Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for the Alyeska Pump Station #12 Drinking Water System, Richardson Highway Milepost 65, Alaska

PWSID # 296608.001

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1369
Alaska Department of Environmental Conservation

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

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

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Source Water Assessment for Alyeska Pump Station # 12 Source of Public Drinking Water, Richardson Highway Milepost 65, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Alyeska Pump Station (PS) #12 has one Public Water System (PWS) well. The well (PWS No. 296608.001) has been used as a drinking water source since it was drilled in July of 1976.

The well is a Class A (community and non-transient non-community) water system located in a well house at Pump Station 12 along the Trans Alaska Pipeline System at Pipeline Milepost 735.0 and Richardson Highway Milepost 65. Available records indicate that the drinking water is treated and has a 42,000 gallon storage facility with a 2,000 gallon daytank. This system operates year round and serves approximately 25 nonresidents. 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, large-capacity septic systems, fuel tanks, monitoring wells, ADEC contaminated sites, motor vehicle storage facilities, the Trans-Alaska Pipeline, and highways and roads. These identified potential and existing sources of contamination are considered 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 well received a vulnerability rating of **High** for bacteria and viruses, nitrates and nitrites, volatile organic chemicals, and other organic chemicals; a vulnerability rating of **Medium** for heavy metals, cyanide and other inorganic chemicals; and a vulnerability rating of **Low** for synthetic organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The Alyeska PS 12 PWS well is a Class A (community/non-transient/non-community) public water system. The system is located at Pump Station 12 along the Trans Alaska Pipeline System at Pipeline Milepost 735.0 and Richardson Highway Milepost 65 (Sec. 36, T045N, R001E, Copper River Meridian, see Map A of Appendix A). Pump Station 12 is located south of Copper Center just east of the Little Tonsina State Recreation Site. The crew stationed at the facility varies from 10-25 Alyeska employees year-round (Alyeska, 2004). Average annual precipitation in the area is 9 inches, including approximately 39 inches of snowfall. Temperatures can be as extreme as -75 to 90°F (ADCED, 2003).

Alyeska PS 12 helps push oil over the Chugach Mountains located between the station and the Valdez Marine Terminal. The facility produces it's own power and also purchases commercial power when needed.

According to information supplied by ADEC for the Alyeska PS 12 PWS, the depth of the well is 77 feet below the ground surface. Based on available well construction details, the well was completed in a confined aquifer and is unscreened. The well is not located within a floodplain.

Information acquired from an August 2003 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.

Thrust faulting from subduction in the Aleutian trench over the past 20 million years gradually uplifted the Chugach Range in the Prince William Sound area. This range at first was most probably an uplifted plateau. But the combined physical forces of uplift and glaciation created the highly sculpted Chugach Mountains. The only higher range of coastal mountains is the Andes.

The Chugach Terrarie crops out in an arc from the Shumagin Islands to southeast Alaska. Alyeska PS 12 falls within what is referred to as the Valdez Group and is composed largely of structurally imbricated trench-fill turbidites (Burns, 1991).

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 Alyeska PS 12 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 Alyeska PS 12 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 Alyeska PS 12 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, and
- 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 Alyeska PS 12 Public Water System'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	40	Very High
Nitrates and/or Nitrites	45	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	25	Medium
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	40	Very High

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

Natural Susceptibility (0 – 50 points)
+
Contaminant Risks (0 – 50 points)
=
Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

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

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

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	60	High
Nitrates and Nitrites	65	High
Volatile Organic Chemicals	70	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Medium
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	60	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of a Large capacity septic system in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 2 – Appendix B).

Positive bacteria counts have not been reported in recent (within five years) sampling events (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Only a small amount of bacteria and viruses are required to endanger public health.

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

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **High**. The risk to this source of public drinking water is primarily attributed to the presence of a Large capacity septic system in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that nitrates have been detected in recent sampling events, however they did not exceed the MCL of 10mg/L. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L; therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

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 **High.**

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of an active ADEC recognized contaminated site in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

All recent sampling data indicates results below detection limits (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

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

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

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 fuel tanks and monitoring wells in Zone A (see Table 5 – Appendix B).

The reported concentrations of lead and copper are likely attributed to the water treatment/conveyance system. No risk points were assigned since neither analyte exceeded 100% of the MCL in the most recent sampling event (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

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 a large capacity septic system, three ADEC recognized contaminated sites and a domestic wastewater collection system in Zone A (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the Alyeska PS 12 PWS (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 **Very High**. The risk is primarily attributed to the presence of the Trans Alaska Pipeline in Zone A. Several 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 Alyeska PS 12 Public Water System (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 **High**.

Using the Source Water Assessment

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the community of Alyeska PS 12 to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

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APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

APPENDIX B

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

APPENDIX C

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

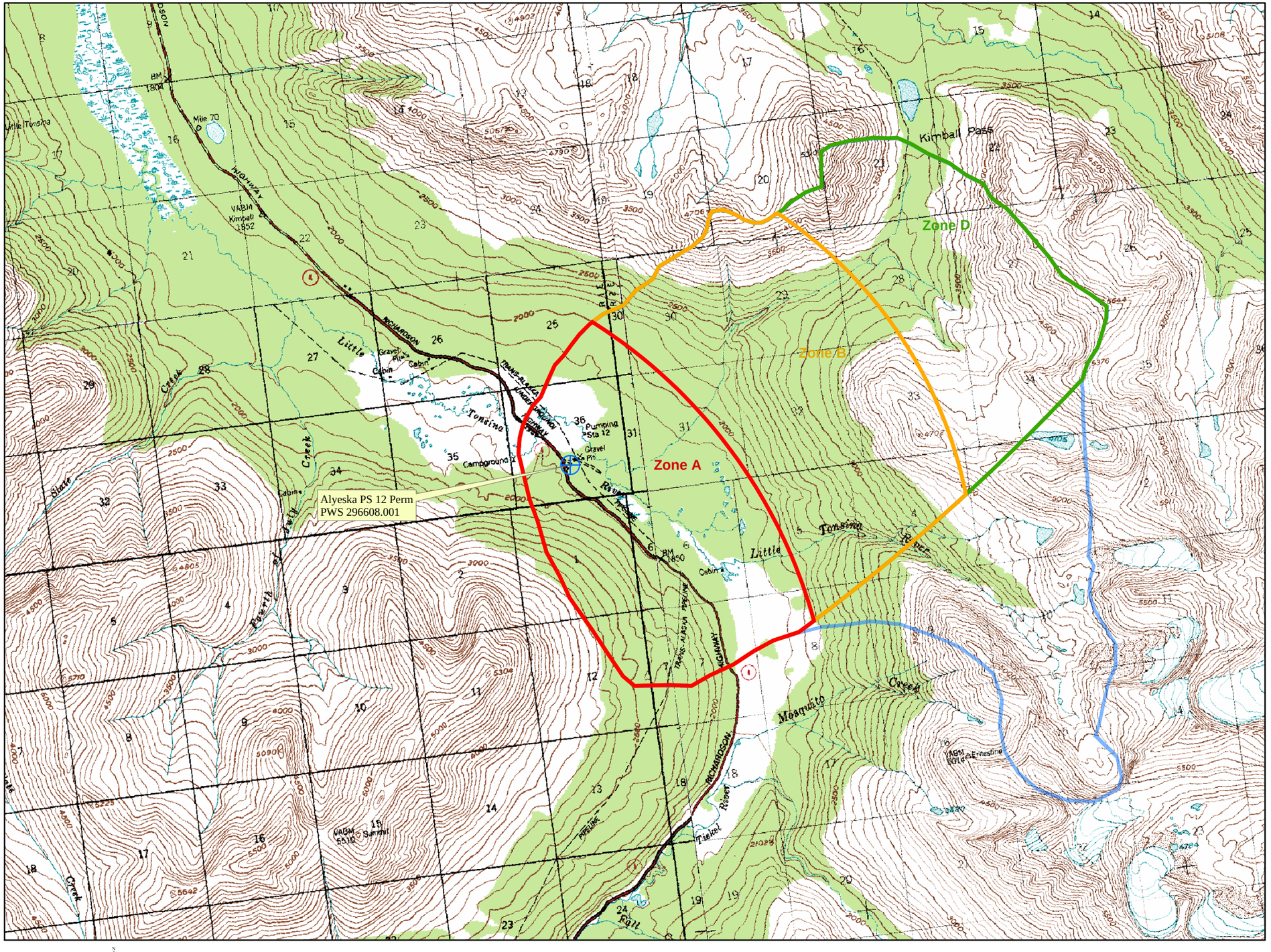
APPENDIX D

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

APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #296608.001 Alyeska PS 12 Perm



LEGEND

- Public Water System Well

Hydrography/Physical

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

Transportation

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

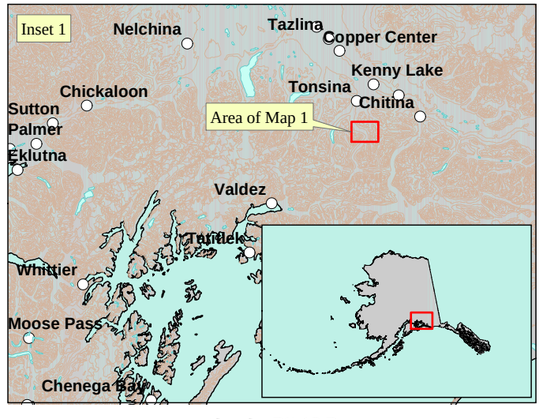
Groundwater Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time 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 "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.



Alyeska PS 12 Perm
PWS 296608.001
Appendix A Map A

APPENDIX B

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

Table 1

Contaminant Source Inventory for ***Alyeska PS 12***

PWSID 296608.00

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stati	D01	D01-01	A	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfie Disposal Method)	D10	D10-01	A	C	
Tanks, diesel (above ground)	T06	T06-01	A	C	
Tanks, gasoline (above ground)	T10	T10-01	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	C	Alyeska PLMP 734 Pipe Leak, RecKey #1979240116601, Status: Active structural failure of the pipeline, estimated volume of the historical spill is estimated to be between 126,000 and 168,000 gallons of crude oil.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	A	C	Alyeska PS 12 Mainline Turbine Sump, RecKey #1992720125001, Status Active, during excavation activities related to the removal of the MLT su petroleum impacted soils were encountered. The release was reported as 3 gallons of turbine fuel.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	A	C	Alyeska PS 12 Fuel Island Area, RecKey #1992720130107, Status: Inacti during a site assessment of the fuel handling area, contamianted soils were found, excavated, and thermally incinerated at the Valdez Terminal.
Monitoring wells	W06	W06-01	A	C	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	C	Richardson Highway
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Motor vehicle/general storage yards/facilities	X27	X27-01	A	C	
Pipelines (oil and gas)	X28	X28-01	A	C	Trans-Alaska Pipeline

Table 2

Contaminant Source Inventory and Risk Ranking for Alyeska PS 12
Sources of Bacteria and Viruses

PWSID 296608.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	C	Richardson Highway
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 3

Contaminant Source Inventory and Risk Ranking for Alyeska PS 12
Sources of Nitrates/Nitrites

PWSID 296608.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	C	Richardson Highway
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 4

Contaminant Source Inventory and Risk Ranking for Alyeska PS 12
Sources of Volatile Organic Chemicals

PWSID 296608.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Tanks, diesel (above ground)	T06	T06-01	A	Medium	C	
Tanks, gasoline (above ground)	T10	T10-01	A	Medium	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	High	C	Alyeska PLMP 734 Pipe Leak, RecKey #1979240116601, Status: Active, structural failure of the pipeline, estimated volume of the historical spill is estimated to be between 126,000 and 168,000 gallons of crude oil.
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-02	A	High	C	Alyeska PS 12 Mainline Turbine Sump, RecKey #1992720125001, Status: Active, during excavation activities related to the removal of the MLT sur petroleum impacted soils were encountered. The release was reported as 3(gallons of turbine fuel.
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-03	A	High	C	Alyeska PS 12 Fuel Island Area, RecKey #1992720130107, Status: Inactiv during a site assessment of the fuel handling area, contamianted soils were found, excavated, and thermally incinerated at the Valdez Terminal.
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	C	Richardson Highway
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Motor vehicle/general storage yards/facilities	X27	X27-01	A	Low	C	
Pipelines (oil and gas)	X28	X28-01	A	Medium	C	Trans-Alaska Pipeline

Table 5

Contaminant Source Inventory and Risk Ranking for Alyeska PS 12

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 296608.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Tanks, gasoline (above ground)	T10	T10-01	A	Medium	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	Low	C	Alyeska PLMP 734 Pipe Leak, RecKey #1979240116601, Status: Active, structural failure of the pipeline, estimated volume of the historical spill is estimated to be between 126,000 and 168,000 gallons of crude oil.
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Monitoring wells	W06	W06-01	A	Medium	C	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	C	Richardson Highway
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	Low	C	Trans-Alaska Pipeline

Table 6

Contaminant Source Inventory and Risk Ranking for Alyeska PS 12
Sources of Synthetic Organic Chemicals

PWSID 296608.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	Low	C	Alyeska PLMP 734 Pipe Leak, RecKey #1979240116601, Status: Active, structural failure of the pipeline, estimated volume of the historical spill is estimated to be between 126,000 and 168,000 gallons of crude oil.
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Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-03	A	Low	C	Alyeska PS 12 Fuel Island Area, RecKey #1992720130107, Status: Inactiv during a site assessment of the fuel handling area, contamianted soils were found, excavated, and thermally incinerated at the Valdez Terminal.

Table 7

Contaminant Source Inventory and Risk Ranking for Alyeska PS 12
Sources of Other Organic Chemicals

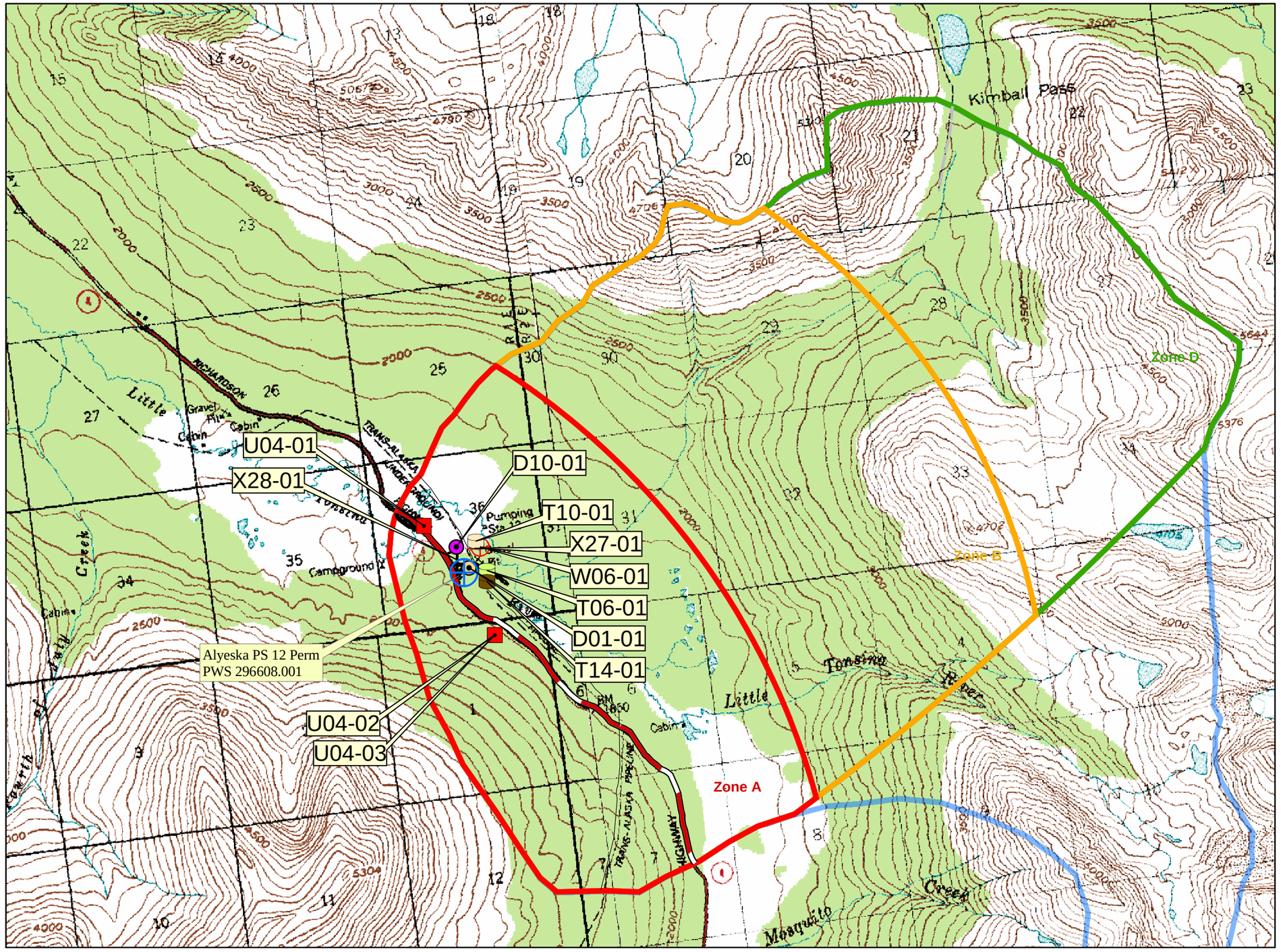
PWSID 296608.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	Low	C	Alyeska PLMP 734 Pipe Leak, RecKey #1979240116601, Status: Active, structural failure of the pipeline, estimated volume of the historical spill is estimated to be between 126,000 and 168,000 gallons of crude oil.
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-02	A	Low	C	Alyeska PS 12 Mainline Turbine Sump, RecKey #1992720125001, Status: Active, during excavation activities related to the removal of the MLT sur petroleum impacted soils were encountered. The release was reported as 3(gallons of turbine fuel.
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-03	A	Low	C	Alyeska PS 12 Fuel Island Area, RecKey #1992720130107, Status: Inactiv during a site assessment of the fuel handling area, contamianted soils were found, excavated, and thermally incinerated at the Valdez Terminal.
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	C	Richardson Highway
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Motor vehicle/general storage yards/facilities	X27	X27-01	A	Low	C	
Pipelines (oil and gas)	X28	X28-01	A	High	C	Trans-Alaska Pipeline

APPENDIX C

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

Public Water Well System for PWS #296608.001 Alyeska PS 12 Perm
Sources of Existing and Potential Contamination



LEGEND

Public Water System Well

Hydrography/Physical

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

Transportation

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

Groundwater Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time or Watershed Boundary

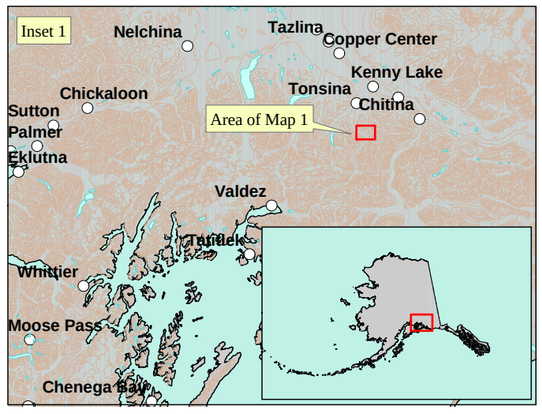
Existing or Potential Contaminant Sources

- Domestic wastewater collection systems (sewer lines or lift stations) (D01)
- Injection Wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) (D10)
- Tanks, diesel (aboveground) (T06)
- Tanks, gasoline (aboveground) (T10)
- Tanks, heating oil, nonresidential (aboveground) (T14)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)
- Monitoring Wells (W06)
- Motor vehicle/general storage yards/facilities (X27)
- Pipelines (oil and gas) (X28)

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.



Alyeska PS 12 Perm
PWS 296608.001
Appendix C Map C

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - Alyeska Pump Station 12 (PWS No.296608.001)

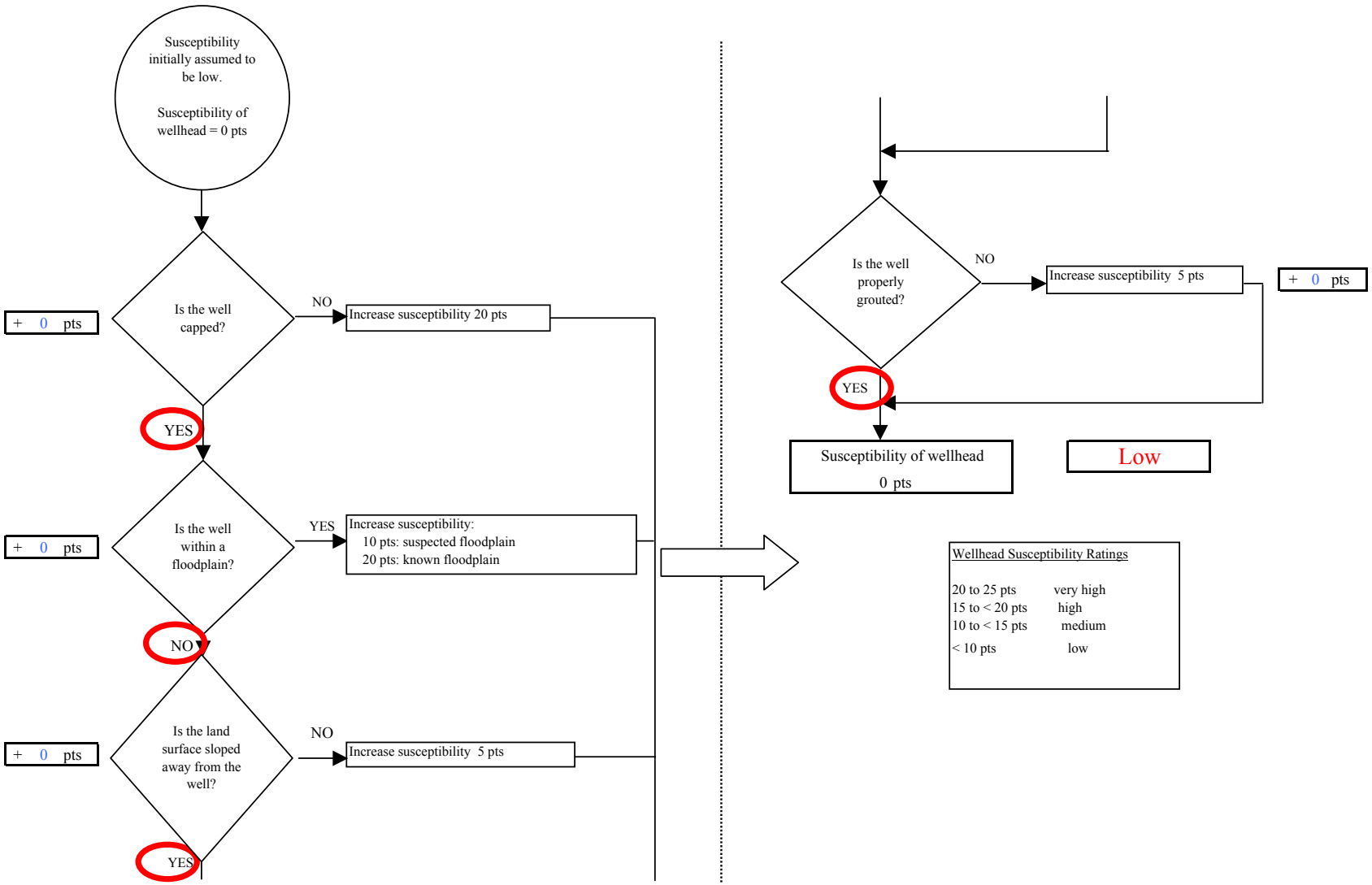


Chart 2. Susceptibility of the aquifer Alyeska Pump Station 12 (PWS No.296608.001)

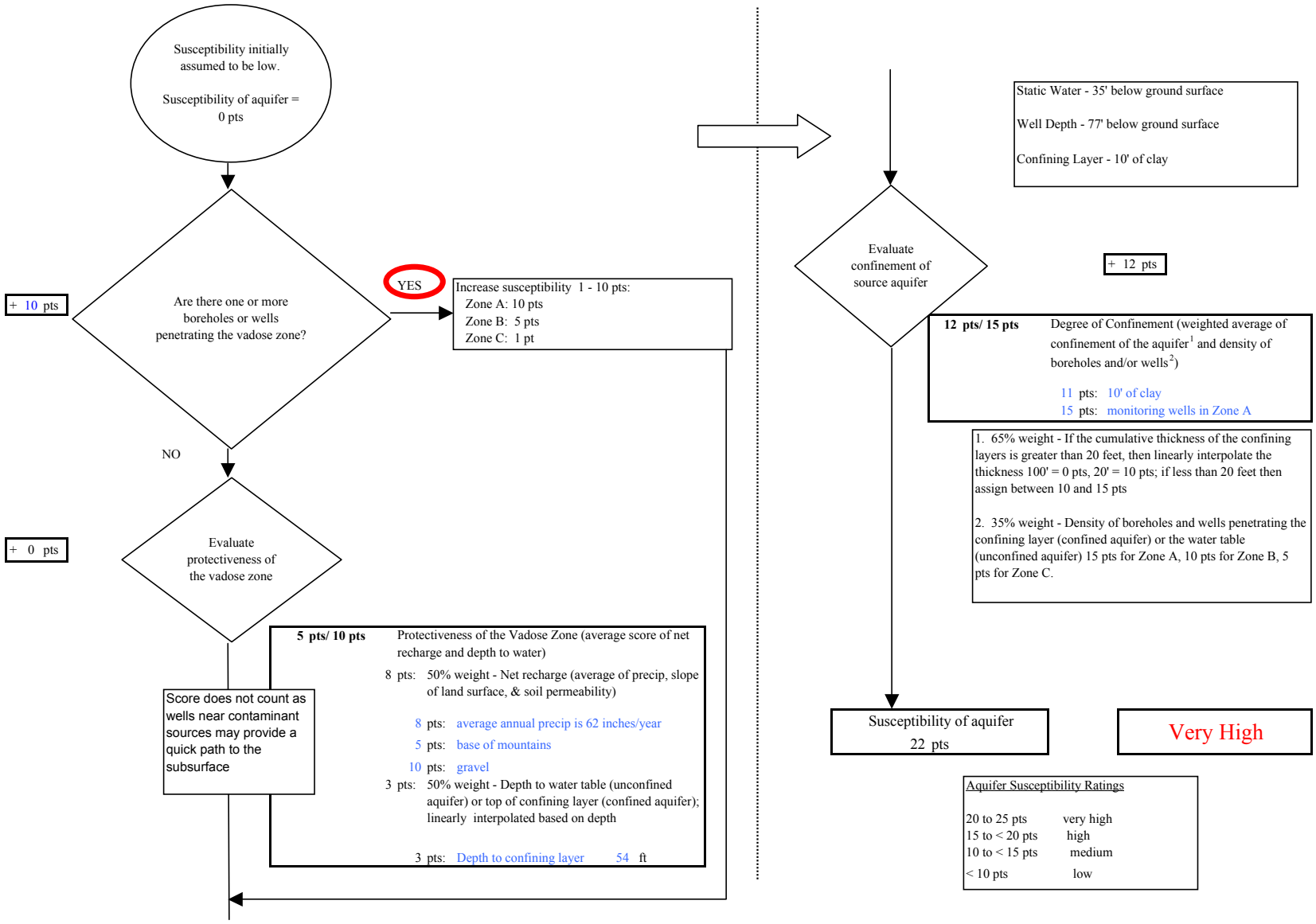
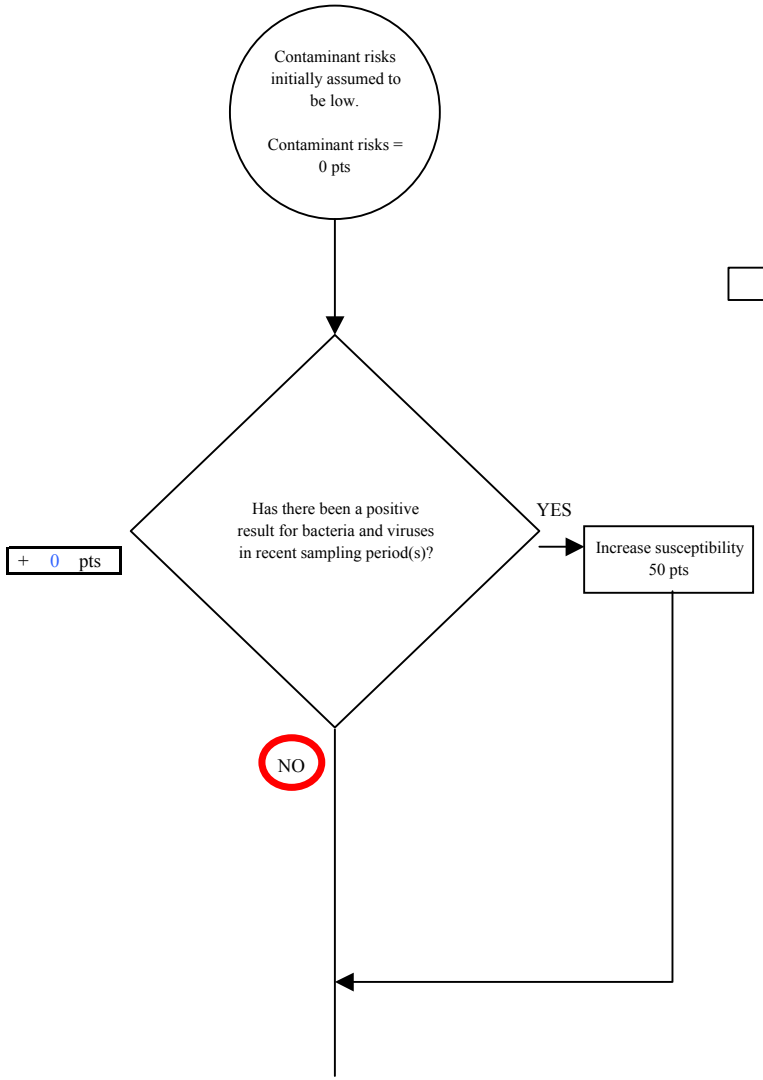
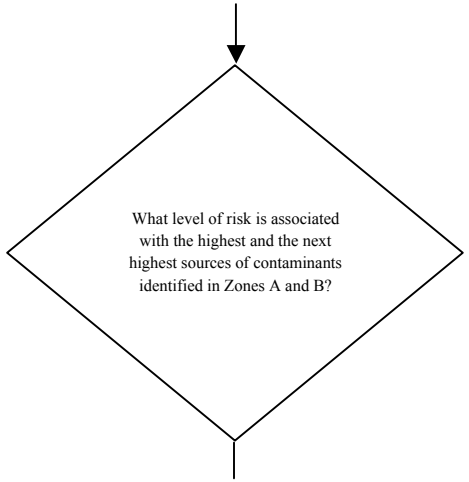


Chart 3. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Bacteria & Viruses





+ 30 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)	1	0	1
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 30

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 Alyeska Pump Station 12 (PWS No.296608.001) - Bacteria & Viruses

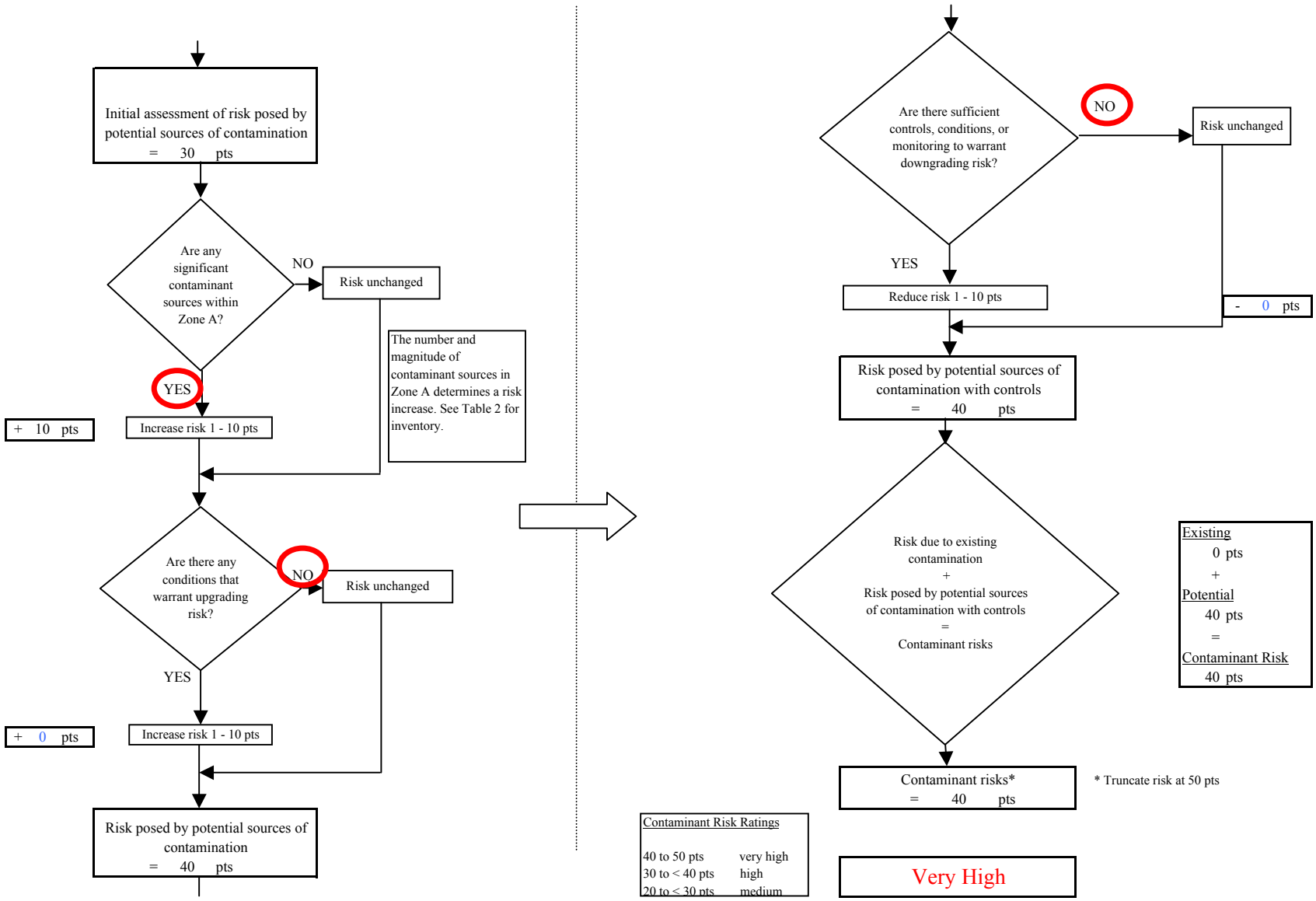


Chart 4. Vulnerability analysis for Alyeska Pump Station 12 (PWS No.296608.001) - Bacteria & Viruses

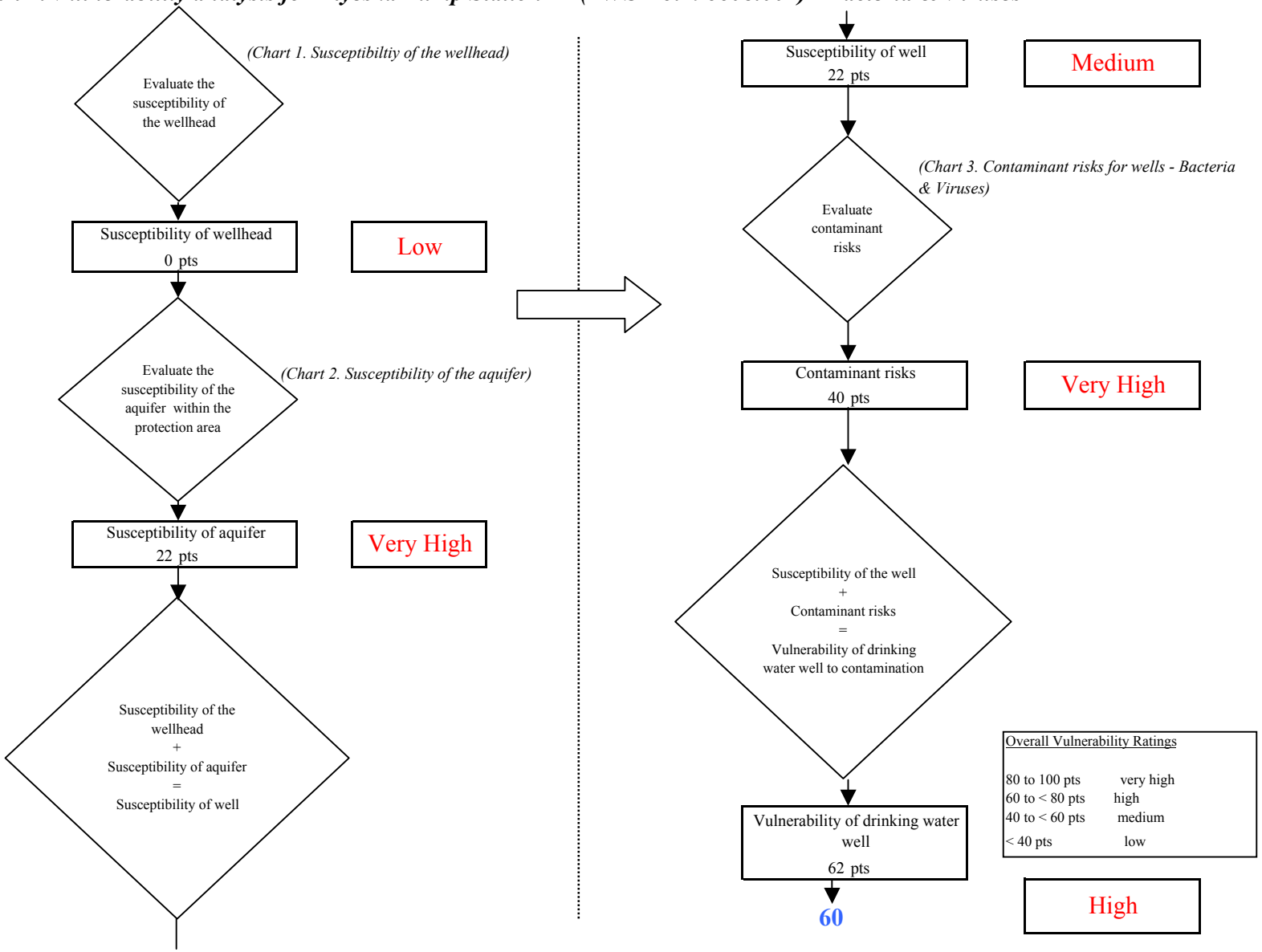


Chart 5. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Nitrates and Nitrites

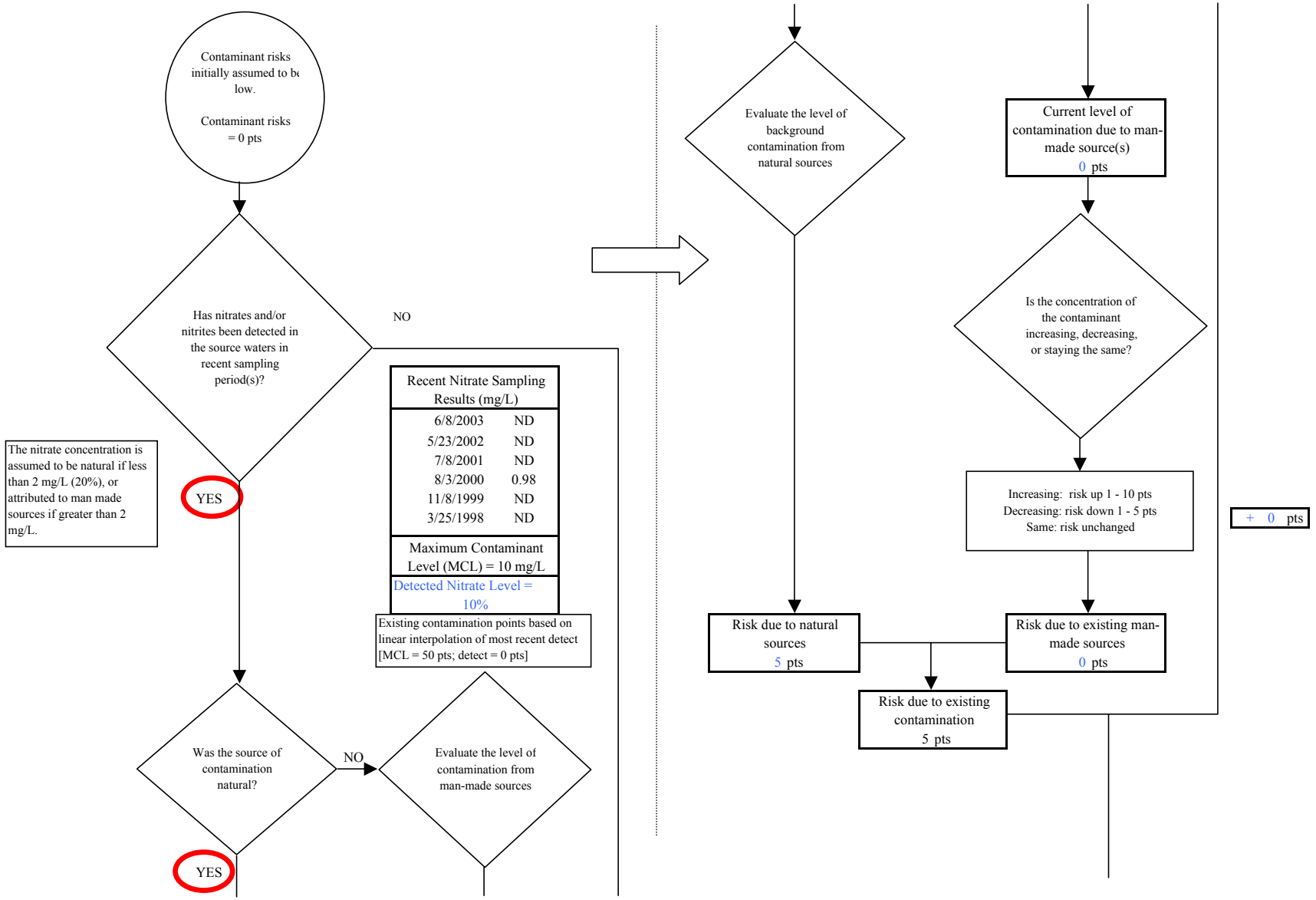


Chart 5. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Nitrates and Nitrites

+ 30 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)	1	0	1
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 30

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.

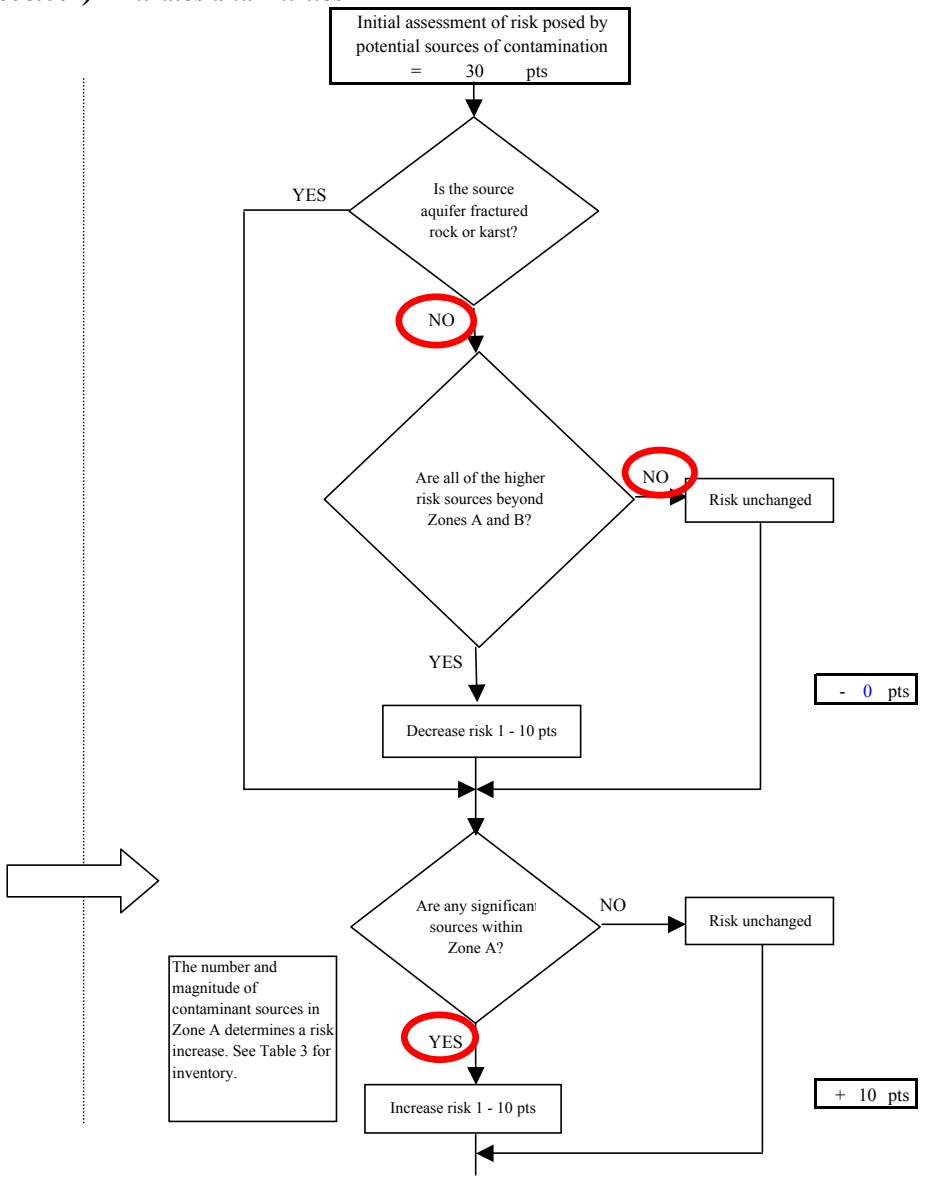


Chart 5. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Nitrates and Nitrites

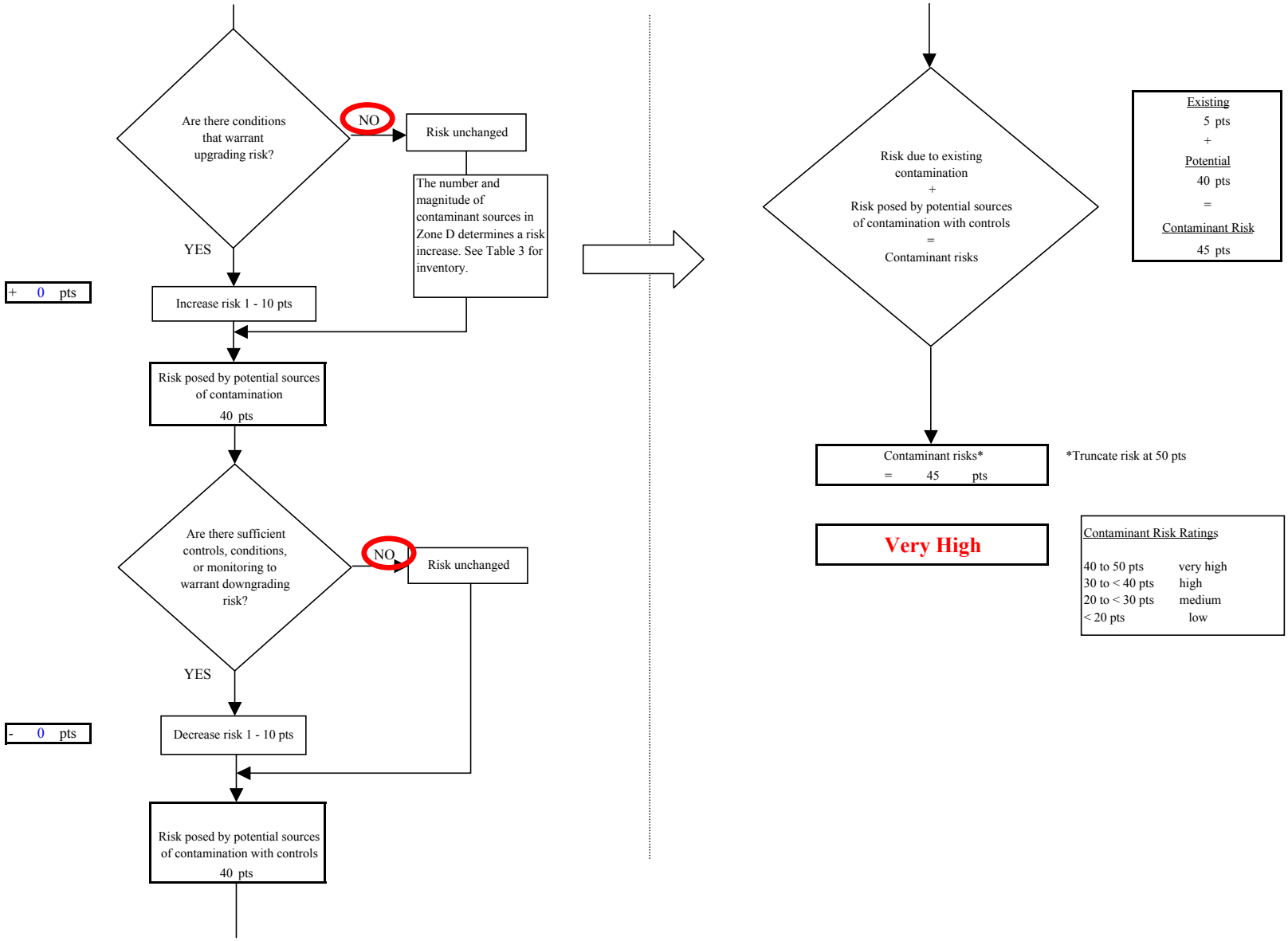


Chart 6. Vulnerability analysis for Alyeska Pump Station 12 (PWS No.296608.001) - Nitrates and Nitrites

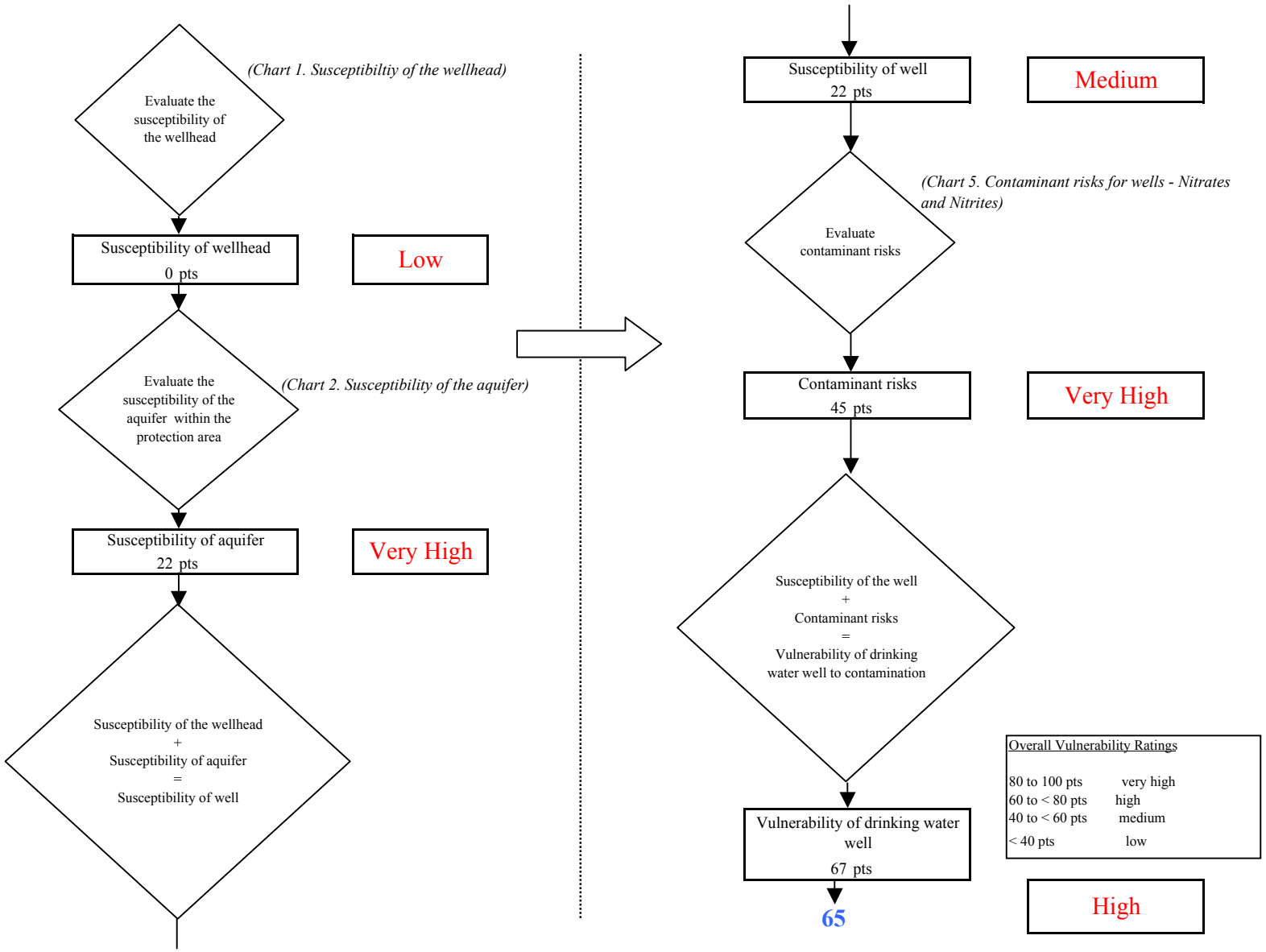


Chart 7. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Volatile Organic Chemicals

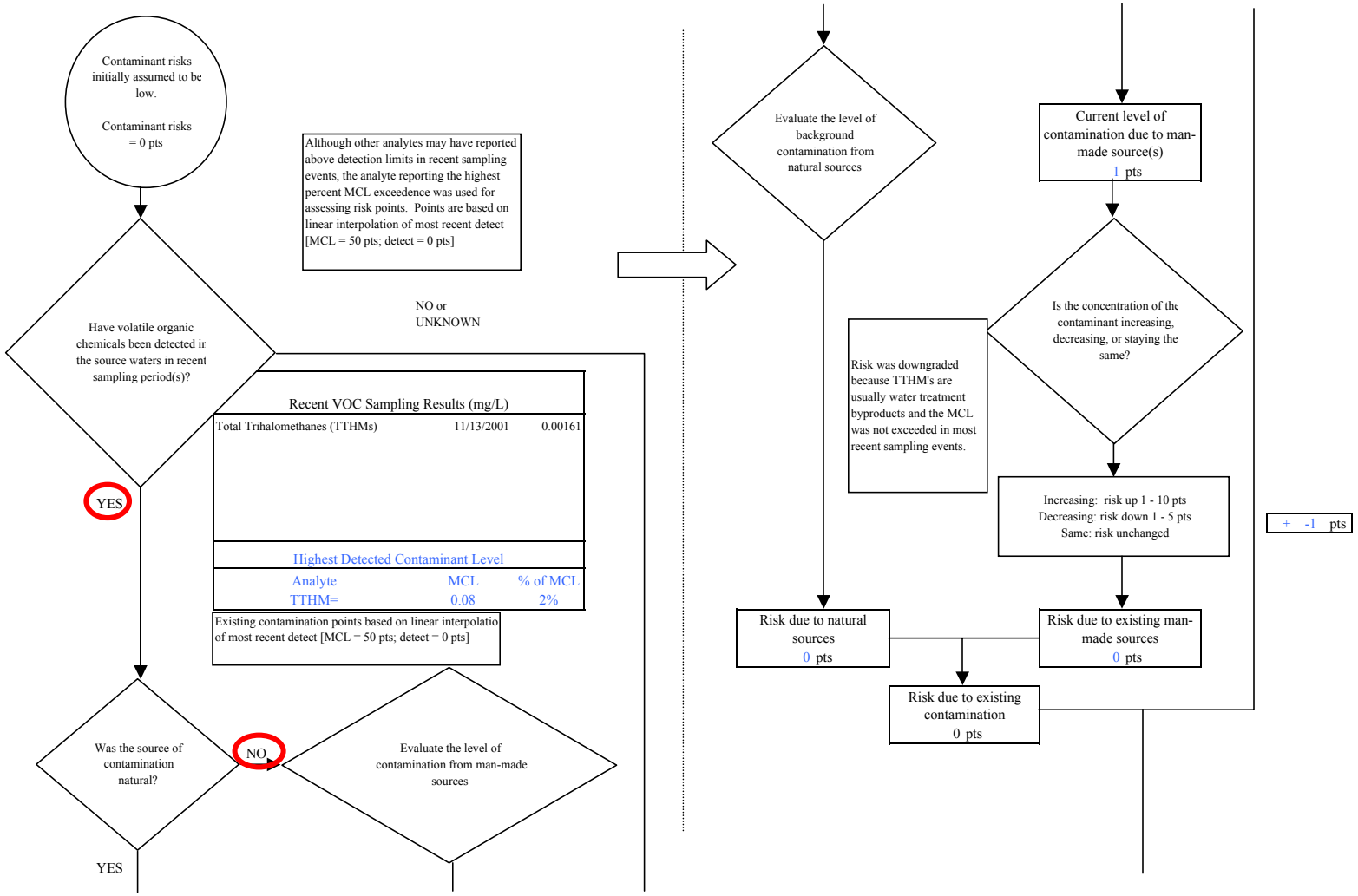


Chart 7. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Volatile Organic Chemicals

+ 40 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)	3	0	3
Medium(s)	3	0	3
Low(s)	5	0	5

	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 40

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CS 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 = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 10 pts

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

Chart 7. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Volatile Organic Chemicals

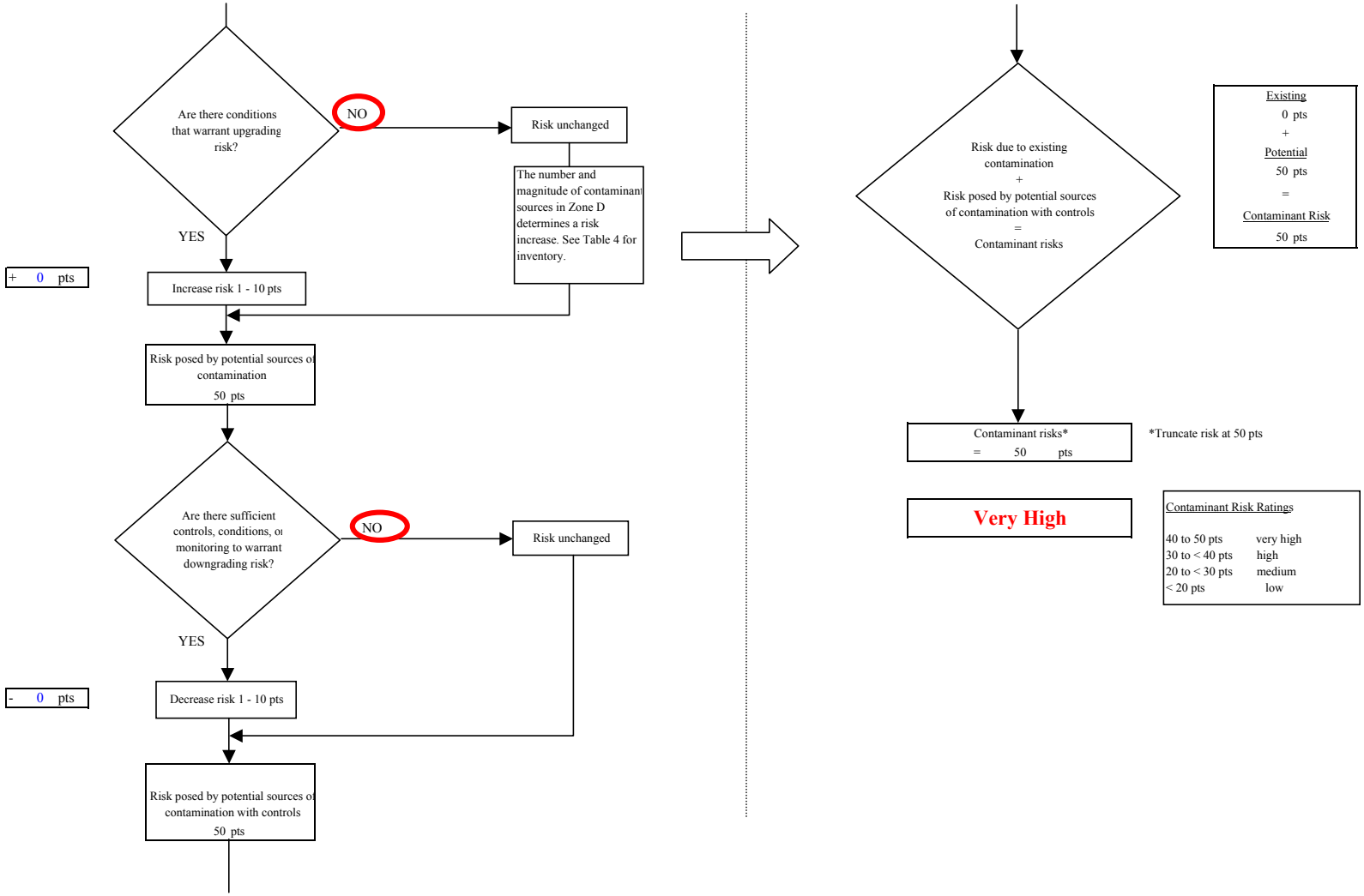


Chart 8. Vulnerability analysis for Alyeska Pump Station 12 (PWS No.296608.001) - Volatile Organic Chemicals

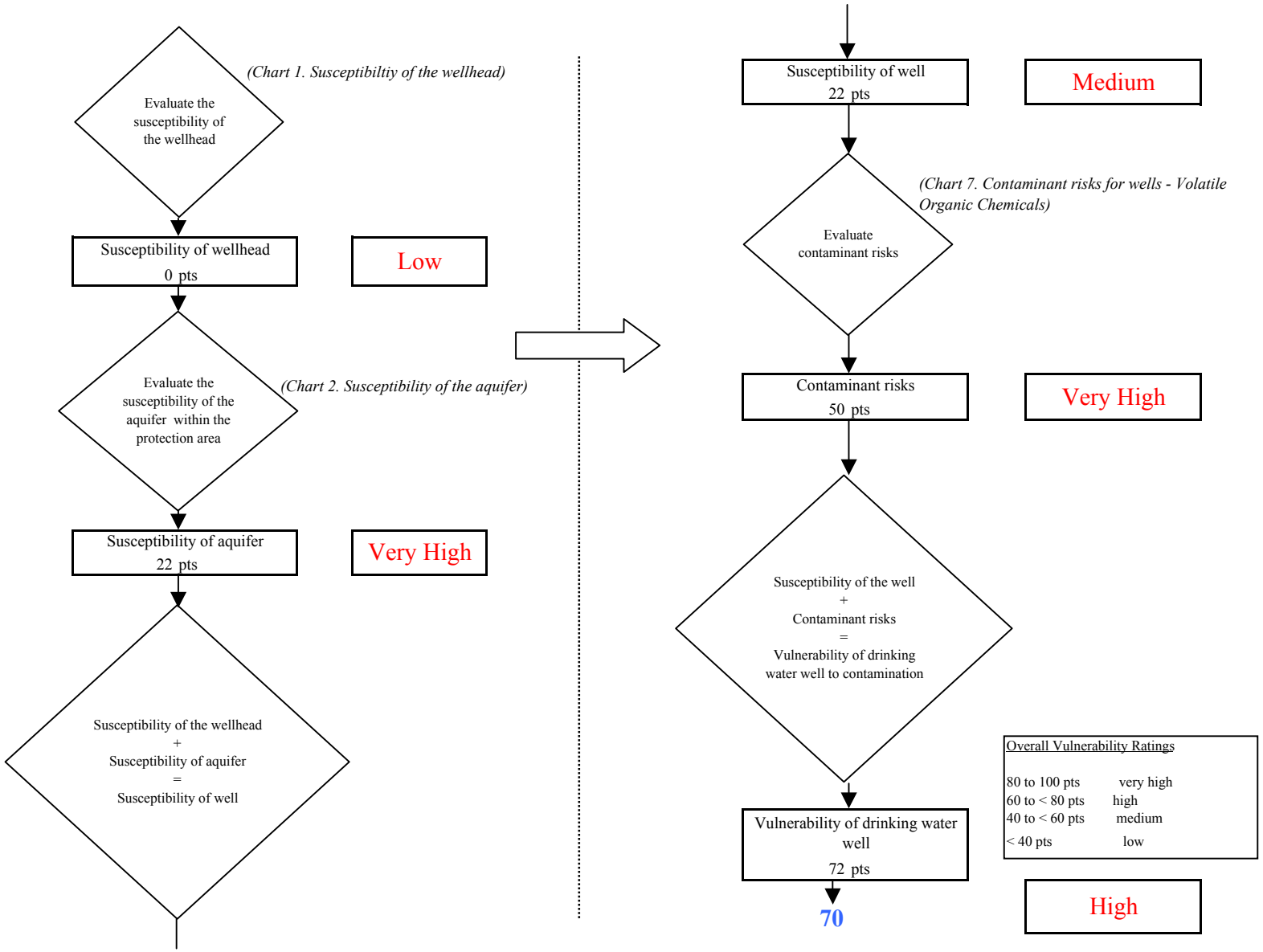


Chart 9. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

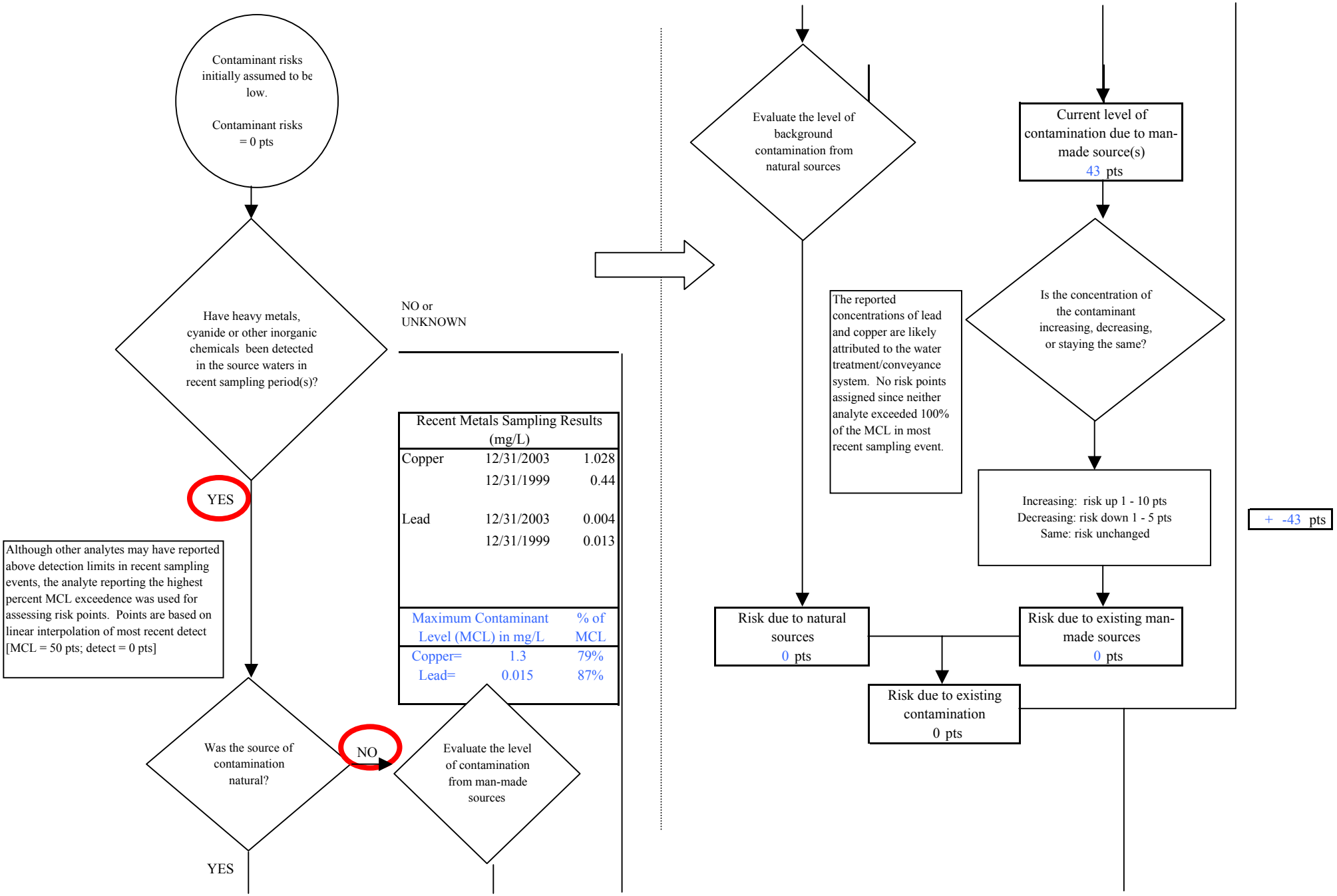


Chart 9. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 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)	2	0	2
Low(s)	8	0	8

	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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

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

YES

Increase risk 1 - 10 pts

+ 5 pts

Chart 9. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

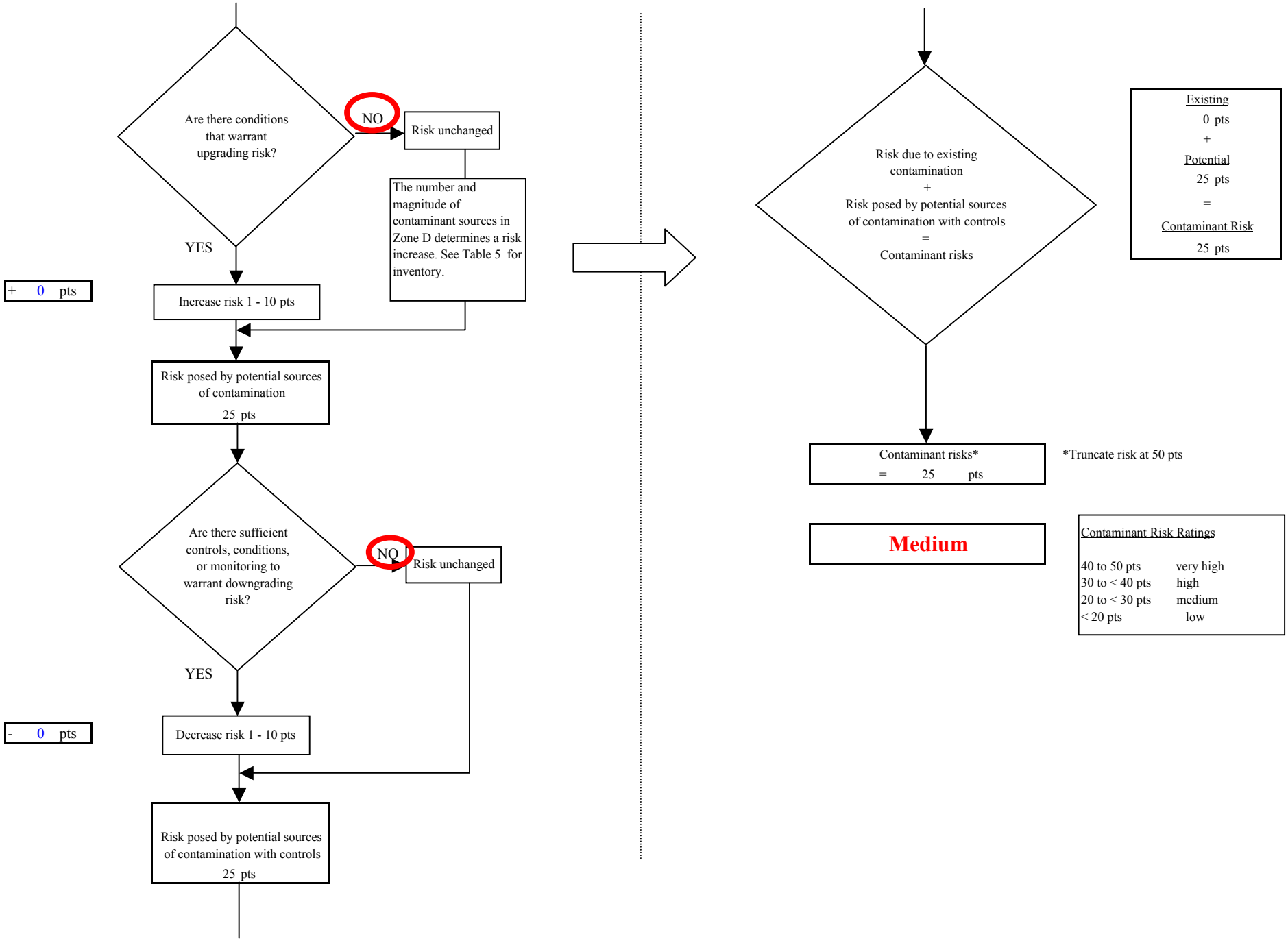


Chart 10. Vulnerability analysis for Alyeska Pump Station 12 (PWS No.296608.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

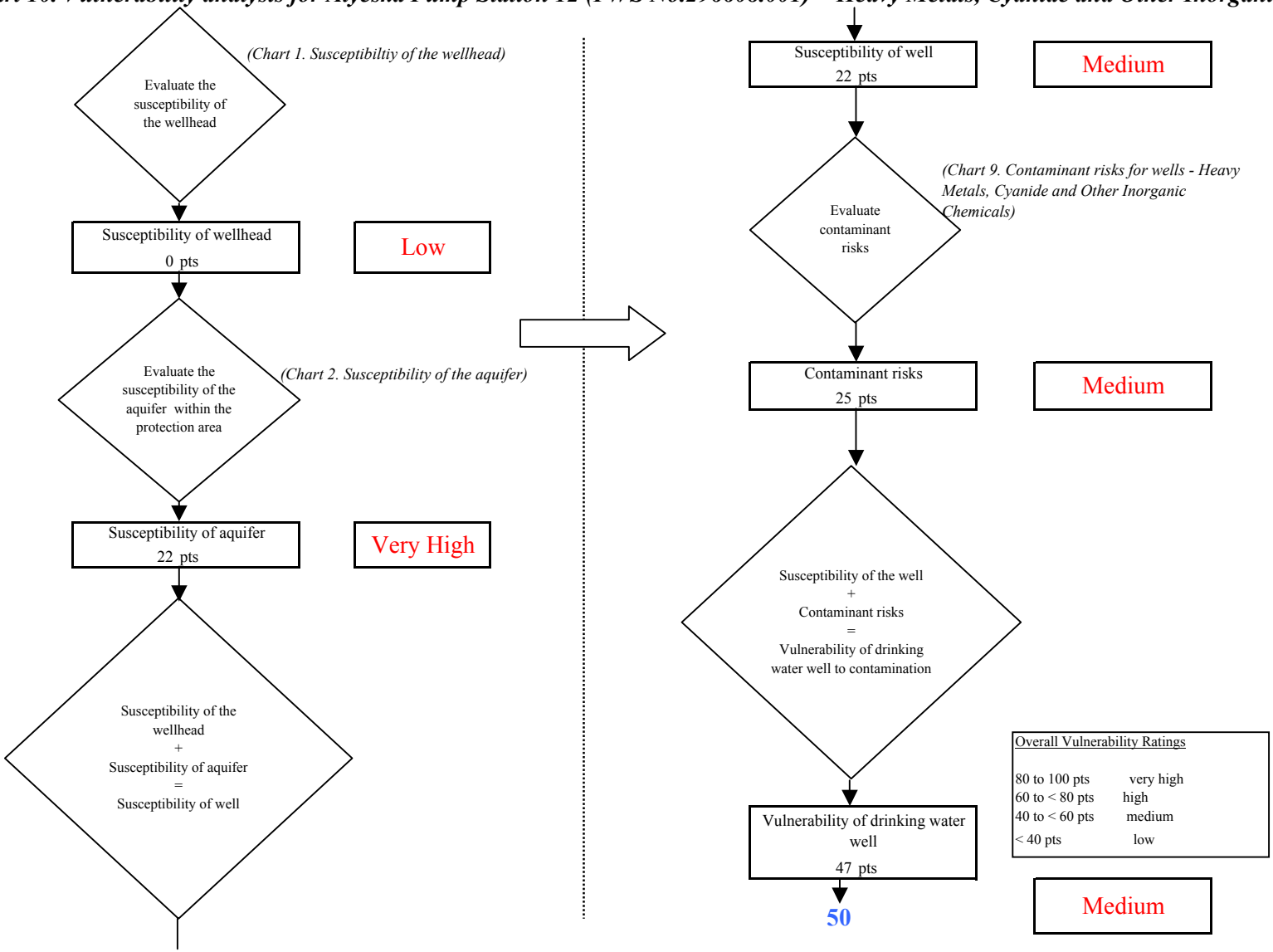


Chart 11. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Synthetic Organic Chemicals

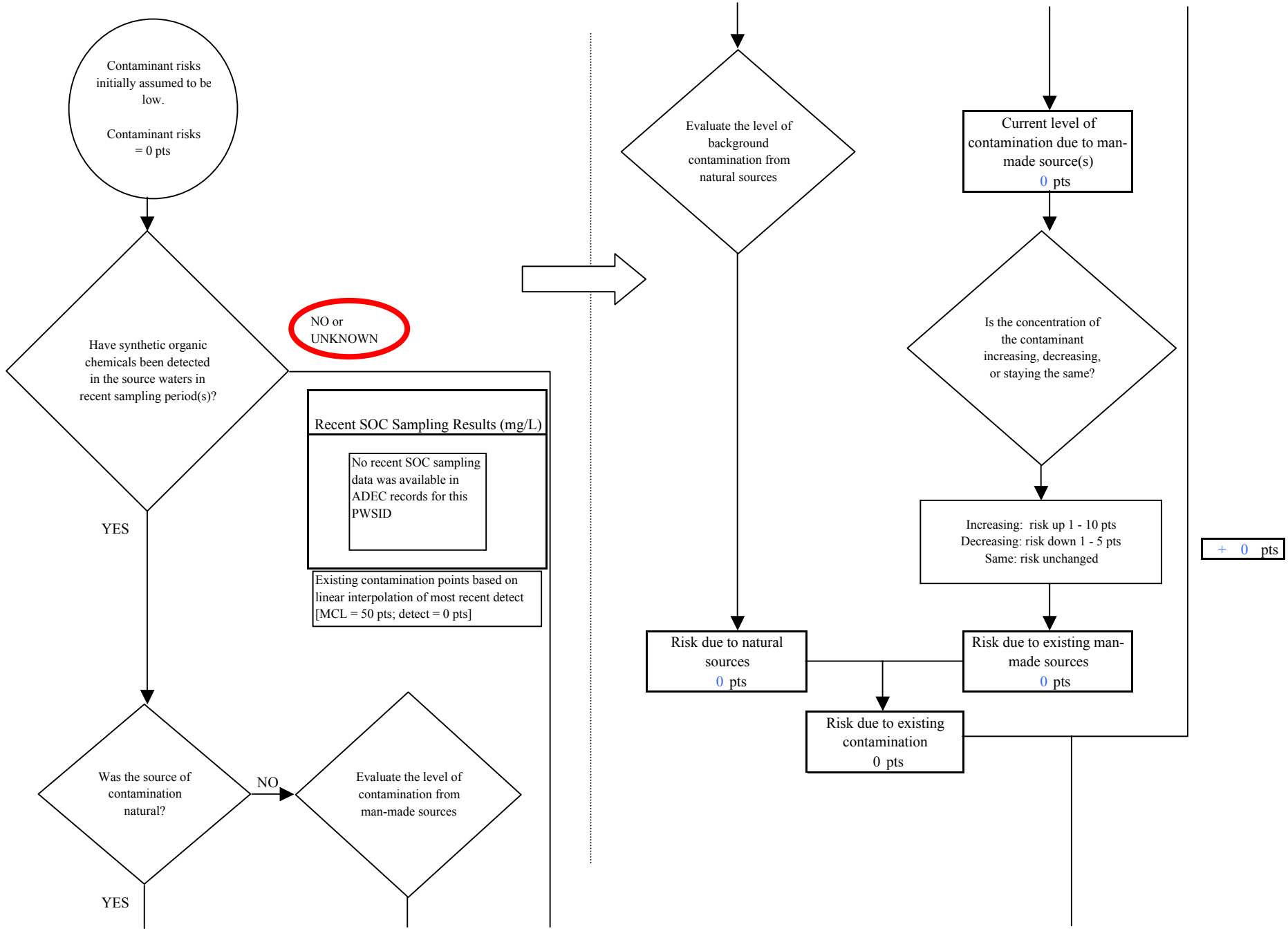
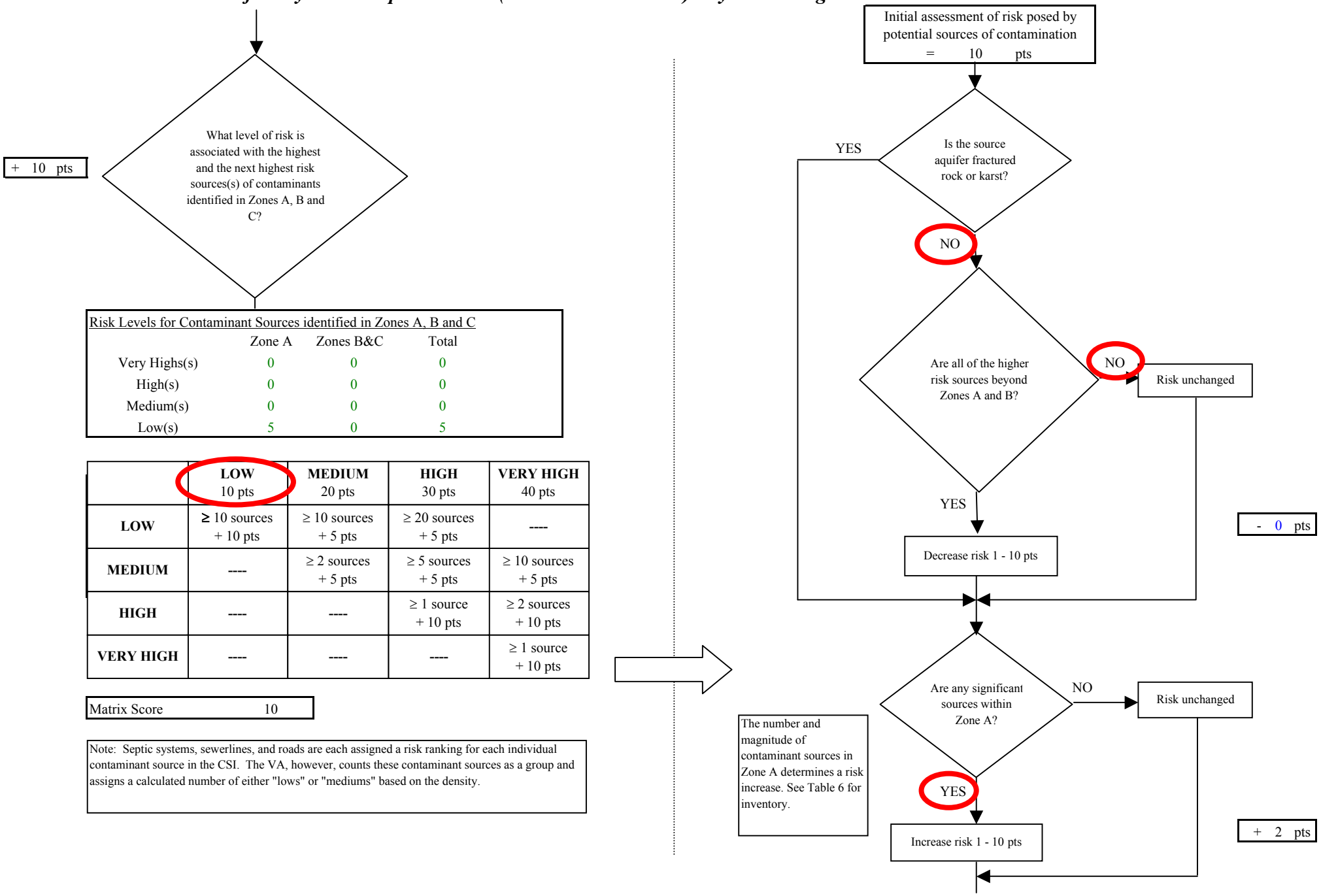


Chart 11. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Synthetic Organic Chemicals



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

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

	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 11. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Synthetic Organic Chemicals

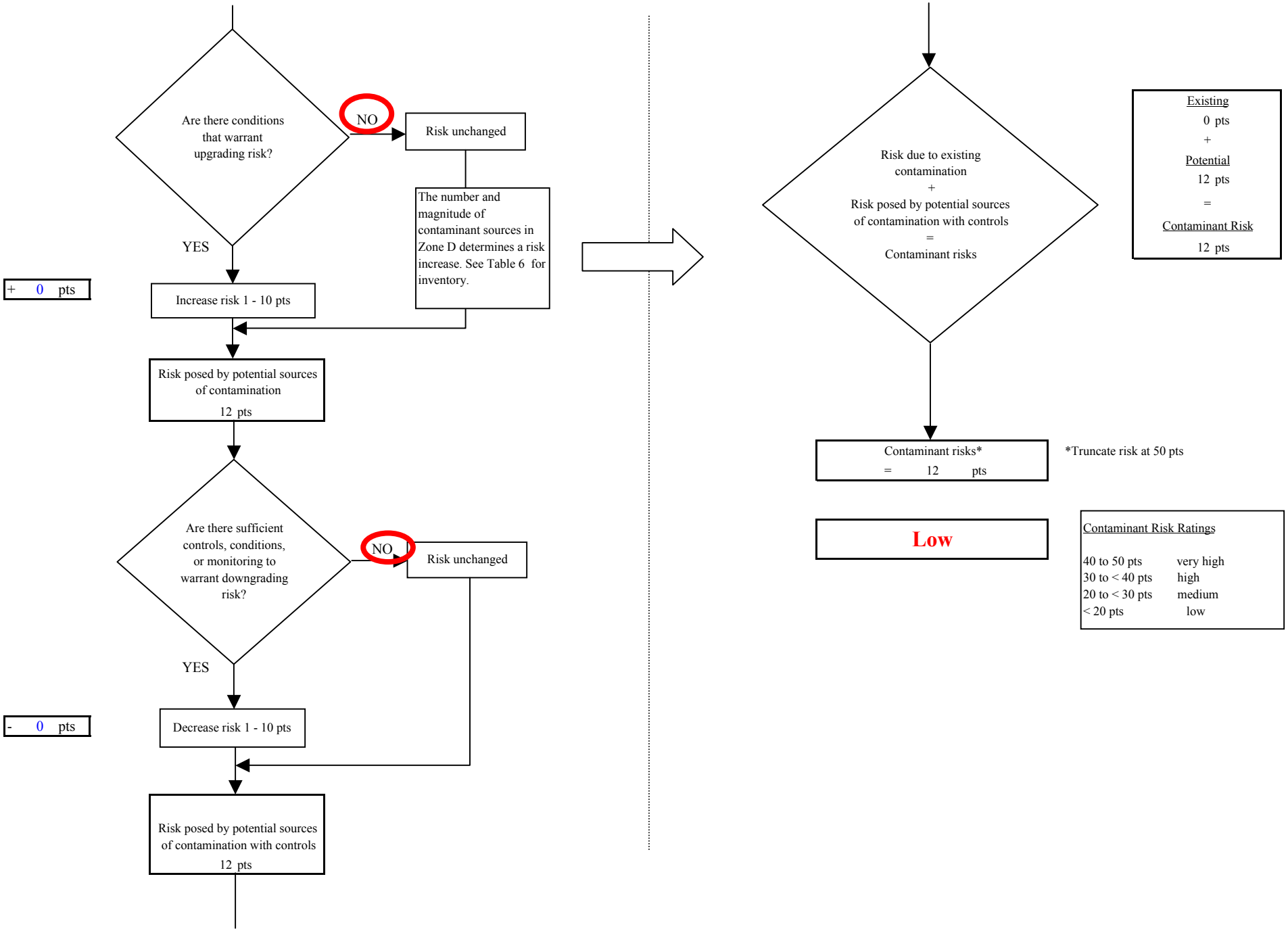


Chart 12. Vulnerability analysis for Alyeska Pump Station 12 (PWS No.296608.001) - Synthetic Organic Chemicals

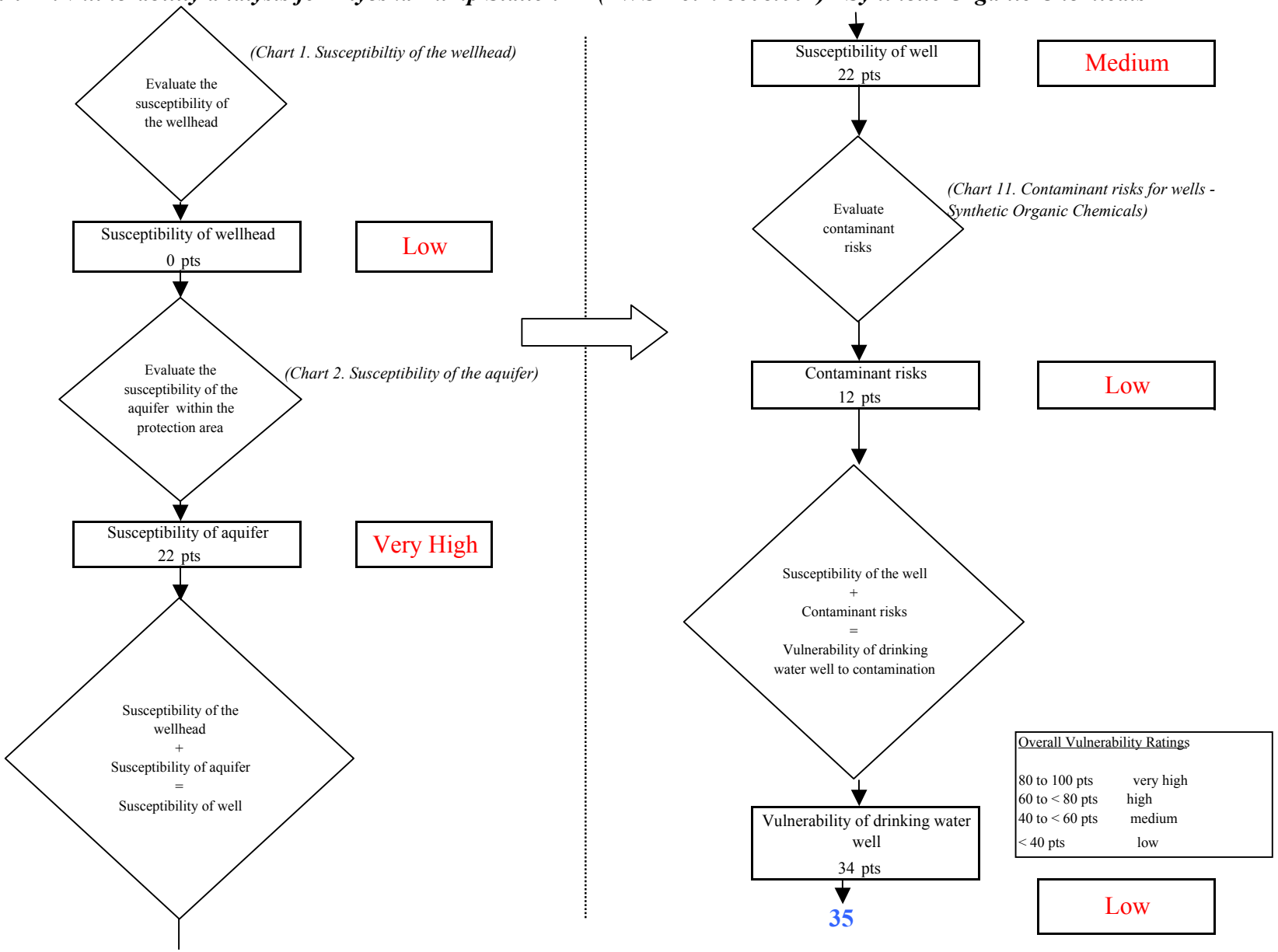


Chart 13. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Other Organic Chemicals

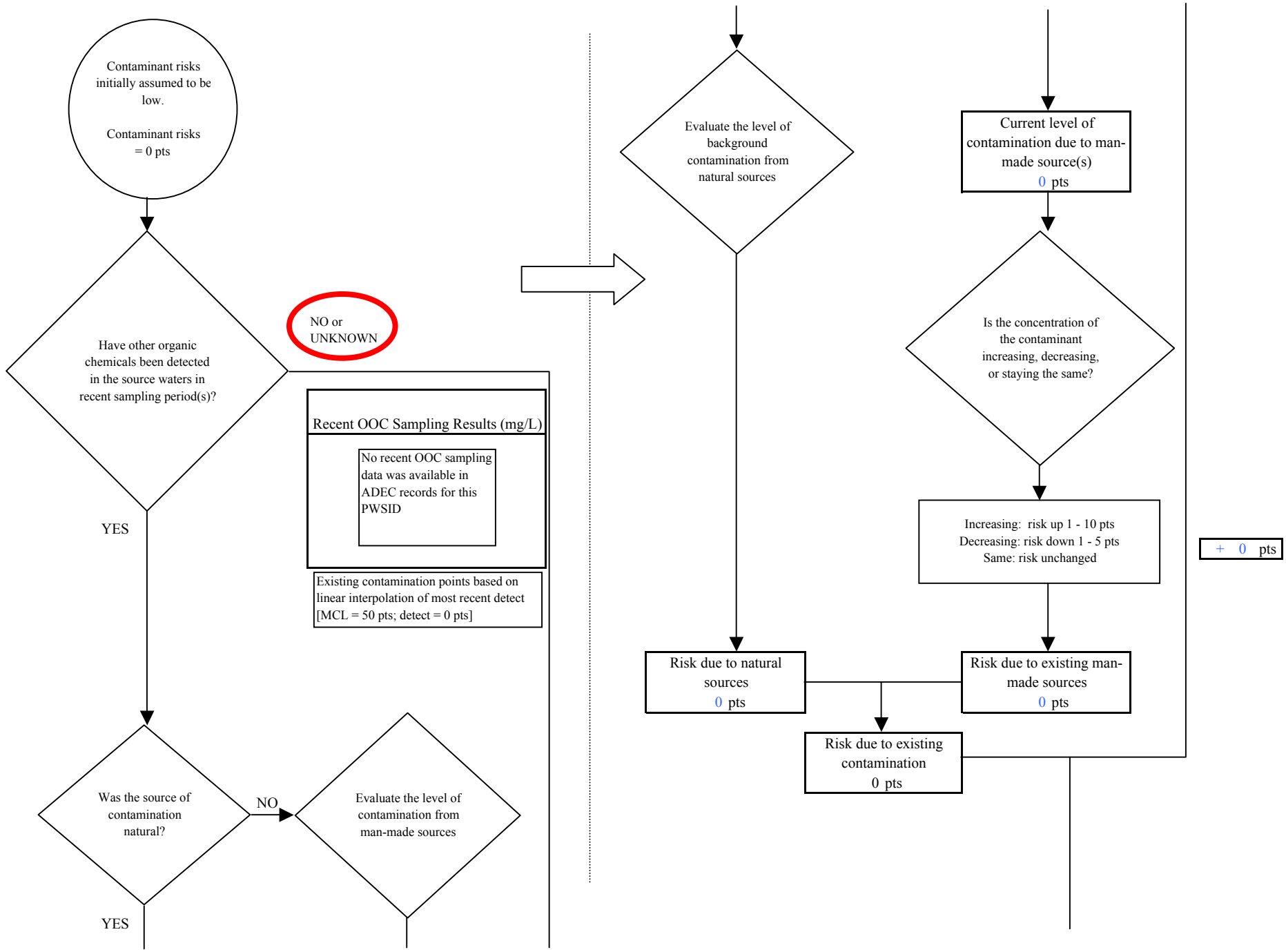
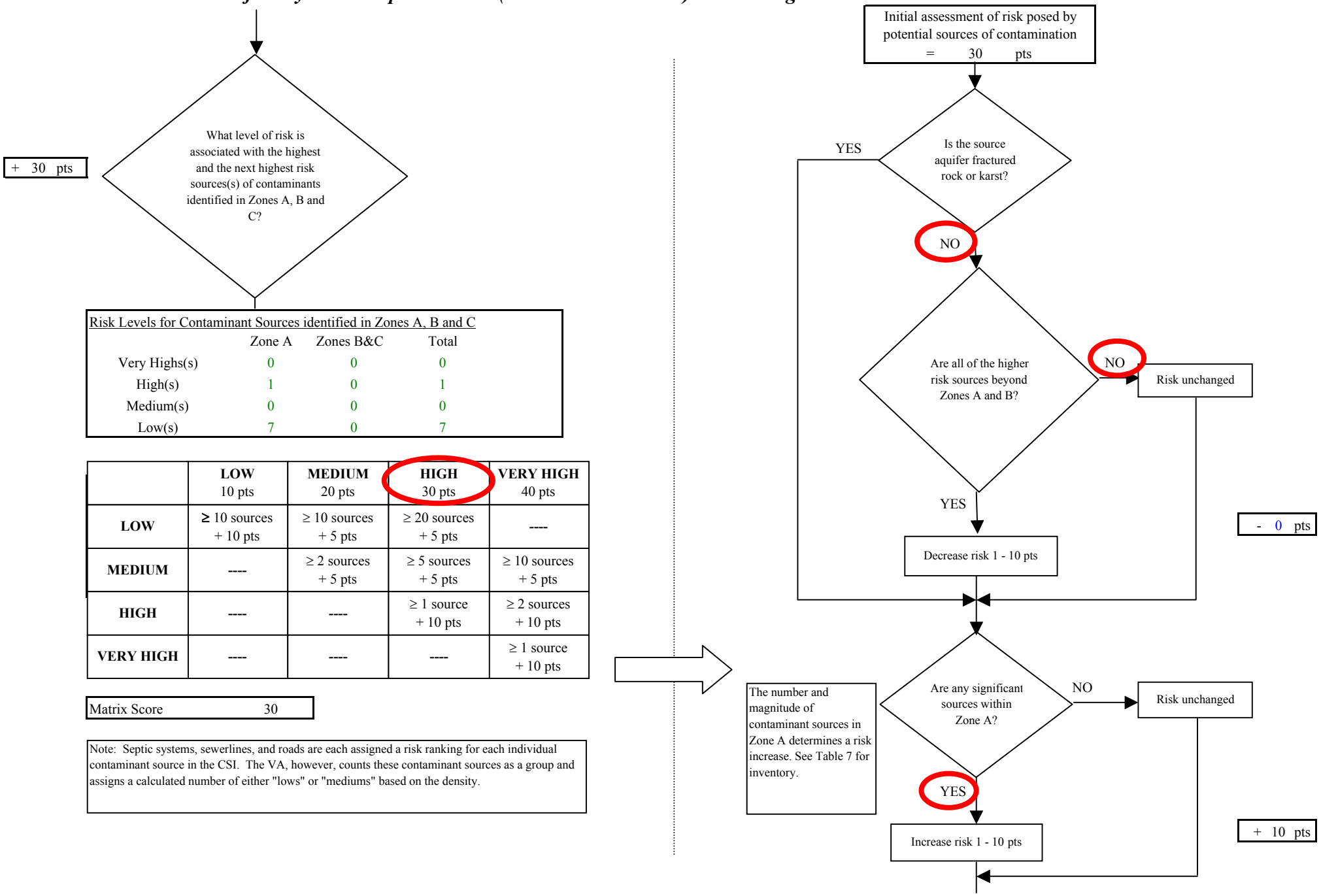


Chart 13. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Other Organic Chemicals



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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	7	0	7

	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 30

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 13. Contaminant risks for Alyeska Pump Station 12 (PWS No.296608.001) - Other Organic Chemicals

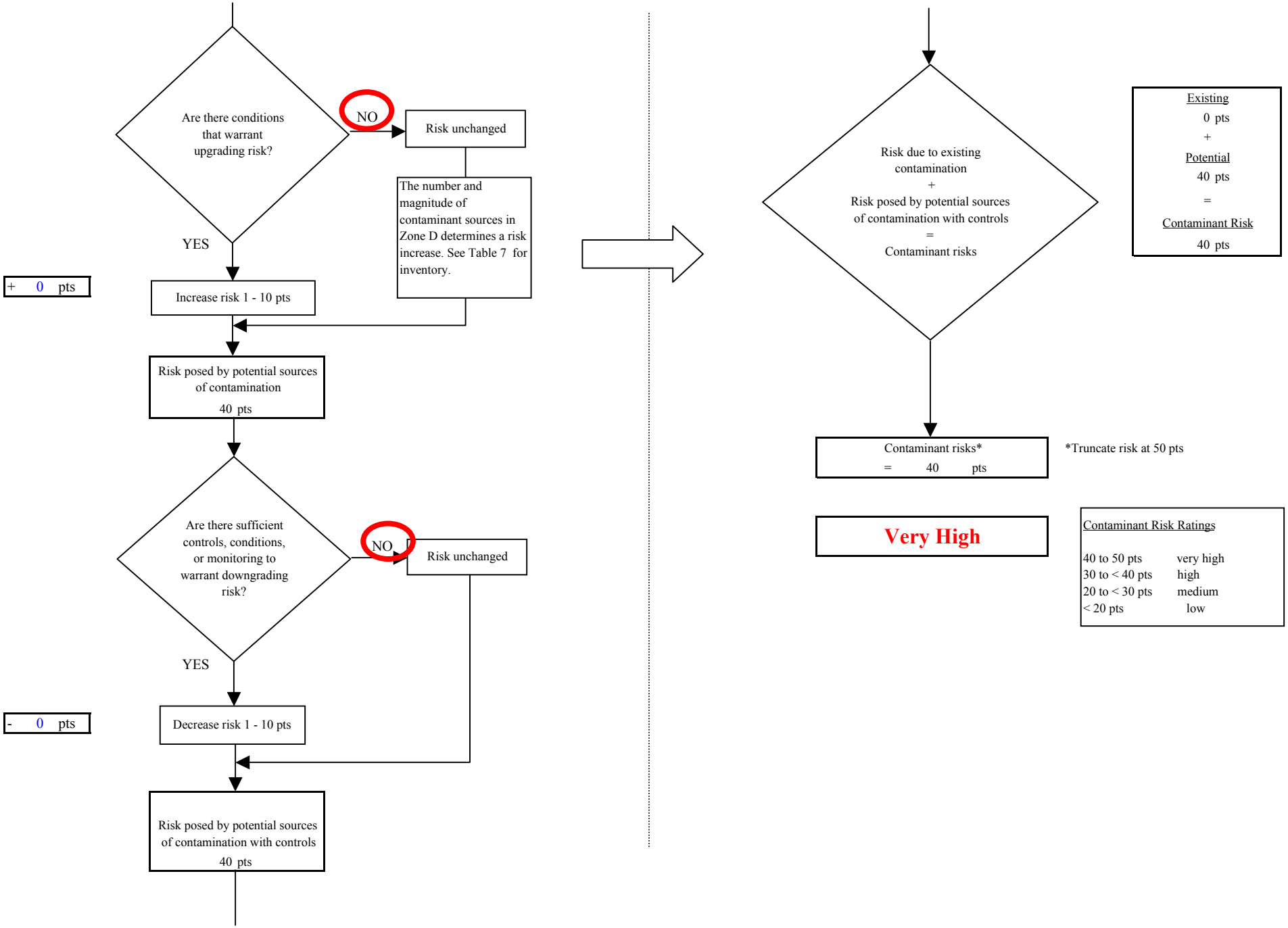


Chart 14. Vulnerability analysis for Alyeska Pump Station 12 (PWS No.296608.001) - Other Organic Chemicals