



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Kantishna Roadhouse
Drinking Water System,
Denali National Park, Alaska
PWSID # 390803

DRINKING WATER PROTECTION PROGRAM REPORT # 269
Alaska Department of Environmental Conservation

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By Ecology & Environment, Inc.

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August 2002

The Drinking Water Protection Program 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. 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 Kantishna Roadhouse Source of Public Drinking Water, Denali National Park, Alaska

By Ecology & Environment, Inc.

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Kantishna Roadhouse is a Class B (transient/non-community) water system consisting of one surface water source in Denali National Park, Alaska. Identified potential and current sources of contaminants for Kantishna Roadhouse's public drinking water source include: a septic system, placer and underground mines. 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 Kantishna Roadhouse received a vulnerability rating of **High** for bacteria and viruses, **High** for nitrates and nitrites, and **High** for volatile organic chemicals.

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 owners and/or operators, 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 and 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.

DESCRIPTION OF DENALI NATIONAL PARK AREA

Location

The entrance to Denali National Park is located 237 miles north of Anchorage and 120 miles south of Fairbanks, along the George Parks Highway. The park is accessed via the 89-mile Denali Park Road. Private vehicle access is restricted past mile 15. The road dead-ends in the Kantishna area. (Figure 1)



Figure 1

Precipitation

The Denali National Park area averages approximately 15 inches of precipitation per year, with approximately 81 inches of annual snowfall (ACRC 2002).

Topography and Drainage

The high peaks of the Alaska Range dominate the topography of Denali National Park. Drainage is typically off the mountains and alpine glaciers south of the road into the Savage, Sanctuary, Teklanika, and Toklat Rivers, among others, which flow generally north.

Groundwater Use

There are no permanent residences in the Park. Lodging establishments in the Kantishna area obtain their water from surface water sources or springs. Campgrounds within the Park obtain potable water from wells. (ADCED 2002).

Geology and Soils

The surficial geology along the road is mainly composed of alluvial sand and gravel, with some glacial deposits. Mountainous terrain in the vicinity of the Kantishna Hills and Mounts Healy, Margaret, and Wright is typically composed of metamorphic quartzite and mica schist, with quartz schist and marble. Volcanic basalts and rhyolites, together with sandstone, shale and conglomerate of the Cantwell Formation, also are present in some areas along the road (Gilbert 1979).

KANTISHNA ROADHOUSE PUBLIC DRINKING WATER SYSTEM

Kantishna Roadhouse is a Class B (transient/non-community) water system. The system consists of one surface water source at milepost 95 at the end of the McKinley Park Road in the Kantishna area of Denali National Park.

The system's intake is Moose Creek, a stream in mountainous terrain with an estimated discharge of less than 20,000 cfs. The most recent Sanitary Survey (9/4/98) indicates the intake is not adequately constructed, based on the lack of a cover for the infiltration gallery and the lack of a sealed water tank.

This system operates June 5 to September 11 and serves no residents and more than 140 non-residents.

KANTISHNA ROADHOUSE 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 source. Some areas are more likely to allow contamination to reach the surface water source than others are.

The most probable area for contamination to reach the drinking water source is the area that contributes water to the surface water source. This area is designated as the Drinking Water Protection Area (DWPA). Because a release of contaminants within the DWPA is most likely to impact the drinking water source, this area will serve as the focus for voluntary protection efforts.

The Drinking Water Protection Areas established for surface water bodies by the Alaska Department of Environmental Conservation (ADEC) are separated into zones. The Drinking Water Protection Areas for the Kantishna Roadhouse source contains three zones, Zone A through Zone C (See Map 1 in Appendix A). These zones identify areas along the Kantishna Roadhouse source and its main feeder tributaries. Contaminants released within these areas can potentially pollute the drinking water source.

Zone A corresponds to an area within 1000 feet of Kantishna Roadhouse source and its main tributaries. Zone B identifies the area within one mile, and Zone C encompasses the entire watershed. (Please refer to the Guidance Manual for Class B Water Systems for additional information).

The following is a summary of the three DWPA zones:

Table 1. Definition of Zones

Zone	Definition
A	1000 Feet from Surface Water Source
B	1 Mile from Surface Water Source
C	Entire Watershed of Surface Water Source

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 Kantishna Roadhouse DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water source 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 water system assessments, three categories of drinking water contaminants were inventoried. They include:

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

Inventoried potential sources of contamination within Zones A through Zone C were associated with mining and commercial lodging activities. Map 2 and Map 3 in Appendix C of this report depict the contaminant source inventory for Kantishna Roadhouse. The sources are

summarized in the tables in Appendix B of the Guidance Manual.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are sorted and ranked 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. Further, contaminant risks are a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the surface water source.

VULNERABILITY OF KANTISHNA ROADHOUSE DRINKING WATER SOURCE

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and
- Contaminant risks.

Each of the three categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

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

A score for the natural susceptibility to contamination is achieved by examining the construction of the intake, potential for runoff, and the capacity of the water body to dilute contaminants. The Kantishna Roadhouse water source has an inherent susceptibility simply because it is a surface water body. Surface water generally has more debris and dirt particles (higher turbidity) and biological contamination. Contaminants are able to flow directly into the water source. Table 1 shows the overall susceptibility score and rating for Kantishna Roadhouse.

Appendix D contains seven 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 Surface Water’ to contamination by looking at the construction of the well and its surrounding area. Chart 2 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 3 contains the ‘Vulnerability Analysis for Bacteria and Viruses’. Charts 4 through 7 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

Table 2 shows the Susceptibility score and rating for Kantishna Roadhouse (see Chart 1).

Table 2. Natural Susceptibility - Susceptibility of the Surface Water Source to Contamination

	Score	Rating
Susceptibility of the Surface Water	48	Very High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing or historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants (see Appendix D: Charts 2, 4, and 6).

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	12	Low
Volatile Organic Chemicals	14	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 (see Appendix D: Charts 3, 5, and 7).

Table 4. Overall Vulnerability of Kantishna Roadhouse to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	60	High
Nitrates and Nitrites	60	High
Volatile Organic Chemicals	60	High

In Appendix B, Tables 2 through 4 contain a list of

potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

Only a small amount of bacteria and viruses are required to endanger public health. If bacteria and viruses have been detected during recent water sampling of the system at Kantishna Roadhouse, the result is a maximum score on Chart 2 in Appendix D.

The sampling history for Kantishna Roadhouse source indicates that nitrates and/or nitrites are found in natural background concentration at this site, as elsewhere throughout Alaska. Nitrate concentrations in uncontaminated groundwater are typically less than 2 milligrams per liter (mg/L) and are derived primarily from the decomposition of organic matter in soils [Wang, Strelakos, Jokela, 2000]. Existing nitrate concentration in Kantishna Roadhouse surface water source is approximately 0.1 mg/L or 1% of the Maximum Contaminant Level (MCL) of 10mg/L. 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. Though existing nitrate contamination was detected at the site, concentrations remain at safe levels with respect to human health (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Class B Public Water systems are not required to test for volatile organic chemicals (VOCs); therefore, no score for pre-existing contamination has been assigned. The vulnerability score for VOCs reflects the potential for contamination from the sources indicated on Table 4 in Appendix B.

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Kantishna Roadhouse. The overall vulnerability of this source to contamination is **High** for bacteria and viruses, **High** for nitrates and nitrites, and **High** 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 continuous efforts on the part of Kantishna Roadhouse 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 Kantishna Roadhouse public drinking water source.

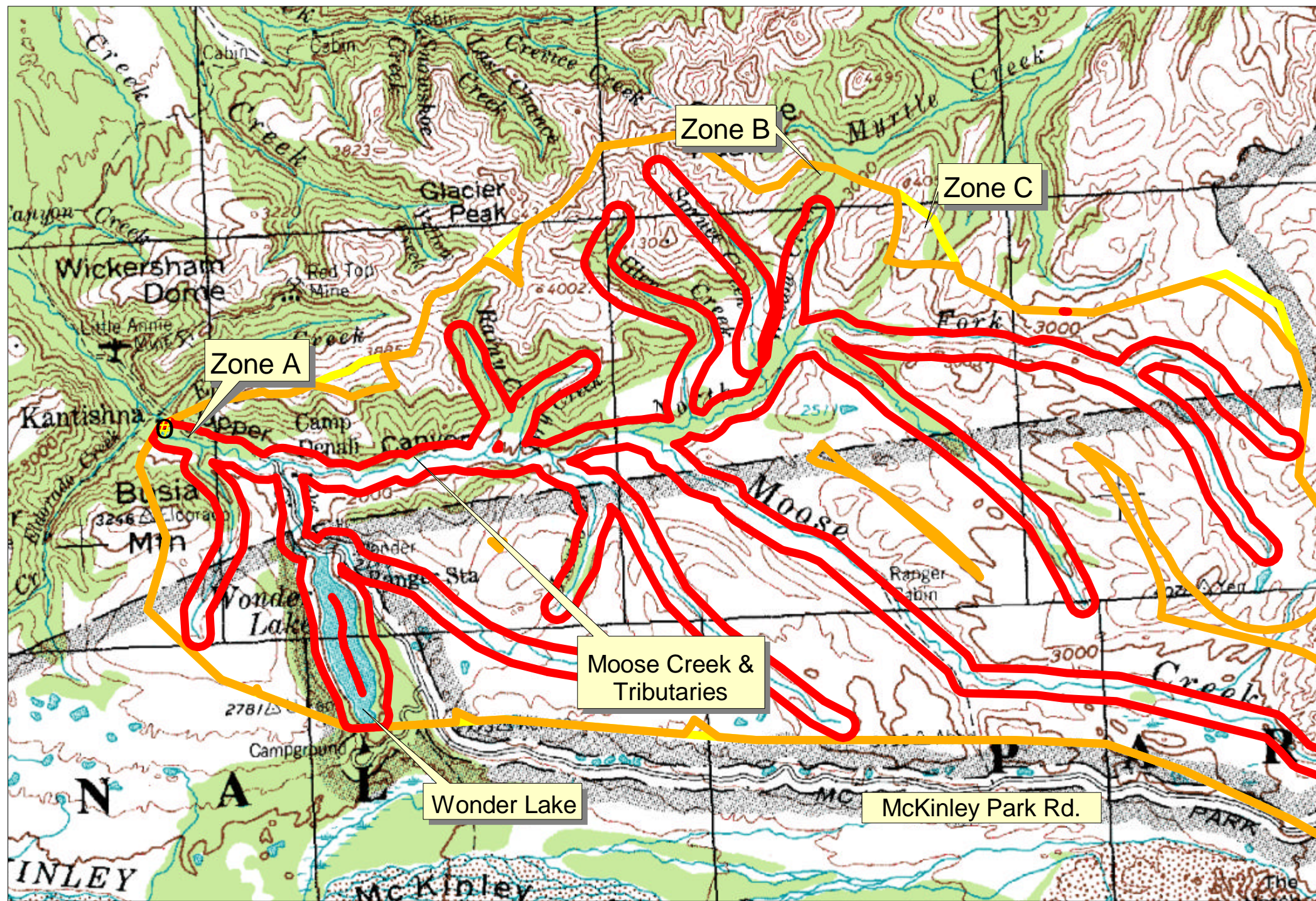
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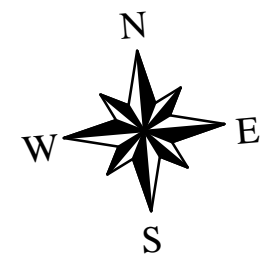
APPENDIX A

Kantishna Roadhouse Drinking Water Protection Area (Map 1)

Drinking Water Protection Area for Kantishna Roadhouse



-  Kantishna Roadhouse Water Intake
-  Zone A (1000' from Surface Water Body)
-  Zone B (1 Mile from Surface Water Body)
-  Zone C (Entire Watershed)



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Kantishna Roadhouse (Tables 1-4)

Table 1**Contaminant Source Inventory for
Kantishna Roadhouse****PWSID 390803.001**

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Location	Map Number	Comments
Metals mining, placer (active)	E04	E4-1	A	Wonder Lake	2	
Metals mining, placer (active)	E04	E4-2	A	Rainy Creek	2	
Metals mining, placer (inactive)	E04	E4-4	A	Glen Creek	2	
Metals mining, placer (inactive)	E04	E4-5	A	Spruce Creek	2	
Metals mining, placer (active)	E04	E4-6	A	Willow Creek	2	
Metals mining, underground (active)	E05	E5-7	A	Glen Creek Rhodochrosite	2	
Septic systems (serves one single-family home)	R02	R2-1	A	Kantishna Roadhouse	2	
Metals mining, placer (active)	E04	E4-3	B	Dry Creek	2	
Metals mining, underground (active)	E05	E5-1	B	Busia Mountain	2	
Metals mining, underground (inactive)	E05	E5-10	B	Glen East Fork	2	
Metals mining, underground (active)	E05	E5-11	B	Rainy Creek Ridge I & II	2	
Metals mining, underground (active)	E05	E5-12	B	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-13	B	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-14	B	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-15	B	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-16	B	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-17	B	Spruce Peak	2	
Metals mining, underground (active)	E05	E5-18	B	Unnamed/ Unknown Claim	3	
Metals mining, underground (active)	E05	E5-19	B	Stony Moose Divide	3	
Metals mining, underground (active)	E05	E5-2	B	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-3	B	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-6	B	Arkansas Claim	2	
Metals mining, underground (active)	E05	E5-8	B	Weiler Antimony	2	
Metals mining, underground (active)	E05	E5-9	B	Lloyd	2	

Table 2

*Contaminant Source Inventory and Risk Ranking for
Kantishna Roadhouse
Sources of Bacteria and Viruses*

PWSID 390803.001

<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one single-family home)	R02	R2-1	A	Low	Kantishna Roadhouse	2	

Table 3

*Contaminant Source Inventory and Risk Ranking for
Kantishna Roadhouse
Sources of Nitrates/Nitrites*

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<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one single-family home)	R02	R2-1	A	Low	Kantishna Roadhouse	2	

Table 4

*Contaminant Source Inventory and Risk Ranking for
Kantishna Roadhouse
Sources of Volatile Organic Chemicals*

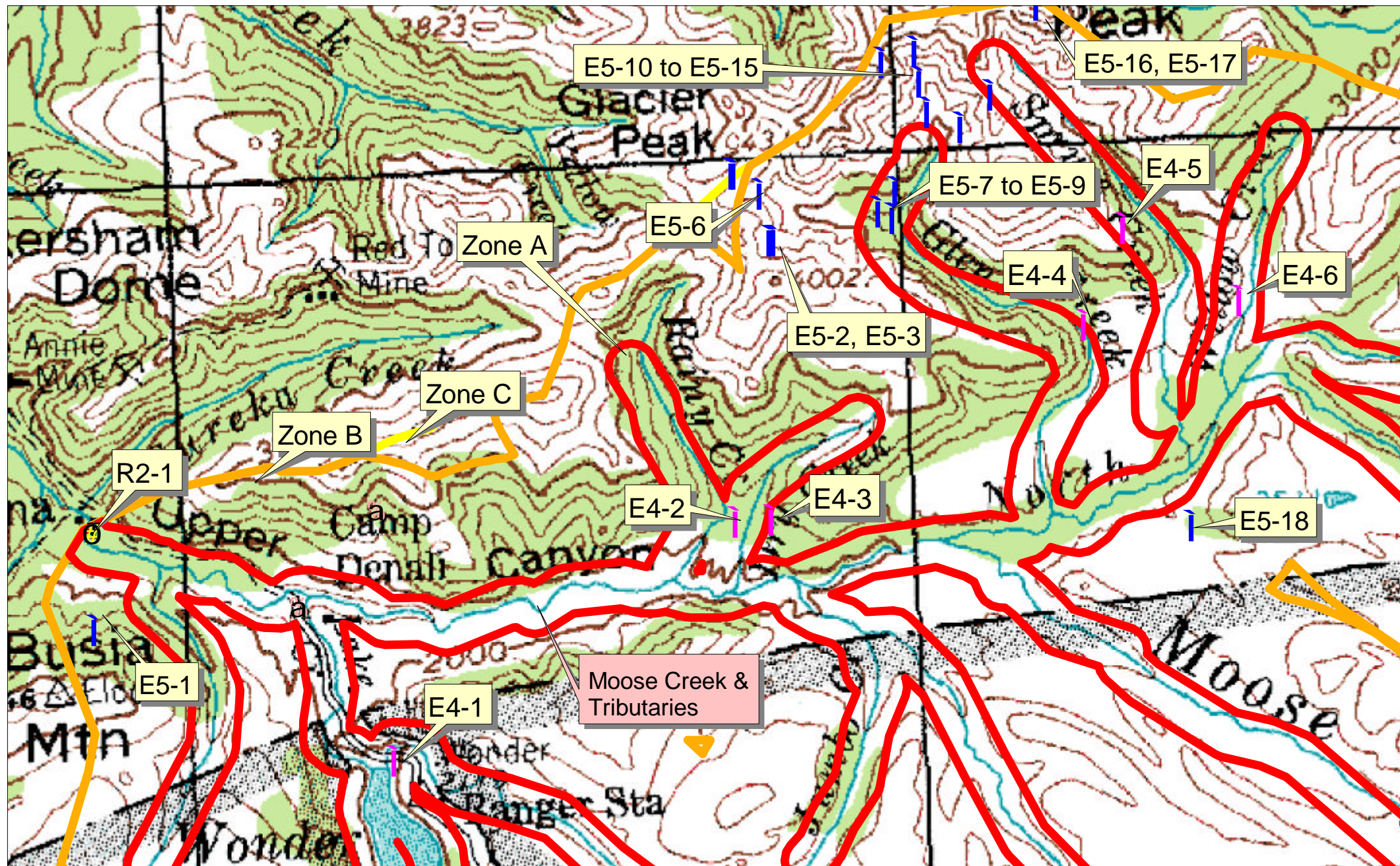
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<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Metals mining, underground (active)	E05	E5-7	A	Low	Glen Creek Rhodochrosite	2	
Septic systems (serves one single-family home)	R02	R2-1	A	Low	Kantishna Roadhouse	2	
Metals mining, underground (active)	E05	E5-1	B	Low	Busia Mountain	2	
Metals mining, underground (inactive)	E05	E5-10	B	Low	Glen East Fork	2	
Metals mining, underground (active)	E05	E5-11	B	Low	Rainy Creek Ridge I & II	2	
Metals mining, underground (active)	E05	E5-12	B	Low	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-13	B	Low	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-14	B	Low	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-15	B	Low	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-16	B	Low	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-17	B	Low	Spruce Peak	2	
Metals mining, underground (active)	E05	E5-18	B	Low	Unnamed/ Unknown Claim	3	
Metals mining, underground (active)	E05	E5-19	B	Low	Stony Moose Divide	3	
Metals mining, underground (active)	E05	E5-2	B	Low	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-3	B	Low	Unnamed/ Unknown Claim	2	
Metals mining, underground (active)	E05	E5-6	B	Low	Arkansas Claim	2	
Metals mining, underground (active)	E05	E5-8	B	Low	Weiler Antimony	2	
Metals mining, underground (active)	E05	E5-9	B	Low	Lloyd	2	

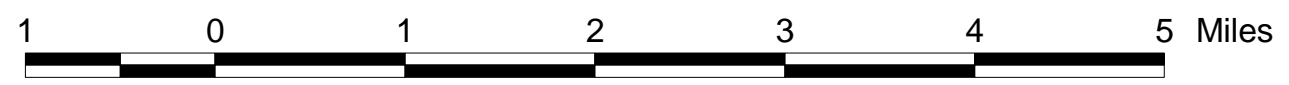
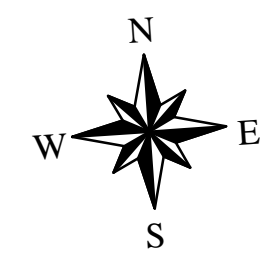
APPENDIX C

Kantishna Roadhouse Drinking Water Protection Area and Potential and Existing Contaminant Sources (Maps 2 and 3)

Drinking Water Protection Area for Kantishna Roadhouse and Potential and Existing Sources of Contamination



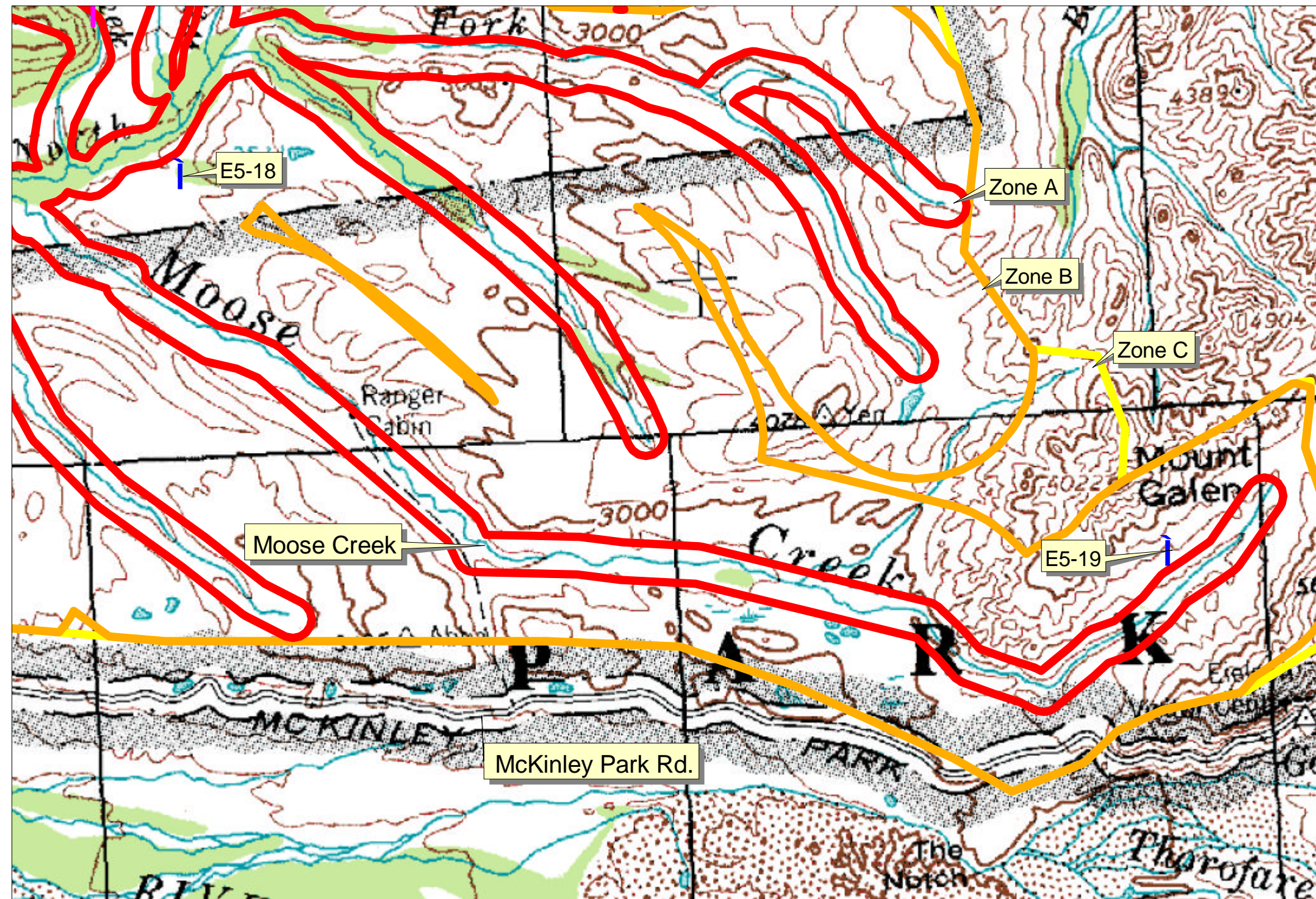
- Kantishna Roadhouse Water Intake
- Public Water Intakes
- Septic System
- Mines
 - Placer
 - Underground
- Zone A (1000' from Surface Water Body)
- Zone B (1 Mile from Surface Water Body)
- Zone C (Entire Watershed)



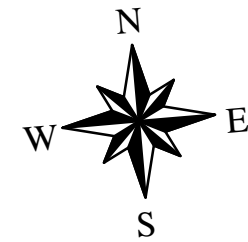
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Map 2

Drinking Water Protection Area for Kantishna Roadhouse and Potential and Existing Sources of Contamination



- Kantishna Roadhouse Water Intake
- Public Water Intakes
- Septic System
- Mines**
- Placer
- Underground
- Zone A (1000' from Surface Water Body)
- Zone B (1 Mile from Surface Water Body)
- Zone C (Entire Watershed)



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Map 3

APPENDIX D

Vulnerability Analysis for Kantishna Roadhouse Public Drinking Water Source (Charts 1-7)

Chart 1. Susceptibility of the surface water source - *Kantishna Roadhouse*

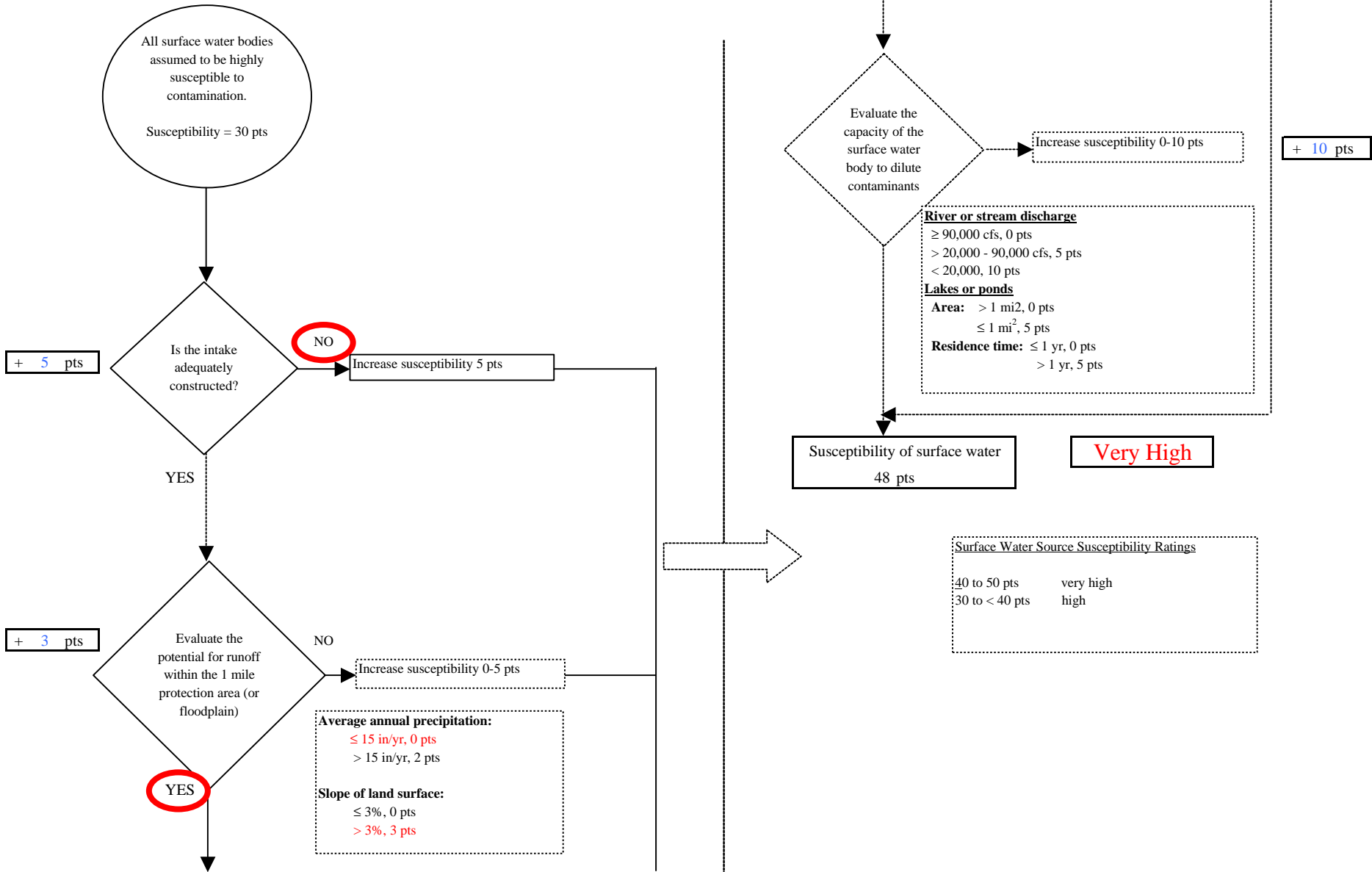
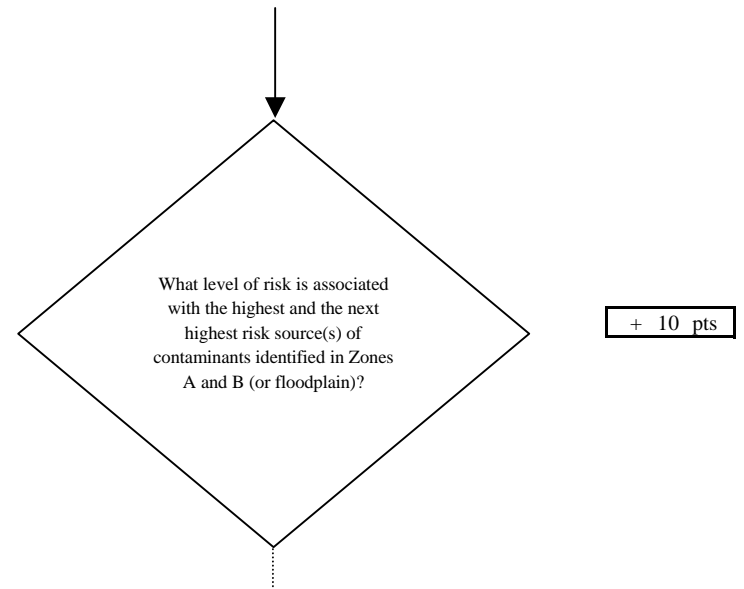
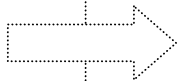
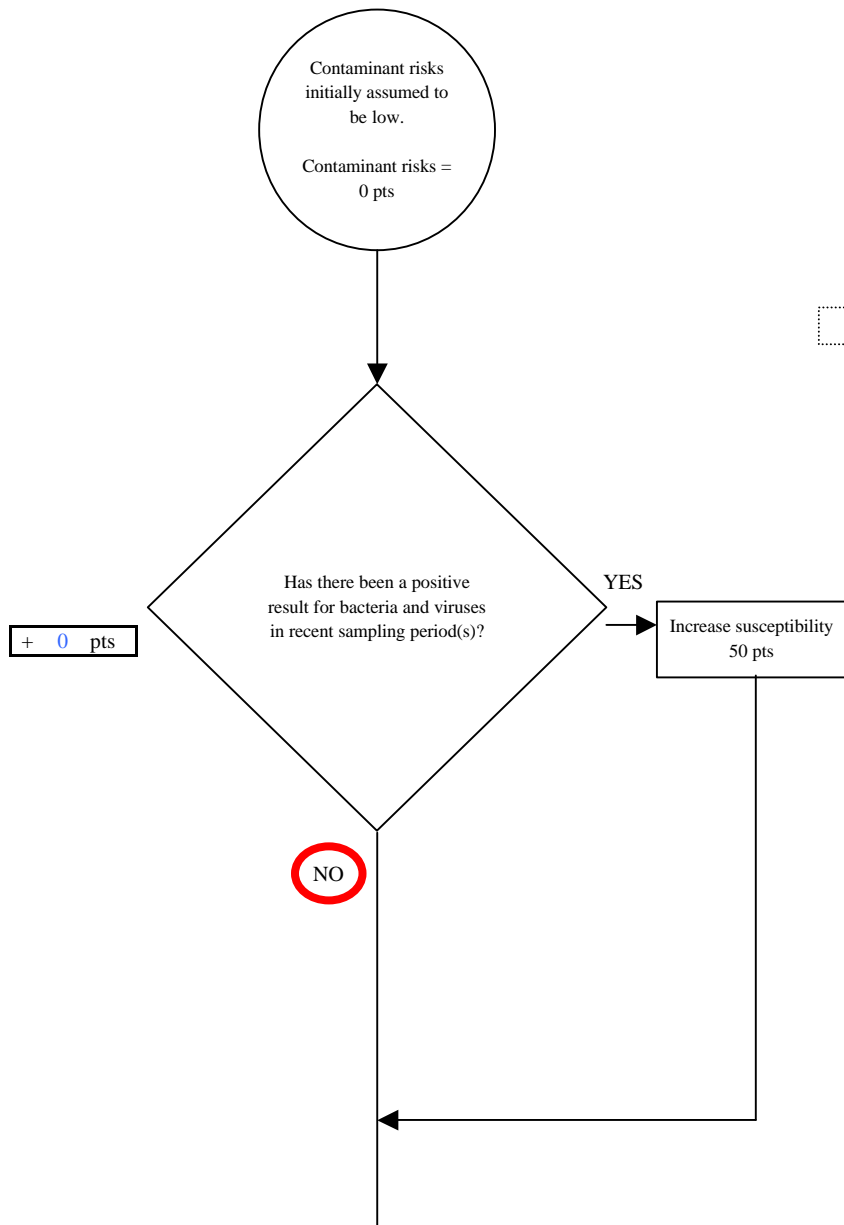


Chart 2. Contaminant risks for *Kantishna Roadhouse - Bacteria & Viruses*



Risk Rankings for Contaminant Sources Identified in Zones A and B			
	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	0	0	0
Medium(s)	0		0
Low(s)	1		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 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 2. Contaminant risks for Kantishna Roadhouse - Bacteria & Viruses

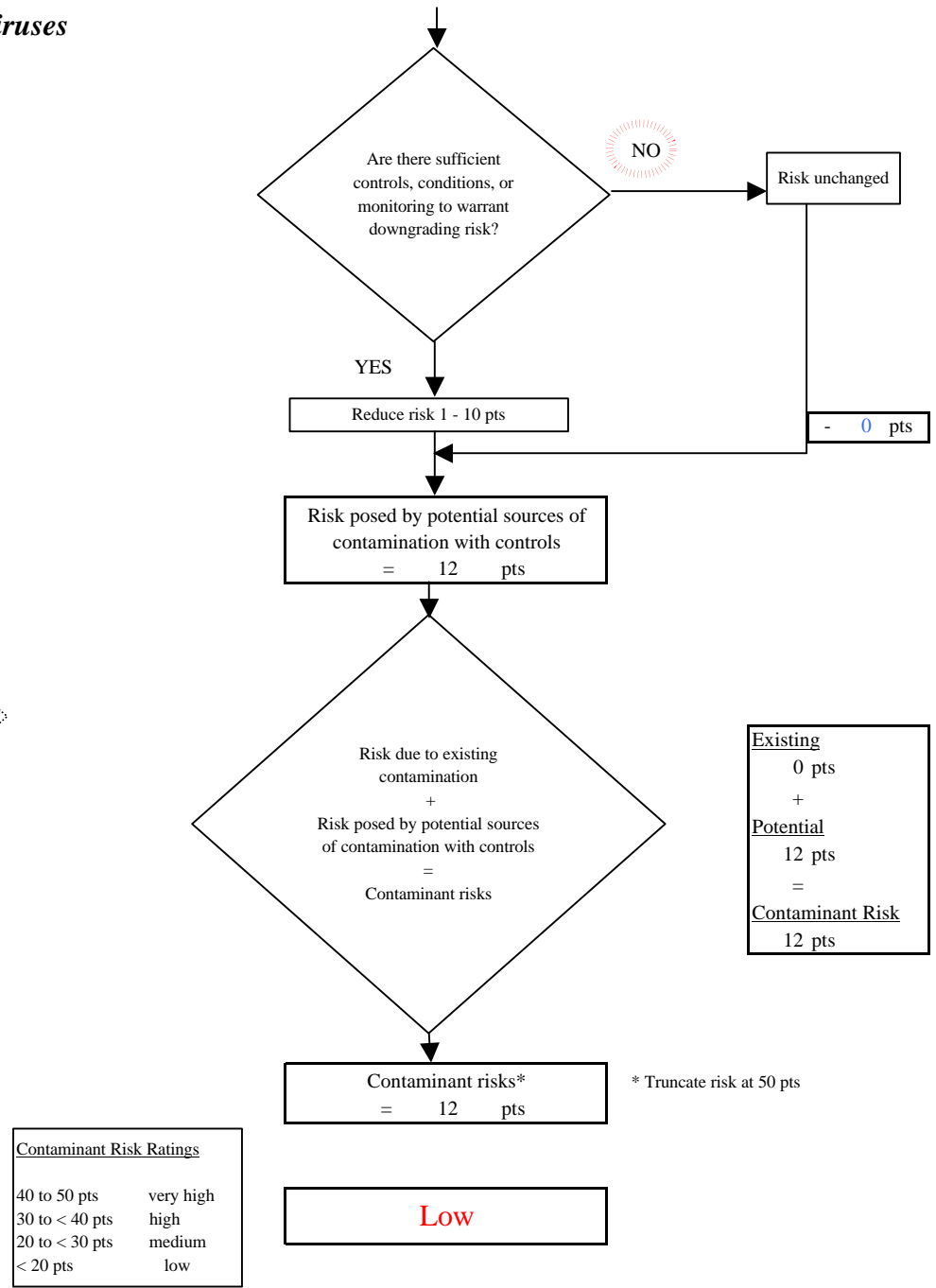
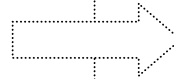
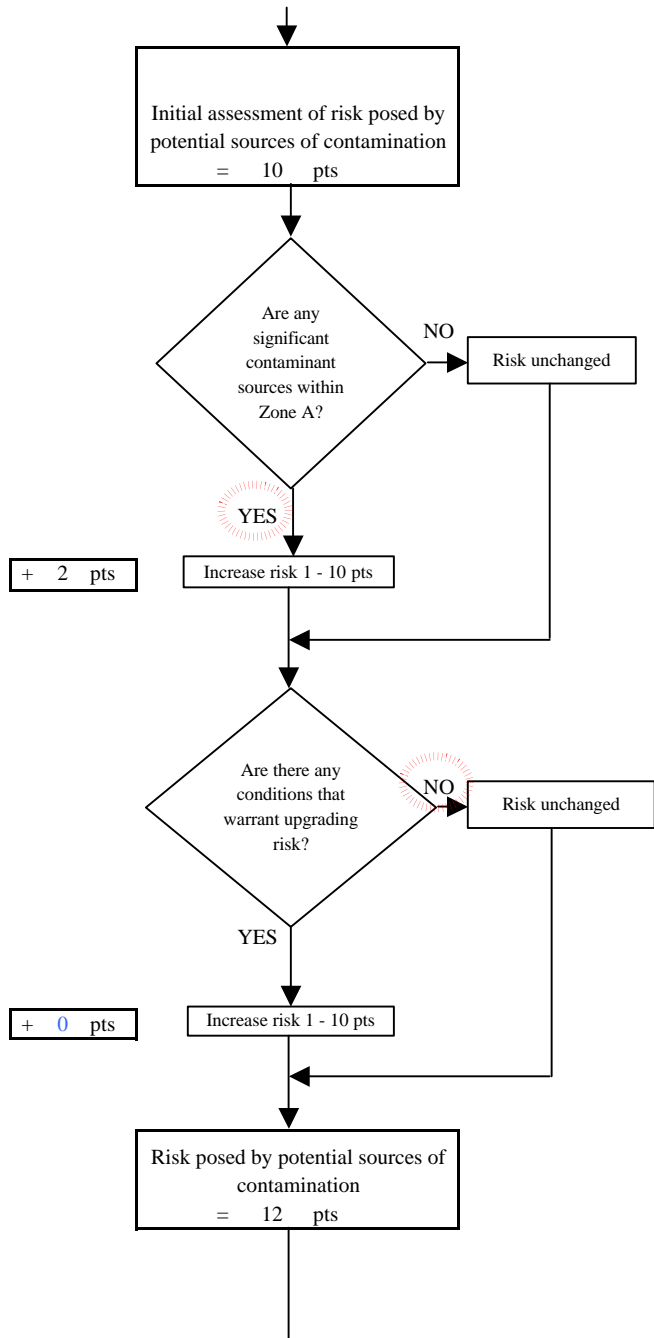


Chart 3. Vulnerability analysis for *Kantishna Roadhouse* - Bacteria & Viruses

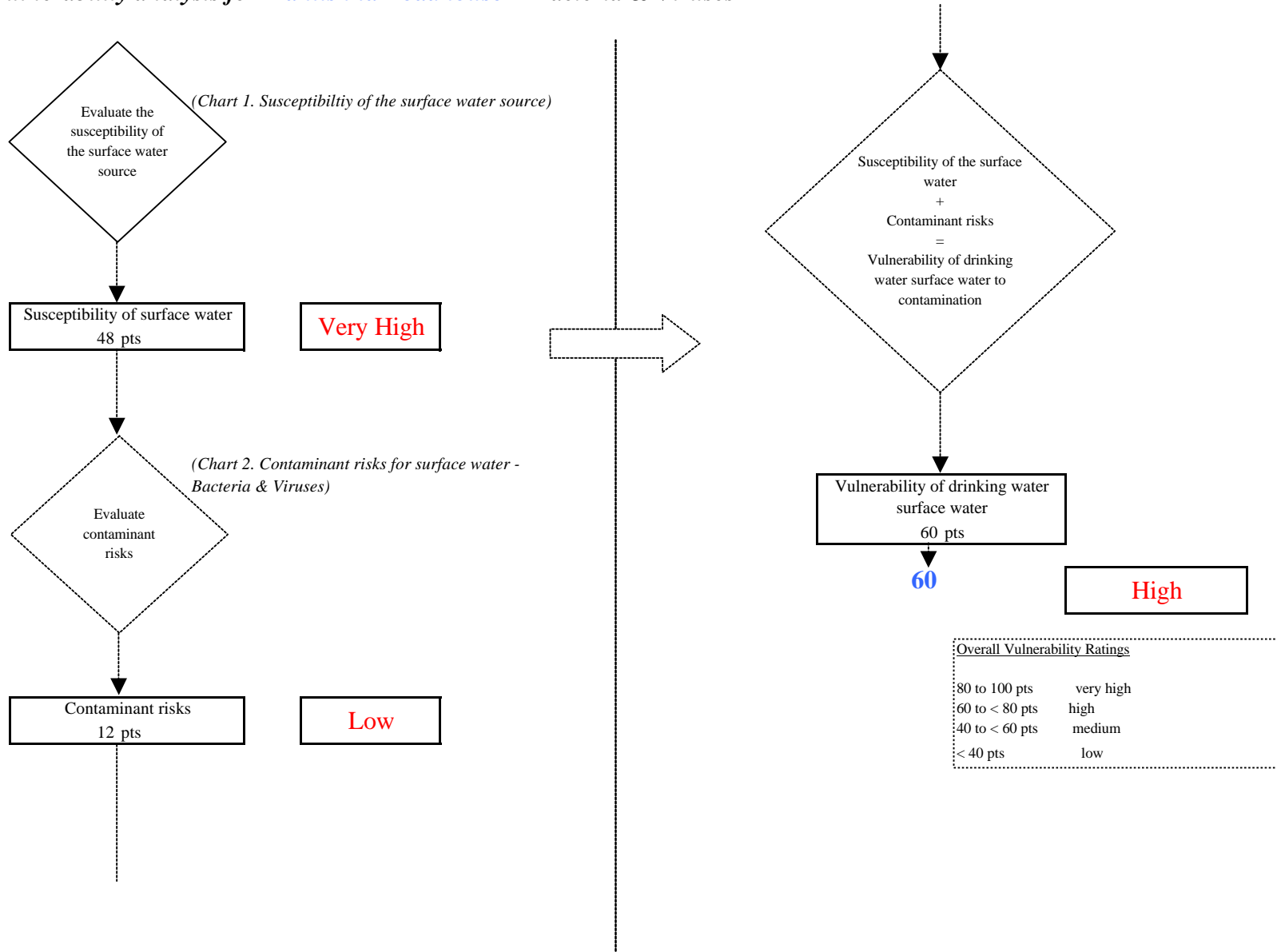


Chart 4. Contaminant risks for *Kantishna Roadhouse* - Nitrates and Nitrites

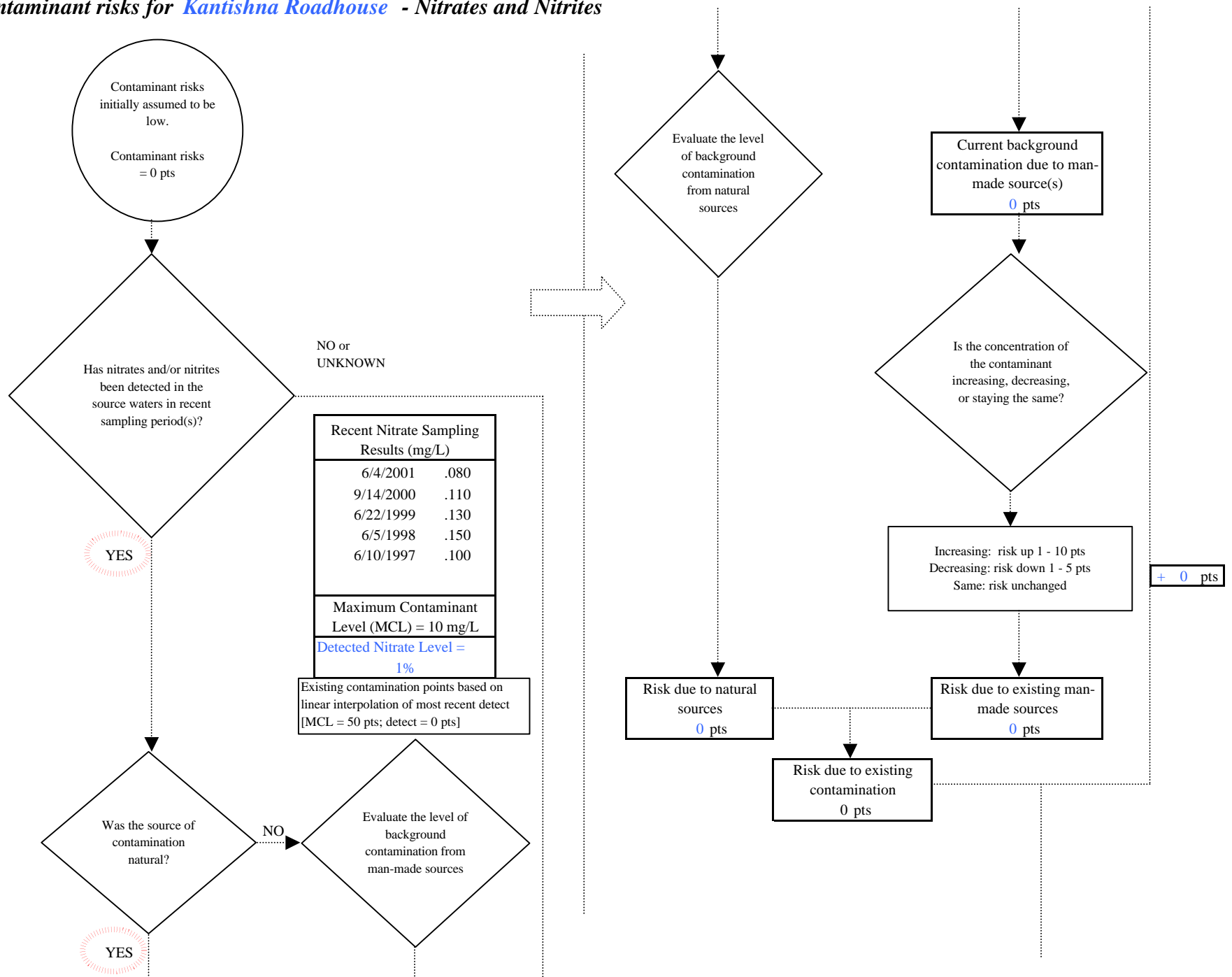


Chart 4. Contaminant risks for Kantishna Roadhouse - Nitrates and Nitrites

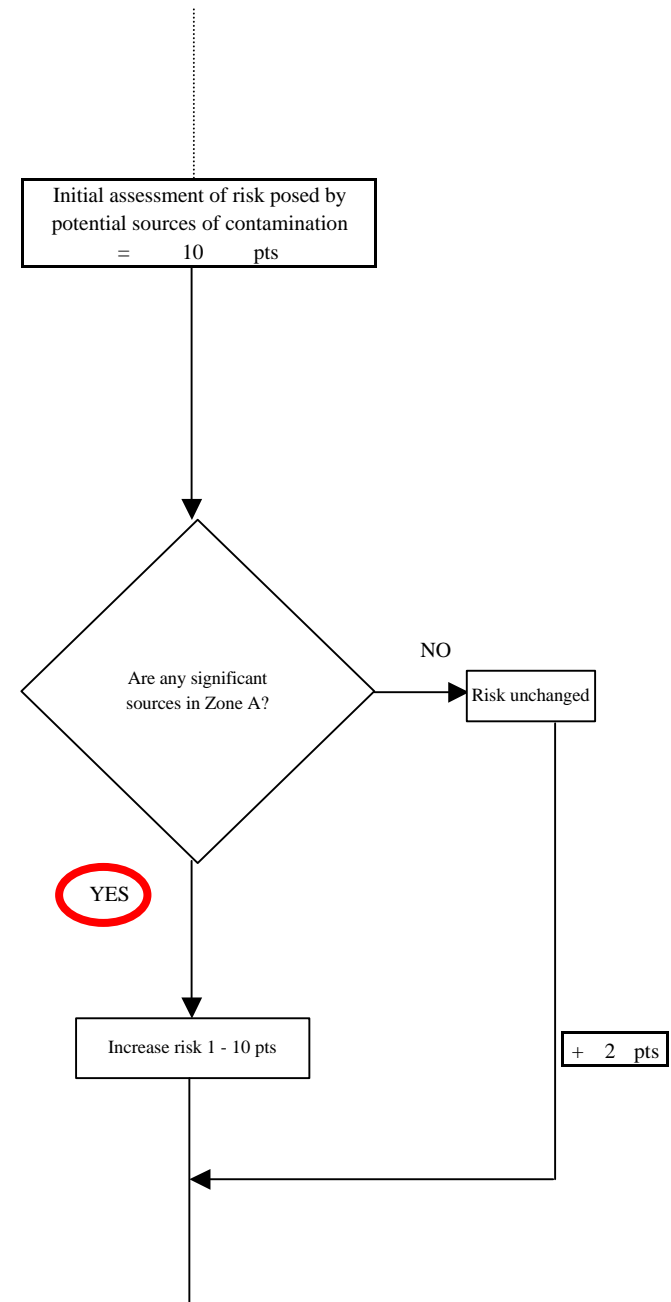
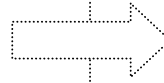
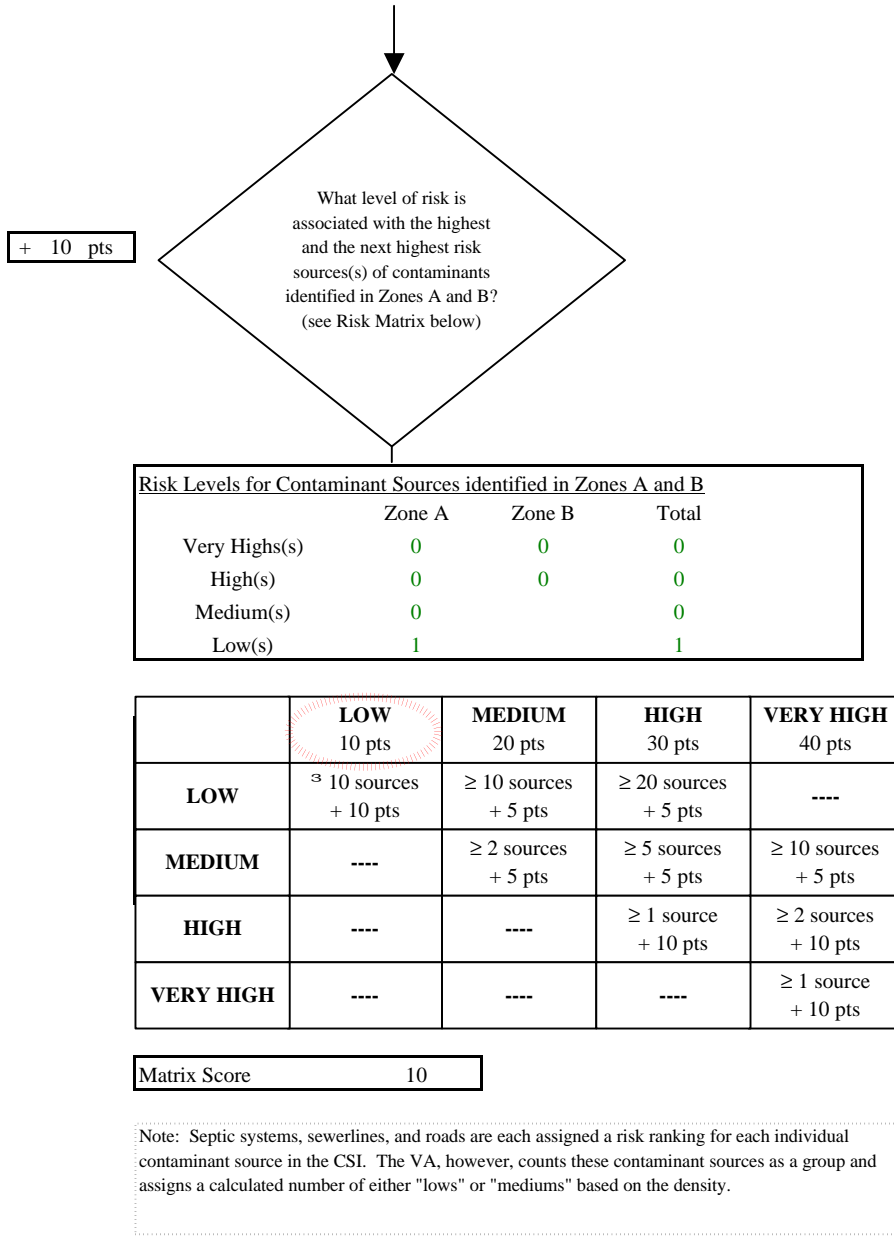


Chart 4. Contaminant risks for Kantishna Roadhouse - Nitrates and Nitrites

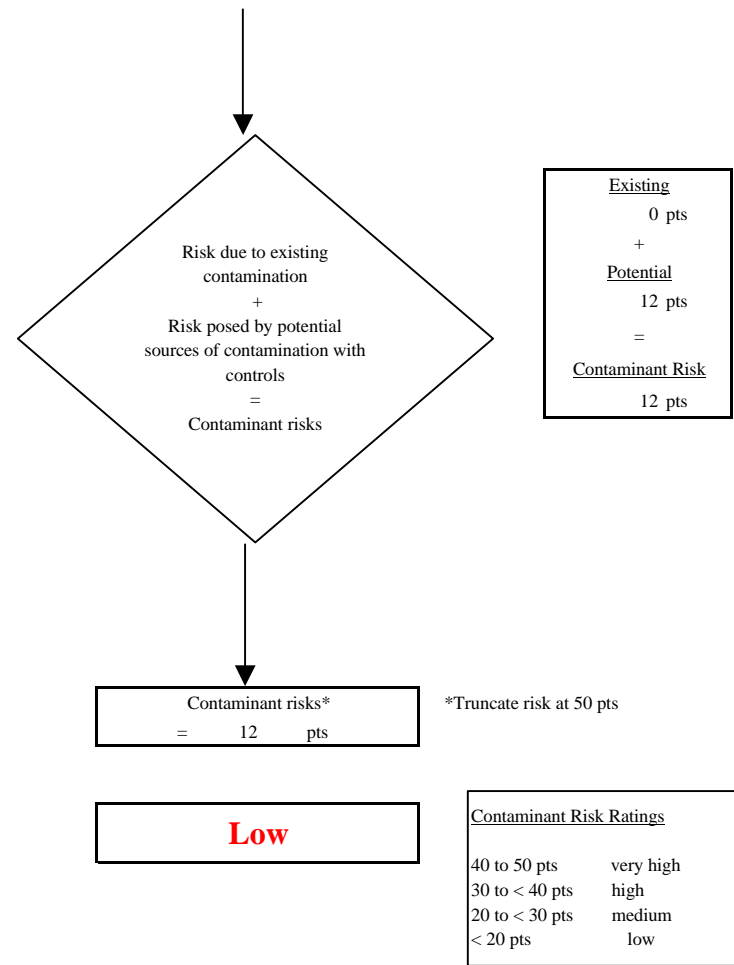
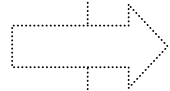
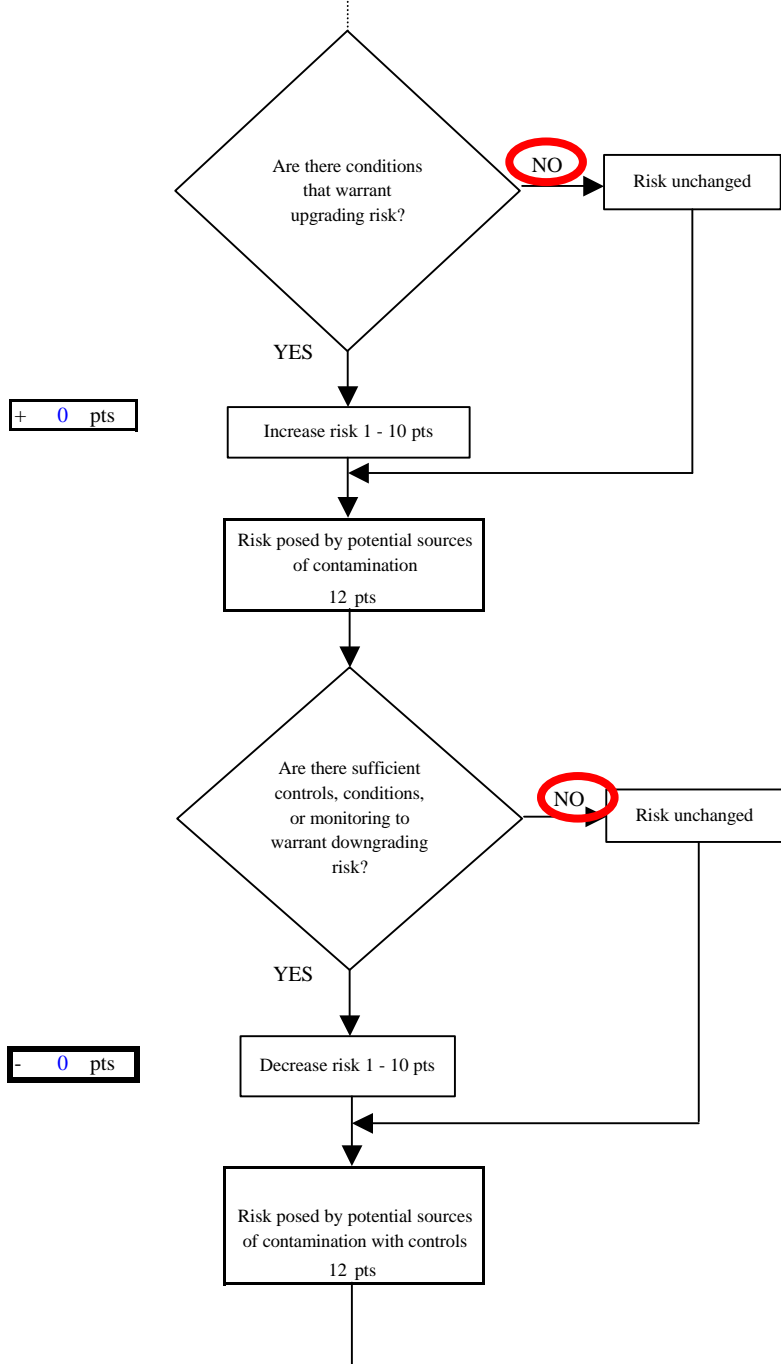


Chart 5. Vulnerability analysis for *Kantishna Roadhouse* - Nitrates and Nitrites

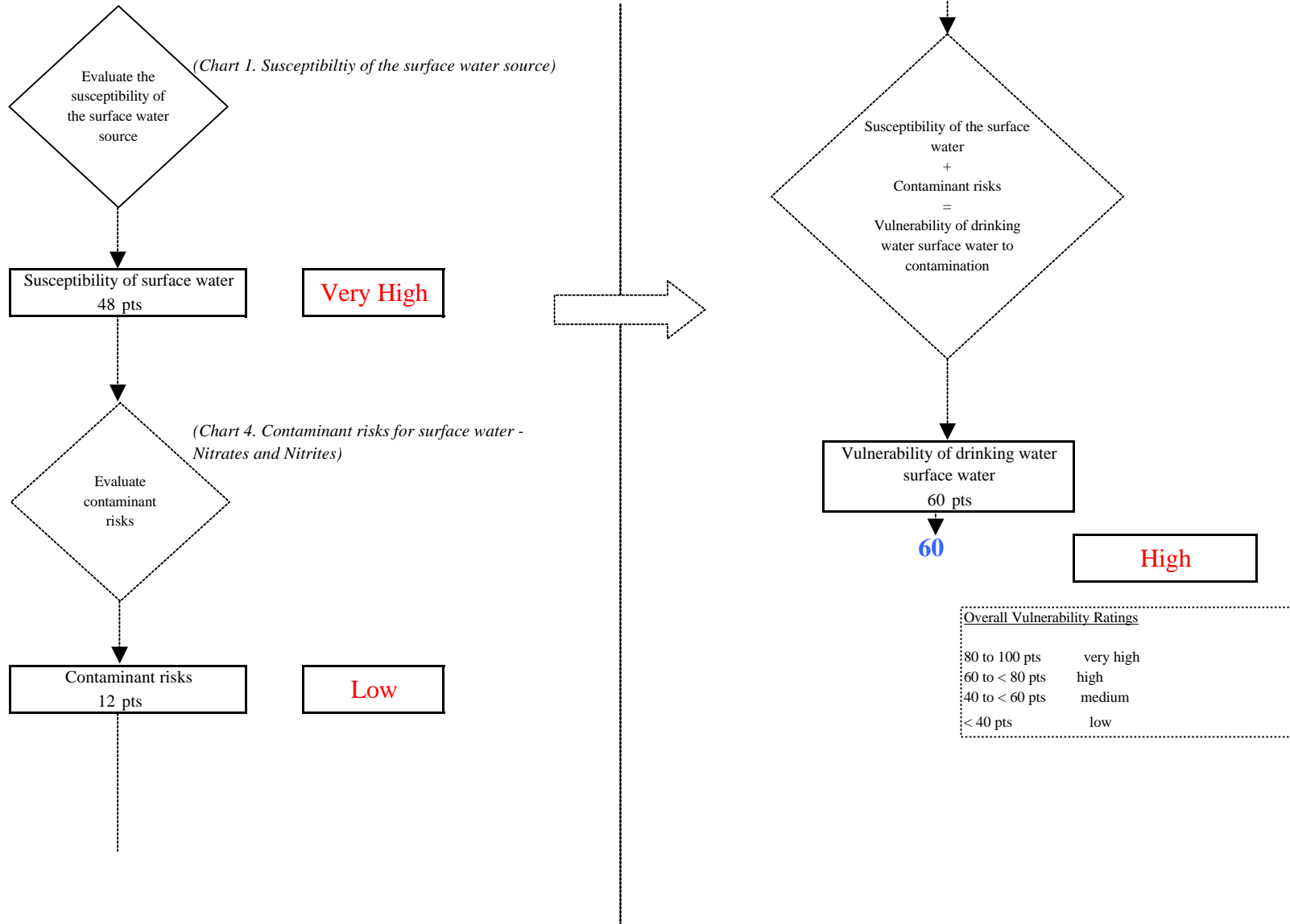


Chart 6. Contaminant risks for *Kantishna Roadhouse* - Volatile Organic Chemicals

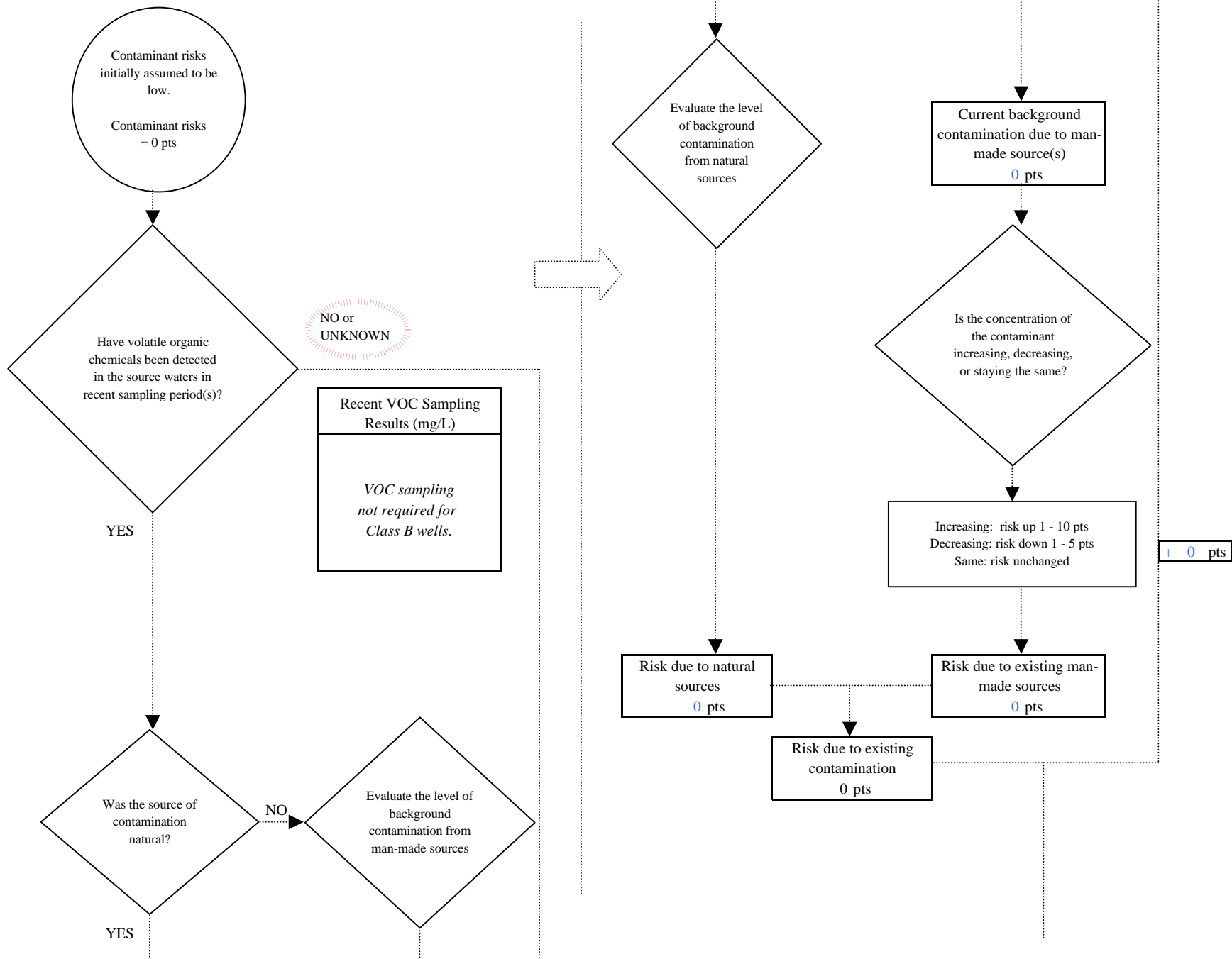
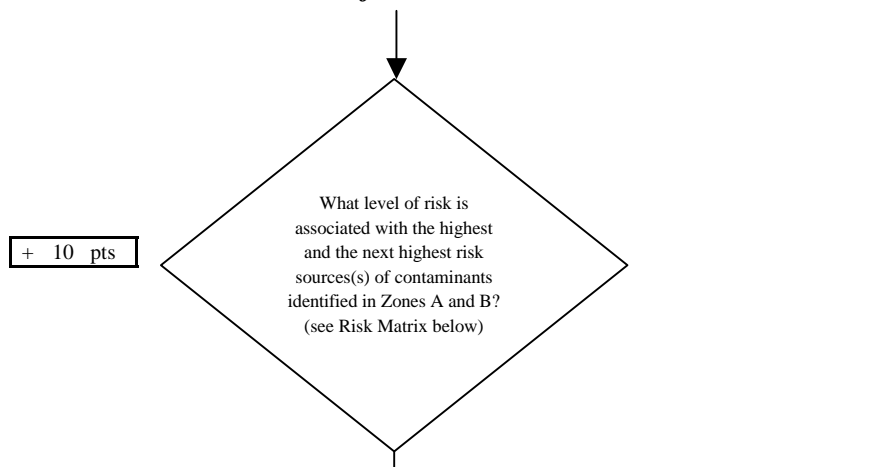


Chart 6. Contaminant risks for Kantishna Roadhouse - Volatile Organic Chemicals



Risk Levels for Contaminant Sources identified in Zones A and B			
	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	0	2

	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.

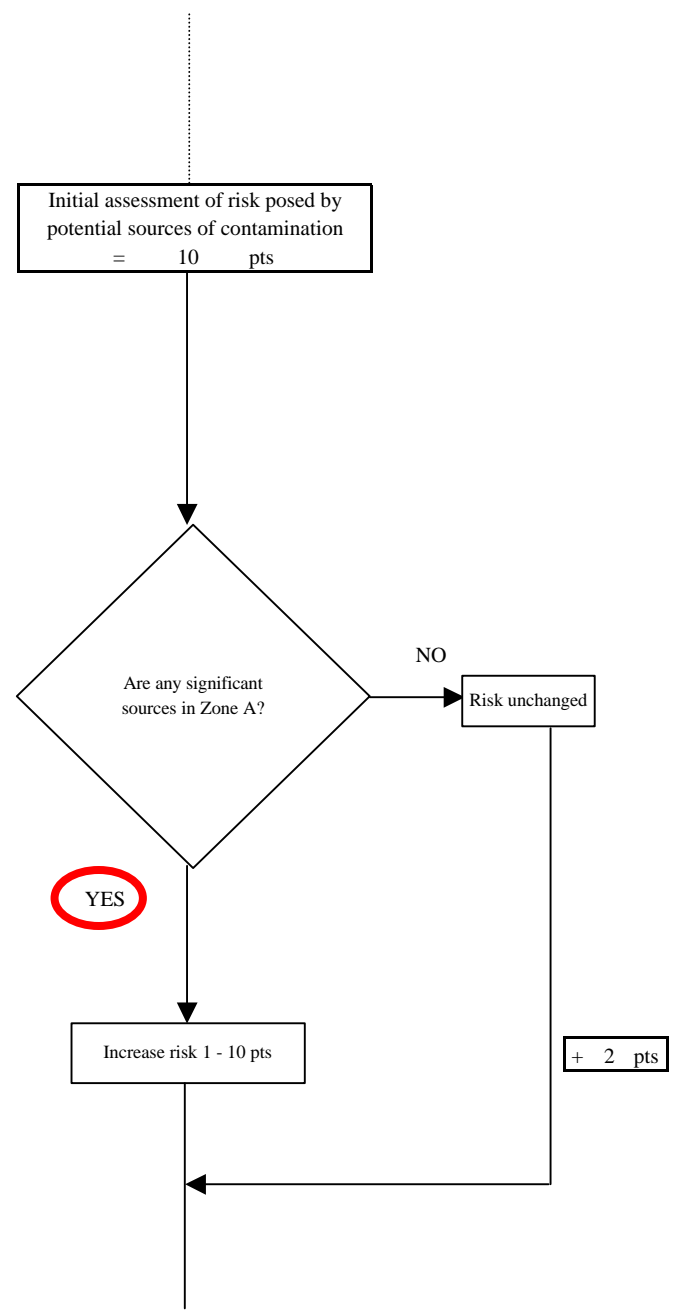
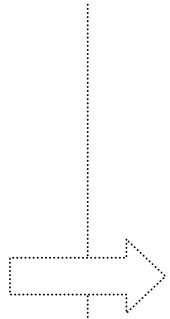


Chart 6. Contaminant risks for Kantishna Roadhouse - Volatile Organic Chemicals

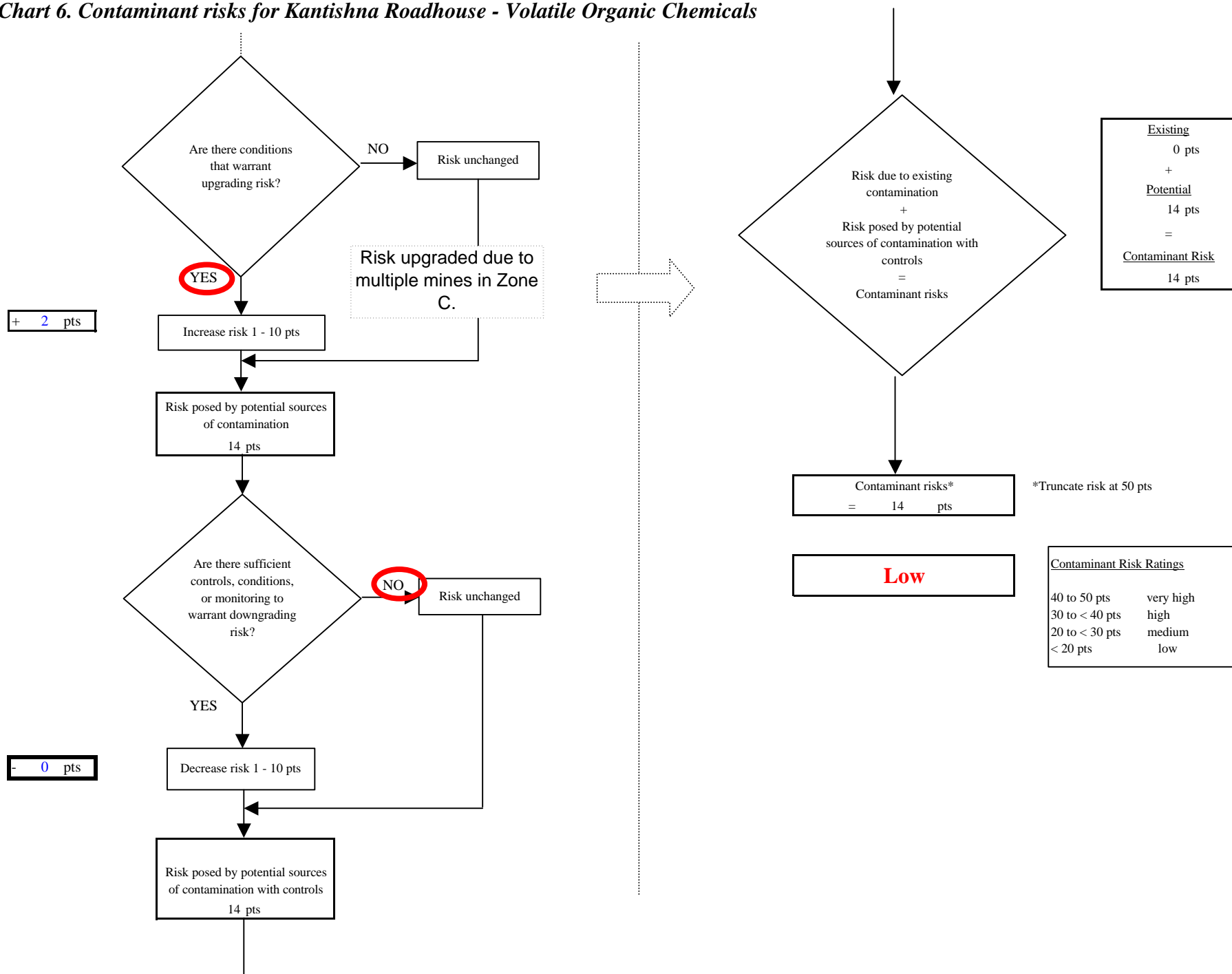


Chart 7. Vulnerability analysis for *Kantishna Roadhouse* - Volatile Organic Chemicals

