# Source Water Assessment

## A Hydrogeologic Susceptibility and Vulnerability Assessment for the City of Yakutat

## Ridge Road Well

## PWSID #130172.001

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT #1551

Alaska Department of Environmental Conservation

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

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

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# APPENDICES

# Source Water Assessment for the City of Yakutat Drinking Water System - Ridge Road Well

**Drinking Water Protection Program**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The City of Yakutat operates a Class A water system that obtains water from three wells in two locations. One well is located on Ridge Road and two wells are located on ARCO Road. The well on Ridge Road received a susceptibility rating of **Low**. The aquifer received a susceptibility rating of **High**. Combining these two produces a rating of **Low** for the natural susceptibility of the well. Potential and existing sources of the following contaminants were evaluated for the Source Water Assessment: bacteria and viruses, nitrates and/or nitrites, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, volatile organic chemicals, and other organic chemicals. Identified potential and current sources of contaminants for the well intake area include: a municipal landfill, a wood waste landfill, a septic system, and roads. This evaluation included all available water sampling data submitted to ADEC by the system operator. The samples may have been collected from either raw water or post-treated water. Combining the natural susceptibility of the well with the contaminant risks, the wells received a vulnerability rating of "**high**" for nitrates and/or nitrites, synthetic organic chemicals, and other organic chemicals; and "**medium"** for bacteria and viruses, volatile organic chemicals, and heavy metals. This assessment can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the City of Yakutat to protect public health.

## DRINKING WATER SYSTEM AND AREA OVERVIEW

Yakutat (Sec. 30, T027S, R034E, Copper River Meridian) is isolated among the lowlands along the Gulf of Alaska, 225 miles northwest of Juneau and 220 miles southeast of Cordova. It is at the mouth of Yakutat Bay, one of the few refuges for vessels along this stretch of coast. The Hubbard and Malaspina Glaciers are nearby (Please see the inset of Map 1 in Appendix A for location). The current population is approximately 700 (ADCED, 2004).

Yakutat lies along a vast coastal plain that reaches out from the slopes of the St. Elias Mountains. This area is a gently sloping complex of unconsolidated glacial, alluvial, and marine deposits. There is a cool maritime climate that brings extensive periods of overcast, fog, and precipitation. This area is perpetually wet and blanketed with wetlands. Sitka spruce and hemlock forests occur where soil drainage permits (USDA, 2001).

Summer temperatures range from 42 to 60; winter temperatures, 17 to 39. Yakutat receives some of the heaviest precipitation in the state, averaging 132 inches, including 219 inches of snowfall (ADCED, 2004).

The City's water system is a Class A (community) water system that serves approximately 245 connections and 800 people. There is one well located along Ridge Road and two wells located along ARCO Road (See Map 1 of Appendix A).

According to the 2001 sanitary survey, the Ridge Road well is approximately 325 feet in depth and has a pump capacity of 175 gallons per minute. The well is screened for 50-feet beginning at 150-feet. The storage capacity for the Ridge Road well is 125,000 gallons. The first ARCO Road well is approximately 174 feet in depth and has a pump capacity of 725 gallons per minute. The well is screened for 73-feet beginning at 100-feet. The second ARCO Road well is approximately 125 feet in depth and has a pump capacity of 375 gallons per minute. The well is screened for 23-feet beginning at 97-feet. The storage capacity for the ARCO Road wells is 100,000 gallons.

All wells are grouted, capped, and protected from foreign matter & surface water entering the well.

## RIDGE ROAD WELL 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. 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 outline of the immediate and adjacent watershed was used to determine the size and shape of the protection area for the system's wells. Available geology was also considered in accounting for uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

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. An analytical calculation was used to determine the size and shape of the protection area. The input parameters describing the attributes of the aquifer in this calculation were adopted from a 1979 groundwater publication by Allan Freeze and John A. Cherry.

The time of travel for contaminants (TOT) 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 TOT of the water for each:

**Table 1. Definition of Zones**

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

The protection area for the Ridge Road well includes each of Zones A through D (See Appendix C).

## 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 protection area. 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 2 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 TOT 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 travel to the well.

Tables 2 through 7 (if necessary) in Appendix B contain the ranking of potential and existing sources of contamination with respect each contaminant source.

## VULNERABILITY OF THE DRINKING WATER SYSTEM

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well

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

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

- Natural susceptibility; and
- Contaminant risks.

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 |

Table 2 shows the Susceptibility scores and ratings for the basin.

**Table 2. Susceptibility of the Well**

| | Score | Rating |
|---|---|---|
| Susceptibility of the Wellhead | 0 | Low |
| Susceptibility of the Aquifer | 19 | High |
| Natural Susceptibility | 19 | 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 | 32 | High |
| Nitrates and/or Nitrites | 43 | Very High |
| Volatile Organic Chemicals | 32 | High |
| Heavy Metals, Cyanide, and Other Inorganic Chemicals | 32 | High |
| Synthetic Organic Chemicals | 42 | Very High |
| Other Organic Chemicals | 42 | Very High |

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

Again, rankings are assigned according to a point score:

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

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

**Table 4. Overall Vulnerability**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 50 | Medium |
| Nitrates and Nitrites | 60 | High |
| Volatile Organic Chemicals | 50 | Medium |
| Heavy Metals, Cyanide, and Other Inorganic Chemicals | 50 | Medium |
| Synthetic Organic Chemicals | 60 | High |
| Other Organic Chemicals | 60 | High |

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is "high" with the municipal landfill presenting the most significant risk to the wells (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system. 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 "medium".

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is "very high" with the municipal landfill posing the most significant contaminant risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history indicates that nitrates have not been detected in amounts exceeding the MCL in samples collected in 2003. The Maximum Contaminant Level (MCL) for nitrate is 10 milligrams per liter (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.

It is unknown how much of the existing nitrate concentration can be attributed to natural or human-made sources. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L, or 20% of the MCL, and are derived primarily from the decomposition of organic matter in soils [Wang, Strelakos, Jokela, 2000].

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**

The contaminant risk for volatile organic chemicals is "high" with the municipal landfill creating the most significant risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Volatile organic chemicals have not been detected in significant levels during recent sampling. 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**

The contaminant risk for heavy metals is "high" with the municipal landfill creating the greatest risk of contamination (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

Copper has been detected in levels below the MCL in sampling performed during 2001 – 2003. After combining the contaminant risk for heavy metals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is "medium".

**Synthetic Organic Chemicals**

The contaminant risk for synthetic organic chemicals is "very high". After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to synthetic organic chemicals of the well is "high" (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

Review of the historical sampling data indicates that no synthetic organic chemicals have been detected in amounts exceeding the MCL within the past 5 years.

**Other Organic Chemicals**

The contaminant risk for other organic chemicals is "very high". After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals of the well is "high" (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

Review of the historical sampling data indicates that no other organic chemicals have been detected in amounts exceeding the MCL within the past 5 years.

**Using the Source Water Assessment**

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the City of Yakutat to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of this drinking water source.

# REFERENCES


Alaska Department of Community and Economic Development (ADCED), 2004 [WWW document]. URL: http://www.dced.state.ak.us/mra/CF_BLOCK.cfm

Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

Jokela, J.B., Munter, J.A., and Evans, J.G., 1991, Ground-water resources of the Palmer-Big Lake area, Alaska: a conceptual model. Division of Geological &Geophysical Surveys Reports of Investigations 90-4, State of Alaska Department of Natural Resources, Fairbanks, AK.

King, P.B., compiler, 1969, Tectonic map of North America: US Geological Survey Map, (scale 1:5,000,000) 2 sheets.

United States Environmental Protection Agency (EPA), 2004 [WWW document]. URL: http://www.epa.gov/safewater/mcl.html

United States Forest Service – Alaska Region (USDA), 2001. Technical Publication No. R10-TP-75. Ecological Subsections of Southeast Alaska and Neighboring Areas of Canada.

# APPENDIX A

## Ridge Road Well
## Drinking Water Protection Area Location Map
## (Map 1)

Yakutat Water System -
Well .001 (Ridge Road)

Yakutat Water System -
Wells .002 & .003 (ARCO Road)

# Map 1: Yakutat - Drinking Water Protection Area

**PWSID: 130172.001, .002, & .003**

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 3,000 6,000 12,000 18,000 24,000 Feet

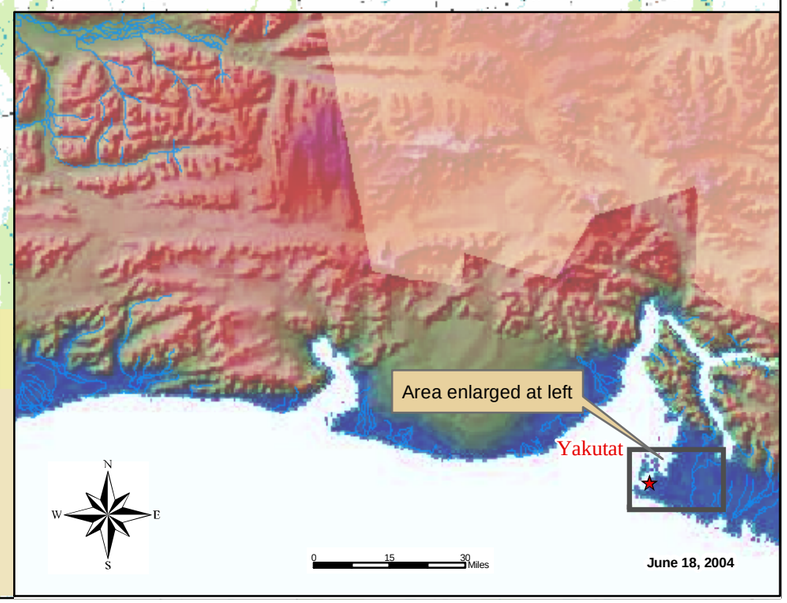
1:72,000

***Data Sources:***
***Background image***
***- USGS 1:63,000 mapping***

*Protection zones were delineated based upon groundwater flow data, well information, and streams noted on USGS 1:63,000 mapping.*

**Legend**

- Yakutat Well Locations
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Zone D Protection Area




June 18, 2004

# APPENDIX B

## Contaminant Source Inventory and Risk Ranking

## (Tables 1-7)

***Table 1***

# *Contaminant Source Inventory for* ***Yakutat PWS - Ridge Road***

***PWSID 130172.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 1-2 | A | 2 | From DWPP database |
| Highways and roads, dirt/gravel | X24 | X24 1-7 | A | 2 | From USGS mapping and Community Profile data |
| Landfills (municipal; Class III) | D51 | D51-1 | B | 2 | From ADEC information |
| Landfills (wood waste) | D52 | D52-1 | D | 2 | From ADEC information |

***Table 2***

# *Contaminant Source Inventory and Risk Ranking for Yakutat PWS - Ridge Road Sources of Bacteria and Viruses*

***PWSID 130172.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 1-2 | A | Low | 2 | From DWPP database |
| Highways and roads, dirt/gravel | X24 | X24 1-7 | A | Low | 2 | From USGS mapping and Community Profile data |
| Landfills (municipal; Class III) | D51 | D51-1 | B | High | 2 | From ADEC information |

***Table 3***

# *Contaminant Source Inventory and Risk Ranking for Yakutat PWS - Ridge Road Sources of Nitrates/Nitrites*

***PWSID 130172.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 1-2 | A | Low | 2 | From DWPP database |
| Highways and roads, dirt/gravel | X24 | X24 1-7 | A | Low | 2 | From USGS mapping and Community Profile data |
| Landfills (municipal; Class III) | D51 | D51-1 | B | Very High | 2 | From ADEC information |

***Table 4***

# *Contaminant Source Inventory and Risk Ranking for Yakutat PWS - Ridge Road Sources of Volatile Organic Chemicals*

***PWSID 130172.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 1-2 | A | Low | 2 | From DWPP database |
| Highways and roads, dirt/gravel | X24 | X24 1-7 | A | Low | 2 | From USGS mapping and Community Profile data |
| Landfills (municipal; Class III) | D51 | D51-1 | B | High | 2 | From ADEC information |

***Table 5***

# *Contaminant Source Inventory and Risk Ranking for Yakutat PWS - Ridge Road*

## *Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

***PWSID 130172.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 1-2 | A | Low | 2 | From DWPP database |
| Highways and roads, dirt/gravel | X24 | X24 1-7 | A | Low | 2 | From USGS mapping and Community Profile data |
| Landfills (municipal; Class III) | D51 | D51-1 | B | High | 2 | From ADEC information |

***Table 6***

# *Contaminant Source Inventory and Risk Ranking for Yakutat PWS - Ridge Road Sources of Synthetic Organic Chemicals*

***PWSID 130172.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 1-2 | A | Low | 2 | From DWPP database |
| Landfills (municipal; Class III) | D51 | D51-1 | B | Very High | 2 | From ADEC information |

***Table 7***

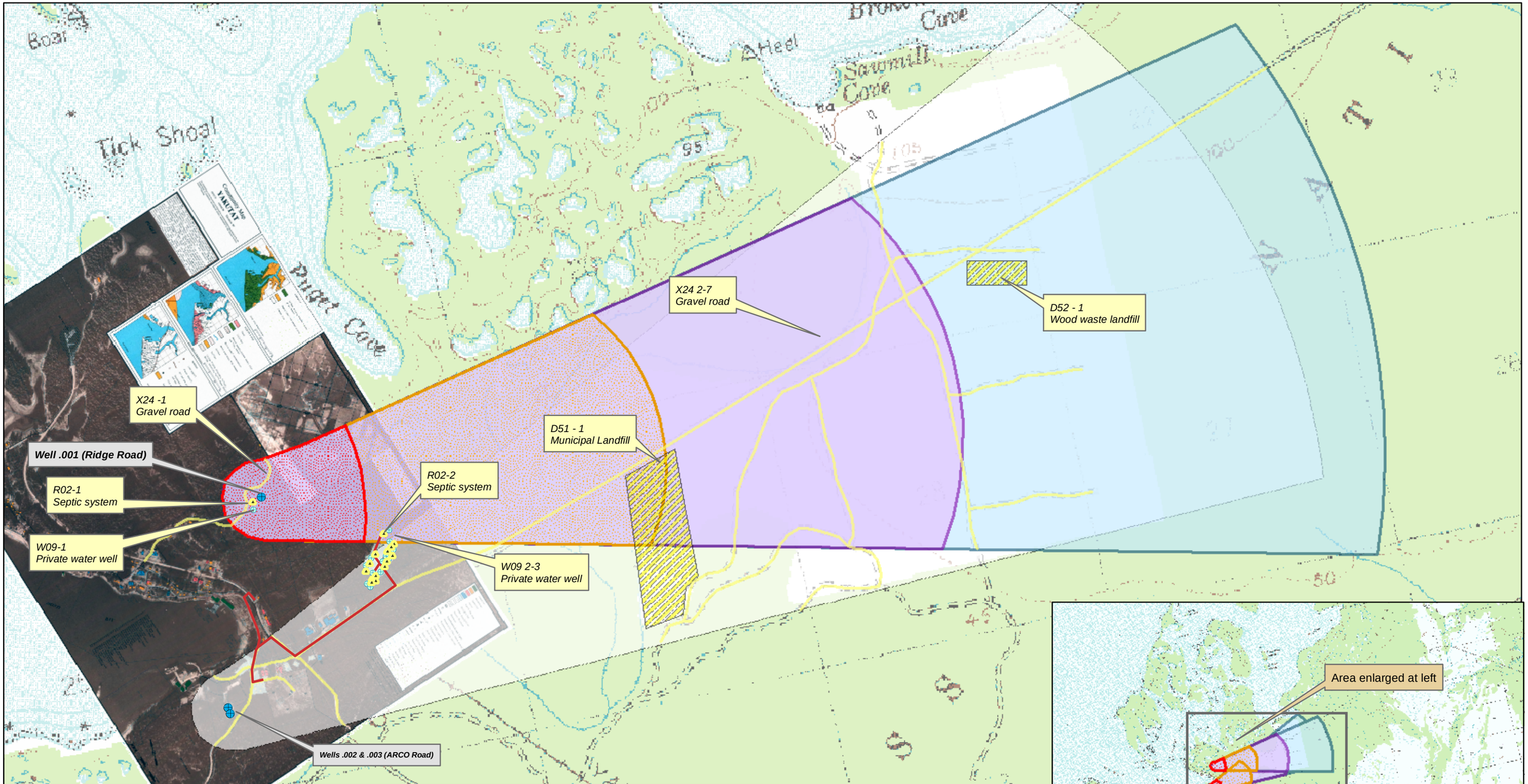
# *Contaminant Source Inventory and Risk Ranking for Yakutat PWS - Ridge Road Sources of Other Organic Chemicals*

***PWSID 130172.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 1-2 | A | Low | 2 | From DWPP database |
| Highways and roads, dirt/gravel | X24 | X24 1-7 | A | Low | 2 | From USGS mapping and Community Profile data |
| Landfills (municipal; Class III) | D51 | D51-1 | B | Very High | 2 | From ADEC information |
| Landfills (wood waste) | D52 | D52-1 | D | Very High | 2 | From ADEC information |

# APPENDIX C

## Ridge Road Well
## Drinking Water Protection Area
## and Potential and Existing Contaminant Sources
## (Map 2)




# Map 2: Potential and Existing Contaminant Sources

**PWSID: 130172.001**

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 875 1,750 3,500 5,250 Feet

1:20,000

***Data Sources:***

***1:63,000 mapping***
***- USGS***
***Community Profile Mapping***
***- ADCED***

*Protection zones were delineated based upon groundwater flow data, well information, and streams noted on USGS 1:63,000 mapping.*

**Legend**

- Public Water Well Location
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Zone D Protection Area

N W E S

0 1 2 4 Miles

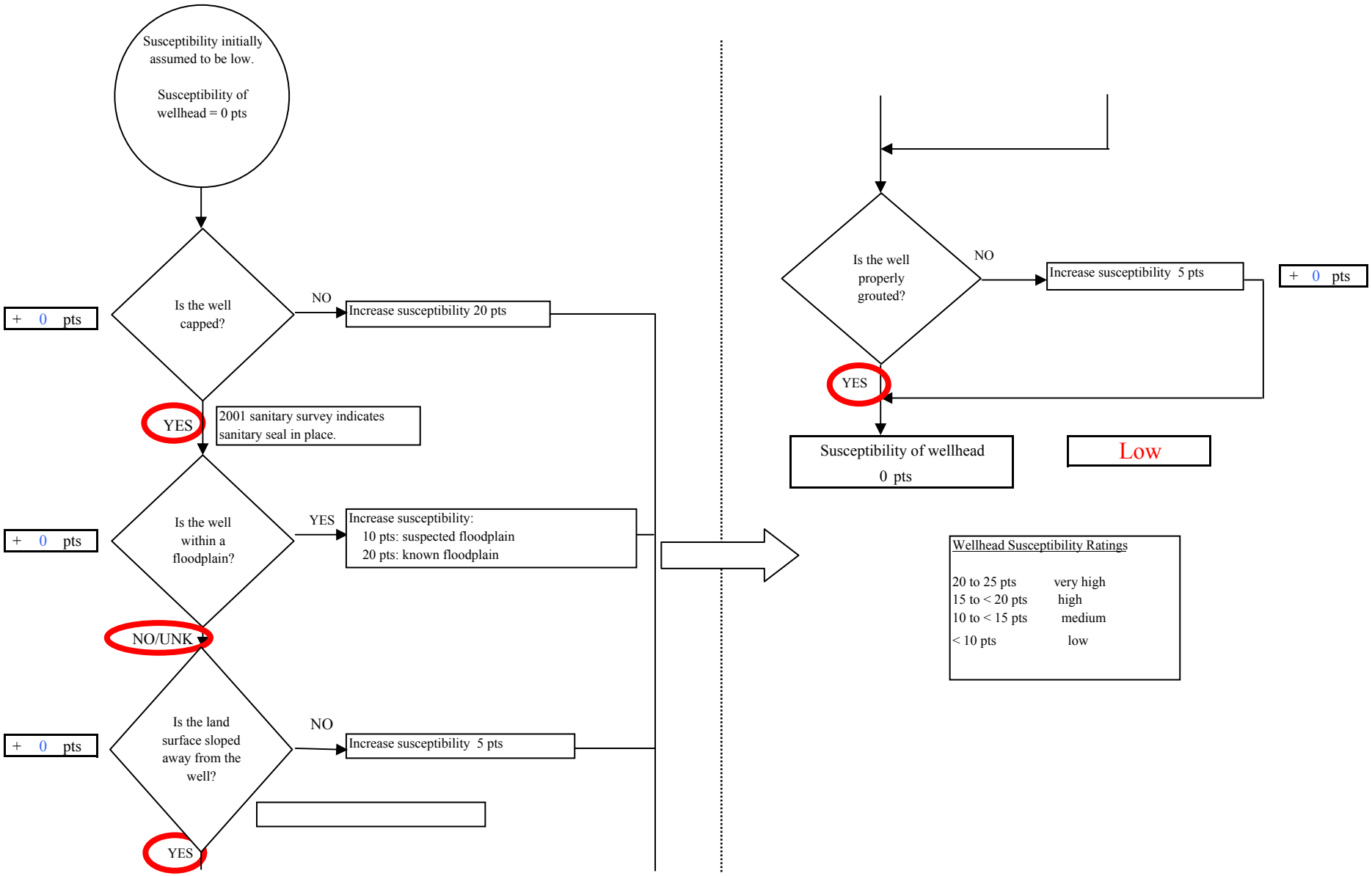
**June 18, 2004**

# APPENDIX D

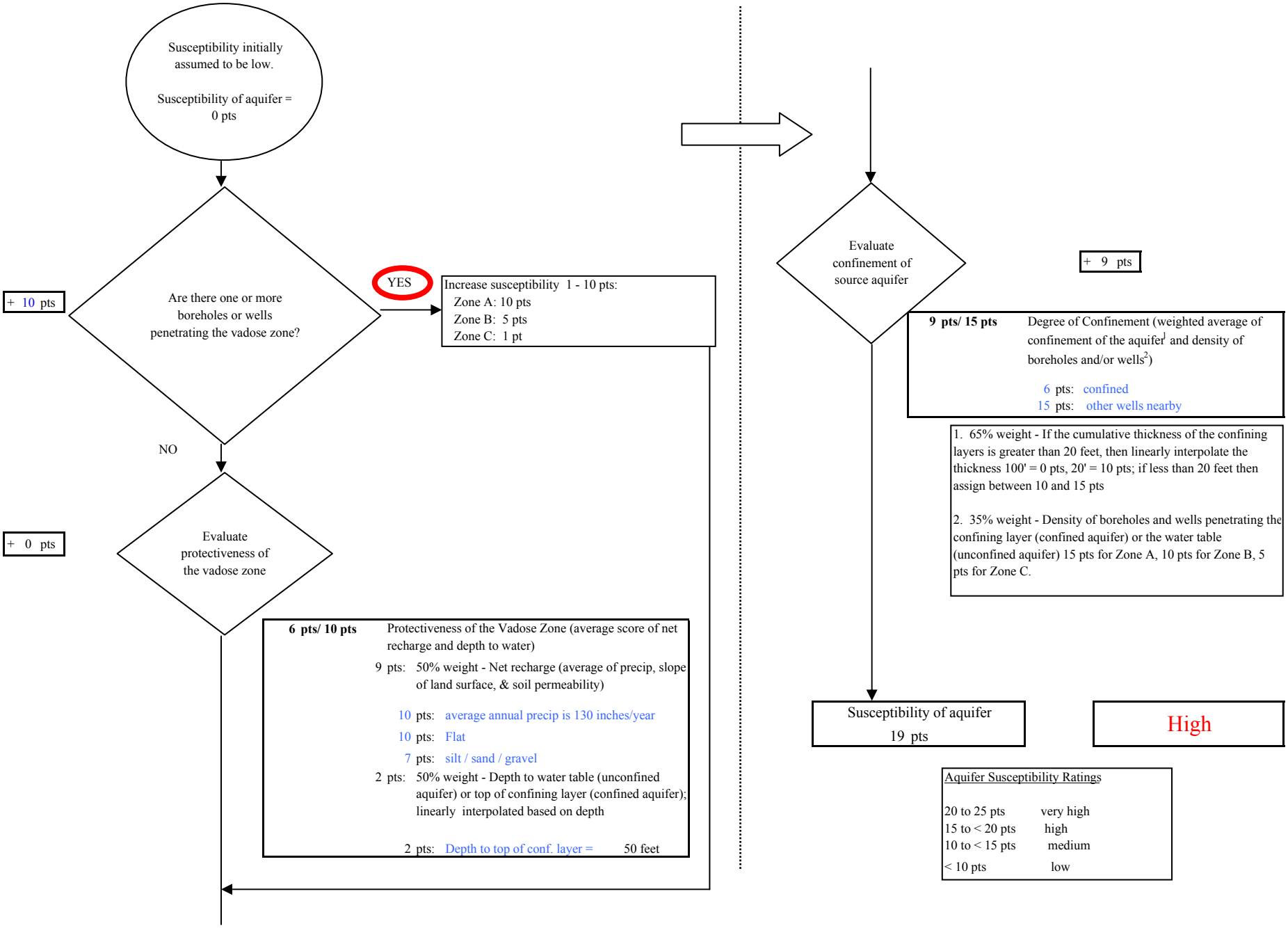
# Vulnerability Analysis

## (Charts 1-14)

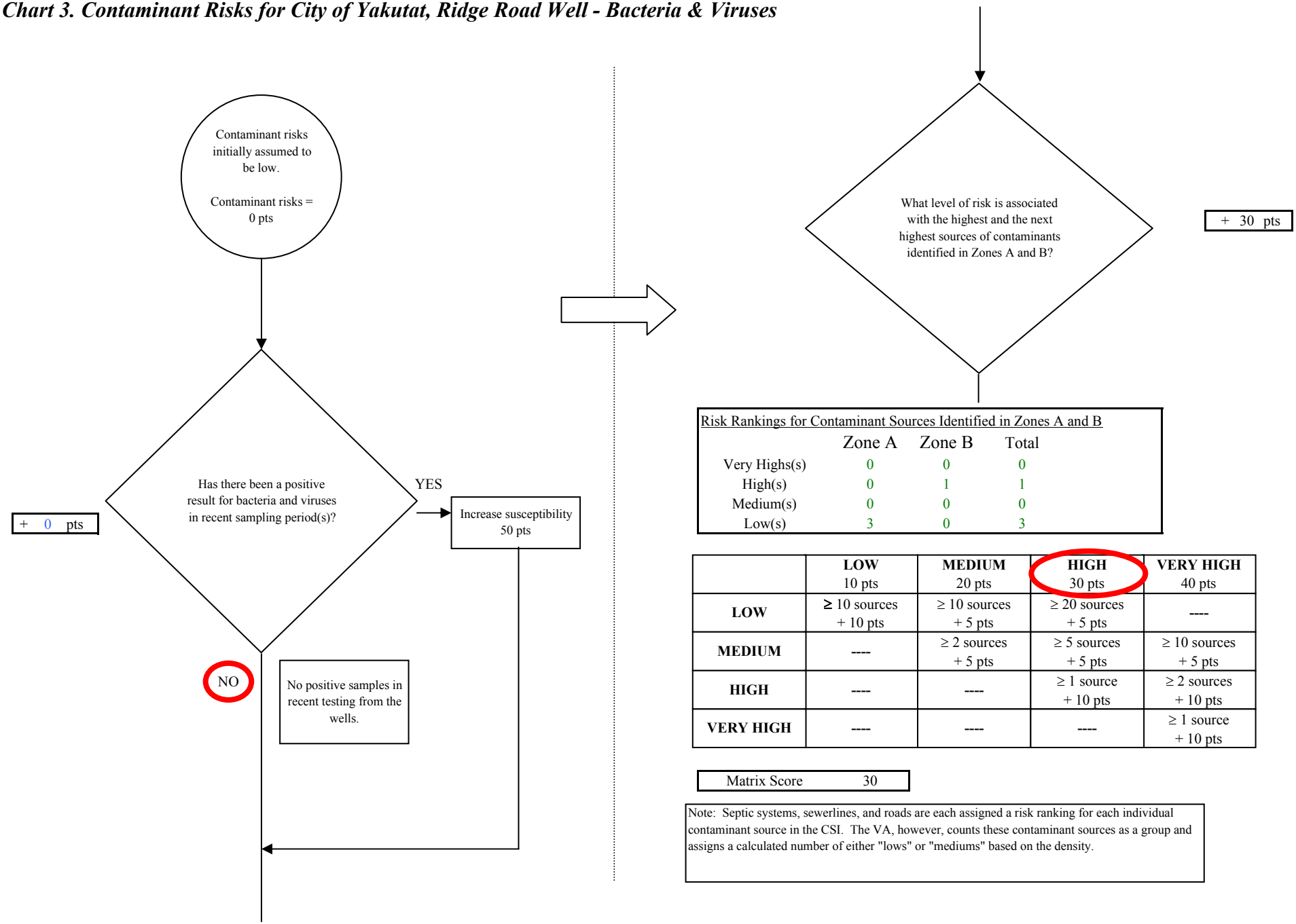
## *Chart 1. Susceptibility of the Wellhead - City of Yakutat, Ridge Road Well*



## *Chart 2. Susceptibility of the Aquifer - City of Yakutat, Ridge Road Well*



## *Chart 3. Contaminant Risks for City of Yakutat, Ridge Road Well - Bacteria & Viruses*




Risk Rankings for Contaminant Sources Identified in Zones A and B

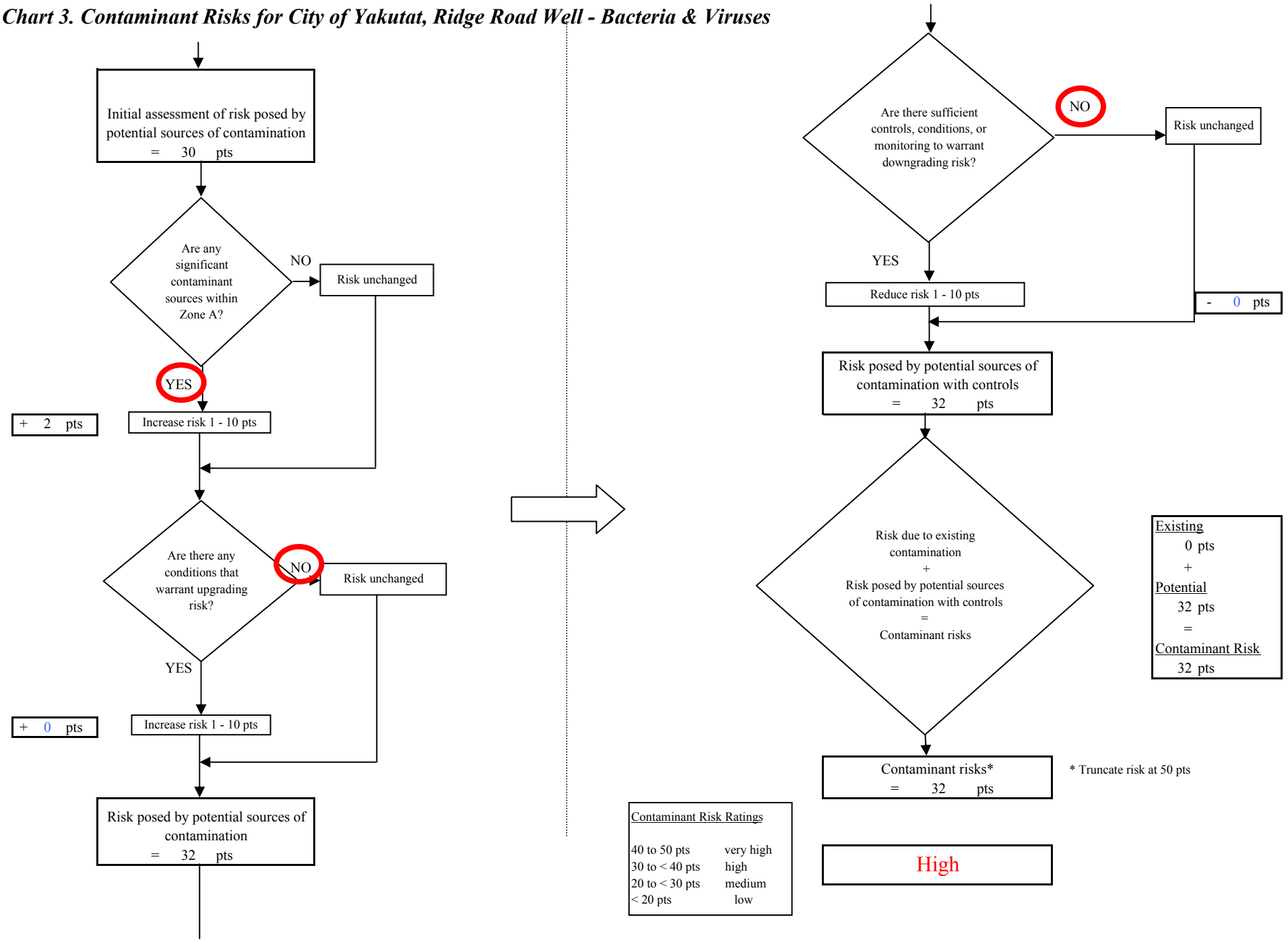
| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 1 | 1 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 3 | 0 | 3 |

| | 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 |

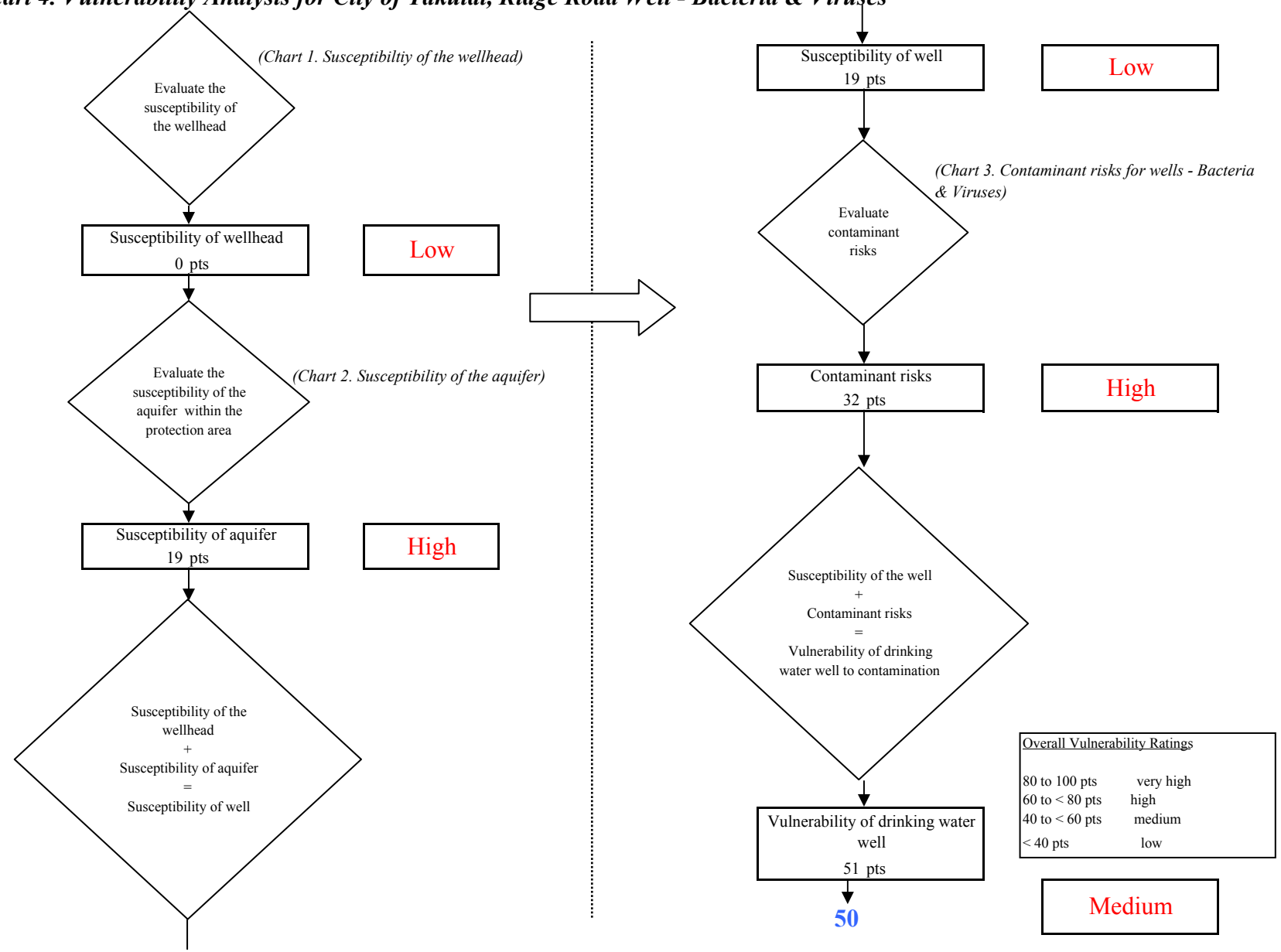
Matrix Score 30

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.

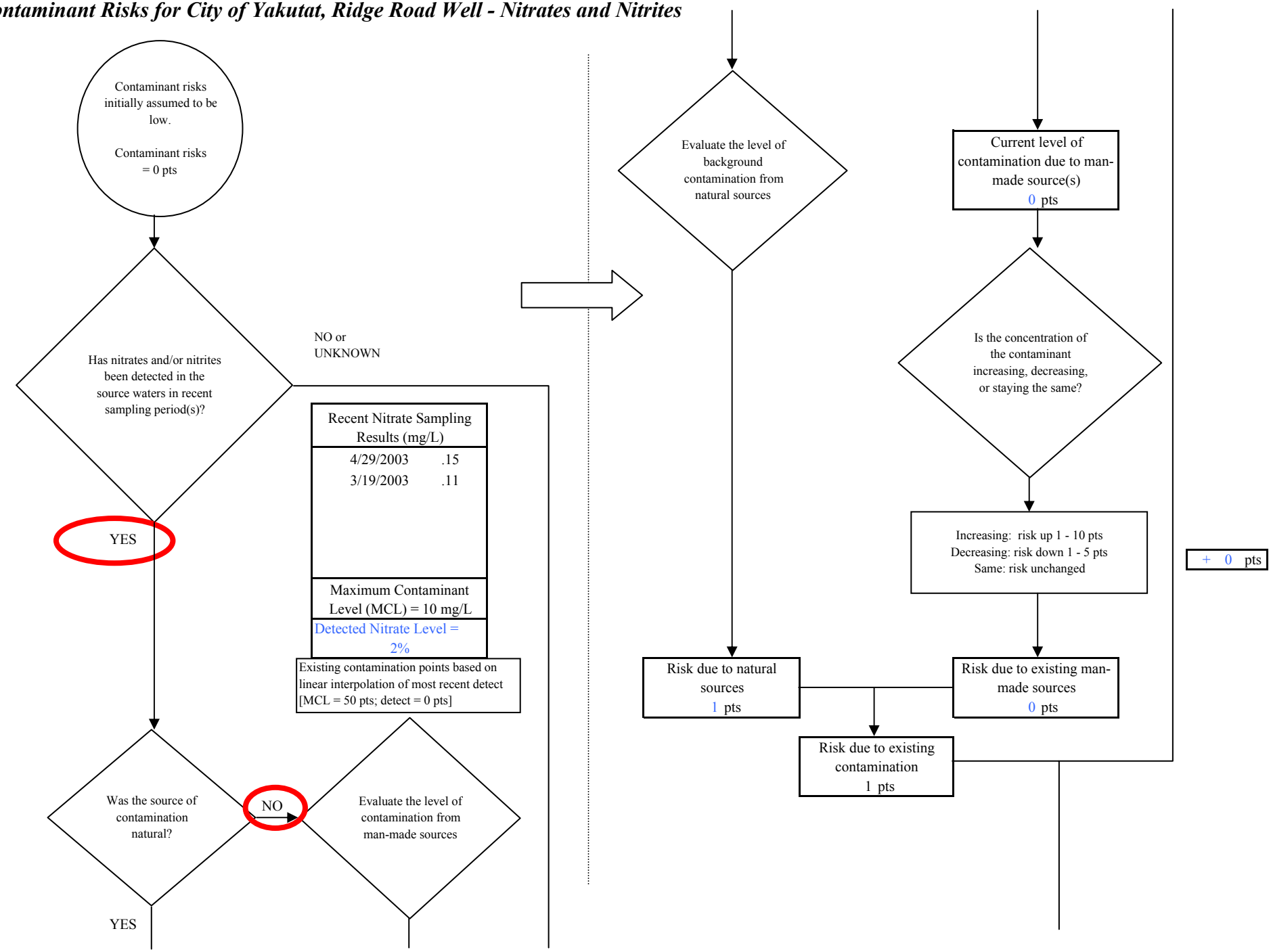
## *Chart 3. Contaminant Risks for City of Yakutat, Ridge Road Well - Bacteria & Viruses*



## *Chart 4. Vulnerability Analysis for City of Yakutat, Ridge Road Well - Bacteria & Viruses*



## *Chart 5. Contaminant Risks for City of Yakutat, Ridge Road Well - Nitrates and Nitrites*



## *Chart 5. Contaminant Risks for City of Yakutat, Ridge Road Well - 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 | 1 | 1 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 3 | 0 | 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 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

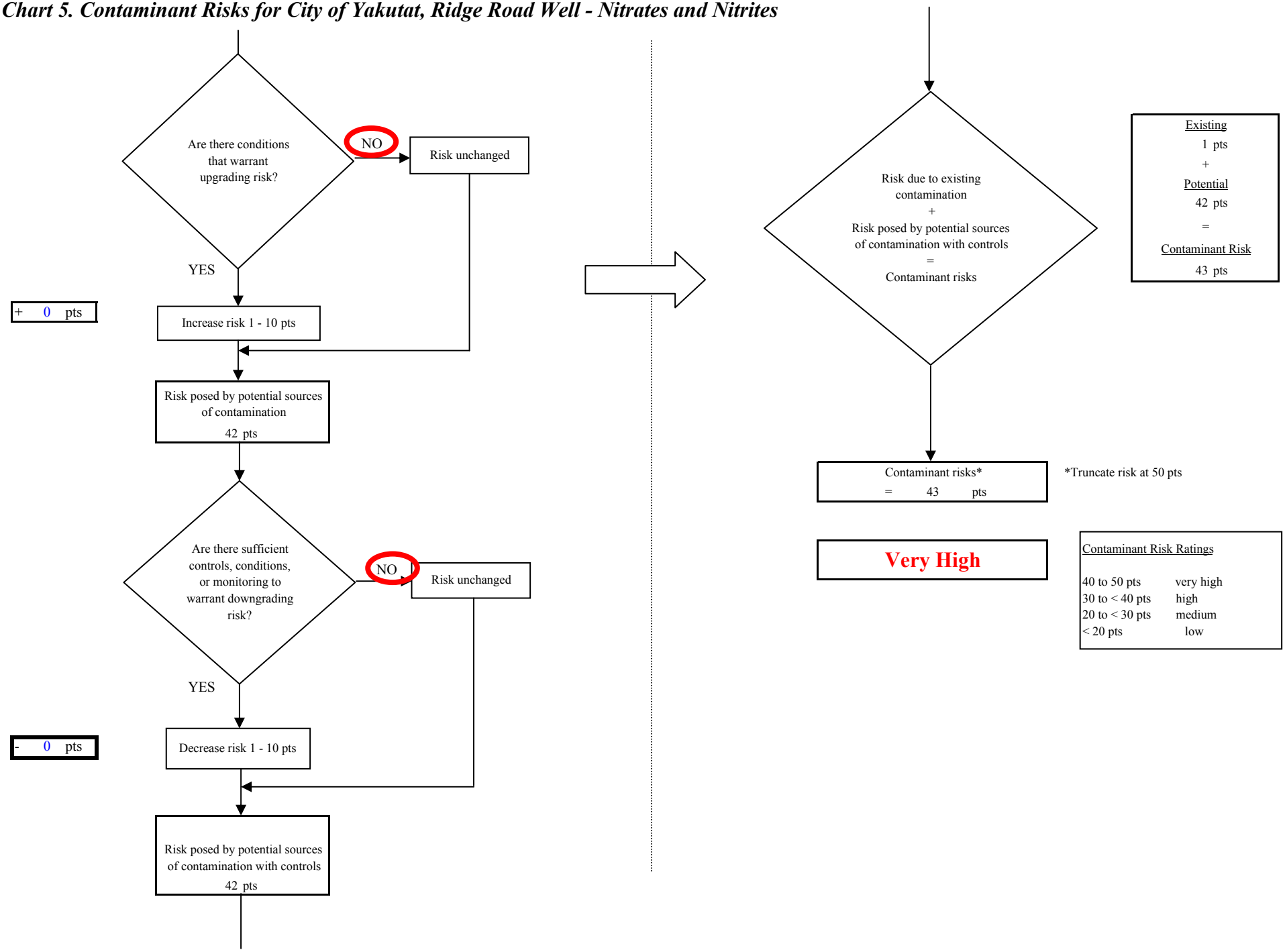
Risk unchanged

YES

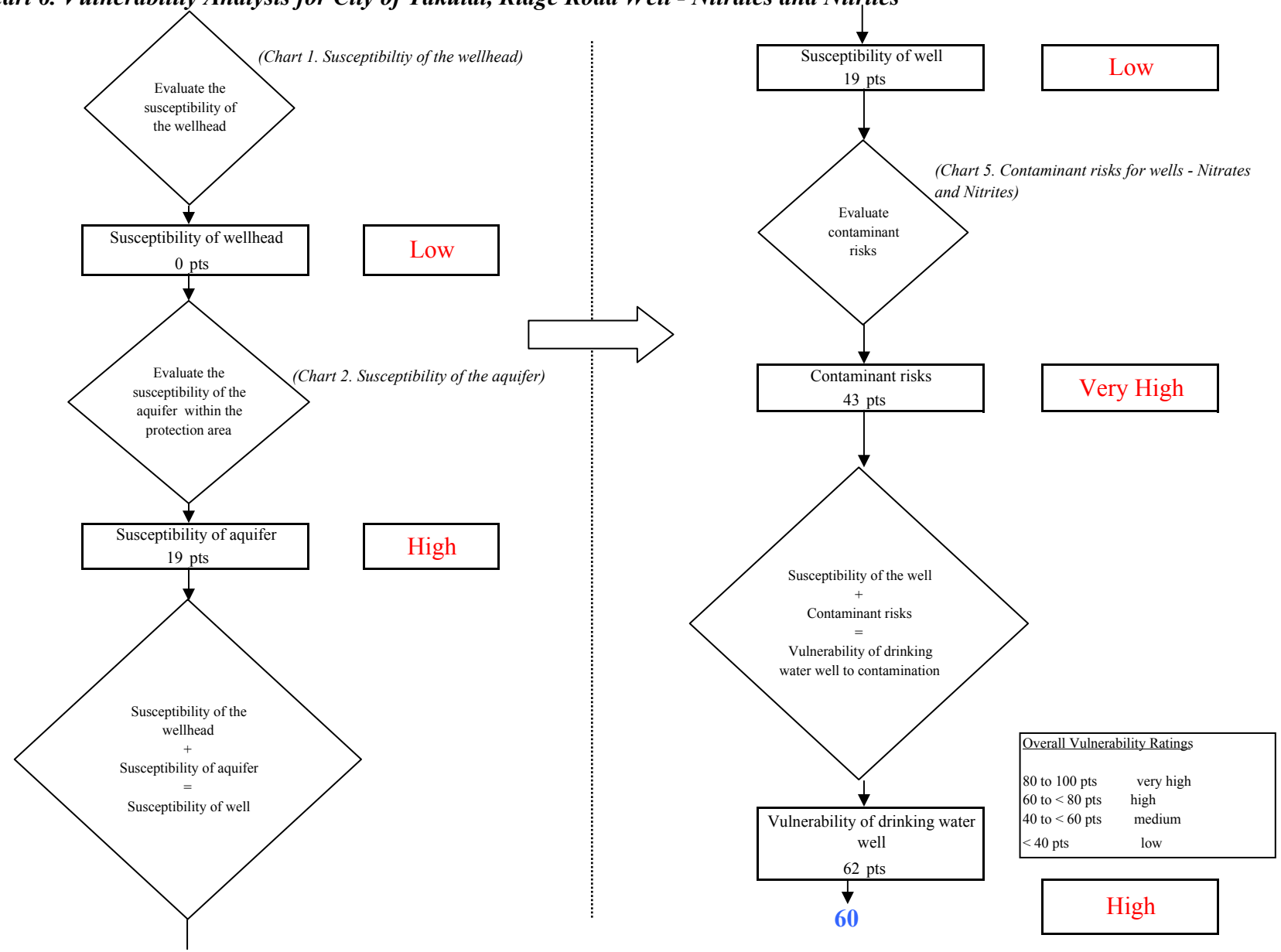
Increase risk 1 - 10 pts

+ 2 pts

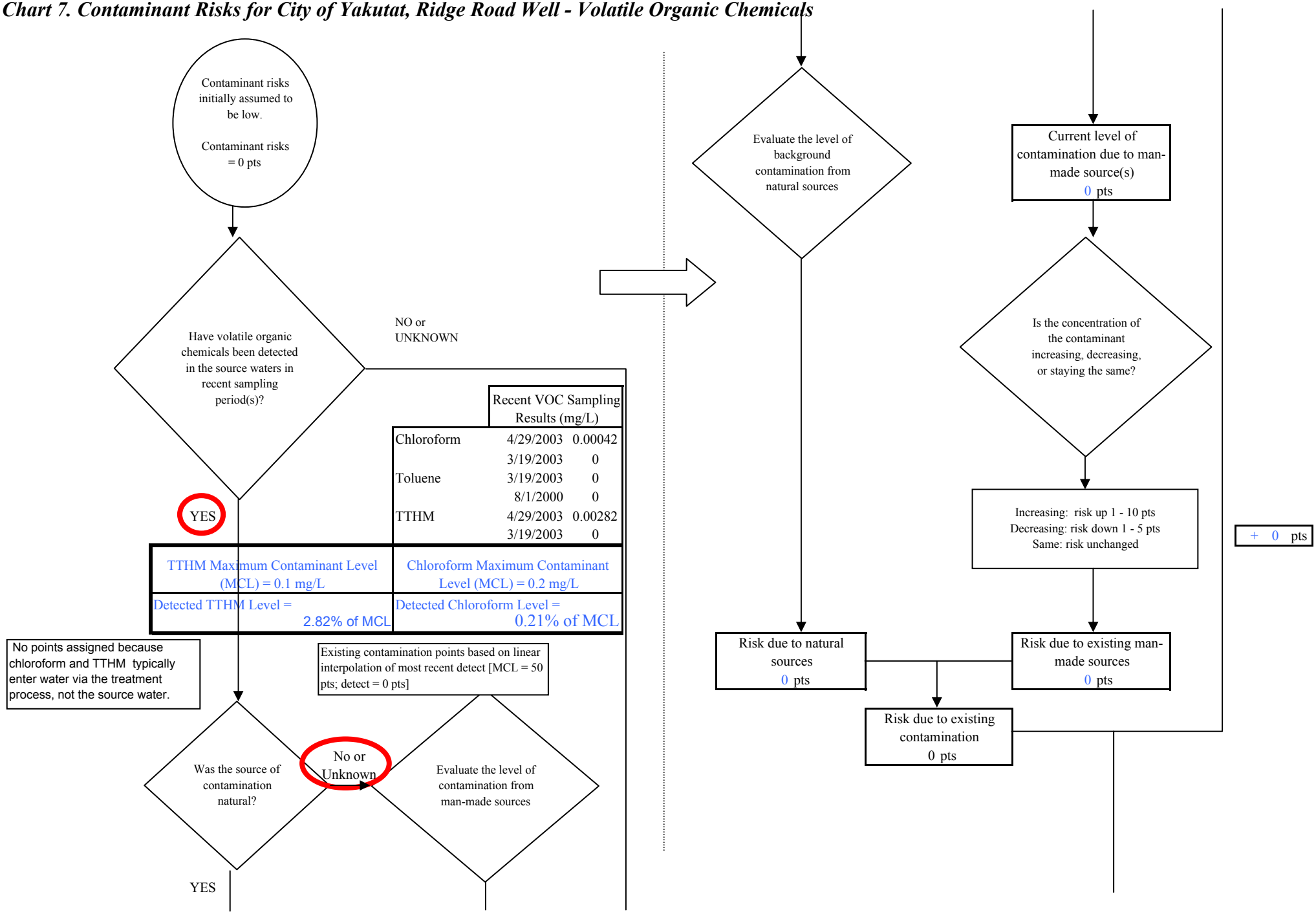
## *Chart 5. Contaminant Risks for City of Yakutat, Ridge Road Well - Nitrates and Nitrites*



## *Chart 6. Vulnerability Analysis for City of Yakutat, Ridge Road Well - Nitrates and Nitrites*



## *Chart 7. Contaminant Risks for City of Yakutat, Ridge Road Well - Volatile Organic Chemicals*



## *Chart 7. Contaminant Risks for City of Yakutat, Ridge Road Well - Volatile 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?

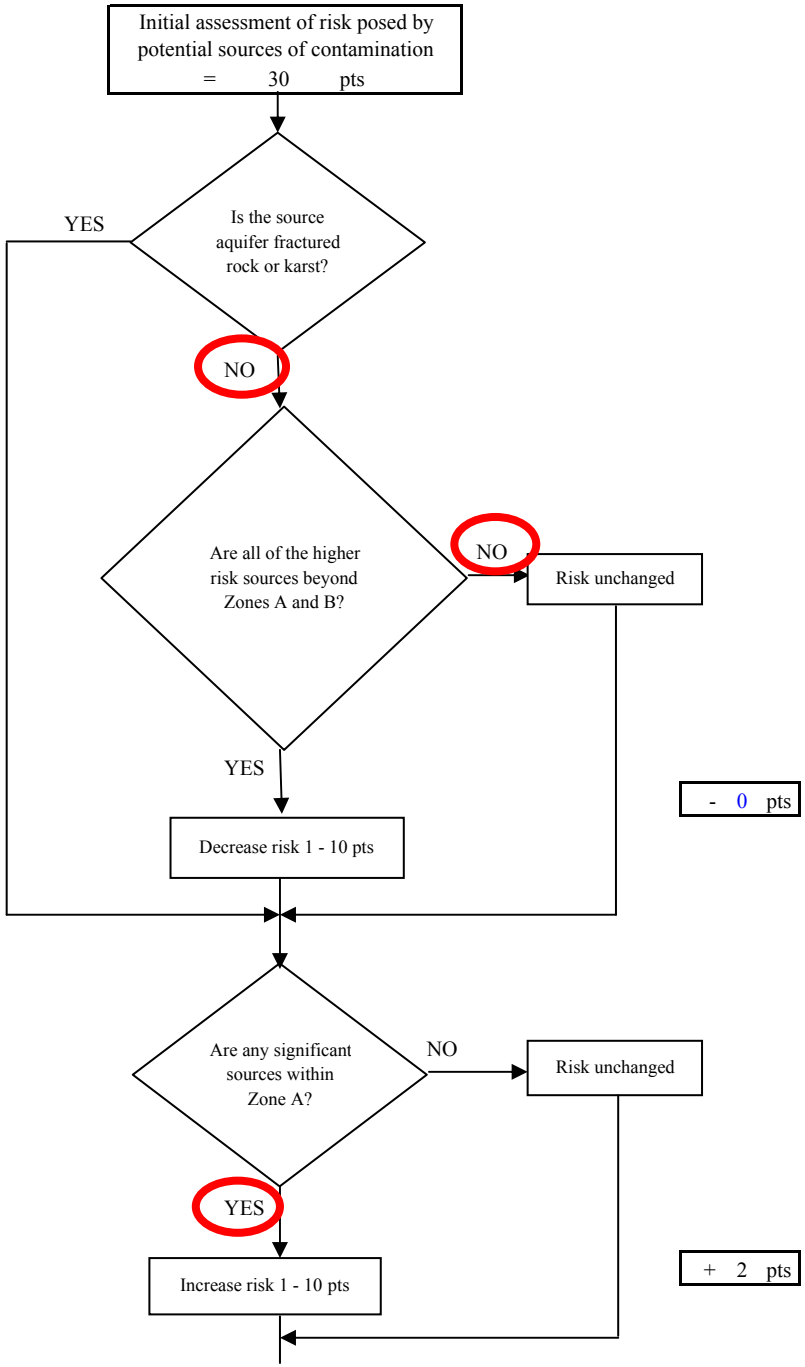
Risk Levels for Contaminant Sources identified in Zones A, B and C

| | Zone A | Zones B&C | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 1 | 1 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 2 | 0 | 2 |

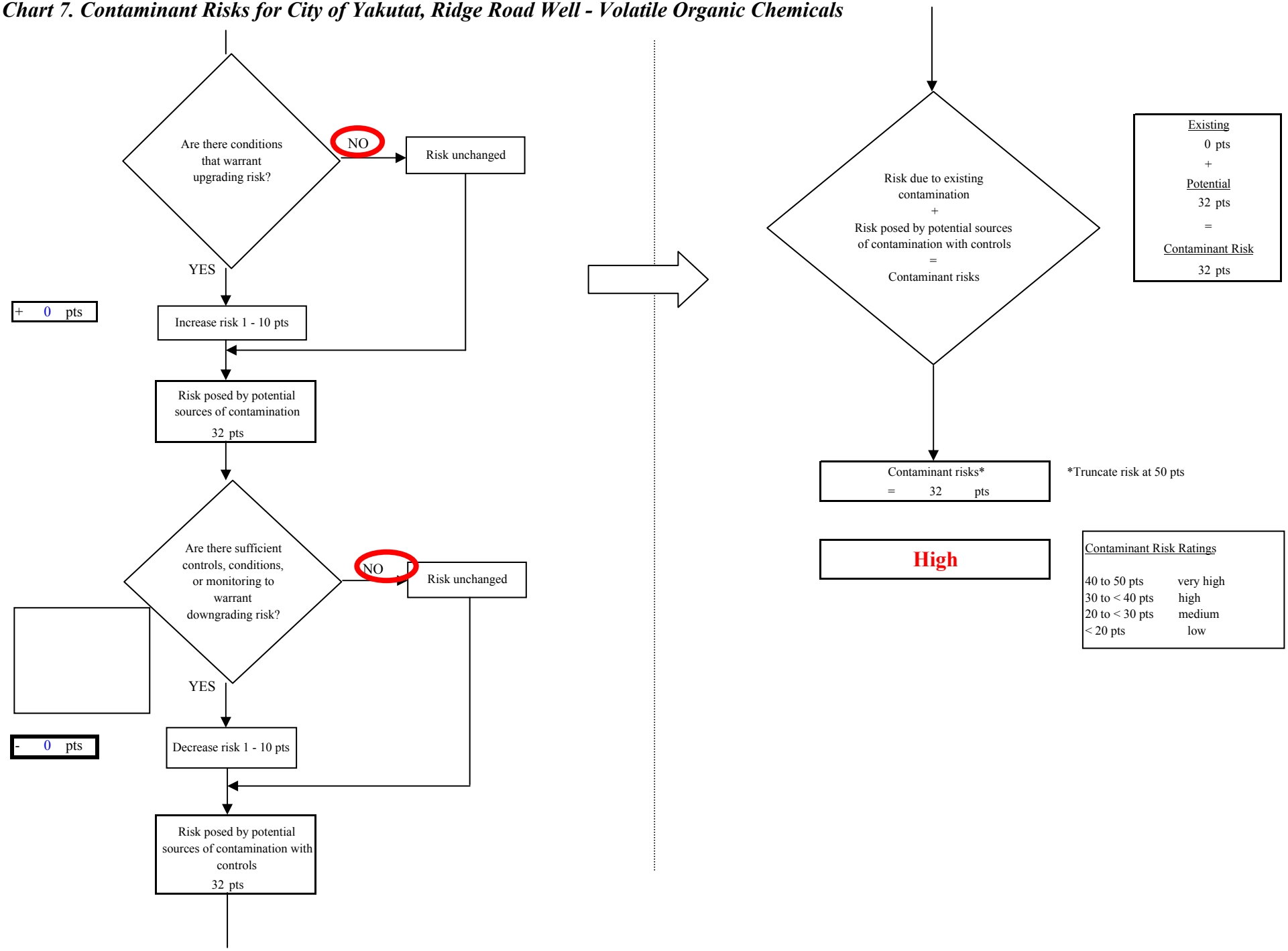
| | **LOW** 10 pts | **MEDIUM** 20 pts | **HIGH** 30 pts | **VERY HIGH** 40 pts |
|---|---|---|---|---|
| **LOW** | ≥ 10 sources + 10 pts | ≥ 10 sources + 5 pts | ≥ 20 sources + 5 pts | ---- |
| **MEDIUM** | ---- | ≥ 2 sources + 5 pts | ≥ 5 sources + 5 pts | ≥ 10 sources + 5 pts |
| **HIGH** | ---- |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

Matrix Score 30

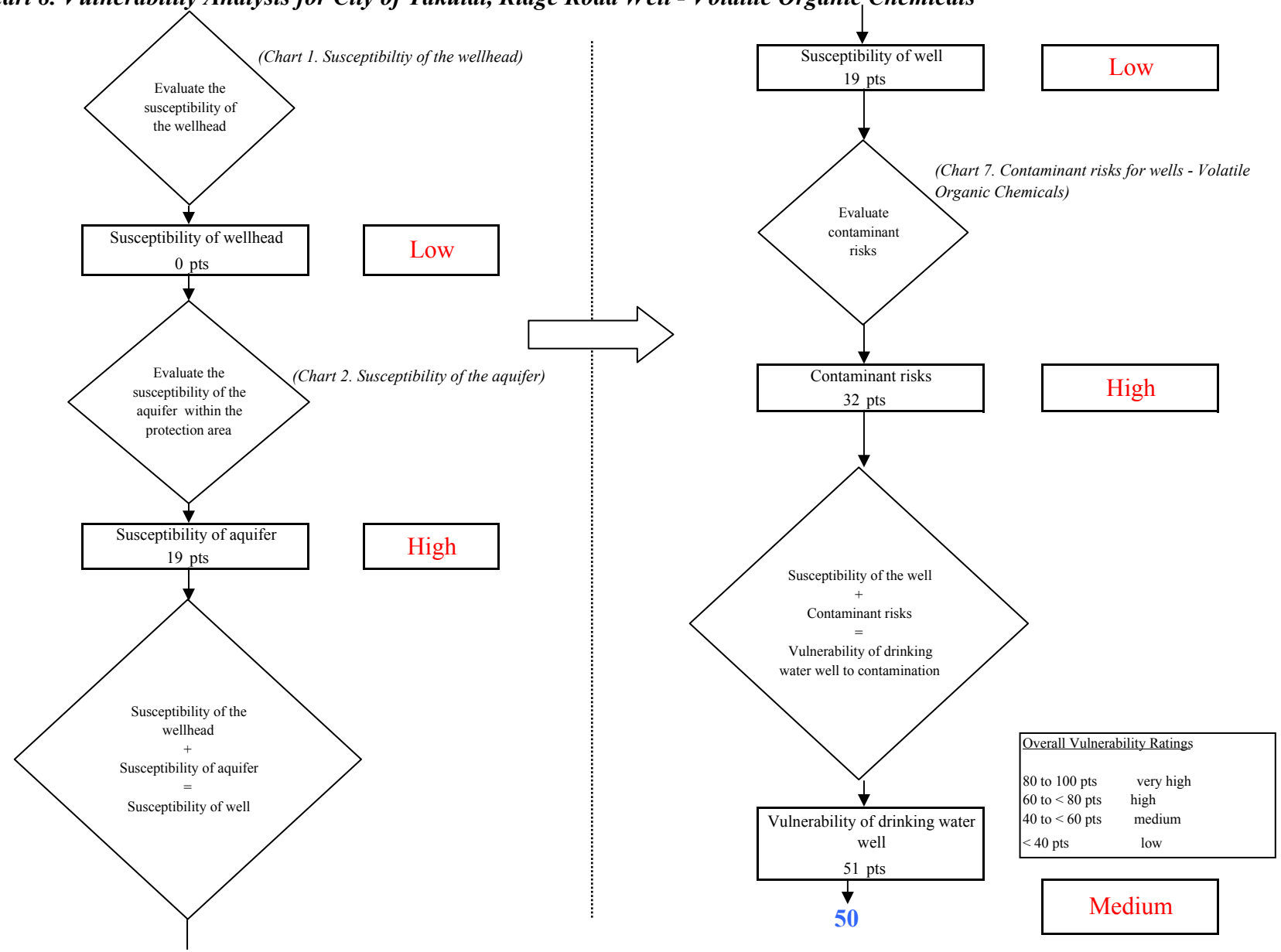
Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.



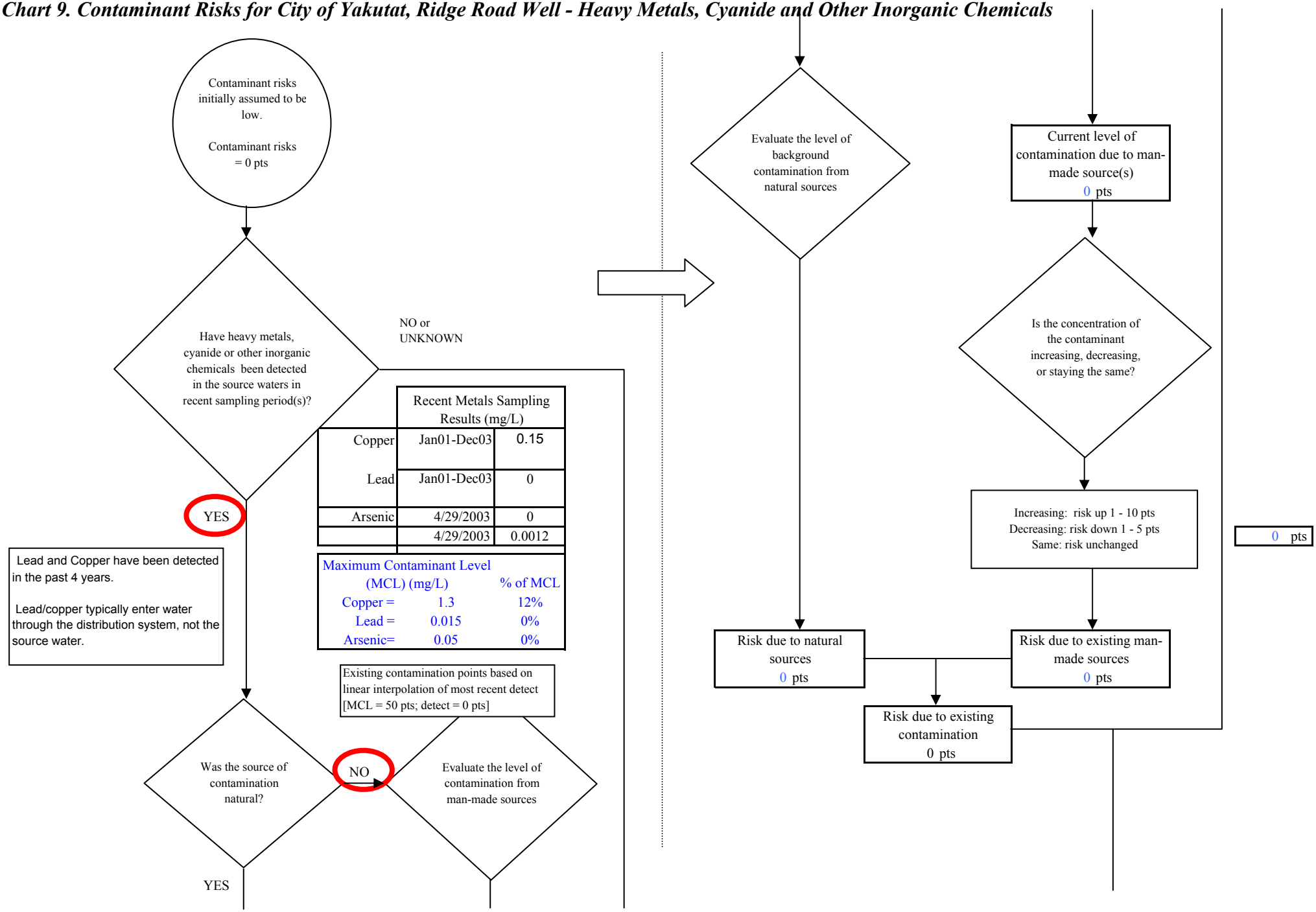
## *Chart 7. Contaminant Risks for City of Yakutat, Ridge Road Well - Volatile Organic Chemicals*



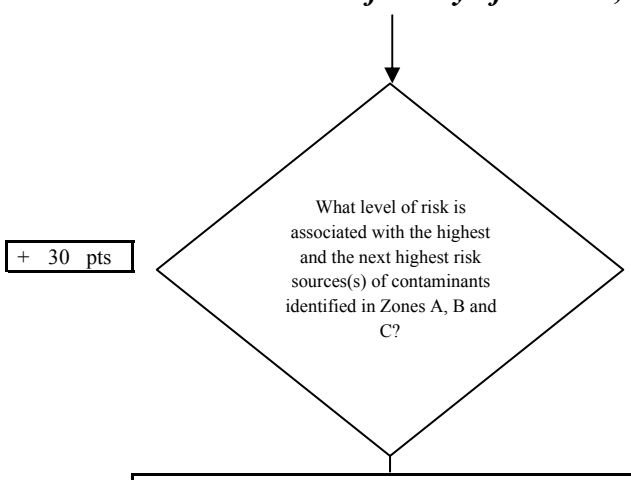
## *Chart 8. Vulnerability Analysis for City of Yakutat, Ridge Road Well - Volatile Organic Chemicals*



## *Chart 9. Contaminant Risks for City of Yakutat, Ridge Road Well - Heavy Metals, Cyanide and Other Inorganic Chemicals*



## *Chart 9. Contaminant Risks for City of Yakutat, Ridge Road Well - Heavy Metals, Cyanide and Other Inorganic Chemicals*

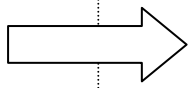


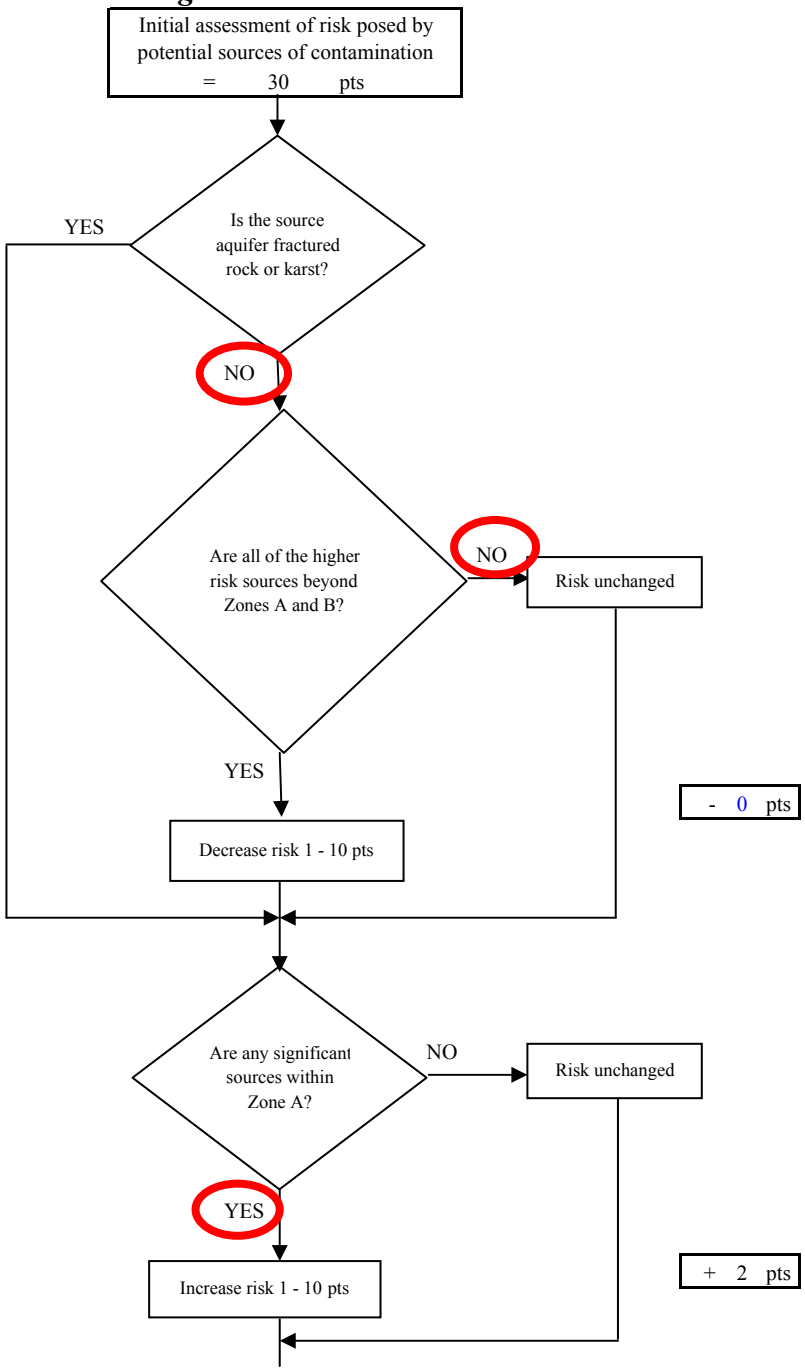

| Risk Levels for Contaminant Sources identified in Zones A, B and C | | | |
|---|---|---|---|
| | Zone A | Zones B&C | Total |
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 1 | 1 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 2 | 0 | 2 |

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

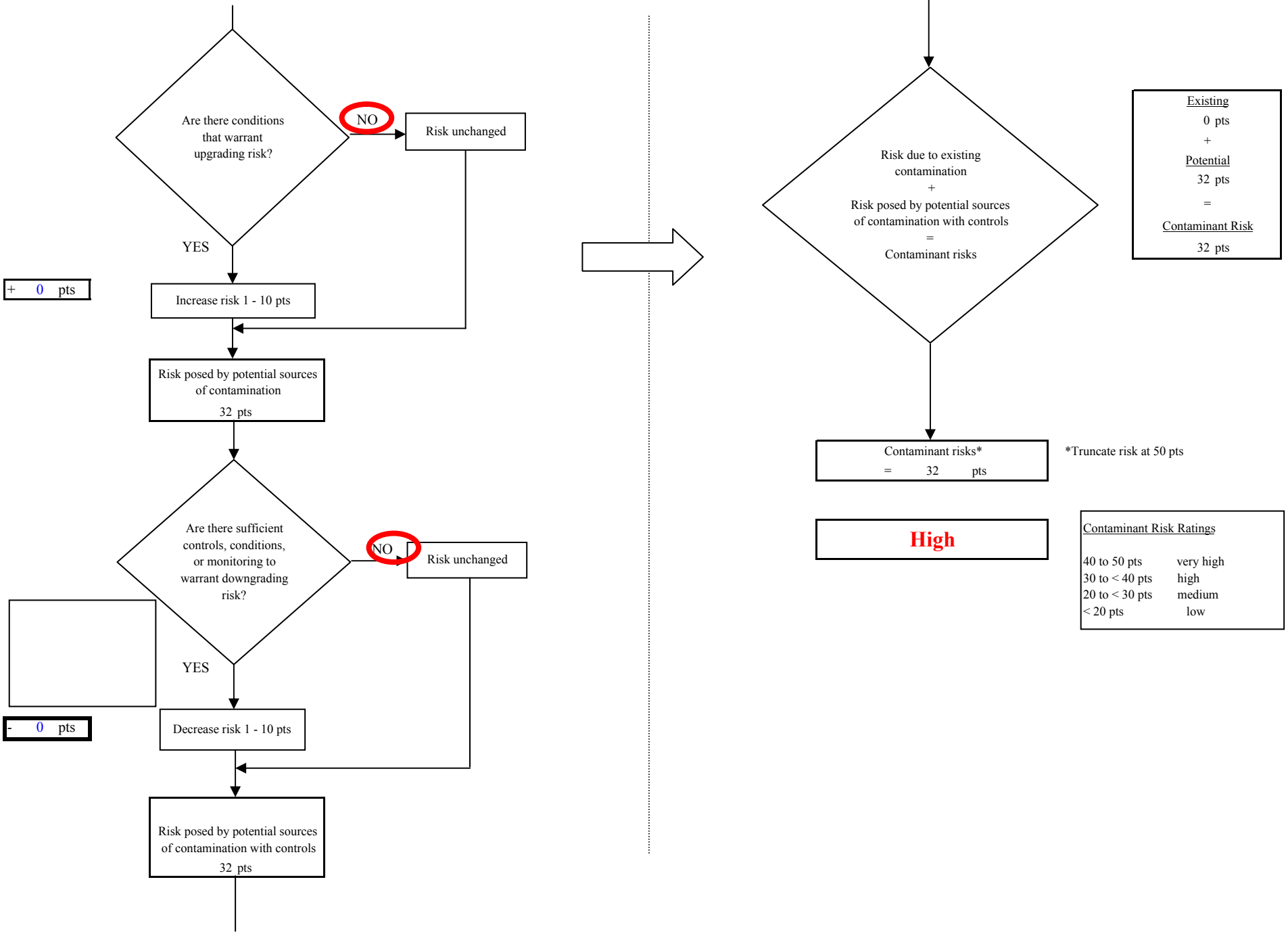
Matrix Score 30

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.

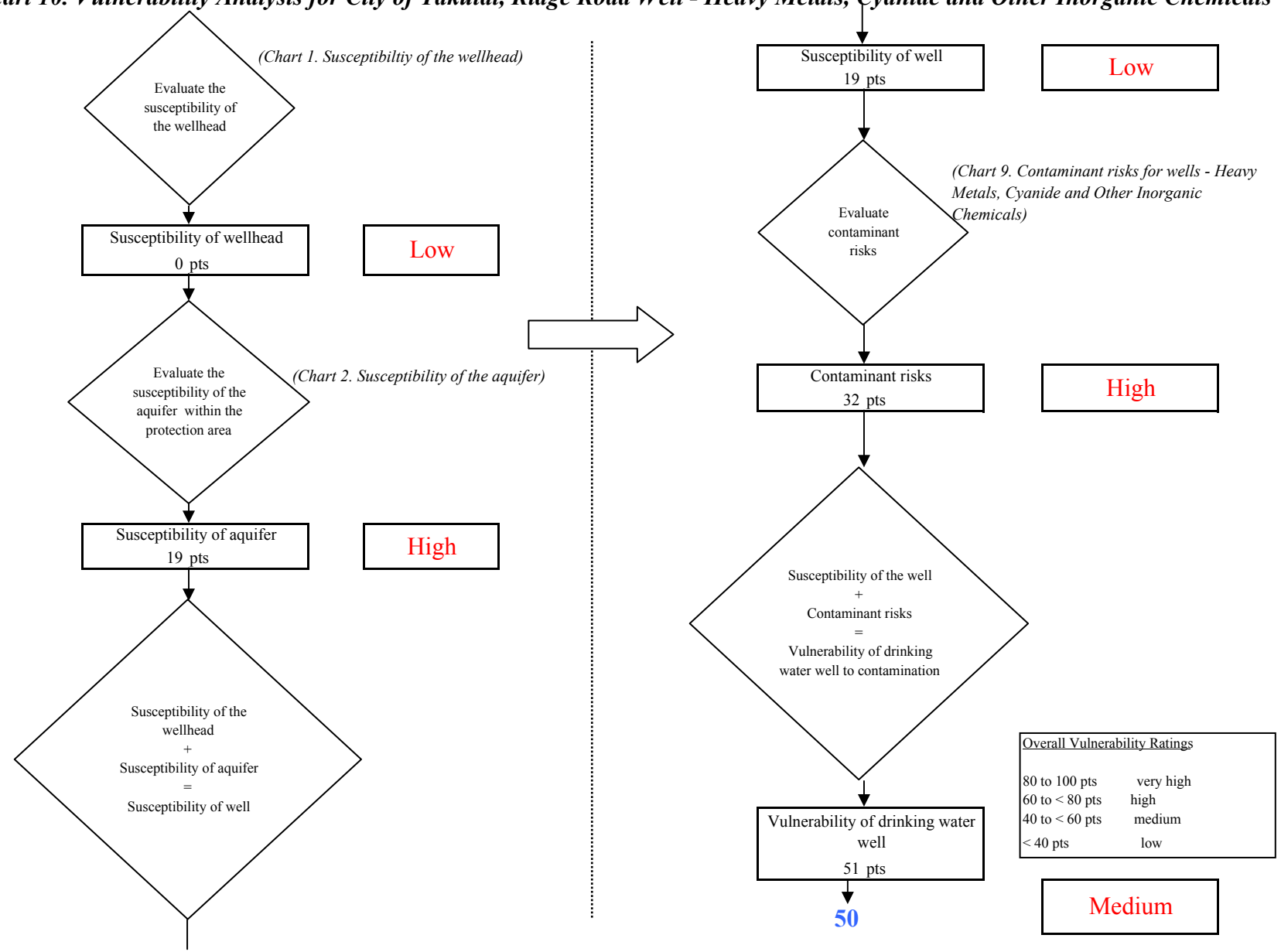




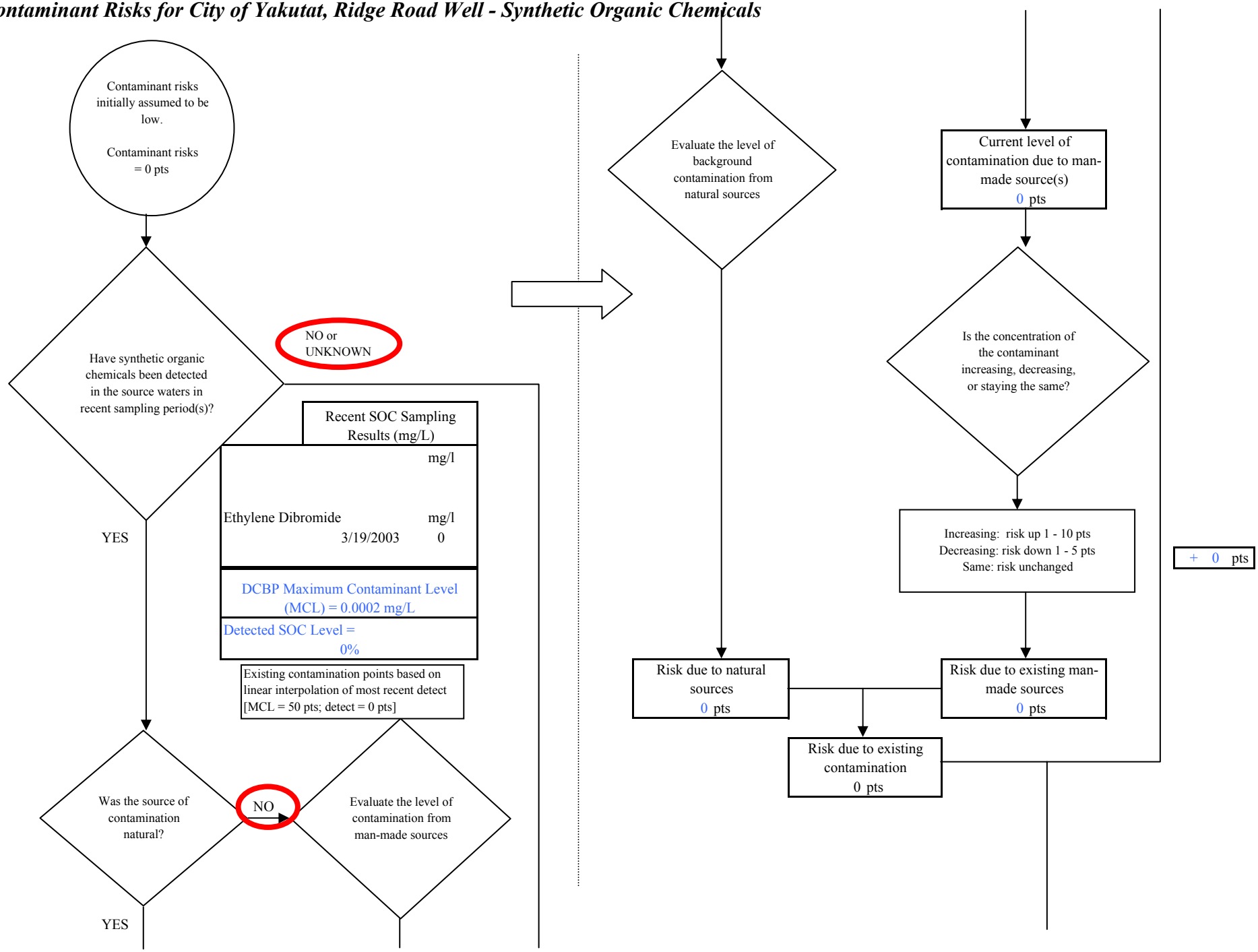
## *Chart 9. Contaminant Risks for City of Yakutat, Ridge Road Well - Heavy Metals, Cyanide and Other Inorganic Chemicals*



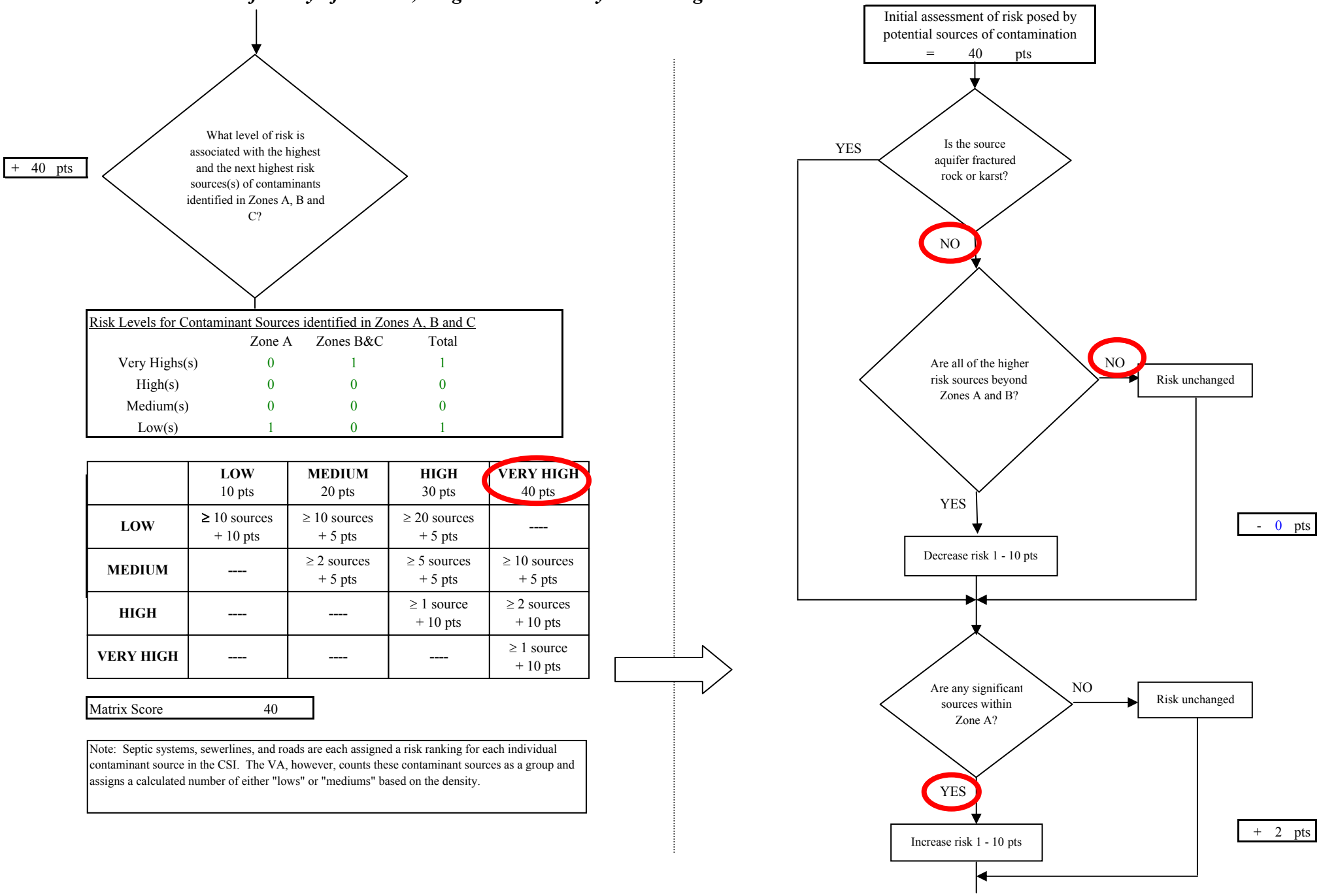
## *Chart 10. Vulnerability Analysis for City of Yakutat, Ridge Road Well - Heavy Metals, Cyanide and Other Inorganic Chemicals*



## *Chart 11. Contaminant Risks for City of Yakutat, Ridge Road Well - Synthetic Organic Chemicals*



## *Chart 11. Contaminant Risks for City of Yakutat, Ridge Road Well - 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 | 1 | 1 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 1 | 0 | 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 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 11. Contaminant Risks for City of Yakutat, Ridge Road Well - Synthetic Organic Chemicals*

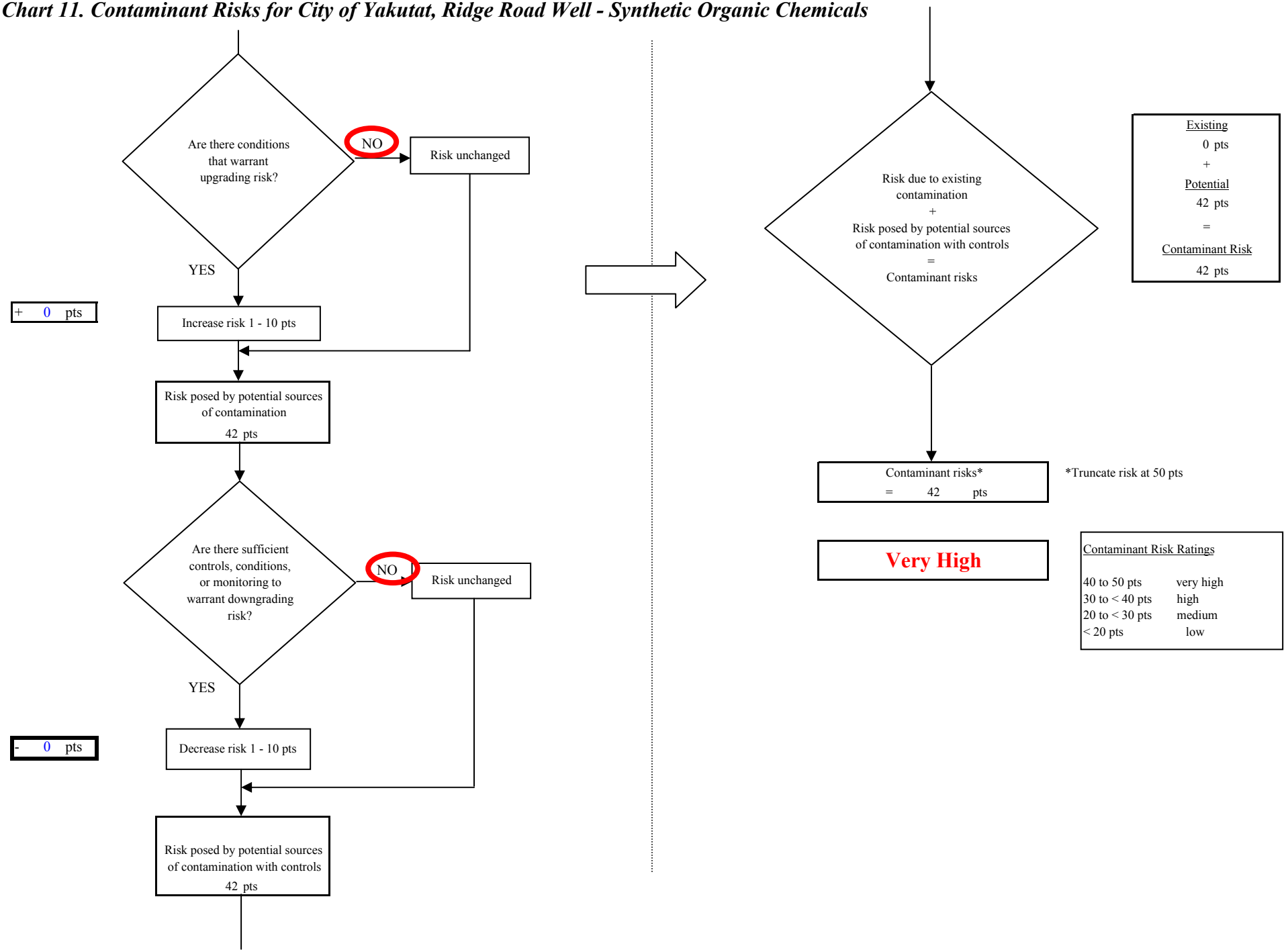


***Chart 12. Vulnerability Analysis for City of Yakutat, Ridge Road Well - Synthetic Organic Chemicals***

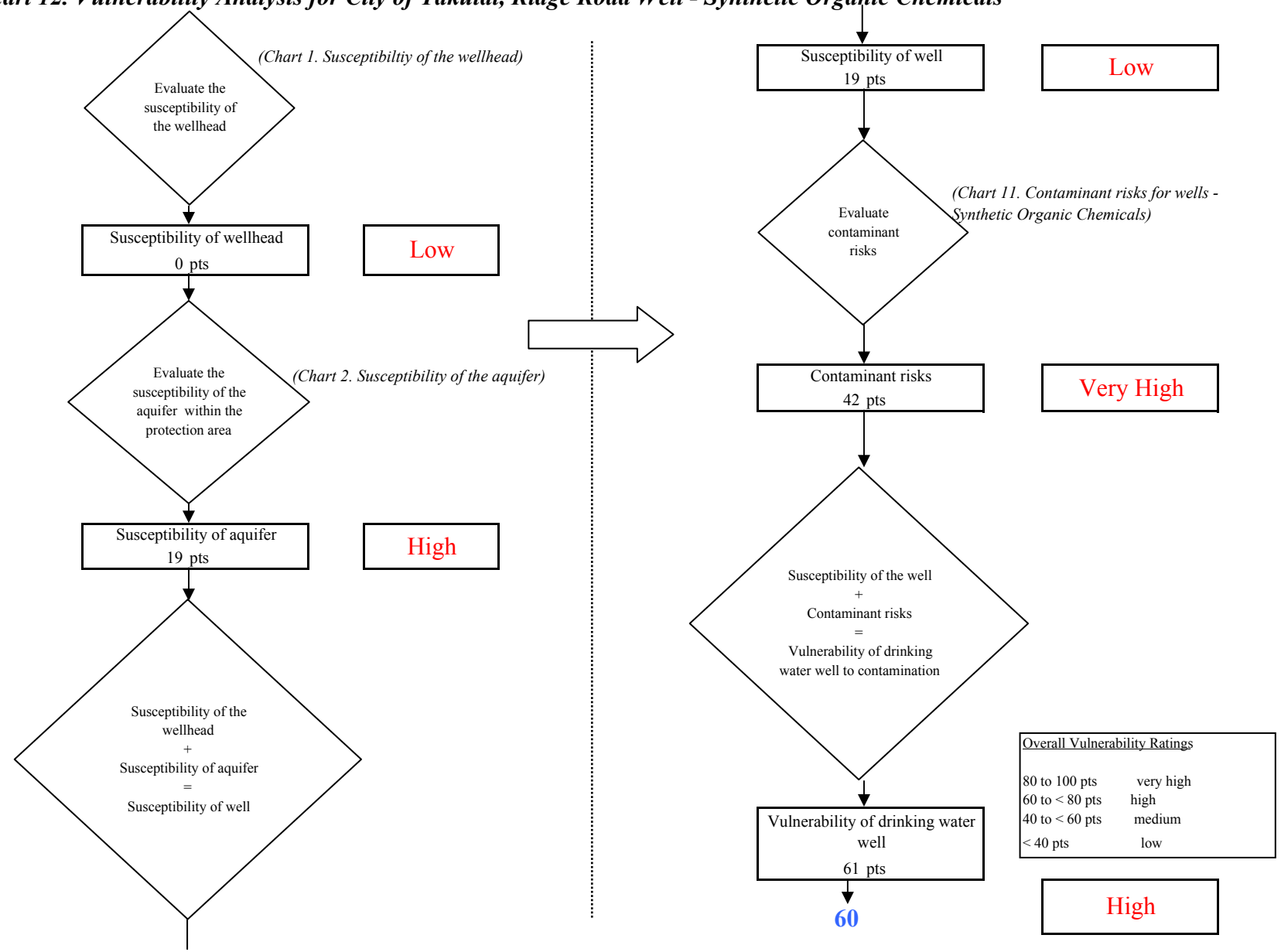
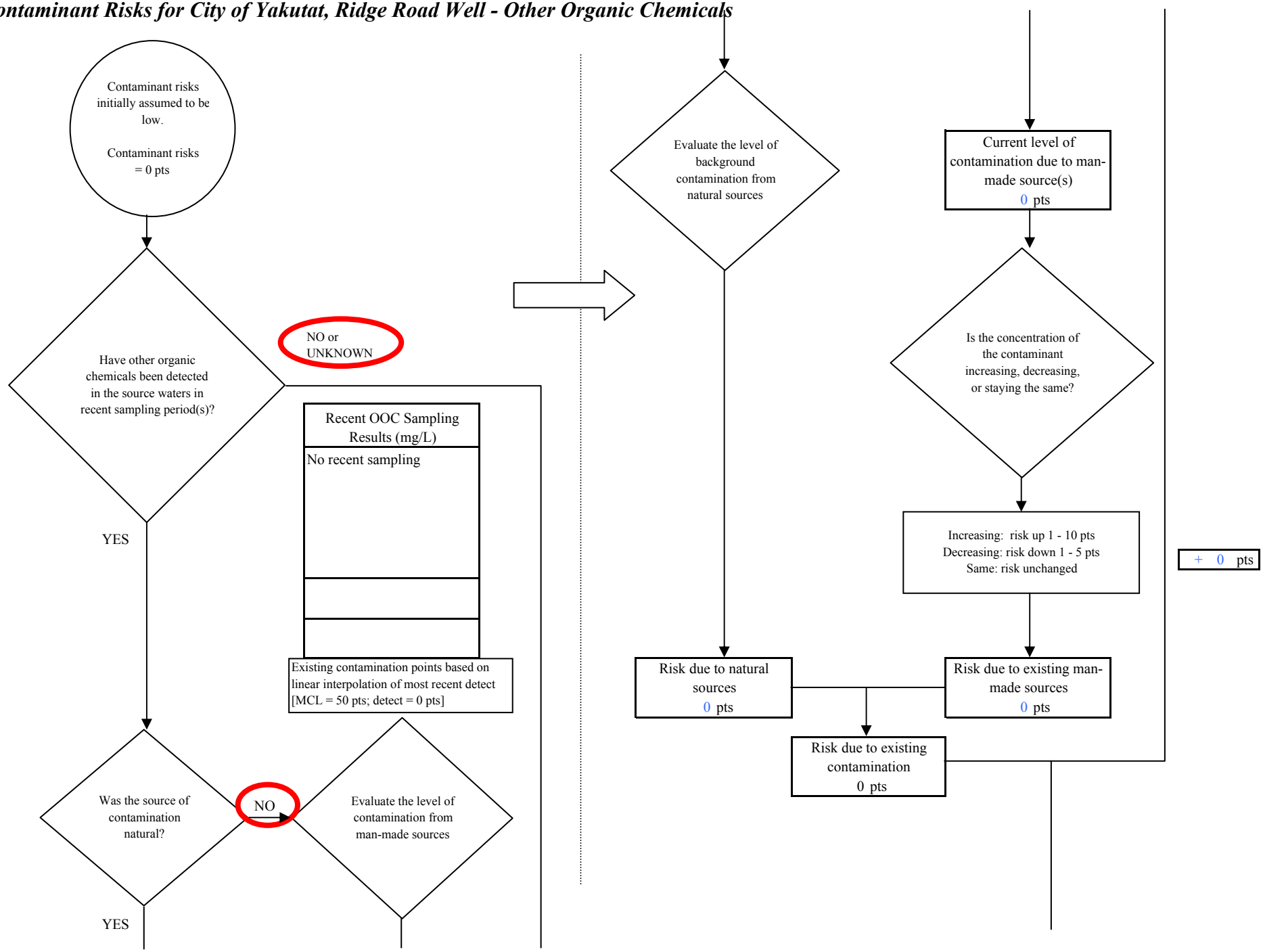
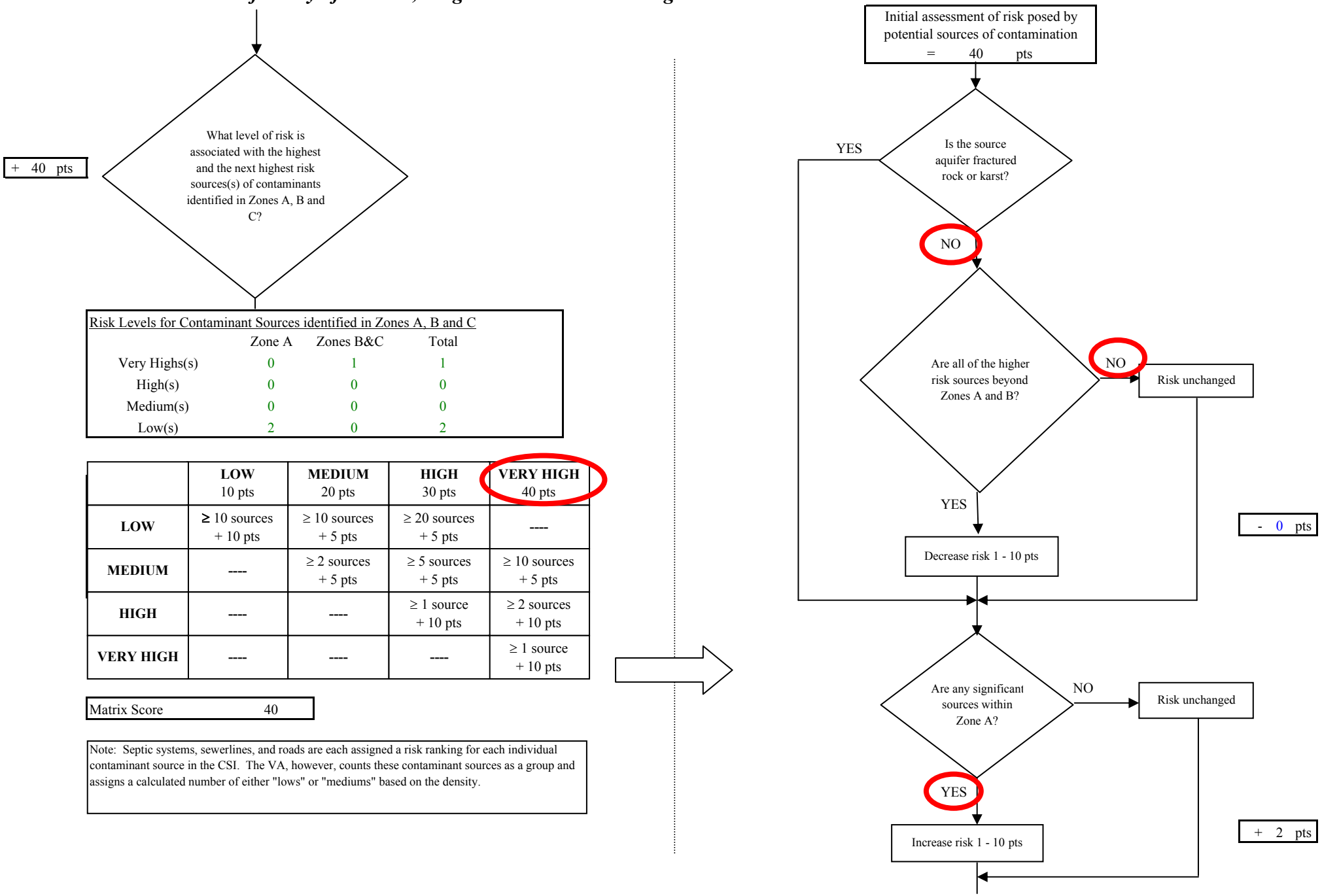


***Chart 13. Contaminant Risks for City of Yakutat, Ridge Road Well - Other Organic Chemicals***



## *Chart 13. Contaminant Risks for City of Yakutat, Ridge Road Well - Other Organic Chemicals*




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

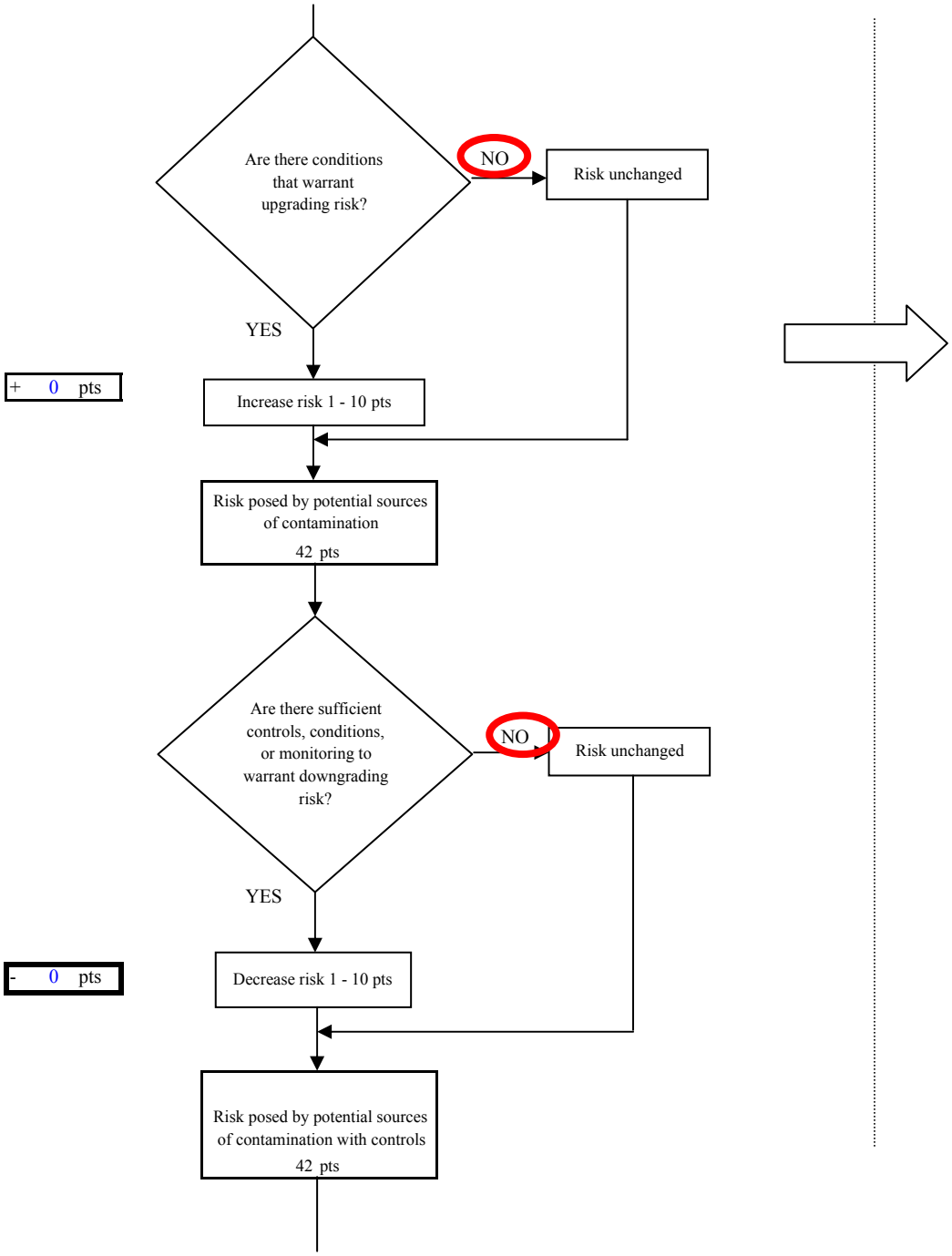
| | Zone A | Zones B&C | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 1 | 1 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 2 | 0 | 2 |

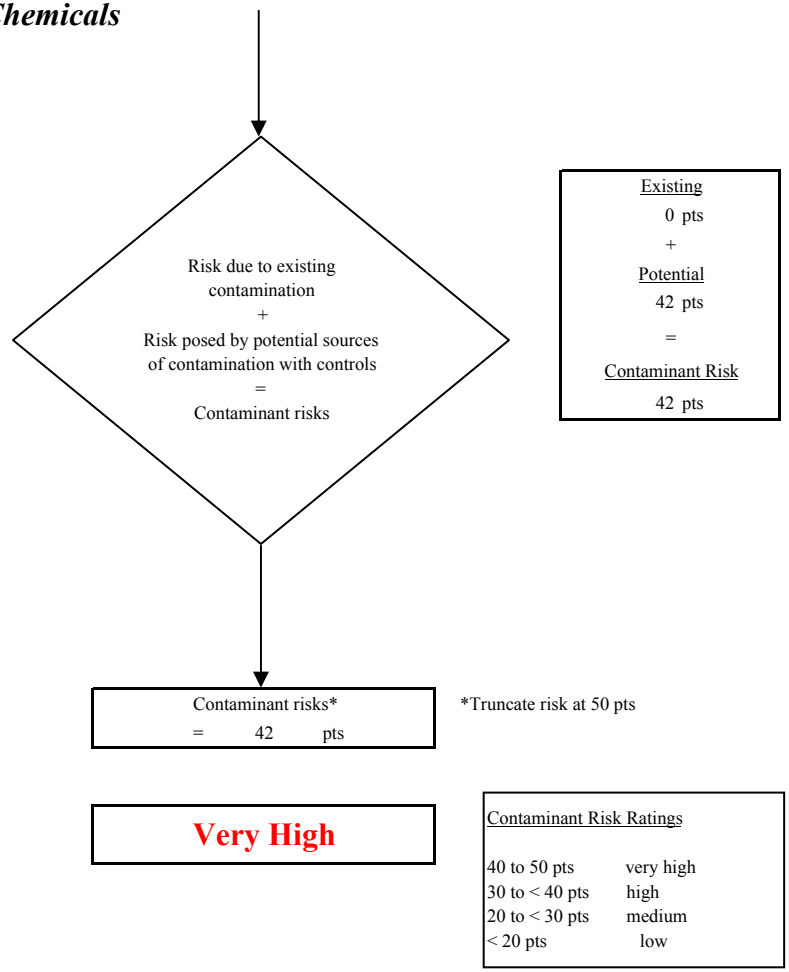
| | **LOW** 10 pts | **MEDIUM** 20 pts | **HIGH** 30 pts | **VERY HIGH** 40 pts |
|---|---|---|---|---|
| **LOW** | ≥ 10 sources + 10 pts | ≥ 10 sources + 5 pts | ≥ 20 sources + 5 pts | ---- |
| **MEDIUM** | ---- | ≥ 2 sources + 5 pts | ≥ 5 sources + 5 pts | ≥ 10 sources + 5 pts |
| **HIGH** | ---- |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

Matrix Score 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 13. Contaminant Risks for City of Yakutat, Ridge Road Well - Other Organic Chemicals*



## *Chart 14. Vulnerability Analysis for City of Yakutat, Ridge Road Well - Other Organic Chemicals*