Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Yukon Kuskokwim School District – Merreline A. Kangas School/Ruby Drinking Water System, Ruby, Alaska

PWSID # 360248.001

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1341
Alaska Department of Environmental Conservation

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DRINKING WATER PROTECTION PROGRAM REPORT 1341

The Drinking Water Protection Program (DWPP) is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Yukon Kuskokwim School District (YKSD) - Merreline A. Kangas School/Ruby has one Public Water System (PWS) well. The primary well (PWS No 360248.001) has been used as a drinking water source since it was drilled; however the date of drilling is unknown.

The well is a Class A (community and non-transient non-community) water system located in front of the Merreline A. Kangas School building in Ruby, Alaska. The December 2001 sanitary survey indicates that the system has two 500-gallon storage tanks and that the drinking water source is untreated. This system operates seasonally and serves an unspecified number of non-residents though 1 service connection. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produce a **Low** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include pit toilets, residential septic systems, and aboveground fuel storage tanks. An inventory of potential or existing contamination sources can be found in Appendix B, Table 1. 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 **High** for bacteria and viruses; a vulnerability rating of **Medium** for nitrates and nitrites and volatile organic chemicals, and a vulnerability rating of **Low** for heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals and other organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The YKSD - Merreline A. Kangas/Ruby well is a Class A (community/non-transient/non-community) public water system. The system located in front of the Merreline A. Kangas School building in Ruby, Alaska (Sec. 04, T009S, R017E, Kateel River Meridian; see Map A of Appendix A). Ruby is located on the south bank of the Yukon River in the Kilbuck-Kuskokwim Mountains, 50 miles east of Galena. Ruby has a population of 169 (ADCED, 2003). Average annual precipitation in Ruby is 17 inches, including approximately 66 inches of snowfall. Temperatures can be as extreme as -53 to 98°F.

The community of Ruby obtains their water supply from community wells. The school uses their own well water systems. Some households utilize individual septic systems but the majority use honeybucket pits or outhouses. Most households lack complete plumbing (ADCED, 2003). Ruby receives electrical power from the City of Ruby. Power generating facilities are fueled by diesel. Refuse is collected by individuals and transported to the landfill (ADCED, 2003).

According to information supplied by ADEC for the YKSD - Merreline A. Kangas/Ruby PWS, the depth of the primary water well is 380 feet below the ground surface. It is unknown if the well is screened. The well is assumed to be completed in a confined aquifer, and is not located within a floodplain.

Information acquired from a December 2001 sanitary survey for the public water system indicated that the land surface is 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 grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

Ruby and the surrounding area are situated on the Yukon River floodplain within the unglaciated Yukon-Tanana Uplands physiographic province. The regional topography consists of relatively flat floodplain deposits dominated by oxbow lakes and abandoned river meanders. Large accumulations of

wind-blown sediments are common across the Yukon River floodplain (URS 2001).

The area is comprised of thick deposits of sediment that overlies most of the bedrock. These deposits consist of floodplain alluvium and river terrace deposits. Floodplain alluvium is divided into organic rich and organic poor deposits. Organic rich alluvial deposits consist of well-stratified layers and lenses of silt with wood, peat, and other intermixed organic materials. Organic-poor alluvial deposits consist of well-stratified layers and lenses of silt with some sand, gravel and minor quantities of clay and lightly organic rich silt (URS 2001).

The soils in the area consist of a thick sequence of undifferentiated fluvial sediments deposited by the Yukon River. The uppermost floodplain deposits are composed of poorly graded silt to silty sand. Poorly graded sands and gravelly sand are found below these floodplain deposits (URS 2001).

A layer of discontinuous permafrost underlies the local area (URS 2001).

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 YKSD - Merreline A. Kangas/Ruby 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 YKSD - Merreline A. Kangas/Ruby 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 YKSD - Merreline A. Kangas/Ruby 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 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, 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 YKSD - Merreline A. Kangas/Ruby's water well is assumed to be completed in a confined aquifer. Confined aquifers are less 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	0	Low
Susceptibility of the Aquifer	14	Medium
Natural Susceptibility	14	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	50	Very High
Nitrates and/or Nitrites	38	High
Volatile Organic Chemicals	35	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	25	Medium
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:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

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

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	65	High
Nitrates and Nitrites	50	Medium
Volatile Organic Chemicals	50	Medium
Heavy Metals, Cyanide and Other Inorganic Chemicals	35	Low
Synthetic Organic Chemicals	25	Low
Other Organic Chemicals	25	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to postive results in recent sampling events and the presence of honeybucket pits or outhouses located in Zone A. Other potential contaminant sources are also found within the protection area (see Table 2 – Appendix B).

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli, which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination.

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 **High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **High.** The risk to this source of public drinking water is primarily attributed to the presence of honeybucket pits or outhouses located in Zone A. Other potential contaminant sources are also found within the protection area (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 low levels nitrates have been detected in recent sampling events, however they did not exceed the MCL of 10mg/L. 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).

Nitrate levels are often derived from the decomposition of organic matter in soils. Although the nitrate source is unknown, such occurrences may be attributed to septic systems or other sources. 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

The contaminant risk for volatile organic chemicals is **High**. The risk is primarily attributed to the presence of aboveground fuel storage tanks located in Zone A (see Table 4 – Appendix B).

All recent volatile organic sampling data was reported to be below detection levels (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, and roads. See Table 4 in Appendix B for a complete listing.

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

Heavy Metals, Cyanide and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Medium.** The risk is primarily attributed the presence of residential septic systems in Zone A (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, low levels of copper have been detected in recent sampling history, however, the analyte did not exceed the MCL of 1.3 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentrations of copper in recent sampling events are not likely representative of source water conditions and may be an indication of recent maintenance to the distribution system. Risk points were not assigned because the analyte did not exceed 100% of the MCL.

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 **Low.**

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Low**. The risk is primarily attributed to the presence of residential septic systems located in Zone A (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the YKSD - Merreline A. Kangas/Ruby (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 **Low.**

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Low**. The risk is primarily attributed to the presence of residential septic systems located in Zone A (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the YKSD - Merreline A. Kangas/Ruby (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 **Low**.

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 community of Ruby 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.

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APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS # 360248.001 YKSD- Merriline Kangas/Ruby

LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

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

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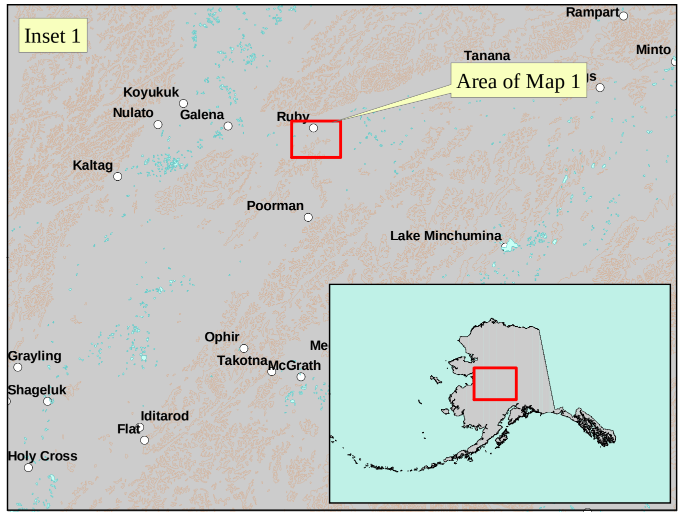


YKSD- Merriline Kangas/Ruby
PWS# 360248.001
Appendix A Map A

APPENDIX B

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

Table 1

Contaminant Source Inventory for
YKSD - Merriline Kangas / Ruby

PWSID 360248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	C	Assume 30 or less honeybucket pits/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	C	Assume 5 or less residential septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 17 or less residential aboveground heating oil storage tanks in Zoı
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1 - 20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1 - 20 roads in Zone B
Metals mining, placer (active or inactive?)	E04	E04-01	C	C	BIG CREEK
Metals mining, placer (active or inactive?)	E04	E04-02	C	C	COX PUP
Metals mining, placer (active or inactive?)	E04	E04-03	C	C	GLACIER CREEK
Highways and roads, dirt/gravel	X24	X24-03	C	C	Assume 1 - 20 roads in Zone C
Quarries (sand, gravel, rock, other?)	E10	E10-01	D	C	BEAVER CREEK LL
Highways and roads, dirt/gravel	X24	X24-04	D	C	Assume 1 - 20 roads in Zone D

Table 2

Contaminant Source Inventory and Risk Ranking for YKSD - Merriline Kangas / Ruby Sources of Bacteria and Viruses

PWSID 360248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or mor	D16	D16-01	A	Medium	C	Assume 30 or less honeybucket pits/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 5 or less residential septic systems in Zone A
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 3

Contaminant Source Inventory and Risk Ranking for YKSD - Merriline Kangas / Ruby Sources of Nitrates/Nitrites

PWSID 360248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or mor	D16	D16-01	A	Medium	C	Assume 30 or less honeybucket pits/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 5 or less residential septic systems in Zone A
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
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1 - 20 roads in Zone C

Table 4

Contaminant Source Inventory and Risk Ranking for YKSD - Merriline Kangas / Ruby Sources of Volatile Organic Chemicals

PWSID 360248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or mor	D16	D16-01	A	Low	C	Assume 30 or less honeybucket pits/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 5 or less residential septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 17 or less residential aboveground heating oil storage tanks in Zone
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
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1 - 20 roads in Zone C

Table 5

Contaminant Source Inventory and Risk Ranking for YKSD - Merriline Kangas / Ruby Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 360248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Pit toilets (open hole), nonresidential (one or mor	D16	D16-01	A	Low	C	Assume 30 or less honeybucket pits/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 5 or less residential septic systems in Zone A
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
Metals mining, placer (active or inactive?)	E04	E04-01	C	Low	C	BIG CREEK
Metals mining, placer (active or inactive?)	E04	E04-02	C	Low	C	COX PUP
Metals mining, placer (active or inactive?)	E04	E04-03	C	Low	C	GLACIER CREEK
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1 - 20 roads in Zone C

Table 6

Contaminant Source Inventory and Risk Ranking for YKSD - Merriline Kangas / Ruby Sources of Synthetic Organic Chemicals

PWSID 360248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 5 or less residential septic systems in Zone A

Table 7

Contaminant Source Inventory and Risk Ranking for YKSD - Merriline Kangas / Ruby Sources of Other Organic Chemicals

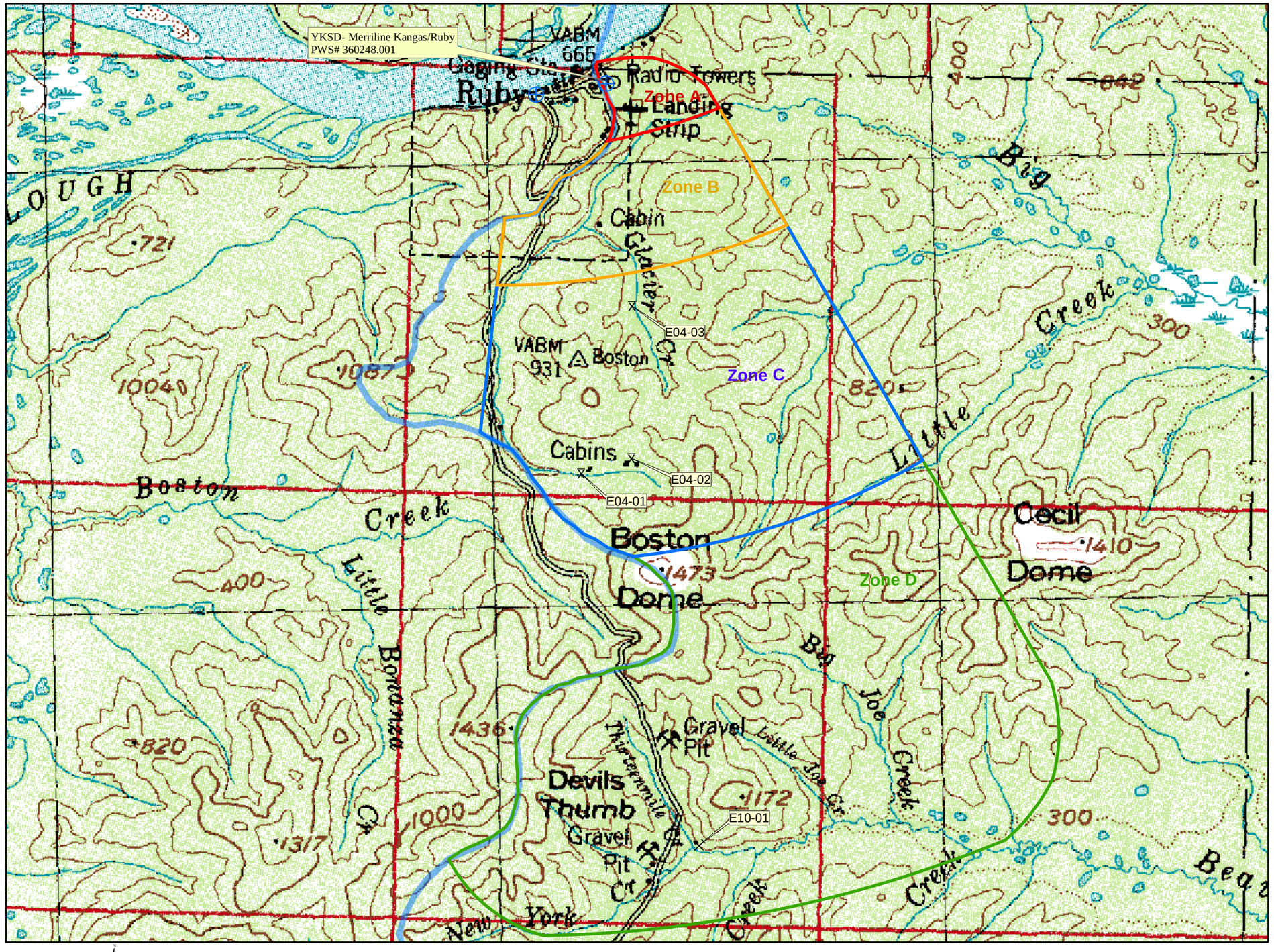
PWSID 360248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 5 or less residential septic systems in Zone A
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
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1 - 20 roads in Zone C

APPENDIX C

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

Public Water Well System for PWS # 360248.001 YKSD- Merriline Kangas/Ruby
Sources of Potential and Exsisting Contamination



LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

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

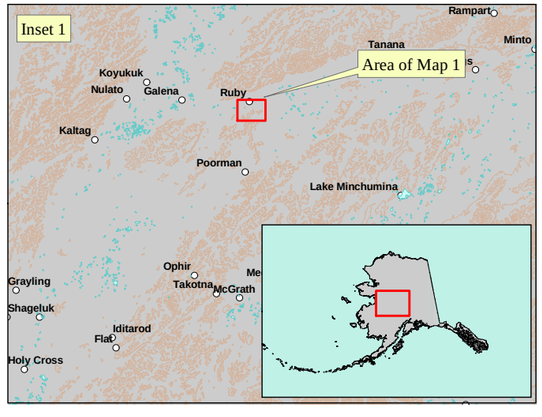
Existing or Potential Contaminant Sources

- Placer Mine (E04)
- Other Mine or Quarry (E10)

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.



0 1 2 4 6 8 Miles

YKSD- Merriline Kangas/Ruby
PWS# 360248.001
Appendix C Map C

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - YKSD - Merriline Kangas/Ruby (PWS No. 360248.001)

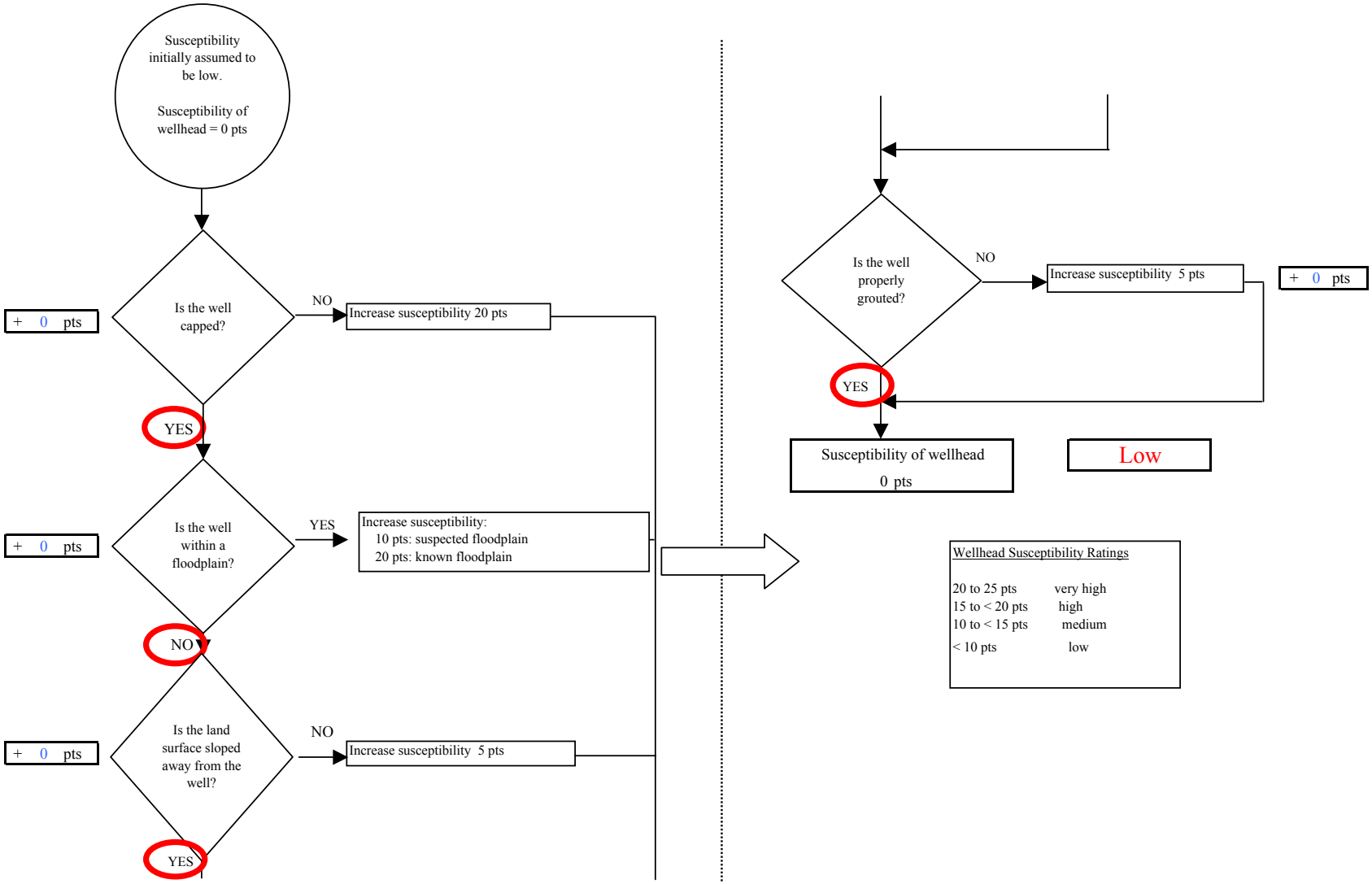


Chart 2. Susceptibility of the aquifer YKSD - Merriline Kangas/Ruby (PWS No. 360248.001)

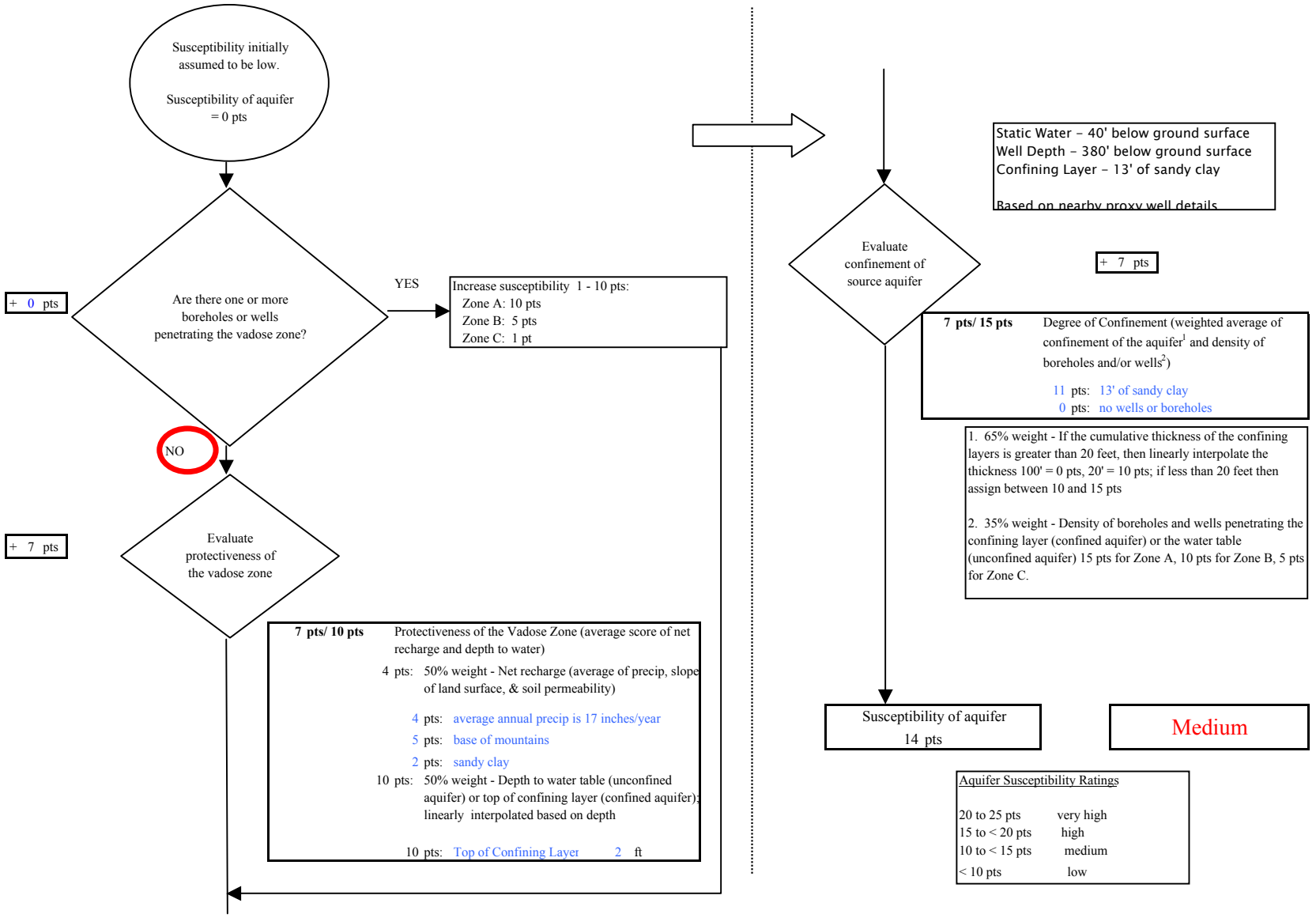
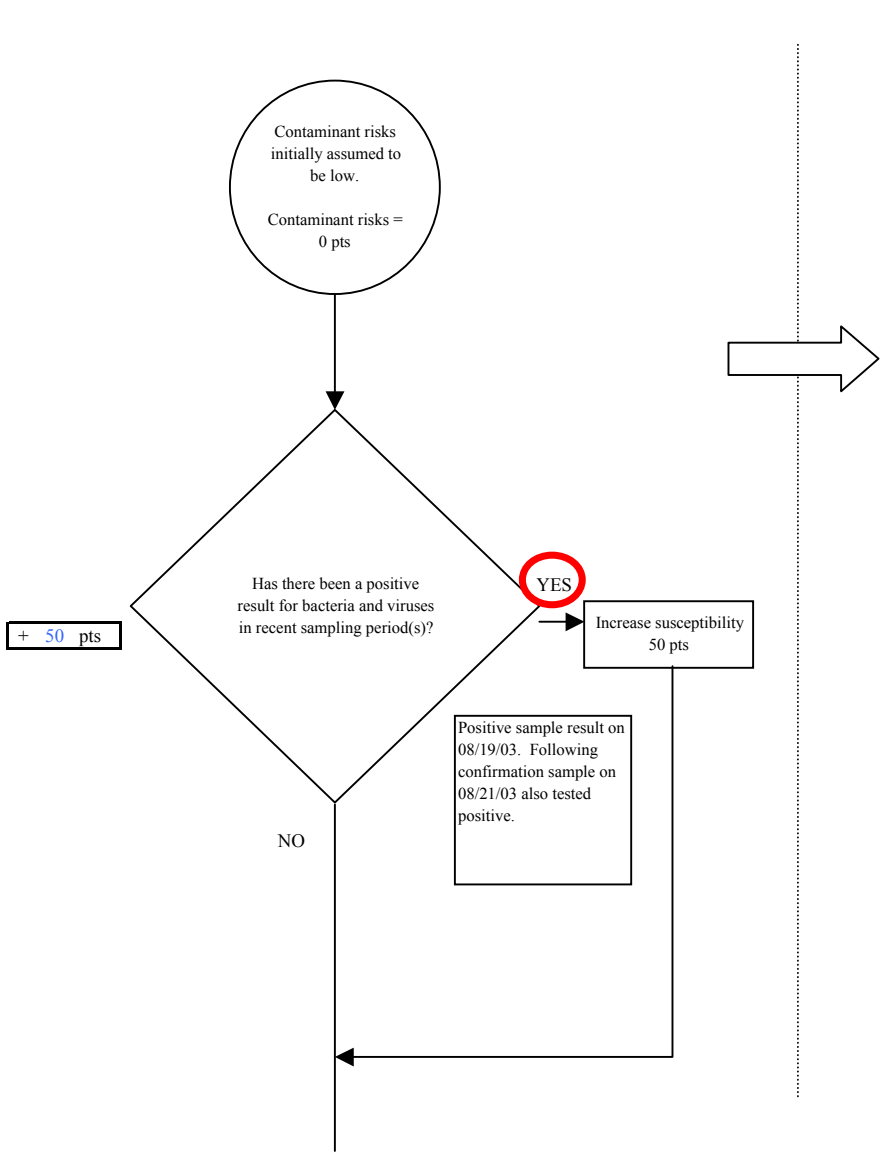
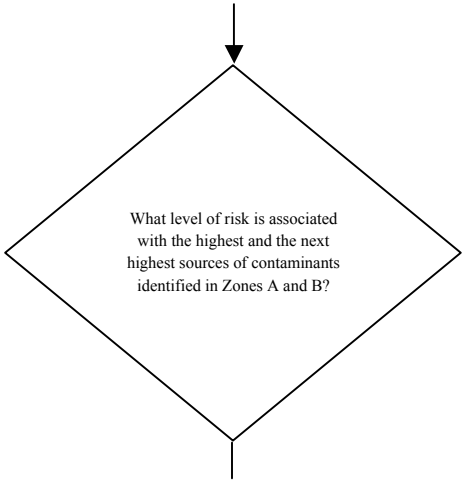


Chart 3. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Bacteria & Viruses





+ 25 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)	30	0	30
Low(s)	5	1	6

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

Matrix Score 25

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

Chart 3. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Bacteria & Viruses

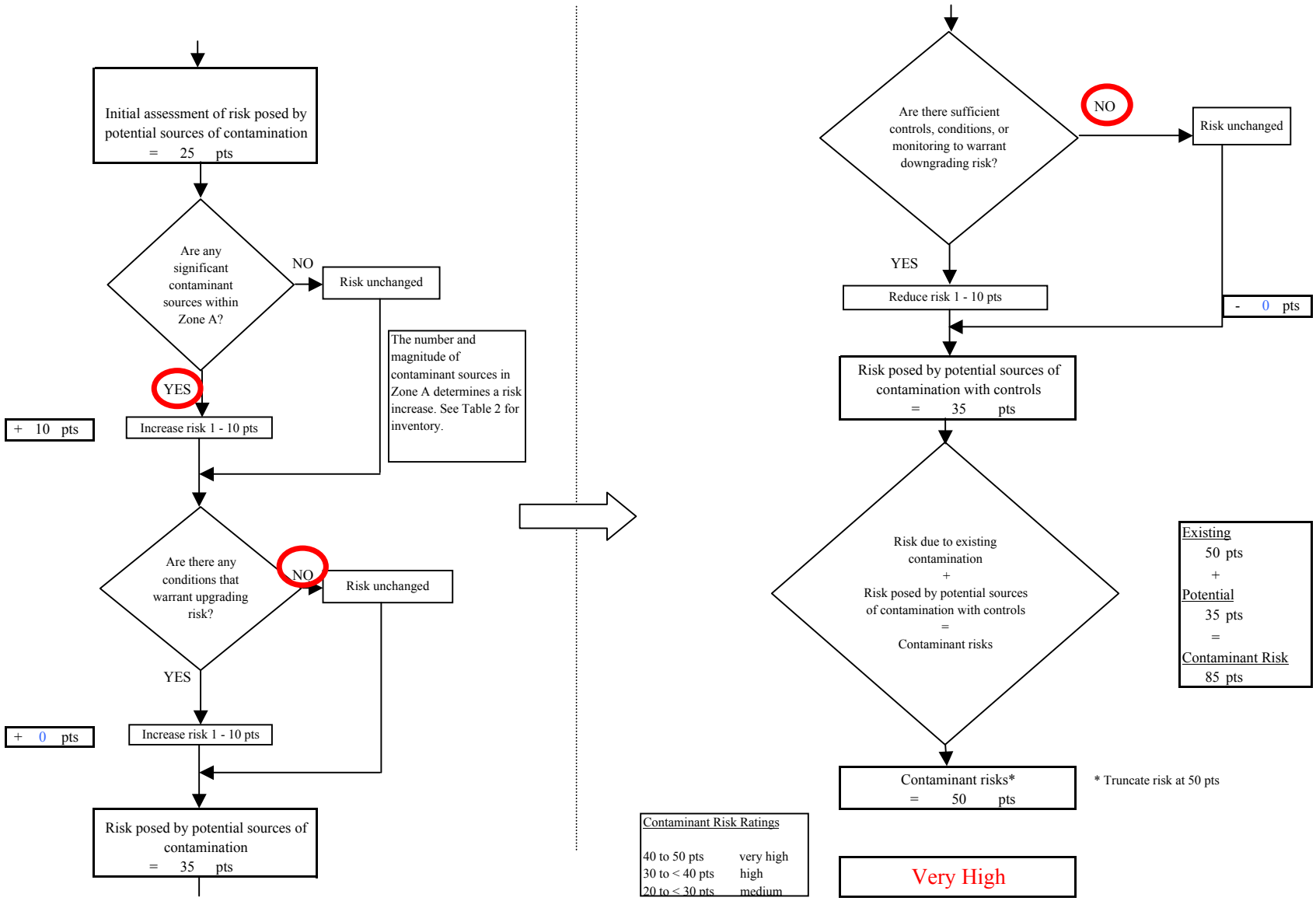


Chart 4. Vulnerability analysis for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Bacteria & Viruses

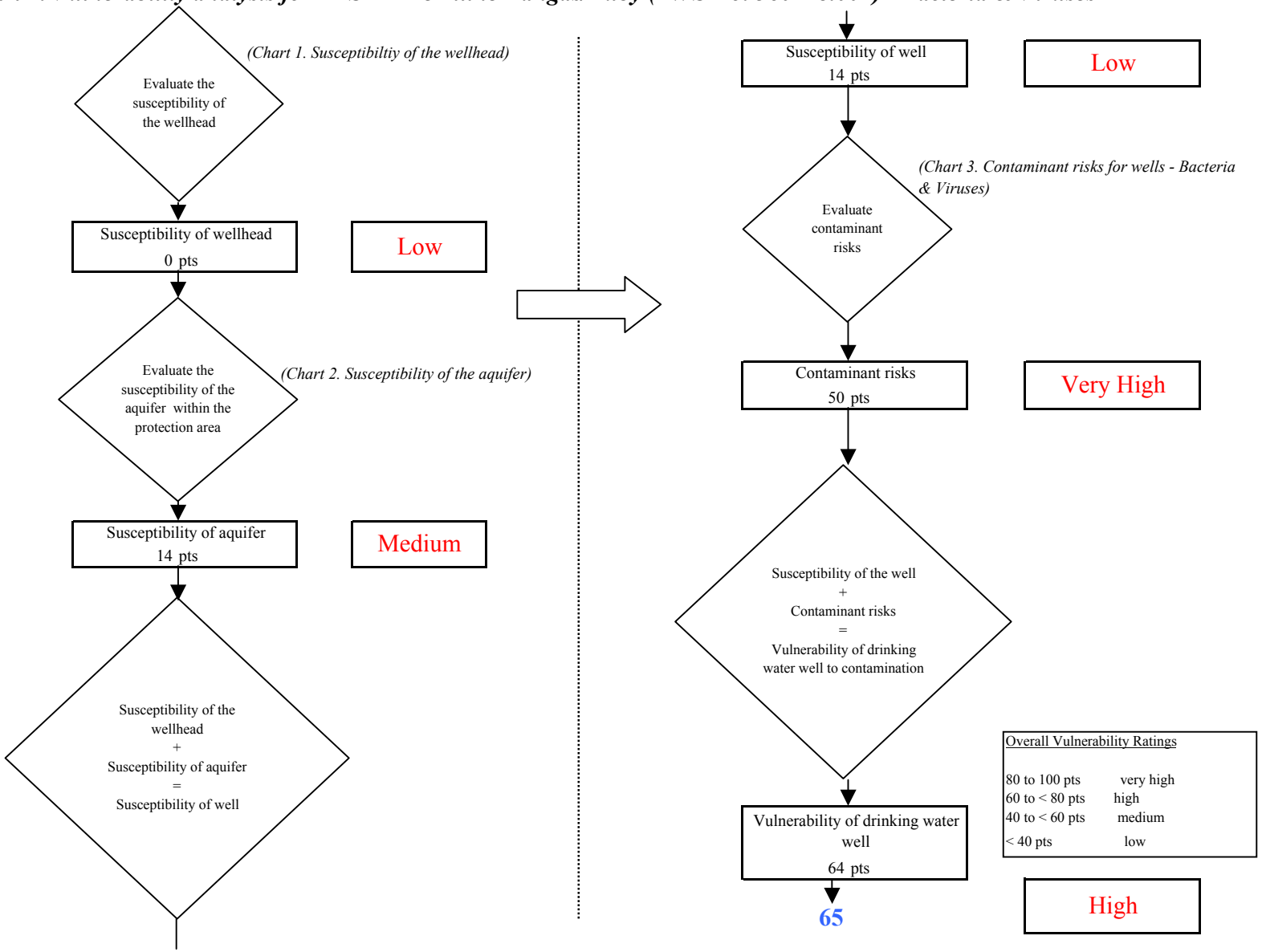


Chart 5. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Nitrates and Nitrites

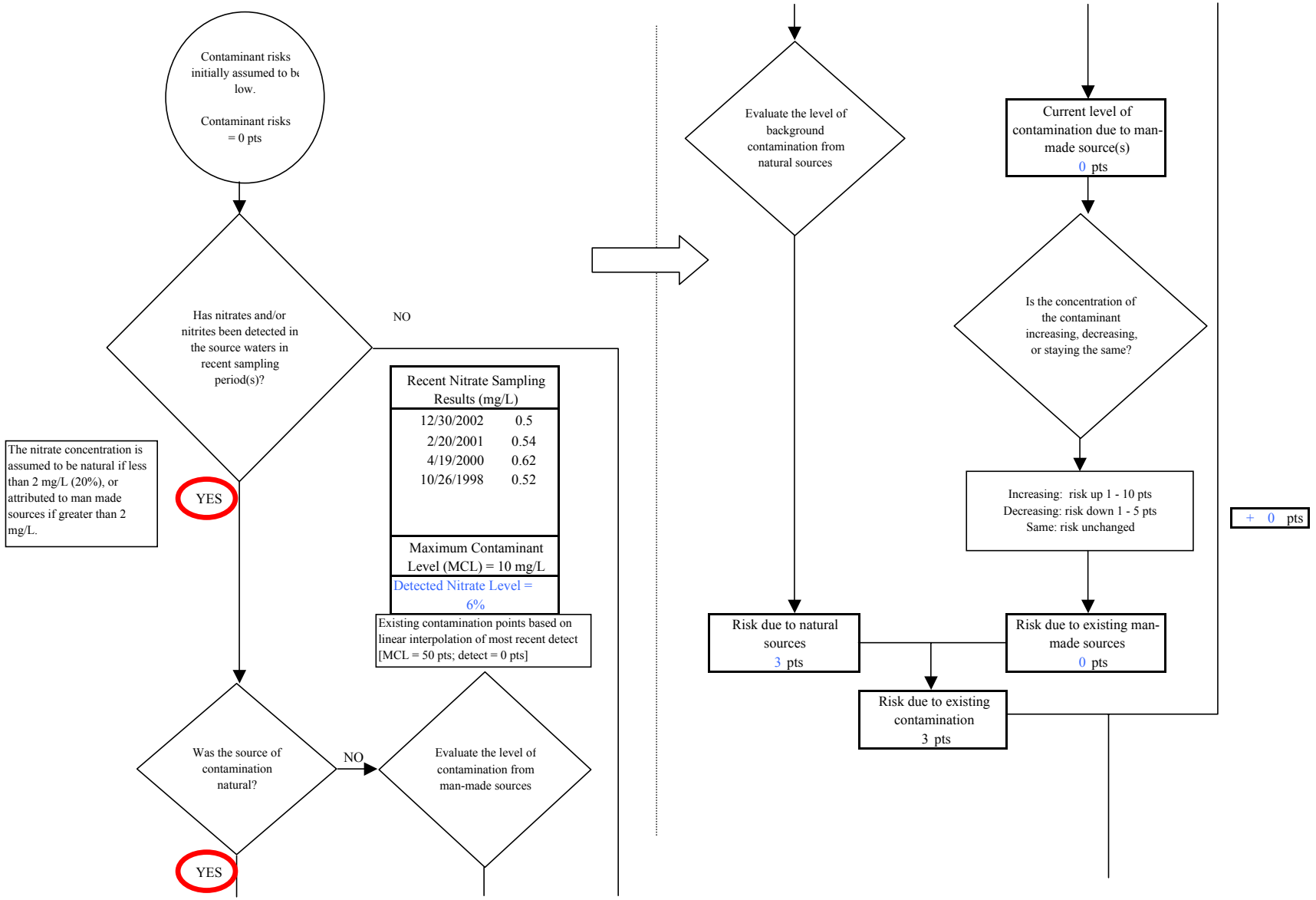


Chart 5. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Nitrates and Nitrites

+ 25 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	30	0	30
Low(s)	5	1	6

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

Matrix Score 25

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 3 for inventory.

Chart 5. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Nitrates and Nitrites

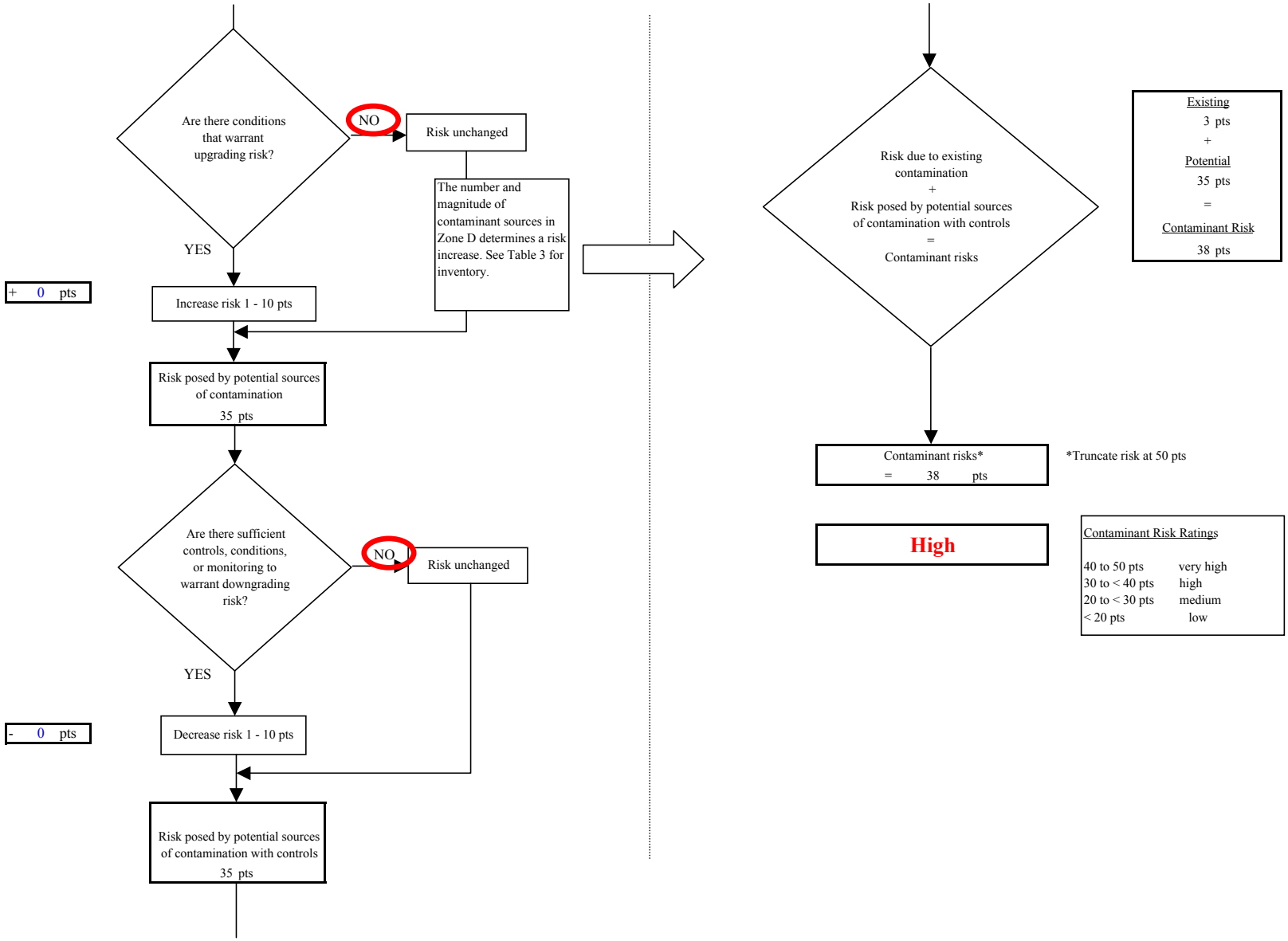


Chart 6. Vulnerability analysis for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Nitrates and Nitrites

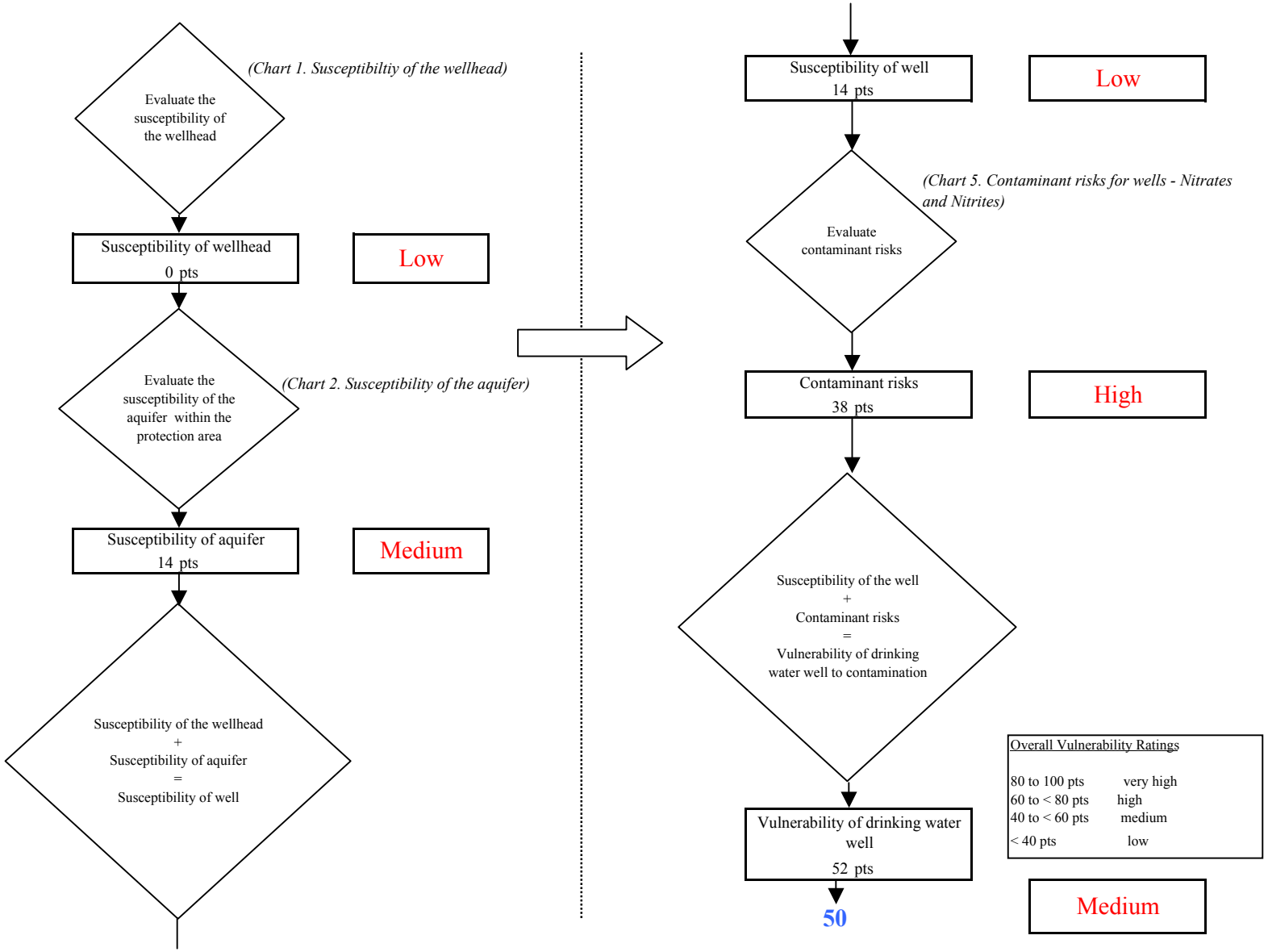


Chart 7. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Volatile Organic Chemicals

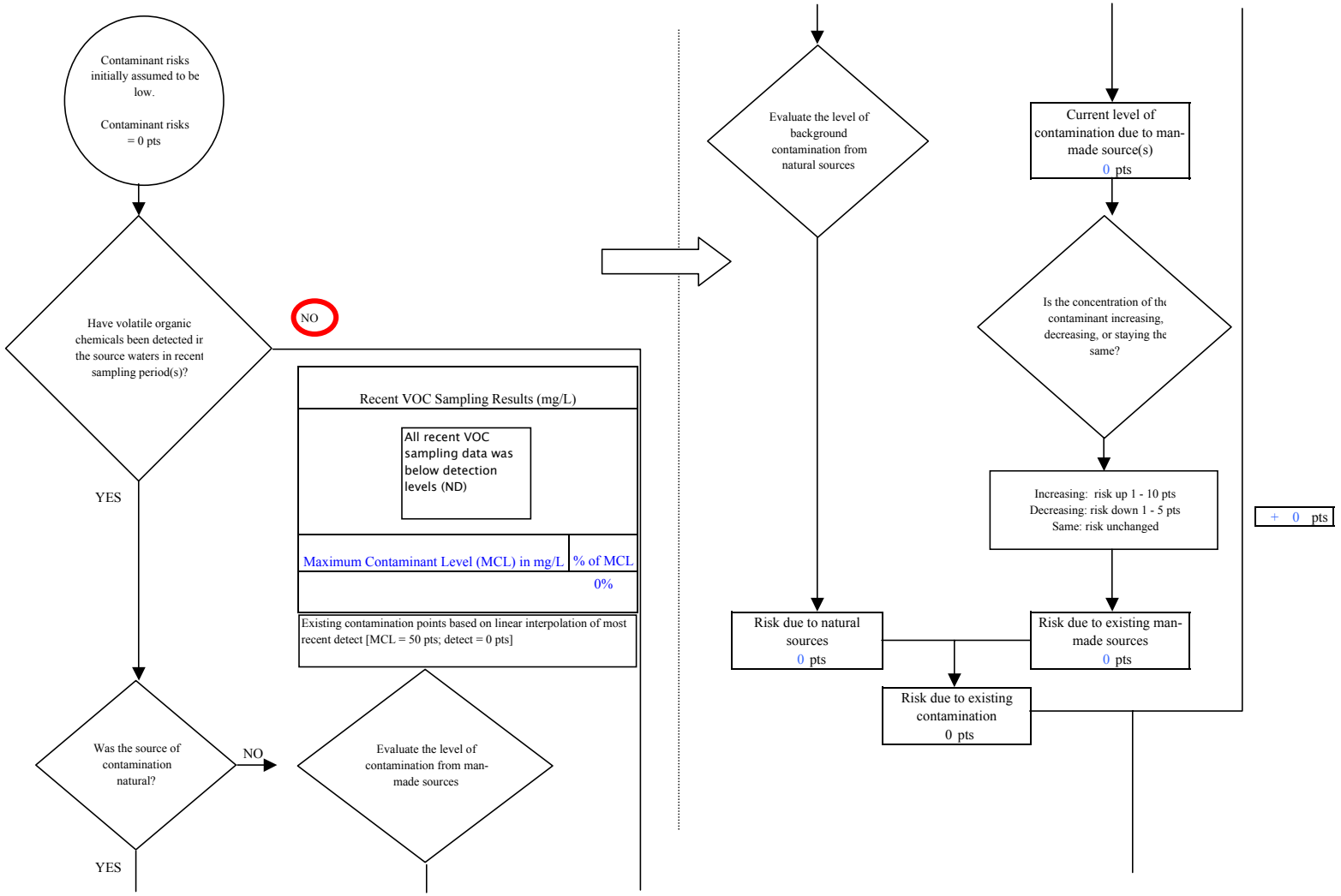
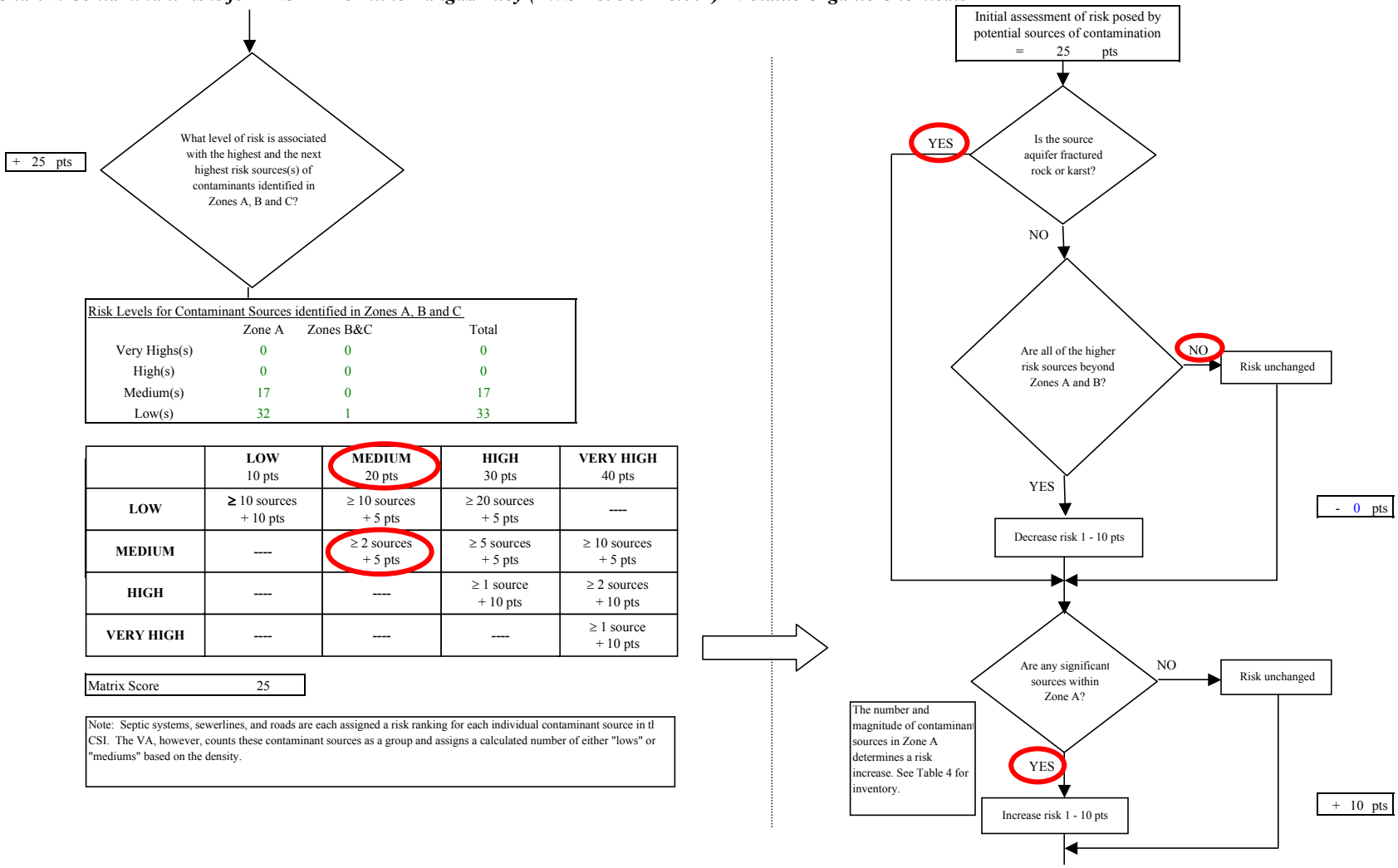


Chart 7. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Volatile Organic Chemicals



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)	17	0	17
Low(s)	32	1	33

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

Matrix Score 25

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

Chart 7. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Volatile Organic Chemicals

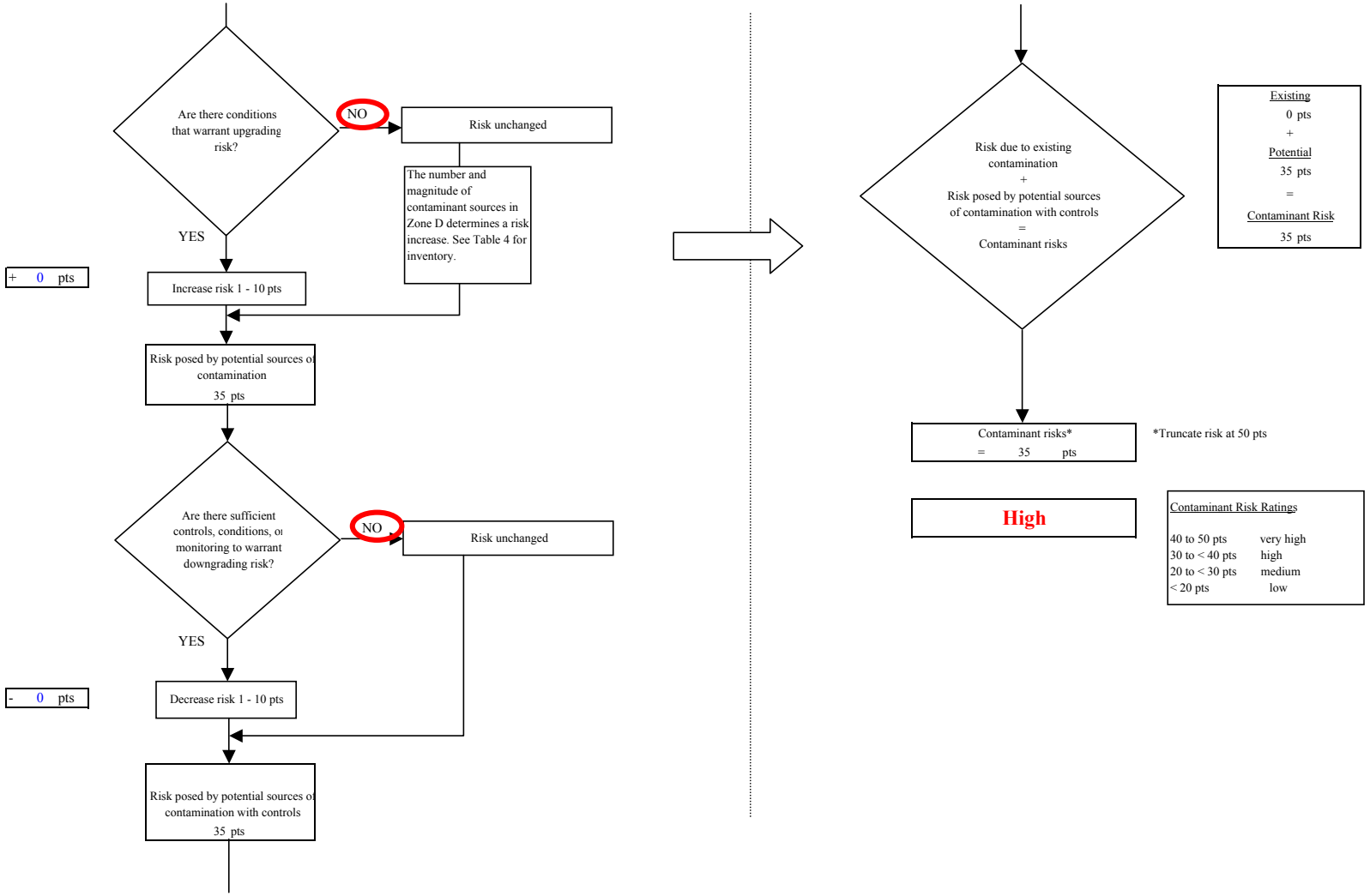


Chart 8. Vulnerability analysis for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Volatile Organic Chemicals

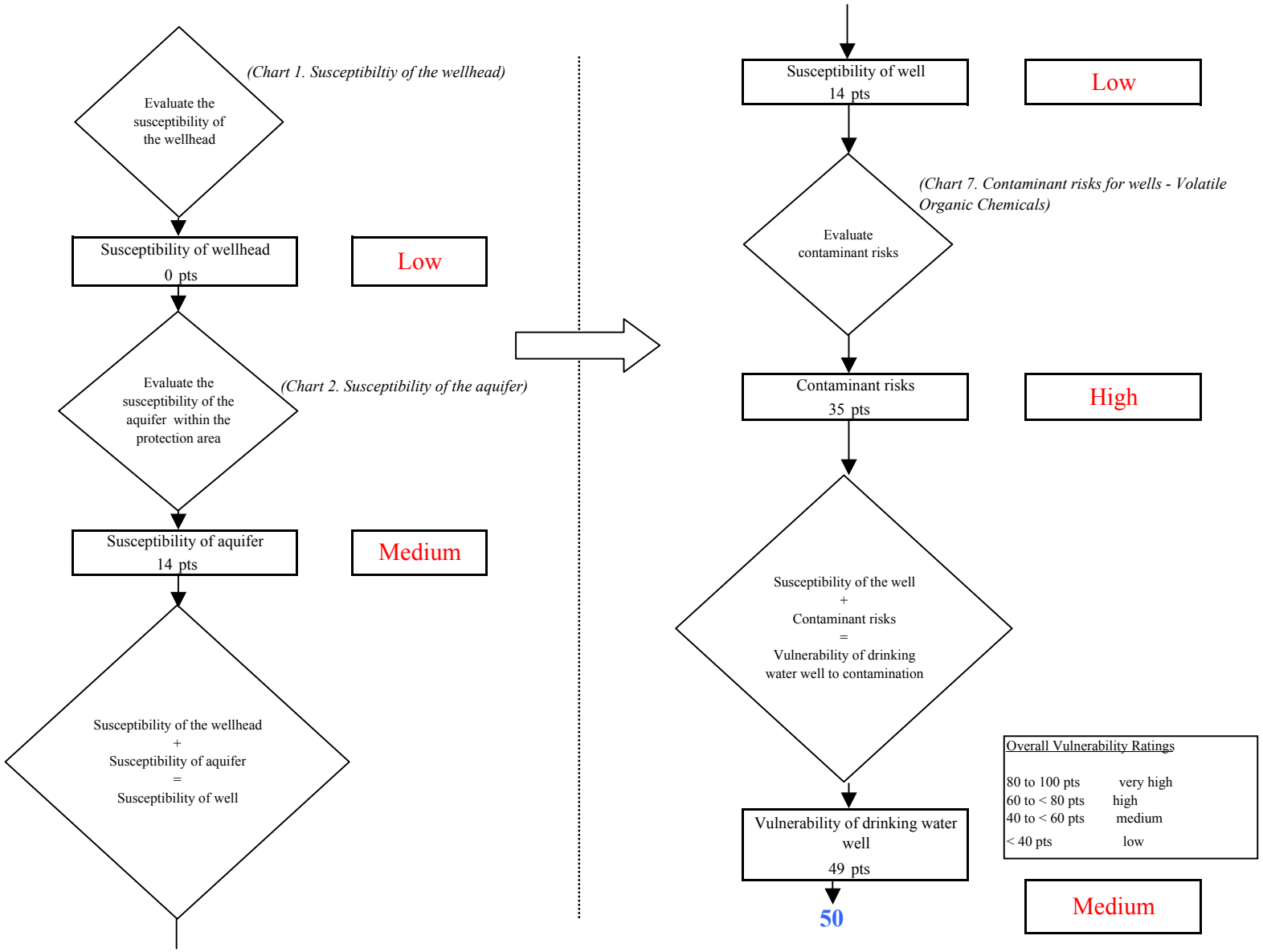


Chart 9. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

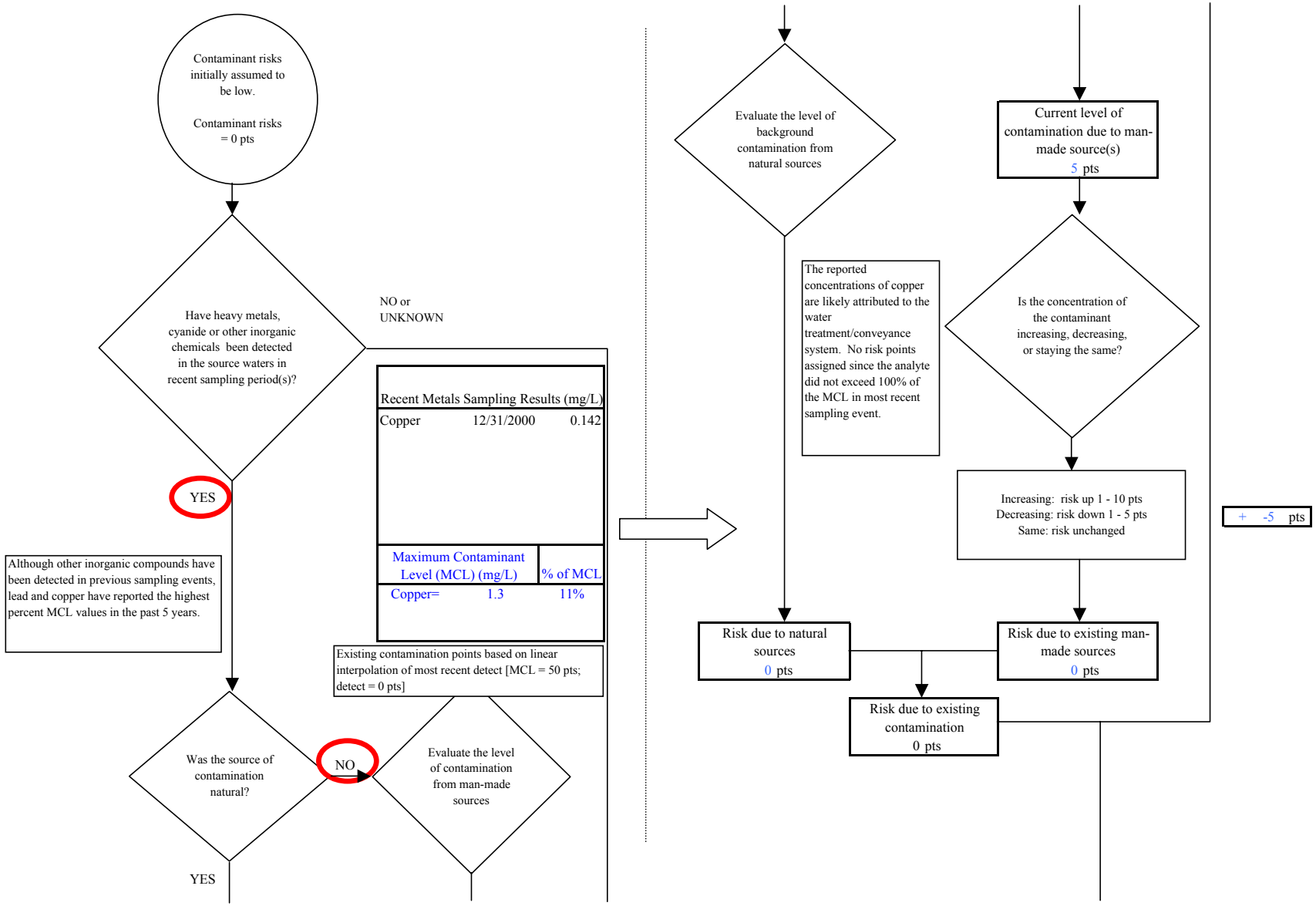
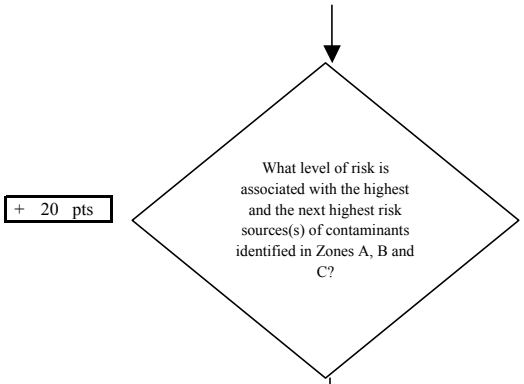


Chart 9. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 20 pts

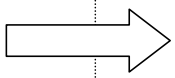
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	32	4	36

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

Matrix Score 20

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



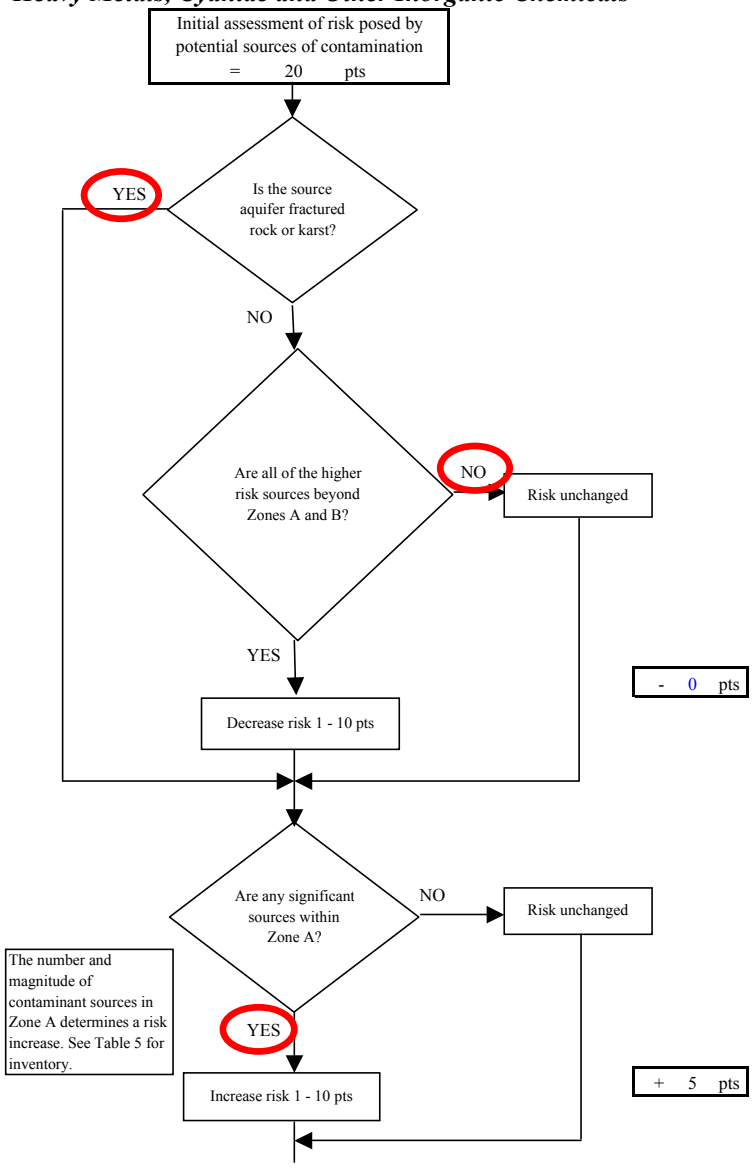


Chart 9. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

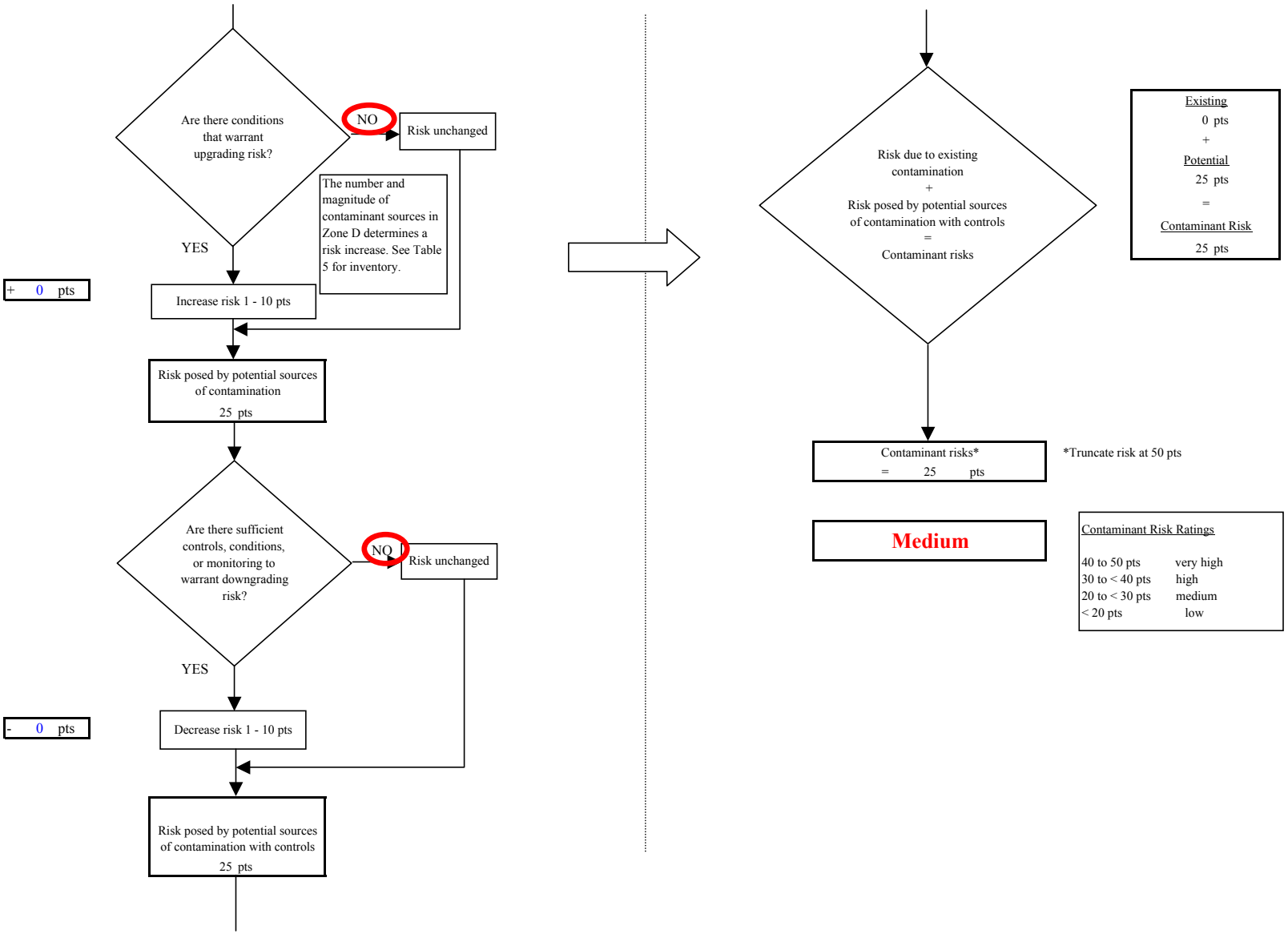


Chart 10. Vulnerability analysis for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

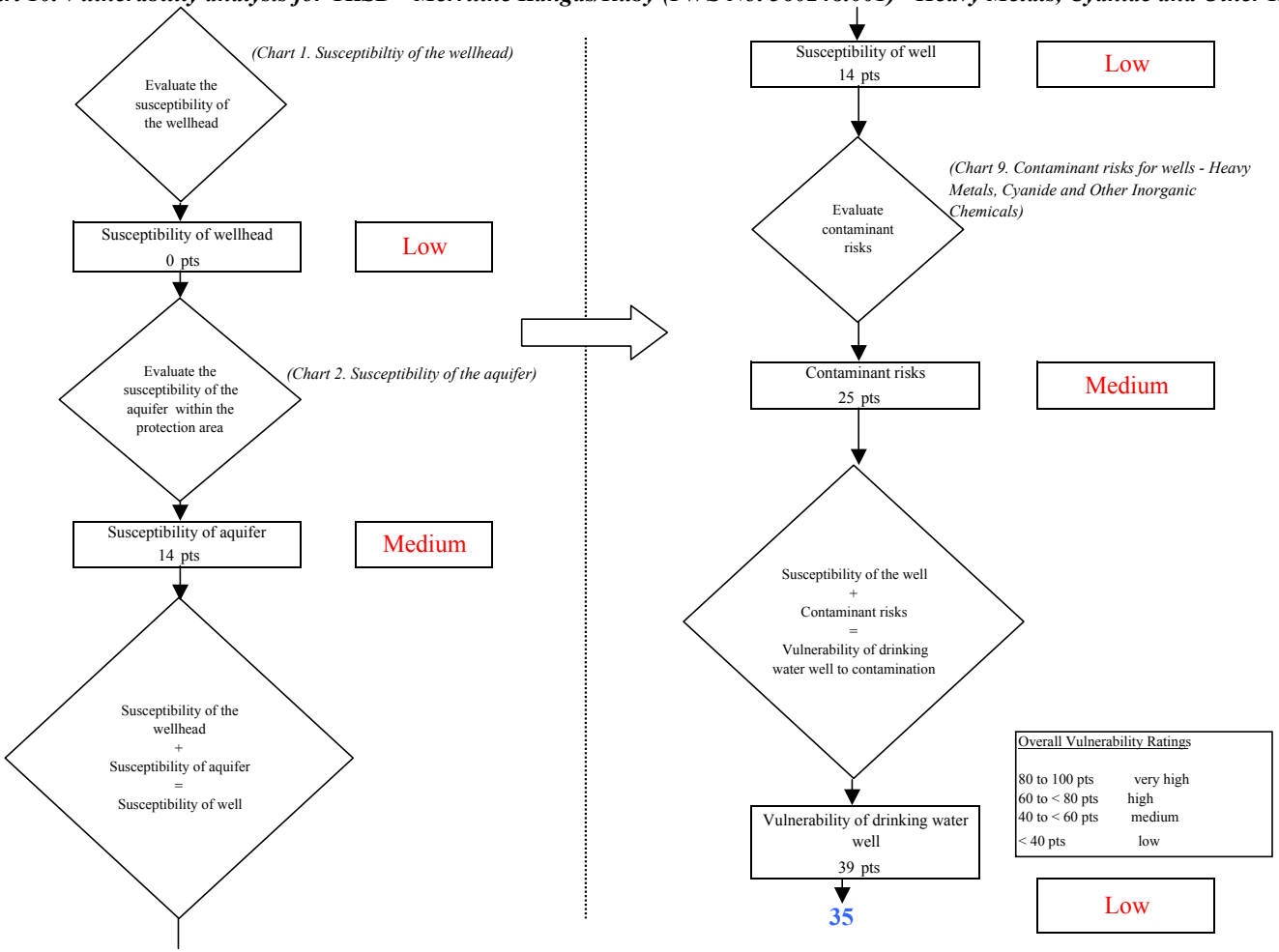


Chart 11. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Synthetic Organic Chemicals

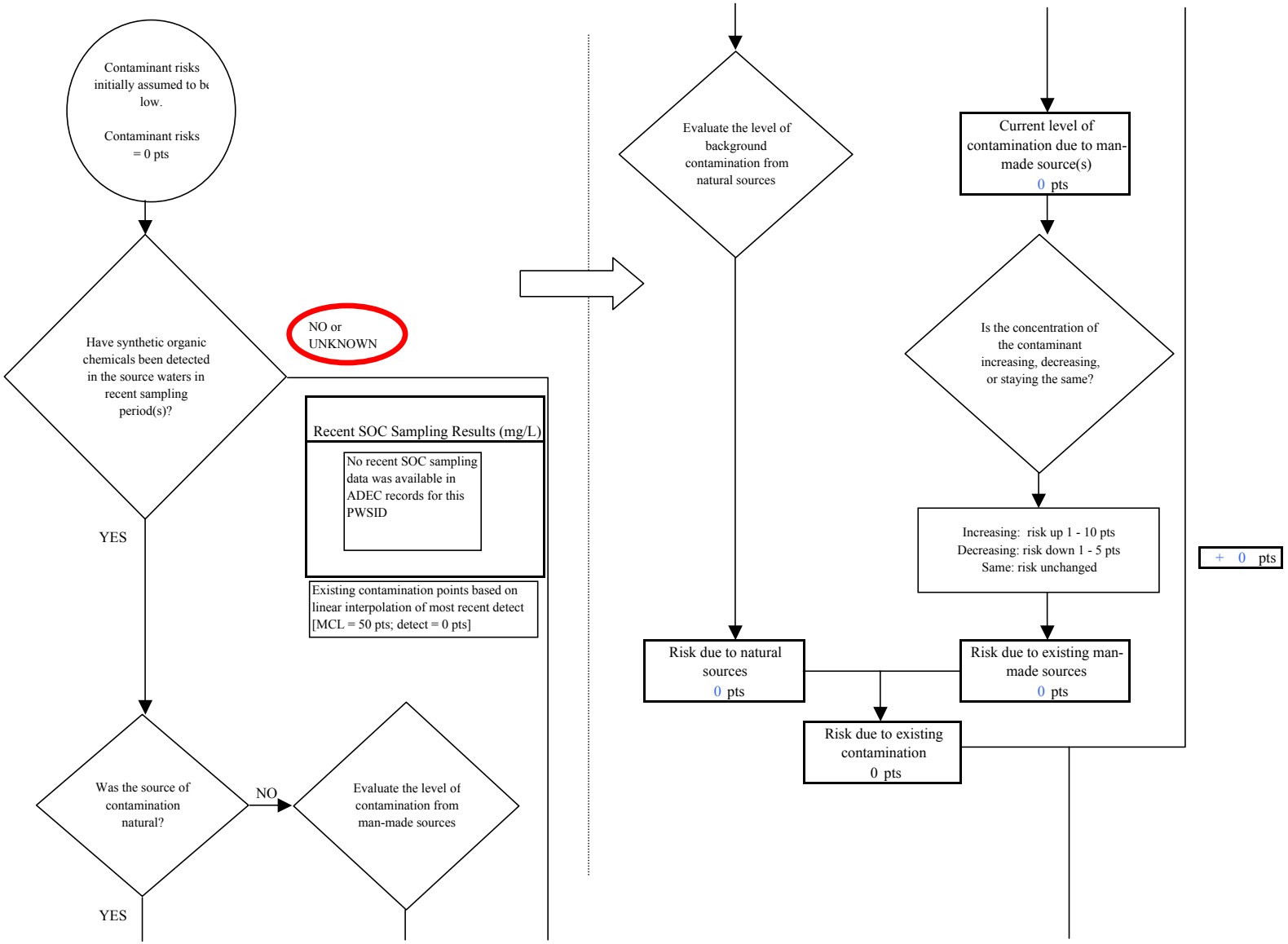
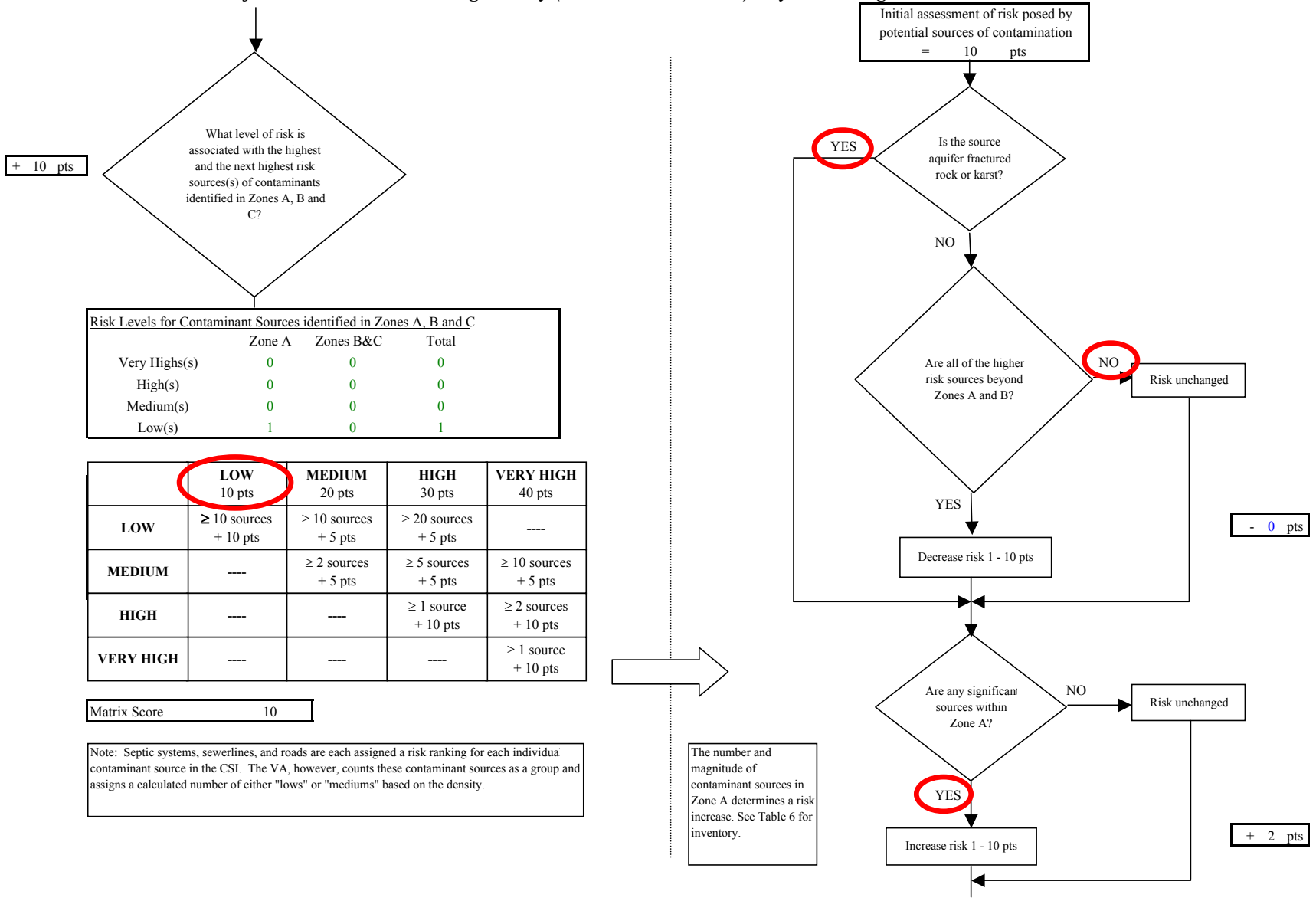


Chart 11. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Synthetic Organic Chemicals



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	0	1

	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 individua 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.

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 6 for inventory.

Chart 11. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Synthetic Organic Chemicals

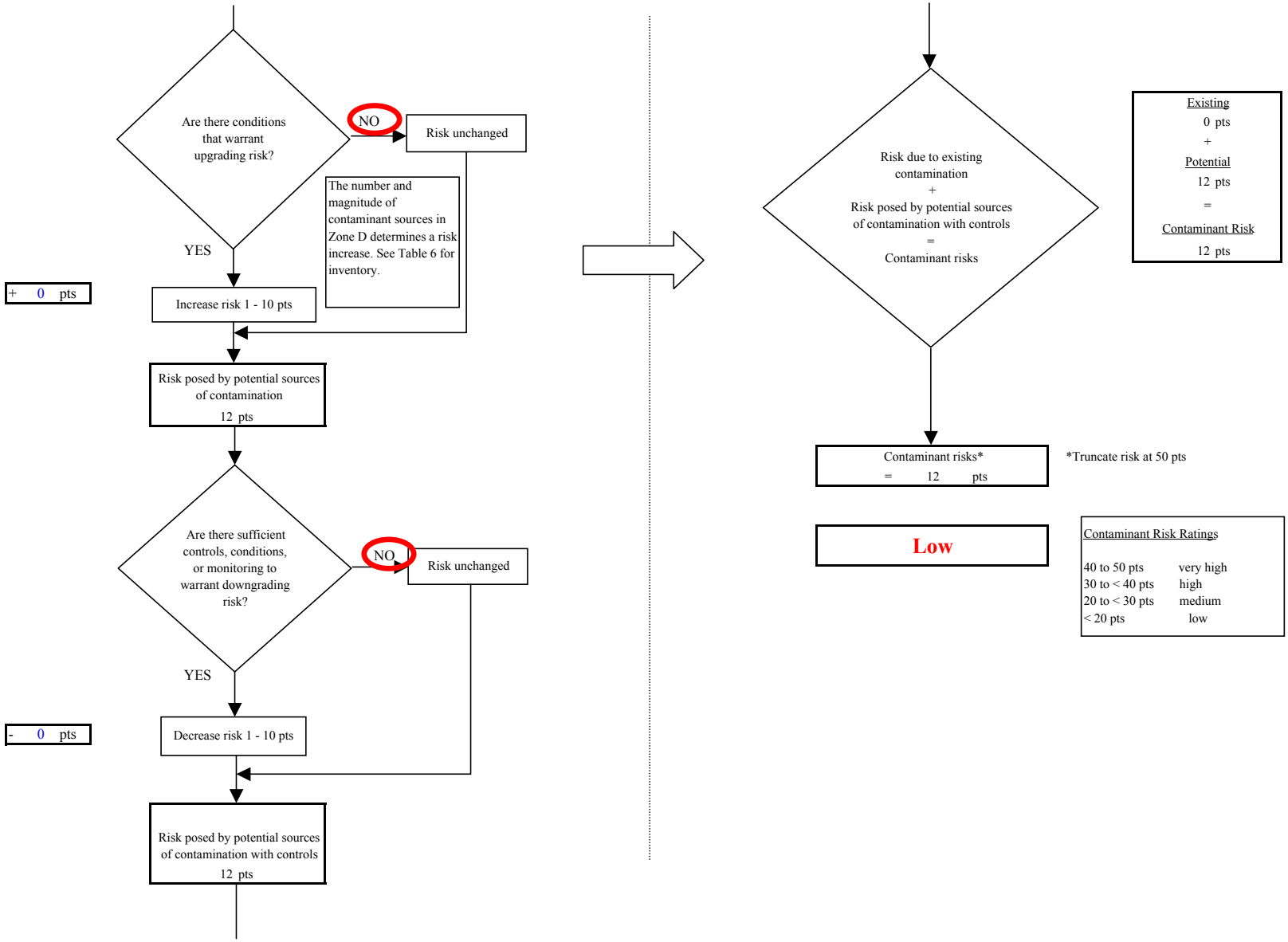


Chart 12. Vulnerability analysis for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Synthetic Organic Chemicals

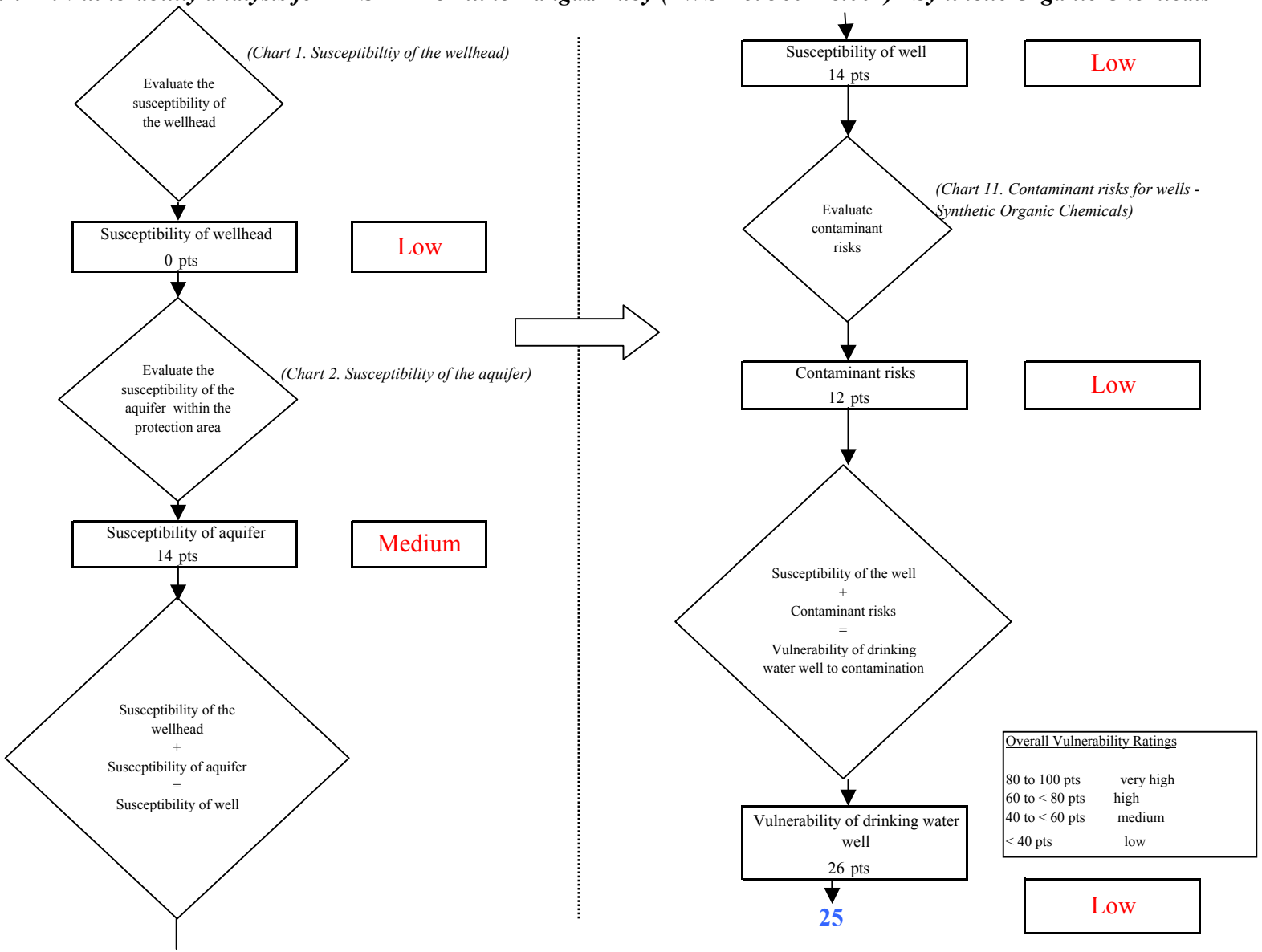


Chart 13. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Other Organic Chemicals

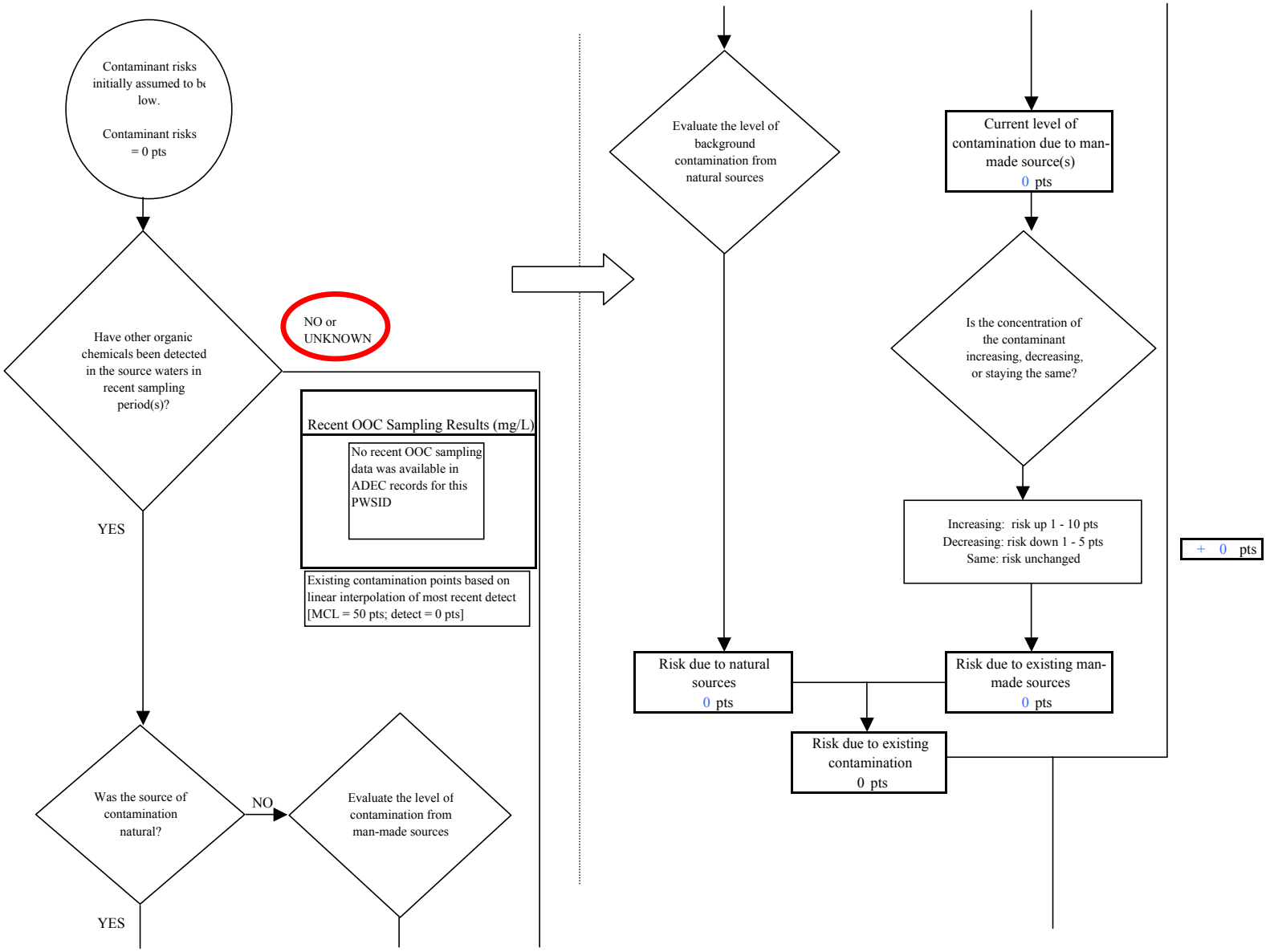
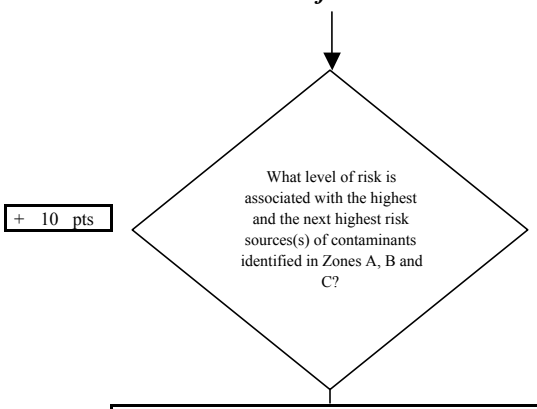


Chart 13. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Other Organic Chemicals



Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	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 10

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individua 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.

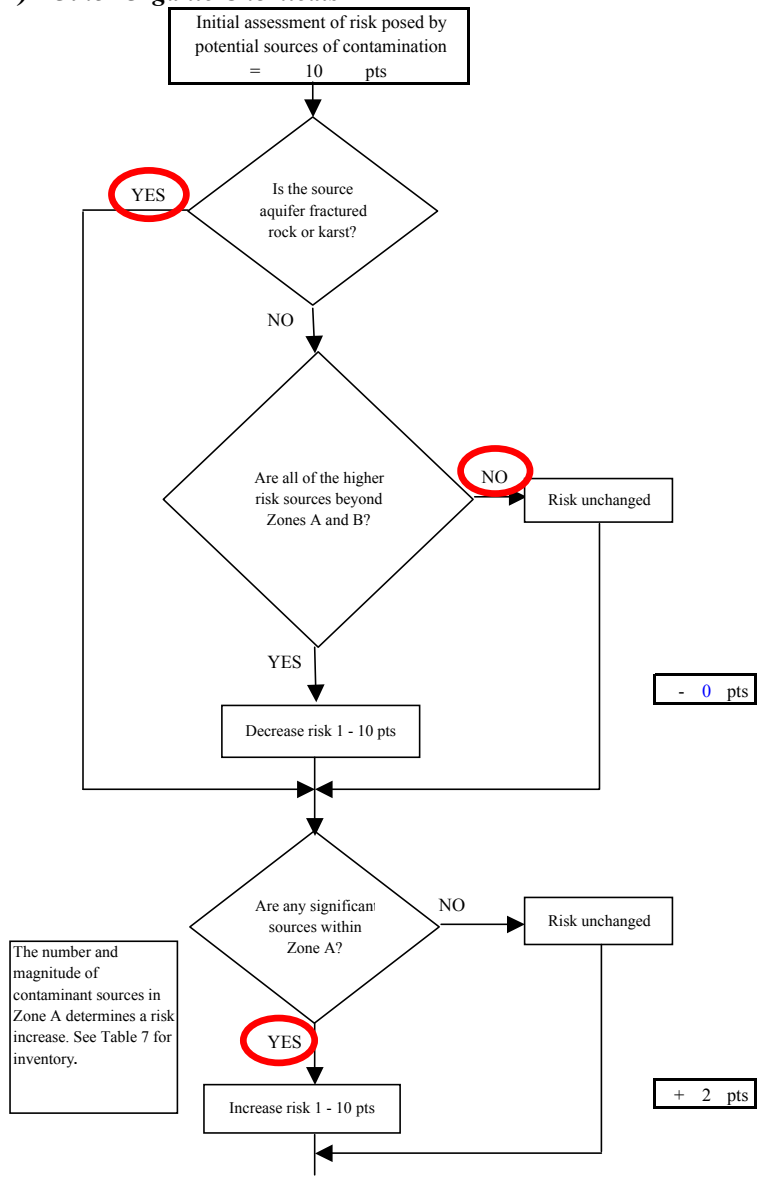


Chart 13. Contaminant risks for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Other Organic Chemicals

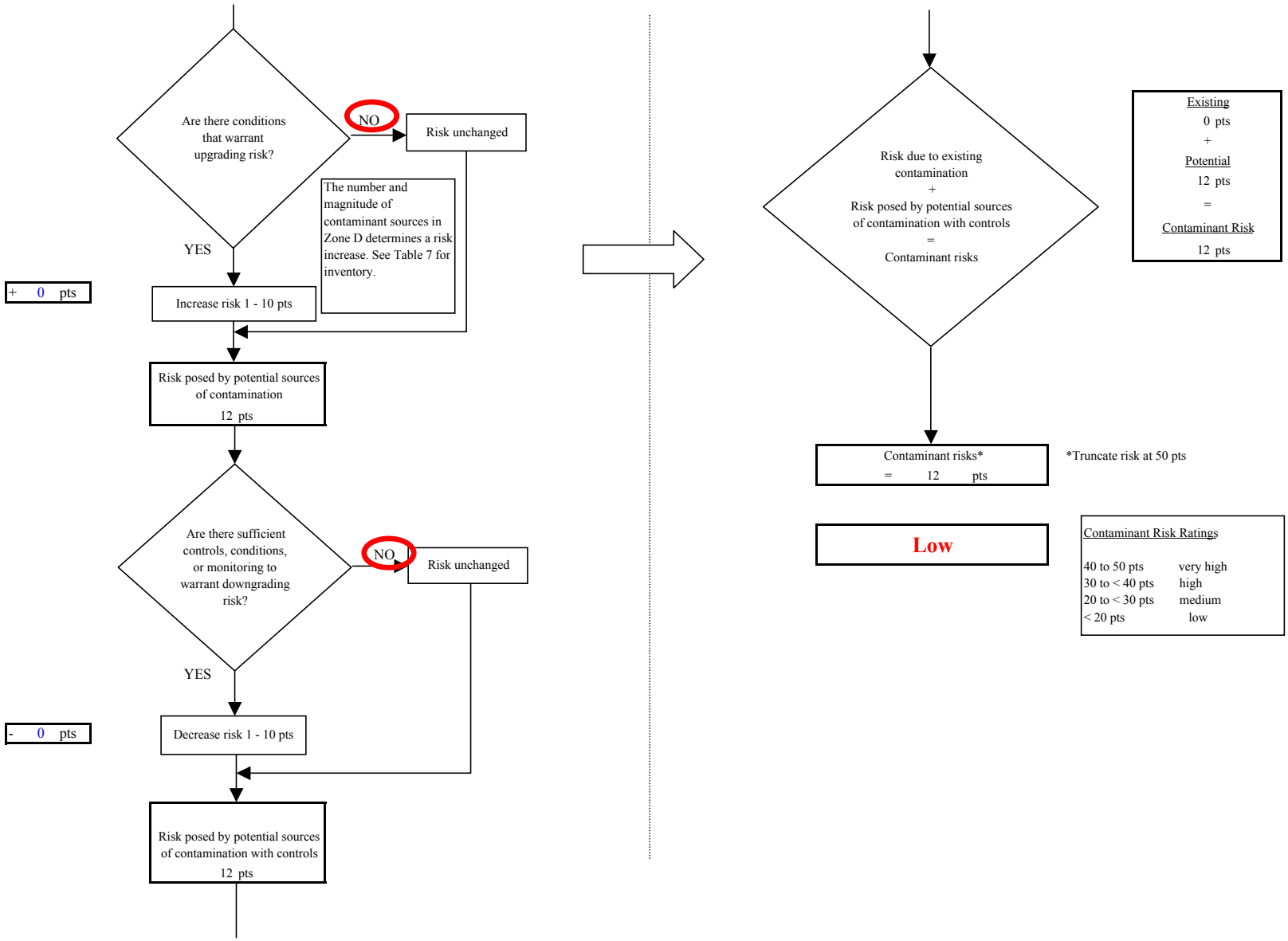


Chart 14. Vulnerability analysis for YKSD - Merriline Kangas/Ruby (PWS No. 360248.001) - Other Organic Chemicals