Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Young Properties, Anchorage, Alaska PWSID # 215566

DRINKING WATER PROTECTION PROGRAM REPORT 820

Alaska Department of Environmental Conservation

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The Drinking Water Protection Program 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. 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 Young Properties Source of Public Drinking Water, Anchorage, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Young Properties is a Class A (community) water system consisting of one well in the Anchorage area. Identified potential and existing sources of contaminants for Young Properties include: sewer lines, residential areas, roads, recreational trails, parks and bulk fuel storage. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals. Overall, Young Properties received a vulnerability rating of **Low** for volatile organic chemicals, synthetic organic chemicals and other organic chemicals, **Medium** for bacteria and viruses, nitrate/nitrites, and other organic chemicals.

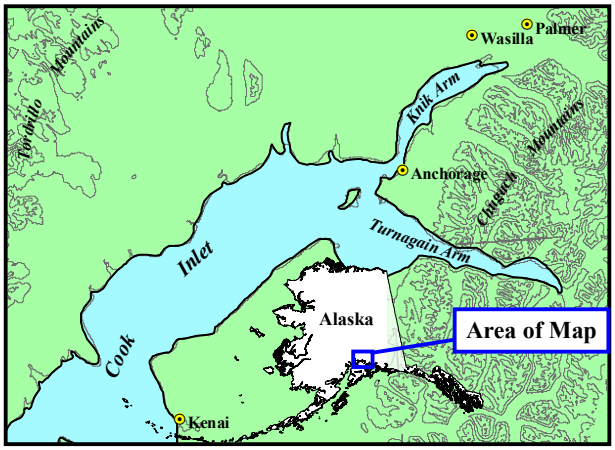

Figure 1. Index map showing the location of Anchorage, Alaska

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide public water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and what efforts will be most effective in reducing contaminant risks to your water system.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

DESCRIPTION OF THE ANCHORAGE AREA, ALASKA

Location

Anchorage, located in south-central Alaska, encompasses 1,698 square miles of land and 264 square miles of water. The area containing a majority of the urban development, commonly referred to as the Anchorage Bowl, encompasses approximately 180 square miles [*Partick, Brabets, and Glass, 1989*] and envelopes the low lands of the area. This area is bounded on the east by the Chugach Mountains and the north, west, and south by the Knik and Turnagain Arm of Cook Inlet (Figure 1). In recent times, urban development has extended eastward along the flanks of the Chugach Mountains. This area, known locally as the Anchorage Hillside, contains development at elevations exceeding 3,700 feet in elevation above sea level.

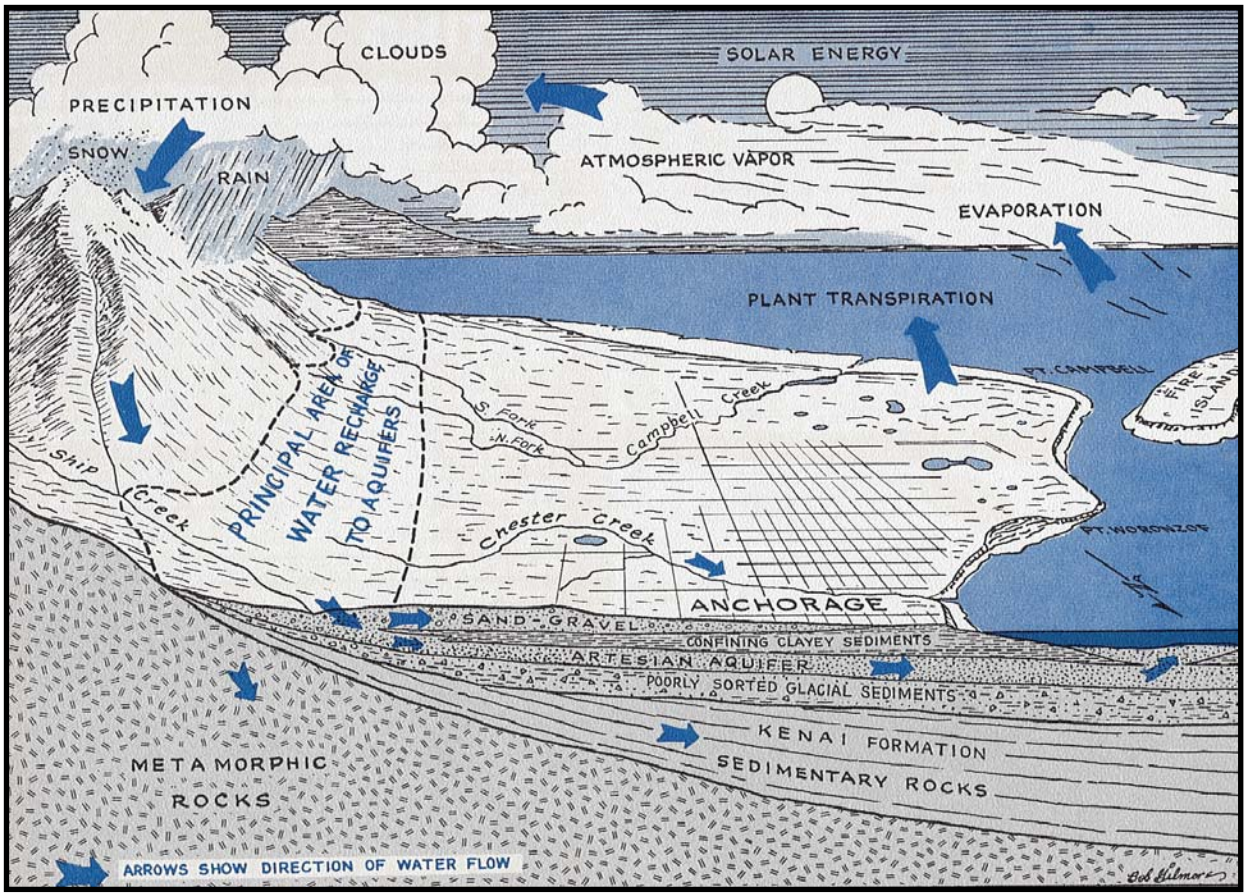

Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

Climate

The Anchorage area climate is somewhat transitional in that it does not experience large daily and annual temperature fluctuations like those experienced in the interior of Alaska nor does it experience high amounts of precipitation typified by gulf coast regions. Mean annual precipitation at the Anchorage International Airport is approximately 16 inches per year. On average, Anchorage receives a total snow accumulation of 69 inches per year. Precipitation generally increases inland toward the Chugach Mountains where annual precipitation may exceed 160 inches per year [*Barnwell, George, Dearborn, Weeks, and Zenone*, 1972]. Mean daily temperature ranges from 65^{o} F during July to 8^{o} F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

Surface elevations in the Anchorage area range from sea level at Knik and Turnagain Arms to well over 5,000 feet in the peaks that bound the area. Glacial moraine and outwash deposits primarily mantle the surface of the Anchorage Bowl.

The backbone of the Chugach Mountains is composed primarily of metamorphic marine and volcanic rocks (bedrock). These high peaks that bound Anchorage's east side are flanked with colluvium or slope deposits. These slope deposits eventually grade into the glacial and stream deposits at lower elevations in the Anchorage Bowl.

In the Anchorage area, two principal groundwater flow systems or aquifers exist (see Figure 2). The upper unconfined aquifer or water-table aquifer is separated from a lower confined aquifer system by layers of silty, clayey glacially derived sediments (confining layer) [*Ulery and Updike*, 1983]. The lower confined aquifer system consists of a series of hydrologically interconnected layers and lenses of gravel, sand and silt that, collectively, form the confined aquifer. The confining layer ranges from 0 to 270 feet thick throughout the Anchorage area and generally thins with increasing distance from Cook Inlet, thus pinching out at the mountain front [*Patrick, Brabets, and Glass*, 1989].

Water enters or recharges these two aquifer systems in several different ways. Along the front of the Chugach Mountains, groundwater seeps from fractures in

bedrock into the sediments. At these higher elevations, rain and snowmelt also enters the sediments. This area along the mountain front is considered the principal recharge area for wells in the Anchorage area. Precipitation in the low lands may also percolate directly into the ground. Lastly, aquifers may also be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). Groundwater flow in the confined aquifer is generally east to west from the mountain front toward Cook Inlet and Turnagain Arm, except in areas where the direction of flow is influenced by large municipal or industrial production wells. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surfacial topography as well as its close connection with surface water bodies.

YOUNG PROPERTIES PUBLIC DRINKING WATER SYSTEM

Young Properties is a Class A (community) water system. The system consists of one well in the Anchorage area. (See Map 1 of Appendix A).

The well is located near the Seward Hwy off of Homer Road, at an elevation of approximately 100 feet above sea level.

The 1997 Sanitary Survey indicates that the well is installed with caps providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. Records indicate that the well was installed prior to grouting regulations. Thus, it is assumed that the well was not grouted according to current ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

Records indicate that the well depth is 100 feet deep. The well log is unavailable. However, logs of nearby wells indicate that there is a confining layer from 71 feet to 98 feet below the surface. This confining layer may provide protection from contaminates entering the aquifer. However, the protectiveness of the clay layers tend to thin out towards the mountains allowing contaminants that enter the subsurface near the base of the mountains to enter the confined aquifer uninhibited by the absence of any protective layer.

This system operates 365 days per year and serves 50 residents through 1 service connection.

YOUNG PROPERTIES PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. Some areas are more likely to allow contamination to reach the well than others. 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 recharge area. This area is designated as the Drinking Water Protection Area (DWPA). Because releases of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

The DWPAs established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*). Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at meaningful and conservative protection areas with respect to public health (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four DWPA zones and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. TOT
B	Less than the 2 year TOT
C	Less Than the 5 year TOT
D	Less than the 10 year TOT

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within Young Properties DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. 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 Maps 2 -5 in 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 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 function of toxicity and volumes of specific contaminants associated with that source.

Tables 2 through 7 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF YOUNG PROPERTIESDRINKING WATER SOURCE

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and
- Contaminant risks.

Each of the six categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the

Drinking Water Source to Contamination (0 – 100).

A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

Natural Susceptibility (Susceptibility of the Well) (0 – 50 Points)

Table 2 shows the Susceptibility scores and ratings for the well serving Young Properties.

Table 2. Susceptibility of the well

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	10	Medium
Natural Susceptibility	15	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	25	Medium
Nitrates and/or Nitrites	25	Medium
Volatile Organic Chemicals	22	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	32	High
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	Low

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 naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. 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 contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains 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, synthetic organic chemicals, and other organic chemicals, respectively.
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	35	Low
Heavy Metals, Cyanide and Other Inorganic Chemicals	45	Medium
Synthetic Organic Chemicals	25	Low
Other Organic Chemicals	25	Low

Bacteria and Viruses
The contaminant risk for bacteria and viruses is medium with sewer lines, roads and recreational trails presenting the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Recent sampling of the well indicates that no bacteria and viruses have been detected. .

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability is medium.

Nitrates and Nitrites
The contaminant risk for nitrates and nitrites is medium with sewer lines, residential areas, parks and recreational trails presenting the most significant risk to the drinking water well.

Sampling history indicates that nitrates/nitrites have not been detected in source waters
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 contaminant risk for volatile organic chemicals is medium with residential areas, sewer lines, roads presenting the most significant risk to the drinking water source.

Recent sampling indicates that very low levels of 1,1,1-trichloroethane was detected on December 20th, 1995. (See Chart 7 Appendix D). Since this detection, no other volatile organics have been detected.

1,1,1-trichloroethane is largely used as a solvent removing grease from machined metal products, in textile processing and dyeing and in aerosols (USEPA, 2002). It is also a commonly associated with laboratory error. The small level detected and that fact that it was only detected on one occasion makes it likely that the detection is due to laboratory cross contamination.

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 low.

Heavy Metals, Cyanide, and Other Inorganic Chemicals
The contaminant risk for heavy metals, cyanide and other inorganic chemicals is high with sewer lines, residential areas, roads and the presence of existing contamination presenting the most significant risk to the drinking water source (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

Sampling on 10/14/98 indicates that arsenic was detected in the source waters at 0.004 mg/l. This is 40% of the current MCL of 0.01 mg/l (See Chart 9 – Contaminant Risks for Heavy Metals and Other Inorganic Chemicals in Appendix D). The MCL for arsenic has recently been lowered from 0.050 mg/l to 0.01 mg/l.

According to the EPA, "Arsenic occurs naturally in rocks and soil, water, air, and plants and animals. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks, and forest fires, or through human actions. Approximately

90 percent of industrial arsenic in the U.S. is currently used as a wood preservative, but arsenic is also used in paints, dyes, metals, drugs, soaps, and semi-conductors. Agricultural applications, mining, and smelting also contribute to arsenic releases in the environment." (USEPA, 2001). It is likely that the arsenic detected is from natural sources.

Studies have linked long-term exposure to arsenic in drinking water to cancer of the bladder, lungs, skin, kidney, nasal passages, liver, and prostate. Non-cancer effects of ingesting arsenic include cardiovascular, Pulmonary, immunological, neurological, and endocrine (e.g., diabetes) effects. Short-term exposure to high doses of arsenic can cause other adverse health effects, but such effects are unlikely to occur from U.S. public water supplies that are in compliance with the previous arsenic standard of 0.050 mg/l. (USEPA, 2001). The levels detected in the source waters are considered to be safe with the respect to human health.

In addition, very low levels of barium have been detected in source waters. These levels are likely to be from natural sources and are considered safe with respect to human consumption.

After combining the contaminant risk for heavy metals and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability is medium.

Synthetic Organic Chemicals
The contaminant risk for synthetic organic chemicals is low with sewer lines, residential areas, presenting the most significant risk. (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D, respectively).

The system has a wavier and sampling of synthetic organic chemicals has not occurred.

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

Other Organic Chemicals
The contaminant risk for other organic chemicals is low with sewer lines, residential areas, and roads presenting the most significant risk.

Sampling of other organic chemicals has not occurred. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals is low.

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Young Properties. The overall vulnerability of this source to contamination is **Low** for volatile organic chemicals, synthetic organic chemicals and other organic chemicals, **Medium** for bacteria and viruses, nitrate/nitrites, and other organic chemicals

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Young Properties to protect public health. It is anticipated that *Source Water Assessments* will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of Young Properties public drinking water source.

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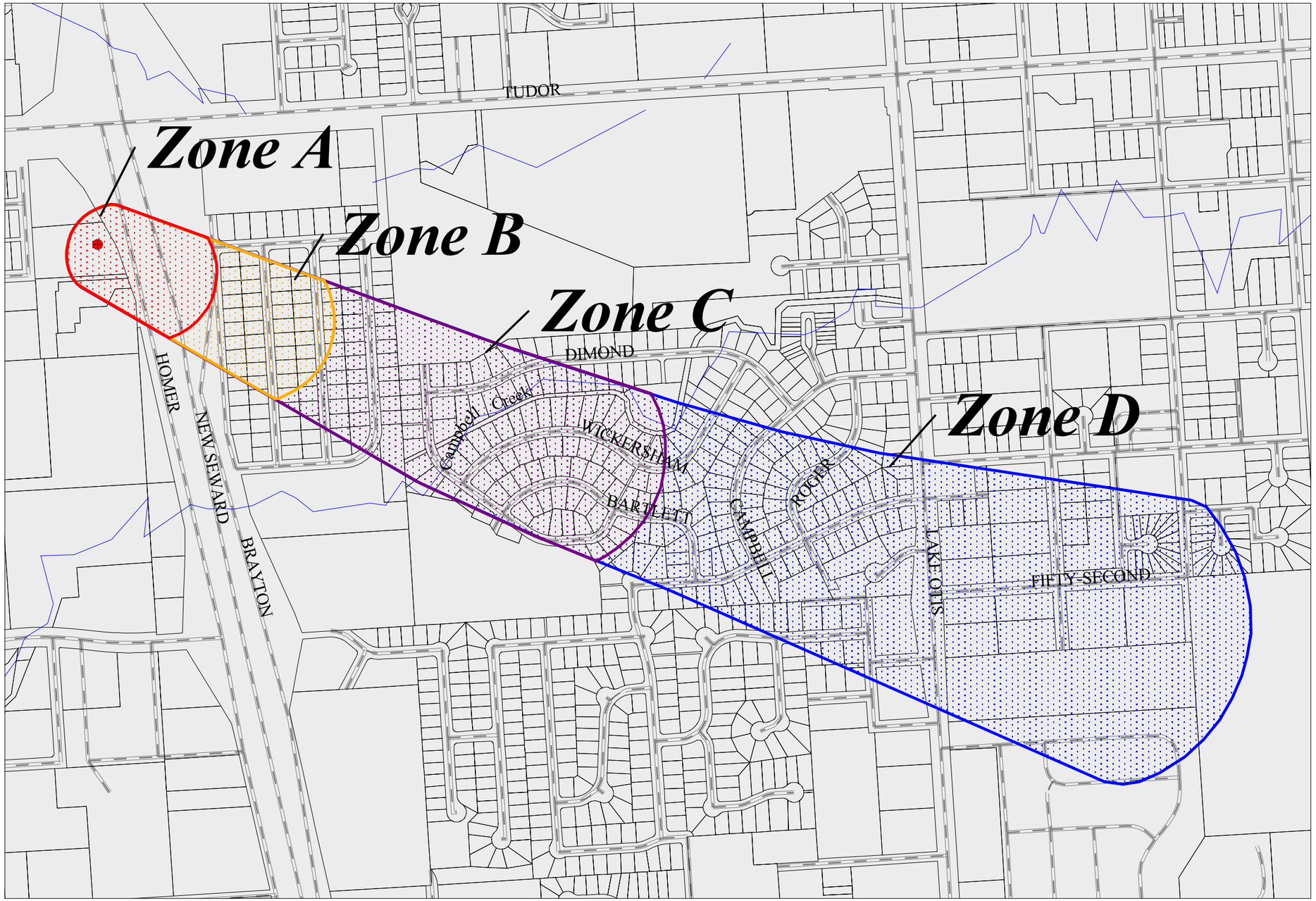
APPENDIX A

Young Properties
Drinking Water Protection Area Location
(Map 1)

Drinking Water Protection Area for Young Properties



Legend

- Young Properties Well

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Streams
- Lakes
- MOA Land Parcels
- Roads

N
W E
S

600 0 600 Feet

PWSID 215566.001

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Young Properties (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Young Properties***

PWSID 215566.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	2	
Dog walking areas/foot trails	X46	X46-1	A	3	
Dog walking areas/foot trails	X46	X46-2	A	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	2	
Residential Areas	R01	R1-1	B	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	2	
Dog walking areas/foot trails	X46	X46-3	B	3	
Paint sales /service	C32	C32-1	C	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-11	C	2	
Residential Areas	R01	R1-2	C	3	
Municipal or city parks (with green areas)	X04	X4-1	C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-11	C	2	
Dog walking areas/foot trails	X46	X46-4	C	3	
Petroleum product bulk station/terminals	X11	X11-1	D	4	

Table 2

Contaminant Source Inventory and Risk Ranking for Young Properties
Sources of Bacteria and Viruses

PWSID 215566.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	2	
Dog walking areas/foot trails	X46	X46-1	A	Low	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Medium	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Medium	2	
Residential Areas	R01	R1-1	B	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	2	
Dog walking areas/foot trails	X46	X46-3	B	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-11	C	Medium	2	
Residential Areas	R01	R1-2	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-11	C	Low	2	
Municipal or city parks (with green areas)	X04	X4-1	C	Medium	3	
Dog walking areas/foot trails	X46	X46-4	C	Low	3	

Table 3

Contaminant Source Inventory and Risk Ranking for Young Properties
Sources of Nitrates/Nitrites

PWSID 215566.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	2	
Dog walking areas/foot trails	X46	X46-1	A	Low	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Medium	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Medium	2	
Residential Areas	R01	R1-1	B	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	2	
Dog walking areas/foot trails	X46	X46-3	B	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-11	C	Medium	2	
Residential Areas	R01	R1-2	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-11	C	Low	2	
Municipal or city parks (with green areas)	X04	X4-1	C	Medium	3	
Dog walking areas/foot trails	X46	X46-4	C	Low	3	

Table 4

Contaminant Source Inventory and Risk Ranking for Young Properties
Sources of Volatile Organic Chemicals

PWSID 215566.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Low	2	
Residential Areas	R01	R1-1	B	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	2	
Paint sales /service	C32	C32-1	C	Medium	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-11	C	Low	2	
Residential Areas	R01	R1-2	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-11	C	Low	2	
Petroleum product bulk station/terminals	X11	X11-1	D	Very High	4	

Table 5

Contaminant Source Inventory and Risk Ranking for Young Properties

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 215566.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Low	2	
Residential Areas	R01	R1-1	B	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	2	
Paint sales /service	C32	C32-1	C	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-11	C	Low	2	
Residential Areas	R01	R1-2	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-11	C	Low	2	
Petroleum product bulk station/terminals	X11	X11-1	D	Low	4	

Table 6

Contaminant Source Inventory and Risk Ranking for Young Properties
Sources of Synthetic Organic Chemicals

PWSID 215566.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Low	2	
Residential Areas	R01	R1-1	B	Low	3	
Paint sales /service	C32	C32-1	C	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-11	C	Low	2	
Residential Areas	R01	R1-2	C	Low	3	
Municipal or city parks (with green areas)	X04	X4-1	C	Low	3	
Petroleum product bulk station/terminals	X11	X11-1	D	Low	4	

Table 7

Contaminant Source Inventory and Risk Ranking for Young Properties
Sources of Other Organic Chemicals

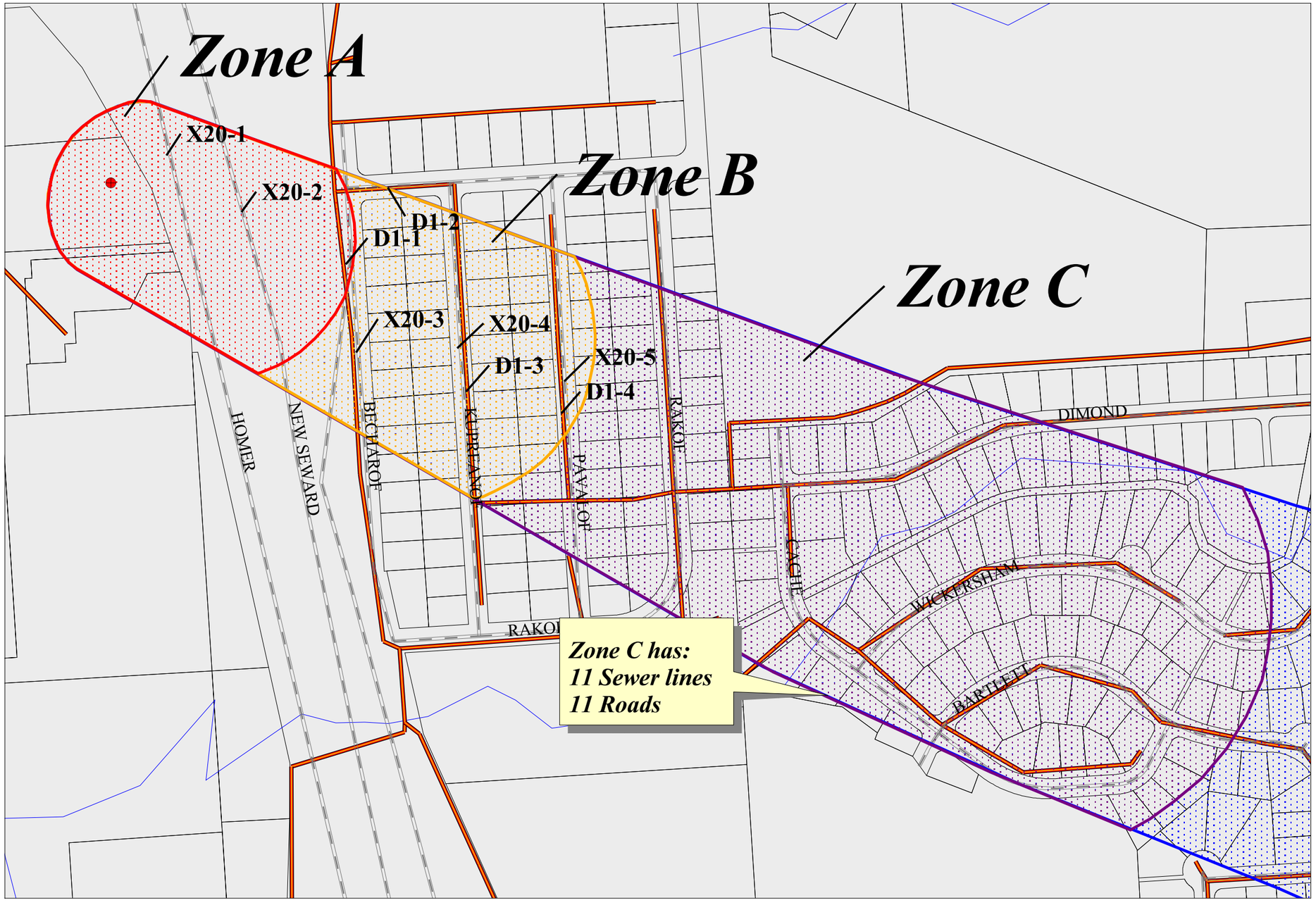
PWSID 215566.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Low	2	
Residential Areas	R01	R1-1	B	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-11	C	Low	2	
Residential Areas	R01	R1-2	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-11	C	Low	2	
Petroleum product bulk station/terminals	X11	X11-1	D	High	4	

APPENDIX C

Young Properties
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-5)

Drinking Water Protection Area for Young Properties with Potential and Existing Sources of Contamination



Legend

- Young Properties Well
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less Than 2 Years Travel Time
- Zone C Protection Area
  - Less Than 5 Years Travel Time
- Zone D Protection Area
  - Less Than 10 Years Travel Time
- Roads
- Sewers (D1)
- Streams
- MOA Land Parcels

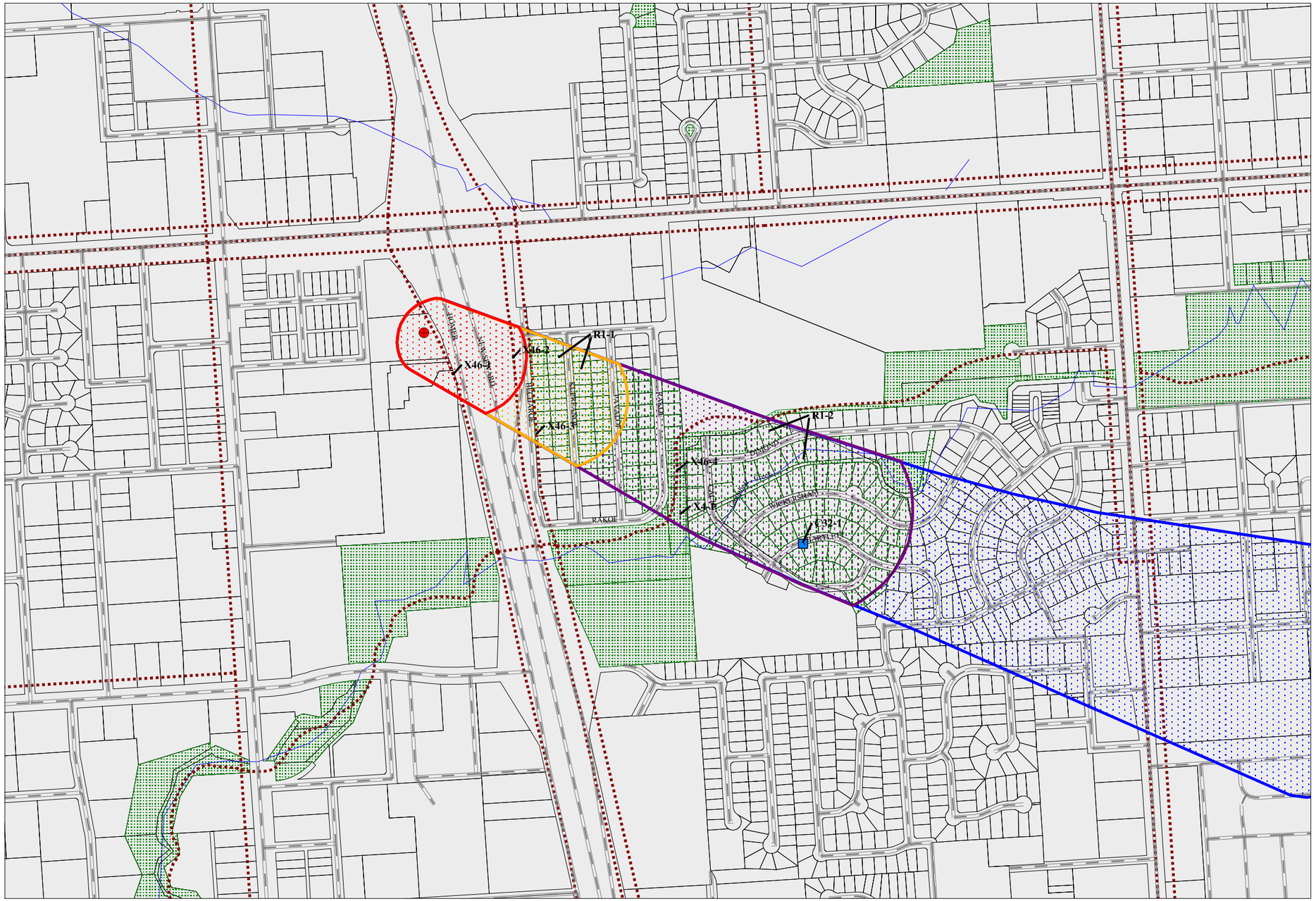
N
W E
S

300 0 300 Feet

PWSID 215566.001

Map 2

Drinking Water Protection Area for Young Properties with Potential and Existing Sources of Contamination



Legend

- Young Properties Well

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time

Contaminant Sources
- Paint sales/service (C32)
- Roads
- Trails (X46)
- Streams
- Residential lawns (R1)
- Parks (X4)
- MOA Land Parcels

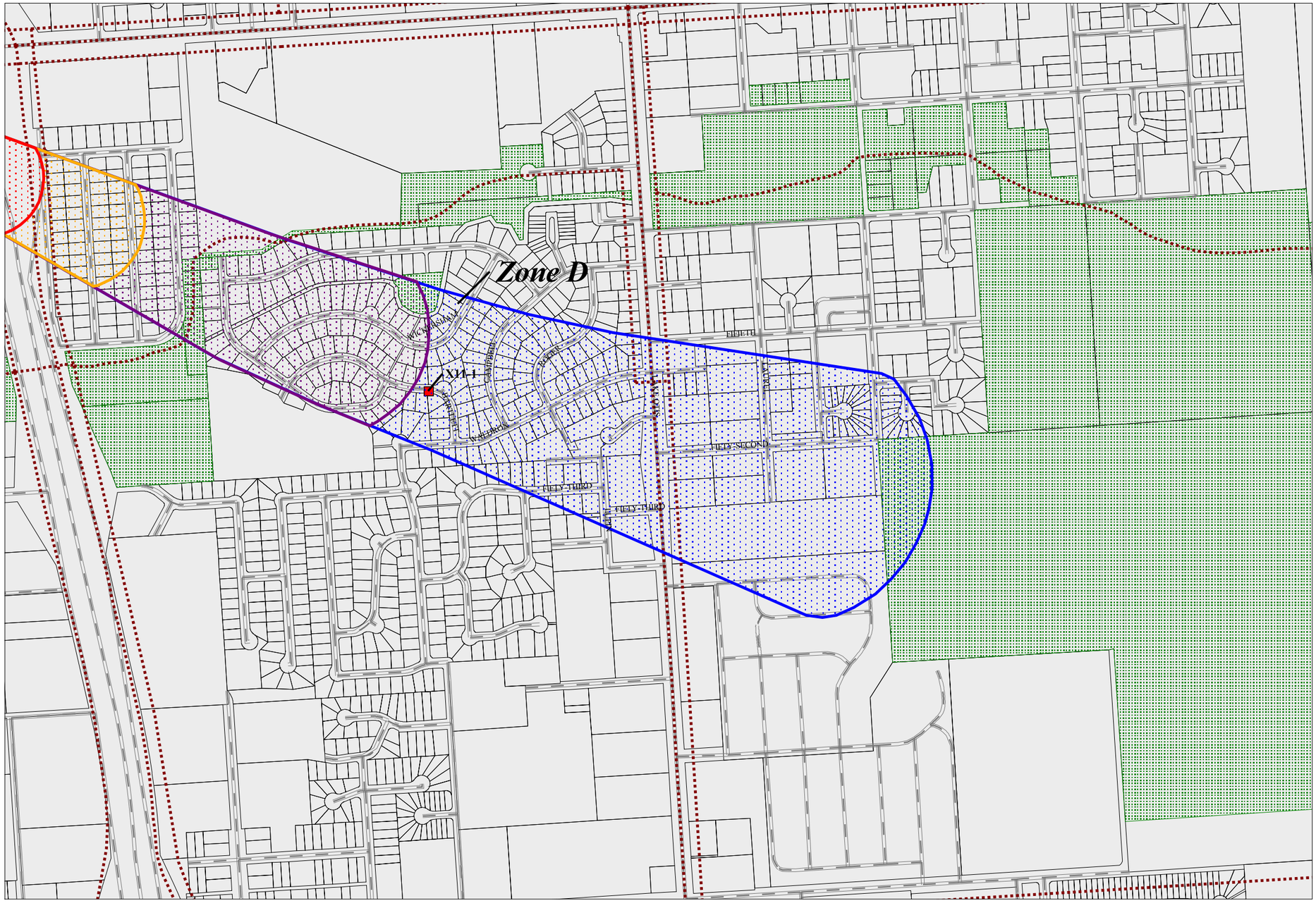
N
W E
S

800 0

PWSID 215566.001

Map 3

Drinking Water Protection Area for Young Properties with Potential and Existing Sources of Contamination



Legend

Zone A Protection Area
Several Months Travel Time
Zone B Protection Area
Less Than 2 Years Travel Time
Zone C Protection Area
Less Than 5 Years Travel Time
Zone D Protection Area
Less Than 10 Years Travel Time
Contaminant Sources
Petroleum product bulk station/terminals (X11)
Trails (X46)
Roads
Parks (X4)
MOA Land Parcels

N
W E
S

700 0

PWSID 215566.001

Map 4

APPENDIX D

Vulnerability Analysis for Young Properties

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Young Properties

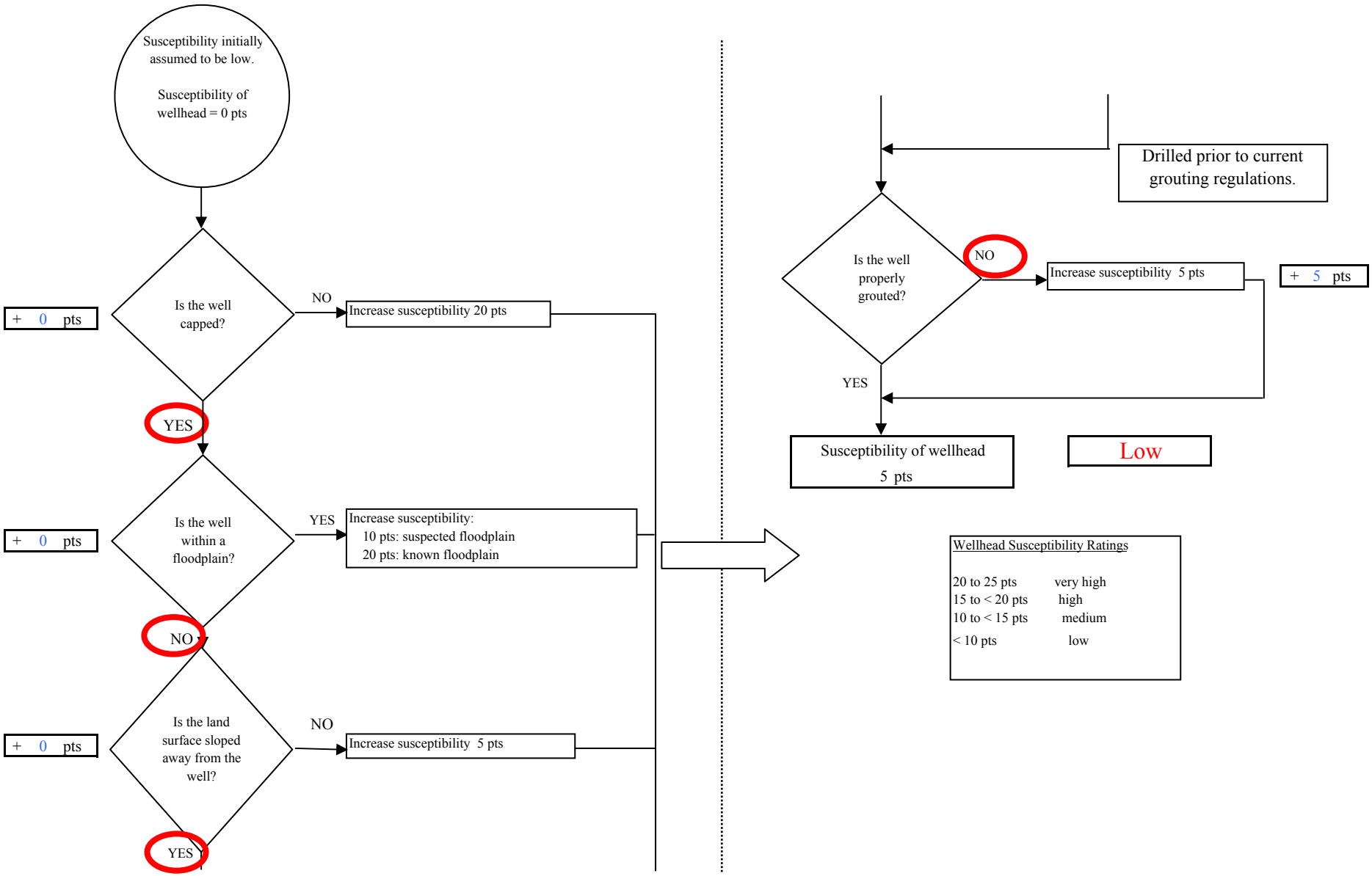


Chart 2. Susceptibility of the aquifer - Young Properties

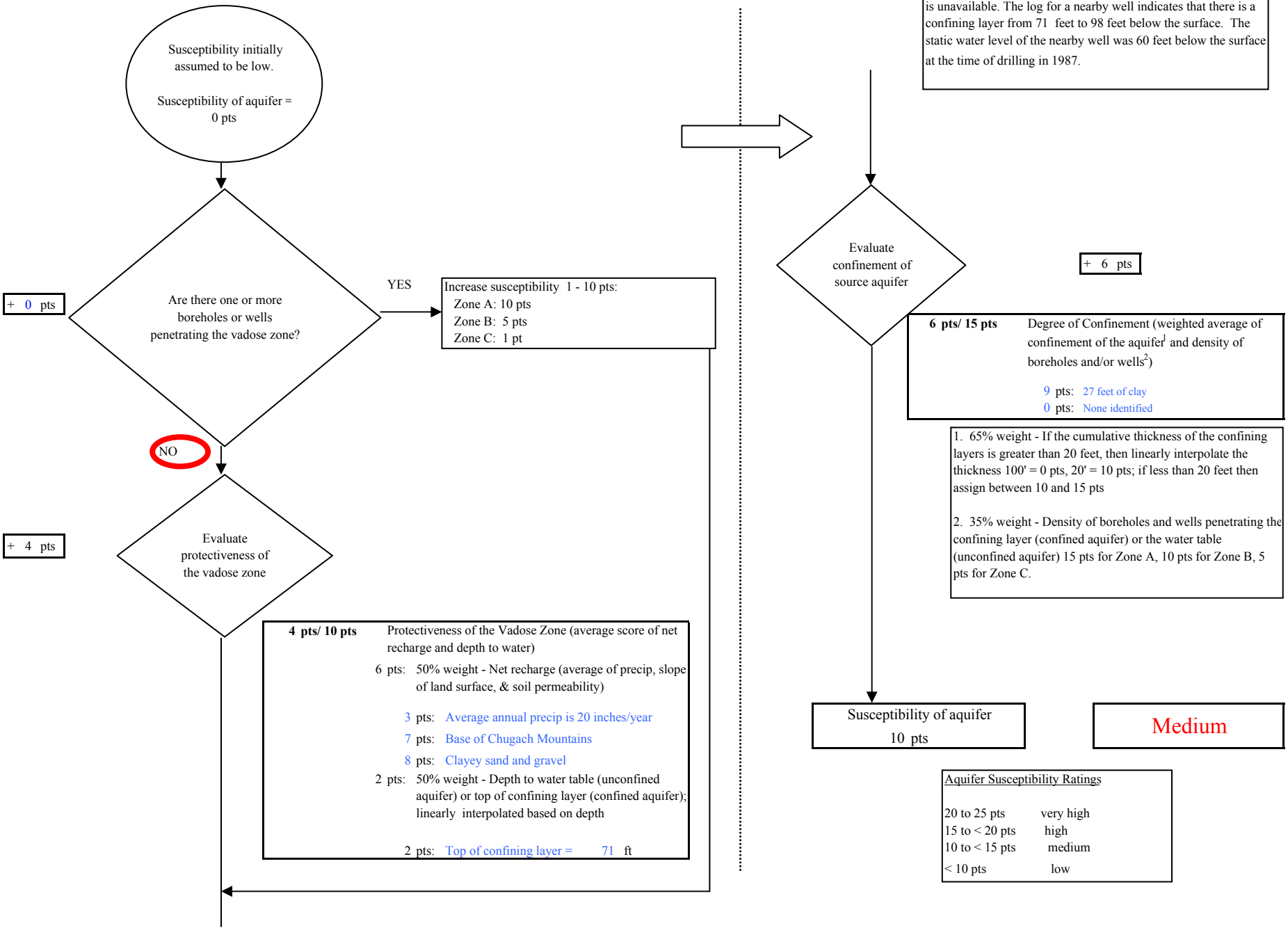
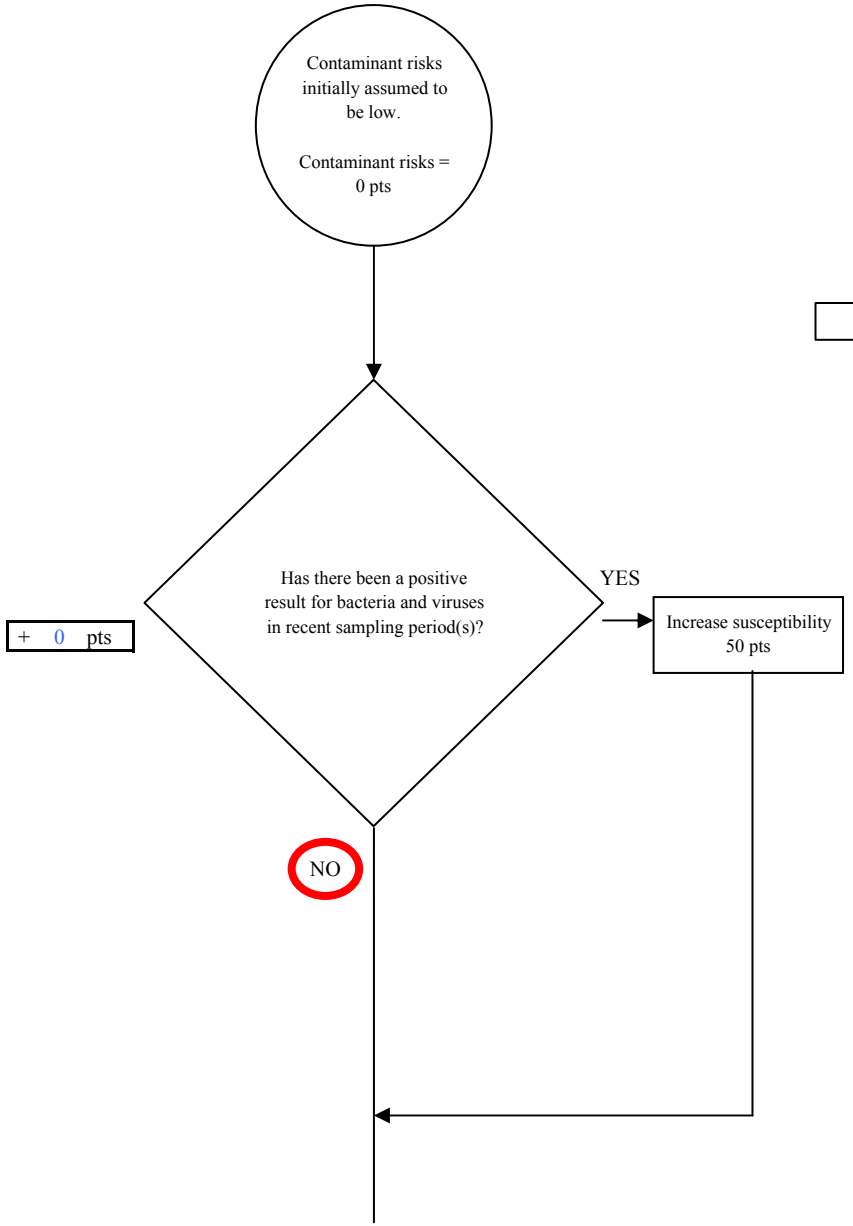
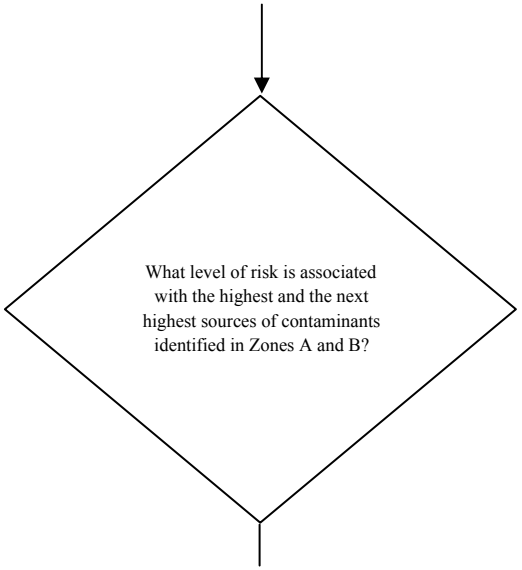


Chart 3. Contaminant risks for Young Properties- Bacteria & Viruses





+ 20 pts

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)	1	0	1
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 20

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

Chart 3. Contaminant risks for Young Properties- Bacteria & Viruses

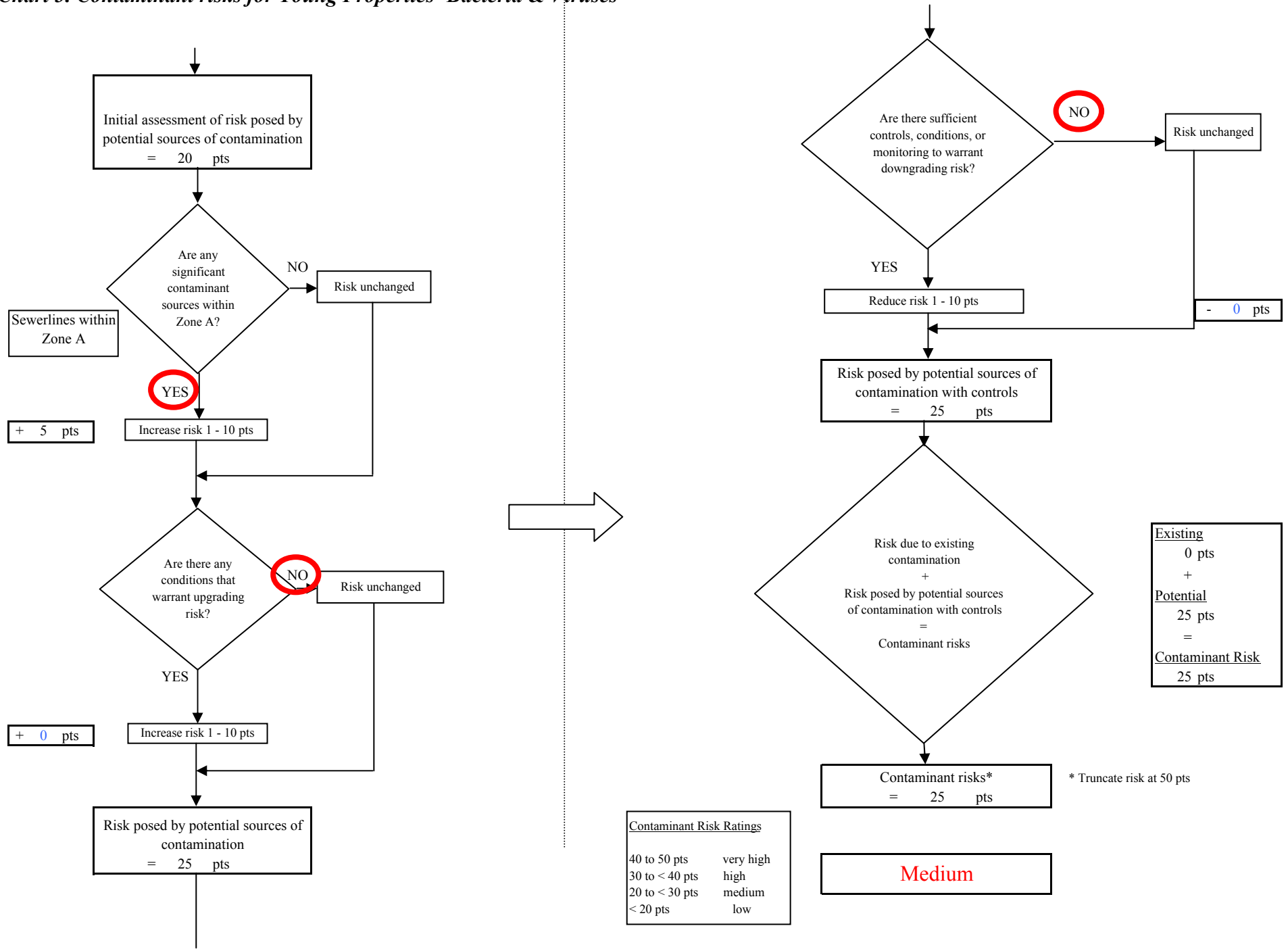


Chart 4. Vulnerability analysis for Young Properties- Bacteria & Viruses

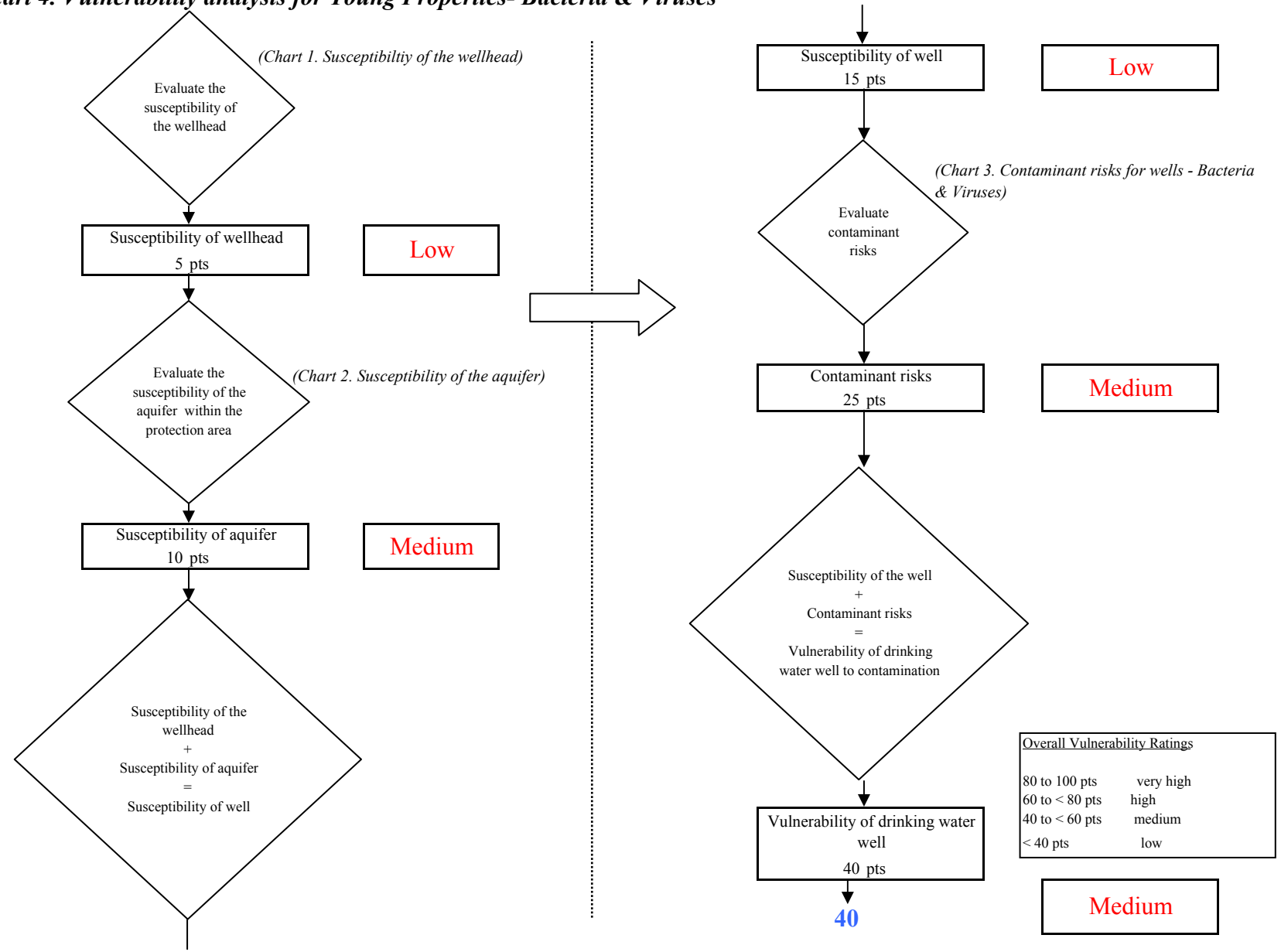


Chart 5. Contaminant risks for Young Properties- Nitrates and Nitrites

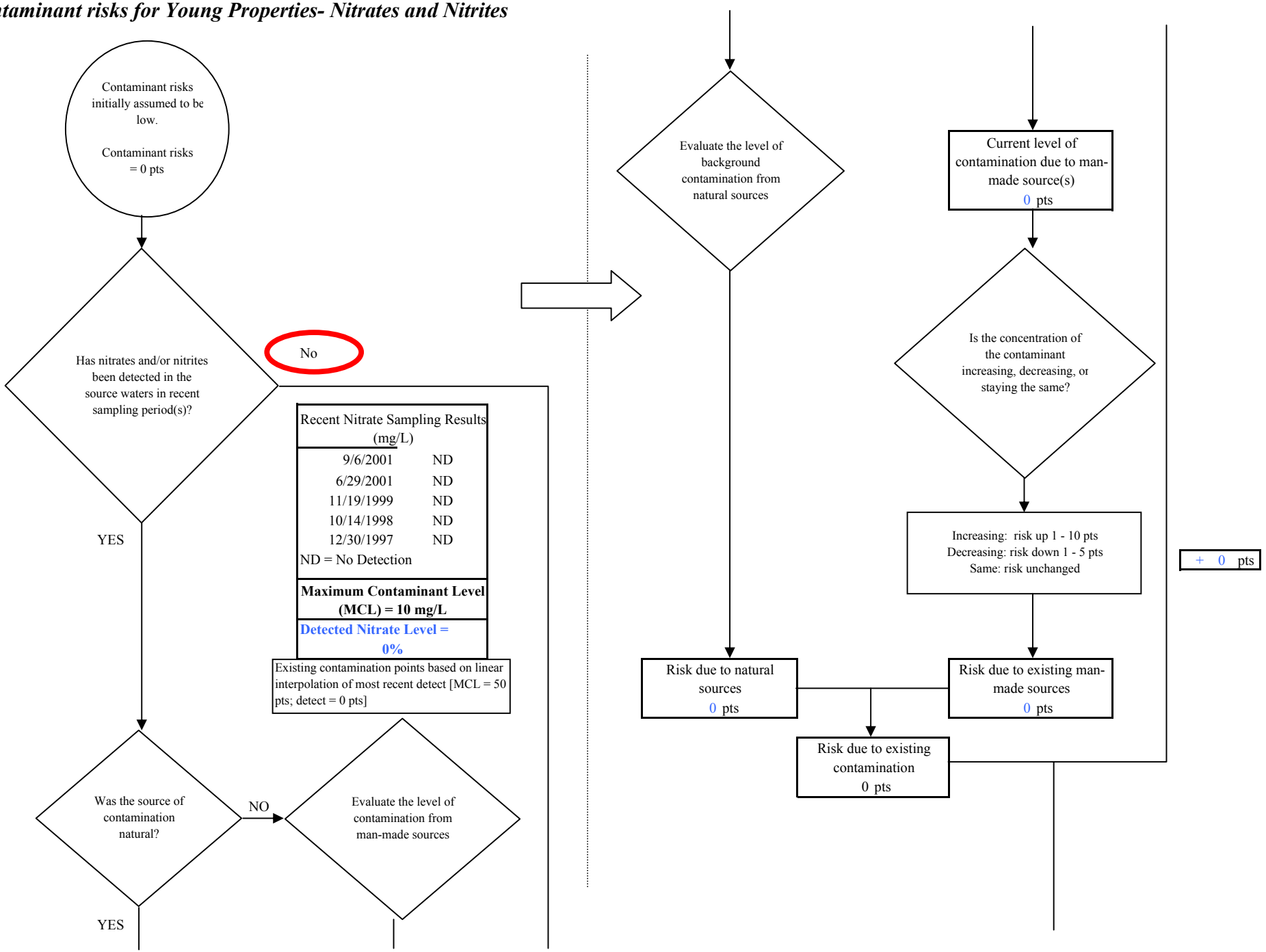


Chart 5. Contaminant risks for Young Properties- Nitrates and Nitrites

+ 20 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)	1	1	2
Low(s)	3	6	9

	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.

Initial assessment of risk posed by potential sources of contamination = 20 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

- 0 pts

Decrease risk 1 - 10 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Sewer lines

Increase risk 1 - 10 pts

+ 5 pts

Chart 5. Contaminant risks for Young Properties- Nitrates and Nitrites

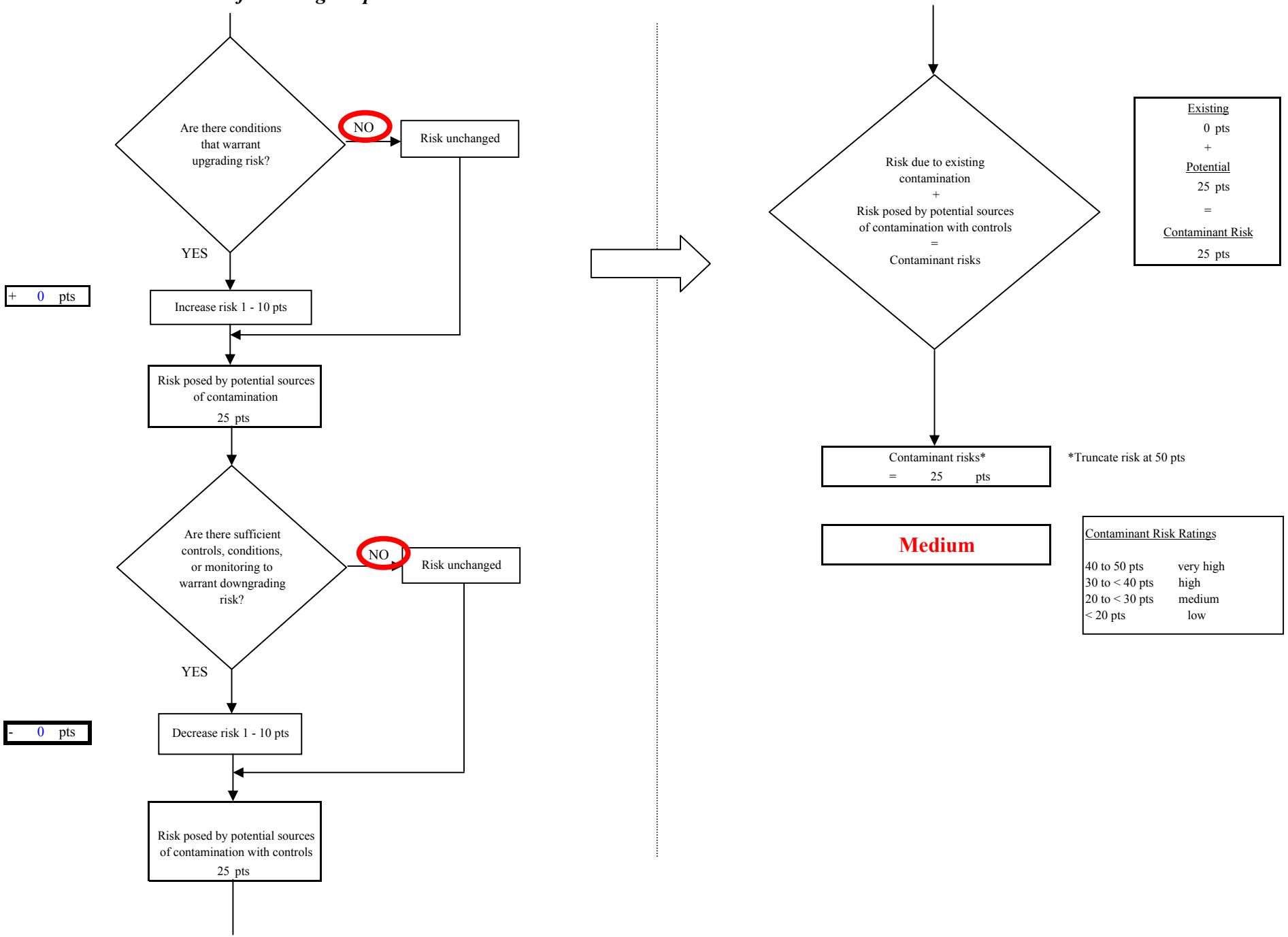


Chart 6. Vulnerability analysis for Young Properties- Nitrates and Nitrites

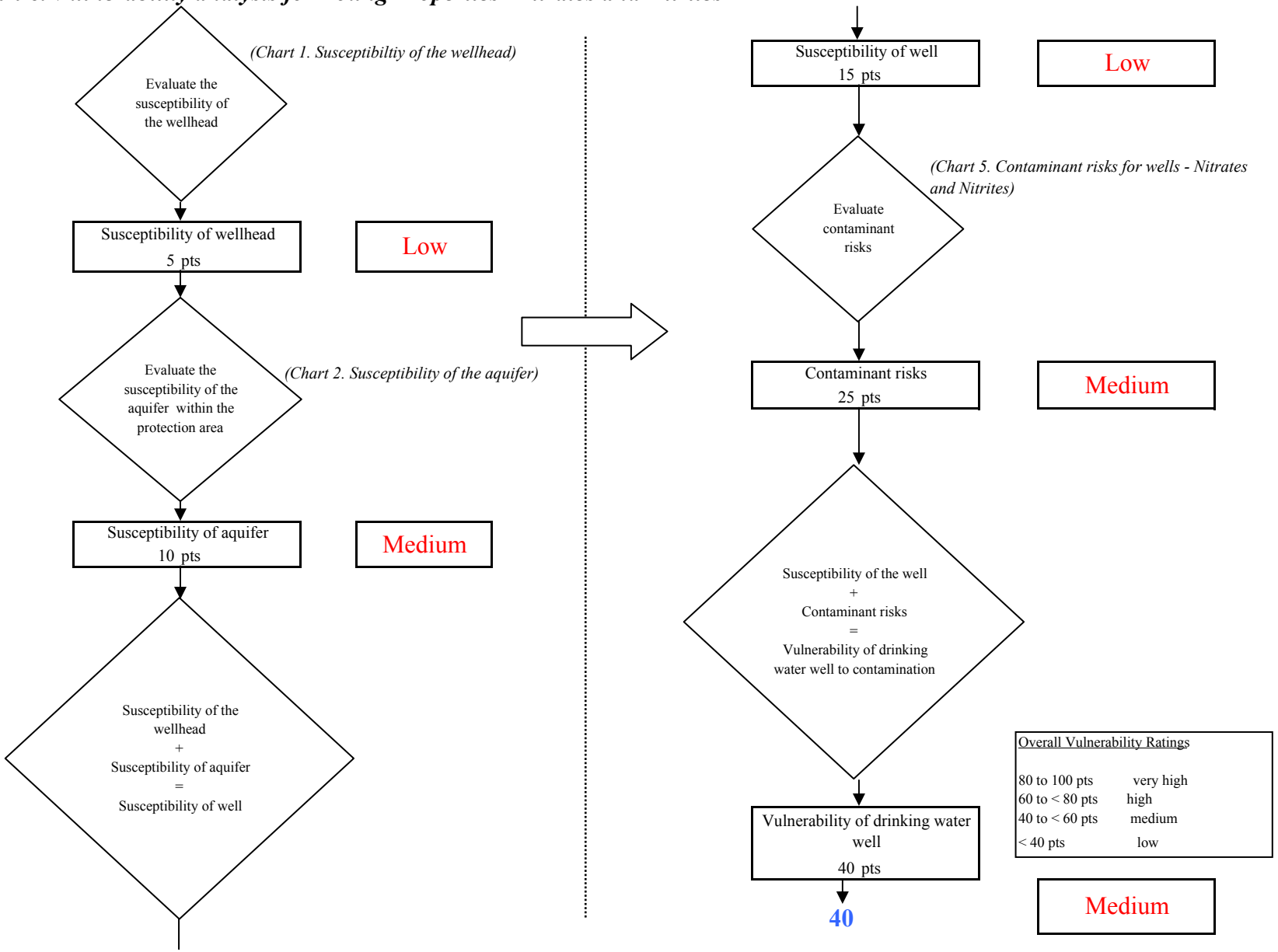


Chart 7. Contaminant risks for Young Properties- Volatile Organic Chemicals

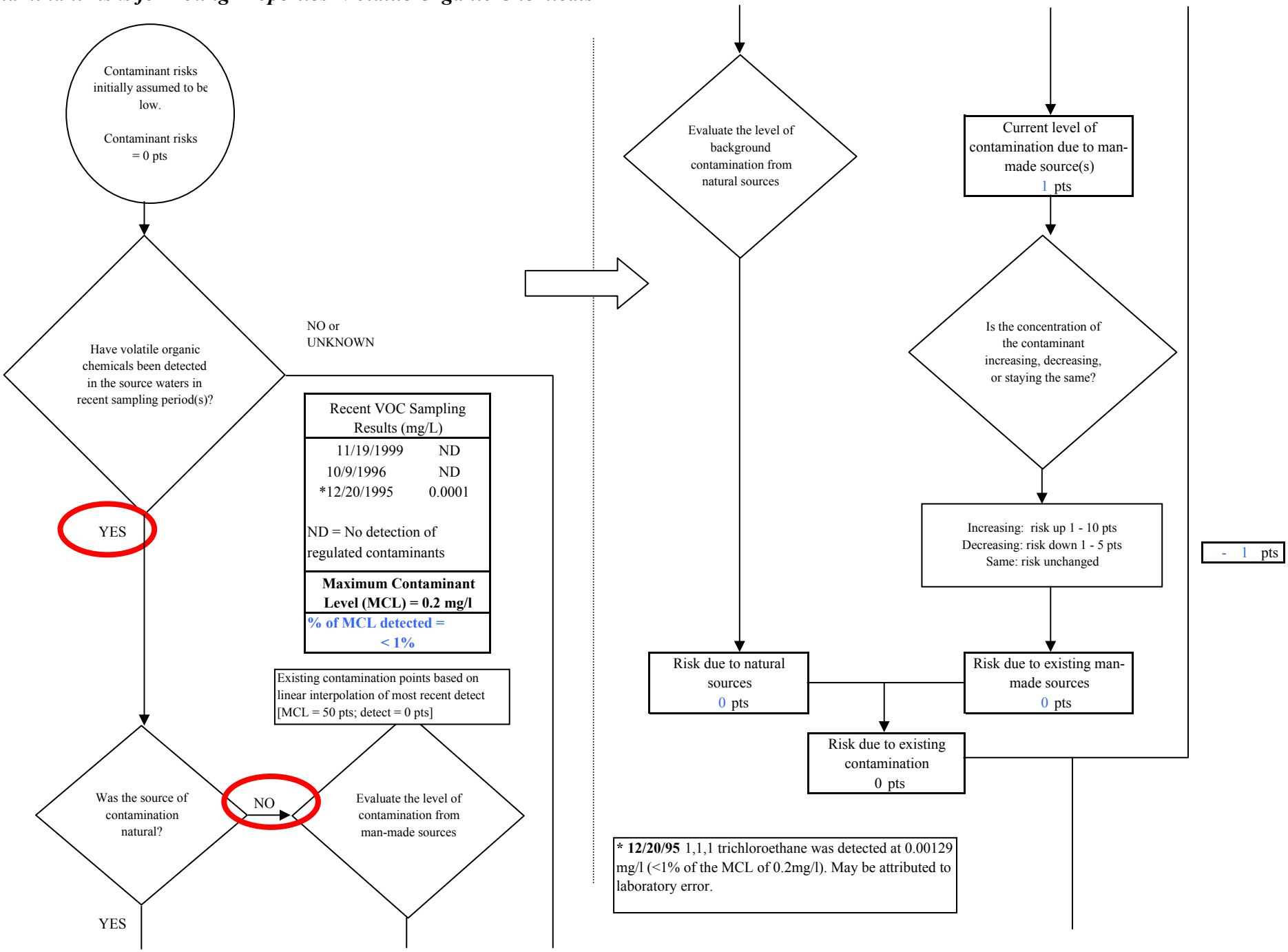


Chart 7. Contaminant risks for Young Properties- Volatile Organic Chemicals

+ 20 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	1	1
Low(s)	2	3	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 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.

Initial assessment of risk posed by potential sources of contamination = 20 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

roads and sewer lines

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 7. Contaminant risks for Young Properties- Volatile Organic Chemicals

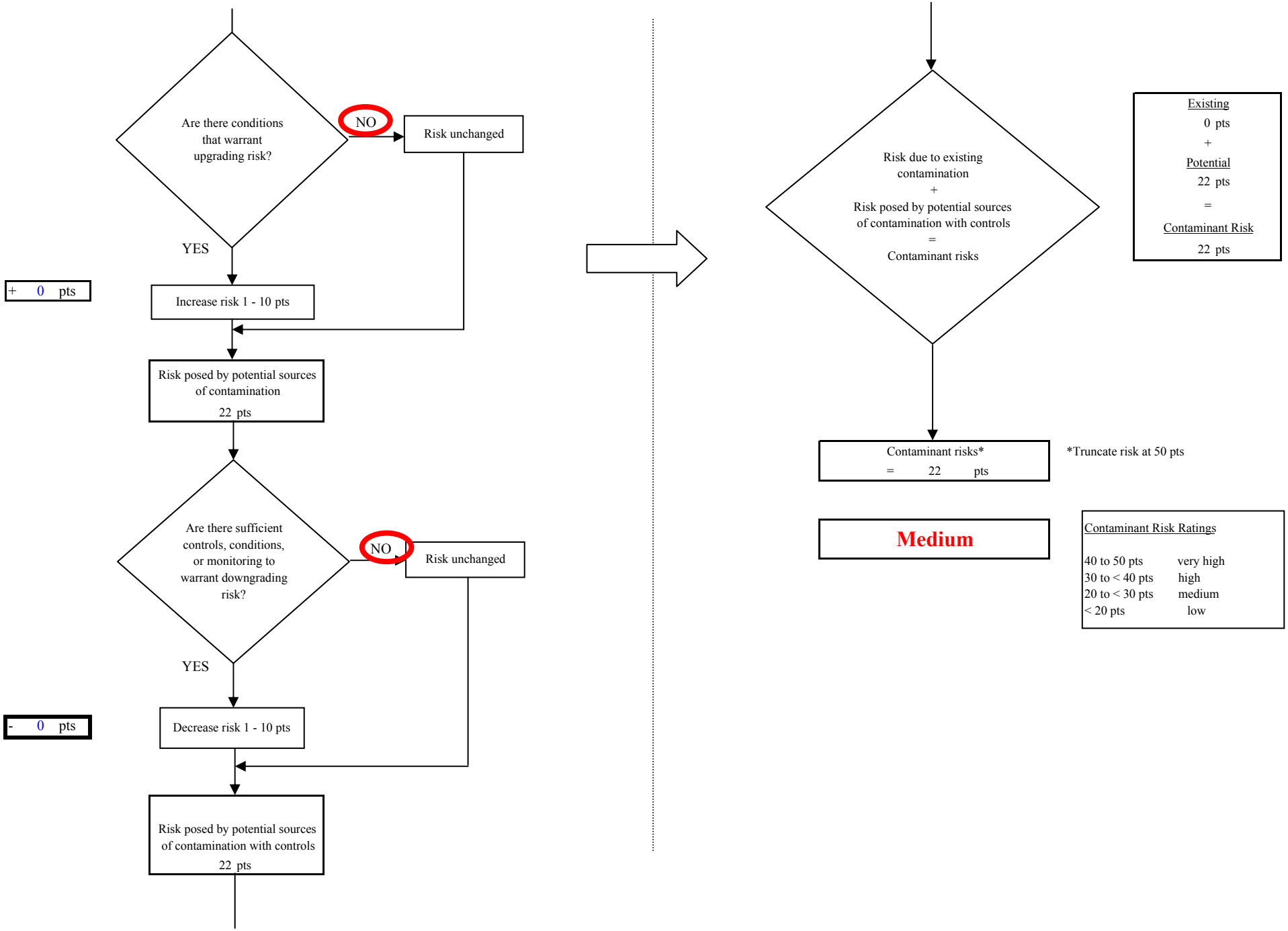


Chart 8. Vulnerability analysis for Young Properties- Volatile Organic Chemicals

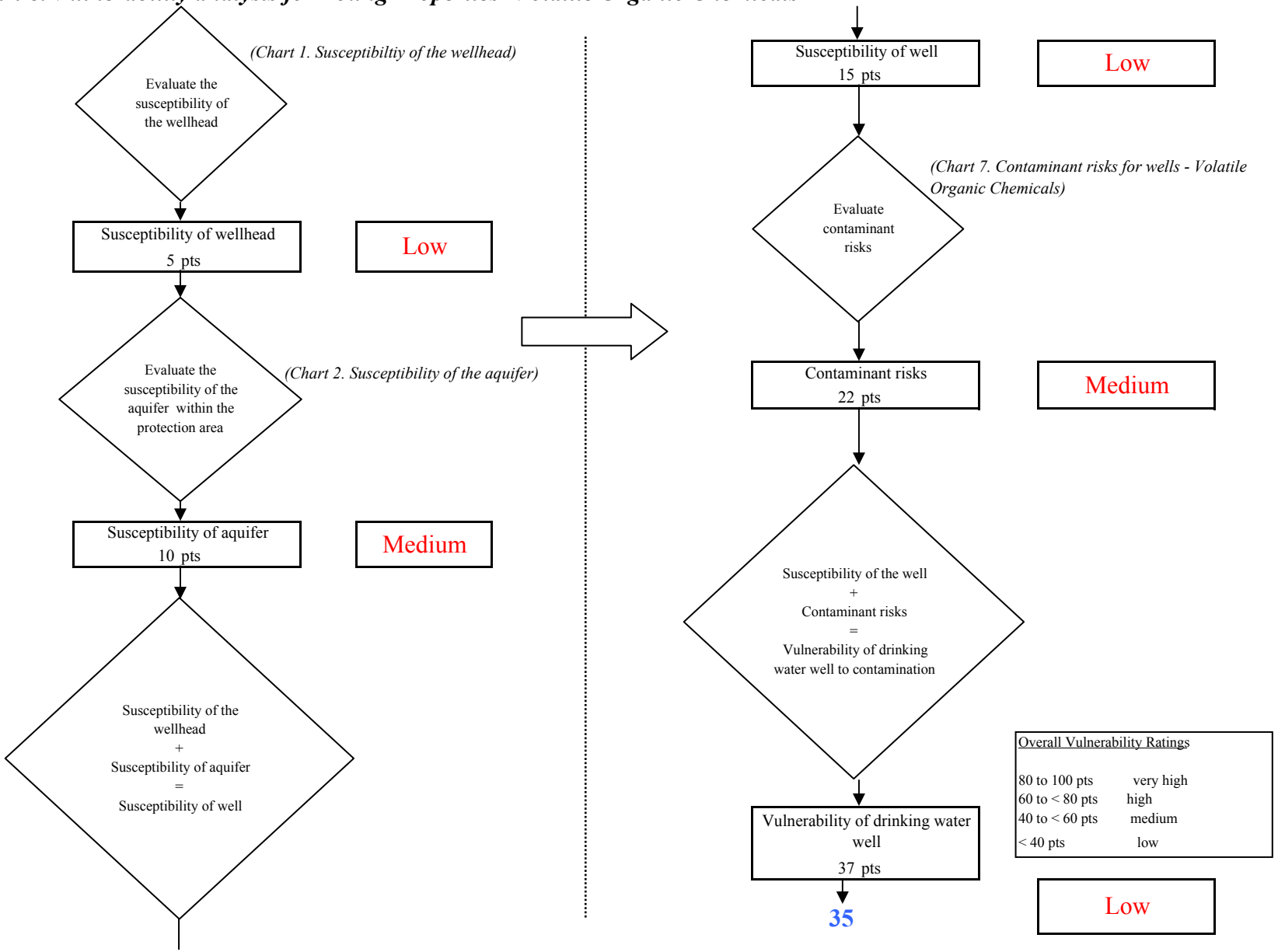


Chart 9. Contaminant risks for Young Properties- Heavy Metals, Cyanide and Other Inorganic Chemicals

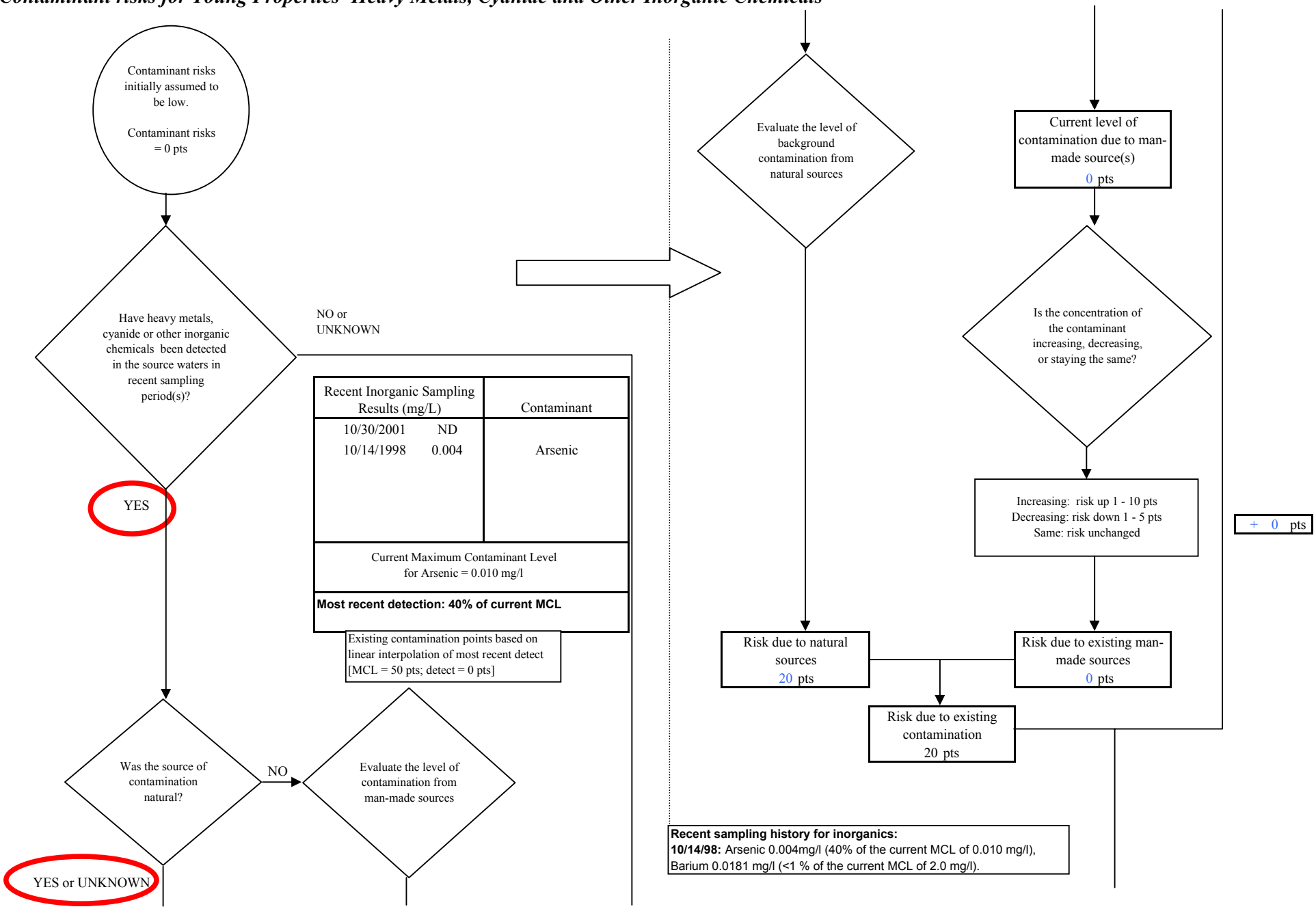


Chart 9. Contaminant risks for Young Properties- Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 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)	2	4	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

Sewer lines and roads

YES → Increase risk 1 - 10 pts

+ 2 pts

Chart 9. Contaminant risks for Young Properties- Heavy Metals, Cyanide and Other Inorganic Chemicals

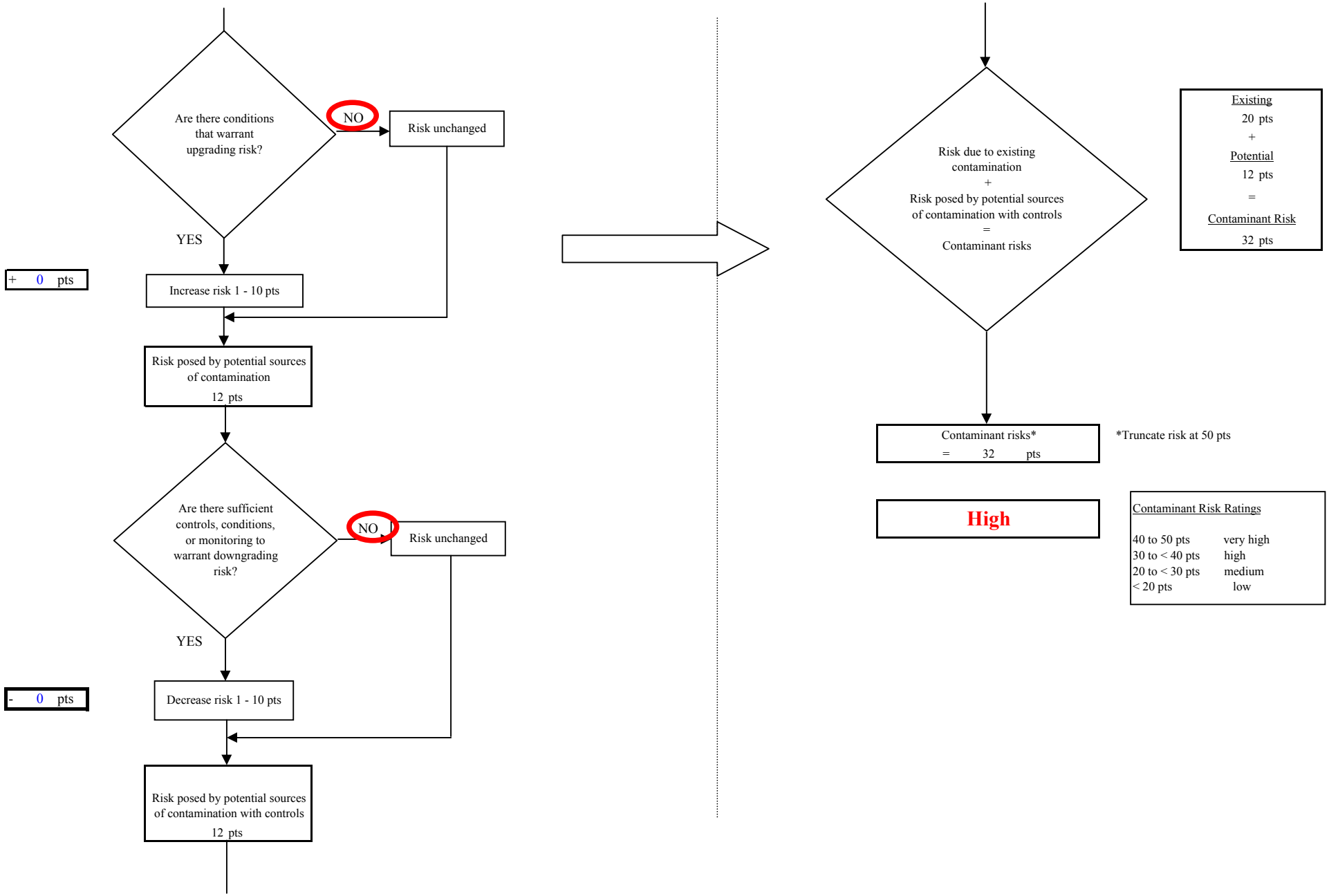


Chart 10. Vulnerability analysis for Young Properties- Heavy Metals, Cyanide and Other Inorganic Chemicals

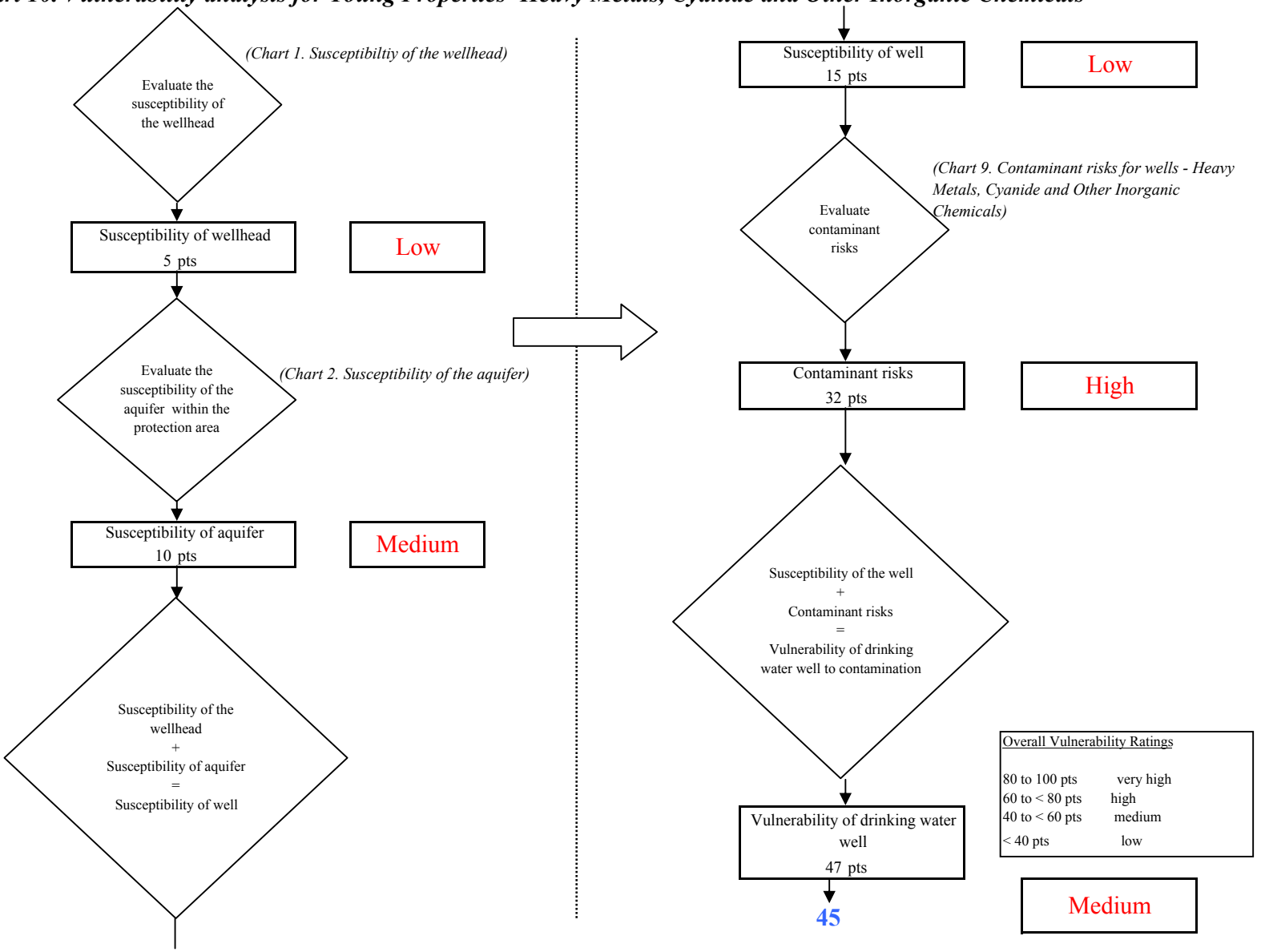


Chart 11. Contaminant risks for Young Properties- Synthetic Organic Chemicals

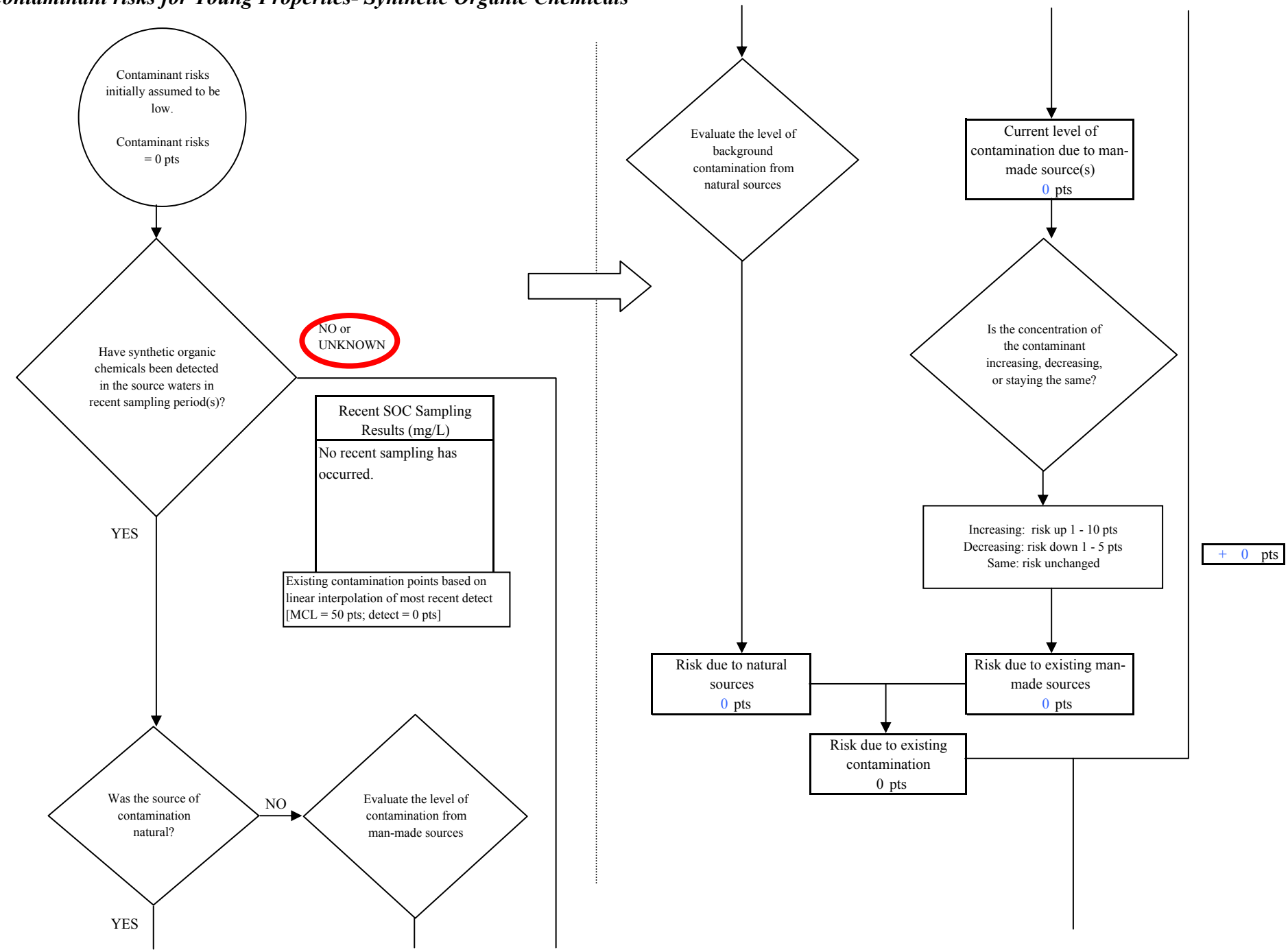
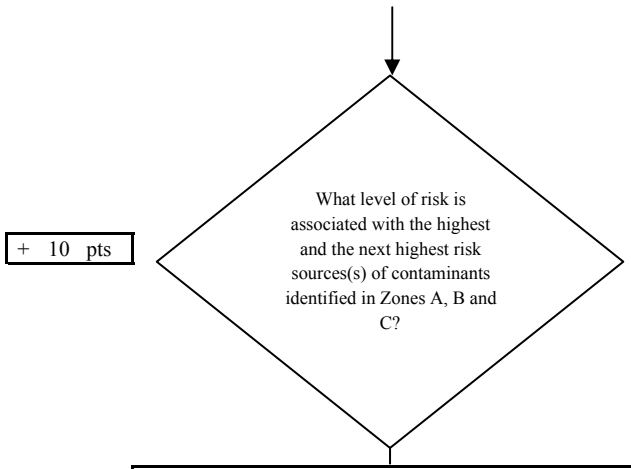


Chart 11. Contaminant risks for Young Properties- Synthetic Organic Chemicals



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)	1	4	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.

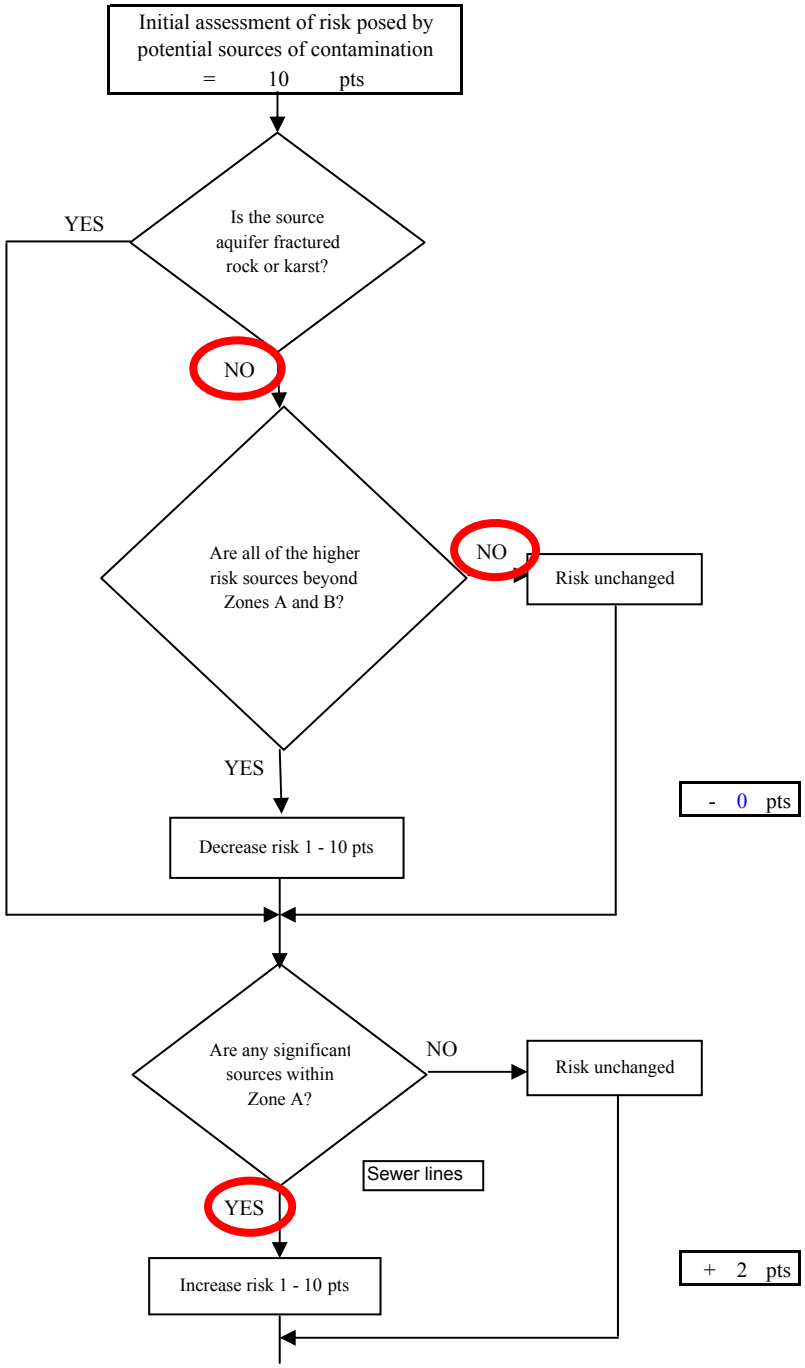


Chart 11. Contaminant risks for Young Properties- Synthetic Organic Chemicals

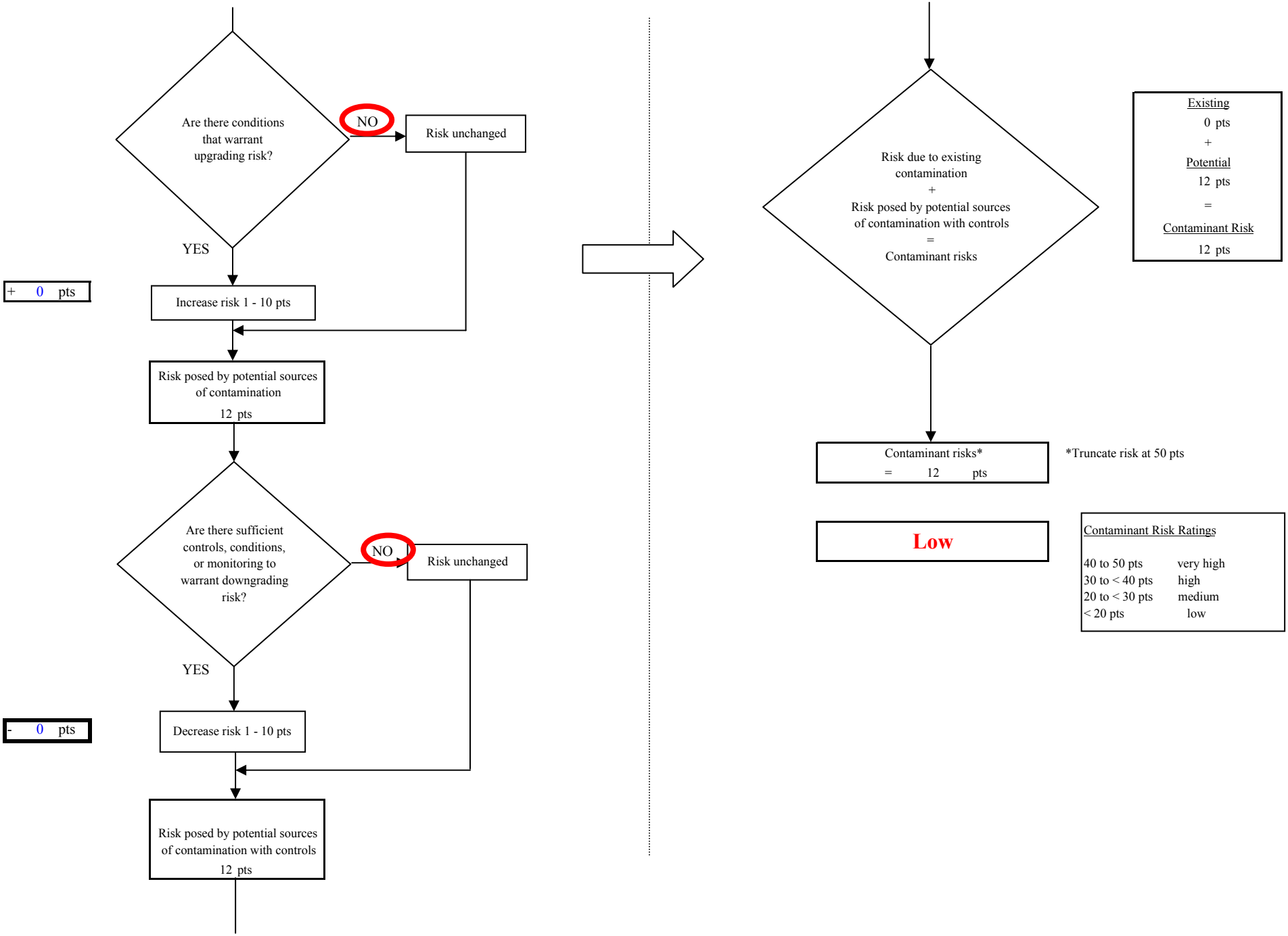


Chart 12. Vulnerability analysis for Young Properties- Synthetic Organic Chemicals

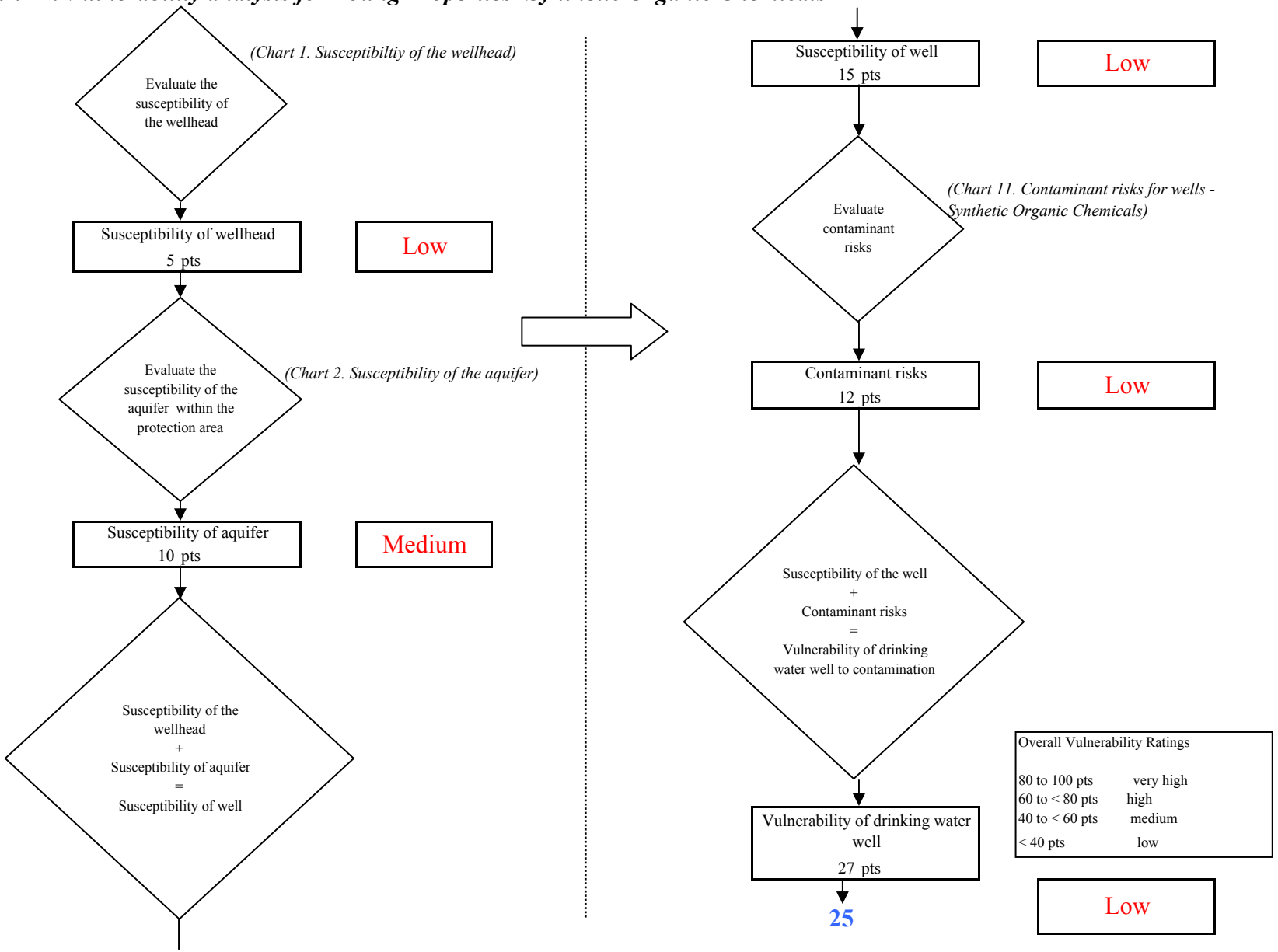


Chart 13. Contaminant risks for Young Properties- Other Organic Chemicals

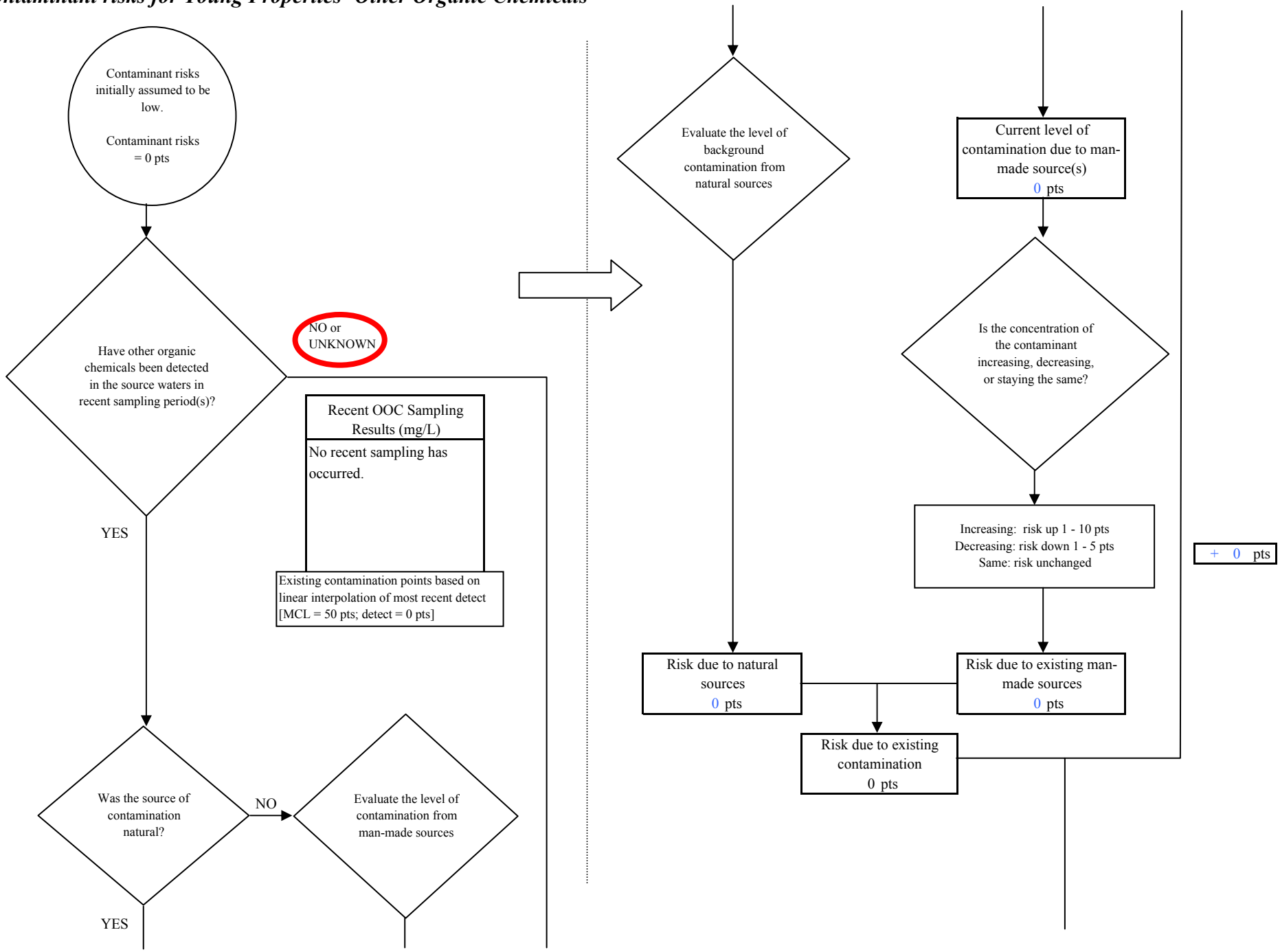
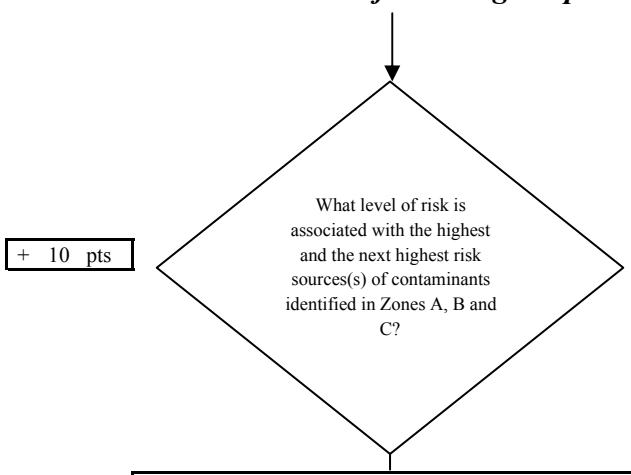


Chart 13. Contaminant risks for Young Properties- Other Organic Chemicals



+ 10 pts

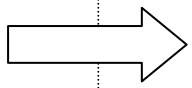
Risk Levels for Contaminant Sources identified in Zones A, B and C

	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.



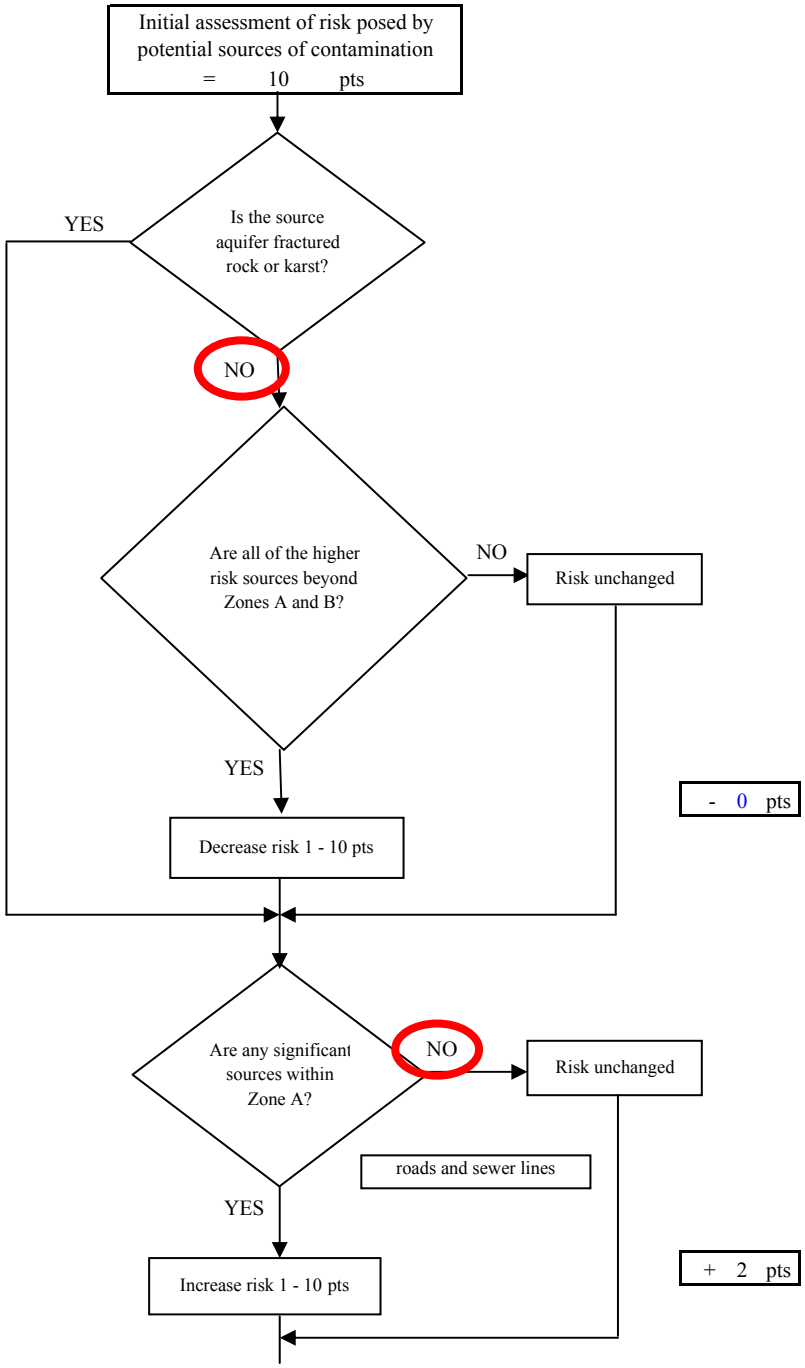
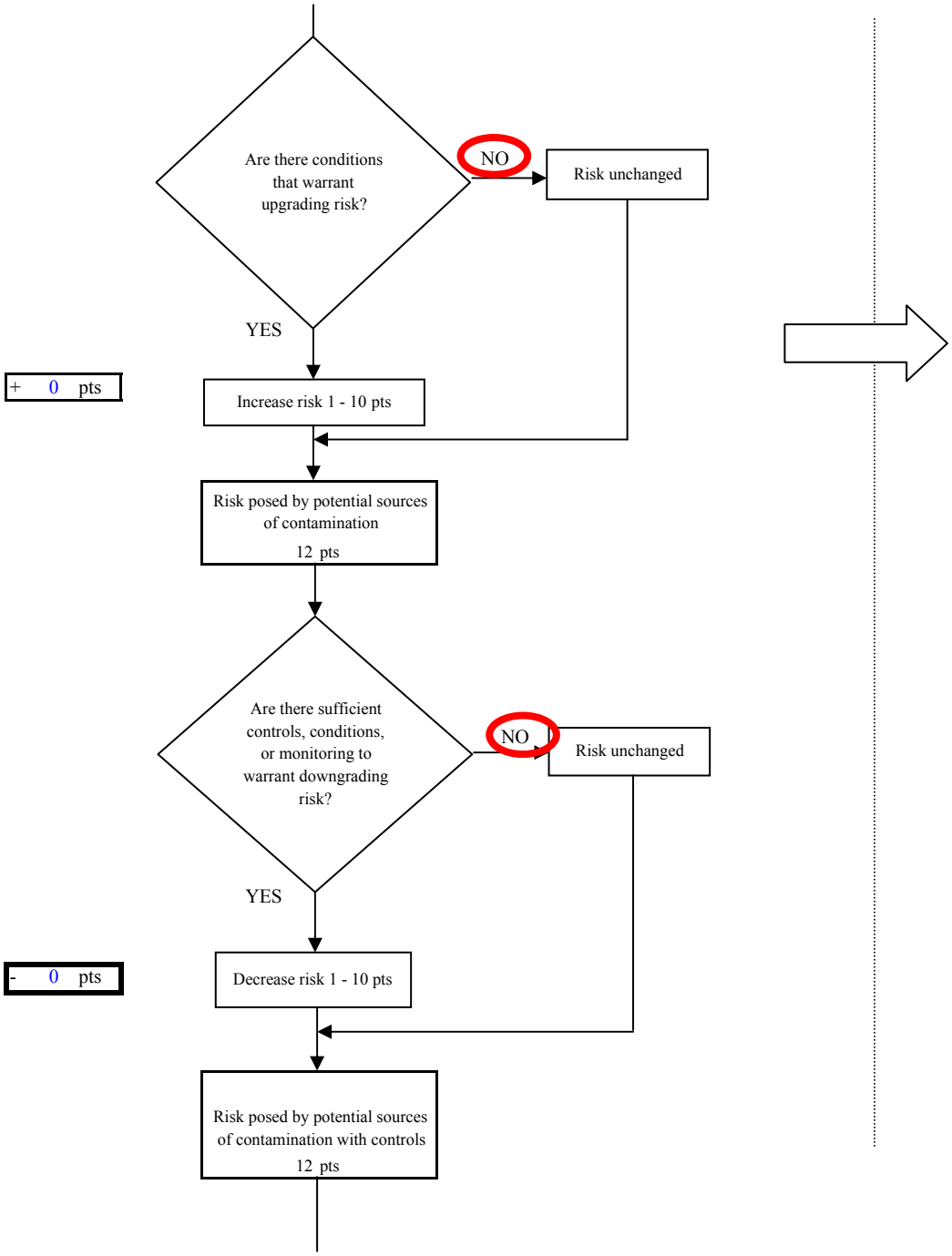
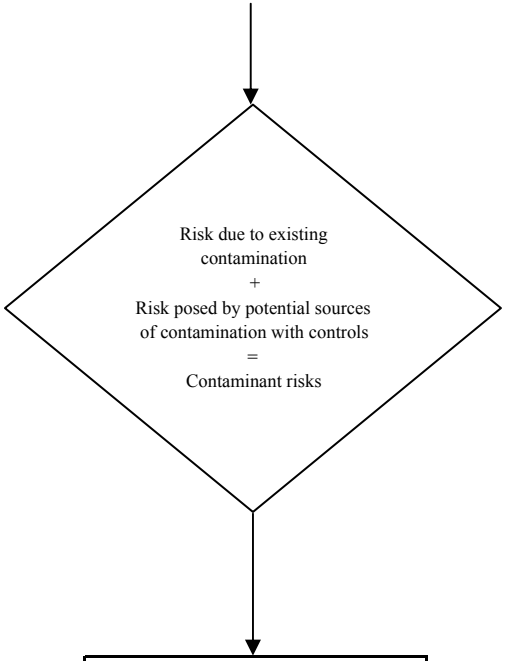


Chart 13. Contaminant risks for Young Properties- Other Organic Chemicals





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

Contaminant risks*
= 12 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 14. Vulnerability analysis for Young Properties- Other Organic Chemicals