Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Phillips Petroleum-Well No. 3 Drinking Water System, Nikiski area, Alaska PWSID 240969.001

December 2003

DRINKING WATER PROTECTION PROGRAM REPORT Report 1290
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.

CONTENTS

TABLES

APPENDICES

Source Water Assessment for Phillips Petroleum Source of Public Drinking Water, Nikiski area, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Phillips Petroleum is a Class A (non-transient/non-community) water system consisting of two wells. This report looks at The Phillips Petroleum-Well No. 3. The well is located off of the Kenai Spur Highway. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Low**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the Phillips Petroleum Well No. 3 include: roads and petroleum bulk stations. 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 source for the Phillips Petroleum received a vulnerability rating of **Low** for bacteria and viruses, nitrates and nitrites and synthetic organic chemicals, **Medium** for volatile organic chemicals and other organic chemicals and **High** for inorganic chemicals

PHILLIPS PETROLEUM PUBLIC DRINKING WATER SYSTEM

The Phillips Petroleum public water system (PWS) is a Class A (non-transient/non-community) water system. The system consists of two wells Well No. 3 and No. 4. This report assesses Well No. 3. Refer to Report No. 1291 for the assessment of Well No. 4. The Phillips Petroleum Well No. 3 is located off of the Kenai Spur Highway. (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. Nikiski 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.

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 Phillips Petroleum 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.

According to the SOC/OOC Waiver (1/20/98) the depth of the well is 308 feet below ground surface (bgs). Well logs indicate that a 28 foot clay confining layer exists. The well log indicates that the well is completed in an artesian aquifer.

The Sanitary Survey indicates that the well is properly sealed. A properly installed sanitary seal may provide protection against contaminant from entering the source waters at the casing. The well is not located in a floodplain and the surface is sloped away from the wellhead. Since the well was drilled in 1969, prior to grouting regulations it is assumed that the well is not 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 14 residents, 38 non-residents through 3 service connections.
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PHILLIPS PETROLEUM 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 Phillips Petroleum. 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 Phillips Petroleum 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 Phillips Petroleum 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 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals/cyanide/other inorganic chemicals, synthetic organic chemicals and other organic chemical

VULNERABILITY OF PHILLIPS PETROLEUM 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 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals/cyanide/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

Phillips Petroleum-Well No. 3 is completed in a confined aquifer setting. Studies in the area indicate the well penetrates numerous confining layers and is completed in the lower confined aquifer. The 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 Phillips Petroleum.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	7	Low
Natural Susceptibility	12	Low

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	12	Low
Nitrates and/or Nitrites	15	Low
Volatile Organic Chemicals	42	Very High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	High
Synthetic Organic Chemicals	10	Low
Other Organic Chemicals	32	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	25	Low
Nitrates and Nitrites	25	Low
Volatile Organic Chemicals	55	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	60	High
Synthetic Organic Chemicals	20	Low
Other Organic Chemicals	45	Medium

Bacteria and Viruses

Roads represent the greatest risk for bacteria and viruses to this 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 low**.**

Nitrates and Nitrites

Roads represent the greatest risk 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 Nikiski Trailer Court well indicates that nitrate concentrations have ranged from 2.51 milligrams per liter (mg/L) in 1999 to being non-detect in 2003. The reported nitrate concentrations suggest that the nitrate concentrations are 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 nitrate concentration from the most recent detect is 17% (1.71 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 low.

Volatile Organic Chemicals

Petroleum bulk storage and roads 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.

Volatile Organic Chemicals have not been detected within source waters. 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 medium.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

Petroleum bulk storage and roads present the greatest risk for inorganic chemicals to the well.

Samplings of inorganic chemicals have detected barium, at levels below the maximum contaminant levels (MCLs). Also, arsenic was detected at levels exceeding the MCL of 0.010 mg/l. Further sampling of additional wells in the area indicates arsenic levels are naturally elevated. Prolonged exposure to levels exceeding the MCL can skin damage, problems with circulatory systems, and may create an increased risk of developing cancer (EPA, 2002).

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

The petroleum bulk storage represents the greatest risk for synthetic organic chemicals to the well.

Synthetic organic chemicals have not been sampled for in this water system.

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 low.

Other Organic Chemicals

Petroleum bulk storage and roads represents the greatest risk for other organic chemicals to the well.

Other organic chemicals have not been sampled for in this water system.

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

Source Water Assessments in the Nikiski area were jointly prepared by ADEC-Drinking Water Protection Program and URS Corporation. The Drinking Water Protection Program would like to thank URS Corporation for their efforts in researching the area.

APPENDIX A

Phillips Petroleum
Drinking Water Protection Area Location Map
(Map 1)

Map 1- Phillips Petroleum Drinking Water Protection Area

PWSID: 240969.001 and 240969.002

Alaska Department of Environmental Conservation

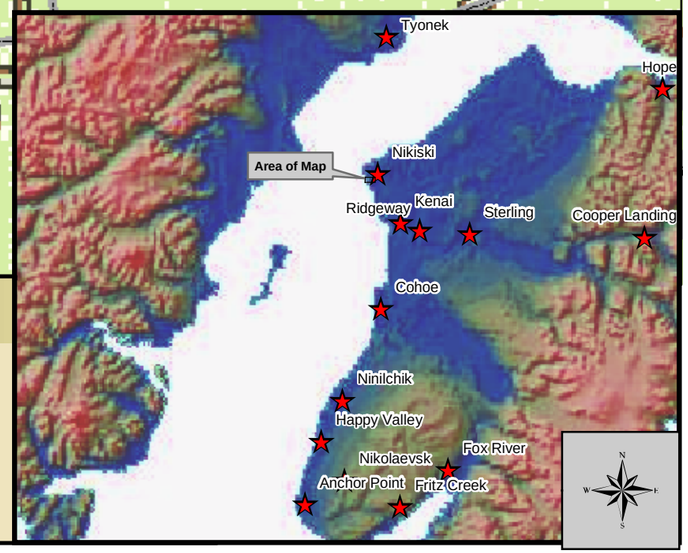
Alaska Drinking Water Protection Program

0 1,300 2,600 Feet 1:7,662

Data Sources:
Kenai Borough: Roads and parcels
USGS-63,360 topo map and hillshade
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



APPENDIX B

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

Table 1

Contaminant Source Inventory for

Phillips Pet Kenai LNG Plant

PWSID 240969.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	2	
Petroleum product bulk station/terminals	X11	X11-01	B	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-4	C	2	

Table 2

Contaminant Source Inventory and Risk Ranking for Phillips Pet Kenai LNG Plant Sources of Bacteria and Viruses

PWSID 240969.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	2	

Table 3

Contaminant Source Inventory and Risk Ranking for Phillips Pet Kenai LNG Plant Sources of Nitrates/Nitrites

PWSID 240969.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-4	C	Low	2	

Table 4

Contaminant Source Inventory and Risk Ranking for Phillips Pet Kenai LNG Plant Sources of Volatile Organic Chemicals

PWSID 240969.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	
Petroleum product bulk station/terminals	X11	X11-01	B	Very High	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-4	C	Low	2	

Table 5

Contaminant Source Inventory and Risk Ranking for Phillips Pet Kenai LNG Plant

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 240969.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	
Petroleum product bulk station/terminals	X11	X11-01	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-4	C	Low	2	

Table 6

Contaminant Source Inventory and Risk Ranking for Phillips Pet Kenai LNG Plant Sources of Synthetic Organic Chemicals

PWSID 240969.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Petroleum product bulk station/terminals	X11	X11-01	B	Low	2	

Table 7

Contaminant Source Inventory and Risk Ranking for Phillips Pet Kenai LNG Plant Sources of Other Organic Chemicals

PWSID 240969.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-1-2	A	Low	2	
Petroleum product bulk station/terminals	X11	X11-01	B	High	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-4	C	Low	2	

APPENDIX C

Phillips Petroleum
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

TESORO RD

STERNICE LAKE RD

ROSS POINT CT

TAIGA WAY

FOREST LN

KENA

X11-01

Area of Map

Map 2- Phillips Petroleum (Well No.3) Potential and Existing Source of Contamination

PWSID: 240969.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 250 500 1,000 1,500 Feet

Data Sources:
USGS- 1:63,360 Background
Microsoft Terraserver-aerial photo
Kenai Borough: Roads and parcels

Legend

- Class A Public Water System
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Zone D Protection Area
- Petroleum products bulk station/terminals (X11)
- Roads
- Rivers and Streams
- Water
- Parcels

N W E S

APPENDIX D

Vulnerability Analysis for Phillips Petroleum Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Phillips Petroleum (Well No.3) PWSID 240969.001

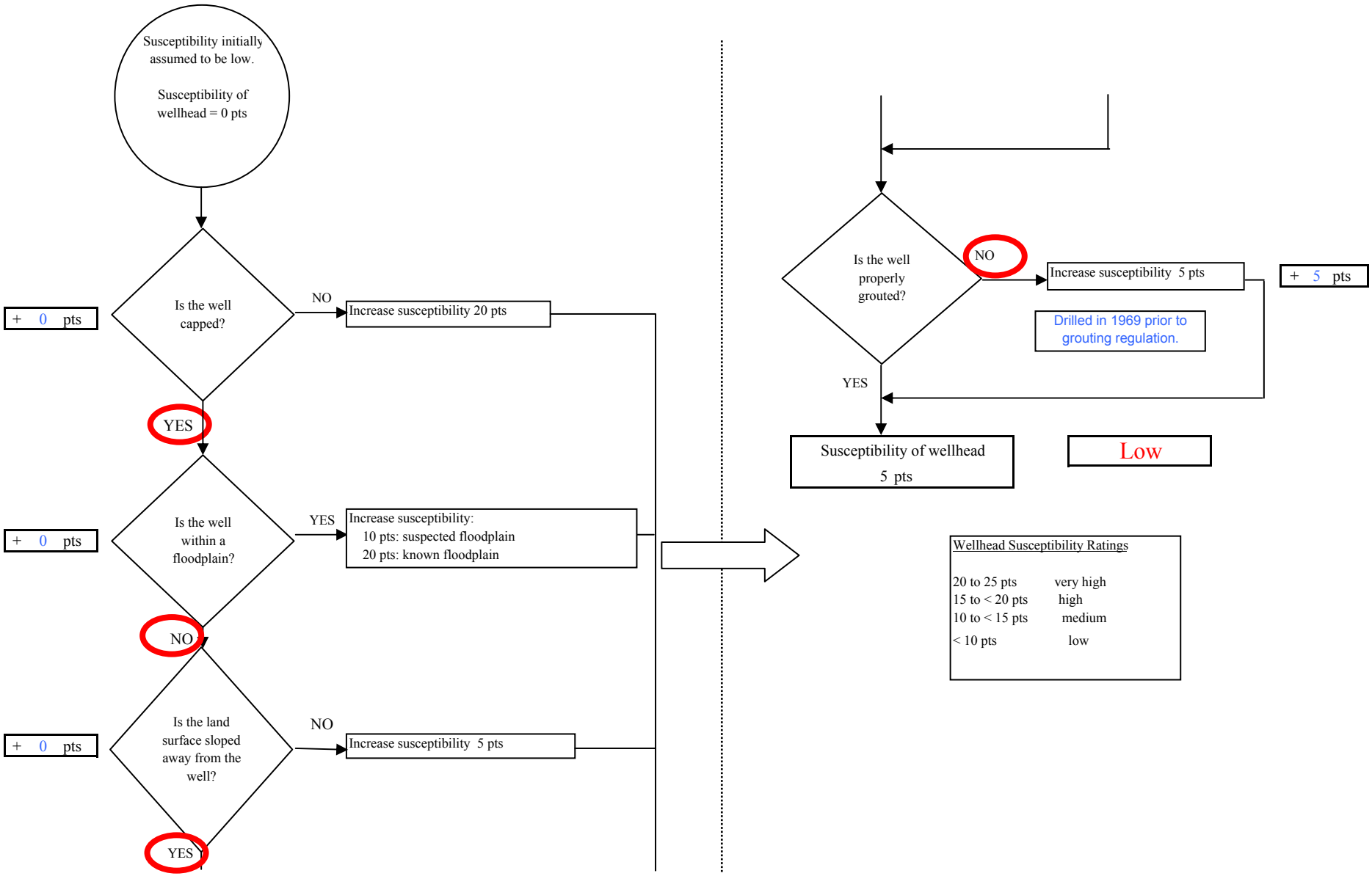


Chart 2. Susceptibility of the aquifer - Phillips Petroleum (Well No.3) PWSID 240969.001

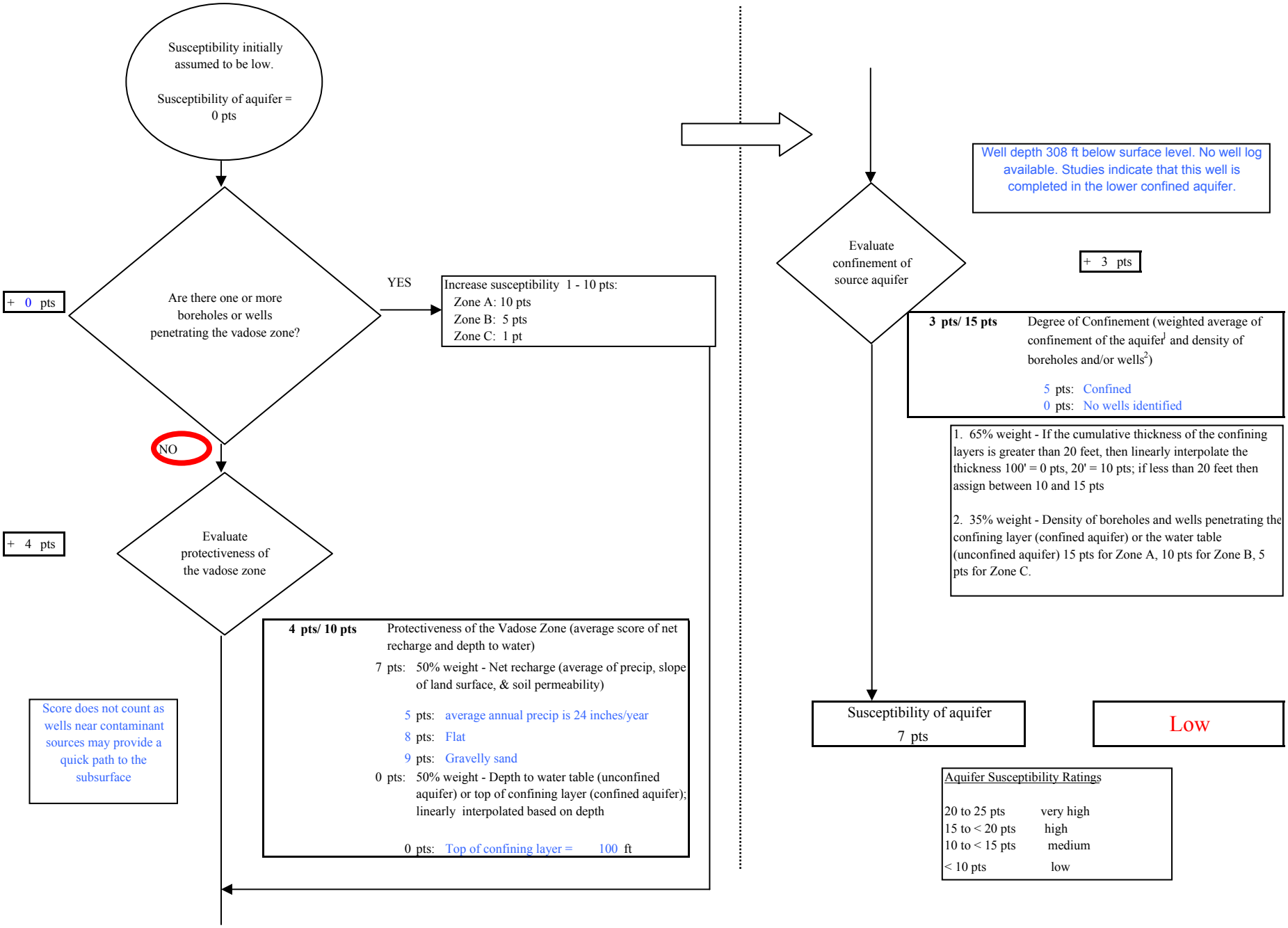
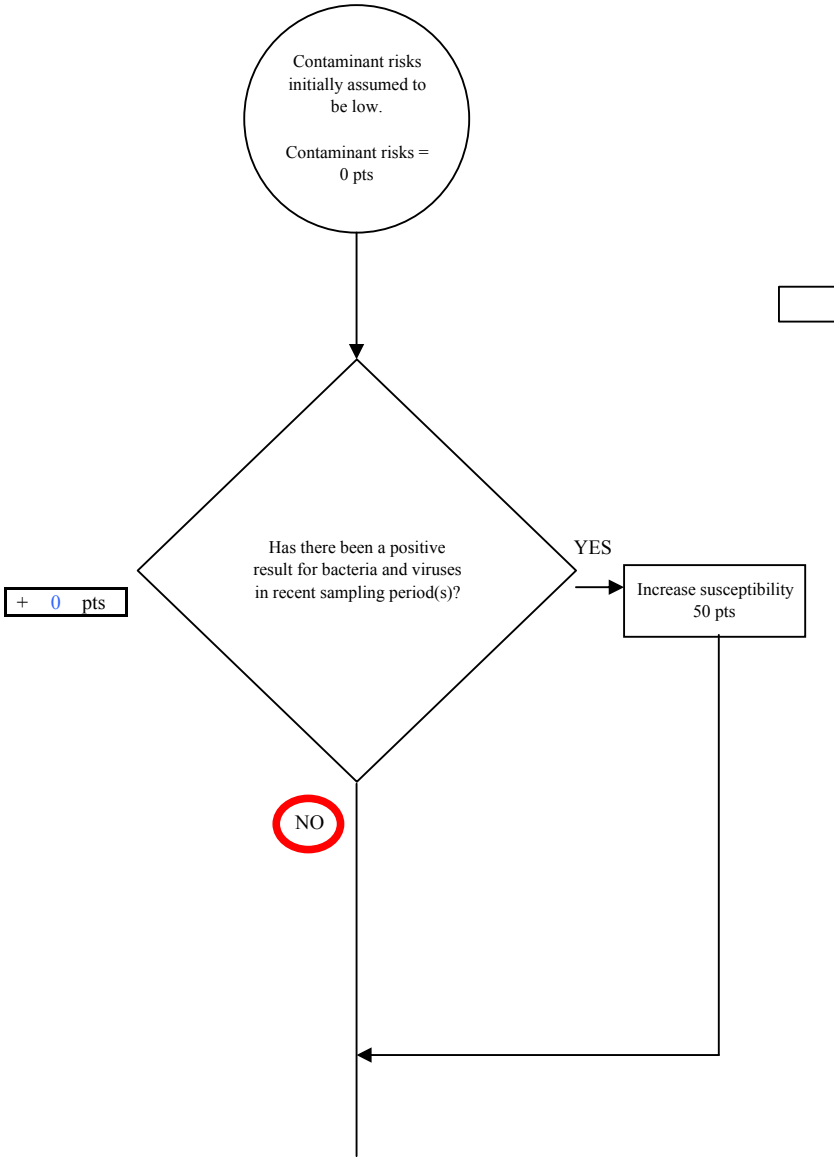
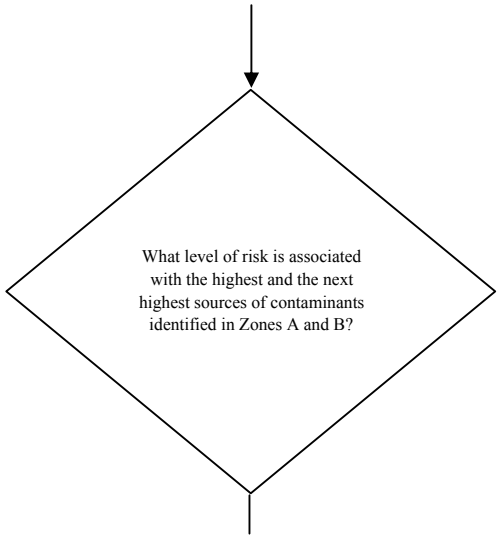


Chart 3. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Bacteria & Viruses





+ 10 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	1	1	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 10

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

Chart 3. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Bacteria & Viruses

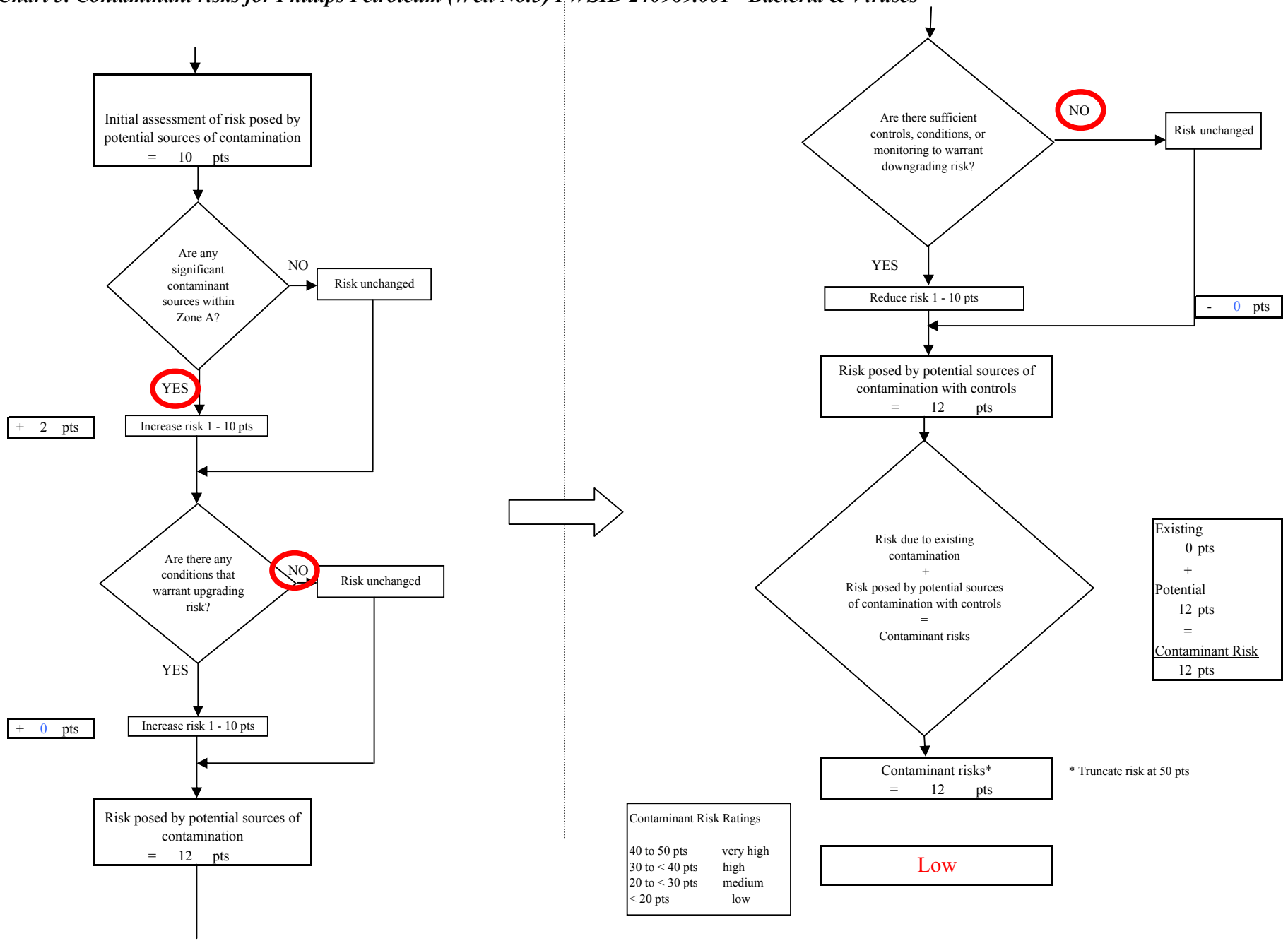


Chart 4. Vulnerability analysis for Phillips Petroleum (Well No.3) PWSID 240969.001 - Bacteria & Viruses

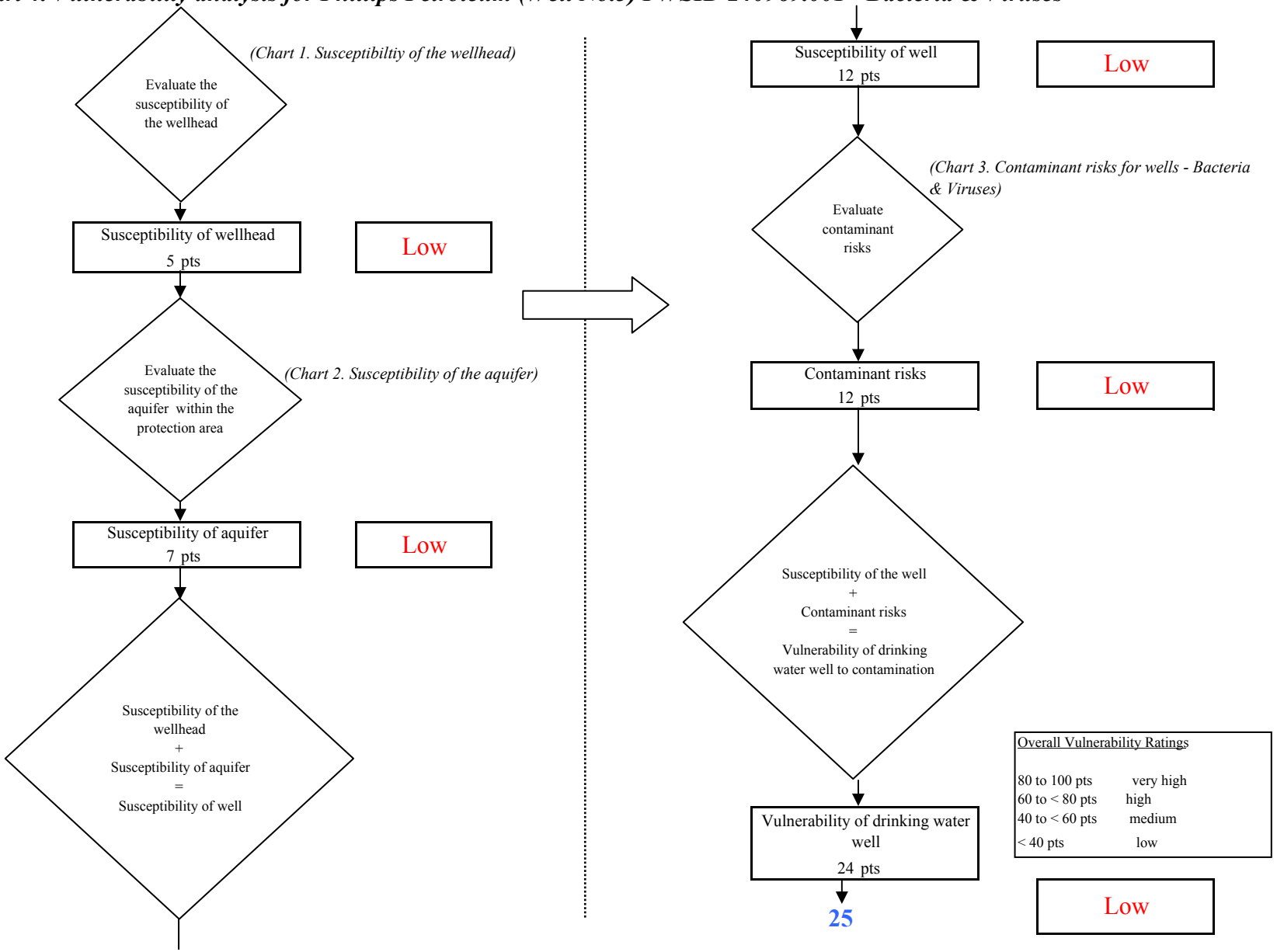


Chart 5. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Nitrates and Nitrites

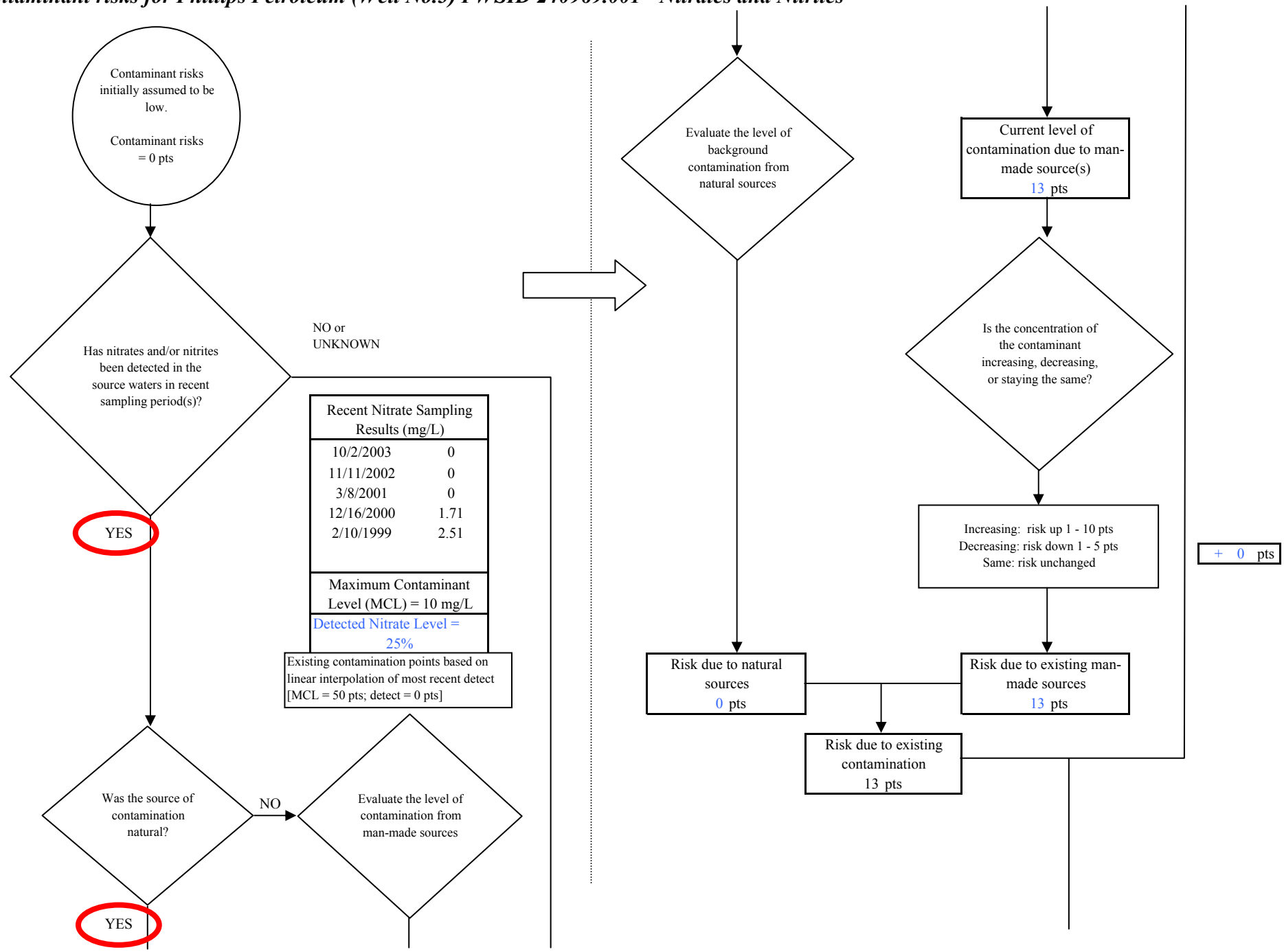
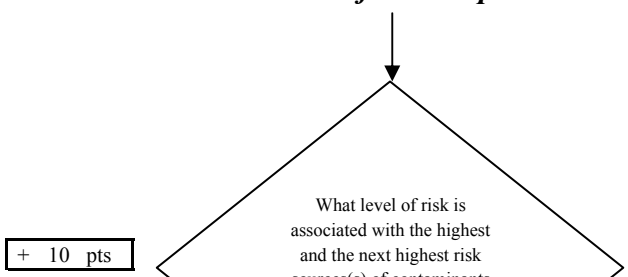


Chart 5. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Nitrates and Nitrites



+ 10 pts

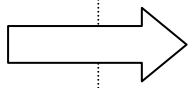
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	1	1	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 10

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



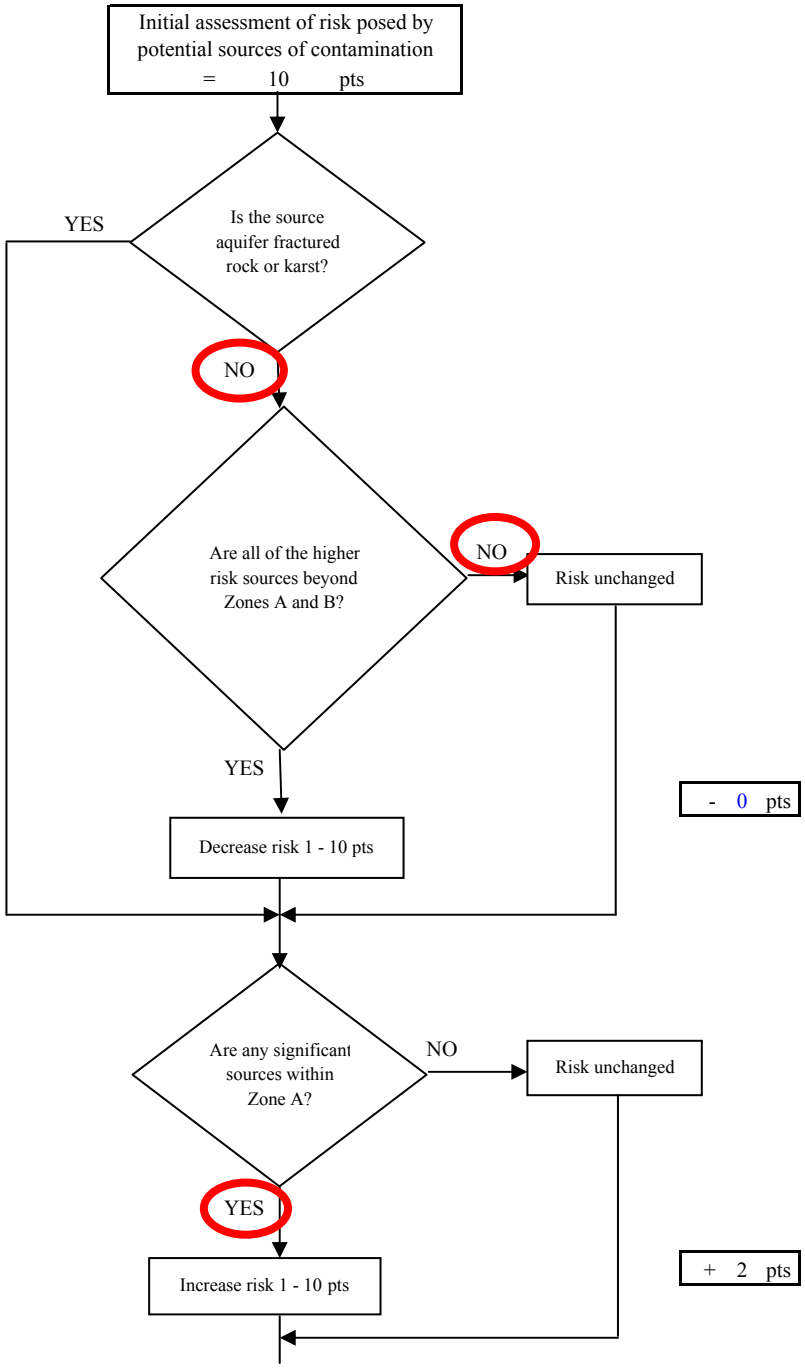


Chart 5. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Nitrates and Nitrites

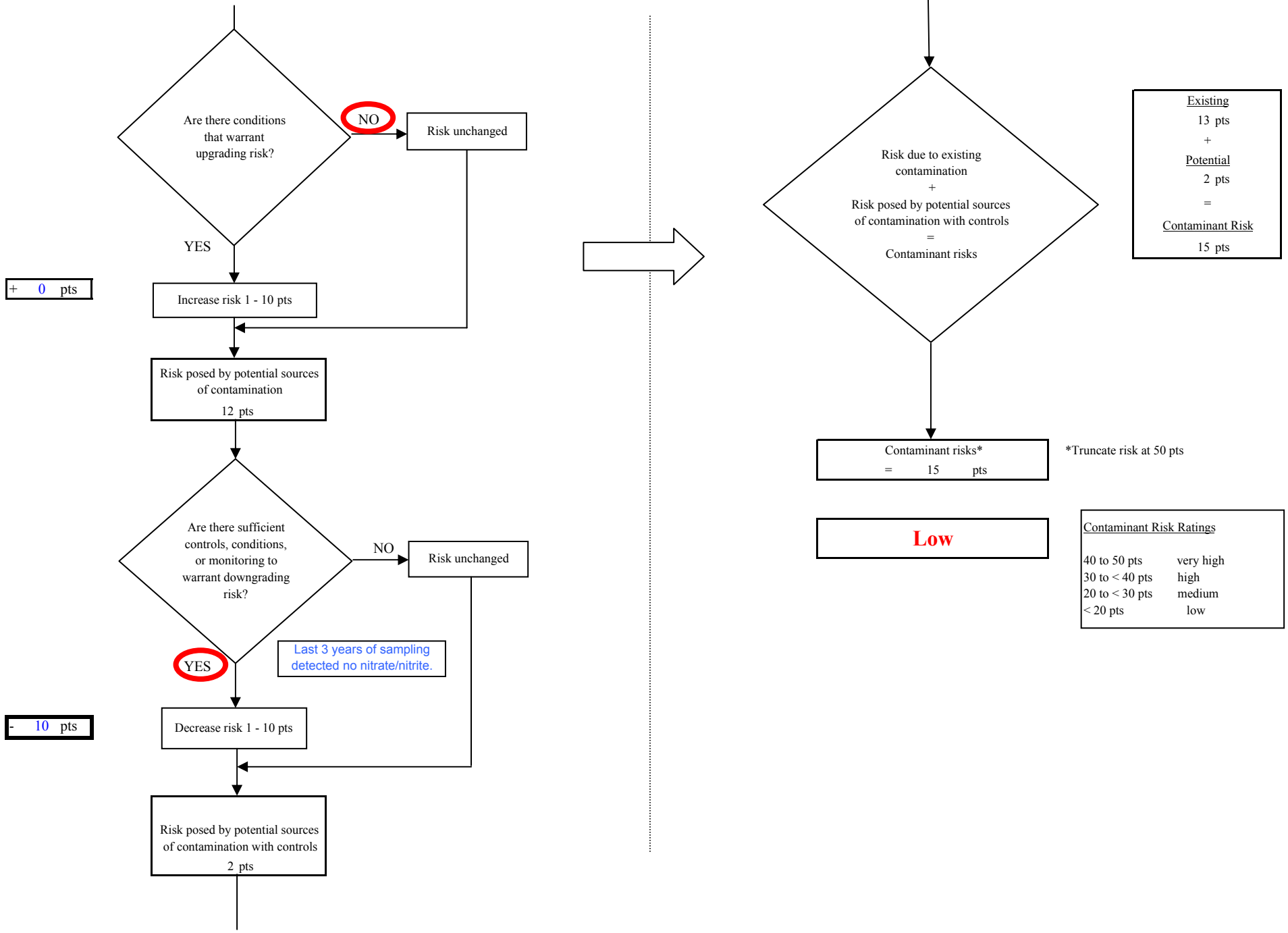


Chart 6. Vulnerability analysis for Phillips Petroleum (Well No.3) PWSID 240969.001 - Nitrates and Nitrites

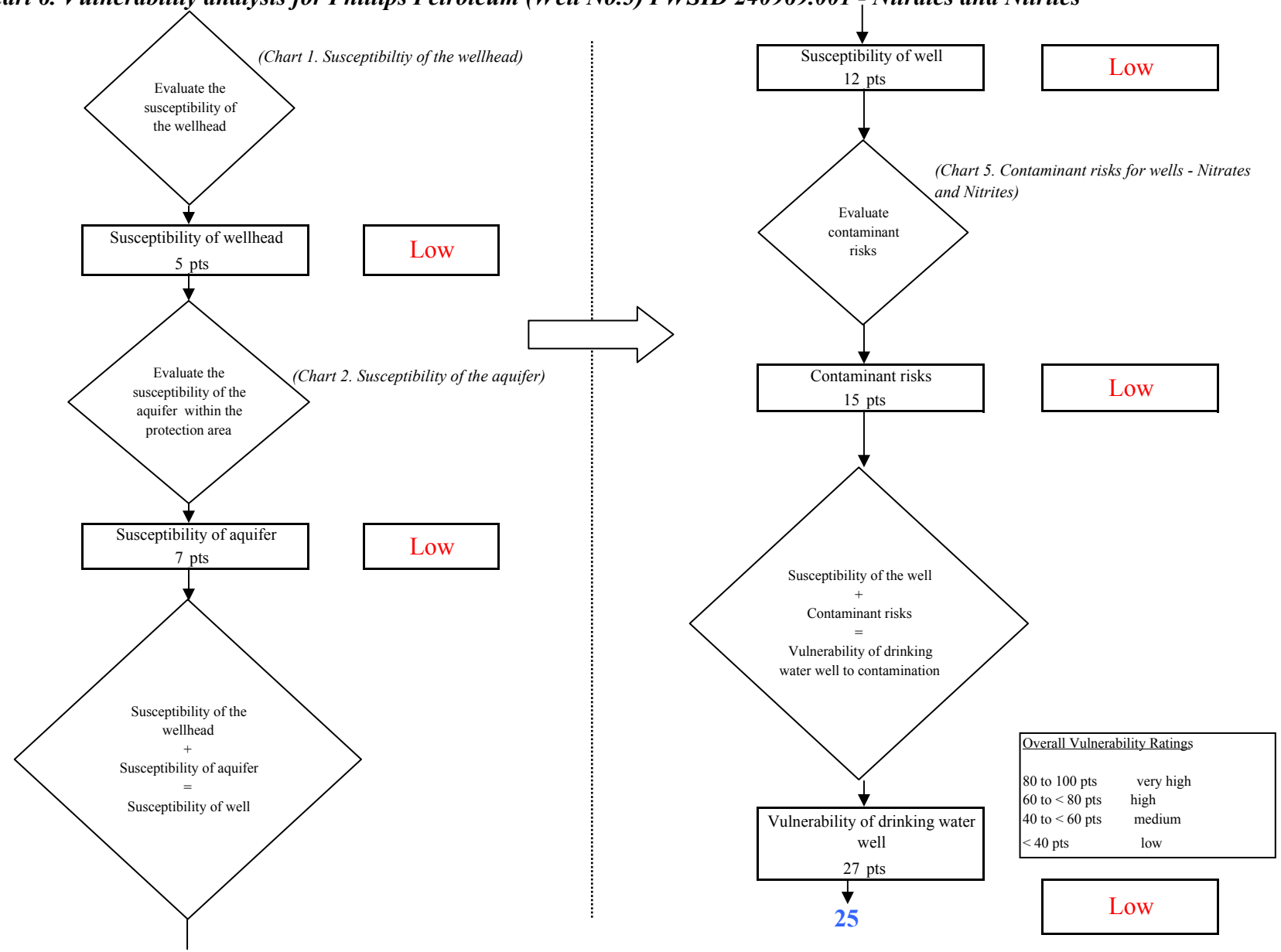


Chart 7. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Volatile Organic Chemicals

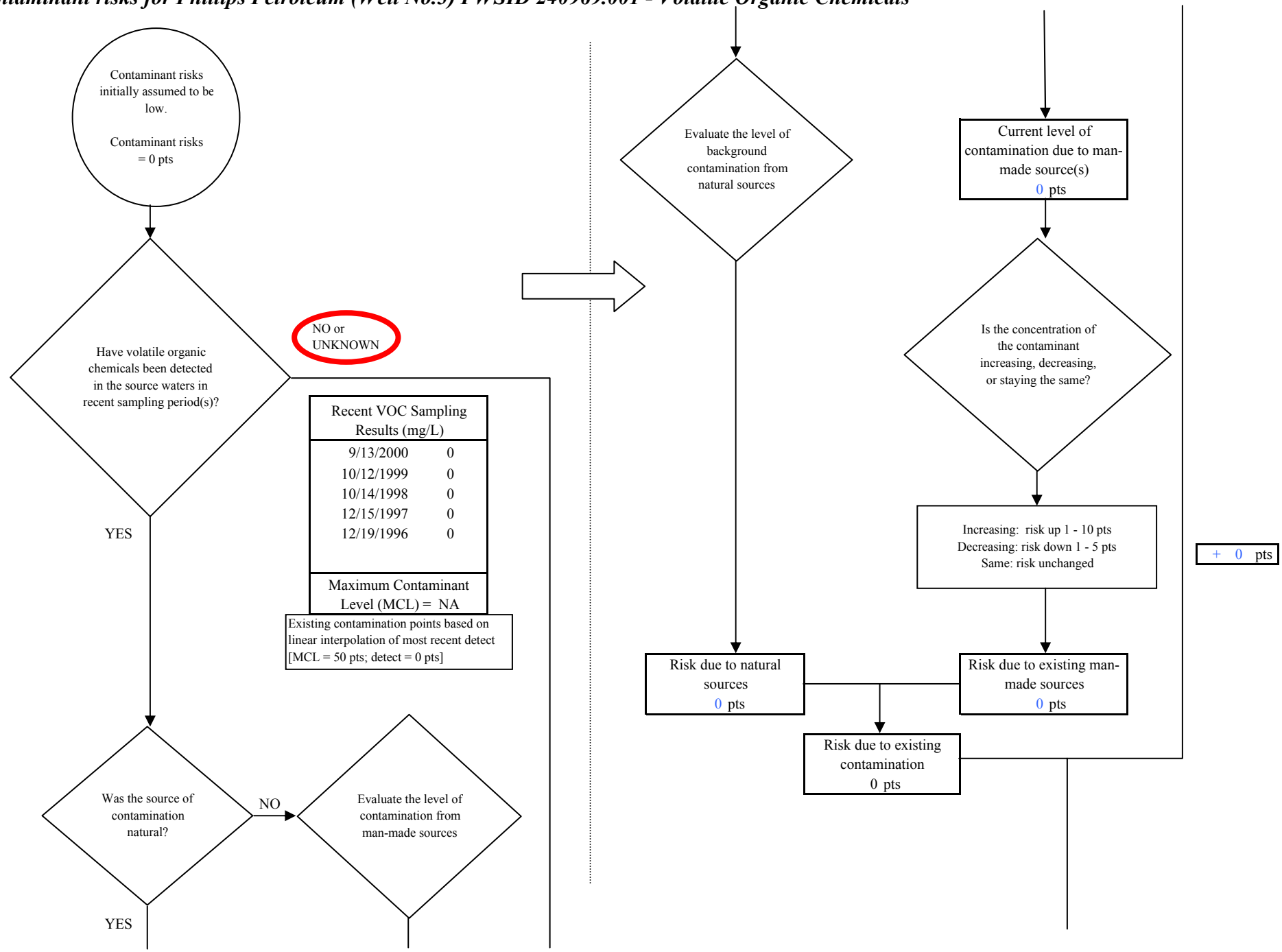


Chart 7. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Volatile Organic Chemicals

+ 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	1	1
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	1	1	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 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

+ 2 pts

Chart 7. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Volatile Organic Chemicals

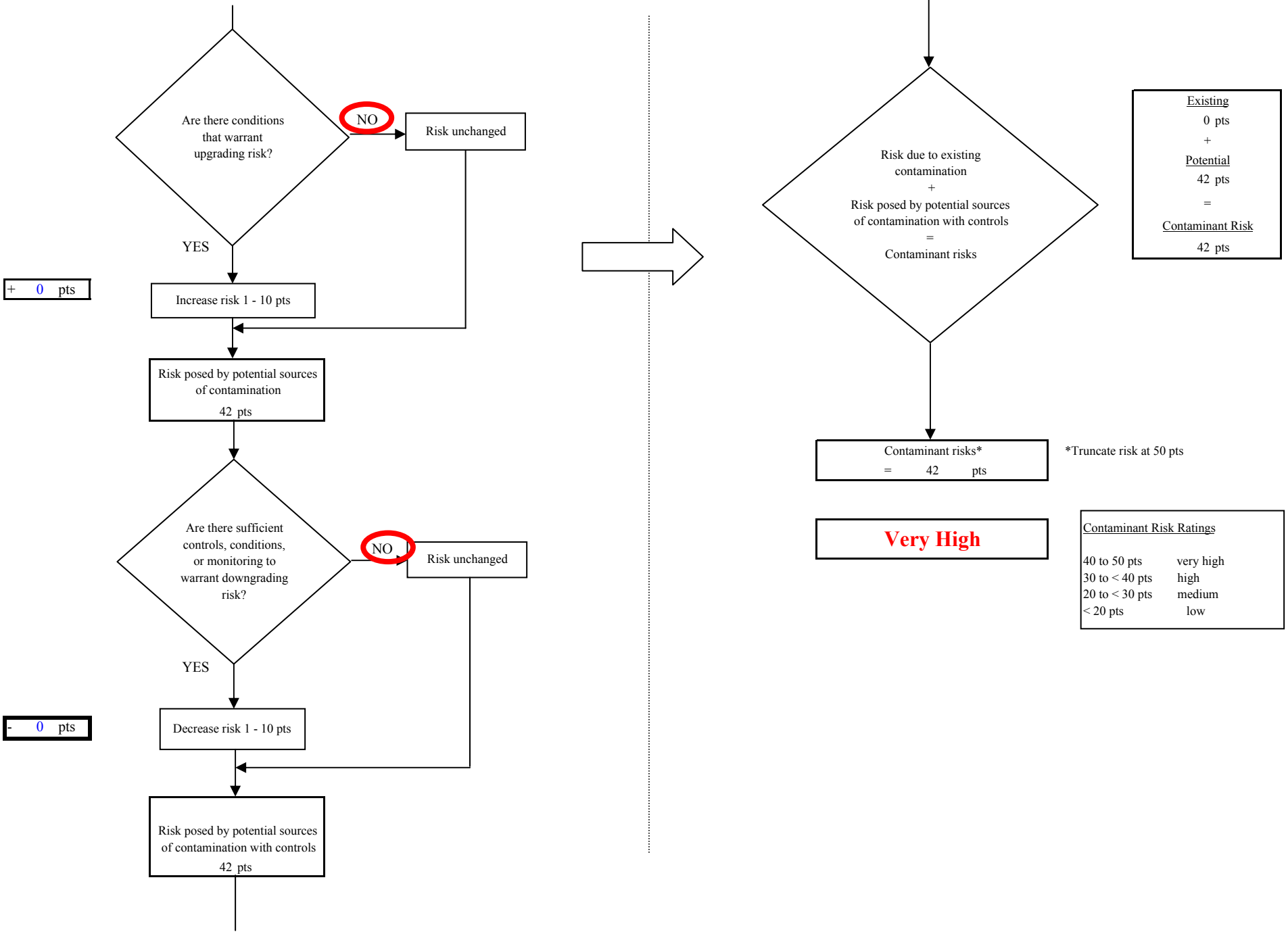


Chart 8. Vulnerability analysis for Phillips Petroleum (Well No.3) PWSID 240969.001 - Volatile Organic Chemicals

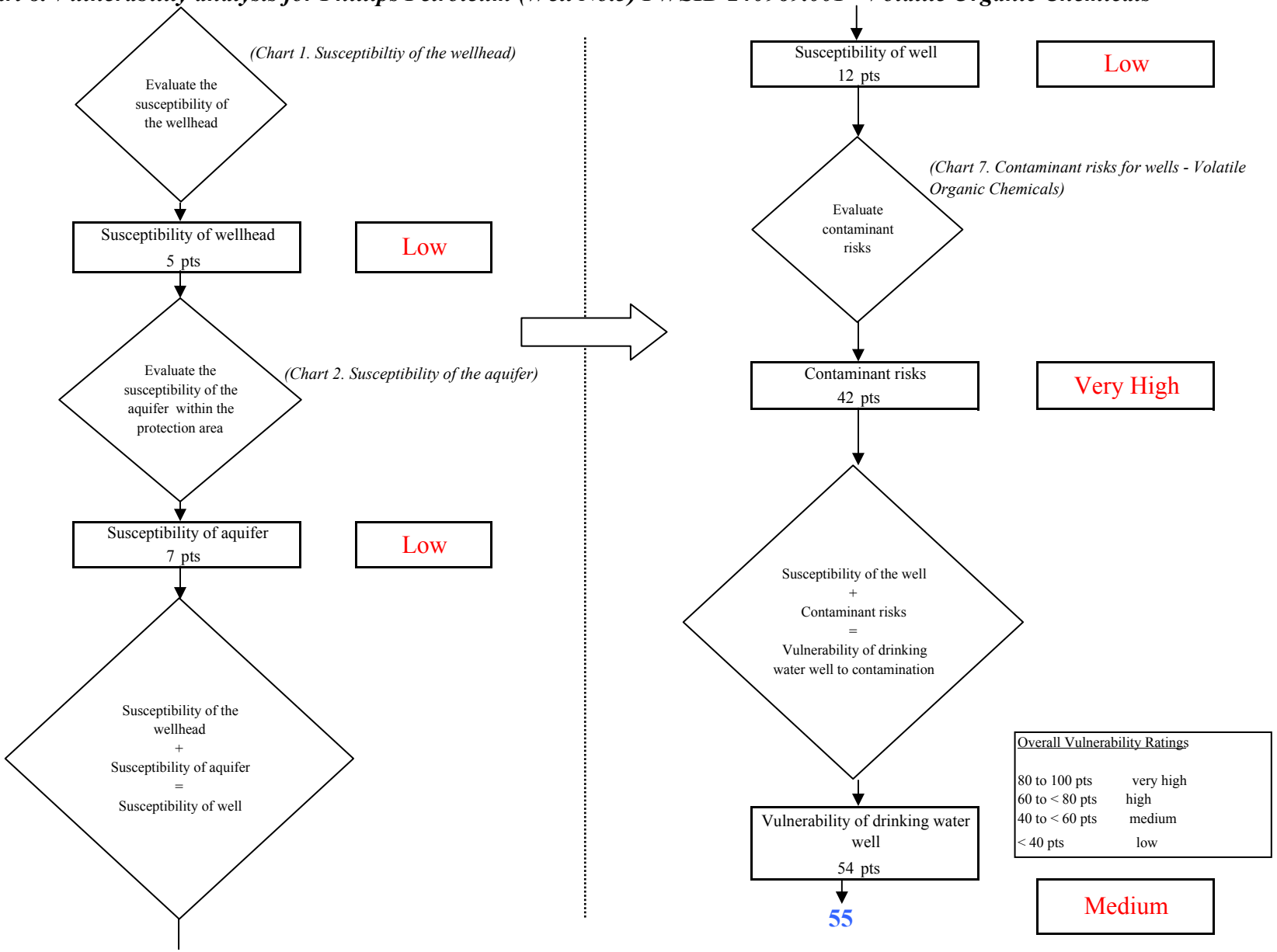


Chart 9. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

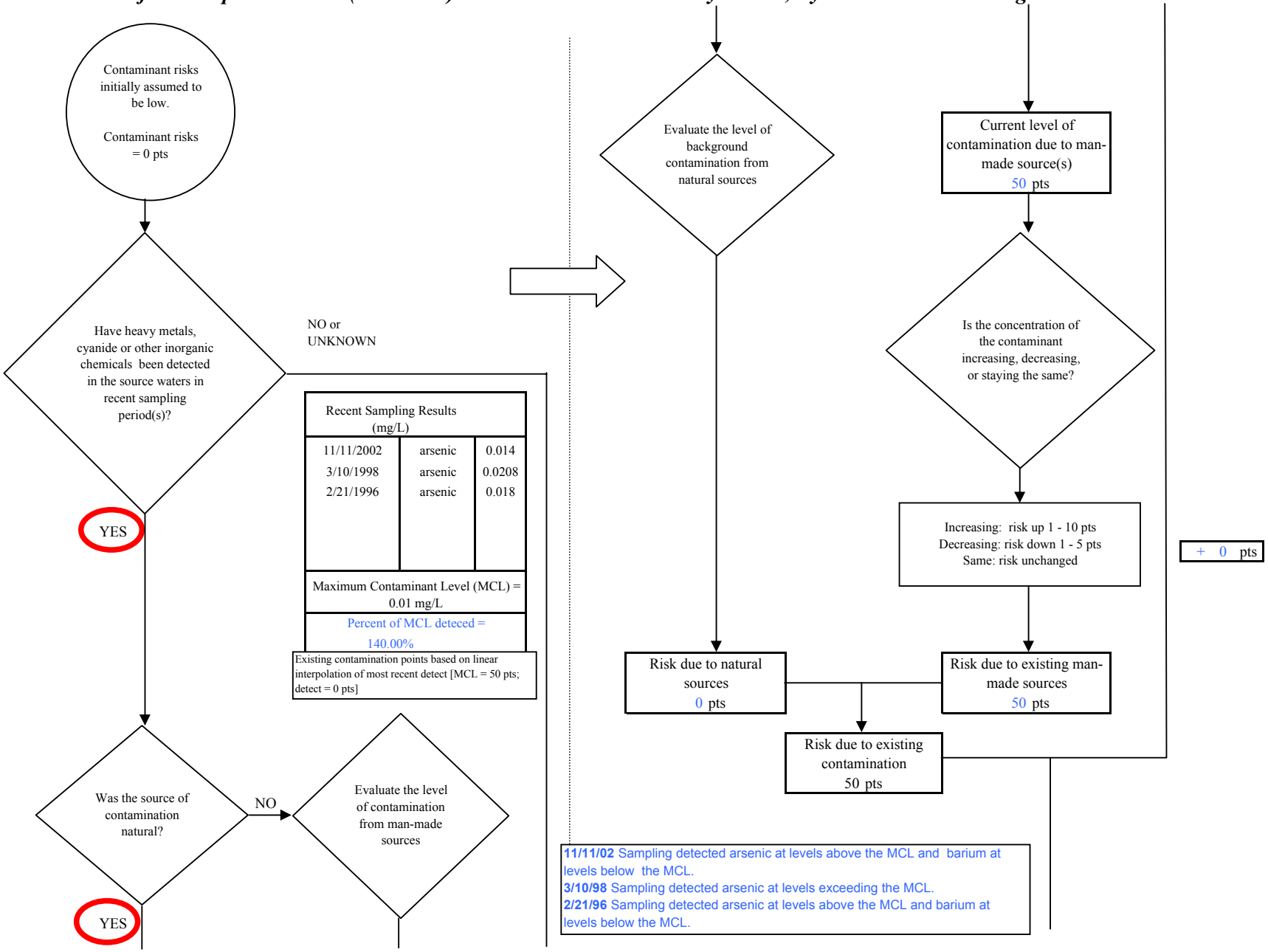
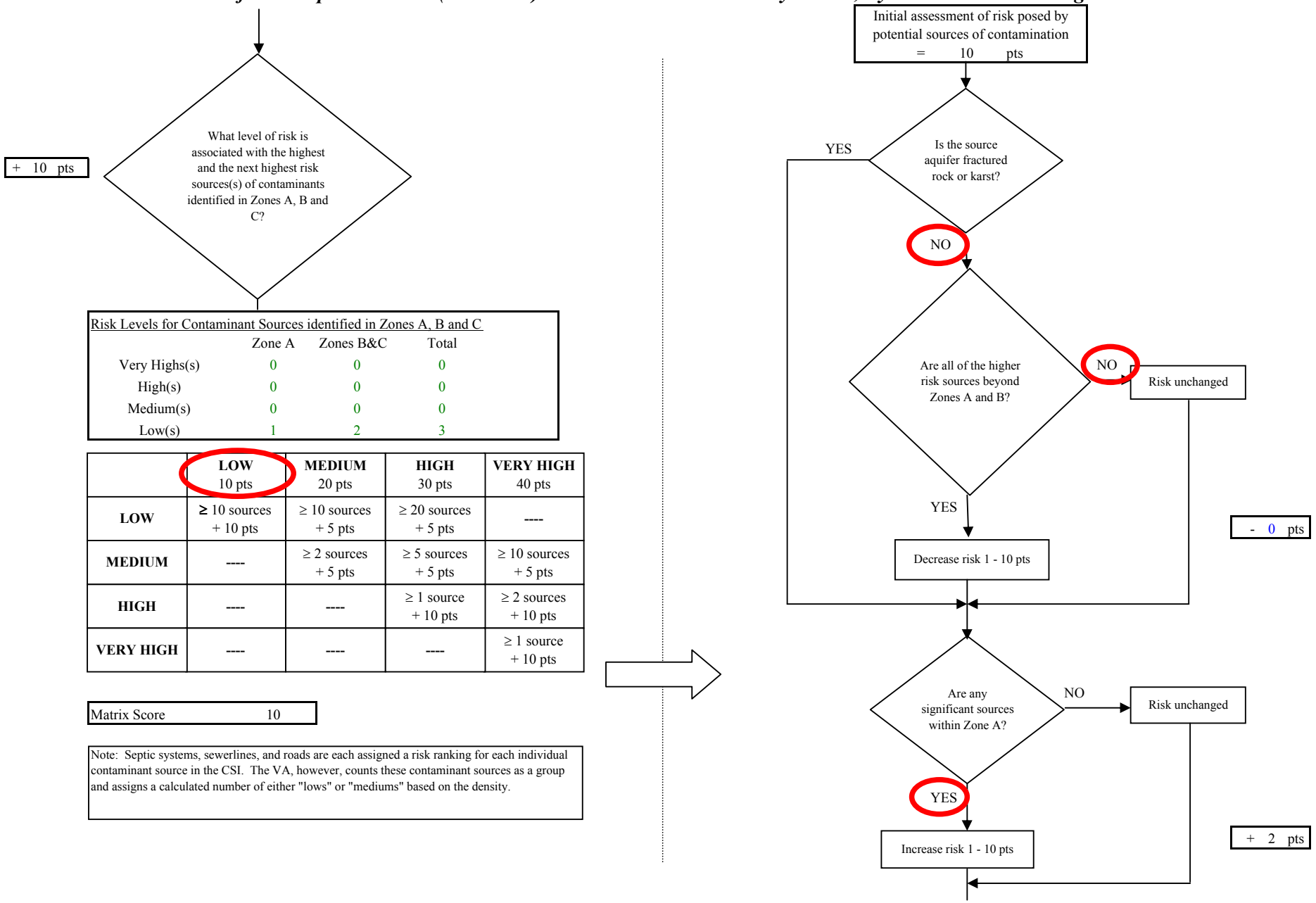


Chart 9. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals



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)	0	0	0
Medium(s)	0	0	0
Low(s)	1	2	3

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

Matrix Score 10

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

Chart 9. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

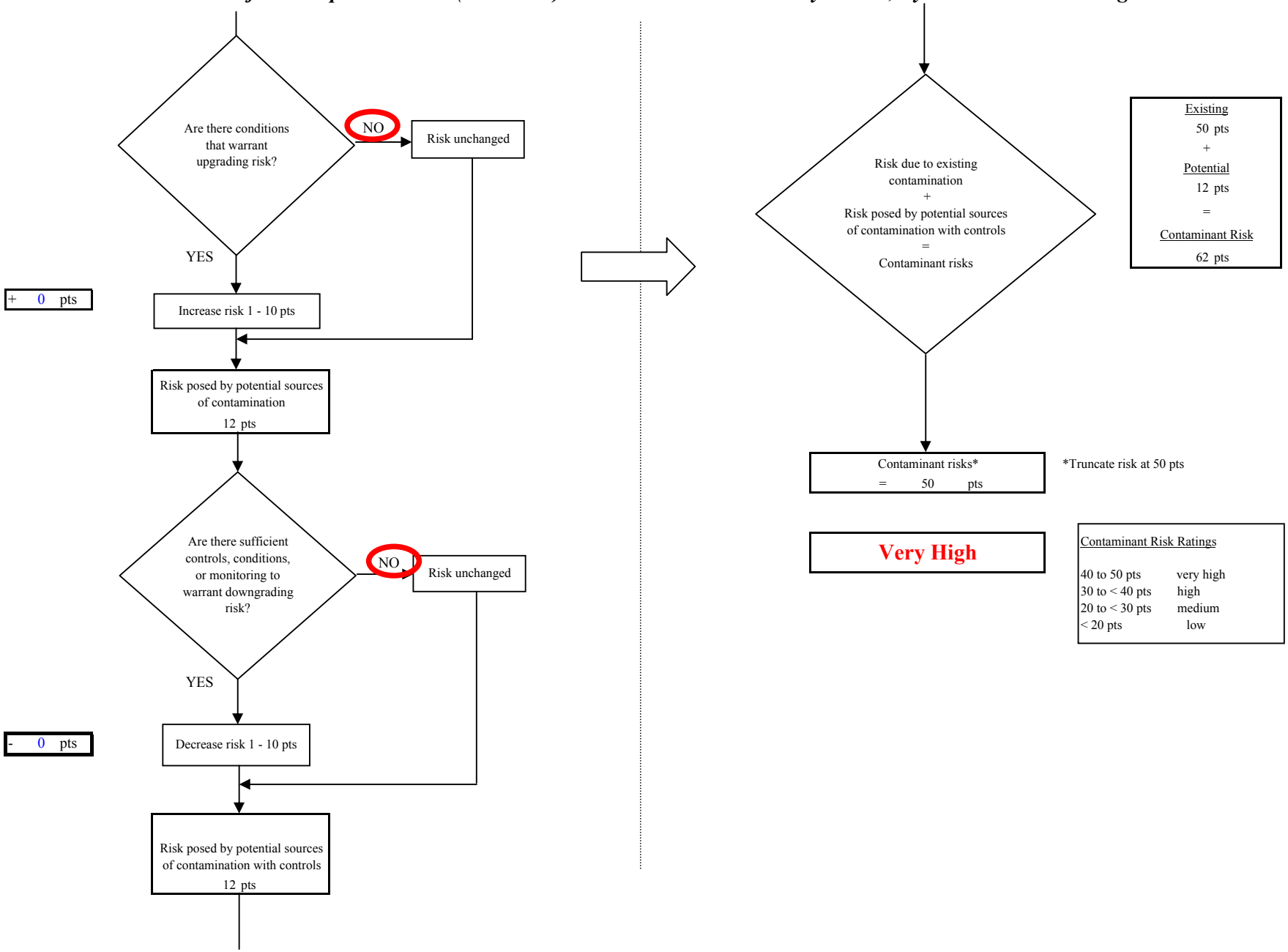


Chart 10. Vulnerability analysis for Phillips Petroleum (Well No.3) PWSID 240969.001 - Heavy Metals, Cyanide and Other Inorganic Chemicals

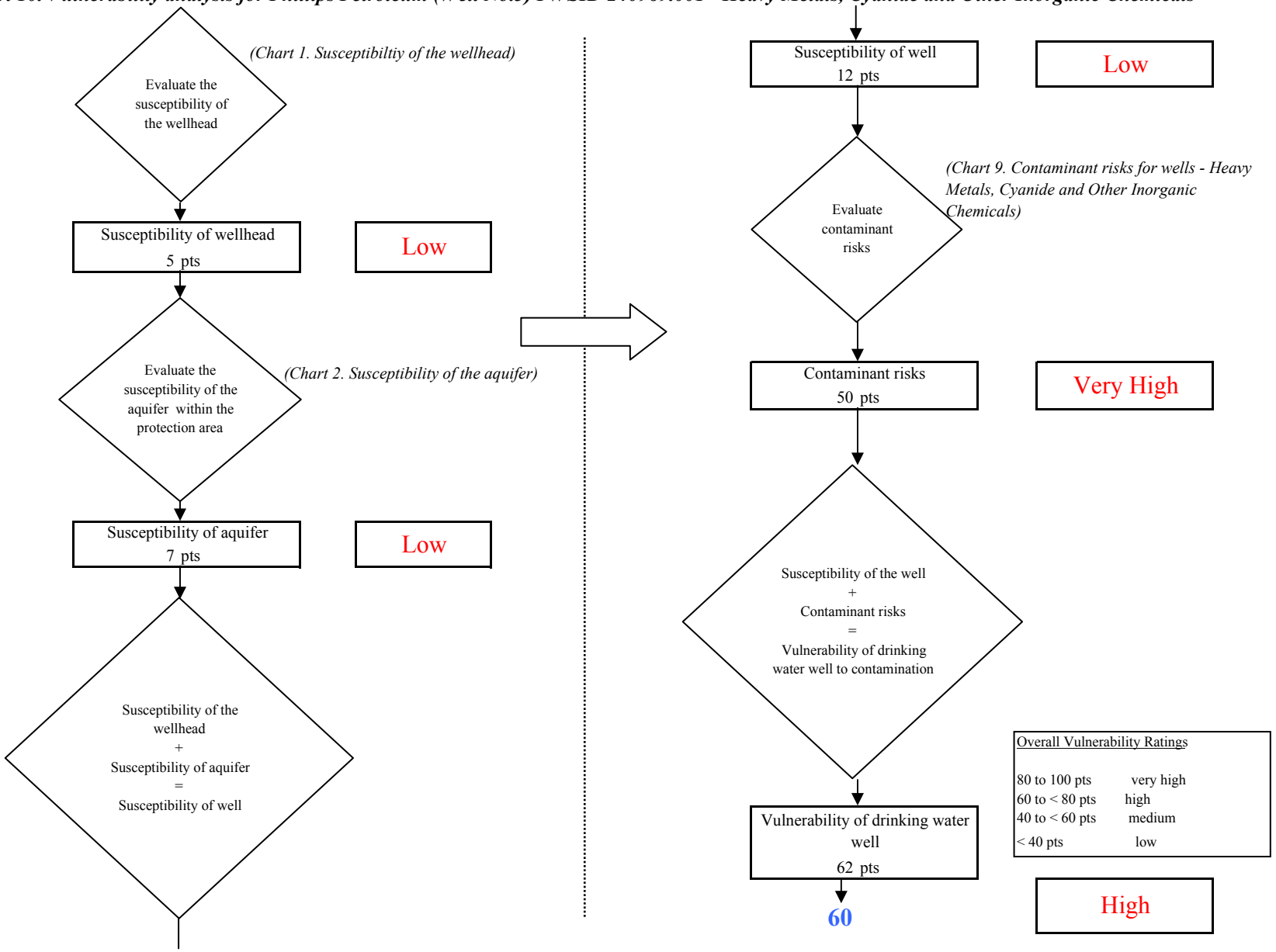


Chart 11. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Synthetic Organic Chemicals

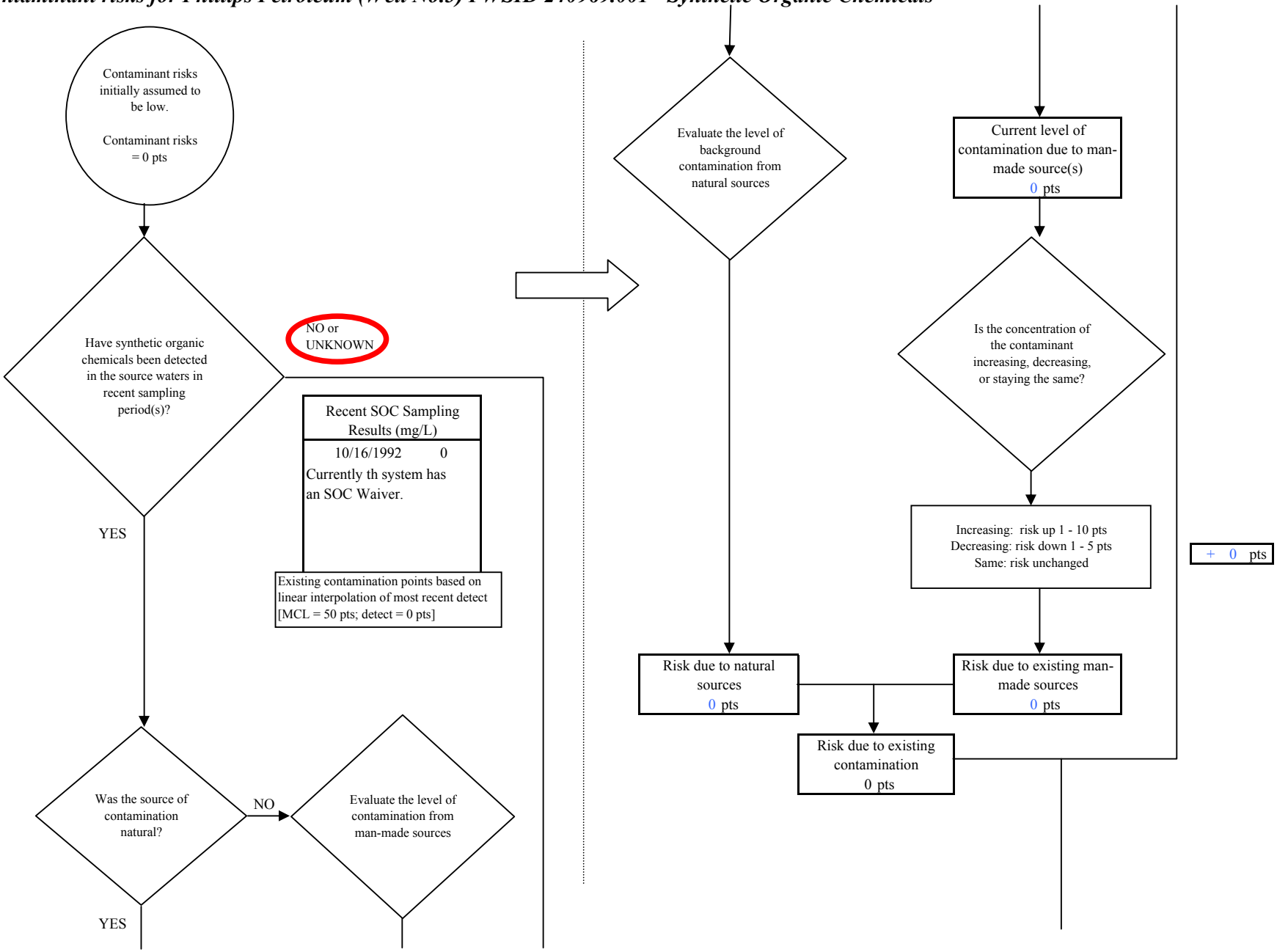
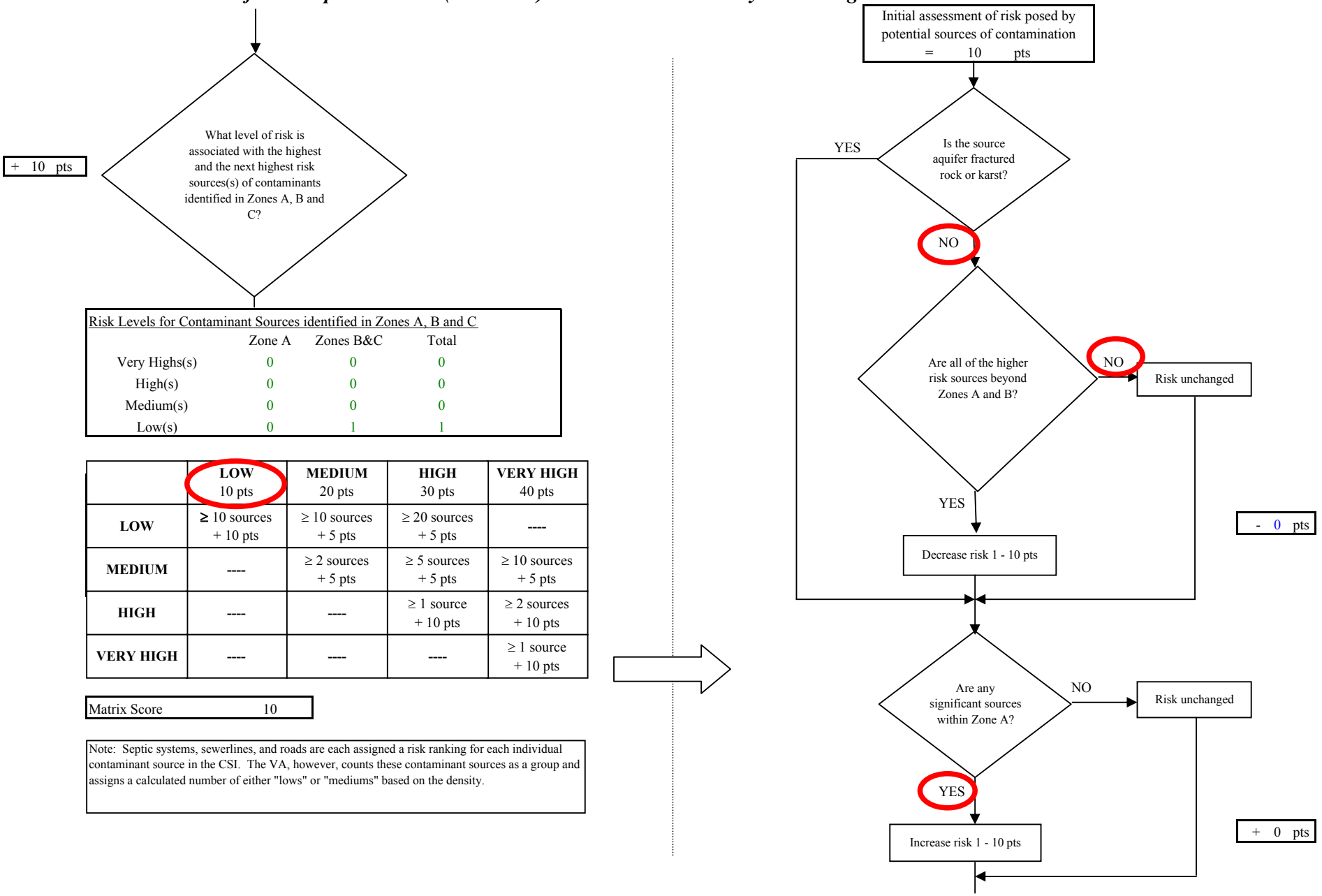


Chart 11. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Synthetic Organic Chemicals



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)	0	0	0
Medium(s)	0	0	0
Low(s)	0	1	1

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

Matrix Score 10

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

Chart 11. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Synthetic Organic Chemicals

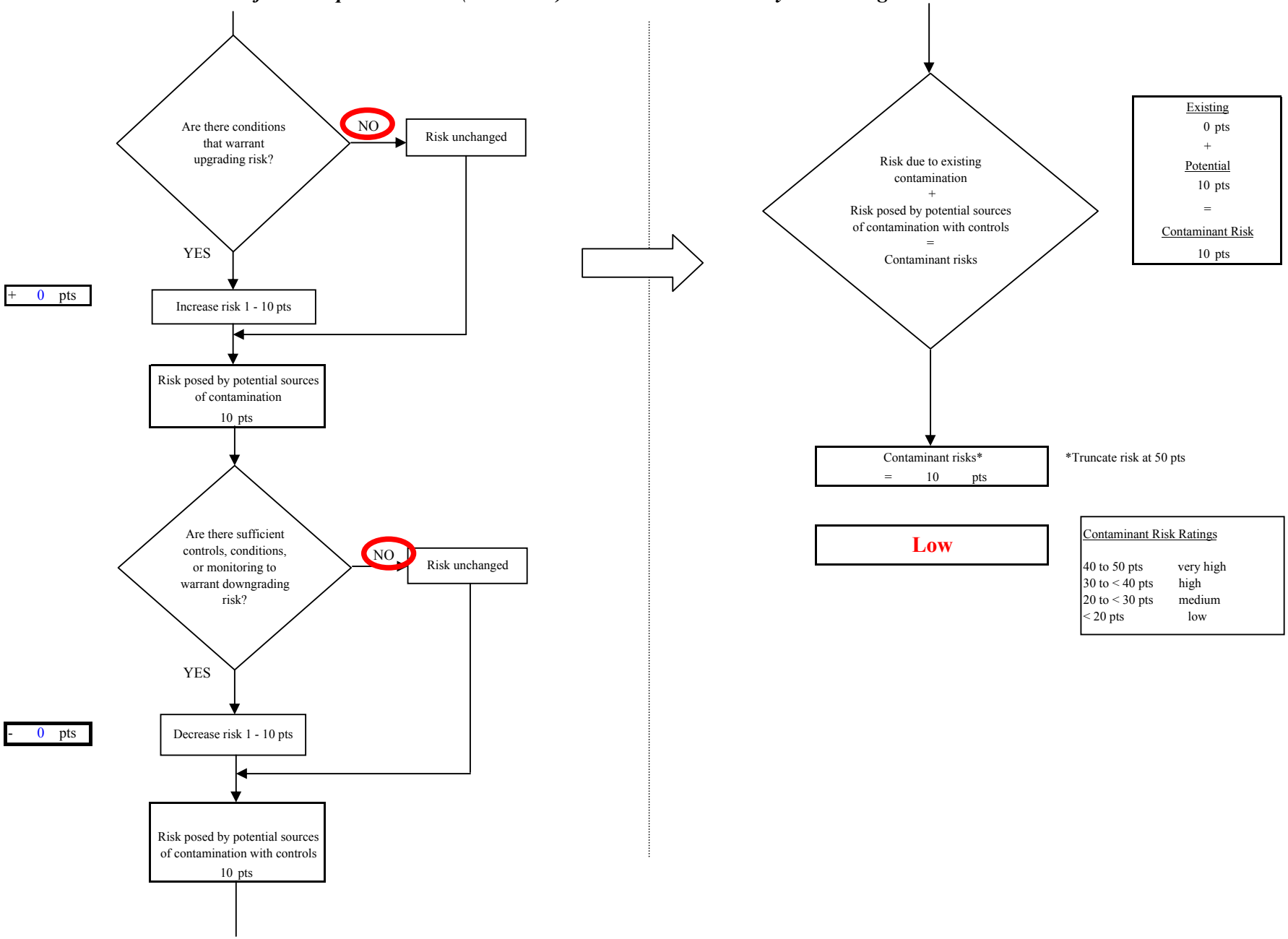


Chart 12. Vulnerability analysis for Phillips Petroleum (Well No.3) PWSID 240969.001 - Synthetic Organic Chemicals

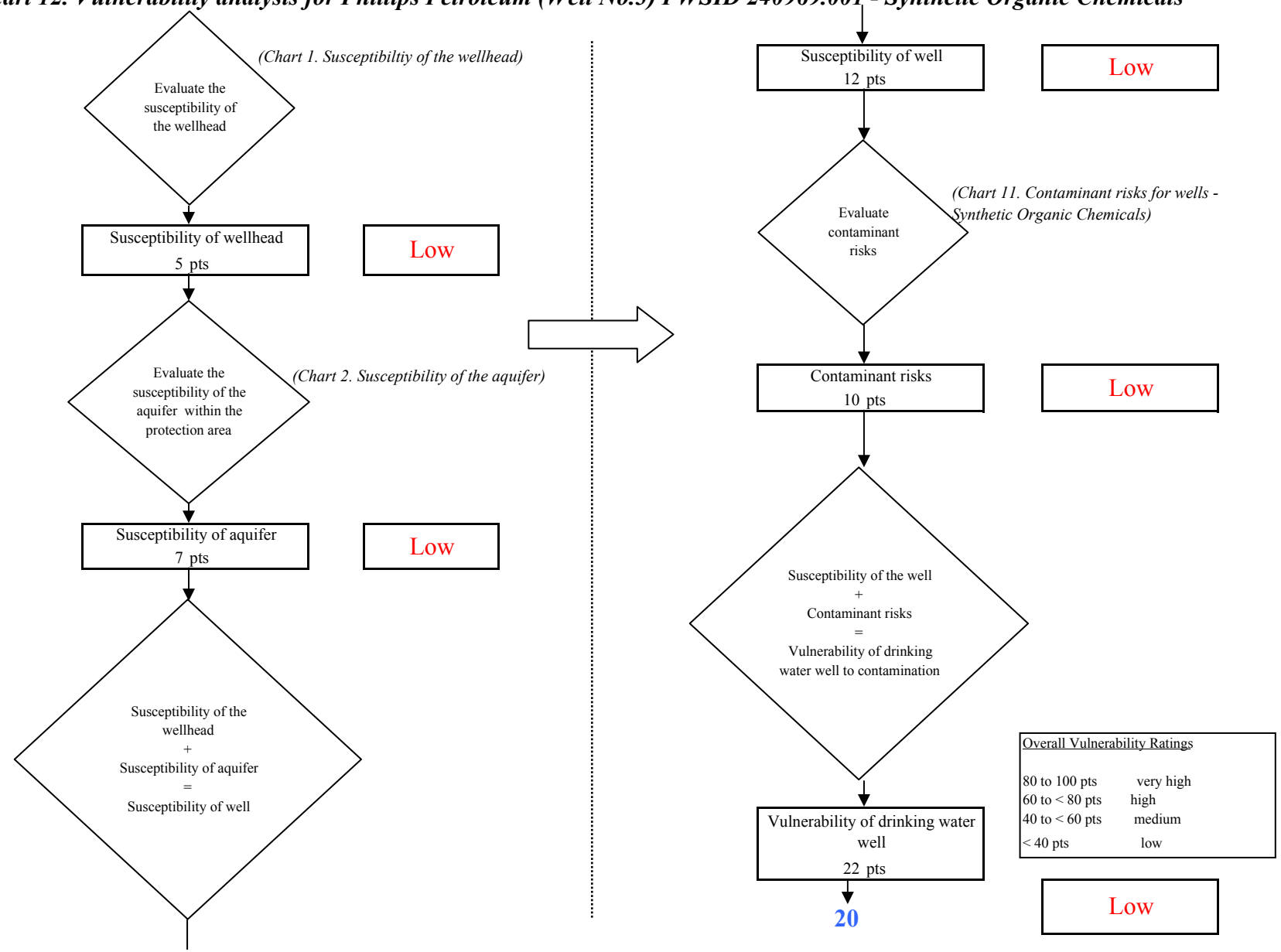


Chart 13. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Other Organic Chemicals

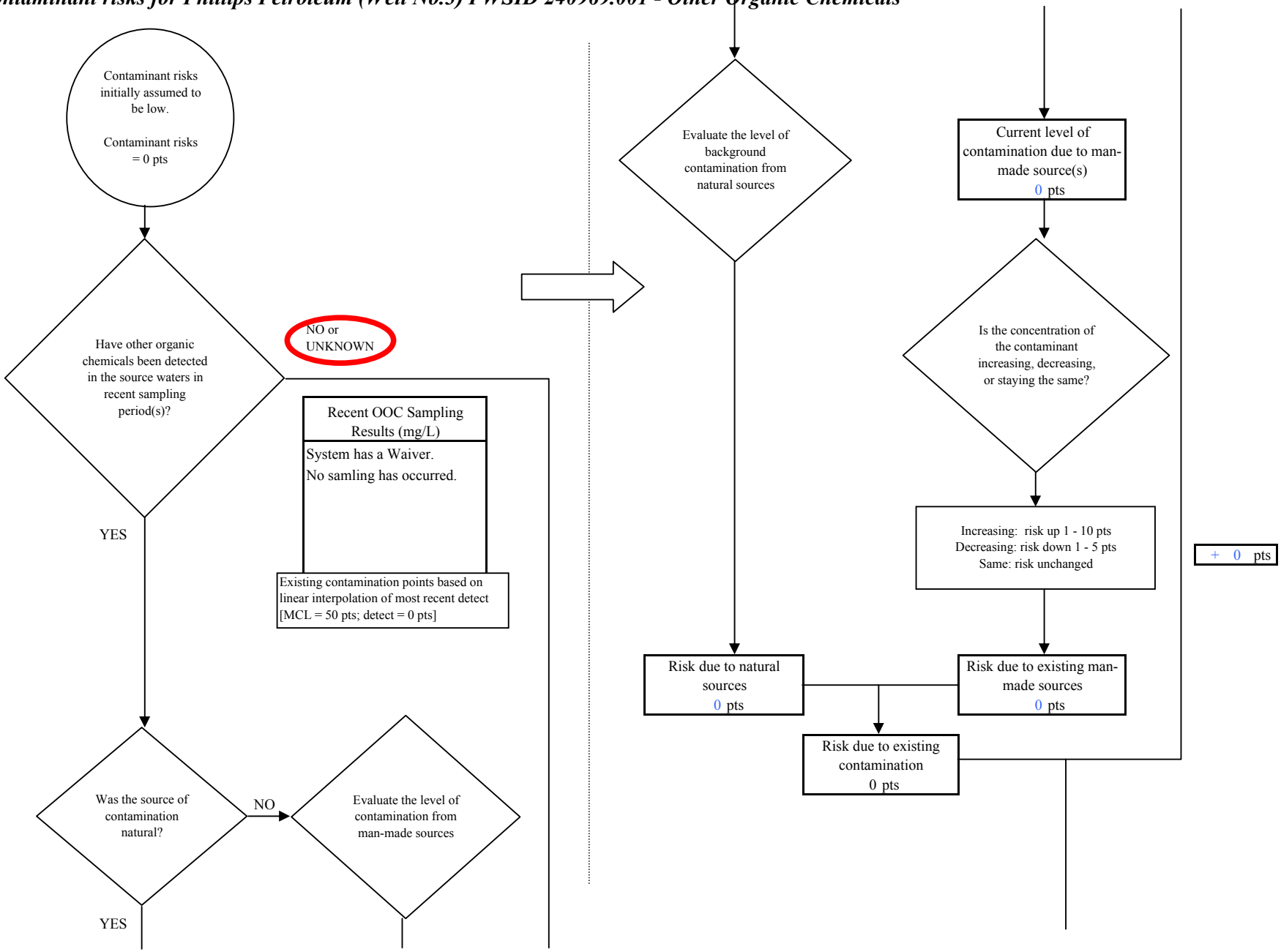


Chart 13. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Other Organic Chemicals

+ 30 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	1	1
Medium(s)	0	0	0
Low(s)	1	1	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 30

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 = 30 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 13. Contaminant risks for Phillips Petroleum (Well No.3) PWSID 240969.001 - Other Organic Chemicals

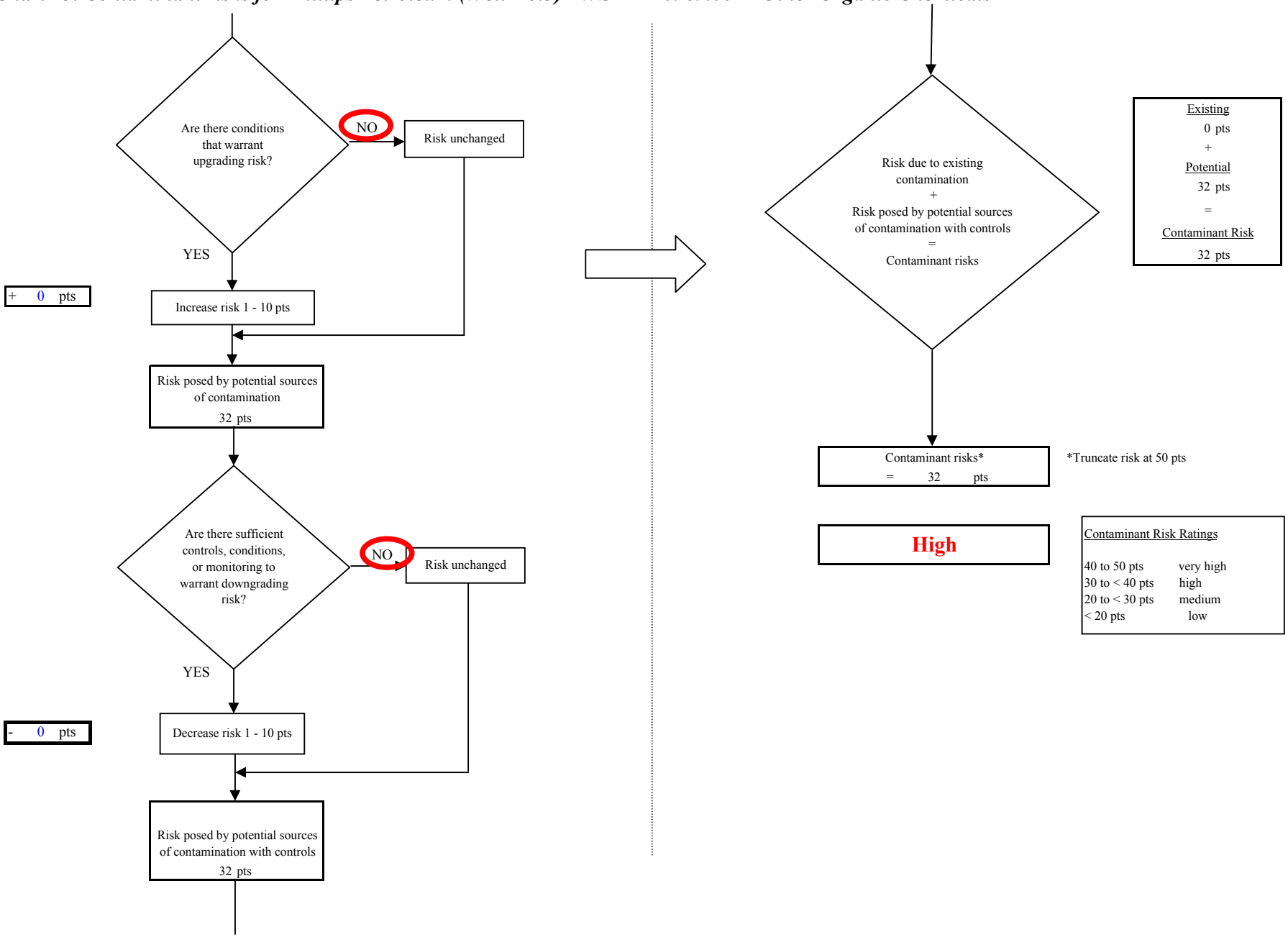


Chart 14. Vulnerability analysis for Phillips Petroleum (Well No.3) PWSID 240969.001 - Other Organic Chemicals