Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Hitching Post Drinking Water System, Kenai, Alaska

Kenai

PWSID # 243153.001

June 23, 2003

DRINKING WATER PROTECTION PROGRAM REPORT 518
Alaska Department of Environmental Conservation

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Kenai, Alaska
Hitching Post
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DRINKING WATER PROTECTION PROGRAM REPORT 518

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 public water system for the Hitching Post is a Class B (transient/non-community) water system consisting of one well. The Hitching Post is located at mile 16 of the Kenai Spur Highway, Government Lot 137, north of the Kenai Spur Road, Kenai, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the Hitching Post public drinking water source include: motor vehicle supply stores, a hardware store, large capacity septic systems, residential septic systems, motor vehicle waste disposal wells, areas of active logging, 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 Hitching Post received a vulnerability rating of **Very High** for bacteria and viruses, a vulnerability rating of **Very High** for nitrates and nitrites, and a vulnerability rating of **Very High** for volatile organic chemicals contaminant categories.

HITCHIN POST PUBLIC DRINKING WATER SYSTEM

The Hitching Post public water system (PWS) is a Class B (transient/non-community) water system. The system consists of one well located at mile 16 of the Kenai Spur Highway, Kenai, Alaska (T06N, R12W, Section 14) (See Map 1 of Appendix A). Kenai 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. Soldotna 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 Hitching Post 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 glacial 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 Hitching Post PWS, the depth of the well is 68 feet below ground surface (bgs). The static water level is 45 feet bgs, and the well is screened in sand and gravel. The well is not located in a floodplain.

No Sanitary Survey for the water system was available; however, 1995 Soil Absorption System (SAS) records did not note any PWS deficiencies. Based on the SAS report it was assumed that the land is sloped away from the well providing adequate surface water drainage. It was also assumed that the well is not grouted according to ADEC regulations based on the date of well construction on July 2, 1985. 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 75 non-residents through one service connection.

HITCHING POST 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 Hitching Post. 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 Hitching Post 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 Hitching Post 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 HITCHING POST 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

The well for the Hitching Post is completed in an unconfined aquifer setting. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Susceptibility scores and ratings for the Hitching Post.

Table 2. Susceptibility

	Score	**Rating**
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	High

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	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	50	Very High

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

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

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the 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	80	Very High
Nitrates and Nitrites	80	Very High
Volatile Organic Chemicals	80	Very High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is Very High. The risk is primarily attributed to the presence of nine large-capacity septic systems located in Zones A and C (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 Hitching Post. 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 **Very High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is Very High. The high risk to this source of public drinking water is primarily attributed to the presence of eight large-capacity septic systems located in Zones A, and C, and reported nitrate concentrations 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 Hitching Post well indicates that a nitrate concentration of 0.17 milligrams per liter (mg/L) was detected in 2000. The low concentration and single occurrence of detectable nitrate concentrations suggest that the reported nitrate concentrations are attributed to natural sources. 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. The nitrate concentration from the most recent detectable sampling event is 2% (0.17 mg/L) of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Though

existing nitrate contamination was detected at the site, recent data indicates that nitrate concentrations are safe with respect to human health.

Nitrate levels are often derived from the decomposition of organic matter in soils. Although the nitrate source is unknown, such occurrences may be attributed to septic systems or other sources. 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 remains **Very High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is Very High. The risk is primarily attributed to the presence of nine motor vehicle waste disposal wells located in Zones A and B (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

The drinking water at the Hitching Post 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 **Very High**.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2002 [WWW document]. URL http://www.dced.state.ak.us/mra/CF_BLOCK.cfm.

Alaska Department of Environmental Conservation, Contaminated Sites Database, 2003 [WWW database], URL http://www.state.ak.us/dec/dspar/csites/cs_search.htm

Alaska Department of Environmental Conservation, Leaking Underground Storage Tank Database, 2003 [WWW database], URL http://www.dec.state.ak.us/spar/stp/ust/search/fac_search.asp

Bailey, B.J., and Hogan, E.V., 1995Overview of environmental and hydrogeologic conditions near Kenai, Alaska. U.S. Geological Survey Open-File Report 95-410, 18 p.

Freethey, G.W., and Scully, D.R. 1980 Water Resources of the Cook Inlet Basin, Alaska. U.S. Geological Survey Hydrologic Investigation Atlas HA-620, prepared in cooperation with Alaska Water Study Committee, State of Alaska Department of Natural Resources, and Division of Geological and Geophysical Surveys.

Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey

Glass, Roy, L. 1996 Groundwater Conditions and Quality in the Western Part of the Kenai Peninsula, Southcentral Alaska. U.S. Geological Survey Open File Report 94-466, prepared in cooperation with the Alaska Department of Natural Resources, Kenai Peninsula Borough, and Kenai Soil and Water Conservation District.

Hartman, D.C., Pessel, G.H., and McGee, D.I., 1972 Kenai Group of Cook Inlet Basin, Alaska: State of Alaska. Open File Report #49, Department of Natural Resources Division of Geological and Geophysical Surveys, 5p.

Karlstrom, T.N.V. 1964 Quaternary geology of the Kenai Lowland and glacial history of the Cook Inlet region, Alaska. U.S. Geological Survey Professional Paper 443, 64 p.

Kenai River Watershed, 2002 [WWW document]. URL *http://www.kenai-watershed.org/spawning/kenai_river/kenai_river.html*.

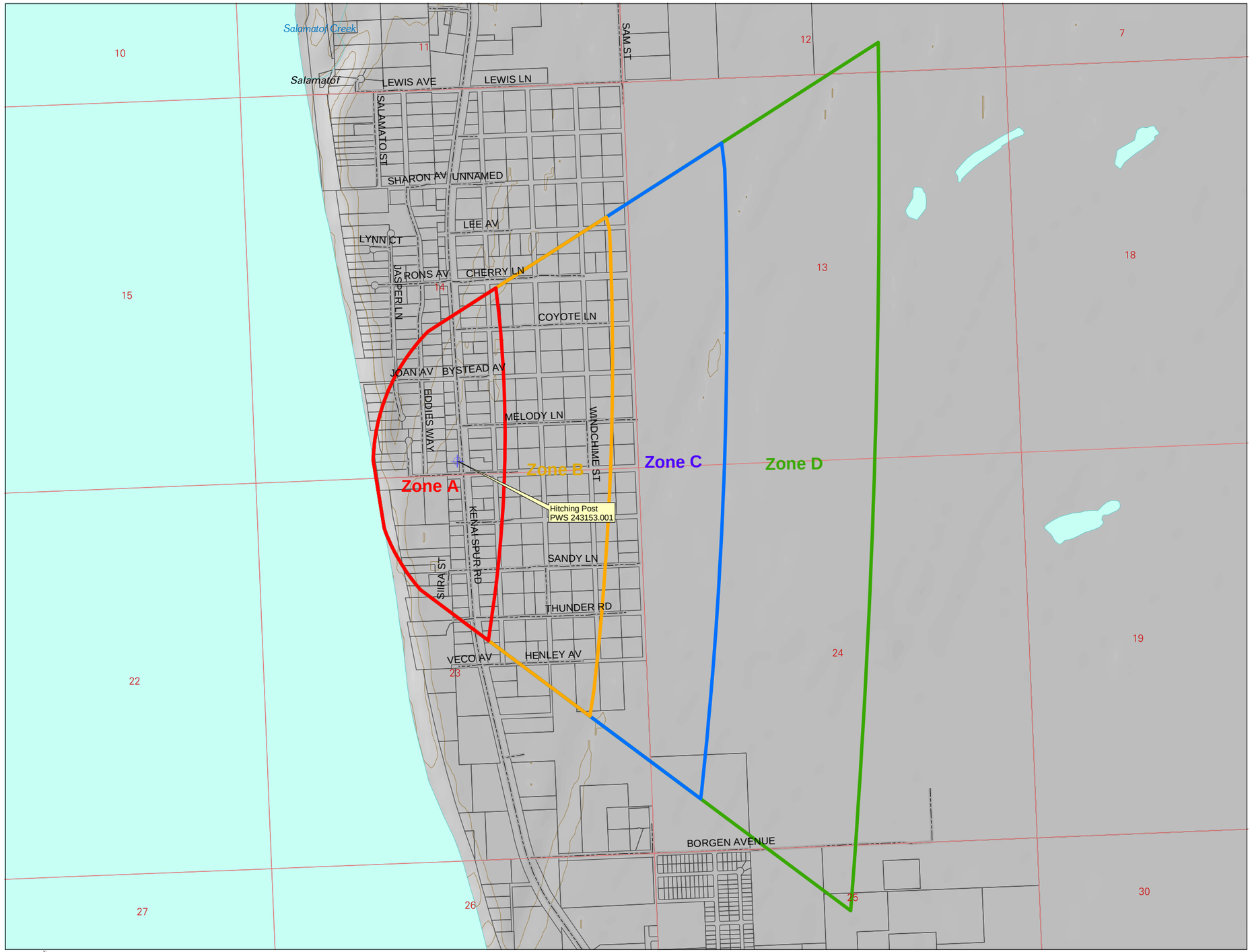
Martin, G.C., Johnson, B.L., and Grant, 1915, Geology and mineral resources of Kenai Peninsula, Alaska: US Geological Survey Bulletin 587, 243 p., maps.

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

APPENDIX A

Hitching Post
Drinking Water Protection Area Location Map
(Map 1)

Drinking Water Protection Areas for the Public Water Well System for PWS #243153.001 Hitching Post



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

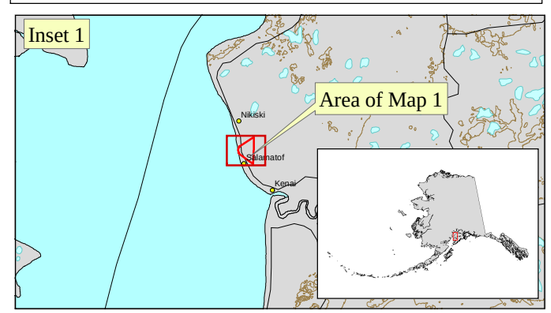
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

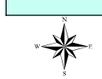
Parcels
Kenai Peninsula Borough

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.





0 700 1,400 2,800 4,200 5,600 7,000 8,400 Feet

Hitching Post PWS 243153.001

Appendix A Map 1

APPENDIX B

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

Table 1 *Contaminant Source Inventory for* ***PWSID 243153.00***

Hitching Post

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Hardware stores	C17	C17-01	A	1	
Motor/motor vehicle supplies stores	C28	C28-01	A	1	
Motor /motor vehicle repair shops	C31	C31-01	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-05	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-06	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-07	A	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-08	A	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01	A	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-02	A	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	A	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-04	A	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-05	A	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-06	A	1	
Residential Areas	R01	R01-01	A	1	20.61 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	1	34 Septics in Zone A

Table 2

Contaminant Source Inventory and Risk Ranking for Hitching Post

Sources of Bacteria and Viruses

PWSID 243153.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-05	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-06	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-07	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-08	A	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-02	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-04	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-05	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-06	A	Low	1	
Residential Areas	R01	R01-01	A	Low	1	20.61 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	1	34 Septics in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	1	

Table 2 (continued)

Contaminant Source Inventory and Risk Ranking for Hitching Post

Sources of Bacteria and Viruses

PWSID 243153.001

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	X20-03	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-04	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-05	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-06	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-07	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-08	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-09	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-11	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-12	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-13	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-14	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-07	B	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-08	B	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-09	B	Low	1	
Residential Areas	R01	R01-02	B	Low	1	45.01 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R02-02	B	Low	1	24 Septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-15	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-16	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-17	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-18	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-23	B	Low	1	

Table 2 (continued)

Contaminant Source Inventory and Risk Ranking for Hitching Post

Sources of Bacteria and Viruses

PWSID 243153.001

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	X20-24	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-25	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-26	B	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-09	C	High	1	

Table 3

Contaminant Source Inventory and Risk Ranking for Hitching Post
Sources of Nitrates/Nitrites

PWSID 243153.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Hardware stores	C17	C17-01	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-05	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-06	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-07	A	High	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-08	A	High	1	
Residential Areas	R01	R01-01	A	Low	1	20.61 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	1	34 Septics in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-03	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-04	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-05	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-06	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-07	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-08	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-09	A	Low	1	

Contaminant Source Inventory and Risk Ranking for Hitching Post

Sources of Nitrates/Nitrites

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	X20-11	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-12	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-13	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-14	A	Low	1	
Residential Areas	R01	R01-02	B	Low	1	45.01 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R02-02	B	Low	1	24 Septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-15	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-16	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-17	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-18	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-23	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-24	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-25	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-26	B	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-09	C	High	1	
Logging (active)	E02	E02-01	C	Low	1	211 acres

Table 4

Contaminant Source Inventory and Risk Ranking for Hitching Post
Sources of Volatile Organic Chemicals

PWSID 243153.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Hardware stores	C17	C17-01	A	Low	1	
Motor/motor vehicle supplies stores	C28	C28-01	A	Low	1	
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-05	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-06	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-07	A	Low	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-08	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01	A	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-02	A	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	A	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-04	A	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-05	A	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-06	A	High	1	
Residential Areas	R01	R01-01	A	Low	1	20.61 acres of residential area in Zone A

Contaminant Source Inventory and Risk Ranking for Hitching Post

Sources of Volatile Organic Chemicals

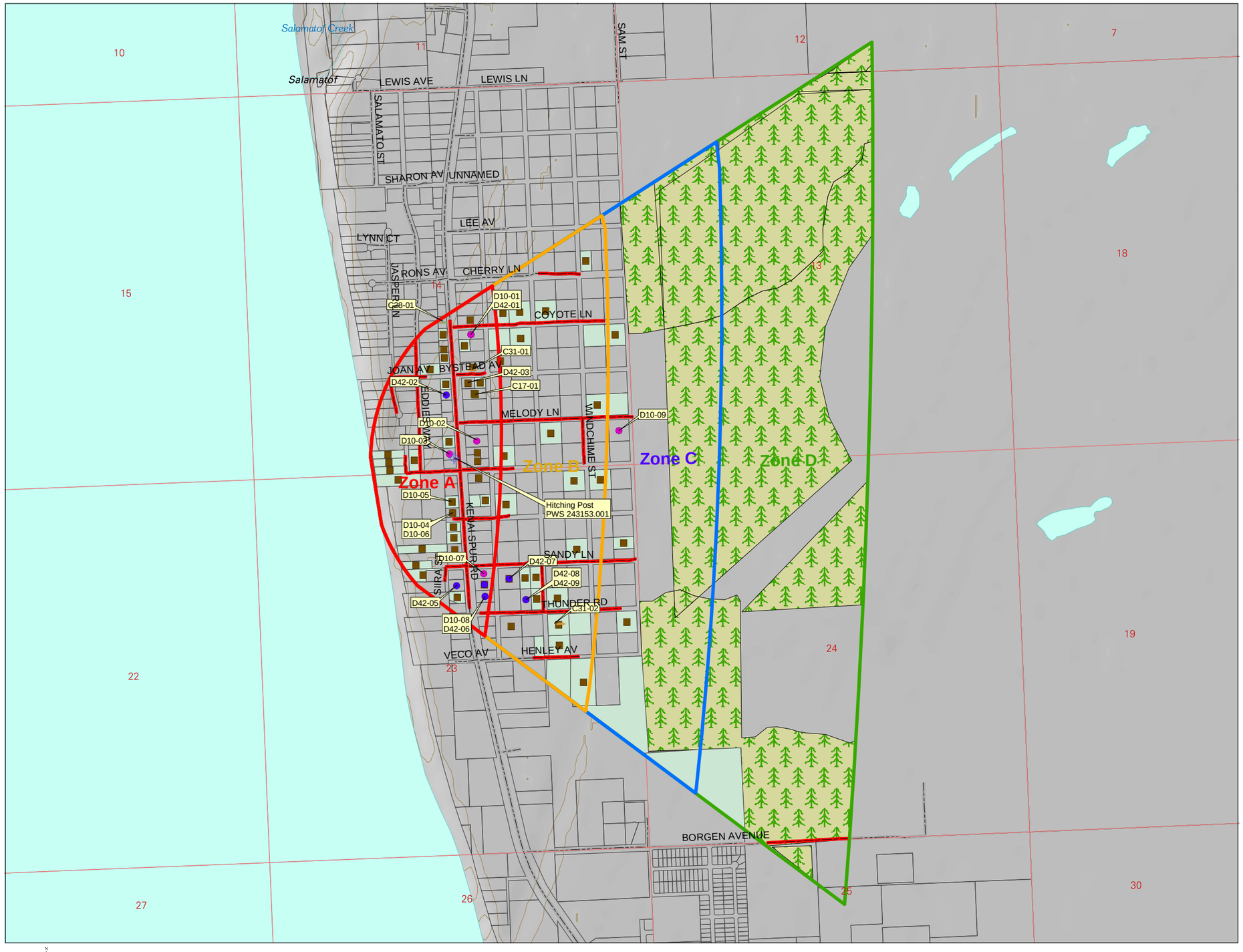
Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	1	34 Septics in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-03	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-04	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-05	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-06	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-07	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-08	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-09	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-11	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-12	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-13	A	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-14	A	Low	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-07	B	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-08	B	High	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-09	B	High	1	
Residential Areas	R01	R01-02	B	Low	1	45.01 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R02-02	B	Low	1	24 Septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-15	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-16	B	Low	1	

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	X20-17	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-18	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-23	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-24	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-25	B	Low	1	
Highways and roads, paved (cement or asphalt)	X20	X20-26	B	Low	1	
Motor /motor vehicle repair shops	C31	C31-02	C	Medium	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-09	C	Low	1	
Logging (active)	E02	E02-01	C	Low	1	211 acres

APPENDIX C

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

Drinking Water Protection Areas for the Public Water Well System for PWS #243153.001 Hitching Post
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)
- Injection wells (Class V) Motor Vehicle Waste Disposal Well (D42)
- Septic Systems (serves one or more single family homes) (R2)
- Hardware Stores (C17)
- Motor vehicle supplies stores (C28)
- Motor vehicle repair shops (C31)
- Highways and roads, paved (X20)
- Logging (E3)
- Residential Areas (R1)

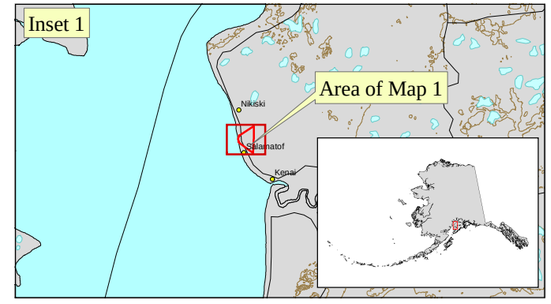
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

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.



0 700 1,400 2,800 4,200 5,600 7,000 8,400 Feet

Hitching Post PWS 243153.001

Appendix C Map 1

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - Hitching Post (243153.001)

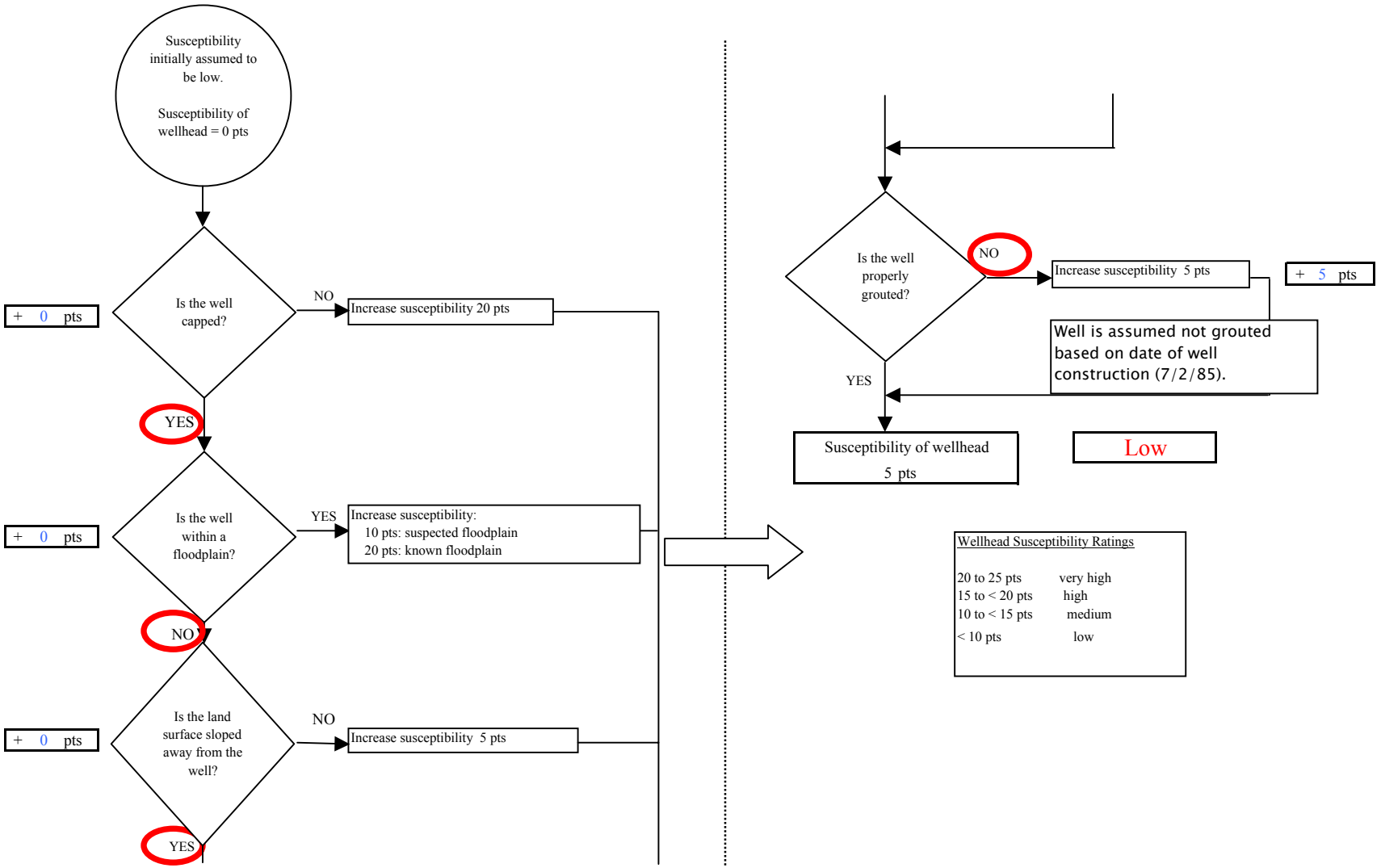


Chart 2. Susceptibility of the aquifer - Hitching Post (243153.001)

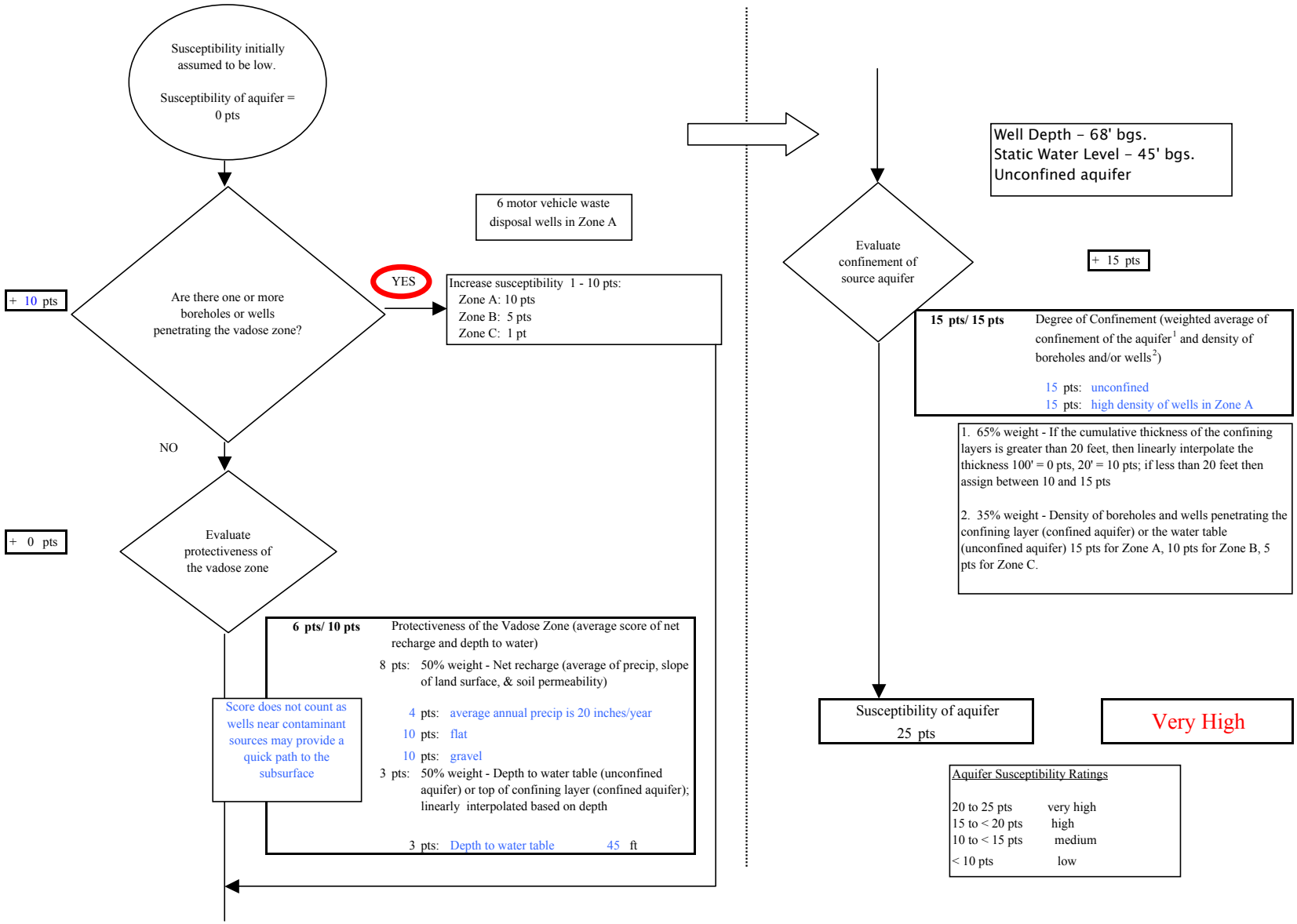
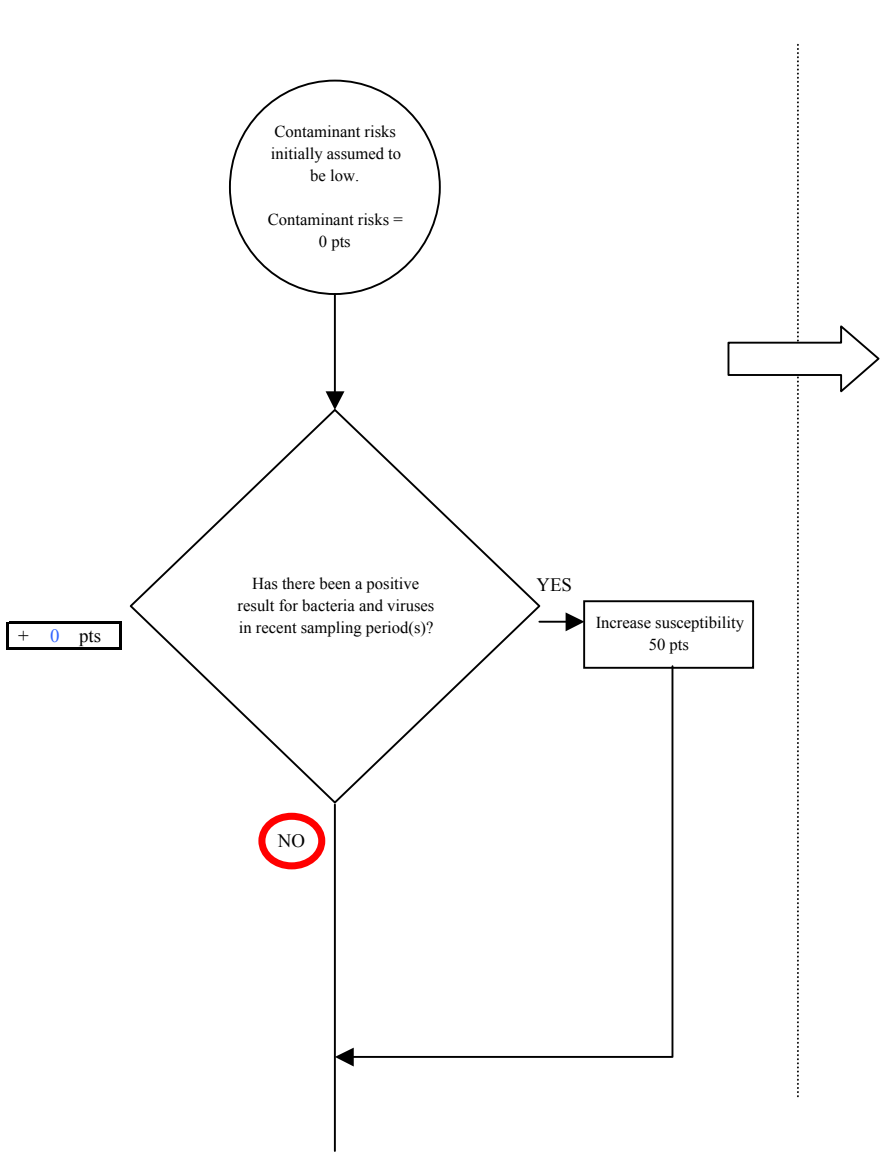
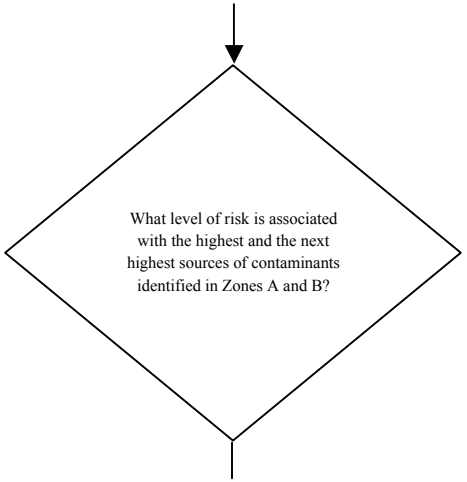


Chart 3. Contaminant risks for Hitching Post (243153.001) - Bacteria & Viruses





+ 40 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)	8	0	8
Medium(s)	0	0	0
Low(s)	41	7	48

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

Matrix Score 40

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the 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 Hitching Post (243153.001) - Bacteria & Viruses

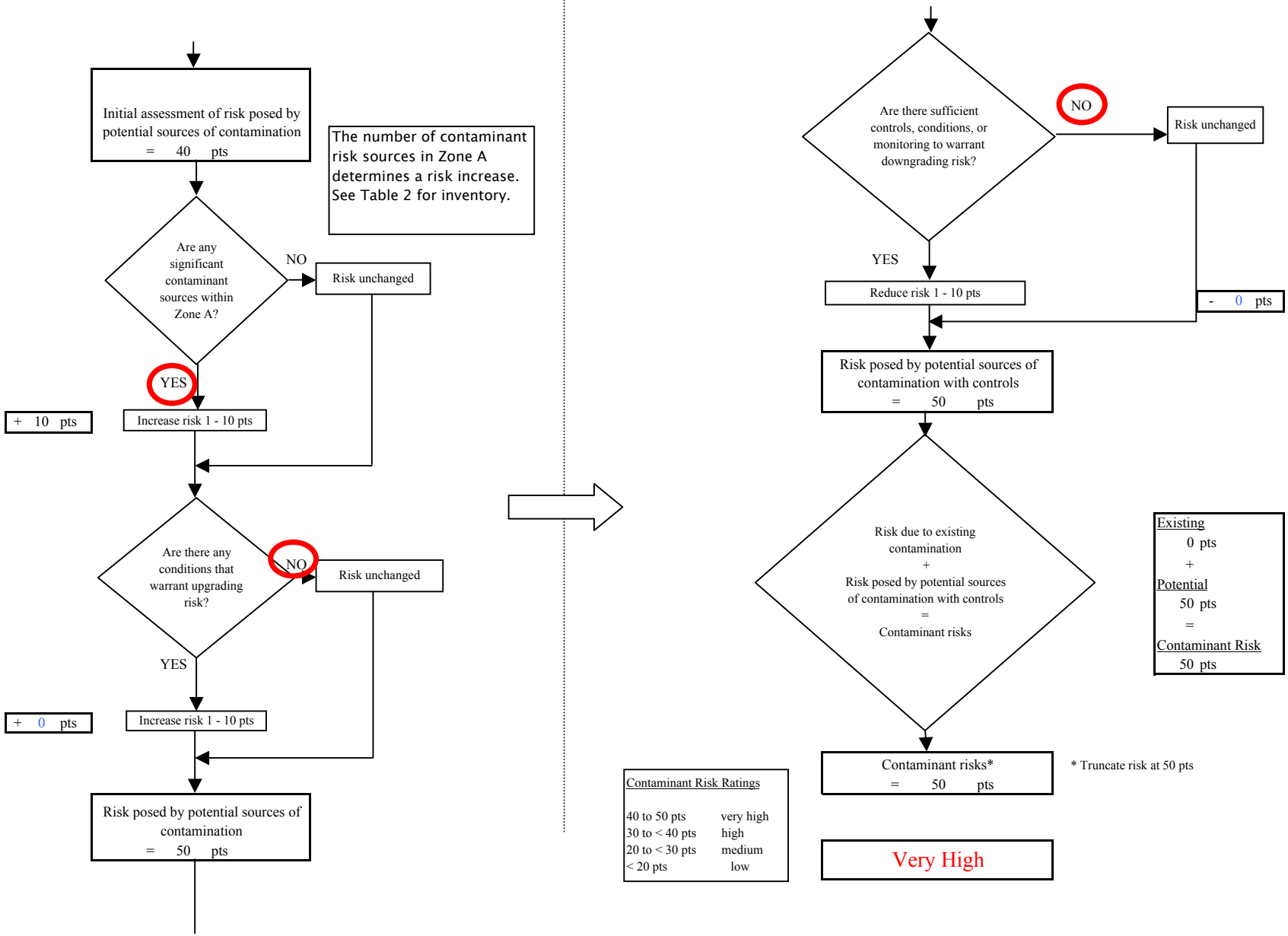

Initial assessment of risk posed by potential sources of contamination
= 40 pts
The number of contaminant risk sources in Zone A determines a risk increase. See Table 2 for inventory.
Are any significant contaminant sources within Zone A?
NO
Risk unchanged
YES
+ 10 pts
Increase risk 1 - 10 pts
Are there any conditions that warrant upgrading risk?
NO
Risk unchanged
YES
+ 0 pts
Increase risk 1 - 10 pts
Risk posed by potential sources of contamination
= 50 pts
Are there sufficient controls, conditions, or monitoring to warrant downgrading risk?
NO
Risk unchanged
YES
Reduce risk 1 - 10 pts
- 0 pts
Risk posed by potential sources of contamination with controls
= 50 pts
Risk due to existing contamination
+
Risk posed by potential sources of contamination with controls
=
Contaminant risks
Existing
0 pts
+
Potential
50 pts
=
Contaminant Risk
50 pts
Contaminant risks*
= 50 pts
* Truncate risk at 50 pts
Contaminant Risk Ratings
40 to 50 pts very high
30 to < 40 pts high
20 to < 30 pts medium
< 20 pts low
Very High

Chart 4. Vulnerability analysis for Hitching Post (243153.001) - Bacteria & Viruses

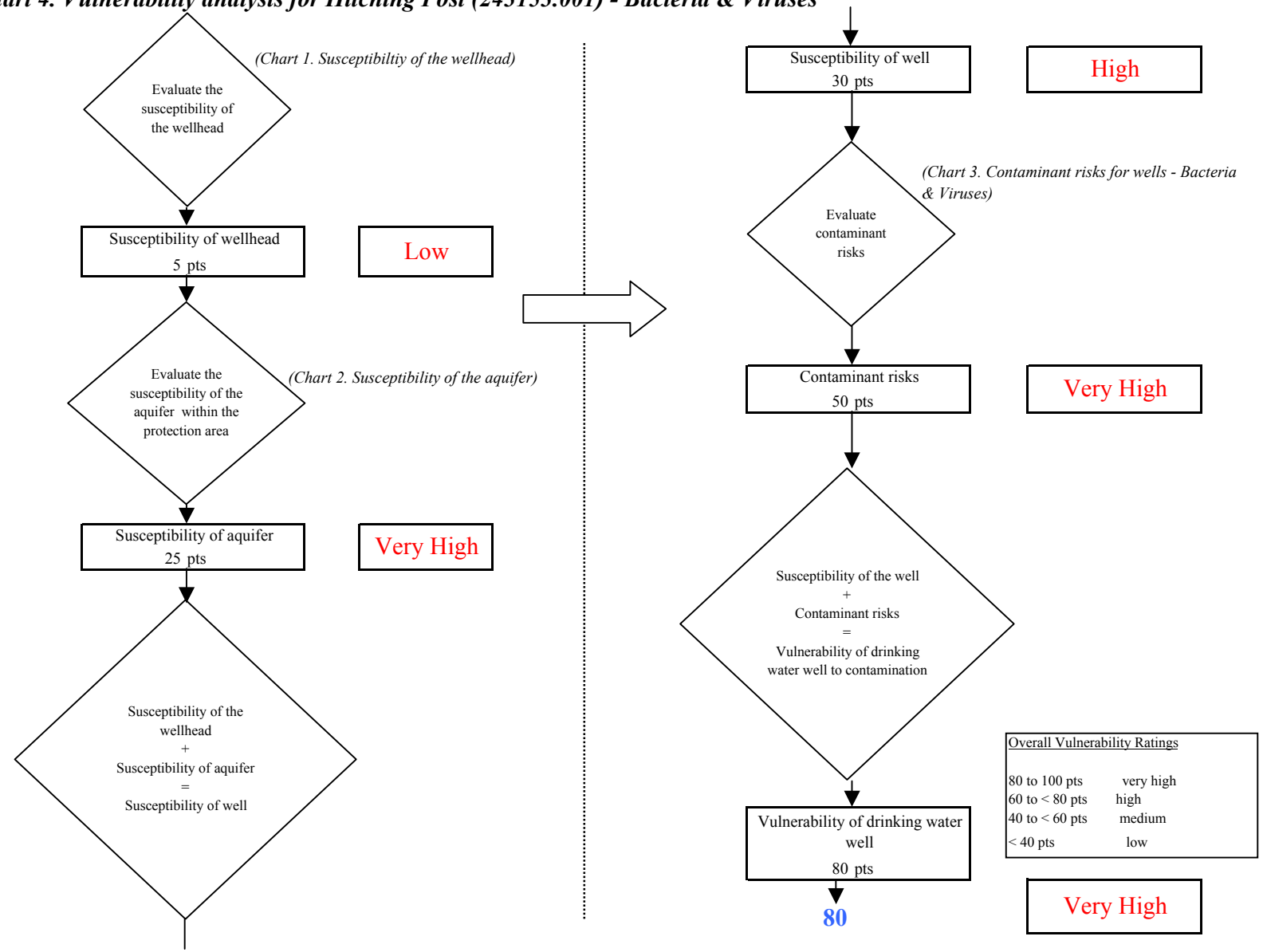


Chart 5. Contaminant risks for Hitching Post (243153.001) - Nitrates and Nitrites

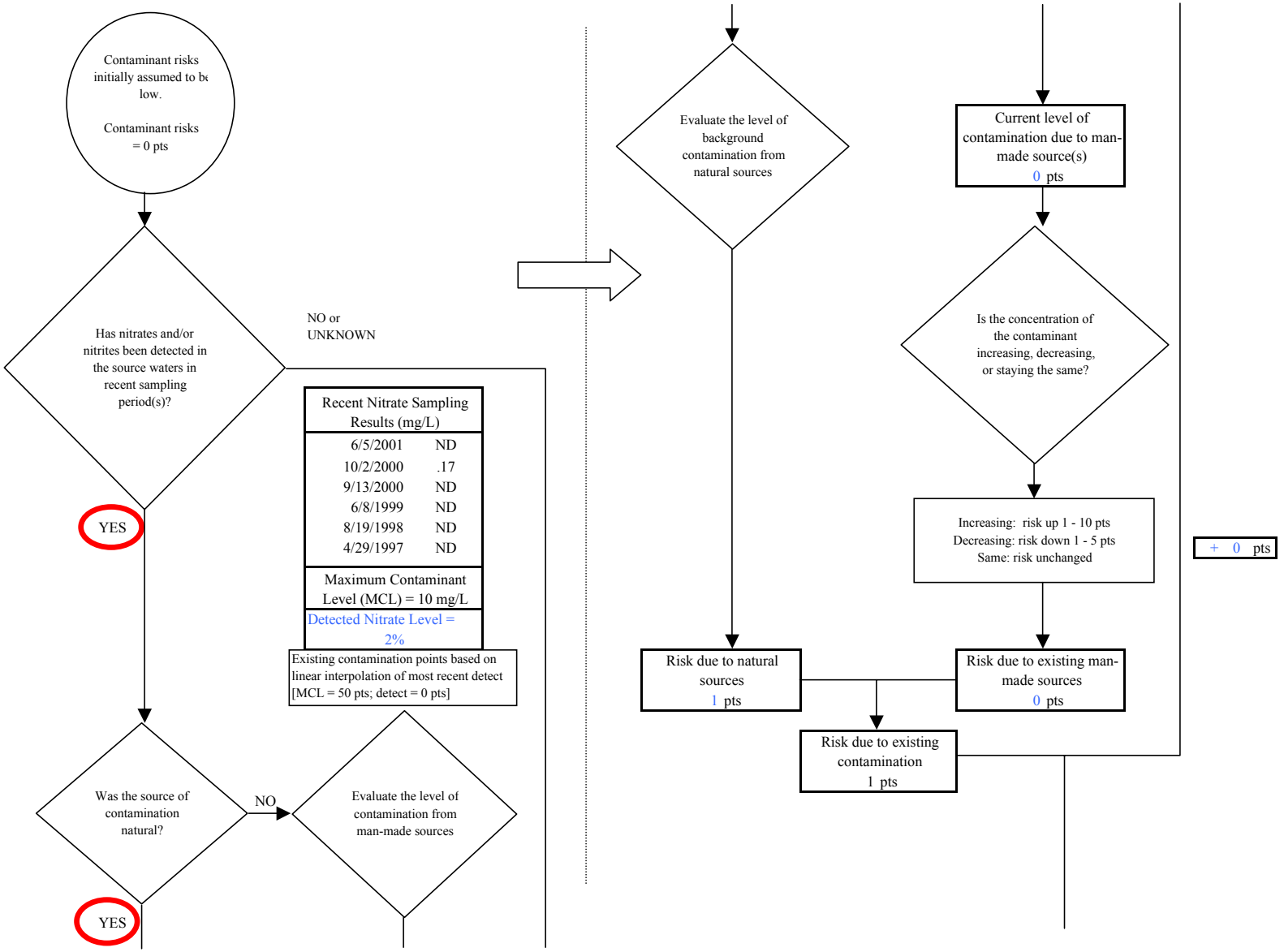
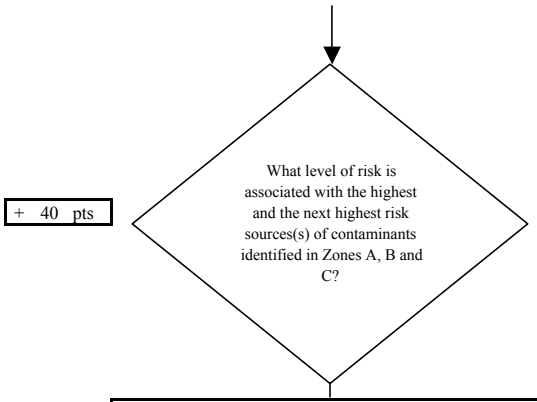


Chart 5. Contaminant risks for Hitching Post (243153.001) - Nitrates and Nitrites



+ 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)	8	1	9
Medium(s)	0	0	0
Low(s)	36	6	42

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

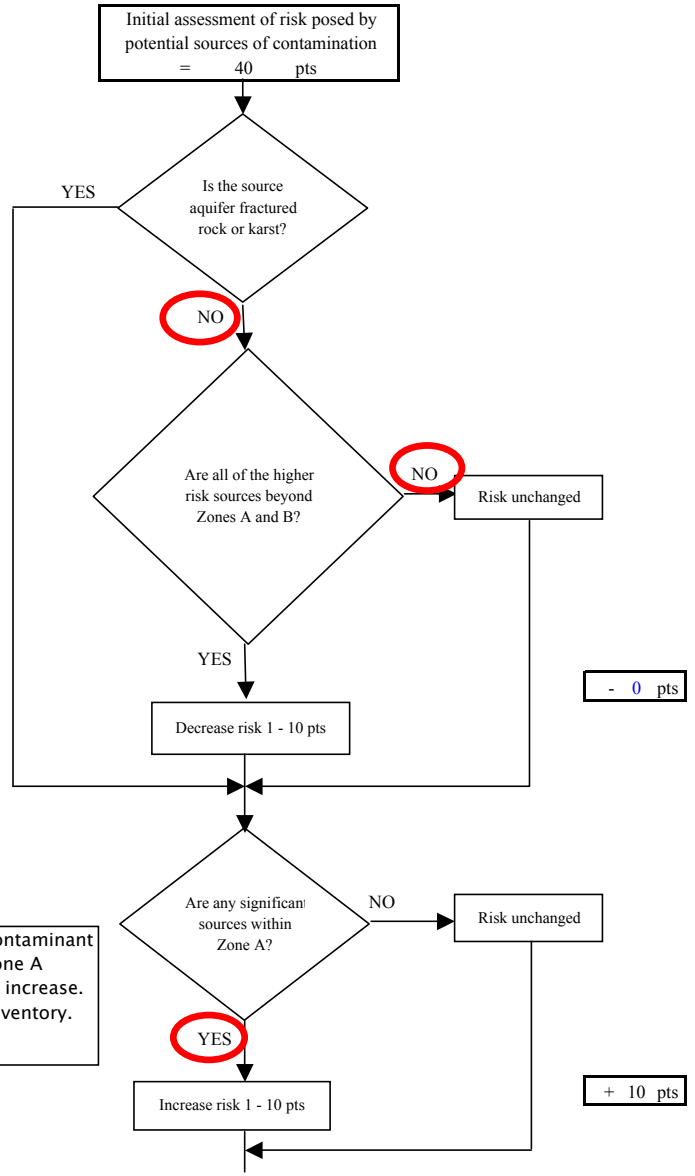


Chart 5. Contaminant risks for Hitching Post (243153.001) - Nitrates and Nitrites

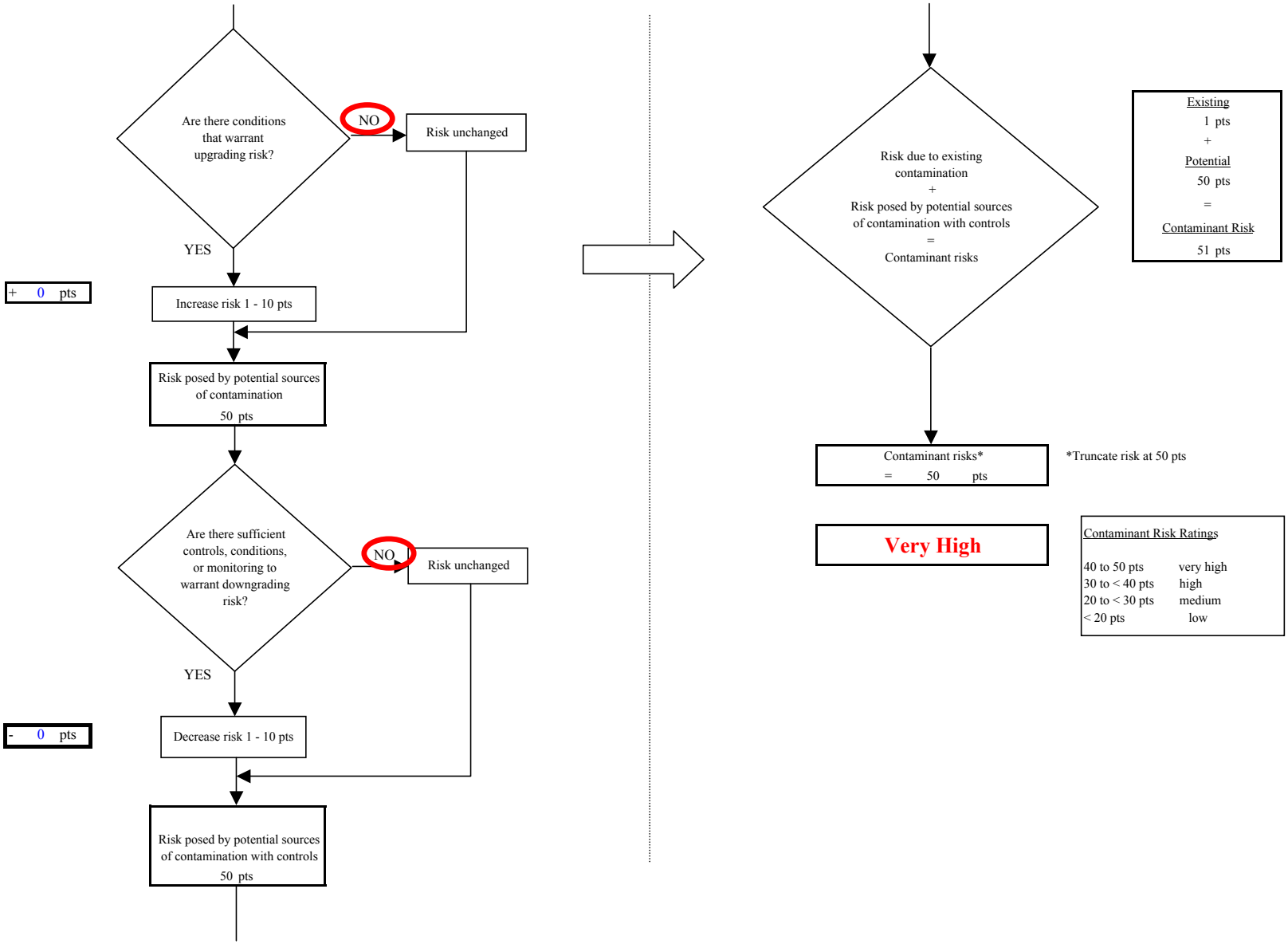


Chart 6. Vulnerability analysis for Hitching Post (243153.001) - Nitrates and Nitrites

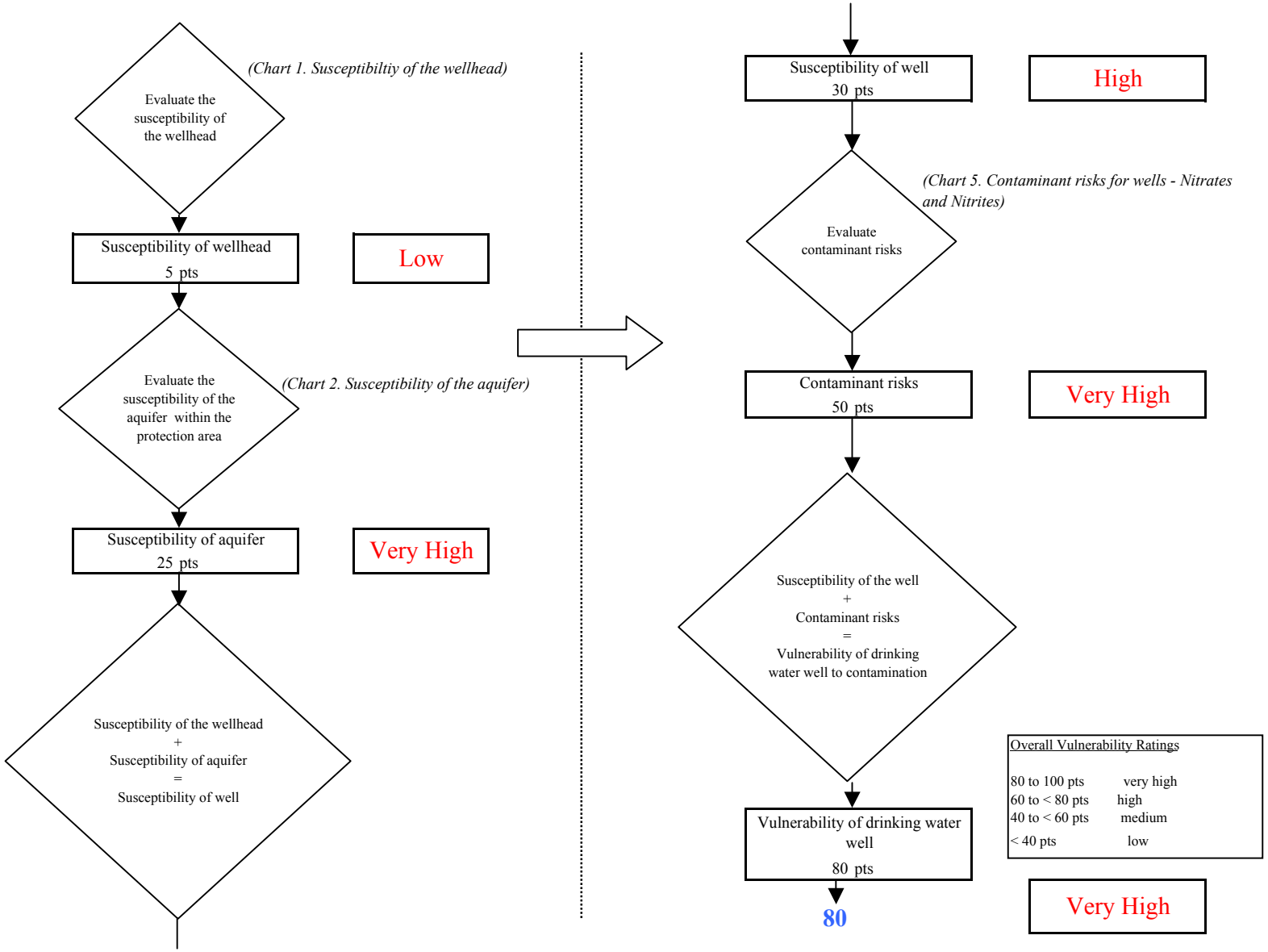


Chart 7. Contaminant risks for Hitching Post (243153.001) - Volatile Organic Chemicals

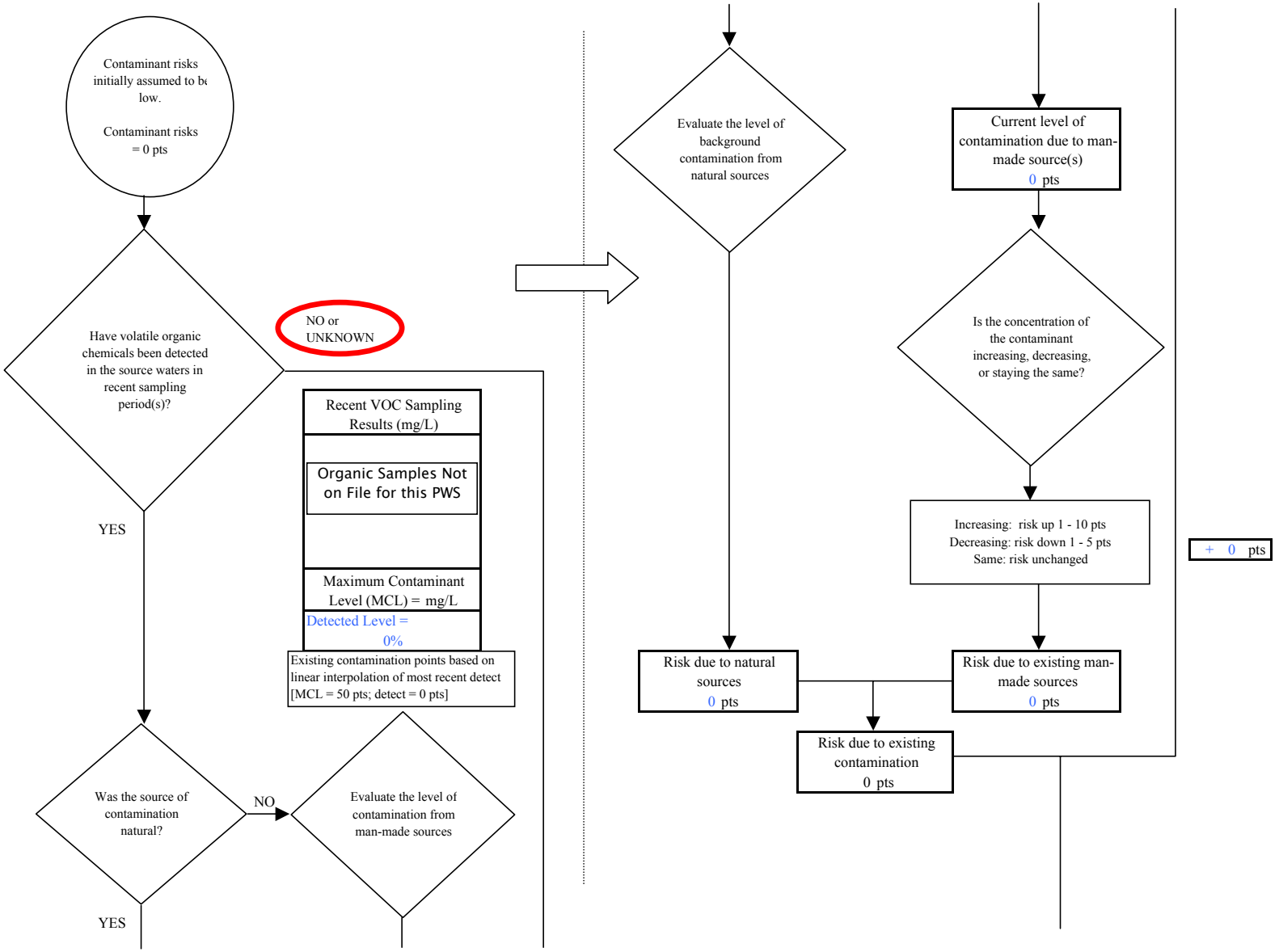


Chart 7. Contaminant risks for Hitching Post (243153.001) - Volatile Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	6	3	9
Medium(s)	1	1	2
Low(s)	14	5	19

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

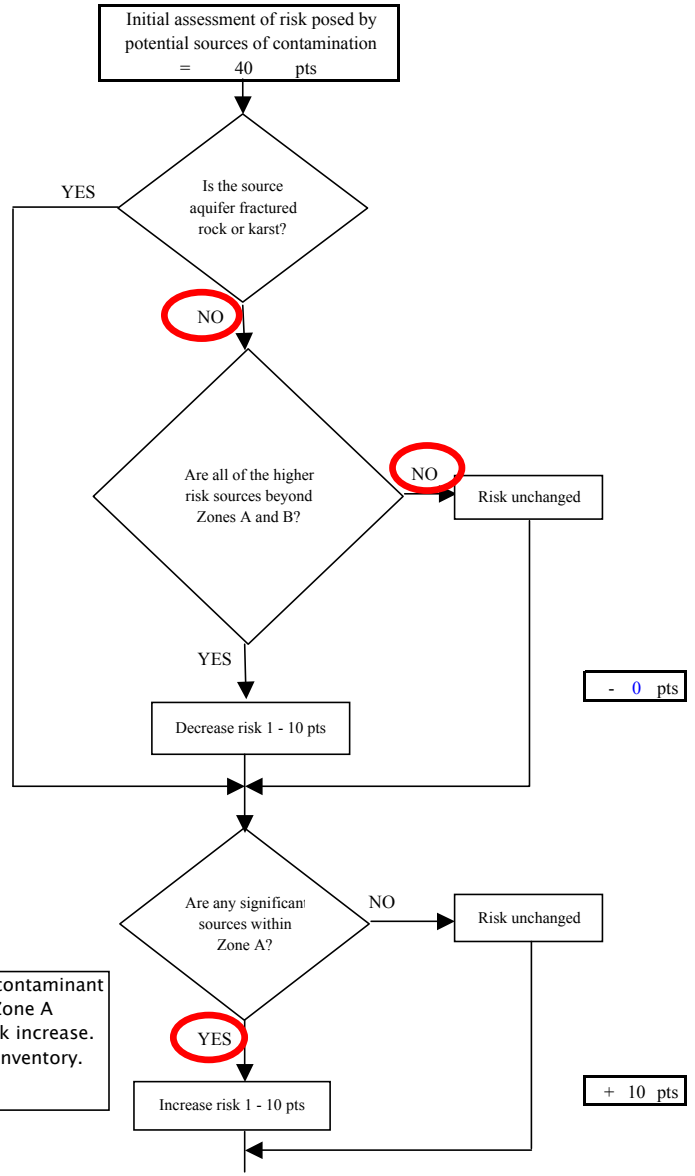


Chart 7. Contaminant risks for Hitching Post (243153.001) - Volatile Organic Chemicals

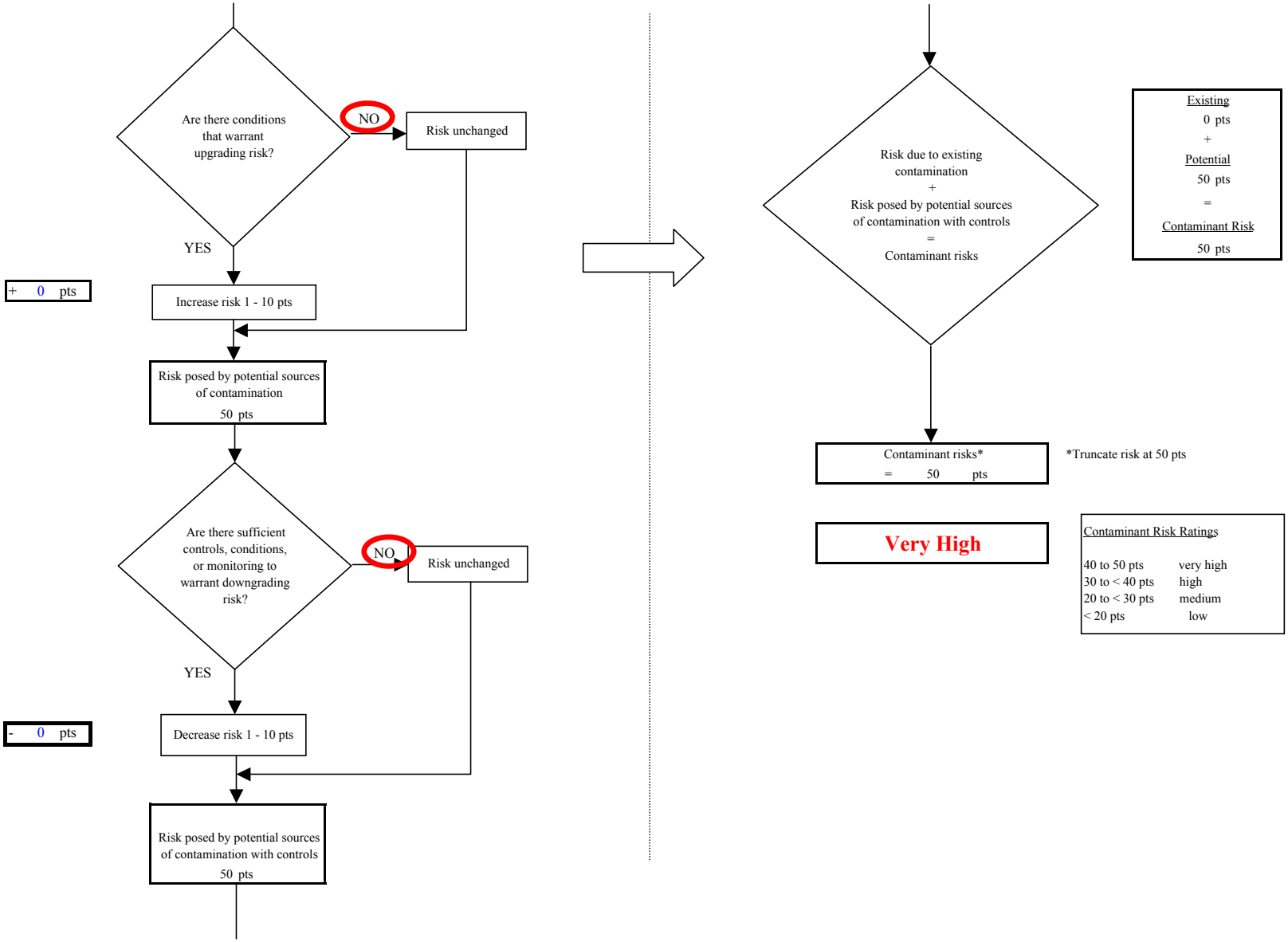


Chart 8. Vulnerability analysis for Hitching Post (243153.001) - Volatile Organic Chemicals