Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for McGahan Utilities Drinking Water System, Nikiski area, Alaska PWSID 241020.001 and 241020.002

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1534
Alaska Department of Environmental Conservation

Source Water Assessment for McGahan Utilities Drinking Water System Nikiski area, Alaska PWSID 244997.001 and 244997.002

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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.

CONTENTS

TABLES

APPENDICES

Source Water Assessment for McGahan Utilities Source of Public Drinking Water, Nikiski area, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for McGahan Utilities is a Class A (community) water system consisting of two wells. The McGahan Utilities wells are located off of Nikiski Beach Road and the Kenai Spur Highway in the city of Nikiski. The wellheads received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the wells. Identified potential and current sources of contaminants for the McGahan Utilities public drinking water system include: Gasoline stations, large capacity septic systems, motor vehicle waste disposal wells, underground fuel tanks, motor vehicle storage, swimming pools, seafood processing, highways and roads, ADEC recognized contaminated sites and residential septic systems. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals, inorganic chemicals, synthetic organic chemicals and other organic chemicals. Overall, the public water sources for the McGahan Utilities received a vulnerability rating of **High** for bacteria and viruses, nitrates and nitrites, inorganic chemicals, volatile organic chemicals and **Medium** for other organic chemicals and synthetic organic chemicals.

MCGAHAN UTILITIES PUBLIC DRINKING WATER SYSTEM

The McGahan Utilities public water system (PWS) is a Class A (community) water system. The system consists of two wells located off Nikiski Beach Road and the Kenai Spur Highway in the City of Nikiski (See Map 1 of Appendix A). Nikiski is part of the Kenai Peninsula Borough, which is located directly south of the city of Anchorage (Please see the inset of Map 1 in Appendix A for location). The borough encompasses 25,600 square miles, of which only 15,700 square miles is land.

The Kenai Peninsula is broken into two distinct geographic areas; the Kenai Mountains and the Kenai Lowlands**.** Kenai and its surrounding communities are located in the Kenai Lowlands. Communities located within the Kenai Lowlands include Sterling, Soldotna, Kenai, Nikiski, Clam Gulch, Ninilchik, and Homer. Communities located in the Kenai Mountains include: Cooper Landing, Moose Pass and Seward.

The Kenai Peninsula area topography varies from about 3,000 feet to 5,000 feet above sea level in the Kenai Mountains, the highest point being about 6,400 feet above sea level. The Kenai Peninsula is dotted with many lakes and small streams, including three large lakes (Kenai Lake, Skilak Lake, and Tustemena Lake) and two substantial rivers (Kenai River, and Kasilof River) (USGS 1915).

The McGahan Utilities water system is located within the Kenai Lowlands, which is a sub-province of the Cook Inlet-Susitna Lowland physiographic region. The Kenai Lowland is a glaciated coastal shelf situated west of the northeast-trending Kenai Mountains. Approximately 100 miles long, the coastal shelf is bordered on the west by Cook Inlet, on the east by Kenai Mountains, on the north by Turnagain Arm, and on the south by the Caribou Hills and Kachemak Bay. The following summary of regional geology and hydrogeology is based on studies by Bailey and Hogan (1995); Freethey and Scully (1980); Glass (1996); Hartman, et al. (1972); and Karlstrom (1964).

The Kenai Lowland is underlain by bedrock. Tertiary sedimentary bedrock is more than 500 feet below the city of Kenai airport, but is exposed along beach cliffs and road cuts near the southwest end of the lowland. Unconsolidated surficial deposits of Quaternary age include coastal deposits, glaciolacustrine deposits, glaciofluvial deposits, glacial moraine deposits, and periglacial wind deposits. Unconsolidated Quaternary cover on the lowlands generally thickens from south to North being thin or absent in the Homer area, and over 750 feet thick near Nikiski.

The most significant groundwater resources of the Kenai Lowlands are contained in Quarternary coarse-grained sands and gravels. Flood plain, river terrace and other alluvial deposits are common aquifer materials in the area, and are characterized by high rates of recharge, and large saturated thicknesses. Other favorable materials include proglacial lake and associated river deposits and glacial outwash deposits consisting of meltwater sorted sand and gravel material. Unsorted glacial moraine and drift deposits generally have poor groundwater yields, as do discontinuous

layers of confining clays and silt that are common throughout the unconsolidated materials. The relatively thicker sequence of unconsolidated sediments in the northern portions of the Kenai Lowlands locally hosts thicker, more extensive clay aquitards and multiple aquifers.

The Kenai Peninsula area has a central water system, however, many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are deep with depths between 50 and 200 feet. Static water levels in many of these wells are between 10 and 30 feet below the surface. Although groundwater quality can vary significantly in short distance, groundwater supplies are abundant in the area.

There is some discrepancy regarding the depth of the well. This assessment uses the information provided in the 1997 Sanitary Survey. According to the sanitary survey the depths of Well No. 1(241020.002) and Well No. 2 (241020.001) are 91 and 97 feet below ground surface (bgs) respectively. Both wells are reportedly perforated. Well No. 1 is perforated from 68-83 feet and Well No. 2 from 66-85.

According to the 1997 sanitary survey the wells are properly sealed. A properly installed sanitary seal may provide protection against contaminant from entering the source waters at the casing. The wells are not located in a floodplain and the surface is sloped away from the wellheads. The wells were constructed prior to grouting regulations and are not properly grouted. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates year round and serves up to 420 non-residents and 50 non-residents through 100 service connections.

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MCGAHAN UTILITIES DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. 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 McGahan Utilities. 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 2 years time-of-travel
C	Less than 5 years time-of-travel
D	Less than 10 years time-of-travel

The DWPA for the McGahan Utilities was determined using an analytical calculation and includes Zone A, B, C, and D (See Map 1 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 McGahan Utilities 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; and
- Other organic chemicals.

The sources are displayed on Map 1 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 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

VULNERABILITY OF MCGAHAN UTILITIES 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 eight 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. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile 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 well for McGahan Utilities is completed in a semi-confined aquifer setting. Studies and well logs in the area indicate thin confining layers exists approximately from 53-55 and 75-77 feet bgs. These confining layers may provide a protective barrier from the movement of contaminants in the subsurface. However, wells penetrating the confining layer may provide a quick path for contaminants to enter the confining aquifer.

Table 2 shows the Susceptibility scores and ratings for the McGahan Utilities.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	23	Very High
Natural Susceptibility	28	Medium

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	40	Very High
Nitrates and/or Nitrites	50	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	25	Medium

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 three categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	70	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	75	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	75	High
Synthetic Organic Chemicals	55	Medium
Other Organic Chemicals	55	Medium

Bacteria and Viruses

Large capacity septic systems, motor vehicle waste disposal wells, residential septic systems, roads, seafood processin and residential areas in the protection area represent the greatest risk for bacteria and viruses to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coli forms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coli forms and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Sampling has not detected bacteria within source waters.

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

Large capacity septic systems, motor vehicle waste disposal wells and seafood processing in the protection area represents the greatest risk to to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for the McGahan Utilities well indicates that nitrate concentrations have ranged from 0 mg/l to 3.88 mg/l. The reported nitrate concentrations suggest that the nitrate concentrations may be attributed to natural sources. 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. The most recent nitrate level detected was 35% (3.49 mg/L) of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Though existing nitrate contamination was detected at the site, recent data indicates that nitrate concentrations are safe with respect to human health.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Volatile Organic Chemicals

Gasoline stations, large capacity septic systems, motor vehicle waste disposal wells, construction trade areas, septic systems, underground fuel tanks, motor vehicle storage, residential area and seafood processing facilities represent the greatest identified risk for volatile organic chemical contamination to the well.

Approximately 20% residents in the area typically heat their homes with various types of on-site fuel sources, including propane and heating oil stored in aboveground or underground storage tanks. Although this report does not address heating oil tanks (unless their location is known), they can pose a risk of volatile organic chemical contamination to drinking water sources. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Secondary containment around the tank and regular system maintenance can help prevent many of these harmful fuel leaks and help protect the drinking water supply.

Sampling for volatile organic chemicals has detected trichloroethylene and 1,1,1-trichloroethane below its maximum contaminant level (MCL) and tetrachloroethlene above the MCL. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. According to the USEPA, “Some people who drink water containing tetrachloroethylene in excess of the MCL over many years could have problems with their liver and may have an increased risk of getting cancer” (USEPA).

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 high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

Large capacity septic systems, gasoline stations, motor vehicle waste disposal wells, construction trade areas, underground fuel tanks, residential septic systems, roads and residential areas in the protection area present the greatest risk for inorganic chemicals to the well.

Samplings of inorganic chemicals have detected barium and chromium at levels below the maximum contaminant level (MCL).

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 high.

Synthetic Organic Chemicals

Large capacity septic systems, motor vehicle waste disposal wells, residential septic systems and residential areas in the protection area represent the greatest identified risk for synthetic organic chemicals to the well.

Sampling for synthetic organic chemicals (SOC’s) has not occurred. The system currently has a SOC Waiver and is not required to sample.

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

Other Organic Chemicals

Large capacity septic systems, motor vehicle waste disposal wells, gasoline stations, construction trade areas, roads, septic systems and residential area in the protection area represent the greatest identified risk for other organic chemicals to the well.

Sampling for other organic chemicals (OOC’s) has not occurred. The system currently has a OOC Waiver and is not required to sample.

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

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ACKNOWLEDGMENT

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APPENDIX A

McGahan Utilities
Drinking Water Protection Area Location Map
(Map 1)

Map 1- McGahan Utilities-Drinking Water Protection Area

PWSID: 241020.001 and 241020.002

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

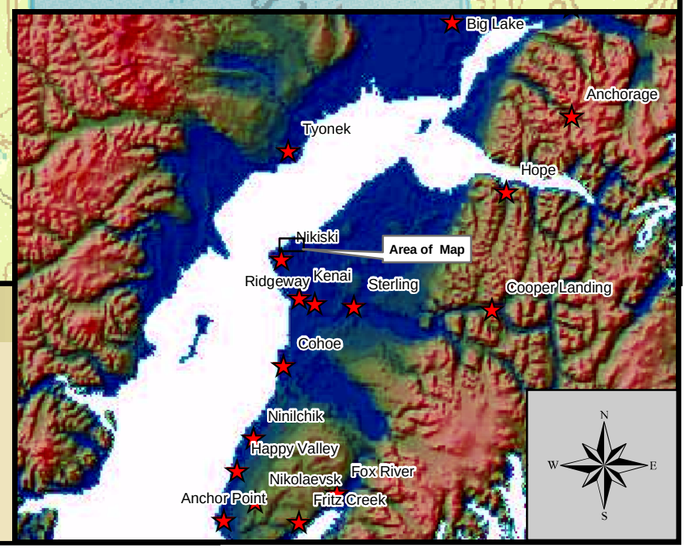
0 937.5 1,875 3,750 Feet

1:23,355

Data Sources:
Kenai Borough: Roads and parcels
Aerial Photo: USGS and Microsoft Terraserver
Potential Sources of Contamination: ADEC

Legend

- Class A Public Water System
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Zone D Protection Area
- Roads
- Rivers and Streams
- Water



APPENDIX B

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

Table 1

Contaminant Source Inventory for ***McGahan Utilities***

PWSID 241020.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Construction trade areas and materials	C09	C09-1	A	2	
Gasoline stations (with repair shop)	C16	C16-1	A	2	51835 NORTH RD MIL 26.5
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-11	A	2	Zone A has 11 large capacity septic systems identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1-8	A	2	Zone A has 8 motor vehicle waste disposal wells identified. .
Septic systems (serves one single-family home)	R02	R02-1-59	A	2	Zone A has 59 residential septic systems identified.
Tanks, diesel (underground)	T08	T08-1	A	2	51835 NORTH RD MIL 26.5
Tanks, gasoline (underground)	T12	T12-1	A	2	51835 NORTH RD MIL 26.5
Highways and roads, paved (cement or asphalt)	X20	X20-1-8	A	2	Zone A has 8 roads identified.
Motor vehicle/general storage yards/facilities	X27	X27-1	A	2	
Swimming pools (public)	X44	X44-1	A	2	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-9	B	2	Zone B has 1 motor vehicle waste disposal well.
Seafood processing	N10	N10-1	B	2	MI 27.5 KENAI SPUR HWY
Residential Areas	R01	R01-2	B	2	Zone B has 13 residential acres
Septic systems (serves one single-family home)	R02	R02-60-64	B	2	Zone B has 5 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	2	Zone B has 1 road identified.
Residential Areas	R01	R01-3	C	2	Zone C has 57 residential acres
Septic systems (serves one single-family home)	R02	R02-	C	2	Zone C has 13 residential septic systems
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-2	D	2	Former Lamplight Chevron

Table 2

Contaminant Source Inventory and Risk Ranking for McGahan Utilities Sources of Bacteria and Viruses

PWSID 241020.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-11	A	High	2	Zone A has 11 large capacity septic systems identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1-8	A	Low	2	Zone A has 8 motor vehicle waste disposal wells identified. .
Septic systems (serves one single-family home)	R02	R02-1-59	A	Low	2	Zone A has 59 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-1-8	A	Low	2	Zone A has 8 roads identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-9	B	Low	2	Zone B has 1 motor vehicle waste disposal well.
Seafood processing	N10	N10-1	B	Medium	2	MI 27.5 KENAI SPUR HWY
Seafood processing	N10	N10-1	B	Medium	2	MI 27.5 KENAI SPUR HWY
Residential Areas	R01	R01-2	B	Low	2	Zone B has 13 residential acres
Septic systems (serves one single-family home)	R02	R02-60-64	B	Low	2	Zone B has 5 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	2	Zone B has 1 road identified.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 57 residential acres
Septic systems (serves one single-family home)	R02	R02-	C	Low	2	Zone C has 13 residential septic systems

Table 3

Contaminant Source Inventory and Risk Ranking for McGahan Utilities

Sources of Nitrates/Nitrites

PWSID 241020.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-11	A	High	2	Zone A has 11 large capacity septic systems identified.
Septic systems (serves one single-family home)	R02	R02-1-59	A	Low	2	Zone A has 59 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-1-8	A	Low	2	Zone A has 8 roads identified.
Seafood processing	N10	N10-1	B	Low	2	MI 27.5 KENAI SPUR HWY
Seafood processing	N10	N10-1	B	Low	2	MI 27.5 KENAI SPUR HWY
Residential Areas	R01	R01-2	B	Low	2	Zone B has 13 residential acres
Septic systems (serves one single-family home)	R02	R02-60-64	B	Low	2	Zone B has 5 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	2	Zone B has 1 road identified.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 57 residential acres
Septic systems (serves one single-family home)	R02	R02-	C	Low	2	Zone C has 13 residential septic systems

Table 4

Contaminant Source Inventory and Risk Ranking for McGahan Utilities

Sources of Volatile Organic Chemicals

PWSID 241020.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Construction trade areas and materials	C09	C09-1	A	Low	2	
Gasoline stations (with repair shop)	C16	C16-1	A	High	2	51835 NORTH RD MIL 26.5
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-11	A	Low	2	Zone A has 11 large capacity septic systems identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1-8	A	High	2	Zone A has 8 motor vehicle waste disposal wells identified. .
Septic systems (serves one single-family home)	R02	R02-1-59	A	Low	2	Zone A has 59 residential septic systems identified.
Tanks, diesel (underground)	T08	T08-1	A	High	2	51835 NORTH RD MIL 26.5
Tanks, gasoline (underground)	T12	T12-1	A	High	2	51835 NORTH RD MIL 26.5
Highways and roads, paved (cement or asphalt)	X20	X20-1-8	A	Low	2	Zone A has 8 roads identified.
Motor vehicle/general storage yards/facilities	X27	X27-1	A	Low	2	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-9	B	High	2	Zone B has 1 motor vehicle waste disposal well.
Seafood processing	N10	N10-1	B	Medium	2	MI 27.5 KENAI SPUR HWY
Residential Areas	R01	R01-2	B	Low	2	Zone B has 13 residential acres
Septic systems (serves one single-family home)	R02	R02-60-64	B	Low	2	Zone B has 5 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	2	Zone B has 1 road identified.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 57 residential acres
Septic systems (serves one single-family home)	R02	R02-	C	Low	2	Zone C has 13 residential septic systems

Table 5

Contaminant Source Inventory and Risk Ranking for McGahan Utilities

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 241020.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Construction trade areas and materials	C09	C09-1	A	Low	2	
Gasoline stations (with repair shop)	C16	C16-1	A	Low	2	51835 NORTH RD MIL 26.5
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-11	A	Low	2	Zone A has 11 large capacity septic systems identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1-8	A	High	2	Zone A has 8 motor vehicle waste disposal wells identified. .
Septic systems (serves one single-family home)	R02	R02-1-59	A	Low	2	Zone A has 59 residential septic systems identified.
Tanks, gasoline (underground)	T12	T12-1	A	Medium	2	51835 NORTH RD MIL 26.5
Highways and roads, paved (cement or asphalt)	X20	X20-1-8	A	Low	2	Zone A has 8 roads identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-9	B	High	2	Zone B has 1 motor vehicle waste disposal well.
Residential Areas	R01	R01-2	B	Low	2	Zone B has 13 residential acres
Septic systems (serves one single-family home)	R02	R02-60-64	B	Low	2	Zone B has 5 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	2	Zone B has 1 road identified.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 57 residential acres
Septic systems (serves one single-family home)	R02	R02-	C	Low	2	Zone C has 13 residential septic systems

Table 6

Contaminant Source Inventory and Risk Ranking for McGahan Utilities

Sources of Synthetic Organic Chemicals

PWSID 241020.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-11	A	Low	2	Zone A has 11 large capacity septic systems identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1-8	A	Low	2	Zone A has 8 motor vehicle waste disposal wells identified. .
Septic systems (serves one single-family home)	R02	R02-1-59	A	Low	2	Zone A has 59 residential septic systems identified.
Swimming pools (public)	X44	X44-1	A	Low	2	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-9	B	Low	2	Zone B has 1 motor vehicle waste disposal well.
Residential Areas	R01	R01-2	B	Low	2	Zone B has 13 residential acres
Septic systems (serves one single-family home)	R02	R02-60-64	B	Low	2	Zone B has 5 residential septic systems identified.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 57 residential acres
Septic systems (serves one single-family home)	R02	R02-	C	Low	2	Zone C has 13 residential septic systems

Table 7

Contaminant Source Inventory and Risk Ranking for McGahan Utilities

Sources of Other Organic Chemicals

PWSID 241020.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Construction trade areas and materials	C09	C09-1	A	Low	2	
Gasoline stations (with repair shop)	C16	C16-1	A	Medium	2	51835 NORTH RD MIL 26.5
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-11	A	Low	2	Zone A has 11 large capacity septic systems identified.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1-8	A	Medium	2	Zone A has 8 motor vehicle waste disposal wells identified. .
Septic systems (serves one single-family home)	R02	R02-1-59	A	Low	2	Zone A has 59 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-1-8	A	Low	2	Zone A has 8 roads identified.
Motor vehicle/general storage yards/facilities	X27	X27-1	A	Low	2	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-9	B	Medium	2	Zone B has 1 motor vehicle waste disposal well.
Seafood processing	N10	N10-1	B	Low	2	MI 27.5 KENAI SPUR HWY
Residential Areas	R01	R01-2	B	Low	2	Zone B has 13 residential acres
Septic systems (serves one single-family home)	R02	R02-60-64	B	Low	2	Zone B has 5 residential septic systems identified.
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	2	Zone B has 1 road identified.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 57 residential acres
Septic systems (serves one single-family home)	R02	R02-	C	Low	2	Zone C has 13 residential septic systems

APPENDIX C

McGahan Utilities
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Zone A has:
8 motor vehicle disposal wells (D42)
11 large capacity septic systems (D10)
59 residential septic systems (R02)
17 residential acres (R01)
8 roads (X20)

Zone B has:
5 residential septic systems (R02)
13 residential acres (R01)
1 motor vehicle waste disposal well (D10)
2 roads (X20)

Zone C has:
57 residential acres (R01)
13 residential septic systems (R02)

X44-1
X27-01
D52-1
C16-1
T08-1
T12-1
C09-1
N10-01
U04-2

TRAVERSE AVE
HOLLEY BECK ST
K TEAL DR
AGATE DR
CHARLIES WAY
ROUNDS RD
EDUCATION DR
NIKISHKA BEACH RD
OLD NIKISHKA BEA
MERKLE AVE
KENAI SPUR RD
DANA ST
MAZIE AVE
CHRISTIE AV
MARIE AVE
MCGAHAN DR
MARHENKE ST
MARLENE AVE
MYRON AVE
MERRILL AVE
AURORA DR
FISH AVE
LAND MARINE DR
CURRY LN
CRESTVIEW AVE

Map 2-McGahan Utilities: Potential Sources of Contamination

PWSID: 241020.001 and 241020.002

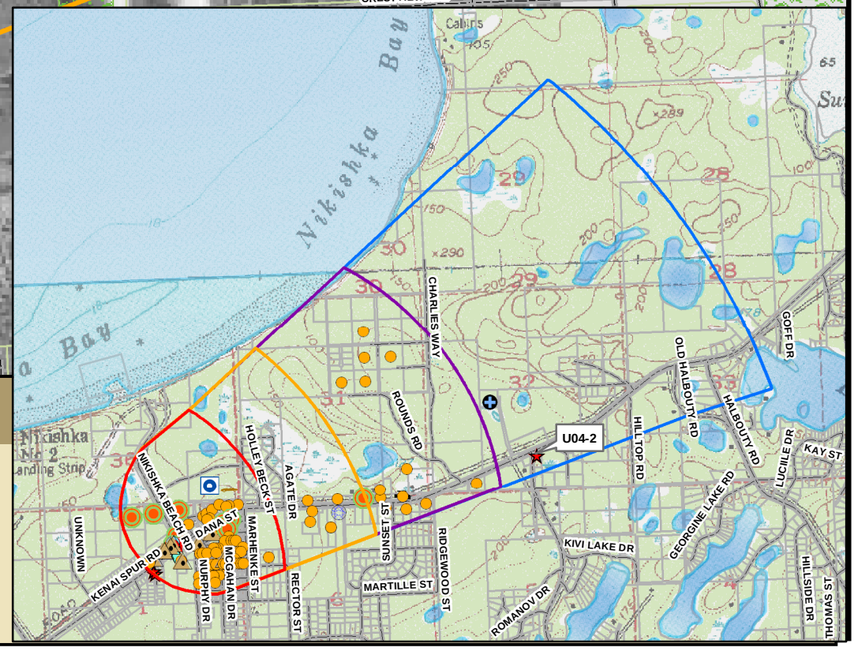
Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

Feet
0 565 1,130
1:6,793

Data Sources:
Roads and parcels: Kenai Borough
63K Topographic Map: USGS
Aerial Photo: USGS and Microsoft Terraserver
Potential Sources of Contamination: ADEC

- Class A Public Water System
  - Zone A Protection Area
  - Zone B Protection Area
  - Zone C Protection Area
  - Zone D Protection Area
  - Roads
  - Residential Area (R02)
  - Water
  - Rivers and Streams
  - Parcels
  - Elevation Contour (20 meters)
- Construction Areas (C09)
- Gasoline stations (with repair shop) (C16)
- Hardware stores (C17)
- Motor Vehicle Waste Disposal Well (D42)
- Seafood processing (N10)
- Tanks, diesel (underground) (T08)
- Tanks, gasoline (underground) (T12)
- Contaminated sites, DEC recognized, (U04)
- Motor vehicle/general storage yards/facilities (X27)
- Medical/veterinary facilities (X40)
- Swimming pools (public) (X44)



APPENDIX D

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

Chart 1. Susceptibility of the wellhead - McGahan Utilities PWSID 241020.001 and 241020.002

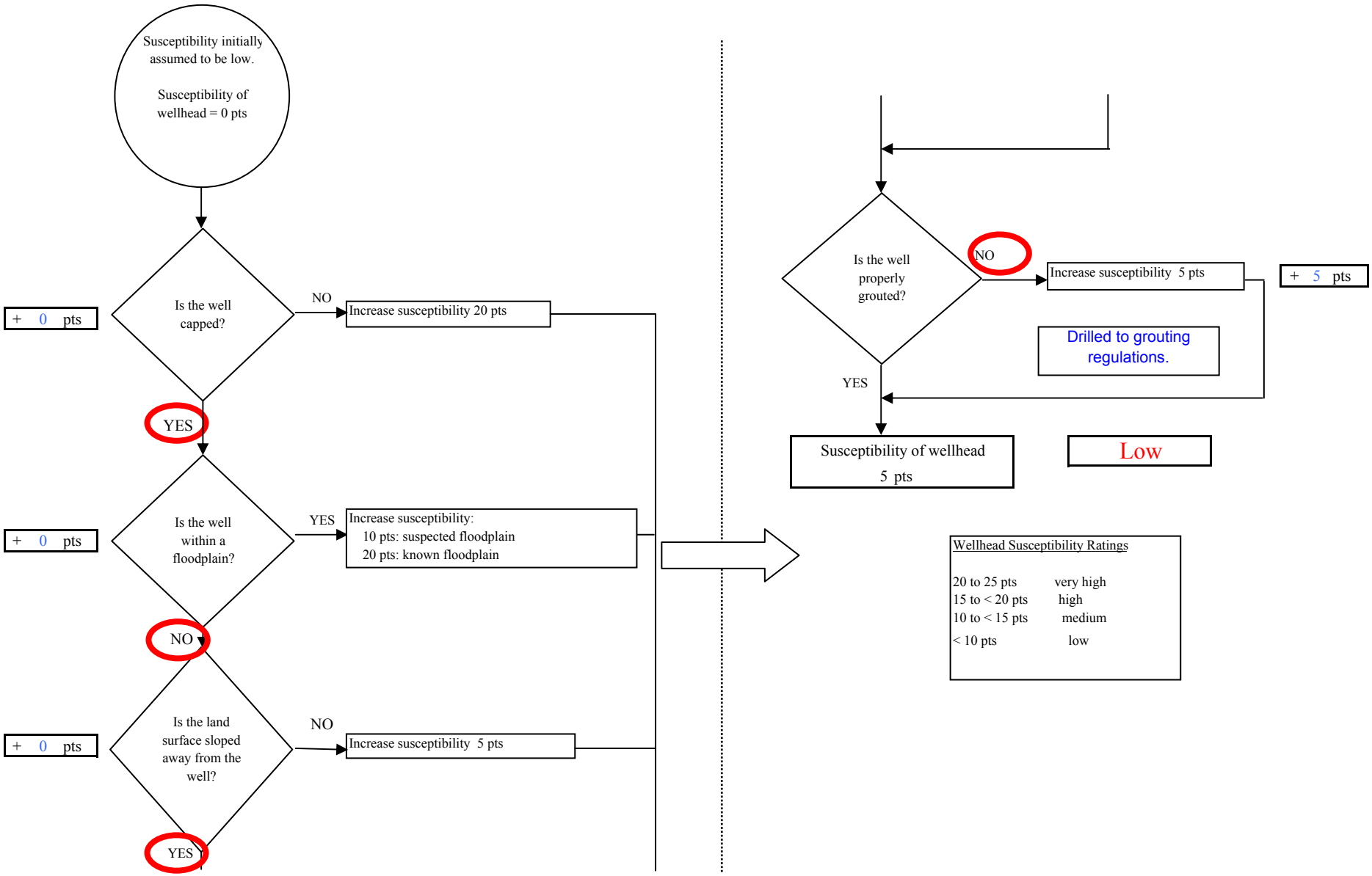


Chart 2. Susceptibility of the aquifer - McGahan Utilities PWSID 241020.001 and 241020.002

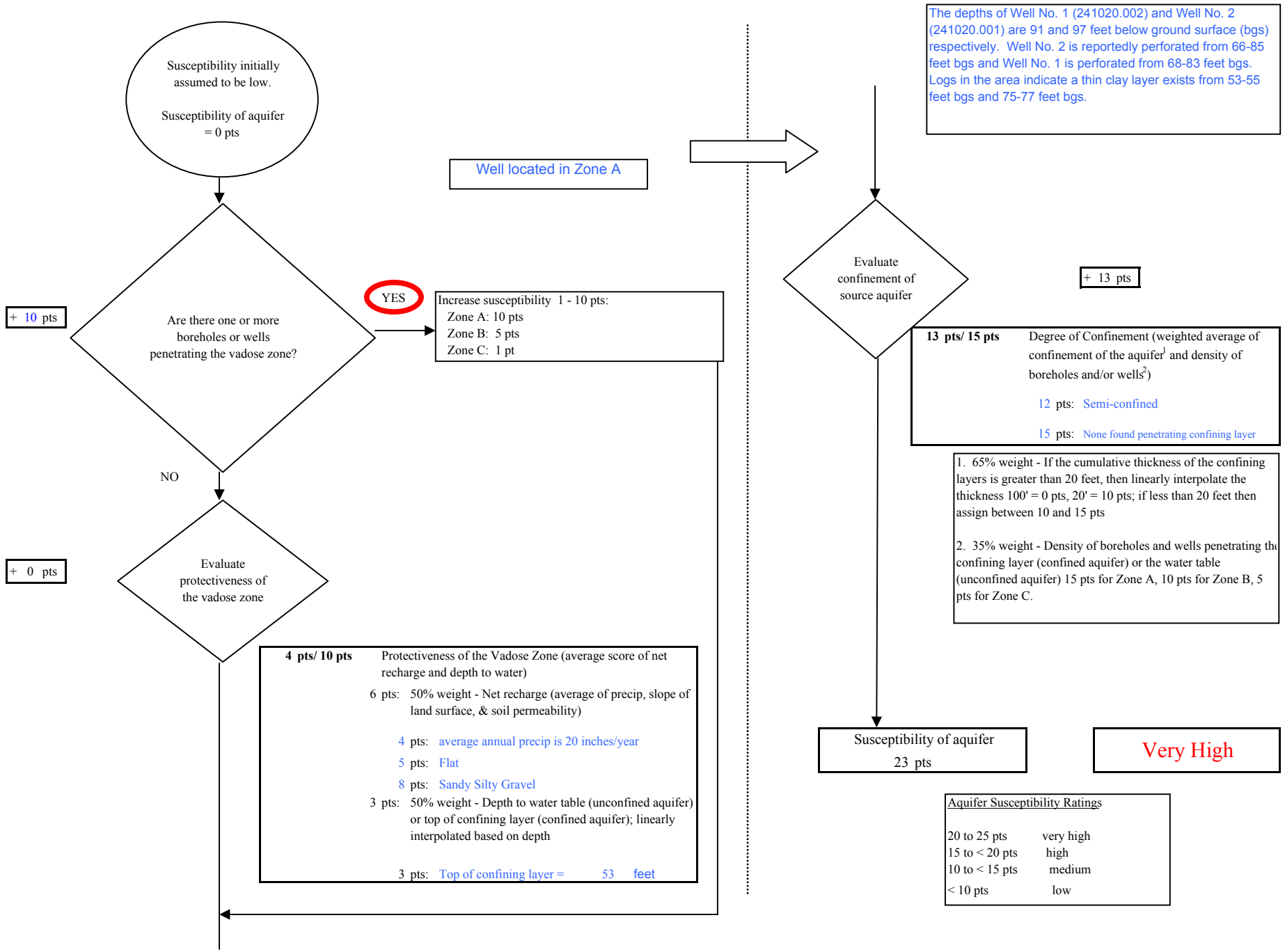
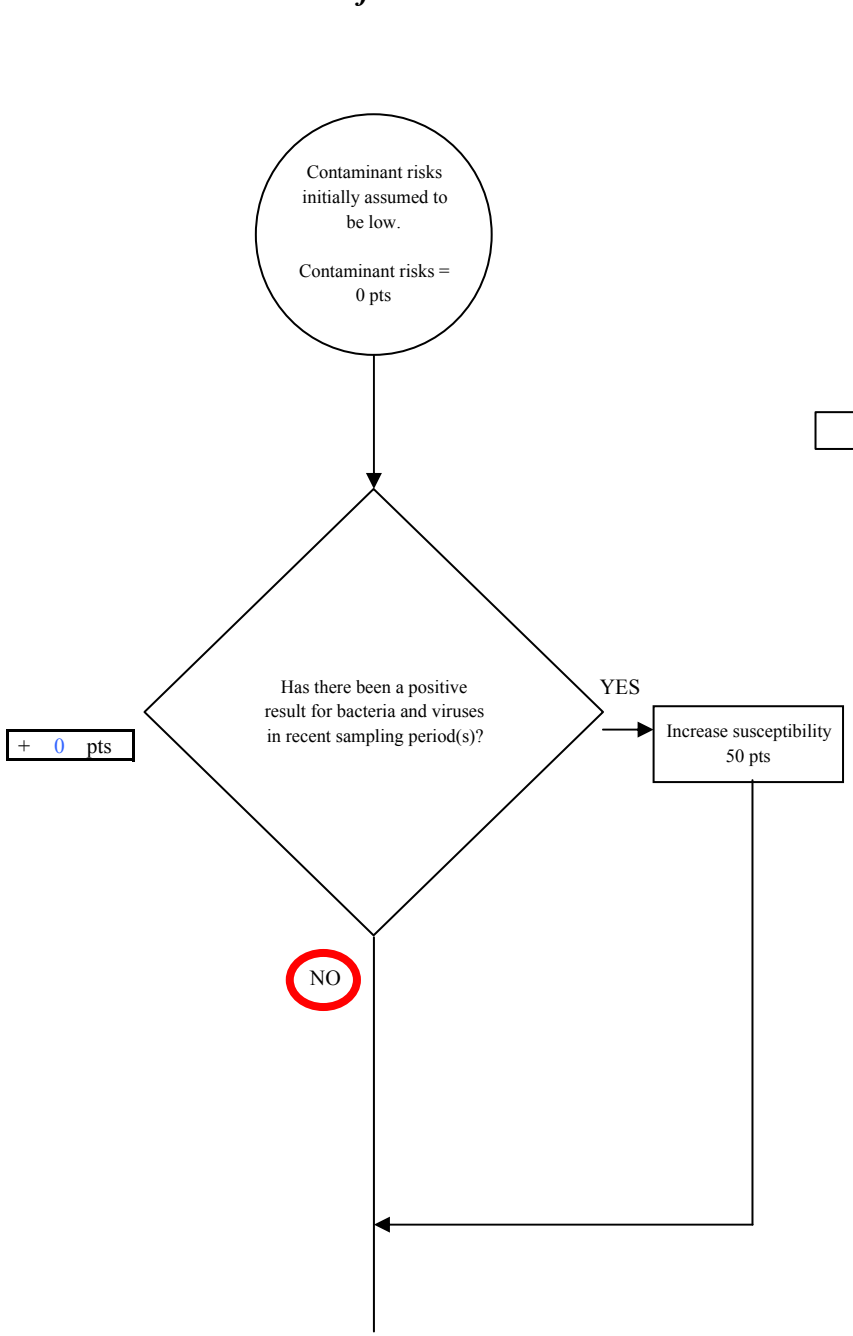
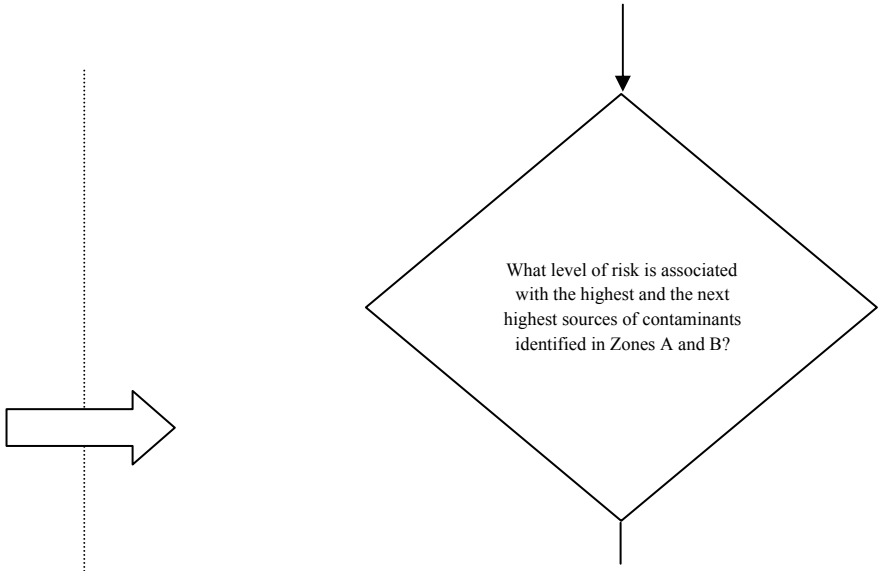


Chart 3. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Bacteria & Viruses





+ 40 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)	12	0	12
Medium(s)	0	0	0
Low(s)	67	2	69

	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 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 McGahan Utilities PWSID 241020.001 and 241020.002 - Bacteria & Viruses

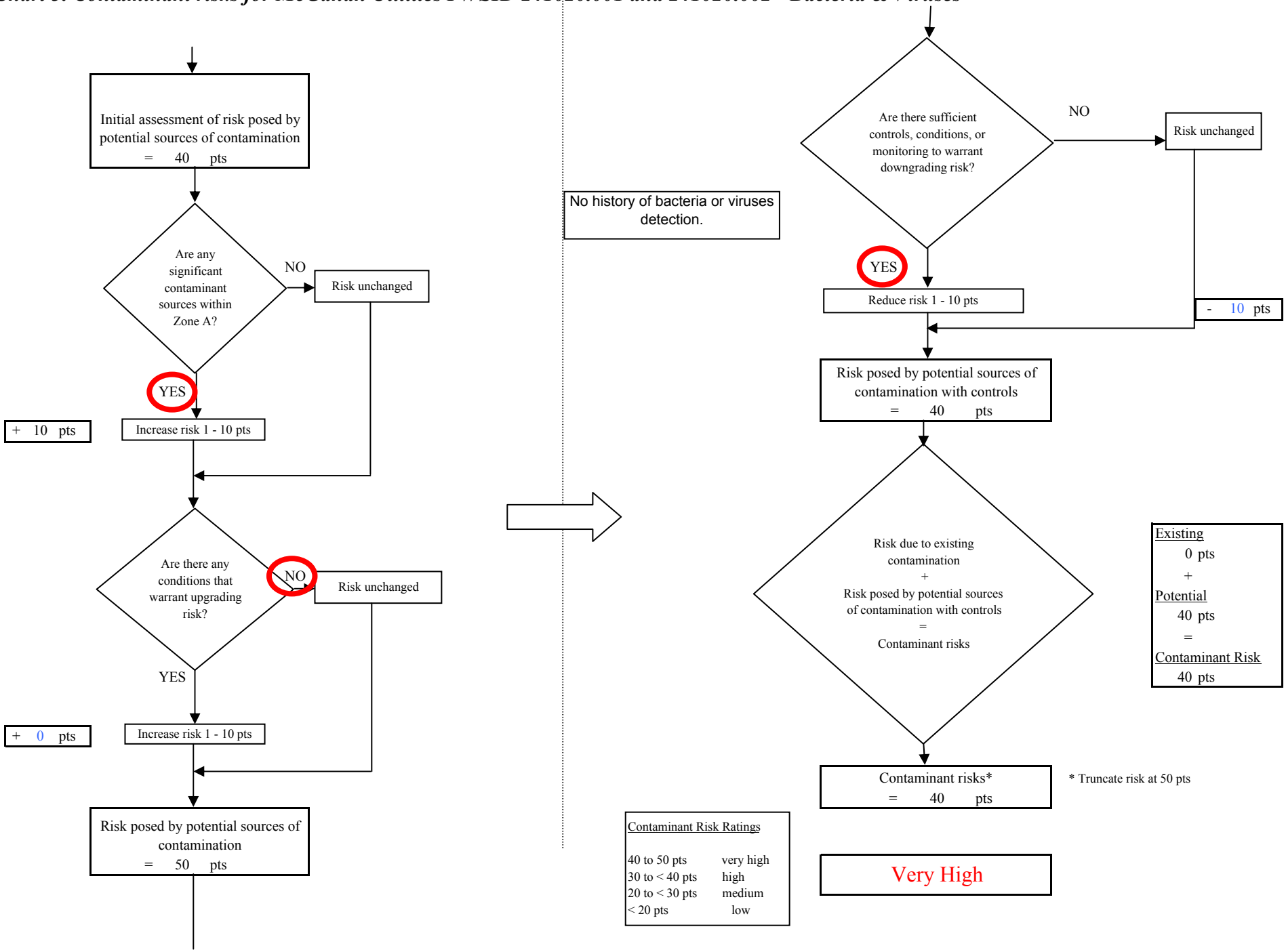


Chart 4. Vulnerability analysis for McGahan Utilities PWSID 241020.001 and 241020.002 - Bacteria & Viruses

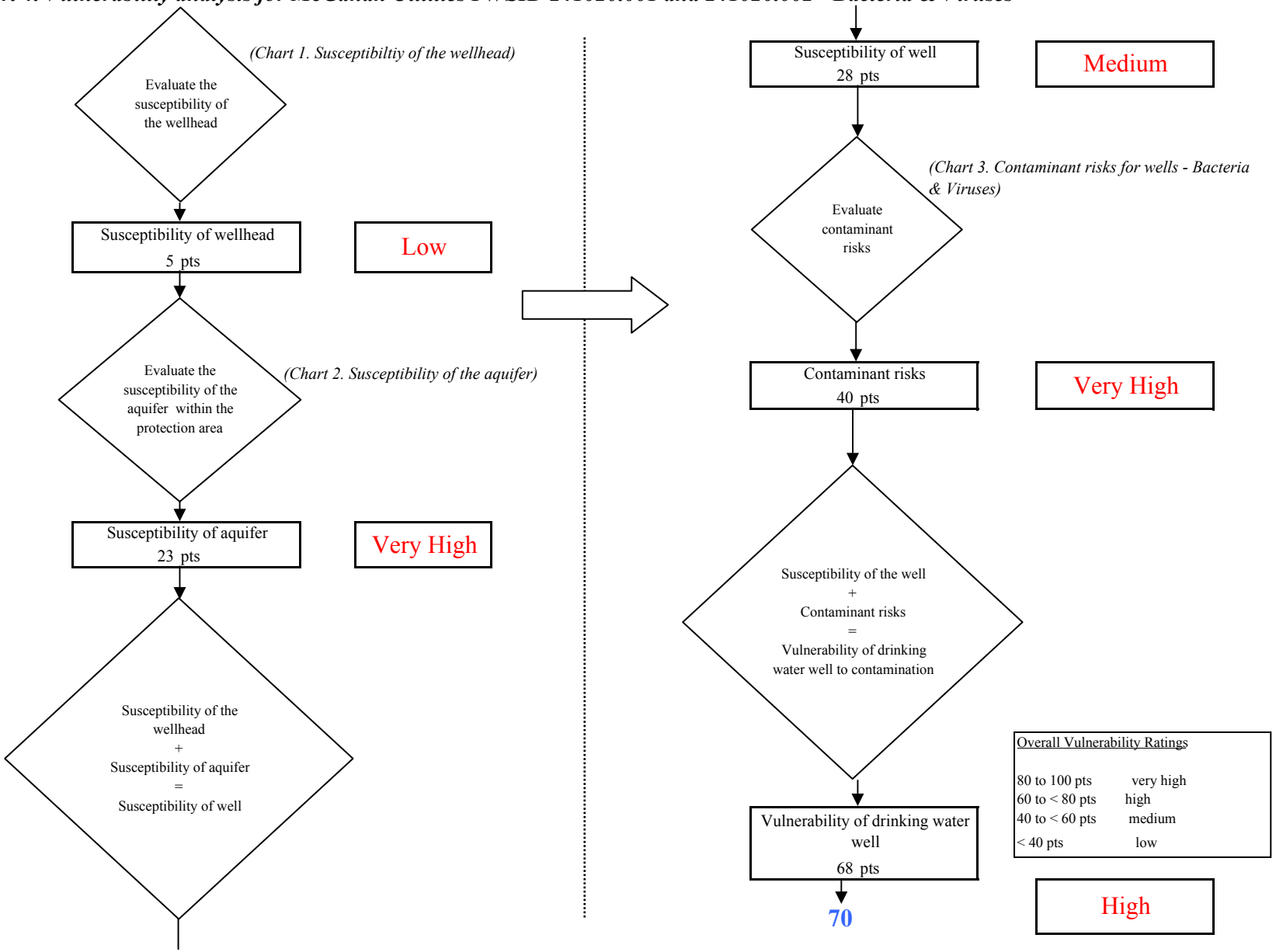


Chart 5. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Nitrates and Nitrites

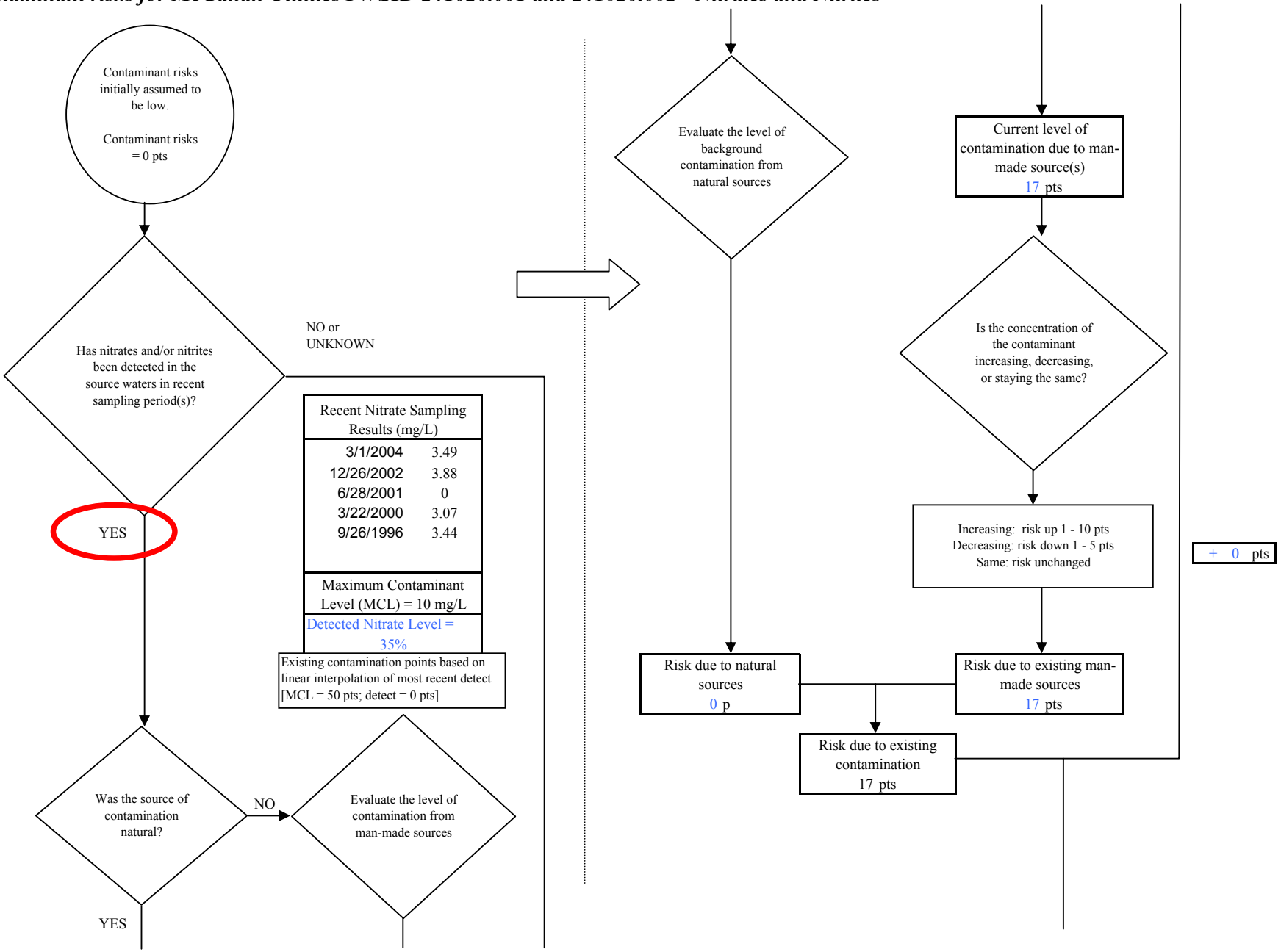


Chart 5. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Nitrates and Nitrites

+ 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)	12	0	12
Medium(s)	0	0	0
Low(s)	67	4	71

	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 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 = 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

Chart 5. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Nitrates and Nitrites

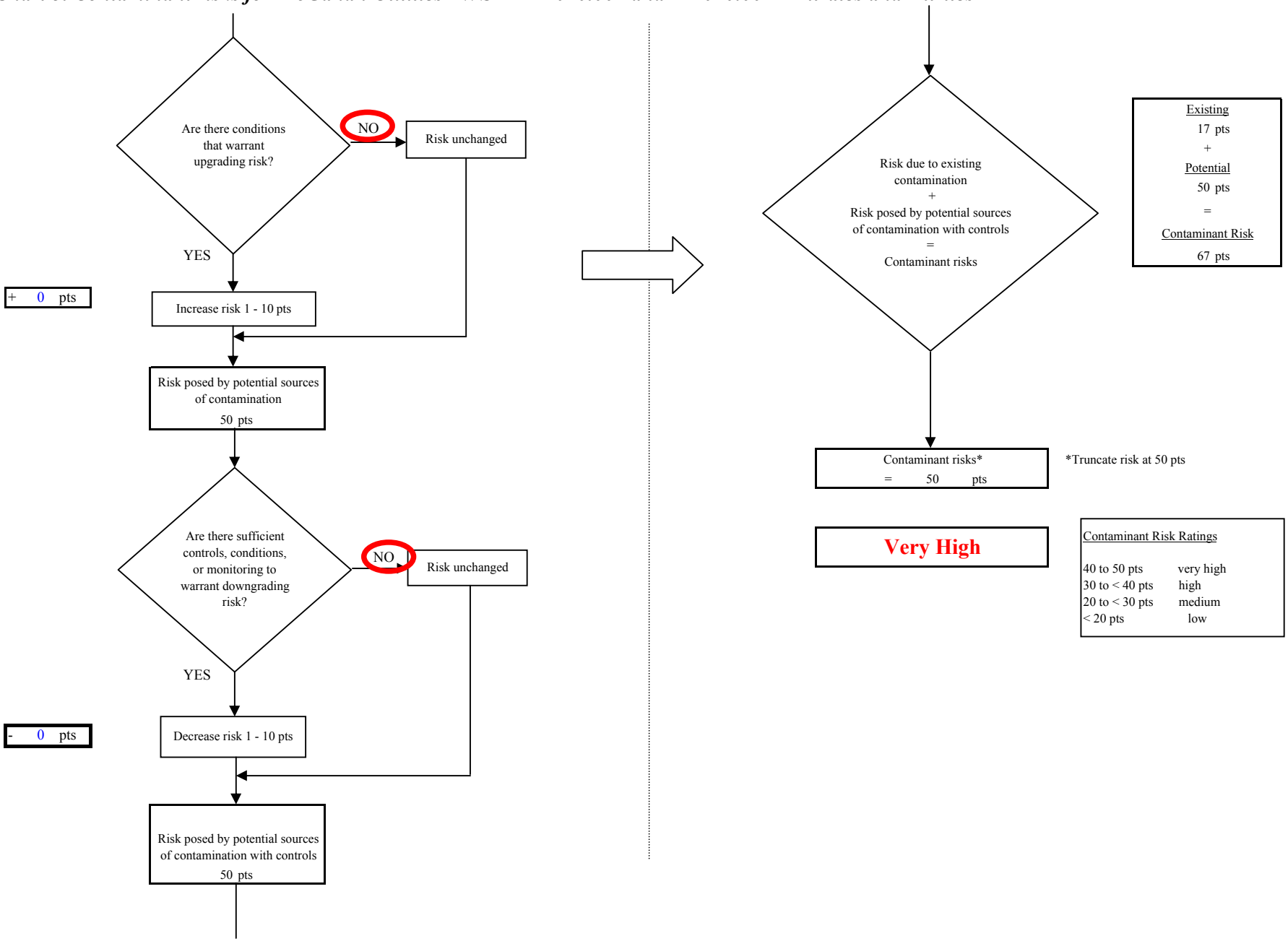


Chart 6. Vulnerability analysis for McGahan Utilities PWSID 241020.001 and 241020.002 - Nitrates and Nitrites

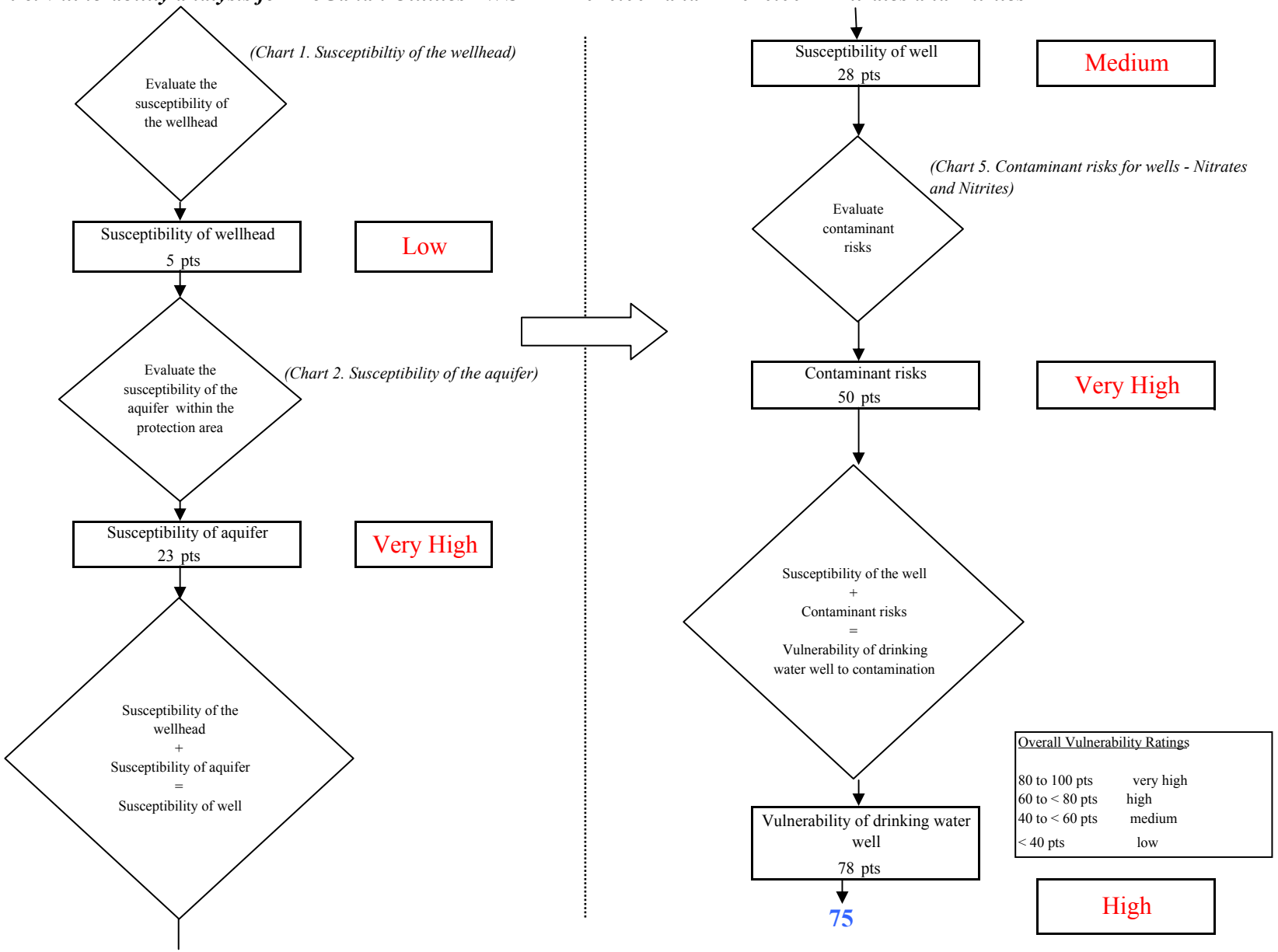


Chart 7. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Volatile Organic Chemicals

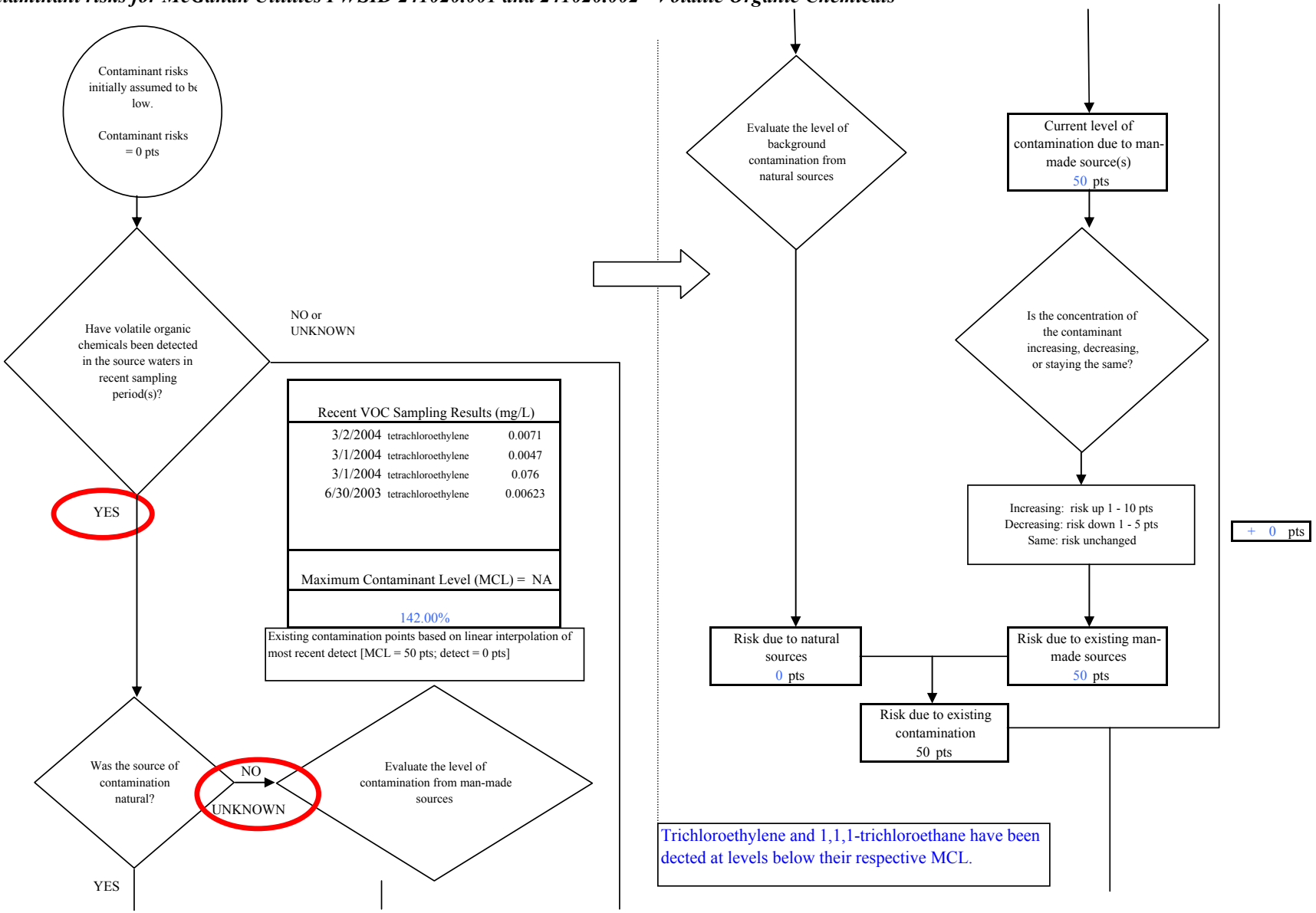


Chart 7. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Volatile Organic Chemicals

+ 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)	8	1	9
Medium(s)	0	0	0
Low(s)	16	2	18

	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 individual contaminant source in th 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 significan sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 10 pts

Chart 7. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Volatile Organic Chemicals

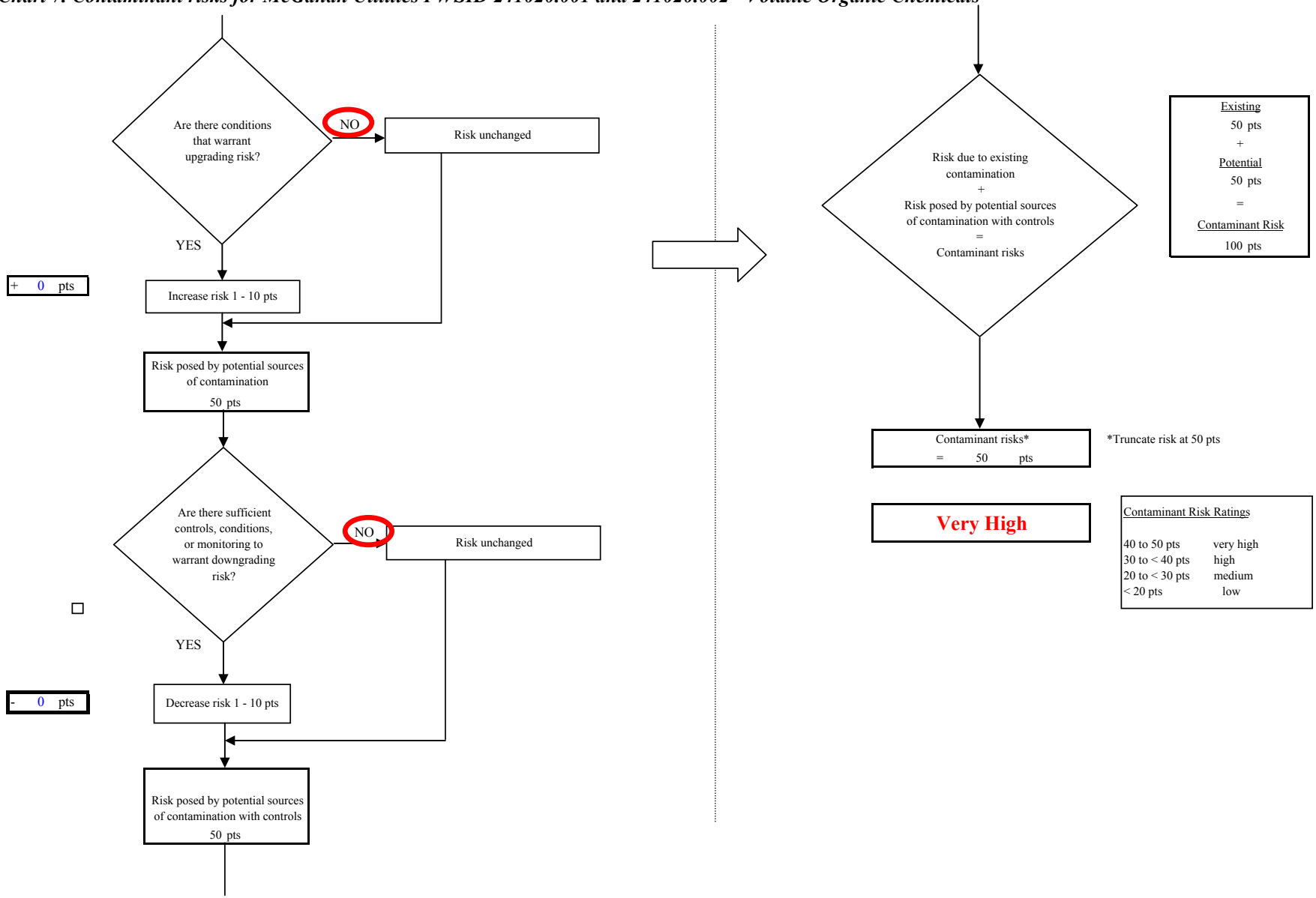


Chart 8. Vulnerability analysis for McGahan Utilities PWSID 241020.001 and 241020.002 - Volatile Organic Chemicals

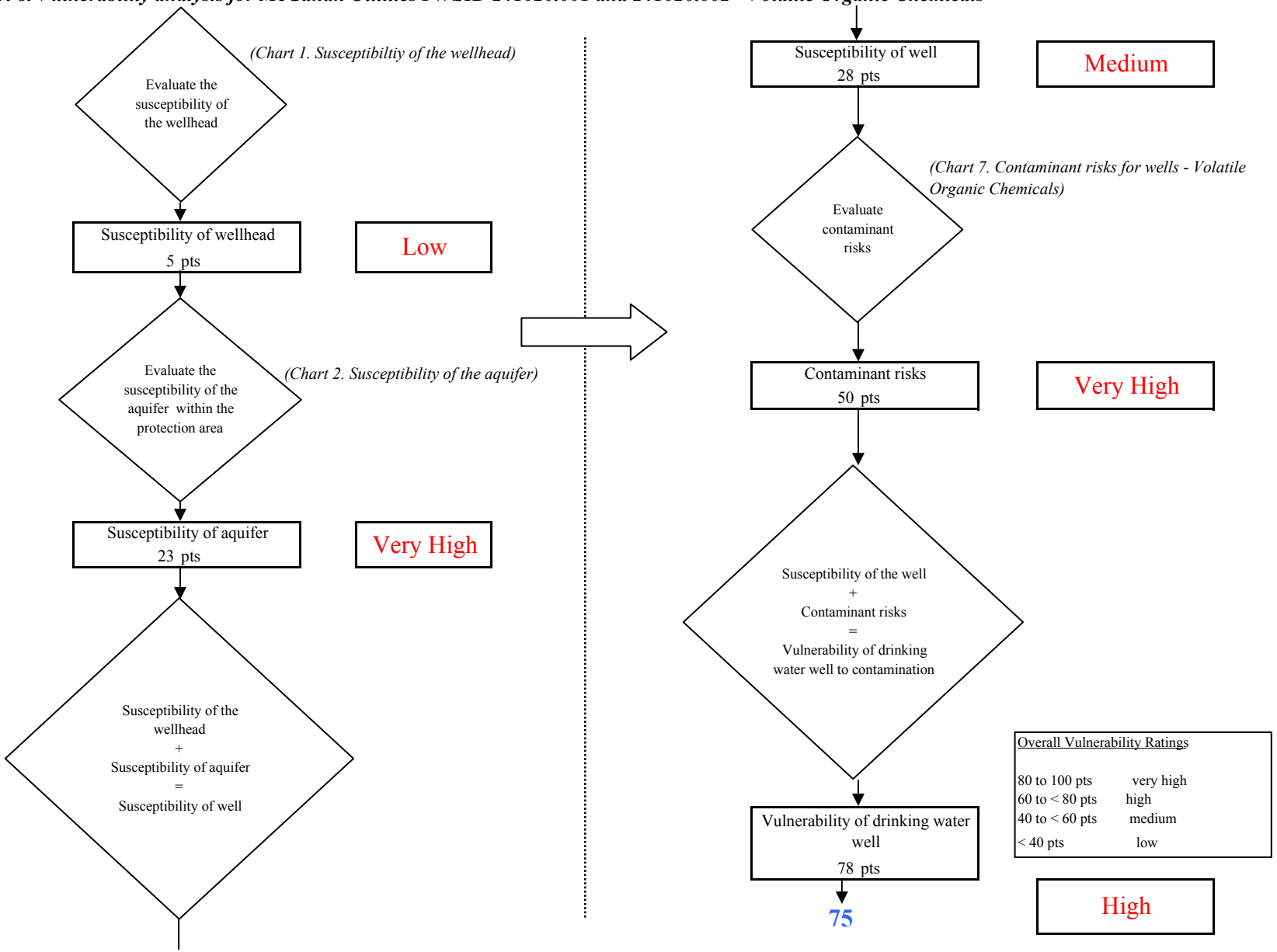


Chart 9. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Heavy Metals, Cyanide and Other Inorganic Chemicals

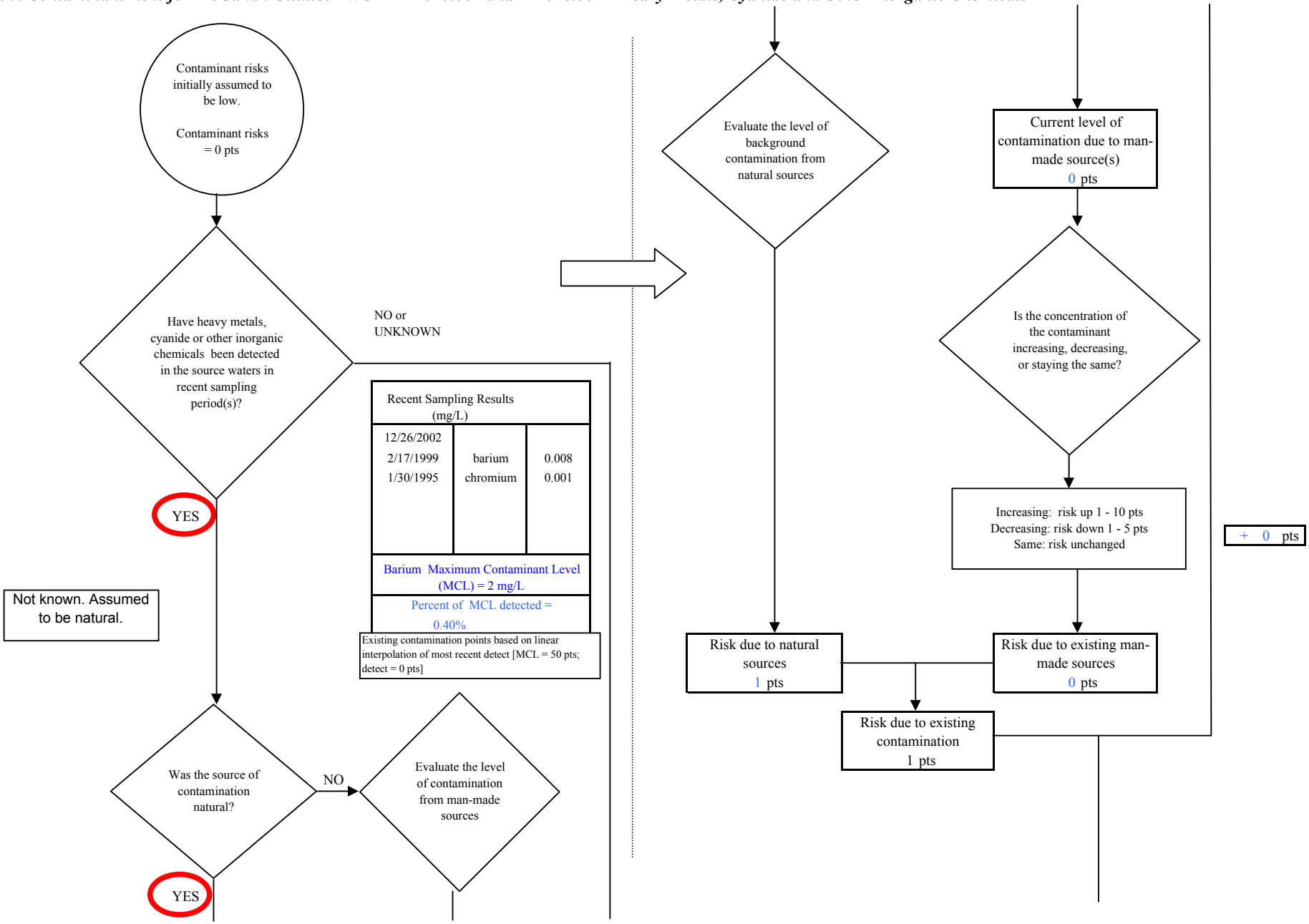
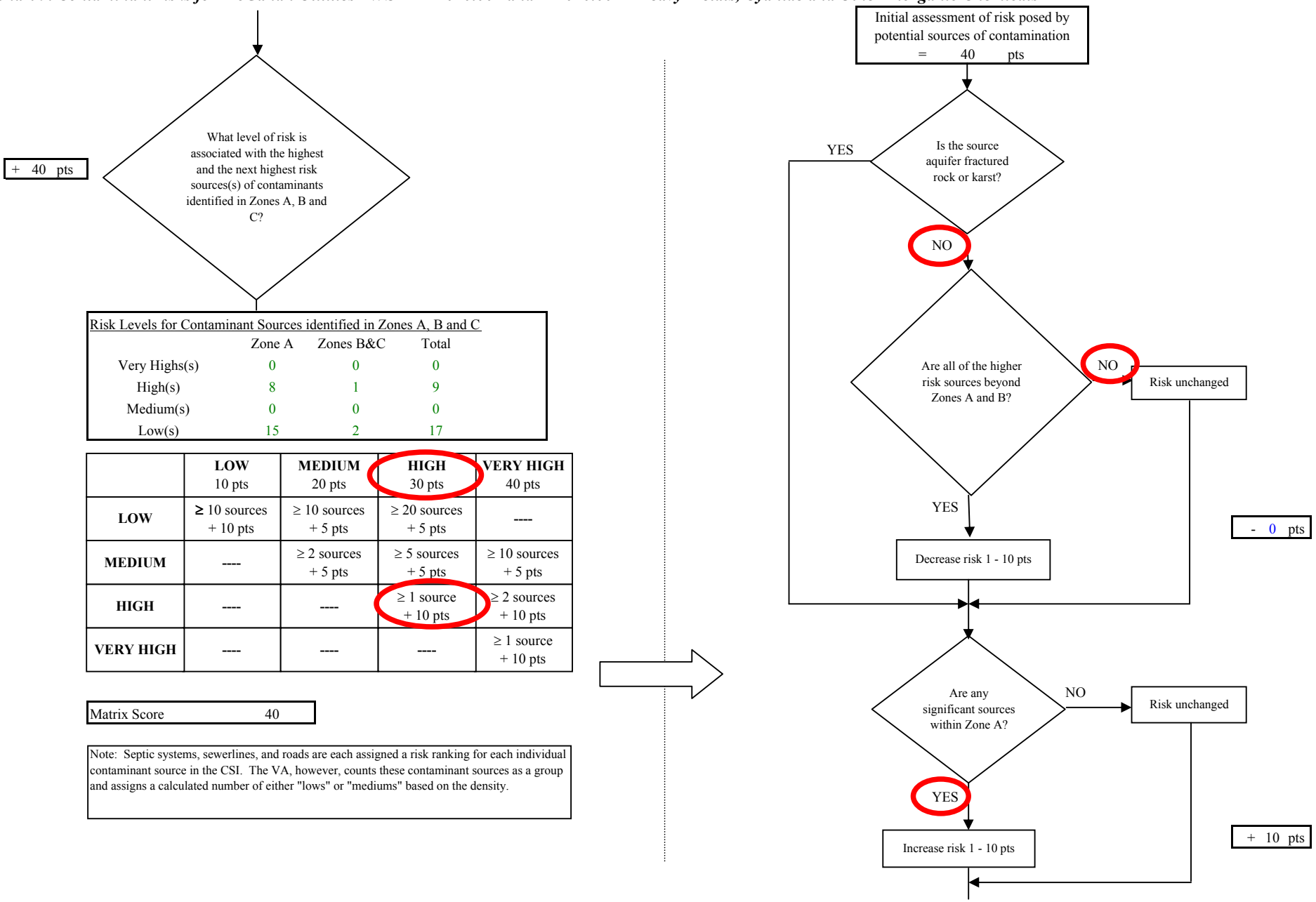


Chart 9. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Heavy Metals, Cyanide and Other Inorganic Chemicals



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)	8	1	9
Medium(s)	0	0	0
Low(s)	15	2	17

	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 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 McGahan Utilities PWSID 241020.001 and 241020.002 - Heavy Metals, Cyanide and Other Inorganic Chemicals

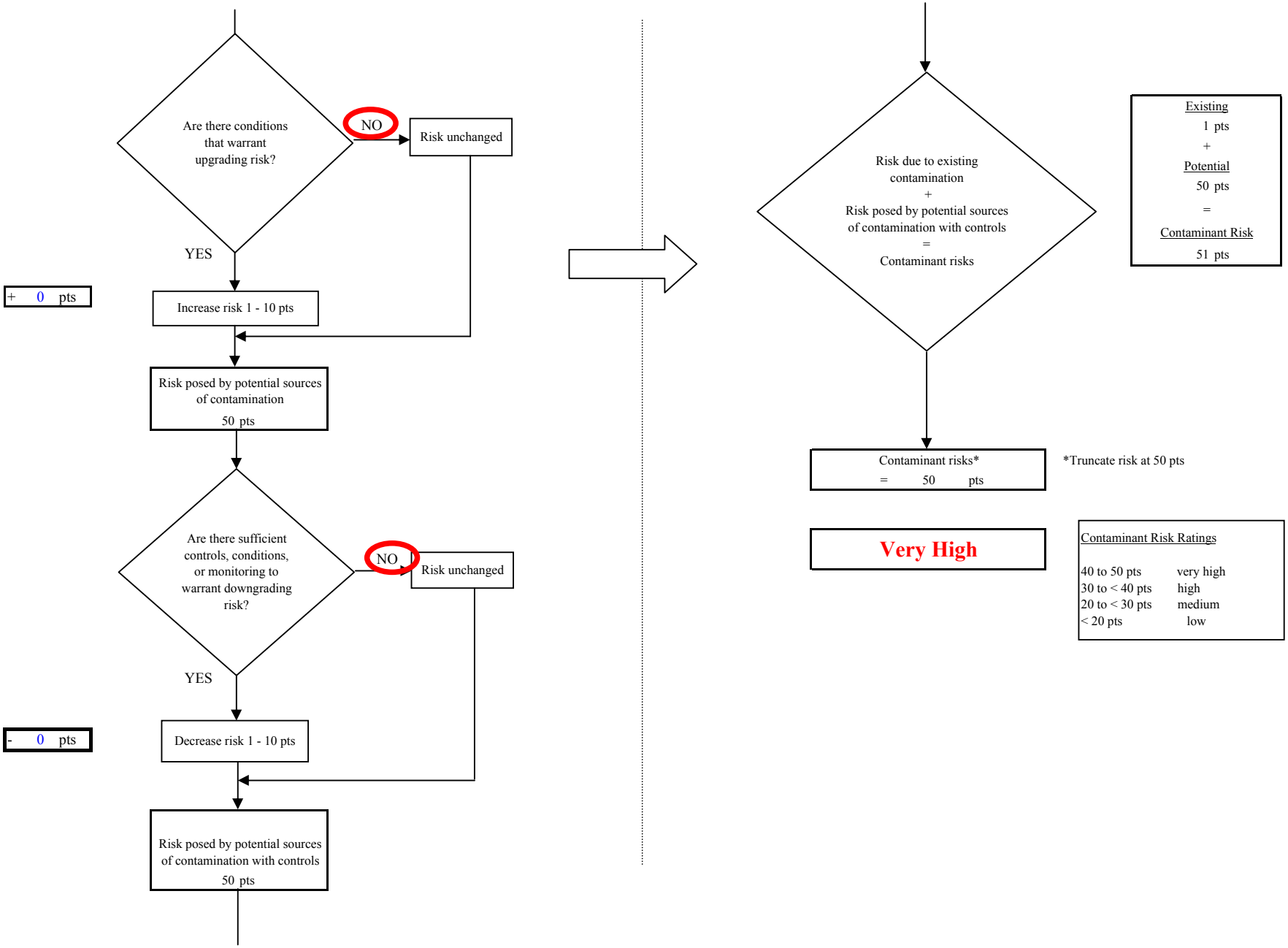


Chart 10. Vulnerability analysis for McGahan Utilities PWSID 241020.001 and 241020.002 - Heavy Metals, Cyanide and Other Inorganic Chemicals

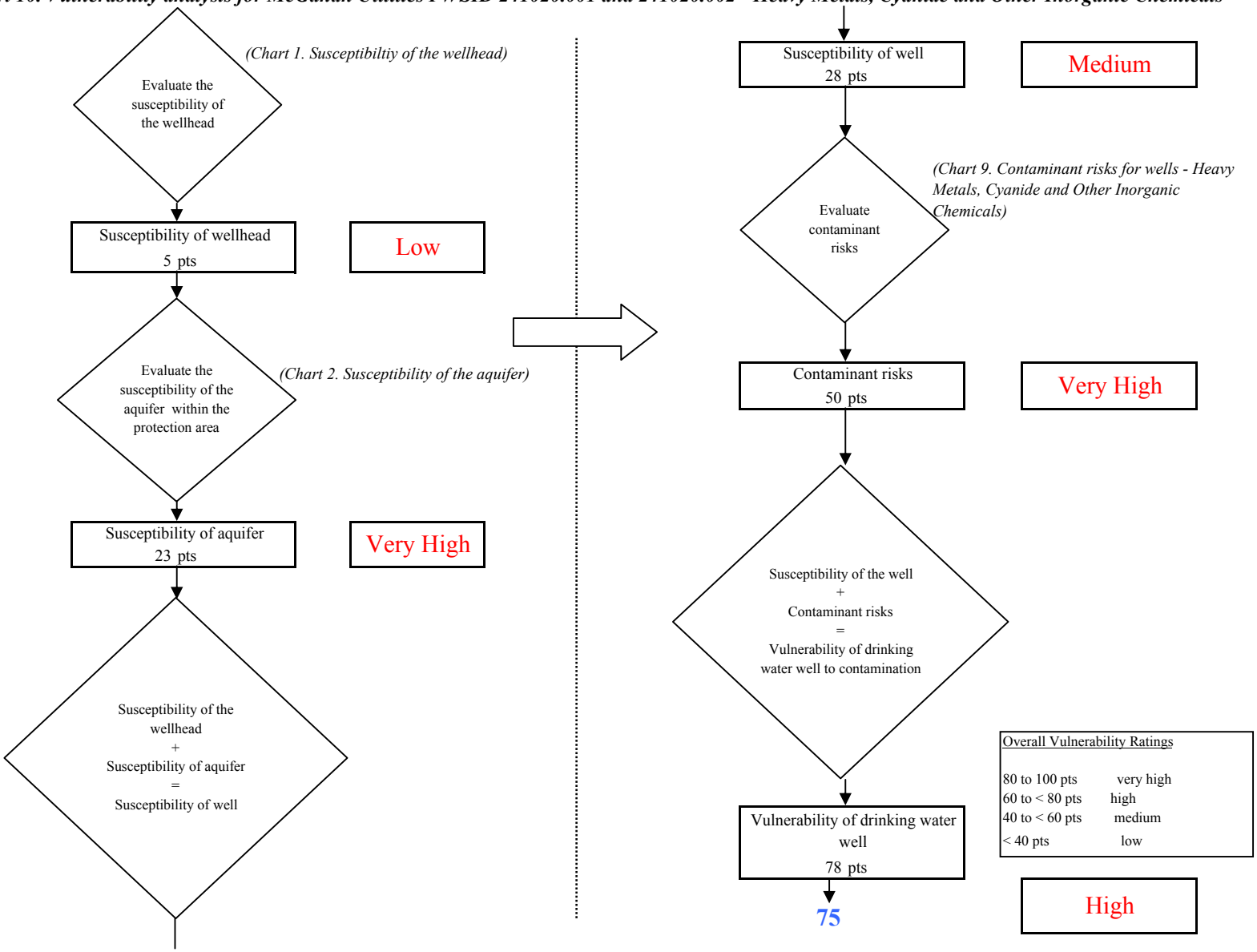


Chart 11. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Synthetic Organic Chemicals

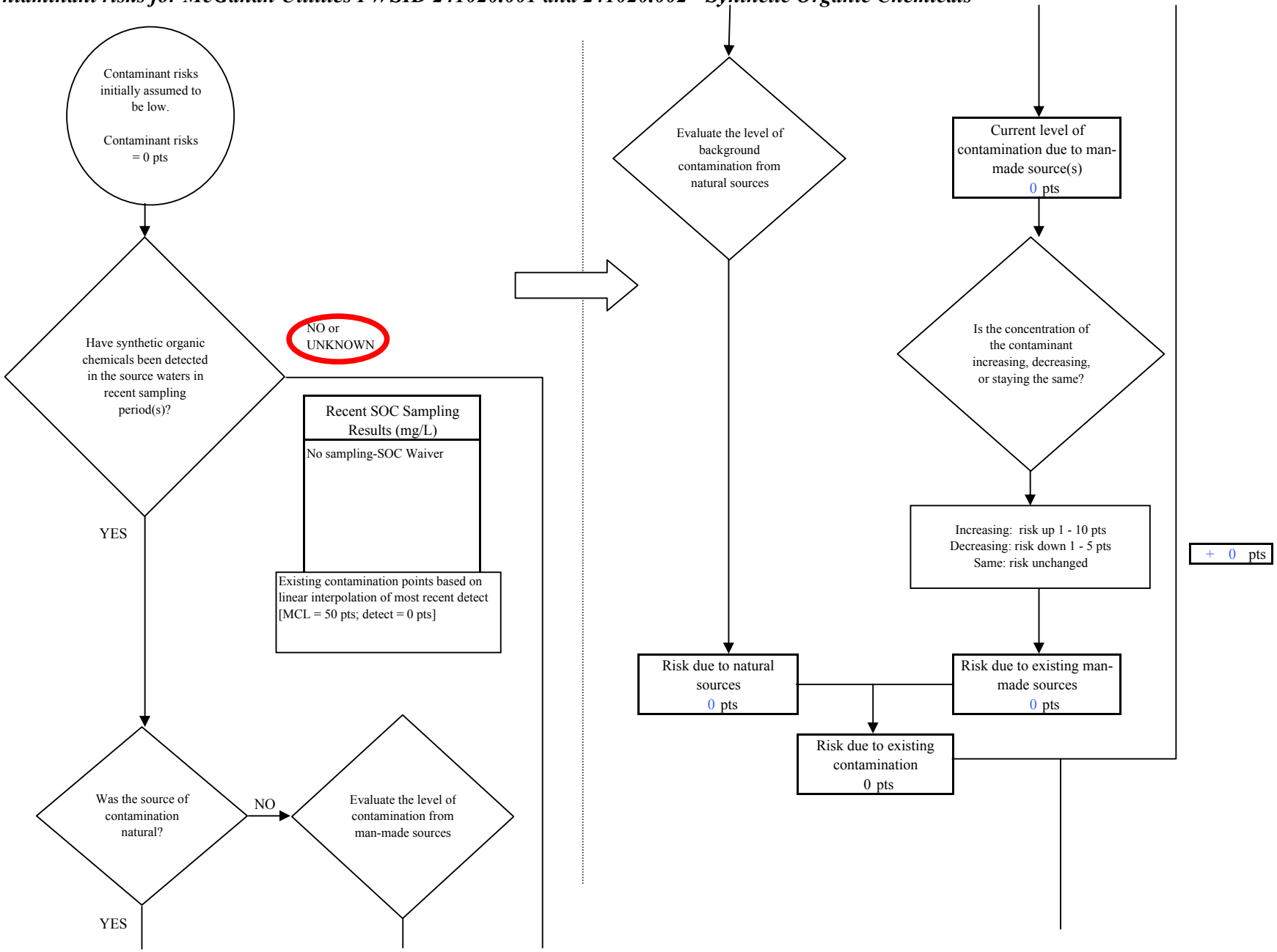


Chart 11. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Synthetic Organic Chemicals

+ 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)	0	0	0
Low(s)	21	2	23

	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 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 = 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 McGahan Utilities PWSID 241020.001 and 241020.002 - Synthetic Organic Chemicals

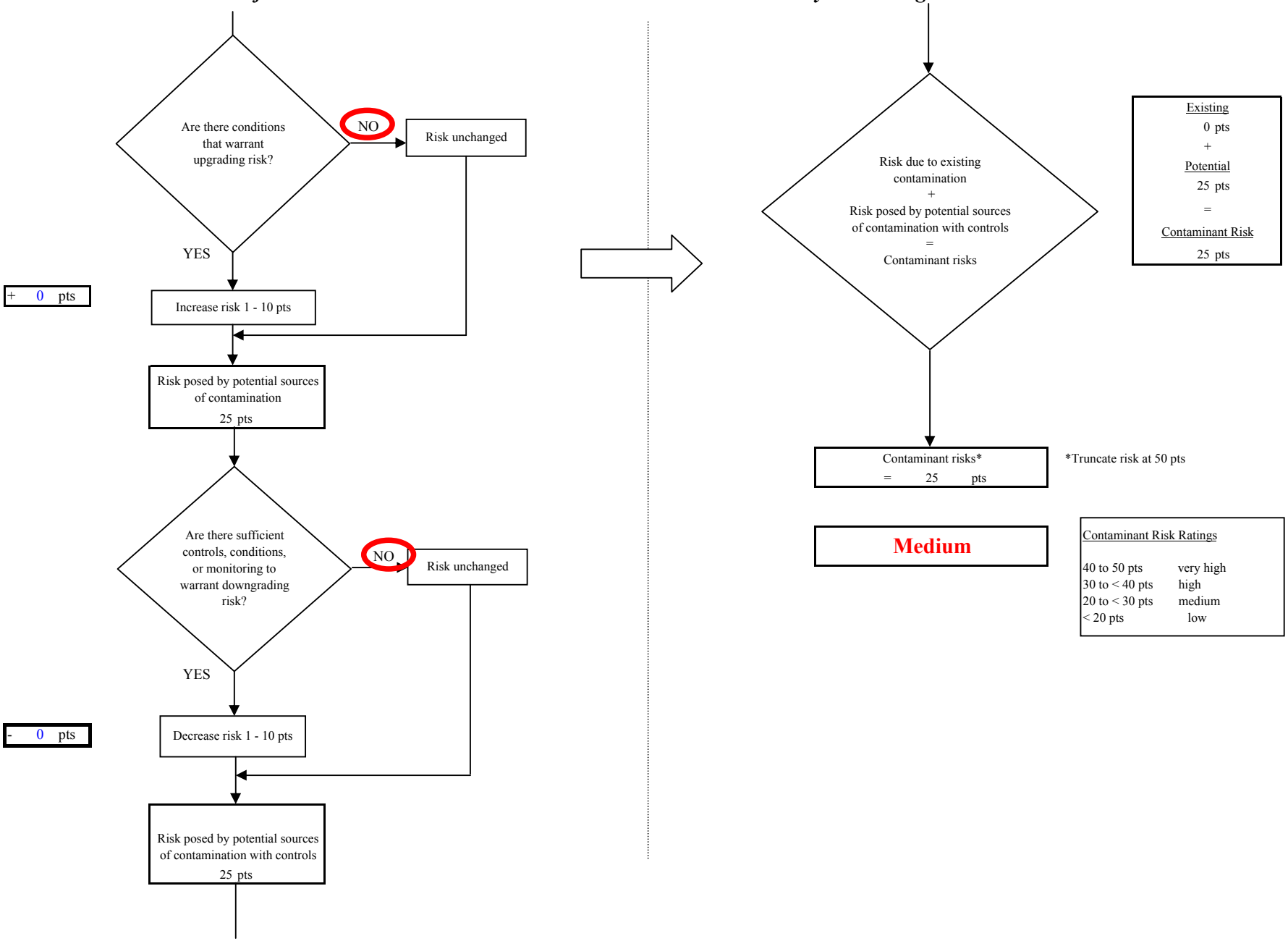


Chart 12. Vulnerability analysis for McGahan Utilities PWSID 241020.001 and 241020.002 - Synthetic Organic Chemicals

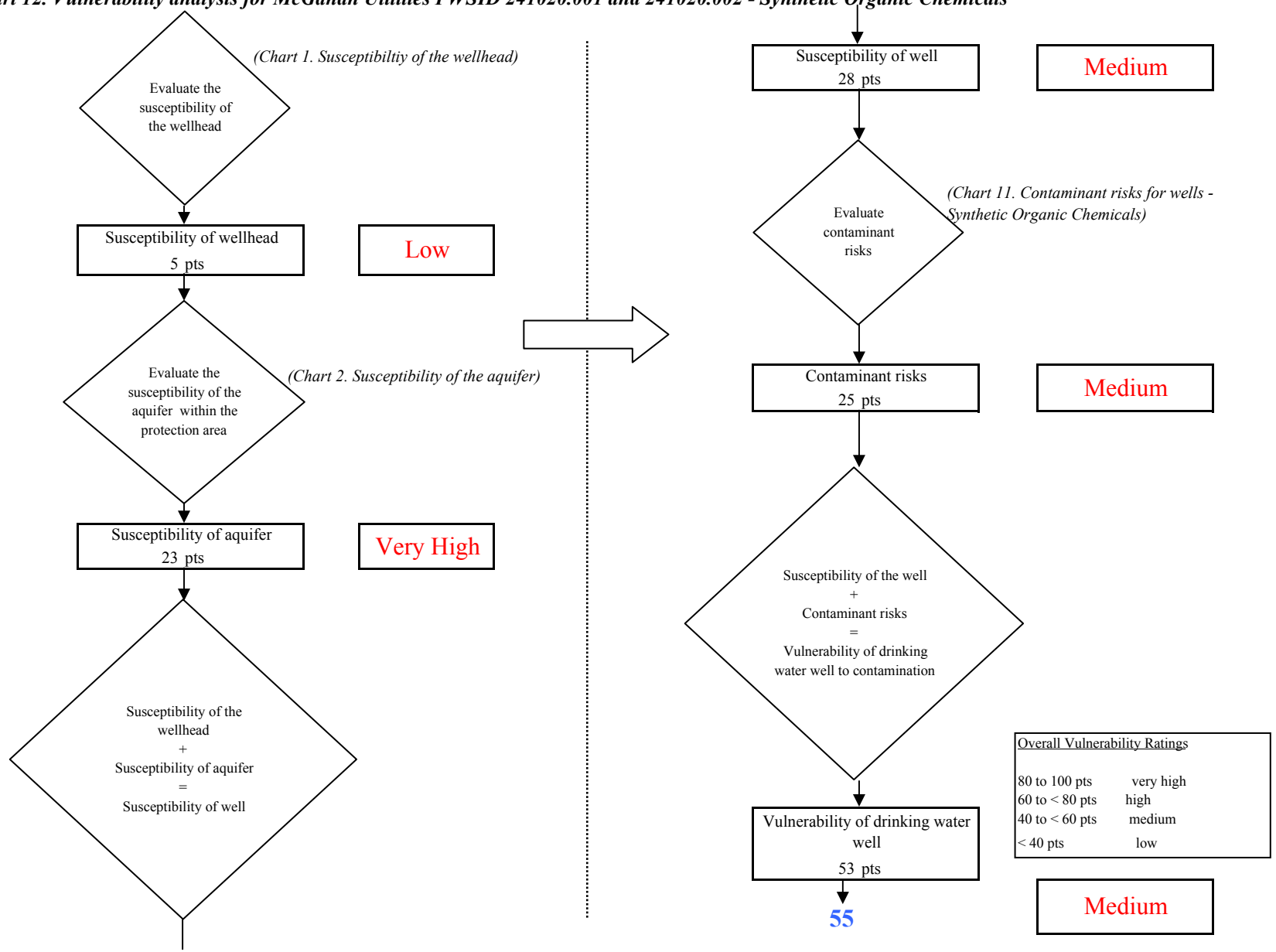


Chart 13. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Other Organic Chemicals

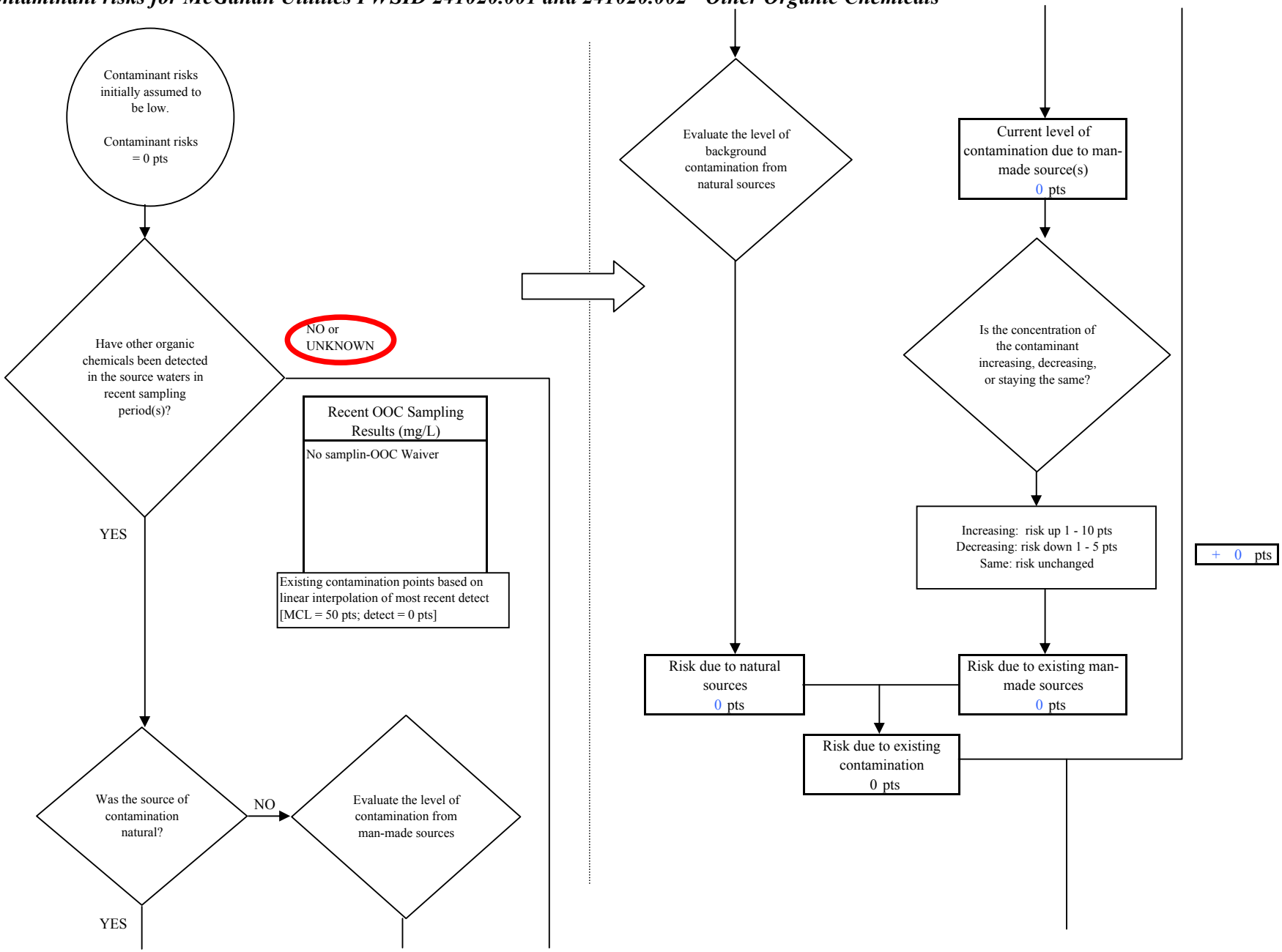


Chart 13. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Other Organic Chemicals

+ 25 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)	8	1	9
Low(s)	14	2	16

	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.

Initial assessment of risk posed by potential sources of contamination = 25 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

Chart 13. Contaminant risks for McGahan Utilities PWSID 241020.001 and 241020.002 - Other Organic Chemicals

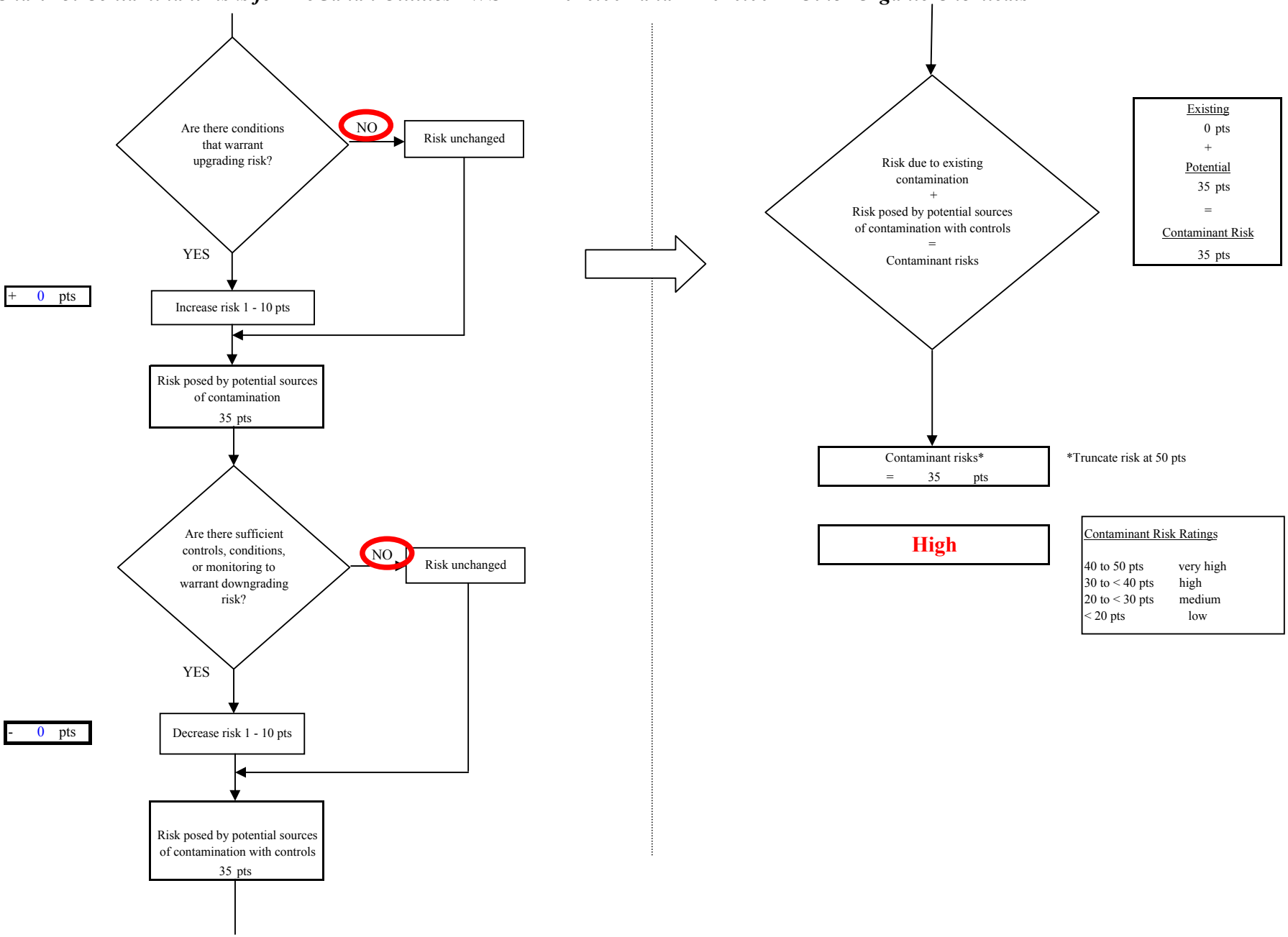


Chart 14. Vulnerability analysis for McGahan Utilities PWSID 241020.001 and 241020.002 - Other Organic Chemicals