Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Moose Creek Apartments Drinking Water System,
Moose Creek, Alaska
PWSID 370552

March 2004

DRINKING WATER PROTECTION PROGRAM REPORT Report 1443
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 Moose Creek Apartments Source of Public Drinking Water, Moose Creek, 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 Moose Creek Apartments to potential contamination. This Class A (community) water system consists of two wells on Bellwood Street near its intersection with the Old Richardson Highway in Moose Creek, Alaska. The wells received a natural susceptibility rating of **Medium.** This rating is a combination of a susceptibility rating of **Low** for the actual wellheads and a **High** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Moose Creek Apartments public water system include: an automotive body shop, residential area, septic systems, heating oil tanks, roads and a Leaking Underground Storage Tank (LUST) site. These are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals. Combining the natural susceptibility of the well with the contaminant risk, the public water system for Moose Creek Apartments received an overall vulnerability rating of **High** for bacteria and viruses, **Medium** for volatile organic chemicals, heavy metals and other inorganic chemicals, and other organic chemicals, and **Low** for nitrates and/or nitrites, and synthetic organic chemicals.

MOOSE CREEK APARTMENTS PUBLIC DRINKING WATER SYSTEM

Moose Creek Apartments public water system is a Class A (community) water system. This Class A (community) water system consists of two wells on Bellwood Street near its intersection with the Old Richardson Highway in Moose Creek, Alaska (T2S, R3E, Section 28). (See Map 1 of Appendix A). Moose Creek 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.

Residents of Moose Creek use individual wells and septic systems, with the exception of Moose Creek Apartments which operates its own piped sewer system. 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.

This general 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 Moose Creek Apartments water system is located in the alluvial plain at an elevation of approximately 500 feet above sea level.

Most wells in this area are screened in sand and gravel, and it is assumed this one is also. 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).

The Moose Creek Apartments public water systems serves between 140 and 210 residents through one service connection.

MOOSE CREEK APARTMENTS 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 Moose Creek Apartments, 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 all, 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 of the groundwater 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 Moose Creek Apartments 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 Moose Creek Apartments 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 A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide and other inorganic chemicals;
- Synthetic Organic Chemicals; and
- Other 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 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to the six contaminant categories.

VULNERABILITY OF MOOSE CREEK APARTMENTS 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 fourteen 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 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals and other inorganic chemicals, synthetic organic chemicals, and other 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 wellheads for the Moose Creek Apartments received a Low Susceptibility rating. The 9/20/99 Sanitary Survey indicates both wells are capped with a sanitary seal and the land surface is sloped away from each well. However, the wells are 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 Moose Creek Apartments well is completed in received a Very 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 Moose Creek Apartments.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	20	Very High
Natural Susceptibility	25	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	32	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	25	Medium
Synthetic Organic Chemicals	10	Low
Other 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:

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 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 Nitrites	35	Low
Volatile Organic Chemicals	55	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Medium
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	50	Medium

Bacteria and Viruses

The residential septic systems represent the greatest risk of Bacteria and Viruses to this water system. There are also sewerlines connecting the apartment to the wastewater treatment plant. The exact location of these lines is unknown but they do represent a risk to the 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). Coliforms were detected most recently on 8/21/00 (verified on 8/23/00). Routine sampling has not detected fecal coliforms or E. Coli in this 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 high.

Nitrates and Nitrites

The residential septic systems and assumed sewer lines also represent 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 concentrations during recent sampling history for the Moose Creek Apartments 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 residential heating oil tanks and the automotive body shop represent 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 Moose Creek area. 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.

There is a Leaking Underground Storage Tank (LUST) site located in Zone B of the protection area (FNSB – North Star UFD Station #5; RecKey 1991310034601). The site was closed on 3/22/04 and represents very little risk to the drinking water system. Specific information on the site can be found on the internet at http://info.dec.state.ak.us/SPAR/CSP/UST/Search/lust_search.asp or by calling the ADEC Contaminated Sites Program at (907) 269-7658.

Volatile Organic Chemicals have not been detected in this water system during routine sampling. 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.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The automotive body shop represents the greatest risk to Heavy Metals, Cyanide, and Other Inorganic Chemicals for this source of public drinking water.

Inorganic chemicals have not been detected during routine sampling.

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.

Synthetic Organic Chemicals

The septic systems and residential area represent the only identified risk to Synthetic Organic Chemicals for this source of public drinking water.

Synthetic Organic Chemicals have not recently been sampled for.

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

Other Organic Chemicals

The automotive body shop also represents the greatest risk to Other Organic Chemicals for Moose Creek Apartments public drinking water system.

Other Organic Chemicals have not recently been sampled for.

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

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APPENDIX A

Moose Creek Apartments
Drinking Water Protection Area Location Map
(Map 1)

KAYE AVENUE
CORY STREET
MILDRED AVENUE
OLD RICHARDSON HIGHWAY
NEW RICHARDSON HIGHWAY
ALASKA RAILROAD
TRANSMITTER ROAD
ARCTIC AVENUE
MANCHU ROAD
POLARIS STREET
NORTH STREET
KODIAK STREET
INDUSTRIAL DRIVE
BROADWAY AVENUE
CENTRAL AVENUE
WABASH AVENUE
INDUSTRIAL DRIVE
QUARRY ROAD
OUTER LOOP
INNER LOOP
EIELSON FARM ROAD
RICHARDSON HIGHWAY
OLD VALDEZ TRAIL

Map 1: Moose Creek Apartments Drinking Water Protection Area

PWSID: 370552

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 2,012.5 4,025 8,050 Feet

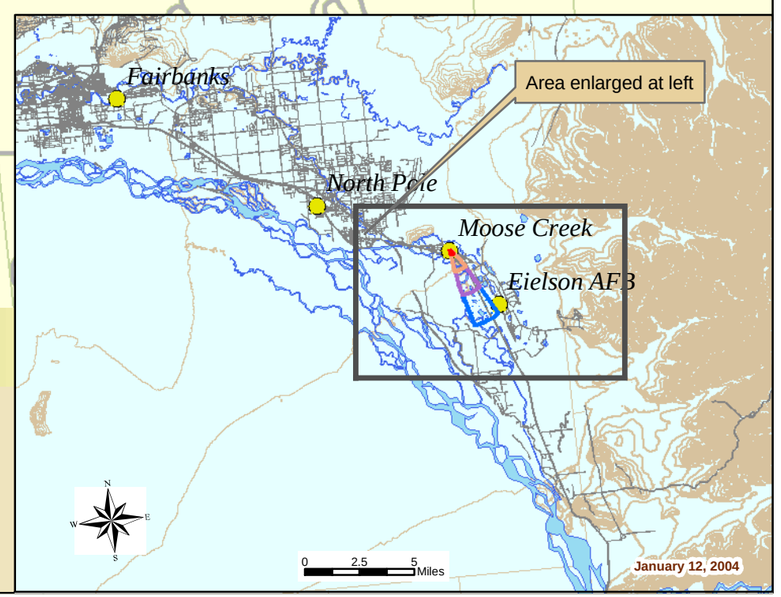
1:48,300

Data Sources:

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

Legend

- Moose Creek Apartment wells
- Zone A
- Zone B
- Zone C
- Zone D
- Towns
- Parcels
- Surface Water
- Roads



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Moose Creek Apartments (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Moose Creek Apartments***

PWSID 370552.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Body shops (automotive)	C05	C05-1	A	2	3457 Old Richardson Highway
Residential Areas	R01		A	2	Estimated 3 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		A	2	Assumed one septic system in Zone A
Tanks, heating oil, residential (above ground)	R08		A	2	Assumed one heating oil tank in Zone A
Highways and roads, paved (cement or asphalt)	X20		A	2	Bellwood Street; Pam Street; Old Richardson Highway
Residential Areas	R01		B	2	Estimated 20 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		B	2	Assumed 12 septic systems in Zone B
Tanks, heating oil, residential (above ground)	R08		B	2	Assumed 12 heating oil tanks in Zone B
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	B	2	3477 Old Richardson Highway; FNSB - North Star UFD Station #5
Highways and roads, paved (cement or asphalt)	X20		B	2	6 roads in Zone B

Table 2

Contaminant Source Inventory and Risk Ranking for Moose Creek Apartments Sources of Bacteria and Viruses

PWSID 370552.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 3 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Bellwood Street; Pam Street; Old Richardson Highway
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	6 roads in Zone B
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 12 septic systems in Zone B
Residential Areas	R01		B	Low	2	Estimated 20 acres of residential area in Zone B

Table 3

Contaminant Source Inventory and Risk Ranking for Moose Creek Apartments Sources of Nitrates/Nitrites

PWSID 370552.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 3 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Bellwood Street; Pam Street; Old Richardson Highway
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A
Residential Areas	R01		B	Low	2	Estimated 20 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 12 septic systems in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	6 roads in Zone B

Table 4

Contaminant Source Inventory and Risk Ranking for Moose Creek Apartments Sources of Volatile Organic Chemicals

PWSID 370552.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Tanks, heating oil, residential (above ground)	R08		A	Medium	2	Assumed one heating oil tank in Zone A
Residential Areas	R01		A	Low	2	Estimated 3 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Bellwood Street; Pam Street; Old Richardson Highway
Body shops (automotive)	C05	C05-1	A	Medium	2	3457 Old Richardson Highway
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 12 septic systems in Zone B
Tanks, heating oil, residential (above ground)	R08		B	Medium	2	Assumed 12 heating oil tanks in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	6 roads in Zone B
Residential Areas	R01		B	Low	2	Estimated 20 acres of residential area in Zone B
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	B	Medium	2	3477 Old Richardson Highway; FNSB - North Star UFD Station #5

Table 5

Contaminant Source Inventory and Risk Ranking for Moose Creek Apartments

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 370552.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Bellwood Street; Pam Street; Old Richardson Highway
Residential Areas	R01		A	Low	2	Estimated 3 acres of residential area in Zone A
Body shops (automotive)	C05	C05-1	A	Medium	2	3457 Old Richardson Highway
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 12 septic systems in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	6 roads in Zone B
Residential Areas	R01		B	Low	2	Estimated 20 acres of residential area in Zone B
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	B	Medium	2	3477 Old Richardson Highway; FNSB - North Star UFD Station #5

Table 6

Contaminant Source Inventory and Risk Ranking for Moose Creek Apartments Sources of Synthetic Organic Chemicals

PWSID 370552.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A
Residential Areas	R01		A	Low	2	Estimated 3 acres of residential area in Zone A
Residential Areas	R01		B	Low	2	Estimated 20 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 12 septic systems in Zone B

Table 7

Contaminant Source Inventory and Risk Ranking for Moose Creek Apartments Sources of Other Organic Chemicals

PWSID 370552.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 3 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Bellwood Street; Pam Street; Old Richardson Highway
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A
Body shops (automotive)	C05	C05-1	A	Medium	2	3457 Old Richardson Highway
Residential Areas	R01		B	Low	2	Estimated 20 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	6 roads in Zone B
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 12 septic systems in Zone B
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	B	Medium	2	3477 Old Richardson Highway; FNSB - North Star UFD Station #5

APPENDIX C

Moose Creek Apartments
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

UB ROAD
LLWOOD STREET
IVERS STREET
OSSAGE STREET
PAM STREET
Zone A
OLD RICHARDSON HIGHWAY
C05-1
PULLMAN DRIVE
GIVE-A-WAY STREET
HOPE STREET
Zone B
PUTNAM LANE
U07-1
DA NIECE STREET
GO THATTA WAY
CUL-DE-SAC COURT
ALASK
NEW RICHARDSON HIGHWAY
DA NEPHEW STREET

Area enlarged at left
X14-1
0 0.5 1 2 Miles
N W E S
January 12, 2004

Map 2: Moose Creek Apartments Drinking Water Protection Area

PWSID: 370552

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 187.5 375 750 Feet
1:4,500

Data Sources:

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

Legend

- C05, Autobody shop
- U07, Closed LUST site
- R01, Residential area
- R08, Residential heating oil tanks
- R02, Residential septic systems
- X14, Airport
- Roads
- Parcels
- Surface water

APPENDIX D

Vulnerability Analysis for Moose Creek Apartments Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Moose Creek Apartments

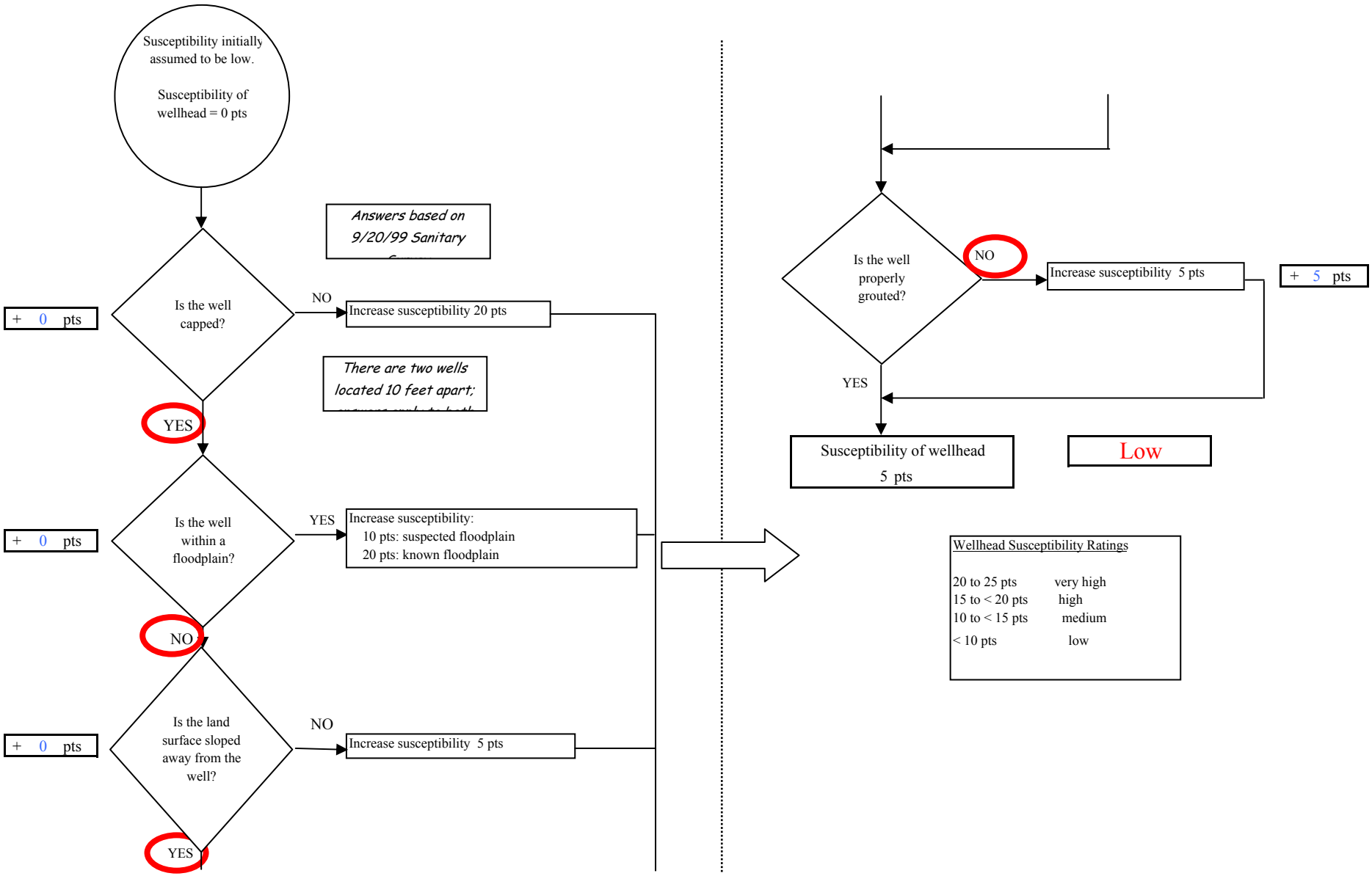


Chart 2. Susceptibility of the aquifer - Moose Creek Apartments

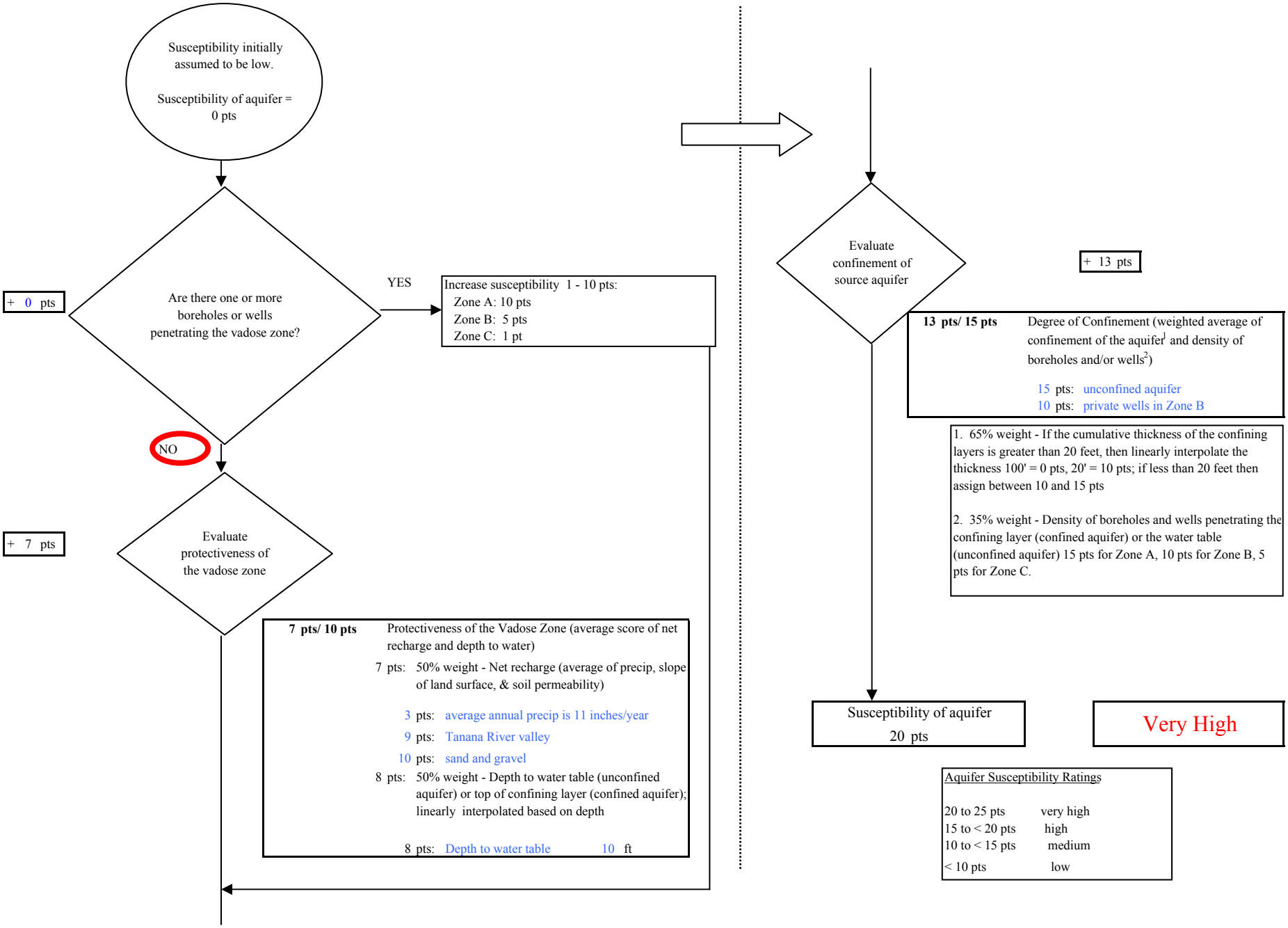
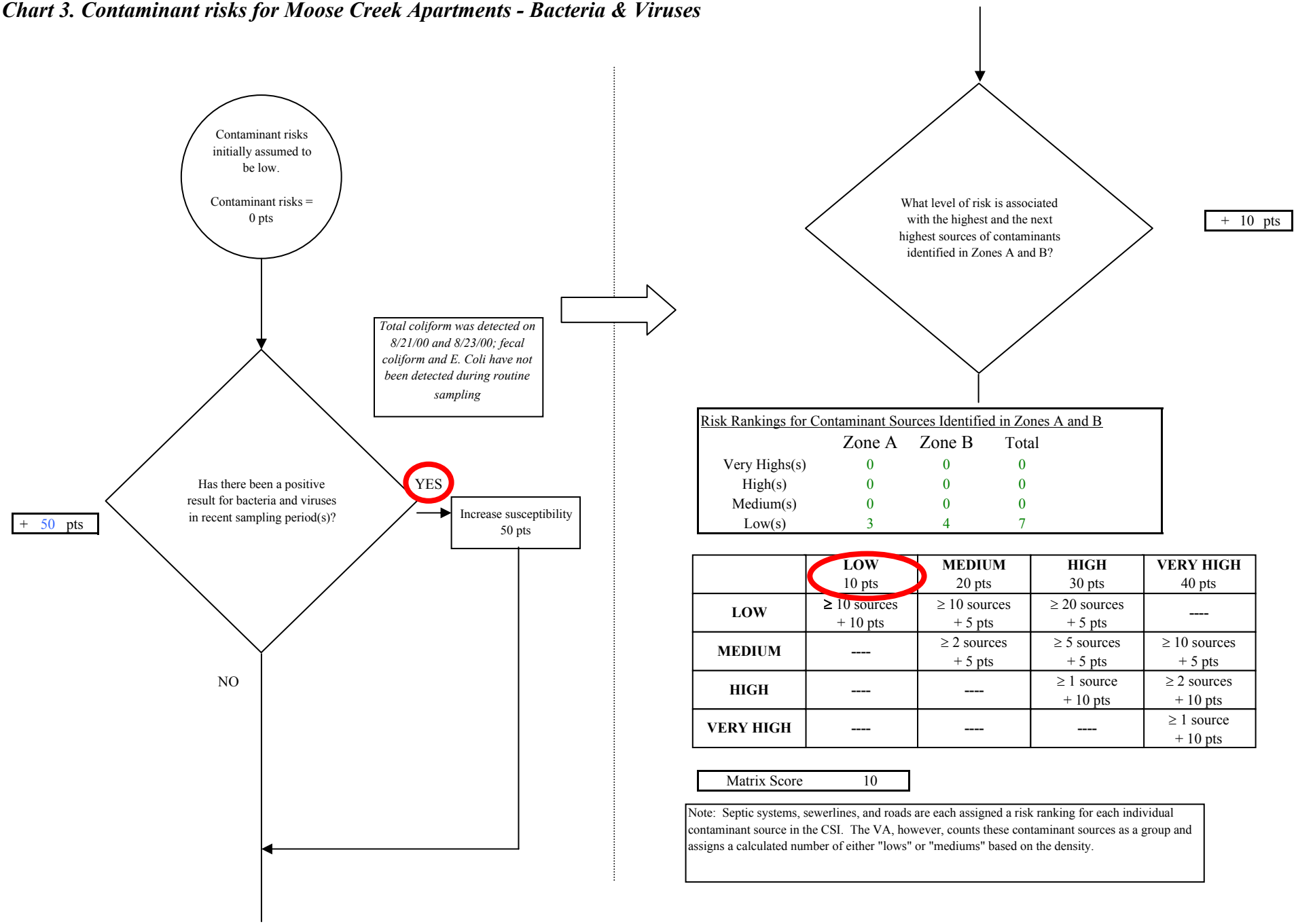


Chart 3. Contaminant risks for Moose Creek Apartments - Bacteria & Viruses



Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	4	7

	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 3. Contaminant risks for Moose Creek Apartments - Bacteria & Viruses

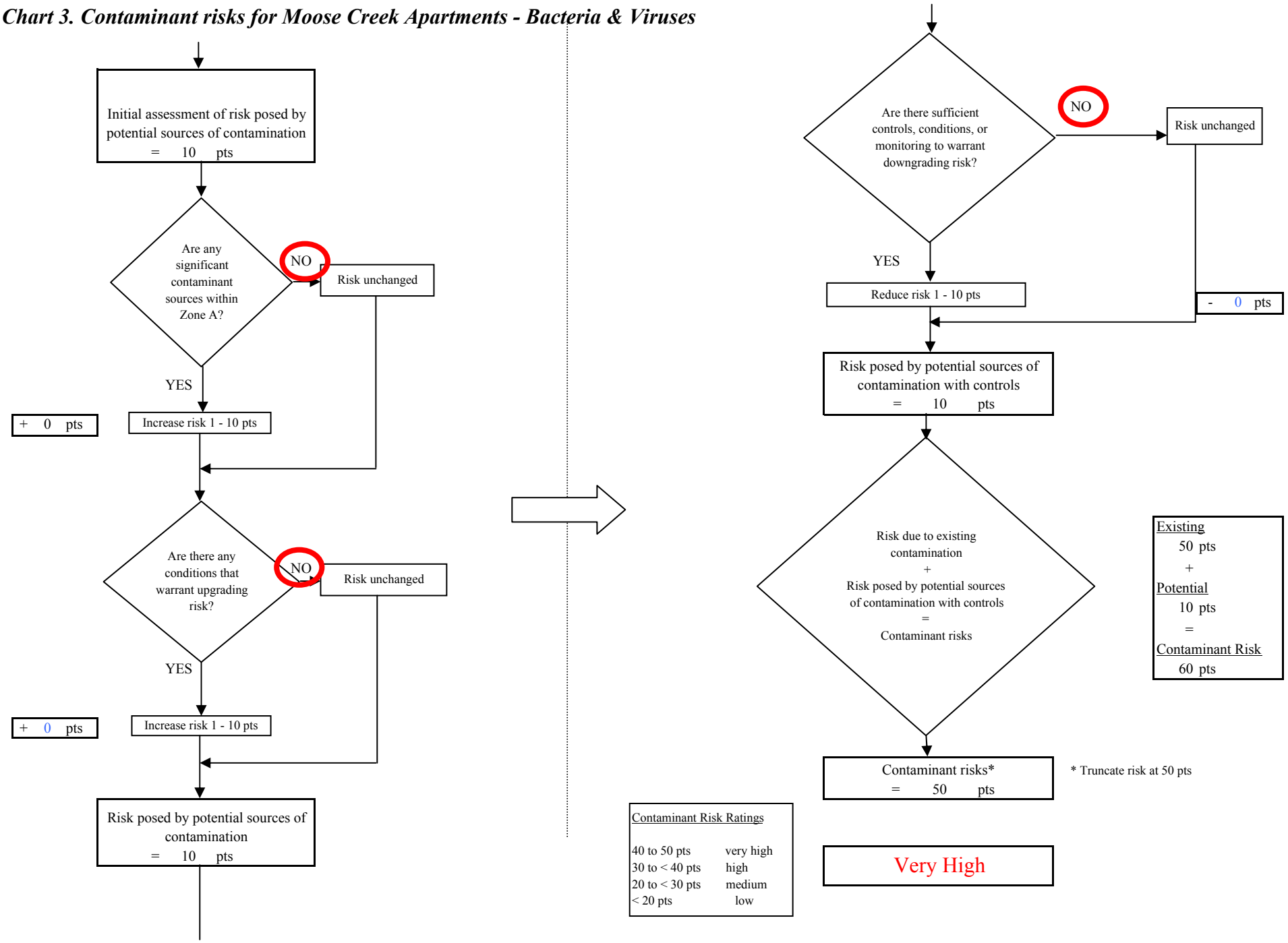


Chart 4. Vulnerability analysis for Moose Creek Apartments - Bacteria & Viruses

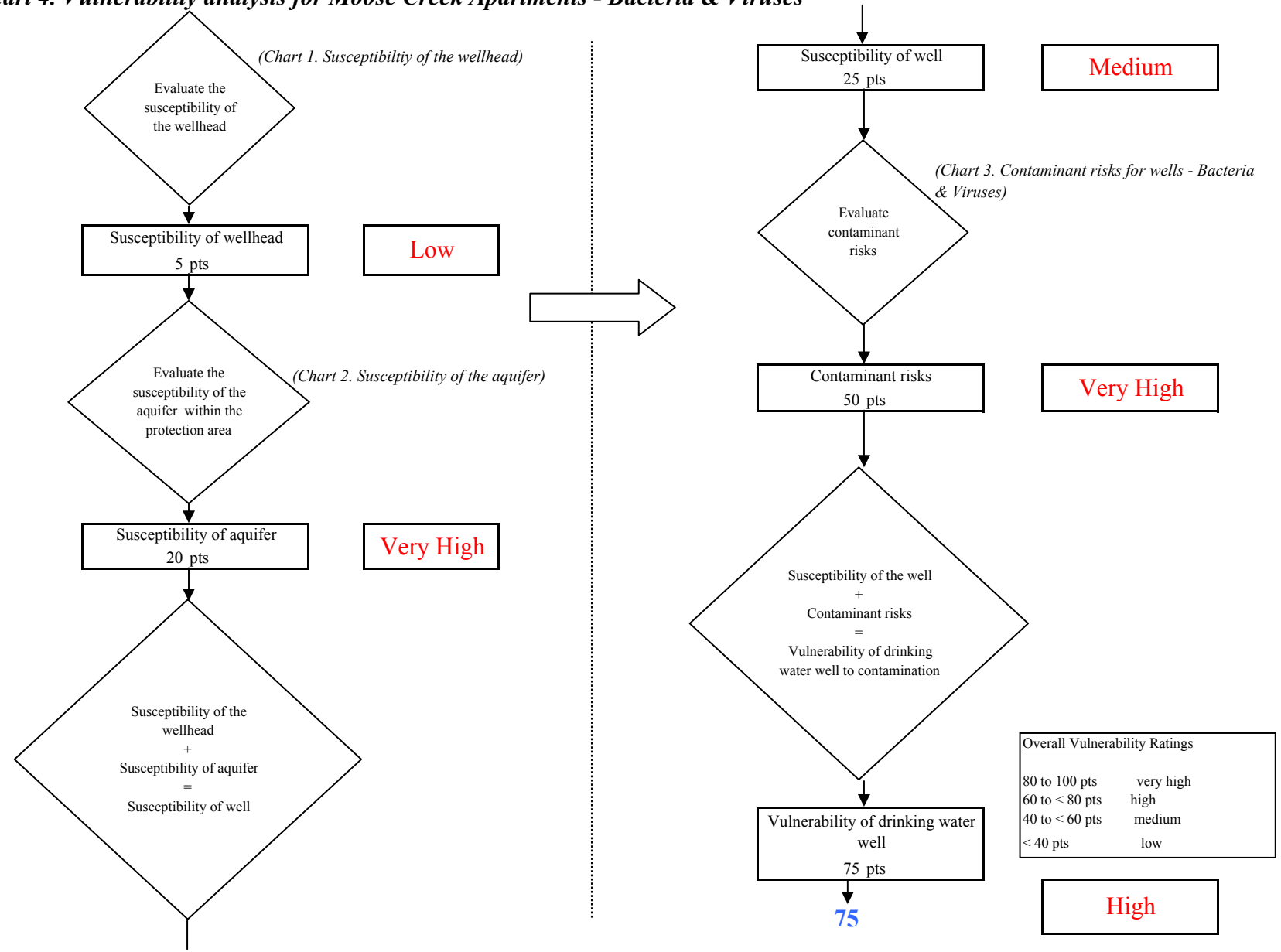


Chart 5. Contaminant risks for Moose Creek Apartments - Nitrates and Nitrites

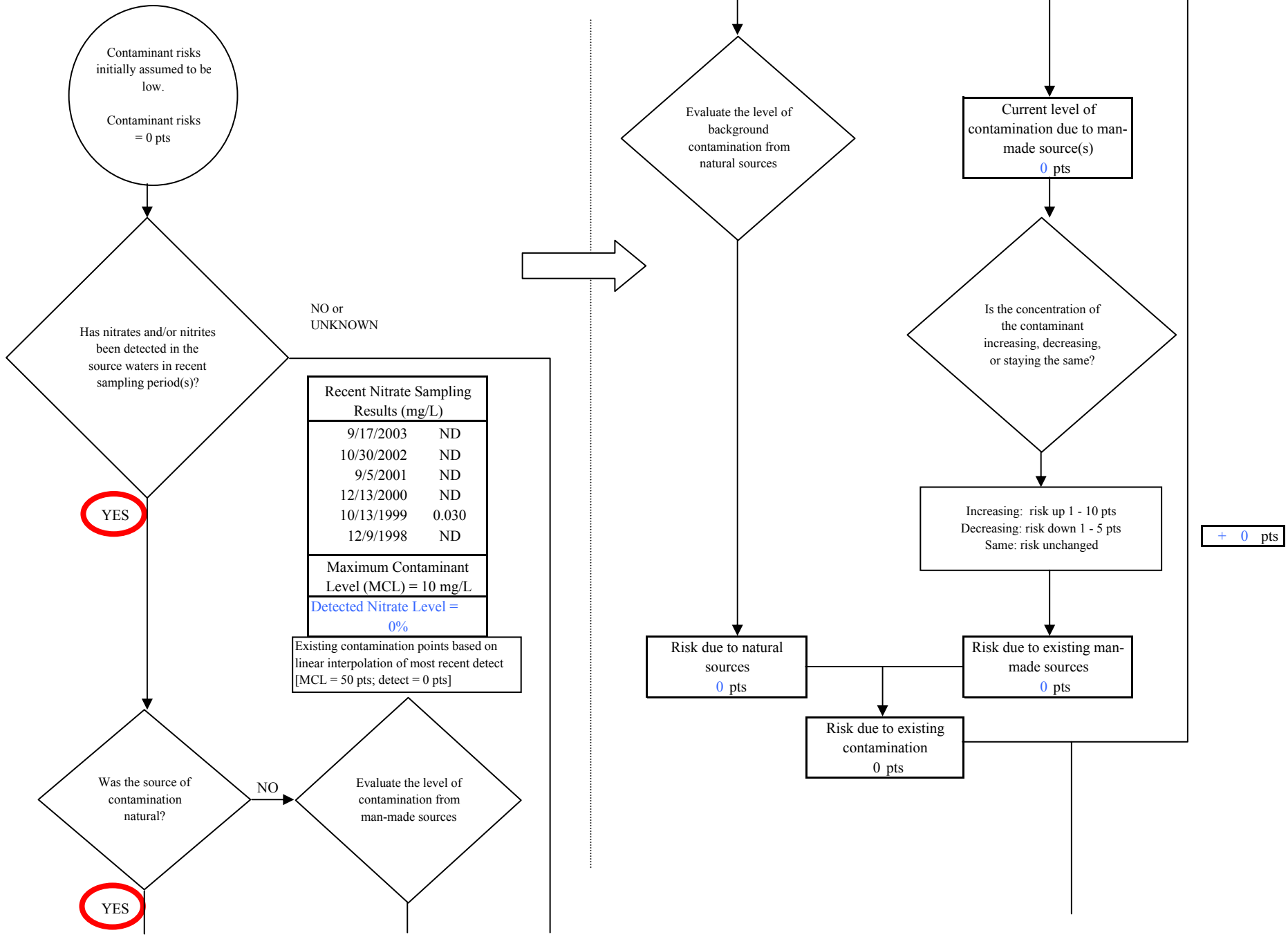
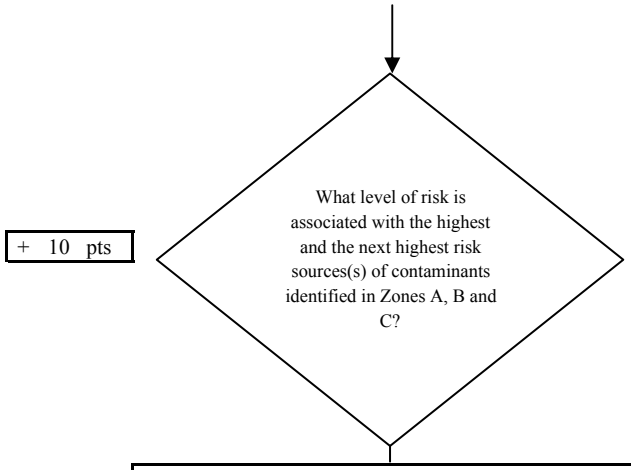


Chart 5. Contaminant risks for Moose Creek Apartments - Nitrates and Nitrites



Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	4	7

	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.

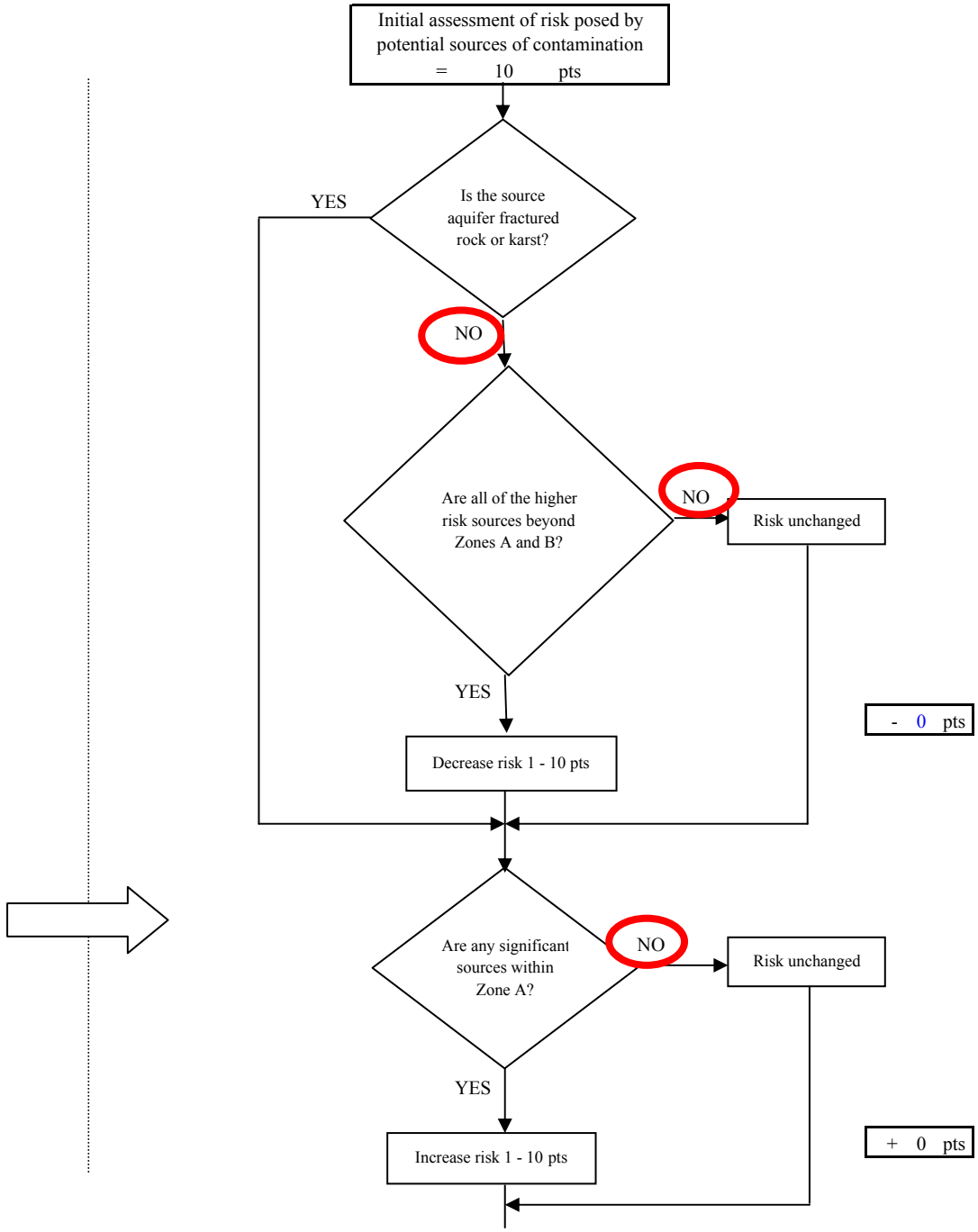
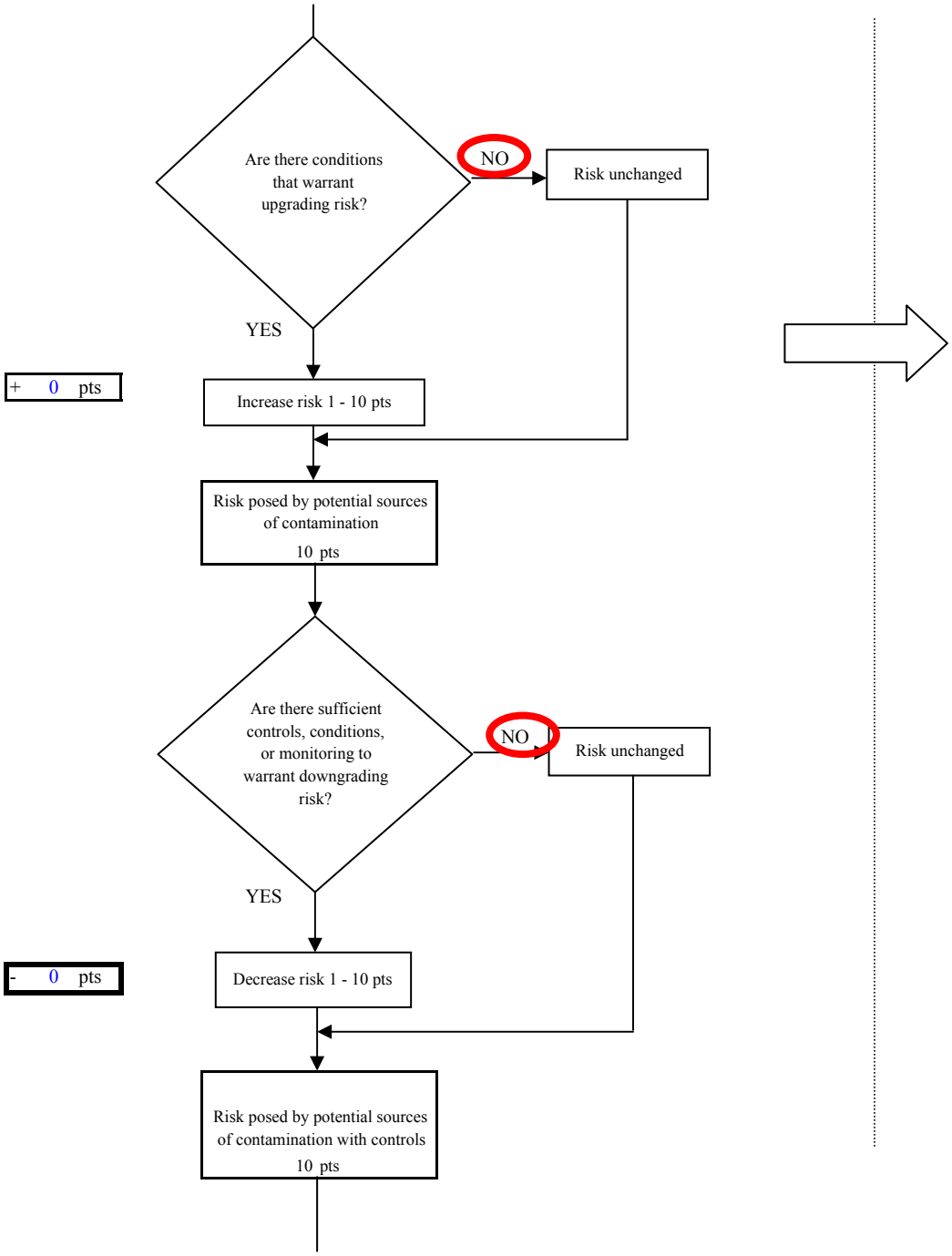


Chart 5. Contaminant risks for Moose Creek Apartments - Nitrates and Nitrites



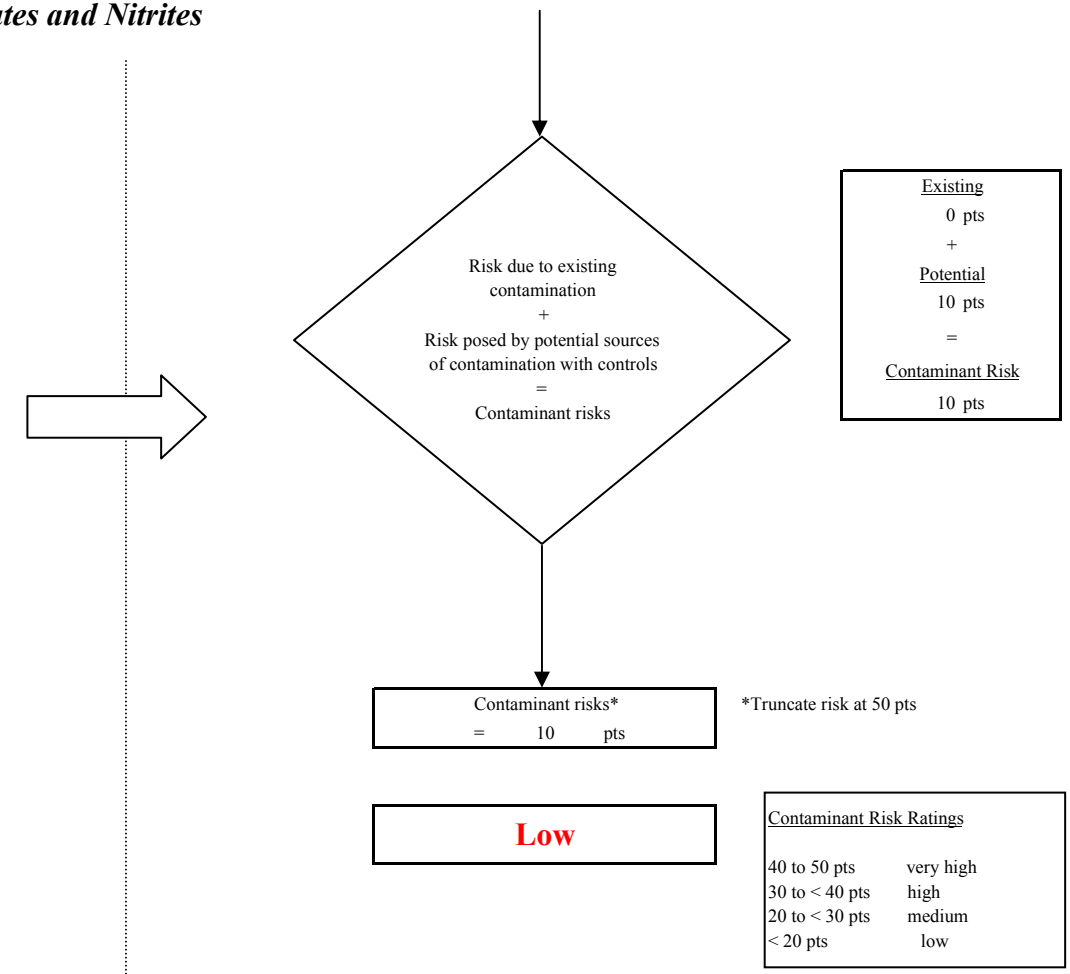


Chart 6. Vulnerability analysis for Moose Creek Apartments - Nitrates and Nitrites

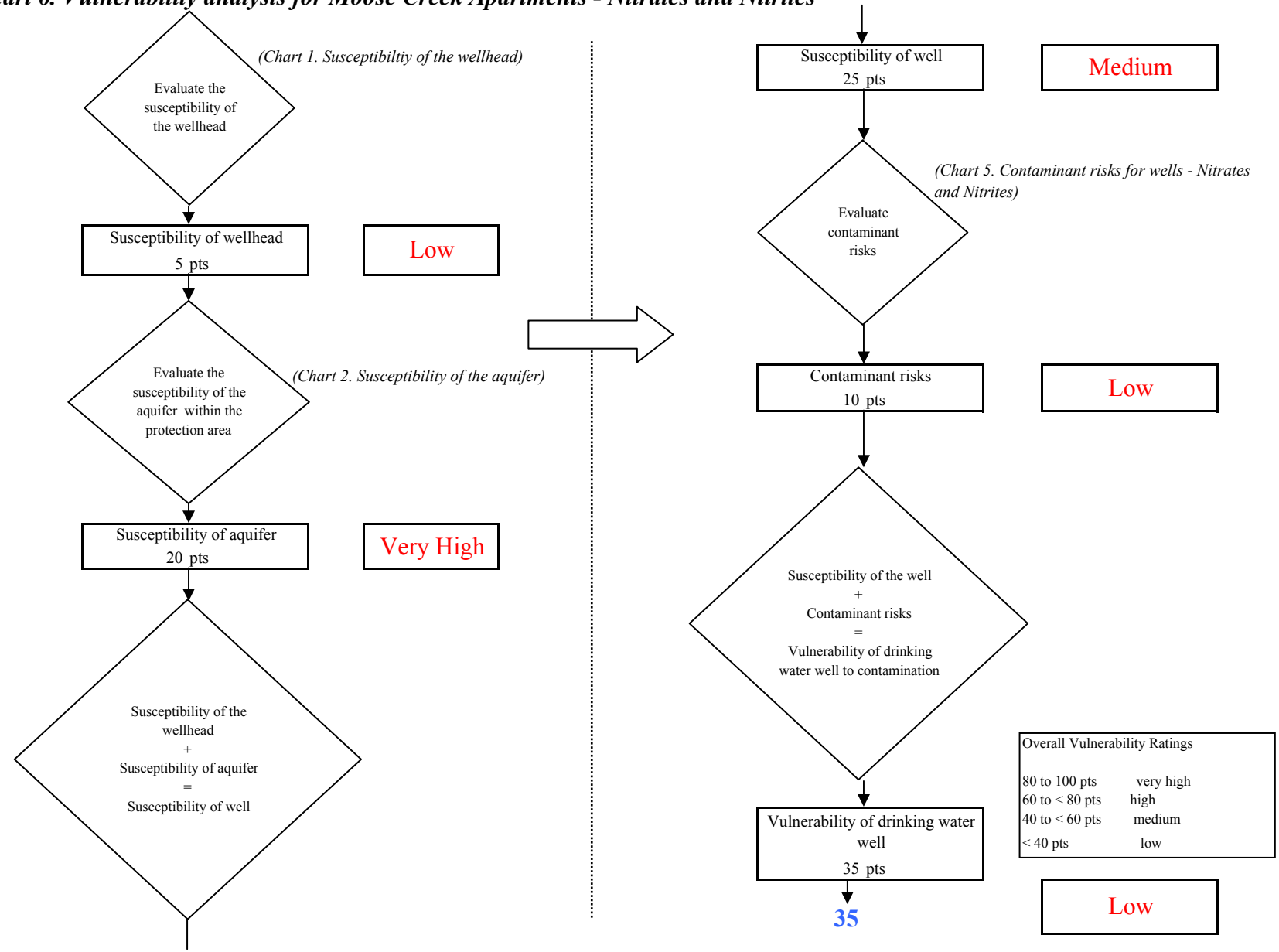


Chart 7. Contaminant risks for Moose Creek Apartments - Volatile Organic Chemicals

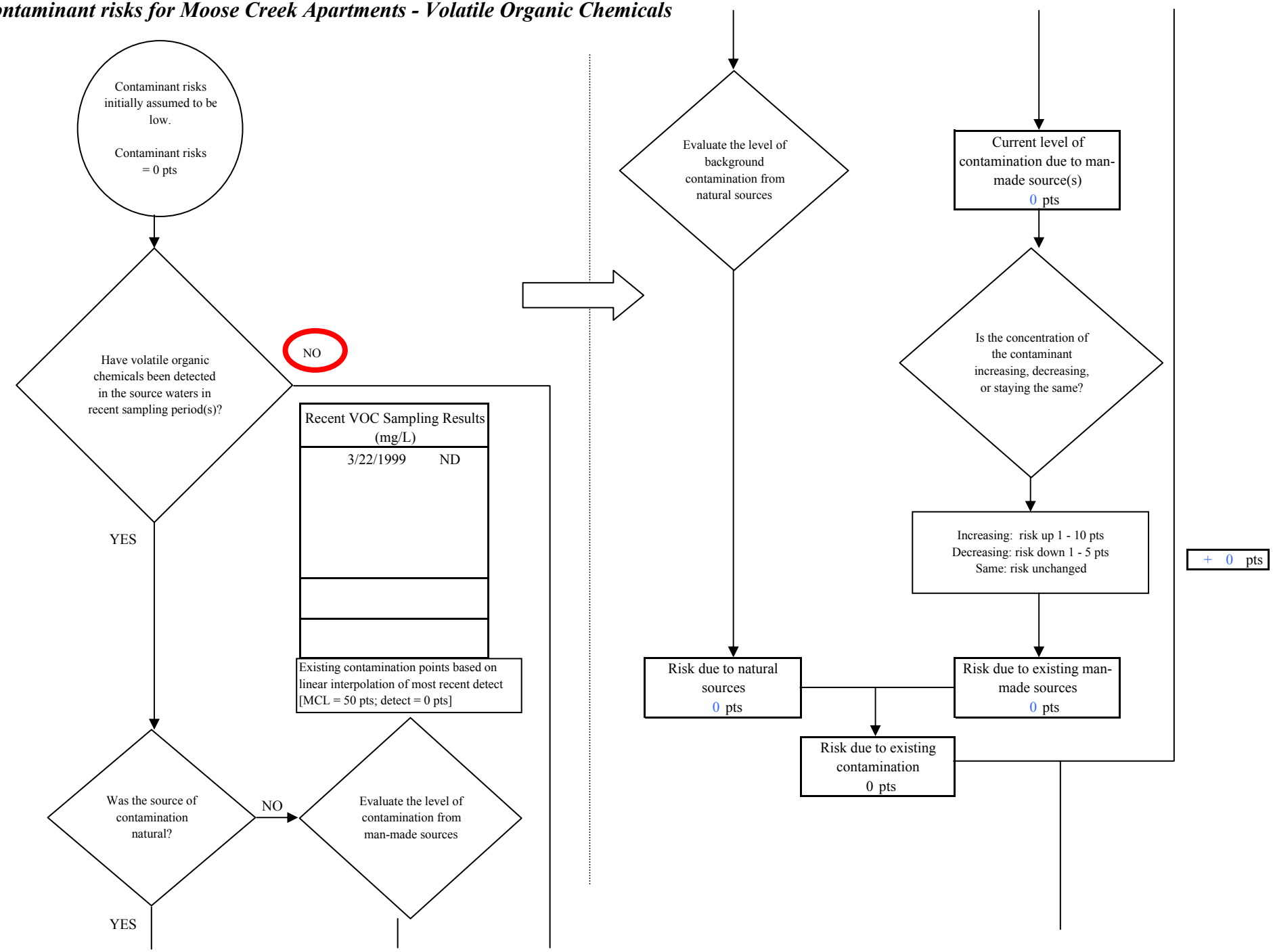
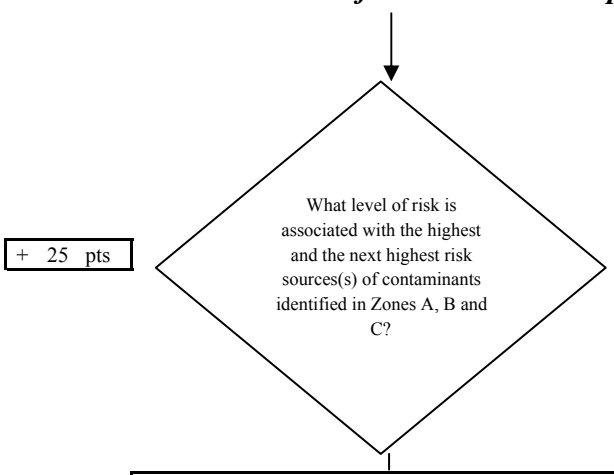


Chart 7. Contaminant risks for Moose Creek Apartments - Volatile Organic Chemicals



+ 25 pts

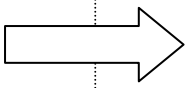
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	3	14	17
Low(s)	3	3	6

	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 25

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.



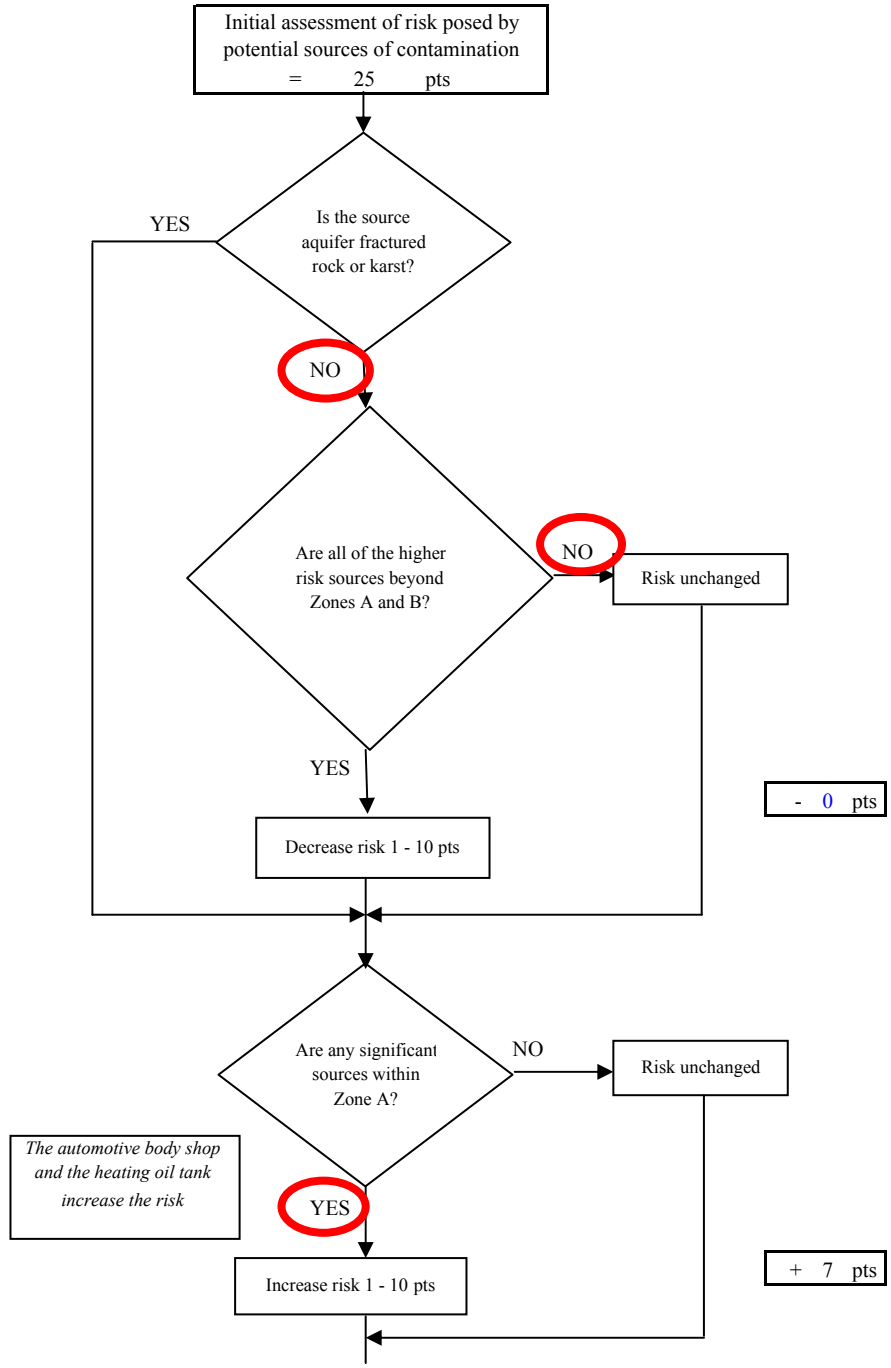
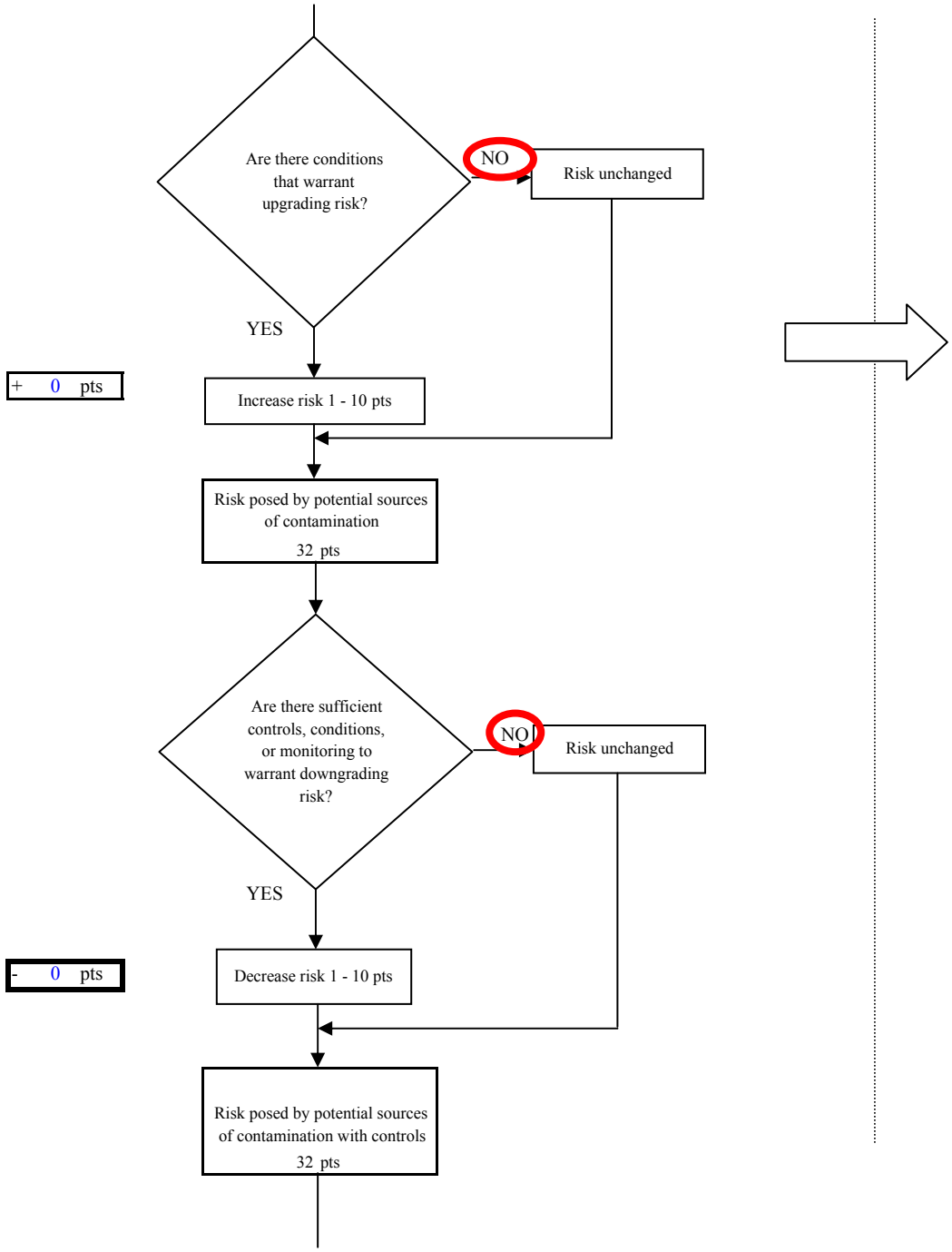
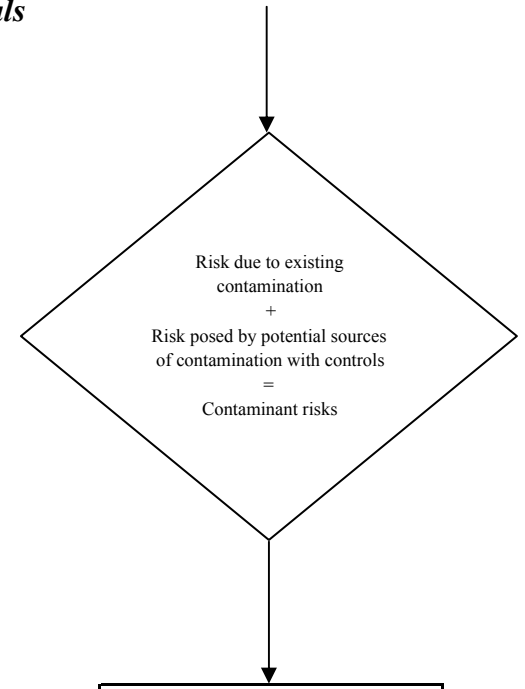


Chart 7. Contaminant risks for Moose Creek Apartments - Volatile Organic Chemicals





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

Contaminant risks*
= 32 pts

*Truncate risk at 50 pts

High

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 Moose Creek Apartments - Volatile Organic Chemicals

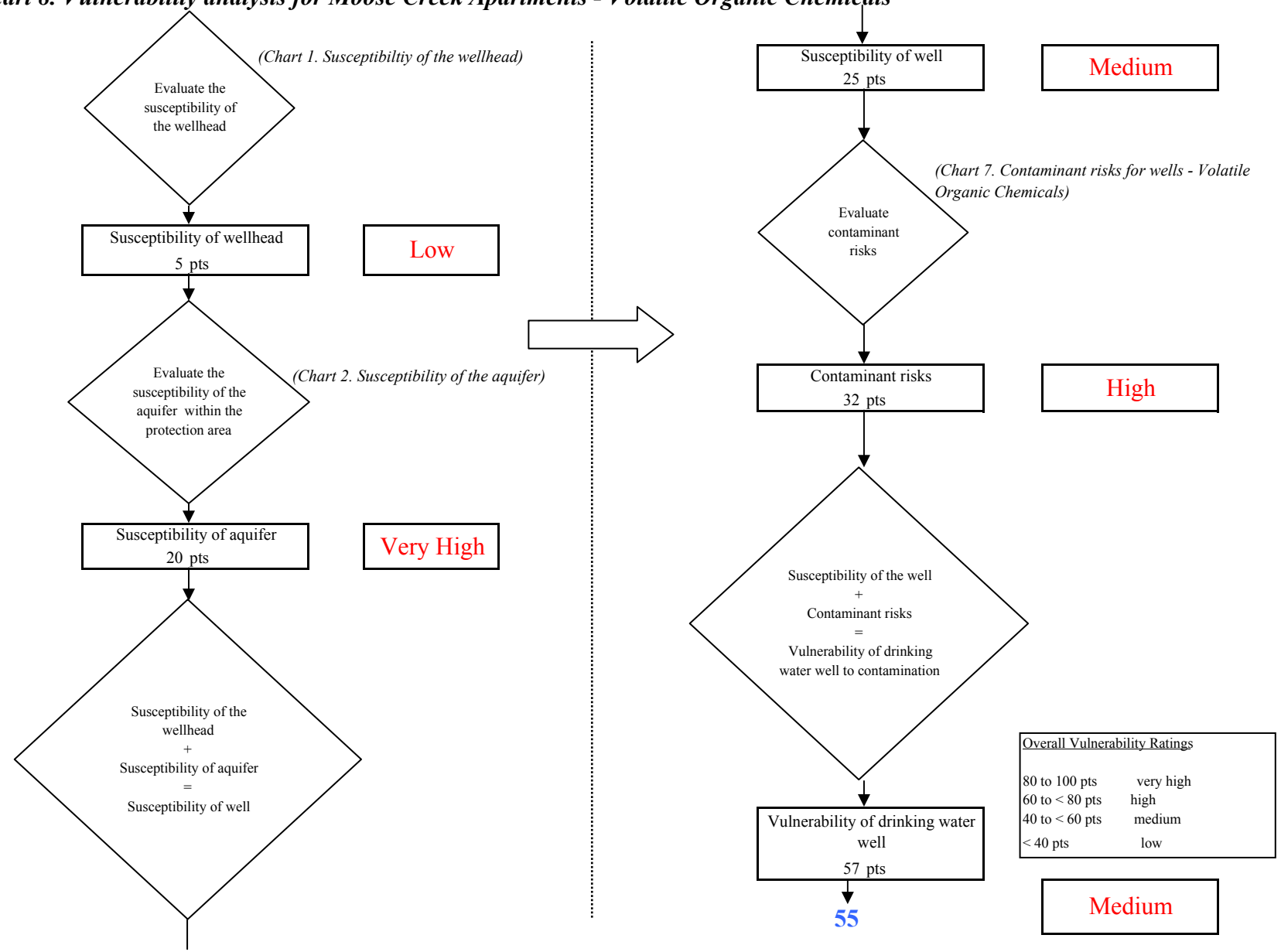


Chart 9. Contaminant risks for Moose Creek Apartments - Heavy Metals, Cyanide and Other Inorganic Chemicals

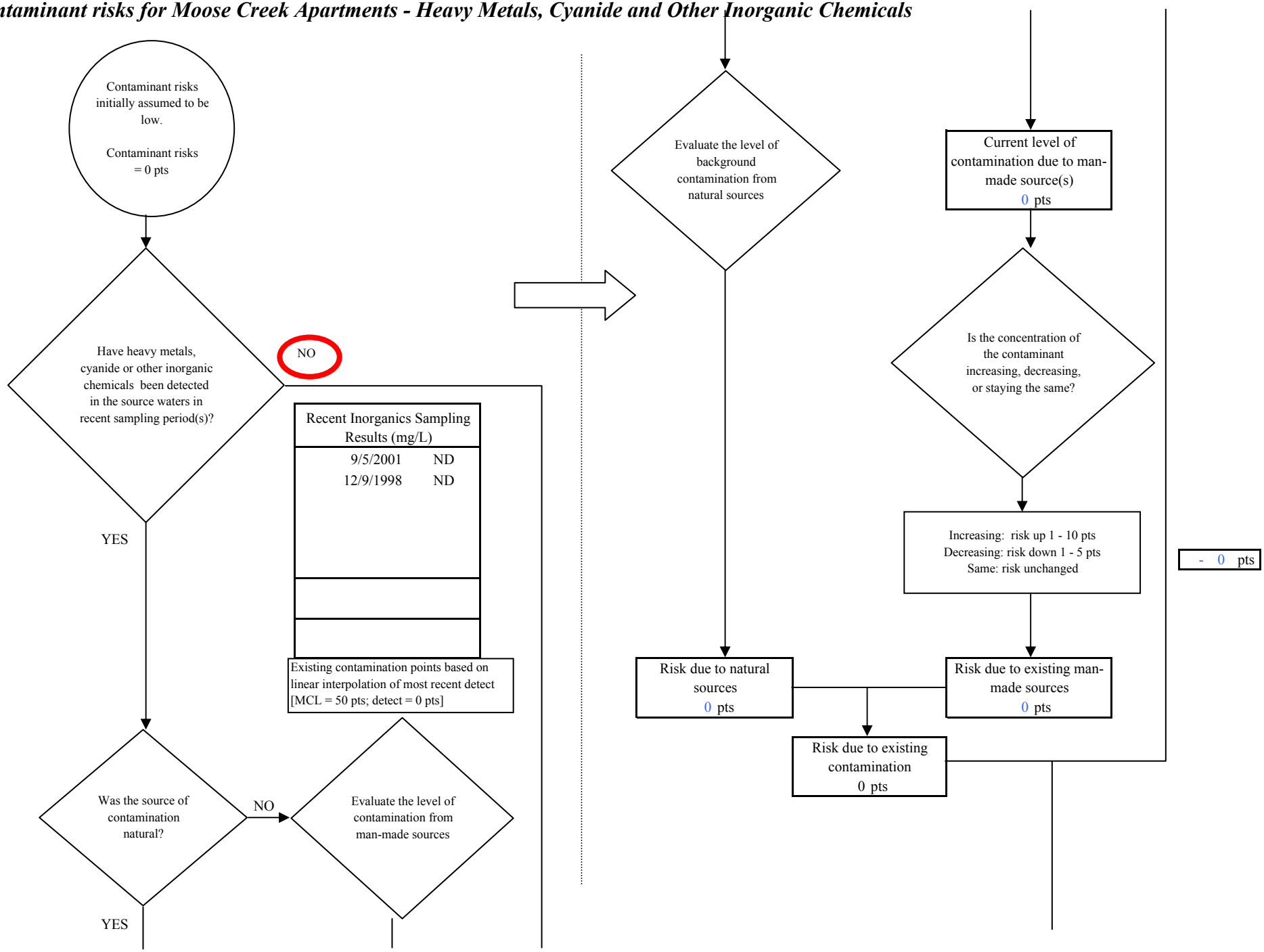
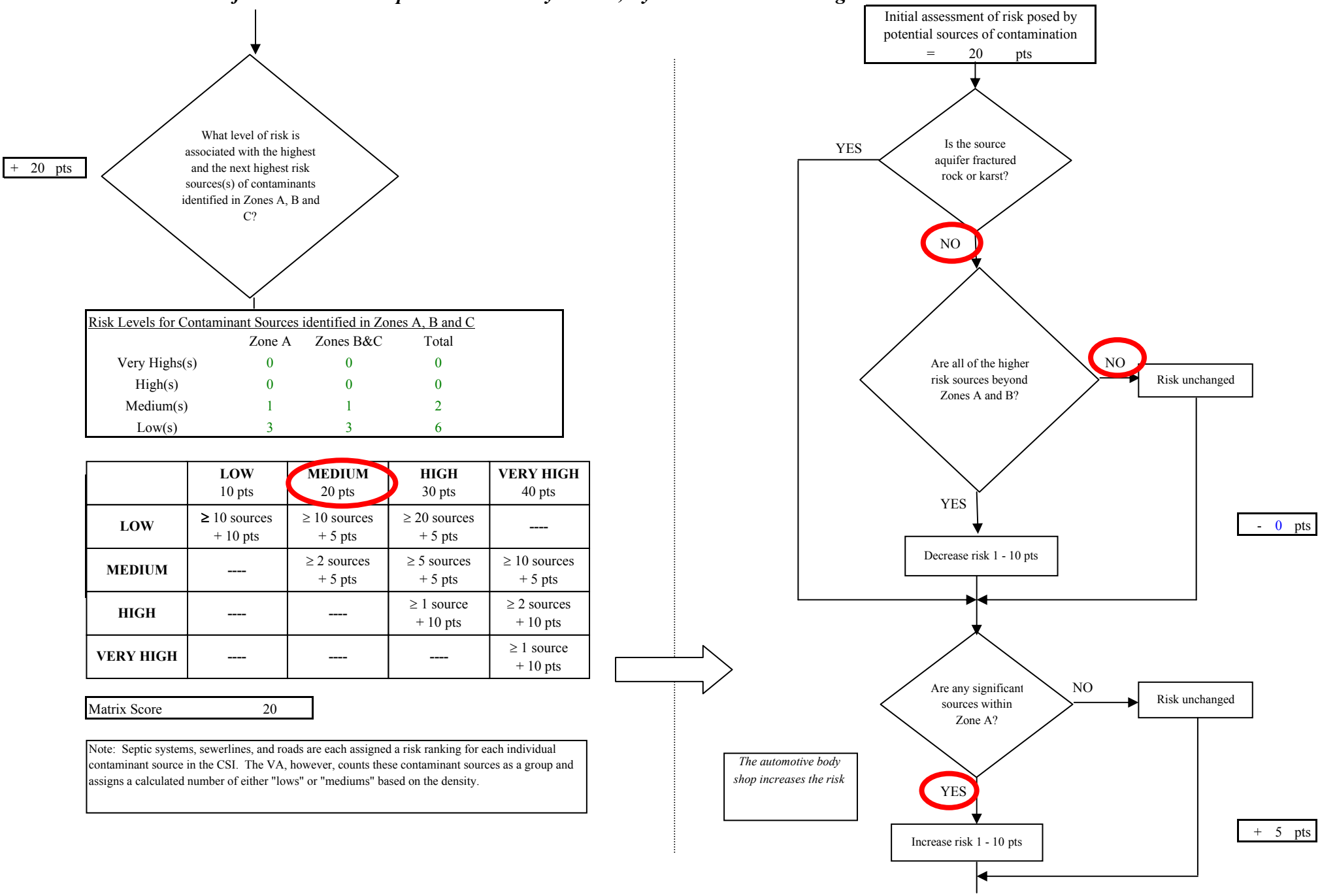


Chart 9. Contaminant risks for Moose Creek Apartments - Heavy Metals, Cyanide and Other Inorganic Chemicals



Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	1	2
Low(s)	3	3	6

	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 9. Contaminant risks for Moose Creek Apartments - Heavy Metals, Cyanide and Other Inorganic Chemicals

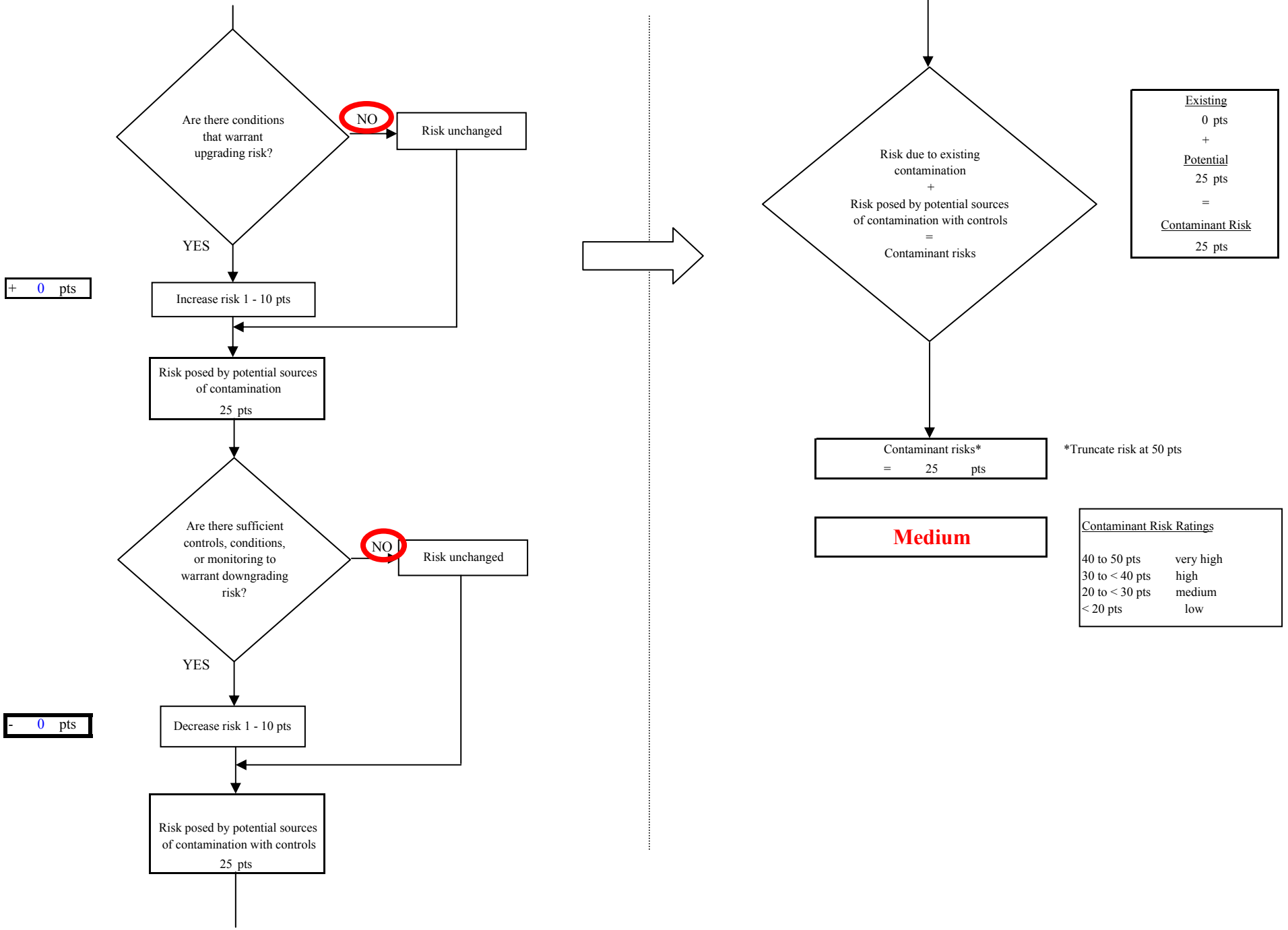


Chart 10. Vulnerability analysis for Moose Creek Apartments - Heavy Metals, Cyanide and Other Inorganic Chemicals

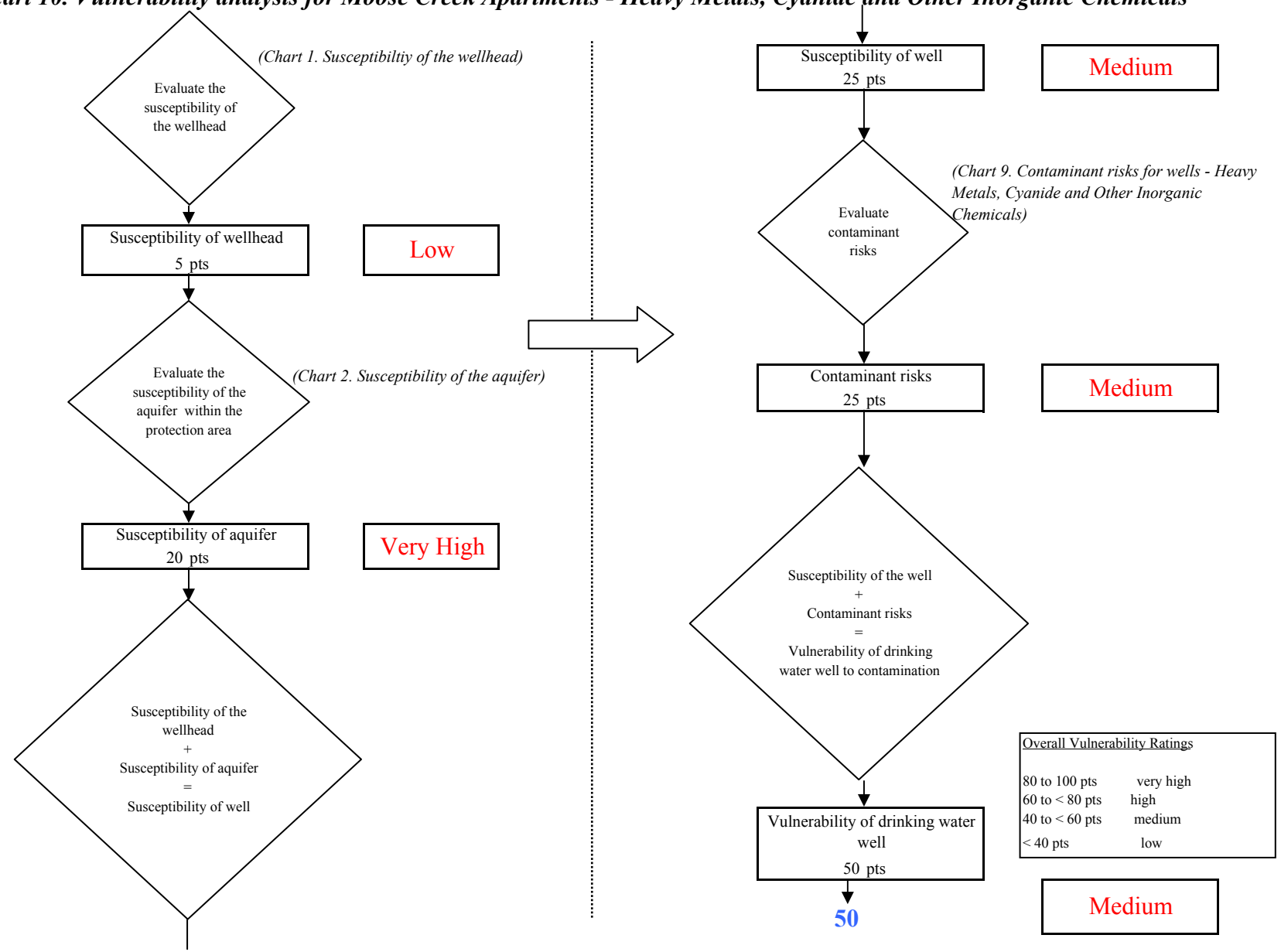


Chart 11. Contaminant risks for Moose Creek Apartments - Synthetic Organic Chemicals

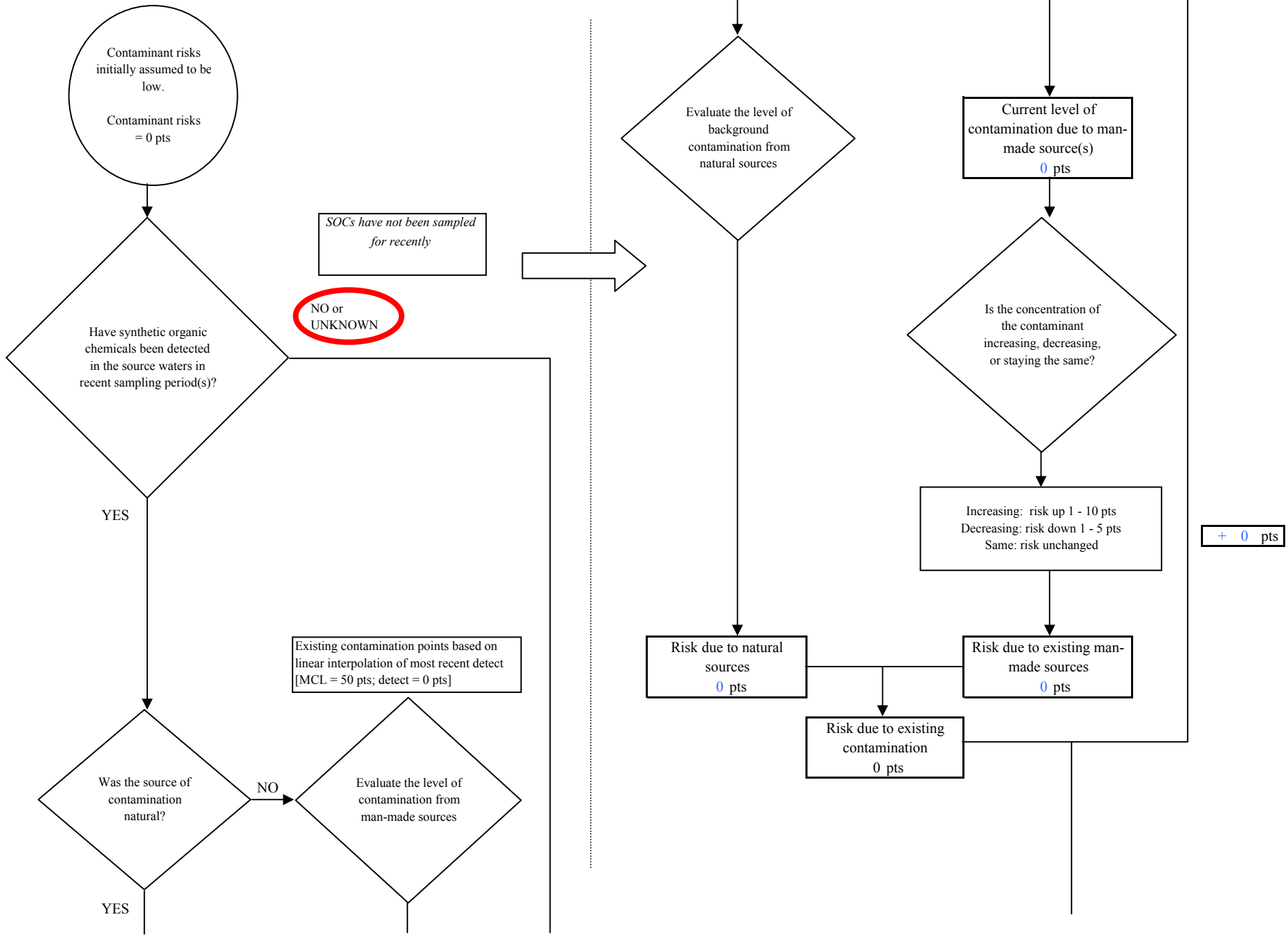
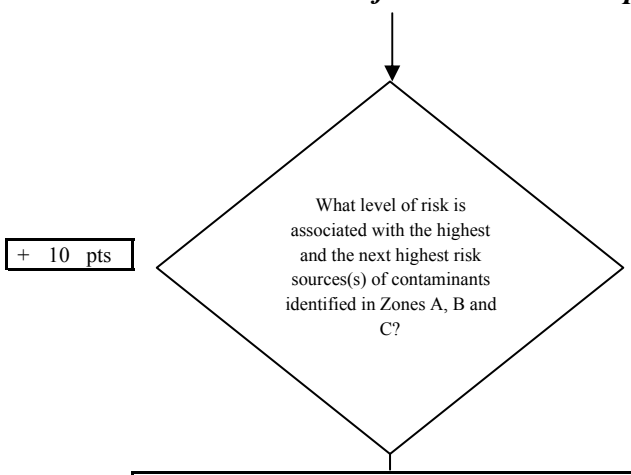


Chart 11. Contaminant risks for Moose Creek Apartments - Synthetic Organic Chemicals



+ 10 pts

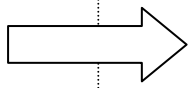
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	2	4

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 10

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



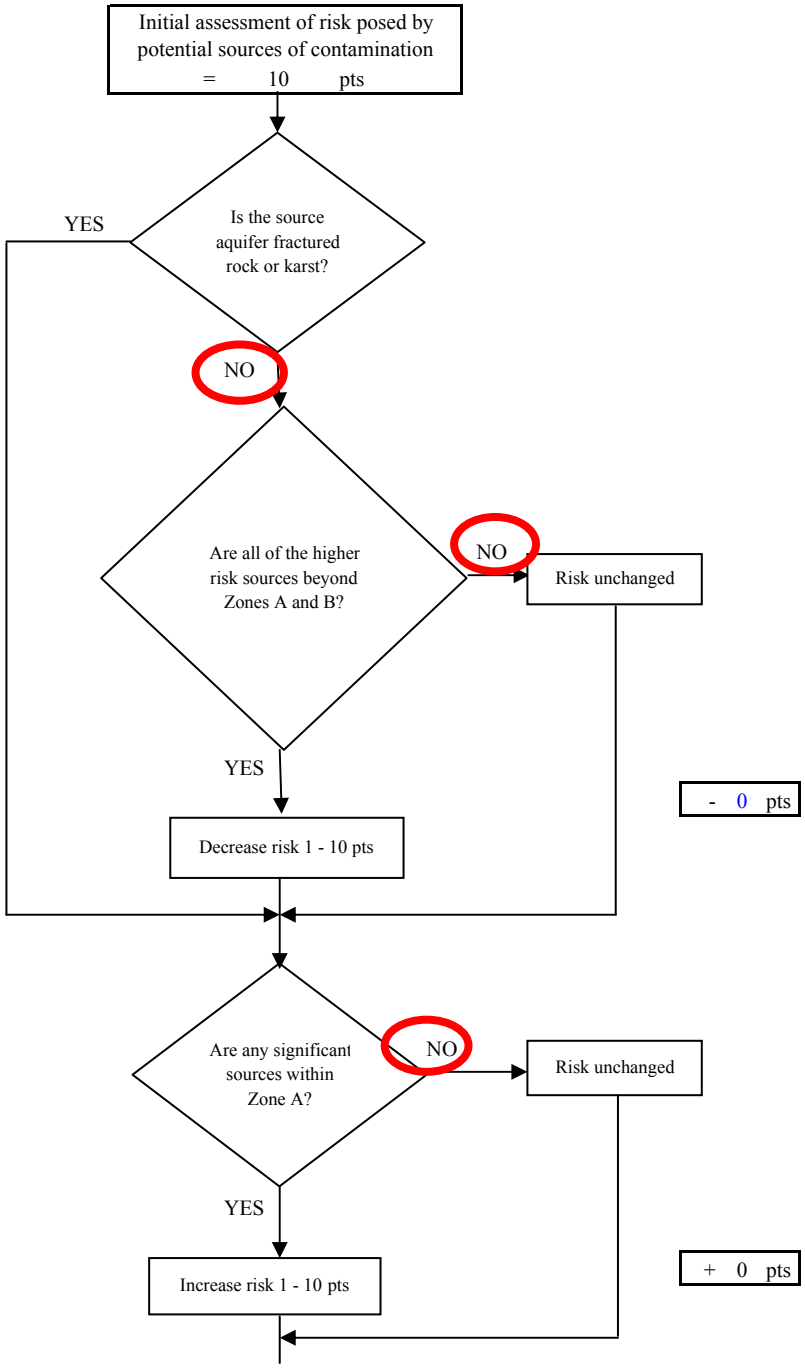


Chart 11. Contaminant risks for Moose Creek Apartments - Synthetic Organic Chemicals

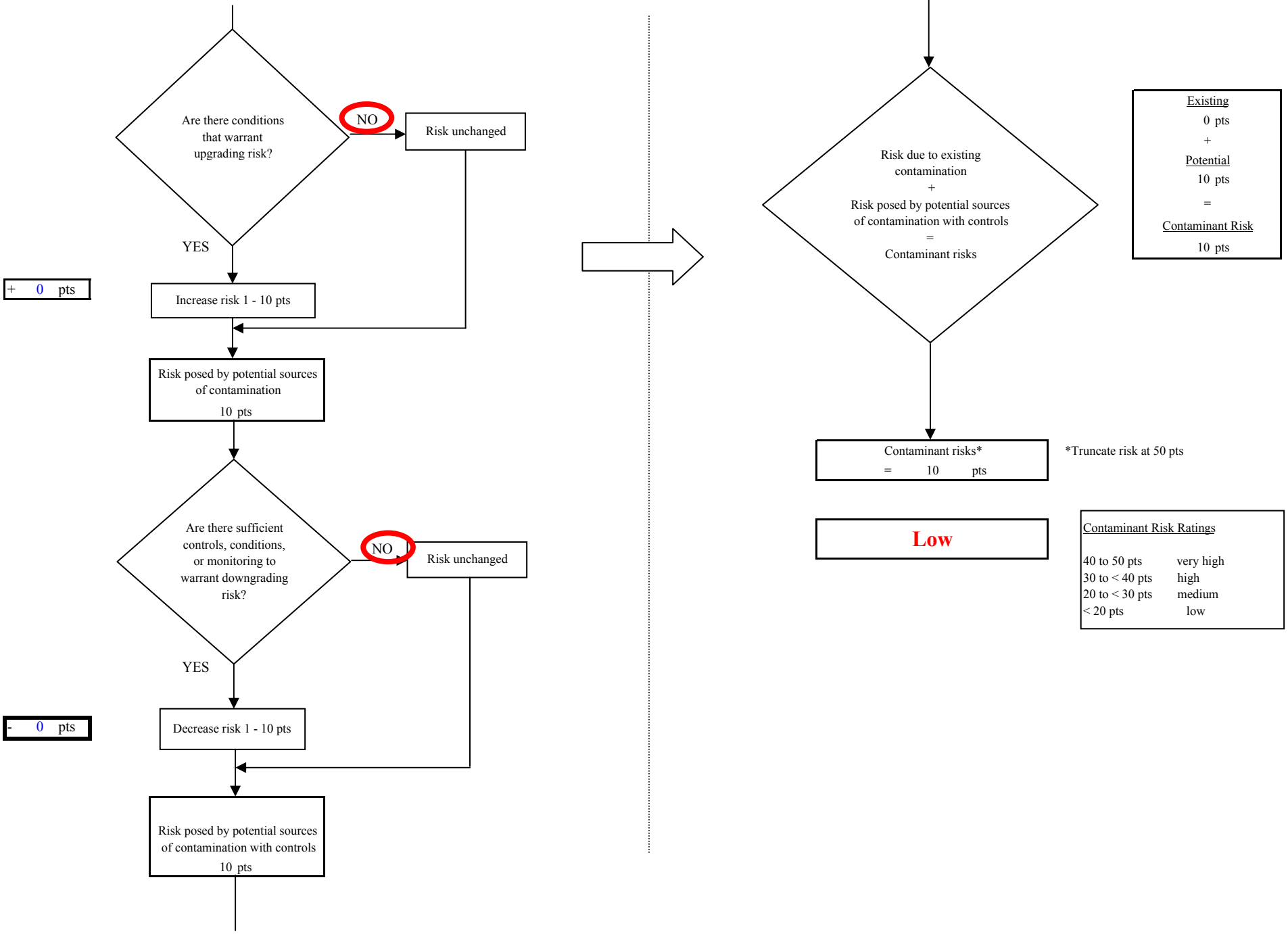


Chart 12. Vulnerability analysis for Moose Creek Apartments - Synthetic Organic Chemicals

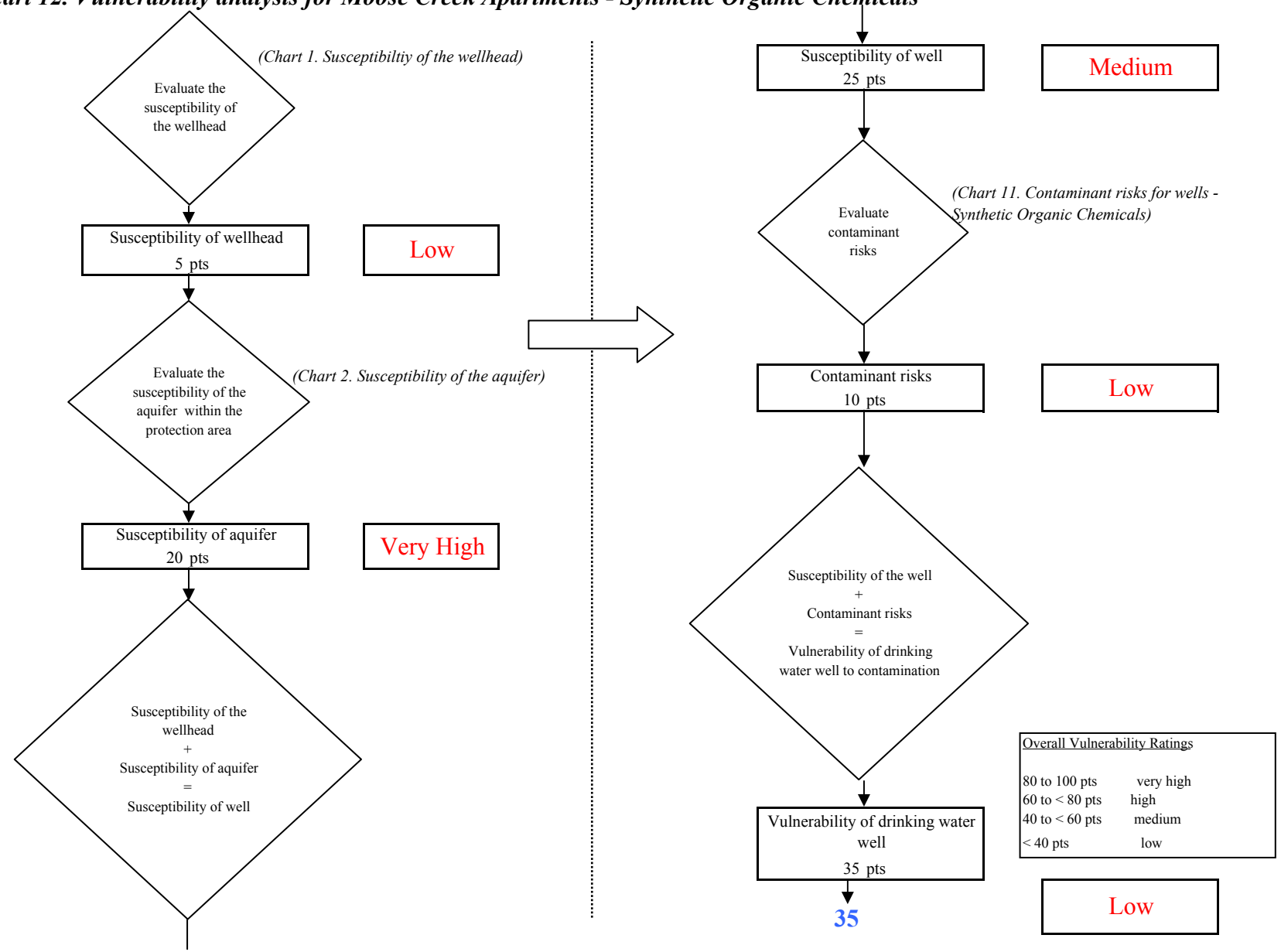


Chart 13. Contaminant risks for Moose Creek Apartments - Other Organic Chemicals

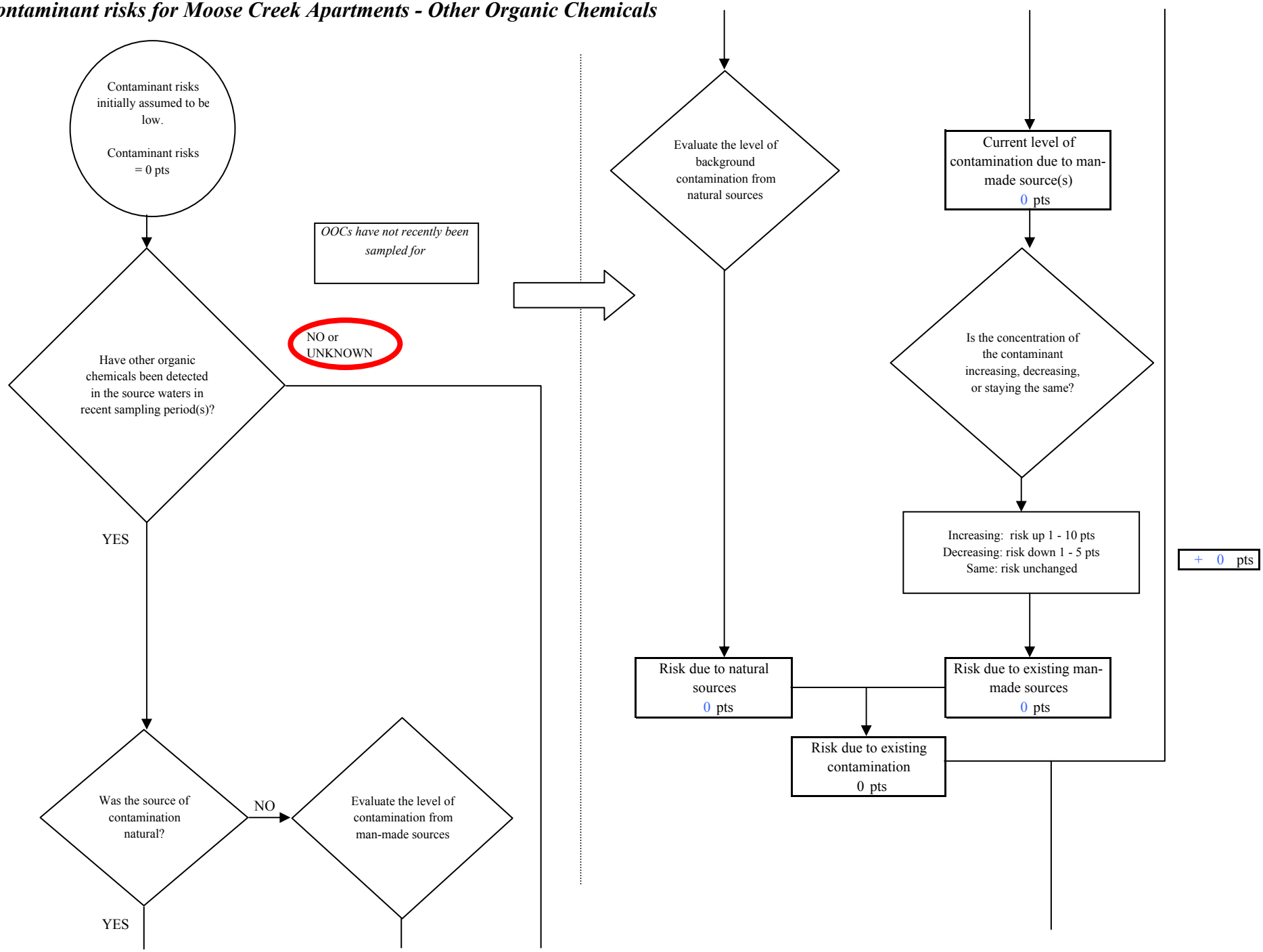
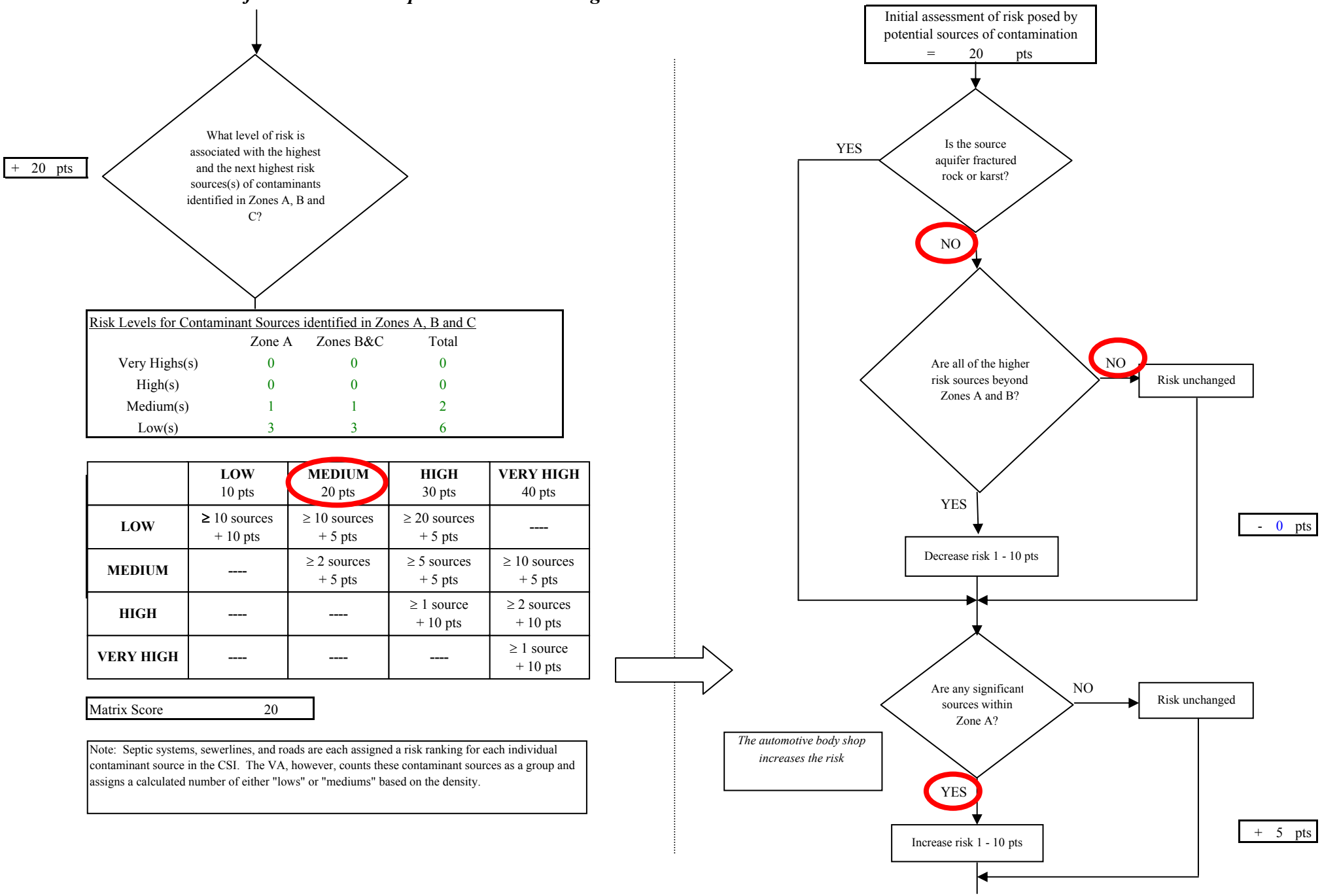


Chart 13. Contaminant risks for Moose Creek Apartments - Other Organic Chemicals



Risk Levels for Contaminant Sources identified in Zones A, B and C

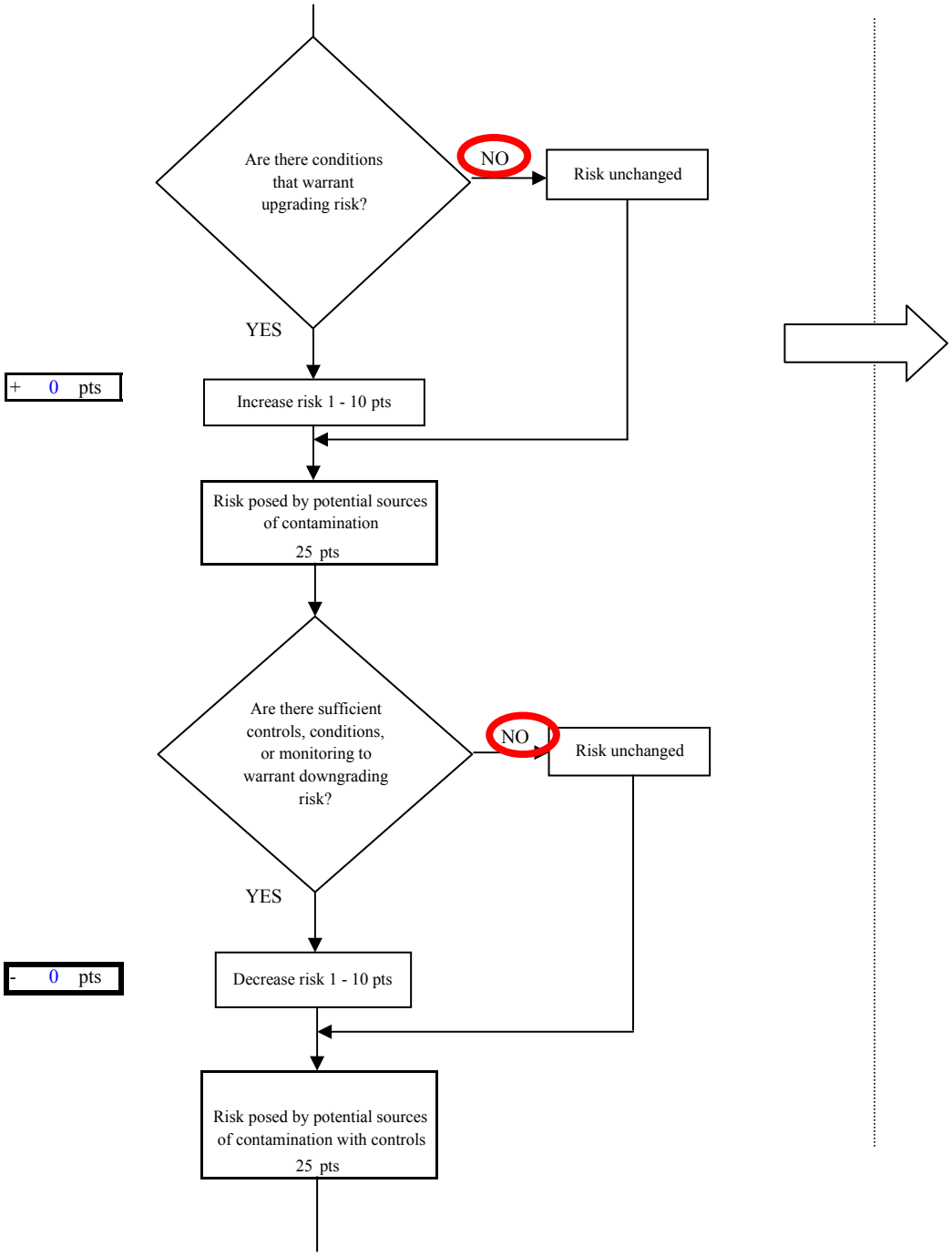
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	1	2
Low(s)	3	3	6

	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 13. Contaminant risks for Moose Creek Apartments - Other Organic Chemicals



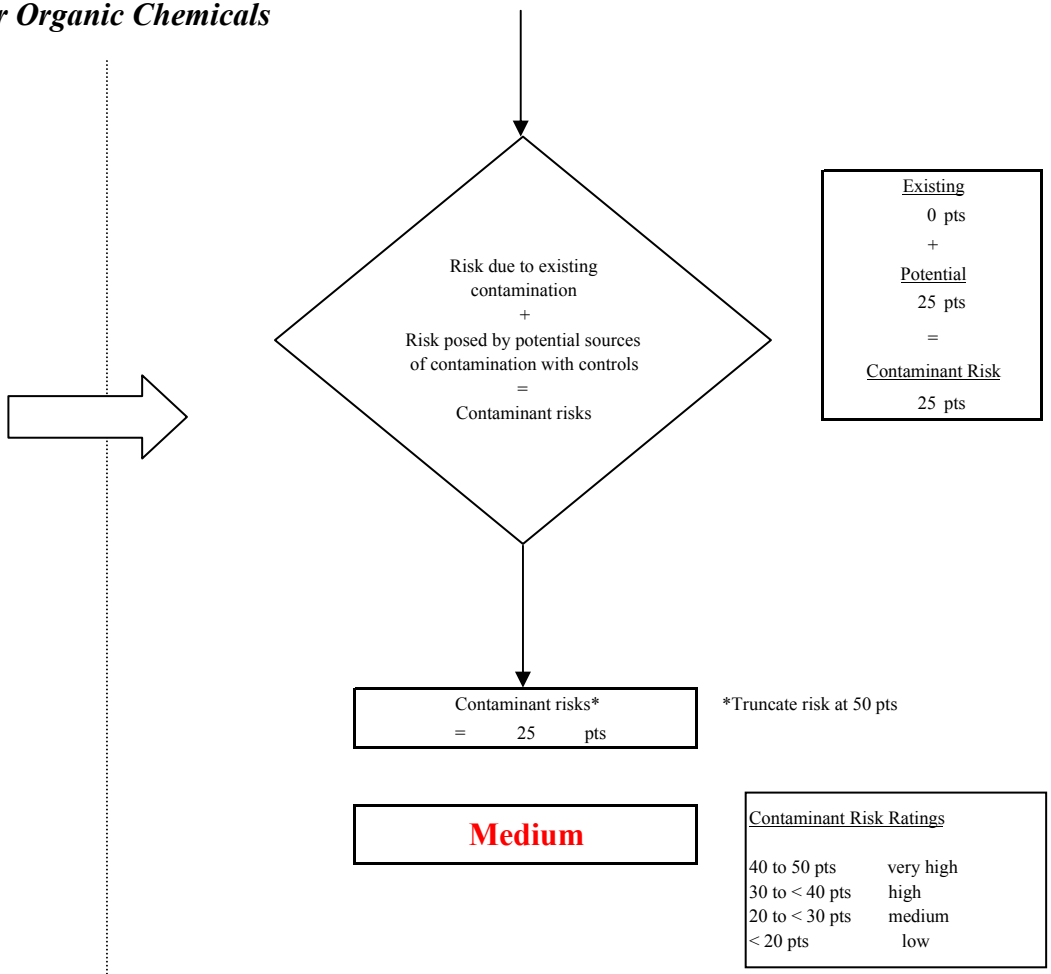


Chart 14. Vulnerability analysis for Moose Creek Apartments - Other Organic Chemicals