Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for
BLM - Paxson Lake Campground
Drinking Water System,
Paxson area, Alaska
PWSID # 370934

DRINKING WATER PROTECTION PROGRAM REPORT #956

Alaska Department of Environmental Conservation

November 2003

Source Water Assessment for BLM - Paxson Lake Campground Drinking Water System Paxson area, Alaska PWSID# 370934

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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.

November 2003

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Source Water Assessment for BLM - Paxson Lake Campground Source of Public Drinking Water
Paxson area, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for BLM - Paxson Lake Campground is a Class B (transient/non-community) water system consisting of one well in the Paxson area, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for BLM - Paxson Lake Campground public drinking water source include: the Richardson Highway and the Trans-Alaska Pipeline. 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 source for BLM - Paxson Lake Campground received a vulnerability rating of **Low** for bacteria and viruses, **Low** for nitrates and nitrites, and **Low** for volatile organic chemicals. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts, as well as a basis for the continuing efforts on the part of the system owner/operator to protect public health.

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide the owner/operator of BLM - Paxson Lake Campground, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system. Ecology & Environment, Inc. has been contracted to perform these assessments under the supervision of ADEC.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

BLM - PAXSON LAKE CAMPGROUND PUBLIC DRINKING WATER SYSTEM

BLM - Paxson Lake Campground public water system is a Class B (transient/non-community) water system. The system consists of one well located at mile 175 Richardson Highway (see Map 1 of Appendix A). The community of Paxson is located at the junction of the Richardson and Denali Highways, at mile 185 of the Richardson Highway (see the inset of Map 1 in Appendix A for location). It has an estimated population of 33 residents (ADCED 2003).

Residents in the area rely on individual wells and septic systems, or haul water. Approximately half of the residences are fully plumbed (ADCED 2003). Private generators are used to provide electricity. Refuse is transported to the Glennallen landfill. Many of the homes in the area are used only seasonally (ADCED 2003).

The geology of the Paxson area generally comprises unconsolidated glacial sediments of Cenozoic age. Permafrost is found discontinuously throughout the area and may intrude the silt, sand, and gravel sediments (ADOT&PF 1982).

Drainage patterns and groundwater flow in the area may be somewhat complicated by the presence of discontinuous glacial deposits. The most likely flow direction is off the hills towards the many lakes that dot the area. Average annual snowfall is approximately 110 inches, while annual precipitation totals 20.7 inches (WRCC 2003).

According to the well log, the depth of the BLM - Paxson Lake Campground well is approximately 55 feet below ground surface.

The most recent Sanitary Survey (7/11/1998) for the water system indicates the land surface is appropriately sloped away from the well. Sloping of the ground surface around the well provides drainage of surface water away from the well casing. Also, the well is grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates June - September and serves approximately 30 non-residents.

BLM - PAXSON LAKE CAMPGROUND DRINKING WATER PROTECTION AREA (DWPA)

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. 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.

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. An analytical calculation was used to determine the size and shape of the protection area. The input parameters describing the attributes of the aquifer in this calculation were derived from Freeze and Cherry (1979), and from a review of well logs in the area found in the Alaska Department of Natural Resources and United States Geological Survey databases. Additional methods were considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area. (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four protection area zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. time-of-travel
B	Less than the 2 year time-of-travel
C	Less Than the 5 year time-of-travel
D	Less than the 10 year time-of-travel

The DWPA may be limited by its immediate watershed and therefore may not include all four zones (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 BLM - Paxson Lake Campground 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 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, and volatile organic chemicals.

VULNERABILITY OF BLM - PAXSON LAKE CAMPGROUND 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 BLM - Paxson Lake Campground 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 impact this aquifer adversely. Table 2 shows the Susceptibility scores and ratings for BLM - Paxson Lake Campground.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	14	Medium
Natural Susceptibility	14	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	10	Low
Nitrates and/or Nitrites	11	Low
Volatile Organic Chemicals	20	Medium

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	25	Low
Nitrates and/or Nitrites	25	Low
Volatile Organic Chemicals	35	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is Low, with the highway representing the greatest risk to the drinking water well (see Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Residents and businesses in the area generally dispose of wastewater in private septic systems. Although this report does not address such systems (unless their location is known), they can pose a risk of bacteria/virus and nitrate/nitrite contamination to drinking water sources. Proper design and maintenance of septic systems is the best safeguard against such contamination.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination by bacteria and viruses is Low.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is Low, with the highway representing the highest 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 last five years' sampling history for BLM - Paxson Lake Campground public water source indicates the most recent concentration detected was 0.271 mg/L on 8/21/2002, which represents 2.7% of the Maximum Contaminant Level (MCL). While nitrates and nitrites can occur naturally in groundwater, a level of 20% of the MCL or more is considered to be due to manmade sources. Water with levels of nitrates and nitrites below 100% of the MCL is considered safe to drink by the U.S. Environmental Protection Agency (EPA 2003). 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 Medium, with the pipeline representing the highest risk for volatile organic chemicals (see Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Residents in the area typically heat their homes with various types of on-site fuel sources, including propane and heating oil stored in aboveground or underground storage tanks. Although this report does not address heating oil tanks (unless their location is known), they can pose a risk of volatile organic chemical contamination to drinking water sources. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Secondary containment around the tank and regular system maintenance can help prevent many of these harmful fuel leaks and help protect the drinking water supply.

Class B water systems generally are not required to test for volatile organic chemicals. After combining the

potential 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.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2003, Alaska Community Database [WWW database]. URL http://www.dced.state.ak.us/cbd/commdb/CF_BLOCK.cfm

Alaska Department of Transportation and Public Facilities (ADOT&PF), 1982, *Environmental Assessment: Big Timber to Paxson, Mile 129-186 Richardson Highway*.

Freeze, R.A. and Cherry, J.A., 1979, *Groundwater*, Upper Saddle River, NJ: Prentice Hall, Inc.

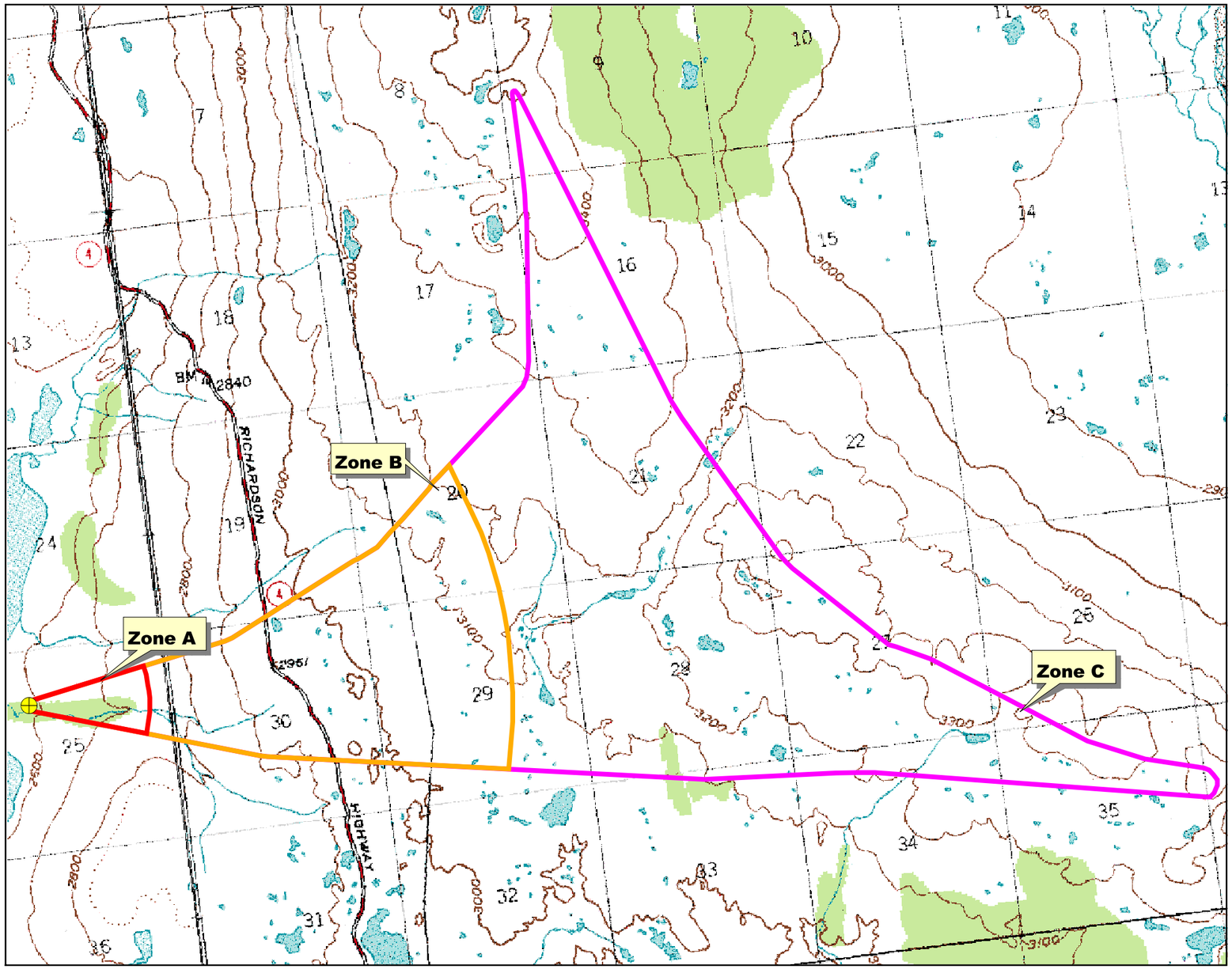
United States Environmental Protection Agency (EPA), 2003, Consumer Fact Sheet on Nitrates/Nitrites, http://www.epa.gov/OGWDW/contaminants/dw_contamfs/nitrates.html.

Western Regional Climate Center (WRCC), 2003, *Alaska Climate Summaries: Paxson*, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?akpaxs.

APPENDIX A

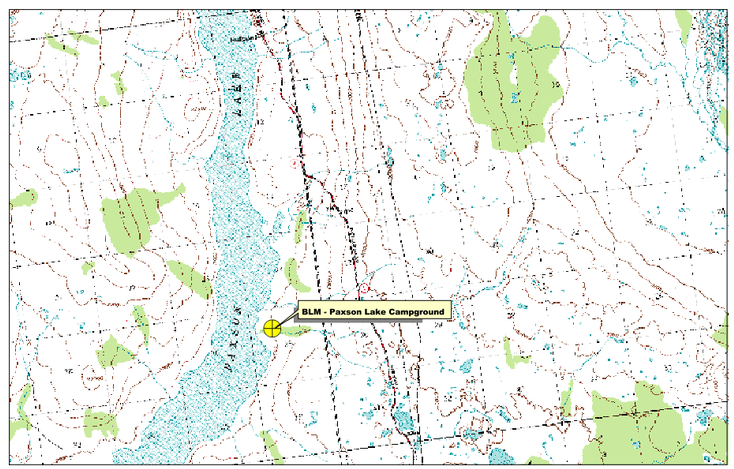
BLM - Paxson Lake Campground
Drinking Water Protection Area Location Map
(Map 1)

Drinking Water Protection Area for BLM - Paxson Lake Campground



BLM-Paxson Lake Campground Well
Zone A (Few Months Travel Time)
Zone B (Less Than 2 Years Travel Time)
Zone C (Less Than 5 Years Travel Time)

N
W E
S



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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for BLM - Paxson Lake Campground (Tables 1-4)

Table 1

Contaminant Source Inventory for

BLM - Paxson Lake Campground

PWSID 370934.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	B	2	Richardson Highway
Pipelines (oil and gas)	X28	X28-1	B	2	Trans-Alaska Pipeline

Table 2

Contaminant Source Inventory and Risk Ranking for BLM - Paxson Lake Campground Sources of Bacteria and Viruses

PWSID 370934.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Highways and roads, paved (cement or asphalt)	X20	X20-1	B	Low	2	Richardson Highway

Table 3

Contaminant Source Inventory and Risk Ranking for BLM - Paxson Lake Campground Sources of Nitrates/Nitrites

PWSID 370934.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	B	Low	2	Richardson Highway

Table 4

Contaminant Source Inventory and Risk Ranking for BLM - Paxson Lake Campground Sources of Volatile Organic Chemicals

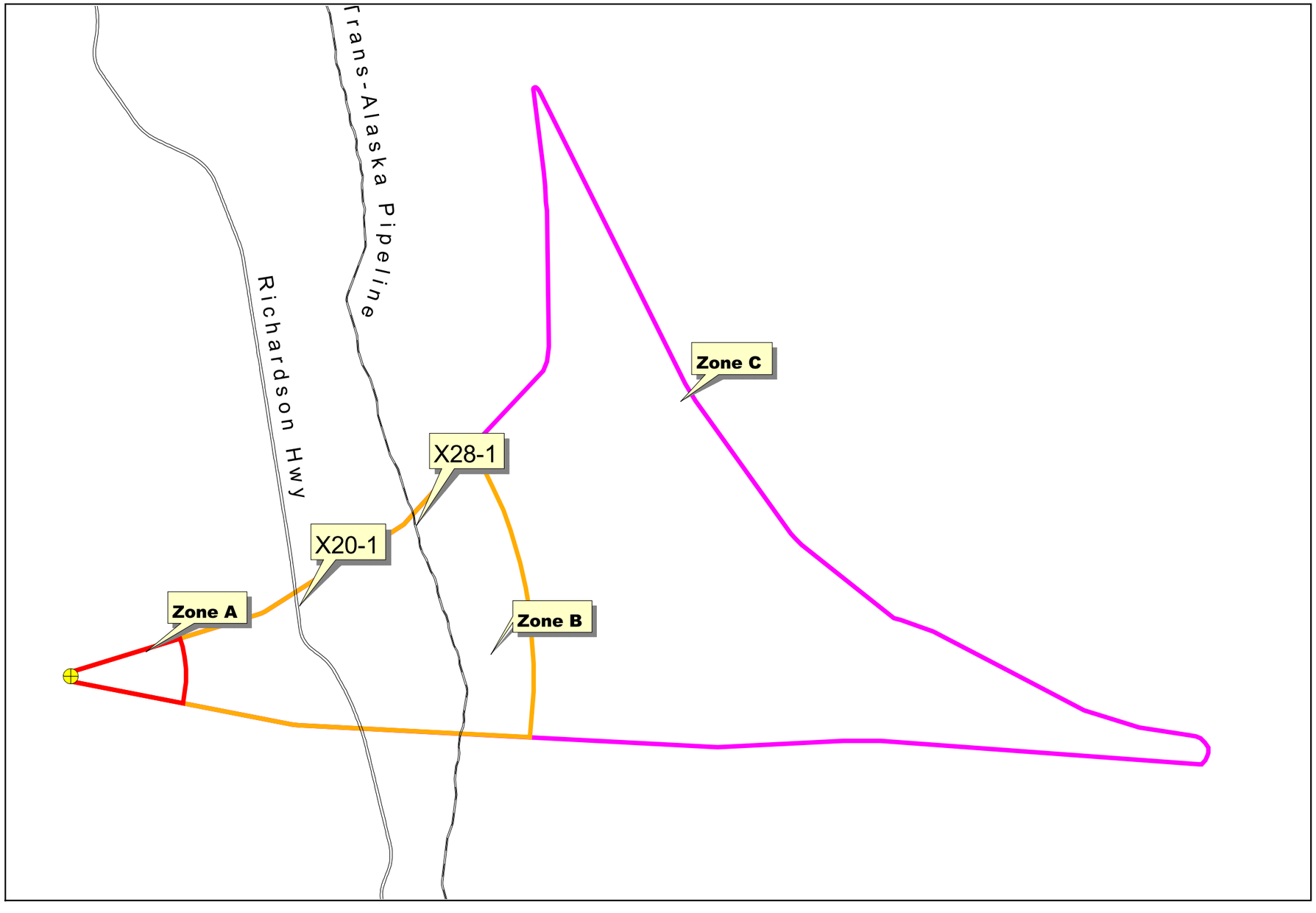
PWSID 370934.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1	B	Low	2	Richardson Highway
Pipelines (oil and gas)	X28	X28-1	B	Medium	2	Trans-Alaska Pipeline

APPENDIX C

BLM - Paxson Lake Campground
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Drinking Water Protection Area for BLM - Paxson Lake Campground and Existing and Potential Sources of Contamination



BLM-Paxson Lake Campground Well
Roads-X20
Pipeline-X28
Zone A (Few Months Travel Time)
Zone B (Less Than 2 Years Travel Time)
Zone C (Less Than 5 Years Travel Time)

N
W E
S

0.5 0 0.5 1 1.5 2 2.5 Miles

PWSID 370934.001

Map 2

APPENDIX D

Vulnerability Analysis for
BLM - Paxson Lake Campground
Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the wellhead - BLM- Paxson Lake Campground

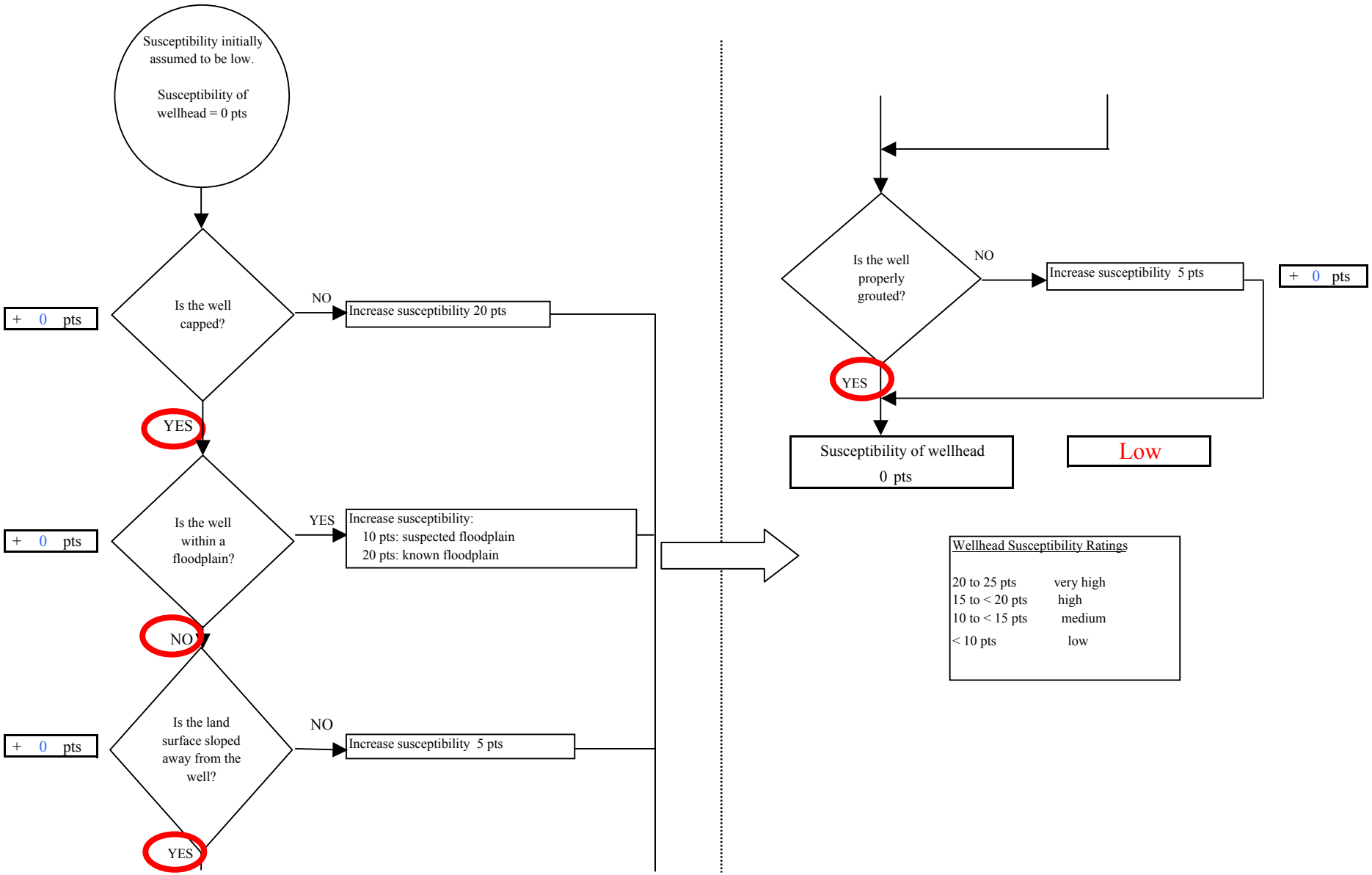


Chart 2. Susceptibility of the aquifer - BLM- Paxson Lake Campground

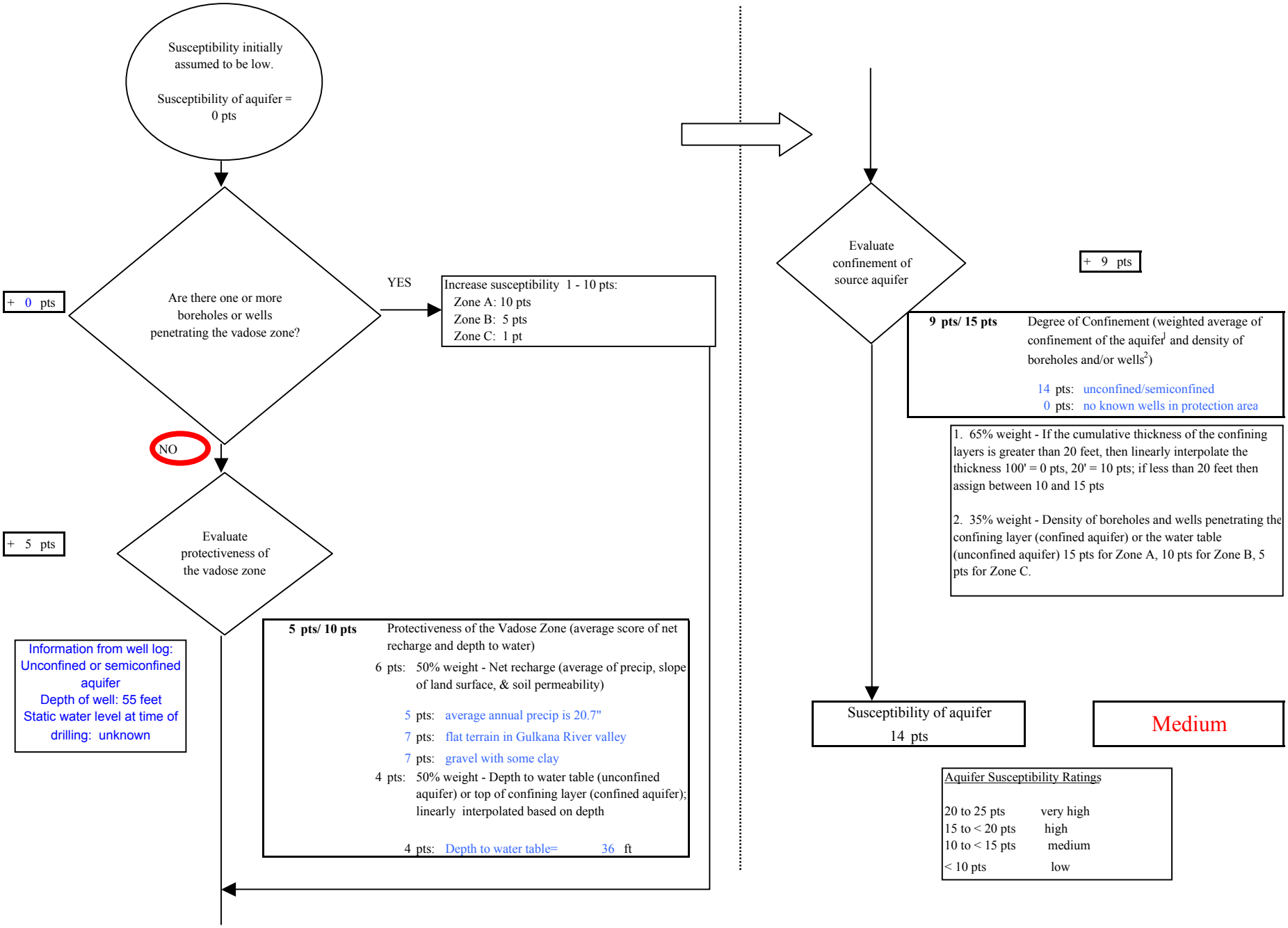
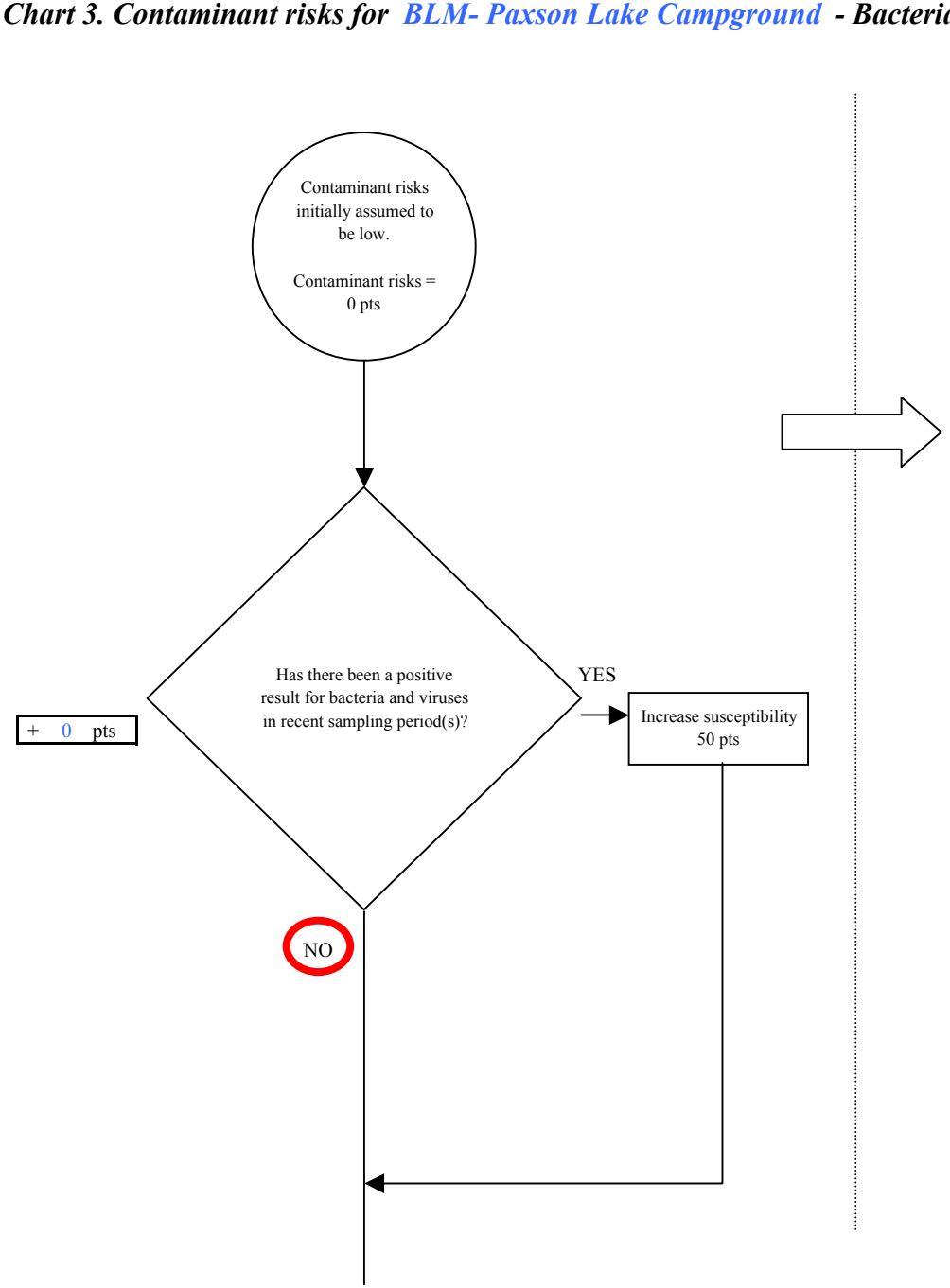
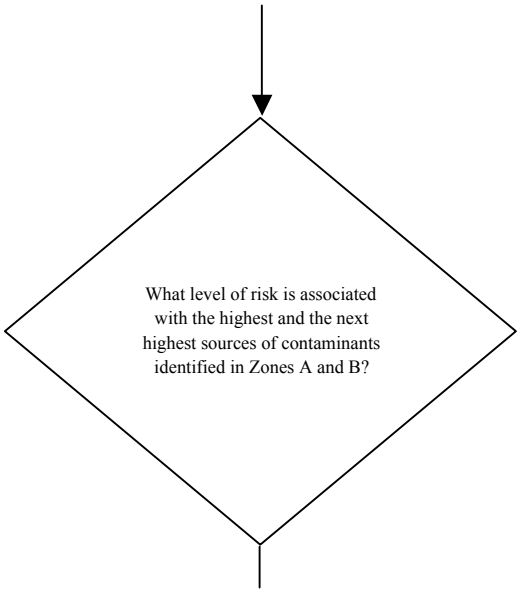


Chart 3. Contaminant risks for BLM- Paxson Lake Campground - Bacteria & Viruses





+ 10 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)	0	0	0
Medium(s)	0	0	0
Low(s)	0	1	1

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

Matrix Score 10

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

Chart 3. Contaminant risks for BLM- Paxson Lake Campground - Bacteria & Viruses

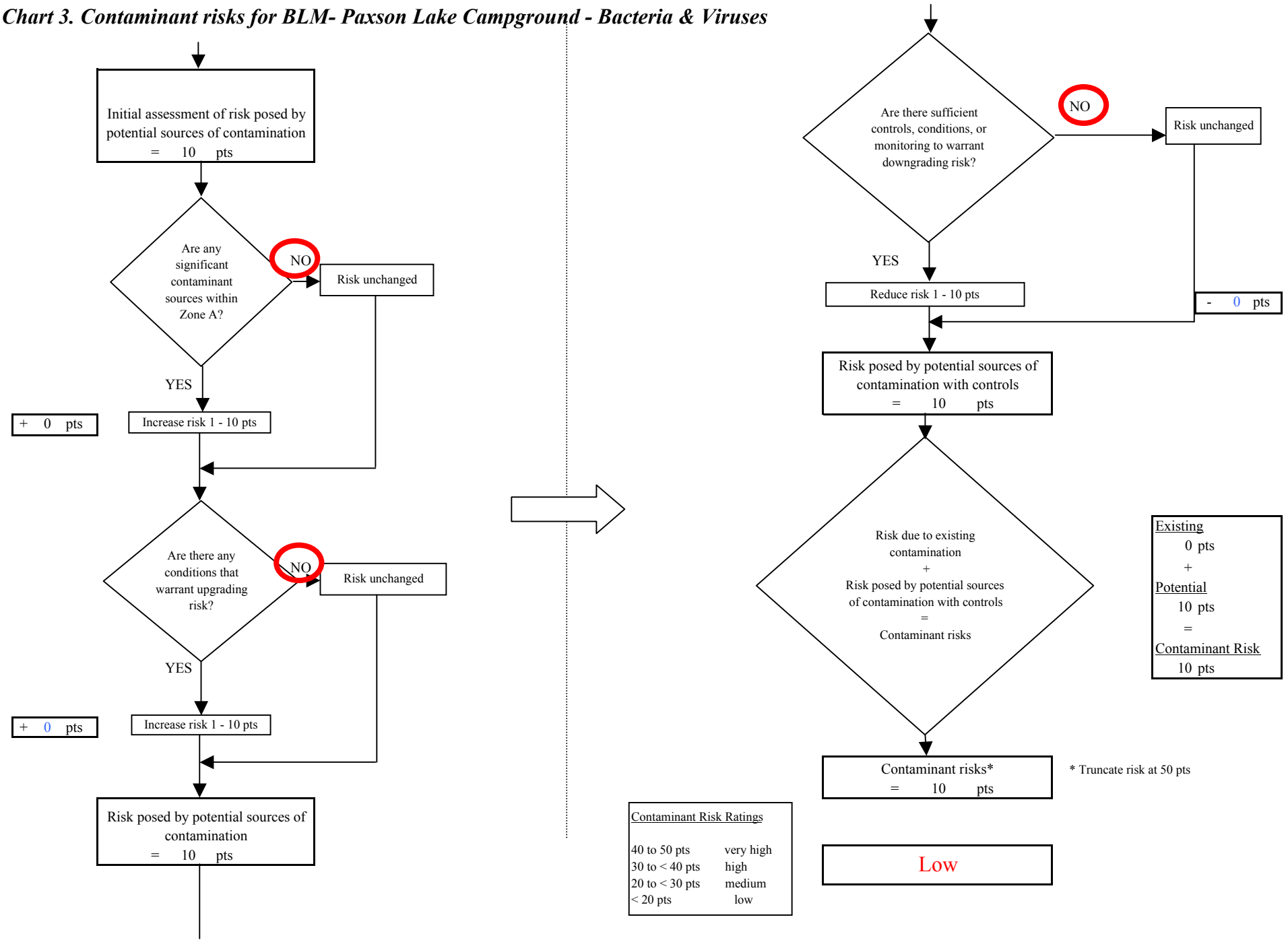


Chart 4. Vulnerability analysis for BLM- Paxson Lake Campground - Bacteria & Viruses

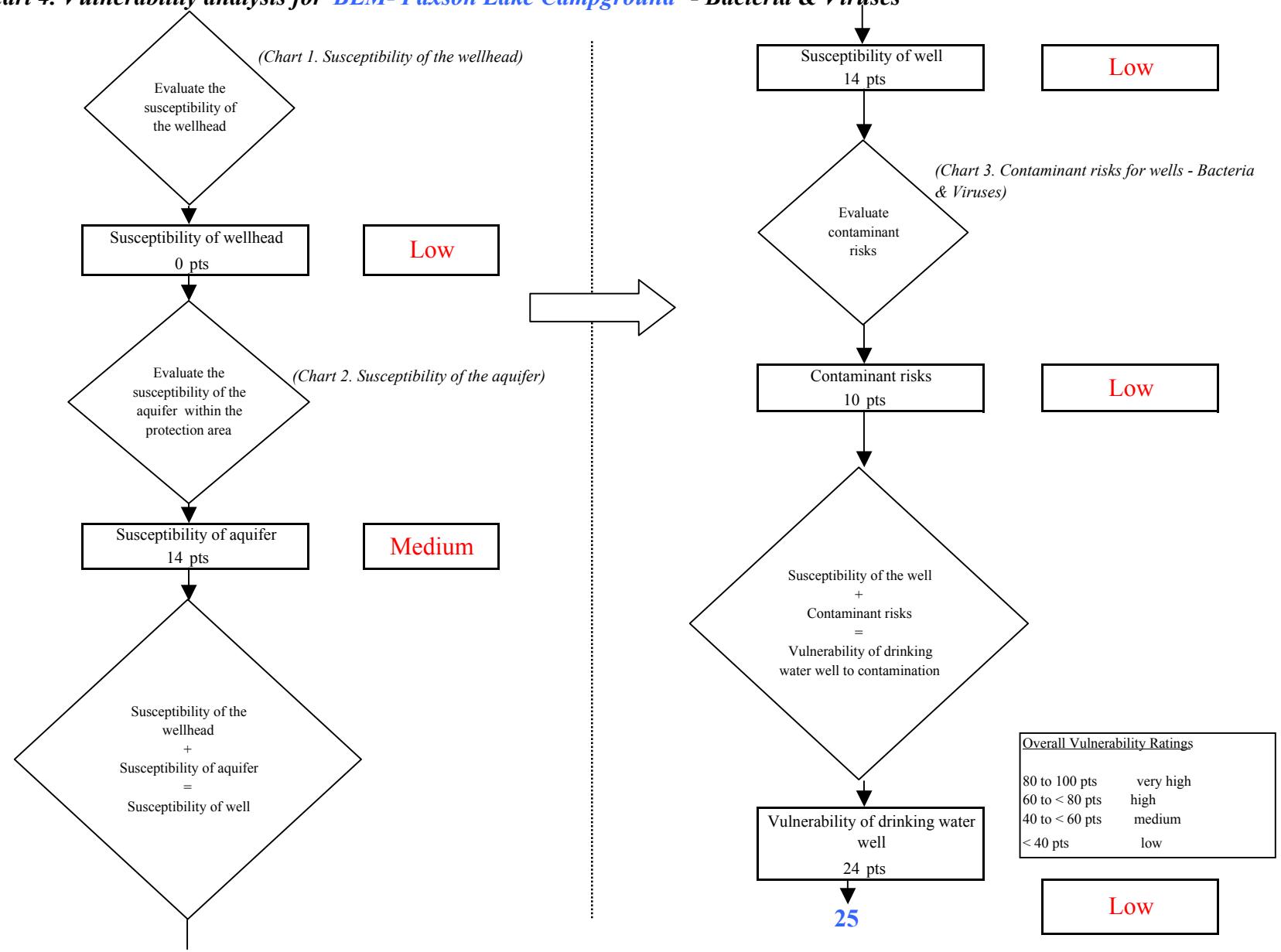


Chart 5. Contaminant risks for BLM- Paxson Lake Campground - Nitrates and Nitrites

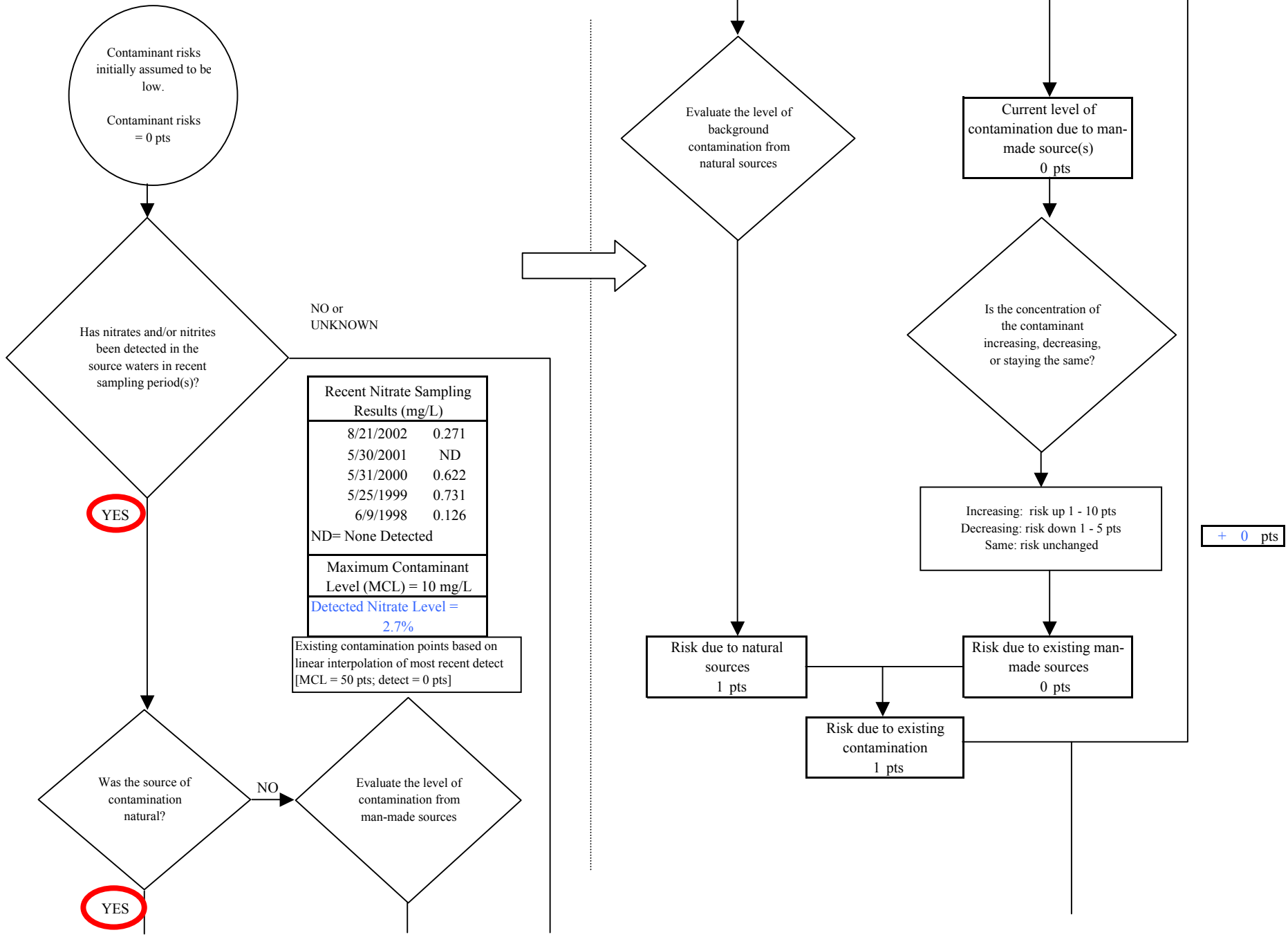


Chart 5. Contaminant risks for BLM- Paxson Lake Campground - Nitrates and Nitrites

+ 10 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?

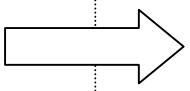
Risk Levels for Contaminant Sources identified in Zones A, B and C

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

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

Matrix Score 10

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



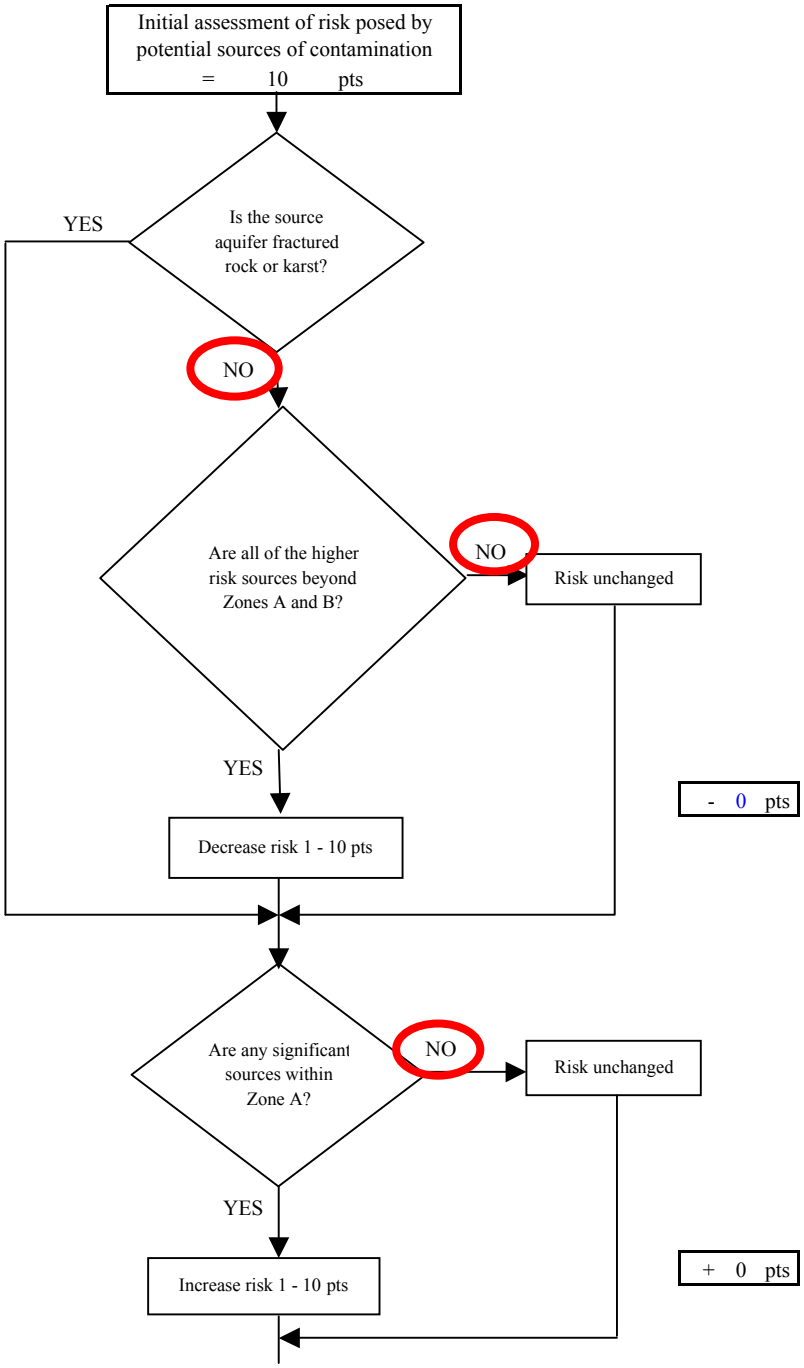


Chart 5. Contaminant risks for BLM- Paxson Lake Campground - Nitrates and Nitrites

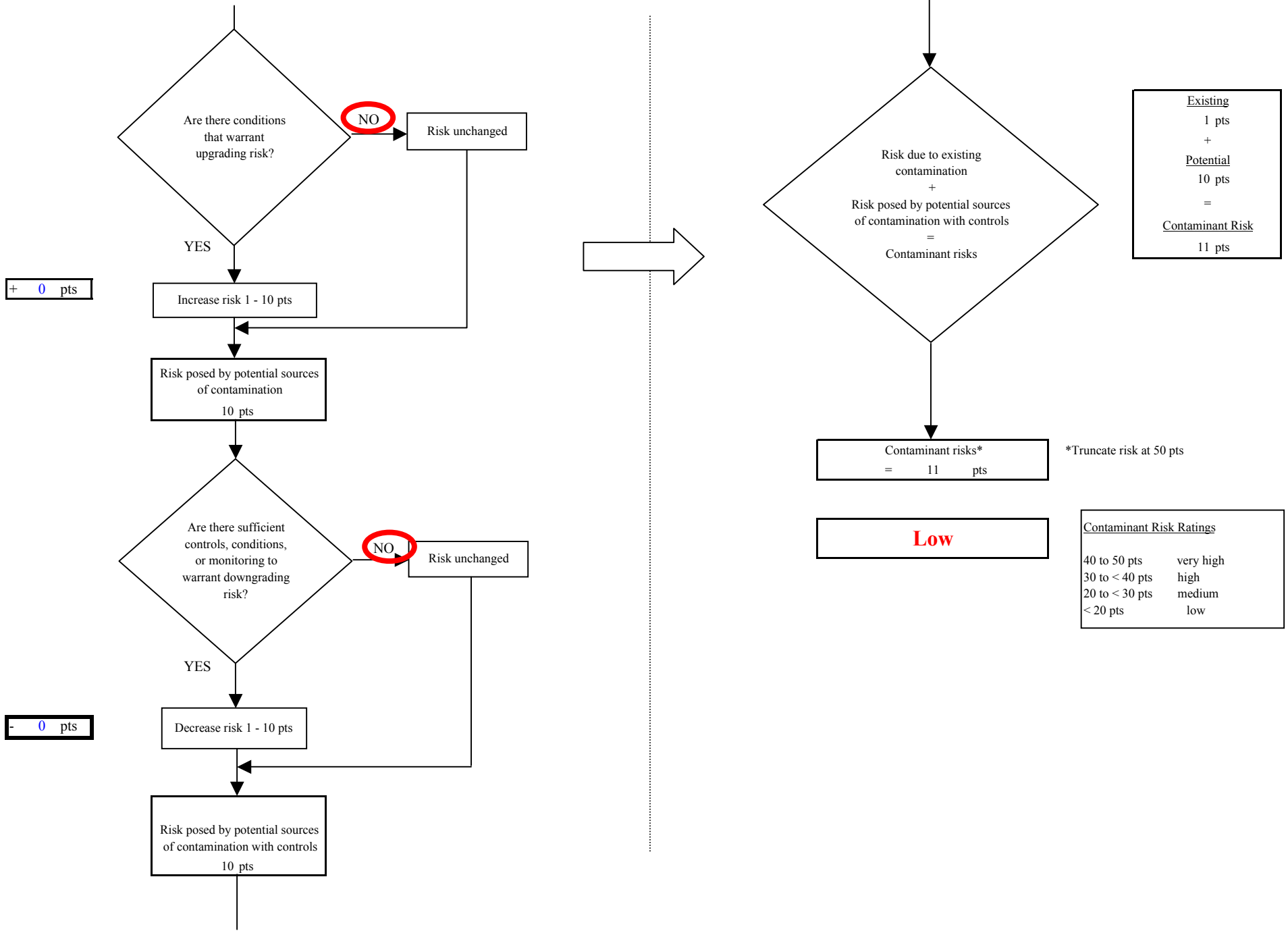


Chart 6. Vulnerability analysis for BLM- Paxson Lake Campground - Nitrates and Nitrites

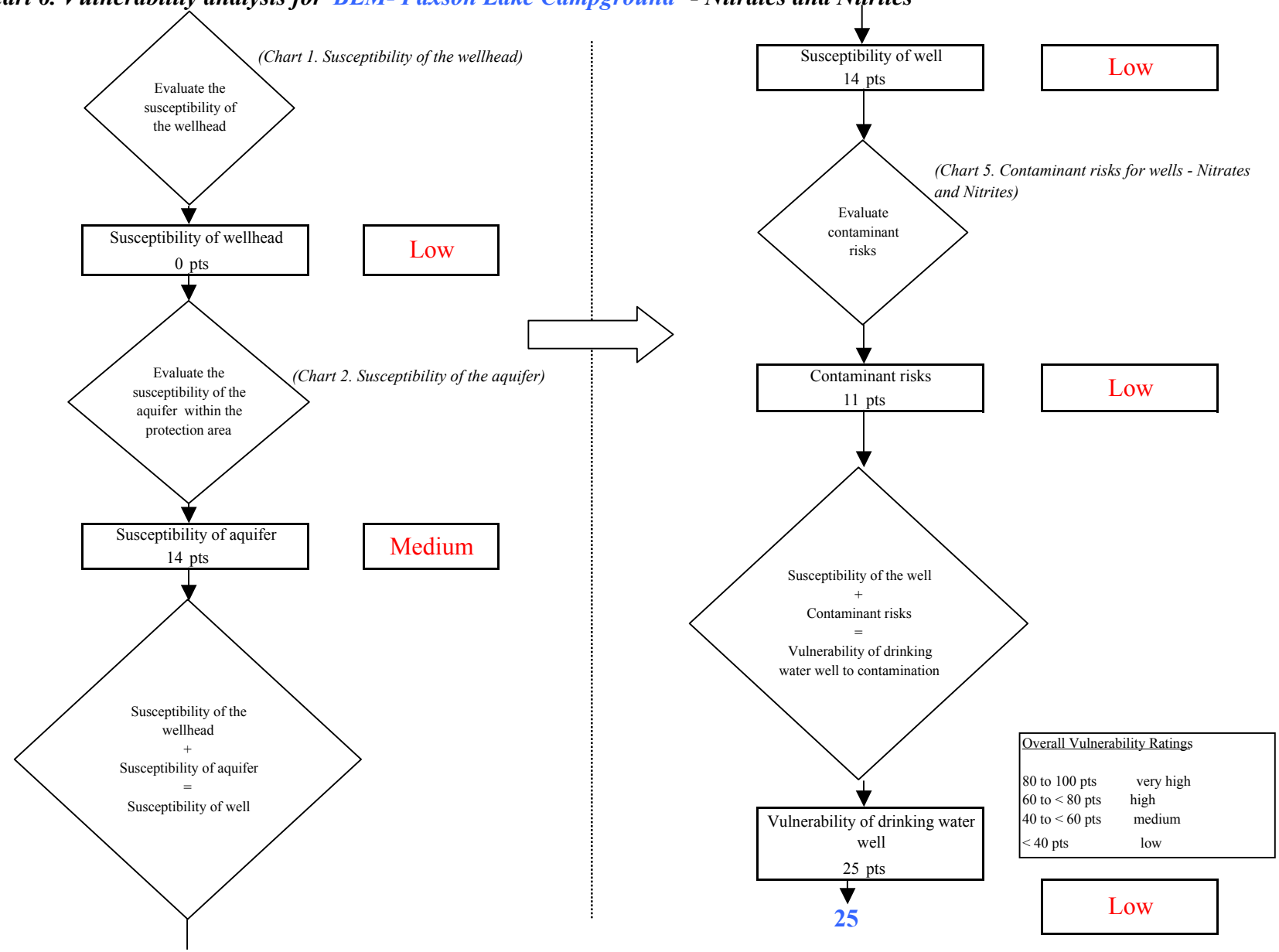


Chart 7. Contaminant risks for BLM- Paxson Lake Campground - Volatile Organic Chemicals

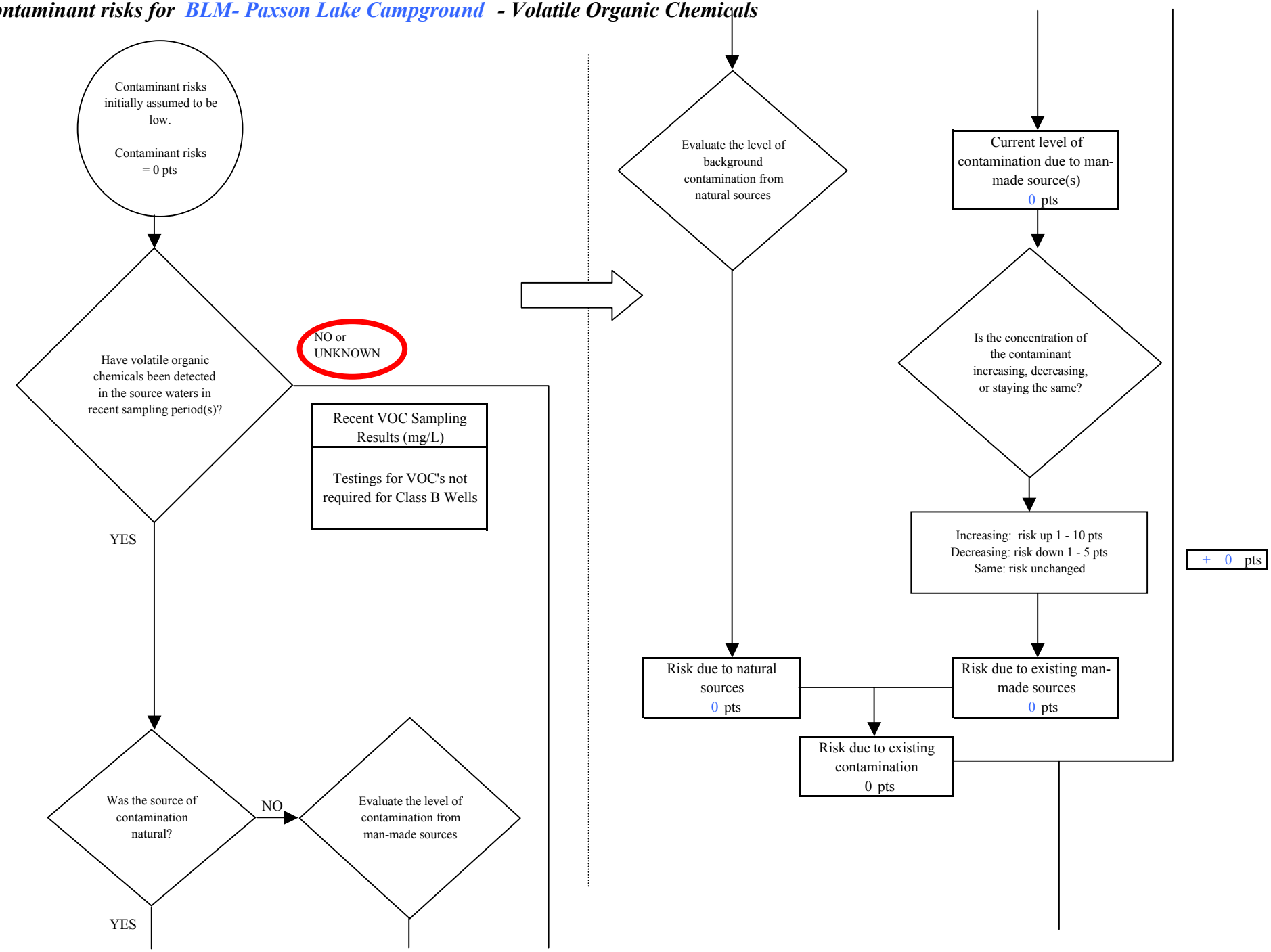


Chart 7. Contaminant risks for BLM- Paxson Lake Campground - Volatile Organic Chemicals

+ 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)	0	1	1
Low(s)	0	1	1

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

Matrix Score 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

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 7. Contaminant risks for BLM- Paxson Lake Campground - Volatile Organic Chemicals

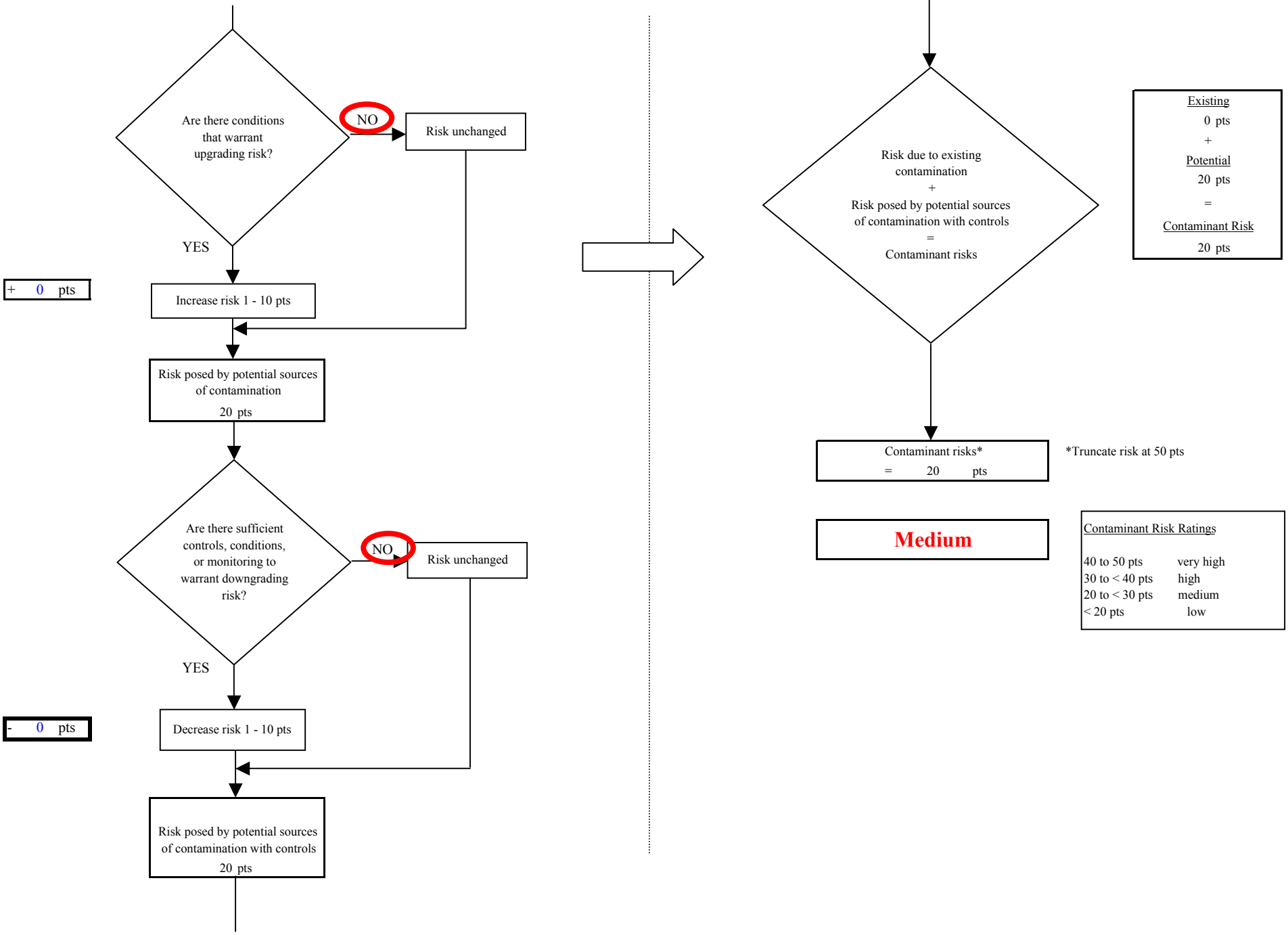


Chart 8. Vulnerability analysis for BLM- Paxson Lake Campground - Volatile Organic Chemicals