



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Ft. Wainwright Ski Lodge Drinking Water
System,
Fairbanks area, Alaska

PWSID 311087

September 2003

DRINKING WATER PROTECTION PROGRAM REPORT Report 1232
Alaska Department of Environmental Conservation

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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.

CONTENTS

	Page		Page
Executive Summary	1	Inventory of Potential and Existing Contaminant Sources	2
Ft. Wainwright Ski Lodge Public Drinking Water System	1	Ranking of Contaminant Risks	2
Ft. Wainwright Ski Lodge Protection Area	1	Vulnerability of Ft. Wainwright Ski Lodge Drinking Water System	2
		References	5

TABLES

TABLE	1. Definition of Zones	2
	2. Susceptibility	3
	3. Contaminant Risks	3
	3. Overall Vulnerability	3

APPENDICES

APPENDIX	A. Ft. Wainwright Ski Lodge Drinking Water Protection Area (Map 1)	
	B. Contaminant Source Inventory for Ft. Wainwright Ski Lodge (Table 1)	
	Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Ski Lodge – – Bacteria and Viruses (Table 2)	
	Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Ski Lodge – – Nitrates/Nitrites (Table 3)	
	Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Ski Lodge – – Volatile Organic Chemicals (Table 4)	
	C. Ft. Wainwright Ski Lodge Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)	
	D. Vulnerability Analysis for Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Ski Lodge Public Drinking Water Source (Charts 1 – 8)	

Source Water Assessment for Ft. Wainwright Ski Lodge Source of Public Drinking Water, Fairbanks Area, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the Ft. Wainwright Ski Lodge to potential contamination. This Class B (non-community) water system consists of one well Birch Hill Loop northeast of Fairbanks, Alaska. The well received a natural susceptibility rating of **Very High**. This rating is a combination of a susceptibility rating of **Very High** for the actual wellhead and a **High** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Ft. Wainwright Ski Lodge public water system include: a wastewater collection system, a fuel storage tank, and a road. These are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Combining the natural susceptibility of the well with the contaminant risk, the public water system for Ft. Wainwright Ski Lodge received an overall vulnerability rating of **High** for bacteria and viruses, and nitrates and/or nitrites; and a **Medium** for volatile organic chemicals.

FT. WAINWRIGHT SKI LODGE PUBLIC DRINKING WATER SYSTEM

Ft. Wainwright Ski Lodge public water system is a Class B (non-community) water system. The system consists one well Birch Hill Loop northeast of Fairbanks, Alaska (T1S, R1E, Section 5) (See Map 1 of Appendix A). Fairbanks is located in the Fairbanks North Star Borough which is near the center of Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include : College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

The majority of residents located in the area surrounding the city of Fairbanks use individual water wells or hauled water, and septic systems (ADCED, 2002). Heating oil (typically stored in both above and below ground 275 to 500-gallon tanks) is used for heating homes and buildings. Refuse is transported to the Fairbanks North Star Borough landfill.

The Fairbanks area includes two distinct topographic

areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north of this alluvial plain. The Ft. Wainwright Ski Lodge water system is located on the border of the uplands and the alluvial plain at an elevation of approximately 460 feet above sea level.

According to the well log for this well, the depth of the well is 260 feet below the ground surface. Other wells in the area at this depth are screened in bedrock and it is assumed that this one is also. Bedrock in this area is predominantly a metamorphosed marine mud deposit, called a pelitic schist. The schist is locally intruded by granitic rocks – granite and quartz diorite. Groundwater in the bedrock is principally contained in fractures. The water wells in this area with the greatest well recharge appear to be in quartz veins, quartzite, and siliceous schist (Nelson, 1978).

Groundwater in the uplands is recharged by local precipitation. Outflow of ground water in the uplands primarily occurs two ways. In areas under artesian pressure (pressure caused by overlying permafrost), water can flow to the surface through thawed conduits within the permafrost. Otherwise groundwater will flow under the permafrost (if present) and out to the groundwater beneath the adjacent flood plain or creek valley (Nelson, 1978). Areas with discontinuous permafrost may locally affect the ground water flow directions.

FT. WAINWRIGHT SKI LODGE DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. 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 capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

An outline of the immediate watershed was used to determine the size and shape of the protection area for the Ft. Wainwright Ski Lodge. Available geology was also considered to take into account any uncertainties in

groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

Because of uncertainties and changing site conditions, a factor of safety is added to the groundwater capture zone to form the drinking water protection area for the well.

The protection areas established for wells are usually separated into four zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety). Because the rate at which water travels through fractured bedrock is unknown but usually relatively fast, the protection area for the Ft. Wainwright Ski Lodge consists only of Zone A.

The following is a summary of the four 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 2 years time-of-travel
C	Less than 5 years time-of-travel
D	Less than 10 years time-of-travel

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Ft. Wainwright Ski Lodge on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program (DWPP) has completed an inventory of potential and existing sources of contamination within the Ft. Wainwright Ski Lodge protection area. This inventory was completed through a search of agency records and other publicly available information. 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 each 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 combination of toxicity and volume associated with that source. Rankings include:

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

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

VULNERABILITY OF FT. WAINWRIGHT SKI 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 properties of the aquifer and the presence of other wells or boreholes in the area. 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 the water system’s contaminant sample results. Lastly, Chart 4 combines the results of the first three charts to produce 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 wellhead for the Ft. Wainwright Ski Lodge received a Very High Susceptibility rating. The 12/22/98 Sanitary Survey indicated the well is not capped with a sanitary seal, the well site is not adequately drained, and the well is not grouted. A sanitary seal prevents potential contaminant from entering the well while grouting helps to prevent potential contaminants from traveling down the outside of the well casing.

The aquifer in the area the Ft. Wainwright Ski Lodge well is completed in received a High Susceptibility rating. The fractured bedrock can allow contaminants to travel at a fast rate downward from the surface with the precipitation and surface water runoff. Table 2 summarizes the Susceptibility scores and ratings for Ft. Wainwright Ski Lodge.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	19	High
Natural Susceptibility	44	Very High

The Contaminant Risk has been derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources. 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	25	Medium
Nitrates and/or Nitrites	25	Medium
Volatile Organic Chemicals	10	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	55	Medium

Bacteria and Viruses

The wastewater holding tank in the protection area represents the greatest risk to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coli forms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coli forms and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Routine sampling has not detected coli forms in the water.

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 and Nitrites

The wastewater holding tank in the protection area also represents the greatest risk to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have not been detected in significant levels in recent sampling history for the Ft. Wainwright Ski Lodge well.

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 high.

Volatile Organic Chemicals

The heating oil tank represents the greatest risk for volatile organic chemical contamination to the well.

Both underground and above ground heating oil storage tanks are the standard way of heating homes and businesses in the area surrounding Fairbanks. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Regular system maintenance can help prevent many of these harmful fuel leaks.

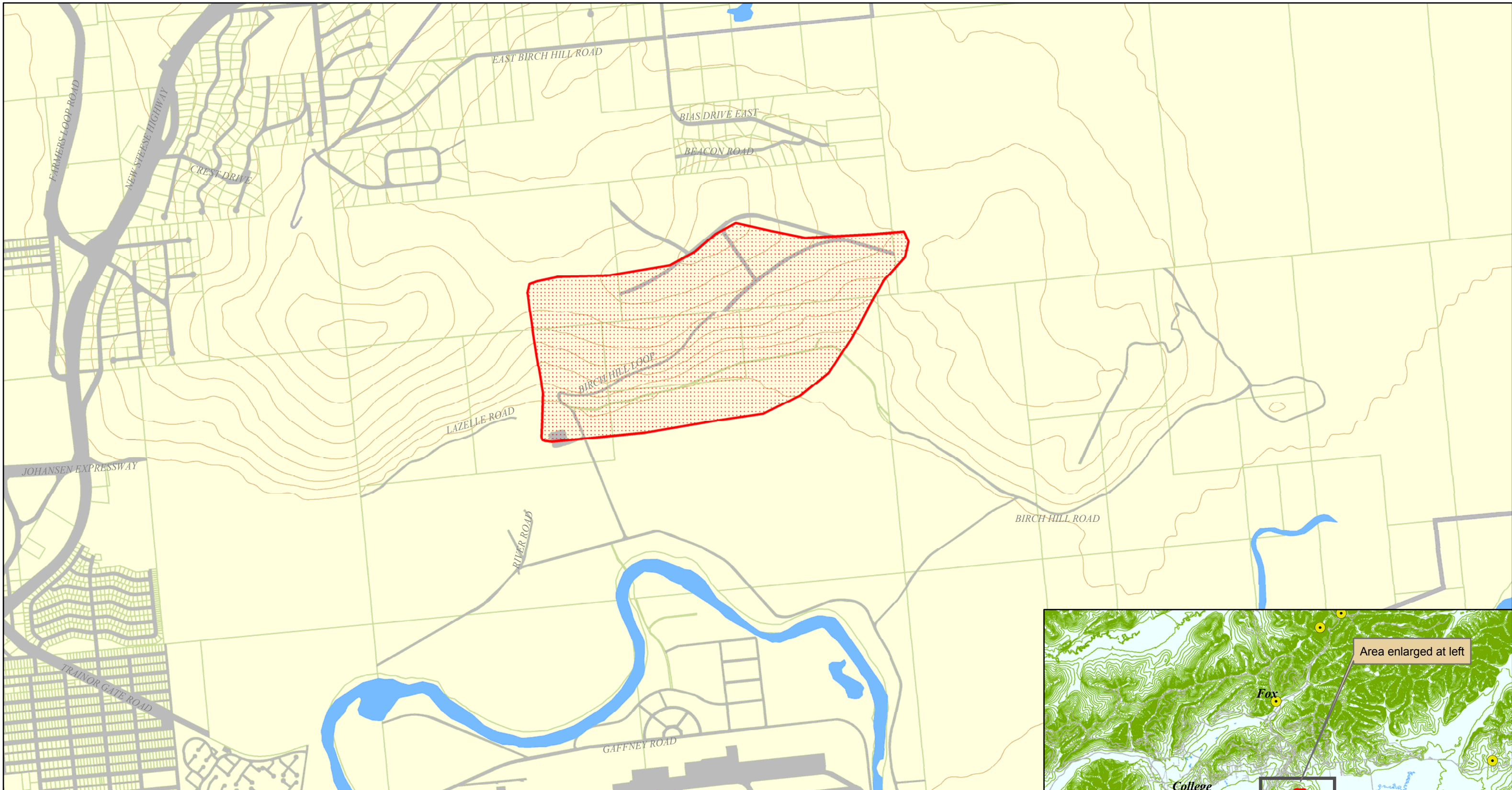
Volatile Organic Chemicals are routinely sampled for but have not been detected in significant quantities (<1% of the Maximum Contaminant Level) in the Ft. Wainwright Ski Lodge public water system. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

REFERENCES

- Alaska Department of Community and Economic Development (ADCED), 2002 [WWW document]. URL http://www.dced.state.ak.us/mra/CF_BLOCK.cfm.
- Anderson, G.S., 1970, Hydrologic reconnaissance of the Tanana basin, central Alaska: U.S. Geological Survey Hydrologic Investigations Atlas HA-319.
- Forbes, R.B. and Weber, F.R., 1981. Bedrock Geologic Map of the Fairbanks Mining District, Alaska. Funded by the State of Alaska, US Geological Survey, and The National Science Foundation.
- Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.
- Glass, Roy L., Lilly, Micheal R., and Meyer, David F., 1996. Ground-Water Levels in an Alluvial Plain Between the Tanana and Chena Rivers Near Fairbanks, Alaska 1986-93. US Geological Survey Water Resources Investigations Report 96-4060, 39p.
- Nakanishi, Allan S. and Lilly, Micheal R., 1998. Estimate of Aquifer Properties by Numerically Simulating Ground-Water/Surface-Water Interactions, Fort Wainwright, Alaska. US Geological Survey Water Resources Investigations Report 98-4088, 27p.
- Nelson, Gordon L., 1978, Hydrologic Information for Land-Use Planning, Fairbanks Vicinity, Alaska. US Department of the Interior Geological Survey Open File Report 78-959, 47p.
- Pewe, T. L., 1958, Geologic map of the Fairbanks D-2 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-110, scale 1:63,360.
- United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL <http://www.epa.gov/safewater/mcl.html>.

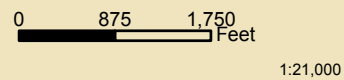
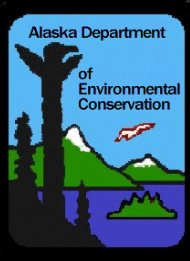
APPENDIX A

Ft. Wainwright Ski Lodge Drinking Water Protection Area Location Map (Map 1)



Map 1: Drinking Water Protection Area

PWSID: 311087

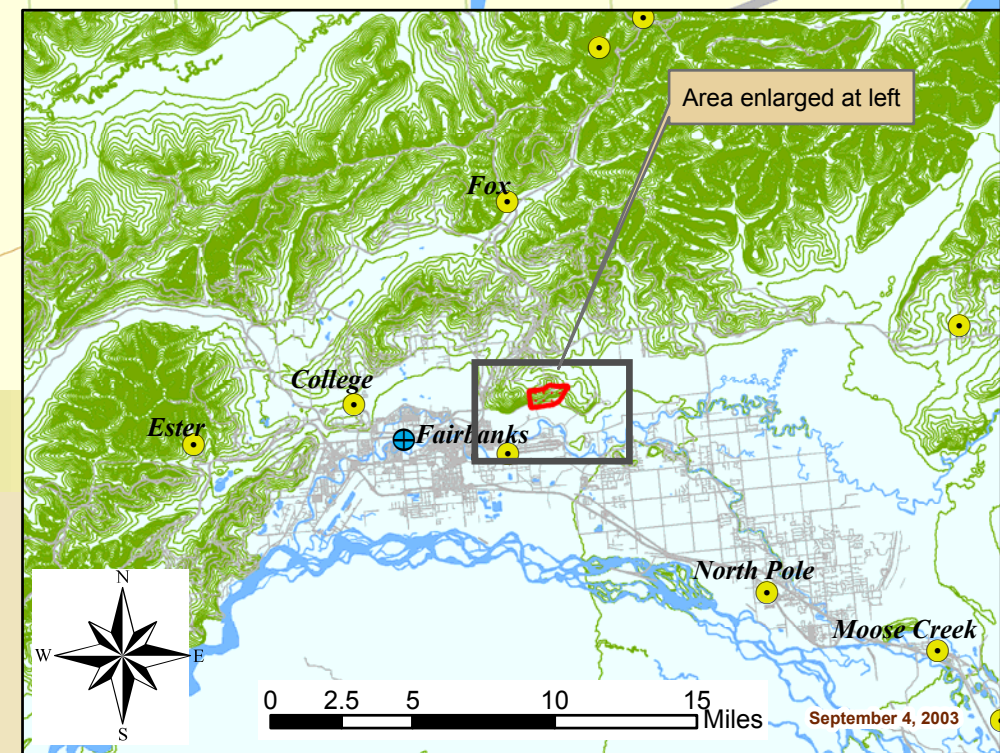


Data Sources:

Parcel, roads - Fairbanks North Star Borough
 Water bodies, railroad - Geographic Data Technology
 Elevation contours - USGS digital elevation models (DEMs)

Legend

- Ft Wainwright Ski Lodge well
- Zone A
- Roads
- Parcels
- Surface water
- Elevation contour



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Ski Lodge (Tables 1-4)

Table 1

**Contaminant Source Inventory for
Ft Wainwright / Ski Lodge Well**

PWSID 311087.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	2	
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	2	
Highways and roads, paved (cement or asphalt)	X20		A	2	Birch Hill Loop

Table 2

*Contaminant Source Inventory and Risk Ranking for
Ft Wainwright / Ski Lodge Well
Sources of Bacteria and Viruses*

PWSID 311087.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Birch Hill Loop
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Medium	2	

Table 3

*Contaminant Source Inventory and Risk Ranking for
Ft Wainwright / Ski Lodge Well
Sources of Nitrates/Nitrites*

PWSID 311087.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Birch Hill Loop
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Medium	2	

Table 4

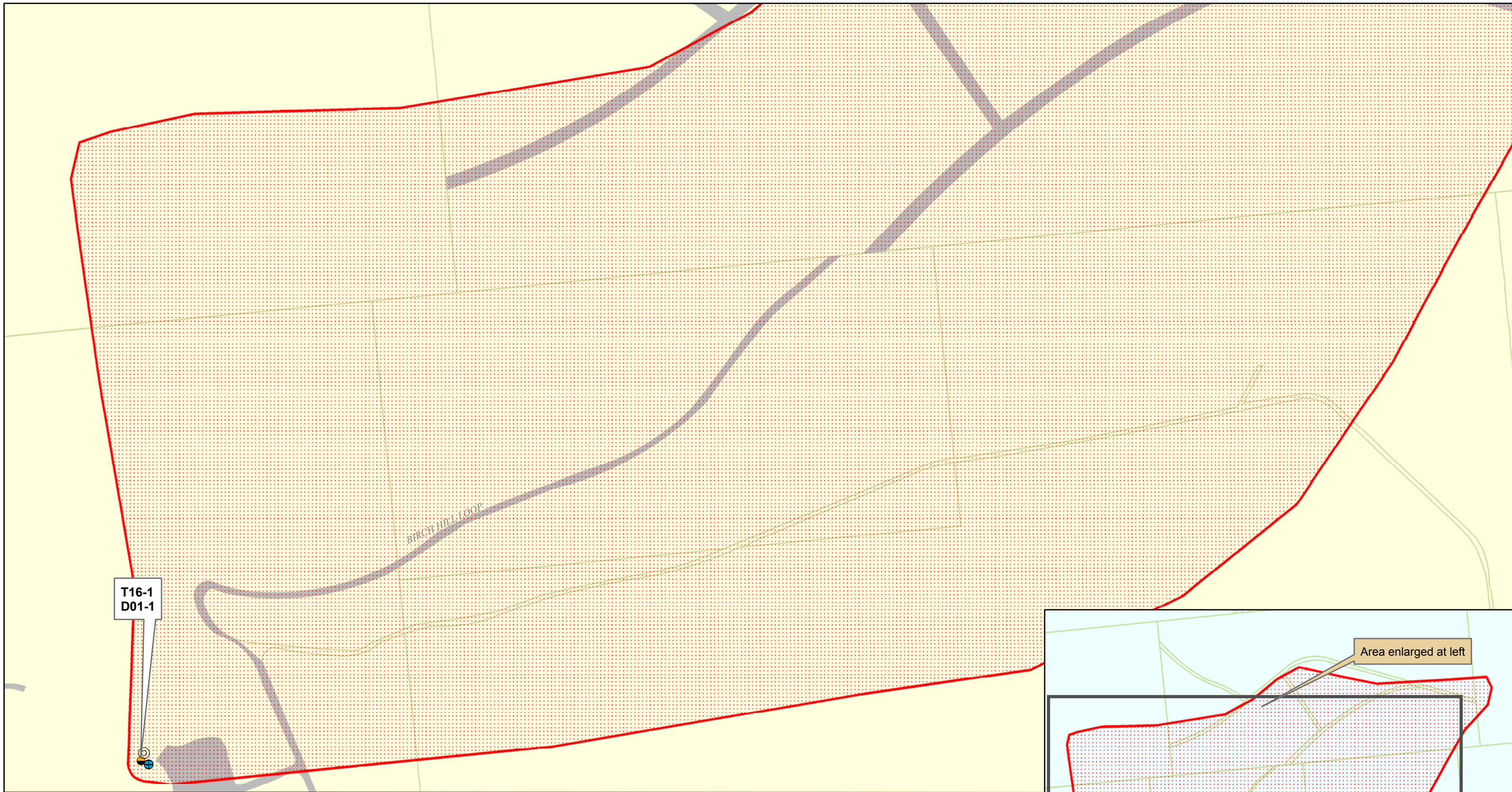
*Contaminant Source Inventory and Risk Ranking for
Ft Wainwright / Ski Lodge Well
Sources of Volatile Organic Chemicals*

PWSID 311087.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Birch Hill Loop
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Low	2	
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	Low	2	

APPENDIX C

Ft. Wainwright Ski Lodge Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)



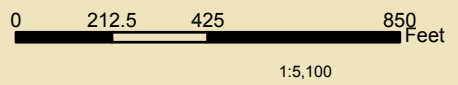
T16-1
D01-1

BIRCH HILL LOOP

Area enlarged at left

Map 2: Potential Contaminant Sources

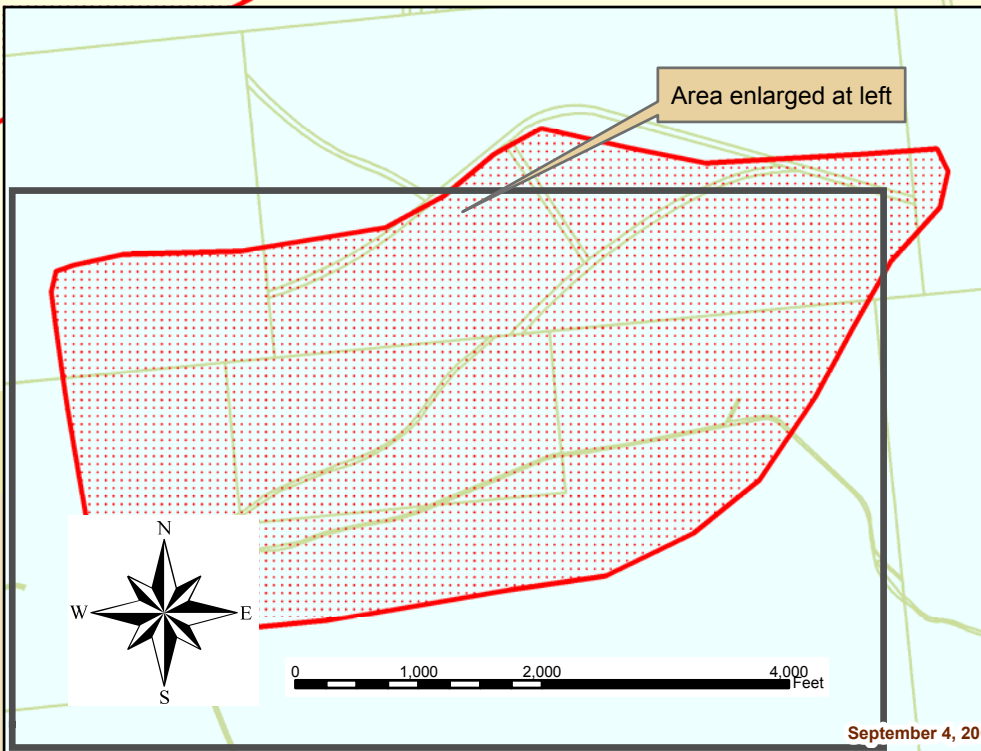
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Data Sources:
Parcel, roads - Fairbanks North Star Borough
Water bodies, railroad - Geographic Data Technology
Elevation contours - USGS digital elevation models (DEMs)

Legend

- ⊙ D01, Domestic wastewater collection system
- T16, Underground heating oil tank
- ⊕ Ft Wainwright Ski Lodge well
- ▨ Zone A
- ▬ Roads
- ▬ Parcels
- ▬ Surface water



APPENDIX D

Vulnerability Analysis for Ft. Wainwright Ski Lodge Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Ft Wainwright Ski Lodge

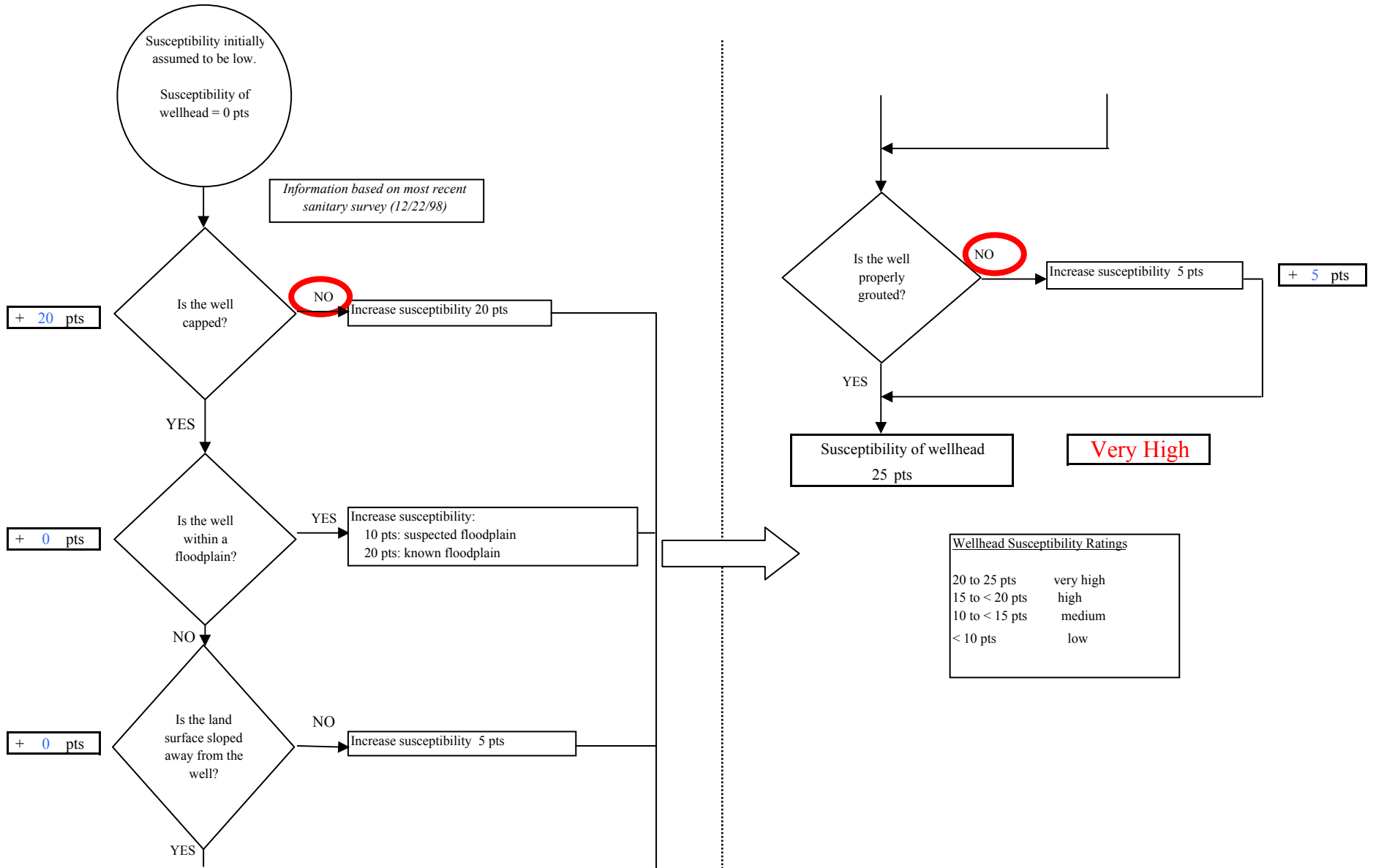


Chart 2. Susceptibility of the aquifer - Ft Wainwright Ski Lodge

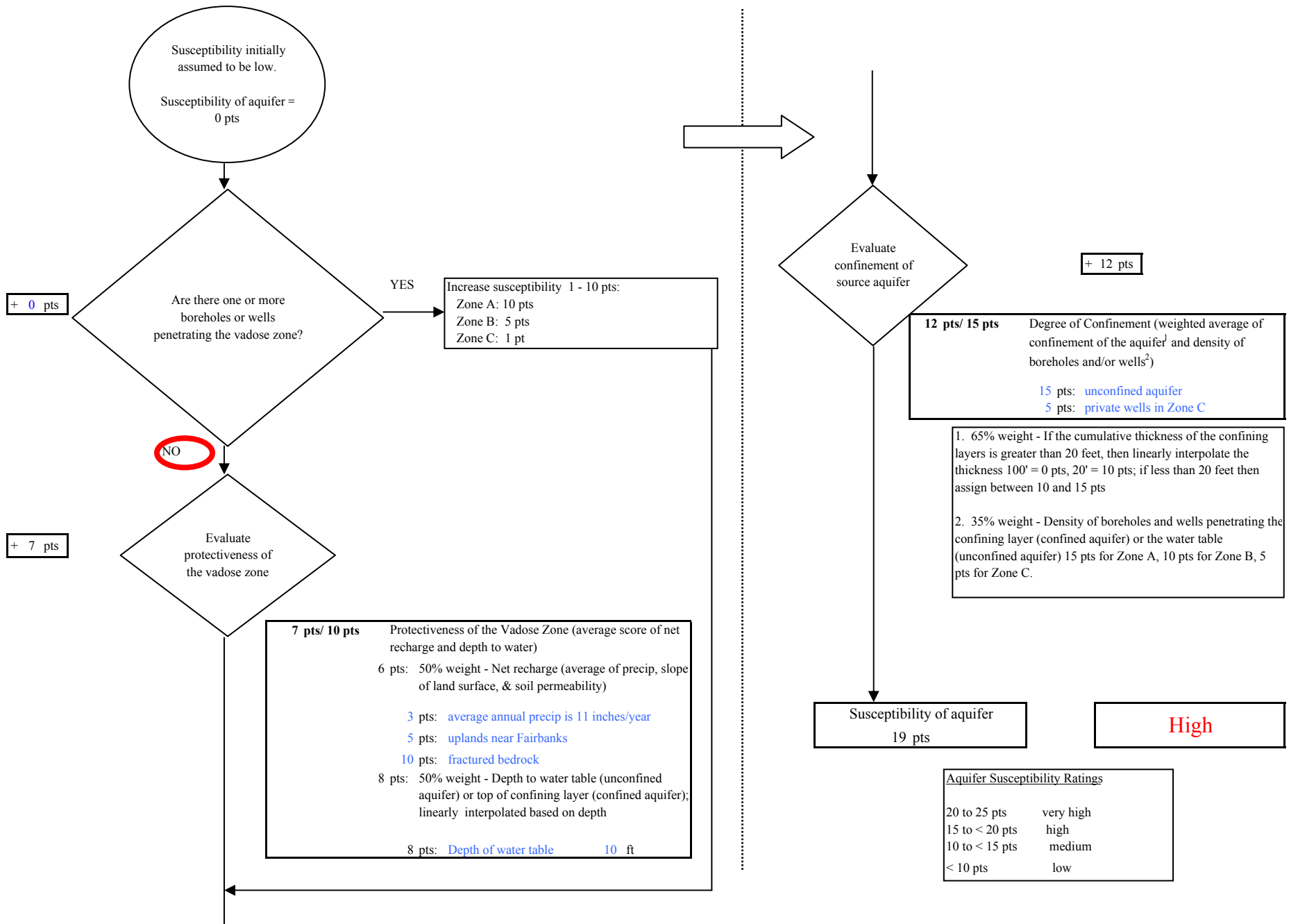


Chart 3. Contaminant risks for Ft Wainwright Ski Lodge - Bacteria & Viruses

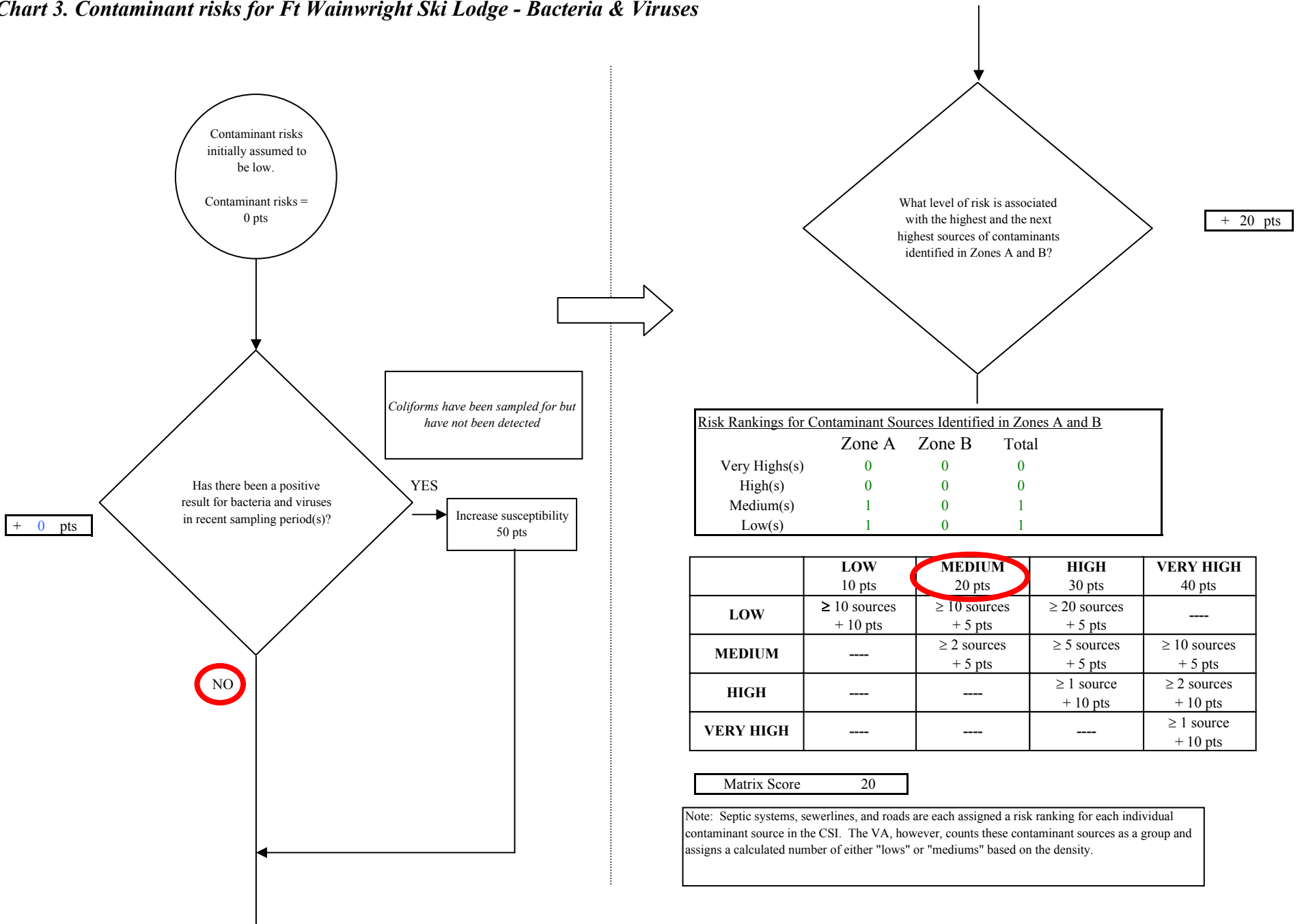
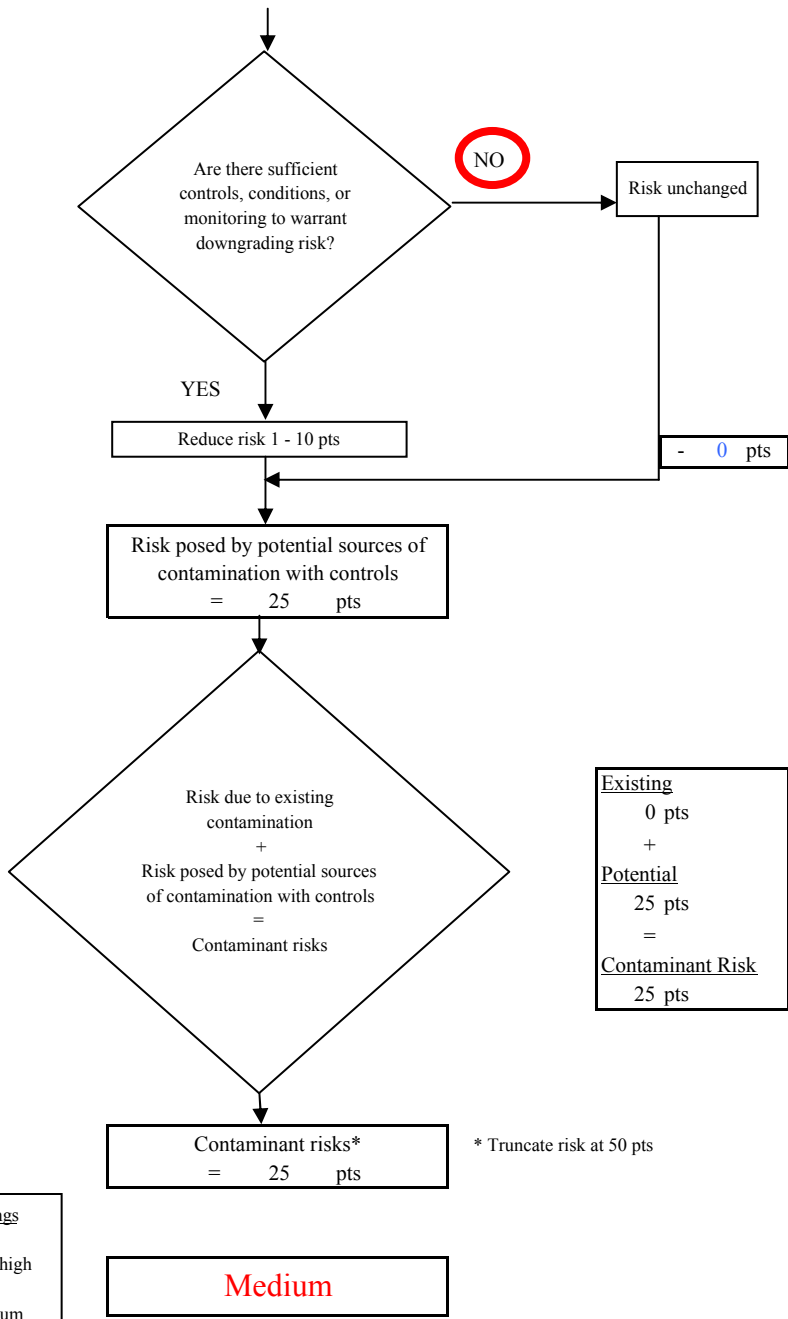
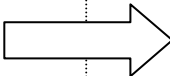
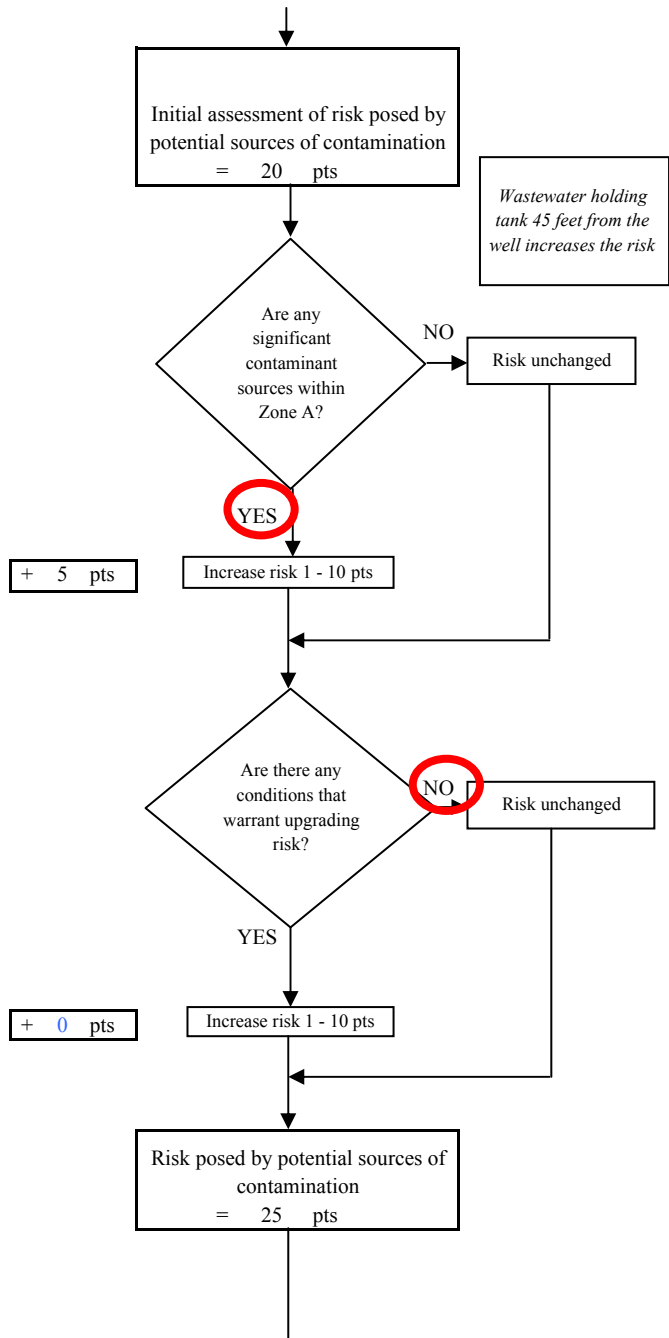


Chart 3. Contaminant risks for Ft Wainwright Ski Lodge - Bacteria & Viruses



Contaminant Risk Ratings	
40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

Chart 4. Vulnerability analysis for Ft Wainwright Ski Lodge - Bacteria & Viruses

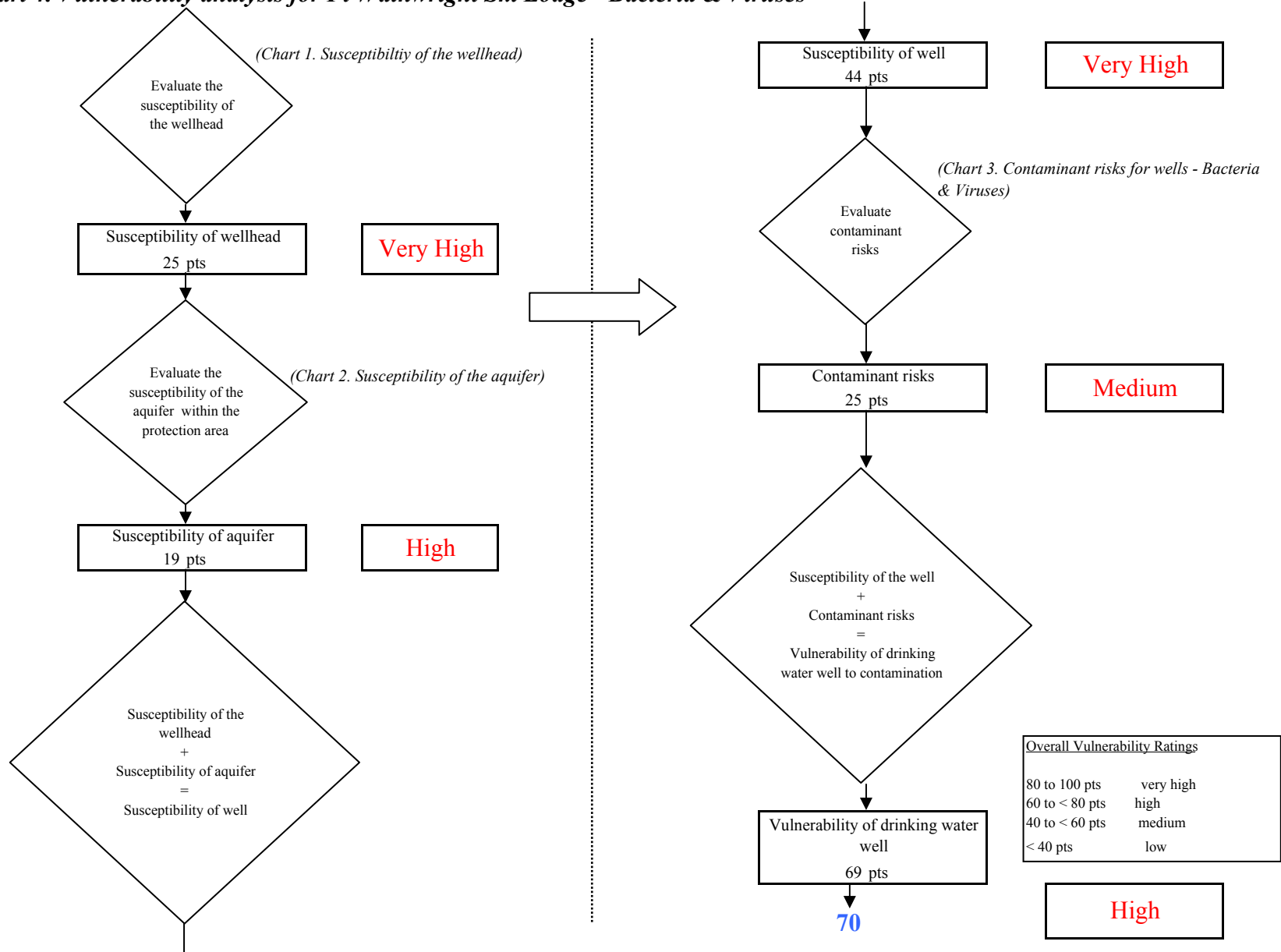


Chart 5. Contaminant risks for Ft Wainwright Ski Lodge - Nitrates and Nitrites

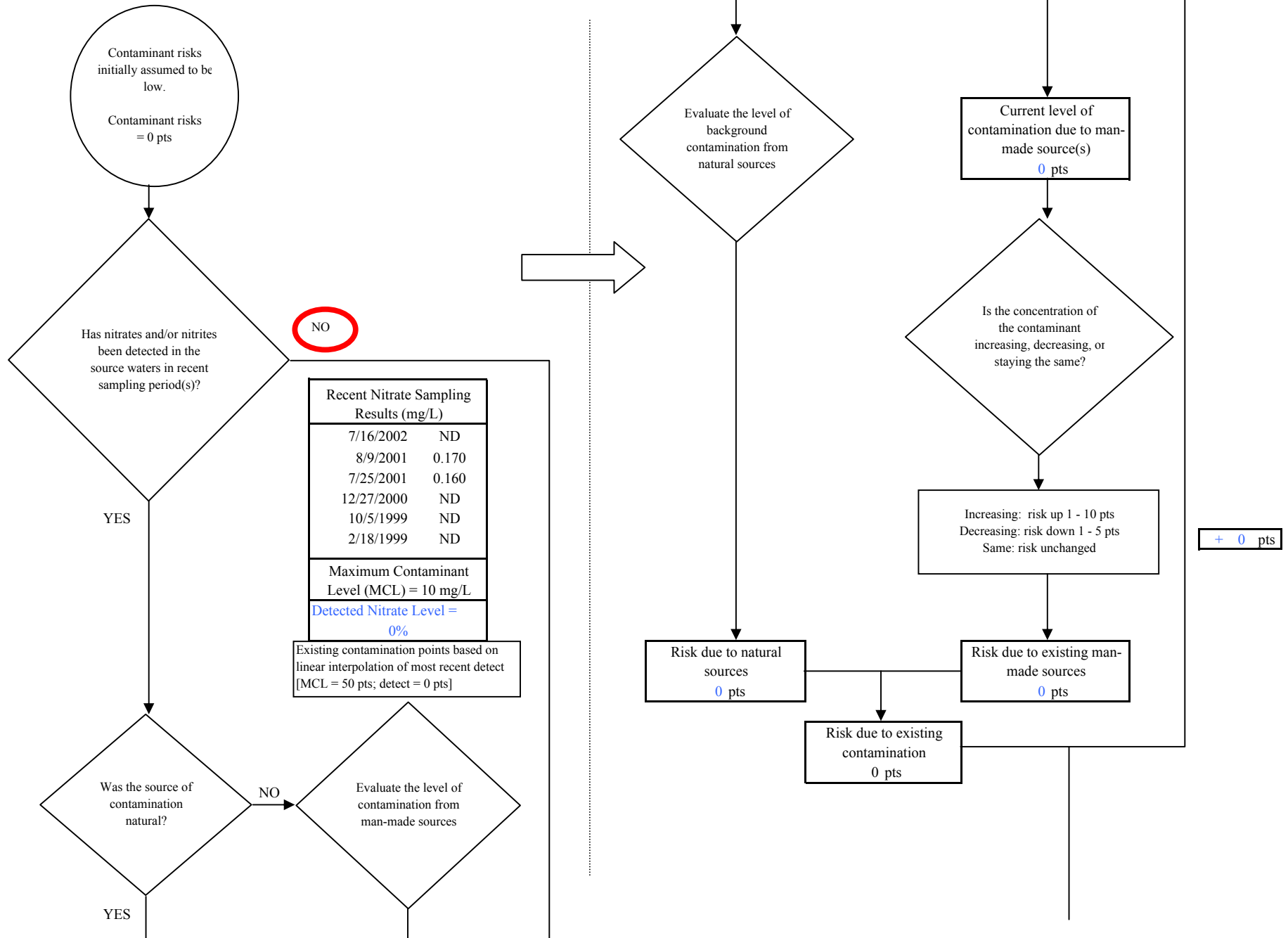


Chart 5. Contaminant risks for Ft Wainwright Ski Lodge - Nitrates and Nitrites

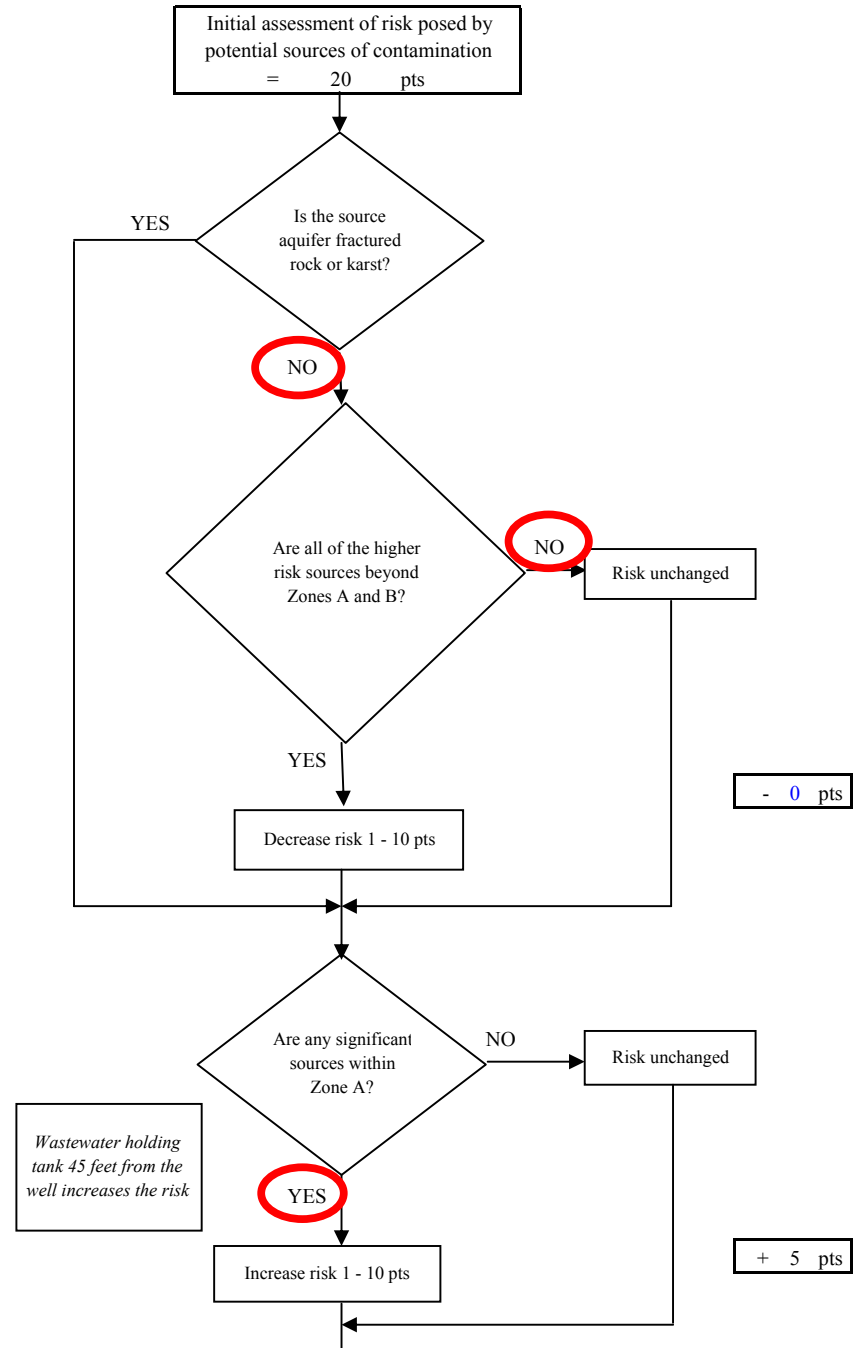
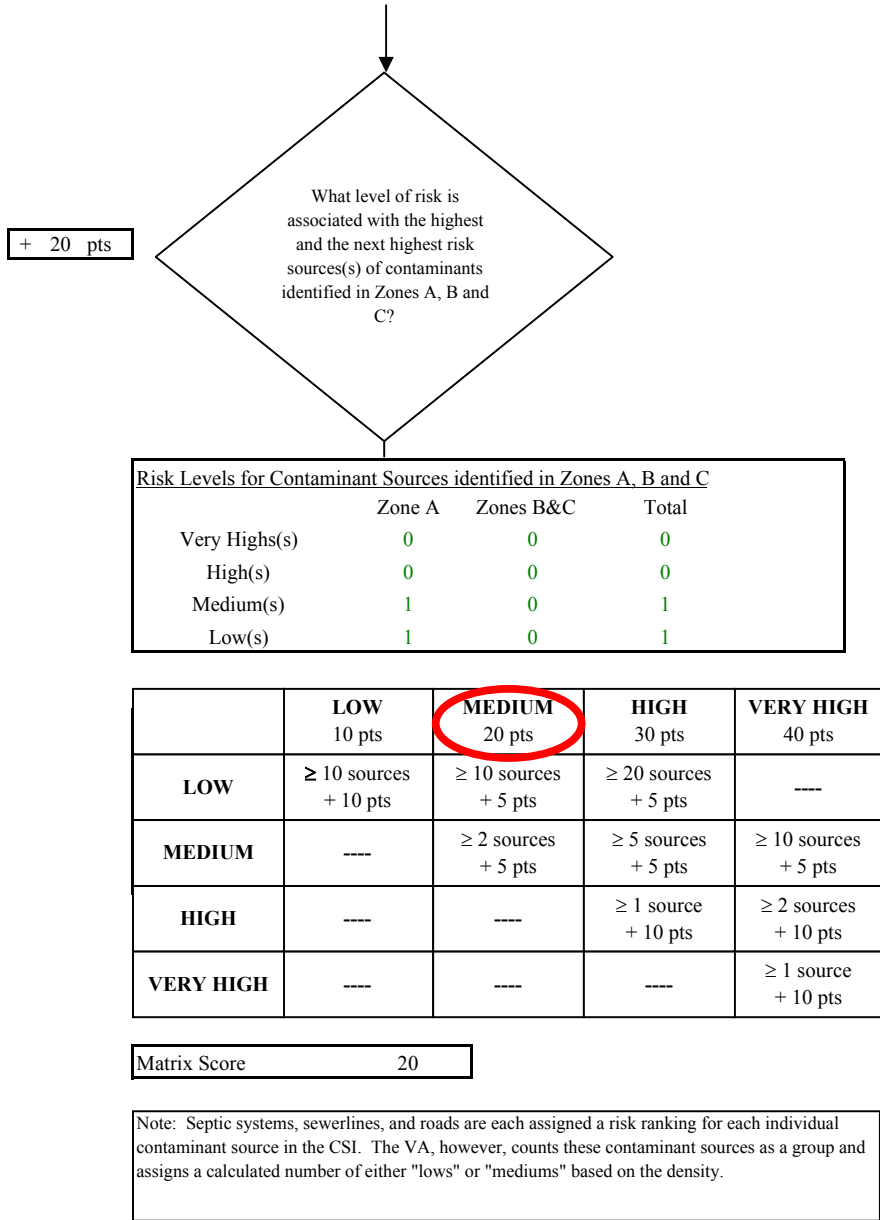


Chart 5. Contaminant risks for Ft Wainwright Ski Lodge - Nitrates and Nitrites

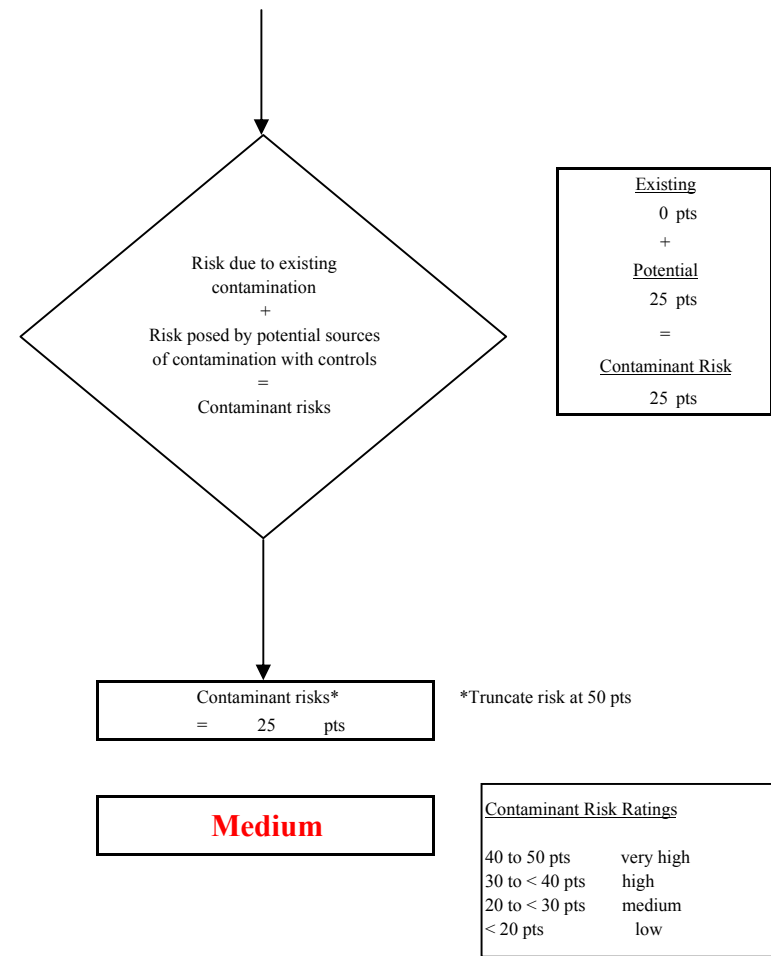
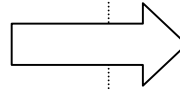
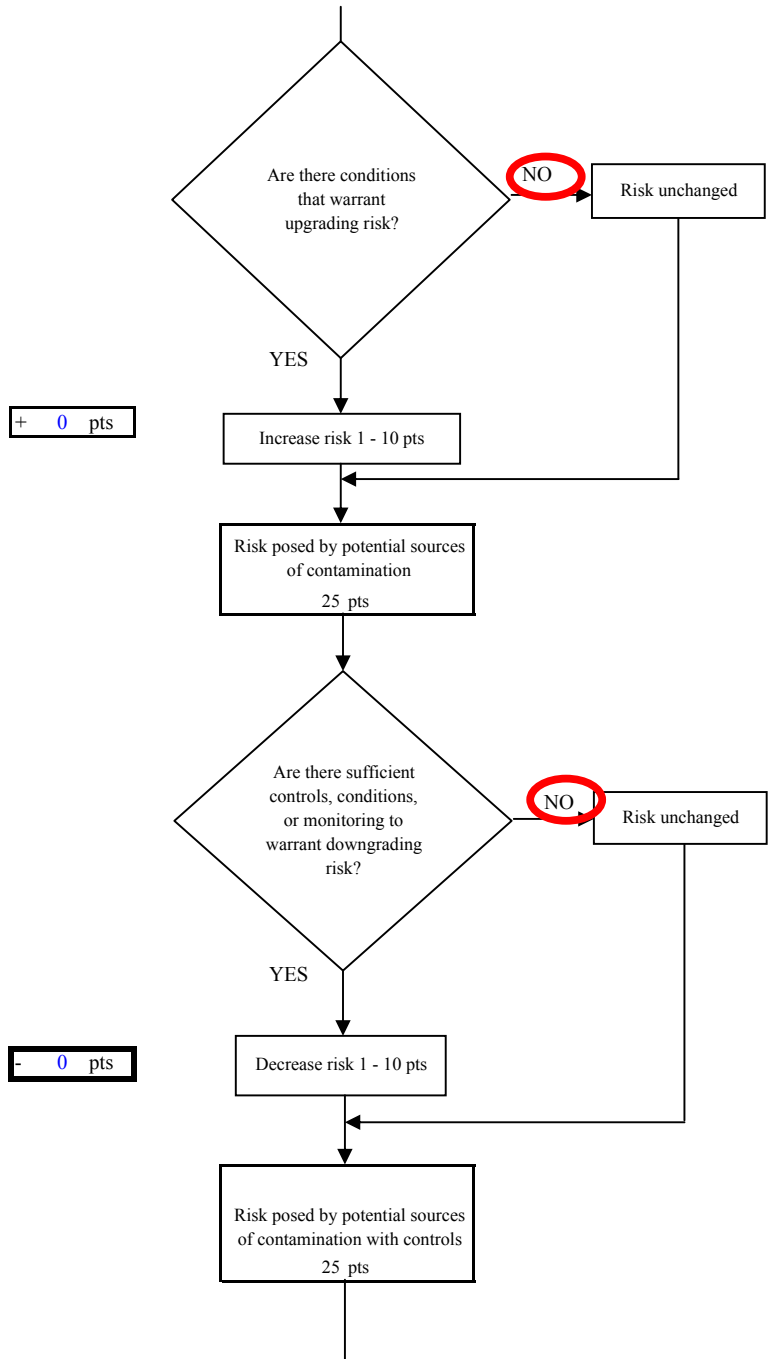


Chart 6. Vulnerability analysis for Ft Wainwright Ski Lodge - Nitrates and Nitrites

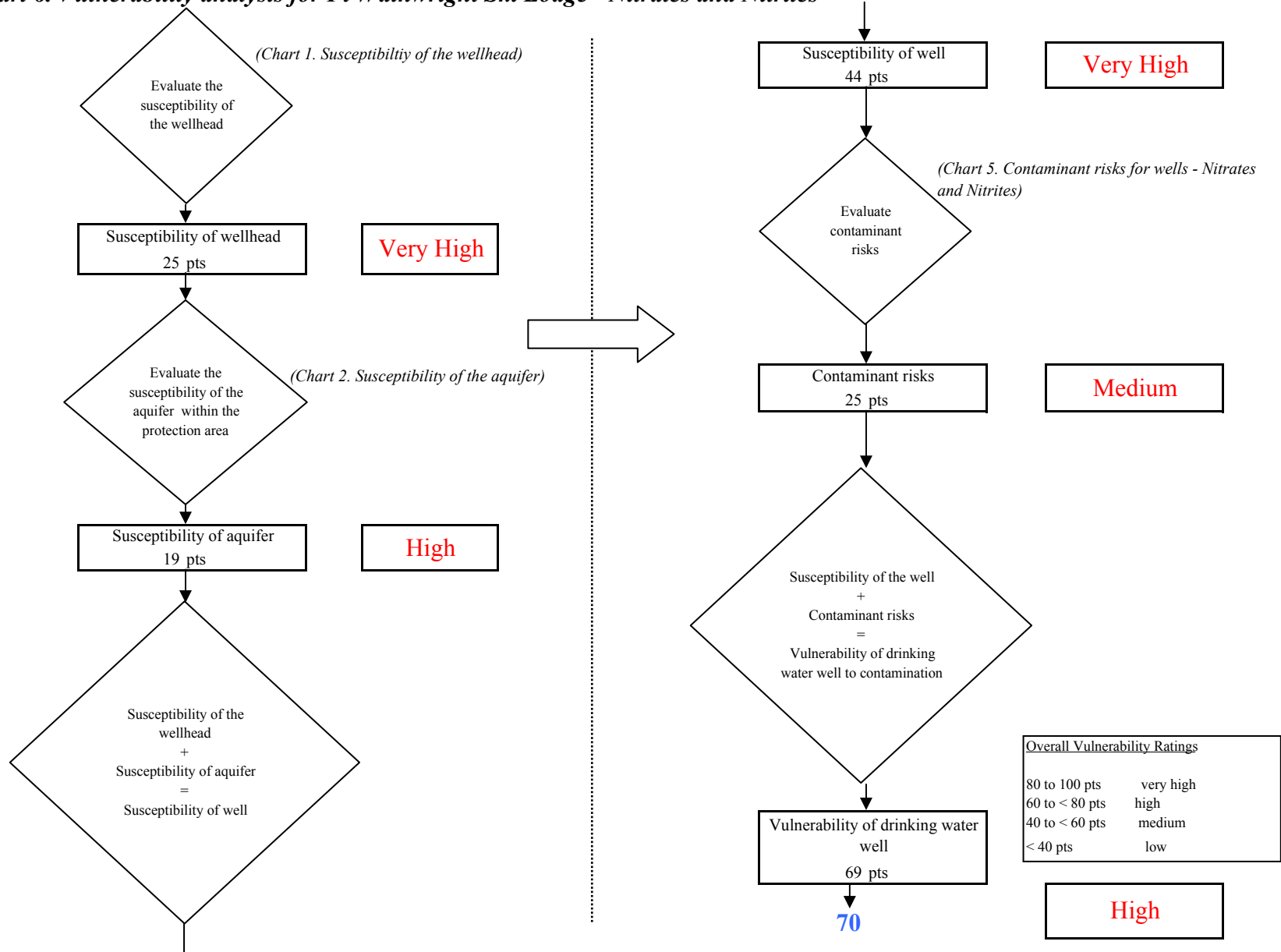


Chart 7. Contaminant risks for Ft Wainwright Ski Lodge - Volatile Organic Chemicals

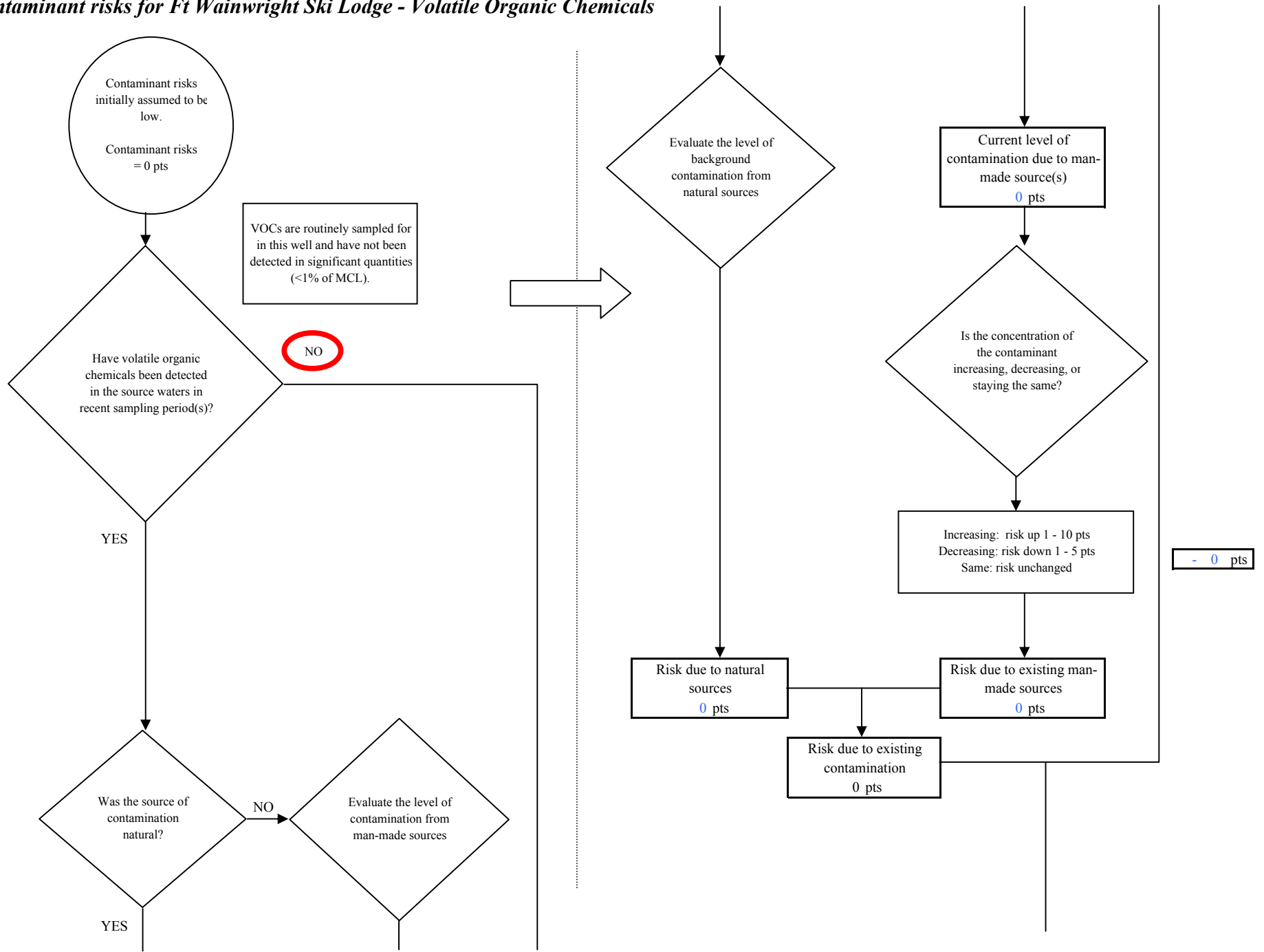
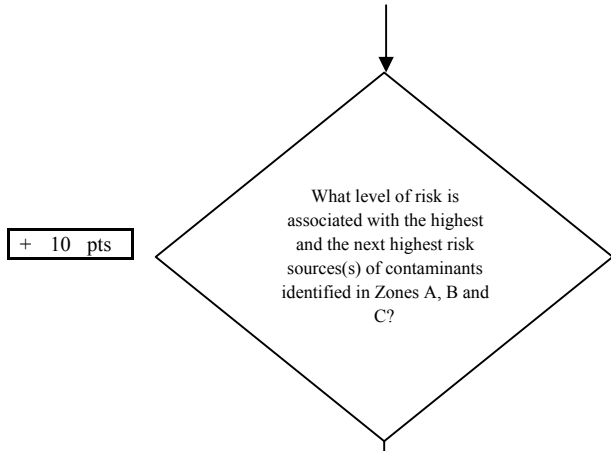


Chart 7. Contaminant risks for Ft Wainwright Ski Lodge - Volatile Organic Chemicals



+ 10 pts

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very High(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	≥ 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.

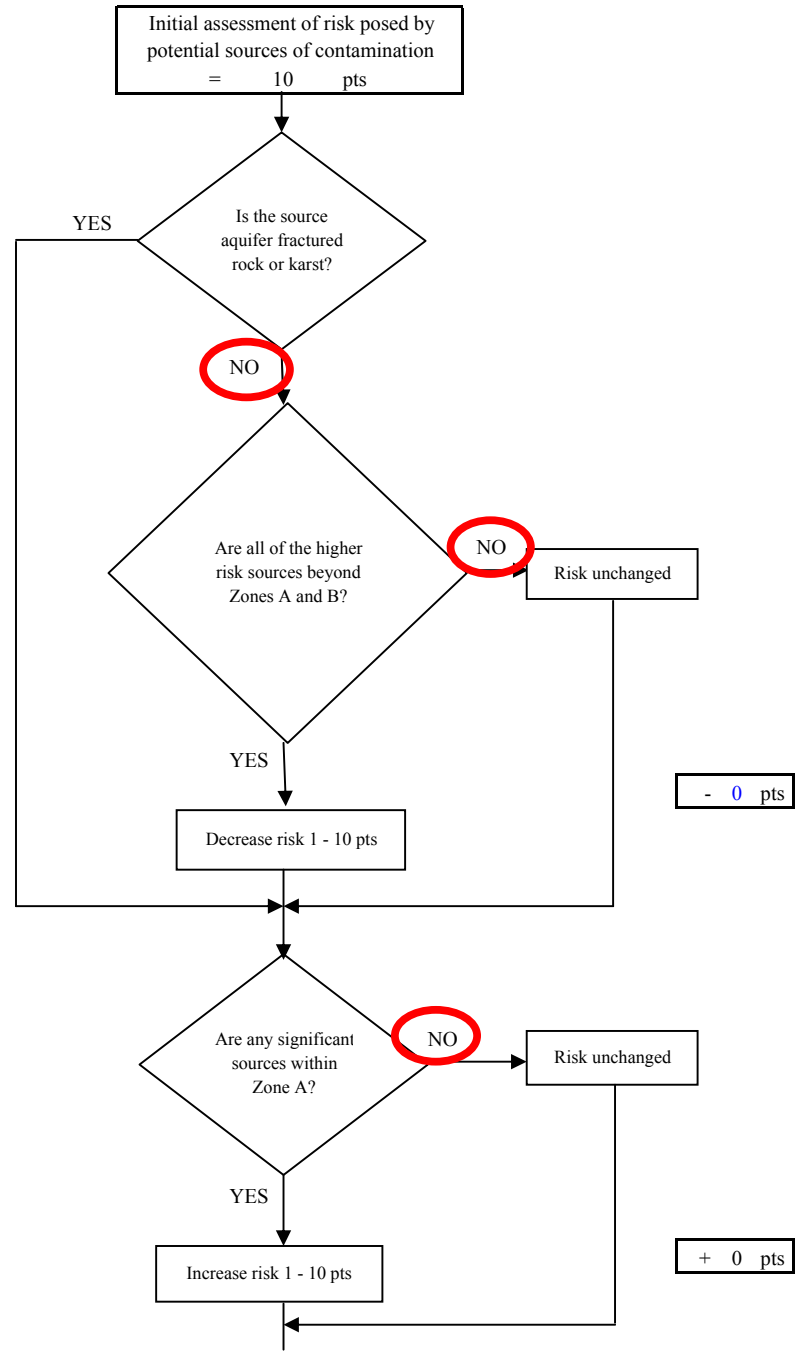
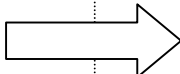


Chart 7. Contaminant risks for Ft Wainwright Ski Lodge - Volatile Organic Chemicals

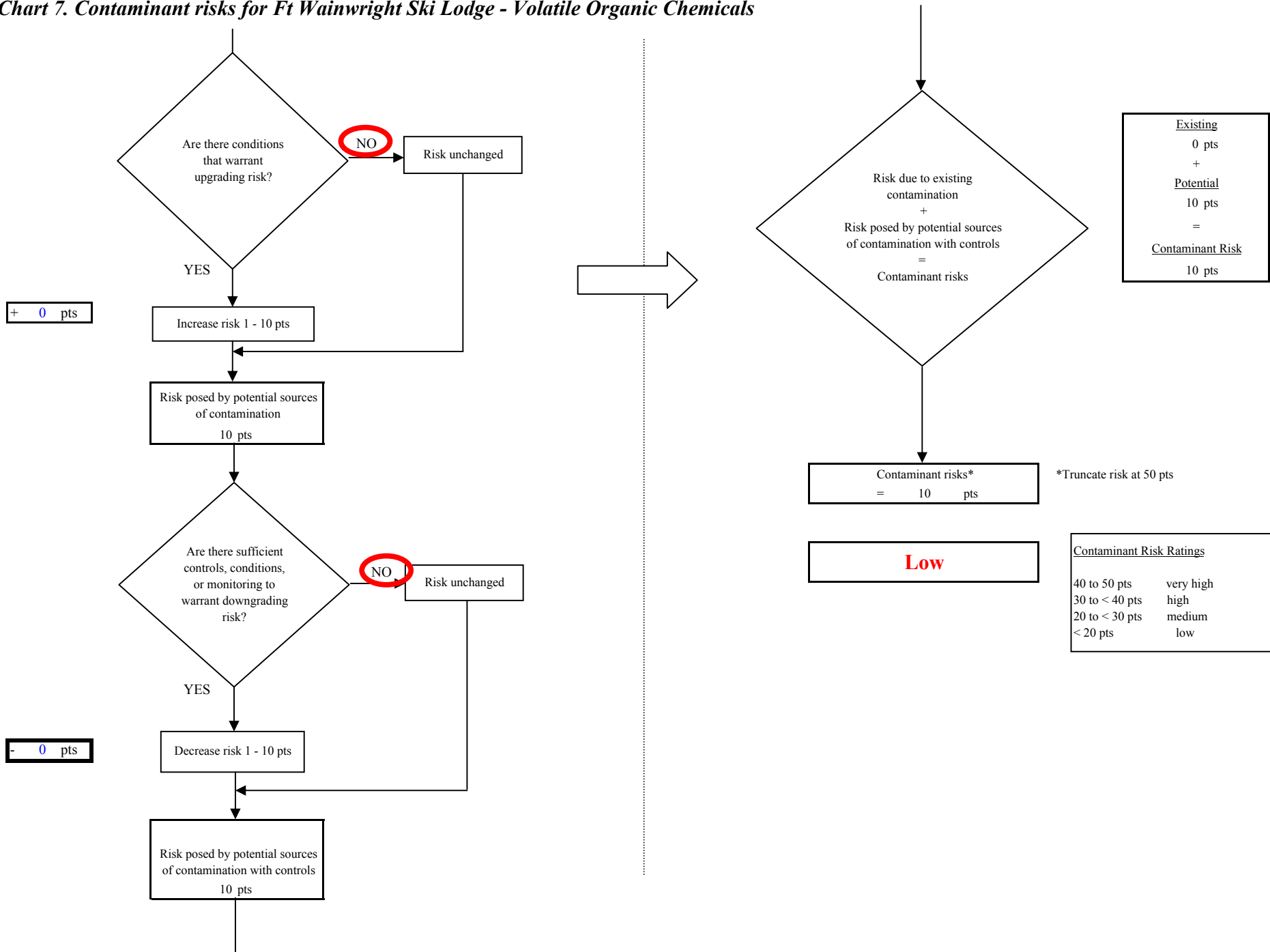


Chart 8. Vulnerability analysis for Ft Wainwright Ski Lodge - Volatile Organic Chemicals

