Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Quinhagak Water System

Quinhagak, Alaska

PWSID #271041.001

January 2004

Drinking Water Protection Program Report #1116

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 (EPA), the 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 that 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 Quinhagak Water System, Quinhagak, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for the City of Quinhagak, Alaska, is a Class A surface water system that obtains water from the Kanektok River. The infiltration gallery intake is located nine feet below the riverbed buried in gravel. Water from the river is filtered, chlorinated, and stored in a tank on the corner of Seahawk Lane and Petmilleq Heights. The storage tank has an approximate volume of 45,000 gallons.

The Quinhagak protection area is approximately 545 square miles in size and has received a susceptibility rating of **Very High**. *A rating of High to Very High is typical for all systems with surface water intakes*. Potential and existing sources of the following contaminants were evaluated for the Source Water Assessment: bacteria and viruses, nitrates and/or nitrites, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, volatile organic chemicals, and other organic chemicals.

Known potential contaminant sources are located within the surface water protection area and include highways, roads, and airports. These sources may affect drinking water at the source and could potentially influence sampling results. Samples were collected from post-treated water. Contaminant sources identified within the surface water protection area for this public water system have been considered in order to provide the most conservative evaluation.

This evaluation included all available water sampling data submitted to the Alaska Department of Environmental Conservation (ADEC) by the system operator. As stated previously, the samples were collected from post-treated water. Vulnerability ratings for the water system have been determined by combining the susceptibility of the surface water source with the contaminant risks. The system received a vulnerability rating of **Medium** in all six of the source water assessment categories: bacteria and viruses, nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic compounds, and other organic compounds.

This assessment 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 Quinhagak to protect public health.

DRINKING WATER SYSTEM AND AREA OVERVIEW

Quinhagak (Sec. 17, T005S, R074W, Seward Meridian) is located on the Kanektok River on the east shore of Kuskokwim Bay (ADCED, 2003). Only one mile from the Bering Sea, the village is within the Togiak National Wildlife Refuge. The Yup'ik Eskimo community lies about 71 miles southwest of Bethel on the Yukon-Kuskokwim Delta. Quinhagak has a current population of 572 (ADCED, 2003). Average annual precipitation in Quinhagak is 22 inches, including approximately 43 inches of snowfall. Summer temperatures range from 41 to 57°F and winter can range from 6 to 24°F.

The public water system is a Class A surface water system that operates year-round and obtains water at the Kanektok River. The infiltration gallery intake is located nine feet below the riverbed buried in gravel. Water from the river is piped south about 300 yards to the village water treatment plant located in the center of the village. The water is filtered, chlorinated, and stored in a 45,000-gallon tank. Treated water is piped another 200 feet to the washeteria and school. The number of households that are connected to the flush haul system is increasing. Currently, about 30% of the households in the community are connected to the flush/haul system (ADCED, 2003). The majority of households still haul water and use honeybuckets for sewage disposal, although a few have individual septic tanks.

Quinhagak receives its electrical power from AVEC operated by the REA Co-op. Power generating facilities are fueled by diesel. The City operates the washeteria, as well as sewage collection services, and the local landfill (ADCED, 2003).

Information acquired from a July 2003 sanitary survey for the public water system indicated that the surface water intake is adequately constructed. The intake is screened and protected against ice buildup and siltation. The average production of the system is 2,000 gallons per day.

Quinhagak is located on the Yukon-Kuskokwim (Y-K) Delta. The Y-K Delta is located on the southwest coast

of Alaska and primarily consists of lowlands formed by the deposition of fluvial sediment from the Yukon and Kuskokwim Rivers.

The Y-K Delta topography is relatively flat and approximately 40% to 50% of the delta surface is wet (Alaska Geographic Society). The lower delta area generally receives about 20 inches of precipitation annually. Areas of both discontinuous and continuous permafrost are present on the Y-K Delta. Permafrost is often present within 10 feet of ground surface and varies in thickness from 15 feet to 600 feet thick (R&M, 1979b). Thaw bulbs generally persist around areas of standing and flowing water.

QUINHAGAK DRINKING WATER PROTECTION AREA

Identifying the pathways most likely for surface contamination to reach water intake areas is the first step in determining the water system's risk. These pathways are initially determined by looking at the drainage area contributing overland water flow to a surface water source intake. The entire drainage area is also known as the "drinking water protection area." Please refer to pages 10-11 of the "Guidance Manual for Class A Public Water Systems" for additional information.

The protection area established for surface water sources by the ADEC is usually separated into three zones. These zones correspond to the overland-flow distance that water travels to get to the source. The ADEC Drinking Water Protection Program's Technical Advisory Committee developed guidelines for derivation of these zones in 1998. The following is a summary of the three protection area zones:

Table 1. Definition of Zones

Zone	Definition
A	Areas within 1000-ft of lakes or streams
B	Areas within 1-mile of lakes or streams
C	The watershed boundary

The protection area for the Quinhagak water intake includes each of these Zones (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 Quinhagak surface water protection area. This inventory was completed through a search of agency records and other publicly available information. There is a wide array of potential contamination sources to surface water. These contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For Class A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic Organic Chemicals; and
- Other Organic Chemicals.

Several contaminant sources were identified in the Quinhagak protection area as displayed on Map C of Appendix C and in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once potential and existing sources of contamination have been identified, they are assigned a ranking according to what category and level of risk they represent. Ranking of contaminant risks for "potential" or "existing" sources of contamination is a function of the toxicity and the volume of specific contaminants associated with that source. Rankings include:

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

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

The remaining tables 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:

- Surface Water Susceptibility and
- Contaminant risks.

Appendix D contains 13 charts, which together form the 'Vulnerability Analysis' for the public drinking water Source Water Assessment. Chart 1 analyzes the 'Susceptibility of the Surface Water Source' to contamination by looking at the climate, terrain, and intake location. Chart 2 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 intake area. Chart 3 contains the 'Vulnerability Analysis for Bacteria and Viruses,' which is a composite score of the Vulnerability Analysis and the overall Susceptibility. Charts 4 through 13 repeat 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 Surface Water Susceptibility of the source is reached by considering the properties of the water intake and the surrounding area. The derivation of this information is presented below and the data for this source is shown in Chart 1 of Appendix D.

Susceptibility of the Surface Water Source – always considered to be "high" (30 points)

+

Adequate Construction of the Intake (0 – 5 Points)

+

Runoff Potential Within Zone B (0 – 5 Points)

+

Dilution Capacity of the Surface Water (0 – 10 Points)

=

Natural Susceptibility
(0 – 50 Points)

A ranking is assigned for the Surface Water Susceptibility according to the point score:

Surface Water Source Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High

Table 2. Susceptibility of the Water Source

	Score	Rating
Minimum Allowable Susceptibility	30	
Intake Construction Adequate	0	
Runoff Potential	2	
Dilution Capacity	10	
Overall Susceptibility	***42***	***Very High***

For contaminants, risks to a drinking water source depend on the type, number or density, and distribution of the contaminant sources. The Contaminant Risk score has been derived from an examination of existing, and historical contamination sources that have been detected in the protection area 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 the 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. Quinhagak Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	13	Low
Volatile Organic Chemicals	17	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	12	Low
Synthetic Organic Chemicals	0	Low
Other Organic Chemicals	14	Low

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

Susceptibility of the Surface Water Source

(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 and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Quinhagak Water System Overall Vulnerability

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

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Low**. The contaminant risk for bacteria and viruses is primarily attributed to the presence of roads in Zone A.

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, 2003). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination. Typically, coliform detection in raw water samples collected from surface water sources is normal. (See Chart 2 – Contaminant Risks for Bacteria and Viruses in Appendix D).

No positive bacteria counts were reported in recent (previous five years) sampling events.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the source, the overall vulnerability of the source to bacteria and virus contamination is considered **Medium**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Low** (See Chart 4 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). One potential contaminant risk source for nitrates were identified in the protection area for this public water system. The contaminate risk is primary attributed to the presence of roads in Zone A. Nitrates are very mobile, moving at approximately the same rate as water.

The Maximum Contaminant Level (MCL) for nitrates is 10 milligrams per liter (mg/L). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects (EPA, 2003).

Although low concentrations of nitrates have been reported in recent sampling history, none of the concentrations exceed the MCL of 10 mg/L.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the source, the overall vulnerability of the source to contamination remains **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Low** (See Chart 6 – Contaminant Risks for Vo latile Organic Chemicals in Appendix D). Two potential contaminant sources for volatile organic chemicals were identified in the protection area for this public water system (See Table 4 – Appendix B). The contaminate risk is partially attributed to the roads in Zone A.

Detectable concentrations of trihalomethane were reported in sampling events for this public water system. However, the detectible concentrations of trihalomethane reported were well below the MCL of 0.08 mg/L. Trihalomethanes are considered byproducts of the water treatment process and are not from the source waters. Since the reported concentration of

TTHM's in the most recent sampling did not exceed the applicable MCLs, risk points were not retained.

Aside from being byproducts of the drinking water treatment process, possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports. See Table 4 in Appendix D for a complete listing.

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

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is **Low**. One contaminant source for heavy metals, cyanide, and other inorganic chemicals was identified in the protection area for this public water system. The contaminate risk is primary attributed to the presence of roads in Zone A.

Based on review of recent sampling records for this public water system, low levels of copper and barium have been detected. Although copper and barium have been detected in recent sampling events, they have not exceeded their respective MCLs of 1.3 mg/L and 2.0 mg/L (See Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentrations of copper and barium in recent sampling events are not likely to be representative of source water conditions. The presence of copper is likely attributed to either the water treatment process or water distribution network; therefore, no risk points were assigned based on the presence of this analyte.

After combining the contaminant risk for heavy metals with the natural susceptibility of the source, the overall vulnerability of the well to contamination is **Medium**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Low**. No potential contaminant sources for synthetic organic chemicals were identified in the protection area for this public water system.

Review of historical sampling data found no recent sampling results for synthetic organic chemical contaminants.

After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to synthetic organic chemicals of the source is **Medium** (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Low**. Two potential contaminant risk sources for other organic chemicals were identified in the protection area. The contaminate risk is partially attributed to the roads in Zone A (see Table 7 – Appendix B).

Review of the historical sampling data found no recent sampling results for other organic chemicals.

After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to other organic chemicals of the source is **Medium** (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

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 Quinhagak 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 Geographic Society, 1979, The Yukon Kuskokwim Delta. Alaska Geographic, v. 6, no. 1, 95 p.

R&M Consultants, Inc., 1979b, Lower Kuskokwim School District School Site Investigation for Tununak, Alaska.

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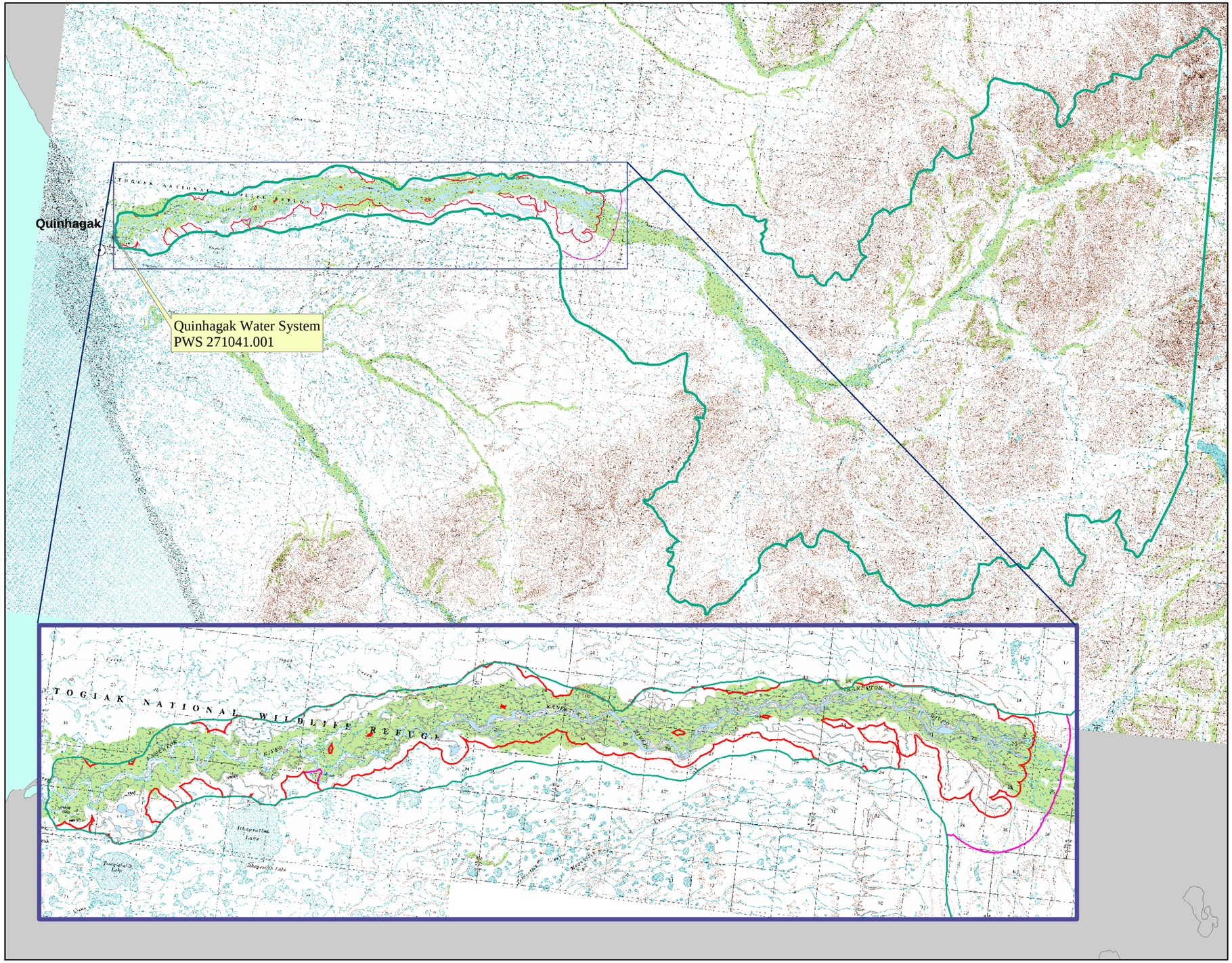
APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

Public Water System for PWS #271041.001 Quinhagak Water System



LEGEND

- Public Water System

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours (approx. 50 ft. or as indicated)
- Watershed Boundary

Transportation

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

Surface Water Protection Zones

- Zone A – 1000 Feet from Surface Water
- Zone B – 1 Mile from Surface Water
- Zone C – 30 Miles from Surface Water or Watershed Boundary

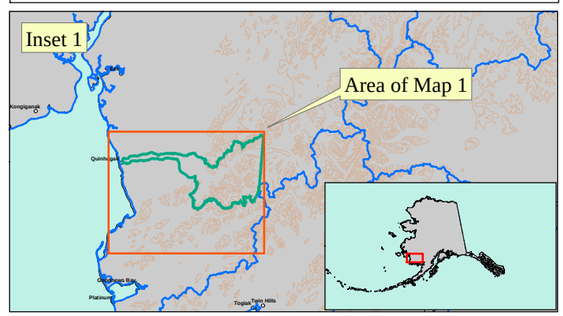
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities
Federal Emergency Management Agency (FEMA)

All other data
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC published document:
"Alaska Drinking Water Protection Progarm - Guidance Manual for
Class A Public Water Systems"

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



0 2 4 8 12 16 Miles

Quinhagak Water System PWS 271041.001
Appendix A Map A

APPENDIX B

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

Table 1

Contaminant Source Inventory for

Quinhagak Water System

PWSID 271041.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assumed at least 1 unpaved road in Zone A to provide access to water system intake
Airports	X14	X14-01	C	C	Quinhagak landing strip
Highways and roads, dirt/gravel	X24	X24-02	C	C	Assumed at least 1 unpaved road in Zone C to provide access to landing strip

Table 2

Contaminant Source Inventory and Risk Ranking for Quinhagak Water System Sources of Bacteria and Viruses

PWSID 271041.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to water system intake

Table 3

Contaminant Source Inventory and Risk Ranking for Quinhagak Water System Sources of Nitrates/Nitrites

PWSID 271041.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to water system intake

Table 4

Contaminant Source Inventory and Risk Ranking for Quinhagak Water System
Sources of Volatile Organic Chemicals

PWSID 271041.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to water system intake

Table 5

Contaminant Source Inventory and Risk Ranking for Quinhagak Water System
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 271041.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to water system intake

Table 6

Contaminant Source Inventory and Risk Ranking for Quinhagak Water System
Sources of Other Organic Chemicals

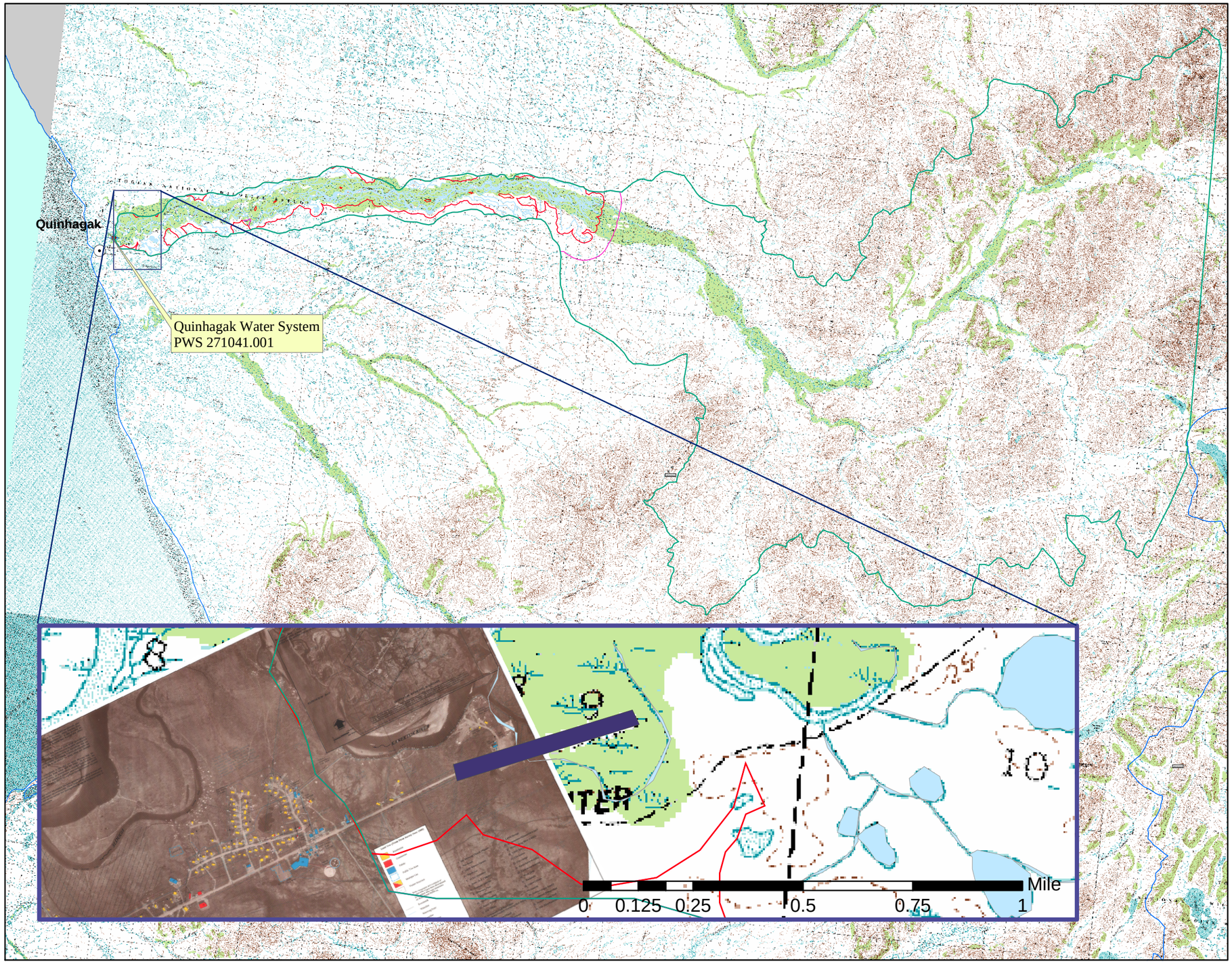
PWSID 271041.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to water system intake

APPENDIX C

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

Public Water Well System for PWS #271041.001 Quinhagak Water System
Showing Potential and Existing Sources of Contamination



LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours (approx. 50 ft. or as indicated)
- Watershed Boundary

Transportation

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

Surface Water Protection Zones

- Zone A – 1000 Feet from Surface Water
- Zone B – 1 Mile from Surface Water
- Zone C – 30 Miles from Surface Water or Watershed Boundary

Existing or Potential Contaminant Sources

- Airport/Landing Strip (X14)

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

Critical Facilities
Federal Emergency Management Agency (FEMA)

All other data
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC published document:
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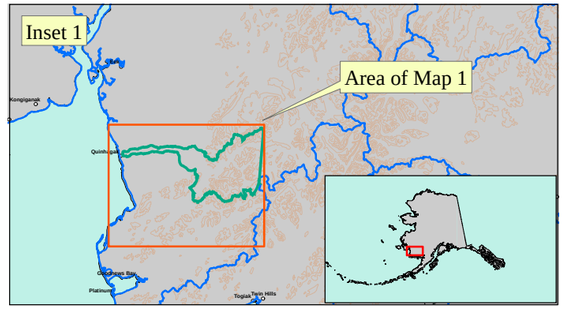


0 2.5 5 10 15 20 Miles

Quinhagak Water System PWS 271041.001
Appendix C Map C

APPENDIX D

Vulnerability Analysis and Contaminant Risks
(Charts 1-13)

Chart 1. Susceptibility of the Surface Water Source - Quinhagak Water System (PWS No. 271041.001)

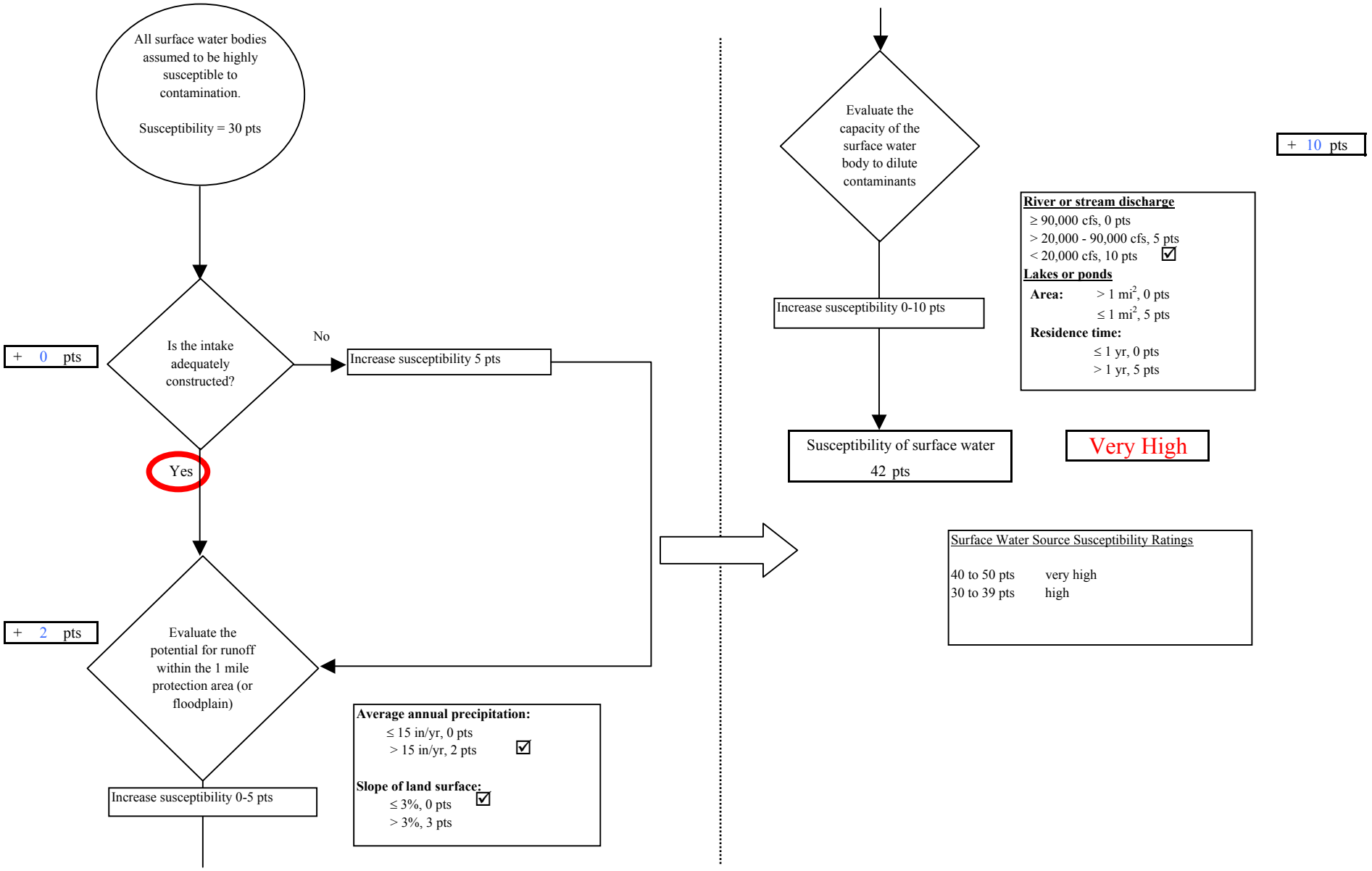
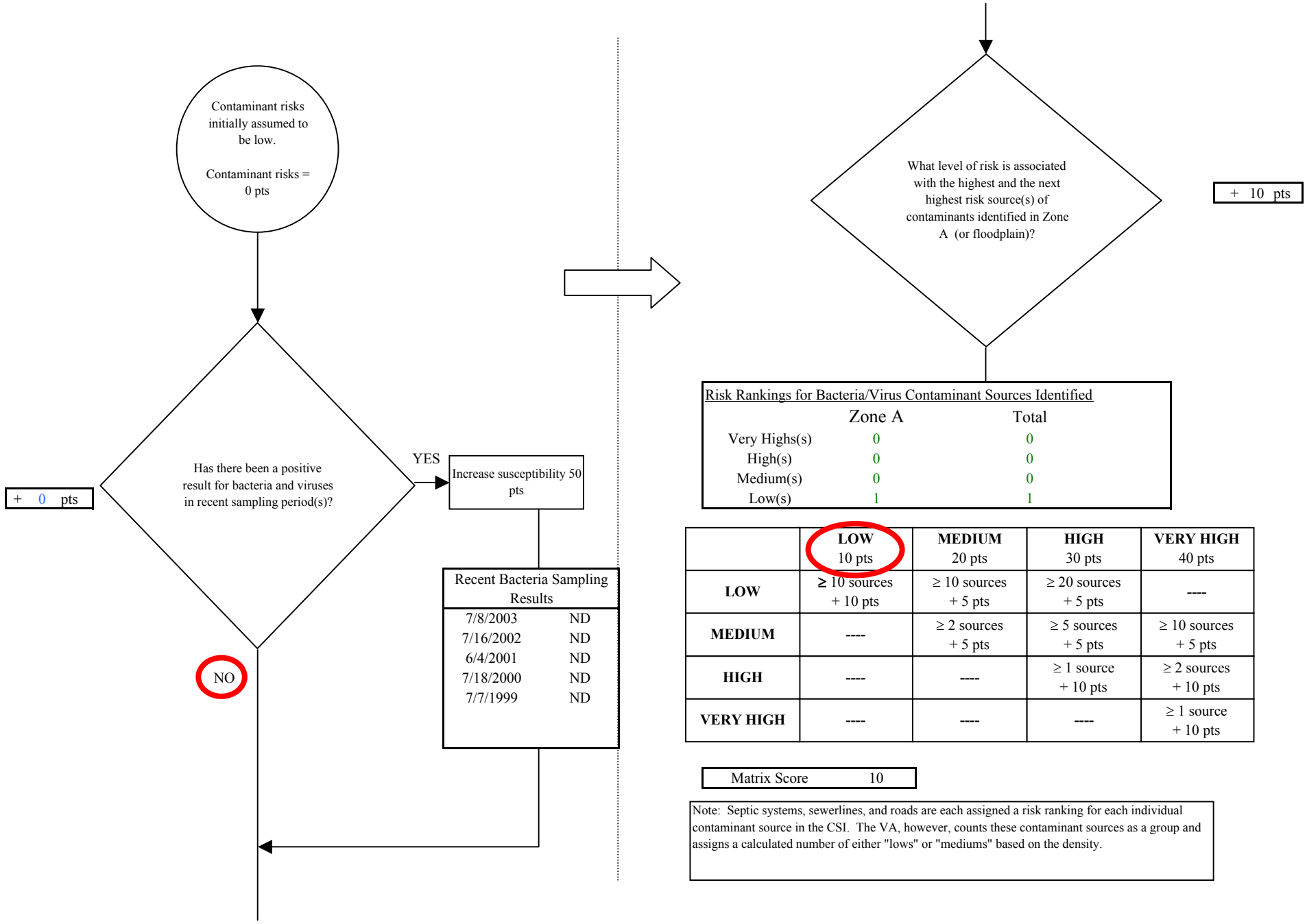


Chart 2. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Bacteria & Viruses



Risk Rankings for Bacteria/Virus Contaminant Sources Identified

	Zone A	Total
Very Highs(s)	0	0
High(s)	0	0
Medium(s)	0	0
Low(s)	1	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 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 2. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Bacteria & Viruses

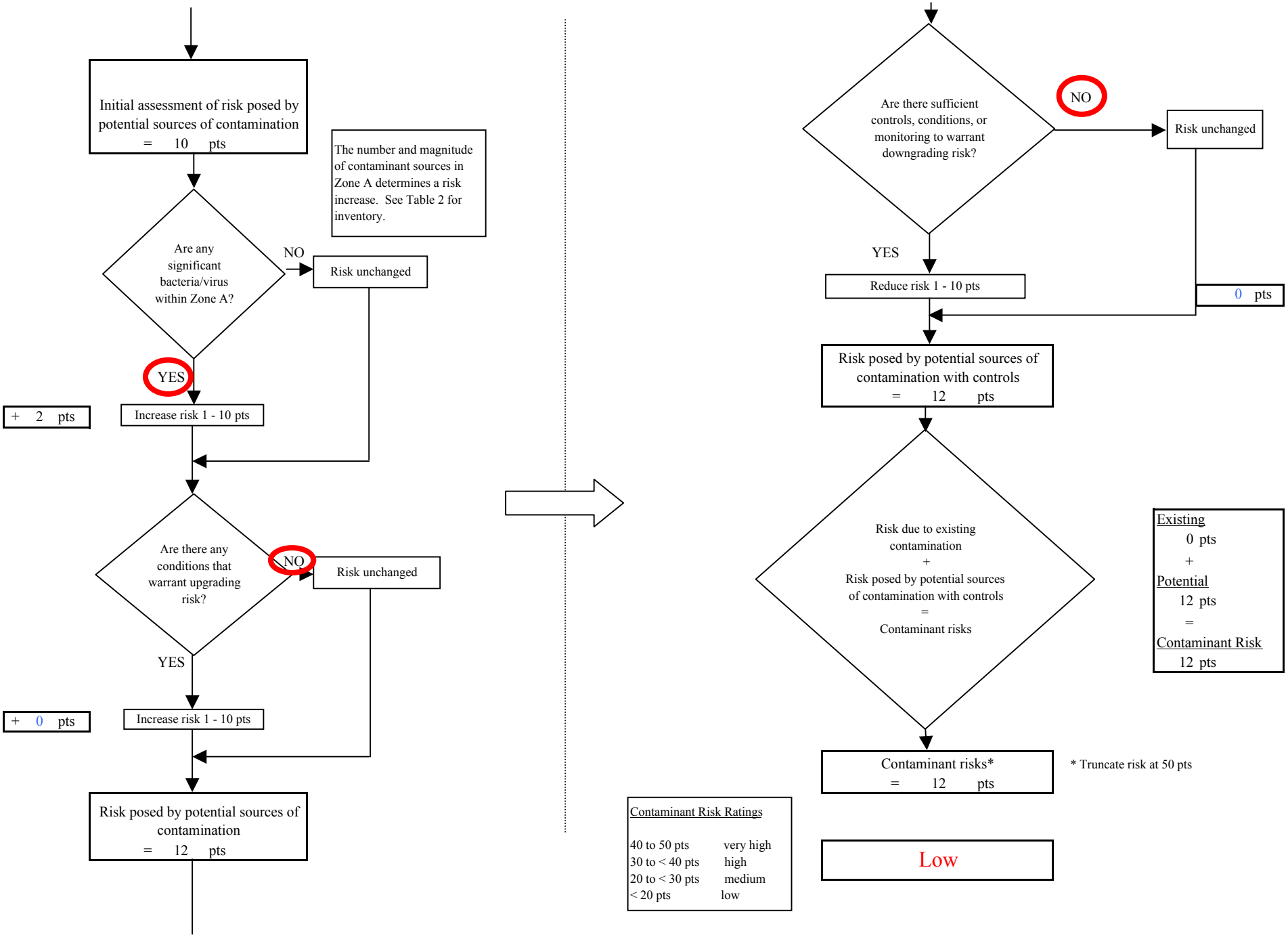


Chart 3. Vulnerability analysis for Quinhagak Water System (PWS No. 271041.001) - Bacteria & Viruses

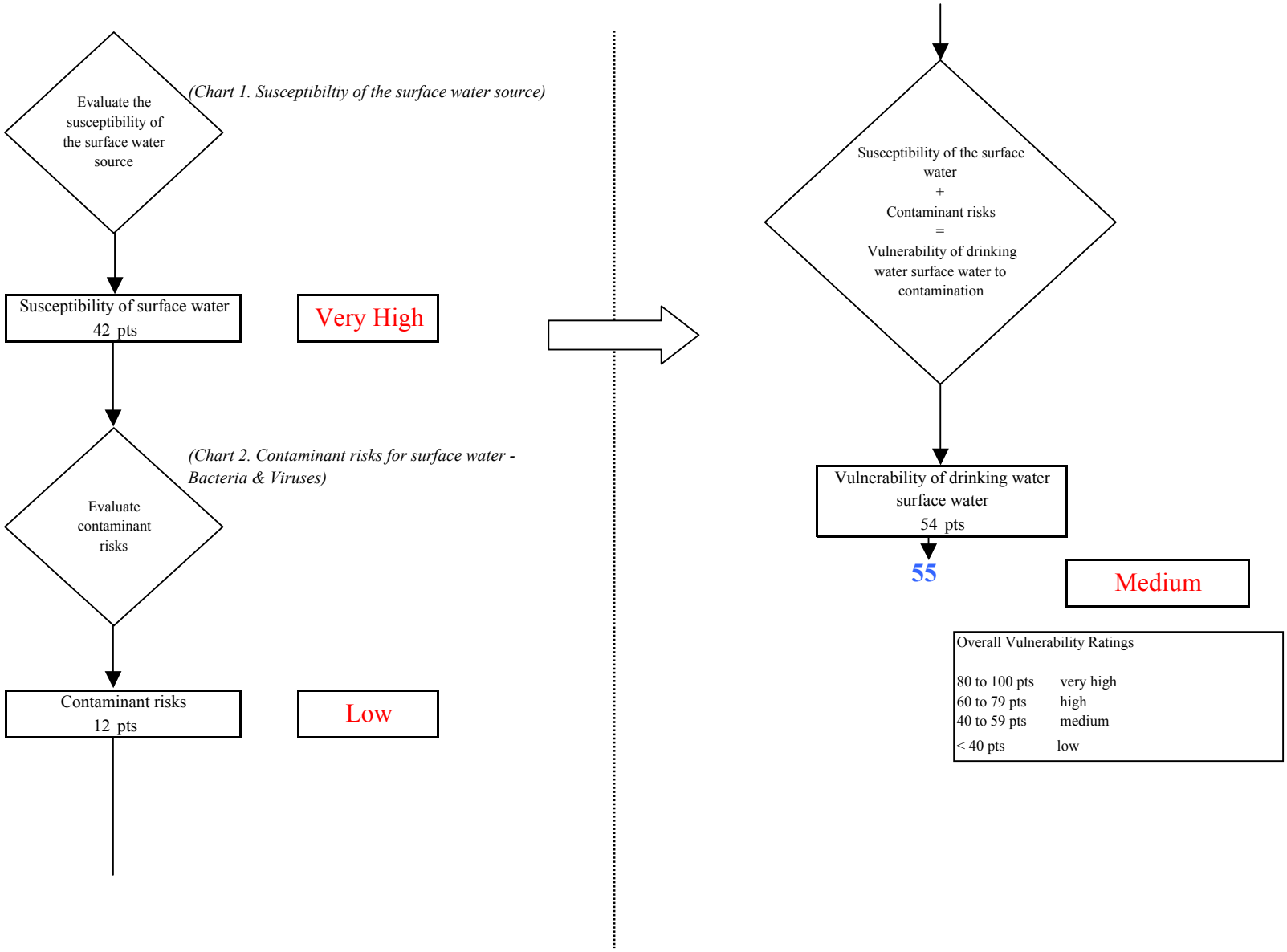


Chart 4. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Nitrates and Nitrites

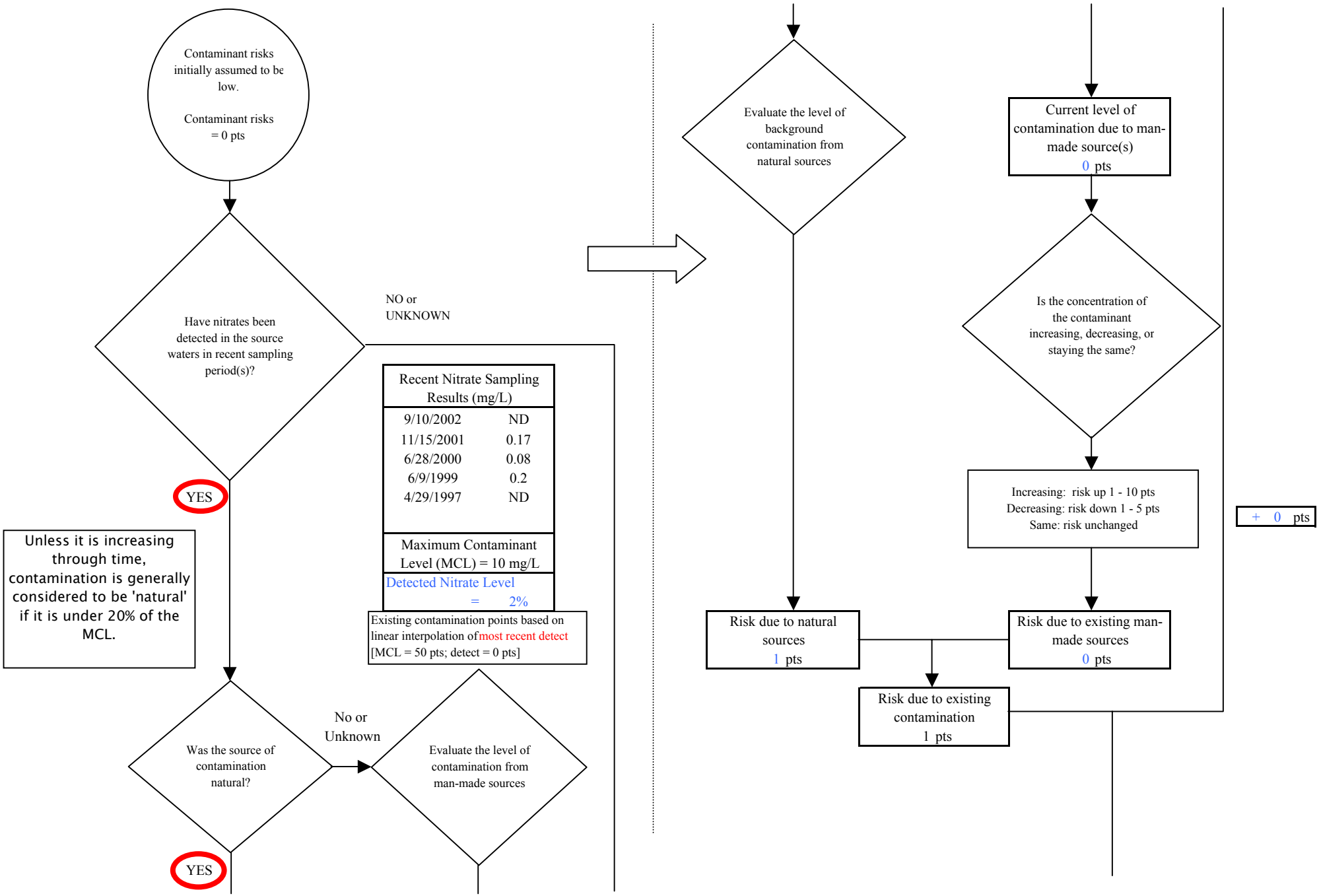
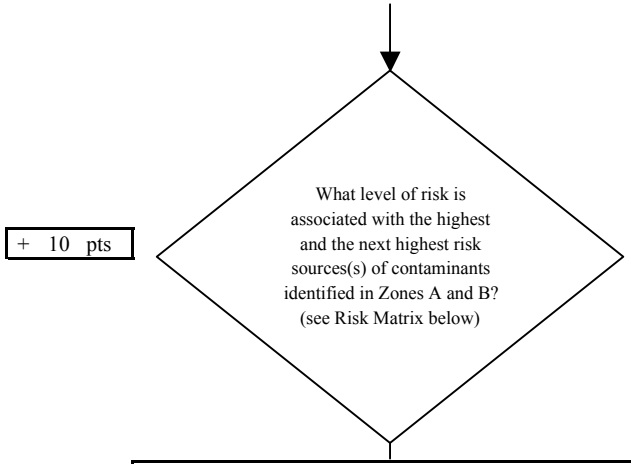


Chart 4. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Nitrates and Nitrites



+ 10 pts

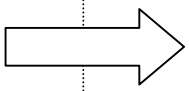
Risk Levels for Nitrate/Nitrite Sources identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0		0
Low(s)	1		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 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.



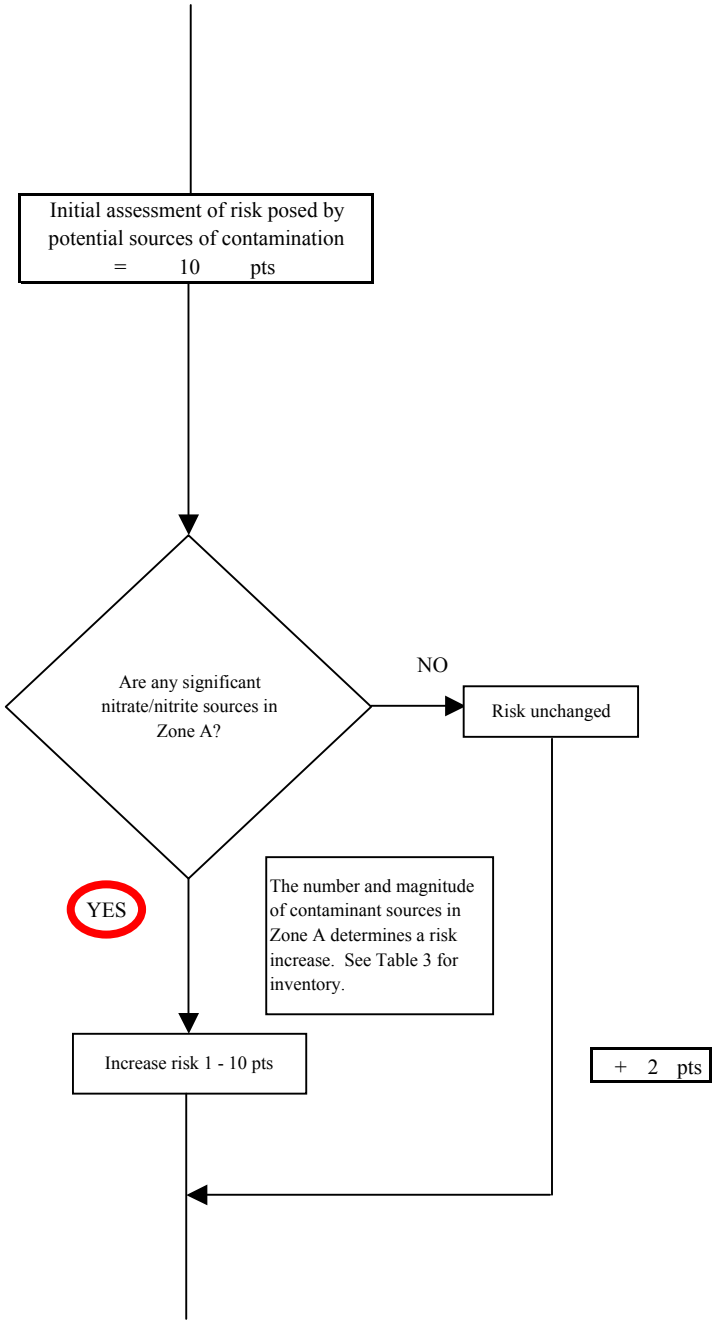


Chart 4. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Nitrates and Nitrites

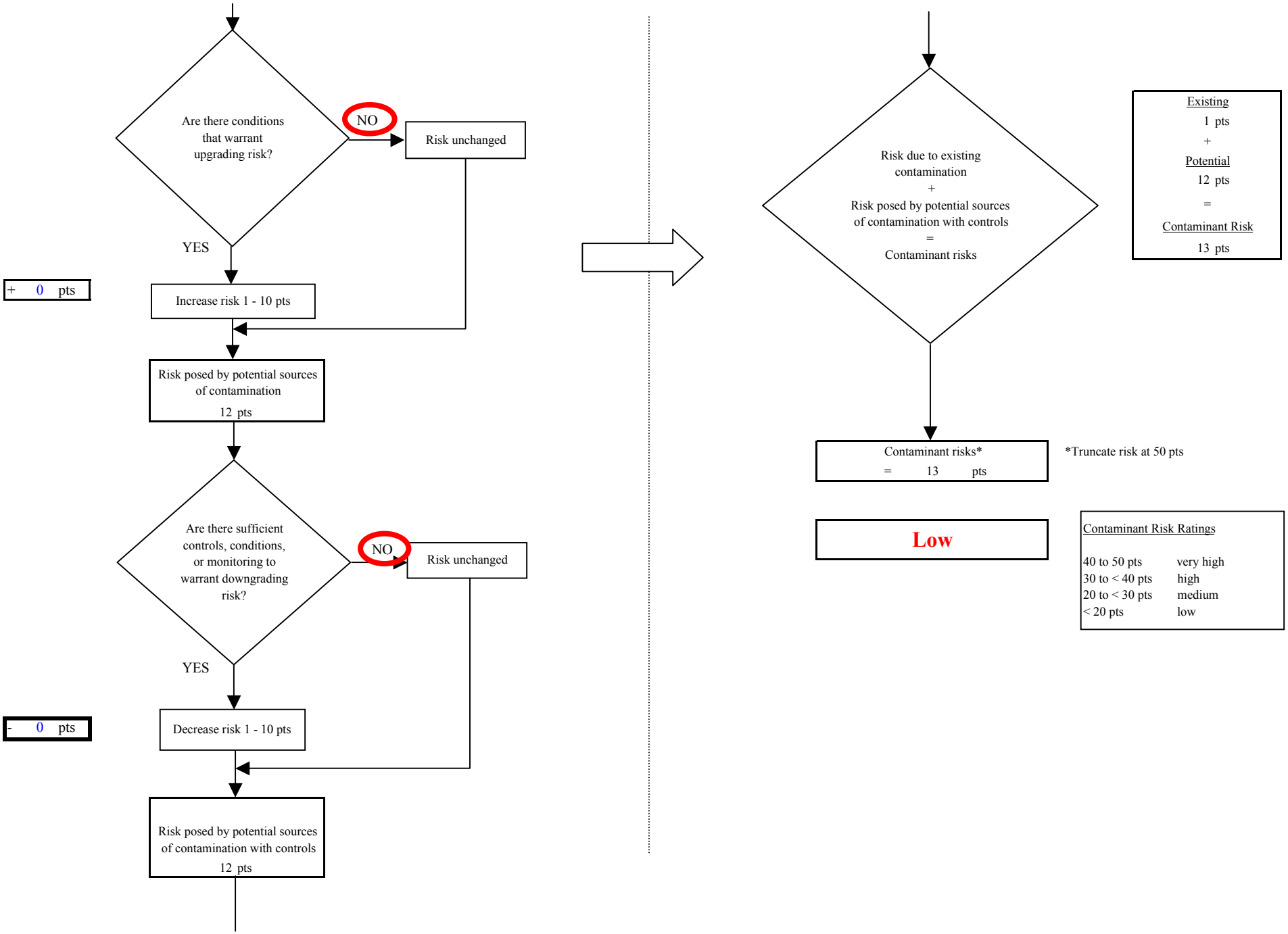


Chart 5. Vulnerability analysis for Quinhagak Water System (PWS No. 271041.001) - Nitrates and Nitrites

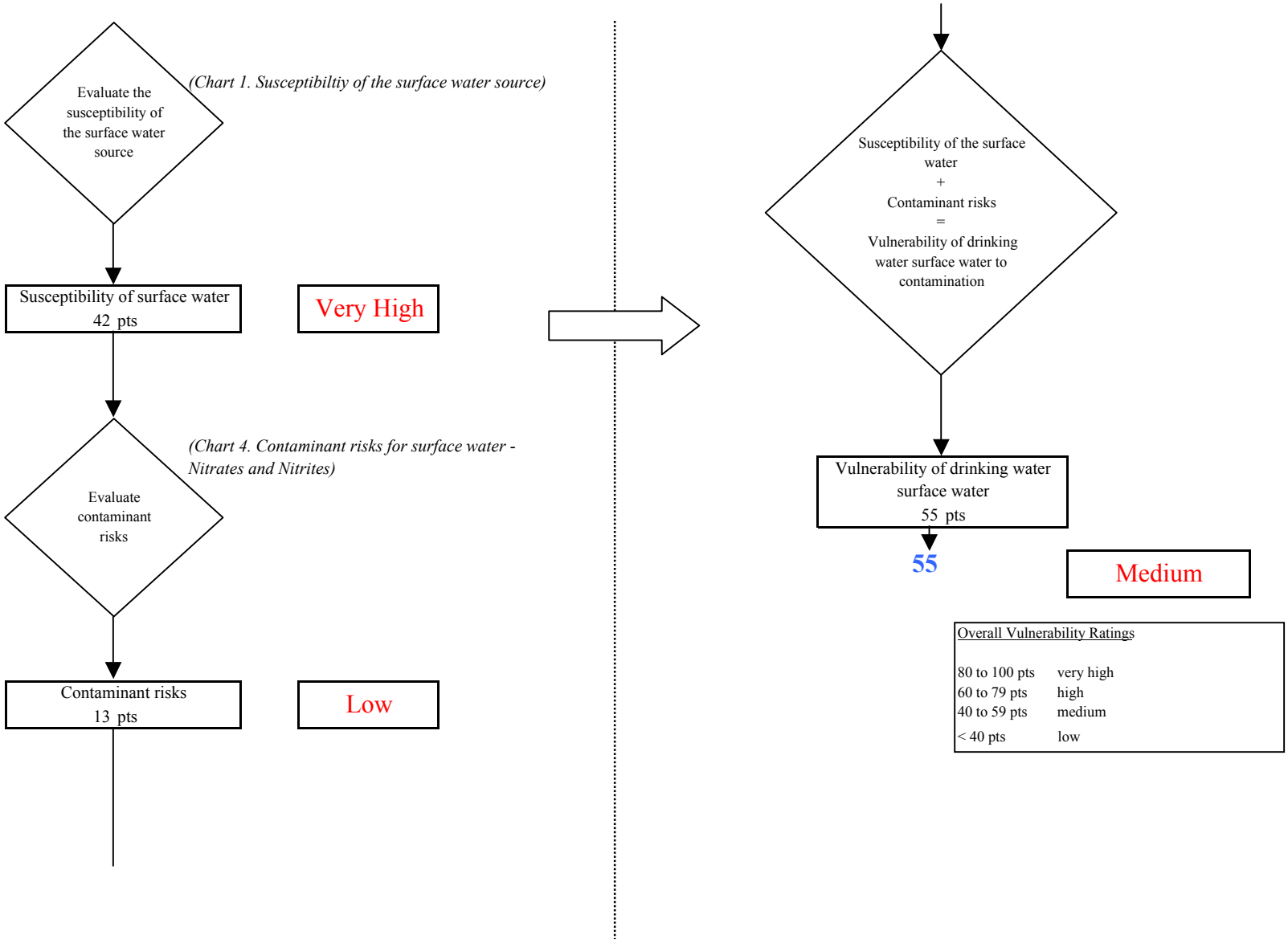


Chart 6. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Volatile Organic Chemicals

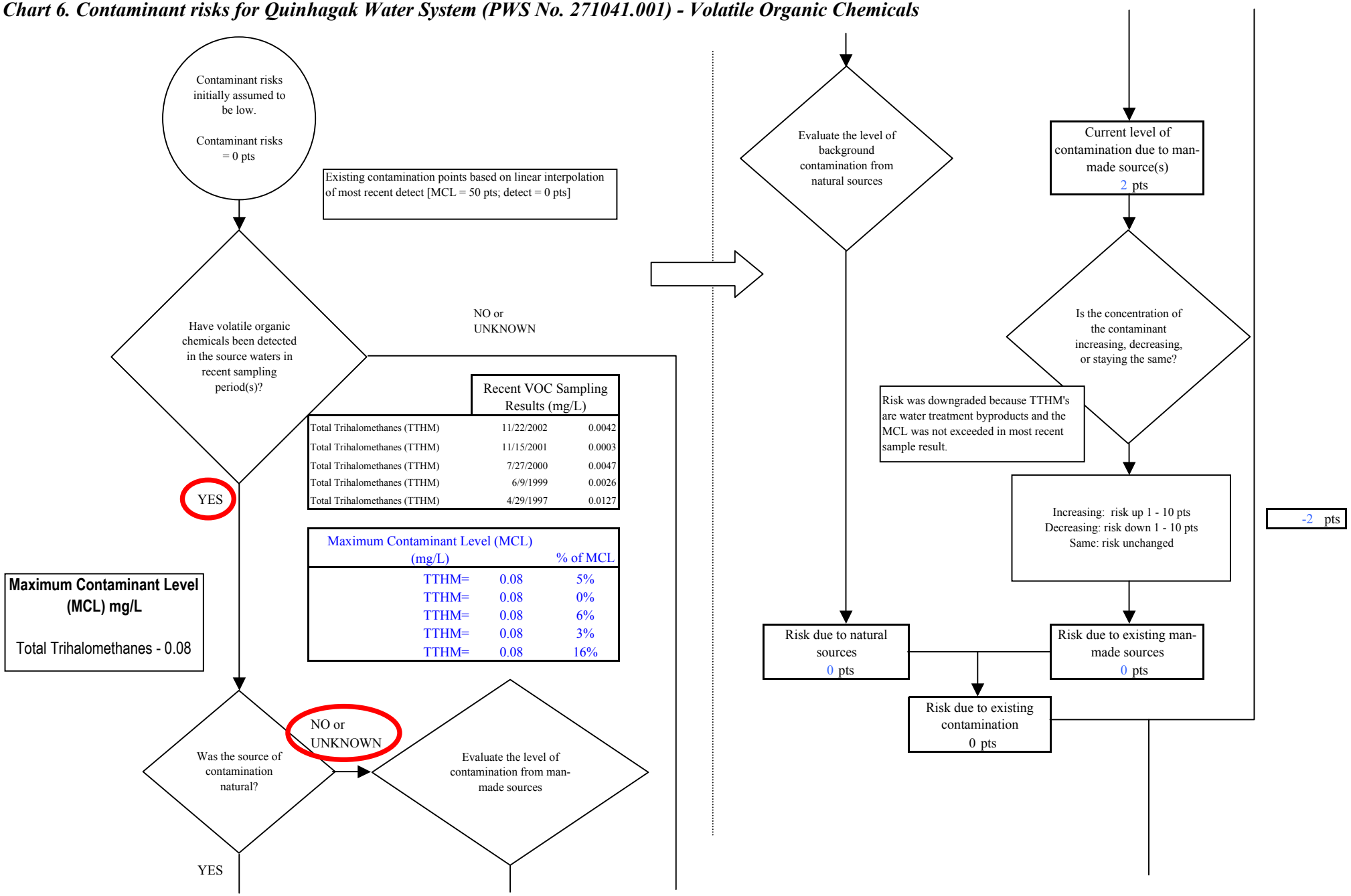


Chart 6. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Volatile Organic Chemicals

+ 10 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A and B? (see Risk Matrix below)

Initial assessment of risk posed by potential sources of contamination = 10 pts

Are any significant VOC sources in Zone A?

NO → Risk unchanged

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 4 for inventory.

+ 2 pts

YES

Increase risk 1 - 10 pts

Risk Levels for VOC 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)	0		0
Low(s)	1		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 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 6. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Volatile Organic Chemicals

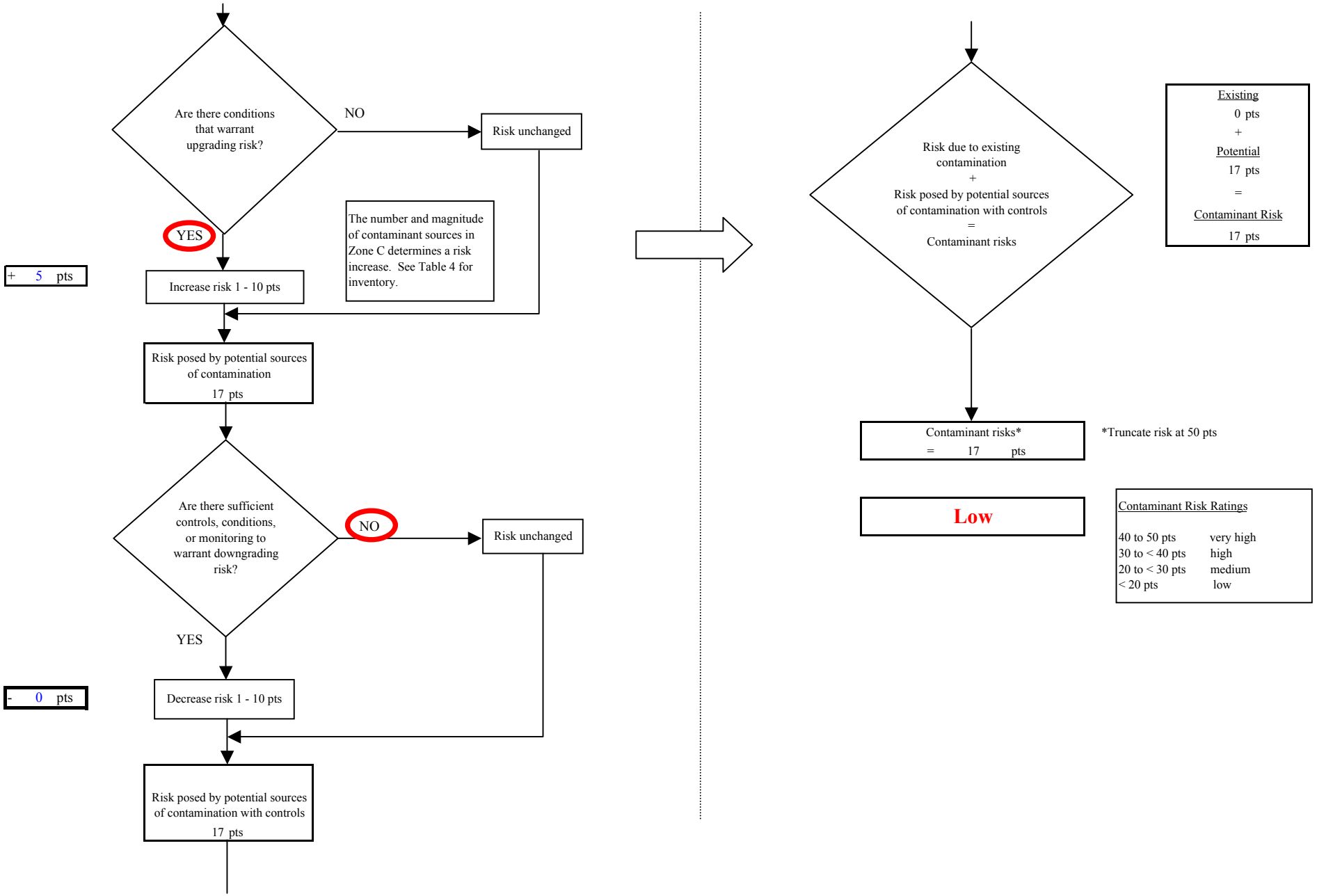


Chart 7. Vulnerability analysis for Quinhagak Water System (PWS No. 271041.001) - Volatile Organic Chemicals

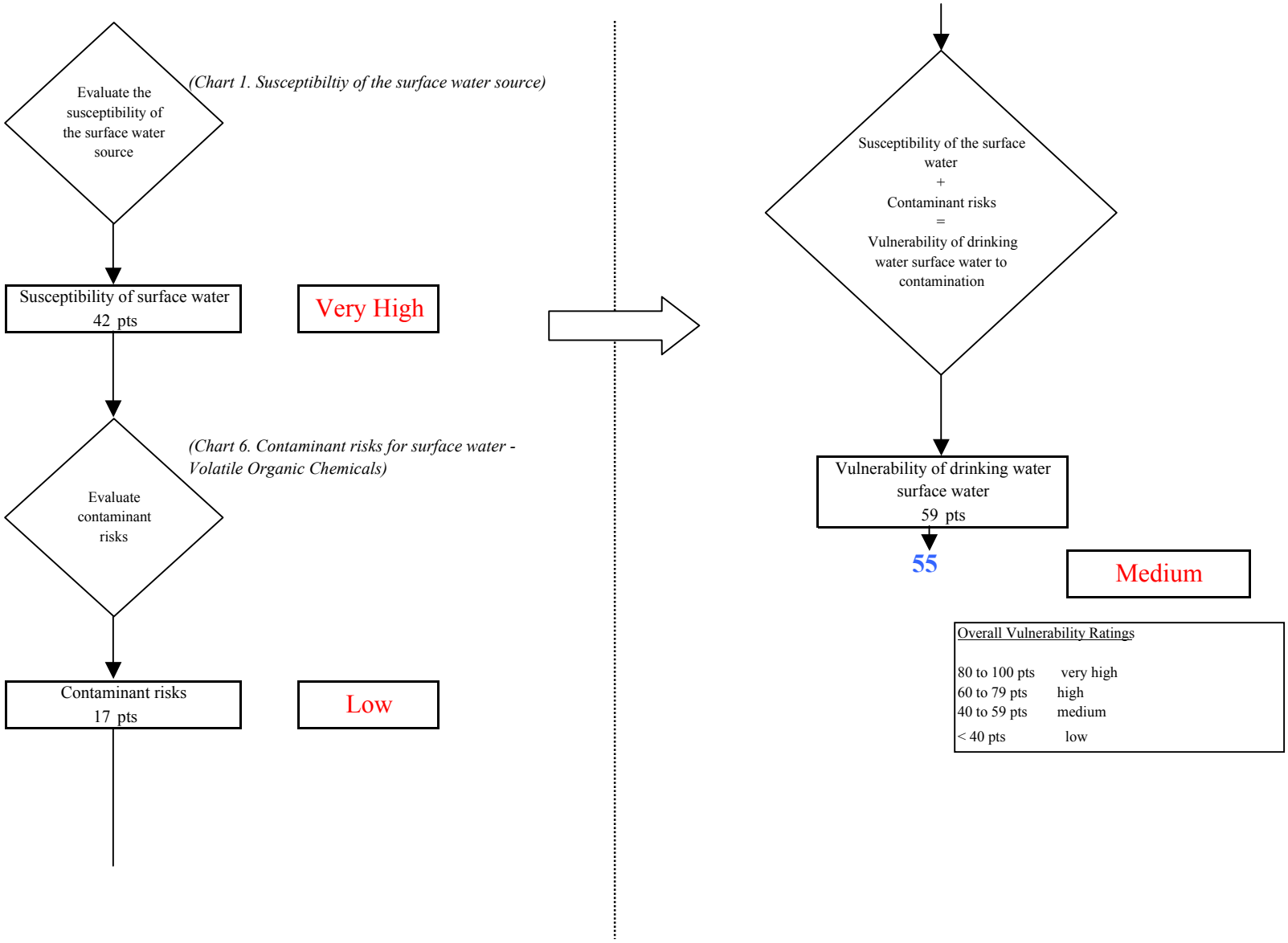


Chart 8. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

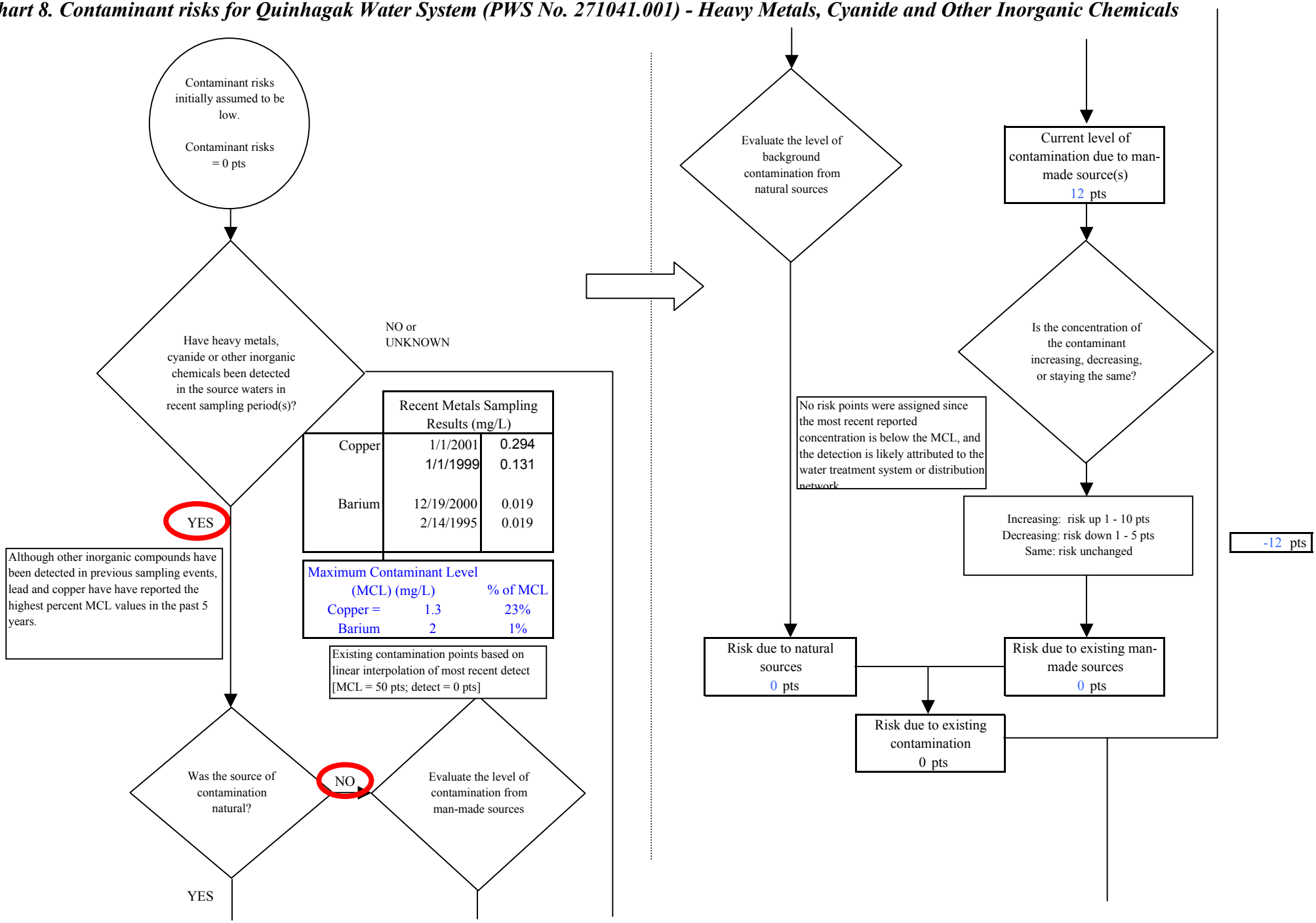


Chart 8. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 10 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A and B? (see Risk Matrix below)

Initial assessment of risk posed by potential sources of contamination = 10 pts

Are any significant HM, Cyanide, or OIC sources in Zone A?

NO → Risk unchanged

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 5 for inventory.

+ 2 pts

YES

Increase risk 1 - 10 pts

Risk Levels for HM, Cyanide, or OIC 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)	0		0
Low(s)	1		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 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 8. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

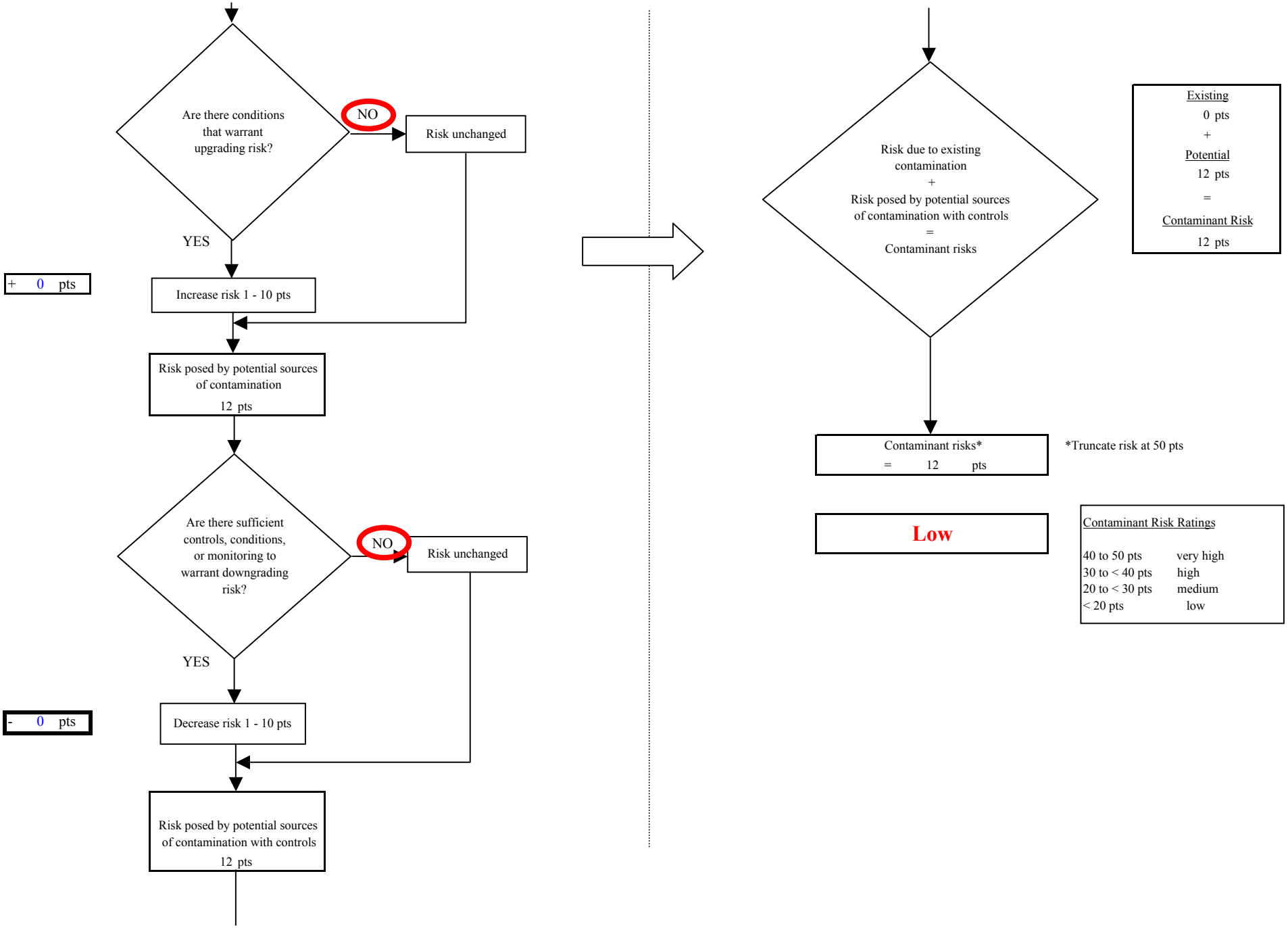


Chart 9. Vulnerability analysis for Quinhagak Water System (PWS No. 271041.001) - Heavy Metals, Cyanide and Other Inorganic Chem

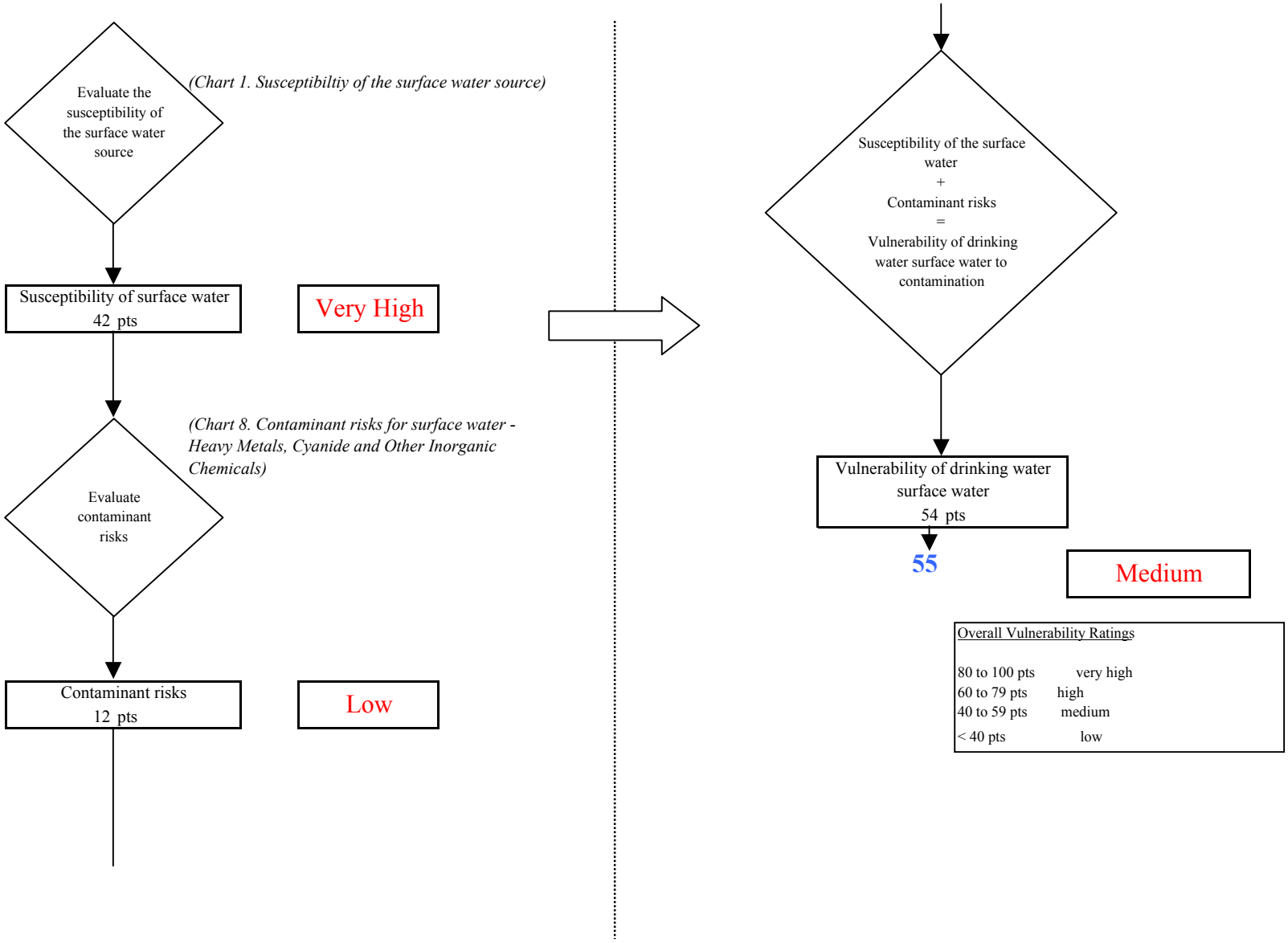


Chart 10. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Synthetic Organic Chemicals

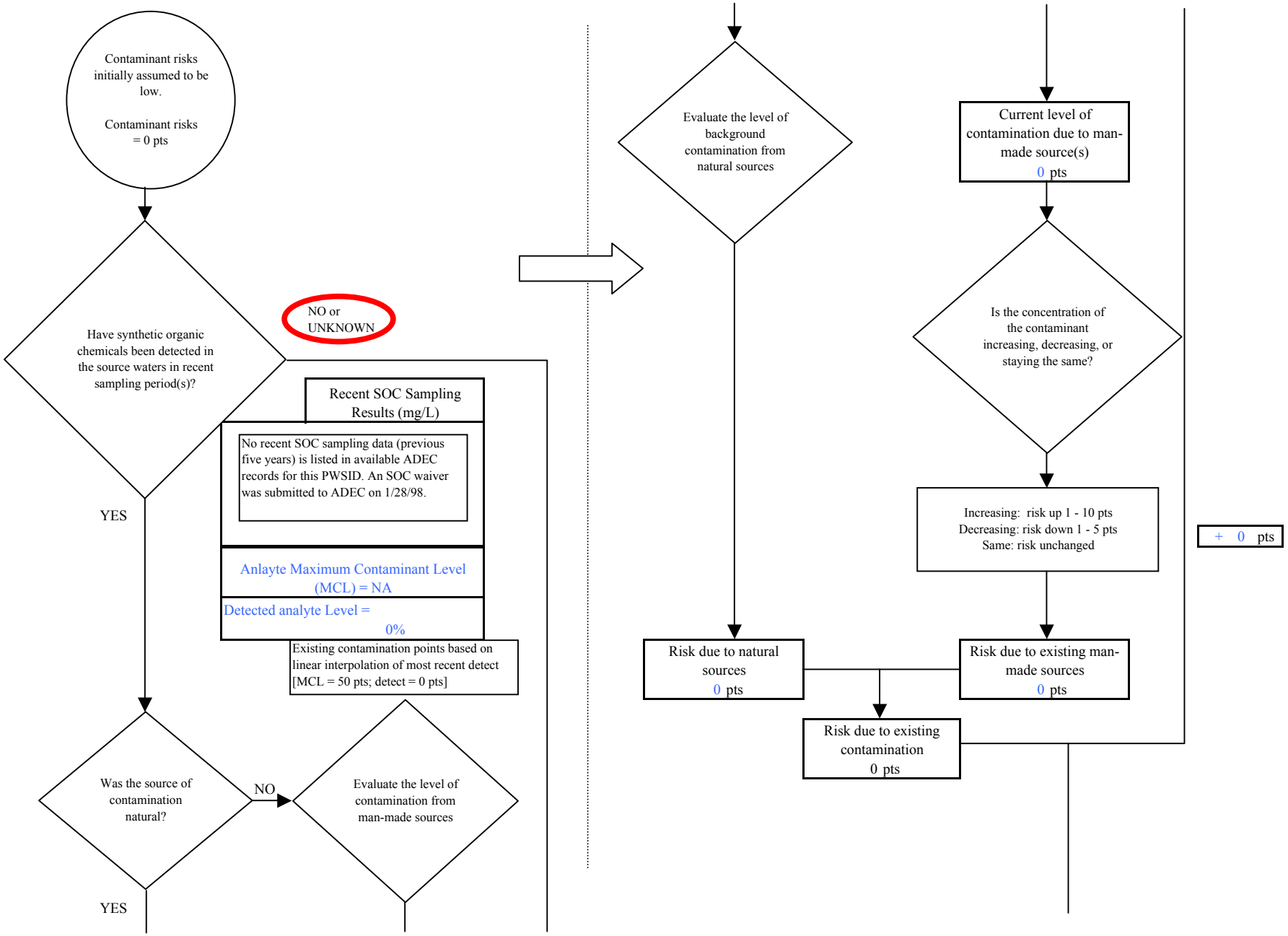
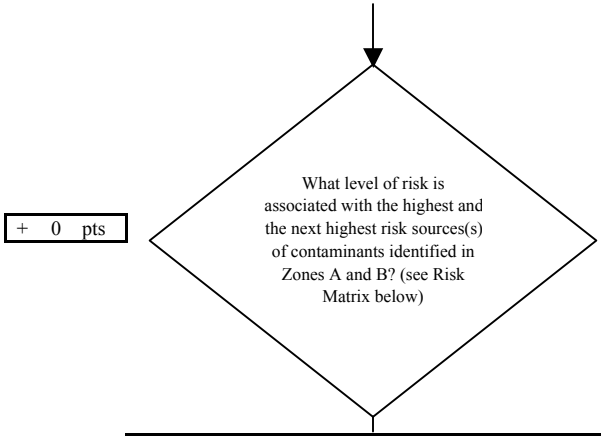


Chart 10. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Synthetic Organic Chemicals



+ 0 pts

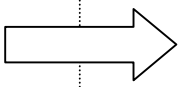
Risk Levels for SOC Sources identified in Zones A and C

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	0	0	0

	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 0

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.



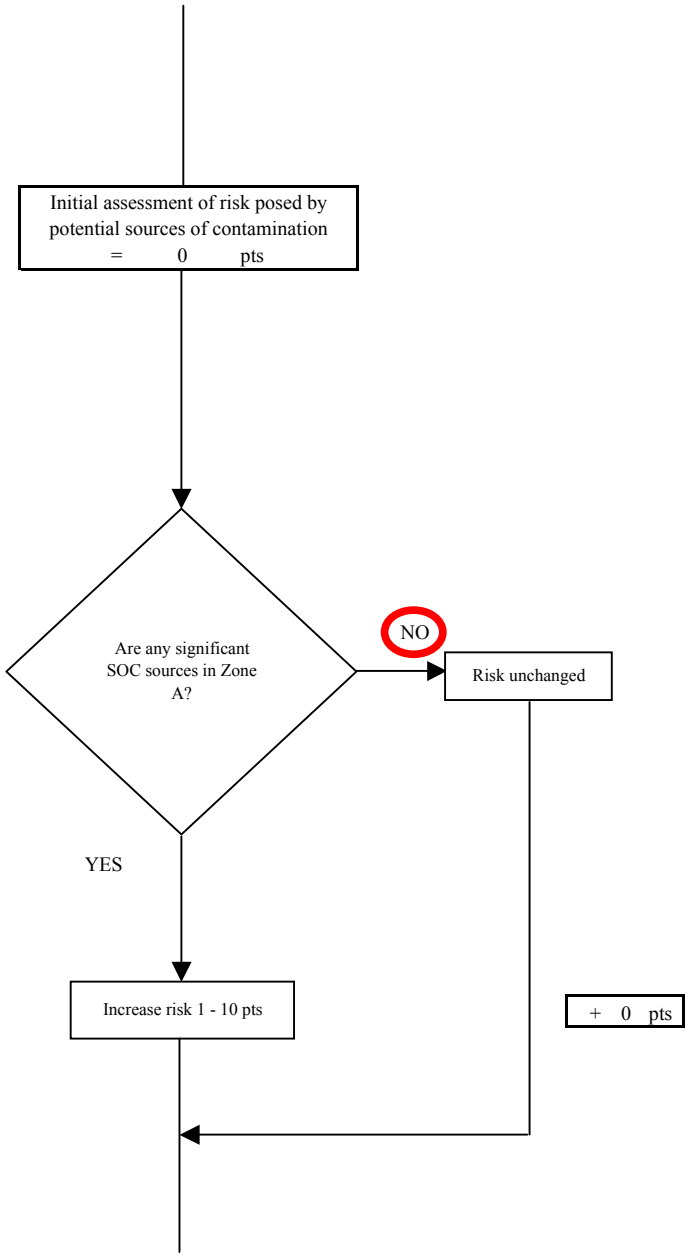
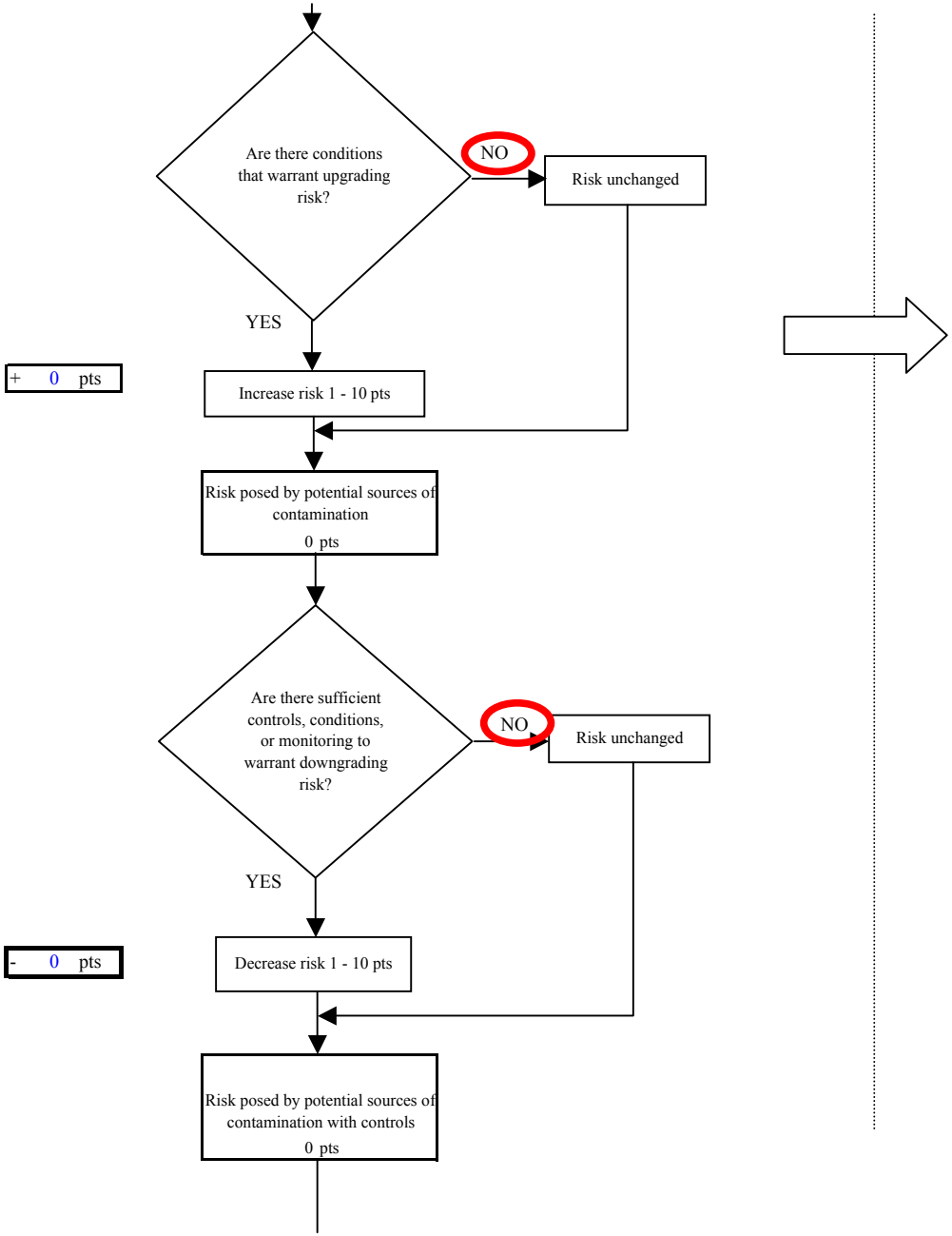


Chart 10. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Synthetic Organic Chemicals



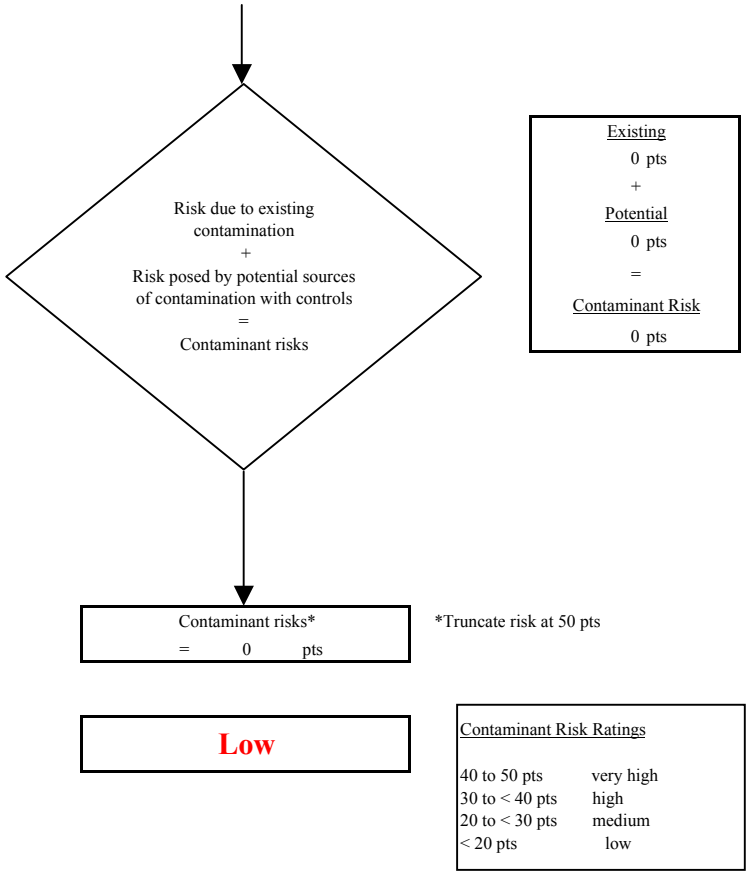


Chart 11. Vulnerability analysis for Quinhagak Water System (PWS No. 271041.001) - Synthetic Organic Chemicals

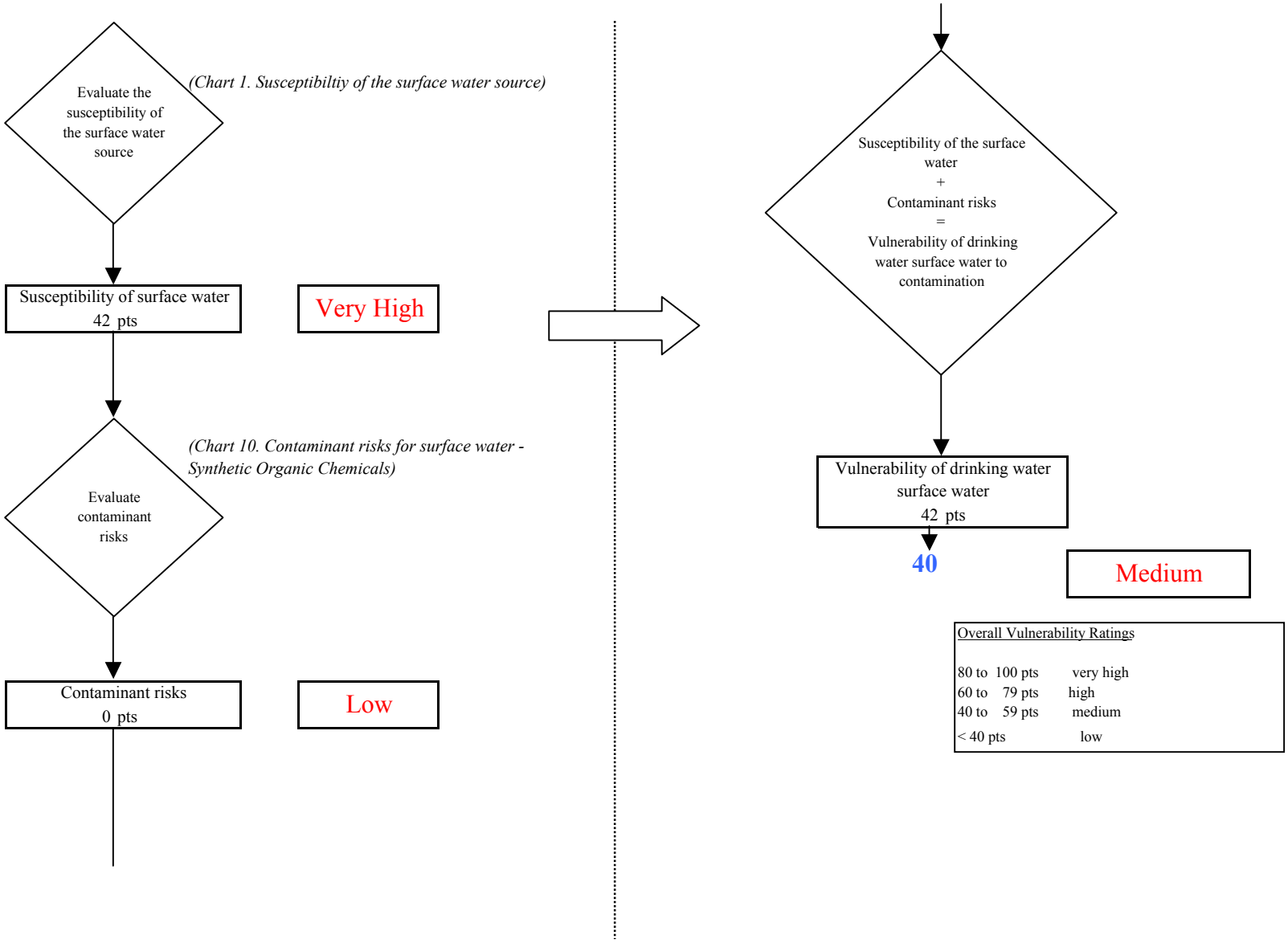


Chart 12. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Other Organic Chemicals

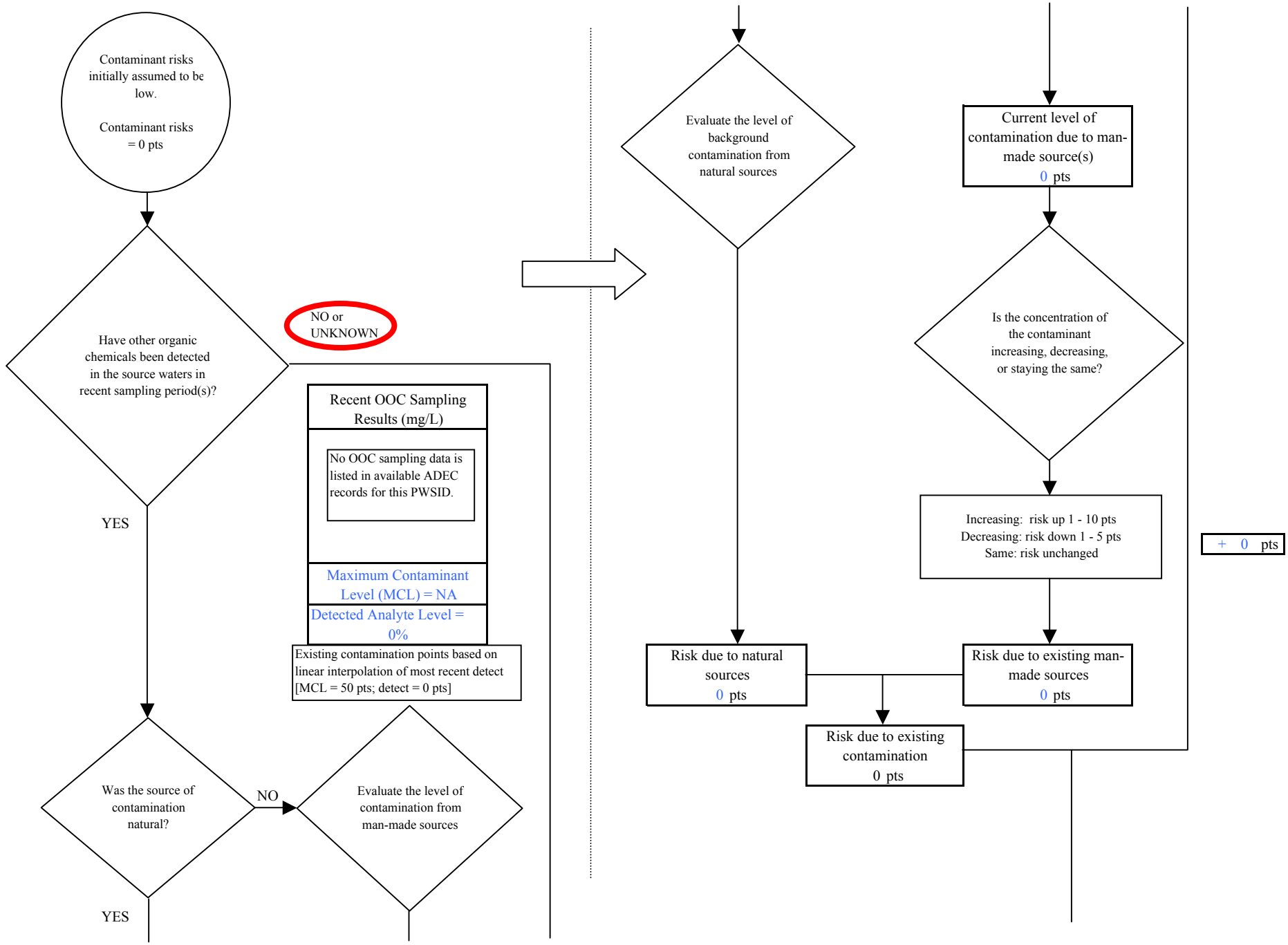
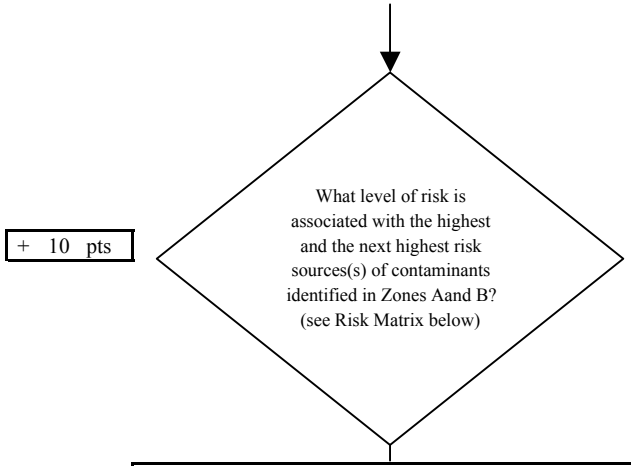


Chart 12. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Other Organic Chemicals



+ 10 pts

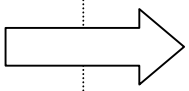
Risk Levels for OOC Sources identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	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 individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.



Initial assessment of risk posed by potential sources of contamination = 10 pts

Are any significant sources <1000 ft from the spring, lake, river, or stream, or within the floodplain?

NO

Risk unchanged

YES

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 7 for inventory.

Increase risk 1 - 10 pts

+ 2 pts

Chart 12. Contaminant risks for Quinhagak Water System (PWS No. 271041.001) - Other Organic Chemicals

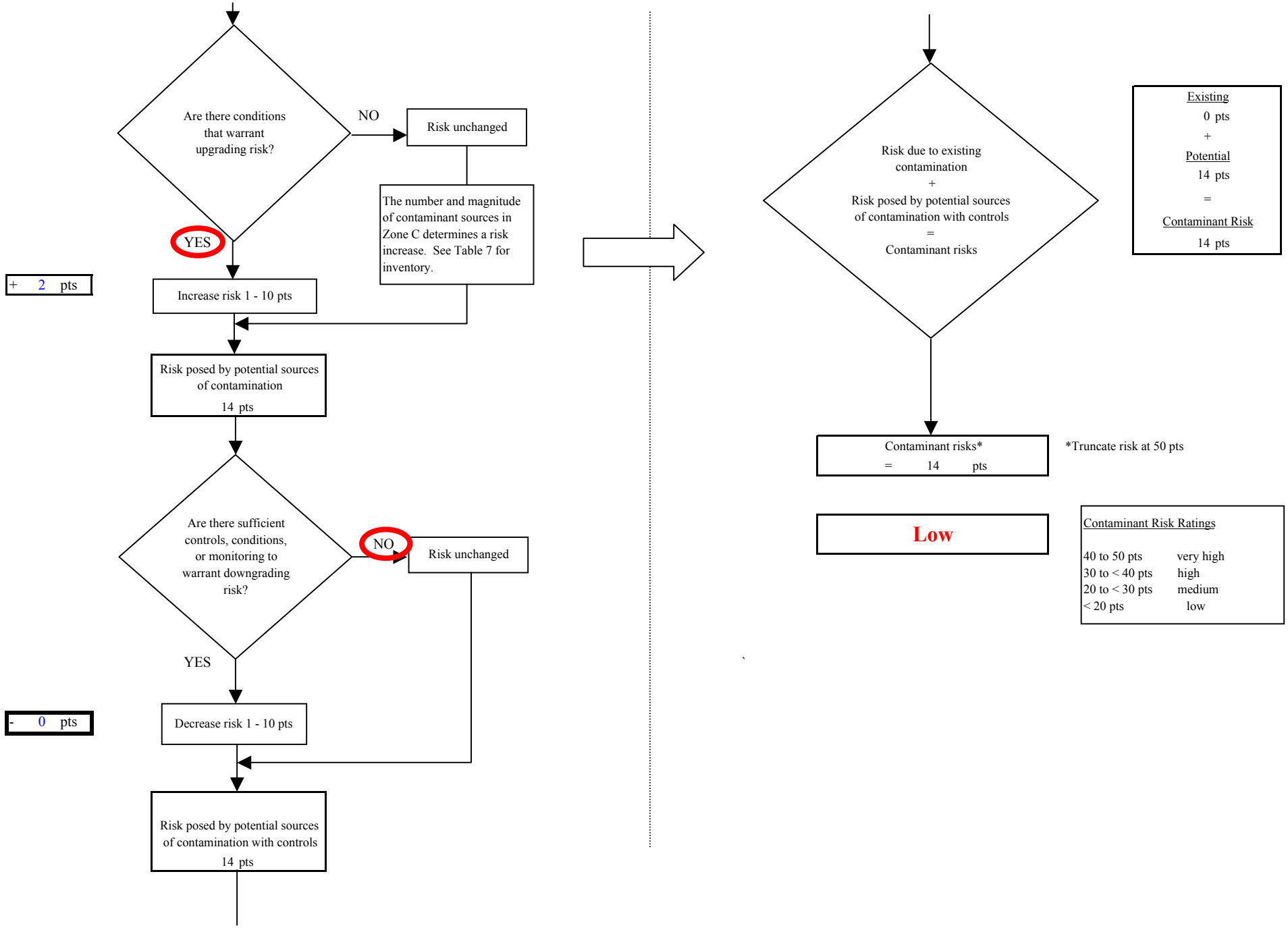


Chart 13. Vulnerability analysis for Quinhagak Water System (PWS No. 271041.001) - Other Organic Chemicals