Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Tolsona Wilderness Campground Drinking Water System, Glennallen, Alaska

Tolsona Wilderness Campground #291431

DRINKING WATER PROTECTION PROGRAM REPORT *259*
Alaska Department of Environmental Conservation

AUGUST 2002

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By Shannon & Wilson, Inc.

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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.

CONTENTS

TABLES

ILLUSTRATIONS

APPENDICES

Source Water Assessment for Tolsona Wilderness Campground Source of Public Drinking Water, Glennallen, Alaska

By Shannon & Wilson, Inc.

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Tolsona Wilderness Campground is a Class B (transient/non-community) water system consisting of one well, located at Mile 173 of the Glenn Highway. There are no identified potential sources of contaminants for Tolsona Wilderness Campground public drinking water source. Overall, the public water sources for Tolsona Wilderness Campground received a vulnerability rating of **Medium** for volatile organic chemicals, **Medium** for bacteria and viruses, and **Medium** for nitrates and nitrites due to the apparent water system construction details and depth to groundwater.

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. Shannon & Wilson has been contracted to perform these assessments under the supervision of ADEC.

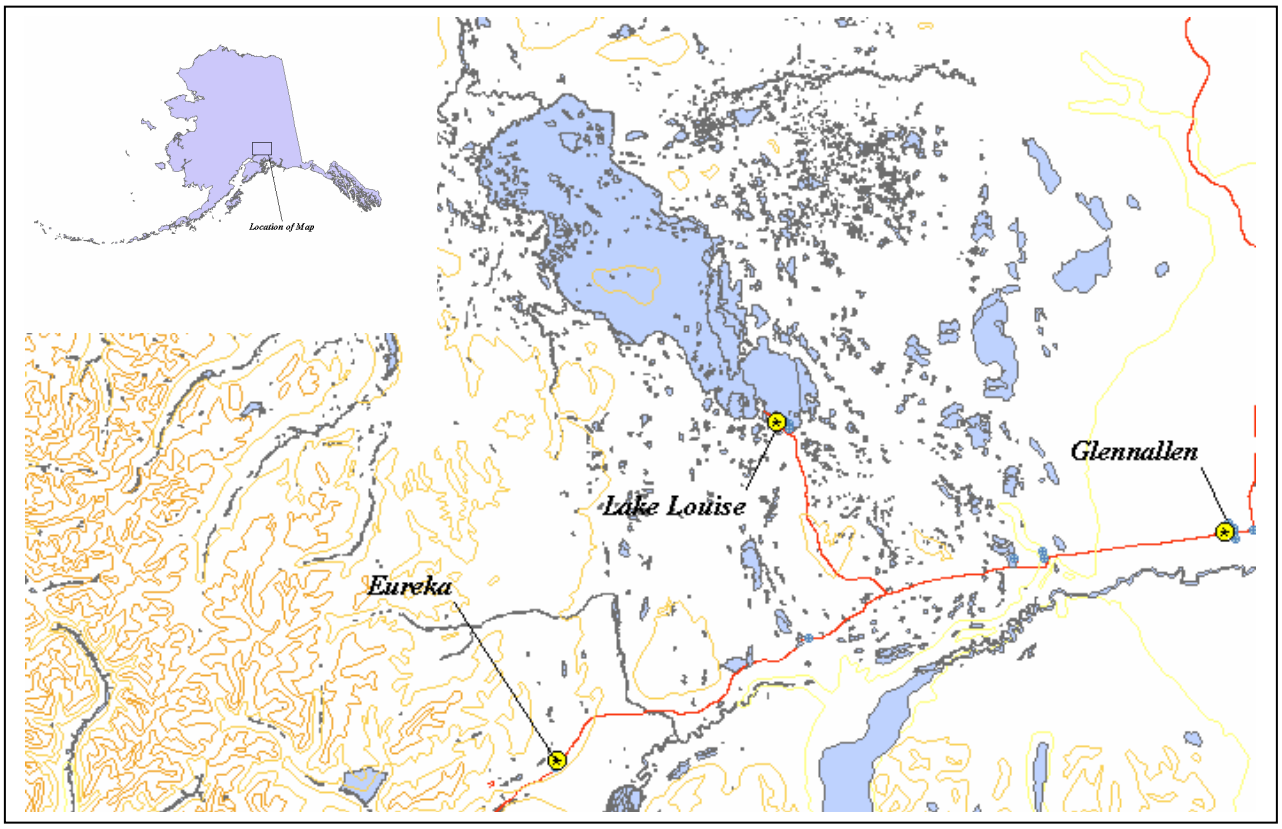


Figure 1. Index map showing the location of the Western Copper River Basin.

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 THE WESTERN COPPER RIVER BASIN

Glennallen

The western portion of the Copper River Basin encompasses the headwaters of the Nelchina, Little Nelchina, Tazlina and Gulkana Rivers and generally includes Lake Louise. The area is located west of the community of Glennallen, as shown in Figure 1. While Lake Louise is located in the Matanuska-Susitna (Mat-Su) Borough, other portions of the Copper River Basin are not located within the Mat-Su Borough.

A large lake occupied the Copper River Basin before the Copper River cut an outlet through the Chugach Mountains and entered the Gulf of Alaska east of Cordova. The former lake and glaciers that reached the lake margins, coupled with recent alluvial forces, have shaped the landforms of the Copper River Basin. Landforms common in the western portion of the Copper River Basin include gentle undulating terrain and low ridges, terraces, and numerous lakes and streams.

Precipitation

Glennallen averages about 12 inches of precipitation per year.

Topography and Drainage

The area topography varies from about 3,000 feet at Tahneta Pass (separating the Matanuska and Copper river drainage basins) to 2,000 feet at Tolsona Creek, due west of Glennallen. Drainages along the Glenn Highway in this area generally flow south into the Tazlina Lake or Tazlina River and then on into the Copper River.

Groundwater

Although the quality can vary significantly in a short distance, groundwater supplies are generally abundant in the area. Many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are shallow with depths of less than 100 feet to 200 feet. Static water levels in many of these wells are less than 15 feet below the surface. The coarse, alluvial, sandy gravel in the floodplains of the areas streams and rivers provides a large aquifer even in the winter when infiltration is low.

Geology and Soils

The unconsolidated soils in the western portion of the Copper River Basin include fine-grained lacustrine deposits (silts and clays deposited in a lake depositional environment), fine to coarse-grained soils deposited at the margins of the glaciers, and reworked sands and gravels along the streams and rivers. Much of the soils in the area provide good sources of sand, gravel.

TOLSONA WILDERNESS CAMPGROUND PUBLIC DRINKING WATER SYSTEM

Tolsona Wilderness Campground is a Class B (transient/non-community) water system. The system consists of one well at Mile 173 of the Glenn Highway.

According to the well description and construction log completed for the water system, installation of the well occurred prior to 1983, to a total depth of approximately 8.5 feet below ground surface using a backhoe. The well finish consists of a 16-inch diameter aluminum culvert pipe with slot cut into it. There is no record on file of a sanitary survey conducted for the system. It is unknown if a sanitary seal protects the well casing. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. It is assumed that the land surface is also appropriately sloped away from the well providing adequate surface water drainage. The well was not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates seasonally and serves no residents and more than 30 non-residents through one service connection.

TOLSONA WILDERNESS CAMPGROUND 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. Some areas are more likely to allow contamination to reach the well than others. 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 a release 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 adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*), and State of Alaska Department of Water Resources. 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 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 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 DWPA zones and the calculated TOT for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2 year TOT
B	Less than the 2 year TOT
C	Less Than the 5 year TOT
D	Less than the 10 year TOT

As an example, water moving through the aquifer in Zone B will reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Tolsona Wilderness 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; and
- Volatile organic chemicals.

No potential sources of contamination were noted in databases reviewed for this site.

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 well.

VULNERABILITY OF TOLSONA WILDERNESS CAMPGROUND 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:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

The water system for Tolsona Wilderness Campground is completed in an unconfined aquifer setting. Because an unconfined aquifer is 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

Overall Susceptibility score and rating for Tolsona Wilderness Campground.

Table 2. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility of the Wellhead	35	Very High
Susceptibility of the Aquifer	18	High
Natural Susceptibility	53	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.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	0	Low
Nitrates and/or Nitrites	1	Low
Volatile Organic Chemicals	0	Low

Appendix C 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.

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 of Tolsona Wilderness Campground to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	55	Medium
Nitrates and Nitrites	55	Medium
Volatile Organic Chemicals	55	Medium

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 Tolsona Wilderness Campground.

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, adopted from the U.S. Geological Survey (Wang, et al., 2000).

Sampling history for Tolsona Wilderness Campground well indicates that low concentrations of nitrate have been detected (see Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Existing nitrate concentration is approximately 0.22 mg/L or 2% of the Maximum Contaminant Level (MCL) of 10 mg/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 very safe levels with respect to human health.

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Tolsona Wilderness Campground. The overall vulnerability of this source to contamination is **Medium** for volatile organic chemicals, **Medium** for bacteria and viruses, and **Medium** for nitrates and nitrites primarily due to the water system construction details and the depth of the groundwater. 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 Tolsona Wilderness Campground 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 Tolsona Wilderness Campground public drinking water source.

REFERENCES CITED

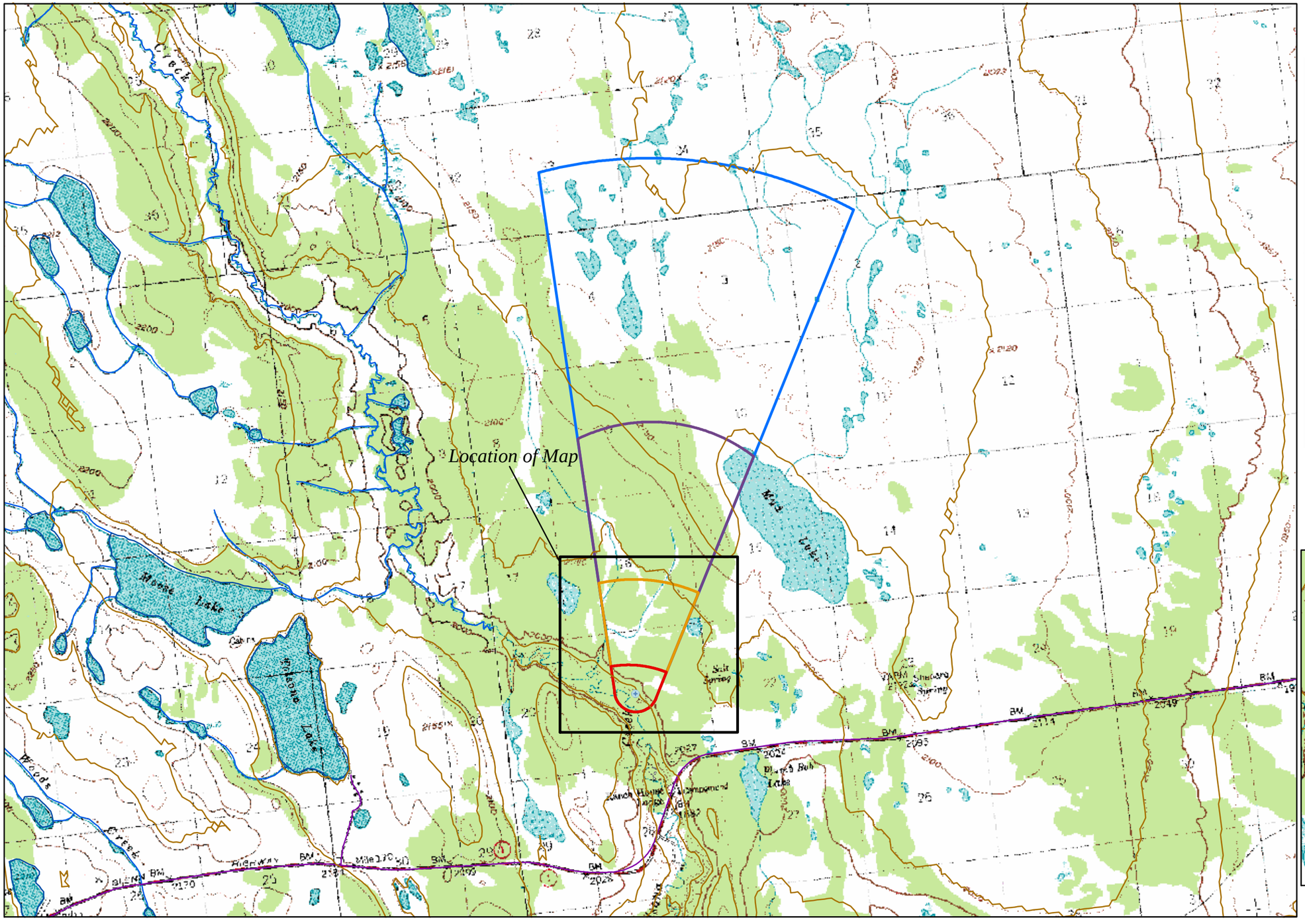
Wang, B., Strelakos, P.M., and Jokela, J.B., 2000, Nitrate source indicators in ground water of the scimitar subdivision, Peters Creek Area, Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 00-4137.

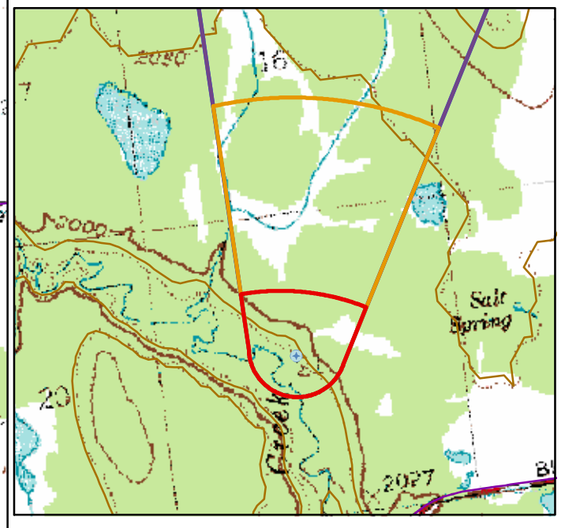
Weather Underground, June 18, 2002, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://www.wunderground.com

APPENDIX A

Tolsona Wilderness Campground
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Areas for Tolsona Wilderness Campground





Tolsona Wilderness Campground Well

MSB Roads

Smaller Rivers

Main Rivers

Lakes

MSB Land Parcels

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

PWSID 291431.001

1 0.5 0 1 Miles

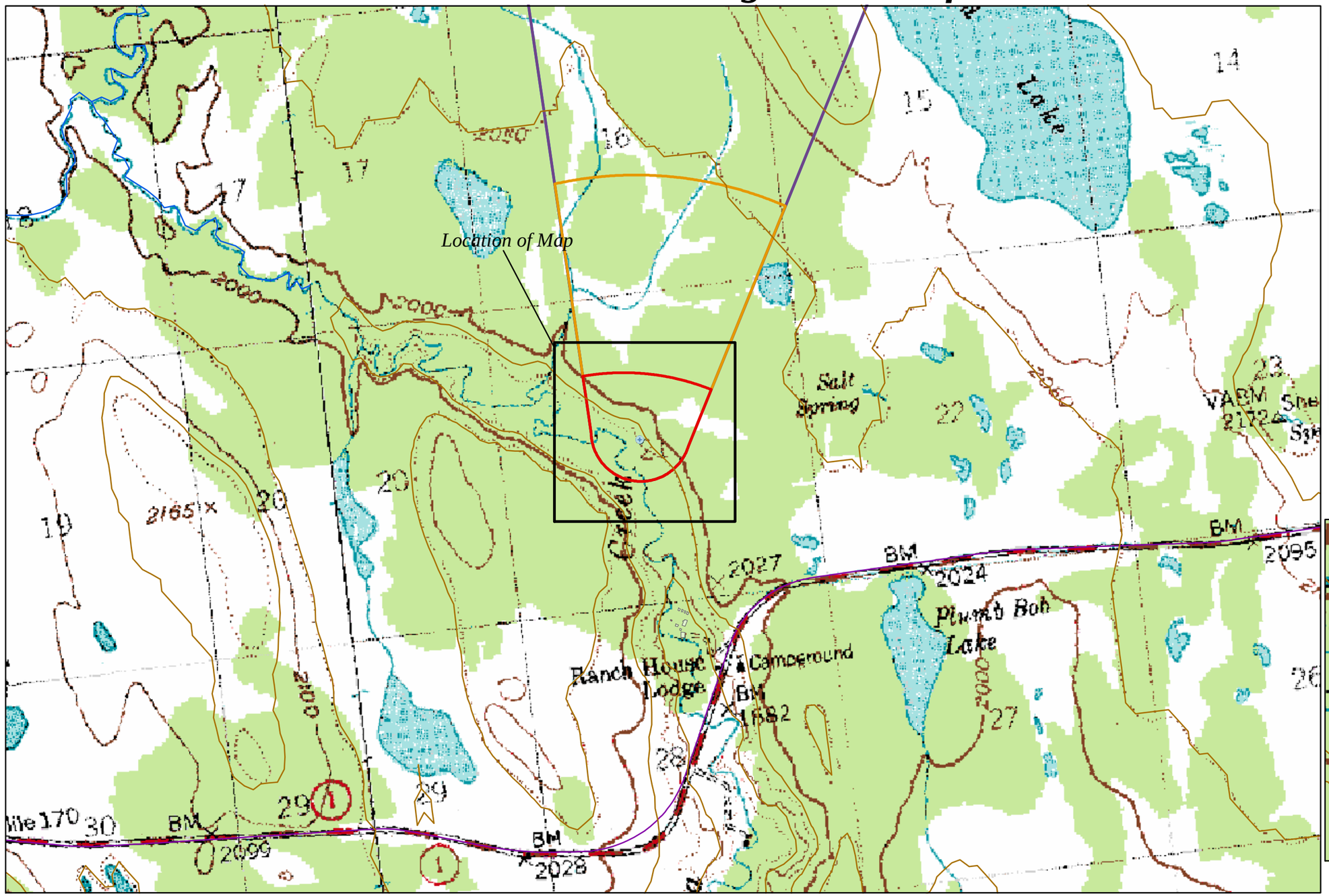
N W E S

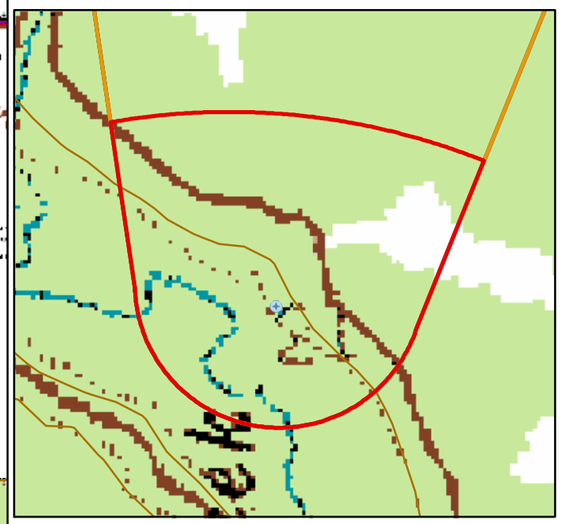
Map 1

APPENDIX B

Tolsona Wilderness Campground
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-3)

Drinking Water Protection Areas for Tolsona Wilderness Campground and Potential and Existing Sources of Contamination





Tolsona Wilderness Campground Well

MSB Roads

Smaller Rivers

Main Rivers

Lakes

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

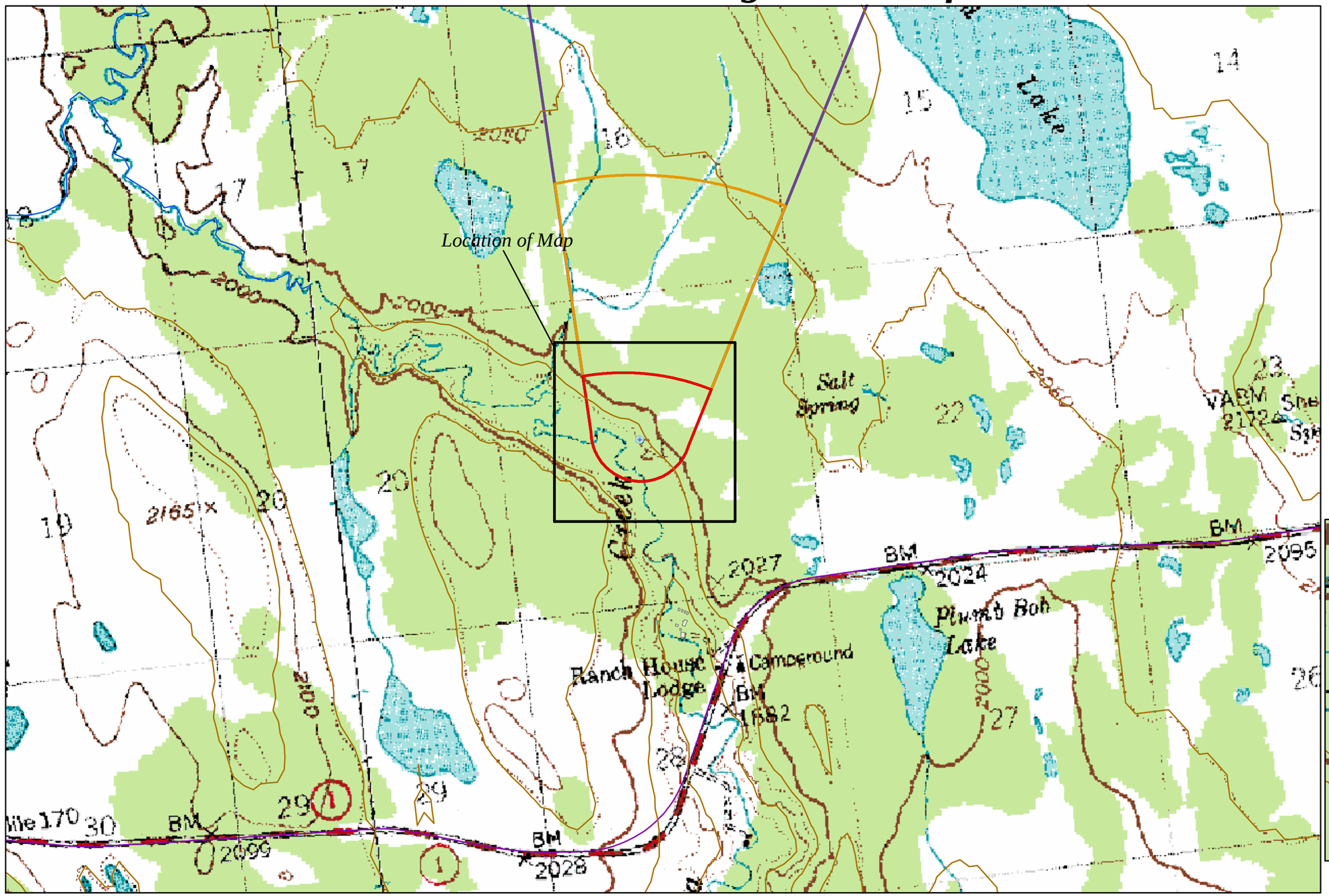
PWSID 291431.001

0.4 0.2 0 0.4 Miles

N W E S

Map 2

Drinking Water Protection Areas for Tolsona Wilderness Campground and Potential and Existing Sources of Contamination



Tolsona Wilderness Campground Well

MSB Roads

Smaller Rivers

Main Rivers

Lakes

Zone A Protection Area

Several Months Travel Time

Zone B Protection Area

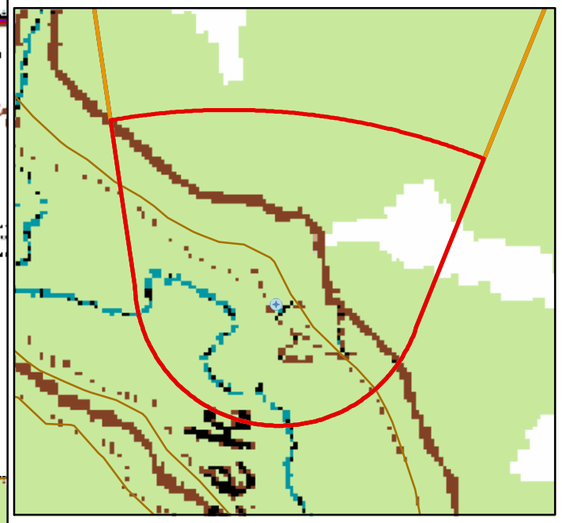
Less than 2-Years Travel Time

Zone C Protection Area

Less than 5-Years Travel Time

Zone D Protection Area

Less than 10-Years Travel Time



PWSID 291431.001

0.4 0.2 0 0.4 Miles

N W E S

Map 3

APPENDIX C

Vulnerability Analysis for Tolsona Wilderness Campground Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the Wellhead - Tolsona Wilderness Campground

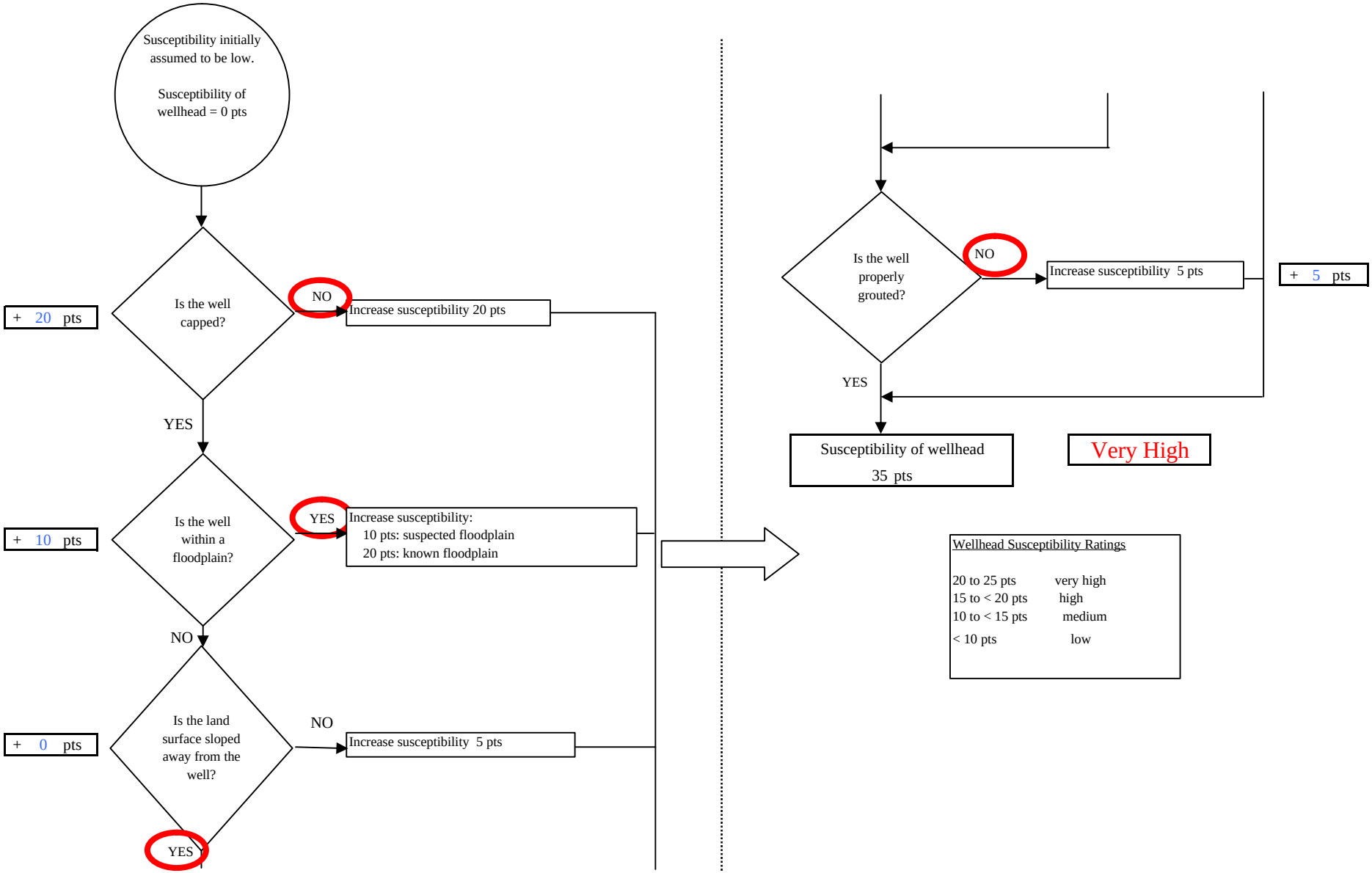


Chart 2. Susceptibility of the Aquifer - Tolsona Wilderness Campground

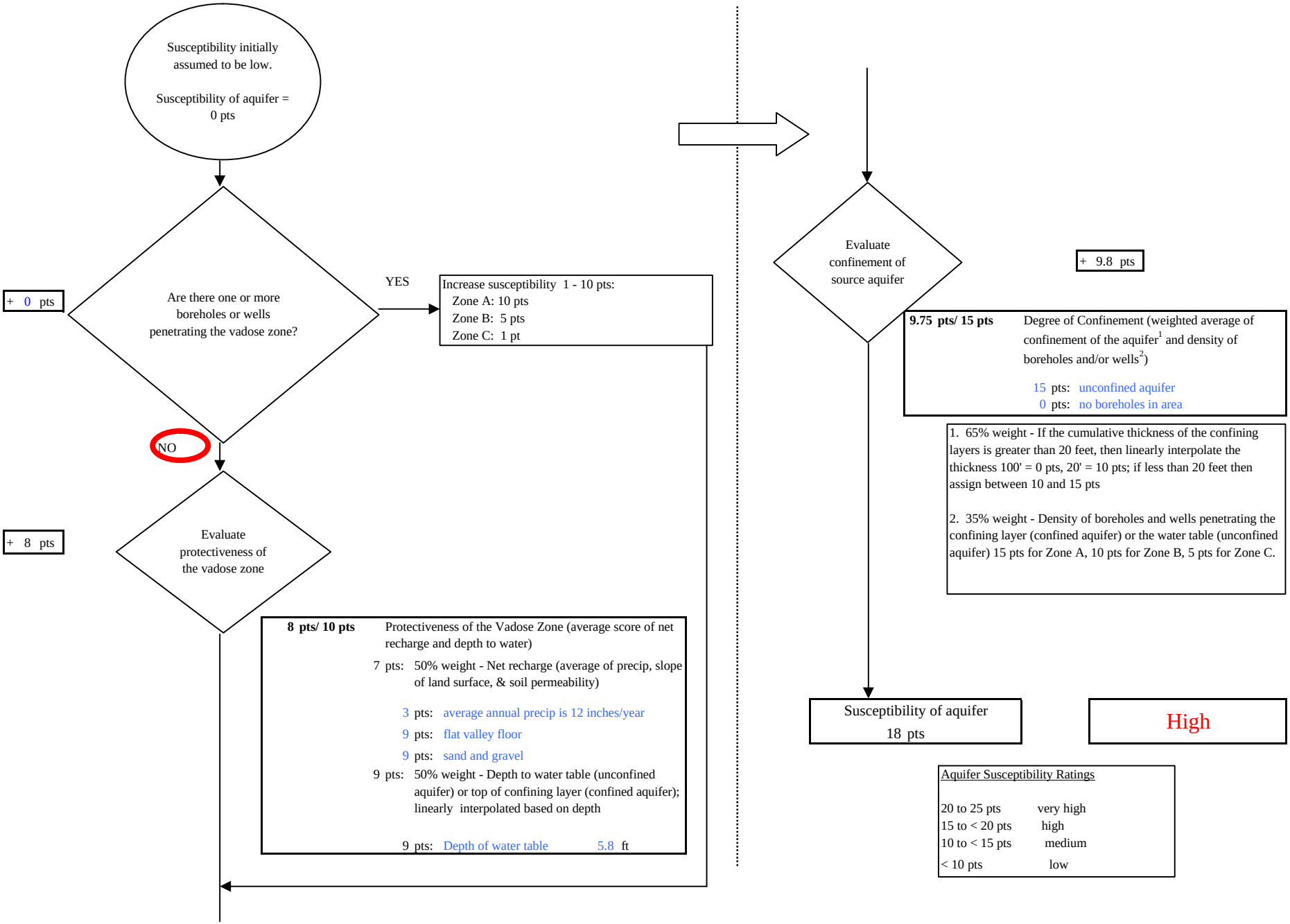
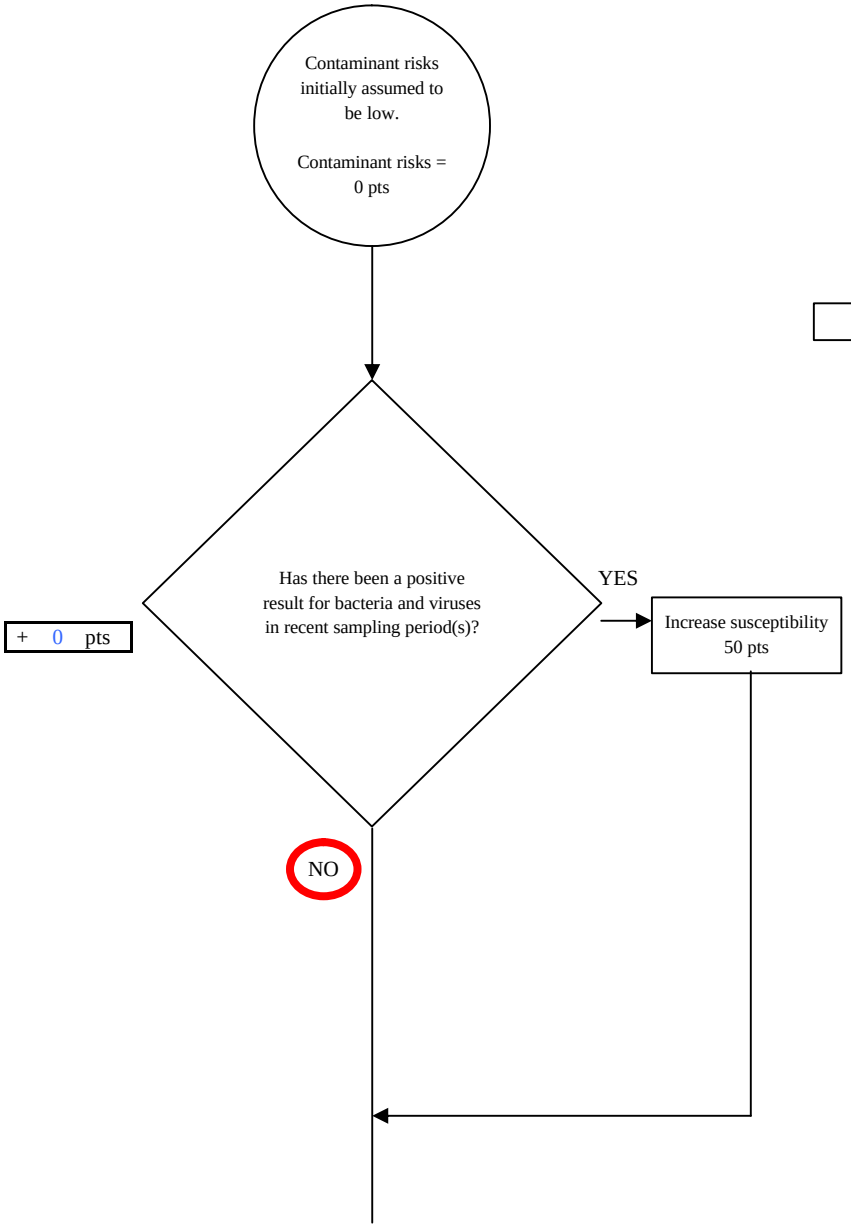
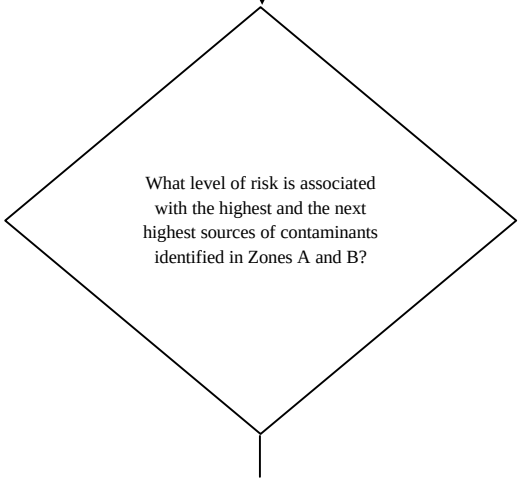


Chart 3. Contaminant Risks for Tolsona Wilderness Campground - Bacteria & Viruses





+ 0 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	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 0

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 Tolsona Wilderness Campground - Bacteria & Viruses

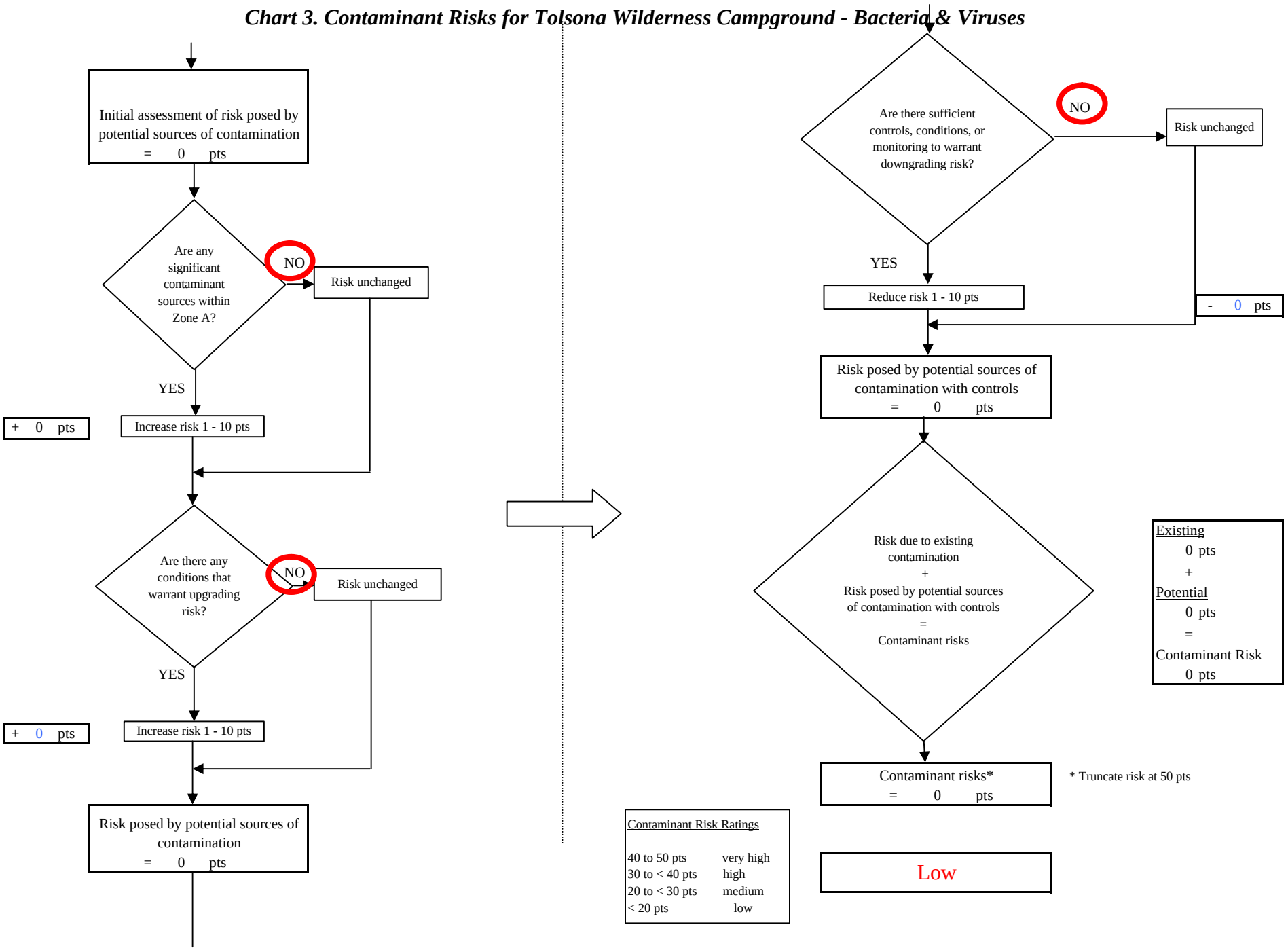


Chart 4. Vulnerability Analysis for Tolsona Wilderness Campground - Bacteria & Viruses

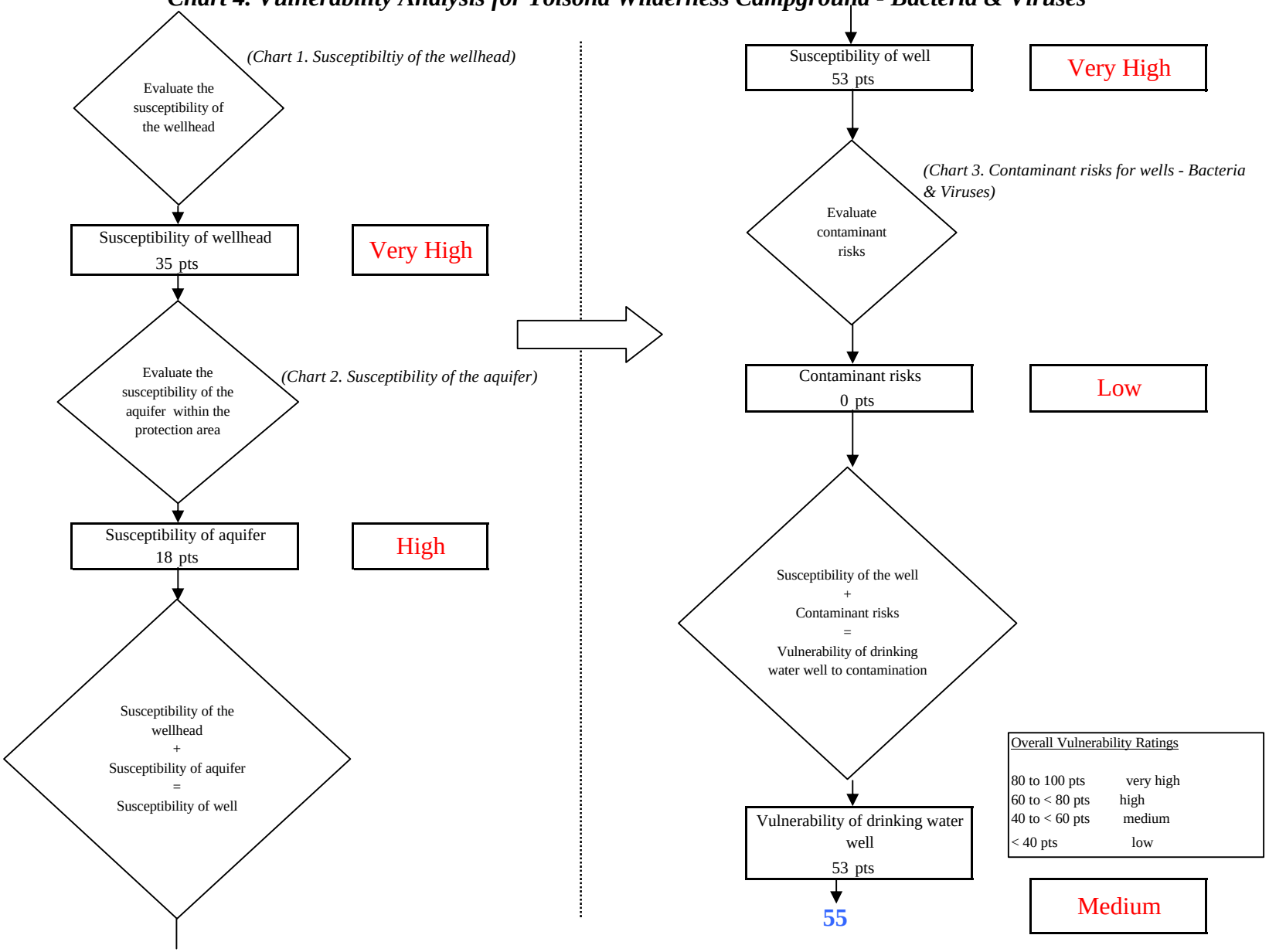


Chart 5. Contaminant Risks for Tolsona Wilderness Campground - Nitrates and Nitrites

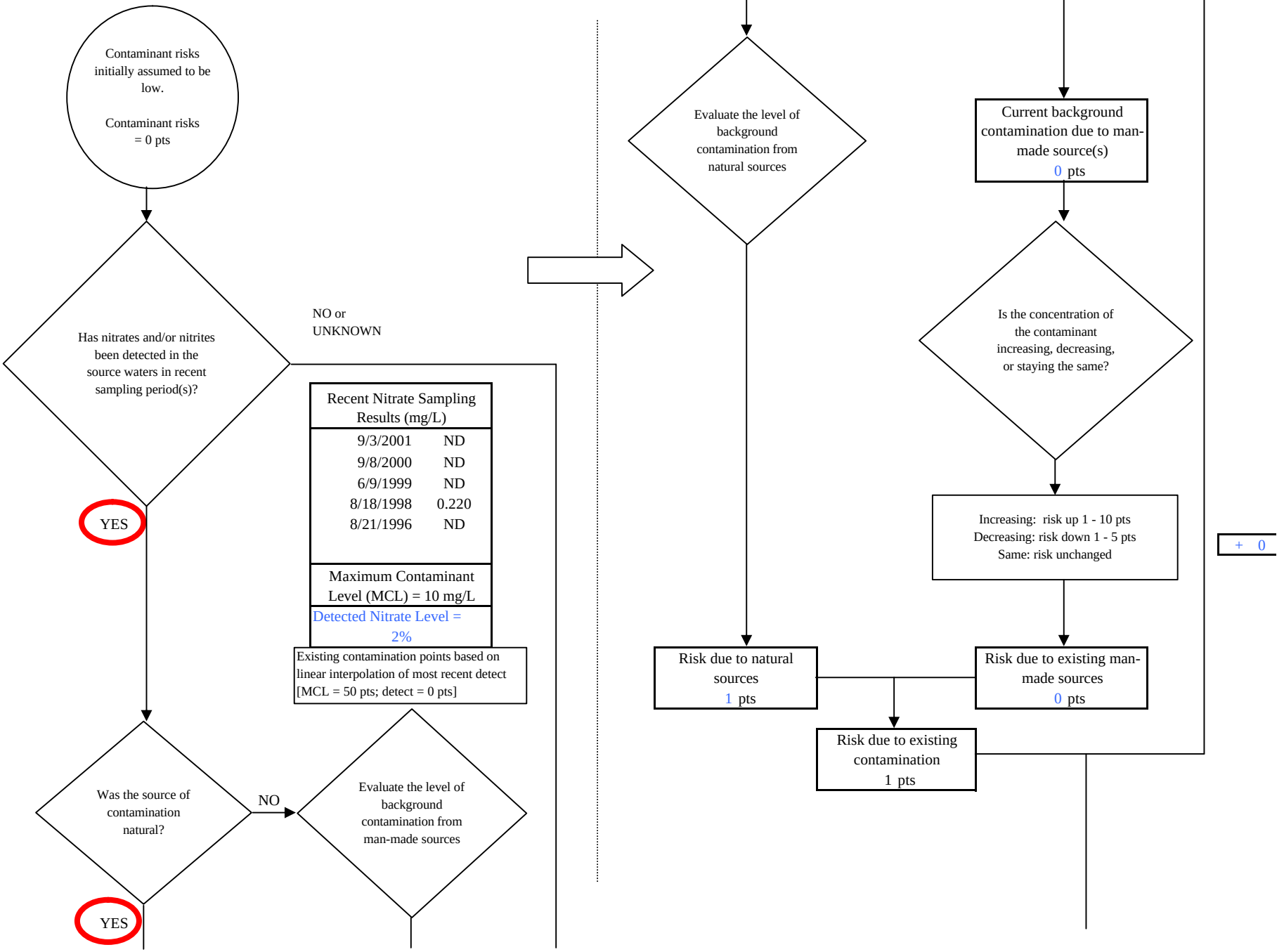
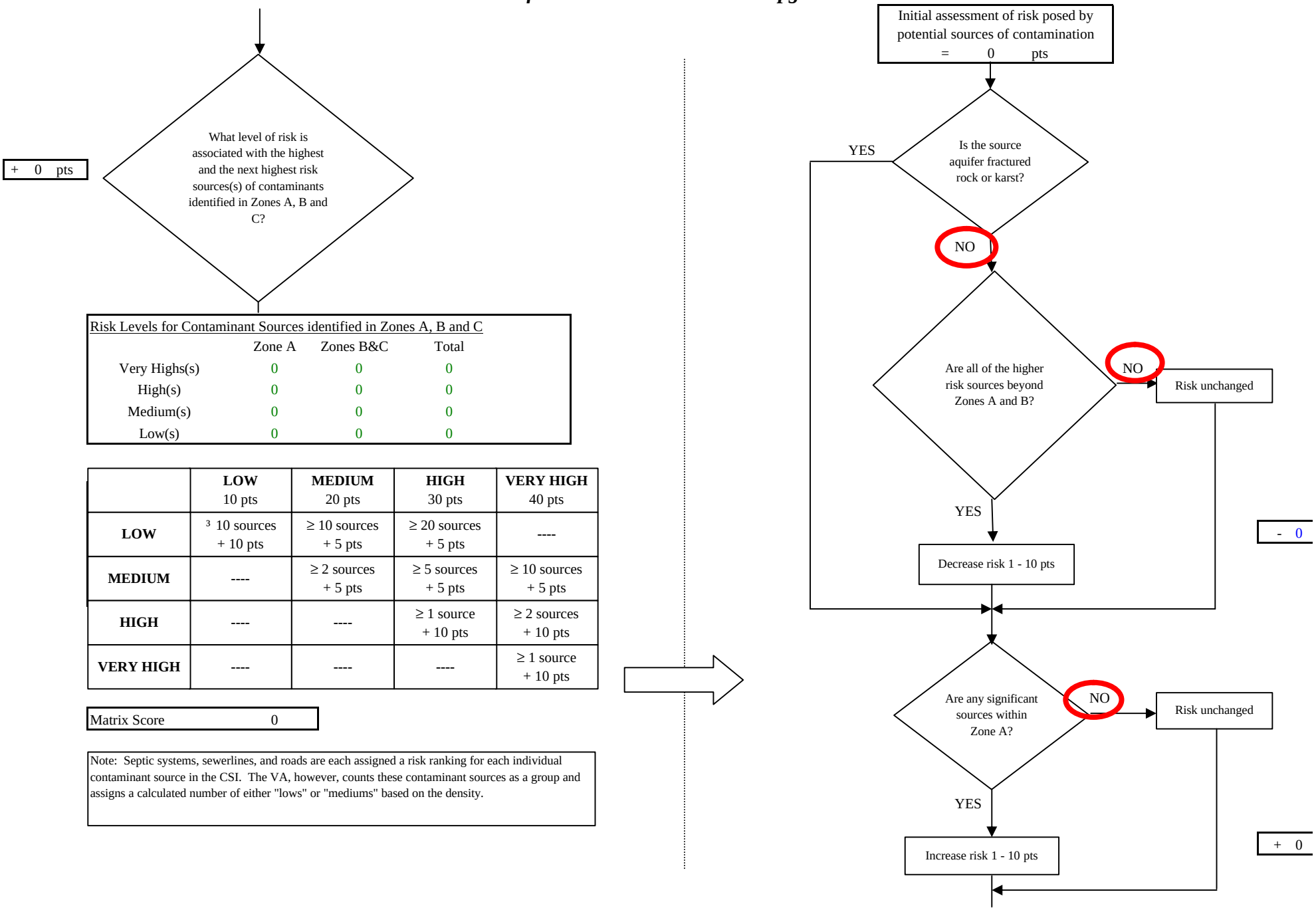


Chart 5. Contaminant Risks for Tolsona Wilderness Campground - Nitrates and Nitrites



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	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 0

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 Tolsona Wilderness Campground - Nitrates and Nitrites

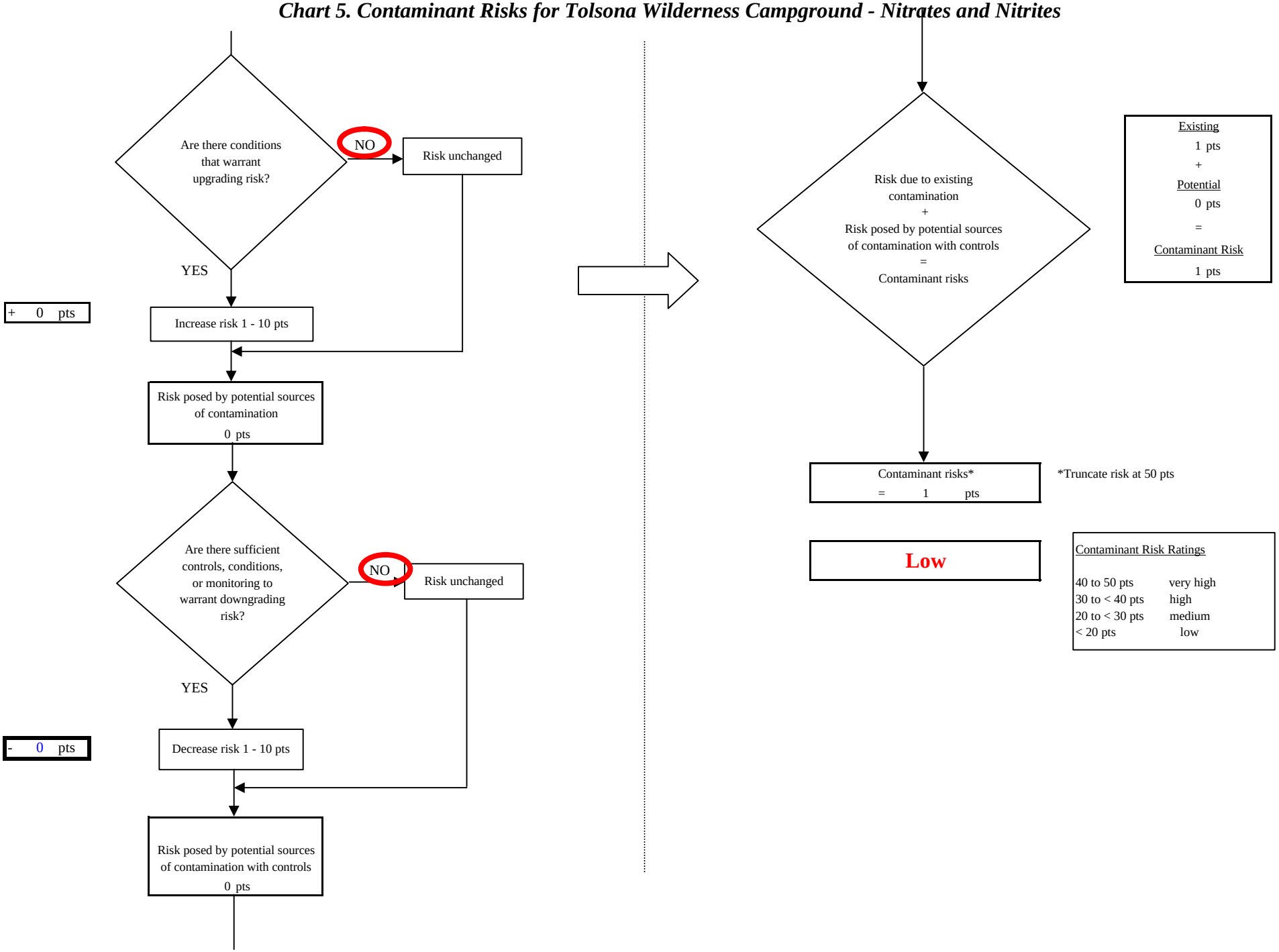


Chart 6. Vulnerability Analysis for Tolsona Wilderness Campground - Nitrates and Nitrites

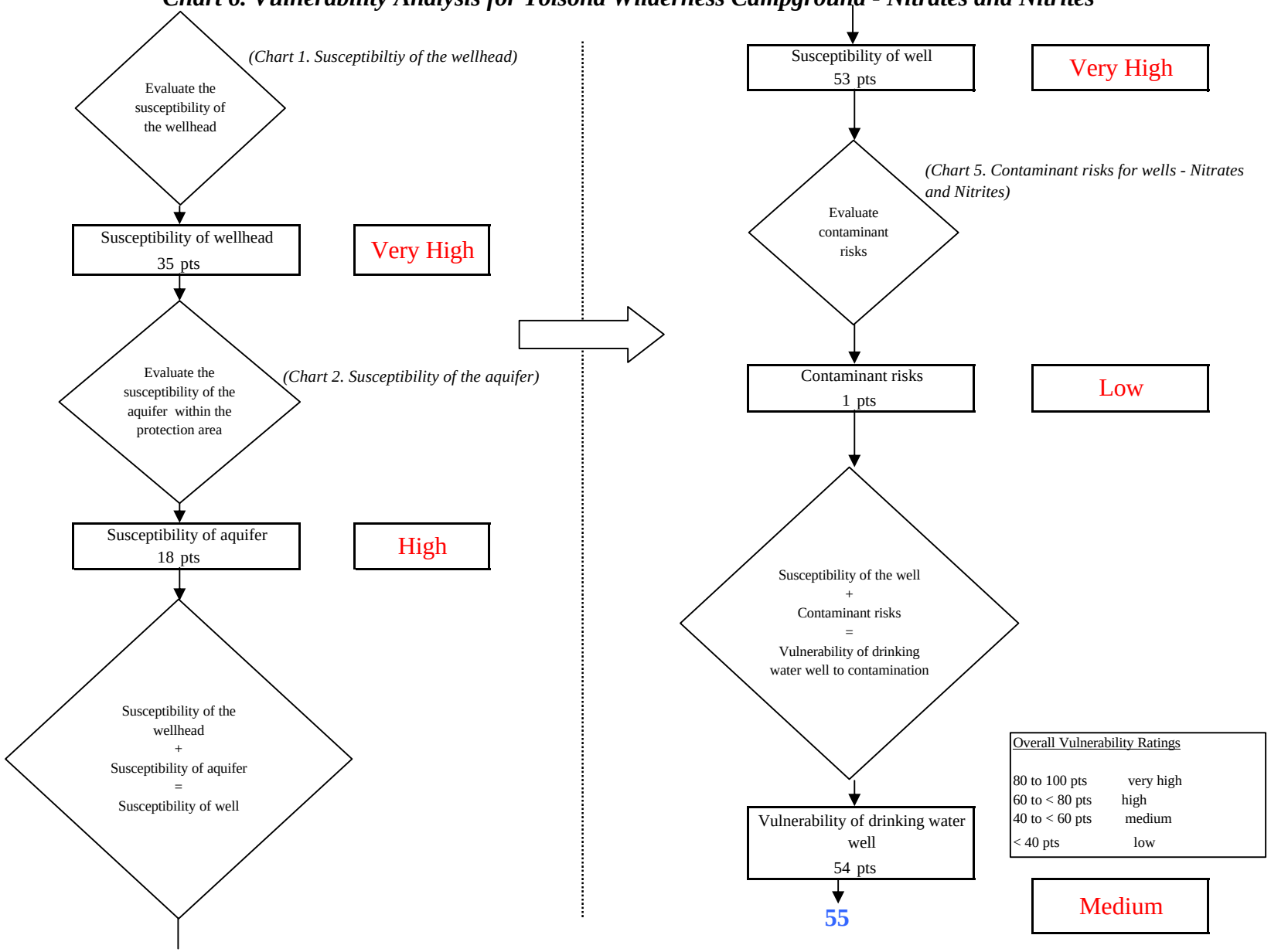


Chart 7. Contaminant Risks for Tolsona Wilderness Campground - Volatile Organic Chemicals

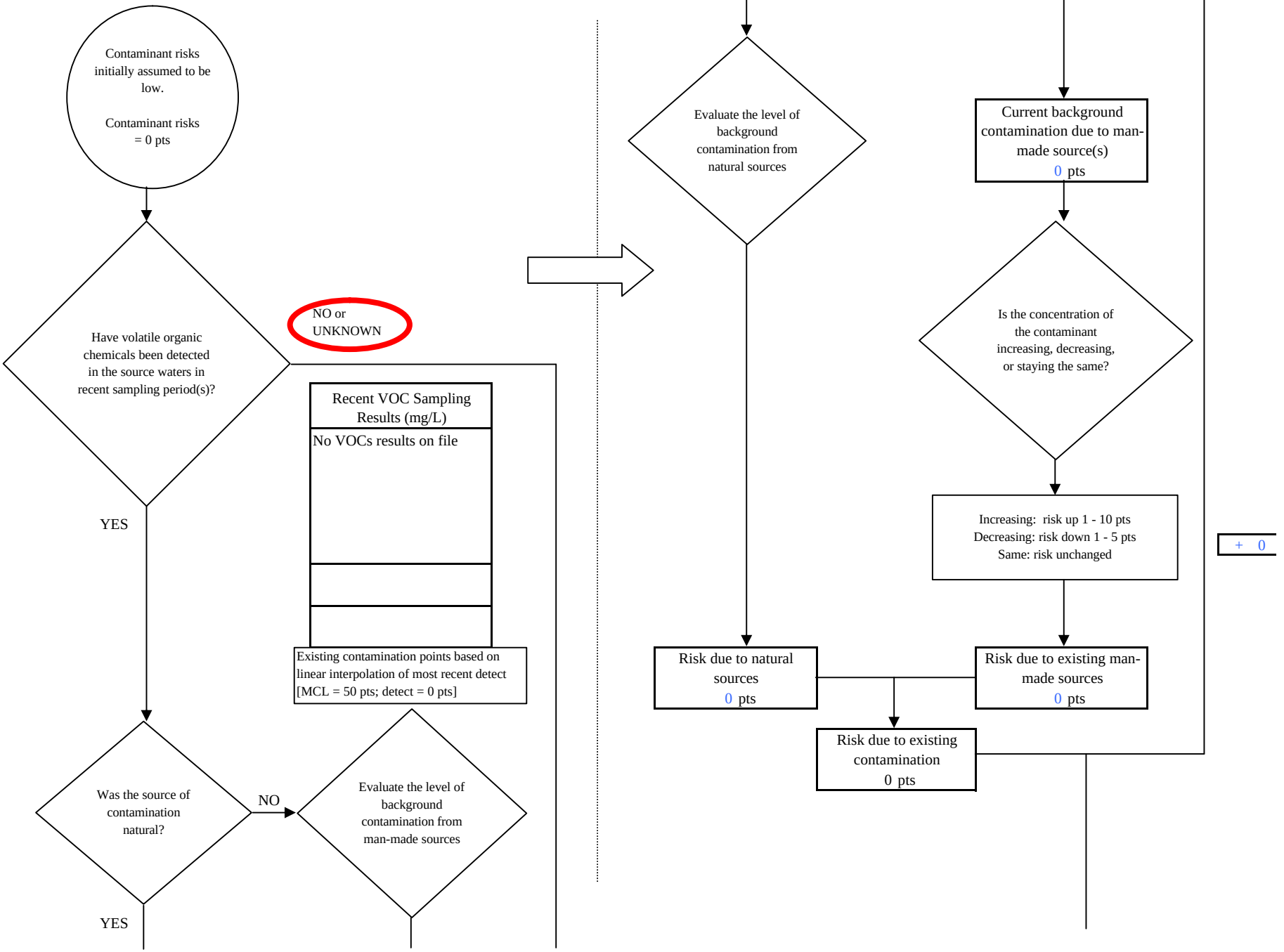
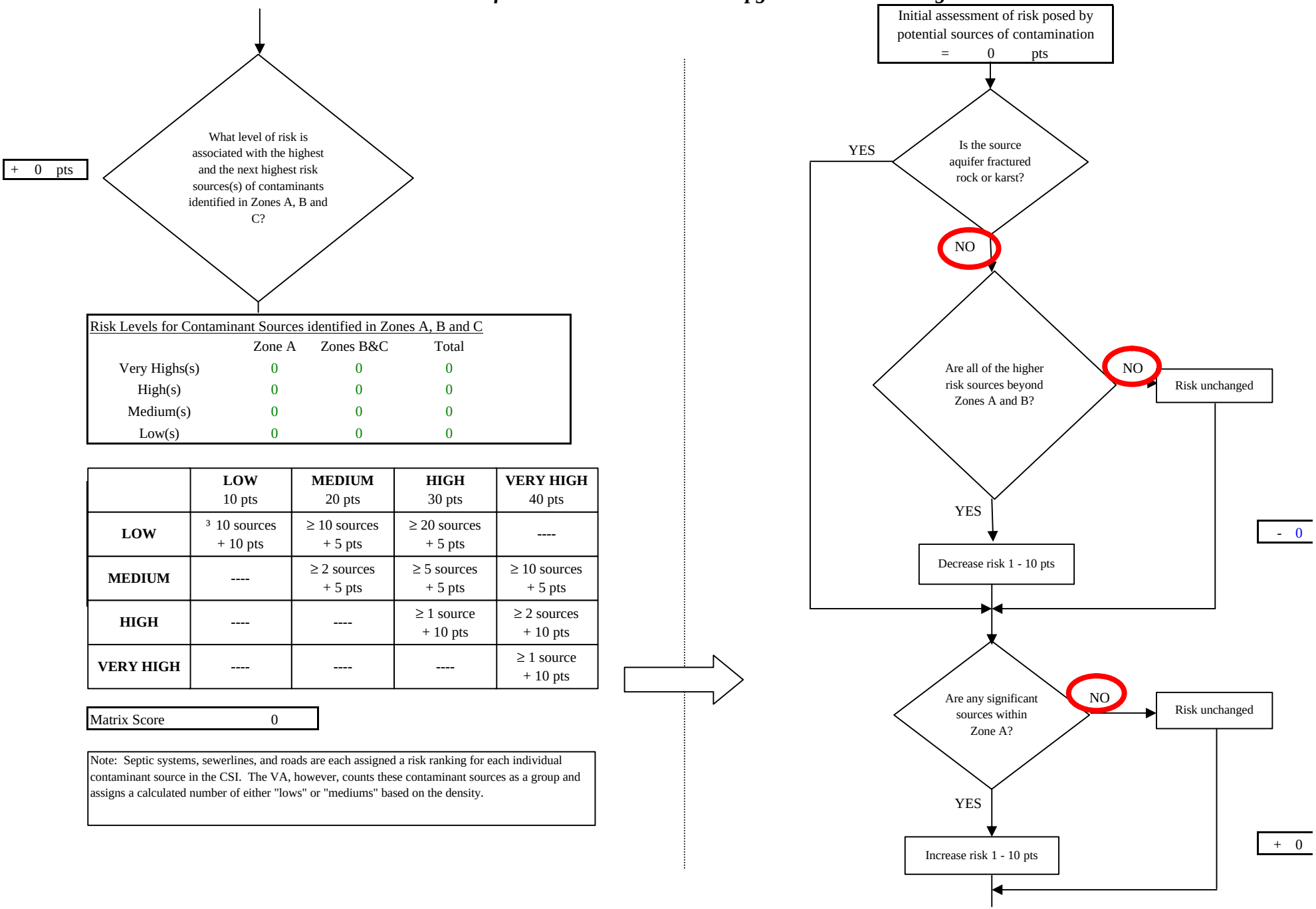


Chart 7. Contaminant Risks for Tolsona Wilderness Campground - Volatile Organic Chemicals



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

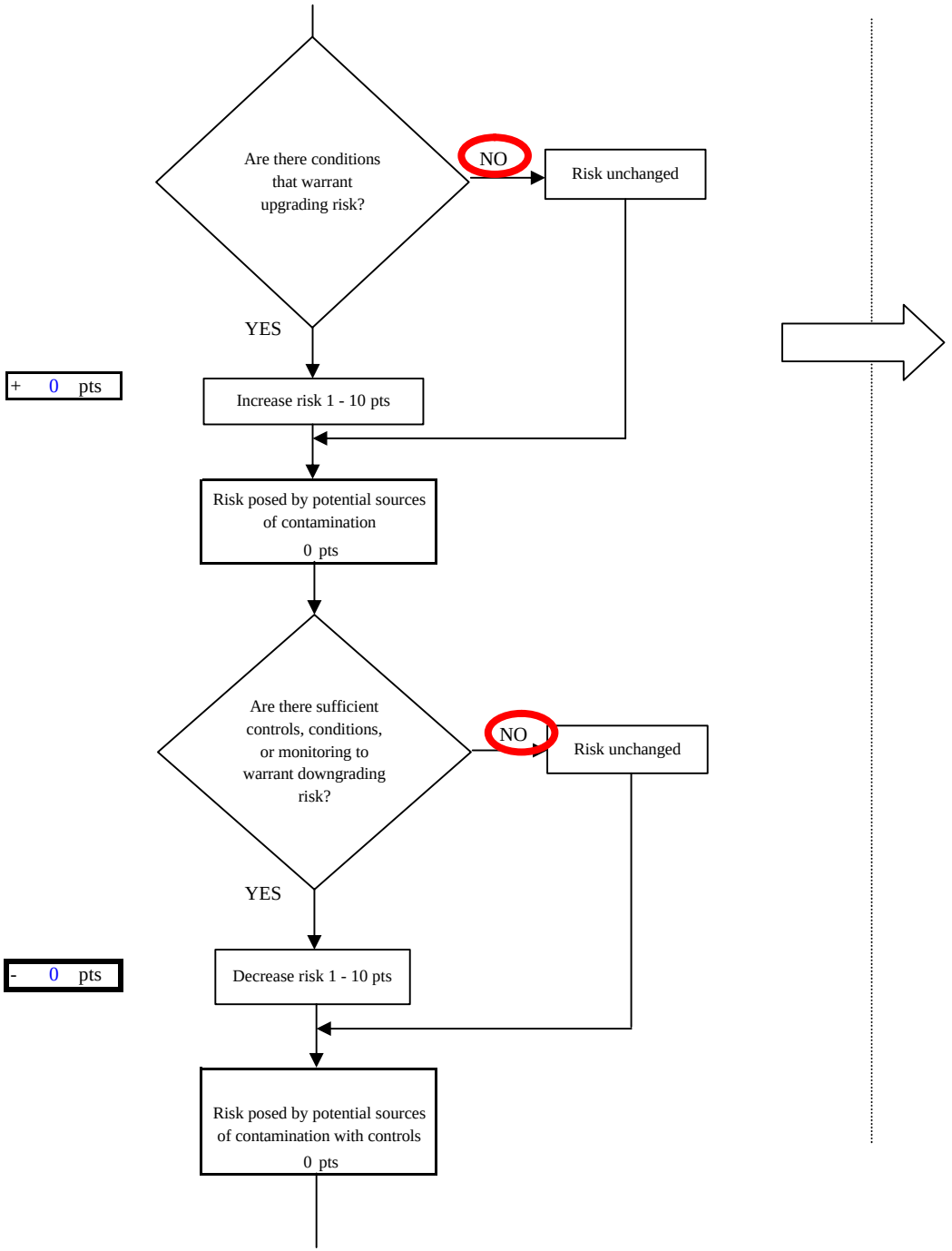
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	0	0	0

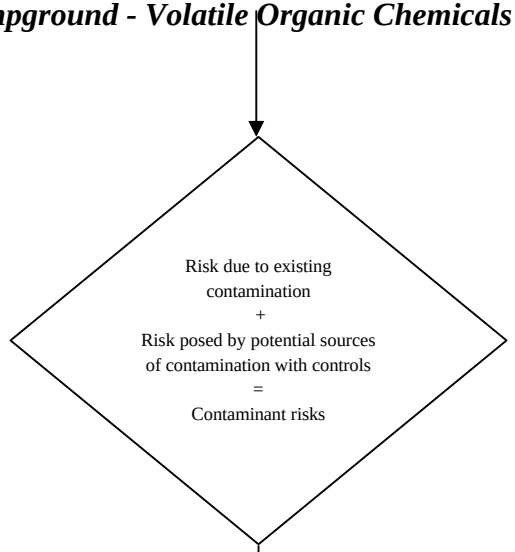
	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 0

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 Tolsona Wilderness Campground - Volatile Organic Chemicals





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

Contaminant risks*
= 0 pts

*Truncate risk at 50 pts

Low

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

Chart 8. Vulnerability Analysis for Tolsona Wilderness Campground - Volatile Organic Chemicals