Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for BBBSD Naknek Drinking Water System, Naknek, Alaska

PWSID # 260464.003

April 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1052
Alaska Department of Environmental Conservation

Source Water Assessment for
BBBSD Naknek
Drinking Water System
Naknek, Alaska

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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 BBBSD Naknek Source of Public Drinking Water, Naknek, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The BBBSD Naknek has two Public Water System (PWS) wells. The well (PWS No. 260464.003) has been used as a drinking water source since it was drilled in 1990. This source water assessment report is exclusively limited to PWSID #260464.003.

The well is a Class A (community and non-transient/non-community) water system located at #1 Schoolhouse Road in Naknek, Alaska. Available records indicate that there is a combined water storage capacity of 2,000-gallons, and that the drinking water is treated with calcium hypochlorite. This system operates year round and serves approximately 387 non-residents through three service connections. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produce a **Medium** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: domestic wastewater collection systems, above ground fuel tanks, water supply wells, roads, paint sales/service, seafood processing, an airport, boat yards and marinas, and electric power generation. 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 **Medium** for the bacteria and viruses, nitrates and nitrites, heavy metals, cyanide and other inorganic chemicals, and volatile organic chemicals, and a vulnerability rating of **Low** for synthetic organic chemicals and other organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The BBBSD Naknek well is a Class A (community/non-transient/non-community) public water system. The system is located off of #1 Schoolhouse Road in Naknek, Alaska (Sec. 2, T17S, R47W, Seward Meridian; see Map A of Appendix A). Naknek is the primary fishery center in Bristol Bay, located about 12 miles northwest of King Salmon and 300 miles southwest of Anchorage. The community has a population of 642 (ADCED, 2003). Average annual precipitation in Naknek is 20 inches, including approximately 45 inches of snowfall. Temperatures range from 42 to 63°F in summer and -4 to 16°F in winter. Temperatures can be as extreme as -46 to 88°F.

The community of Naknek obtains most of their water supply from individual wells. Most households are served by the piped sewage collection system operated by the Borough and the remaining households have individual septic tanks (ADCED, 2003). Naknek receives electrical power from the Naknek Electric Association operated by the REA Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by the Patterson Sanitation Company and trucked to the Borough operated landfill located five miles outside of the community (ADCED, 2003).

According to information supplied by ADEC for the BBBSD Naknek PWS, the depth of the primary water well is 240 feet below the ground surface and is screened in a confined aquifer based on available construction details. The well is assumed to be not located within a floodplain.

Information acquired from a September 1996 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 grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

The entire Bristol Bay area was formerly covered by glaciers and the topography is representative of a

postglacial area. Soils information is limited. Generally, the soils consist of silty sand overlying relatively clean sand. The silty soils are slightly frost-susceptible. Isolated pockets of permafrost are scattered throughout the area (DOWL, 1982).

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 BBBSD Naknek 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 BBBSD Naknek 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 BBBSD Naknek DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

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

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

The sources are displayed on Map C of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

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

- Low,
- Medium,
- High, and
- Very High.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B

because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well. Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF THE DRINKING WATER SYSTEM

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

- Natural susceptibility, and
- Contaminant risks.

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
(Chart 2 of Appendix D)

=

Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

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

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The BBBSD Naknek's water well is 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	22	Very High
Natural Susceptibility	22	Medium

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	25	Medium
Nitrates and/or Nitrites	32	High
Volatile Organic Chemicals	27	Medium
Heavy Metals, Cyanide and Other Inorganic Chemicals	24	Medium
Synthetic Organic Chemicals	11	Low
Other Organic Chemicals	13	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	50	Medium
Nitrates and Nitrites	55	Medium
Volatile Organic Chemicals	50	Medium
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Medium
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	35	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Medium**. The risk is primarily attributed to the presence of domestic wastewater collection systems, roads, and seafood processing in Zones A, B, and D (see Table 2 – Appendix B).

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

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

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 domestic wastewater collection systems, roads, seafood processing, and an airport in Zones A, B, and D (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 of nitrates have been detected in recent sampling events. However, the reported concentrations of nitrates do not exceed the maximum contaminant level (MCL) of 10 mg/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 **Medium**. The risk is primarily attributed to the presence of above ground fuel tanks, paint sales/service, electric power generation, and an airport located in Zones A and D. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

No recent sampling data was available in ADEC records for the BBBSD Naknek (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **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 to the presence of above ground fuel tanks and electric power generation located in Zones A and D. Numerous other potential contaminant sources are also found within the protection area (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, moderate levels of copper have been detected. Copper has been detected in recent sampling history, but has not exceeded the respective 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 to be representative of source water conditions. This analyte 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, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Medium**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Low**. The risk is primarily attributed to the presence of an airport in Zones D. Numerous other potential contaminant sources are also found within the protection area (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the BBBSD Nakenk (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 an airport and electric power generation in Zone D. Numerous other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the BBBSD Naknek (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 BBBSD Naknek and the community of Naknek to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2003 [WWW document]. URL: http://www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm

Alaska Department of Environmental Conservation, Contaminated Sites Database, 2003 [WWW database], URL http://www.state.ak.us/dec/dspar/csites/cs_search.htm

Alaska Department of Environmental Conservation, Leaking Underground Storage Tank Database, 2003 [WWW database], URL http://www.dec.state.ak.us/spar/stp/ust/search/fac_search.asp

DOWL Engineers (DOWL), 1982, Upper Bristol Bay Region Community Planning Profiles.

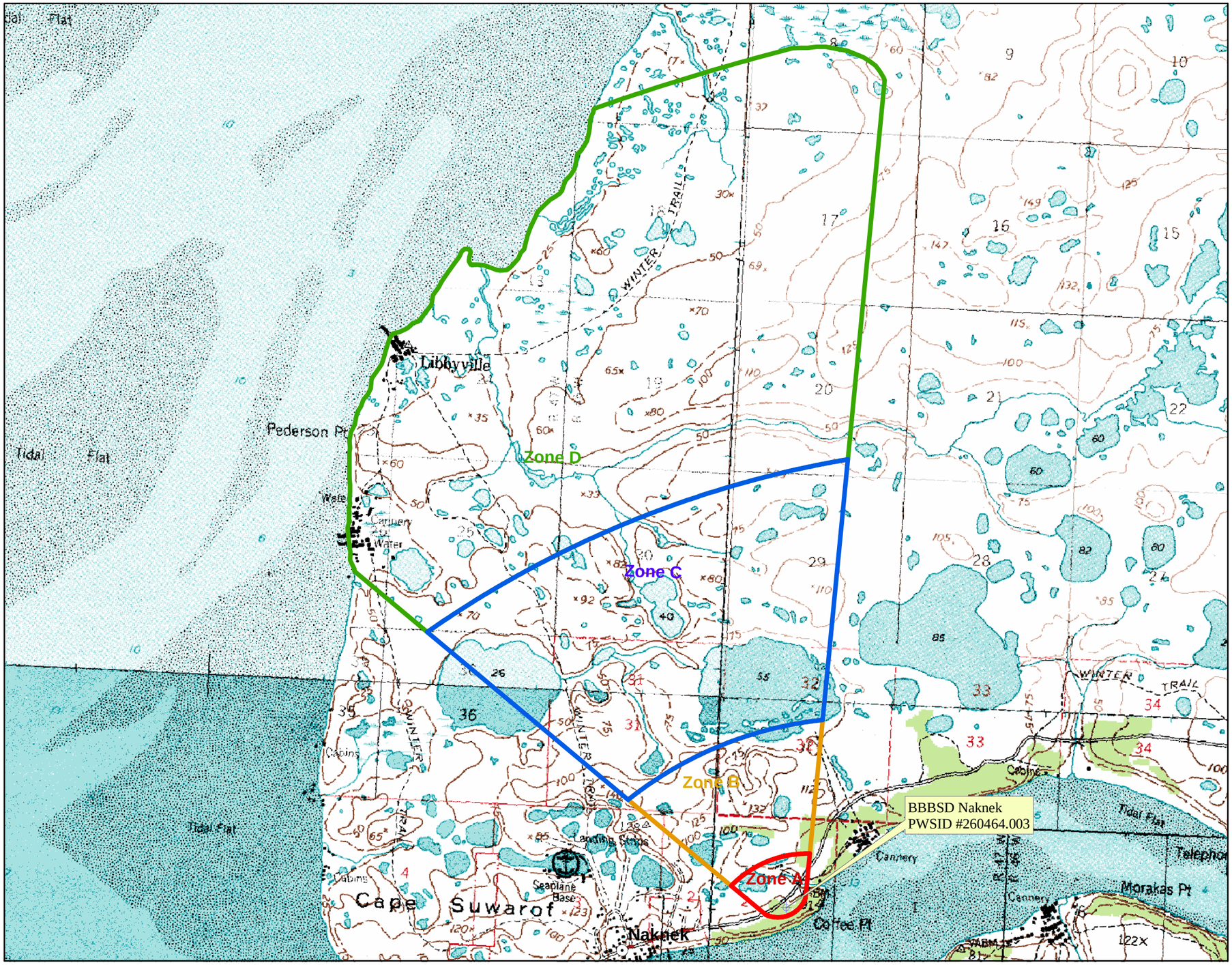
Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL http://www.epa.gov/safewater/mcl.html .

APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #260464.003 BBBSD Naknek



LEGEND

- Public Water System Well

Groundwater Protection Zones

- Zone A – Several Months Travel Time
- Zone B – Less Than 2 Years Travel Time
- Zone C – Less Than 5 Years Travel Time
- Zone D – Less Than 10 Years Travel Time

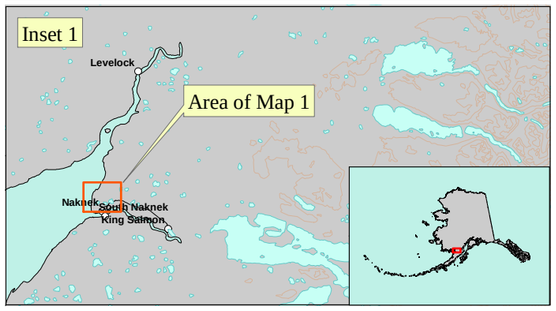
Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

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 0.3 0.6 1.2 1.8 2.4 Miles

BBBSD Naknek
PWS 260464.003
Appendix A Map A

APPENDIX B

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

Table 1

Contaminant Source Inventory for ***BBBSD Naknek***

PWSID 260464.003

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Map Number***	***Comments***
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	Assume area serviced by municipal sewage
Tanks, diesel (above ground)	T06	T06-04	A	C	Due to insufficient data, it is assumed that at least one diesel AST is located in Zone A
Tanks, gasoline (above ground)	T10	T10-02	A	C	Due to insufficient data, it is assumed that at least one gasoline AST is located in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	Due to insufficient data, it is assumed that at least one non-residential heating oil tank is located in Zone A
Water supply wells	W09	W09-01	A	C	1 water supply well in Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Water supply wells	W09	W09-02	B	C	1 water supply well located in Zone B
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B
Paint sales /service	C32	C32-01	D	C	
Seafood processing	N10	N10-01	D	C	
Tanks, diesel (above ground)	T06	T06-01	D	C	
Tanks, diesel (above ground)	T06	T06-02	D	C	
Tanks, diesel (above ground)	T06	T06-03	D	C	
Tanks, gasoline (above ground)	T10	T10-01	D	C	
Water supply wells	W09	W09-03	D	C	2 water supply wells located in Zone D
Airports	X14	X14-01	D	C	Peterson Point Landing Strip
Boat yards and marinas	X15	X15-01	D	C	
Electric power generation (fossil fuels)	X36	X36-01	D	C	

Table 2

Contaminant Source Inventory and Risk Ranking for BBBSD Naknek
Sources of Bacteria and Viruses

PWSID 260464.003

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	Assume area serviced by municipal sewage
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
Seafood processing	N10	N10-01	D	Medium	C	

Table 3

Contaminant Source Inventory and Risk Ranking for BBBSD Naknek

Sources of Nitrates/Nitrites

PWSID 260464.003

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	Assume area serviced by municipal sewage
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
Seafood processing	N10	N10-01	D	Low	C	
Airports	X14	X14-01	D	Low	C	Peterson Point Landing Strip

Table 4

Contaminant Source Inventory and Risk Ranking for BBBSD Naknek

Sources of Volatile Organic Chemicals

PWSID 260464.003

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume area serviced by municipal sewage
Tanks, diesel (above ground)	T06	T06-04	A	Medium	C	Due to insufficient data, it is assumed that at least one diesel AST is located in Zone A
Tanks, gasoline (above ground)	T10	T10-02	A	Medium	C	Due to insufficient data, it is assumed that at least one gasoline AST is located in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Due to insufficient data, it is assumed that at least one non-residential heating oil tank is located 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
Paint sales /service	C32	C32-01	D	Medium	C	
Tanks, diesel (above ground)	T06	T06-01	D	Medium	C	
Tanks, diesel (above ground)	T06	T06-02	D	Medium	C	
Tanks, diesel (above ground)	T06	T06-03	D	Medium	C	
Tanks, gasoline (above ground)	T10	T10-01	D	Medium	C	
Airports	X14	X14-01	D	High	C	Peterson Point Landing Strip
Boat yards and marinas	X15	X15-01	D	Low	C	
Electric power generation (fossil fuels)	X36	X36-01	D	Medium	C	

Table 5

Contaminant Source Inventory and Risk Ranking for BBBSD Naknek

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 260464.003

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume area serviced by municipal sewage
Tanks, gasoline (above ground)	T10	T10-02	A	Medium	C	Due to insufficient data, it is assumed that at least one gasoline AST is located in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Due to insufficient data, it is assumed that at least one non-residential heating oil tank is located 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
Paint sales /service	C32	C32-01	D	Low	C	
Tanks, gasoline (above ground)	T10	T10-01	D	Medium	C	
Airports	X14	X14-01	D	Low	C	Peterson Point Landing Strip
Boat yards and marinas	X15	X15-01	D	Low	C	
Electric power generation (fossil fuels)	X36	X36-01	D	Medium	C	

Table 6

Contaminant Source Inventory and Risk Ranking for BBBSD Naknek

Sources of Synthetic Organic Chemicals

PWSID 260464.003

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume area serviced by municipal sewage
Paint sales /service	C32	C32-01	D	Low	C	
Airports	X14	X14-01	D	Medium	C	Peterson Point Landing Strip

Table 7

Contaminant Source Inventory and Risk Ranking for BBBSD Naknek

Sources of Other Organic Chemicals

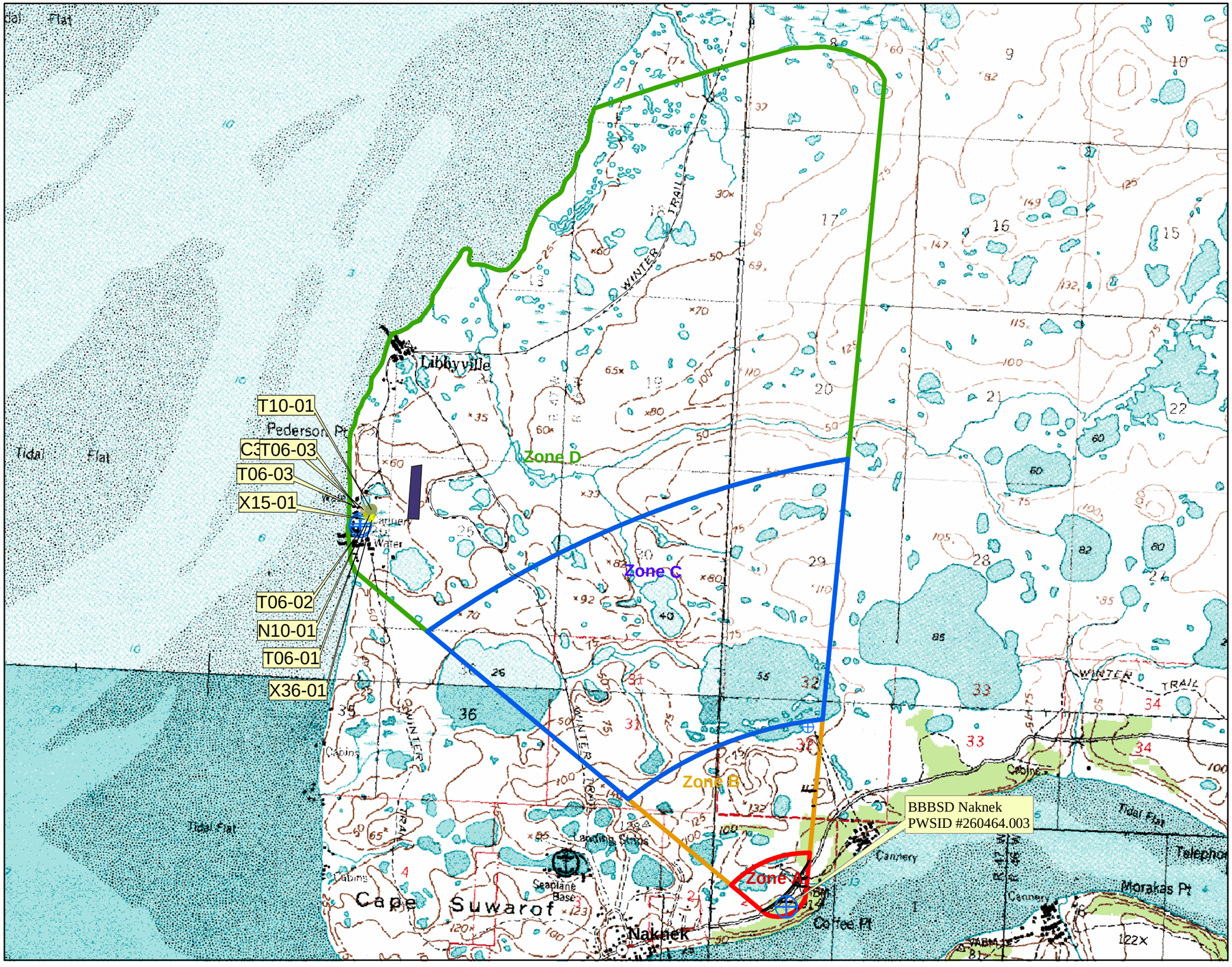
PWSID 260464.003

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume area serviced by municipal sewage
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
Airports	X14	X14-01	D	Medium	C	Peterson Point Landing Strip
Boat yards and marinas	X15	X15-01	D	Low	C	
Electric power generation (fossil fuels)	X36	X36-01	D	High	C	

APPENDIX C

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

Public Water Well System for PWS #260464.003 BBBSD Naknek
Showing Potential and Existing Sources of Contamination



LEGEND

- Public Water System Well

Groundwater Protection Zones

- Zone A – Several Months Travel Time
- Zone B – Less Than 2 Years Travel Time
- Zone C – Less Than 5 Years Travel Time
- Zone D – Less Than 10 Years Travel Time

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

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

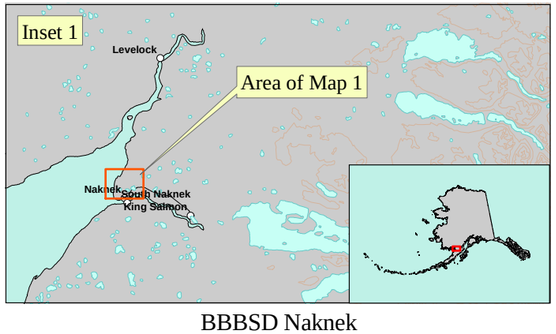
Existing or Potential Contaminant Sources

- Paint sales or service (C32)
- Seafood Processing (N10)
- Tanks, diesel (aboveground) (T06)
- Tanks, gasoline (aboveground) (T10)
- Boat yards and marinas (X15)
- Electric power generation (fossil fuels) (X36)
- Airport or landing strip (X14)

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

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

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



0 0.3 0.6 1.2 1.8 2.4 Miles

BBBSD Naknek
PWS 260464.003
Appendix C Map C

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - BBBSD Naknek (PWS No.260464.003)

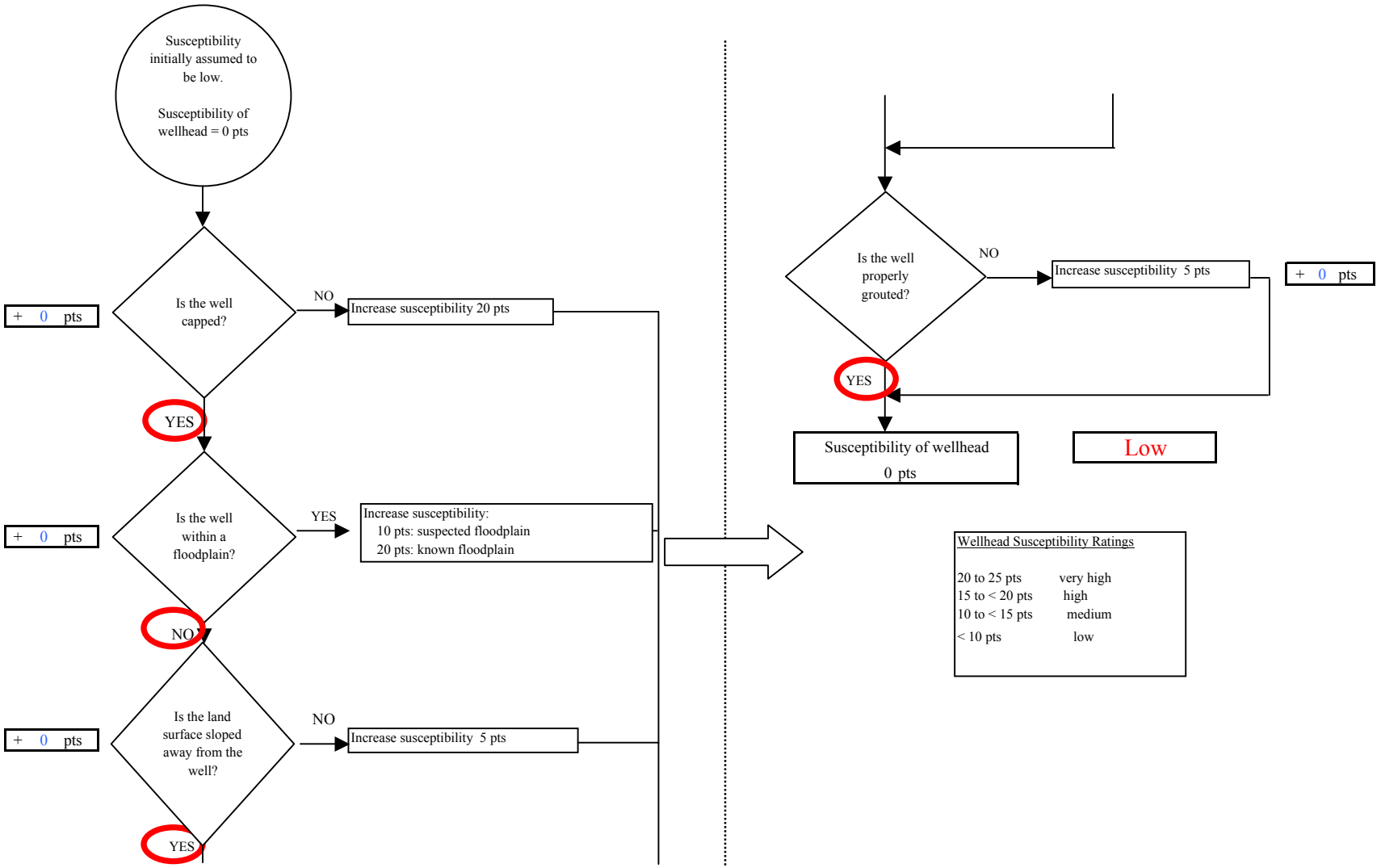


Chart 2. Susceptibility of the aquifer BBBSD Naknek (PWS No.260464.003)

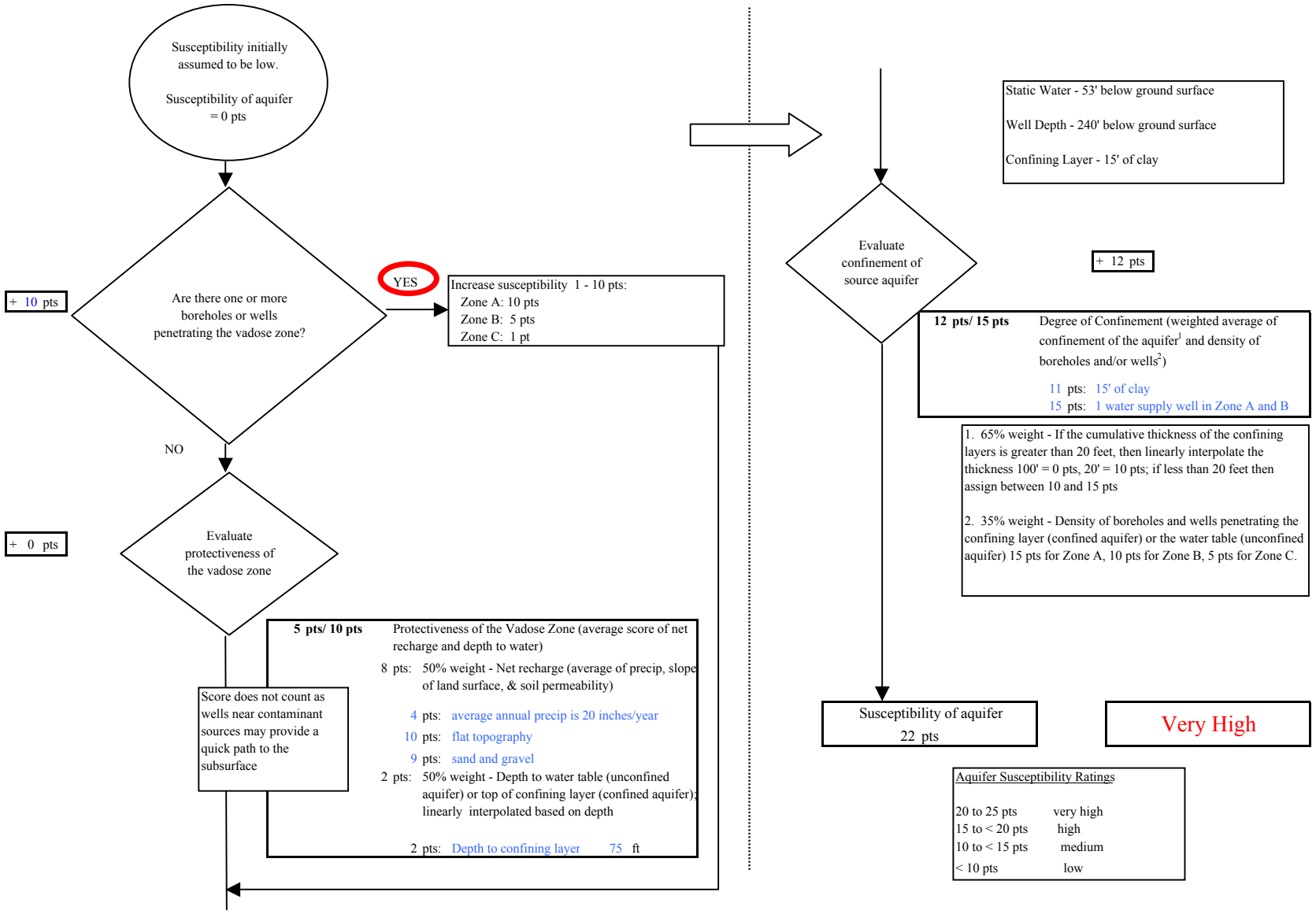
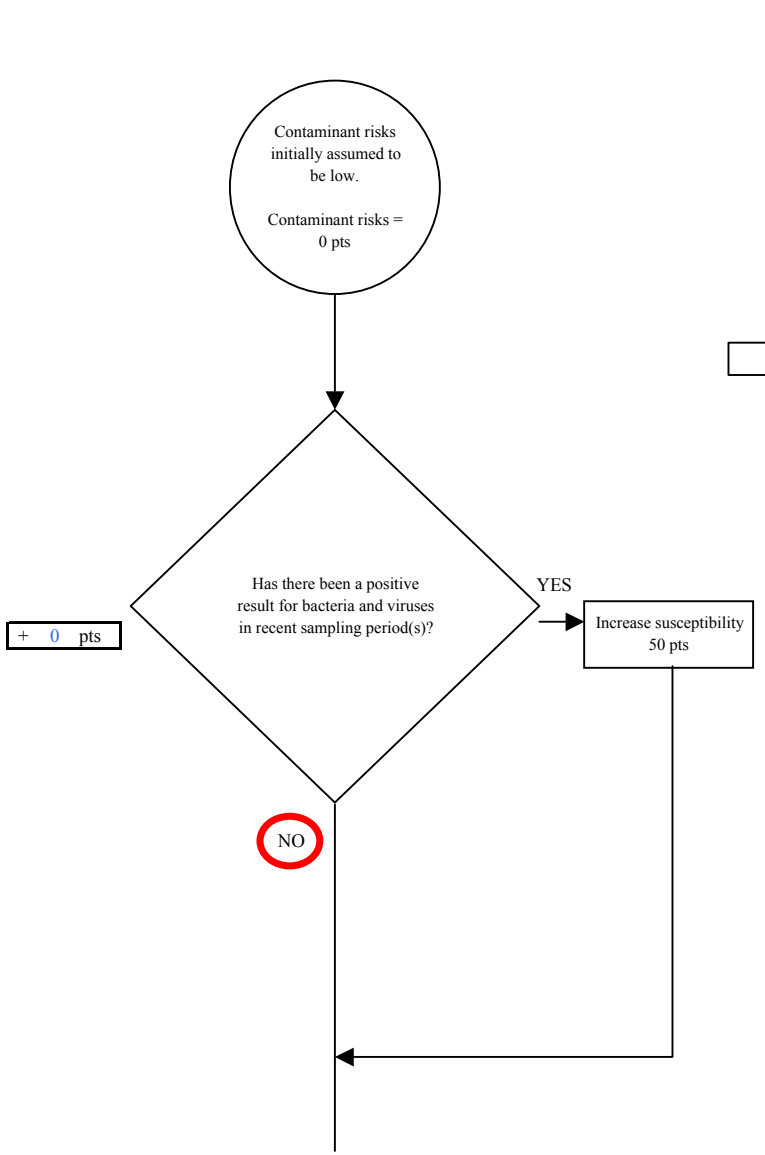
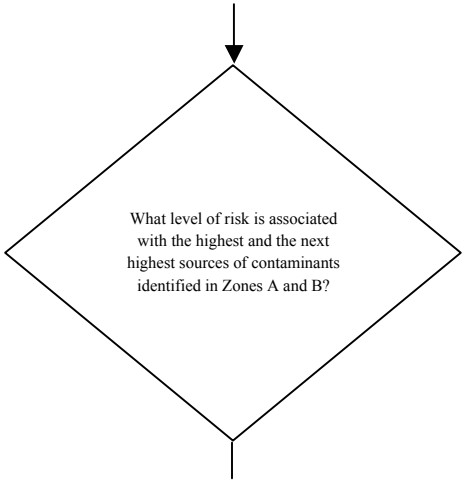


Chart 3. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Bacteria & Viruses





+ 20 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)	1	0	1
Low(s)	1	1	2

	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 3. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Bacteria & Viruses

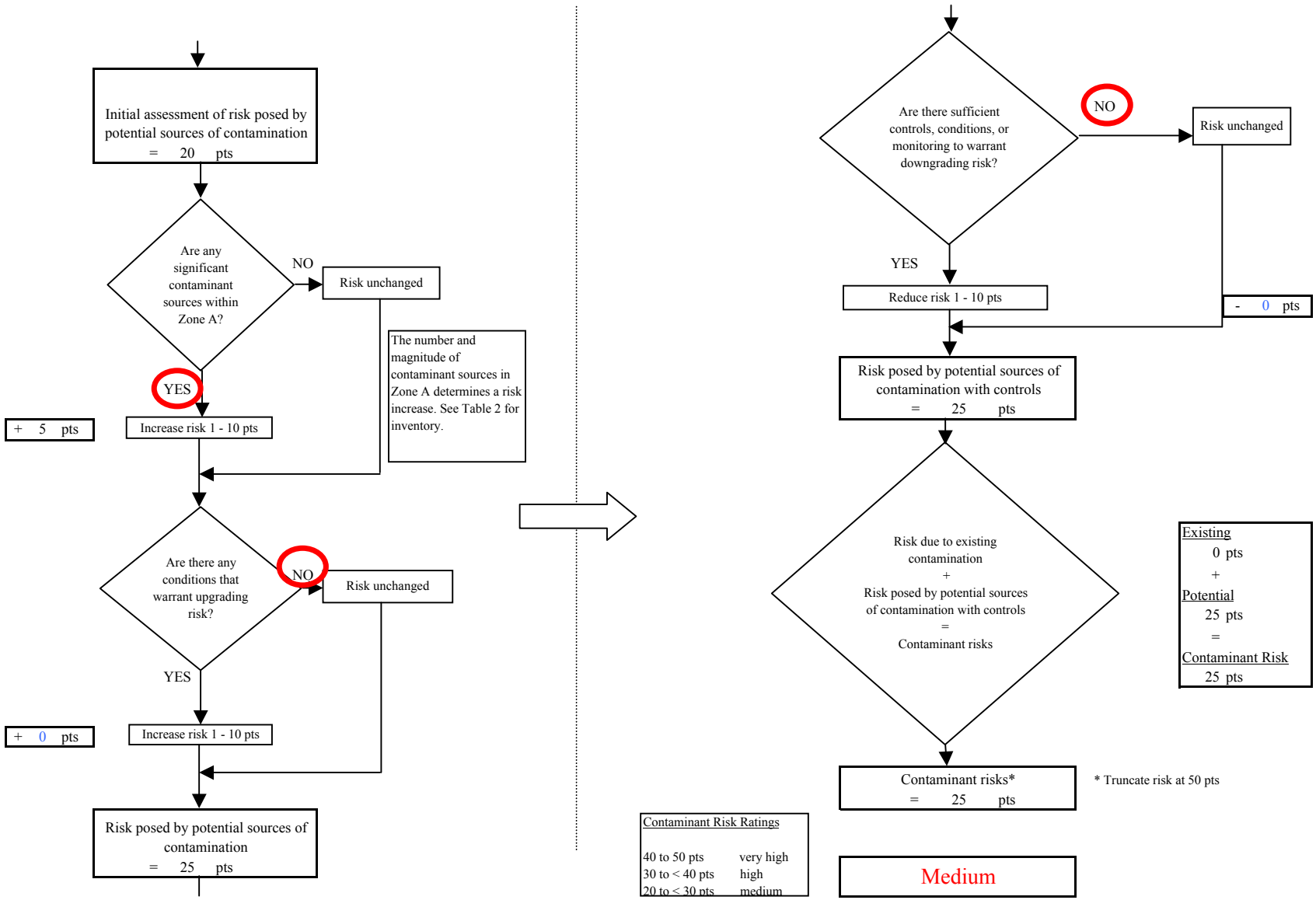

Initial assessment of risk posed by potential sources of contamination
= 20 pts
Are any significant contaminant sources within Zone A?
NO
Risk unchanged
YES
+ 5 pts
Increase risk 1 - 10 pts
The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 2 for inventory.
Are there any conditions that warrant upgrading risk?
NO
Risk unchanged
YES
+ 0 pts
Increase risk 1 - 10 pts
Risk posed by potential sources of contamination
= 25 pts
Are there sufficient controls, conditions, or monitoring to warrant downgrading risk?
NO
Risk unchanged
YES
Reduce risk 1 - 10 pts
- 0 pts
Risk posed by potential sources of contamination with controls
= 25 pts
Risk due to existing contamination
+
Risk posed by potential sources of contamination with controls
=
Contaminant risks
Existing
0 pts
+
Potential
25 pts
=
Contaminant Risk
25 pts
Contaminant risks*
= 25 pts
* Truncate risk at 50 pts
Contaminant Risk Ratings
40 to 50 pts very high
30 to < 40 pts high
20 to < 30 pts medium
Medium

Chart 4. Vulnerability analysis for BBBSD Naknek (PWS No.260464.003) - Bacteria & Viruses

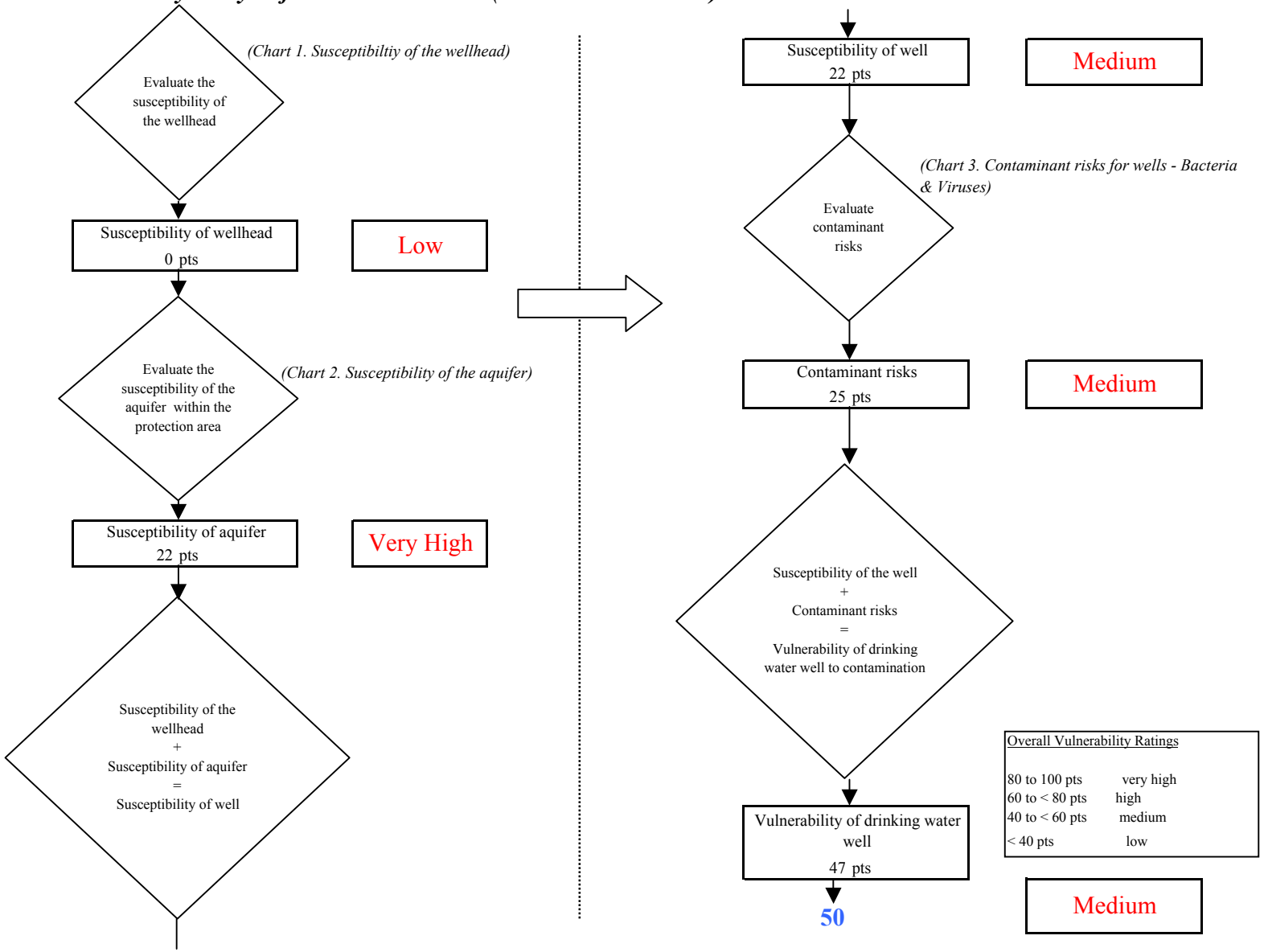


Chart 5. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Nitrates and Nitrites

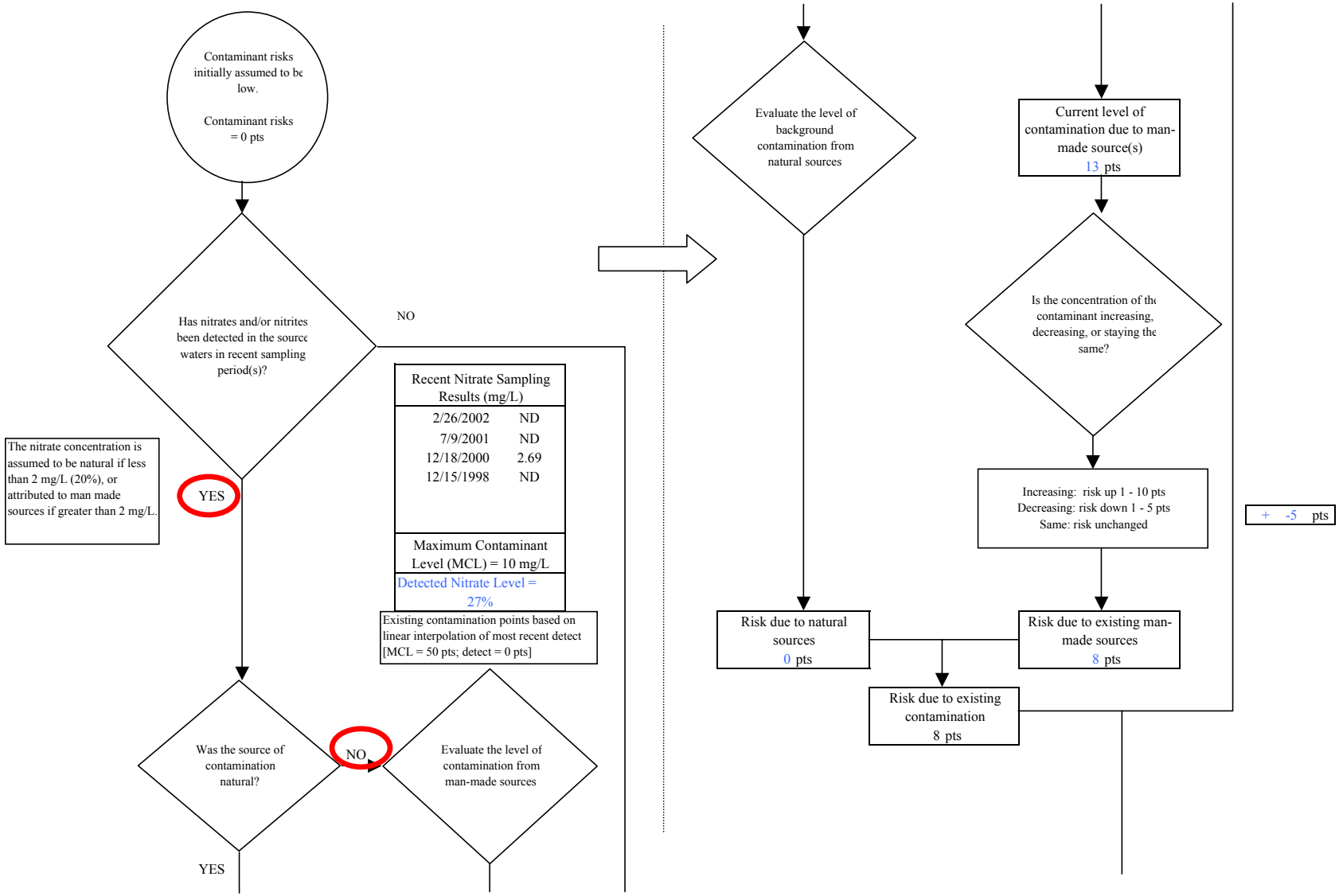
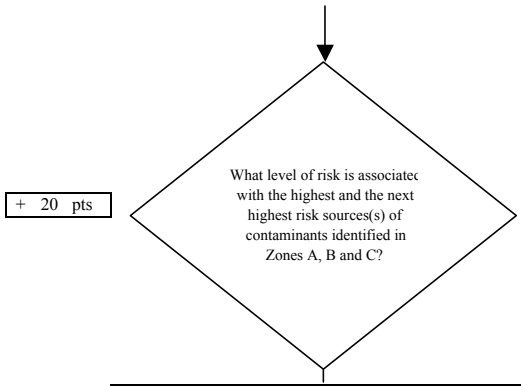


Chart 5. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Nitrates and Nitrites



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)	1	0	1
Low(s)	1	1	2

	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.

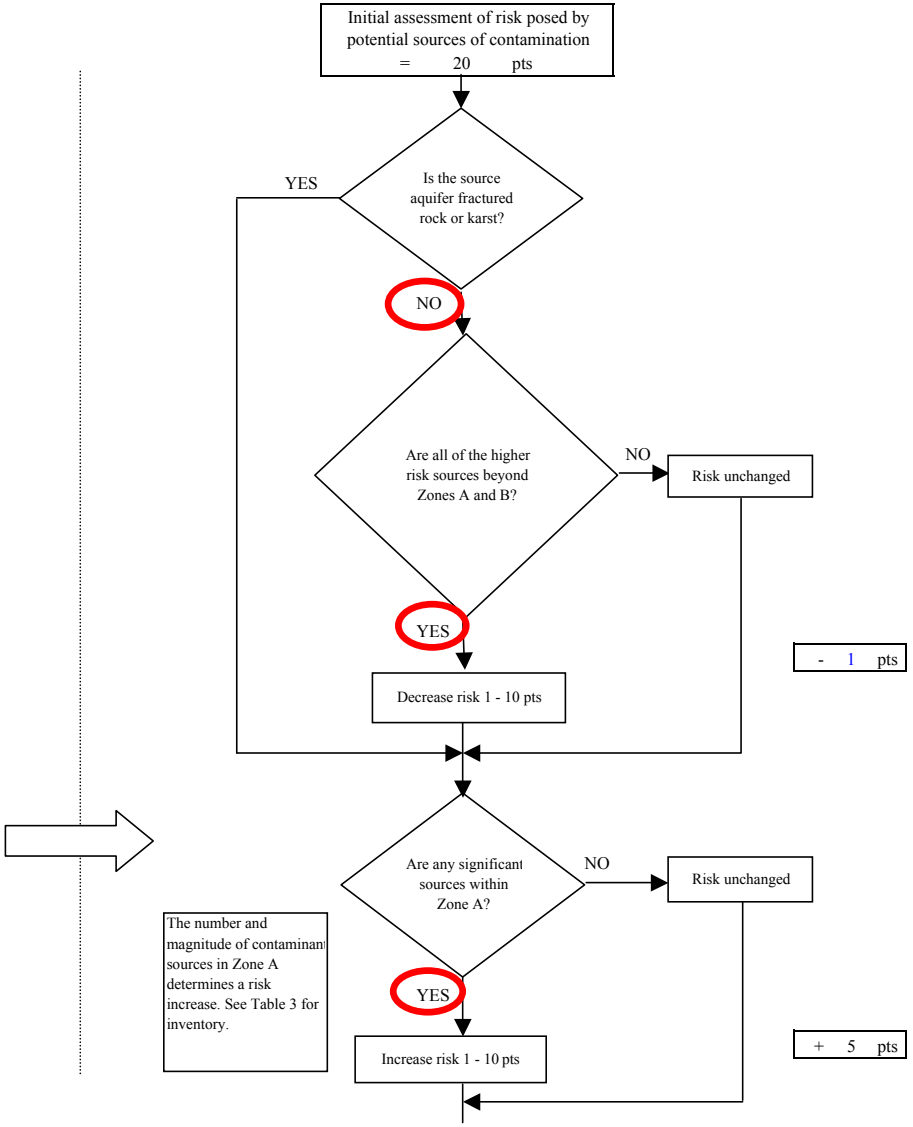


Chart 5. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Nitrates and Nitrites

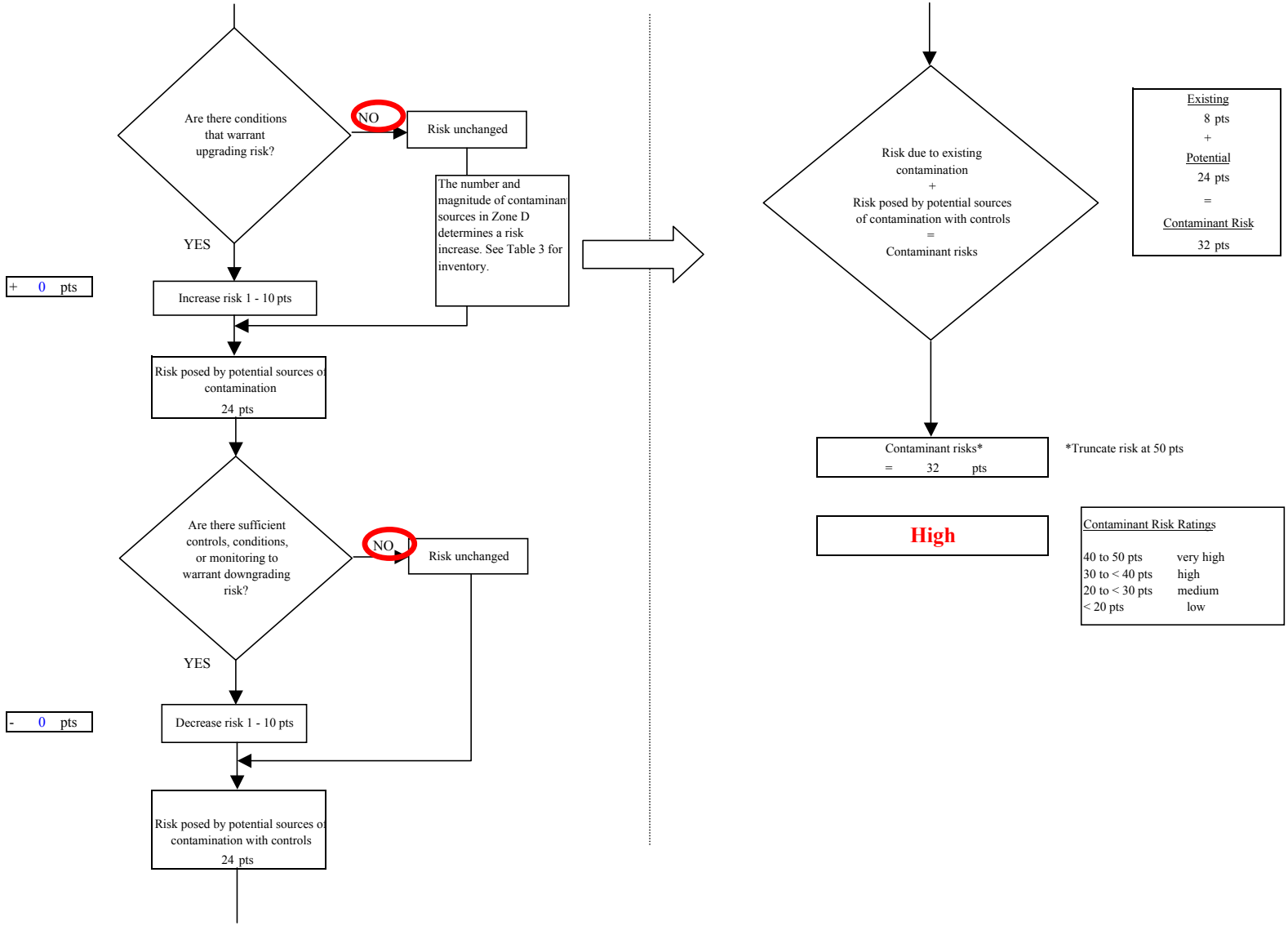


Chart 6. Vulnerability analysis for BBBSD Naknek (PWS No.260464.003) - Nitrates and Nitrites

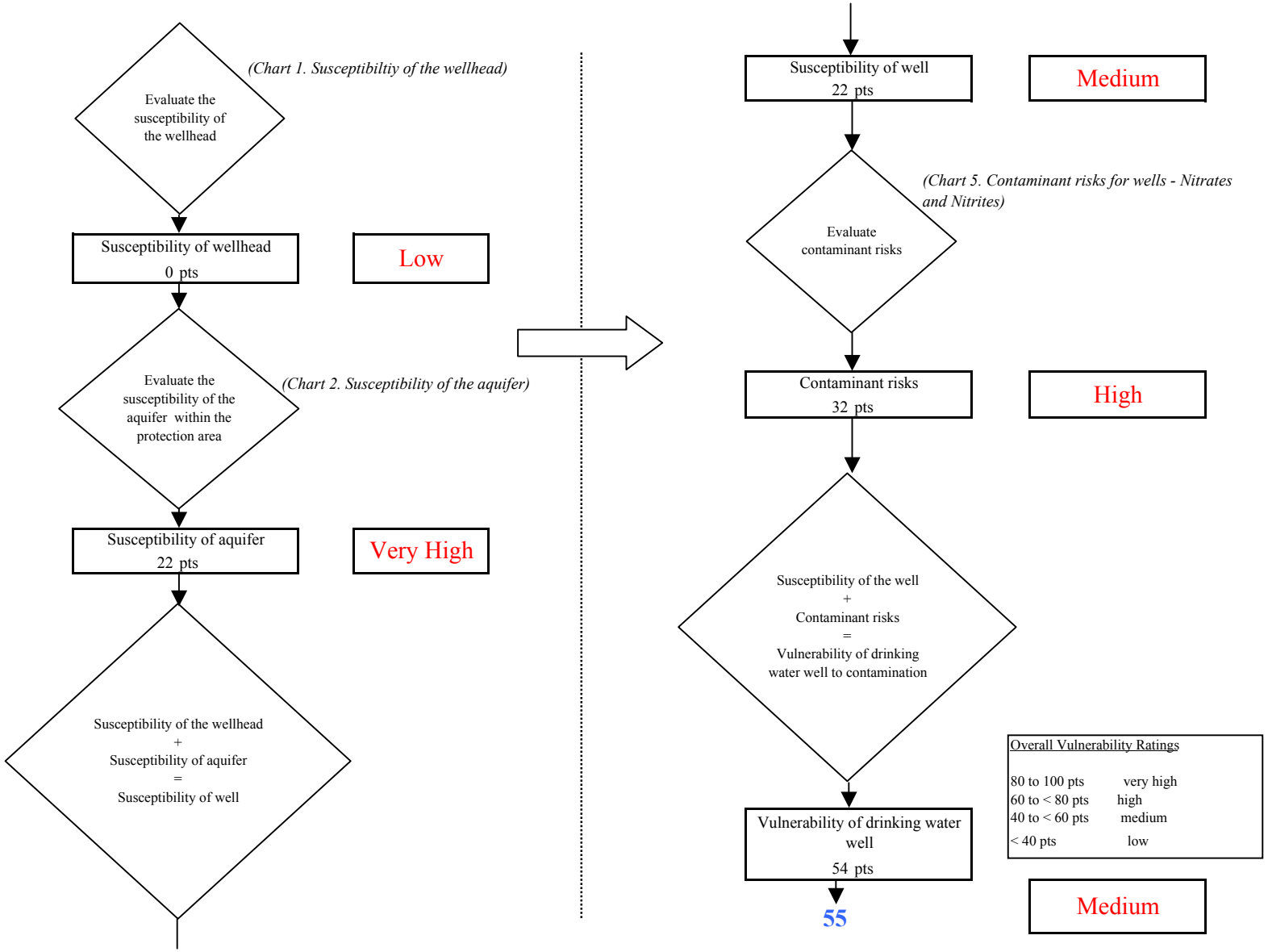


Chart 7. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Volatile Organic Chemicals

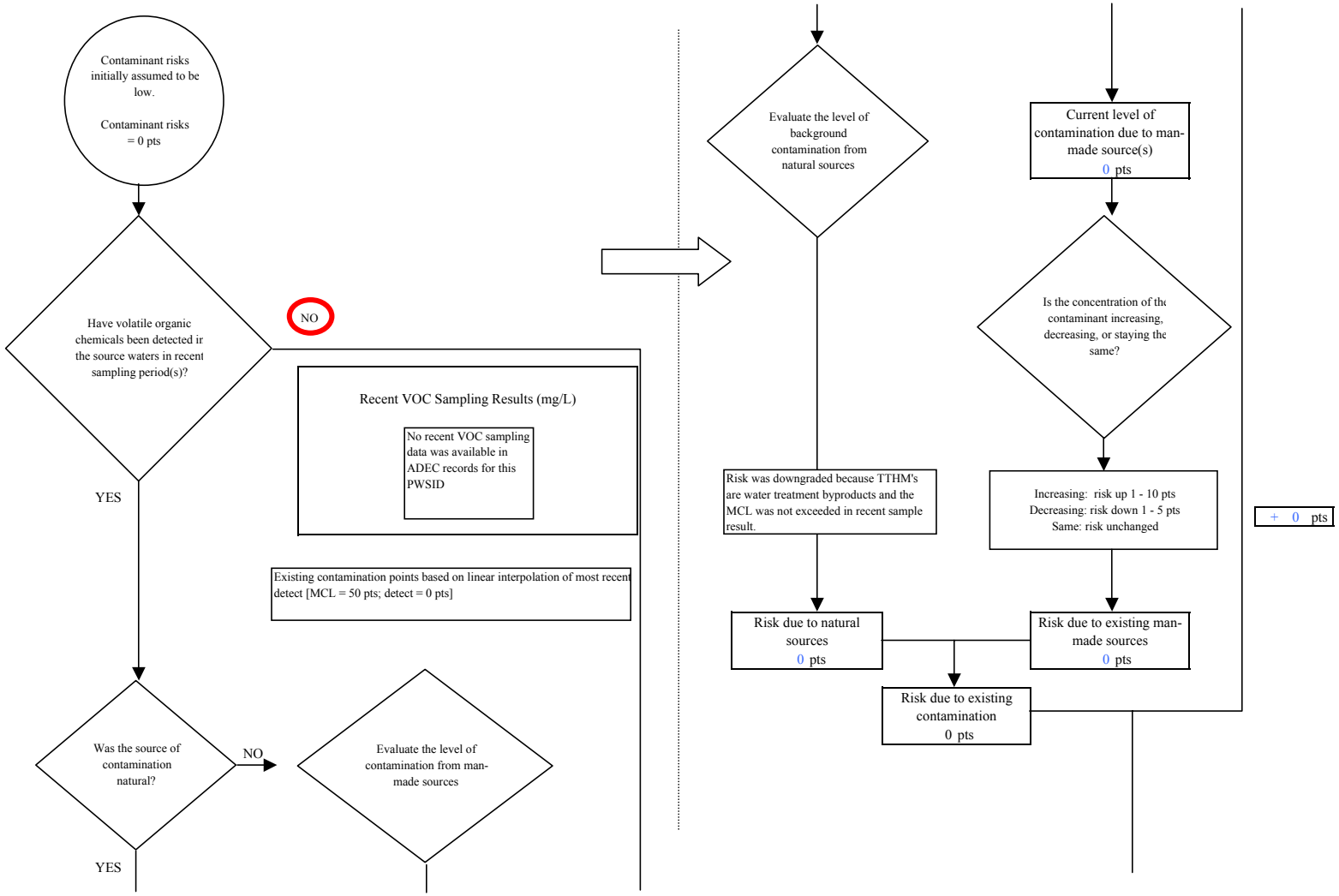
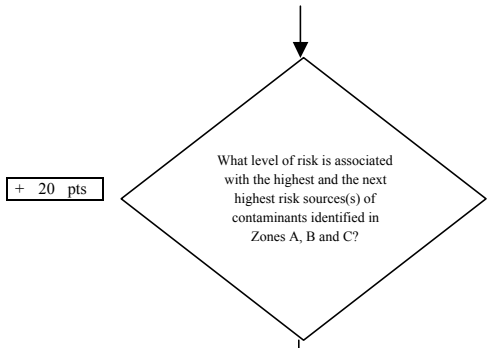


Chart 7. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Volatile Organic Chemicals



+ 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)	2	0	2
Low(s)	3	1	4

	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 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.

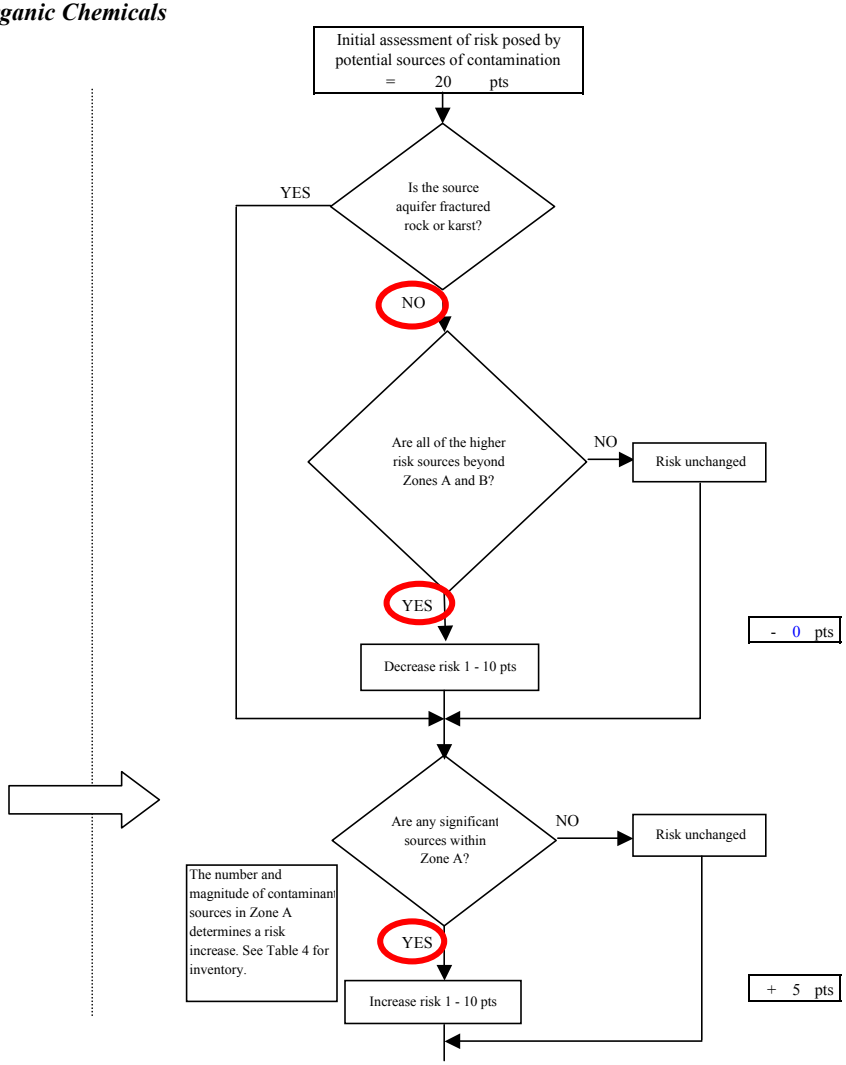


Chart 7. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Volatile Organic Chemicals

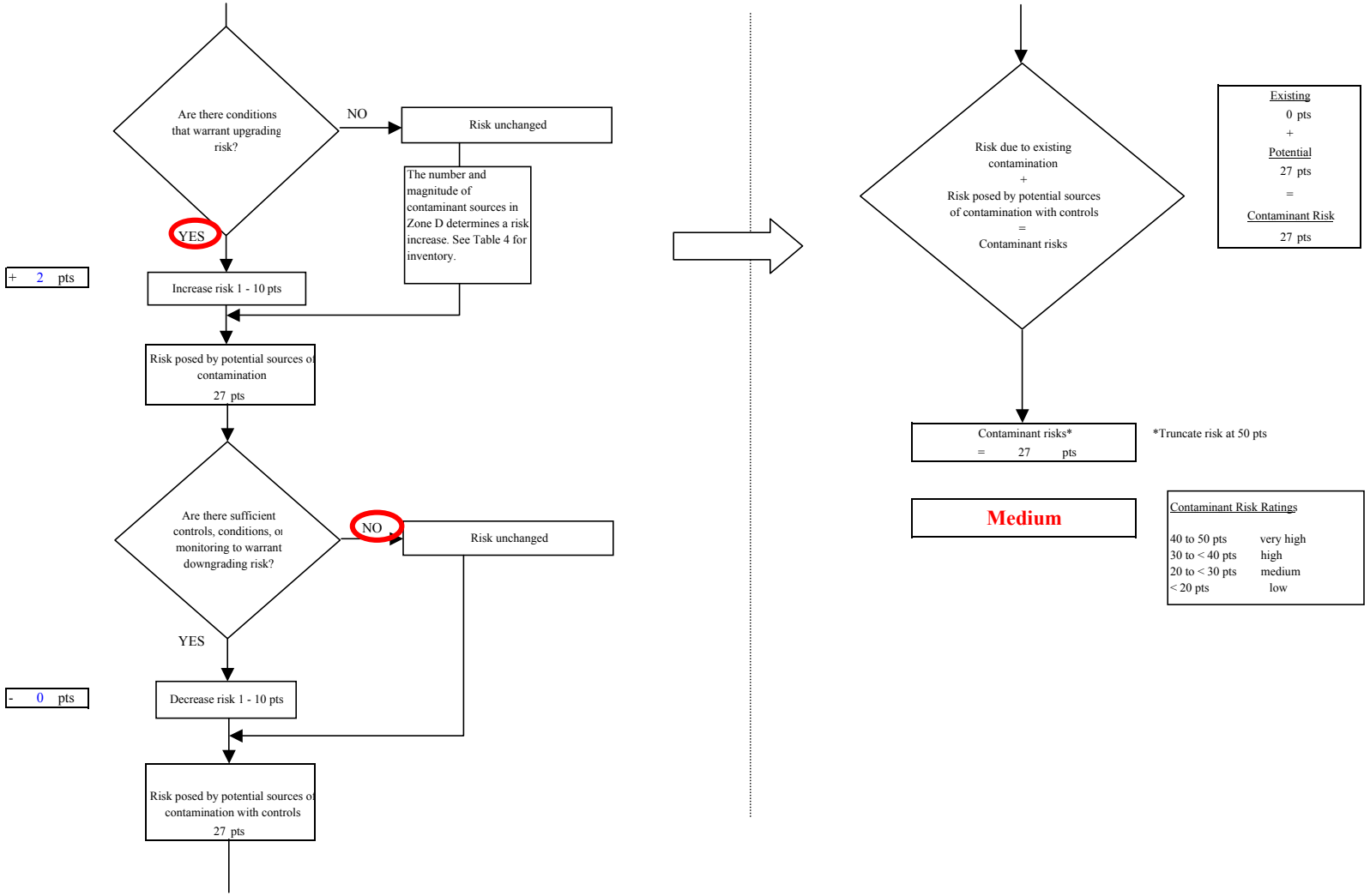


Chart 8. Vulnerability analysis for BBBSD Naknek (PWS No.260464.003) - Volatile Organic Chemicals

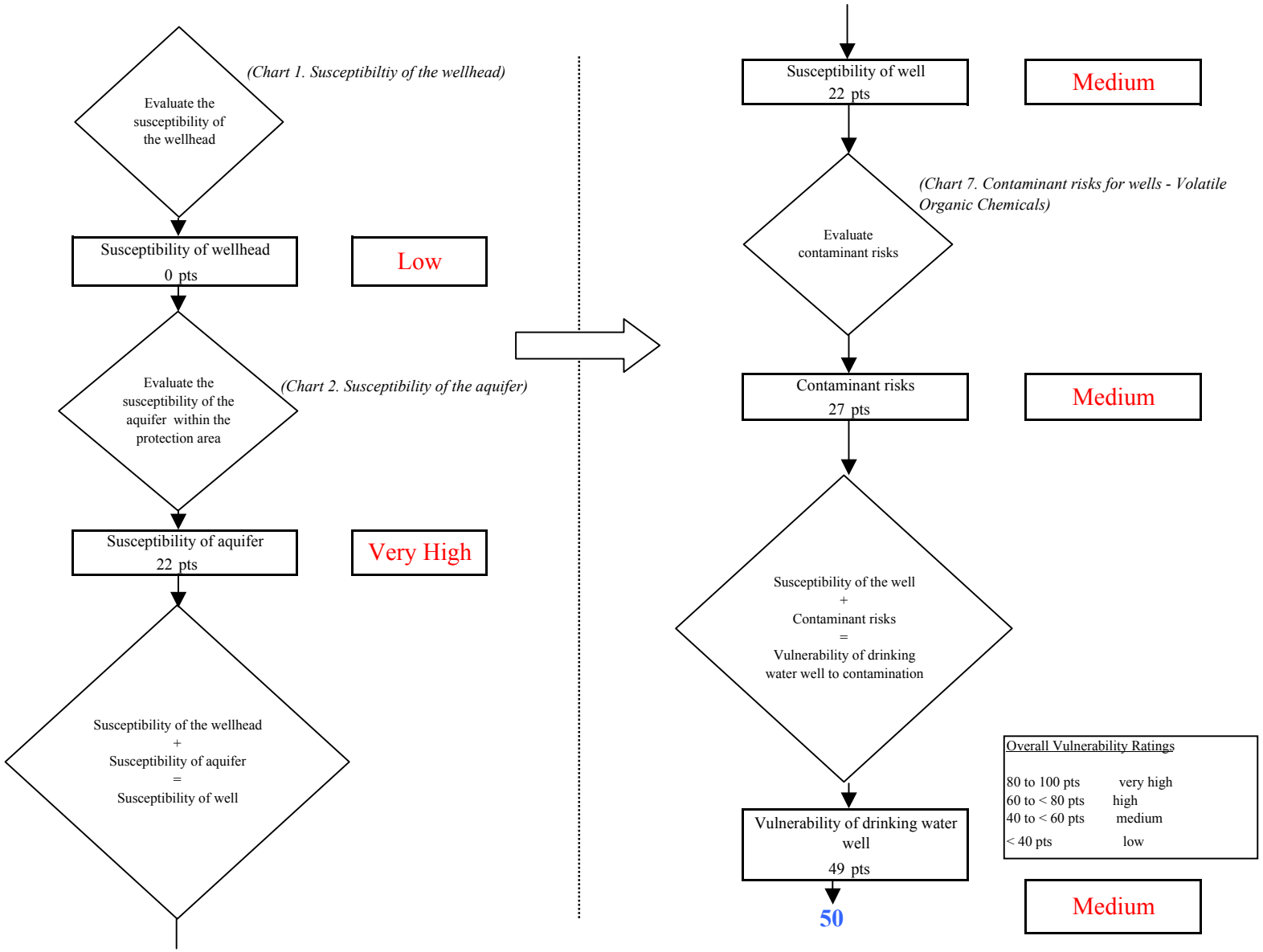


Chart 9. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Heavy Metals, Cyanide and Other Inorganic Chemicals

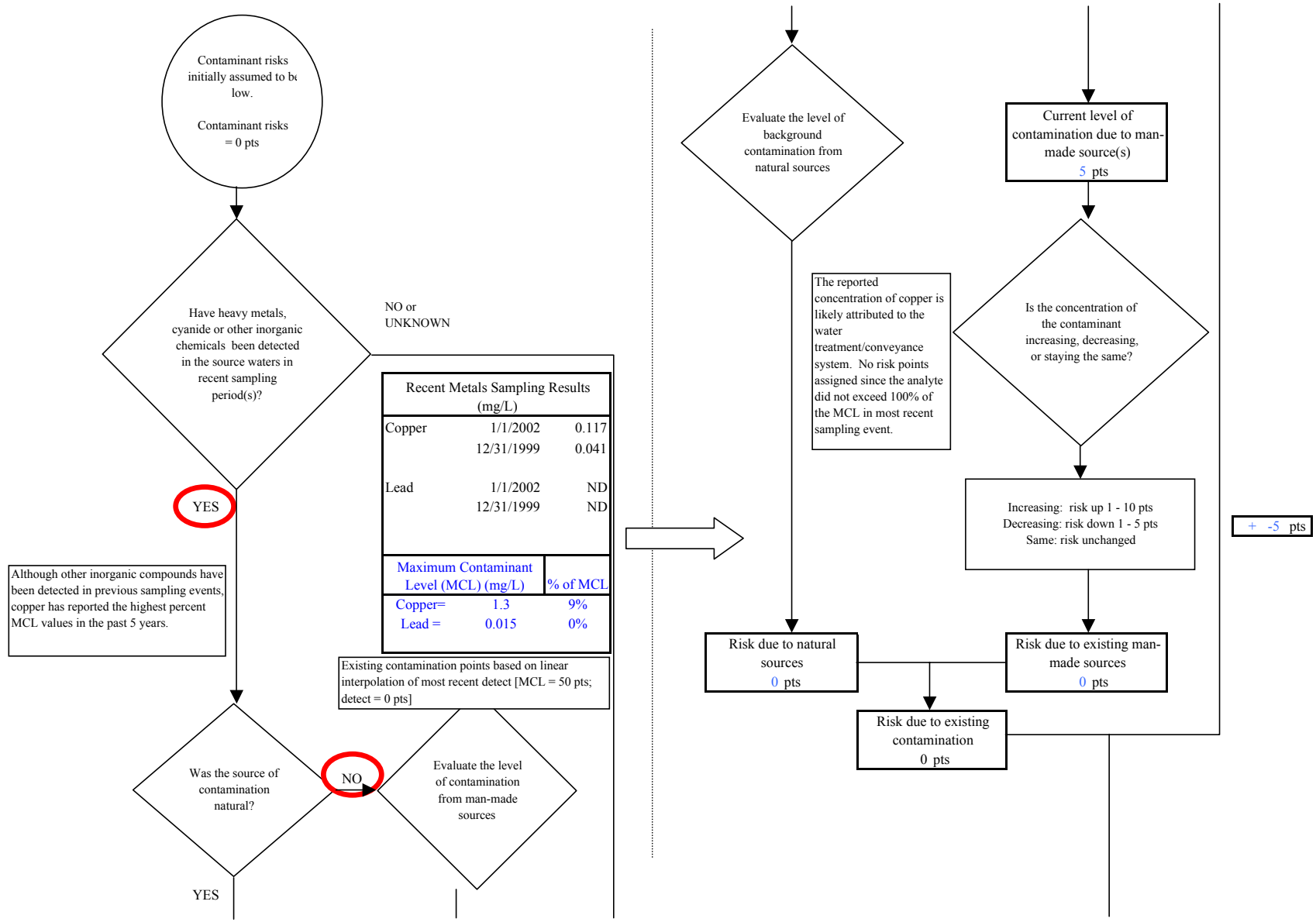


Chart 9. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 20 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)	1	0	1
Low(s)	3	1	4

	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 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 = 20 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

- 1 pts

Decrease risk 1 - 10 pts

Are any significan sources within Zone A?

NO → Risk unchanged

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

YES

+ 5 pts

Increase risk 1 - 10 pts

Chart 9. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Heavy Metals, Cyanide and Other Inorganic Chemicals

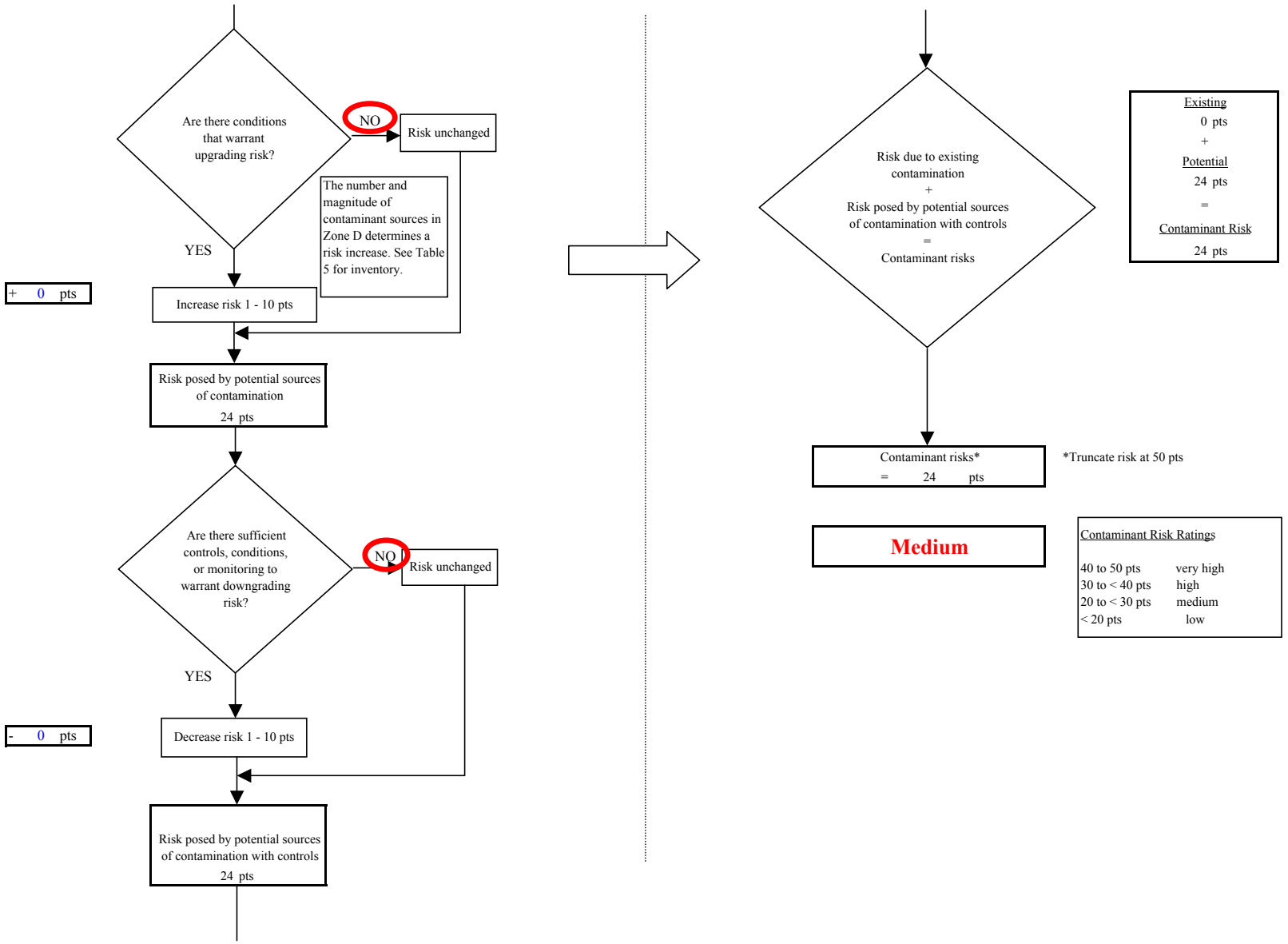


Chart 10. Vulnerability analysis for BBBSD Naknek (PWS No.260464.003) - Heavy Metals, Cyanide and Other Inorganic Chemicals

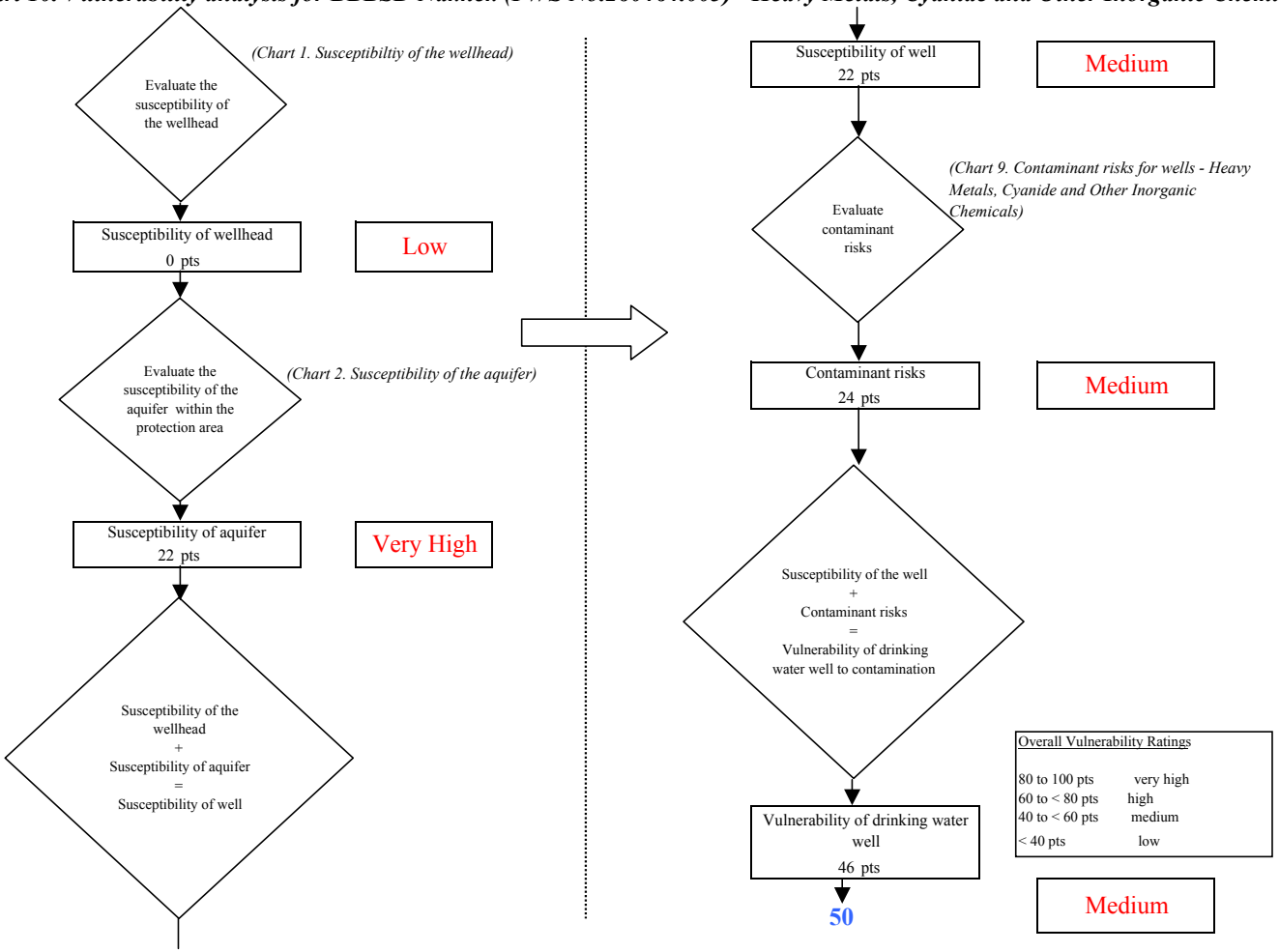


Chart 11. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Synthetic Organic Chemicals

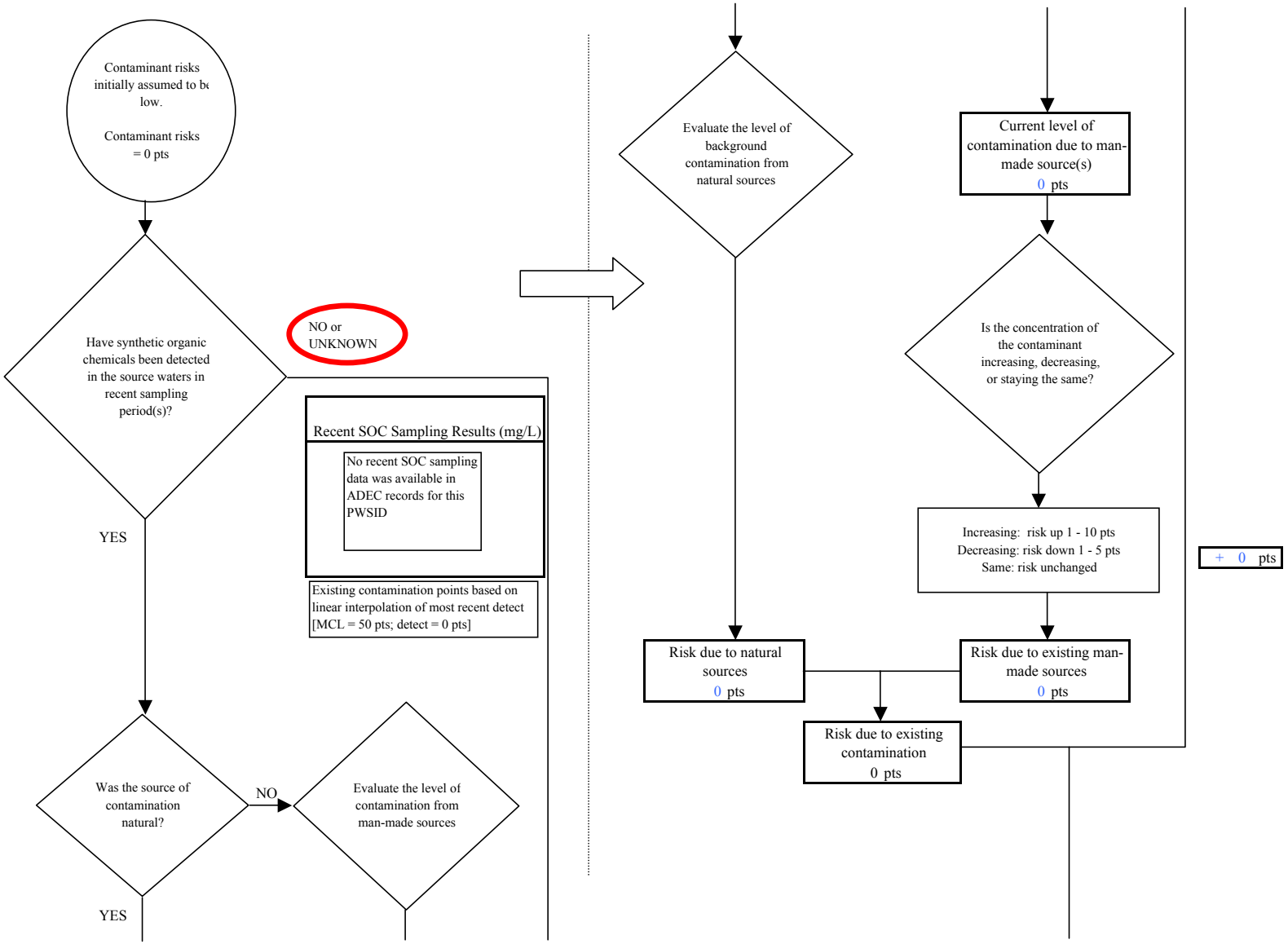
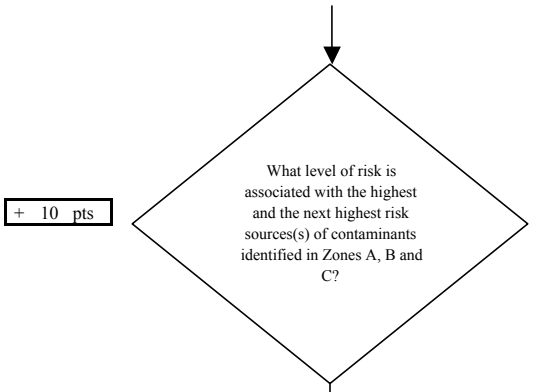


Chart 11. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Synthetic Organic Chemicals



+ 10 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)	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.

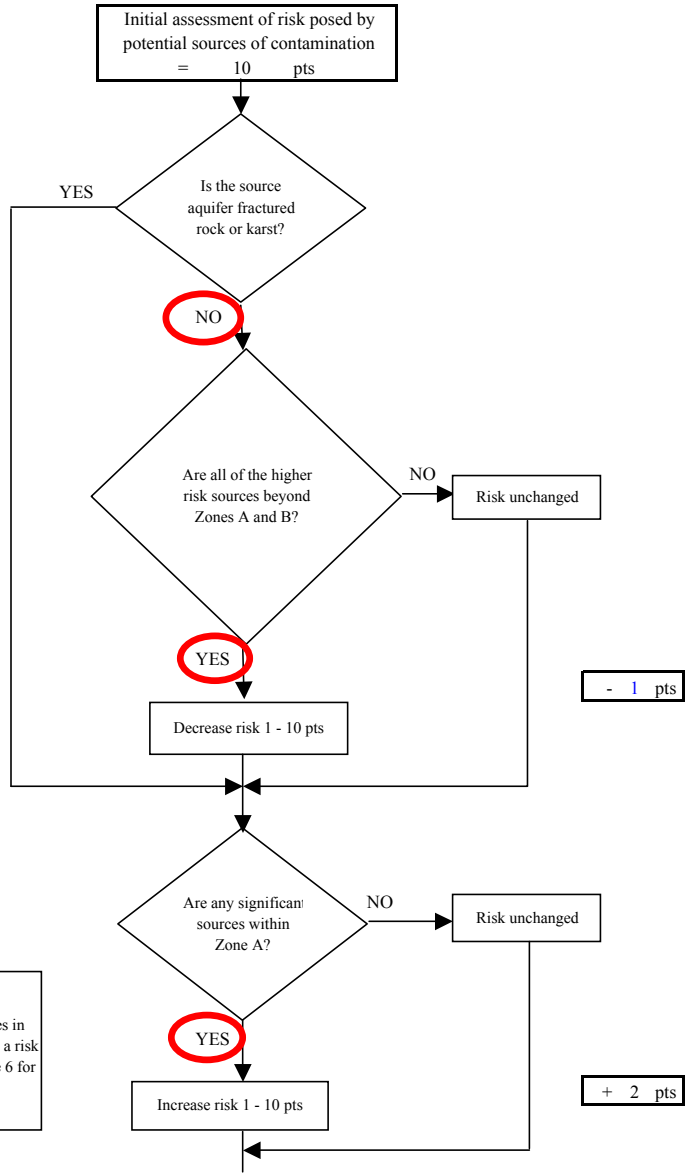


Chart 11. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Synthetic Organic Chemicals

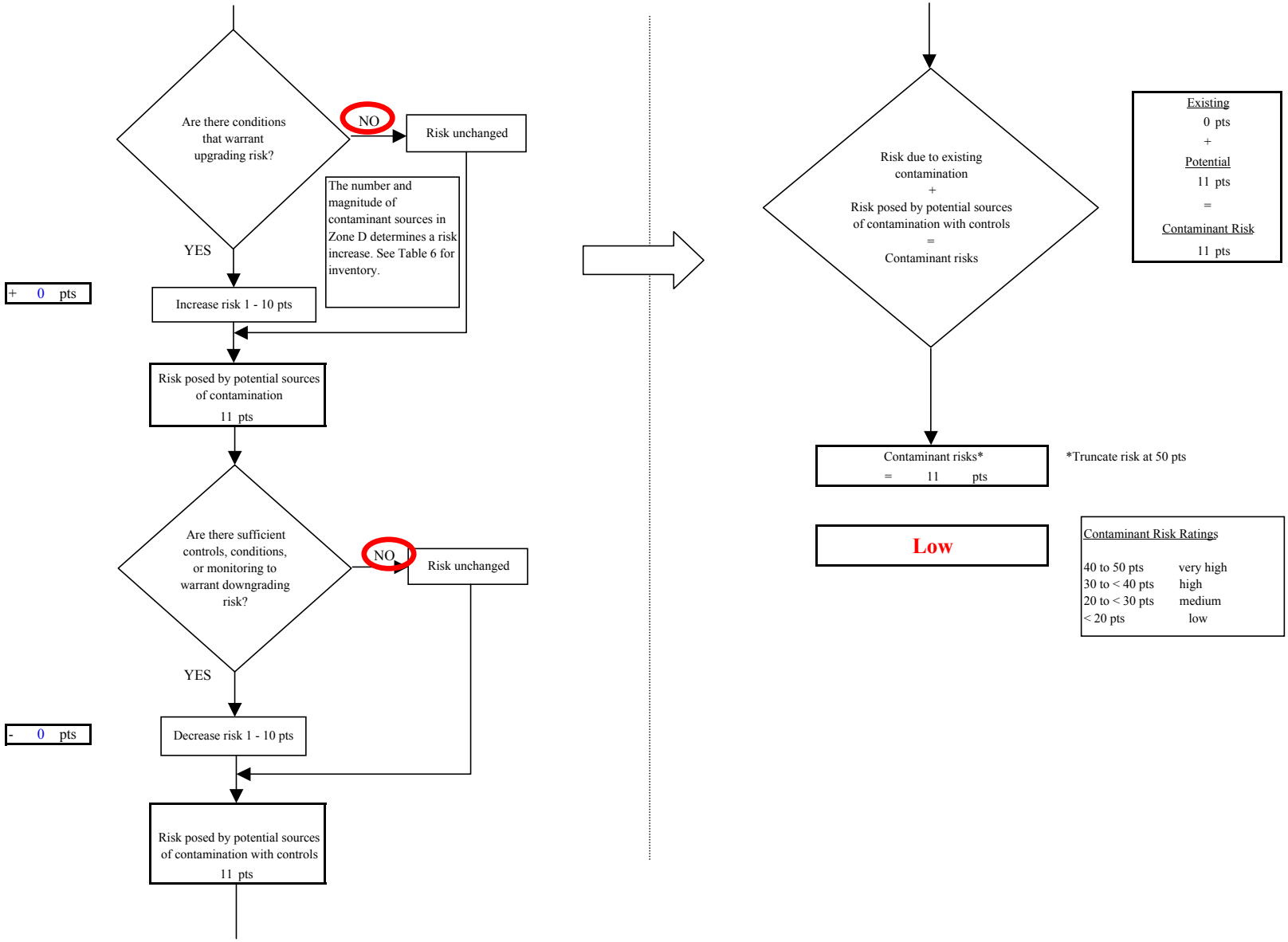


Chart 12. Vulnerability analysis for BBBSD Naknek (PWS No.260464.003) - Synthetic Organic Chemicals

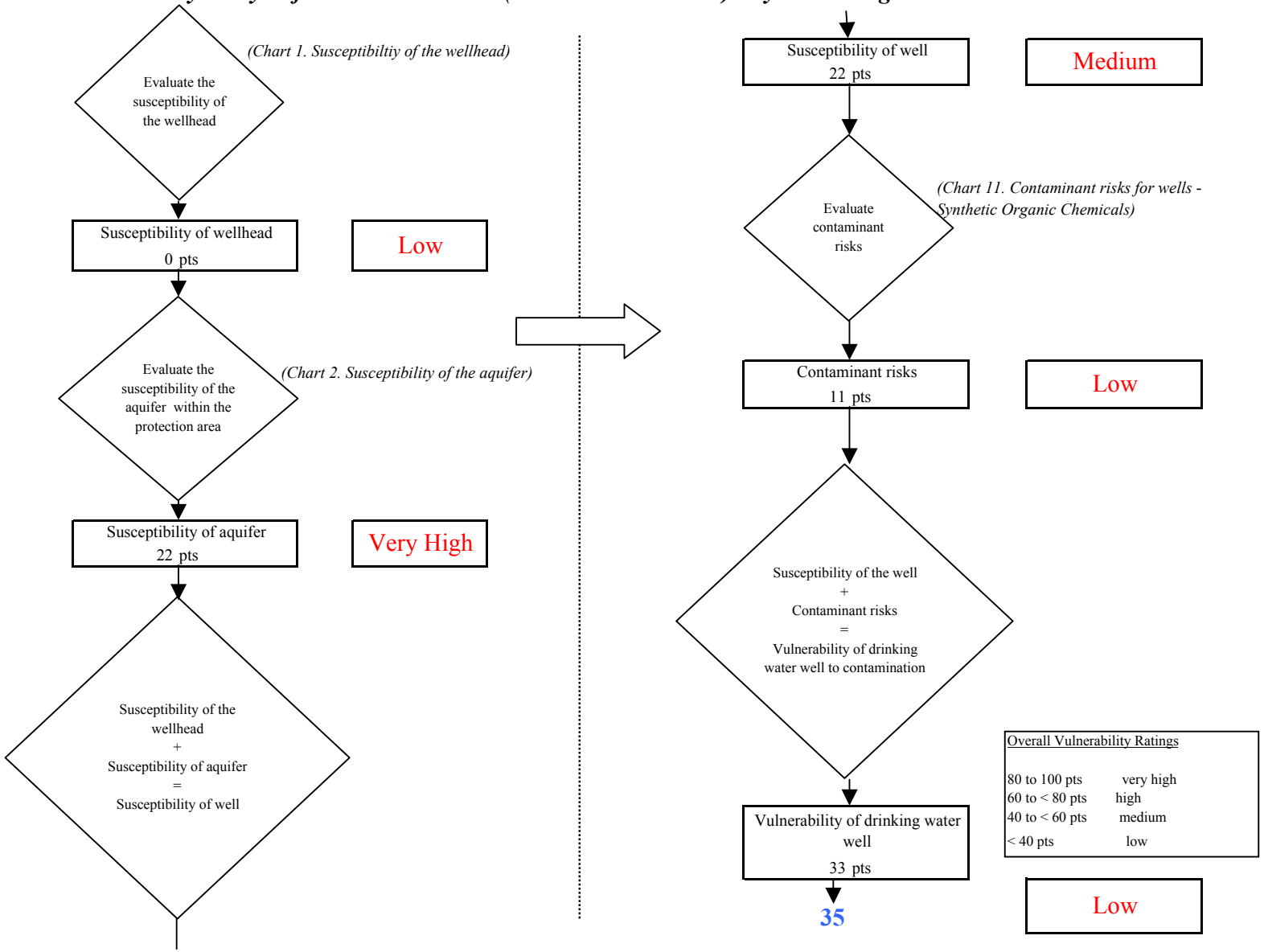


Chart 13. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Other Organic Chemicals

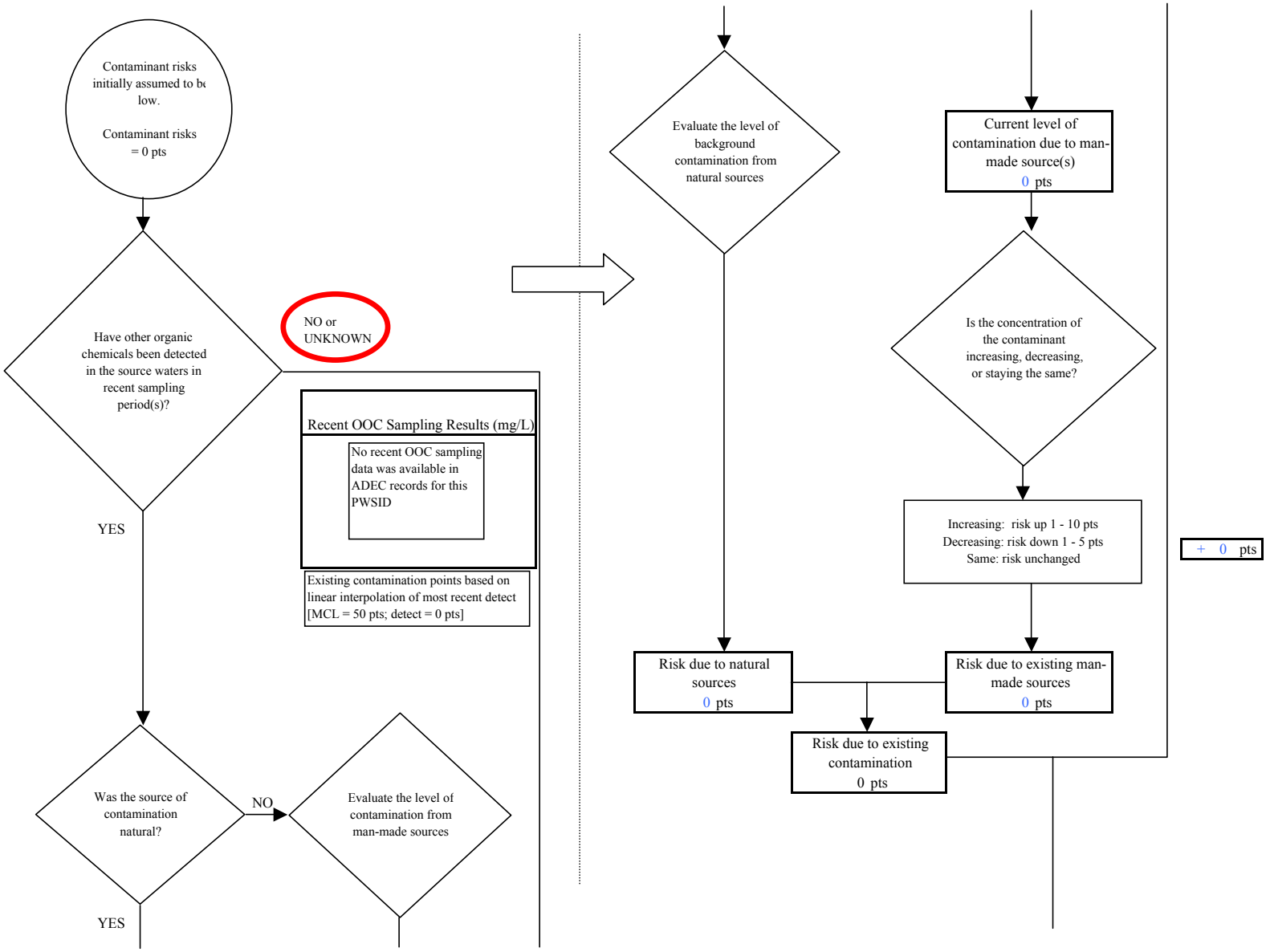
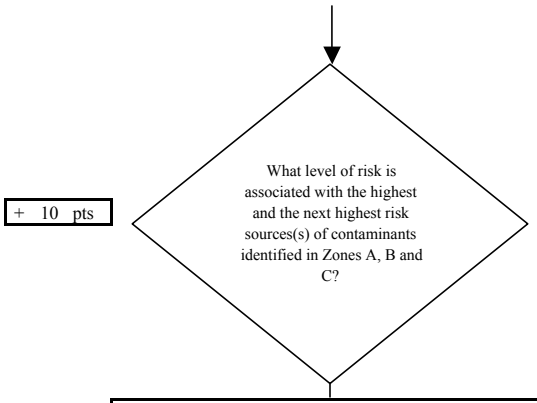


Chart 13. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Other Organic Chemicals



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.

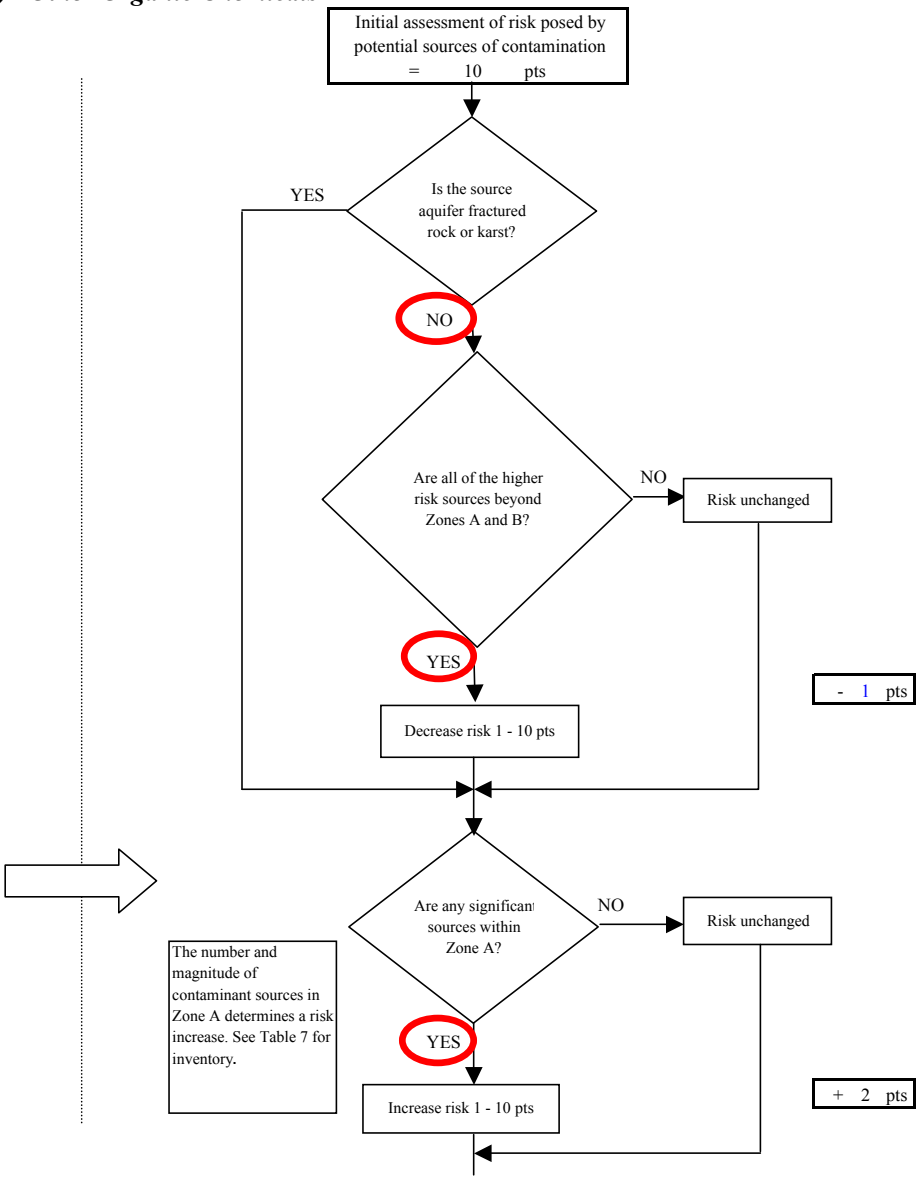


Chart 13. Contaminant risks for BBBSD Naknek (PWS No.260464.003) - Other Organic Chemicals

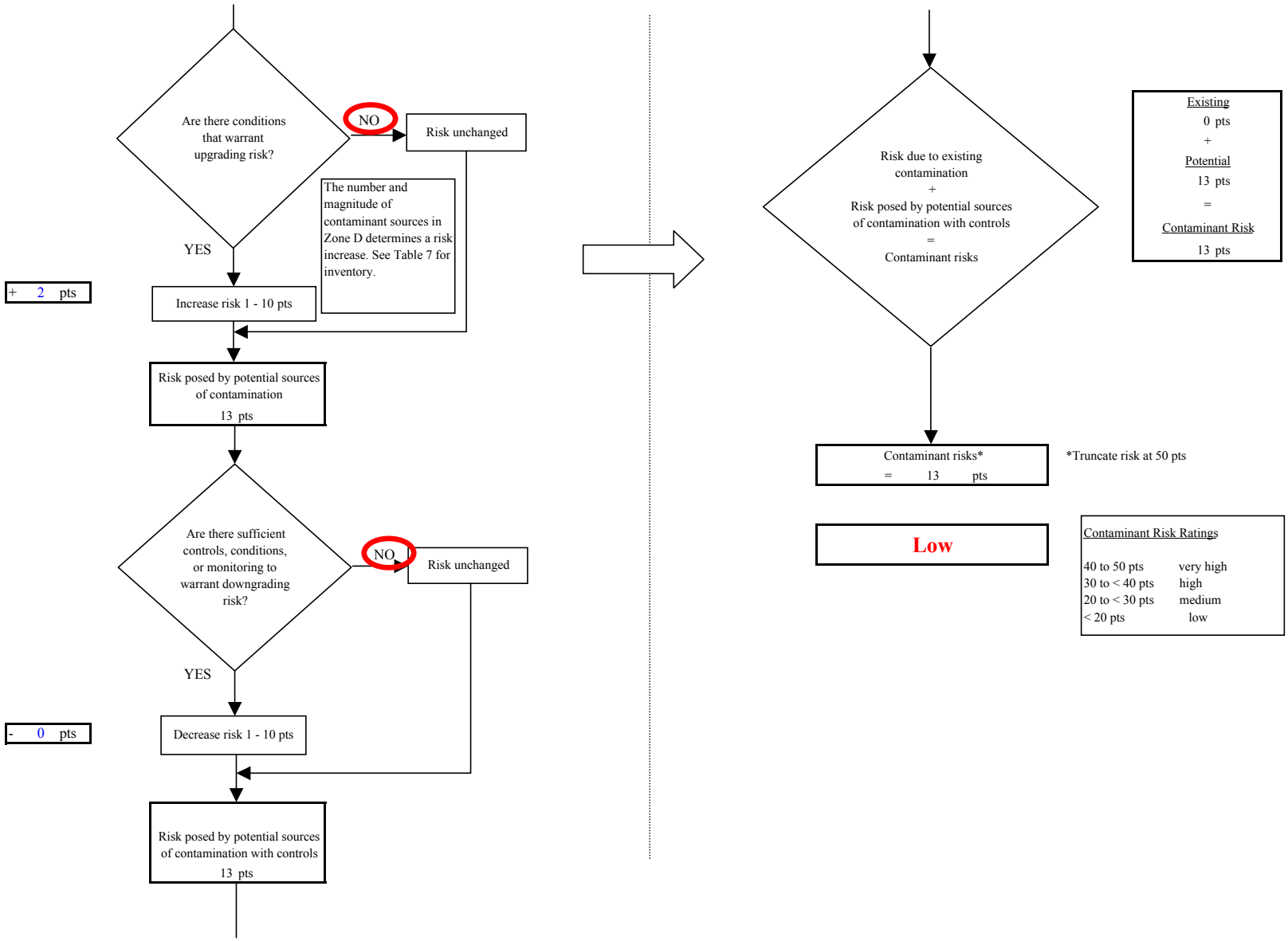


Chart 14. Vulnerability analysis for BBBSD Naknek (PWS No.260464.003) - Other Organic Chemicals