



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Koyukuk Safe Water Facility
Drinking Water System,
Koyukuk, Alaska

PWSID # 360214.001

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DRINKING WATER PROTECTION PROGRAM REPORT 1339
Alaska Department of Environmental Conservation

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

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

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Source Water Assessment for the Koyukuk Safe Water Facility Source of Public Drinking Water, Koyukuk, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Koyukuk Safe Water Facility has one Public Water System (PWS) well. The well (PWS No 360214.001) has been used as a drinking water source since it was drilled in November of 1975.

The well is a Class A (community and non-transient non-community) water system located directly outside of the washeteria in Koyukuk, Alaska. Available records indicate that there is secondary storage of drinking water, with a capacity of 5,000-gallons, and that the drinking water source is treated with calcium hypochlorite. This system operates year round and serves approximately 126 residents. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produce a **High** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include water treatment facilities, fuel tanks, cemeteries, ADEC recognized contaminated sites, airports, power generation facilities, and bulk fuel facilities. A detailed inventory is located on Table 1 of Appendix B. 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 the bacteria and viruses, nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The Koyukuk Safe Water Facility well is a Class A (community/non-transient/non-community) public water system. The system located directly outside the washeteria in Koyukuk, Alaska (Sec. 17, T007S,

R006E, Kateel River Meridian; see Map A of Appendix A). Koyukuk is located on the Yukon River near the mouth of the Koyukuk River, 30 miles west of Galena. Koyukuk has a population of 111 (ADCED, 2003). Average annual precipitation in Koyukuk is 13 inches, including approximately 60 inches of snowfall. Temperatures range from the 70's°F in summer and 10°F in the winter.

The community of Koyukuk obtains their water supply from the community well at the washeteria. Households are not plumbed, and residents haul honeybuckets to the sewage lagoon (ADCED, 2003). Koyukuk receives electrical power from the city of Koyukuk. 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 Koyukuk Safe Water Facility PWS, the depth of the well is 190 feet below the ground surface. It is unknown if the well is screened. The well is completed in a confined aquifer, and is located within a floodplain.

Information acquired from a February 1998 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.

Koyukuk is located near the Nulato Hills, on the bank of the Yukon River. The hills are underlain by compact silt (loess) overlying colluvial and alluvial silt and sand underlain at varying depths by shale, siltstone, and muddy sandstone (I.H.S. 1994).

Soils in the area are generally characterized by moderately well-drained silts and sands (I.H.S. 1994).

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 Koyukuk Safe Water Facility 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 Koyukuk Safe Water Facility 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 Koyukuk Safe Water Facility 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 Koyukuk Safe Water Facility's water well is 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	25	Very High
Susceptibility of the Aquifer	13	Medium
Natural Susceptibility	38	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	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	50	Very High
Other Organic Chemicals	50	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:

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

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of wastewater treatment facilities located in Zone A and a landfill located in Zone B (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 not 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 wastewater treatment facilities located in Zone A and a landfill located in Zone B (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 nitrate levels have all been below detection limits. 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. 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 bulk fuel facilities located in Zone A (see Table 4 – Appendix B).

Recent sampling data for VOC's indicated the presence of total trihalomethanes (TTHM's). TTHM's are generally a byproduct of water treatment and not indicative of source water conditions. Risk points were not assigned due to the TTHM's not exceeding the MCL in the most recent sampling events for Koyukuk Safe Water Facility (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Possible sources of VOC's 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 **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 beryllium in recent sampling events and power generation facilities located in Zone A (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, moderate levels of beryllium have been detected in recent sampling history, but have not exceeded the MCL of 0.004 mg/L (see Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The greatest known naturally occurring concentrations of beryllium are found in certain pegmatite bodies. Certain fossil fuels contain beryllium compounds. Beryllium is not likely to be found in natural water above trace levels due to its relative insolubility. It has been reported to occur in US drinking water at 0.01 to 0.7 ug/L. EPA has found beryllium to potentially cause damage to bones and lungs from long-term exposure.

Although the source of beryllium is unknown, it is likely representative of source water conditions. See Table 5 for a complete listing of possible contaminant sources. 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 **Very High**. The risk is primarily attributed to the presence of a landfill in Zone B (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the Koyukuk Safe Water Facility (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 **Very High**.

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of bulk fuel facilities in Zone A and a landfill in Zone B (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the Koyukuk Safe Water Facility (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 community of Koyukuk 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
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- Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey
- Information from Project Summary, Sanitation Facilities Construction, City of Nulato, Alaska, Indian Health Services (I.H.S.), Project No. AN 94-074 dated April 1994.
- 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)

APPENDIX B

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

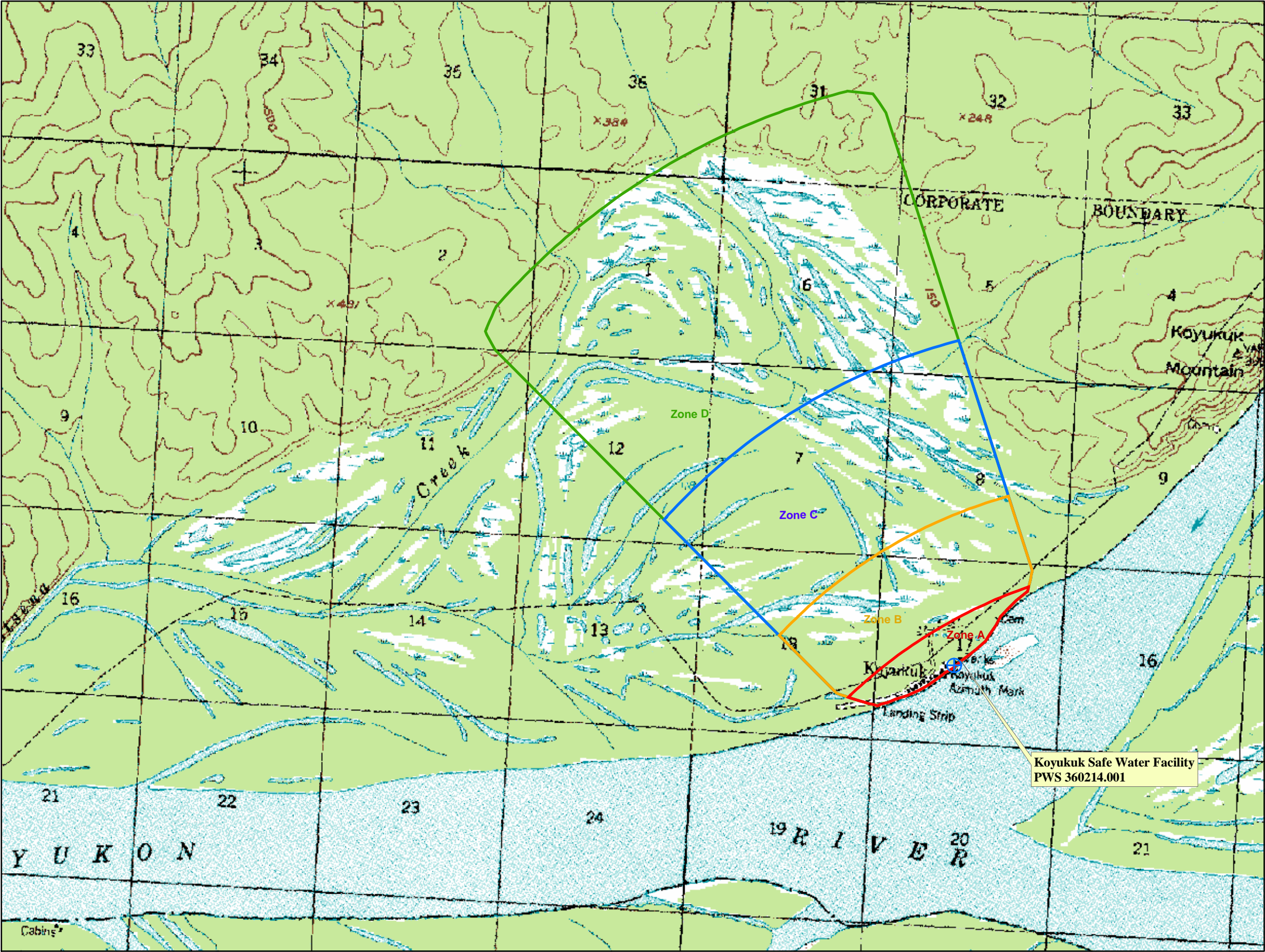
APPENDIX C

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

APPENDIX D

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

Public Water Well System for PWS #360214.001 Koyukuk Safe Water Facility



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

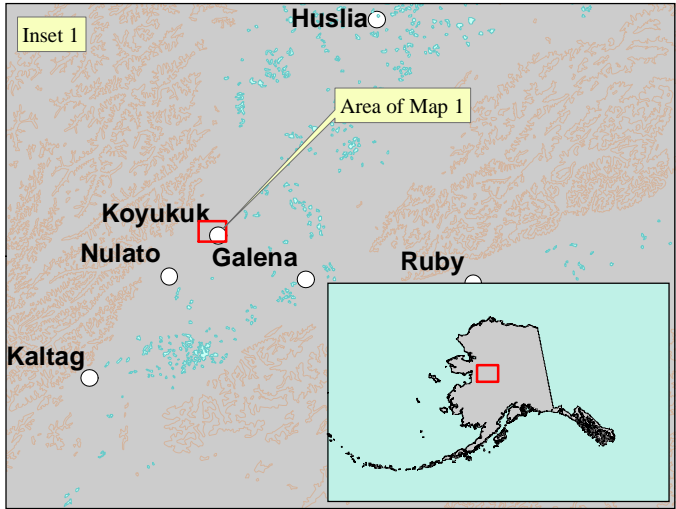
- Zone A Protection Area- Several Months Travel Time
- Zone B Protection Area- 2 Years Travel Time
- Zone C Protection Area- 5 Years Travel Time
- Zone D Protection Area- 10 Years Travel Time

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

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.



Koyukuk Safe Water Facility
PWS 360214.001
Appendix A Map A

Table 1

**Contaminant Source Inventory for
Koyukuk Safe Water Facility**

PWSID 360214.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Laundromats without dry cleaning	C22	C22-01	A	C	
Motor /motor vehicle repair shops	C31	C31-01	A	C	Airport DOT
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	Assume 2 or less sewer lines in Zone A
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	C	
Domestic wastewater treatment plants	D05	D05-01	A	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	C	Assume 3 or less septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 5 or less residential heating oil tanks in Zone A
Tanks, diesel (above ground)	T06	T06-01	A	C	School Backup Generator
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	City of Koyukuk Power Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	Koyukuk Health Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	C	City and Tribal Storage Shed
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	C	City and Tribal Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	C	Village Public Safety Officer
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	C	

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Map Number</i>	<i>Comments</i>
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	C	City TV Receiver
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	C	School Internet Receiver
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	C	Ella B. Verneti School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	A	C	Preschool
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	A	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Cemeteries	X01	X01-01	A	C	Cemetery 1
Cemeteries	X01	X01-02	A	C	Cemetery 2
Cemeteries	X01	X01-03	A	C	Cemetery 3
Petroleum product bulk station/terminals	X11	X11-01	A	C	City Electric Utility
Petroleum product bulk station/terminals	X11	X11-02	A	C	Pumphouse Tank
Petroleum product bulk station/terminals	X11	X11-03	A	C	YK Schools
Airports	X14	X14-01	A	C	KOYUKUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Electric power generation (fossil fuels)	X36	X36-01	A	C	City of Koyukuk Power Plant
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	C	Koyukuk Health Clinic
Landfills (municipal; Class III)	D51	D51-01	B	C	Koyukuk Landfill (New)

Table 2

*Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Bacteria and Viruses*

PWSID 360214.001

<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>
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	Assume 2 or less sewer lines in Zone A
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	
Domestic wastewater treatment plants	D05	D05-01	A	Medium	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 3 or less septic systems in Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Medium	C	Koyukuk Health Clinic
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Koyukuk Landfill (New)

Table 3

*Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Nitrates/Nitrites*

PWSID 360214.001

<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>
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	Assume 2 or less sewer lines in Zone A
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	
Domestic wastewater treatment plants	D05	D05-01	A	Medium	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 3 or less septic systems in Zone A
Cemeteries	X01	X01-01	A	Medium	C	Cemetery 1
Cemeteries	X01	X01-02	A	Medium	C	Cemetery 2
Cemeteries	X01	X01-03	A	Medium	C	Cemetery 3
Airports	X14	X14-01	A	Low	C	KOYUKUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyukuk Health Clinic
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Koyukuk Landfill (New)

Table 4

*Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Volatile Organic Chemicals*

PWSID 360214.001

<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>
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Airport DOT
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 2 or less sewer lines in Zone A
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 3 or less septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 5 or less residential heating oil tanks in Zone A
Tanks, diesel (above ground)	T06	T06-01	A	Medium	C	School Backup Generator
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	City of Koyukuk Power Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Koyukuk Health Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	Low	C	City and Tribal Storage Shed
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	Low	C	City and Tribal Offices

Table 4 (continued)

*Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Volatile Organic Chemicals*

PWSID 360214.001

<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>
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	Low	C	Village Public Safety Officer
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	Low	C	City TV Receiver
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	Low	C	School Internet Receiver
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	Low	C	Ella B. Verneti School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	A	Low	C	Preschool
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	High	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	A	High	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	City Electric Utility
Petroleum product bulk station/terminals	X11	X11-02	A	Very High	C	Pumphouse Tank
Petroleum product bulk station/terminals	X11	X11-03	A	Very High	C	YK Schools
Airports	X14	X14-01	A	High	C	KOYUKUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	City of Koyukuk Power Plant
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyukuk Health Clinic
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Koyukuk Landfill (New)

Table 5

*Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

PWSID 360214.001

<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>
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Airport DOT
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 2 or less sewer lines in Zone A
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Sewage Lagoon
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 3 or less septic systems in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	City of Koyukuk Power Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Koyukuk Health Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	Low	C	City and Tribal Storage Shed
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	Low	C	City and Tribal Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	Low	C	Village Public Safety Officer
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	Low	C	City TV Receiver

Table 5 (continued)

**Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals**

PWSID 360214.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	Low	C	School Internet Receiver
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	Low	C	Ella B. Verneti School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	A	Low	C	Preschool
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	A	Low	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Cemeteries	X01	X01-01	A	Low	C	Cemetery 1
Cemeteries	X01	X01-02	A	Low	C	Cemetery 2
Cemeteries	X01	X01-03	A	Low	C	Cemetery 3
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	City Electric Utility
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	Pumphouse Tank
Petroleum product bulk station/terminals	X11	X11-03	A	Low	C	YK Schools
Airports	X14	X14-01	A	Low	C	KOYUKUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	City of Koyukuk Power Plant
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyukuk Health Clinic
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Koyukuk Landfill (New)

Table 6

*Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Synthetic Organic Chemicals*

PWSID 360214.001

<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>
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 2 or less sewer lines in Zone A
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Sewage Lagoon
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 3 or less septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	A	Low	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Cemeteries	X01	X01-01	A	Medium	C	Cemetery 1
Cemeteries	X01	X01-02	A	Medium	C	Cemetery 2
Cemeteries	X01	X01-03	A	Medium	C	Cemetery 3
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	City Electric Utility
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	Pumphouse Tank
Petroleum product bulk station/terminals	X11	X11-03	A	Low	C	YK Schools
Airports	X14	X14-01	A	Medium	C	KOYUKUK LANDING STRIP
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyukuk Health Clinic
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Koyukuk Landfill (New)

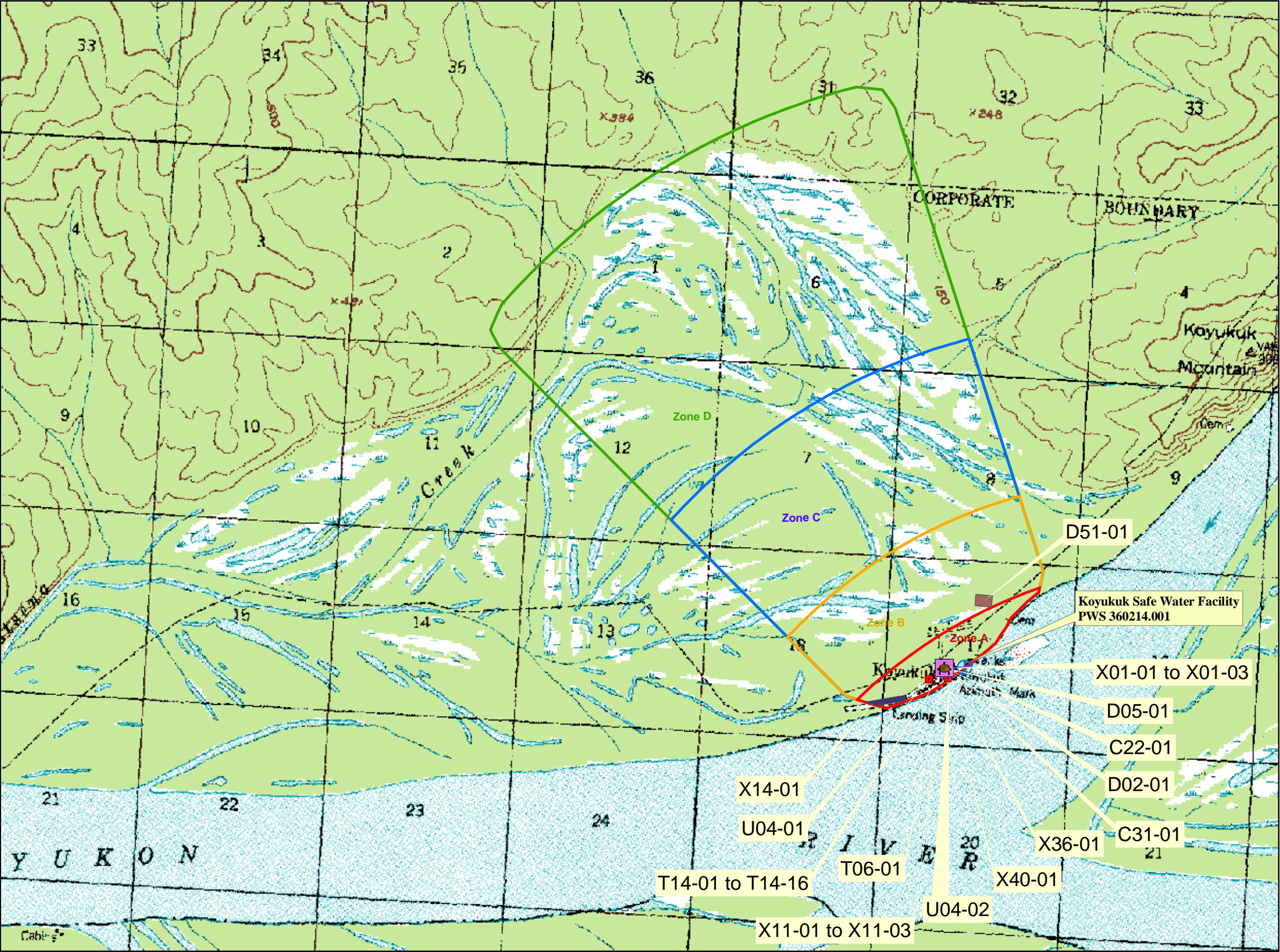
Table 7

*Contaminant Source Inventory and Risk Ranking for
Koyukuk Safe Water Facility
Sources of Other Organic Chemicals*

PWSID 360214.001

<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>
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Airport DOT
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 2 or less sewer lines in Zone A
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Sewage Lagoon
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 3 or less septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	A	Low	C	Koyukuk Elementary School. Reckey: 1992310114601. Status: Inactive. Heating oil leak from above ground fuel line. Unknown quantity spilled/recovered, line now removed. Estimated approximate surface area of 2,500 square feet.
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	City Electric Utility
Petroleum product bulk station/terminals	X11	X11-02	A	High	C	Pumphouse Tank
Petroleum product bulk station/terminals	X11	X11-03	A	High	C	YK Schools
Airports	X14	X14-01	A	Medium	C	KOYUKUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Electric power generation (fossil fuels)	X36	X36-01	A	High	C	City of Koyukuk Power Plant
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Koyukuk Landfill (New)

Public Water Well System for PWS #360214.001 Koyukuk Safe Water Facility
Showing Potential and Existing Sources of 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**
- Laundromat without dry cleaning (C22)
 - Motor/motor vehicle repair shop (C31)
 - Domestic wastewater treatment disposal ponds/lagoons (D02)
 - Domestic wastewater treatment plant (D05)
 - Tanks, diesel, aboveground (T06)
 - Tanks, heating oil, non-residential, aboveground (T14)
 - Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)
 - Cemetery (X01)
 - Bulk fuel storage or terminal (X11)
 - Electric Power Generation (fossil fuels) (X36)
 - Hospital/Clinic/ER (X40)
 - Landfill, municipal, Class III (D51)
 - Airport or Landing Strip (X14)
- Data Sources:**
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)
- 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.**

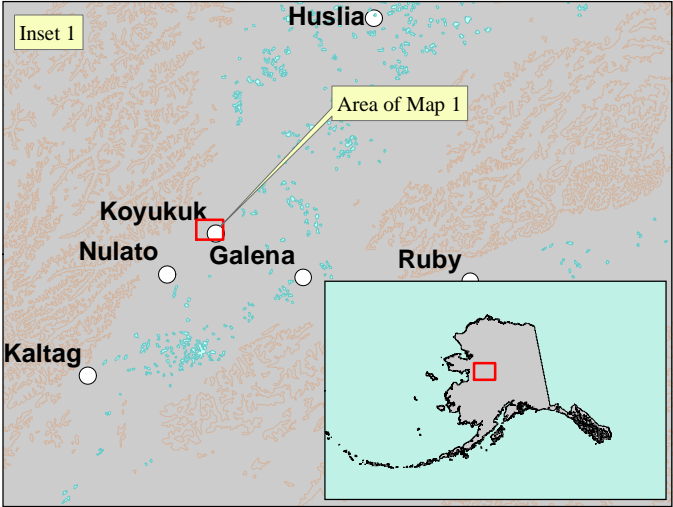


Chart 1. Susceptibility of the wellhead - Koyukuk Safe Water Facility (PWS No. 360214.001)

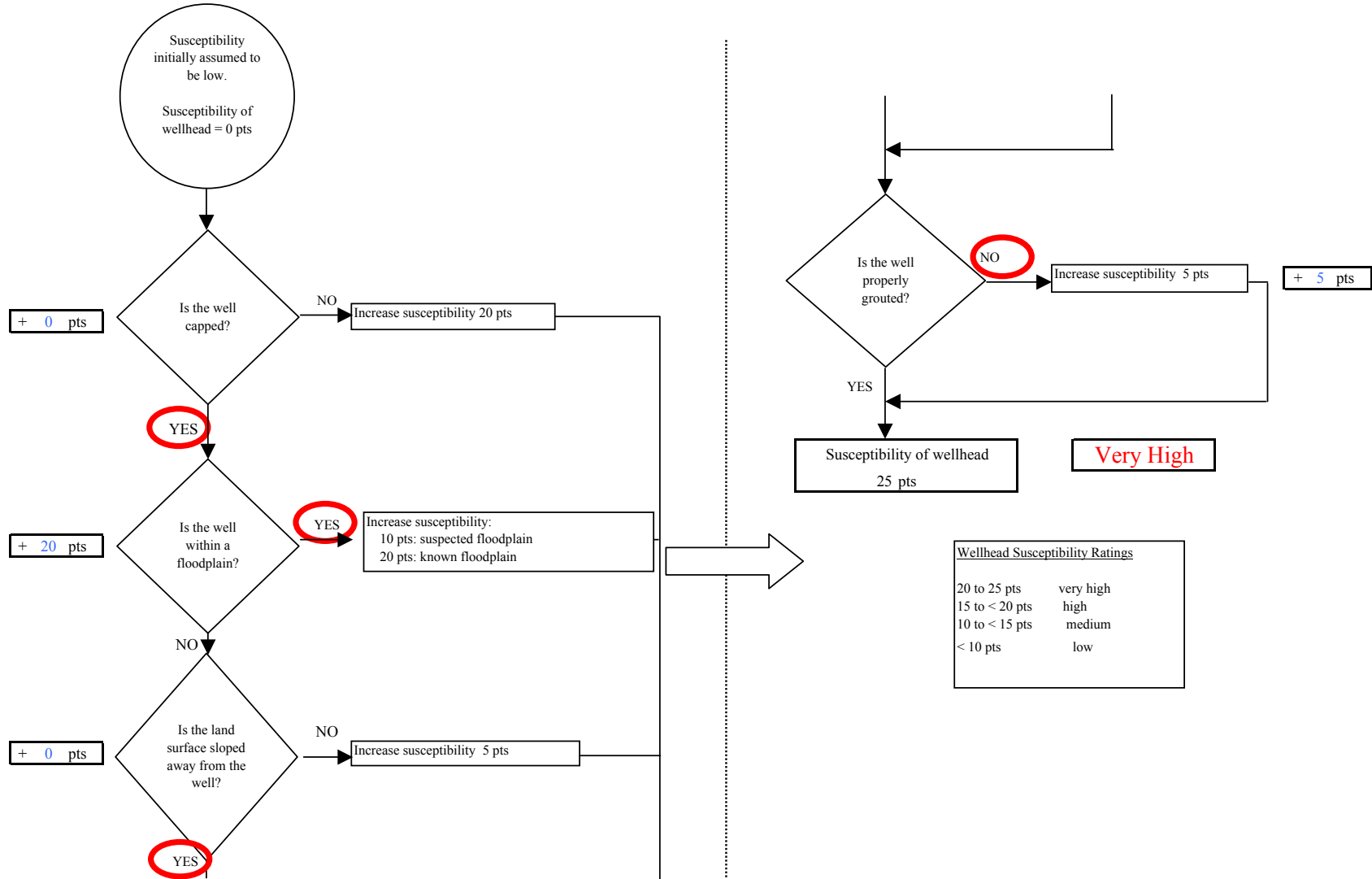


Chart 2. Susceptibility of the aquifer Koyukuk Safe Water Facility (PWS No. 360214.001)

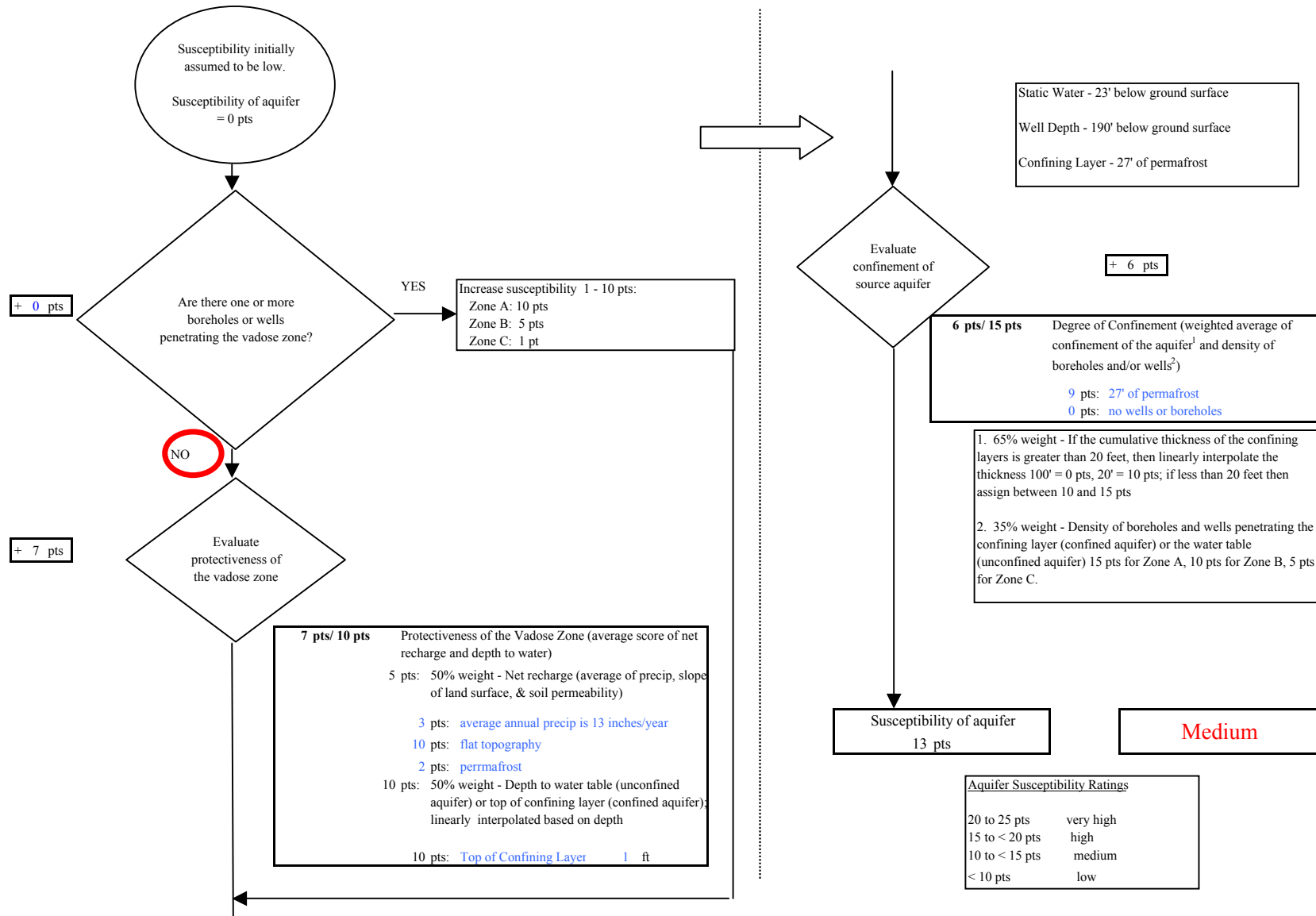


Chart 3. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Bacteria & Viruses

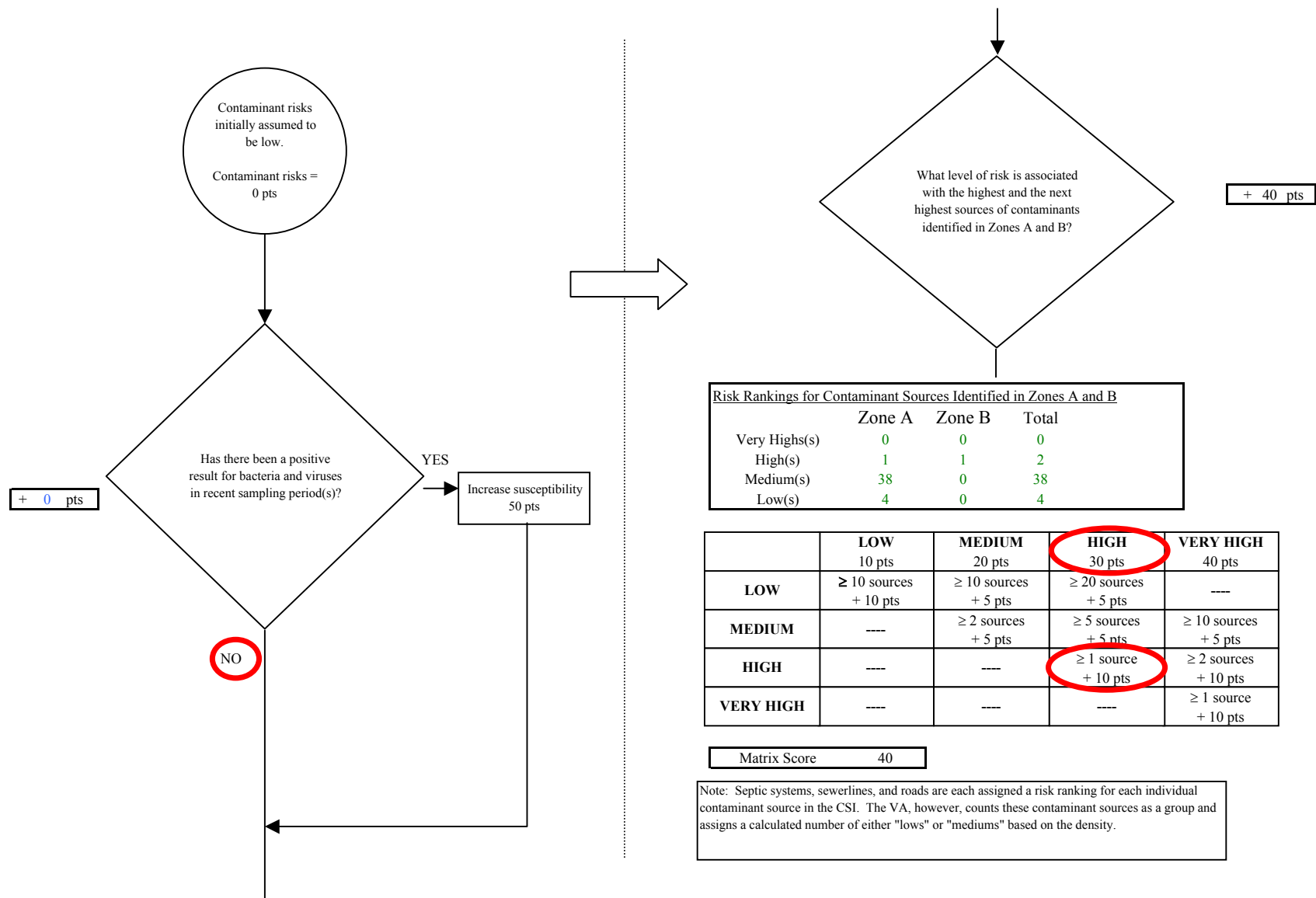


Chart 3. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Bacteria & Viruses

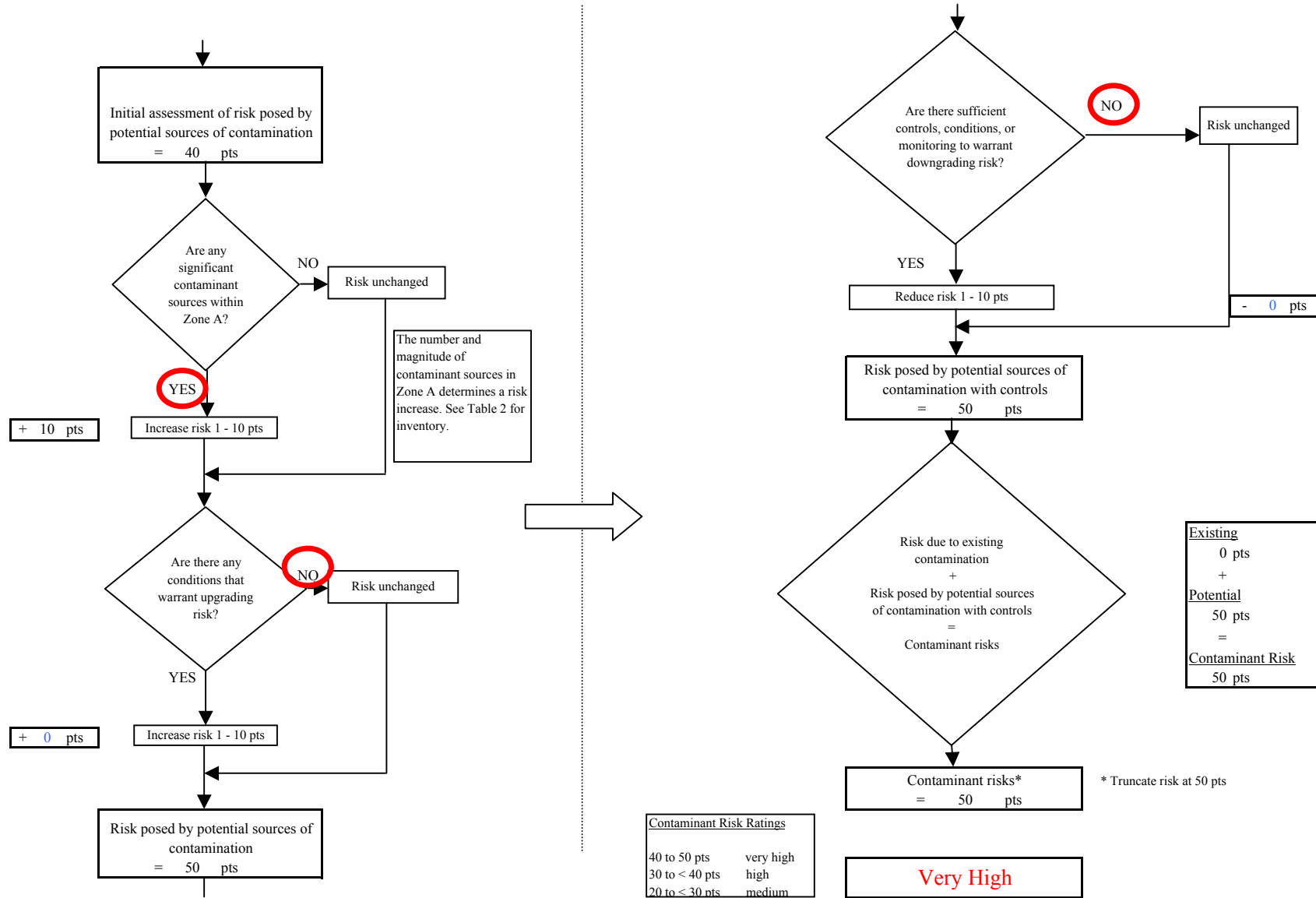


Chart 4. Vulnerability analysis for Koyukuk Safe Water Facility (PWS No. 360214.001) - Bacteria & Viruses

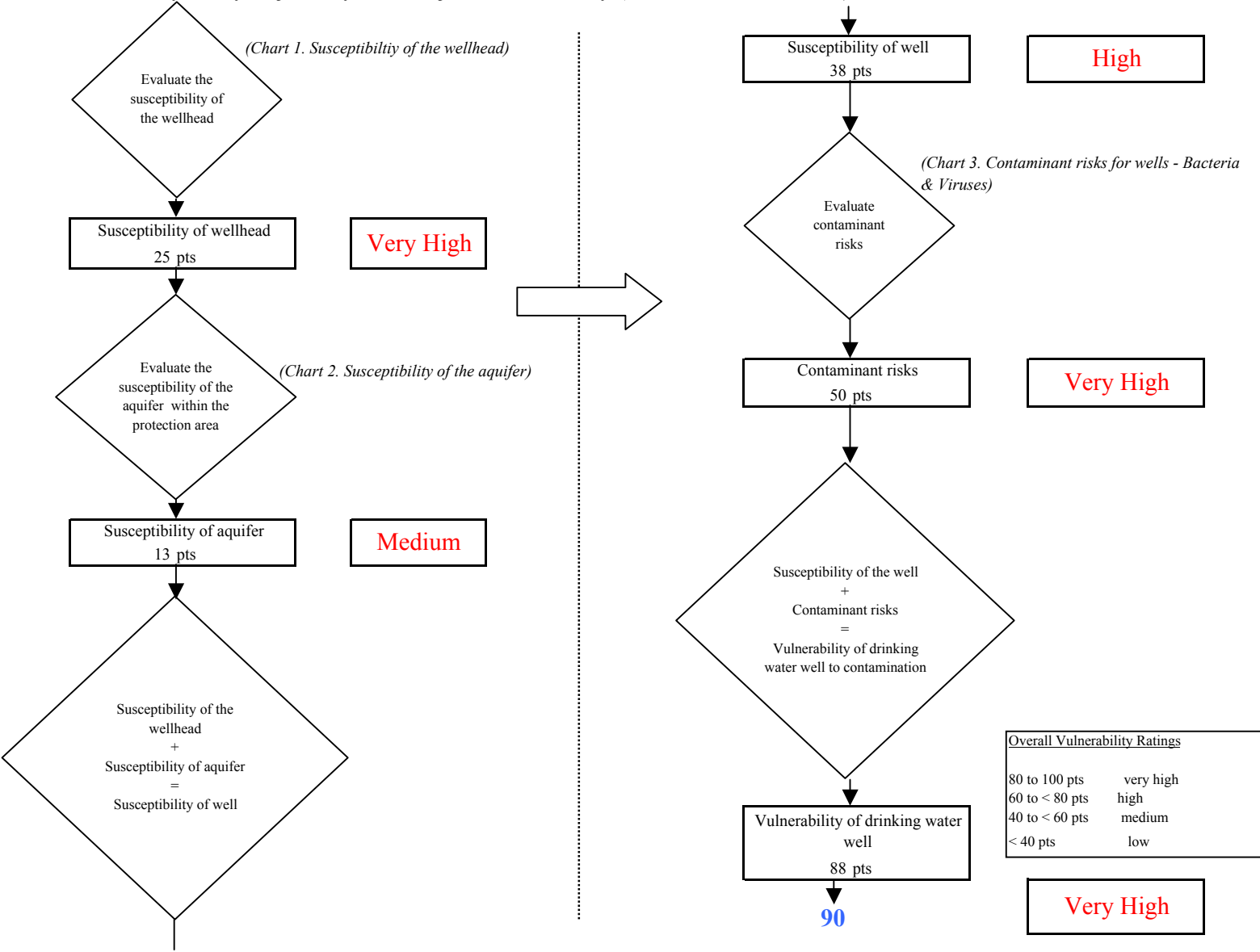


Chart 5. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Nitrates and Nitrites

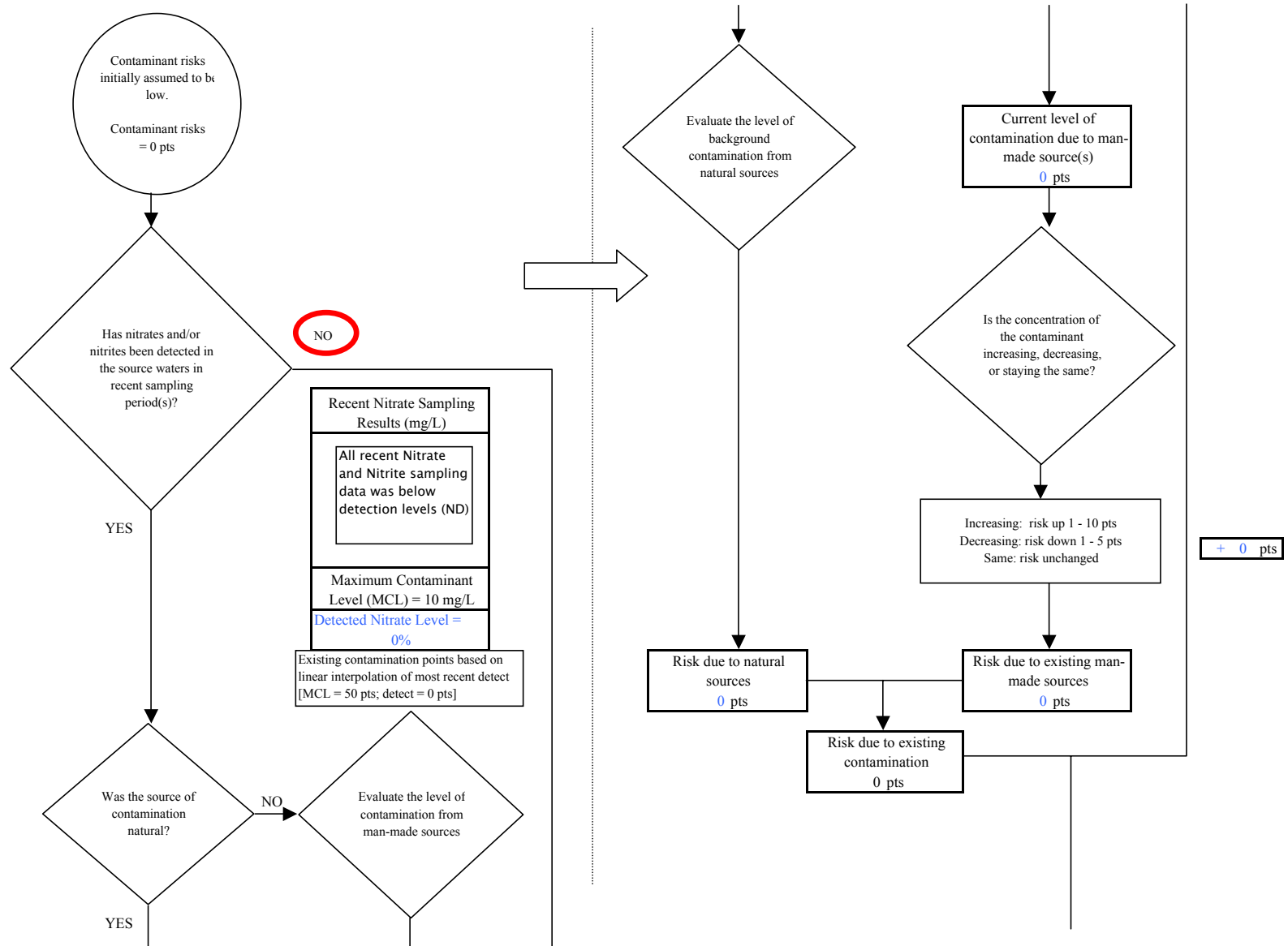


Chart 5. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Nitrates and Nitrites

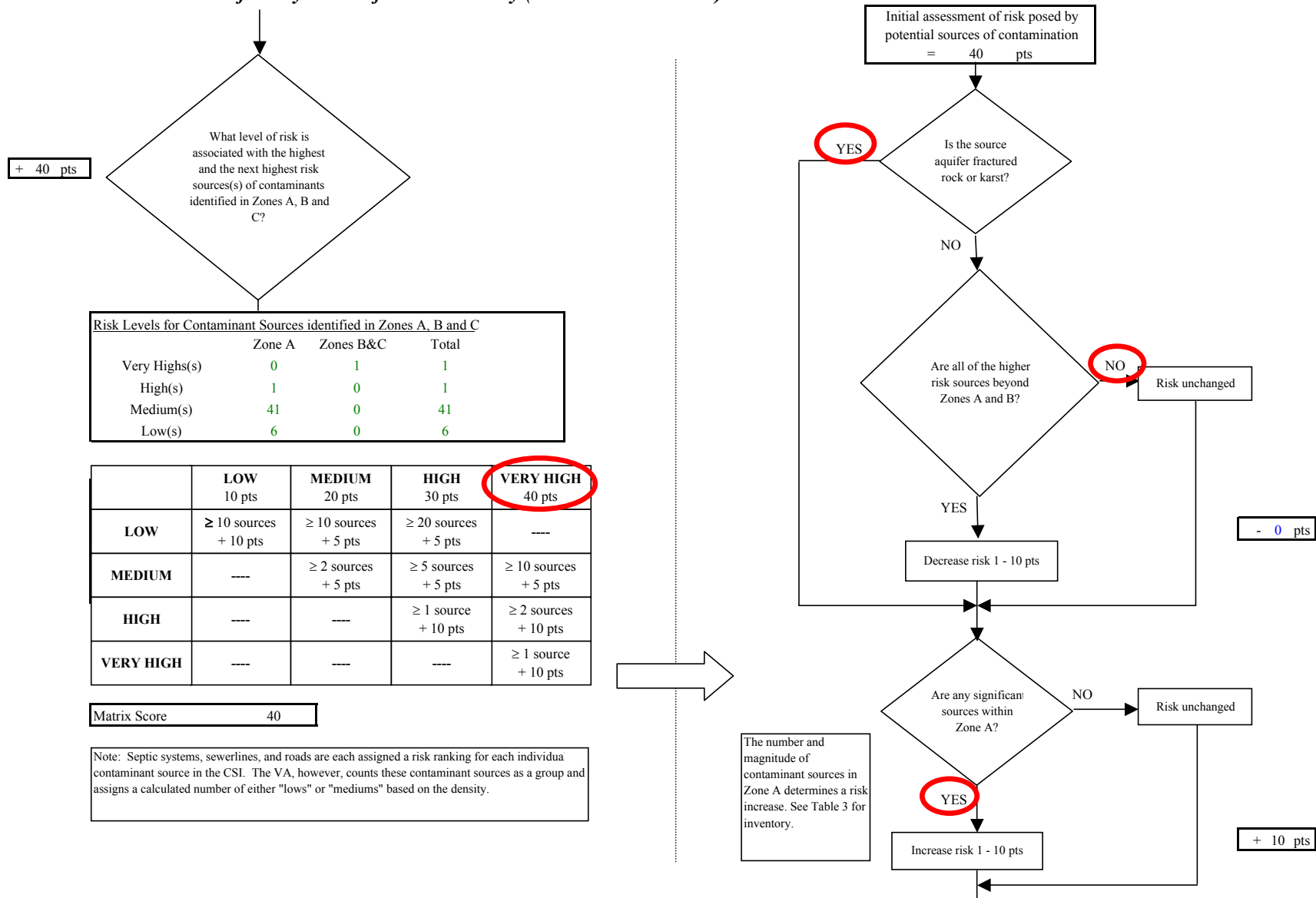


Chart 5. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Nitrates and Nitrites

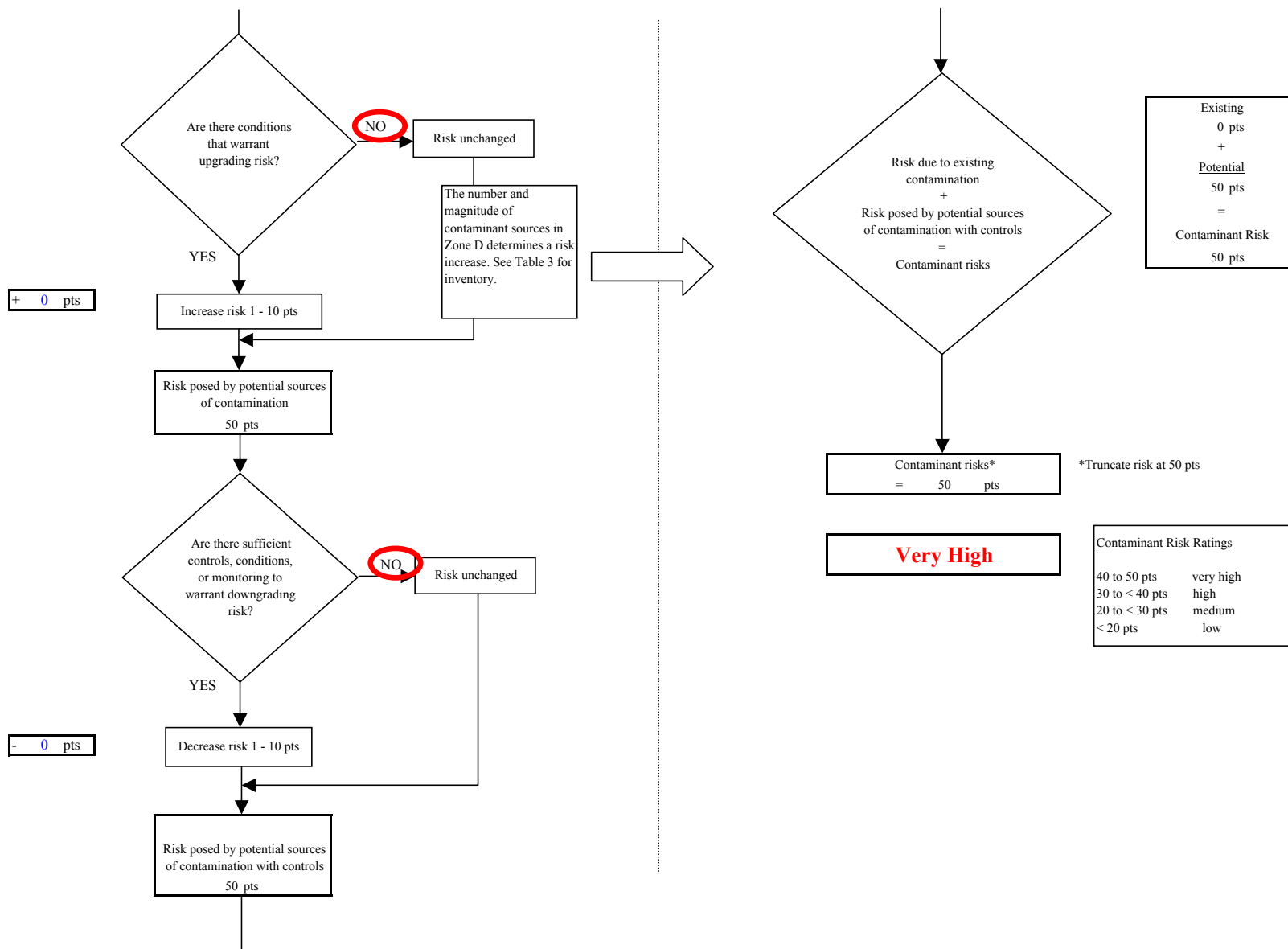


Chart 6. Vulnerability analysis for Koyukuk Safe Water Facility (PWS No. 360214.001) - Nitrates and Nitrites

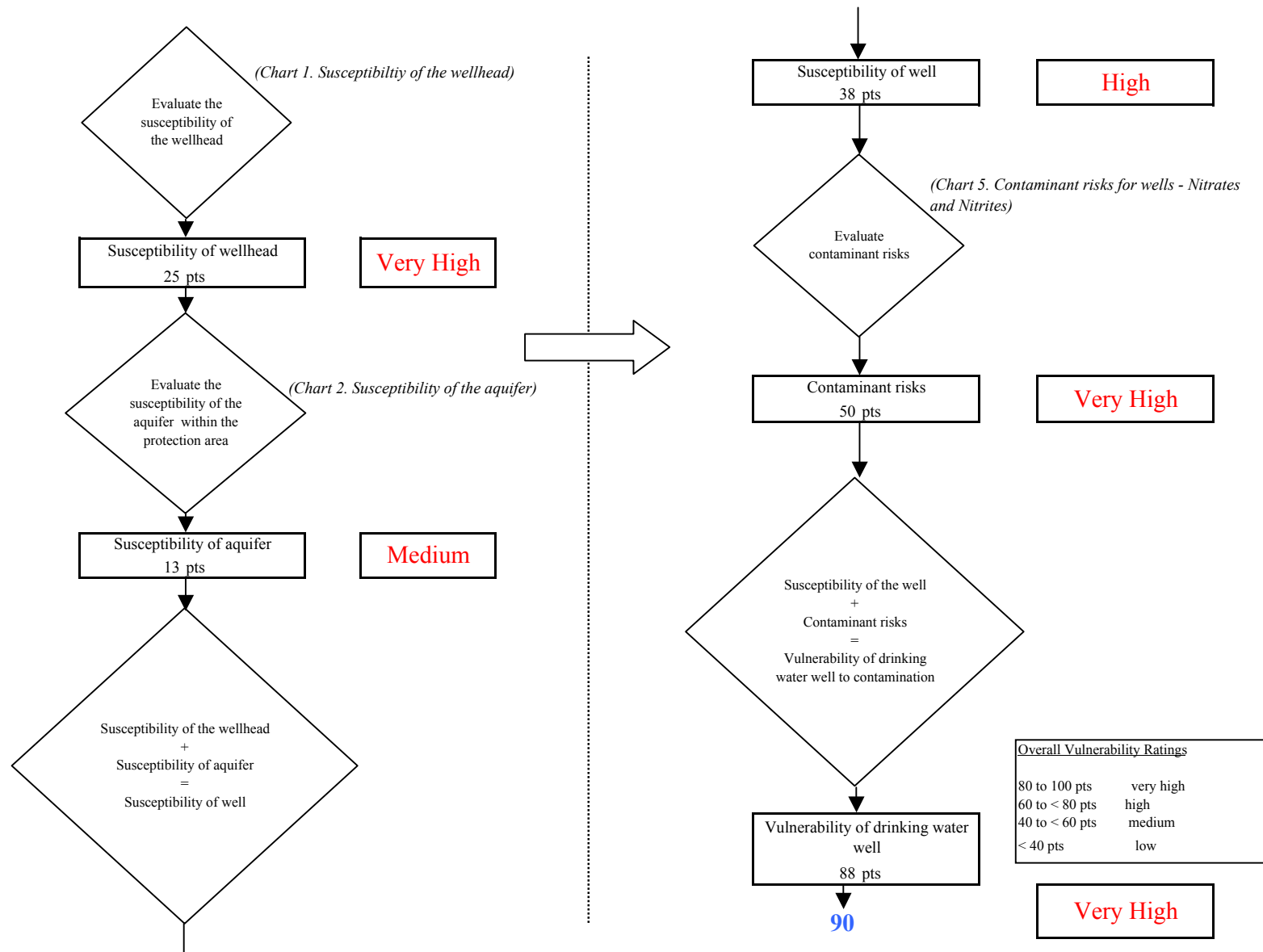


Chart 7. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Volatile Organic Chemicals

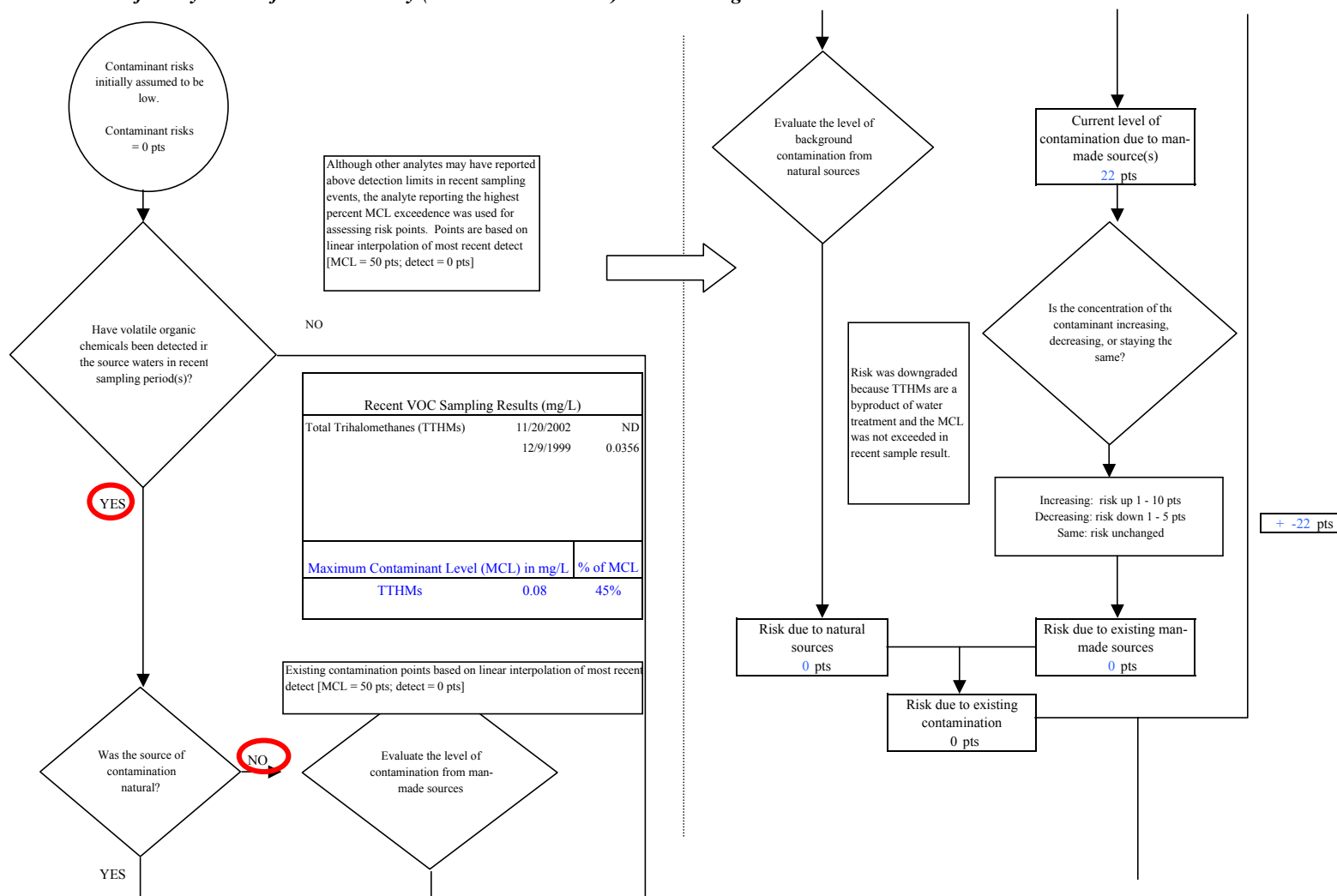


Chart 7. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Volatile Organic Chemicals

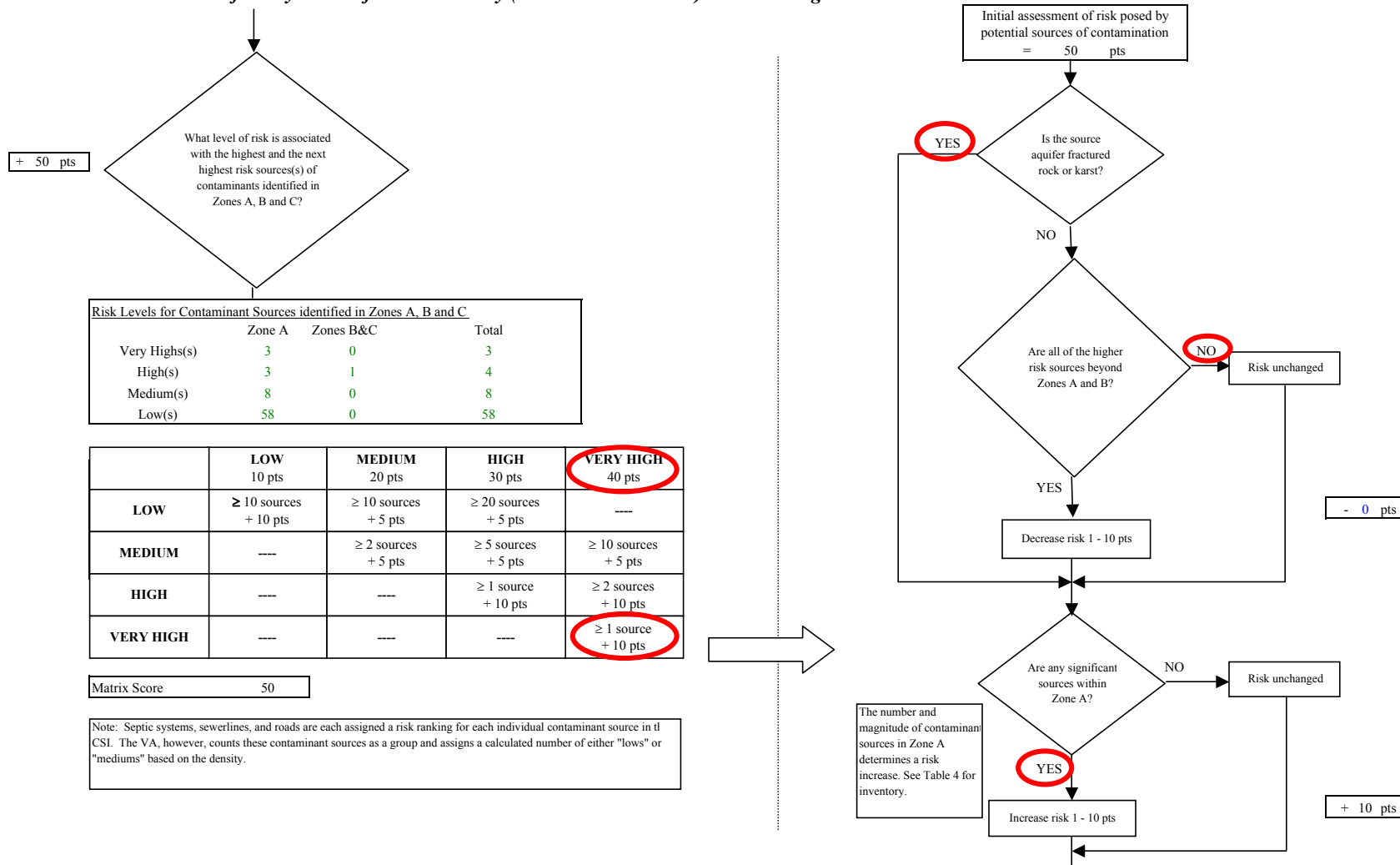


Chart 7. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Volatile Organic Chemicals

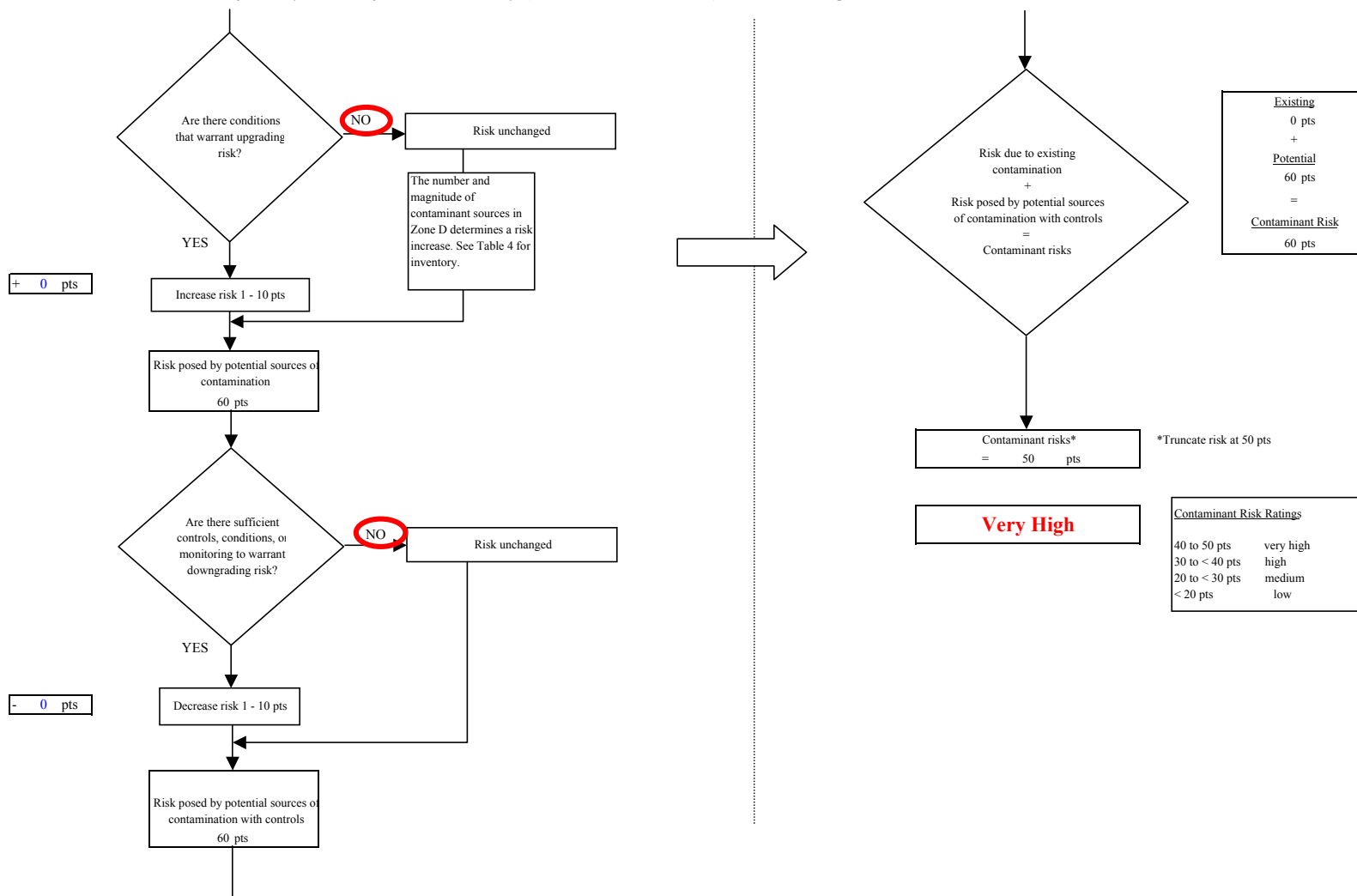


Chart 8. Vulnerability analysis for Koyukuk Safe Water Facility (PWS No. 360214.001) - Volatile Organic Chemicals

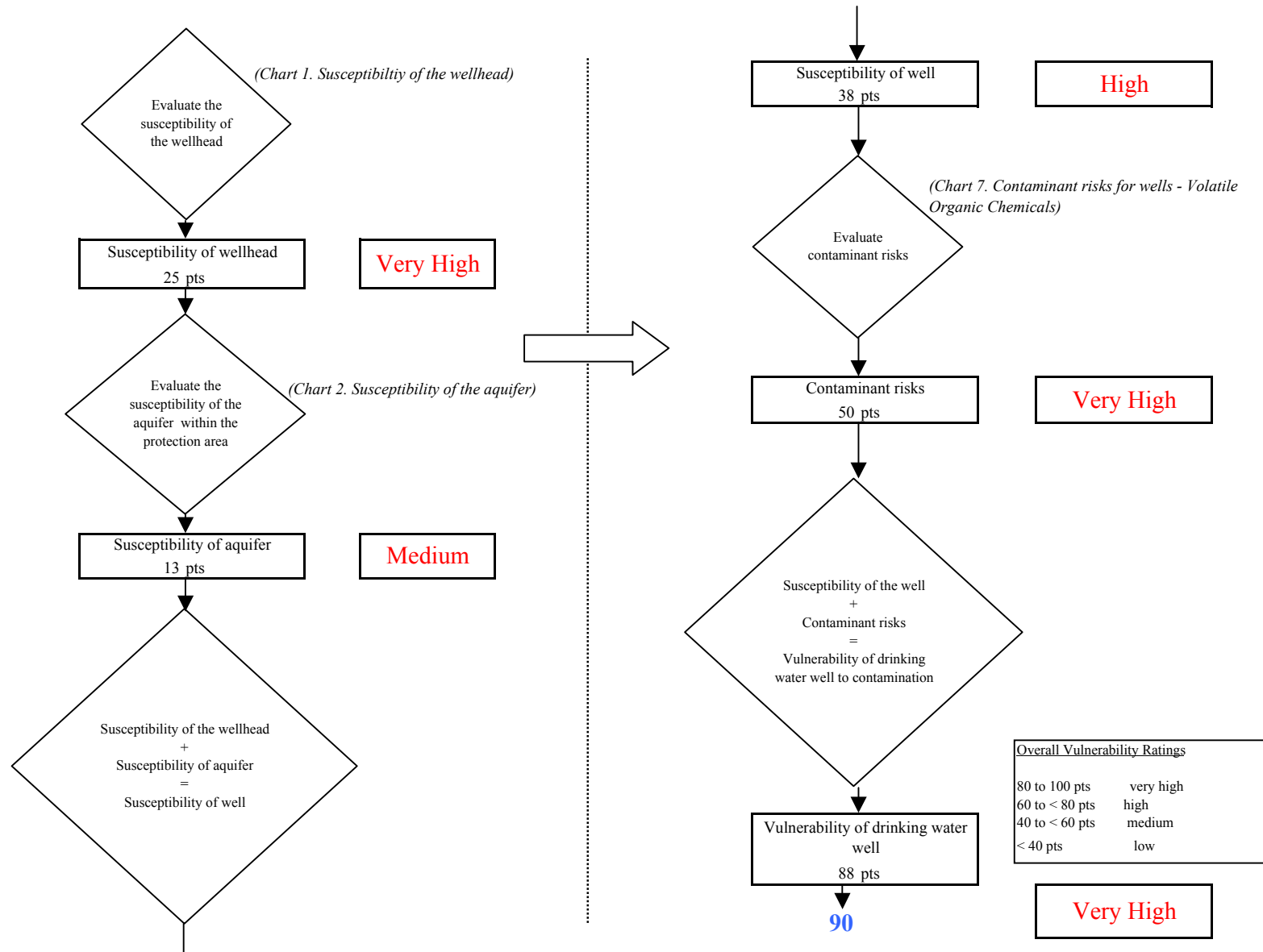


Chart 9. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

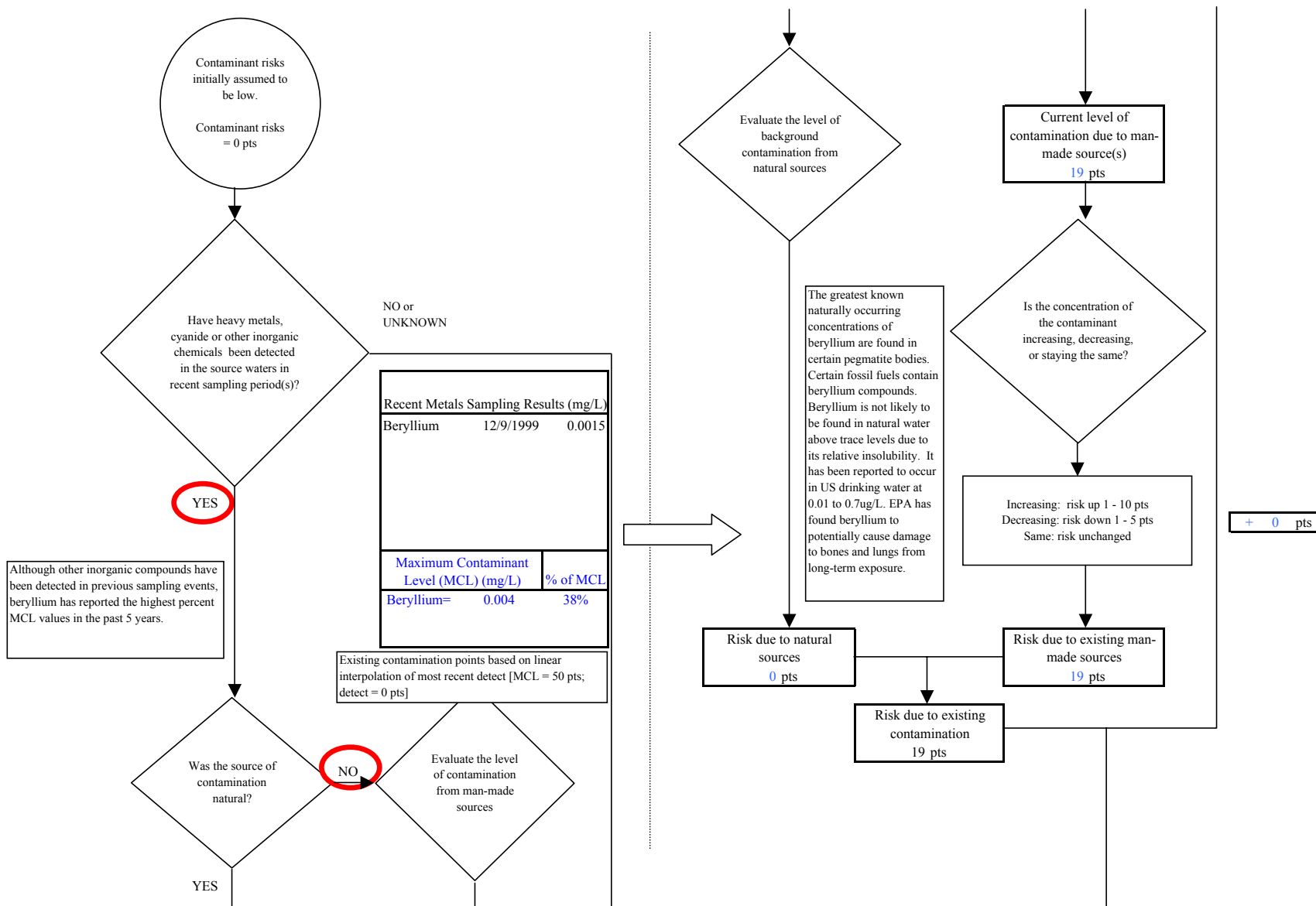


Chart 9. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

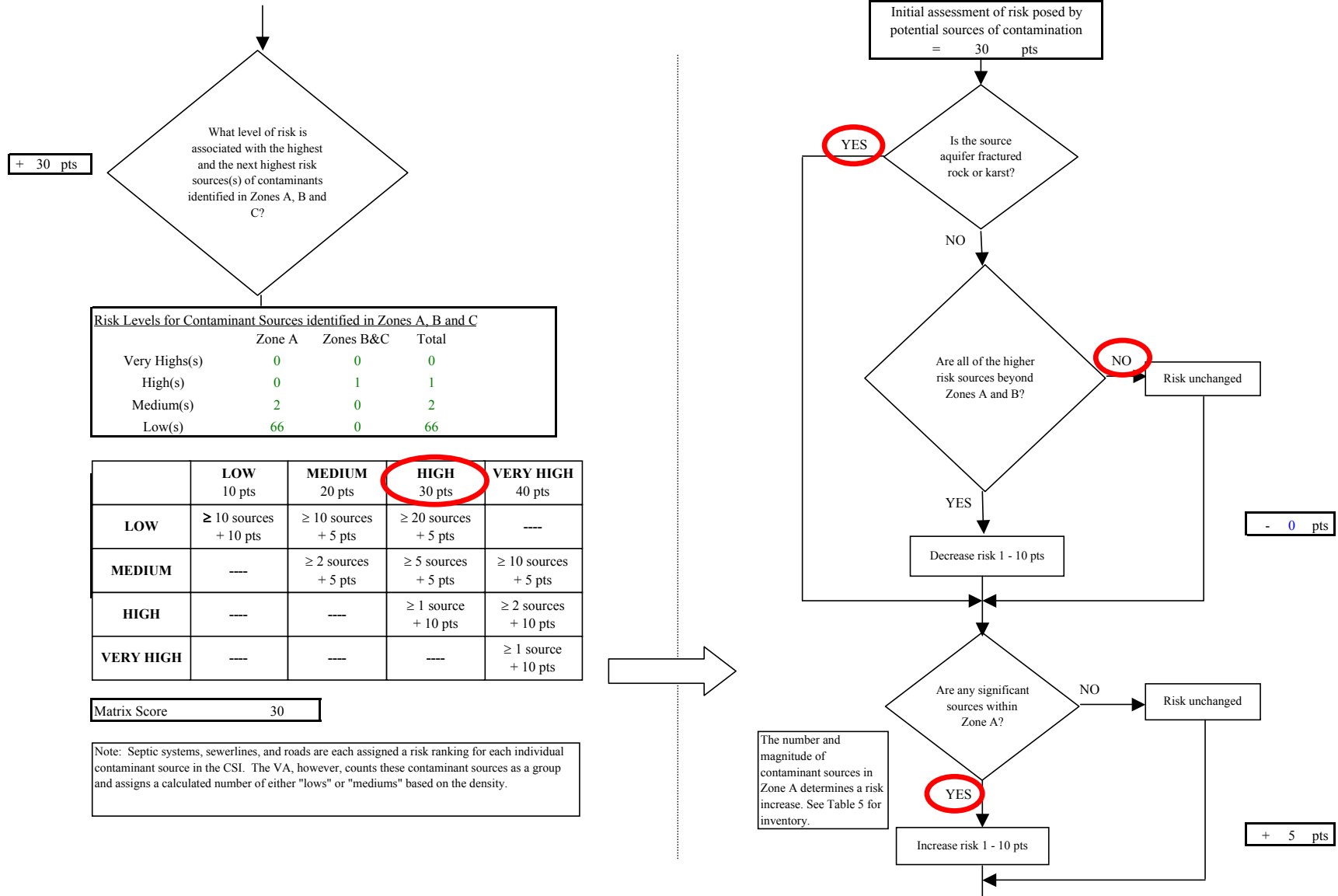


Chart 9. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

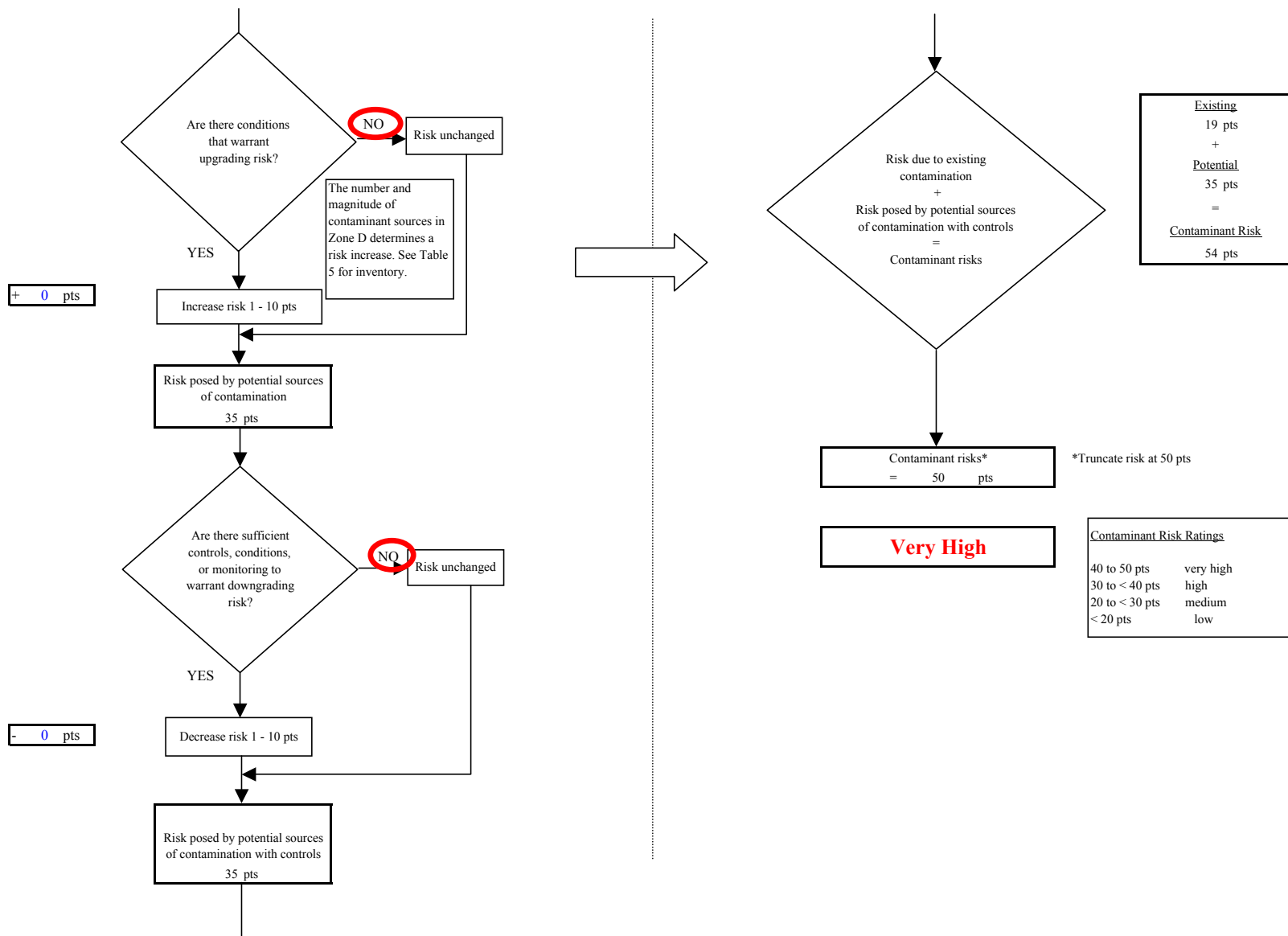


Chart 10. Vulnerability analysis for Koyukuk Safe Water Facility (PWS No. 360214.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

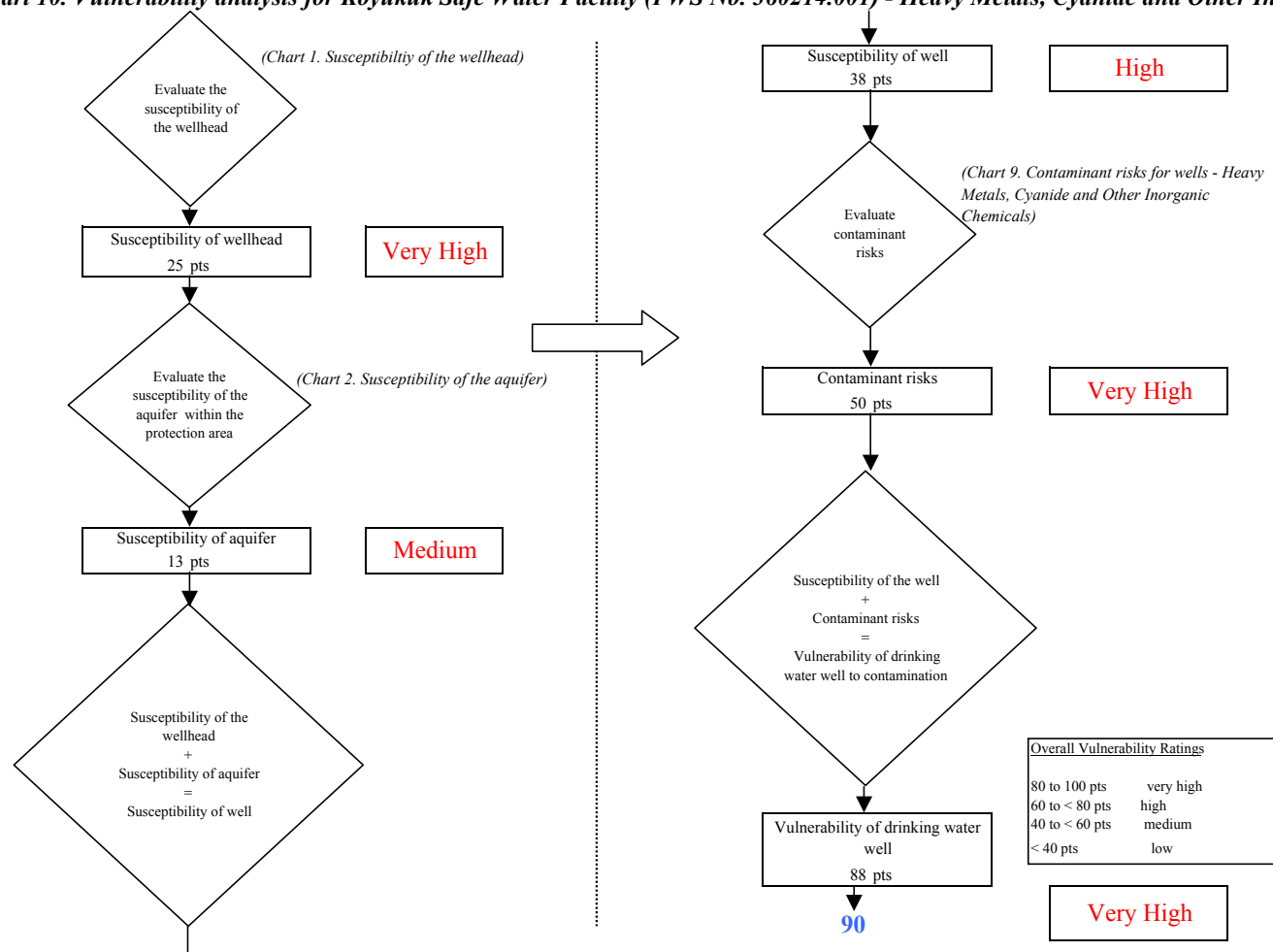


Chart 11. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Synthetic Organic Chemicals

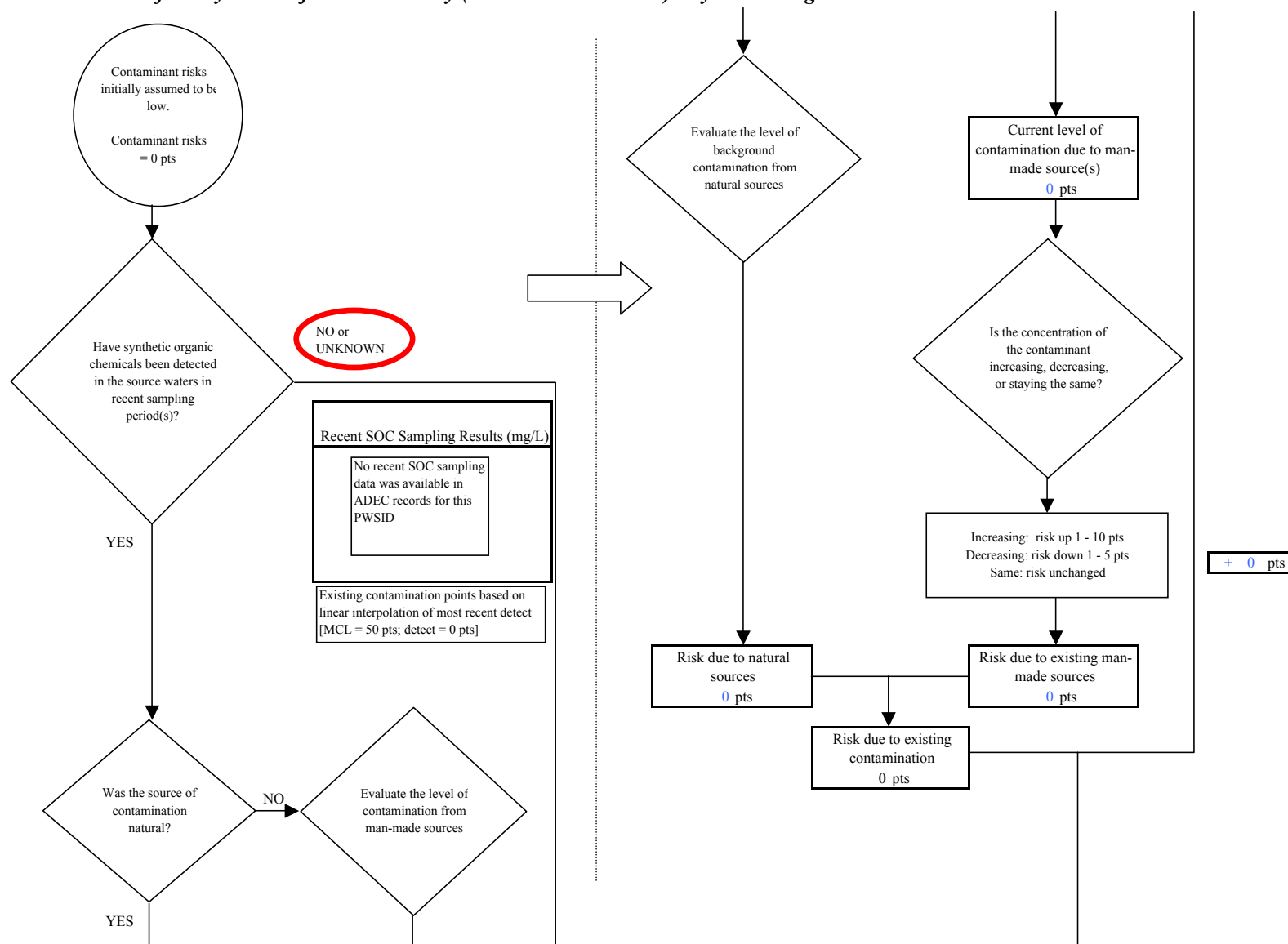


Chart 11. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Synthetic Organic Chemicals

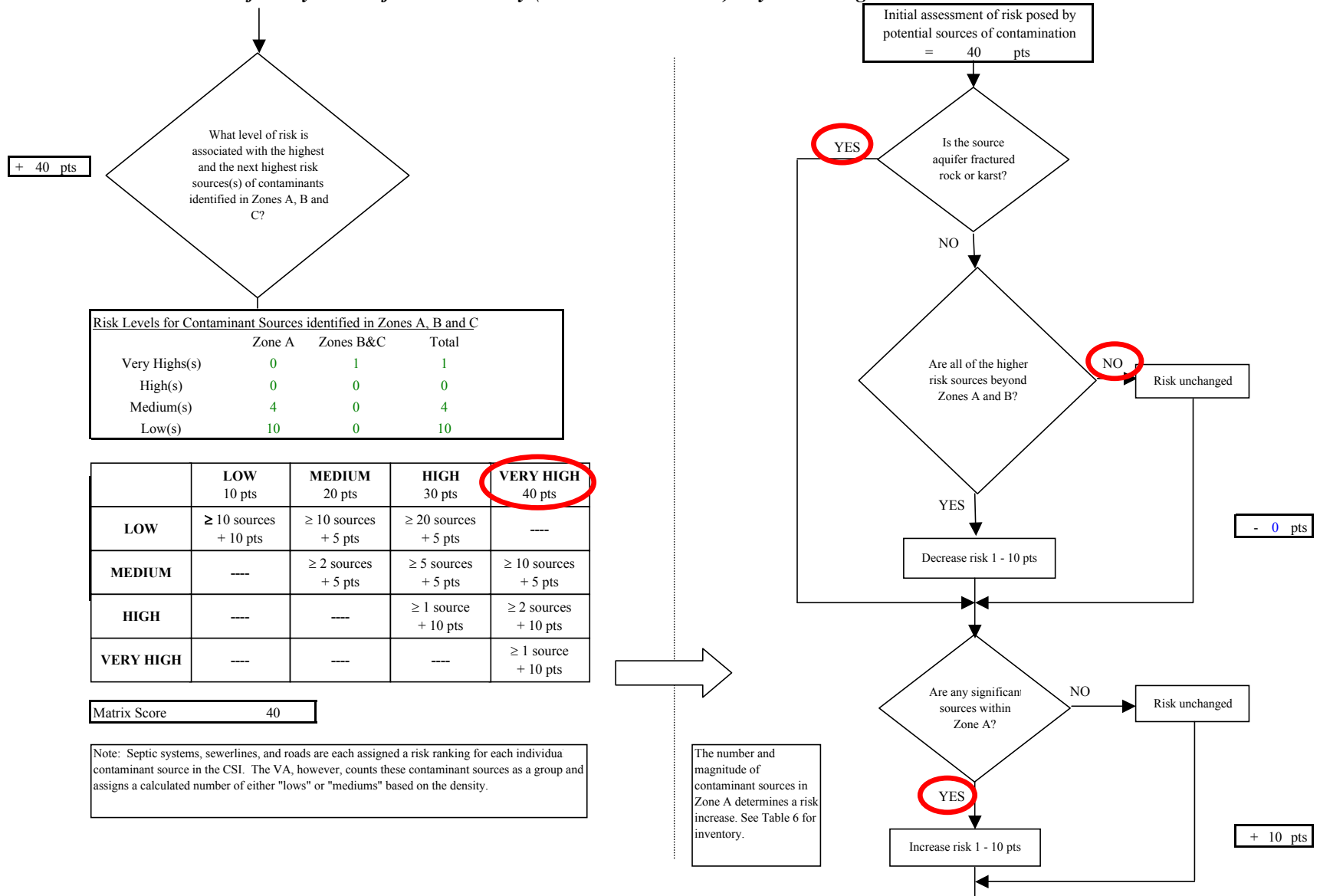


Chart 11. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Synthetic Organic Chemicals

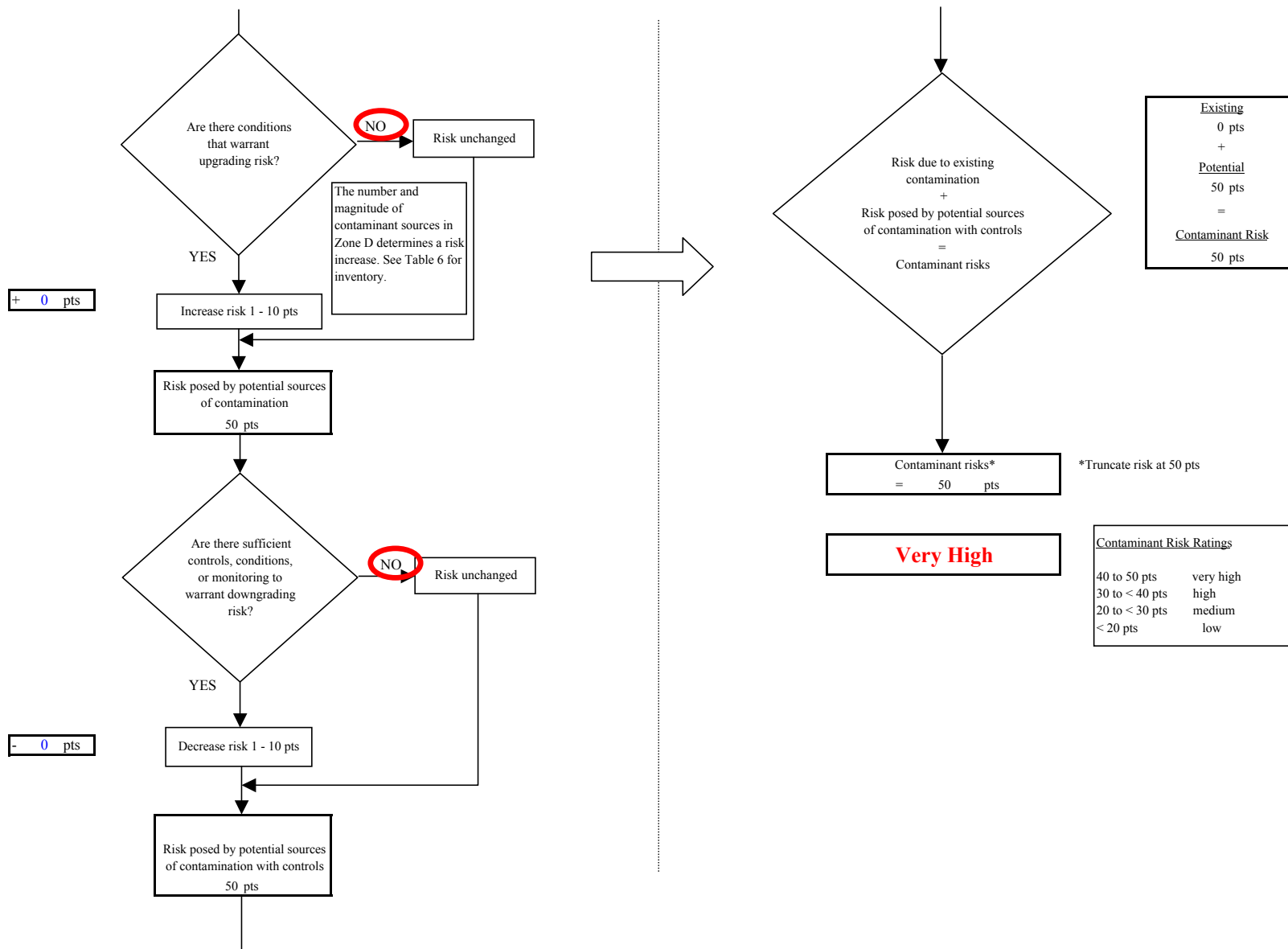


Chart 12. Vulnerability analysis for Koyukuk Safe Water Facility (PWS No. 360214.001) - Synthetic Organic Chemicals

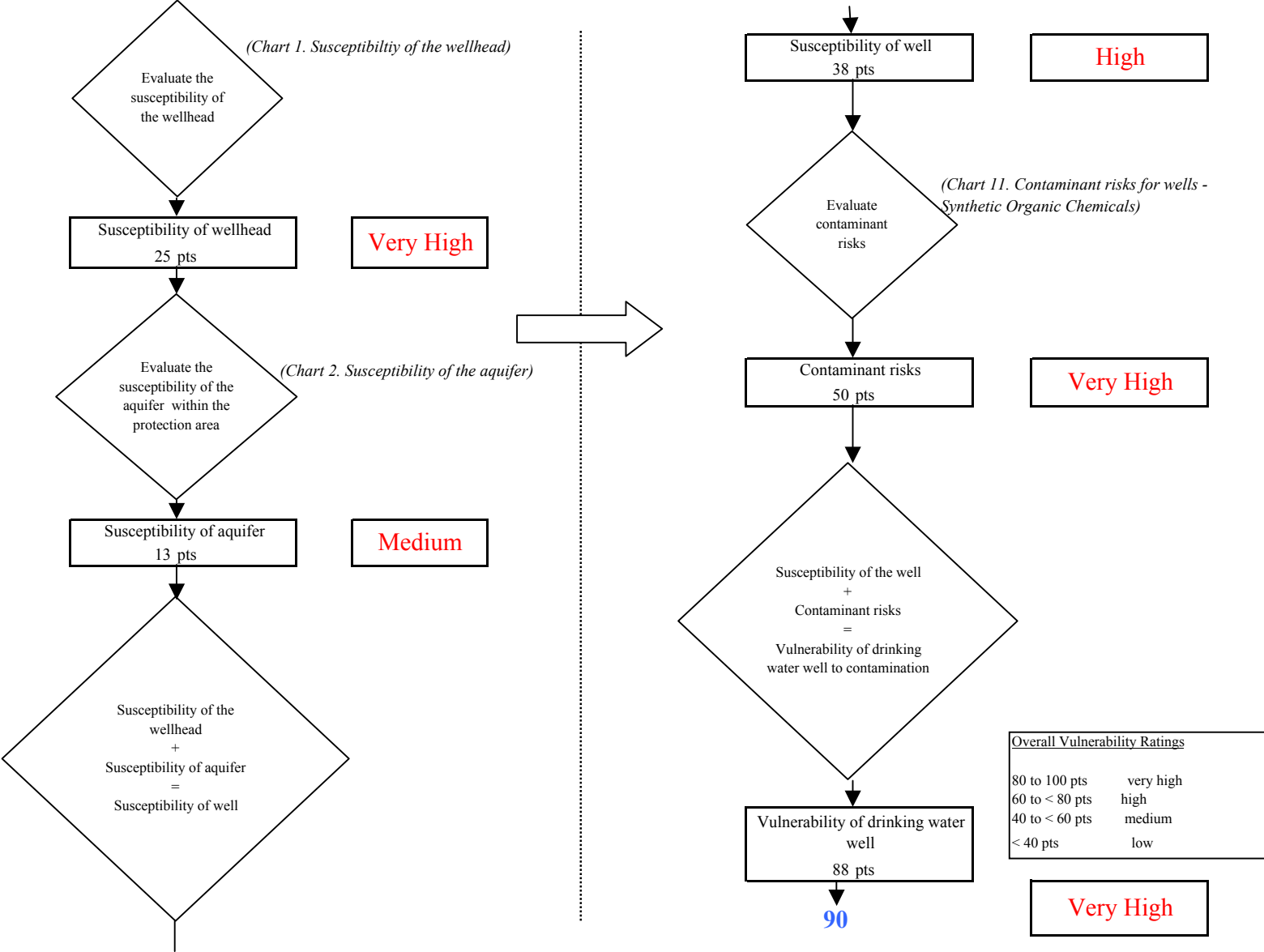


Chart 13. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Other Organic Chemicals

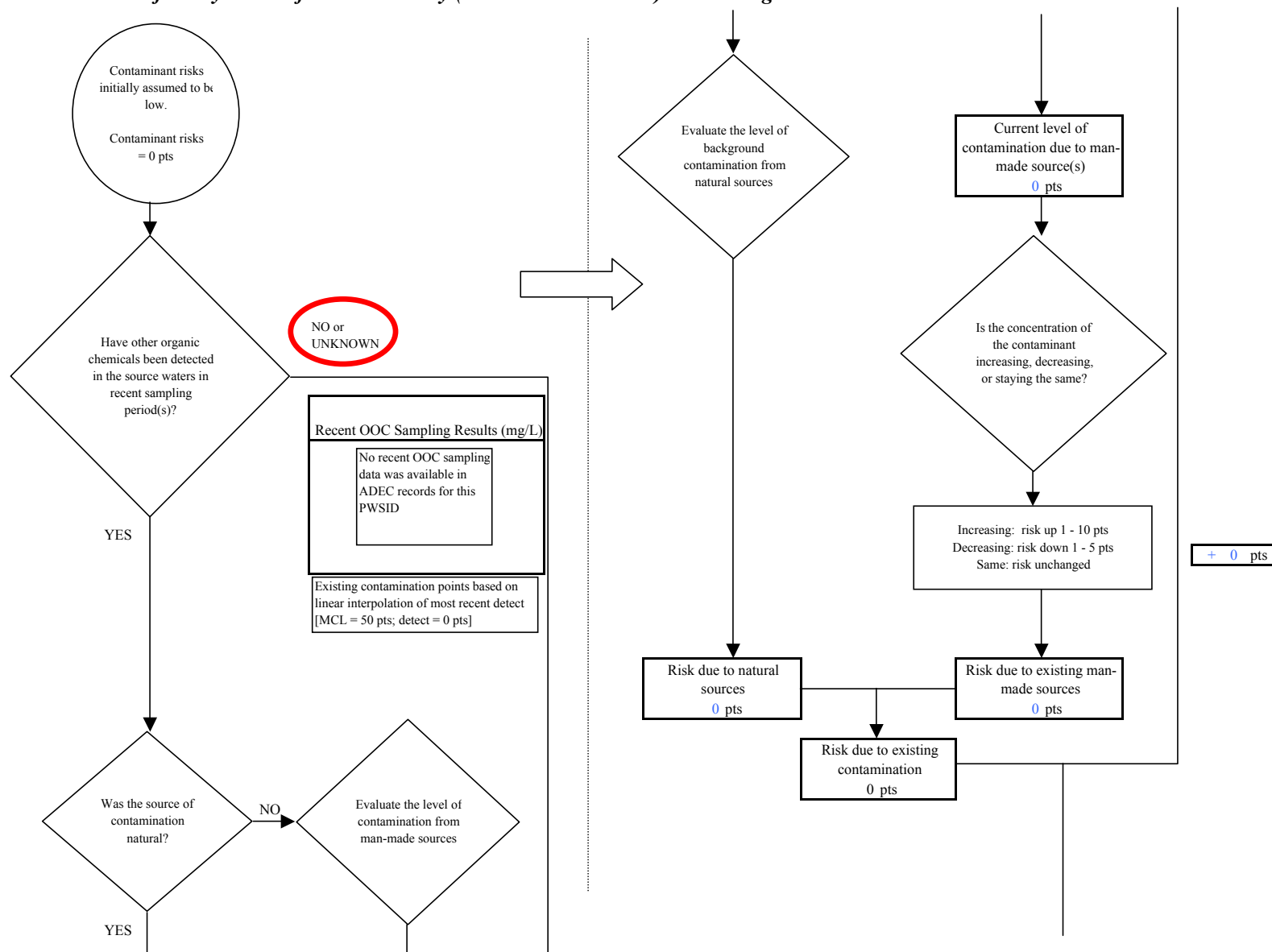


Chart 13. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Other Organic Chemicals

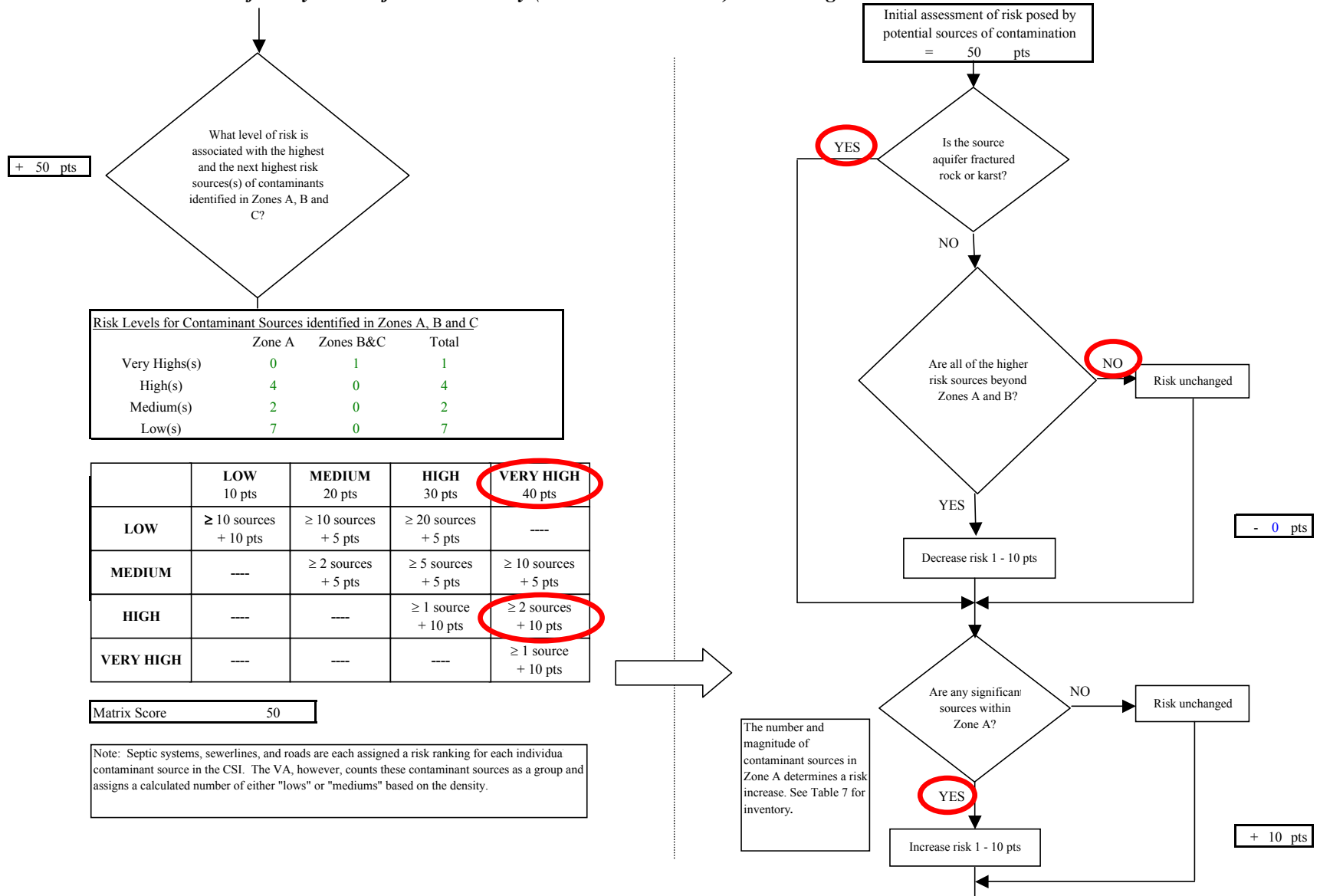


Chart 13. Contaminant risks for Koyukuk Safe Water Facility (PWS No. 360214.001) - Other Organic Chemicals

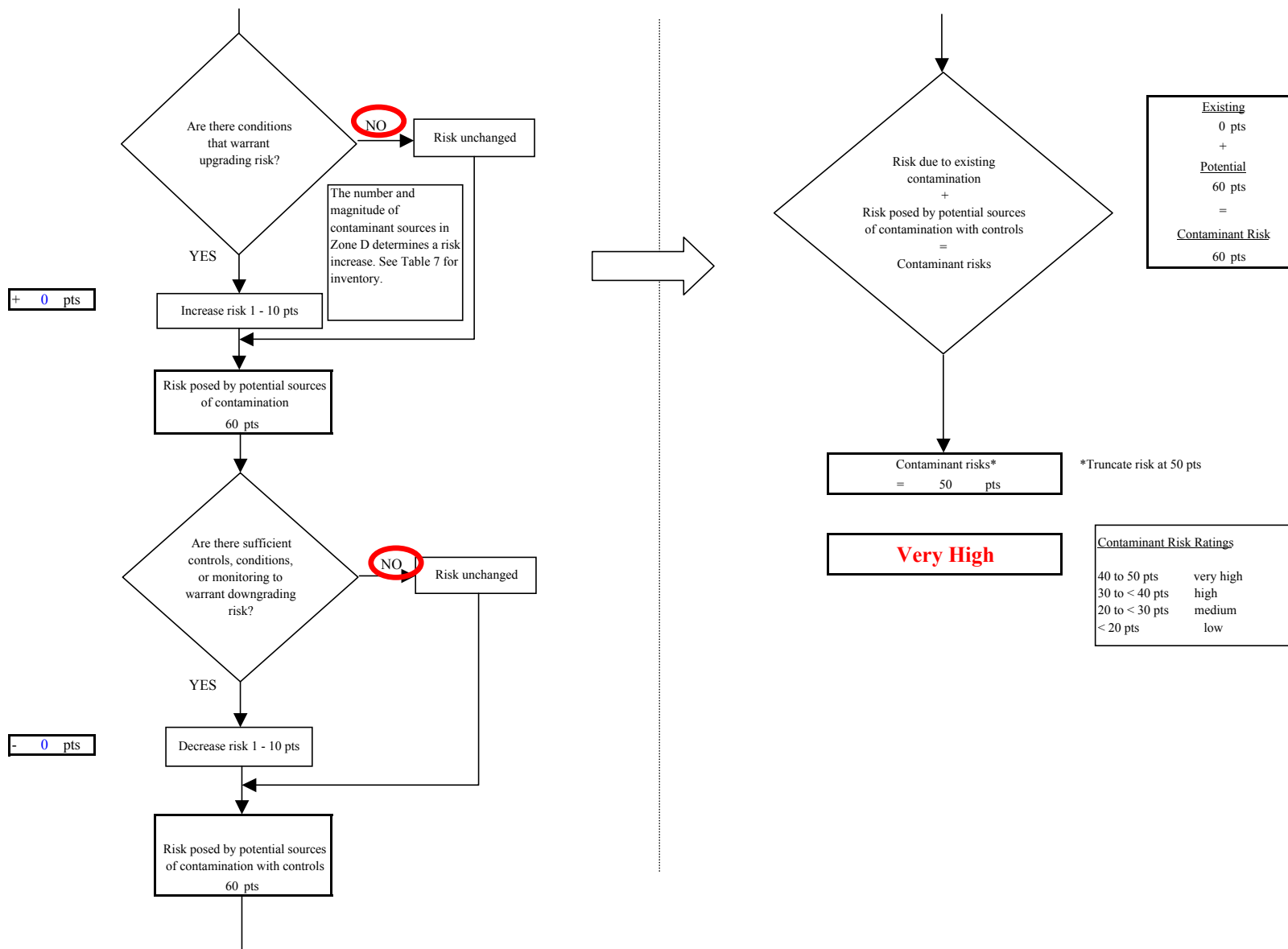


Chart 14. Vulnerability analysis for Koyukuk Safe Water Facility (PWS No. 360214.001) - Other Organic Chemicals

