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# Source Water Assessment

A Hydrogeologic Susceptibility and  
Vulnerability Assessment for  
the Brevig Mission Water System  
Drinking Water System,  
Brevig Mission, Alaska

PWSID # 340418.001

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1330  
Alaska Department of Environmental Conservation

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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.

## CONTENTS

EXECUTIVE SUMMARY .....	1	INVENTORY OF POTENTIAL AND EXISTING	
PUBLIC DRINKING WATER SYSTEM .....	1	CONTAMINANT SOURCES .....	2
DRINKING WATER PROTECTION AREA .....	1	RANKING OF CONTAMINANT RISKS .....	2
		VULNERABILITY OF DRINKING WATER	
		SYSTEM.....	3

## TABLES

Table 1. Definition of Zones .....	2
Table 2. Susceptibility .....	3
Table 3. Contaminant Risks.....	4
Table 4. Overall Vulnerability .....	4

## APPENDICES

APPENDIX	A. Brevig Mission Water System Drinking Water Protection Area (Map A)
	B. Contaminant Source Inventory for Brevig Mission Water System (Table 1)
	Contaminant Source Inventory and Risk Ranking for Brevig Mission Water System– Bacteria and Viruses (Table 2)
	Contaminant Source Inventory and Risk Ranking for Brevig Mission Water System– Nitrates/Nitrites (Table 3)
	Contaminant Source Inventory and Risk Ranking for Brevig Mission Water System– Volatile Organic Chemicals (Table 4)
	Contaminant Source Inventory and Risk Ranking for Brevig Mission Water System – Heavy Metals, Cyanide and Other Inorganic Chemicals (Table 5)
	Contaminant Source Inventory and Risk Ranking for Brevig Mission Water System – Synthetic Organic Chemicals (Table 6)
	Contaminant Source Inventory and Risk Ranking for Brevig Mission Water System– Other Organic Chemicals (Table 7)
	C. Brevig Mission Water System Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)
	D. Vulnerability Analysis for Contaminant Source Inventory and Risk Ranking for Brevig Mission Water System Public Drinking Water Source (Charts 1 – 14)

# Source Water Assessment for Brevig Mission Water System Source of Public Drinking Water, Brevig Mission, Alaska

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## Drinking Water Protection Program Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The Brevig Mission Water System has two Public Water System (PWS) wells. The well (PWS No. 340418.001) has been used as a drinking water source since in its current configuration since September of 1976. This source water assessment report is exclusively limited to PWSID #340418.001.

The well is a Class A (community and non-transient non-community) water system located adjacent to Shelman Creek in Brevig Mission, Alaska. Available records indicate that there is secondary storage of drinking water, with a capacity of 100,000-gallons, and that the drinking water is treated with calcium hypochlorite. This system operates year round and serves approximately 280 residents through 1 service connection. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produce a **High** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: landfills, domestic wastewater treatment processes, and aboveground fuel storage tanks. An inventory of potential or existing contamination sources can be found in Appendix B, Table 1. These identified potential and existing sources of contamination are considered 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 chemical contaminant categories.

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

### PUBLIC DRINKING WATER SYSTEM

The Brevig Mission Water System well is a Class A (community/non-transient/non-community) public water system. The system is located

adjacent to Shelman Creek in Brevig Mission, Alaska. (Sec. 09, T002S, R038W, Kateel River Meridian, see Map A of Appendix A). The community of Brevig Mission is on Port Clarence and is located 65 miles northwest of Nome. The community has a population of 314 (ADCED, 2003). Average annual precipitation in Brevig Mission is 11.5 inches, including approximately 50 inches of snowfall. Temperatures can be as extreme as -9 to 57°F.

The community of Brevig Mission obtains most of their water supply from the community's two wells. Treated water is supplied to the school district. A majority of the occupied households use honeybuckets or outhouses. Almost all of the occupied households lack complete plumbing (ADCED, 2003). Brevig Mission receives electrical power from Alaska Village Electric Authority; power-generating facilities are diesel powered. The local landfill is operated by the City of Brevig Mission (ADCED, 2003).

According to information supplied by ADEC for the Brevig Mission Water System PWS, the depth of the well is 27 feet below the ground surface. Based on available well construction details, the well is completed in an unconfined aquifer and is screened. The well is not located within a floodplain.

Information acquired from the January 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 properly grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

Brevig Mission is located at the mouth of Shelman Creek on the north shore of Port Clarence. Shelman Creek runs through the eastern side of the village while Reindeer Creek, a smaller stream, runs through

the center of the village. Features in the immediate vicinity of the village include low-lying hills and small stream drainages. There are numerous tussock and strangmoor ridges (ADOT&PF 1996).

The hills immediately north and east of Brevig Mission are composed of thin bedded, dolomitic limestone and argillaceous limestone. The lower regions are composed of alluvium transported a short distance from the hills, as well as wind blown deposits of silt. Recent beach deposits are located along the existing shoreline (ADOT&PF 1996).

Surface soils generally consist of clay, gravel and sand with frozen mixed clay, sand, gravel and seashells. Unfrozen clays and gravels were found from 112 to 225 feet bgs. Occasional zones of ice rich soils are found in the area (ADOT&PF 1996).

### 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 Rampart Washeteria Public Water System 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**

<b>Zone</b>	<b>Definition</b>
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 Brevig Mission Water System 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 Brevig Mission Water System 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, and
- 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 Brevig Mission Water System’s water well is in an unconfined 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	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	High

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	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	50	Very High
Other 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:

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

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	80	Very High
Nitrates and Nitrites	80	Very High
Volatile Organic Chemicals	80	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	80	Very High
Synthetic Organic Chemicals	80	Very High
Other Organic Chemicals	80	Very High

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of landfills and large capacity domestic wastewater treatment processes in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 2 – Appendix B).

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, 2003). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination.

Positive bacteria counts have not 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 **Very High**.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Very High**. The risk to this source of public drinking water is primarily attributed to the presence of landfills and domestic wastewater treatment processes in Zone A. Numerous other potential contaminant sources are also found within the protection area (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 **Very High**.

### **Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of landfills and airports within Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

Detectable concentrations of trihalomethanes were reported in sampling events for this public water system. The detectible concentrations of trihalomethanes reported in 2000 were well below the MCL of 0.08 mg/L. Trihalomethanes (TTHM's) are generally considered byproducts of the water treatment process and are not from the source waters. Since the reported concentration of TTHM's in recent sampling events did not exceed the applicable MCL, risk points were not retained (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Aside from being byproducts of the drinking water treatment process, possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports.

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 **Very High**.

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

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

Based on review of recent sampling records for this public water system, low levels of barium have been detected, however has not exceeded its MCL of 2.0 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). Moderate levels of lead and copper have also been detected, however they have not exceeded their respective MCL's of 0.015 mg/L and 1.3 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 are likely attributed to the water treatment/conveyance system. No risk point were assigned since neither analyte exceeded 100% of the in the recent sampling events.

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 **Very High**.

### **Synthetic Organic Chemicals**

The contaminant risk for synthetic organic chemicals is **Very High**. The risk is primarily attributed to landfills in Zone A (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the Brevig Mission Water System (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 **Very High**.

### **Other Organic Chemicals**

The contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of landfills in Zone A. Several other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the Brevig Mission Water System (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 **Very 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 the community of Rampart 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.

## REFERENCES

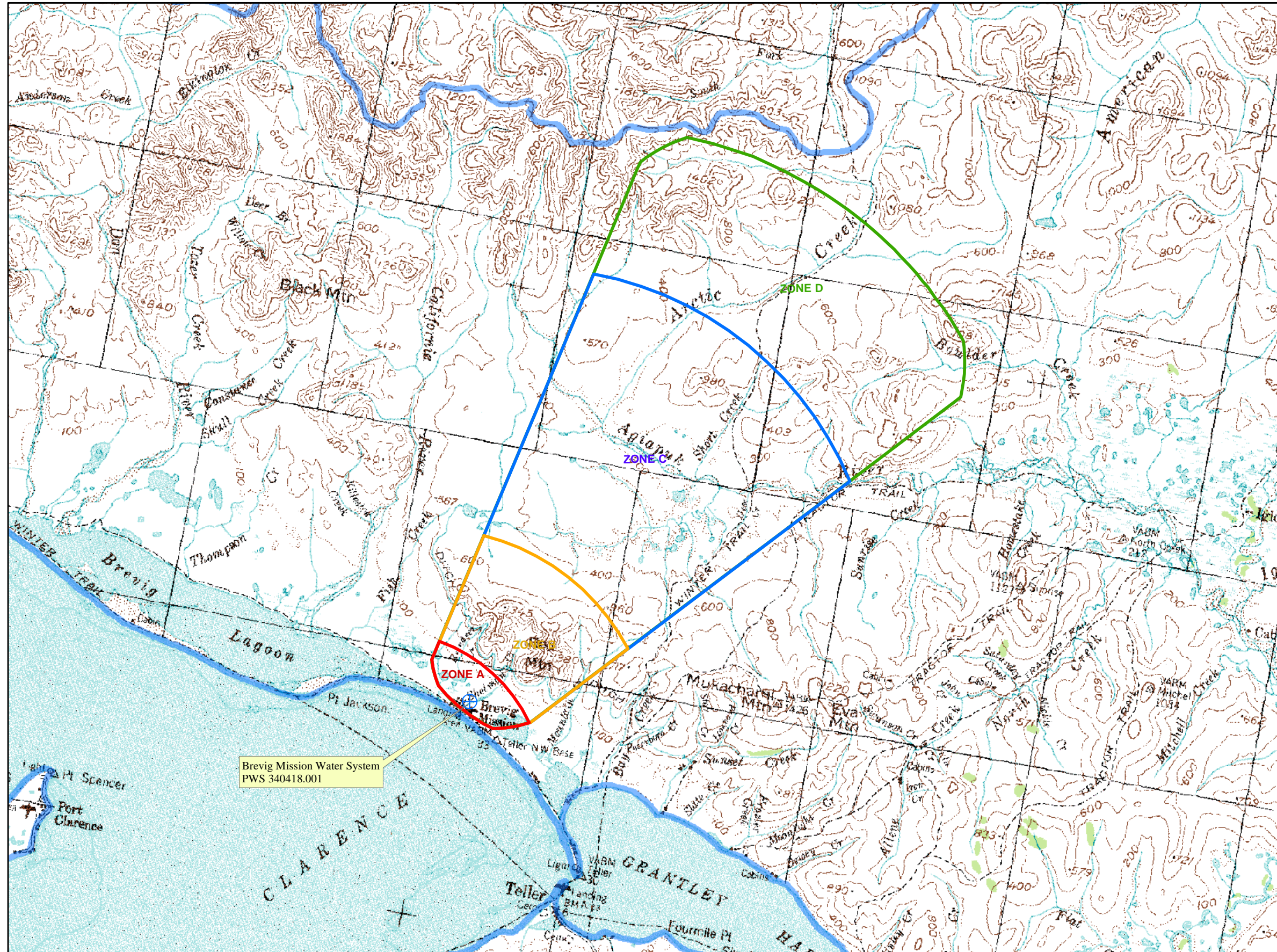
- Alaska Department of Community and Economic Development (ADCED), 2003 [WWW document]. URL: [http://www.dced.state.ak.us/cbd/commdb/CF\\_COMDB.htm](http://www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm)
- Alaska Department of Environmental Conservation, Contaminated Sites Database, 2003 [WWW database], URL [http://www.state.ak.us/dec/dspar/csites/cs\\_search.htm](http://www.state.ak.us/dec/dspar/csites/cs_search.htm)
- Alaska Department of Environmental Conservation, Leaking Underground Storage Tank Database, 2003 [WWW database], URL [http://www.dec.state.ak.us/spar/stp/ust/search/fac\\_search.asp](http://www.dec.state.ak.us/spar/stp/ust/search/fac_search.asp)
- Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey
- Information from ADOT&PF and FAA, Brevig Mission Airport Master Plan and Environmental Assessment, Project No. 65475, dated January 1996.
- United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL <http://www.epa.gov/safewater/mcl.html>.

# **APPENDIX A**

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



Public Water Well System for PWS #340418.001 Brevig Mission Water System



**LEGEND**

⊕ Public Water System Well

**Hydrography/Physical**

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

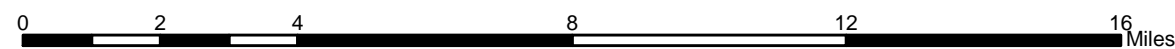
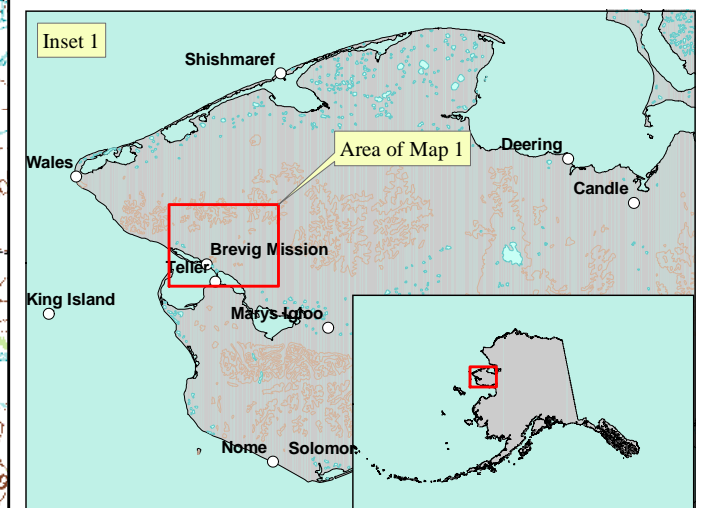
**Transportation**

- 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.





## **APPENDIX B**

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

**Table 1**

**Contaminant Source Inventory for  
Brevig Mission Water System**

**PWSID 340418.00**

<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>
Motor /motor vehicle repair shops	C31	C31-01	A	C	Service/Maintenance Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	C	Assume 38 or fewer honeybucket pits/outhouses in Zone A
Landfills (municipal; Class III)	D51	D51-01	A	C	Brevig Mission Landfill 1
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 30 or fewer aboveground residential heating oil tanks in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	Brevig Mission Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	Mukluk Switchboard
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	IRA Traditional Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	C	VPSO Holding Cell
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	C	IRA Traditional Office
Airports	X14	X14-01	A	C	Airport
Airports	X14	X14-02	A	C	Landing Strip
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 20 or fewer roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	C	Brevig Mission Clinic
Landfills (municipal; Class III)	D51	D51-02	C	C	Brevig Mission Landfill 2

Table 2

*Contaminant Source Inventory and Risk Ranking for  
Brevig Mission Water System  
Sources of Bacteria and Viruses*

PWSID 340418.001

<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	A	High	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assumes 38 or fewer honeybucket pits/outhouses in Zone A
Landfills (municipal; Class III)	D51	D51-01	A	High	C	Brevig Mission Landfill 1
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 20 or fewer roads in Zone A
Medical/veterinary facilities (doctor or dentist office, hospitals, nursing homes)	X40	X40-01	A	Medium	C	Brevig Mission Clinic
Landfills (municipal; Class III)	D51	D51-02	C	High	C	Brevig Mission Landfill 2

Table 3

*Contaminant Source Inventory and Risk Ranking for  
Brevig Mission Water System  
Sources of Nitrates/Nitrites*

PWSID 340418.001

<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	A	High	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assumes 38 or fewer honeybucket pits/outhouses in Zone A
Landfills (municipal; Class III)	D51	D51-01	A	Very High	C	Brevig Mission Landfill 1
Airports	X14	X14-01	A	Low	C	Airport
Airports	X14	X14-02	A	Low	C	Landing Strip
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 20 or fewer roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Brevig Mission Clinic
Landfills (municipal; Class III)	D51	D51-02	C	Very High	C	Brevig Mission Landfill 2



Table 4

*Contaminant Source Inventory and Risk Ranking for  
Brevig Mission Water System  
Sources of Volatile Organic Chemicals*

PWSID 340418.001

<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>
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Service/Maintenance Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assumes 38 or fewer honeybucket pits/outhouses in Zone A
Landfills (municipal; Class III)	D51	D51-01	A	High	C	Brevig Mission Landfill 1
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assumes 30 or fewer aboveground residential heating oil tanks in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Brevig Mission Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Mukluk Switchboard
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	IRA Traditional Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	VPSO Holding Cell
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	IRA Traditional Office
Airports	X14	X14-01	A	High	C	Airport
Airports	X14	X14-02	A	High	C	Landing Strip
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 20 or fewer roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Brevig Mission Clinic
Landfills (municipal; Class III)	D51	D51-02	C	High	C	Brevig Mission Landfill 2

Table 5

*Contaminant Source Inventory and Risk Ranking for  
Brevig Mission Water System  
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

PWSID 340418.001

<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>
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Service/Maintenance Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assumes 38 or fewer honeybucket pits/outhouses in Zone A
Landfills (municipal; Class III)	D51	D51-01	A	High	C	Brevig Mission Landfill 1
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Brevig Mission Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Mukluk Switchboard
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	IRA Traditional Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	VPSO Holding Cell
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	IRA Traditional Office
Airports	X14	X14-01	A	Low	C	Airport
Airports	X14	X14-02	A	Low	C	Landing Strip
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 20 or fewer roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Brevig Mission Clinic
Landfills (municipal; Class III)	D51	D51-02	C	High	C	Brevig Mission Landfill 2

Table 6

*Contaminant Source Inventory and Risk Ranking for  
Brevig Mission Water System  
Sources of Synthetic Organic Chemicals*

PWSID 340418.001

<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	A	Low	C	Sewage Lagoon
Landfills (municipal; Class III)	D51	D51-01	A	Very High	C	Brevig Mission Landfill 1
Airports	X14	X14-01	A	Medium	C	Airport
Airports	X14	X14-02	A	Medium	C	Landing Strip
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Brevig Mission Clinic
Landfills (municipal; Class III)	D51	D51-02	C	Very High	C	Brevig Mission Landfill 2

*Contaminant Source Inventory and Risk Ranking for  
Brevig Mission Water System  
Sources of Other Organic Chemicals*

*PWSID 340418.001*

*Table 7*

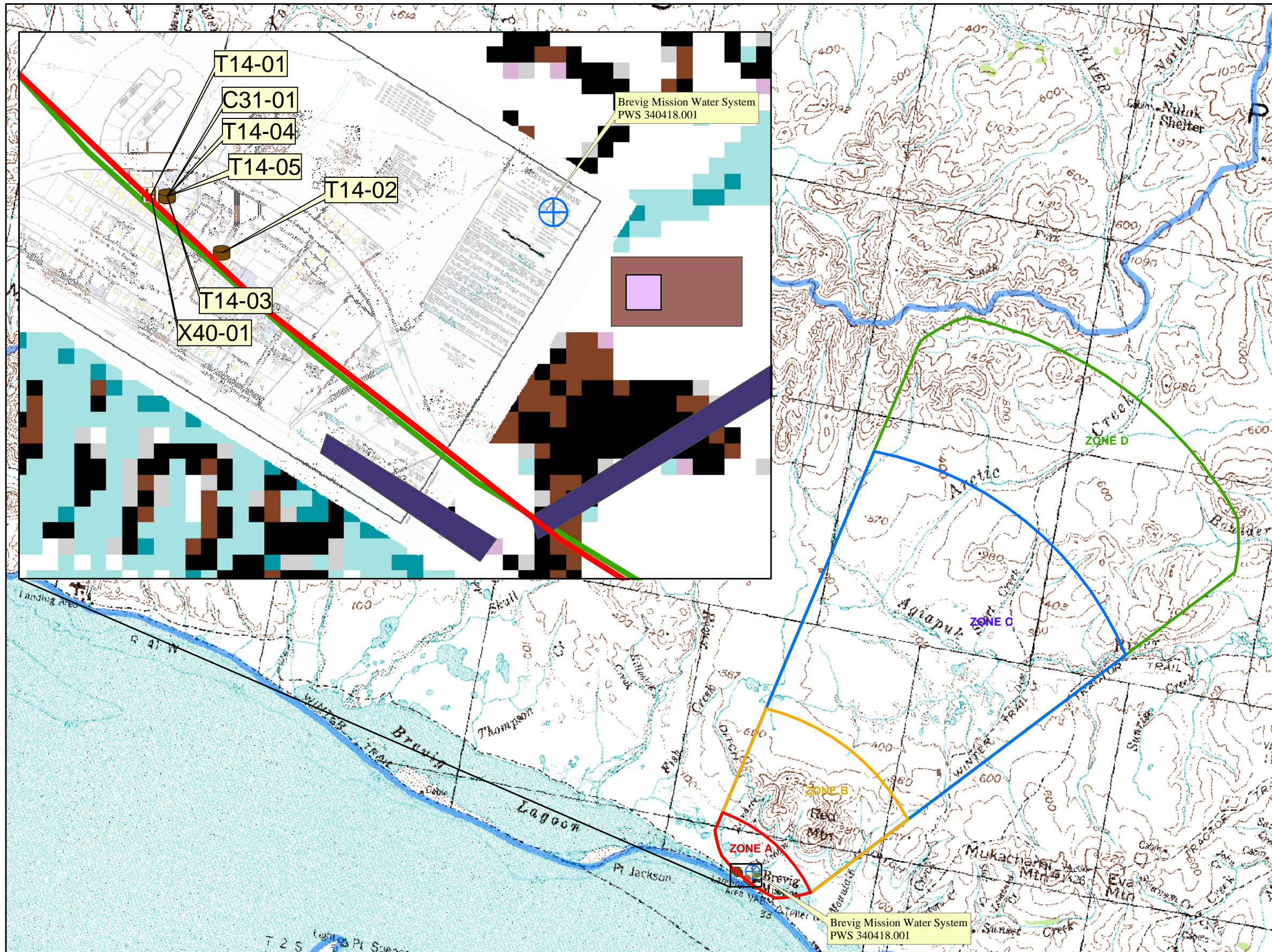
<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Service/Maintenance Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	Sewage Lagoon
Landfills (municipal; Class III)	D51	D51-01	A	Very High	C	Brevig Mission Landfill 1
Airports	X14	X14-01	A	Medium	C	Airport
Airports	X14	X14-02	A	Medium	C	Landing Strip
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 20 or fewer roads in Zone A
Landfills (municipal; Class III)	D51	D51-02	C	Very High	C	Brevig Mission Landfill 2

## **APPENDIX C**

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



**Public Water Well System for PWS #340418.001 Brevig Mission Water System  
Potential and Existing Sources of Contamination**



**LEGEND**

	Public Water System Well
--	--------------------------

**Hydrography/Physical**

	Parcels	<b>Transportation</b>	
	Stream		Primary Route (Class 1)
	Lake or Pond		Secondary Route (Class 2)
	Contours		Road (Class 3)
	Watershed Boundary		Road (Class 4)
			Road (Class 5, Four-wheel drive)

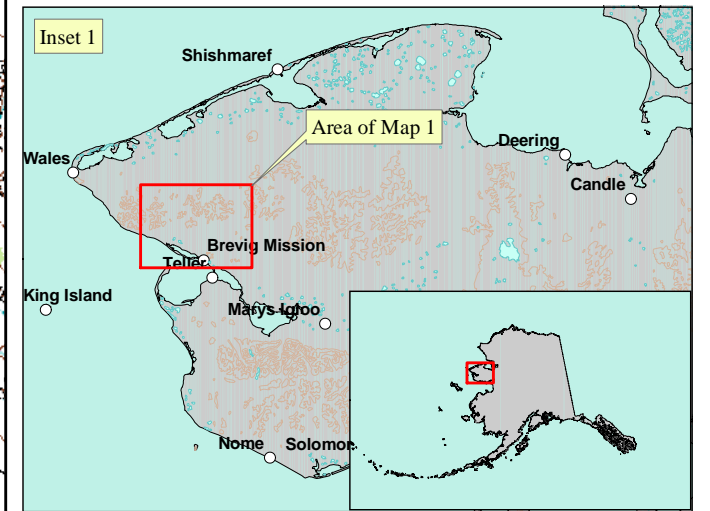
**Groundwater Protection Zones**

	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**

	Motor/motor vehicle repair facility (C31)
	Tanks, heating oil, nonresidential (aboveground) (T14)
	Medical/veterinary facilities (doctors or dentists offices, hospitals, nursing homes) (X40)
	Domestic Wastewater Treatment disposal ponds/lagoons (D02)
	Landfills (Municipal, Class III) (D51)
	Airports or landing strips (X14)

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.

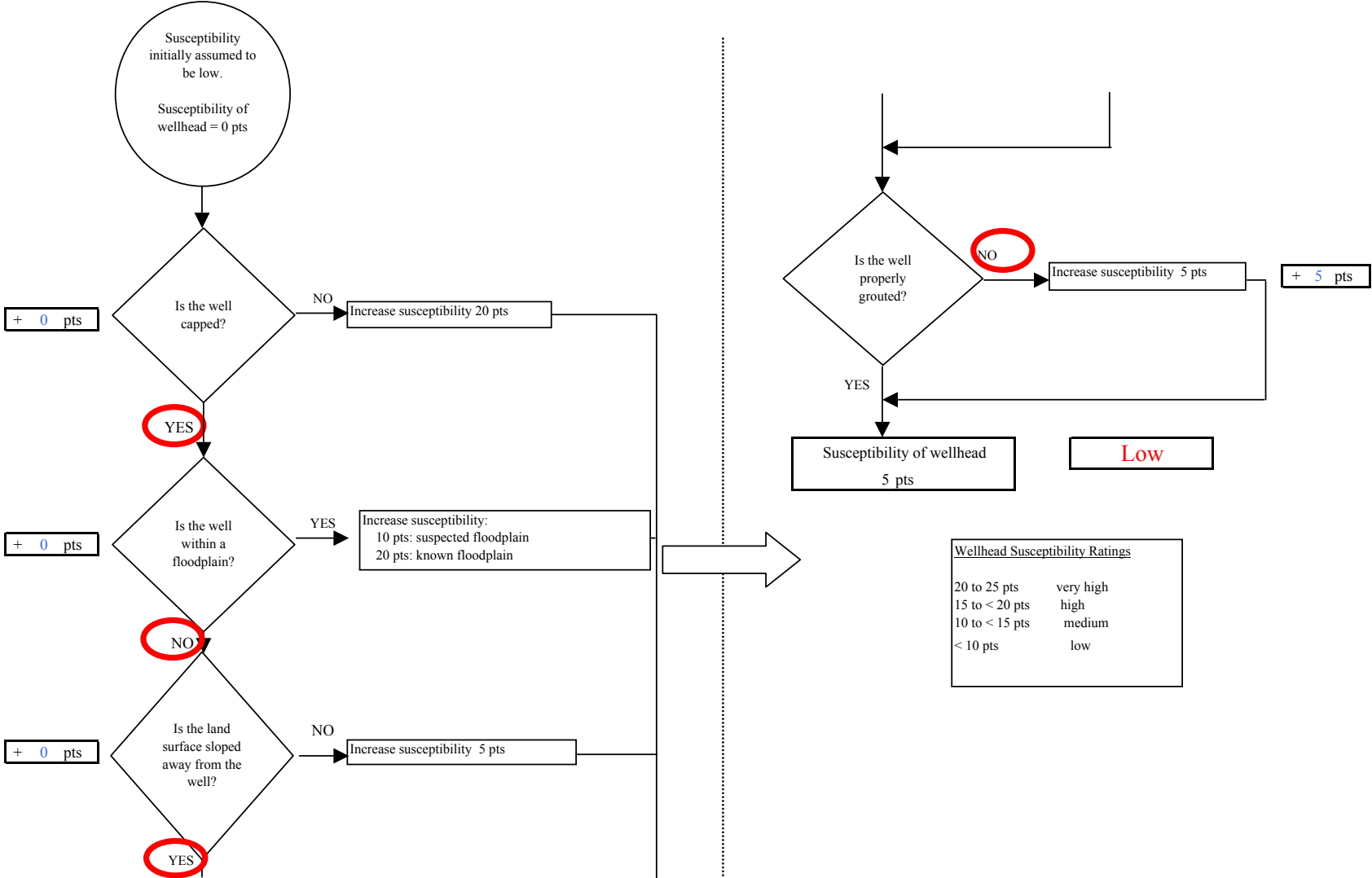




## **APPENDIX D**

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

**Chart 1. Susceptibility of the wellhead - Brevig Mission Water System (PWS No. 340418.001)**



Wellhead Susceptibility Ratings	
20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10 pts	low



**Chart 2. Susceptibility of the aquifer Brevig Mission Water System (PWS No. 340418.001)**

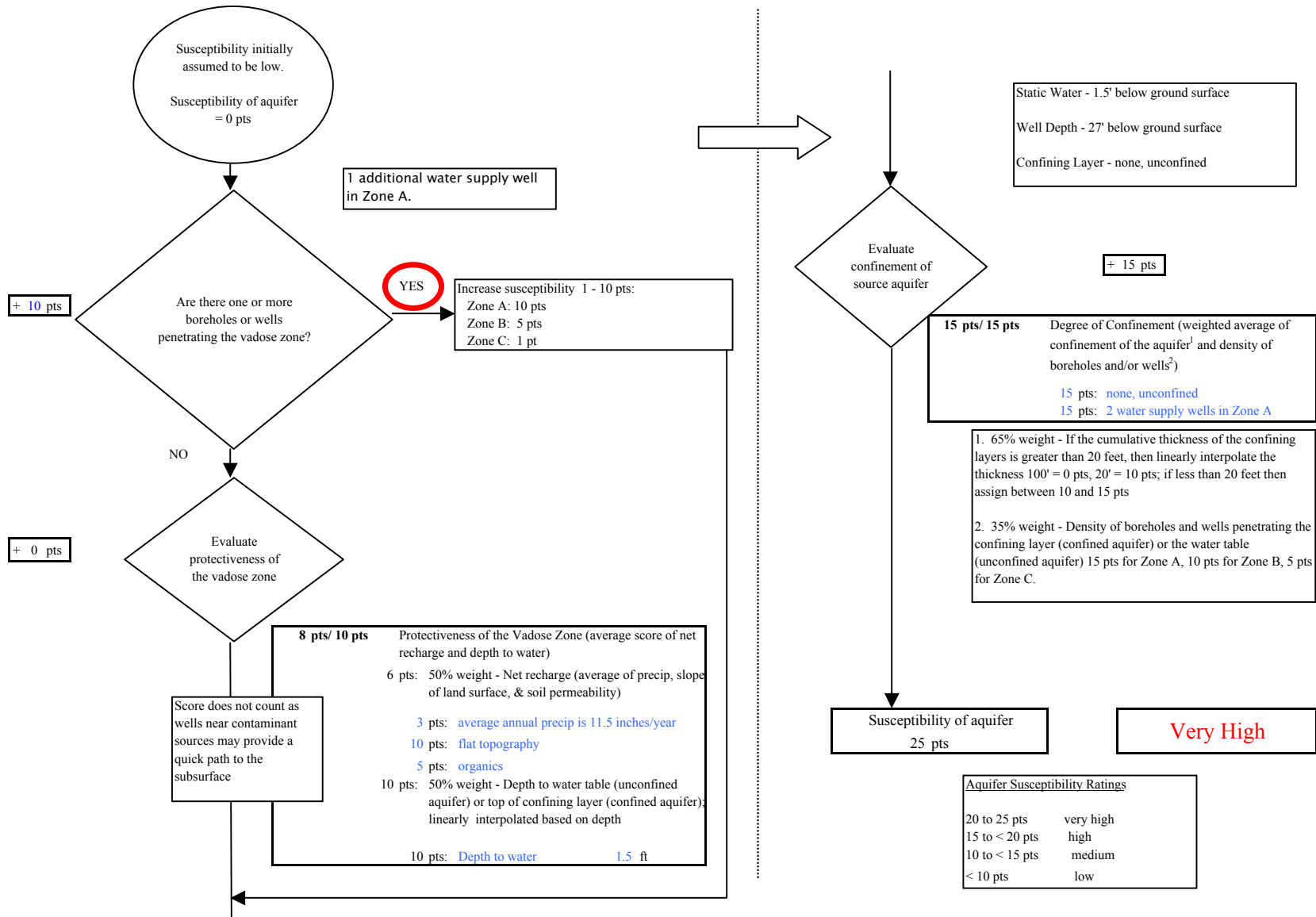


Chart 3. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Bacteria & Viruses

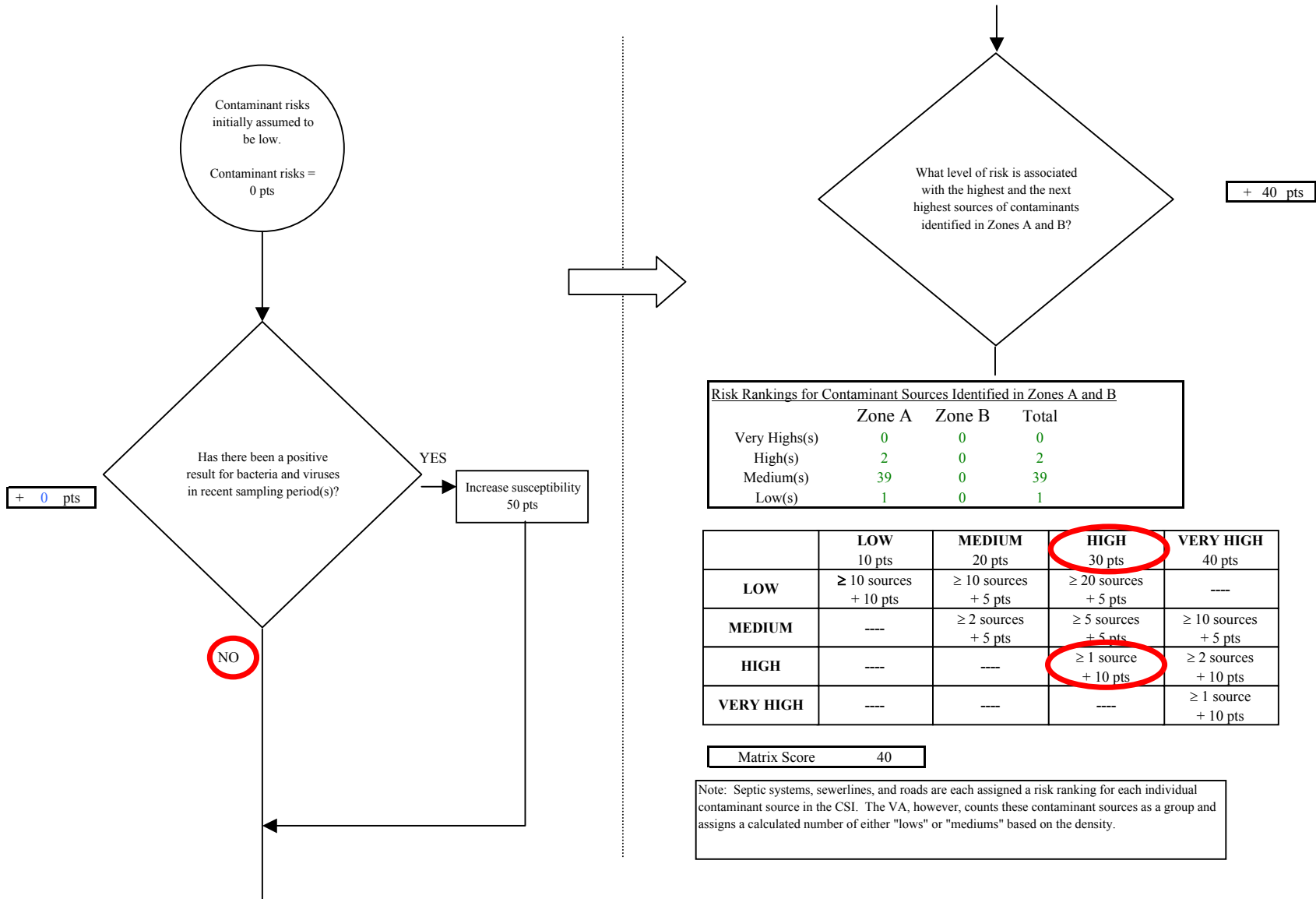
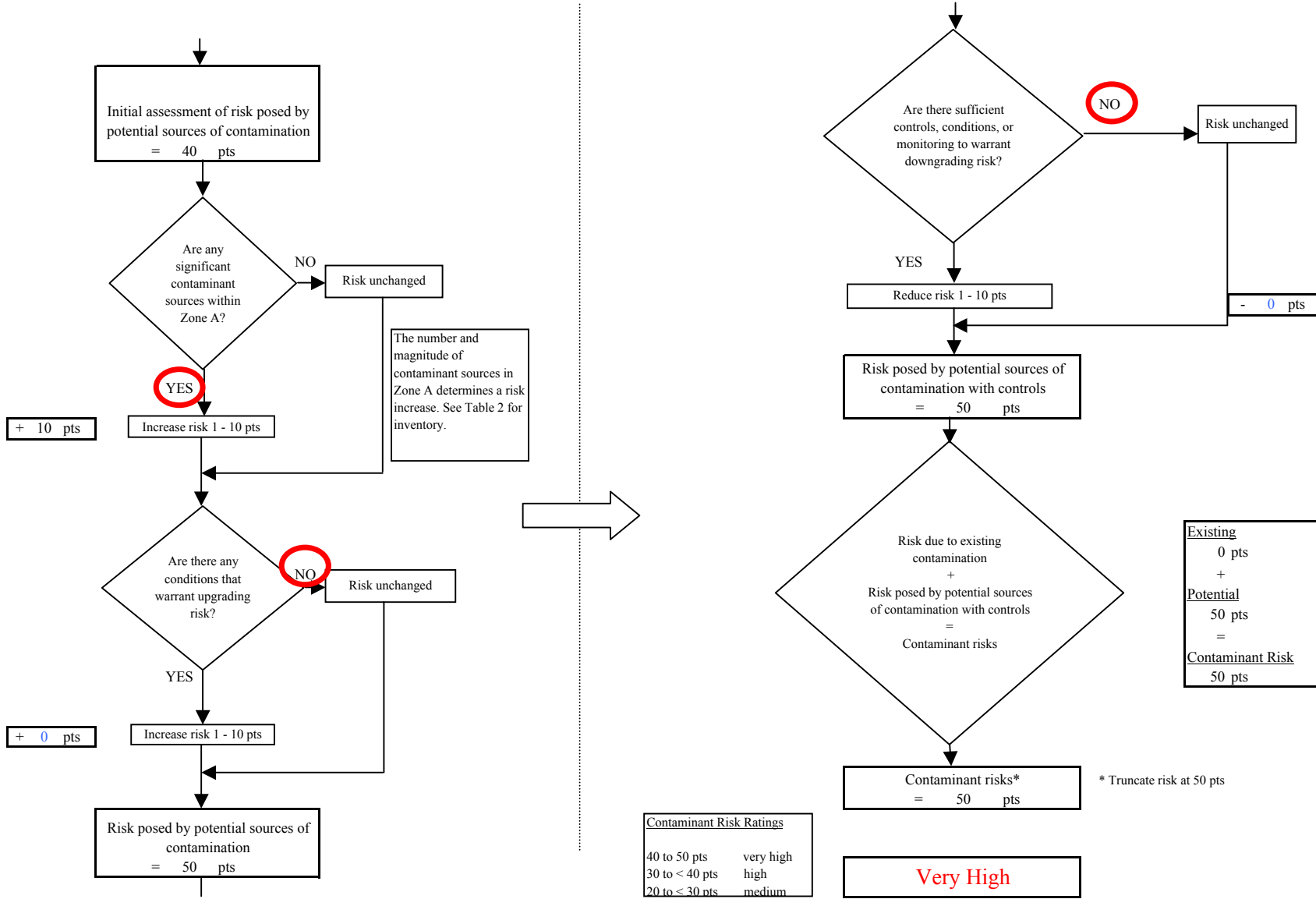


Chart 3. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Bacteria & Viruses



Contaminant Risk Ratings	
40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium

Existing	0 pts
+	
Potential	50 pts
=	
Contaminant Risk	50 pts

**Chart 4. Vulnerability analysis for Brevig Mission Water System (PWS No. 340418.001) - Bacteria & Viruses**

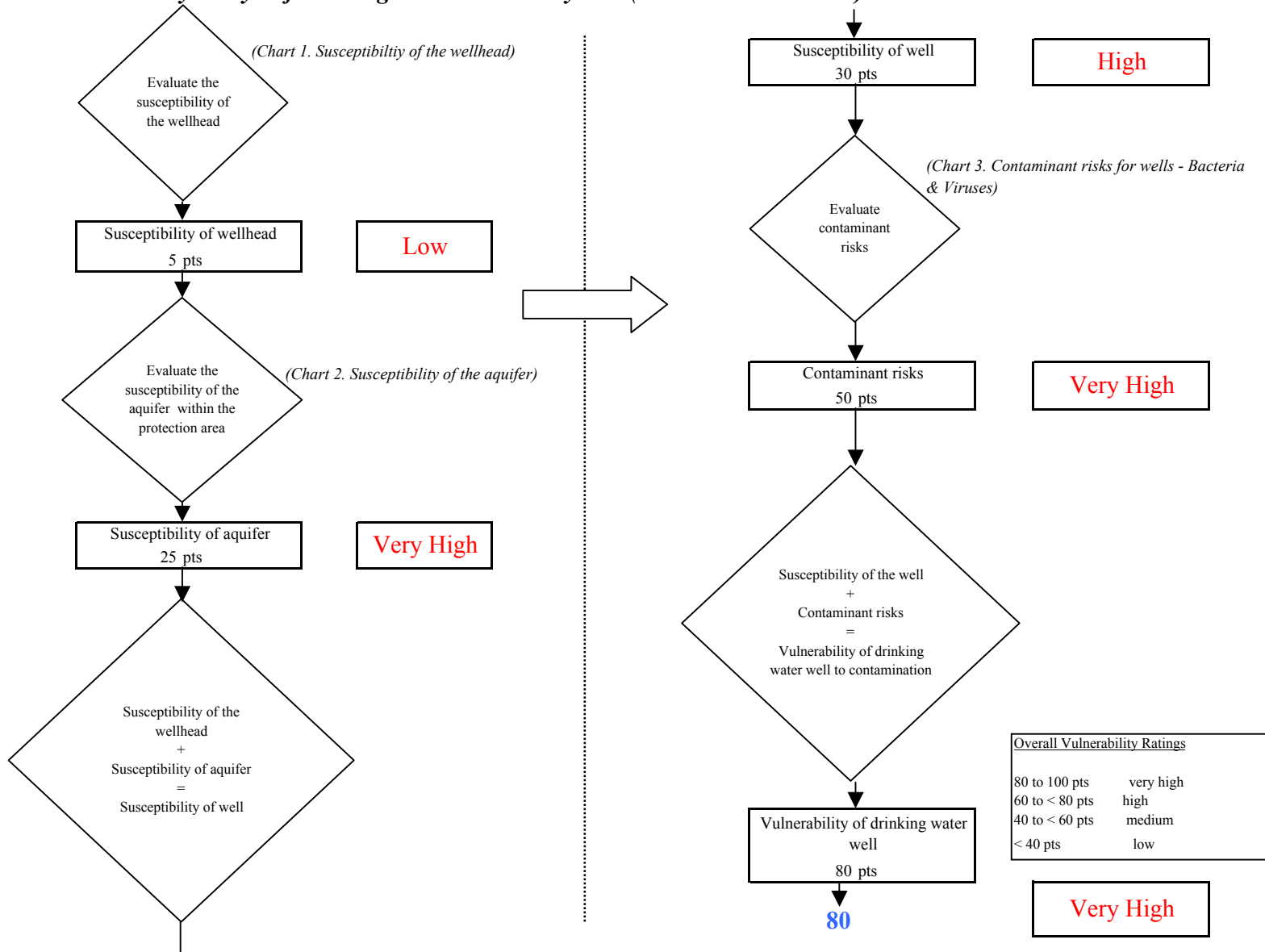


Chart 5. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Nitrates and Nitrites

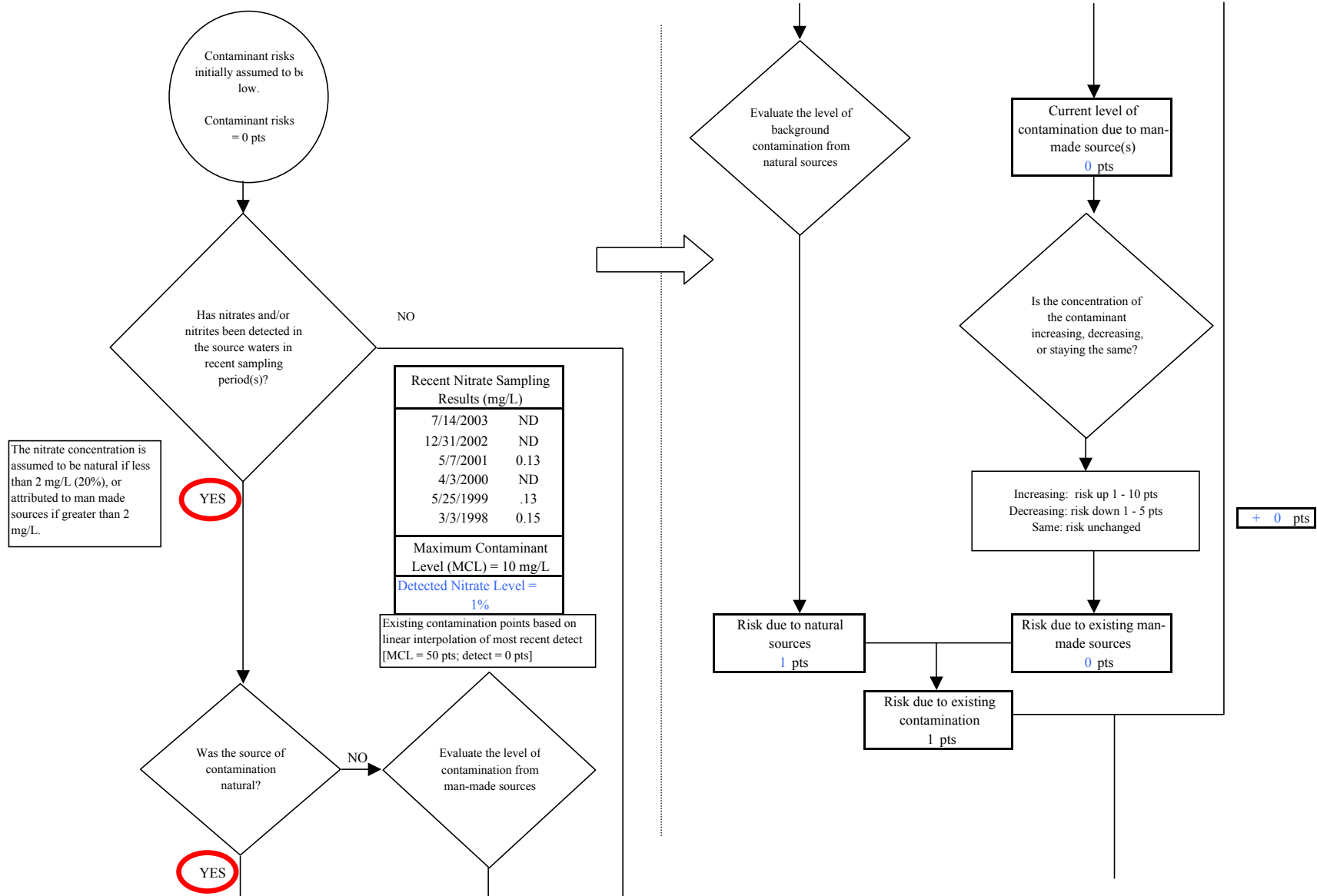
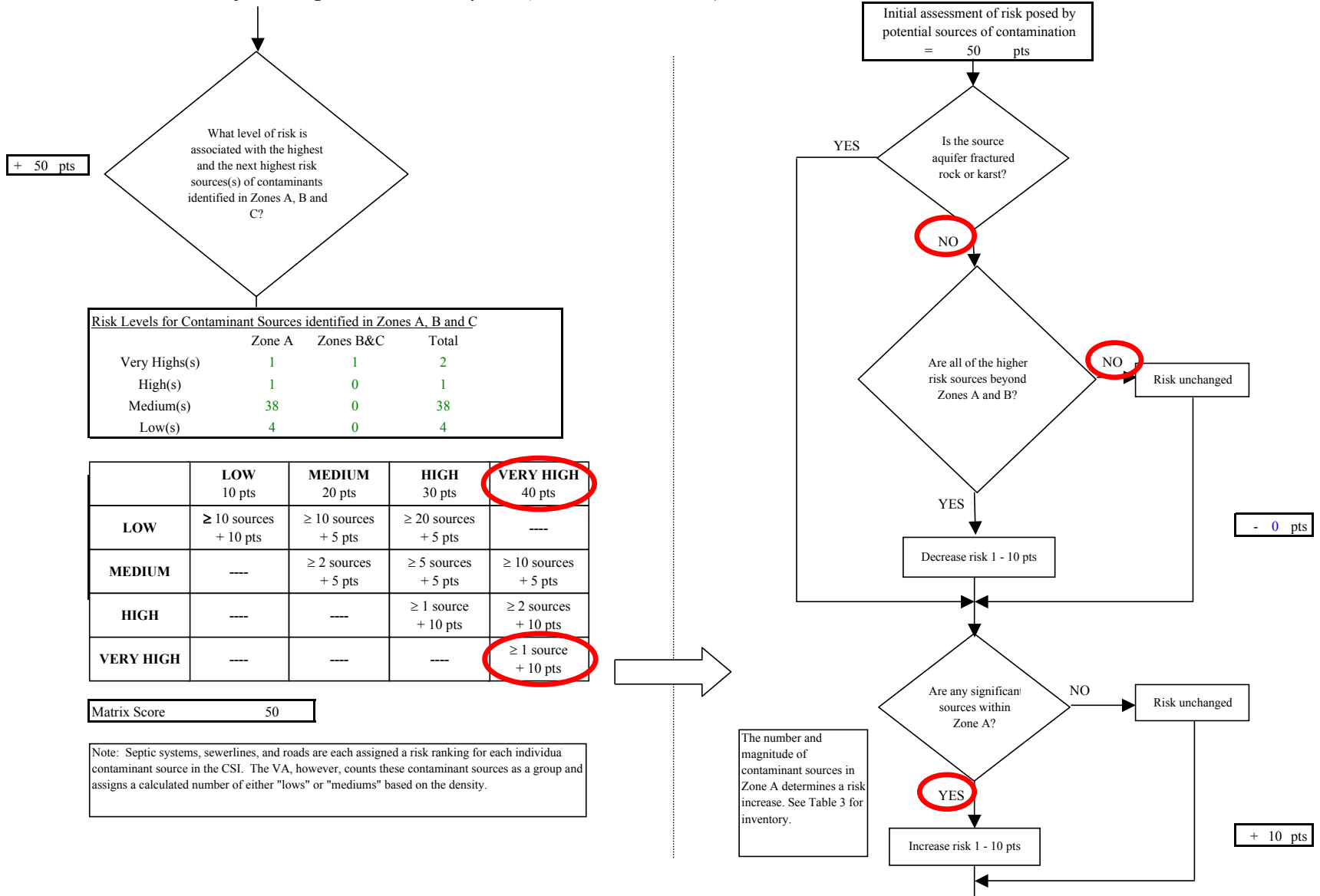
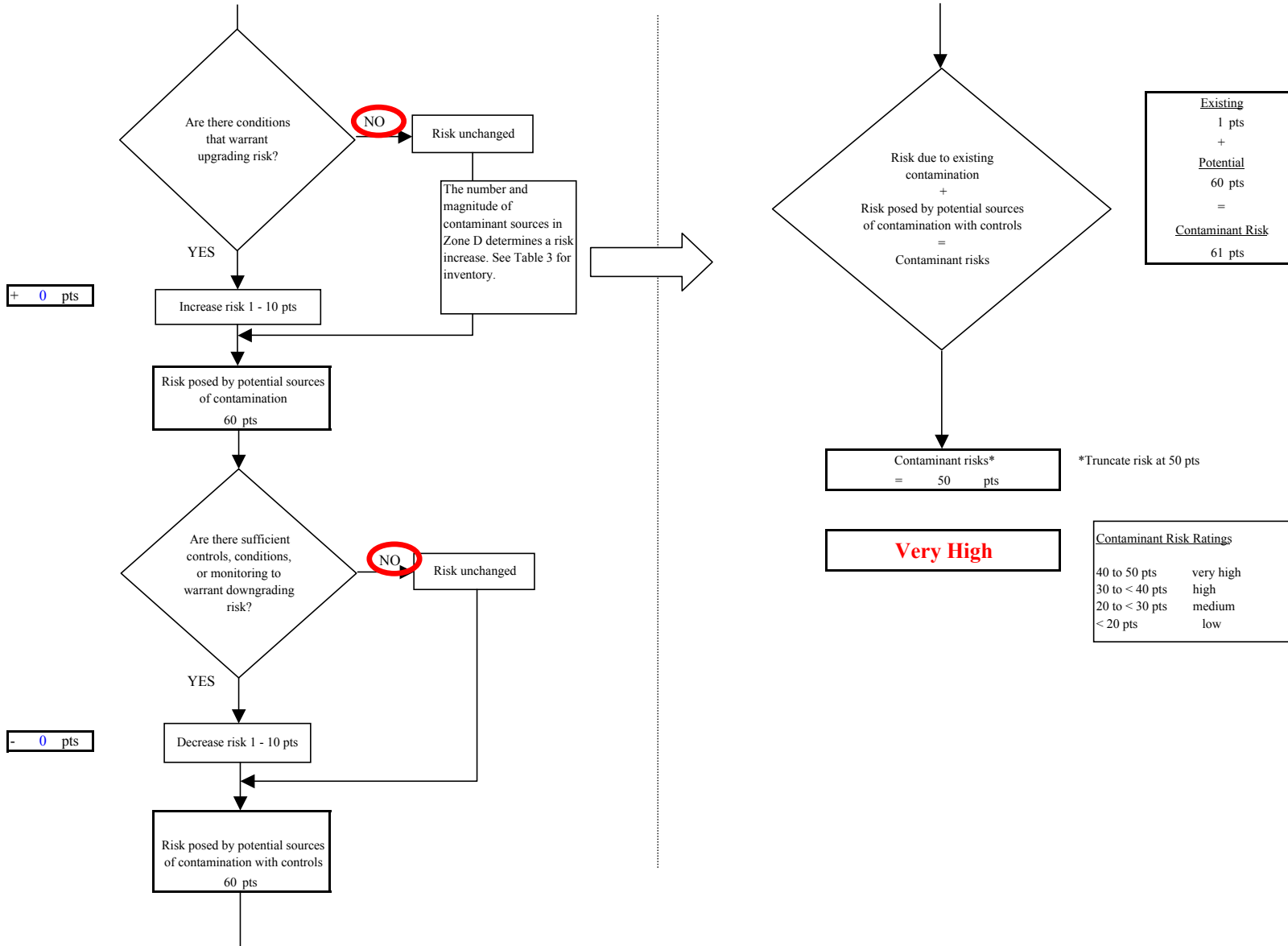


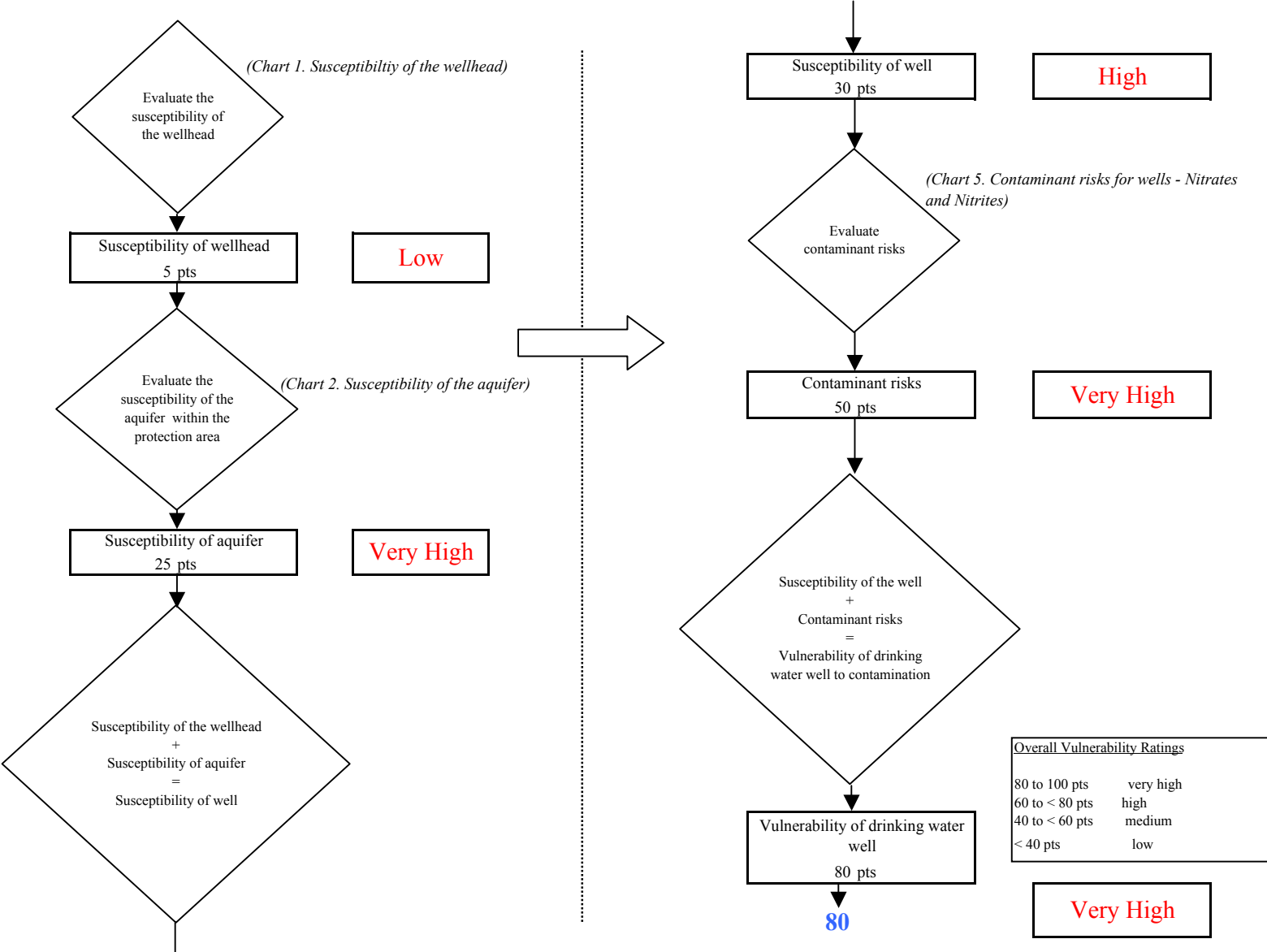
Chart 5. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Nitrates and Nitrites



**Chart 5. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Nitrates and Nitrites**

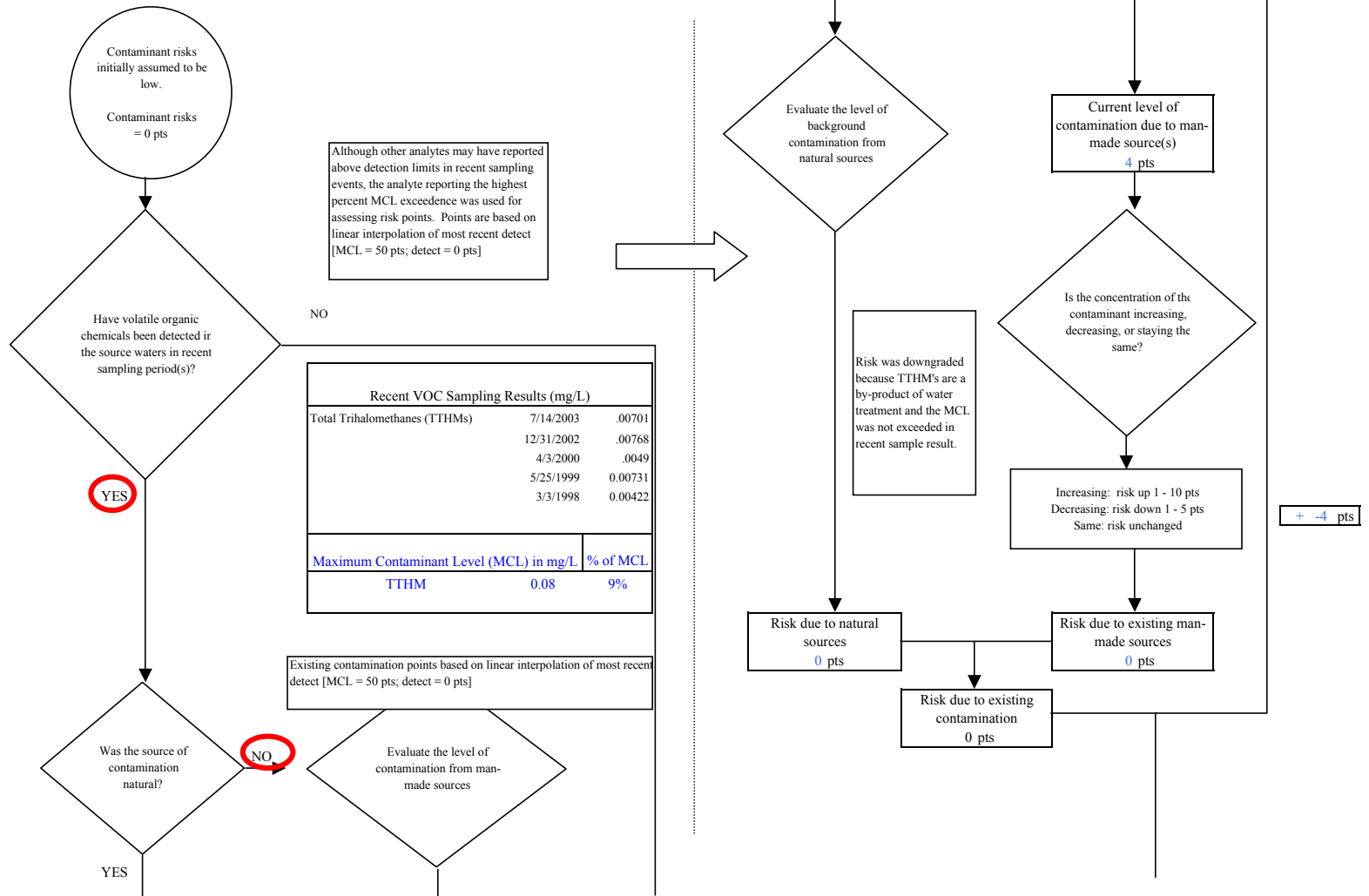


**Chart 6. Vulnerability analysis for Brevig Mission Water System (PWS No. 340418.001) - Nitrates and Nitrites**

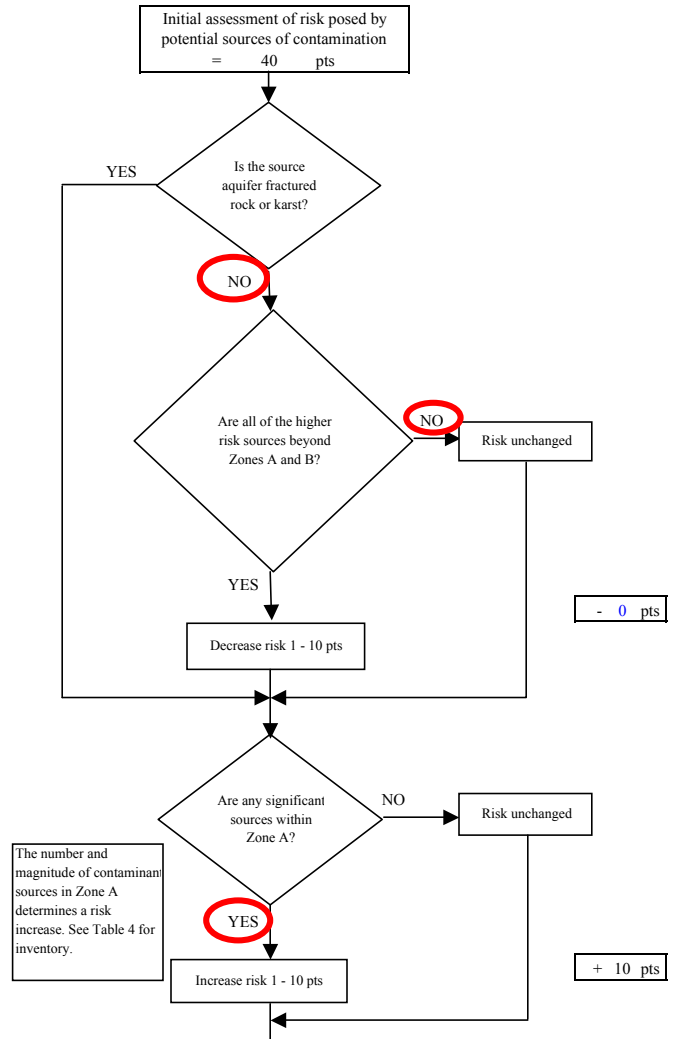
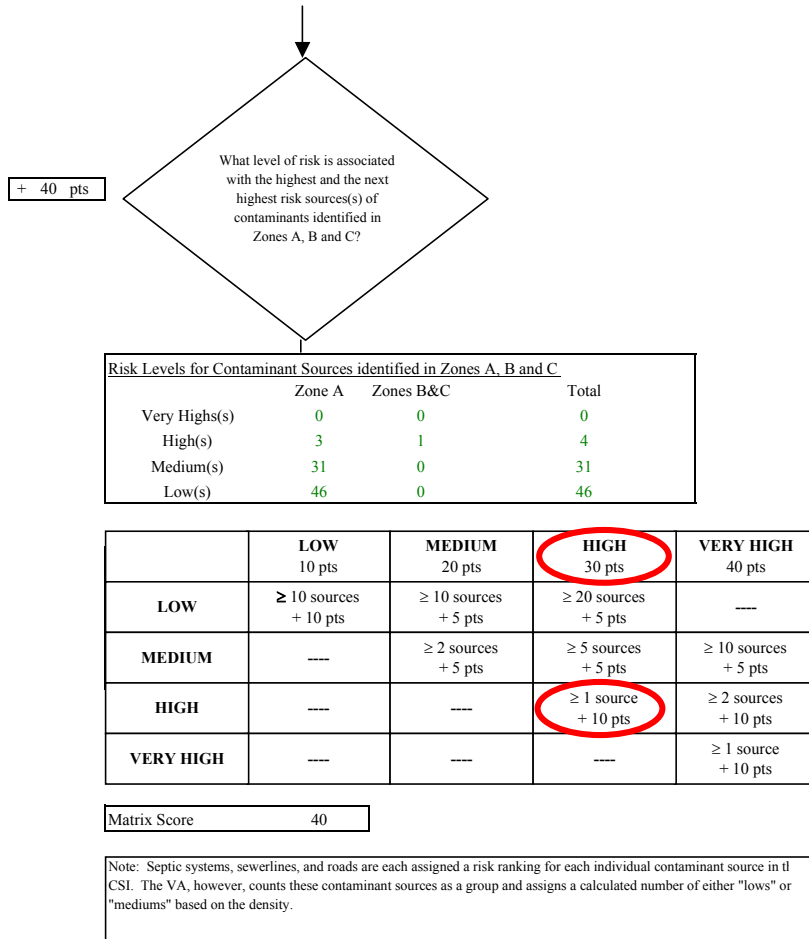




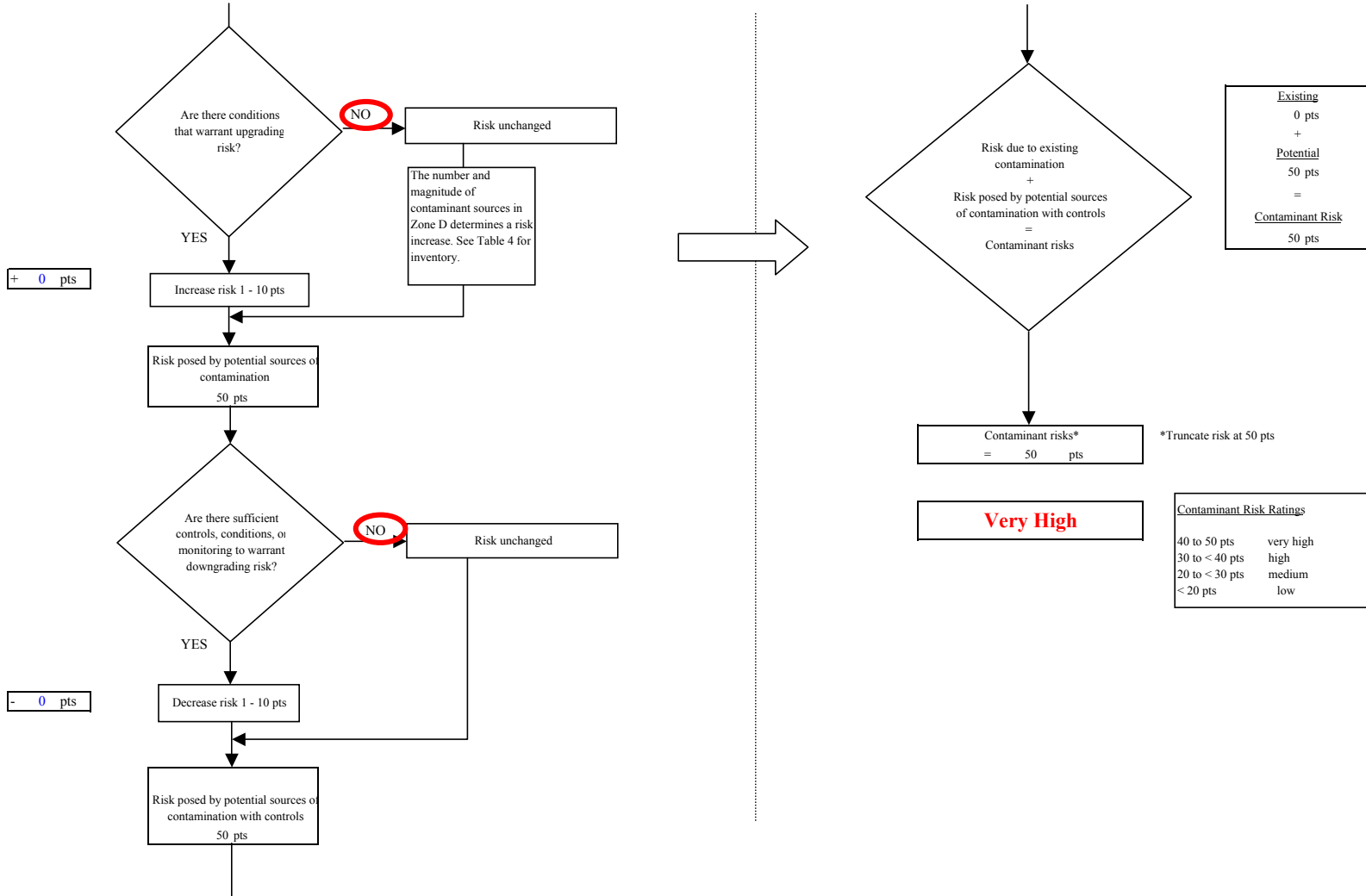
**Chart 7. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Volatile Organic Chemicals**



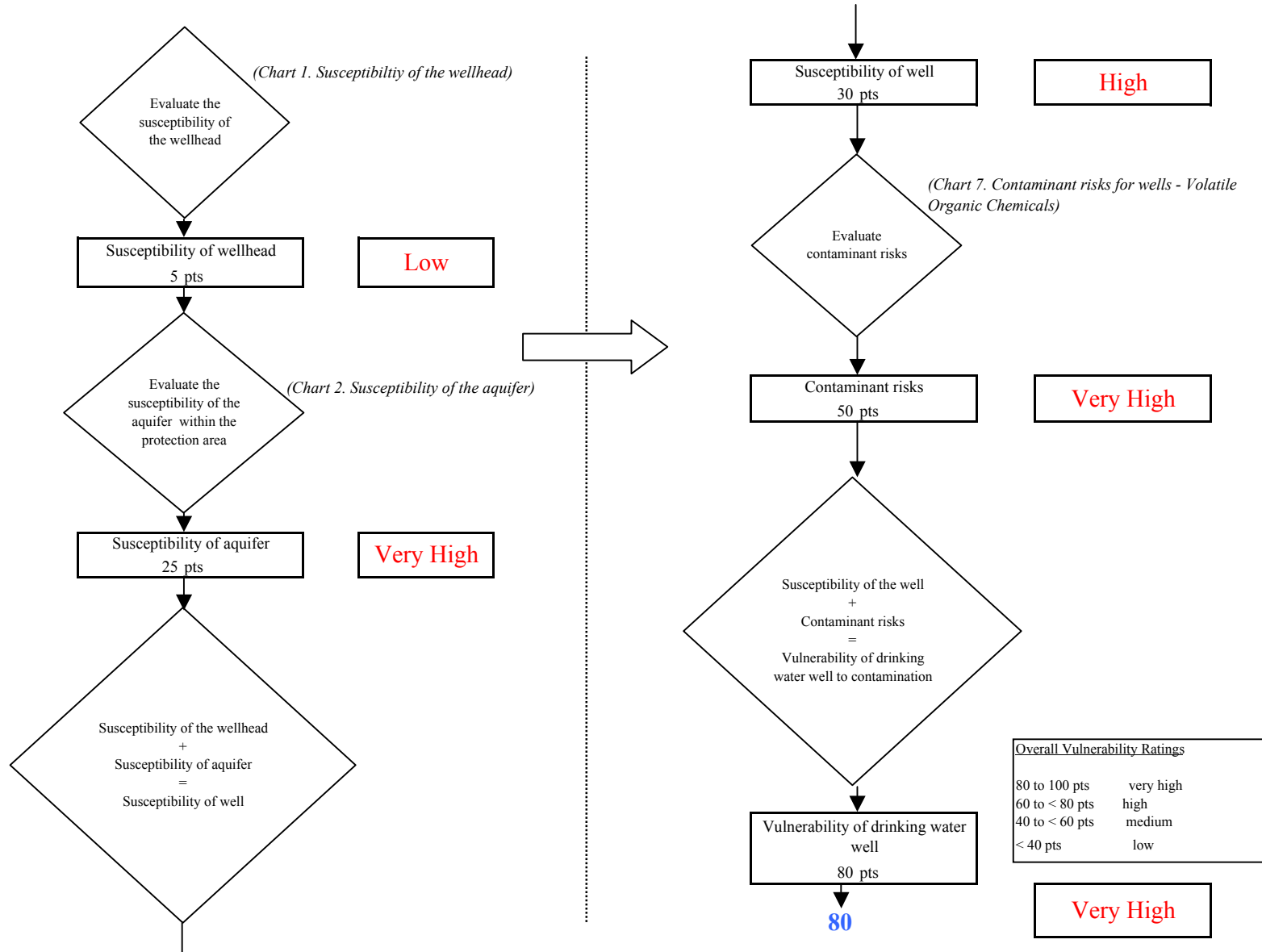
**Chart 7. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Volatile Organic Chemicals**



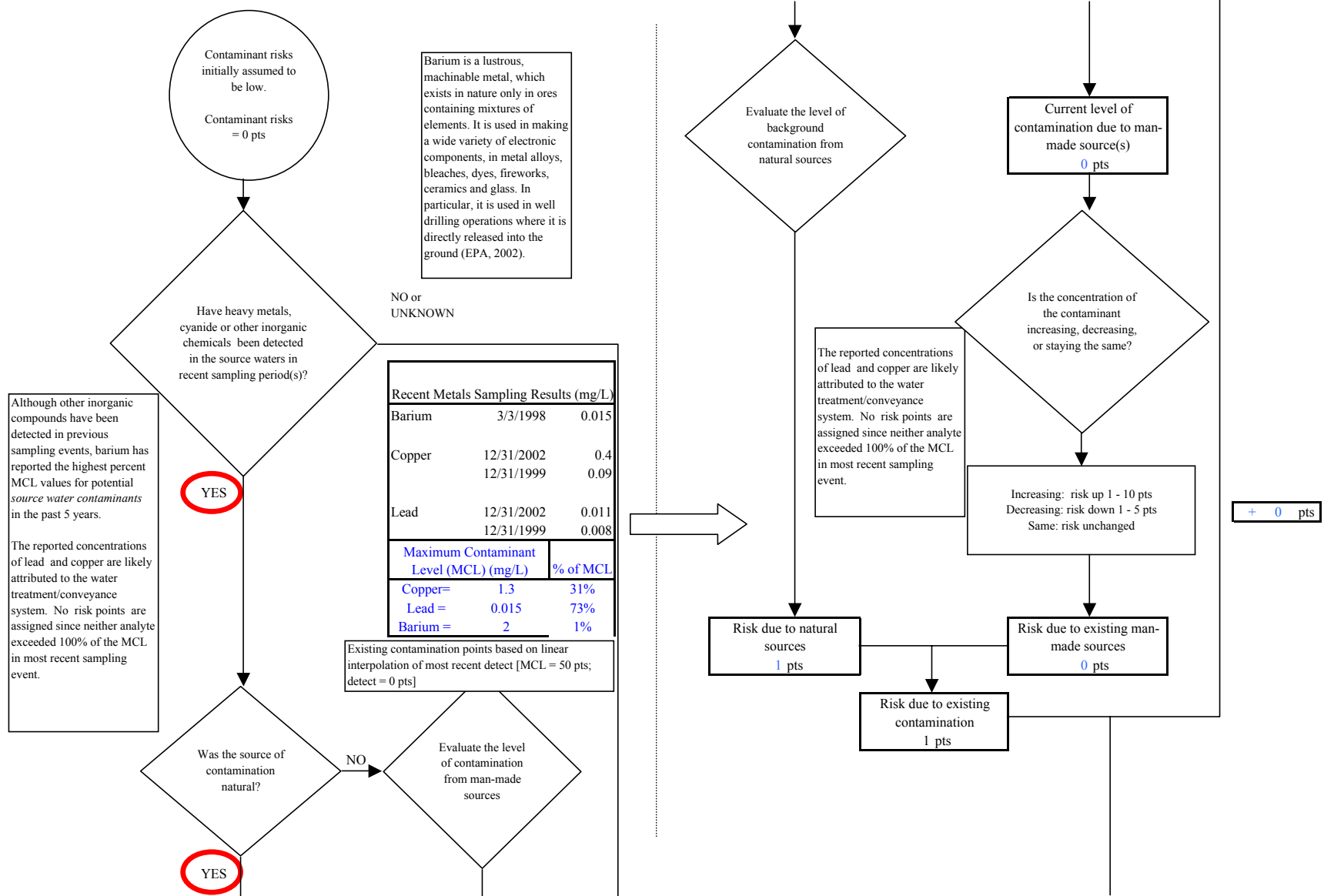
**Chart 7. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Volatile Organic Chemicals**



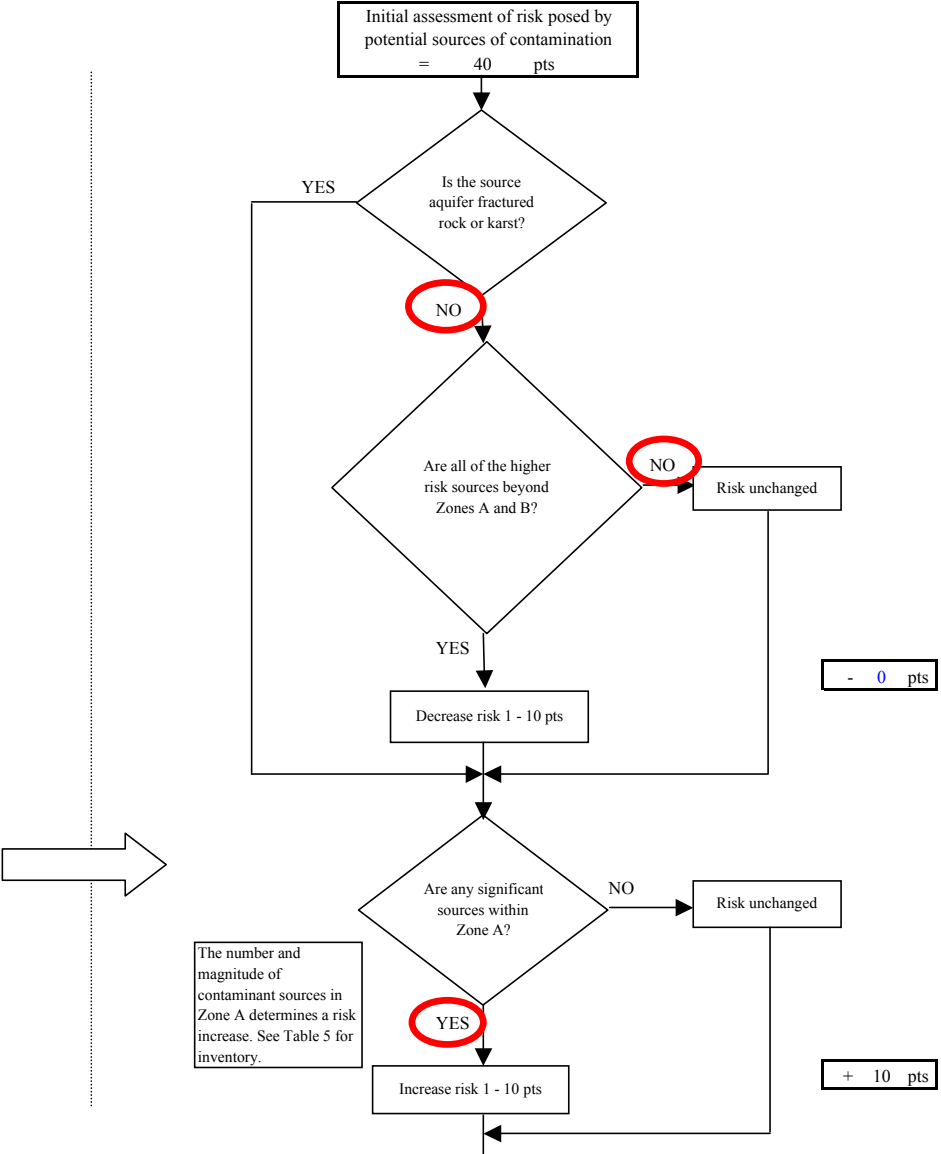
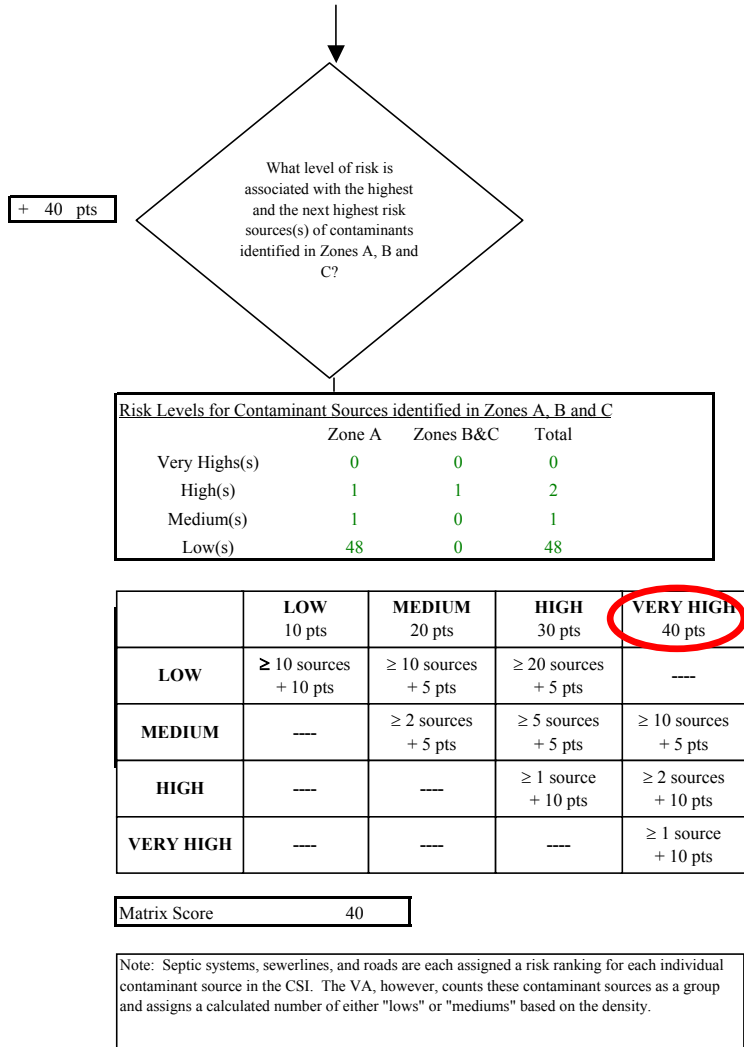
**Chart 8. Vulnerability analysis for Brevig Mission Water System (PWS No. 340418.001) - Volatile Organic Chemicals**



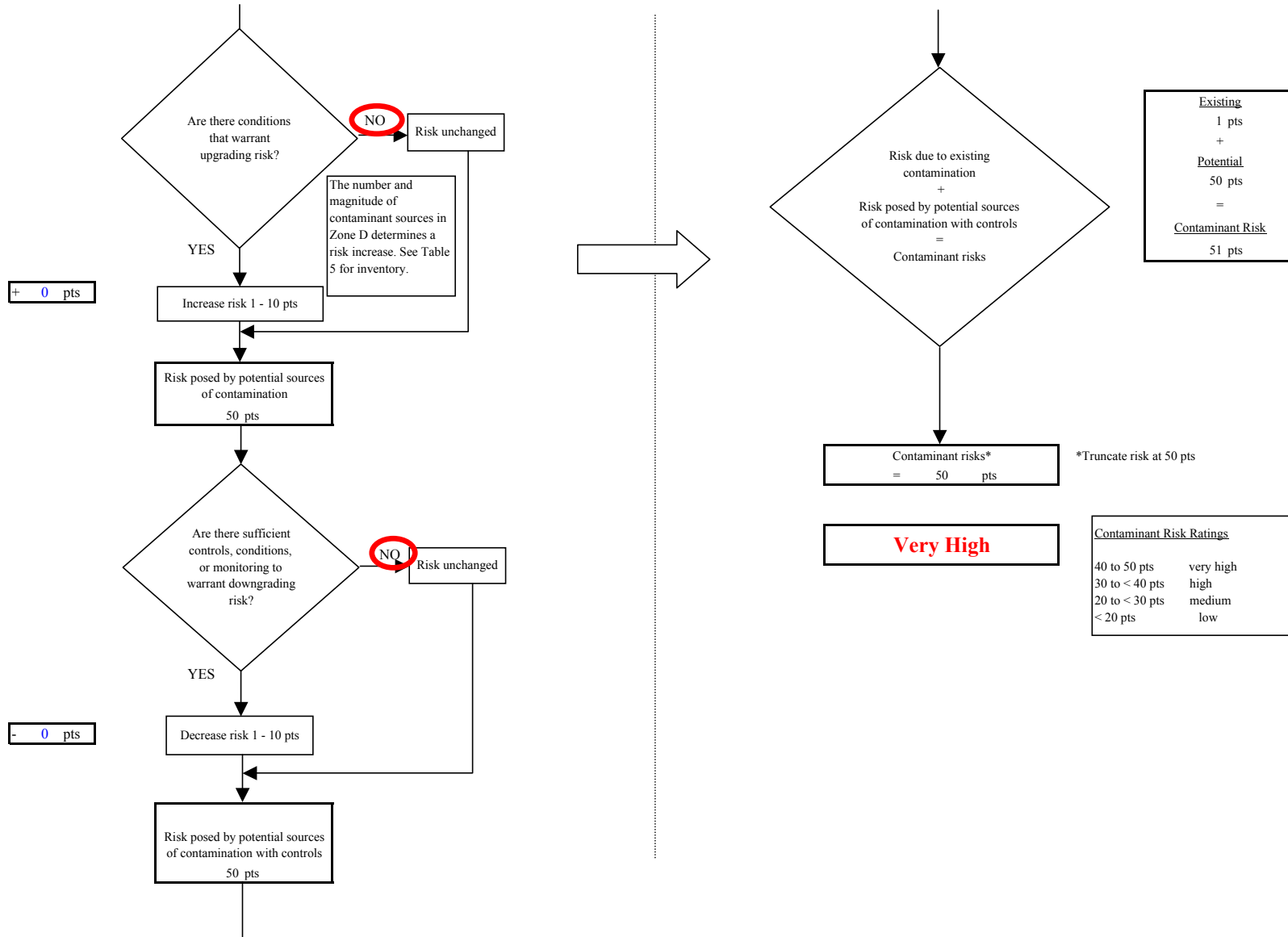
**Chart 9. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**



**Chart 9. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**



**Chart 9. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**



**Chart 10. Vulnerability analysis for Brevig Mission Water System (PWS No. 340418.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**

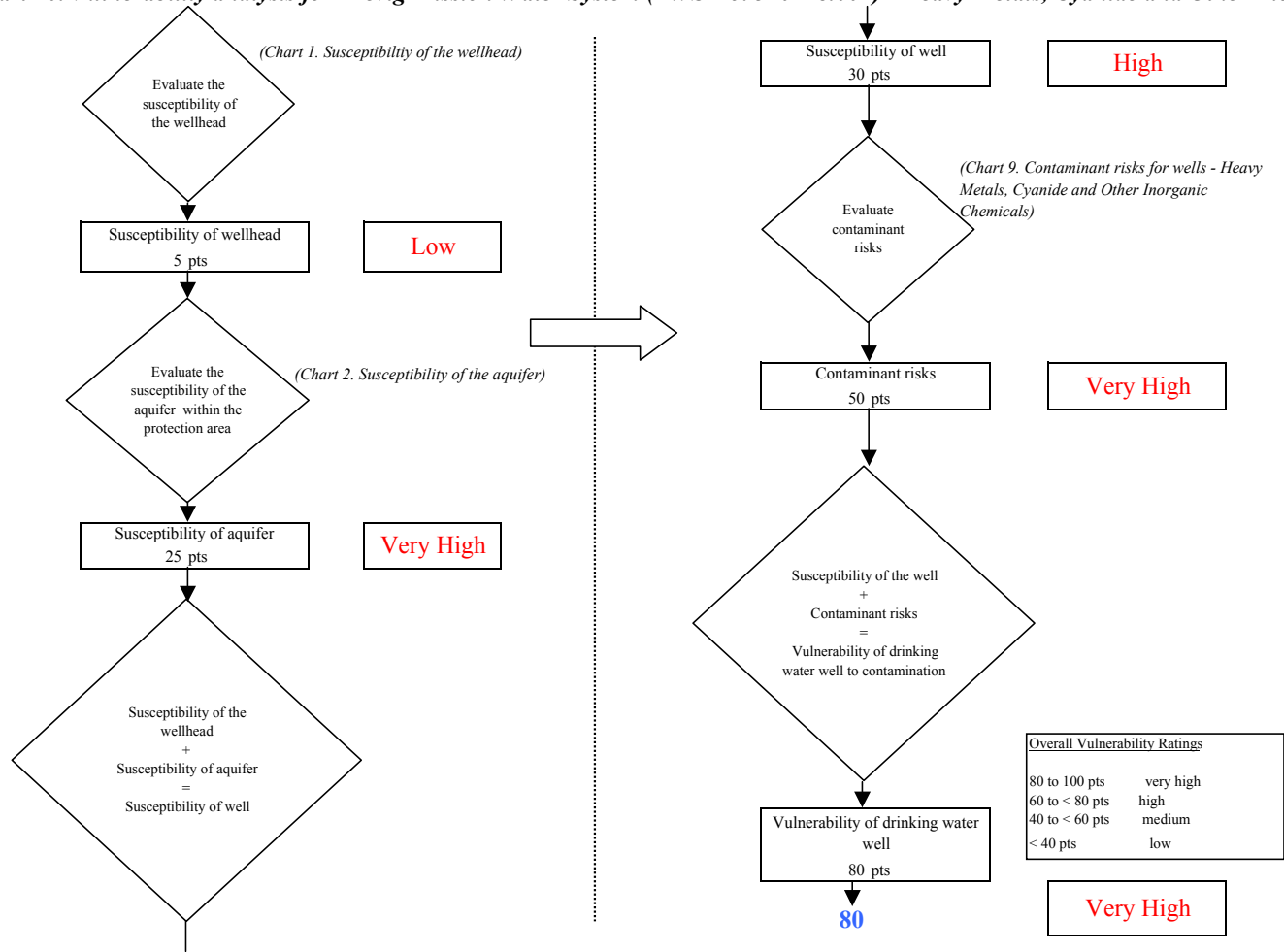




Chart 11. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Synthetic Organic Chemicals

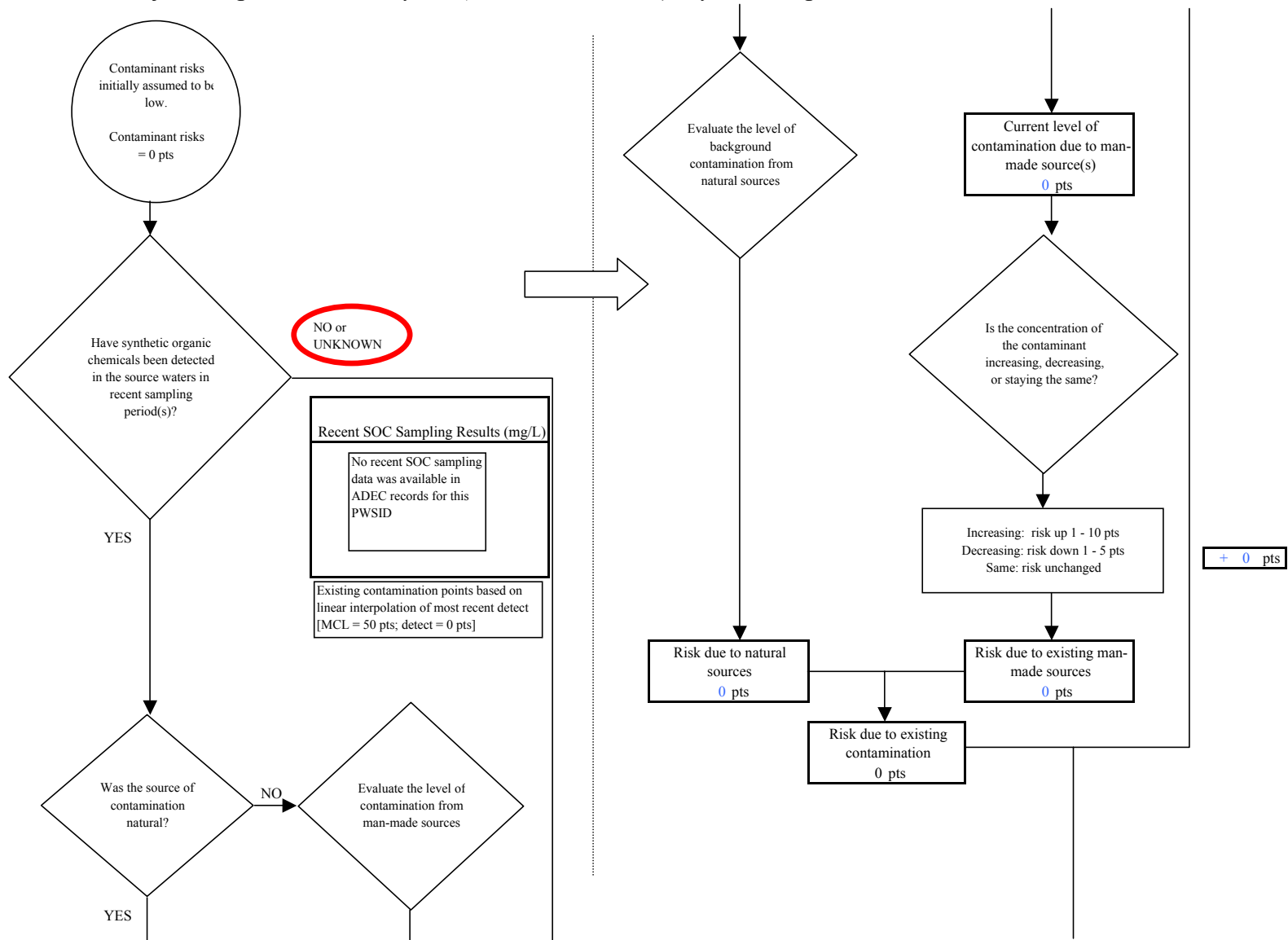
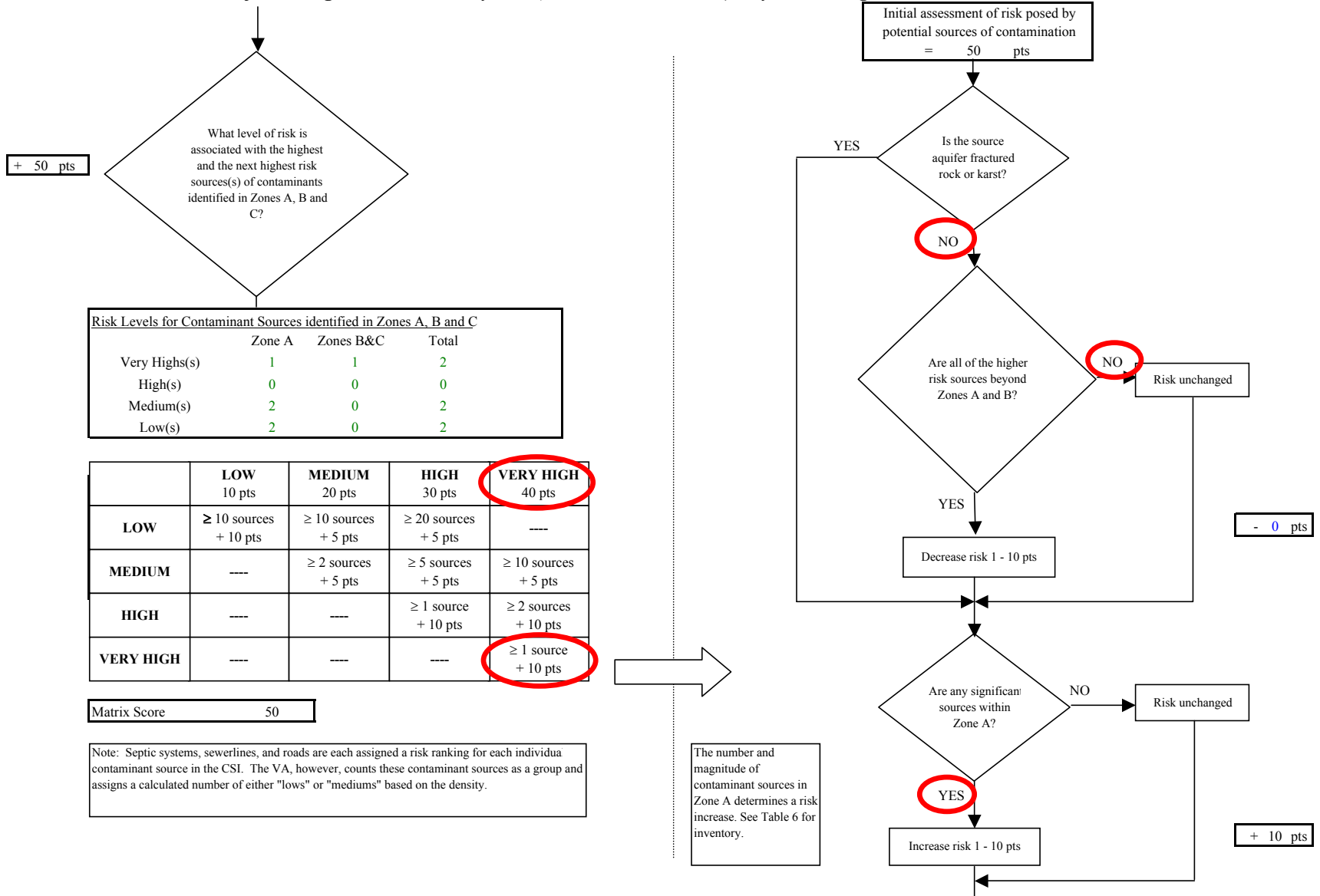
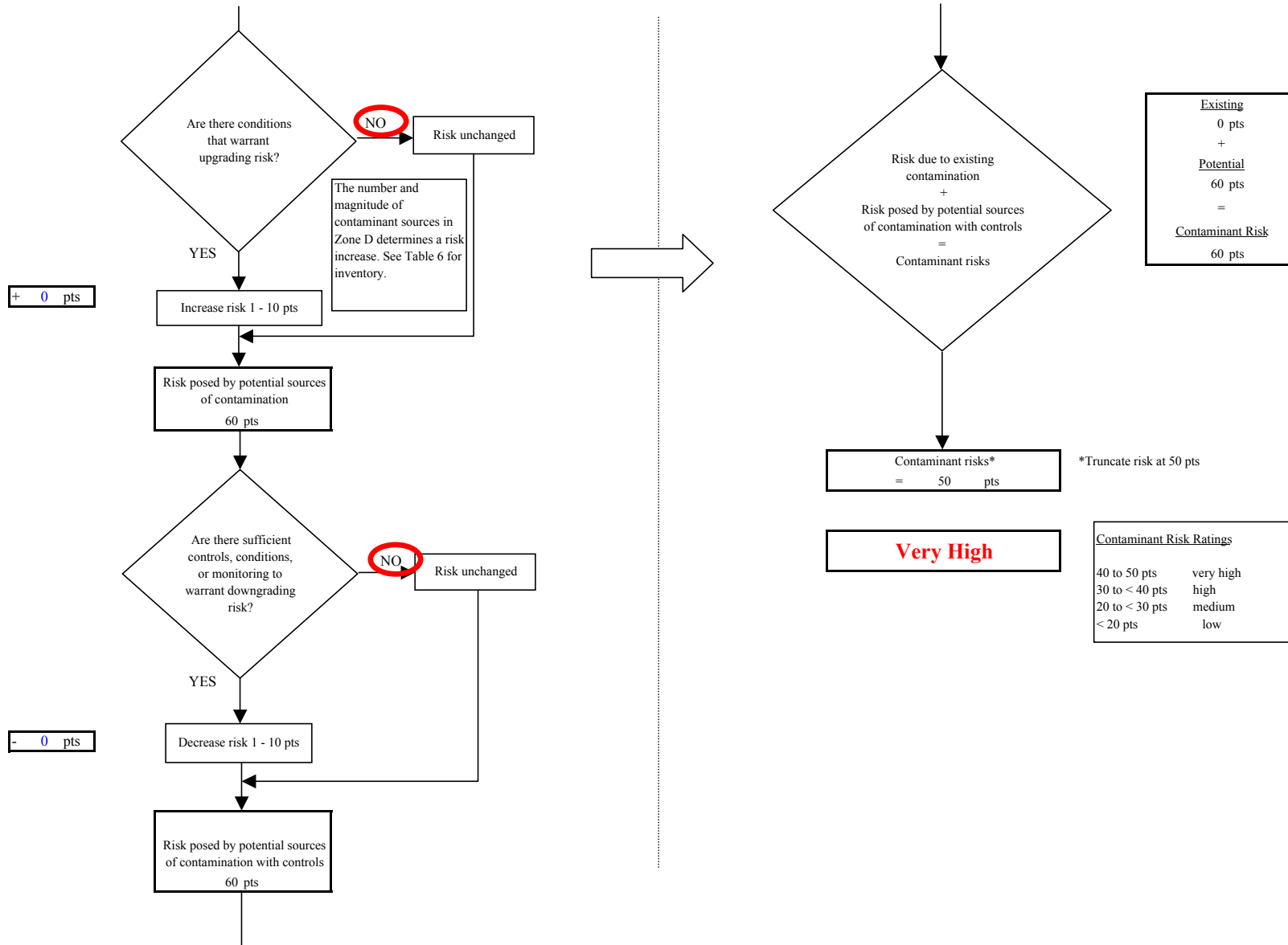


Chart 11. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Synthetic Organic Chemicals



**Chart 11. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Synthetic Organic Chemicals**



**Chart 12. Vulnerability analysis for Brevig Mission Water System (PWS No. 340418.001) - Synthetic Organic Chemicals**

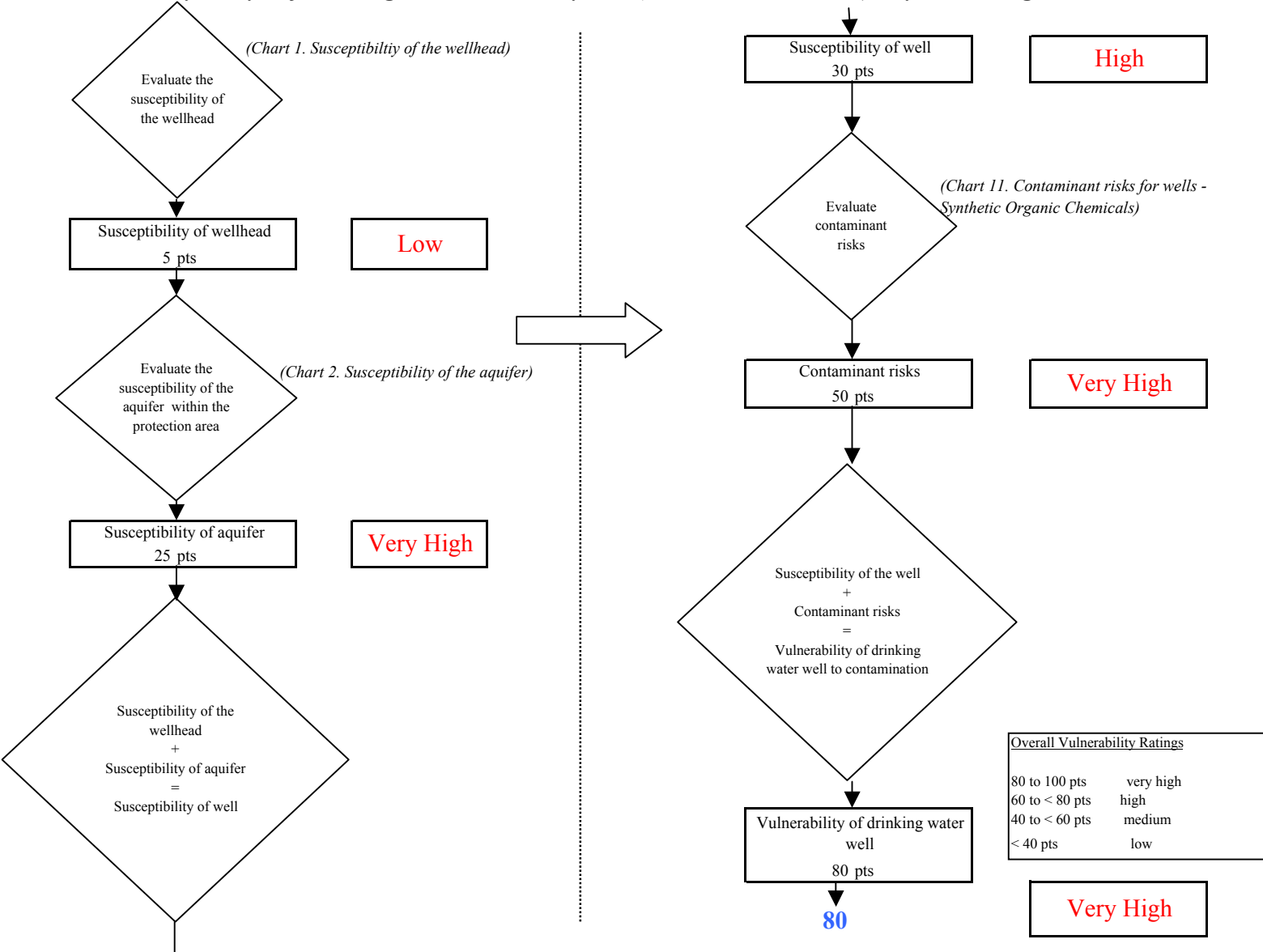


Chart 13. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Other Organic Chemicals

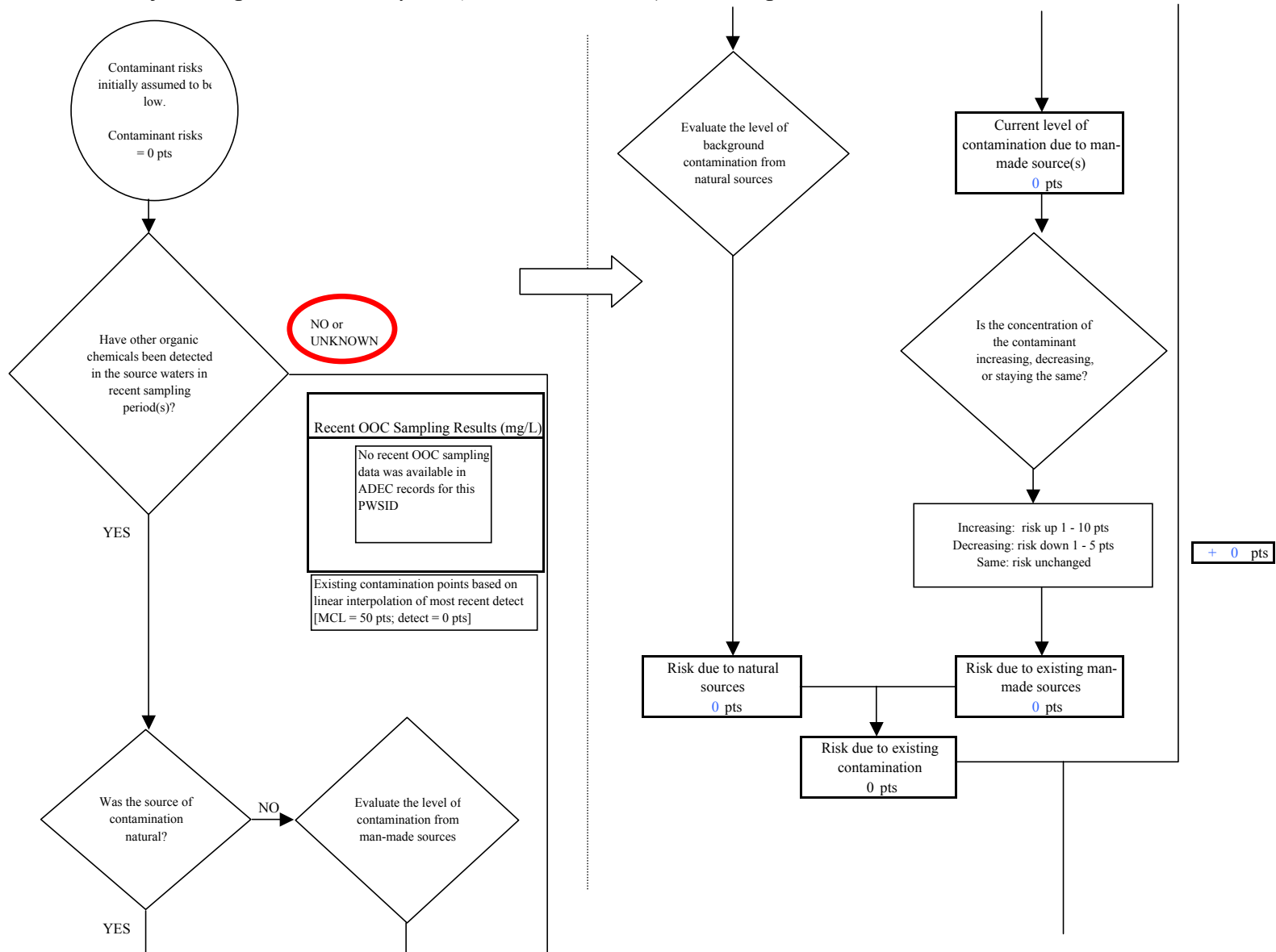
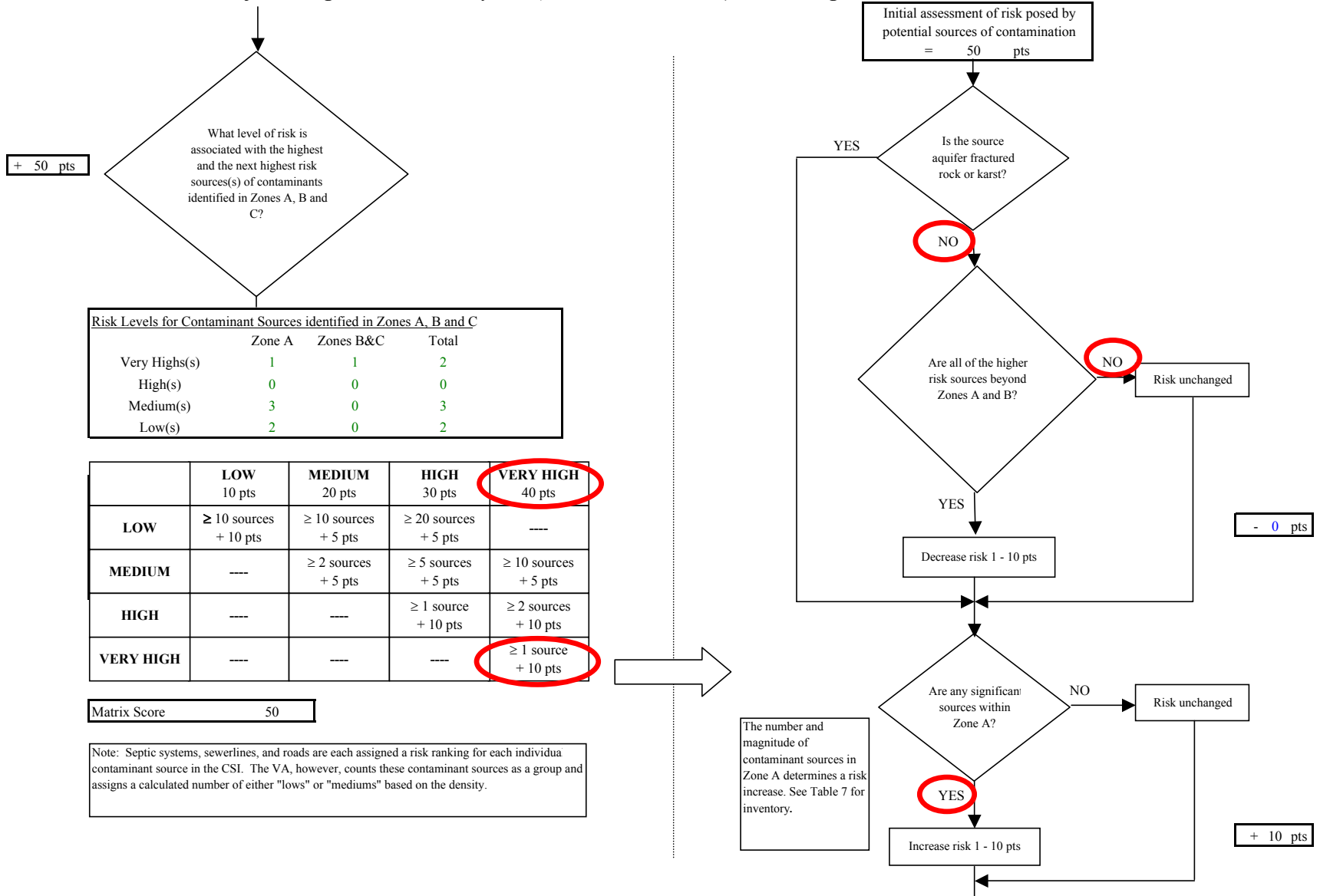
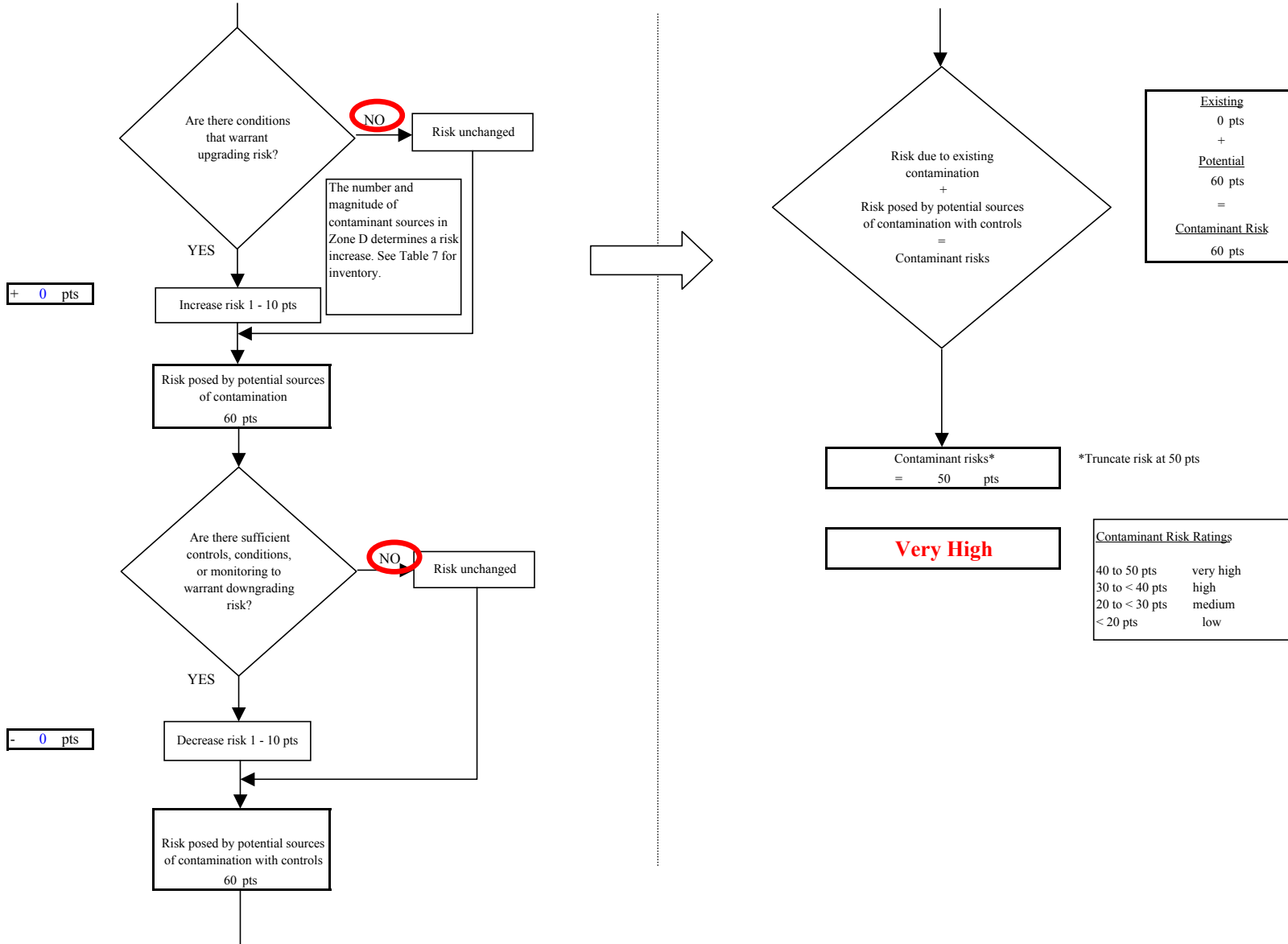


Chart 13. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Other Organic Chemicals



**Chart 13. Contaminant risks for Brevig Mission Water System (PWS No. 340418.001) - Other Organic Chemicals**



**Chart 14. Vulnerability analysis for Brevig Mission Water System (PWS No. 340418.001) - Other Organic Chemicals**

