



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Quickie Pizza Drinking Water System,
Pleasant Valley, Alaska

PWSID 314409

March 2004

DRINKING WATER PROTECTION PROGRAM REPORT Report 1472
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.

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Source Water Assessment for Quickie Pizza Source of Public Drinking Water, Pleasant Valley, 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 Quickie Pizza to potential contamination. This Class B (non-community) water system consists of one well on Burgundy Street near its intersection with Chena Hot Springs Road in Pleasant Valley, Alaska. The well received a natural susceptibility rating of **Medium**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **High** rating for the aquifer in which the well is drawing water from. Identified potential and existing sources of contamination for the Quickie Pizza public water system include: residential area, septic systems, heating oil tanks, and a road. Contaminant sources 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 Quickie Pizza received an overall vulnerability rating of **Medium** for all three contaminant categories: bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

QUICKIE PIZZA PUBLIC DRINKING WATER SYSTEM

Quickie Pizza public water system is a Class B (non-community) water system. The system consists of one well on Burgundy Street near its intersection with Chena Hot Springs Road in Pleasant Valley, Alaska (T1N R4E Section 26) (See Map 1 of Appendix A). Pleasant Valley is located northeast 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.

The majority of residents of Pleasant Valley 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. Refuse is collected in dumpsters and transported to the Fairbanks North Star Borough Class I Landfill on South Cushman Street in Fairbanks.

The Fairbanks area includes two distinct topographic areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north and east of this alluvial plain. The Quickie Pizza water system is located in the uplands northeast of the alluvial plain at an elevation of approximately 625 feet above sea level.

The depth of this well is 56 feet below ground surface. Other wells are screened in a combination of gravel and sand above bedrock and it is assumed 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. Discontinuous permafrost (perennially frozen areas) is also common in this area. Areas with discontinuous permafrost may locally affect the ground water flow directions.

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).

This public drinking water system serves between 2 and 10 non-residents per day.

QUICKIE PIZZA 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).

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

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 Quickie Pizza 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 Quickie Pizza 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 QUICKIE PIZZA 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.

$$\begin{aligned}
 &\text{Susceptibility of the Wellhead (0 – 25 Points)} \\
 &\quad \text{(Chart 1 of Appendix D)} \\
 &\quad + \\
 &\text{Susceptibility of the Aquifer (0 – 25 Points)} \\
 &\quad \text{(Chart 2 of Appendix D)} \\
 &\quad = \\
 &\text{Natural Susceptibility (Susceptibility of the Well)} \\
 &\quad \text{(0 – 50 Points)}
 \end{aligned}$$

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 Quickie Pizza received a Low Susceptibility rating. It is not known if the well is capped with a sanitary seal or if the land surface is correctly sloped away from the well according to ADEC regulations. It is assumed the well is not grouted. A sanitary seal prevents potential contaminant 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 Quickie Pizza well is completed in received a High Susceptibility rating. The highly transmissive aquifer material allows contaminants to quickly travel downward from the surface with the precipitation and surface water runoff. Other wells in the protection area can also provide a quick path to the aquifer if they are not grouted properly. Table 2 summarizes the Susceptibility scores and ratings for Quickie Pizza.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Very High
Susceptibility of the Aquifer	15	High
Natural Susceptibility	20	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	22	Medium
Nitrates and/or Nitrites	22	Medium
Volatile Organic Chemicals	30	

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

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

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.

susceptibility of the well, the overall vulnerability of the well to contamination is medium.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	40	Medium
Nitrates and Nitrites	40	Medium
Volatile Organic Chemicals	50	Medium

Bacteria and Viruses

The septic systems are the greatest identified potential source of bacteria and virus contamination to this well.

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, it is 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 not detected coliforms in this drinking water system.

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 medium.

Nitrates and Nitrites

The septic systems are also the greatest identified potential source of nitrate and nitrite contamination to this well.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have not been detected in recent (within the past 5 years) sampling history for Quickie Pizza.

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 medium.

Volatile Organic Chemicals

The heating oil tanks are the greatest potential source of volatile organic chemicals identified in the protection area.

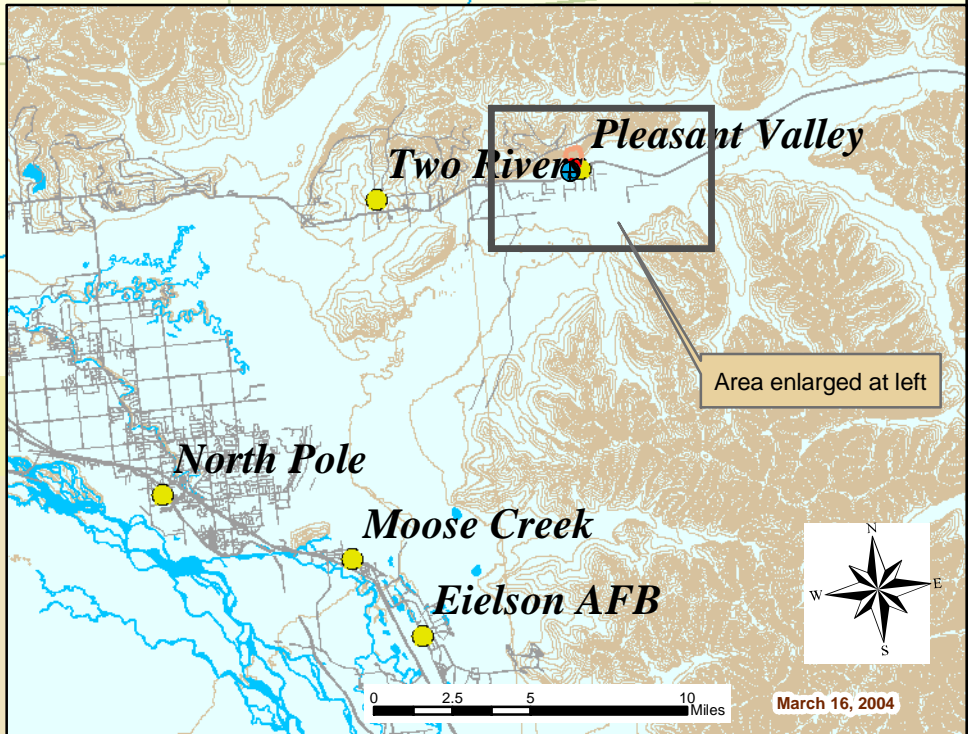
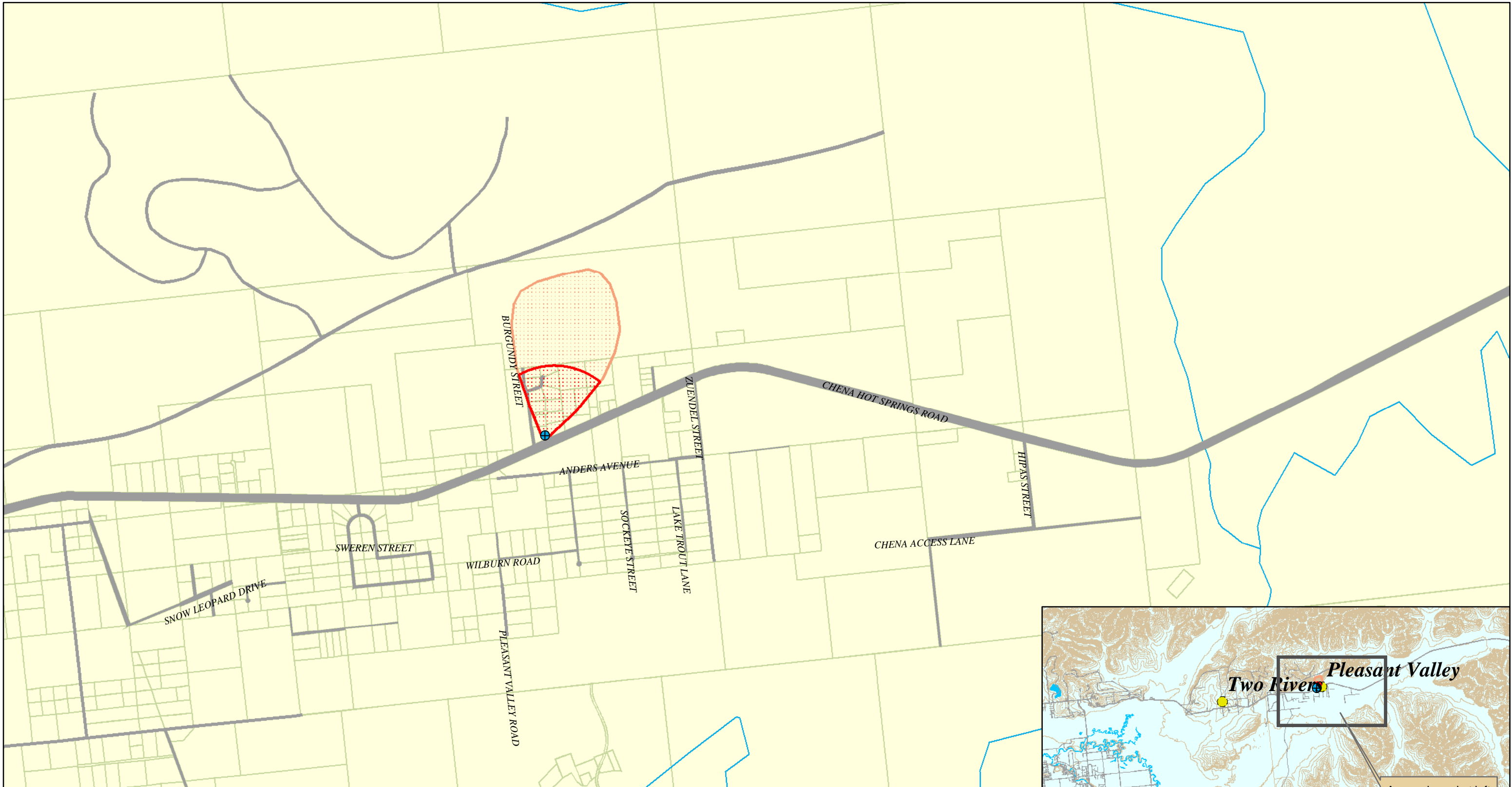
Volatile Organic Chemicals have not been sampled for in this water system. After combining the contaminant risk for volatile organic chemicals with the natural

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APPENDIX A

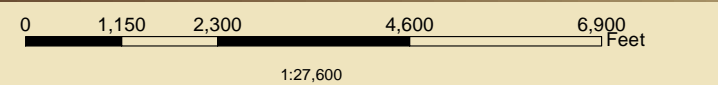
Quickie Pizza Drinking Water Protection Area Location Map (Map 1)



Map 1: Quickie Pizza Drinking Water Protection Area **PWSID: 314409**



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



- Legend**
- Quickie Pizza well
 - Zone A
 - Zone B
 - Towns
 - Parcels
 - Roads
 - Surface water



March 16, 2004

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Quickie Pizza (Tables 1-4)

Table 1

**Contaminant Source Inventory for
Quickie Pizza**

PWSID 314409.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Residential Areas	R01		A	2	Approximately 25 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		A	2	Assumed 8 septic systems in Zone A based on number of tax parcels listed as residential
Tanks, heating oil, residential (above ground)	R08		A	2	Assumed 8 heating oil tanks in Zone A based on number of tax parcels listed as residential
Residential Areas	R01		B	2	Approximately less than 5 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		B	2	Assumed one septic system in Zone B
Tanks, heating oil, residential (above ground)	R08		B	2	Assumed one heating oil tank in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	2	Zinfindel Court

Table 2

*Contaminant Source Inventory and Risk Ranking for
Quickie Pizza
Sources of Bacteria and Viruses*

PWSID 314409.001

<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>
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 8 septic systems in Zone A based on number of tax parcels listed as residential
Residential Areas	R01		A	Low	2	Approximately 25 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Zinfindel Court
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed one septic system in Zone B
Residential Areas	R01		B	Low	2	Approximately less than 5 acres of residential area in Zone B

Table 3

*Contaminant Source Inventory and Risk Ranking for
Quickie Pizza
Sources of Nitrates/Nitrites*

PWSID 314409.001

<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>
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 8 septic systems in Zone A based on number of tax parcels listed as residential
Residential Areas	R01		A	Low	2	Approximately 25 acres of residential area in Zone A
Residential Areas	R01		B	Low	2	Approximately less than 5 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed one septic system in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Zinfindel Court

Table 4

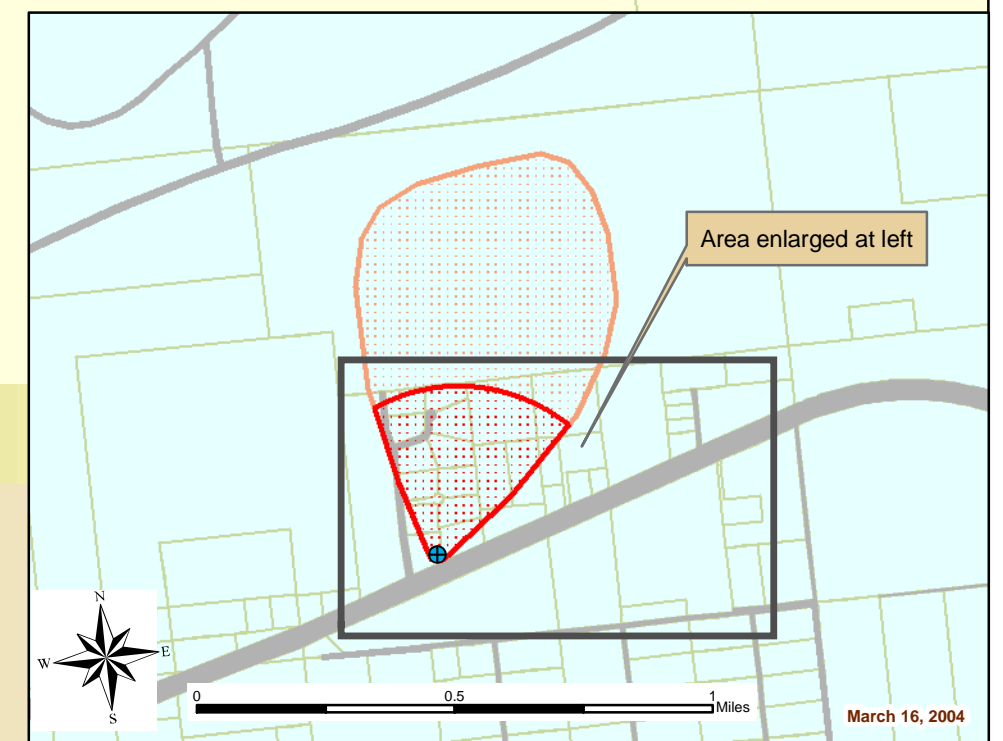
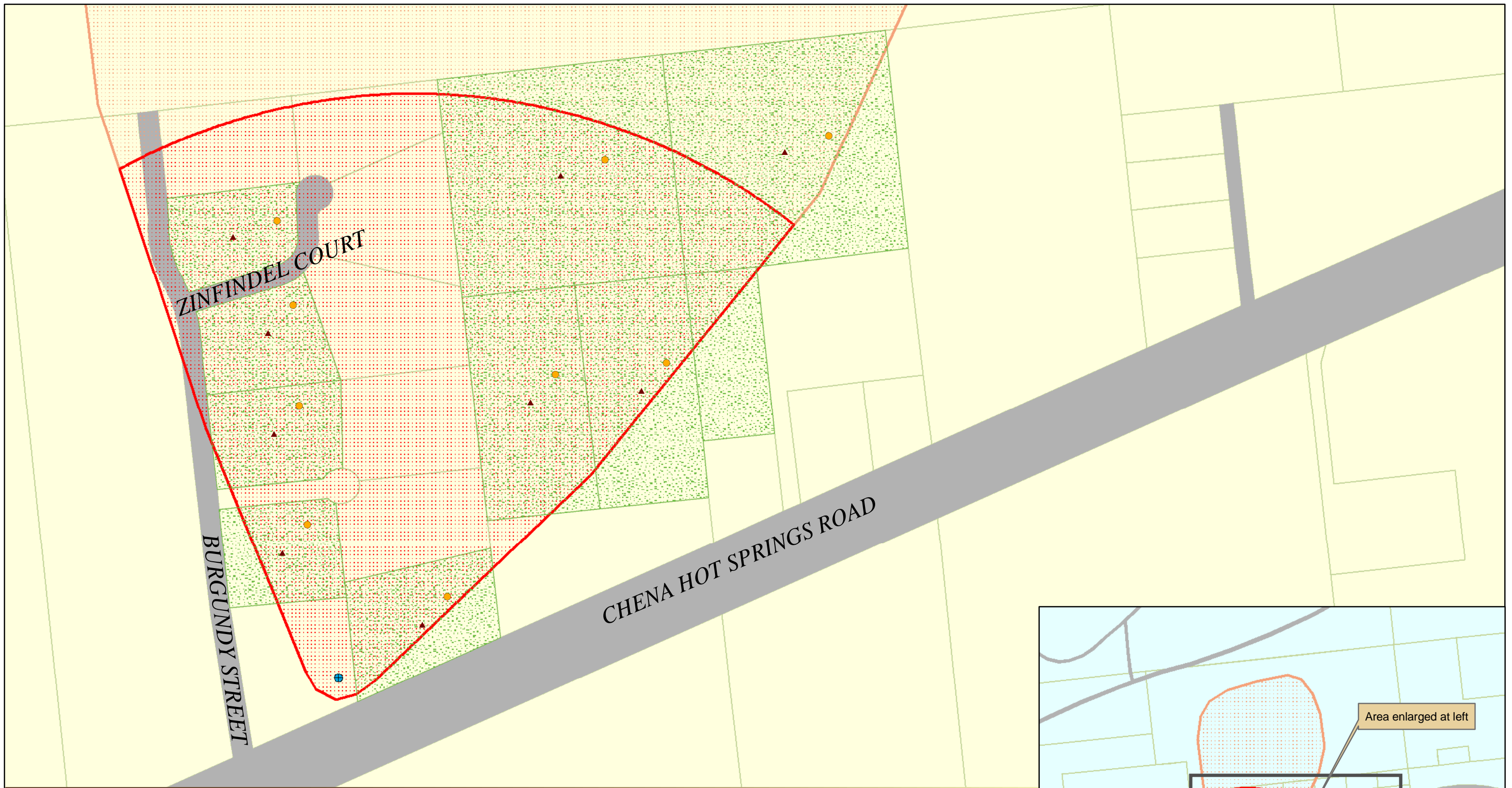
*Contaminant Source Inventory and Risk Ranking for
Quickie Pizza
Sources of Volatile Organic Chemicals*

PWSID 314409.001

<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>
Tanks, heating oil, residential (above ground)	R08		A	Medium	2	Assumed 8 heating oil tanks in Zone A based on number of tax parcels listed as residential
Residential Areas	R01		A	Low	2	Approximately 25 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 8 septic systems in Zone A based on number of tax parcels listed as residential
Residential Areas	R01		B	Low	2	Approximately less than 5 acres of residential area in Zone B
Tanks, heating oil, residential (above ground)	R08		B	Medium	2	Assumed one heating oil tank in Zone B
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed one septic system in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Zinfindel Court

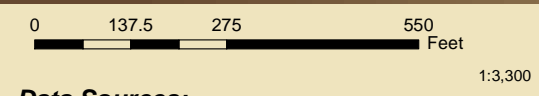
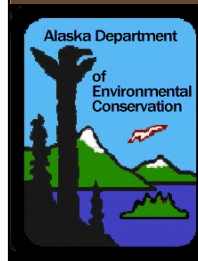
APPENDIX C

Quickie Pizza Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)



Map 2: Quickie Pizza Potential Contaminant Sources

PWSID: 314409



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

Legend

- Quickie Pizza well
- R02, Septic systems
- Zone A
- R01, Residential area
- Zone B
- Roads
- R08, Heating oil tanks
- Parcels

APPENDIX D

Vulnerability Analysis for Quickie Pizza Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Quickie Pizza

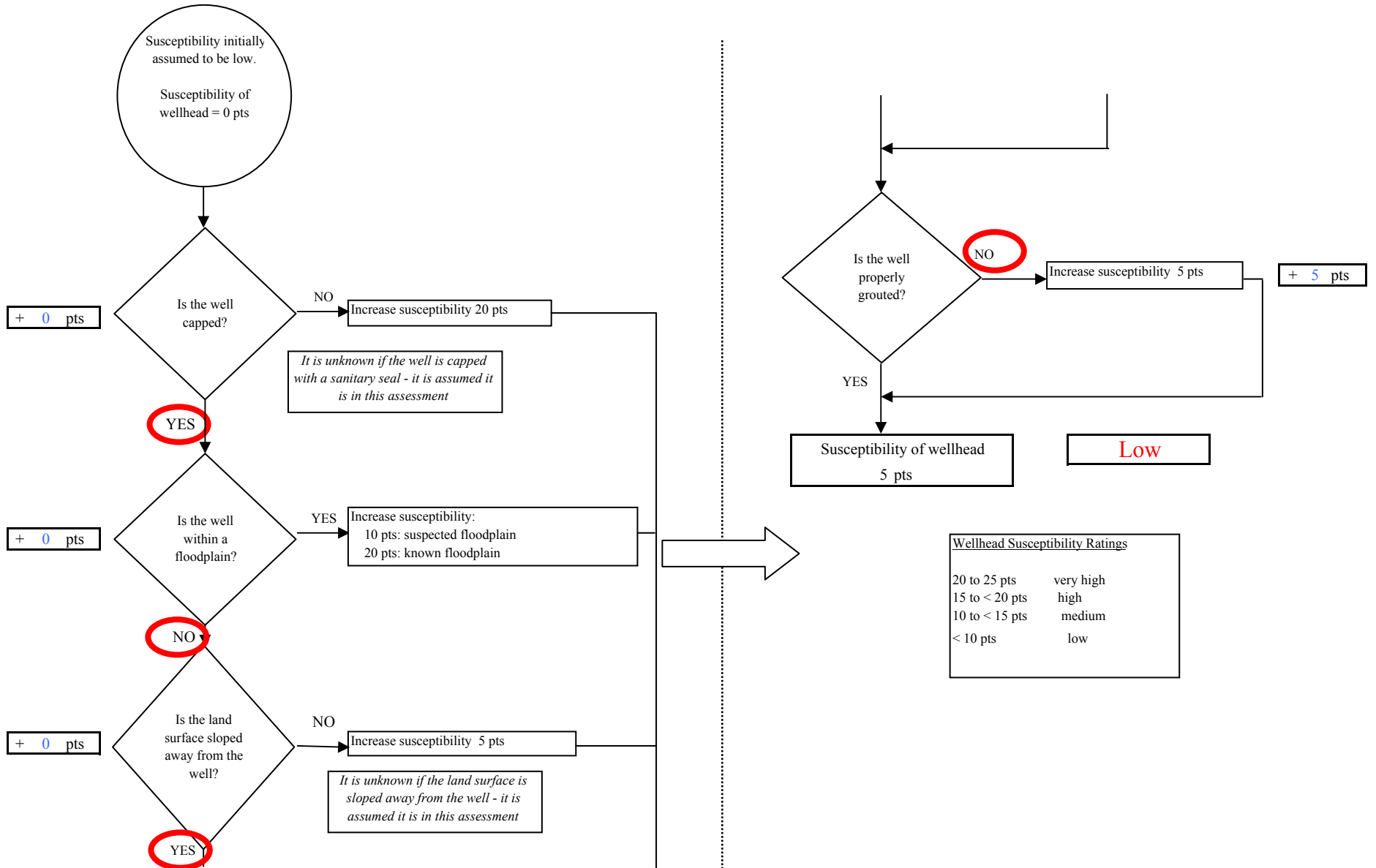


Chart 2. Susceptibility of the aquifer - Quickie Pizza

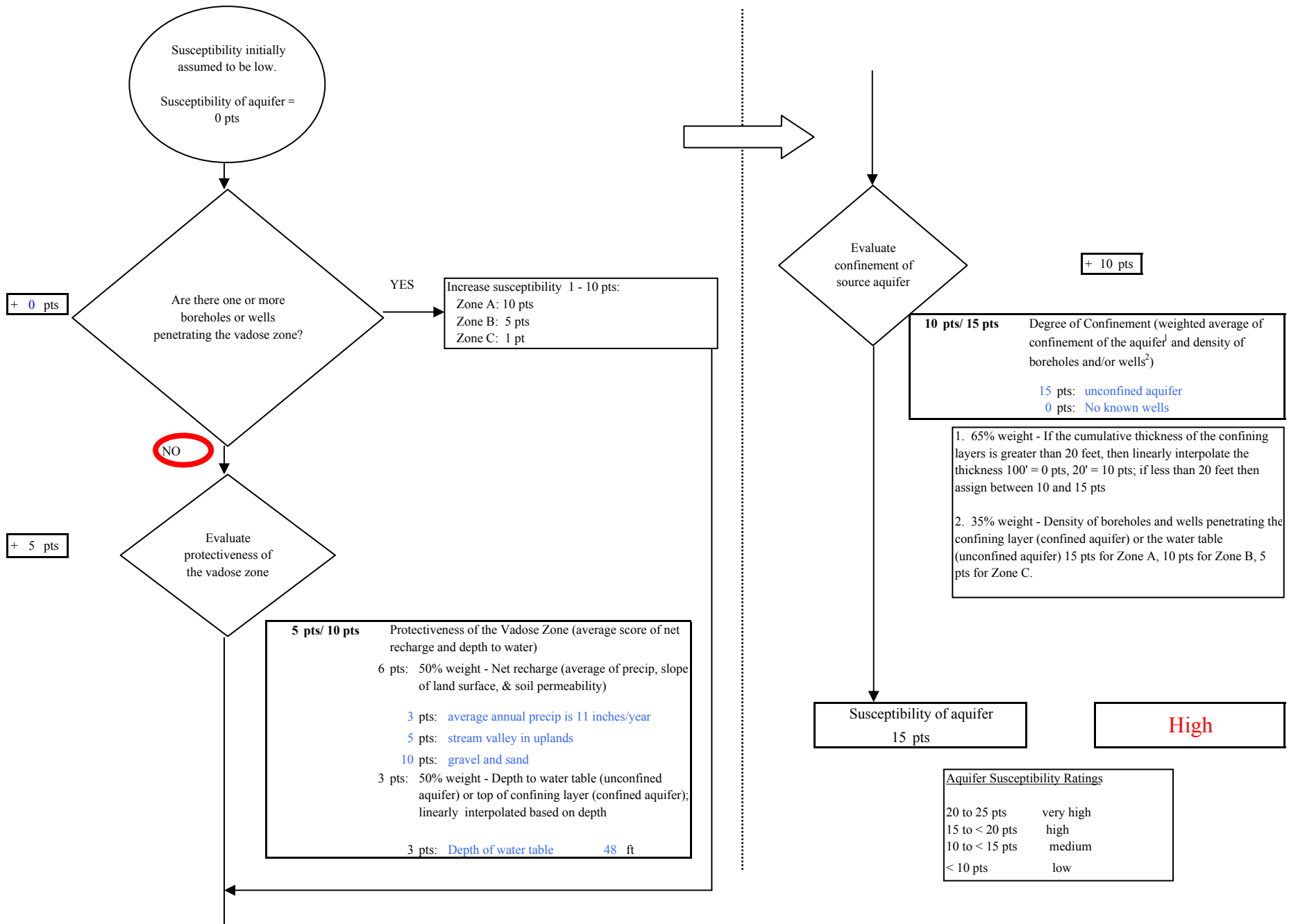
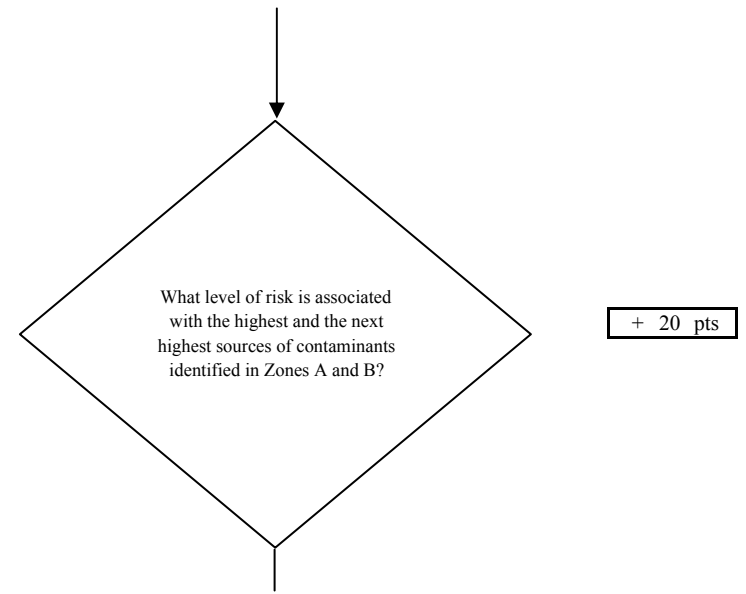
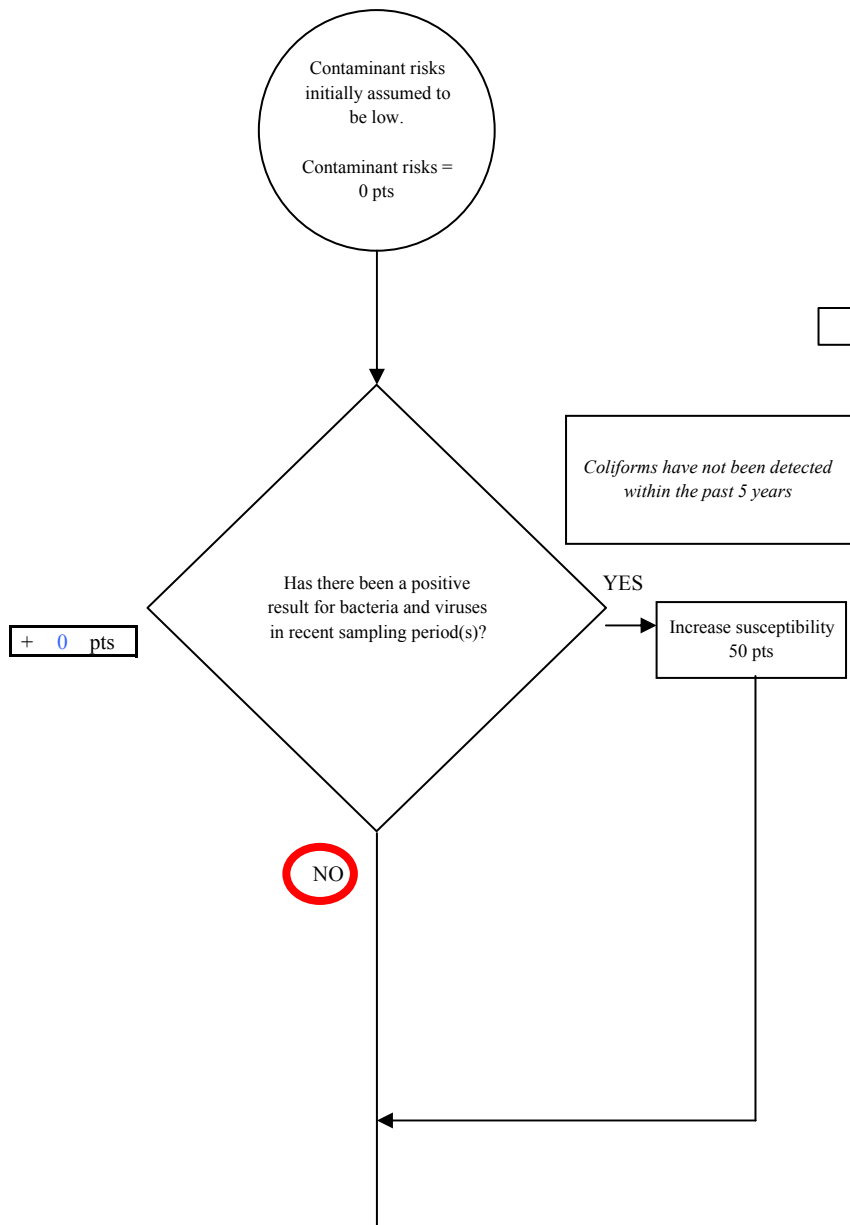


Chart 3. Contaminant risks for Quickie Pizza - Bacteria & Viruses



	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	9	3	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 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 3. Contaminant risks for Quickie Pizza - Bacteria & Viruses

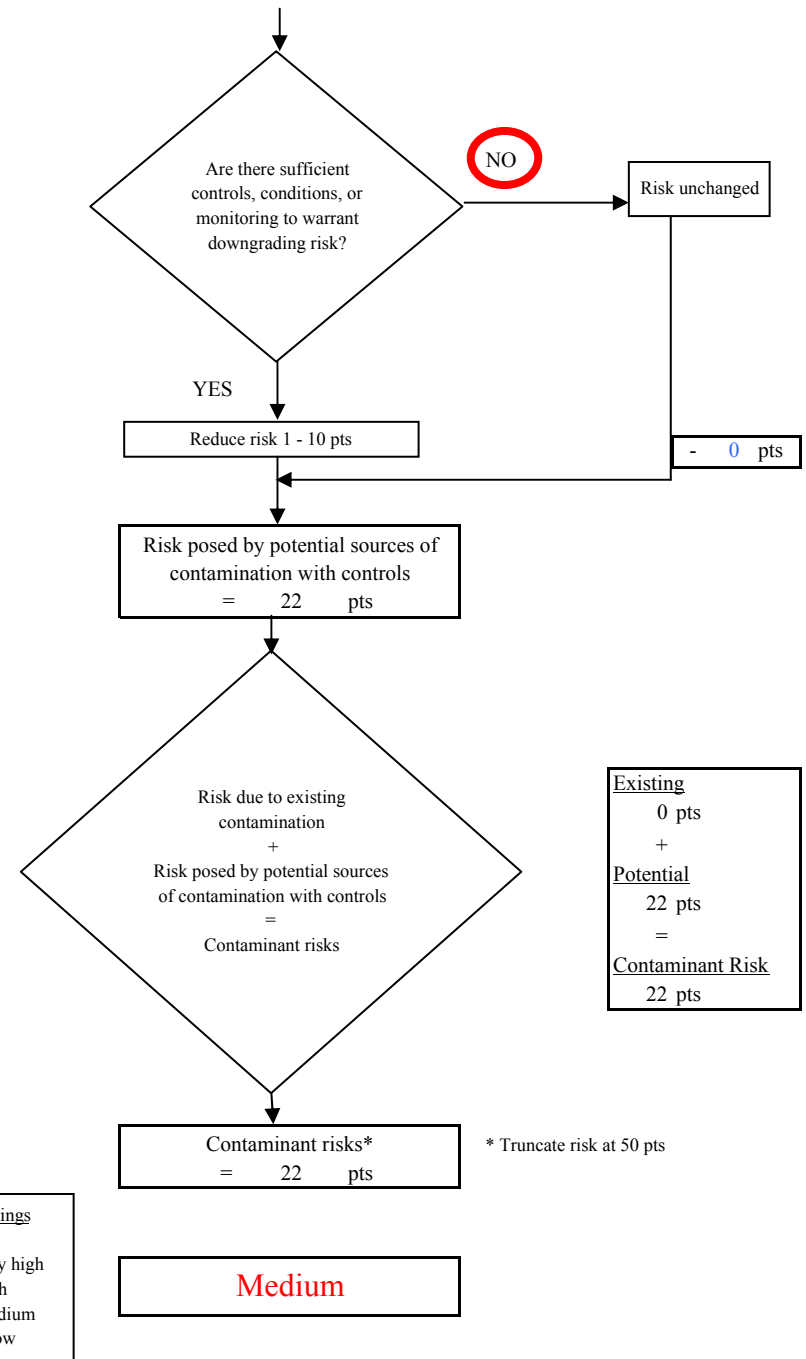
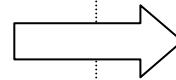
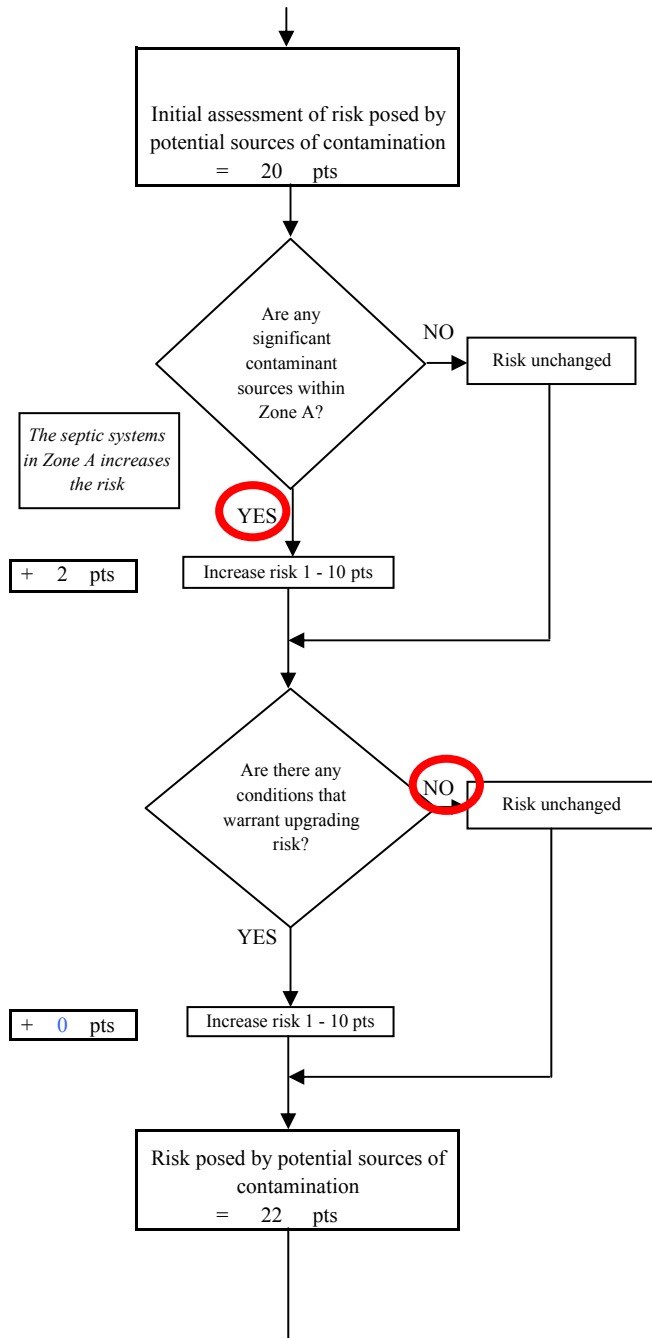


Chart 4. Vulnerability analysis for Quickie Pizza - Bacteria & Viruses

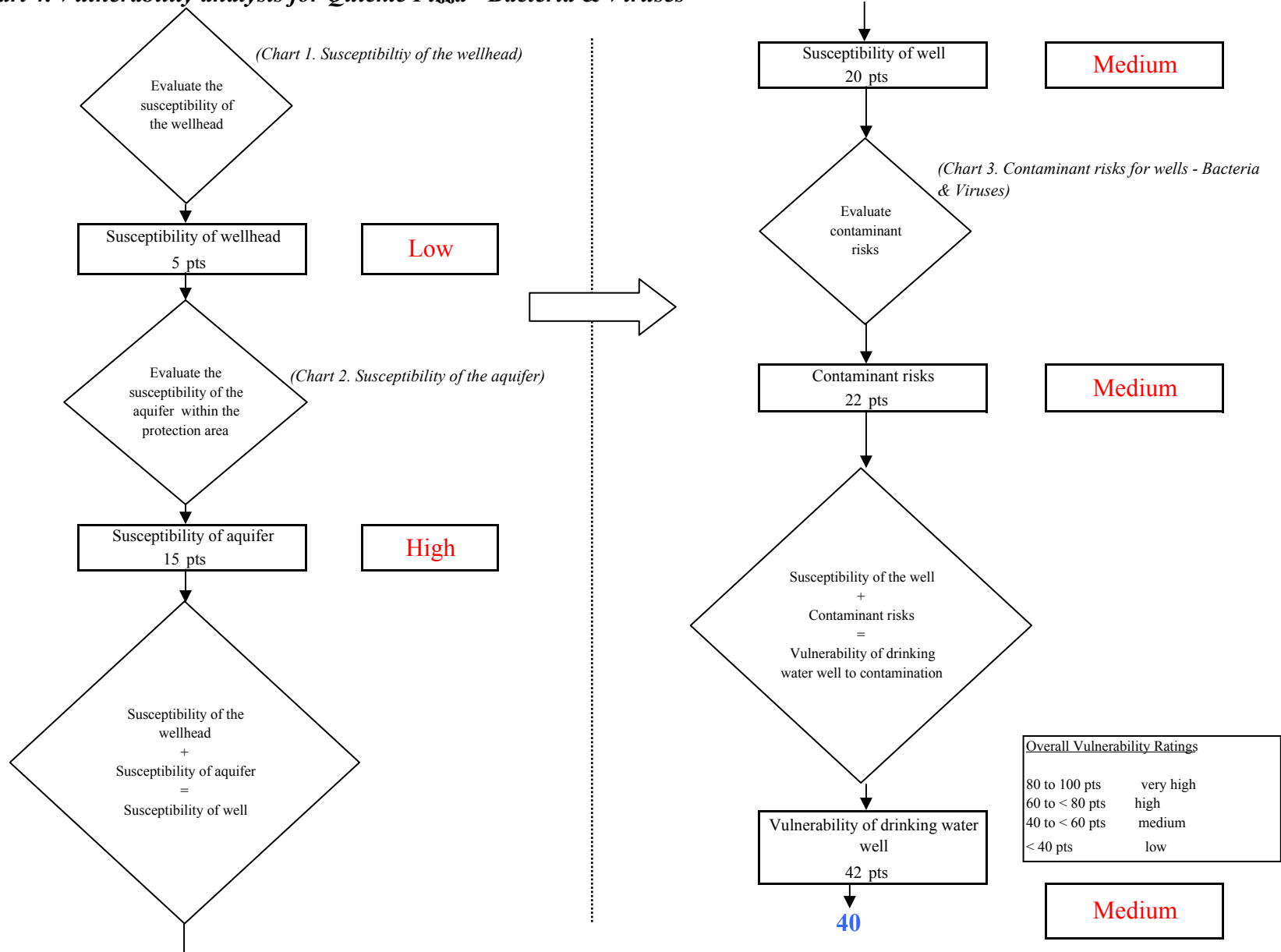


Chart 5. Contaminant risks for Quickie Pizza - Nitrates and Nitrites

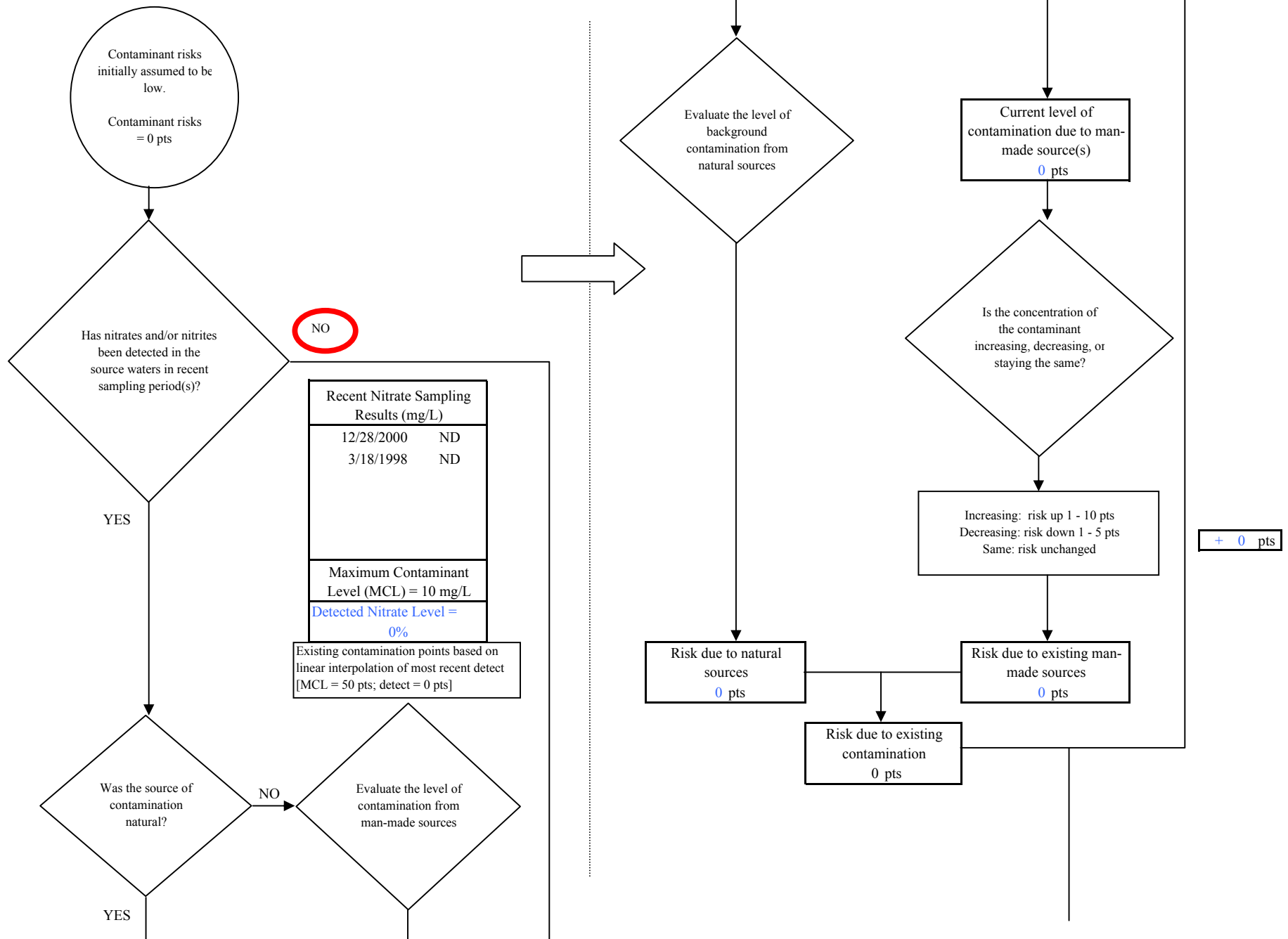


Chart 5. Contaminant risks for Quickie Pizza - Nitrates and Nitrites

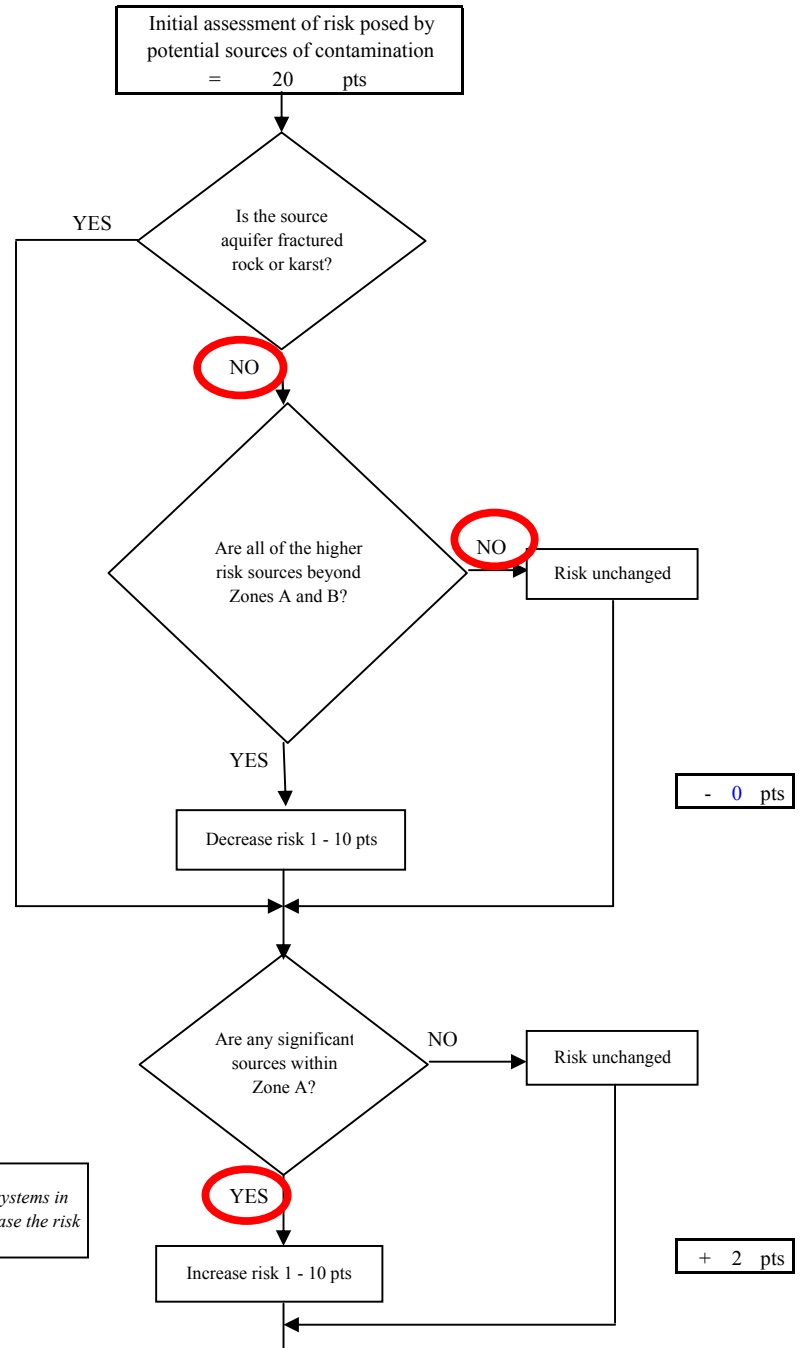
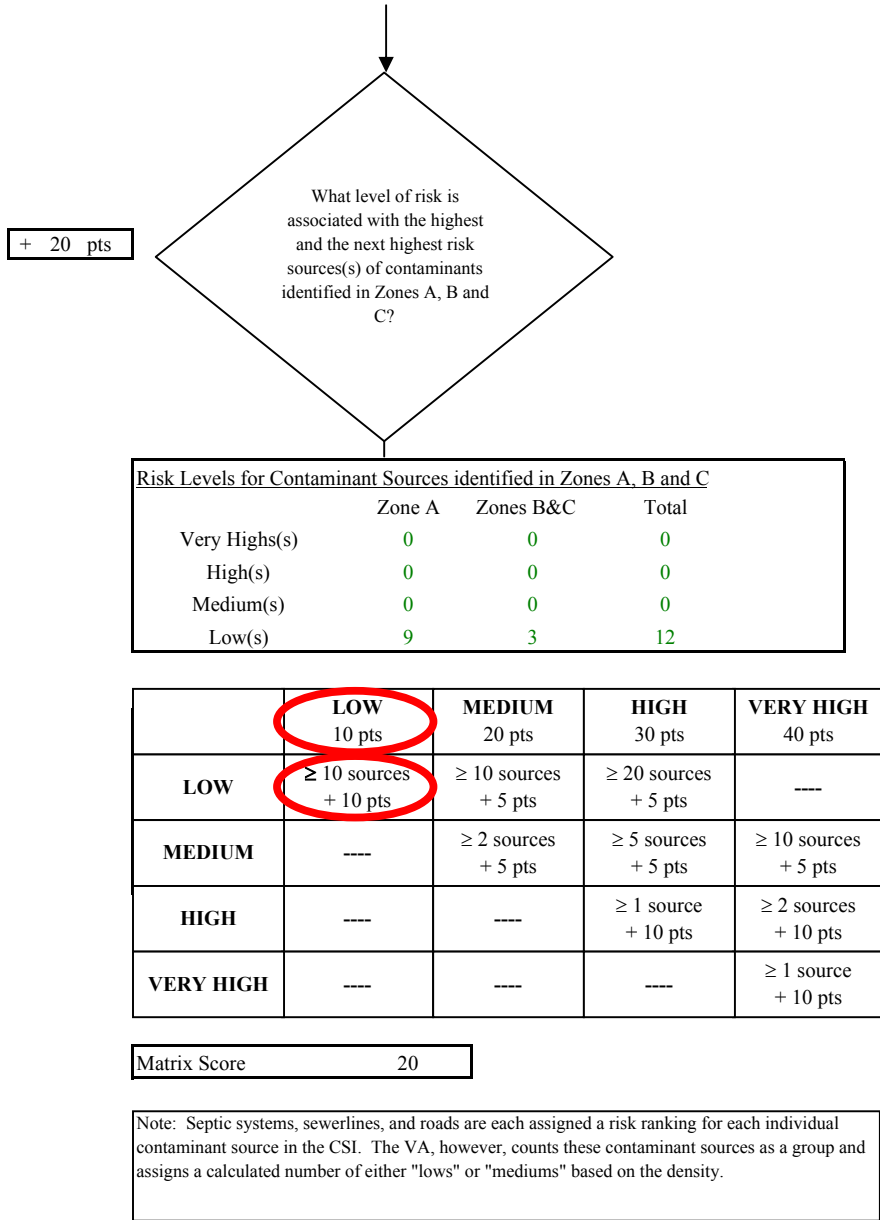


Chart 5. Contaminant risks for Quickie Pizza - Nitrates and Nitrites

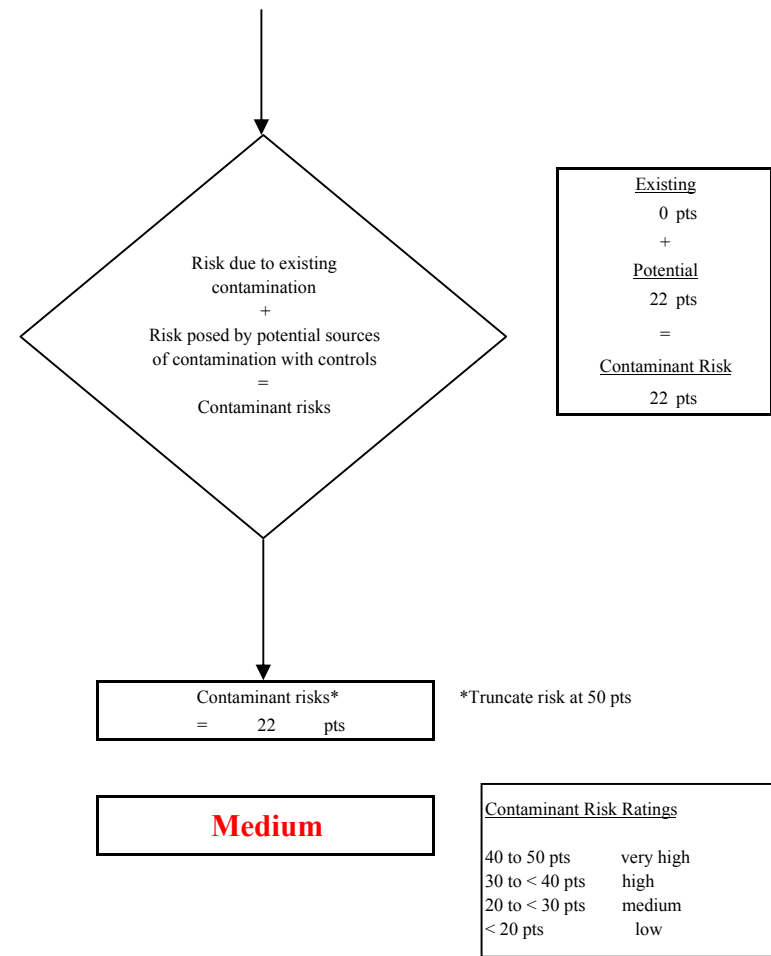
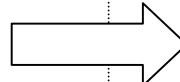
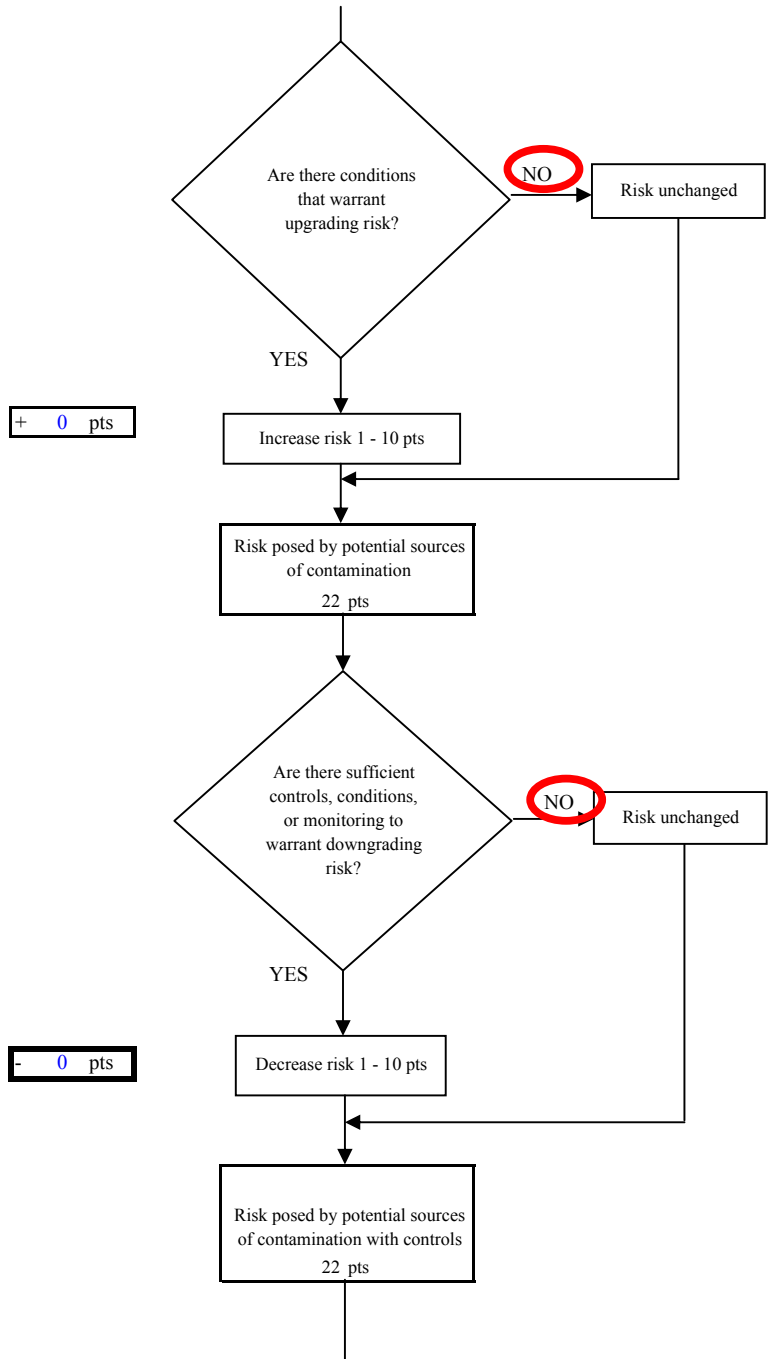


Chart 6. Vulnerability analysis for Quickie Pizza - Nitrates and Nitrites

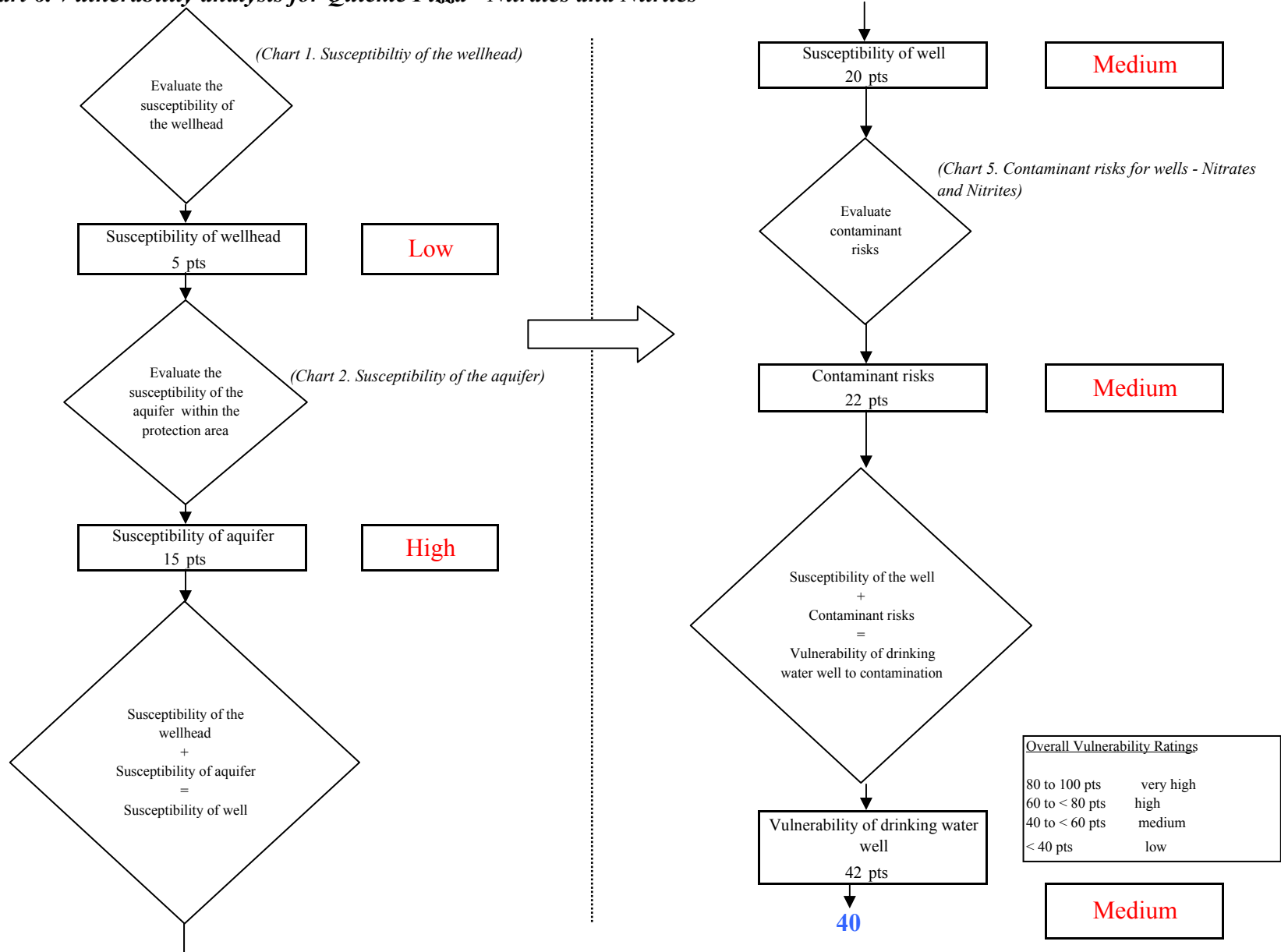


Chart 7. Contaminant risks for Quickie Pizza - Volatile Organic Chemicals

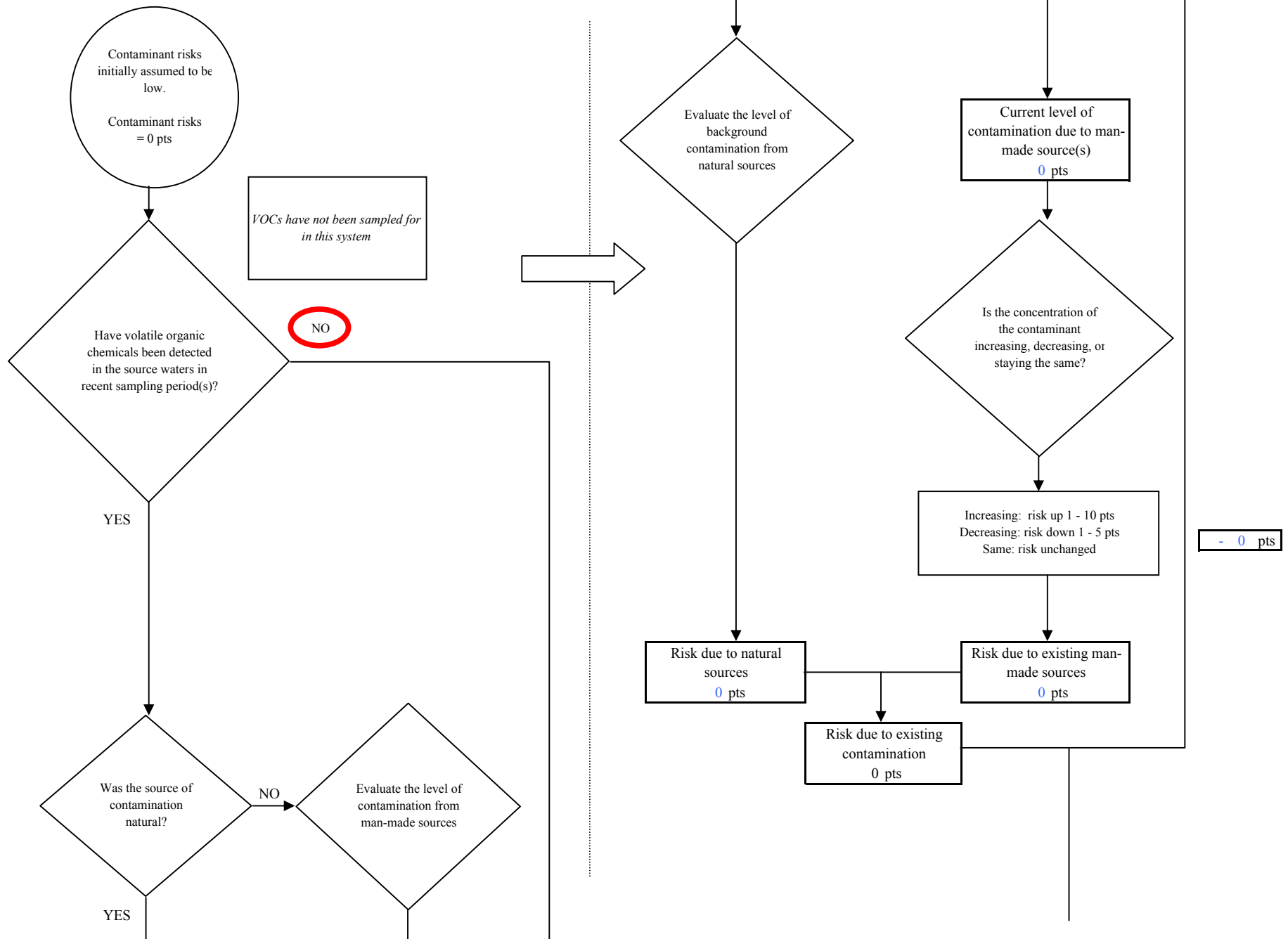


Chart 7. Contaminant risks for Quickie Pizza - Volatile Organic Chemicals

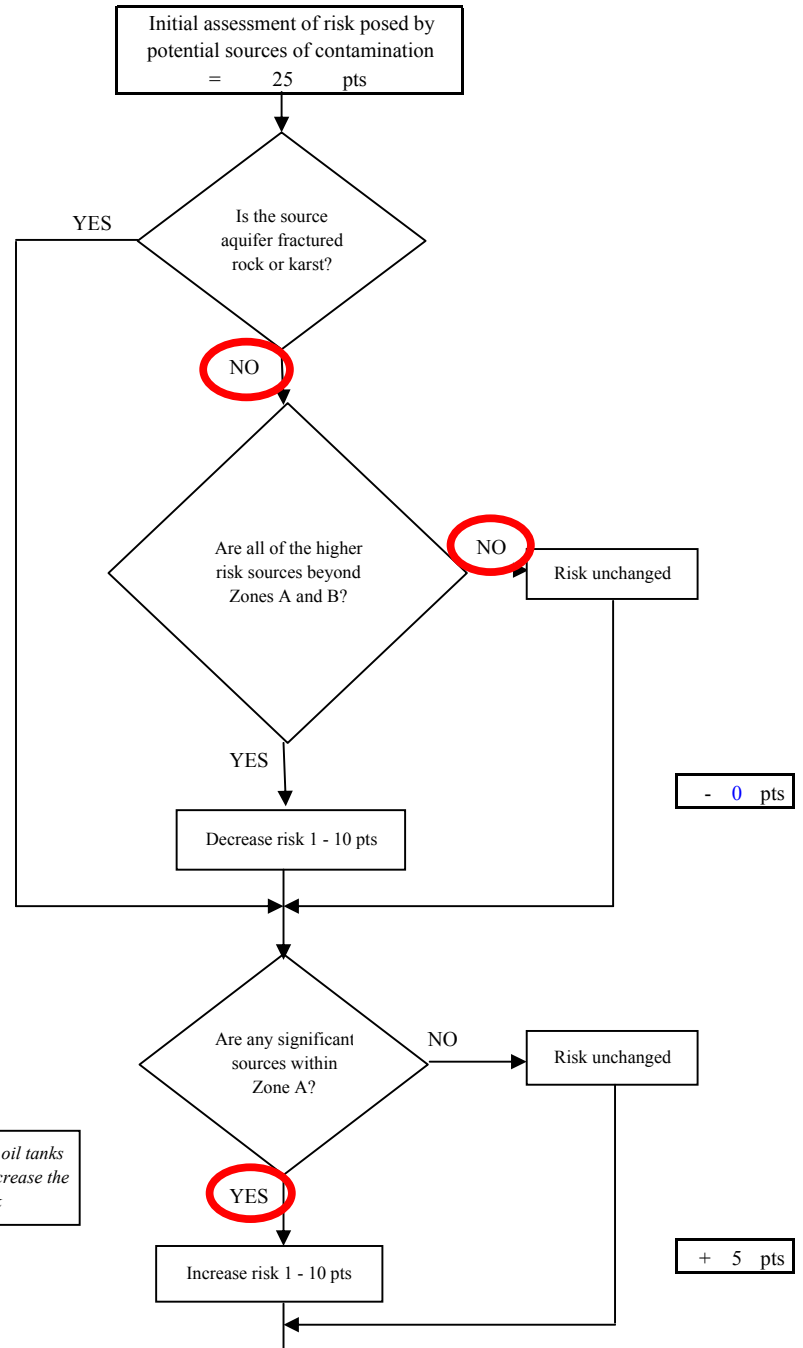
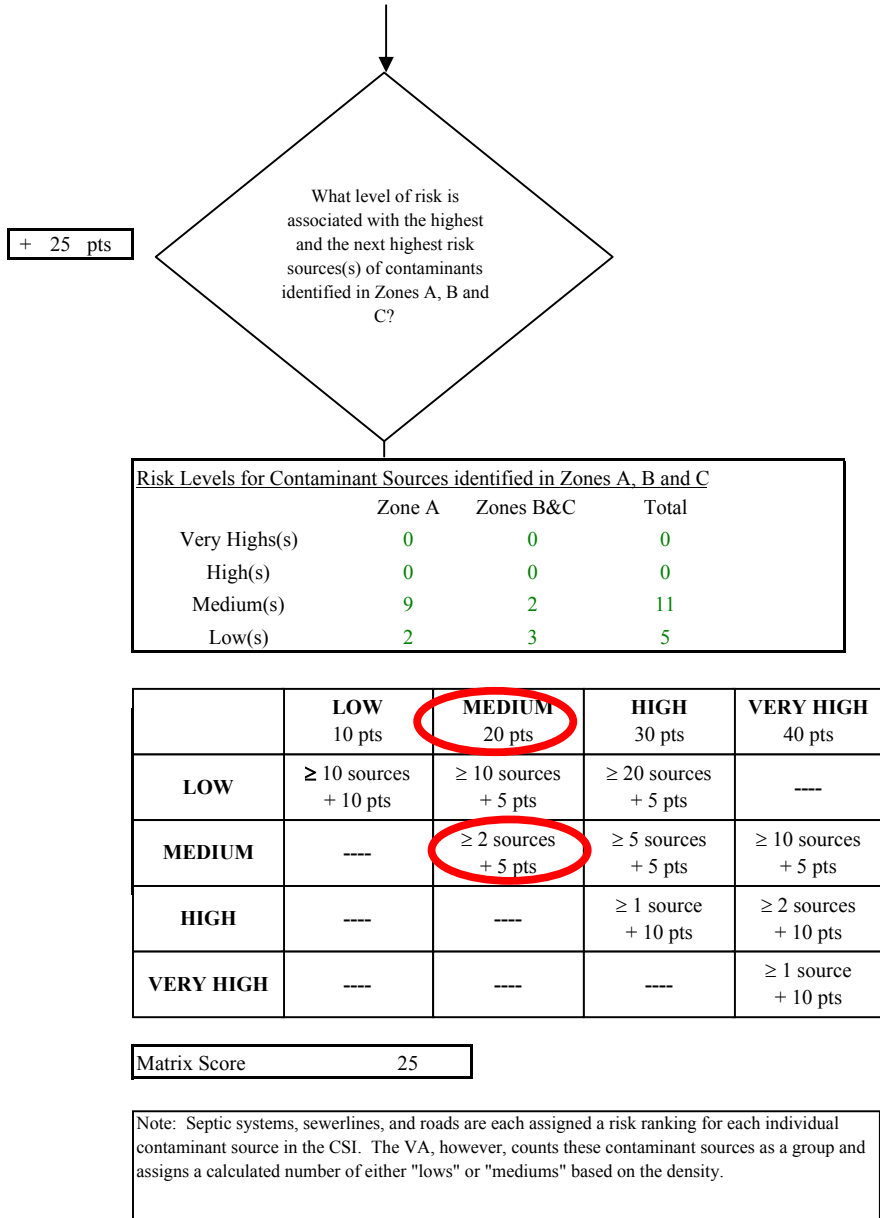


Chart 7. Contaminant risks for Quickie Pizza - Volatile Organic Chemicals

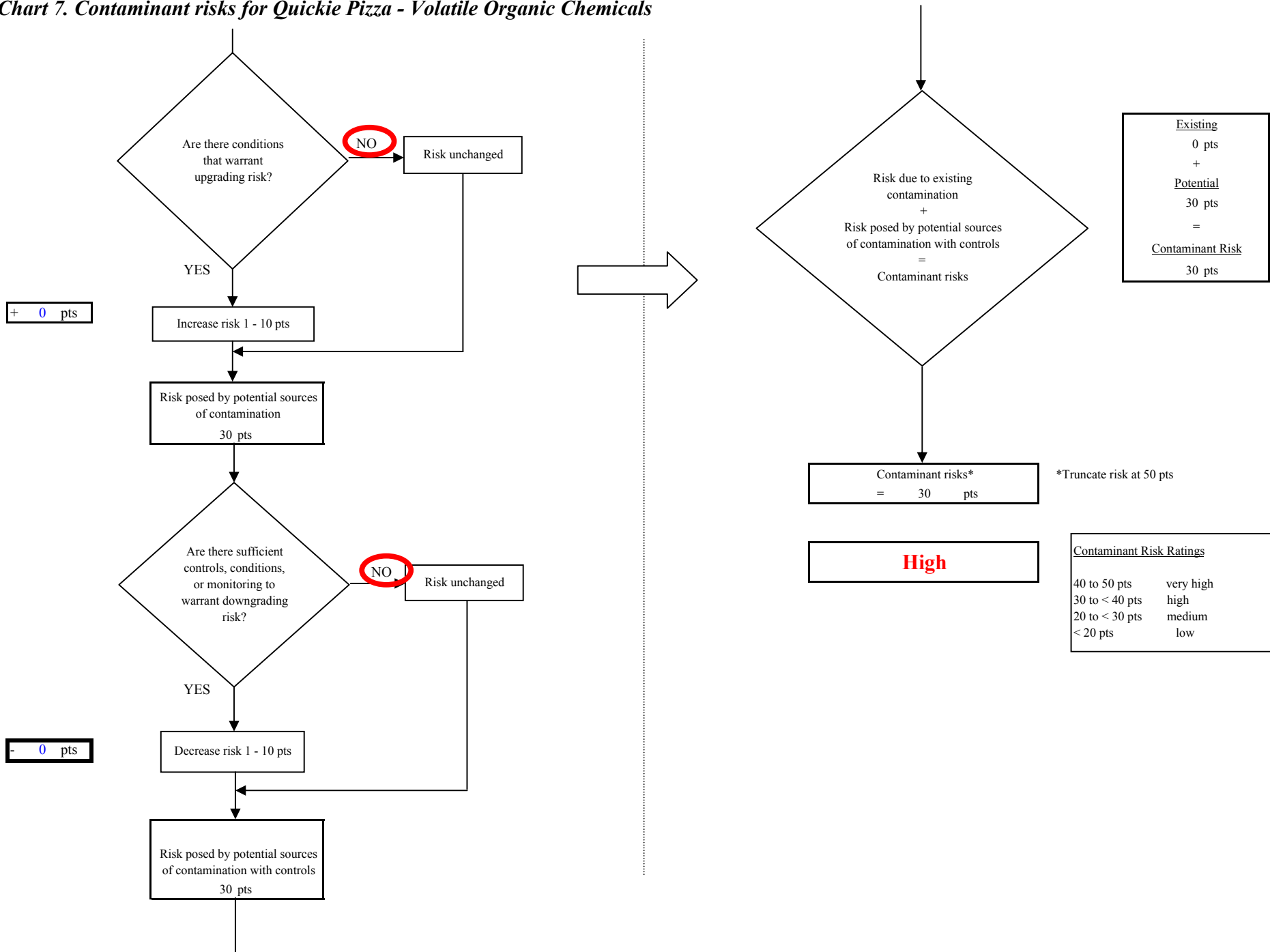


Chart 8. Vulnerability analysis for Quickie Pizza - Volatile Organic Chemicals

