



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
KSD George Morgan Sr. High School
Drinking Water System,
Kalskag, Alaska

PWSID # 270833.001

April 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1103
Alaska Department of Environmental Conservation

Source Water Assessment for KSD George Morgan Sr. High School Drinking Water System Kalskag, Alaska

PWSID # 270833.001

DRINKING WATER PROTECTION PROGRAM REPORT 1103

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

EXECUTIVE SUMMARY	1	INVENTORY OF POTENTIAL AND EXISTING	
PUBLIC DRINKING WATER SYSTEM	1	CONTAMINANT SOURCES	2
DRINKING WATER PROTECTION AREA	2	RANKING OF CONTAMINANT RISKS	2
		VULNERABILITY OF DRINKING WATER	
		SYSTEM	3

TABLES

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

APPENDICES

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

Source Water Assessment for KSD George Morgan Sr. High School Source of Public Drinking Water, Kalskag, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The KSD George Morgan Sr. High School has one Public Water System (PWS) well. The well (PWS No. 270833.001) has been used as a drinking water source since it was drilled in 1978.

The well is a Class A (community and non-transient non-community) water system located between Lower Kalskag and Upper Kalskag, Alaska, on the north bank of the Kuskokwim River. Available records indicate that there is no secondary storage of drinking water, other than a pressure tank, and that the untreated drinking water source is derived directly from the wellhead. This system operates seasonally and serves approximately 50 non-residents through one service connection. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produce a **Very High** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: a large capacity septic system, a cemetery, a petroleum product bulk station/terminal, an airport, roads, and a municipal park. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

Overall, the water well received a vulnerability rating of **Very High** for bacteria and viruses, nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, and other organic chemicals, and a vulnerability rating of **High** for synthetic organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The KSD George Morgan Sr. High School well is a Class A (community/non-transient/non-community) public water system. The system is located between Lower Kalskag and Upper Kalskag, Alaska, on the

north bank of the Kuskokwim River (Sec. 28, T17N, R61W, Seward Meridian; see Map A of Appendix A). Kalskag is located on the north bank of the Kuskokwim River. The communities are about 30 miles west of Aniak, 99 miles northeast of Bethel, and 348 miles west of Anchorage. The community of Upper Kalskag has a population of 231, and the community of Lower Kalskag has a population of 267 (ADCED, 2003). Average annual precipitation in Kalskag is 19 inches, including approximately 60 inches of snowfall. Temperatures can be as extreme as -55 to 87°F.

The community of Kalskag obtains most of their water supply from community wells. Most households are served by the piped sewage collection system and the remaining households either have individual septic tanks (ADCED, 2003). Kalskag receives electrical power from AVEC, a REA Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by individuals and transported to the landfill that is located between the villages of Upper and Lower Kalskag (ADCED, 2003).

According to information supplied by ADEC for the KSD George Morgan Sr. High School PWS, the depth of the primary water well is 40 feet below the ground surface. Based on available construction details for surrounding wells, it is assumed that the well is screened in an unconfined aquifer. The well is located within a floodplain.

Information acquired from a November 2002 sanitary survey for the public water system indicated that the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. The sanitary survey indicates that the well is not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

The Kalskag area is located on a flat former floodplain of the Kuskokwim River and the

topographic relief in the area is less than 20 feet. Soils information is limited. Generally, the soils consist of sandy silt overlying sand and fine gravels. Kalskag is located in an area that is considered a discontinuous permafrost zone and the permafrost masses are small, thin and generally isolated (U.S. Department of Health and Human Services, et. al, 1983).

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 the KSD George Morgan Sr. High School PWS. 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 the 2 year time-of-travel
C	Less Than the 5 year time -of-travel

D Less than the 10 year time -of-travel

The DWPA for the KSD George Morgan Sr. High School PWS was determined using an analytical calculation and includes Zones A, B, C, and D (See Map A 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 KSD George Morgan Sr. High School 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,
- Other organic chemicals.

The sources are displayed on Map C 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, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF THE 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 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. 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 KSD George Morgan Sr. High School’s water well is in an unconfined aquifer. Unconfined aquifers are more susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the susceptibility scores and ratings for this PWS.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	15	High
Natural Susceptibility	40	Very High

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:

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	40	Very High
Nitrates and/or Nitrites	40	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	25	Medium
Other Organic Chemicals	40	Very High

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

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

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	80	Very High
Nitrates and Nitrites	80	Very High
Volatile Organic Chemicals	90	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	90	Very High
Synthetic Organic Chemicals	65	High

Other Organic Chemicals 80 Very High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of a large capacity septic system in Zone A (see Table 2 – Appendix B).

No positive bacteria counts have been reported in recent (within five years) sampling events (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Only a small amount of bacteria and viruses are required to endanger public health.

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 **Very High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High**. The risk to this source of public drinking water is primarily attributed to the presence of a large capacity septic system in Zone A (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that nitrates have not been detected in recent sampling events. 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 (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

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 **Very High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of an airport and a petroleum product bulk station/terminal located in Zones A. Several other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

All recent sampling data for VOCs were below detection levels for the KSD George Morgan Sr. High School (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

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 **Very High**

Heavy Metals, Cyanide and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Very High**. The risk is primarily attributed to the presence of a large capacity septic system, a cemetery, a petroleum product bulk station/terminal, an airport, roads, and a municipal park located in Zones A and B (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, high levels of copper have been detected in recent sampling history. This analyte exceeded the MCL of 1.3 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

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 **Very High**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Medium**. The risk is primarily attributed to the presence of an airport and a cemetery located in Zone A. Several other potential contaminant sources are also found within the protection area (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the KSD George Morgan Sr. High School (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

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 **High**.

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of a petroleum product bulk station/terminal located in Zone A. Several other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the KSD George Morgan Sr. High School

(See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

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 **Very High**.

Using the Source Water Assessment

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 the KSD George Morgan Sr. High School and the communities of Upper and Lower Kalskag 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 the drinking water source.

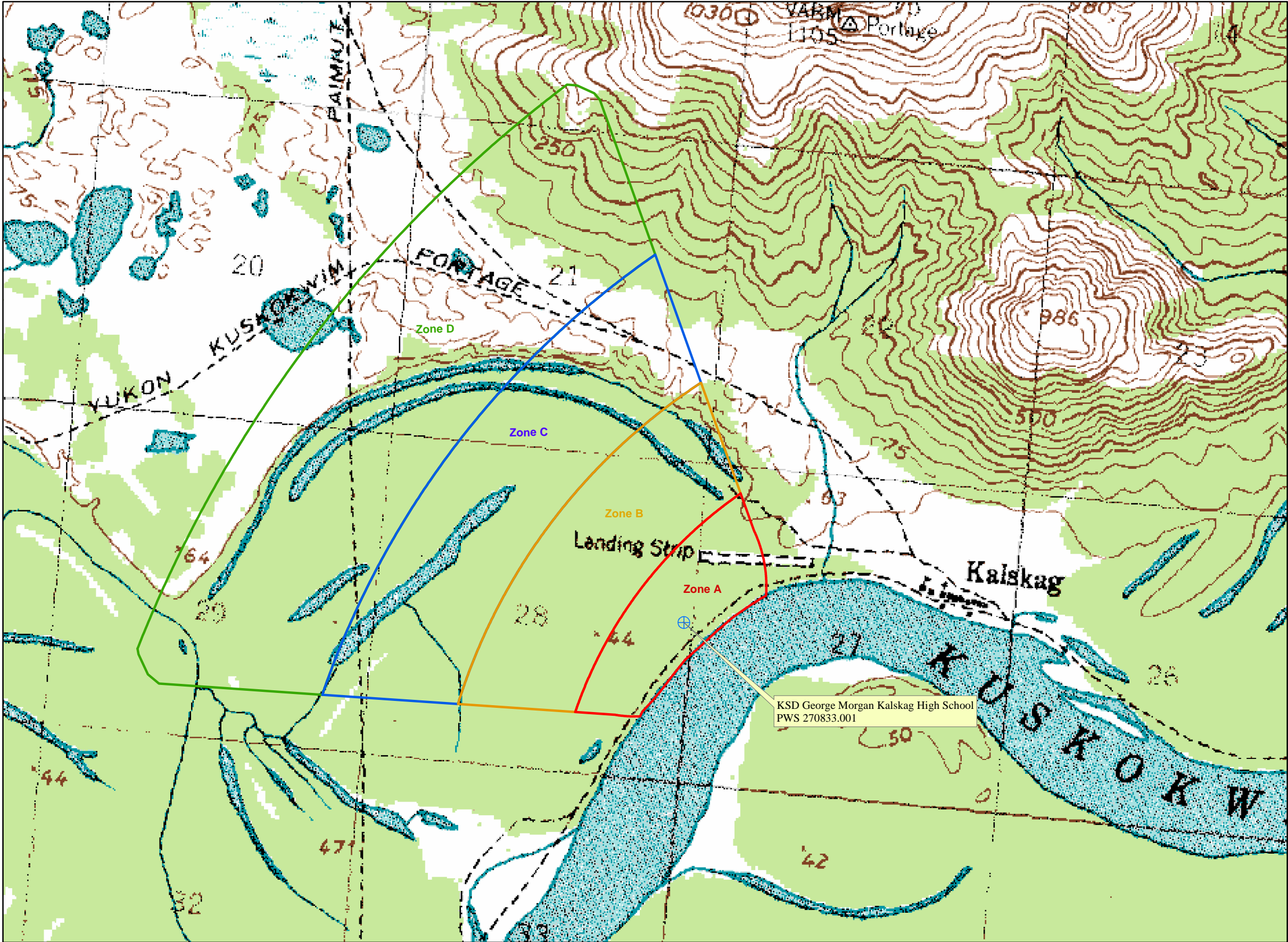
REFERENCES

- Alaska Department of Community and Economic Development (ADCED), 2003 [WWW document]. URL: http://www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm
- Alaska Department of Environmental Conservation, Contaminated Sites Database, 2003 [WWW database], URL http://www.state.ak.us/dec/dspar/csites/cs_search.htm
- Alaska Department of Environmental Conservation, Leaking Underground Storage Tank Database, 2003 [WWW database], URL http://www.dec.state.ak.us/spar/stp/ust/search/fac_search.asp
- Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey
- United States Department of Health and Human Services, et.al, 1983. Final Report, Sanitation Facilities Construction for Aniak, Alaska, Project No. AN-80-222.
- United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL <http://www.epa.gov/safewater/mcl.html>.

APPENDIX A

Drinking Water Protection Area Location Map (Map A)

Public Water Well System for PWS #270833.001 KSD George Morgan Kalskag High School



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

Groundwater Protection Zones

- Zone A Protection Area- Several Months Travel Time
- Zone B Protection Area- 2 Years Travel Time
- Zone C Protection Area- 5 Years Travel Time
- Zone D Protection Area- 10 Years Travel Time

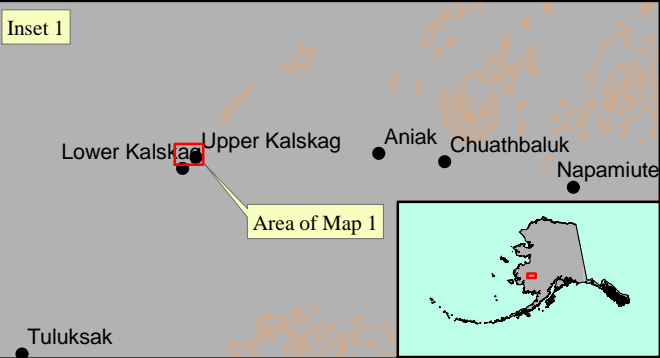
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
United States Geological Survey (USGS)

Drinking Water Protection Areas based on "Alaska Drinking
Water Protection Program - Guidance Manual for Class A
Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or
validity of the data provided.



KSD George Morgan Kalskag High School
PWS 270833.001

Appendix A Map A

APPENDIX B

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

Table 1**Contaminant Source Inventory for
KSD George Morgan Kalskag HS****PWSID 270833.001**

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	C	KSD
Cemeteries	X01	X01-01	A	C	
Petroleum product bulk station/terminals	X11	X11-01	A	C	KSD
Airports	X14	X14-01	A	C	
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Municipal or city parks (with green areas)	X04	X04-01	B	C	
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B

Table 2

*Contaminant Source Inventory and Risk Ranking for
KSD George Morgan Kalskag HS
Sources of Bacteria and Viruses*

PWSID 270833.001

<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	C	KSD
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Municipal or city parks (with green areas)	X04	X04-01	B	Medium	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 3

*Contaminant Source Inventory and Risk Ranking for
KSD George Morgan Kalskag HS
Sources of Nitrates/Nitrites*

PWSID 270833.001

<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	C	KSD
Cemeteries	X01	X01-01	A	Medium	C	
Airports	X14	X14-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Municipal or city parks (with green areas)	X04	X04-01	B	Medium	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 4

*Contaminant Source Inventory and Risk Ranking for
KSD George Morgan Kalskag HS
Sources of Volatile Organic Chemicals*

PWSID 270833.001

<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	C	KSD
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	KSD
Airports	X14	X14-01	A	High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 5

*Contaminant Source Inventory and Risk Ranking for
KSD George Morgan Kalskag HS
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

PWSID 270833.001

<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	C	KSD
Cemeteries	X01	X01-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	KSD
Airports	X14	X14-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Municipal or city parks (with green areas)	X04	X04-01	B	Low	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 6

*Contaminant Source Inventory and Risk Ranking for
KSD George Morgan Kalskag HS
Sources of Synthetic Organic Chemicals*

PWSID 270833.001

<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	C	KSD
Cemeteries	X01	X01-01	A	Medium	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	KSD
Airports	X14	X14-01	A	Medium	C	
Municipal or city parks (with green areas)	X04	X04-01	B	Low	C	

Table 7

*Contaminant Source Inventory and Risk Ranking for
KSD George Morgan Kalskag HS
Sources of Other Organic Chemicals*

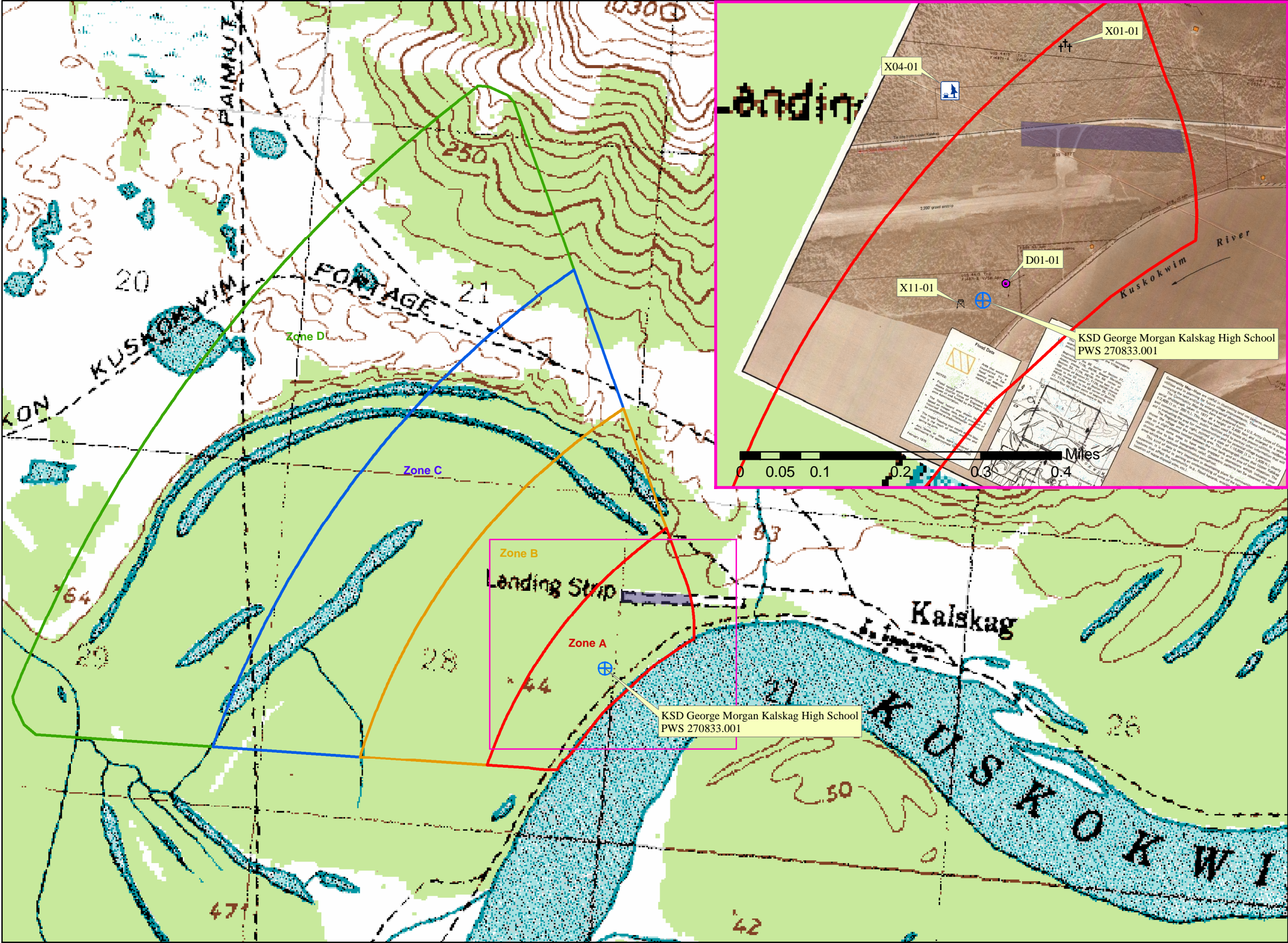
PWSID 270833.001

<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	C	KSD
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	KSD
Airports	X14	X14-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

APPENDIX C

Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)

Public Water Well System for PWS #270833.001 KSD George Morgan Kalskag High School
Showing Potential and Existing Sources of Contamination



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

Groundwater Protection Zones

- Zone A Protection Area- Several Months Travel Time
- Zone B Protection Area- 2 Years Travel Time
- Zone C Protection Area- 5 Years Travel Time
- Zone D Protection Area- 10 Years Travel Time

Existing or Potential Contaminant Sources

- Injection well (Class V) Large capacity septic system (drainfield disposal method) (D10)
- Cemetery (X01)
- Municipal or city park (X04)
- Petroleum product bulk station/terminal (X11)
- Airport/landing strip (X14)

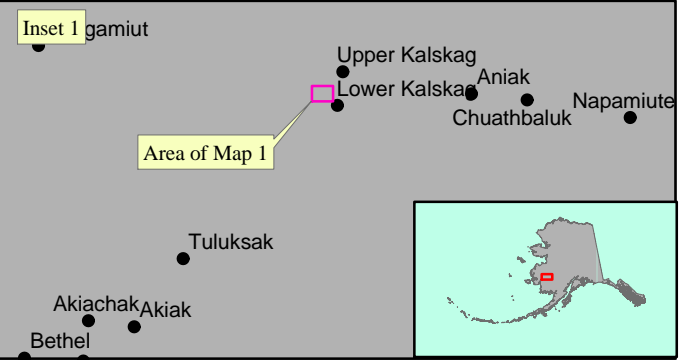
Data Sources:

Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)
Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:

United States Geological Survey (USGS)
Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



KSD George Morgan Kalskag High School
PWS 270833.001

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - KSD George Morgan Sr. High School (PWS No. 270833.001)

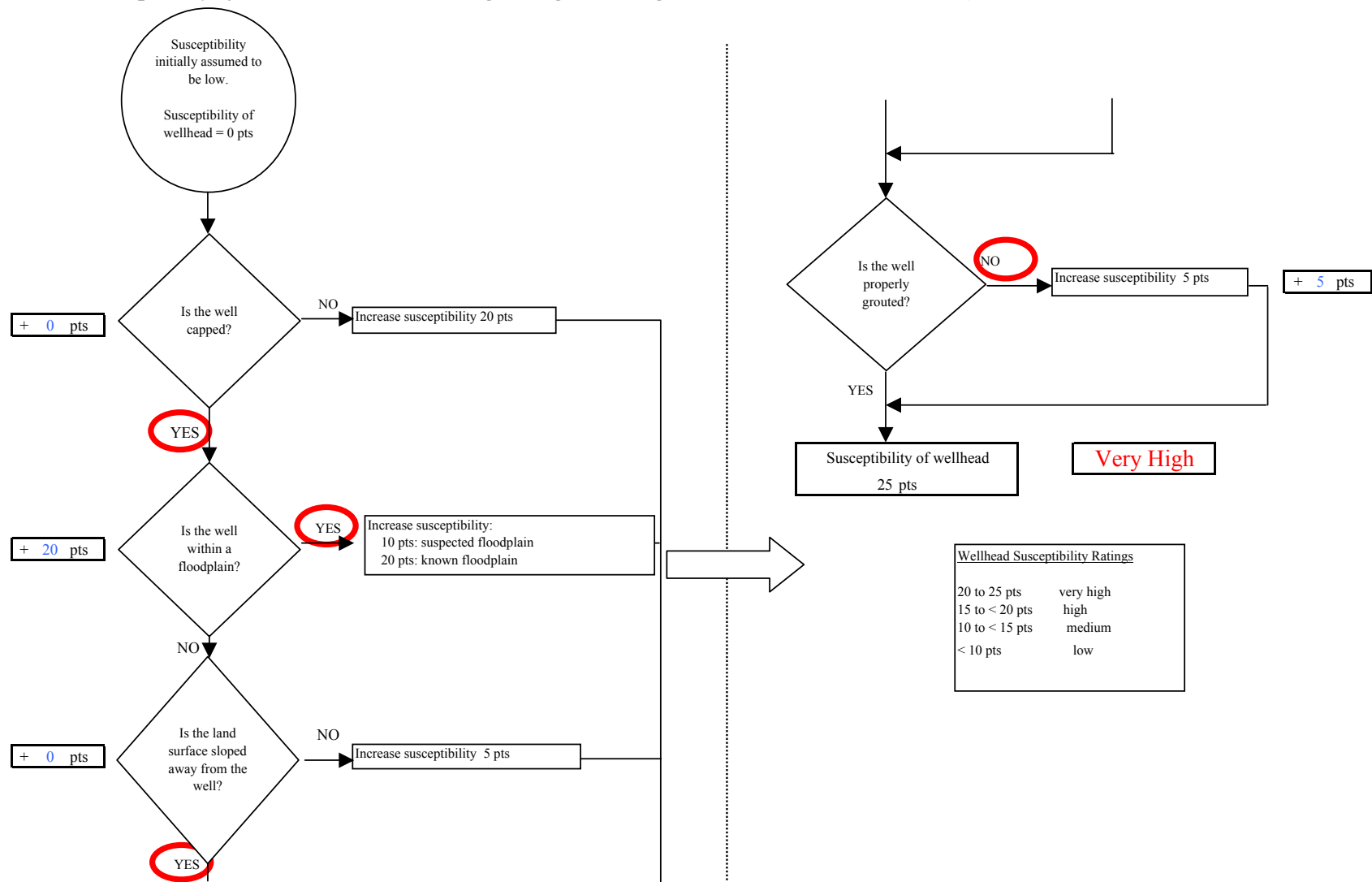


Chart 2. Susceptibility of the aquifer KSD George Morgan Sr. High School (PWS No. 270833.001)

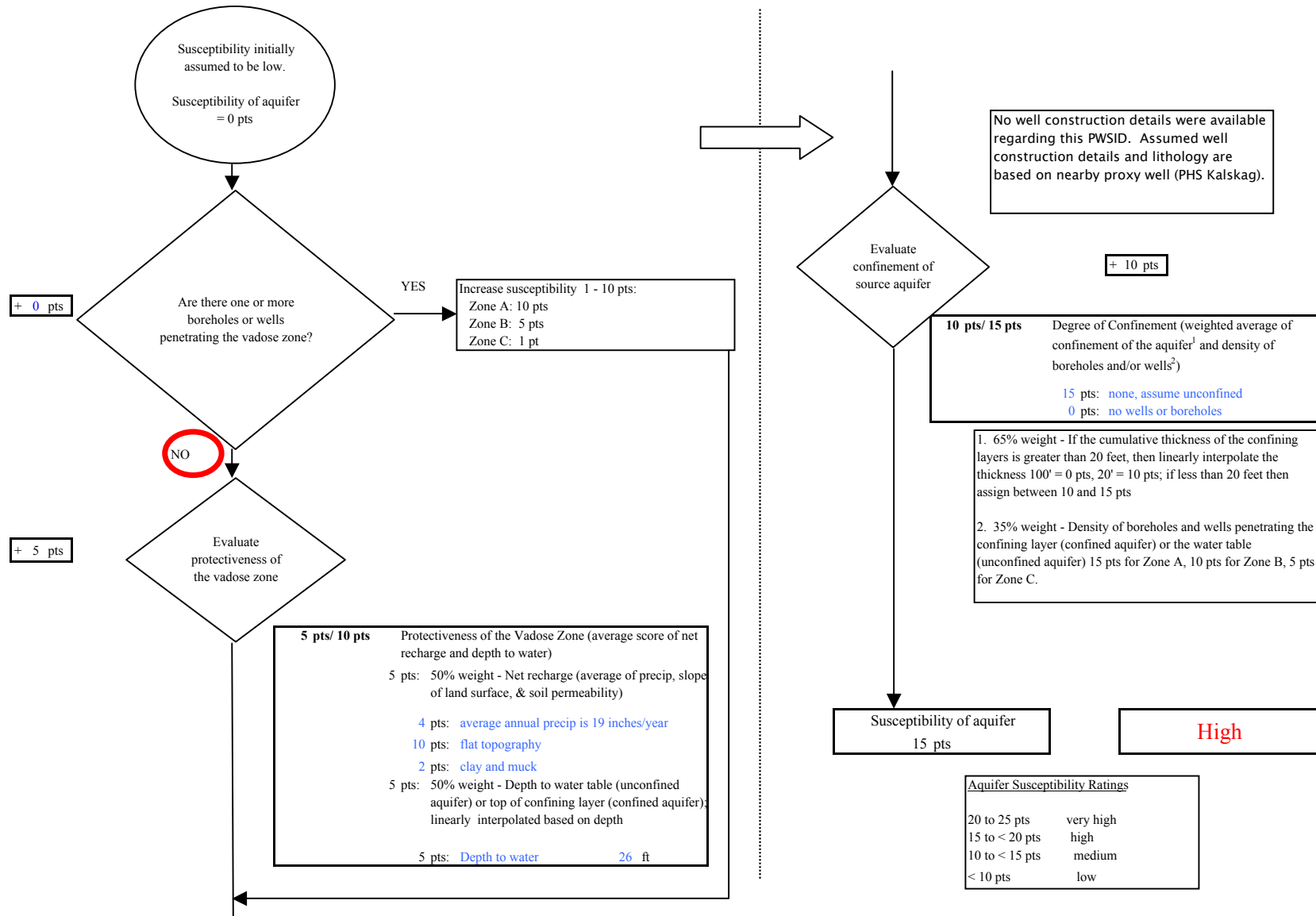


Chart 3. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Bacteria & Viruses

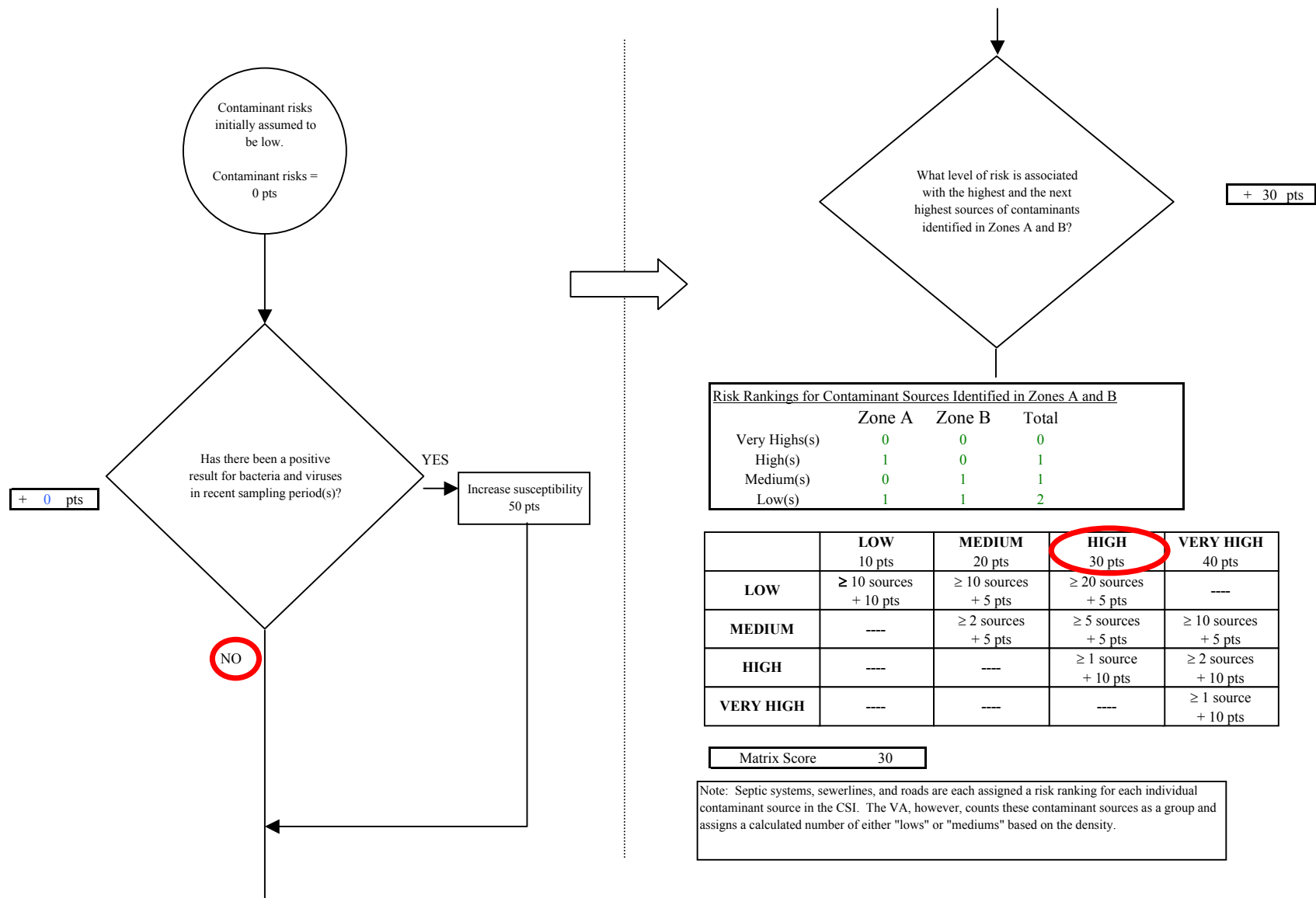


Chart 3. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Bacteria & Viruses

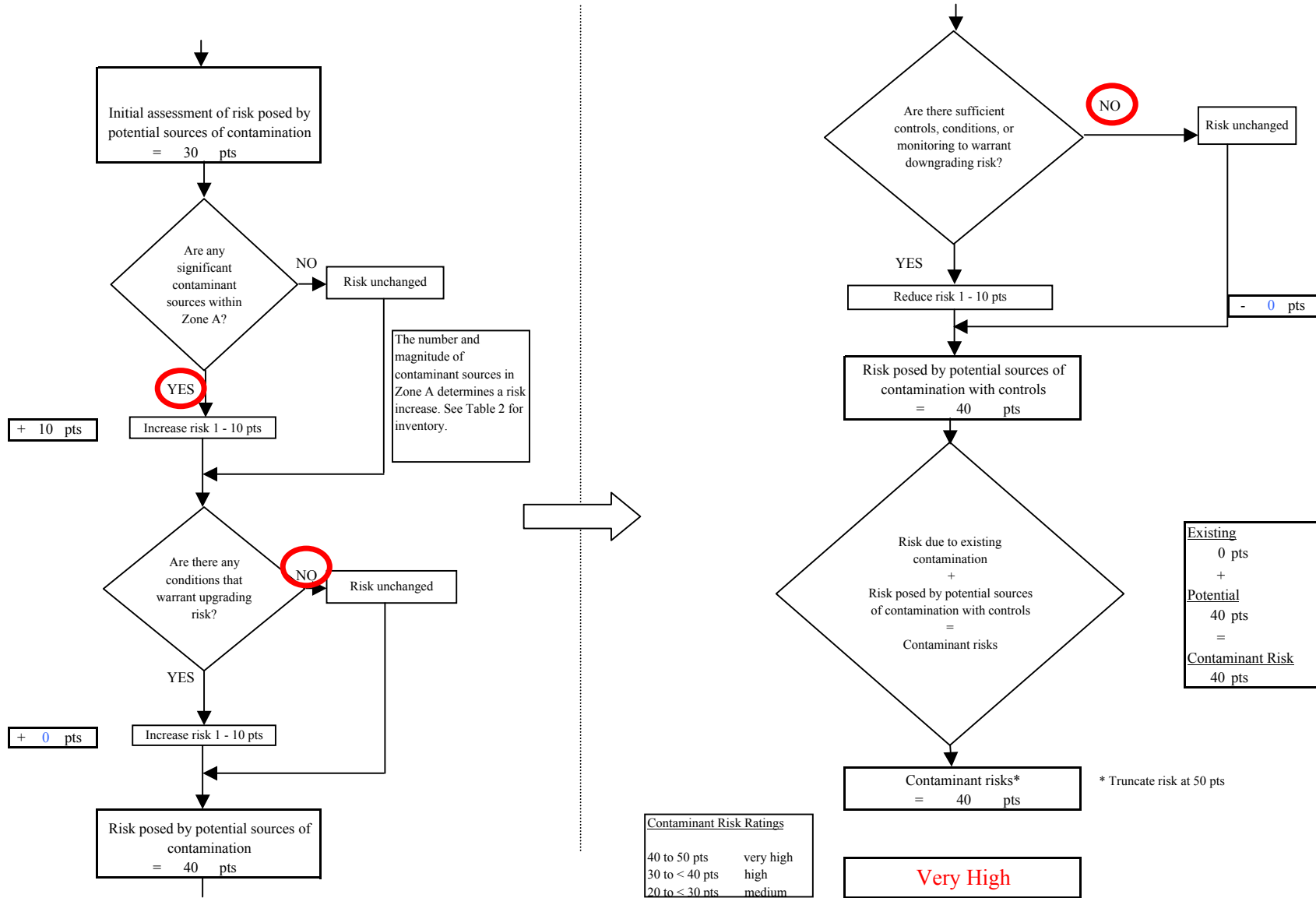


Chart 4. Vulnerability analysis for KSD George Morgan Sr. High School (PWS No. 270833.001) - Bacteria & Viruses

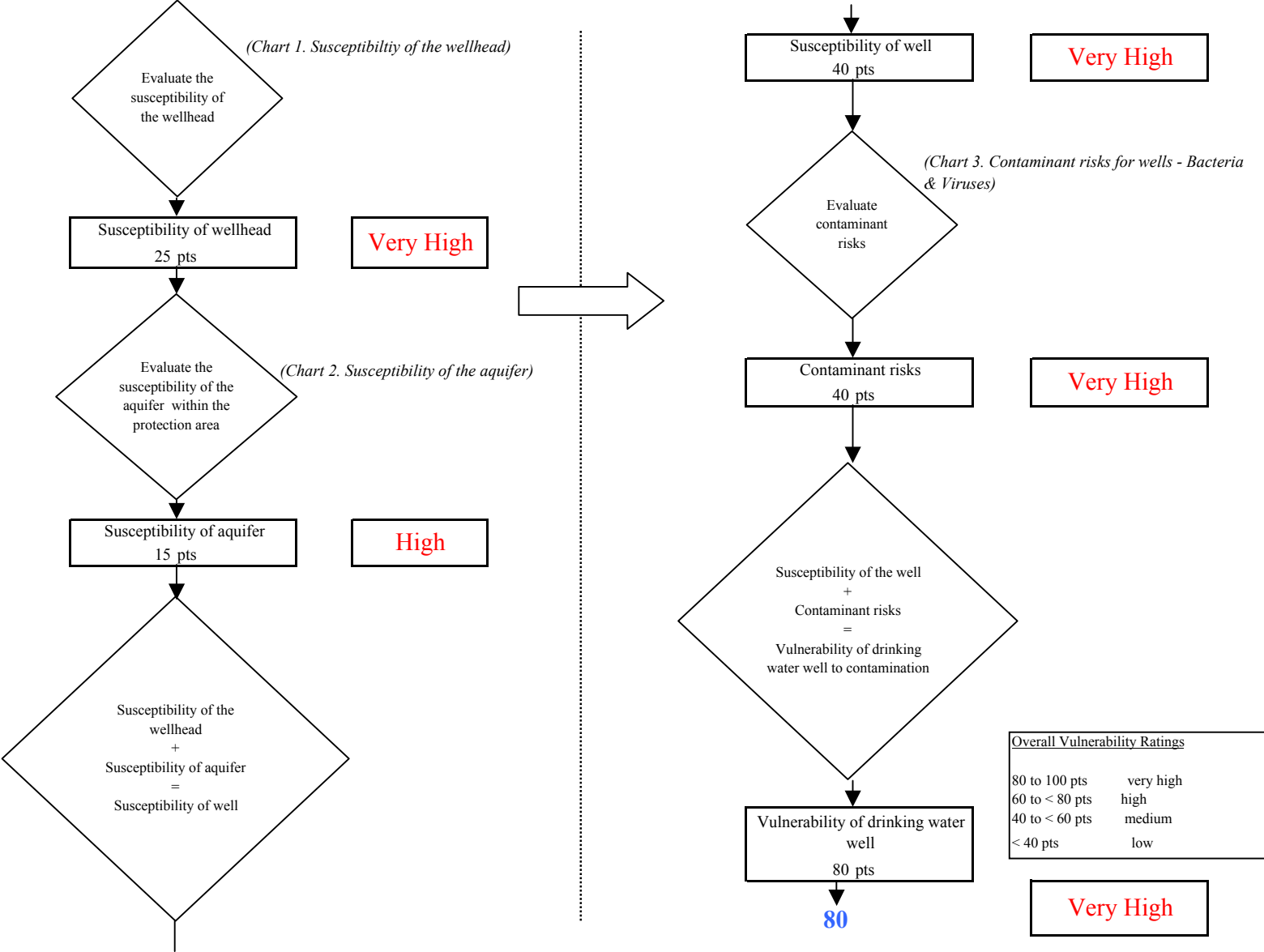


Chart 5. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Nitrates and Nitrites

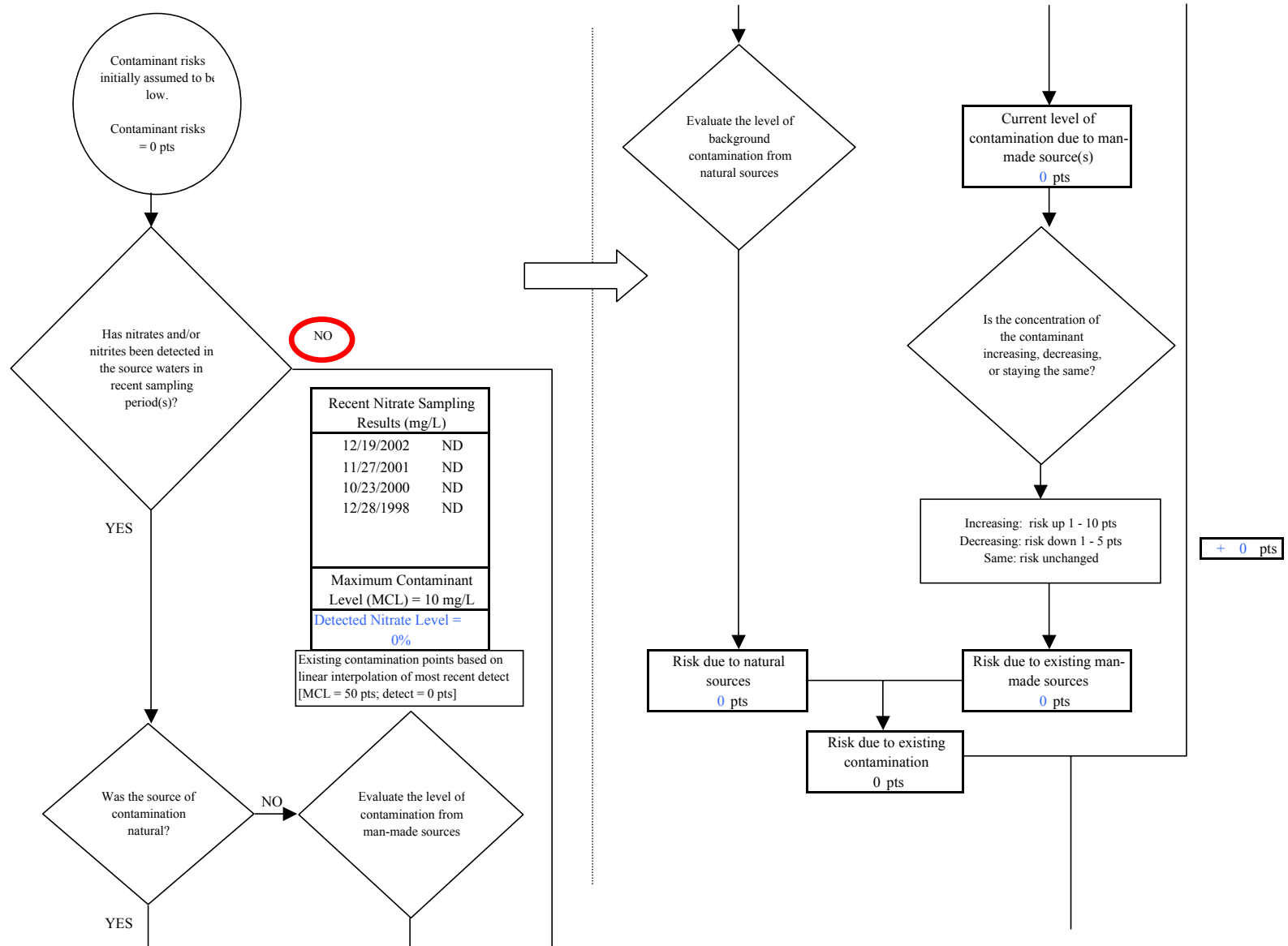


Chart 5. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Nitrates and Nitrites

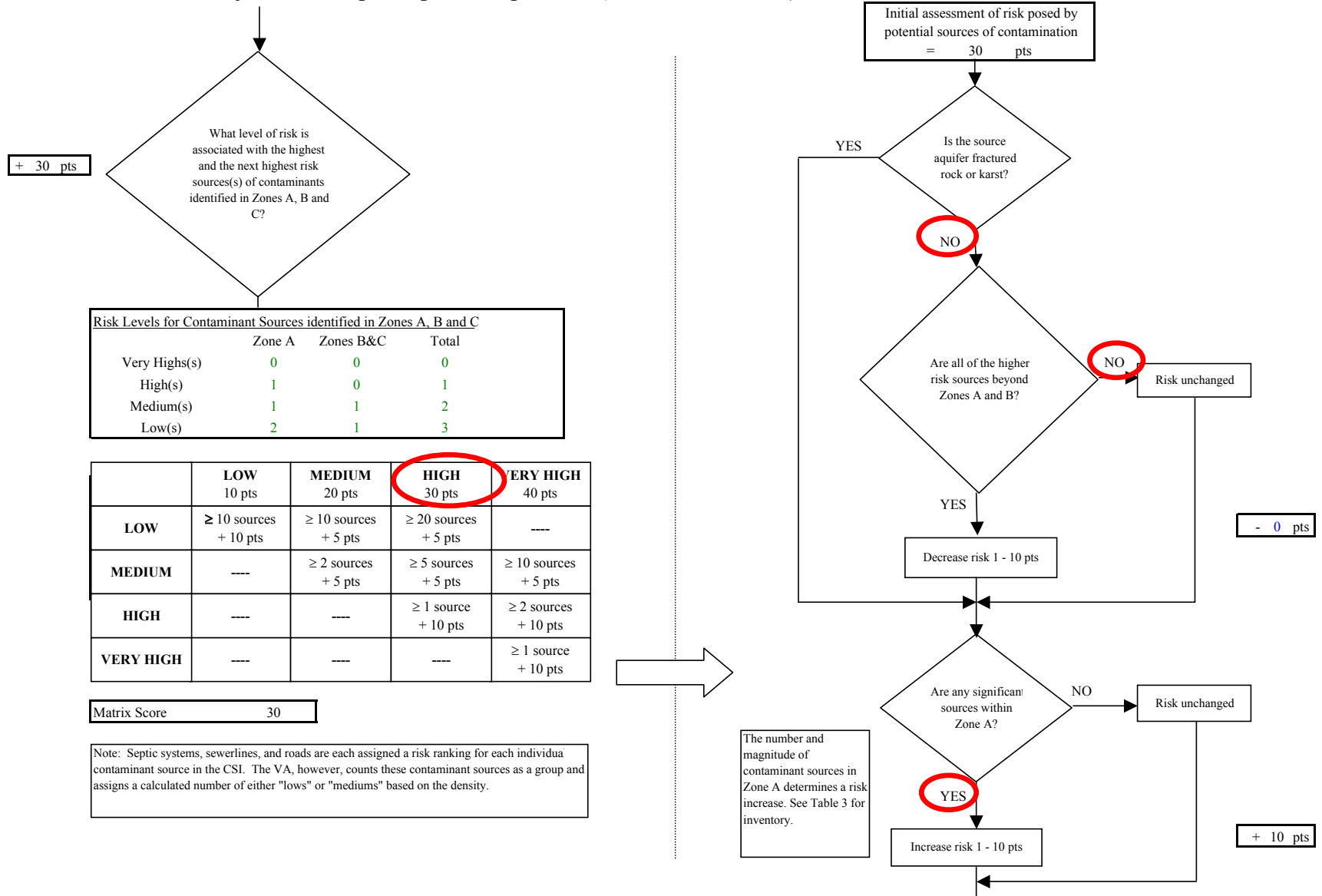


Chart 5. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Nitrates and Nitrites

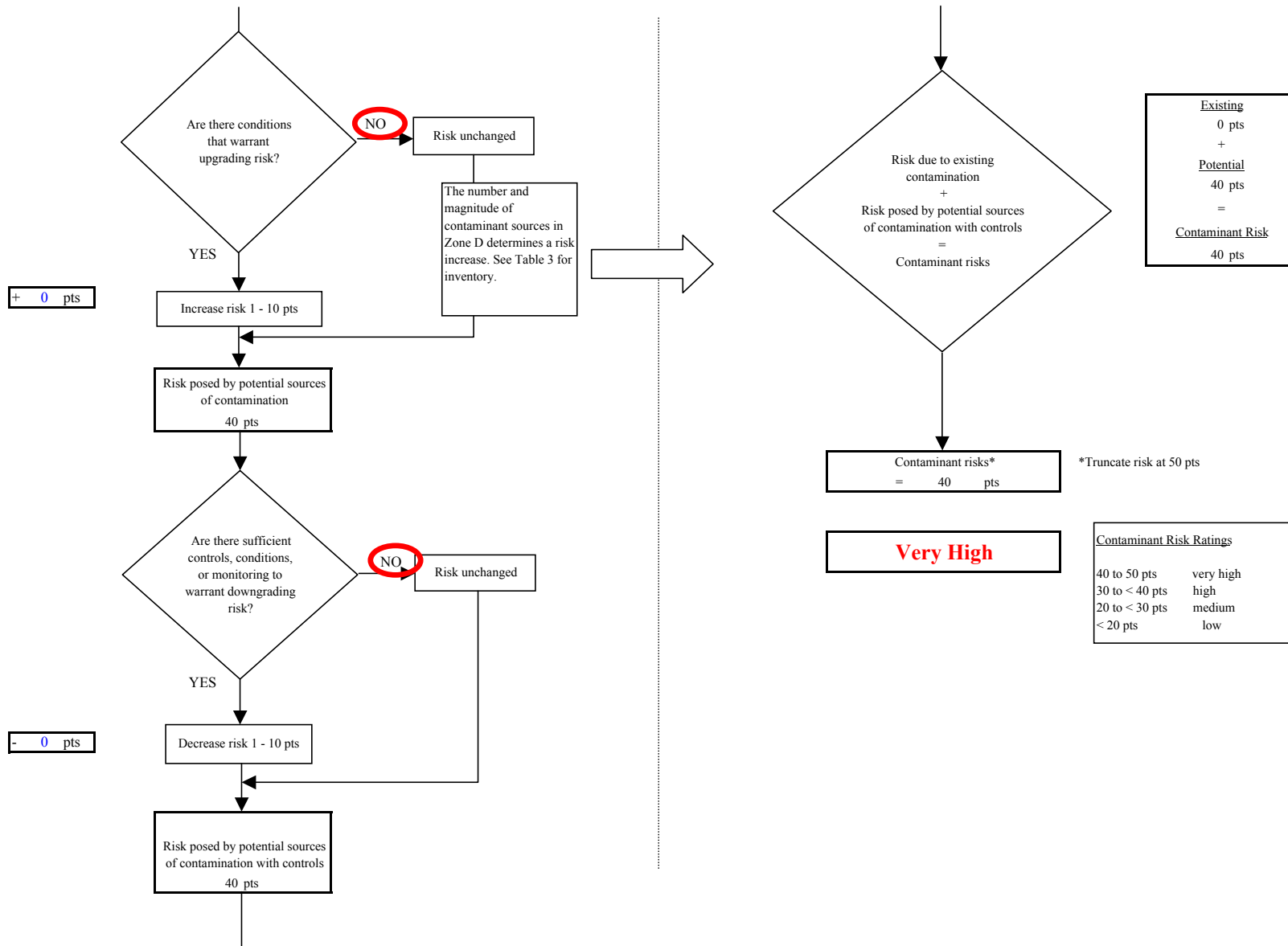


Chart 6. Vulnerability analysis for KSD George Morgan Sr. High School (PWS No. 270833.001) - Nitrates and Nitrites

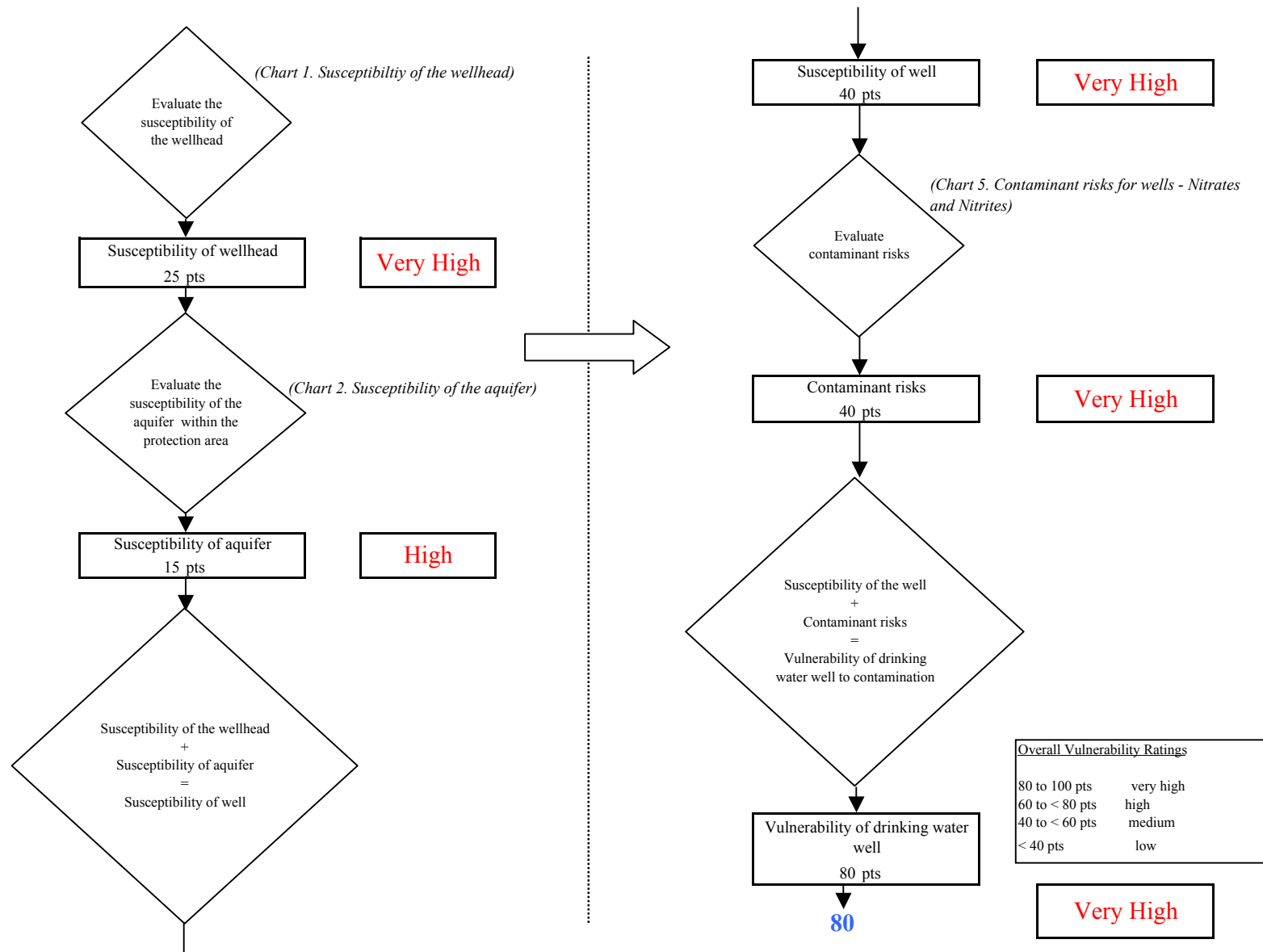


Chart 7. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Volatile Organic Chemicals

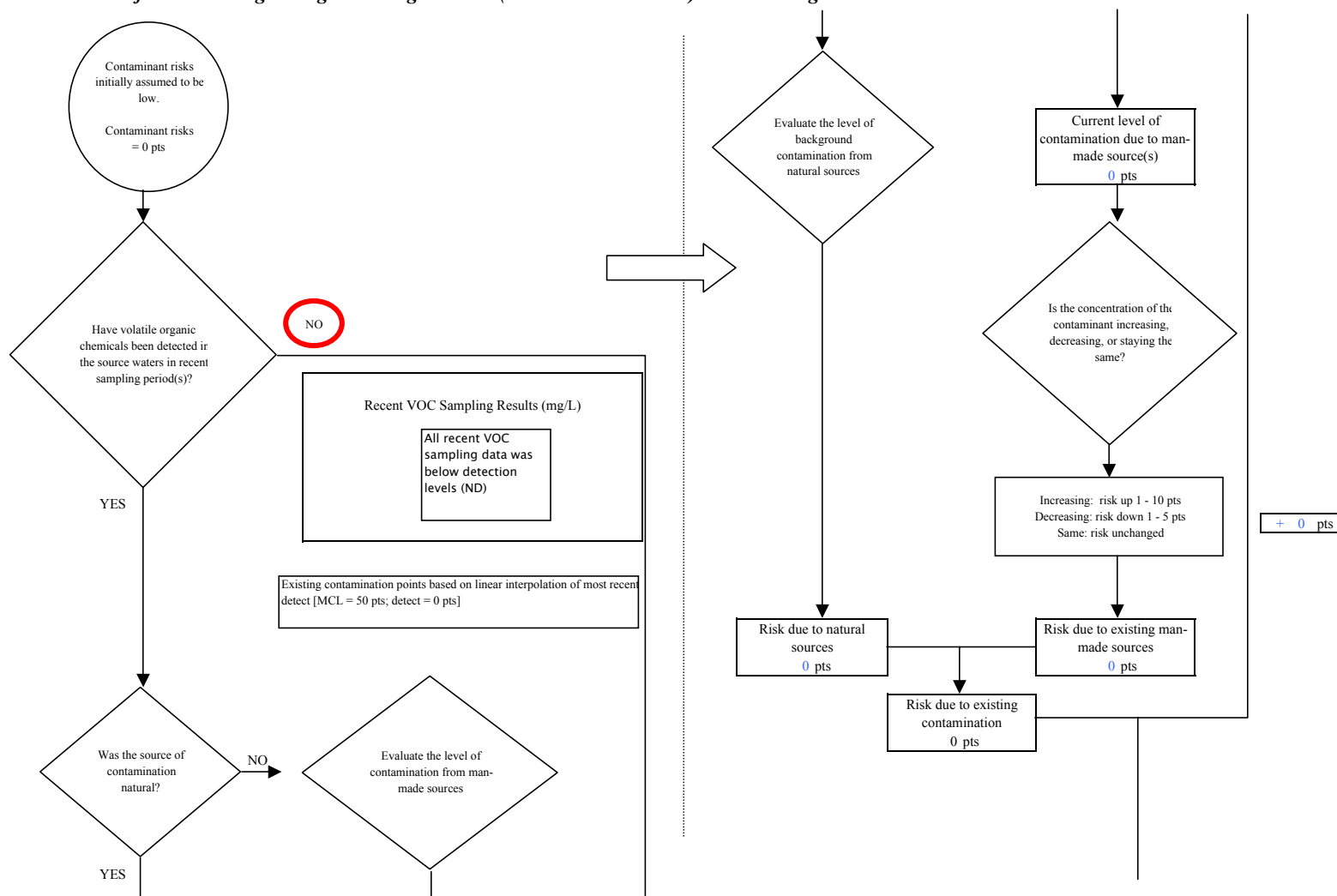


Chart 7. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Volatile Organic Chemicals

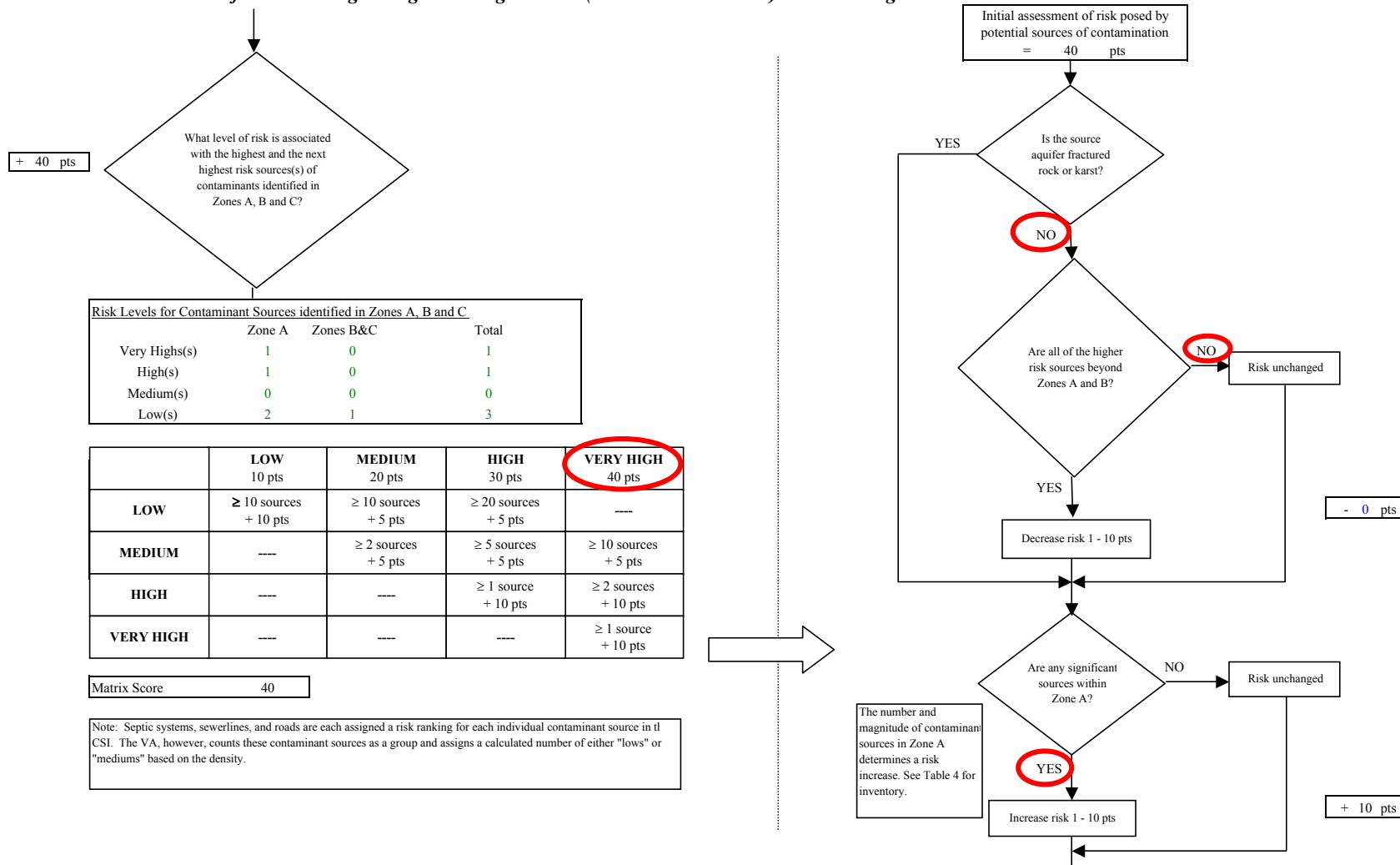


Chart 7. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Volatile Organic Chemicals

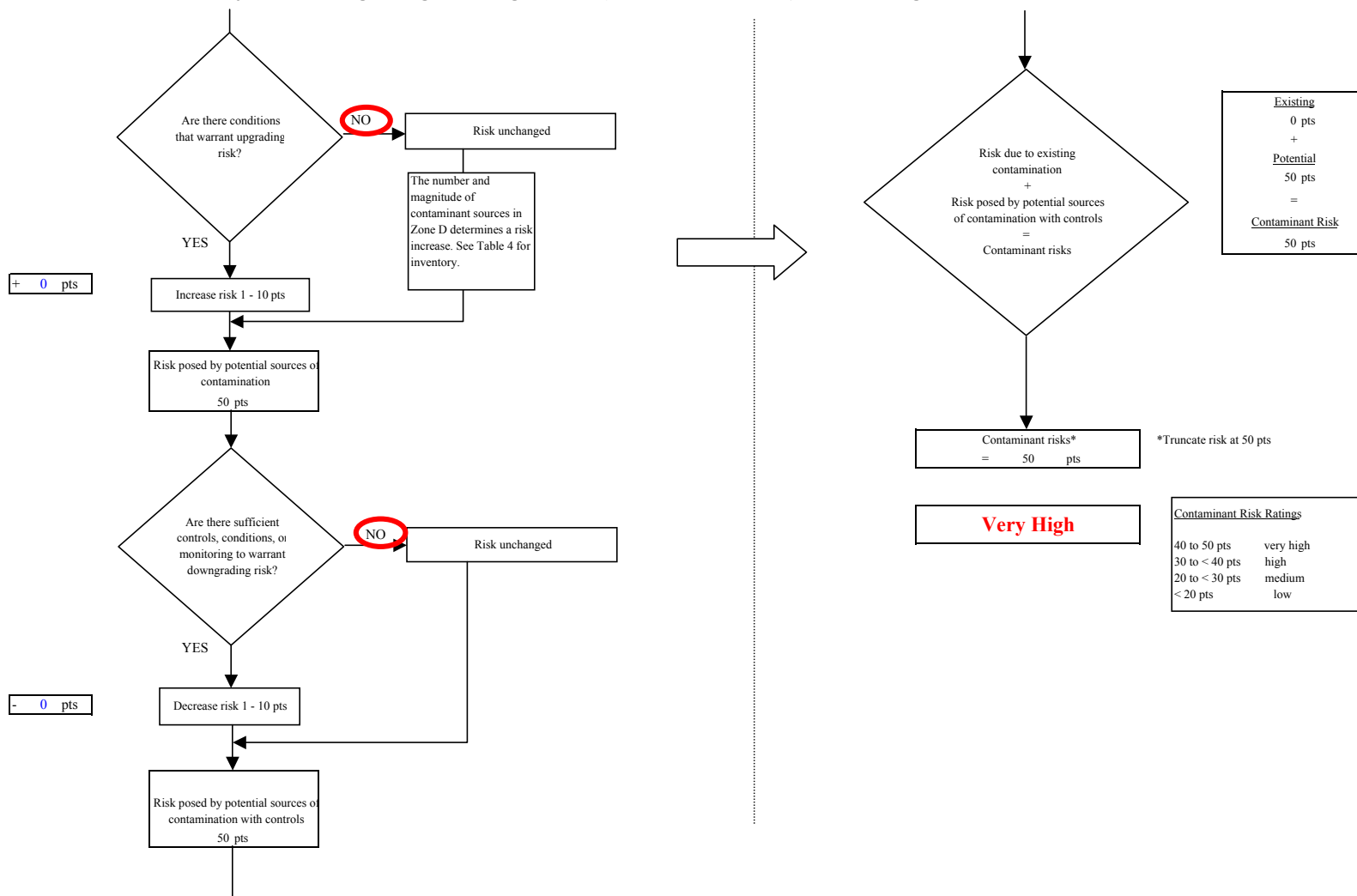


Chart 8. Vulnerability analysis for KSD George Morgan Sr. High School (PWS No. 270833.001) - Volatile Organic Chemicals

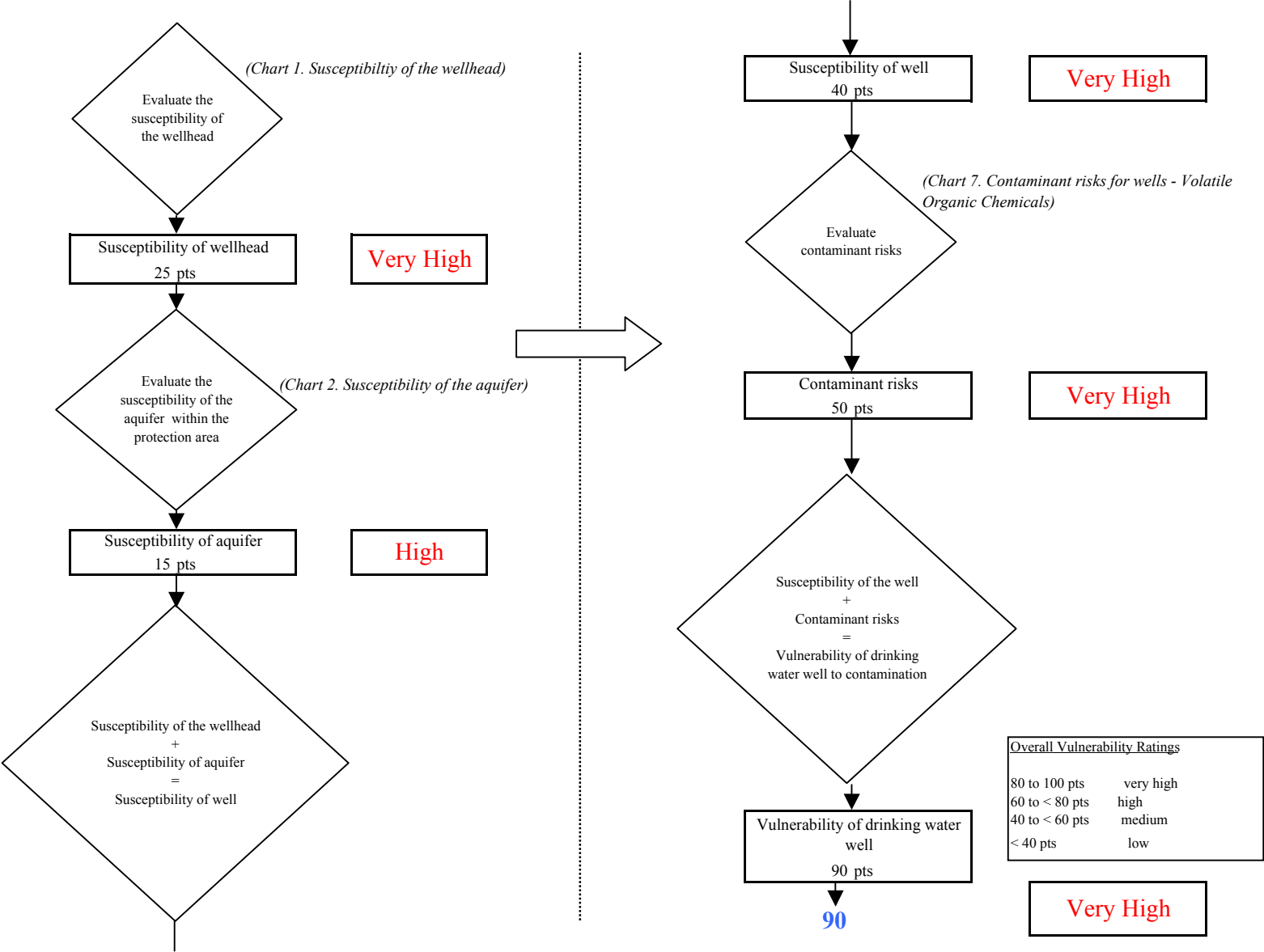


Chart 9. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

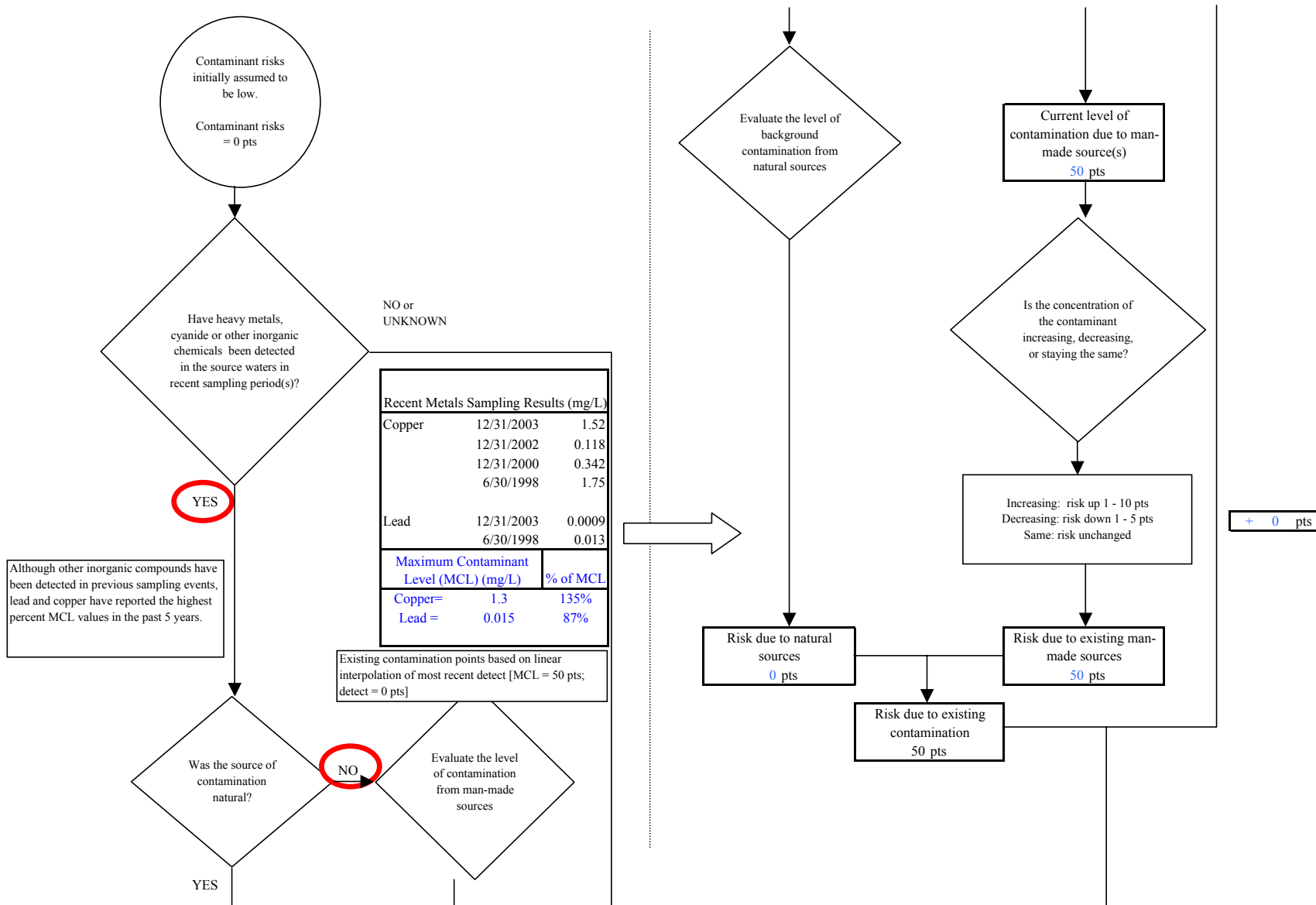


Chart 9. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

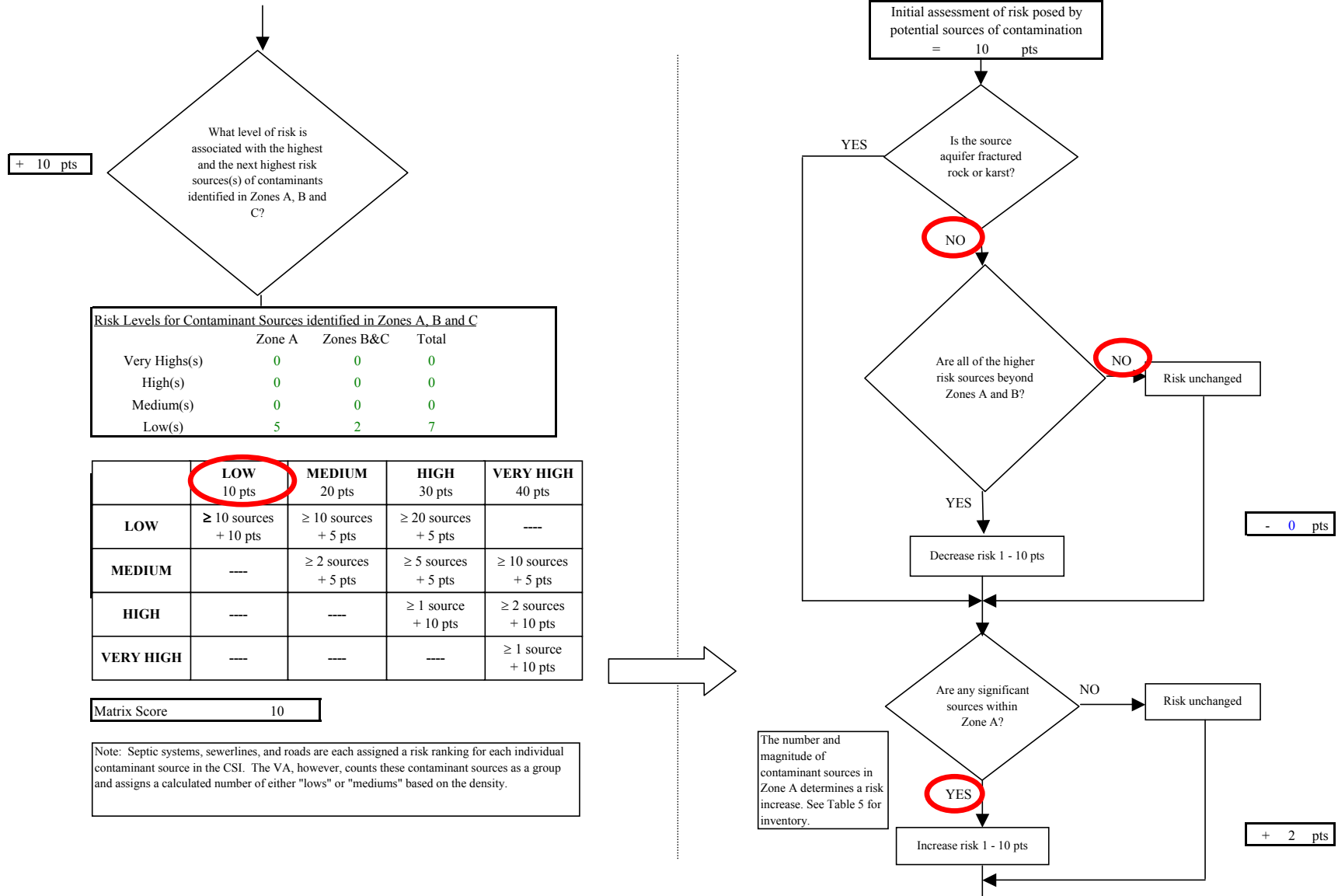


Chart 9. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

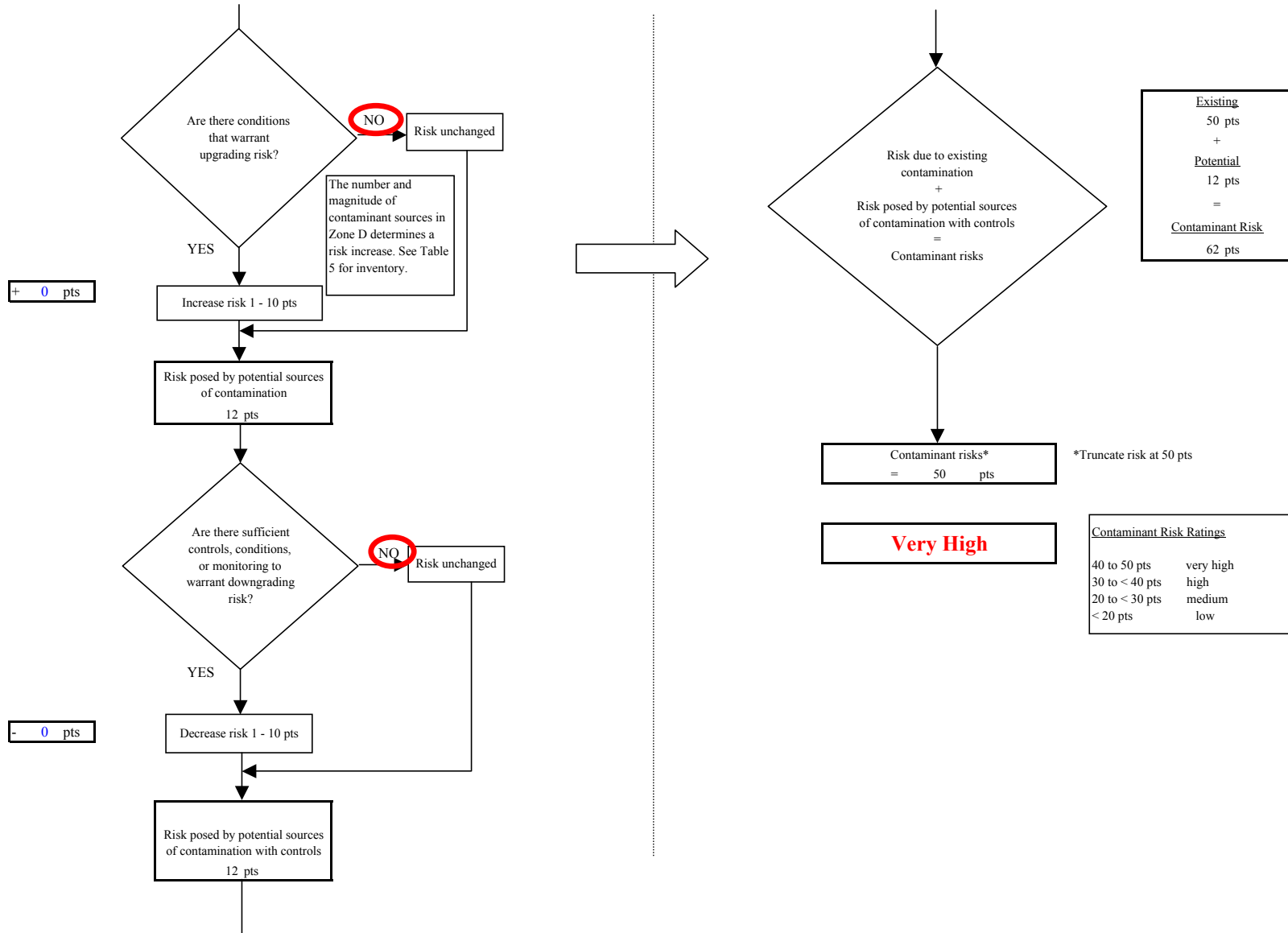


Chart 10. Vulnerability analysis for KSD George Morgan Sr. High School (PWS No. 270833.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

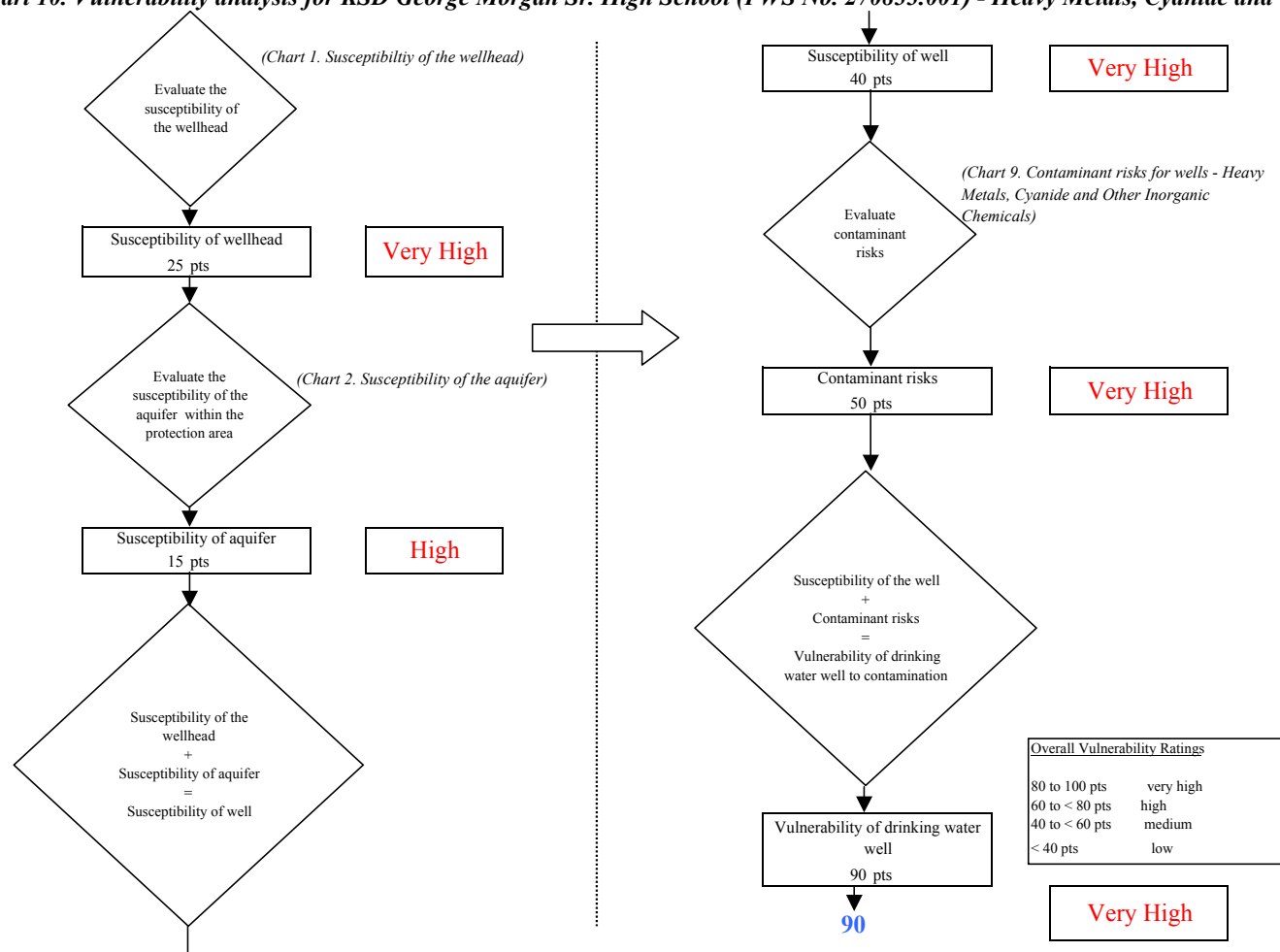


Chart 11. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Synthetic Organic Chemicals

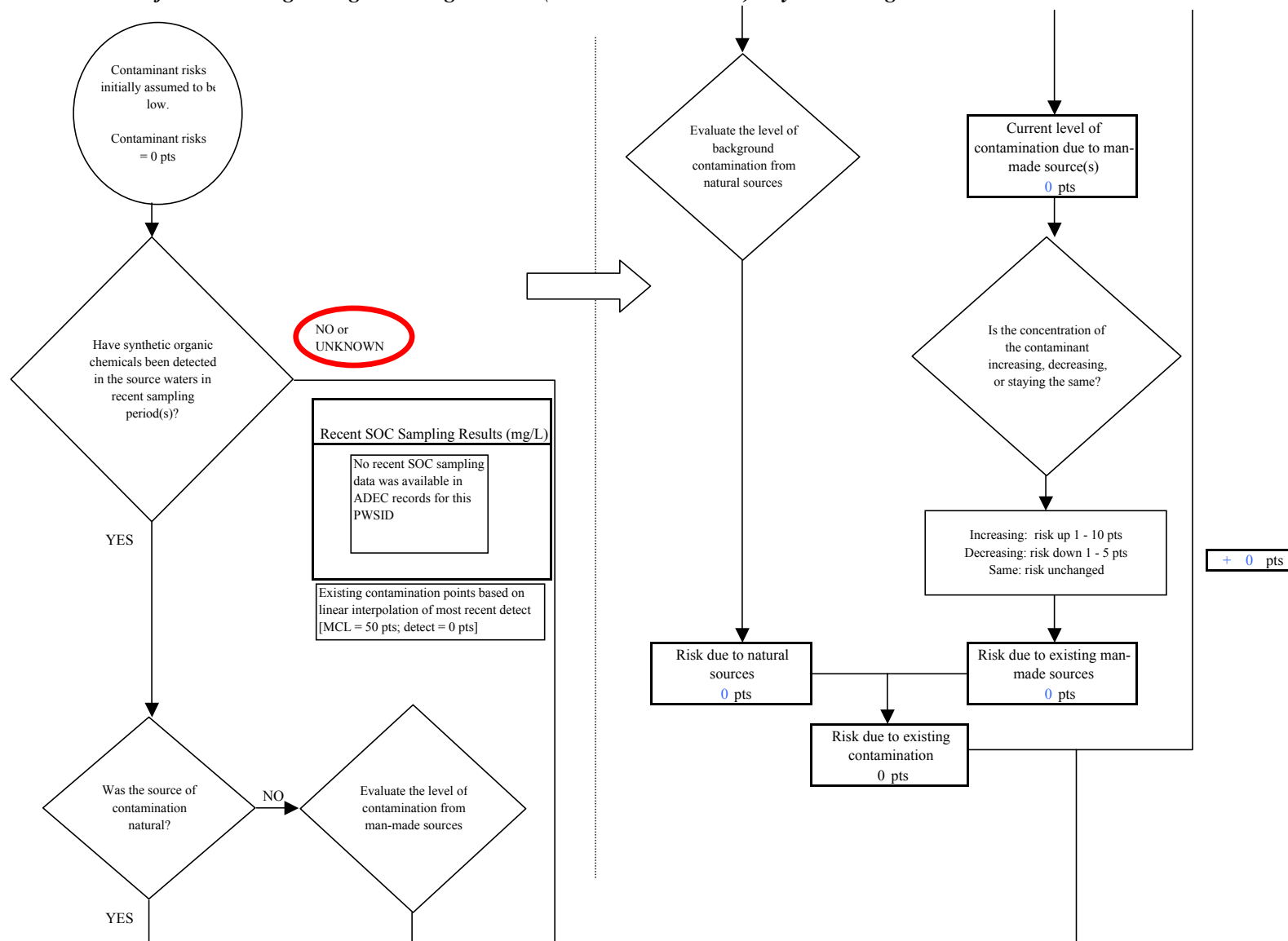


Chart 11. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Synthetic Organic Chemicals

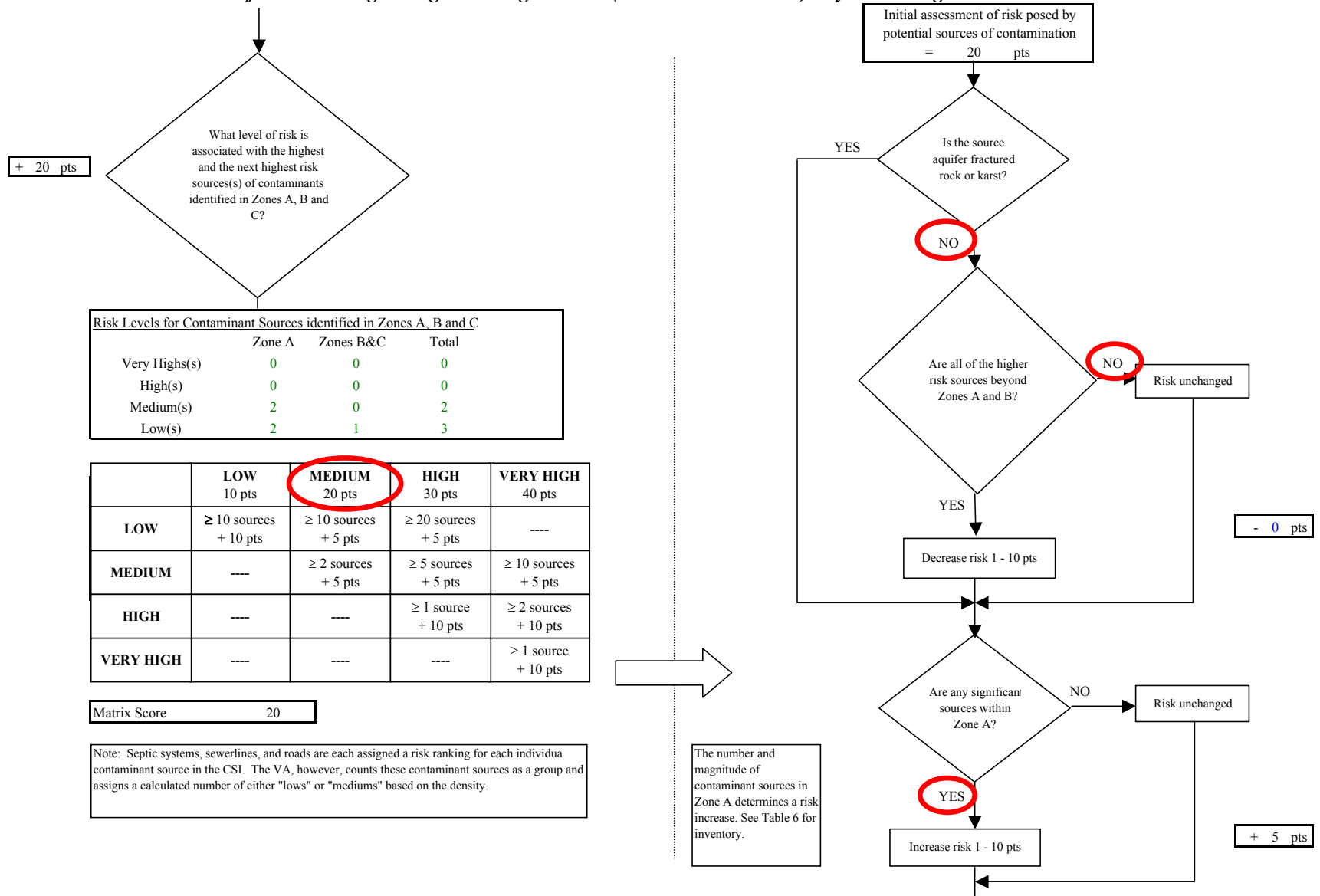


Chart 11. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Synthetic Organic Chemicals

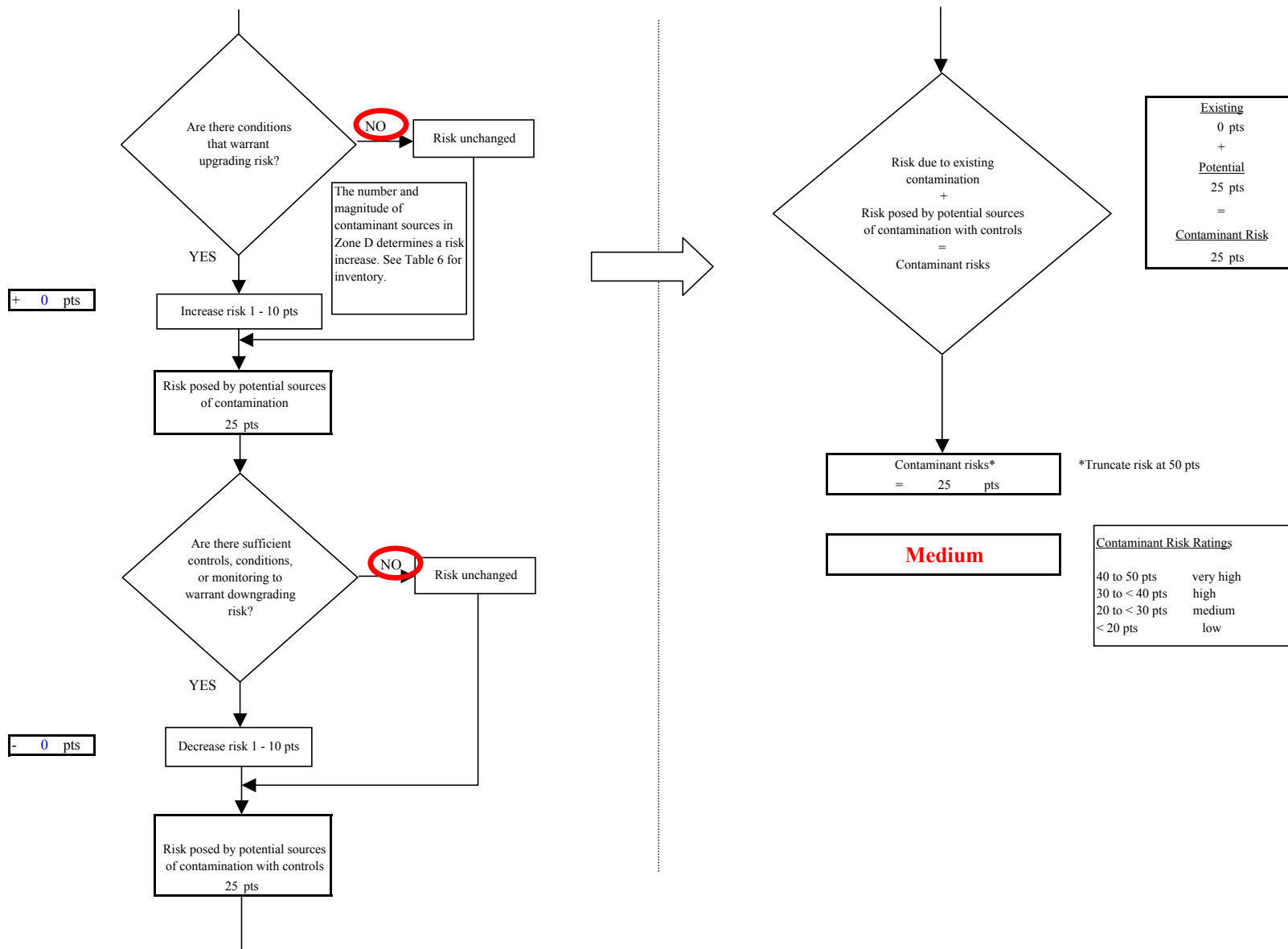


Chart 12. Vulnerability analysis for KSD George Morgan Sr. High School (PWS No. 270833.001) - Synthetic Organic Chemicals

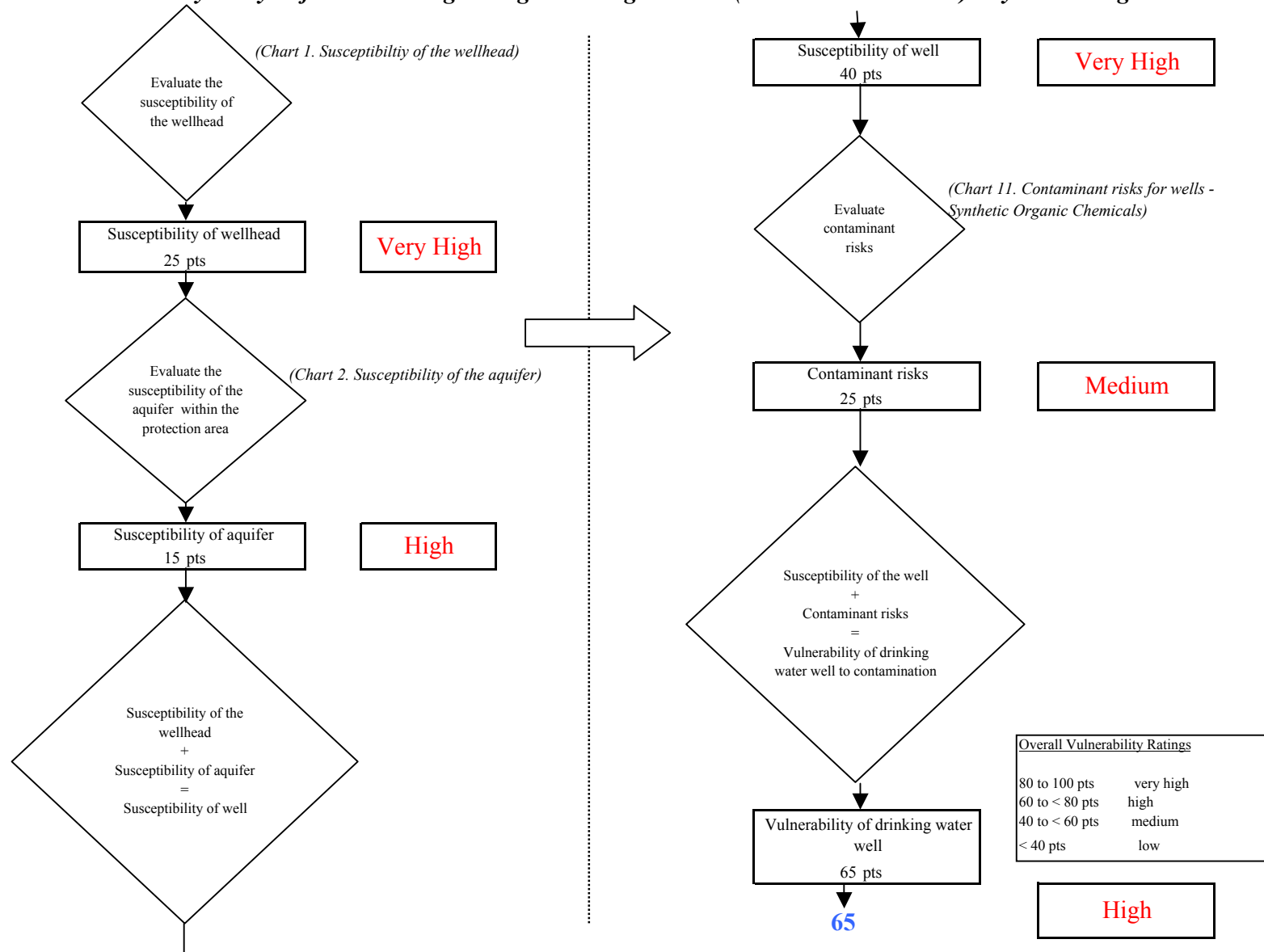


Chart 13. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Other Organic Chemicals

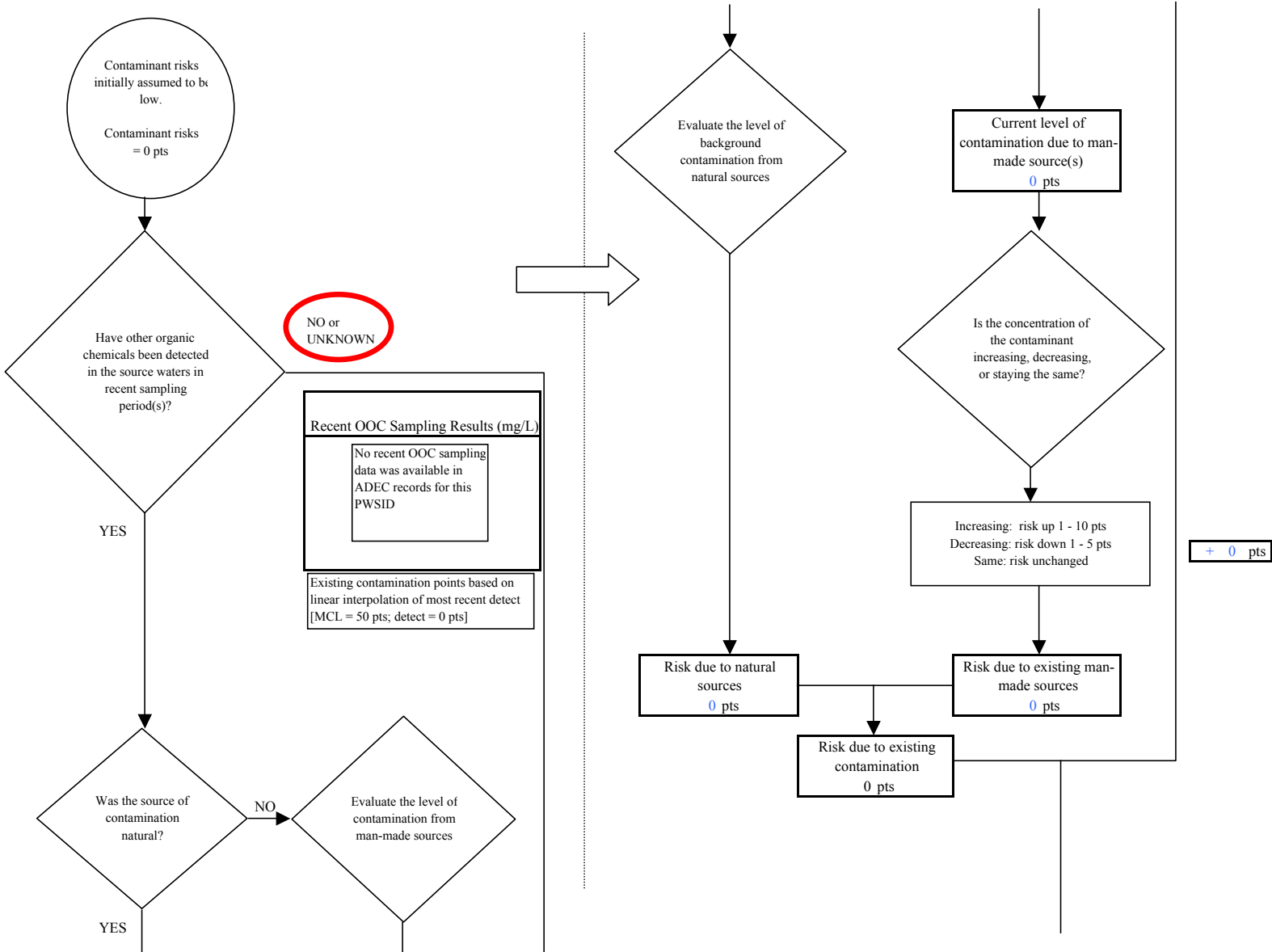


Chart 13. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Other Organic Chemicals

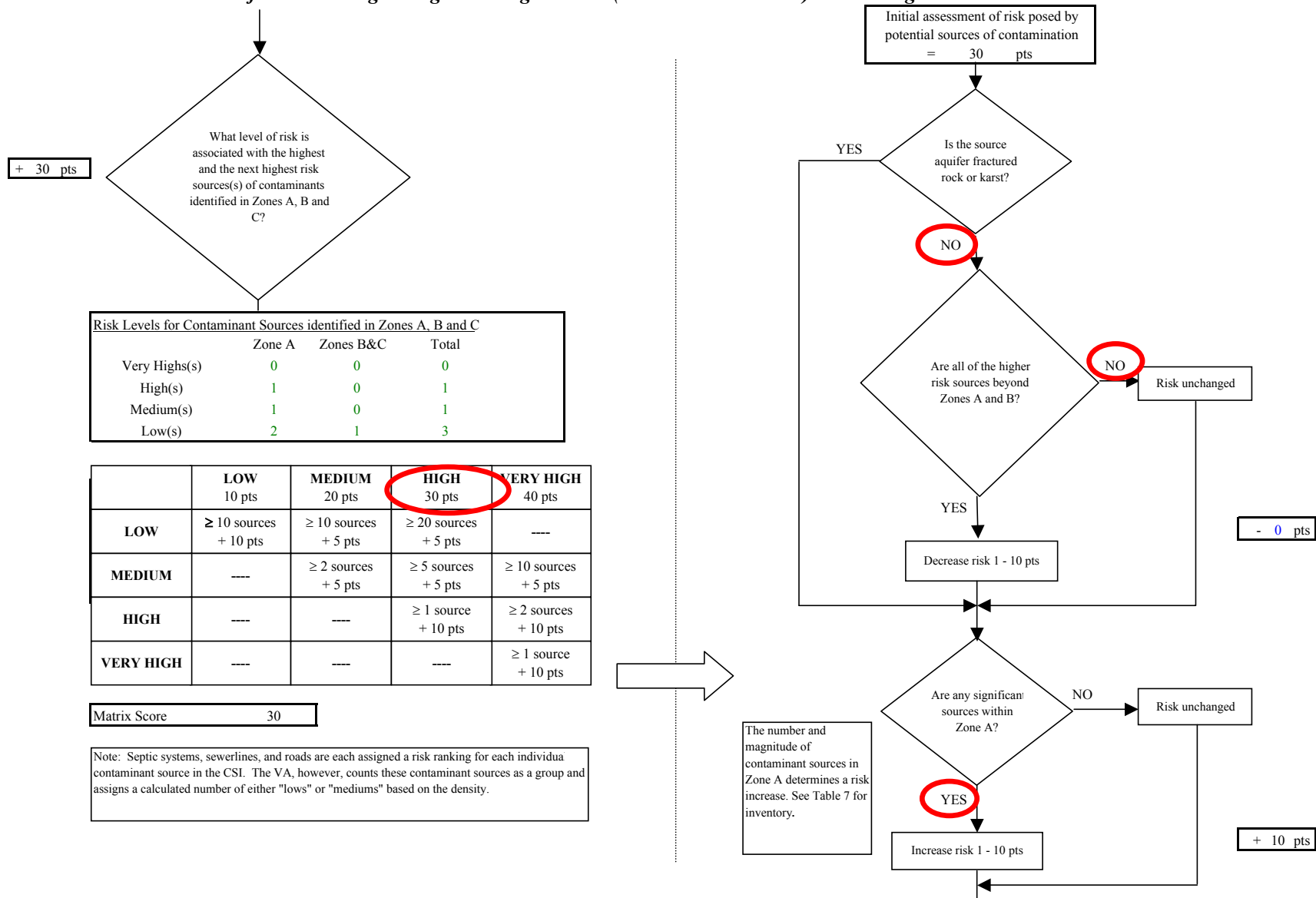


Chart 13. Contaminant risks for KSD George Morgan Sr. High School (PWS No. 270833.001) - Other Organic Chemicals

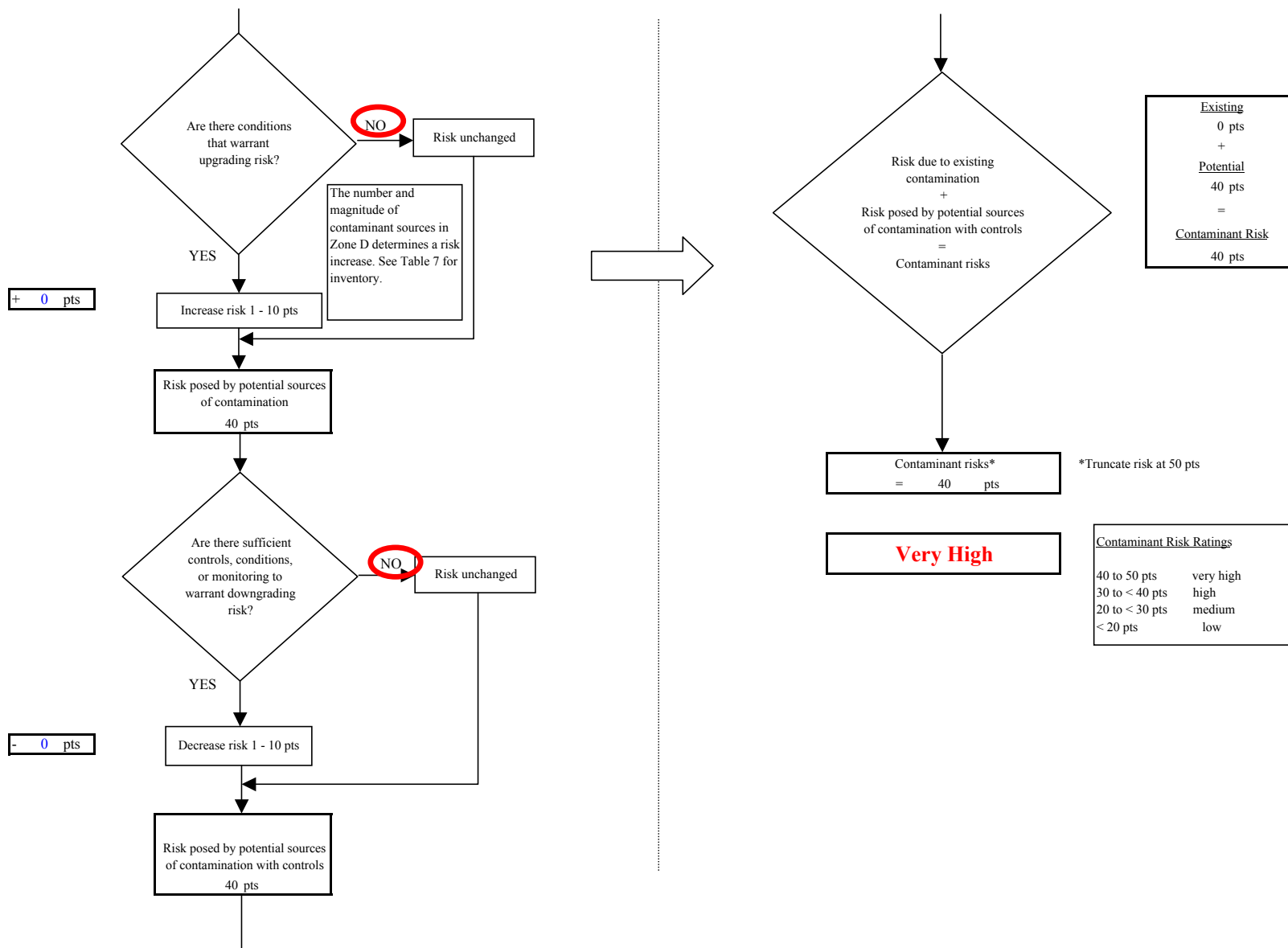


Chart 14. Vulnerability analysis for KSD George Morgan Sr. High School (PWS No. 270833.001) - Other Organic Chemicals

