Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Begich Boggs Visitor Center Well No. 1
Drinking Water System,
Portage Valley, Alaska
PWSID # 213718.001

DRINKING WATER PROTECTION PROGRAM REPORT # 332
Alaska Department of Environmental Conservation

Source Water Assessment for Begich Boggs Visitor Center Well No. 1 Drinking Water System, Portage Valley, Alaska PWSID # 213718.001

By URS Corporation

DRINKING WATER PROTECTION PROGRAM REPORT # 332

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Source Water Assessment for Begich Boggs Visitor Center Well No. 1 Source of Public Drinking Water, Portage Valley, Alaska

By URS Corporation

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Begich Boggs Visitor Center Well No. 1 is a Class B (transient/non-community) water system consisting of one well located at the Begich Boggs Visitor Center in Portage Valley, Alaska. Identified potential and current sources of contaminants for Begich Boggs Visitor Center Well No. 1 public drinking water source include: domestic wastewater treatment plant disposal ponds/lagoons, a large capacity septic system, vaulted pit toilets, closed underground heating oil tanks, paved highways or roads in Zone A; and domestic wastewater sludge land application areas, and injection wells for a large capacity septic system in Zone B. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Begich Boggs Visitor Center Well No. 1 received a vulnerability rating of **Very High** for bacteria and viruses, and nitrates and nitrites, and **High** for volatile organic chemicals.

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system. URS Corporation has been contracted to perform these assessments under the supervision of ADEC.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

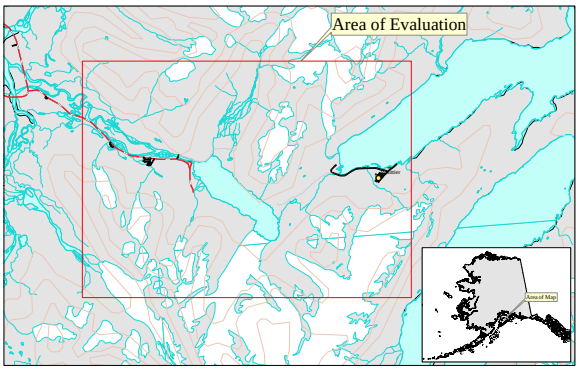
DESCRIPTION OF PORTAGE VALLEY, ALASKA

Location

Portage Valley is located at the eastern edge of Turnagain Arm, which begins where the Cook Inlet divides near Anchorage and extends southeast to the junction of the Kenai Peninsula. The Seward Highway travels along the coast of the arm, connecting Anchorage with the communities of Indian, Bird, Girdwood, and Portage, all located within the Municipality of Anchorage. The communities of Hope and Sunrise are located on the southern side of the Turnagain Arm within the Kenai Peninsula Borough. Most of these communities (Indian, Bird Creek and Girdwood) are also contained within the Chugach State Park. The area north of the arm is bordered by the Chugach Mountains and to the south are the Kenai Mountains. The highest peak, called Turnagain Arm Pass (988 feet) is located almost directly south of Girdwood on the northern portion of the Kenai Peninsula.

Portage Valley and the Turnagain Arm were formed mainly by the erosive force of glaciers.

Figure 1



Precipitation

Due to the marine air coming from the Gulf of Alaska and Prince William Sound, precipitation tends to be more abundant and winter temperatures warmer in the Turnagain Arm area. Winds are also relatively stronger and more persistent *(Chugach State Park Master Plan, 1980).*

The Kenai Mountains lie in the path of the strong Aleutian lows as they come onshore delivering high precipitation to the coastal areas. A rains shadow effect occurs on the landward side of the mountains (the western side of the ice cap). This results in a mean annual precipitation of 140 inches at sea level on the coastal side of the ice cap, and 60 inches on the landward side of the mountains (Crossen, 1992).

The mean annual temperature, as recorded by weather stations at Whittier and Portage, is 38^0F. This includes the area around the northern section of the ice cap from Tebenkov Glacier to Portage Glacier (Crossen, 1992).

Topography and Drainage

The topography in the site vicinity is typical of valleys formed by glaciation, with a relatively flat to gently sloping valley bottom and steep sidewalls. Relatively steep mountainous terrain comprises more than 90% of the watershed. Elevations range from sea level to just over 3,500 feet.

Groundwater

According to the Major Ecosystems of Alaska map (JFSLUPC, 1973), this area lies within the southcentral hydrologic region and the Cook Inlet sub-region. Surface water and groundwater flow is abundant in this area. Based on the USGS, Water Resources Division, groundwater database, groundwater in this area is designated as having existing beneficial uses for domestic and commercial applications.

Although the quality can vary significantly in a short distance, groundwater supplies are abundant in the area. Many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are shallow with depths of 30 feet up to 100 feet. Static water levels in many of these wells are between 4 feet to 20 feet below the surface.

Geology and Soils

The Kenai Mountains in this area are composed of the Valdez Group, a widely distributed flysch in southcentral Alaska. The group is predominantly dark gray mudstone, siltstone, argillite, and slate, with sandstone (mostly greywacke) interbeds. The rocks are locally calcareous and highly deformed, showing cleavage development, disrupted beds, and folding. Where sedimentary features are preserved, the sandstones are typically turbidites. The age of the Valdez Group is considered late Cretaceous. The formation consists of clastic debris that is likely shed from an uplifted arc and deposited by turbidity flows in an elongate trench (Crossen, 1992).

The Valdez Group is one of the two rock units making up the Chugach terrane, which is one of the four tectonostratigraphic terranes found in southcentral Alaska. The Kenai Mountains and Kenai Peninsula lie in the present arc-trench gap, between the volcanoes of the Aleutian Range arc and the Aleutian trench. The Kenai-Chugach Range is underlain by an oceanic flysch and mélange accretion complex that records convergent margin history extending back to Triassic time. The Kenai-Chugach Range is largely underlain by subduction rocks and is one of the main topographic features that flank the seaward edge of the forearc basin in southcentral Alaska (Crossen, 1992).

Various Quaternary-age surficial deposits are found in the general area. The origin of these deposits is predominantly glacial, with components of alluvial, colluvial, and lacustrine deposition (Winkler, 1992). The glacier ice mass deposited silt, sand, gravel, cobbles and boulders during multiple glacial advancements and recessions. The soils deposited during the glacial advancements were consolidated by the weight of the ice. During the recessional phase of glaciation, soils consolidated by the ice mass were probably eroded to some degree by melt water, and unconsolidated alluvial materials were deposited.

BEGICH BOGGS VISITOR CENTER WELL NO. 1 PUBLIC DRINKING WATER SYSTEM

Begich Boggs Visitor Center Well No. 1 is a Class B (transient/non-community) water system. The system consists of one well located at the Begich Boggs Visitor Center in Portage Valley (T8N, R3E, Section 13). This area is at an elevation of approximately 150 feet above sea level.

According to the well log completed for the water system, installation of the well occurred on October 30, 1979 to a total depth of approximately 100 feet below ground surface in a gravel formation and was completed in 6-inch well casing. The most recent Sanitary Survey (6/5/99) indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at

the well casing. The land surface is also appropriately sloped away from the well providing adequate surface water drainage. The well was grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates seasonally for approximately 270 days per year. The well serves more than 500 non-residents through two service connections.

BEGICH BOGGS VISITOR CENTER WELL NO. 1 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. Some areas are more likely to allow contamination to reach the well than others. 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 a release of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

The DWPAs 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. An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (Patrick, Brabets, and Glass, 1989), and State of Alaska Department of Water Resources (Jokela et. al., 1991). Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DWPA (Please refer to the Guidance Manual for Class Bs 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 DWPA zones and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. TOT
B	Less than the 2 year TOT
C	Less Than the five year TOT
D	Less than the 10 year TOT

As an example, water moving through the aquifer in Zone B will reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

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 Begich Boggs Visitor Center Well No. 1 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 assessments, three categories of drinking water contaminants were inventoried. They include:

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

Inventoried potential sources of contamination within Zones A through Zone B were associated with residential and light industrial type activities. The sources are summarized in the tables in Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are sorted and ranked 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. Further,

contaminant risks are a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the well.

VULNERABILITY OF BEGICH BOGGS VISITOR CENTER WELL NO. 1 DRINKING WATER SOURCE

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

- Natural susceptibility; and
- Contaminant risks.

Each of the three categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

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

The well for Begich Boggs Visitor Center Well No. 1 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 Overall Susceptibility score and rating for Begich Boggs Visitor Center Well No. 1.

Table 2. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	50	Very High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing or historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. 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	25	Medium

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.

Table 3 contains the overall vulnerability scores (0 – 10) 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 of Begich Boggs Visitor Center Well No. 1 to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	100	Very High
Nitrates and Nitrites	100	Very High
Volatile Organic Chemicals	75	High

Tables 2 through 5 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.

The domestic wastewater treatment plant disposal ponds/lagoons, a large capacity septic system, vaulted pit toilets, closed underground heating oil tanks, and paved highways or roads in Zone A; and domestic wastewater sludge land application areas, and injection wells for a large capacity septic system in Zone B, create a risk increase for the bacteria and viruses, nitrates and nitrites, and volatile organic chemicals contaminant categories.

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses (total fecal coliform) were detected during the annual and two subsequent confirmation water sampling events of the system at Begich Boggs Visitor Center Well No. 1 in 1999. These positive results automatically increase the risk for this category. The source of the detects is unknown.

Nitrates and/or nitrites are found in natural background concentration at this site, as elsewhere throughout Alaska. Nitrate concentrations in uncontaminated groundwater are typically less than 2 milligrams per liter (mg/L) and are derived primarily from the decomposition of organic matter in soils [Wang, Strelakos, Jokela, 2000].

Sampling history for Begich Boggs Visitor Center Well No. 1 well indicates that low concentrations of nitrate have been detected (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Existing nitrate concentration is approximately 0.7 mg/L or 7% of the Maximum Contaminant Level (MCL) of 10mg/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. Due to the high solubility and weak retention by soil, nitrates are very mobile, moving at approximately the same rate as water. Though existing nitrate contamination was detected at the site, concentrations remain at very safe levels with respect to human health.

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Begich Boggs Visitor Center Well No. 1. The overall vulnerability of this source to contamination is **Very High** for bacteria and viruses, and nitrates and nitrites, and **High** for volatile organic chemicals. 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 Begich Boggs Visitor Center Well No. 1 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 Begich Boggs Visitor Center Well No. 1 public drinking water source.

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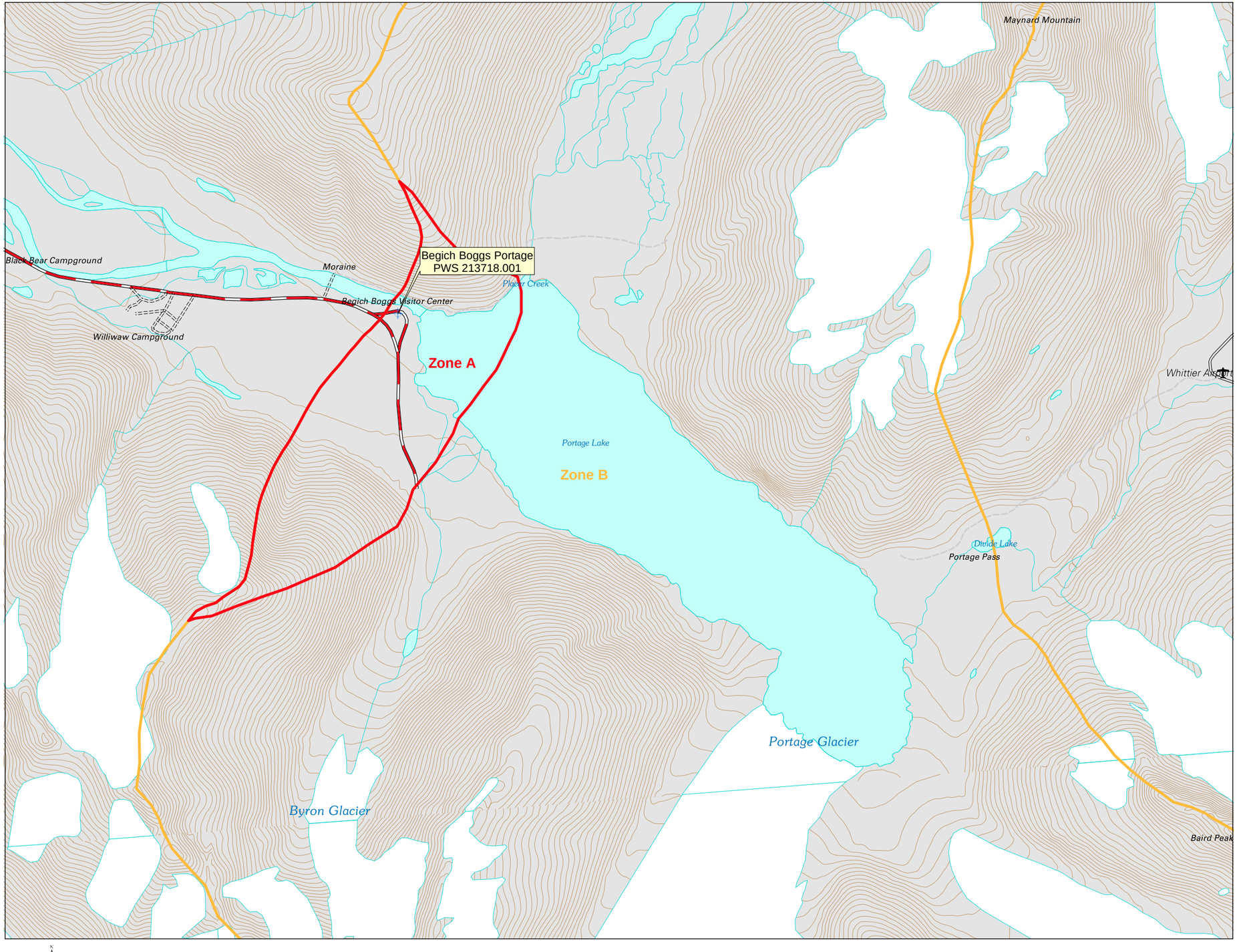
APPENDIX A

Begich Boggs Visitor Center Well No. 1
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Areas for the Public Water Well System for PWS # 213718.001 Begich Boggs Portage



LEGEND

- Public Water System Well

Groundwater Protection Zones

- Zone A – Several Months Travel Time
- Zone B – Less Than 2 Years Travel Time

Hydrography/Physical

- Parcels
- Stream
- Aqueduct or Pipeline
- Lake or Pond
- Glacier
- Contours (approx. 70 ft.)

Transportation

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

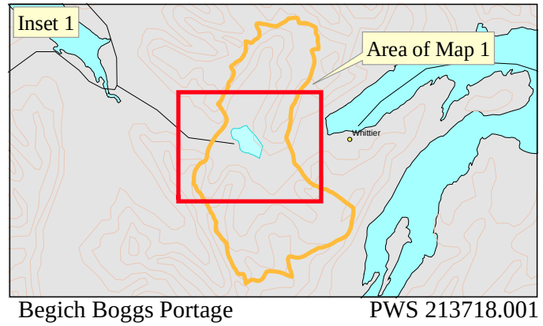
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

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 2,300 4,600 9,200 13,800 18,400 Feet

Begich Boggs Portage PWS 213718.001

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Begich Boggs Visitor Center Well No. 1 (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 213718.001***

Begich Boggs Portage

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Location***	***Map Number***	***Comments***
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A		1	
Pit toilets (vaulted) nonresidential (one or more)	D17	D17-01	A		1	
Pit toilets (vaulted) nonresidential (one or more)	D17	D17-02	A		1	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A		1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A		1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A		1	
Domestic wastewater sludge land application areas	D04	D04-01	B	Whittier Tunnel-Inert Monofill	1	Construction/Demolition
Domestic wastewater sludge land application areas	D04	D04-02	B	Whittier Tunnel-Inert Monofill	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	B		1	

Table 2

Contaminant Source Inventory and Risk Ranking for Begich Boggs Portage Sources of Bacteria and Viruses

PWSID 213718.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Analysis	Location	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	1		1	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	2		1	
Pit toilets (vaulted) nonresidential (one or more)	D17	D17-01	A	Low	3		1	
Pit toilets (vaulted) nonresidential (one or more)	D17	D17-02	A	Low	4		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	B	High	5		1	
Domestic wastewater sludge land application areas	D04	D04-01	B	High	6	Whittier Tunnel-Inert Monofill	1	Construction/Demolition
Domestic wastewater sludge land application areas	D04	D04-02	B	High	7	Whittier Tunnel-Inert Monofill	1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	8		1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	9		1	

Table 3

Contaminant Source Inventory and Risk Ranking for Begich Boggs Portage Sources of Nitrates/Nitrites

PWSID 213718.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Analysis	Location	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	1		1	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	2		1	
Pit toilets (vaulted) nonresidential (one or more)	D17	D17-01	A	Low	3		1	
Pit toilets (vaulted) nonresidential (one or more)	D17	D17-02	A	Low	4		1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	5		1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	6		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	B	High	7		1	
Domestic wastewater sludge land application areas	D04	D04-01	B	High	8	Whittier Tunnel-Inert Monofill	1	Construction/Demolition
Domestic wastewater sludge land application areas	D04	D04-02	B	High	9	Whittier Tunnel-Inert Monofill	1	

Table 4

Contaminant Source Inventory and Risk Ranking for Begich Boggs Portage Sources of Volatile Organic Chemicals

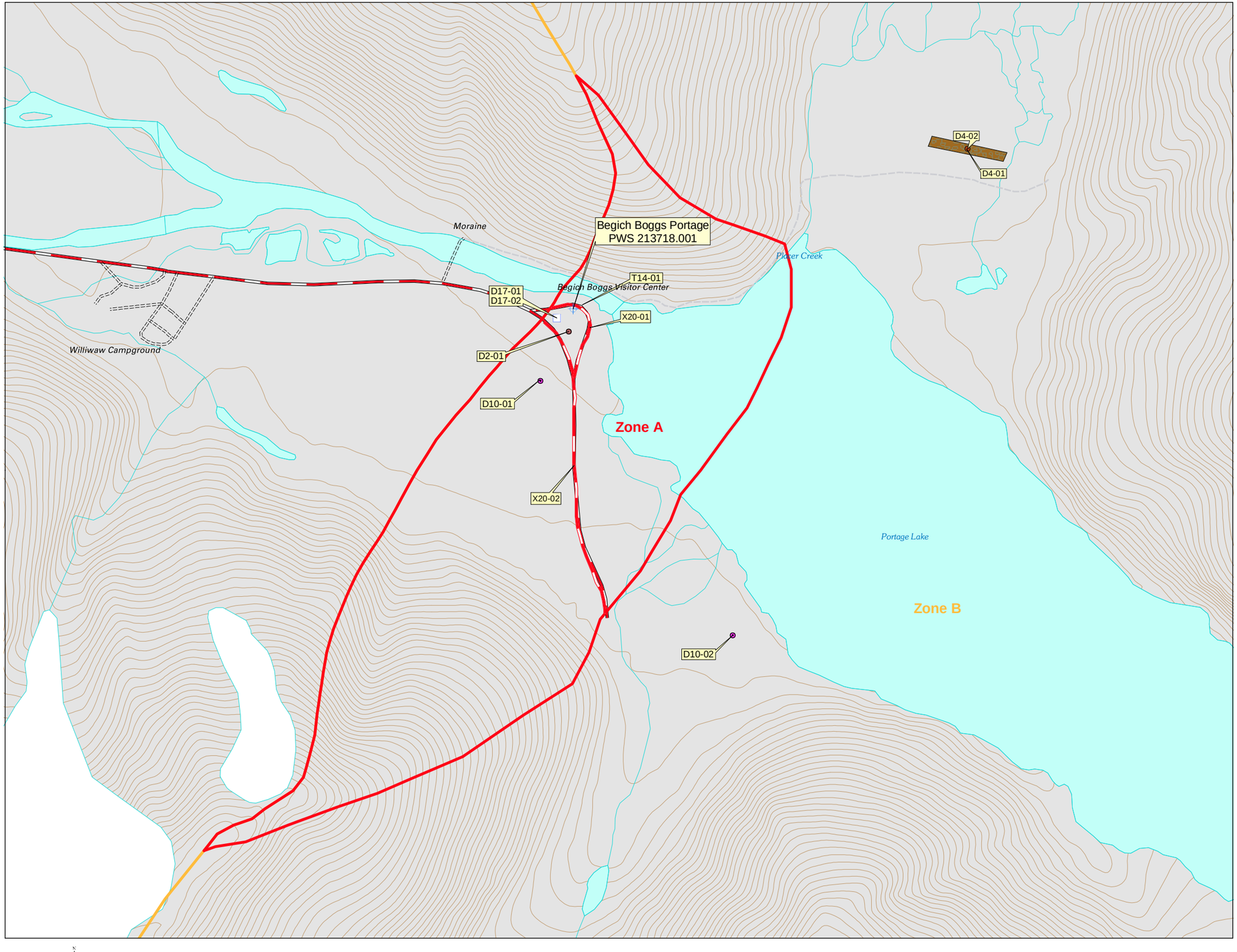
PWSID 213718.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Medium	1		1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	2		1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	3		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	4		1	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	5		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	B	Low	6		1	
Domestic wastewater sludge land application areas	D04	D04-01	B	Low	7	Whittier Tunnel-Inert Monofill	1	Construction/Demolition
Domestic wastewater sludge land application areas	D04	D04-02	B	Low	8	Whittier Tunnel-Inert Monofill	1	

APPENDIX C

Begich Boggs Visitor Center Well No. 1
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Drinking Water Protection Areas for the Public Water Well System for PWS # 213718.001 Begich Boggs Portage
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

Contaminant Sources

- Tanks, heating oil, nonresidential (aboveground) (T14)
- Domestic Wastewater Treatment Plant Disposal Lagoon (D2)
- Domestic Wastewater Sludge Land Application Areas (D4)
- Injection Wells (Class V) Large Capacity Septic System Drainfield Disposal (D10)
- Pit toilets (vaulted) nonresidential (one or more) (D17)
- Highways and roads, paved (X20)
- Domestic Wastewater Sludge Land Application Areas (D4)

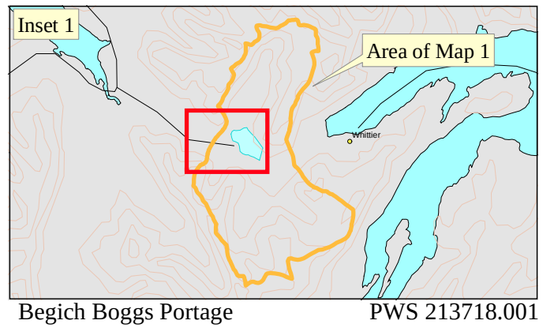
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

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.



Feet
0 1,350 2,700 5,400 8,100 10,800

Begich Boggs Portage PWS 213718.001

APPENDIX D

Vulnerability Analysis for
Begich Boggs Visitor Center Well No. 1
Public Drinking Water Source
(Charts 1-8)

Chart 1. Susceptibility of the wellhead - Begich Boggs Visitor Center (213718.001)

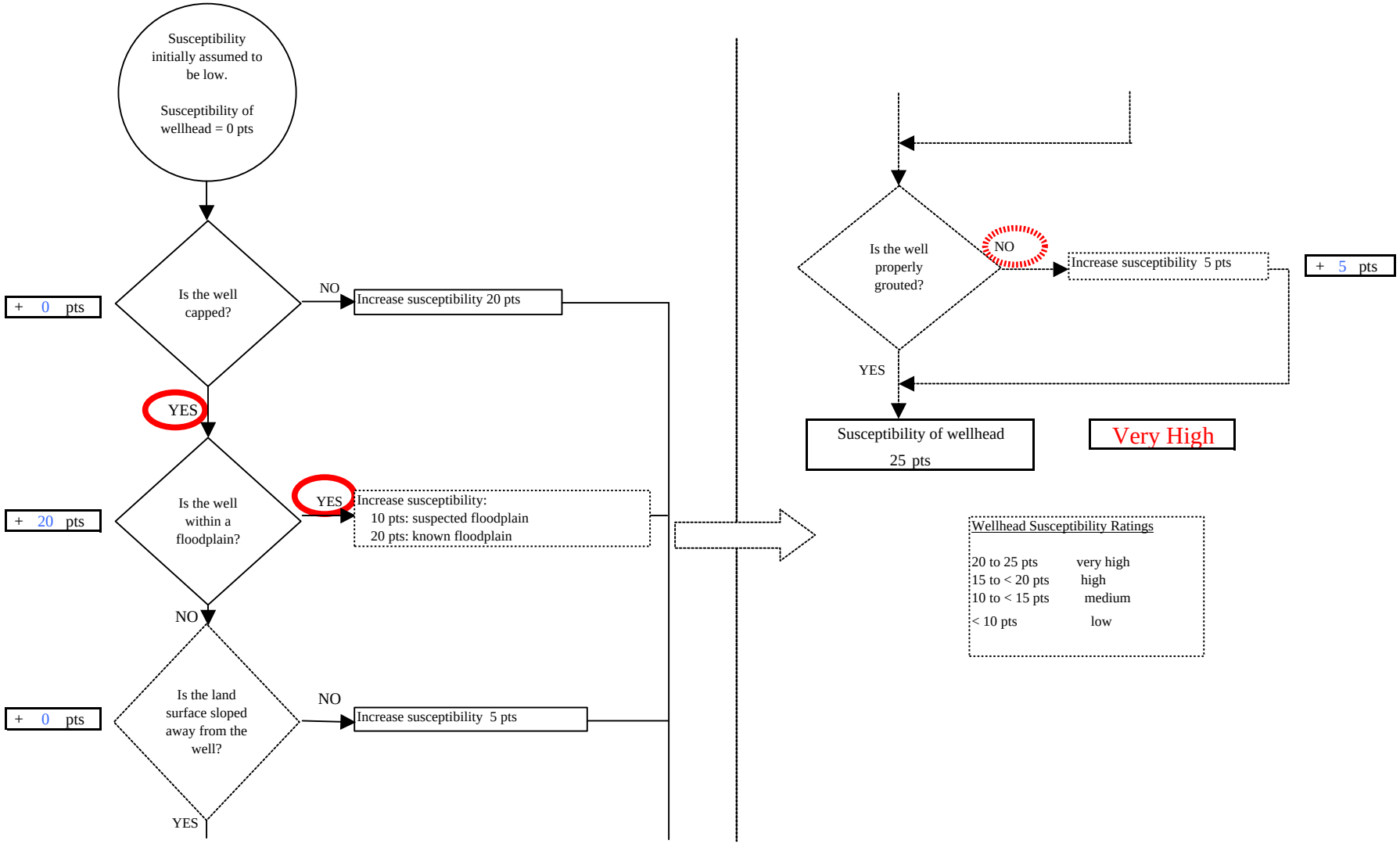


Chart 2. Susceptibility of the aquifer - Begich Boggs Visitor Center (213718.001)

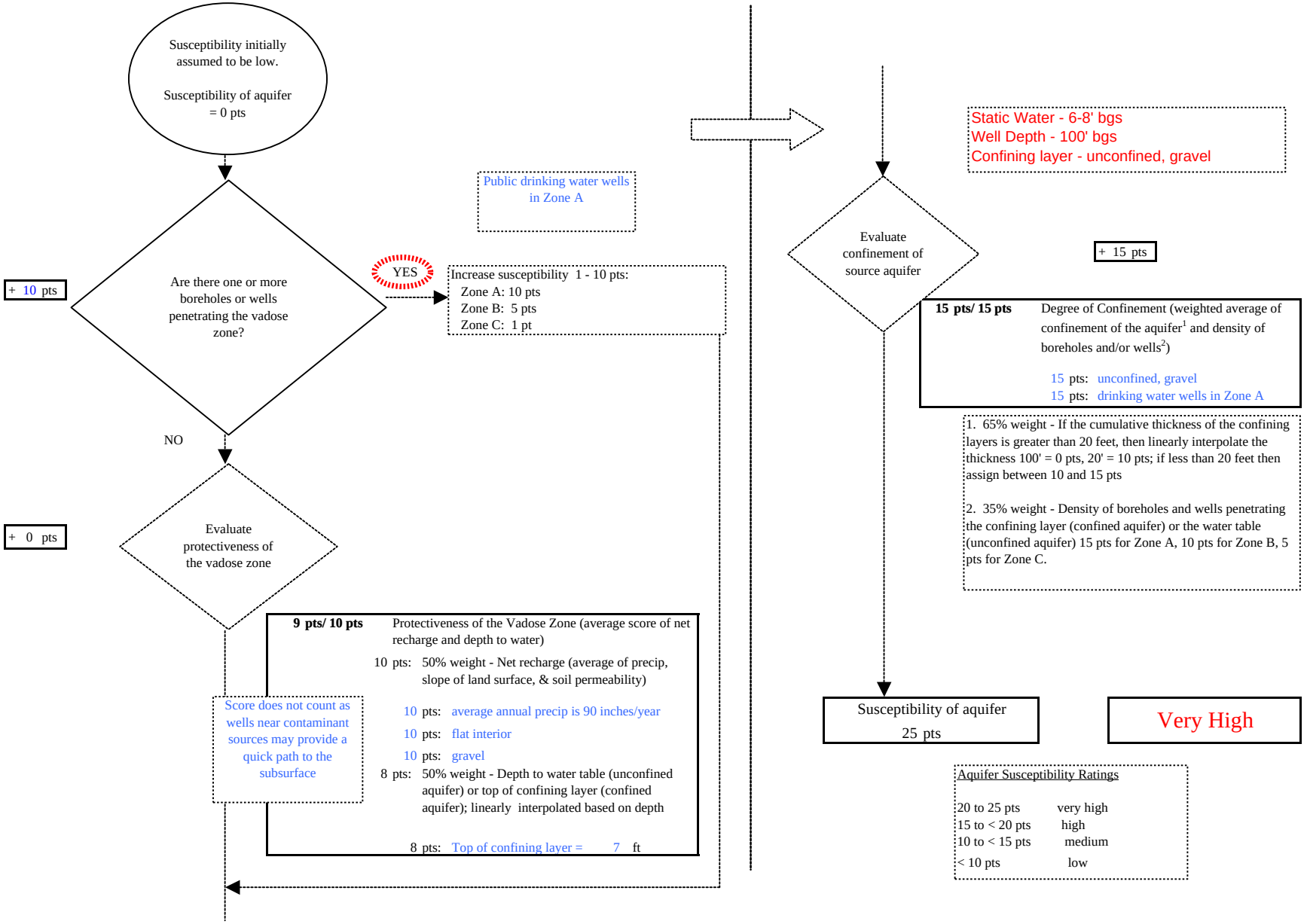
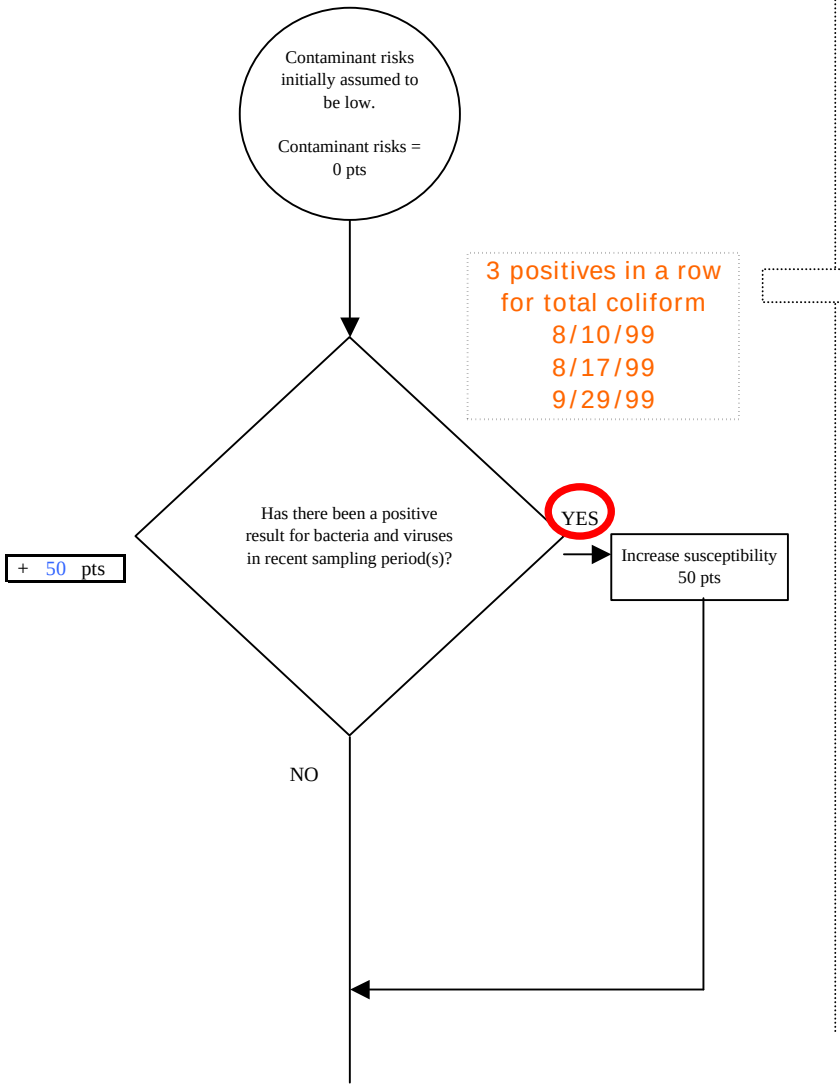
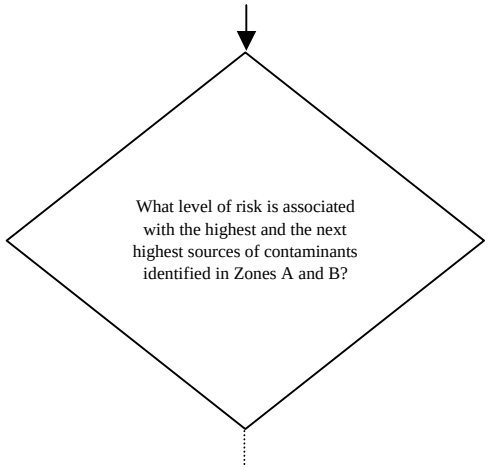


Chart 3. Contaminant risks for Begich Boggs Visitor Center (213718.001) - Bacteria & Viruses





+ 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)	2	3	5
Medium(s)	0	0	0
Low(s)	3	0	3

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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 Begich Boggs Visitor Center (213718.001) - Bacteria & Viruses

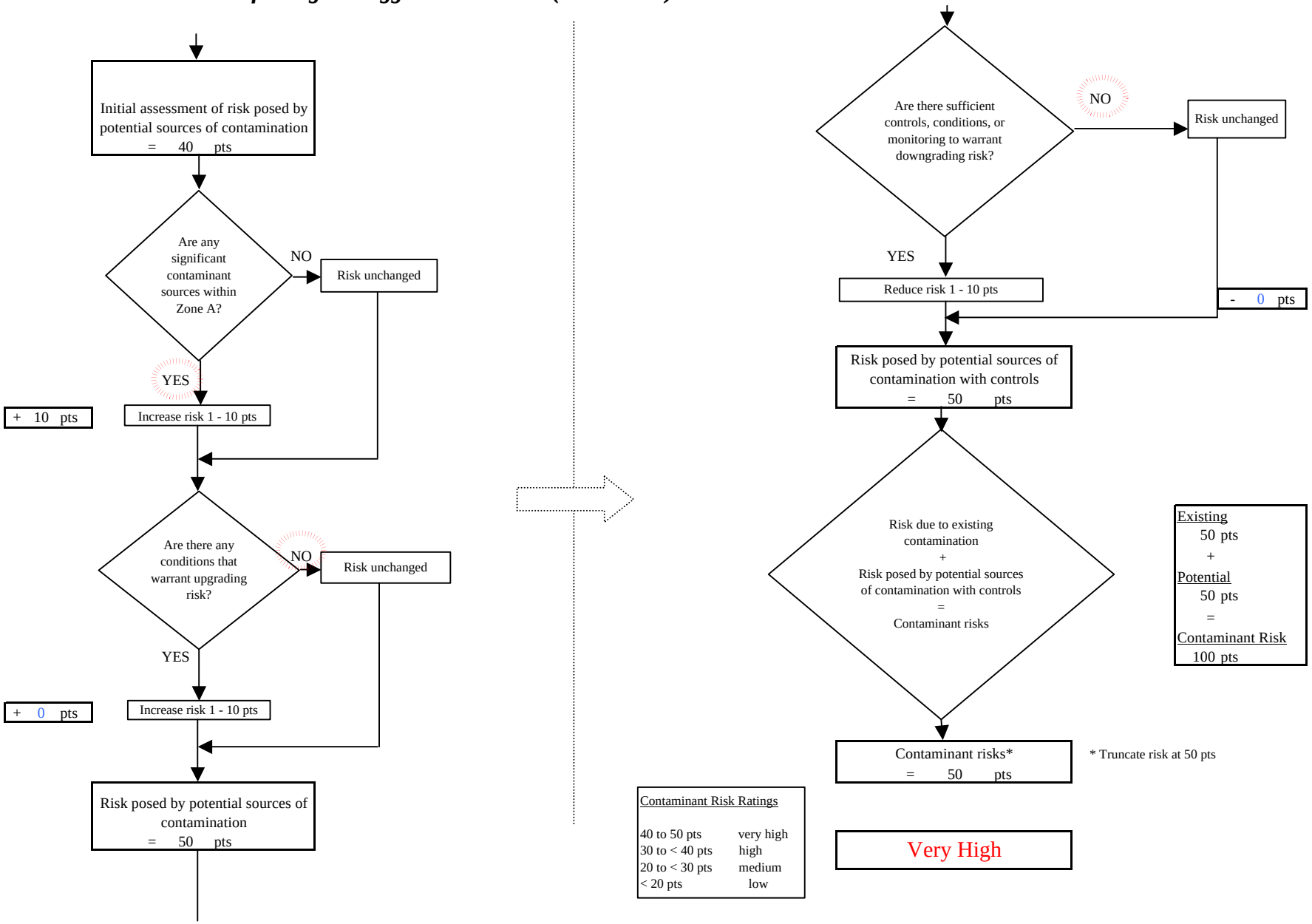


Chart 4. Vulnerability analysis for Begich Boggs Visitor Center (213718.001) - Bacteria & Viruses

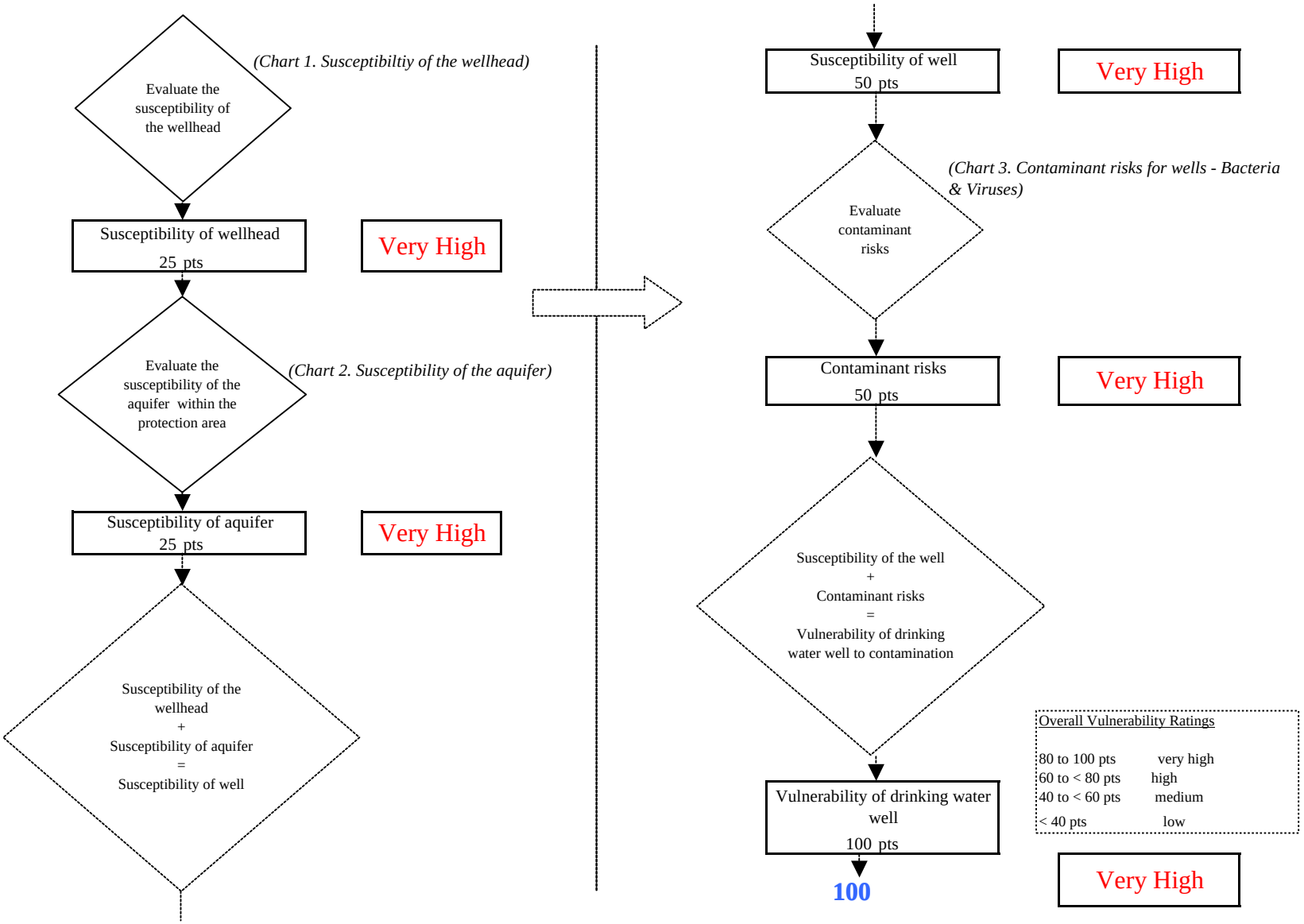


Chart 5. Contaminant risks for Begich Boggs Visitor Center (213718.001) - Nitrates and Nitrites

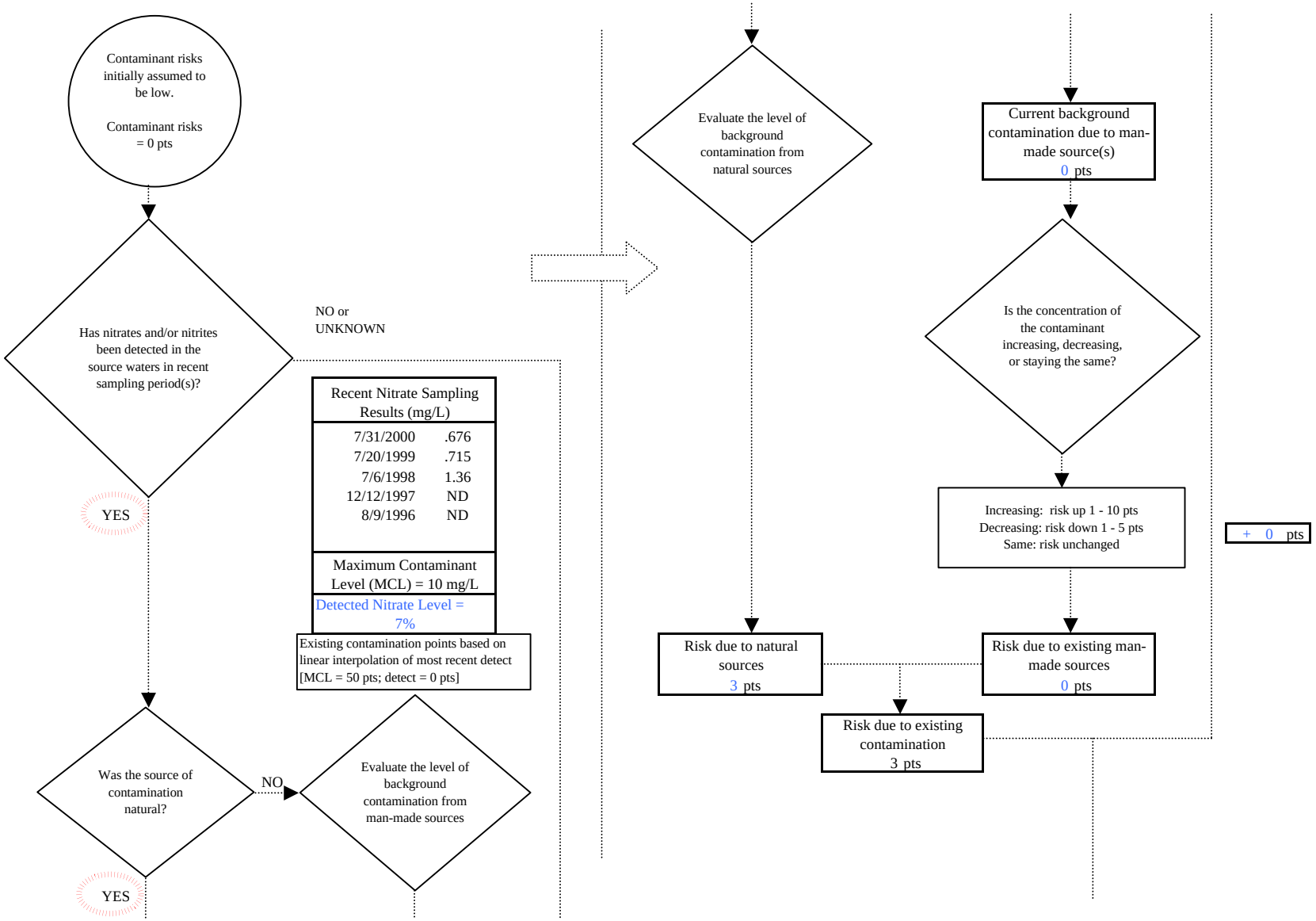


Chart 5. Contaminant risks for Begich Boggs Visitor Center (213718.001) - Nitrates and Nitrites

+ 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)	2	3	5
Medium(s)	0	0	0
Low(s)	3	0	3

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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.

Initial assessment of risk posed by potential sources of contamination = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

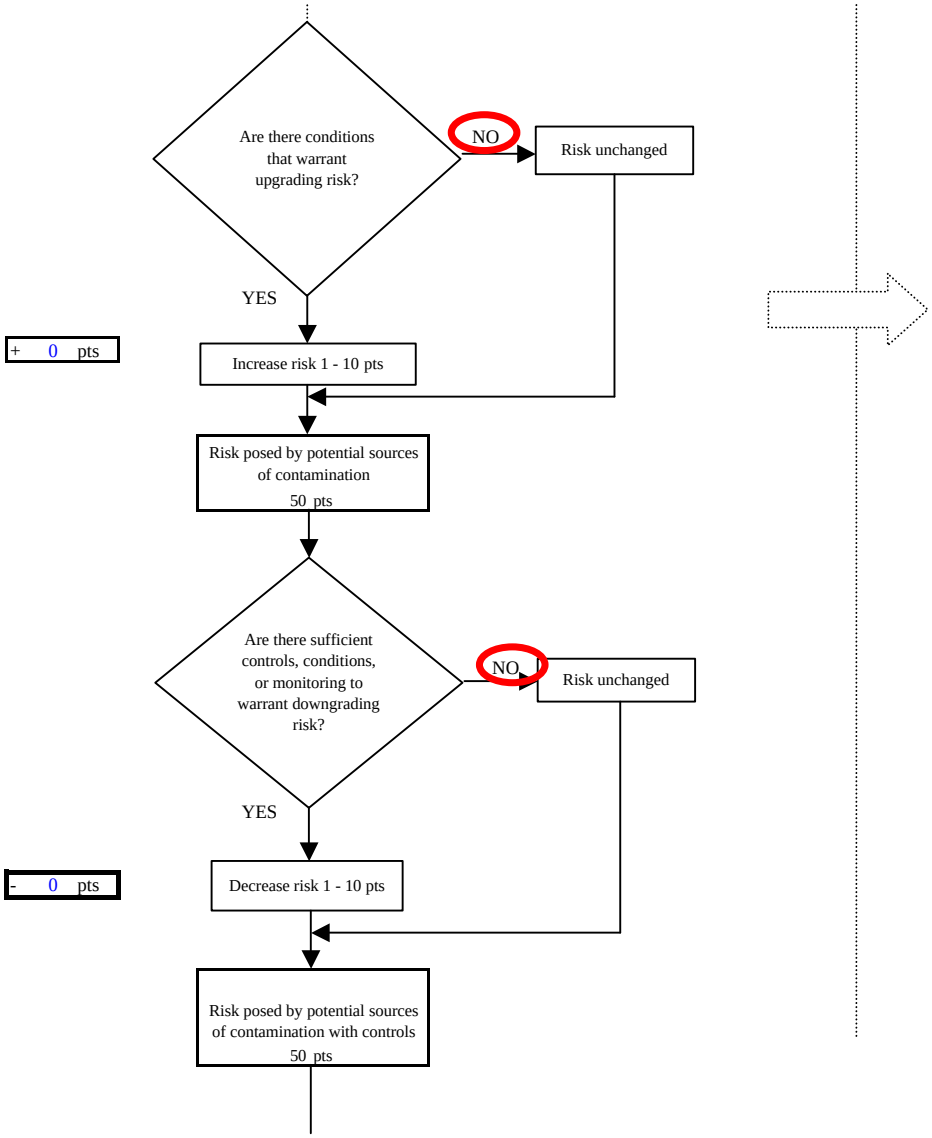
Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10 pts

Chart 5. Contaminant risks for Begich Boggs Visitor Center (213718.001) - Nitrates and Nitrites



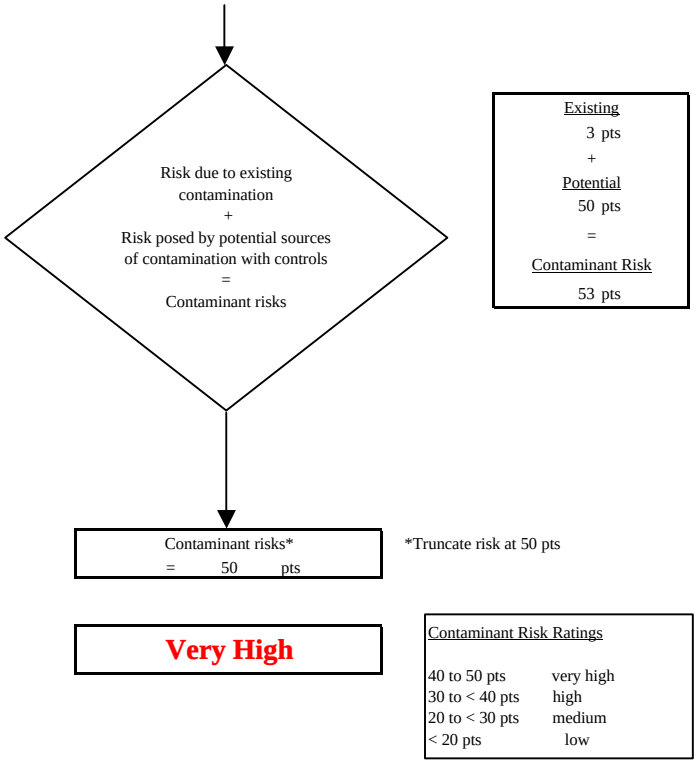


Chart 6. Vulnerability analysis for Begich Boggs Visitor Center (213718.001) - Nitrates and Nitrites

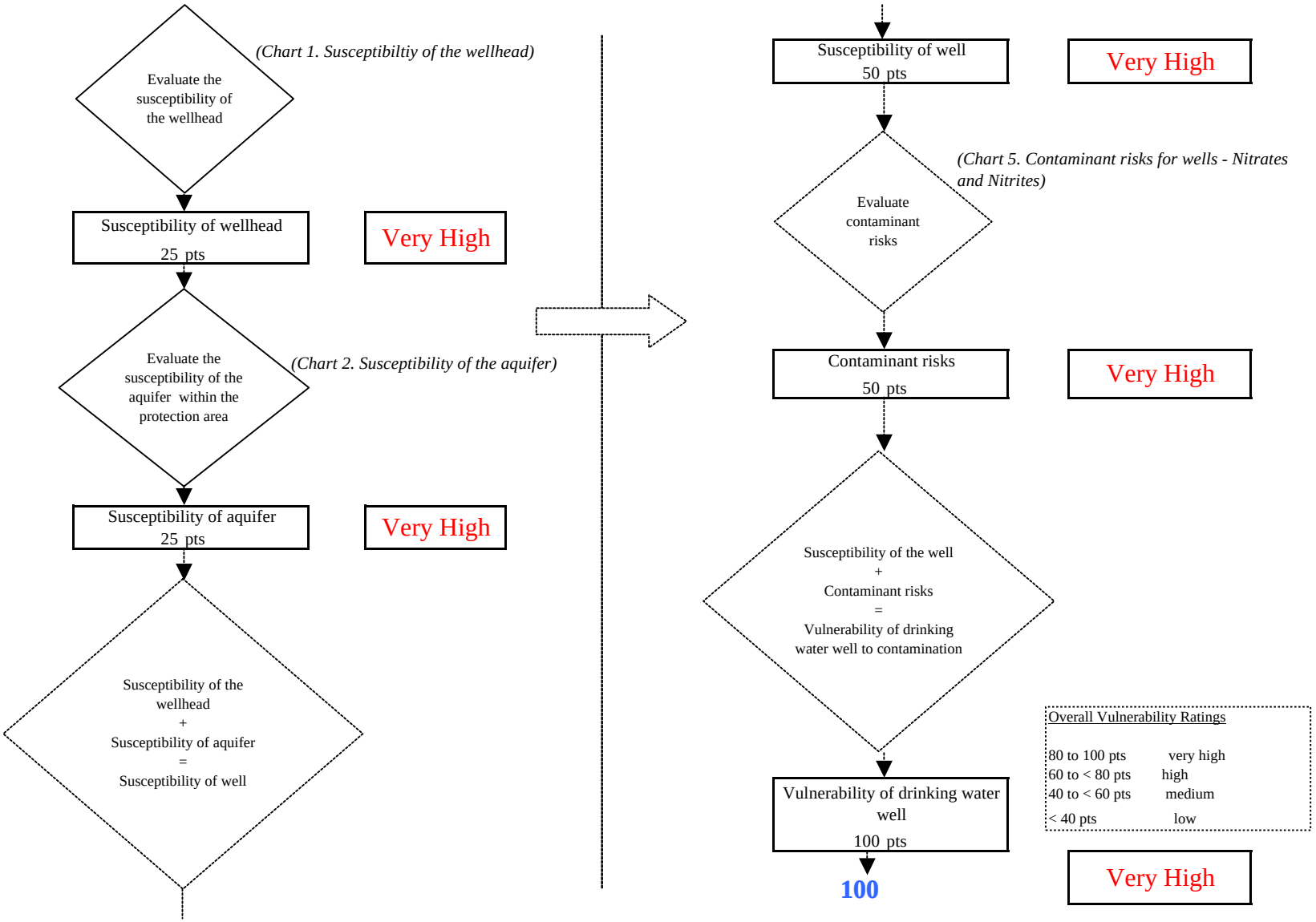


Chart 7. Contaminant risks for Begich Boggs Visitor Center (213718.001) - Volatile Organic Chemicals

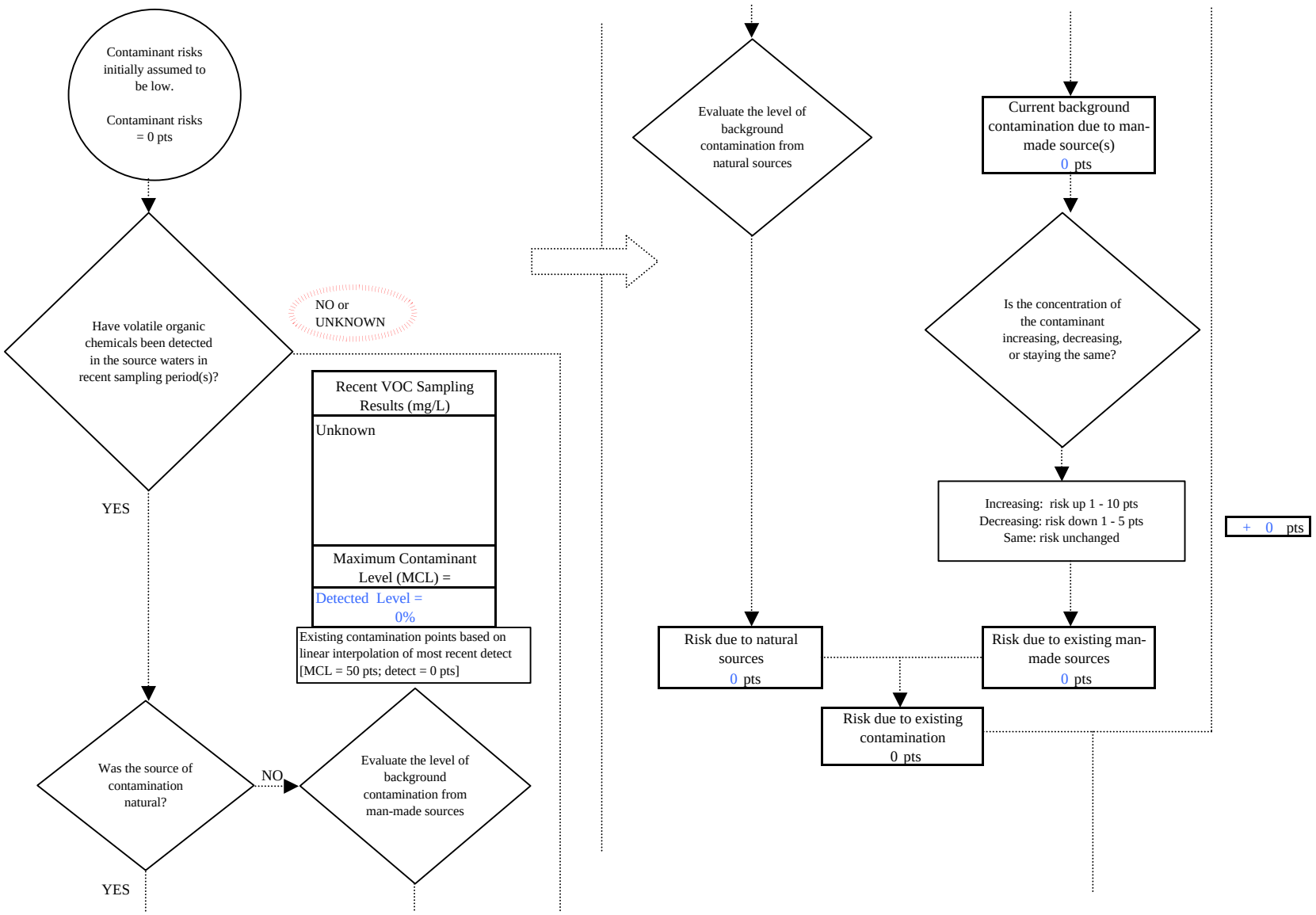


Chart 7. Contaminant risks for Begich Boggs Visitor Center (213718.001) - Volatile Organic Chemicals

+ 20 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	3	3	6

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 20

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

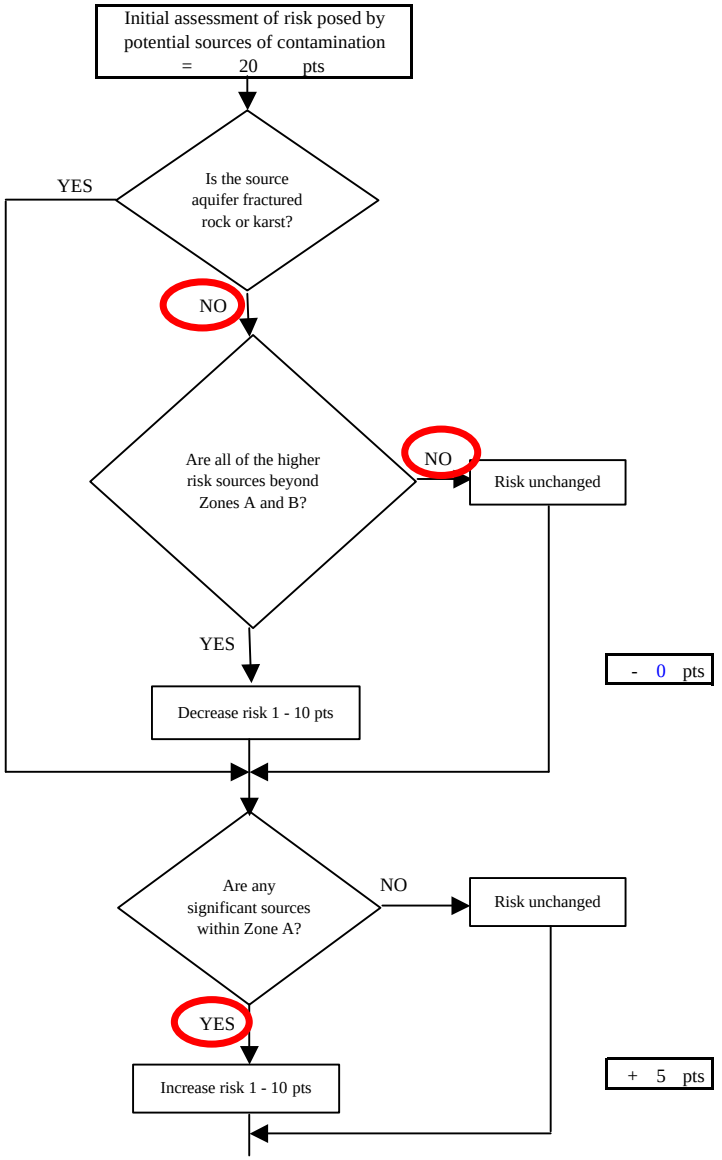
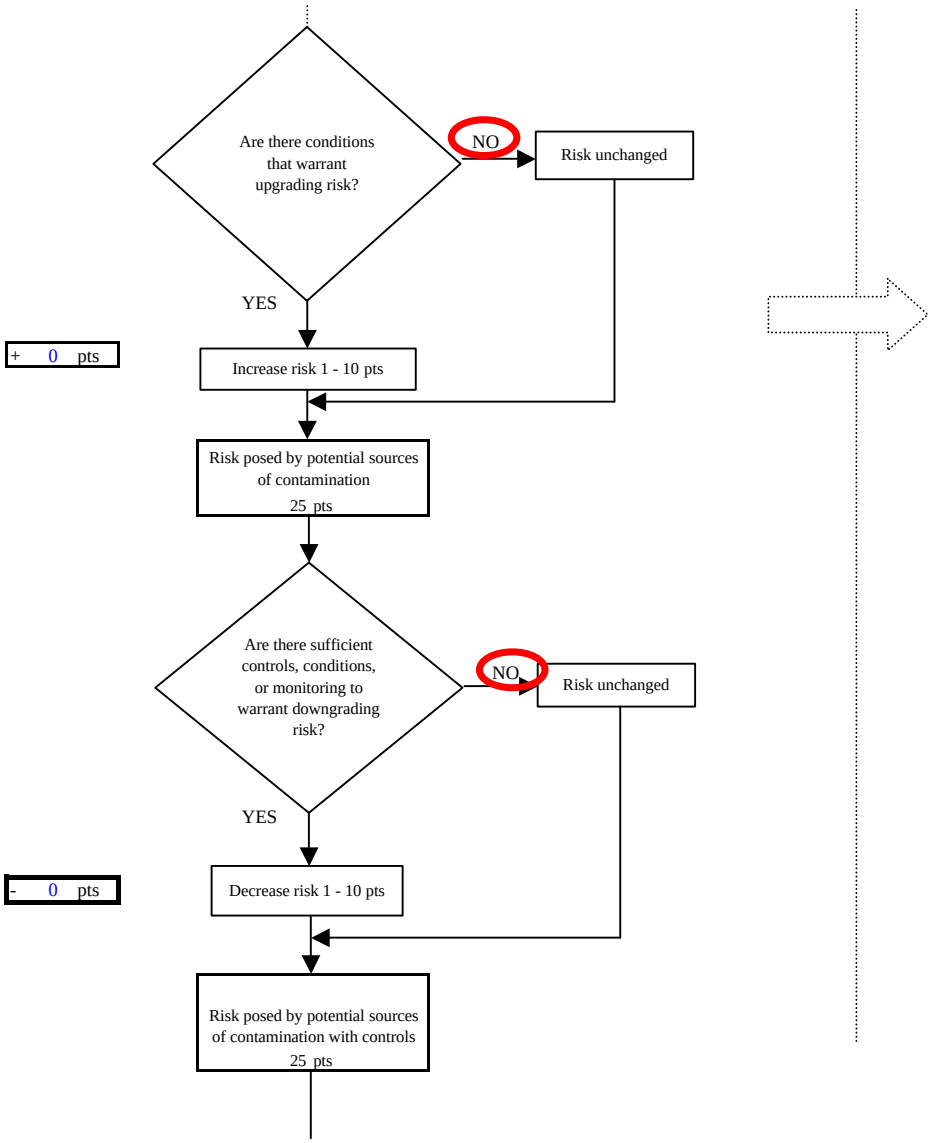
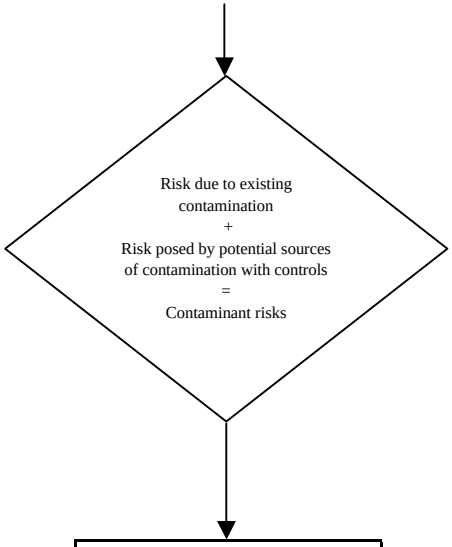


Chart 7. Contaminant risks for Begich Boggs Visitor Center (213718.001) - Volatile Organic Chemicals





Existing
0 pts
+
Potential
25 pts
=
Contaminant Risk
25 pts

Contaminant risks*
= 25 pts

*Truncate risk at 50 pts

Medium

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

Chart 8. Vulnerability analysis for Begich Boggs Visitor Center (213718.001) - Volatile Organic Chemicals