Hydrogeologic Susceptibility and Vulnerability Assessment for Carr's Crow Creek Public Drinking Water Well, Girdwood, Alaska

DRINKING WATER PROTECTION PROGRAM REPORT 5

August 2000

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2000

CONTENTS

TABLES

ILLUSTRATIONS

APPENDICES

Hydrogeologic Susceptibility and Vulnerability Assessment for Carr's Crow Creek Public Drinking Water Well, Girdwood, Alaska

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Carr's Crow Creek Public Water System is a Class B (transient) water system consisting of one well. Identified potential and existing sources of contamination include: domestic wastewater sewer lines, above ground fuel tanks, closed underground fuel storage tanks (USTs), a large-capacity cesspool, livestock stables, home heating fuel tanks, gravel and paved roads and right-a-ways, closed contaminated sites, parks, airports, and an old landfill. Overall, Carr's Crow Creek's public water system received a vulnerability rating of **High** for bacteria and viruses, and **Very High** for nitrates and/or nitrites and volatile organic chemicals.

INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners/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 Carr's Crow Creek's source of public drinking water. This source consists of one well in the Glacier Creek Valley (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 voluntary local protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

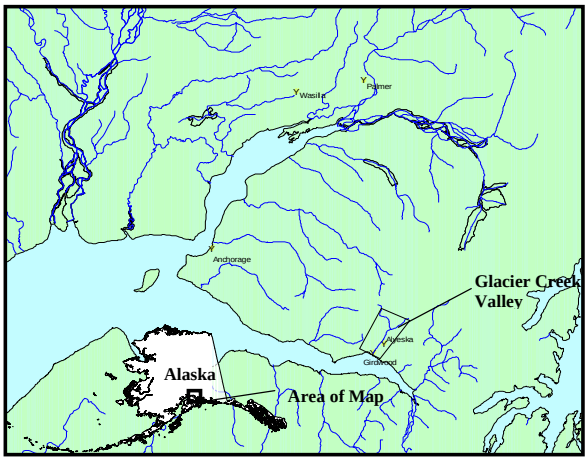

Figure 1. Index map showing the location of the Glacier Creek Valley, Alaska

PHYSIOGRAPHY OF THE GLACIER CREEK VALLEY, ALASKA

Glacier Creek Valley, drained primarily by Glacier Creek, is located near the head of Turnagain Arm of Cook Inlet, approximately 45 miles south of Anchorage, Alaska (see Figure 1). Widened by glaciers and surrounded by steep mountain slopes, the valley is approximately six miles in length and trends northeast-southwest. The valley floor is roughly four miles wide. Elevations within the valley increase inland, from sea level at Turnagain Arm to approximately 6500 feet at the head of the valley. Development comprising the community of Girdwood is present along the lower four miles of the valley.

The floor of the Glacier Creek Valley is covered primarily by coniferous forests consisting of *western hemlock* and *Sitka spruce*. Bedrock is exposed at the surface and wetlands occur intermittently in the valley floor. Bedrock also crops out at elevation in the mountains. Glacier Creek originates in uplands at the head of the valley, drains an area of approximately 58.2 square miles and is roughly centrally located. A mean annual discharge of 265 cubic feet per second was recorded in Glacier Creek (USGS gaging station near the mouth) from 1965-78. California Creek and Alyeska Creek flow into Glacier Creek. California Creek drains an area of roughly 6.96 square miles. Virgin Creek flows directly into the Turnagain Arm and drains an area of about 3.5 square miles in the valley [*Glass and Brabets*, 1988].

Mean annual precipitation of roughly 40 inches per year was recorded near the mouth of the valley from 1955-66

and 1977-78. At the base of the Alyeska Ski Resort, annual precipitation in excess of 65 inches per year has been recorded (1985-86) [*Glass and Brabets, 1988*]. Mean daily temperature ranges from 65.1° F during cool rainy summers to 13.9° F in snowy winters, with average total snow depths of 197.4 inches [*Western Regional Climate Center*, 2000].

Groundwater flows from bedrock highlands, including steep valley walls, toward sediments in the center of the valley. Flow through valley sediments, or unconsolidated deposits, is generally to the southwest toward Turnagain Arm.

CARR'S CROW CREEK PUBLIC WATER SYSTEM

Carr's Crow Creek Public Water System is a Class B (transient/non-community) water system, which is owned by Carr's-Safeway Corporation and operated by Carr's Crow Creek. The system consists of one well, which is located near the corner of Girdwood Place and Hightower Road, in the new Girdwood Townsite (see Figure 2). The well log for Carr's Crow Creek has not been located, however, adjacent wells in the area penetrate gravel and silty gravel. The adjacent wells have static water levels ranging from five to twelve feet below land surface at the time of drilling. The land surrounding the entire new Girdwood Townsite falls

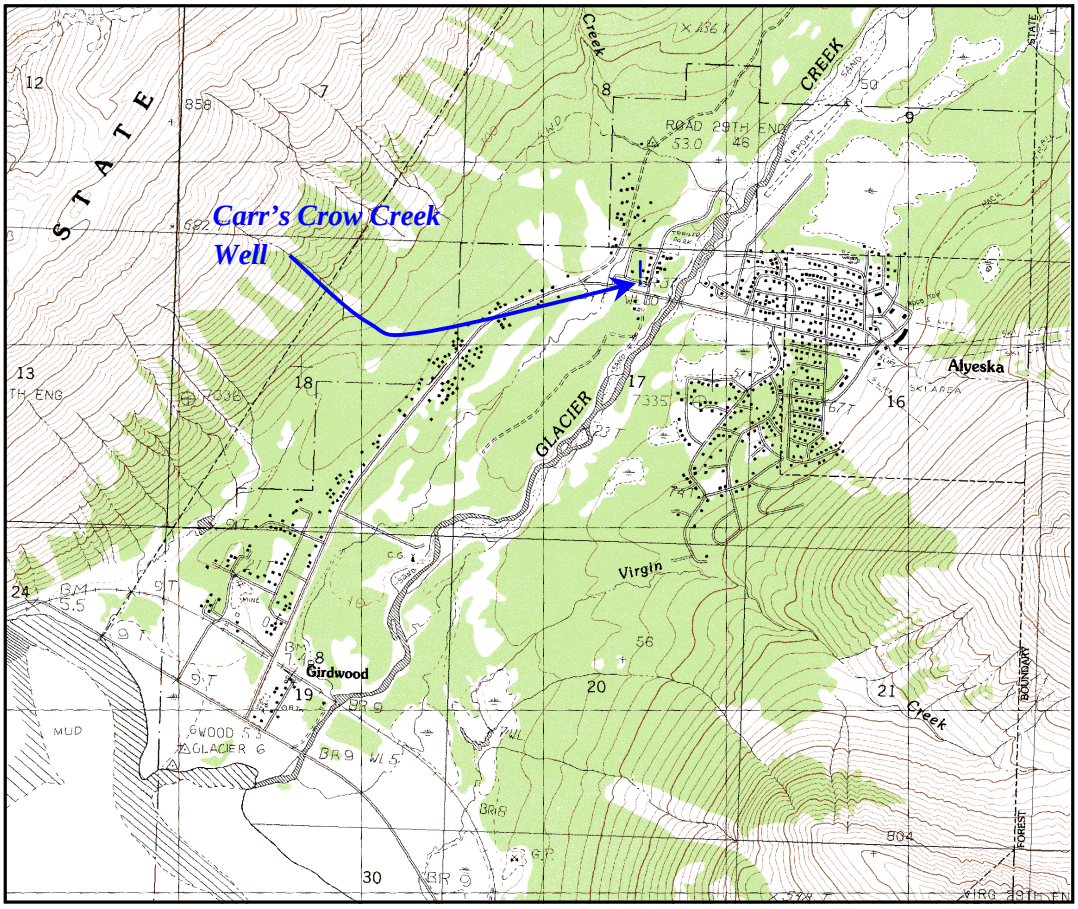

Figure 2. Map showing the location of the drinking water source for Carr's Crow Creek.

within a Floodplain Hazard Zone designated by the Army Corp of Engineers [*Municipality of Anchorage, 2000*]. The well for Carr's Crow Creek is situated on the 100-year floodplain for Glacier Creek (See Appendix E – Map 6). This means that Carr's Crow Creek can expect the waters of Glacier Creek to equal or exceed this zone once every 100 years. Figure 3 explains the floodplain designations in more detail. This water system operates year round and serves approximately 280 non-residents through a single connection.

ASSESSMENT AND PROTECTION AREA FOR CARR'S CROW CREEK'S DRINKING WATER SOURCE

The Drinking Water Protection/Assessment Area that has been established for Carr's Crow Creek's public drinking water well 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. This zone around the drinking water source is the most critical area to the preservation of the quality of the drinking water. For simplicity, this area will be known as your Drinking Water Protection Area, and will serve as the area of focus for voluntary protection efforts.

Flood Hazard Area Designation Description

100-YEAR …Means having a 1% chance of being equaled or exceeded in any given year

500-YEAR…Moderate to minimal flood risks

FLOODWAY…Means the channel of a river or other watercourse and the adjacent land areas which must be reserved in order to discharge the base flood (100-year) without cumulatively increasing the water surface elevation more than one foot.

Figure 3. Definitions of Floodplain Hazard Area Designations [***Municipality of Anchorage, 2000***]**.**

Conceptually, surface water and groundwater flow is from steep bedrock slopes toward the unconsolidated stream and glacial deposits in the valley (see Figure 4). A 2-dimensional groundwater flow model was built to simulate groundwater flow in the saturated valley sediments (water table aquifer). This model was used as a guide in the first step in establishing the protection area for Carr's Crow Creek's source of public drinking water. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful and conservative protection area 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/Assessment Area for the Carr's Crow Creek contains five zones, Zone A through Zone G (See Map 1 - Map 3 in Appendix B). Zone A corresponds to ¼ of the distance to the 2-year time-of-travel isochron (an isochron is a line on a map at which the time interval has the same value). Depending on where a contaminant source is located, travel time for a contaminant to the well may be on the order of several days to several hours within Zone A. The Zone B protection area for Carr's Crow Creek corresponds to a time-of-travel of less than two years. Zone B extends up-slope to the top of the watershed divide to take into account contaminants that may flow overland or in California Creek and enter valley sediments.

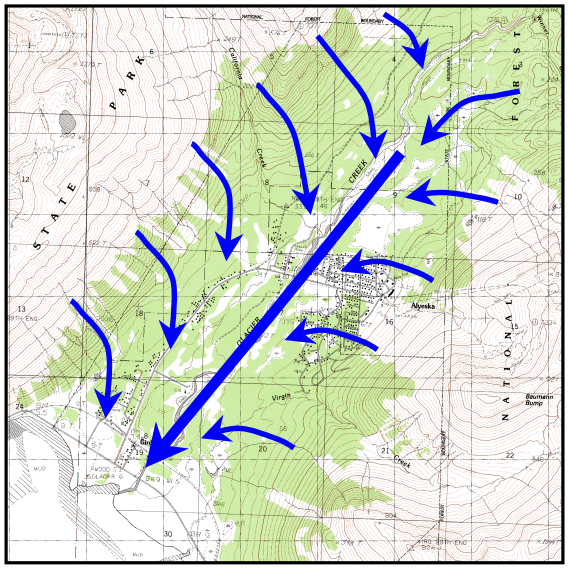

Figure 4. Map showing the conceptual groundwater flow in the Glacier Creek Valley.

Zones E through G identify the areas along Glacier Creek upstream from Carr's Crow Creek. The well for Carr's Crow Creek is situated on the 100-Year floodplain for Glacier Creek. This means that the well has the potential for inundation by the waters of Glacier Creek on a frequency of one episode every 100 years. Contaminants released along Glacier Creek may enter the creek at any point by flowing overland or in small tributaries or feeder streams. Contaminants may also enter the subsurface, reach the groundwater, and enter Glacier Creek through baseflow. Baseflow is the portion of a stream's discharge or flow from groundwater seeping into the stream. This type of release can lead to pollution of the well either through flooding of the well casing or through the subsurface where the aquifer may be in close connection with Glacier Creek. Zone E identifies an area within 1000 feet of Glacier Creek and its upstream tributaries. Zones F and G identify the area within 1 mile of Glacier Creek and the entire watershed or the area that contributes water to Glacier Creek, respectively.

INVENTORY OF CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within Carr's Crow Creek's Drinking Water Protection Area. This survey was conducted 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 assessments, three categories of drinking water contaminants were inventoried. They include:

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

Map 4 and Map 5 in Appendix C depict the Contaminant Source Inventory for Carr's Crow Creek. Inventoried potential sources of contamination within Zones A through Zone G were associated with residential and light industrial and commercial type activities (see Table 1 in Appendix A). Below is a summary of the contaminant sources inventoried within Carr's Crow Creek's protection area:

- Domestic wastewater sewer lines;
- Gravel and paved roads and right-of-ways;
- Residential areas;
- A large-capacity cesspool;
- Closed underground fuel storage tanks (USTs);
- ADEC Contaminated Sites;
- Above ground gasoline fuel tanks;
- Above ground home heating fuel tanks;
- Old landfill;
- An airport;
- Parks;
- Recreation trails; and
- Livestock stables.

These potential contaminant sources present risk for all three categories of drinking water contaminants for Carr's Crow Creek's drinking water source.

RANKING OF CONTAMINANT RISKS

Potential and existing sources of contamination have been identified, 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/or density of those types of contaminant sources as well as the proximity of those sources to the well.

VULNERABILITY OF CARR'S CROW CREEK'S DRINKING WATER SOURCE

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

- natural susceptibility; and
- contaminant risks.

Appendix D contains four charts, which together form the 'Vulnerability Analysis' for a *Source Water Assessment* for a public drinking water source. Chart 1 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Chart 2 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 3 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. Lastly, Chart 4 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. 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. The 'Contaminant Risks' portion of the analysis also considers potential sources of contaminants. Chart 5 through 8 contains the Vulnerability Analysis for nitrates and/or nitrites and volatile organic chemicals, respectively.

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 susceptibility of the aquifer and the well to contamination is achieved by analyzing the properties of the aquifer and the well. The Carr's Crow Creek well, based on adjacent well logs, penetrates mostly gravel with only minor discontinuous layers of silty gravel and clay, which provide little if any protective barrier for the movement of contaminants in the subsurface. The water table is high in the new Girdwood Townsite, ranging from five to fifteen feet below land surface. The well is located on the floodplain of Glacier Creek and appears not to be properly grouted, as indicated from information obtained from Department records. The absence of can lead to the transport of contaminants along the well casing. Combining the susceptibility of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility. Table 1 shows the overall Susceptibility score and rating for Carr's Crow Creek.

Table 1. Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility	48	Very High

Contaminant risks to a drinking water source depend on the type, number and/or density, and distribution of contaminant sources. Domestic wastewater sewer lines, above ground fuel tanks, a large-capacity cesspool, livestock stables, an airstrip, gravel and paved roads and right-a-ways, unsewered residential areas, closed contaminated sites, parks, trails, an old landfill, and closed underground fuel storage tanks (USTs), contribute the highest risk for potential contamination to the Carr's Crow Creek's source of public drinking water.

A score (0 – 50 points) and rating of Contaminant Risks is assigned based on the findings of the Contaminant Source Inventory (Appendix A - Table 1 – Table 4). Table 2 below summarizes the Contaminant Risks for Carr's Crow Creek for each category of drinking regulated contaminants.

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	30	High
Nitrates and/or Nitrites	32	High
Volatile Organic Chemicals	33	High

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. Note: scores are rounded off to the nearest five, unless rounding to the nearest five places ranking into next highest category (see Vulnerability Analysis for Bacteria and Viruses – Chart 1 in Appendix D).

Table 3. Overall Vulnerability of Carr's Crow Creek Public Drinking Water System to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	75	High
Nitrates and/or Nitrites	80	Very High
Volatile Organic Chemicals	80	Very High

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates/nitrites, and volatile organic chemicals, respectively.

Sewer lines, a large-capacity cesspool, the Girdwood Town Square Park, and a livestock stable/corral rank as the highest sources of bacteria and viruses as well as nitrates and/or nitrites for Carr's Crow Creek. A

residential fuel tank, a closed contaminated site, activities associated with roads in the new Girdwood Townsite, closed underground fuel storage tanks (USTs), and sewer lines rank as the highest sources of volatile organic chemicals for this source of public drinking water.

Nitrates and/or nitrites have been detected in the source waters of Carr's Crow Creek, as elsewhere in the Glacier Creek Valley. Sampling history of the Carr's Crow Creek's source waters indicate low concentrations of nitrate (See Chart 6 – Contaminant Risks for Nitrates/Nitrites in Appendix D). Existing nitrate contamination is approximately 8.5% of the allowable limit (MCL) for this contaminant, paralleling what is found throughout the valley. This existing contamination, coupled with the existence of unsewered residential areas, sewer lines, a park, a large-capacity cesspool, and a horse stable within Zone A and B, has lead to nitrates and/or nitrites receiving a "Very High" rating for Overall Vulnerability.

In July 1990, the U.S. Postal Office notified ADEC of their plans to remove a leaking underground fuel storage tank containing heating oil. The tank was removed and monitoring wells were installed to assess groundwater flow and contaminant levels. Volatile organic chemicals were detected in one monitoring well, but the level was below the Maximum Contaminant Level (MCL) set by ADEC. The site (ADEC Contaminated Site 72.01) was closed and the monitoring wells were decommissioned in November 1993. This contaminated site is considered a low volatile organic chemical risk for Carr's Crow Creek.

On April 24, 1990 representatives from the Municipality of Anchorage and the Alaska Department of Environmental Conservation responded to a report of a diesel fuel spill on the grounds of Max's Bar & Grill on Crow Creek Road. A 500-gallon fuel tank had been punctured and spilled approximately 200 gallons of diesel on the gravel at the site. To prevent off site migration of volatile organic chemicals, approximately 250 cubic yards of contaminated soils were excavated, stockpiled, covered, and later shipped off site to be incinerated. This site is within the Drinking Water Protection Area Zone A for Carr's Crow Creek. A second spill was discovered further to the west on the same property during the inspection. This spill site was "partially covered by recently placed gravel" [*Golder Associates, Inc., 1990*]. Max's Bar & Grill's drinking water well, in addition to another well down-gradient of the contaminated site, were sampled for volatile organic chemicals on August 8, 1990. These tests yielded no evidence of contamination as a result of this spill. The excavation and shipment of contaminated soils appeared to be successful in recovering "most" of the spilled fuel [*Golder Associates, Inc., 1990*] and no further site (ADEC Contaminated Site 100.34) cleanup was required after September 30, 1991. Volatile organic chemicals may still be present in soil onsite and en route to the water table. This contaminated site was ranked as a medium risk and is the sixth highest-ranking source of volatile organic chemicals for Carr's Crow Creek.

Overall, volatile organic chemicals are the highest-ranking risk of contamination for Carr's Crow Creek. Combining the susceptibility of the well with volatile organic chemical contaminant risks, Carr's Crow Creek received an overall vulnerability rating of very high for this category.

During construction of the Alyeska Prince Hotel, a 3000-gallon above ground diesel fuel tank was located near Arlberg Avenue. In July 1992, a spill occurred at this site in which diesel leaked into the soil and a small creek, which runs through Moose Meadows and into Glacier Creek. Approximately 150 cubic yards of soil was removed from this site and shipped to Anchorage for treatment. No further action was needed for this site (ADEC Contaminated Site 100.99) and it was closed on January 6, 1994. This site represents a very low risk for volatile organic chemicals for the Carr's Crow Creek's source of public drinking water.

On October 25, 1993 an underground storage tank containing used oil was removed from the Alyeska Resort Maintenance Shop. Approximately 30 cubic yards of contaminated soil was removed and later transported off-site for treatment. An additional 1 cubic yard of contaminated soil was excavated from the site in the fall of 1999 and was disposed of on-site through soil spreading. A Release Investigation was completed in November 1999 to determine the extent of contamination. A further investigation was requested by the Alaska Department of Environmental Conservation in April 2000 to characterize the lateral and vertical extent of the contamination. Due to inclement weather conditions, further remediation of the site is postponed until May 2001. This leaking underground storage tank (LUST) site is within the Zone E Protection Area for Carr's Crow Creek. Due to its distant proximity to the drinking water source, this potential contaminant source (ADEC LUST Site #L55.298) represents a low risk for volatile organic chemicals, heavy metals, and other synthetic organic

chemicals.

An old landfill was in service until December 5, 1974 near what is now Girdwood Elementary School. The old landfill was covered at the time of closure and Girdwood Elementary School began operation during the fall of 1981. Currently, the site is contained within a "very impermeable soil", however, samples taken (June 27, 1996) within a french drain at the site contained volatile organic chemical levels above the MCL. Leachate from old landfill may enter Glacier Creek. Once in Glacier Creek, the leachate may be diluted to drinking water standards for wells in the new Girdwood Townsite that may be under the influence of Glacier Creek. This old landfill site represents a low risk for volatile organic chemicals for Carr's Crow Creek.

In August and September of 1997, two underground fuel storage tanks (USTs) were removed from behind Girdwood Elementary School. These USTs were identified as a 10,000-gallon heating oil tank and a 500-gallon diesel tank. No significant volatile organic chemical contamination was encountered in association with the heating oil tank. However, soil contamination was encountered beneath the 500-gallon diesel UST. A total of 7.15 tons of contaminated material was removed and transported offsite for treatment. A further study on the release of contaminants in both the soil and groundwater was conducted to determine the magnitude and extent of the contamination. Four monitoring wells were drilled to delineate the contaminant plume beneath the former 500-gallon tank site. No further remedial action was necessary and site cleanup was completed on January 26, 1999. . These sites where the tanks once existed represent a very low risk for volatile organic chemicals for Carr's Crow Creek.

A 3000-gallon above ground diesel fuel tank is located behind Girdwood Elementary School within the Zone E Protection Area for this drinking water source. This fuel tank replaces the underground storage tanks mentioned above and serves as an emergency fuel source for the school's generator. The tank is double walled to increase the protection from puncturing. However, no containment structure is present that might otherwise prevent the transport of fuel offsite in the event of a catastrophic failure of the tank, a valve on the tank or pipe into the school, or from the fuel truck that refuels the tank. This tank is within 650 feet of Glacier Creek and within the Zone E Protection Area for Carr's Crow Creek. Contaminant risk due to this above ground fuel tank stems from the potential for having a catastrophic release of the fuel from the tank. In order for volatile organic chemicals to impact Carr's Crow Creek's well, fuel would have to enter Glacier Creek either through overland flow or through the subsurface. Further, the fuel, once in Glacier Creek, would be diluted. Contaminated surface water may enter the well through either floodwaters during a flood event or through the subsurface. This tank was initially ranked as a medium risk source of volatile organic chemicals. However, because of the tank's distant proximity to the well and the nature of a potential release impacting the well, this potential contaminant source may be considered a low potential risk for Carr's Crow Creek's source of drinking water.

A large-capacity cesspool is located approximately 350 feet from the drinking water source for Carr's Crow Creek. This potential contaminant source is located within the Zone E Protection Area or 1000 feet from Glacier Creek. Risk due to this potential contaminant source stems from the fact that the drinking water well and the cesspool are located on the 100-year floodplain for Glacier and California Creeks. However, it seems reasonably likely that the flow around the cesspool during a 100-year or greater flood may direct flow away from the well, thus alleviating the risk posed by this potential contaminant source.

SUMMARY

A *Source Water Assessment* has been completed for the Carr's Crow Creek's source of public drinking water. The overall vulnerability of this source to contamination is **High** for bacteria and viruses, and **Very High** for 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 Carr's Crow Creek 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 this drinking water source to contamination.

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Glass, Roy L. and Brabets, Timothy P., 1988, Summary of water resources data for the Girdwood-Alyeska Area, Alaska: USGS Open-File Report 87-678.

Municipality of Anchorage, Management Information Systems Department, 2000, Data layer representing flood hazard zones within specific study areas (after U.S. Army Corps of Engineers FEMA – 1979).

Western Regional Climate Center, 2000, August 24, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://www.wrcc.dri.edu/index.html

APPENDIX A

Contaminant Source Inventory and Risk Ranking for Carr's Crow Creek

Table 1

Contaminant Source Inventory for Carr's Crow Creek Public Water System

PWSID 214277

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Location	Map Number	Notes/Comments
Closed tanks, diesel (above ground)	T7	T7-1	A	Northeast corner of Max's Bar & Grill	4 and 5	Tank removed when punctured; 4/90
Closed tanks, diesel (above ground)	T7	T7-2	A	Max's Bar & Grill	4 and 5	Tank removed; 4/90
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	A	North and west side of Max's Bar & Grill	4 and 5	Diesel spill in 4/90. Site Closed. ADEC Contaminated Sites File CS100.34
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Holmgren Place	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Lindblad Avenue	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-3	A	Crow Creek Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-1	A	Holmgren Place	4 and 5	
Highways and roads, dirt/gravel	X24	X24-2	A	Lindblad Avenue	4 and 5	
Highways and roads, dirt/gravel	X24	X24-3	A	Crow Creek Road	4 and 5	
Municipal or city parks (with green areas)	X4	X4-1	A	Girdwood Town Square Park	4 and 5	
Tanks, fuel, residential (above ground)	R7	R7-1	A	Holmgren Place	4 and 5	Fuel
Livestock stables/corrals	A9	A9-1	B	Crow Creek Road	4 and 5	Horse Stables
Unsewered residential areas	R1	R1-1	B	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-2	B	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-3	B	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-4	B	Along Crow Creek Road	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R2	R1-5	B	Along Crow Creek Road	4 and 5	Residential areas that may have septic systems for wastewater disposal
Airports	X14	X14-1	E	Mt. Hood Way	4 and 5	Airstrip fueled by mobile fuel truck
Injection wells (Class V) Cesspools, large capacity	D8	D8-1	E	Hightower Road approximately 300 feet from drinking water source	4 and 5	Cesspool on 500-year floodplain
Tanks, diesel (above ground)	T6	T6-1	E	Behind Girdwood Elementary School	4 and 5	3,000 gallon diesel fuel tank used for emergency power supply
Closed Leaking Underground Fuel Storage Tank (LUST) (diesel)	U14	U14-1	E	Behind Girdwood Elementary School	4 and 5	500 gallon fuel tank removed 1997; ADEC LUST File L68.20
Closed Leaking Underground Fuel Storage Tank (LUST) (heating oil)	U10	U10-1	E	Behind Girdwood Elementary School	4 and 5	10000 gallon heating oil tank removed 1997; ADEC LUST File L68.20
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-2	E	Linblad and Hightower	4 and 5	Heating oil tank removed on 7/90. Site Closed. ADEC Contaminated Sites File CS72.01
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-3	E	Moose Creek along Arlberg	4	Diesel leak from 3000 gallon tank in 2/93. Site closed 1/94. ADEC Contaminated Sites File CS100.99
Dog walking areas/foot trails	X46	X46-1	E	Along Glacier and Winner Creeks	4	Winner Creek Trail
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-4	E	Hightower Road	4 and 5	

Table 1

Contaminant Source Inventory for Carr's Crow Creek Public Water System

PWSID 214277

Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-5	E	Davos	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-6	E	Tahoe Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-7	E	Mt. Hood Way	4 and 5	
Highways and roads, dirt/gravel	X24	X24-4	E	Hightower Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-5	E	Davos	4 and 5	
Highways and roads, dirt/gravel	X24	X24-6	E	Tahoe Road	4	
Highways and roads, dirt/gravel	X24	X24-7	E	Mt. Hood Way	4 and 5	
Municipal or city parks (with green areas)	X4	X4-2	E	Alyeska Basin Park reserves	4	
Municipal or city parks (with green areas)	X4	X4-3	E	Alyeska Basin Park reserves	4	
Old landfill	U17	U17-1	E	Behind Girdwood Elementary School	4 and 5	
Tanks, heating oil, residential (above ground)	R8	R8-1	E	Hightower Road	4 and 5	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-10	E	Corner of Tahoe Circle and Mt Hood	4 and 5	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-2	E	Birghton	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-3	E	Brighton	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-4	E	Banff Circle	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-5	E	Corner of Mt. Hood and Tahoe Street	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-6	E	Tahoe Circle	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-7	E	Mt Hood Way, along the Girdwood Airstrip	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-8	E	Mt Hood Way, along the Girdwood Airstrip	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-9	E	Mt Hood Way, along the Girdwood Airstrip	4	Fuel oil #1 - Heating oil
Closed Leaking Underground Fuel Storage Tank (LUST) (Used Oil)	U8	U8-1	E	TRACT A-1 ALYESKA NORTH SUB.	4	300 gallon used oil tank removed; status still open -Release Investigation still in progress. ADEC LUST File # L55.298
Dog walking areas/foot trails	X46	X46-2	E AND F	Moose Meadows Park	4	Moose Meadows Trail
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-11	E AND F	Arlberg Avenue	4	
Highways and roads, paved (cement or asphalt)	X20	X20-1	E AND F	Arlberg Avenue	4	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-4	F	GIRDWOOD NW CORNER OF ASPEN AND ARLBERG	4	DIESEL
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-10	F	Alyeska Avenue	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-12	F	Crystal Road	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-13	F	Taos Road	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-8	F	Banff Circle	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-9	F	Aspen	4	
Highways and roads, dirt/gravel	X24	X24-10	F	Alyeska Avenue	4	
Highways and roads, dirt/gravel	X24	X24-11	F	Crystal Road	4	
Highways and roads, dirt/gravel	X24	X24-12	F	Taos Road	4	
Highways and roads, dirt/gravel	X24	X24-8	F	Banff Circle	4	
Highways and roads, dirt/gravel	X24	X24-9	F	Aspen	4	

Table 1

Contaminant Source Inventory for Carr's Crow Creek Public Water System

PWSID 214277

Municipal or city parks (with green areas)	X4	X4-4	F	Alyeska Basin Park reserves	4	
Municipal or city parks (with green areas)	X4	X4-5	F	Moose Meadows Park	4	
Municipal or city parks (with green areas)	X4	X4-6	F	Moose Meadows Park	4	

Table 2

Contaminant Source Inventory and Risk Ranking for Carr's Crow Creek Public Water System Sources of Bacteria and Viruses

PWSID 214277

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Medium	1	Holmgren Place	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Medium	2	Lindblad Avenue	4 and 5	
Injection wells (Class V) Cesspools, large capacity	D8	D8-1	E	Medium	3	Hightower Road approximately 300 feet from drinking water source	4 and 5	Cesspool on 500-year floodplain
Municipal or city parks (with green areas)	X4	X4-1	A	Low	4	Girdwood Town Square Park	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-3	A	Medium	5	Crow Creek Road	4 and 5	
Livestock stables/corrals	A9	A9-1	B	Medium	6	Crow Creek Road	4 and 5	Horse Stables
Unsewered residential areas	R1	R1-1	B	Medium	7	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-2	B	Medium	8	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-3	B	Medium	9	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-4	B	Medium	10	Along Crow Creek Road	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R2	R1-5	B	Medium	11	Along Crow Creek Road	4 and 5	Residential areas that may have septic systems for wastewater disposal
Highways and roads, dirt/gravel	X24	X24-1	A	Low	12	Holmgren Place	4 and 5	
Highways and roads, dirt/gravel	X24	X24-2	A	Low	13	Lindblad Avenue	4 and 5	
Highways and roads, dirt/gravel	X24	X24-3	A	Low	14	Crow Creek Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-4	E	Medium	15	Hightower Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-5	E	Medium	16	Davos	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-6	E	Medium	17	Tahoe Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-7	E	Medium	18	Mt. Hood Way	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-8	F	Medium	19	Banff Circle	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-9	F	Medium	20	Aspen	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-10	F	Medium	21	Alyeska Avenue	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-11	E AND F	Medium	22	Arlberg Avenue	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-12	F	Medium	23	Crystal Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-13	F	Medium	24	Taos Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-4	E	Low	25	Hightower Road	4 and 5	

Table 2

Contaminant Source Inventory and Risk Ranking for Carr's Crow Creek Public Water System Sources of Bacteria and Viruses

PWSID 214277

Highways and roads, dirt/gravel	X24	X24-7	E	Low	26	Mt. Hood Way	4 and 5	
Dog walking areas/foot trails	X46	X46-1	E	Low	27	Along Glacier and Winner Creeks	4 and 5	Winner Creek Trail
Highways and roads, dirt/gravel	X24	X24-5	E	Low	28	Davos	4 and 5	
Highways and roads, dirt/gravel	X24	X24-6	E	Low	29	Tahoe Road	4 and 5	
Municipal or city parks (with green areas)	X4	X4-2	E	Low	30	Alyeska Basin Park Reserves	4 and 5	
Municipal or city parks (with green areas)	X4	X4-3	E	Low	31	Alyeska Basin Park Reserves	4 and 5	
Dog walking areas/foot trails	X46	X46-2	E AND F	Low	32	Moose Meadows Park	4 and 5	Moose Meadows Trail
Highways and roads, dirt/gravel	X24	X24-8	F	Low	33	Banff Circle	4 and 5	
Municipal or city parks (with green areas)	X4	X4-4	F	Low	34	Alyeska Basin Park reserves	4 and 5	
Municipal or city parks (with green areas)	X4	X4-5	F	Low	35	Moose Meadows Park	4 and 5	
Highways and roads, dirt/gravel	X24	X24-9	F	Low	36	Aspen	4 and 5	
Municipal or city parks (with green areas)	X4	X4-6	F	Low	37	Moose Meadows Park	4 and 5	
Highways and roads, paved (cement or asphalt)	X20	X20-1	E AND F	Low	38	Arlberg Avenue	4 and 5	
Highways and roads, dirt/gravel	X24	X24-10	F	Low	39	Alyeska Avenue	4 and 5	
Highways and roads, dirt/gravel	X24	X24-11	F	Low	40	Crystal Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-12	F	Low	41	Taos Road	4 and 5	

Table 3

Contaminant Source Inventory and Risk Ranking for Carr's Crow Creek Public Water System Sources of Nitrates/Nitrites

PWSID 214277

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Medium	1	Holmgren Place	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Medium	2	Lindblad Avenue	4 and 5	
Injection wells (Class V) Cesspools, large capacity	D8	D8-1	E	Medium	3	Hightower Road approximately 300 feet from drinking water source	4 and 5	Cesspool on 500-year floodplain
Municipal or city parks (with green areas)	X4	X4-1	A	Low	4	Girdwood Town Square Park	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-3	A	Medium	5	Crow Creek Road	4 and 5	
Livestock stables/corrals	A9	A9-1	B	Medium	6	Crow Creek Road	4 and 5	Horse Stables
Unsewered residential areas	R1	R1-1	B	Medium	7	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-2	B	Medium	8	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-3	B	Medium	9	Along Crow Creek Road and Snowmass Circle	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R1	R1-4	B	Medium	10	Along Crow Creek Road	4 and 5	Residential areas that may have septic systems for wastewater disposal
Unsewered residential areas	R2	R1-5	B	Medium	11	Along Crow Creek Road	4 and 5	Residential areas that may have septic systems for wastewater disposal
Highways and roads, dirt/gravel	X24	X24-1	A	Low	12	Holmgren Place	4 and 5	
Highways and roads, dirt/gravel	X24	X24-2	A	Low	13	Lindblad Avenue	4 and 5	
Highways and roads, dirt/gravel	X24	X24-3	A	Low	14	Crow Creek Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-4	E	Medium	15	Hightower Road	4 and 5	
Old landfills	U17	U17-1	E	Low	16	Behind Girdwood Elementary School	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-5	E	Medium	17	Davos	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-6	E	Medium	18	Tahoe Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-7	E	Medium	19	Mt. Hood Way	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-8	F	Medium	20	Banff Circle	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-9	F	Medium	21	Aspen	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-10	F	Medium	22	Alyeska Avenue	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-11	E AND F	Medium	23	Arlberg Avenue	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-12	F	Medium	24	Crystal Road	4 and 5	

Table 3

Contaminant Source Inventory and Risk Ranking for Carr's Crow Creek Public Water System Sources of Nitrates/Nitrites

PWSID 214277

Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-13	F	Medium	25	Taos Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-4	E	Low	26	Hightower Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-7	E	Low	27	Mt. Hood Way	4 and 5	
Dog walking areas/foot trails	X46	X46-1	E	Low	28	Along Glacier and Winner Creeks	4 and 5	Winner Creek Trail
Highways and roads, dirt/gravel	X24	X24-5	E	Low	29	Davos	4 and 5	
Highways and roads, dirt/gravel	X24	X24-6	E	Low	30	Tahoe Road	4 and 5	
Municipal or city parks (with green areas)	X4	X4-2	E	Low	31	Alyeska Basin Park Reserves	4 and 5	
Municipal or city parks (with green areas)	X4	X4-3	E	Low	32	Alyeska Basin Park Reserves	4 and 5	
Dog walking areas/foot trails	X46	X46-2	E AND F	Low	33	Moose Meadows Park	4 and 5	Moose Meadows Trail
Highways and roads, dirt/gravel	X24	X24-8	F	Low	34	Banff Circle	4 and 5	
Municipal or city parks (with green areas)	X4	X4-4	F	Low	35	Alyeska Basin Park reserves	4 and 5	
Municipal or city parks (with green areas)	X4	X4-5	F	Low	36	Moose Meadows Park	4 and 5	
Highways and roads, dirt/gravel	X24	X24-9	F	Low	37	Aspen	4 and 5	
Municipal or city parks (with green areas)	X4	X4-6	F	Low	38	Moose Meadows Park	4 and 5	
Highways and roads, paved (cement or asphalt)	X20	X20-1	E AND F	Low	39	Arlberg Avenue	4 and 5	
Highways and roads, dirt/gravel	X24	X24-10	F	Low	40	Alyeska Avenue	4 and 5	
Highways and roads, dirt/gravel	X24	X24-11	F	Low	41	Crystal Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-12	F	Low	42	Taos Road	4 and 5	

Table 4

Contaminant Source Inventory and Risk Ranking for Carr's Crow Creek Public Water System Sources of Volatile Organic Chemicals

PWSID 214277

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Tanks, fuel, residential (above ground)	R7	R7-1	A	Medium	1	Holmgren Place	4 and 5	Fuel
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	Holmgren Place	4 and 5	
Highways and roads, dirt/gravel	X24	X24-2	A	Low	3	Lindblad Avenue	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Low	4	Holmgren Place	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Low	5	Lindblad Avenue	4 and 5	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	A	Medium	6	North and west side of Max's Bar & Grill	4 and 5	Diesel spill on 4/90. Site Closed. ADEC Contaminated Sites File CS100.34
Highways and roads, dirt/gravel	X24	X24-3	A	Low	7	Crow Creek Road	4 and 5	
Tanks, diesel (above ground)	T6	T6-1	E	Medium	8	Behind Girdwood Elementary School	4 and 5	3,000 gallon diesel fuel tank used for emergency power supply
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-3	A	Medium	9	Crow Creek Road	4 and 5	
Highways and roads, dirt/gravel	X24	X24-7	E	Low	10	Mt. Hood Way	4 and 5	Fuel truck to airport
Tanks, heating oil, residential (above ground)	R8	R8-1	E	Medium	11	Hightower Road	4 and 5	Fuel oil #1 - Heating oil
Airports	X14	X14-1	E	High	12	Mt. Hood Way	4 and 5	Airstrip fueled by mobile fuel truck
Injection wells (Class V) Cesspools, large capacity	D8	D8-1	E	Low	13	Hightower Road	4 and 5	Cesspool on 500-year floodplain
Highways and roads, dirt/gravel	X24	X24-4	E	Low	14	Hightower Road	4 and 5	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-4	E	Low	15	Hightower Road	4 and 5	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-2	E	Low	16	Linblad and Hightower	4 and 5	Heating oil; Closed 11/12/93. ADEC Contaminated Site 72.01
Old landfill	U17	U17-1	E	Low	17	Behind Girdwood Elementary School	4 and 5	
Closed Leaking Underground Fuel Storage Tank (LUST) (diesel)	U14	U14-1	E	Low	18	Behind Girdwood Elementary School	4 and 5	500 gallon fuel tank removed 1997; ADEC LUST File L68.20
Closed Leaking Underground Fuel Storage Tank (LUST) (heating oil)	U10	U10-1	E	Low	19	Behind Girdwood Elementary School	4 and 5	10,000 gallon heating oil tank removed 1997; ADEC LUST File L68.20
Closed Leaking Underground Fuel Storage Tank (LUST) (Used Oil)	U8	U8-1	E	Low	20	TRACT A-1 ALYESKA NORTH SUB.	4	300 gallon used oil tank removed; status still open -Release Investigation still in progress. ADEC LUST File # L55.298
Tanks, heating oil, residential (above ground)	R8	R8-10	E	Medium	21	Corner of Tahoe Circle and Mt Hood	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-5	E	Medium	22	Corner of Mt. Hood and Tahoe Street	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-6	E	Medium	23	Tahoe Circle	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-7	E	Medium	24	Mt Hood Way, along the Girdwood Airstrip	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-8	E	Medium	25	Mt Hood Way, along the Girdwood Airstrip	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-9	E	Medium	26	Mt Hood Way, along the Girdwood Airstrip	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-4	E	Medium	27	Banff Circle	4	Fuel oil #1 - Heating oil

Table 4

Contaminant Source Inventory and Risk Ranking for Carr's Crow Creek Public Water System Sources of Volatile Organic Chemicals

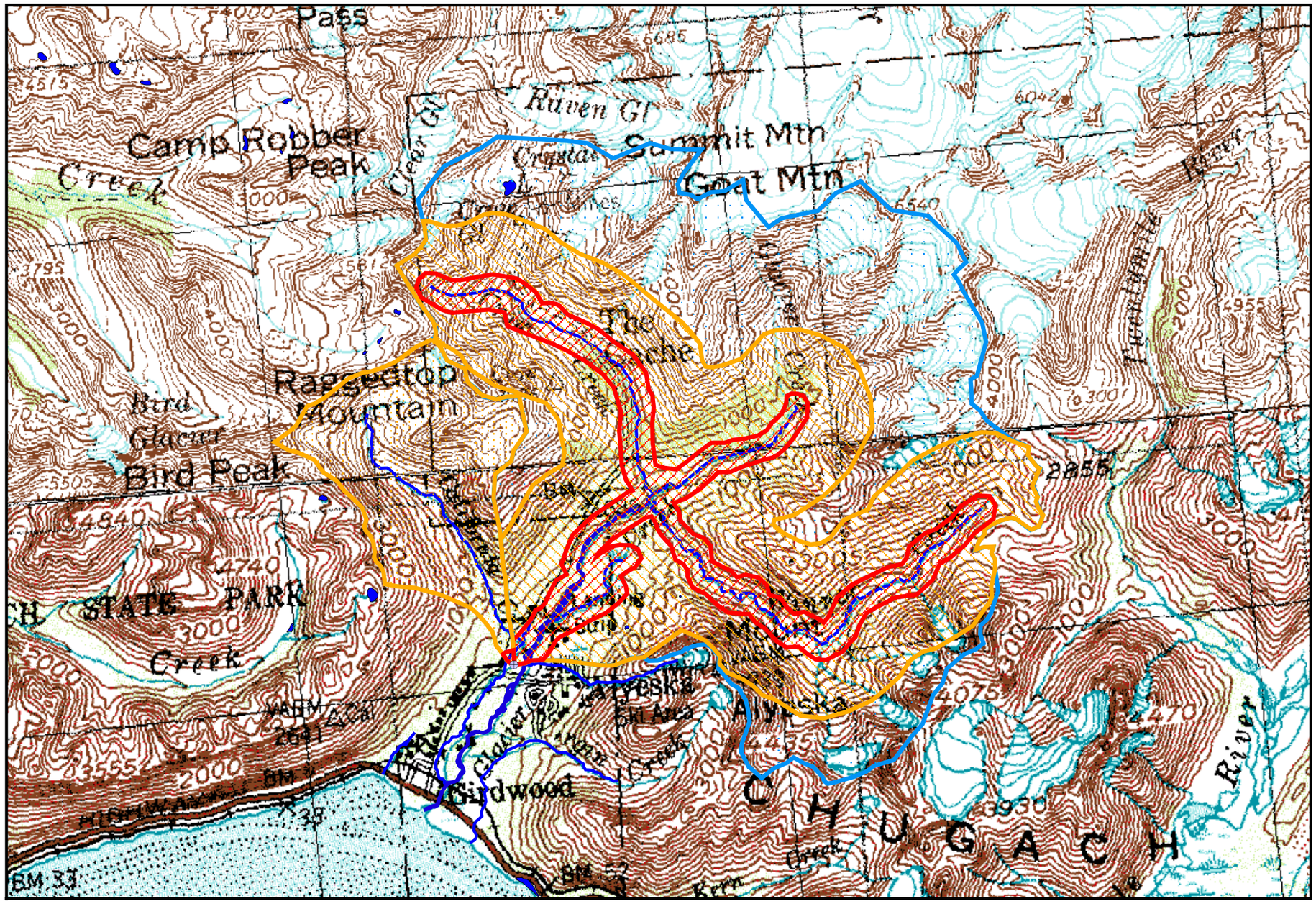
PWSID 214277

Tanks, heating oil, residential (above ground)	R8	R8-2	E	Medium	28	Brighton	4	Fuel oil #1 - Heating oil
Tanks, heating oil, residential (above ground)	R8	R8-3	E	Medium	29	Brighton	4	Fuel oil #1 - Heating oil
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-3	E	Low	30	Along Alrberg Avenue and Upper Moose Creek	4	Diesel spill; Closed 1/6/94. ADEC Contaminated Site 100.99
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-4	F	Low	31	GIRDWOOD NW CORNER OF ASPEN AND ARLBERG	4	Diesel spill; Site reference and status unknown
Highways and roads, paved (cement or asphalt)	X20	X20-1	E AND F	Low	32	Arlberg Avenue	4	
Highways and roads, dirt/gravel	X24	X24-5	E	Low	33	Davos	4	
Highways and roads, dirt/gravel	X24	X24-6	E	Low	34	Tahoe Road	4	
Highways and roads, dirt/gravel	X24	X24-8	F	Low	35	Banff Circle	4	
Highways and roads, dirt/gravel	X24	X24-9	F	Low	36	Aspen	4	
Highways and roads, dirt/gravel	X24	X24-10	F	Low	37	Alyeska Avenue	4	
Highways and roads, dirt/gravel	X24	X24-11	F	Low	38	Crystal Road	4	
Highways and roads, dirt/gravel	X24	X24-12	F	Low	39	Taos Road	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-5	E	Low	40	Davos	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-6	E	Low	41	Tahoe Road	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-7	E	Low	42	Mt. Hood Way	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-8	F	Low	43	Banff Circle	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-9	F	Low	44	Aspen	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-10	F	Low	45	Alyeska Avenue	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-11	E AND F	Low	46	Arlberg Avenue	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-12	F	Low	47	Crystal Road	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-13	F	Low	48	Taos Road	4	

APPENDIX B

Carr's Crow Creek's
Drinking Water Protection Area

Carr's Crow Creek (PWSID 214277)
Drinking Water Protection Areas



- Carr's Crow Creek Well

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than Two Years Travel Time

Zone E Protection Area
- 1000 Feet From Surface Water Body

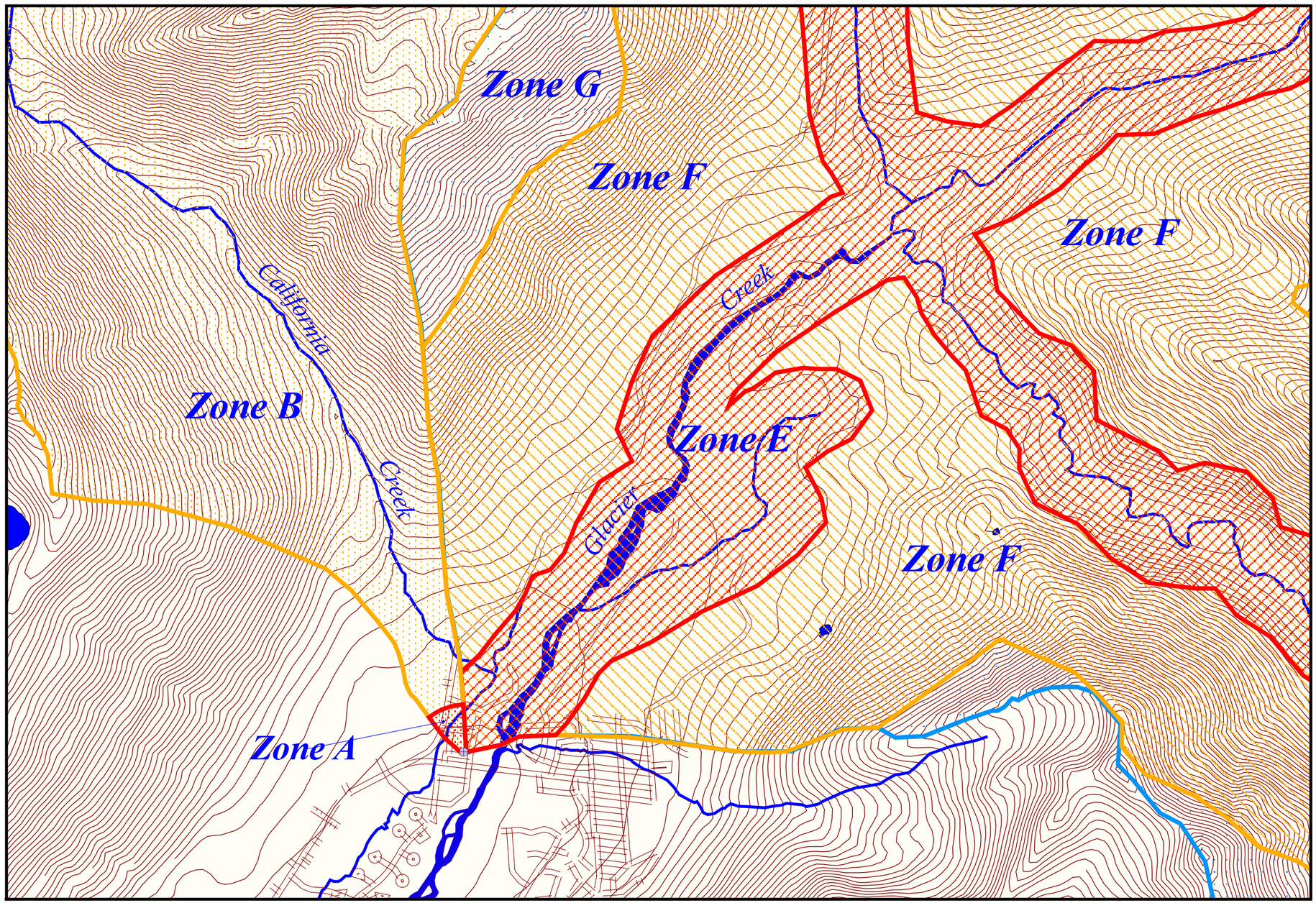
Zone F Protection Area
- 1 Mile From Surface Water Body

Zone G Protection Area
- Entire Watershed
- 2nd order streams
- 3rd order streams
- 4th order streams
- Lakes and Ponds
- Glacier Creek

N W E S

Map 1

Carr's Crow Creek (PWSID 214277)
Drinking Water Protection Areas



- Carr's Crow Creek Well

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than Two Years Travel Time

Zone E Protection Area
- 1000 Feet From Surface Water Body

Zone F Protection Area
- 1 Mile From Surface Water Body

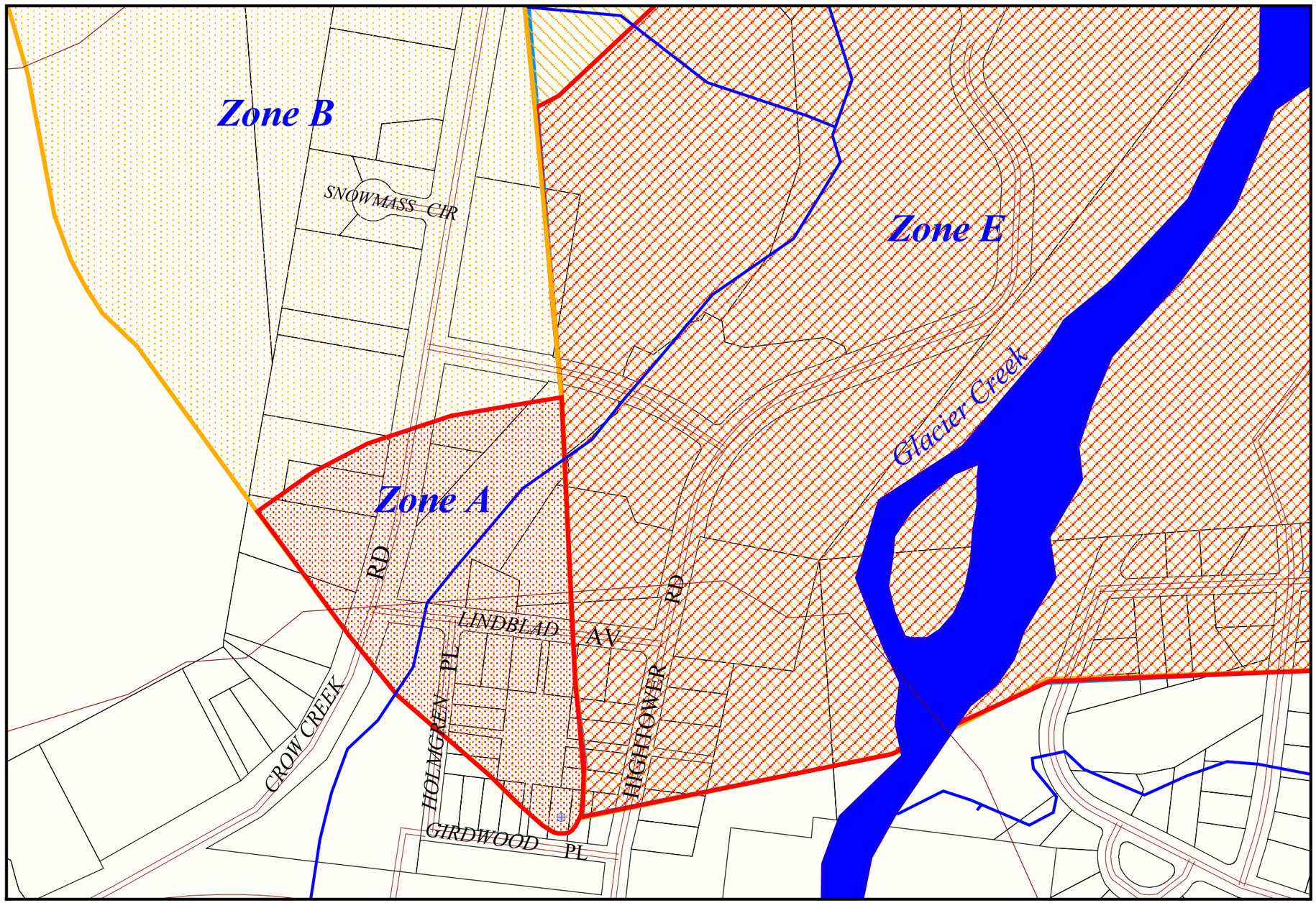
Zone G Protection Area
- Entire Watershed
- MOA Roads
- 2nd order streams
- 3rd order streams
- 4th order streams
- Lakes and Ponds
- Glacier Creek
- Elevation Contours

3000 0 3000 Feet

N W E S

Map 2

Carr's Crow Creek (PWSID 214277)
Drinking Water Protection Areas



- Carr's Crow Creek Well
- MOA Roads
- 2nd order streams
- 3rd order streams
- 4th order streams
- Elevation Contours
- Glacier Creek
- Lakes and Ponds

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than Two Years Travel Time

Zone E Protection Area
- 1000 Feet From Surface Water Body

Zone F Protection Area
- 1 Mile From Surface Water Body

Zone G Protection Area
- Entire Watershed
- MOA Land Parcels

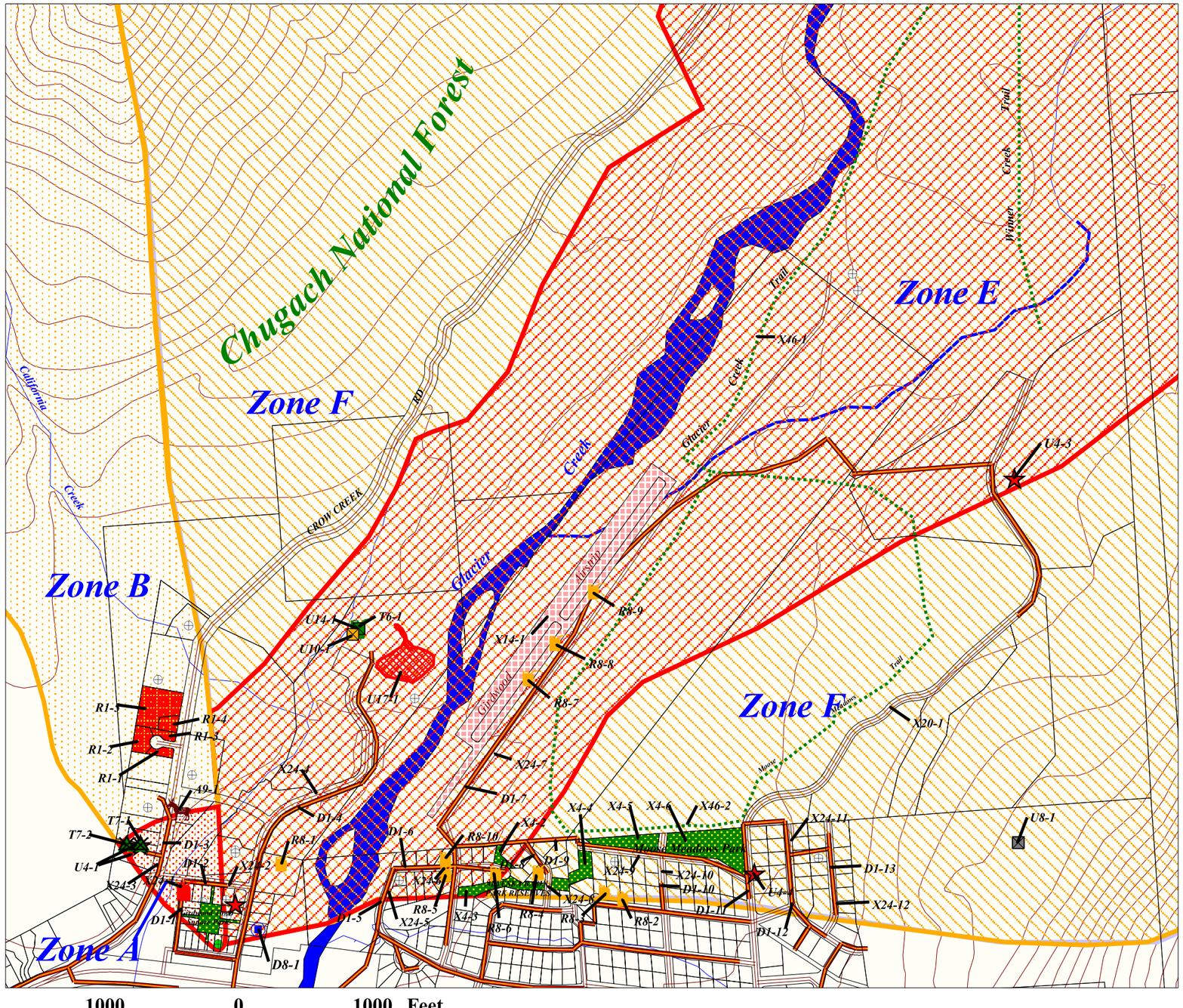
N W E S

Map 3

APPENDIX C

Carr's Crow Creek's Drinking Water Protection Area and Potential & Existing Contaminant Sources

Carr's Crow Creek Drinking Water Protection Area and Potential and Existing Sources of Contamination



Potential and Existing Sources of Contamination
- Closed Leaking Underground Fuel Storage Tank (LUST) (diesel)
- Closed Leaking Underground Fuel Storage Tank (LUST) (heating oil)
- Closed Leaking Underground Fuel Storage Tank (LUST) (lubicants
- Closed Tanks, diesel (above ground)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA
- Injection wells (Class V) Cesspools, large capacity
- Livestock stables/corrals
- Tanks, fuel, residential (above ground)
- Tanks, diesel (above ground)
- Tanks, heating oil, residential (above ground)
- Old Landfill
- Trails
- MOA Land Parcels
- Contaminated Sites Areas
- Parks
- Airports
- Unsewered Residential Areas
- Sewers Lines
- Roads
- Carr's Crow Creek Well
- Private & Public Drinking Water Wells

Zone A Drinking Water Protection Area
- Several Months Travel Time

Zone B Drinking Water Protection Area
- Less than 2 Years Travel Time

Zone E Drinking Water Protection Area
- 1000 Feet From Surface Water Body

Zone F Drinking Water Protection Area
- 1 Mile From Surface Water Body

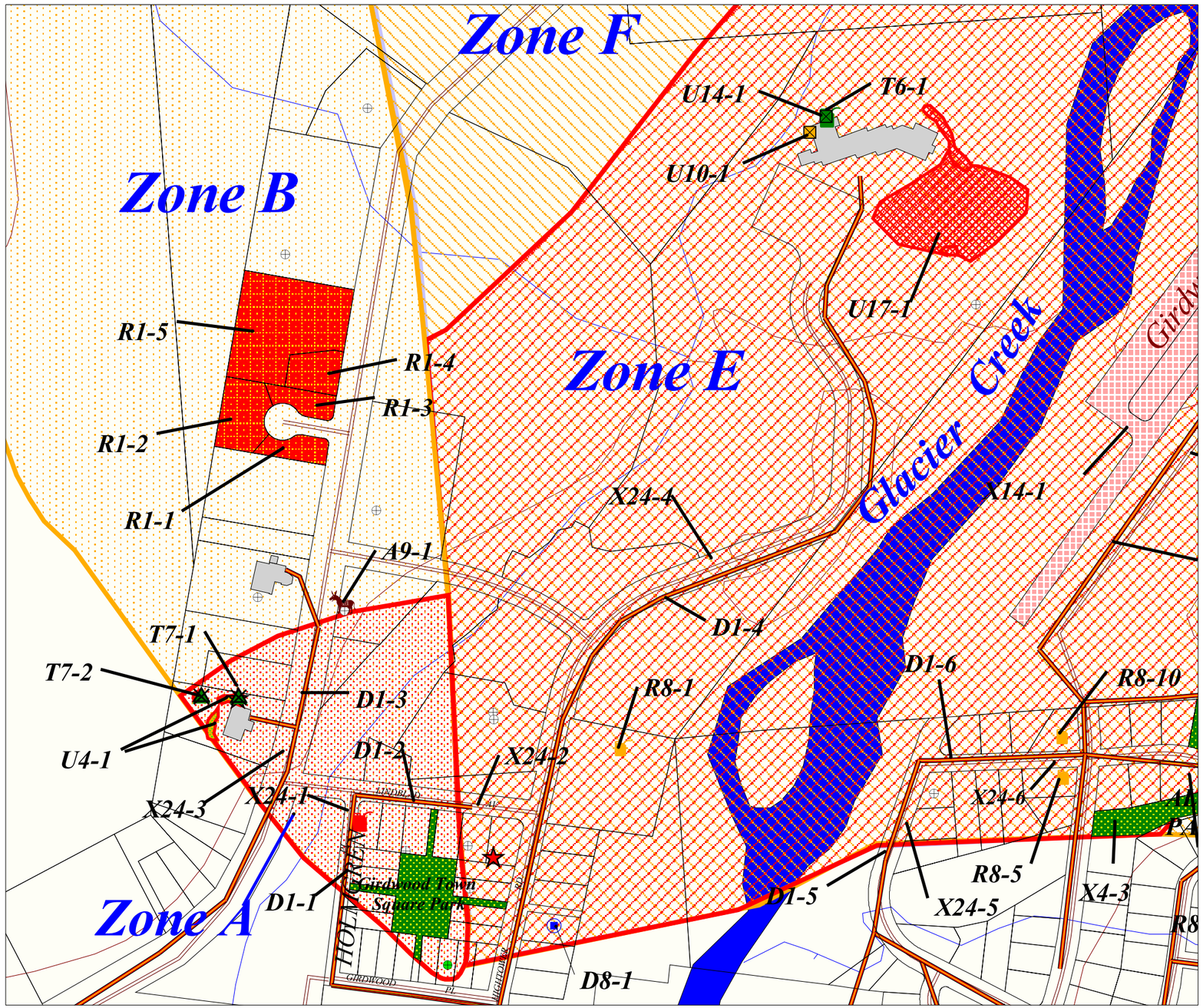
Zone G Drinking Water Protection Area
- Entire Watershed
- Glacier Creek
- 1st Order Streams
- 2nd Order Sreams
- 3rd Order Streams
- Elevation Contours

N W E S

PWSID 214277

Map 4

Carr's Crow Creek Drinking Water Protection Area and Potential and Existing Sources of Contamination



Potential and Existing Sources of Contamination
- Closed Leaking Underground Fuel Storage Tank (LUST) (diesel)
- Closed Leaking Underground Fuel Storage Tank (LUST) (heating oil)
- Closed Leaking Underground Fuel Storage Tank (LUST) (lubicants
- Closed Tanks, diesel (above ground)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA
- Injection wells (Class V) Cesspools, large capacity
- Livestock stables/corrals
- Tanks, fuel, residential (above ground)
- Tanks, diesel (above ground)
- Tanks, heating oil, residential (above ground)
- Old Landfill
- Trails
- MOA Land Parcels
- Contaminated Sites Areas
- Parks
- Airports
- Unsewered Residential Areas
- Sewers Lines
- Buildings
- Roads
- Carr's Crow Creek Well
- Private & Public Drinking Water Wells

Zone A Drinking Water Protection Area
- Several Months Travel Time

Zone B Drinking Water Protection Area
- Less than 2 Years Travel Time

Zone E Drinking Water Protection Area
- 1000 Feet From Surface Water Body

Zone F Drinking Water Protection Area
- 1 Mile From Surface Water Body

Zone G Drinking Water Protection Area
- Entire Watershed
- Glacier Creek
- 1st Order Streams
- 2nd Order Sreams
- 3rd Order Streams
- Elevation Contours

N W E S

PWSID 214277

Map 5

APPENDIX D

Vulnerability Analysis for Carr's Crow Creek Public Drinking Water System

Chart 1. Vulnerability analysis for Bacteria & Viruses – Carr's Crow Creek

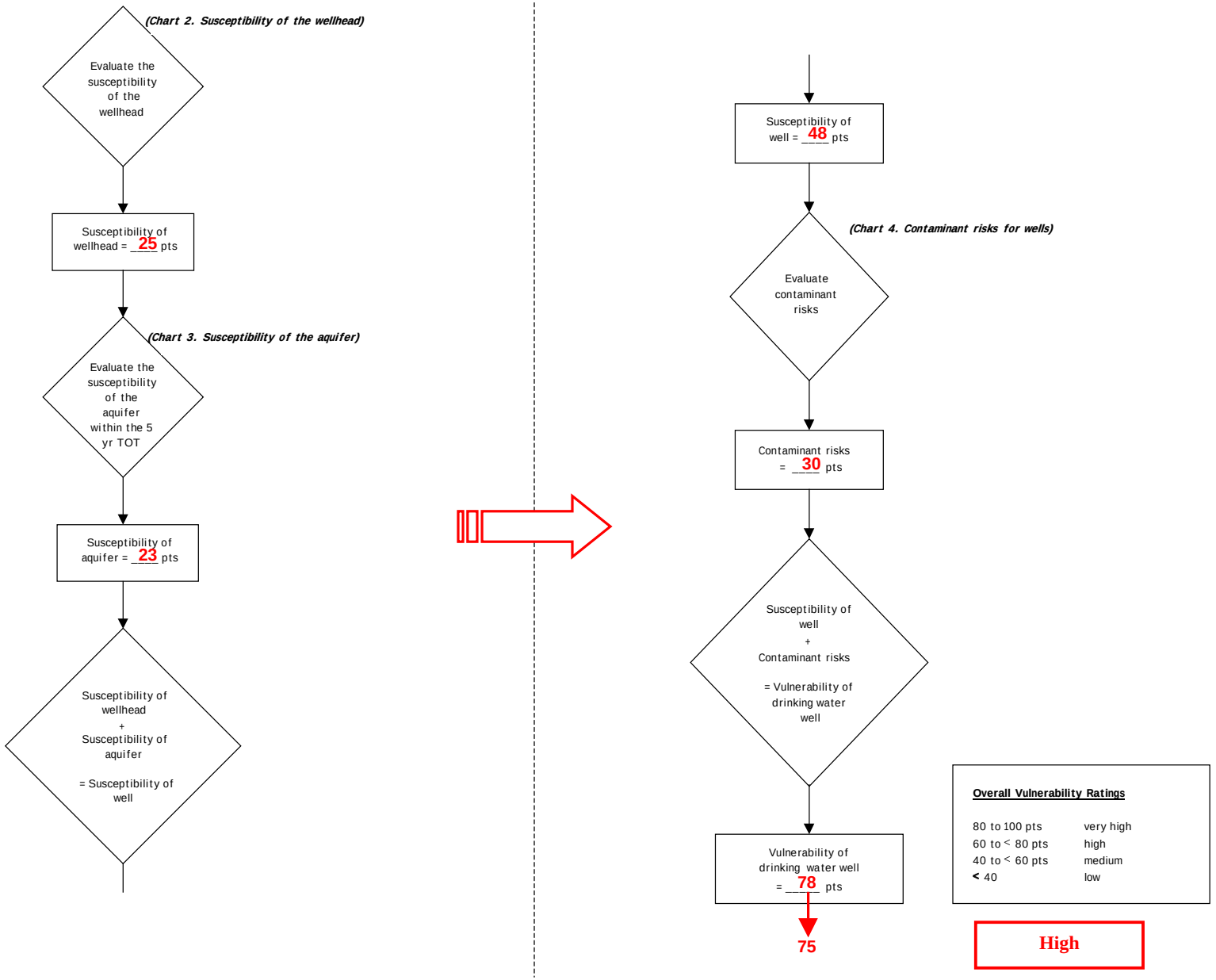


Chart 2. Susceptibility of the wellhead

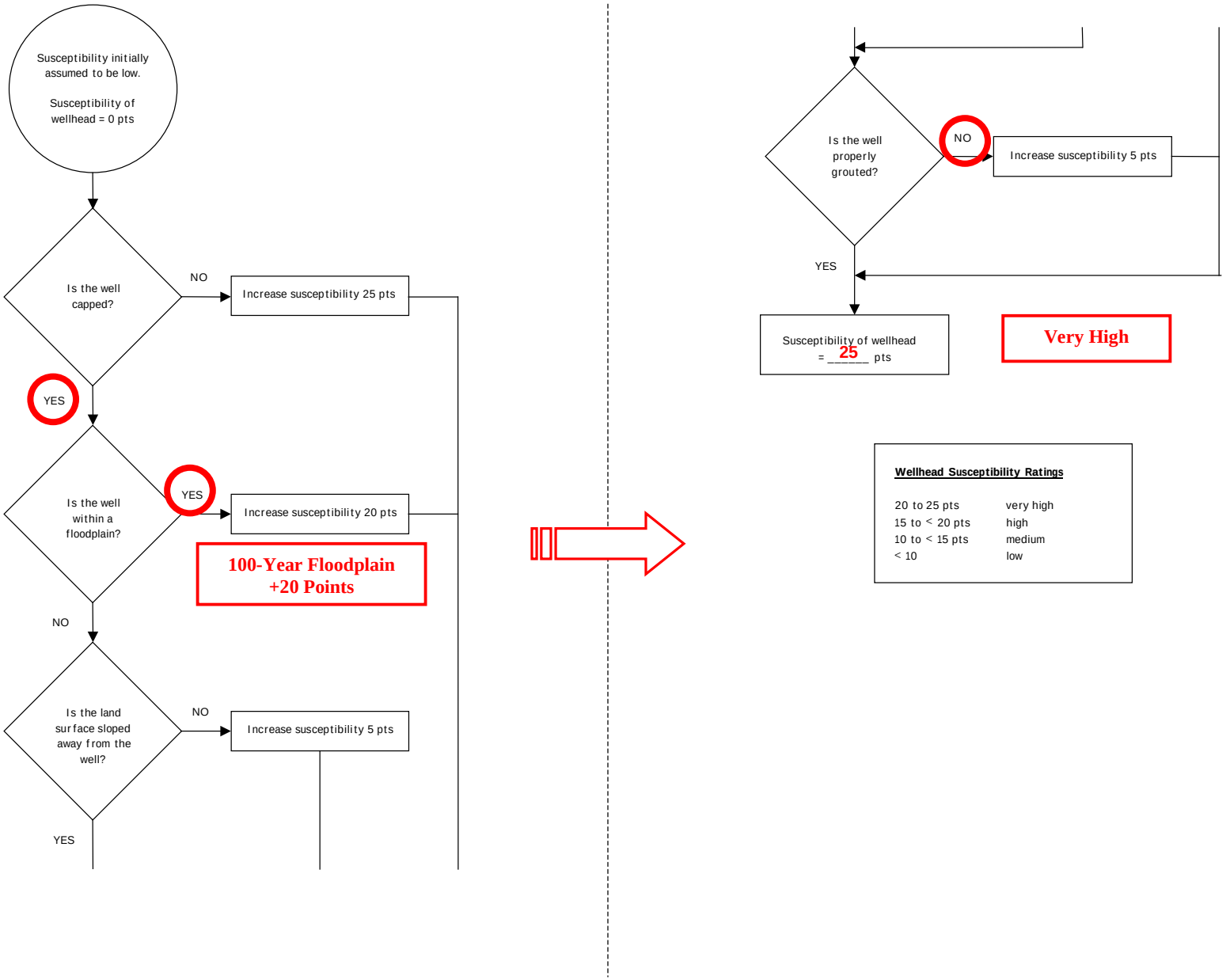
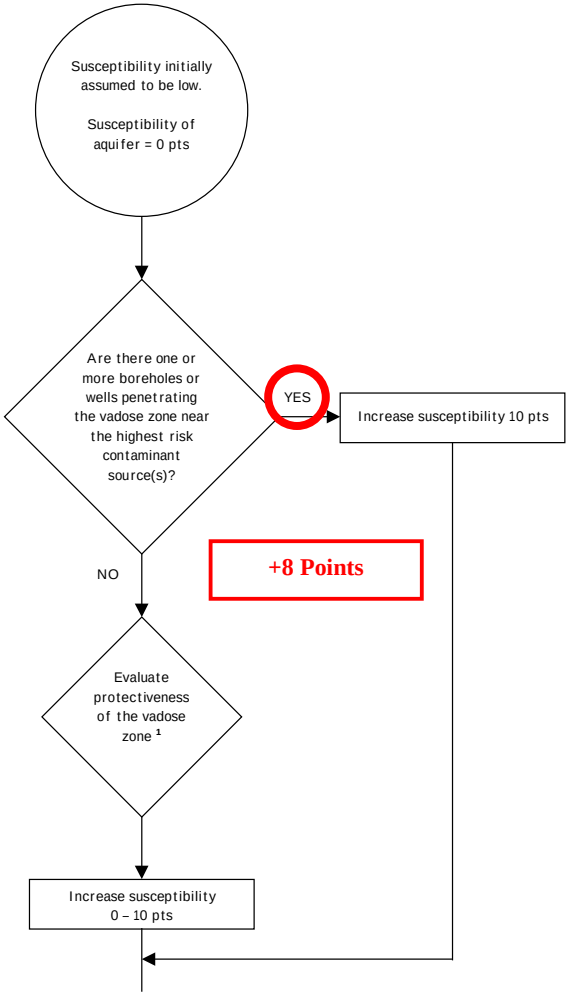
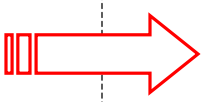
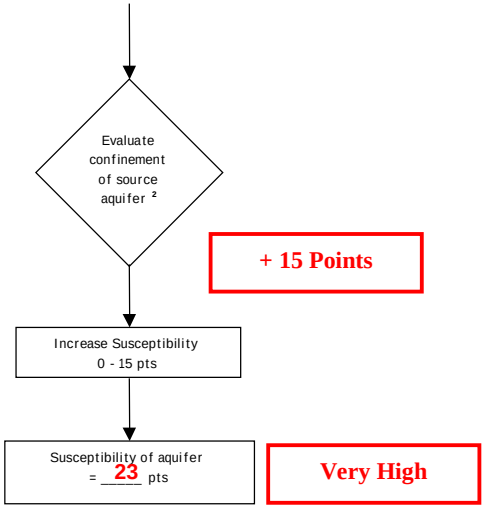


Chart 3. Susceptibility of the aquifer







1. Protectiveness of the Vadose Zone

- net recharge (function of precipitation, slope of land surface, & permeability of soils)
  [0 – 10 pts; 50% weight]
- depth to water table (unconfined aquifer) or top of confining layer (confined aquifer)
  [interpolate linearly: 100' – 20', 0 – 5 pts; 20' – 0', 5 – 10 pts; 50% weight]

Recharge 8/10 = 4 Points
Depth to water table 8/10 = 4 Points

Protectiveness of the Vadose Zone Total = **8 Points**

2. Degree of Confinement

- confined verses unconfined aquifer
  [confined: K ≤ 10^{-6} cm/s, minimum thickness of at least one layer = 20 ft, interpolate linearly 100' – 20', 0 – 10 pts; unconfined = 15 pts; 65% weight]
- density of boreholes and wells penetrating the confining layer (confined aquifer) or the water table (unconfined aquifer)
  [confined: 0 – 15 pts; unconfined = 15 pts; 35% weight]

Confinement 15/15 = 9.75 Points
Depth to water table 15/15 = 5.25 Points

Degree of Confinement Total = **15 Points**

Aquifer Susceptibility Ratings

20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10	low

Very High

Chart 4. Contaminant risks for Carr's Crow Creek – Bacteria & Viruses

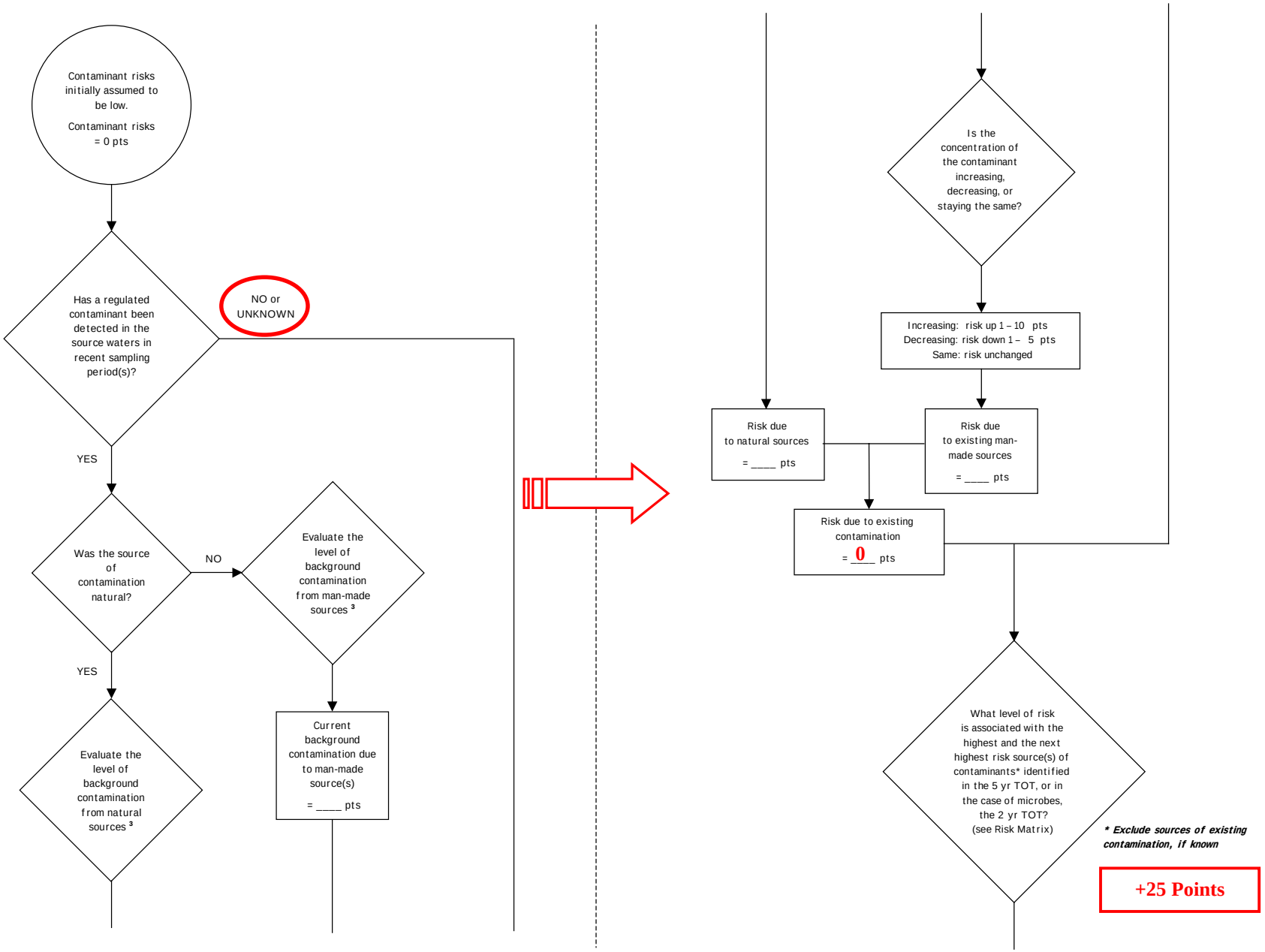


Chart 4. Contaminant risks for Carr's Crow Creek – Bacteria & Viruses (Continued)

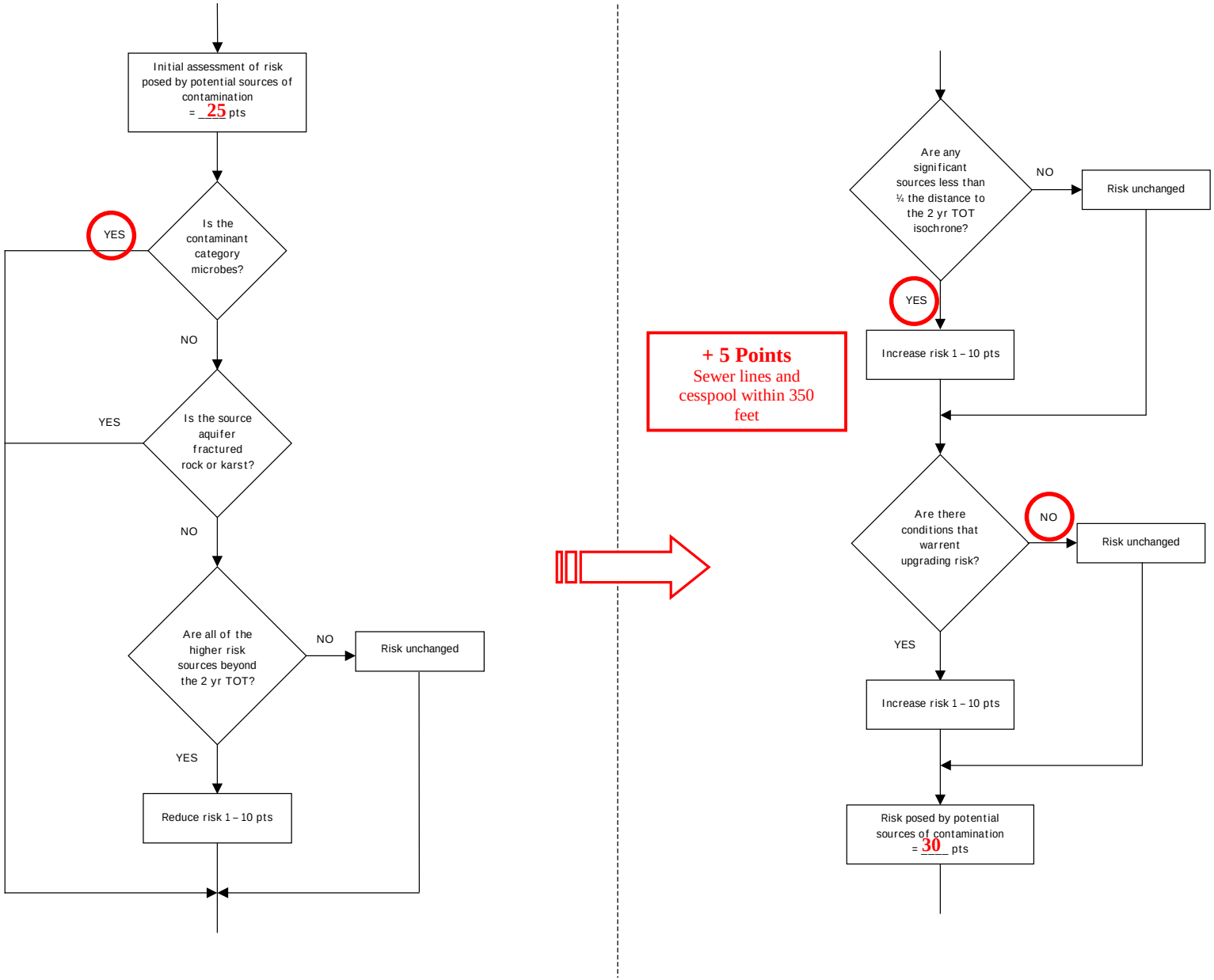
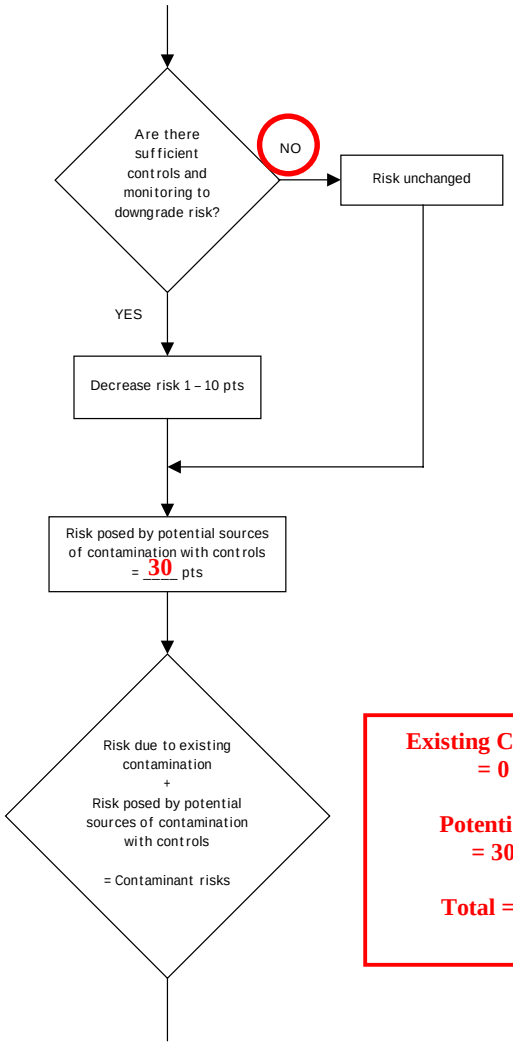
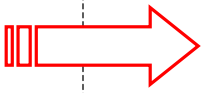


Chart 4. Contaminant risks for Carr's Crow Creek – Bacteria & Viruses (Continued)



Existing Contamination
= 0 Points
+
Potential Sources
= 30 Points

Total = 30 Points



Contaminant risks*
= 30 pts

**** Truncate risk at 50 pts***

3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	20 pts
0.2 MCL to < 0.5 MCL	10 pts
'detect' to < 0.2 MCL	5 pts

Contaminant Risk Ratings

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

High

Table 1. Risk Matrix for Contaminant Sources for Bacteria & Viruses – Carr's Crow Creek

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Large capacity cesspool, sewer lines, unsewered residential areas, and livestock stable initially ranked as medium	**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

Chart 5. Vulnerability analysis for Nitrates/Nitrites – Carr's Crow Creek

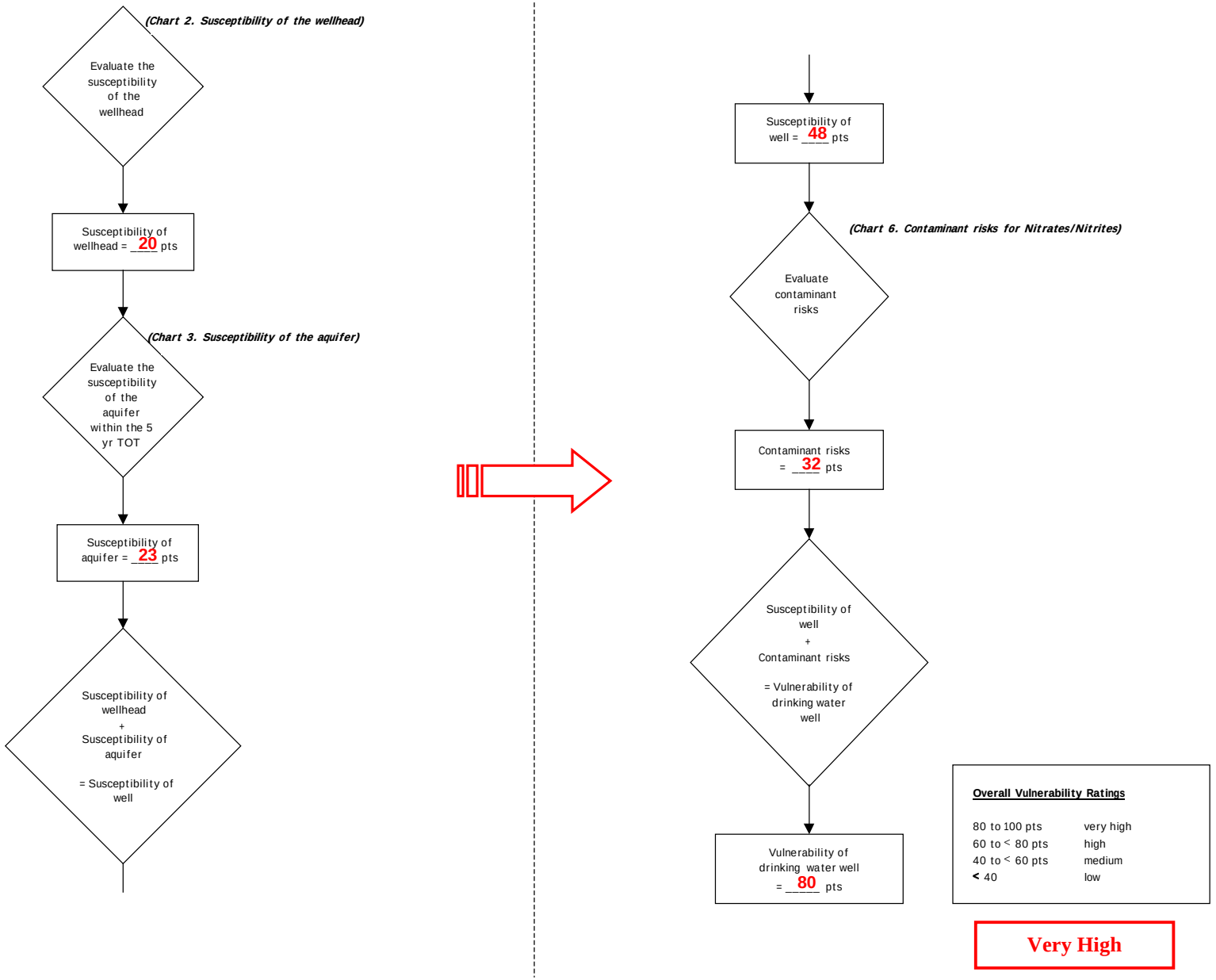


Chart 6. Contaminant risks for Carr's Crow Creek – Nitrates/Nitrites

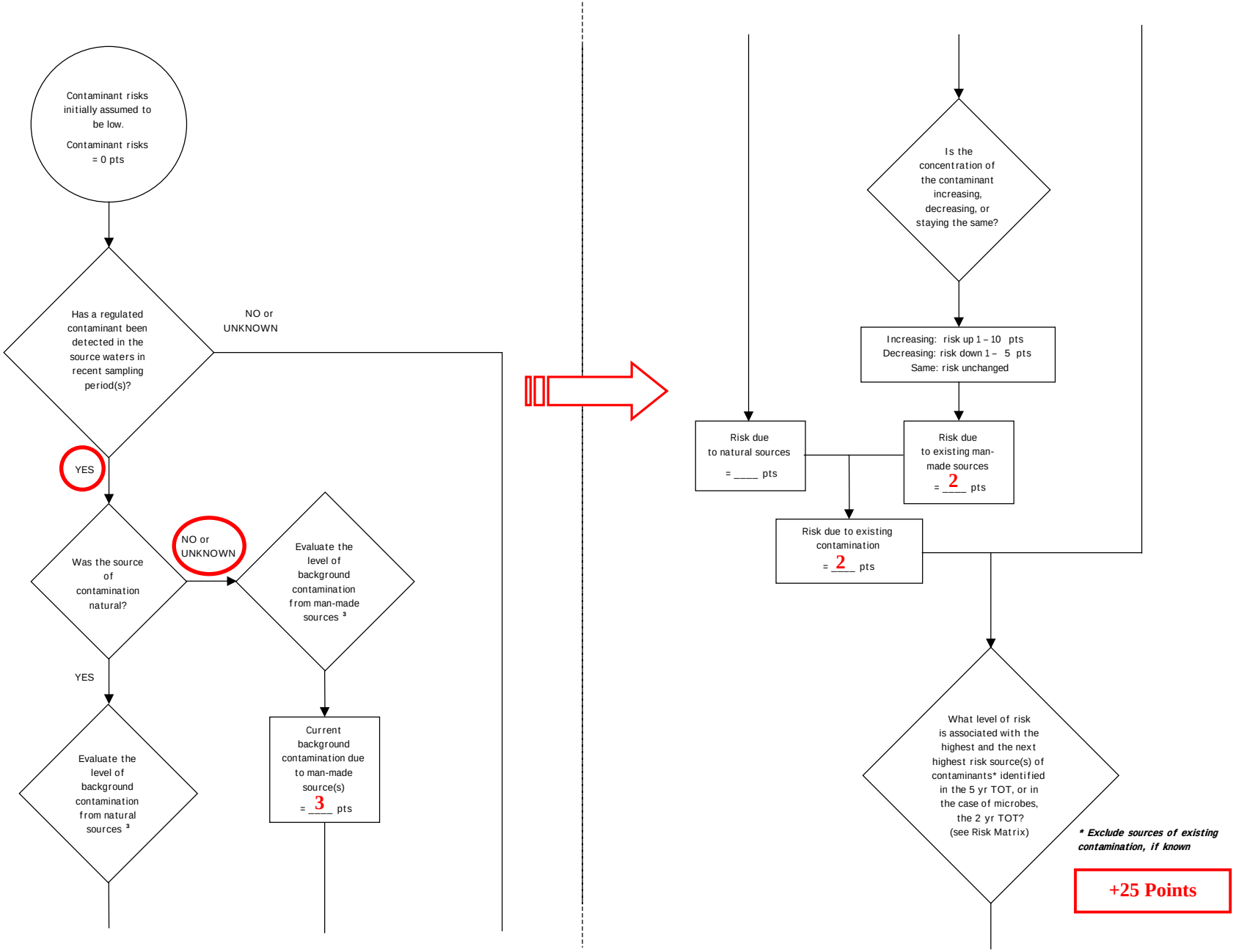


Chart 6. Contaminant risks for Carr's Crow Creek – Nitrates/Nitrites (Continued)

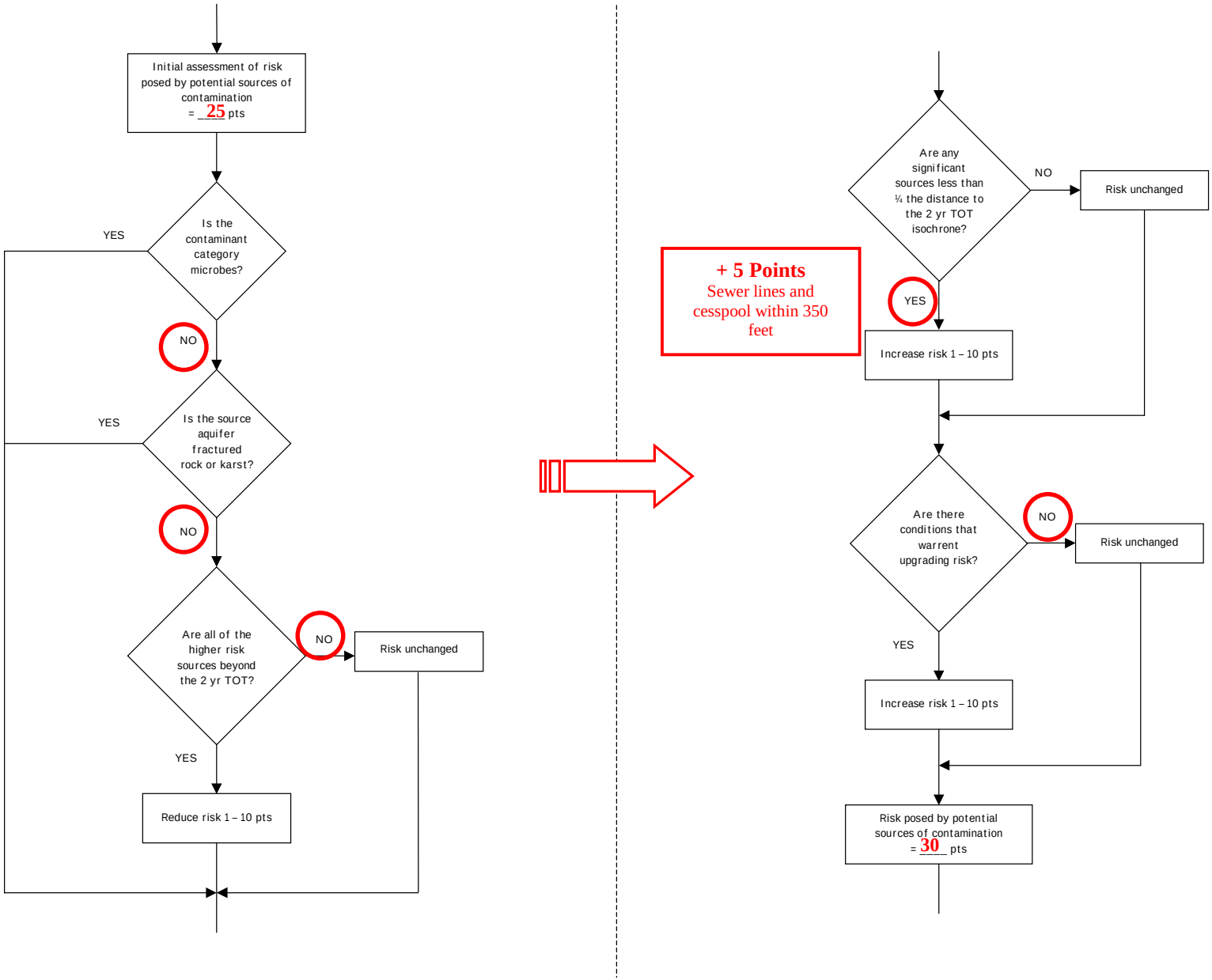
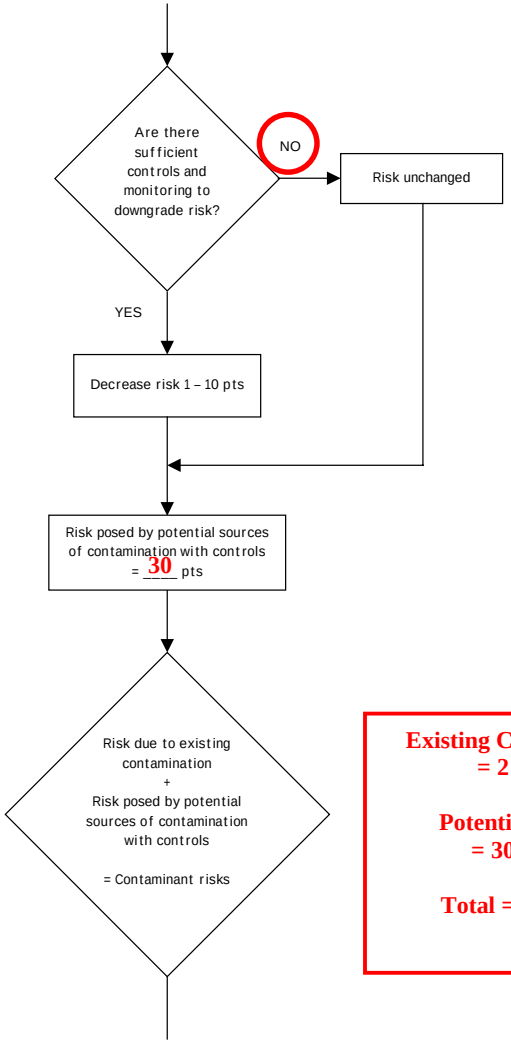


Chart 6. Contaminant risks for Carr's Crow Creek – Nitrates/Nitrites (Continued)



Existing Contamination = 2 Points + Potential Sources = 30 Points

Total = 32 Points

Contaminant risks* = 32 pts

Truncate risk at 50 pts

High

3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	20 pts
0.2 MCL to < 0.5 MCL	10 pts
'detect' to < 0.2 MCL	5 pts

Contaminant Risk Ratings

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

Nitrate concentration = 0.850 mg/L in source waters (2/13/98)
Maximum Contaminant Level (MCL) = 10 mg/L

0.85/10 = 0.104 or 8.5% of MCL
0.085/0.2 = 0.43 * 5 points = 2.125 Points

+ 2 Points for existing Nitrate in source waters

Table 2. Risk Matrix for Contaminant Sources for Nitrates/Nitrites – Carr's Crow Creek

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Large capacity cesspool, sewer lines, unsewered residential areas, and livestock stable initially ranked as medium	**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

Chart 7. Vulnerability analysis for Volatile Organic Chemicals – Carr's Crow Creek

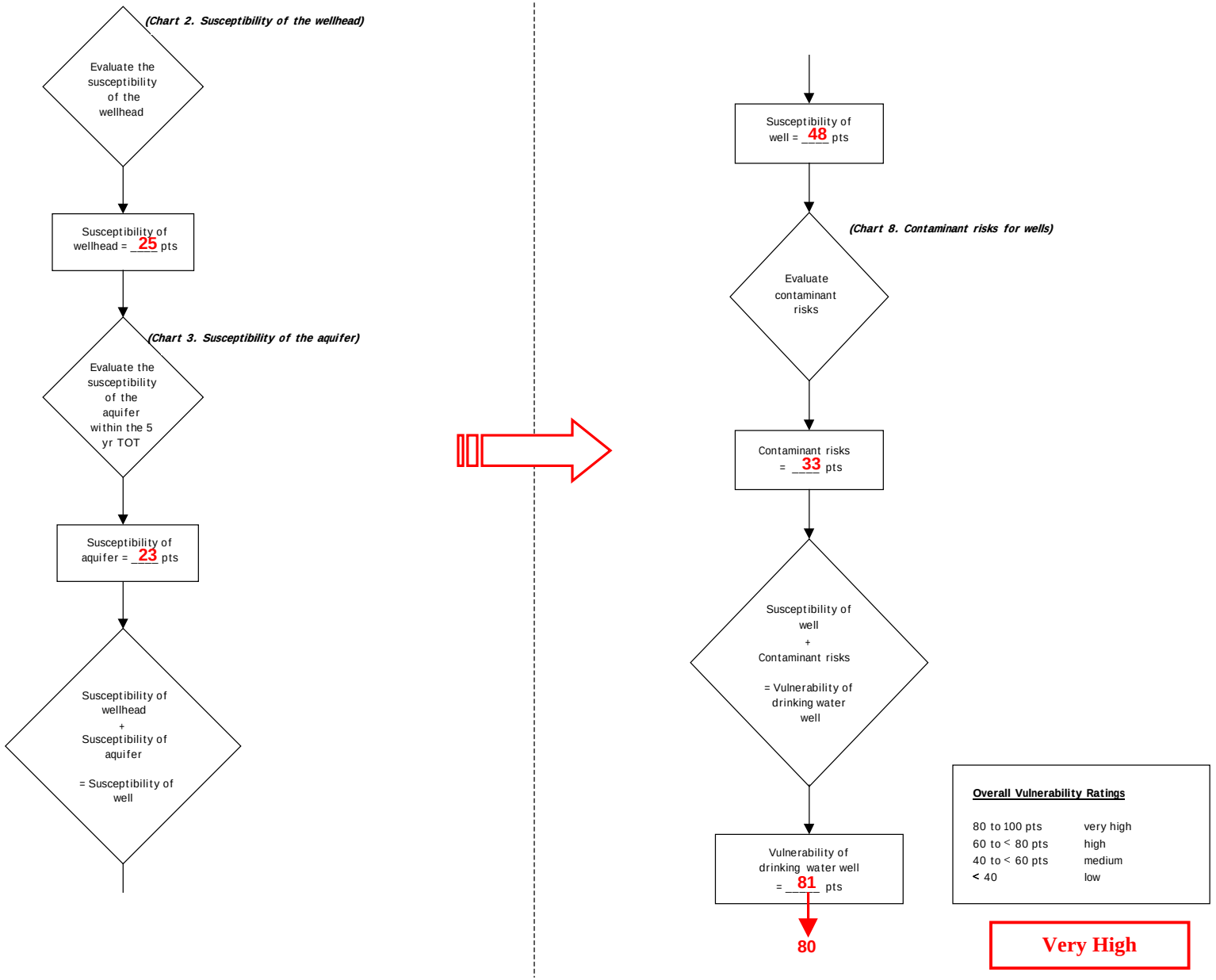


Chart 8. Contaminant risks for Carr's Crow Creek – Volatile Organic Chemicals

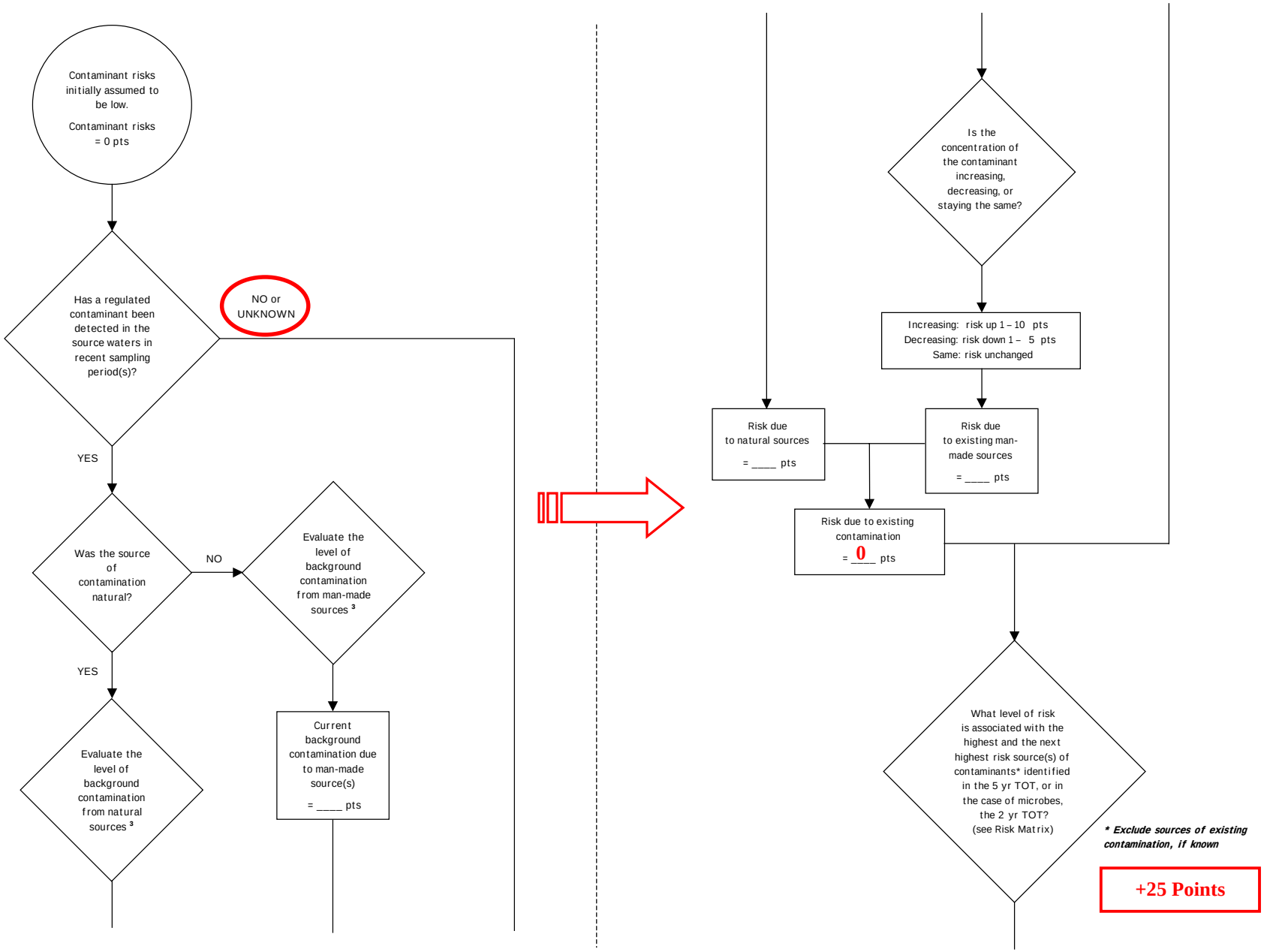


Chart 8. Contaminant risks for Carr's Crow Creek – Volatile Organic Chemicals (Continued)

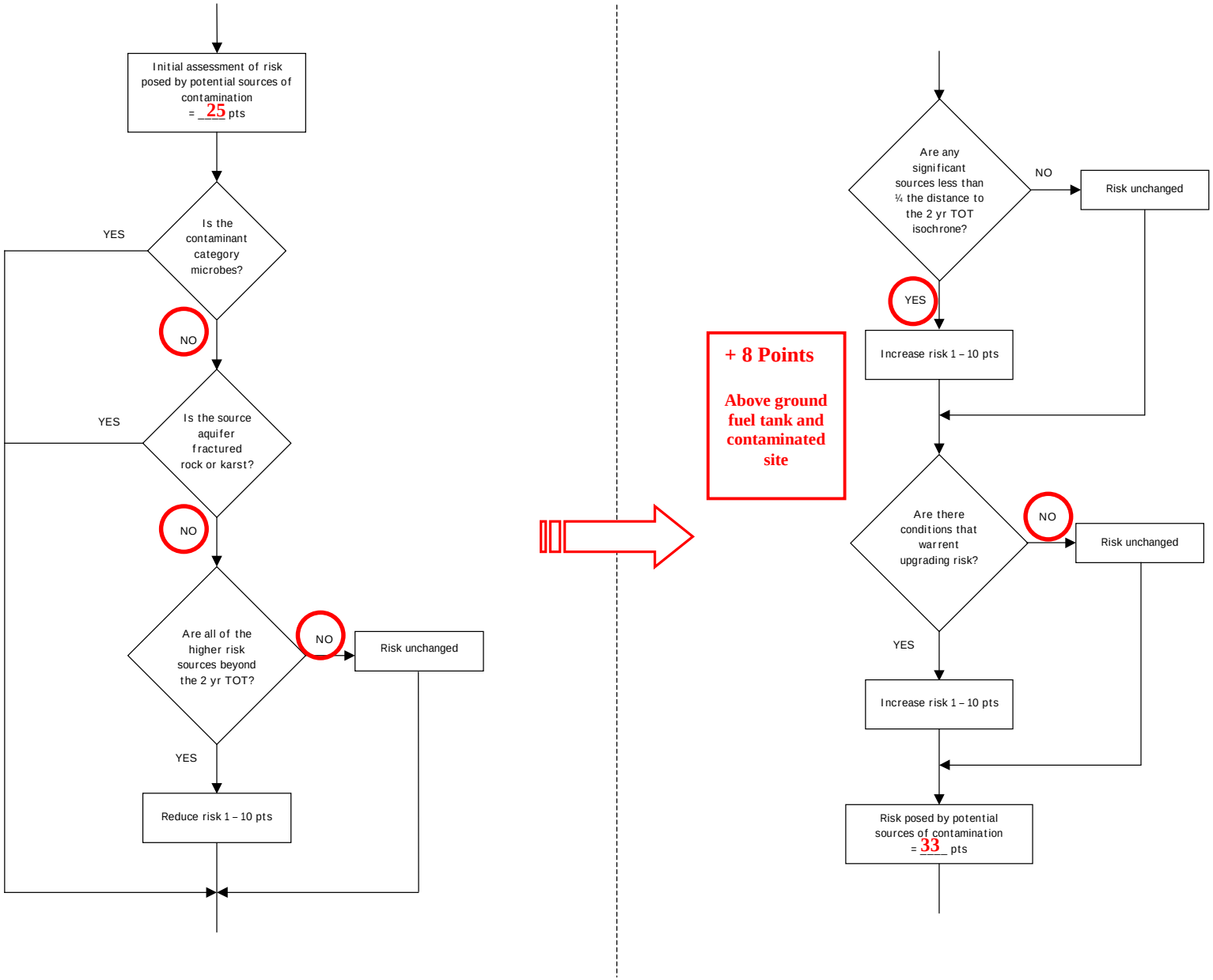
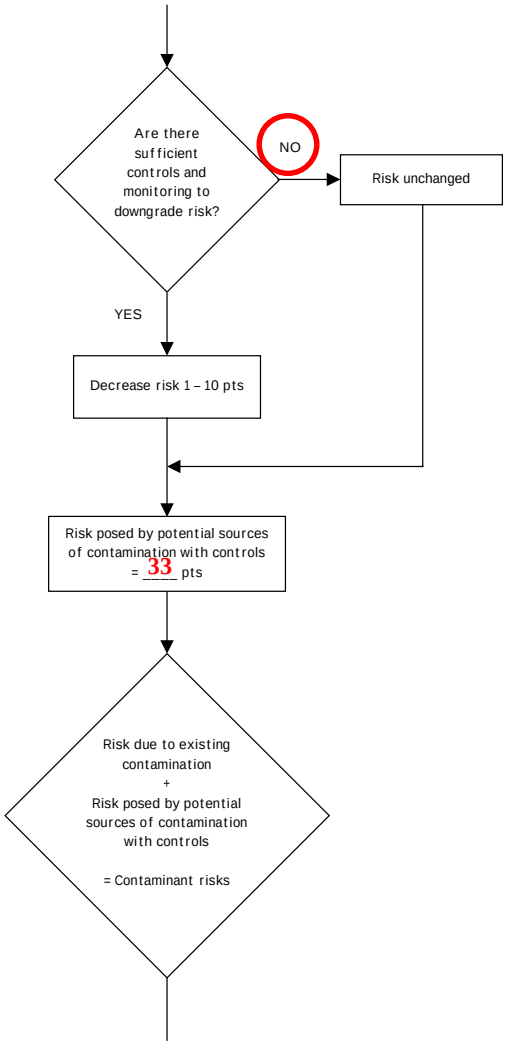
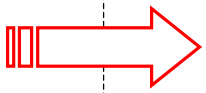
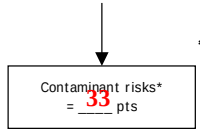


Chart 8. Contaminant risks for Carr's Crow Creek – Volatile Organic Chemicals (Continued)







**** Truncate risk at 50 pts***

3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	20 pts
0.2 MCL to < 0.5 MCL	10 pts
'detect' to < 0.2 MCL	5 pts

Contaminant Risk Ratings

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

High

Table 3. Risk Matrix for Contaminant Sources for Volatile Organic Chemicals – Carr's Crow Creek

Level of Risk Associated with the Highest Risk Sources

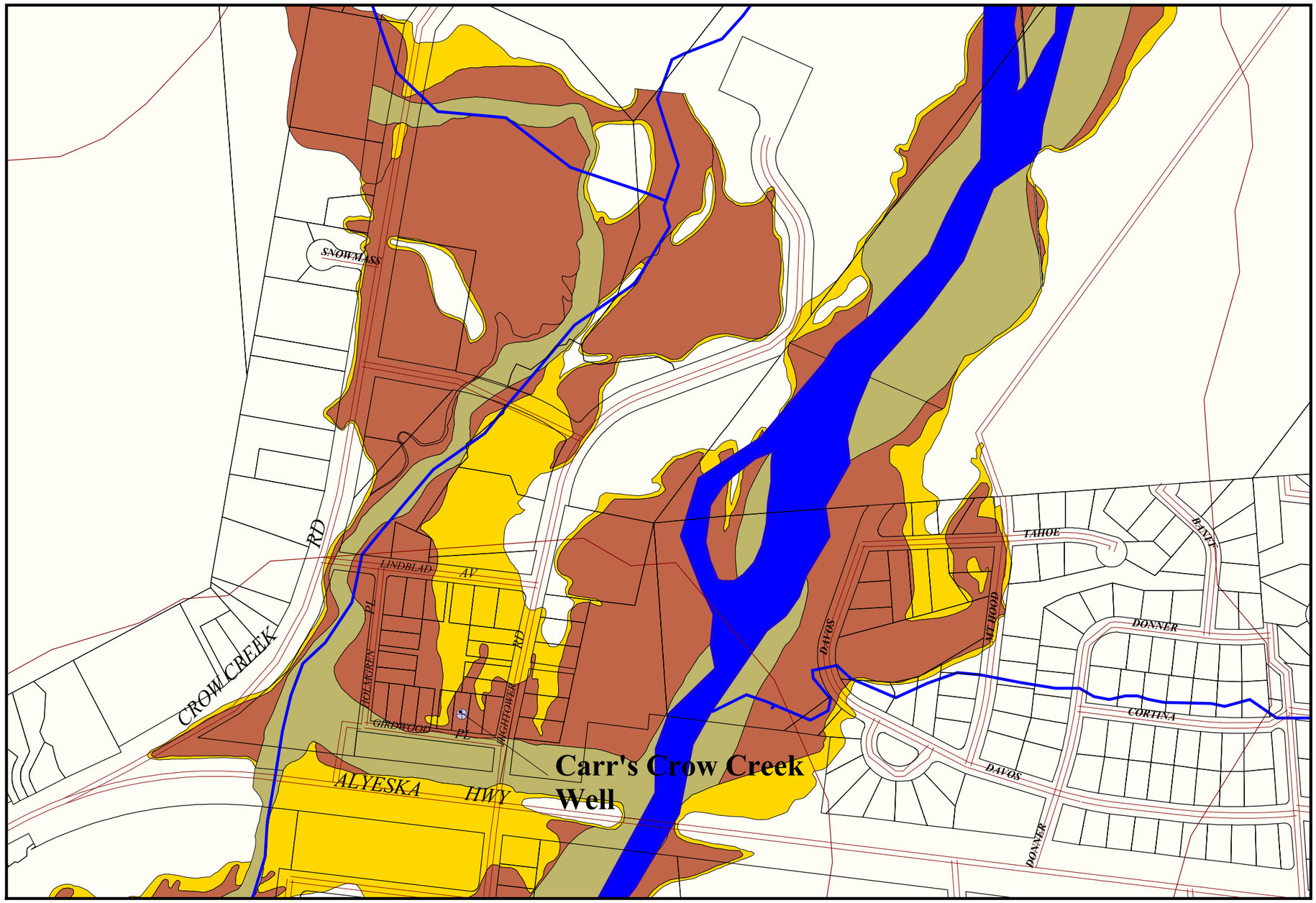
Next Highest Risk Sources(s)

Residential above ground fuel tank and contaminated site ranked as medium	**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	**ΣX**
Medium	**ΣX**	∃ 2 sources + 5 pts	∃ 5 sources + 5 pts	∃ 10 sources + 5 pts
High	**ΣX**	**ΣX**	1 source + 10 pts	∃ 2 sources + 10 pts
Very High	**ΣX**	**ΣX**	**ΣX**	1 source + 10 pts

APPENDIX E

Map of Carr's Crow Creek's Drinking Water Protection Area and Floodplain Hazards

Carr's Crow Creek (PWSID 214277) Drinking Water Protection Area and Floodplain Hazards



MOA Land Parcels
Carr's Crow Creek Well
MOA Roads
2nd order streams
3rd order streams
4th order streams
Elevation Contours
Glacier Creek
Lakes and Ponds
MOA Floodplains
100 YEAR
500 YEAR
FLOODWAY

N
W
E
S

400 0 400 Feet

Floodplain Hazards base from Municipality of Anchorage (2000), after U.S. Army Coprs of Engineers

Map 6