

Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Div Parks Fort Abercrombie Bay
Drinking Water System,
Kodiak, Alaska

PWSID # 250249.001

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1448
Alaska Department of Environmental Conservation

Source Water Assessment for Div Parks Fort Abercrombie Bay Drinking Water System Kodiak, Alaska

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DRINKING WATER PROTECTION PROGRAM REPORT 1448

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 Div Parks Fort Abercrombie Bay Source of Public Drinking Water, Kodiak, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Div Parks Fort Abercrombie Bay has one Public Water System (PWS) well. It is assumed that the well (PWSID# 250249.001) has been used as a drinking water source since it was drilled in approximately 1981.

The well is a Class B (transient/non-community) water system located approximately 10 miles north of the City of Kodiak on Kodiak Island, Alaska. Available records do not indicate that there is secondary storage of drinking water. It can be assumed that the drinking water source is derived directly from the wellhead and is untreated. It is unknown if this system operates year round. This system serves approximately 25 non-residents and 0 residents, through one service connection. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produce a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the primary public drinking water source include: nonresidential pit toilets (open hole), municipal or city parks, roads, campgrounds and RV parks, a construction area, government vehicle maintenance facilities, general storage yard, and DEC recognized contaminated sites. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the water well received a vulnerability rating of **Medium** for the bacteria and viruses, a vulnerability rating of **Medium** for nitrates and nitrites, and a vulnerability rating of **Low** for volatile organic chemicals contaminant categories.

DIV PARKS FORT ABERCROMBIE BAY PUBLIC DRINKING WATER SYSTEM

The Div Parks Fort Abercrombie Bay well is a Class B (transient/non-community) public water system. The well is located approximately 10 miles north of the City of Kodiak on Kodiak Island, Alaska (Sec.

32, T027S, R019W, Seward Meridian; see Map A of Appendix A). The City of Kodiak is located about 250 miles south of Anchorage. The City of Kodiak has a population of 6,138 (ADCED, 2003). Average annual precipitation in the City of Kodiak is 67 inches. Temperatures range from 39 to 76°F in summer and 14 to 46°F in winter.

The City of Kodiak obtains their water supply from a city-operated water system. Households utilize a city operated piped sewer system (ADCED, 2003). The City of Kodiak receives electrical power from Kodiak Electric Association, which is operated by a REA Co-op. Power generating facilities are fueled by hydro and diesel sources. Refuse is collected by the Kodiak Island Borough and transported to the Borough landfill located in and operated by the Kodiak Island Borough (ADCED, 2003).

According to information supplied by ADEC for the Div Parks Fort Abercrombie Bay PWS, the depth of the primary water well is 225 feet below the ground surface. The well is not screened and is assumed unconfined. Unconfined aquifers are more susceptible to groundwater impacts resulting from the downward migration of surface contaminants. The well is not located in a suspected floodplain.

Information acquired from a June 1999 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 potential of contaminant migration down the well casing annulus. 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.

Glaciers formerly covered most of Kodiak Island and the topography of the island is representative of a postglacial area with rugged peaks and fjord coastlines. Soils information is limited. Streams occupy the glacial valleys and have deposited alluvial silt, sand, and gravel in depressions and at the mouth of streams. The alluvial deposits tend to be coarse

grained toward the shore and fine grained in the floodplains. The soils have thick, dark surface horizons, and normally no horizon of clay (Chiniak Community Forum, et. al 1987).

DIV PARKS FORT ABERCROMBIE BAY 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 Div Parks Fort Abercrombie Bay 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 B 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 Div Parks Fort Abercrombie Bay 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 Div Parks Fort Abercrombie Bay 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 B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses,
- Nitrates and/or nitrites,
- Volatile 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, and volatile organic chemicals.

VULNERABILITY OF THE DIV PARKS FORT ABERCROMBIE BAY 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 eight 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. Lastly, Chart 4 contains the ‘Vulnerability Analysis for Bacteria and Viruses’. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

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

$$\begin{array}{r}
 \text{Susceptibility of the Wellhead (0 – 25 Points)} \\
 \text{(Chart 1 of Appendix D)} \\
 + \\
 \text{Susceptibility of the Aquifer (0 – 25 Points)} \\
 \text{(Chart 2 of Appendix D)} \\
 = \\
 \text{Natural Susceptibility (Susceptibility of the Well)} \\
 \text{(0 – 50 Points)}
 \end{array}$$

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 Div Parks Fort Abercrombie Bay’s water well is in an unconfined 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	0	Low
Susceptibility of the Aquifer	16	High
Natural Susceptibility	16	Low

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	35	High
Nitrates and/or Nitrites	35	High
Volatile Organic Chemicals	28	Medium

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

$$\begin{array}{r}
 \text{Natural Susceptibility (0 – 50 points)} \\
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the} \\
 \text{Drinking Water Source to Contamination (0 – 100).}
 \end{array}$$

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 three 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	45	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **High**. The risk is primarily attributed to the presence of municipal or city parks and nonresidential pit toilets (open hole) located in Zone A (see Table 2 – Appendix B).

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli, which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other

symptoms (EPA, 2003). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination.

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

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

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **High**. The risk to this source of public drinking water is primarily attributed to the presence of municipal or city parks and nonresidential pit toilets (open hole) in Zone A (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 not been detected in recent sampling events. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L; therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils. After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Medium**. The risk is primarily attributed to the presence of a vehicle maintenance facility located in Zone C. Some other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

Recent sampling data available in ADEC records for Div Parks Fort Abercrombie Bay detected total trihalomethanes (TTHMs), but risk points were not assigned because TTHMs are water treatment byproducts and the MCL was not exceeded (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

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

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 Div Parks Fort Abercrombie Bay and the community of the City of Kodiak 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.

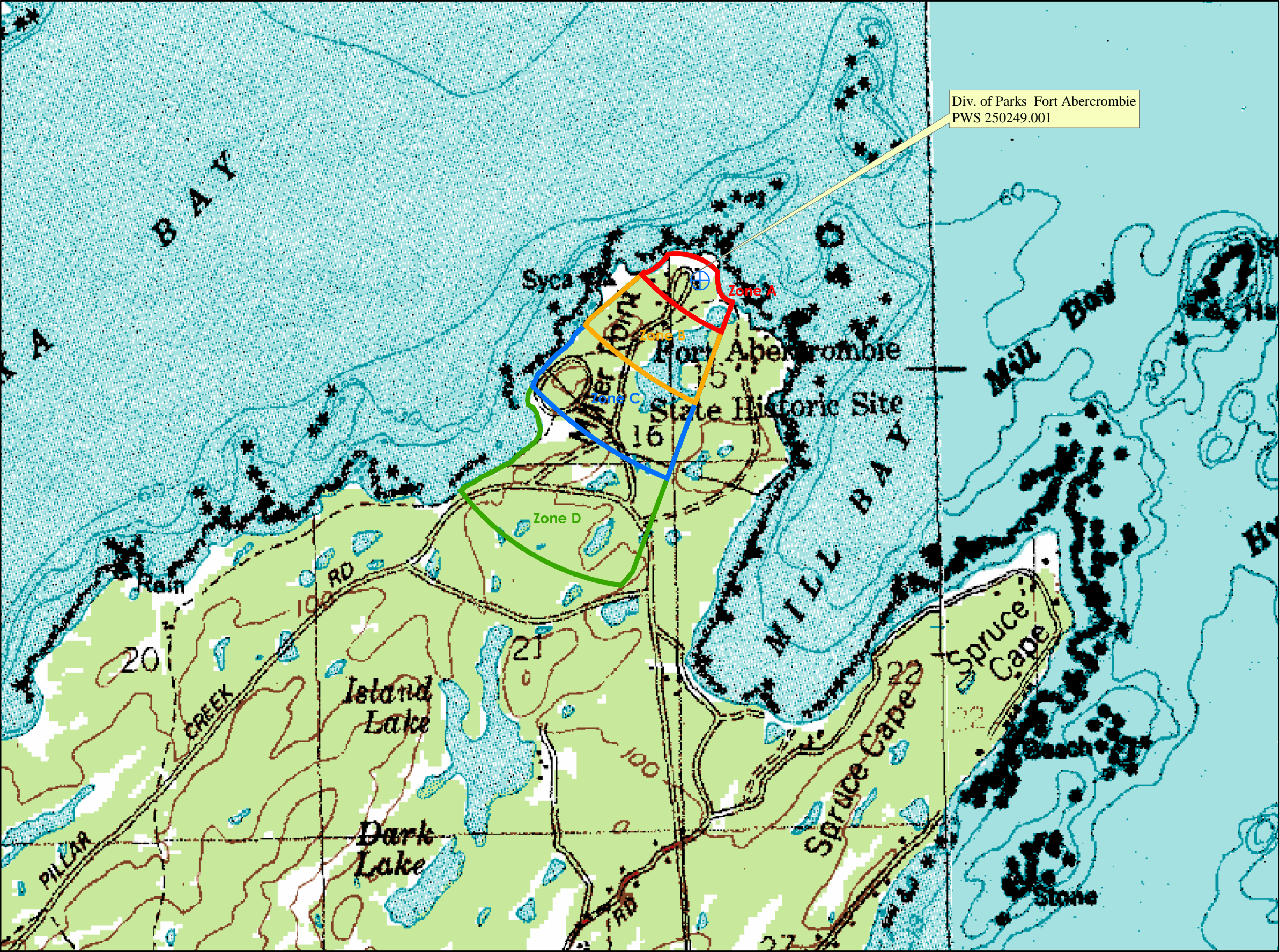
REFERENCES

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APPENDIX A

Drinking Water Protection Area Location Map (Map A)

Public Water Well System for PWSID 250249.001 Division of Parks Fort Abercrombie



LEGEND

- Public Water System Well
- Groundwater Protection Zones**
- Zone A – 2 Months Travel Time
 - Zone B – 2 Years Travel Time
 - Zone C – 5 Years Travel Time
 - Zone D – 10 Years Travel Time or Watershed Boundary

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

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

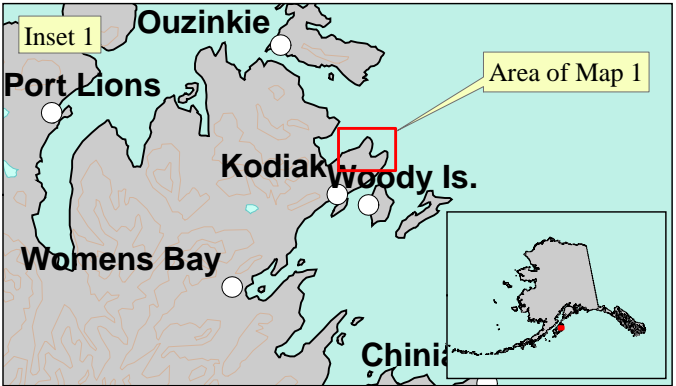
Data Sources:

- 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 B Public Water Systems" published by ADEC

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



APPENDIX B

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

Table 1**Contaminant Source Inventory for
Div Parks Fort Abercrombie Bay****PWSID 250249.00**

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	C	Assume 5 pit toilets in Zone A
Municipal or city parks (with green areas)	X04	X04-01	A	C	
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Campgrounds and RV Parks	X35	X35-01	A	C	
Construction trade areas and materials	C09	C09-01	B	C	Majdic & Sons
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B
Government vehicle maintenance facilities	X19	X19-01	C	C	Bayside Volunteer Fire Dept
Highways and roads, dirt/gravel	X24	X24-03	C	C	Assume 1-20 roads in Zone C
Motor vehicle/general storage yards/facilities	X27	X27-01	C	C	Bayside West Business Park
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	D	C	Oberg Rental, Reckey #1990250119001, Status: Closed Renter reported petroleum contamination of well in 7/90. Sampling show 400 ug/L benzene in drinking water.

Table 2

*Contaminant Source Inventory and Risk Ranking for
Div Parks Fort Abercrombie Bay
Sources of Bacteria and Viruses*

PWSID 250249.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 5 pit toilets in Zone A
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Campgrounds and RV Parks	X35	X35-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 3

*Contaminant Source Inventory and Risk Ranking for
Div Parks Fort Abercrombie Bay
Sources of Nitrates/Nitrites*

PWSID 250249.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 5 pit toilets in Zone A
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Campgrounds and RV Parks	X35	X35-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C

Table 4

*Contaminant Source Inventory and Risk Ranking for
Div Parks Fort Abercrombie Bay
Sources of Volatile Organic Chemicals*

PWSID 250249.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 5 pit toilets in Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Campgrounds and RV Parks	X35	X35-01	A	Low	C	
Construction trade areas and materials	C09	C09-01	B	Low	C	Majdic & Sons
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Government vehicle maintenance facilities	X19	X19-01	C	Medium	C	Bayside Volunteer Fire Dept
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C
Motor vehicle/general storage yards/facilities	X27	X27-01	C	Low	C	Bayside West Business Park
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	D	High	C	Oberg Rental, Reckey #1990250119001, Status: Closed Renter reported petroleum contamination of well in 7/90. Sampling showed 400 ug/L benzene in drinking water.

Table 5

*Contaminant Source Inventory and Risk Ranking for
Div Parks Fort Abercrombie Bay
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

PWSID 250249.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 5 pit toilets in Zone A
Municipal or city parks (with green areas)	X04	X04-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Construction trade areas and materials	C09	C09-01	B	Low	C	Majdic & Sons
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Government vehicle maintenance facilities	X19	X19-01	C	Low	C	Bayside Volunteer Fire Dept
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C

Table 6

*Contaminant Source Inventory and Risk Ranking for
Div Parks Fort Abercrombie Bay
Sources of Synthetic Organic Chemicals*

PWSID 250249.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Municipal or city parks (with green areas)	X04	X04-01	A	Low	C	

Table 7

*Contaminant Source Inventory and Risk Ranking for
Div Parks Fort Abercrombie Bay
Sources of Other Organic Chemicals*

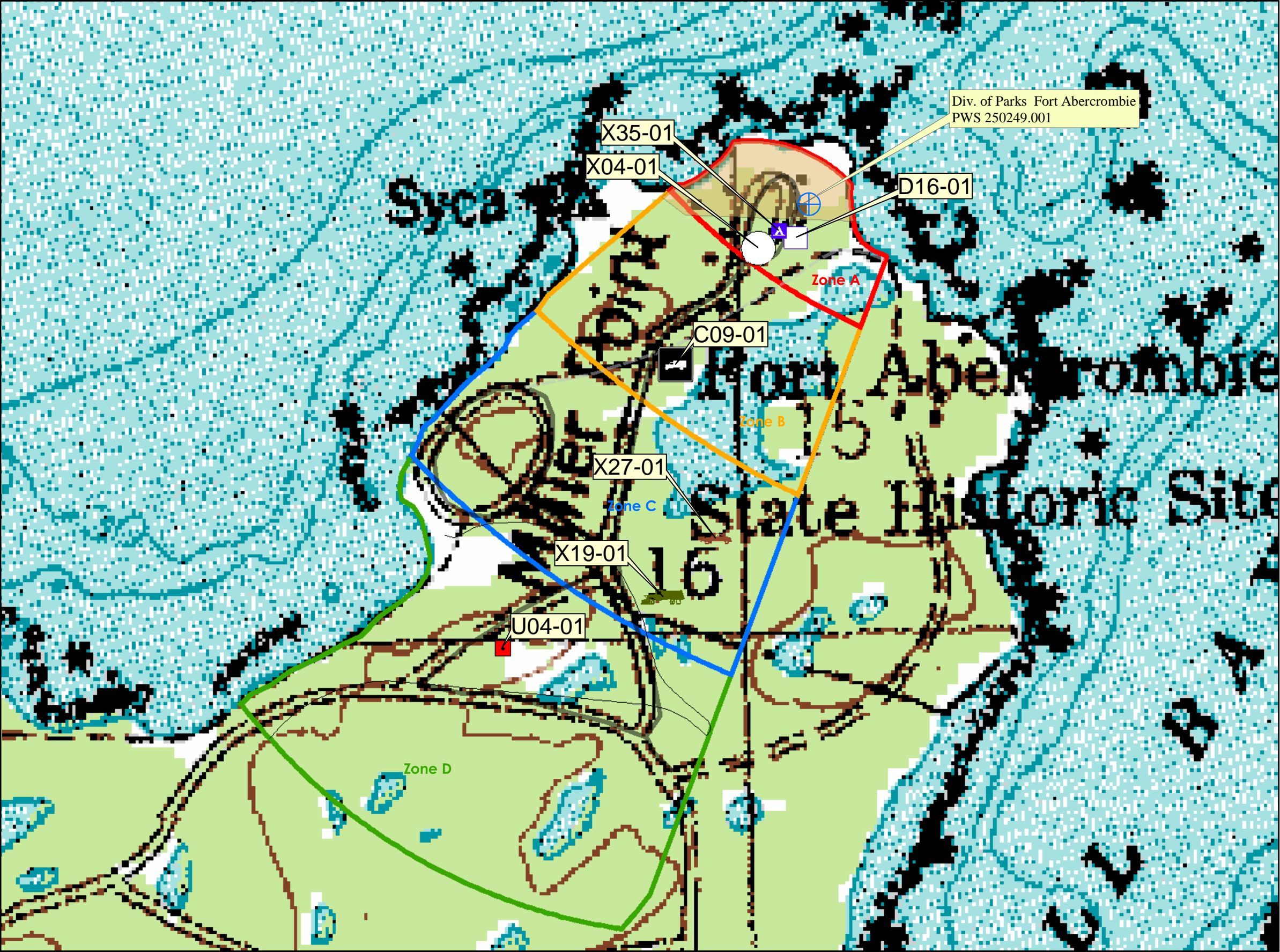
PWSID 250249.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Construction trade areas and materials	C09	C09-01	B	Low	C	Majdic & Sons
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Government vehicle maintenance facilities	X19	X19-01	C	Medium	C	Bayside Volunteer Fire Dept
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C
Motor vehicle/general storage yards/facilities	X27	X27-01	C	Low	C	Bayside West Business Park

APPENDIX C

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

Public Water Well System for PWSID 250249.001 Division of Parks Fort Abercrombie
Showing Potential and Existing Sources of Contamination



LEGEND

- Public Water System Well
- Groundwater Protection Zones**
- Zone A – 2 Months Travel Time
 - Zone B – 2 Years Travel Time
 - Zone C – 5 Years Travel Time
 - Zone D – 10 Years Travel Time or Watershed Boundary

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

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

Existing or Potential Contaminant Sources

- Construction Trade Areas and Materials (C09)
- Pit Toilets (open hole), non-residential (one or more) (D16)
- Contaminated site, DEC recognized, non-Superfund, non-RCRA (U04)
- Government vehicle maintenance facility (X19)
- Motor vehicle/general storage yards/facilities (X27)
- Campgrounds and RV Parks (X35)
- Municipal or City Parks (X04)

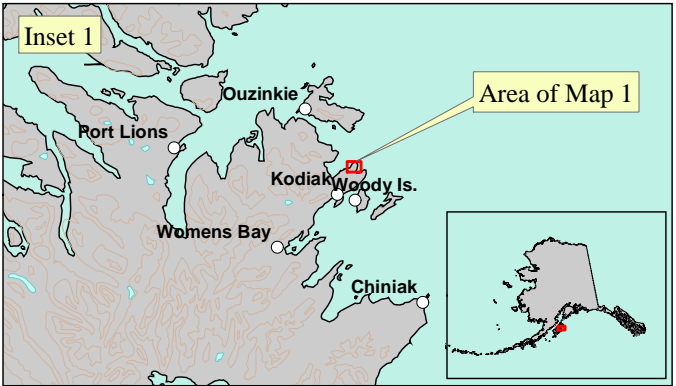
Data Sources:

- 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 B Public Water Systems" published by ADEC

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



0 0.05 0.1 0.2 0.3 0.4 Miles

APPENDIX D

Vulnerability Analysis for Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Div Parks Fort Abercrombie Bay (PWS No. 250249.001)

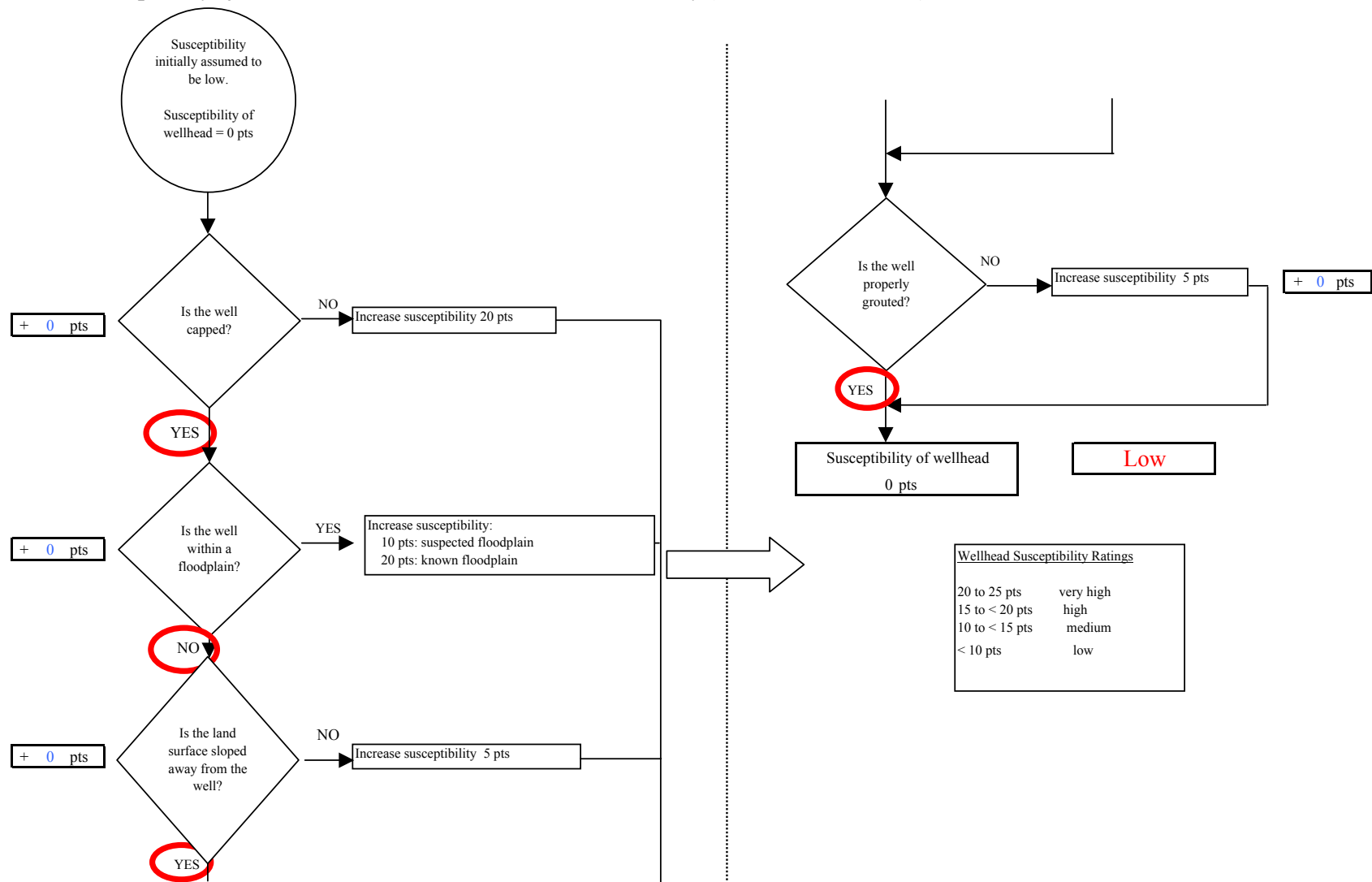


Chart 2. Susceptibility of the aquifer Div Parks Fort Abercrombie Bay (PWS No. 250249.001)

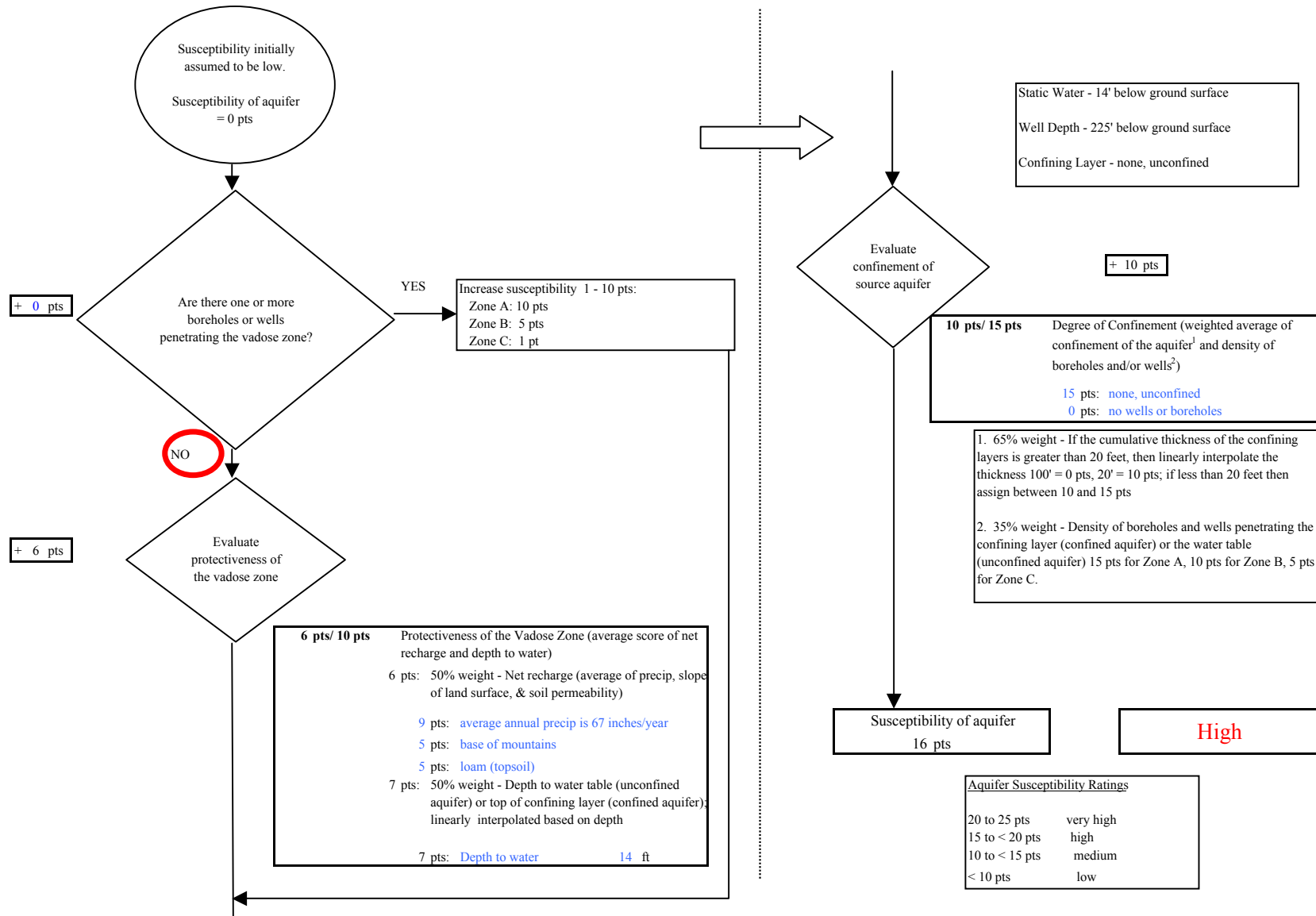


Chart 3. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Bacteria & Viruses

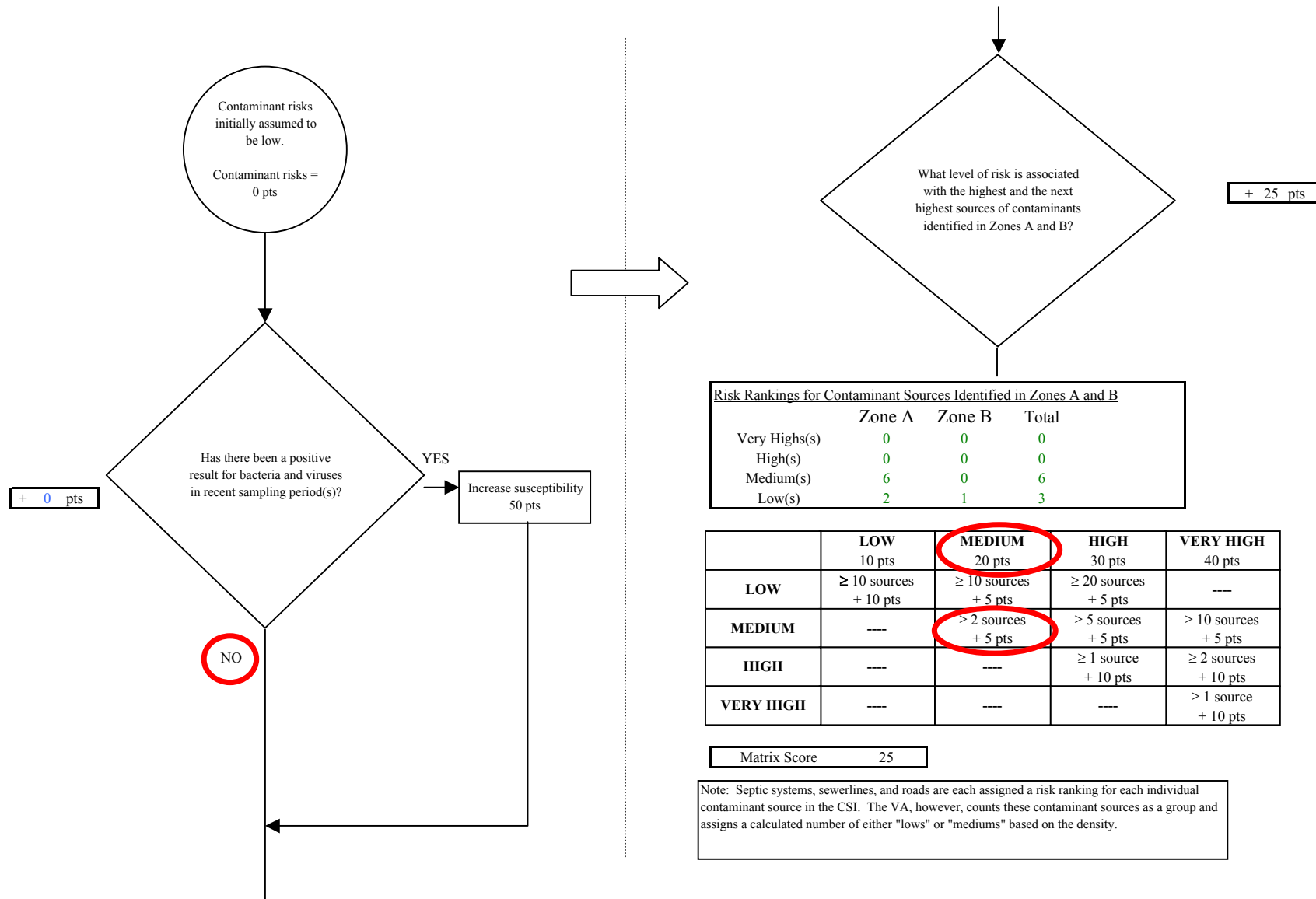


Chart 3. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Bacteria & Viruses

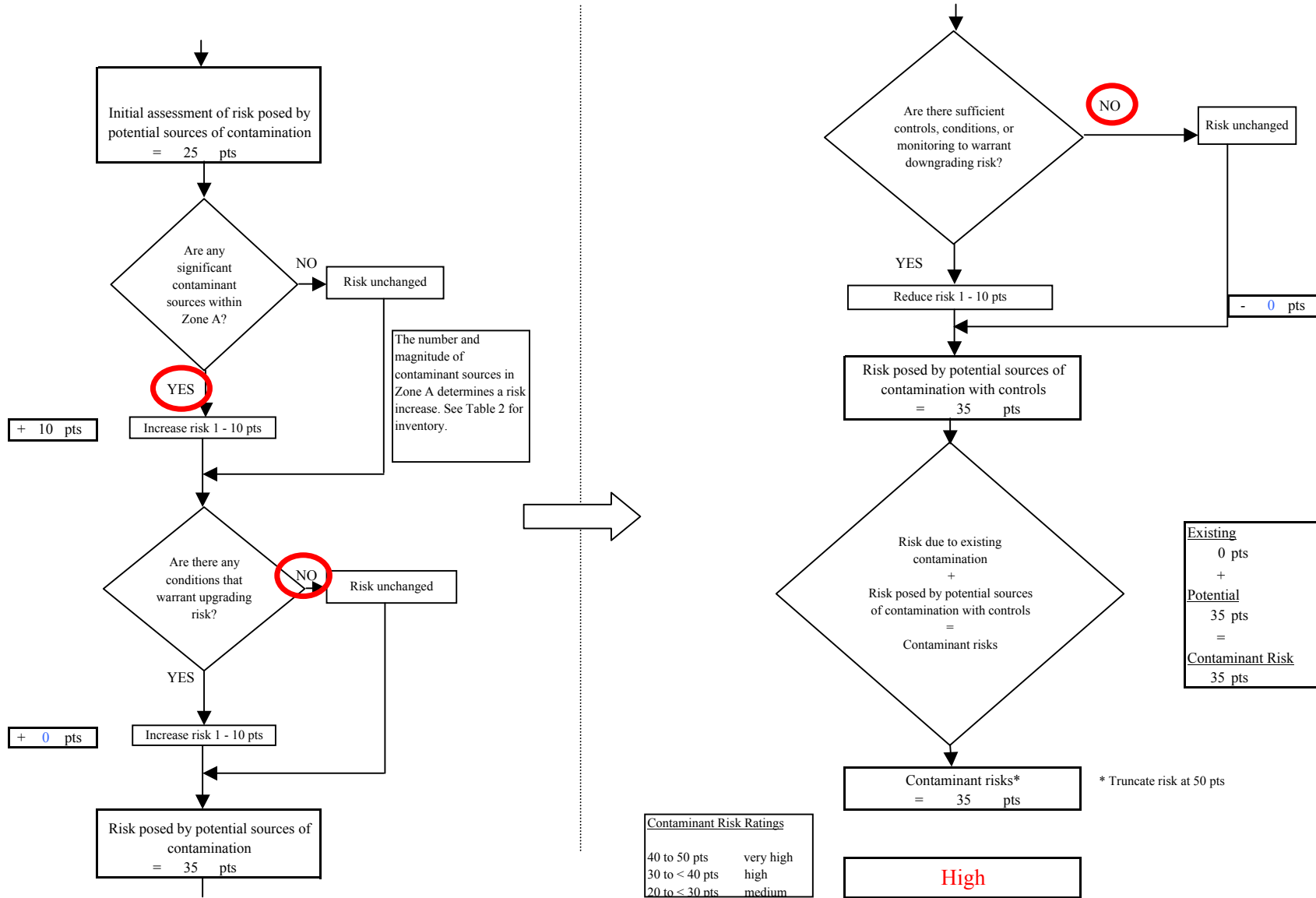


Chart 4. Vulnerability analysis for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Bacteria & Viruses

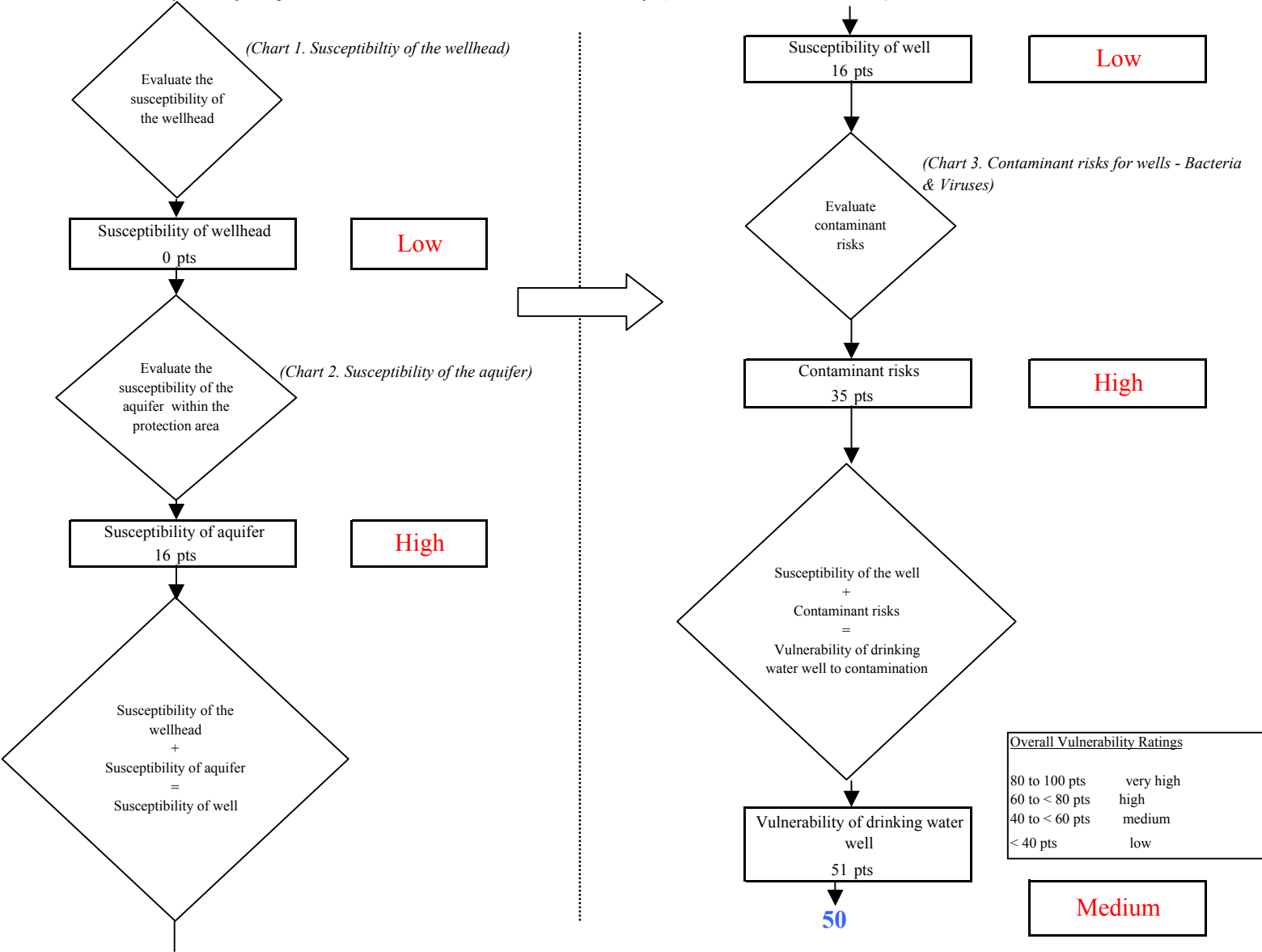


Chart 5. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Nitrates and Nitrites

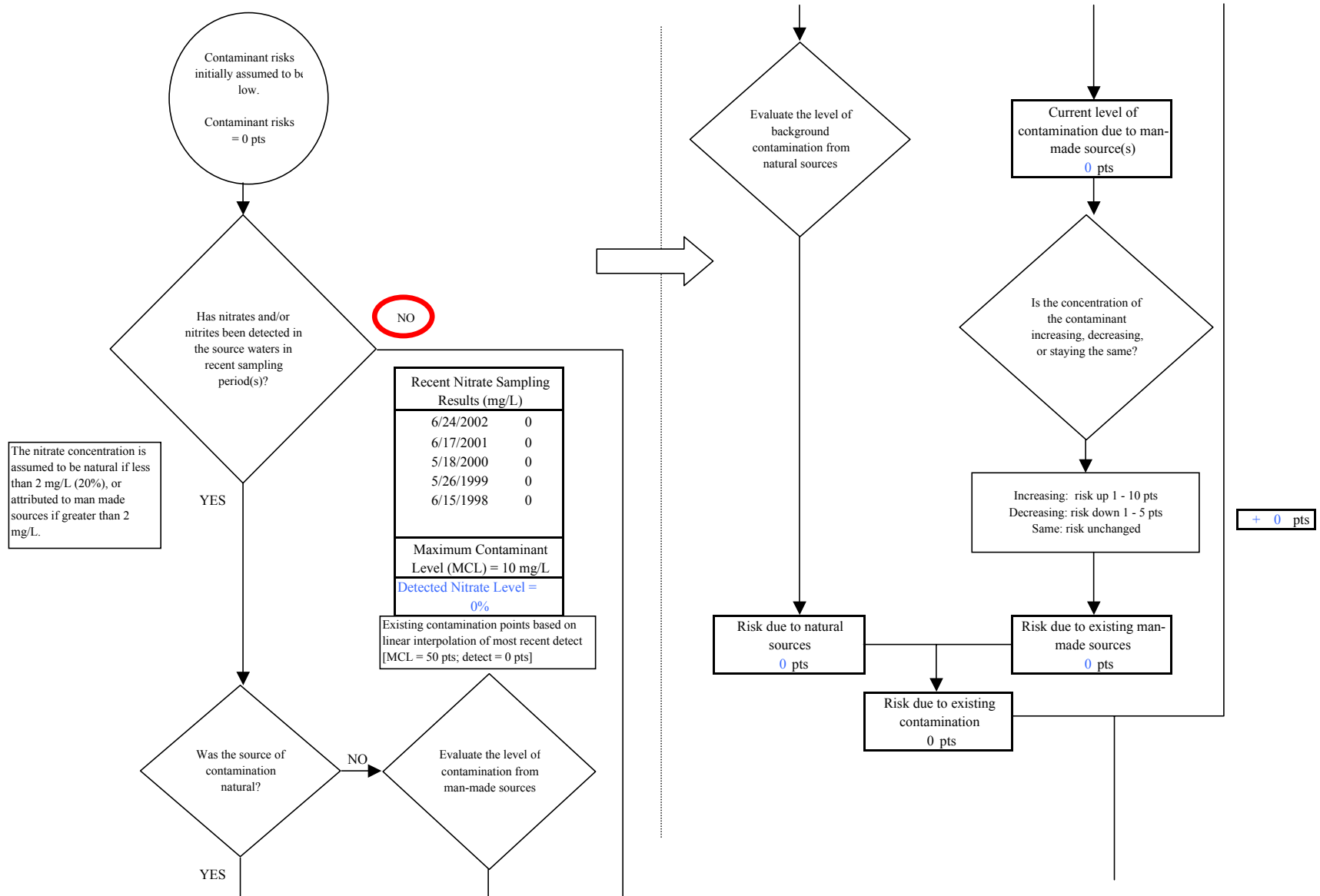


Chart 5. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Nitrates and Nitrites

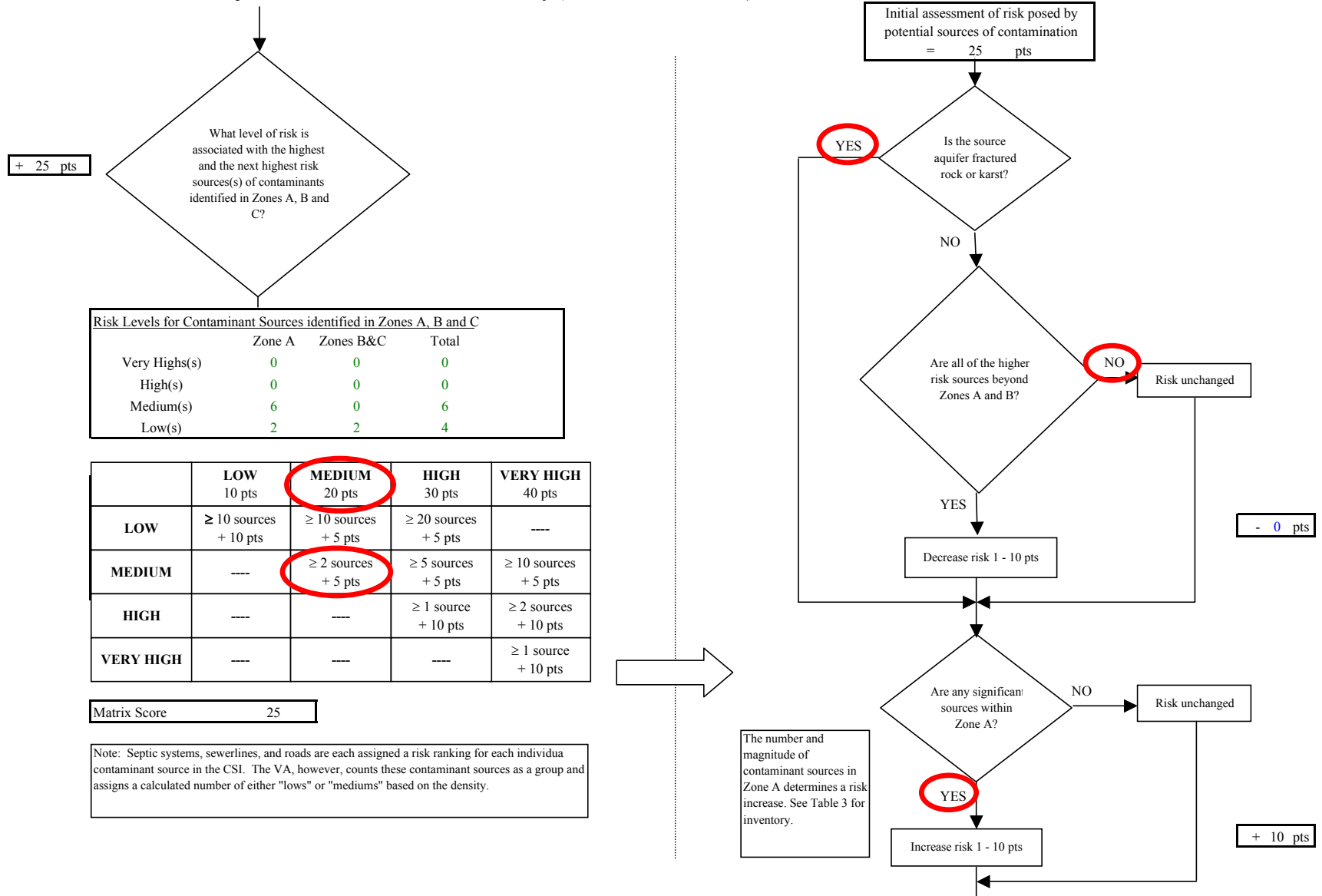


Chart 5. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Nitrates and Nitrites

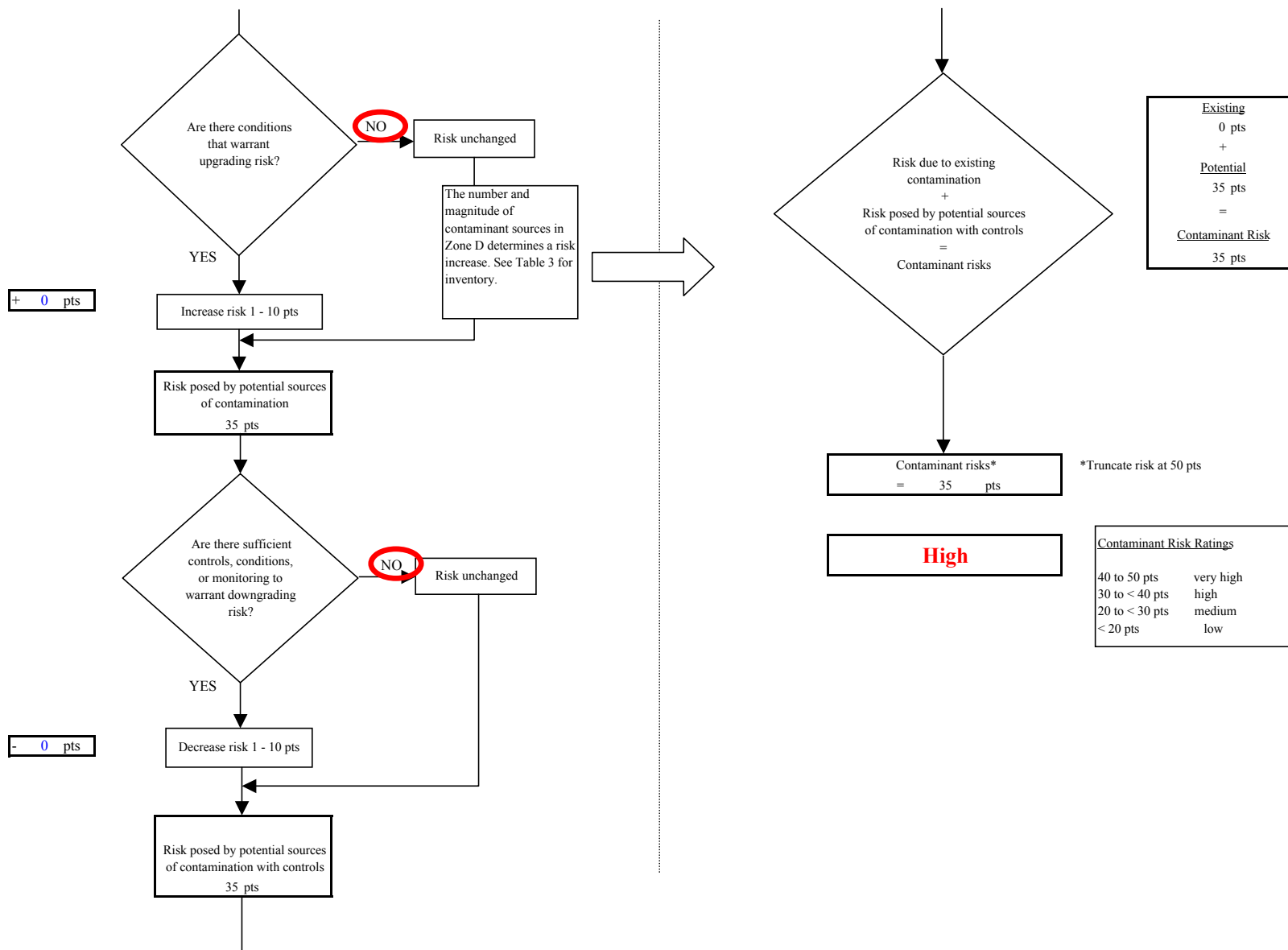


Chart 6. Vulnerability analysis for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Nitrates and Nitrites

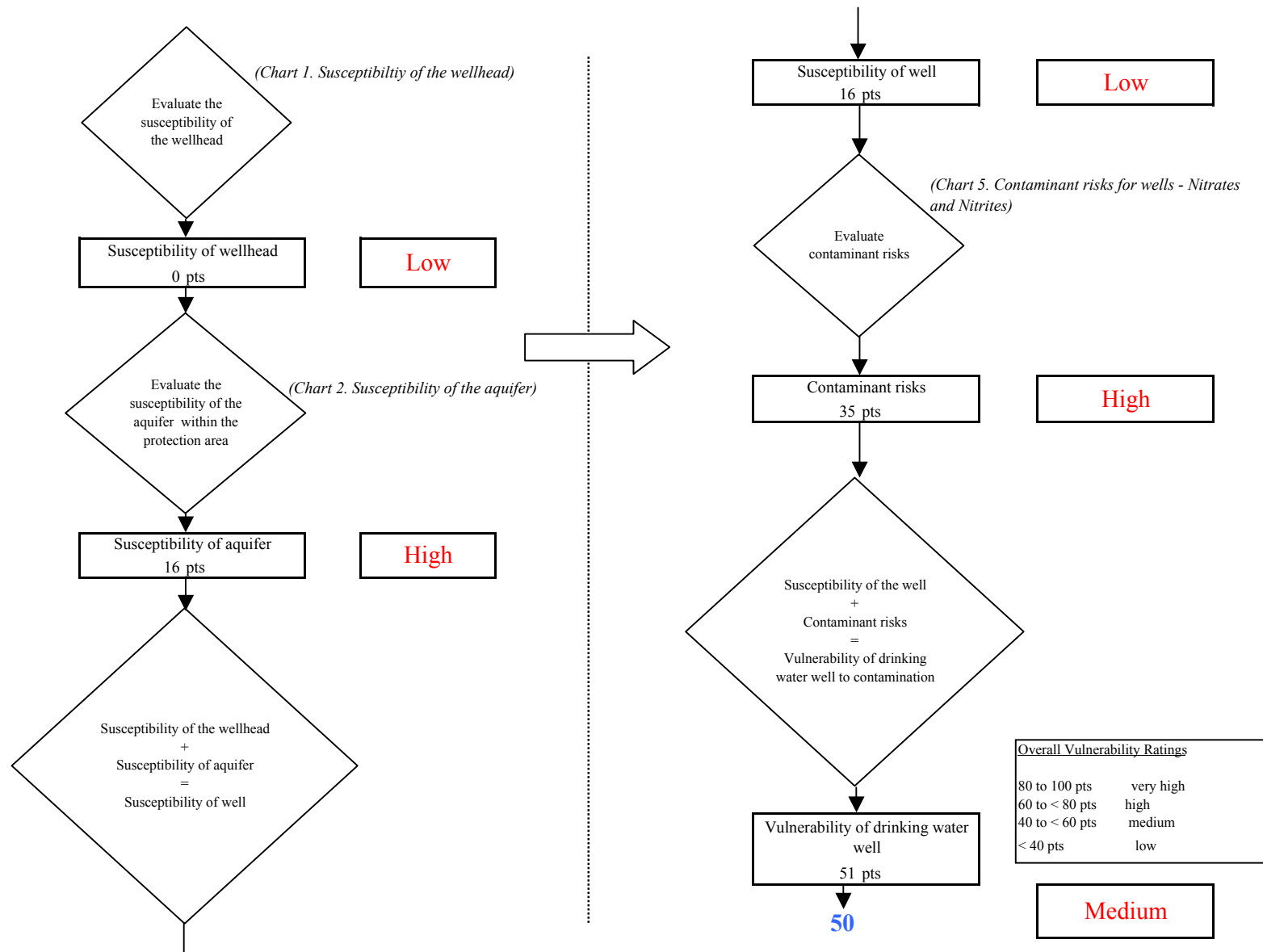


Chart 7. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Volatile Organic Chemicals

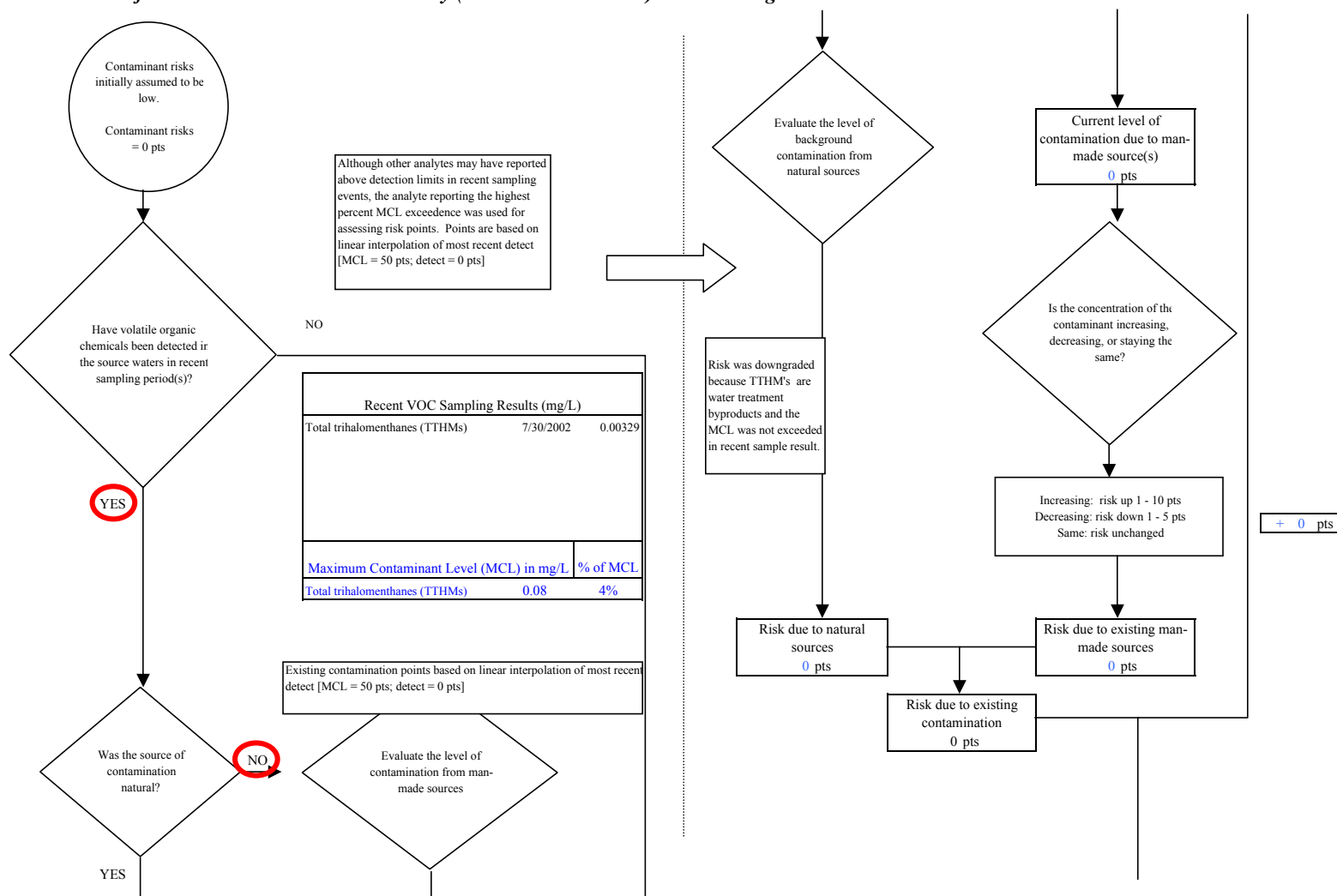


Chart 7. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Volatile Organic Chemicals

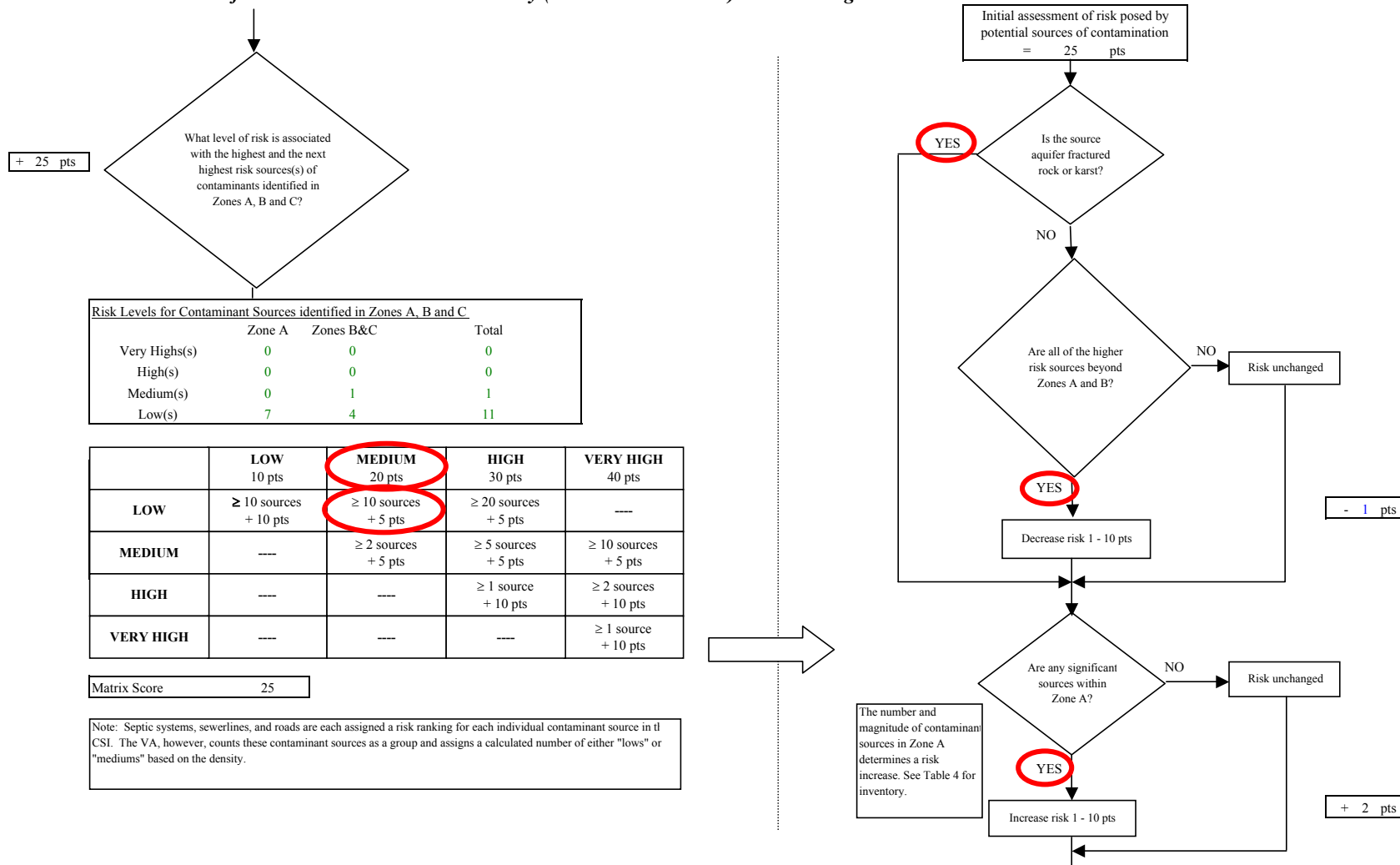


Chart 7. Contaminant risks for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Volatile Organic Chemicals

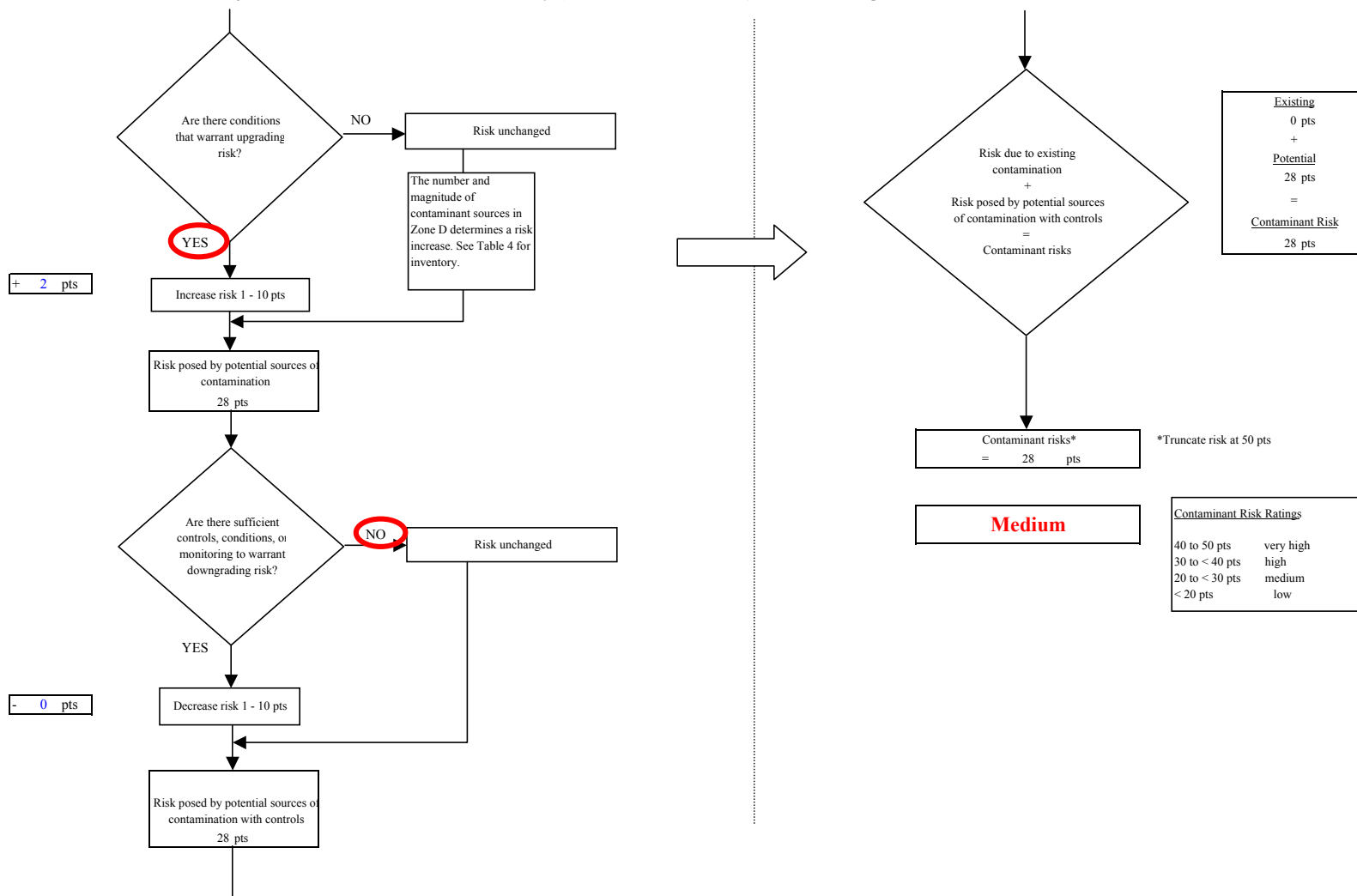


Chart 8. Vulnerability analysis for Div Parks Fort Abercrombie Bay (PWS No. 250249.001) - Volatile Organic Chemicals

