Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Mosquito Lake Recreation Site, Haines, Alaska PWSID #110839

DRINKING WATER PROTECTION PROGRAM REPORT NO. 731

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

TABLES

APPENDICES

Source Water Assessment for Mosquito Lake Recreation Site, Haines, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Mosquito Lake Recreation Site is a Class B (transient/non-community) water system consisting of one artesian well. The Mosquito Lake Recreation Site is located at Mile 27.5 Haines Highway, north of Haines, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer a susceptibility rating of **Low**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the wells. Identified potential and current sources of contaminants for Mosquito Lake Recreation Site public drinking water source includes: pit toilets; and dirt/gravel highways and roads. 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 Mosquito Lake Recreation Site received a vulnerability rating of **Low** for bacteria and viruses; nitrates and nitrites; and volatile organic chemicals.

MOSQUITO LAKE RECREATION SITE PUBLIC DRINKING WATER SYSTEM

Mosquito Lake Recreation Site public water system is a Class B (transient/non-community) water system. The system consists of one artesian well at Mile 27.5 Haines Highway, north of Haines, Alaska (please see the inset of Map 1 in Appendix A for location). The population of Haines is approximately 2,300.

Haines averages about 60 inches of precipitation per year; and approximately 133 inches of snow. The groundwater aquifers underlying the area are recharged through the infiltration of precipitation and surface water. Groundwater aquifers in the region generally occur in the fractured bedrock and unconsolidated sediments deposited by glaciers and/or rivers. The elevation for Haines is at sea level.

According to a Sanitary Survey dated July 17, 2002, there is one artesian well that was installed in 1979. The Survey indicates that the land surface is not appropriately sloped away from the well, allowing surface water to pool around the concrete pad. The well is grouted. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates from May to September and serves approximately 1 resident and 25 non-residents through one service connection.

MOSQUITO LAKE RECREATION SITE 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 attribute of the aquifer in this calculation were adopted from the U.S. Geological Survey (Patrick, Brabets, and Glass, 1989), and State of Alaska Department of Water Resources (Jokela, et. al., 1991). Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DPWA (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 Mosquito Lake Recreation Site is limited by its immediate watershed. 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 Mosquito Lake Recreation Site 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 MOSQUITO LAKE RECREATION SITE 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 wells for the Mosquito Lake Recreation Site are completed in a confined 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 Mosquito Lake Recreation Site

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	6	Low
Natural Susceptibility	11	Low

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	25	Medium
Volatile Organic Chemicals	12	Low

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

Natural Susceptibility (0 – 50 points)
+
Contaminant Risks (0 – 50 points)
=
Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings

80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4 contains the overall vulnerability scores (0 - 100) and ratings for each of the 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	35	Low
Nitrates and Nitrites	35	Low
Volatile Organic Chemicals	25	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Medium** with pit toilets; and dirt/gravel highways and roads located within Zone A representing the risk 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. Bacteria and viruses have not been detected during recent water sampling of the system at Mosquito Lake Recreation Site. However, after combining the contaminant risks from the large-capacity septic systems and dirt/gravel highways and roads with the overall natural susceptibility of the well, the vulnerability of the well to contamination by bacteria and viruses is **Low**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Medium** with pit toilets; and dirt/gravel highways and roads representing the risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

The current sampling history for Mosquito Lake Recreation Site well indicates nitrate samples were not detected during recent sampling events (see Chart 5 – Contaminant Risks for Nitrates and/or Nitrites in Appendix D). 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 **Low**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Low** with pit toilets; and dirt/gravel highways and roads creating the only known risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

There are no recent sample data available for the drinking water at Mosquito Lake Recreation Site for volatile organic chemicals. 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 **Low**.

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Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL: http://www.epa.gov/safewater/mcl.html.

APPENDIX A

Mosquito Lake Recreation Site
Drinking Water Protection Area Location Map
(Map 1)

Map 1: Mosquito Lake State Recreation Area Drinking Water Protection Areas

PWSID: 110839.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 305 610 1,220 1,830 2,440 Feet

1:6,822

Data Sources:

Background image - USGS 1:63,000 mapping

Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.

Legend

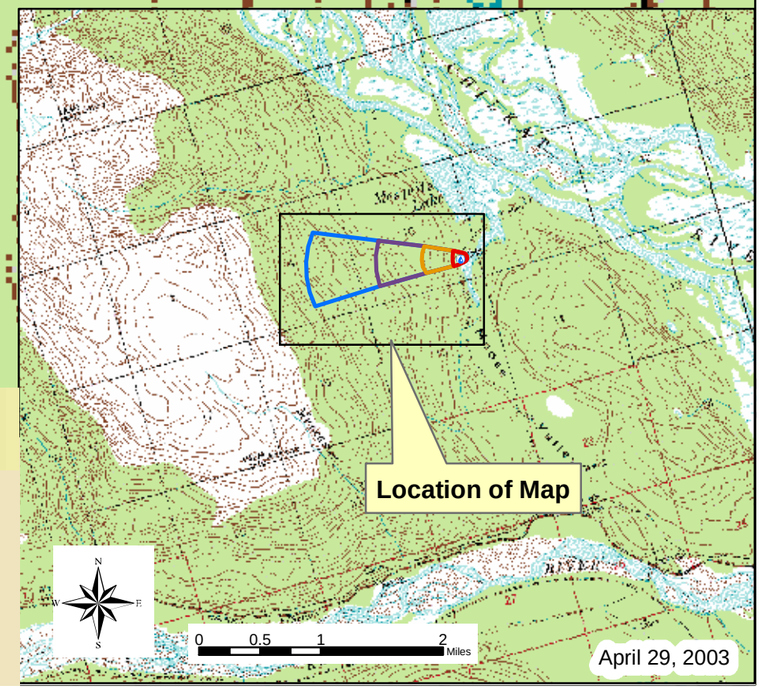
- Public Drinking Water Systems

Zone A Protection Area
Several Months Travel Time

Zone B Protection Area
Less than 2 Years Travel Time

Zone C Protection Area
Less than 5 Years Travel Time

Zone D Protection Area
Less than 10 Years Travel Time



April 29, 2003

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Mosquito Lake Recreation Site (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 110839.001***

Mosquito Lake State Recreation Site

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or more)	D16	D16-1	A	2	Southwest of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-1	A	2	West of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-2	B	2	West of Mosquito Lake State Recreation Area

Contaminant Source Inventory and Risk Ranking for

Table 2 ***PWSID 110839.001***

Mosquito Lake State Recreation Site

Sources of Bacteria and Viruses

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Pit toilets (open hole), nonresidential (one or more)	D16	D16-1	A	Medium	2	Southwest of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	West of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-2	B	Low	2	West of Mosquito Lake State Recreation Area

Table 3

Contaminant Source Inventory and Risk Ranking for

PWSID 110839.001

Mosquito Lake State Recreation Site

Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or more)	D16	D16-1	A	Medium	2	Southwest of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	West of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-2	B	Low	2	West of Mosquito Lake State Recreation Area

Table 4

PWSID 110839.001

Contaminant Source Inventory and Risk Ranking for

Mosquito Lake State Recreation Site

Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or more)	D16	D16-1	A	Low	2	Southwest of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	West of Mosquito Lake State Recreation Area
Highways and roads, dirt/gravel	X24	X24-2	B	Low	2	West of Mosquito Lake State Recreation Area

APPENDIX C

Mosquito Lake Recreation Site
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

MOSQUITO LAKE STATE RECREATION SITE

X24-2

X24-1

Mosquito Lake State Rec Site

D16-1

Location of Map

Map 2: Drinking Water Protection Areas for Mosquito Lake State Recreation Area and Potential and Existing Sources of Contamination

PWSID: 110839.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 125 250 500 750 1,000 Feet

1:3,113

Data Sources:

Background image - USGS 1:25,000 mapping

Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.

Legend

- Public Drinking Water Systems
- Open Hole Pit Toilet (D16)

Zone A Protection Area
Several Months Travel Time

Zone B Protection Area
Less than 2 Years Travel Time

Zone C Protection Area
Less than 5 Years Travel Time

Zone D Protection Area
Less than 10 Years Travel Time

N W S

0 0.5 1 2 Miles

May 27, 2003

APPENDIX D

Vulnerability Analysis for Mosquito Lake Recreation Site Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the wellhead - Mosquito Lake State Recreation Area

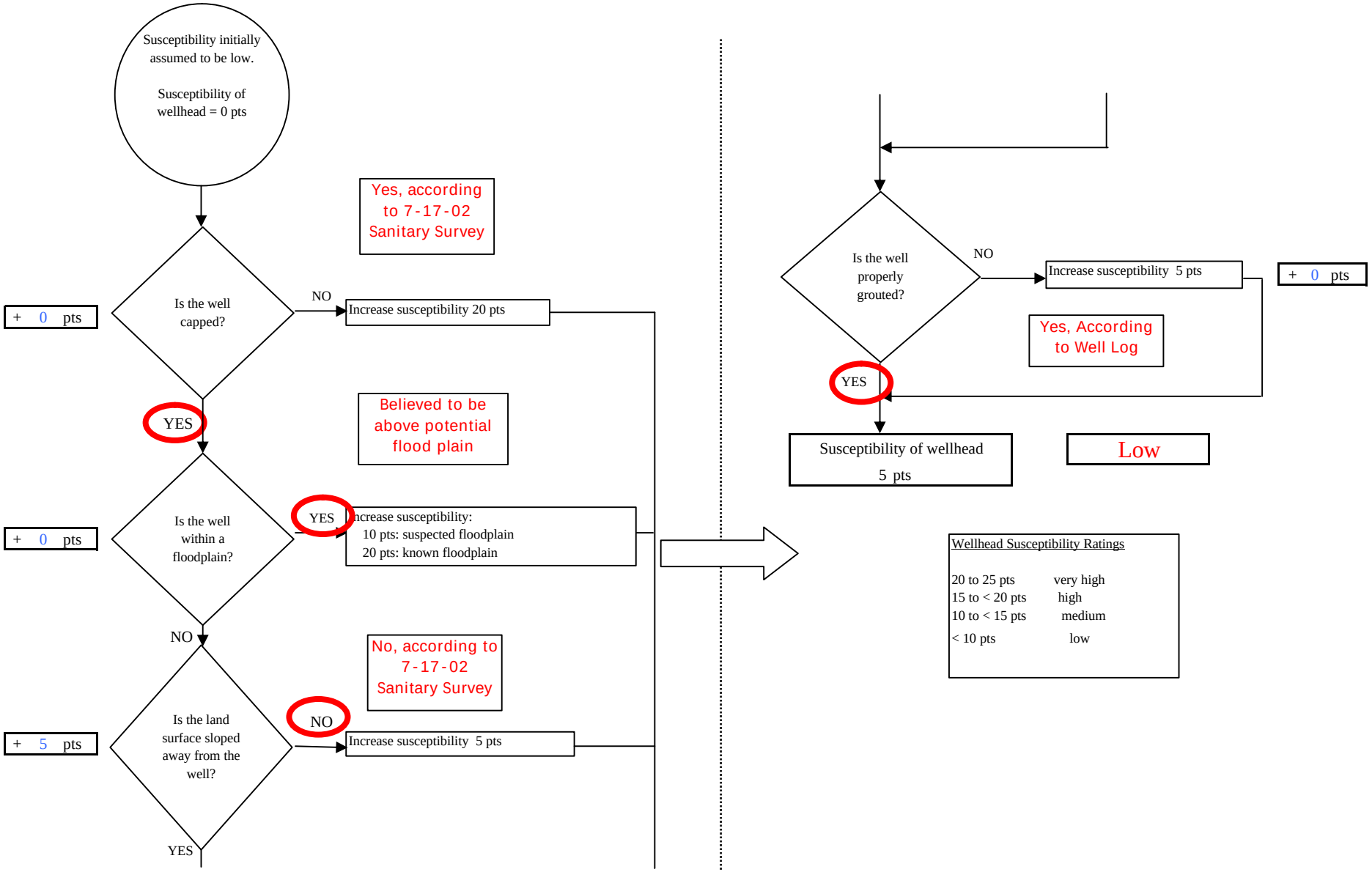


Chart 2. Susceptibility of the aquifer - Mosquito Lake State Recreation Area

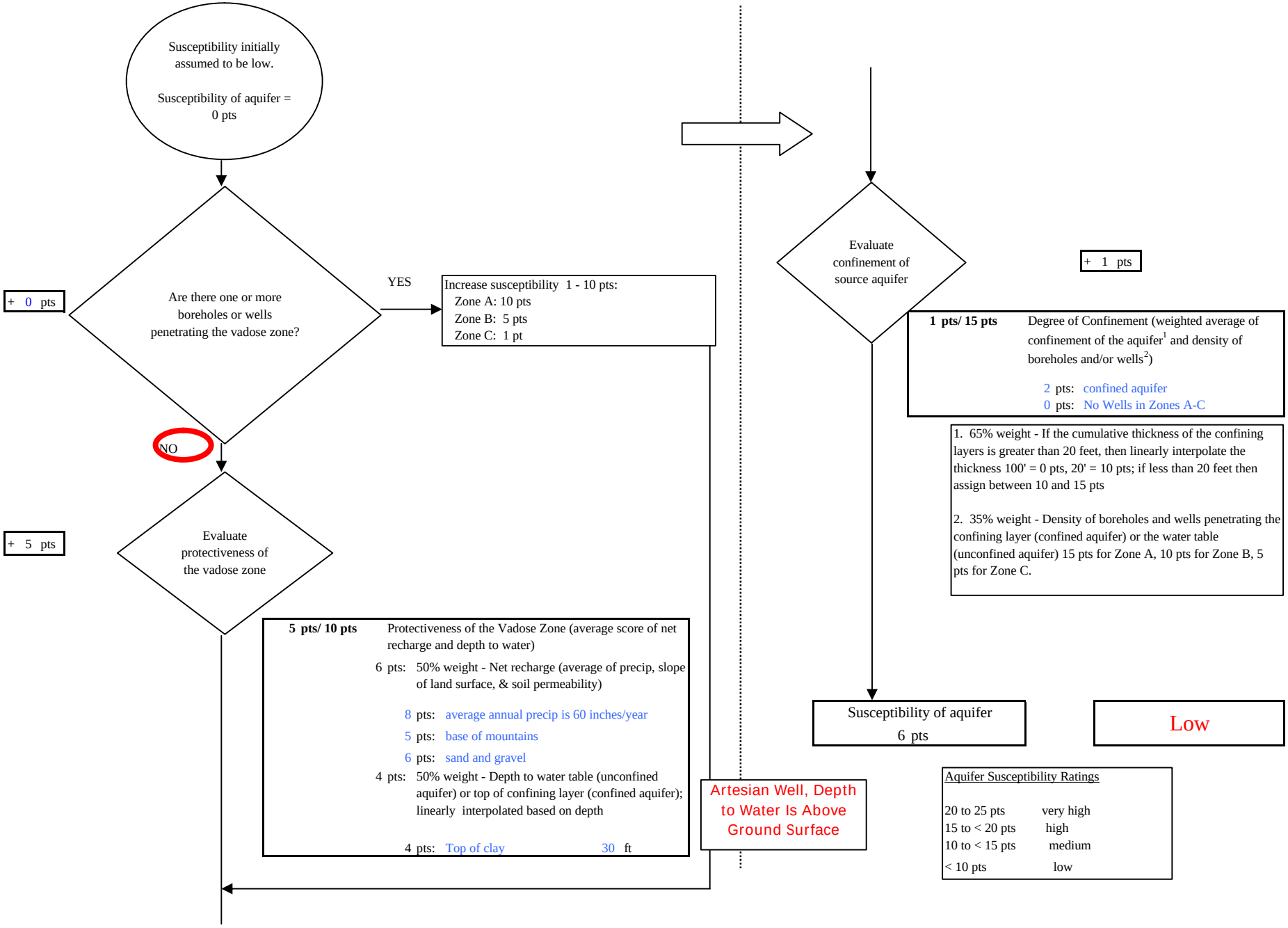
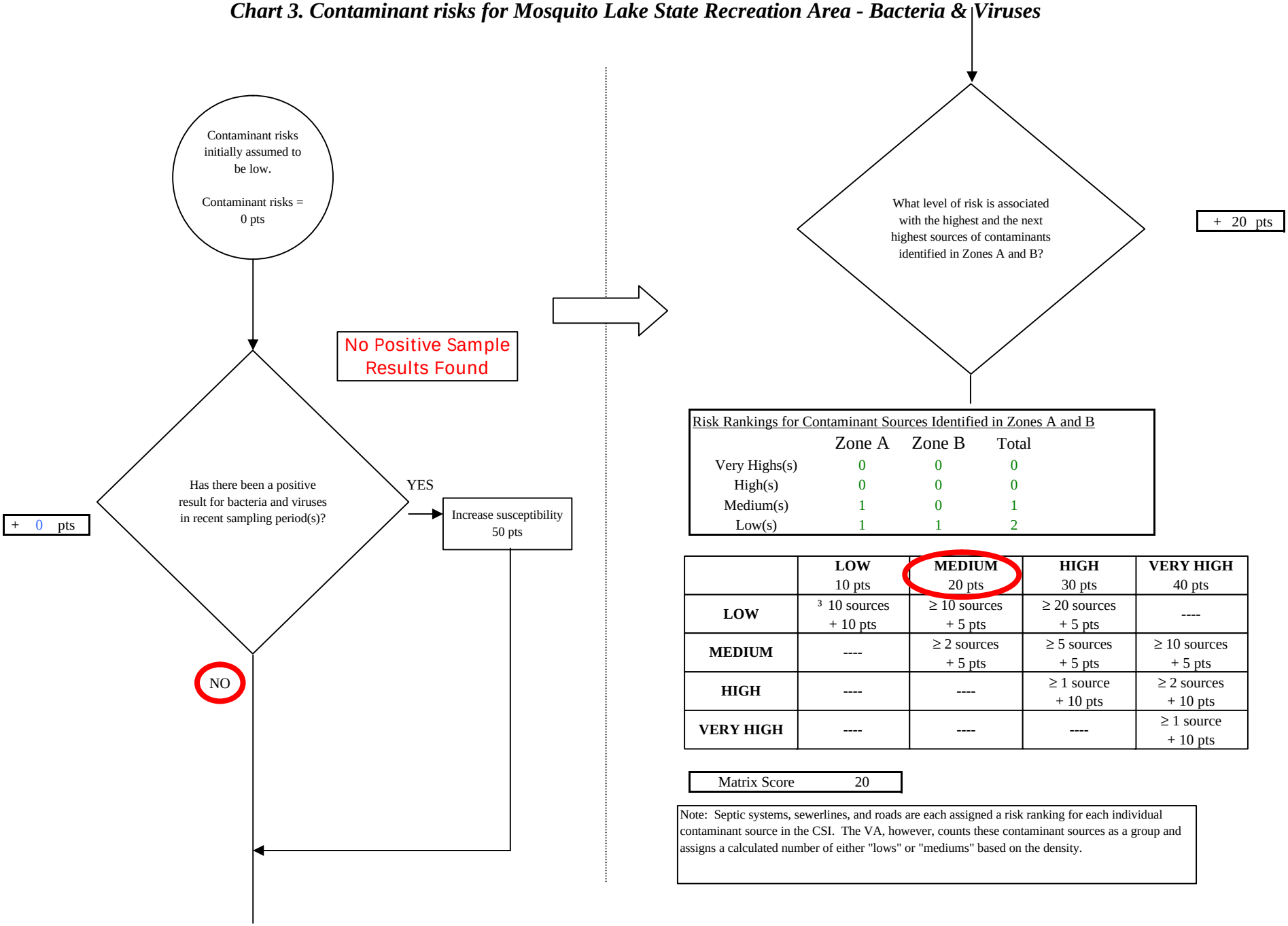


Chart 3. Contaminant risks for Mosquito Lake State Recreation Area - Bacteria & Viruses



Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	1	1	2

	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 20

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 Mosquito Lake State Recreation Area - Bacteria & Viruses

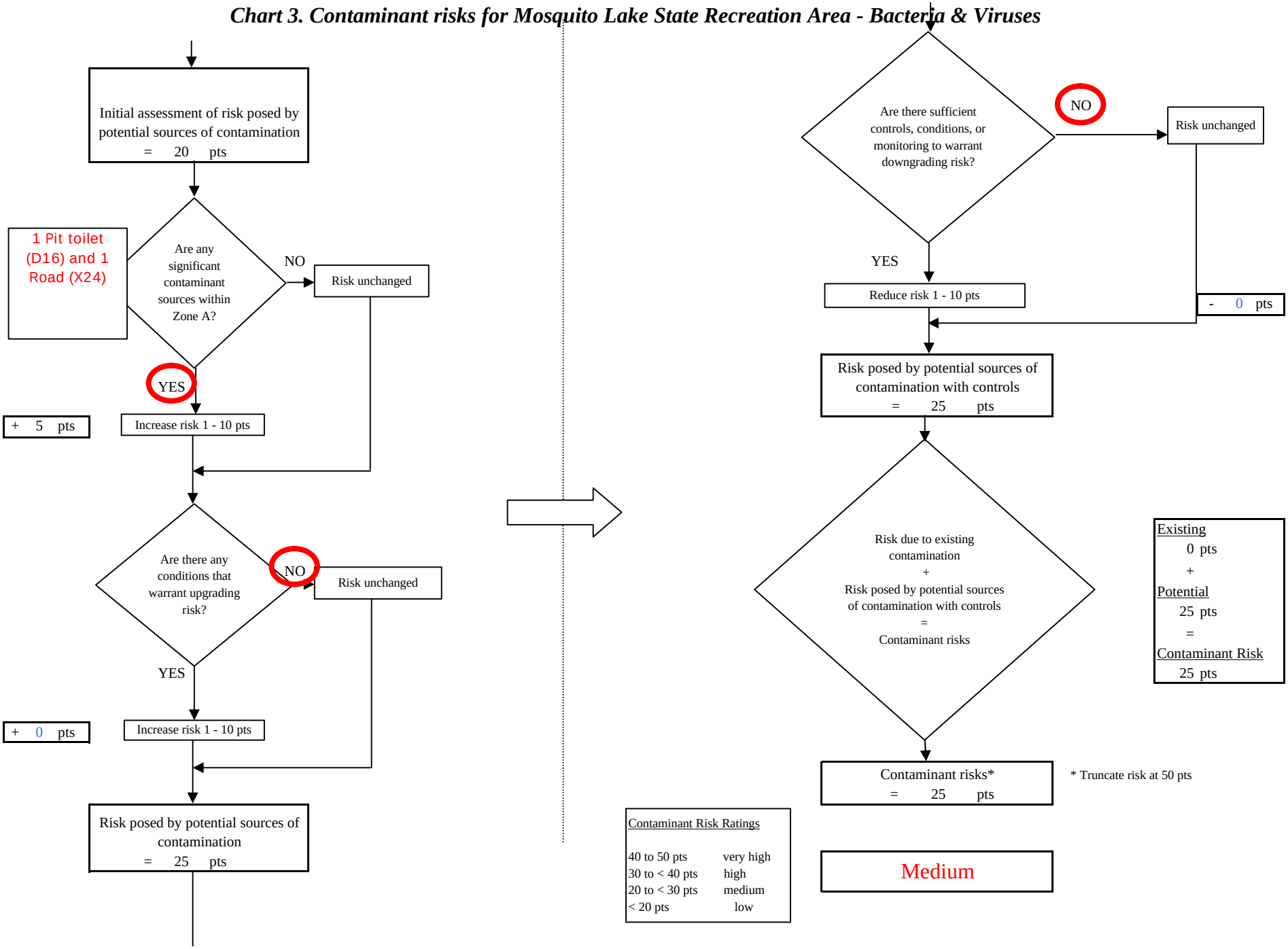


Chart 4. Vulnerability analysis for Mosquito Lake State Recreation Area - Bacteria & Viruses

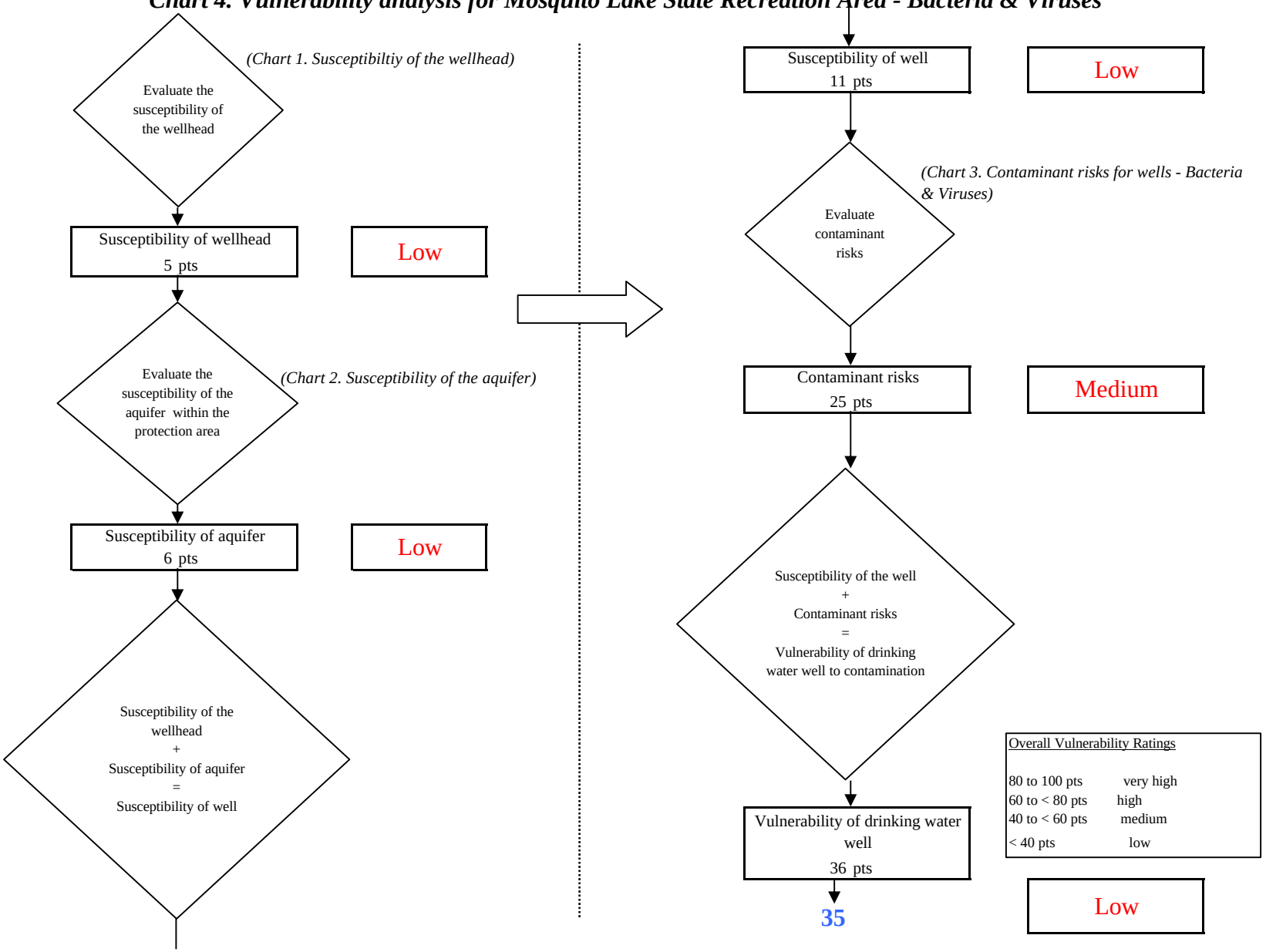


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Chart 5. Contaminant risks for Mosquito Lake State Recreation Area - Nitrates and Nitrites

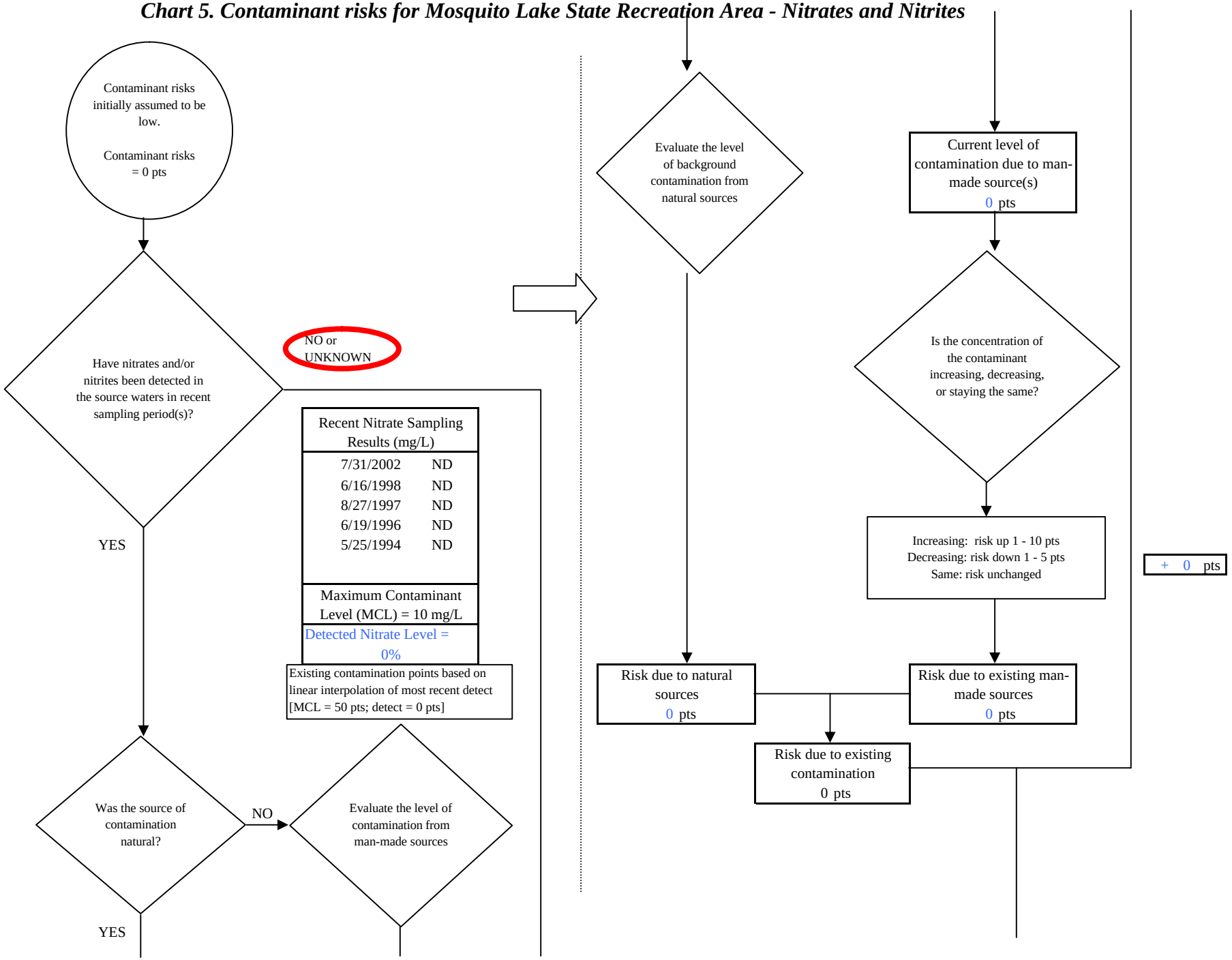


Chart 5. Contaminant risks for Mosquito Lake State Recreation Area - Nitrates and Nitrites

+ 20 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)	0	0	0
Medium(s)	1	0	1
Low(s)	1	1	2

	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 20

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 = 20 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

1 pit toilet (D16) and 1 Road (X24)

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 5 pts

Chart 5. Contaminant risks for Mosquito Lake State Recreation Area - Nitrates and Nitrites

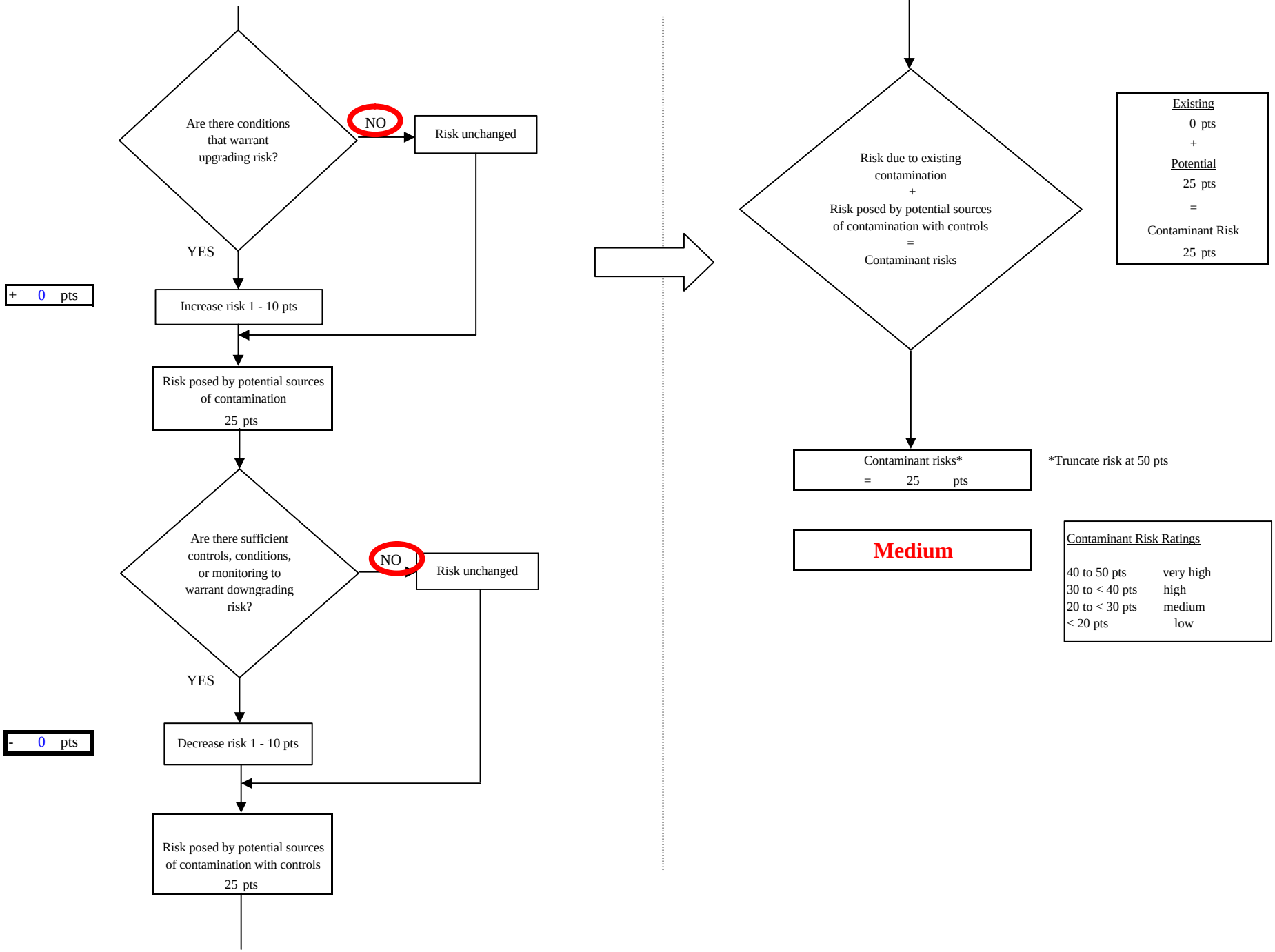


Chart 6. Vulnerability analysis for Mosquito Lake State Recreation Area - Nitrates and Nitrites

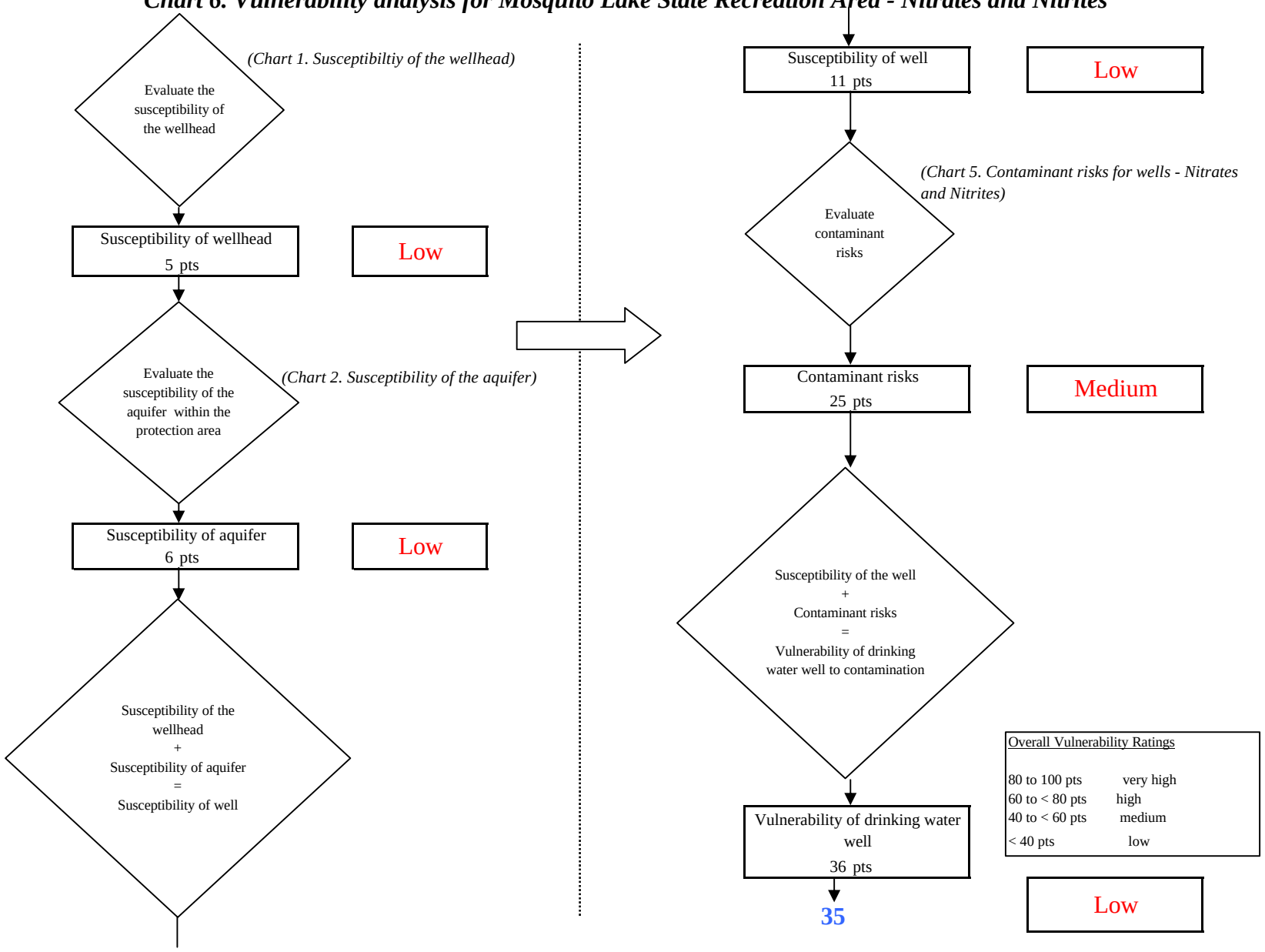


Chart 7. Contaminant risks for Mosquito Lake State Recreation Area - Volatile Organic Chemicals

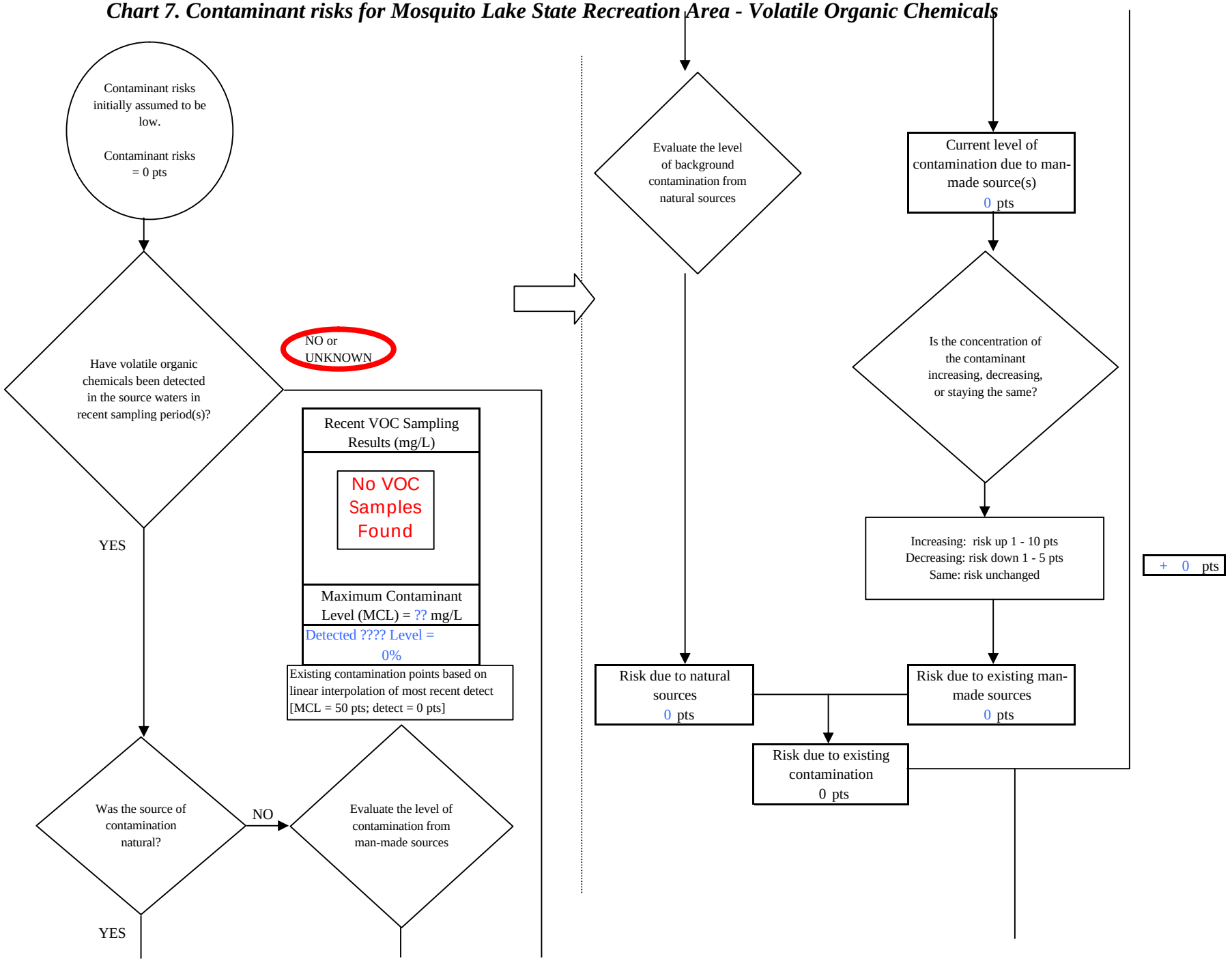
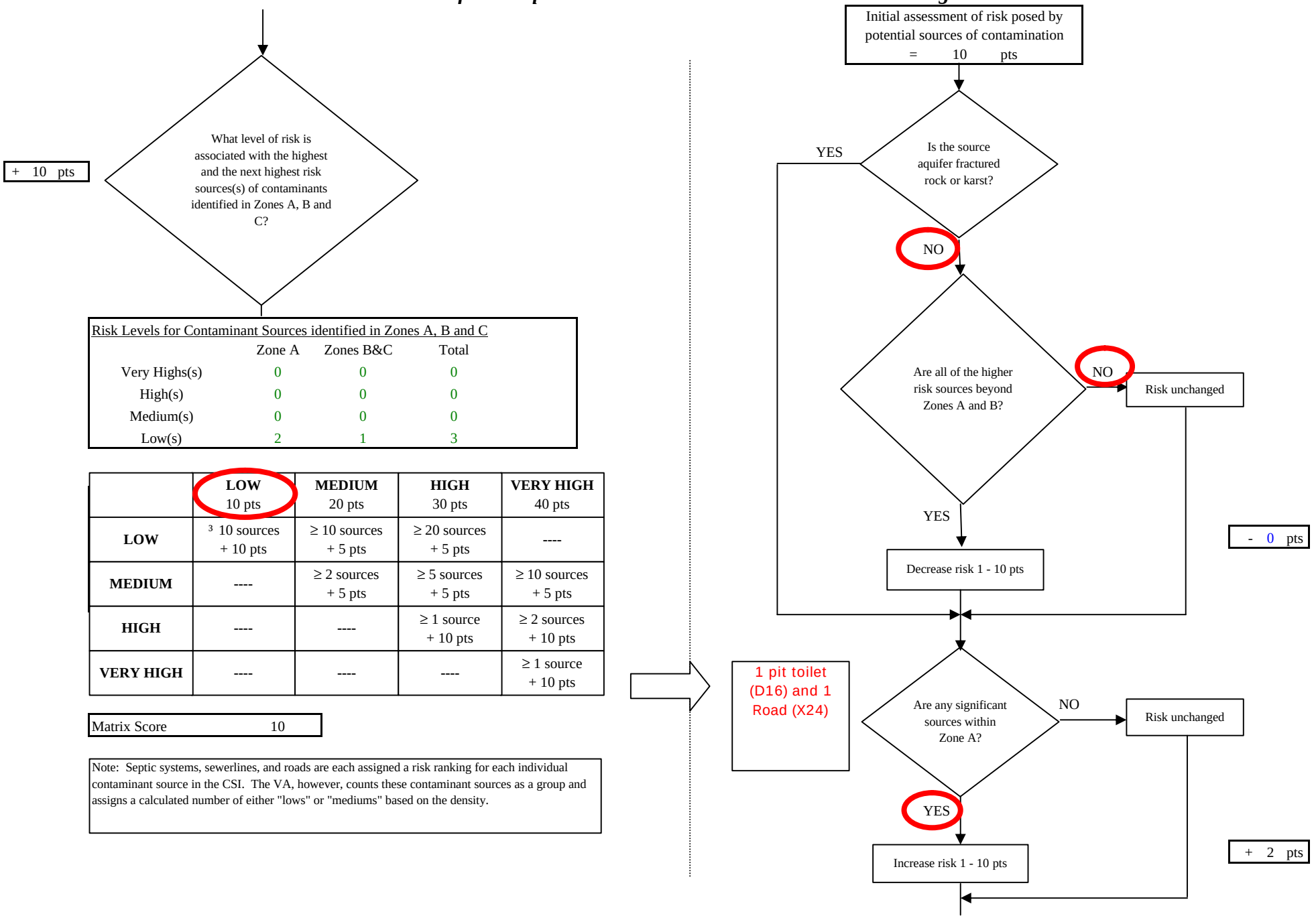


Chart 7. Contaminant risks for Mosquito Lake State Recreation Area - Volatile Organic Chemicals



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)	0	0	0
Medium(s)	0	0	0
Low(s)	2	1	3

	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 10

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

Chart 7. Contaminant risks for Mosquito Lake State Recreation Area - Volatile Organic Chemicals

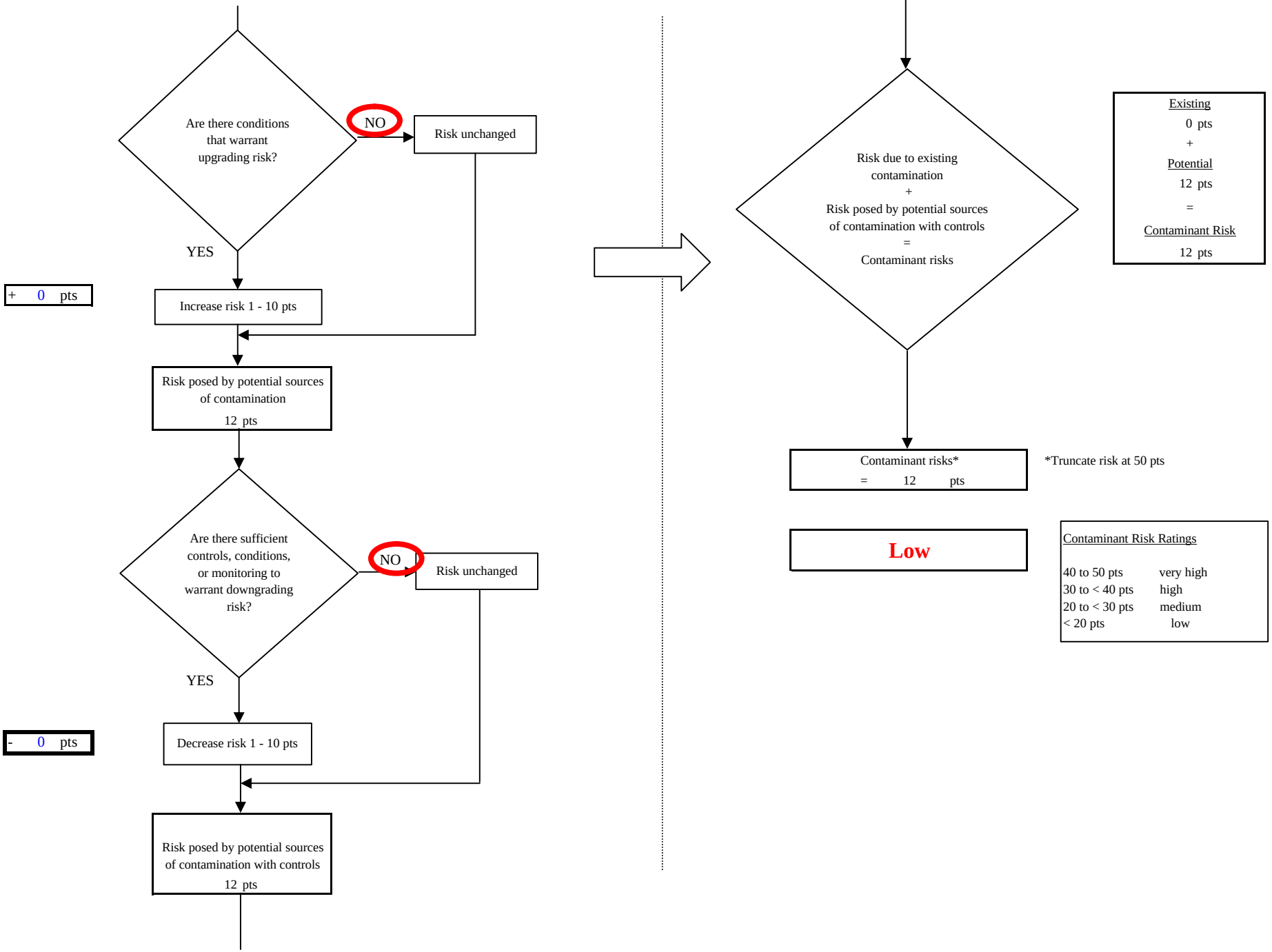


Chart 8. Vulnerability analysis for Mosquito Lake Recreation Area - Volatile Organic Chemicals