Source Water Assessment for the The BBQ Pit Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

DRINKING WATER PROTECTION PROGRAM REPORT 435
PWSID 214015.001

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Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Public Water System for the BBQ Pit is a Class B (transient/non-community) water system consisting of one well in the Anchorage area. Identified potential and current sources of contaminants that present the most significant risk to the BBQ Pit's drinking water source includes approximately 87 acres of residential area, city parks, sewer lines, orchards or nurseries, lawn and garden supply distributors, and motor vehicle repair shops (See Appendix B for a comprehensive list of the contaminant source inventory). 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 source for the BBQ Pit received a vulnerability rating of **medium** for bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

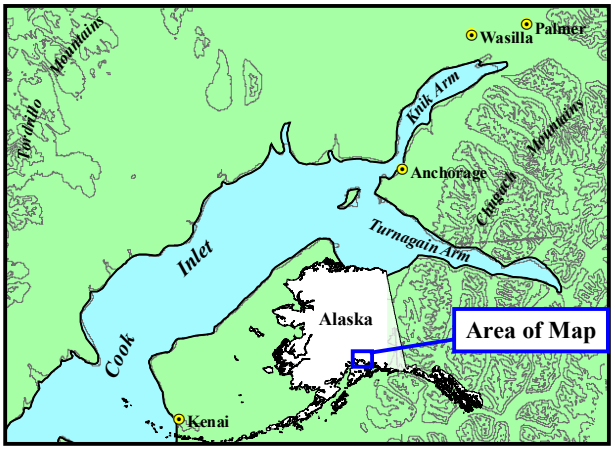

Figure 1. Index map showing the location of Anchorage, Alaska

INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. This assessment was completed for the source of public drinking water serving the BBQ Pit. This water system consists of one well in the Anchorage area (see Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, has combined a review of the natural hydrogeologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for local voluntary protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

DESCRIPTION OF THE ANCHORAGE AREA, ALASKA

Location

Anchorage, located in southcentral Alaska, encompasses 1,698 square miles of land and 264 square miles of water. The area containing a majority of the urban development, commonly referred to as the Anchorage Bowl, encompasses approximately 180 square miles [*Partick, Brabets, and Glass, 1989*] and envelopes the low lands of the area. This area is bounded on the east by the Chugach Mountains and the north, west, and south by the Knik and Turnagain Arms of Cook Inlet (Figure 1). In recent times, urban development has extended eastward along the flanks of the Chugach Mountains. This area, known locally as the Anchorage Hillside, contains development at elevations exceeding 3,700 feet in elevation above sea level.

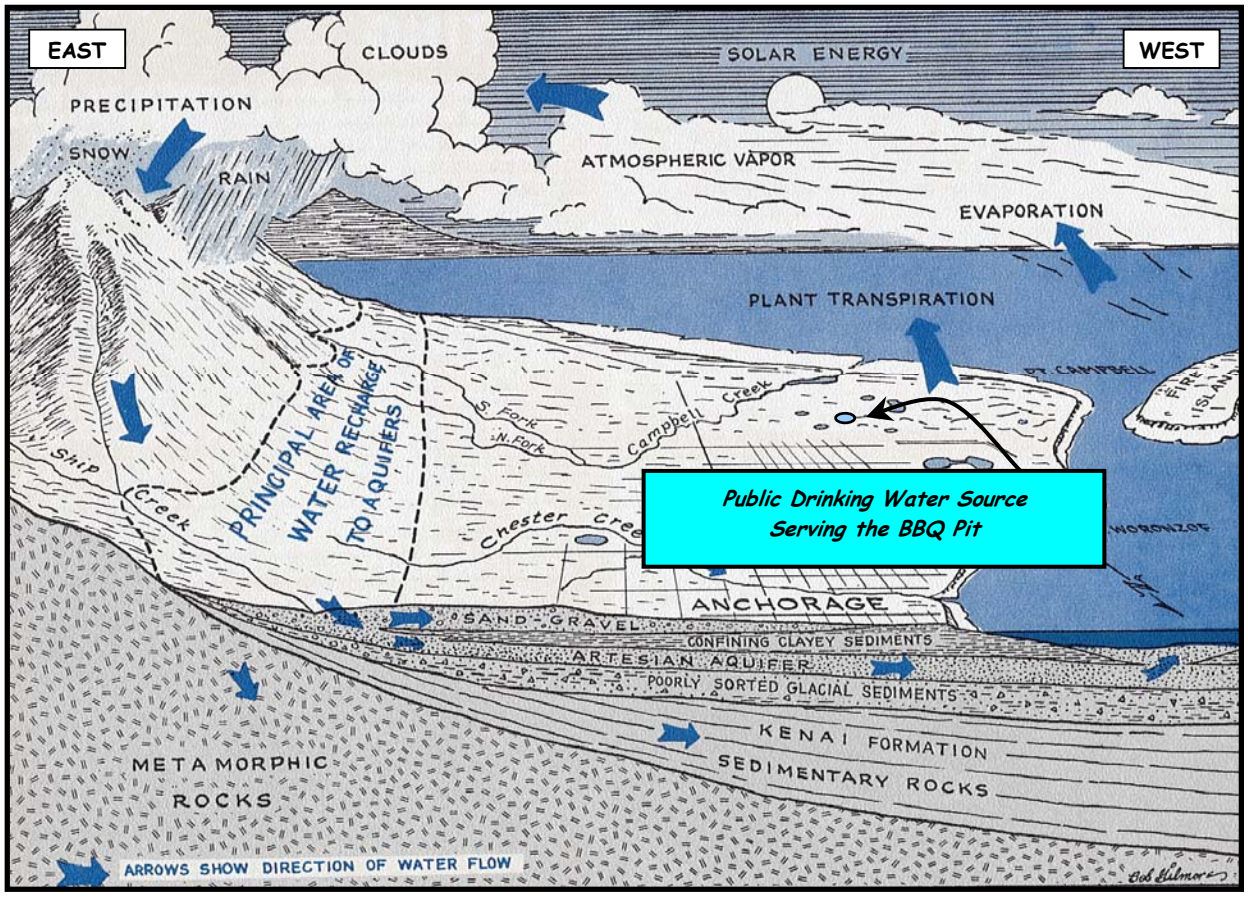

Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

Climate

The Anchorage area climate is somewhat transitional in that it does not experience large daily and annual temperature fluctuations like those experienced in the interior of Alaska nor does it experience high amounts of precipitation typified by gulf coast regions. Mean annual precipitation at the Anchorage International Airport is approximately 16 inches per year. On average, Anchorage receives a total snow accumulation of 69 inches per year. Precipitation generally increases inland toward the Chugach Mountains where annual precipitation may exceed 160 inches per year [*Barnwell, George, Dearborn, Weeks, and Zenone*, 1972]. Mean daily temperature ranges from 65^{o} F during July to 8^{o} F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

Surface elevations in the Anchorage area range from sea level at Knik and Turnagain Arms to well over 5,000 feet in the peaks that bound the area. Glacial moraine and outwash deposits primarily mantle the surface of the Anchorage Bowl.

The backbone of the Chugach Mountains is composed primarily of metamorphic marine and volcanic rocks (bedrock). These high peaks that bound Anchorage's east side are flanked with colluvium or slope deposits. These slope deposits eventually grade into the glacial and stream deposits at lower elevations in the Anchorage Bowl.

In the Anchorage area, two principal groundwater flow systems or aquifers exist (see Figure 2). The upper unconfined aquifer or water-table aquifer is separated from a lower confined aquifer system by layers of silty, clayey glacially derived sediments (confining layer) [*Ulery and Updike*, 1983]. The lower confined aquifer system consists of a series of hydrologically interconnected layers and lenses of gravel, sand and silt that, collectively, form the confined aquifer. The confining layer ranges from 0 to 270 feet thick throughout the Anchorage area and generally thins with increasing distance from Cook Inlet, thus pinching out at the mountain front [*Patrick, Brabets, and Glass*, 1989].

Water enters or recharges these two aquifer systems in several different ways. Along the front of the Chugach Mountains, groundwater seeps from fractures in bedrock into the sediments. At these higher elevations, rain and snowmelt also enter the sediments. This area along the mountain front is considered the principal recharge area

for wells in the Anchorage area. Precipitation in the low lands may also percolate directly into the ground. Lastly, aquifers may also be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). Groundwater flow in the confined aquifer is generally east to west from the mountain front toward Cook Inlet and Turnagain Arm, except in areas where the direction of flow is influenced by large municipal or industrial production wells. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surfacial topography as well as its close connection with surface water bodies.

PUBLIC DRINKING WATER SYSTEM SERVING THE BBQ PIT

The public water system serving the BBQ Pit is a Class B (transient/non-community) water system. The system consists of one well, and is located off of Dimond Boulevard near the foothills of the Chugach Mountains at an elevation of approximately 100 feet above sea level (see Figure 3).

According to the most recent Sanitary Survey (12/13/93) the entire well-head is located inside a concrete encasement. The well can only be accessed through a manhole cover. The manhole cover was frozen shut at the time the survey was conducted. The survey indicates that the site is properly drained and protected against flooding. Adequate sloping of the ground surface aids in diverting foreign matter and surface water away from the well site so that contaminants do not enter the well along the casing. Proper sealing and grouting of the well can also aid in the protection of source waters against contaminants.

This system operates year round serving 100 non-residents through 1 service connection.

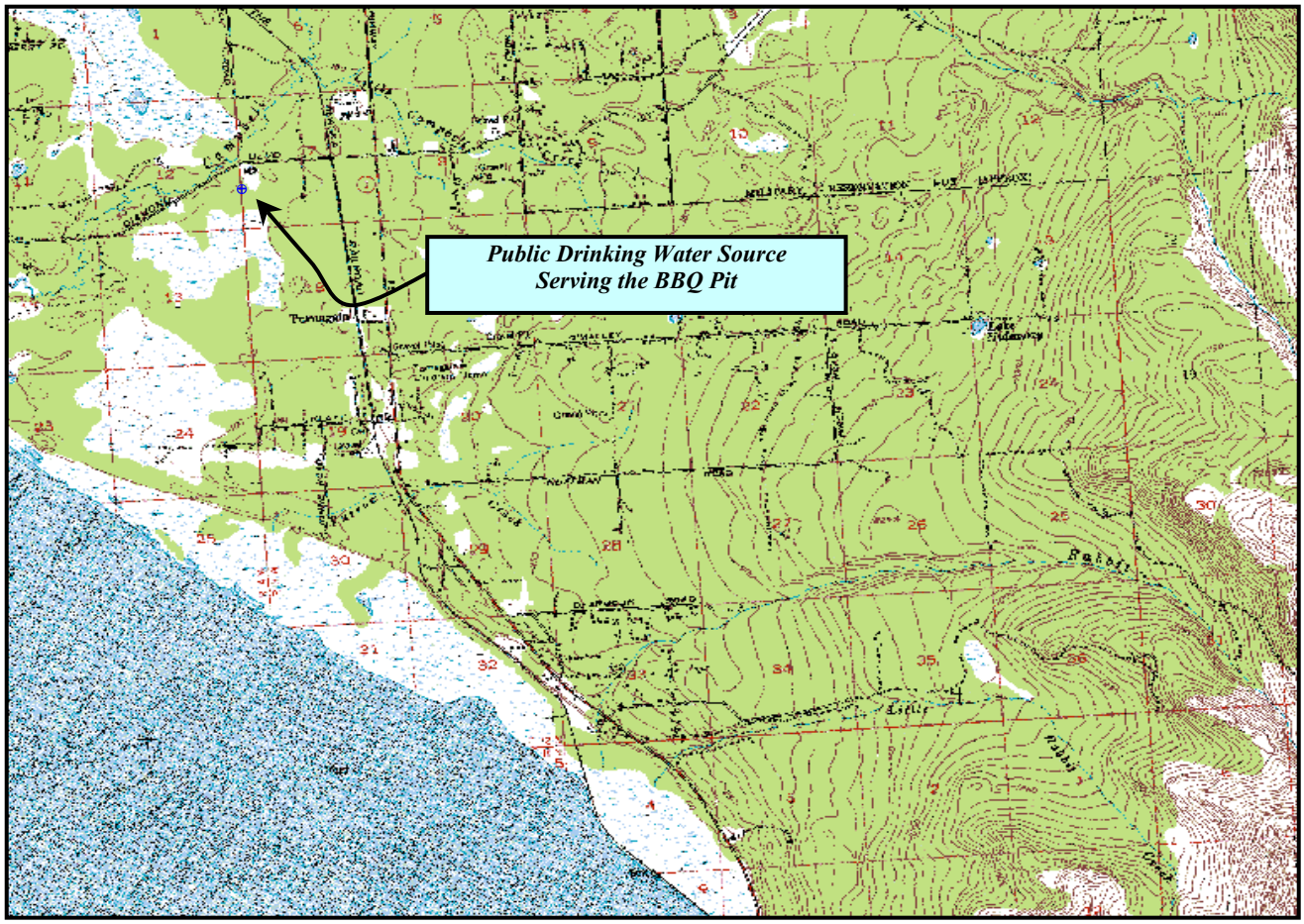

Figure 3. Map showing the location of the drinking water source for The BBQ Pit [Base: USGS Anchorage A8].

ASSESSMENT AND PROTECTION AREA FOR THE DRINKING WATER SOURCE SERVING THE BBQ PIT

The Drinking Water Protection and Assessment Area that has been established for the source of drinking water serving the BBQ Pit is the area that is most sensitive to contamination. This area has served as a basis for assessing the risk of the drinking water source to contamination. The zones around the drinking water source outline the most critical area for the preservation of the quality of the drinking water for this system. For simplicity, this area will be known as your Drinking Water Protection Area and will serve as the focus for voluntary protection efforts.

Conceptually, groundwater enters the aquifer systems along the front range of the Chugach Mountains (Figure 2) and flows toward Cook Inlet. An analytical calculation was used to determine the size and shape of the area that contributes water to the well. 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*]. This analytical calculation was used as a guide as the first step in establishing the protection area for each public drinking water source in Anchorage. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at meaningful and conservative protection areas with respect to public health (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation are separated into zones. These zones correspond to a time-of-travel. Time-of-travel is the time required for water to move in the saturated zone of the ground from a specific point to the well. The Drinking Water Protection Area for the BBQ Pit contains four zones, Zone A through Zone D (See Map 1 in Appendix A). Zone A corresponds to the area between the well and the distance equal to ¼ of the distance of the 2-year time-of-travel. Depending on where a contaminant source is located within Zone A, travel time for a contaminant to the well may be on the order of several days to several hours. Zone A also extends downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Zone B corresponds to a time-of-travel of less than two years. Zones C and D correspond to those areas between 5 years and 10 years time-of-travel, respectively.

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 Drinking Water Protection Area for the BBQ Pit. This survey was completed through a search of agency records and other publicly available information. Potential sources of contamination to drinking water supplies cover 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 this assessment and 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

Maps 2 through 6 in Appendix C depict the Contaminant Source Inventory for the BBQ Pit. Table 1 in Appendix B lists the inventoried potential sources of contamination within Zones A through D. Below is a summary of the contaminant sources inventoried within the Drinking Water Protection Area for the BBQ Pit:

- Approximately 87 acres of residential area;
- city parks;
- sewer lines;
- orchards or nurseries;
- lawn and garden supply distributors;
- motor vehicle repair shops;
- recreation trails;
- appliance repair shops;
- a boat yard;
- medical facilities;
- a DEC recognized contaminated site.

These potential and existing contaminant sources present risk for all three categories of drinking water contaminants.

RANKING OF CONTAMINANT RISKS

Potential and existing sources of contamination have been 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. Contaminant risks are further a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the public drinking water well.

VULNERABILITY OF THE DRINKING WATER SOURCE SERVING THE BBQ PIT

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 have been analyzed and an overall vulnerability score of 0 to 100 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 log was not available for the drinking water well serving the BBQ Pit. Therefore, the geological information presented was gathered from well logs within ¼ mile radius of the well serving the BBQ Pit. According to the surrounding well logs there is a confining layer consisting of silty clay from 57 to 65 feet below ground surface. This confining layer may provide a protective barrier against the movement of contaminants in the subsurface. However, near the base of the Chugach Mountains, these clay layers tend to be discontinuous and thin toward the mountains. Therefore, contaminants that enter the subsurface near the base of the mountains may enter the confined aquifer uninhibited by the absence of any protective layer. Static water level in the area tends to be approximately 30 feet below ground surface. The depth of the BBQ Pit's drinking water is unknown. However, wells researched within ¼ mile radius of the BBQ Pit were approximately 200 to 300 feet deep.

Combining the susceptibility of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility of the well to contamination (See Appendix D). Table 1 depicts the overall Susceptibility score and rating for the source of public drinking water serving the BBQ Pit.

Table 1. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	11	Medium
Natural Susceptibility	16	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. A score (0 – 50 points) and rating of Contaminant Risks (See Appendix D) is assigned based on the findings of the Contaminant Source Inventory (See Appendix B - Table 1 – Table 7). This portion of the analysis examines any existing or historical contamination that has been detected at the drinking water source through routine sampling. It also reviews contamination that has or may have occurred but has not arrived or been detected at the well. Table 2 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	25	Medium
Nitrates and/or Nitrites	32	High
Volatile Organic Chemicals	22	Medium

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a Class B public drinking water system. 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 Analysis for nitrates and nitrites, volatile organic chemicals, respectively. Vulnerability of the drinking water source to contamination is the combination of susceptibility of the aquifer and the well with contaminant risks. Table 3 contains the overall vulnerability scores (0 – 100) and ratings for each of the three categories of drinking water contaminants (See Appendix D). Note: scores are rounded off to the nearest five.

Table 3. Overall Vulnerability of the Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	40	Medium
Nitrates and Nitrites	50	Medium
Volatile Organic Chemicals	40	Medium

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.

The contaminant risk is medium for bacteria and viruses with residential areas, city parks, and sewer lines presenting the most significant risk to the drinking water well. Review of the sampling history revealed that bateria and viruses have not been detected in the drinking water. After combining the contaminant risk with the natural susceptibility of the well the overall vulnerability to contamiantion is medium from bacteria and viruses.

Nitrates and/or nitrites are found in natural background concentration at this site, as elsewhere throughout Alaska. Nitrate concentrations in uncontaminanted 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 the The BBQ Pit indicates that low concentrations of nitrates were detected August 8, 2000 (See Chart 5 – Contaminant Risks for Nitrates and/or Nitrites in Appendix D). The contaminant risk for nitrates and/or nitrites is high with residential areas, city parks, orcharsd or nurseries, lawn and garden supply distributors, and sewer lines presenting the most significant risk to the drinking water well. Existing nitrate concentration is approximately 3% of the Maximum Contaminant Level or MCL. 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.

The contaminant risk for volatile organic chemicals is medium with the motor vehicle repair shops, residential areas, roads, and sewer lines presenting the most significant risk to the drinking water well. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the overall vulnerability of the well to contamiantion to medium from volatile organic chemicals.

Motor vehicle repair shops within the protection area present the most significant risk to the drinking water source. Roads within the are also significant sources of potential contamination for bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Due to the potential for fuel spills to occur, major road routes were ranked as a low potential source of contamination to the drinking water source for volatile organic chemicals.

There is a located in Zone D off of King Street. A citizen complaint was documented, in December 1989, of numerous spills of solvents used to clean heavy equipment were being disposed of on the ground surface. After site reconnaissance and discussion with the owner of the property it was discovered that a leaking above ground storage (AST) tank was causing staining on the ground surface. The AST was removed along with stained surface soils. No obvious evidence of staining remains at the site. The site was closed in February, 1996. Due to the distant proximity of Zone D to the drinking water source and its inactive/closed status, the contaminated site was does not present a significant risk to the source of drinking water serving the BBQ Pit.

Review of the historical sampling data indicates that no volatile organic chemical contamination has been detected in the source of public drinking water serving the BBQ Pit.

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving the BBQ Pit. The overall vulnerability of this source to contamination is **medium** for bacteria and viruses, nitrates and/or nitrites, and 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 the BBQ Pit to protect public health. It is anticipated that *Source Water Assessments* will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the public drinking water source serving the BBQ Pit.

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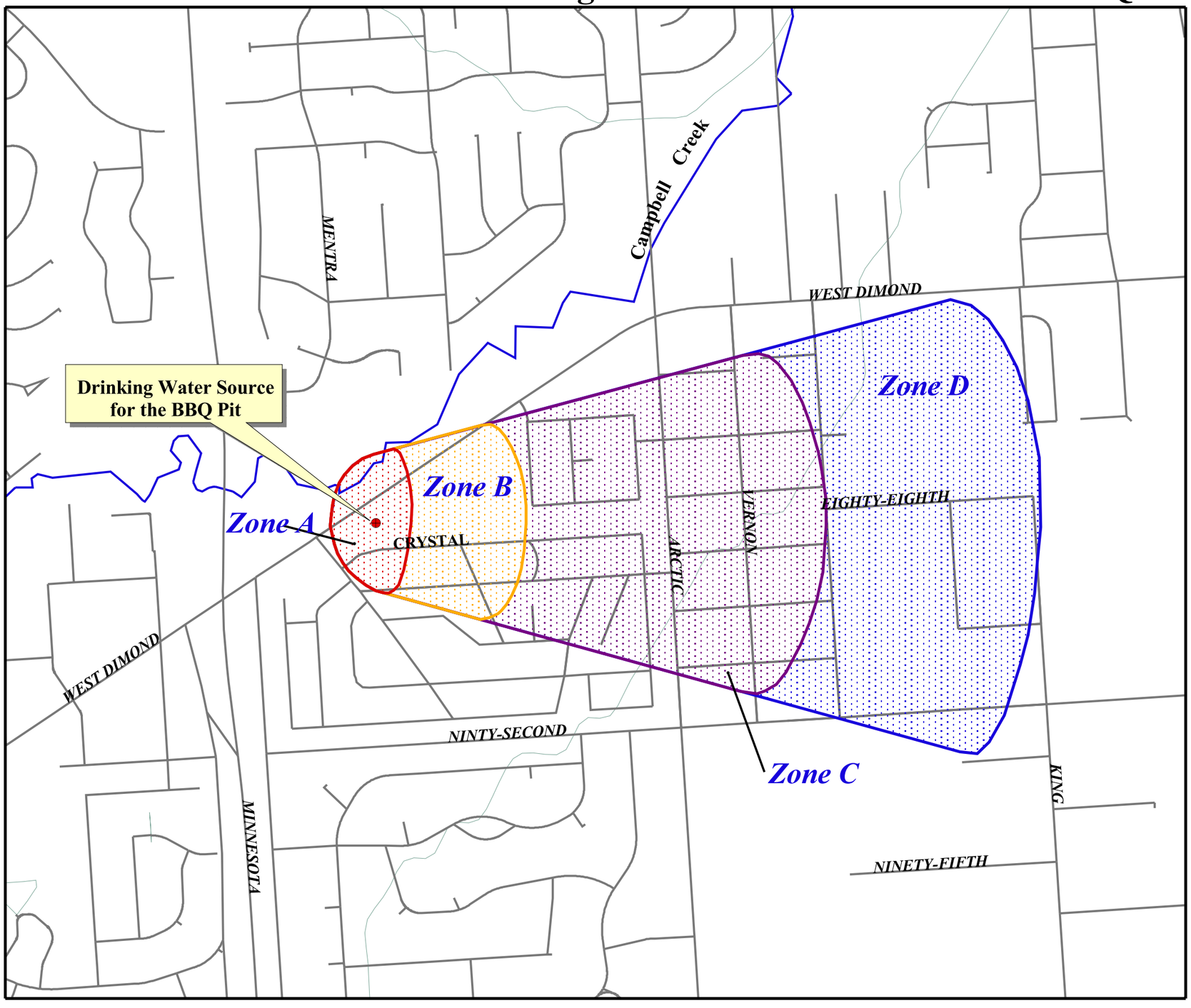
APPENDIX A

Drinking Water Protection Area for the BBQ Pit

Drinking Water Protection Area and Potential & Existing Contaminant Sources for the BBQ Pit



- Drinking Water Well for the BBQ Pit

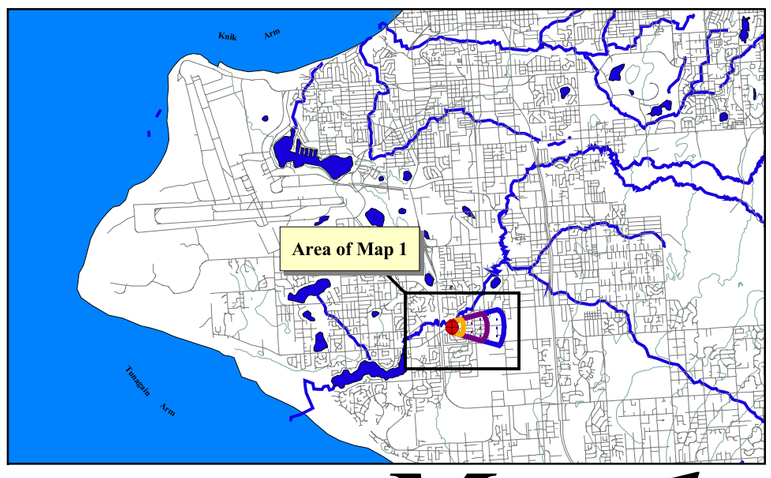
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Anchorage Roads (X20)
- Anchorage Streams
- Elevation Contours

N W E S



PWSID 214015.001

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for the BBQ Pit

Table 1 *Contaminant Source Inventory for* ***PWSID 214015.001***

BBQ Pit

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Along West Dimond Blvd.	3	
Residential Areas	R01	R1-1	A	Residential areas located within Zone A	3	Approximately 2 acres of residential area in Zone A.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	West Dimond Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Crystal Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Garnet Street	2	
Municipal or city parks (with green areas)	X04	X4-1	A	Anchorage parks intersecting Zones A and B	2	
Dog walking areas/foot trails	X46	X46-1	A	Trail along the south side of West Dimond Blvd.	2	
Orchards or nurseries	A10	A10-1	B	Off of Crystal Street	2	
Lawn and garden supplies/services	C23	C23-1	B	Off of Crystal Street	2	
Motor /motor vehicle repair shops	C31	C31-1	B	Off of West Dimond Blvd.	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	B	Running across West Dimond Blvd.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Along West Dimond Blvd.	3	
Residential Areas	R01	R1-2	B	Residential areas located within Zone B	3	Approximately 10 acres of residential area in Zone B.
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Unnamed Road	2	
Appliance repair shops	C03	C3-1	C	Off of Eighty-sixth Ave.	4	
Motor /motor vehicle repair shops	C31	C31-2	C	Off of Eighty-sixth Ave.	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4-18	C	All sewer lines located within Zone C	5	
Residential Areas	R01	R1-3	C	Residential areas located within Zone C	5	Approximately 75 acres of residential area in Zone C.
Boat yards and marinas	X15	X15-1	C	On the corner of Vernon Street and Eighty-ninth Ave.	4	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-5-25	C	All roads located within Zone C	4	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	C	Off of West Dimond Blvd.	4	
Dog walking areas/foot trails	X46	X46-2-4	C	All trails located within Zone C	4	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-1	D	Off of King Street	6	Citizen complaint of numerous spills of solvents on the ground. Site reconnaissance and discussion with owner indicated that a leaking AST was the problem and was removed. Site has since been graded and no obvious evidence of staining remains.

Table 2

Contaminant Source Inventory and Risk Ranking for BBQ Pit

Sources of Bacteria and Viruses

PWSID 214015.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R1-1	A	Low	1	Residential areas located within Zone A	3	Approximately 2 acres of residential area in Zone A.
Residential Areas	R01	R1-2	B	Low	2	Residential areas located within Zone B	3	Approximately 10 acres of residential area in Zone B.
Municipal or city parks (with green areas)	X04	X4-1	A	Medium	3	Anchorage parks intersecting Zones A and B	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	4	Along West Dimond Blvd.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	B	Medium	5	Running across West Dimond Blvd.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Medium	6	Along West Dimond Blvd.	3	
Residential Areas	R01	R1-3	C	Low	7	Residential areas located within Zone C	5	Approximately 75 acres of residential area in Zone C.
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4-18	C	Medium	8	All sewer lines located within Zone C	5	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	9	West Dimond Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	10	Crystal Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low		Garnet Street	2	
Dog walking areas/foot trails	X46	X46-1	A	Low		Trail along the south side of West Dimond Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		Unnamed Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5-25	C	Low		All roads located within Zone C	4	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	C	Medium		Off of West Dimond Blvd.	4	
Dog walking areas/foot trails	X46	X46-2-4	C	Low		All trails located within Zone C	4	

Table 3

Contaminant Source Inventory and Risk Ranking for BBQ Pit

Sources of Nitrates/Nitrites

PWSID 214015.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R1-1	A	Low	1	Residential areas located within Zone A	3	Approximately 2 acres of residential area in Zone A.
Residential Areas	R01	R1-2	B	Low	2	Residential areas located within Zone B	3	Approximately 10 acres of residential area in Zone B.
Municipal or city parks (with green areas)	X04	X4-1	A	Medium	3	Anchorage parks intersecting Zones A and B	2	
Orchards or nurseries	A10	A10-1	B	Medium	4	Off of Crystal Street	2	
Lawn and garden supplies/services	C23	C23-1	B	Medium	5	Off of Crystal Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	6	Along West Dimond Blvd.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	B	Medium	7	Running across West Dimond Blvd.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Medium	8	Along West Dimond Blvd.	3	
Residential Areas	R01	R1-3	C	Low	9	Residential areas located within Zone C	5	Approximately 75 acres of residential area in Zone C.
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4-18	C	Medium	10	All sewer lines located within Zone C	5	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		West Dimond Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low		Crystal Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low		Garnet Street	2	
Dog walking areas/foot trails	X46	X46-1	A	Low		Trail along the south side of West Dimond Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		Unnamed Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5-25	C	Low		All roads located within Zone C	4	
Dog walking areas/foot trails	X46	X46-2-4	C	Low		All trails located within Zone C	4	

Table 4

Contaminant Source Inventory and Risk Ranking for BBQ Pit

Sources of Volatile Organic Chemicals

PWSID 214015.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	1	Off of West Dimond Blvd.	2	
Residential Areas	R01	R1-1	A	Low	2	Residential areas located within Zone A	3	Approximately 2 acres of residential area in Zone A.
Residential Areas	R01	R1-2	B	Low	3	Residential areas located within Zone B	3	Approximately 10 acres of residential area in Zone B.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	4	West Dimond Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	5	Crystal Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	6	Garnet Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	7	Along West Dimond Blvd.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	B	Low	8	Running across West Dimond Blvd.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	B	Low	9	Along West Dimond Blvd.	3	
Motor /motor vehicle repair shops	C31	C31-2	C	Medium	10	Off of Eighty-sixth Ave.	4	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		Unnamed Road	2	
Appliance repair shops	C03	C3-1	C	Low		Off of Eighty-sixth Ave.	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4-18	C	Low		All sewer lines located within Zone C	5	
Residential Areas	R01	R1-3	C	Low		Residential areas located within Zone C	5	Approximately 75 acres of residential area in Zone C.
Boat yards and marinas	X15	X15-1	C	Low		On the corner of Vernon Street and Eighty-ninth Ave.	4	
Highways and roads, paved (cement or asphalt)	X20	X20-5-25	C	Low		All roads located within Zone C	4	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	C	Low		Off of West Dimond Blvd.	4	

Table 4 (continued)

Contaminant Source Inventory and Risk Ranking for BBQ Pit

Sources of Volatile Organic Chemicals

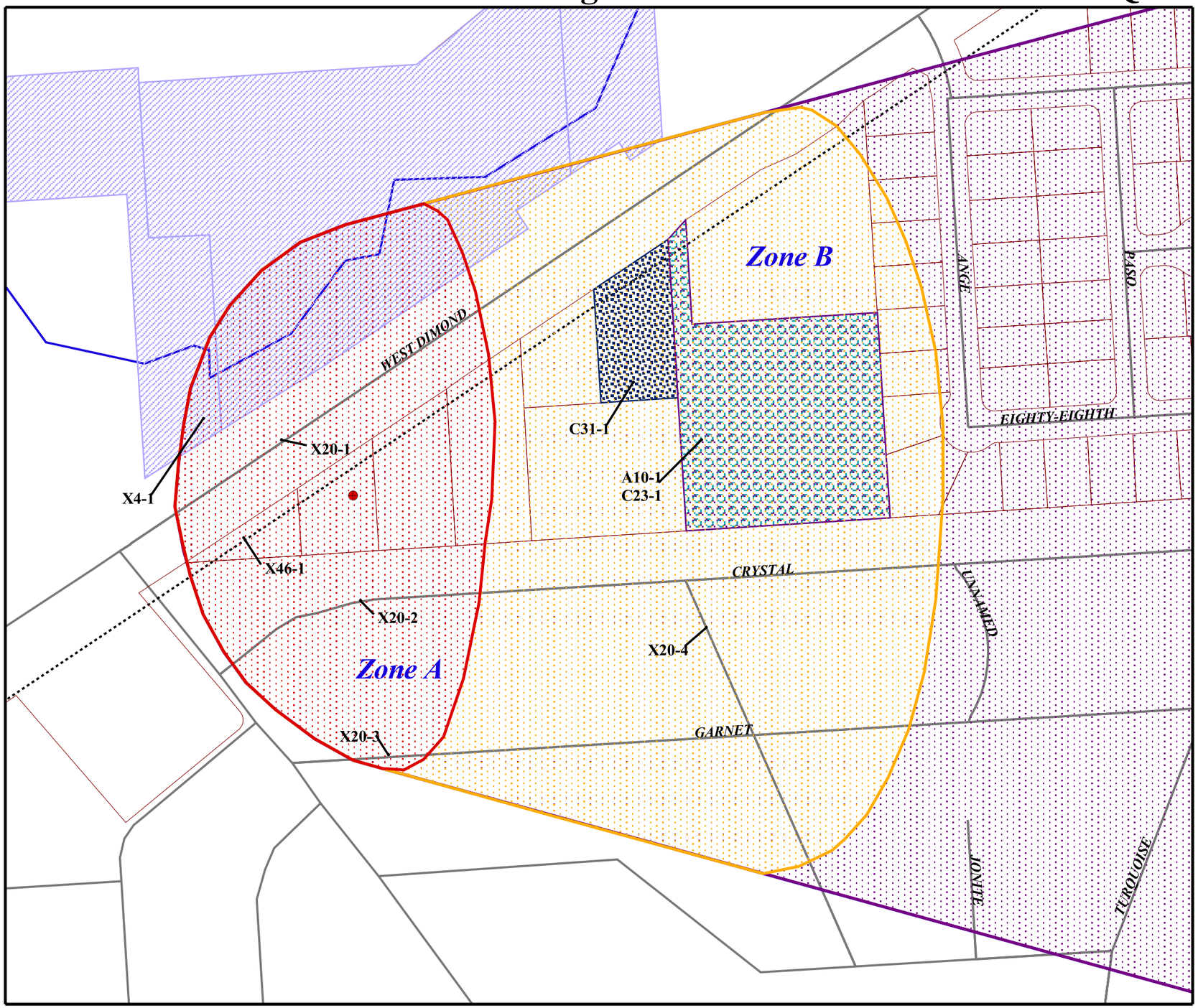
PWSID 214015.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-1	D	High		Off of King Street	6	Citizen complaint of numerous spills of solvents on the ground. Site reconnaissance and discussion with owner indicated that a leaking AST was the problem and was removed. Site has since been graded and no obvious evidence of staining remains.

APPENDIX C

Drinking Water Protection Area and Potential & Existing Contaminant Sources for the BBQ Pit

Drinking Water Protection Area and Potential & Existing Contaminant Sources for the BBQ Pit



300 0 300 600 Feet

Potential Contaminant Sources
- Heavy Equipment Rental/Storage (C18)
- Appliance Repair Shops (C3)
- Motor/Motor Vehicle Repair Shops (C31)
- Contaminated Sites, DEC Recognized (U4)
- Boat Yards and Marinas (X15)
- BBQ Pit Well

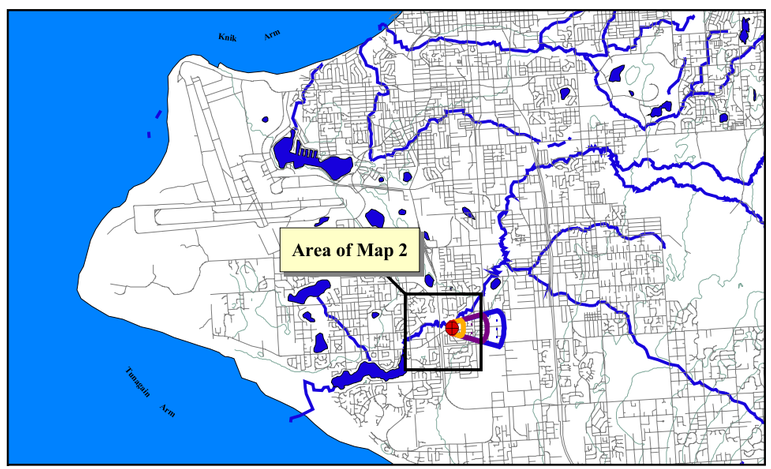
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Orchards and Nurseries (A10)
- Anchorage Parks (X4)
- Motor/Motor Vehicle Repair Shops (C31)
- Lawn and Garden Supplies (C23)
- Anchorage Land Parcels
- Trails (X46)
- Anchorage Roads (X20)
- Anchorage Streams
- Elevation Contours

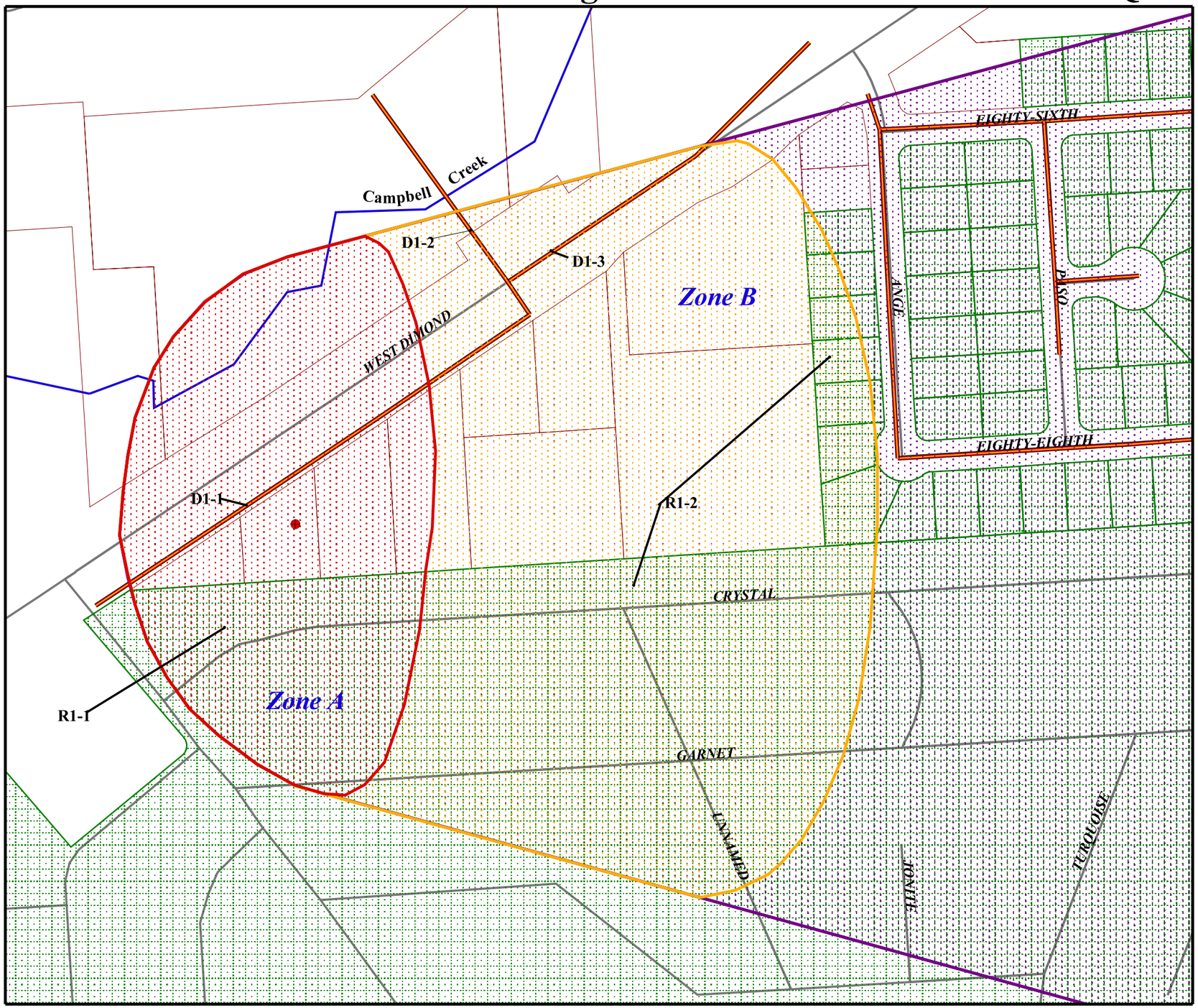
N W E S



PWSID 214015.001

Map 2

Drinking Water Protection Area and Potential & Existing Contaminant Sources for the BBQ Pit



- BBQ Pit Well

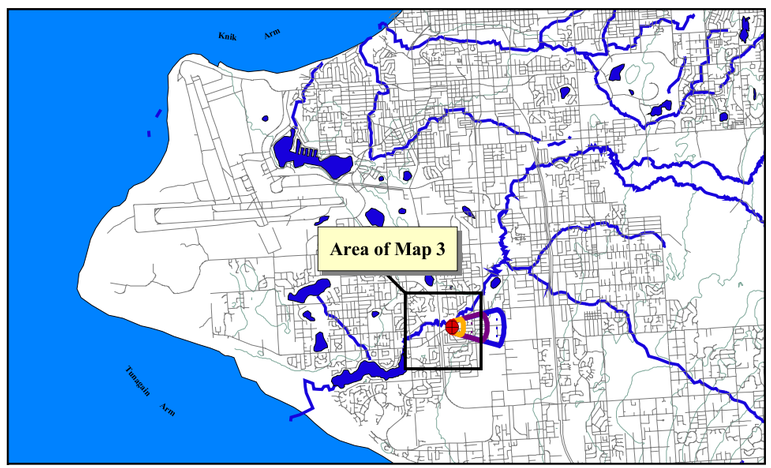
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Lawns and Gardens (R1)
- Anchorage Land Parcels
- Sewer Lines (D1)
- Anchorage Roads (X20)
- Anchorage Streams
- Elevation Contours

N W E S

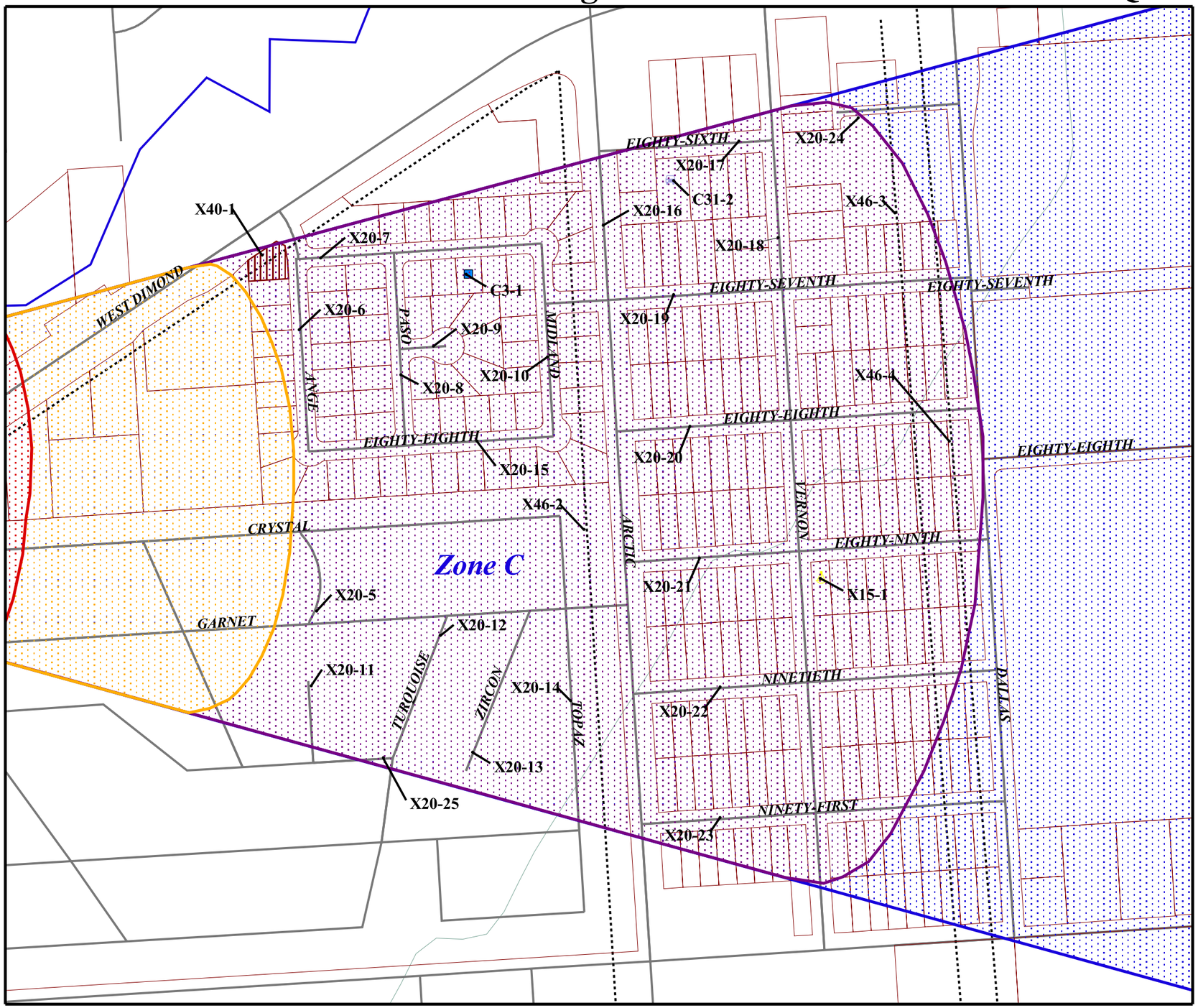


300 0 300 600 Feet

PWSID 214015.001

Map 3

Drinking Water Protection Area and Potential & Existing Contaminant Sources for the BBQ Pit



500 0 500 1000 Feet

- BBQ Pit Well

Zone A Protection Area
- Several Months Travel Time

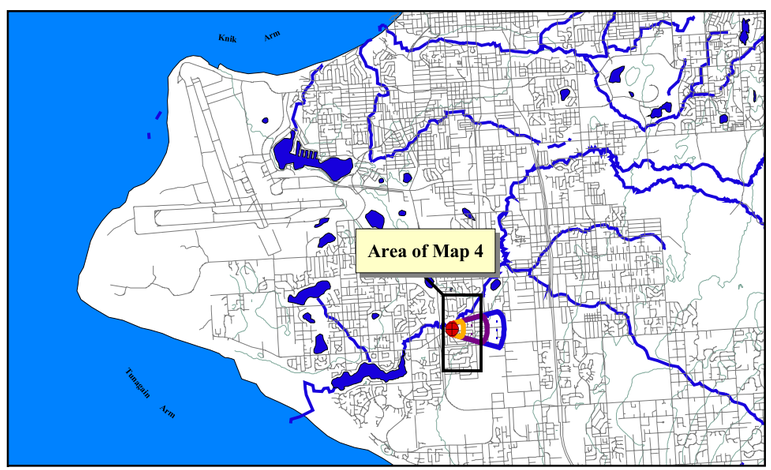
Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time

Potential Contaminant Sources
- Appliance Repair Shops (C3)
- Motor/Motor Vehicle Repair Shops (C31)
- Contaminated Sites, DEC Recognized (U4)
- Boat Yards and Marinas (X15)
- Medical/Veterinary Facilities (X40)
- Anchorage Land Parcels
- Trails (X46)
- Anchorage Roads (X20)
- Anchorage Streams
- Elevation Contours

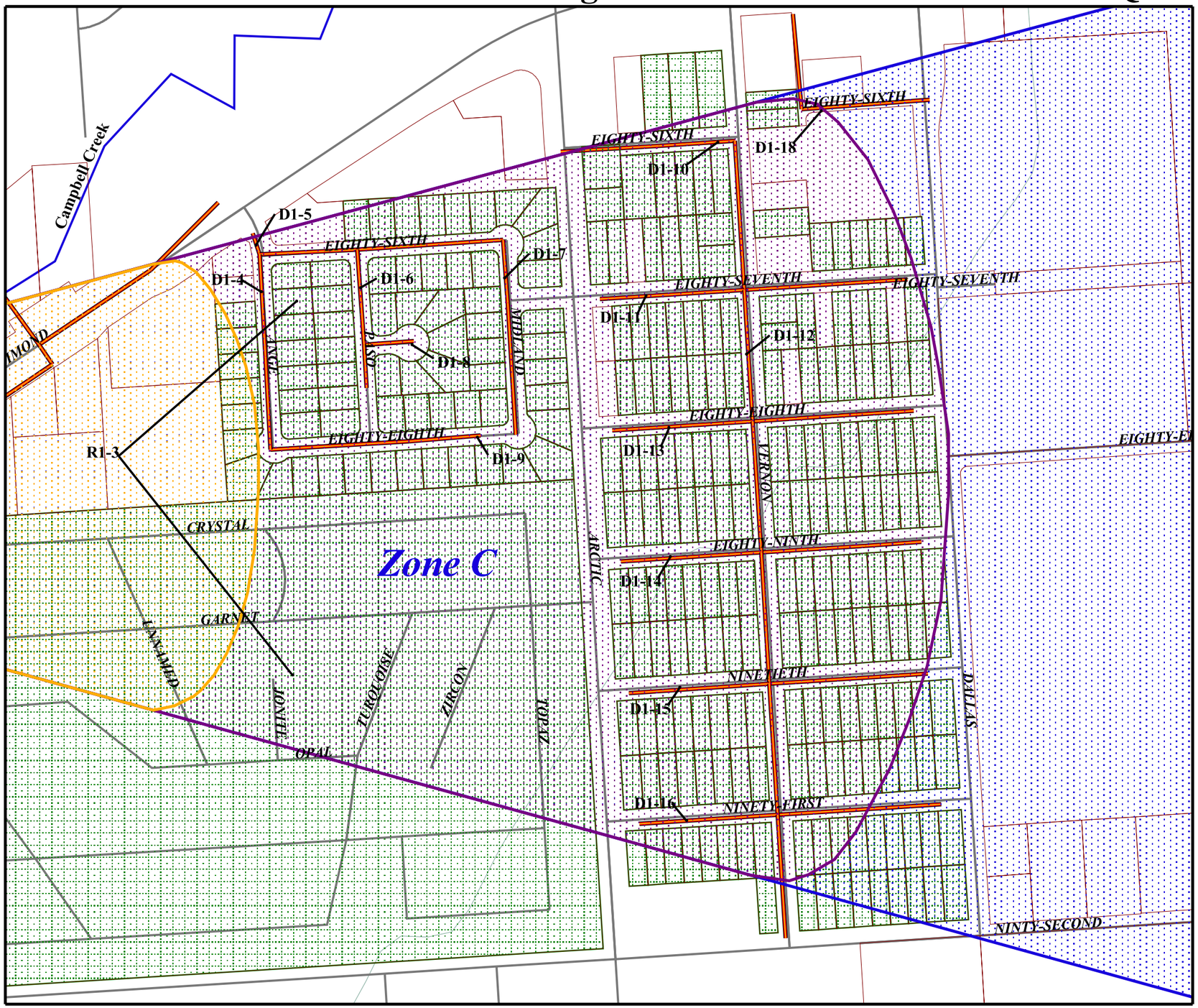
N W E S



PWSID 214015.001

Map 4

Drinking Water Protection Area and Potential & Existing Contaminant Sources for the BBQ Pit



500 0 500 1000 Feet

- BBQ Pit Well

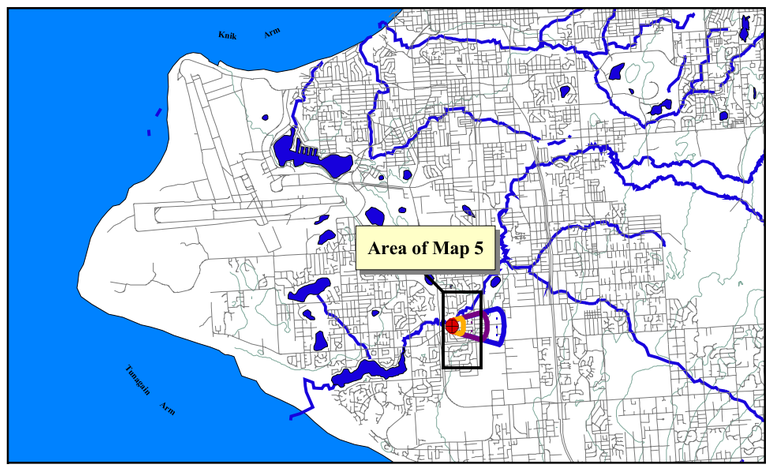
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Anchorage Land Parcels
- Lawns and Gardens (R1)
- Sewer Lines (D1)
- Anchorage Roads (X20)
- Anchorage Streams
- Elevation Contours

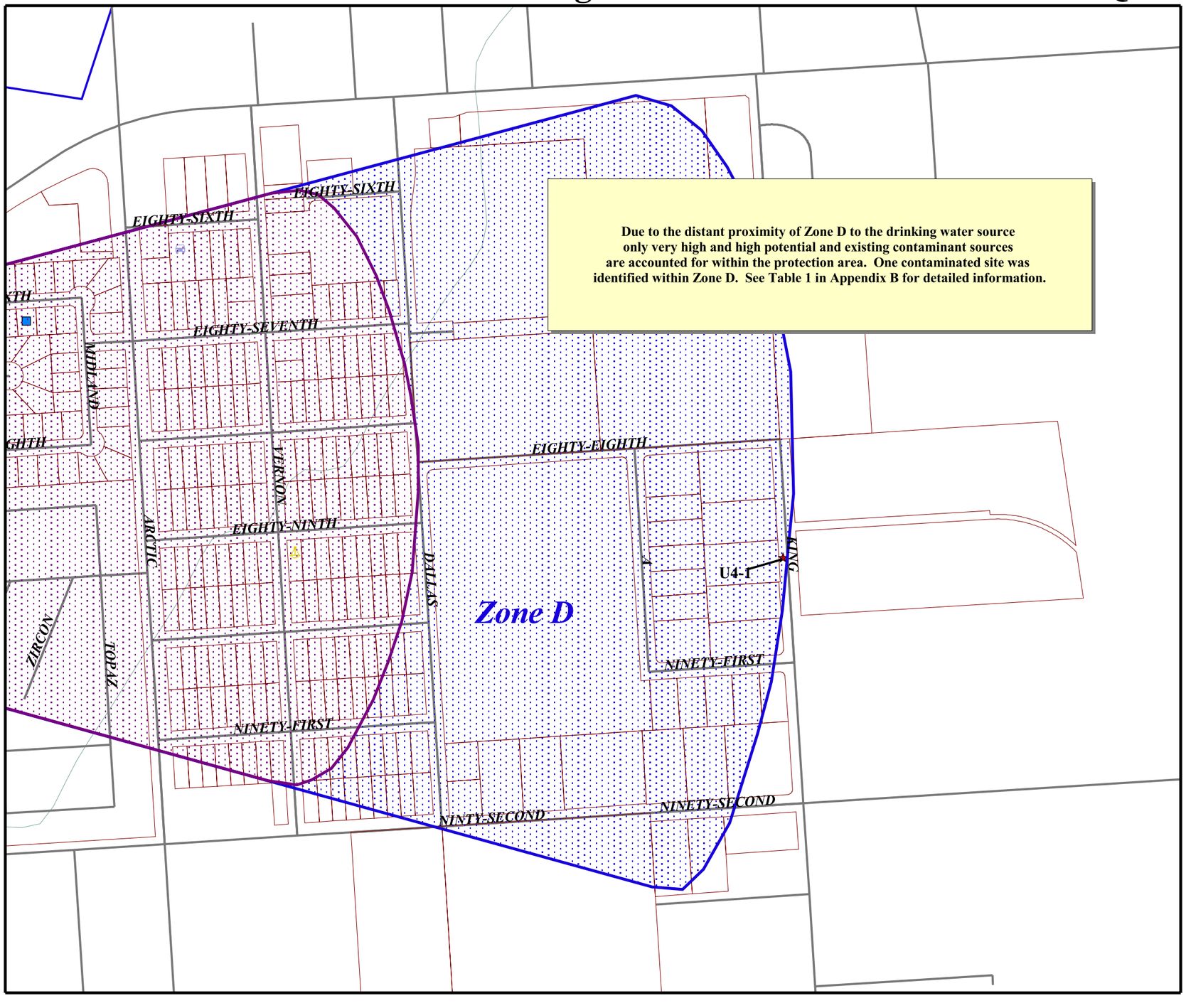
N W E S



PWSID 214015.001

Map 5

Drinking Water Protection Area and Potential & Existing Contaminant Sources for the BBQ Pit



Due to the distant proximity of Zone D to the drinking water source only very high and high potential and existing contaminant sources are accounted for within the protection area. One contaminated site was identified within Zone D. See Table 1 in Appendix B for detailed information.

- BBQ Pit Well

Zone A Protection Area
- Several Months Travel Time

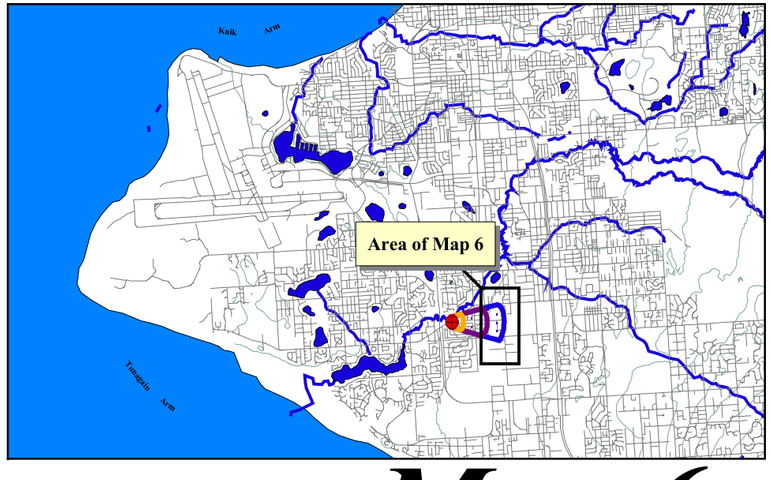
Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time

Potential Contaminant Sources
- Appliance Repair Shops (C3)
- Motor/Motor Vehicle Repair Shops (C31)
- Contaminated Sites, DEC Recognized (U4)
- Boat Yards and Marinas (X15)
- Anchorage Land Parcels
- Anchorage Roads (X20)
- Anchorage Streams
- Elevation Contours

N W E S



700 0 700 1400 Feet

PWSID 214015.001

Map 6

APPENDIX D

Vulnerability Analysis

Chart 1. Susceptibility of the wellhead - The BBQ Pit

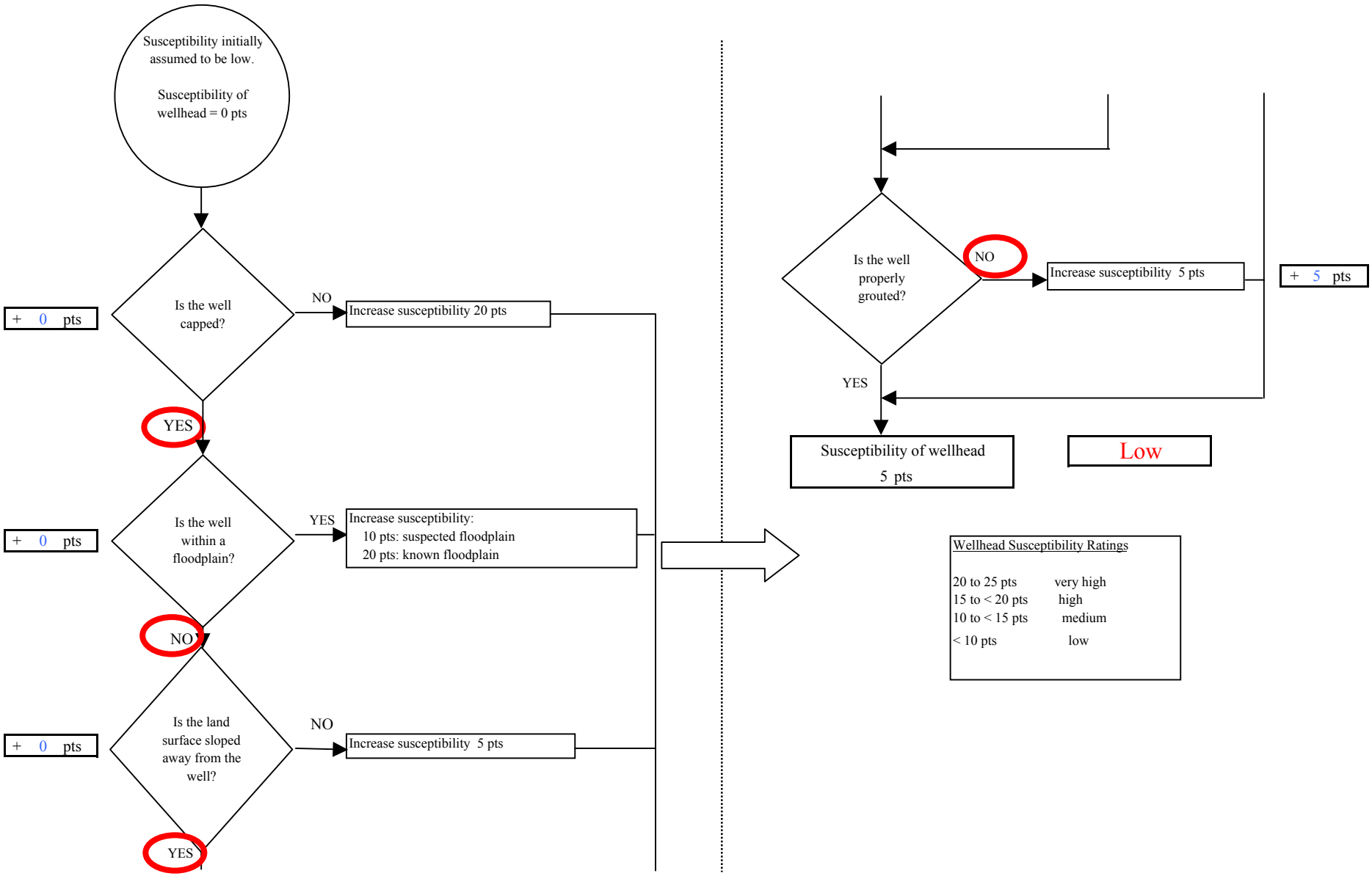


Chart 2. Susceptibility of the aquifer - The BBQ Pit

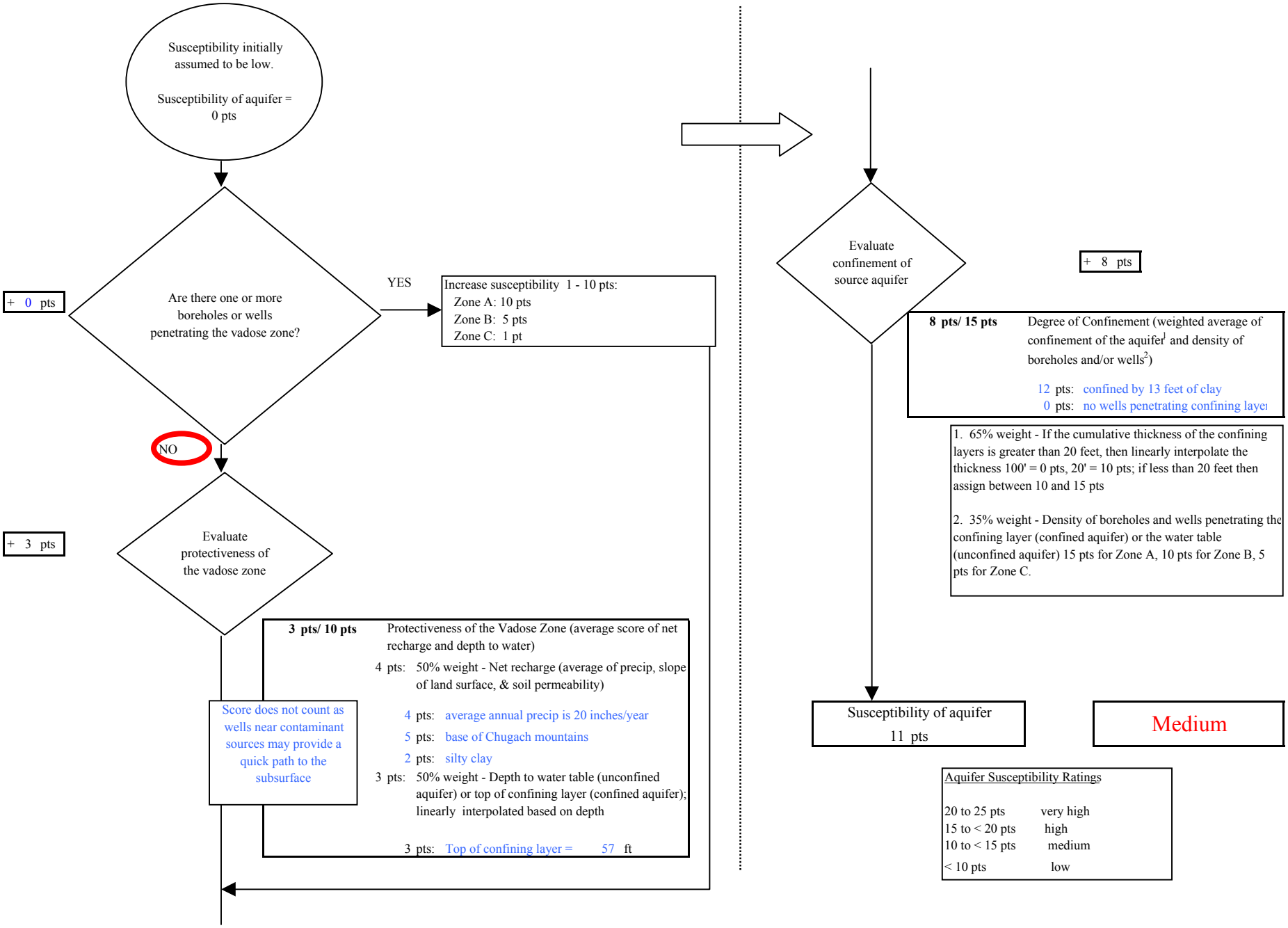
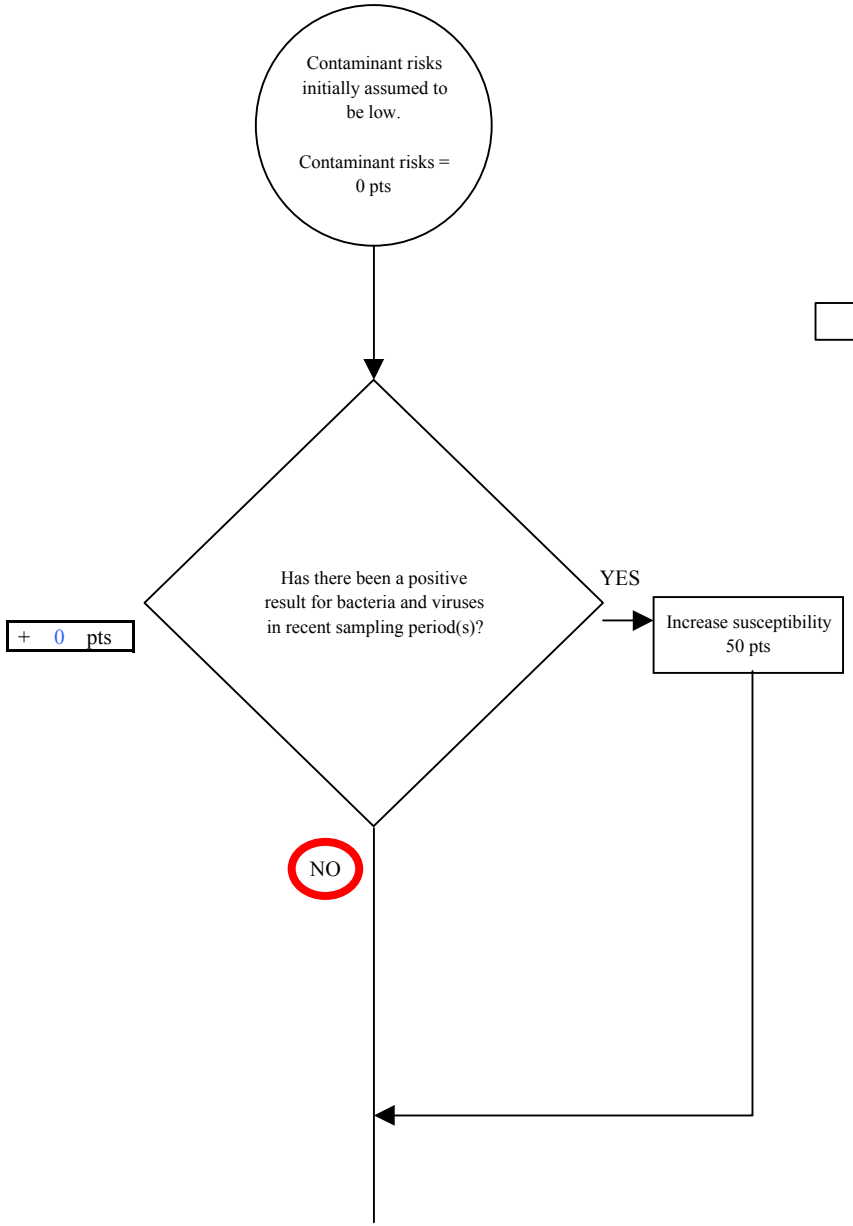
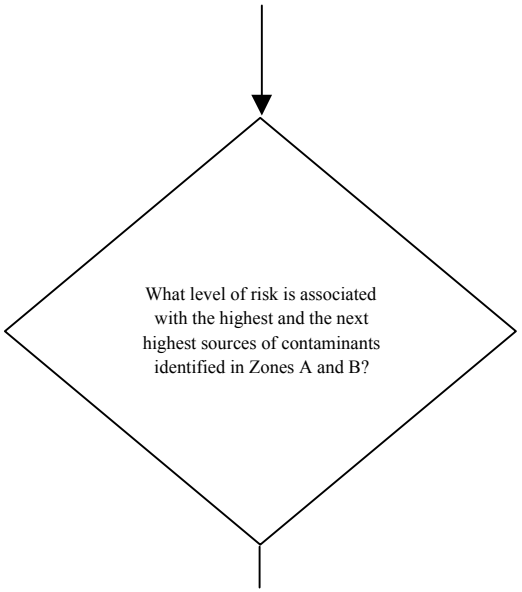


Chart 3. Contaminant risks for The BBQ Pit - Bacteria & Viruses





+ 20 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	2	0	2
Low(s)	3	3	6

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

Matrix Score 20

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

Chart 3. Contaminant risks for The BBQ Pit - Bacteria & Viruses

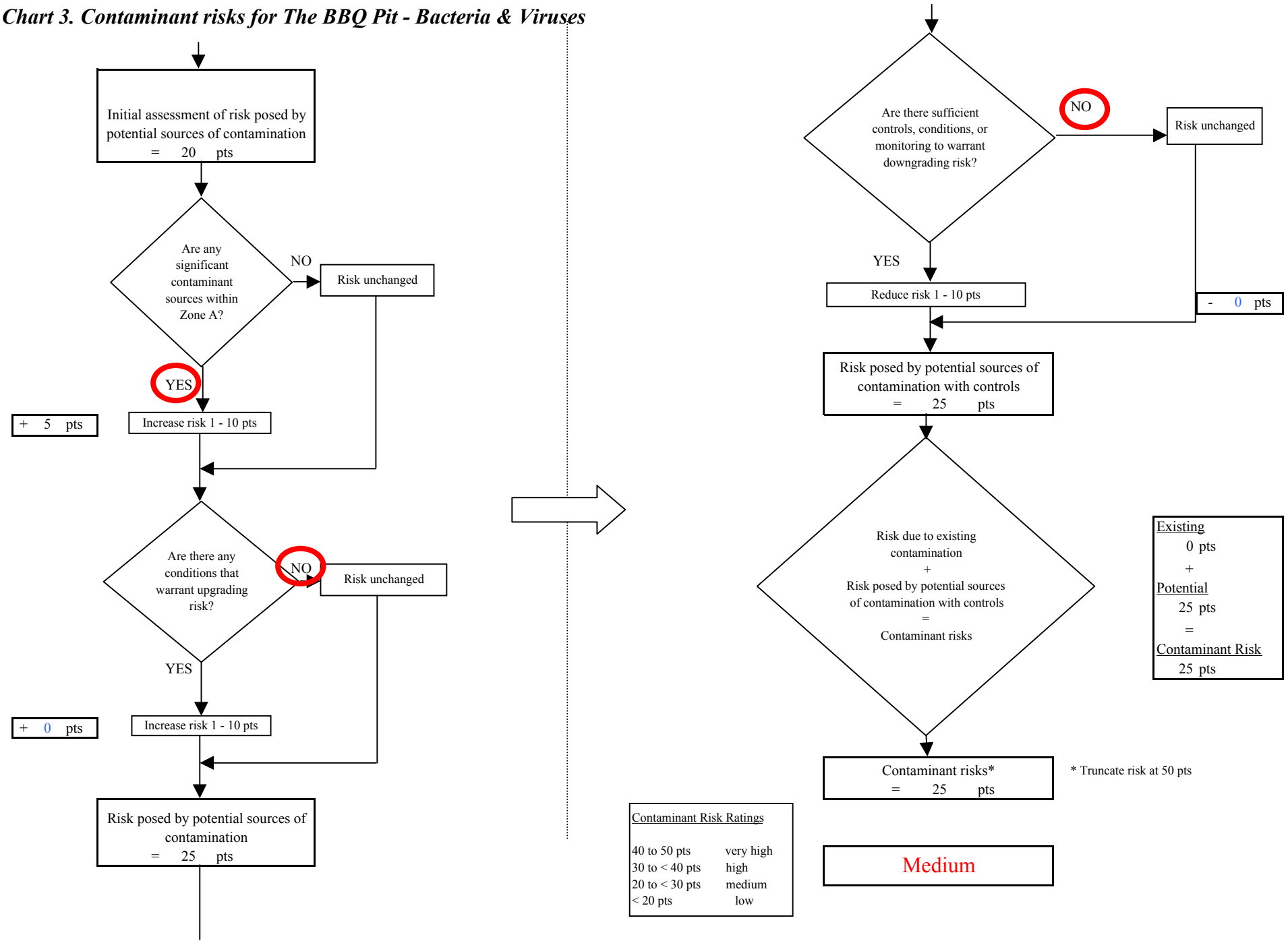


Chart 4. Vulnerability analysis for The BBQ Pit - Bacteria & Viruses

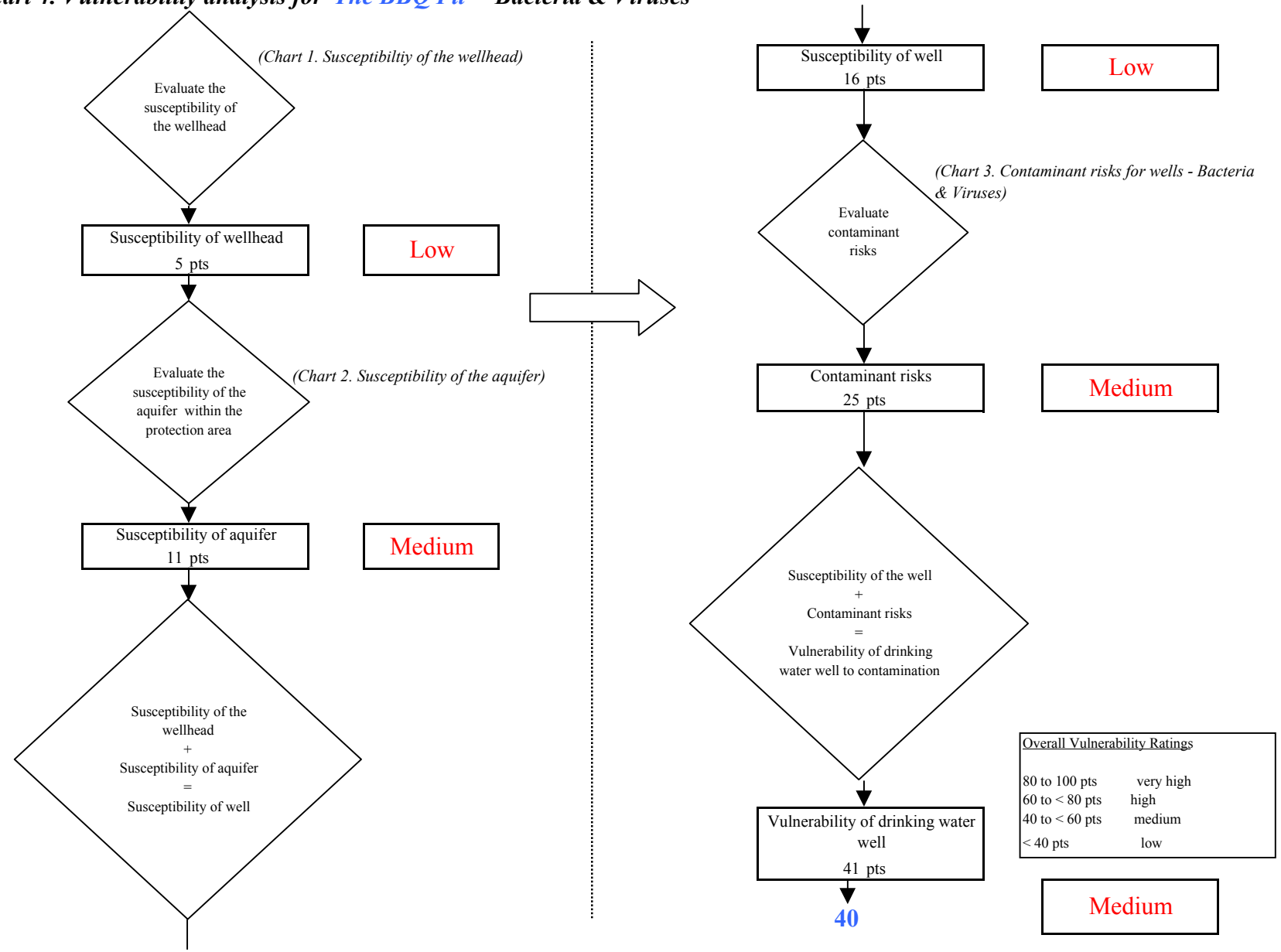


Chart 5. Contaminant risks for The BBQ Pit - Nitrates and Nitrites

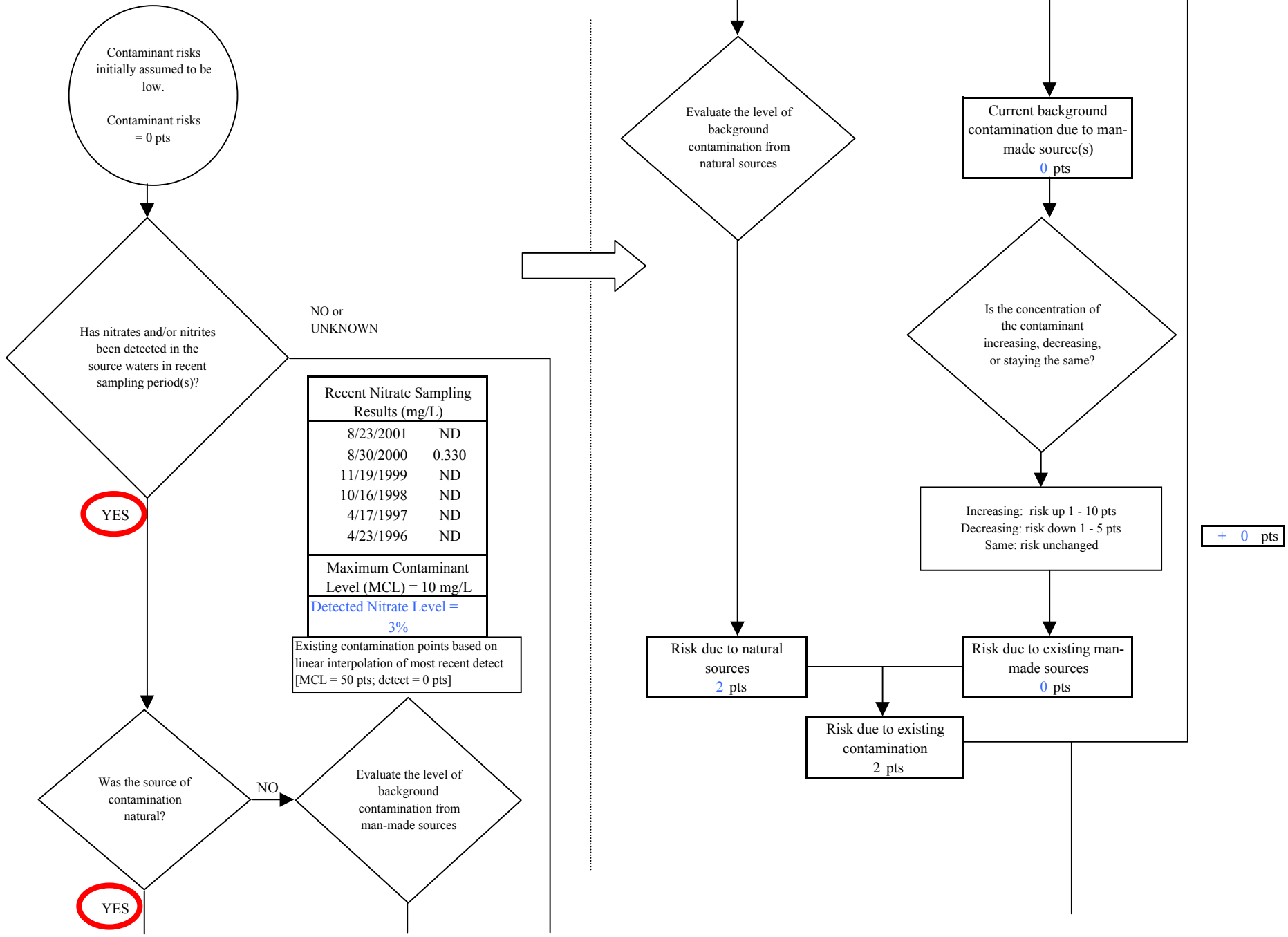
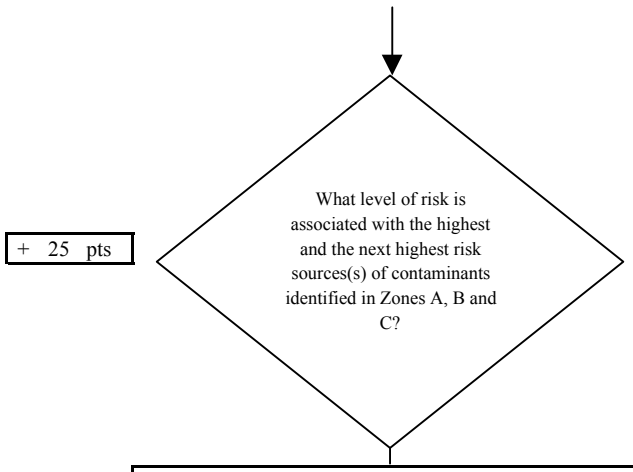


Chart 5. Contaminant risks for The BBQ Pit - Nitrates and Nitrites



+ 25 pts

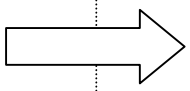
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	2	2	4
Low(s)	3	5	8

	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 25

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.



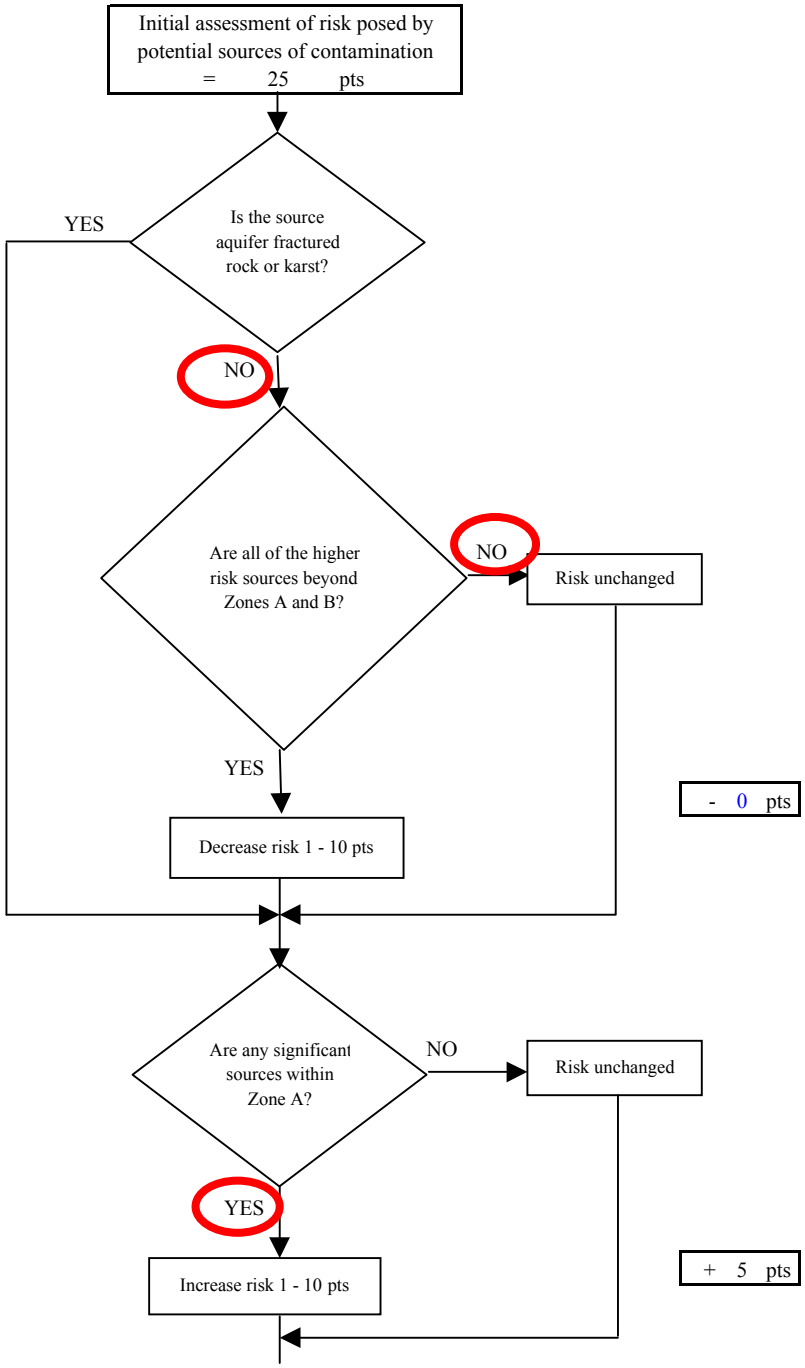


Chart 5. Contaminant risks for The BBQ Pit - Nitrates and Nitrites

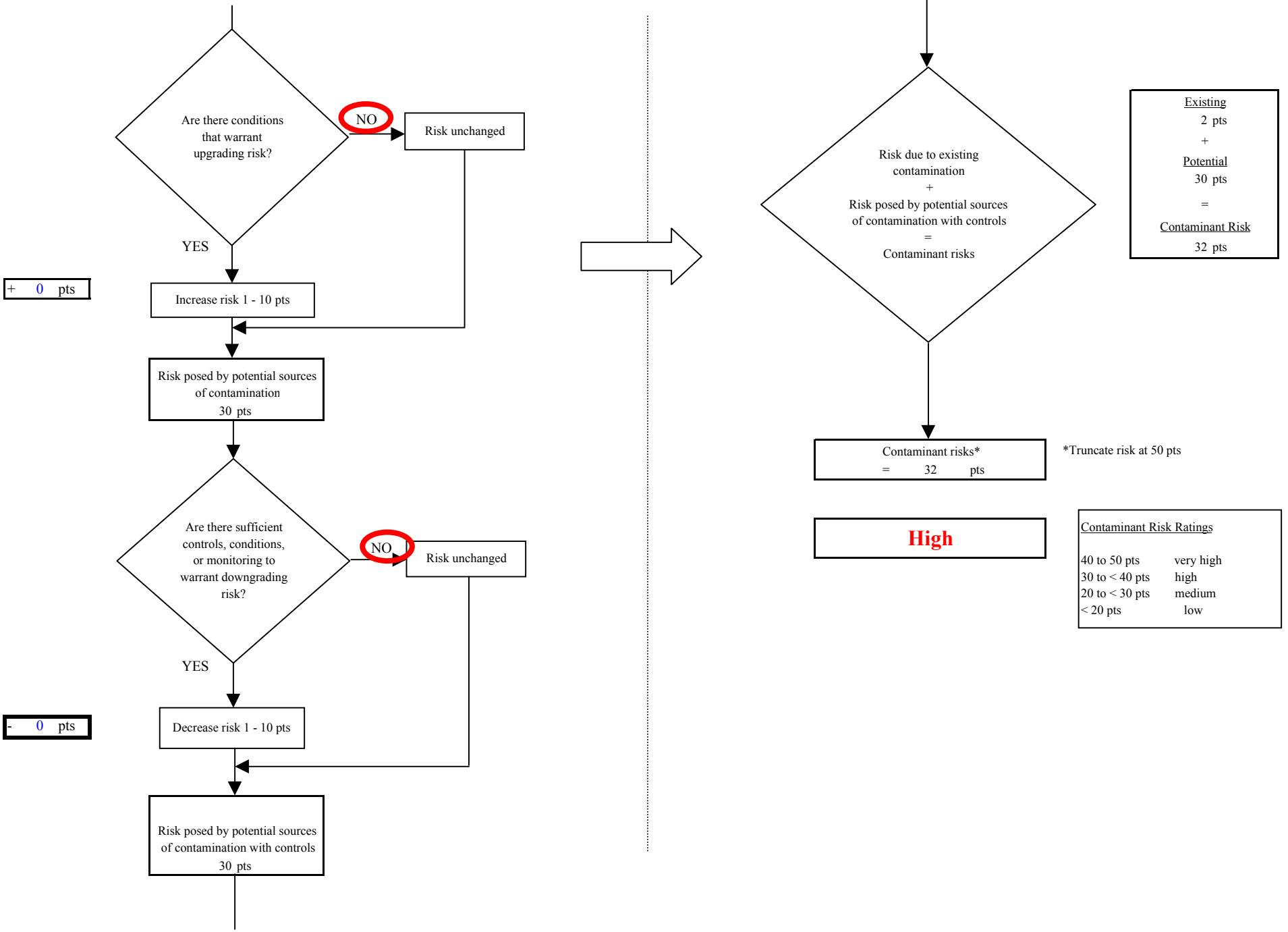


Chart 6. Vulnerability analysis for The BBQ Pit - Nitrates and Nitrites

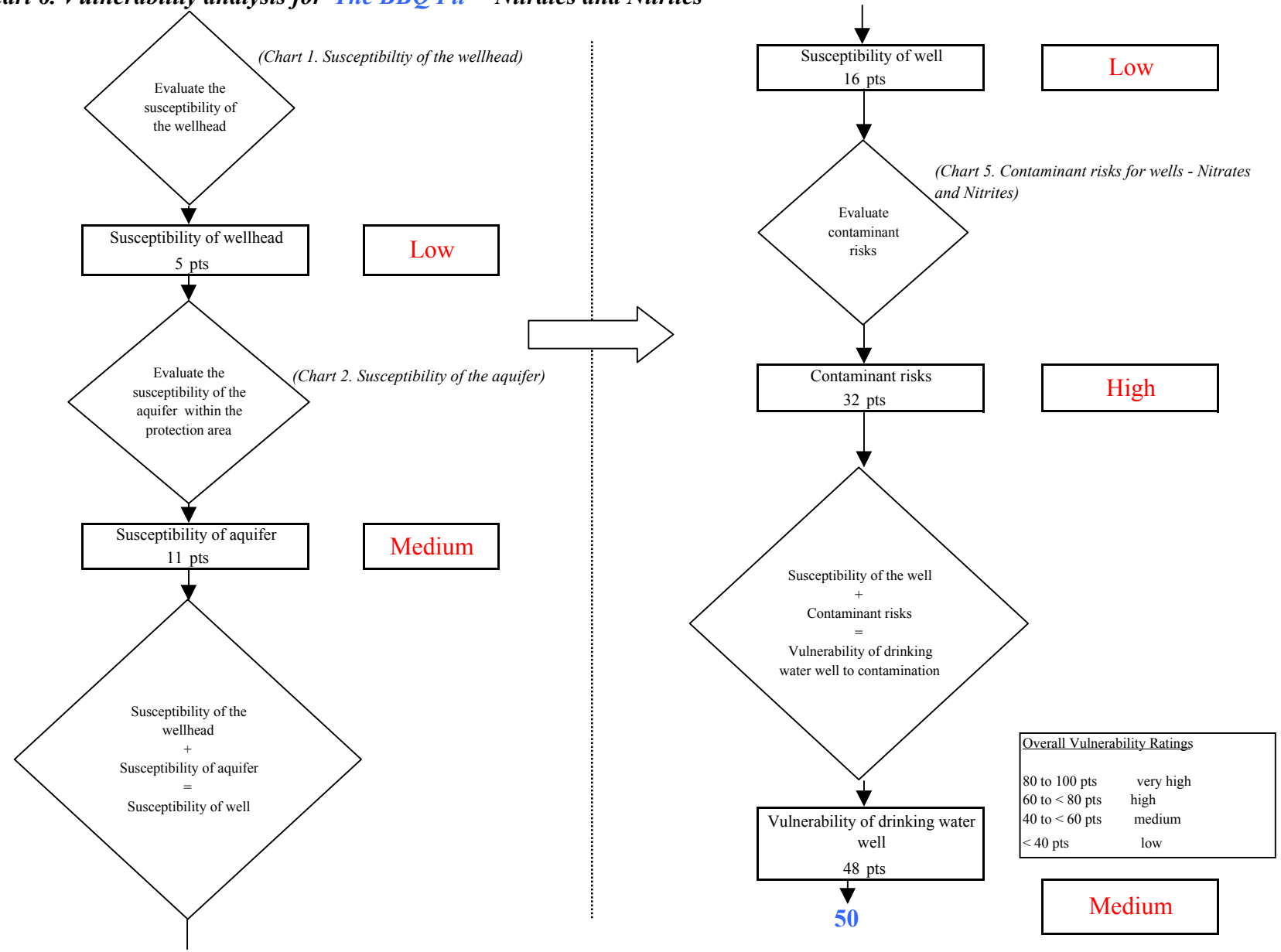


Chart 7. Contaminant risks for The BBQ Pit - Volatile Organic Chemicals

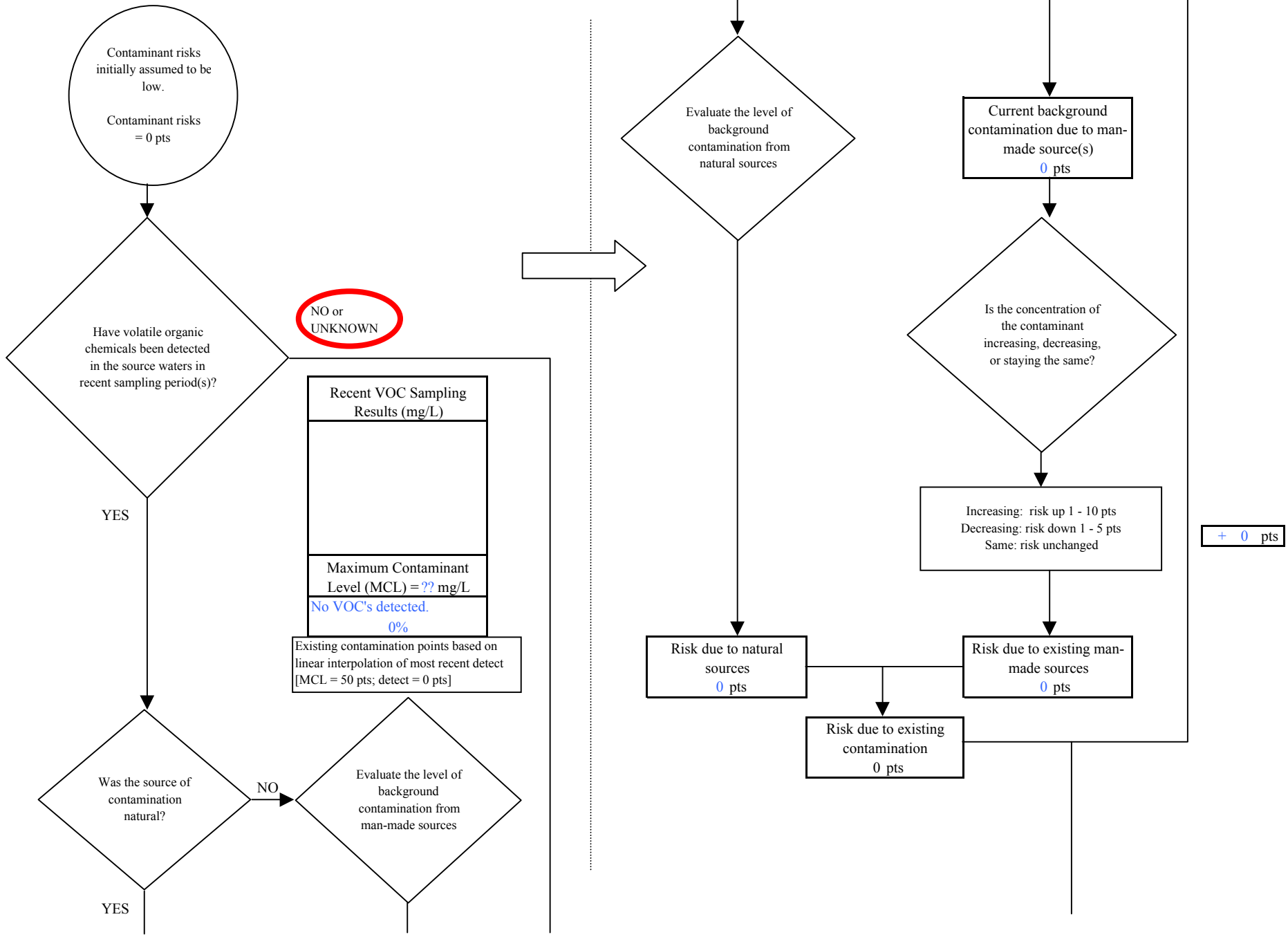
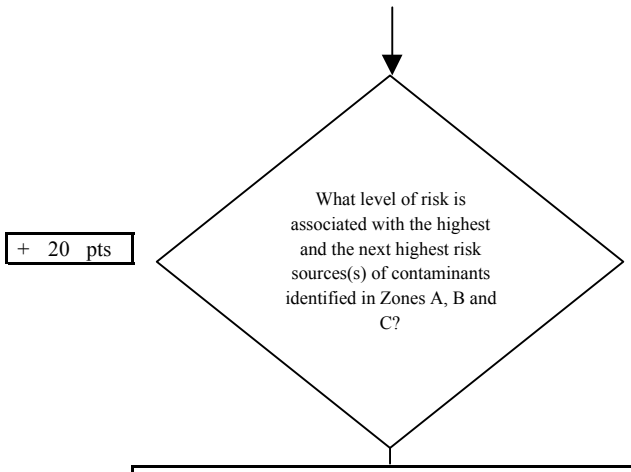


Chart 7. Contaminant risks for The BBQ Pit - Volatile Organic Chemicals



+ 20 pts

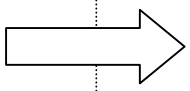
Risk Levels for Contaminant Sources identified in Zones A, B and C

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

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

Matrix Score 20

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



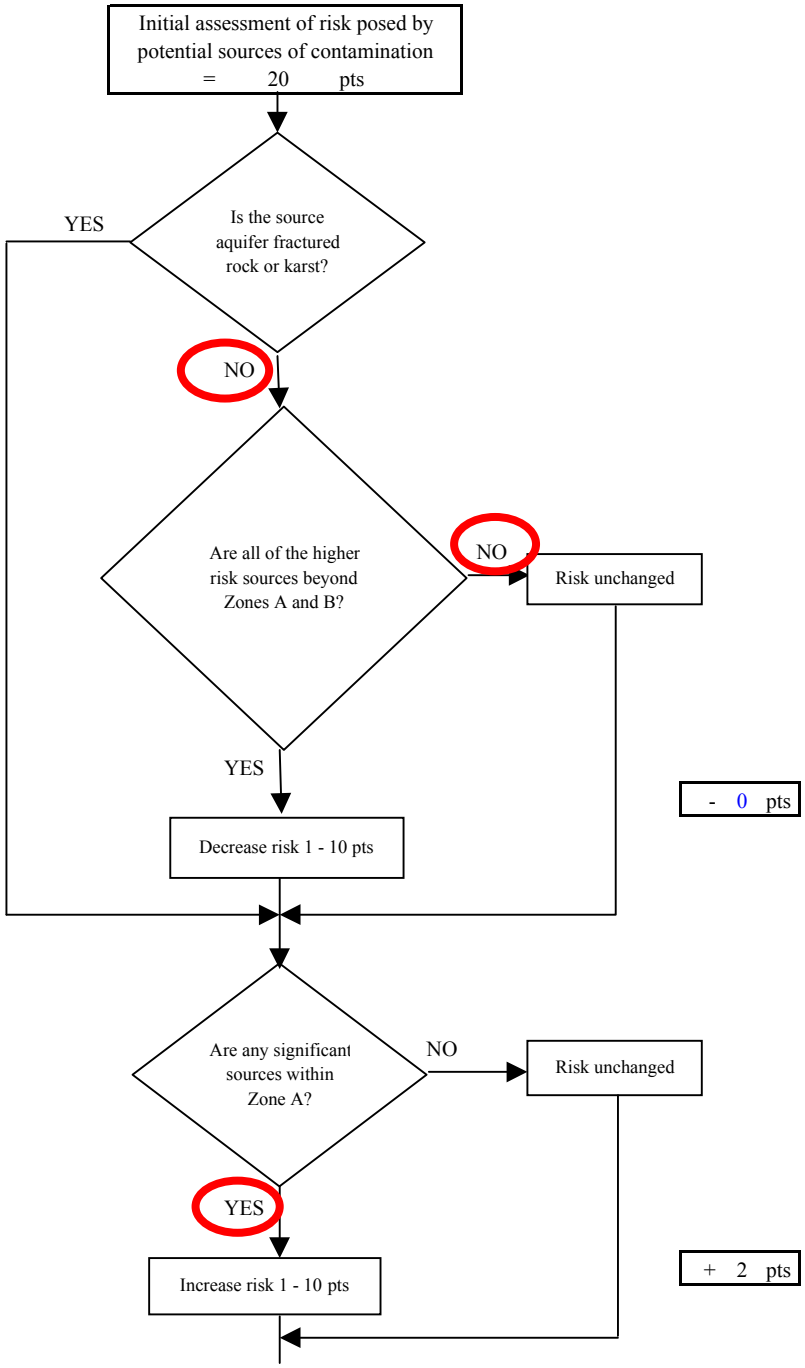


Chart 7. Contaminant risks for The BBQ Pit - Volatile Organic Chemicals

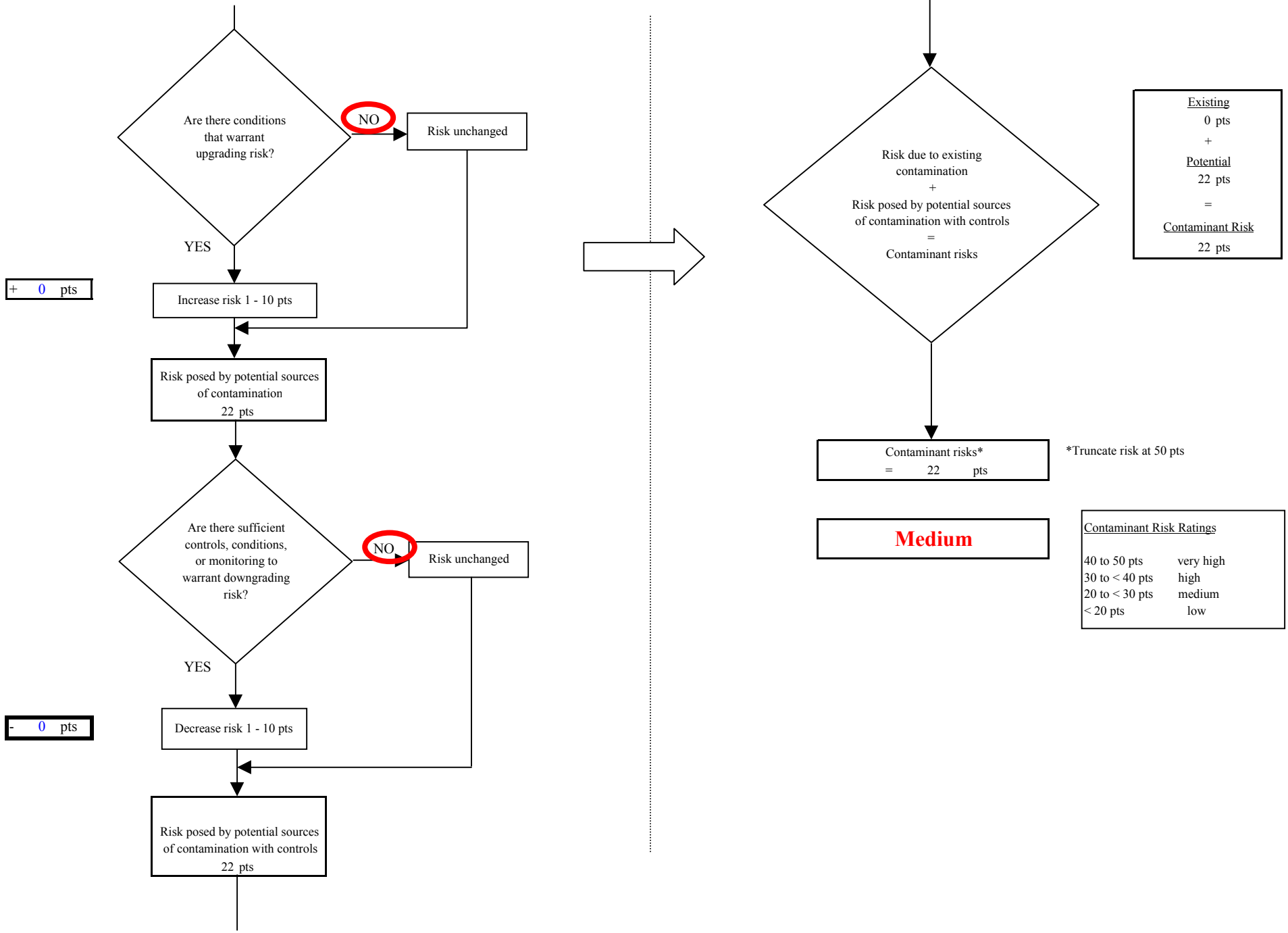


Chart 8. Vulnerability analysis for The BBQ Pit - Volatile Organic Chemicals