Source Water Assessment for Matansuka Susitna College

A Hydrogeologic Susceptibility and Vulnerability Assessment

DRINKING WATER PROTECTION PROGRAM REPORT 394
PWSID 220477.001

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By Chris Miller,

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Hydrogeologic Susceptibility and Vulnerability Assessment for Matansuka Susitna College Public Drinking Water Source, Palmer, Alaska

By Chris Miller, ADEC

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Matansuka Susitna College is a Class A (nontransient/noncommunity) drinking water source consisting of one well. Identified potential and current sources of contaminants for Matansuka Susitna College include: parking lots, snow disposal areas, paved roads, residential septic systems, . 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 Matanuska Susitna College received a vulnerability rating of **Low** for bacteria and viruses and nitrates and nitrites, and a **Low** for volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals.
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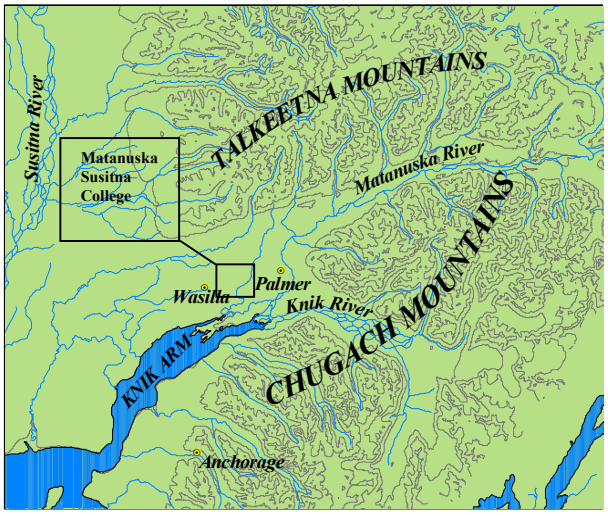

Figure 1. Index Map showing the location of the Matanuska-Susitna Valley and Matanuska Susitna College

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 Matansuka Susitna College source of public drinking water. This source consists of one well in the Palmer area (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 MATANUSKA-SUSITNA VALLEY-AREA, ALASKA

Location

The Matanuska-Susitna Valley is part of the lowland lying about 50 miles north of Anchorage in south-central Alaska. The well described in this report is part of the Matanuska River Watershed. This study area is roughly bounded on the north by the Talkeetna Mountains; on the west by Wasilla Creek; on the south by the Knik River; and on the east by the Chugach Mountains. The area covers approximately 150 square miles.

Climate

The climate of the Matanuska-Susitna Valley is the result of a combination of marine and continental

influences. The 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 is approximately 15 inches per year. On the average, the Valley receives a total snow accumulation of 58 inches per year. Precipitation generally increased inland toward the Talkeetna Mountains where annual precipitation may exceed 60 inches. Mean daily temperature ranges from 67° F during July to 5° F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

The Matanuska-Susitna Valley is surrounded by rugged mountains that rise abruptly above the valley floor. The Chugach Mountains at the southern edge of the valley reach altitudes greater than 6300 feet. These mountains are composed primarily of metamorphosed sedimentary marine and volcanic rocks, and greenstone of Mesozoic age. Along the northern edge of the valley, peaks in the Talkeetna Mountains reach altitudes of 3000 to 5000 feet. The Talkeenta Mountains are composed mainly of igneous rocks, chiefly granitic intrusives and subordinate lavas and tuffs; Cretaceous and Tertiary sedimentary rocks form the south flank of the mountains. Although the altitude of the valley floor ranges from sea level at Knik Arm to 1000 feet at the base of Wishbone Hill, the local relief is commonly not more than 100 to 200 feet.

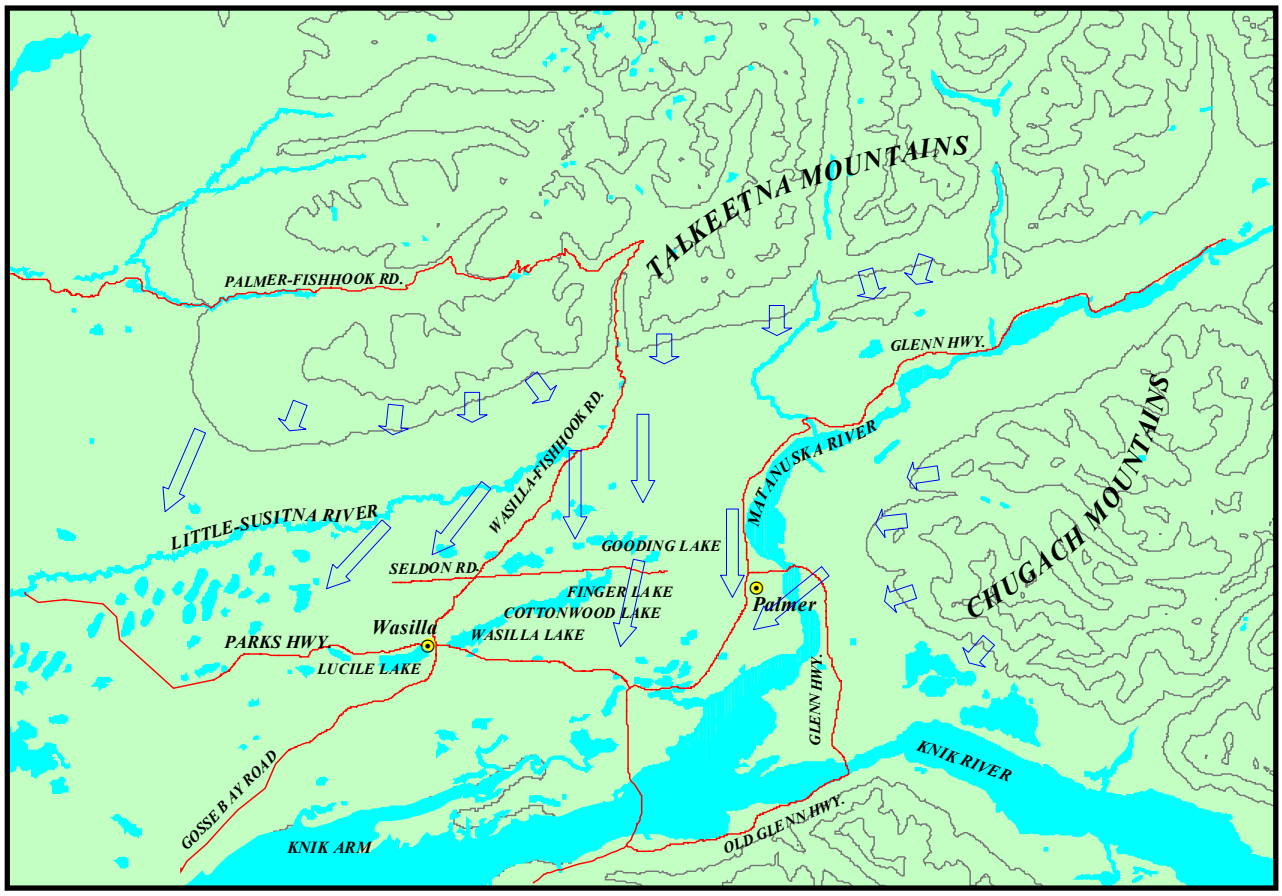

Figure 2. Map showing groundwater flow in the Matanuska-Susitna Valley (Jokela, Munter and Evans, 1991).

The Matanuska and Knik River's drain the area. These rivers are braided glacial outwash streams having wide floodplains. Drainage is poor in many interstream tracts resulting in large areas of swampy ground with shallow lakes occupying depressions.

The Matanuska-Susitna Valley is floored with unconsolidated deposits, chiefly glacial drift, that represents several episodes of glacial advances and retreats. The drift includes till, outwash stream deposits, and estuarine and lake deposits. Physiographic features formed by these deposits in or adjacent to the study area include end moraine, lateral moraines, eskers, crevasse fillings, and other pitted features, river terraces, outwash floodplains and an extensive estuarine flat (Trainer, 1960).

The glacial till and bedrock form aquifers of minor importance. The chief hydrologic significance of the till is in confining the artesian aquifer. Generally, the till is poorly permeable, although locally thin layers of sand may yield small quantities of water. Till that is present at or near the land surface in much of the area makes the acquisition of shallow groundwater difficult. The bedrock is poorly permeable. It yields water only from fractures, whose location and frequency cannot be easily predicted.

The chief aquifers are composed of outwash sand and gravel laid down by melt-water streams or in lakes. The outwash deposits are of two chief forms. The first consists of sheet-like deposits that lie just beneath the ground surface. These deposits range in thickness from a few feet to more than 100 feet. They typically rest on till or bedrock. The water in these deposits is unconfined. The other outwash deposits are buried beneath till. They are known to be as much as 50 to 60 feet thick, and probably are considerably thicker in some places. They commonly contain confined, or artesian, groundwater. Well logs and data from pumping tests suggest that outwash sand and gravel form a continuous or nearly continuous sheet in an area of more than 10 square miles north and west of Palmer (Jakola et al, 1991).

In the Mat-Su Valley, groundwater is primarily recharged by snowmelt and precipitation infiltrating both directly and also from the infiltration into the foothill slopes of the Talkeetna and Chugach Mountains. In addition,, aquifers may be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). This is the case for the water-table aquifers in the terrace south of Palmer and in the Bodenburg Butte area, which receive underground flow from the Matanuska River. Groundwater flow in the confined aquifers is generally from the north and north-northwest. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surficial topography as well as its close connection with surface water bodies (Trainer,1960).

MATANSUKA SUSITNA COLLEGE PUBLIC WATER SOURCE

Matansuka Susitna College public water source is a Class A (nontransient/noncommunity) water source, which is owned by the University of Alaska, Anchorage (UAA).The source consists of one well located approximately 1 mile of the Palmer Wasilla Highway. .. The well is at an approximate elevation of 320 feet above sea level. According to the well log, Matanuska Susitna College does not appear to be grouted but is functioning properly. The well penetrates gravel and silty sand to a depth of 250 feet below the surface. The well is screened from 236 to 246 feet below the surface. It had a static water level of 125 feet below land surface at the time of drilling (7/27/1982).

The water system at Matanuska Susitna College operates 365 days per year and collectively serves approximately 750 non-residents through one service connection. The operator estimates the peak production to be 500 gallons per day.

ASSESSMENT AND PROTECTION AREA FOR MATANSUKA SUSITNA COLLEGE DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for Matansuka Susitna College is the area that is most sensitive to contamination. This area has served as a basis for assessing the risk of the drinking water source to contamination. This zone around the drinking water source is the most critical area for the preservation of the quality of the drinking water for this source. For simplicity, this area will be known as your Drinking Water Protection Area and will serve as the area of focus for voluntary protection efforts.
Conceptually, groundwater enters the aquifer systems along the front range of the Talkeetna Mountains and flows toward Cook Inlet. An analytical calculation was used to calculate 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 well log and the recent Sanitary Survey. This analytical calculation was used as a guide in establishing the protection area for Matansuka Susitna College. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to

arrive at a meaningful and conservative protection area with respect to public health (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation (ADEC) 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 Areas for Matansuka Susitna College contains four zones, Zone A, Zone B, Zone C and Zone D (Map 1, Appendix A). Zone A corresponds to the area between the well and the distance equal to ¼ of the distance of the 2-year time-of-travel. Depending on where a contaminant source is located within Zone A, travel time for a contaminant to the well may be on the order of several days to several hours. Zone A also extends down gradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. The Zone B protection area for Matansuka Susitna College corresponds to a time-of-travel of less than two years and extends toward base of the Talkeetna Mountains. Zone C protection area corresponds to a time-of-travel of greater than 2 years and less than 5 years. Zone D corresponds to a time-of-travel of greater than 5 years and less than 10 years.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within Matansuka Susitna College Drinking Water Protection Area. 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

Table 1 in Appendix C lists the Contaminant Source Inventory for Matanuska Susitna College. Inventoried potential sources of contamination within Zone A were attributed to motor vehicle storage (parking lots), snow disposal sites. Zones B contained roads, residential areas, residential septic systems; Zone C contained roads, residential septic systems and residential area. Zone D did not contain any significant sources. Below is a summary of the contaminant sources inventoried within the Matanuska Susitna College protection area:

- Paved Roads
- Parking lots
- Snow disposal sites
- Residential Septic Systems
- Residential Area

These potential contaminant sources present risks for all six categories of drinking water contaminants for Matansuka Susitna College 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 (Appendices B & C).

VULNERABILITY OF MATANSUKA SUSITNA COLLEGE DRINKING WATER SOURCES

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

- Natural susceptibility; and
- Contaminant risks.

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

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

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

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

Matanuska Susitna College is completed in a semi-confined aquifer setting. The well penetrates gravel and silty sand to 250 feet below the surface. Although the log indicates some layers of gravelly clay, it is not a clearly defined projective layer. Geologic protective barriers in this area tend to be discontinuous and thin (Jakola, J.B., Munter). These discontinuous layers provide a potential pathway for contaminants to enter the subsurface near. The well does not appear to be properly grouted.

Combining the susceptibilities of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility (Appendix D). Table 1 shows the overall Susceptibility score and rating for Matanuska Susitna College.

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

	Score	Rating
Susceptibility of the Wellheads	5	Low
Susceptibility of the Aquifer	12	Medium
Natural Susceptibility	17	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 recent 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	12	Low
Nitrates and/or Nitrites	21	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 contains 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 Matansuka Susitna College Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	30	Low
Nitrates and Nitrites	35	Low
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.

The presence of a parking lot near the wellhead drives the score for volatile organic chemicals synthetic organic chemicals and other organic chemicals. The presence of snow disposal sites near the well drives the score for heavy metals, cyanide and other inorganic chemicals. The presence of septic systems and residential areas in Zone B drives the score for nitrates/nitrites and bacteria and viruses.

Matanuska Susitna College potential contaminant risks for the Bacteria/Viruses and Nitrate/Nitrite is driven by septic systems in Zone B. Nitrates/Nitrites are found in natural background concentration at this site, as elsewhere in Alaska. Historic sampling indicates existing Nitrate/Nitrite concentrations of 1.8 mg/l or 18% of the Maximum Concentration Level (MCL) established by the Environmental Protection Agency (EPA). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful effects. It is not known whether the presence natural or human induced. Since 1997 the nitrate levels have varied from 0.730 to 3.0 mg/l, showing no signs of a steady increase. Although the concentration levels are within safe levels with respect to human health, the levels should be watched closely over time. Increase nitrate levels is often directly correlated by an increase in septic systems upgradient from the drinking source.

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Matanuska Susitna College. The overall vulnerability of this source to contamination is **Low** for bacteria and viruses, nitrates and nitrites, heavy metals, volatile organic chemicals, synthetic organic chemicals and other 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 Matanuska Susitna College 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 Matanuska Susitna College's public drinking water source.

REFERENCES CITED

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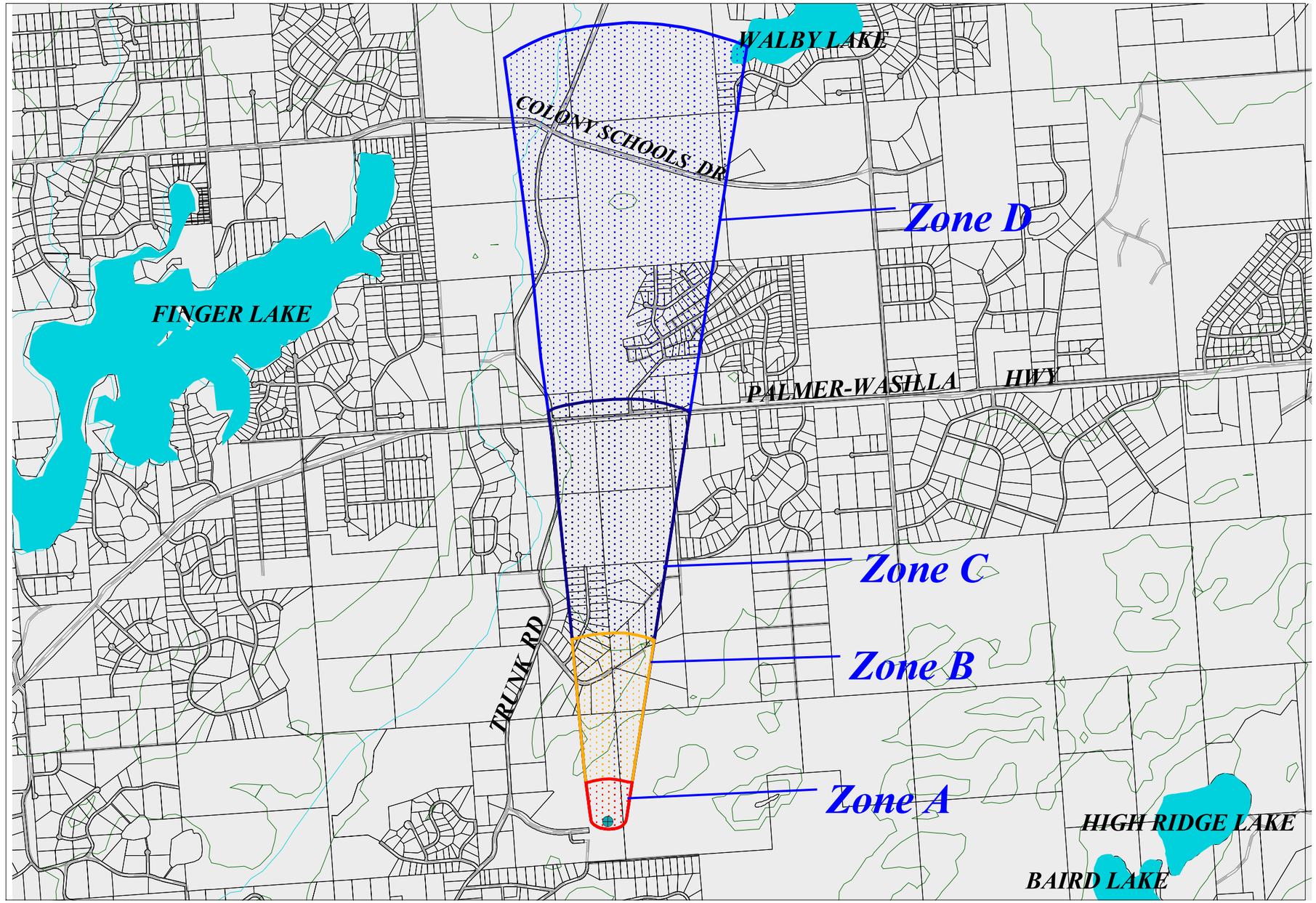
APPENDIX A

Matansuka Susitna College
Drinking Water Protection Area

Drinking Water Protection Area for Matanuska Susitna College



Legend

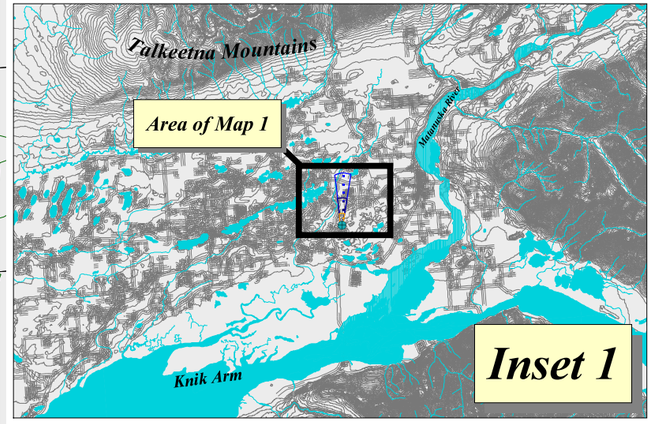
- Matanuska Susitna College Well

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less than 2 Years Travel Time

Zone C Protection Area
- Less than 5 Years Travel Time

Zone D Protection Area
- Less than 10 Years Travel Time
- Lakes and Rivers
- Rivers and Streams
- Parcels
- Roads
- Elevation Contours



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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Matansuka Susitna College

Table 1 *Contaminant Source Inventory for* ***PWSID 220477.001***

Matanuska Susitna College

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Snow disposal areas	D60	D60-01	A	Near parking lot	2	
Motor vehicle/general storage yards/facilities	X27	X27-01	A	Parking lot	2	
Residential Areas	R01	R01-01	B	Residential area in Zone B	2	11.6 acres
Septic systems (serves one single-family home)	R02	R02-01	B	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-02	B	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-03	B	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-04	B	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-05	B	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	B	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-07	B	Near Tina Lane	3	
Septic systems (serves one single-family home)	R02	R02-08-28	B	Residential septics in Zone C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Marcell Circle	2	
Residential Areas	R01	R01-02	C	Residential area in Zone C	2	16 acres
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	Highlands Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-03	C	Tina Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Vroman Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Trunk Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Palmer Wasilla Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Frontage Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-08	C	Westside Drive	2	

Table 2

Contaminant Source Inventory and Risk Ranking for Matanuska Susitna College Sources of Bacteria and Viruses

PWSID 220477.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-02	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-03	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-04	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-07	B	Low	Near Tina Lane	3	
Septic systems (serves one single-family home)	R02	R02-08-28	B	Low	Residential septics in Zone C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	Marcell Circle	2	

Table 3

Contaminant Source Inventory and Risk Ranking for Matanuska Susitna College Sources of Nitrates/Nitrites

PWSID 220477.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	B	Low	Residential area in Zone B	2	11.6 acres
Septic systems (serves one single-family home)	R02	R02-01	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-02	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-03	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-04	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-07	B	Low	Near Tina Lane	3	
Septic systems (serves one single-family home)	R02	R02-08-28	B	Low	Residential septics in Zone C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	Marcell Circle	2	
Residential Areas	R01	R01-02	C	Low	Residential area in Zone C	2	16 acres
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	Low	Highlands Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-03	C	Low	Tina Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Low	Vroman Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Low	Trunk Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Low	Palmer Wasilla Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Low	Frontage Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-08	C	Low	Westside Drive	2	

Table 4

Contaminant Source Inventory and Risk Ranking for Matanuska Susitna College Sources of Volatile Organic Chemicals

PWSID 220477.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Motor vehicle/general storage yards/facilities	X27	X27-01	A	Low	Parking lot	2	
Snow disposal areas	D60	D60-01	A	Low	Near parking lot	2	
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	Marcell Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	Low	Highlands Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-03	C	Low	Tina Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Low	Vroman Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Low	Trunk Road	2	
Residential Areas	R01	R01-01	B	Low	Residential area in Zone B	2	11.6 acres
Septic systems (serves one single-family home)	R02	R02-01	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-02	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-03	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-04	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-07	B	Low	Near Tina Lane	3	
Septic systems (serves one single-family home)	R02	R02-08-28	B	Low	Residential septics in Zone C	3	
Residential Areas	R01	R01-02	C	Low	Residential area in Zone C	2	16 acres
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Low	Palmer Wasilla Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Low	Frontage Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-08	C	Low	Westside Drive	2	

Table 5

Contaminant Source Inventory and Risk Ranking for Matanuska Susitna College

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 220477.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Snow disposal areas	D60	D60-01	A	Low	Near parking lot	2	
Residential Areas	R01	R01-01	B	Low	Residential area in Zone B	2	11.6 acres
Septic systems (serves one single-family home)	R02	R02-01	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-02	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-03	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-04	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-07	B	Low	Near Tina Lane	3	
Septic systems (serves one single-family home)	R02	R02-08-28	B	Low	Residential septics in Zone C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	Marcell Circle	2	
Residential Areas	R01	R01-02	C	Low	Residential area in Zone C	2	16 acres
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	Low	Highlands Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-03	C	Low	Tina Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Low	Vroman Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Low	Trunk Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Low	Palmer Wasilla Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Low	Frontage Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-08	C	Low	Westside Drive	2	

Table 6

Contaminant Source Inventory and Risk Ranking for Matanuska Susitna College Sources of Synthetic Organic Chemicals

PWSID 220477.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	B	Low	Residential area in Zone B	2	11.6 acres
Septic systems (serves one single-family home)	R02	R02-01	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-02	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-03	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-04	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-07	B	Low	Near Tina Lane	3	
Septic systems (serves one single-family home)	R02	R02-08-28	B	Low	Residential septics in Zone C	3	
Residential Areas	R01	R01-02	C	Low	Residential area in Zone C	2	16 acres

Table 7

Contaminant Source Inventory and Risk Ranking for Matanuska Susitna College
Sources of Other Organic Chemicals

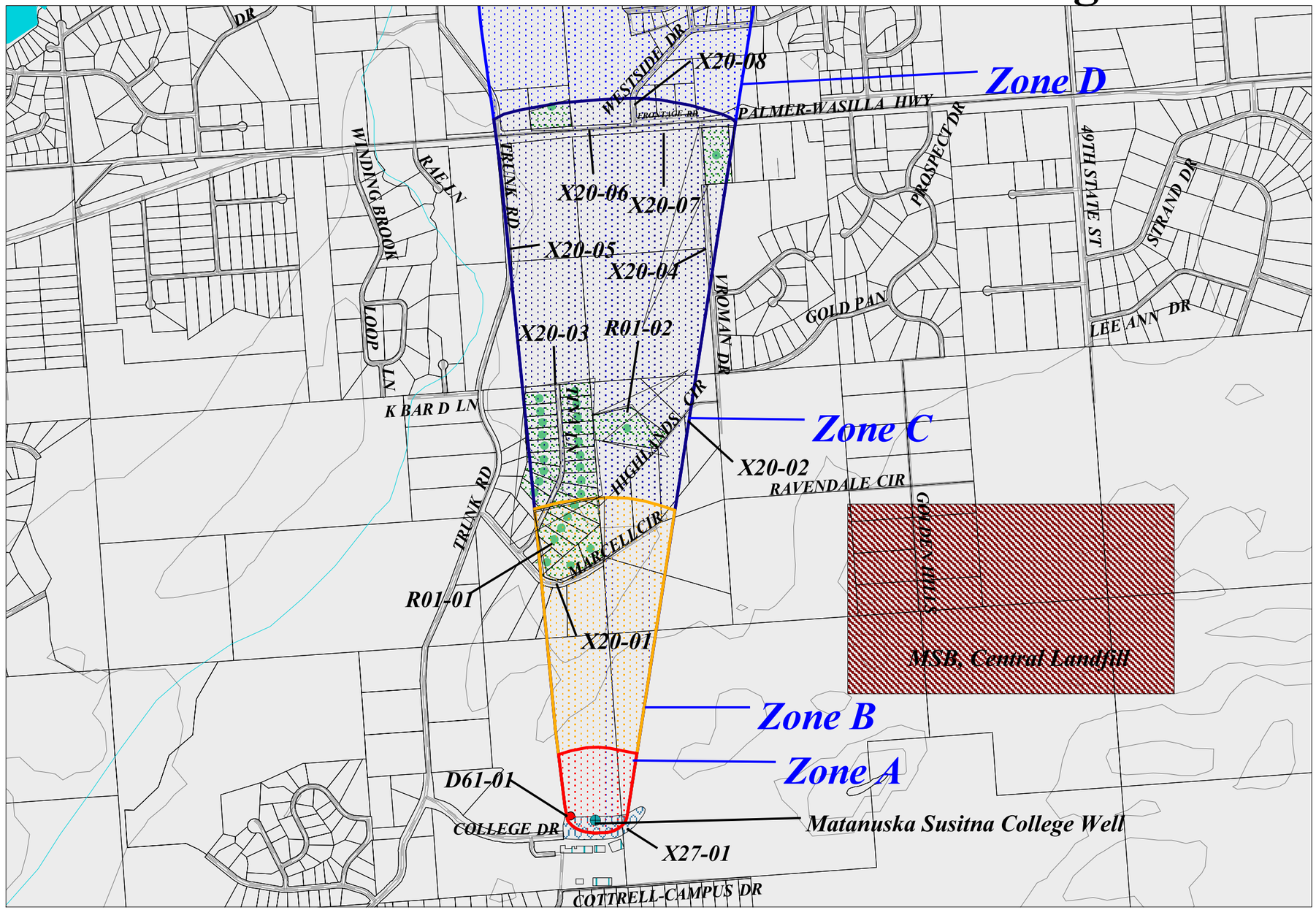
PWSID 220477.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Motor vehicle/general storage yards/facilities	X27	X27-01	A	Low	Parking lot	2	
Residential Areas	R01	R01-01	B	Low	Residential area in Zone B	2	11.6 acres
Septic systems (serves one single-family home)	R02	R02-01	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-02	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-03	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-04	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	B	Low	Near Marcell Drive	3	
Septic systems (serves one single-family home)	R02	R02-07	B	Low	Near Tina Lane	3	
Highways and roads, paved (cement or asphalt)	X20	X20-01	B	Low	Marcell Circle	2	
Septic systems (serves one single-family home)	R02	R02-08-28	B	Low	Residential septics in Zone C	3	
Residential Areas	R01	R01-02	C	Low	Residential area in Zone C	2	16 acres
Highways and roads, paved (cement or asphalt)	X20	X20-02	C	Low	Highlands Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-03	C	Low	Tina Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Low	Vroman Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Low	Trunk Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Low	Palmer Wasilla Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Low	Frontage Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-08	C	Low	Westside Drive	2	

APPENDIX C

Matansuka Susitna College
Drinking Water Protection Area
and Potential & Existing Contaminant Sources

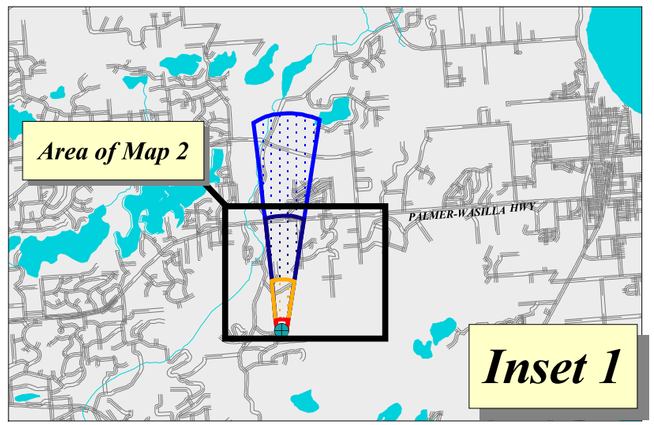
Drinking Water Protection Area and Potential and Existing Sources of Contamination for Matanuska Susitna College



500 0 500 Meters

Legend

- Matanuska Susitna College Well
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less than 2 Years Travel Time
- Zone C Protection Area
  - Less than 5 Years Travel Time
- Zone D Protection Area
  - Less than 10 Years Travel Time
- Potential and Existing Sources of Contamination
- Septics (R02)
- Residential (R01)
- Matansuska Susitna College
- Lakes and Rivers
- Rivers and Streams
- Parcels
- Parking Lot (X27)
- Matanuska Susitna Central Landfill
- Roads
- Elevation Contours

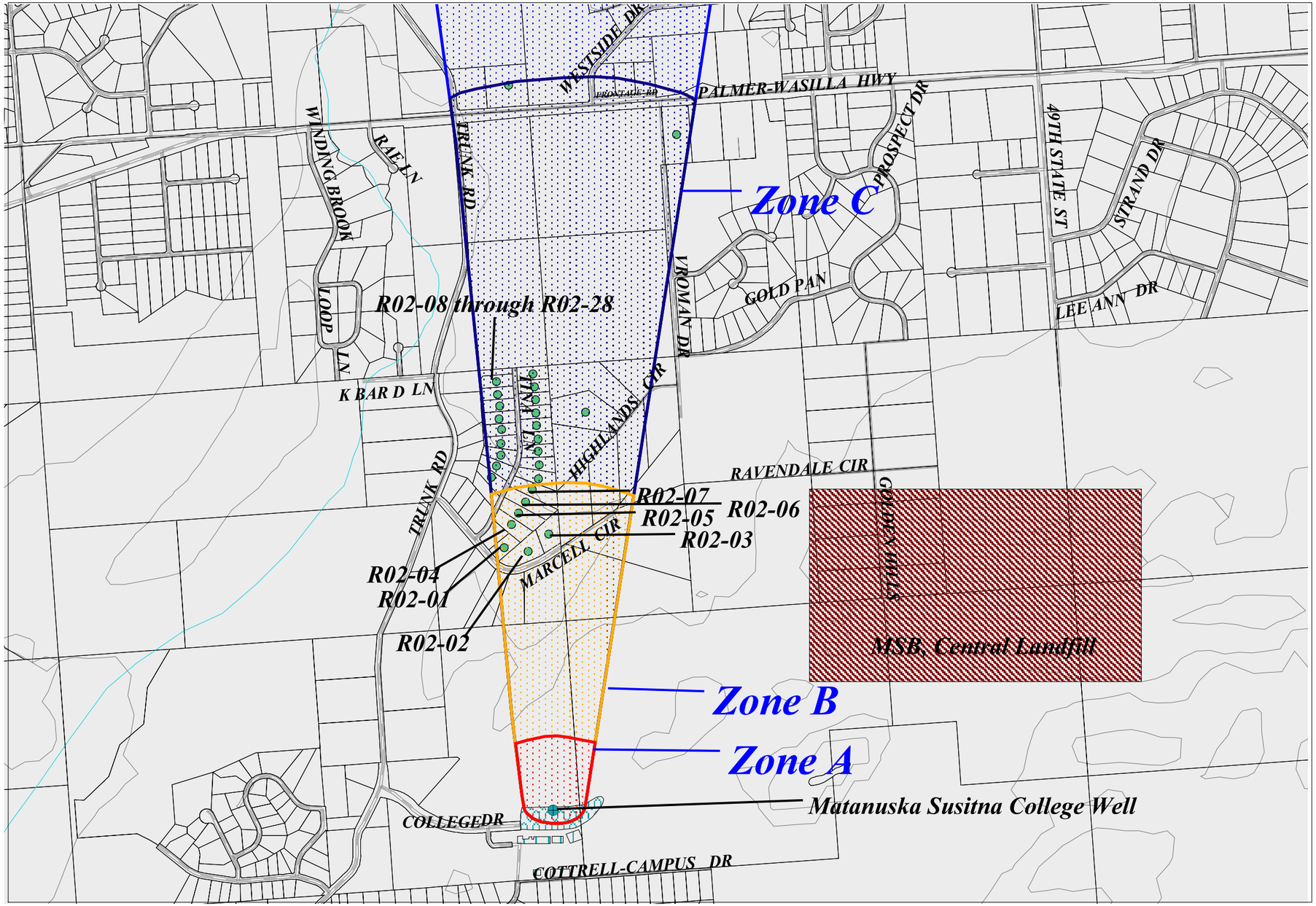


N
W E
S

PWSID 220477.001

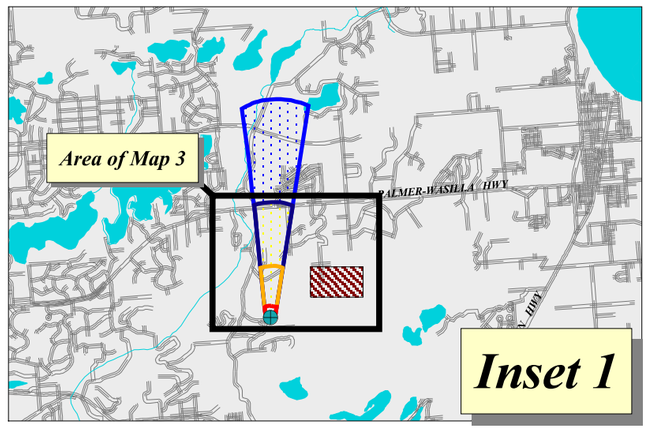
Map 2

Drinking Water Protection Area and Potential and Existing Sources of Contamination for the Matanuska Susitna College



Legend

- Matanuska Susitna College Well
- Zone A Protection Area — Several Months Travel Time
- Zone B Protection Area — Less than 2 Years Travel Time
- Zone C Protection Area — Less than 5 Years Travel Time
- Zone D Protection Area — Less than 10 Years Travel Time
- Septics (R02)
- Residential (R01)
- Matanuska Susitna Central Landfill
- Matanuska Susitna College
- Parking Lot (X27)
- Lakes and Rivers
- Rivers and Streams
- Parcels
- Roads
- Elevation Contours



N
W E
S

0 0.6 Miles

PWSID 220477.001

Map 3

APPENDIX D

Vulnerability Analysis for Matansuka Susitna College Public Drinking Water Source

Chart 1. Susceptibility of the wellhead - Matanuska Susitna College PWSID 220477.001

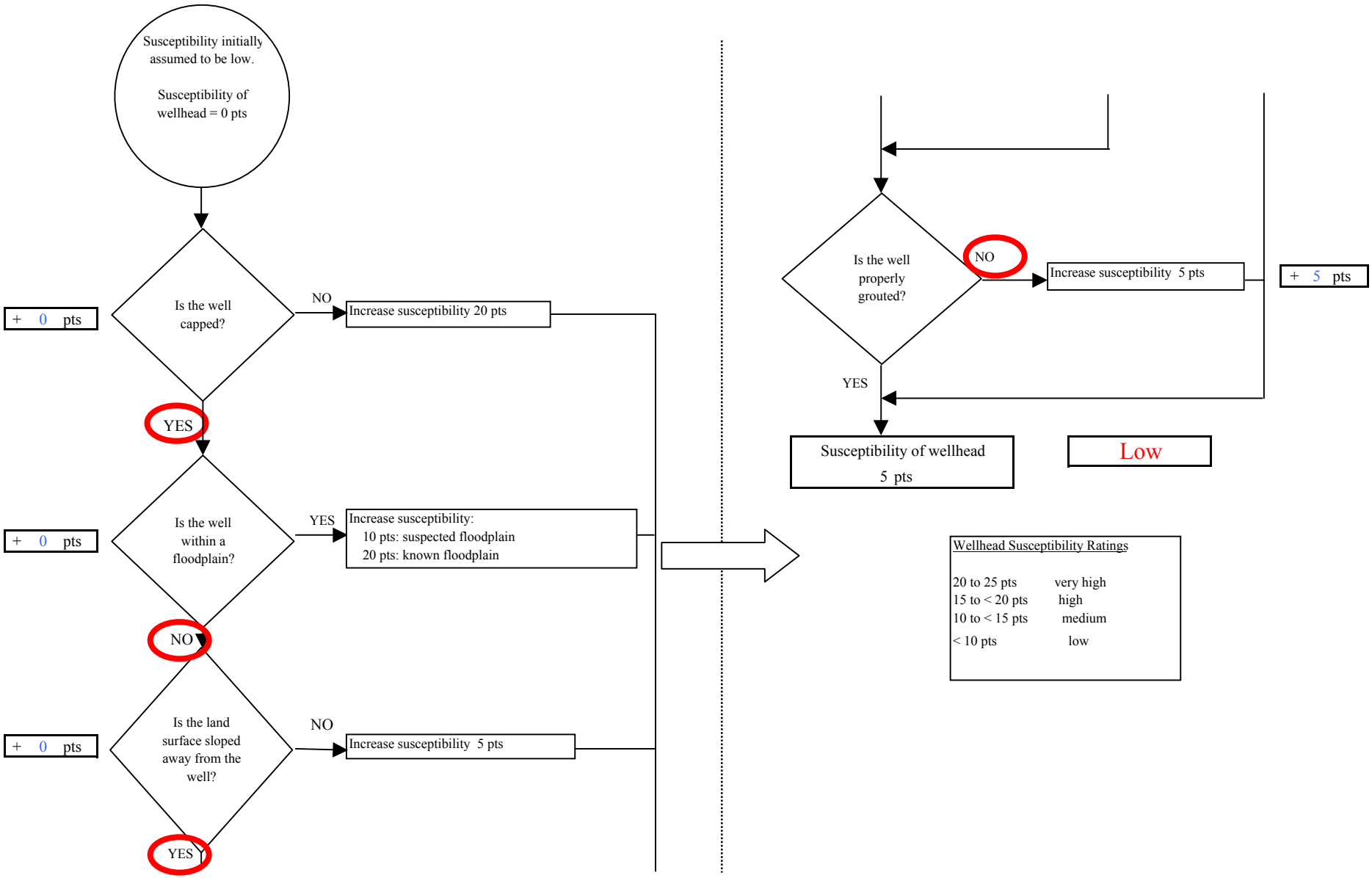


Chart 2. Susceptibility of the aquifer -Matanuska Susitna College PWSID 220477.001

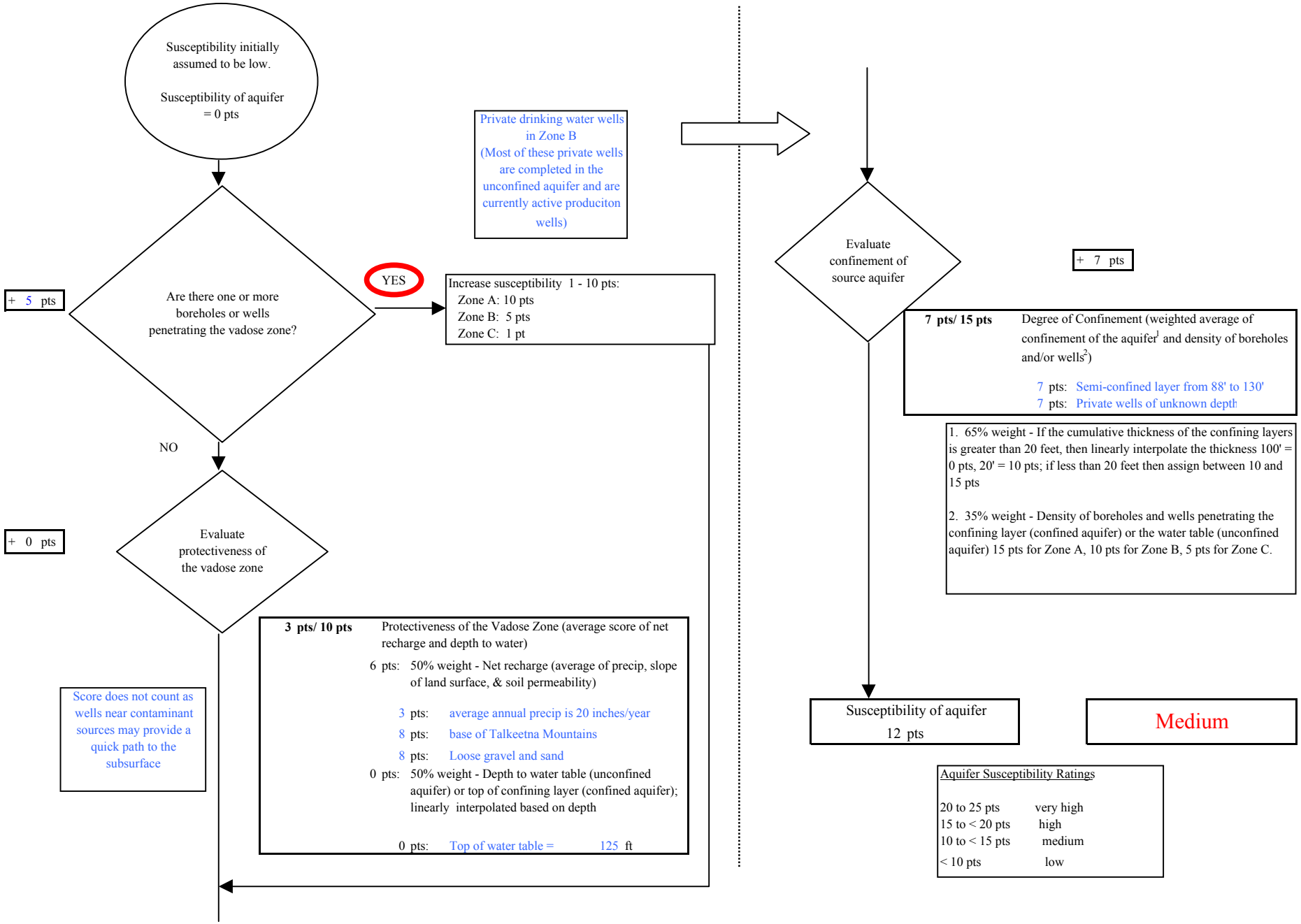
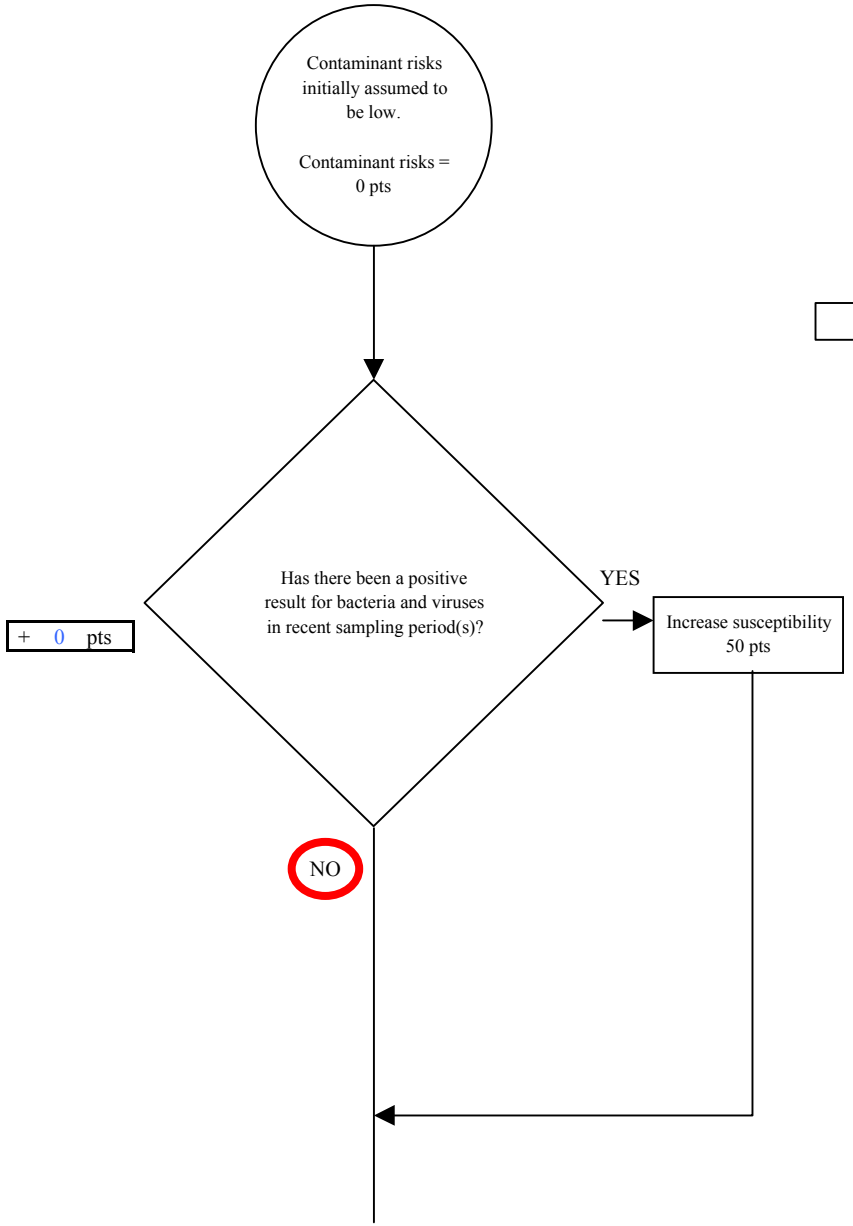
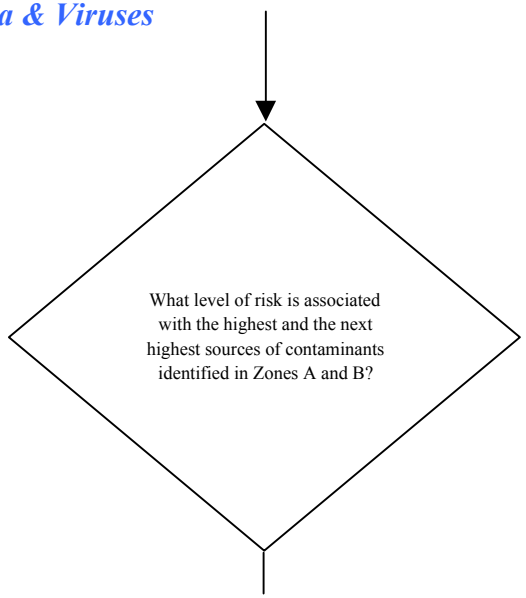


Chart 3. Contaminant risks for Matanuska Susitna College PWSID 220477.001- Bacteria & Viruses





+ 10 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	1	2	3

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

Matrix Score 10

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

Chart 3. Contaminant risks for Matanuska Susitna College PWSID 220477.001- Bacteria & Viruses

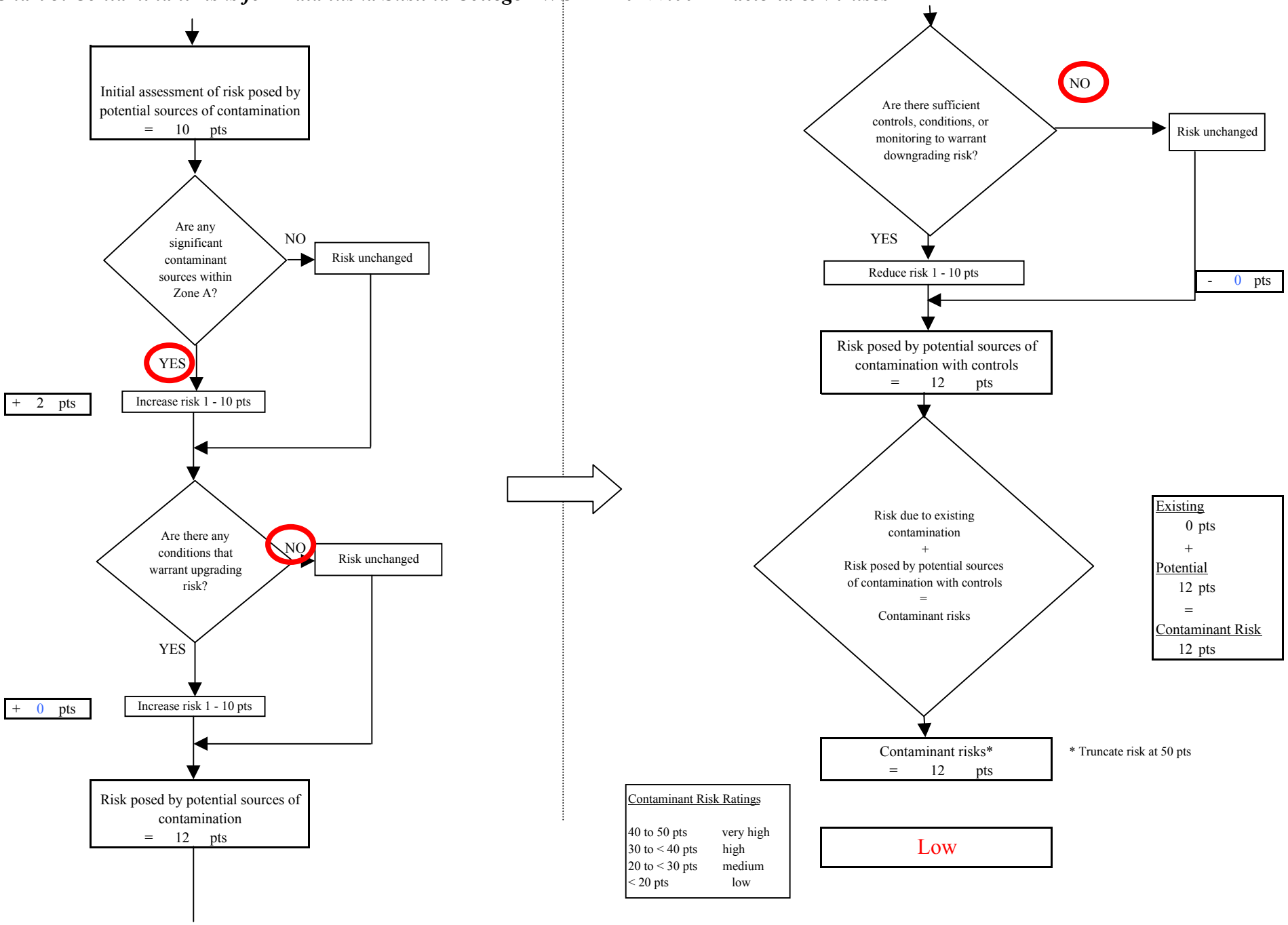


Chart 4. Vulnerability analysis for Matanuska Susitna College PWSID 220477.001- Bacteria & Viruses

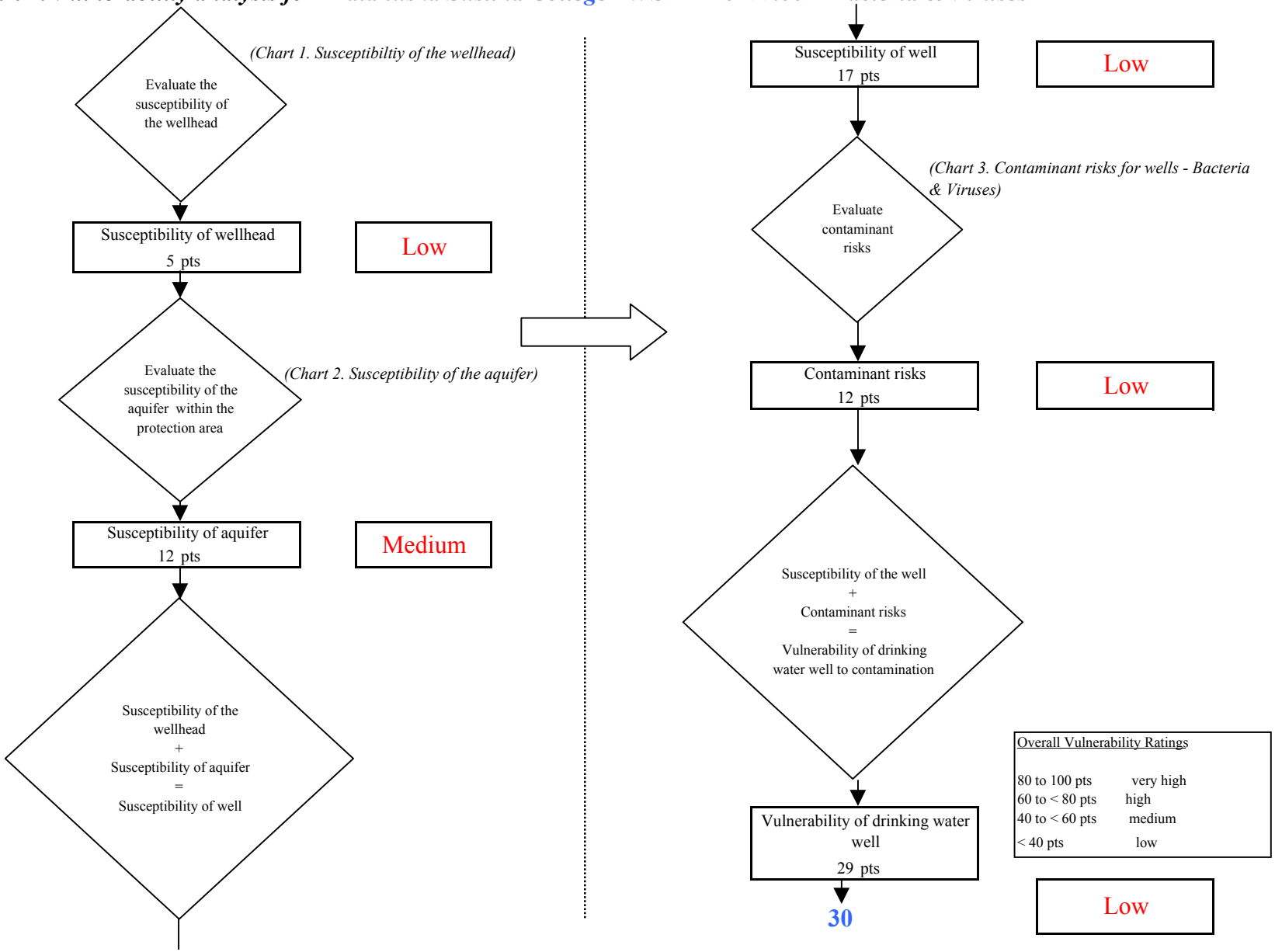


Chart 5. Contaminant risks for Matanuska Susitna College PWSID 220477.001-Nitrates & Nitrites

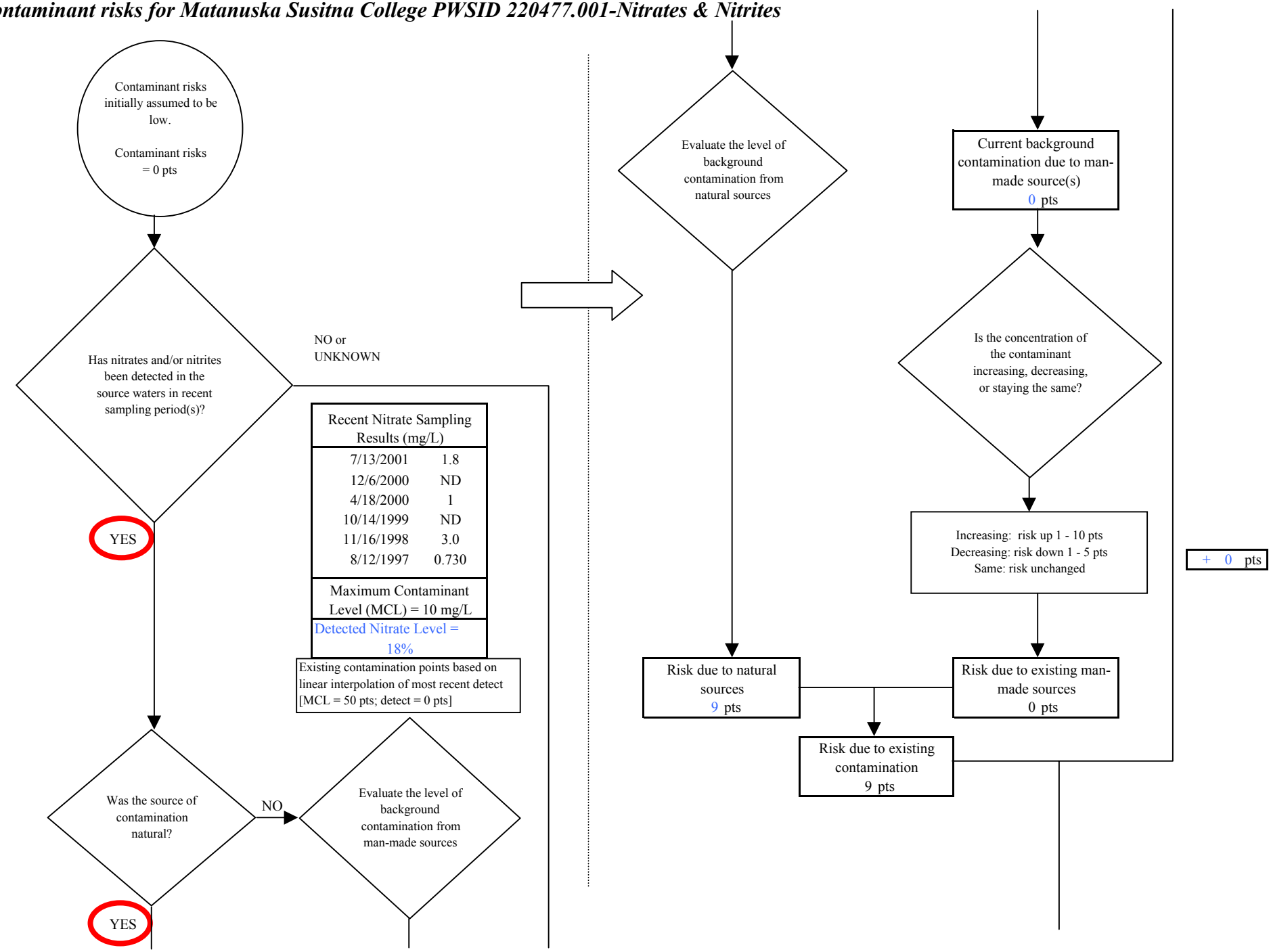


Chart 5. Contaminant risks for Matanuska Susitna College PWSID 220477.001-Nitrates & Nitrites

+ 10 pts

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

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	1	6	7

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

Matrix Score 10

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

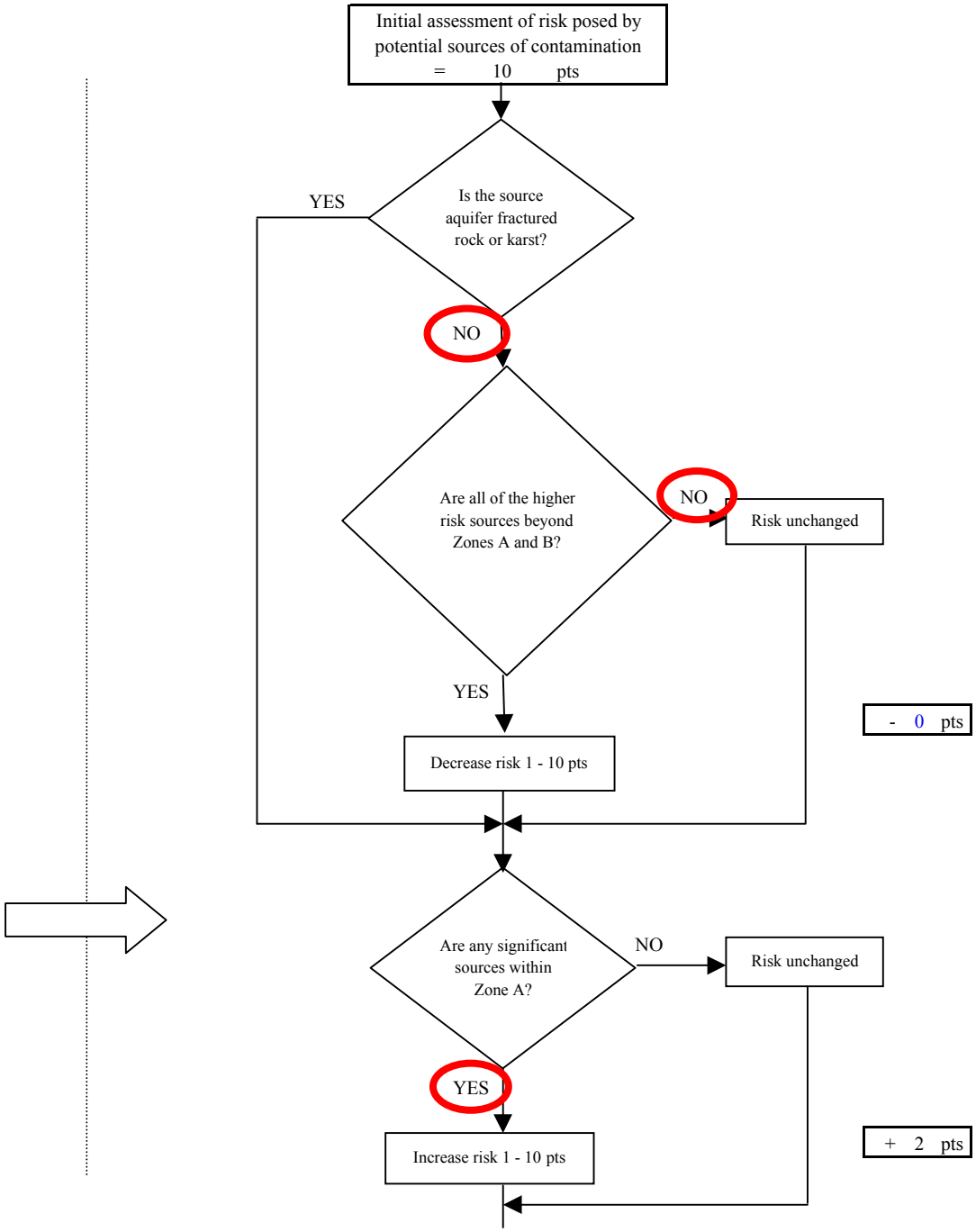


Chart 5. Contaminant risks for Matanuska Susitna College PWSID 220477.001-Nitrates & Nitrites

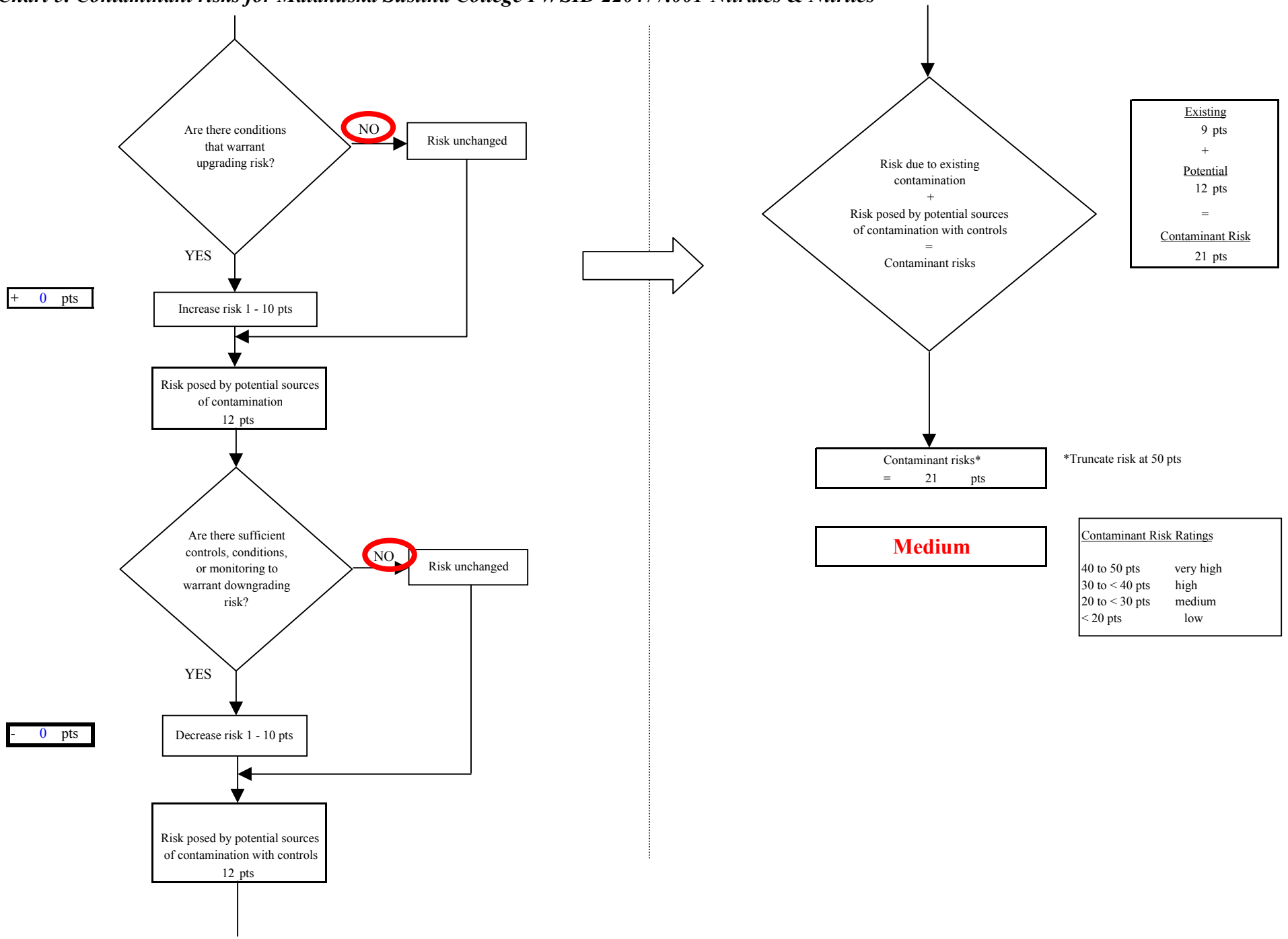


Chart 6. Vulnerability analysis for Matanuska Susitna College PWSID 220477.001- Nitrates & Nitrites

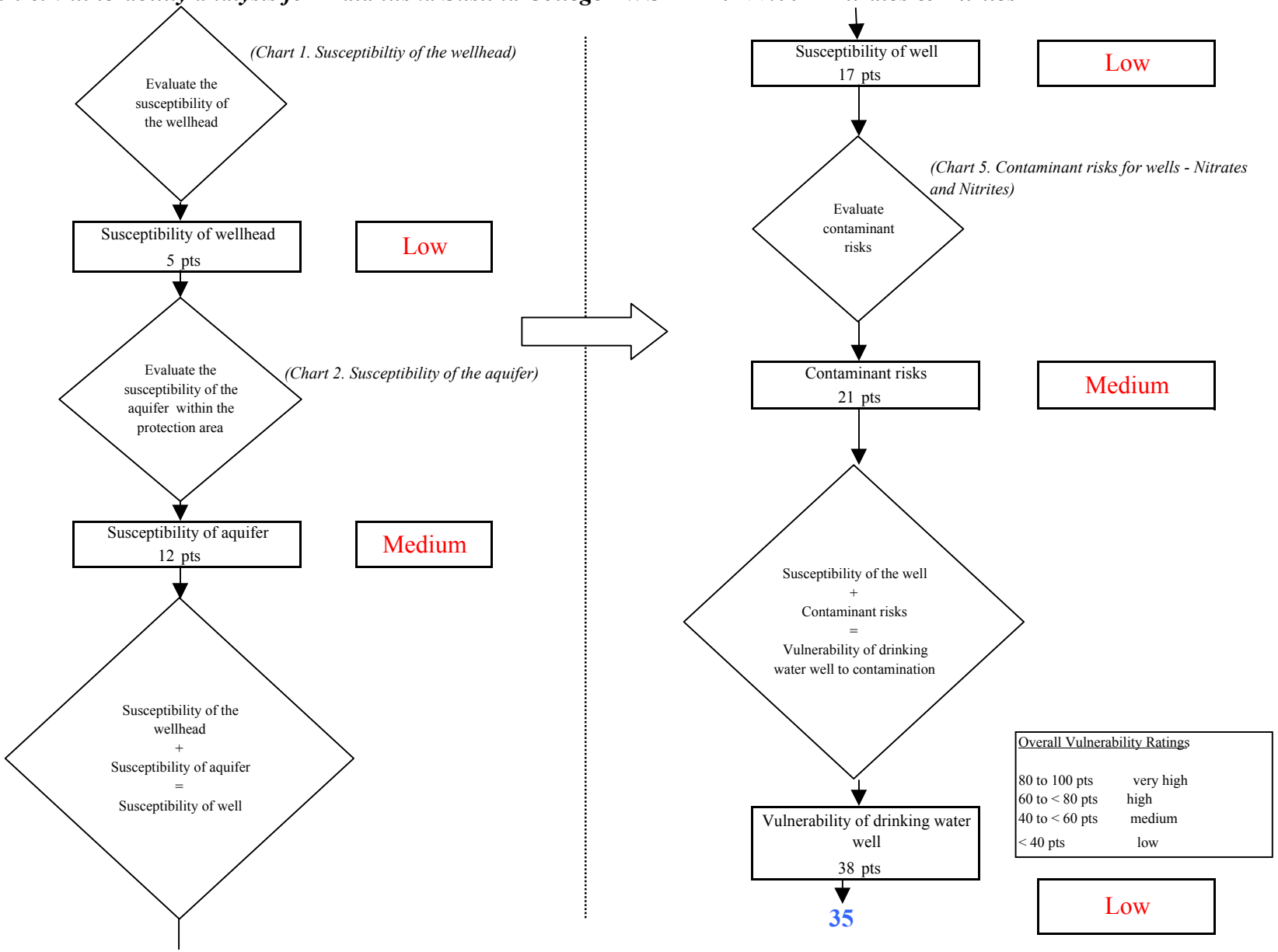


Chart 7. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Volatile Organic Chemicals

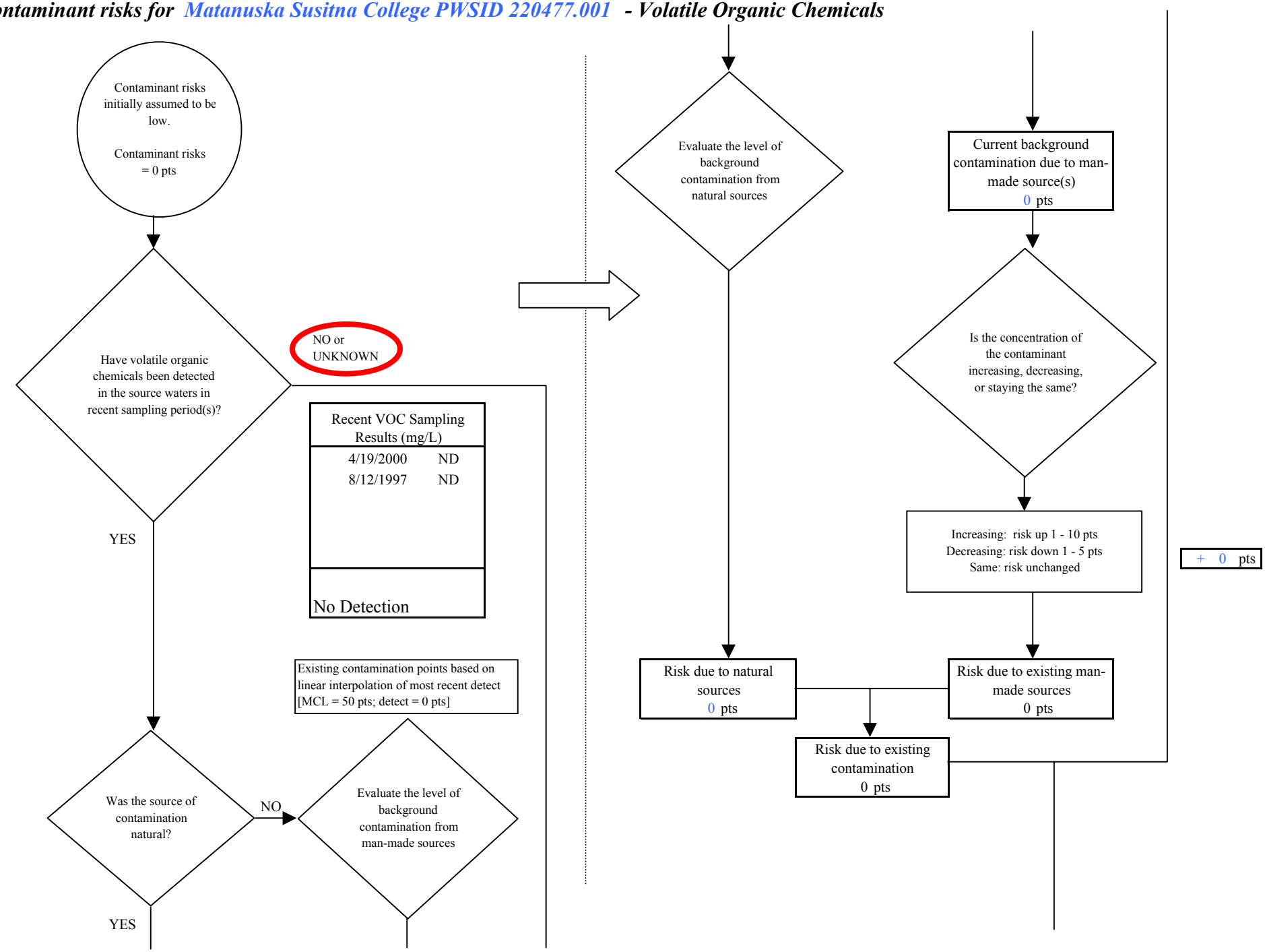


Chart 7. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Volatile Organic Chemicals

+ 10 pts

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

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

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

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

Matrix Score 10

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

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 2 pts

Chart 7. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Volatile Organic Chemicals

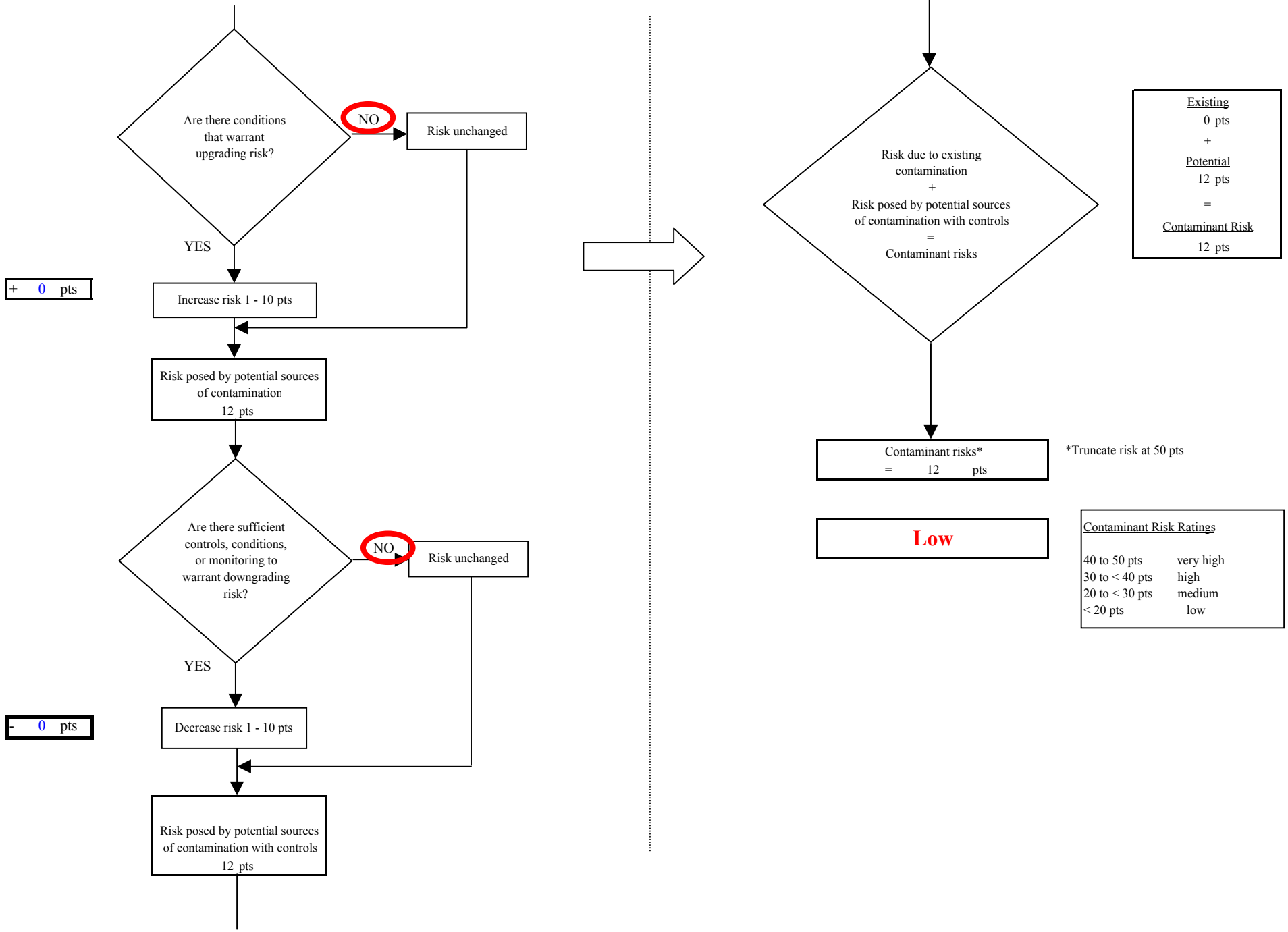


Chart 8. Vulnerability analysis for Matanuska Susitna College PWSID 220477.001 - Volatile Organic Chemicals

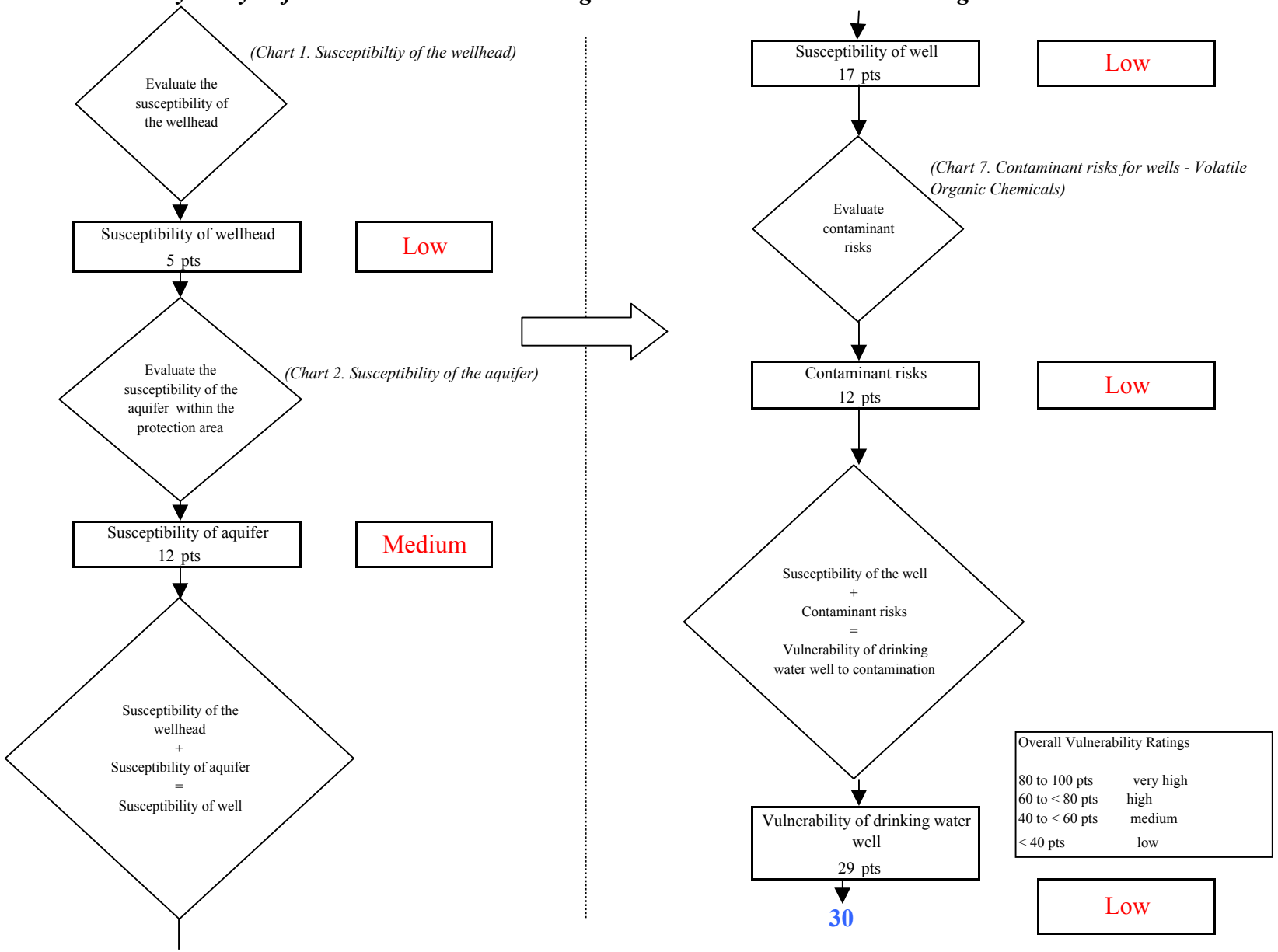


Chart 9. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

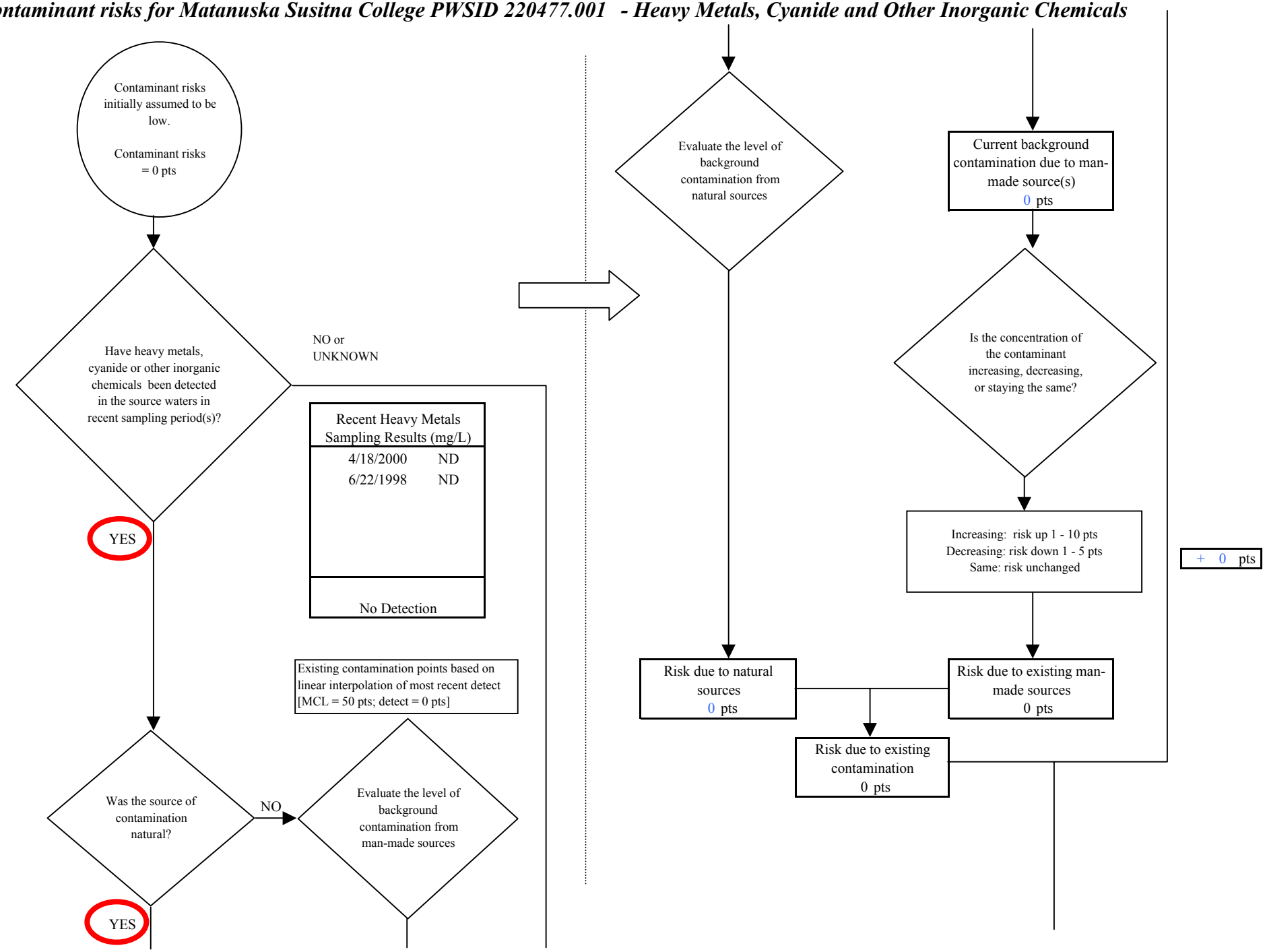


Chart 9. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 10 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	4	7

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

Matrix Score 10

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

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 2 pts

Chart 9. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

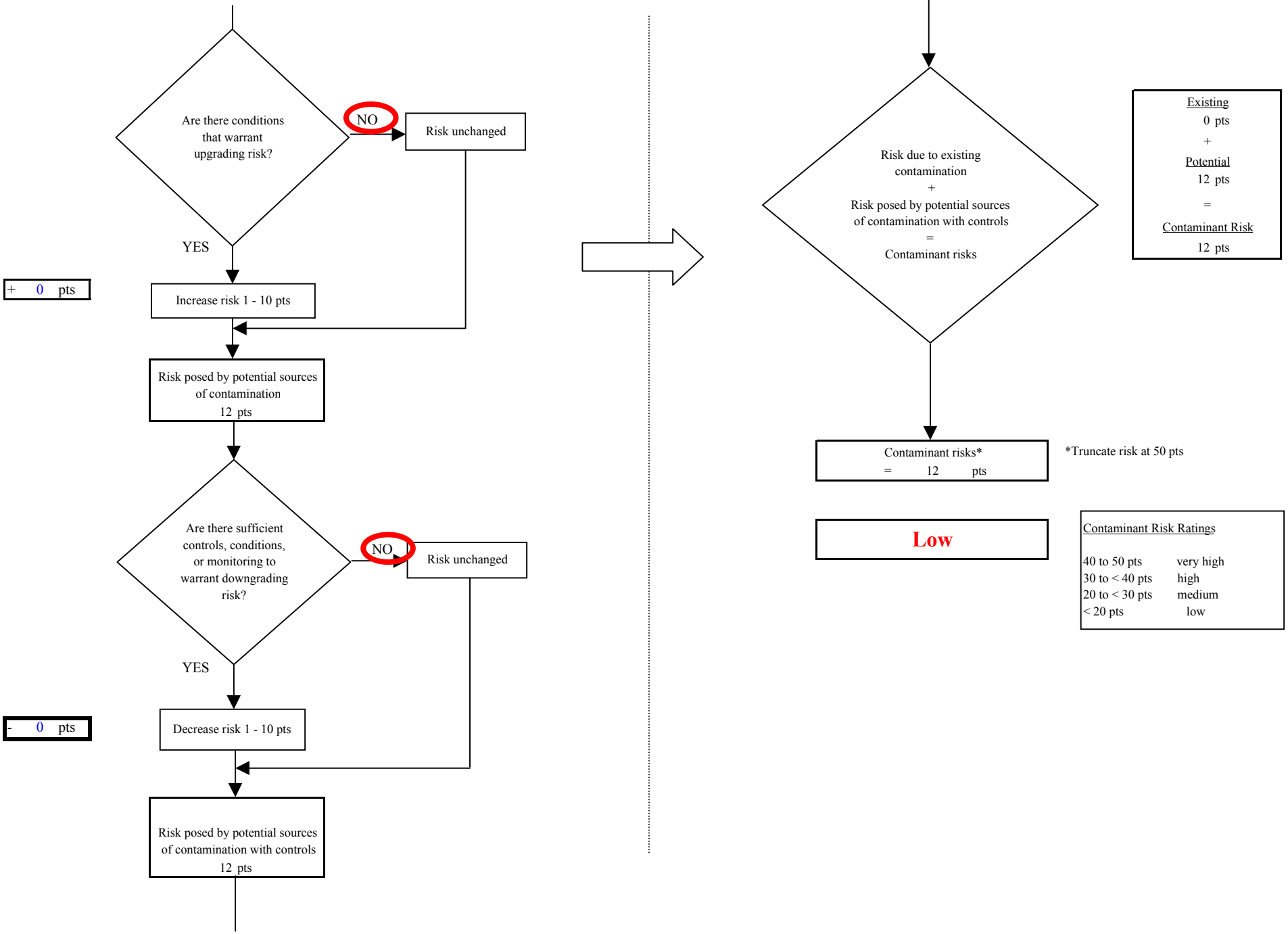


Chart 10. Vulnerability analysis for Matanuska Susitna College PWSID 220477.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

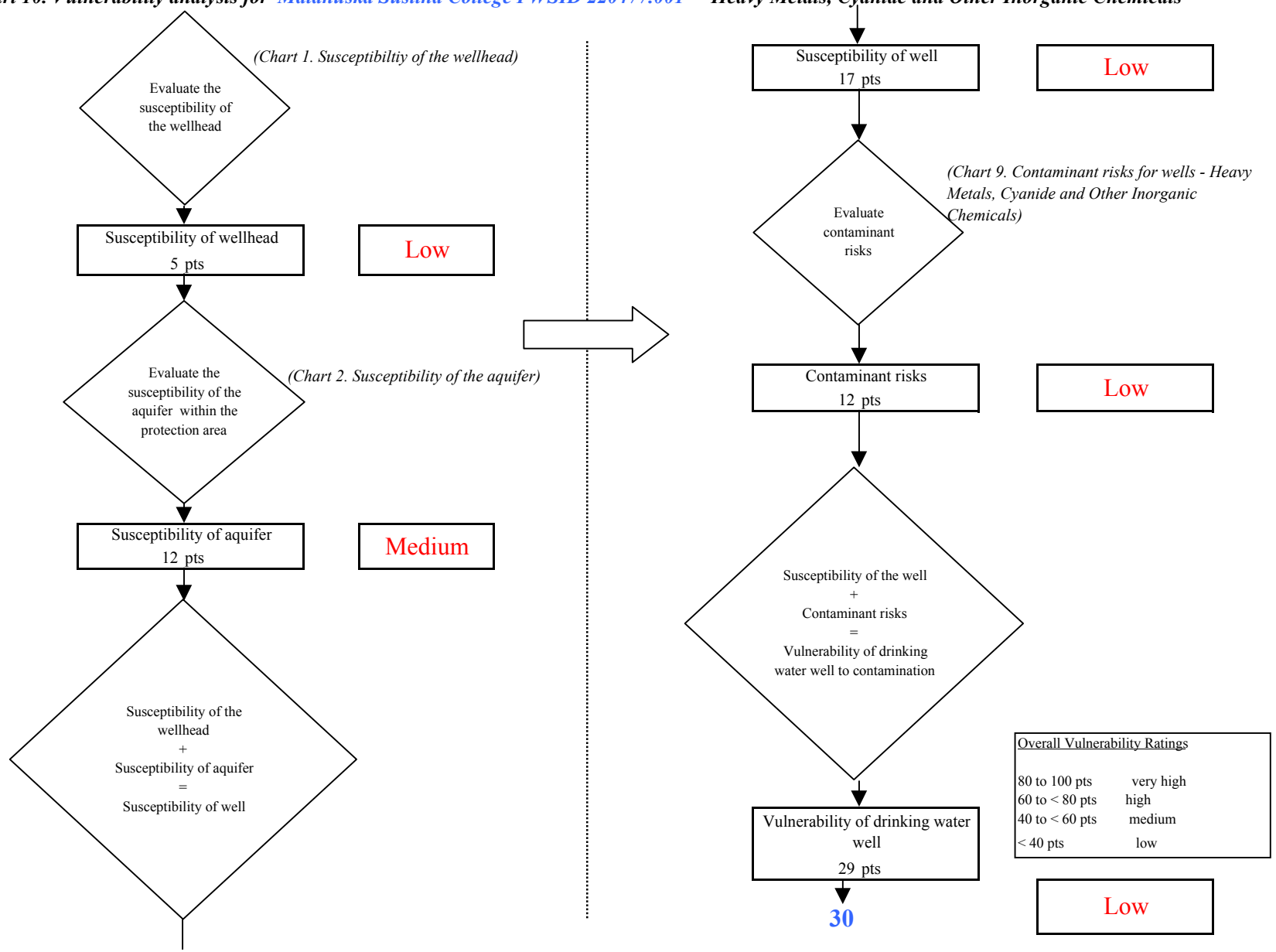


Chart 11. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Synthetic Organic Chemicals

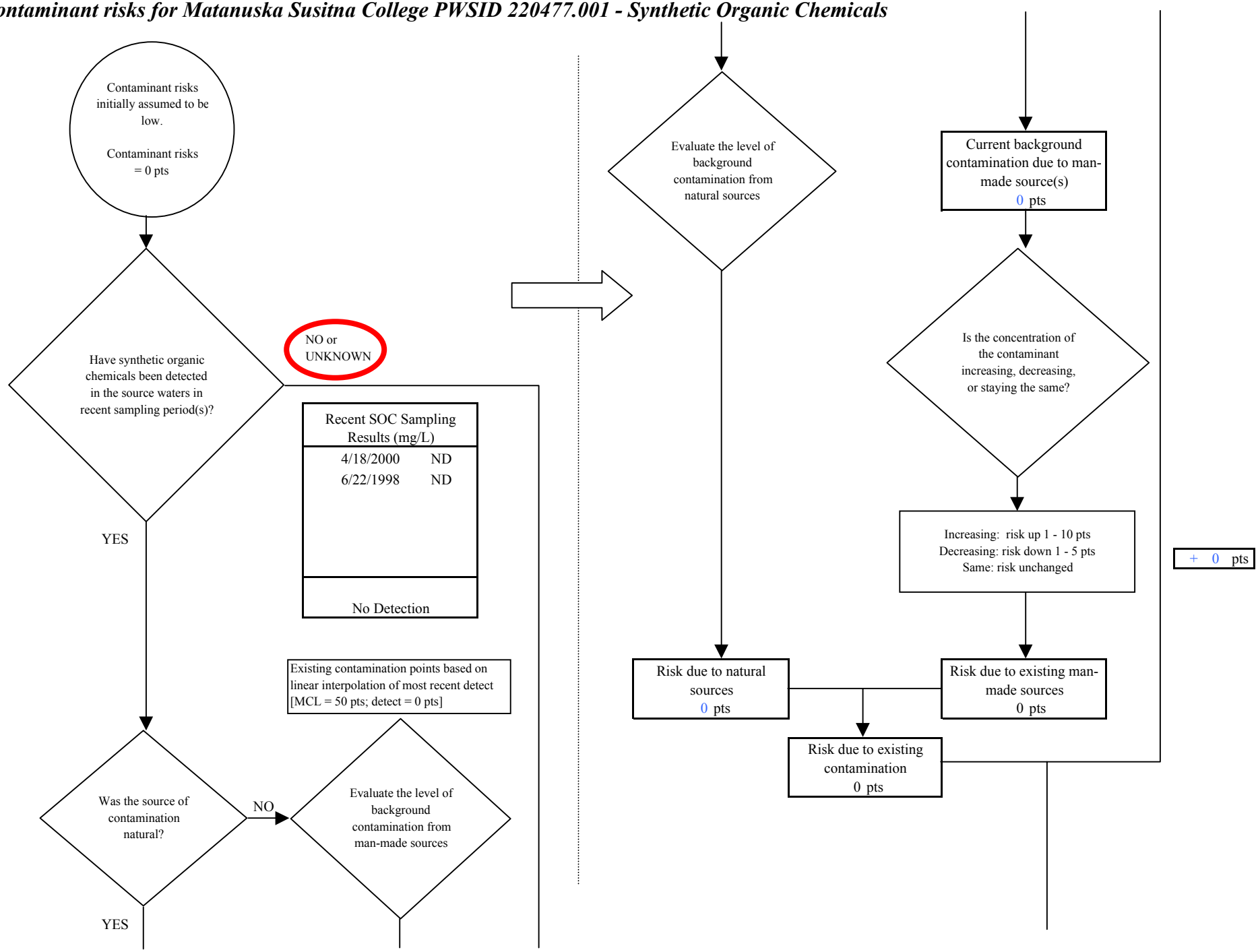


Chart 11. Contaminant risks for Matanuska Susitna College PWSID 220477.001- Synthetic Organic Chemicals

+ 10 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	1	3	4

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

Matrix Score 10

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

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 2 pts

Chart 11. Contaminant risks for Matanuska Susitna College PWSID 220477.001- Synthetic Organic Chemicals

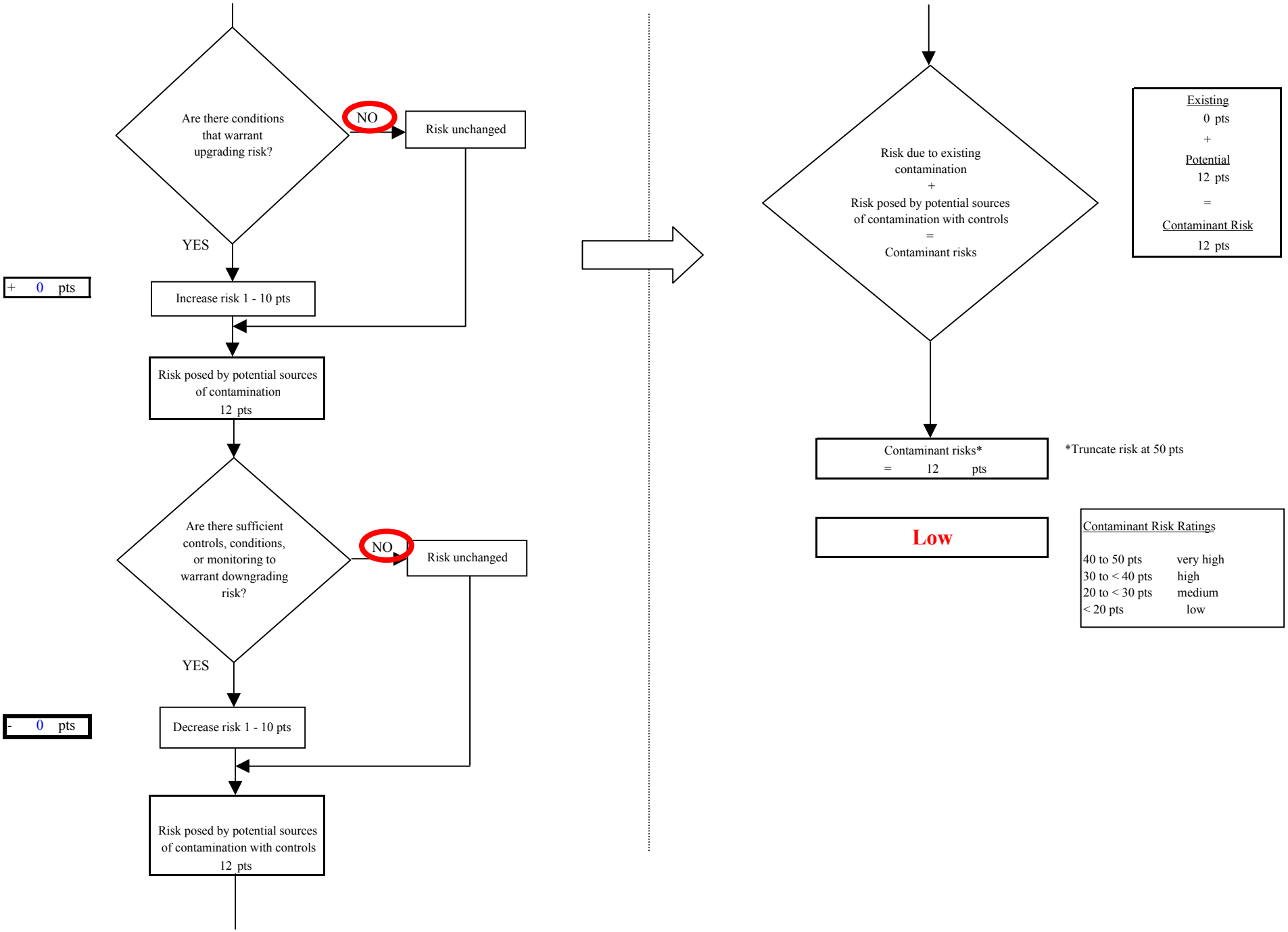


Chart 12. Vulnerability analysis for Matanuska Susitna College PWSID 220477.001 - Synthetic Organic Chemicals

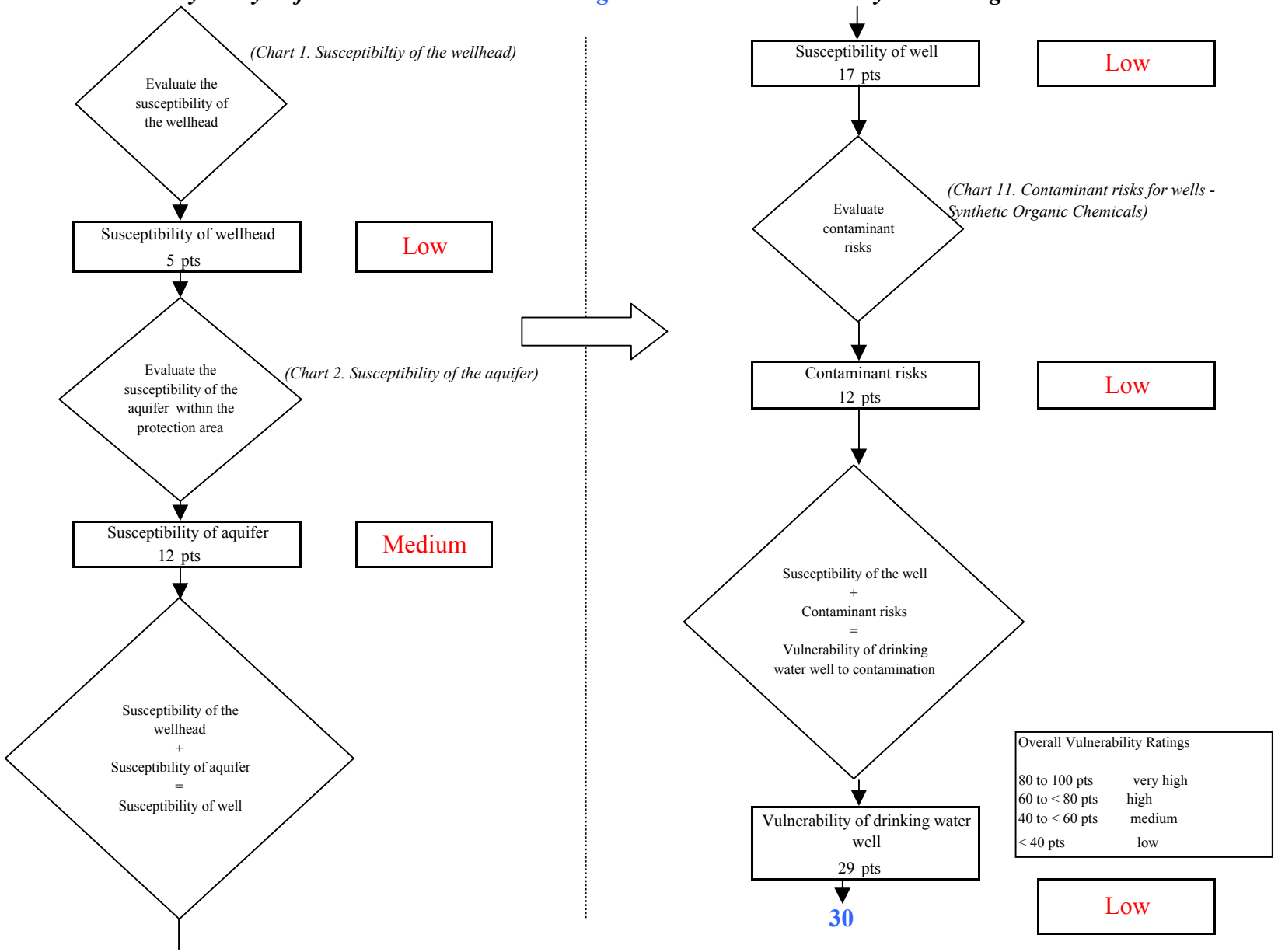


Chart 13. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Other Organic Chemicals

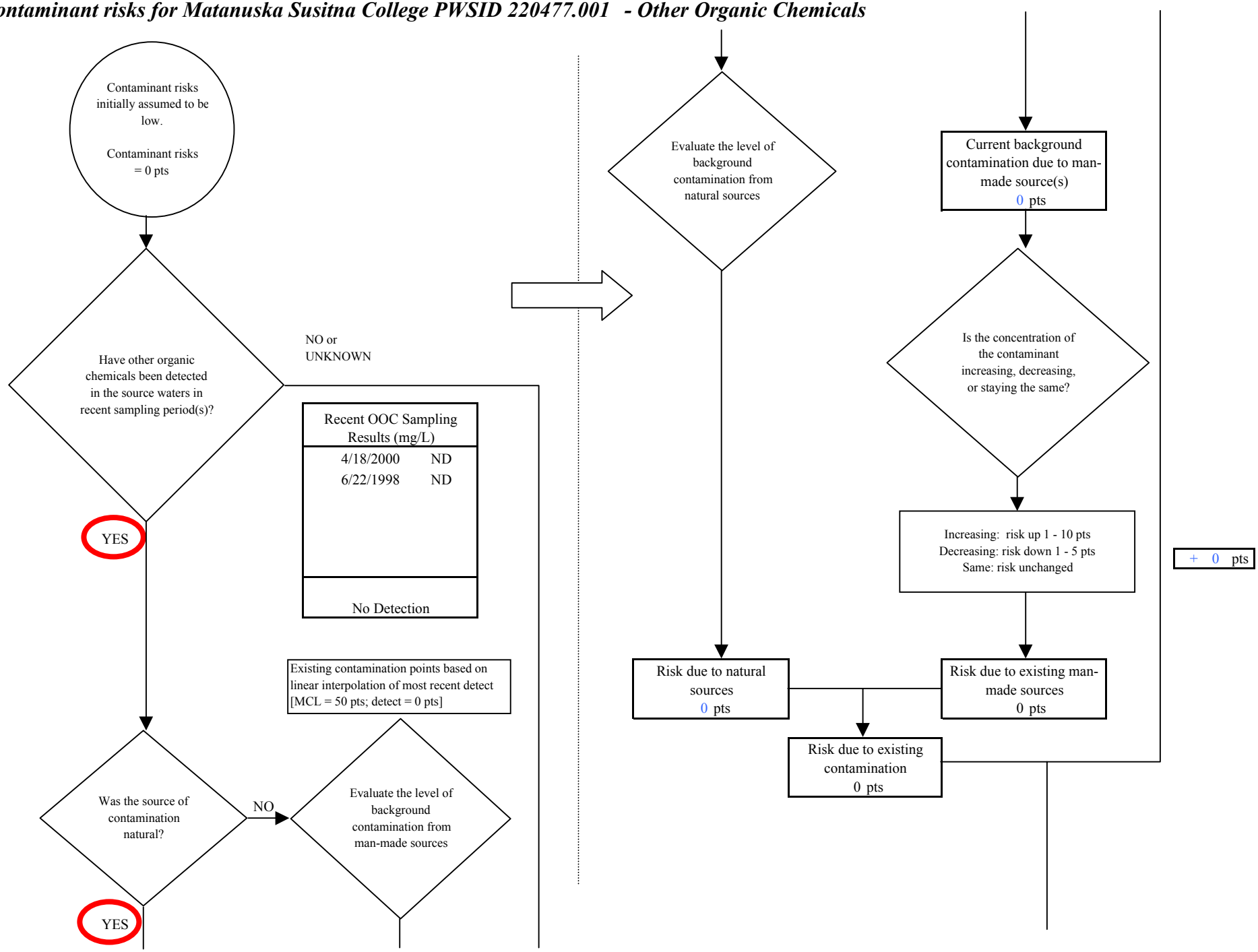


Chart 13. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Other Organic Chemicals

+ 10 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	4	6

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

Matrix Score 10

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

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 13. Contaminant risks for Matanuska Susitna College PWSID 220477.001 - Other Organic Chemicals

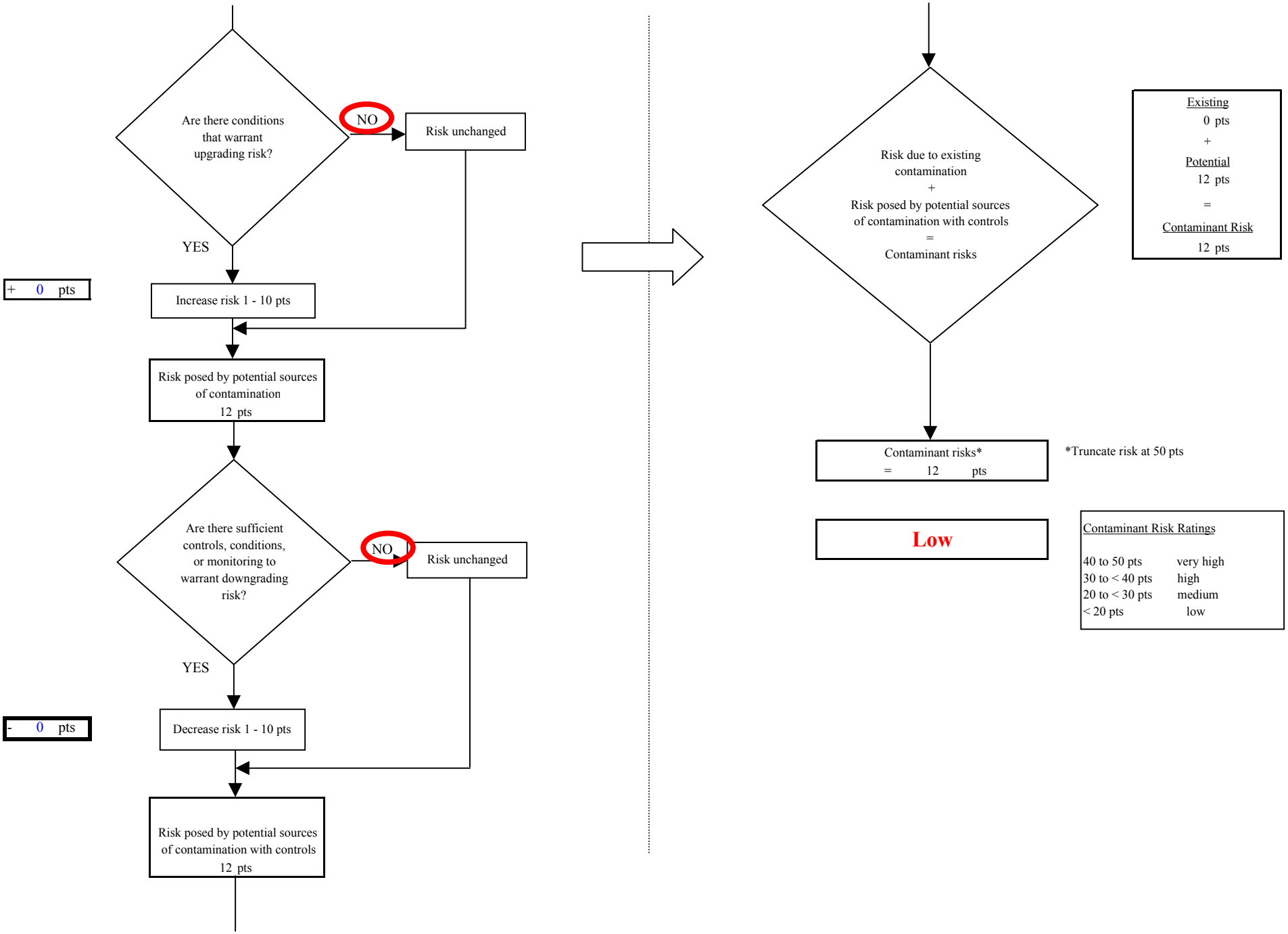


Chart 14. Vulnerability analysis for Matanuska Susitna College PWSID 220477.001- Other Organic Chemicals