Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Takotna Water System

Takotna, Alaska

PWSID #280163.001

January 2004

Drinking Water Protection Program Report #1152

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 Takotna Water System, Takotna, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for the City of Takotna, Alaska, is a Class A surface water system that obtains water northwest of the village from Gold Creek. Gold Creek flows southeast through the village. Water from the creek is filtered, chlorinated, and stored in the water treatment facility. The storage tank has an approximate volume of 11,000 gallons.

The Takotna protection area is approximately 6 square miles in size and has received a susceptibility rating of **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 airports, residential areas, and highways and roads. 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** for bacteria and viruses, a **Medium** rating for nitrates and nitrites, a **High** rating for volatile organic compounds, a **Medium** rating for heavy metals, cyanide, and other inorganics, a **High** rating for synthetic organic compounds, and a **High** rating for 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 Takotna to protect public health.

DRINKING WATER SYSTEM AND AREA OVERVIEW

Takotna (Sec. 35, T034N, R036W, Seward Meridian) is located in Interior Alaska on the north bank of the Takotna River not far from its confluence with the Kuskokwim River (ADCED, 2003). The community lies about 230 miles northwest of Anchorage and 17 miles west of McGrath. Takotna has a current population of 49 (ADCED, 2003). It has a cold, continental climate. Average summer temperatures range from 42 to 80°F and average winter temperatures range from -42 to 0°F.

The public water system is a Class A surface water system that operates year-round and obtains water from Gold Creek, which flows through the village. Water is taken from the creek above the village and piped to the village water treatment facility. At the plant, the water is filtered and chlorinated, and stored in a 11,000-gallon tank at the water treatment facility. Most households haul water from the washeteria or Takotna Waterworks. About 20% of the households have storage tanks with running water for their kitchens, but no households have complete plumbing. Outhouses or honeybuckets are used for sewage disposal (ADCED, 2003).

Takotna Community Association Utilities provides electrical power to the village. The power company is operated by the local community non-profit association and fueled by diesel. The washeteria and landfill are operated by the local village council (ADCED, 2003).

Information acquired from a February 1998 sanitary survey for the public water system indicated that the surface water intake is adequately constructed. The average daily production of the system is variable.

The Takotna River joins the Kuskokwim River at McGrath. Takotna is within the lowlands draining into the upper Kuskokwim. Relief in this area is provided by the Beaver Mountains, and single mountains rising from the valley floor. All of the peaks rise to approximately 3,000 feet above sea level. The area has moderate to thin layers of permafrost, generally found under a thick vegetative mat. Soils in the area are generally well drained alluvial deposits of silt and sand. Underlying deposits are largely greywacke and shale (USDHHS, 1983).

TAKOTNA 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 Takotna 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 Takotna 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.

Numerous contaminant sources were identified in the Takotna 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	0	
Dilution Capacity	5	
Overall Susceptibility	***35***	***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. Takotna Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	16	Low
Volatile Organic Chemicals	25	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	12	Low
Synthetic Organic Chemicals	25	Medium
Other Organic Chemicals	25	Medium

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. Takotna Water System Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	45	Medium
Nitrates and Nitrites	50	Medium
Volatile Organic Chemicals	60	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	45	Medium
Synthetic Organic Chemicals	60	High
Other Organic Chemicals	60	High

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 the small residential area and 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 5 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 **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). Three potential contaminant risk sources for nitrates were identified in the protection area for this public water system. The contaminant risk is primarily attributed to the presence of the airport, roads, and a small residential area 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 is **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Medium** (See Chart 6 – Contaminant Risks for Volatile Organic Chemicals in Appendix D). Three potential contaminant sources for volatile organic chemicals were identified in the protection area for this public water system. The contaminant risk is primarily attributed to the presence of the airport, roads, and a small residential area in Zone A.

Detectable concentrations of trihalomethanes were reported in sampling events for this public water system. However, none of the reported trihalomethane concentrations were reported above 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 concentrations of trihalomethane did not exceed the applicable MCL, no risk points were 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 **High**.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is **Low**. Three contaminant sources for heavy metals, cyanide, and other inorganic chemicals were identified in the protection area for this public water system. The contaminant risk is primarily attributed to the presence of the airport, roads, and a small residential area in Zone A.

Based on review of recent sampling records for this public water system, moderate levels of copper and lead have been detected. Copper and lead have been detected in recent sampling history, but have not exceeded their respective MCLs of 1.3 mg/L and 0.015 mg/L (see Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

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

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 **Medium**. Two contaminant sources for synthetic organic chemicals were identified in the protection area for this public water system. The contaminant risk is primarily attributed to the presence of the airport and a small residential area in Zone A.

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 **High** (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Medium**. Three contaminant risk sources for other organic chemicals were identified in the protection area. The contaminant risk is primarily attributed to the presence of the airport, roads, and a small residential area in Zone A.

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 **High** (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 Takotna to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

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

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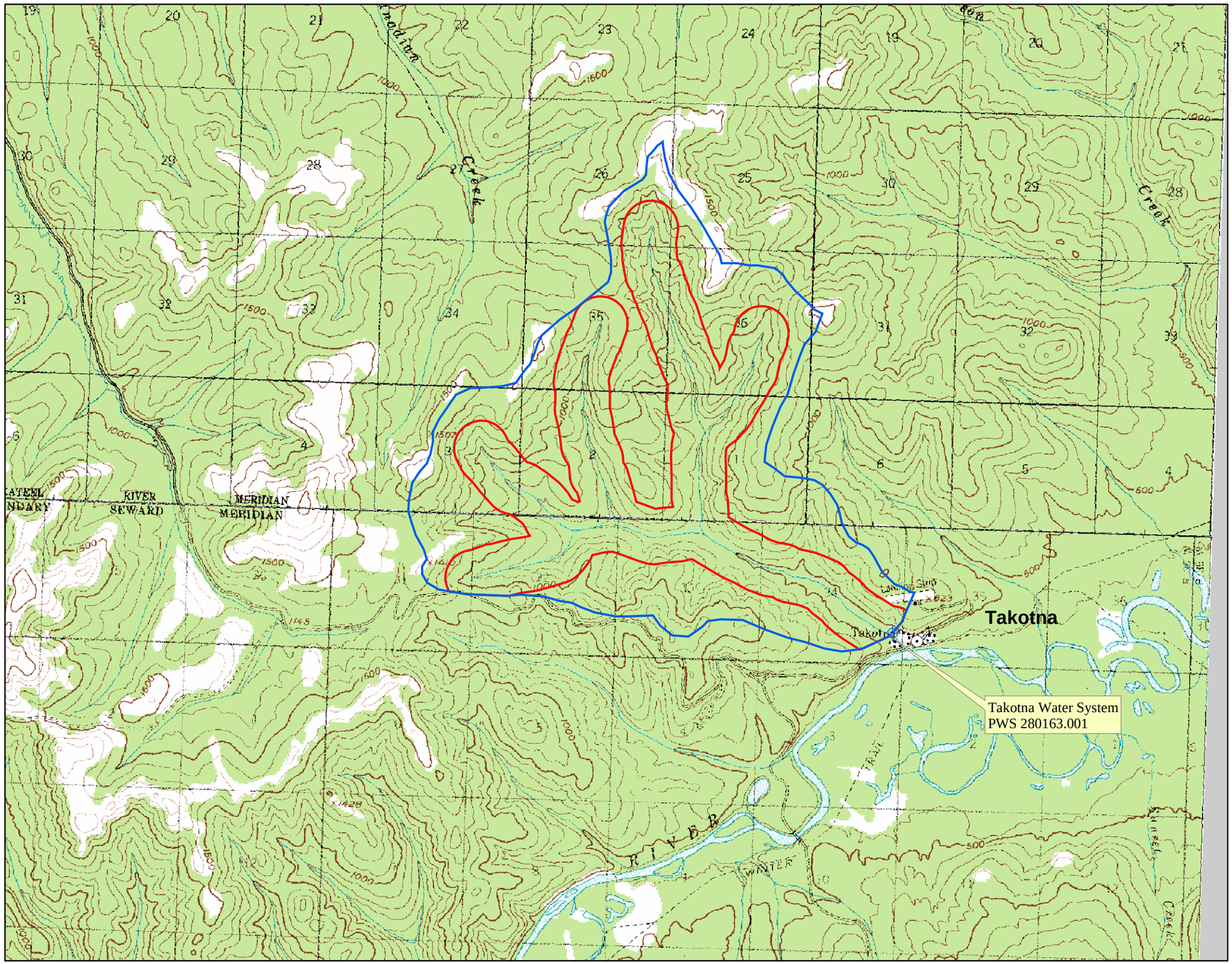
APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

Public Water System for PWS #280163.001 Takotna Water System



LEGEND

- Public Water System

Hydrography/Physical

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

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 C – 30 Miles from Surface Water or Watershed Boundary

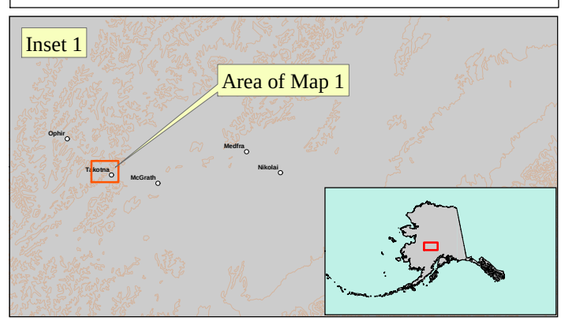
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

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 0.35 0.7 1.4 2.1 2.8 Miles

Takotna Water Sytem PWS 280163.001
Appendix A Map A

APPENDIX B

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

Table 1

Contaminant Source Inventory for ***Takotna Water System***

PWSID 280163.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	C	Less than 1/4 acre of residential area
Airports	X14	X14-01	A	C	USGS 1:63,360 Topographic Maps / Community Profile Map
Highways and roads, dirt/gravel	X24	X24-01	A	C	

Table 2

Contaminant Source Inventory and Risk Ranking for Takotna Water System

Sources of Bacteria and Viruses

PWSID 280163.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	C	Less than 1/4 acre of residential area
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	

Table 3

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

PWSID 280163.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	C	Less than 1/4 acre of residential area
Airports	X14	X14-01	A	Low	C	USGS 1:63,360 Topographic Maps / Community Profile Map
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	

Table 4

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

PWSID 280163.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	C	Less than 1/4 acre of residential area
Airports	X14	X14-01	A	Medium	C	USGS 1:63,360 Topographic Maps / Community Profile Map
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	

Table 5

Contaminant Source Inventory and Risk Ranking for Takotna Water System

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 280163.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	C	Less than 1/4 acre of residential area
Airports	X14	X14-01	A	Low	C	USGS 1:63,360 Topographic Maps / Community Profile Map
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	

Table 6

Contaminant Source Inventory and Risk Ranking for Takotna Water System
Sources of Synthetic Organic Chemicals

PWSID 280163.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	C	Less than 1/4 acre of residential area
Airports	X14	X14-01	A	Medium	C	USGS 1:63,360 Topographic Maps / Community Profile Map

Table 7

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

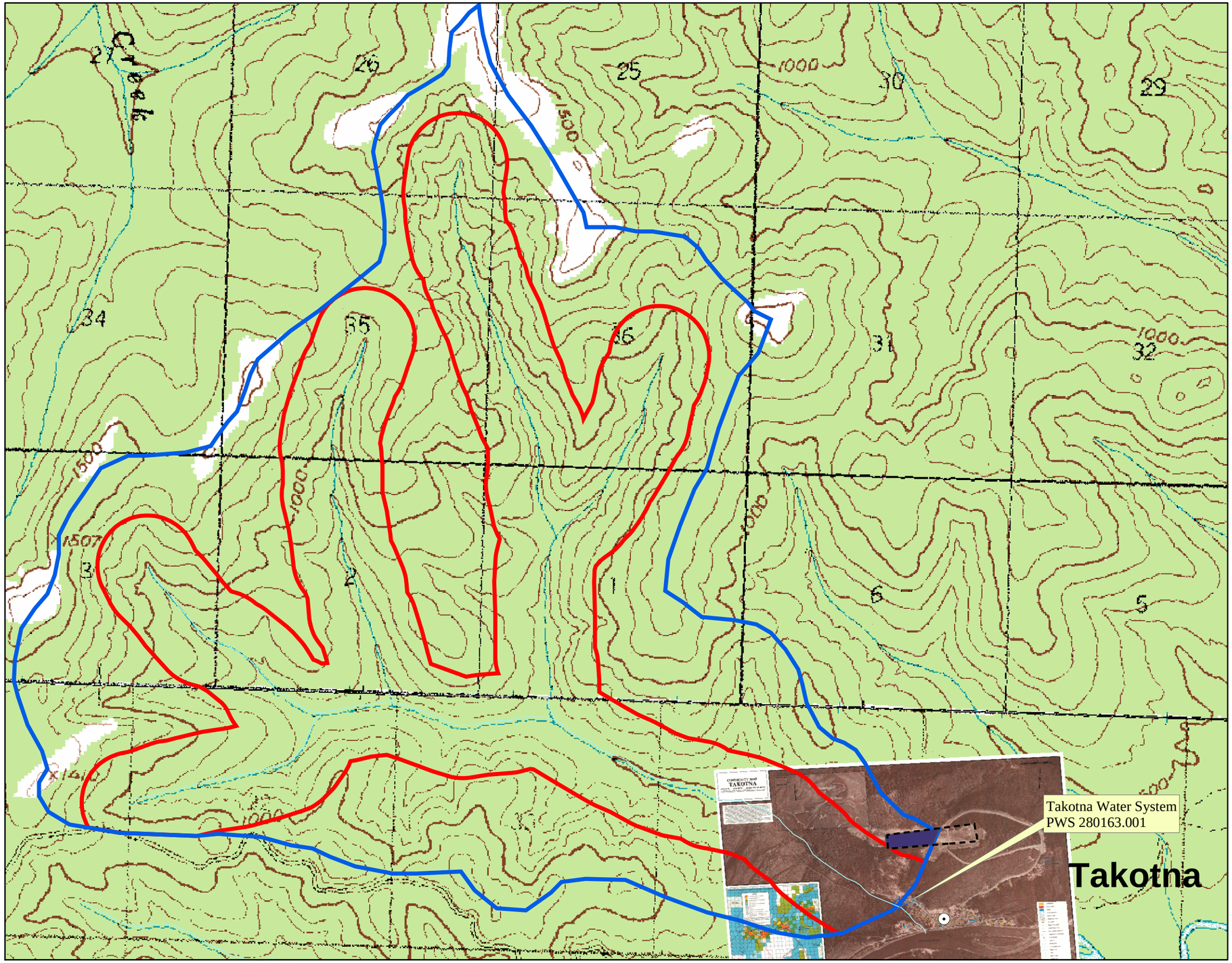
PWSID 280163.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	C	Less than 1/4 acre of residential area
Airports	X14	X14-01	A	Medium	C	USGS 1:63,360 Topographic Maps / Community Profile Map
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	

APPENDIX C

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

Public Water System for PWS #280163.001 Takotna Water System
Showing Potential and Existing Sources of Contamination



LEGEND

- Public Water System

Hydrography/Physical

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

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 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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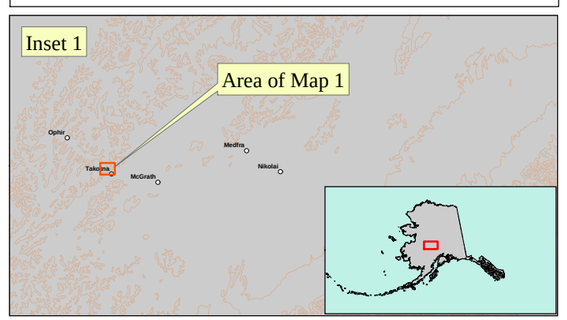


0 0.15 0.3 0.6 0.9 1.2 Miles

Takotna Water Sytem PWS 280163.001
Appendix C Map C

APPENDIX D

Vulnerability Analysis and Contaminant Risks
(Charts 1-13)

Chart 1. Susceptibility of the Surface Water Source - Takotna Water System (PWS No. 280163.001)

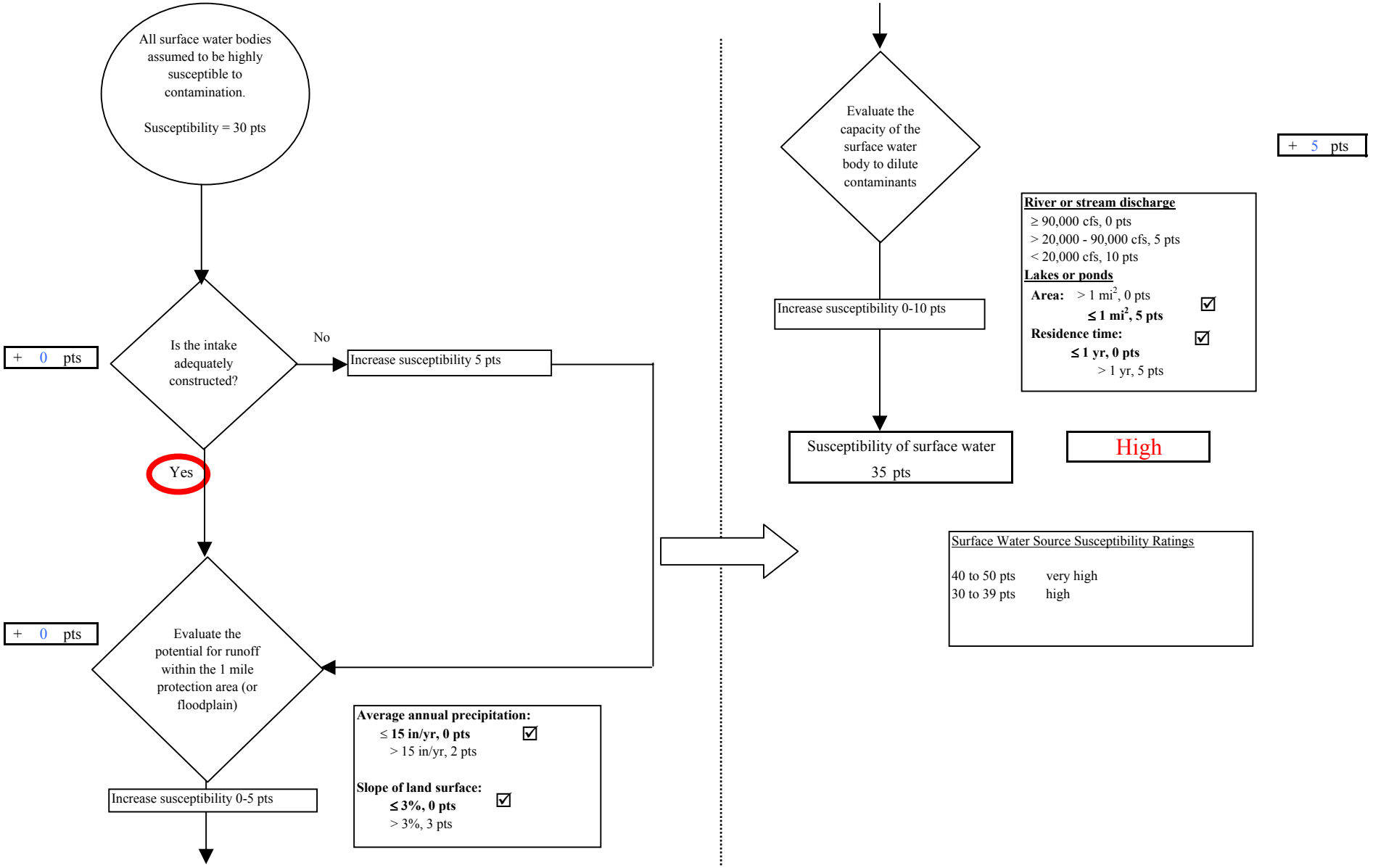
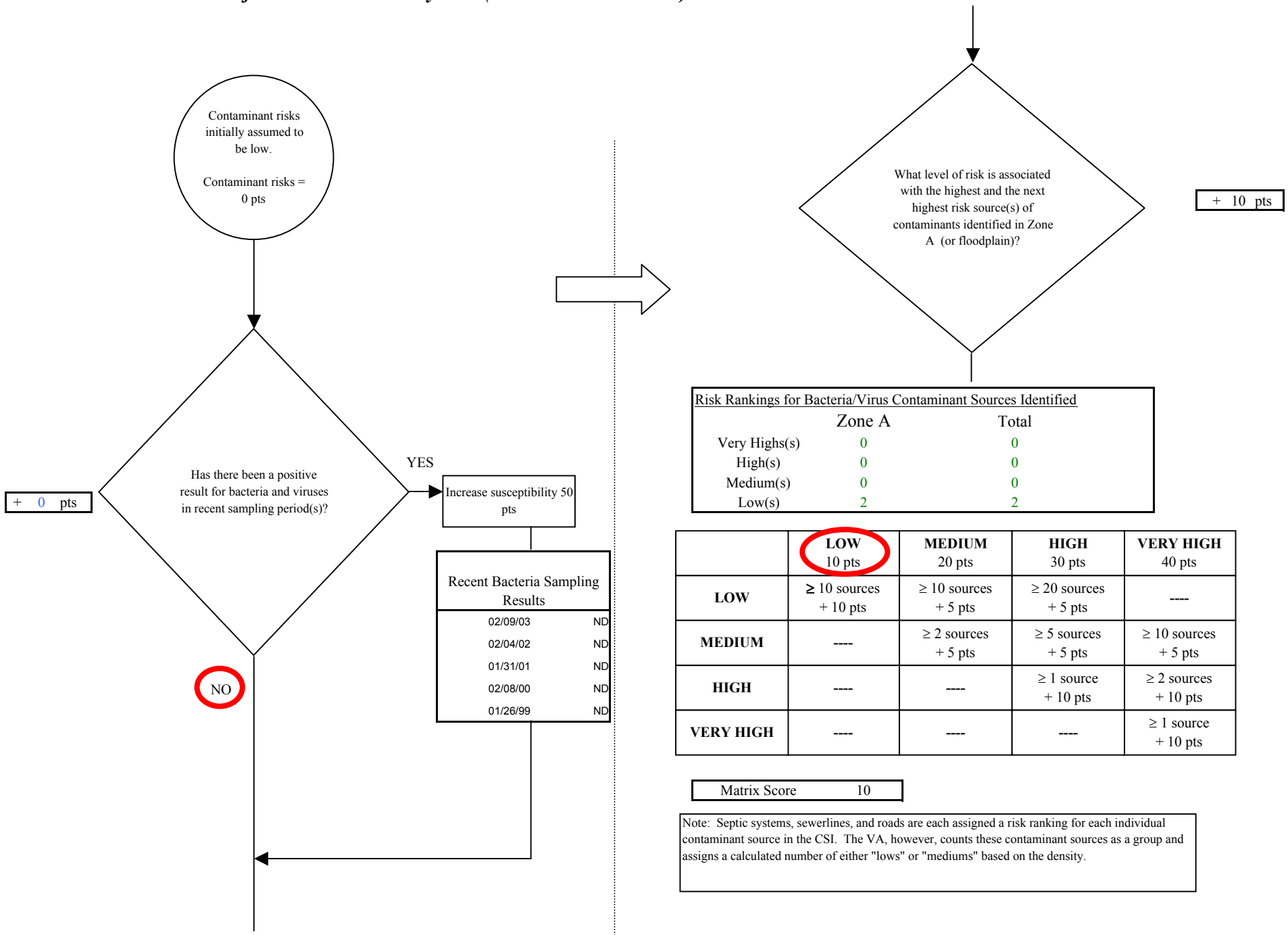


Chart 2. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Bacteria & Viruses



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)	2	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 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 Takotna Water System (PWS No. 280163.001) - Bacteria & Viruses

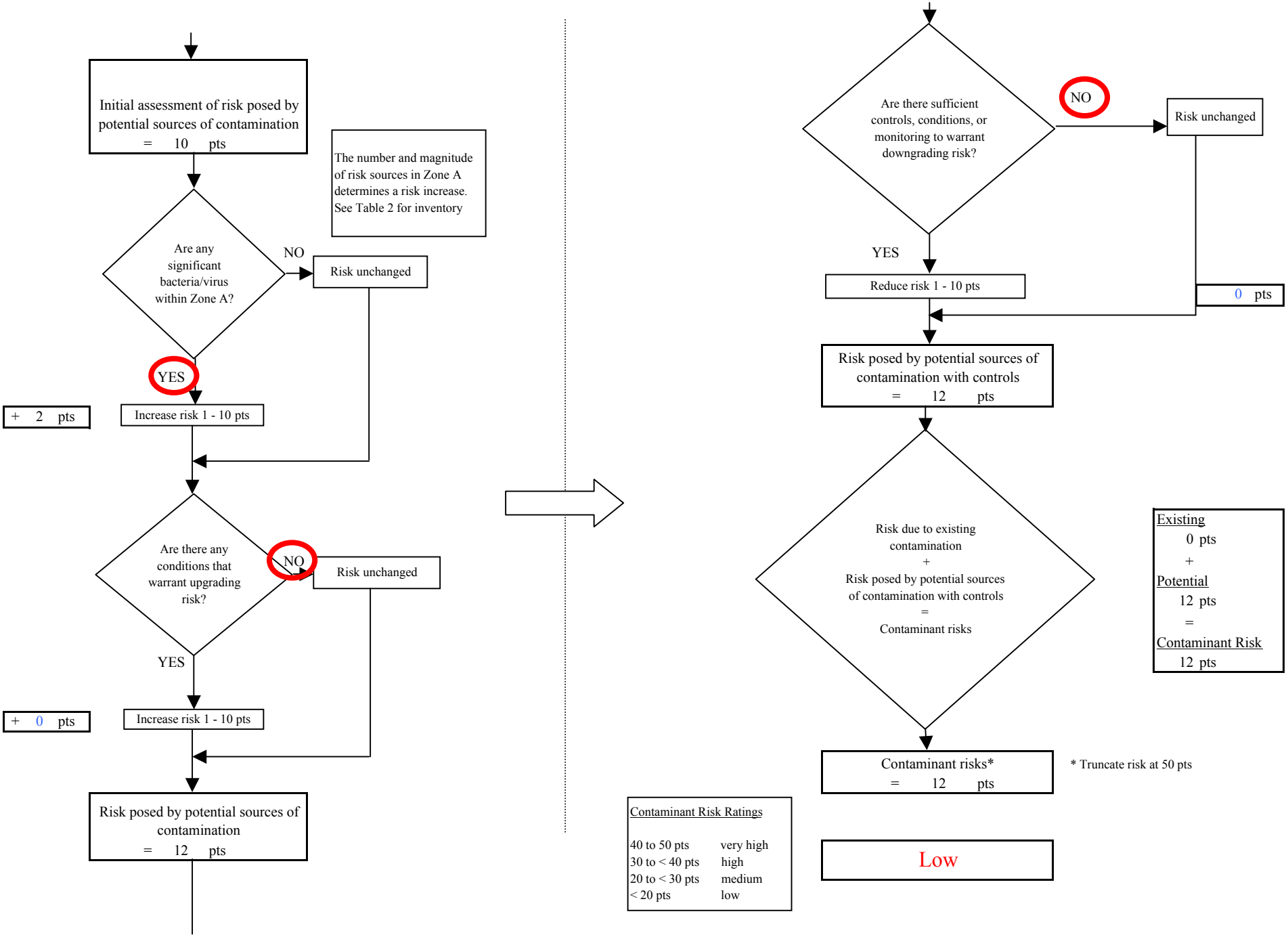


Chart 3. Vulnerability analysis for Takotna Water System (PWS No. 280163.001) - Bacteria & Viruses

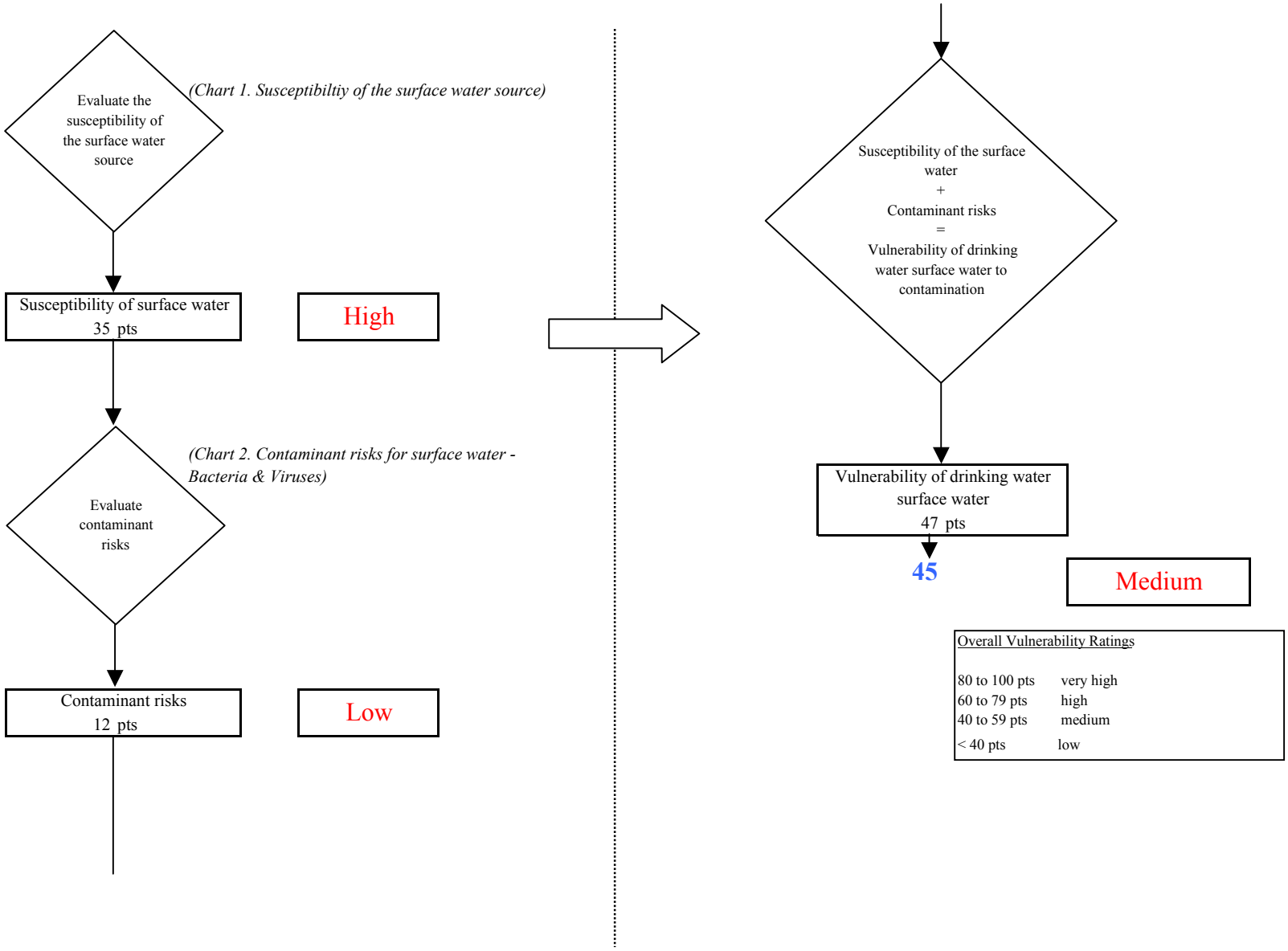


Chart 4. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Nitrates and Nitrites

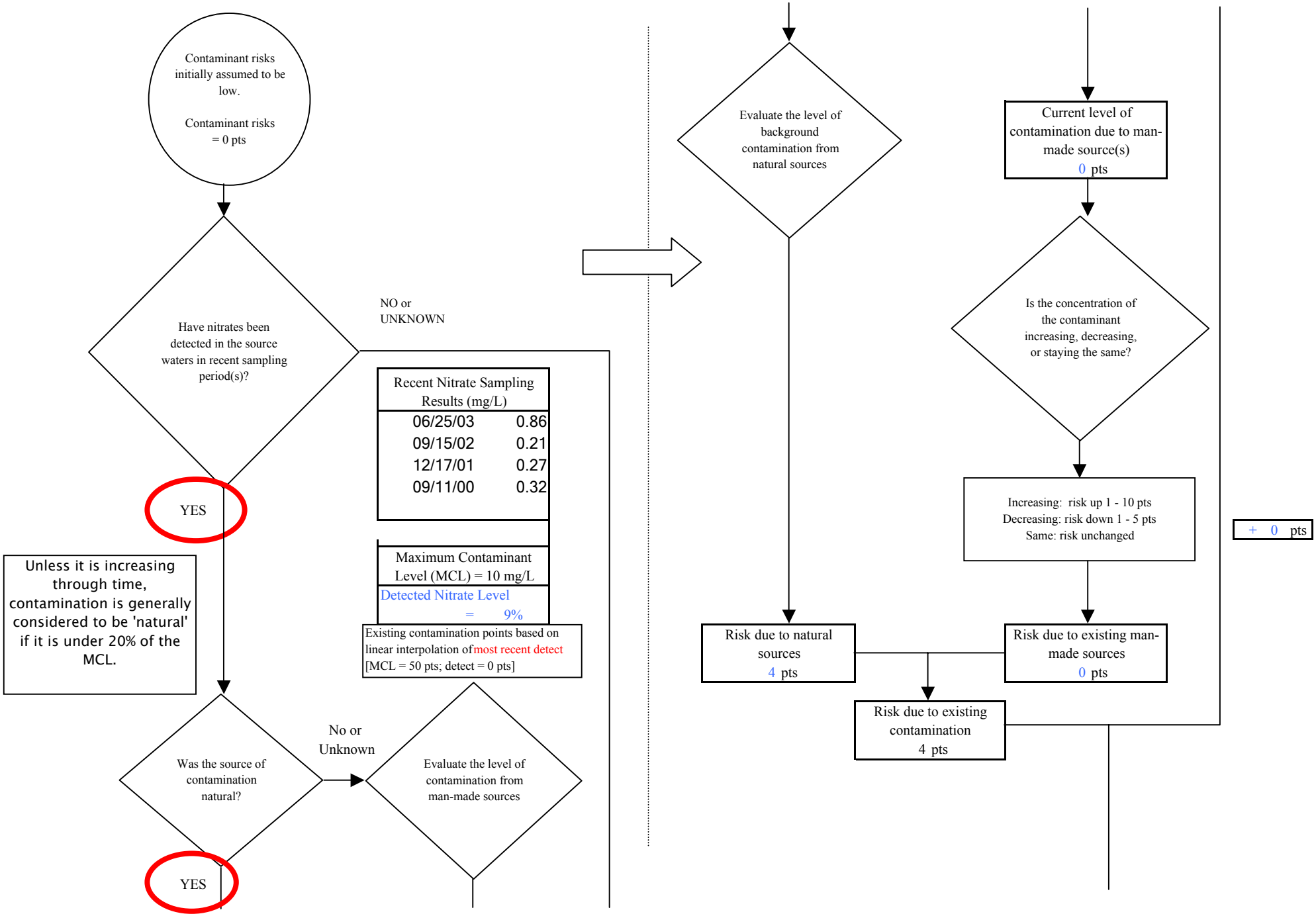


Chart 4. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Nitrates and Nitrites

+ 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 nitrate/nitrite sources in Zone A?

NO → Risk unchanged

YES

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

Increase risk 1 - 10 pts

+ 2 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)	3		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 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 Takotna Water System (PWS No. 280163.001) - Nitrates and Nitrites

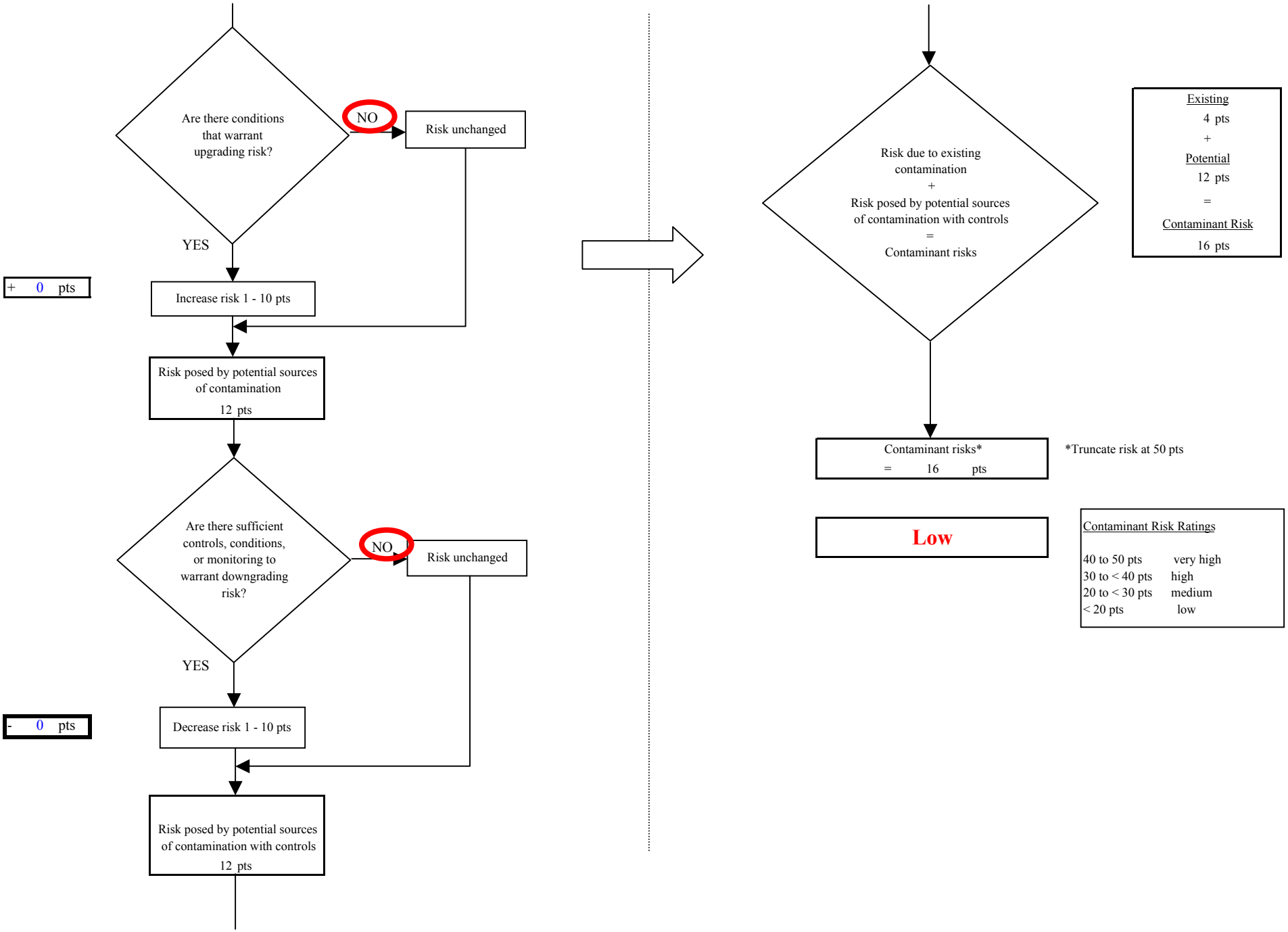


Chart 5. Vulnerability analysis for Takotna Water System (PWS No. 280163.001) - Nitrates and Nitrites

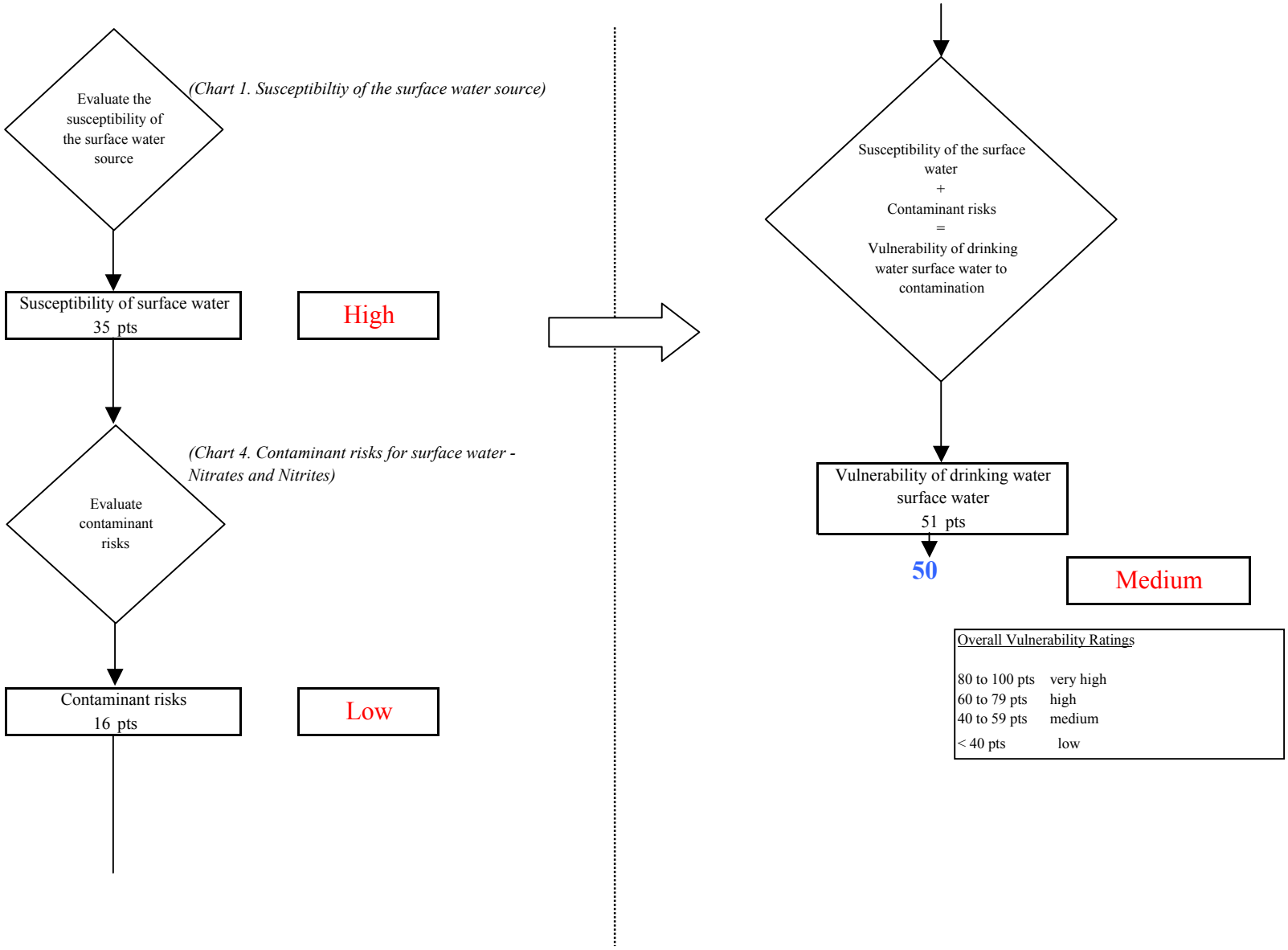


Chart 6. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Volatile Organic Chemicals

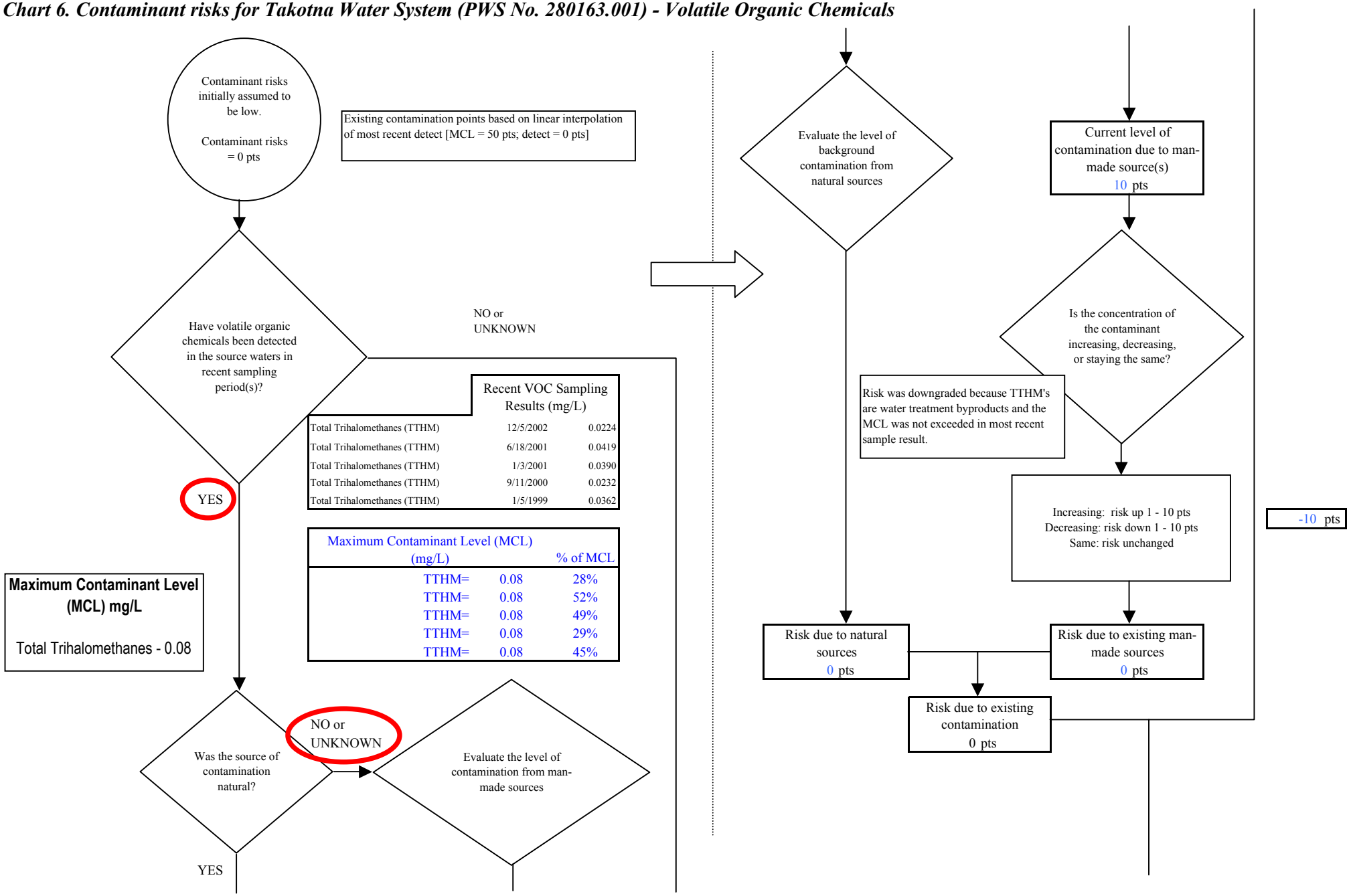


Chart 6. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Volatile Organic Chemicals

+ 20 pts

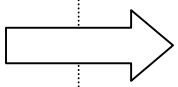
What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A and B? (see Risk Matrix below)

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)	1		1
Low(s)	2		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.



Initial assessment of risk posed by potential sources of contamination = 20 pts

Are any significant VOC sources in Zone A?

NO

Risk unchanged

YES

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

Increase risk 1 - 10 pts

+ 5 pts

Chart 6. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Volatile Organic Chemicals

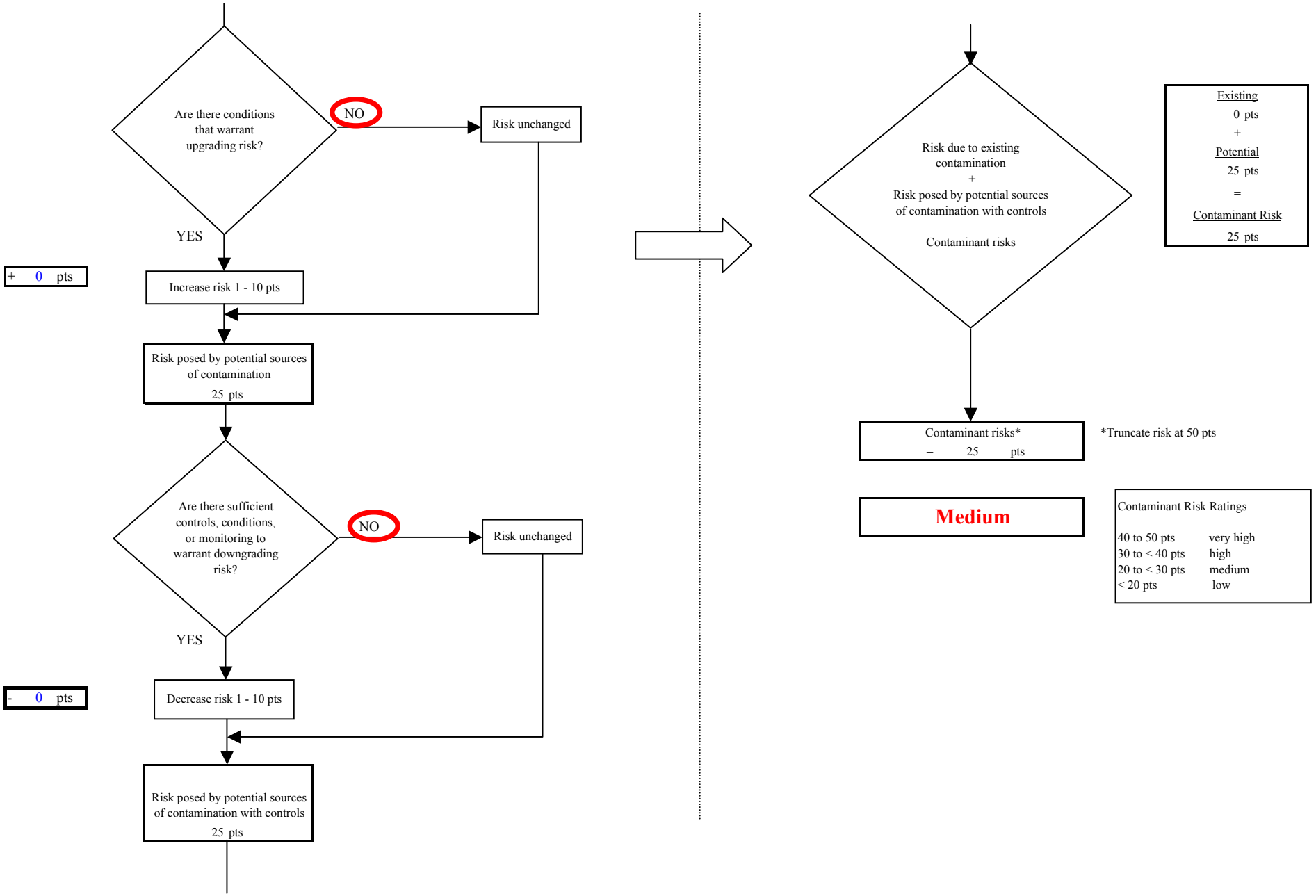


Chart 7. Vulnerability analysis for Takotna Water System (PWS No. 280163.001) - Volatile Organic Chemicals

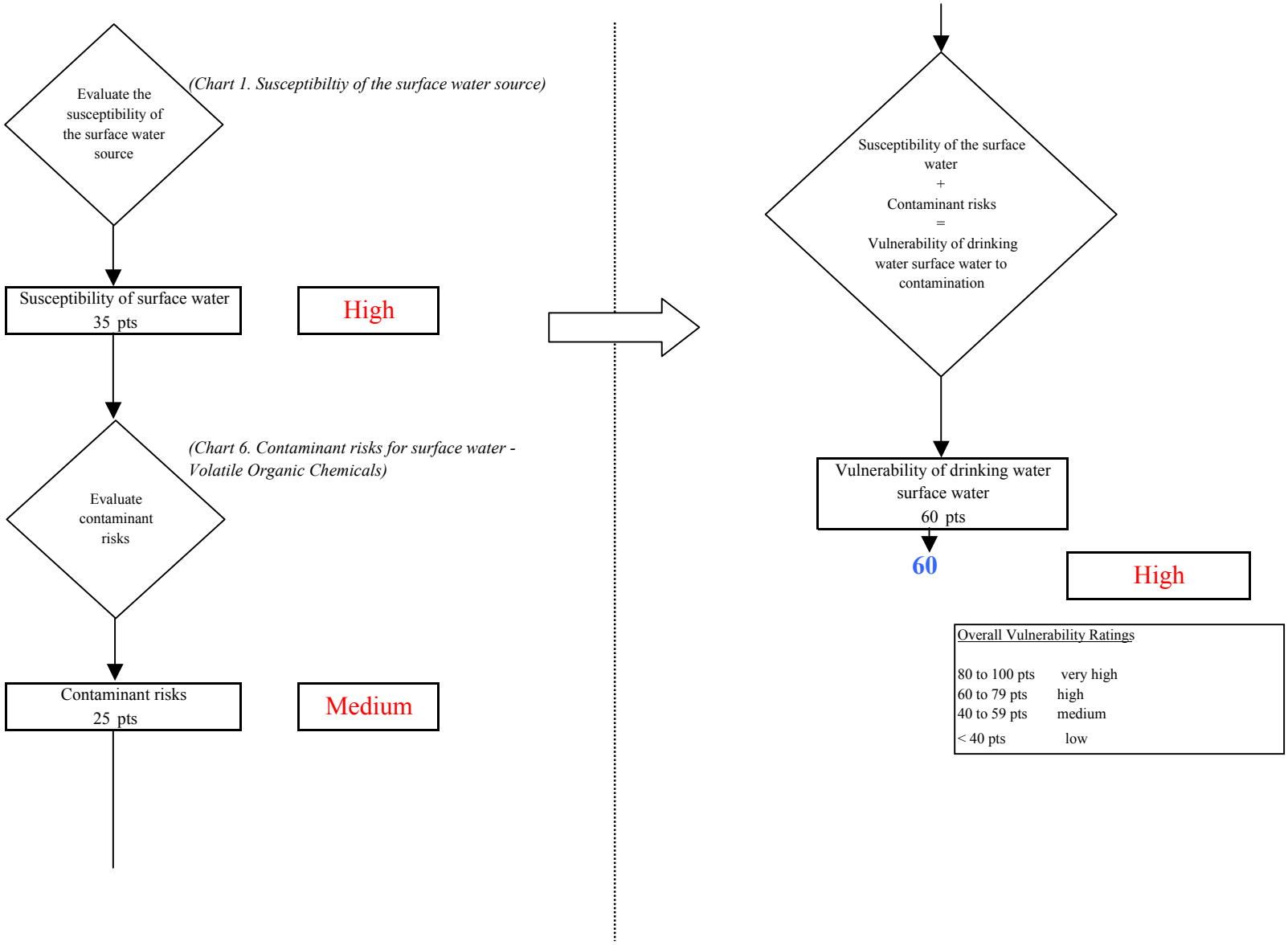


Chart 8. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

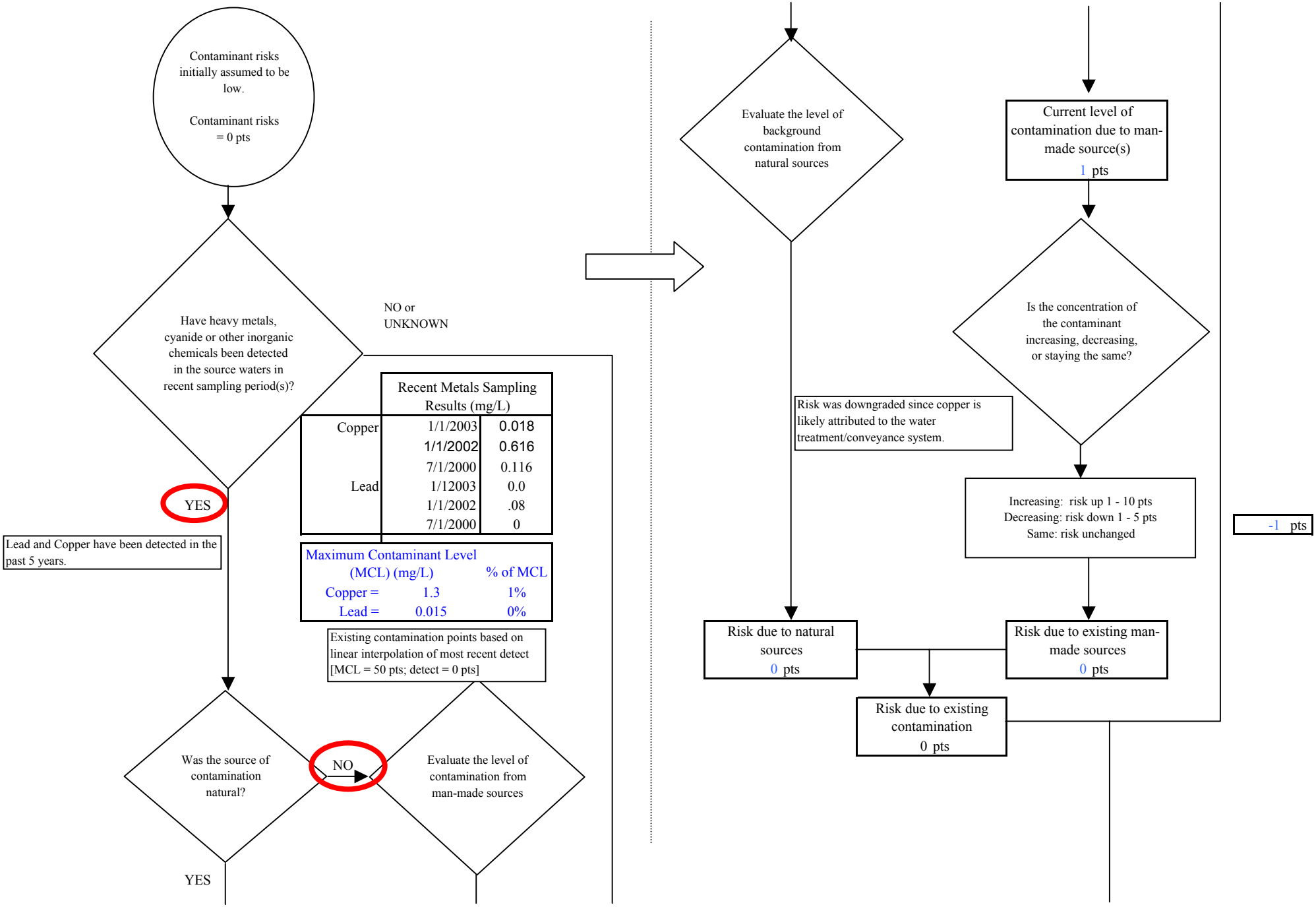


Chart 8. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 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

YES

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

Increase risk 1 - 10 pts

+ 2 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)	3		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 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 Takotna Water System (PWS No. 280163.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

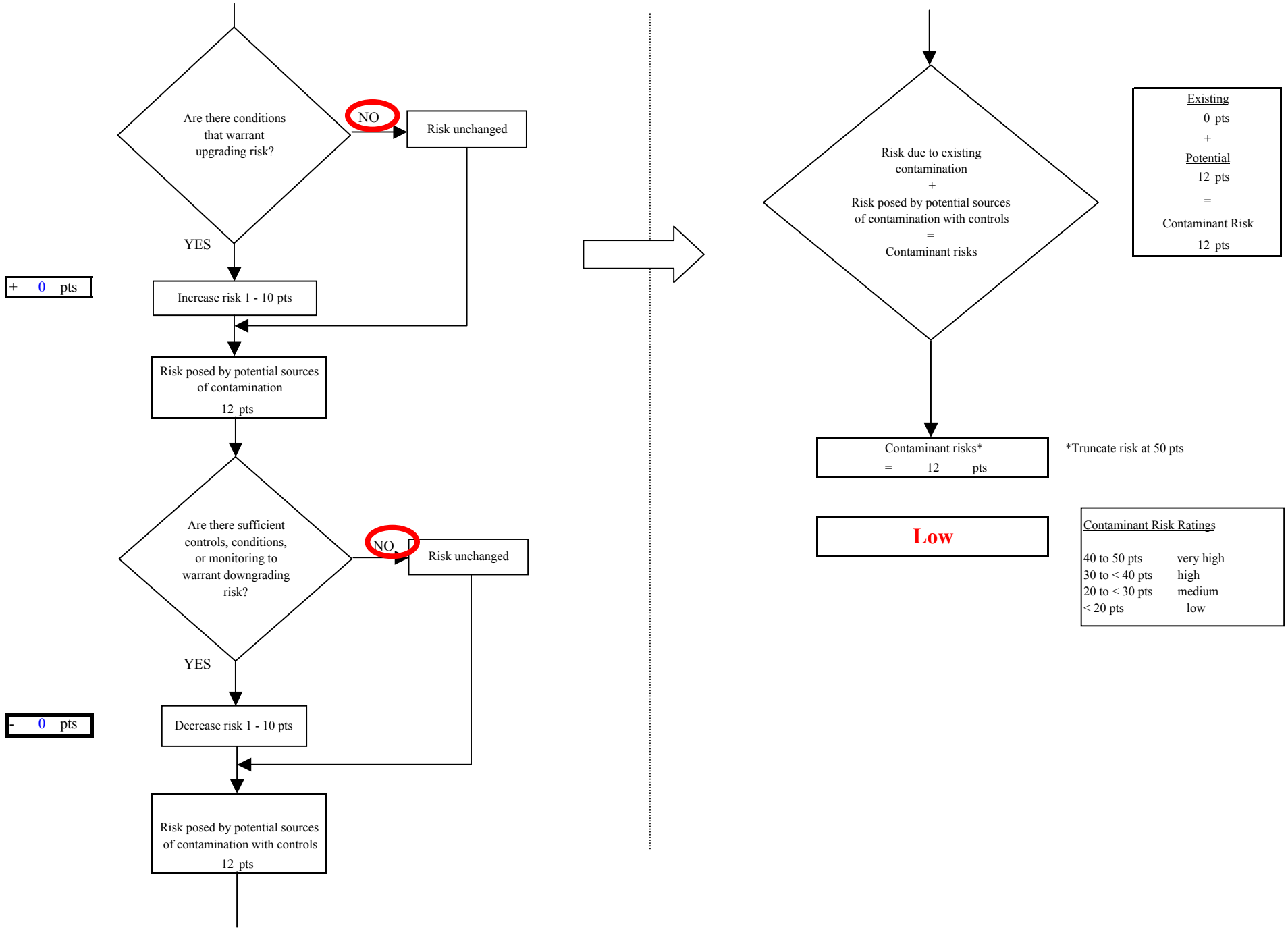


Chart 9. Vulnerability analysis for Takotna Water System (PWS No. 280163.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

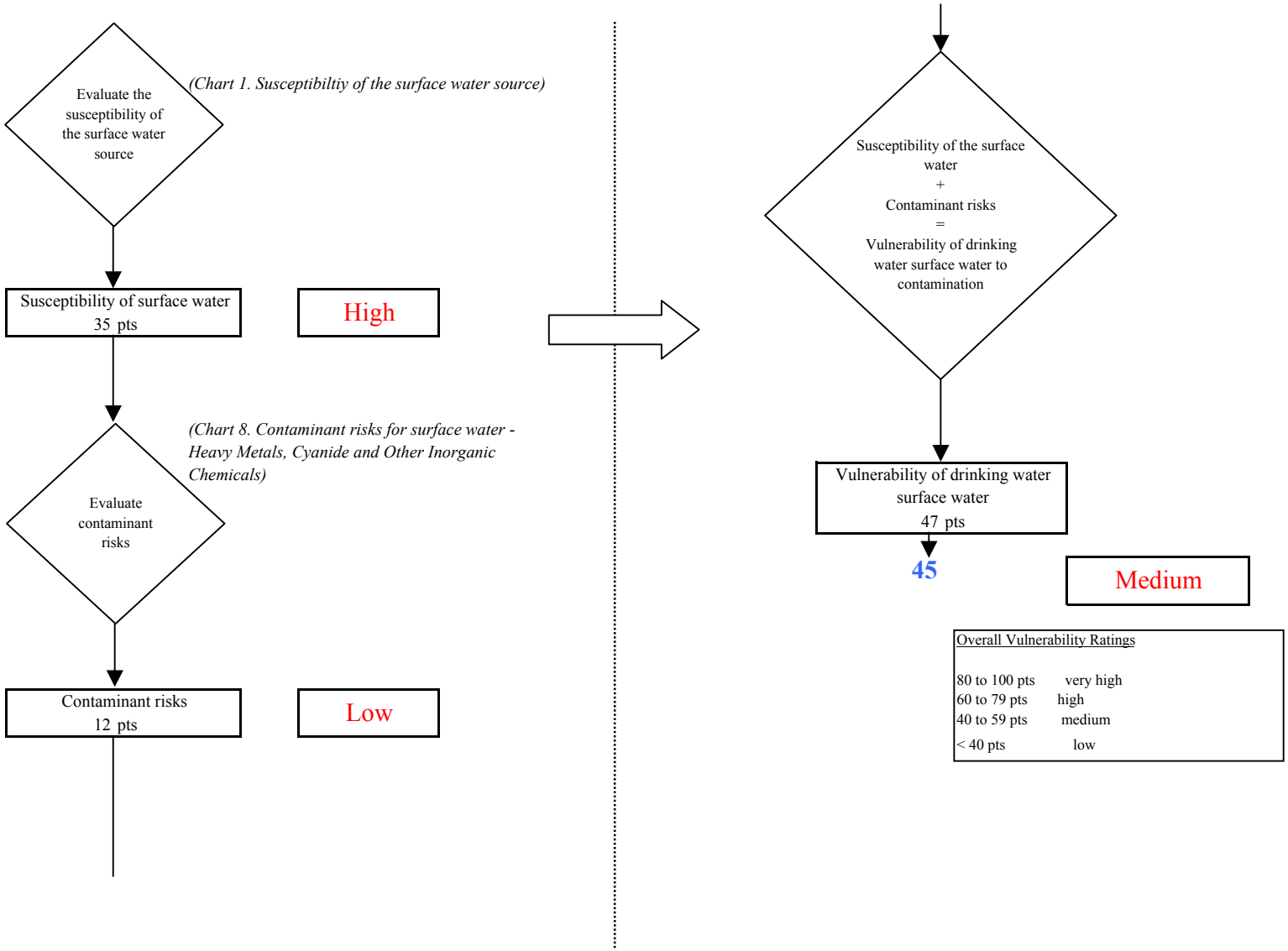


Chart 10. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Synthetic Organic Chemicals

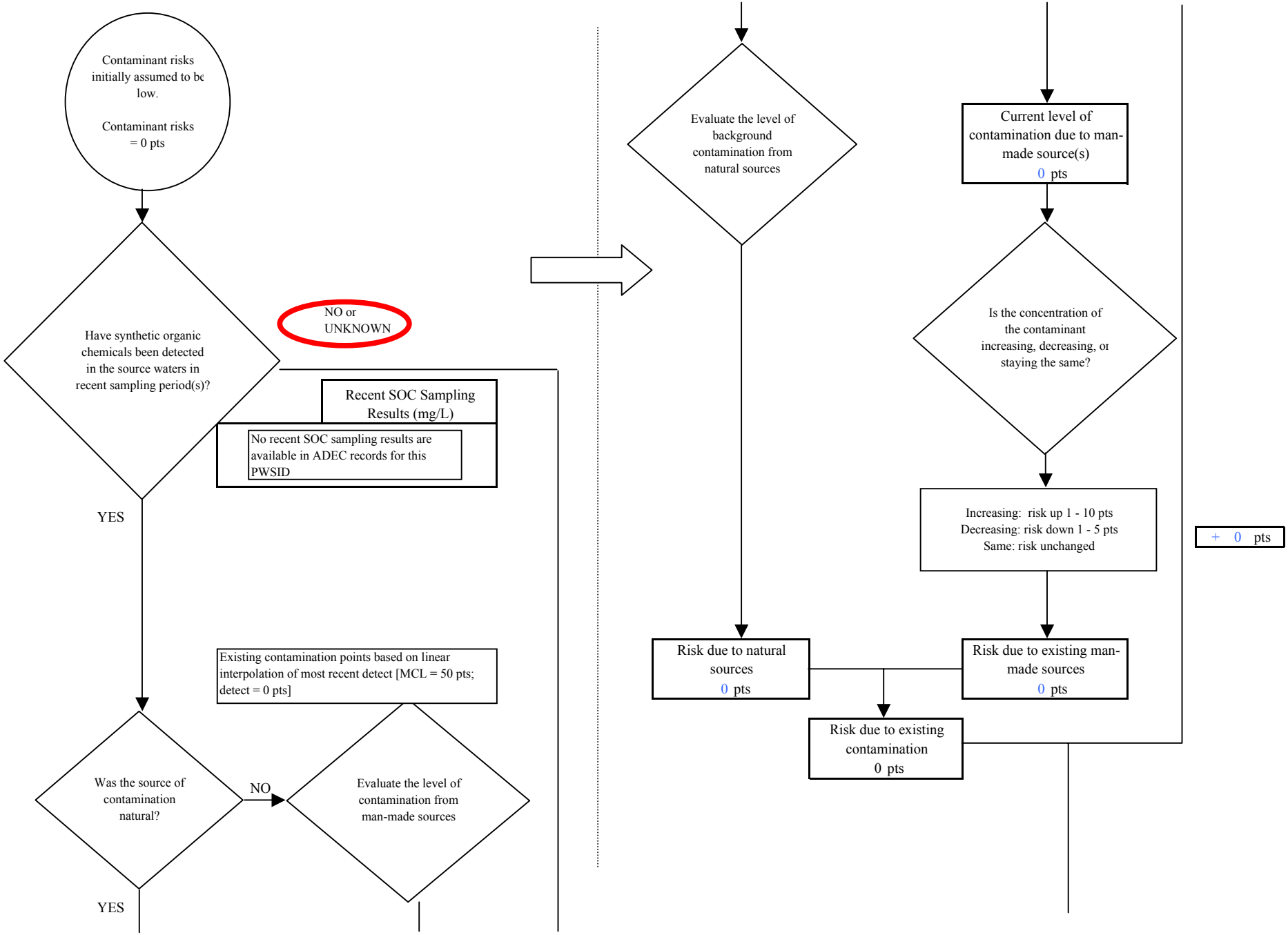


Chart 10. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Synthetic Organic Chemicals

+ 20 pts

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

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)	1	0	1
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 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.

Initial assessment of risk posed by potential sources of contamination = 20 pts

Are any significant SOC sources in Zone A?

NO → Risk unchanged

YES

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

Increase risk 1 - 10 pts

+ 5 pts

Chart 10. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Synthetic Organic Chemicals

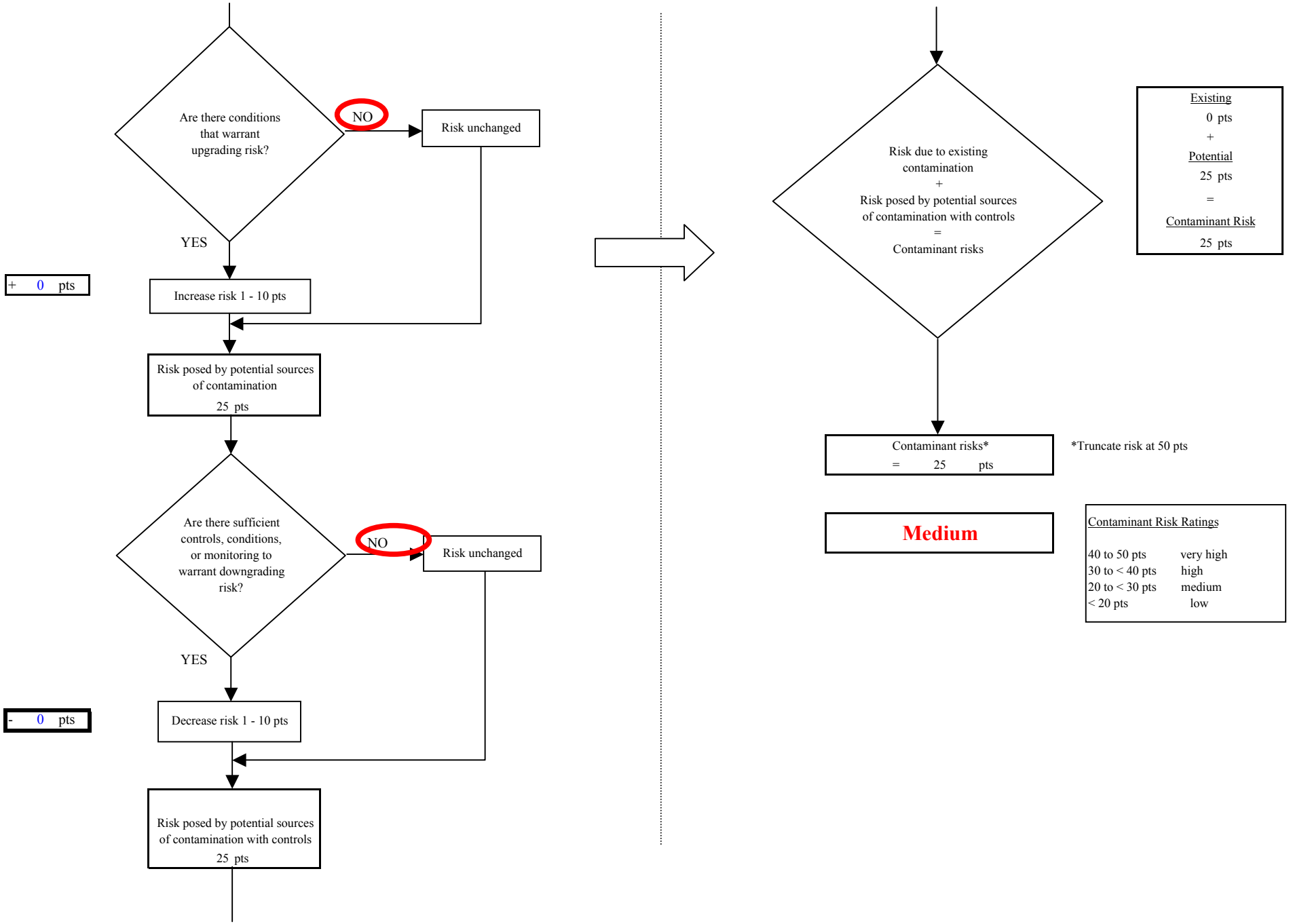


Chart 11. Vulnerability analysis for Takotna Water System (PWS No. 280163.001) - Synthetic Organic Chemicals

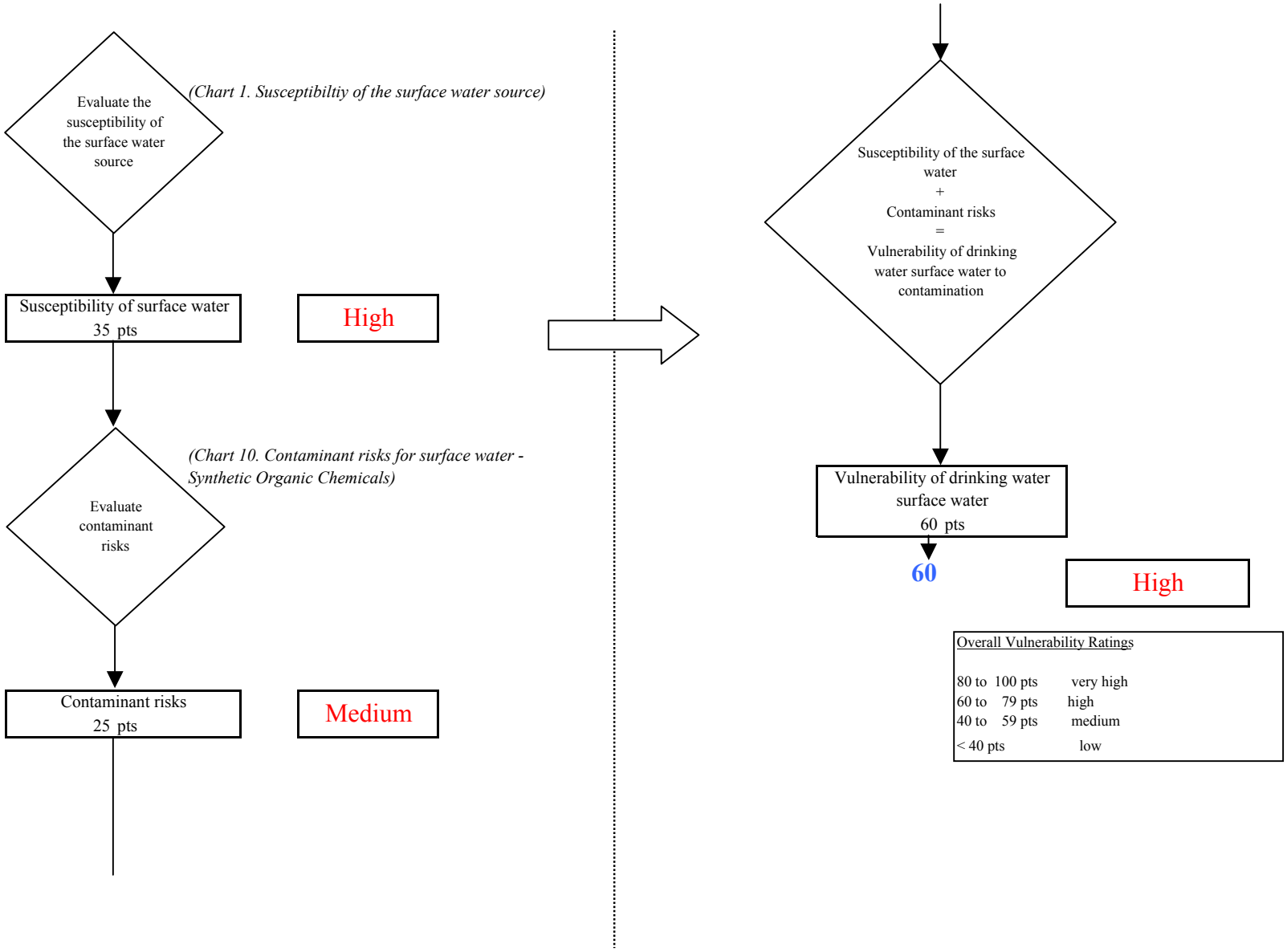


Chart 12. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Other Organic Chemicals

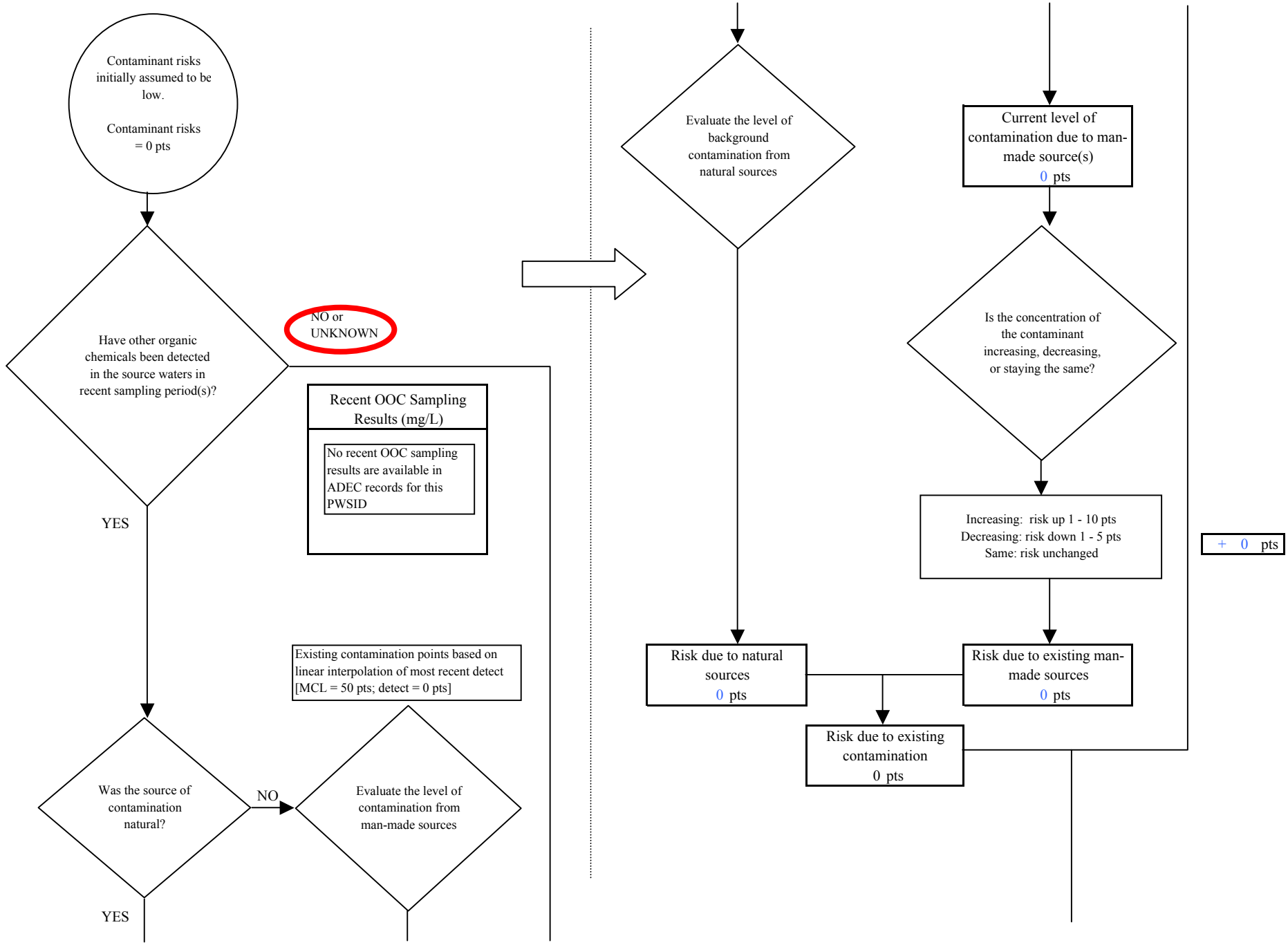
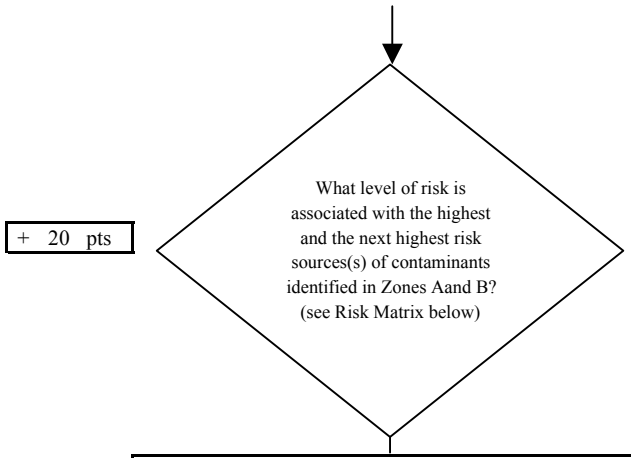


Chart 12. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Other Organic Chemicals



+ 20 pts

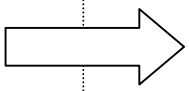
Risk Levels for OOC Sources identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	2	0	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.



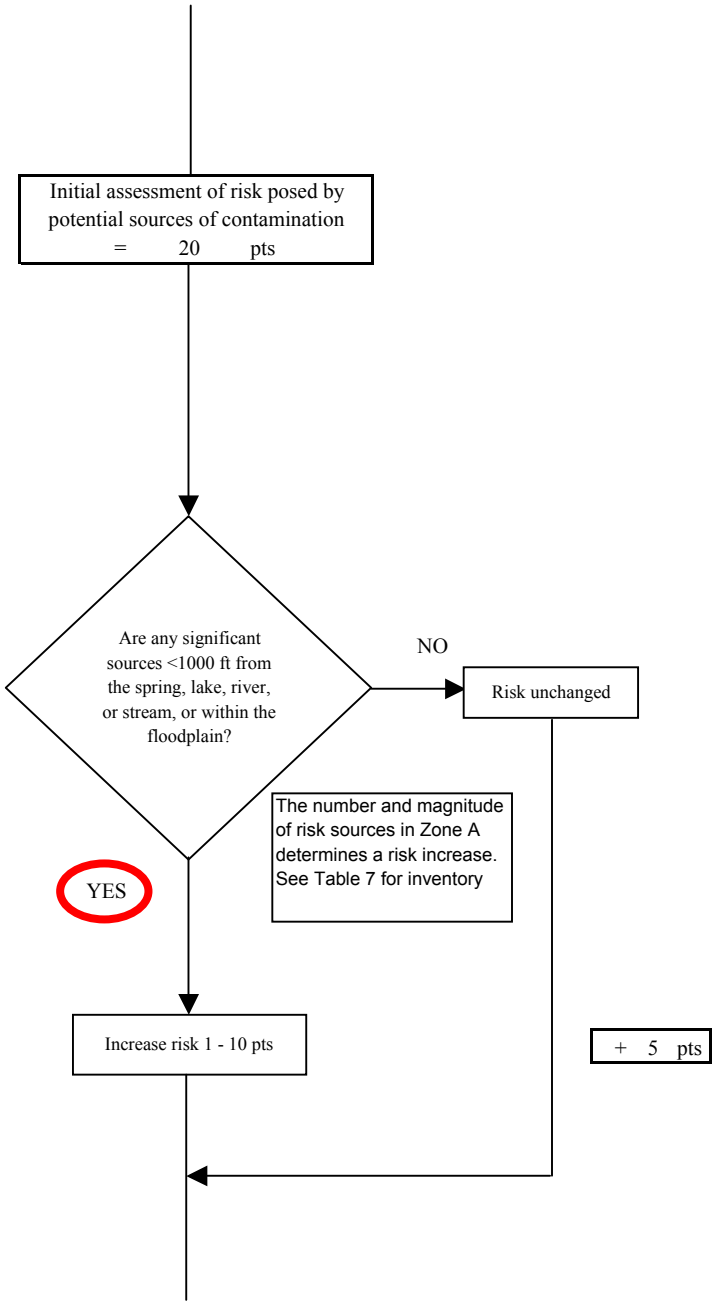


Chart 12. Contaminant risks for Takotna Water System (PWS No. 280163.001) - Other Organic Chemicals

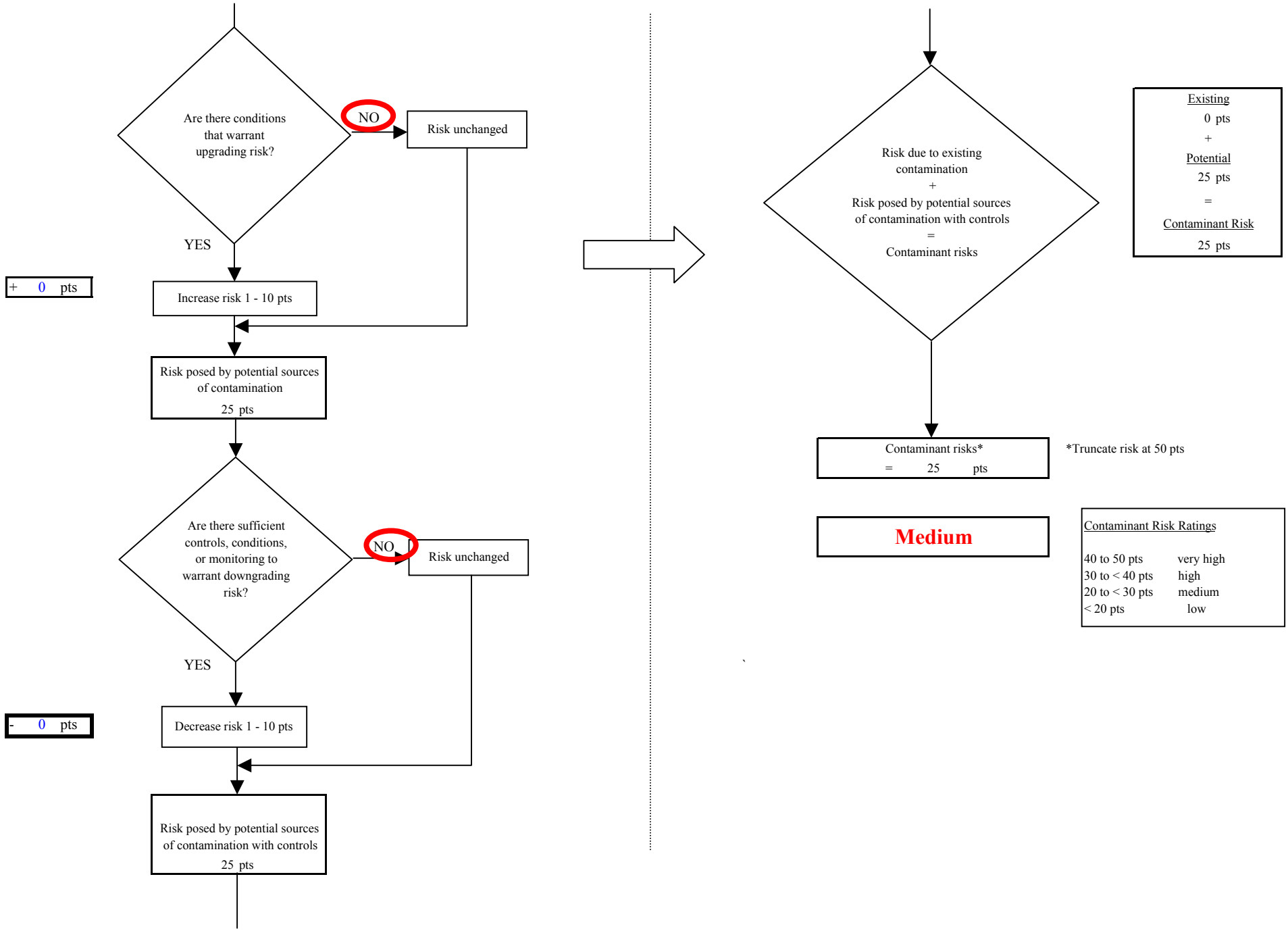


Chart 13. Vulnerability analysis for Takotna Water System (PWS No. 280163.001) - Other Organic Chemicals