Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Koyuk Washeteria & School Drinking Water System, Koyuk, Alaska

PWSID # 340167.001

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DRINKING WATER PROTECTION PROGRAM REPORT 1326
Alaska Department of Environmental Conservation

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The Drinking Water Protection Program (DWPP) is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Source Water Assessment for the Koyuk Washeteria and School Source of Public Drinking Water, Koyuk, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Koyuk Washeteria and School have one primary and several backup Public Water System (PWS) wells. This assessment is exclusively limited to PWS No. 340167.001. The well has been used as a drinking water source since it was drilled in November of 1973

The well is a Class A (community and non-transient/non-community) water system located inside the washeteria. The 2002 sanitary survey indicates that there is a storage tank with a 203,000-gallon capacity. Records also indicate that the drinking water source is untreated. This system operates year round and serves approximately 297 residents and 2 non-residents through 59 service connections. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produce a **Very High** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: bulk fuel facilities, fuel tanks, airports, pipelines and power generation facilities. A detailed inventory of potential or existing contamination sources can be found in Appendix B, Table 1. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

Overall, the water well received a vulnerability rating of **High** for bacteria and viruses and synthetic organic chemicals and a vulnerability rating of **Very High** for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals and other organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The Koyuk Washeteria and School well is a Class A (community/non-transient/non-community) public water system. The system is located in the washeteria in Koyuk, Alaska. (Sec. 32, T006S, R012W, Kateel River Meridian; see Map A of Appendix A). Koyuk is located at the mouth of the Koyuk River, at the northeastern end of Norton Bay on the Seward Peninsula, 90 miles east of Nome. The community has a population of 340 (ADCED, 2003). Average annual precipitation for Koyuk is 19 inches, including approximately 40 inches of snowfall. Temperatures typically range between –8 to 62°F.

A piped water and sewer system was recently completed and serves approximately 50 homes. A central watering point is located at the washeteria. Refuse is collected by the City and disposed of at the City operated landfill (ADCED, 2003). AVEC, a REA cooperative, provides electricity. Power-generating facilities are diesel (ADCED, 2003).

According to information supplied by ADEC for the Koyuk Washeteria and School PWS, the depth of the primary water well is 90 feet below the ground surface. Based on available well construction details, the well is not screened. The well is completed in a confined aquifer and is not located within a floodplain. Coastal flooding has occurred historically, however the well is located away from the high flood marks.

Information acquired from a June 2002 sanitary survey for the public water system indicated that the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. The sanitary survey indicates that the well is grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters. A hole in the sanitary seal is reported to be in need of repair.

Typically, the soils in the area consist of organics overlying frozen silts. Bedrock in the vicinity of the site is shallow, typically on the order of less than 10 feet from the surface (HDL, 2002).

DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what the most likely pathways for surface contamination to reach the groundwater are. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the drinking water protection area (DWPA). Because releases of contaminants within the protection area are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts. An analytical calculation was used to determine the size and shape of the DWPA for the Koyuk Washeteria and School PWS. The input parameters describing the attributes of the aquifer in this calculation were adopted from Groundwater (Freeze and Cherry, 1979). Available geology and groundwater contours were also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

The protection areas established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four protection area zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. time-of-travel
B	Less than the 2 year time-of-travel
C	Less Than the 5 year time-of-travel
D	Less than the 10 year time-of-travel

The DWPA for the Koyuk Washeteria and School PWS was determined using an analytical calculation and includes Zones A, B, C, and D (See Map A of Appendix A).

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 Koyuk Washeteria and School DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include 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 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.

The sources are displayed on Map C of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking 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. Rankings include:

- Low,
- Medium,
- High, and
- Very High.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer

Zone D due to the probability of contaminant dilution by the time the contaminants get to the well. 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, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF THE DRINKING WATER SYSTEM

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

- Natural susceptibility, and
- Contaminant risks.

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 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. Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
(Chart 2 of Appendix D)

=

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

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The Koyuk Washeteria and School water well is completed in a confined aquifer. Confined aquifers are less susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the susceptibility scores and ratings for this PWS.

Table 2. Susceptibility

	Score	**Rating**
Susceptibility of the Wellhead	22	Very High
Susceptibility of the Aquifer	22	Very High
Natural Susceptibility	42	Very High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Contaminant Risk Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	35	High
Nitrates and/or Nitrites	40	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	25	Medium
Other Organic Chemicals	50	Very High

Finally, an overall vulnerability score is assigned for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings	
80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	75	High
Nitrates and Nitrites	80	Very High
Volatile Organic Chemicals	90	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	90	Very High
Synthetic Organic Chemicals	70	High
Other Organic Chemicals	90	Very High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **High**. The risk is primarily attributed to the presence of water treatment and disposal facilitites located in Zone A. Numerous other contaminant sources are located in the protection area (see Table 2 – Appendix B).

Coliform (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliform and E. coli, which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2003).

No positive bacteria counts have been reported in recent (within five years) sampling events (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Only a small amount of bacteria and viruses are required to endanger public health.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High**. The risk to this source of public drinking water is primarily attributed to the presence of water treatment and disposal facilitites located in Zone A. Numerous other contaminant sources are located in the protection area (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that nitrates have been detected in recent sampling events, however they did not exceed the MCL of 10 mg/L. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L; therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils. Although the nitrate source in unknown, such occurrences may be attributed to septic systems or other sources.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is **Very High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of dichloromethane in recent sampling results and a bulk fuel facility located in Zone A. Other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

Recent sampling results identified dichloromethane in the water supply for Koyuk Washeteria and School (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

The greatest use of dichloromethane (DCM) is as a paint remover. Most DCM is released to the atmosphere where it degrees; releases into water are primarily removed by evaporation. Biodegradation is possible in natural waters but will probably be very slow. The major route of human exposure is from air. Potential health effects from the acute or long to lifetime exposure at levels above the MCL are neurological and blood cell damage, liver damage and cancer an occur. While the source is unknown, it is most likely indicative of source water conditions and risk points were assigned.

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Very High**.

Heavy Metals, Cyanide and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Very high**. The risk is primarily attributed to the presence of lead in recent sampling events and an electric power generation facility using fossil fuels located in Zone A (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, lead has been detected in recent sampling history that has met the MCL of 0.15 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The presence of lead is most likely indicative of recent maintenance to the water distribution/conveyance system, however since the MCL was met risk points were assigned.

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Very High**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Medium**. The risk is primarily attributed to the presence of an airport located in Zone A. Other potential contaminant sources are also found within the protection area (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for Koyuk Washeteria and School (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

After combining the contaminant risk for synthetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **High**.

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of bulk fuel facilities and an electric power generator (fossil fuels) in Zone A. Other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for Koyuk Washeteria and School (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

After combining the contaminant risk for other organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Very High.**

Using the Source Water Assessment

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 Koyuk Washeteria and School and the community of Koyuk to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

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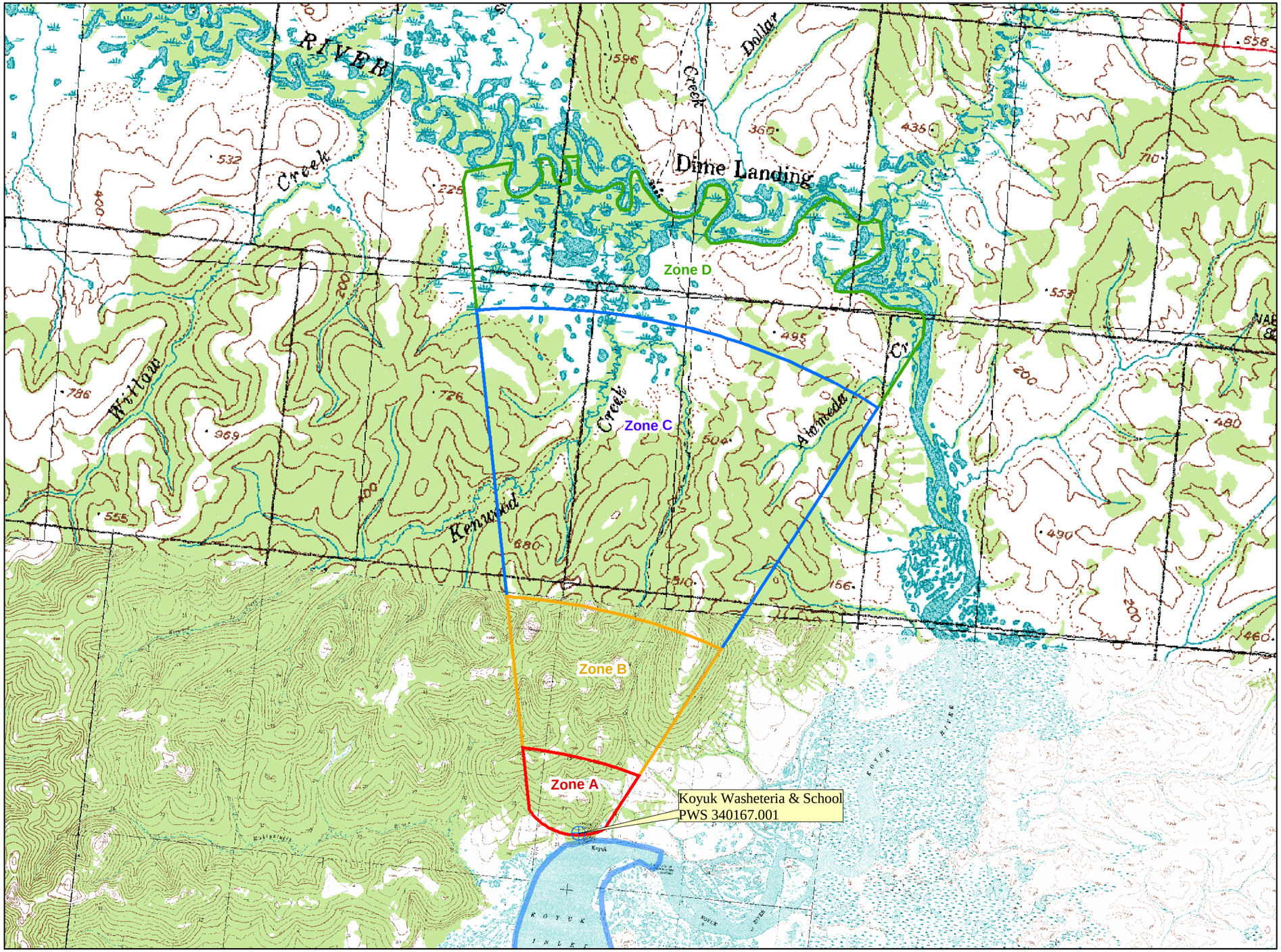
APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #340167.001 Koyuk Washeteria & School



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

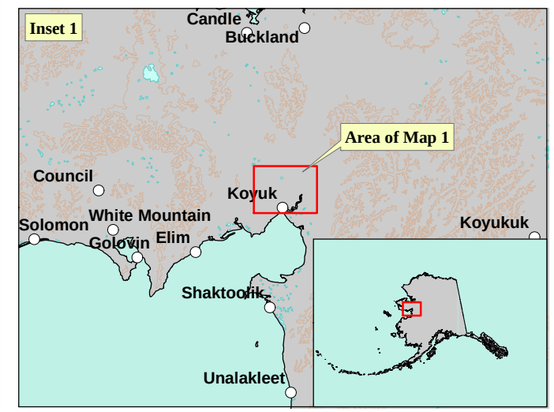
Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time or Watershed Boundary

Data Sources:
- Contaminant Sources, Public Water System Wells, Contours Alaska Department of Environmental Conservation (ADEC)
- Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
- United States Geological Survey (USGS)
- Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 1.5 3 6 9 12 Miles

Koyuk Washeteria & School
PWS 340167.001
Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking (Tables 1-7)

Table 1

Contaminant Source Inventory for

Koyuk City Washeteria / School

PWSID 340167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	C	Washeteria
Motor /motor vehicle repair shops	C31	C31-01	A	C	Airport Maintenance Building
Motor /motor vehicle repair shops	C31	C31-02	A	C	City Garage
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	Assume 3 or less sewer lines in Zone A
Domestic wastewater treatment plants	D05	D05-01	A	C	Washeteria
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	C	Assume 75 or less pit toilets/outhouses in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 35 or less residential heating oil tanks in Zone A
Tanks, aviation fuel (above ground)	T02	T02-01	A	C	Assume 1 aboveground aviation fuel tank in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	Koyuk Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	KOYUK-MALEMUTE SCHOOL
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	
Water supply wells	W09	W09-01	A	C	KOY3 Well/Well House
Water supply wells	W09	W09-02	A	C	KOY2 Well/Well House
Municipal or city parks (with green areas)	X04	X04-01	A	C	Community Playground
Petroleum product bulk station/terminals	X11	X11-01	A	C	Assume 3 or less petroleum product bulk station/terminal in Zone A
Airports	X14	X14-01	A	C	KOYUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	C	
Electric power generation (fossil fuels)	X36	X36-01	A	C	Assume electric power generation source in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	C	Koyuk Clinic

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-02	A	C	
Quarries (sand, gravel, rock, other?)	E10	E10-01	B	C	KOYUK RIVER
Metals mining, placer (active or inactive?)	E04	E04-01	C	C	ALAMEDA CREEK
Metals mining, placer (active or inactive?)	E04	E04-02	C	C	PLACER CREEK
Metals mining, placer (active or inactive?)	E04	E04-03	C	C	RUBY GULCH

Table 2

Contaminant Source Inventory and Risk Ranking for Koyuk City Washeteria / School Sources of Bacteria and Viruses

PWSID 340167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	Low	C	Washeteria
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	Assume 3 or less sewer lines in Zone A
Domestic wastewater treatment plants	D05	D05-01	A	Medium	C	Washeteria
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 75 or less pit toilets/outhouses in Zone A
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	C	Community Playground
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Medium	C	Koyuk Clinic
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-02	A	Medium	C	

Table 3

Contaminant Source Inventory and Risk Ranking for Koyuk City Washeteria / School Sources of Nitrates/Nitrites

PWSID 340167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	Low	C	Washeteria
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	Assume 3 or less sewer lines in Zone A
Domestic wastewater treatment plants	D05	D05-01	A	Medium	C	Washeteria
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 75 or less pit toilets/outhouses in Zone A
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	C	Community Playground
Airports	X14	X14-01	A	Low	C	KOYUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyuk Clinic
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-02	A	Low	C	
Quarries (sand, gravel, rock, other?)	E10	E10-01	B	Low	C	KOYUK RIVER

Table 4

Contaminant Source Inventory and Risk Ranking for Koyuk City Washeteria / School Sources of Volatile Organic Chemicals

PWSID 340167.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Laundromats without dry cleaning	C22	C22-01	A	Low	C	Washeteria
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Airport Maintenance Building
Motor /motor vehicle repair shops	C31	C31-02	A	Medium	C	City Garage
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 3 or less sewer lines in Zone A
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Washeteria
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 75 or less pit toilets/outhouses in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 35 or less residential heating oil tanks in Zone A
Tanks, aviation fuel (above ground)	T02	T02-01	A	Medium	C	Assume 1 aboveground aviation fuel tank in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Koyuk Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	KOYUK-MALEMUTE SCHOOL
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	Assume 3 or less petroleum product bulk station/terminal in Zone A
Airports	X14	X14-01	A	High	C	KOYUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	Medium	C	
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	Assume electric power generation source in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyuk Clinic
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-02	A	Low	C	
Quarries (sand, gravel, rock, other?)	E10	E10-01	B	Low	C	KOYUK RIVER

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*

Table 5

Contaminant Source Inventory and Risk Ranking for Koyuk City Washeteria / School
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 340167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Airport Maintenance Building
Motor /motor vehicle repair shops	C31	C31-02	A	Medium	C	City Garage
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 3 or less sewer lines in Zone A
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Washeteria
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 75 or less pit toilets/outhouses in Zone A
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Koyuk Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	KOYUK-MALEMUTE SCHOOL
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	
Municipal or city parks (with green areas)	X04	X04-01	A	Low	C	Community Playground
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	Assume 3 or less petroleum product bulk station/terminal in Zone A
Airports	X14	X14-01	A	Low	C	KOYUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	Low	C	
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	Assume electric power generation source in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyuk Clinic
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-02	A	Low	C	

Table 6

Contaminant Source Inventory and Risk Ranking for Koyuk City Washeteria / School Sources of Synthetic Organic Chemicals

PWSID 340167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 3 or less sewer lines in Zone A
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Washeteria
Municipal or city parks (with green areas)	X04	X04-01	A	Low	C	Community Playground
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	Assume 3 or less petroleum product bulk station/terminal in Zone A
Airports	X14	X14-01	A	Medium	C	KOYUK LANDING STRIP
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	Koyuk Clinic
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-02	A	Low	C	

Table 7

Contaminant Source Inventory and Risk Ranking for Koyuk City Washeteria / School Sources of Other Organic Chemicals

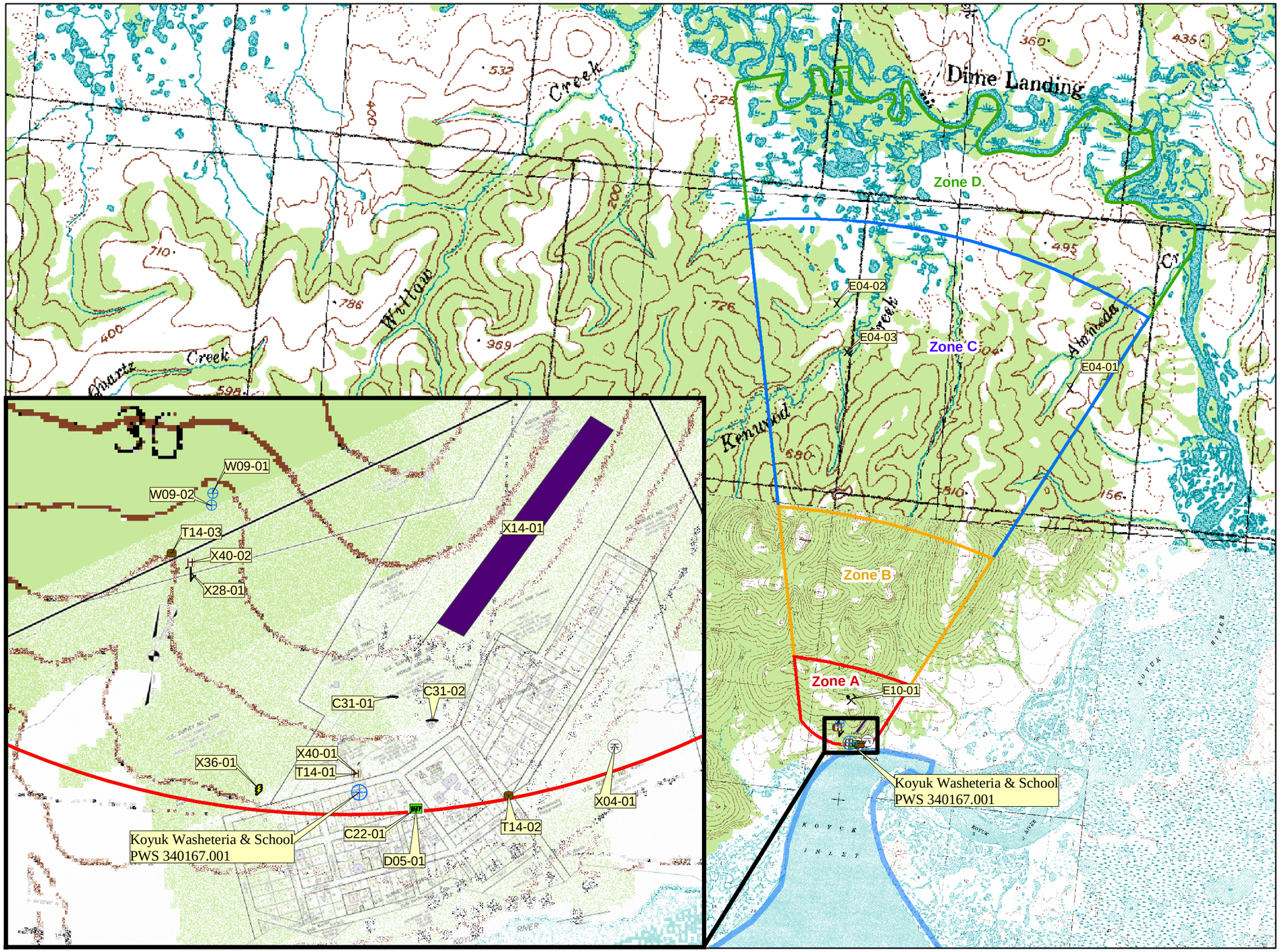
PWSID 340167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	Airport Maintenance Building
Motor /motor vehicle repair shops	C31	C31-02	A	Medium	C	City Garage
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	Assume 3 or less sewer lines in Zone A
Domestic wastewater treatment plants	D05	D05-01	A	Low	C	Washeteria
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	Assume 3 or less petroleum product bulk station/terminal in Zone A
Airports	X14	X14-01	A	Medium	C	KOYUK LANDING STRIP
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	High	C	
Electric power generation (fossil fuels)	X36	X36-01	A	High	C	Assume electric power generation source in Zone A
Quarries (sand, gravel, rock, other?)	E10	E10-01	B	Low	C	KOYUK RIVER

APPENDIX C

Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS #340167.001 Koyuk Washeteria & School
Showing Potential and Existing Sources of Contamination



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time or Watershed Boundary

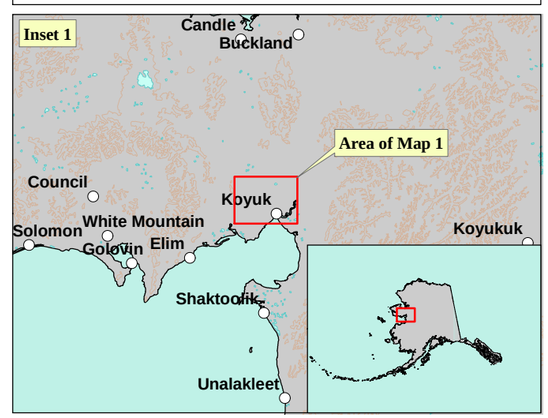
Existing or Potential Contaminant Sources

- Laundromats without dry cleaning (C22)
- Motor/motor vehicle repair shops (C31)
- Domestic wastewater treatment plants (D05)
- Placer Mines (E04)
- Other mines or Quarries (E10)
- Tanks, heating oil, nonresidential (aboveground) (T14)
- Water supply wells (W09)
- Pipelines (oil and gas) (X28)
- Electric Power Generation (fossil fuels) (X36)
- Medical/veterinary facilities (X40)
- Municipal or city parks (X04)
- Airport or landing strip (X14)

Data Sources:
- Contaminant Sources, Public Water System Wells, Contours Alaska Department of Environmental Conservation (ADEC)
- Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
- United States Geological Survey (USGS)
- Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 1.5 3 6 9 12 Miles

Koyuk Washeteria & School
PWS 340167.001
Appendix C Map C

APPENDIX D

Vulnerability Analysis for Public Drinking Water Source (Charts 1-14)

Chart 1. Susceptibility of the wellhead - Koyuk City Washeteria/School (PWS No. 340167.001)

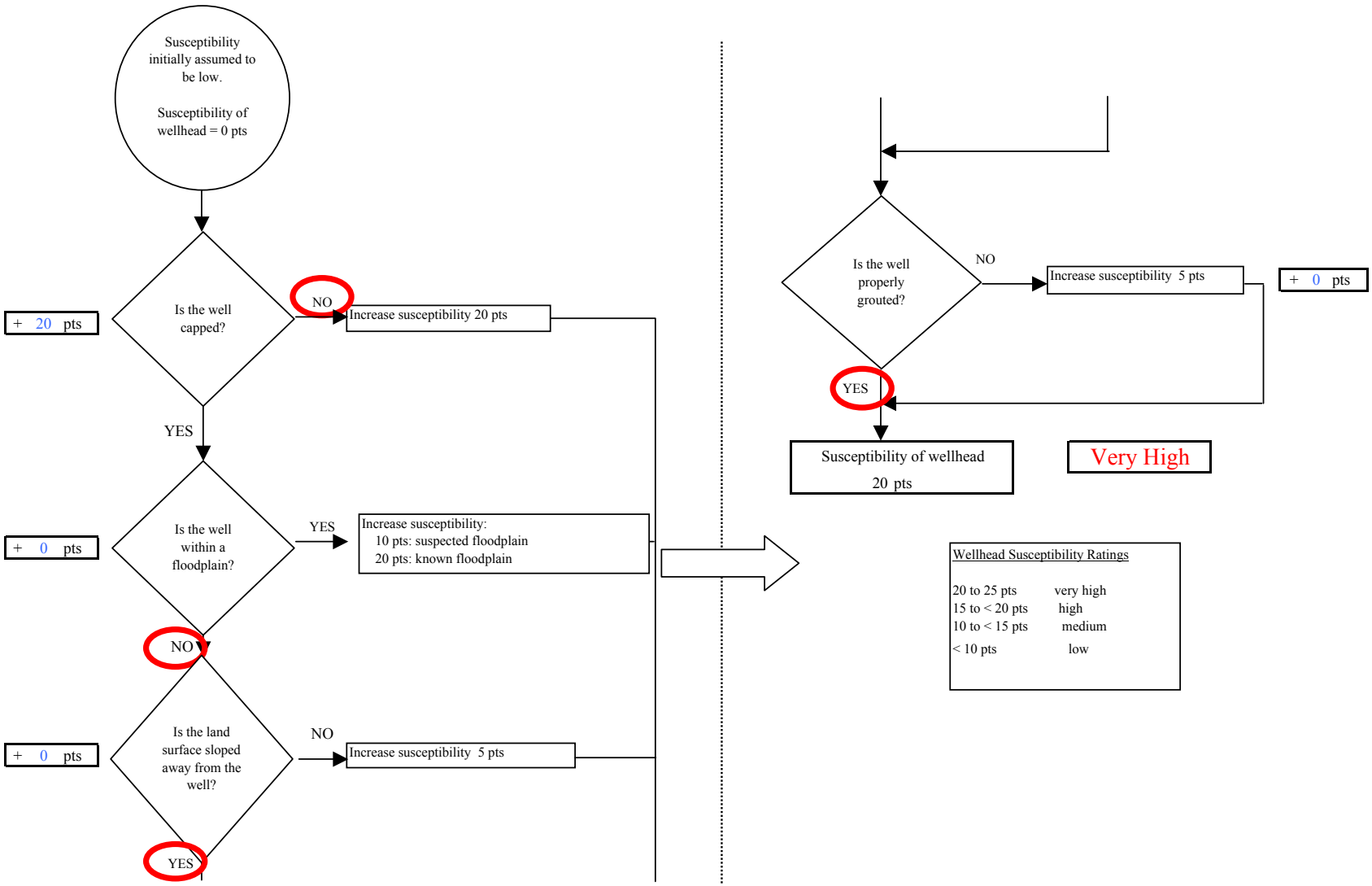


Chart 2. Susceptibility of the aquifer Koyuk City Washeteria/School (PWS No. 340167.001)

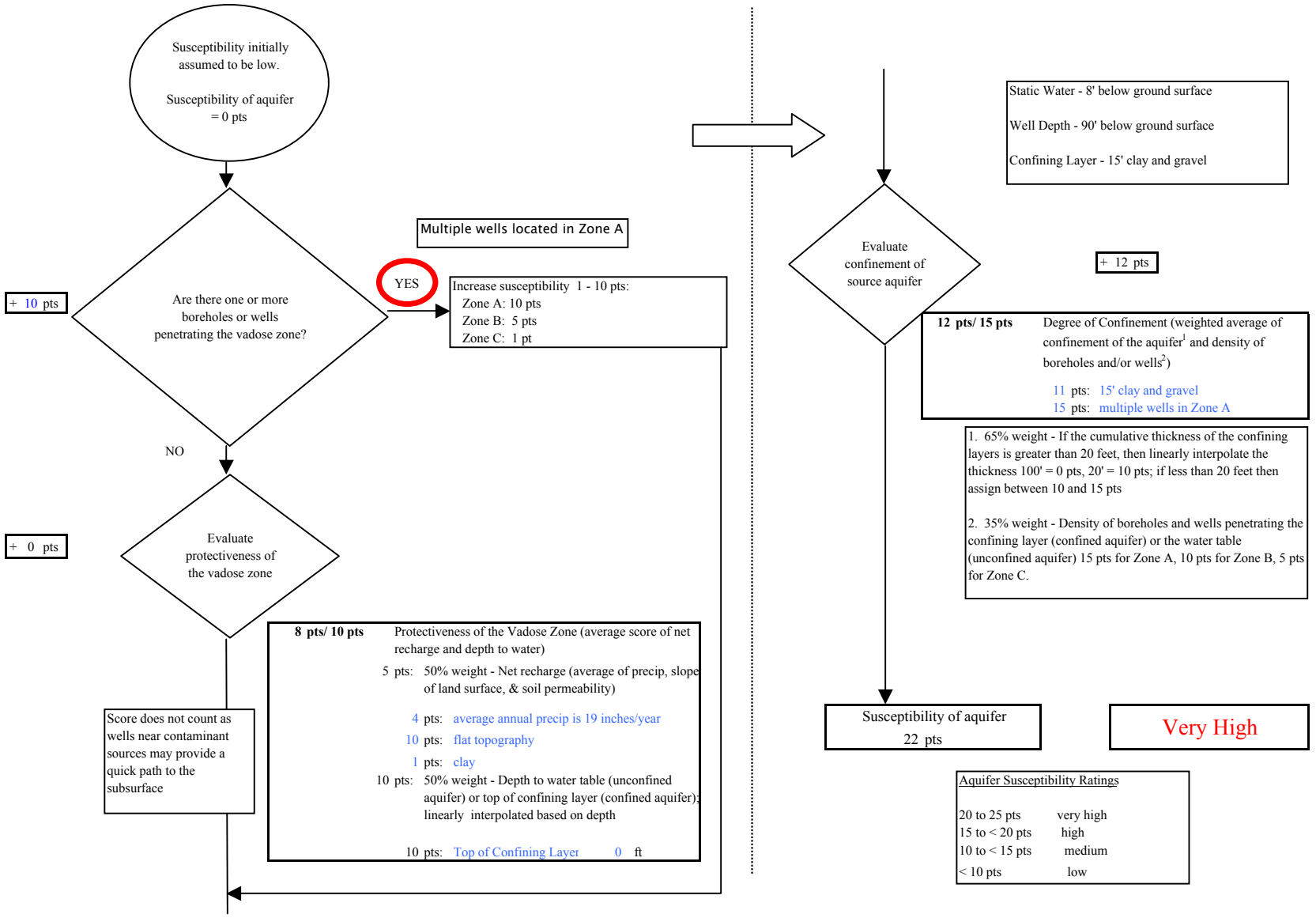
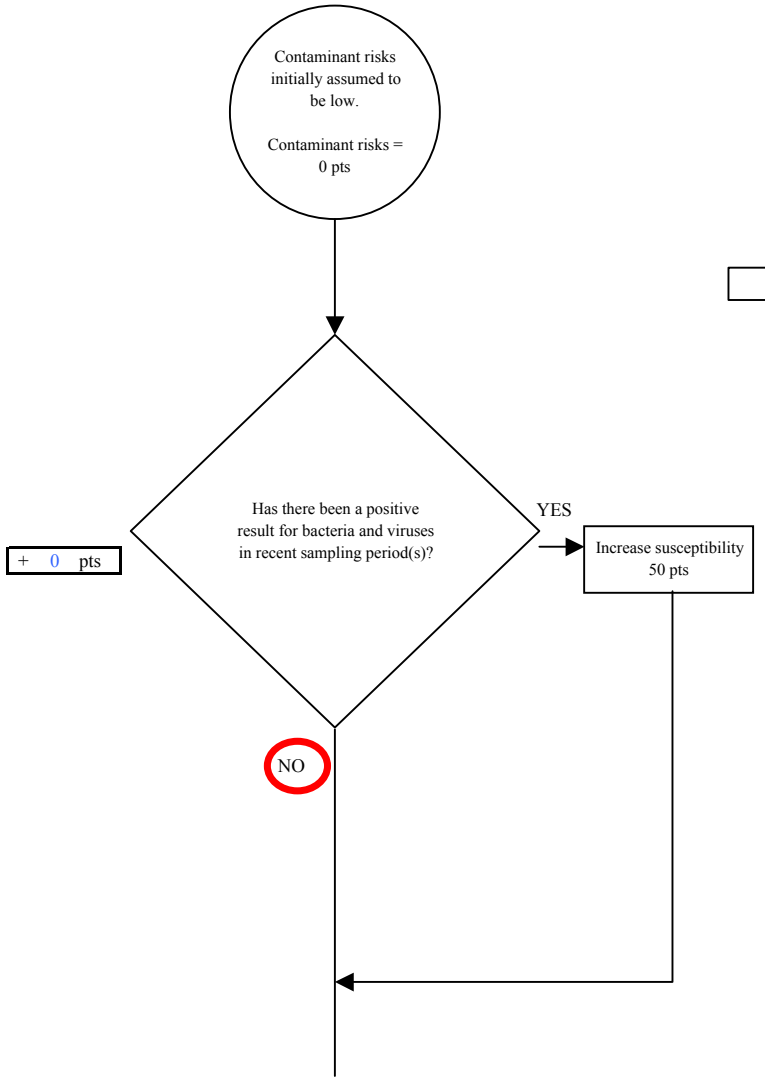
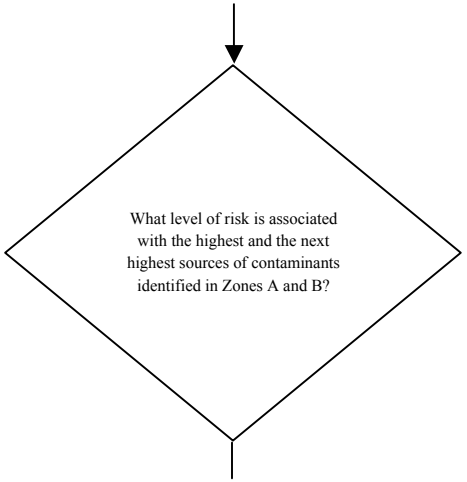


Chart 3. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Bacteria & Viruses





+ 25 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)	82	0	82
Low(s)	2	0	2

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

Matrix Score 25

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

Chart 3. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Bacteria & Viruses

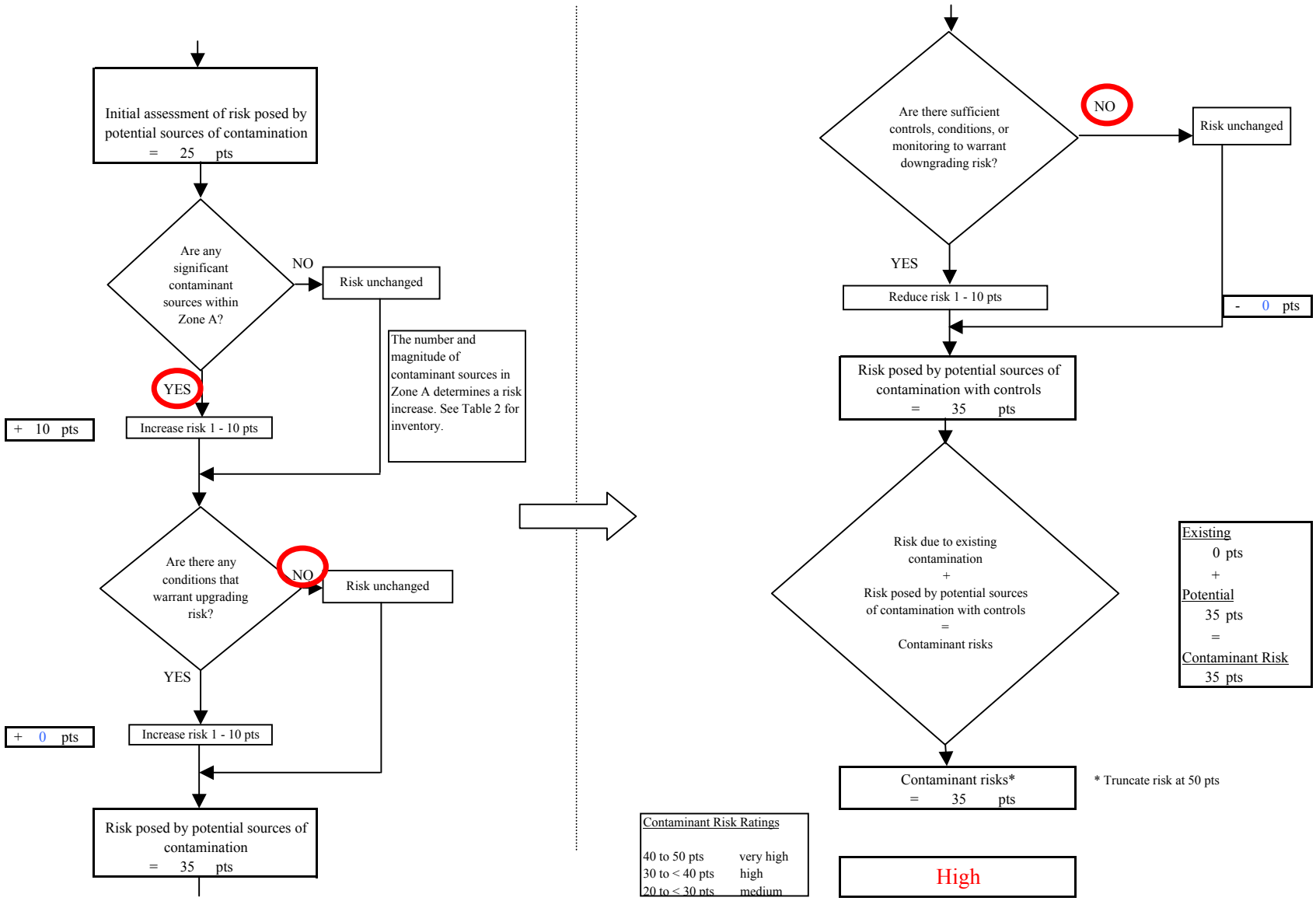


Chart 4. Vulnerability analysis for Koyuk City Washeteria/School (PWS No. 340167.001) - Bacteria & Viruses

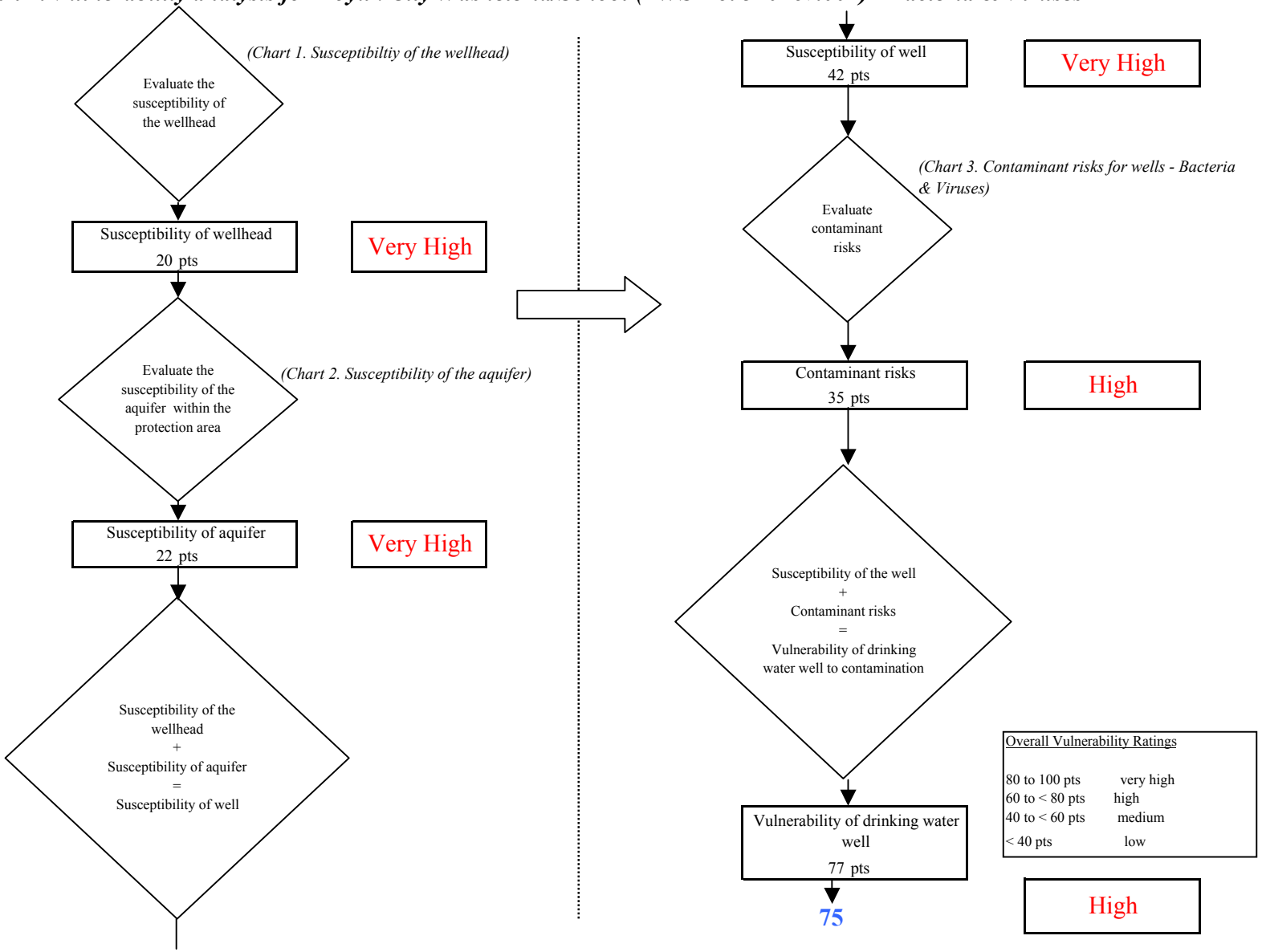


Chart 5. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Nitrates and Nitrites

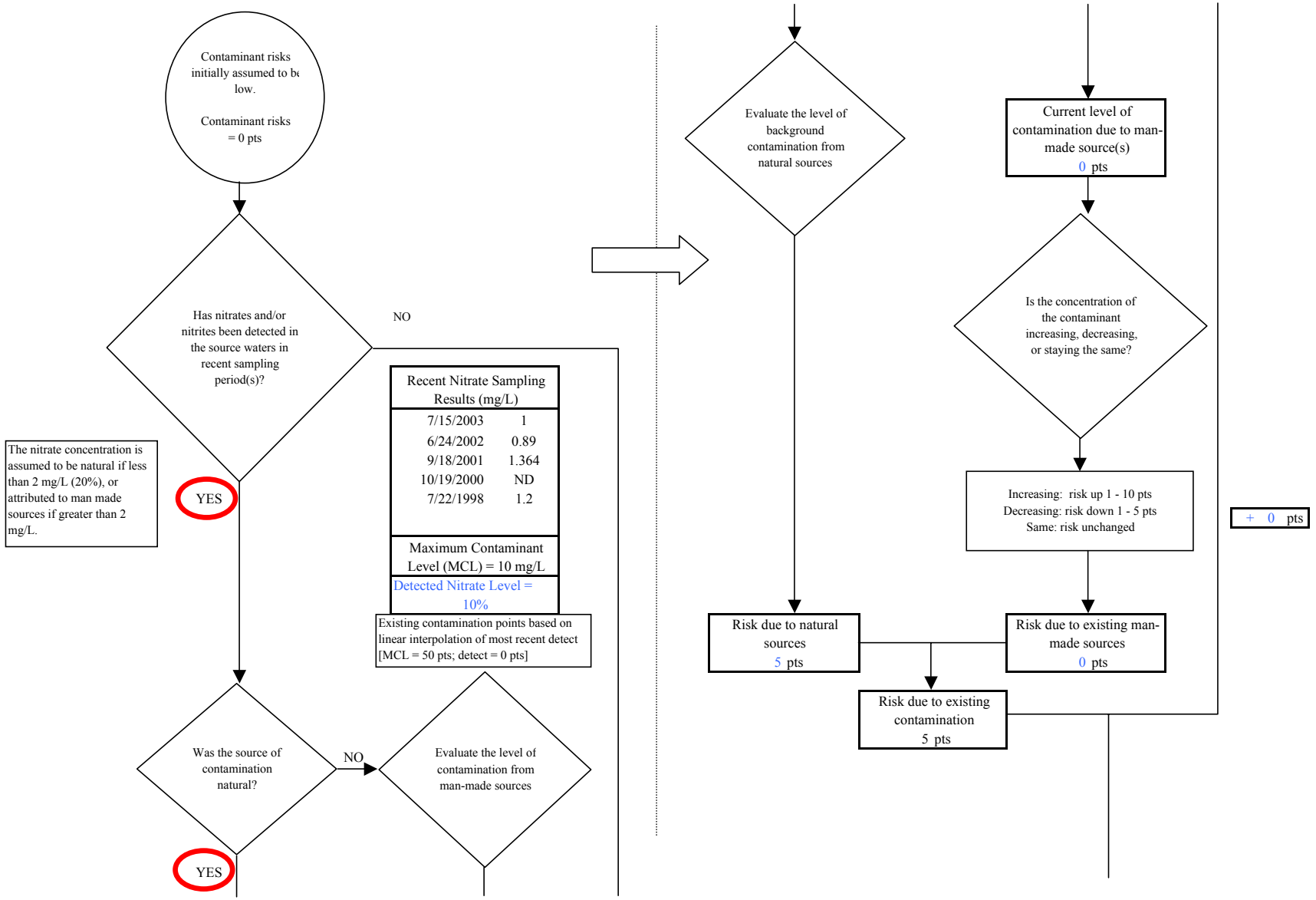
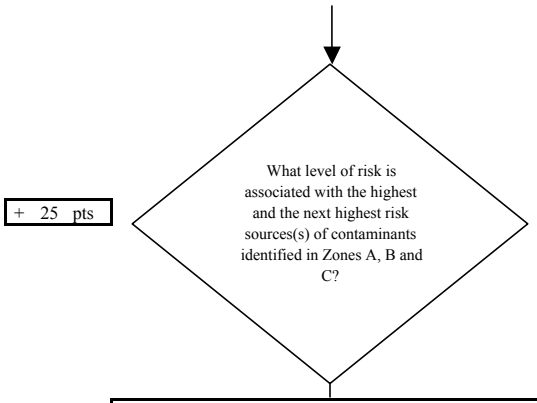


Chart 5. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Nitrates and Nitrites



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)	80	0	80
Low(s)	5	1	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 25

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individua 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.

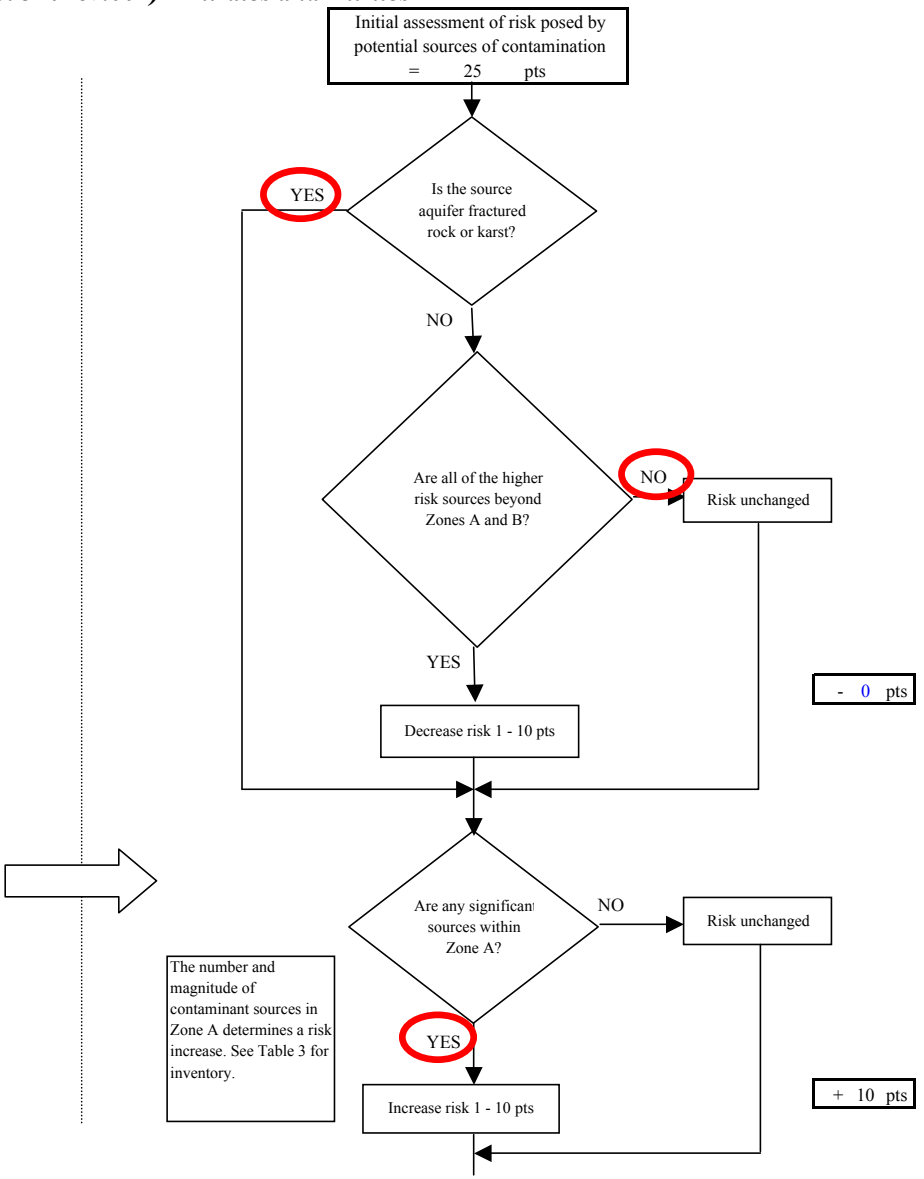


Chart 5. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Nitrates and Nitrites

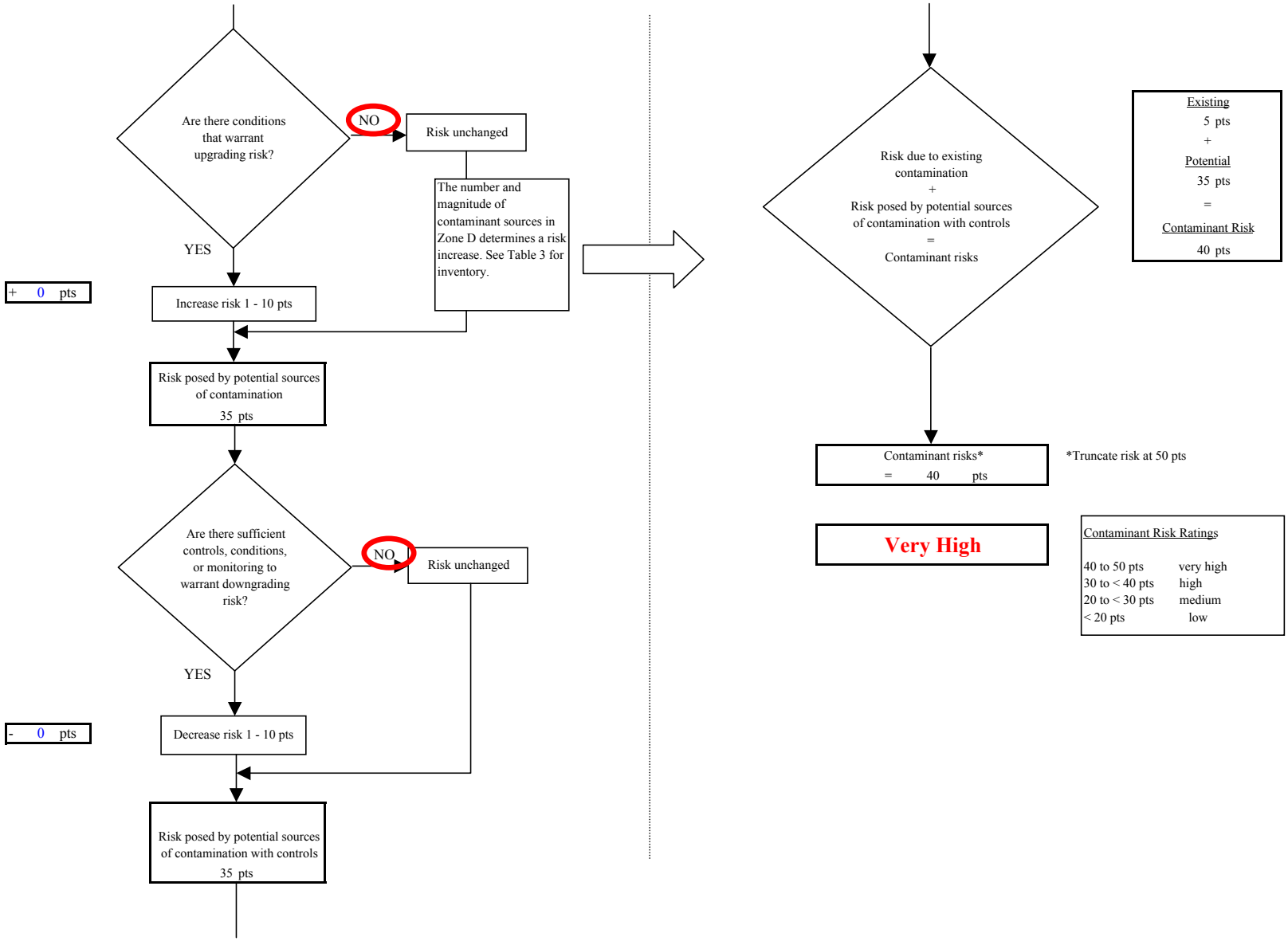


Chart 6. Vulnerability analysis for Koyuk City Washeteria/School (PWS No. 340167.001) - Nitrates and Nitrites

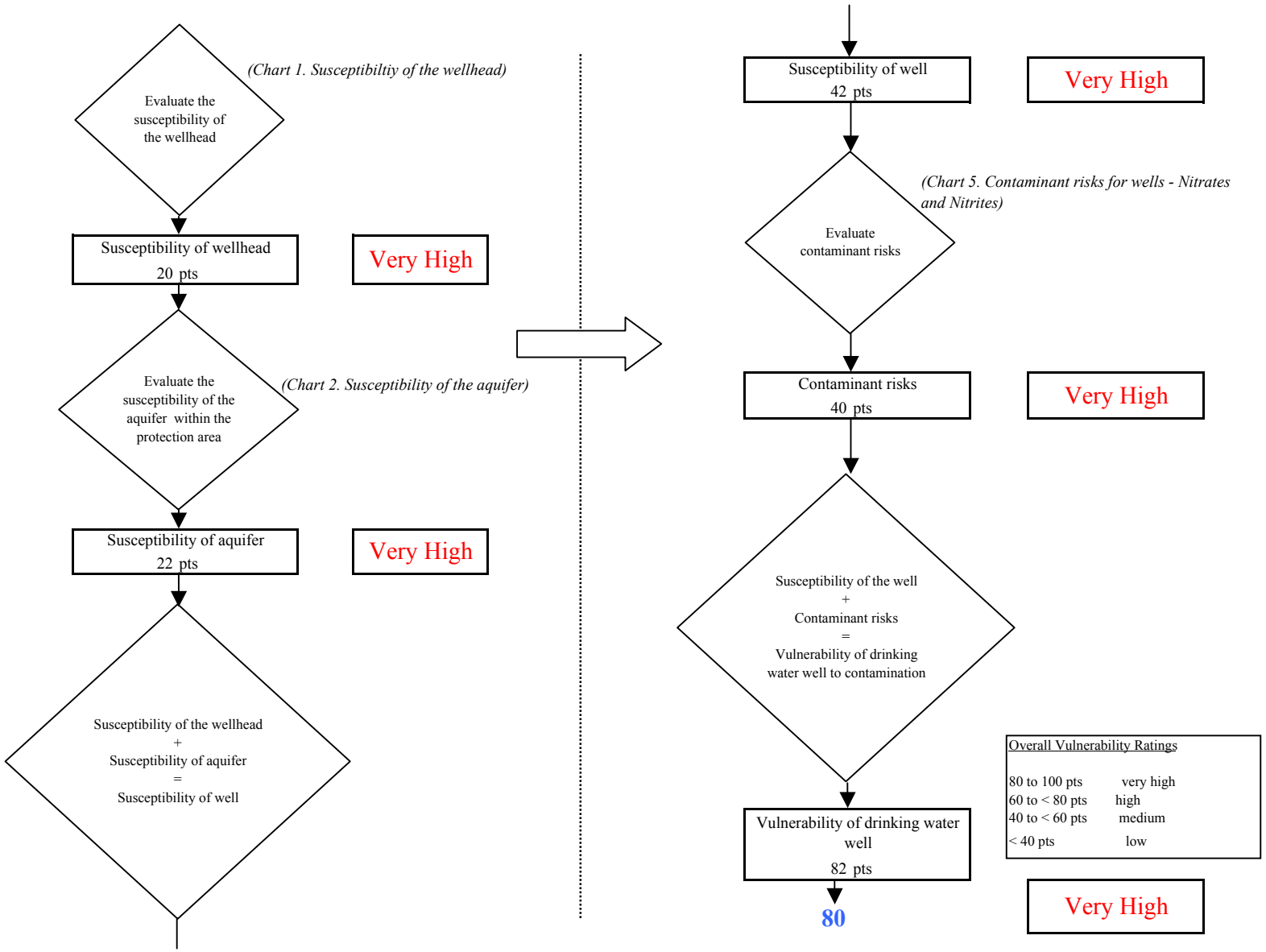


Chart 7. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Volatile Organic Chemicals

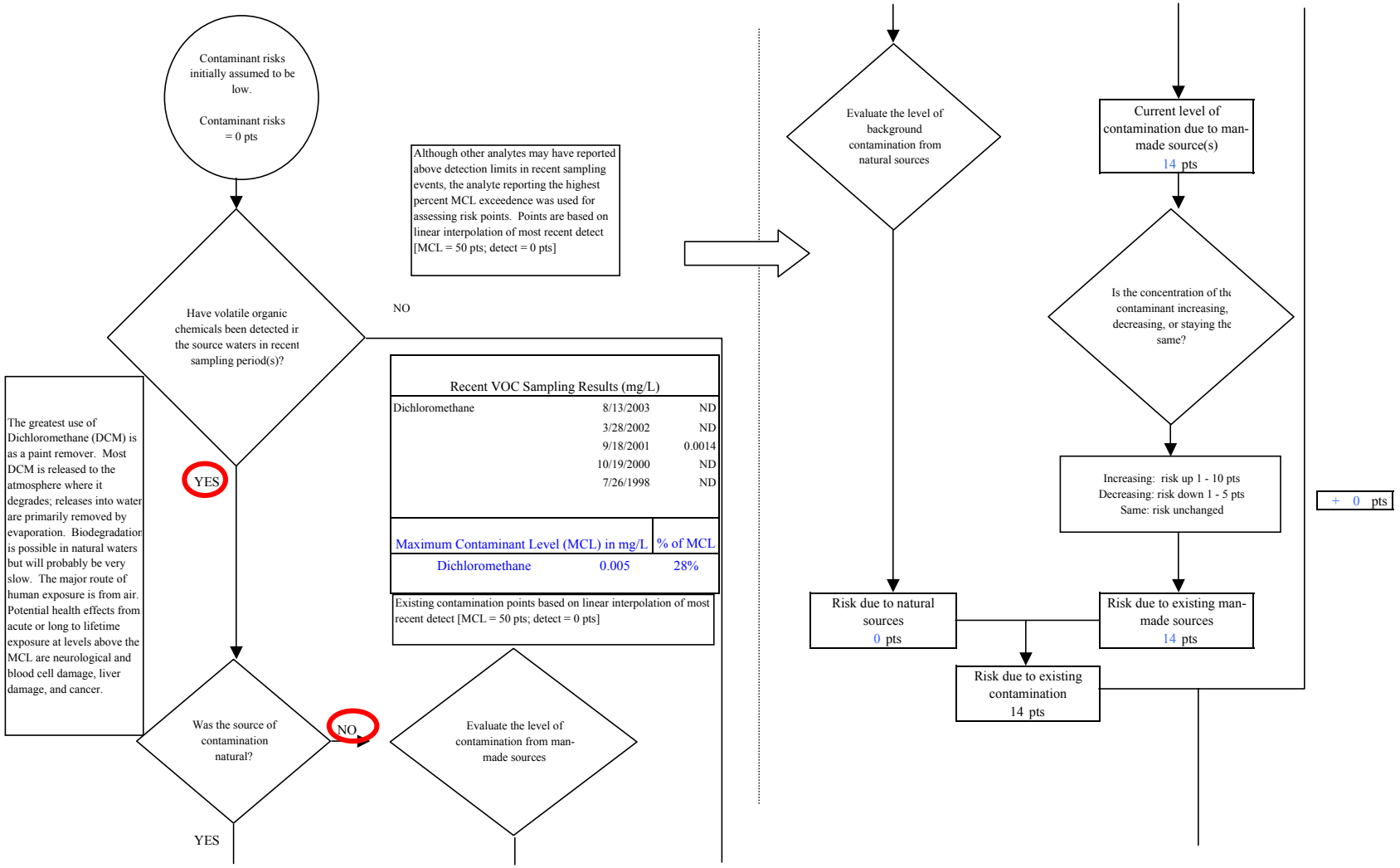
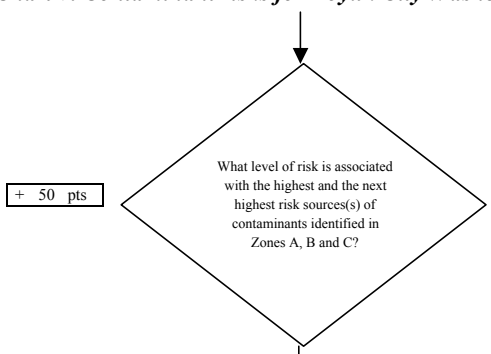


Chart 7. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Volatile Organic Chemicals



+ 50 pts

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

	Zone A	Zones B&C	Total
Very Highs(s)	3	0	3
High(s)	1	0	1
Medium(s)	43	0	43
Low(s)	84	1	85

	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 50

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

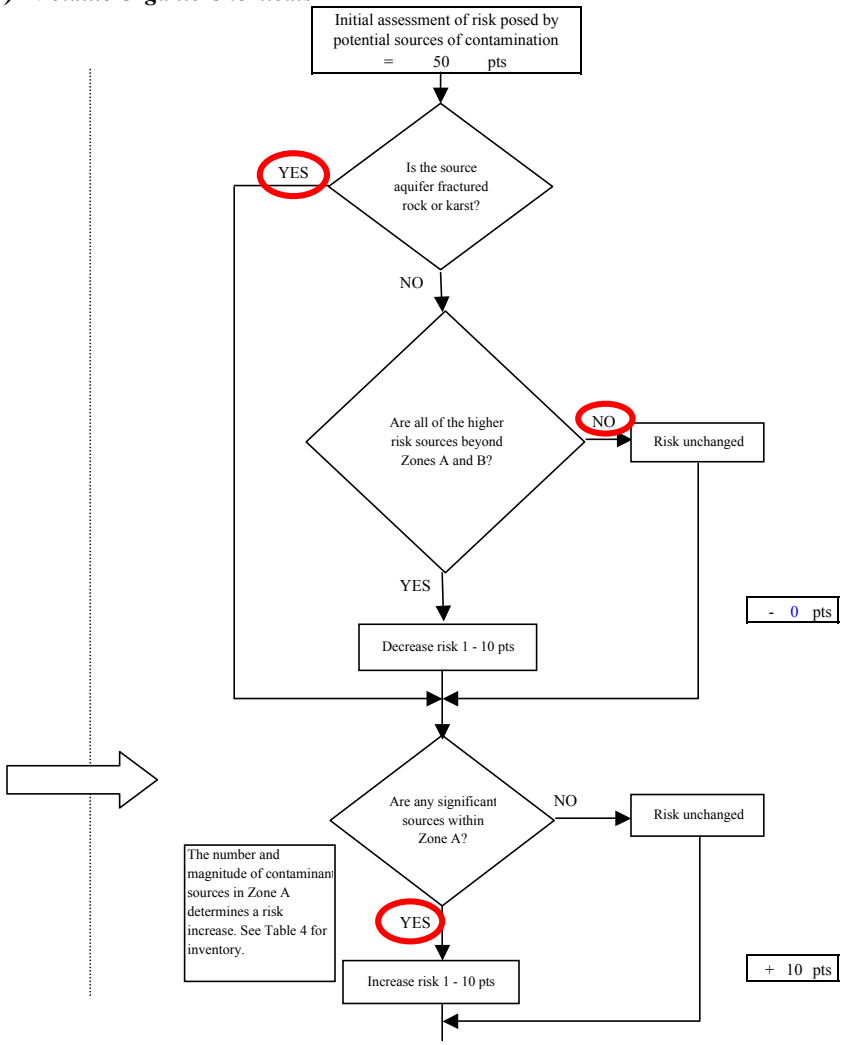


Chart 7. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Volatile Organic Chemicals

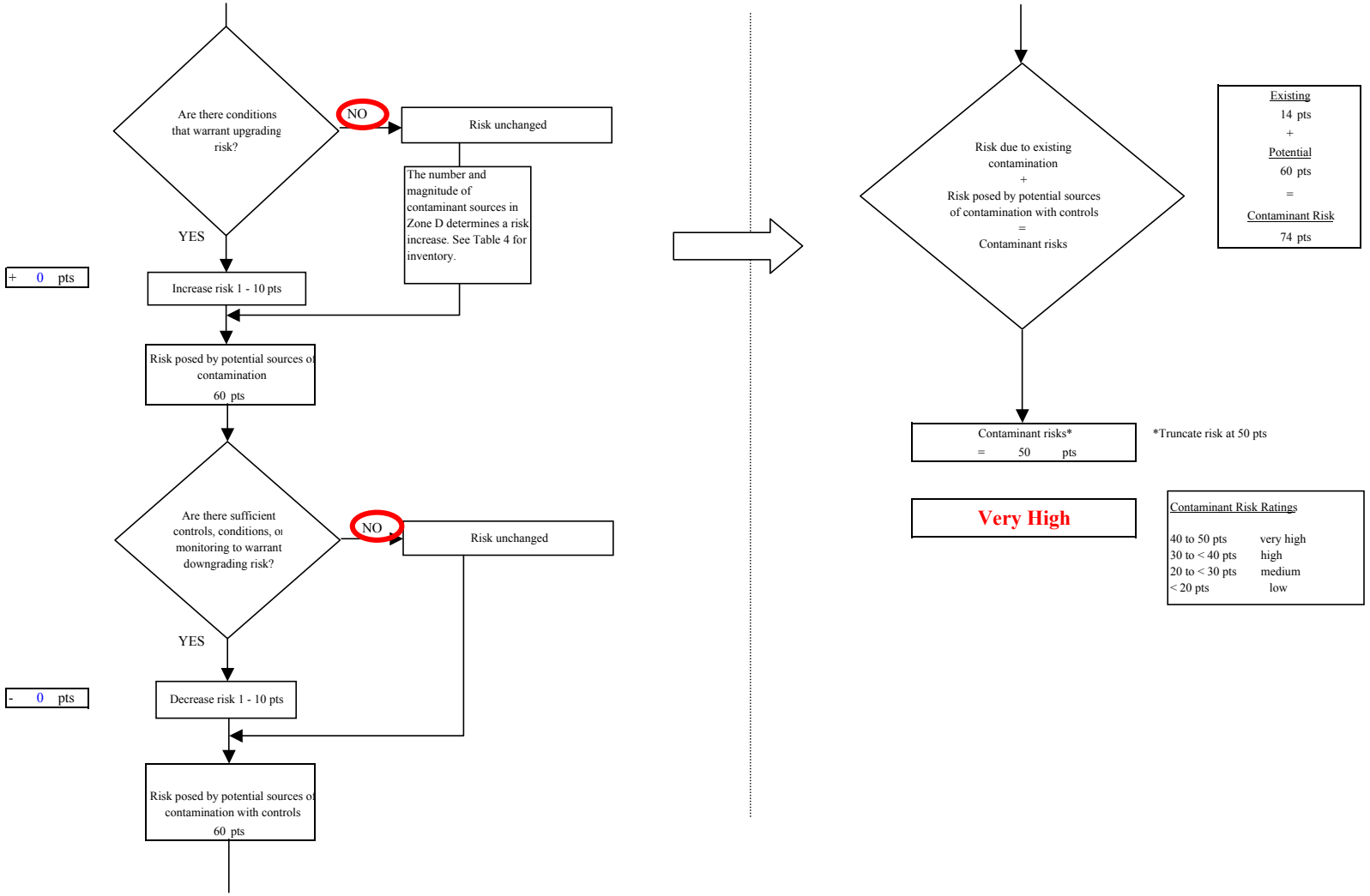


Chart 8. Vulnerability analysis for Koyuk City Washeteria/School (PWS No. 340167.001) - Volatile Organic Chemicals

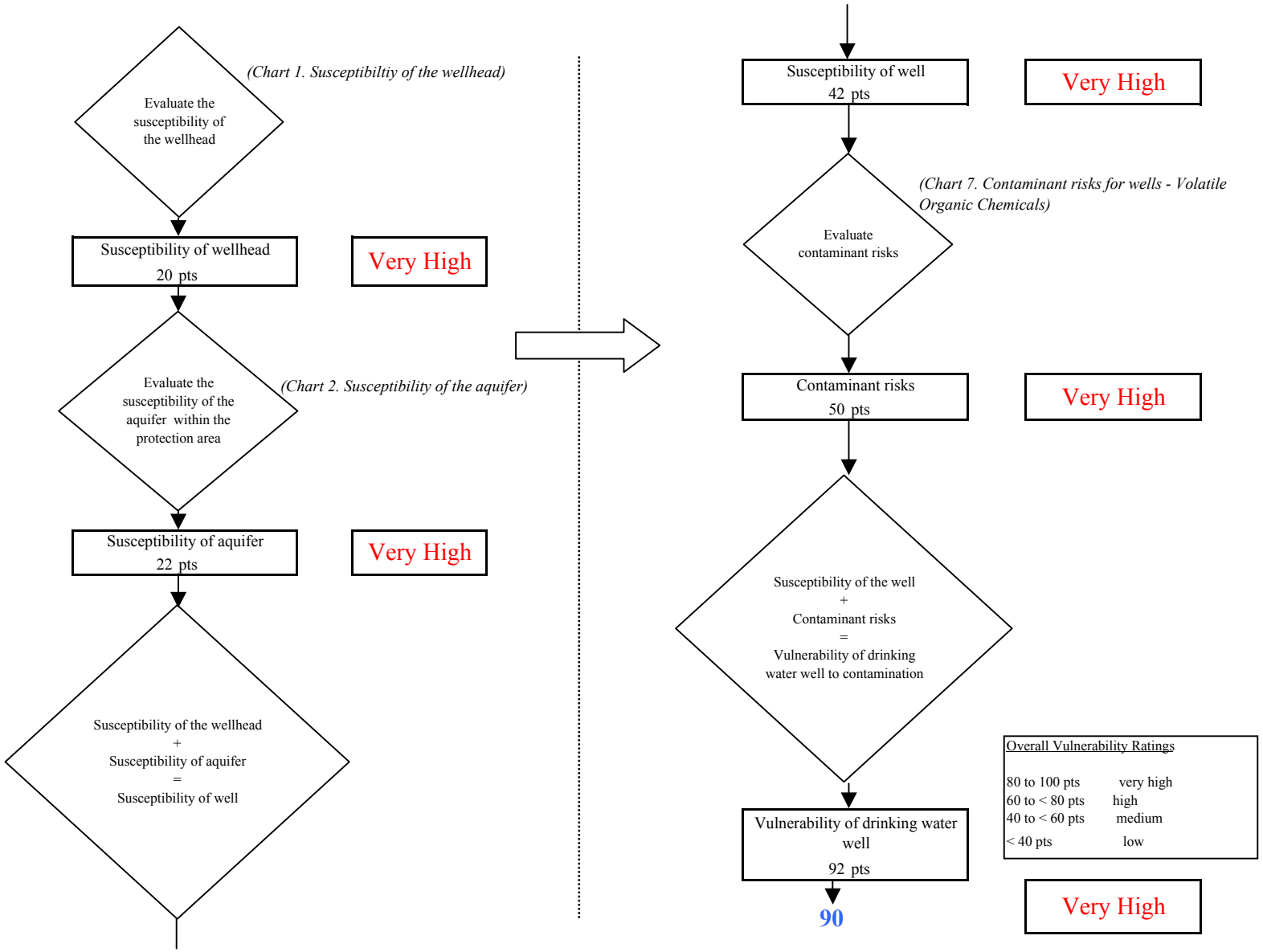


Chart 9. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

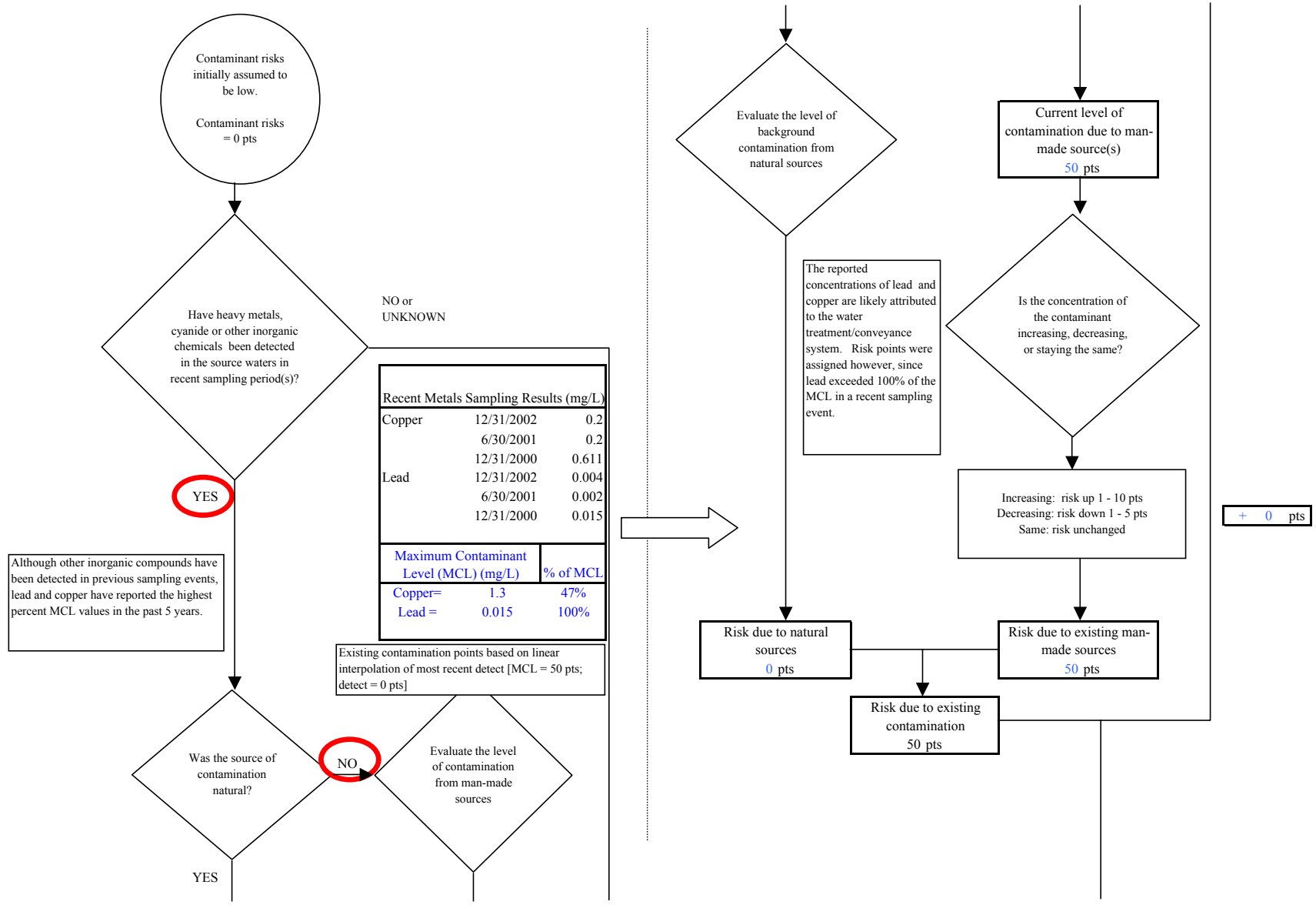
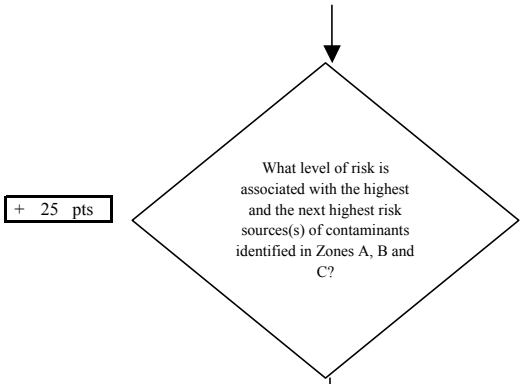


Chart 9. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 25 pts

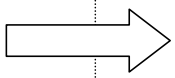
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	3	0	3
Low(s)	110	0	110

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

Matrix Score 25

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



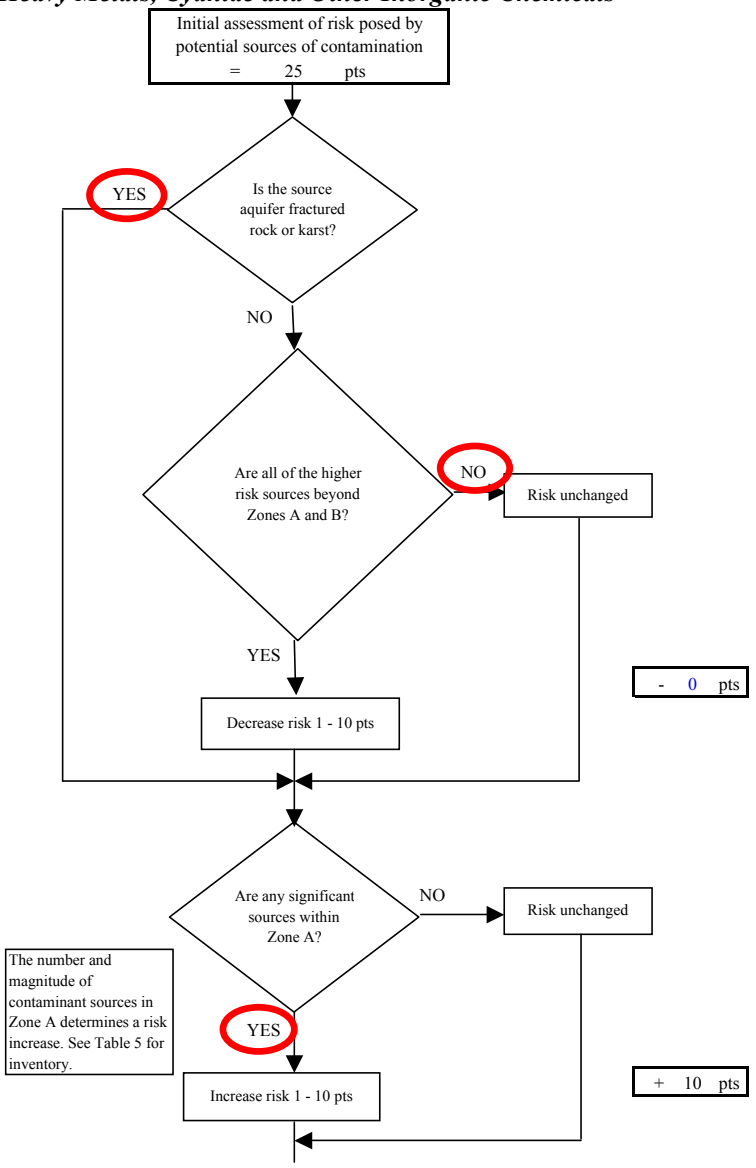


Chart 9. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

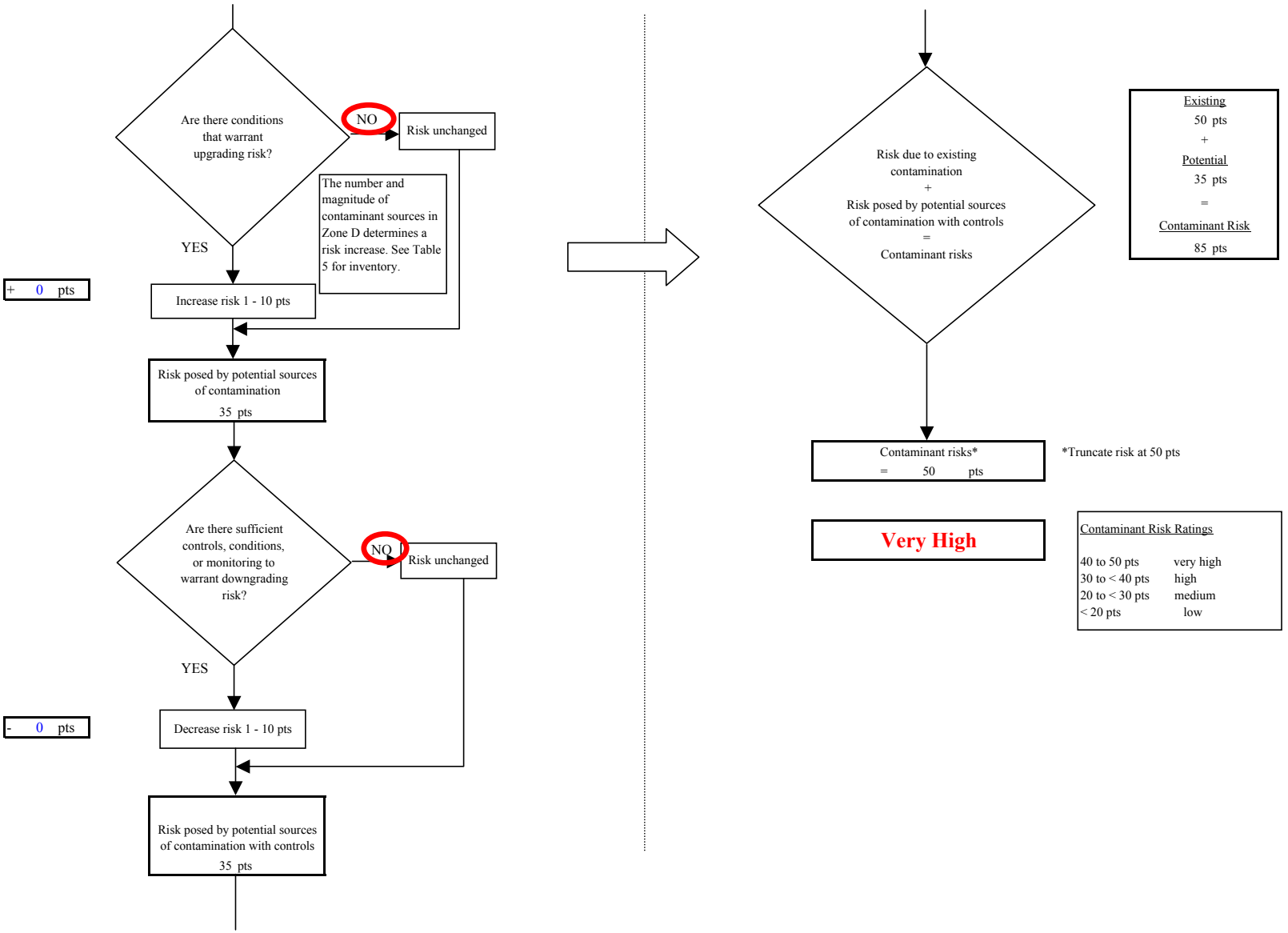


Chart 10. Vulnerability analysis for Koyuk City Washeteria/School (PWS No. 340167.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

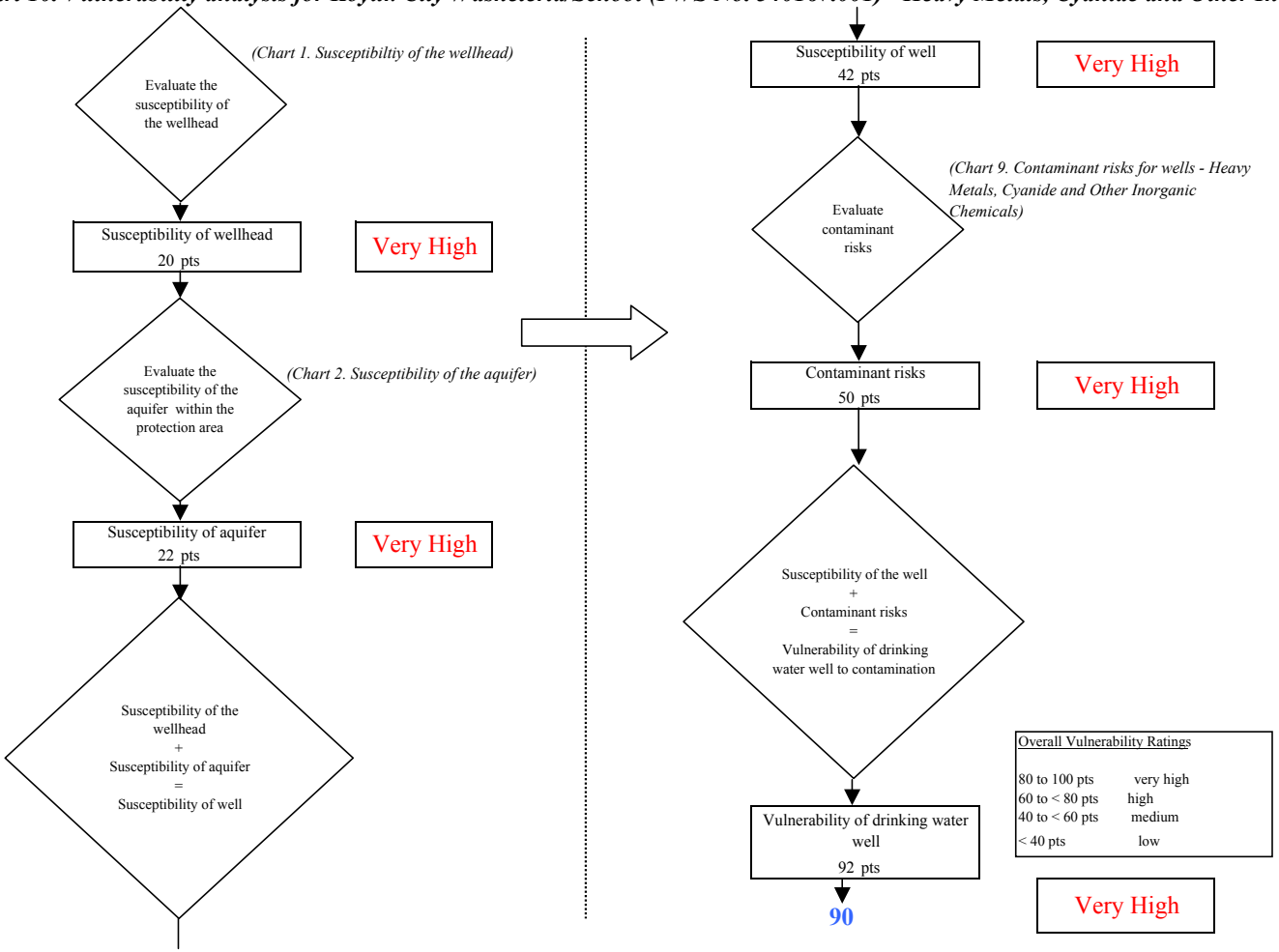


Chart 11. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Synthetic Organic Chemicals

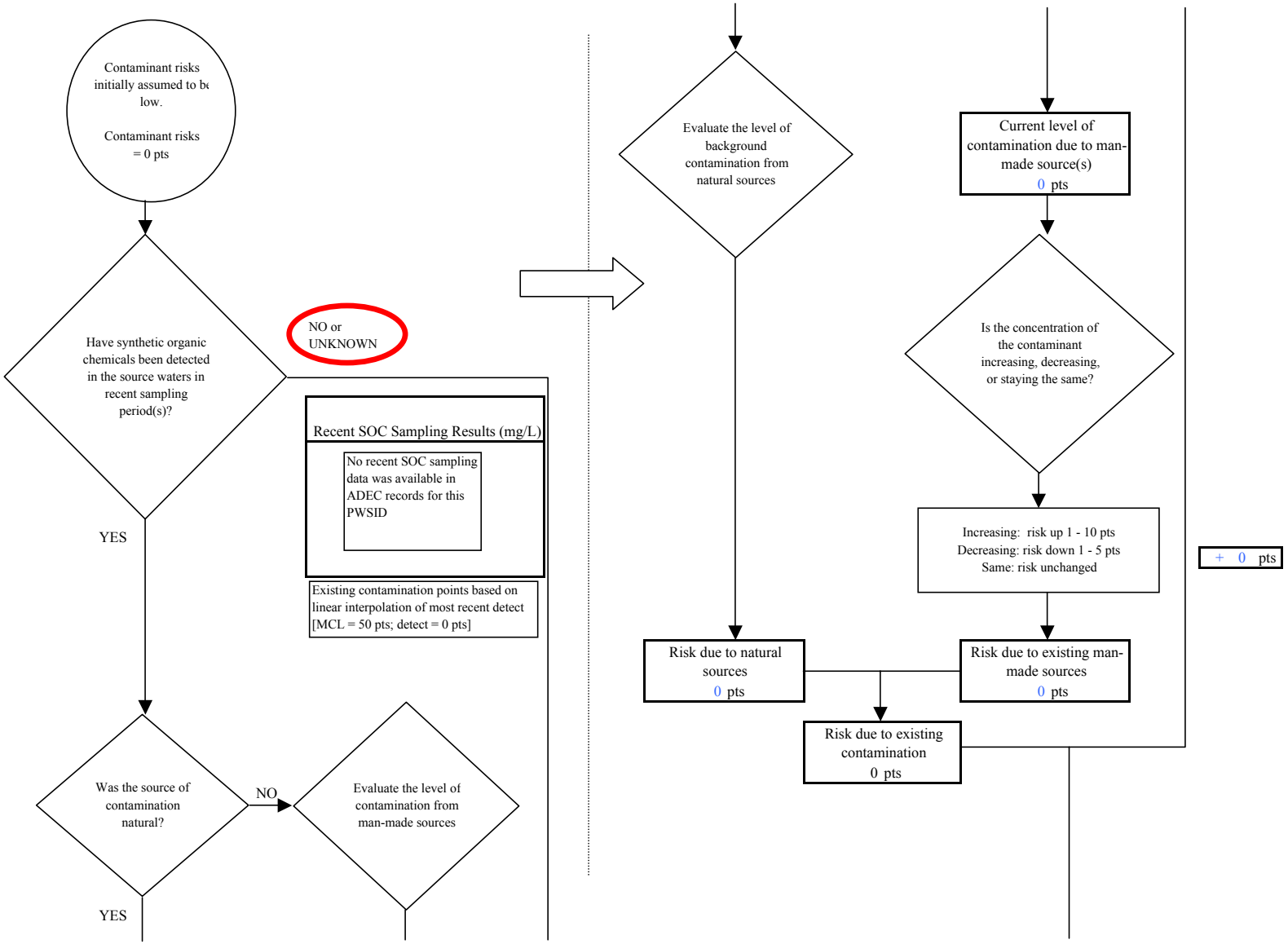


Chart 11. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Synthetic Organic Chemicals

+ 20 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)	1	0	1
Low(s)	8	0	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 20

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individua 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.

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 6 for inventory.

Initial assessment of risk posed by potential sources of contamination = 20 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

+ 5 pts

Chart 11. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Synthetic Organic Chemicals

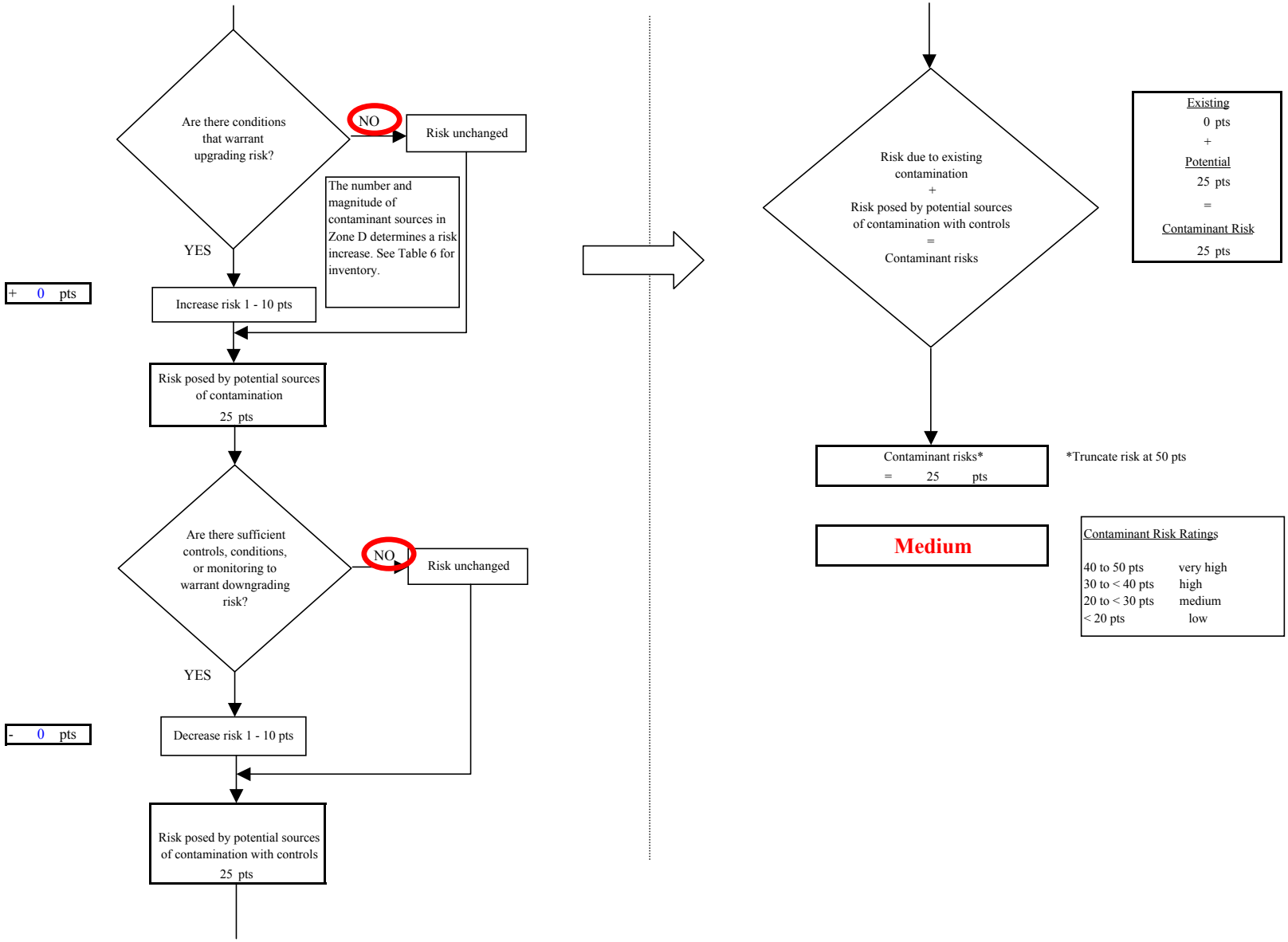


Chart 12. Vulnerability analysis for Koyuk City Washeteria/School (PWS No. 340167.001) - Synthetic Organic Chemicals

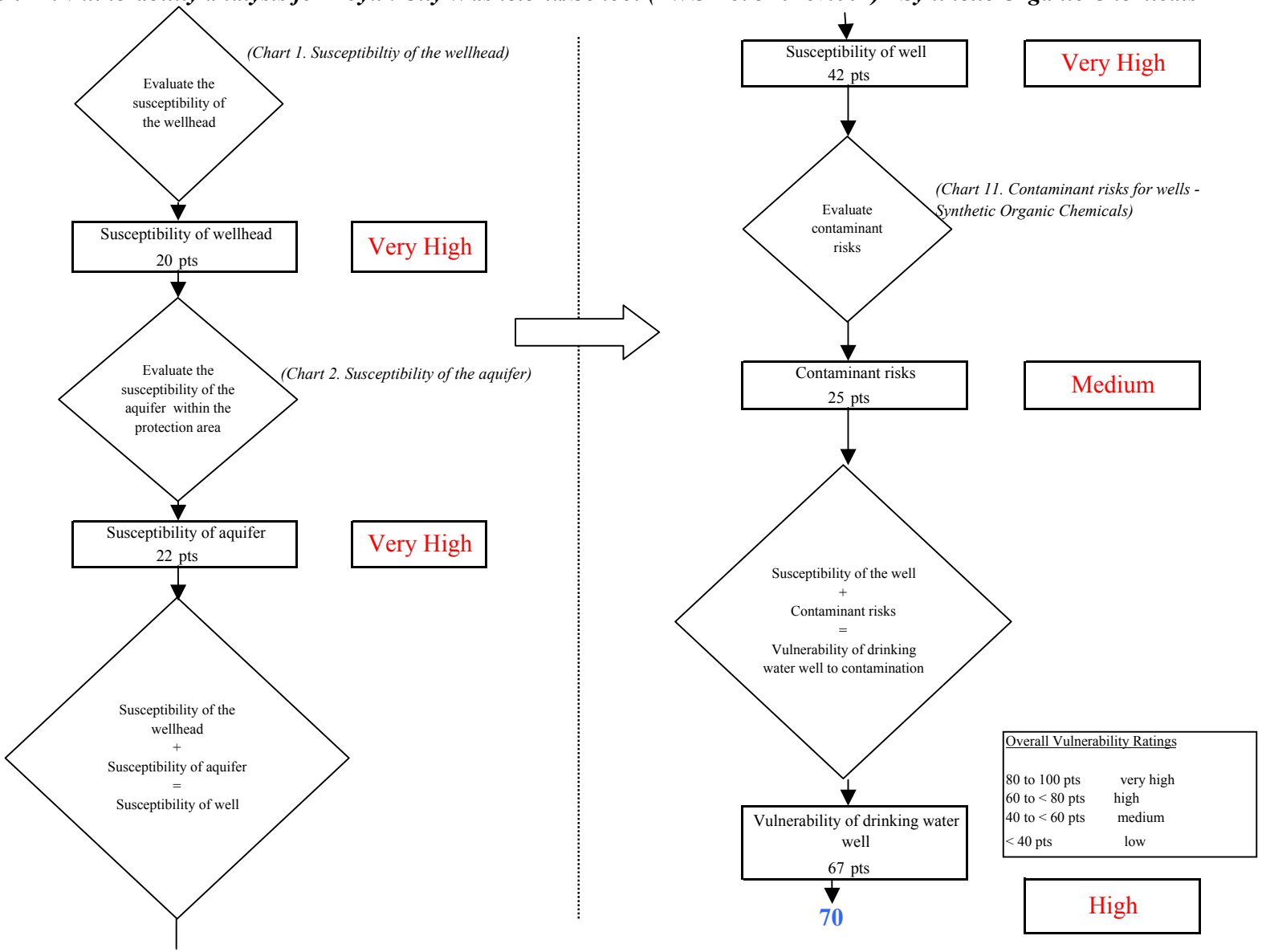


Chart 13. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Other Organic Chemicals

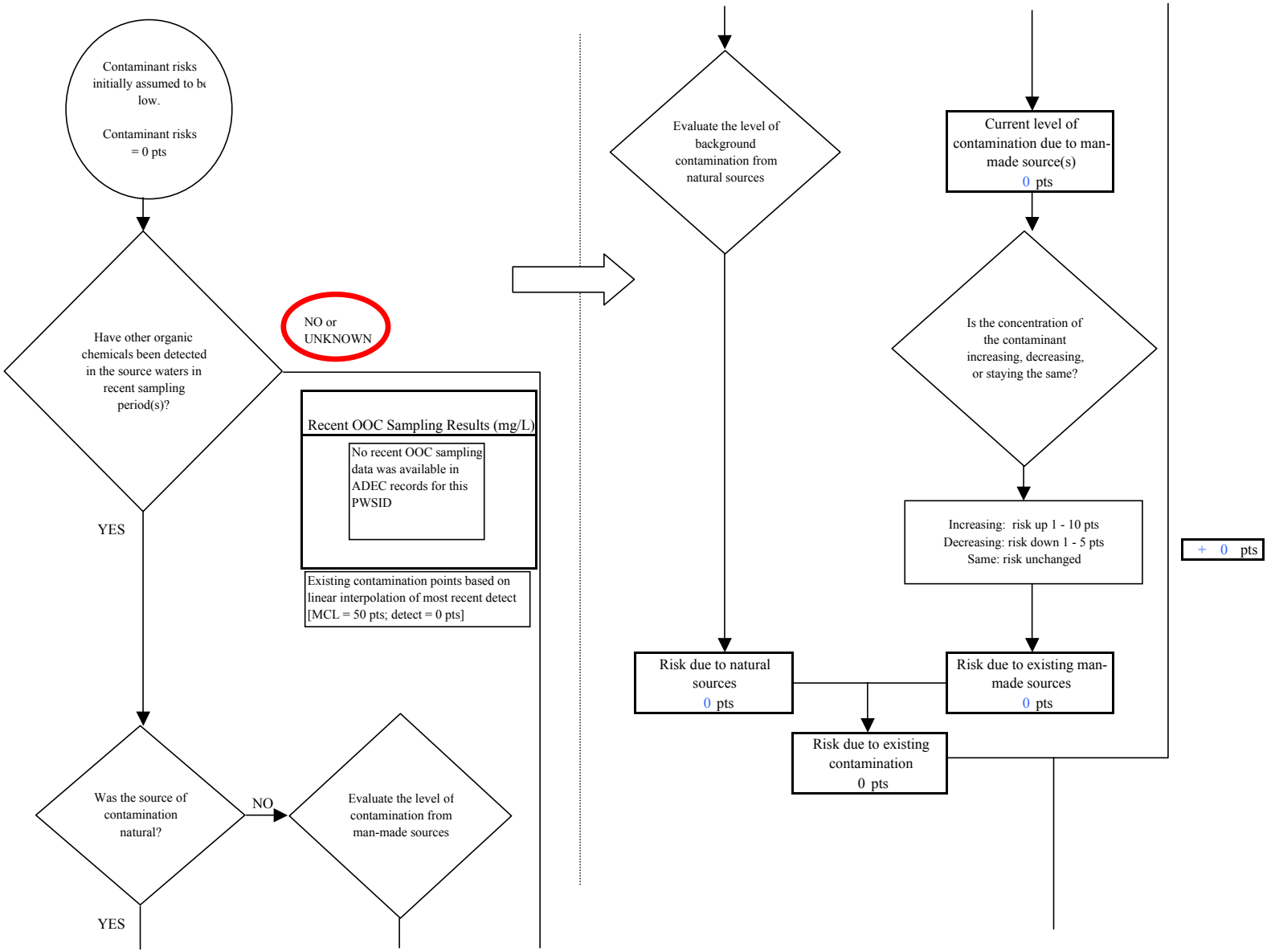


Chart 13. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Other Organic Chemicals

+ 40 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)	3	0	3
Medium(s)	3	0	3
Low(s)	3	1	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 40

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individua 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 = 40 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

+ 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 7 for inventory.

Chart 13. Contaminant risks for Koyuk City Washeteria/School (PWS No. 340167.001) - Other Organic Chemicals

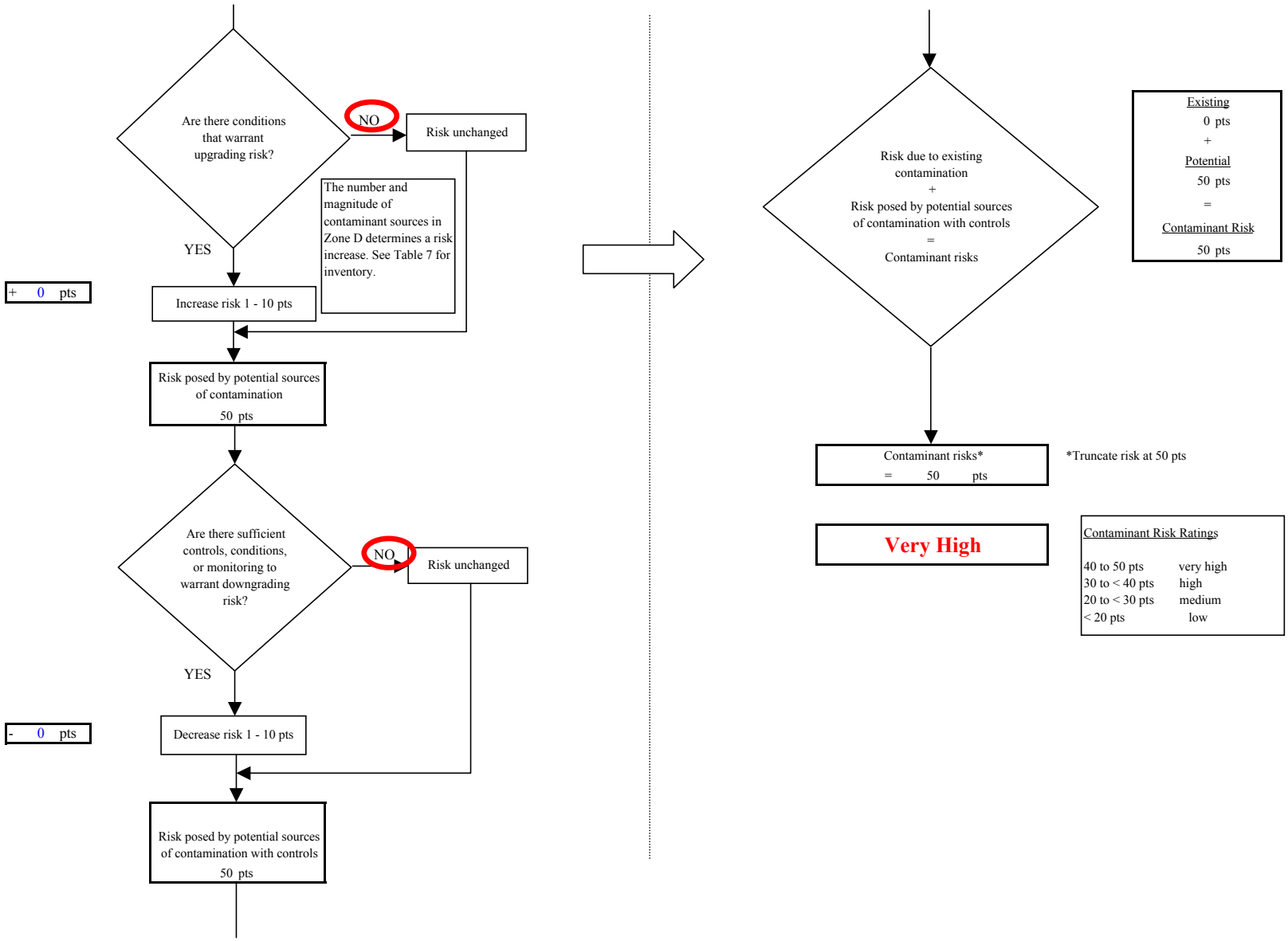


Chart 14. Vulnerability analysis for Koyuk City Washeteria/School (PWS No. 340167.001) - Other Organic Chemicals