Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Taku Glacier Lodge, Juneau, Alaska PWSID #110110

DRINKING WATER PROTECTION PROGRAM REPORT NO. 737

Alaska Department of Environmental Conservation

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Taku Glacier Lodge
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The Drinking Water Protection Program (DWPP) is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Source Water Assessment for Taku Glacier Lodge, Juneau, Alaska

Drinking Water Protection Program
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EXECUTIVE SUMMARY

The public water system for Taku Glacier Lodge is a Class B (transient/non-community) water system consisting of one well. The Taku Glacier Lodge is a remote lodge located approximately 30 miles north-northeast of Juneau, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Taku Glacier Lodge public drinking water source include: a large-capacity septic system, single-family septic systems; and other water supply wells. 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 Taku Glacier Lodge received a vulnerability rating of **High** for both bacteria and viruses and nitrates and nitrites, and **Medium** for volatile organic chemicals.

TAKU GLACIER LODGE PUBLIC DRINKING WATER SYSTEM

Taku Glacier Lodge public water system is a Class B (transient/non-community) water system. The system consists of one well on the east side of the Taku River (See Map 1 of Appendix A). Taku Glacier Lodge lies within the Tongass National Forest and the City and Borough of Juneau, Alaska (please see the inset of Map 1 in Appendix A for location). The population of the City and Borough of Juneau is approximately 30,000.

Glacial and alluvial forces have shaped the region surrounding Taku Glacier Lodge. Taku Glacier, to the northwest of Taku Glacier Lodge, is the largest, maritime, temperate glacier fed by the Juneau Icefield. The Juneau Icefield stretches over a 5,000 square mile area between Alaska and Canada and is a natural reservoir of snow and ice for over 40 glaciers.

Based on records for Juneau, the area averages about 92 inches of precipitation per year, and approximately 101 inches of snow. The groundwater aquifers underlying the area are recharged through the infiltration of precipitation and surface water. Groundwater aquifers in the region generally occur in the fractured bedrock and unconsolidated sediments deposited by glaciers and/or rivers.

The Taku Glacier Lodge area topography varies from near sea level along the Taku River to 3,271 feet at the mountain peak due east of the lodge.

According to a Sanitary Survey from August 5, 1998. the existing well was installed in 1989. The depth of the well is 28 feet below the ground surface, and is screened from 25 to 28 feet. The well reportedly consists of a driven 2-inch diameter sand point and casing and is completed in unconsolidated sand and sandy gravel.

The Sanitary Survey (8/05/98) for the water system indicates the land surface is appropriately sloped away from the well providing adequate surface water drainage. The well is 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 from May to September and serves approximately 100 non-residents through one service connection.

TAKU GLACIER LODGE 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. 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.

An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attribute 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*). Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DPWA (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

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

Table 1. Definition of Zones

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

The DWPA for Taku Glacier Lodge is limited by its immediate watershed, and includes only Zones A, B, and C. Because the upland groundwater system may include fractured bedrock, the TOT may be more rapid than predicted. For this reason, the zones related to TOT have been expanded at the upland base. Development in the vicinity of the well is limited to only Zone A (See Map 1 of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Taku Glacier Lodge DWPA. This inventory was completed through a search of agency records and other publicly-available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

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

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

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

The TOT for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well.

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

VULNERABILITY OF TAKU GLACIER LODGE DRINKING WATER SYSTEM

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

- Natural susceptibility; and
- Contaminant risks.

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well

and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
(Chart 2 of Appendix D)

=

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

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings

40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The well for the Taku Glacier Lodge is completed in an unconfined aquifer. Because unconfined aquifers are recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Susceptibility scores and ratings for Taku Glacier Lodge

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	24	Very High
Natural Susceptibility	29	Medium

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Contaminant Risk Ratings

40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	40	Very High
Nitrates and/or Nitrites	42	Very High
Volatile Organic Chemicals	12	Low

Finally, an overall vulnerability score is assigned for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings

80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

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

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	70	High
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	40	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with the large-capacity septic system and other septic systems located within Zone A representing the risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

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 the Taku Glacier Lodge. After combining the contaminant risks with the overall natural susceptibility of the well, the vulnerability of the well to contamination by bacteria and viruses is **High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High** with the large-capacity septic system and single-family septic systems representing the risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Sampling history for Taku Glacier Lodge well indicates that nitrates have been detected in the water, but only in very low concentrations (most recently at 0.15 mg/L on 5/15/2002) or 1.5% of the Maximum Contaminant Level (MCL). 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.

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

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Low** with the campground creating the only known risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

The drinking water at Taku Glacier Lodge has not recently been sampled for volatile organic chemicals. However, after combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination by volatile organic chemicals is **Medium**.

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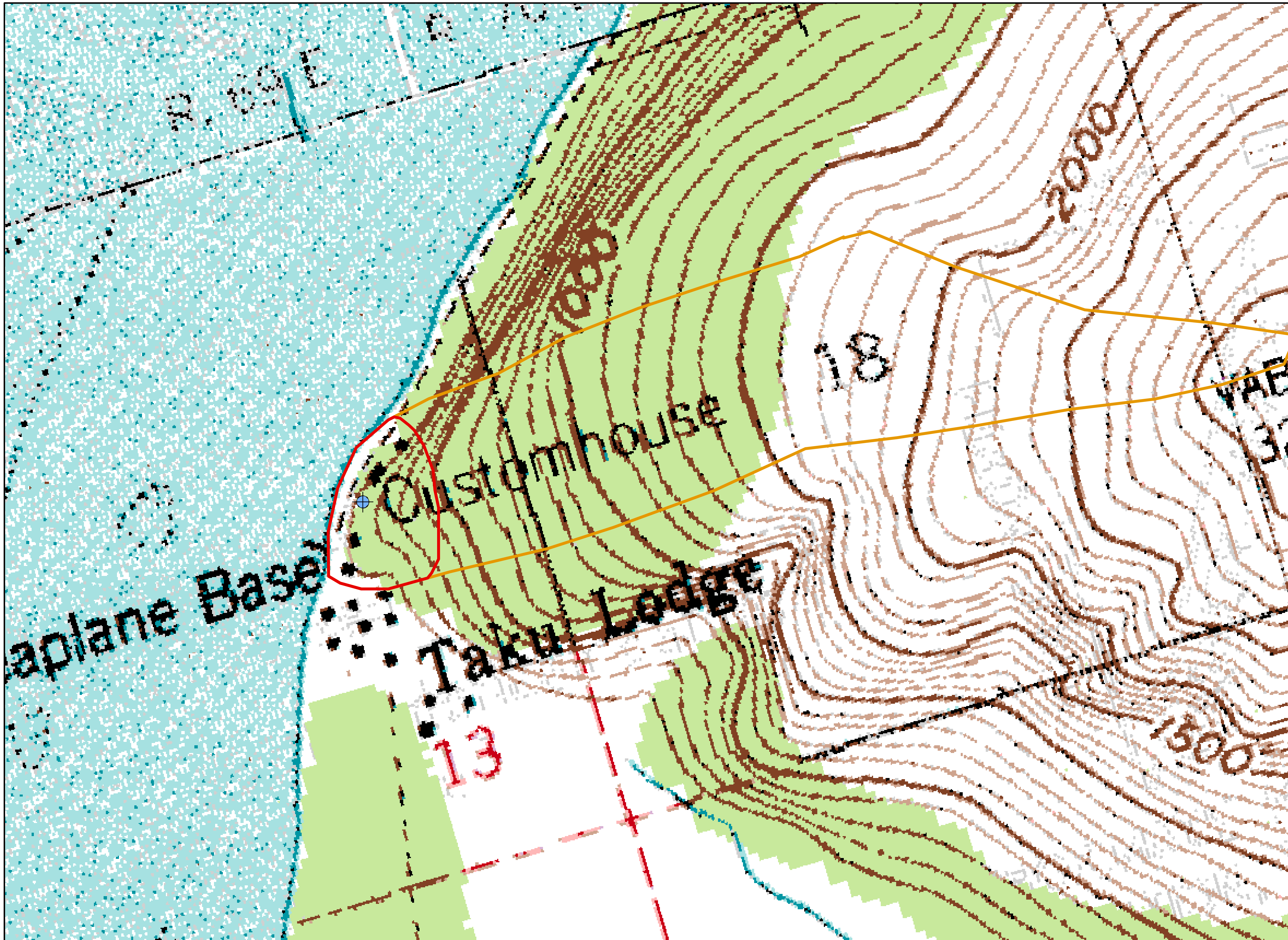
APPENDIX A

Taku Glacier Lodge
Drinking Water Protection Area Location Map
(Map 1)

Map 1: Taku Glacier Lodge Drinking Water Protection Areas

PWSID: 110110.001



Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 550 1,100 2,200 3,300 4,400 Feet

1:9,599

Data Sources:

Background image - USGS 1:63,000 mapping

Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.

Legend

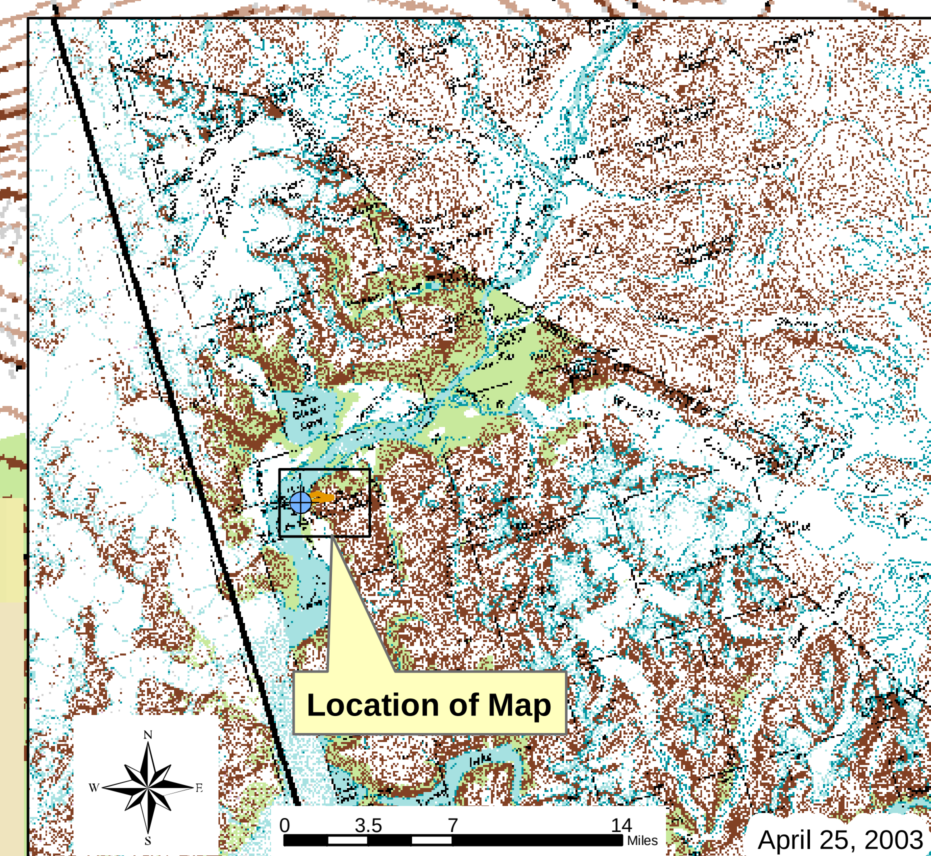
- Public Drinking Water Systems

Zone A Protection Area

- Several Months Travel Time

Zone B Protection Area

- Less than 2 Years Travel Time



April 25, 2003

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Taku Glacier Lodge (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 110110.001***

Taku Glacier Lodge

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	Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-1	A	2	Residence North of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-2	A	2	Residence South of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-3	A	2	Residence South of Taku Glacier Lodge
Water supply wells	W09	W09-1	A	2	Residence North of Taku Glacier Lodge
Water supply wells	W09	W09-2	A	2	Residence South of Taku Glacier Lodge
Water supply wells	W09	W09-3	A	2	Residence South of Taku Glacier Lodge

Contaminant Source Inventory and Risk Ranking for

Table 2 ***PWSID 110110.001***

Taku Glacier Lodge

Sources of Bacteria and Viruses

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	Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	Residence North of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Residence South of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-3	A	Low	2	Residence South of Taku Glacier Lodge

Contaminant Source Inventory and Risk Ranking for

Table 3 ***PWSID 110110.001***

Taku Glacier Lodge

Sources of Nitrates/Nitrites

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	Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	Residence North of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Residence South of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-3	A	Low	2	Residence South of Taku Glacier Lodge

Contaminant Source Inventory and Risk Ranking for

Table 4 ***PWSID 110110.001***

Taku Glacier Lodge

Sources of Volatile Organic Chemicals

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	Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	Residence North of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Residence South of Taku Glacier Lodge
Septic systems (serves one single-family home)	R02	R02-3	A	Low	2	Residence South of Taku Glacier Lodge

APPENDIX C

Taku Glacier Lodge
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

R02-1
W09-1
D10-1
R02-2
W09-2
R02-3
W09-3

Map 2: Drinking Water Protection Areas for Taku Glacier Lodge and Potential and Existing Sources of Contamination

PWSID: 110110.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 75 150 300 450 600 Feet

1:1,996

Data Sources:

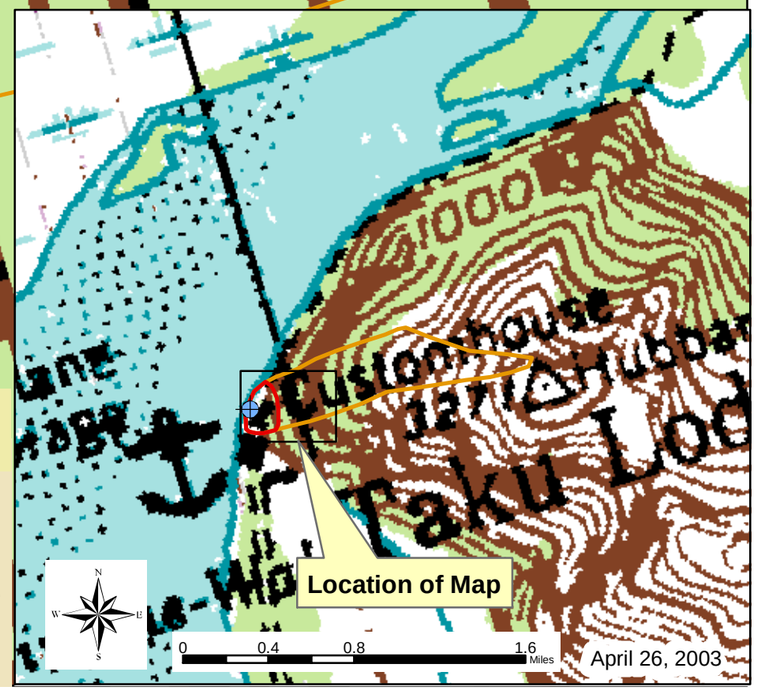
Background image - USGS 1:63,000 mapping

Legend

- Public Drinking Water Systems
- Large Capacity Septic System (D10)
- Single Family Septic System (R02)
- Private Water Supply Well (W09)

Zone A Protection Area
Several Months Travel Time

Zone B Protection Area
Less than 2 Years Travel Time



April 26, 2003

APPENDIX D

Vulnerability Analysis for Taku Glacier Lodge Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the wellhead - Taku Glacier Lodge

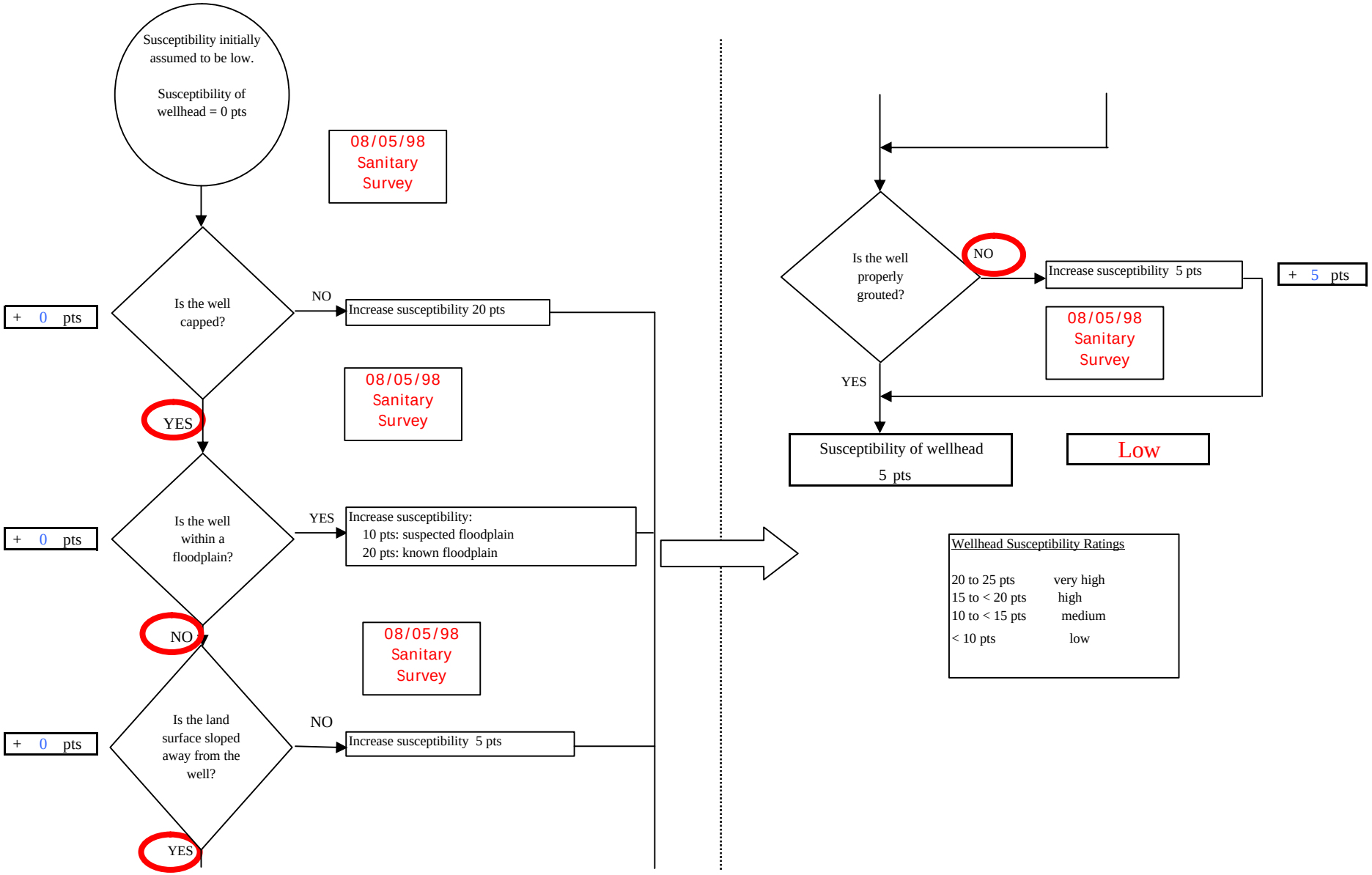


Chart 2. Susceptibility of the aquifer - Taku Glacier Lodge

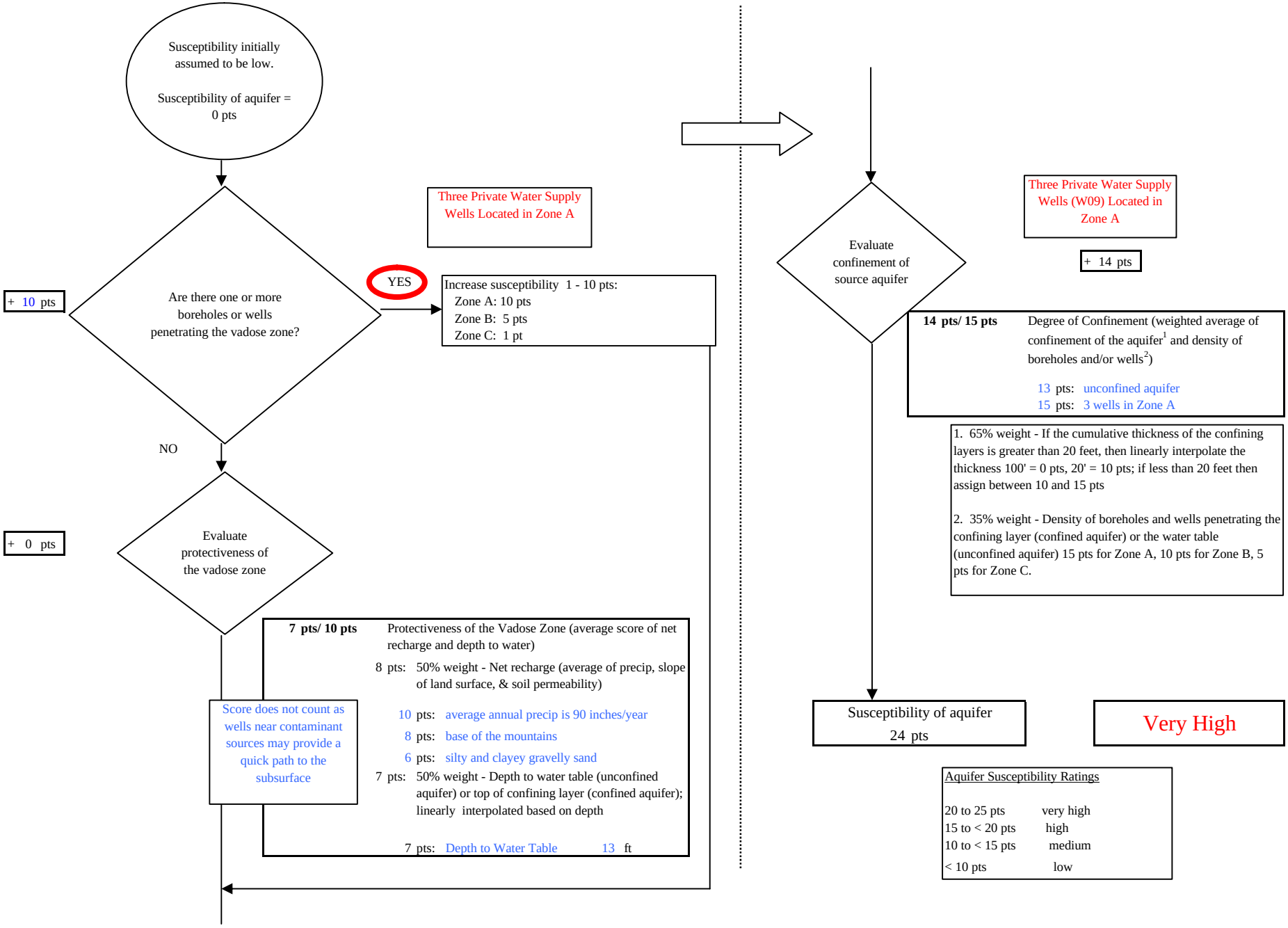
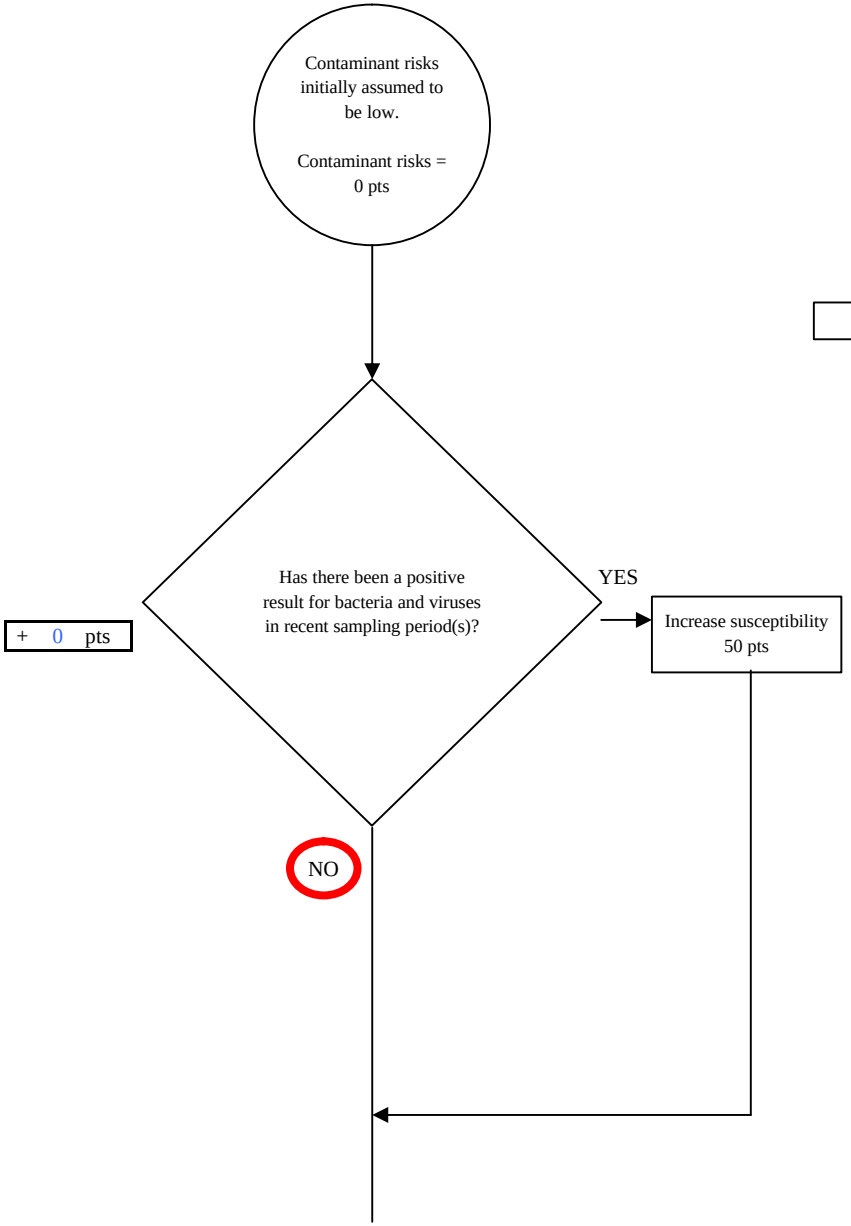
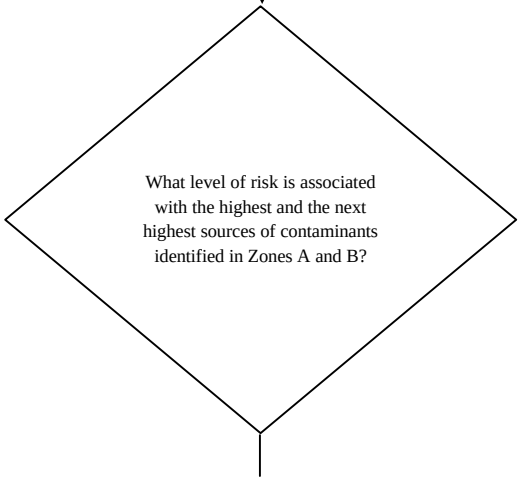


Chart 3. Contaminant risks for Taku Glacier Lodge - Bacteria & Viruses





+ 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)	3	0	3

	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 3. Contaminant risks for Taku Glacier Lodge - Bacteria & Viruses

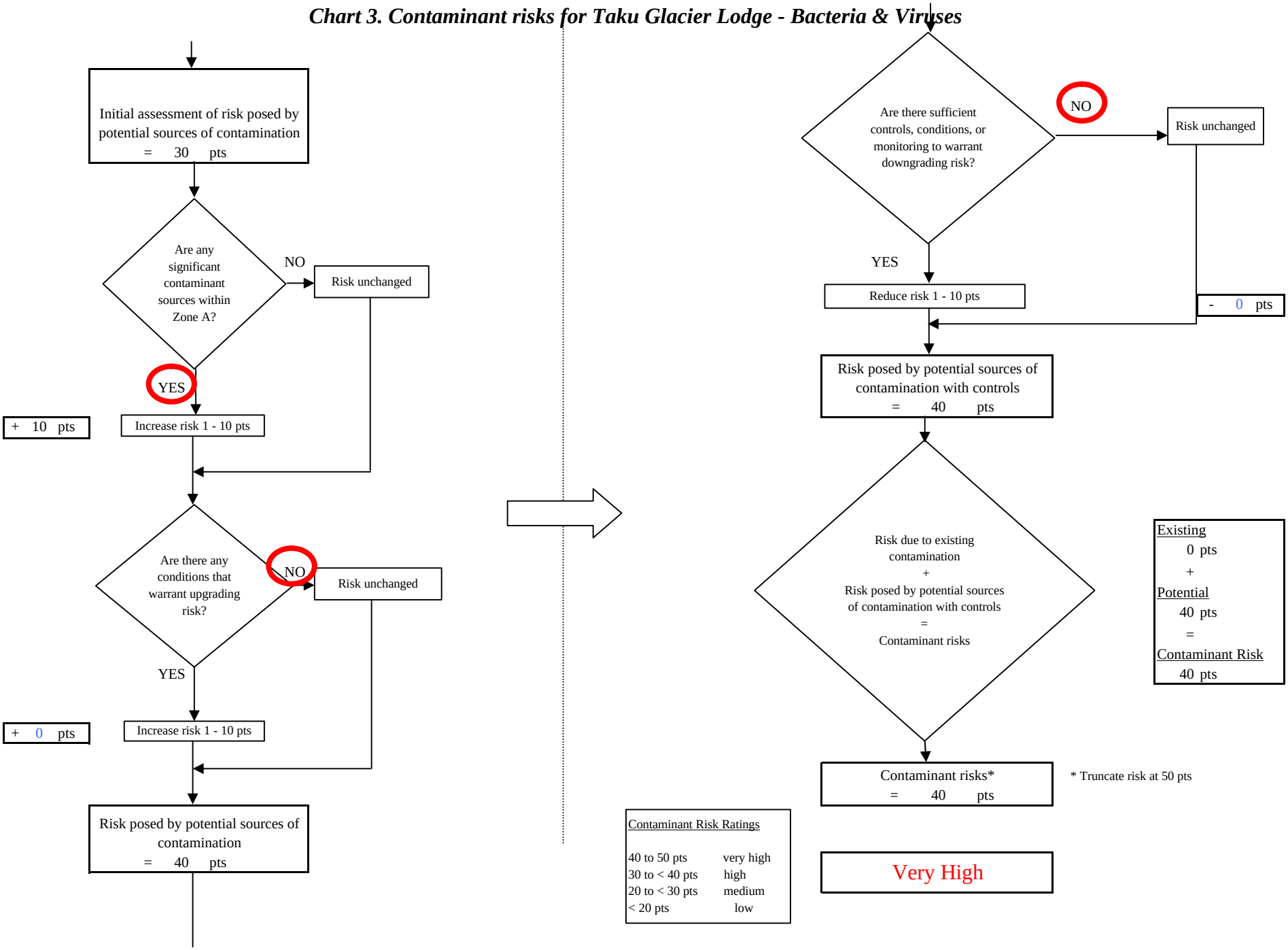


Chart 4. Vulnerability analysis for Taku Glacier Lodge - Bacteria & Viruses

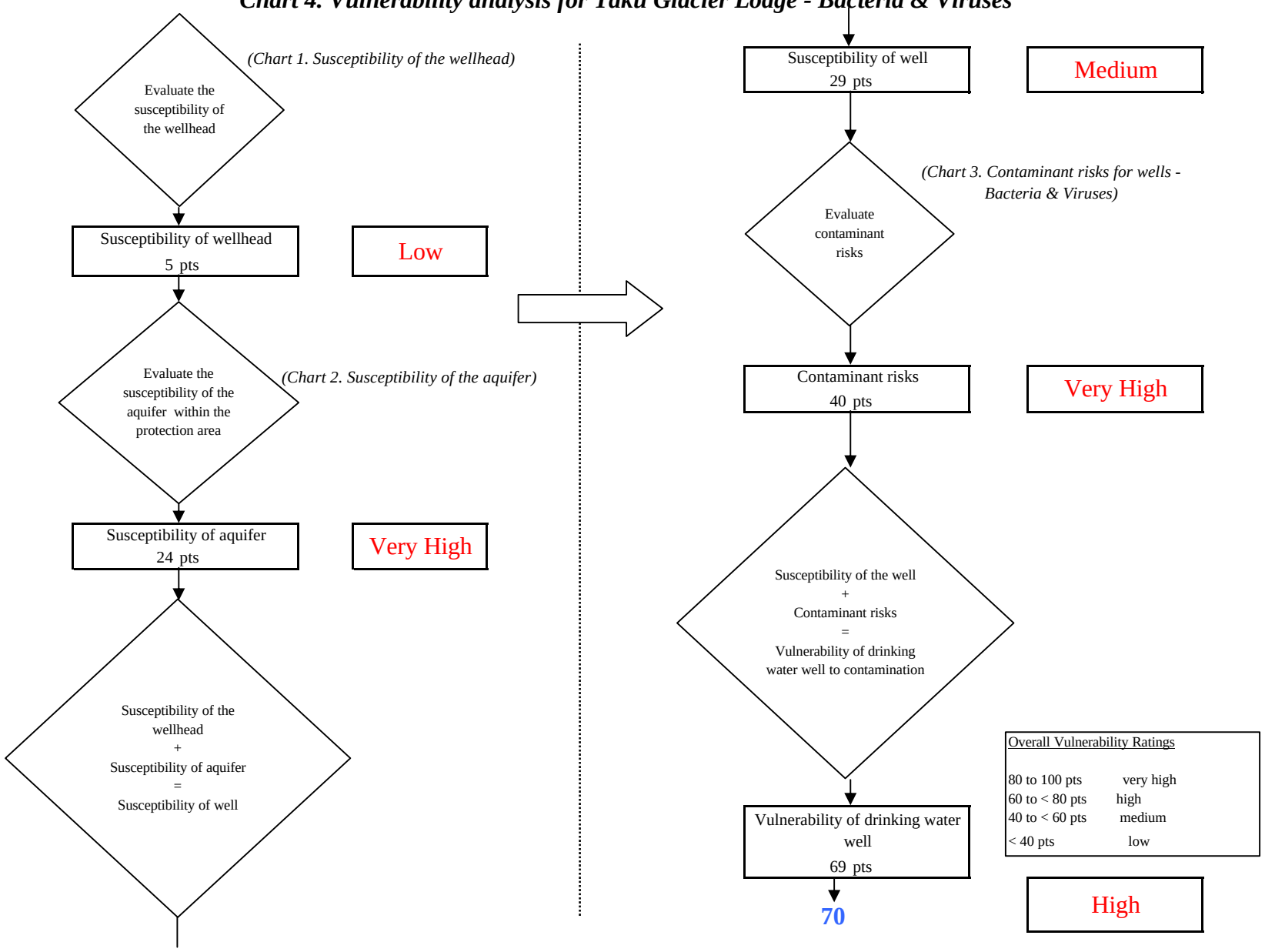


Chart 5. Contaminant risks for Taku Glacier Lodge - Nitrates and Nitrites

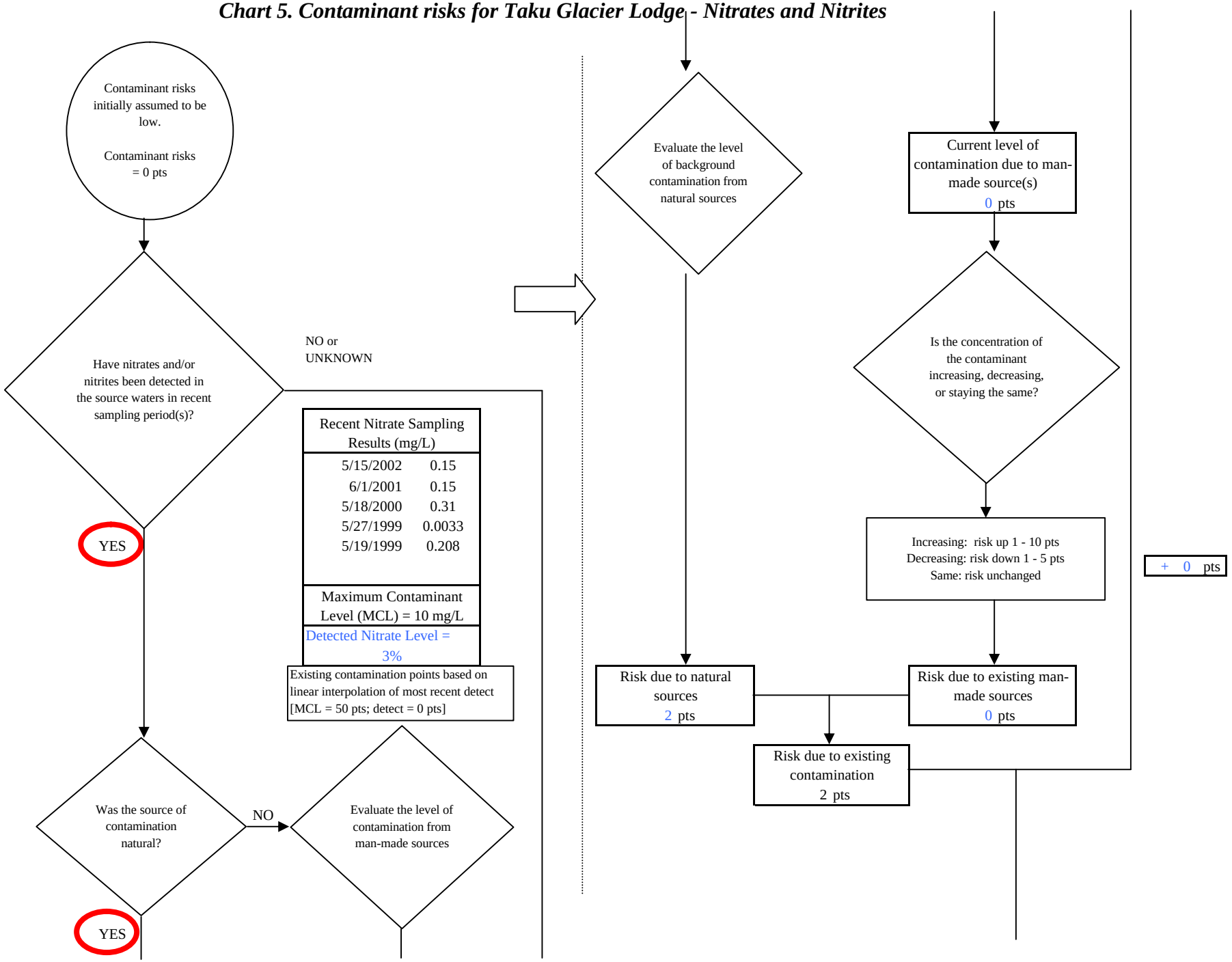


Chart 5. Contaminant risks for Taku Glacier Lodge - Nitrates and Nitrites

+ 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)	0	0	0
Low(s)	3	0	3

	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, sewerline, 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 = 30 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 Taku Glacier Lodge - Nitrates and Nitrites

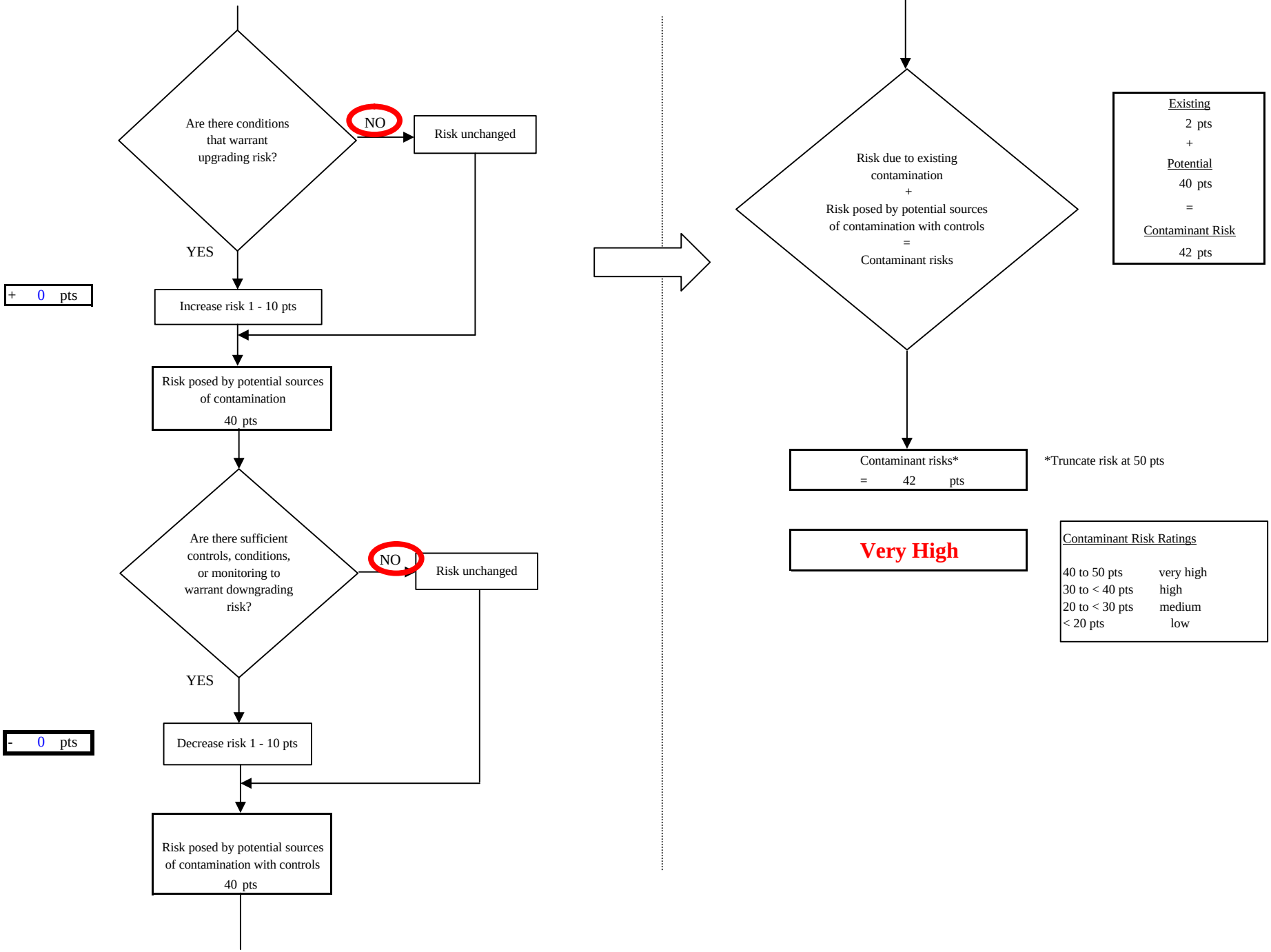


Chart 6. Vulnerability analysis for Taku Glacier Lodge - Nitrates and Nitrites

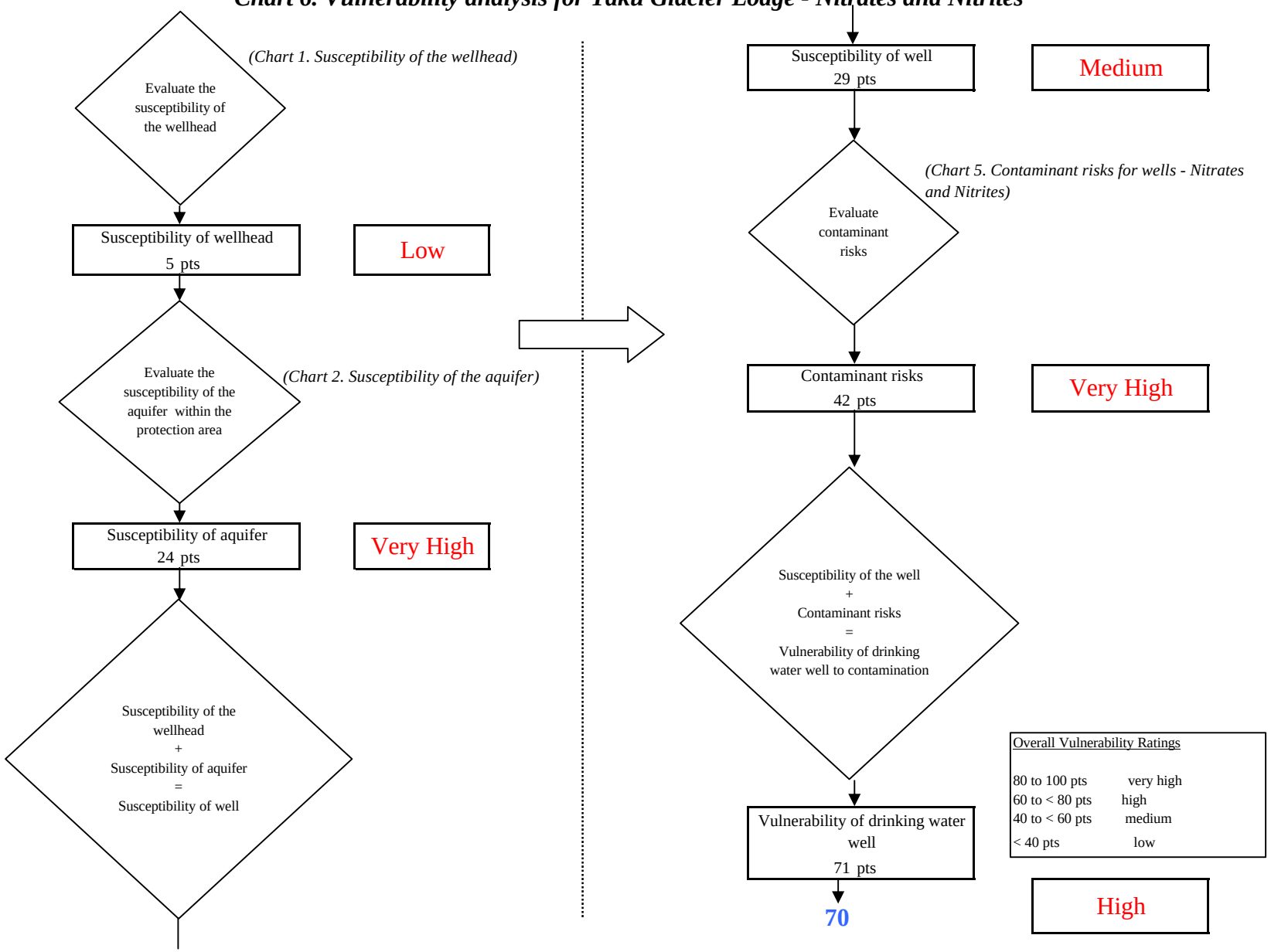


Chart 7. Contaminant risks for Taku Glacier Lodge - Volatile Organic Chemicals

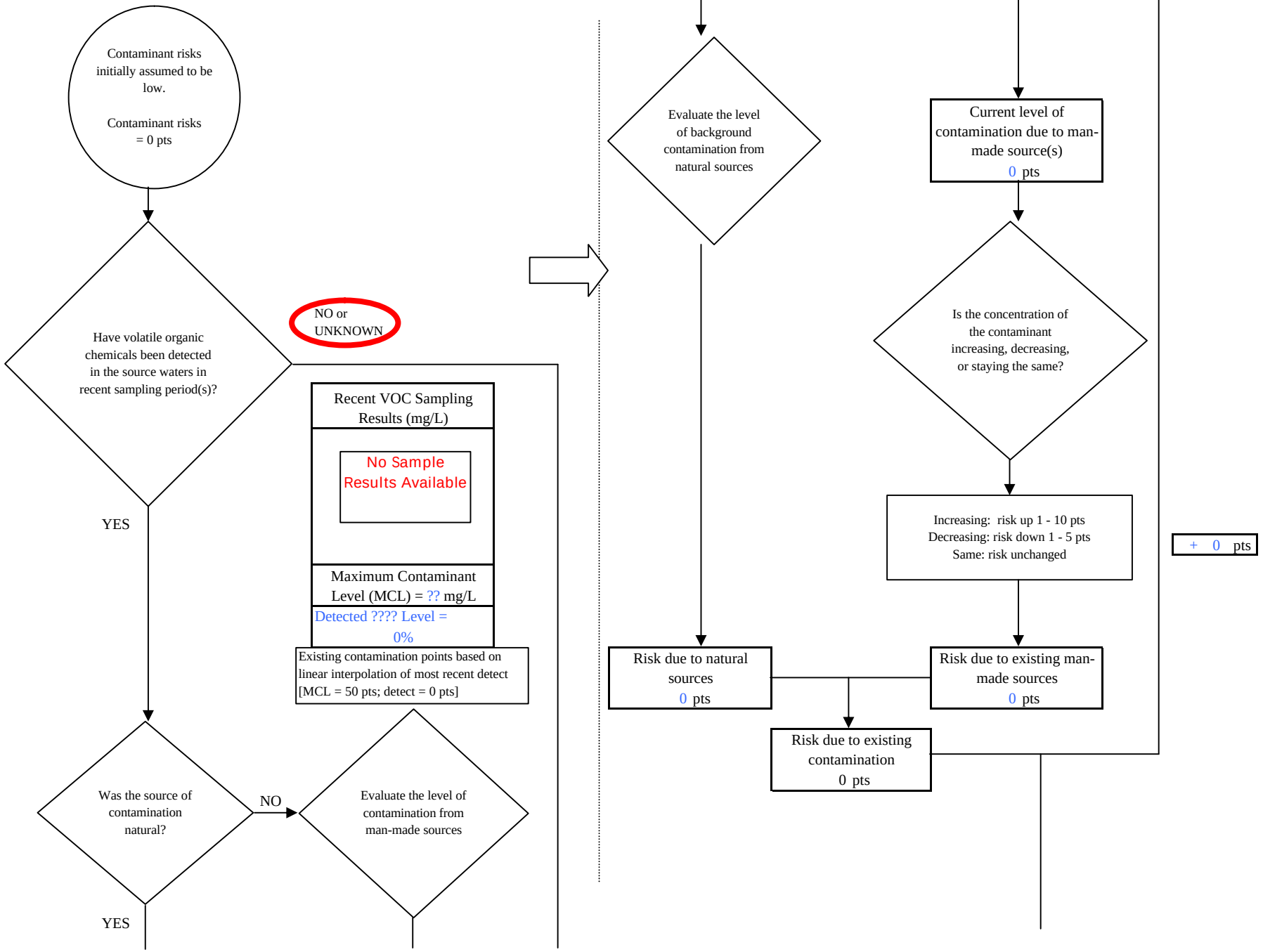


Chart 7. Contaminant risks for Taku Glacier Lodge - Volatile Organic Chemicals

+ 10 pts

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

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	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, sewerline, 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 = 10 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

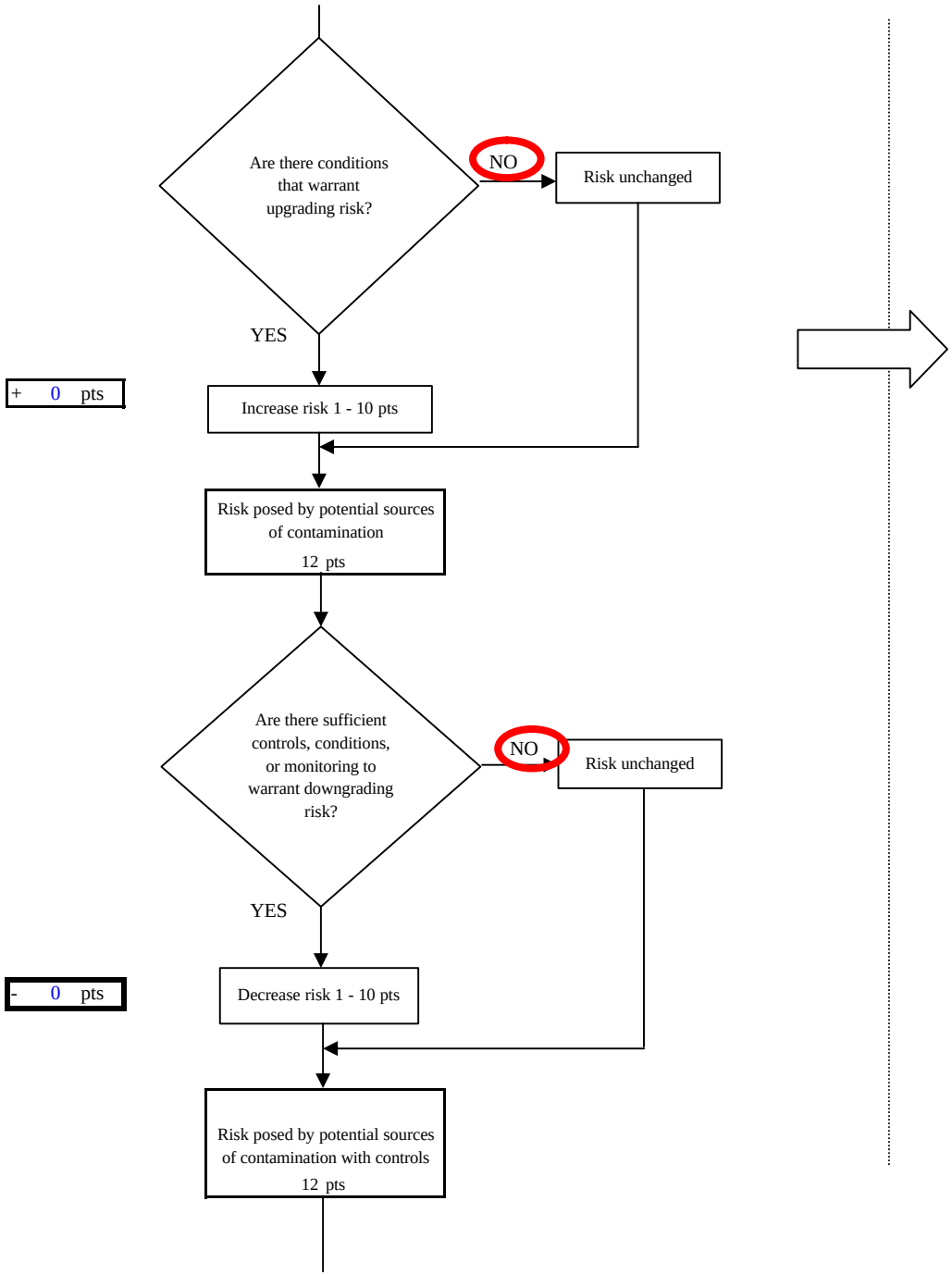
Risk unchanged

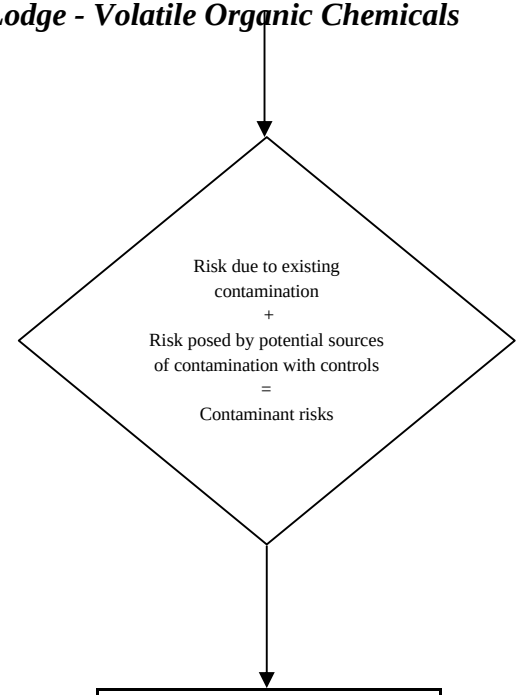
YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 7. Contaminant risks for Taku Glacier Lodge - Volatile Organic Chemicals





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

Contaminant risks*
= 12 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 Taku Glacier Lodge - Volatile Organic Chemicals