Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Bowers Investment Building Drinking Water System, Fairbanks, Alaska PWSID 311930

March 2004

DRINKING WATER PROTECTION PROGRAM REPORT Report 1483
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 Bowers Investment Building Source of Public Drinking Water,
Fairbanks, 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 Bowers Investment Building to potential contamination. This Class A (non-community) water system consists of one well at the corner of University Avenue and Davis Road in Fairbanks, Alaska. The well received a susceptibility rating of **High**. This rating is a combination of a **Medium** rating for the actual wellhead and a **Very High** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Bowers Investment Building public water system include: residential area, septic systems, fuel storage tanks, roads, a dry cleaner, and Leaking Underground Storage Tank (LUST) sites. 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 Bowers Investment Building received an overall vulnerability rating of **High** for volatile organic chemicals, and a **Medium** for bacteria and viruses, nitrates and/or nitrites, heavy metals and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

BOWERS INVESTMENT BUILDING PUBLIC DRINKING WATER SYSTEM

Bowers Investment Building public water system is a Class A (non-community) water system. The system consists of one well at the corner of University Avenue and Davis Road in Fairbanks, Alaska (T1S, R1W, Section 17) (See Map 1 of Appendix A). Fairbanks is located in the Fairbanks North Star Borough which is near the center of Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include : College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

Golden Heart Utilities provides water and sewer for most areas of the city of Fairbanks. Residents in the area of the Bowers Investment Building primarily use septic systems. Electricity is provided by Golden Valley Electric Association. The majority of residents (approximately 70%) use heating oil (typically stored in both above and below ground 275 to 500-gallon tanks) to heat homes and buildings (ADCED, 2002). Garbage collection services are proved 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 Bowers Investment Building water system is located in the alluvial plain at an elevation of approximately 425 feet above sea level.

According to the well log, the depth of the well is 120 feet below the ground surface and is screened in a combination of gravel. The alluvial plain consists of alternating layers of 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). Areas with discontinuous permafrost may locally affect the ground water flow directions.

Primarily the Tanana River, but also the Chena River contributes 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 Bowers Investment Building public drinking water system serves approximately 100 non-residents through one service connection.

BOWERS INVESTMENT BUILDING 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 methods for 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 an estimate using the available information and resources, 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 States Geological Survey (USGS) reports, area well logs, and the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

The water table in the area of the Bowers Investment Building, 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 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 Bowers Investment Building 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 Bowers Investment Building 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 bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

VULNERABILITY OF BOWERS INVESTMENT BUILDING 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 wellhead for the Bowers Investment Building received a Medium Susceptibility rating. The 8/27/02 Sanitary Survey for this system indicates the well is capped with a sanitary seal. A sanitary seal prevents potential contaminant from entering the well. The well diagrams indicate that the wells are encased in a cement vault. Even though the land may be sloped away from the vaulted well, the cement can easily develop cracks allowing potential contaminants to travel down the outside of the well casing. The well is also not grouted. Grouting also works to prevent contaminants from traveling down the outside of the well casing.

The aquifer the Bowers Investment Building 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. Wells in the area can also provide a quick pathway for contaminants to travel down into the aquifer if the wells are not grouted correctly. Table 2 summarizes the Susceptibility scores and ratings for Bowers Investment Building.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	10	Medium
Susceptibility of the Aquifer	21	Very High
Natural Susceptibility	31	High

The Contaminant Risk has been derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Contaminant Risk Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

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

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	10	Low
Nitrates and/or Nitrites	10	Low
Volatile Organic Chemicals	29	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	10	Low
Synthetic Organic Chemicals	10	Low
Other Organic Chemicals	10	Low

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

Natural Susceptibility (0 – 50 points)
+
Contaminant Risks (0 – 50 points)
=
Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings	
80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the 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	40	Medium
Nitrates and Nitrites	40	Medium
Volatile Organic Chemicals	60	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	40	Medium
Synthetic Organic Chemicals	40	Medium
Other Organic Chemicals	40	Medium

Bacteria and Viruses

The septic systems represent greatest risk of Bacteria and Viruses to the Bowers Investment Building 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, 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). Coli forms have not been detected during recent sampling (within the past 5 years).

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 also represent the greatest risk to 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 during routine sampling in the Bowers Investment Building 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 medium.

Volatile Organic Chemicals

The residential heating oil tanks represent the greatest risk of volatile organic chemical contamination to the Bowers Investment Building water system.

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

There are three Leaking Underground Storage Tank (LUST) sites located in Zone D of the protection area (displayed on Map 2). Site cleanup and monitoring is completed at all three sites and they represent very little risk to the well. Specific information on each site can be found on the internet at http://info.dec.state.ak.us/SPAR/CSP/UST/Search/ or by calling the ADEC Contaminated Sites Program at (907) 269-7658.

Volatile Organic Chemicals have not recently been detected in this water system during routine sampling (within the past 5 years).

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 high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The septic systems also represent the greatest risk to Heavy Metals, Cyanide, and Other Inorganic Chemicals for this source of public drinking water.

Cadmium and Fluoride were detected in extremely small concentrations with respect to their Maximum Contaminant Levels (MCLs). An MCL is the concentration of a contaminant allowed in drinking water by the Environmental Protection Agency (EPA).

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

Again, septic systems represent the greatest risk to Synthetic Organic Chemicals for this source of public drinking water.

Synthetic Organic Chemicals have not recently been sampled for (within the past 5 years).

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 medium.

Other Organic Chemicals

The septic systems also represent the greatest risk to Other Organic Chemicals for Bowers Investment Building public drinking water system.

Other Organic Chemicals have not been sampled for recently (within the past 5 years).

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

Bowers Investment Building
Drinking Water Protection Area Location Map
(Map 1)

DAVIS ROAD
PEGER ROAD
WILBUR STREET
VIAN WAY
DOROTHY ROAD
PACIFIC PLACE
ROBERT J. MITCHELL EXPRESSWAY
30TH AVENUE
SOUTH FAIRBANKS EXPRESSWAY
VAN HORN COURT
SHELL STREET
FIFTH WHEEL STREET
TRUCK STREET
TRAILER STREET
KOBA WAY
VAN HORN ROAD
SHELDON AVE

Map 1: Bowers Investment Company Drinking Water Protection Areas

PWSID: 311930

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 350 700 1,400 Feet

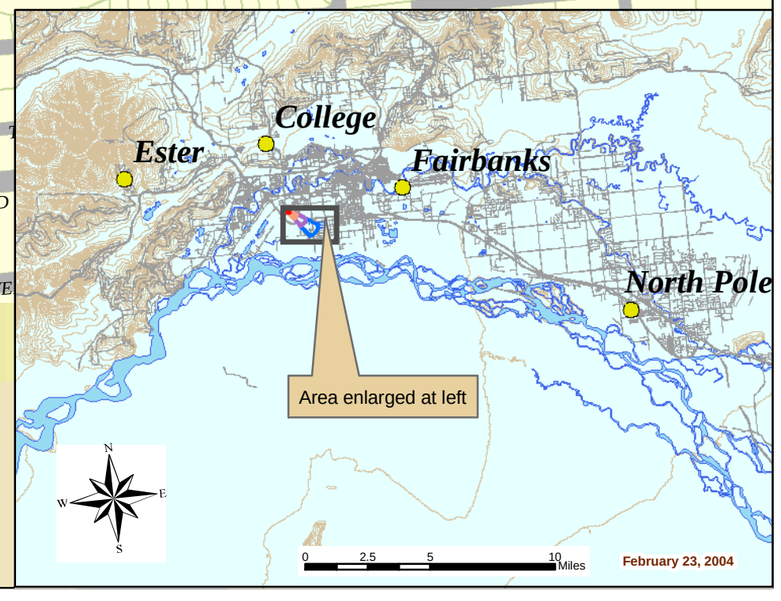
1:8,400

Data Sources:

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

Legend

- Bowers Investment well
- Zone A
- Zone B
- Zone C
- Zone D
- Towns
- Roads
- Surface Water
- Parcels



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APPENDIX B

Contaminant Source Inventory and Risk Ranking for Bowers Investment Building (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Bowers Investment 6 Bldg.***

PWSID 311930.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Residential Areas	R01		A	2	Estimated 1.5 acres of residential area
Septic systems (serves one single-family home)	R02		A	2	Assumed one septic system in Zone A based on tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		A	2	Assumed one tank in Zone A based on number of tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		A	2	Davis Road
Residential Areas	R01		B	2	Estimated 15 acres of residential area
Septic systems (serves one single-family home)	R02		B	2	Assumed 10 septics based on number of tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		B	2	Assumed 10 tanks based on number of tax parcels designated as residential
Residential Areas	R01		C	2	Estimated 1 acre of residential area
Septic systems (serves one single-family home)	R02		C	2	Assumed 1 septic based on number of tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		C	2	Assumed 1 tank based on number of tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	2	South Fairbanks Expressway
Dry cleaners	C10	C10-1	D	2	2260 Standard Ave
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	D	2	3030 Peger Road
Tanks, diesel (underground)	T08	T08-1	D	2	3175 Peger Road
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	D	2	KIC/TU; 3061 Peger Rd; File Number 100.26.036
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-2	D	2	FNSB - Transit Garage Facility; 3175 Peger Road
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-3	D	2	Lynden Transport Inc; 3001 Peger Road; File Number 102.26.048

Table 2

Contaminant Source Inventory and Risk Ranking for Bowers Investment 6 Bldg. Sources of Bacteria and Viruses

PWSID 311930.001

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 based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Davis Road
Residential Areas	R01		A	Low	2	Estimated 1.5 acres of residential area
Residential Areas	R01		B	Low	2	Estimated 15 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 10 septics based on number of tax parcels designated as residential
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 1 septic based on number of tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	South Fairbanks Expressway
Residential Areas	R01		C	Low	2	Estimated 1 acre of residential area
Dry cleaners	C10	C10-1	D	Low	2	2260 Standard Ave
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	D	High	2	3030 Peger Road

Table 3

Contaminant Source Inventory and Risk Ranking for Bowers Investment 6 Bldg. Sources of Nitrates/Nitrites

PWSID 311930.001

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 based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Davis Road
Residential Areas	R01		A	Low	2	Estimated 1.5 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 10 septics based on number of tax parcels designated as residential
Residential Areas	R01		B	Low	2	Estimated 15 acres of residential area
Residential Areas	R01		C	Low	2	Estimated 1 acre of residential area
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	South Fairbanks Expressway
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 1 septic based on number of tax parcels designated as residential
Dry cleaners	C10	C10-1	D	Low	2	2260 Standard Ave
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	D	High	2	3030 Peger Road

Table 4

Contaminant Source Inventory and Risk Ranking for Bowers Investment 6 Bldg. Sources of Volatile Organic Chemicals

PWSID 311930.001

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 tank in Zone A based on number of tax parcels designated as residential
Residential Areas	R01		A	Low	2	Estimated 1.5 acres of residential area
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Davis Road
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A based on tax parcels designated as residential
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 10 septics based on number of tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		B	Medium	2	Assumed 10 tanks based on number of tax parcels designated as residential
Residential Areas	R01		B	Low	2	Estimated 15 acres of residential area
Tanks, heating oil, residential (above ground)	R08		C	Medium	2	Assumed 1 tank based on number of tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	South Fairbanks Expressway
Residential Areas	R01		C	Low	2	Estimated 1 acre of residential area
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 1 septic based on number of tax parcels designated as residential
Dry cleaners	C10	C10-1	D	High	2	2260 Standard Ave
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	D	Low	2	3030 Peger Road
Tanks, diesel (underground)	T08	T08-1	D	High	2	3175 Peger Road

Table 5

Contaminant Source Inventory and Risk Ranking for Bowers Investment 6 Bldg. Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 311930.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 1.5 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Davis Road
Residential Areas	R01		B	Low	2	Estimated 15 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 10 septics based on number of tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	South Fairbanks Expressway
Residential Areas	R01		C	Low	2	Estimated 1 acre of residential area
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 1 septic based on number of tax parcels designated as residential
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	D	Low	2	3030 Peger Road

Table 6

Contaminant Source Inventory and Risk Ranking for Bowers Investment 6 Bldg. Sources of Synthetic Organic Chemicals

PWSID 311930.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 1.5 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A based on tax parcels designated as residential
Residential Areas	R01		B	Low	2	Estimated 15 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 10 septics based on number of tax parcels designated as residential
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 1 septic based on number of tax parcels designated as residential
Residential Areas	R01		C	Low	2	Estimated 1 acre of residential area
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	D	Low	2	3030 Peger Road

Table 7

Contaminant Source Inventory and Risk Ranking for Bowers Investment 6 Bldg. Sources of Other Organic Chemicals

PWSID 311930.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Davis Road
Residential Areas	R01		A	Low	2	Estimated 1.5 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed one septic system in Zone A based on tax parcels designated as residential
Residential Areas	R01		B	Low	2	Estimated 15 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 10 septics based on number of tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	South Fairbanks Expressway
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 1 septic based on number of tax parcels designated as residential
Residential Areas	R01		C	Low	2	Estimated 1 acre of residential area
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	D	Low	2	3030 Peger Road

APPENDIX C

Bowers Investment Building
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

DAVIS ROAD

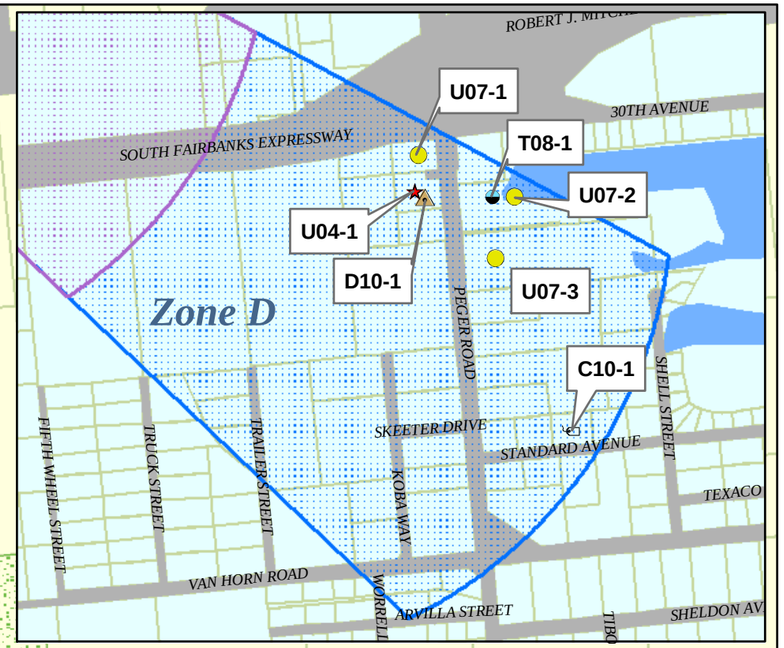
VIAN WAY

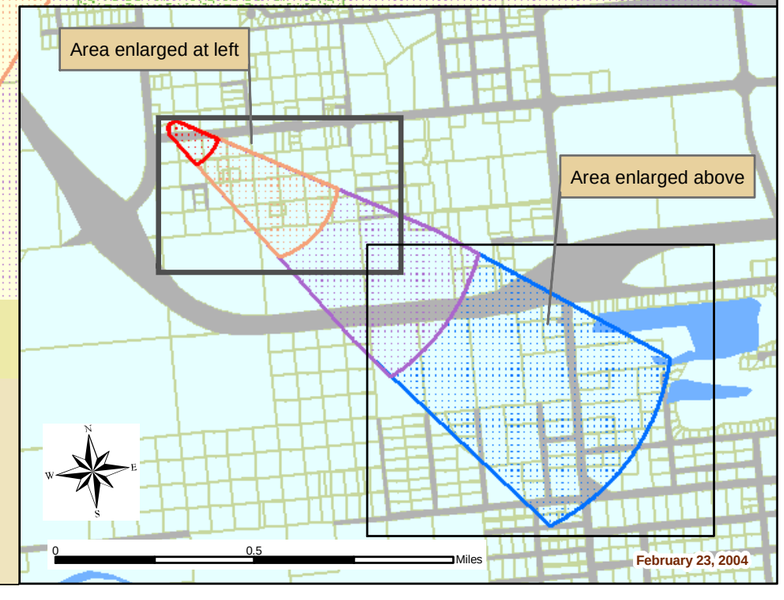
DOROTHY ROAD

Zone A

Zone B

Zone C





Map 2: Bowers Investment Company Potential Contaminant Sources

PWSID: 311930

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 100 200 400 Feet

1:2,400

Data Sources:

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

Legend

- C10, Dry cleaner
- D10, Large capacity septic systems
- T08, Underground diesel tank
- U04, DEC-recognized contaminated site
- U07, Open LUST site
- R02, Septic systems
- R08, Heating oil tanks
- R01, Residential areas
- Roads
- Parcels

APPENDIX D

Vulnerability Analysis for Bowers Investment Building Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Bowers Investment Building

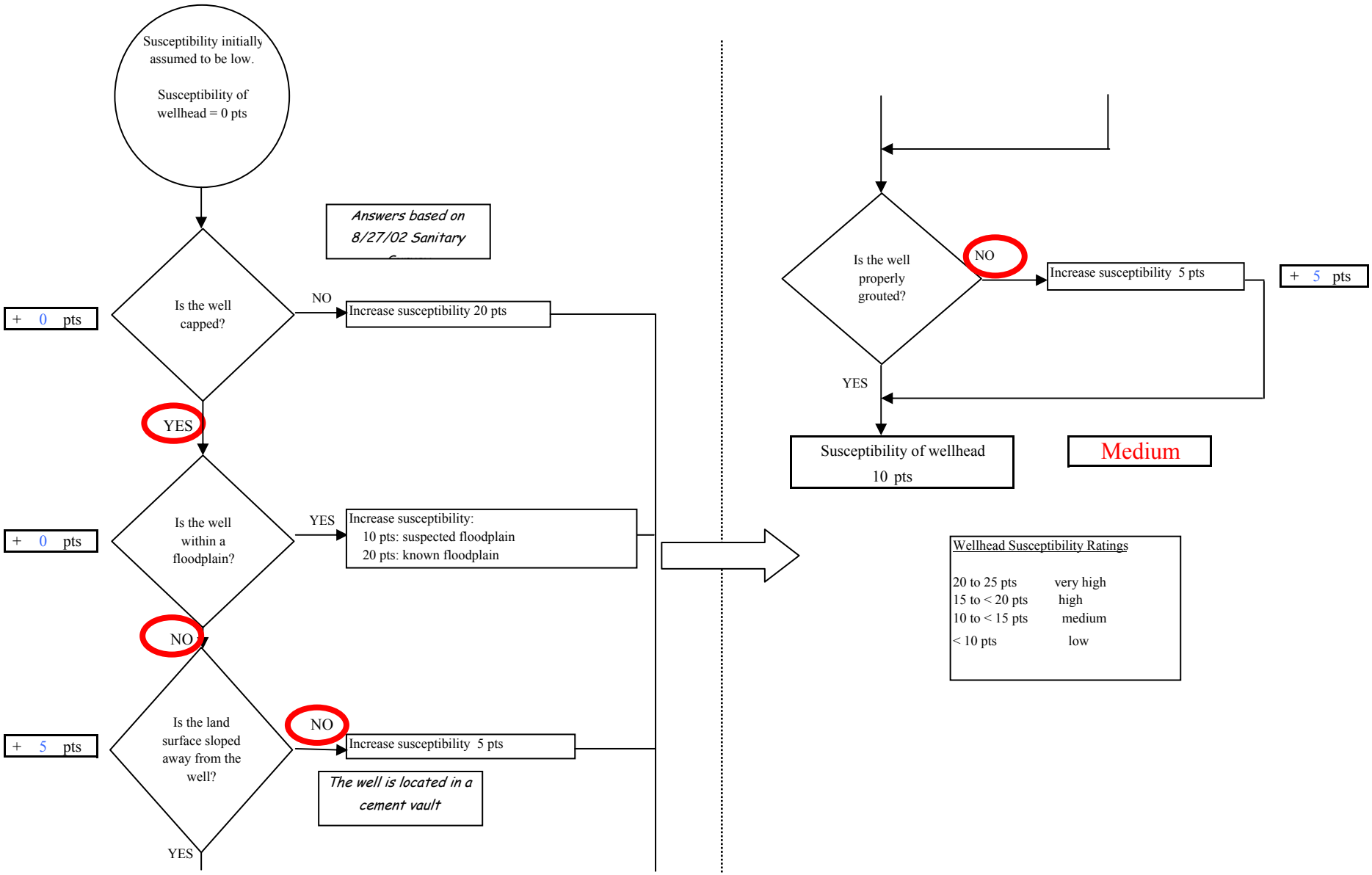


Chart 2. Susceptibility of the aquifer - Bowers Investment Building

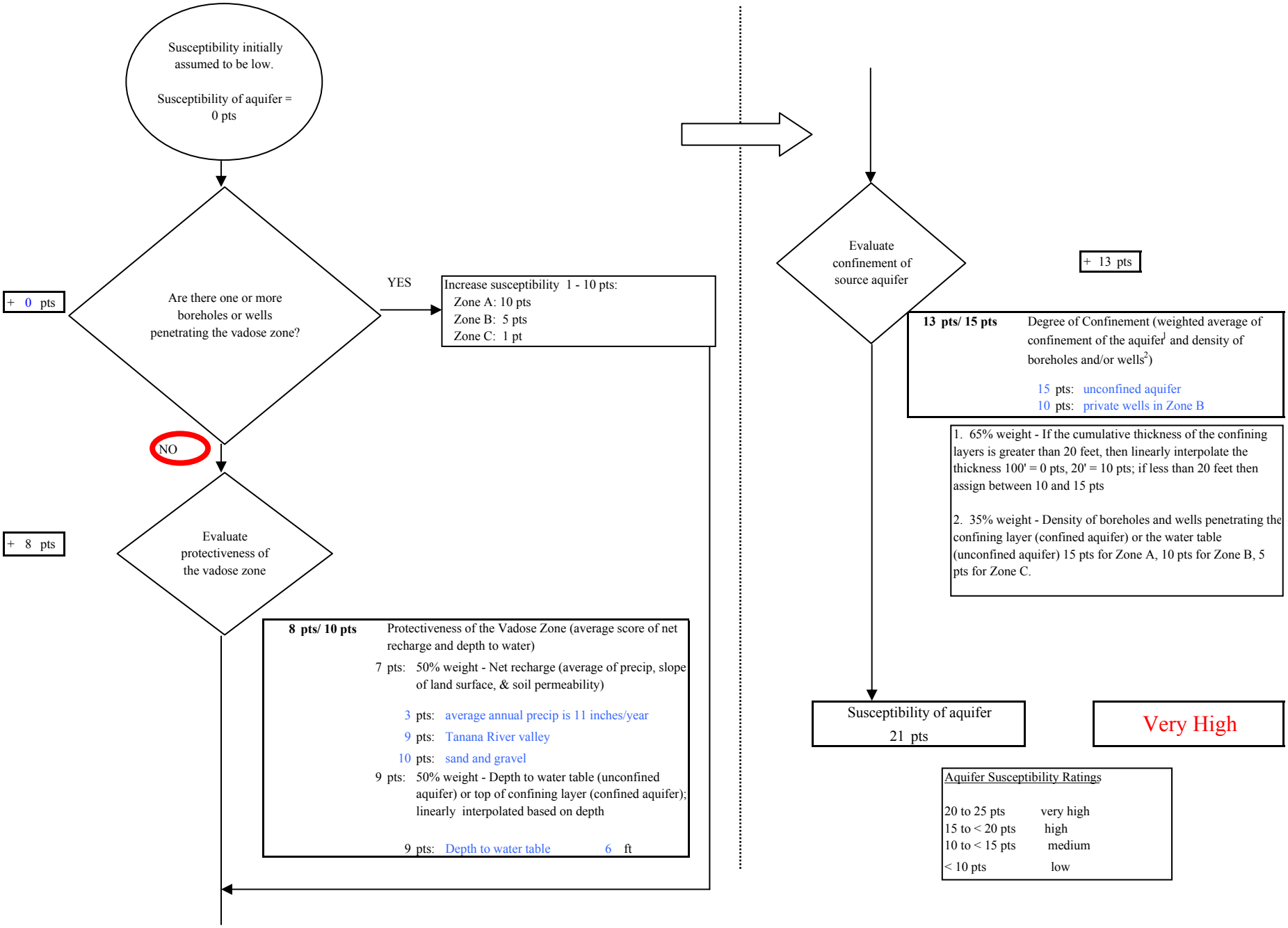
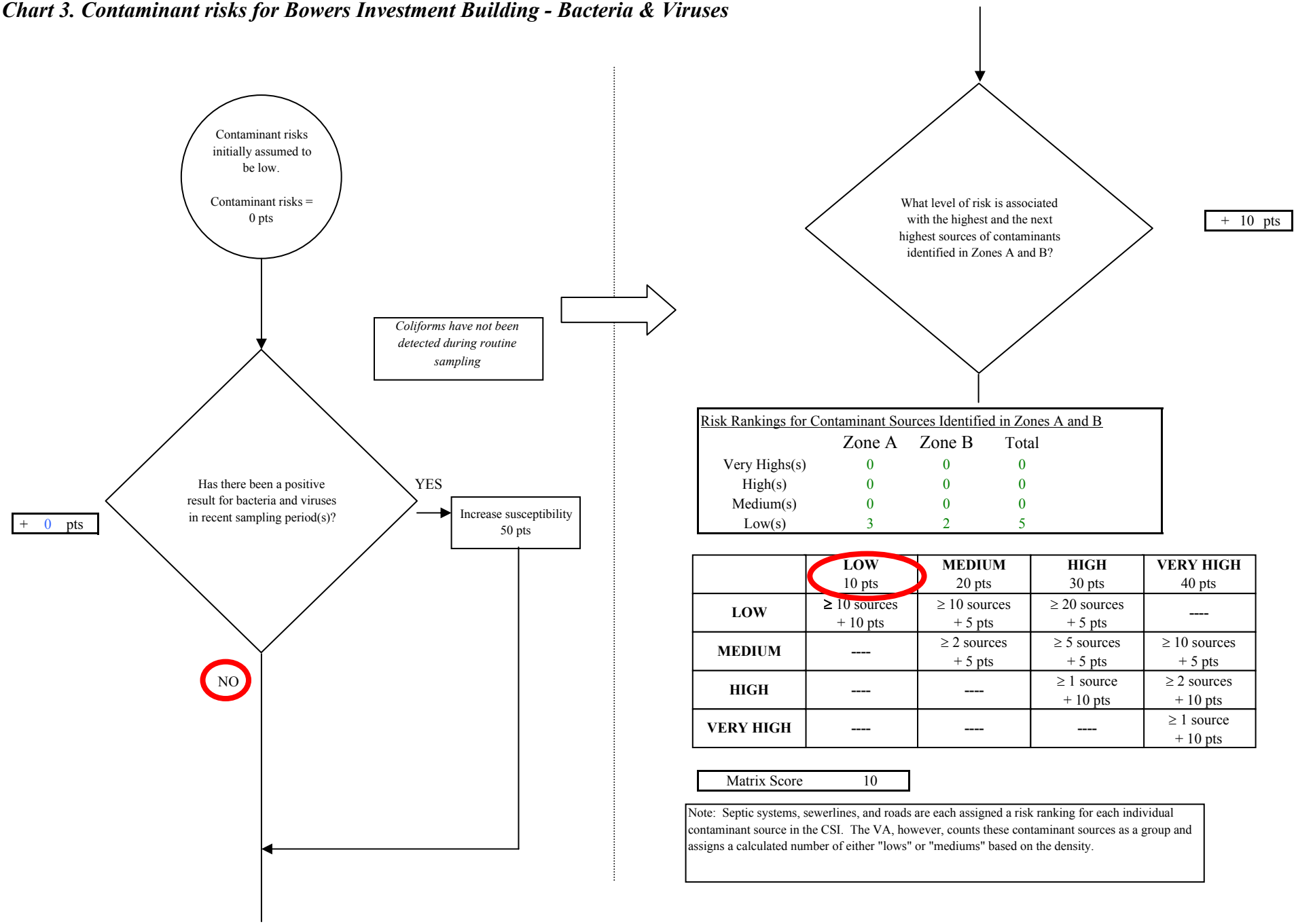


Chart 3. Contaminant risks for Bowers Investment Building - Bacteria & Viruses



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	2	5

	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 Bowers Investment Building - Bacteria & Viruses

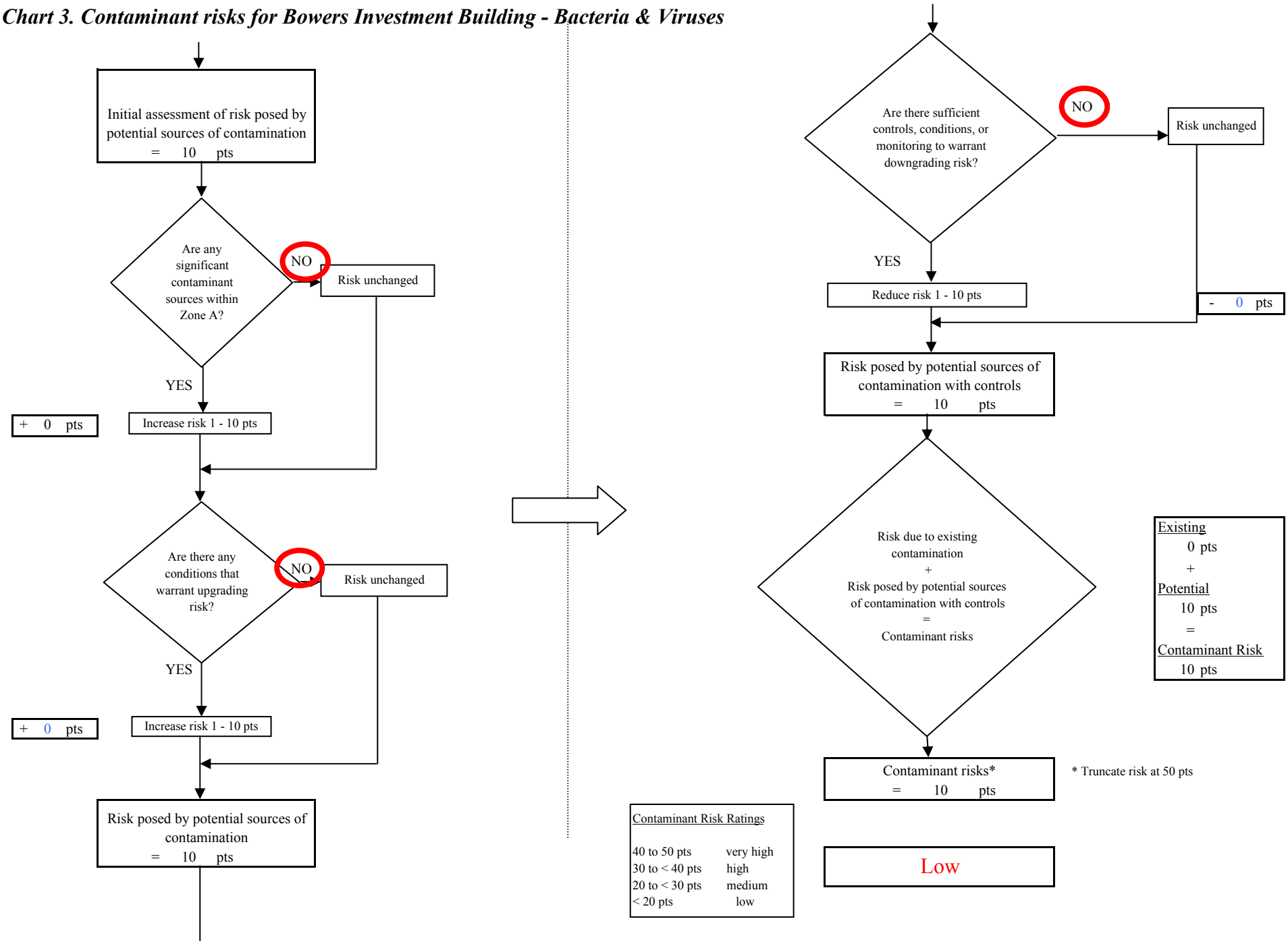


Chart 4. Vulnerability analysis for Bowers Investment Building - Bacteria & Viruses

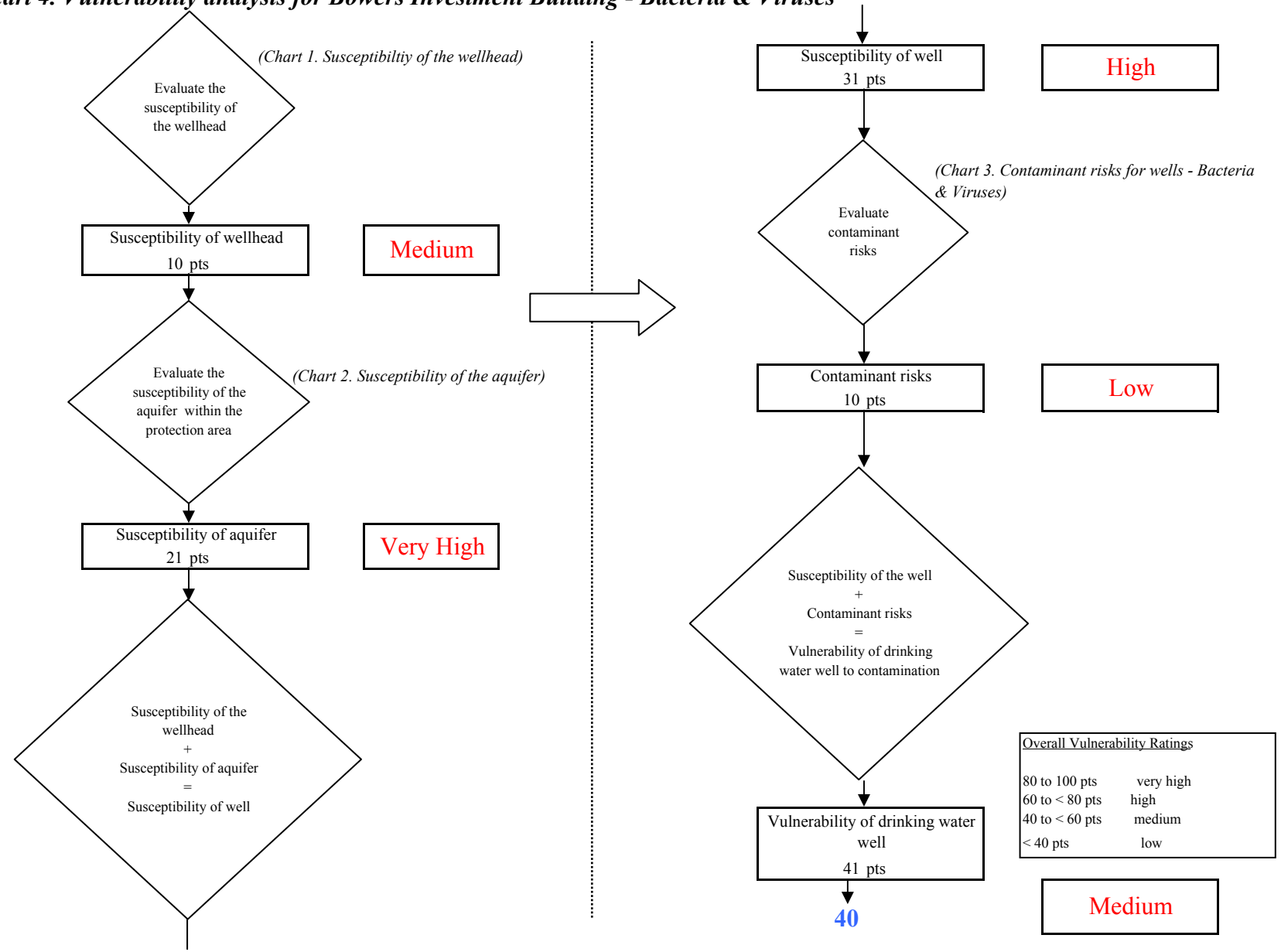


Chart 5. Contaminant risks for Bowers Investment Building - Nitrates and Nitrites

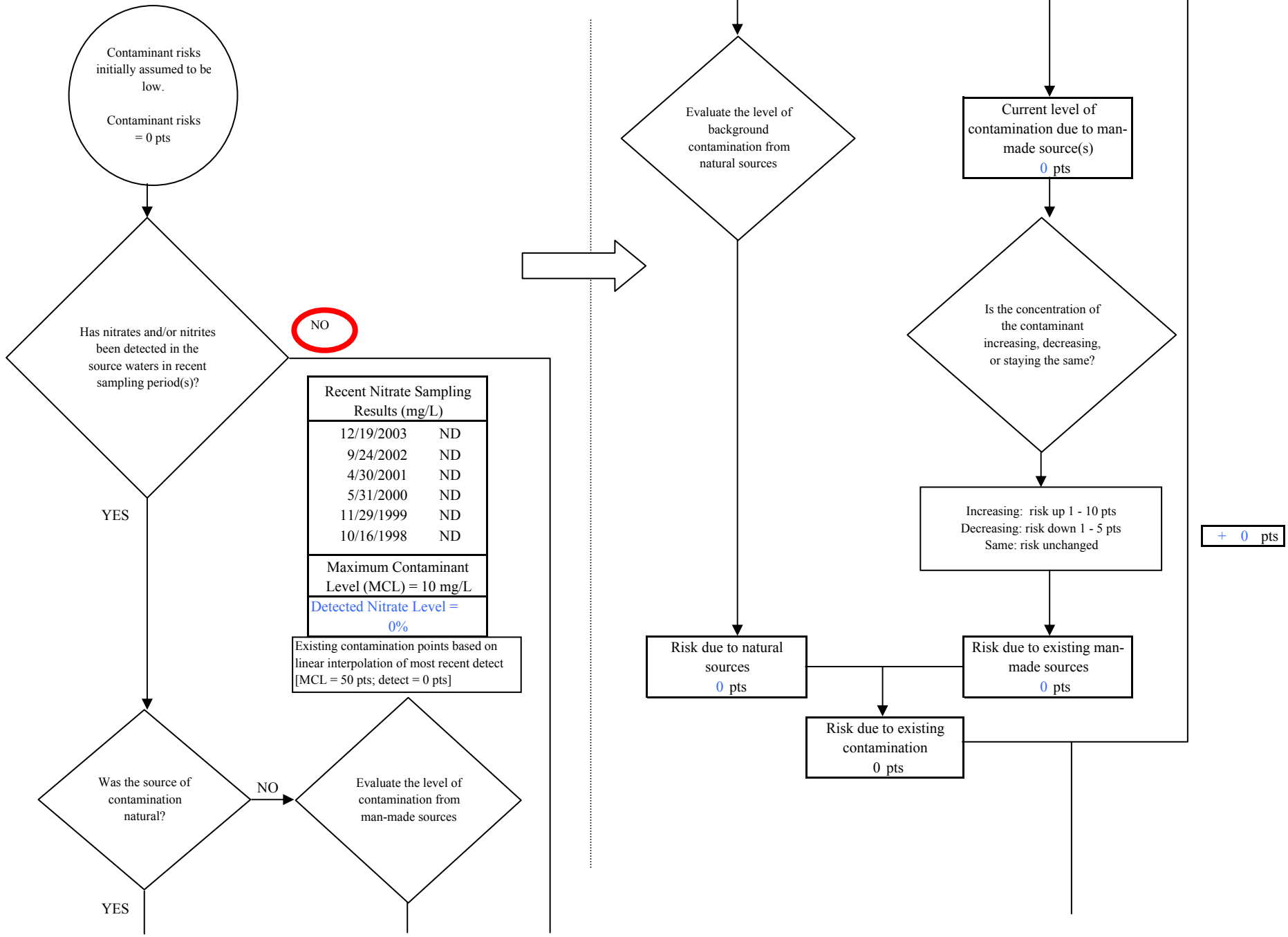


Chart 5. Contaminant risks for Bowers Investment Building - Nitrates and Nitrites

+ 10 pts

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

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

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

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

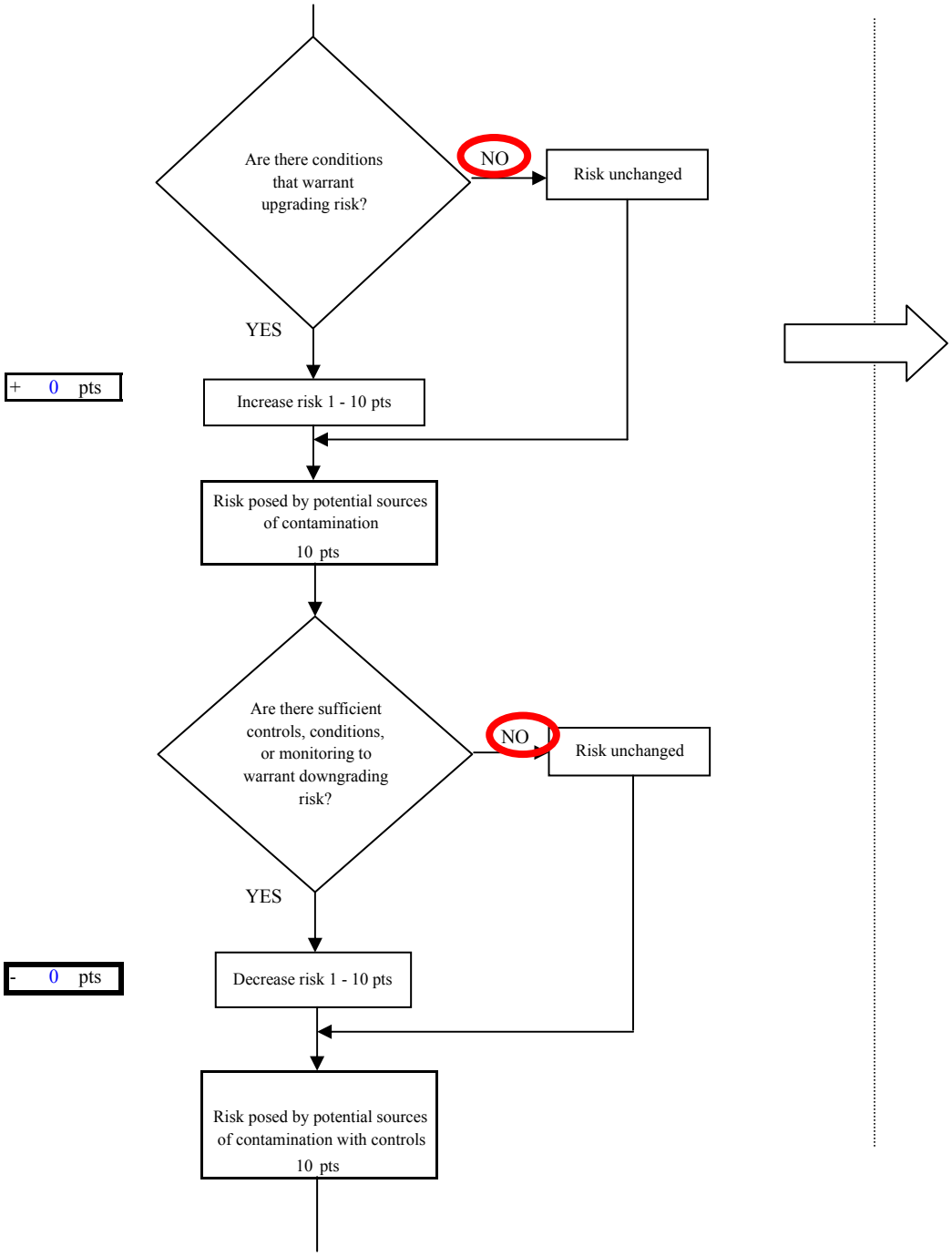
Risk unchanged

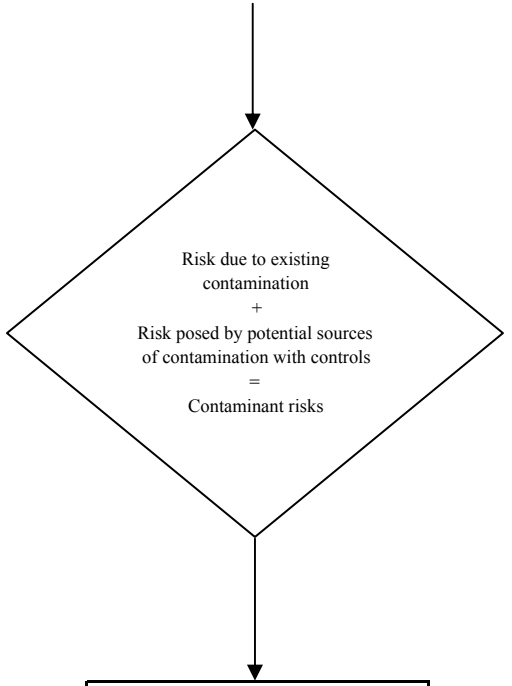
YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 5. Contaminant risks for Bowers Investment Building - Nitrates and Nitrites





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

Contaminant risks*
= 10 pts

*Truncate risk at 50 pts

Low

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

Chart 6. Vulnerability analysis for Bowers Investment Building - Nitrates and Nitrites

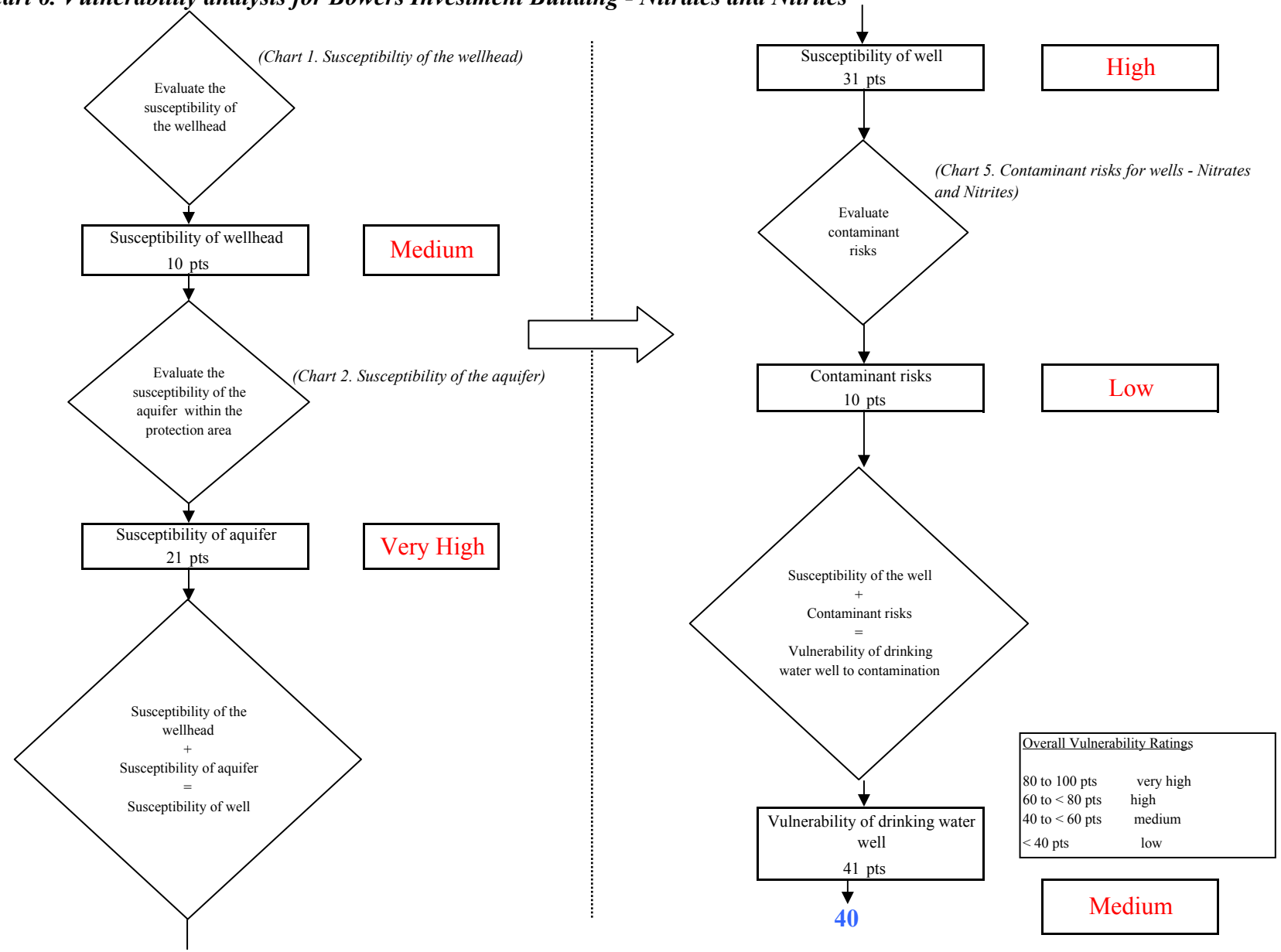


Chart 7. Contaminant risks for Bowers Investment Building - Volatile Organic Chemicals

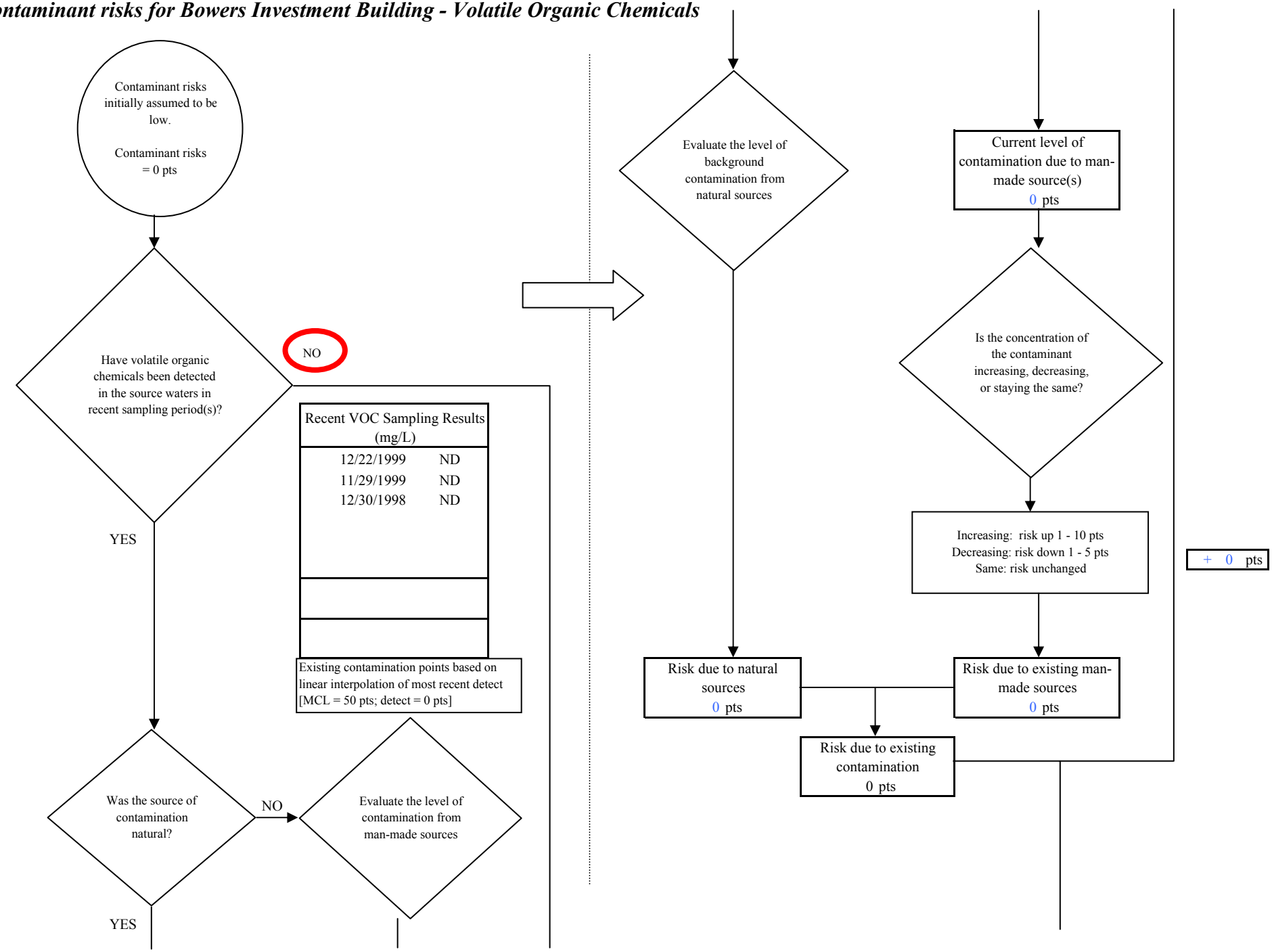


Chart 7. Contaminant risks for Bowers Investment Building - Volatile Organic Chemicals

+ 25 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	2	13	15
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.

Initial assessment of risk posed by potential sources of contamination = 25 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

The residential heating oil tank increases the risk

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 7. Contaminant risks for Bowers Investment Building - Volatile Organic Chemicals

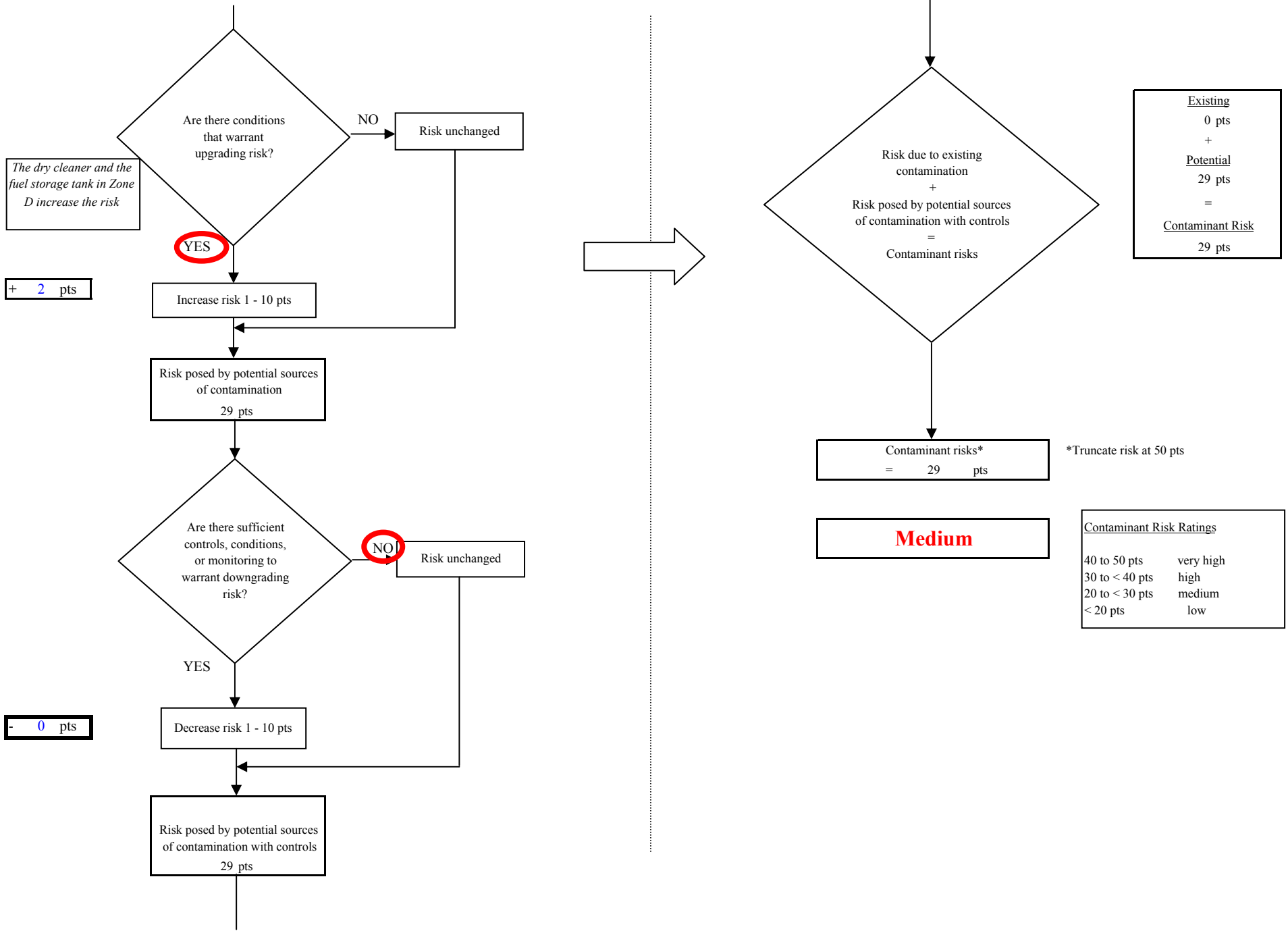


Chart 8. Vulnerability analysis for Bowers Investment Building - Volatile Organic Chemicals

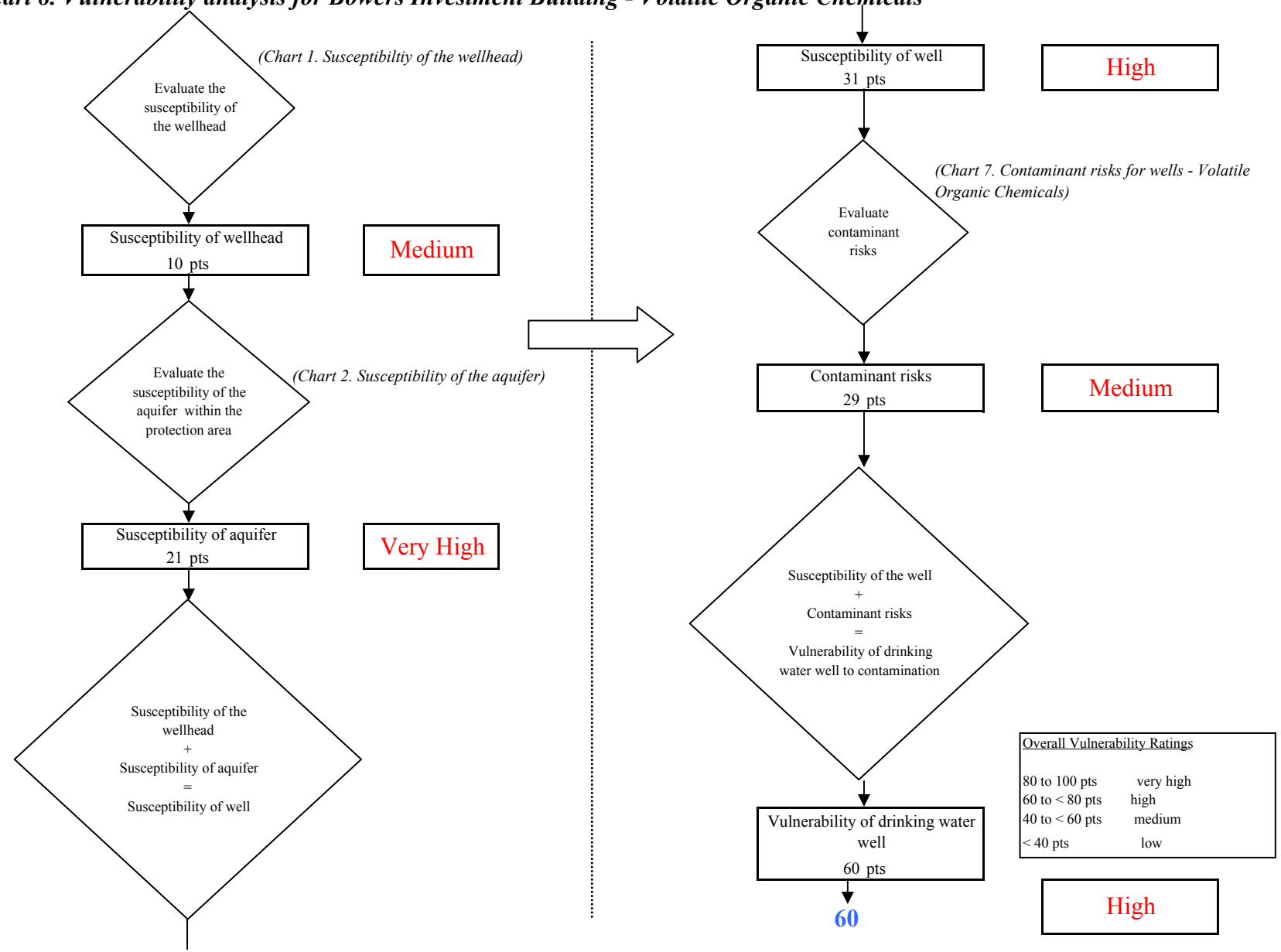


Chart 9. Contaminant risks for Bowers Investment Building - Heavy Metals, Cyanide and Other Inorganic Chemicals

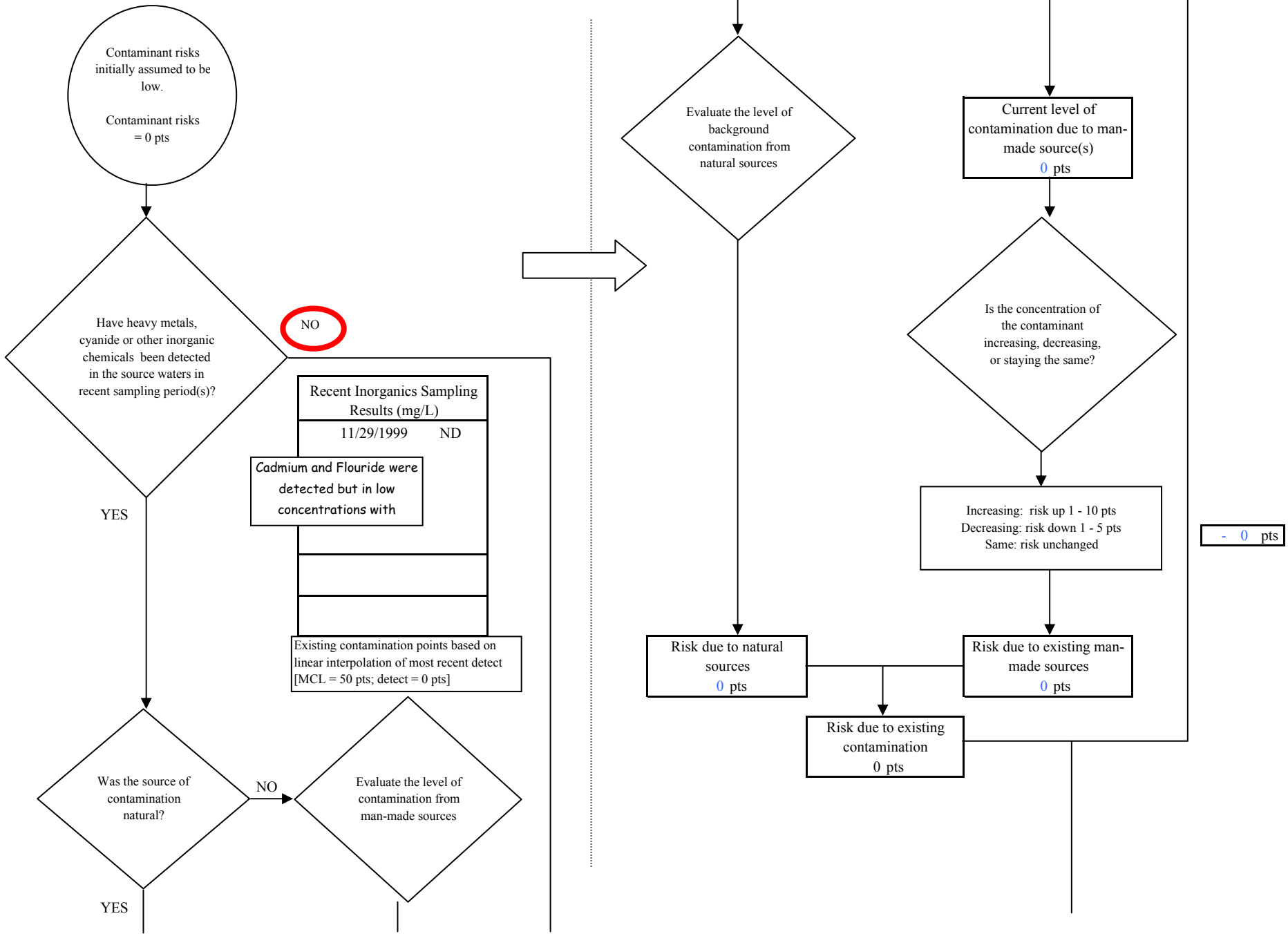


Chart 9. Contaminant risks for Bowers Investment Building - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 10 pts

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

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

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

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 9. Contaminant risks for Bowers Investment Building - Heavy Metals, Cyanide and Other Inorganic Chemicals

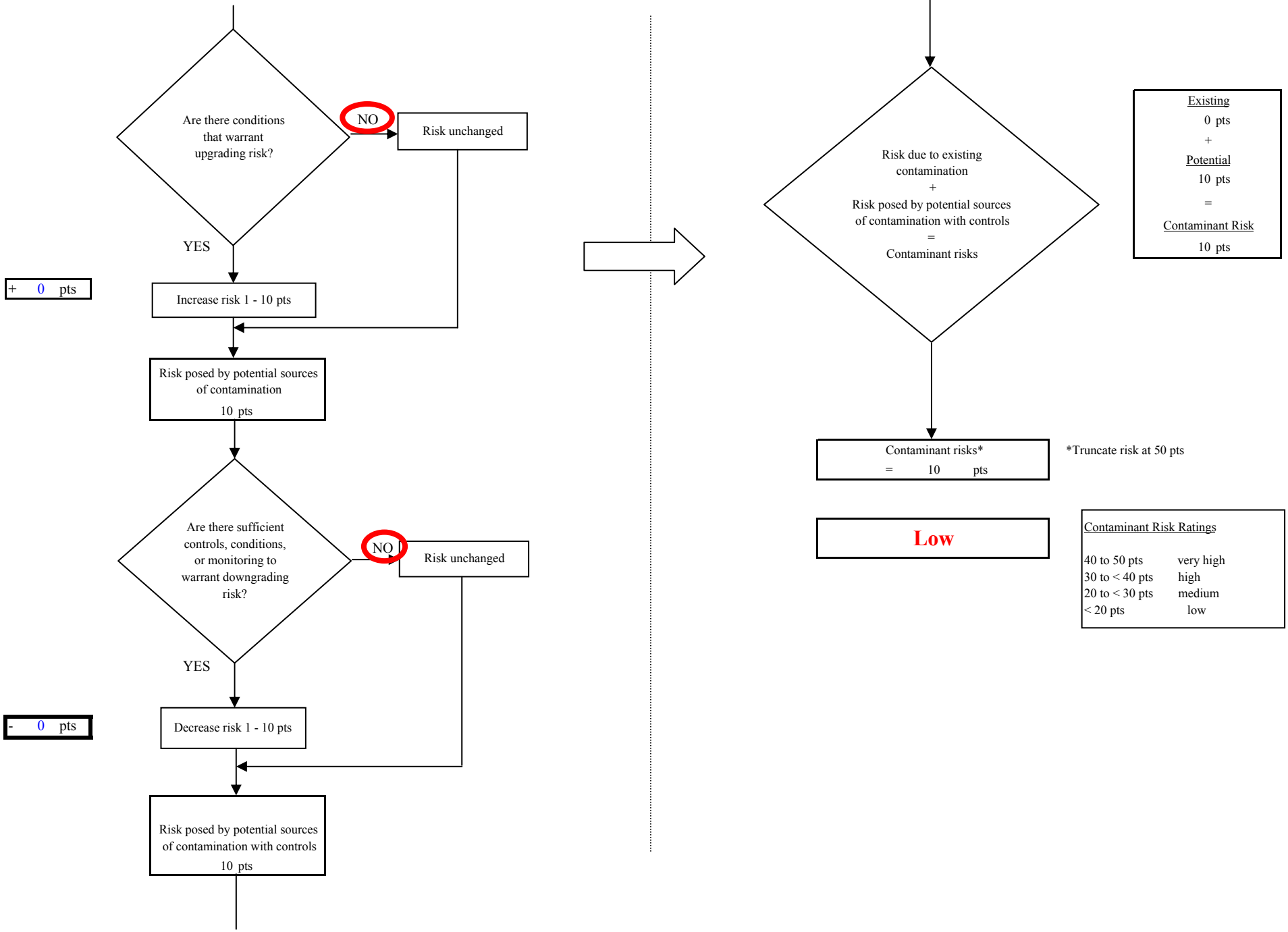


Chart 10. Vulnerability analysis for Bowers Investment Building - Heavy Metals, Cyanide and Other Inorganic Chemicals

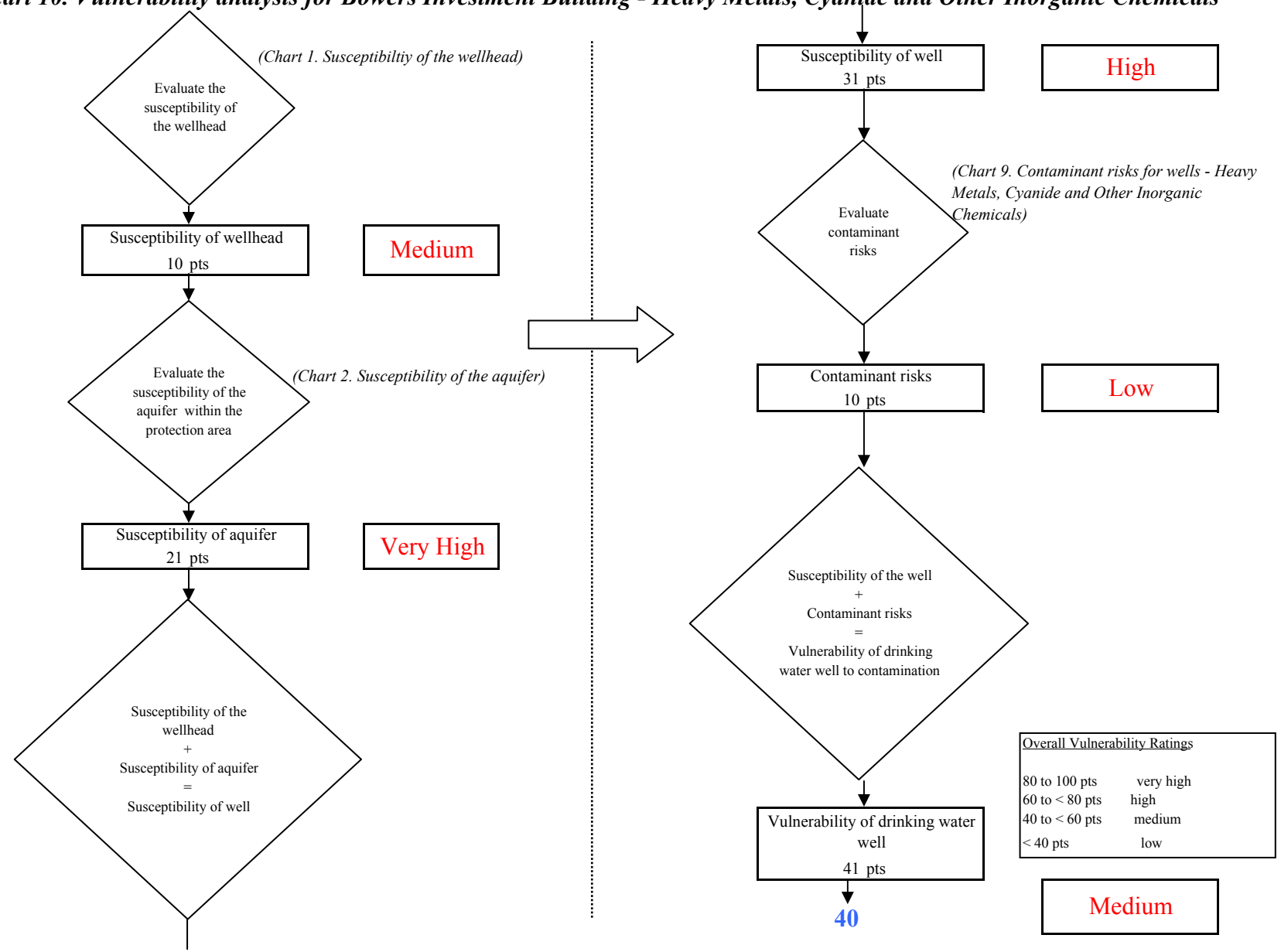


Chart 11. Contaminant risks for Bowers Investment Building - Synthetic Organic Chemicals

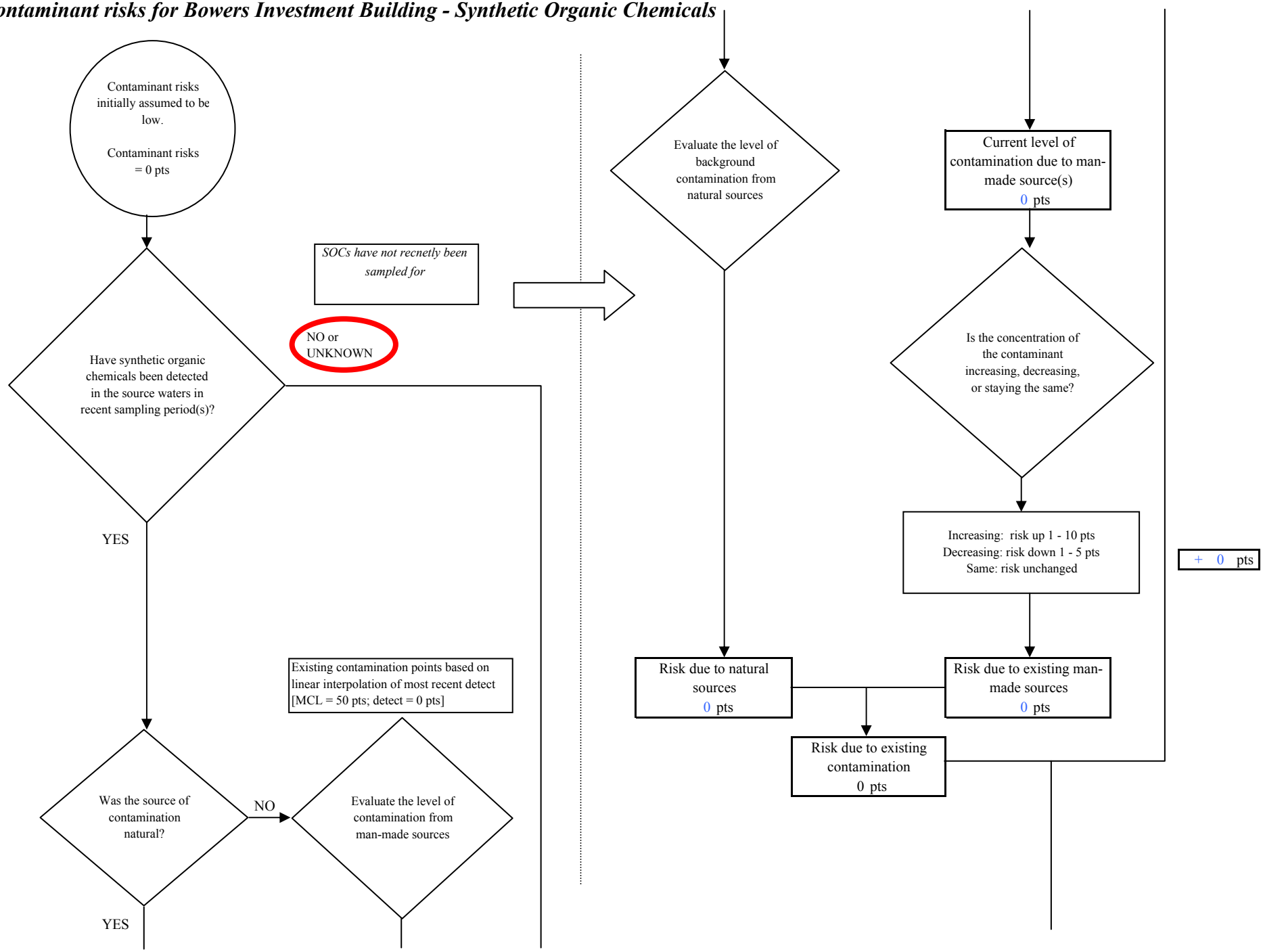
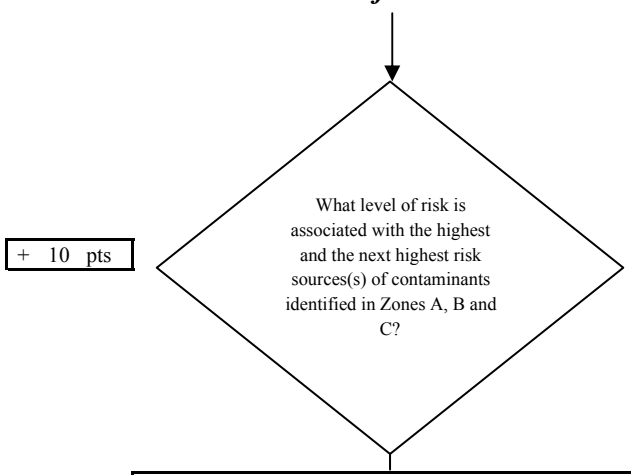


Chart 11. Contaminant risks for Bowers Investment Building - Synthetic Organic Chemicals



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)	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.

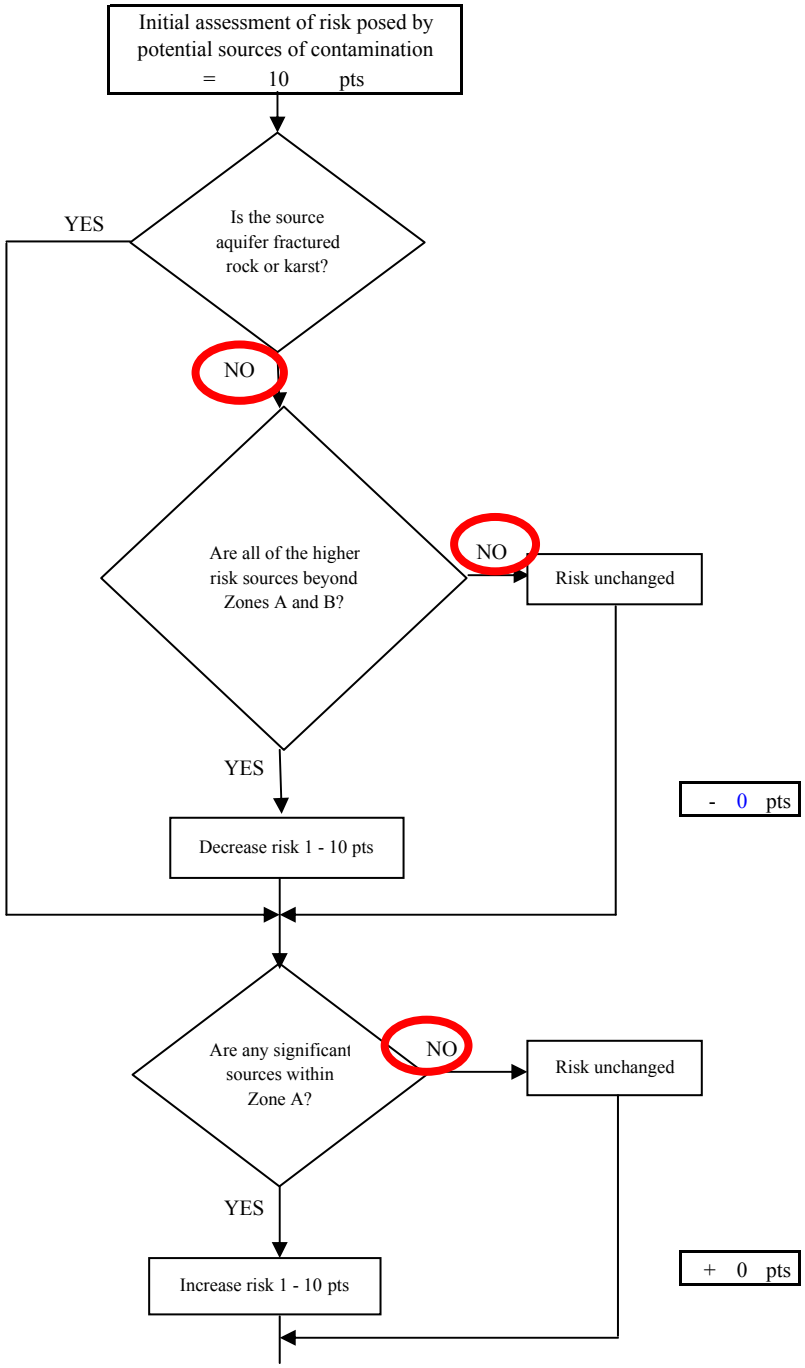
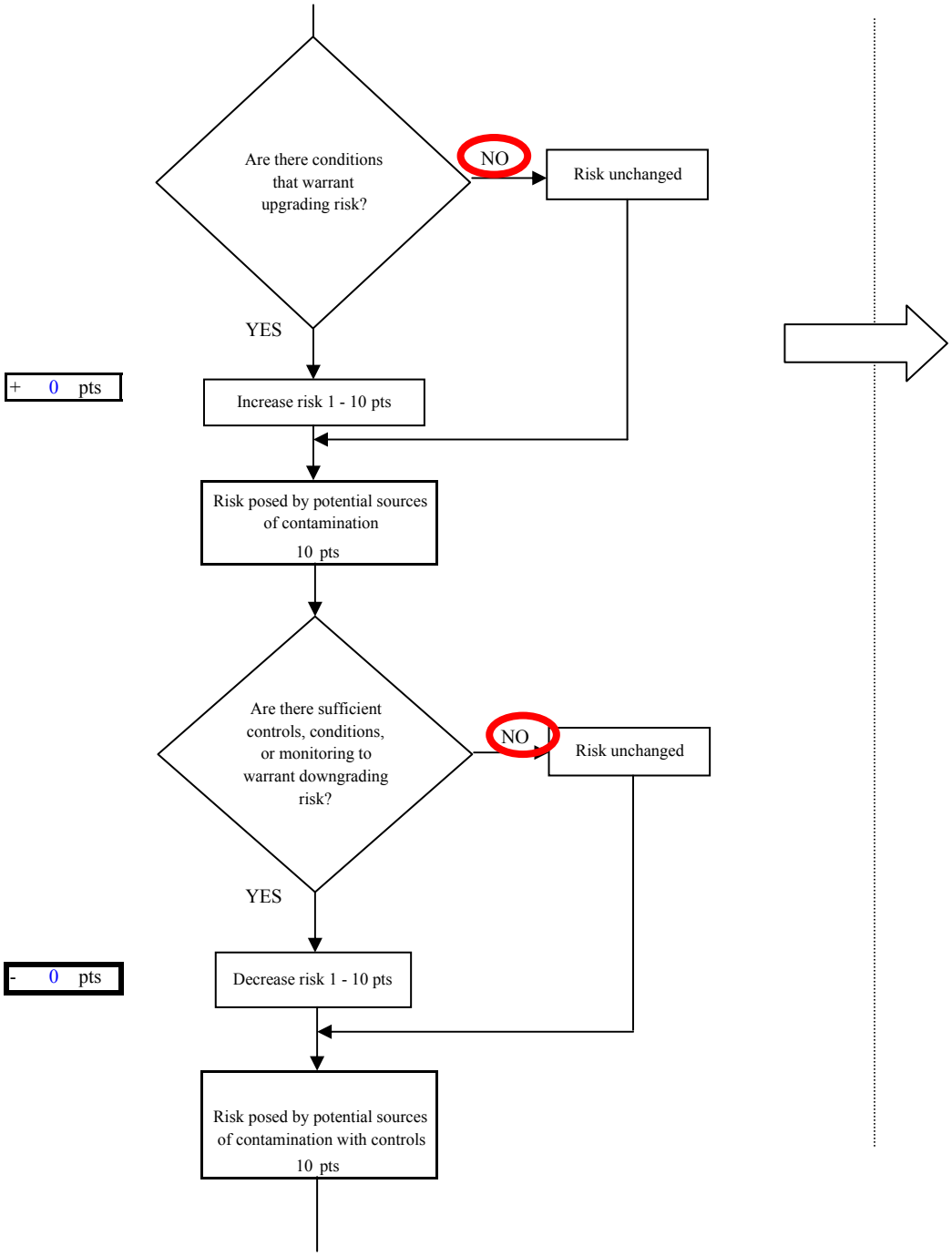


Chart 11. Contaminant risks for Bowers Investment Building - Synthetic Organic Chemicals



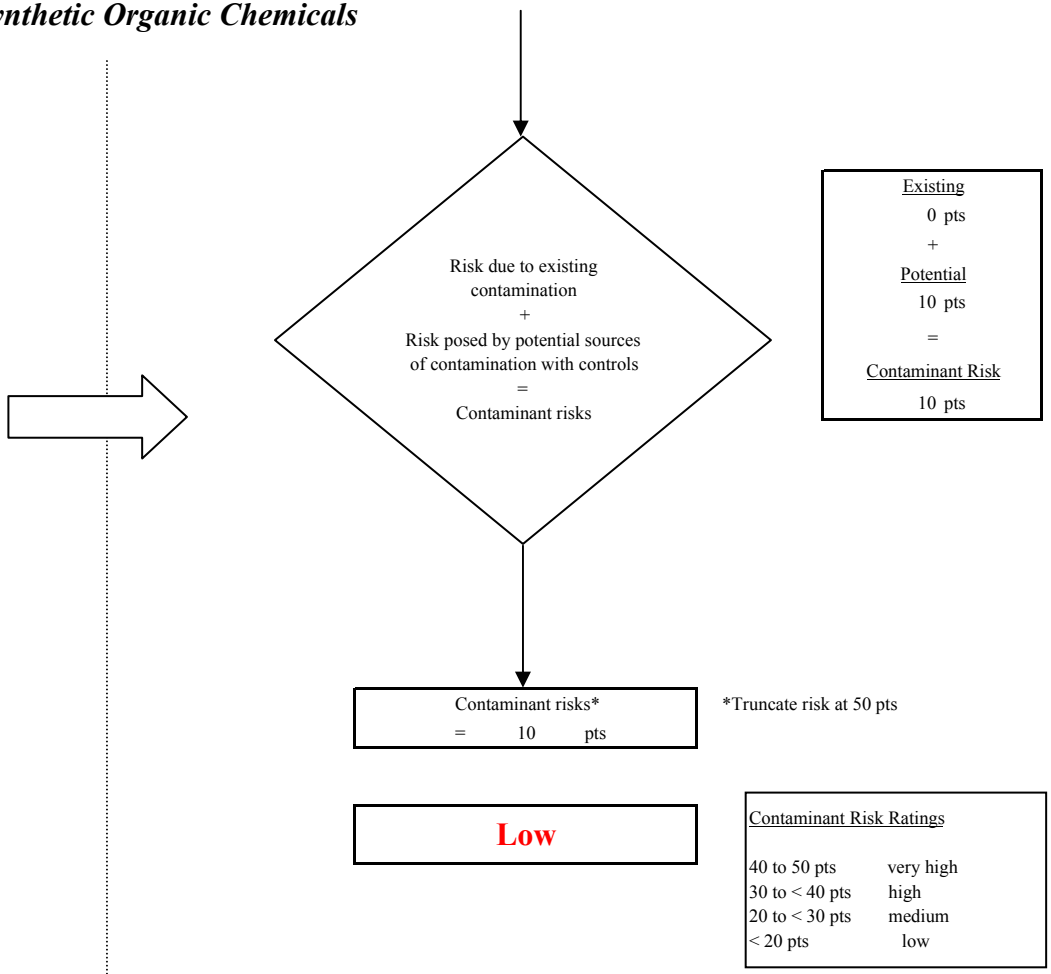


Chart 12. Vulnerability analysis for Bowers Investment Building - Synthetic Organic Chemicals

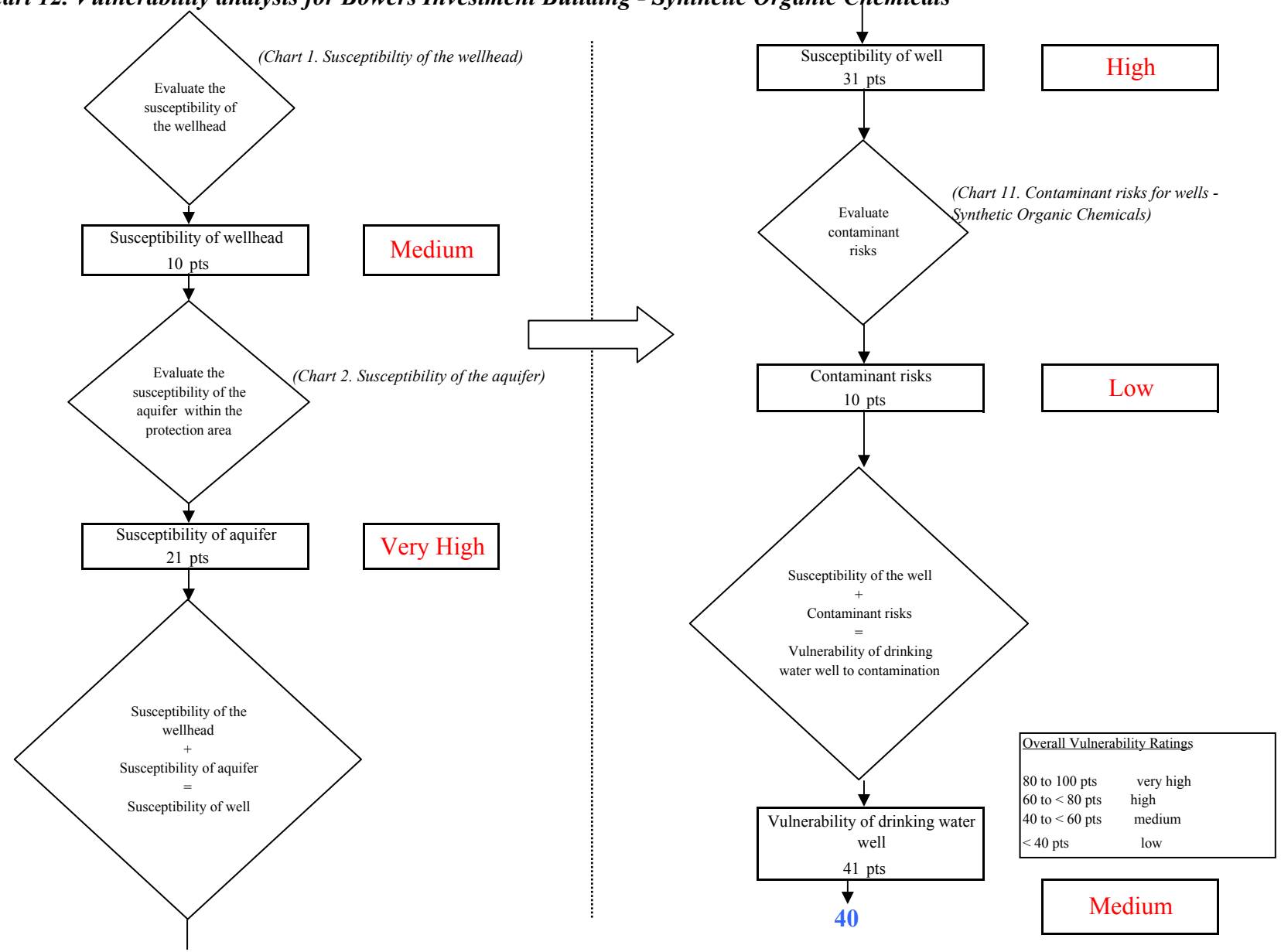


Chart 13. Contaminant risks for Bowers Investment Building - Other Organic Chemicals

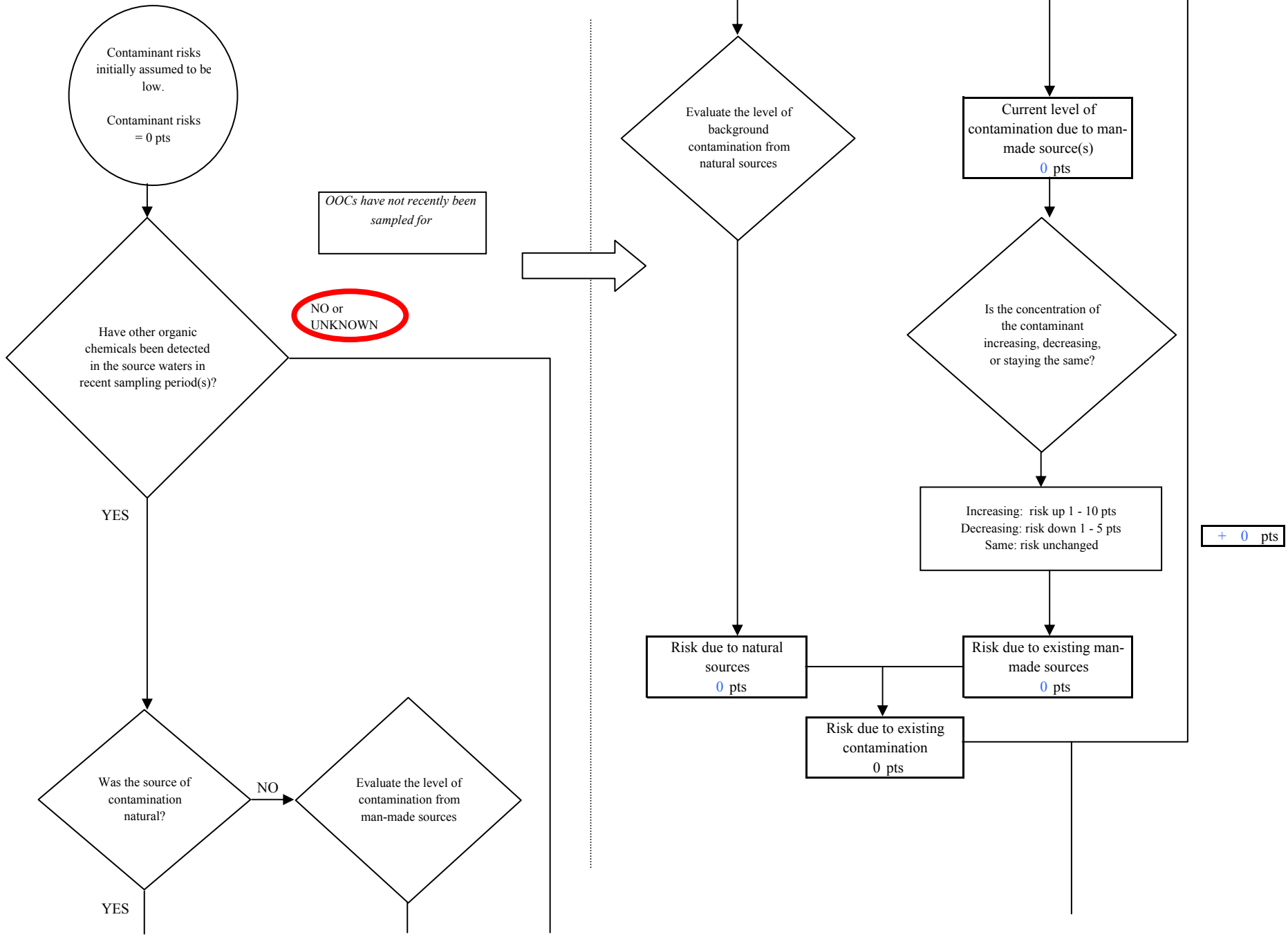


Chart 13. Contaminant risks for Bowers Investment Building - Other Organic Chemicals

+ 10 pts

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

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

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

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 13. Contaminant risks for Bowers Investment Building - Other Organic Chemicals

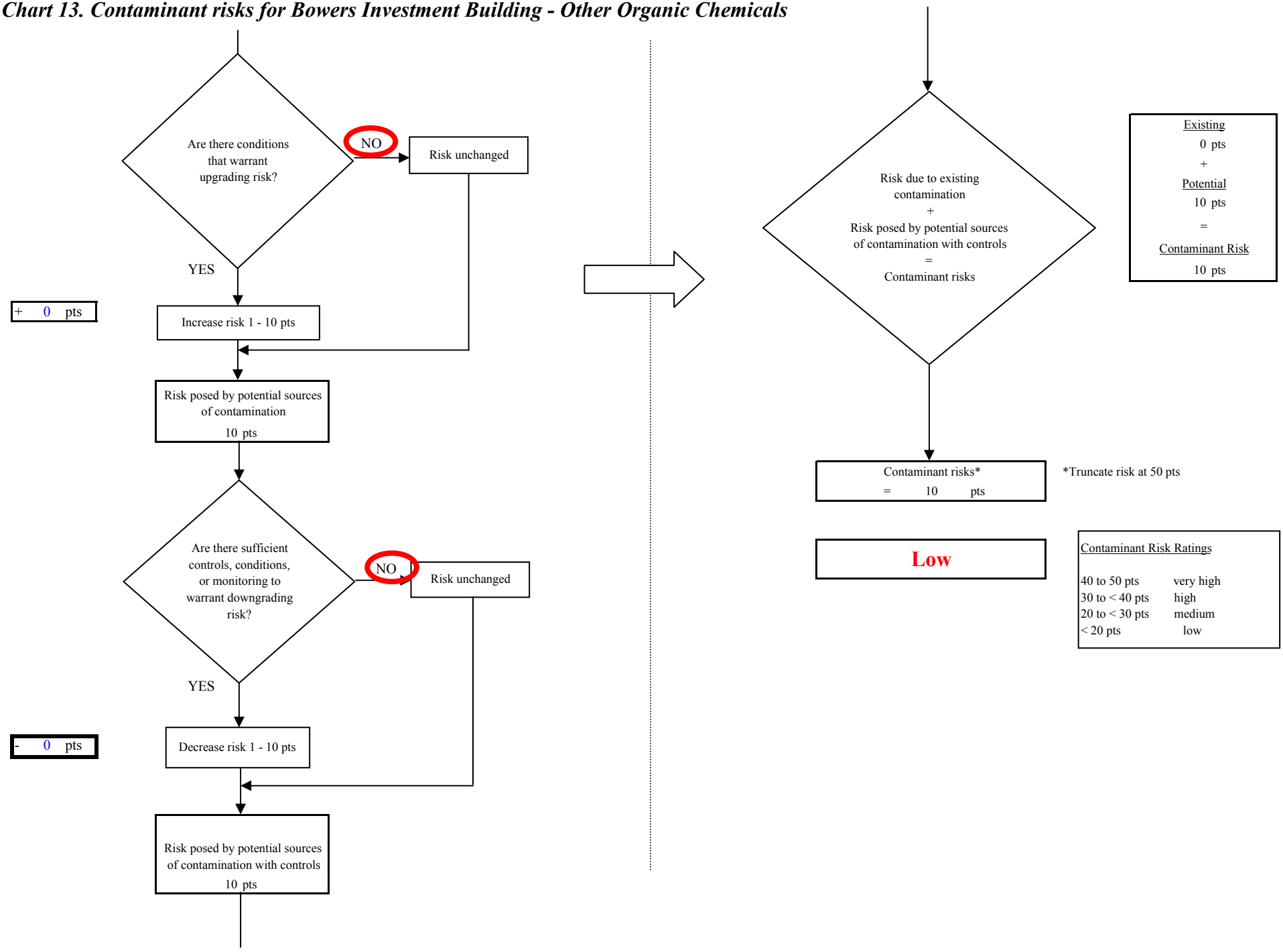


Chart 14. Vulnerability analysis for Bowers Investment Building - Other Organic Chemicals