Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for
Peters Creek Trading Post Drinking Water System, Chugiak, Alaska
Peters Creek Trading Post PWSID # 212746.001

DRINKING WATER PROTECTION PROGRAM REPORT 845

Alaska Department of Environmental Conservation

Hydrogeologic Susceptibility and Vulnerability Assessment for Peters Creek Trading Post, Chugiak, Alaska

By: Suzan J. Hill

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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.

March, 2003

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2003

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By Suzan J. Hill

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Peters Creek Trading Post is a Class B (transient/ noncommunity) drinking water source consisting of one well. Identified potential and current sources of contaminants for Peters Creek Trading Post include construction trade areas, domestic wastewater collection systems, roads and approximately 203 acres of residential area. 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 Peters Creek Trading Post public water source received a vulnerability rating of **High** for bacteria and viruses, **Very High** for nitrates and/or nitrites; and **Medium** for volatile organic chemicals.

INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. This assessment was completed for Peters Creek Trading Post source of public drinking water. This source consists of one well in the Wasilla area. This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, has combined a review of the natural hydrogeologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for local voluntary protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

DESCRIPTION OF THE CHUGACH MOUNTAIN FRONT EAST OF ANCHORAGE

Location

Between the Chugach Mountain Front east of Anchorage and Knik Arm lie the communities of Eagle River, Chugiak, Peters Creek, and Eklutna. The Eagle River Valley is one of the largest valleys in the western Chugach Mountains. Eagle River and the neighboring communities are located in the Municipality of Anchorage Borough.

Glacial and alluvial forces have shaped the Eagle River Valley and Chugach Mountain front in this area. These forces have resulted in the U-shaped river valleys and moraine-mantled mountain flanks of the mountain front and lakes, streams and undulating ridges and hills of the glaciated lowlands extending to Knik Arm.

Precipitation

Eagle River averages between 20 and 25 inches of precipitation per year, including about 68 inches of snowfall.

Topography and Drainage

The area topography varies from sea level to about 400 feet in the area surrounding Knik Arm to several thousand feet on the surrounding ridges and mountain flanks.

Groundwater

Although the quality can vary significantly in a short distance, groundwater supplies are generally abundant in the area, except for some reported well failures that have occurred within the city limits of Eagle River. Groundwater occurs within both confined and unconfined aquifers and from both unconsolidated and bedrock aquifers. 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.

Geology and Soils

Most of the soils in the area provide good sources of sand, gravel and topsoil. The deposition of silt, clay and organic muck in old lakes, oxbows and depressions means that some areas have soil conditions that vary over relatively short distances.

PETERS CREEK TRADING POST PUBLIC WATER SOURCE

Peters Creek Trading Post public water source is a Class B (transient/noncommunity) water source. The system consists of one well and is located at 23108 Barbara St. (see Map 1 in Appendix A). This area is at an approximate elevation of 425 feet above sea level.

According to the well log, Peters Creek Trading Post's well penetrates topsoil from 0 to 3 feet; sand and gravel from 3 to 15 feet; hardpan from 15 to 93 feet; sand and gravel from 93 to 114 feet; hardpan from 114 to 119 feet; and bedrock from 119 feet to a total depth of 200 feet below land surface. The well was drilled on 10/15/79. The Sanitary Survey (7/02/96) indicates that the well's sanitary seal is properly installed and the well site is protected from flooding. The well site is not properly drained and not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters. This water system operates year round and serves approximately 5 residents and 20 non-residents through one service connection.

ASSESSMENT AND PROTECTION AREA FOR PETERS CREEK TRADING POST DRINKING WATER SOURCE

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 are. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the Drinking Water Protection Area (DWPA). Because releases of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts. DWPA (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The DWPA's 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. 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 (Jokela et. al., 1991).

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 for the 2-yr. 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 down gradient 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 DWPA for the Peters Creek Trading Post contain four zones: Zone A, Zone B, and Zone C (see Map 1 in 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 Peters Creek Trading Post Drinking Water Protection Area. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to drinking water supplies cover 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 this assessment and 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.

The sources are displayed on Map 2 and Map 3 of Appendix B and summarized in table 1 of Appendix C.

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.

Tables 2 through 4 in Appendix C 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 PETERS CREEK TRADING POST DRINKING WATER SOURCES

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 well for Peters Creek Trading Post was completed in an semi-confined aquifer setting. The aquifer that is utilized by the well is protected from surface contamination by approximately 5 feet of relatively impermeable hardpan. However, the well is perforated from 109 feet to 114 feet allowing water to be drawn from the unconfined aquifer above. Table 2 shows the Susceptibility scores and ratings for Peters Creek Trading Post.

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

	Score	Rating
Susceptibility of the Wellhead	10	Medium
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	35	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 and 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

Contaminant Risks	Score	Rating
Bacteria and Viruses	40	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	22	Medium

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 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability of Peters Creek Trading Post Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	75	High
Nitrates and Nitrites	85	Very High
Volatile Organic Chemicals	55	Medium

Tables 2 through 4 in Appendix C contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

Bacteria and Viruses

The contaminant risk for bacteria and viruses is very high with large capacity septic systems in Zones A and residential septic systems in Zone B posing the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Recent sampling of Peters Creek Trading Post shows no detection of Bacteria and Viruses. After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Nitrates/Nitrites

The contaminant risk for nitrates and nitrites is very high. Large capacity septic systems, because of their effluent discharge, pose the most significant contaminant 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.

Sampling history for the Peters Creek Trading Post well indicates that low concentrations of nitrate were detected at the last sampling date. Existing nitrate concentration is approximately 2.720 mg/L or 27% 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. Throughout the past 5 years nitrate and/or nitrite concentrations at this site have remained somewhat high. Because the concentration is over 20% of the MCL, it is assumed that nitrate level is man-made, most probably from the large capacity septic system in Zone A.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is very high.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is medium with roads and residential areas posing the most significant risk. (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

SUMMARY

A *Source Water Assessment* has been completed for the Peters Creek Trading Post source of public drinking water. Overall, the Peters Creek Trading Post public water source received a vulnerability rating of **High** for bacteria and viruses, **Very High** for nitrates and/or nitrites; and **Medium** for volatile organic chemicals.

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts. It is anticipated that *Source Water Assessments* will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the public drinking water source.

REFERENCES CITED

Munter, J.A., and Allely, R. D., 1992, Water-Supply Aquifers at Eagle River, Alaska: State of Alaska Division of Geological & Geophysical Surveys Professional Report 108.

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.

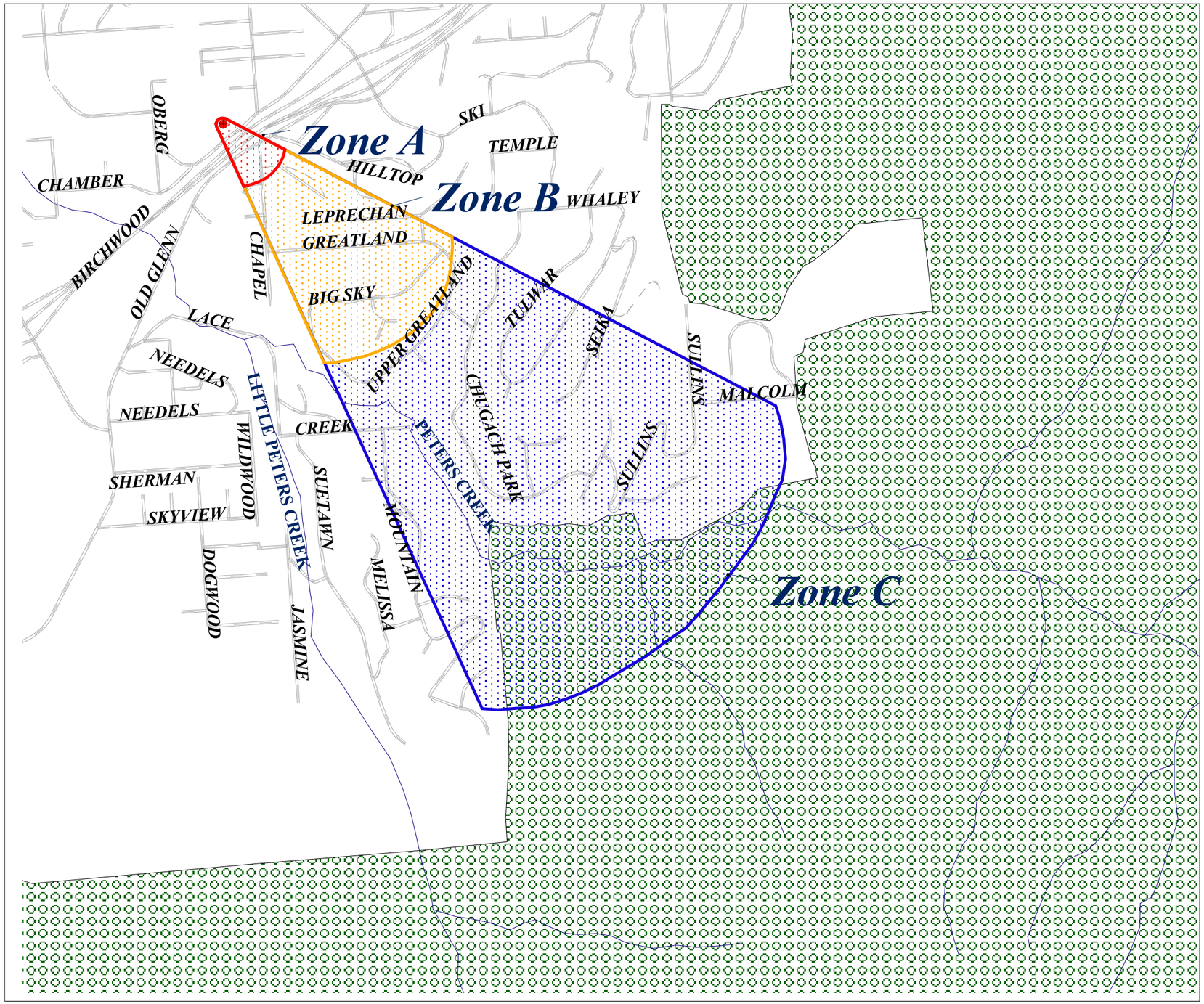
Wang, B., Strelakos, P.M., and Jokela, J.B., 2000, Nitrate source indicators in ground water of the scimitar subdivision, Peters Creek Area, Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 00-4137.

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

APPENDIX A

Drinking Water Protection Area

Peters Creek Trading Post Protection Area - #212746



800 0 800 1600 2400 3200 Yards

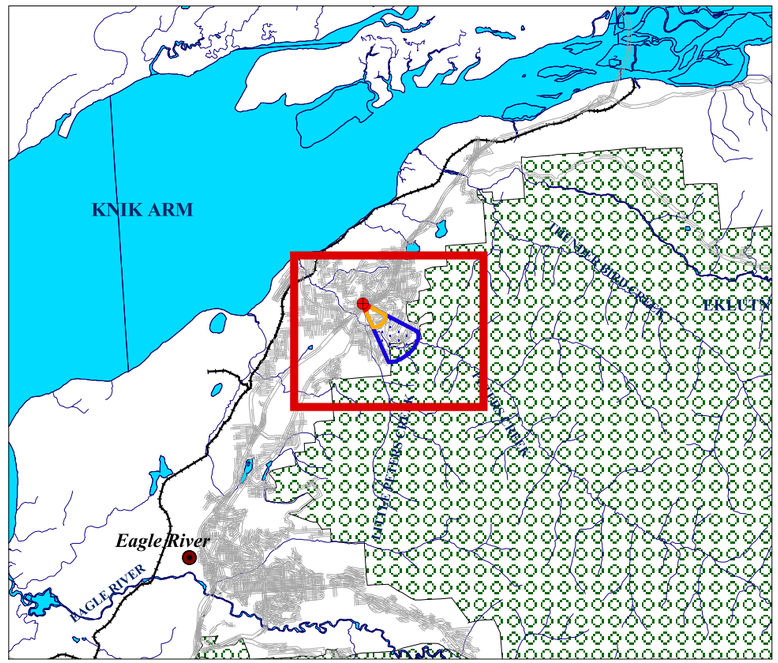
Legend

- Peters Creek Trading Post Well Location

Zone A
- Several Months Time of Travel

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel
- Roads
- Rivers or Streams
- Chugach State Park



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Map One

APPENDIX B

Drinking Water Protection Area Showing Sources of Contamination (Maps 2 and 3)

Peters Creek Trading Post Existing and Potential Contaminant Sources

R02-1 thru R02-3
R01-1
Zone A
SKI
HILLTOP
HILLTOP
GLENN HWY
NEW GLENN
PETERS CREEK
D10-1
GLENN HILL
R01-2
X20-1 thru X20-5
Zone B
R02-4 thru R02-48
LEPRECHAN
OLD GLENN
GREATLAND
C09-1
CHAPEL
BIG SKY
X20-6 thru X20-10
PONIARD
UPPER GREATLAND
UPPER GREATLAND
CHUGACH PARK
LACE

200 0 200 400 600 800 Yards

Legend

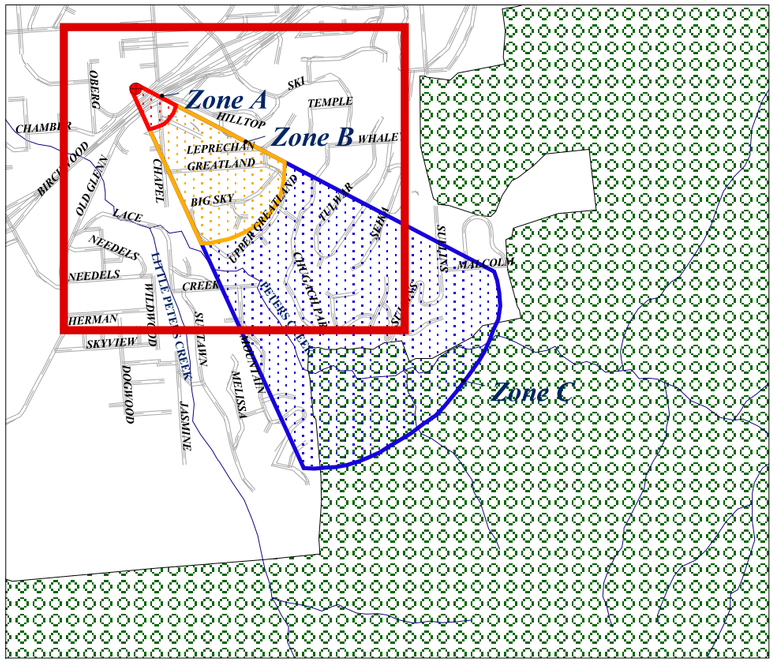
- Peters Creek Trading Post Well Location

Zone A
- Several Months Time of Travel

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel
- Roads
- Rivers or Streams
- Land Parcels
- Residential Areas (R01)

Septic Systems
- Large Capacity Septic Systems (D10)
- Residential Septic Systems (R02)
- Construction Trade Area (C09)



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Map Two

Peters Creek Trading Post Existing and Potential Contaminant Sources

GREATLAND
BIG SKY
UPPER GREATLAND
TULUAR
CHUGACH PARK
KULLBERG
SULLINS
WARNING
LITTLE PETERS CREEK
SUETAWN
MELISSA
MOUNTAIN
CREEK
R01-3
R02-49 thru R02-161
X20-11 thru X20-17
PETERS CREEK
Zone C

400 0 400 800 1200 1600 Yards

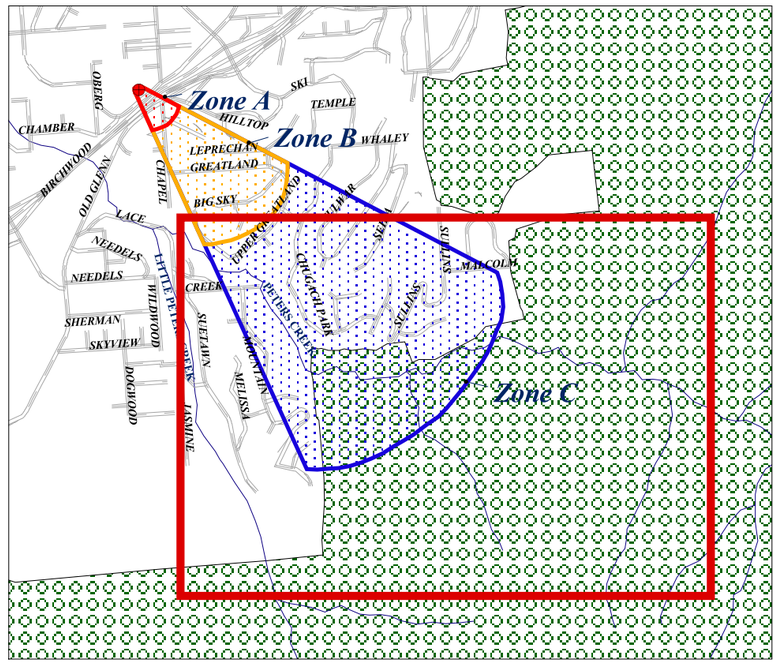
Legend

- Peters Creek Trading Post Well Location

Zone A
- Several Months Time of Travel

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel
- Roads
- Rivers or Streams
- Land Parcels
- Chugach State Park
- Residential Areas (R01)
- Residential Septic Systems (R02)



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Map Three

APPENDIX C

Contaminant Source Inventory Tables
Tables 1 through 4

Table 1

Contaminant Source Inventory for ***Peter's Creek Trading Post***

PWSID 212746.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	2	
Residential Areas	R01	R01-1	A	2	2 Acres
Septic systems (serves one single-family home)	R02	R02-1-3	A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	A	2	
Construction trade areas and materials	C09	C09-1	B	2	
Residential Areas	R01	R01-2	B	2	59 Acres
Septic systems (serves one single-family home)	R02	R02-4-48	B	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6-10	B	2	
Residential Areas	R01	R01-3	C	3	142 Acres
Septic systems (serves one single-family home)	R02	R02-49-161	C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-11-17	C	3	

Table 2

Contaminant Source Inventory and Risk Ranking for Peter's Creek Trading Post Sources of Bacteria and Viruses

PWSID 212746.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	
Residential Areas	R01	R01-1	A	Low	2	2 Acres
Septic systems (serves one single-family home)	R02	R02-1-3	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	A	Low	2	
Residential Areas	R01	R01-2	B	Low	2	59 Acres
Septic systems (serves one single-family home)	R02	R02-4-48	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6-10	B	Low	2	

Table 3

Contaminant Source Inventory and Risk Ranking for Peter's Creek Trading Post Sources of Nitrates/Nitrites

PWSID 212746.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	
Residential Areas	R01	R01-1	A	Low	2	2 Acres
Septic systems (serves one single-family home)	R02	R02-1-3	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	A	Low	2	
Residential Areas	R01	R01-2	B	Low	2	59 Acres
Septic systems (serves one single-family home)	R02	R02-4-48	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6-10	B	Low	2	
Residential Areas	R01	R01-3	C	Low	3	142 Acres
Septic systems (serves one single-family home)	R02	R02-49-161	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-11-17	C	Low	3	

Table 4

Contaminant Source Inventory and Risk Ranking for Peter's Creek Trading Post Sources of Volatile Organic Chemicals

PWSID 212746.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	2 Acres
Septic systems (serves one single-family home)	R02	R02-1-3	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	A	Low	2	
Construction trade areas and materials	C09	C09-1	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	59 Acres
Septic systems (serves one single-family home)	R02	R02-4-48	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6-10	B	Low	2	
Residential Areas	R01	R01-3	C	Low	3	142 Acres
Septic systems (serves one single-family home)	R02	R02-49-161	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-11-17	C	Low	3	

Table 5

Contaminant Source Inventory and Risk Ranking for Peter's Creek Trading Post Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 212746.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	2 Acres
Septic systems (serves one single-family home)	R02	R02-1-3	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	A	Low	2	
Construction trade areas and materials	C09	C09-1	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	59 Acres
Septic systems (serves one single-family home)	R02	R02-4-48	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6-10	B	Low	2	
Residential Areas	R01	R01-3	C	Low	3	142 Acres
Septic systems (serves one single-family home)	R02	R02-49-161	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-11-17	C	Low	3	

Table 6

Contaminant Source Inventory and Risk Ranking for Peter's Creek Trading Post Sources of Synthetic Organic Chemicals

PWSID 212746.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	2 Acres
Septic systems (serves one single-family home)	R02	R02-1-3	A	Low	2	
Residential Areas	R01	R01-2	B	Low	2	59 Acres
Septic systems (serves one single-family home)	R02	R02-4-48	B	Low	2	
Residential Areas	R01	R01-3	C	Low	3	142 Acres
Septic systems (serves one single-family home)	R02	R02-49-161	C	Low	3	

Table 7

Contaminant Source Inventory and Risk Ranking for Peter's Creek Trading Post Sources of Other Organic Chemicals

PWSID 212746.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	2 Acres
Septic systems (serves one single-family home)	R02	R02-1-3	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	A	Low	2	
Construction trade areas and materials	C09	C09-1	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	59 Acres
Septic systems (serves one single-family home)	R02	R02-4-48	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6-10	B	Low	2	
Residential Areas	R01	R01-3	C	Low	3	142 Acres
Septic systems (serves one single-family home)	R02	R02-49-161	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-11-17	C	Low	3	

APPENDIX D

Vulnerability Analysis Charts and Tables
Charts 1 through 8

Chart 1. Susceptibility of the wellhead - Peters Creek Trading Post

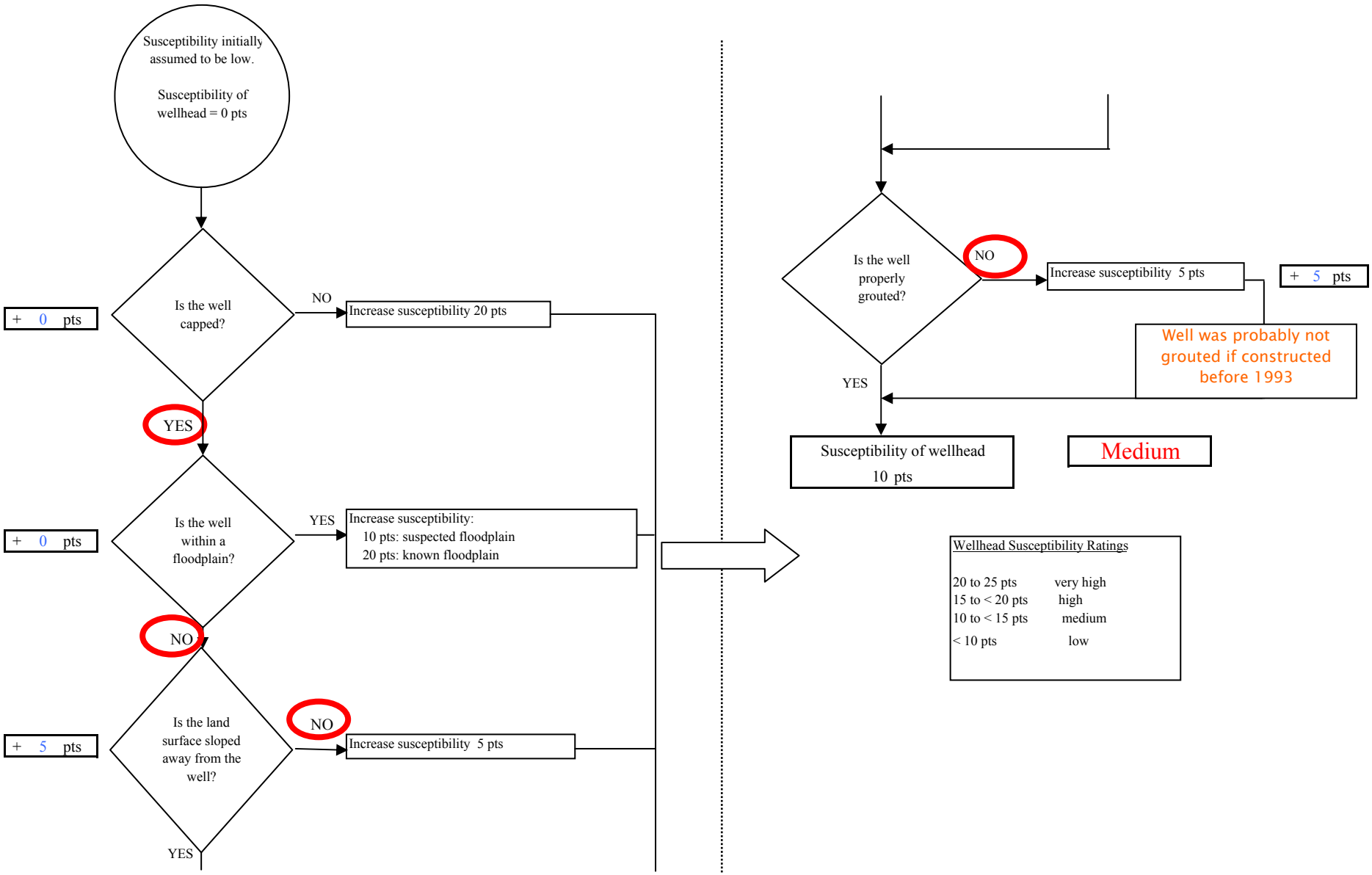


Chart 2. Susceptibility of the aquifer - Peters Creek Trading Post

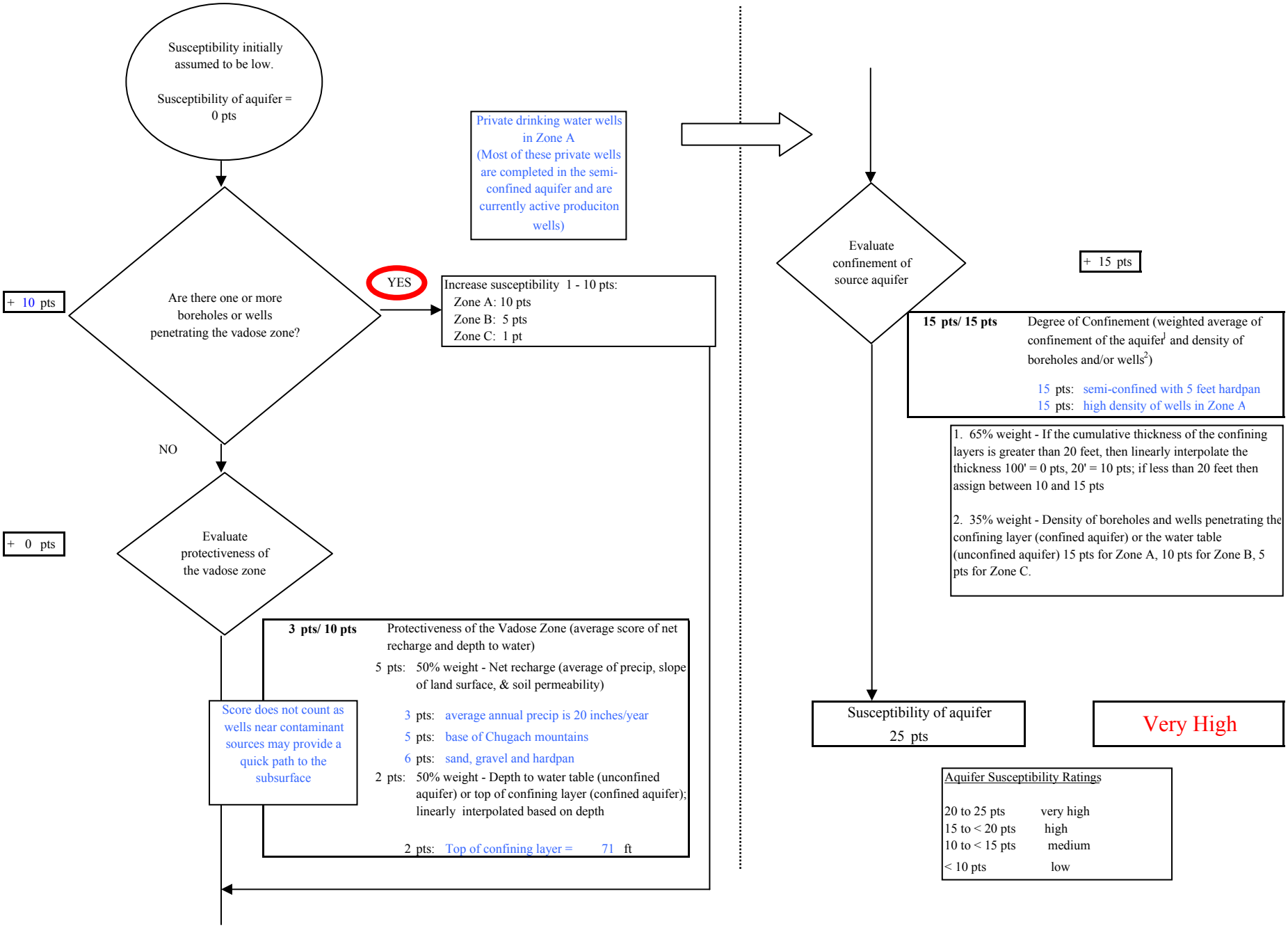
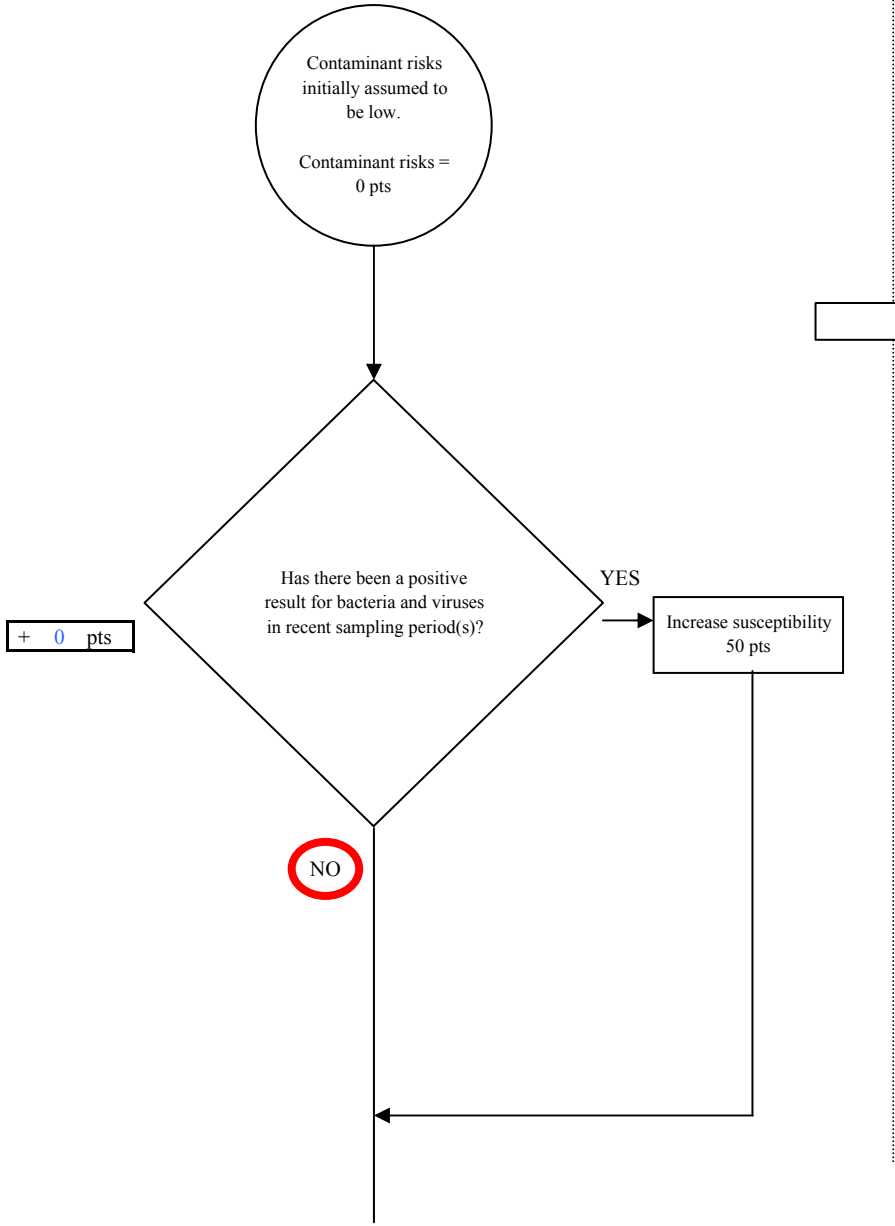
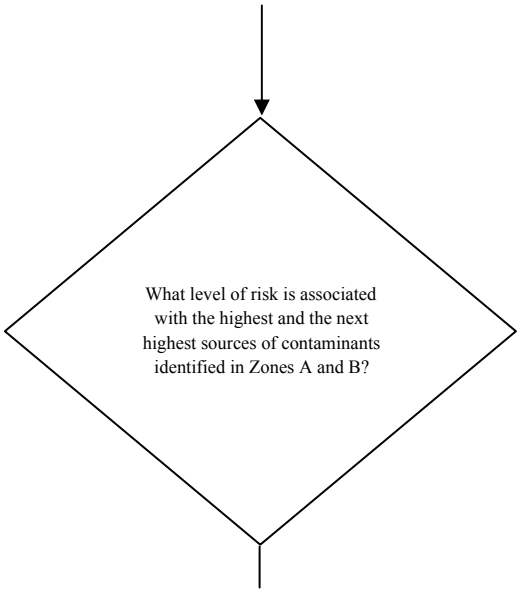


Chart 3. Contaminant risks for Peters Creek Trading Post - Bacteria & Viruses





+ 30 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)	1	0	1
Medium(s)	0	0	0
Low(s)	5	7	12

	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 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 3. Contaminant risks for Peters Creek Trading Post - Bacteria & Viruses

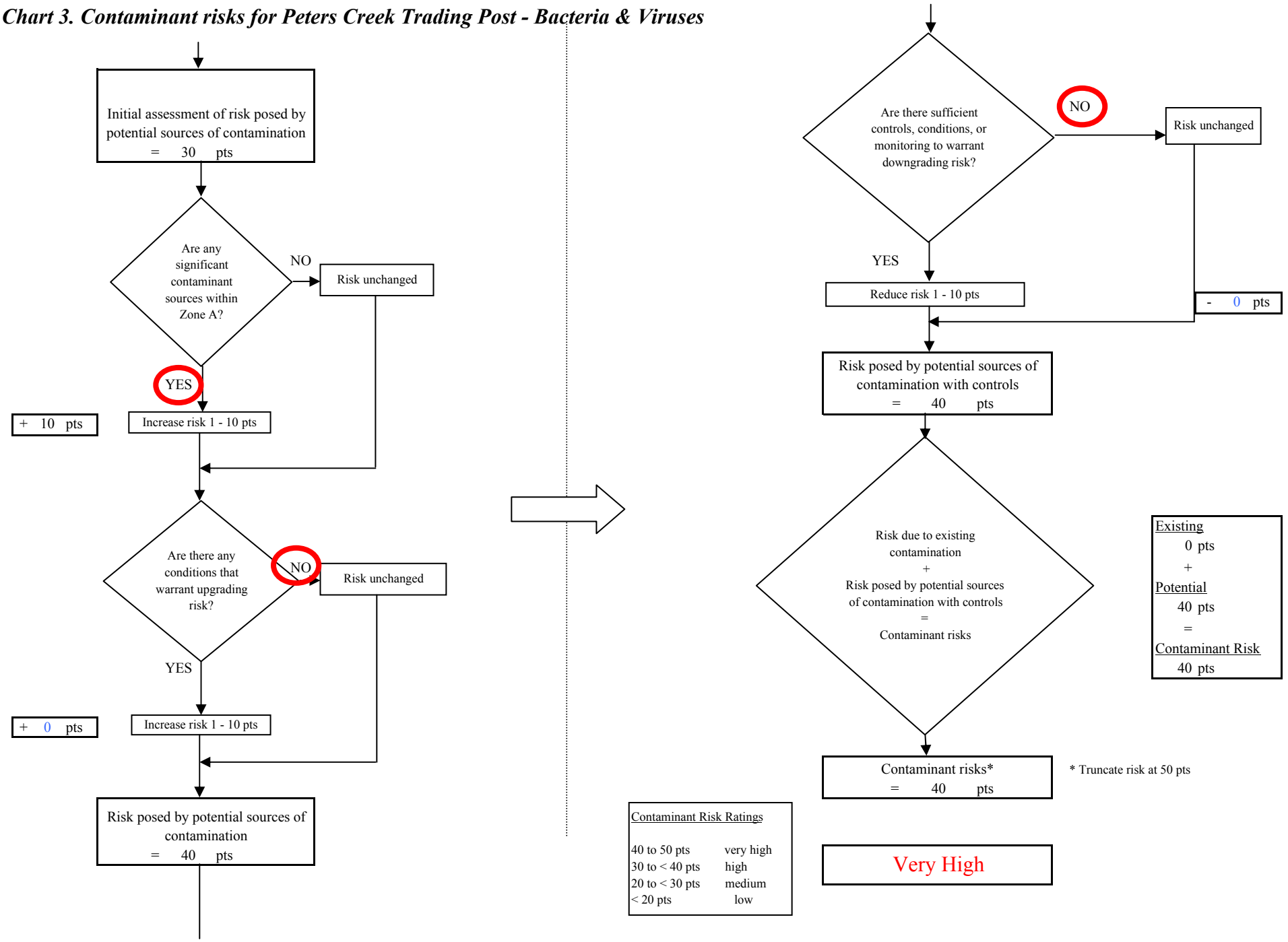


Chart 4. Vulnerability analysis for Peters Creek Trading Post - Bacteria & Viruses

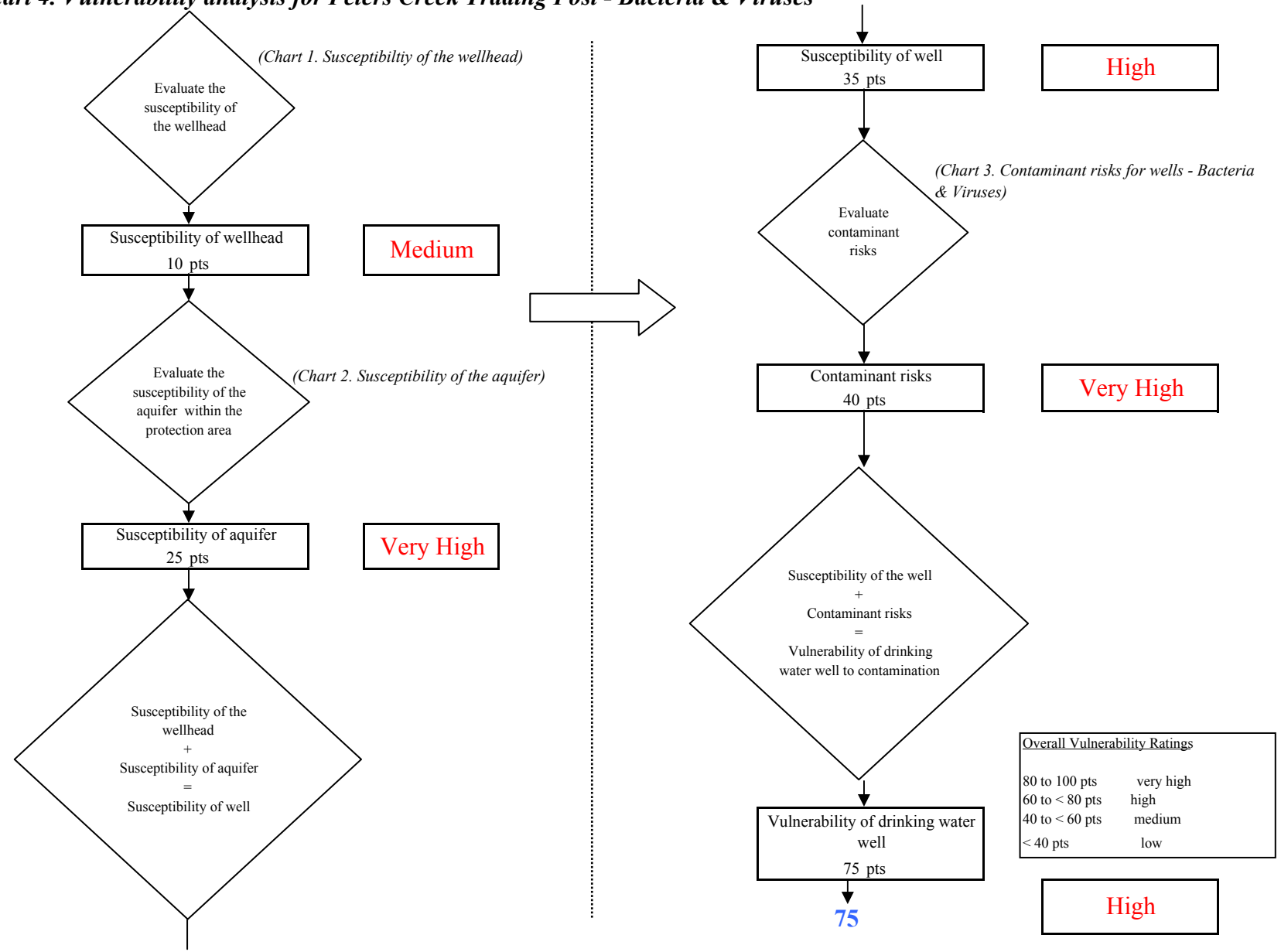


Chart 5. Contaminant risks for Peters Creek Trading Post - Nitrates and Nitrites

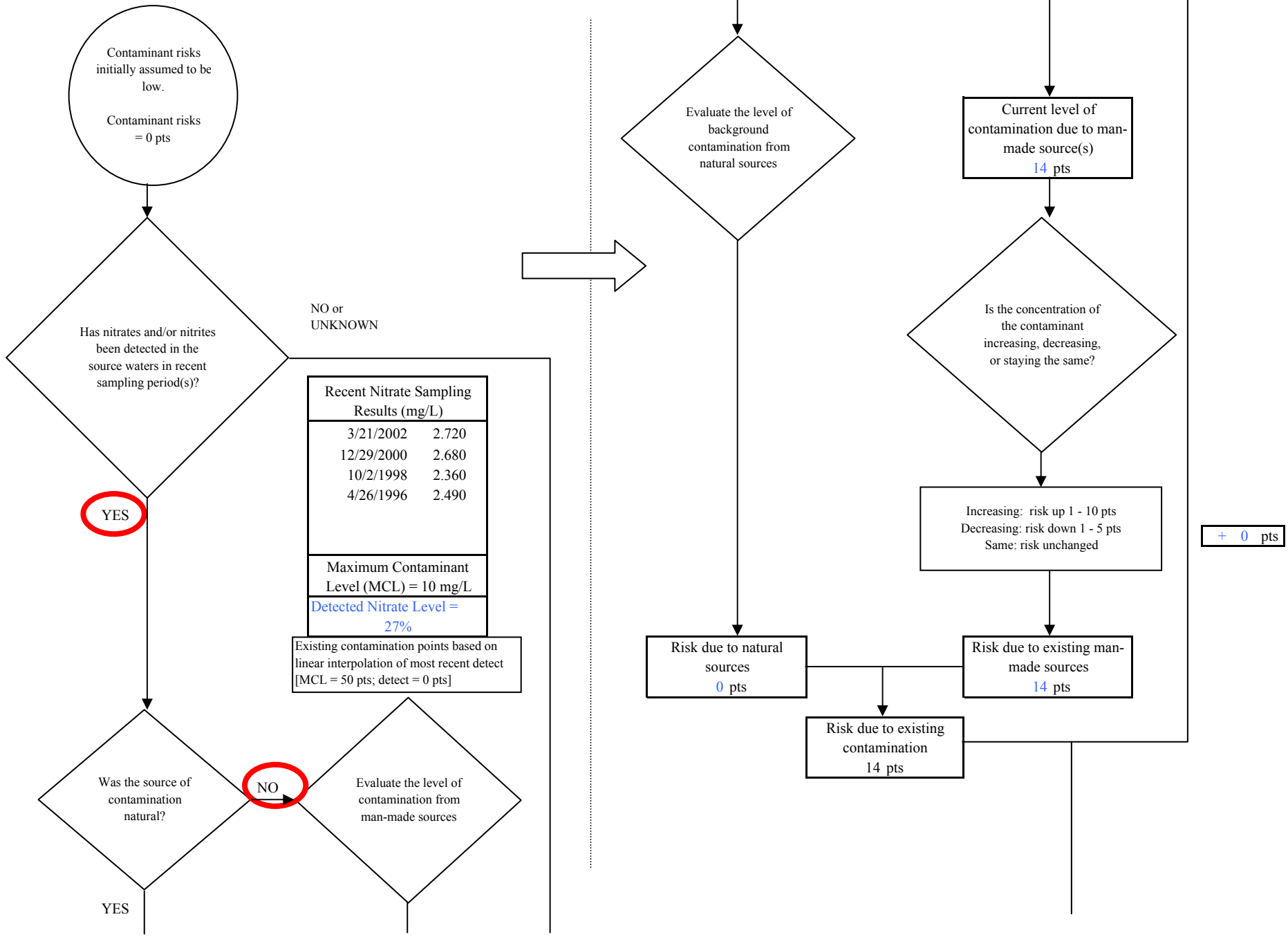


Chart 5. Contaminant risks for Peters Creek Trading Post - Nitrates and Nitrites

+ 35 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)	0	0	0
Low(s)	5	20	25

	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 35

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 = 35 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

+ 10 pts

Chart 5. Contaminant risks for Peters Creek Trading Post - Nitrates and Nitrites

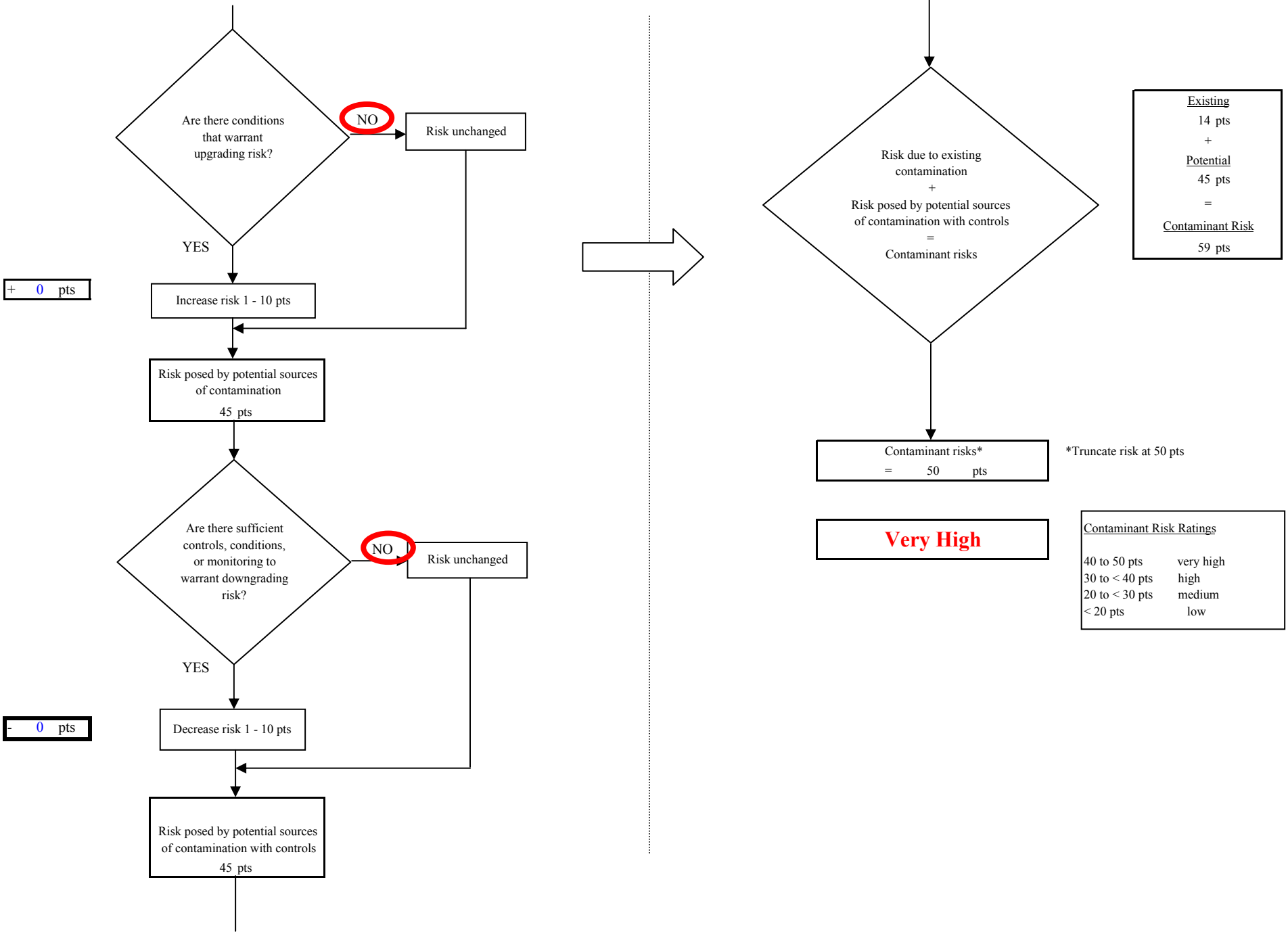


Chart 6. Vulnerability analysis for Peters Creek Trading Post - Nitrates and Nitrites

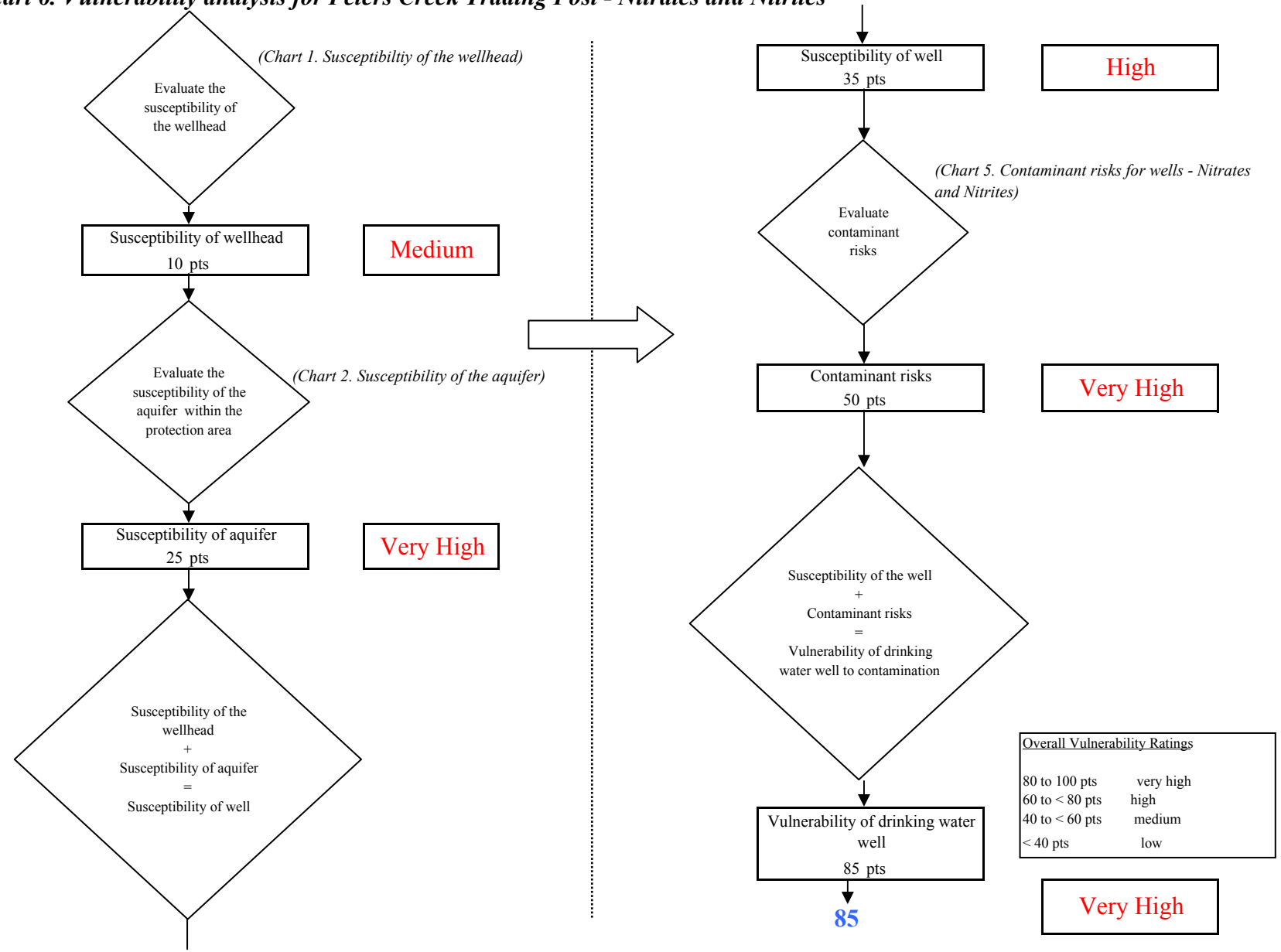


Chart 7. Contaminant risks for Peters Creek Trading Post - Volatile Organic Chemicals

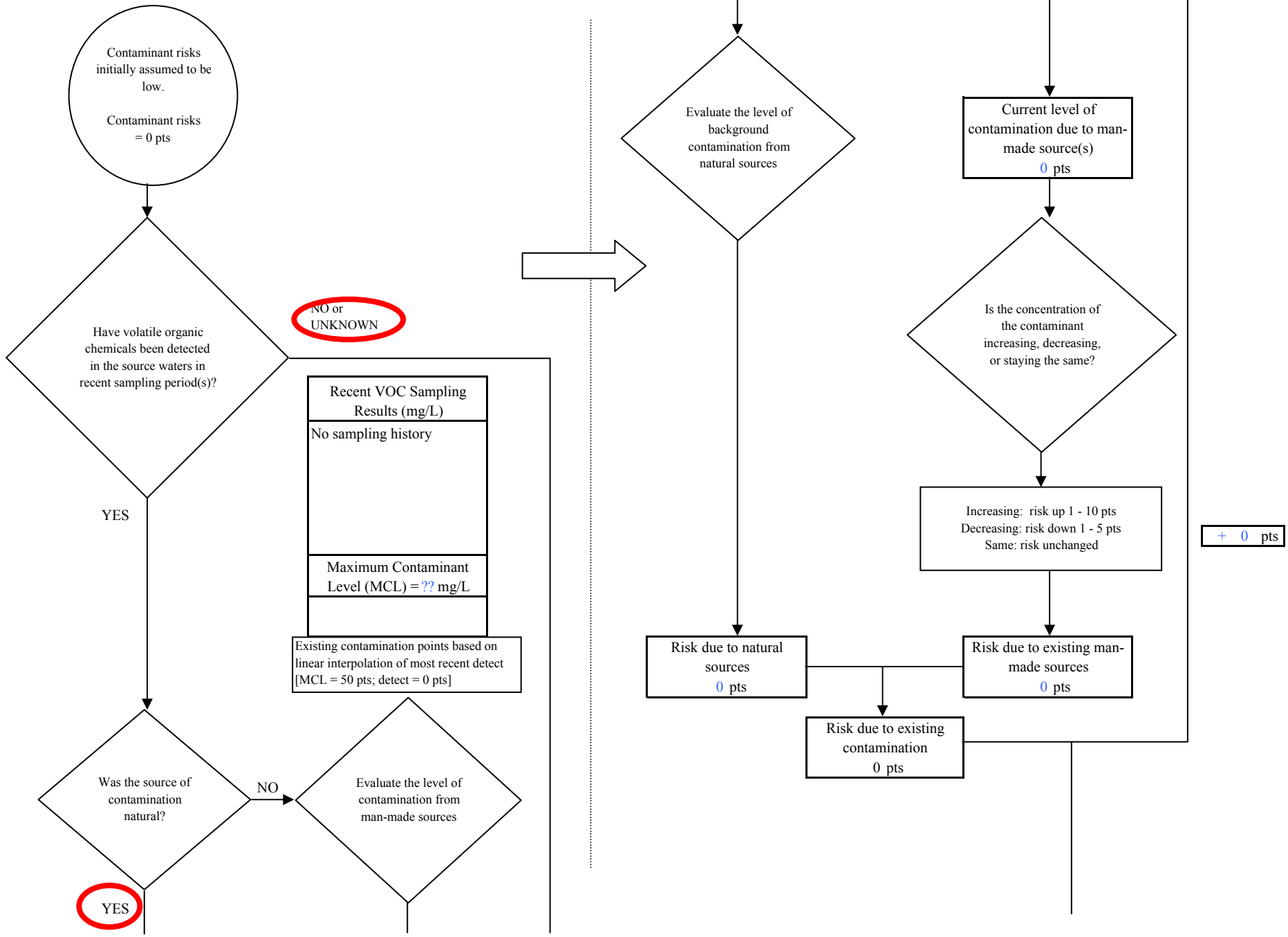
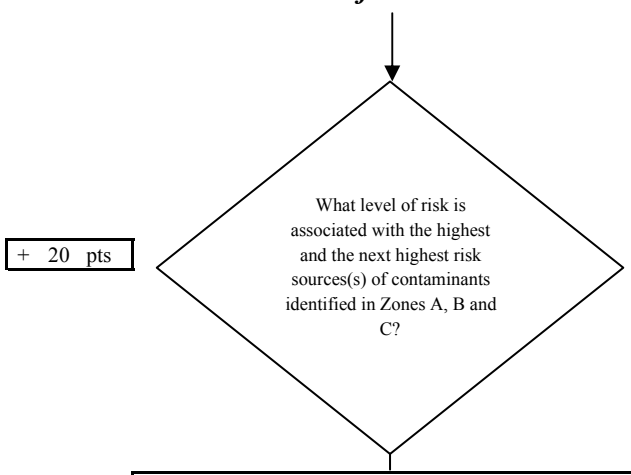


Chart 7. Contaminant risks for Peters Creek Trading Post - Volatile Organic Chemicals



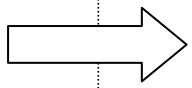
+ 20 pts

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)	4	7	11

	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.



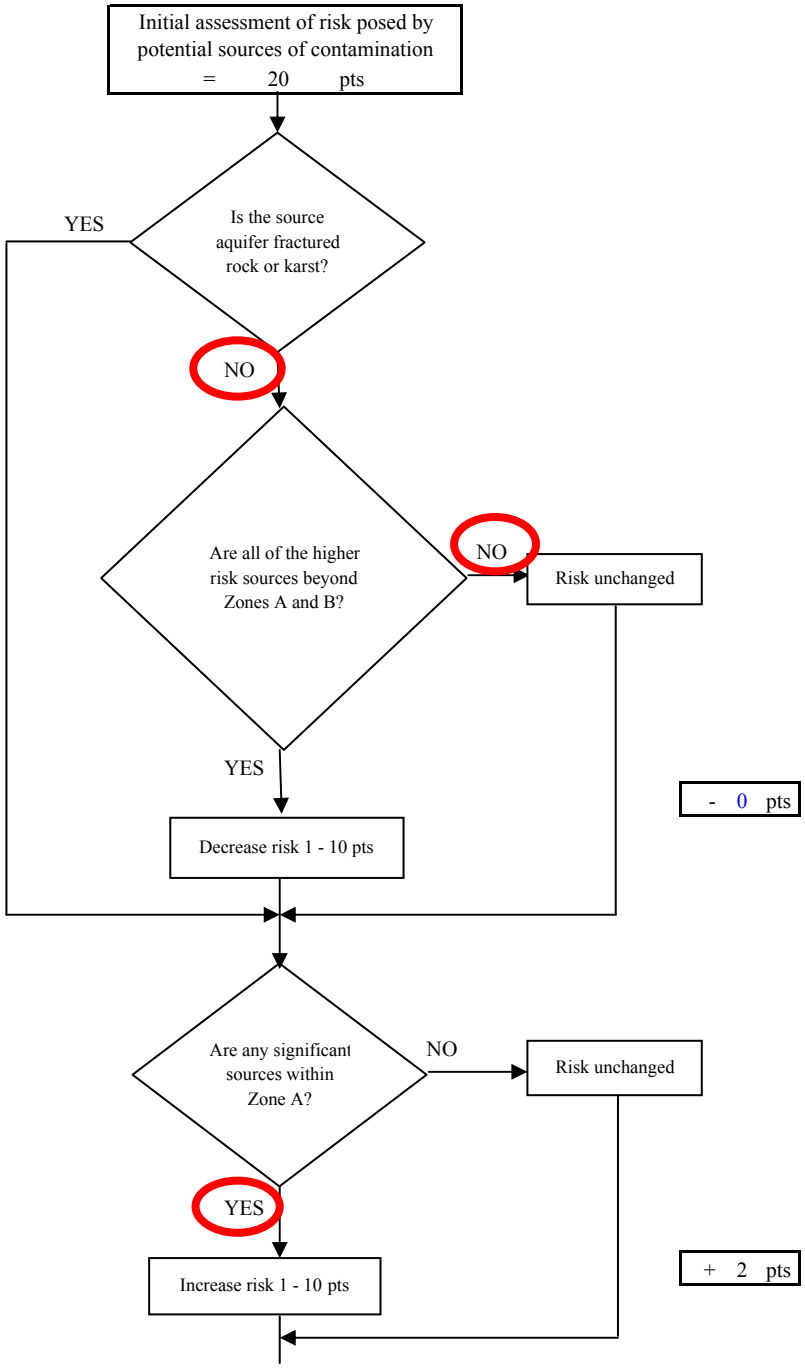


Chart 7. Contaminant risks for Peters Creek Trading Post - Volatile Organic Chemicals

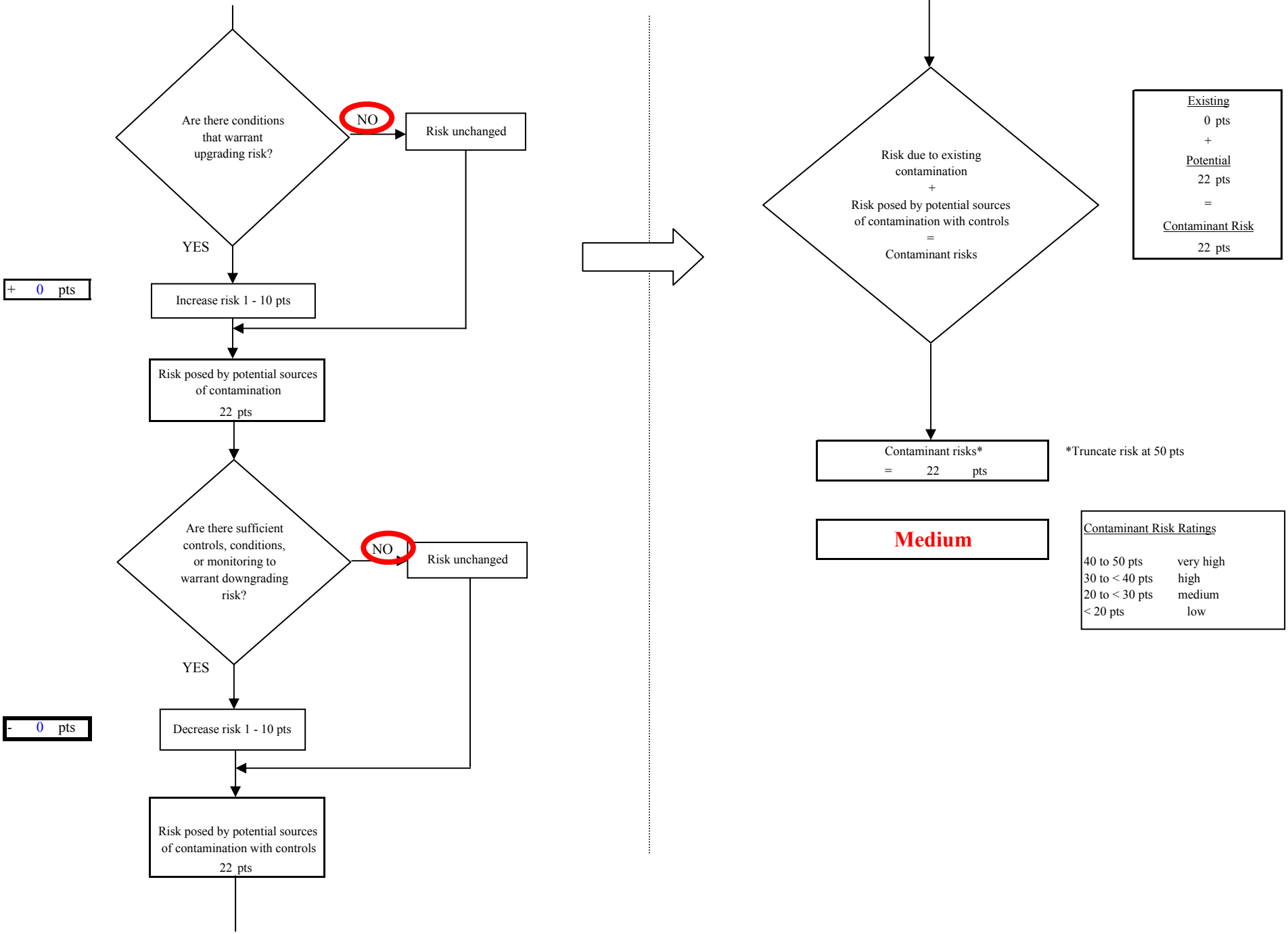


Chart 8. Vulnerability analysis for Peters Creek Trading Post - Volatile Organic Chemicals

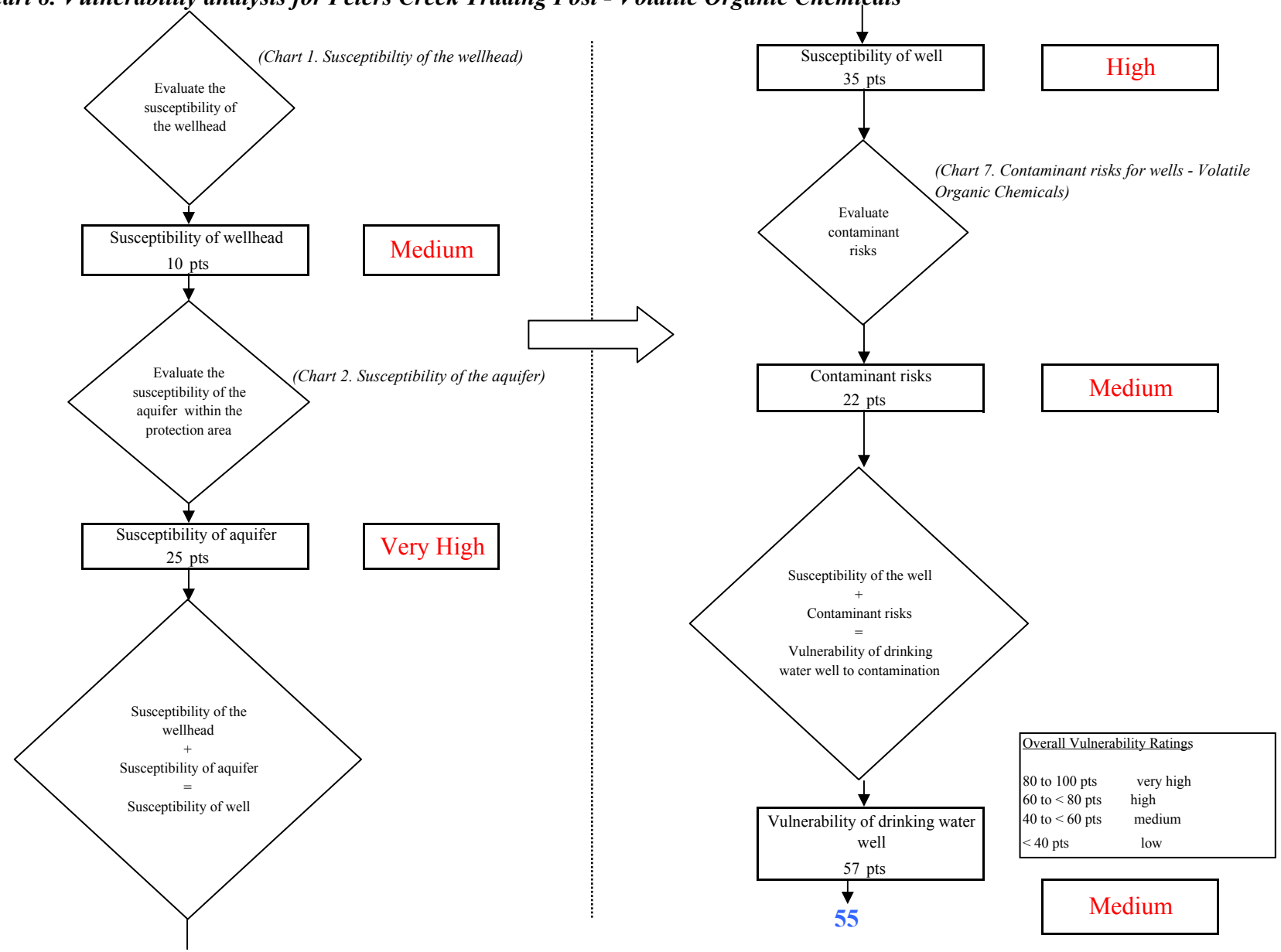


Chart 9. Contaminant risks for Peters Creek Trading Post - Heavy Metals, Cyanide and Other Inorganic Chemicals

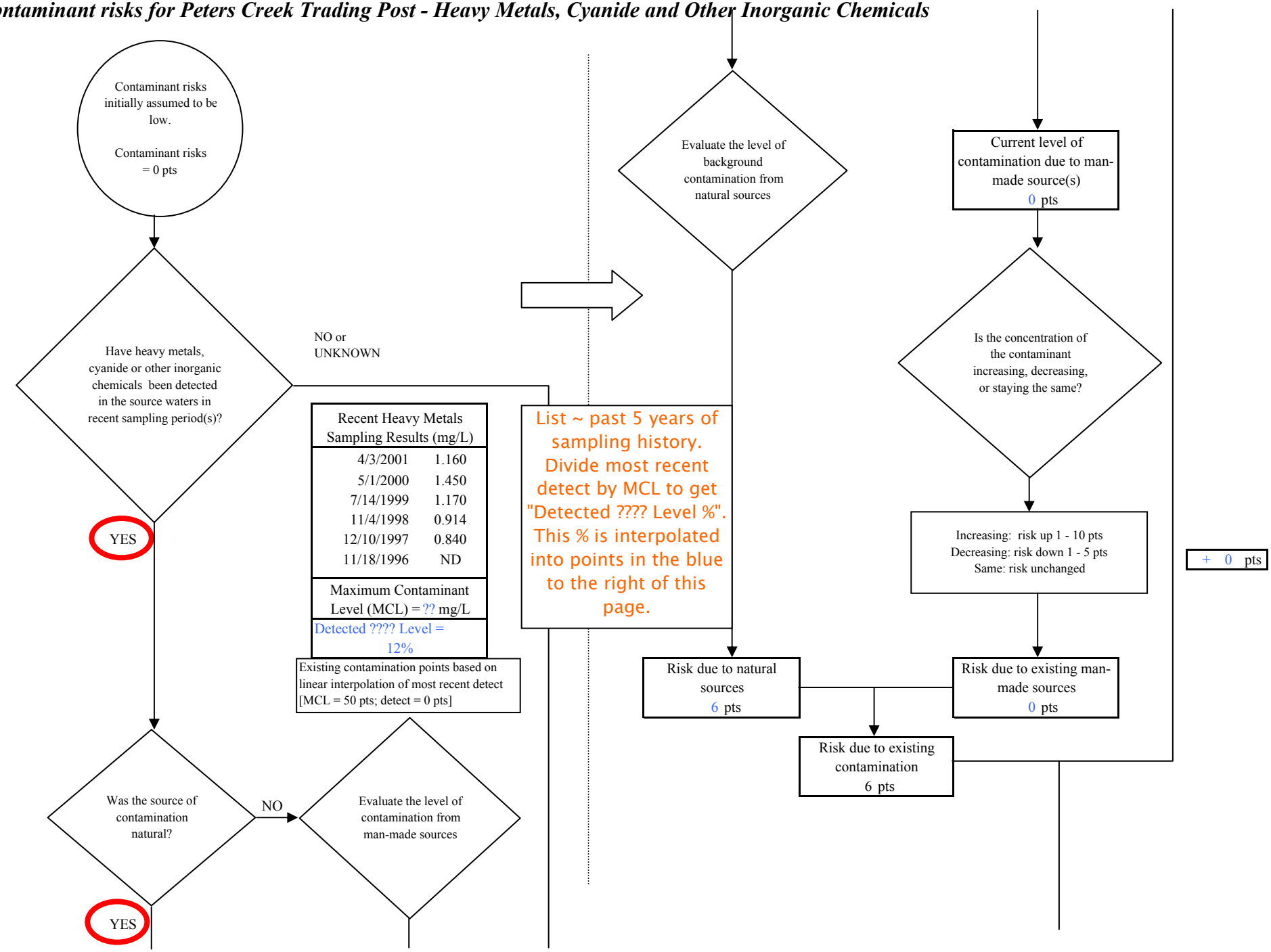
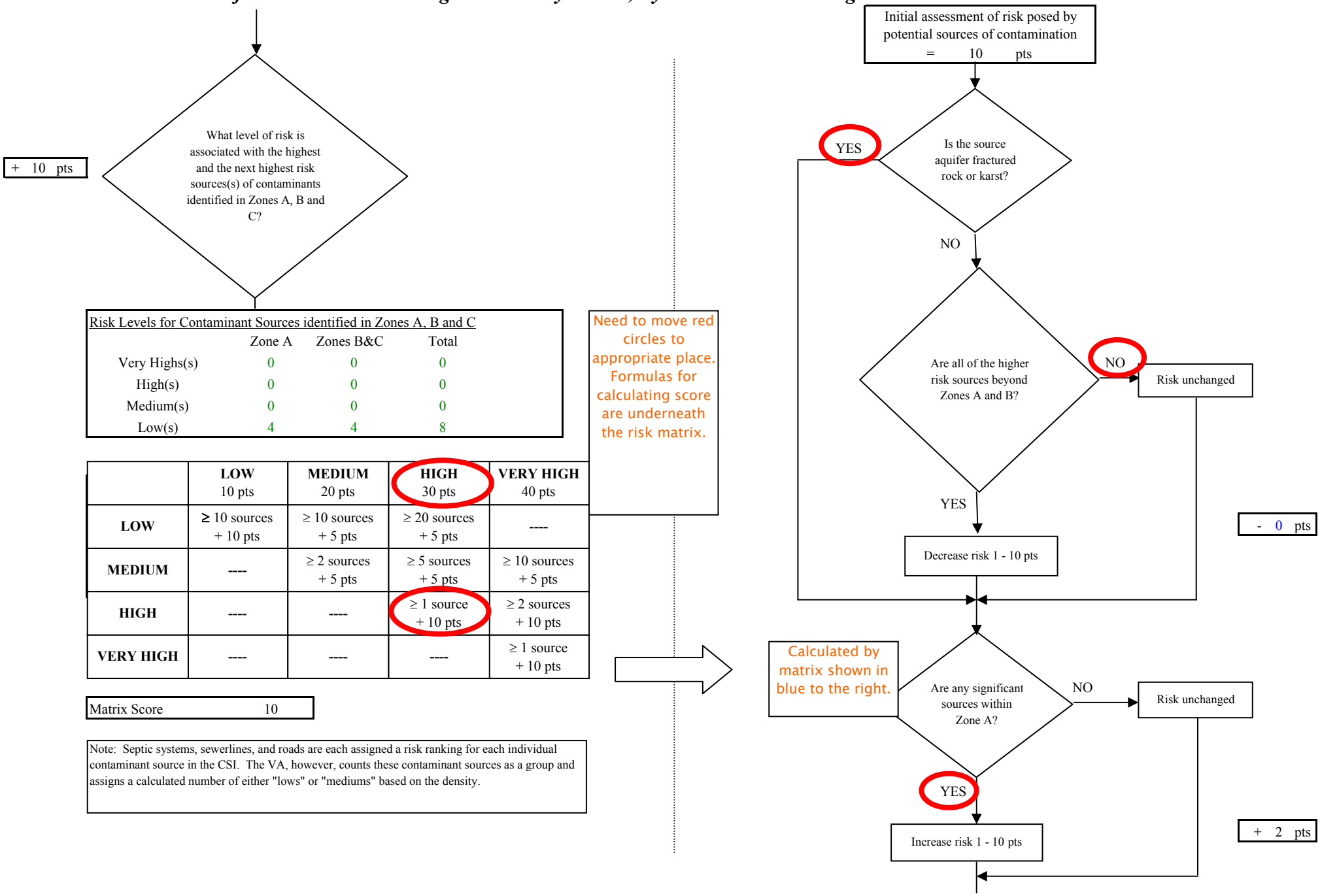


Chart 9. Contaminant risks for Peters Creek Trading Post - Heavy Metals, Cyanide and Other Inorganic Chemicals



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)	4	4	8

Need to move red circles to appropriate place. Formulas for calculating score are underneath the risk matrix.

	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 9. Contaminant risks for Peters Creek Trading Post - Heavy Metals, Cyanide and Other Inorganic Chemicals

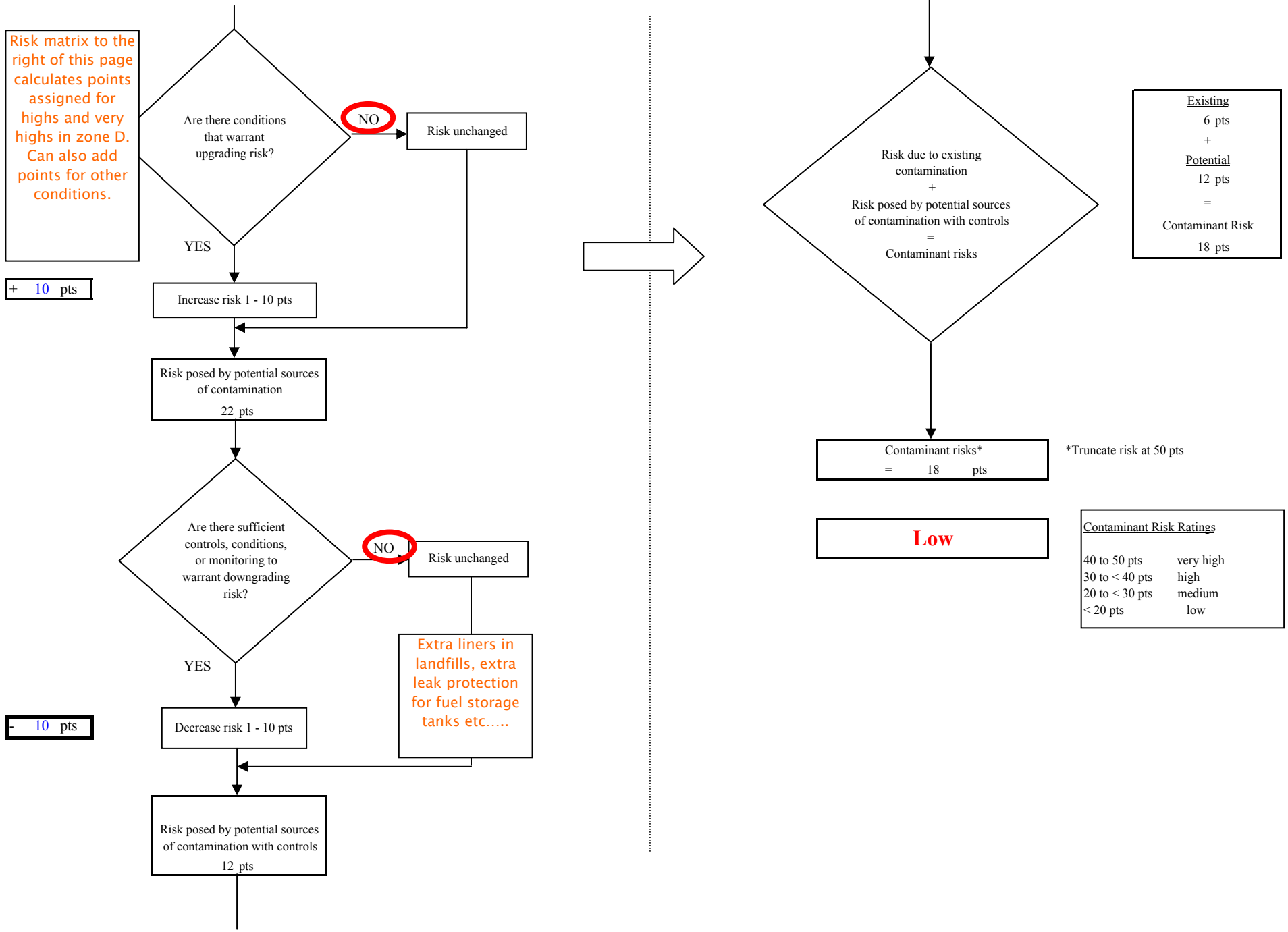


Chart 10. Vulnerability analysis for Peters Creek Trading Post - Heavy Metals, Cyanide and Other Inorganic Chemicals

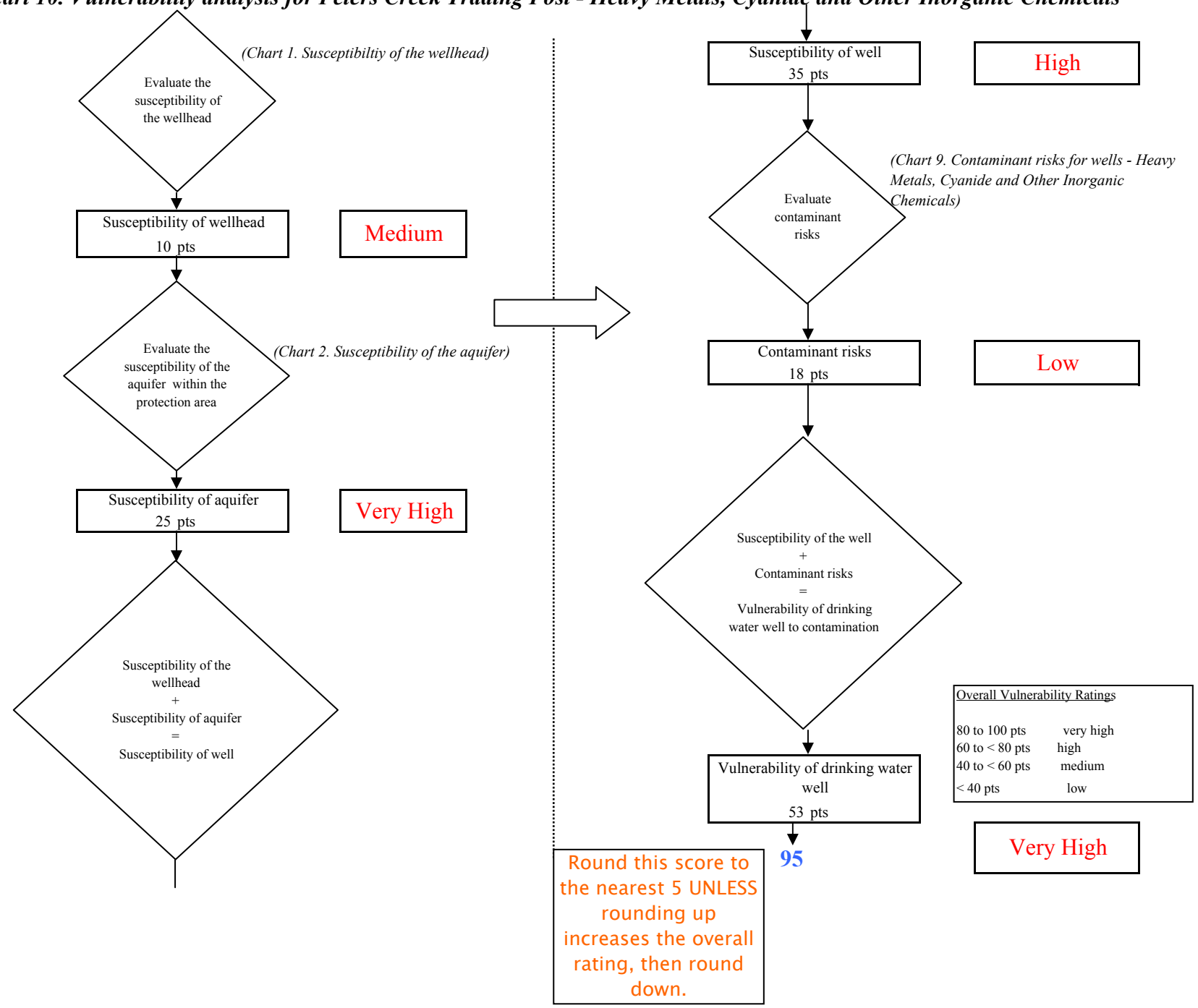


Chart 11. Contaminant risks for Peters Creek Trading Post - Synthetic Organic Chemicals

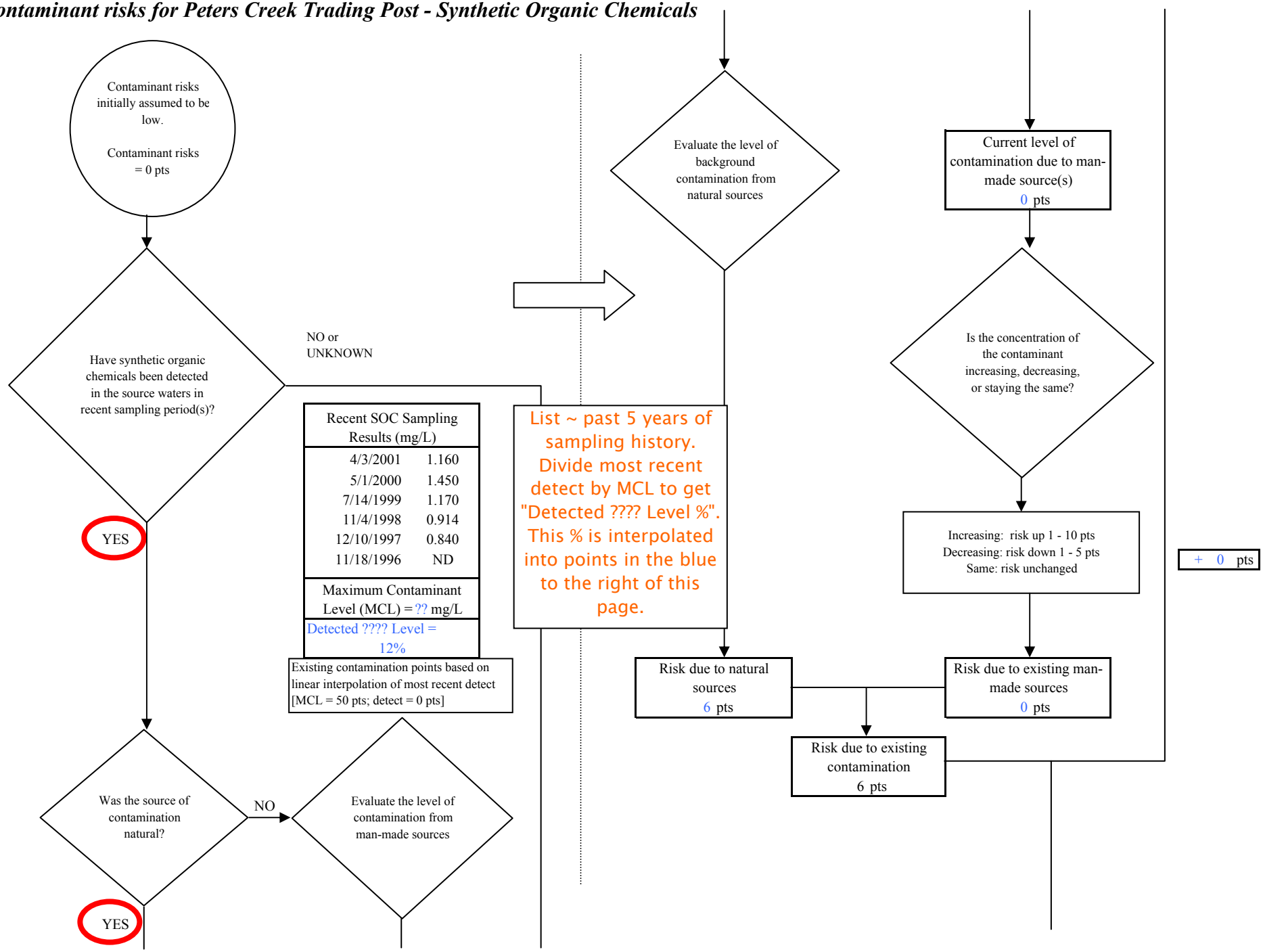
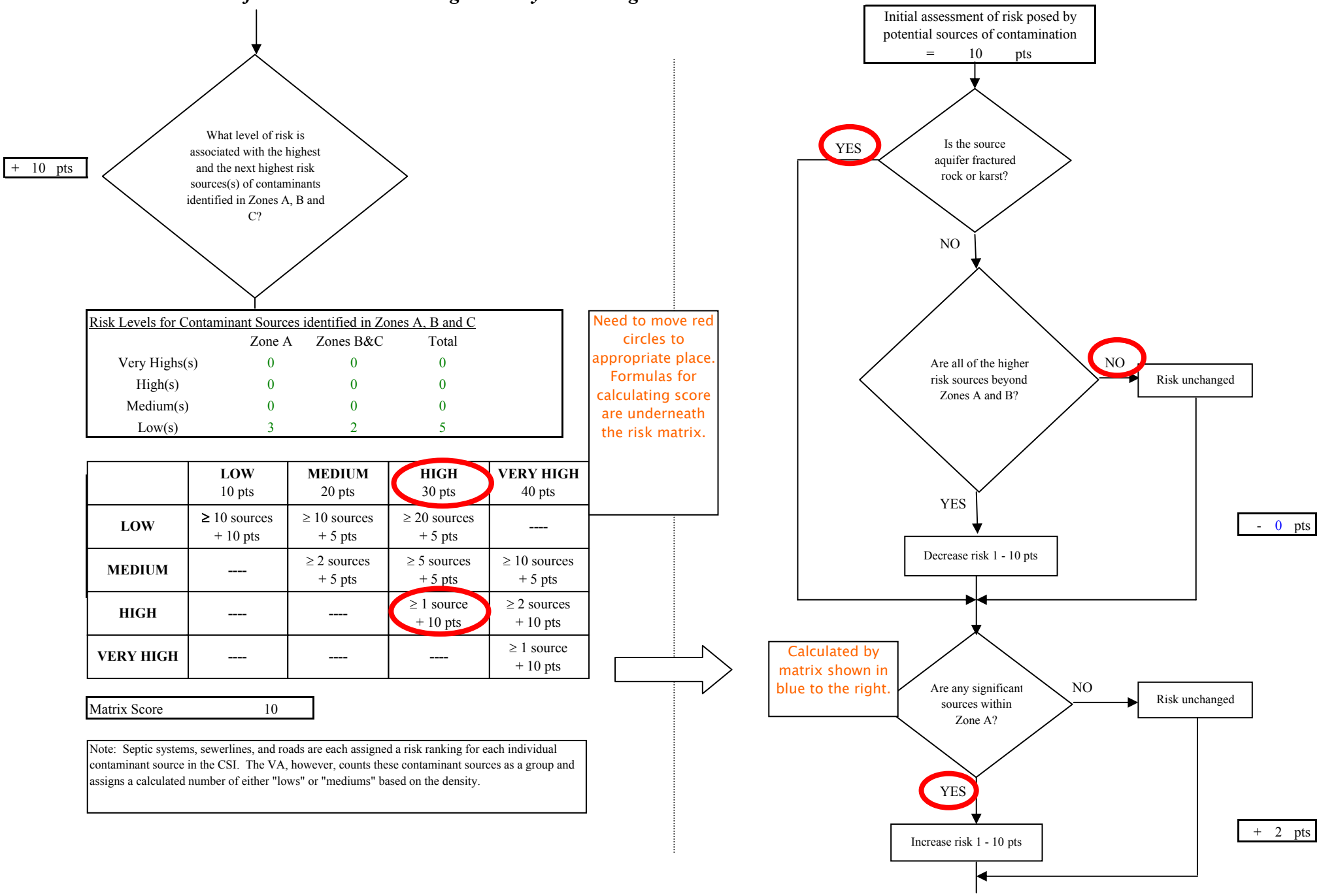


Chart 11. Contaminant risks for Peters Creek Trading Post - Synthetic Organic Chemicals



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)	3	2	5

Need to move red circles to appropriate place. Formulas for calculating score are underneath the risk matrix.

	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 11. Contaminant risks for Peters Creek Trading Post - Synthetic Organic Chemicals

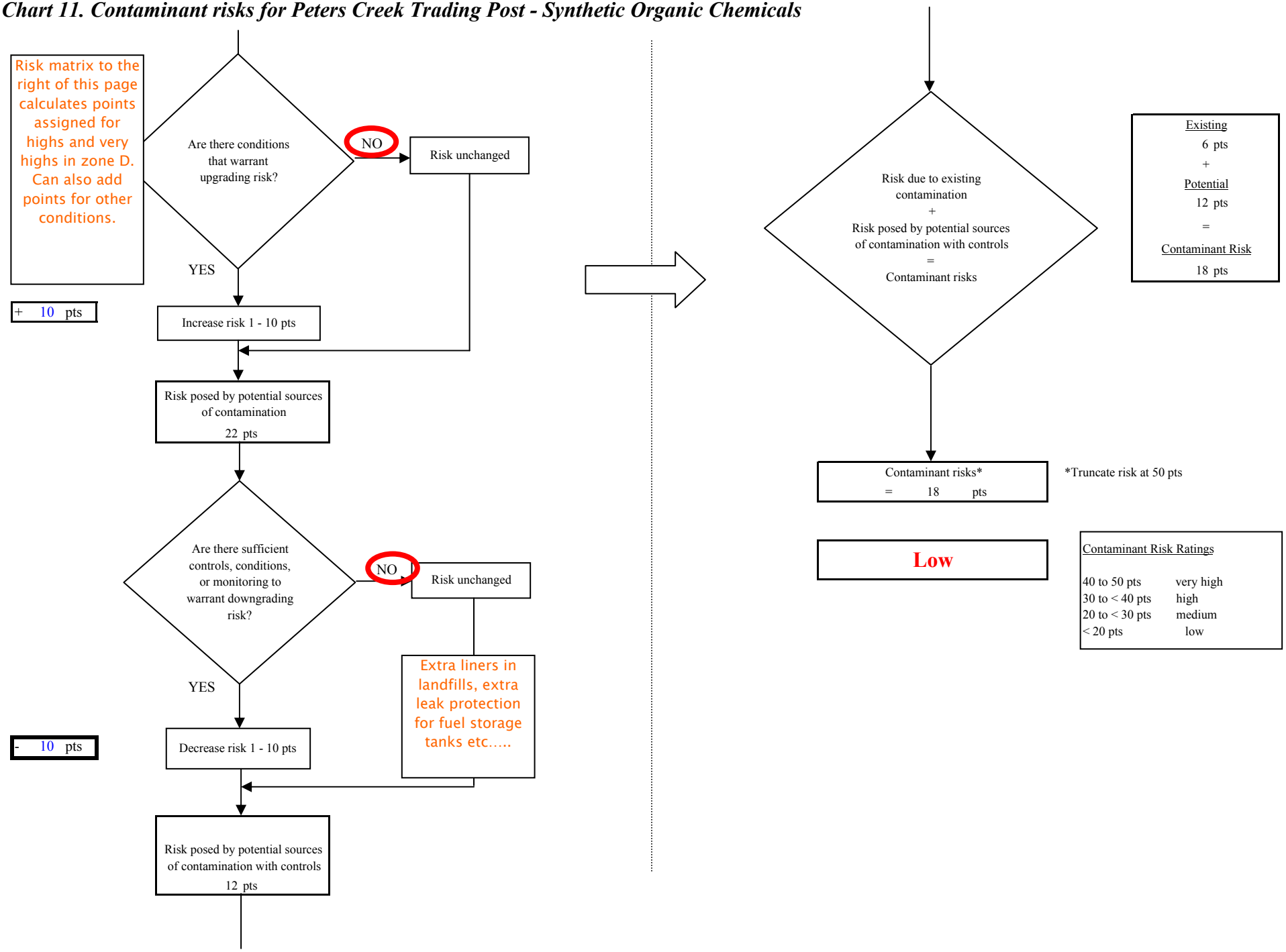


Chart 12. Vulnerability analysis for Peters Creek Trading Post - Synthetic Organic Chemicals

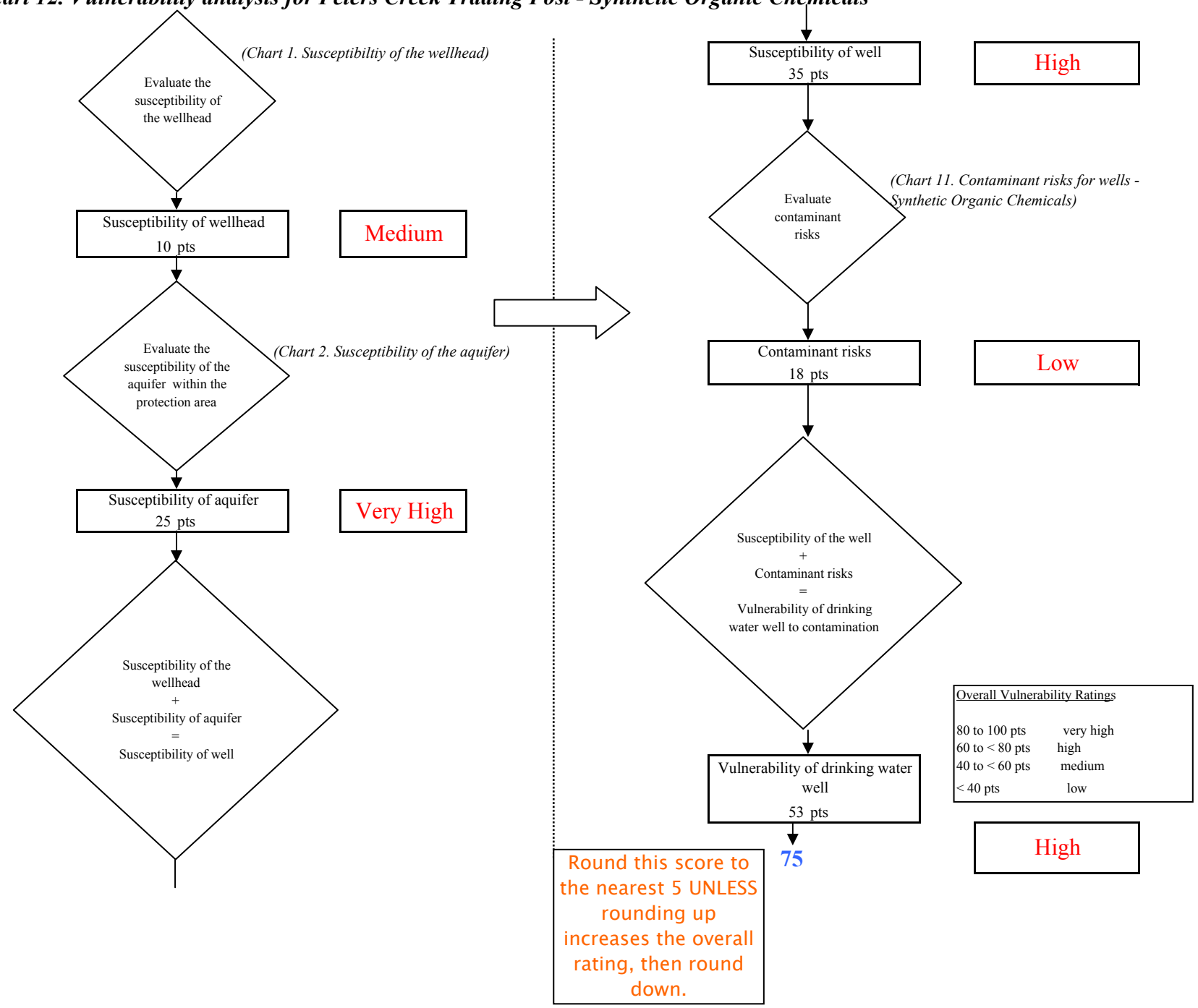


Chart 13. Contaminant risks for Peters Creek Trading Post - Other Organic Chemicals

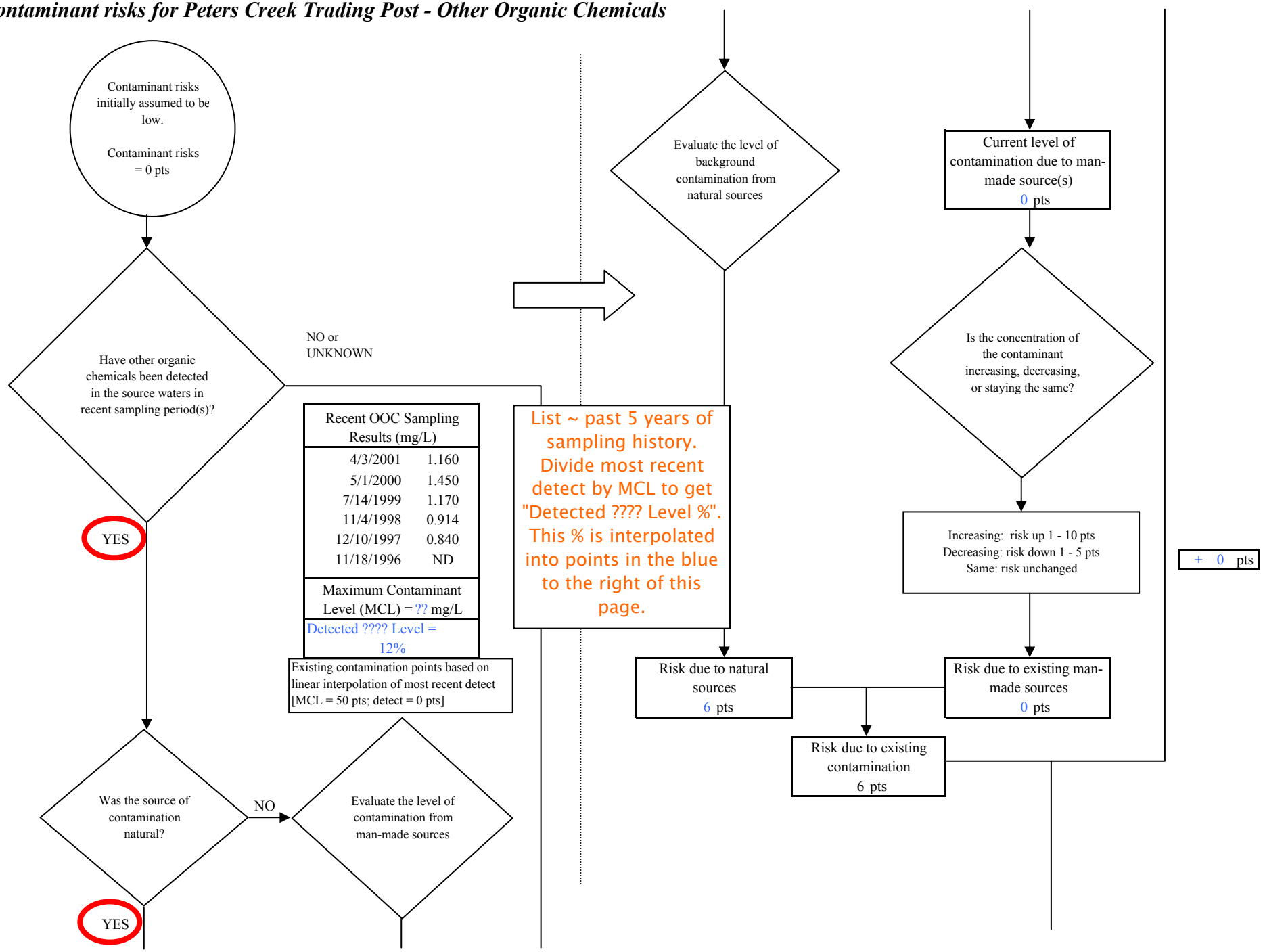
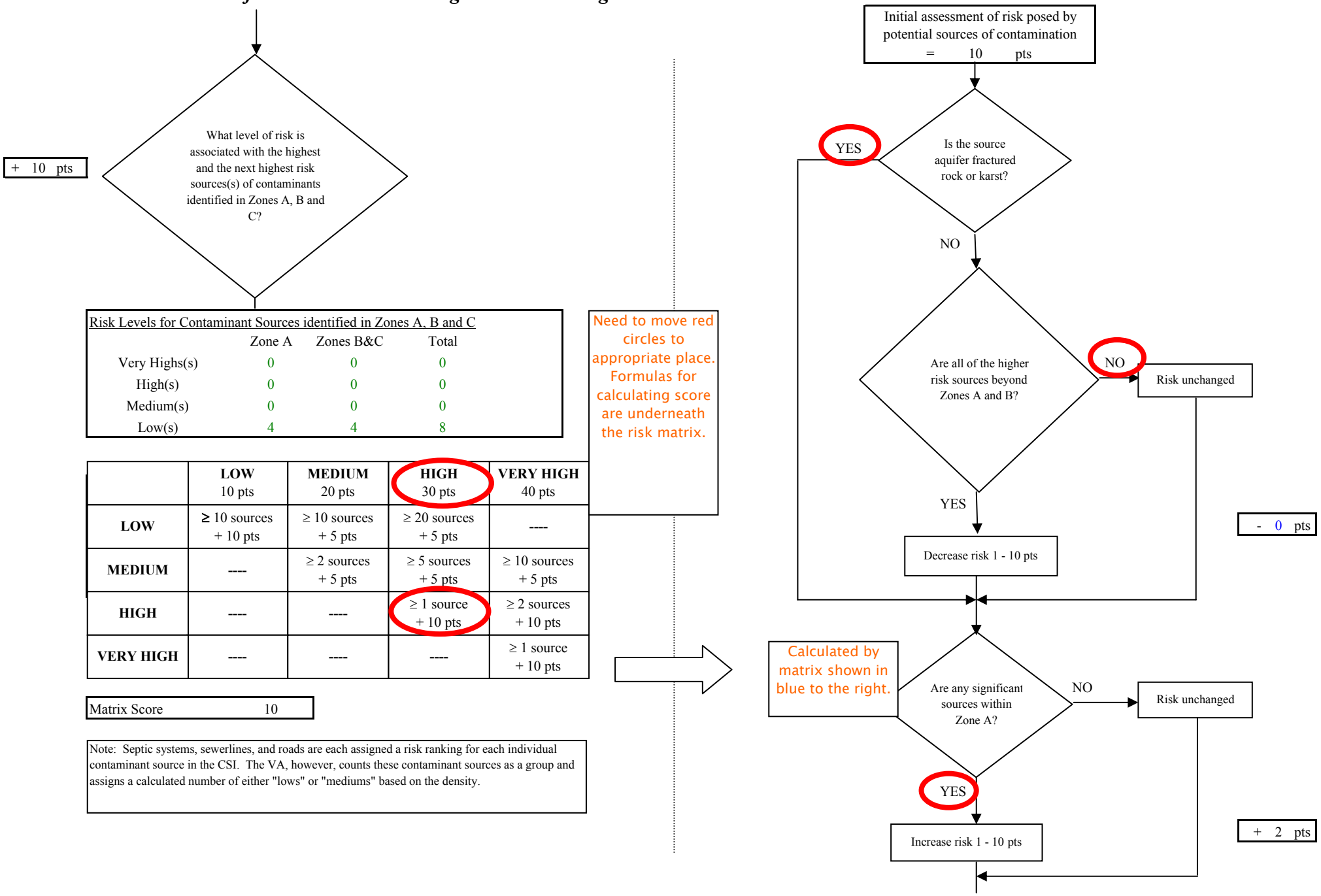


Chart 13. Contaminant risks for Peters Creek Trading Post - Other Organic Chemicals



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)	4	4	8

Need to move red circles to appropriate place. Formulas for calculating score are underneath the risk matrix.

	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 13. Contaminant risks for Peters Creek Trading Post - Other Organic Chemicals

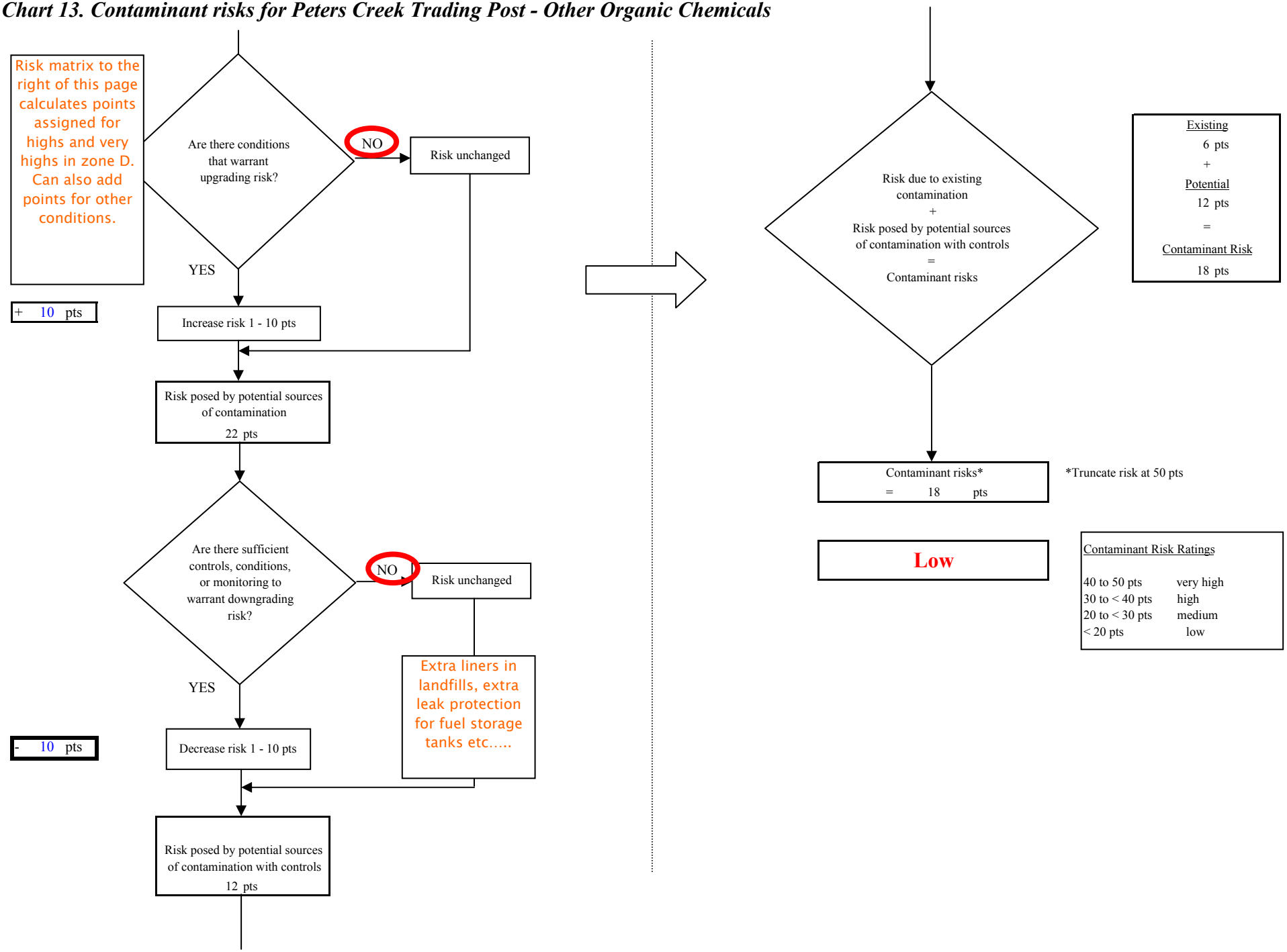


Chart 14. Vulnerability analysis for Peters Creek Trading Post - Other Organic Chemicals