Source Water Assessment for Seventh Day Adventist School Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

DRINKING WATER PROTECTION PROGRAM REPORT 157

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Source Water Assessment for Seventh Day Adventist School's Source of Public Drinking Water, Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

By Heather A. Hammond

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Public Water System for Seventh Day Adventist School is a Class A (non-transient/non-community) water system consisting of one well in the Anchorage area. Identified potential and current sources of contaminants for Seventh Day Adventist School include: residential septic systems, highways and roads, activities associated with parks and recreation trails, approximately 87 acres of residential area, and a public utility corridor. 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 organic chemicals. Overall, the public water sources for Seventh Day Adventist School received a vulnerability rating of **Low** for volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals; and **Medium** for bacteria and viruses and nitrates and/or nitrites.

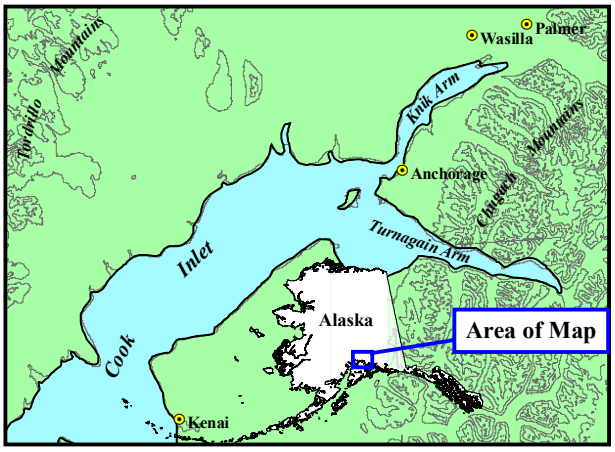


Figure 1. Index map showing the location of Anchorage, Alaska

INTRODUCTION

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

DESCRIPTION OF THE ANCHORAGE AREA, ALASKA

Location

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

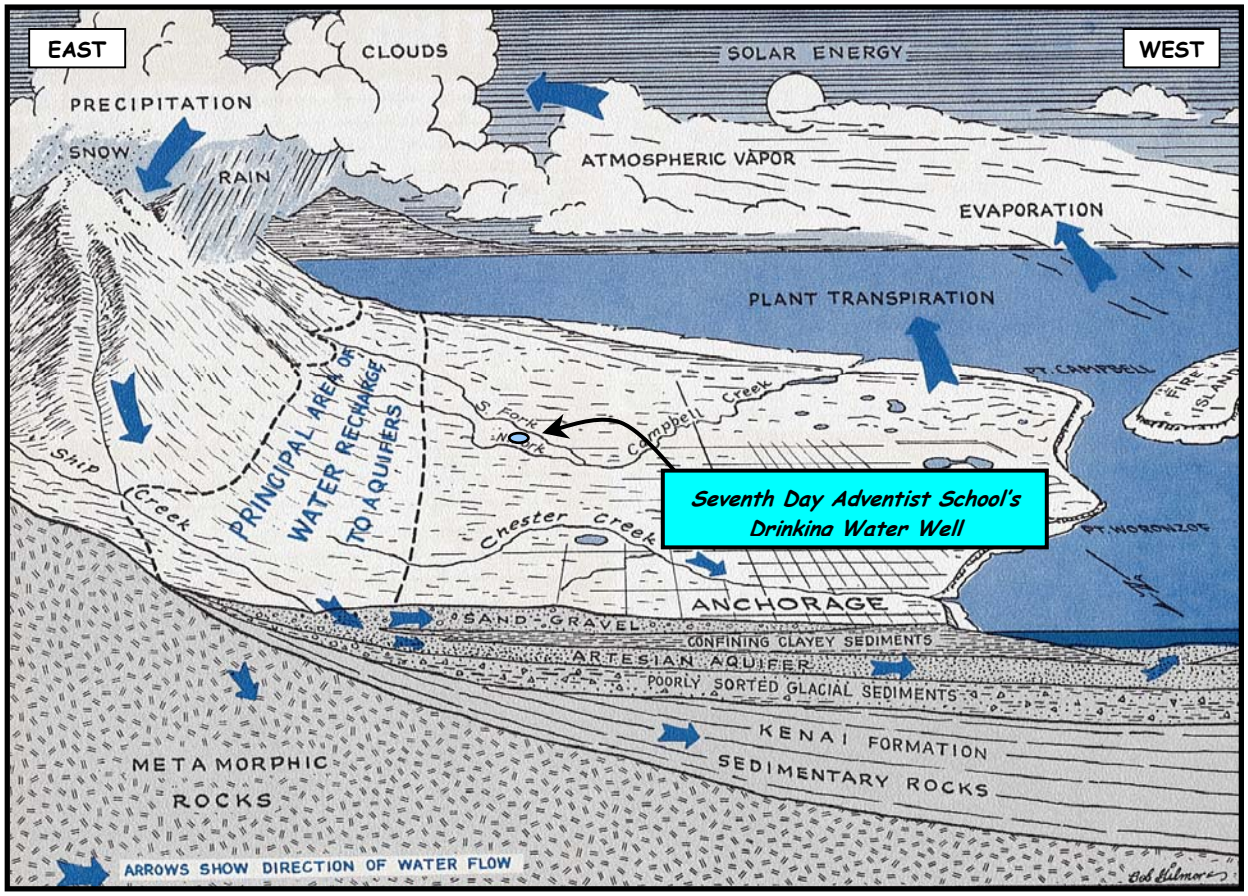


Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

Climate

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

Physiography and Groundwater Conditions

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

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

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

Water enters or recharges these two aquifer systems in several different ways. Along the front of the Chugach

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

SEVENTH DAY ADVENTIST SCHOOL'S PUBLIC DRINKING WATER SYSTEM

Seventh Day Adventist School's public water system is a Class A (non-transient/non-community) water system, which is owned and operated by Seventh Day Adventist School, of Anchorage. The system consists of one well, which is located approximately ten feet south of the school (T12N, R3W, Section 15), near the intersection of Birch Street and O'Malley Road at an elevation of approximately 500 feet above sea level (see Figure 3).

According to the most recent Sanitary Survey (07/26/98) the ground surrounding the well site slopes away from the well providing satisfactory drainage. The well was properly installed with a cap which may provide protection against contaminants from entering the source waters at the well casing. Installation of the well occurred August 23, 1966 to a total depth of 113 feet below ground surface and was completed in a 6" well casing. It is not indicated on the well log whether the well was properly grouted at the time of drilling. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year round and serves 45 non-residents through one service connection.

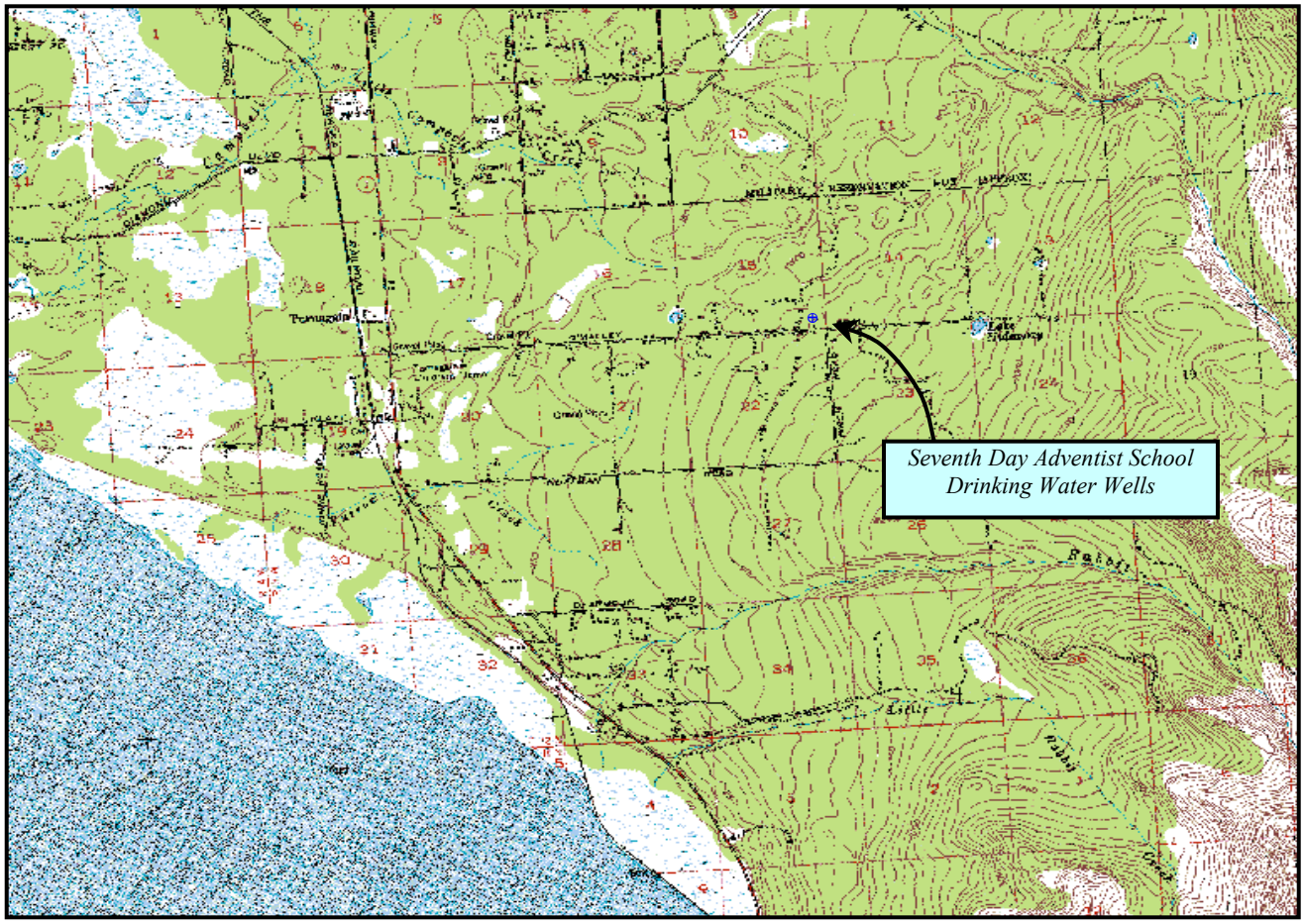


Figure 3. Map showing the location of the drinking water sources for Seventh Day Adventist School [Base: USGS Anchorage A8].

ASSESSMENT AND PROTECTION AREA FOR SEVENTH DAY ADVENTIST SCHOOL'S DRINKING WATER SOURCE

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

Conceptually, groundwater enters the aquifer systems along the front range of the Chugach Mountains (Figure 2) and flows toward Cook Inlet. An analytical calculation was used to determine the size and shape of the area that contributes water to the well. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey [*Patrick, Brabets, and Glass, 1989*]. This analytical calculation was used as a guide as the first step in establishing the protection area for each public drinking water source in Anchorage. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at meaningful and conservative protection areas with respect to public health (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

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

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Drinking Water Protection Area for Seventh Day Adventist School. 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 public water system 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
- Other organic chemicals

Maps 2 through 5 in Appendix C depict the Contaminant Source Inventory for Seventh Day Adventist School. Table 1 in Appendix B lists the inventoried potential sources of contamination within Zones A through D. Below is a summary of the contaminant sources inventoried within the Drinking Water Protection Area for Seventh Day Adventist School:

- Residential septic systems;
- highways and roads;
- activities associated with parks and recreation trails;
- approximately 87 acres of residential area;
- a public utility corridor.

These potential and existing contaminant sources present risk for all six categories of drinking water contaminants for Seventh Day Adventist School's source of public drinking water.

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 public drinking water wells.

VULNERABILITY OF SEVENTH DAY ADVENTIST SCHOOL'S DRINKING WATER SOURCE

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

- natural susceptibility; and
- contaminant risks.

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

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

Susceptibility of the Wellhead (0 – 25 Points)
+
Susceptibility of the Aquifer (0 – 25 Points)

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

The well serving Seventh Day Adventist School was completed in a confining aquifer. The depth to the top of the confining unit is approximately 40 feet below land surface. The thickness of the confining layer is suspected to be approximately 60 feet and composed of silty clay, gravelly hardpan with intermittent layers of gravelly clay. This confining layer may provide a protective barrier against the movement of contaminants in the subsurface. However, near the base of the Chugach Mountains, these clay layers tend to be discontinuous and thin toward the mountains. Therefore, contaminants that enter the subsurface near the base of the mountains may enter the confined aquifer uninhibited by the absence of any protective layer.

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

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

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

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

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	22	Medium
Nitrates and/or Nitrites	22	Medium
Volatile Organic Chemicals	12	Low
Heavy Metals, Cyanide, And Other Inorganic Chemicals	12	Low
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	Low

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a Class A public drinking water system. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analysis for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.

Vulnerability of drinking water sources 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 Seventh Day Adventist School's Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	40	Medium
Nitrates and Nitrites	40	Medium
Volatile Organic Chemicals	30	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	30	Low
Synthetic Organic Chemicals	30	Low
Other Organic Chemicals	30	Low

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

Overall, contaminant risks for bacteria and viruses are medium with residential septic systems driving the increase of contaminant risks. Combining this potential bacteria and viruses contamination risk with the natural susceptibility of the well leads to an overall vulnerability to contamination of medium.

Other low potential and existing sources of contamination for bacteria and viruses include activities associated with residential areas, parks and recreation trails and highways and roads.

Historical sampling data indicates that no nitrates and/or nitrites have been detected in Seventh Day Adventist School's source waters (See Chart 5 – Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Overall, contaminant risks for nitrates and/or nitrites are medium with the density of residential septic systems driving the increase of contaminant risks. Combining this potential nitrates and/or nitrites contamination risk with the natural susceptibility of the well leads to an overall vulnerability to contamination of medium.

Other low potential and existing sources of nitrates and/or nitrites for Seventh Day Adventist School's source waters include activities associated with residential areas, parks and recreation trails, and highways and roads.

Overall, contaminant risk for volatile organic chemicals is low with highways and roads and residential septic systems driving the increase of contaminant risks. Combining this potential volatile organic chemical contamination risk with the natural susceptibility of the well leads to an overall vulnerability to contamination of low.

Other low potential and existing sources of volatile organic chemicals include activities associated with residential areas and a public utility easement corridor.

A natural gas pipeline transverses the Zone C Protection Area. Natural gas does not pose a threat to drinking water supplies. However, this area is an active public utility corridor. This utility corridor, though not heavily used represents a very low contamination risk from volatile organic chemicals due to activities along the corridor. Overall, this corridor ranks as a low potential source of contamination due to its proximity to Seventh Day Adventist School's source of public drinking water.

Overall, contaminant risks for heavy metals, cyanide and other inorganic chemicals is low with highways and roads, residential septic systems and residential areas driving the increase of potential contaminant risks. Combining this potential contaminant risk with the natural susceptibility of the well leads to an overall vulnerability to contamination of low.

Overall, contaminant risks for synthetic organic chemicals and other organic chemicals is low with highways and roads and residential septic systems driving the increase of potential contaminant risks for both categories. Combining this potential contaminant risk with the natural susceptibility of the well leads to an overall vulnerability to contamination of low.

Other low potential sources of contamination for synthetic organic chemicals and other organic chemicals include activities associated with residential areas.

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Seventh Day Adventist School. The overall vulnerability of this source to contamination is **Low** for volatile organic chemicals heavy metals, synthetic organic chemicals, and other organic chemicals and **Medium** for bacteria and viruses and nitrates and/or nitrites. 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 Seventh Day Adventist School 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 Seventh Day Adventist School 's public drinking water source.

REFERENCES CITED

Barnwell, W.W., George, R.S., Dearborn, L.L., Weeks, J.B., and Zenone, C., 1972, Water for Anchorage: an atlas of the water resources of the Anchorage area, Alaska: U.S. Geological Survey Open-File Report, 76 p.

Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: U.S. Geological Survey Water-Resources Investigations Report 88-4139, 41p.

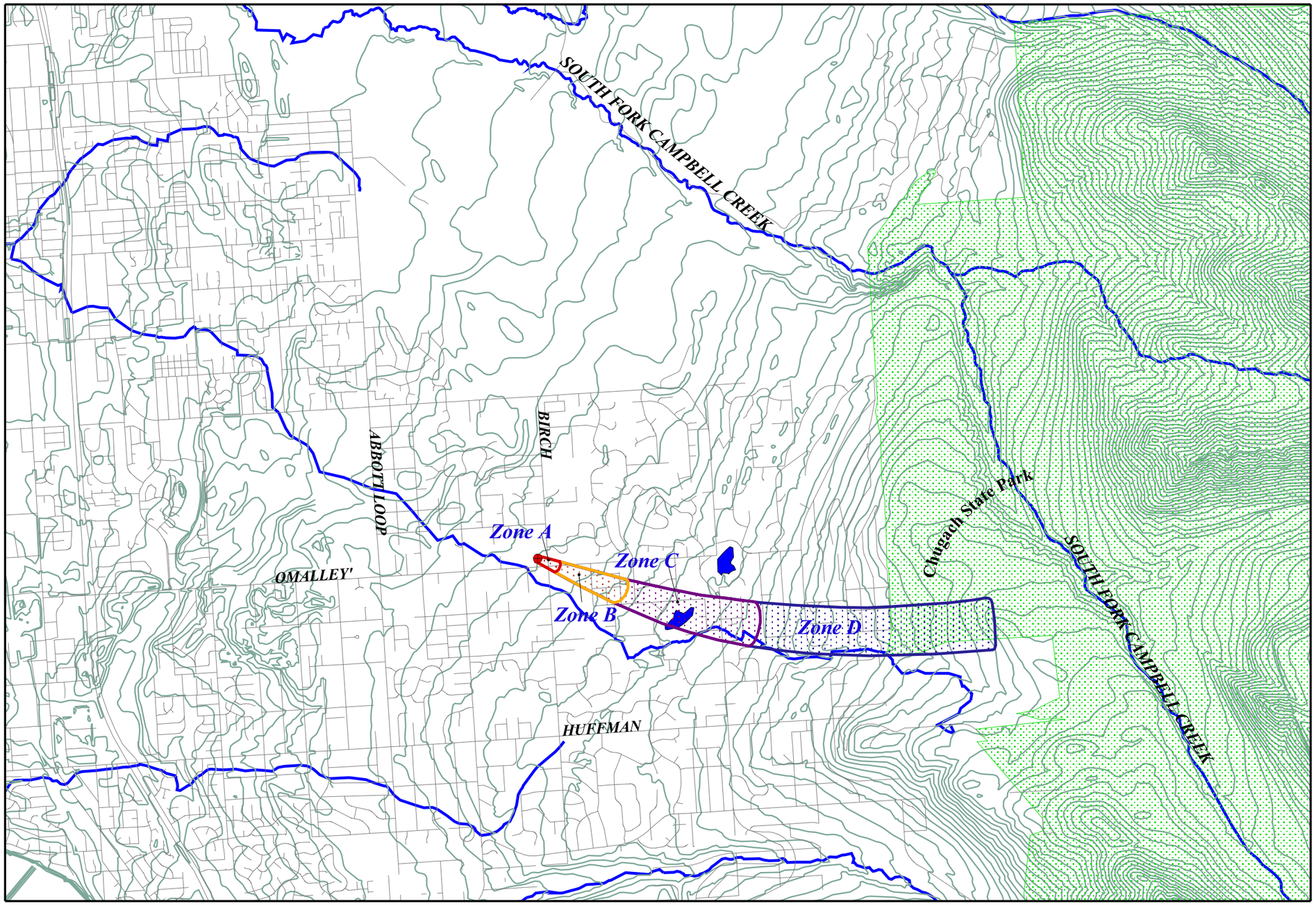
Ulery, C.A. and Updike, R.G, 1983, Subsurface structure of the cohesive facies of the Bootlegger Cove Formation, Southwest Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 84, 5 p.

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

Seventh Day Adventist School
Drinking Water Protection Area

Drinking Water Protection Area for Seventh Day Adventist School



- Seventh Day Adventist School Well

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Areas
- Less Than 2 Years Travel Time

Zone C Protection Areas
- Less Than 10 Years Travel Time

Zone D Protection Areas
- Less Than 5 Years Travel Time
- Anchorage Roads
- Chugach State Park
- Elevation Contours
- MOA Lakes
- Anchorage Streams

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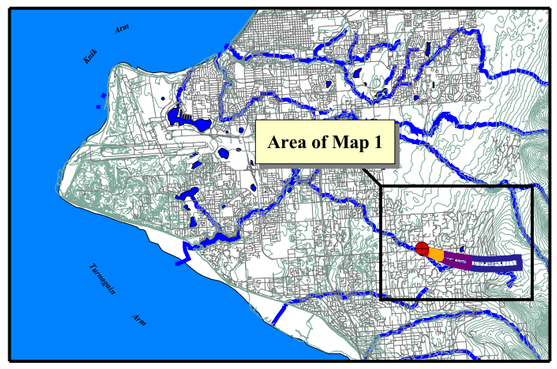


9000 0 9000 Feet

PWSID 210702.001

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Seventh Day Adventist School

Table 1

Contamiant Source Inventory for
Seventh Day Adventist School

PWSID 210702.001

Contaminant Source Category	Contaminant Source ID	CS ID Tag	Zone	Location	Map	Comments
Residential Areas	R01	R1-1	A	3 acres of residential area within Zone A	3	
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-3	A	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-4	A	Off of O'Malley Road	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Birch Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	O'Malley Road	2	
Dog walking areas/foot trails	X46	X46-1	A	Along the north side of O'Malley Road	3	
Dog walking areas/foot trails	X46	X46-2	A	Along the west side of Birch Street	3	
Dog walking areas/foot trails	X46	X46-3	A	Along the east side of Birch Street	3	
Dog walking areas/foot trails	X46	X46-4	A	Along the south side of O'Malley Road	3	
Residential Areas	R01	R1-2	B	14 acres of residential area within Zone B	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Along Michigan Blvd.	3	

Septic systems (serves one or more single-family homes)	R2	R2-18	B	Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Along Woodmont Drive	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Rockridge Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	O'Malley Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Michigan Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Magnolia Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Wildwood Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Michigan Blvd.	2	
Residential Areas	R01	R1-3	C	70 acres of residnetial area within Zone C	4	
Septic systems (serves one or more single-family homes)	R2	R2-23-109	C	Septic System located within Zone C	4	
Highways and roads, paved (cement or asphalt)	X20	X20-9-24	C	All roads located within Zone C	2	
Municipal or city parks (with green areas)	X4	X4-1	C	Along One-hundred-and-twelfth Ave.	2	
Public utility easements/corridors	X42	X42-1	C	Public utility corridor along the 12" pipeline	2	Pipeline transports natural gas
Dog walking areas/foot trails	X46	X46-5	C	Along the west side of Hillside Drive	4	

Dog walking areas/foot trails	X46	X46-6	C	Along the east side of Hillside Drive	4	
Dog walking areas/foot trails	X46	X46-7	C	Near Little Campbell Creek	4	

Table 2

Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Bacteria and Viruses

PWSID 210702.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Low	1	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Low	2	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-3	A	Low	3	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-4	A	Low	4	Off of O'Malley Road	3	
Residential Areas	R01	R1-1	A	Low	5	3 acres of residential area within Zone A	3	
Dog walking areas/foot trails	X46	X46-1	A	Low	6	Along the north side of O'Malley Road	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	7	Along the west side of Birch Street	3	
Dog walking areas/foot trails	X46	X46-3	A	Low	8	Along the east side of Birch Street	3	
Dog walking areas/foot trails	X46	X46-4	A	Low	9	Along the south side of O'Malley Road	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Very Low	10	Birch Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Very Low		O'Malley Road	2	
Residential Areas	R01	R1-2	B	Low		14 acres of residential area within Zone B	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Very Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Very Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Very Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Very Low		Along Michigan Blvd.	3	

Septic systems (serves one or more single-family homes)	R2	R2-5	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Very Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Very Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Very Low		Along Woodmont Drive	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Very Low		Rockridge Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Very Low		O'Malley Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Very Low		Michigan Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Very Low		Magnolia Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Very Low		Wildwood Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Very Low		Michigan Blvd.	2	
Residential Areas	R01	R1-3	C	Low		70 acres of residnetial area within Zone C	4	
Septic systems (serves one or more single-family homes)	R2	R2-23-109	C	Very Low		Septic System located within Zone C	4	
Highways and roads, paved (cement or asphalt)	X20	X20-9-24	C	Very Low		All roads located within Zone C	2	
Municipal or city parks (with green areas)	X4	X4-1	C	Low		Along One-hundred-and-twelfth Ave.	2	
Dog walking areas/foot trails	X46	X46-5	C	Low		Along the west side of Hillside Drive	4	
Dog walking areas/foot trails	X46	X46-6	C	Low		Along the east side of Hillside Drive	4	
Dog walking areas/foot trails	X46	X46-7	C	Low		Near Little Campbell Creek	4	

Table 3

Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Nitrates/Nitrites

PWSID 210702.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Low	1	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Low	2	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-3	A	Low	3	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-4	A	Low	4	Off of O'Malley Road	3	
Residential Areas	R01	R1-1	A	Low	5	3 acres of residential area within Zone A	3	
Dog walking areas/foot trails	X46	X46-1	A	Low	6	Along the north side of O'Malley Road	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	7	Along the west side of Birch Street	3	
Dog walking areas/foot trails	X46	X46-3	A	Low	8	Along the east side of Birch Street	3	
Dog walking areas/foot trails	X46	X46-4	A	Low	9	Along the south side of O'Malley Road	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Very Low	10	Birch Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Very Low		O'Malley Road	2	
Residential Areas	R01	R1-2	B	Low		14 acres of residential area within Zone B	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Very Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Very Low		Along Wildwood Street	3	

Septic systems (serves one or more single-family homes)	R2	R2-21	B	Very Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Very Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Very Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Very Low		Along Woodmont Drive	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Very Low		Rockridge Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Very Low		O'Malley Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Very Low		Michigan Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Very Low		Magnolia Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Very Low		Wildwood Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Very Low		Michigan Blvd.	2	
Residential Areas	R01	R1-3	C	Low		70 acres of residnetial area within Zone C	4	
Septic systems (serves one or more single-family homes)	R2	R2-23-109	C	Very Low		Septic System located within Zone C	4	
Highways and roads, paved (cement or asphalt)	X20	X20-9-24	C	Very Low		All roads located within Zone C	2	
Municipal or city parks (with green areas)	X4	X4-1	C	Low		Along One-hundred-and-twelfth Ave.	2	
Dog walking areas/foot trails	X46	X46-5	C	Low		Along the west side of Hillside Drive	4	
Dog walking areas/foot trails	X46	X46-6	C	Low		Along the east side of Hillside Drive	4	
Dog walking areas/foot trails	X46	X46-7	C	Low		Near Little Campbell Creek	4	

Table 4

Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Volatile Organic Chemicals

PWSID 210702.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	1	Birch Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	2	O'Malley Road	2	
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Low	3	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Low	4	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-3	A	Low	5	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-4	A	Low	6	Off of O'Malley Road	3	
Residential Areas	R01	R1-1	A	Low	7	3 acres of residential area within Zone A	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	8	Rockridge Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	9	O'Malley Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	10	Michigan Blvd.	2	
Residential Areas	R01	R1-2	B	Low		14 acres of residential area within Zone B	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Very Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Very Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Very Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Very Low		Along Wildwood Street	3	

Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Volatile Organic Chemicals

Septic systems (serves one or more single-family homes)	R2	R2-22	B	Very Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Very Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Very Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Very Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Very Low		Along Woodmont Drive	3	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Low		Magnolia Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Low		Wildwood Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Low		Michigan Blvd.	2	
Residential Areas	R01	R1-3	C	Low		70 acres of residnetial area within Zone C	4	
Septic systems (serves one or more single-family homes)	R2	R2-23-109	C	Very Low		Septic System located within Zone C	4	
Highways and roads, paved (cement or asphalt)	X20	X20-9-24	C	Low		All roads located within Zone C	2	
Public utility easements/corridors	X42	X42-1	C	Low		easement/corridor along the 12" pipeline	2	Pipeline transports natural gas

Table 5 **PWSID 210702.001**

Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Residential Areas	R01	R1-1	A	Low	1	3 acres of residential area within Zone A	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	Birch Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	3	O'Malley Road	2	
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Low	4	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Low	5	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-3	A	Low	6	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-4	A	Low	7	Off of O'Malley Road	3	
Residential Areas	R01	R1-2	B	Low	8	14 acres of residential area within Zone B	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	9	Rockridge Road	2	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Low	10	Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Low		Along Michigan Blvd.	3	

Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

Septic systems (serves one or more single-family homes)	R2	R2-5	B	Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Low		Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Low		Along Woodmont Drive	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		O'Malley Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low		Michigan Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Low		Magnolia Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Low		Wildwood Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Low		Michigan Blvd.	2	
Residential Areas	R01	R1-3	C	Low		70 acres of residnetial area within Zone C	4	
Septic systems (serves one or more single-family homes)	R2	R2-23-109	C	Low		Septic System located within Zone C	4	
Highways and roads, paved (cement or asphalt)	X20	X20-9-24	C	Low		All roads located within Zone C	2	

Table 6

Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Synthetic Organic Chemicals

PWSID 210702.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Residential Areas	R01	R1-1	A	Low	1	3 acres of residential area within Zone A	3	
Residential Areas	R01	R1-2	B	Low	2	14 acres of residential area within Zone B	3	
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Low	3	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Low	4	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-3	A	Low	5	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-4	A	Low	6	Off of O'Malley Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Low	7	Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Low	8	Along Woodmont Drive	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Low	9	Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Low	10	Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Low		Along Magnolia Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Low		Along Wildwood Street	3	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Low		Along Michigan Blvd.	3	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Low		Along Rockridge Road	3	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Low		Along Woodmont Drive	3	

Septic systems (serves one or more single-family homes)	R2	R2-9	B	Low		Along Woodmont Drive	3	
Residential Areas	R01	R1-3	C	Low		70 acres of residnetial area within Zone C	4	
Septic systems (serves one or more single-family homes)	R2	R2-23-109	C	Low		Septic System located within Zone C	4	
Municipal or city parks (with green areas)	X4	X4-1	C	Low		Along One-hundred-and-twelfth Ave.	2	

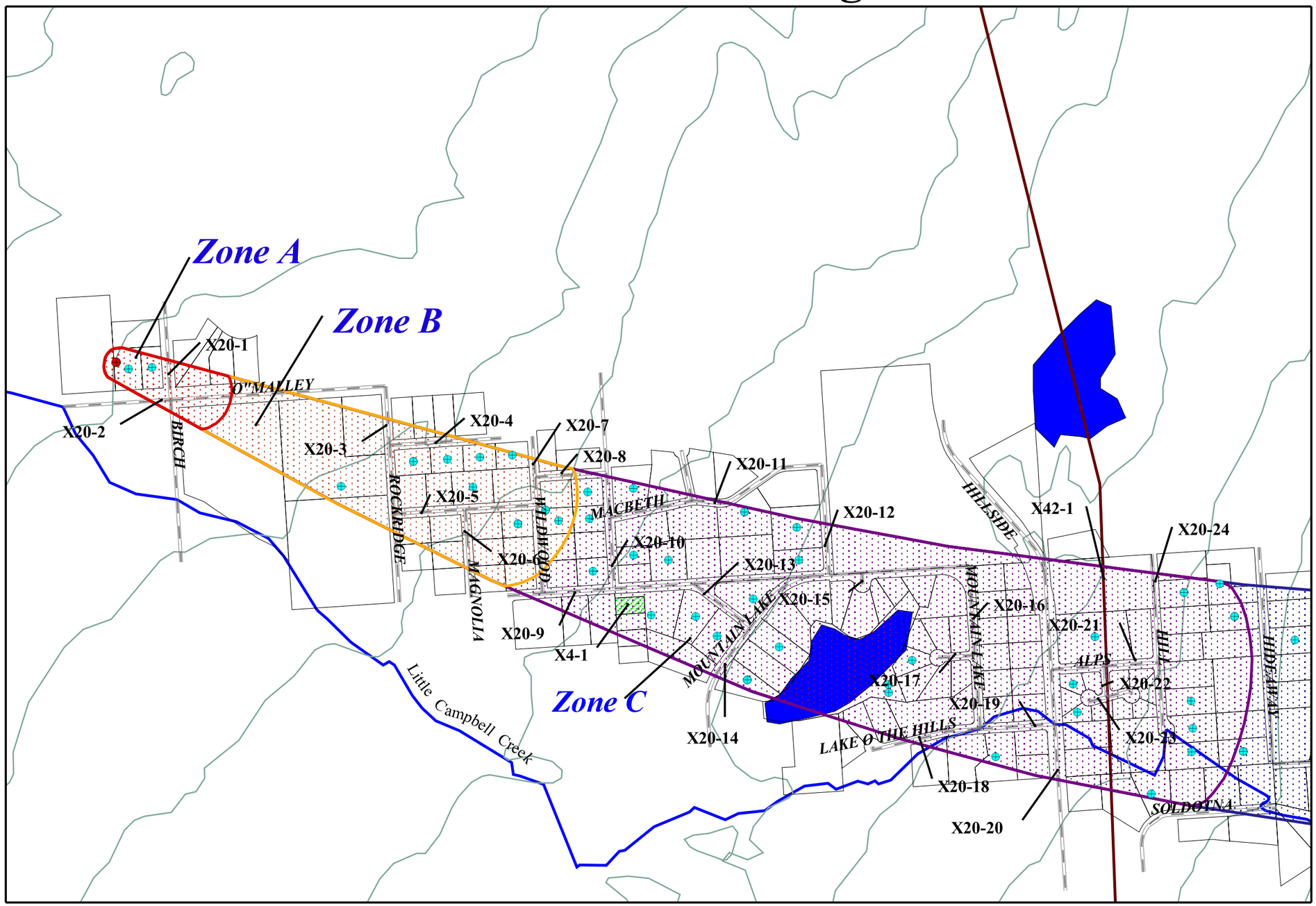
Contaminant Source Inventory and Risk Ranking for
Seventh Day Adventist School
Sources of Other Organic Chemicals

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Residential Areas	R01	R1-1	A	Low	1	3 acres of residential area within Zone A	3	
Residential Areas	R01	R1-2	B	Low	2	14 acres of residential area within Zone B	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	3	Birch Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	4	O'Malley Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	5	Rockridge Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		O'Malley Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low		Michigan Blvd.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Low		Magnolia Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Low		Wildwood Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Low		Michigan Blvd.	2	
Residential Areas	R01	R1-3	C	Low		70 acres of residnetial area within Zone C	4	
Highways and roads, paved (cement or asphalt)	X20	X20-9-24	C	Low		All roads located within Zone C	2	

APPENDIX C

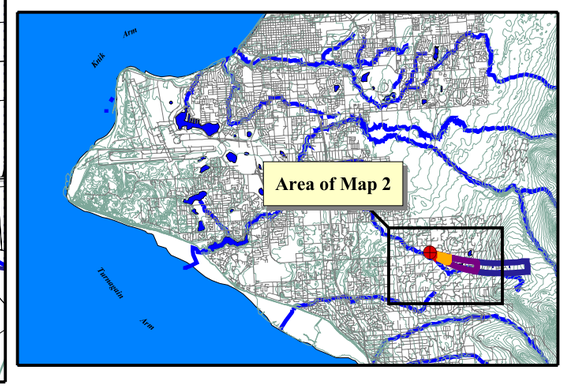
Seventh Day Adventist School
Drinking Water Protection Area
and Potential & Existing Contaminant Sources

Drinking Water Protection Area for Seventh Day Adventist School and Potential & Existing Contaminant Sources



Seventh Day Adventist School Well
Private & Public DW Wells
Zone A Protection Area
Several Months Travel Time
Zone B Protection Areas
Less Than 2 Years Travel Time
Zone C Protection Areas
Less Than 10 Years Travel Time
Zone D Protection Areas
Less Than 5 Years Travel Time
MOA Land Parcels
Roads (X20)
Public utility easements/corridors (X42)
Municipal or city parks (with green areas) (X4)
MOA Lakes
Elevation Contours
Anchorage Streams

N
W E
S

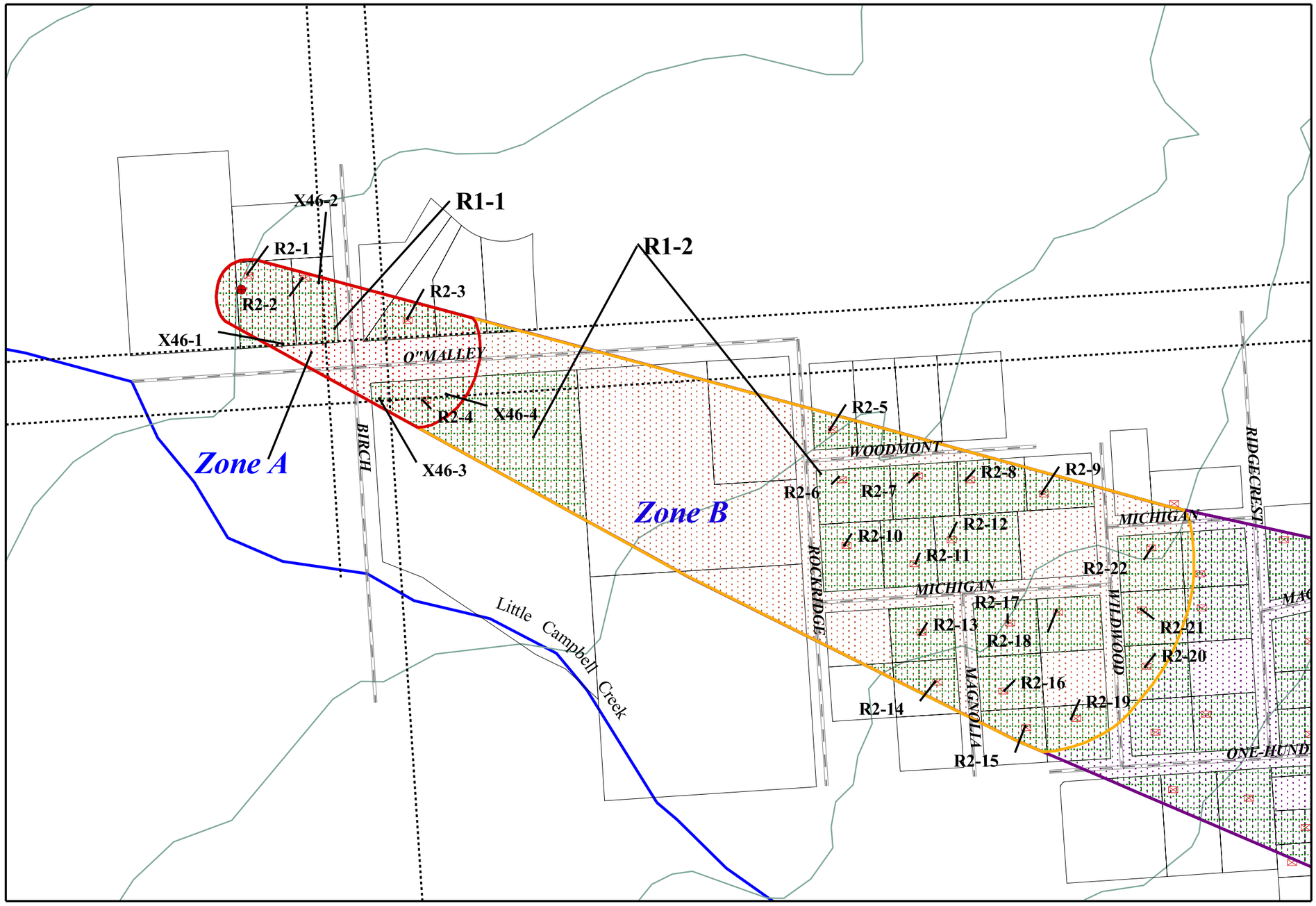


2000 0 2000 Feet

PWSID 210702.001

Map 2

Drinking Water Protection Area for Seventh Day Adventist School and Potential & Existing Contaminant Sources



- Seventh Day Adventist School Well

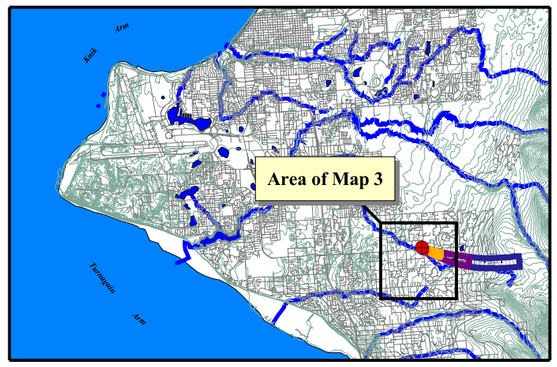
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Areas
- Less Than 2 Years Travel Time

Zone C Protection Areas
- Less Than 10 Years Travel Time

Zone D Protection Areas
- Less Than 5 Years Travel Time
- MOA Land Parcels
- Roads (X20)
- Trails (X46)
- Lawns and gardens (R1)
- Septic Systems (R2)
- Elevation Contours
- MOA Lakes
- Anchorage Streams

N W E S

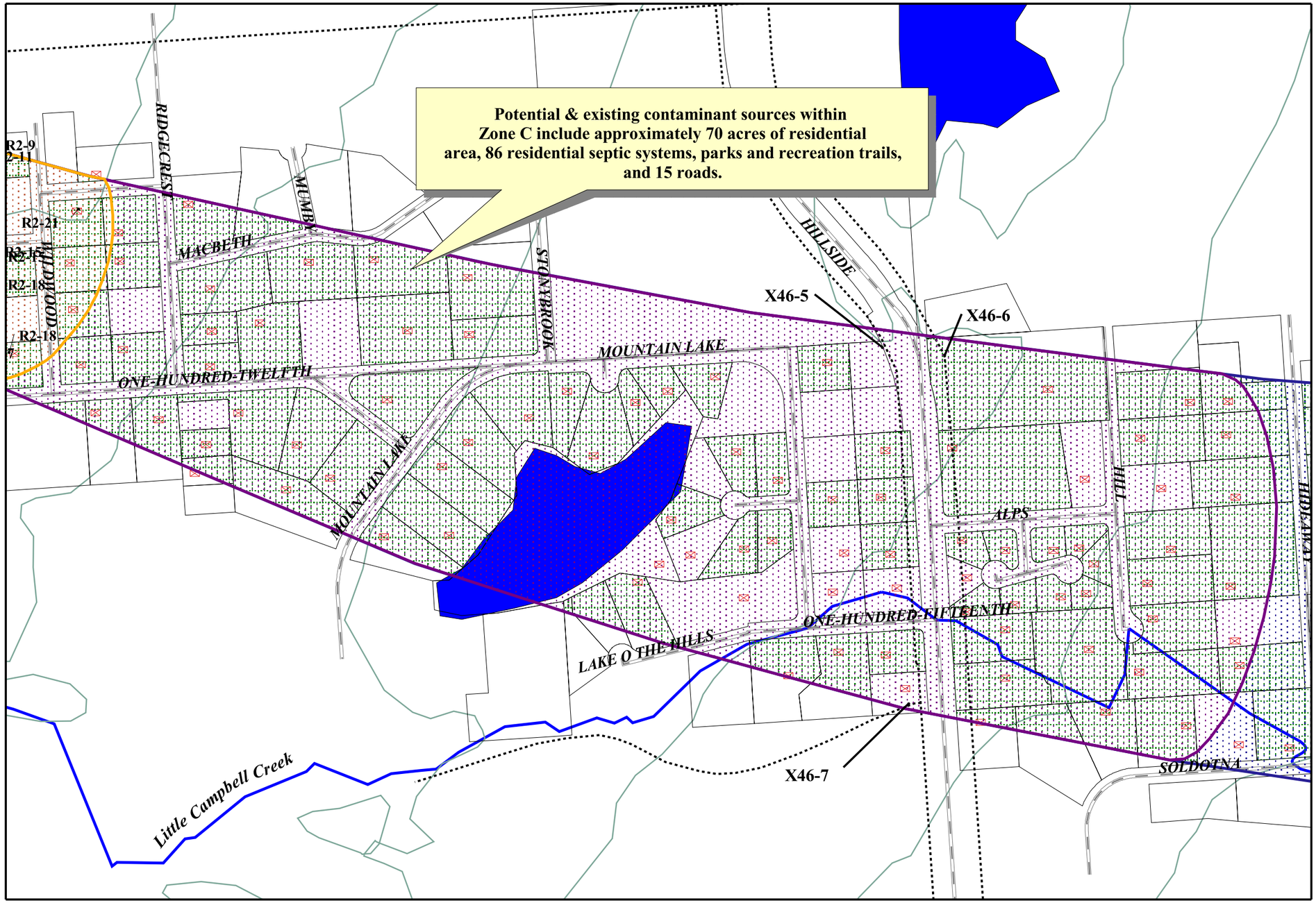


900 0 900 Feet

PWSID 210702.001

Map 3

Drinking Water Protection Area for Seventh Day Adventist School and Potential & Existing Contaminant Sources



- Seventh Day Adventist School Well

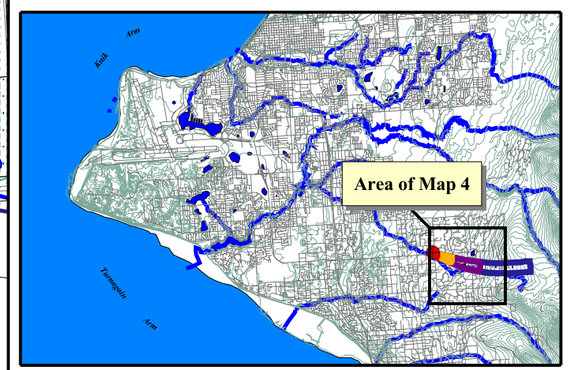
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Areas
- Less Than 2 Years Travel Time

Zone C Protection Areas
- Less Than 10 Years Travel Time

Zone D Protection Areas
- Less Than 5 Years Travel Time
- MOA Land Parcels
- Roads (X20)
- Trails (X46)
- Lawns and gardens (R1)
- Septic Systems (R2)
- Elevation Contours
- MOA Lakes
- Anchorage Streams

N
W E
S

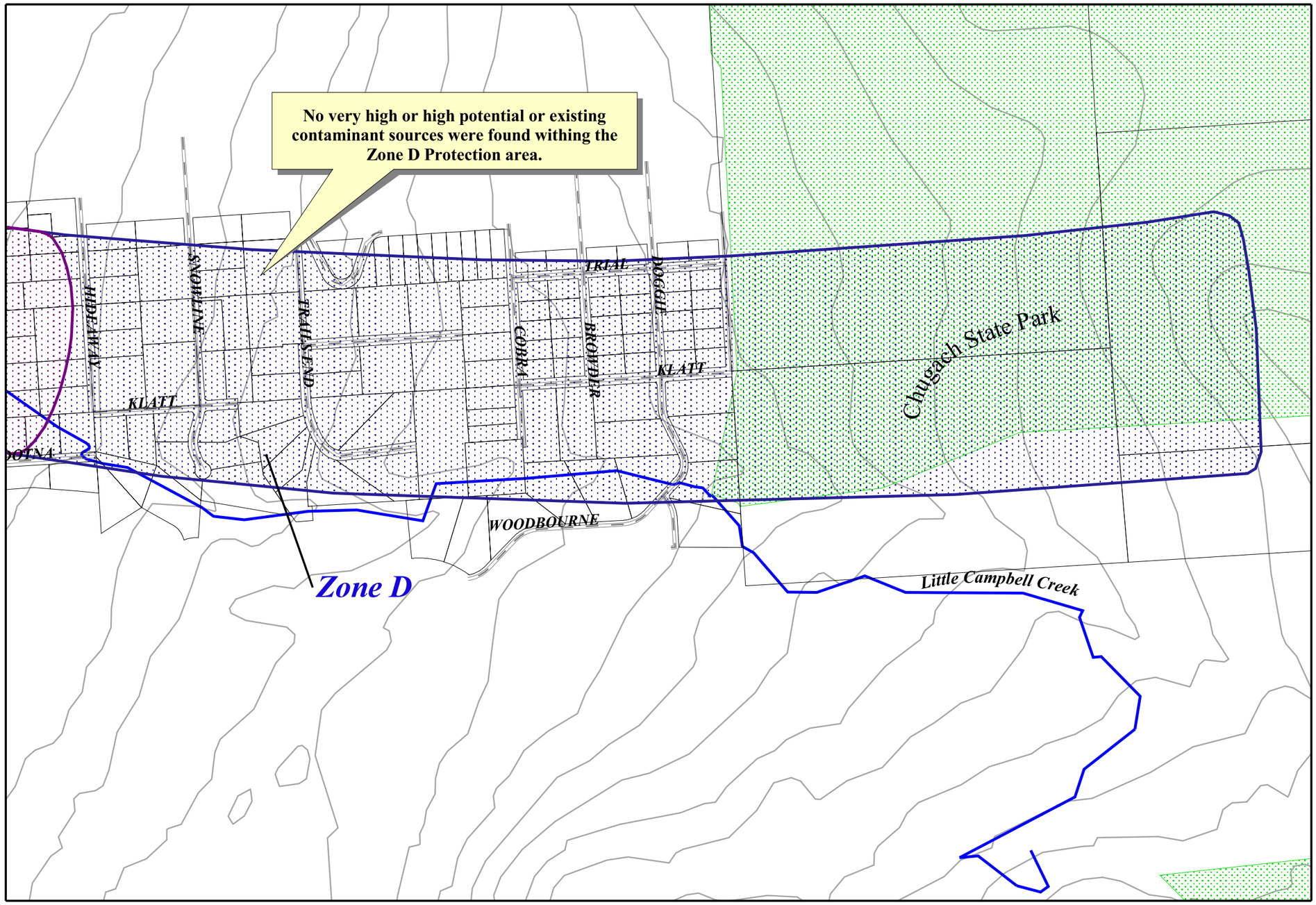


1000 0 1000 Feet

PWSID 210702.001

Map 4

Drinking Water Protection Area for Seventh Day Adventist School and Potential & Existing Contaminant Sources



- Seventh Day Adventist School Well

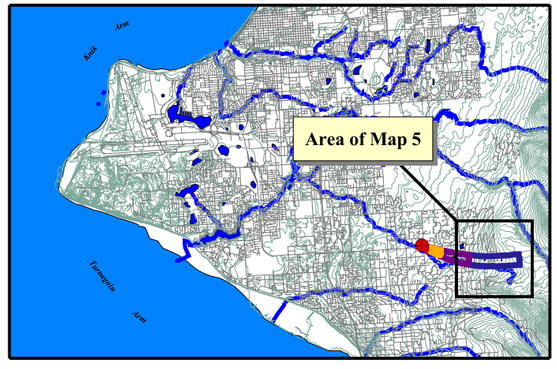
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Areas
- Less Than 2 Years Travel Time

Zone C Protection Areas
- Less Than 10 Years Travel Time

Zone D Protection Areas
- Less Than 5 Years Travel Time
- MOA Land Parcels
- Roads (X20)
- Chugach State Park
- Anchorage Streams
- Elevation Contours

N
W E
S



2000 0 2000 Feet

PWSID 210702.001

Map 5

APPENDIX D

Vulnerability Analysis for Seventh Day Adventist School 's Public Drinking Water Sources

Chart 1. Susceptibility of the wellhead – Seventh Day Adventist School

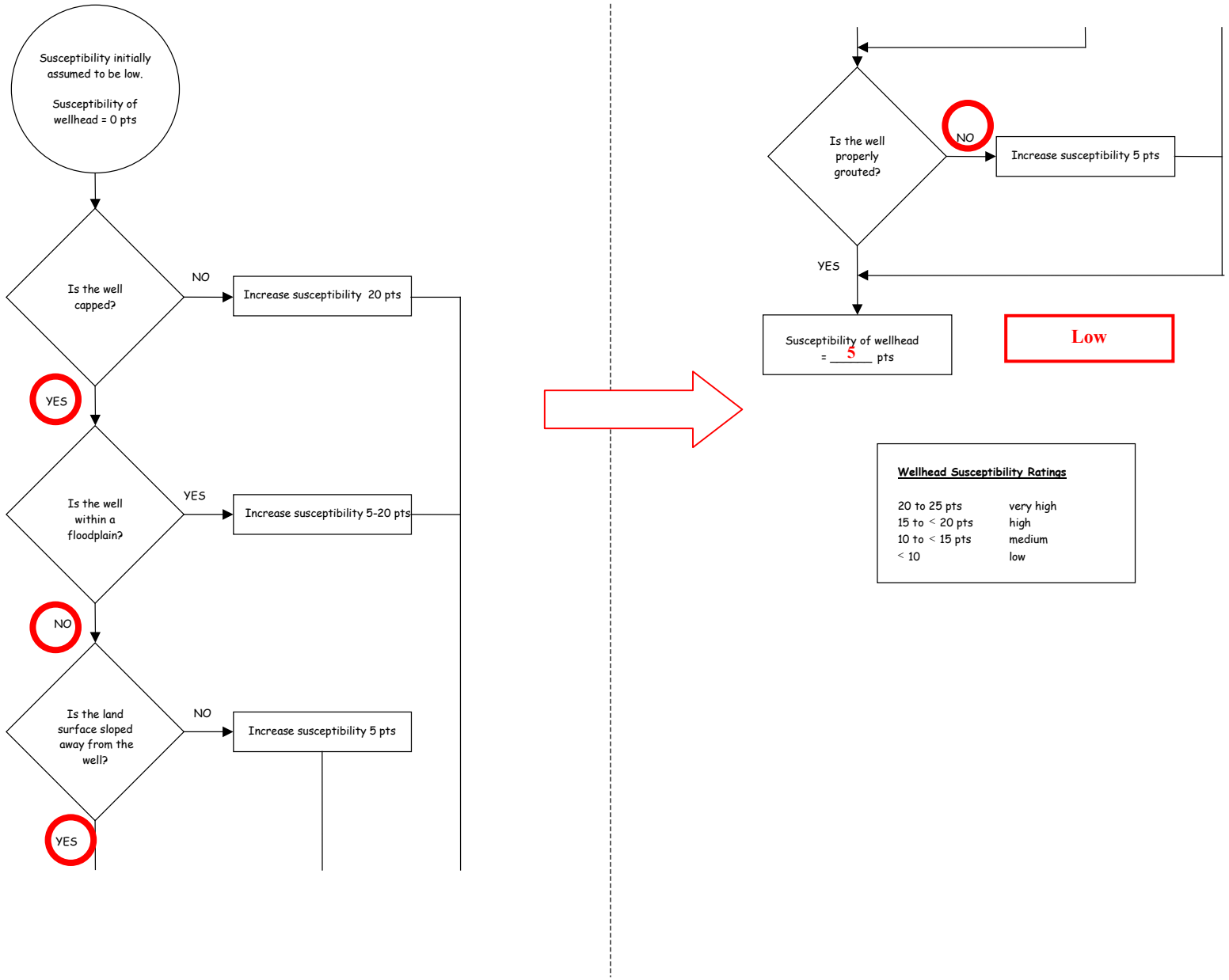
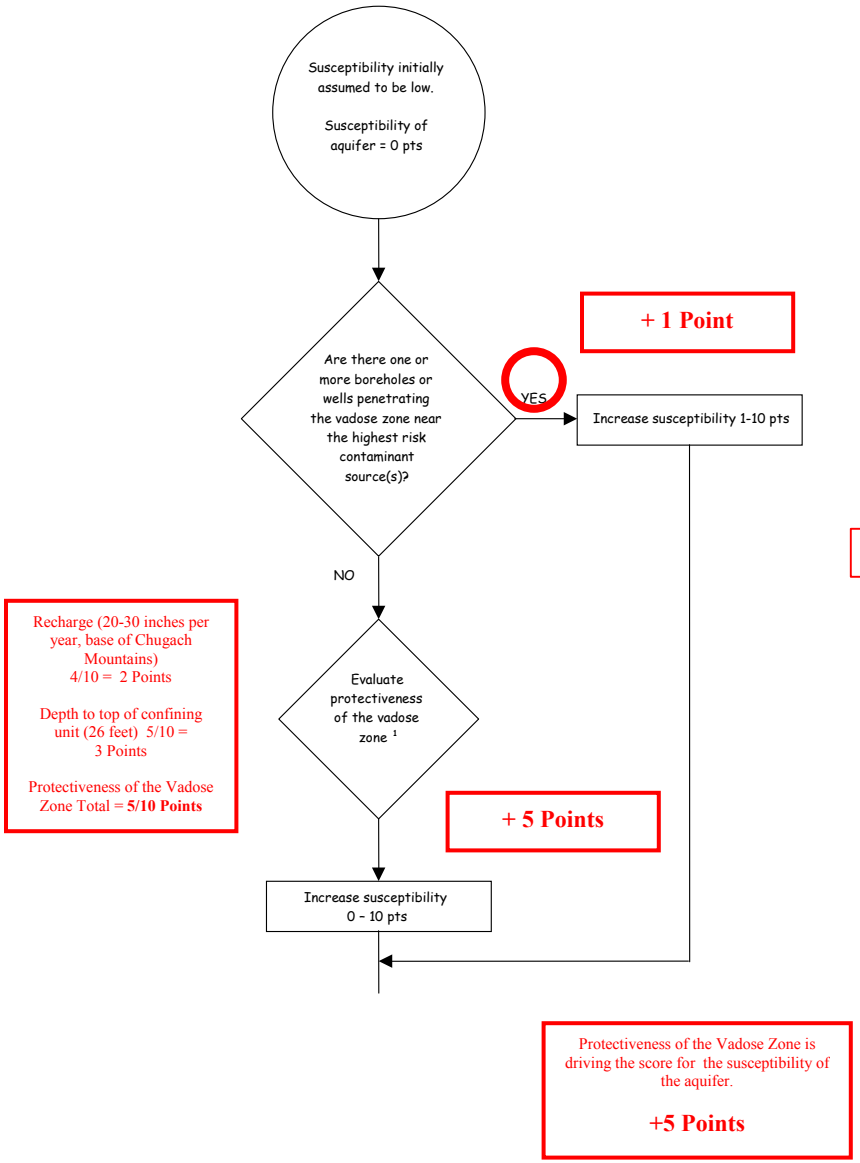
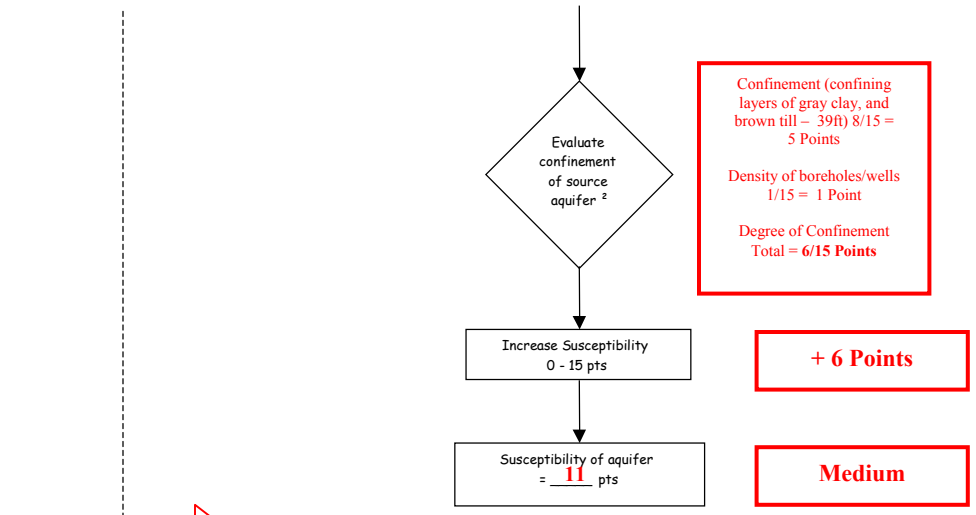


Chart 2. Susceptibility of the aquifer – Seventh Day Adventist School





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]

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]

Aquifer Susceptibility Ratings

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

Chart 3. Contaminant risks for Seventh Day Adventist School – Bacteria & Viruses

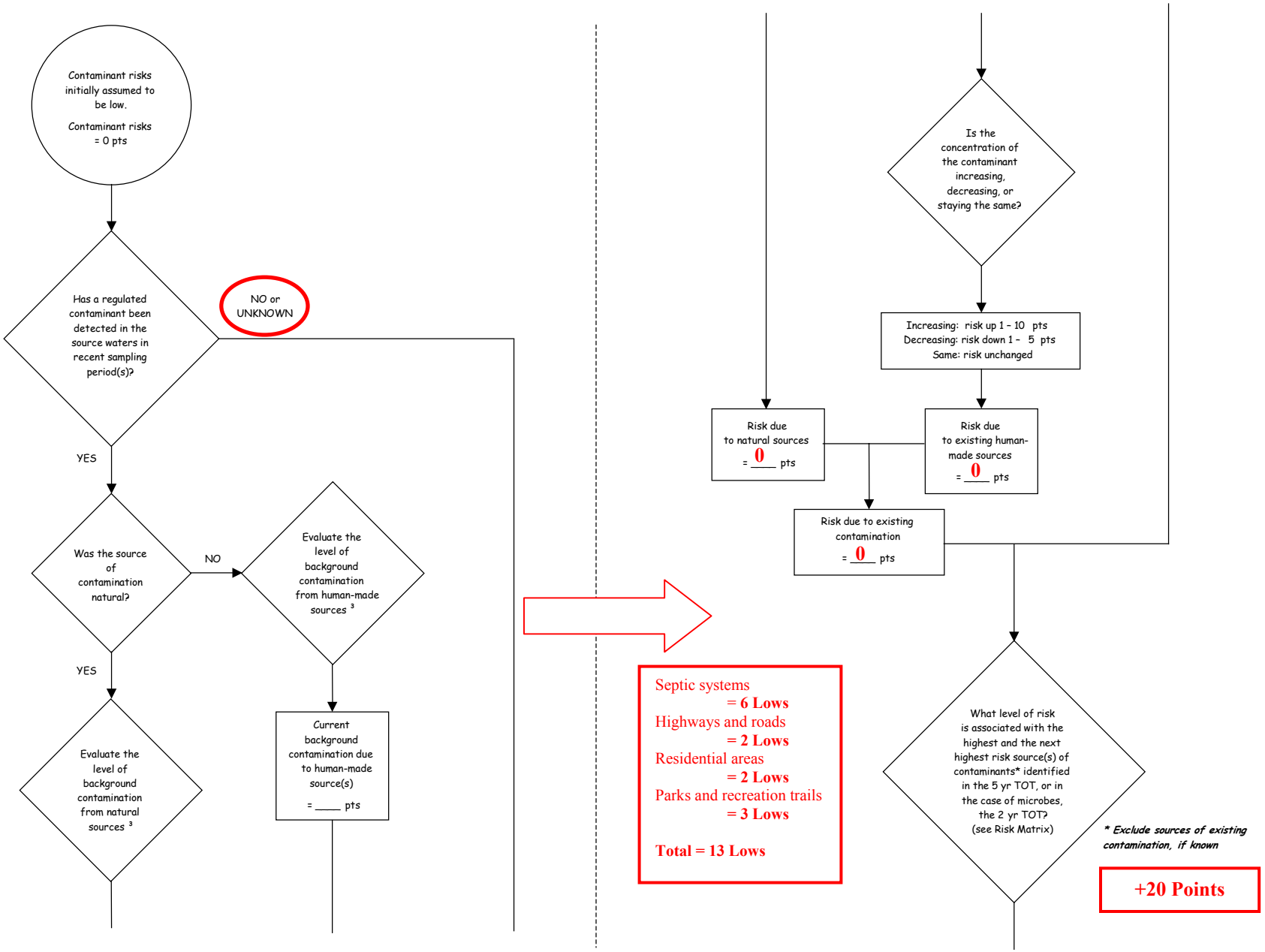


Chart 3. Contaminant risks for Seventh Day Adventist School – Bacteria & Viruses (Continued)

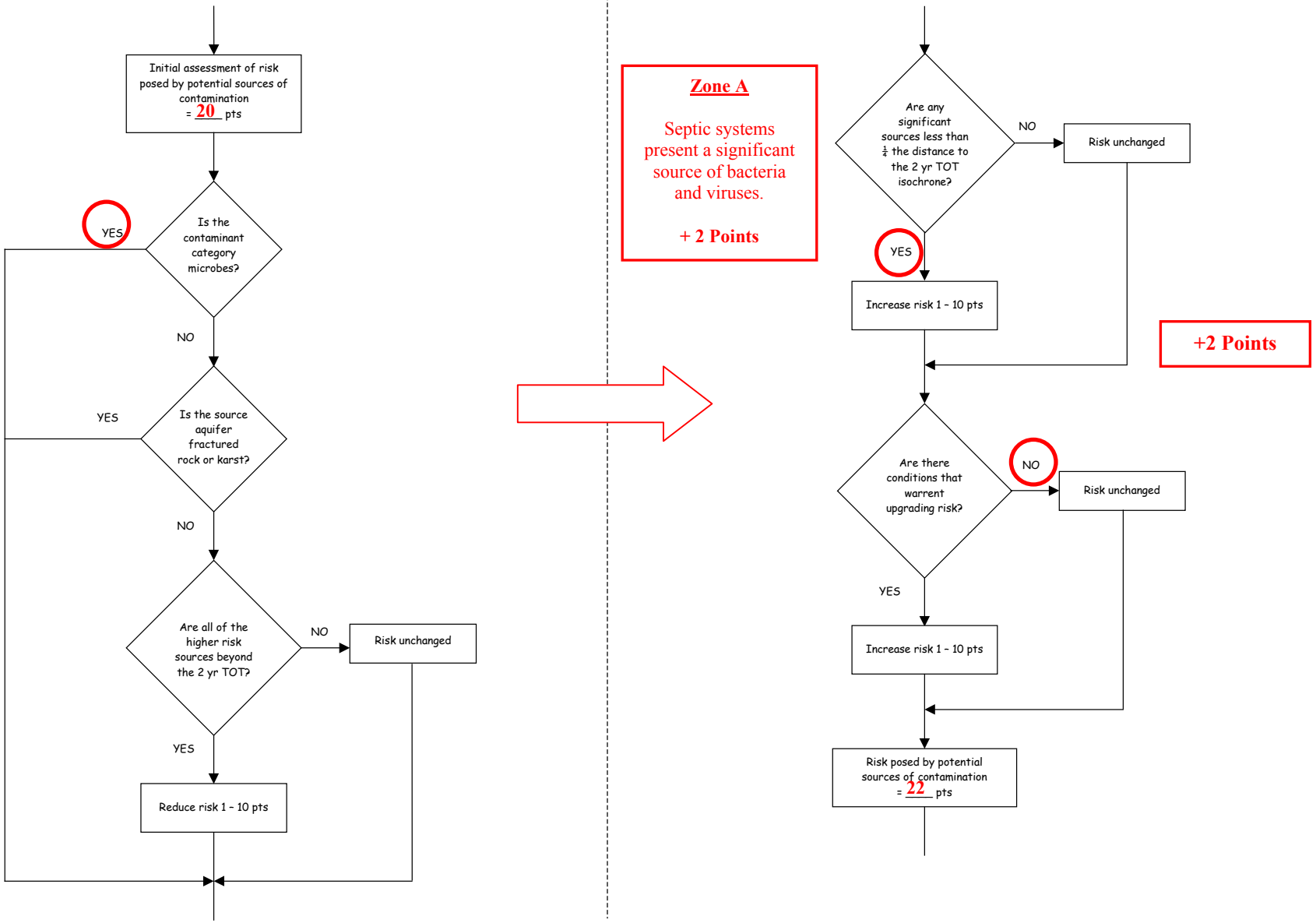
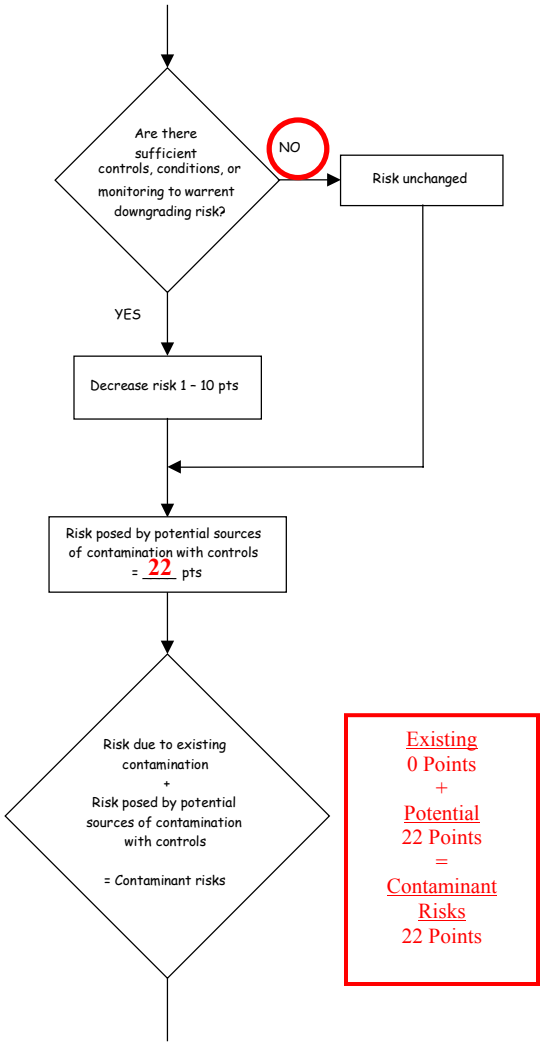
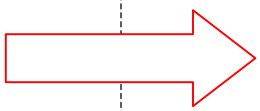
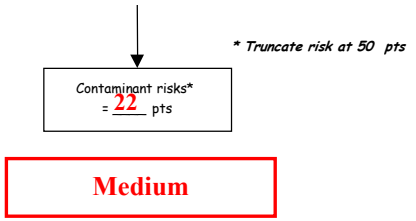


Chart 3. Contaminant risks for Seventh Day Adventist School – Bacteria & Viruses (Continued)



Existing
0 Points
+
Potential
22 Points
=
Contaminant
Risks
22 Points





3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

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

Table 1. Risk Matrix for Contaminant Sources for Seventh Day Adventist School – Bacteria & Viruses

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Septic systems, highways and roads, residential areas, parks and recreation trails	**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 4. Vulnerability analysis for Seventh Day Adventist School – Bacteria & Viruses

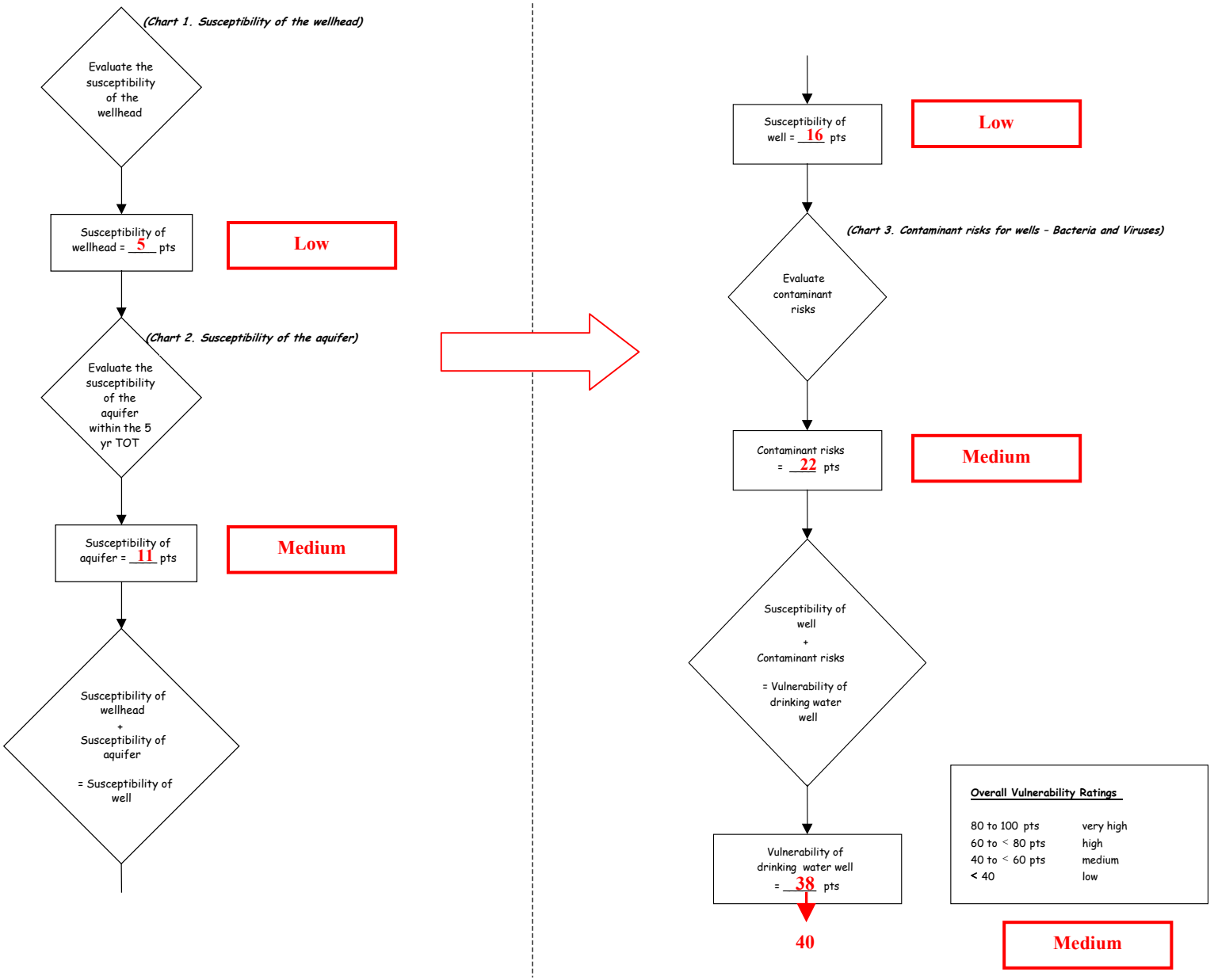


Chart 5. Contaminant risks for Seventh Day Adventist School – Nitrates and Nitrites

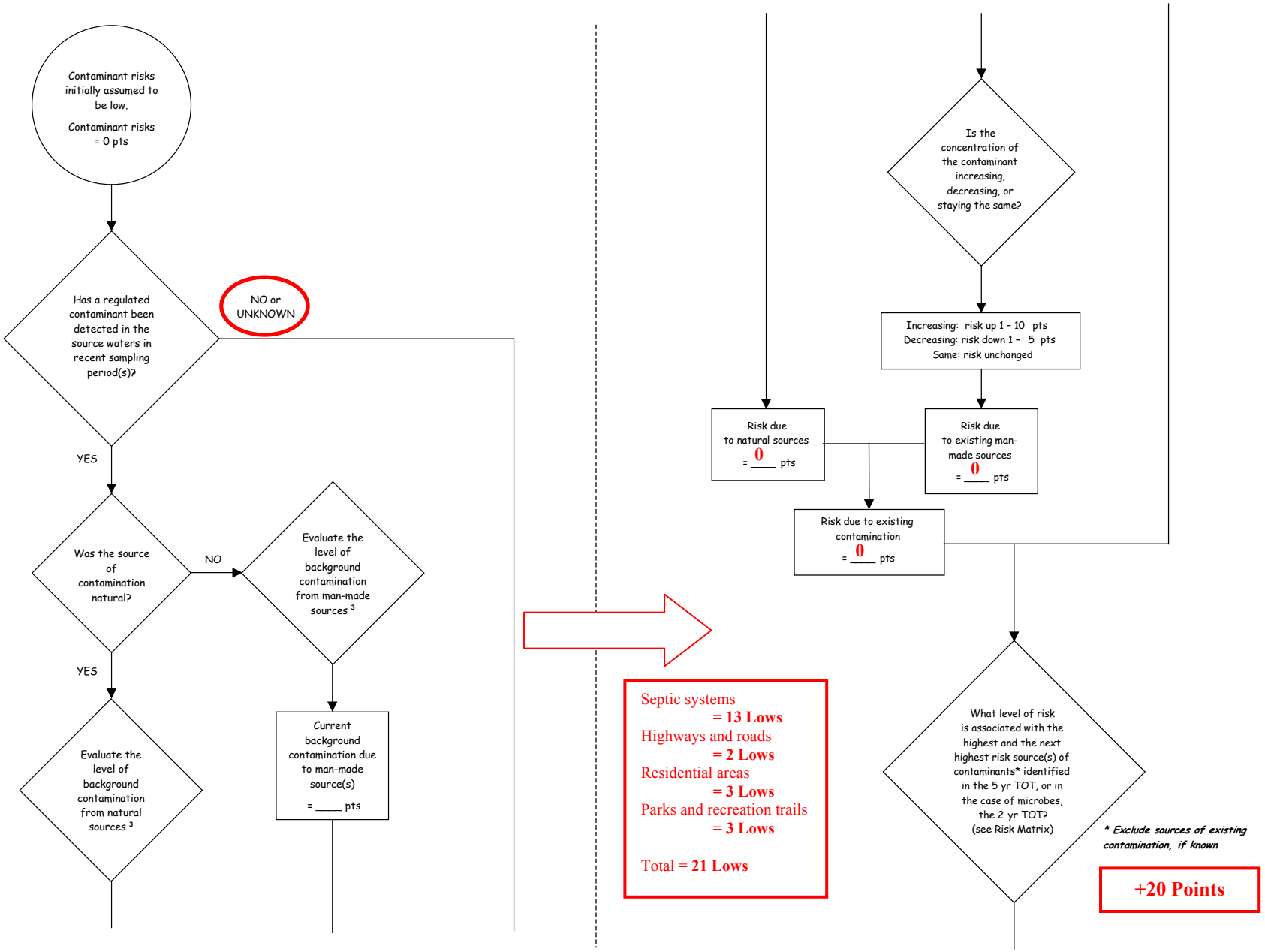
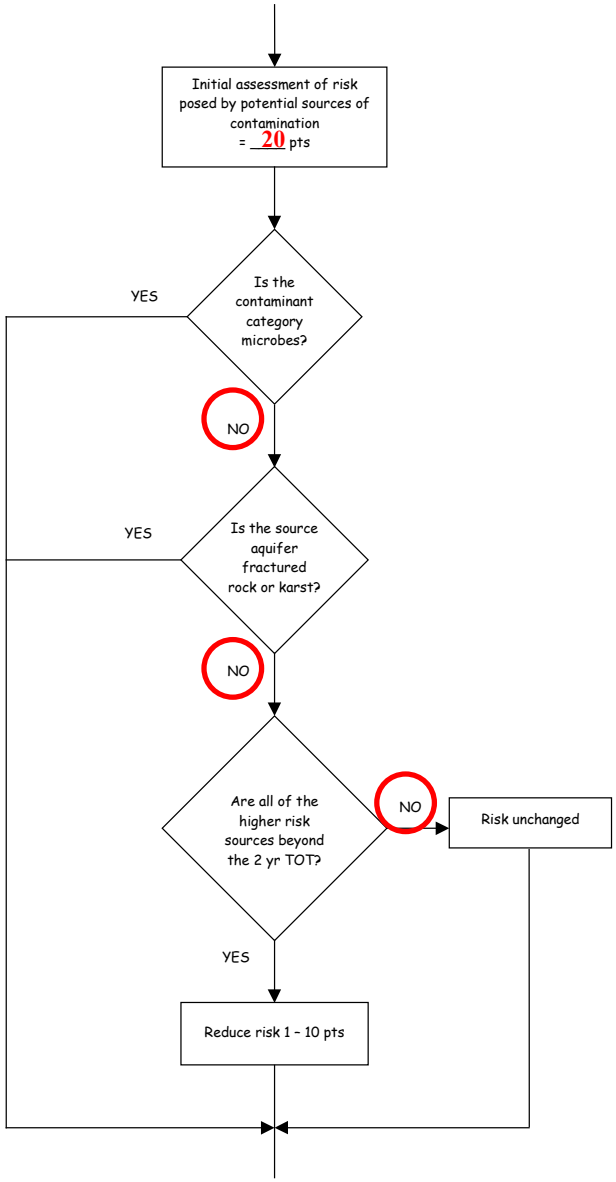


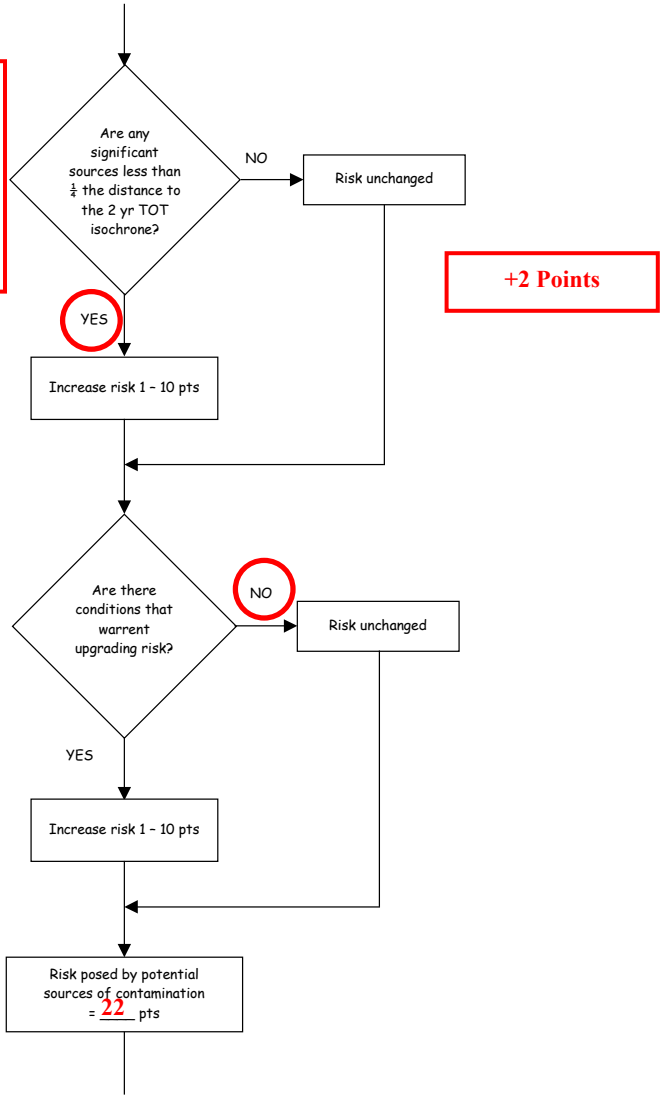
Chart 5. Contaminant risks for Seventh Day Adventist School – Nitrates and Nitrites (Continued)



Zone A

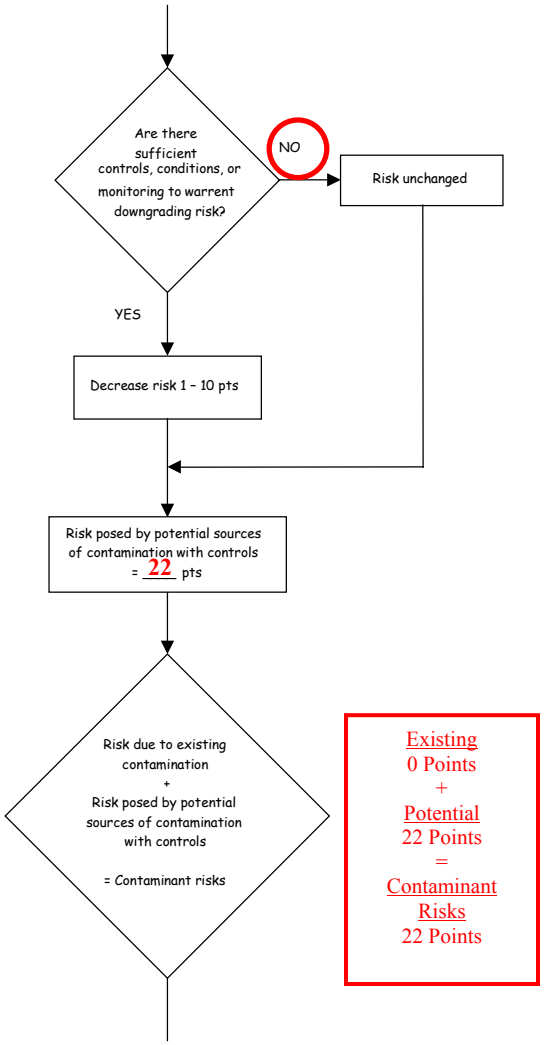
Septic systems present a significant source of nitrates and nitrites.

+2 Points

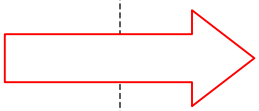


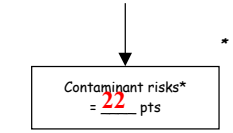
+2 Points

Chart 5. Contaminant risks for Seventh Day Adventist School – Nitrates and Nitrites (Continued)



Existing
0 Points
+
Potential
22 Points
=
Contaminant Risks
22 Points





** Truncate risk at 50 pts*

Medium

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

Historical sampling data indicated that no nitrates and/or nitrites had been detected.

Maximum Contaminant Level (MCL) = 10mg/L

+0 Points

Table 2. Risk Matrix for Contaminant Sources for Seventh Day Adventist School – Nitrates and Nitrites

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Septic systems, highways and roads, residential areas, parks and recreation trails	**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 6. Vulnerability analysis for Lake Seventh Day Adventist School – Nitrates and Nitrites

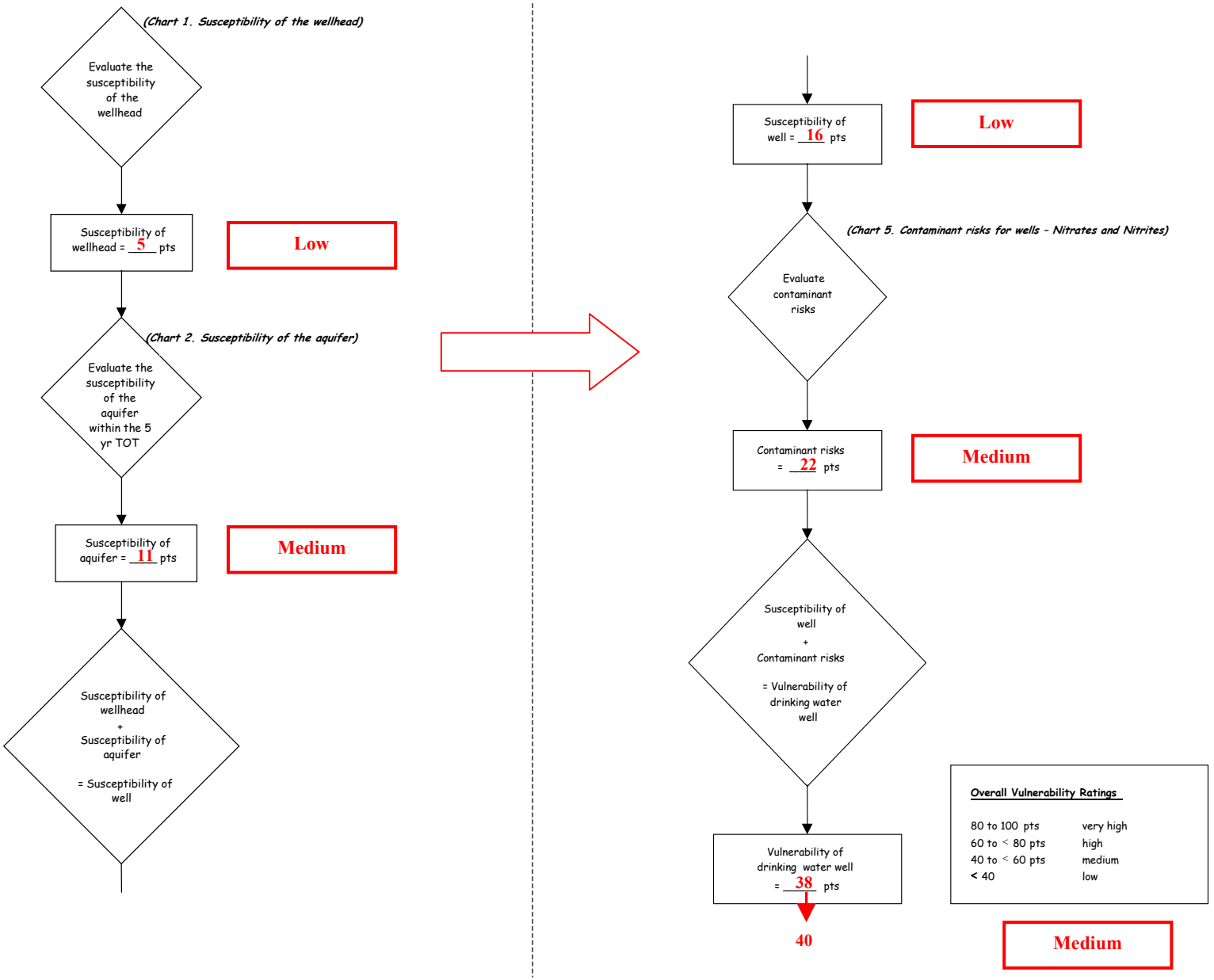


Chart 7. Contaminant risks for Seventh Day Adventist School – Volatile Organic Chemicals

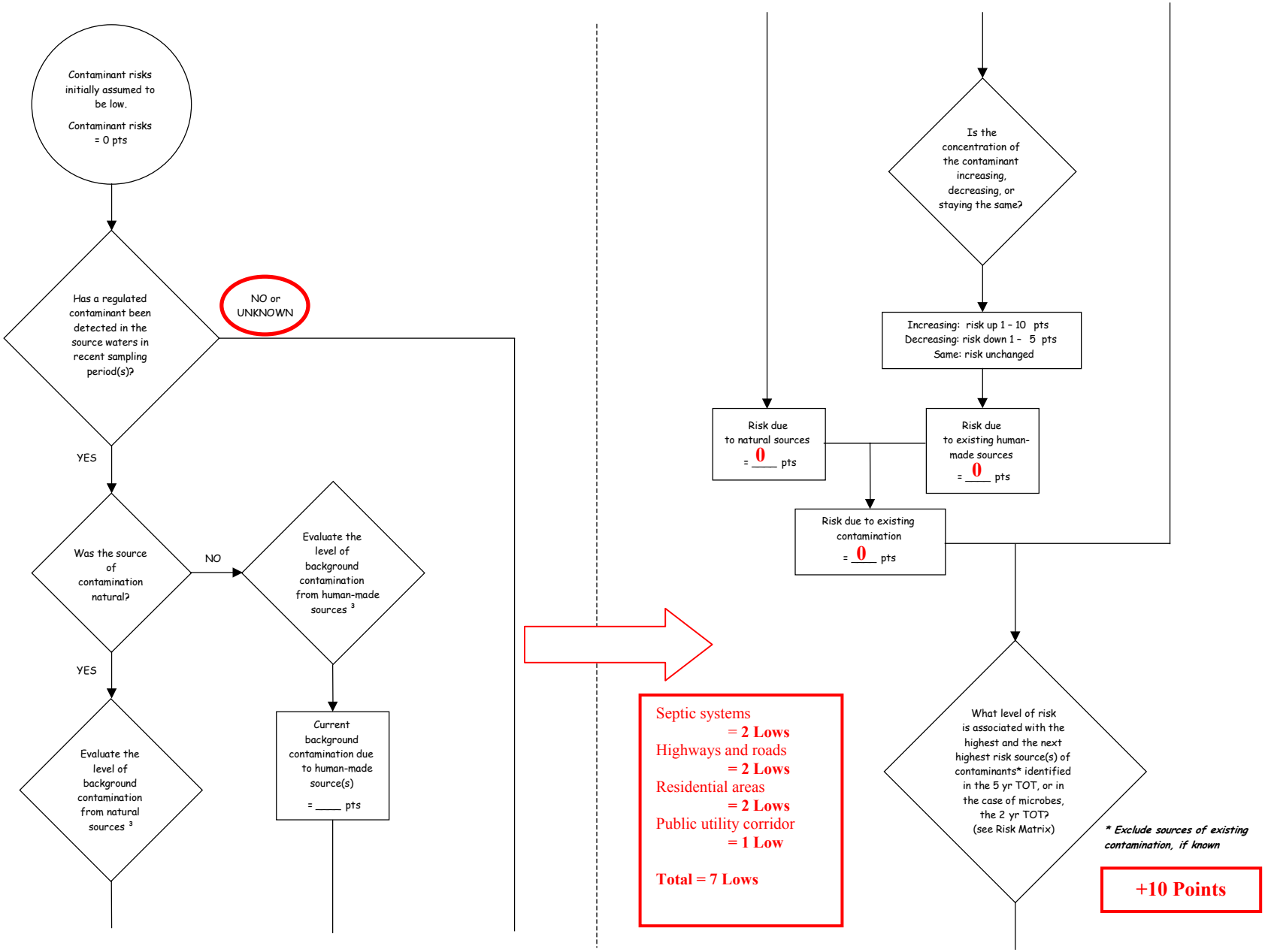


Chart 7. Contaminant risks for Seventh Day Adventist School – Volatile Organic Chemicals (Continued)

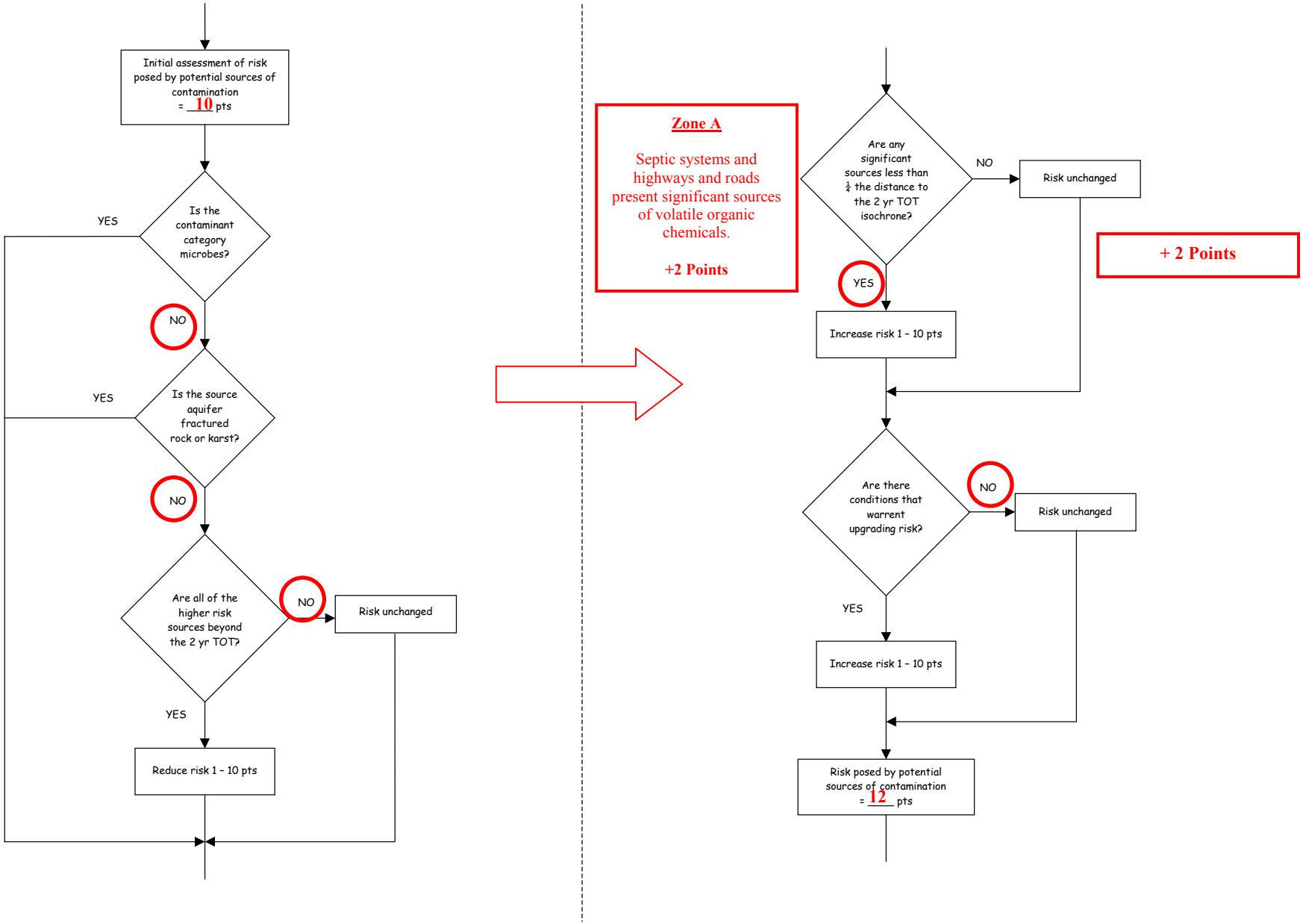
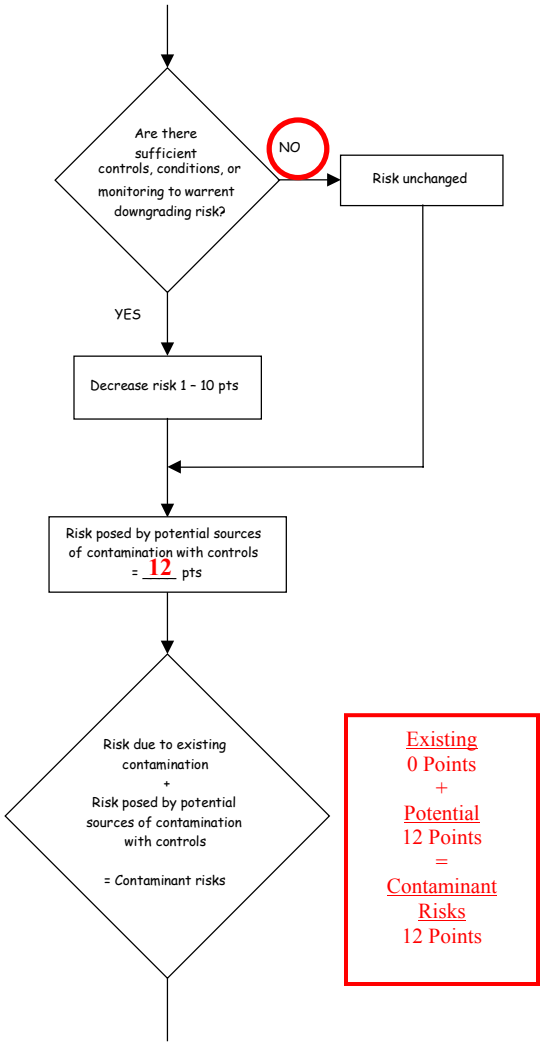


Chart 7. Contaminant risks for Seventh Day Adventist School – Volatile Organic Chemicals (Continued)



Existing
0 Points
+
Potential
12 Points
=
Contaminant Risks
12 Points

** Truncate risk at 50 pts*

Contaminant risks* = 12 pts

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

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

Table 3. Risk Matrix for Contaminant Sources for Seventh Day Adventist School – Volatile Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Septic systems, highways and roads, residential areas, public utiltiy corridor	**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 8. Vulnerability analysis for Seventh Day Adventist School – Volatile Organic Chemicals

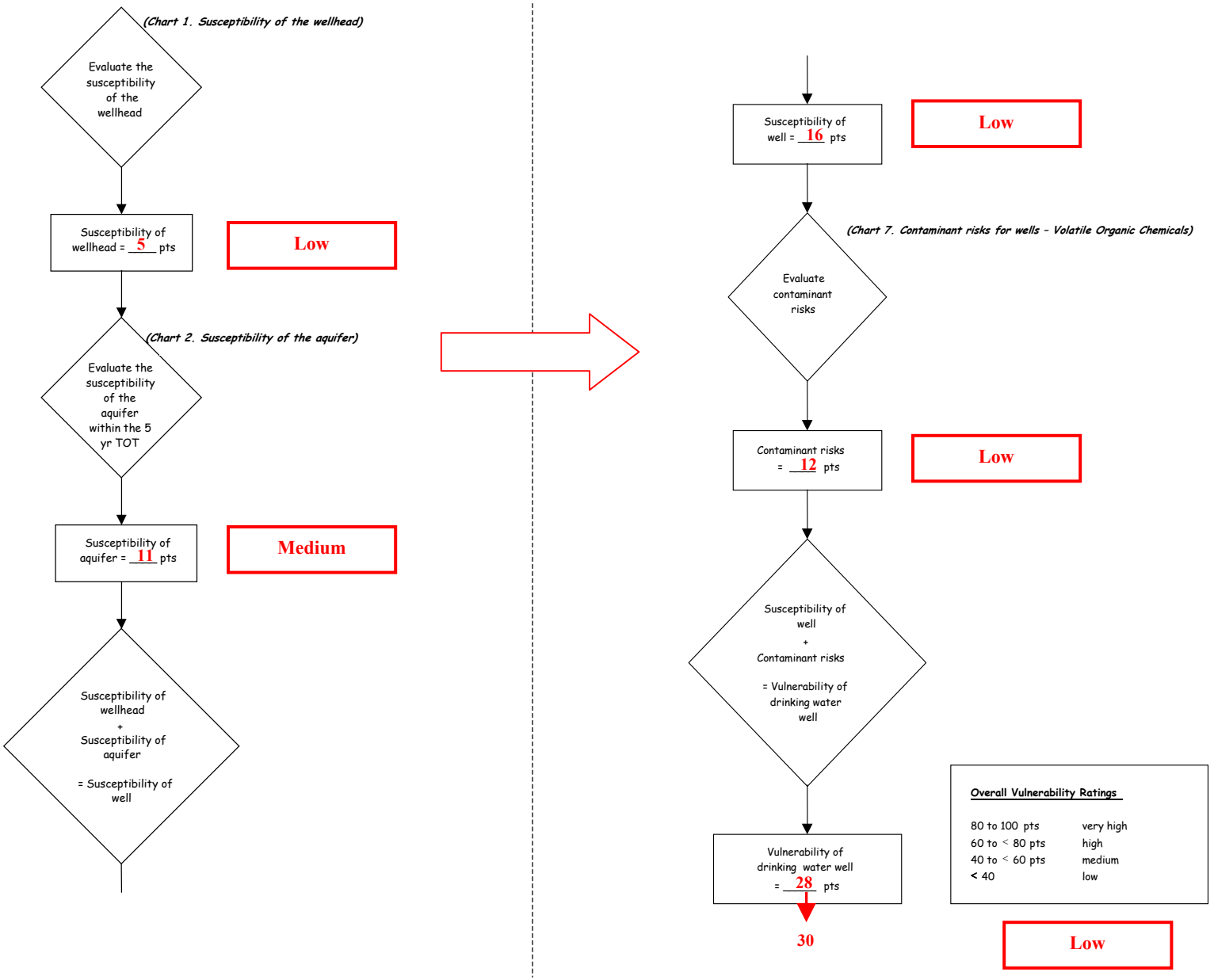


Chart 9. Contaminant risks for Seventh Day Adventist School – Heavy Metals, Cyanide and Other Inorganic Chemicals

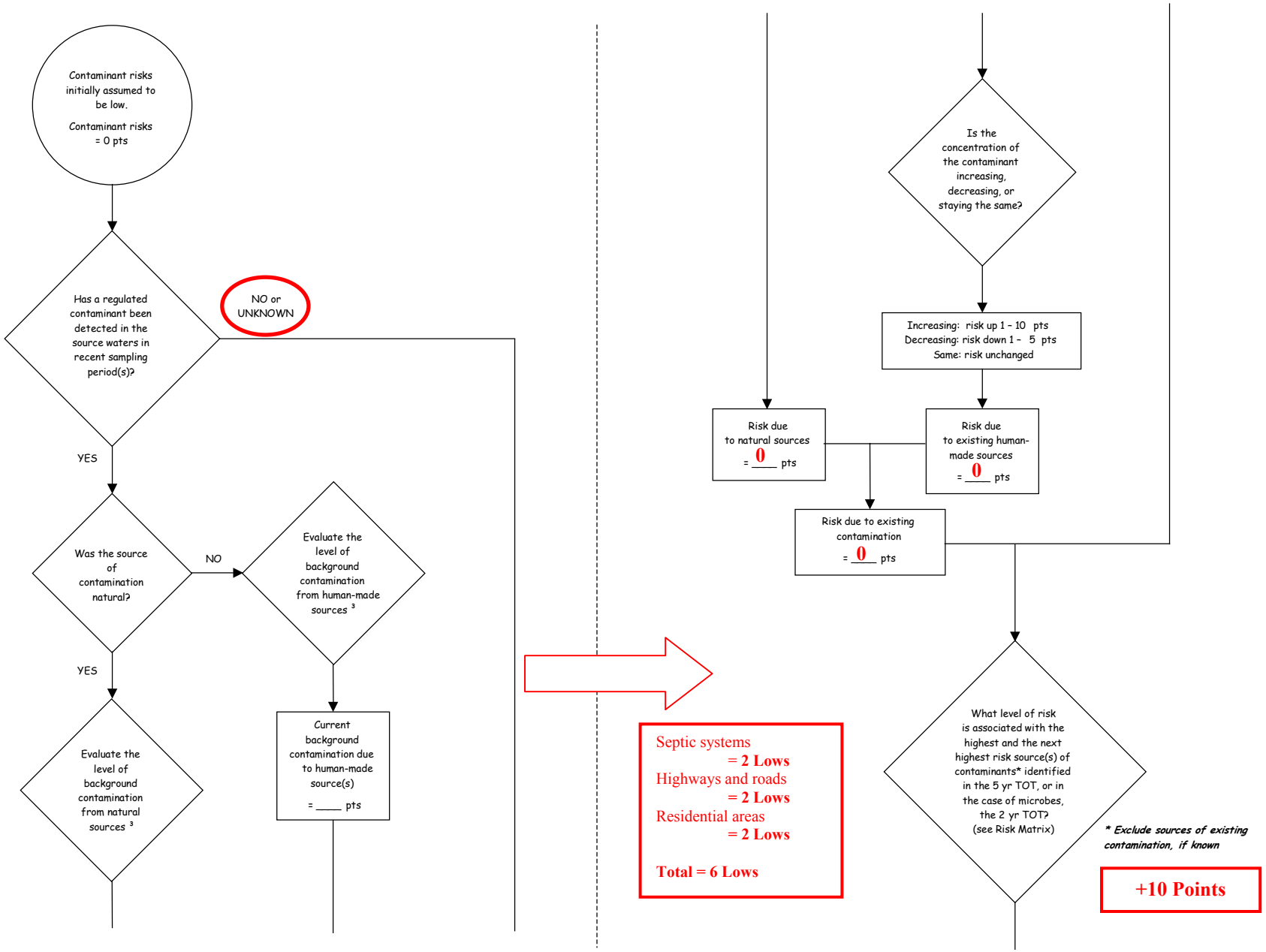


Chart 9. Contaminant risks for Seventh Day Adventist School – Heavy Metals, Cyanide and Other Inorganic Chemicals (Continued)

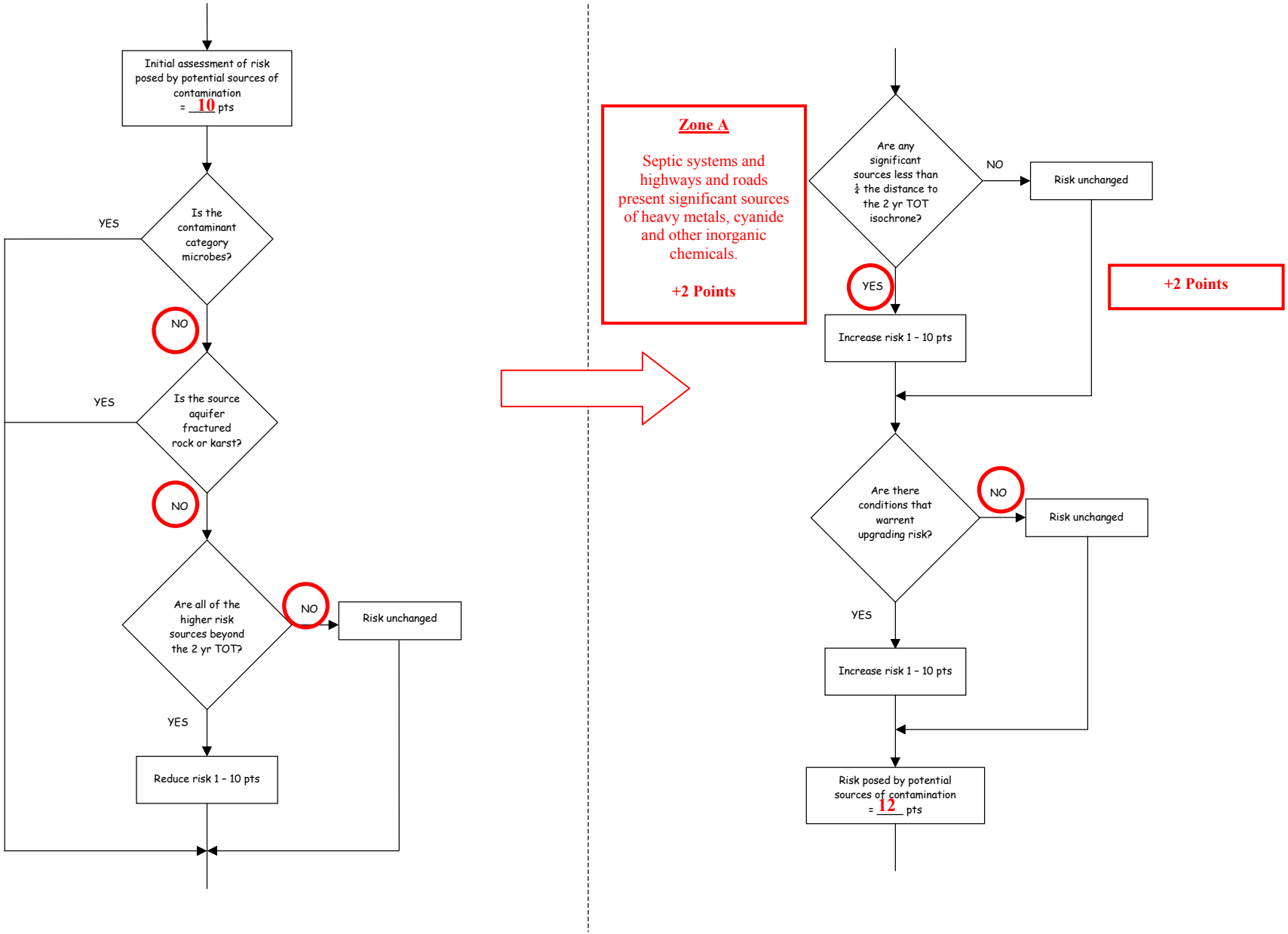
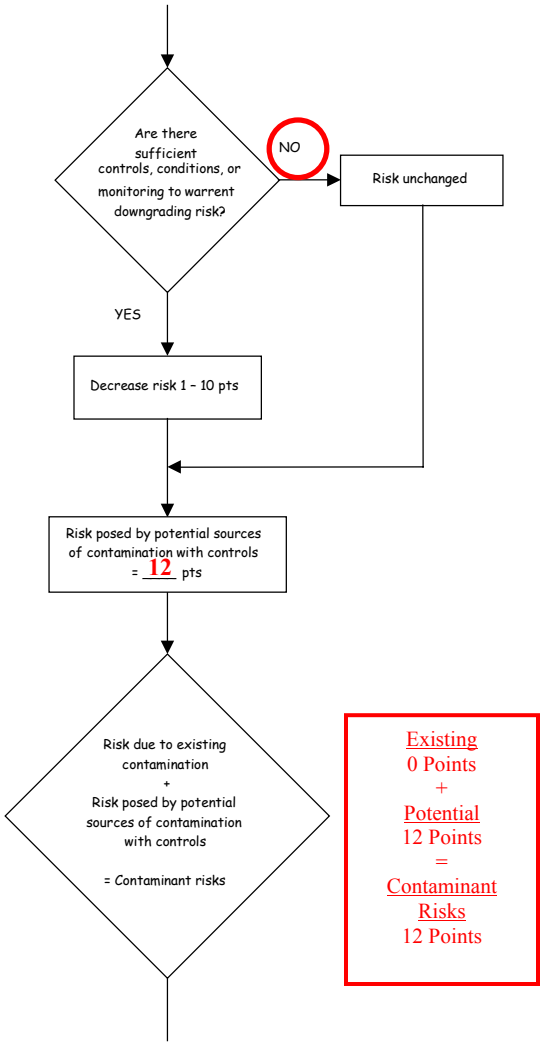
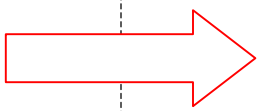
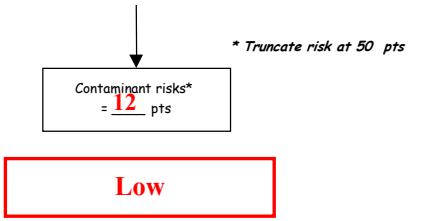


Chart 9. Contaminant risks for Seventh Day Adventist School – Heavy Metals, Cyanide and Other Inorganic Chemicals (Continued)







3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

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

Table 4. Risk Matrix for Contaminant Sources for Seventh Day Adventist School – Heavy Metals, Cyanide and Other Inorganic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Septic systems, highways and roads, residential areas	**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 10. Vulnerability analysis for Seventh Day Adventist School – Heavy Metals, Cyanide and Other Inorganic Chemicals

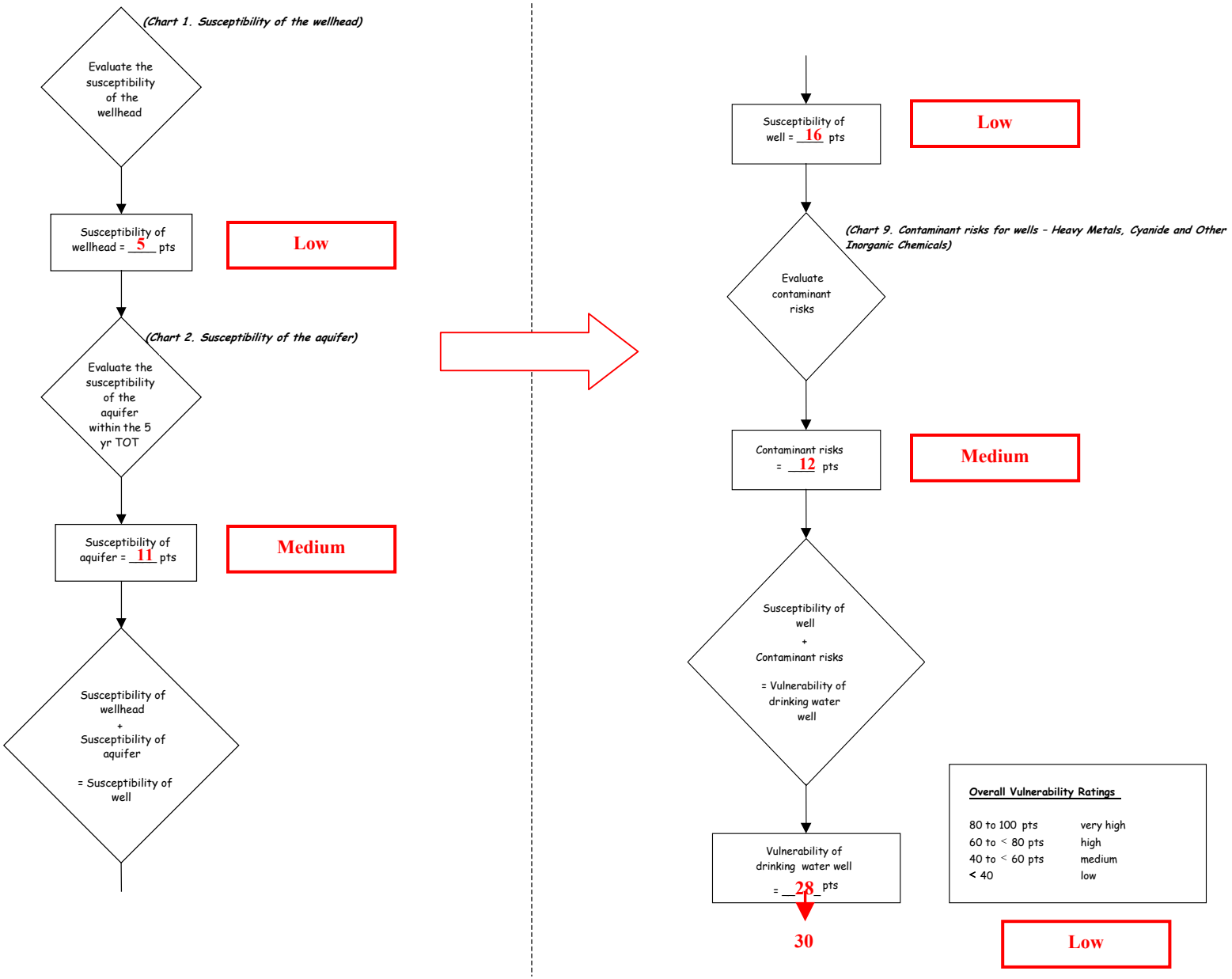


Chart 11. Contaminant risks for Seventh Day Adventist School – Synthetic Organic Chemicals

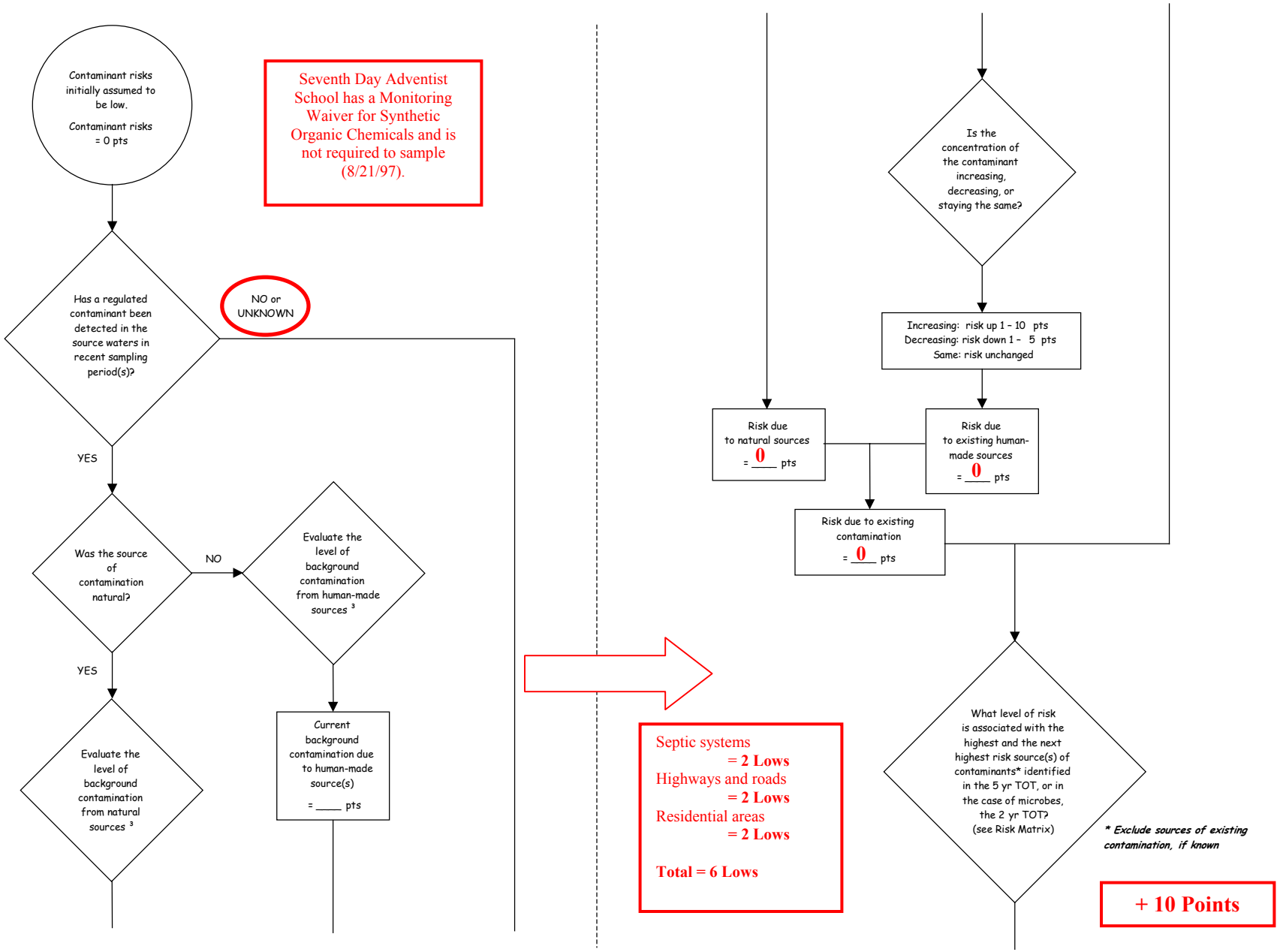


Chart 11. Contaminant risks for Seventh Day Adventist School – Synthetic Organic Chemicals (Continued)

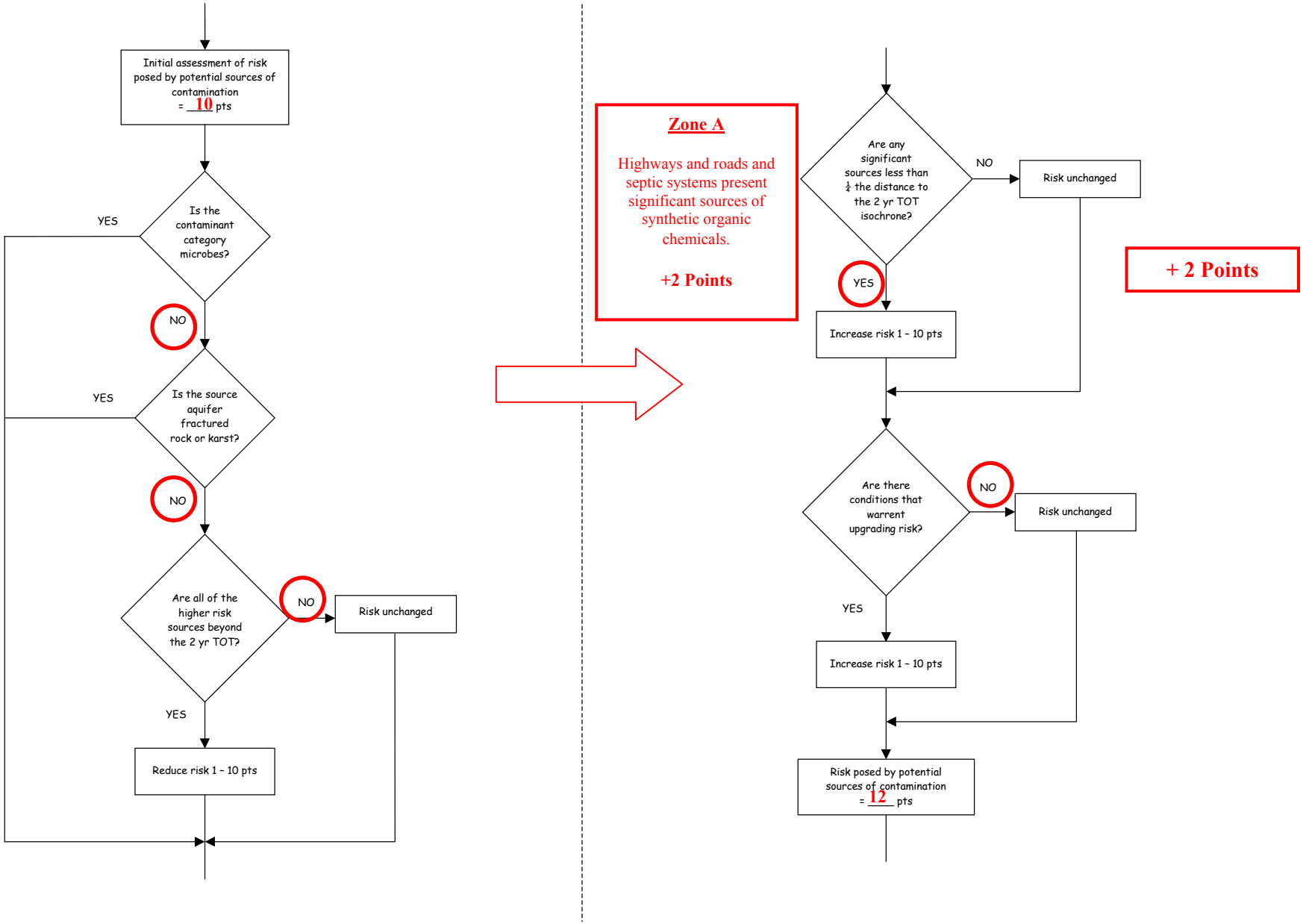
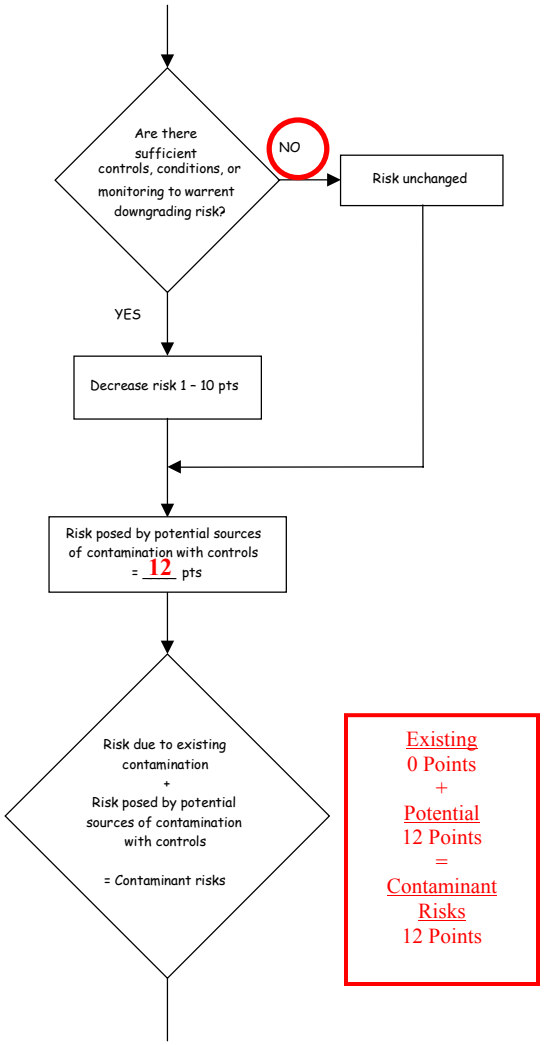


Chart 11. Contaminant risks for Seventh Day Adventist School – Synthetic Organic Chemicals (Continued)



Existing
0 Points
+
Potential
12 Points
=
Contaminant
Risks
12 Points

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

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

** Truncate risk at 50 pts*

Contaminant risks*
= 12 pts

Low

Table 5. Risk Matrix for Contaminant Sources for Seventh Day Adventist School Wells – Synthetic Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Septic systems, highways and roads, and residential areas	**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 12. Vulnerability analysis for Seventh Day Adventist School – Synthetic Organic Chemicals

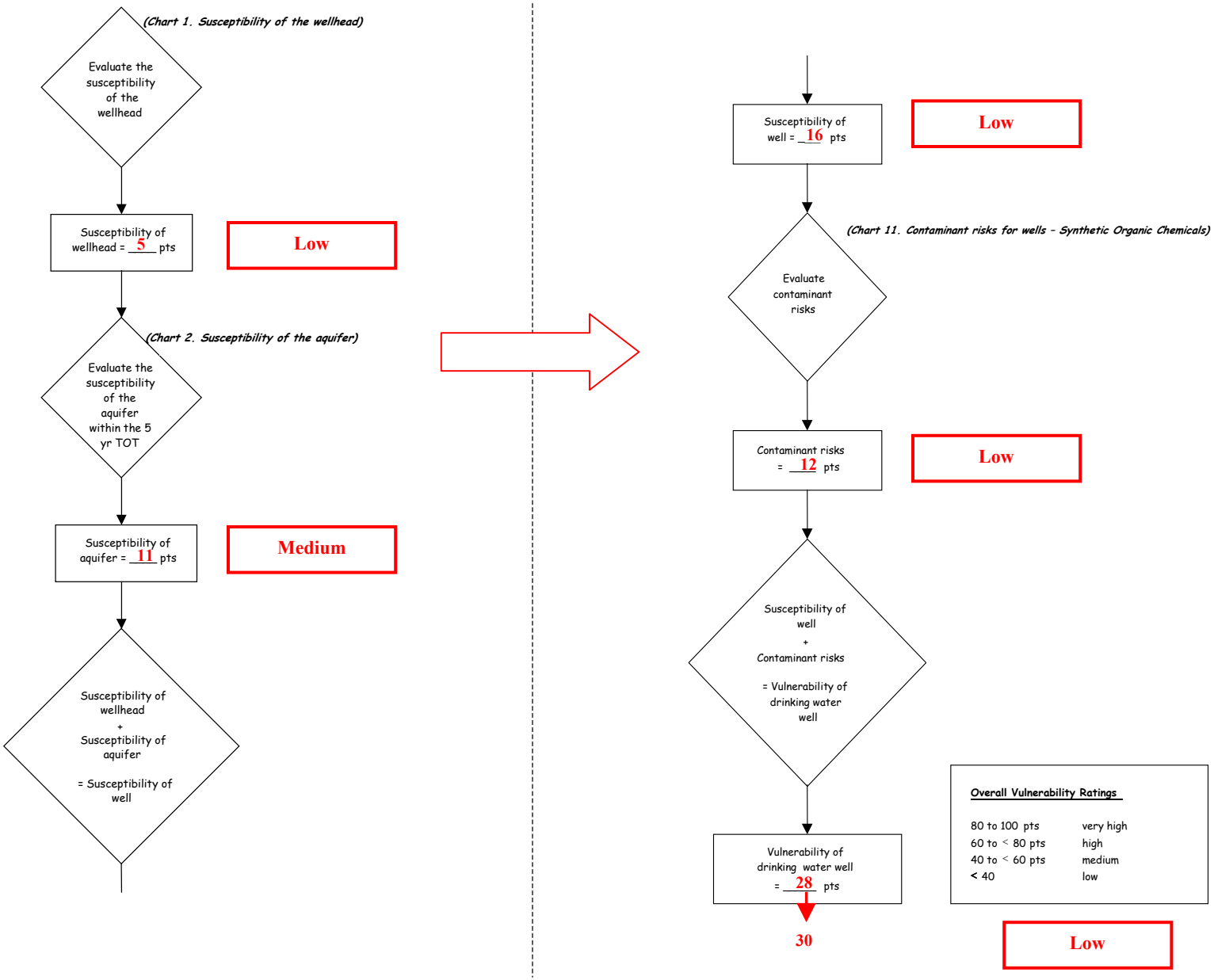


Chart 13. Contaminant risks for Seventh Day Adventist School – Other Organic Chemicals

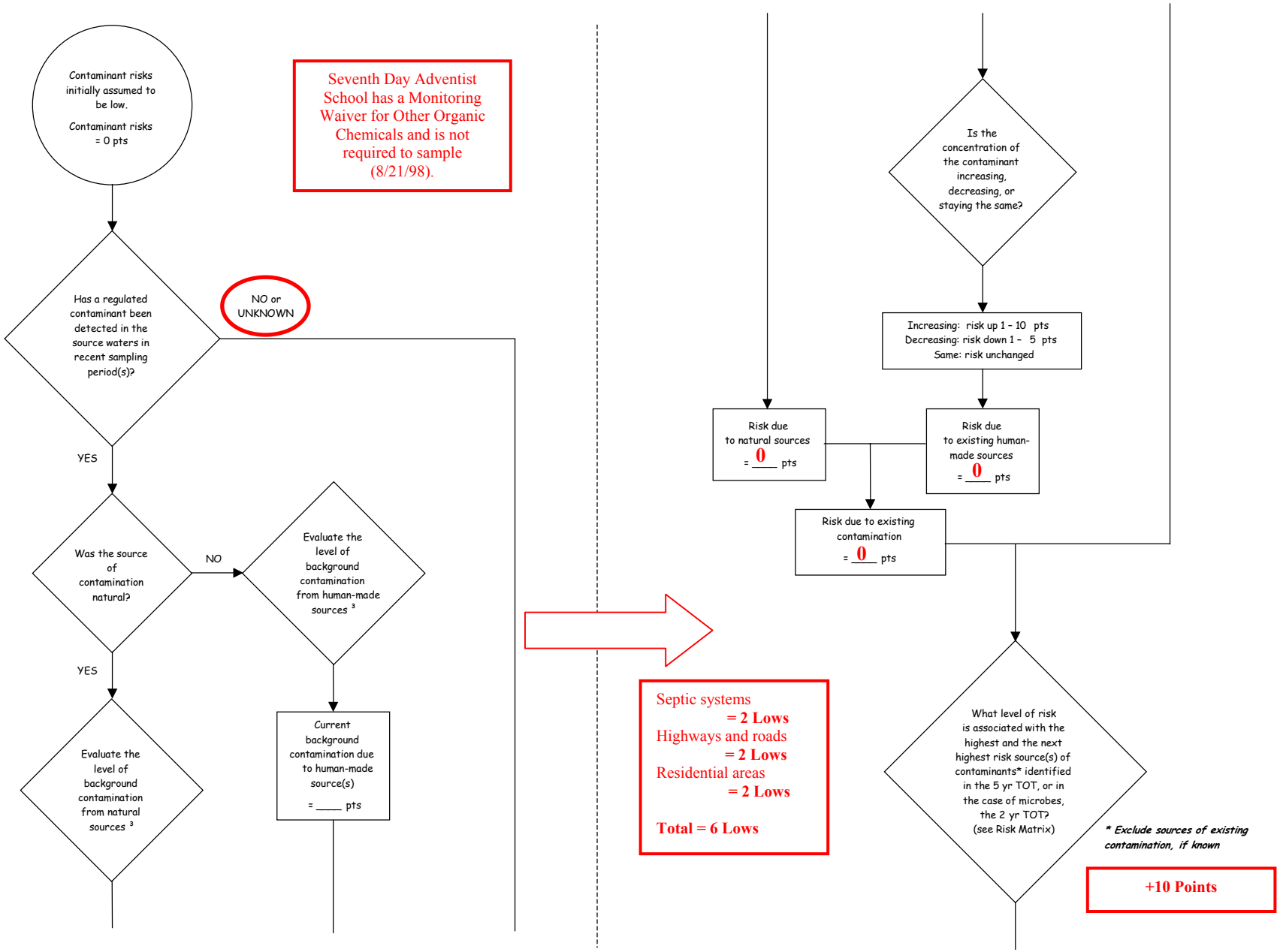
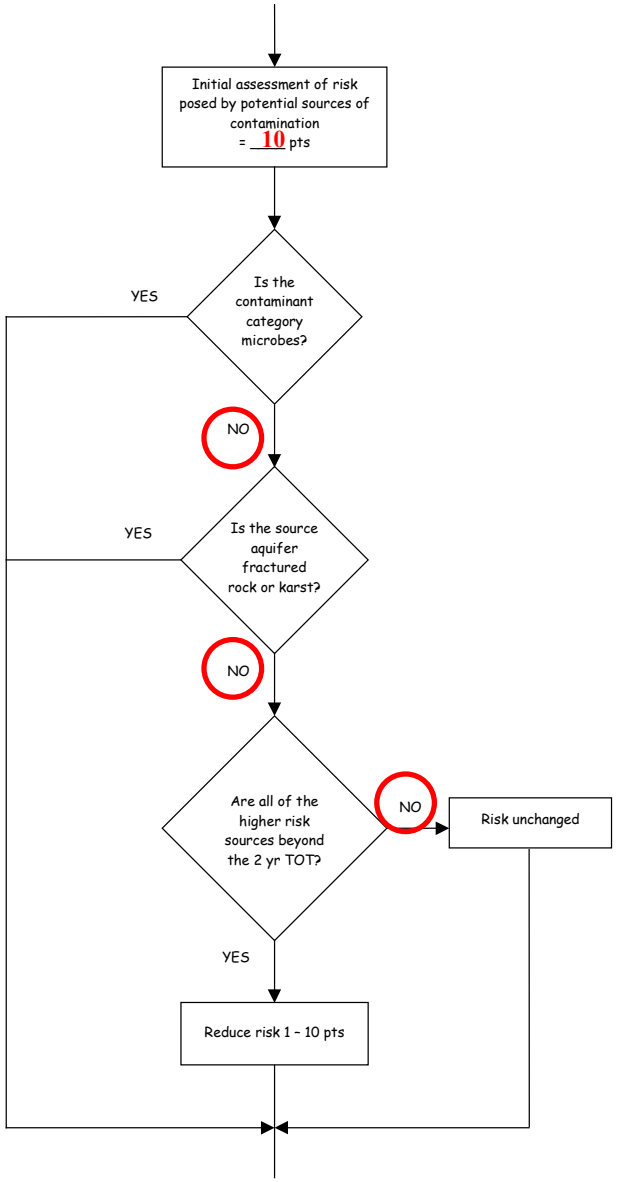


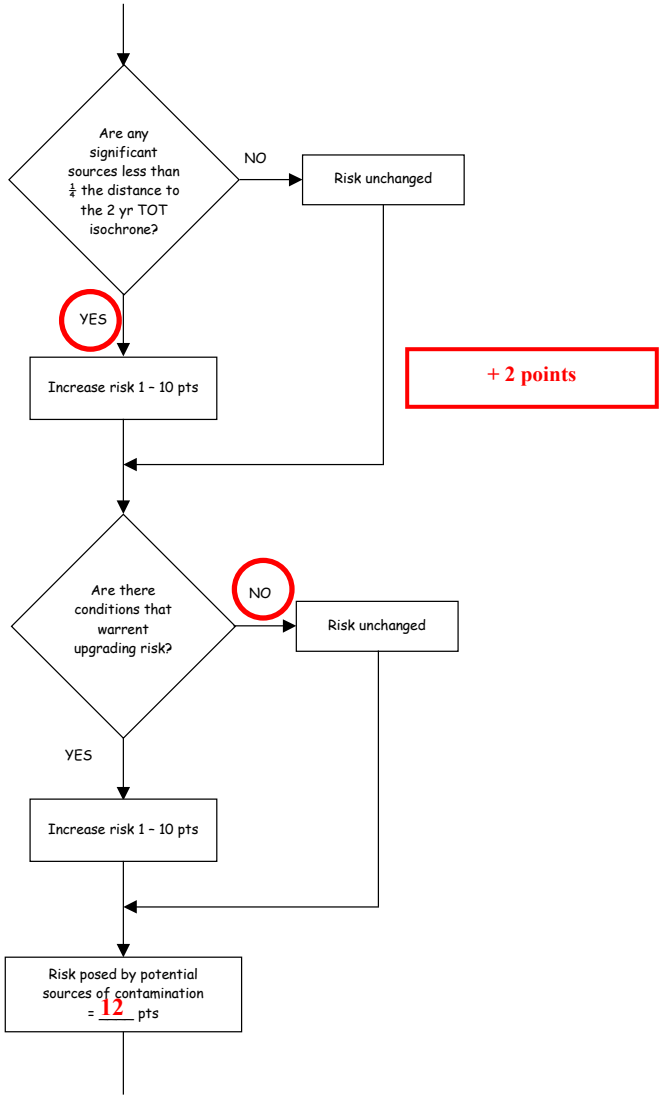
Chart 13. Contaminant risks for Seventh Day Adventist School – Other Organic Chemicals (Continued)



Zone A

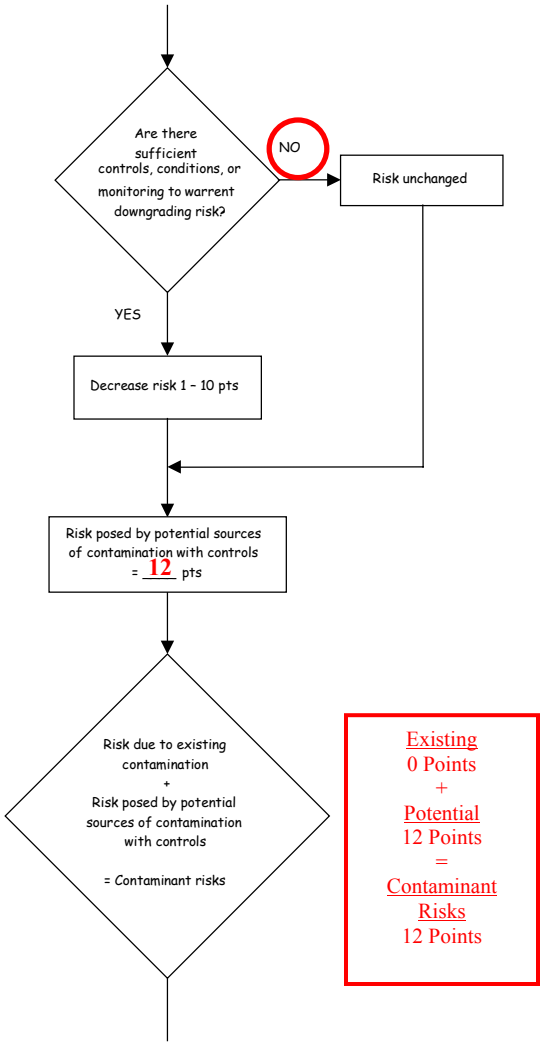
Highways and roads and septic systems present significant sources of other organic chemicals.

+2 points

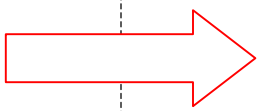


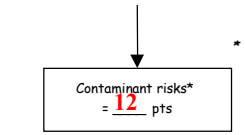
+ 2 points

Chart 13. Contaminant risks for Seventh Day Adventist School – Other Organic Chemicals (Continued)



Existing
0 Points
+
Potential
12 Points
=
Contaminant Risks
12 Points





** Truncate risk at 50 pts*

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

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

Table 6. Risk Matrix for Contaminant Sources for Seventh Day Adventist School – Other Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Septic systems, highways and roads, residential areas	**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 14. Vulnerability analysis for Seventh Day Adventist School – Other Organic Chemicals