Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Lake and Peninsula School District, Port Heiden Elementary School Drinking Water System, Port Heiden, Alaska

PWSID # 260676.001

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DRINKING WATER PROTECTION PROGRAM REPORT 1460
Alaska Department of Environmental Conservation

Source Water Assessment for
Lake and Peninsula School District
Port Heiden Elementary School
Drinking Water System
Port Heiden, 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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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Lake and Peninsula School District - Port Heiden Elementary School (L&PSD Port Heiden) has two Public Water System (PWS) wells. This well (PWS No. 260676.001) has been used as a drinking water source since it was drilled; however the well completion date is unknown. This report contains information exclusively for PWS No. 260676.001.

The well is a Class A (community and non-transient/non-community) water system located at 1000 School Road in Port Heiden, Alaska. The 1998 sanitary survey indicates that there is no secondary storage. Records also indicate that the drinking water source is filtered through greensand but not treated for disinfection. This system operates seasonally and serves approximately 3 residents and 30 non-residents through 1 service connection. 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: septic systems, fuel storage tanks and ADEC recognized contaminated sites. A detailed inventory of potential or existing contamination sources can be found in Appendix B, Table 1. 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 **Low** for and synthetic organic chemicals and other organic chemicals; a vulnerability rating of **Medium** for bacteria and viruses, as well as nitrates and nitrites and a vulnerability rating of **High** for volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals.

PUBLIC DRINKING WATER SYSTEM

The L&PSD Port Heiden Elementary School well is a Class A (community/non-transient/non-community) public water system. The system is located 1000 School Road in Port Heiden, Alaska. (Sec. 27, T037S, R059W, Seward Meridian; see Map A of Appendix A). Port Heiden is located at the mouth of the Meshik River on the north side of the Alaska Peninsula, approximately 424 miles southwest of Anchorage. The community has a population of 87 (ADCED, 2003). Snowfall averages 58 inches per year. Temperatures typically range between 25 in January to 50°F in July.

Households in Port Heiden have individual wells and septic systems. Almost all homes are fully plumbed, and refuse is collected by the City and is transported to the landfill 6.5 miles northeast of town. The landfill is also operated by the City (ADCED, 2003). Port Heiden also operates the electric utility. Power-generating facilities are fueled by diesel (ADCED, 2003).

According to information supplied by ADEC for the L&PSD Port Heiden PWS, the depth of the primary water well is 220 feet below the ground surface. Based on available well construction details, the well is screened from 200 feet to 220 feet. The well is completed in a confined aquifer and is not located within a floodplain.

Information acquired from a January 1998 sanitary survey for the public water system indicated that the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. The sanitary survey indicates that the well is not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

Port Heiden is an embayment of Bristol Bay on the Alaska Peninsula. The dominant physical feature near Port Heiden is Aniakchak Crater, which is about

30 km to the east. The crater is an active volcanic center that last erupted in 1931 (Hogan 1995).

Major geologic units include volcanic deposits, till, estuarine deposits, swamp deposits, alluvial deposits, outwash deposits, and marine terrace deposits. Volcanic deposits consist of pumice, ash, debris-flow deposits, and ash-flow tuff. The tuff is unsorted, poorly stratified, and composed of pumice and scoria in a matrix of fine to coarse ash and lithic fragments. The ash-fall tuff is moderately well sorted, well stratified, and consists of fine- to medium grained dacitic ash. Numerous arcuate moraine ridges are present in the area. Moraines consist of weathered, unsorted, and nonstratified till and have an irregular knob and kettle surface topography. Estuarine deposits found along the Bering Sea coast consist of dark brown to black organic silt and clay. Swamp deposits are adjacent to the estuarine deposits and form by the accumulation of sedge and sphagnum peat. A large alluvial fan, consisting mostly of well-sorted pumice, extends from the base of Aniakchak Crater toward the coast. Outwash deposits consist of moderately well sorted and stratified sand, silt, and gravel that form a flat to gently sloping plain. Marine terrace deposits are typically about 15 meters above mean high tide. These deposits consist of stratified and well-sorted sand and gravel that form level plains truncated by steep wave-cut scarps. Alluvial deposits are found adjacent to Reindeer Creek (Hogan 1995).

Soils in the area are generally poorly developed because of the frequent deposition of volcanic ash. Where soils are developed, they are dark brown to reddish brown and typically have buried surface horizons. The soil particles are mostly sand or gravel sized. The Port Heiden area is generally free of permafrost (Hogan 1995).

DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what the most likely pathways for surface contamination to reach the groundwater are. 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 L&PSD Port Heiden Elementary School 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 L&PSD Port Heiden 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 L&PSD Port Heiden DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

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

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

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

RANKING OF CONTAMINANT RISKS

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

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

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well. Tables 2 through 7 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF THE DRINKING WATER SYSTEM

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

- Natural susceptibility, and
- Contaminant risks.

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

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

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

+

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

=

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

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

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

The L&PSD Port Heiden water well is completed in a confined aquifer. Unconfined aquifers are more 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	5	Low
Susceptibility of the Aquifer	22	Very High
Natural Susceptibility	27	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	25	Medium
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	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	50	Medium
Volatile Organic Chemicals	75	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	75	High
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 septic systems in Zone A. Other contaminant sources are located in the protection area (see Table 2 – Appendix B).

Coliform (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 coliform 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).

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 **Medium**. The risk to this source of public drinking water is primarily attributed to the presence of septic systems located in Zone A. Other contaminant sources are located in the protection area (see Table 3 – Appendix B).

All recent sampling data for Nitrates and Nitrites was below detection levels for L&PSD Port Heiden (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of multiple ADEC recognized contaminates sites in Zone A. Other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

All recent sampling data for VOCs was below detection levels for L&PSD Port Heiden (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 **High**.

Heavy Metals, Cyanide and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Very High**. The risk is primarily attributed to the presence of high levels of copper in recent sampling events as well as multiple ADEC recognized contaminated sites located in Zone A (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, high levels copper have been detected. The analyte has exceeded the 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 is not likely to be representative of source water conditions. It is likely attributed to either the water treatment process or water distribution network; however, risk points were assigned based on the exceedance of the MCL.

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 **High**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Low**. The risk is primarily attributed to the presence of multiple ADEC recognized contaminated sites located in Zone A. (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for L&PSD Port Heiden (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 multiple ADEC recognized contaminated sites located in Zone A. 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 L&PSD Port Heiden (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 L&PSD Port Heiden and the community of Port

Heiden 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

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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)

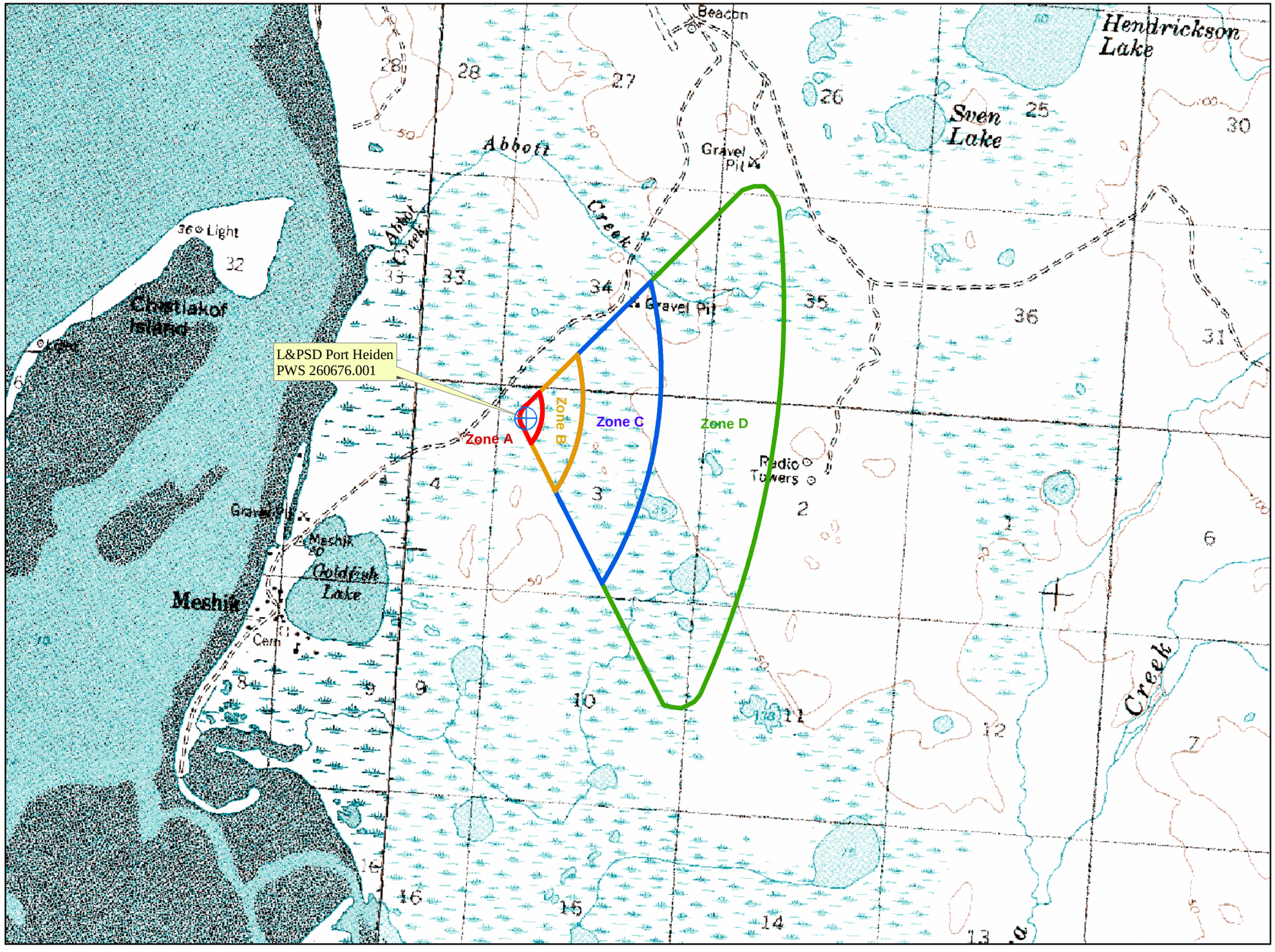
APPENDIX C

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

APPENDIX D

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

Public Water Well System for PWS #260676.001 L&PSD Port Heiden



LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

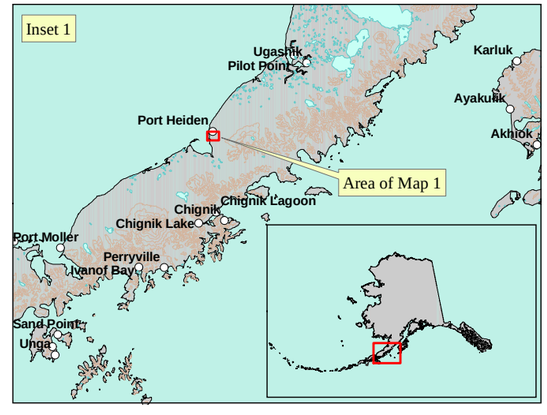
Transportation

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

Groundwater Protection Zones

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

Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)
All other data:
United States Geological Survey (USGS)
Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC
URS Corporation does not guarantee the accuracy or validity of the data provided.



L&PSD Port Heiden
PWS 260676.001
Appendix A Map A

Table 1

Contaminant Source Inventory for

L&PSD Port Heiden

PWSID260676.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	C	Assume 15 or less individual septic systems in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	Gift Shop
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	ACS
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	ARCS television
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	C	PORT HEIDEN SCHOOL (MESHIK)
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	A	C	Port Heiden RRS SS04
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	A	C	Port Heiden RRS WP02
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-04	A	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-05	A	C	Port Heiden RRS SS04
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1 - 20 roads in Zone A

Table 2

Contaminant Source Inventory and Risk Ranking for L&PSD Port Heiden Sources of Bacteria and Viruses

PWSID 260676.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
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 L&PSD Port Heiden Sources of Nitrates/Nitrites

PWSID 260676.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
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 L&PSD Port Heiden
Sources of Volatile Organic Chemicals

PWSID 260676.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Gift Shop
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	ACS
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	ARCS television
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	PORT HEIDEN SCHOOL (MESHIK)
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	High	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-02	A	High	C	Port Heiden RRS SS04
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-03	A	High	C	Port Heiden RRS WP02
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-04	A	High	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-05	A	High	C	Port Heiden RRS SS04
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A

Table 5

Contaminant Source Inventory and Risk Ranking for L&PSD Port Heiden

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 260676.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Gift Shop
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	ACS
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	ARCS television
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	PORT HEIDEN SCHOOL (MESHIK)
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	Low	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-02	A	Low	C	Port Heiden RRS SS04
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-03	A	Low	C	Port Heiden RRS WP02
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-04	A	Low	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-05	A	Low	C	Port Heiden RRS SS04
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A

Table 6

Contaminant Source Inventory and Risk Ranking for L&PSD Port Heiden
Sources of Synthetic Organic Chemicals

PWSID 260676.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	Low	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-02	A	Low	C	Port Heiden RRS SS04
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-03	A	Low	C	Port Heiden RRS WP02
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-04	A	Low	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-05	A	Low	C	Port Heiden RRS SS04

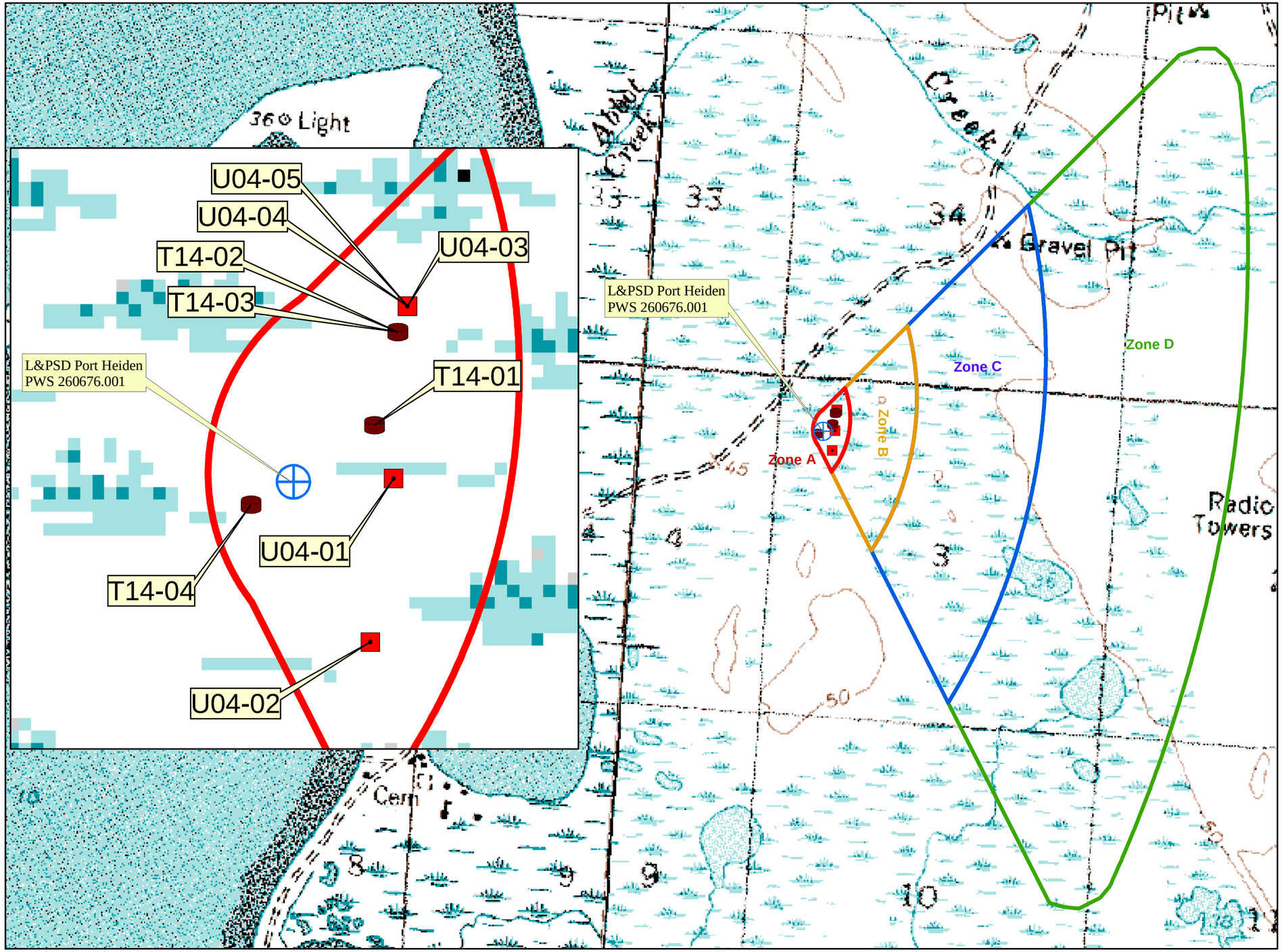
Table 7

Contaminant Source Inventory and Risk Ranking for L&PSD Port Heiden
Sources of Other Organic Chemicals

PWSID 260676.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	Low	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-02	A	Low	C	Port Heiden RRS SS04
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-03	A	Low	C	Port Heiden RRS WP02
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-04	A	Low	C	Port Heiden RRS WP03
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-05	A	Low	C	Port Heiden RRS SS04
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A

Public Water Well System for PWS #260676.001 L&PSD Port Heiden



LEGEND

Public Water System Well

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)

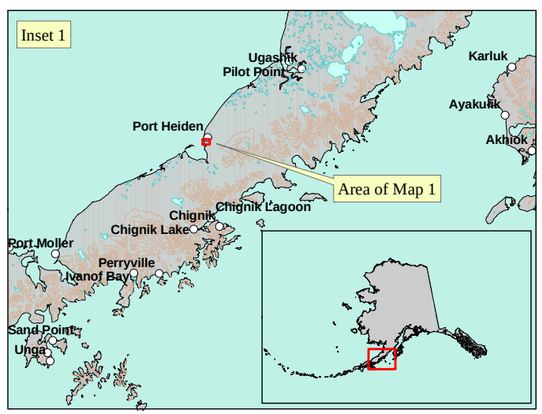
Groundwater Protection Zones

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

Existing or Potential Contaminant Sources

- Tanks, heating oil, non-residential, aboveground (T14)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)

Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)
All other data:
United States Geological Survey (USGS)
Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC
URS Corporation does not guarantee the accuracy or validity of the data provided.



0 0.15 0.3 0.6 0.9 1.2 Miles

L&PSD Port Heiden
PWS 260676.001
Appendix C Map C

Chart 1. Susceptibility of the wellhead - L&PSD Port Heiden (PWS No. 260676.001)

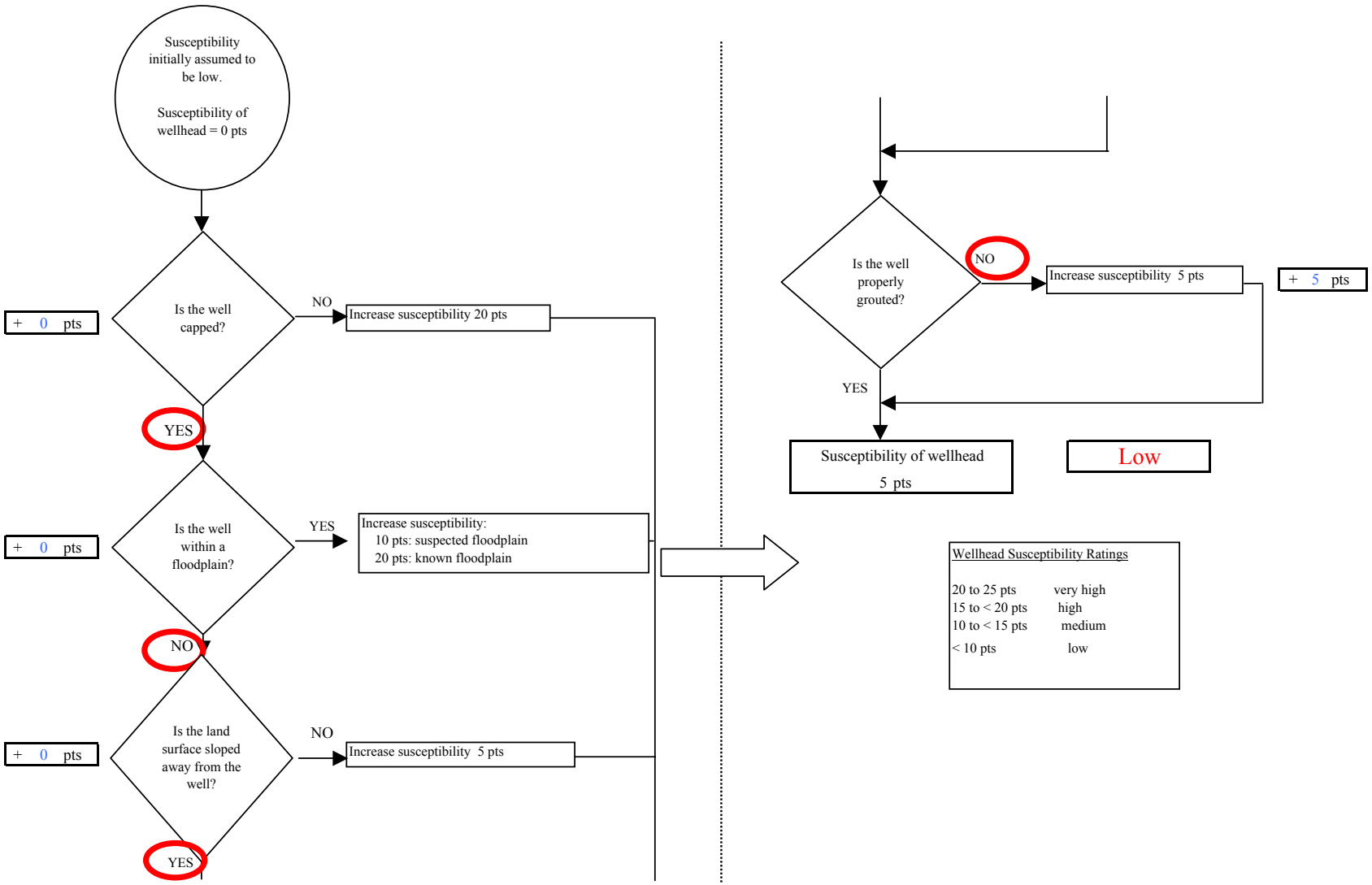


Chart 2. Susceptibility of the aquifer L&PSD Port Heiden (PWS No. 260676.001)

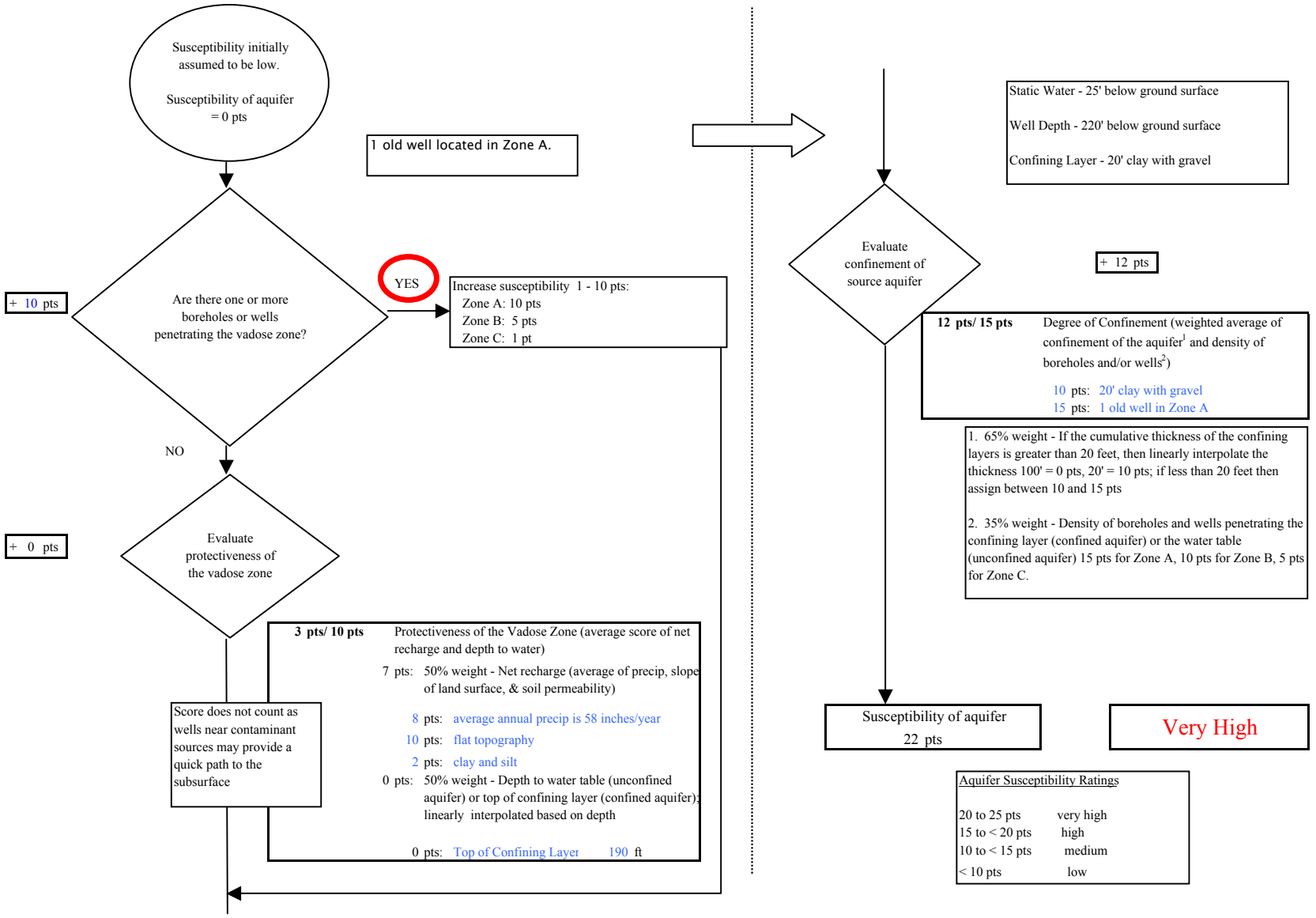
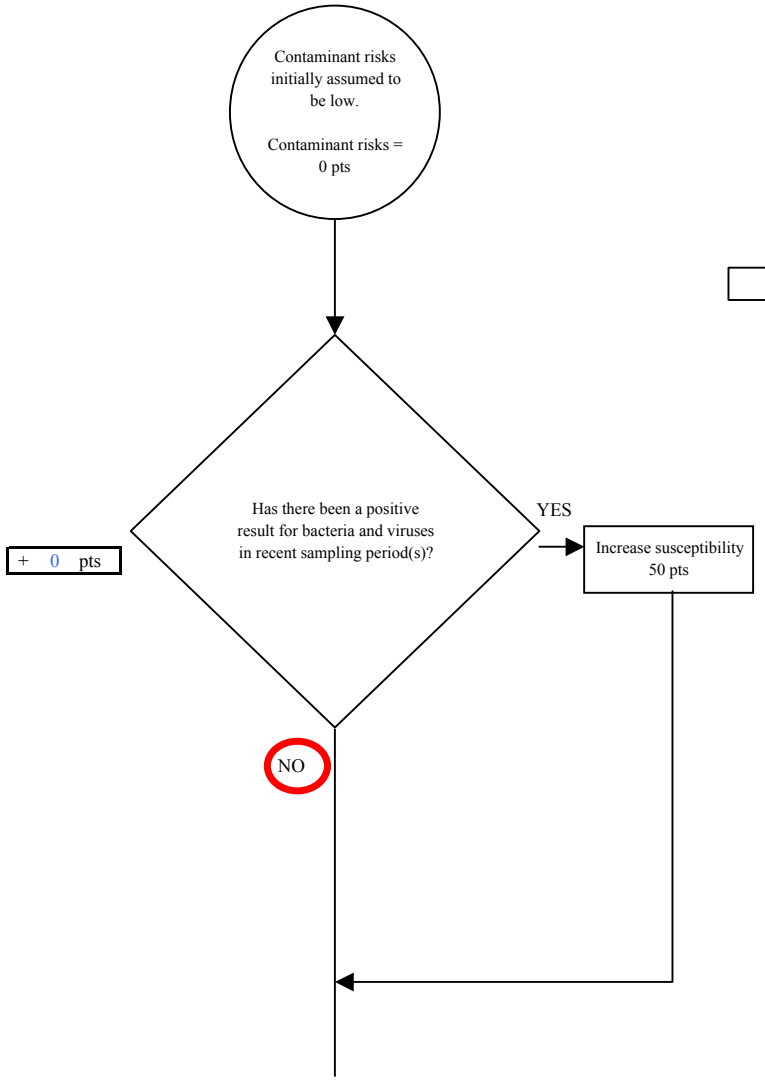
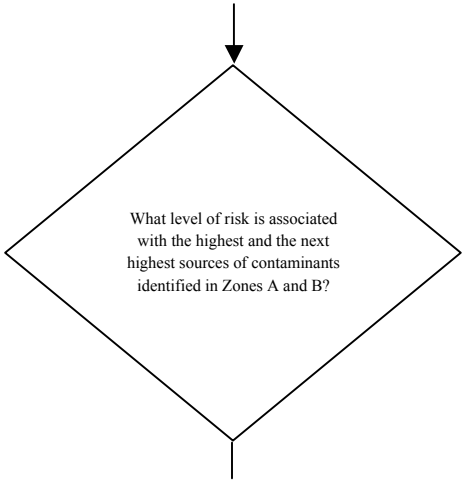


Chart 3. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Bacteria & Viruses





+ 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)	0	0	0
Low(s)	15	0	15

	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 L&PSD Port Heiden (PWS No. 260676.001) - Bacteria & Viruses

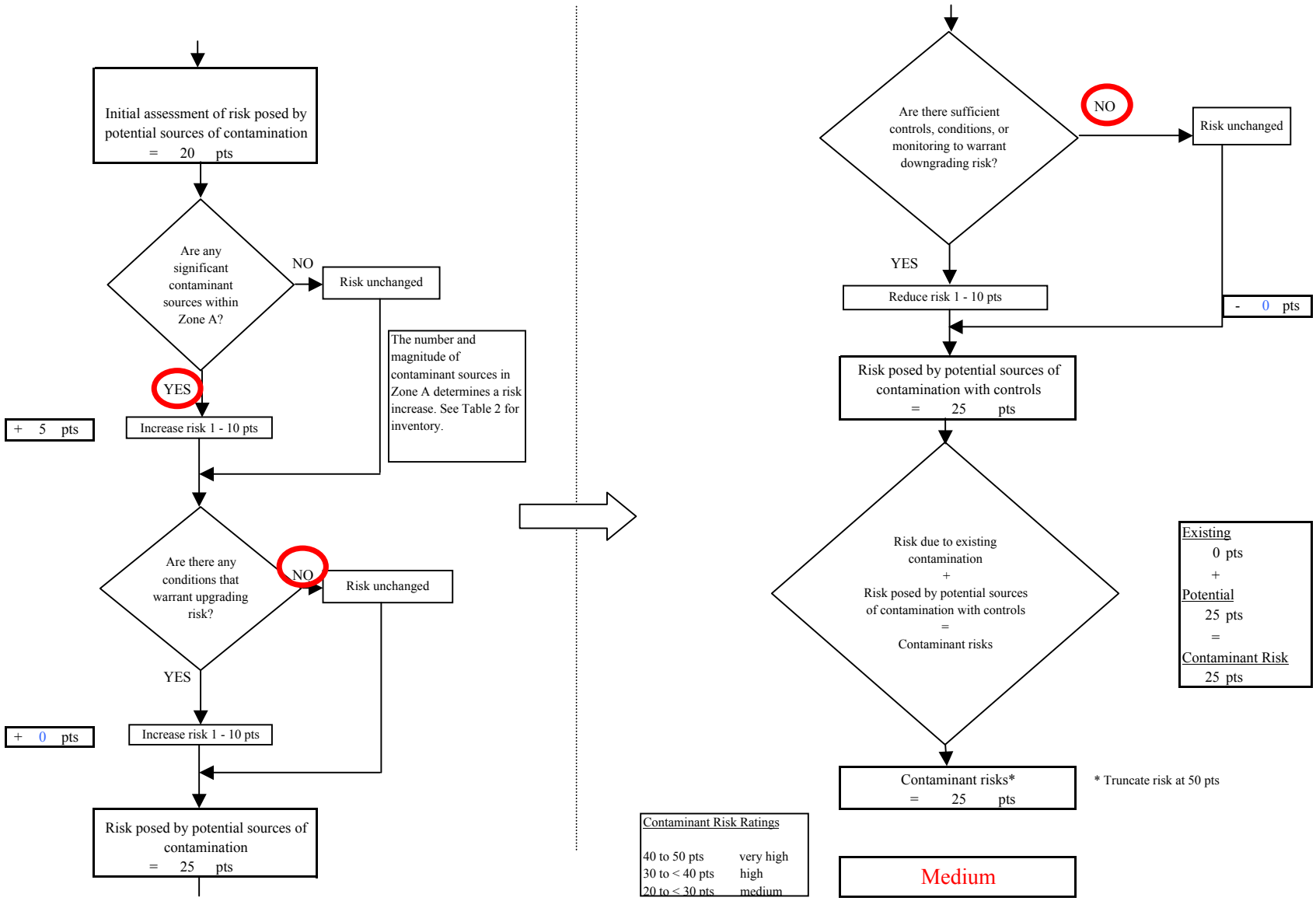


Chart 4. Vulnerability analysis for L&PSD Port Heiden (PWS No. 260676.001) - Bacteria & Viruses

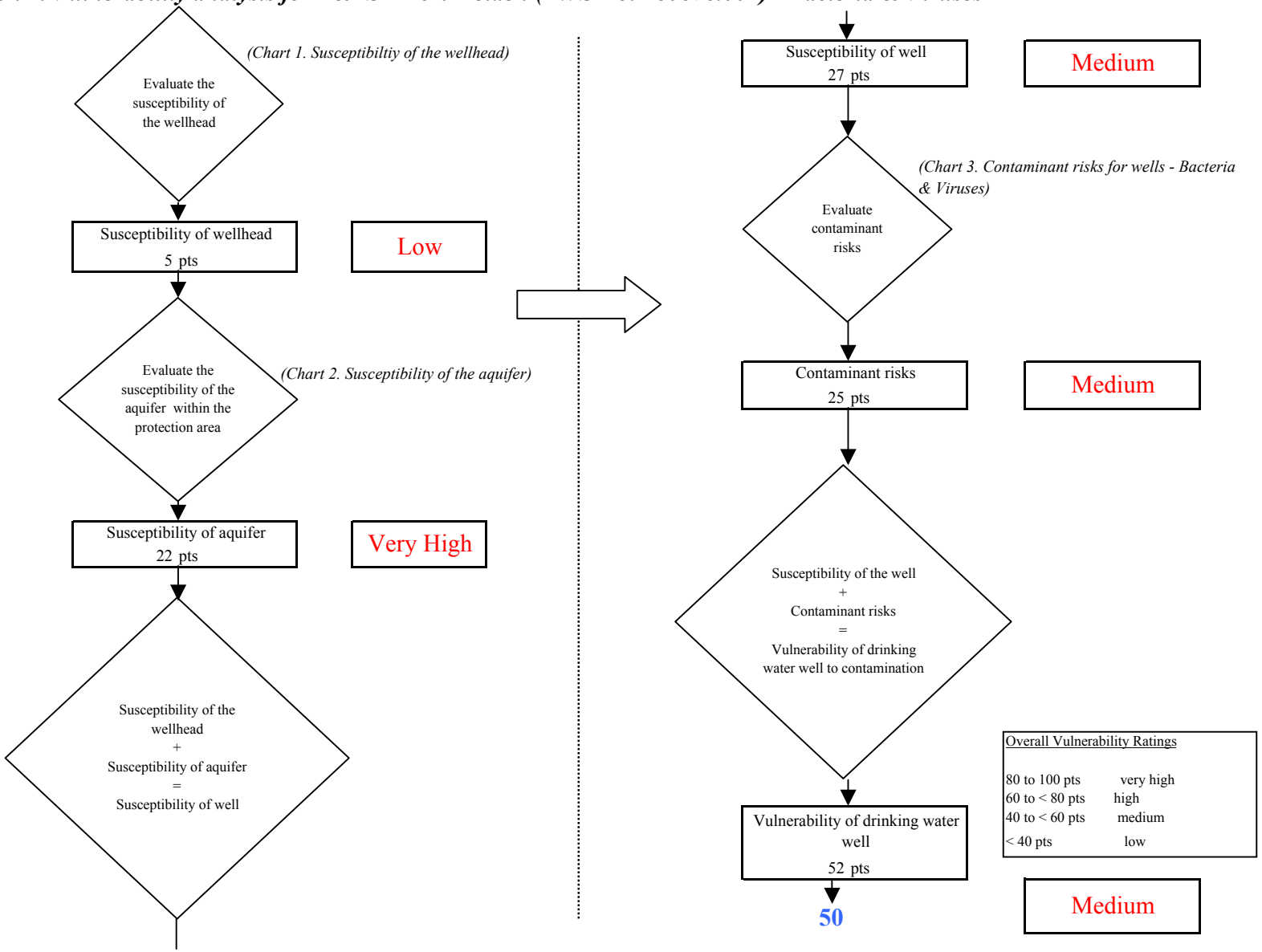


Chart 5. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Nitrates and Nitrites

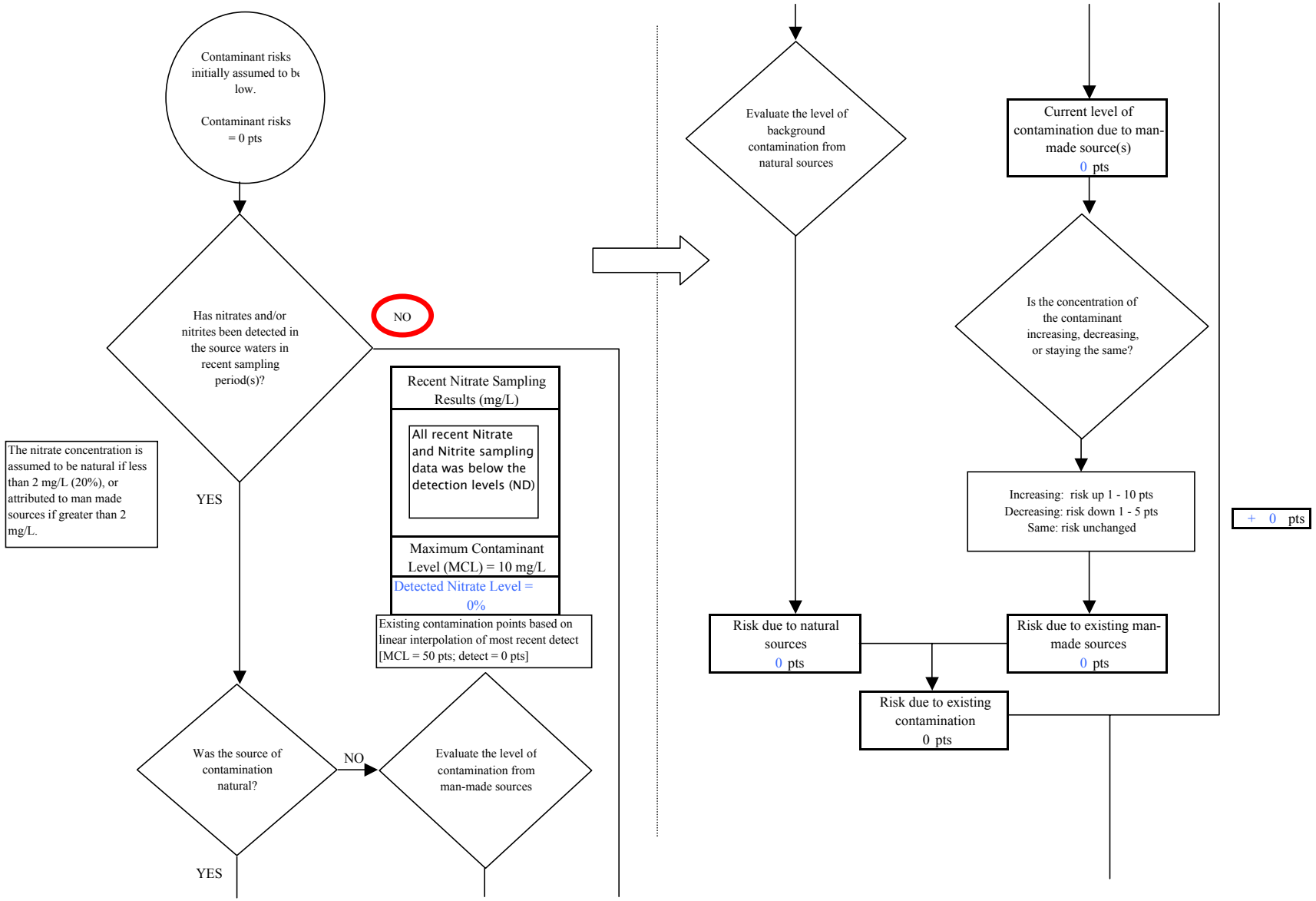


Chart 5. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Nitrates and Nitrites

+ 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)	0	0	0
Low(s)	15	0	15

	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 → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 5 pts

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

Chart 5. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Nitrates and Nitrites

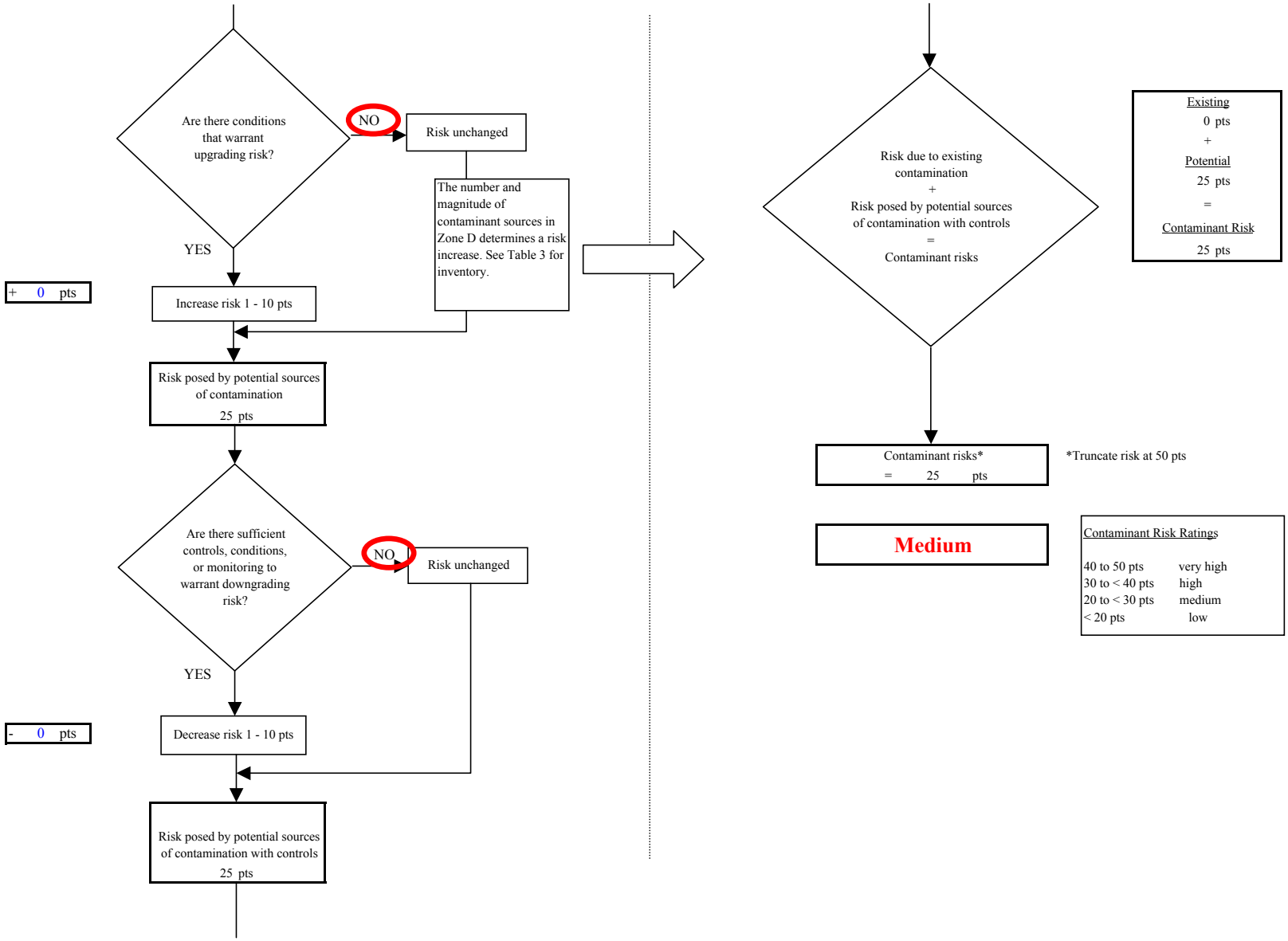


Chart 6. Vulnerability analysis for L&PSD Port Heiden (PWS No. 260676.001) - Nitrates and Nitrites

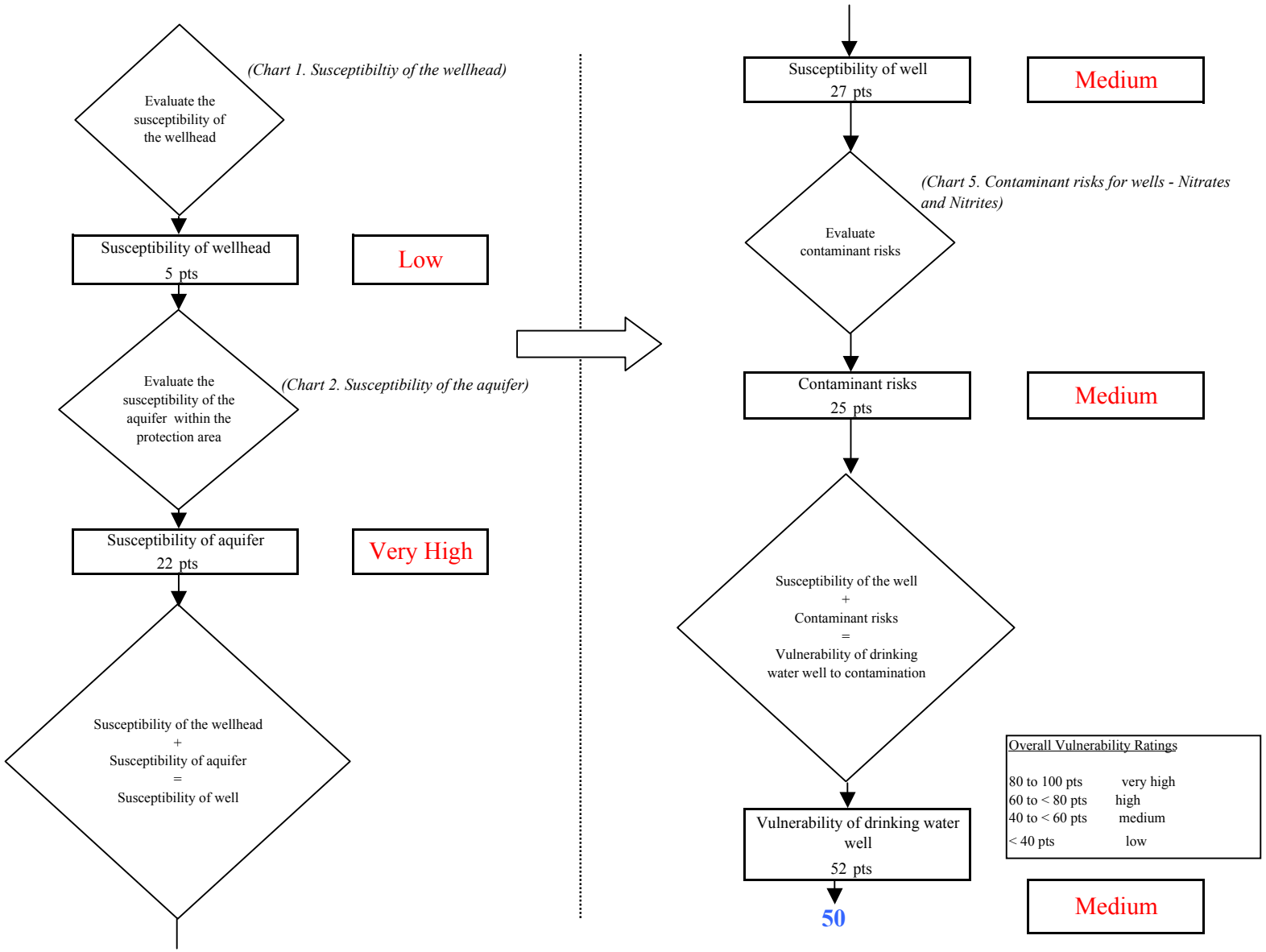


Chart 7. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Volatile Organic Chemicals

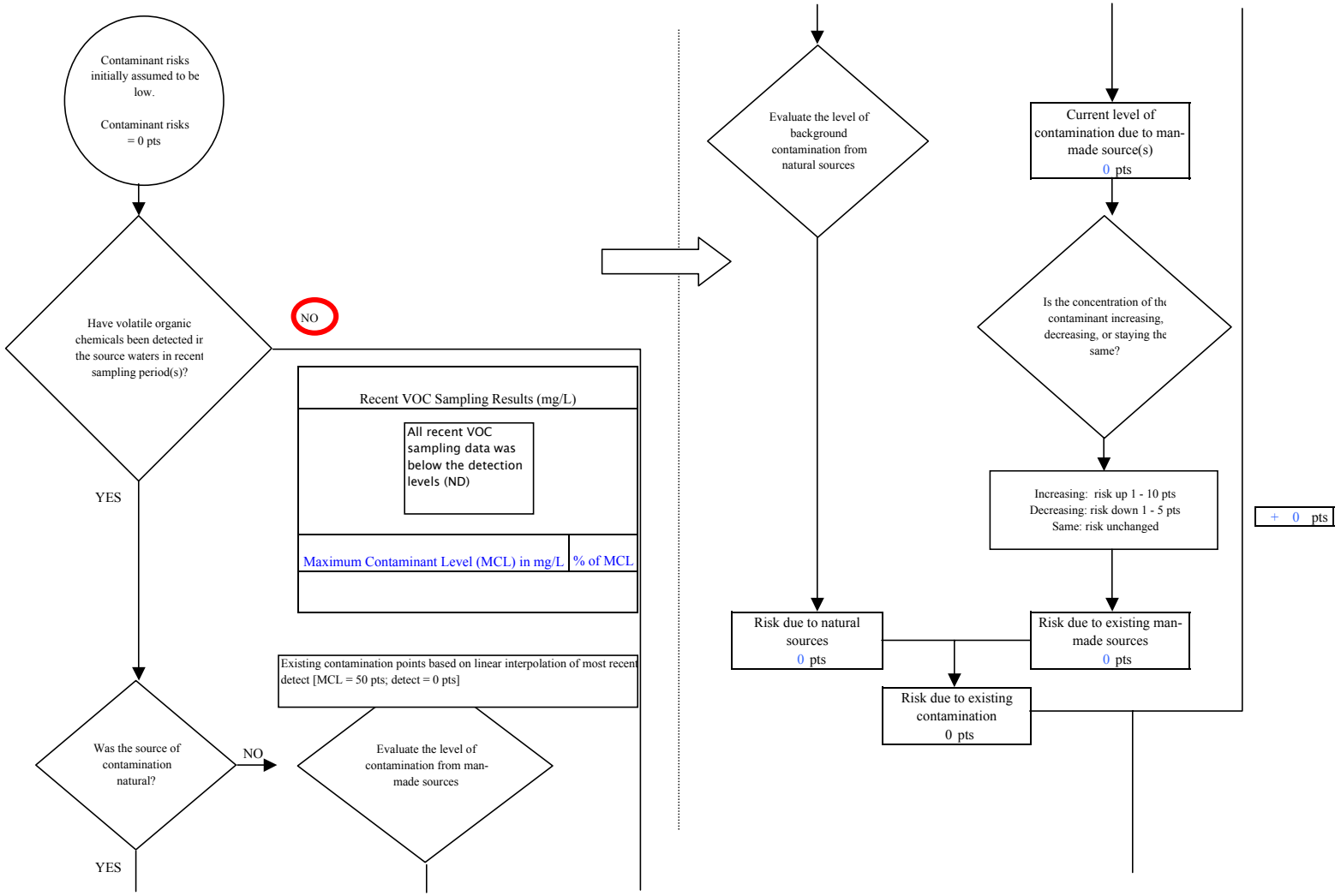
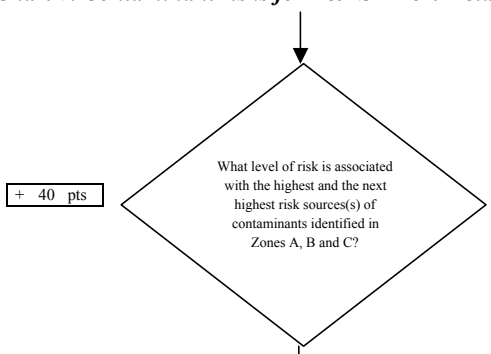


Chart 7. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Volatile Organic Chemicals



+ 40 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)	5	0	5
Medium(s)	0	0	0
Low(s)	6	0	6

	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 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.

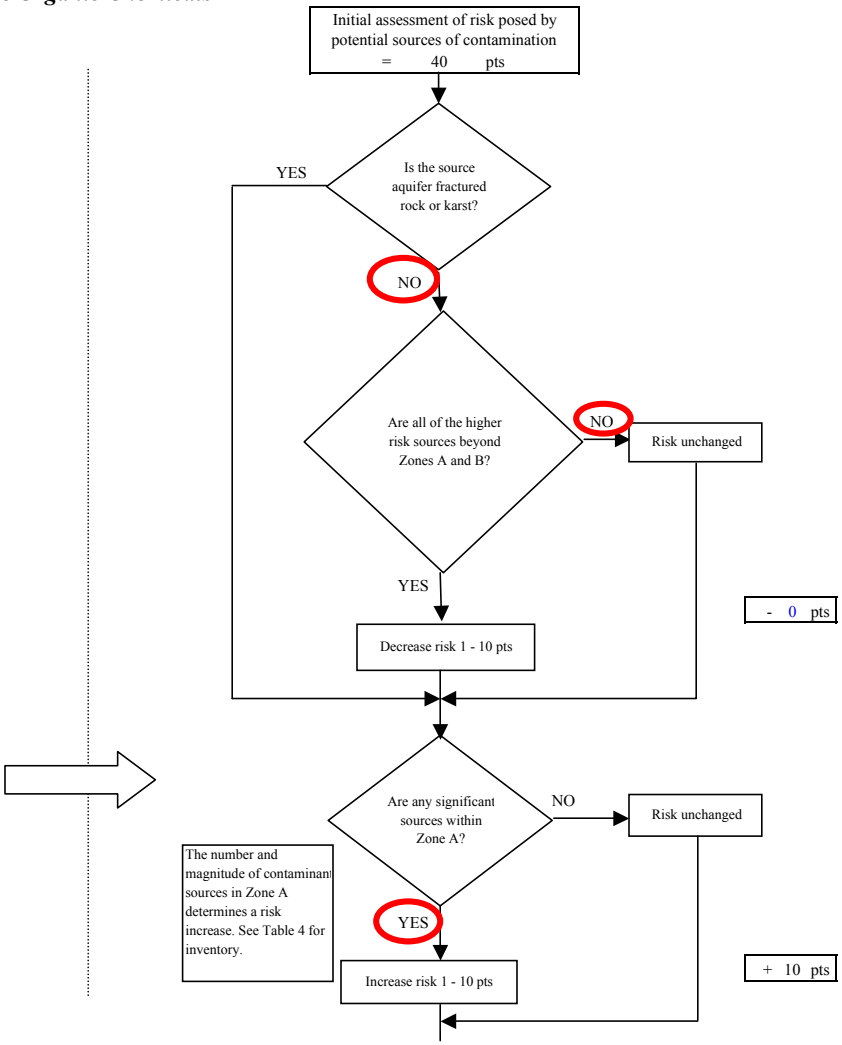


Chart 7. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Volatile Organic Chemicals

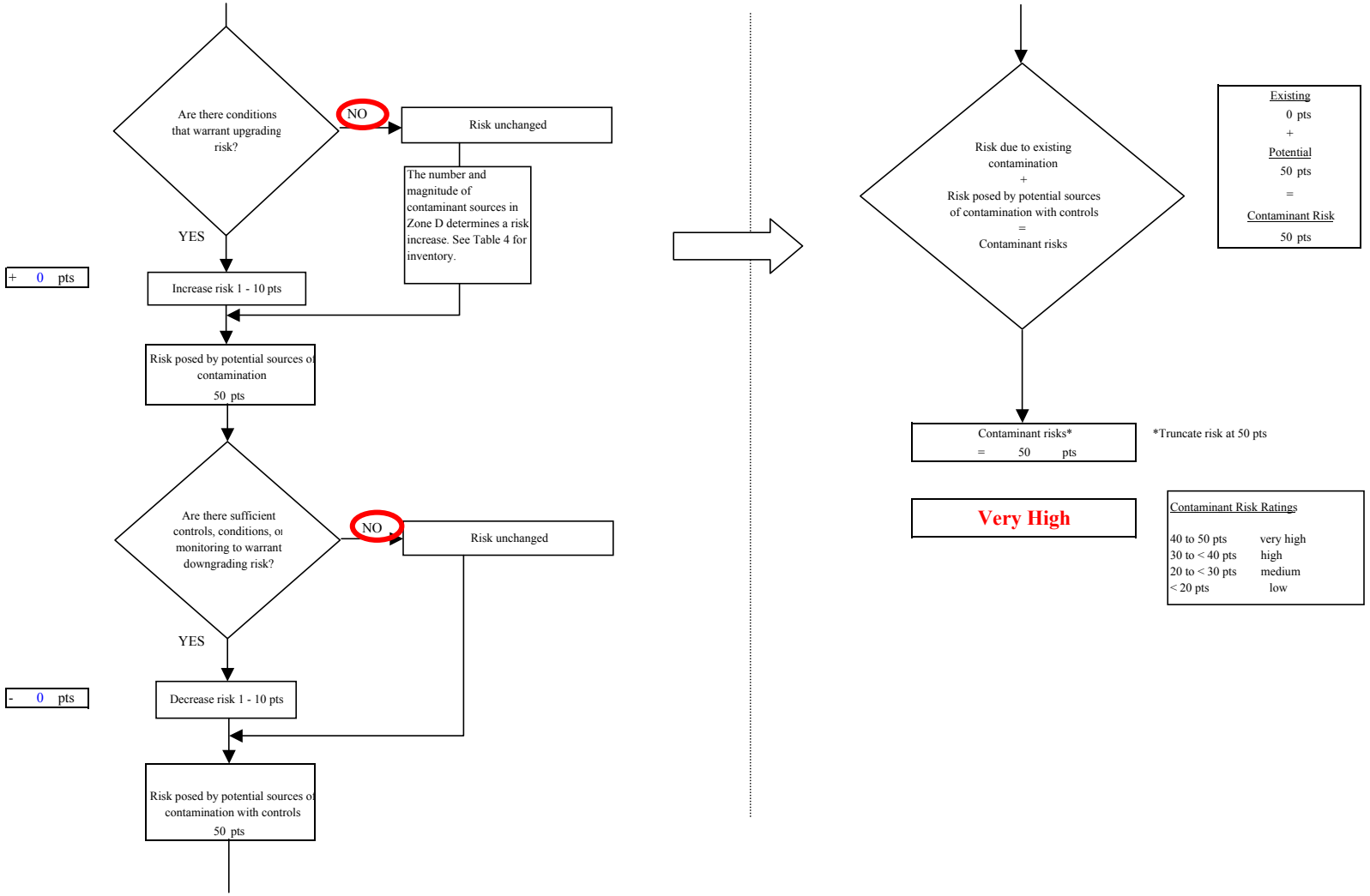


Chart 8. Vulnerability analysis for L&PSD Port Heiden (PWS No. 260676.001) - Volatile Organic Chemicals

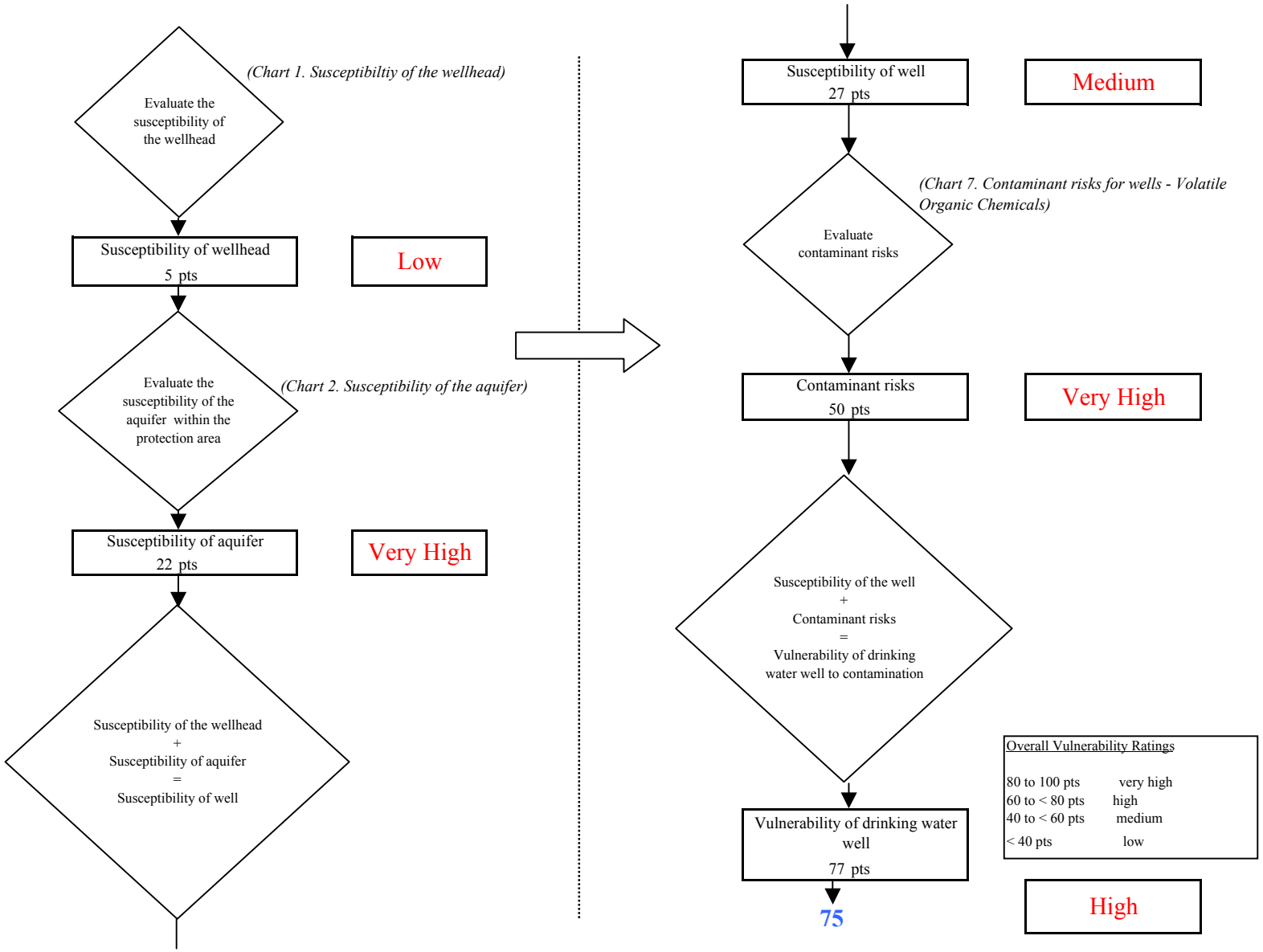


Chart 9. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

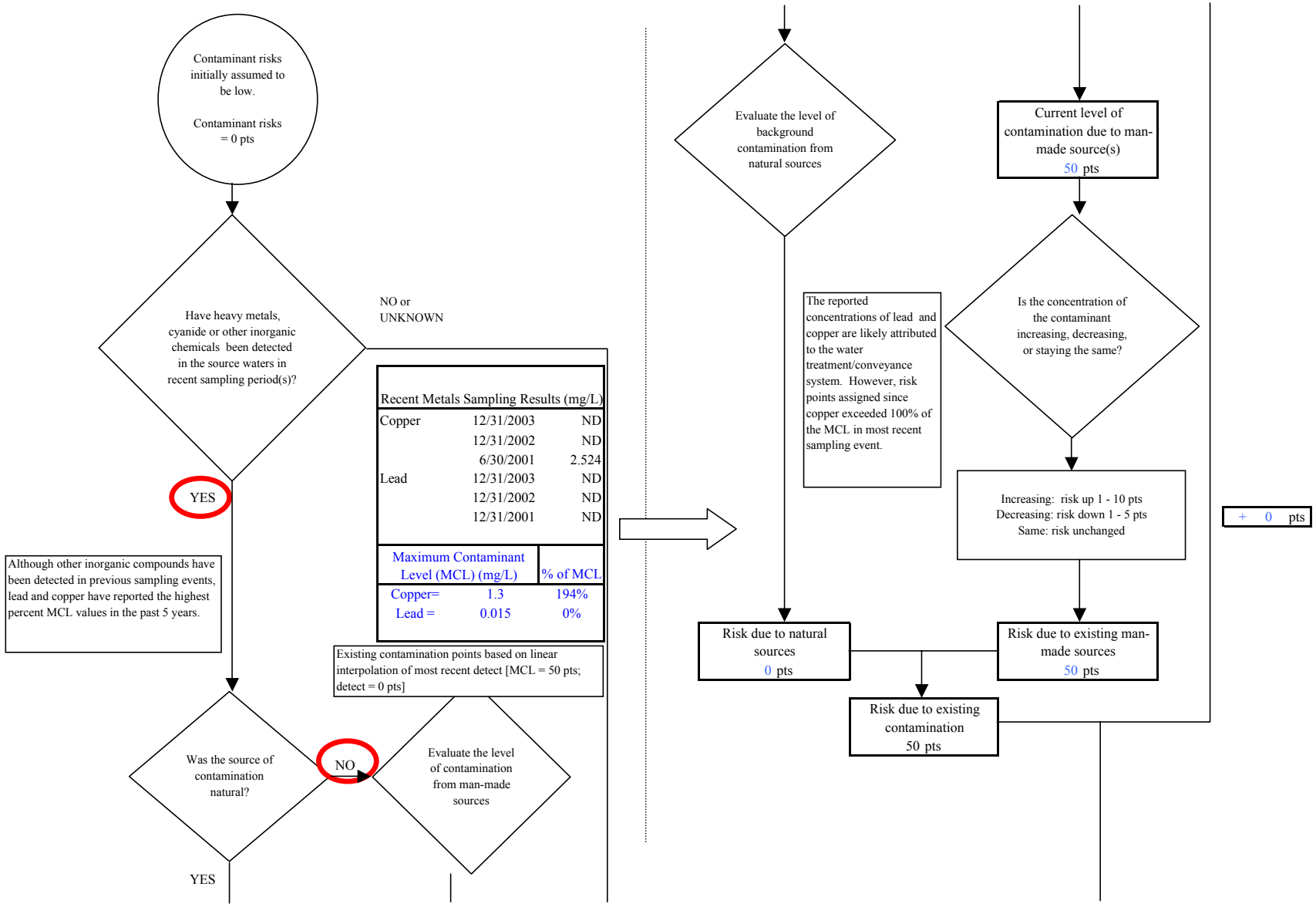
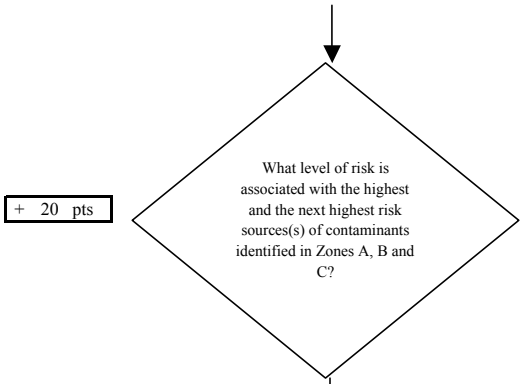


Chart 9. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 20 pts

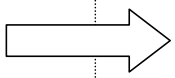
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	11	0	11

	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.



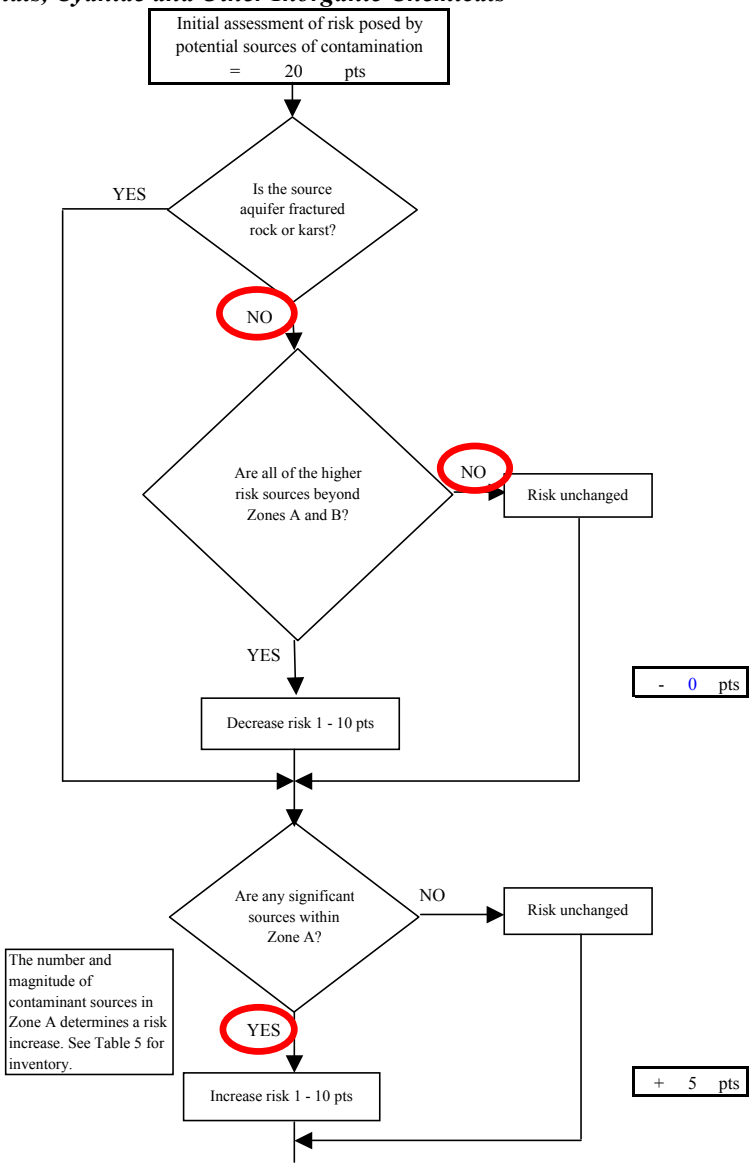


Chart 9. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

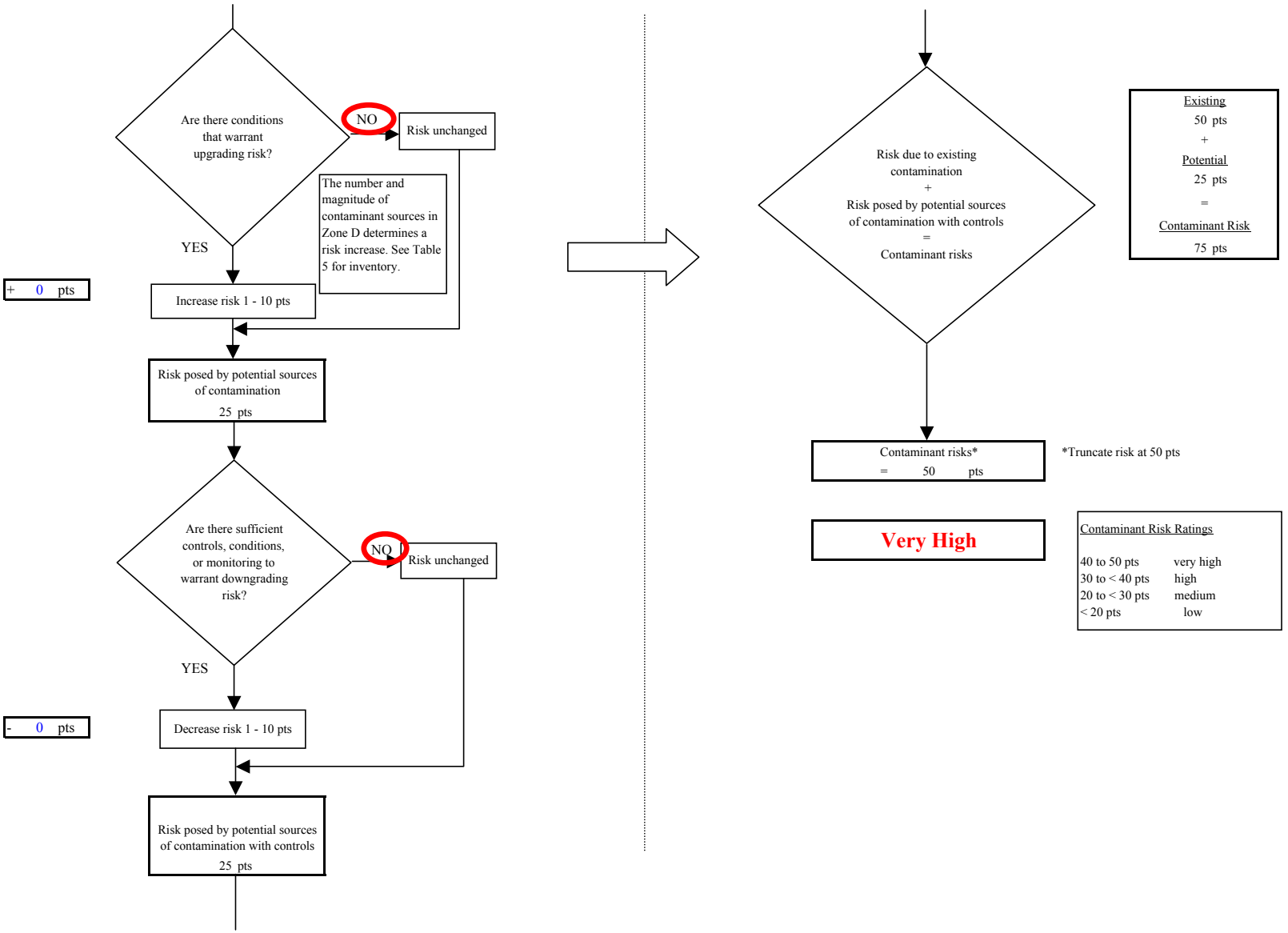


Chart 10. Vulnerability analysis for L&PSD Port Heiden (PWS No. 260676.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

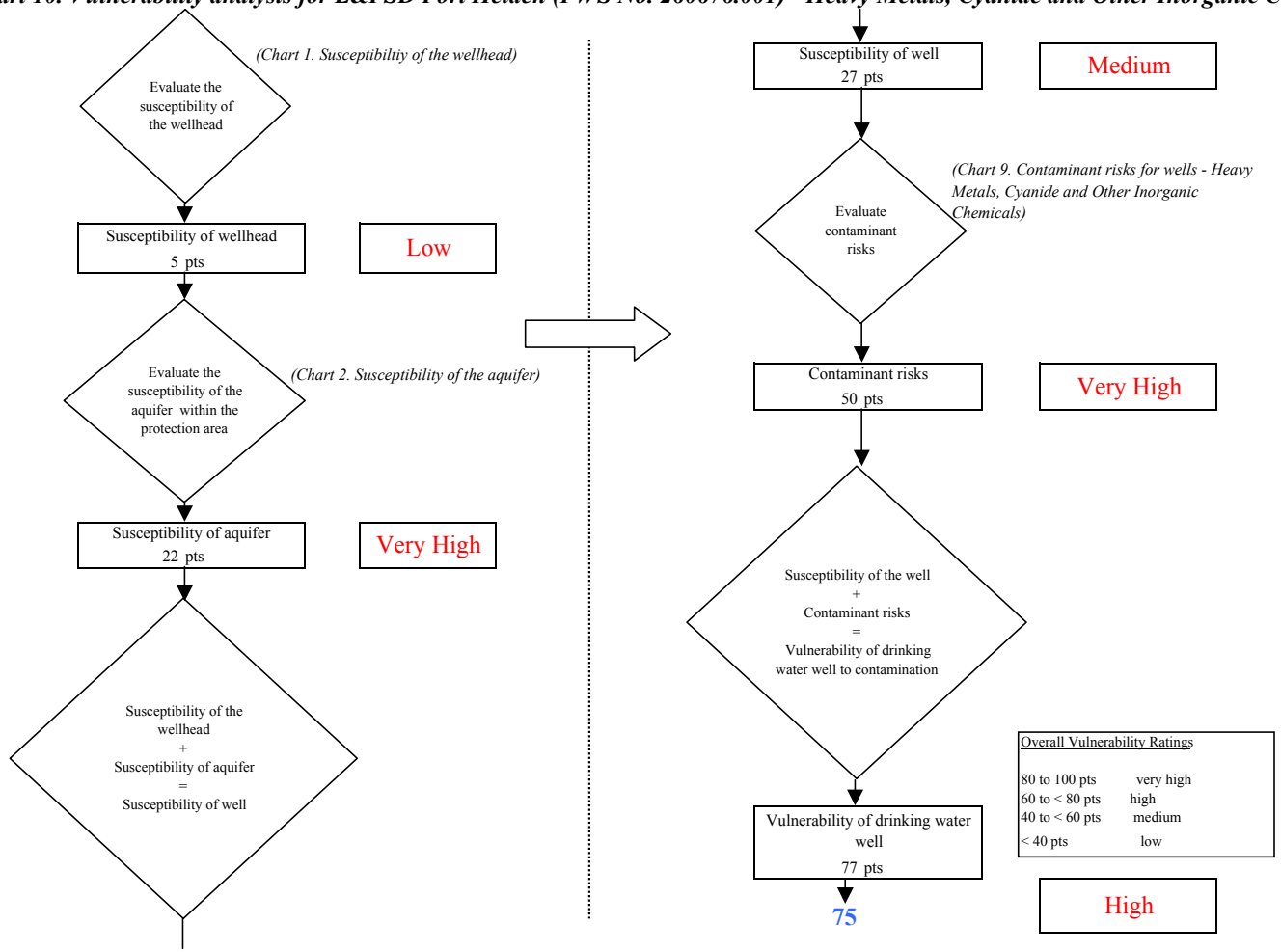


Chart 11. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Synthetic Organic Chemicals

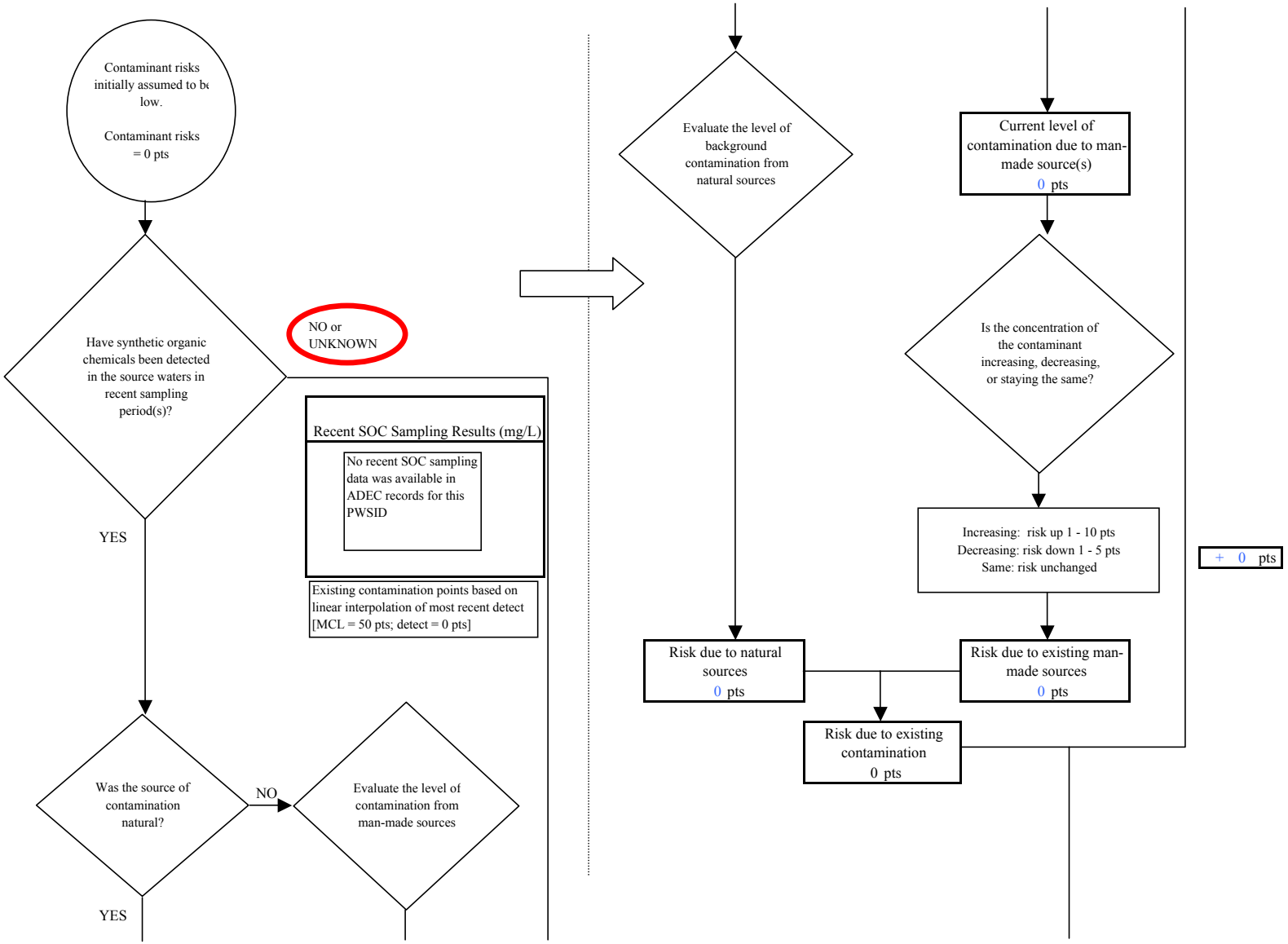
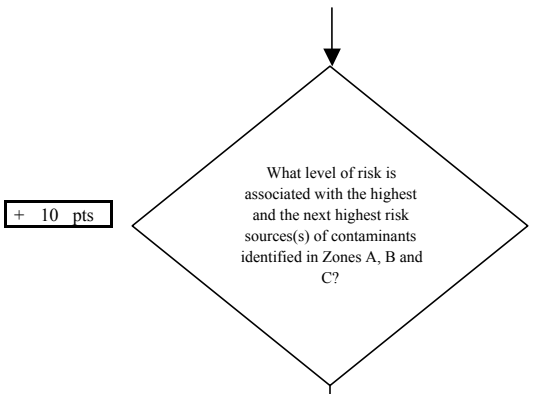


Chart 11. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Synthetic Organic Chemicals



+ 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)	6	0	6

	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.

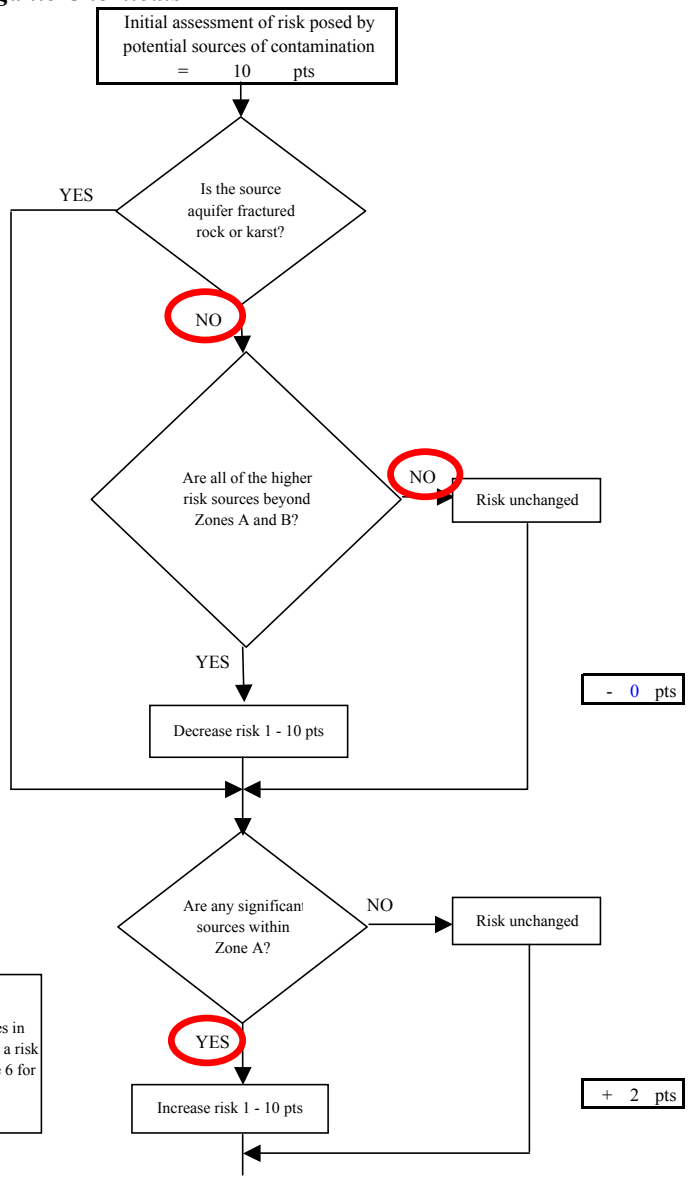


Chart 11. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Synthetic Organic Chemicals

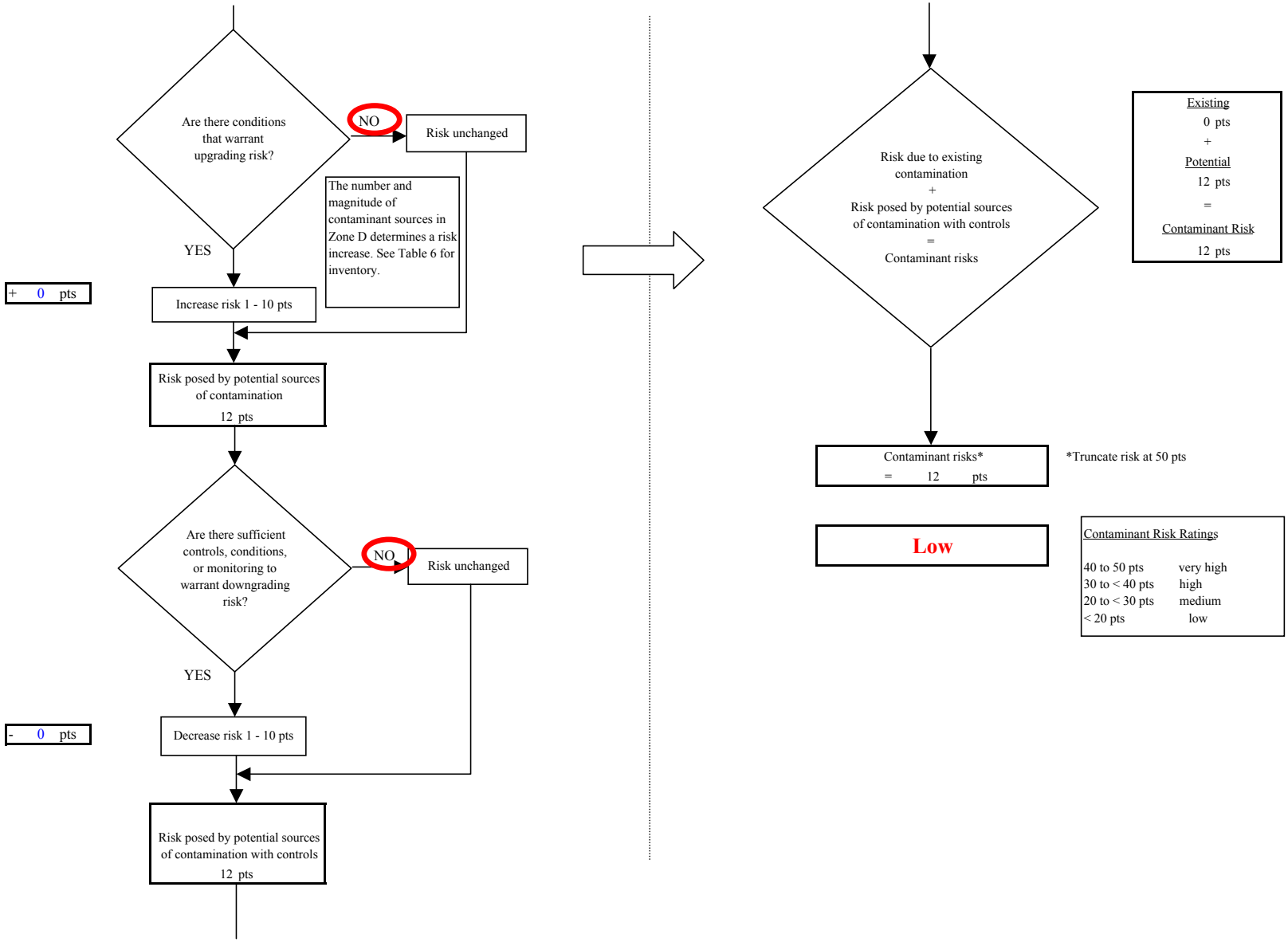


Chart 12. Vulnerability analysis for L&PSD Port Heiden (PWS No. 260676.001) - Synthetic Organic Chemicals

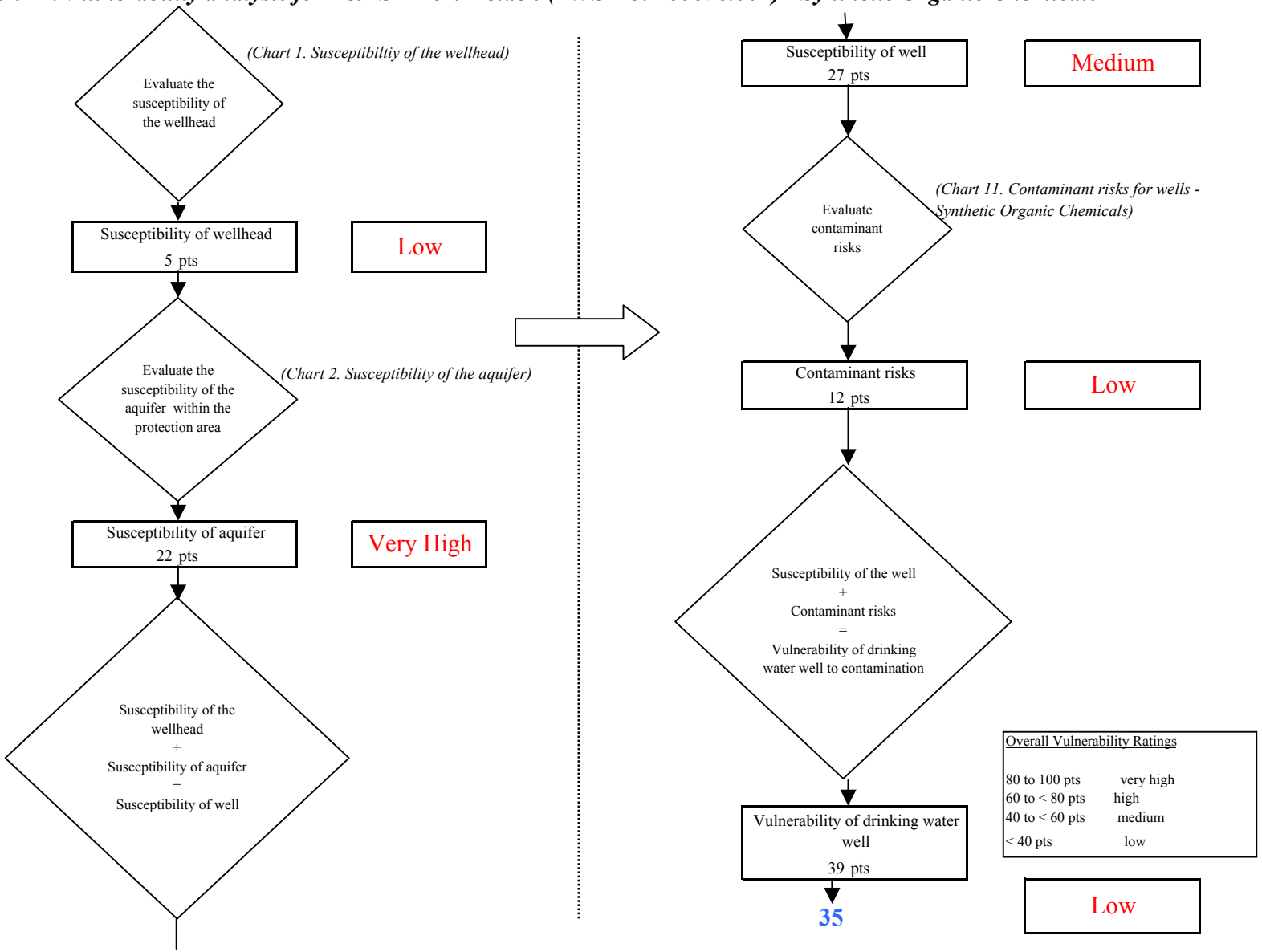


Chart 13. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Other Organic Chemicals

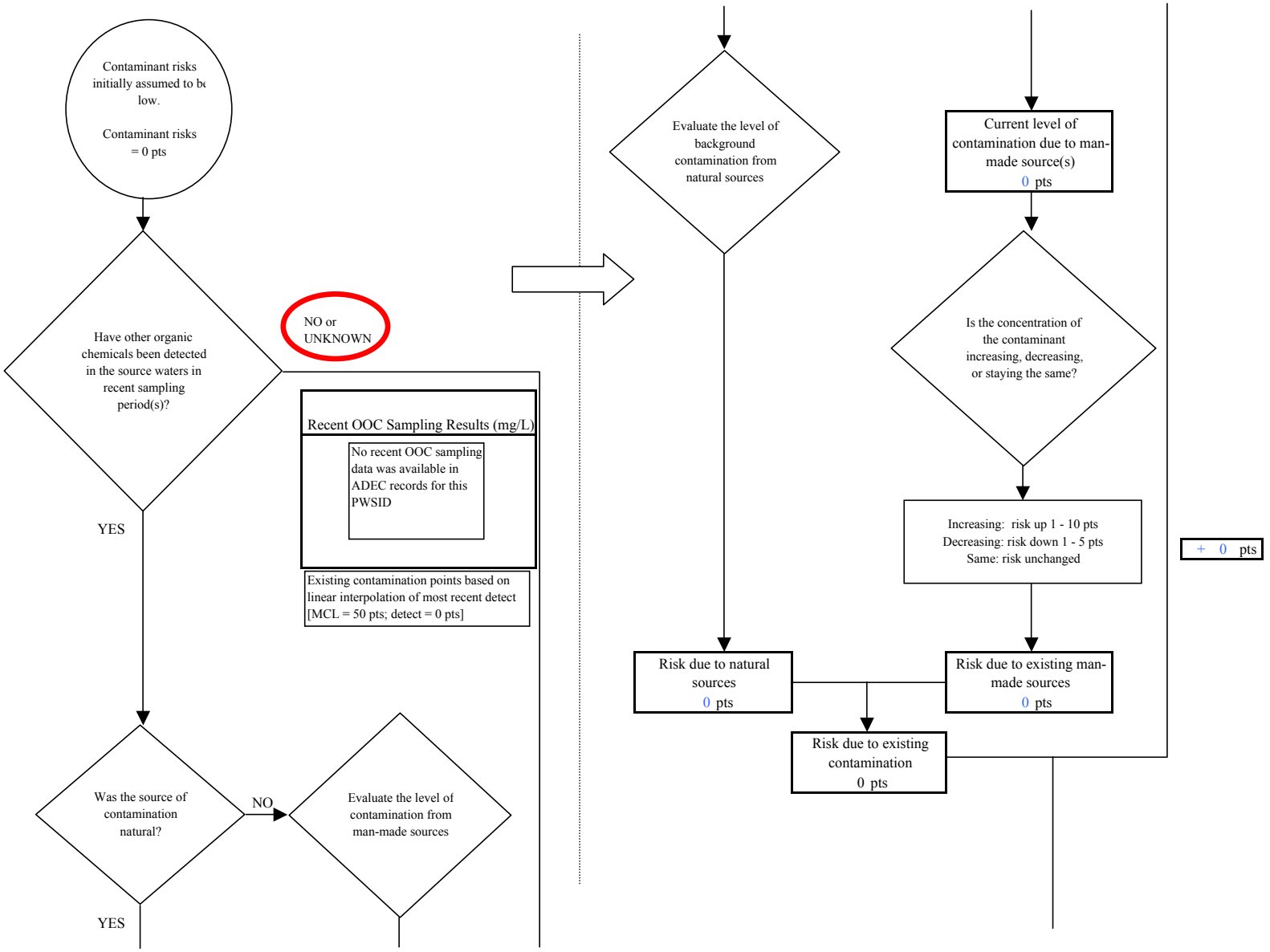


Chart 13. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Other Organic Chemicals

+ 10 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, 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)	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 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.

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

+ 2 pts

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

Chart 13. Contaminant risks for L&PSD Port Heiden (PWS No. 260676.001) - Other Organic Chemicals

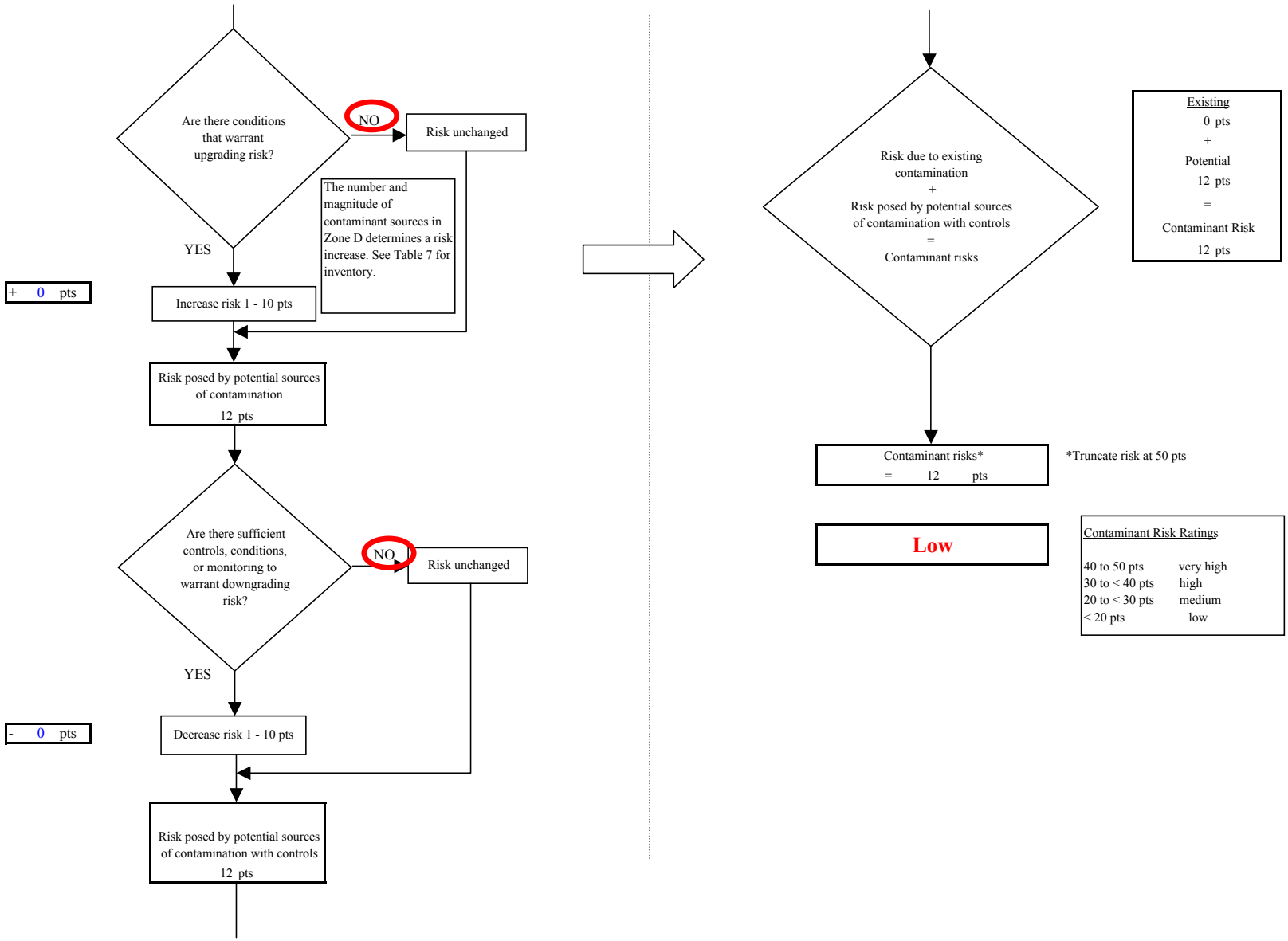


Chart 14. Vulnerability analysis for L&PSD Port Heiden (PWS No. 260676.001) - Other Organic Chemicals