Hydrogeologic Susceptibility and Vulnerability Assessment for Anchorage School District (ASD) – Girdwood Elementary School Public Drinking Water Well, Girdwood, Alaska

DRINKING WATER PROTECTION PROGRAM REPORT 10

November 2000

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2000

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By Michael J. Crotteau

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

ASD Girdwood Elementary School Public Water System is a Class A (non-transient/non-community) water system consisting of one well. Identified potential and current sources of contaminants for the Girdwood Elementary School well include: an old landfill, removed underground fuel storage tanks, domestic wastewater sewer lines, an above ground diesel fuel tank, an airport, activities associated with gravel roads and right-of-ways, a closed contaminated site, above ground home heating fuel tanks, and recreation trails. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals. Overall, ASD Girdwood Elementary School's public water system received a vulnerability rating of **High** for bacteria and viruses, nitrates and/or nitrites, and **Very High** for volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals.

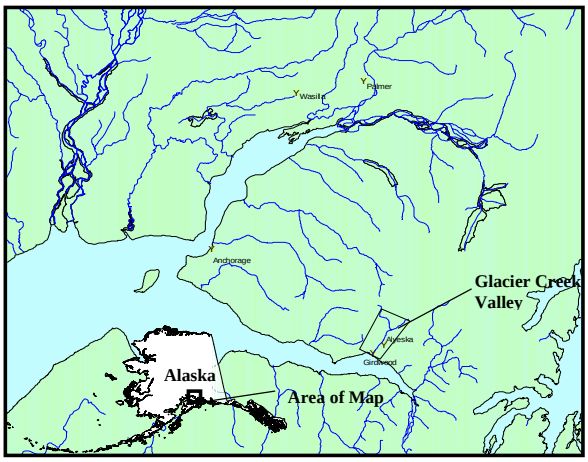

Figure 1. Index map showing the location of the Glacier Creek Valley, Alaska

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 the ASD Girdwood Elementary School'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.

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 Girdwood Valley is covered primarily by coniferous forests. 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.

ASD GIRDWOOD ELEMENTARY SCHOOL PUBLIC WATER SYSTEM

ASD Girdwood Elementary School Public Water System is a Class A (non-transient/non-community) water system, which is owned by and operated by the Anchorage School District. The system consists of one well, which is located to the southeast of Girdwood Elementary School along Glacier Creek, north of the new Girdwood Townsite (see Figure 2). According to the well log, the well for ASD Girdwood Elementary School appears to be grouted and penetrates silty gravel to a total depth of 49 feet below land surface where it encounters bedrock. The well is screened from 46.9 to 49 feet below land surface and had a static water level of ten feet below land surface at the time of drilling (8/20/87).

The land surrounding the well, in addition to the entire new Girdwood Townsite, is within a Floodplain Hazard Zone designated by the U.S. Army Corp of Engineers [*Municipality of Anchorage, 2000*]. The well for ASD Girdwood Elementary School is situated within the 100-

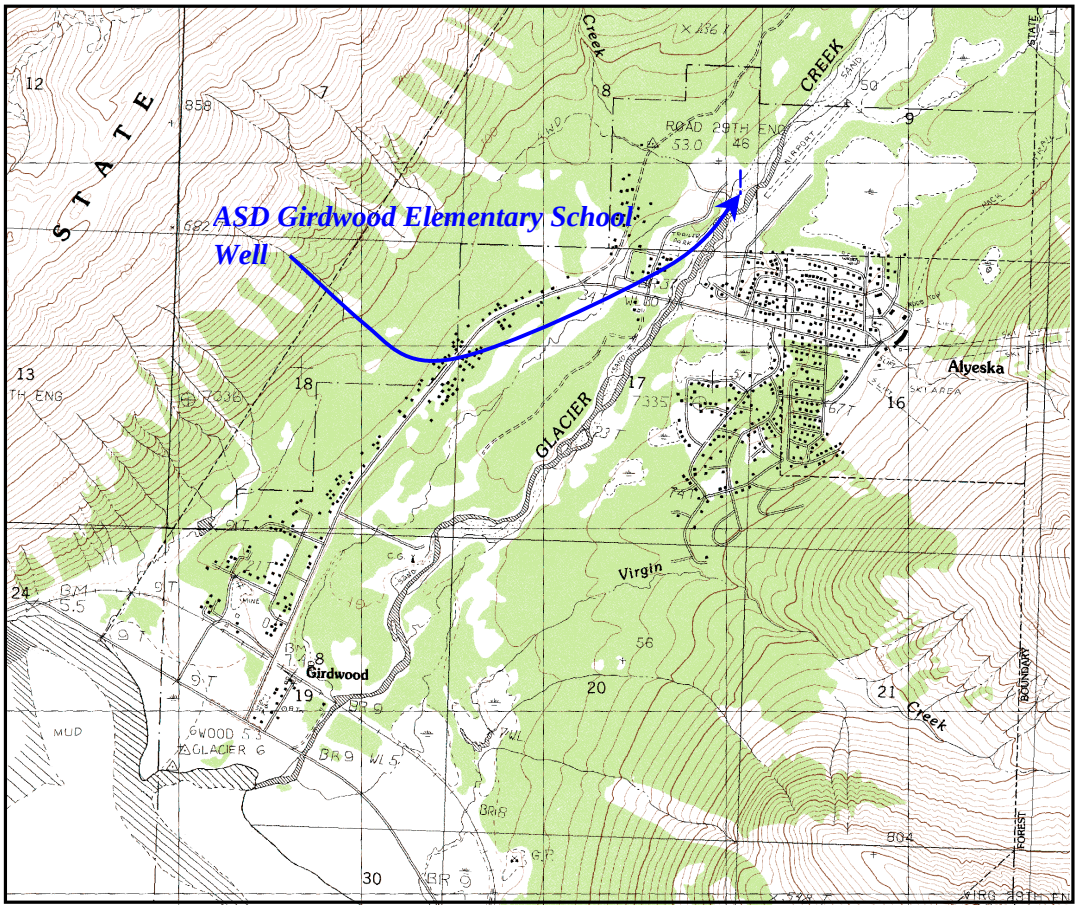

Figure 2. Map showing the location of the drinking water sources for ASD Girdwood Elementary School.

year floodplain for Glacier Creek (See Appendix E–Map 7). This means that ASD Girdwood Elementary School 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 August to June and serves approximately 175 non-residents through one service connection.

ASSESSMENT AND PROTECTION AREA FOR ASD GIRDWOOD ELEMENTARY SCHOOL'S DRINKING WATER SOURCES

The Drinking Water Protection and Assessment Areas that have been established for ASD Girdwood Elementary School's public drinking water well are the areas that are most sensitive to contamination. These areas have served as a basis for assessing the risk of the drinking water source to contamination. These zones around the drinking water source are the most critical areas for the preservation of the quality of the water system's drinking water. Therefore, this area will also 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 downgradient 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 as the first step in establishing the protection and assessment areas for ASD Girdwood Elementary School'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 meaningful and conservative protection and assessment areas with respect to public health (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The Drinking Water Protection and Assessment 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 and Assessment Areas for the Glacier Valley Water Company contains five zones, Zone A through Zone G (See Map 1 - Map 3 in Appendix B). Zone A corresponds 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.

The Zone B protection and assessment area for ASD Girdwood Elementary School 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 and enter valley sediments.

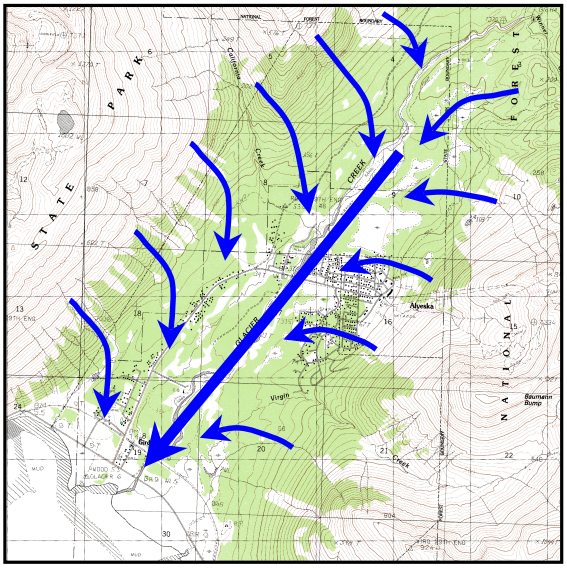

Figure 4. Map showing the conceptual groundwater flow in the Glacier Creek Valley.

Zones E through G identify the areas along Glacier Creek upstream from ASD Girdwood Elementary School. The well for ASD Girdwood Elementary School 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 hydraulic 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 POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within ASD Girdwood Elementary School's Drinking Water Assessment and Protection Areas. 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 A PWS assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other synthetic organic chemicals.

Maps 4 through Map 6 in Appendix C depict the Contaminant Source Inventory for ASD Girdwood Elementary School. 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 the ASD Girdwood Elementary School's protection and assessment area:

- An old landfill;
- Domestic wastewater sewer lines;
- Removed underground fuel storage tanks (USTs);
- An above ground diesel fuel tank
- Gravel and paved roads and right-of-ways;
- An ADEC Contaminated Site;
- Above ground home heating fuel tanks;
- An Airport;
- Recreation trails; and
- Placer mining.

These potential contaminant sources present risk for all six categories of drinking water contaminants for ASD Girdwood Elementary School'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 density of those types of contaminant sources as well as the proximity of those sources to the well.

VULNERABILITY OF ASD GIRDWOOD ELEMENTARY SCHOOL'S DRINKING WATER SOURCES

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

- natural susceptibility; and
- contaminant risks.

Appendix D contains fourteen 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. Charts 5 through 14 contain the Vulnerability Analysis for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals, respectively.

Each of the six 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 ASD Girdwood Elementary School well penetrates mostly silty gravel, which provides little if any of protective barrier for the movement of contaminants in the subsurface. The water table is high near the well because of its proximity to Glacier Creek, which is approximately ten feet below land surface. The well is located on the floodplain of Glacier Creek, but appears to be properly grouted as indicated previously from information obtained from Department records. Grouting can inhibit 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 (See Appendix D). Table 1 shows the overall Susceptibility score and rating for ASD Girdwood Elementary School.

Table 1. Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility	42	Very High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. An old landfill, an above ground fuel storage tank, removed underground fuel storage tanks, domestic wastewater sewer lines, an active airstrip, and gravel roads and right-of-ways contribute the highest risk for potential contamination to the ASD Girdwood Elementary School's source of public drinking water.

A score (0 – 50 points) and rating of Contaminant Risks (See Appendix D) is assigned based on the findings of the Contaminant Source Inventory (Appendix A - Table 1 – Table 7). Table 2 below summarizes the Contaminant Risks for ASD Girdwood Elementary School for each category of drinking water contaminants.

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	23	Medium
Nitrates and/or Nitrites	35	High
Volatile Organic Chemicals	45	Very High
Heavy Metals, Cyanide, and other Inorganic Chemicals	40	Very High
Synthetic Organic Chemicals	40	Very High
Other Synthetic Organic Chemicals	40	Very High

A 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 covered by four feet of soil and is contained within a "very impermeable soil". However, samples taken (June 27, 1996) within a french drain and at the schoolyard spring contained volatile organic chemical and heavy metal levels above the Maximum Contaminant Level for drinking water. The Maximum Contaminant Level or 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. Leachate or contaminated liquid seeping from the old landfill may enter the well. No regulated volatile organic chemical or heavy metal has been detected in recent sampling periods in the well. This old landfill site was initially ranked as a high source of volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals and a medium source of nitrates and/or nitrites. However, because of the close proximity of the old landfill to the well (within 200 feet and upgradient) this site represented a very high potential risk for volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals and a high for nitrates and/or nitrites for the ASD Girdwood Elementary School's public drinking water well. Grouting surrounding the well casing may inhibit the movement of contaminants toward the screened interval of the well. However, some chlorinated volatile organic chemicals are more dense than water and tend to sink once they reach the water table, thus entering the well screen through direct transport from the landfill, and not along the well casing. Therefore, grouting of the well casing is not a fail-safe way to seal off the transport of contaminants to the well.

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. Some contaminated soil remains beneath the generator shed in order not to disturb the foundation. These sites (ADEC LUST Site #L68.20), located within 650 feet upgradient of the well, represent a low to moderate risk for volatile organic chemicals for Girdwood Elementary School's source of public drinking water.

A 3000-gallon above ground diesel fuel tank is located approximately 650 feet away and upgradient of the 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 was initially ranked as a medium risk source of volatile organic chemicals. However, because of the tank's close proximity to the well (within 650 feet and upgradient) and for the lack of spill containment/ control, this potential contaminant source may be considered a high potential risk for Girdwood Elementary School's source of drinking water.

The domestic wastewater sewer line from Girdwood Elementary School is approximately 500 feet north-northwest and upgradient of the ASD Girdwood Elementary School's well. This sewer line is entirely within the Zone A protection and assessment area for this source. Potential risk from this potential contaminant source is medium for bacteria and viruses and nitrates and/or nitrites and low for volatile organic chemicals, heavy metals, and synthetic organic chemicals. All contaminant risks associated with the sewer line stems from the potential of the line having a failure, thus releasing the wastewater in the subsurface.

Crow Creek Road runs through the Zone A Protection Area for this source of public drinking water. Potential for an accidental contaminant spill by the rollover of a fuel or sewage transport truck, for example, is low. Therefore, this gravel road represents a low potential contaminant risk for bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, and other synthetic organic chemicals for the ASD Girdwood Elementary School.

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 ASD Girdwood Elementary School's source of public drinking water.

The Girdwood Airport is adjacent to the Girdwood Elementary School across Glacier Creek. Mobile fuel drums and a mobile fuel truck fuel the aircrafts at the Girdwood Airport. This active airstrip was initially

ranked as a medium potential source of volatile organic chemicals. An accidental release of fuel could enter the surface waters of Glacier Creek and flow toward the well. However, this potential release would have to occur toward the north end of the airstrip in order for the plume of fuel to reach the opposite side of the creek and travel in the vicinity of the well. Therefore, this potential source of contamination ranks as a low for volatile organic chemicals.

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 six categories of drinking water contaminants (See Appendix D). Note: scores are rounded off to the nearest five.

Table 3. Overall Vulnerability of ASD Girdwood Elementary School Public Drinking Water System to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	65	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	85	Very High
Heavy Metals, Cyanide, and other Inorganic Chemicals	80	Very High
Synthetic Organic Chemicals	80	Very High
Other Synthetic Organic Chemicals	80	Very High

Tables 2 through 7 in Appendix A contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals.

The wastewater sewer line from the school is the driving factor in determining contaminant risks for bacteria and viruses (See "Overall Rank after Analysis" in Table 2 of Appendix A). Other potential and existing sources of bacteria and viruses for the ASD Girdwood Elementary School include: activities associated with gravel roads and right-of-ways, and the Winner Creek/Glacier Creek Trail.

The old landfill and the wastewater sewer line from the school as the highest potential and existing sources of contamination for nitrates and/or nitrites, volatile organic chemicals, and other synthetic organic chemicals for the school's drinking water well. The old landfill and the sewer line are the only potential source of contamination for synthetic organic chemicals for the school's drinking water well. Volatile organic chemicals received the highest overall score for contaminant risks (45 out of 50 points) and, therefore, overall vulnerability (85 out of 100 points) due to the close proximity of both the old landfill, the above ground fuel tank behind the school, and removed underground fuel storage tanks.

Nitrates and/or nitrites are found in natural background concentrations at the site, as elsewhere in the Glacier Creek Valley. Sampling history of the ASD Girdwood Elementary School's source waters indicate low concentrations of nitrate (See Chart 6 – Contaminant Risks for Nitrates/Nitrites in Appendix D). Existing nitrate contamination is approximately 5% of the allowable limit (MCL) for this contaminant and parallels what is found throughout the valley. Due to the high solubility and weak retention by soil, nitrates are very mobile in soil, moving at approximately the same rate as water. This high mobility, coupled with the age of the landfill, dilution of nitrates and/or nitrites by precipitation and groundwater, and the toxicity of nitrate and/or nitrite compared to other potential and existing contaminants within the old landfill are all factors in determining the contaminant risks for nitrates and/or nitrites. Overall, contaminant risks for this category is medium with the sewer line and the old landfill driving the score. However, combining this potential nitrates and/or nitrites contamination risk with the susceptibility of the well yields an overall vulnerability to contamination of high for this source of public drinking water.

SUMMARY

A *Source Water Assessment* has been completed for the ASD Girdwood Elementary School's sources of public drinking water. The overall vulnerability of this source to contamination is **High** for bacteria and viruses and nitrates and/or nitrites and **Very High** for volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic 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 Anchorage School District 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.

REFERENCES CITED

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).

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APPENDIX A

Contaminant Source Inventory and Risk Ranking for ASD Girdwood Elementary School

Table 1

Contaminant Source Inventory for ASD Girdwood Elementary School

PWS ID 210710

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Location	Map Number	Notes/Comments
Old landfills	U17	U17-1	A	Between Girdwood Elementary School and Glacier Creek	4, 5, and 6	Old landfill in very impermeable soils; contains four foot cover
Tanks, diesel (above ground)	T6	T6-1	A	Behind Girdwood Elementary School	4, 5, and 6	3,000 gallon fuel tank used for emergency power supply
Closed Leaking Underground Fuel Storage Tank (LUST) (diesel)	U14	U14-1	A	Behind Girdwood Elementary School	4, 5, and 6	500 gallon fuel tank removed 1997; ADEC LUST File L68.20
Closed Leaking Underground Fuel Storage Tank (LUST) (heating oil)	U10	U10-1	A	Behind Girdwood Elementary School	4, 5, and 6	10000 gallon heating oil tank removed 1997; ADEC LUST File L68.20
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Sewer line from school	4, 5, and 6	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Sewer line from Alyeska Prince Hotel	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-1	A	Crow Creek Road	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-2	E	Mt. Hood Way	4, 5, and 6	
Highways and roads, asphalt	X20	X20-1	E and F	Arlberg Avenue	4 and 5	
Tanks, heating oil, residential (above ground)	R8	R8-1	E	Mt Hood Way, along the Girdwood Airstrip	4, 5, and 6	500 gallon home heating oil tank
Tanks, heating oil, residential (above ground)	R8	R8-2	E	Mt Hood Way, along the Girdwood Airstrip	4, 5, and 6	500 gallon home heating oil tank
Tanks, heating oil, residential (above ground)	R8	R8-3	E	Mt Hood Way, along the Girdwood Airstrip	4, 5, and 6	500 gallon home heating oil tank
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	E	TRACT A ALYESKA NORTH SUB.	4 and 5	1000 diesel fuel spill in 1993; status closed
Airports	X14	X14-1	E	Mt. Hood Way	4, 5, and 6	Airstrip fueled by mobile fuel truck
Dog walking areas/foot trails	X46	1	E	Along Glacier and Winner Creeks	4, 5, and 6	Winner Creek Trail
Metals mining, placer (active)	E4	1	E	Crow Creek Mine	4	Mostly limited to recreational/gift shop scale placer gold mining

Table 2

Contaminant Source Inventory and Risk Ranking for ASD Girdwood Elementary Sources of Bacteria and Viruses

PWS ID 210710

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	Sewer line from school	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	Crow Creek Road	4, 5, and 6	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Medium	3	Sewer line from Alyeska Prince Hotel	4, 5, and 6	
Dog walking areas/foot trails	X46	1	E	Low	4	Along Glacier and Winner Creeks	4, 5, and 6	Winner Creek Trail
Highways and roads, dirt/gravel	X24	X24-2	E	Low	5	Mt. Hood Way	4, 5, and 6	
Highways and roads, asphalt	X20	X20-1	E and F	Low	6	Arlberg Avenue	4 and 5	

Table 3

Contaminant Source Inventory and Risk Ranking for ASD Girdwood Elementary School Sources of Nitrates/Nitrites

PWS ID 210710

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Old landfills	U17	U17-1	A	Medium	1	Behind Girdwood Elementary School	4, 5, and 6	Old landfill in very impermeable soils; contains four foot cover
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Medum	2	Sewer line from school	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	3	Crow Creek Road	4, 5, and 6	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	E and F	Medum	4	Sewer line from Alyeska Prince Hotel	4, 5, and 6	
Dog walking areas/foot trails	X46	1	E	Low	5	Along Glacier and Winner Creeks	4, 5, and 6	Winner Creek Trail
Highways and roads, dirt/gravel	X24	X24-2	E	Low	6	Mt. Hood Way	4, 5, and 6	
Highways and roads, asphalt	X20	X20-1	E and F	Low	7	Arlberg Avenue	4 and 5	

Table 4

Contaminant Source Inventory and Risk Ranking for ASD Girdwood Elementary School Sources of Volatile Organic Chemicals

PWS ID 210710

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Old landfills	U17	U17-1	A	High	1	Behind Girdwood Elementary School	4, 5, and 6	Old landfill in very impermeable soils; contains four foot cover
Tanks, diesel (above ground)	T6	T6-1	A	Medium	2	Behind Girdwood Elementary School	4, 5, and 6	3,000 gallon fuel tank used for emergency power supply
Closed Leaking Underground Fuel Storage Tank (LUST) (diesel)	U14	U14-1	A	Low	3	Behind Girdwood Elementary School	4, 5, and 6	500 gallon fuel tank removed 1997; ADEC LUST File L68.20
Closed Leaking Underground Fuel Storage Tank (LUST) (heating oil)	U10	U10-1	A	Low	4	Behind Girdwood Elementary School	4, 5, and 6	10000 gallon heating oil tank removed 1997; ADEC LUST File L68.20
Airports	X14	X14-1	E	Medium	5	Mt. Hood Way	4, 5, and 6	Airstrip fueled by mobile fuel truck
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Low	6	Sewer line from school	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	7	Crow Creek Road	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-2	E	Low	8	Mt. Hood Way	4, 5, and 6	
Tanks, heating oil, residential (above ground)	R8	R8-1	E	Medium	9	Mt Hood Way, along the Girdwood Airstrip	4, 5, and 6	500 gallon home heating oil tank
Tanks, heating oil, residential (above ground)	R8	R8-2	E	Medium	10	Mt Hood Way, along the Girdwood Airstrip	4, 5, and 6	500 gallon home heating oil tank
Tanks, heating oil, residential (above ground)	R8	R8-3	E	Medium	11	Mt Hood Way, along the Girdwood Airstrip	4, 5, and 6	500 gallon home heating oil tank
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	E	Low	12	TRACT A ALYESKA NORTH SUB.	4 and 5	1000 diesel fuel spill in 1993; status closed
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Medum	13	Sewer line from Alyeska Prince Hotel	4, 5, and 6	
Highways and roads, asphalt	X20	X20-1	E and F	Low	14	Arlberg Avenue	4 and 5	

Table 5

Contaminant Source Inventory and Risk Ranking for ASD Girdwood Elementary School Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWS ID 210710

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Old landfills	U17	U17-1	A	High	1	Behind Girdwood Elementary School	4, 5, and 6	Old landfill in very impermeable soils; contains four foot cover
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Low	2	Sewer line from school	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	3	Crow Creek Road	4, 5, and 6	
Metals mining, placer (active)	E4	1	E	Low	4	Crow Creek Mine	4	Mostly limited to recreational/gift shop scale placer gold mining
Airports	X14	X14-1	E	Low	5	Mt. Hood Way	4, 5, and 6	Airstrip fueled by mobile fuel truck
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Low	6	Sewer line from Alyeska Prince Hotel	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-2	E	Low	7	Mt. Hood Way	4, 5, and 6	
Highways and roads, asphalt	X20	X20-1	E and F	Low	8	Arlberg Avenue	4 and 5	

Table 6

Contaminant Source Inventory and Risk Ranking for ASD Girdwood Elementary School Sources of Synthetic Organic Chemicals

PWS ID 210710

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Old landfills	U17	U17-1	A	High	1	Behind Girdwood Elementary School	4, 5, and 6	Old landfill in very impermeable soils; contains four foot cover
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Low	2	Sewer line from school	4, 5, and 6	

Table 7

Contaminant Source Inventory and Risk Ranking for ASD Girdwood Elementary School Sources of Other Synthetic Organic Chemicals

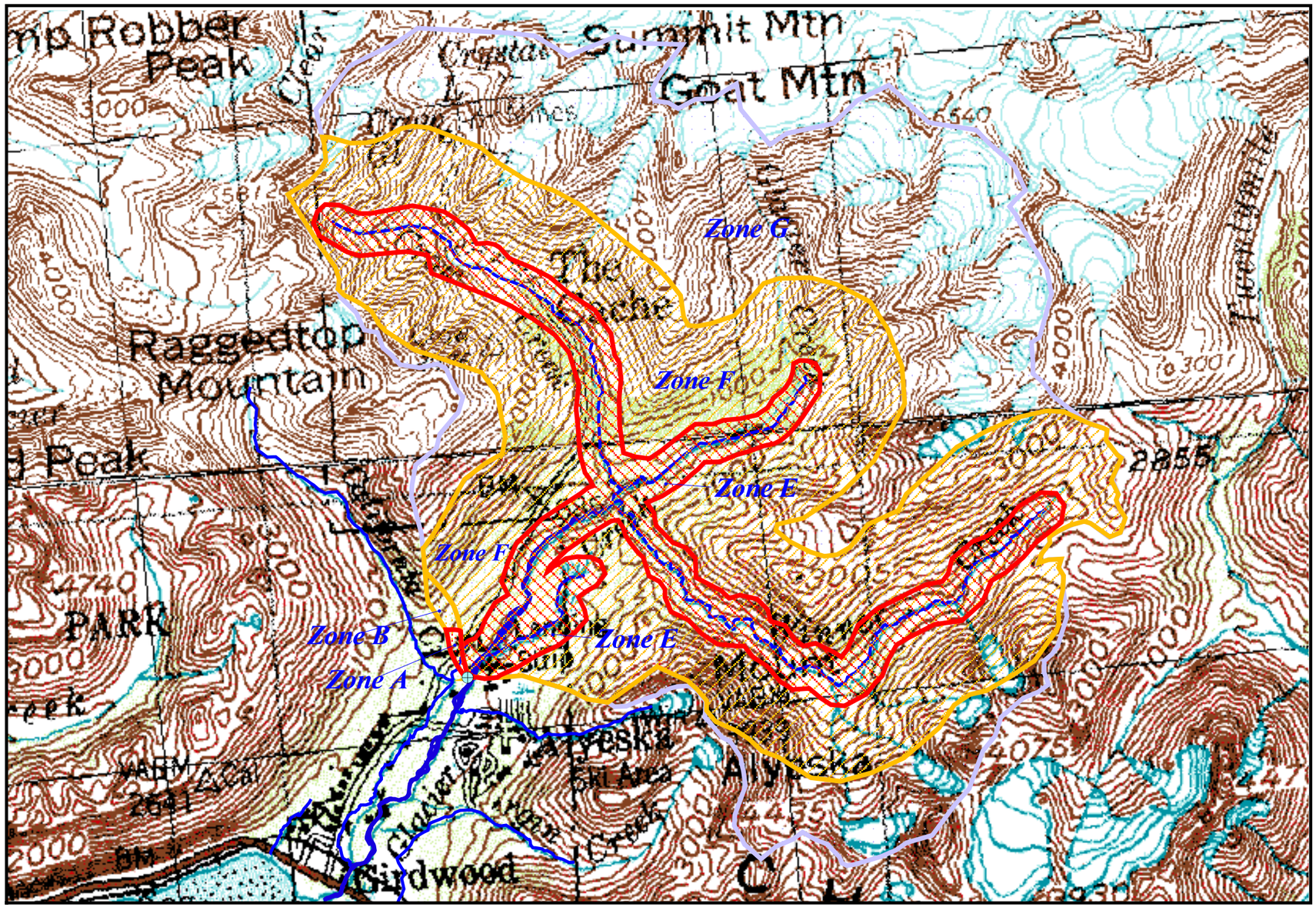
PWS ID 210710

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Anaysis	Location	Map Number	Notes/Comments
Old landfills	U17	U17-1	A	High	1	Behind Girdwood Elementary School	4, 5, and 6	Old landfill in very impermeable soils; contains four foot cover
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	A	Low	2	Sewer line from school	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	3	Crow Creek Road	4, 5, and 6	
Airports	X14	X14-1	E	Low	4	Mt. Hood Way	4, 5, and 6	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	A	Low	5	Sewer line from Alyeska Prince Hotel	4, 5, and 6	
Highways and roads, dirt/gravel	X24	X24-2	E	Low	6	Mt. Hood Way	4, 5, and 6	
Highways and roads, asphalt	X20	X20-1	E and F	Low	7	Arlberg Avenue	4 and 5	

APPENDIX B

ASD Girdwood Elementary School's Drinking Water Protection Areas

ASD Girdwood Elementary School (PWSID 210710)
Drinking Water Protection Area

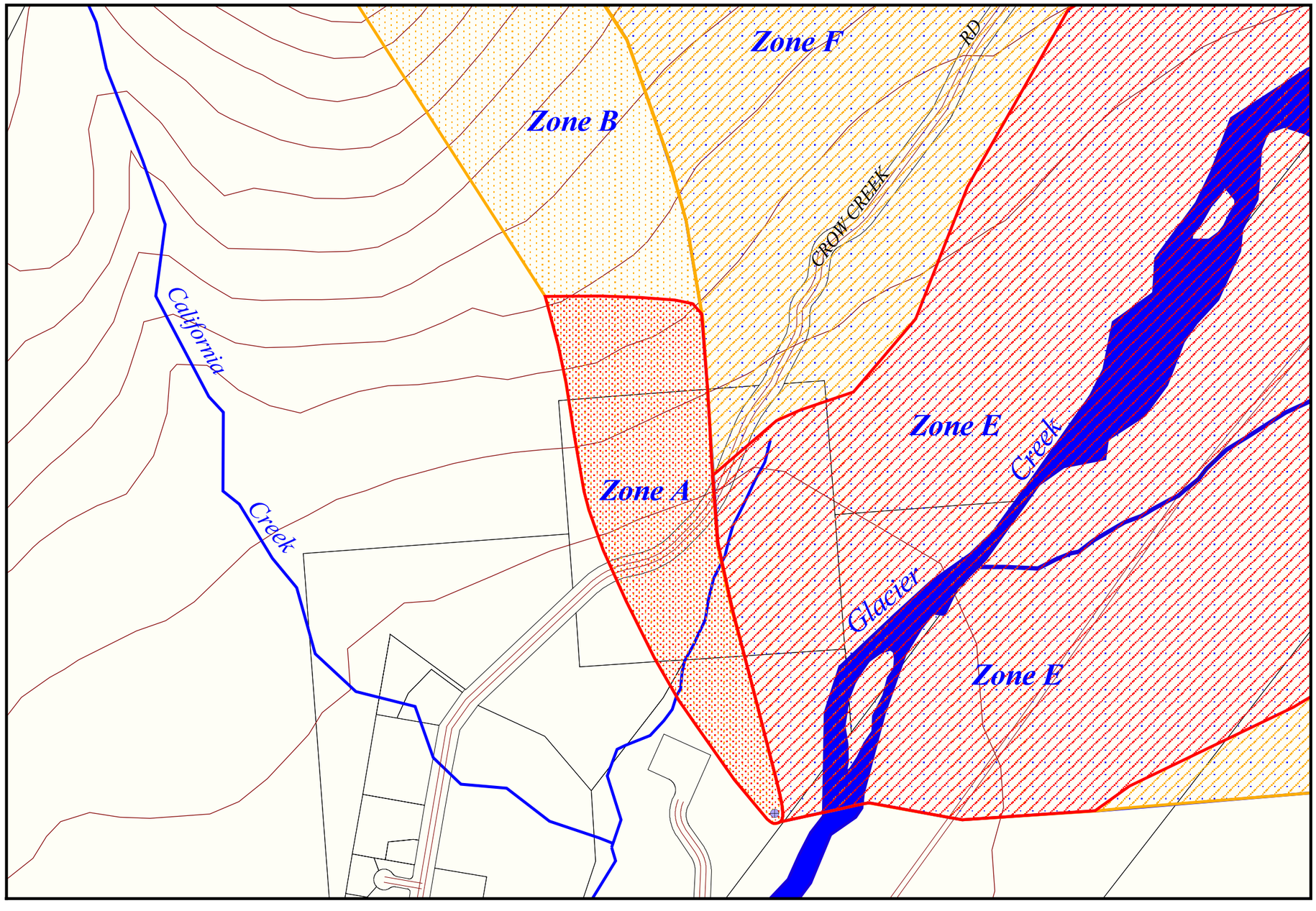


- ASD Girdwood Elementary School Well
- Zone A Protection Area
- Several Months Travel Time
- Zone B Protection Area
- Less Than Two Years Travel Time
- Zone E Protection Area
- 1000 Feet From Surface Water Body
- Zone F Protection Area
- 1 Mile From Surface Water Body
- Zone G Protection Area
- ASD Girdwood Elementary
- 2nd order streams
- 3rd order streams
- 4th order streams
- Glacier Creek

N
W E
S

Map 1

ASD Girdwood Elementary School (PWSID 210710)
Drinking Water Protection Areas



- ASD Girdwood Elementary School Well

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less than 2 Years Travel Time

Zone E Protection Area
- 1000 Feet from Surface Water

Zone F Protection Area
- 1 Mile from Surface Water

Zone G Protection Area
- Entire Watershed
- MOA Roads
- 2nd order streams
- 3rd order streams
- 4th order streams
- Glacier Creek
- Lakes and Ponds
- Elevation Contours = 20 meters
- MOA Land Parcels

N
W E
S

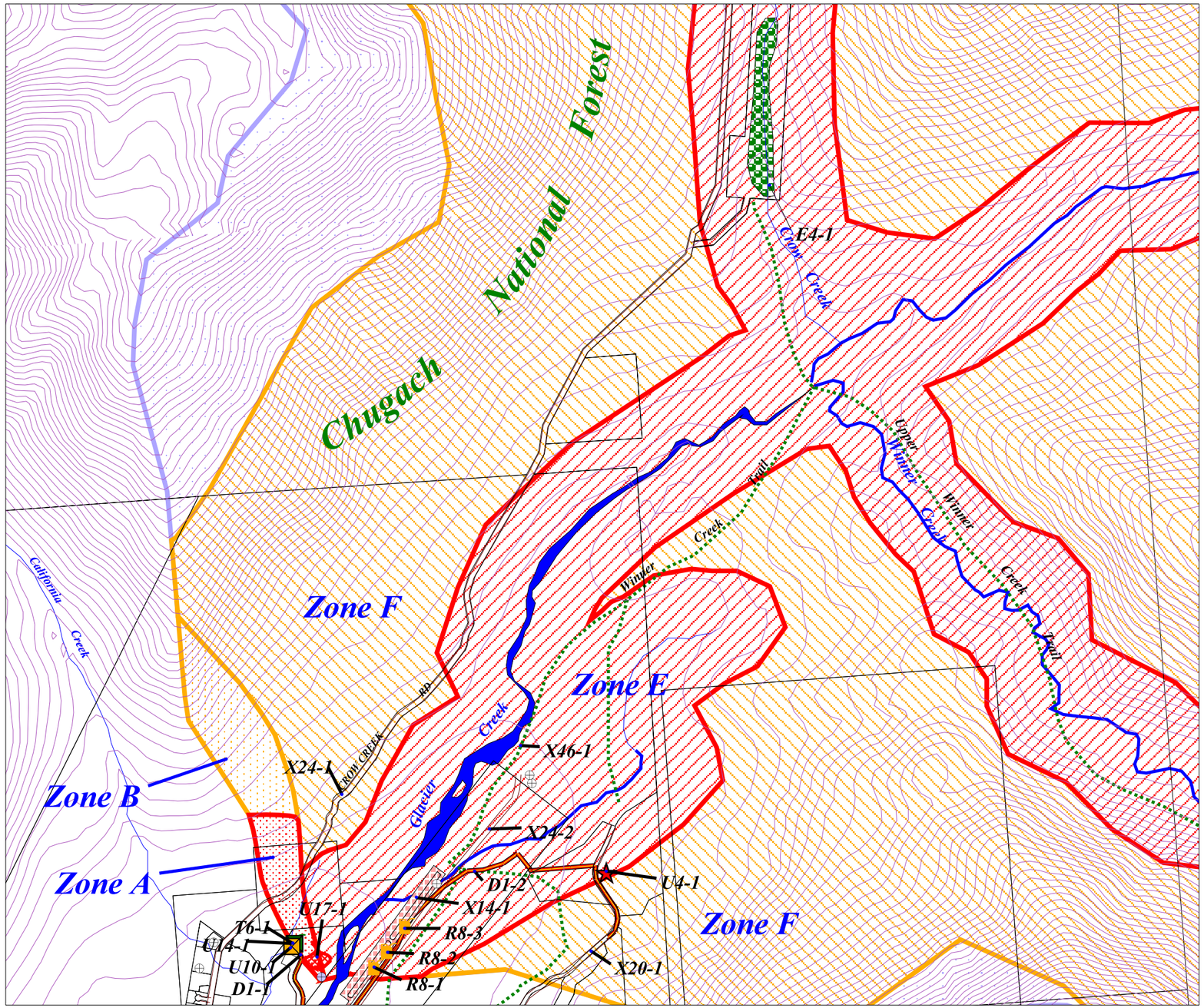
500 0 500 Feet

Map 3

APPENDIX C

ASD Girdwood Elementary School's
Drinking Water Protection Areas
and Potential & Existing Contaminant Sources

ASD Girdwood Elementary School Drinking Water Protection Areas 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)
- Contaminated sites, ADEC recognized
- Tanks, diesel (above ground)
- Tanks, heating oil, residential (above ground)
- ASD Girdwood Elementary Well
- Public and Private Drinking Water Wells - Glacier Valley
- Elevation Contours
- MOA Land Parcels
- Roads
- Airports
- Old Landfill
- Sewers Lines
- Trails
- 1st Order Streams
- 2nd Order Sreams
- 3rd Order Streams
- Placer Mining
- Glacier Creek

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- 1 Mile From Surface Water Body

Zone E Protection Area
- 1000 Feet From Surface Water Body

Zone F Protection Area
- 1 Mile From Surface Water Body

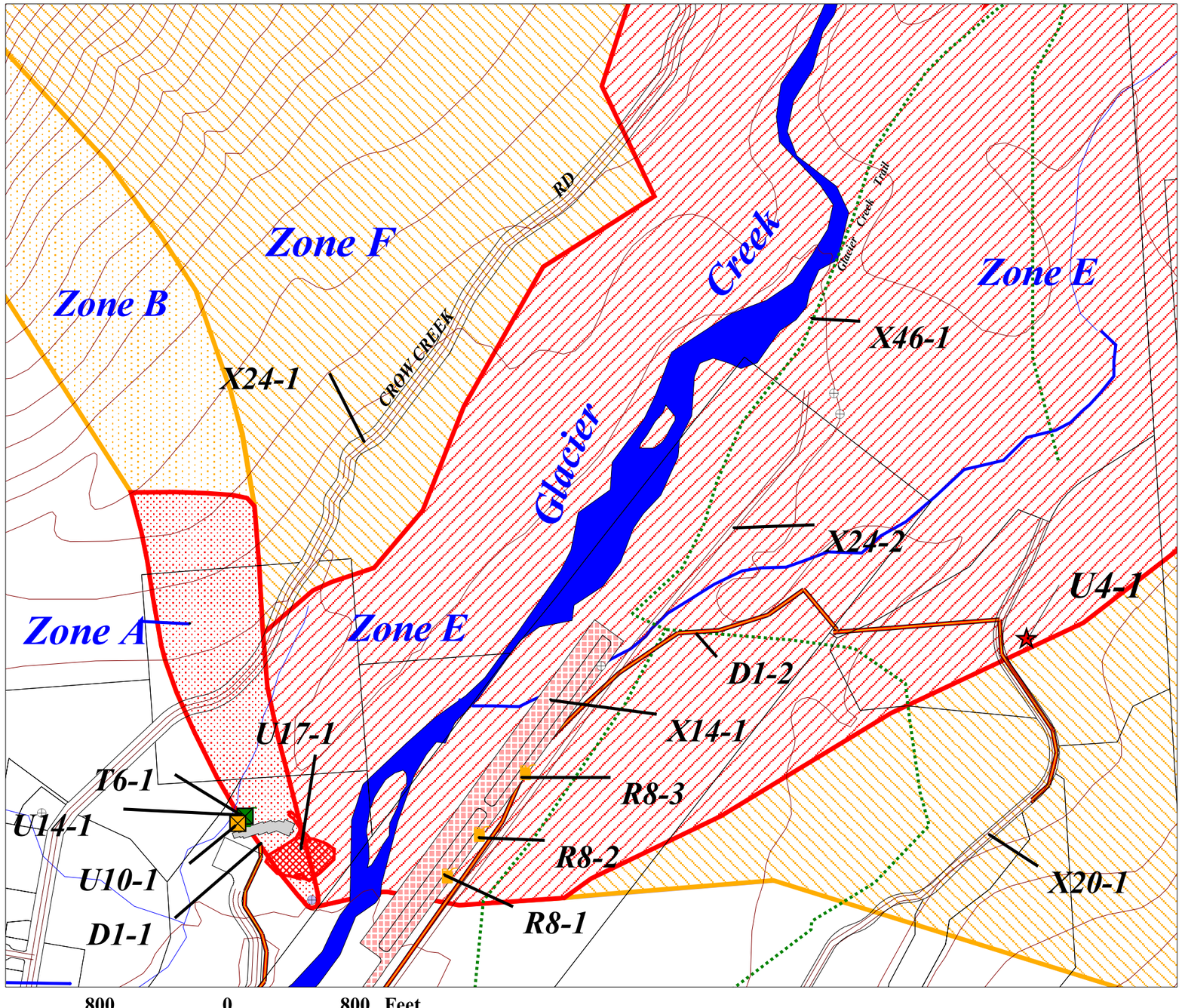
Zone G Protection Area
- Less Than 2 Years Travel Time

N W E S

PWSID 210710

Map 4

ASD Girdwood Elementary School Drinking Water Protection Areas 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)
- Contaminated sites, ADEC recognized
- Tanks, diesel (above ground)
- Tanks, heating oil, residential (above ground)
- ASD Girdwood Elementary Well
- Public and Private Drinking Water Wells - Glacier Valley
- MOA Land Parcels
- Roads
- Airports
- Old Landfill
- Sewers Lines
- Elevation Contours
- Trails
- 1st Order Streams
- 2nd Order Sreams
- 3rd Order Streams
- Placer Mining
- Glacier Creek
- Buildings

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- 1 Mile From Surface Water Body

Zone E Protection Area
- 1000 Feet From Surface Water Body

Zone F Protection Area
- 1 Mile From Surface Water Body

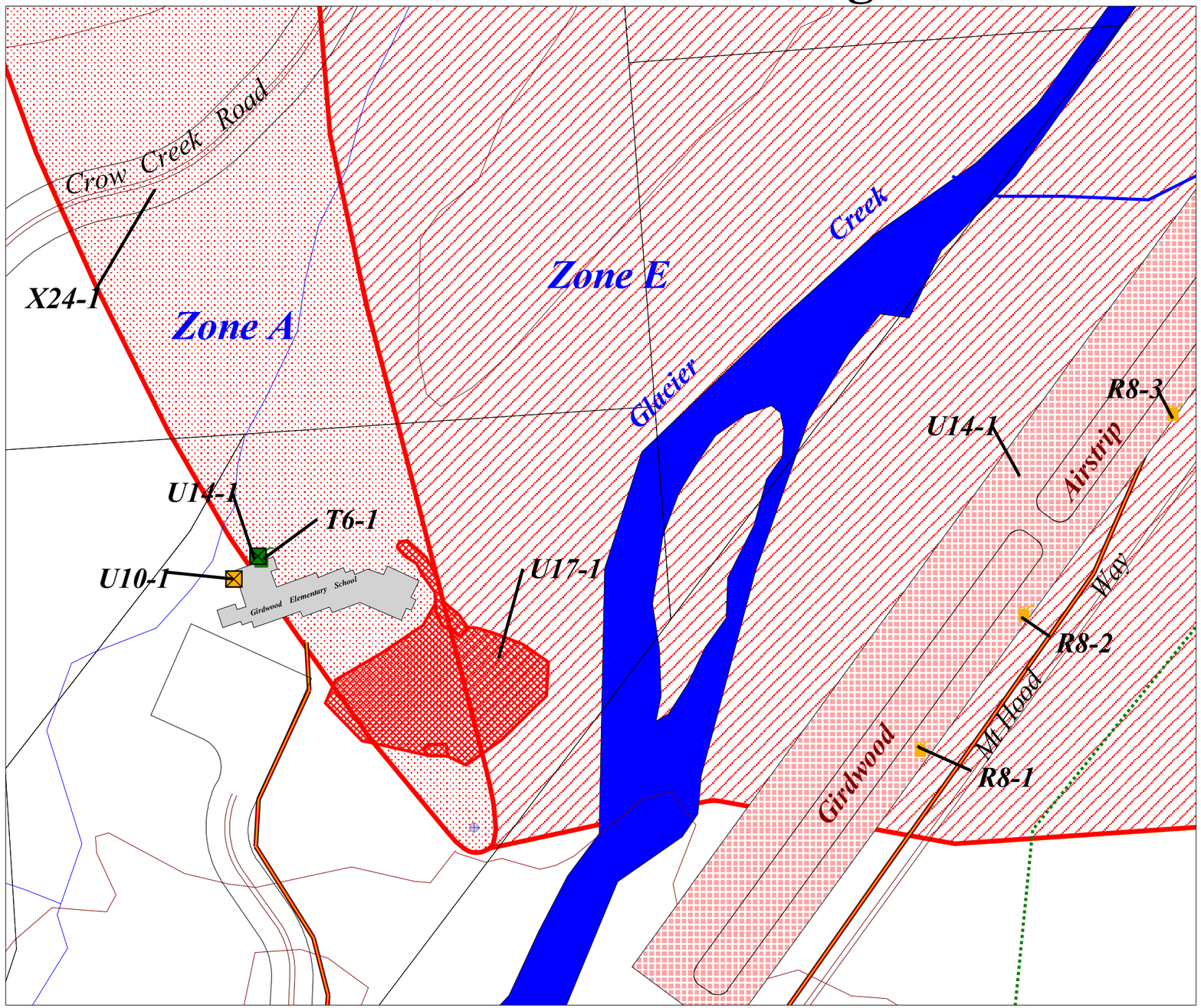
Zone G Protection Area
- Less Than 2 Years Travel Time

N W E S

PWSID 210710

Map 5

ASD Girdwood Elementary School Drinking Water Protection Areas 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)
- Contaminated sites, ADEC recognized
- Tanks, diesel (above ground)
- Tanks, heating oil, residential (above ground)
- ASD Girdwood Elementary Well
- Public and Private Drinking Water Wells - Glacier Valley
- MOA Land Parcels
- Roads
- Airports
- Old Landfill
- Sewers Lines
- Elevation Contours
- Trails
- 1st Order Streams
- 2nd Order Sreams
- 3rd Order Streams
- Placer Mining
- Glacier Creek
- Buildings

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- 1 Mile From Surface Water Body

Zone E Protection Area
- 1000 Feet From Surface Water Body

Zone F Protection Area
- 1 Mile From Surface Water Body

Zone G Protection Area
- Less Than 2 Years Travel Time

N W E S

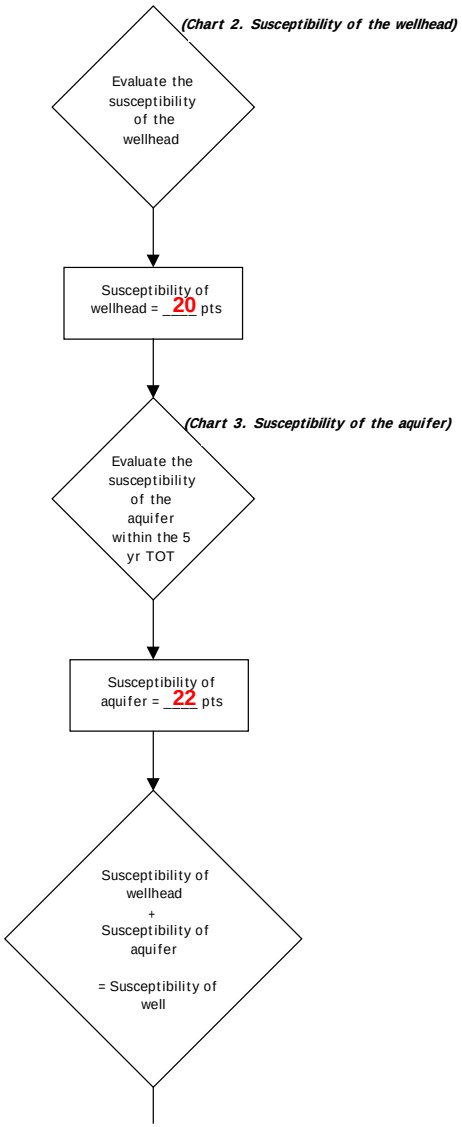
PWSID 210710

Map 6

APPENDIX D

Vulnerability Analysis for ASD Girdwood Elementary School Public Drinking Water System

Chart 1. Vulnerability analysis for Bacteria & Viruses – ASD Girdwood Elementary School



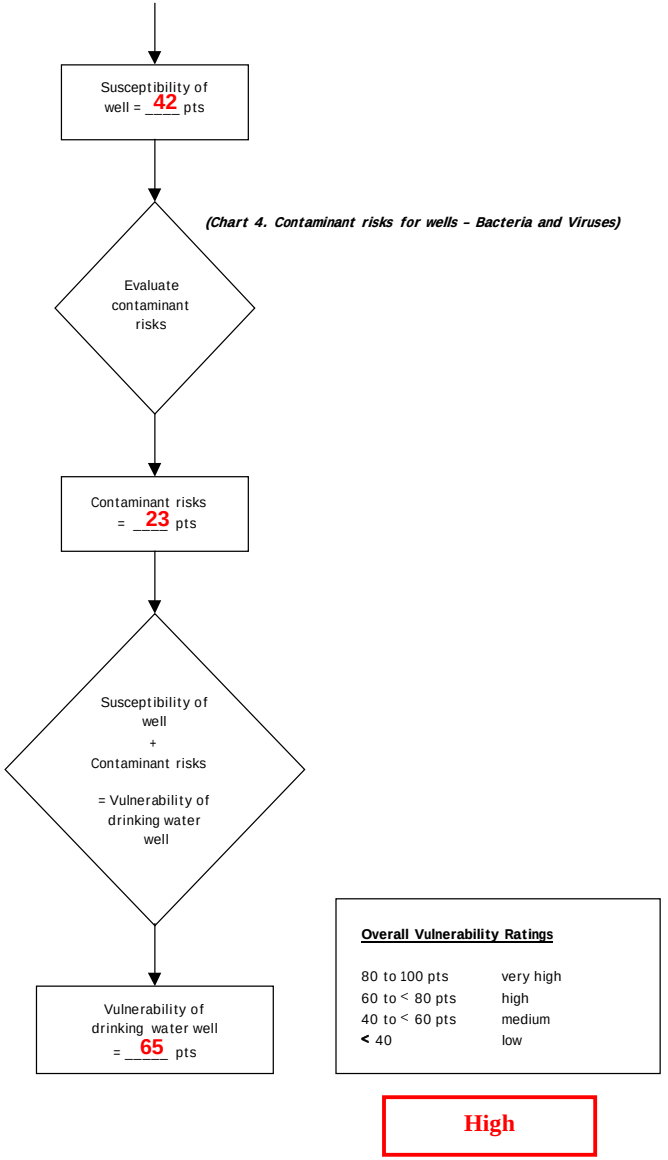
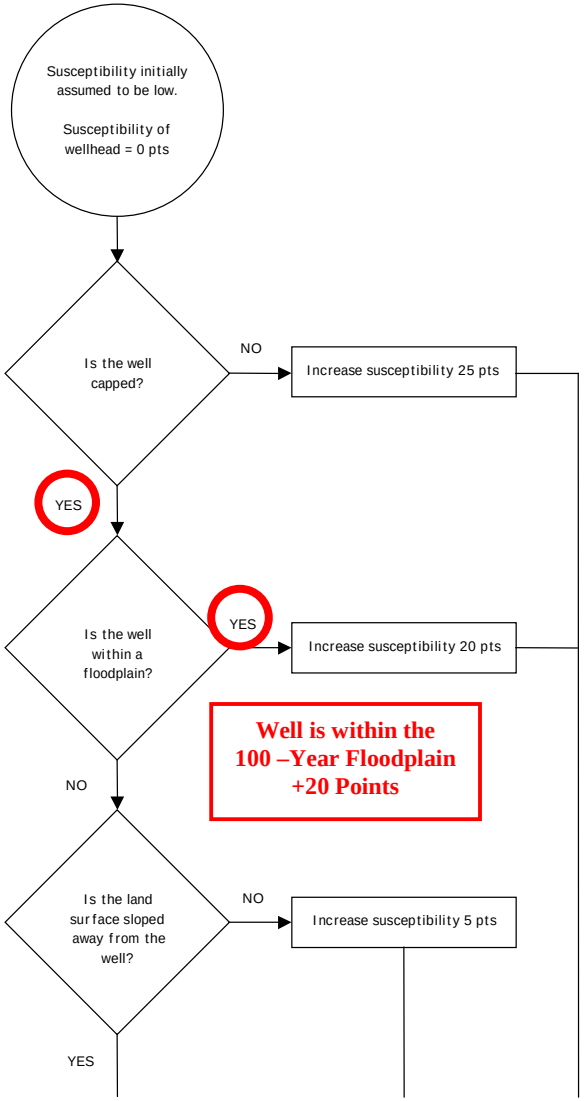
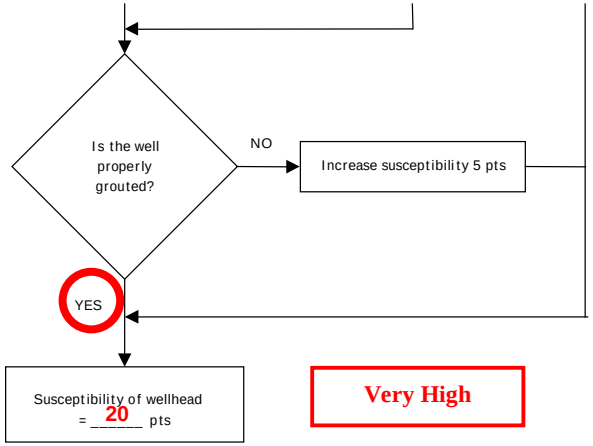


Chart 2. Susceptibility of the wellhead

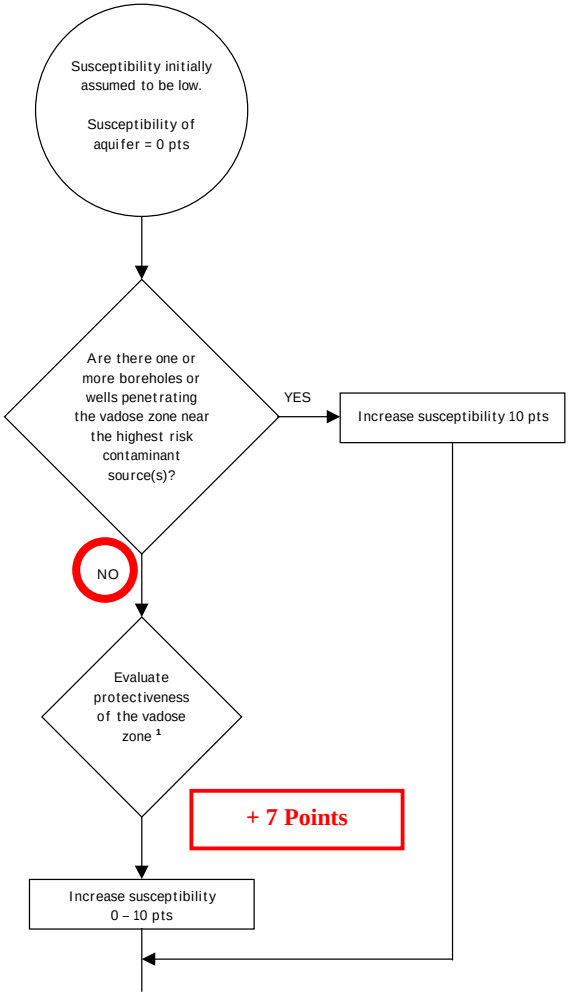


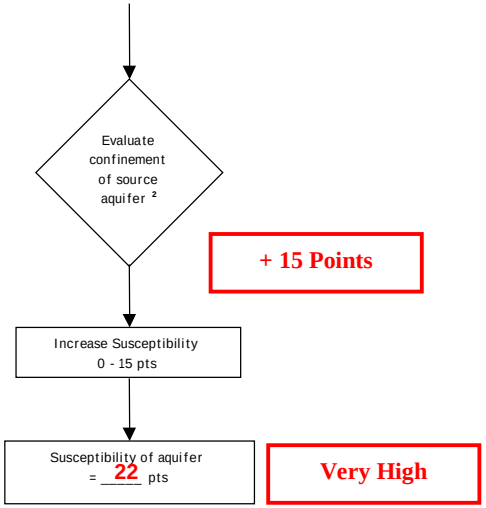


Wellhead Susceptibility Ratings

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

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 6/10 = 3 Points
Depth to water table 8/10 = 4 Points

Protectiveness of the Vadose Zone Total = **7 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 ASD Girdwood Elementary School – Bacteria & Viruses

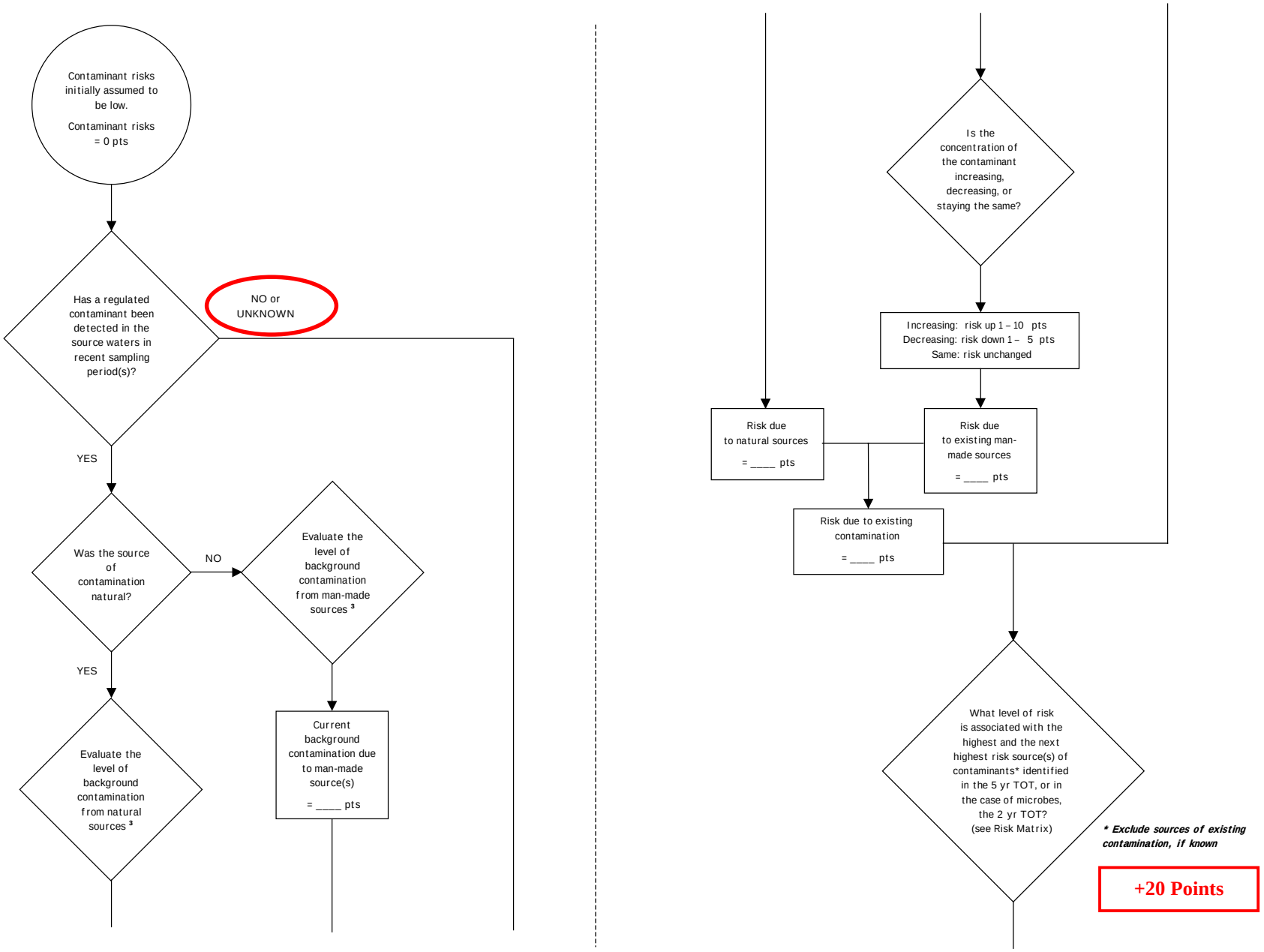
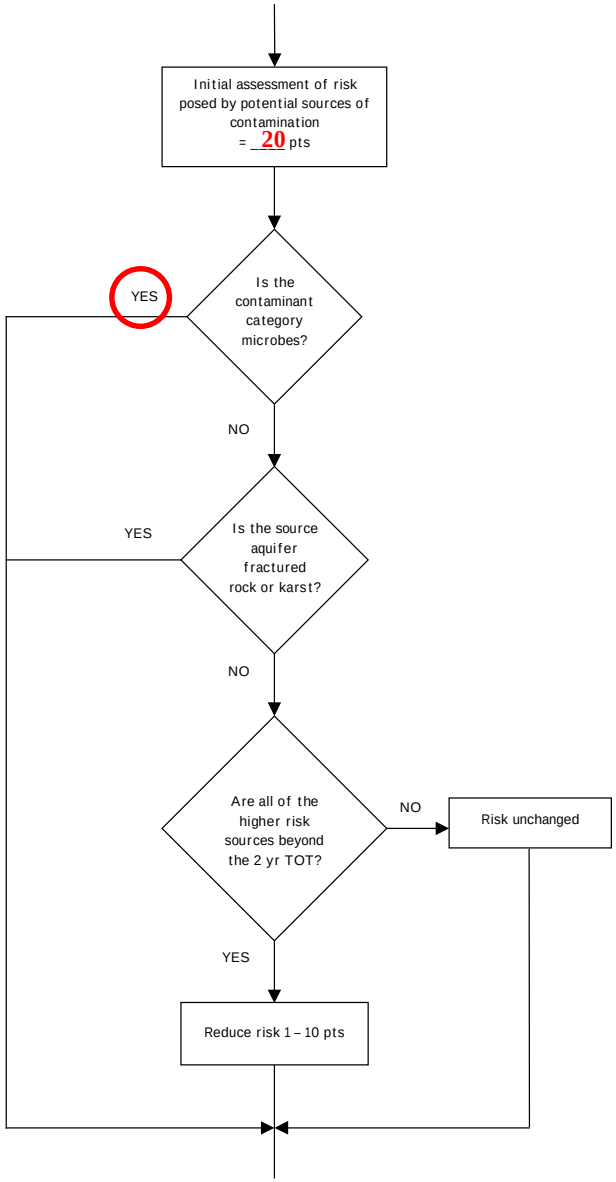


Chart 4. Contaminant risks for ASD Girdwood Elementary School – Bacteria & Viruses (Continued)



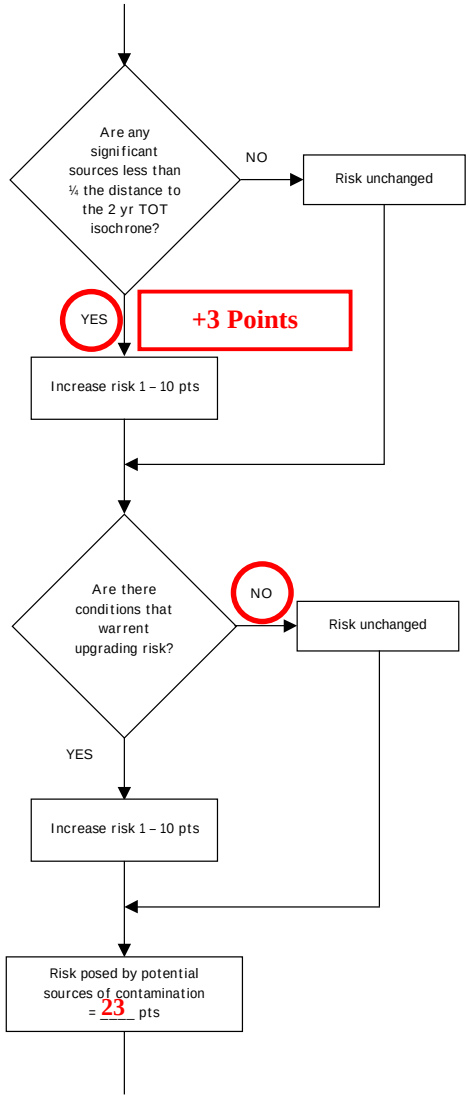
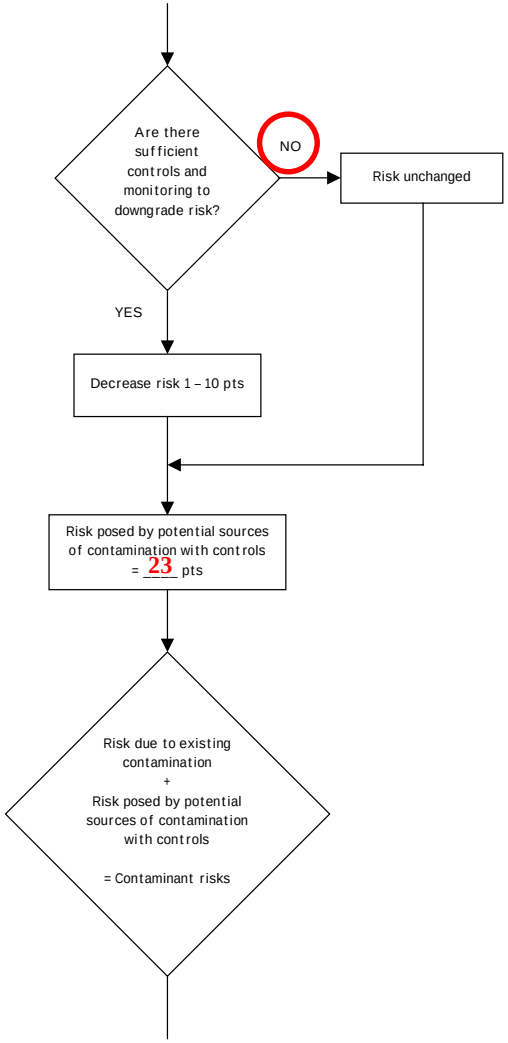
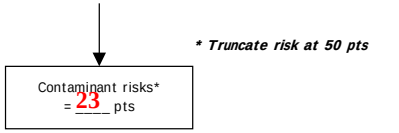


Chart 4. Contaminant risks for ASD Girdwood Elementary School – Bacteria & Viruses (Continued)





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

Medium

Table 1. Risk Matrix for Contaminant Sources for Bacteria & Viruses – ASD Girdwood Elementary School

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Sewer lines from school – initial risk is 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 – ASD Girdwood Elementary School

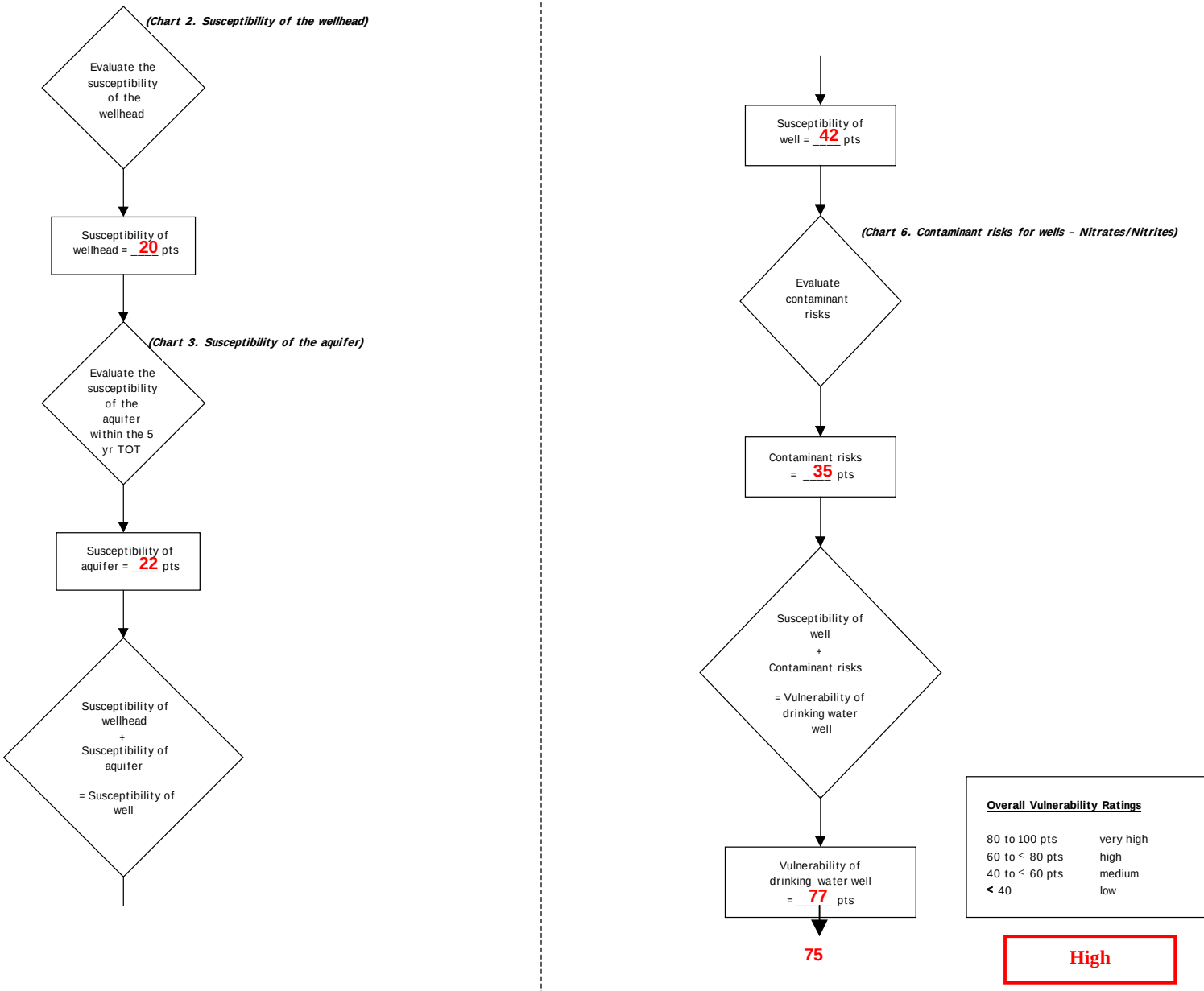


Chart 6. Contaminant risks for ASD Girdwood Elementary School – Nitrates/Nitrites

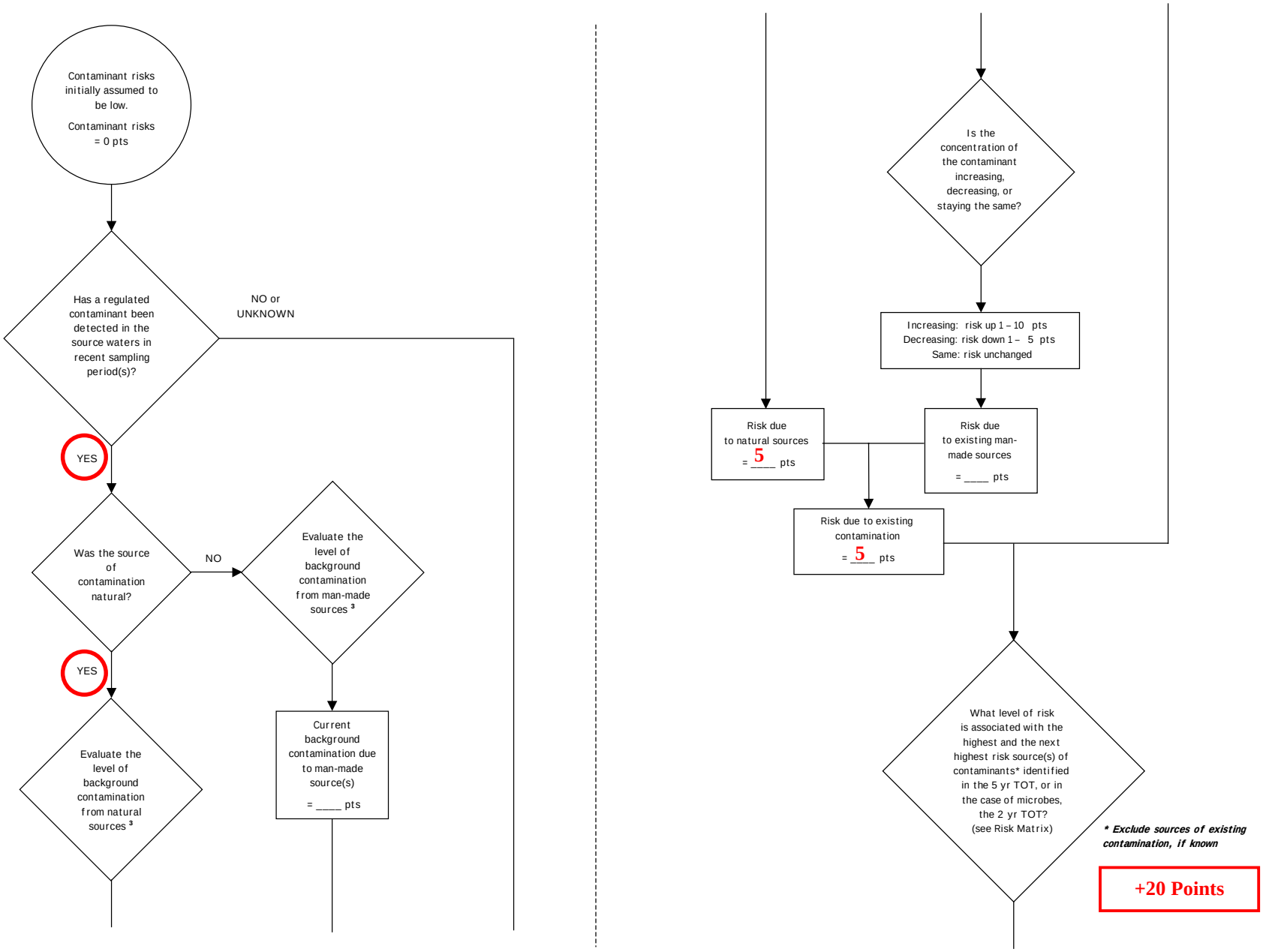
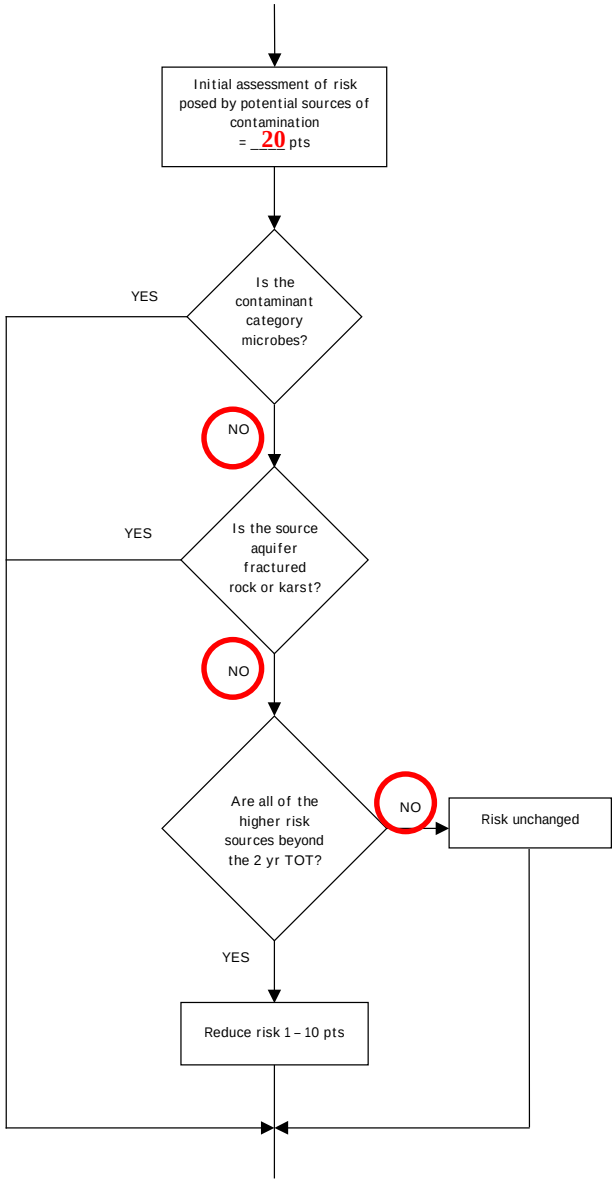


Chart 6. Contaminant risks for ASD Girdwood Elementary School – Nitrates/Nitrites (Continued)



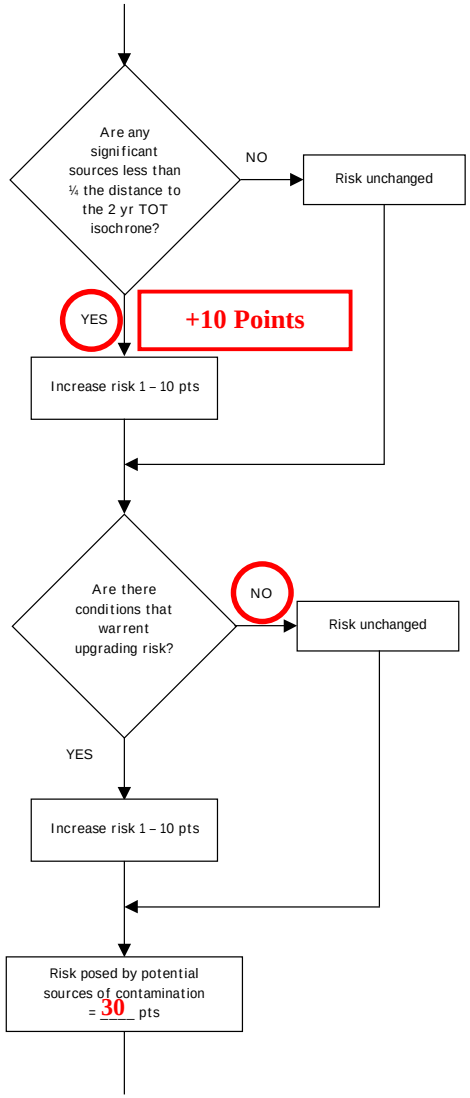
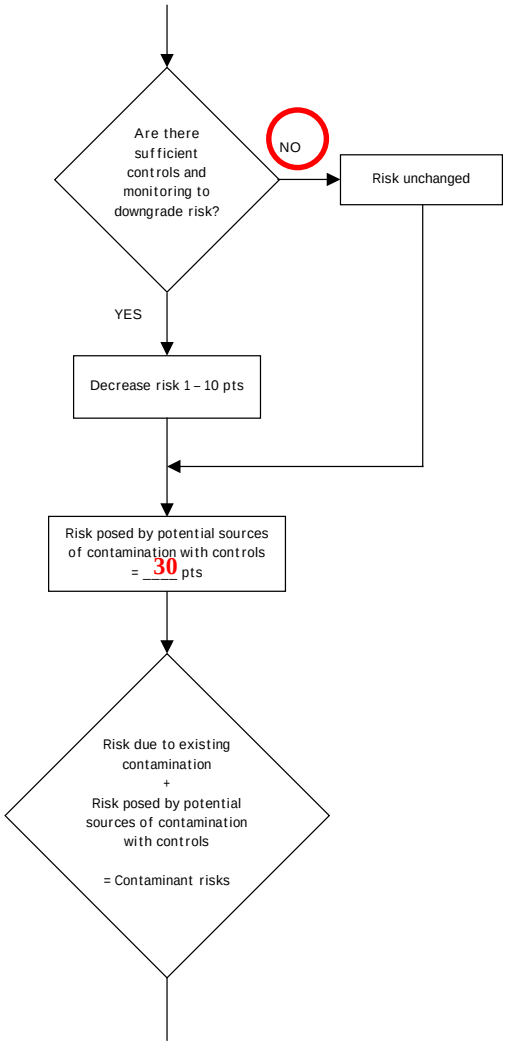
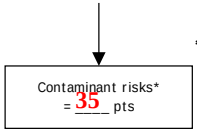


Chart 6. Contaminant risks for ASD Girdwood Elementary School – Nitrates/Nitrites (Continued)





**** 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

Nitrate = 480 µg/L

Maximum Contaminant Level (MCL)

= 10,000 µg/L

480/10,000
= 0.048 of MCL

+5 Points

High

Table 2. Risk Matrix for Contaminant Sources for Nitrates/Nitrites – ASD Girdwood Elementary School

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	SEWER LINE AND CLOSED LANDFILL INITIALLY MEDIUM RISK	**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 – ASD Girdwood Elementary School

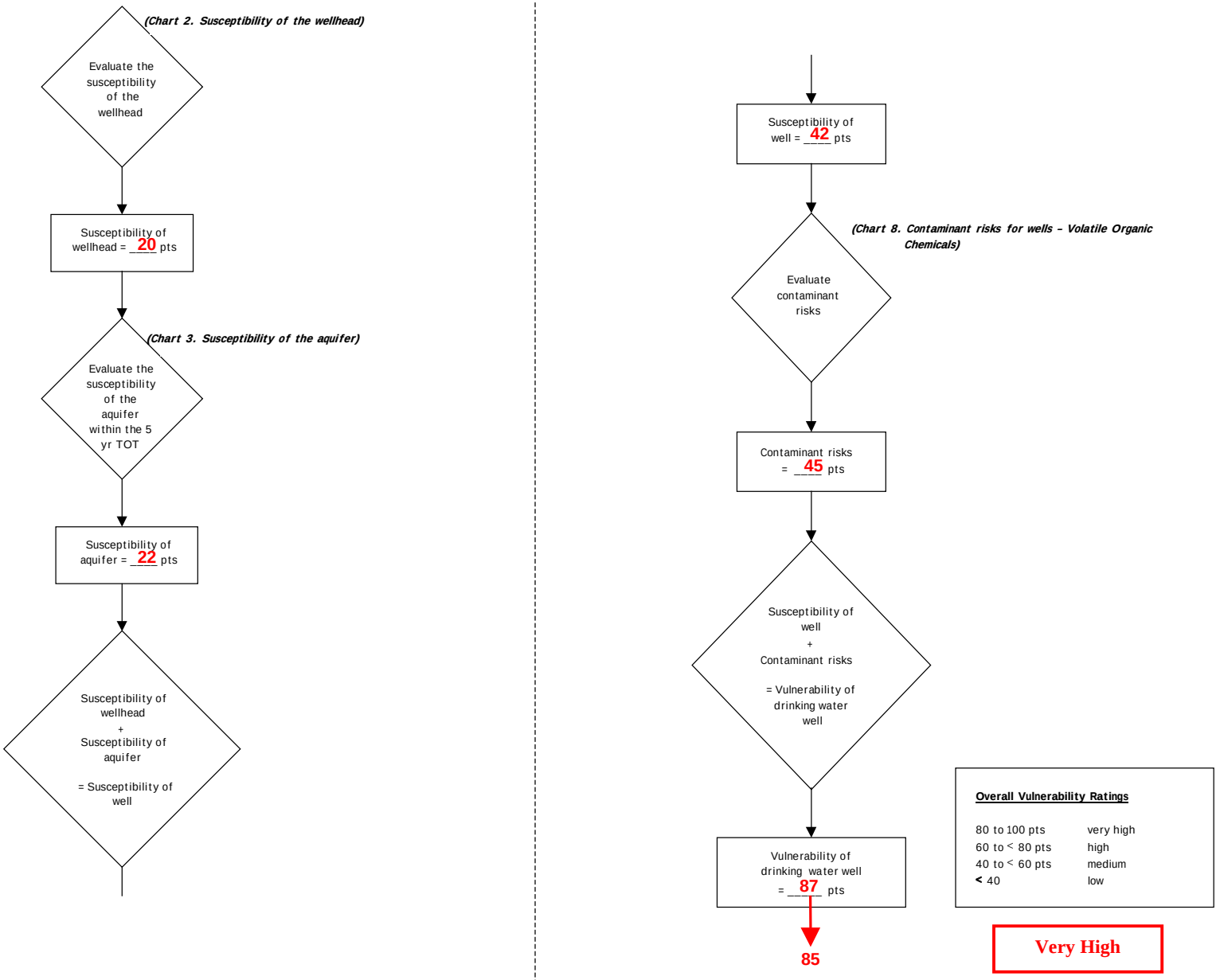


Chart 8. Contaminant risks for ASD Girdwood Elementary School – Volatile Organic Chemicals

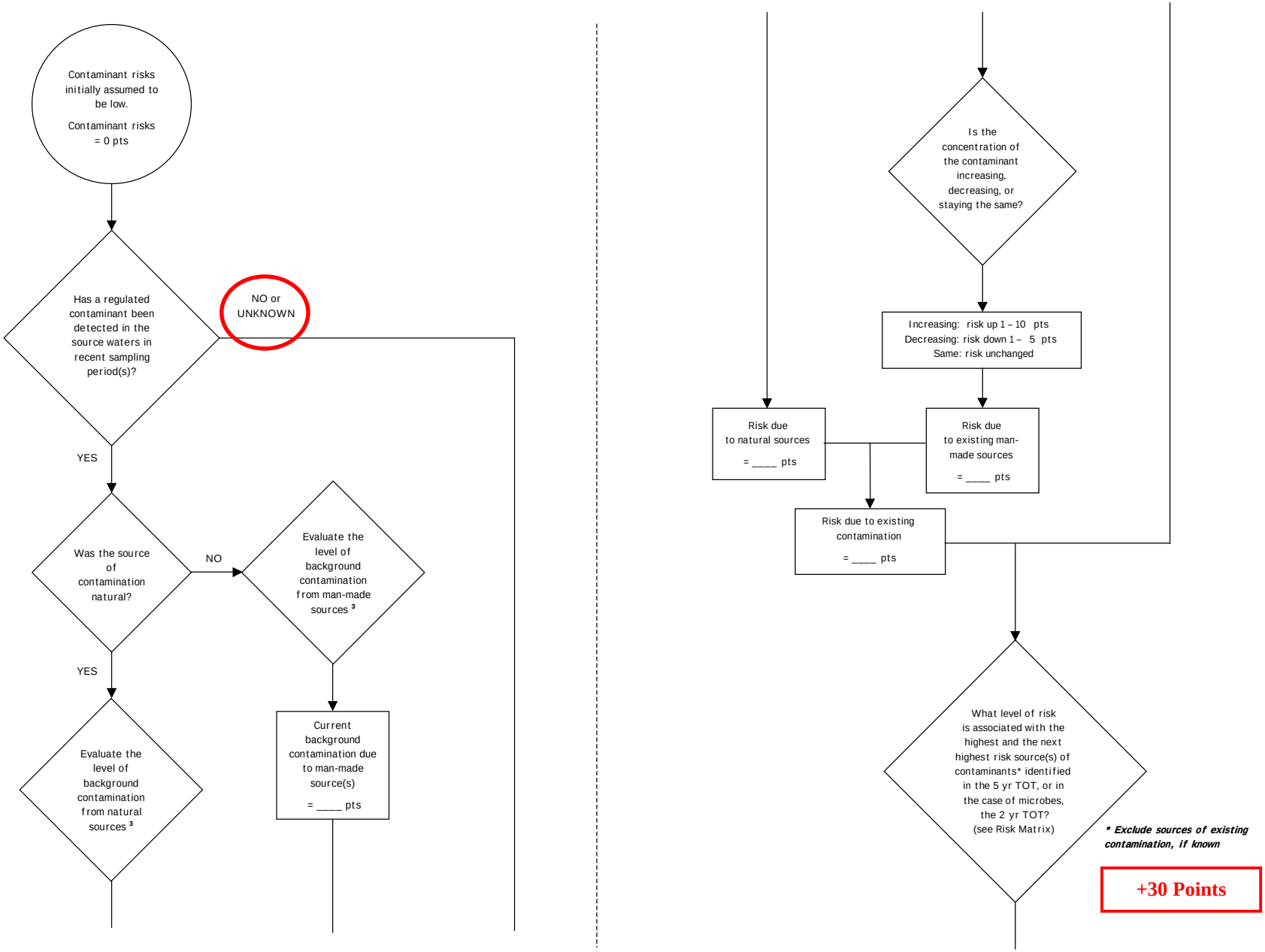
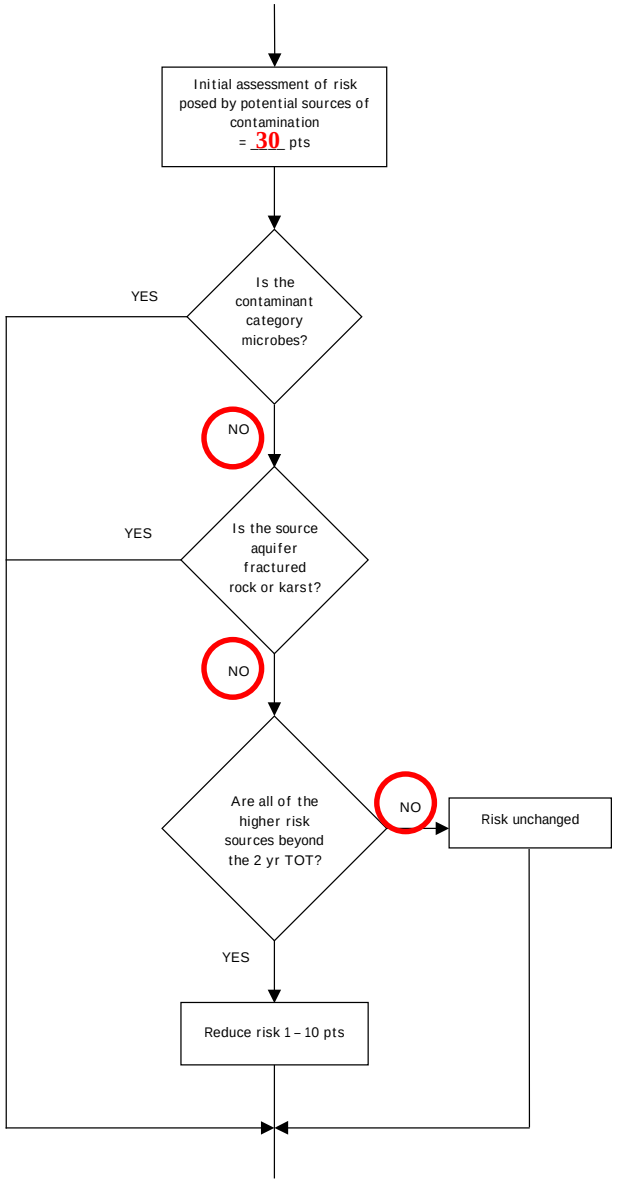
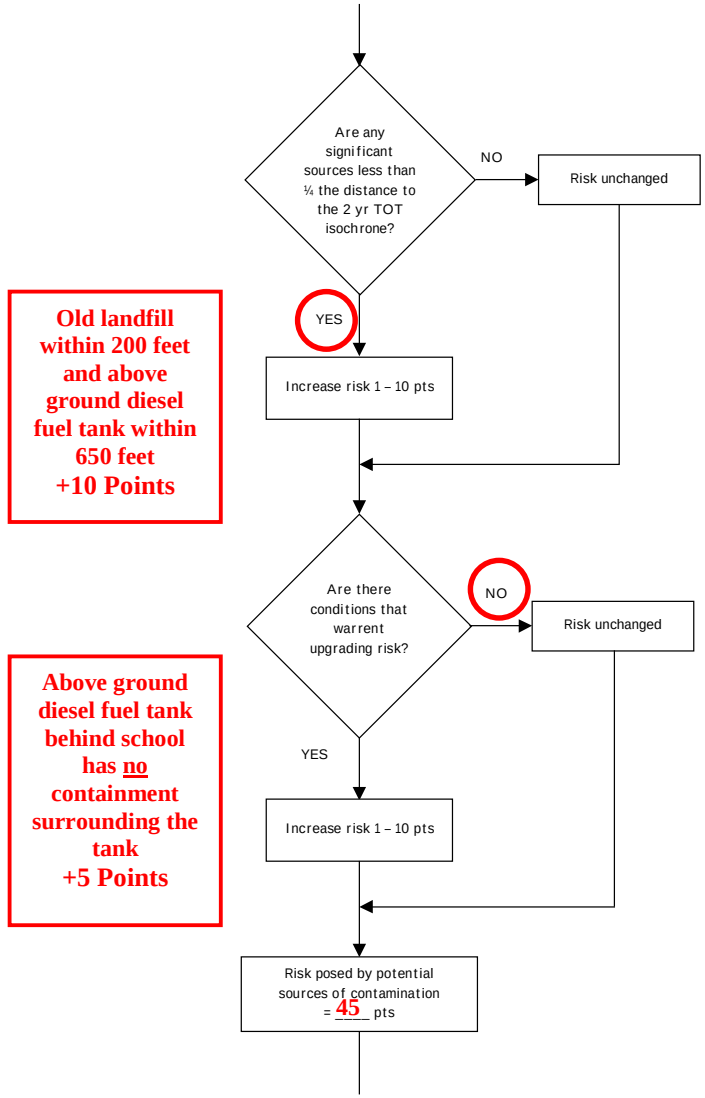


Chart 8. Contaminant risks for ASD Girdwood Elementary School – Volatile Organic Chemicals (Continued)

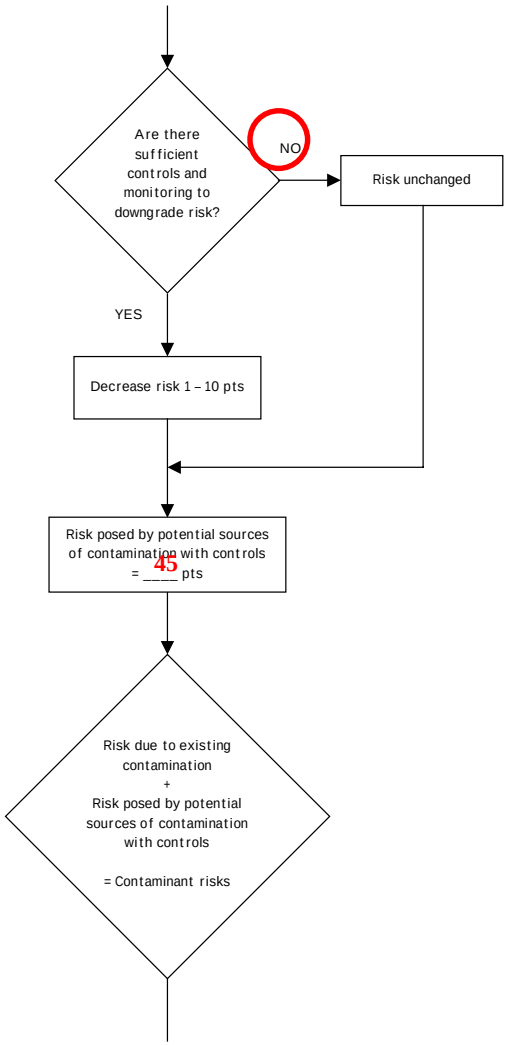


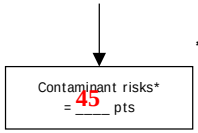


Old landfill within 200 feet and above ground diesel fuel tank within 650 feet
+10 Points

Above ground diesel fuel tank behind school has no containment surrounding the tank
+5 Points

Chart 8. Contaminant risks for ASD Girdwood Elementary School – 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

Very High

Table 3. Risk Matrix for Contaminant Sources for Volatile Organic Chemicals – ASD Girdwood Elementary School

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Closed landfill is initially high risk for VOCs	**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 9. Vulnerability analysis for Heavy Metals, Cyanide, and other Inorganic Chemicals – ASD Girdwood Elementary School

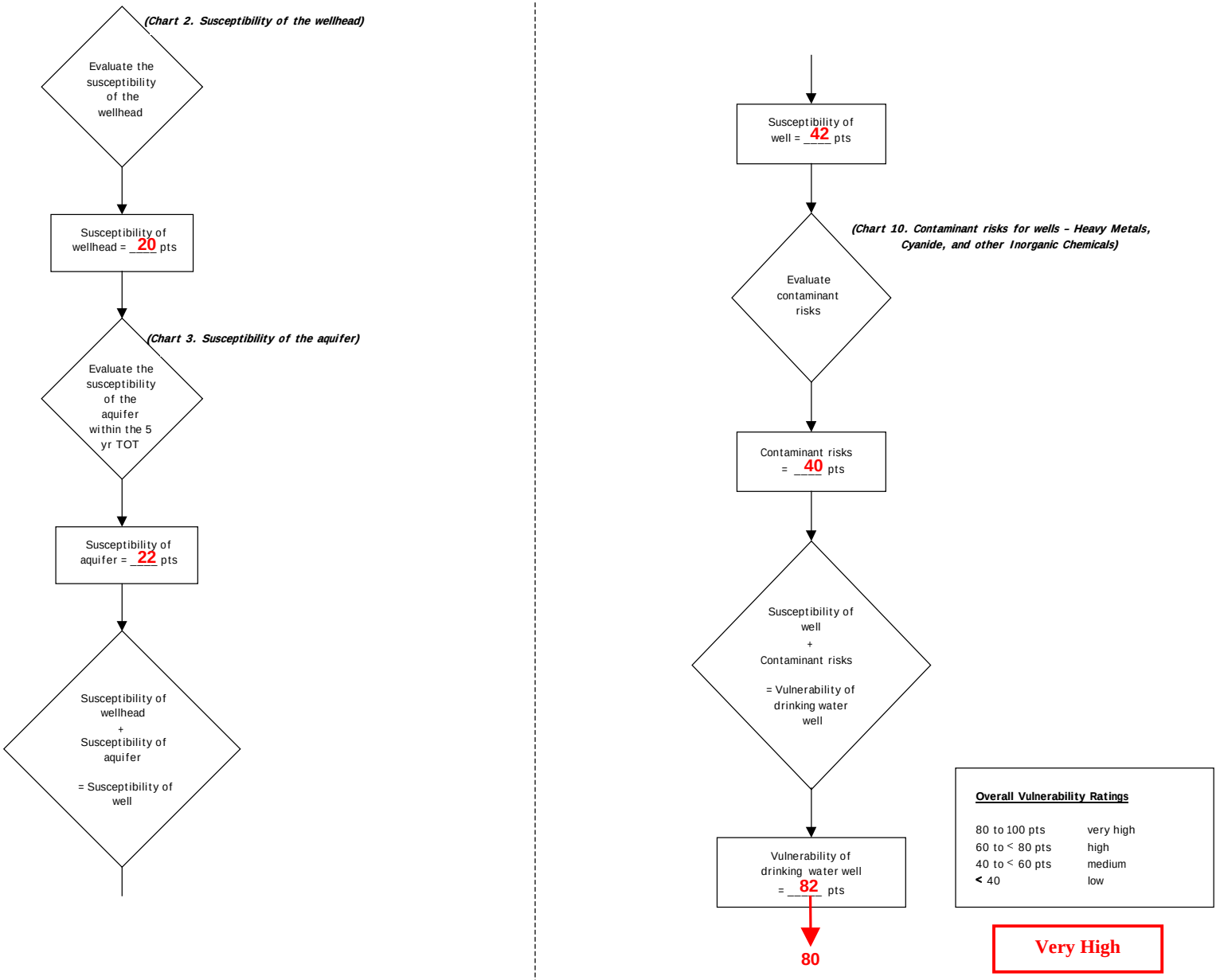


Chart 10. Contaminant risks for ASD Girdwood Elementary School – Heavy Metals, Cyanide, and other Inorganic Chemicals

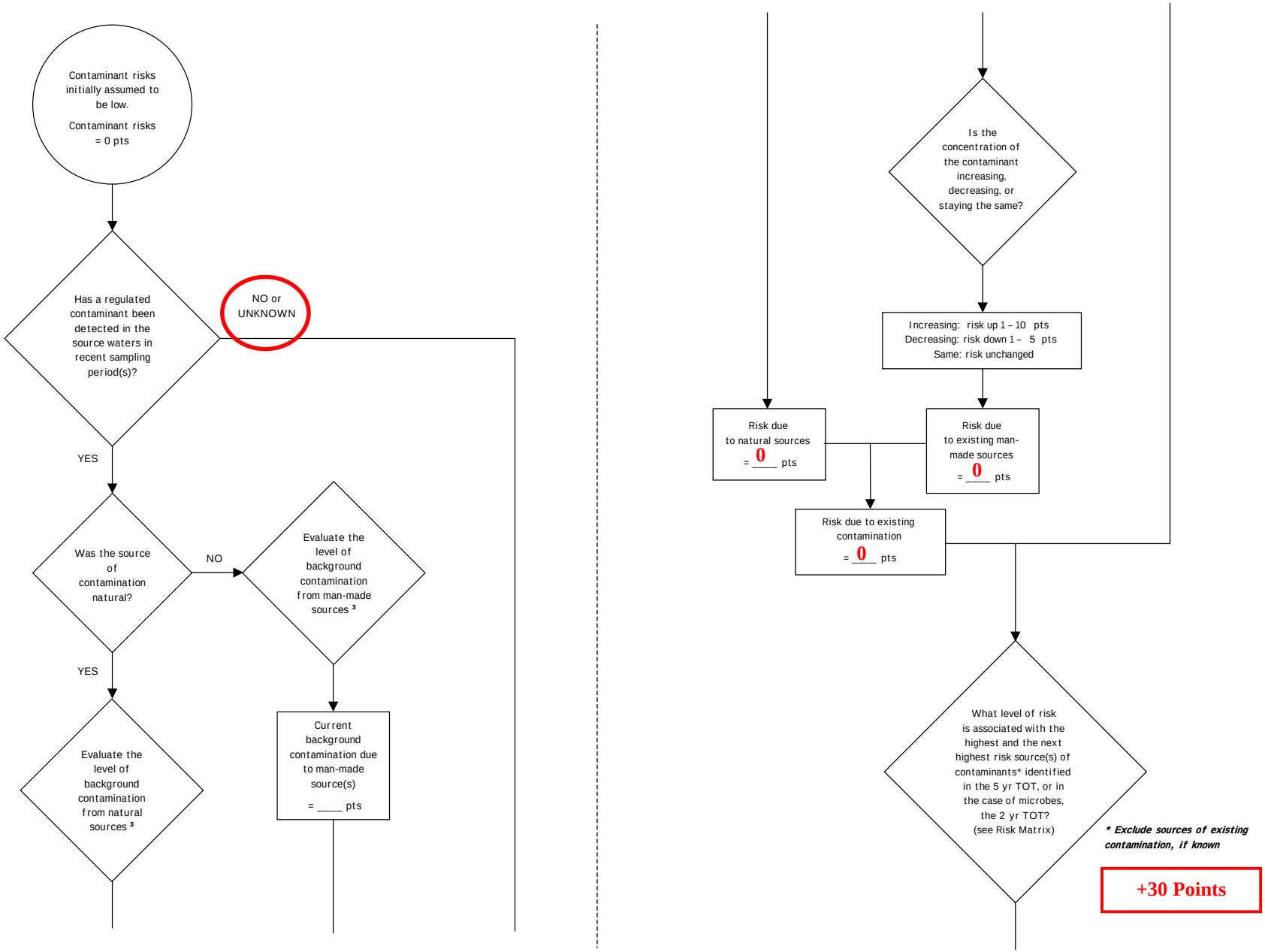
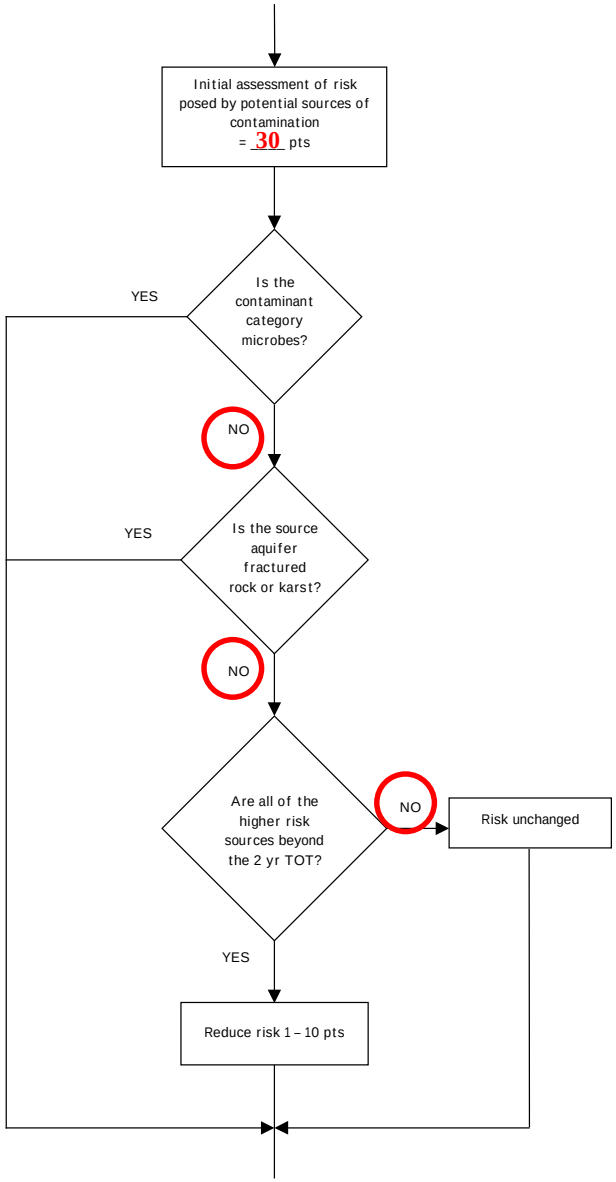


Chart 10. Contaminant risks for ASD Girdwood Elementary School – Heavy Metals, Cyanide, and other Inorganic Chemicals (Continued)



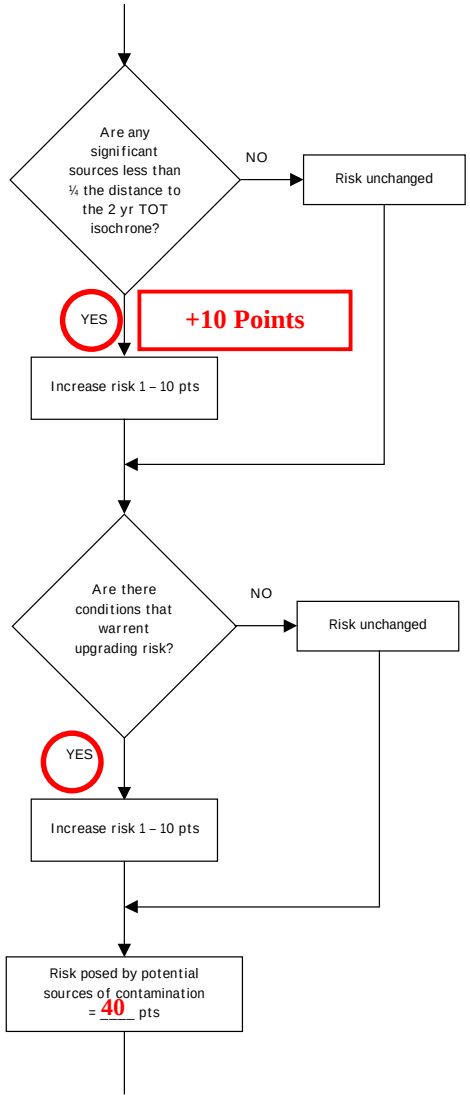
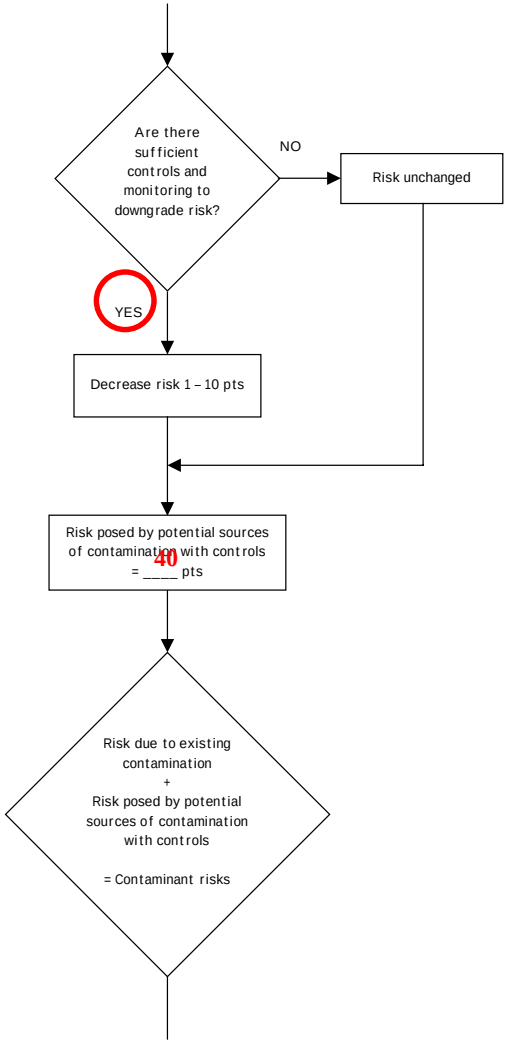
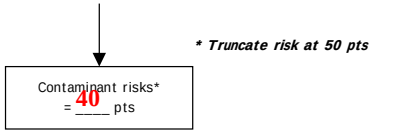


Chart 10. Contaminant risks for ASD Girdwood Elementary School – Heavy Metals, Cyanide, and other Inorganic Chemicals (Continued)





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

Very High

Table 4. Risk Matrix for Contaminant Sources for Heavy Metals, Cyanide, and other Inorganic Chemicals – ASD Girdwood Elementary School

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Closed landfill is initially high risk for heavy metals	**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 11. Vulnerability analysis for Synthetic Organic Chemicals – ASD Girdwood Elementary School

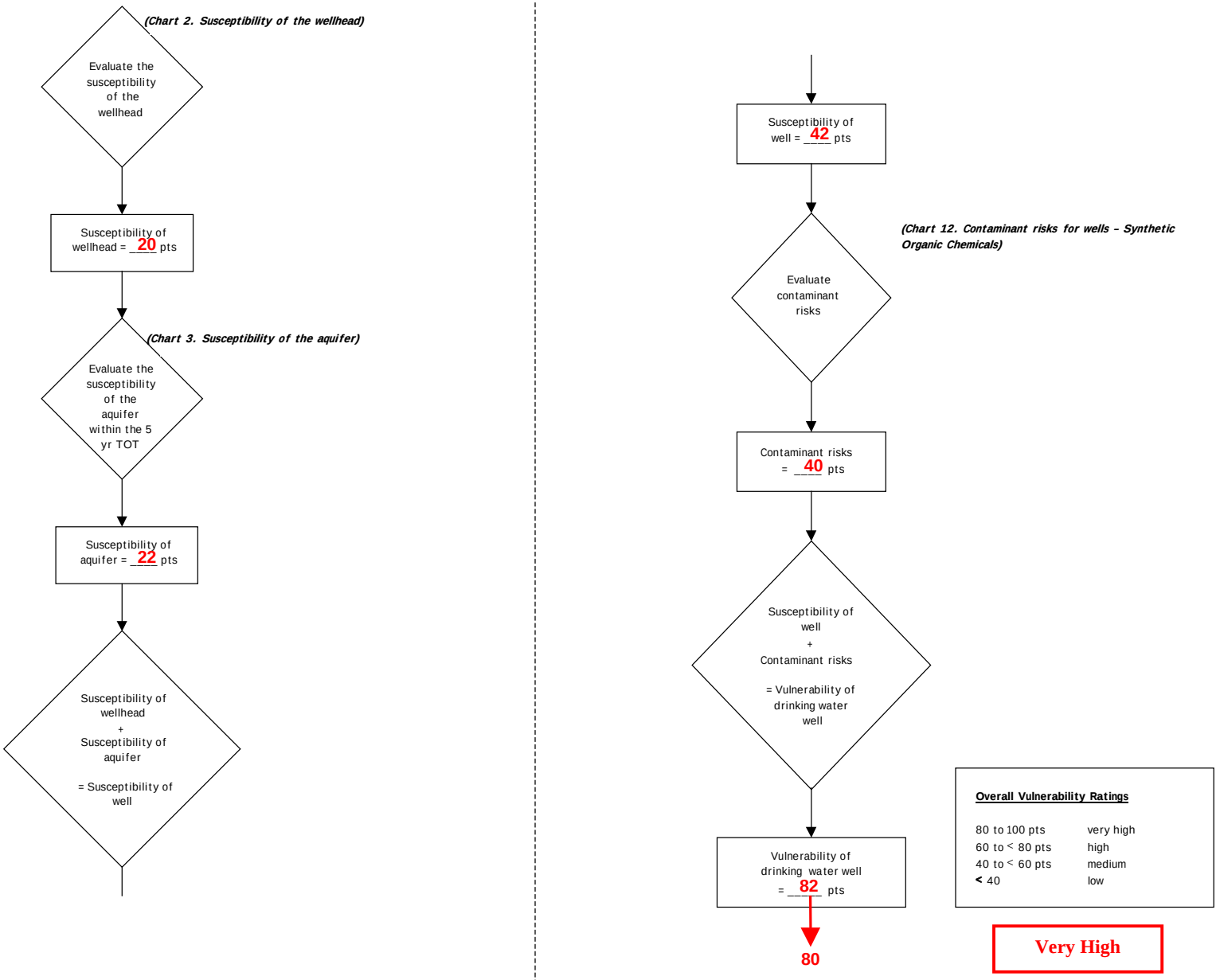


Chart 12. Contaminant risks for ASD Girdwood Elementary School – Synthetic Organic Chemicals

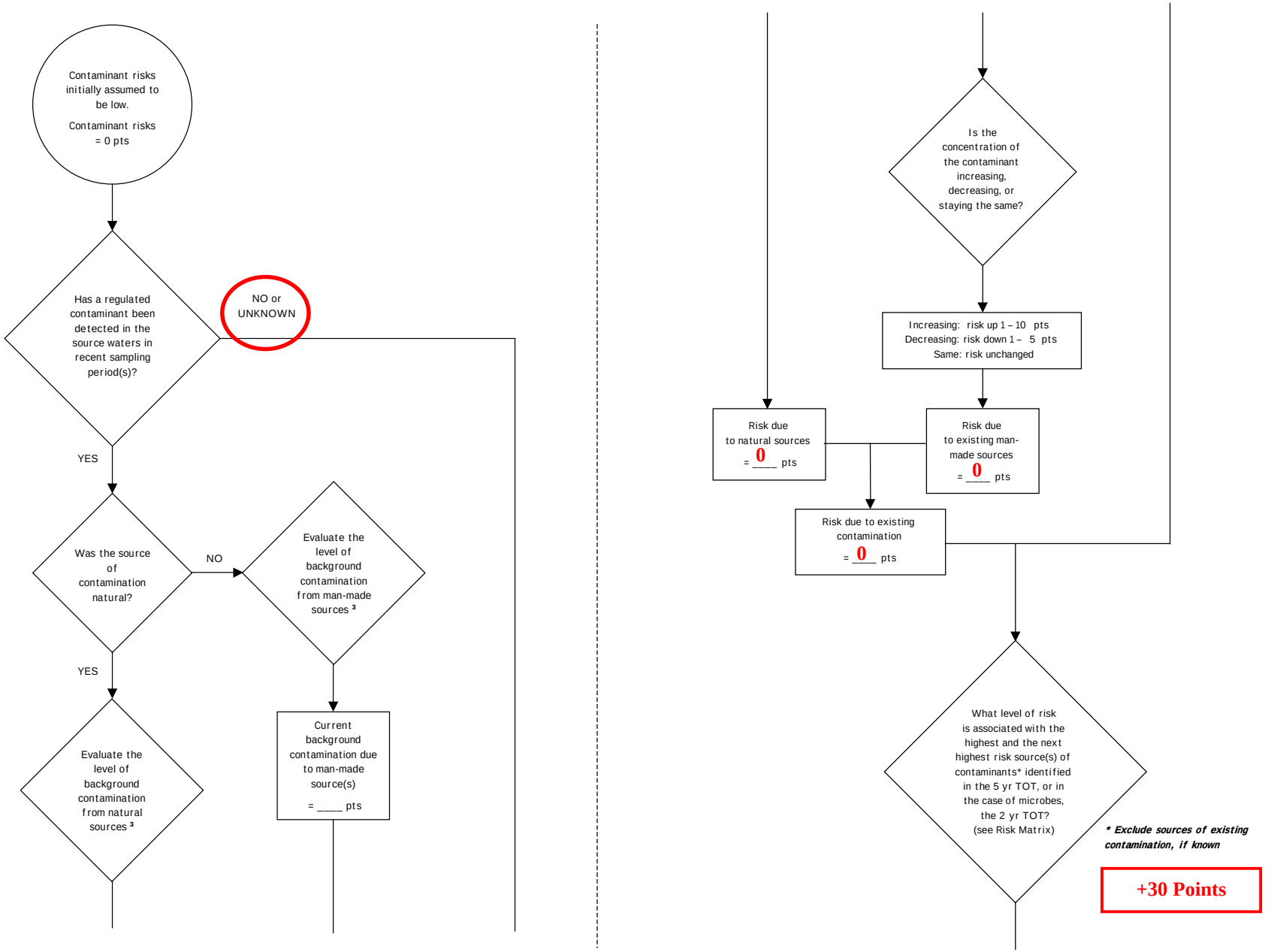
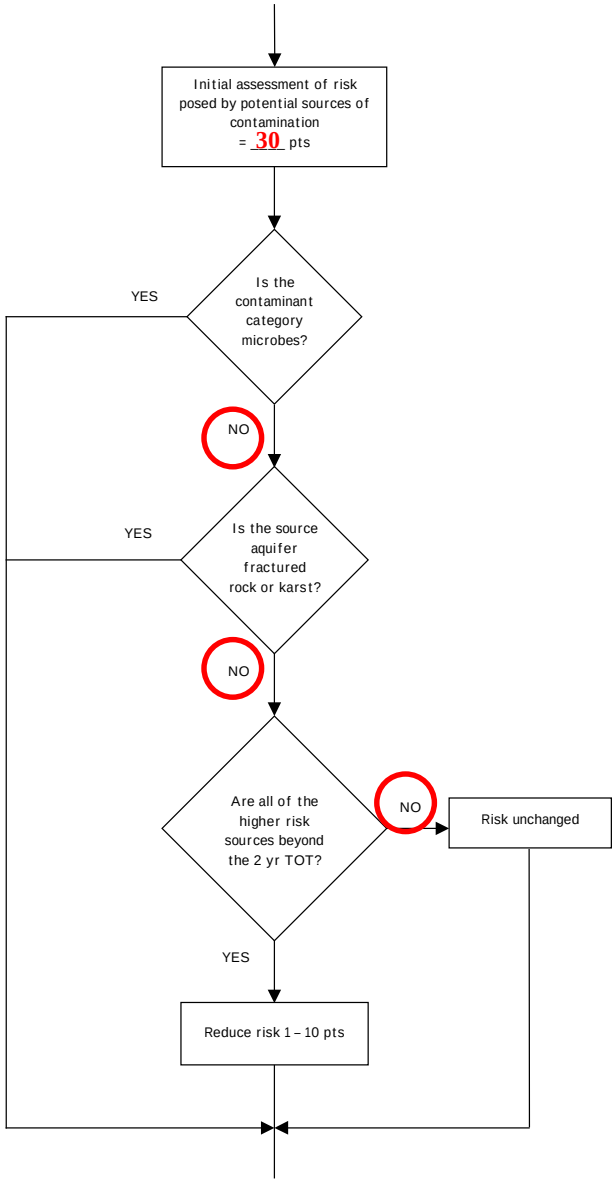


Chart 12. Contaminant risks for ASD Girdwood Elementary School – Synthetic Organic Chemicals (Continued)



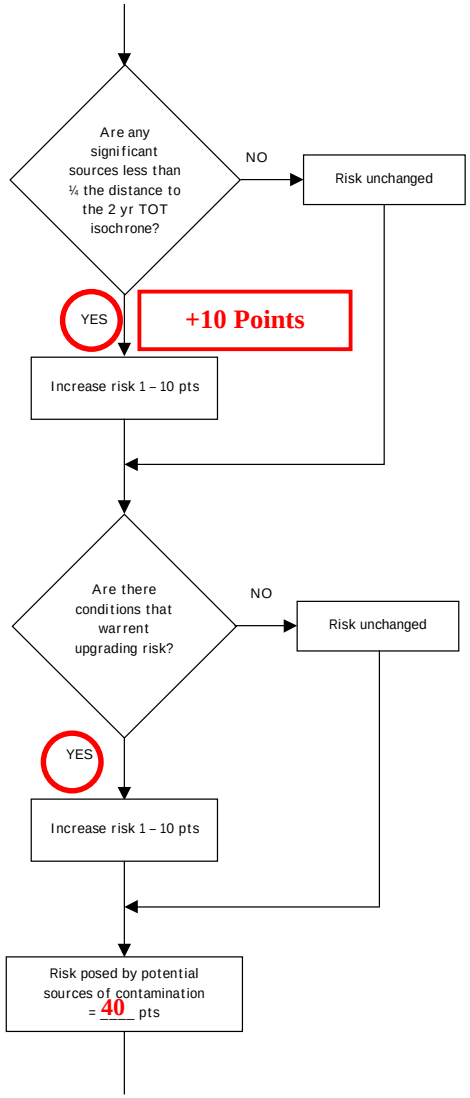
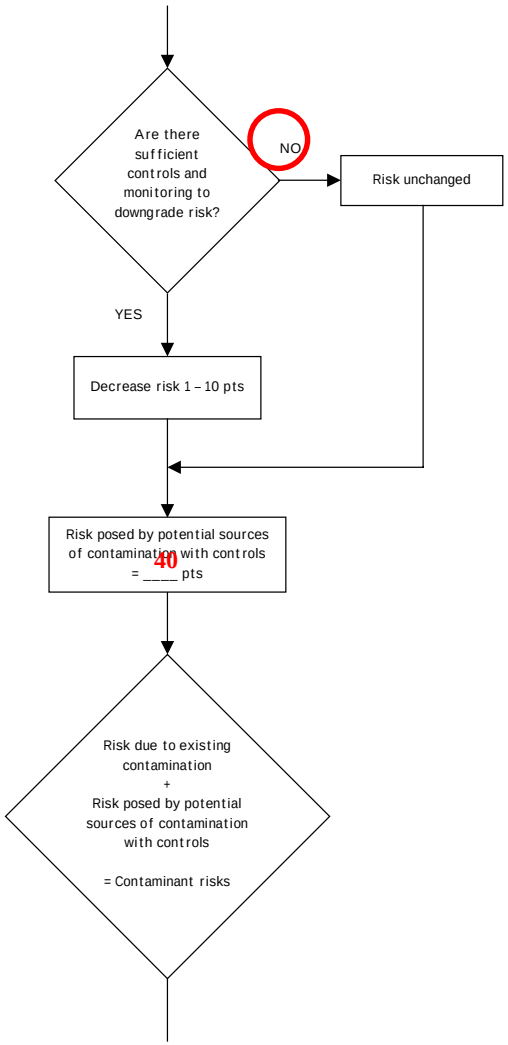
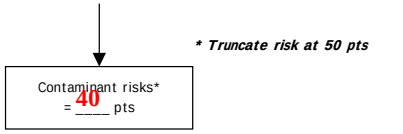


Chart 12. Contaminant risks for ASD Girdwood Elementary School – Synthetic Organic Chemicals (Continued)





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

Very High

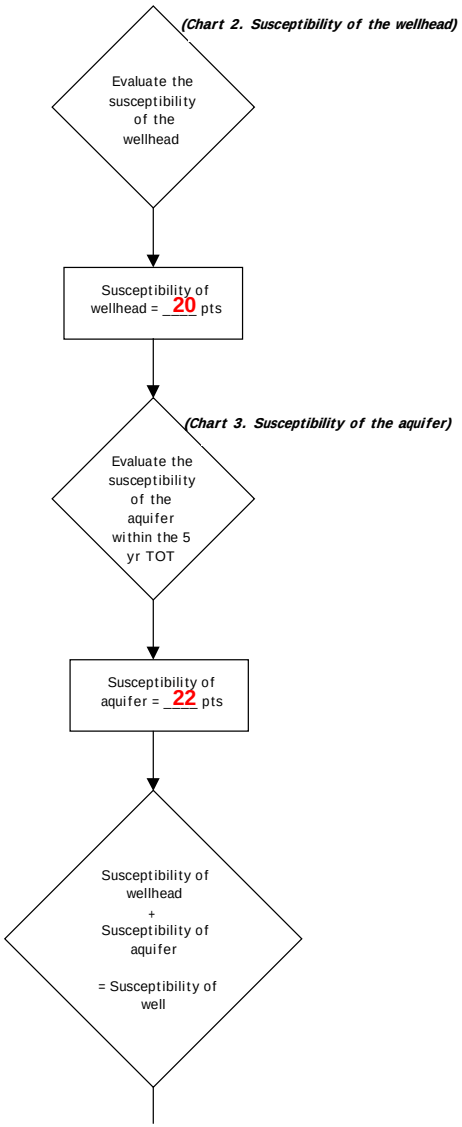
Table 5. Risk Matrix for Contaminant Sources for Synthetic Organic Chemicals – ASD Girdwood Elementary School

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Closed landfill is initially high risk for Synthetic organic chemicals	**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 13. Vulnerability analysis for Other Synthetic Organic Chemicals – ASD Girdwood Elementary School



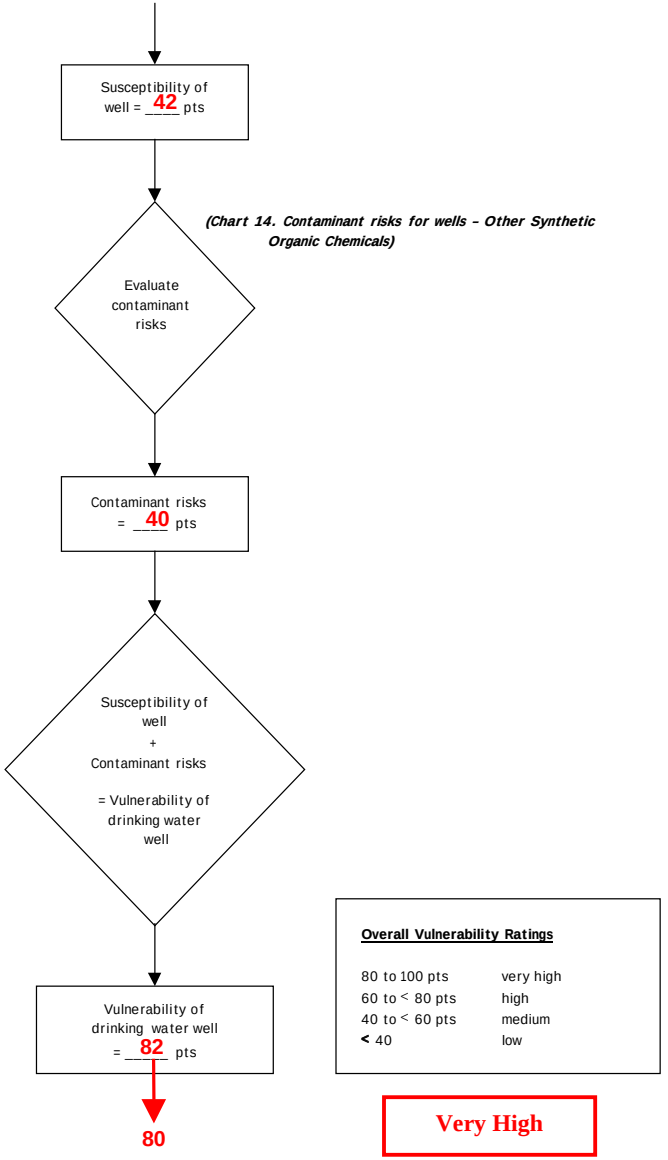


Chart 14. Contaminant risks for ASD Girdwood Elementary School – Other Synthetic Organic Chemicals

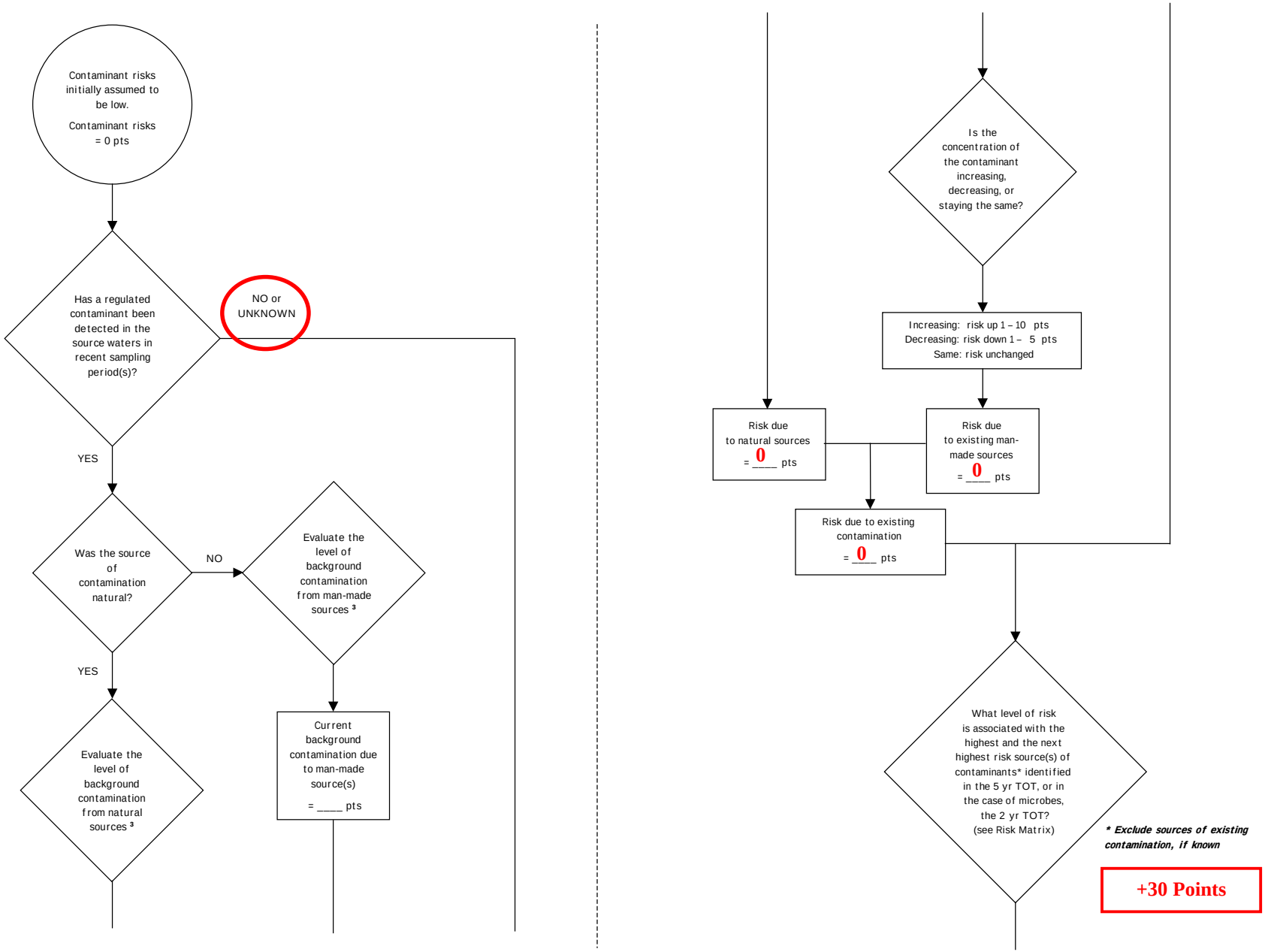
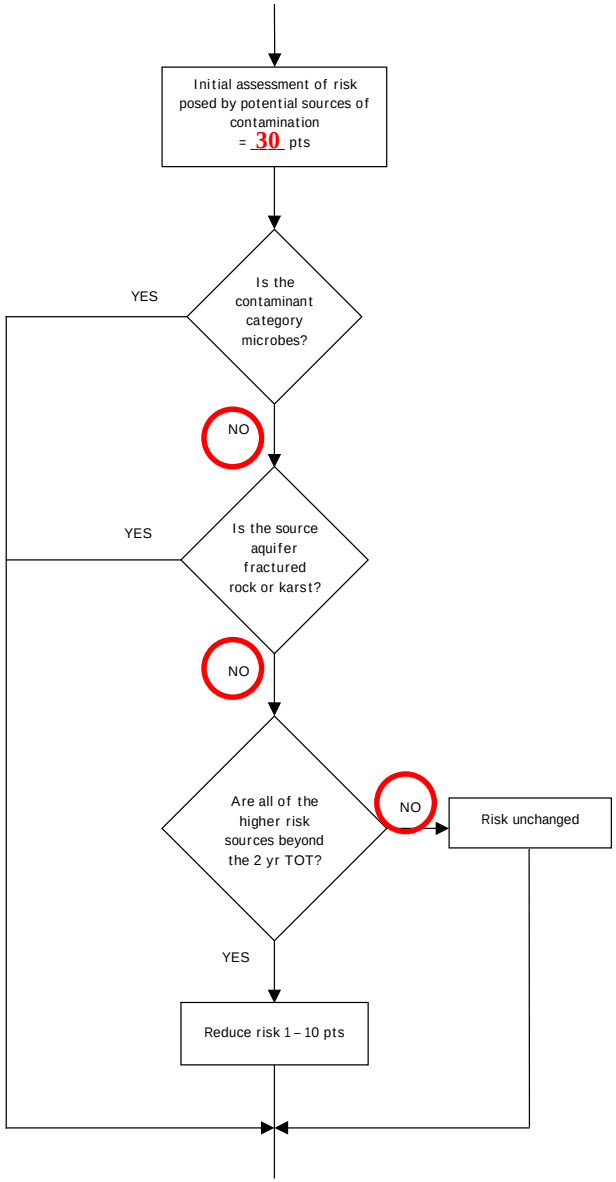


Chart 14. Contaminant risks for ASD Girdwood Elementary School – Other Synthetic Organic Chemicals (Continued)



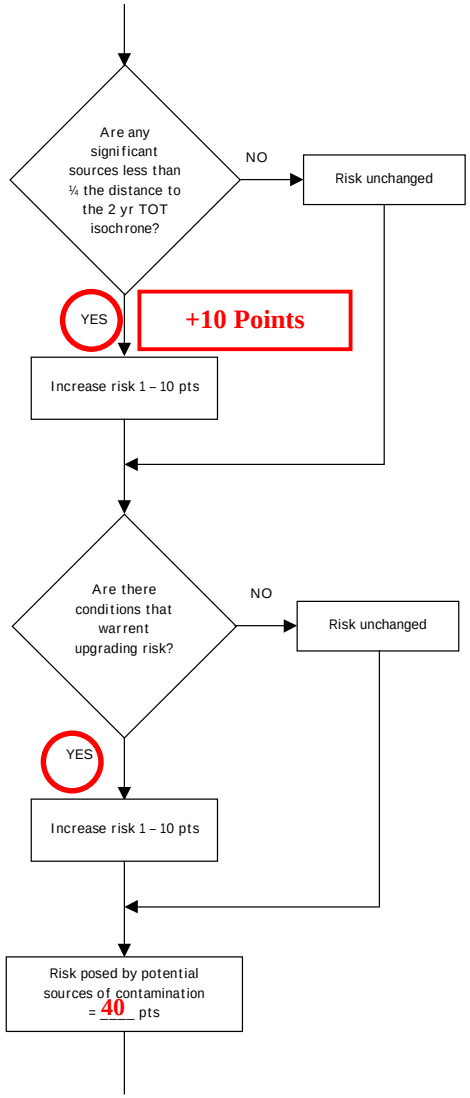
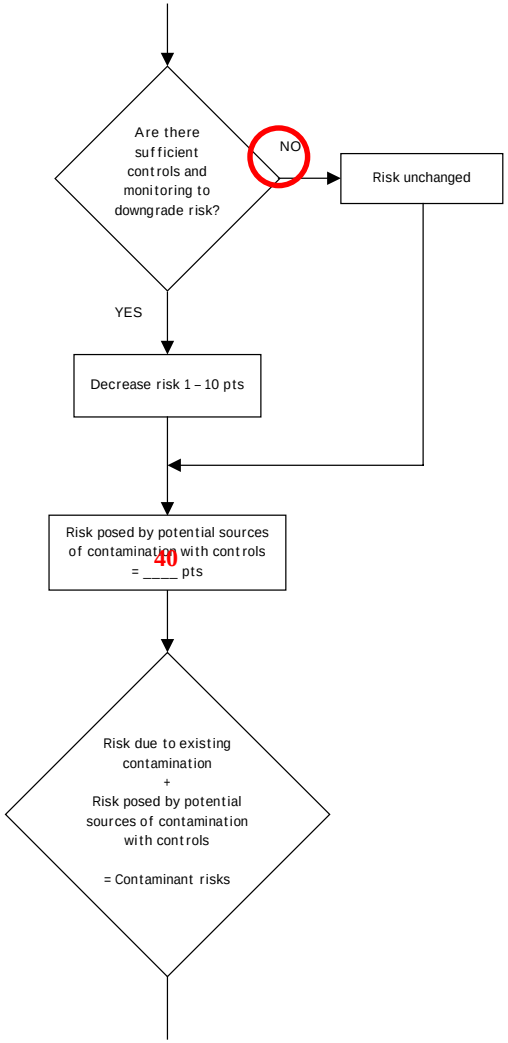
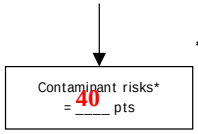


Chart 14. Contaminant risks for ASD Girdwood Elementary School – Other Synthetic Organic Chemicals (Continued)





**** 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

Very High

Table 6. Risk Matrix for Contaminant Sources for Other Synthetic Organic Chemicals – ASD Girdwood Elementary School

Level of Risk Associated with the Highest Risk Sources

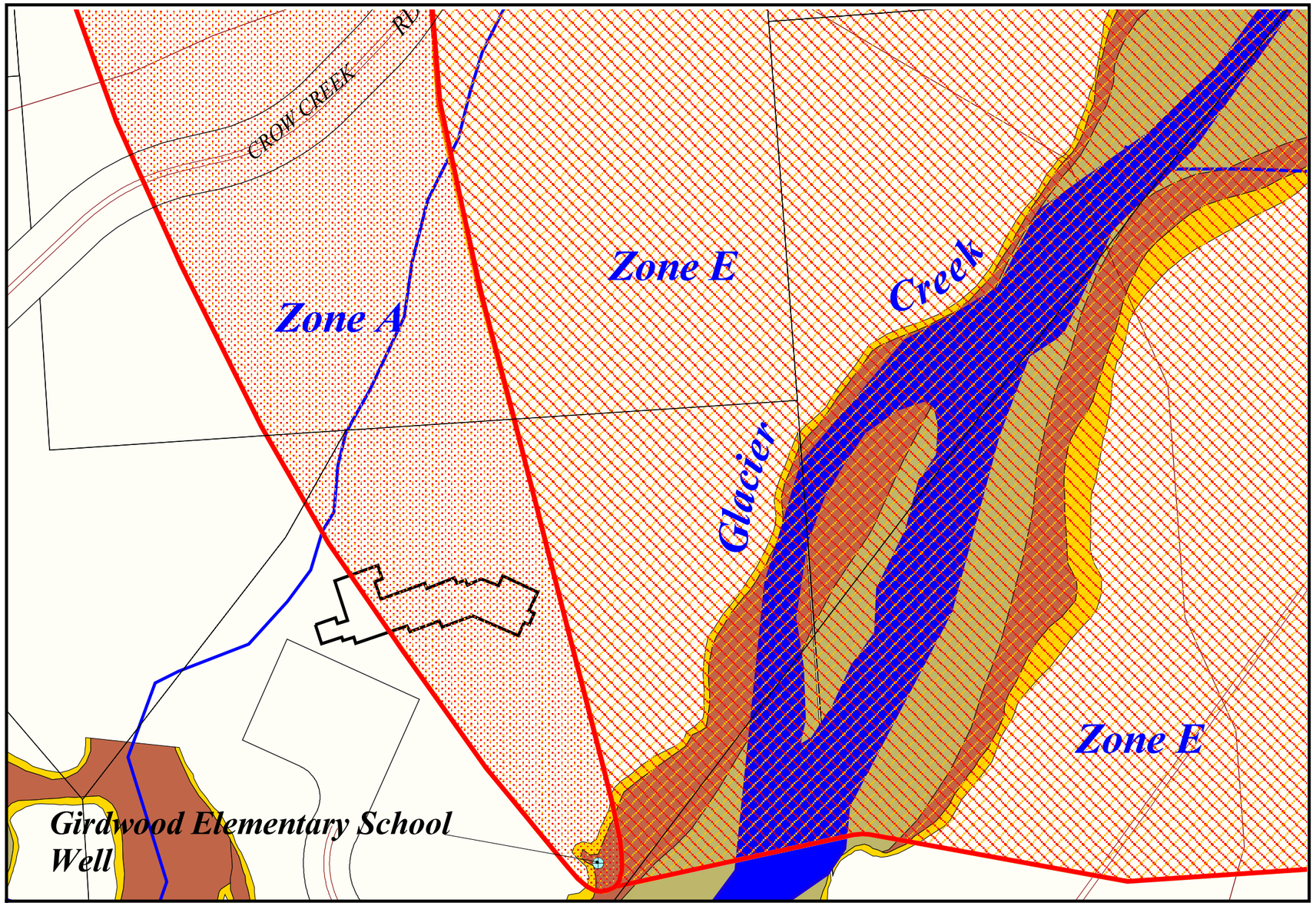
Next Highest Risk Sources(s)

Closed landfill is initially high risk for other synthetic organic chemicals	**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

APPENDIX E

Map of ASD Girdwood Elementary School's Drinking Water Protection Areas and Floodplain Hazards

ASD Girdwood Elementary School (PWSID 210710)
Drinking Water Protection Areas and Floodplain Hazards



ASD Girdwood Elementary School Well
MOA Land Parcels
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
ASD Girdwood Elementary
MOA Roads
2nd order streams
3rd order streams
4th order streams
Elevation Contours
Glacier Creek
Buildings
MOA Floodplains
100 YEAR
500 YEAR
FLOODWAY

Floodplains base from Municipality of Anchorage (2000), after U.S. Army Corps of Engineers

N
W E
S

Map 7