Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Cantwell Cafe/ Longhorn Bar Drinking Water System, Cantwell, Alaska PWSID # 390277

DRINKING WATER PROTECTION PROGRAM REPORT # 290
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 Cantwell Cafe/ Longhorn Bar Source of Public Drinking Water, Cantwell, Alaska

By Ecology & Environment, Inc.

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Cantwell Cafe/ Longhorn Bar is a Class B (transient/non-community) water system consisting of one well in Cantwell, Alaska. Identified potential and current sources of contaminants for Cantwell Cafe/ Longhorn Bar public drinking water source include: a paved road, a railroad corridor and an airport. 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 Cantwell Cafe/ Longhorn Bar received a vulnerability rating of **Low** for bacteria and viruses, **Medium** 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 THE CANTWELL AREA

Location

The community of Cantwell (pop. 222) is located at approximately Mile 210 of the George Parks Highway, and marks the western end of the Denali Highway. (Figure 1).

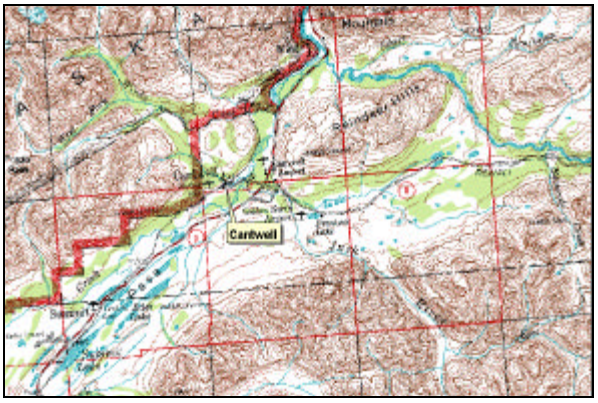

Figure 1

Precipitation

The Cantwell area averages nearly 17 inches of precipitation per year, with approximately 135 inches of annual snowfall (ACRC 2002).

Topography and Drainage

Cantwell is located in Broad Pass, which divides the steeply-rising Alaska Range and the Talkeetna Mountains. Drainage patterns are controlled by the mountain topography; in the flatter region near Cantwell, drainage tends to the northeast towards the Nenana River.

Groundwater Use

The majority of residents in Cantwell have private water wells and septic systems, as does the local school.

There are no municipal water or sewage facilities (ADCED 2002).

Geology and Soils

The surficial geology of the Cantwell area includes three main units: alluvium (chiefly sand and gravel) deposited by rivers in recent geologic time; glacial deposits of generally poorly-sorted sand, gravel, and silt; and older volanic rocks composed mainly of andesite and basalt. The volanics are found to the west of the town of Cantwell. Glacial deposits are found to the north and south of town, while alluvial deposits are found mainly to the east (Hickman and Craddock 1976).

CANTWELL CAFE/ LONGHORN BAR PUBLIC DRINKING WATER SYSTEM

Cantwell Cafe/ Longhorn Bar is a Class B (transient/non-community) water system. The system consists of one well located 1.8 miles west of the intersection of the Denali and Parks Highways.

There is no well log on file for this well; if one could be located, it would help improve the accuracy of this report. Also, there is no sanitary survey on file for this well, which makes the assessment of the wellhead vulnerability difficult. No information in available concerning a sanitary seal; however, a seal is assumed to be in place. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is assumed not to be sloped away from the well. The well is assumed not to be grouted according to ADEC regulations (grouting was not required prior to 1993). Proper grouting provides added protection against contaminants travelling along the well casing and into source waters. The aquifer is assumed to be unconfined based on the lithologies encountered during drilling of a nearby well.

This system operates year-round and serves approximately 2 residents and more than 50 non-residents.

CANTWELL CAFE/ LONGHORN BAR 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 et al. 1989*). 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 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 time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance to 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 most likely 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.

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 Cantwell Cafe/ Longhorn Bar 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 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 D were associated with residential and light industrial type activities. 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 well.

VULNERABILITY OF CANTWELL CAFE/ LONGHORN BAR 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)

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.

Table 2 shows the Overall Susceptibility score and rating for Cantwell Cafe/ Longhorn Bar (see Charts 1 and 2).

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

	Score	Rating
Susceptibility of the Wellhead	10	Medium
Susceptibility of the Aquifer	15	High
Natural Susceptibility	25	Medium

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 Charts 3, 5, and 7).

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	17	Low
Volatile Organic Chemicals	40	Very High

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 Charts 4, 6, and 8).

Table 4. Overall Vulnerability of Cantwell Cafe/ Longhorn Bar to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	35	Low
Nitrates and Nitrites	40	Medium
Volatile Organic Chemicals	65	High

Tables 2 through 4 in Appendix B 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 Cantwell Cafe/ Longhorn Bar, the result is a maximum score on Chart 3.

The sampling history for Cantwell Cafe/ Longhorn Bar well 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 the Cantwell Cafe/ Longhorn Bar well is approximately 1.1 mg/L or 11% 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 Cantwell Cafe/ Longhorn Bar. The overall vulnerability of this source to contamination is **Low** for bacteria and viruses, **Medium** 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 Cantwell Cafe/ Longhorn Bar 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 Cantwell Cafe/ Longhorn Bar public drinking water source.

REFERENCES CITED

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Alaska Department of Community and Economic Development (ADCED), 2002 [WWW document]. URL http://www.dced.state.ak.us/cbd/commdb/CF_BLOCK.cfm

Hickman, R.G and Craddock, C, 1976, *Geologic Map of Central Healy Quadrangle, Alaska*, State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Surveys, Open File Report 95, Juneau, Alaska.

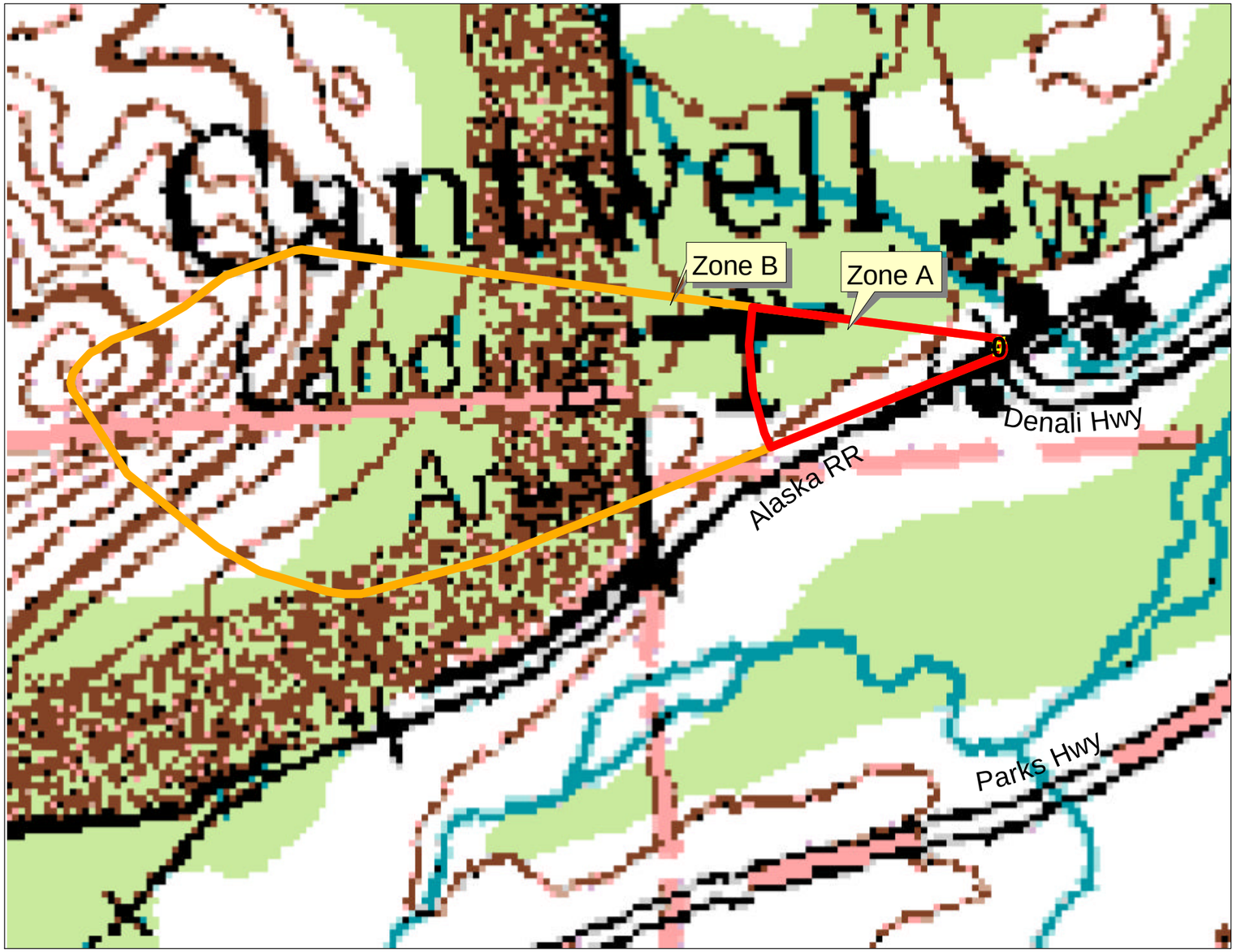
Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

Wang, B., Strelakos, P.M., and Jokela, B., 2000, Nitrate Source Indicators In Groundwater of the Scimitar Subdivision, Peters Creek Area, Anchorage Alaska: U.S. Geological Survey Water-Resources Investigations Report 00-4137, 25p.

APPENDIX A

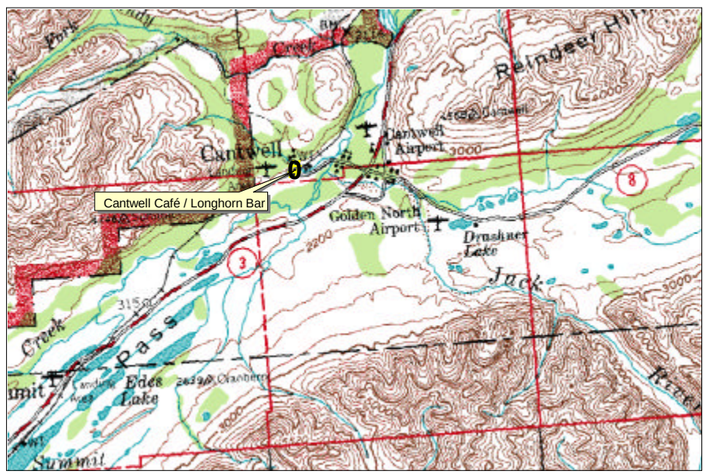
Cantwell Cafe/ Longhorn Bar
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Area for Cantwell Cafe/Longhorn Bar



Cantwell Cafe\Longhorn Bar Well
Zone A (Few Months Travel Time)
Zone B (Less Than 2 Years Travel Time)

N
W
E
S



1 0 1 Miles

PWSID 390277.001

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Cantwell Cafe/ Longhorn Bar (Tables 1-4)

Table 1

Contaminant Source Inventory for
Cantwell Café / Longhorn Bar

PWSID 390277.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Airports	X14	X14-1	A	CANTWELL LANDING STRIP	2	
Highways and roads, dirt/gravel	X24	X24-1	A	LOCAL CANTWELL ROAD	2	
Rail corridors	X30	X30-1	A	ALASKA RAILROAD	2	

Table 2

Contaminant Source Inventory and Risk Ranking for Cantwell Café / Longhorn Bar Sources of Bacteria and Viruses

PWSID 390277.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-1	A	Low	LOCAL CANTWELL ROAD	2	

Table 3

Contaminant Source Inventory and Risk Ranking for Cantwell Café / Longhorn Bar Sources of Nitrates/Nitrites

PWSID 390277.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Airports	X14	X14-1	A	Low	CANTWELL LANDING STRIP	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	LOCAL CANTWELL ROAD	2	

Table 4

Contaminant Source Inventory and Risk Ranking for Cantwell Café / Longhorn Bar Sources of Volatile Organic Chemicals

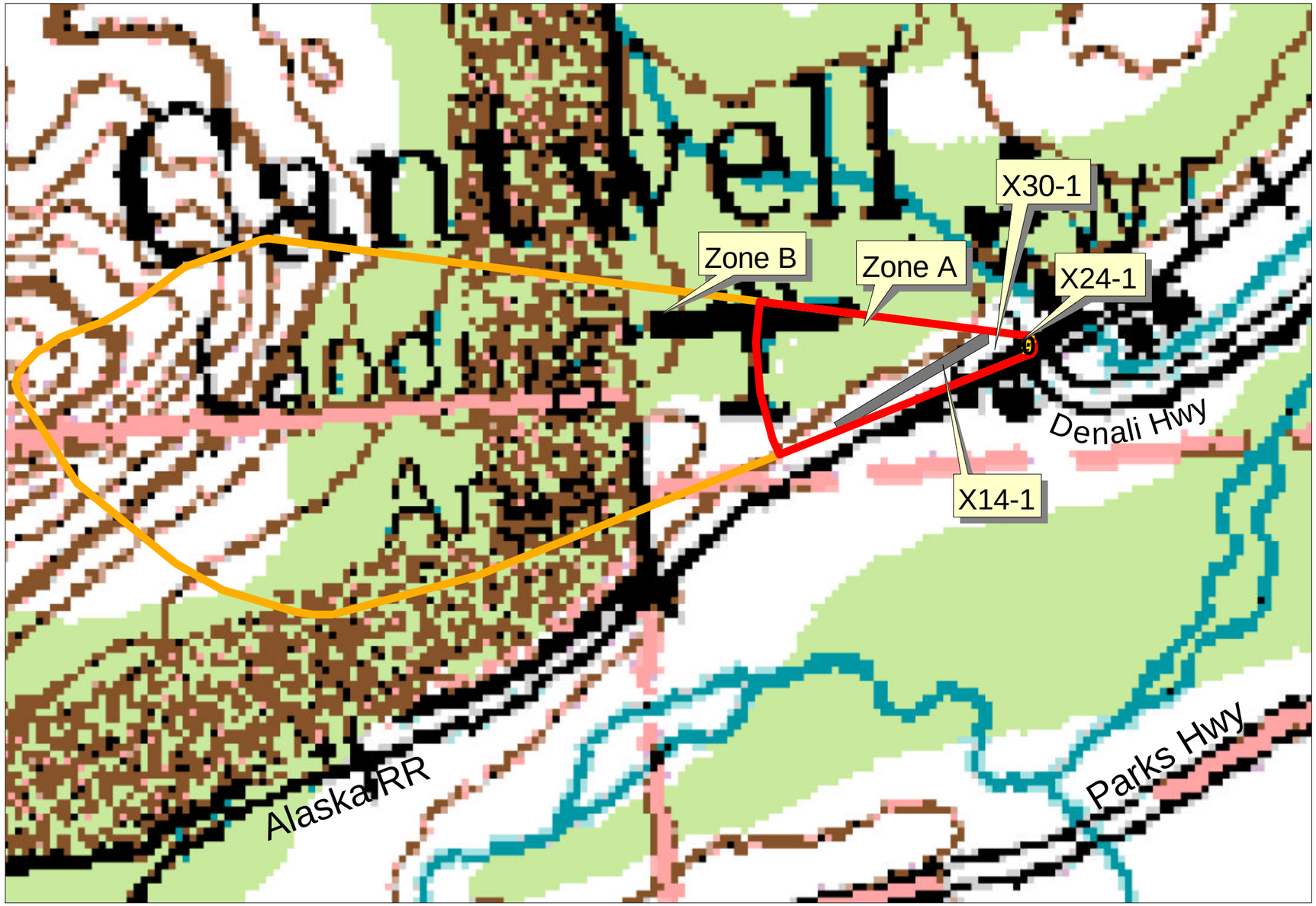
PWSID 390277.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Airports	X14	X14-1	A	High	CANTWELL LANDING STRIP	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	LOCAL CANTWELL ROAD	2	
Rail corridors	X30	X30-1	A	Medium	ALASKA RAILROAD	2	

APPENDIX C

Cantwell Cafe/ Longhorn Bar
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Drinking Water Protection Area for Cantwell Cafe/Longhorn Bar and Potential and Existing Sources of Contamination



Cantwell Cafe\Longhorn Bar Well
Zone A (Few Months Travel Time)
Zone B (Less Than 2 Years Travel Time)
Road-X24
Railroad-X30
Cantwell Landing Strip-X14

N
W
E
S

0.5 0 0.5 1 1.5 Miles

PWSID 390277.001

Map 2

APPENDIX D

Vulnerability Analysis for Cantwell Cafe/ Longhorn Bar Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the wellhead - Cantwell Café/ Longhorn Bar

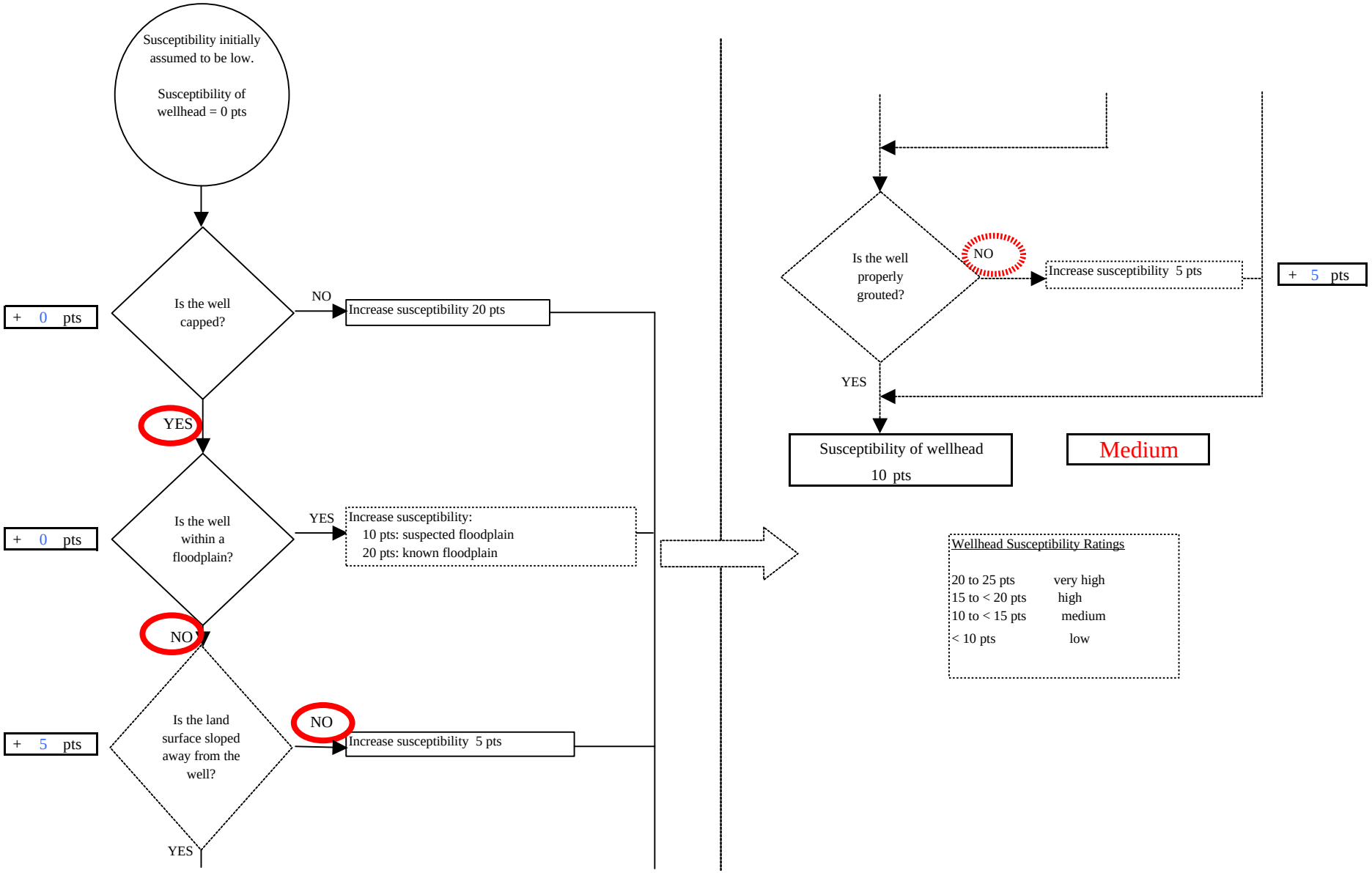


Chart 2. Susceptibility of the aquifer - Cantwell Café/ Longhorn Bar

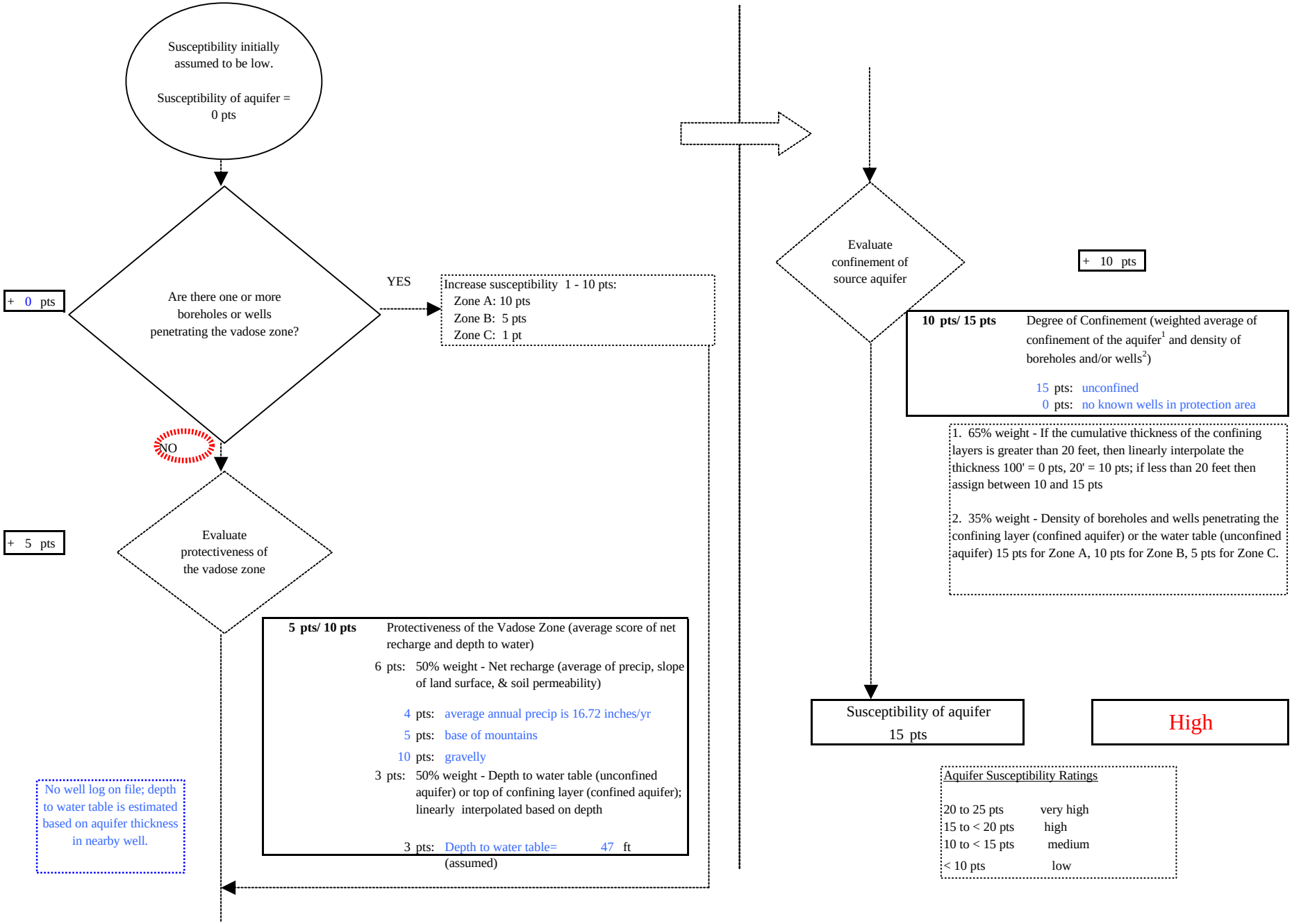
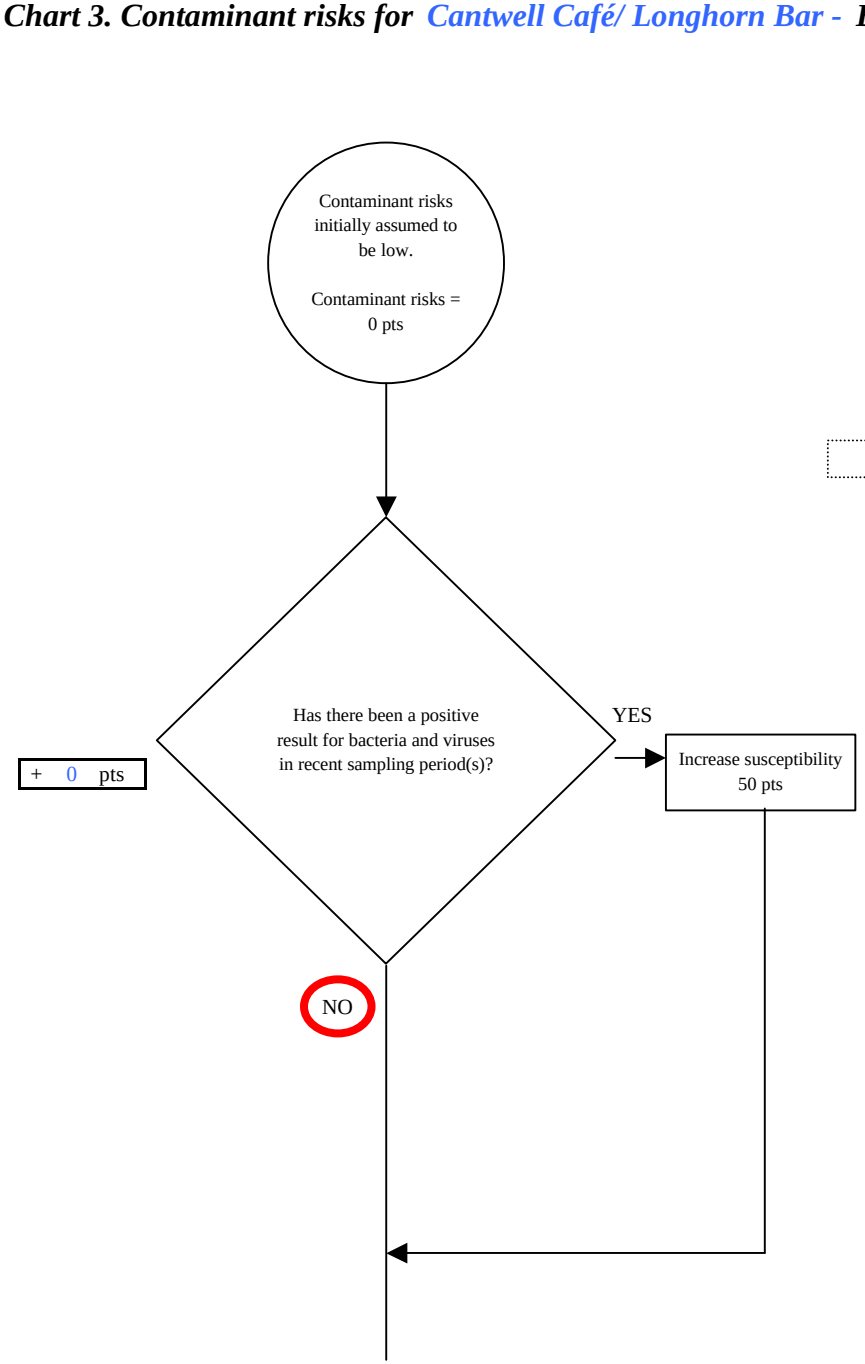
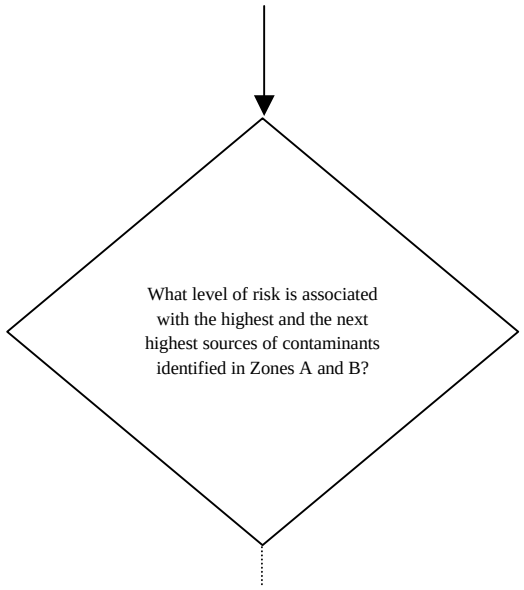


Chart 3. Contaminant risks for Cantwell Café/ Longhorn Bar - Bacteria & Viruses





+ 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)	1	0	1

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

Matrix Score 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 Cantwell Café/ Longhorn Bar - Bacteria & Viruses

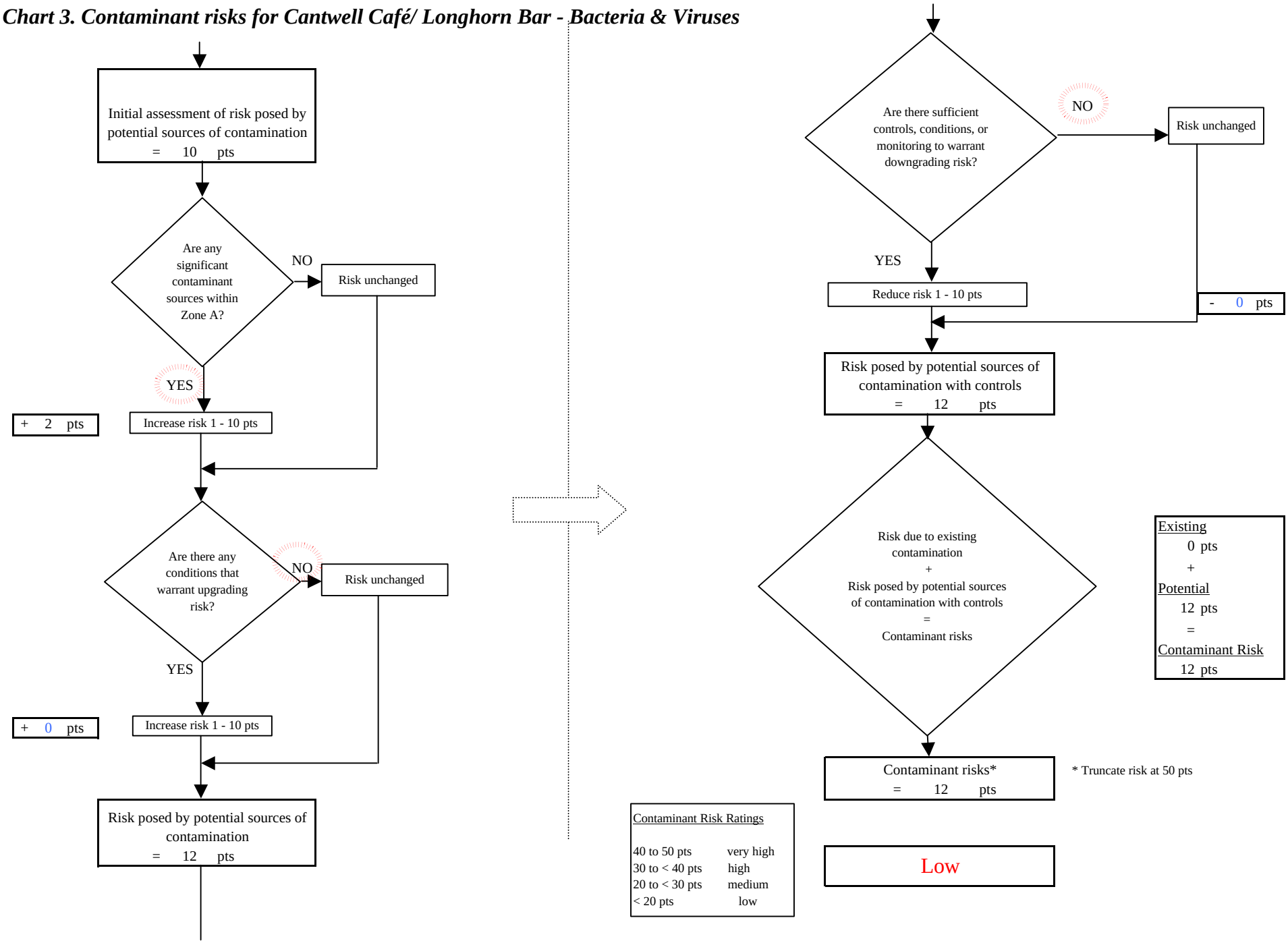


Chart 4. Vulnerability analysis for Cantwell Café/ Longhorn Bar - Bacteria & Viruses

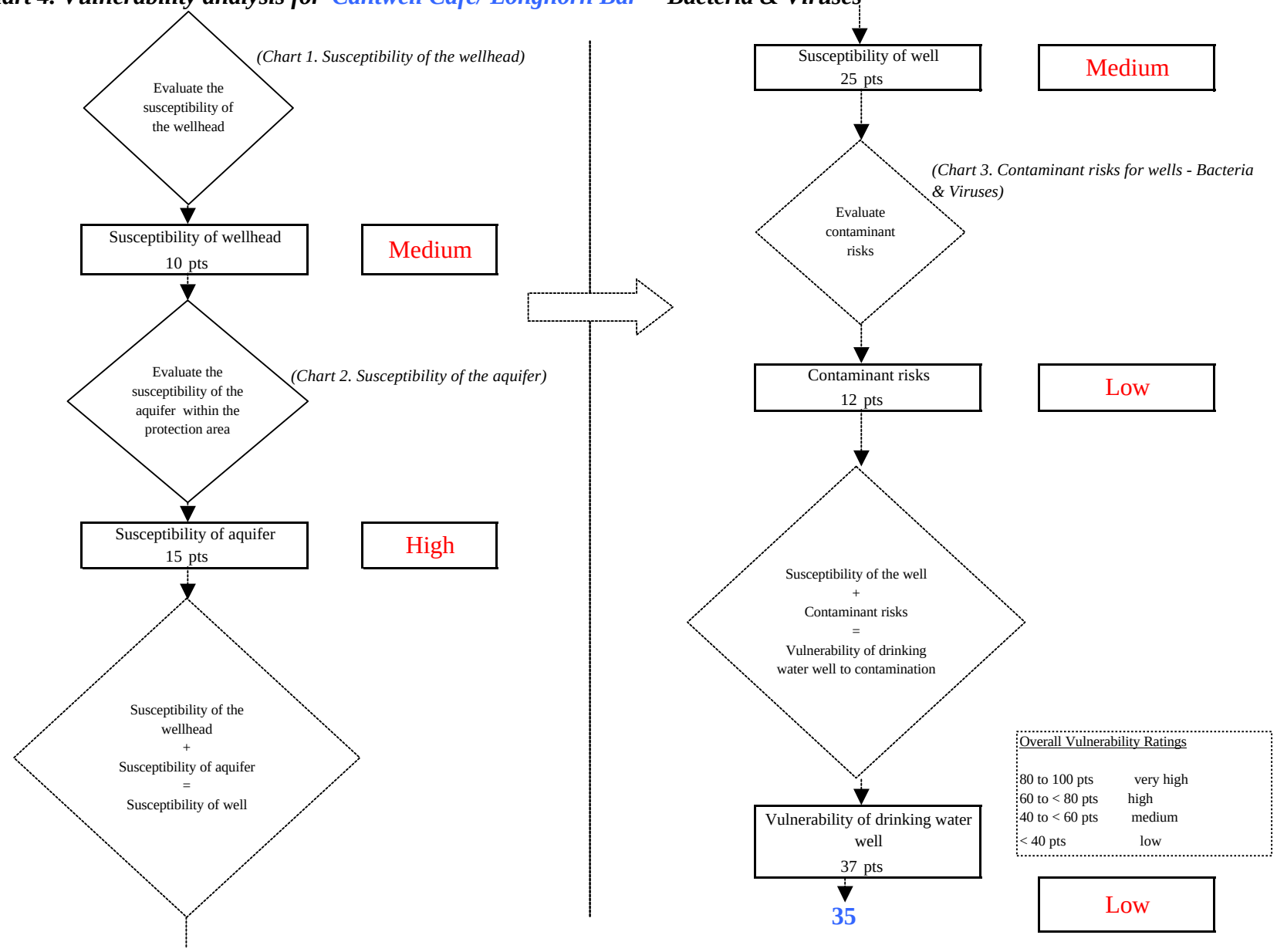


Chart 5. Contaminant risks for Cantwell Café/ Longhorn Bar - Nitrates and Nitrites

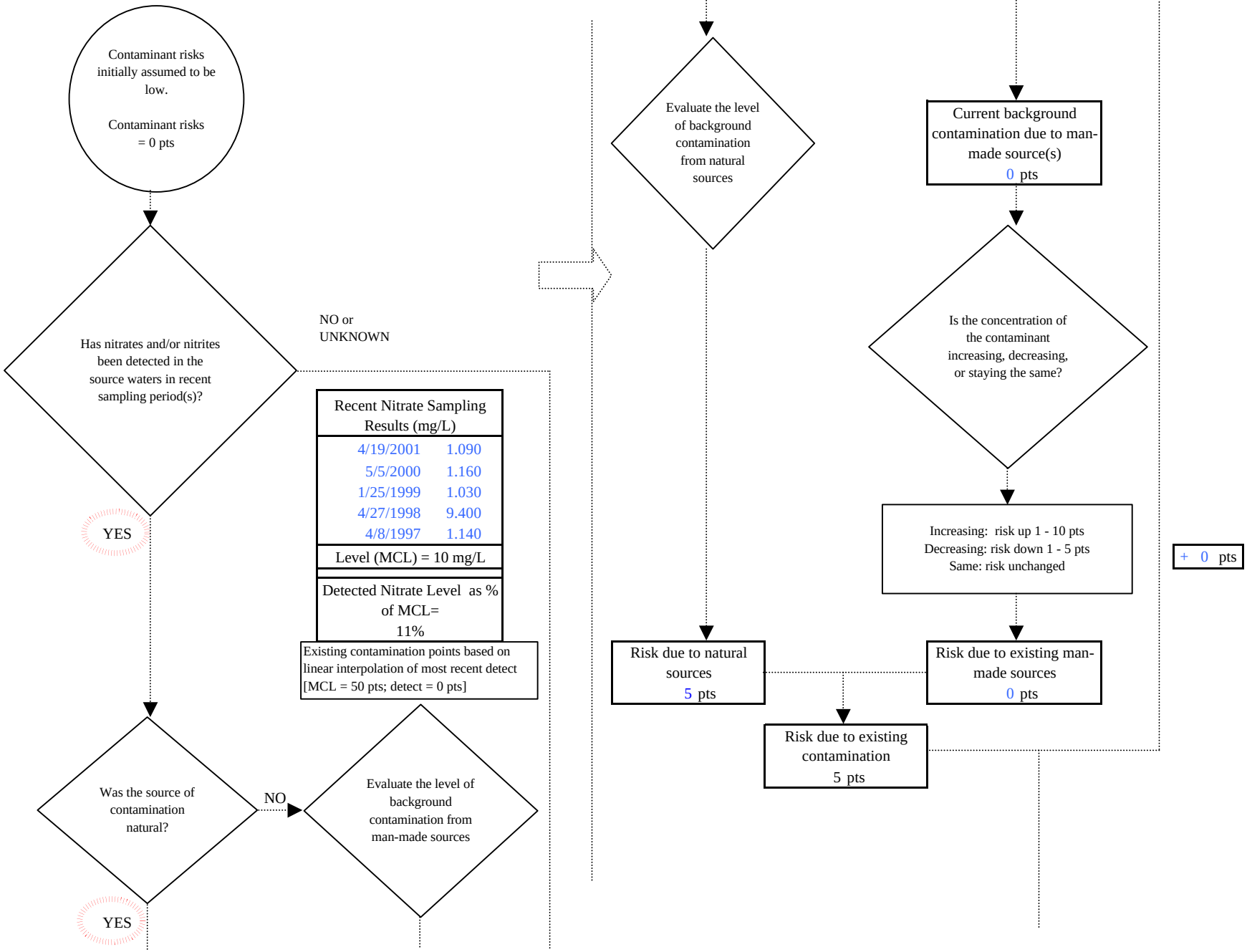
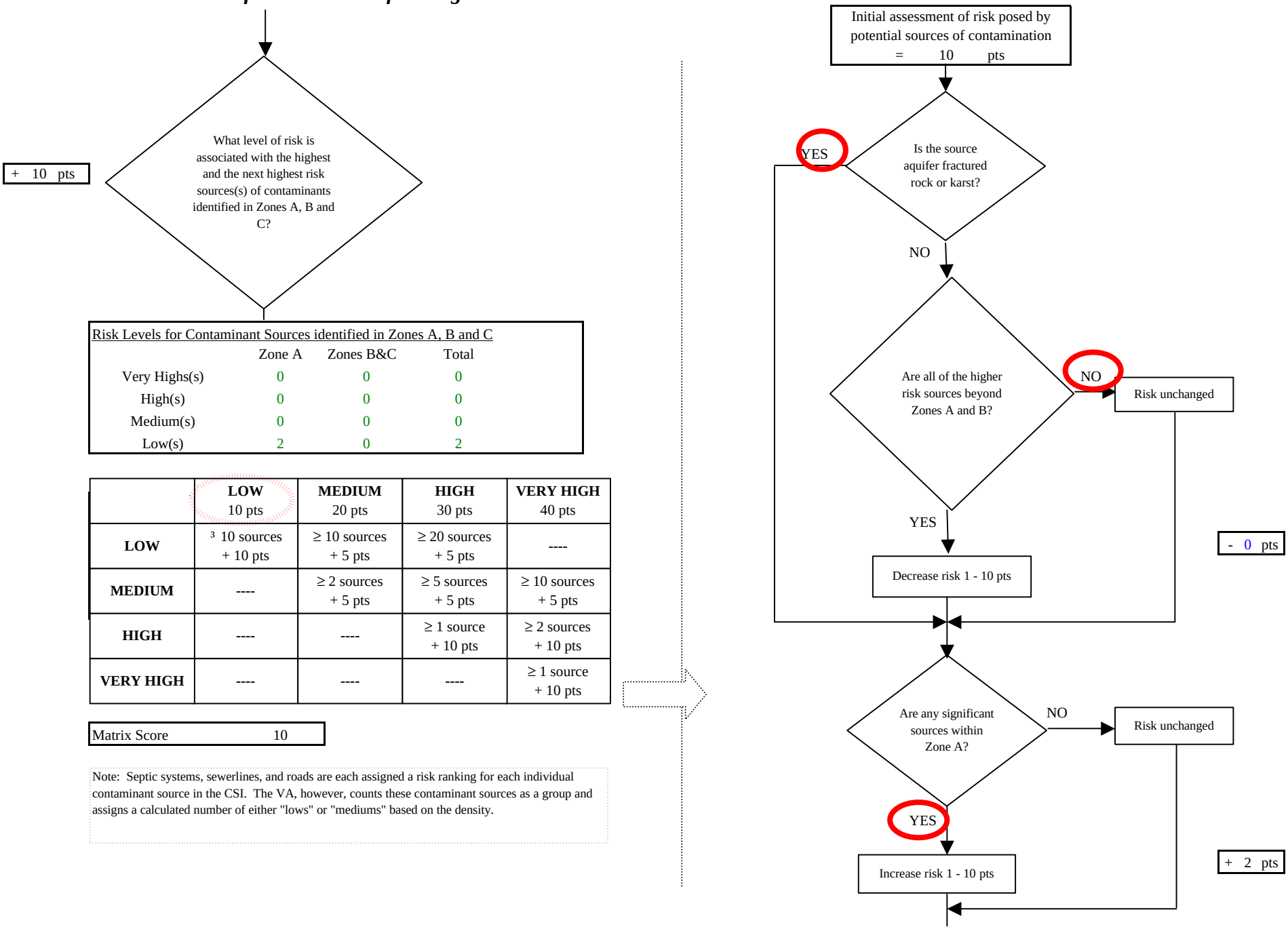


Chart 5. Contaminant risks for Cantwell Café/ Longhorn Bar - Nitrates and Nitrites



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)	2	0	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 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 Cantwell Café/ Longhorn Bar - Nitrates and Nitrites

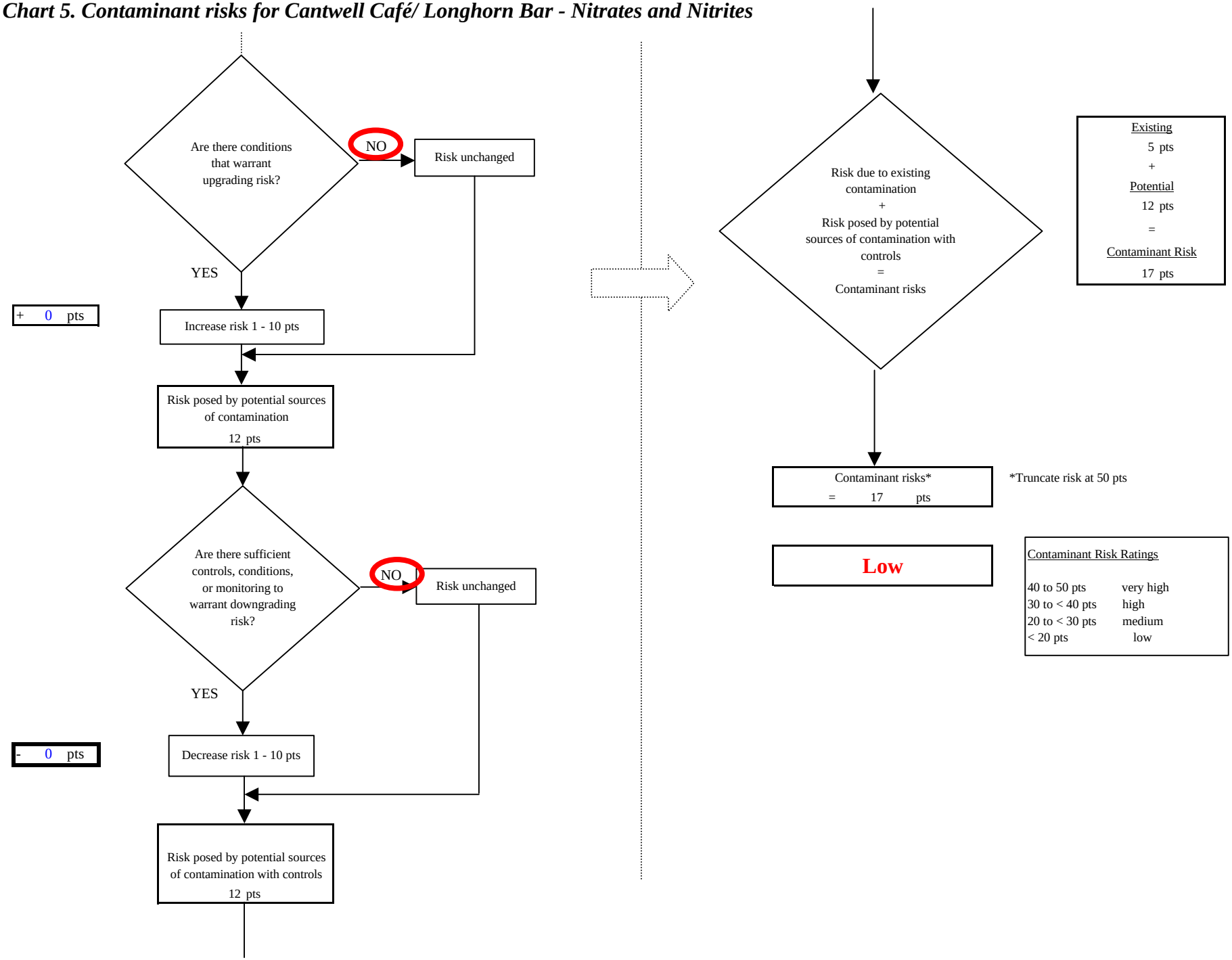


Chart 6. Vulnerability analysis for Cantwell Café/ Longhorn Bar - Nitrates and Nitrites

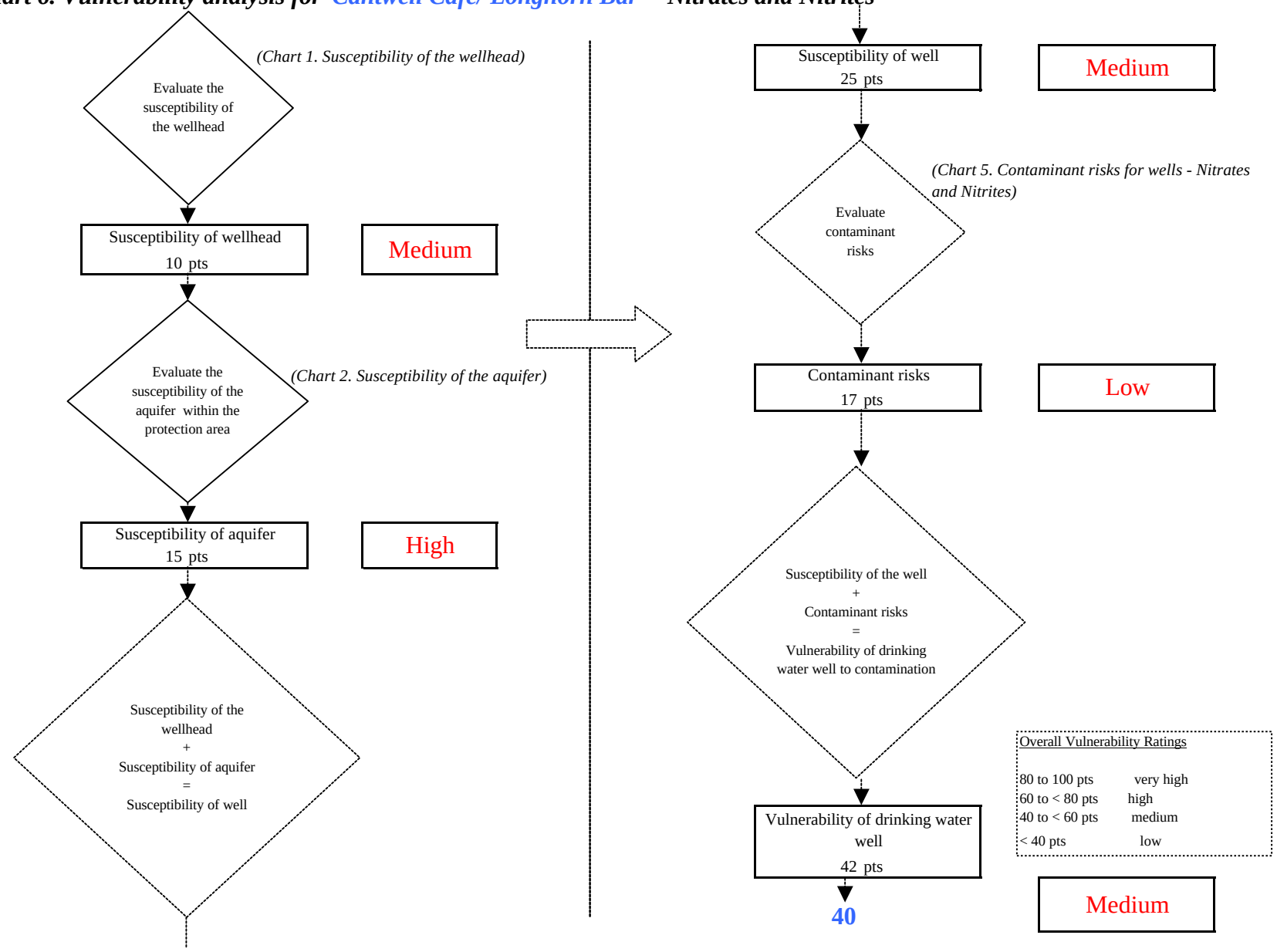


Chart 7. Contaminant risks for Cantwell Café/ Longhorn Bar - Volatile Organic Chemicals

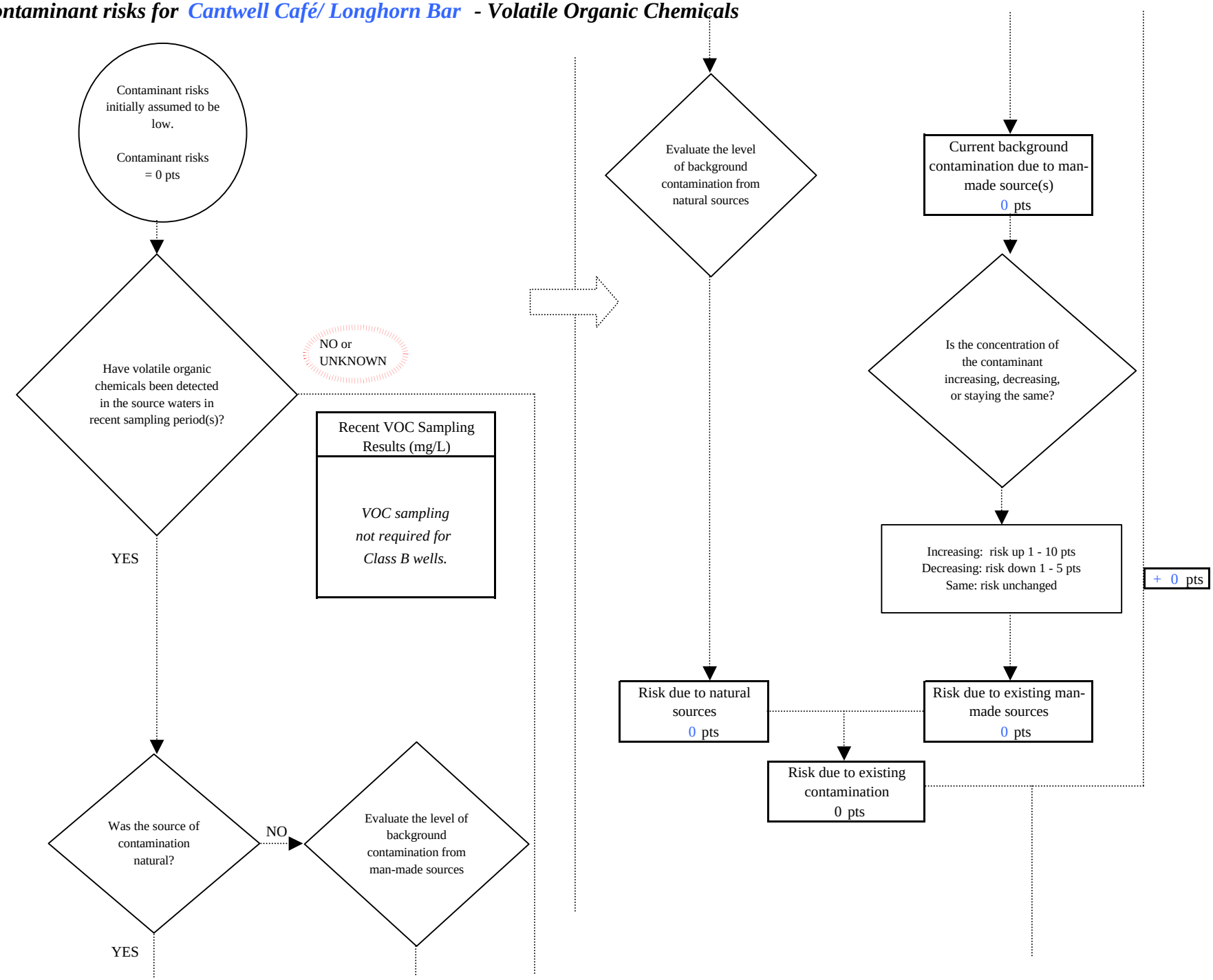


Chart 7. Contaminant risks for Cantwell Café/ Longhorn Bar - Volatile Organic Chemicals

+ 30 pts

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

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	1	0	1
Low(s)	1	0	1

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

Matrix Score 30

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

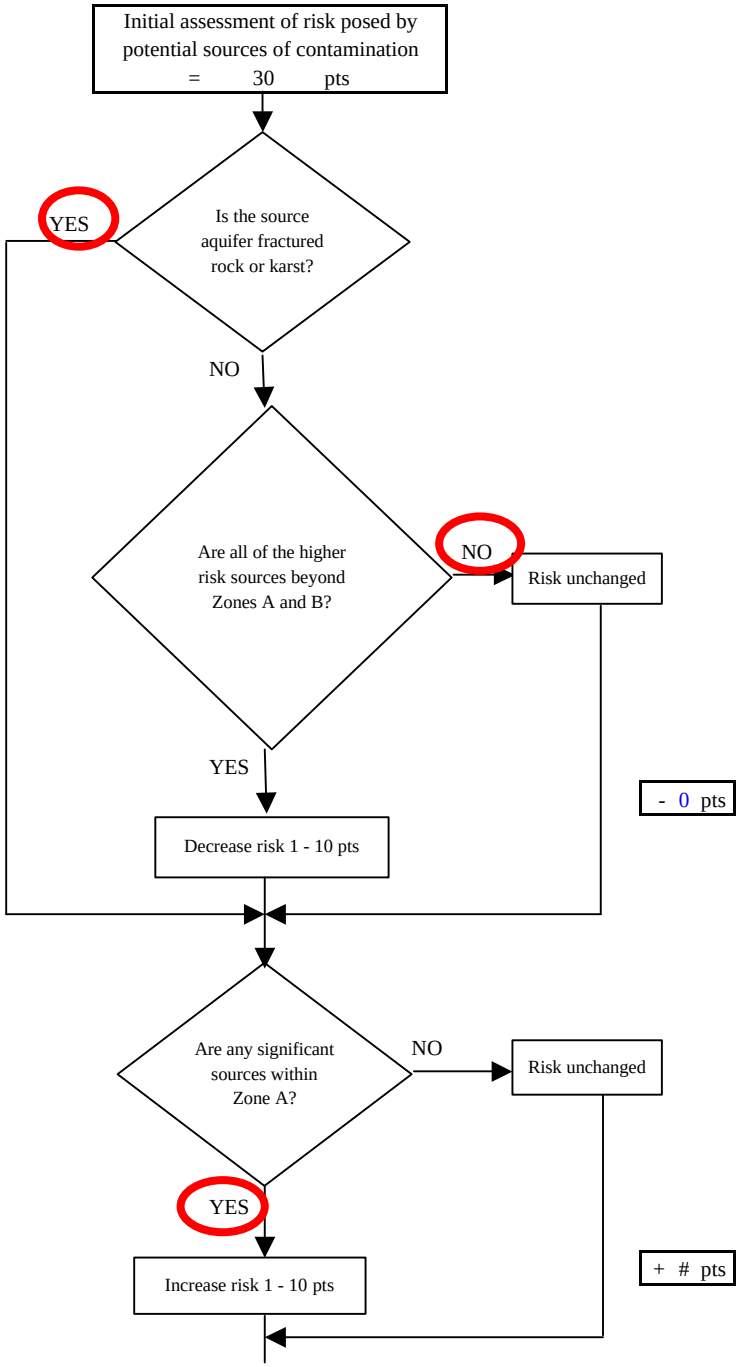


Chart 7. Contaminant risks for Cantwell Café/ Longhorn Bar - Volatile Organic Chemicals

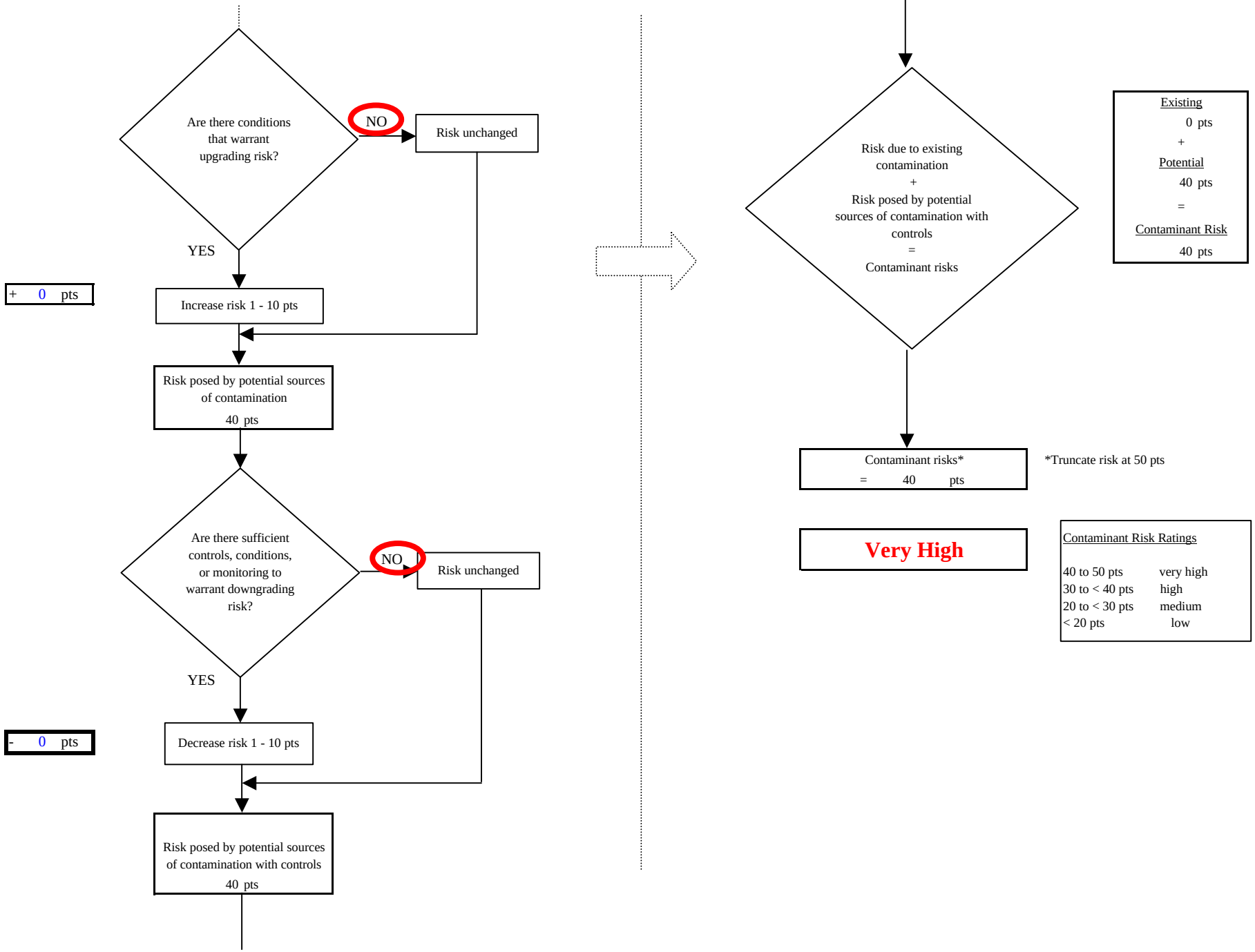


Chart 8. Vulnerability analysis for Cantwell Café/ Longhorn Bar - Volatile Organic Chemicals