



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Living Stones Academy
Drinking Water System,
Sterling area, Alaska
PWSID 248690.001

May 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1512
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.

CONTENTS

	Page		Page
Executive Summary	1	Inventory of Potential and Existing Contaminant Sources	2
Living Stones Academy Public Drinking Water System	1	Ranking of Contaminant Risks Vulnerability of Living Stones Academy Drinking Water System	2 3
Living Stones Academy Protection Area	1	References	7

TABLES

TABLE	1. Definition of Zones	2
	2. Susceptibility	3
	3. Contaminant Risks	4
	3. Overall Vulnerability	4

APPENDICES

APPENDIX	A. Living Stones Academy Drinking Water Protection Area (Map 1)
	B. Contaminant Source Inventory for Living Stones Academy (Table 1) Contaminant Source Inventory and Risk Ranking for Living Stones Academy– Bacteria and Viruses (Table 2) Contaminant Source Inventory and Risk Ranking for Living Stones Academy– Nitrates/Nitrites (Table 3) Contaminant Source Inventory and Risk Ranking for Living Stones Academy– Volatile Organic Chemicals (Table 4) Contaminant Source Inventory and Risk Ranking for Living Stones Academy– Heavy Metals, Cyanide, and Other Inorganic Chemicals (Table 5) Contaminant Source Inventory and Risk Ranking for Living Stones Academy– Synthetic Organic Chemicals (Table 6) Contaminant Source Inventory and Risk Ranking for Living Stones Academy– Other Organic Chemicals (Table 7)
	C. Living Stones Academy Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)
	D. Vulnerability Analysis for Contaminant Source Inventory and Risk Ranking for Living Stones Academy Public Drinking Water Source (Charts 1 – 14)

Source Water Assessment for Living Stones Academy Source of Public Drinking Water, Sterling area, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Living Stones Academy is a Class A (Non-Transient/Non-Community) water system consisting of one well. The well is located off of the Sterling Highway near the intersection of Otter Terrace and Fair Game Avenue. The well received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Low**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the Living Stones Academy include: large capacity septic tanks, residential areas and residential septic systems. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals, inorganic chemicals, synthetic organic chemicals and other organic chemicals. Overall, the Living Stones Academy received a vulnerability rating of **Medium** for nitrates/nitrites and inorganic chemicals and **Low** for bacteria/ viruses, volatile organic chemicals, synthetic organic chemicals and other organic chemicals.

LIVING STONES ACADEMY- PUBLIC DRINKING WATER SYSTEM

The Living Stones Academy public water system (PWS) is a Class A (Non-Transient/Non-Community) water system and is located off of the Sterling Highway near the intersection of Otter Terrace and Fair Game Avenue. The system consists of one well. (See Map 1 of Appendix A).

The Living Stones Academy is located in the Kenai Peninsula Borough, which is located directly south of the city of Anchorage (Please see the inset of Map 1 in Appendix A for location). The borough encompasses 25,600 square miles, of which only 15,700 square miles is land.

The Kenai Peninsula is broken into two distinct geographic areas; the Kenai Mountains and the Kenai Lowlands. Kenai and its surrounding communities are located in the Kenai Lowlands. Communities located within the Kenai Lowlands include Sterling, Soldotna, Kenai, Kenai, Clam Gulch, Ninilchik, and Homer.

The Kenai Peninsula area topography varies from about 3,000 feet to 5,000 feet above sea level in the Kenai Mountains, the highest point being about 6,400 feet above sea level. The Kenai Peninsula is dotted with many lakes and small streams, including three large lakes (Kenai Lake, Skilak Lake, and Tustumena Lake) and two substantial rivers (Kenai River, and Kasilof River) (USGS 1915).

The Living Stones Academy water system is located within the Kenai Lowlands, which is a sub-province of the Cook Inlet-Susitna Lowland physiographic region. The Kenai Lowland is a glaciated coastal shelf situated west of the northeast-trending Kenai Mountains. Approximately 100 miles long, the coastal shelf is bordered on the west by Cook Inlet, on the east by Kenai Mountains, on the north by Turnagain Arm, and on the south by the Caribou Hills and Kachemak Bay. The following summary of regional geology and hydrogeology is based on studies by Bailey and Hogan (1995); Freethey and Scully (1980); Glass (1996); Hartman, et al. (1972); and Karlstrom (1964).

The Kenai Lowland is underlain by bedrock. Tertiary sedimentary bedrock is more than 500 feet below the city of Kenai airport, but is exposed along beach cliffs and road cuts near the southwest end of the lowland. Unconsolidated surficial deposits of Quaternary age include coastal deposits, glaciolacustrine deposits, glaciofluvial deposits, glacial moraine deposits, and periglacial wind deposits. Unconsolidated Quaternary cover on the lowlands generally thickens from south to North being thin or absent in the Homer area, and over 750 feet thick near Kenai.

The most significant groundwater resources of the Kenai Lowlands are contained in Quaternary coarse-grained sands and gravels. Flood plain, river terrace and other alluvial deposits are common aquifer materials in the area, and are characterized by high rates of recharge, and large saturated thicknesses. Other favorable materials include proglacial lake and associated river deposits and glacial outwash deposits consisting of meltwater sorted sand and gravel material. Unsorted glacial moraine and drift deposits generally have poor groundwater yields, as do discontinuous layers of confining clays and silt that are common

throughout the unconsolidated materials. The relatively thicker sequence of unconsolidated sediments in the northern portions of the Kenai Lowlands locally hosts thicker, more extensive clay aquitards and multiple aquifers.

The Kenai Peninsula area has a central water system; however, many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are deep with depths between 50 and 200 feet. Static water levels in many of these wells are between 10 and 30 feet below the surface. Although groundwater quality can vary significantly in short distance, groundwater supplies are abundant in the area.

The Sanitary Survey (2002) indicates that the wellhead is protected with a sanitary seal. A properly installed sanitary seal may provide protection against contaminant from entering the source waters at the casing. The well is not located in a floodplain and the land surface is sloped away from the casing. The well is grouted. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates year round and serves up to 16 residents and 37 non-residents through 9 service connections.

LIVING STONES ACADEMY WATER DRINKING WATER 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. 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 protection area are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

An analytical calculation was used to determine the size and shape of the DWPA for Living Stones Academy. The input parameters describing the attributes of the aquifer in this calculation were adopted from Groundwater (*Freeze and Cherry 1979*). Available geology and groundwater contours were also considered to take into account any uncertainties in

groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

The protection areas 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 (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 protection area 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 DWPA for the Living Stones Academy was determined using an analytical calculation and includes Zone A, B, C, and D (See Map 1 of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Living Stones Academy 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 Map 1 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 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. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only “Very High” and “High” rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well.

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, inorganic chemicals, synthetic organic chemicals and other organic chemicals.

VULNERABILITY OF STERLING AREALIVING STONES ACADEMY DRINKING WATER SYSTEM

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

- Natural susceptibility; and
- Contaminant risks.

Appendix D contains eight charts, which together form the ‘Vulnerability Analysis’ for a source water assessment for a public drinking water source. Chart 1 analyzes the ‘Susceptibility of the Wellhead’ to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the ‘Susceptibility of the Aquifer’ to contamination by looking at the 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, cyanide, 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 well log indicates the well is 305 feet deep and is screened from 294-305 feet below ground surface (bgs). The static water level at the time of drilling was 16 feet bgs. The well is completed in a confined aquifer. The well penetrates a multiple confining layers starting totaling more than 100 feet in thickness. The confining layer provides a protection from the movement of contaminants in the subsurface. However, wells penetrating the confining layers upgradient from the well may provide a path for contaminants to enter the confined aquifer..

Table 2 shows the Susceptibility scores and ratings for the Living Stones Academy.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	5	Low
Natural Susceptibility	5	Low

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

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score 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. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

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

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	30	High
Nitrates and/or Nitrites	36	High
Volatile Organic Chemicals	21	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	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:

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

Again, rankings are assigned according to a point score:

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the three categories of

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

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

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	35	Low
Nitrates and Nitrites	40	Medium
Volatile Organic Chemicals	25	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	55	Medium
Synthetic Organic Chemicals	15	Low
Other Organic Chemicals	15	Low

Bacteria and Viruses

Large capacity septic systems, residential area and residential septic systems represent the greatest risk for bacteria and viruses to this drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coli forms 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). Sampling has not detected bacteria or viruses within source waters.

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 low.

Nitrates and Nitrites

Large capacity septic systems, residential area and residential septic systems plants represent the greatest risk to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for the Living Stones Academy well indicates that nitrate

concentrations have ranged from 0.0 mg/l to 1.1 mg/l. The reported nitrate concentrations suggest that the nitrate concentrations are attributed to natural sources. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/l therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources. The most recent nitrate level detected was 11% (1.1 mg/L) of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Though existing nitrate contamination was detected at the site, recent data indicates that nitrate concentrations are safe with respect to human health.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is medium.

Volatile Organic Chemicals

Large capacity septic systems, residential areas, and residential septic systems represent the greatest identified risk for volatile organic chemical contamination to the well.

Approximately 20% residents in the area typically heat their homes with various types of on-site fuel sources, including propane and heating oil stored in aboveground or underground storage tanks. Although this report does not address heating oil tanks (unless their location is known), they can pose a risk of volatile organic chemical contamination to drinking water sources. 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. Secondary containment around the tank and regular system maintenance can help prevent many of these harmful fuel leaks and help protect the drinking water supply.

Sampling has detected low levels of TTHM, dichloroacetic acid and chloroform. These contaminants are commonly associated with the disinfection process. Since the samples were taken post treatment, it is likely that these contaminants are a result of disinfection and do not exist in source water.

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

Large capacity septic system, residential areas and residential septic systems represent the greatest risk for inorganic chemicals to the well.

Samplings of inorganic chemicals have detected arsenic at levels exceeding the current maximum contaminant levels (MCLs). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. The most recent detection of arsenic detected 0.0408 mg/l which exceeds the current MCL of 0.01mg/l. Prolonged exposure to levels exceeding the MCL can cause skin damage, problems with circulatory systems, and may create an increased risk of developing cancer (EPA, 2002).

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

Synthetic Organic Chemicals

Large capacity septic systems, residential area and residential septic systems represent the greatest risk for inorganic chemicals to the well.

Sampling for synthetic organic chemicals has not occurred. The system currently has an SOC waiver and is not required to sample.

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

Other Organic Chemicals

Large capacity septic systems, residential area and residential septic systems represent the greatest risk for other organic chemicals to the well.

Sampling for other organic chemicals has not occurred. The system currently has an OOC waiver and is not required to sample.

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

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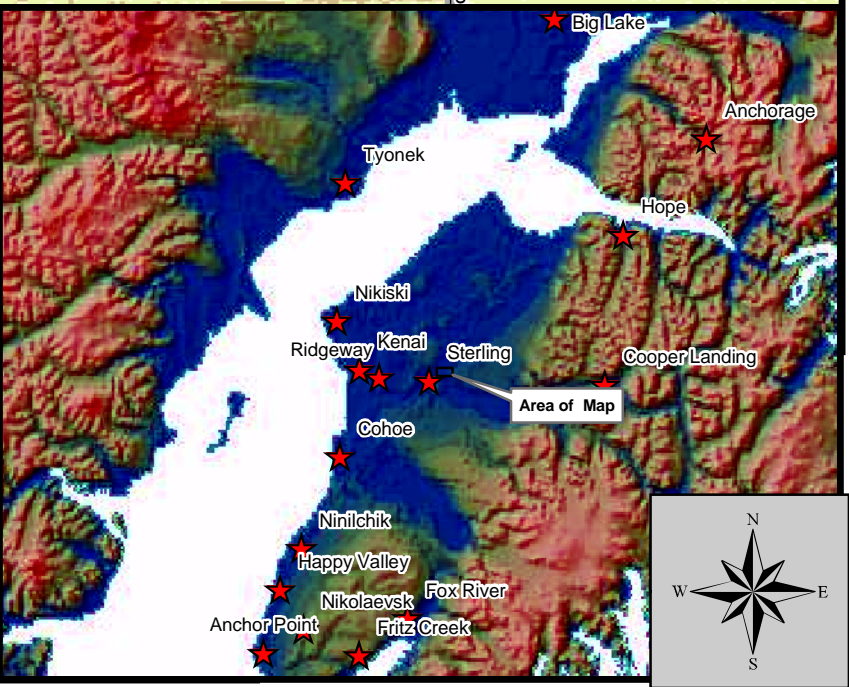
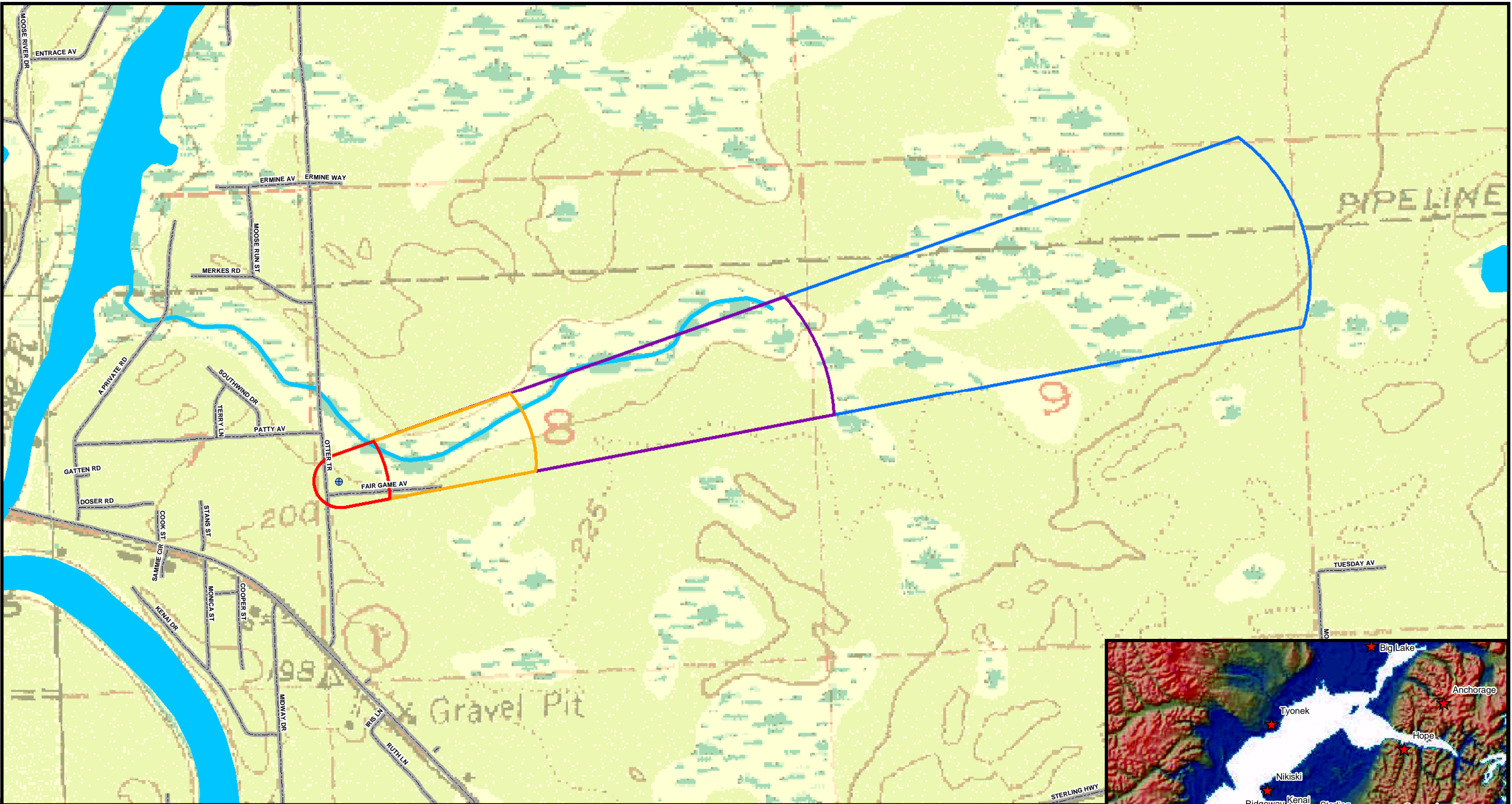
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ACKNOWLEDGMENT

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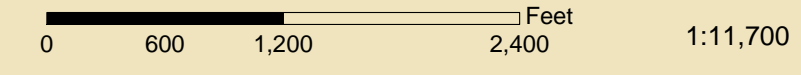
APPENDIX A

Living Stones Academy Drinking Water Protection Area Location Map (Map 1)



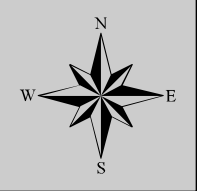
Map 1- Living Stones Academy-Drinking Water Protection Area

PWSID: 248690.001



Data Sources:
 Kenai Borough: Roads and parcels
 63k Topographic Map: USGS
 Potential Sources of Contamination: ADEC

Legend	
	Class A Public Water System
	Zone A Protection Area
	Zone B Protection Area
	Zone C Protection Area
	Zone D Protection Area
	Roads
	Rivers and Streams
	Water



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Living Stones Academy (Tables 1-7)

Table 1

**Contaminant Source Inventory for
Living Stones Academy**

PWSID 248690.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	2	
Residential Areas	R01	R01-1	A	2	Zone A has 2 residential acres (R01)
Residential Areas	R01	R01-2	B	2	Zone B has 5 residential acres (R01)
Septic systems (serves one single-family home)	R02	R02-01	B	2	

Table 2

*Contaminant Source Inventory and Risk Ranking for
Living Stones Academy
Sources of Bacteria and Viruses*

PWSID 248690.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	2	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 2 residential acres (R01)
Residential Areas	R01	R01-2	B	Low	2	Zone B has 5 residential acres (R01)
Septic systems (serves one single-family home)	R02	R02-01	B	Low	2	

Table 3

*Contaminant Source Inventory and Risk Ranking for
Living Stones Academy
Sources of Nitrates/Nitrites*

PWSID 248690.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	2	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 2 residential acres (R01)
Residential Areas	R01	R01-2	B	Low	2	Zone B has 5 residential acres (R01)
Septic systems (serves one single-family home)	R02	R02-01	B	Low	2	

Table 4

*Contaminant Source Inventory and Risk Ranking for
Living Stones Academy
Sources of Volatile Organic Chemicals*

PWSID 248690.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 2 residential acres (R01)
Residential Areas	R01	R01-2	B	Low	2	Zone B has 5 residential acres (R01)
Septic systems (serves one single-family home)	R02	R02-01	B	Low	2	

Table 5

*Contaminant Source Inventory and Risk Ranking for
Living Stones Academy
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

PWSID 248690.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 2 residential acres (R01)
Residential Areas	R01	R01-2	B	Low	2	Zone B has 5 residential acres (R01)
Septic systems (serves one single-family home)	R02	R02-01	B	Low	2	

Table 6

*Contaminant Source Inventory and Risk Ranking for
Living Stones Academy
Sources of Synthetic Organic Chemicals*

PWSID 248690.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 2 residential acres (R01)
Residential Areas	R01	R01-2	B	Low	2	Zone B has 5 residential acres (R01)
Septic systems (serves one single-family home)	R02	R02-01	B	Low	2	

Table 7

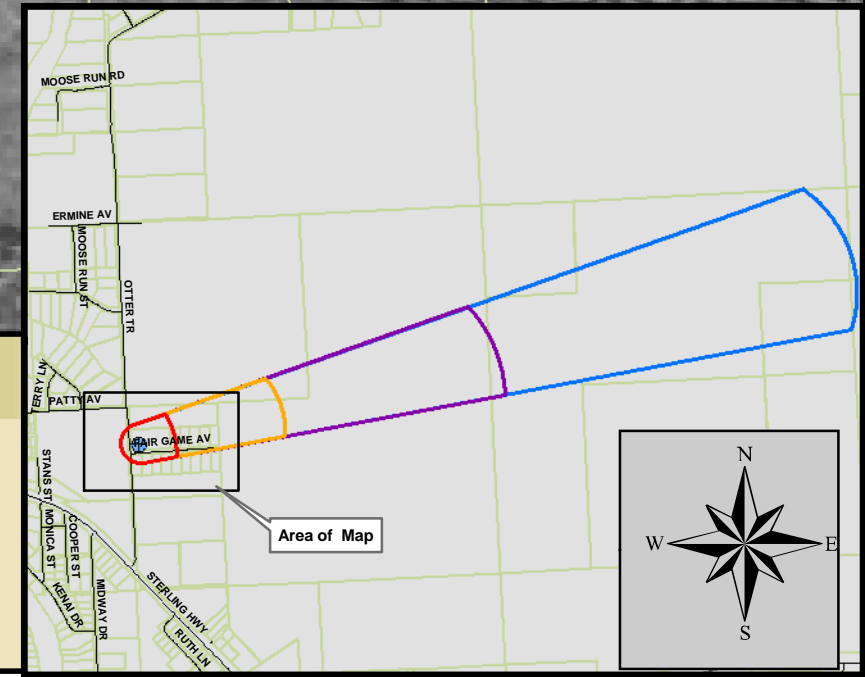
*Contaminant Source Inventory and Risk Ranking for
Living Stones Academy
Sources of Other Organic Chemicals*

PWSID 248690.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	2	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 2 residential acres (R01)
Residential Areas	R01	R01-2	B	Low	2	Zone B has 5 residential acres (R01)
Septic systems (serves one single-family home)	R02	R02-01	B	Low	2	

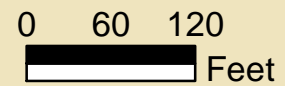
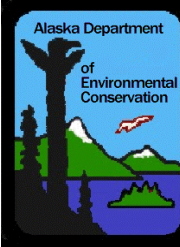
APPENDIX C

Living Stones Academy Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)



Map 2- Living Stones Academy Potential and Existing Source of Contamination

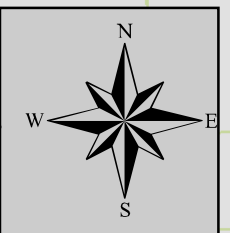
PWSID: 248690.001



Data Sources:
 USGS- 1:63,360 Background
 Microsoft Terraserver-aerial photo
 Kenai Borough: Roads and parcels

1:1,440
 1"=120 feet

Legend	
	Class A Public Water System
	Zone A Protection Area
	Zone B Protection Area
	Zone C Protection Area
	Zone D Protection Area
	Roads
	Parcels
	Water
	Rivers and Streams
	Injection wells (Class V) Septic System (Drainfield Disposal Method) (D10)
	Residential Septic systems (R02)
	Residential area (R01)



APPENDIX D

Vulnerability Analysis for Living Stones Academy Public Drinking Water Source (Charts 1-14)

Chart 1. Susceptibility of the wellhead - Living Stones Academy PWSID 248690.001

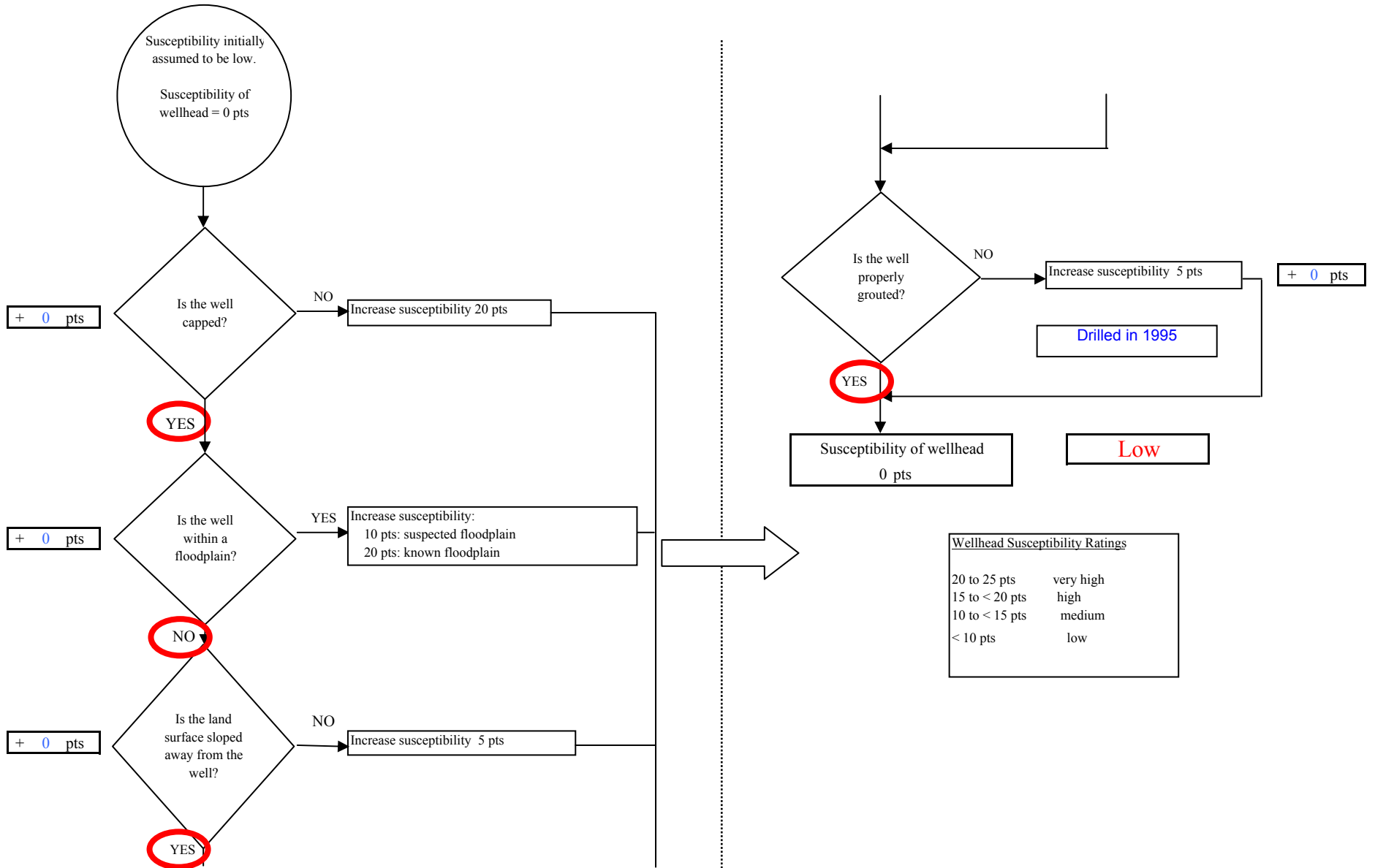


Chart 2. Susceptibility of the aquifer - Living Stones Academy PWSID 248690.001

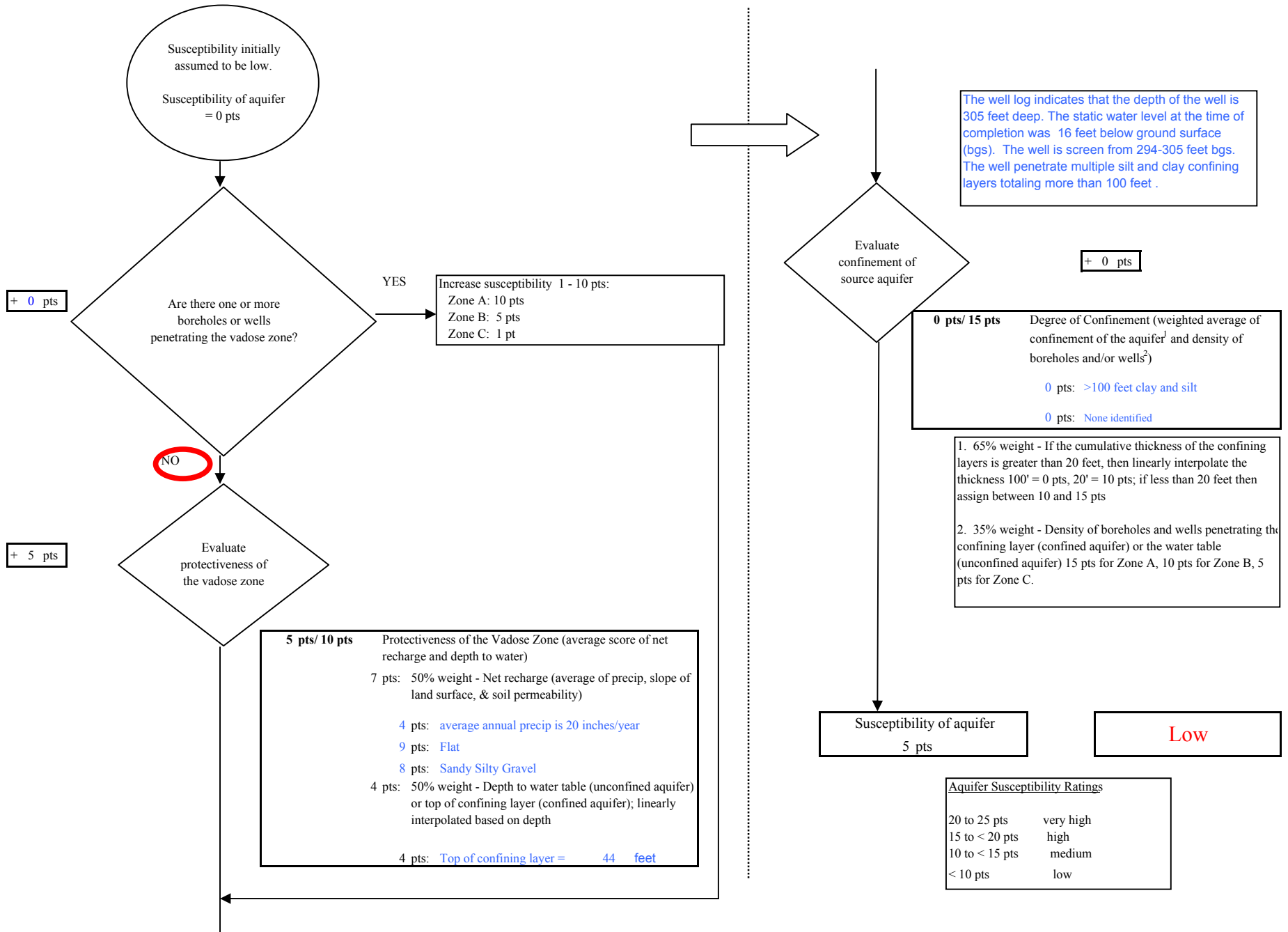
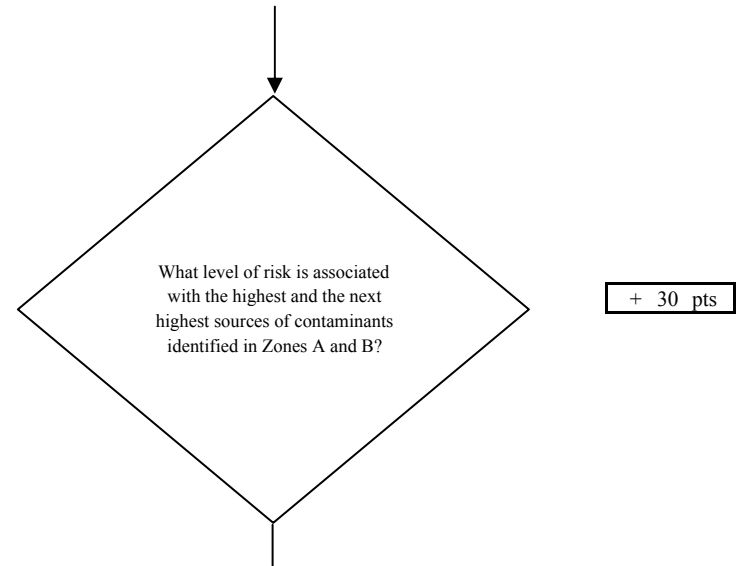
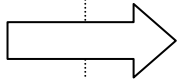
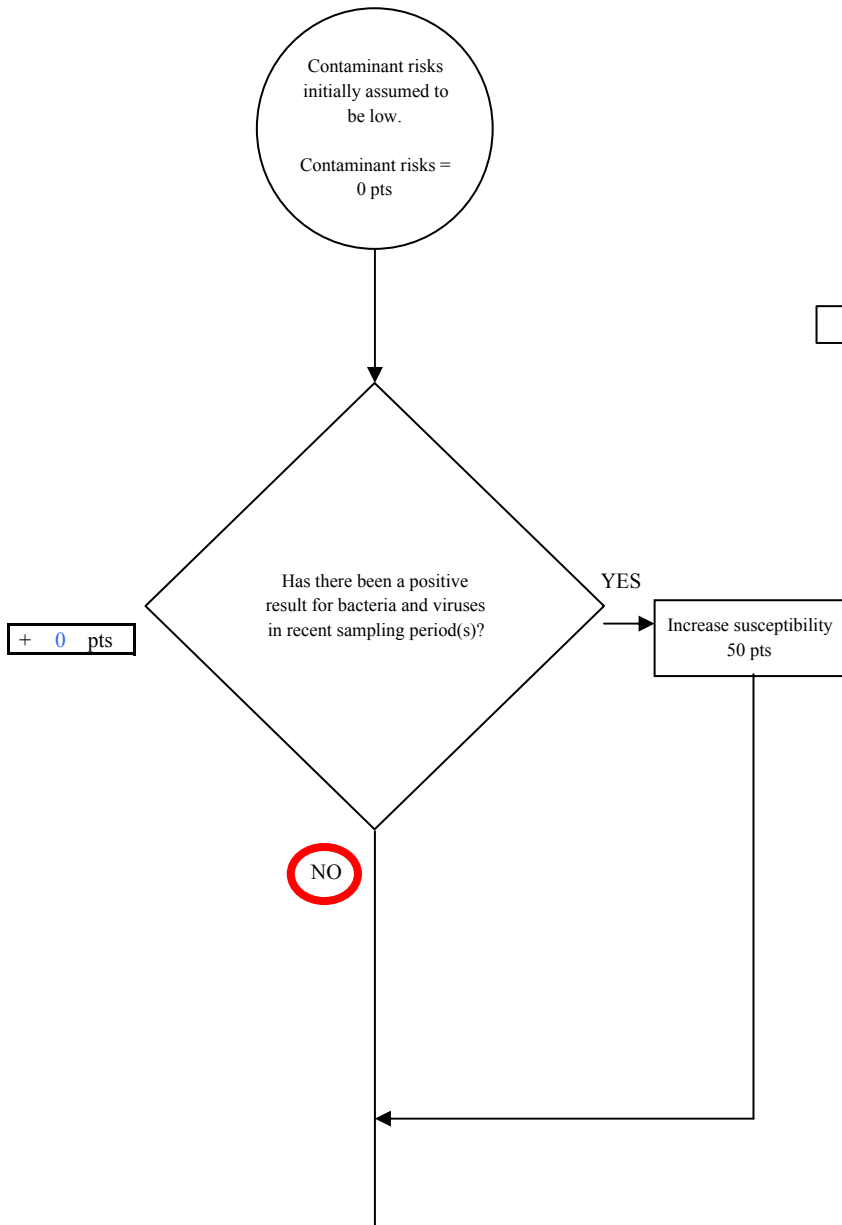


Chart 3. Contaminant risks for Living Stones Academy PWSID 248690.001 - Bacteria & Viruses



Risk Rankings for Contaminant Sources Identified in Zones A and B			
	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	2	1	3

	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 30

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 Living Stones Academy PWSID 248690.001 - Bacteria & Viruses

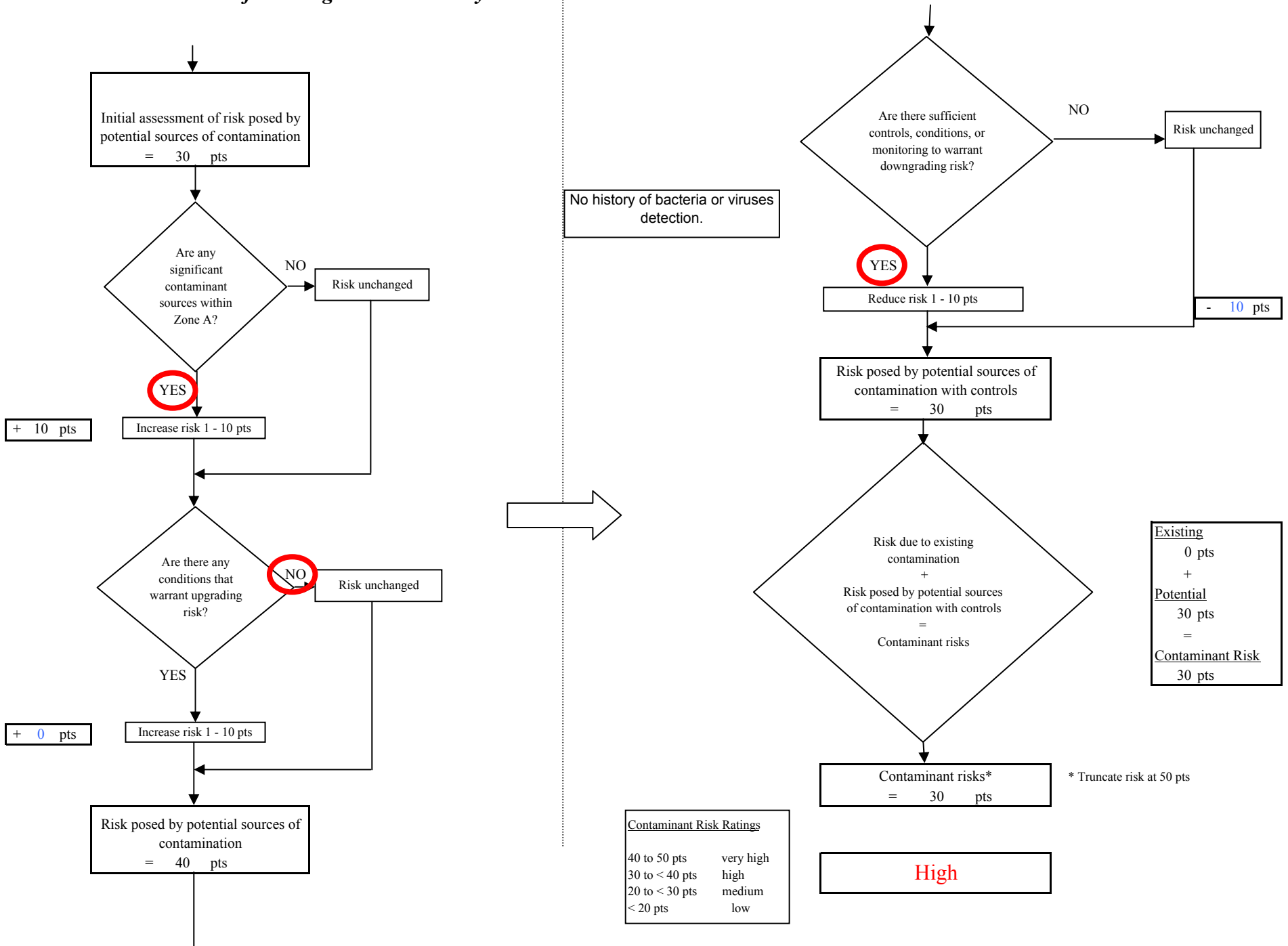


Chart 4. Vulnerability analysis for Living Stones Academy PWSID 248690.001 - Bacteria & Viruses

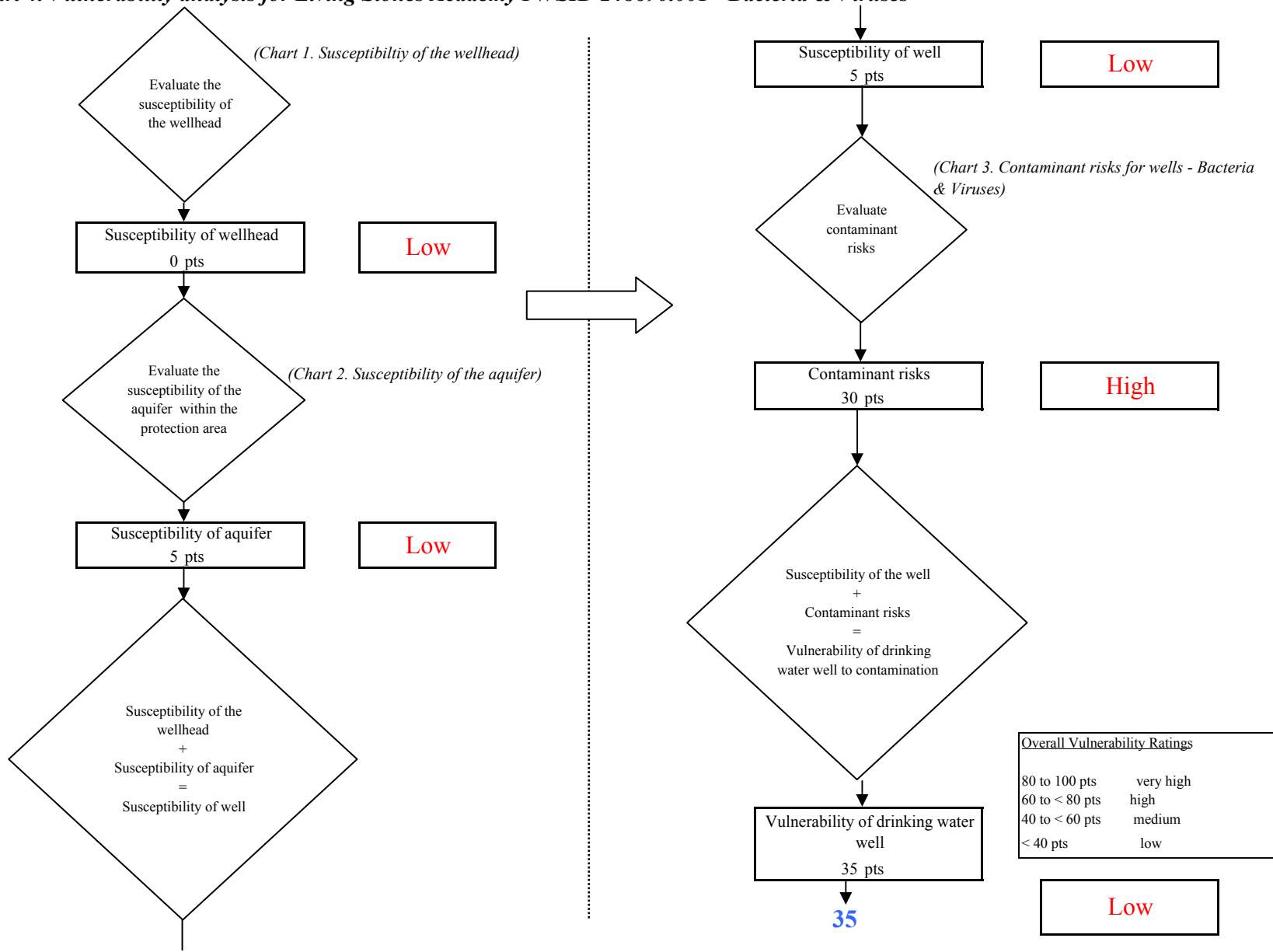


Chart 5. Contaminant risks for Living Stones Academy PWSID 248690.001 - Nitrates and Nitrites

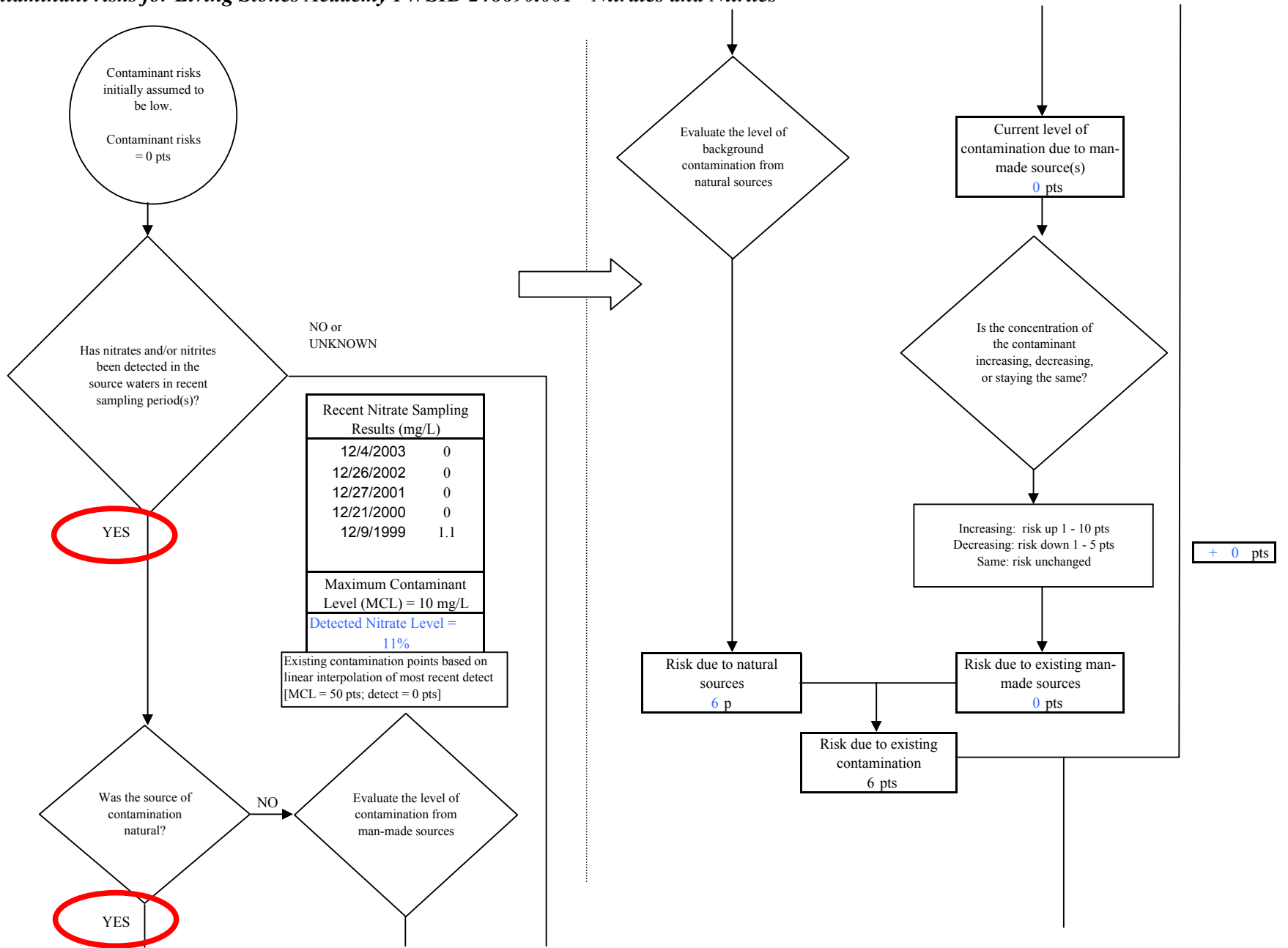


Chart 5. Contaminant risks for Living Stones Academy PWSID 248690.001 - Nitrates and Nitrites

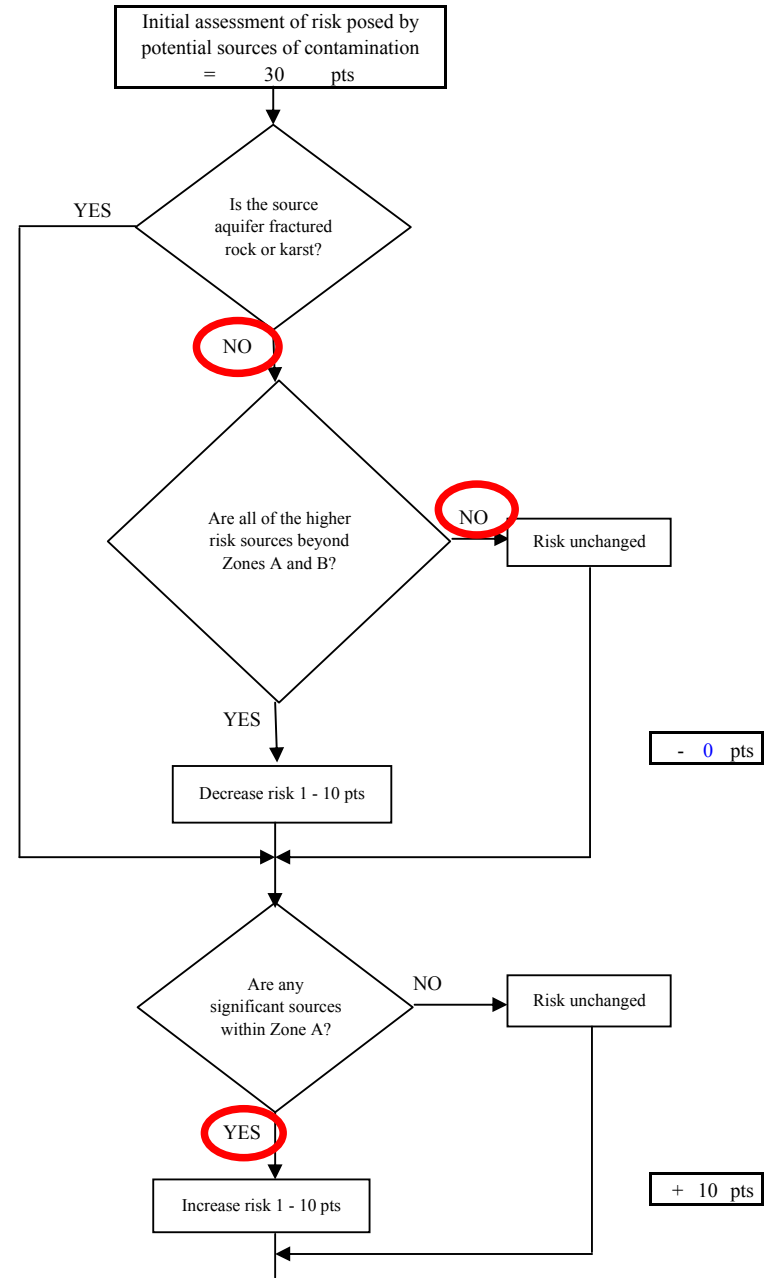
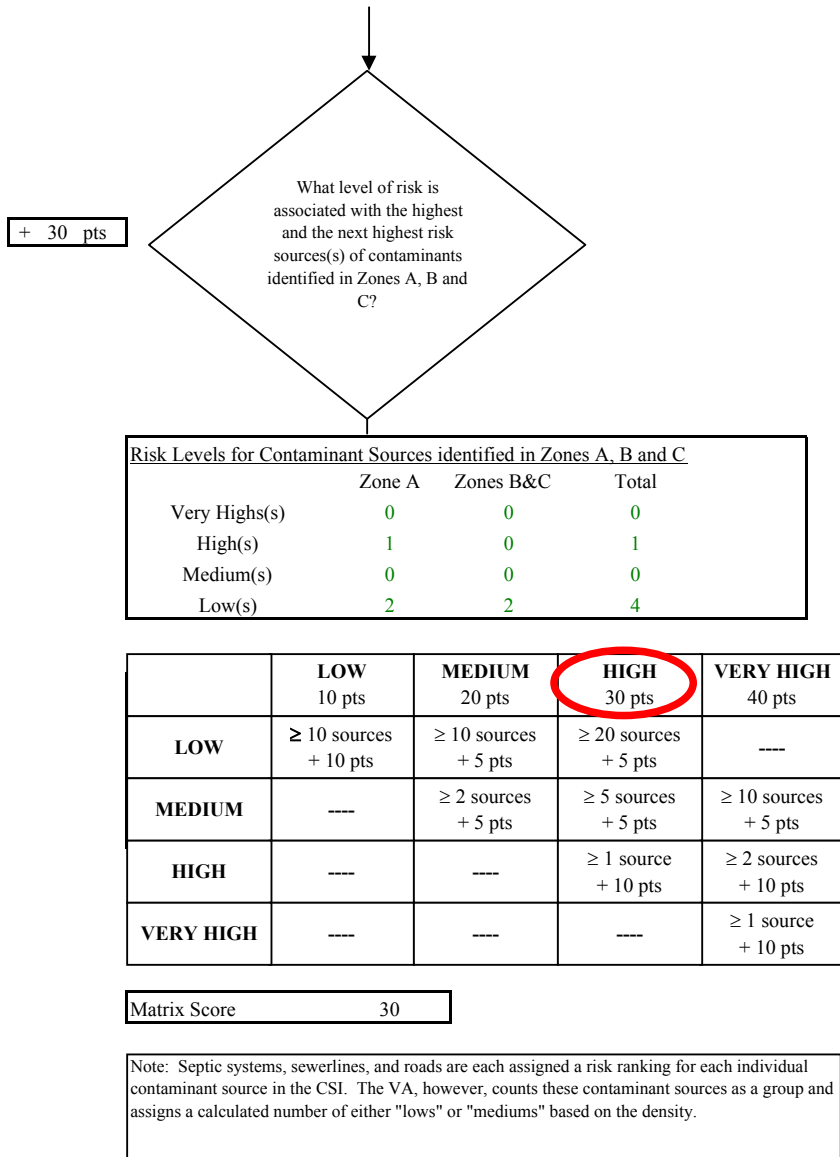


Chart 5. Contaminant risks for Living Stones Academy PWSID 248690.001 - Nitrates and Nitrites

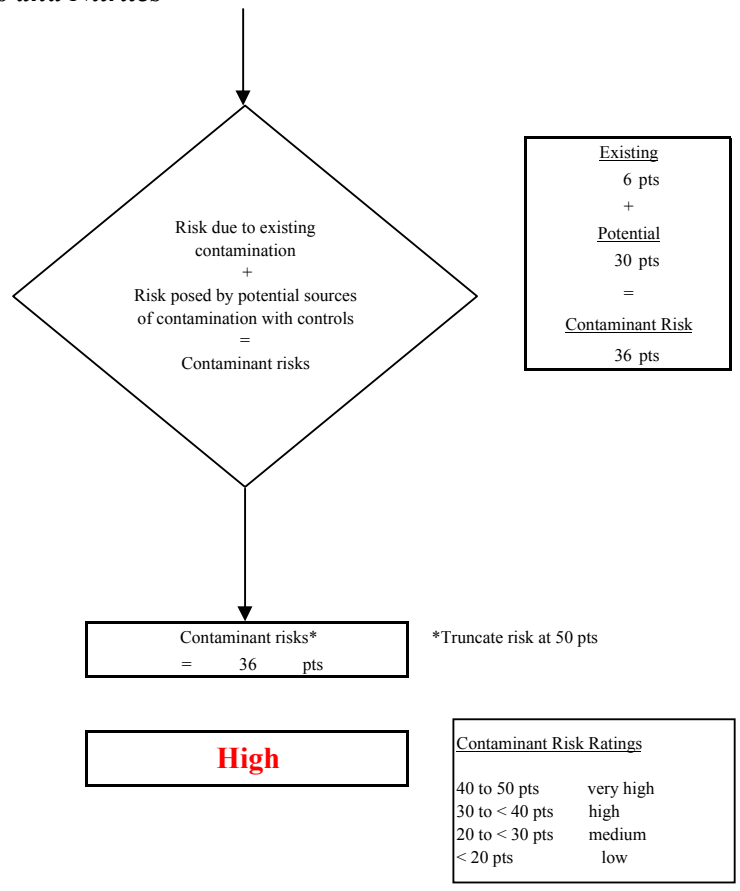
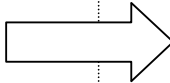
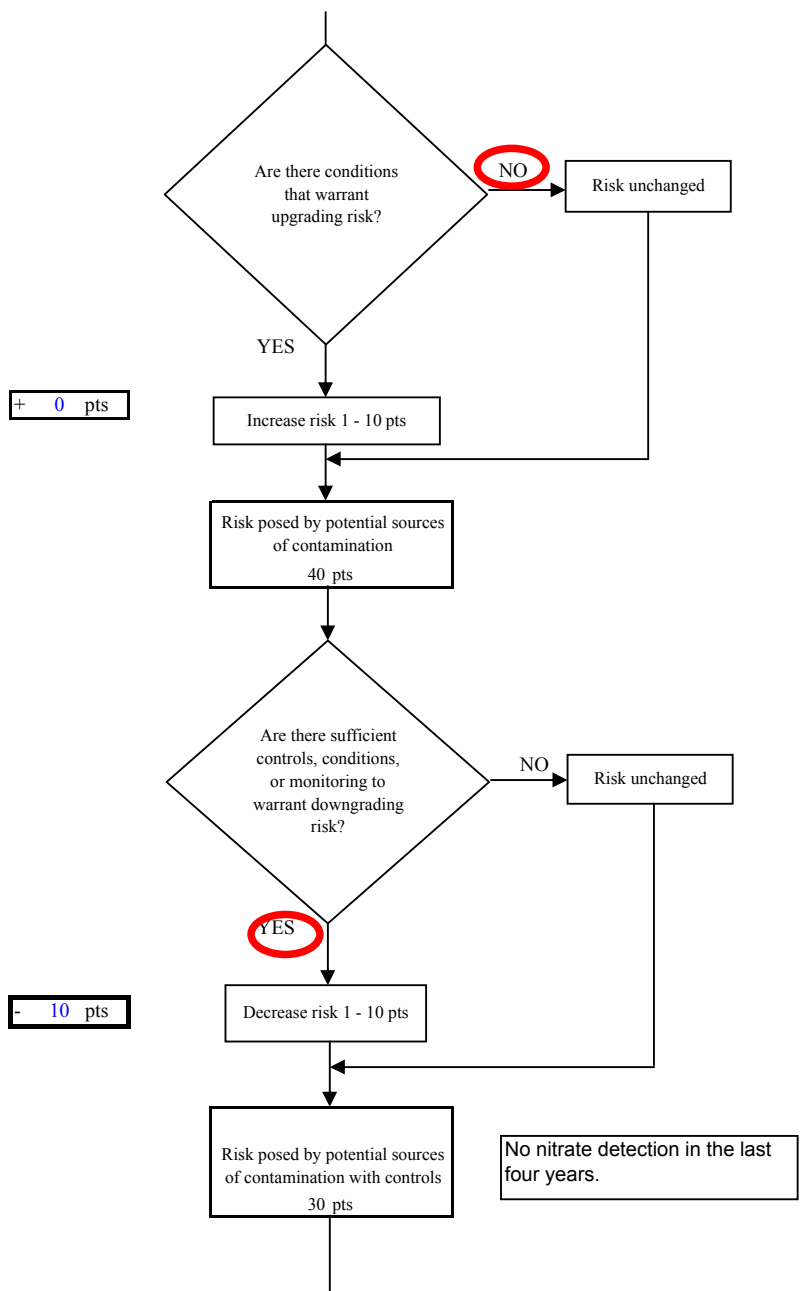


Chart 6. Vulnerability analysis for Living Stones Academy PWSID 248690.001 - Nitrates and Nitrites

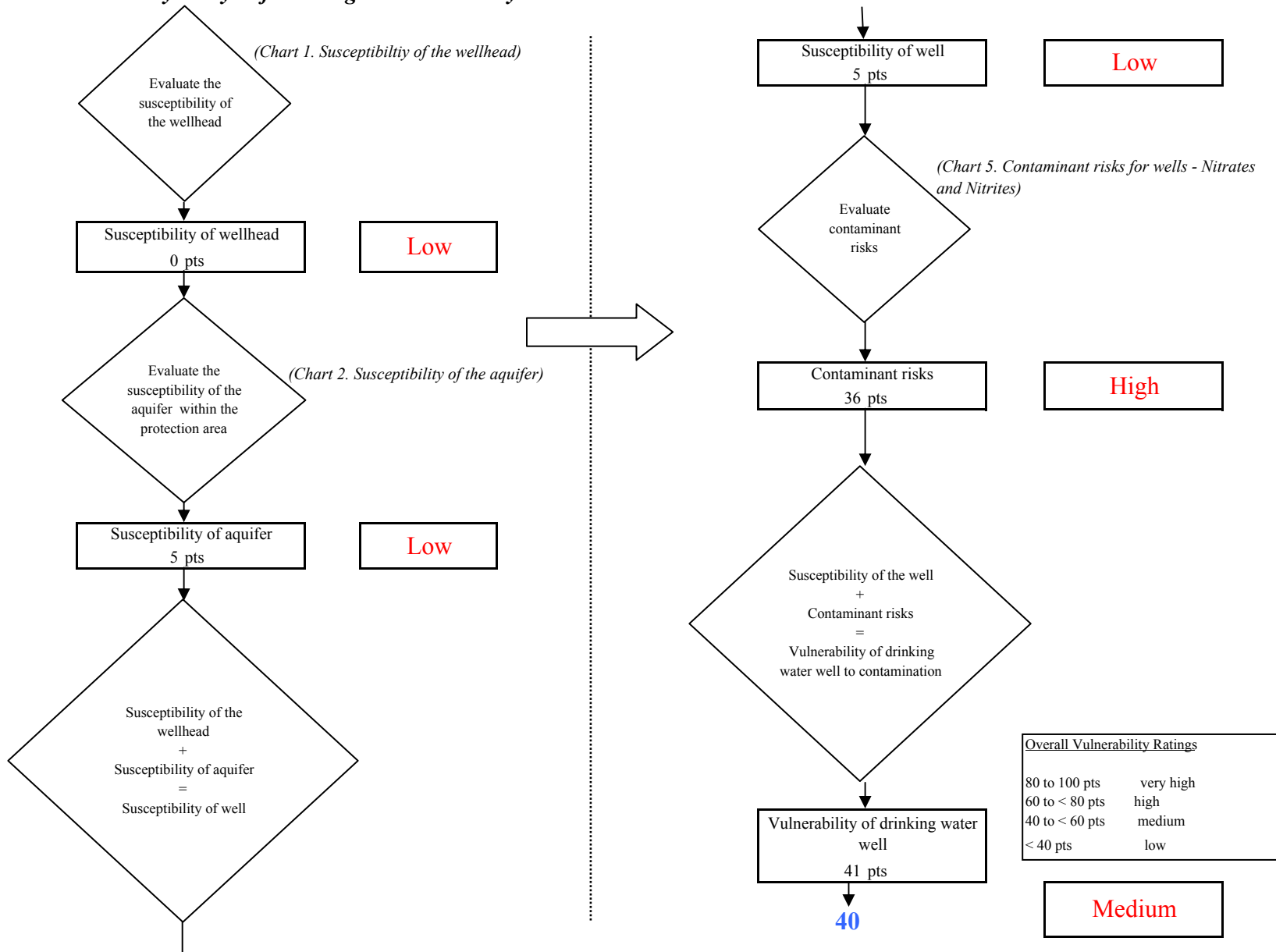


Chart 7. Contaminant risks for Living Stones Academy PWSID 248690.001 - Volatile Organic Chemicals

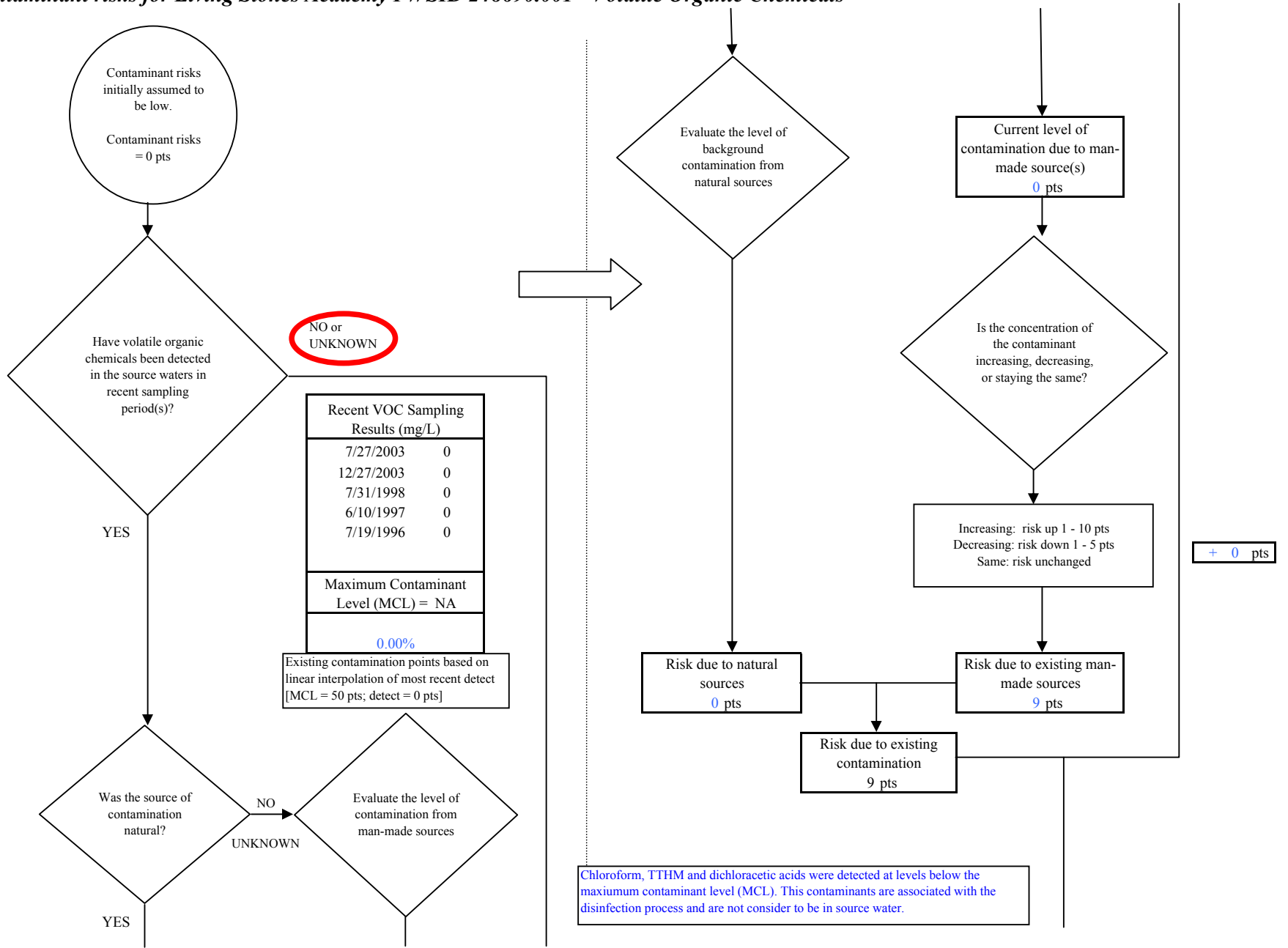


Chart 7. Contaminant risks for Living Stones Academy PWSID 248690.001 - Volatile Organic Chemicals

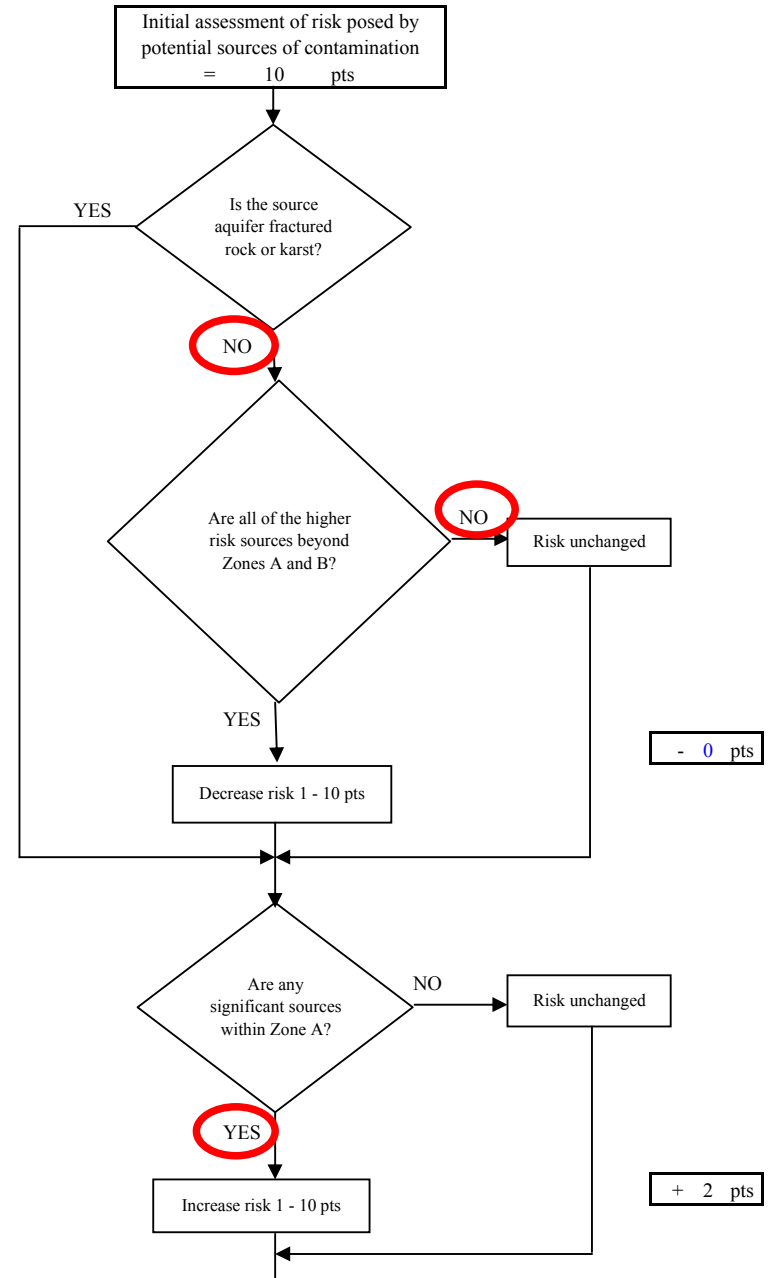
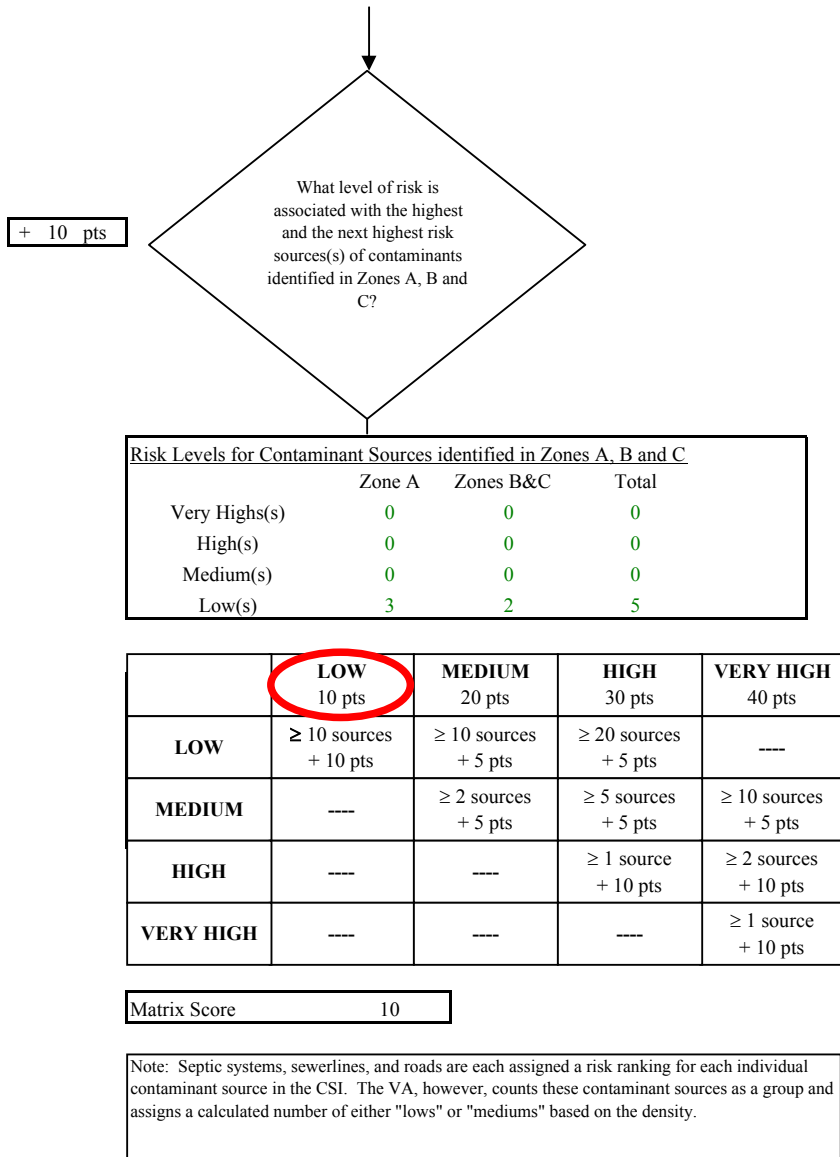


Chart 7. Contaminant risks for Living Stones Academy PWSID 248690.001 - Volatile Organic Chemicals

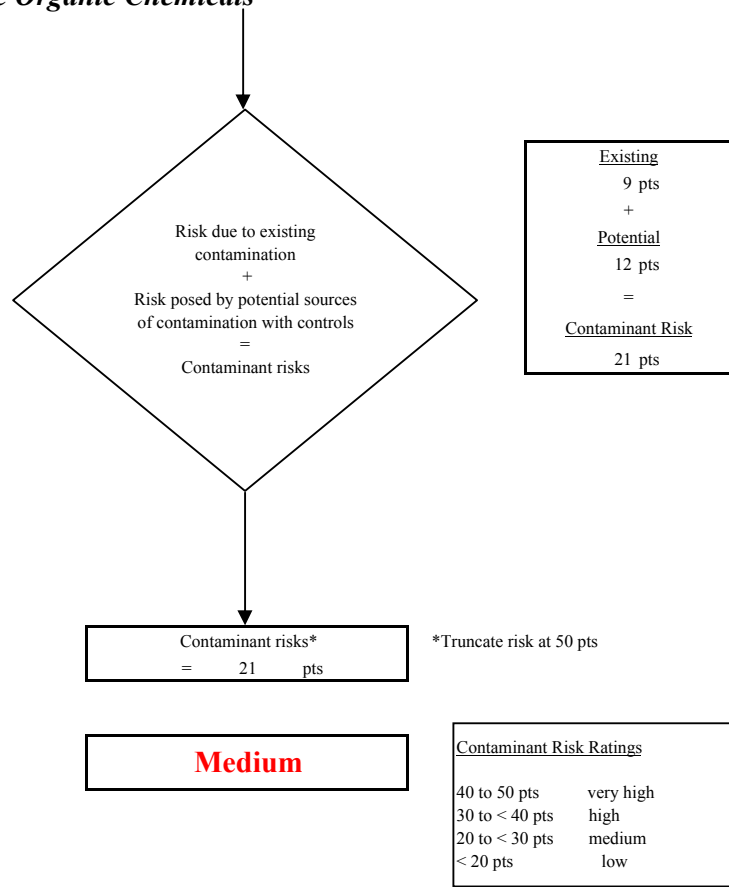
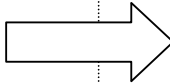
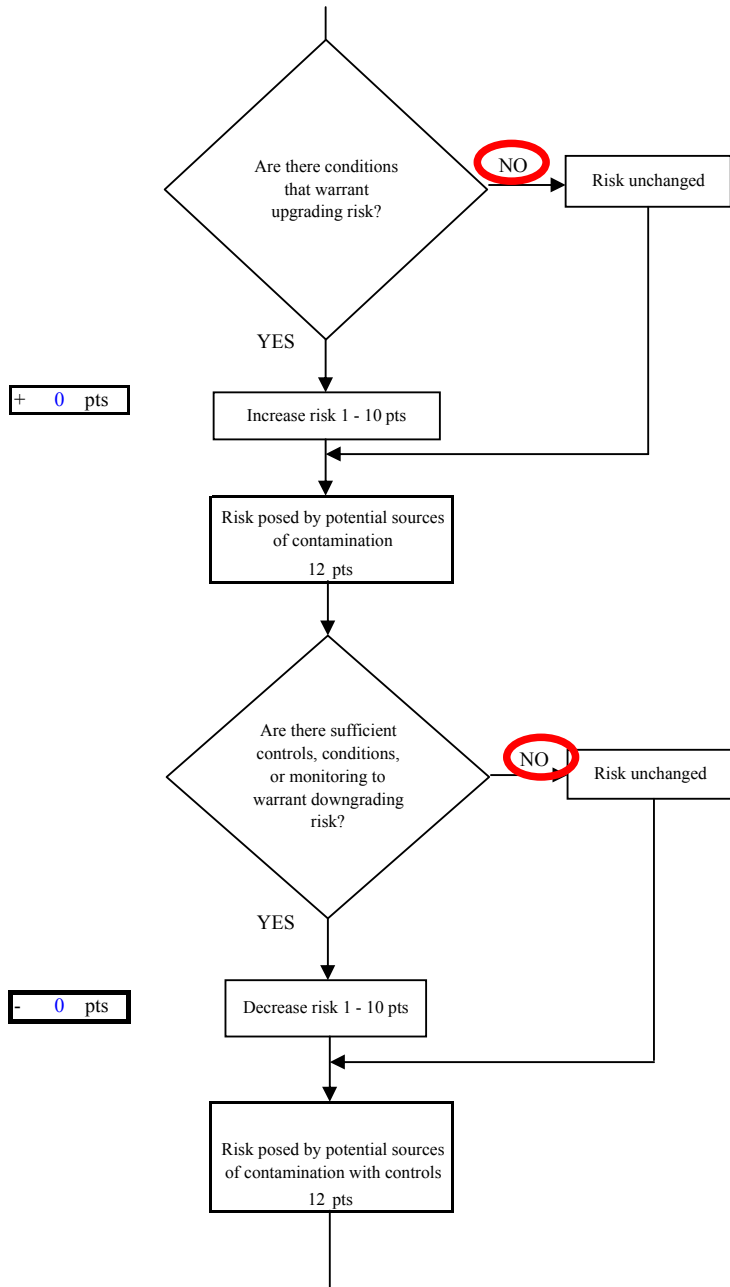


Chart 8. Vulnerability analysis for Living Stones Academy PWSID 248690.001 - Volatile Organic Chemicals

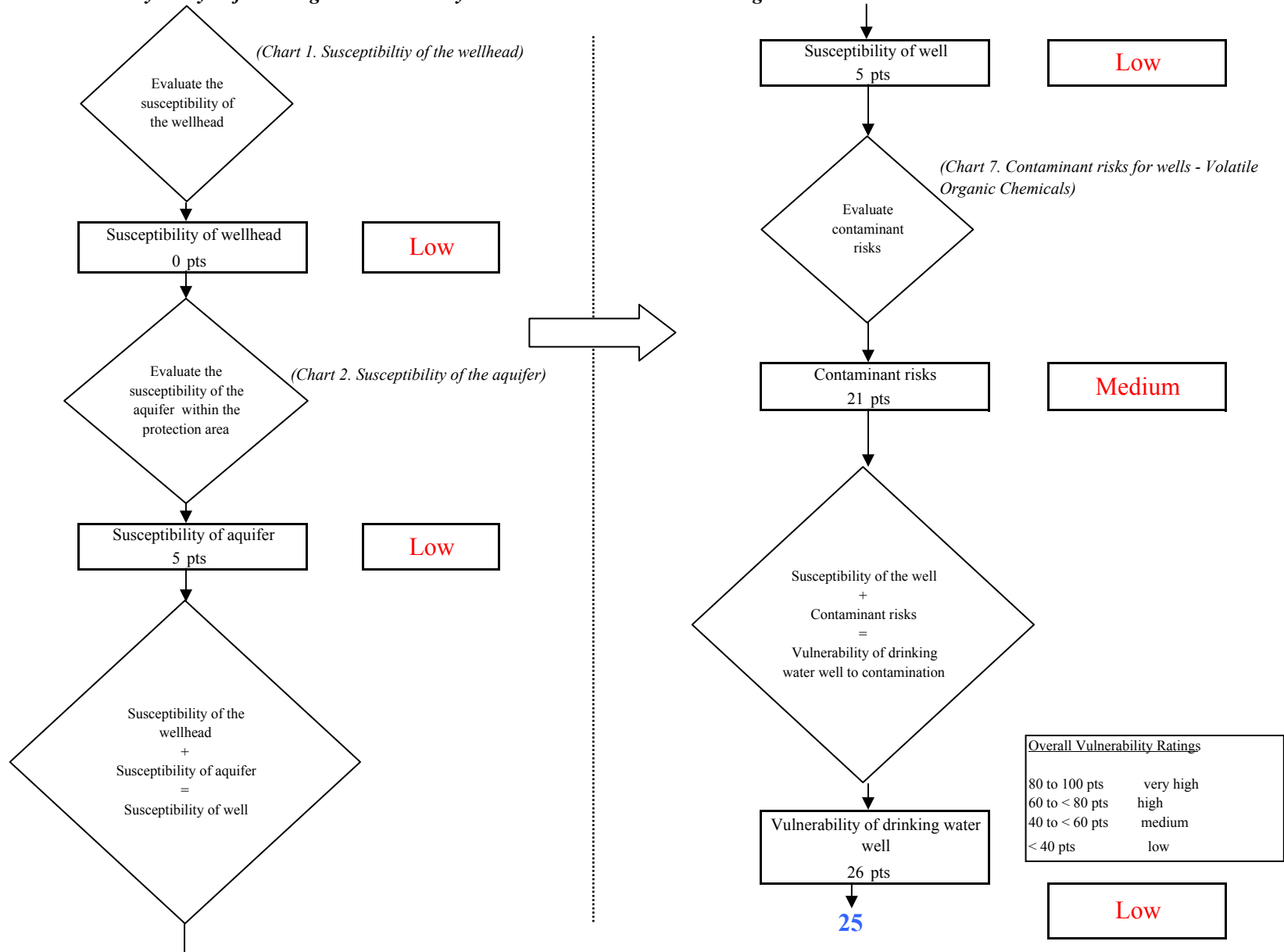


Chart 9. Contaminant risks for Living Stones Academy PWSID 248690.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

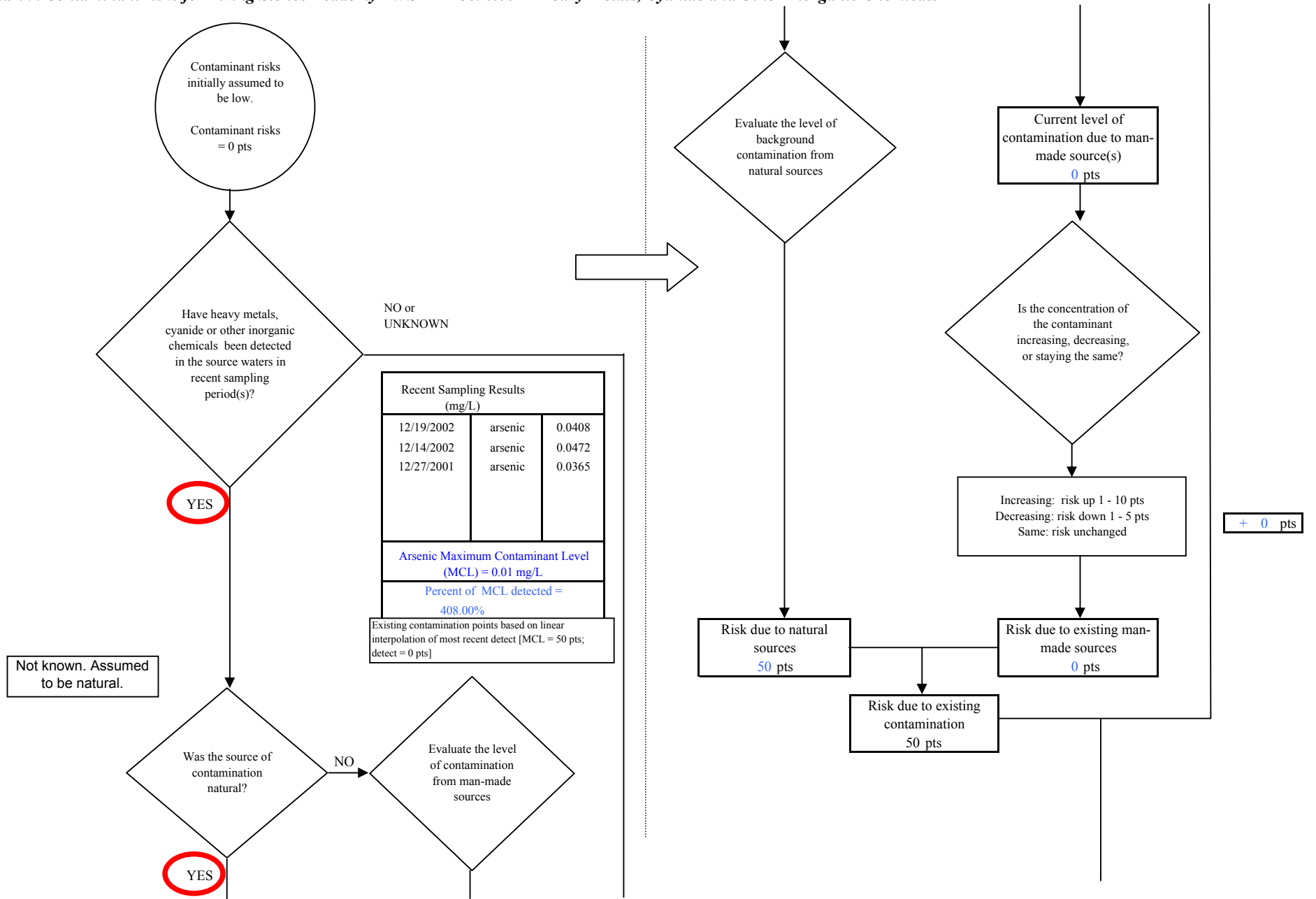


Chart 9. Contaminant risks for Living Stones Academy PWSID 248690.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

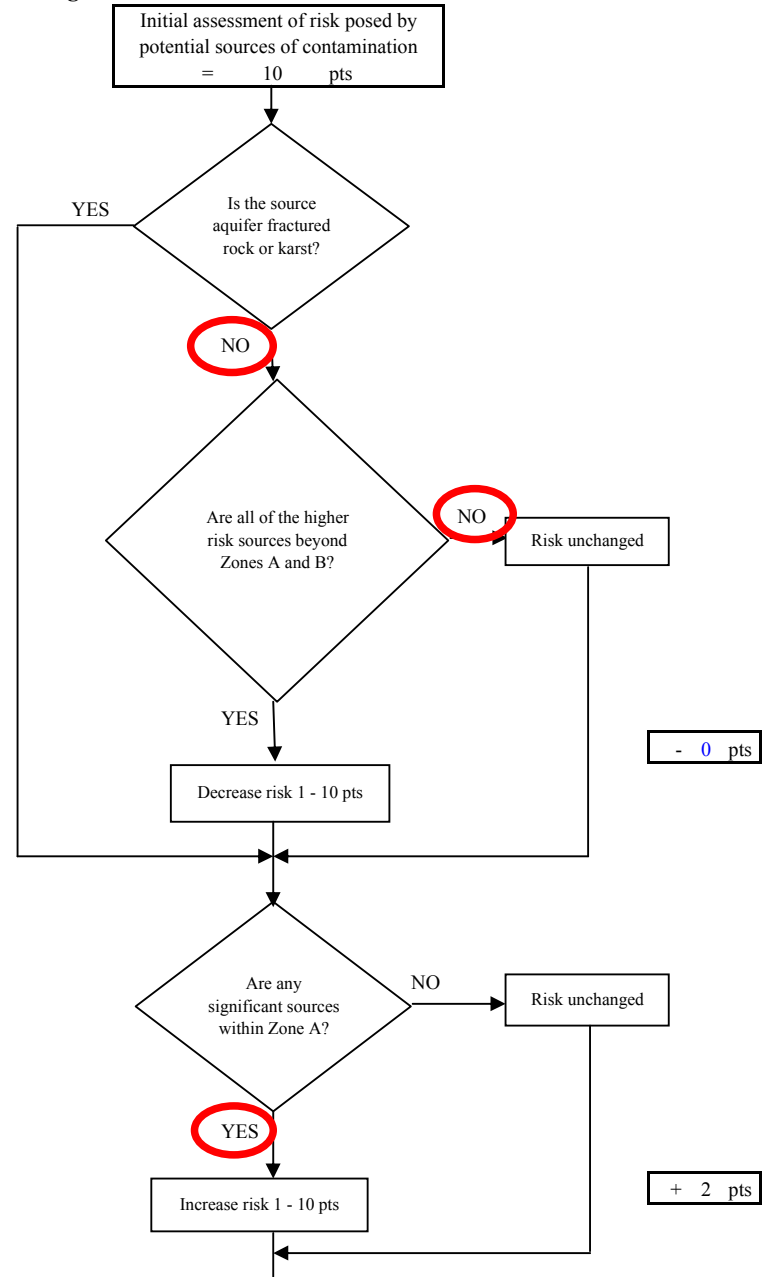
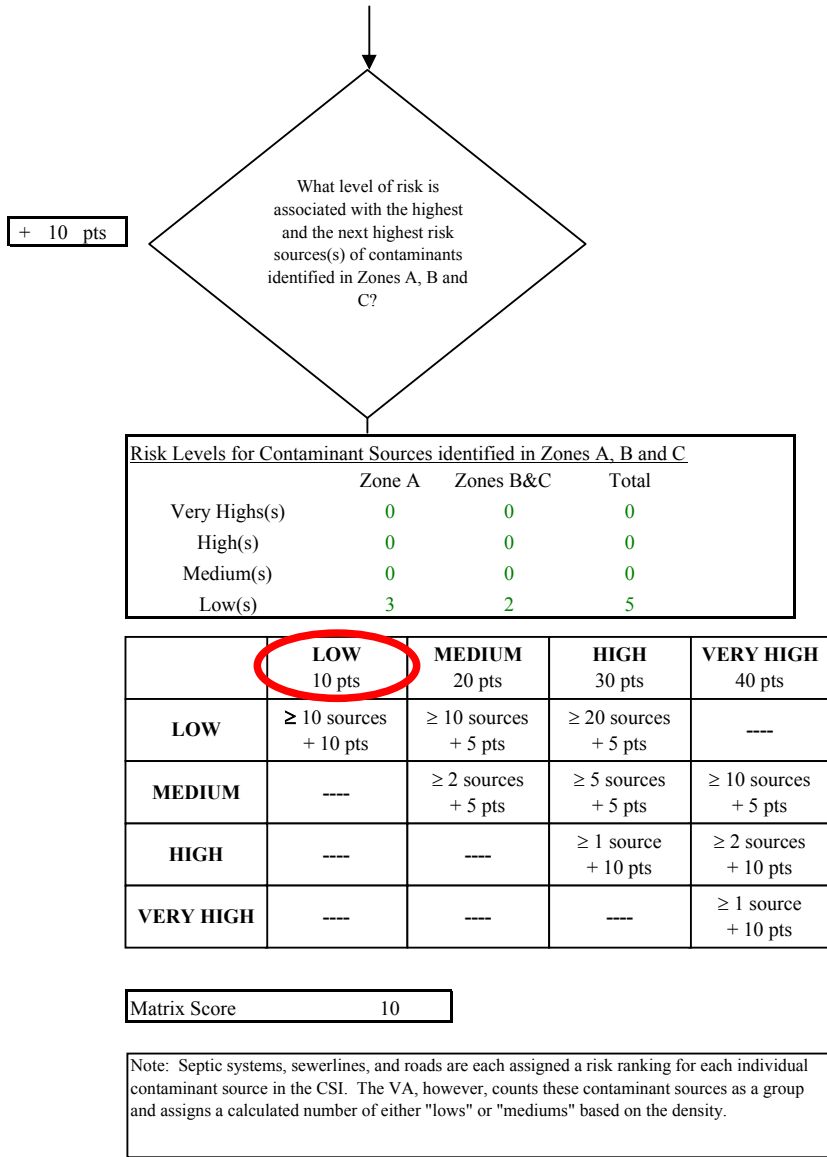


Chart 9. Contaminant risks for Living Stones Academy PWSID 248690.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

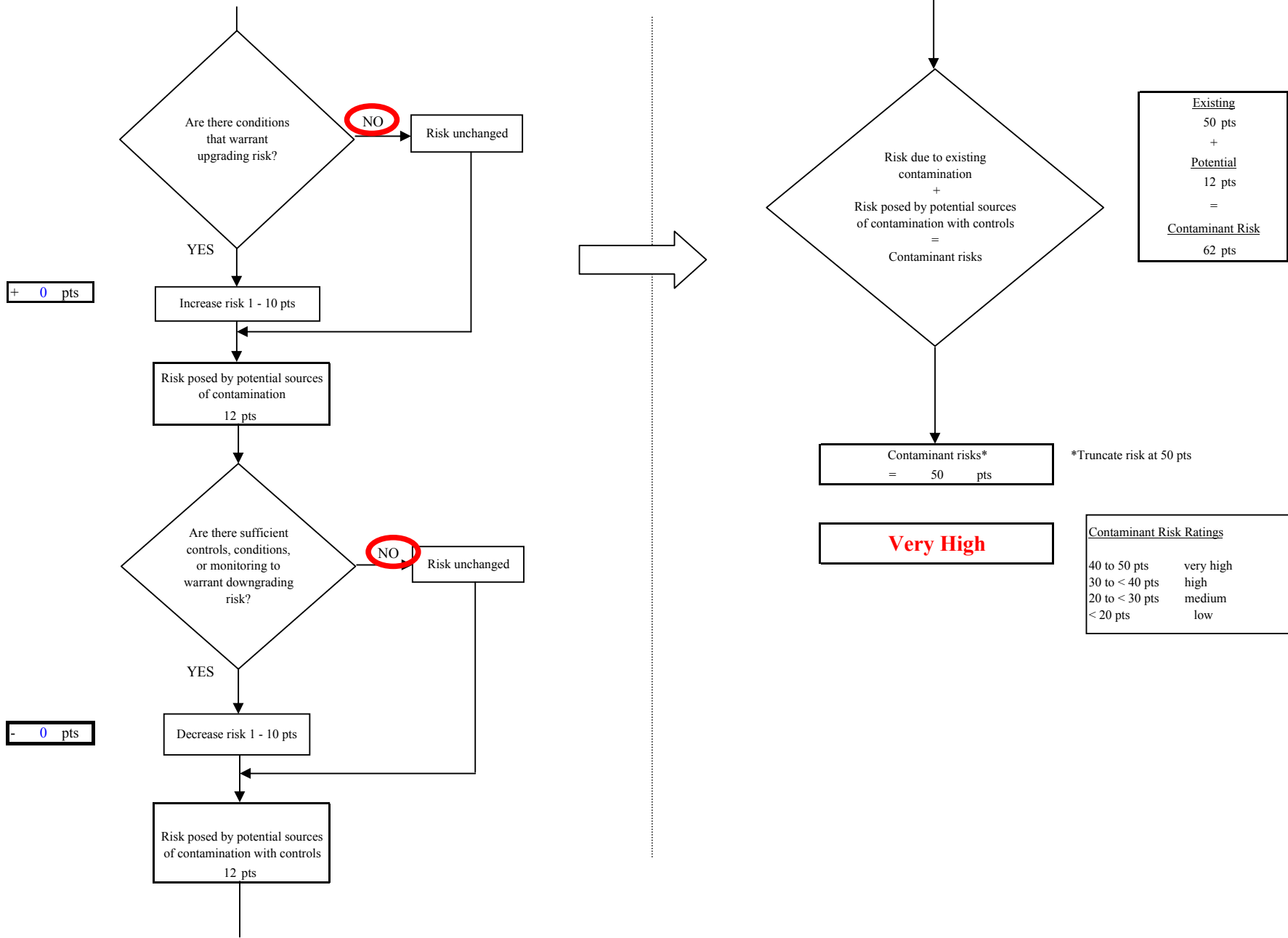


Chart 10. Vulnerability analysis for Living Stones Academy PWSID 248690.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

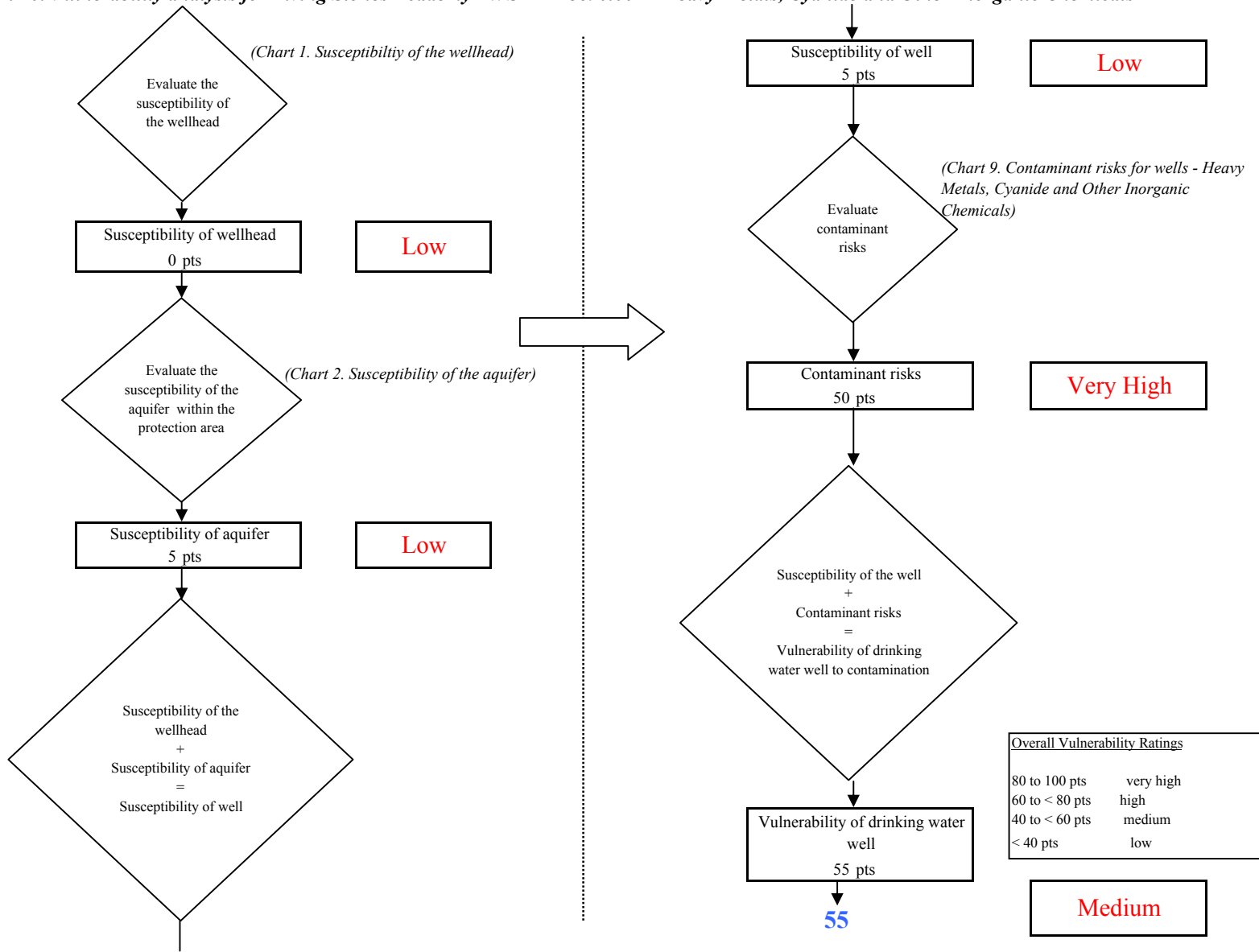


Chart 11. Contaminant risks for Living Stones Academy PWSID 248690.001 - Synthetic Organic Chemicals

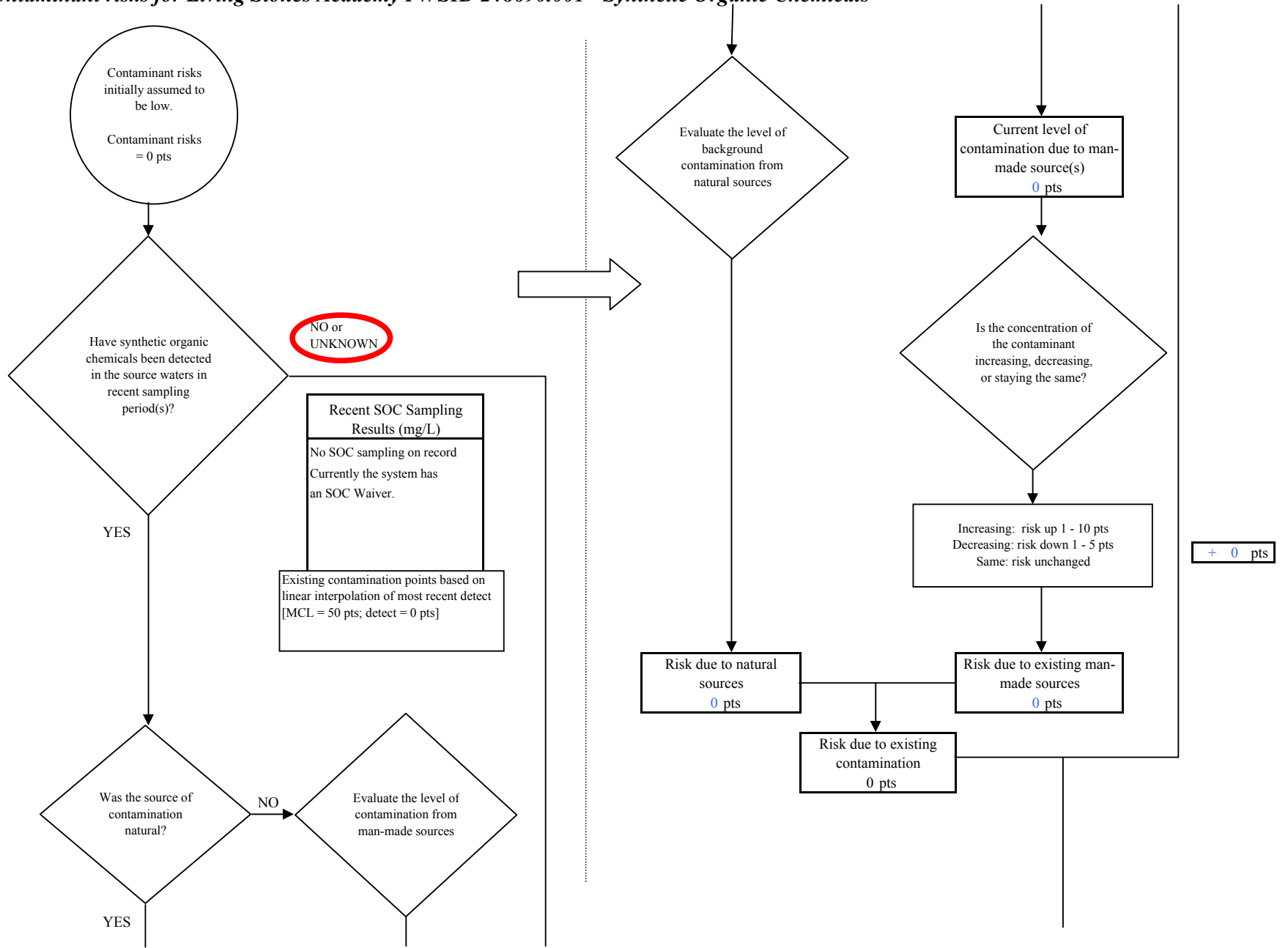


Chart 11. Contaminant risks for Living Stones Academy PWSID 248690.001 - Synthetic Organic Chemicals

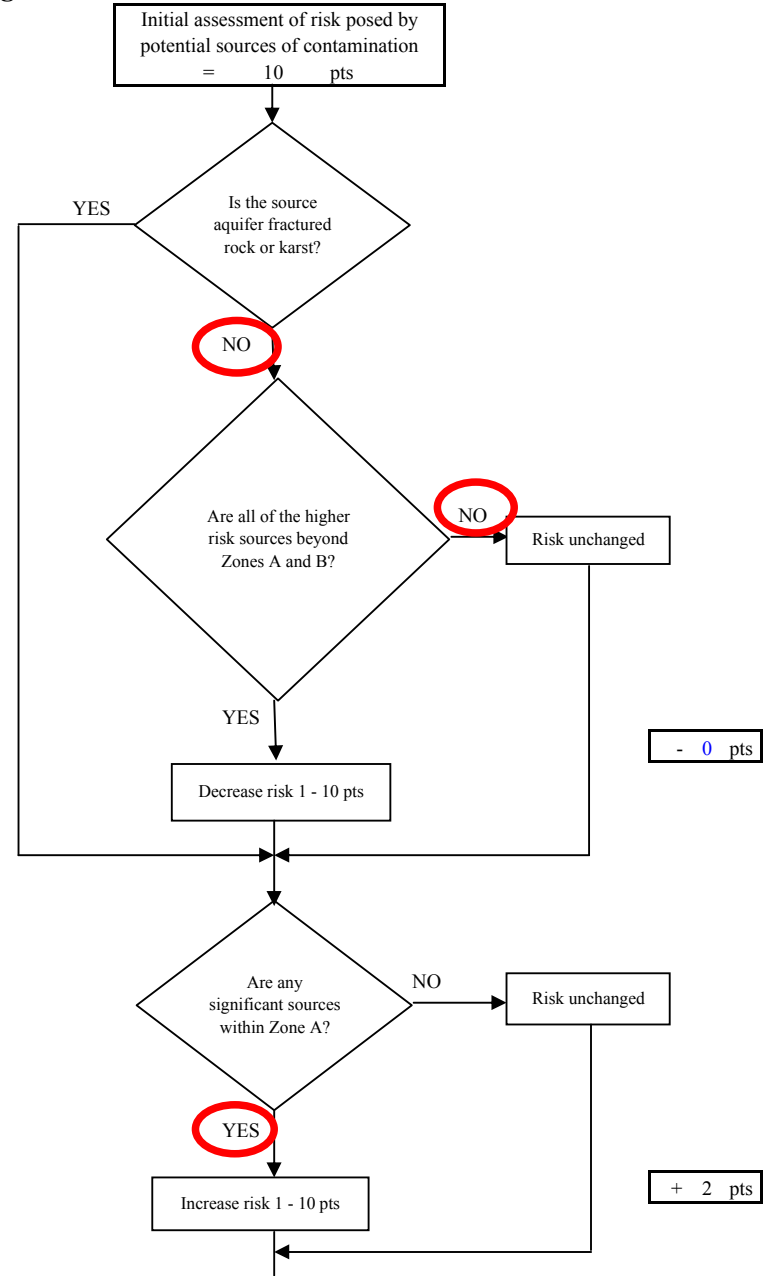
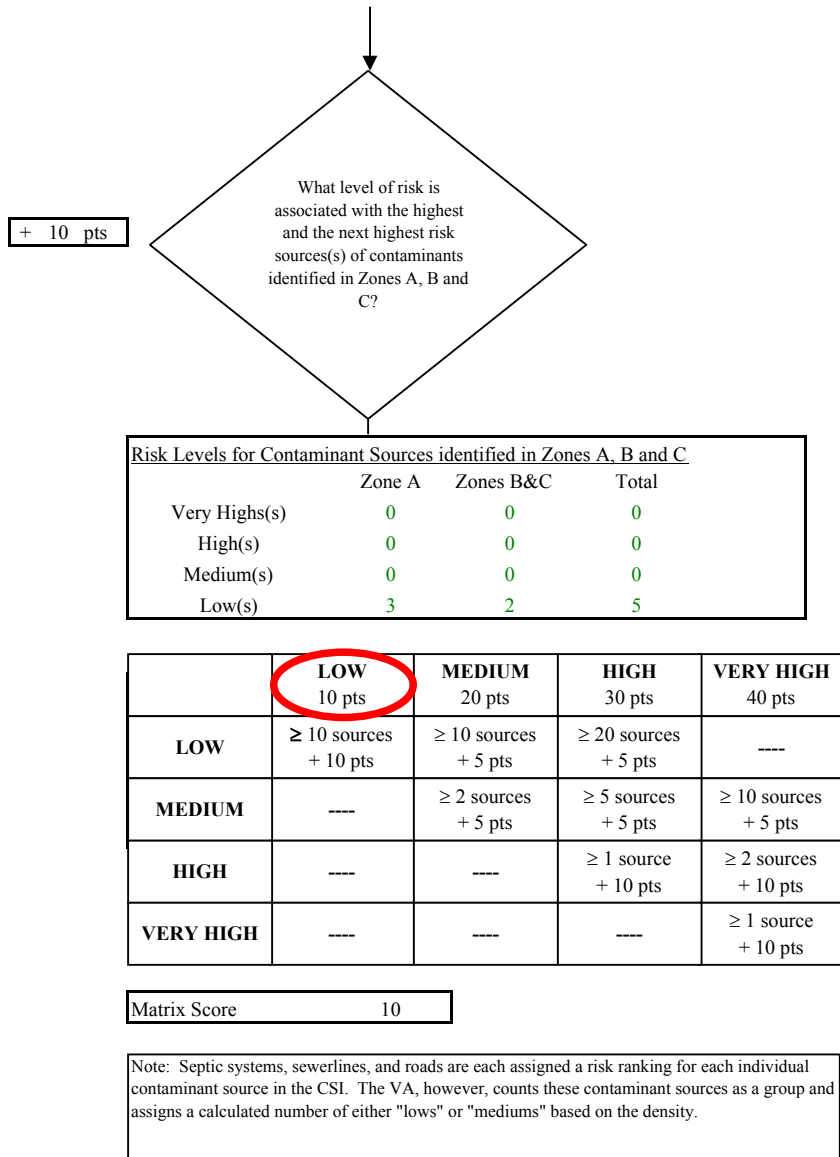


Chart 11. Contaminant risks for Living Stones Academy PWSID 248690.001 - Synthetic Organic Chemicals

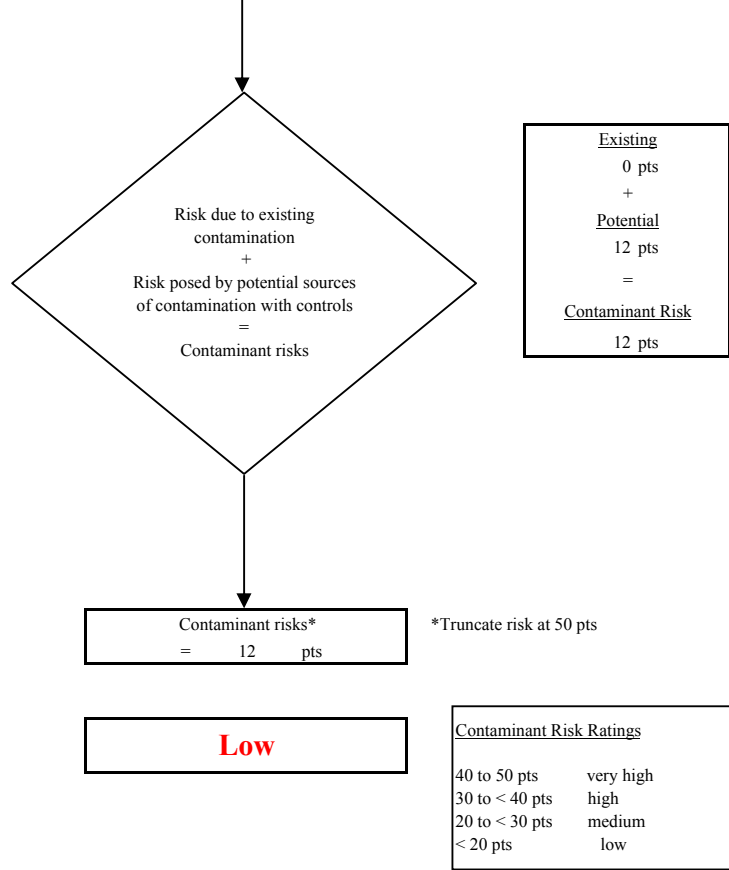
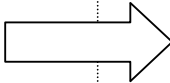
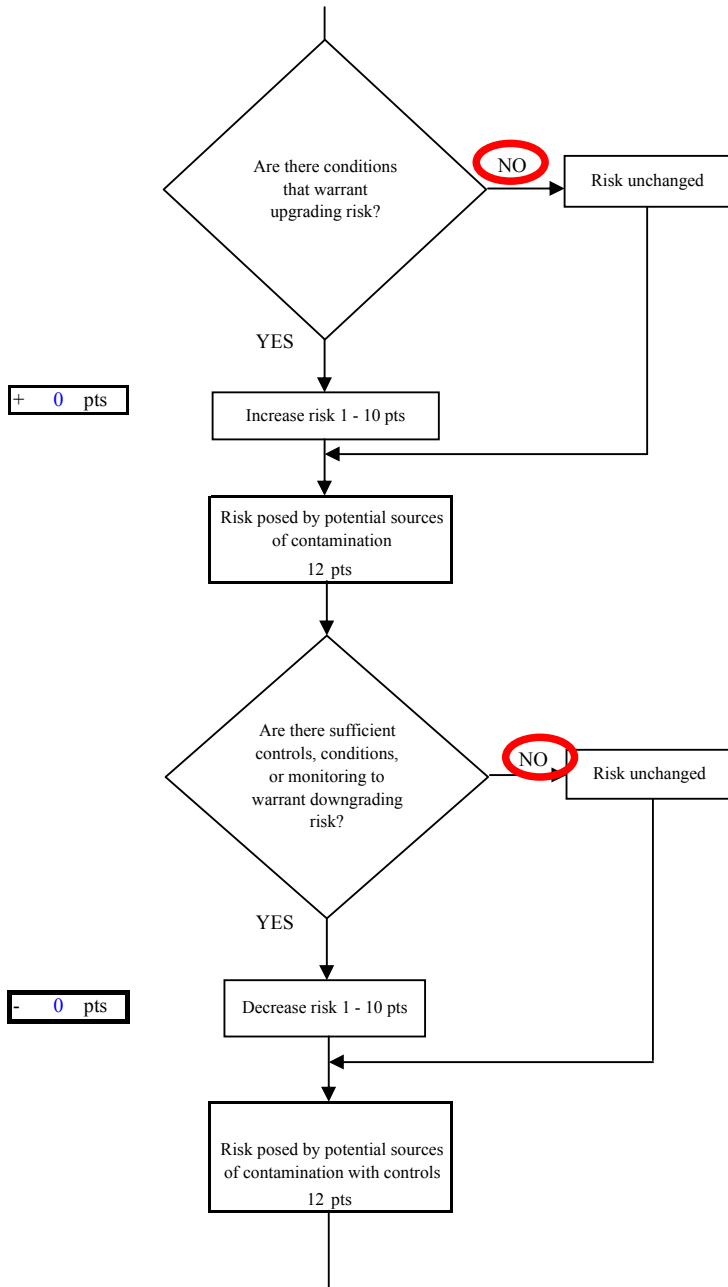


Chart 12. Vulnerability analysis for Living Stones Academy PWSID 248690.001 - Synthetic Organic Chemicals

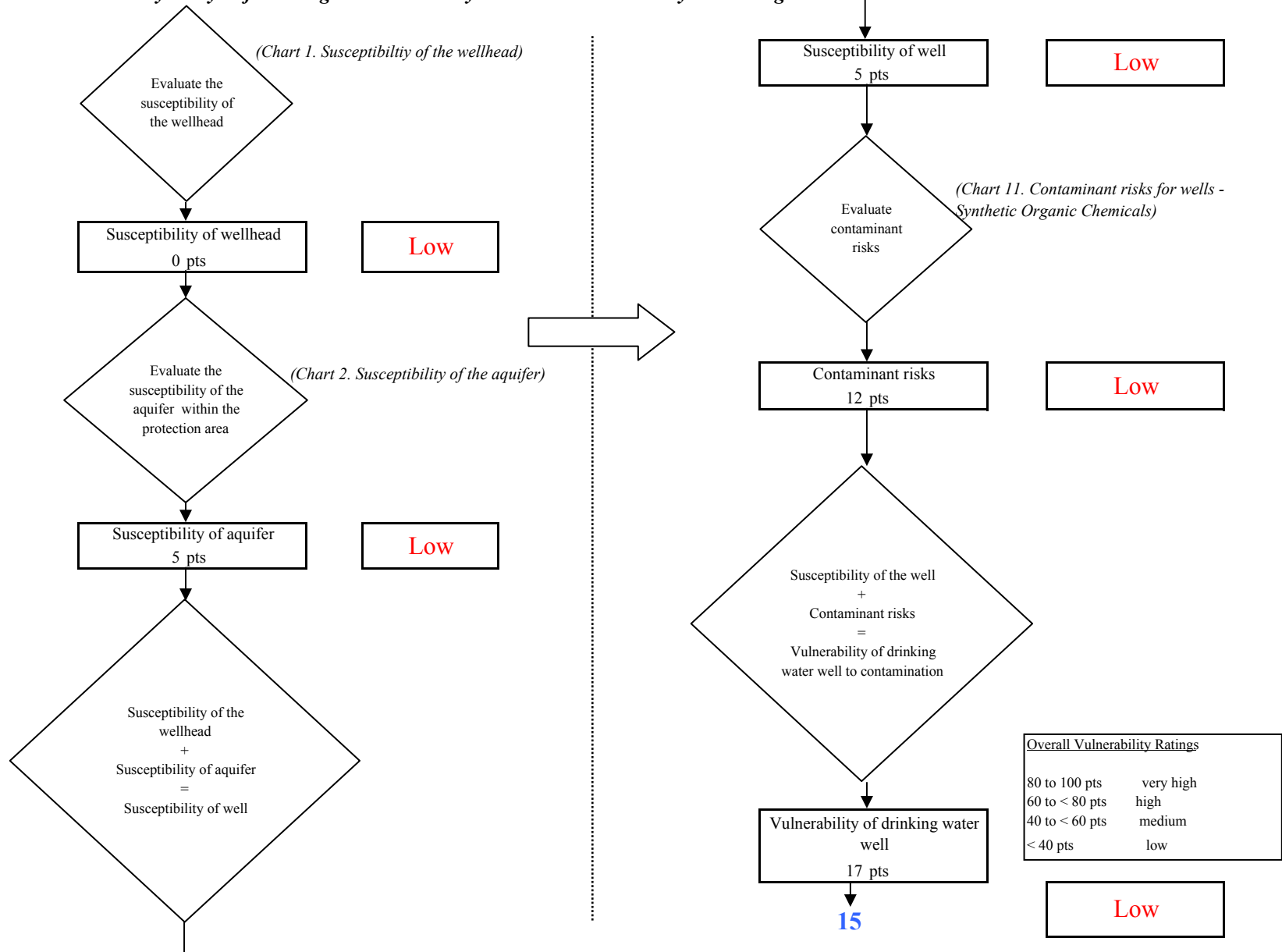


Chart 13. Contaminant risks for Living Stones Academy PWSID 248690.001 - Other Organic Chemicals

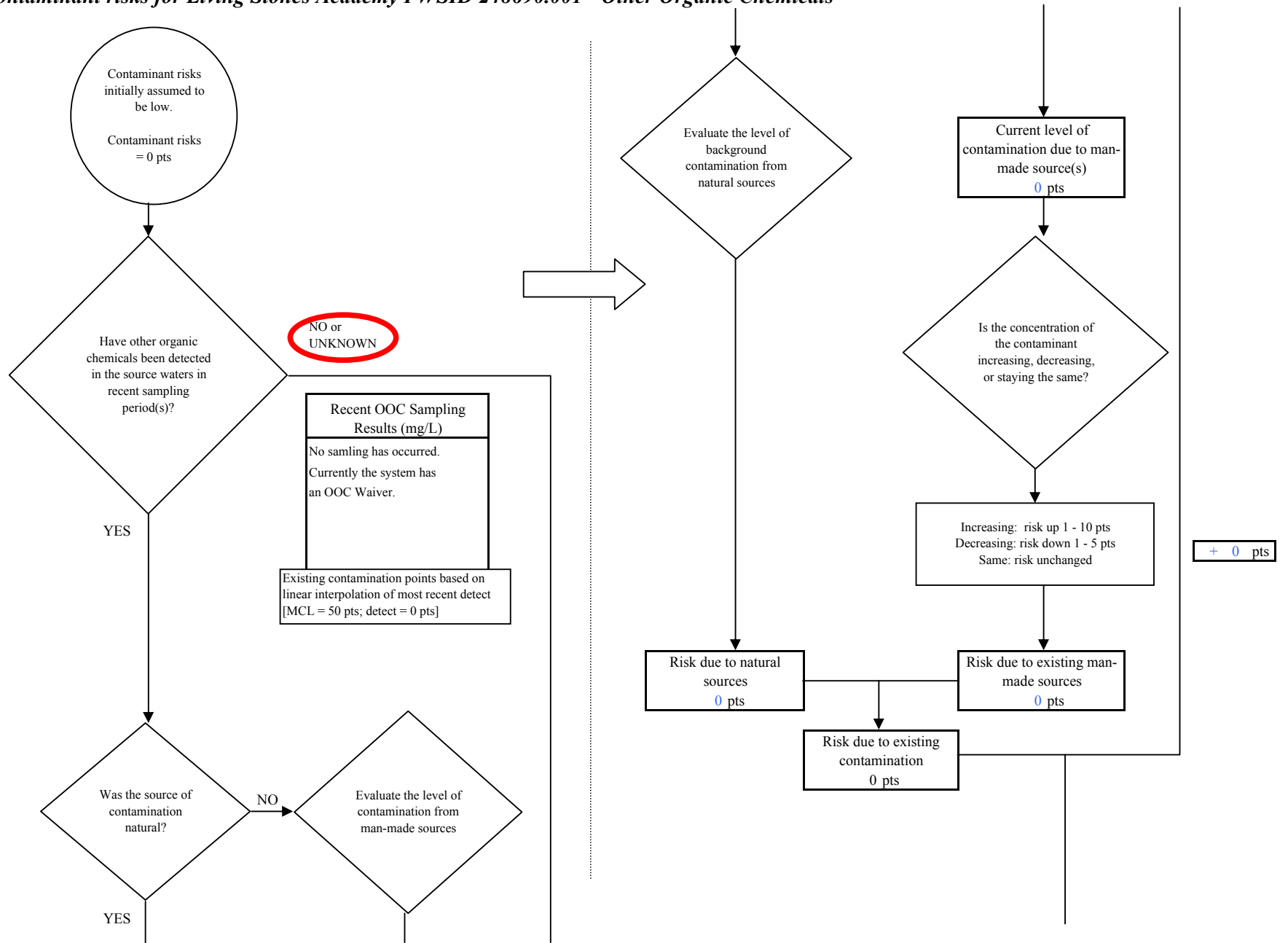


Chart 13. Contaminant risks for Living Stones Academy PWSID 248690.001 - Other Organic Chemicals

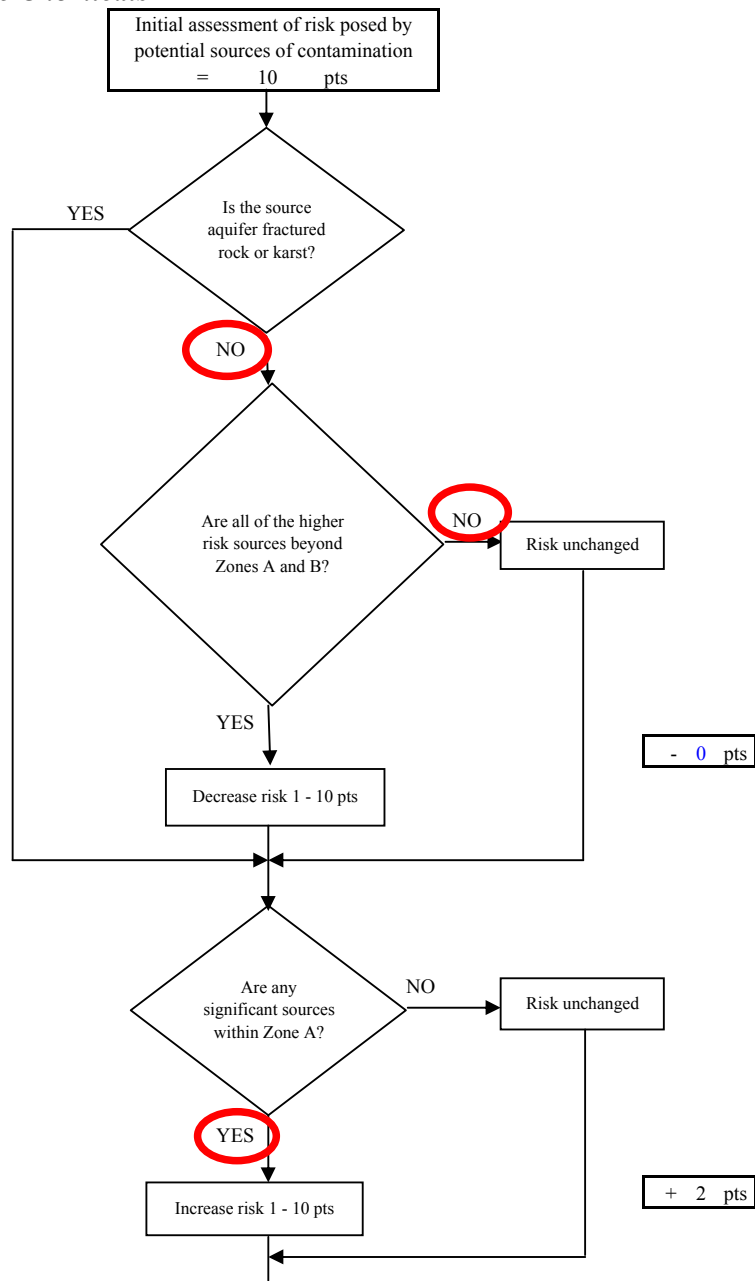
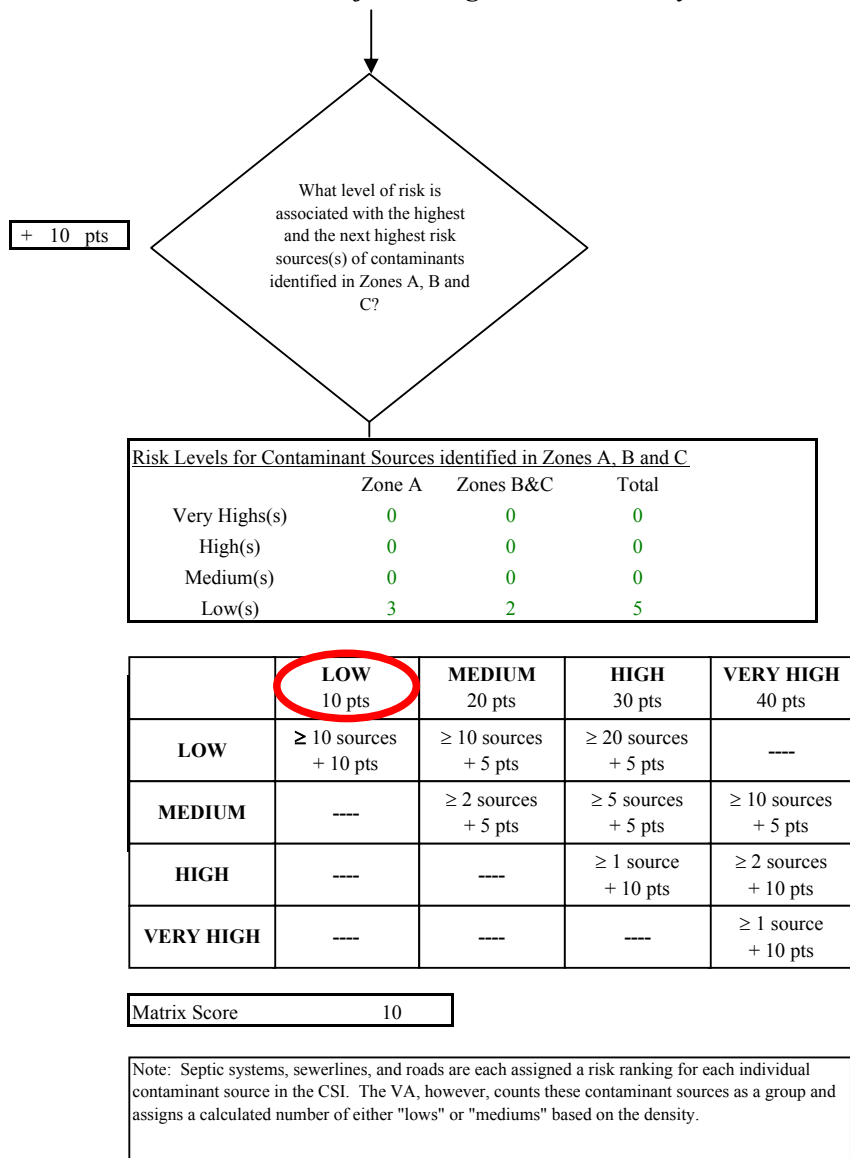


Chart 13. Contaminant risks for Living Stones Academy PWSID 248690.001 - Other Organic Chemicals

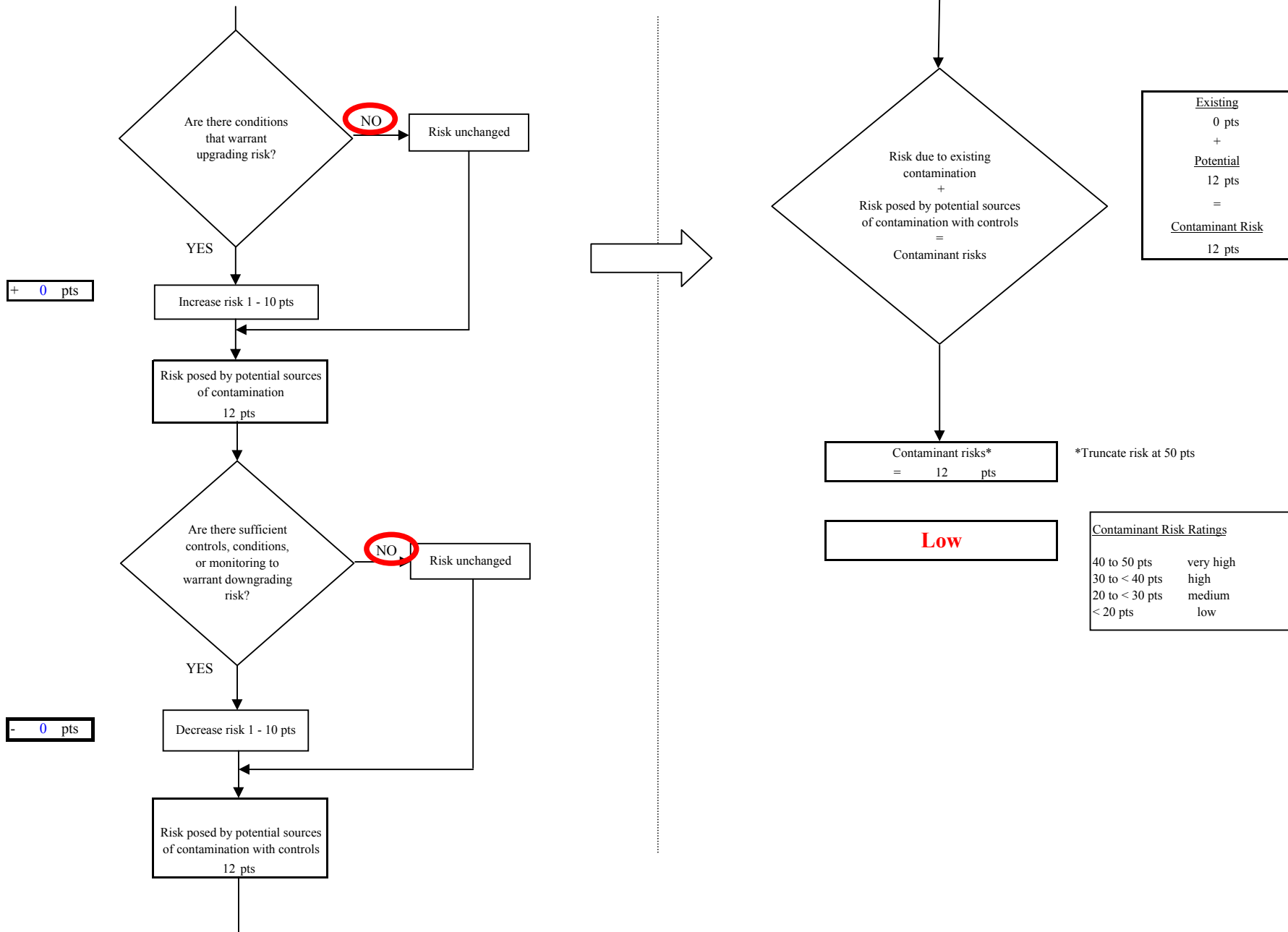


Chart 14. Vulnerability analysis for Living Stones Academy PWSID 248690.001 - Other Organic Chemicals

