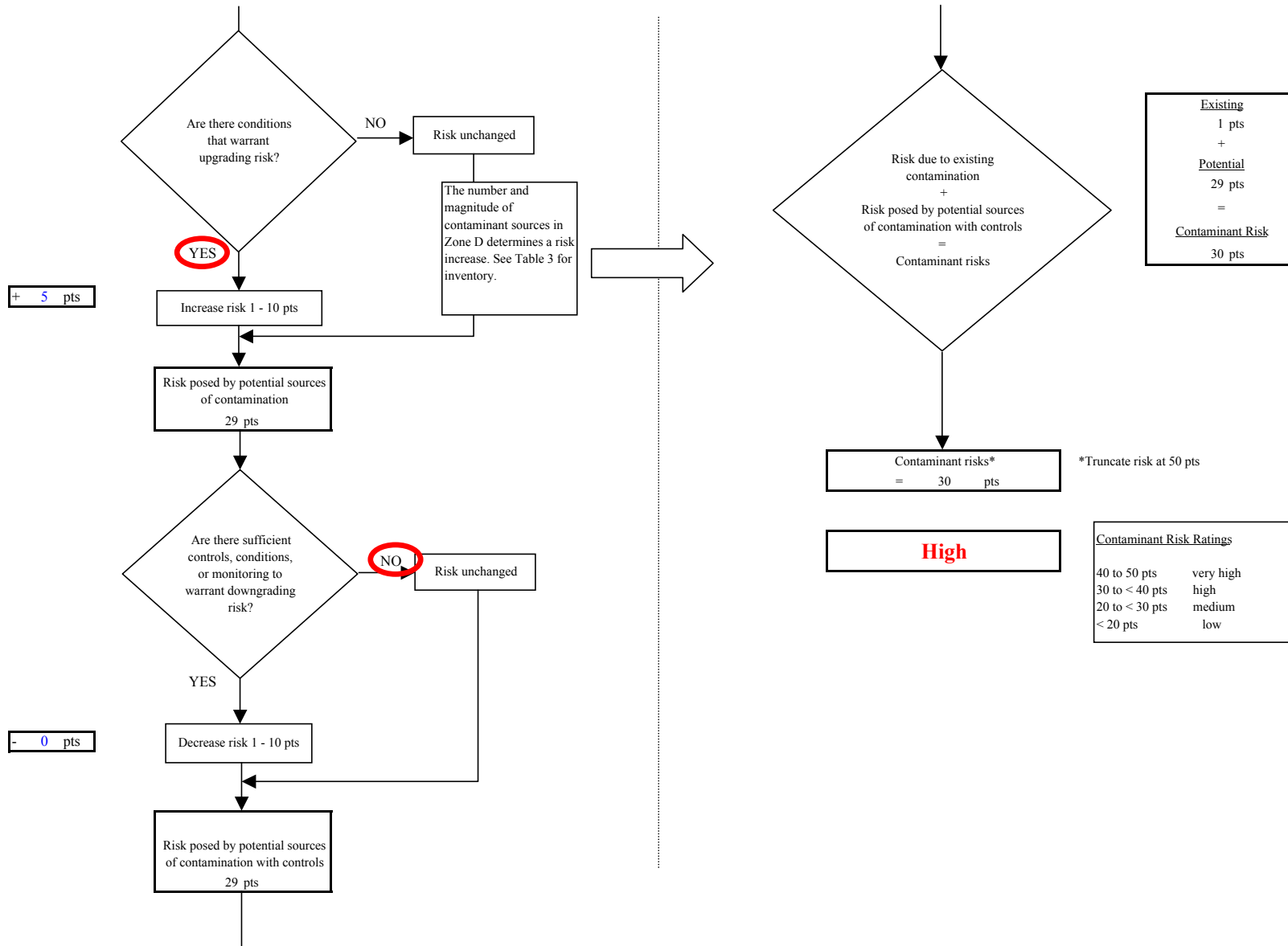


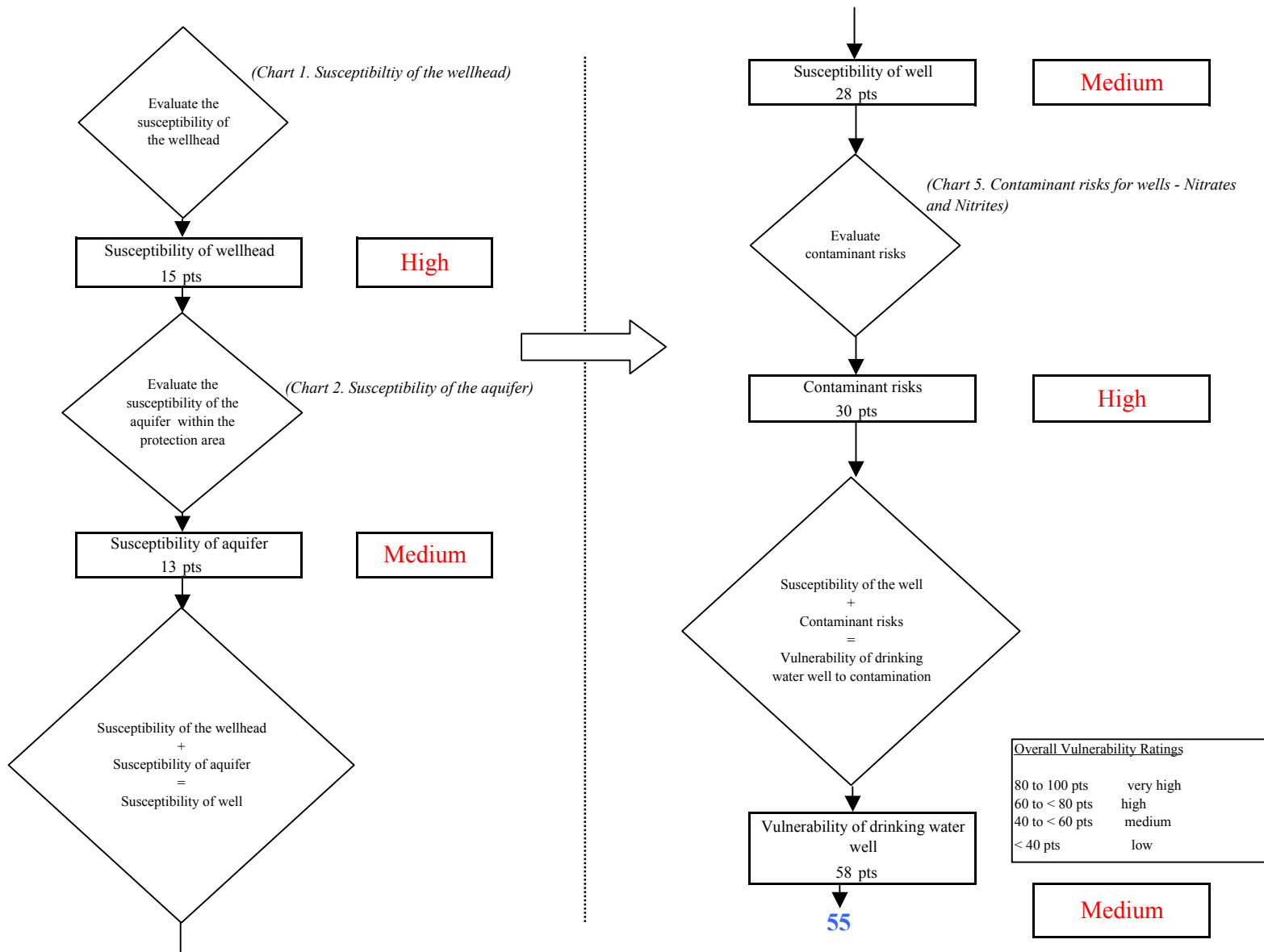
Chart 5. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Nitrates and Nitrites



**Chart 5. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Nitrates and Nitrites**



**Chart 6. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Nitrates and Nitrites**



**Chart 7. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Volatile Organic Chemicals**

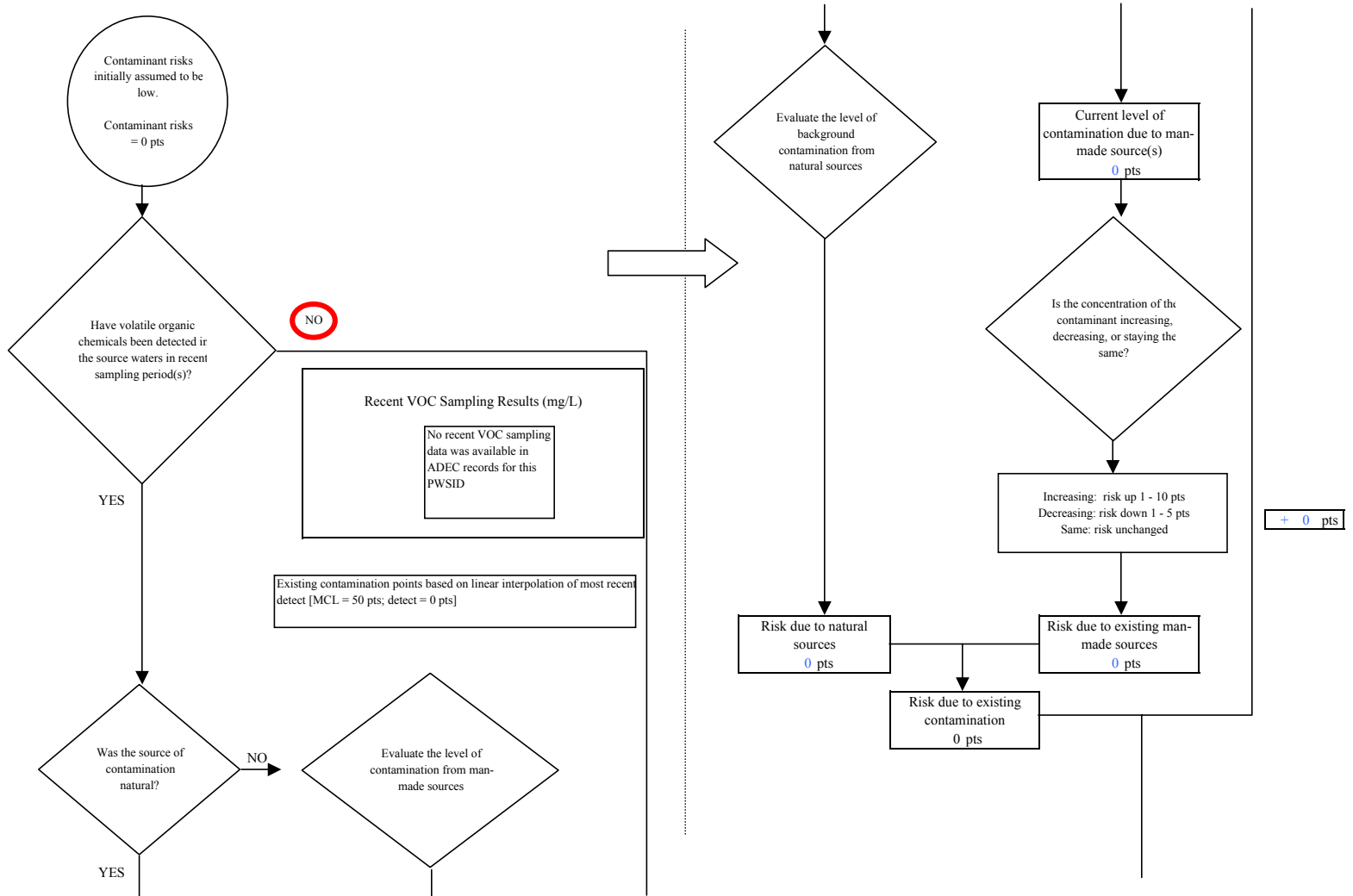
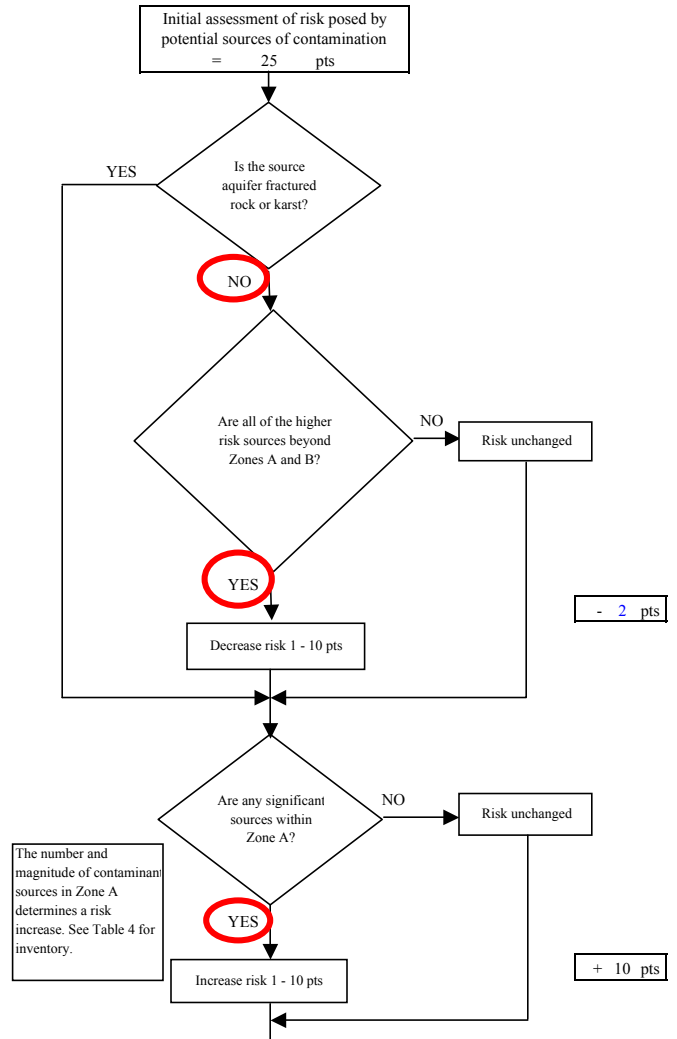
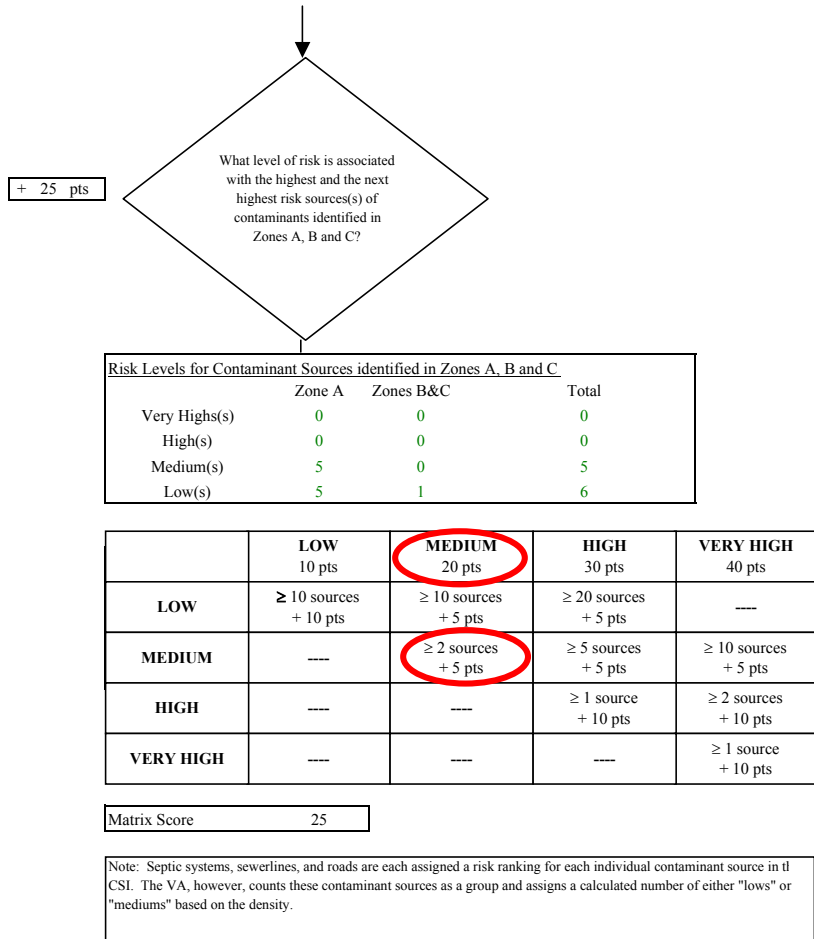
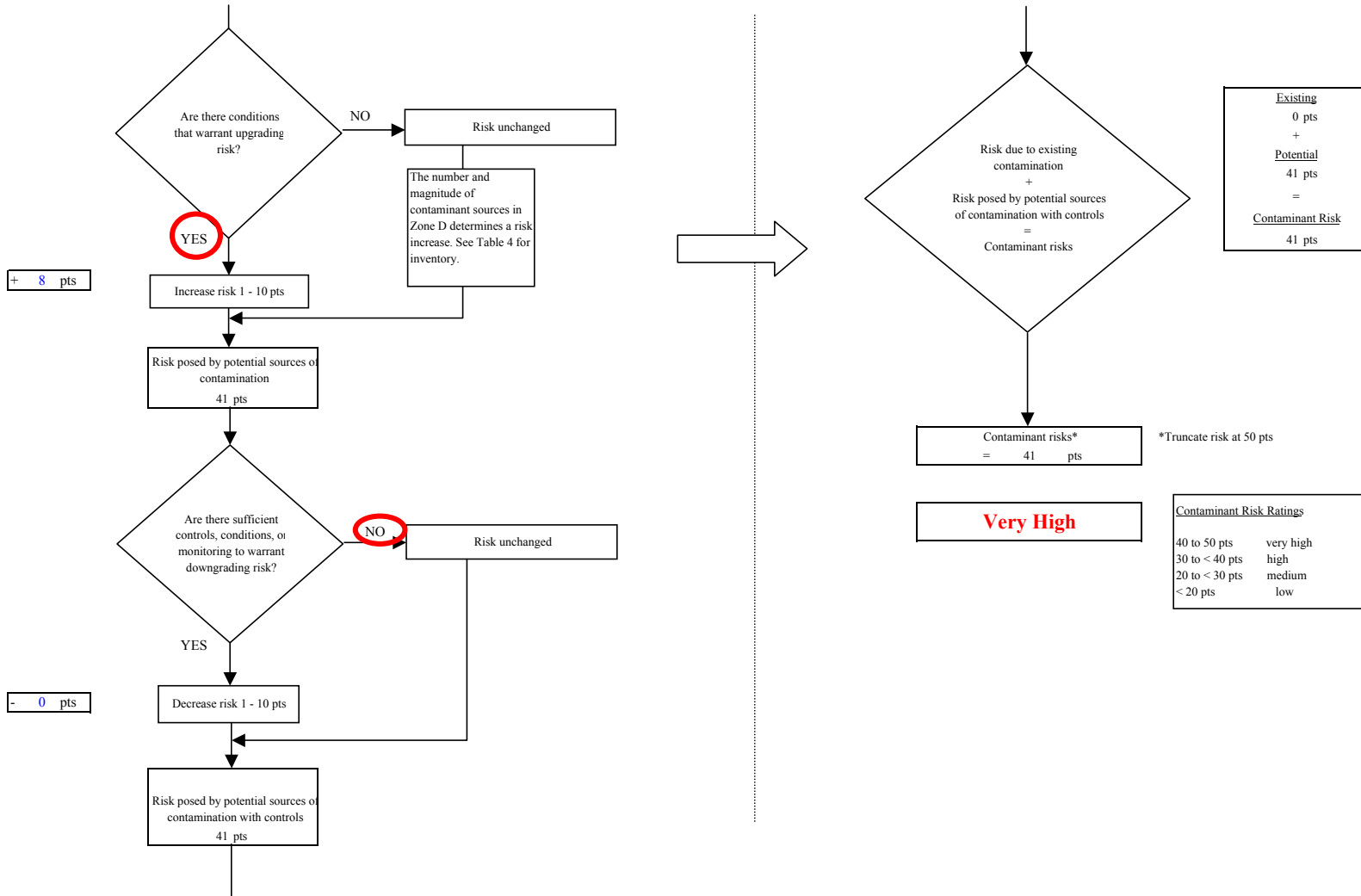




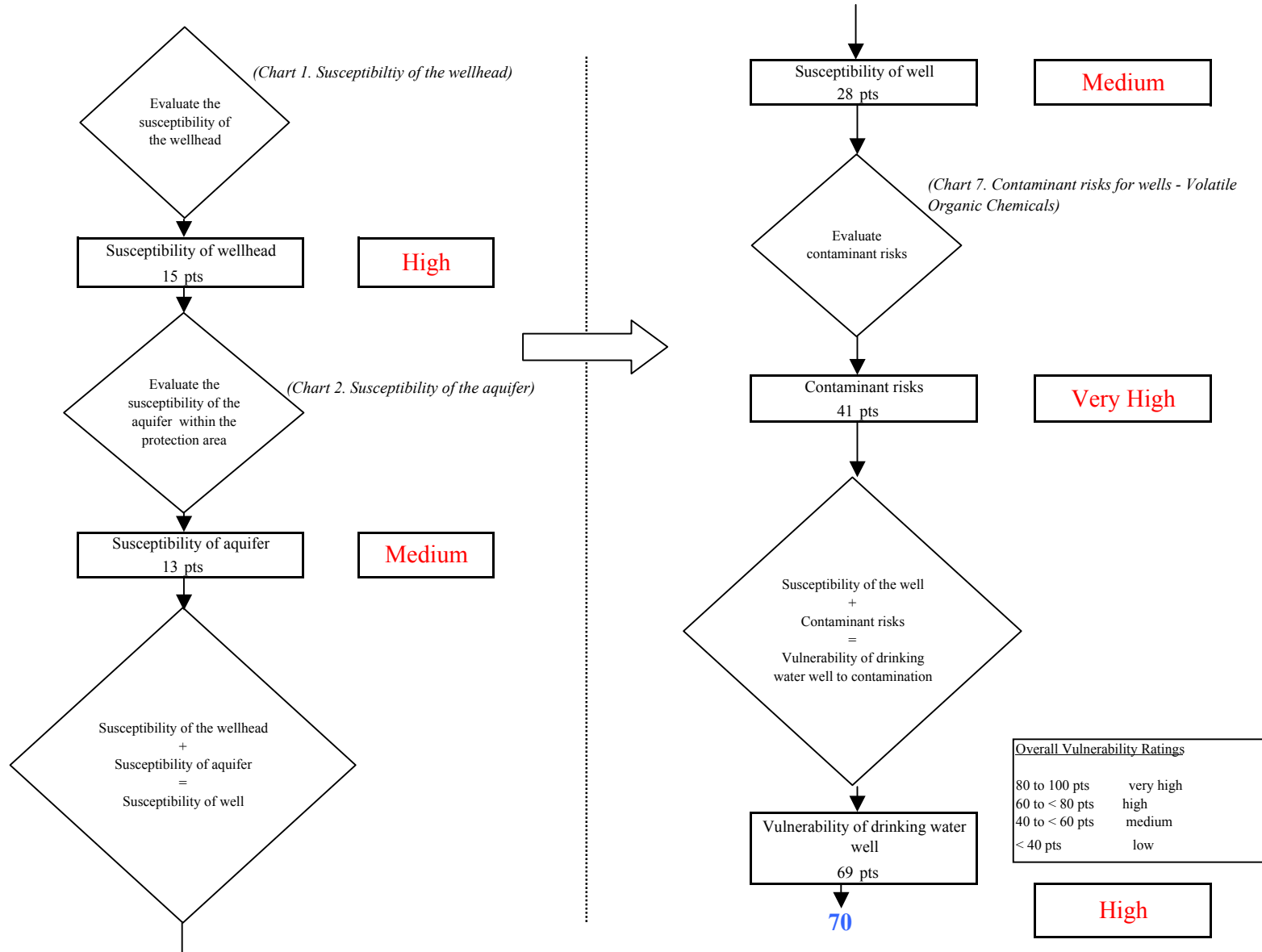
Chart 7. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Volatile Organic Chemicals



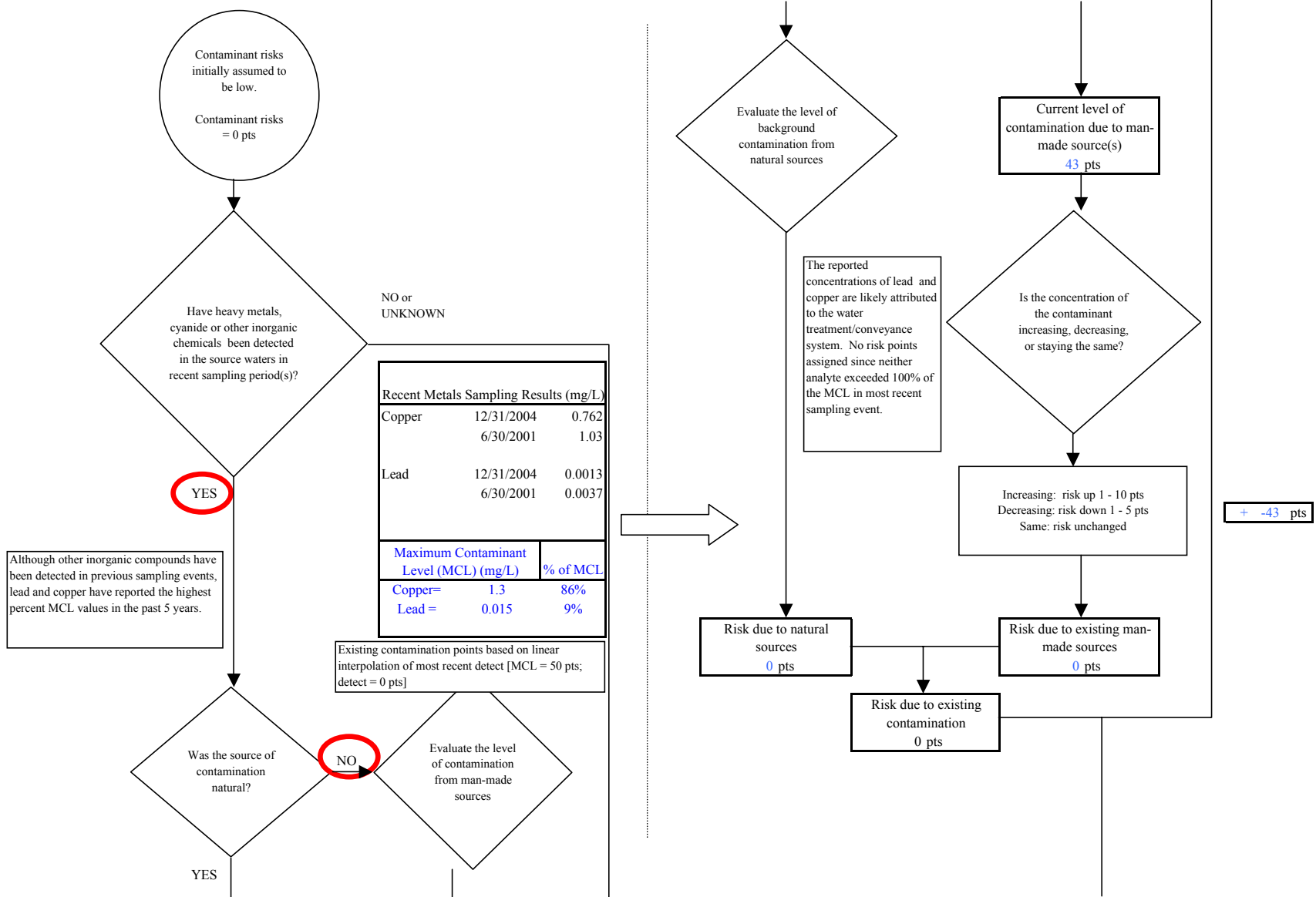
**Chart 7. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Volatile Organic Chemicals**



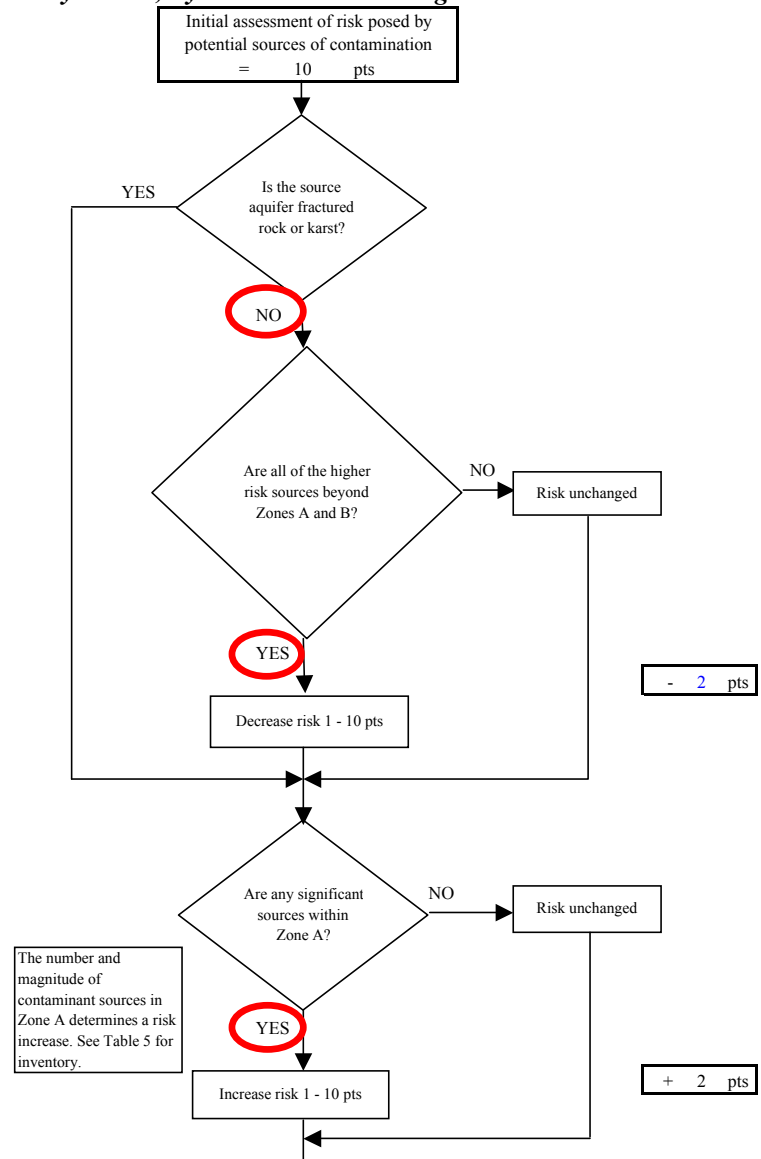
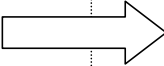
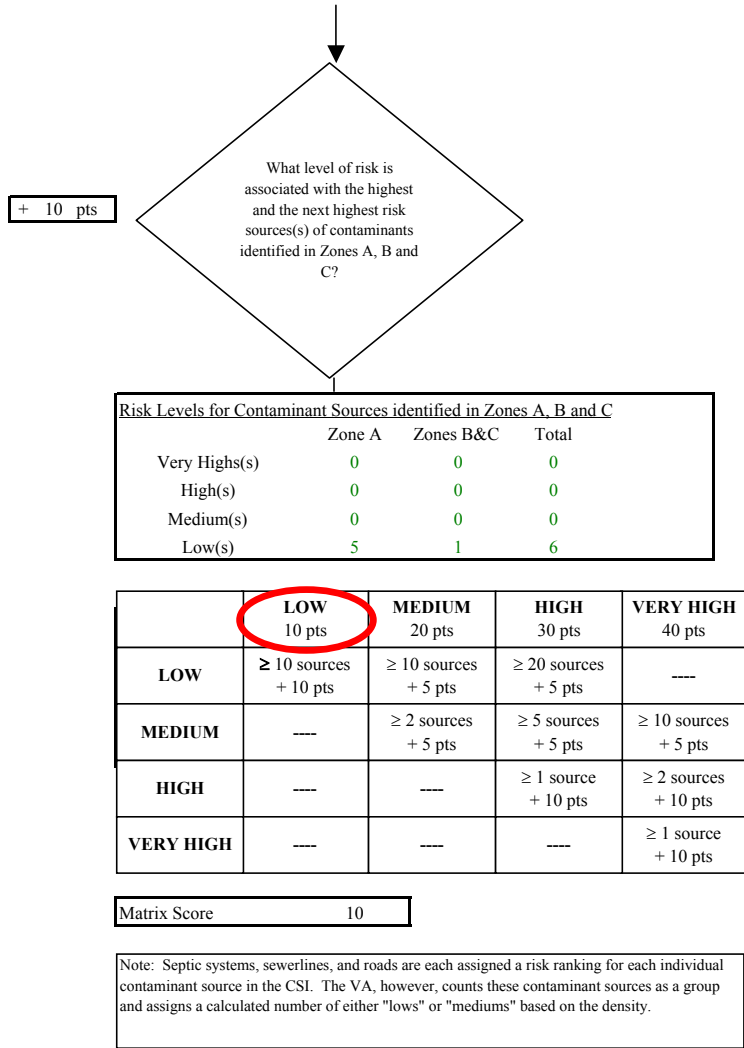
**Chart 8. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Volatile Organic Chemicals**



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

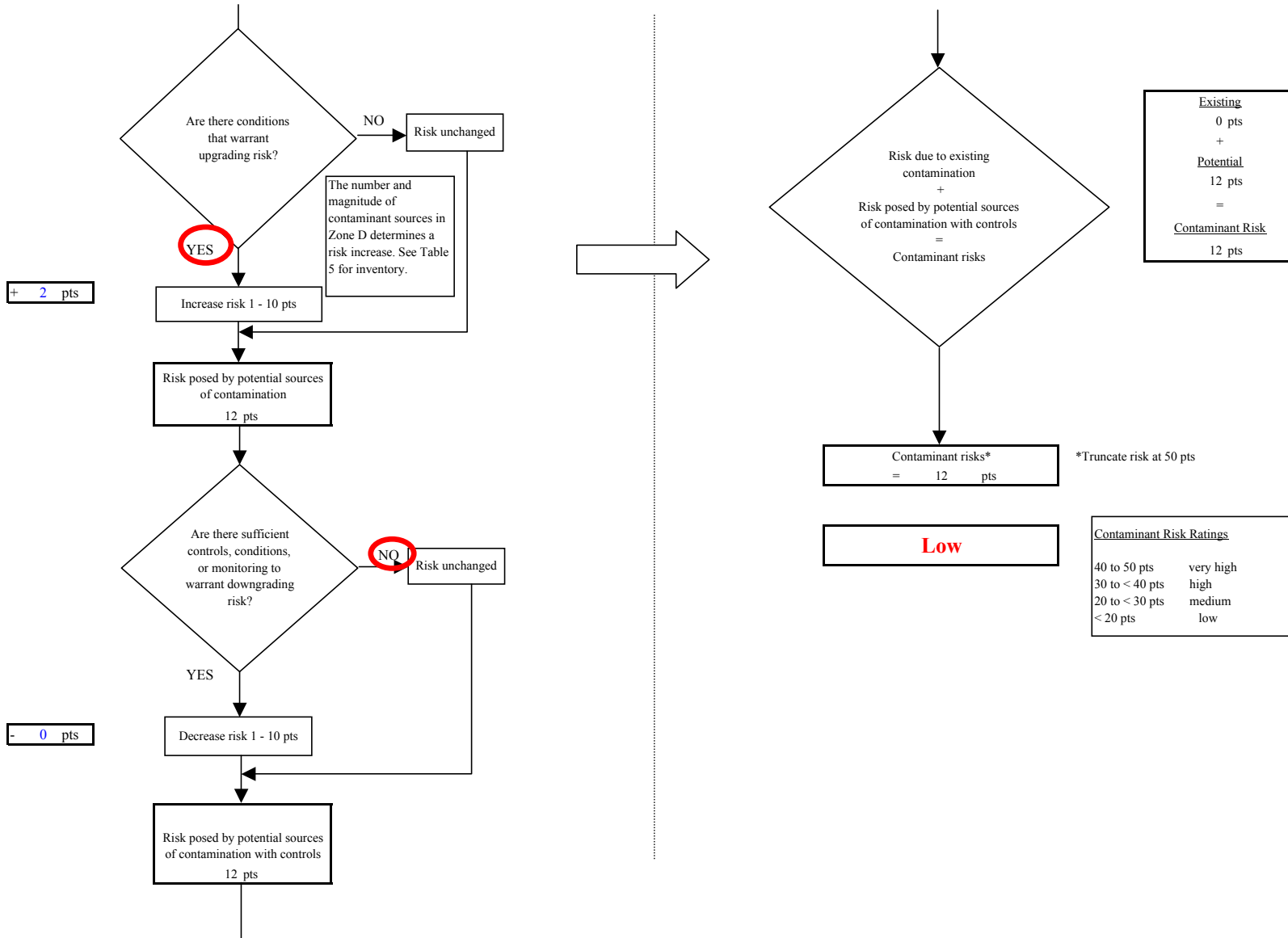


**Chart 9. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**



The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 5 for inventory.

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



**Chart 10. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**

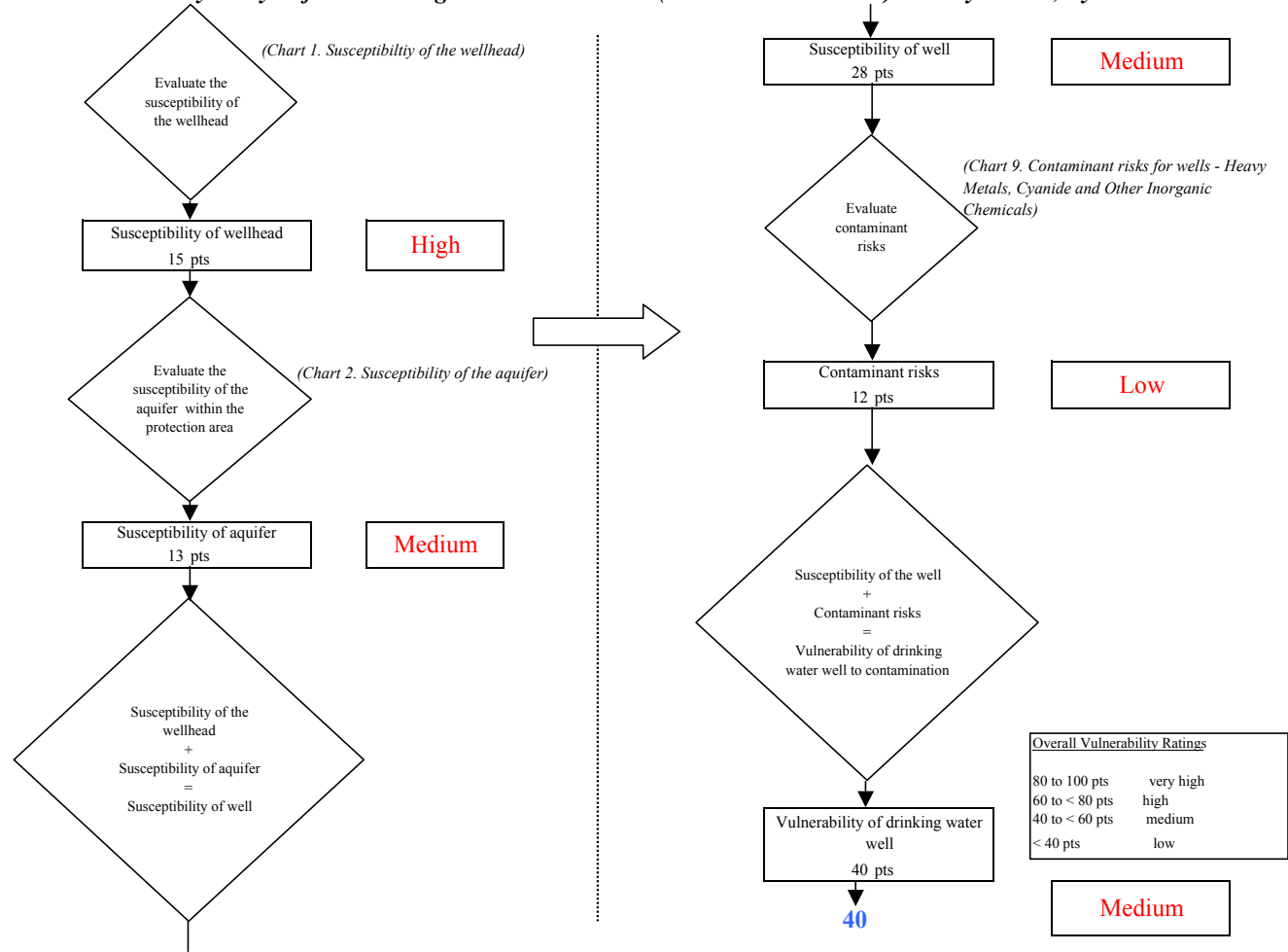


Chart 11. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Synthetic Organic Chemicals

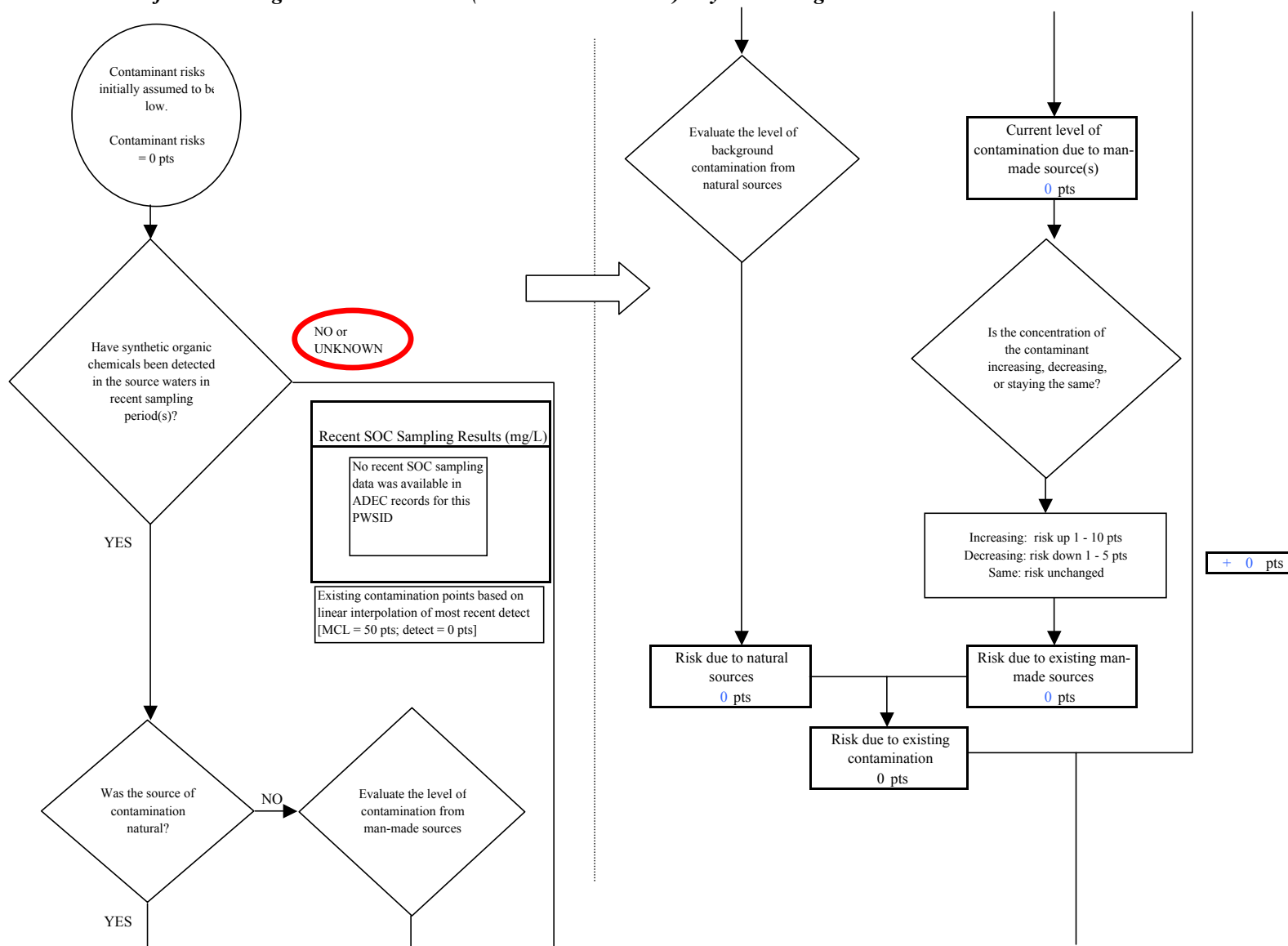
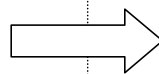
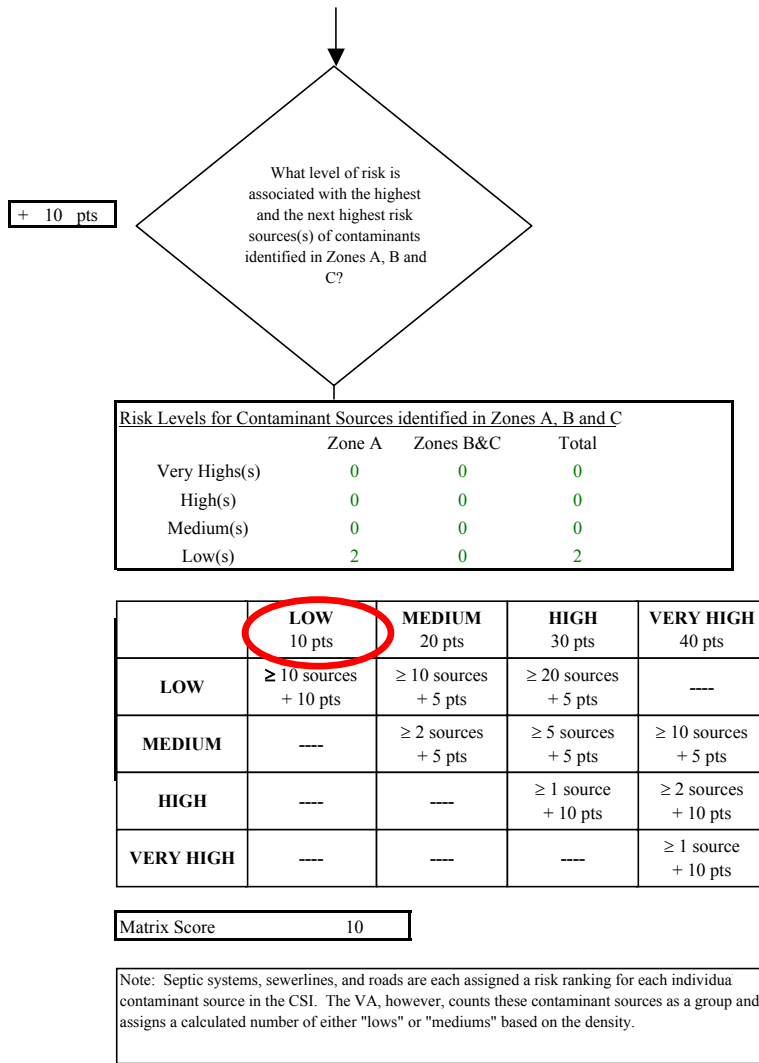
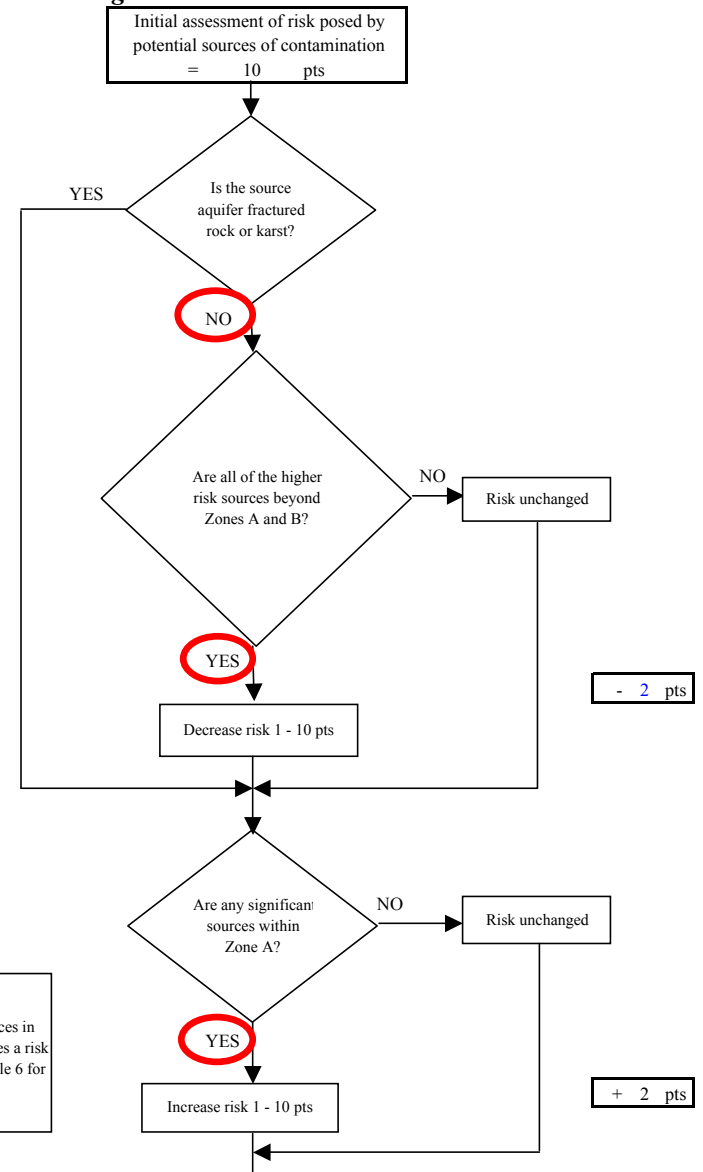




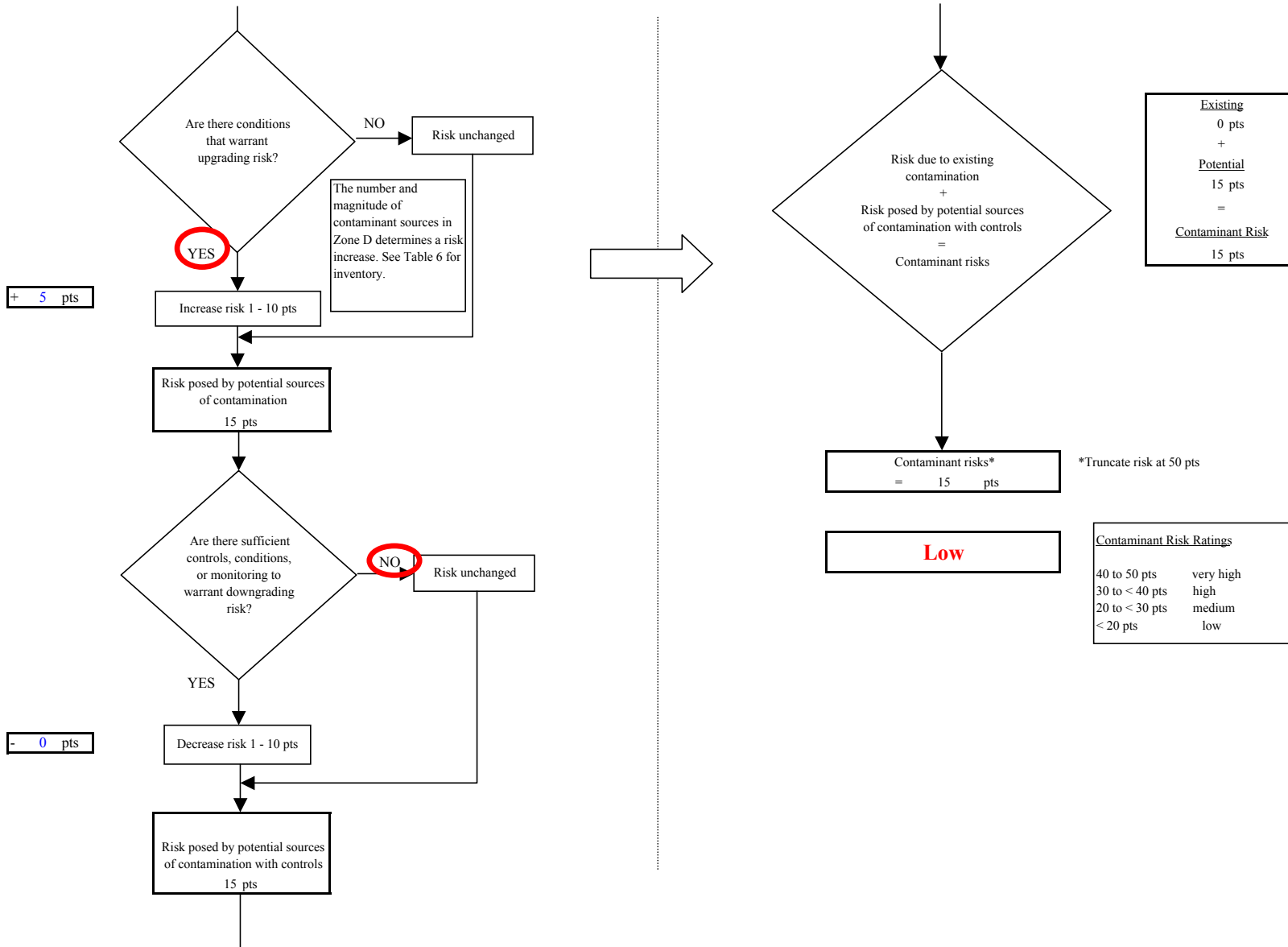
Chart 11. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Synthetic Organic Chemicals



The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 6 for inventory.



**Chart 11. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Synthetic Organic Chemicals**



**Chart 12. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Synthetic Organic Chemicals**

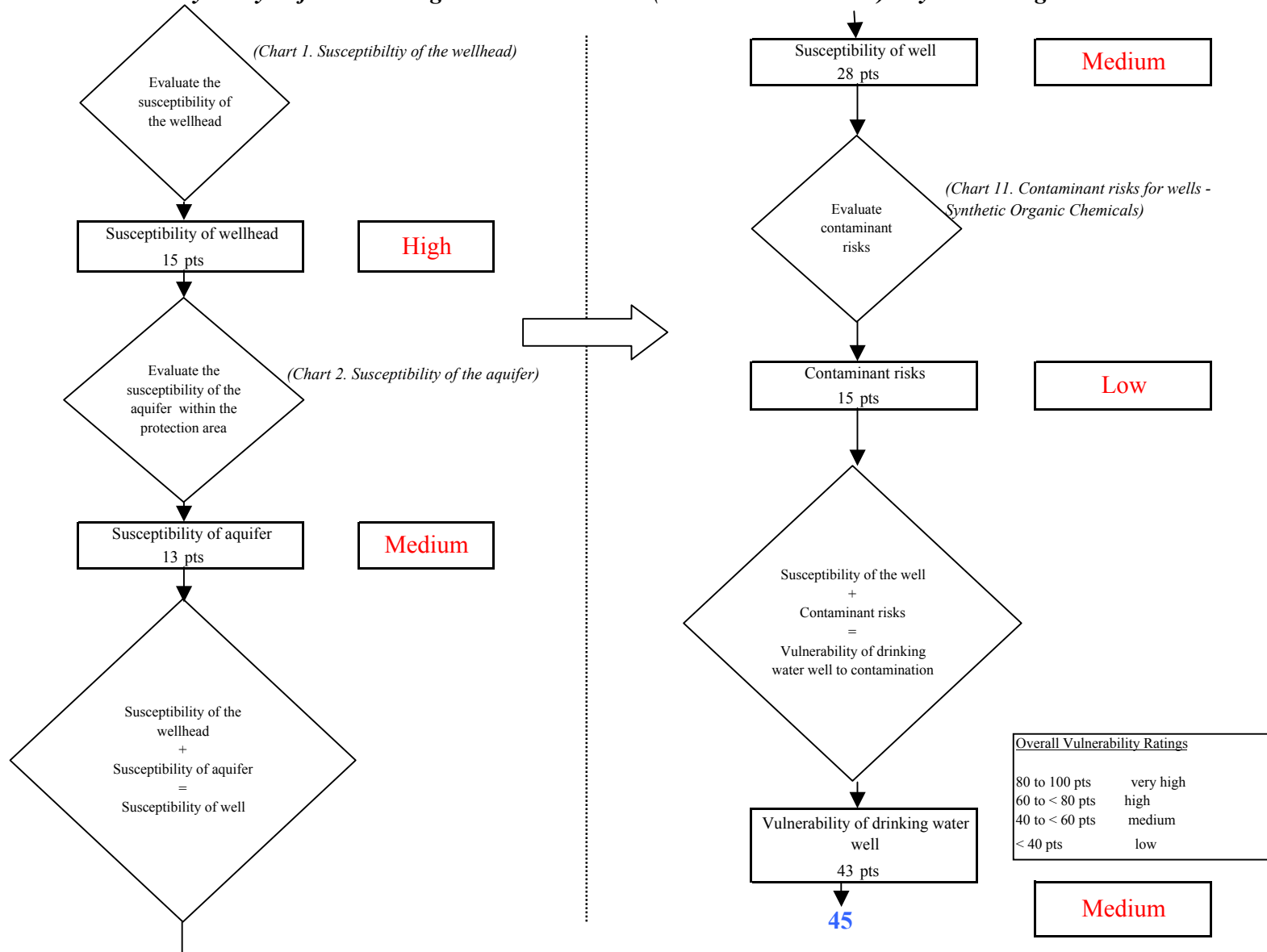


Chart 13. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Other Organic Chemicals

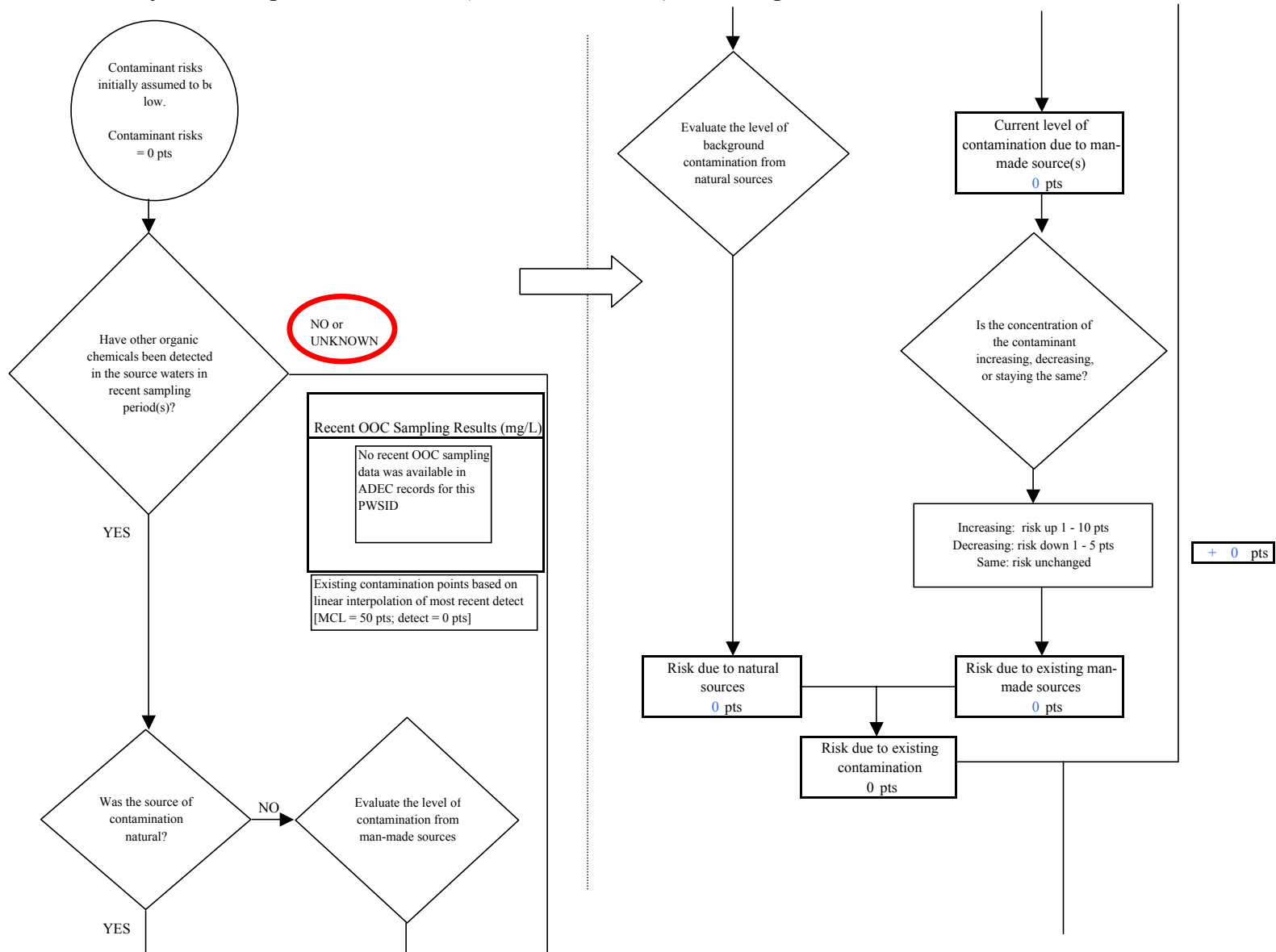


Chart 13. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Other Organic Chemicals

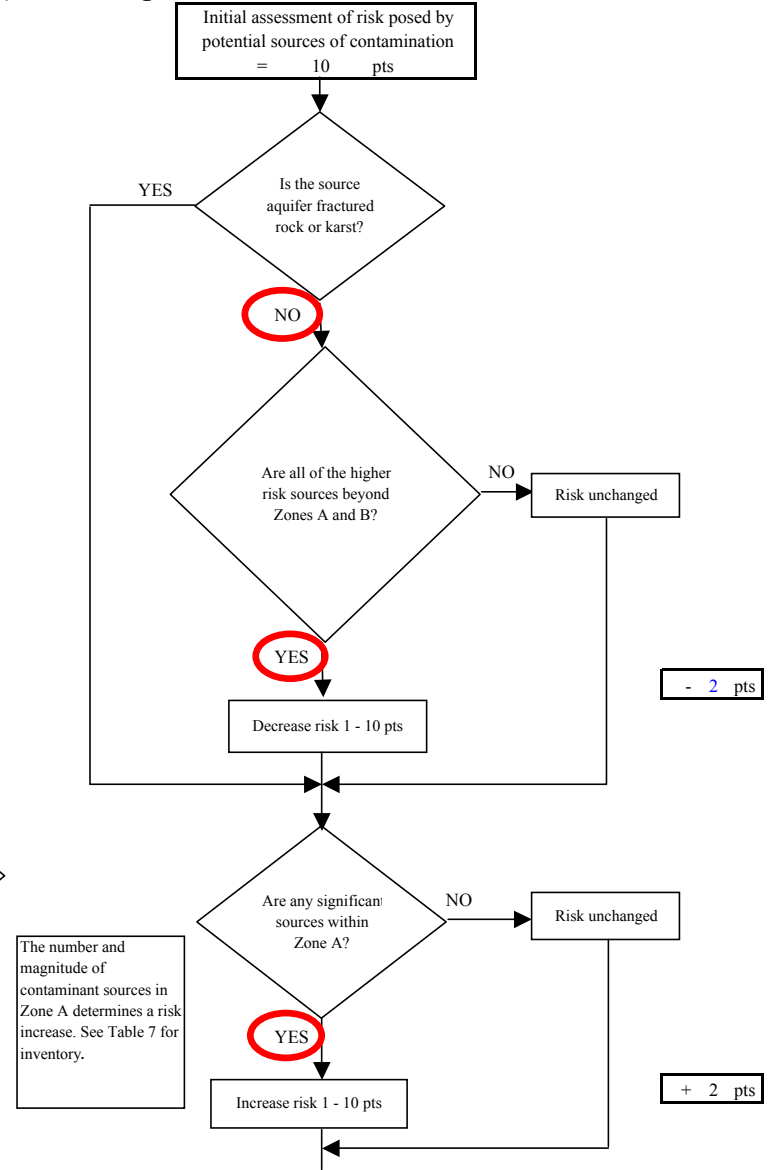
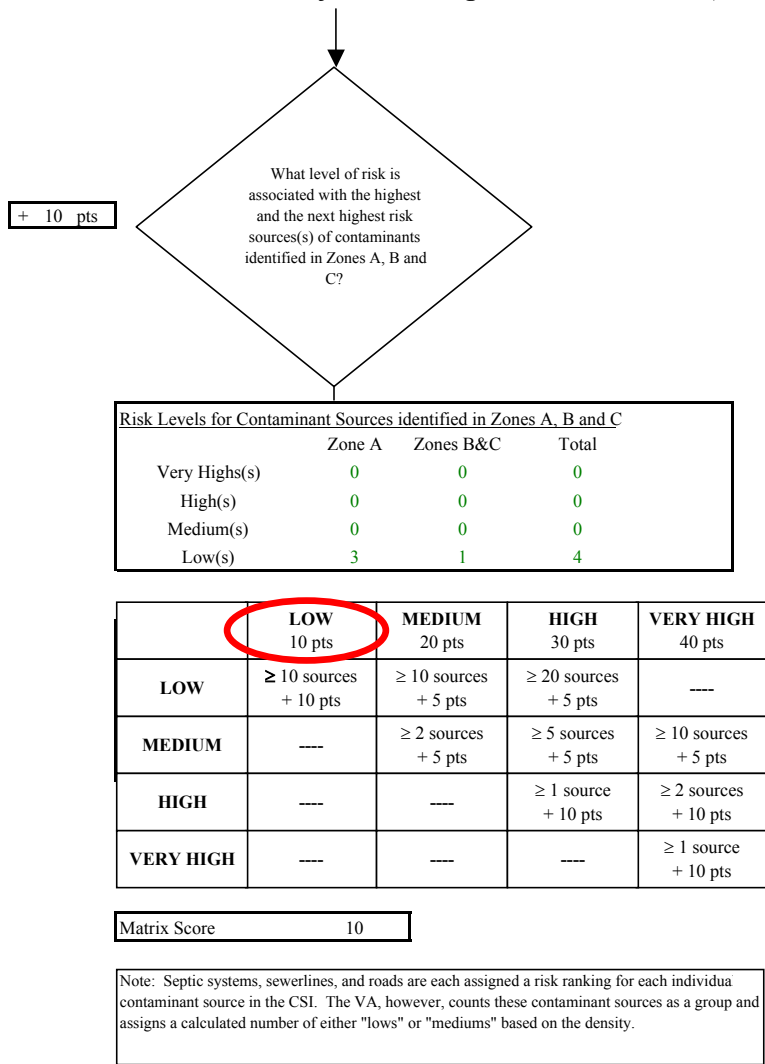
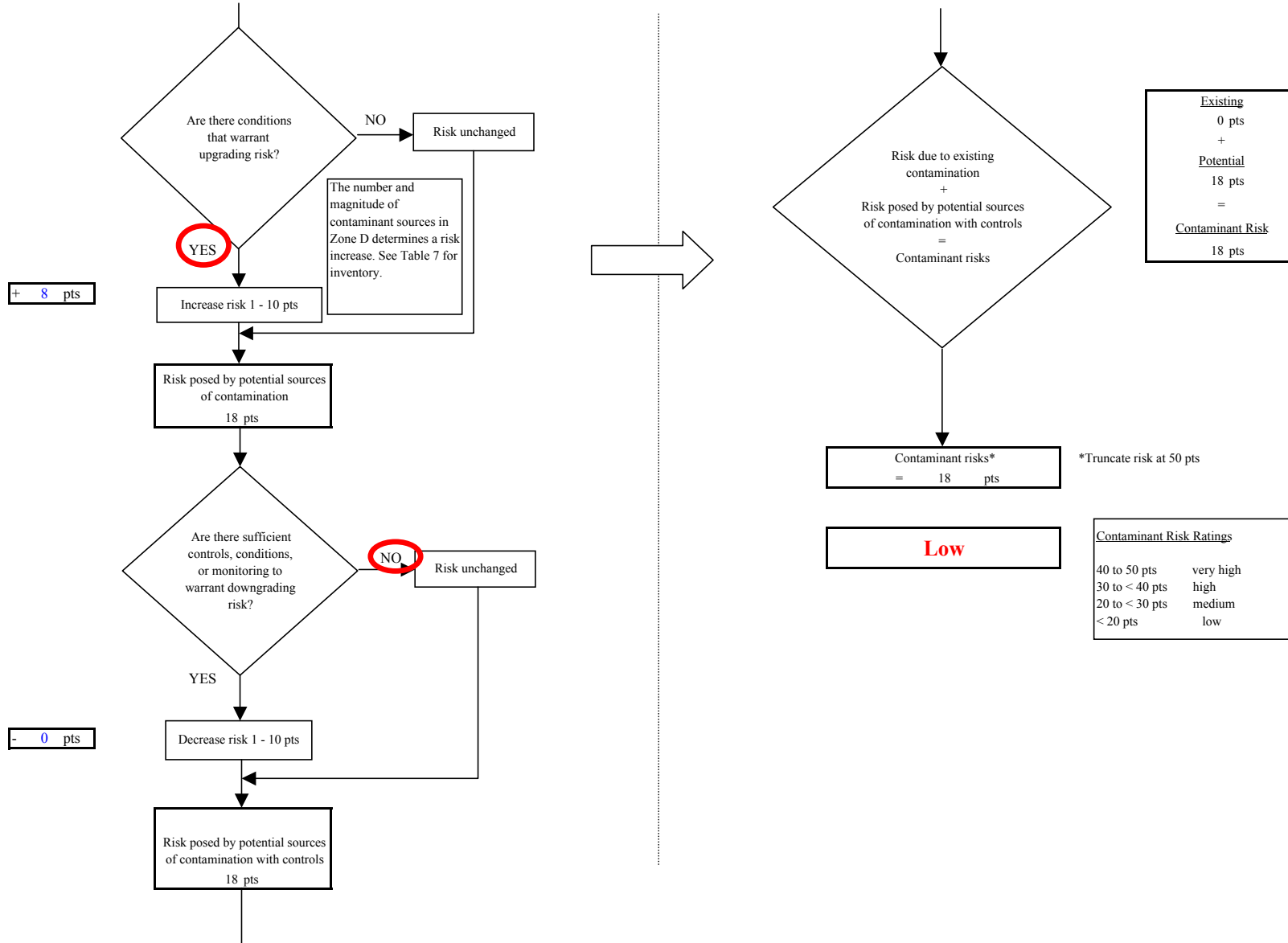


Chart 13. Contaminant risks for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Other Organic Chemicals



**Chart 14. Vulnerability analysis for LKSD Nightmute HS & Elem. (PWS No. 271261.001) - Other Organic Chemicals**

