Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Forelands Drinking Water System, Nikiski, Alaska

Forelands

PWSID # 240634.001

March 31, 2003

DRINKING WATER PROTECTION PROGRAM REPORT 479
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 Forelands Source of Public Drinking Water, Nikiski, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for the Forelands is a Class B (transient/non-community) water system consisting of one well. The Forelands is located north of Kenai on the Kenai Spur Highway in Nikiski, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the Forelands public drinking water source include: large capacity septic systems, an industrial landfill, an ADEC recognized contaminated site, and highways and roads. 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 public water source for the Forelands received a vulnerability rating of **Low** for Bacteria and Viruses and Nitrates and a **Medium** for Volatile Organic Chemicals.

FORELANDS PUBLIC DRINKING WATER SYSTEM

The Forelands public water system (PWS) is a Class B (transient/non-community) water system. The system consists of one well located north of Kenai on the Kenai Spur Highway in Nikiski, Alaska (T07N, R12W, Section 21) (See Map 1 of Appendix A). Nikiski is part of the Kenai Peninsula Borough, which is located directly south of the city of Anchorage (Please see the inset of Map 1 in Appendix A for location). The borough encompasses 25,600 square miles, of which only 15,700 square miles is land.

The Kenai Peninsula is broken into two distinct geographic areas; the Kenai Mountains and the Kenai Lowlands. Nikiski and its surrounding communities are located in the Kenai Lowlands. Communities located within the Kenai Lowlands include Sterling, Soldotna, Kenai, Nikiski, Clam Gulch, Ninilchik, and Homer.

The Kenai Peninsula area topography varies from about 3,000 feet to 5,000 feet above sea level in the Kenai Mountains, the highest point being about 6,400 feet above sea level. The Kenai Peninsula is dotted with many lakes and small streams, including three large lakes (Kenai Lake, Skilak Lake, and Tustemena Lake) and two substantial rivers (Kenai River, and Kasilof River) (USGS 1915).

The Forelands water system is located within the Kenai Lowlands, which is a sub-province of the Cook Inlet-Susitna Lowland physiographic region. The Kenai Lowland is a glaciated coastal shelf situated west of the northeast-trending Kenai Mountains. Approximately 100 miles long, the coastal shelf is bordered on the west by Cook Inlet, on the east by Kenai Mountains, on the north by Turnagain Arm, and on the south by the Caribou Hills and Kachemak Bay. The following summary of regional geology and hydrogeology is based on studies by Bailey and Hogan (1995); Freethey and Scully (1980); Glass (1996); Hartman, et al. (1972); and Karlstrom (1964).

The Kenai Lowland is underlain by bedrock. Tertiary sedimentary bedrock is more than 500 feet below the city of Kenai airport, but is exposed along beach cliffs and road cuts near the southwest end of the lowland. Unconsolidated surficial deposits of Quaternary age include coastal deposits, glaciolacustrine deposits, glaciofluvial deposits, glacial moraine deposits, and periglacial wind deposits. Unconsolidated Quaternary cover on the lowlands generally thickens from south to North being thin or absent in the Homer area, and over 750 feet thick near Nikiski.

The most significant groundwater resources of the Kenai Lowlands are contained in Quarternary coarse-grained sands and gravels. Flood plain, river terrace and other alluvial deposits are common aquifer materials in the area, and are characterized by high rates of recharge, and large saturated thicknesses. Other favorable materials include proglacial lake and associated river deposits and glacial outwash deposits consisting of meltwater sorted sand and gravel material. Unsorted flacial moraine and drift deposits generally have poor groundwater yields, as do discontinuous layers of confining clays and silt that are common throughout the unconsolidated materials. The relatively thicker sequence of unconsolidated sediments in the northern portions of the Kenai

Lowlands locally hosts thicker, more extensive clay aquitards and multiple aquifers.

The Kenai Peninsula area has a central water system, however, many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are deep with depths between 50 and 200 feet. Static water levels in many of these wells are between 10 and 30 feet below the surface. Although groundwater quality can vary significantly in short distance, groundwater supplies are abundant in the area.

According to information supplied by ADEC for the Forelands PWS, the depth of the well is 165 feet below ground surface (bgs), and is assumed screened in a confined aquifer. A well log is not available for this system. Based on surrounding well construction data, it is assumed that the static water level is approximately 89 feet bgs. The well is not located in a floodplain.

The Sanitary Survey (08/10/1999) for the water system indicated that the land is sloped away from the well providing adequate surface water drainage. The well is not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling down the annulus along the well casing and into source waters.

This system operates year round and serves up to 100 non-residents through one service connection.

FORELANDS 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 Forelands. 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 Forelands was determined using an analytical calculation and includes Zone A, B, C, and D (See Map 1 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 Forelands 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 1 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 FORELANDS 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.

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

A well log is not available for the Forelands PWS, however, based on surrounding well construction data, it is assumed completed 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 Forelands.

Table 2. Susceptibility

	Score	**Rating**
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	15	High
Natural Susceptibility	20	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	15	Low
Nitrates and/or Nitrites	5	Low
Volatile Organic Chemicals	35	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 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	35	Low
Nitrates and Nitrites	25	Low
Volatile Organic Chemicals	55	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is Low. The risk is primarily attributed to the presence of one highway and road located in Zone B and two large-capacity septic systems located in Zone D (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. Bacteria and viruses have not been detected during recent water sampling of the system at the Forelands. 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 Low.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is Low. The low risk to this source of public drinking water is primarily attributed to the presence of highway and roads, large capacity septic systems and residential areas located in Zones B, C, and D, and no reported nitrate readings from recent sampling events (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history for the Forelands well does not indicate the presence of nitrates and nitrites. The nitrate concentration from the most recent sampling event is 6% (0.6 mg/L) of the Maximum Contaminant Level (MCL) of 10 mg/L. Nitrates have not been detected at the Forelands well since April of 1996. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects.

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 Low.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is High. The risk is primarily attributed to the presence of an ADEC recgonized contaminated site in Zone A (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

The drinking water at Forelands has not been sampled for volatile organic chemicals. 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.

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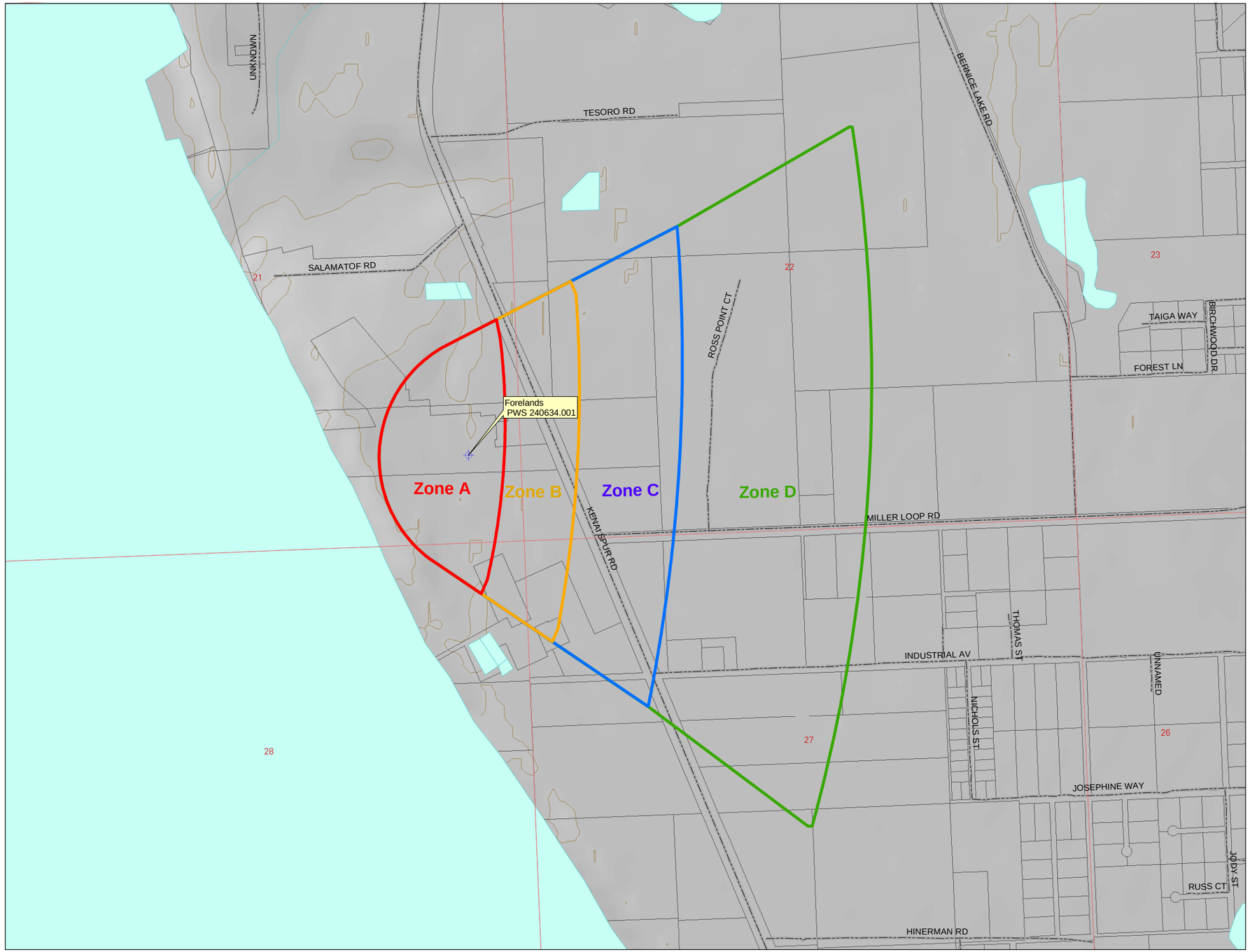
APPENDIX A

Forelands
Drinking Water Protection Area Location Map
(Map 1)

Drinking Water Protection Areas for the Public Water Well System for PWS #240634.001 Forelands



LEGEND

Public Water System Well

Groundwater Protection Zones

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

Hydrography/Physical

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

Transportation

- Roads

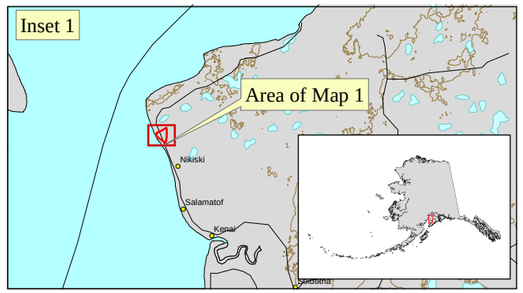
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Parcels
Kenai Peninsula Borough

All other data
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC
Calculation Spreadsheet.

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



0 950 1,900 3,800 5,700 7,600 Feet

Forelands PWS 240634.001

Appendix A Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Forelands (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 240634.001***

Forelands

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	1	Phillips Petroleum LNG Plant - Lower, Closed - No File # - ADEC RECKEY: 1992230131701 http://www.dec.state.ak.us/spar/cs/cs_search.htm
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	1	Miller Loop Rd.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	D	1	
Landfills (industrial;liquid drilling muds)	D52	D52-01	D	1	North Kenai Tesoro Alaska Petroleum Co. Landfill
Residential Areas	R01	R01-01	D	1	4.14 acres of residential area in zone D
Highways and roads, paved (cement or asphalt)	X20	X20-03	D	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-05	D	1	Miller Loop Rd.
Highways and roads, paved (cement or asphalt)	X20	X20-06	D	1	Industrial Ave.
Highways and roads, paved (cement or asphalt)	X20	X20-07	D	1	Ross Point Ct.

Table 2

Contaminant Source Inventory and Risk Ranking for Forelands

Sources of Bacteria and Viruses

PWSID 240634.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	1	Kenai Spur Road
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	D	High	1	

Table 3

Contaminant Source Inventory and Risk Ranking for Forelands

Sources of Nitrates/Nitrites

PWSID 240634.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	Low	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Low	1	Miller Loop Rd.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	D	High	1	
Residential Areas	R01	R01-01	D	Low	1	4.14 acres of residential area in zone D
Highways and roads, paved (cement or asphalt)	X20	X20-03	D	Low	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-05	D	Low	1	Miller Loop Rd.
Highways and roads, paved (cement or asphalt)	X20	X20-06	D	Low	1	Industrial Ave.
Highways and roads, paved (cement or asphalt)	X20	X20-07	D	Low	1	Ross Point Ct.

Table 4

Contaminant Source Inventory and Risk Ranking for Forelands

Sources of Volatile Organic Chemicals

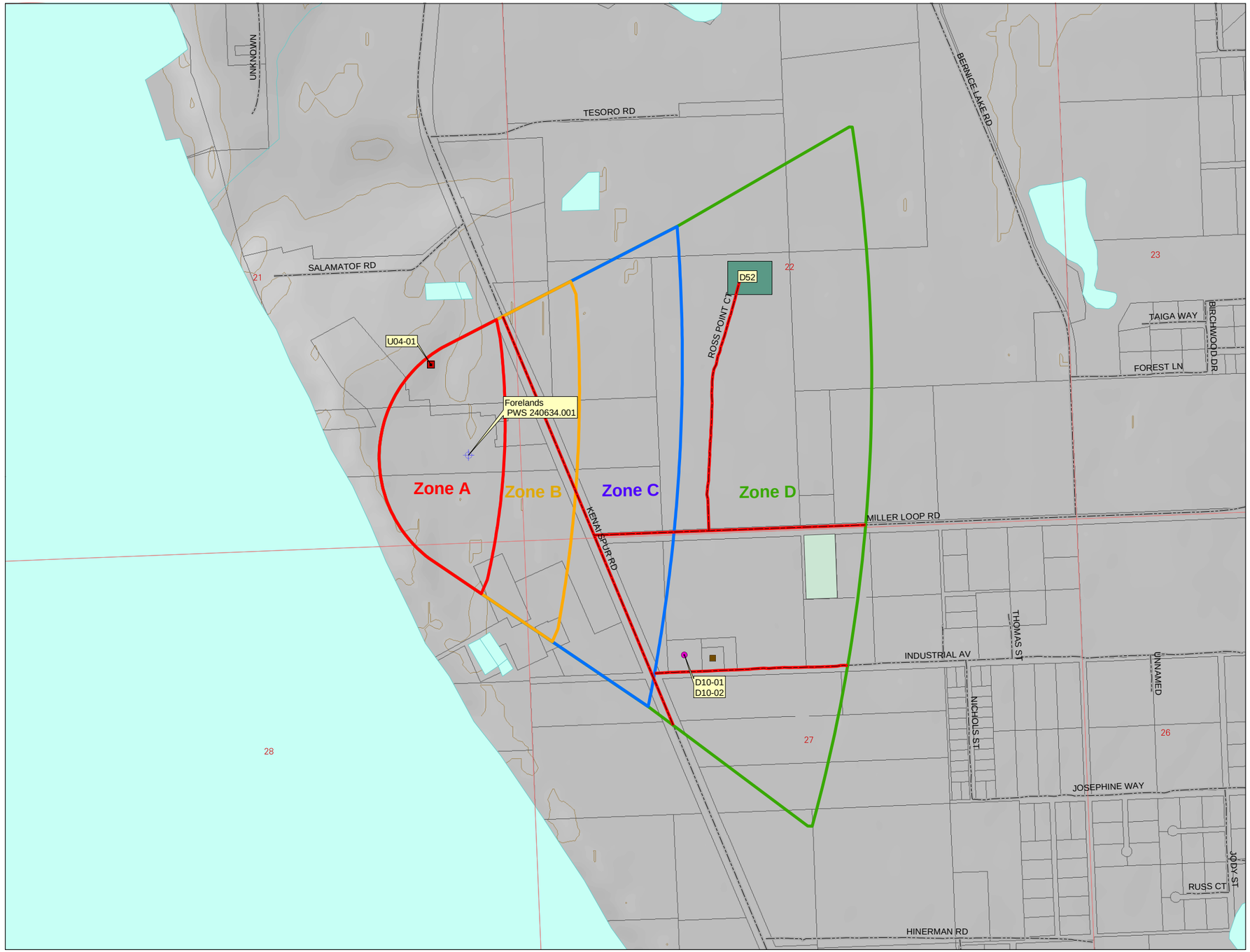
PWSID 240634.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	High	1	Phillips Petroleum LNG Plant - Lower, Closed - No File # - ADEC RECKEY: 1992230131701 http://www.dec.state.ak.us/spar/cs/cs_search.htm
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	Low	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Low	1	Miller Loop Rd.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	D	Low	1	
Residential Areas	R01	R01-01	D	Low	1	4.14 acres of residential area in zone D
Highways and roads, paved (cement or asphalt)	X20	X20-03	D	Low	1	Kenai Spur Road
Highways and roads, paved (cement or asphalt)	X20	X20-05	D	Low	1	Miller Loop Rd.
Highways and roads, paved (cement or asphalt)	X20	X20-06	D	Low	1	Industrial Ave.
Highways and roads, paved (cement or asphalt)	X20	X20-07	D	Low	1	Ross Point Ct.

APPENDIX C

Forelands
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 1)

Drinking Water Protection Areas for the Public Water Well System for PWS #240634.001 Forelands
Showing Potential and Existing Sources of Contamination



LEGEND

Public Water System Well

Groundwater Protection Zones

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

Contaminant Sources

- Injection Wells (Class V) Large Capacity Septic System (D10)
- Septic Systems (serves one or more single family homes) (R2)
- Contaminated Sites, DEC Recognized, non-Superfund, non-RCRA (U04)
- Highways and roads, paved (X20)
- Residential Areas (R1)
- Landfills (Industrial) (D52)

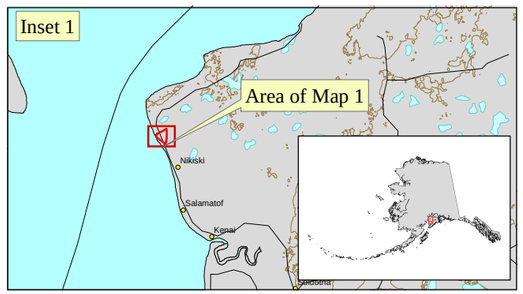
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Parcels
Kenai Peninsula Borough

All other data
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC
Calculation Spreadsheet.

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



0 950 1,900 3,800 5,700 7,600 Feet

Forelands PWS 240634.001

Appendix C Map 1

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - Forelands (240634.001)

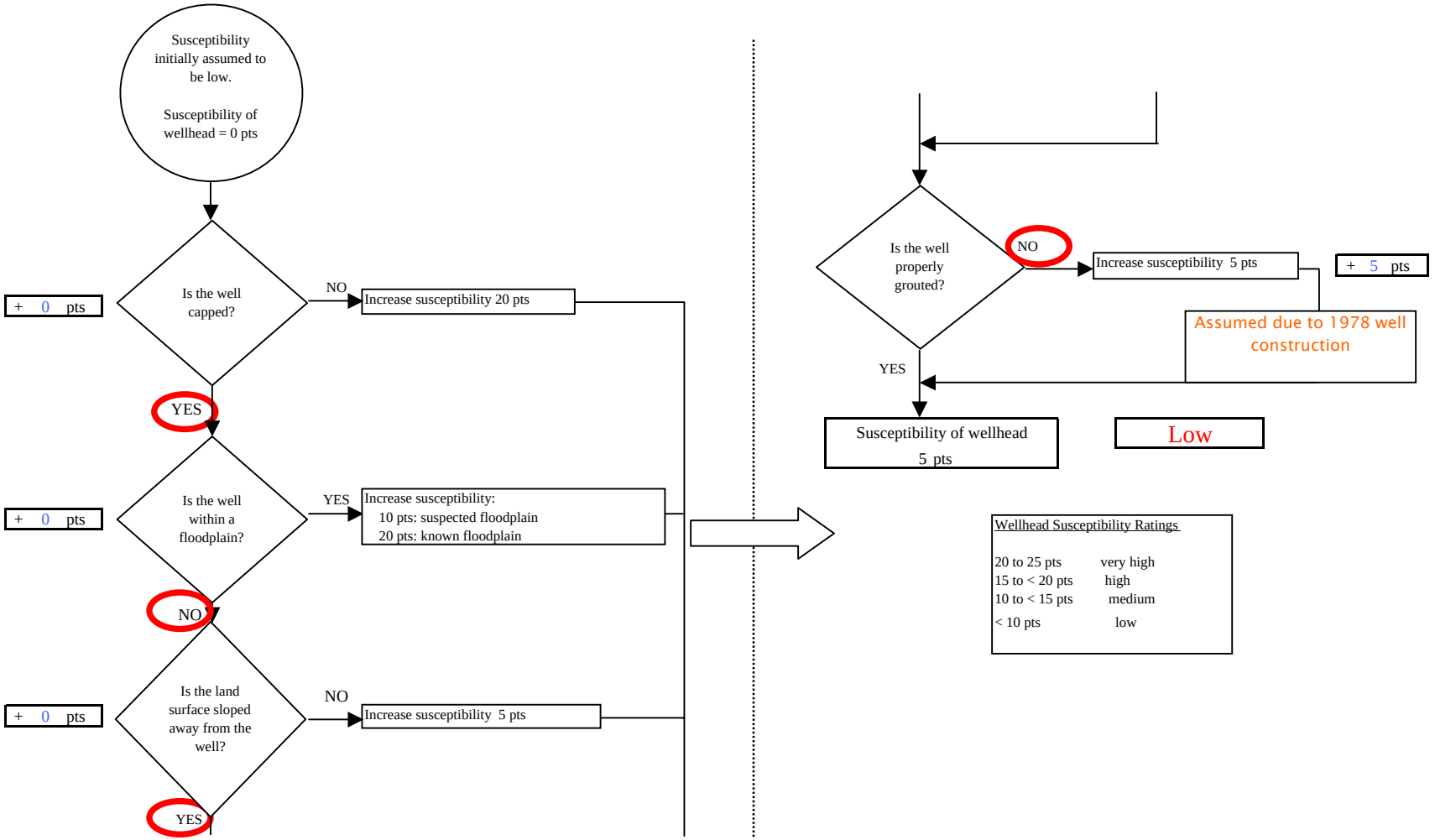


Chart 2. Susceptibility of the aquifer - Forelands (240634.001)

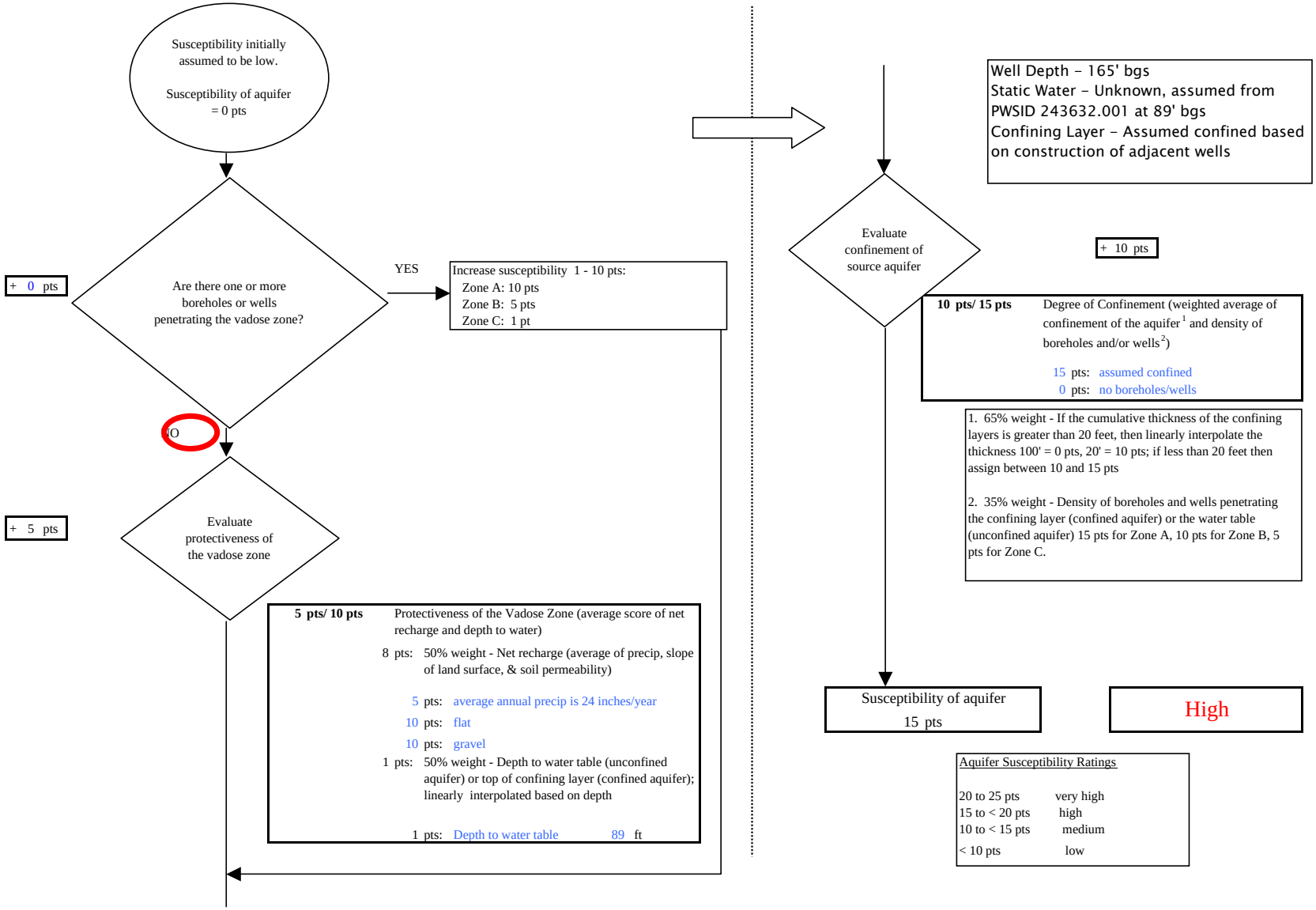
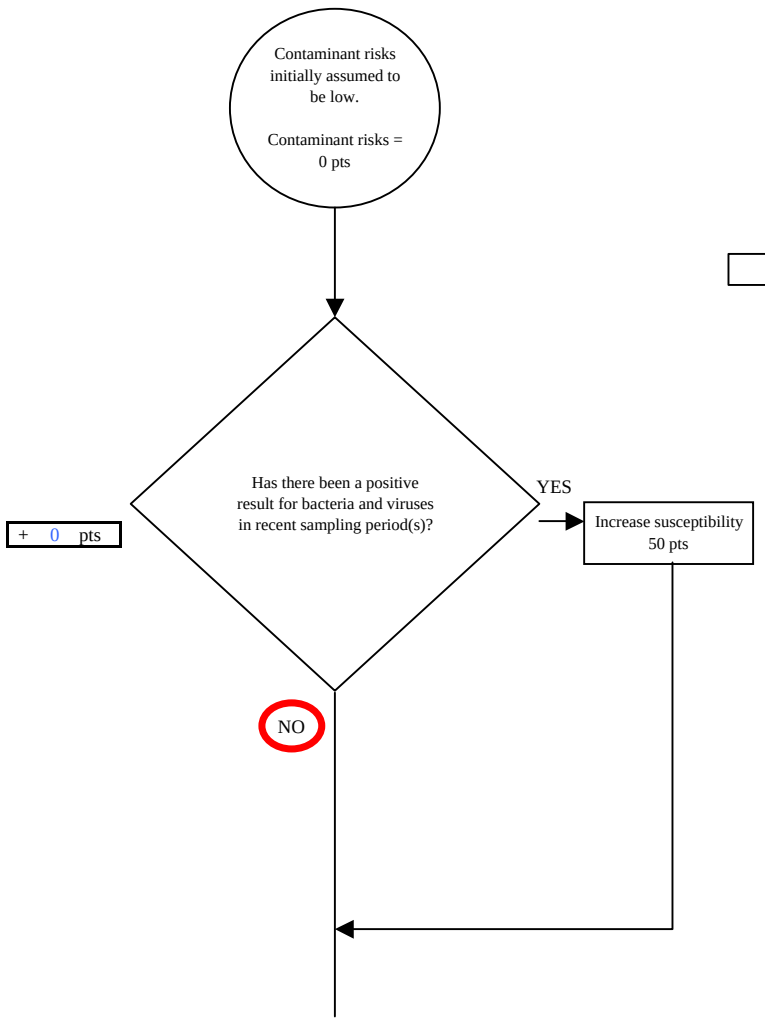
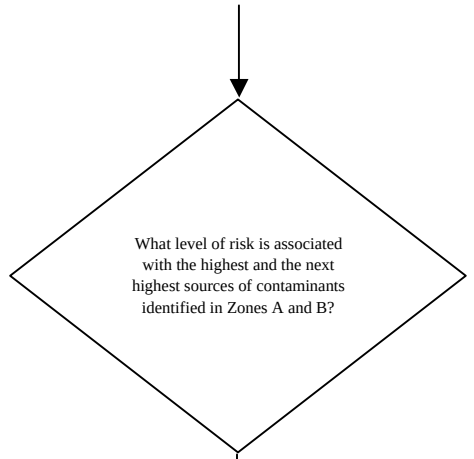


Chart 3. Contaminant risks for Forelands (240634.001) - Bacteria & Viruses





+ 10 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

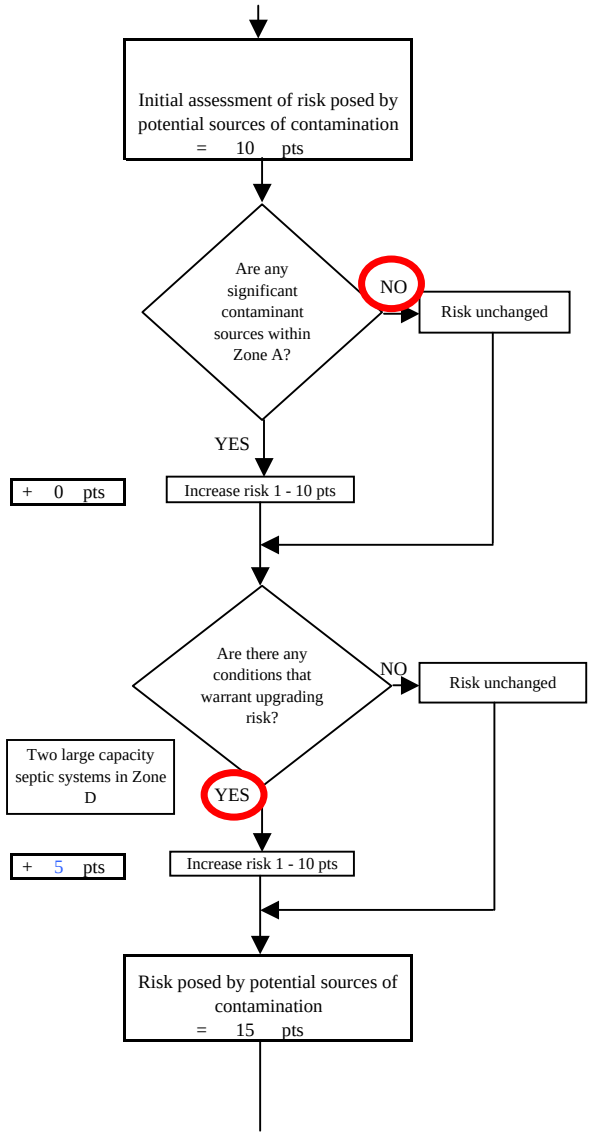
	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	0	1	1

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 10

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each 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 Forelands (240634.001) - Bacteria & Viruses



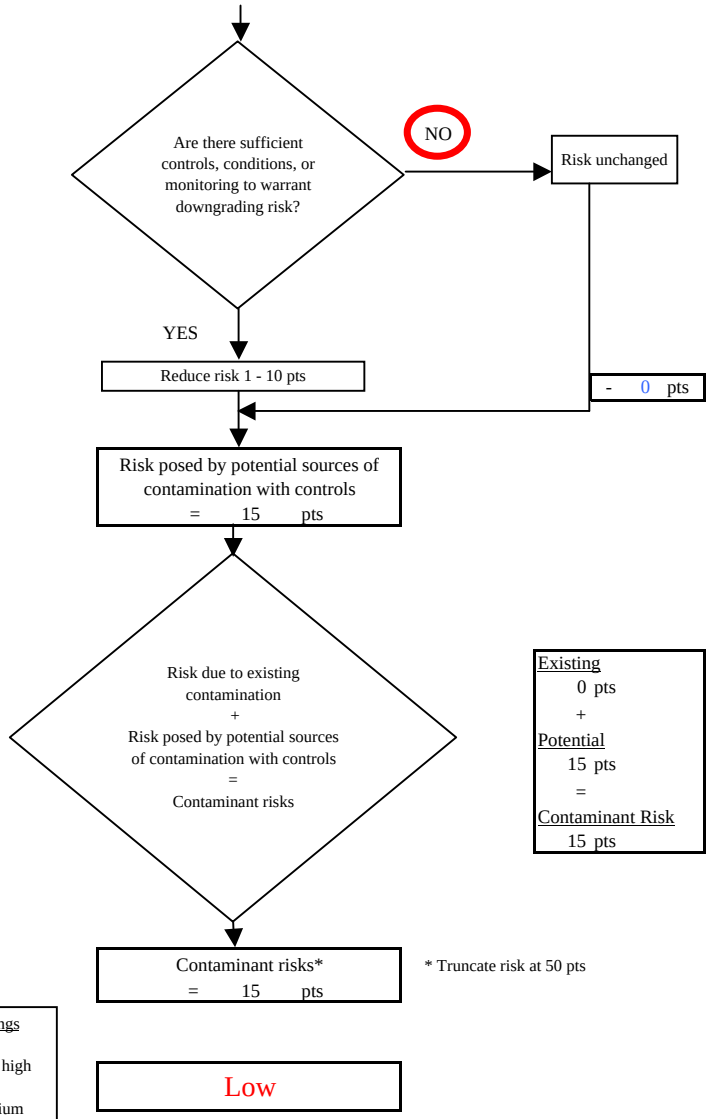


Chart 4. Vulnerability analysis for Forelands (240634.001) - Bacteria & Viruses

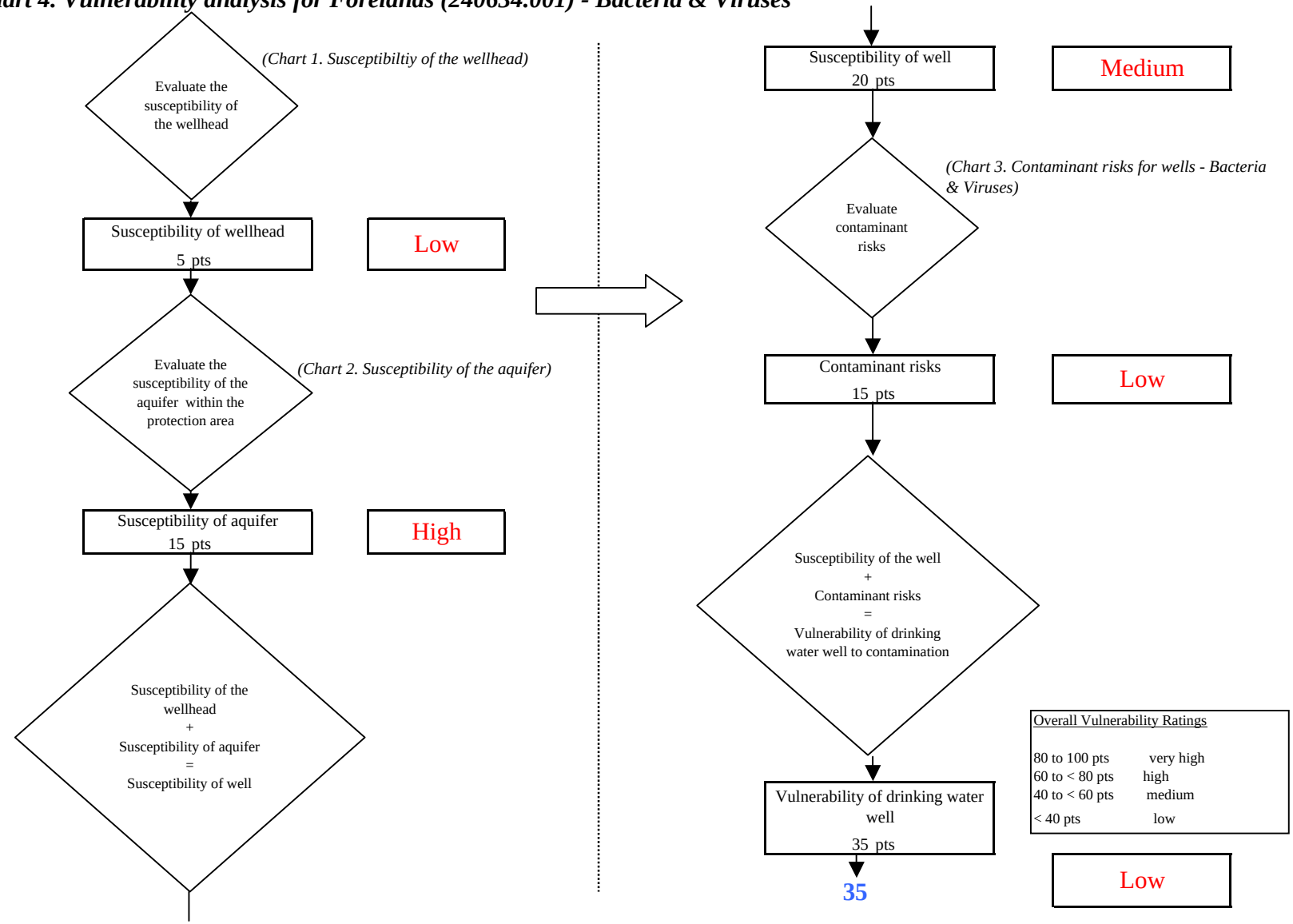


Chart 5. Contaminant risks for Forelands (240634.001) - Nitrates and Nitrites

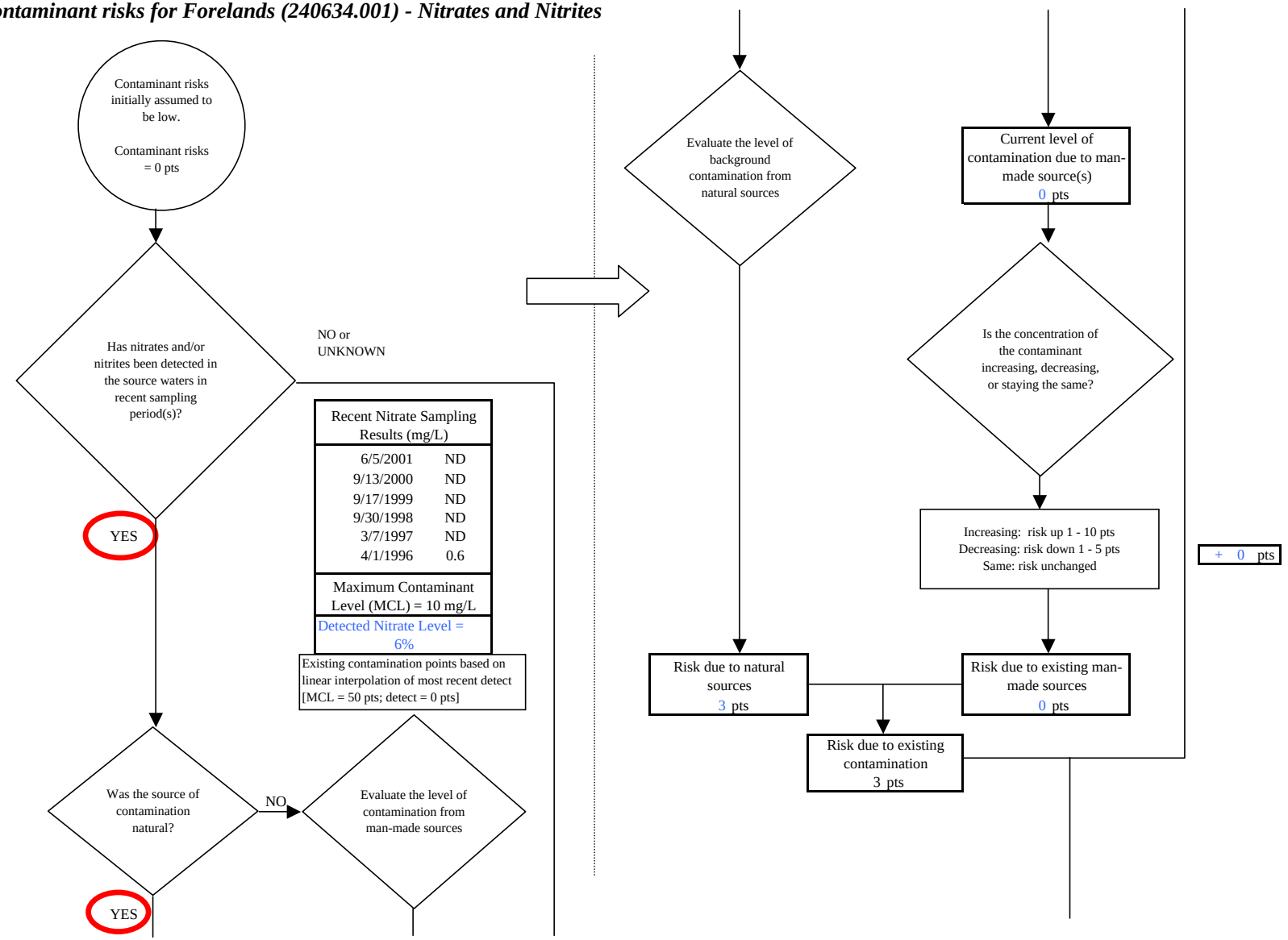


Chart 5. Contaminant risks for Forelands (240634.001) - Nitrates and Nitrites

+ 10 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, 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)	0	1	1

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 10

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

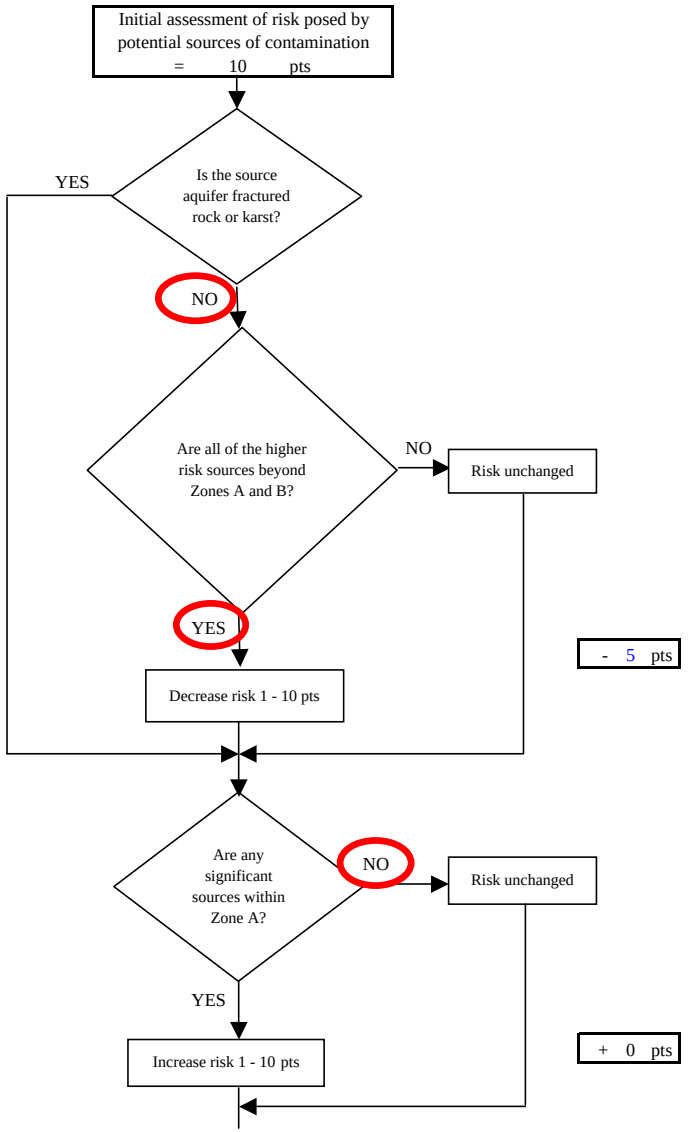


Chart 5. Contaminant risks for Forelands (240634.001) - Nitrates and Nitrites

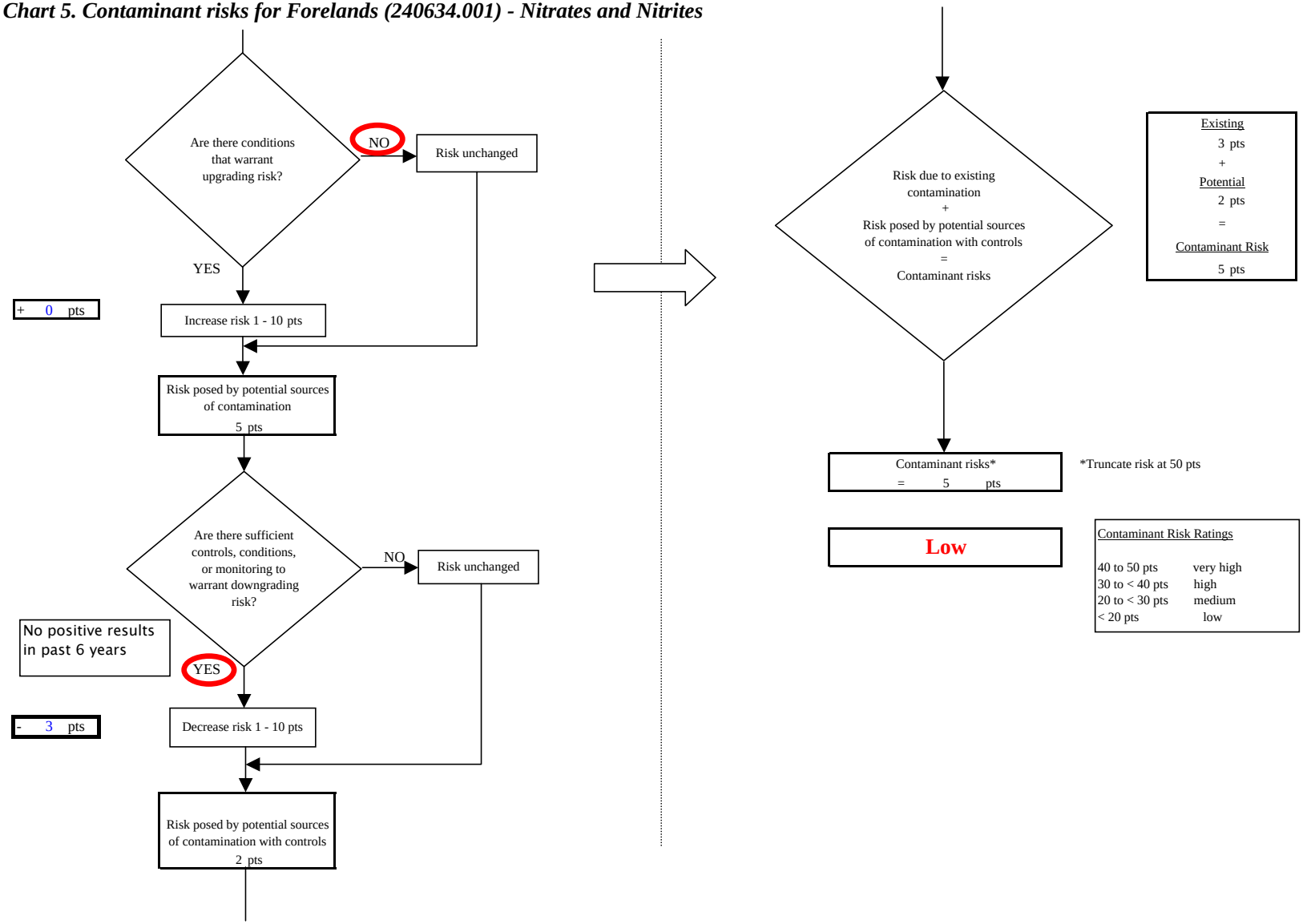


Chart 6. Vulnerability analysis for Forelands (240634.001) - Nitrates and Nitrites

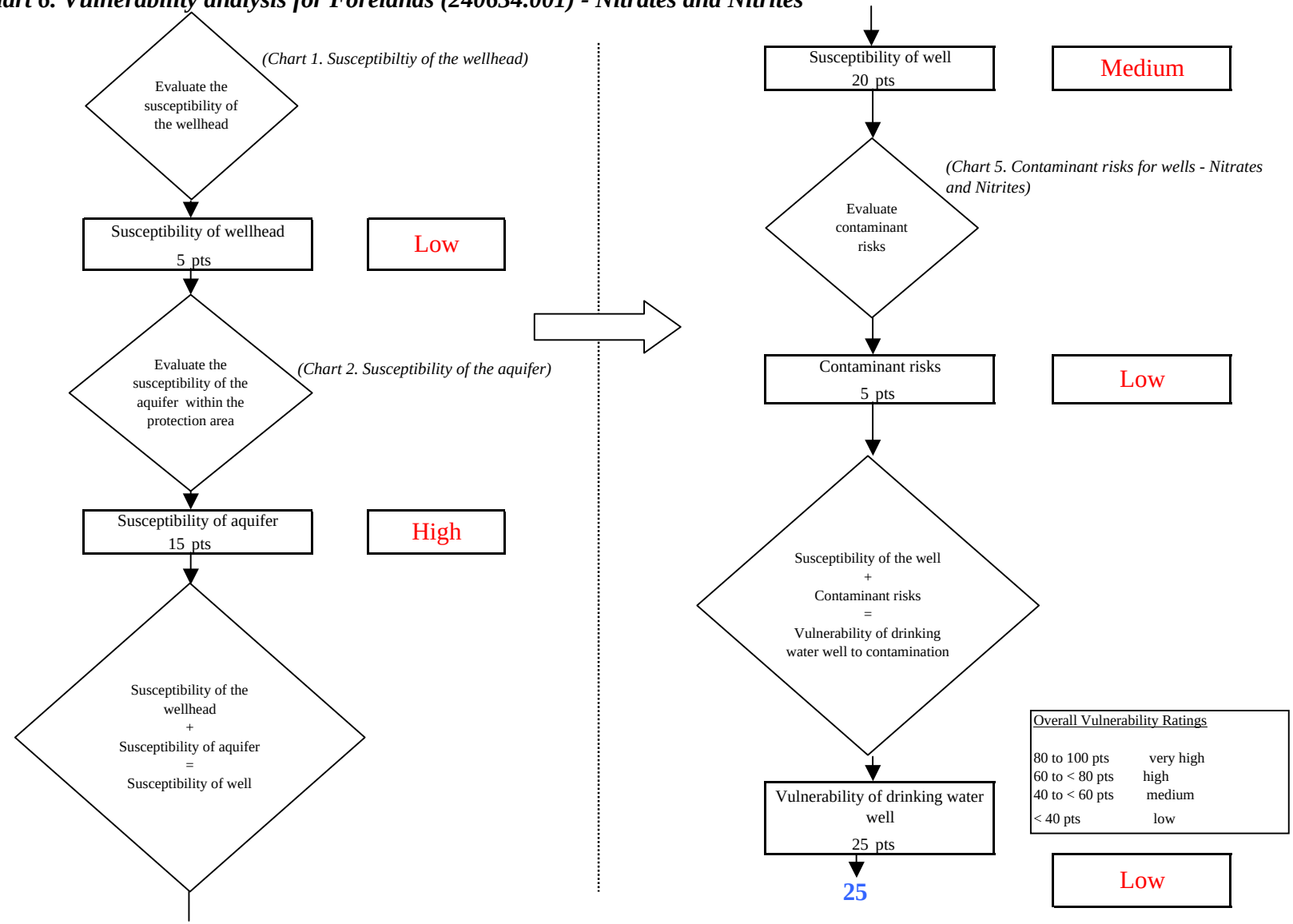


Chart 7. Contaminant risks for Forelands (240634.001) - Volatile Organic Chemicals

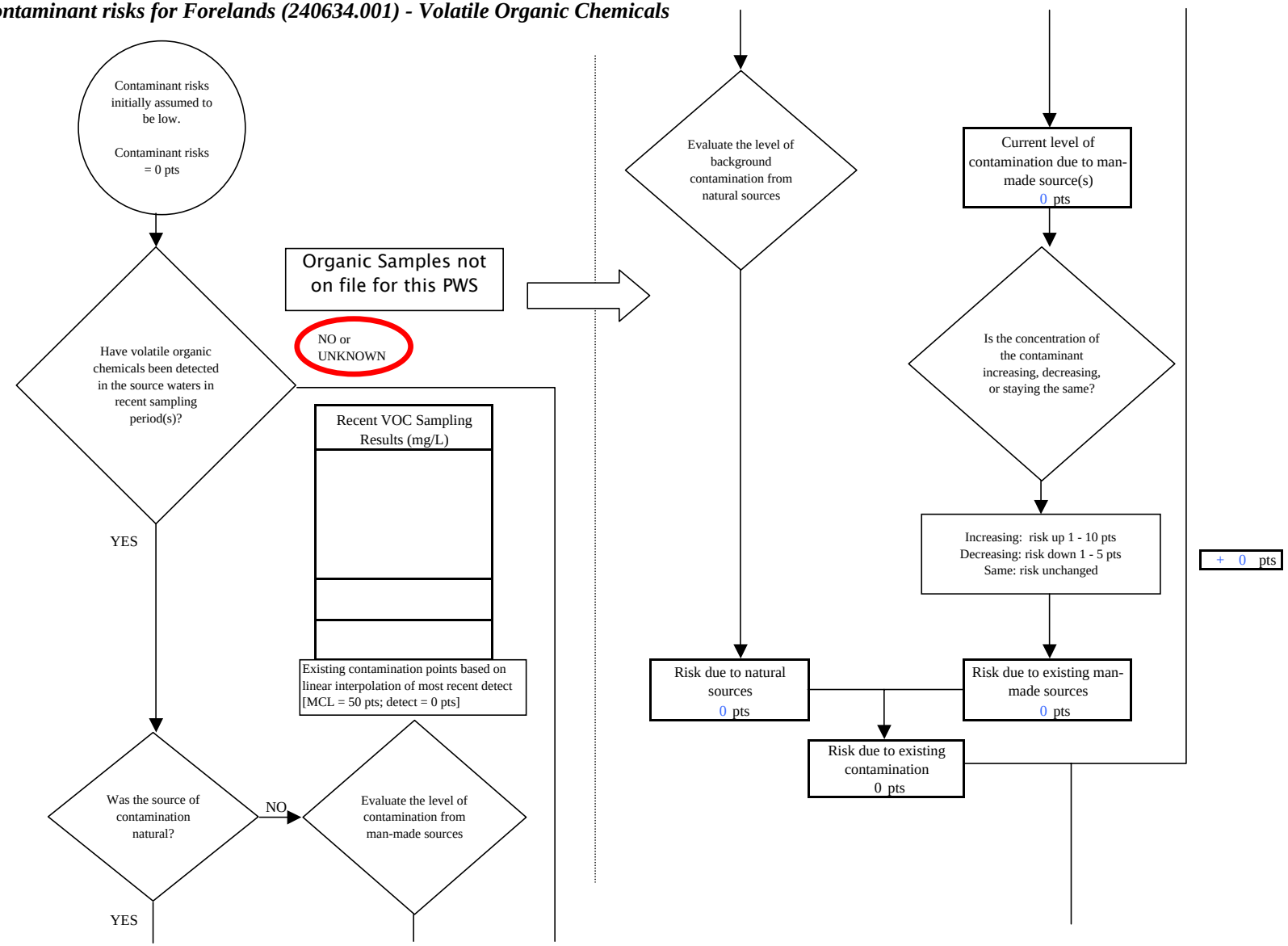
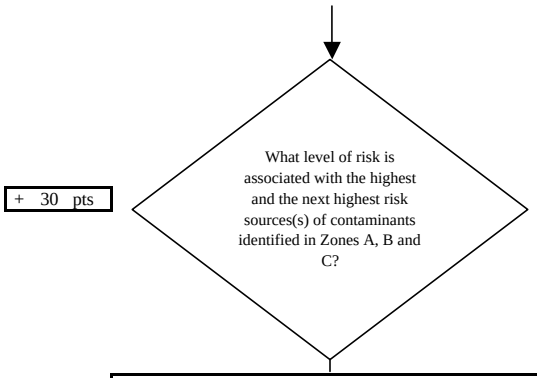


Chart 7. Contaminant risks for Forelands (240634.001) - Volatile Organic Chemicals



+ 30 pts

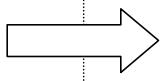
Risk Levels for Contaminant Sources identified in Zones A, B and C

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



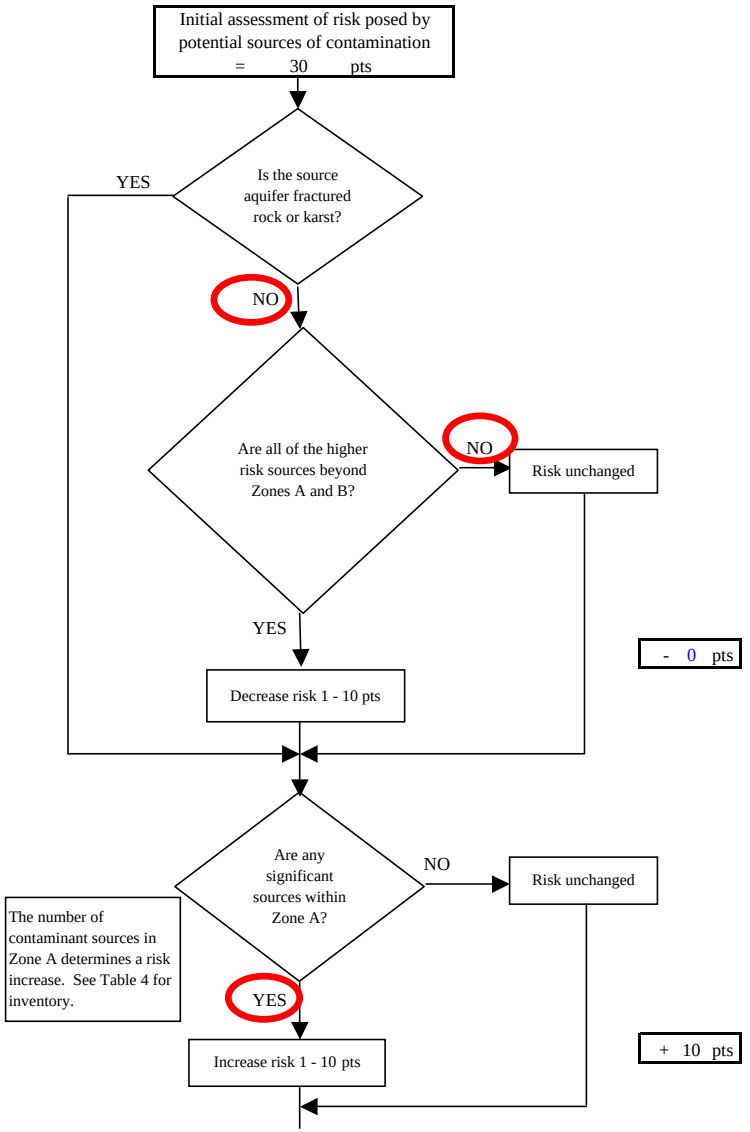


Chart 7. Contaminant risks for Forelands (240634.001) - Volatile Organic Chemicals

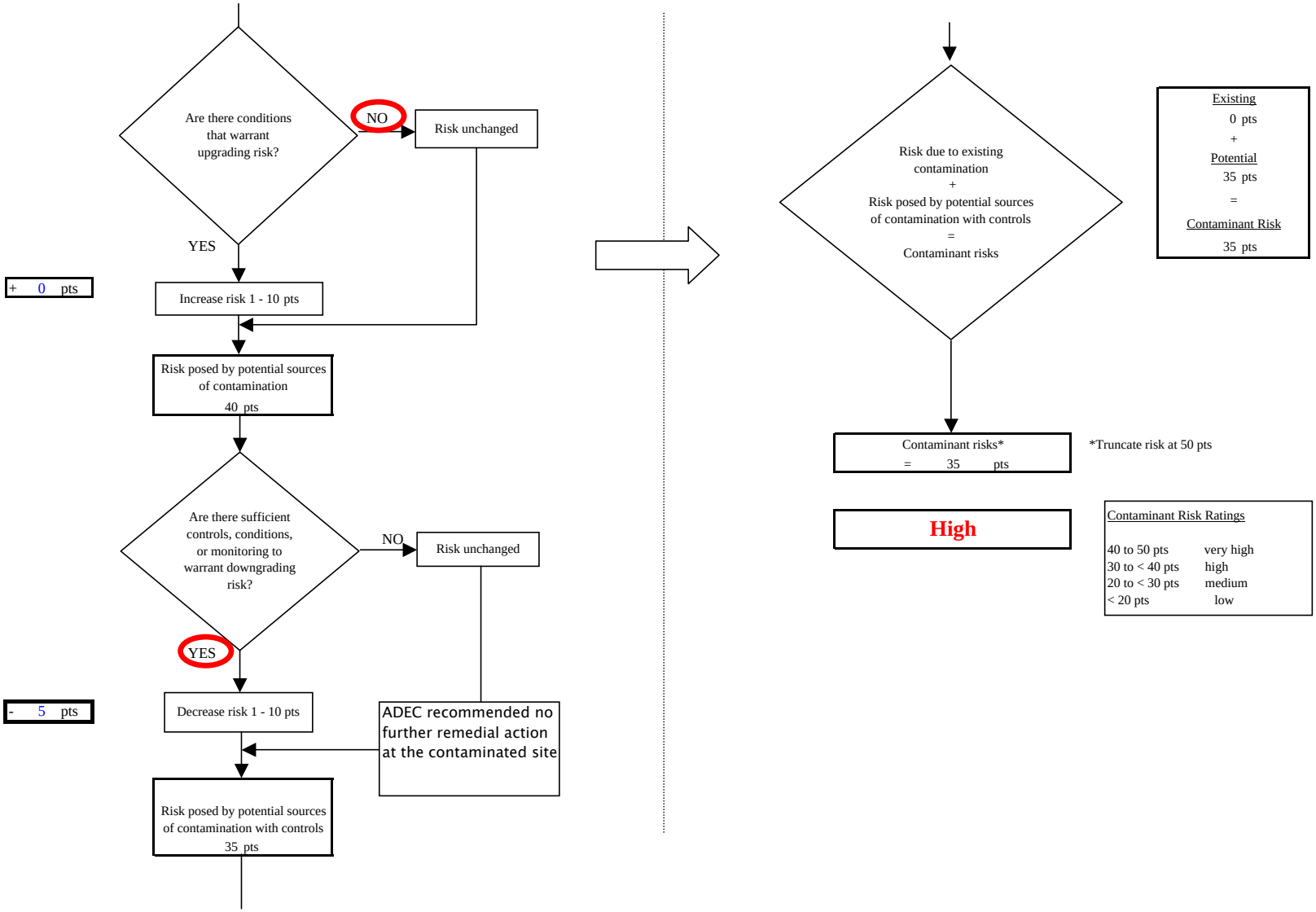


Chart 8. Vulnerability analysis for Forelands (240634.001) - Volatile Organic Chemicals