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# Source Water Assessment

## A Hydrogeologic Susceptibility and Vulnerability Assessment for VFW Post 10029 Drinking Water System, North Pole, Alaska PWSID 370497

December 2003

DRINKING WATER PROTECTION PROGRAM REPORT Report 1276  
Alaska Department of Environmental Conservation

# Source Water Assessment for VFW Post 10029 Drinking Water System North Pole, Alaska PWSID 370497

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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 VFW Post 10029 Source of Public Drinking Water, North Pole, Alaska

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## 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 VFW Post 10029 to potential contamination. This Class B (non-community) water system consists of one well at the intersection of VFW Street and the Old Richardson Highway in North Pole, Alaska. The well received a natural susceptibility rating of **Medium**. This rating is a combination of a susceptibility rating of **Medium** 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 VFW Post 10029 public water system include: roads and a rail corridor. 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 VFW Post 10029 received an overall vulnerability rating of **High** for bacteria and viruses, **Medium** for volatile organic chemicals, and **Low** for nitrates and nitrites.

### VFW POST 10029 PUBLIC DRINKING WATER SYSTEM

VFW Post 10029 public water system is a Class A (community) water system. The system consists of one well at the intersection of VFW Street and the Old Richardson Highway in North Pole, Alaska (T2S, R2E, Section 22) (See Map 1 of Appendix A). North Pole is located southeast of the town of Fairbanks which is located in the Fairbanks North Star Borough 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.

North Pole Utilities provides piped water and sewer collection to part of North Pole, other areas use individual wells and septic systems. Electricity for the city is provided by Golden Valley Electric Association. The majority of residents use heating oil (typically stored in both above and below ground 275 to 500-gallon tanks) to heat homes and buildings. Garbage

collection services are provided by the city, and refuse is transported to the Fairbanks North Star Borough Class I Landfill on South Cushman Street.

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 VFW Post 10029 water system is located in the alluvial plain at an elevation of approximately 500 feet above sea level.

According to the well log for this water system, the depth of the well is 40 feet below the ground surface and is screened in sand and gravel. The alluvial plain consists of alternating layers of silt, sand and gravel up to over 500 feet thick, in some locations overlain by 1 to 10 feet of silt or sandy silt or a few feet of peat (Glass and others, 1996). Discontinuous permafrost (perennially frozen areas) is also common in the alluvial plain. The depth to permafrost in these areas ranges between 2 and 45 feet below the ground surface with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, T.L. 1958. Geology of the Fairbanks (D-2) Quadrangle, Alaska. USGS). Areas with discontinuous permafrost may locally affect the ground water flow directions.

Primarily the Tanana River, but also the Chena River contribute water to this alluvial aquifer. The Chena River typically only contributes water when its stage is high and the Tanana is low (Nelson, 1978). The Tanana River gets approximately 85% of its water from snowmelt of the Alaska Range and 15% from the Yukon-Tanana uplands (Anderson, 1970).

### VFW POST 10029 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.

There are many different ways of calculating the size of capture zones. This assessment uses a combination of two simple groundwater flow equations, the Thiem and uniform flow equations for all groundwater wells screened in unconsolidated material. The orientation of the capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated in this assessment is only a best guess using the information and resources available to us, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture zone are general for the whole alluvial plain and were obtained from various United State Geological Survey (USGS) reports, well logs in the area, and the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

The water table in the area of the VFW Post 10029, the area between the Tanana and the Chena Rivers, is primarily influenced by the level of water flow in each river. The capture zones were drawn based on three separate configurations of the water table during various stages of the rivers: a period of high stage in the Chena River (October 14-17, 1986), high stage in the Tanana River (July 16-17, 1987), and low stages in both rivers (March 30-April 3, 1988) (Glass and others, 1996). High water levels in the Chena usually occur in the spring due to runoff from the uplands and in late summer due to rainstorms (Nelson, 1978). The Tanana usually experiences high flow during the hot, dry periods of mid-summer when maximum snowmelt from the Alaska Range occurs (Nelson, 1978). Groundwater in this area generally flows toward the northwest, from the Tanana River to the Chena River, however flow is reversed very near the Chena River during its high stage periods (Glass and others, 1996). These flow reversals are of short duration (i.e. days versus months) and of limited extent, generally within 1000 feet of the river (Nakanishi, et al, 1998).

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).

The following is a summary of the four zones for wells and the calculated time-of-travel for each:

**Table 1. Definition of Zones**

<b>Zone</b>	<b>Definition</b>
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 VFW Post 10029 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 VFW Post 10029 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; and
- 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 the six contaminant categories.

### VULNERABILITY OF VFW POST 10029 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 7 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 VFW Post 10029 received a Medium Susceptibility rating. The 11/29/82 Sanitary Survey indicates the well is capped with a sanitary seal, however, the land surface is sloped away from the well and the well is not grouted. A sanitary seal prevents potential contaminants from entering the well from the inside while sloping the land surface away from the well and grouting help to prevent potential contaminants from traveling down the outside of the well casing.

The aquifer in the area the VFW Post 10029 well is completed in received a High Susceptibility rating. The highly transmissive aquifer material (sand and gravel) in the area allows contaminants to travel downward from the surface with the precipitation and surface water runoff. The shallow water table allows potential contaminants to come into contact with the water table with little natural filtering where they can disperse quickly. Additionally, wells in the area can provide a quick pathway for contaminants to reach the aquifer. Table 2 summarizes the Susceptibility scores and ratings for VFW Post 10029.

**Table 2. Susceptibility**

	Score	Rating
Susceptibility of the Wellhead	10	Medium
Susceptibility of the Aquifer	18	High
Natural Susceptibility	28	Medium

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	50	Very High
Nitrates and/or Nitrites	10	Low
Volatile Organic Chemicals	25	Medium

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

$$\begin{array}{r}
 \text{Natural Susceptibility (0 – 50 points)} \\
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the} \\
 \text{Drinking Water Source to Contamination (0 – 100).}
 \end{array}$$

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 six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability**

Category	Score	Rating
Bacteria and Viruses	75	High
Nitrates and/or Nitrites	35	Low
Volatile Organic Chemicals	50	Medium

**Bacteria and Viruses**

The roads represent the only identified risk of Bacteria and Viruses to this water system.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms 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 most recently detected coliforms in this water system on 11/20/03 (confirmed on 11/25/03). Fecal coliforms and E. coli have not been detected.

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 roads also represent the only identified 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 recent sampling history for the VFW Post 10029 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 low.

**Volatile Organic Chemicals**

The rail corridor represents the greatest risk for volatile organic chemical contamination to the well.

Volatile Organic Chemicals have not been sampled for in this 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](http://www.dced.state.ak.us/mra/CF_BLOCK.cfm).
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- 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.
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- United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL <http://www.epa.gov/safewater/mcl.html>.



## **APPENDIX A**

### **VFW Post 10029 Drinking Water Protection Area Location Map (Map 1)**



**Map 1: North Star Rent 2555 Mission B Drinking Water Protection Area**

**PWSID: 312499**



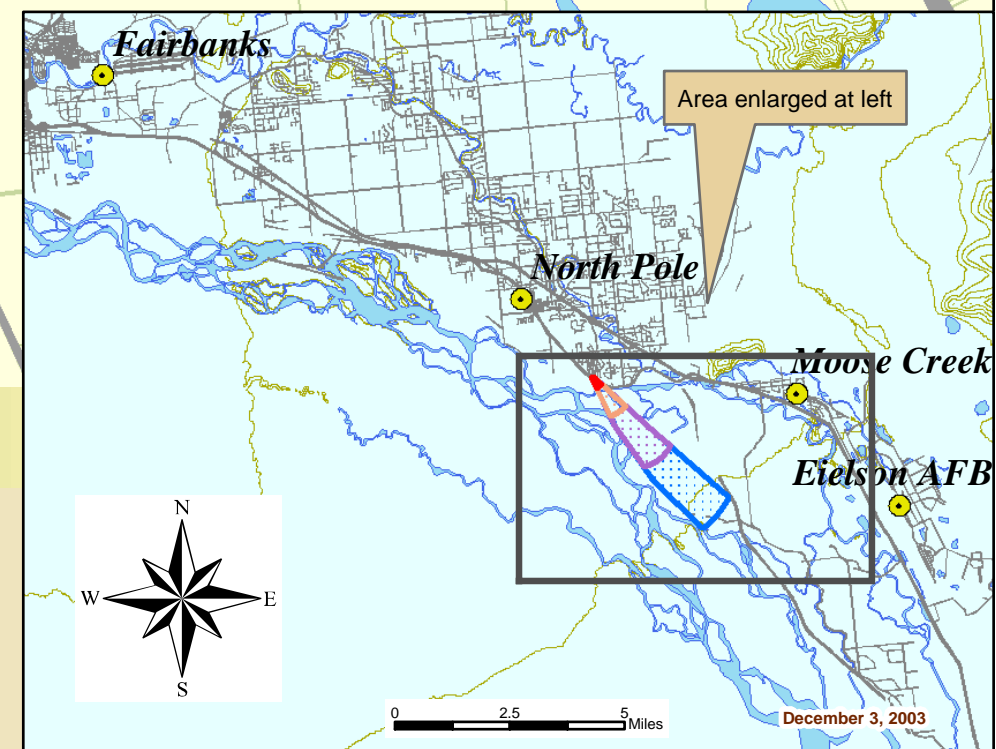
**Data Sources:**

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



**Legend**

- Zone B Less than 2 years travel time
- Zone C Less than 5 years travel time
- Zone D Less than 10 years travel time
- Parcels
- Towns
- Surface water
- Roads



December 3, 2003

## **APPENDIX B**

### **Contaminant Source Inventory and Risk Ranking for VFW Post 10029 (Tables 1-4)**

**Table 1**

**Contaminant Source Inventory for  
VFW # 10029 N. Pole**

**PWSID 370497.001**

<b>Contaminant Source Type</b>	<b>Contaminant Source ID</b>	<b>CS ID tag</b>	<b>Zone</b>	<b>Map Number</b>	<b>Comments</b>
Highways and roads, paved (cement or asphalt)	X20		A	2	Old Richardson Highway; VFW Street
Rail corridors	X30	X3-1	A	2	

**Table 2**

*Contaminant Source Inventory and Risk Ranking for  
VFW # 10029 N. Pole  
Sources of Bacteria and Viruses*

**PWSID 370497.001**

<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	Old Richardson Highway; VFW Street

**Table 3**

*Contaminant Source Inventory and Risk Ranking for  
VFW # 10029 N. Pole  
Sources of Nitrates/Nitrites*

**PWSID 370497.001**

<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	Old Richardson Highway; VFW Street

**Table 4**

*Contaminant Source Inventory and Risk Ranking for  
VFW # 10029 N. Pole  
Sources of Volatile Organic Chemicals*

**PWSID 370497.001**

<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	Old Richardson Highway; VFW Street
Rail corridors	X30	X3-1	A	Medium	2	

**Table 5**

*Contaminant Source Inventory and Risk Ranking for  
VFW # 10029 N. Pole*

**PWSID 370497.001**

*Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

<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	Old Richardson Highway; VFW Street
Rail corridors	X30	X3-1	A	Low	2	



**Table 6**

*Contaminant Source Inventory and Risk Ranking for  
VFW # 10029 N. Pole  
Sources of Synthetic Organic Chemicals*

**PWSID 370497.001**

<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>
Rail corridors	X30	X3-1	A	Medium	2	

**Table 7**

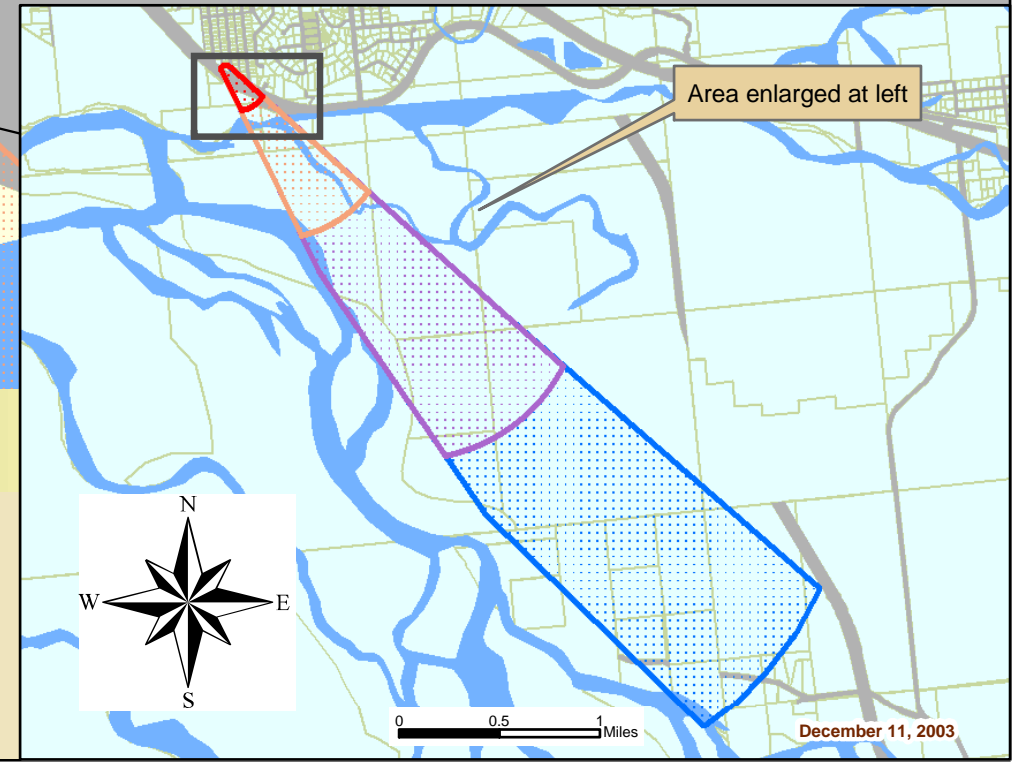
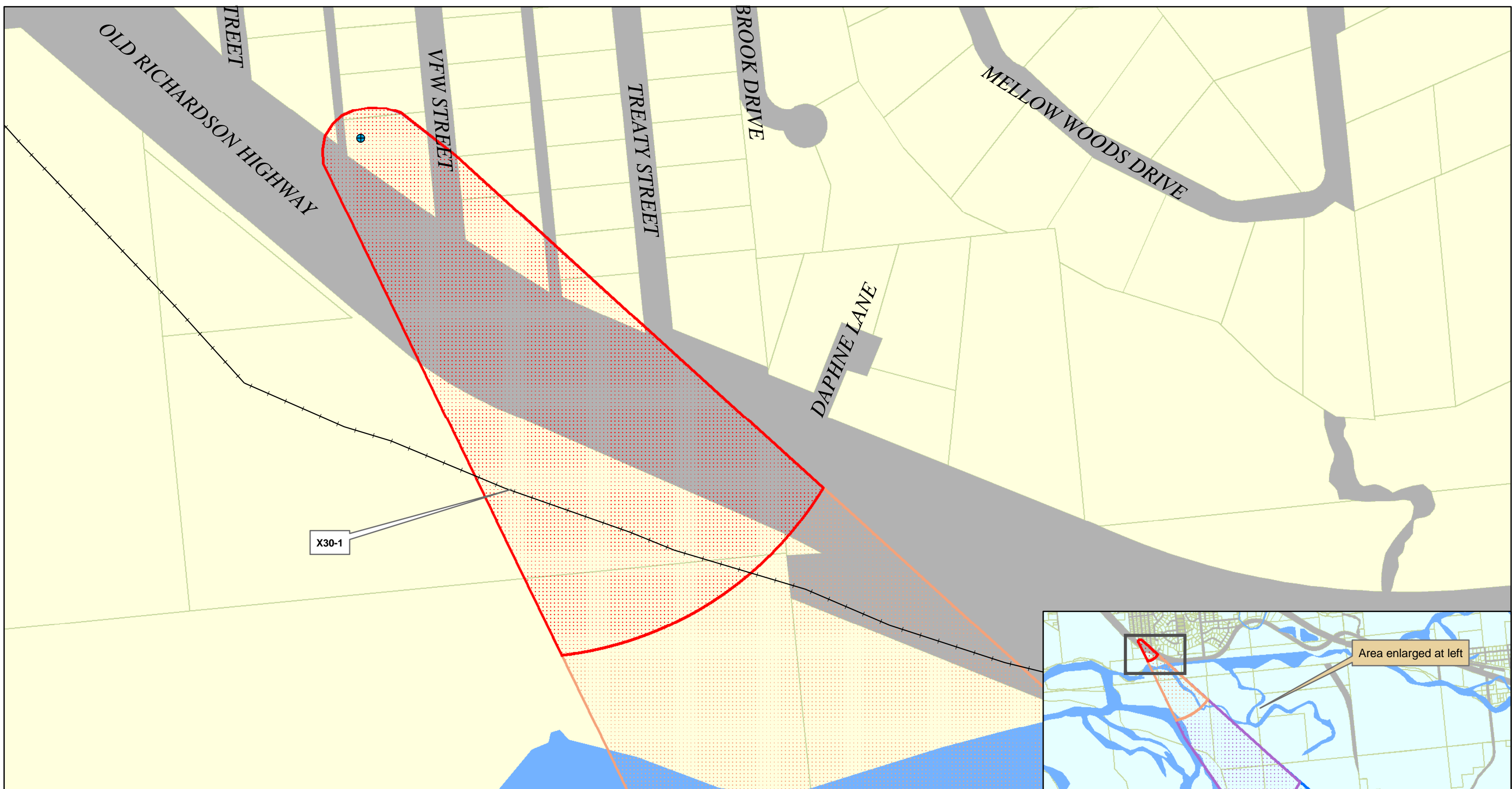
*Contaminant Source Inventory and Risk Ranking for  
VFW # 10029 N. Pole  
Sources of Other Organic Chemicals*

**PWSID 370497.001**

<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	Old Richardson Highway; VFW Street
Rail corridors	X30	X3-1	A	Low	2	

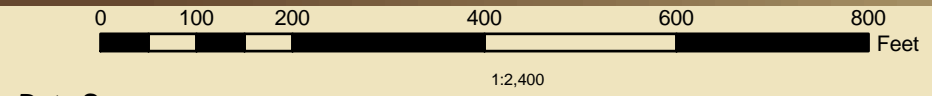
## **APPENDIX C**

### **VFW Post 10029 Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)**



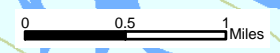
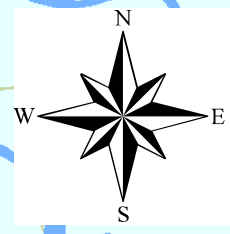
**Map 2: VFW 10029 North Pole Drinking Water Protection Area**

**PWSID: 370497**



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

- Legend**
- X30, Rail corridor
  - Roads
  - Parcels
  - Surface water

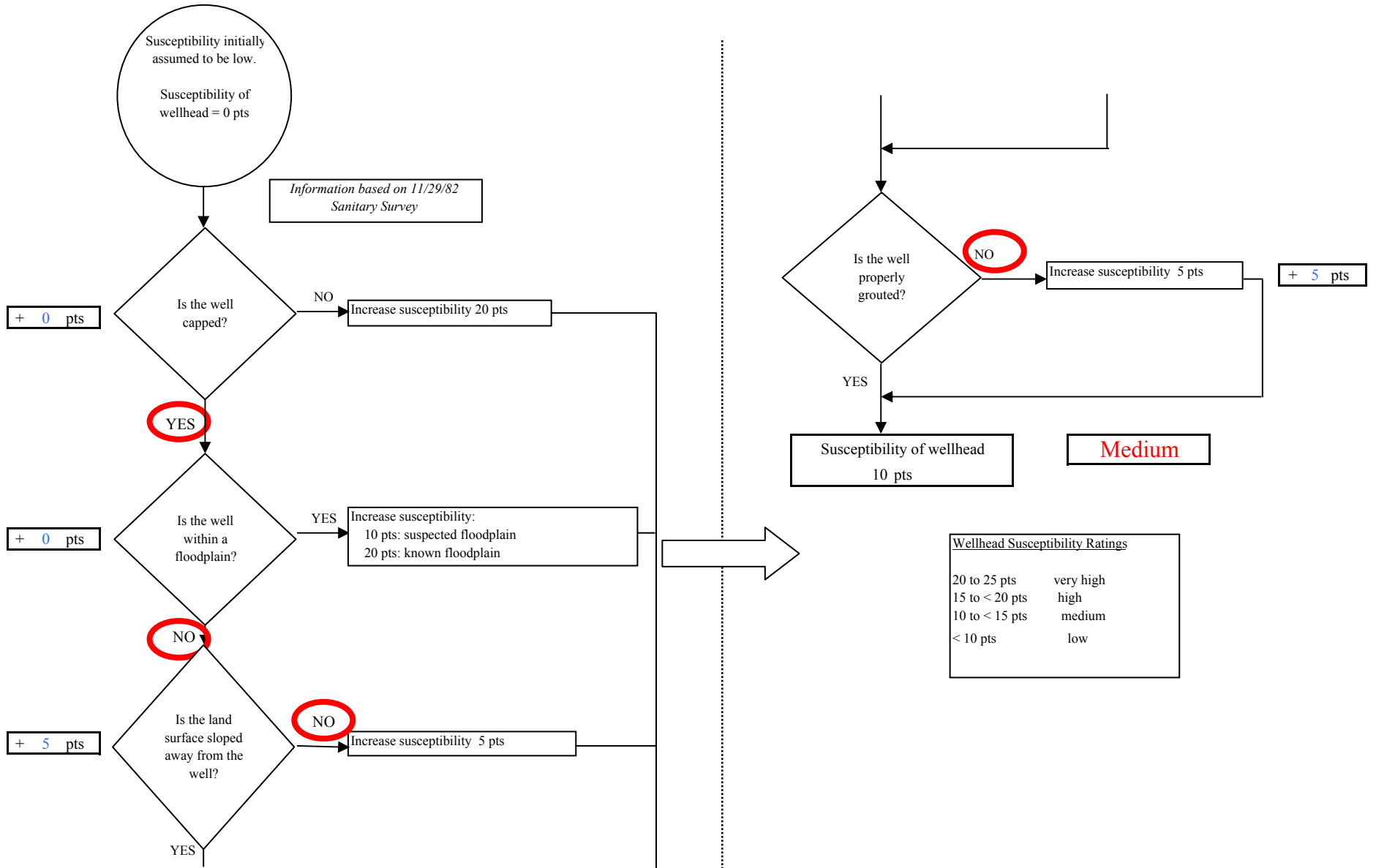


December 11, 2003

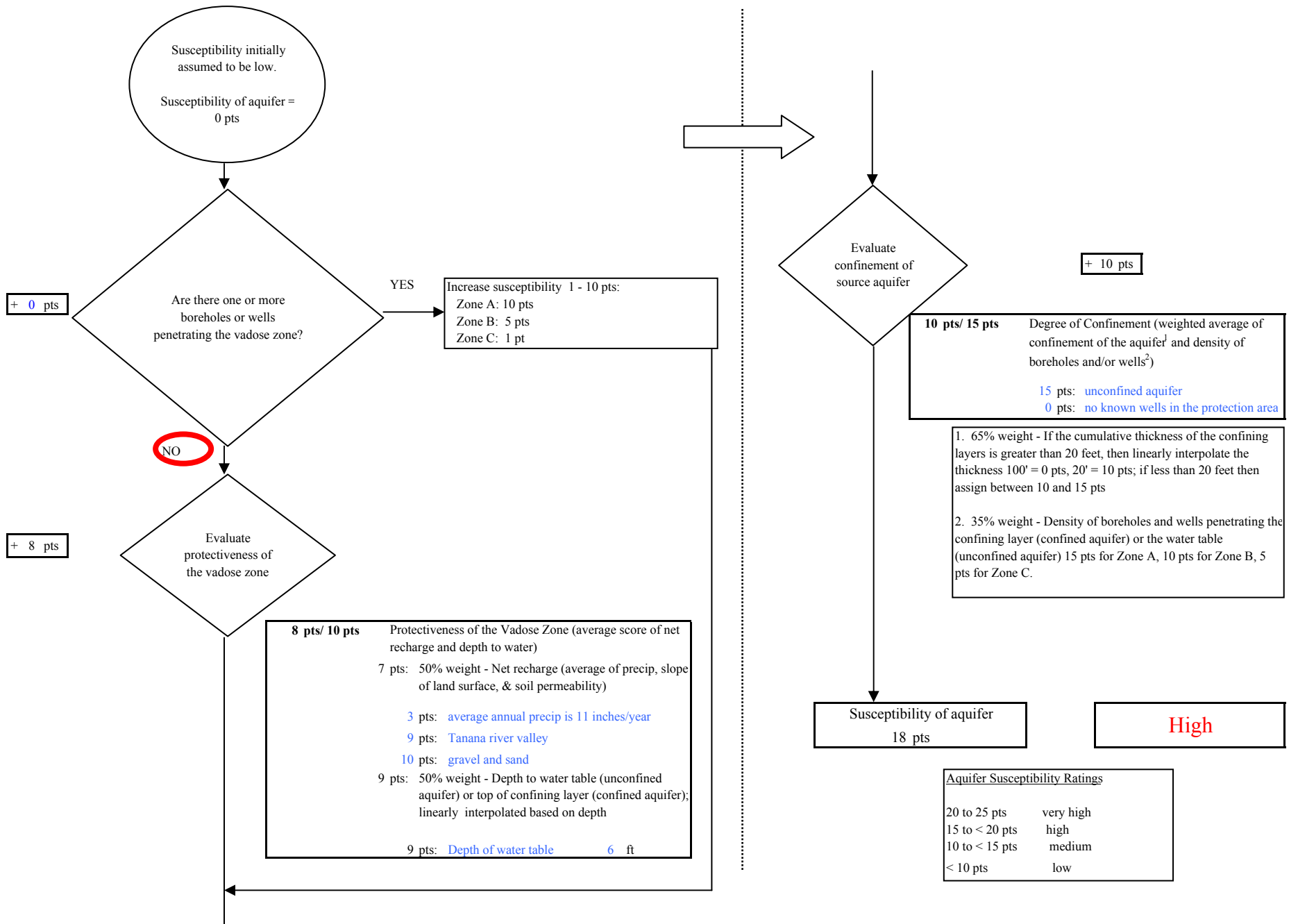
## **APPENDIX D**

### **Vulnerability Analysis for VFW Post 10029 Public Drinking Water Source (Charts 1-8)**

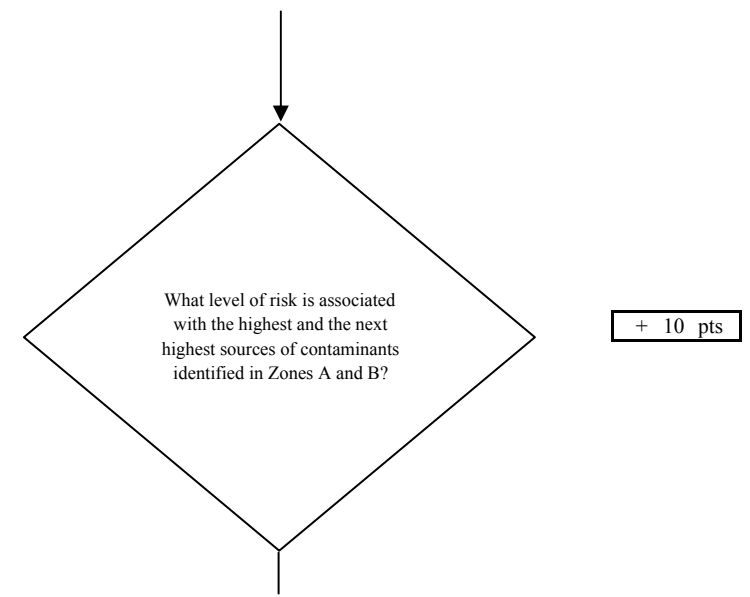
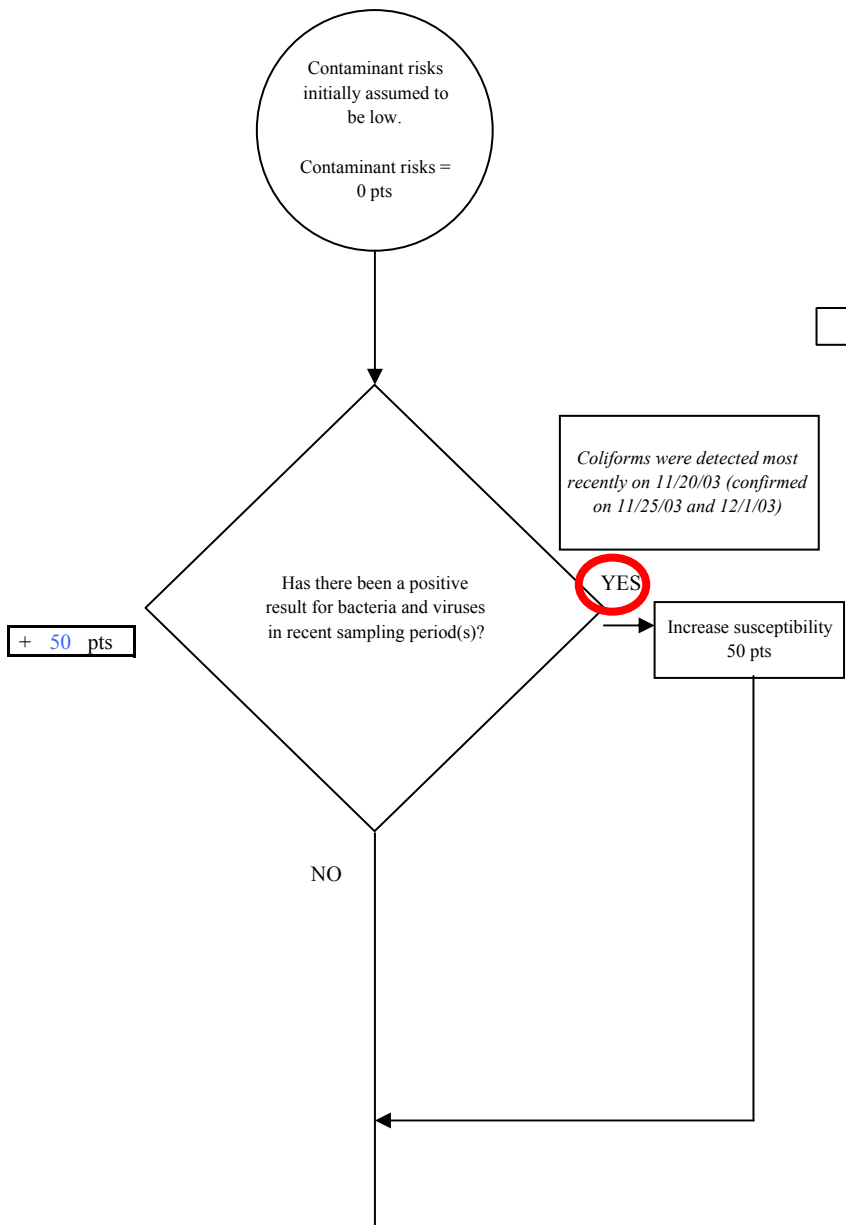
**Chart 1. Susceptibility of the wellhead - VFW #10029 North Pole**



**Chart 2. Susceptibility of the aquifer - VFW #10029 North Pole**



**Chart 3. Contaminant risks for VFW #10029 North Pole - Bacteria & Viruses**



**Risk Rankings for Contaminant Sources Identified in Zones A and B**

	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	1	0	1

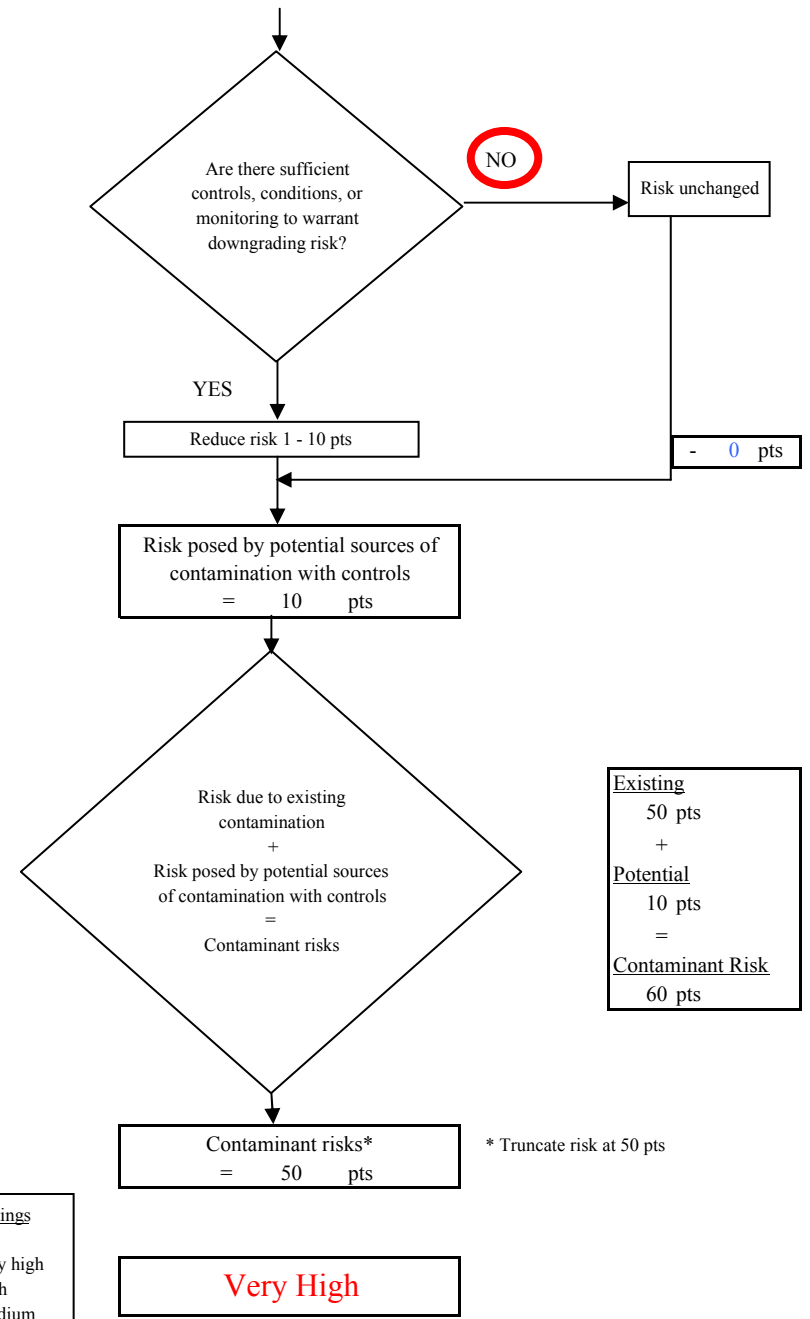
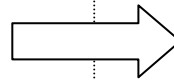
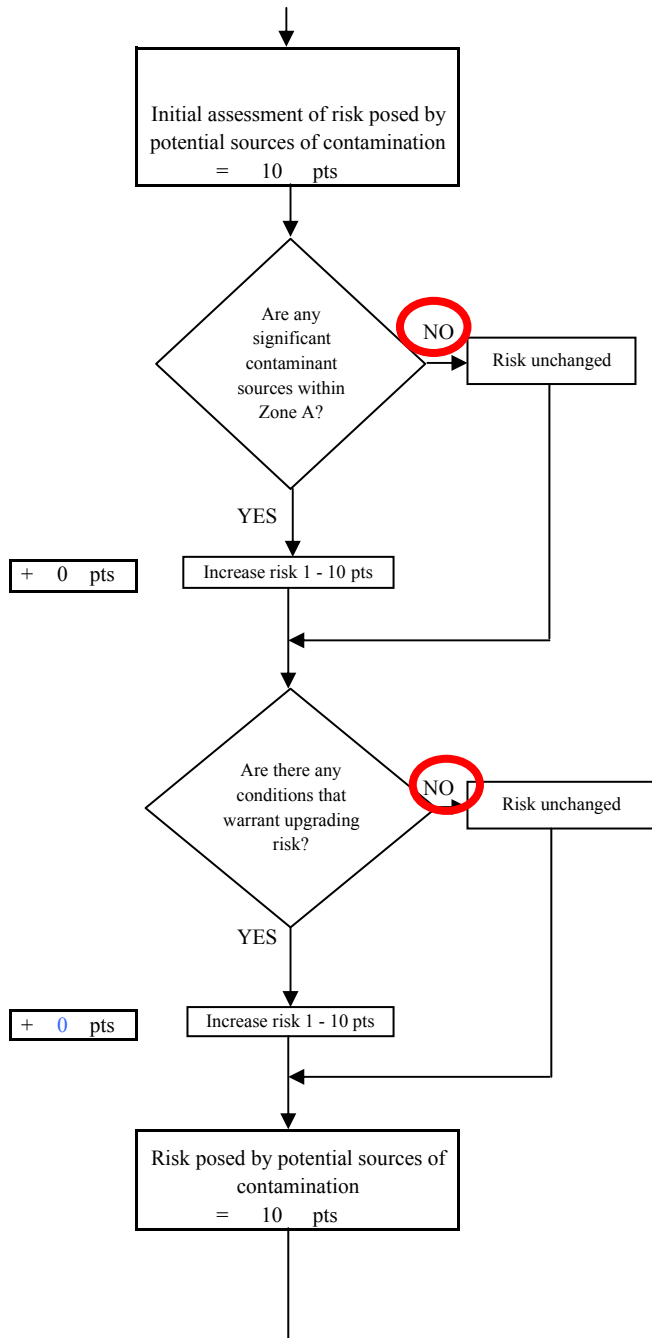
	<b>LOW</b> 10 pts	<b>MEDIUM</b> 20 pts	<b>HIGH</b> 30 pts	<b>VERY HIGH</b> 40 pts
<b>LOW</b>	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
<b>MEDIUM</b>	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
<b>HIGH</b>	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
<b>VERY HIGH</b>	----	----	----	≥ 1 source + 10 pts

Matrix Score 10

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



**Chart 3. Contaminant risks for VFW #10029 North Pole - 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 VFW #10029 North Pole - Bacteria & Viruses**

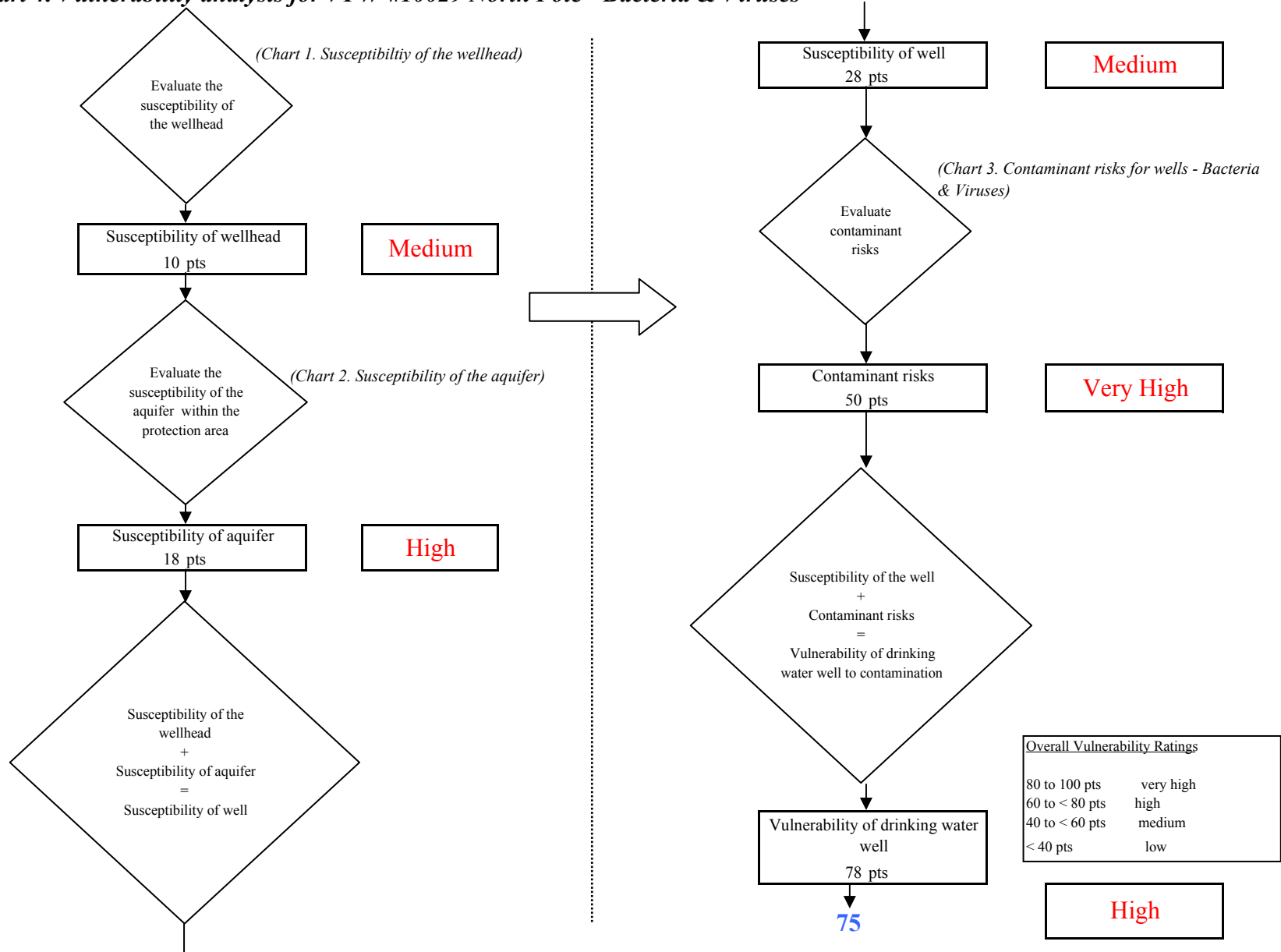


Chart 5. Contaminant risks for VFW #10029 North Pole - Nitrates and Nitrites

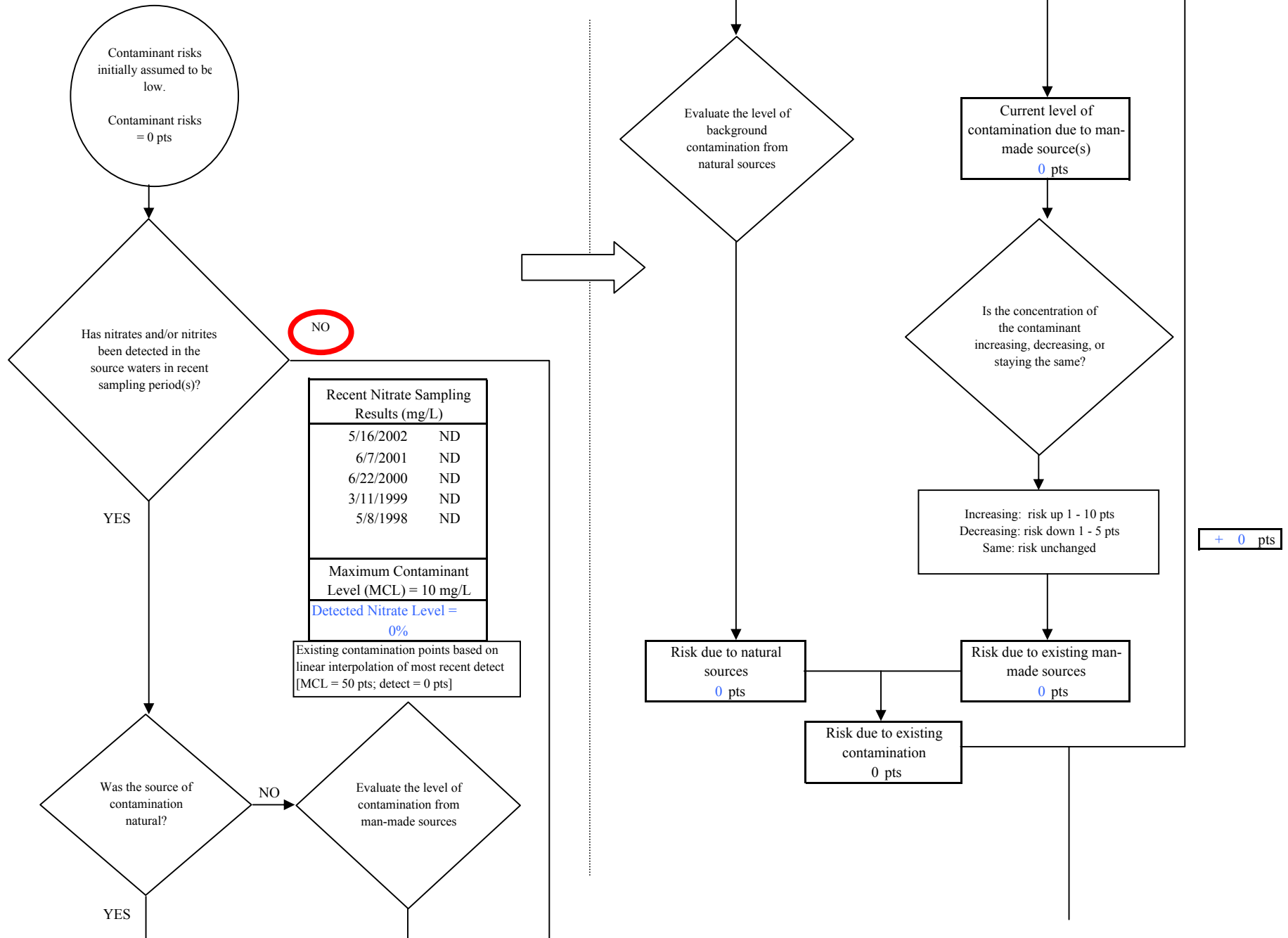


Chart 5. Contaminant risks for VFW #10029 North Pole - Nitrates and Nitrites

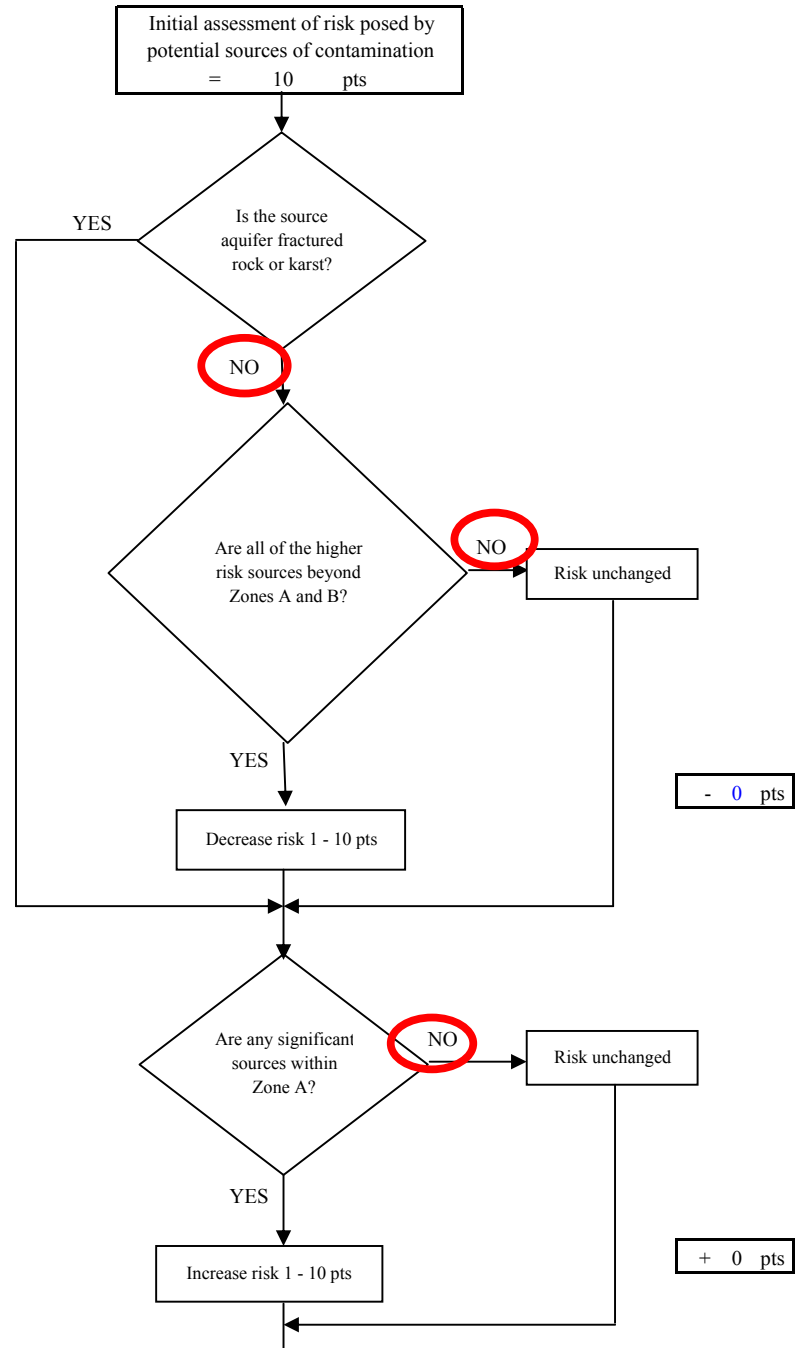
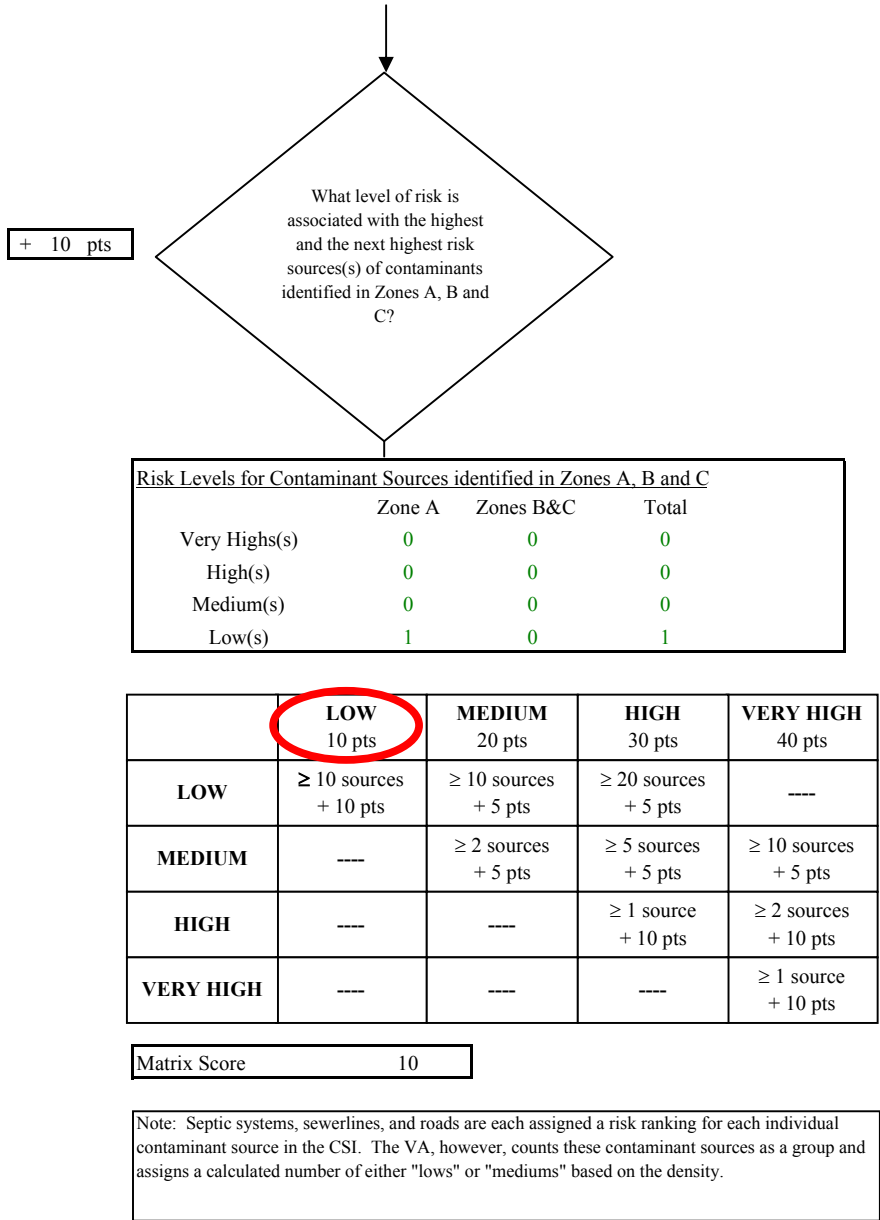
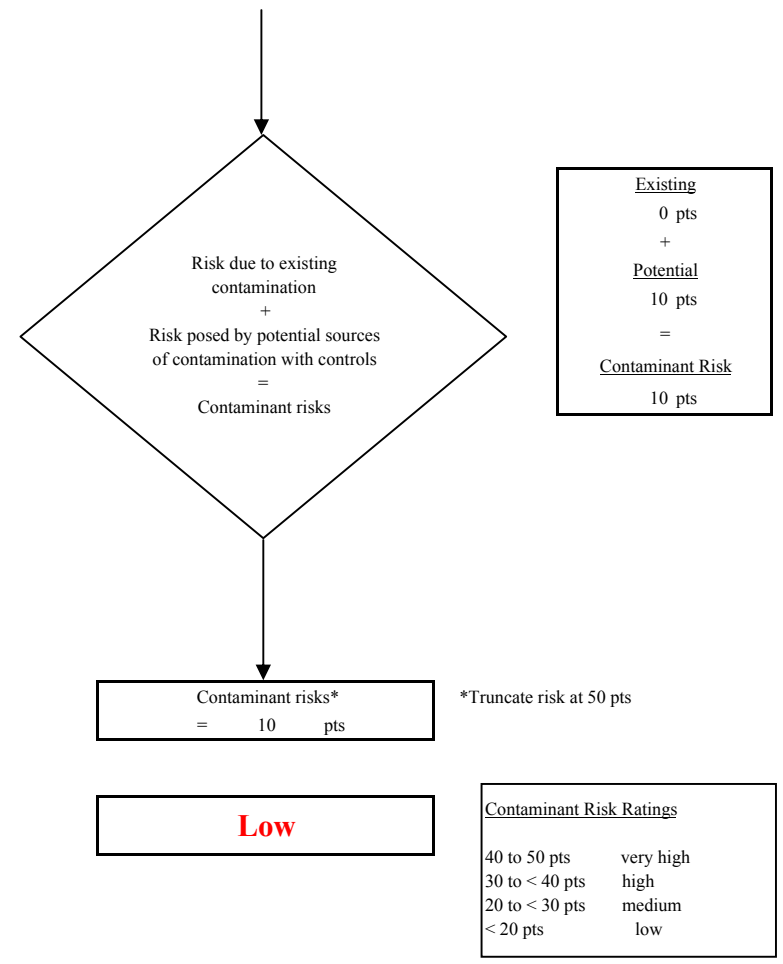
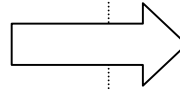
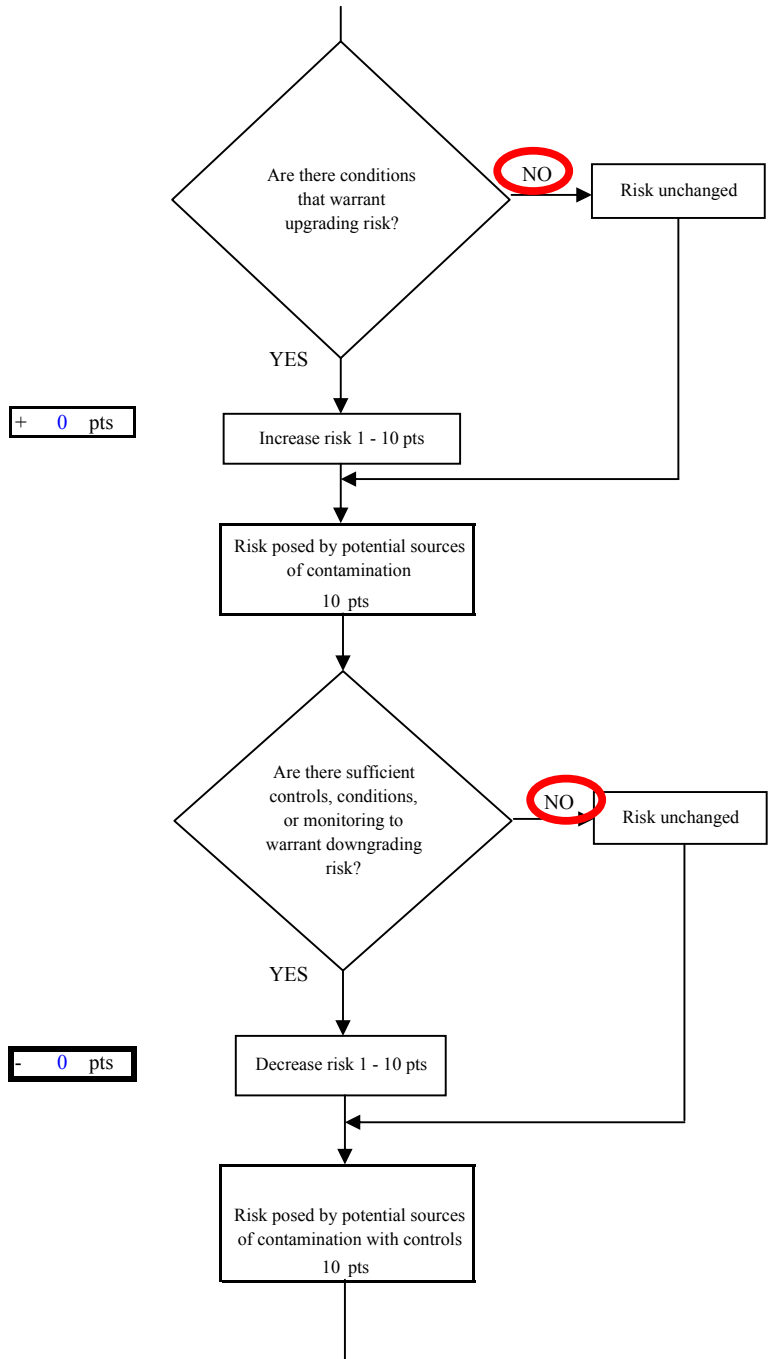
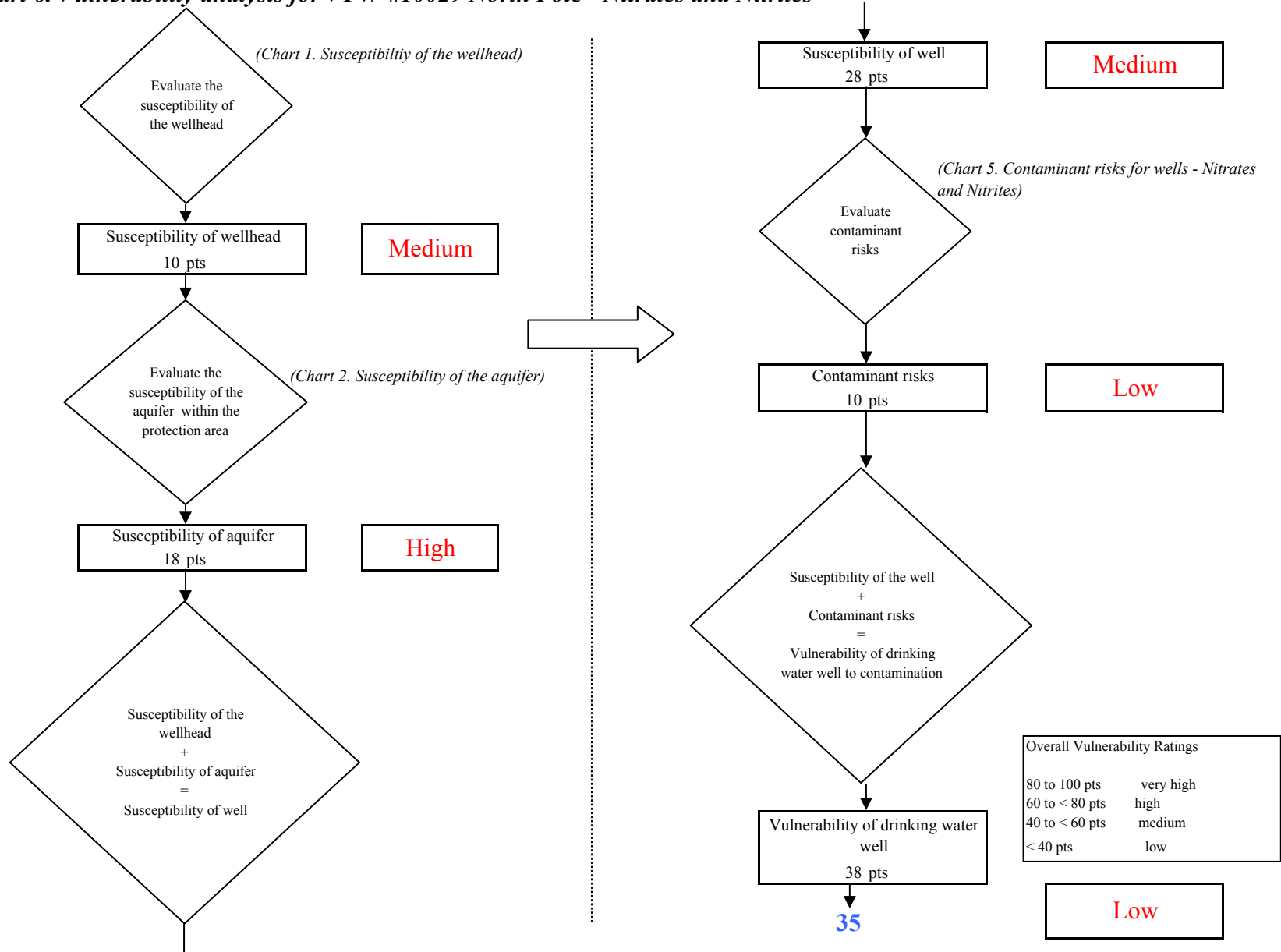


Chart 5. Contaminant risks for VFW #10029 North Pole - Nitrates and Nitrites



**Chart 6. Vulnerability analysis for VFW #10029 North Pole - Nitrates and Nitrites**



**Chart 7. Contaminant risks for VFW #10029 North Pole - Volatile Organic Chemicals**

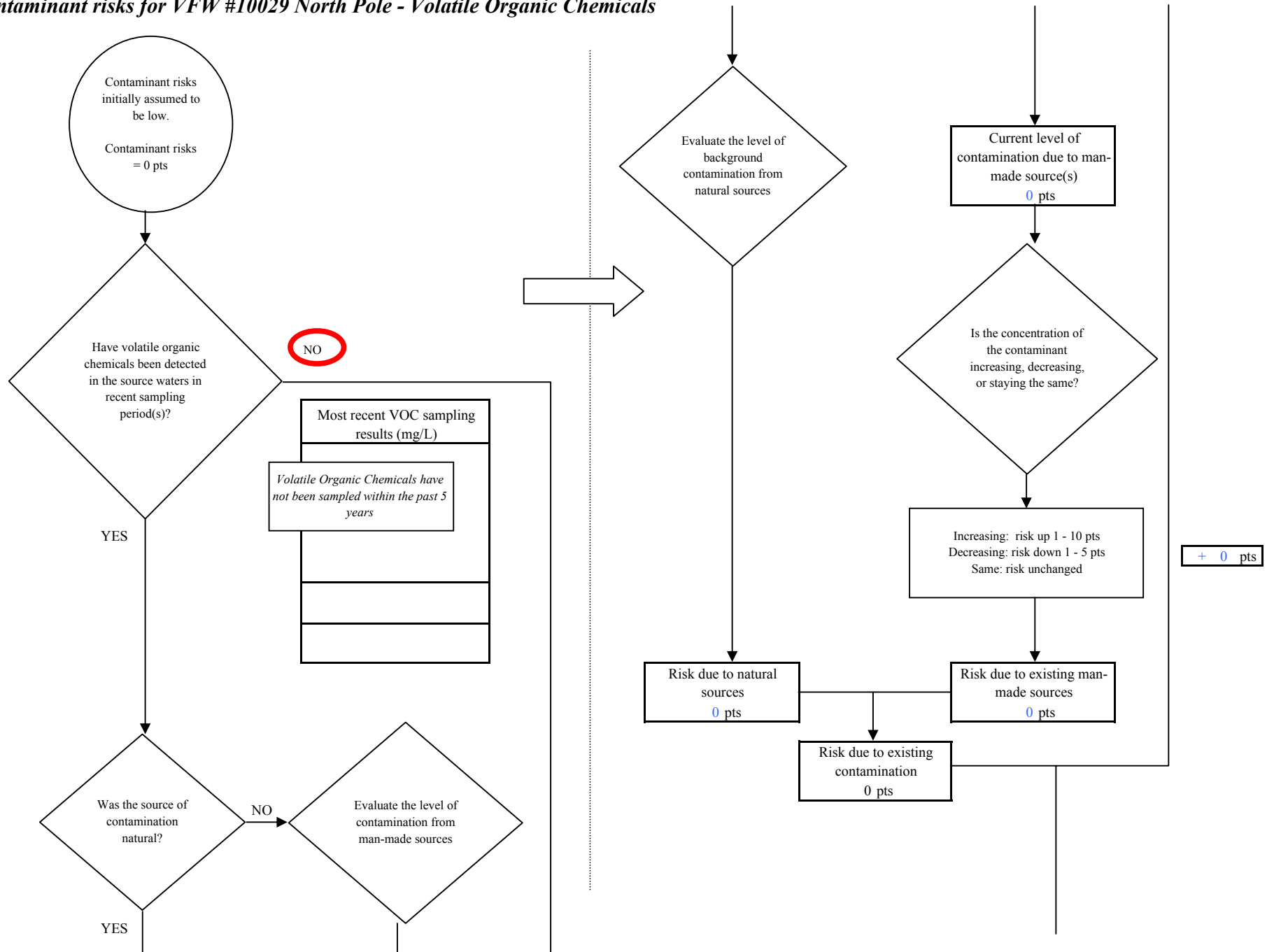
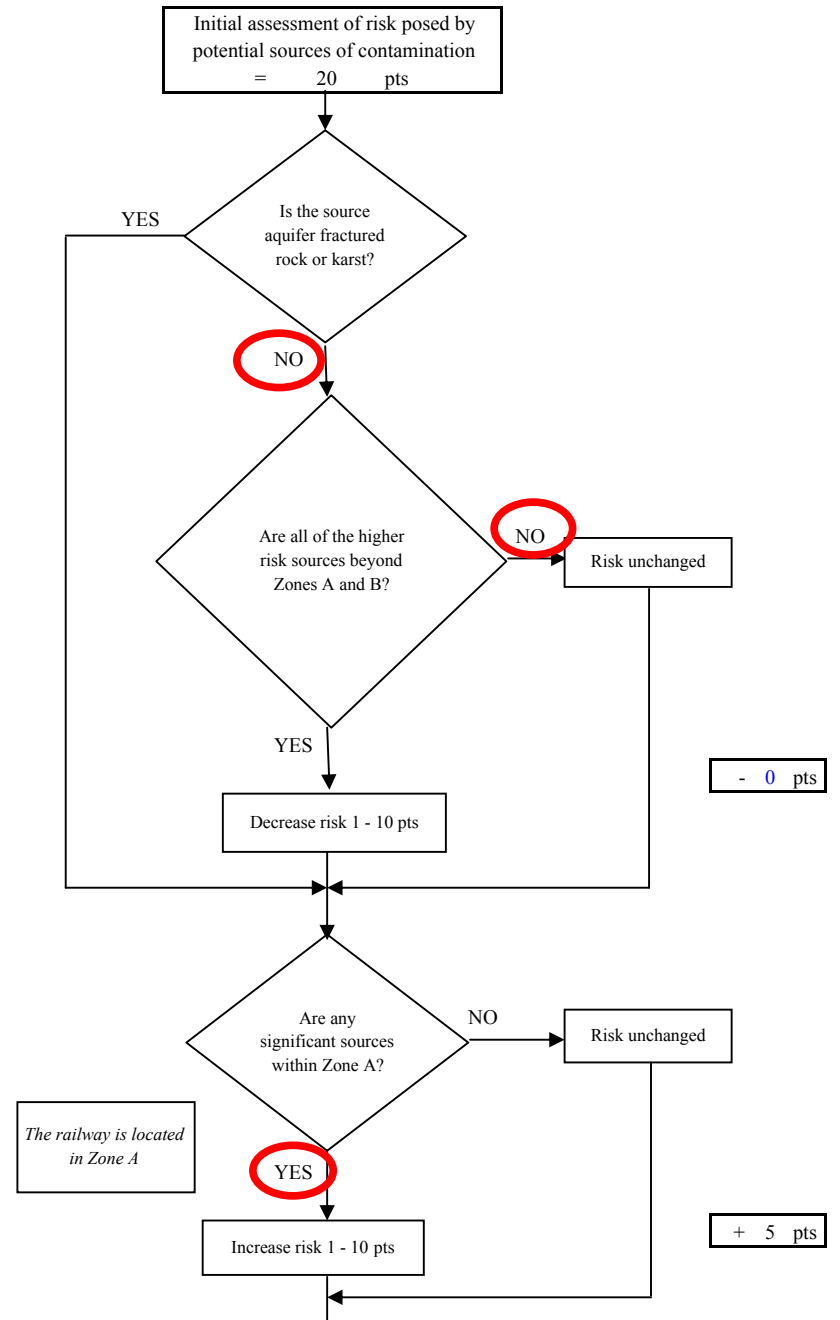
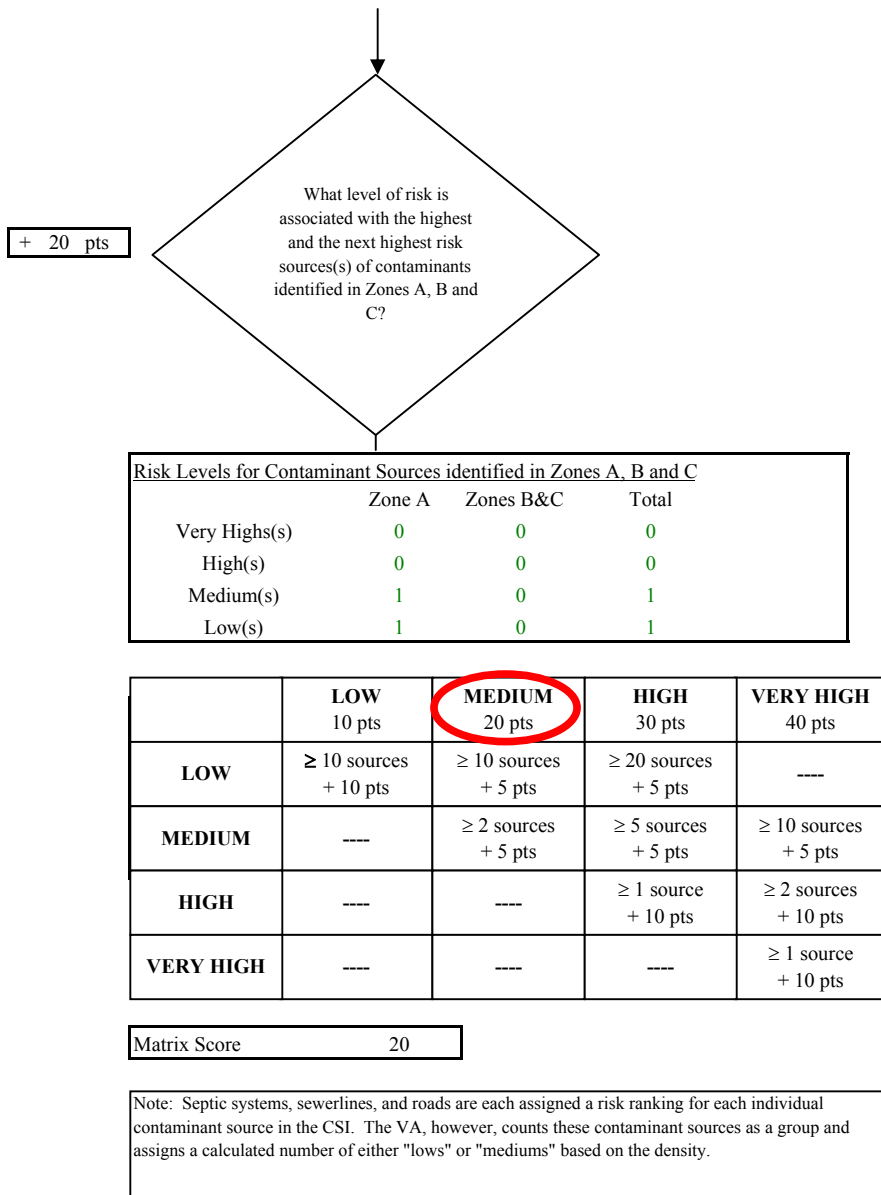
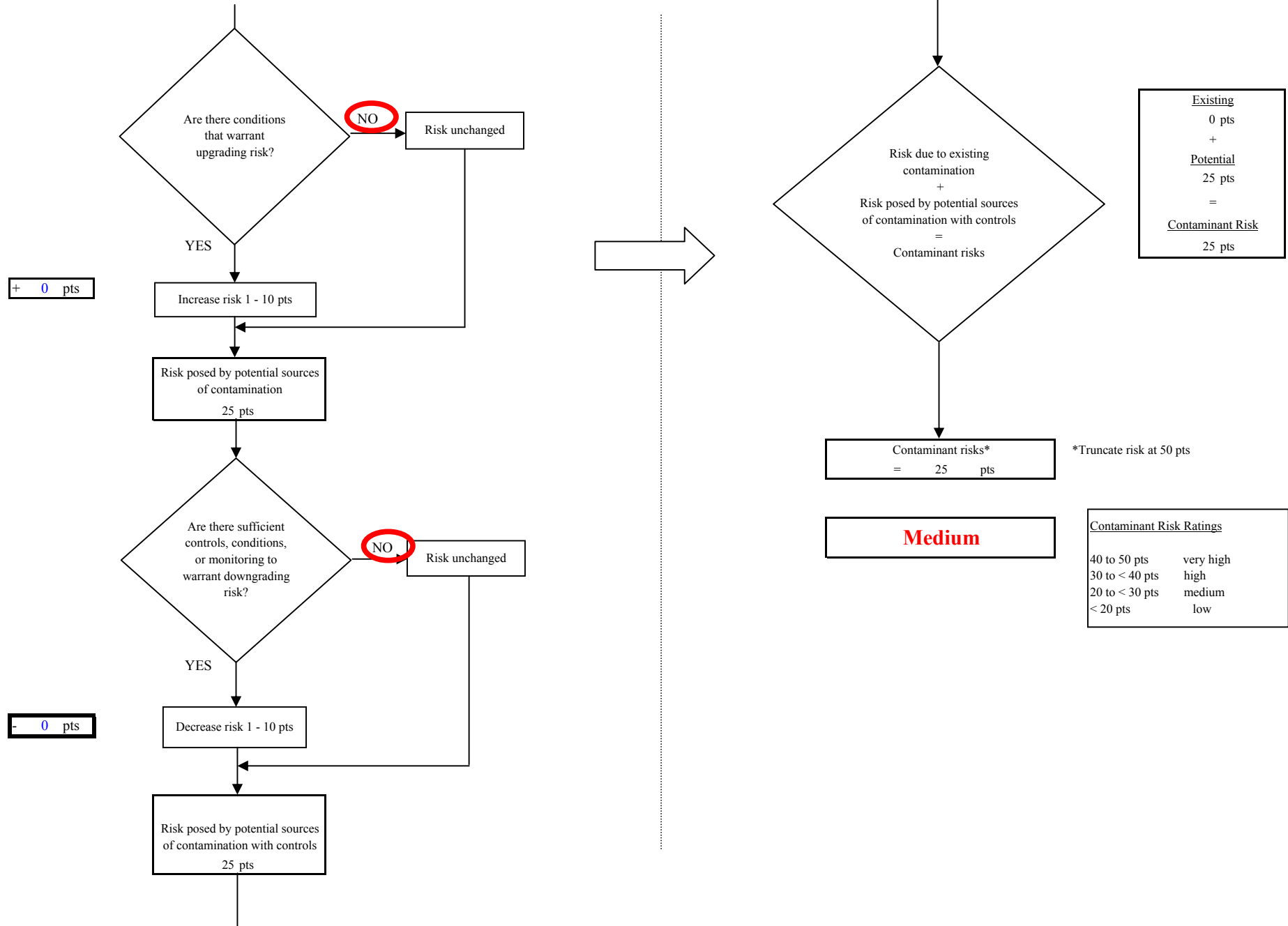


Chart 7. Contaminant risks for VFW #10029 North Pole - Volatile Organic Chemicals





**Chart 7. Contaminant risks for VFW #10029 North Pole - Volatile Organic Chemicals**



**Chart 8. Vulnerability analysis for VFW #10029 North Pole - Volatile Organic Chemicals**

