Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Mentasta Lodge, Gakona, Alaska PWSID #380400

DRINKING WATER PROTECTION PROGRAM REPORT NO. 900

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.

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Source Water Assessment for Mentasta Lodge, Gakona, Alaska

Drinking Water Protection Program
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EXECUTIVE SUMMARY

The public water system for Mentasta Lodge is a Class B (transient/non-community) water system consisting of one well. Mentasta Lodge is located at Mile 78 of the Tok Cutoff, Gakona, Alaska. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **High** Combining these two ratings produces a **Very High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Mentasta Lodge public drinking water source include gasoline stations (without repair shop); large-capacity septic systems; underground diesel and gasoline tanks; and open leaking underground fuel storage sites (at Mentasta Lodge). These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Mentasta Lodge received a vulnerability rating of **Very High** for bacteria and viruses; nitrates and nitrites; and volatile organic chemicals.

MENTASTA LODGE PUBLIC DRINKING WATER SYSTEM

Mentasta Lodge public water system is a Class B (transient/non-community) water system. The system consists of one well located at Mile 78 of the Tok Cutoff, Gakona, Alaska (See Map 1 of Appendix A). Gakona is located at the confluence of the Copper and Gakona rivers, at Mile 2 on the Tok Cutoff to the Glenn Highway, 15 miles northeast of Glennallen. The population of Gakona is approximately 25.

The Mentasta Lodge area averages about 35 inches of precipitation per year, including 61 inches of snow. Although the quality of the groundwater can vary significantly in a short distance, groundwater supplies are generally abundant in the area. The elevation for Mentasta Lodge is approximately 2,300 feet. We assume the aquifer providing water for the drinking water well consists of alluvial sands and gravels.

According to a Sanitary Survey dated June 7, 1999, it is unknown when the existing well was installed; however it was installed with 6-inch diameter casing to a depth of 88 feet below ground surface. It is assumed that the length of the well screen is 10 feet. The Survey indicates that the land surface is sloped away from the well, providing adequate surface water drainage. It is assumed that the well is not grouted according to ADEC standards. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates year round and serves approximately 1 resident and 30 non-residents through one service connection.

MENTASTA LODGE 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 DWPA 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. The input parameters describing the attributes of the aquifer in this calculation were estimated from information contained in the well logs and/or the Sanitary Survey. Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DWPA (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The DWPAs established for wells by the ADEC are usually separated into four zones. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well.

The TOT 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 Mentasta Lodge extends over a mile to the southeast of the well, and includes only Zones A. Because the upland groundwater system may include fractured bedrock, the TOT may be more rapid than predicted. For this reason, the zones related to TOT have been expanded at the upland base. Development in the vicinity of the well is limited to only Zone A (See Map 1 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 Mentasta Lodge 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 B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals

The sources are displayed on Map 2 of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are 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 TOT 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, and volatile organic chemicals.

VULNERABILITY OF MENTASTA LODGE 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 eight 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. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile 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 well for Mentasta Lodge is completed in an unconfined aquifer. Because unconfined aquifers are recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Susceptibility scores and ratings for Mentasta Lodge.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	17	High
Natural Susceptibility	42	Very 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	40	Very High
Nitrates and/or Nitrites	46	Very High
Volatile Organic Chemicals	50	Very High

Finally, an overall vulnerability score is assigned for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

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 three 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	90	Very High
Volatile Organic Chemicals	90	Very High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with large-capacity septic systems representing the risks to the drinking water well (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. Recent sampling events indicated no recent positive results were detected for bacteria and viruses. However, after combining the contaminant risks with the overall natural susceptibility of the well, the vulnerability of the well to contamination by bacteria and viruses is **Very High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High** with large-capacity septic systems representing the risks to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Sampling history for Mentasta Lodge indicates that nitrates have been detected in the water, but only in very low concentrations (at 1.18 mg/L on 9/8/02) or 12% of the Maximum Contaminant Level (MCL). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Due to the high solubility and weak retention by soil, nitrates are very mobile, moving at approximately the same rate as water.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination by nitrates and nitrites is **Very High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High** with gasoline stations (without repair shops); large-capacity septic systems; and underground diesel and gasoline tanks the only known risks for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Recent sample data for the drinking water at Mentasta Lodge indicates that volatile organic chemicals have not been detected in the water. However, after combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination by volatile organic chemicals is **Very High**.

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Alaska Department of Community and Economic Development, Alaska Community Database, Detailed Community Information (2002). <http://www.dced.state.ak.us/mra/CF_BLOCK.cfm> (2003, September 1).

Alaska Department of Natural Resources, Well Log Tracking System (2002). <http://info.dec.state.ak.us/welts/Default.asp> (2003, September 1)

Alaska Geospatial Data Clearinghouse (2003). <http://agdc.usgs.gov/data/datasets.html> (2003, September 1)

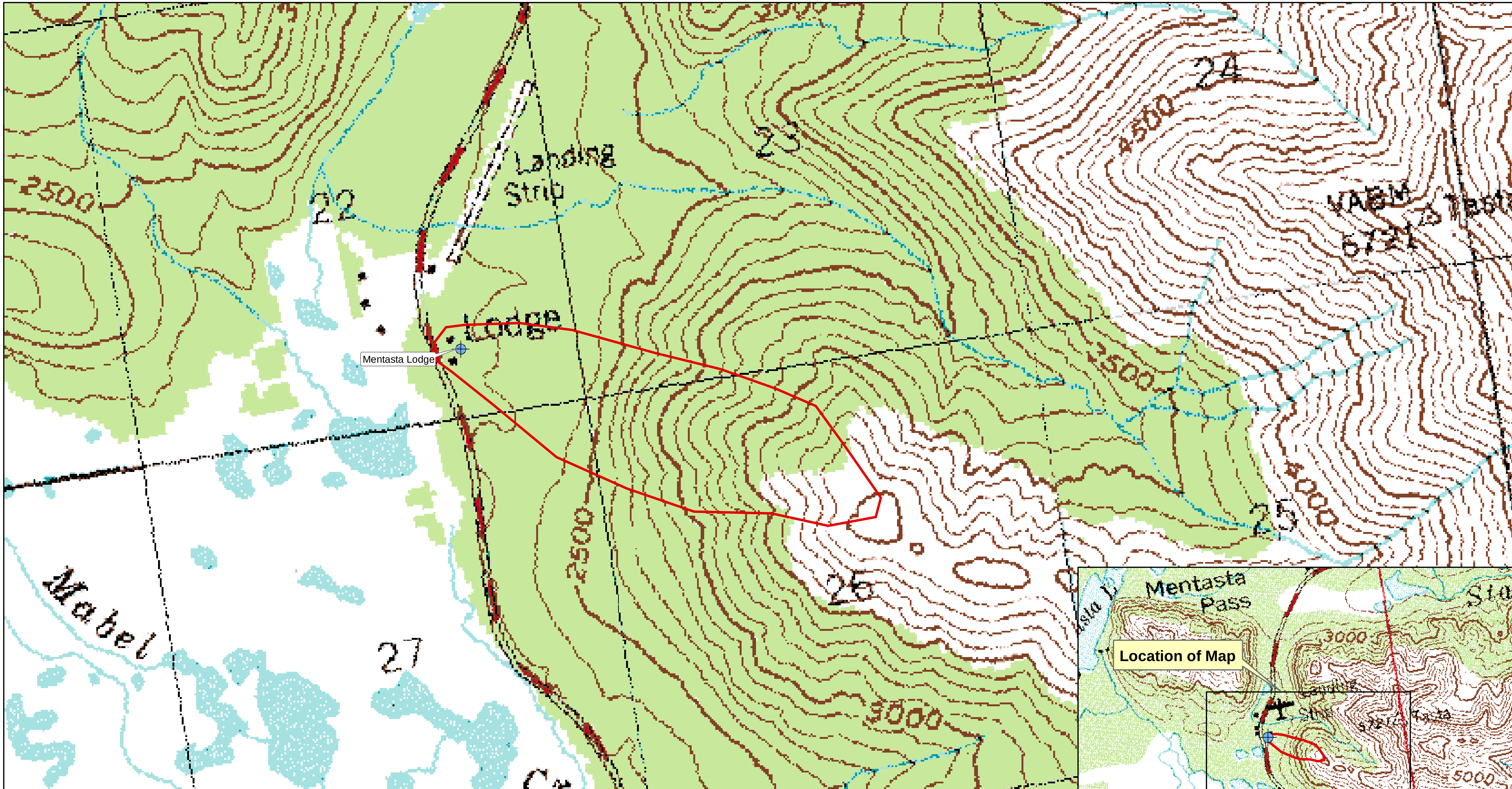
Freeze, R. Allen, and John A. Cherry, Groundwater. Englewood Cliffs: Prentice-Hall 1979.

King, P.B., compiler, 1969, Tectonic map of North America: US Geological Survey Map (Scale 1:5,000,000) 2 sheets.

United States Environmental Protection Agency (2002). <http://www.epa.gov/safewater/mcl.html#mcls> (2003, September 1)

APPENDIX A

Mentasta Lodge
Drinking Water Protection Area Location Map
(Map 1)



Map 1: Mentasta Lodge Drinking Water Protection Areas

PWSID: 380400.001

0 387.5 775 1,550 2,325 3,100 Feet

1:12,765

Legend

Public Drinking Water Systems

DWPA Zone A
Several Months Travel Time

DWPA Zone B
Less than 2 Years Travel Time

DWPA Zone C
Less than 5 Years Travel Time

DWPA Zone D
Less than 10 Years Travel Time

Data Sources:

Background image - USGS 1:63,000 mapping

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Mentasta Lodge (Tables 1-4)

Table 1 **Contaminant Source Inventory for Mentasta Lodge** **PWSID 380400.001**

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Gasoline stations (without repair shop)	C15	C15-1	A	2	Mentasta Lodge Gas Station
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	2	Mentasta Lodge Septic System
Tanks, diesel (underground)	T08	T08-1	A	2	Mentasta Lodge Diesel UST
Tanks, gasoline (underground)	T12	T12-1	A	2	Mentasta Lodge Gas Tank
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	A	2	Mentasta Lodge
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-2	A	2	Mentasta Lodge

Table 2

Contaminant Source Inventory and Risk Ranking for Mentasta Lodge Sources of Bacteria and Viruses

PWSID 380400.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	Mentasta Lodge Septic System

Table 3

Contaminant Source Inventory and Risk Ranking for Mentasta Lodge Sources of Nitrates/Nitrites

PWSID 380400.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	Mentasta Lodge Septic System

Table 4

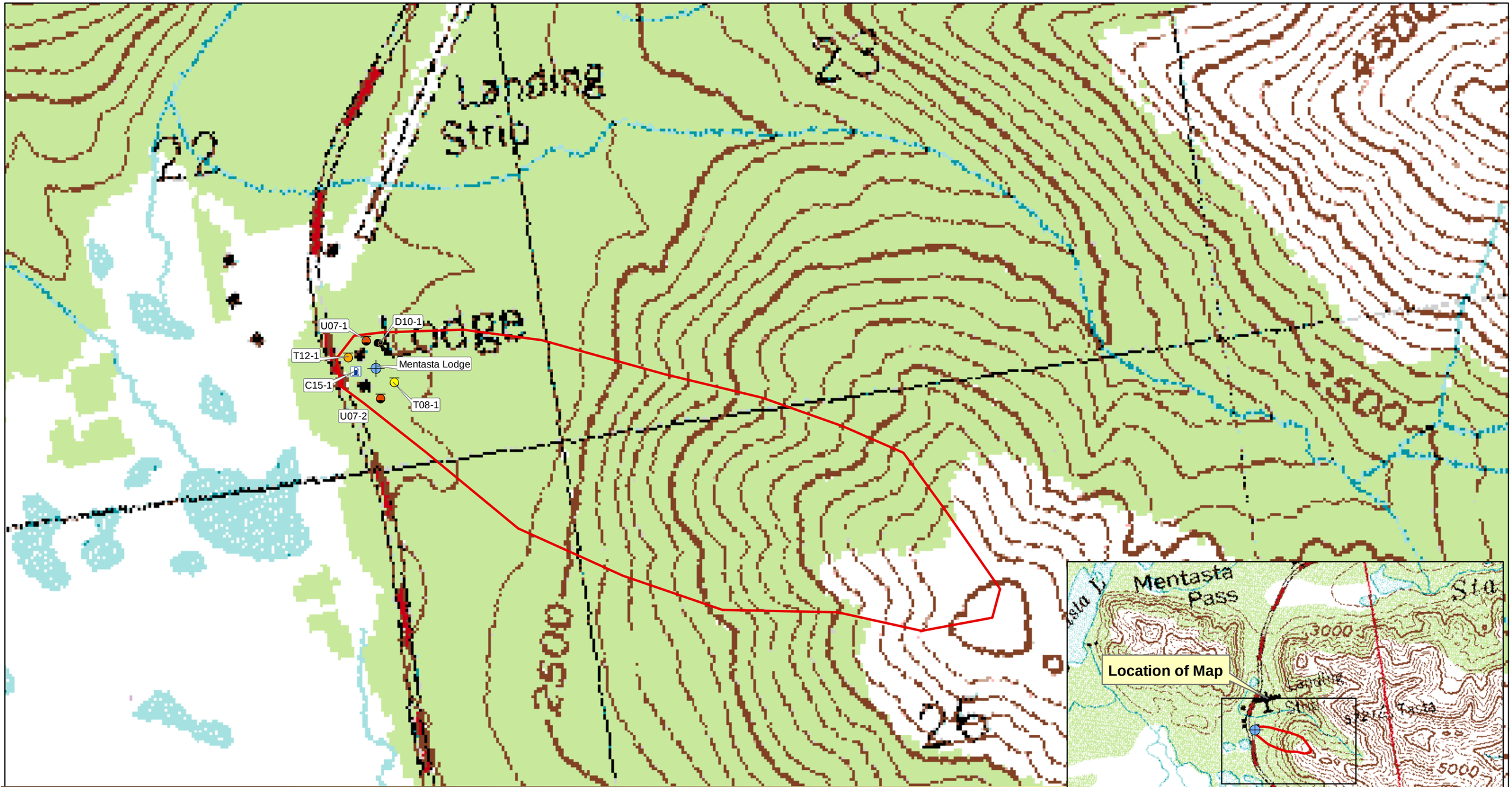
Contaminant Source Inventory and Risk Ranking for Mentasta Lodge Sources of Volatile Organic Chemicals

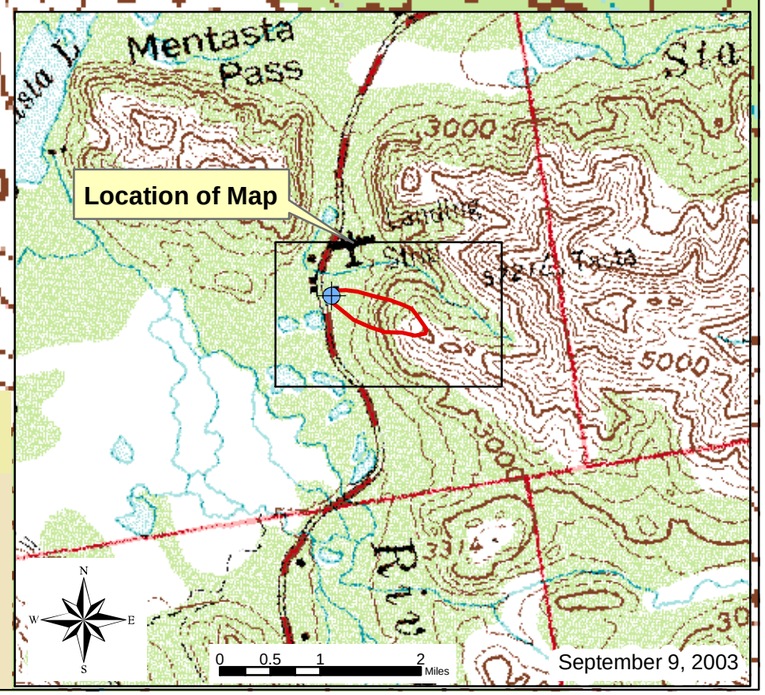
PWSID 380400.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Gasoline stations (without repair shop)	C15	C15-1	A	High	2	Mentasta Lodge Gas Station
Injection wells (Class V) Large-Capacity Septic system (Drainfield Disposal Method)	D10	D10-1	A	Low	2	Mentasta Lodge Septic System
Tanks, diesel (underground)	T08	T08-1	A	High	2	Mentasta Lodge Diesel UST
Tanks, gasoline (underground)	T12	T12-1	A	High	2	Mentasta Lodge Gas Tank

APPENDIX C

Mentasta Lodge
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)





Map 2: Drinking Water Protection Areas for Mentasta Lodge and Potential and Existing Sources of Contamination

PWSID: 380400.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 270 540 1,080 1,620 2,160 Feet

1:8,498

Data Sources:

Background image - USGS 1:63,000 mapping

Legend

- Public Drinking Water Systems
- Gas Station (C15)
- Large Capacity Septic System (D10)
- Underground Diesel Tank (T08)
- Underground Gas Tank (T12)
- Open Leaking Underground Storage Tank (U07)

DWPA Zone A
Several Months Travel Time

DWPA Zone B
Less than 2 Years Travel Time

DWPA Zone C
Less than 5 Years Travel Time

DWPA Zone D
Less than 10 Years Travel Time

APPENDIX D

Vulnerability Analysis for Mentasta Lodge Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Mentasta Lodge

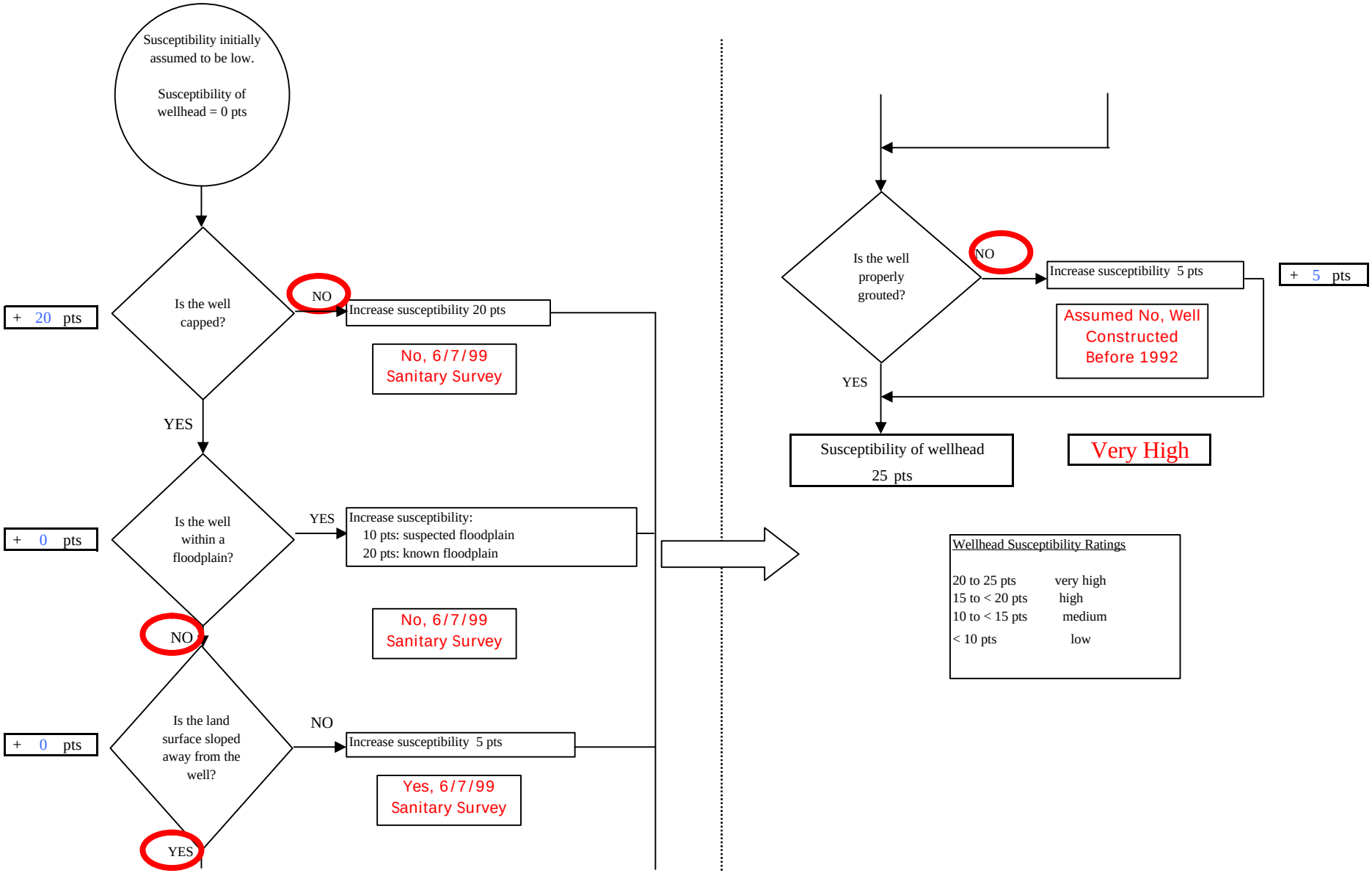


Chart 2. Susceptibility of the aquifer - Mentasta Lodge

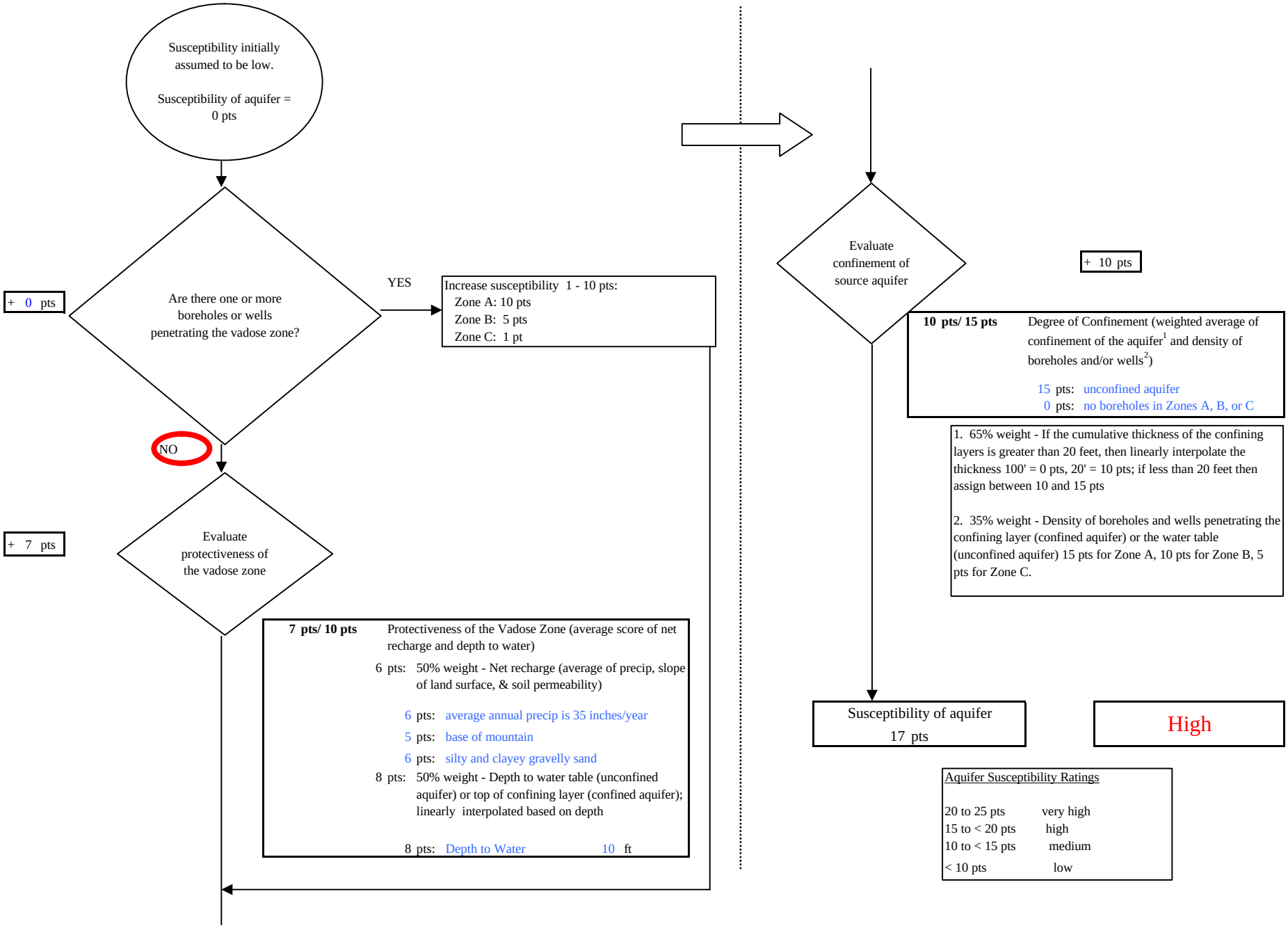
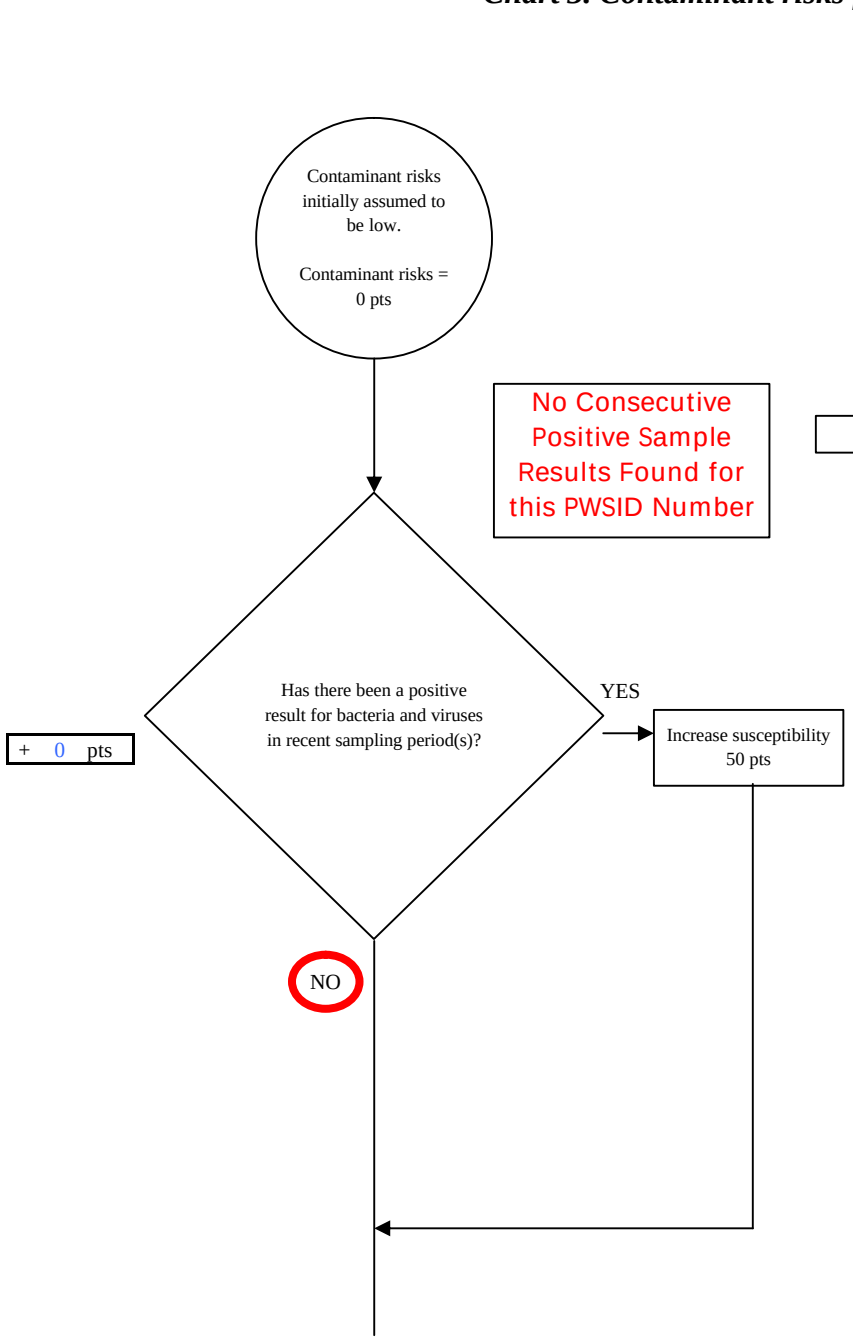
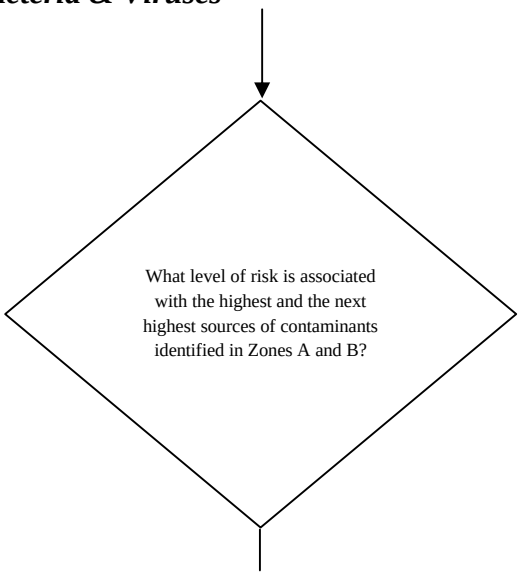


Chart 3. Contaminant risks for Mentasta Lodge - Bacteria & Viruses



No Consecutive Positive Sample Results Found for this PWSID Number



+ 30 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	0	0	0

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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 30

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 3. Contaminant risks for Mentasta Lodge - Bacteria & Viruses

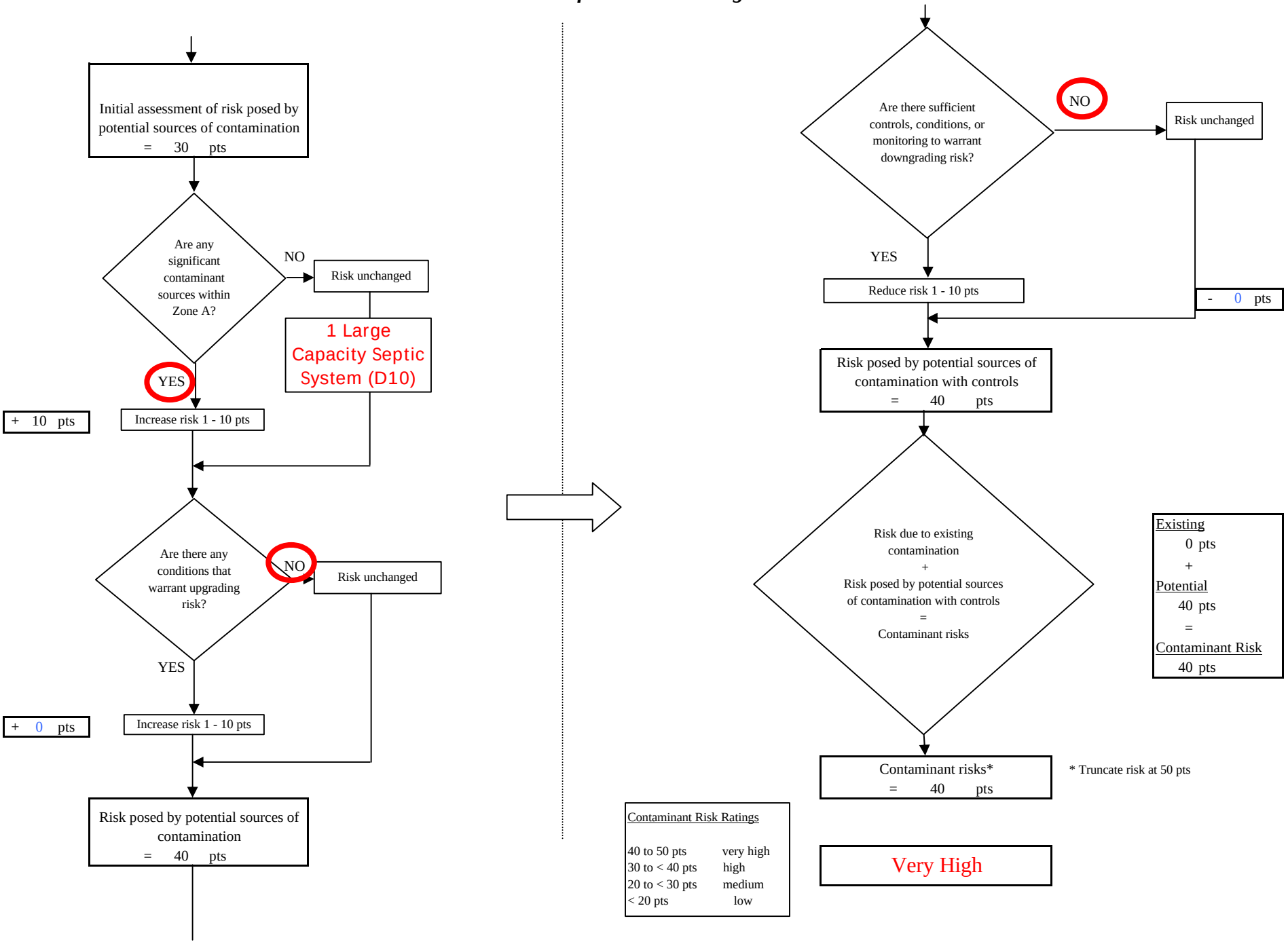


Chart 4. Vulnerability analysis for Mentasta Lodge - Bacteria & Viruses

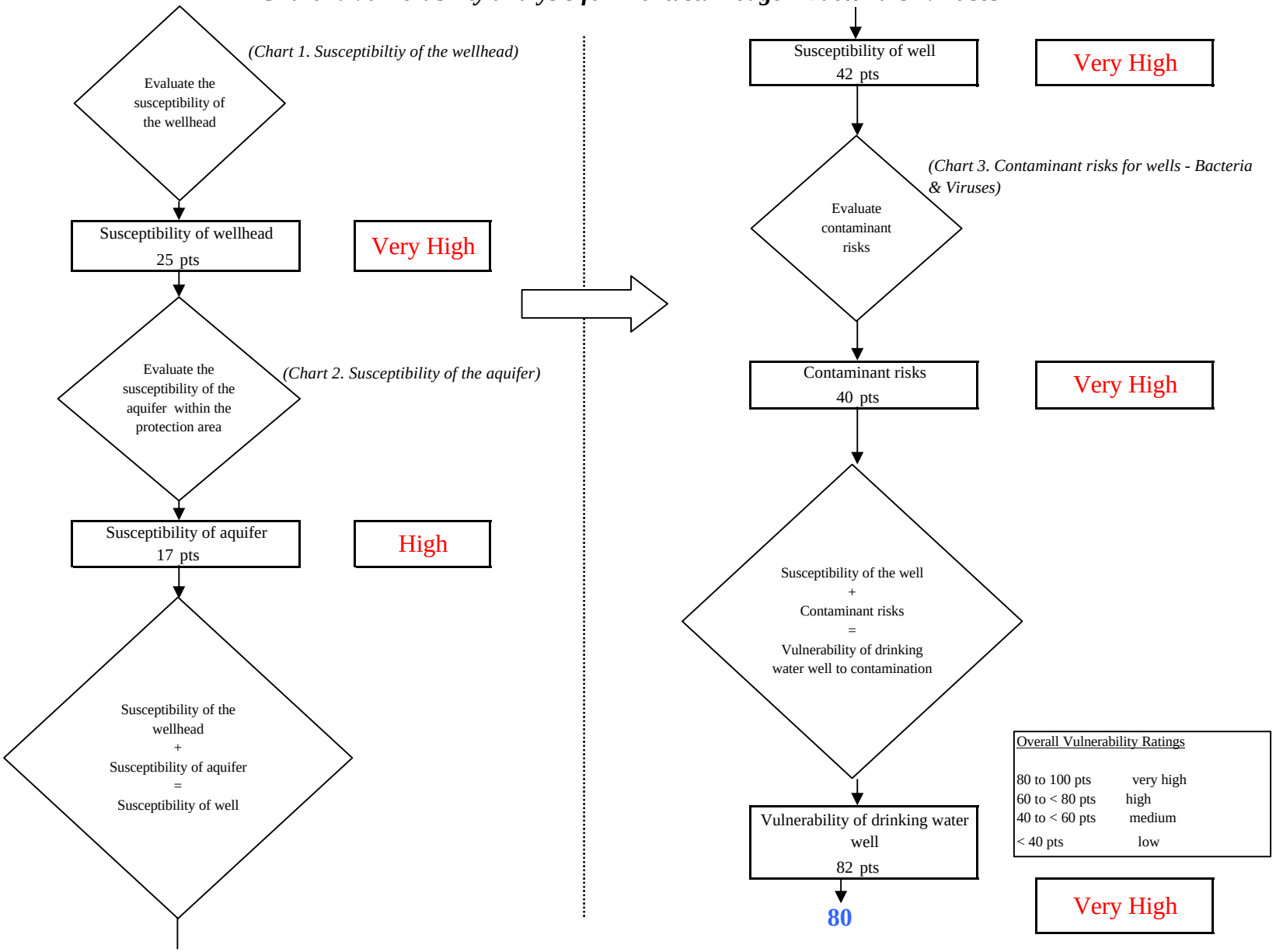


Chart 5. Contaminant risks for Mentasta Lodge - Nitrates and Nitrites

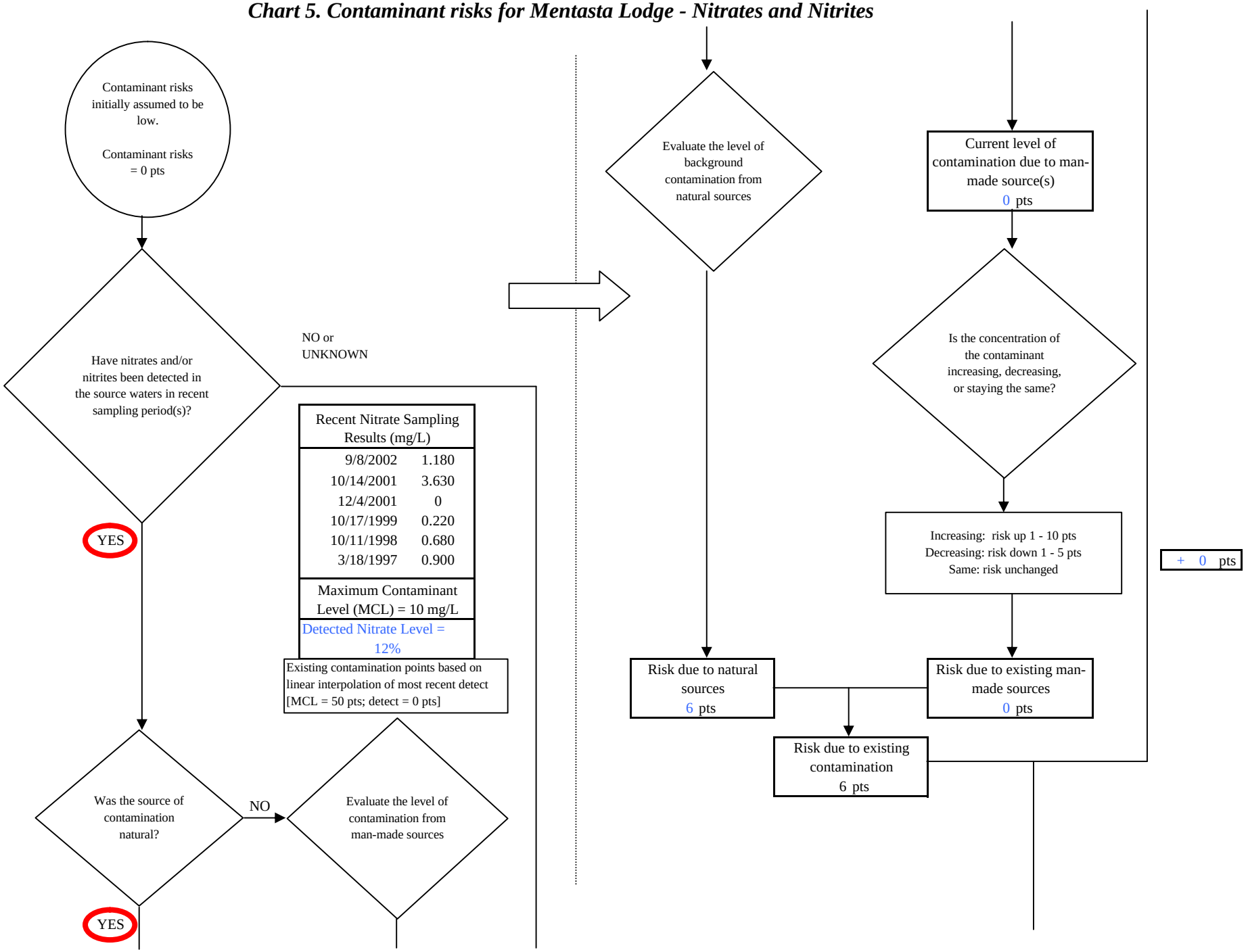


Chart 5. Contaminant risks for Mentasta Lodge - Nitrates and Nitrites

+ 30 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

Risk 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)	1	0	1
Medium(s)	0	0	0
Low(s)	0	0	0

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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 30

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.

Initial assessment of risk posed by potential sources of contamination = 30 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO → Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

1 Large Capacity Septic System (D10)

Increase risk 1 - 10 pts

+ 10 pts

Chart 5. Contaminant risks for Mentasta Lodge - Nitrates and Nitrites

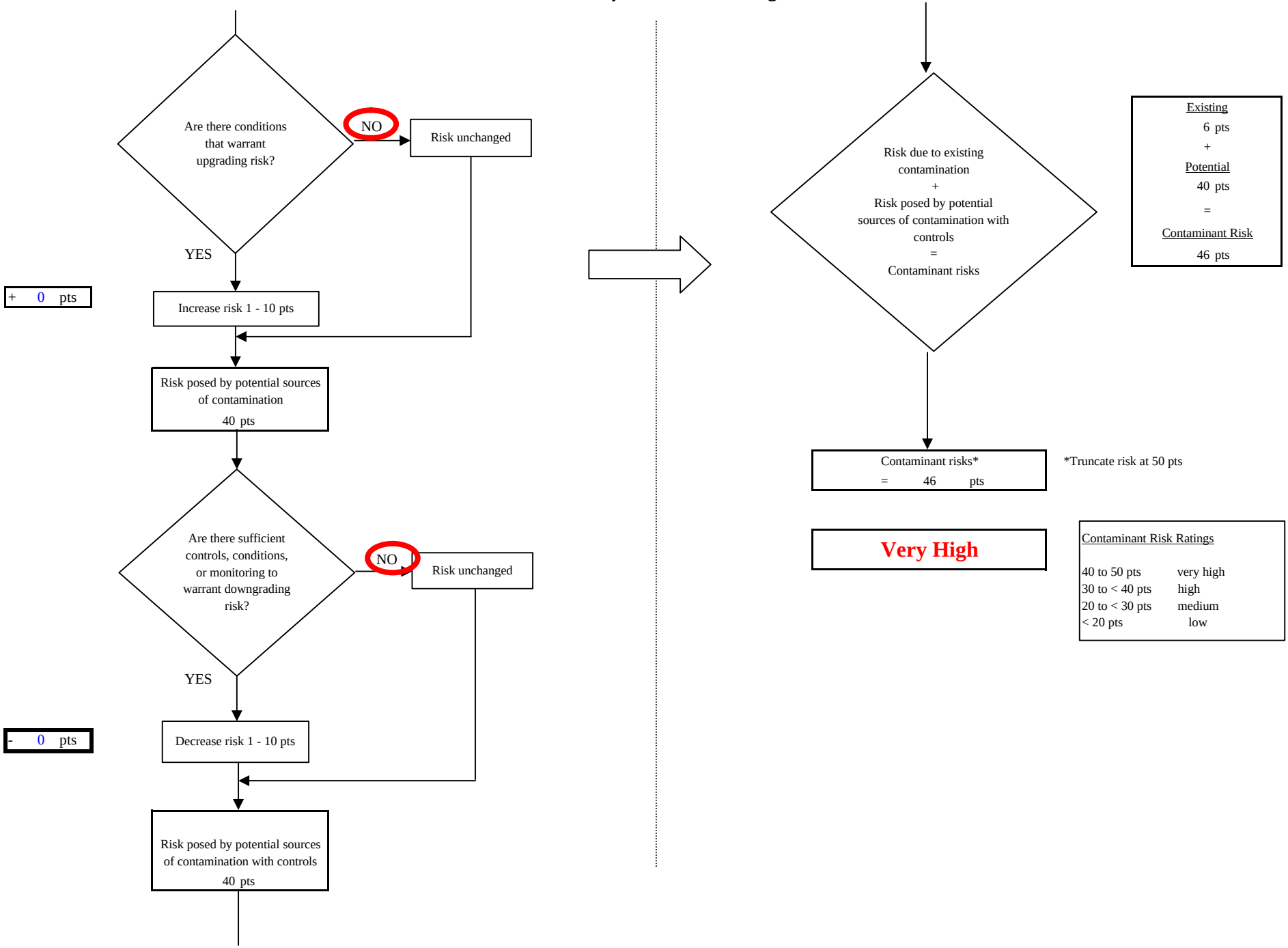


Chart 6. Vulnerability analysis for Mentasta Lodge - Nitrates and Nitrites

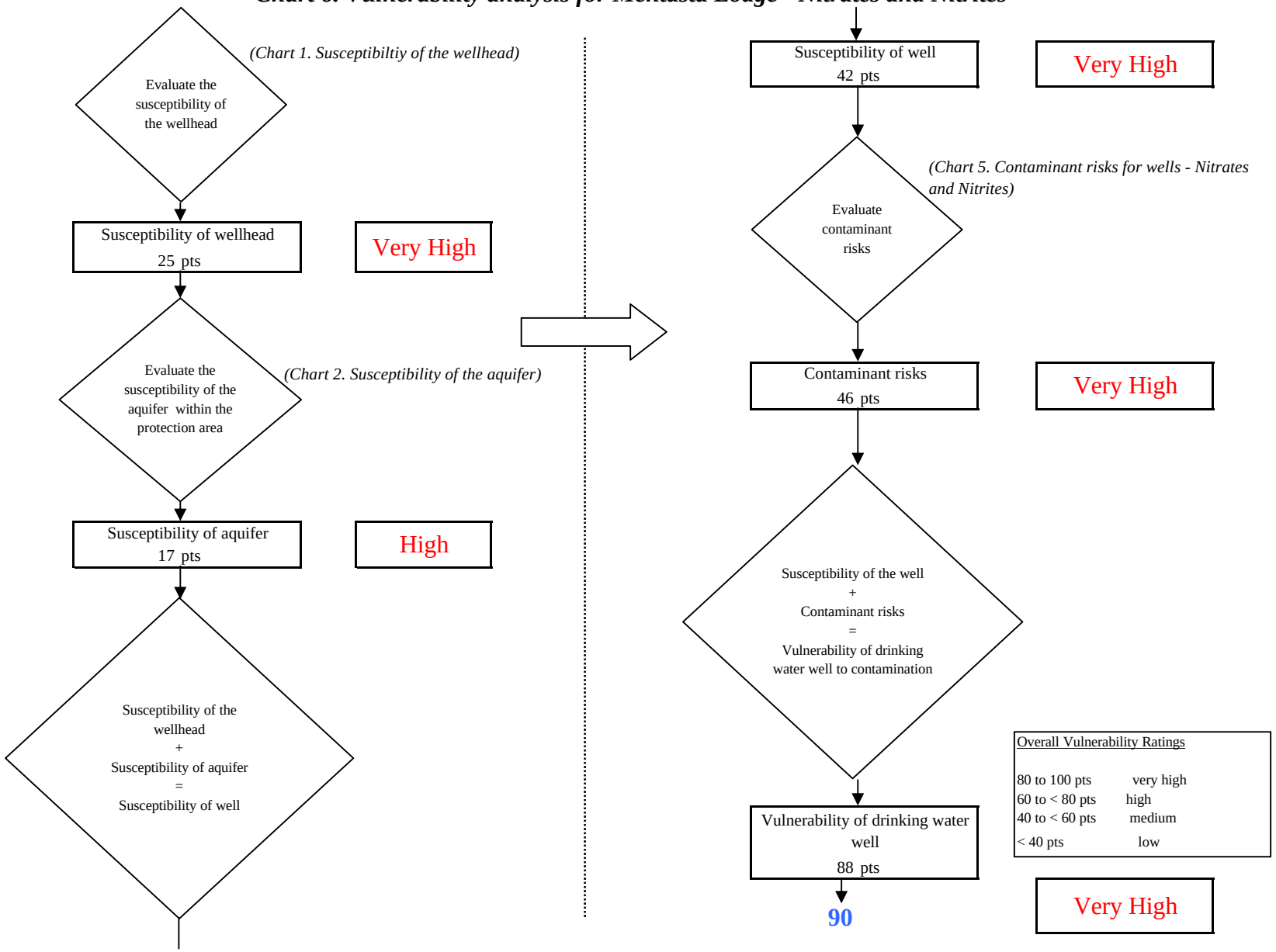


Chart 7. Contaminant risks for Mentasta Lodge - Volatile Organic Chemicals

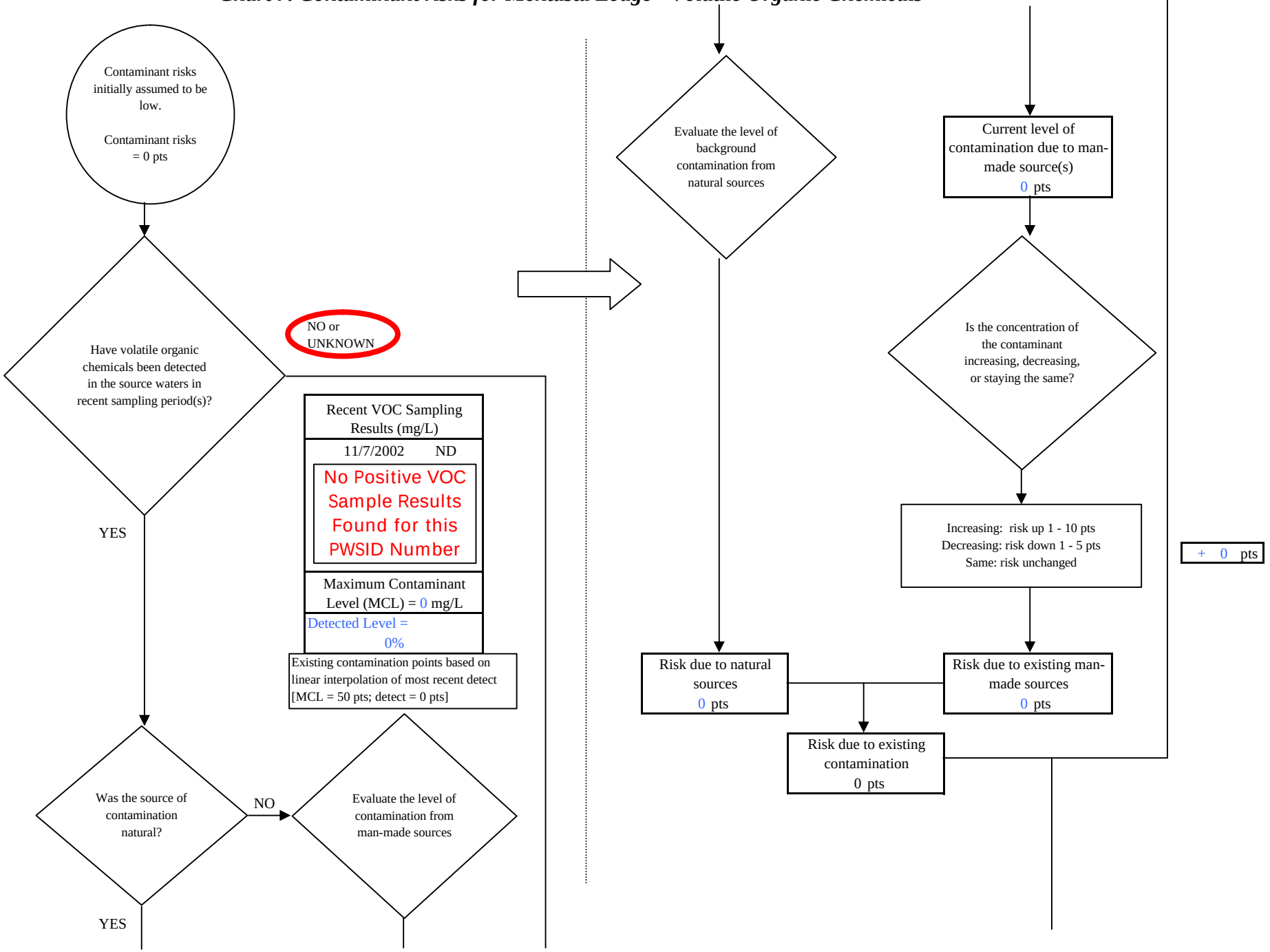


Chart 7. Contaminant risks for Mentasta Lodge - Volatile Organic Chemicals

+ 40 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

Risk 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)	3	0	3
Medium(s)	0	0	0
Low(s)	1	0	1

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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 40

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.

Initial assessment of risk posed by potential sources of contamination = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO → Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

Increase risk 1 - 10 pts

1 Large Capacity Septic System (D10), 1 Gas Station (C15), 1 Diesel UST (T08), and 1 Gas UST (T12)

+ 10 pts

Chart 7. Contaminant risks for Mentasta Lodge - Volatile Organic Chemicals

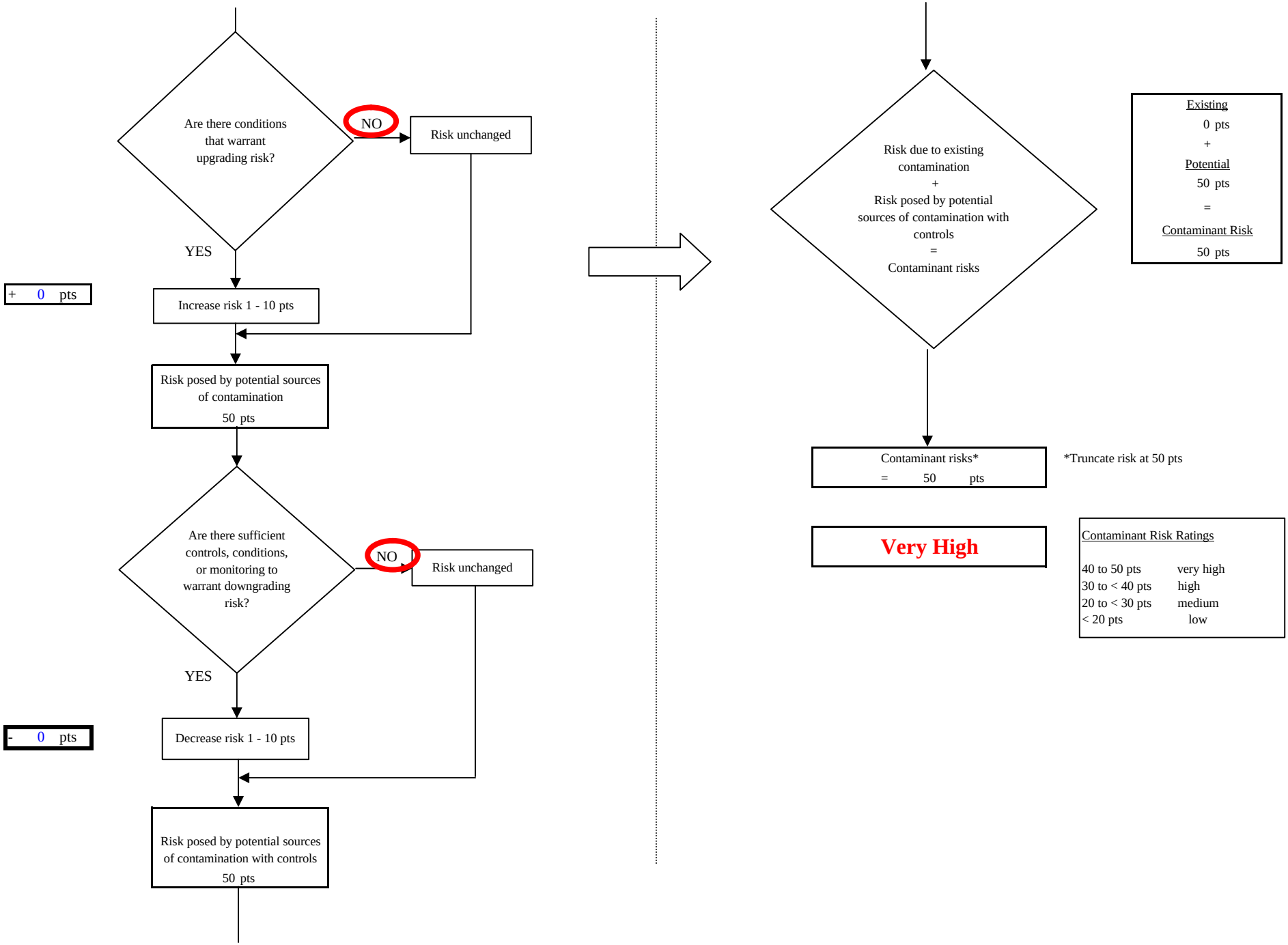


Chart 8. Vulnerability analysis for Mentasta Lodge - Volatile Organic Chemicals