# Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Barrow, Alaska

Barrow Utilities & Electric Coop., In.

PWSID # 320078.001

August 2003

Drinking Water Protection Program Report #1227

Alaska Department of Environmental Conservation

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

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

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# Source Water Assessment for the Barrow Drinking Water System, Barrow Utilities and Electric Cooperative, Inc.

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

## EXECUTIVE SUMMARY

The public water system for Barrow, Alaska is a Class A water system that obtains water from Isatkoak Reservoir, directly northeast of the community. The Barrow Utilities protection area is approximately 4.1 square miles in size and received a susceptibility rating of "**high**". *A rating of high to very high is typical for all systems with surface water intakes*. 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. Motor vehicle repair shops, above ground fuel tanks, roads, and residential areas are some potential sources of contaminants identified for the drinking water source. 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 susceptibility of the surface water source with the contaminant risks, this water system has received a vulnerability rating of **"high"** for each of the six contaminant categories, except for nitrates and nitrites, which received a vulnerability rating of **"medium".** 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 Barrow Utilities & Electric Cooperative to protect public health.

## DRINKING WATER SYSTEM AND AREA OVERVIEW

Barrow (Sec. 06, T022N, R018W, Umiat Meridian), the northernmost community in North America, is located on the Chukchi Sea coast, 10 miles south of Point Barrow from which it takes its name. It lies 725 air miles from Anchorage. The current population is approximately 4,500 (ADEC, 2003).

The Barrow Utilities public water system is a Class A water system that operates year-round and obtains water from Isatkoak Reservoir, directly northeast of the community. The intake is located on the western edge of the lake, which is accessible directly via road.

Most residents are connected to the water distribution system, but nearly one-half use honeybuckets for sewage disposal. Funds have been requested to serve remaining houses and to construct a second water reservoir. The member-owned Barrow Utilities & Electric Cooperative operates the water and sewage treatment plants, generates and distributes electric power, and distributes piped natural gas for home heating. The North Slope Borough provides all other utilities. Refuse collection services are provided by the North Slope Borough. The Barrow Power Plant is fueled by natural gas (ADCED, 2003).

The climate of Barrow is arctic. Precipitation is light, averaging 5 inches, with annual snowfall of 20 inches. Temperatures range from -56 to 78, averaging 40 during summer. The sun does not set between May 10th and August 2nd each summer, and does not rise between Nov. 18th and January 24th each winter. The daily minimum temperature is below freezing 324 days of the year. Prevailing winds are easterly and average 12 MPH. The Chukchi Sea is typically ice free from mid-June through October. (ADCED, 2003).

The 1998 sanitary survey indicates that the water intake is screened and protected from ice buildup and siltation. The survey also states that the average daily production of the system (when active) is approximately 195,000 gallons per day.

System operators provided information indicating that the approximate water volume of Isatkoak Reservoir is 493 million gallons with an estimated input of water into the drainage basin of the Reservoir of somewhere between 80 million and 1.08 billion gallons per year. There is no surface water inflow between October 30 and April 30.

## BARROW UTILITIES DRINKING WATER PROTECTION AREA

Identifying the pathways most likely for surface contamination to reach water intake areas is the first step in determining the water system's risk. These are initially determined by looking at the drainage area contributing overland water flow to a surface water source intake. The entire drainage area is also known as the "drinking water protection area". Please refer to

pages 10-11of the "Guidance Manual for Class A Public Water Systems" for additional information.

The protection area established for surface water sources by the ADEC is usually separated into three zones, limited by the watershed boundary. These zones correspond to the overland-flow distance that water travels to get to the source. The ADEC Drinking Water Protection Program's Technical Advisory Committee developed guidelines for derivation of these zones in 1998. The following is a summary of the three protection area zones:

**Table 1. Definition of Zones**

| Zone | Definition |
|---|---|
| A | Areas within 1000-ft of lakes or streams |
| B | Areas within 1-mile of lakes or streams |
| C | The watershed boundary |

The protection area for the Barrow Utilities water intake includes each of these Zones. Due to the small size of the overall protection area, Zones B and C cover the same region (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 Barrow Utilities protection area. This inventory was completed through a search of agency records and other publicly available information. There is a wide array of potential contamination sources to surface water. These contaminants are found within agricultural, residential, commercial, and industrial areas, but *can also occur within areas that have little or no development*.

For 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.

Sources identified in the Barrow Utilities protection area are displayed on Map 2 of Appendix C and summarized in Table 1 of Appendix B.

## RANKING OF CONTAMINANT RISKS

Once potential and existing sources of contamination have been identified, they are assigned a ranking according to what category and level of risk they represent. Ranking of contaminant risks for "potential" or "existing" sources of contamination is a function of the toxicity and the volume of specific contaminants associated with that source. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

The time-of-travel for contaminants within the water is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zone A because of their short life span. Only "Very High" and "High" rankings are inventoried within Zones B and C due to the probability of contaminant dilution by the time the contaminants reach the water intake.

The remaining tables in Appendix B (if necessary) contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

## VULNERABILITY OF THE DRINKING WATER SYSTEM

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

- Surface Water Susceptibility; and
- Contaminant risks.

Appendix D contains 13 charts, which together form the 'Vulnerability Analysis' for the public drinking water Source Water Assessment. Chart 1 analyzes the 'Susceptibility of the Surface Water Source' to contamination by looking at the climate, terrain, and intake location. Chart 2 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 intake area. Chart 3 contains the 'Vulnerability Analysis for Bacteria and Viruses', which is a composite score of the Vulnerability Analysis and the overall Susceptibility. Charts 4 through 13 repeat the Contaminant Risks and Vulnerability Analyses for

nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively.

A score for the Surface Water Susceptibility of the source is reached by considering the properties of the water intake and the surrounding area. The derivation of this information is presented below and the data for this source is shown in Chart 1 of Appendix D.

Susceptibility of the Surface Water Source – always considered to be "high" (30 points)

+

Adequate Construction of the Intake (0 – 5 Points)

+

Runoff Potential Within Zone B (0 – 5 Points)

+

Dilution Capacity of the Surface Water (0 – 10 Points)

=

Natural Susceptibility
(0 – 50 Points)

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

| Surface Water Source Susceptibility Ratings | |
|---|---|
| 40 to 50 pts | Very High |
| 30 to < 40 pts | High |

**Table 2. Susceptibility of the Water Source**

| | Score | Rating |
|---|---|---|
| Minimum Allowable Susceptibility | 30 | |
| Intake Construction Adequate | 0 | |
| Runoff Potential | 0 | |
| Dilution Capacity | 5 | |
| ***Overall Susceptibility*** | ***35*** | ***High*** |

For contaminants, risks to a drinking water source depend on the type, number or density, and distribution of the contaminant sources. The Contaminant Risk score has been derived from an examination of existing, and historical contamination sources that have been detected in the protection area 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 the 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. Barrow Utilities Contaminant Risks**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 40 | Very High |
| Nitrates and/or Nitrites | 13 | Low |
| Volatile Organic Chemicals | 35 | High |
| Heavy Metals, Cyanide, and Other Inorganic Chemicals | 35 | High |
| Synthetic Organic Chemicals | 25 | Medium |
| Other Organic Chemicals | 35 | High |

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

Susceptibility of the Surface Water Source

(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 and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

**Table 4. Barrow Utilities Overall Vulnerability**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 75 | High |
| Nitrates and Nitrites | 45 | Medium |
| Volatile Organic Chemicals | 70 | High |
| Heavy Metals, Cyanide, and Other Inorganic Chemicals | 70 | High |
| Synthetic Organic Chemicals | 60 | High |
| Other Organic Chemicals | 70 | High |

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is "very high".

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2003). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination. Typically, coliform detection in raw water samples collected from surface water sources is normal. (See Chart 2 – Contaminant Risks for Bacteria and Viruses in Appendix D).

No positive bacteria counts have been detected during the 1999 - 2001 sampling period.

Residential areas and roads could serve as possible sources of bacteria for the drinking water system. See Table 2 in Appendix D for a complete listing.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the source, the overall vulnerability of the source to bacteria and virus contamination is considered "high".

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is "low" (See Chart 4 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

The Maximum Contaminant Level (MCL) for nitrates 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 (EPA, 2003).

Sampling history for the water source indicates that low concentrations of nitrates (below MCL) were detected in sampling performed in 1999-2002. No nitrates have been detected in 2003 sampling data.

Possible sources of nitrate/nitrites are residential areas, airports, roads, and military ordinances. See Table 3 in Appendix D for a complete listing.

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

**Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is "high" (See Chart 6 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Chloroform and trihalomethanes were detected at levels below the MCL during sampling in 2003, although both of these chemicals typically originate during the process of water treatment and not from the source waters. The MCL for chloroform is 0.2 milligrams per liter (mg/L) and the MCL for total trihalomethanes is 0.1 mg/L.

Aside from being byproducts of the drinking water treatment process, possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports. See Table 4 in Appendix D for a complete listing.

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the source, the overall vulnerability of the source to contamination remains "high".

**Heavy Metals, Cyanide, and Other Inorganic Chemicals**

The contaminant risk for heavy metals is "high". Low levels of copper and lead were detected in samples collected during 2000-2002 (See Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). The MCL for copper is 1.3 mg/l. and the MCL for lead is 0.015 mg/l.

The most common source of these chemicals is the infrastructure of the distribution system following the treatment process.

After combining the contaminant risk for heavy metals with the natural susceptibility of the source, the overall vulnerability of the well to contamination is “high”.

See Table 5 in Appendix D for a listing of the identified possible sources of heavy metals, cyanide, and other organic chemicals in the Protection Area.

**Synthetic Organic Chemicals**

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

Review of the historical sampling data indicates that test results for ethylene dibromide in 2003 were negative.

See Table 6 in Appendix D for a listing of the identified possible sources of synthetic organic chemicals in the Protection Area.

**Other Organic Chemicals**

The contaminant risk for other organic chemicals is “high”. After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to other organic chemicals of the source 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 sampled recently.

See Table 7 in Appendix D for a listing of the identified possible sources of other organic chemicals in the Protection Area.

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

# REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2003 [WWW document]. URL: http://www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm

City of Juneau, 2003 [WWW document]. URL: http://www.juneau.org/water/h2odistr.php

United States Environmental Protection Agency (EPA), 2003 [WWW document]. URL: http://www.epa.gov/safewater/mcl.html.

# APPENDIX A

## Barrow Utilities
## Drinking Water Protection Area Location Map
## (Map 1)

Barrow Utilities & Elec. Coop.
Drinking Water Protection Area

Area enlarged at left

# Map 1: Barrow Utilities & Elec. Coop Drinking Water Protection Area

**PWSID: 320078.001**

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

1:56,262

***Data Sources:***

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

*Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.*

*For this PWS Zone C (the entire watershed) covers the same area as Zone B (areas within 1-mile of the lake).*

**Legend**

- Barrow Utilities & Elec. Coop. PWS
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area

Wainwright
Atqasuk
Nuiqsut
Point Lay
Point Hope
Red Dog Mine
Kivalina
Noatak
Anaktuvuk Pass
Kotzebue
Kiana
Ambler
Kobuk
Bettles

0 15 30 60 90 Miles

# APPENDIX B

## Contaminant Source Inventory and Risk Rankings (Tables 1 - 7)

***Table 1***

# *Contaminant Source Inventory for* ***Barrow Utilities & Elec. Coop.***

***PWSID 320078.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Motor vehicle rental facilities - cars, trucks, ATV's, snow machines (with service department) | C30 | C30-1 | A | 2 | UIC<br>(From Barrow Utilities Map) |
| Motor /motor vehicle repair shops | C31 | C31-1 | A | 2 | From USGS Community Profile Map<br>NSB Schol District Bus Shop |
| Motor /motor vehicle repair shops | C31 | C31-2 | A | 2 | NSB Transit Bus Maintenance Facility<br>(From Barrow Utilities Map) |
| Domestic water treatment - pond/lagoon (reject water) | D06 | D06 - 1 | A | 2 | Barrow Utilities Mapping |
| Ordinances (military stock piles or shooting ranges, detonated or undetonated?) | M03 | M03-1 | A | 2 | USGS Community Profile Map<br>National Guard Amory |
| Residential Areas | R01 | R01- 1-10 | A | 2 | USGS Community Profile Map |
| Tanks, fuel, residential (above ground) | R07 | R07-1-2 | A | 2 | USGS Community Profile Map<br>PHS Generator, Barrow Utilities Backup Fuel |
| Tanks, aviation fuel (above ground) | T02 | T02-1 | A | 2 | 3 Tanks<br>(From Barrow Utilities Map) |
| Contaminated sites, DEC recognized, non-Superfund, non-RCRA | U04 | U04-2 | A | 2 | From USGS Community Profile Map<br>PHS Barrow Service Unit Hospital |
| Airports | X14 | X14-1 | A | 2 | USGS 1:63,000 Topographic Maps<br>Will Rogers Memorial Airport |
| Bus maintenance facilities | X16 | X16-1 | A | 2 | USGS Community Profile Map<br>PHS Bus Garage |
| Bus maintenance facilities | X16 | X16-2 | A | 2 | Barrow Utilidoor Service<br>(From Barrow Utilities Map) |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1-6 | A | 2 | USGS Community Profile Map |
| Highways and roads, dirt/gravel | X24 | X24-1-3 | A | 2/3 | USGS 1:63,000 Topographic Maps |
| Aircraft maintenance shops | C01 | C01-1 | B | 2 | NSB Search and Rescue Dept.<br>(From Barrow Utilities Map) |
| Contaminated sites, DEC recognized, non-Superfund, non-RCRA | U04 | U04-1 | B | 2 | DWPP Contaminated Sites Database<br>Mark Air |

***Table 2***

# *Contaminant Source Inventory and Risk Ranking for Barrow Utilities & Elec. Coop. Sources of Bacteria and Viruses*

***PWSID 320078.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Domestic water treatment - pond/lagoon (reject water) | D06 | D06 - 1 | A | High | 2 | Barrow Utilities Mapping |
| Residential Areas | R01 | R01- 1-10 | A | Low | 2 | USGS Community Profile Map |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1-6 | A | Low | 2 | USGS Community Profile Map |
| Highways and roads, dirt/gravel | X24 | X24-1-3 | A | Low | 2/3 | USGS 1:63,000 Topographic Maps |

***Table 3***

# *Contaminant Source Inventory and Risk Ranking for Barrow Utilities & Elec. Coop. Sources of Nitrates/Nitrites*

***PWSID 320078.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Ordinances (military stock piles or shooting ranges, detonated or undetonated?) | M03 | M03-1 | A | Low | 2 | USGS Community Profile Map<br>National Guard Amory |
| Residential Areas | R01 | R01- 1-10 | A | Low | 2 | USGS Community Profile Map |
| Airports | X14 | X14-1 | A | Low | 2 | USGS 1:63,000 Topographic Maps<br>Will Rogers Memorial Airport |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1-6 | A | Low | 2 | USGS Community Profile Map |
| Highways and roads, dirt/gravel | X24 | X24-1-3 | A | Low | 2/3 | USGS 1:63,000 Topographic Maps |

**Table 4**

# *Contaminant Source Inventory and Risk Ranking for Barrow Utilities & Elec. Coop. Sources of Volatile Organic Chemicals*

**PWSID 320078.001**

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Motor vehicle rental facilities - cars, trucks, ATV's, snow machines (with service department) | C30 | C30-1 | A | Medium | 2 | UIC<br>(From Barrow Utilities Map) |
| Motor /motor vehicle repair shops | C31 | C31-1 | A | Medium | 2 | From USGS Community Profile Map<br>NSB Schol District Bus Shop |
| Motor /motor vehicle repair shops | C31 | C31-2 | A | Medium | 2 | NSB Transit Bus Maintenance Facility<br>(From Barrow Utilities Map) |
| Residential Areas | R01 | R01- 1-10 | A | Low | 2 | USGS Community Profile Map |
| Tanks, fuel, residential (above ground) | R07 | R07-1-2 | A | Low | 2 | USGS Community Profile Map<br>PHS Generator, Barrow Utilities Backup Fuel |
| Tanks, aviation fuel (above ground) | T02 | T02-1 | A | Medium | 2 | 3 Tanks<br>(From Barrow Utilities Map) |
| Airports | X14 | X14-1 | A | Medium | 2 | USGS 1:63,000 Topographic Maps<br>Will Rogers Memorial Airport |
| Bus maintenance facilities | X16 | X16-1 | A | Low | 2 | USGS Community Profile Map<br>PHS Bus Garage |
| Bus maintenance facilities | X16 | X16-2 | A | Low | 2 | Barrow Utilidoor Service<br>(From Barrow Utilities Map) |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1-6 | A | Low | 2 | USGS Community Profile Map |
| Highways and roads, dirt/gravel | X24 | X24-1-3 | A | Low | 2/3 | USGS 1:63,000 Topographic Maps |
| Aircraft maintenance shops | C01 | C01-1 | B | Low | 2 | NSB Search and Rescue Dept.<br>(From Barrow Utilities Map) |

**Table 5**

# *Contaminant Source Inventory and Risk Ranking for Barrow Utilities & Elec. Coop. Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

**PWSID 320078.001**

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Motor vehicle rental facilities - cars, trucks, ATV's, snow machines (with service department) | C30 | C30-1 | A | Low | 2 | UIC<br>(From Barrow Utilities Map) |
| Motor /motor vehicle repair shops | C31 | C31-1 | A | Medium | 2 | From USGS Community Profile Map<br>NSB Schol District Bus Shop |
| Motor /motor vehicle repair shops | C31 | C31-2 | A | Medium | 2 | NSB Transit Bus Maintenance Facility<br>(From Barrow Utilities Map) |
| Ordinances (military stock piles or shooting ranges, detonated or undetonated?) | M03 | M03-1 | A | Medium | 2 | USGS Community Profile Map<br>National Guard Amory |
| Residential Areas | R01 | R01- 1-10 | A | Low | 2 | USGS Community Profile Map |
| Airports | X14 | X14-1 | A | Low | 2 | USGS 1:63,000 Topographic Maps<br>Will Rogers Memorial Airport |
| Bus maintenance facilities | X16 | X16-1 | A | Low | 2 | USGS Community Profile Map<br>PHS Bus Garage |
| Bus maintenance facilities | X16 | X16-2 | A | Low | 2 | Barrow Utilidoor Service<br>(From Barrow Utilities Map) |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1-6 | A | Low | 2 | USGS Community Profile Map |
| Highways and roads, dirt/gravel | X24 | X24-1-3 | A | Low | 2/3 | USGS 1:63,000 Topographic Maps |
| Aircraft maintenance shops | C01 | C01-1 | B | Low | 2 | NSB Search and Rescue Dept.<br>(From Barrow Utilities Map) |

***Table 6***

# *Contaminant Source Inventory and Risk Ranking for Barrow Utilities & Elec. Coop. Sources of Synthetic Organic Chemicals*

***PWSID 320078.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Residential Areas | R01 | R01- 1-10 | A | Low | 2 | USGS Community Profile Map |
| Airports | X14 | X14-1 | A | Medium | 2 | USGS 1:63,000 Topographic Maps<br>Will Rogers Memorial Airport |

**Table 7**

# *Contaminant Source Inventory and Risk Ranking for Barrow Utilities & Elec. Coop. Sources of Other Organic Chemicals*

**PWSID 320078.001**

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Motor vehicle rental facilities - cars, trucks, ATV's, snow machines (with service department) | C30 | C30-1 | A | Medium | 2 | UIC<br>(From Barrow Utilities Map) |
| Motor /motor vehicle repair shops | C31 | C31-1 | A | Medium | 2 | From USGS Community Profile Map<br>NSB Schol District Bus Shop |
| Motor /motor vehicle repair shops | C31 | C31-2 | A | Medium | 2 | NSB Transit Bus Maintenance Facility<br>(From Barrow Utilities Map) |
| Residential Areas | R01 | R01- 1-10 | A | Low | 2 | USGS Community Profile Map |
| Airports | X14 | X14-1 | A | Medium | 2 | USGS 1:63,000 Topographic Maps<br>Will Rogers Memorial Airport |
| Bus maintenance facilities | X16 | X16-1 | A | Medium | 2 | USGS Community Profile Map<br>PHS Bus Garage |
| Bus maintenance facilities | X16 | X16-2 | A | Medium | 2 | Barrow Utilidoor Service<br>(From Barrow Utilities Map) |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1-6 | A | Low | 2 | USGS Community Profile Map |
| Highways and roads, dirt/gravel | X24 | X24-1-3 | A | Low | 2/3 | USGS 1:63,000 Topographic Maps |
| Aircraft maintenance shops | C01 | C01-1 | B | Low | 2 | NSB Search and Rescue Dept.<br>(From Barrow Utilities Map) |

# APPENDIX C

## Barrow Utilities
## Drinking Water Protection Area
## and Potential and Existing Contaminant Sources
## (Maps 2 & 3)

D04-1 Domestic Wastewater Sludge Land Application Area
(reject water lagoon)
Barrow Utilities & Electric Coop. Inc.

D05-1 Domestic Wastewater Treatment Plants
Water & Sewage Treatment Facility

R07-1 Residential Fuel Tanks (above ground)
PHS Generator

X16-1 Bus Maintenance Facilities
PHS Bus Garage

M03-1 Military Ordinances
National Guard Armory

X20-1-6 Paved Roads

R01-1-8 Residential Areas

U04-1 Contaminated Sites
Mark Air, Barrow Airport

X14-1 Airports
Wiley Post - Will Rogers Memorial Airport

U04-2 Contaminated Sites
PHS Barrow Service Unit Hospital

R07-2 Residential Fuel Tanks (above ground)
Barrow Utilities, Inc. Fuel Tanks

Water System Intake

R07 - 2
Residential Fuel Tanks (above ground)
Barrow Utilities backup fuel

X16 - 2
Barrow Utilities Maintenance Facility
(BUS) Barrow Utilidoor Service

X24-1 & 2 Dirt/Gravel Roads
Tractor Trails

C31-1 Motor Vehicle Repair Shop
NSB School District Bus Shop

C31-2 Motor Vehicle Repair
NSB Transit Bus Maintenance Facility

C01 - 1
NSB Search and Rescue Dept.
Airplane and helicopter maintenance

C30 - 1
UIC, Car Rental Facility

T02 - 1
Aviation Fuel Storage Tanks (3)
Approx. 10,000 gallons each

Area enlarged at left

# Map 2: Potential and Existing Contaminant Sources

**PWSID: 320078.001**

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 2,000 4,000 Feet

1:14,000

***Data Sources:***

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

***Barrow Map***
***- Barrow Util. & Elec. Cooperative, Inc.***

*Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.*

*For this PWS Zone C (the entire watershed) covers the same area as Zone B (areas within 1-mile of the lake).*

**Legend**

- Barrow Utilities & Elec. Coop. PWS
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Residential Areas
- Transportation

N W E S

0 1 2 Miles

July 18, 2003

X24-3 Dirt/Gravel Roads
Tractor Trail

# Map 3: Potential and Existing Contaminant Sources

**PWSID: 320078.001**

0 2,000 4,000 Feet

1:14,019

***Data Sources:***

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

*Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.*

*For this PWS Zone C (the entire watershed) covers the same area as Zone B (areas within 1-mile of the lake).*

**Legend**

- Barrow Utilities & Elec. Coop. PWS
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Transportation
- River/Stream

Area enlarged at left

N W E S

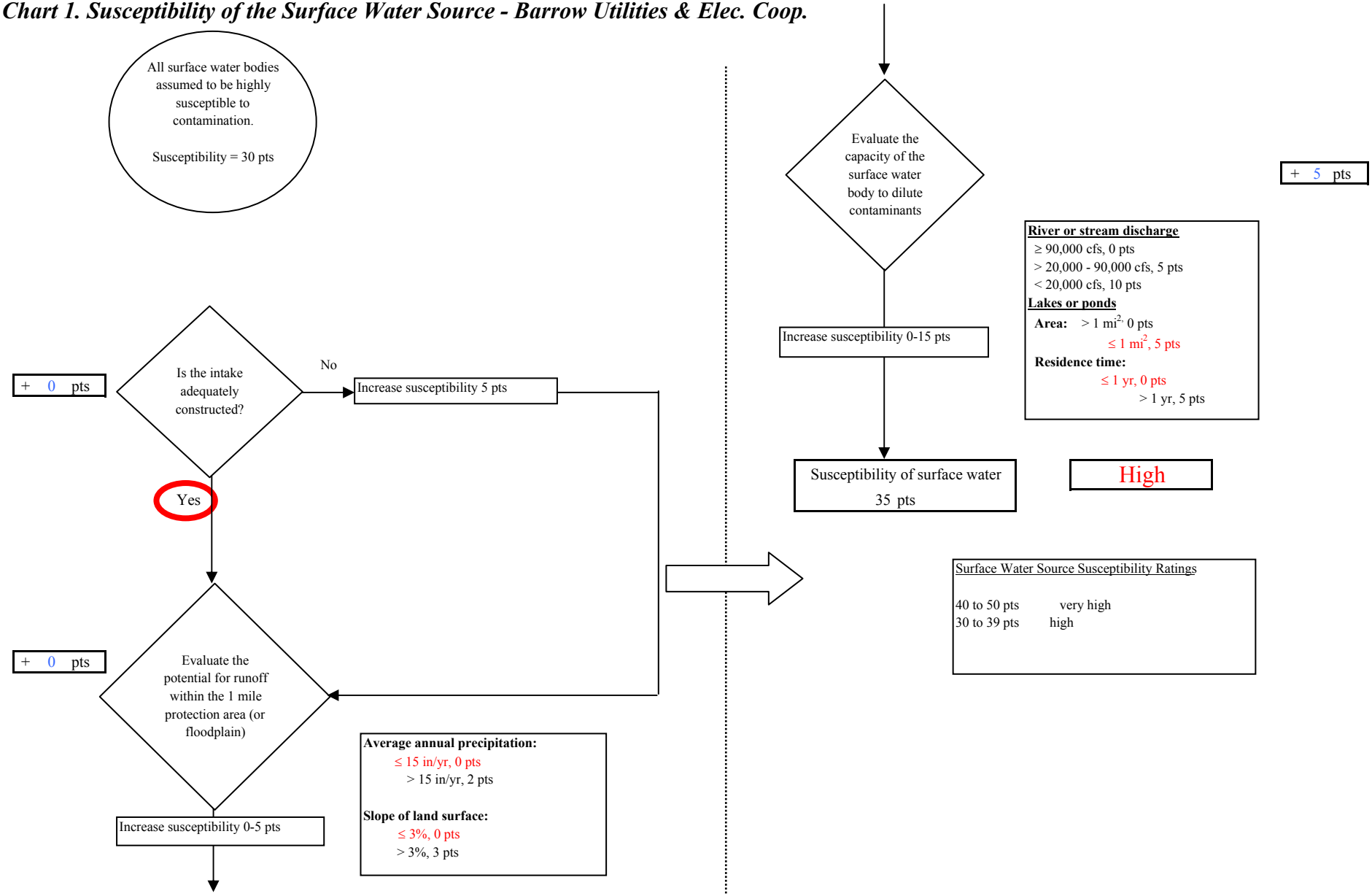
0 2.5 5 Miles

July 21, 2003

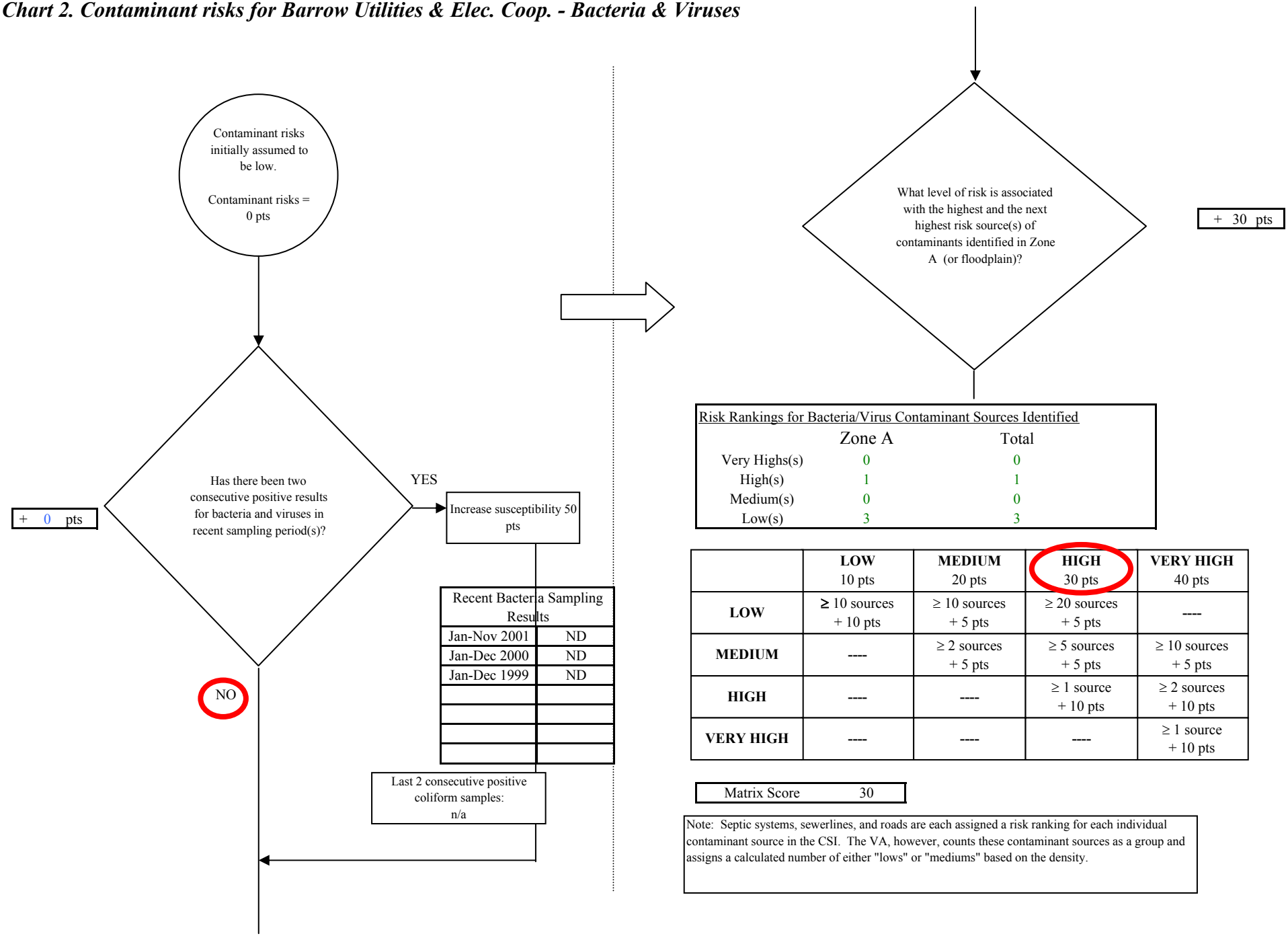
# APPENDIX D

## Vulnerability Analysis and Contaminant Risks
**(Charts 1-13)**

## *Chart 1. Susceptibility of the Surface Water Source - Barrow Utilities & Elec. Coop.*



## *Chart 2. Contaminant risks for Barrow Utilities & Elec. Coop. - Bacteria & Viruses*




Risk Rankings for Bacteria/Virus Contaminant Sources Identified

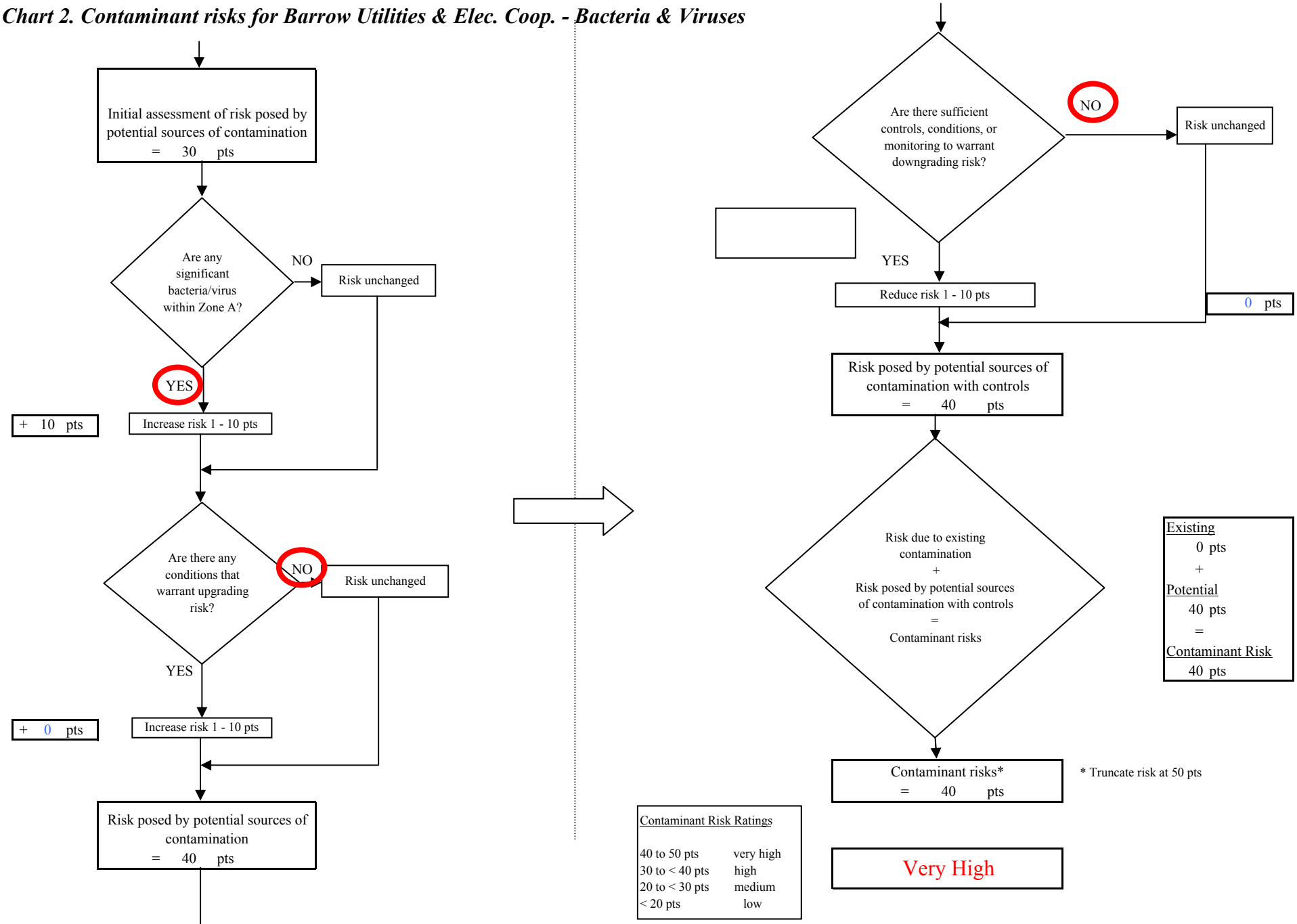
| | Zone A | Total |
|---|---|---|
| Very Highs(s) | 0 | 0 |
| High(s) | 1 | 1 |
| Medium(s) | 0 | 0 |
| Low(s) | 3 | 3 |

| | **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 |

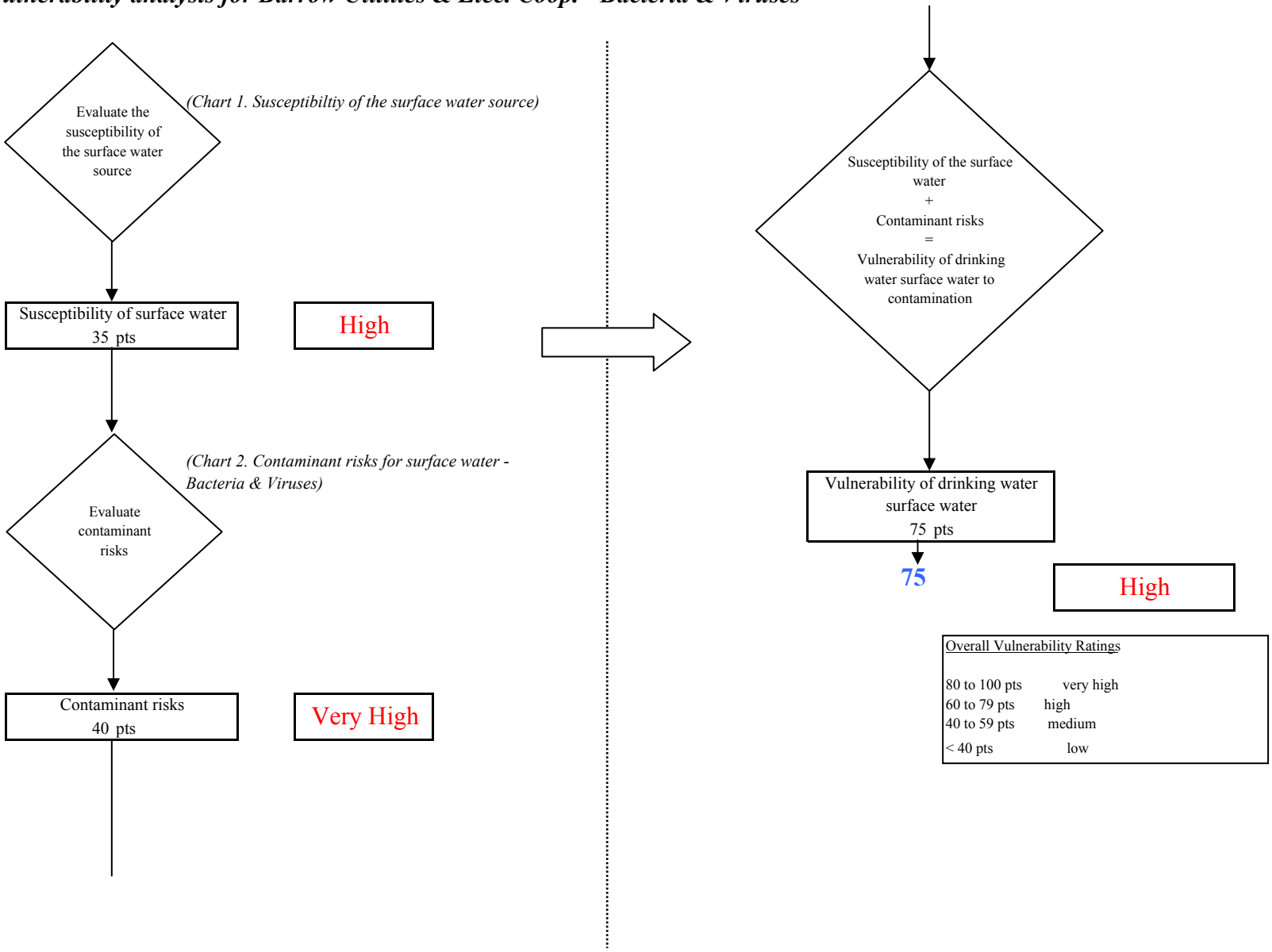
Matrix Score 30

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.

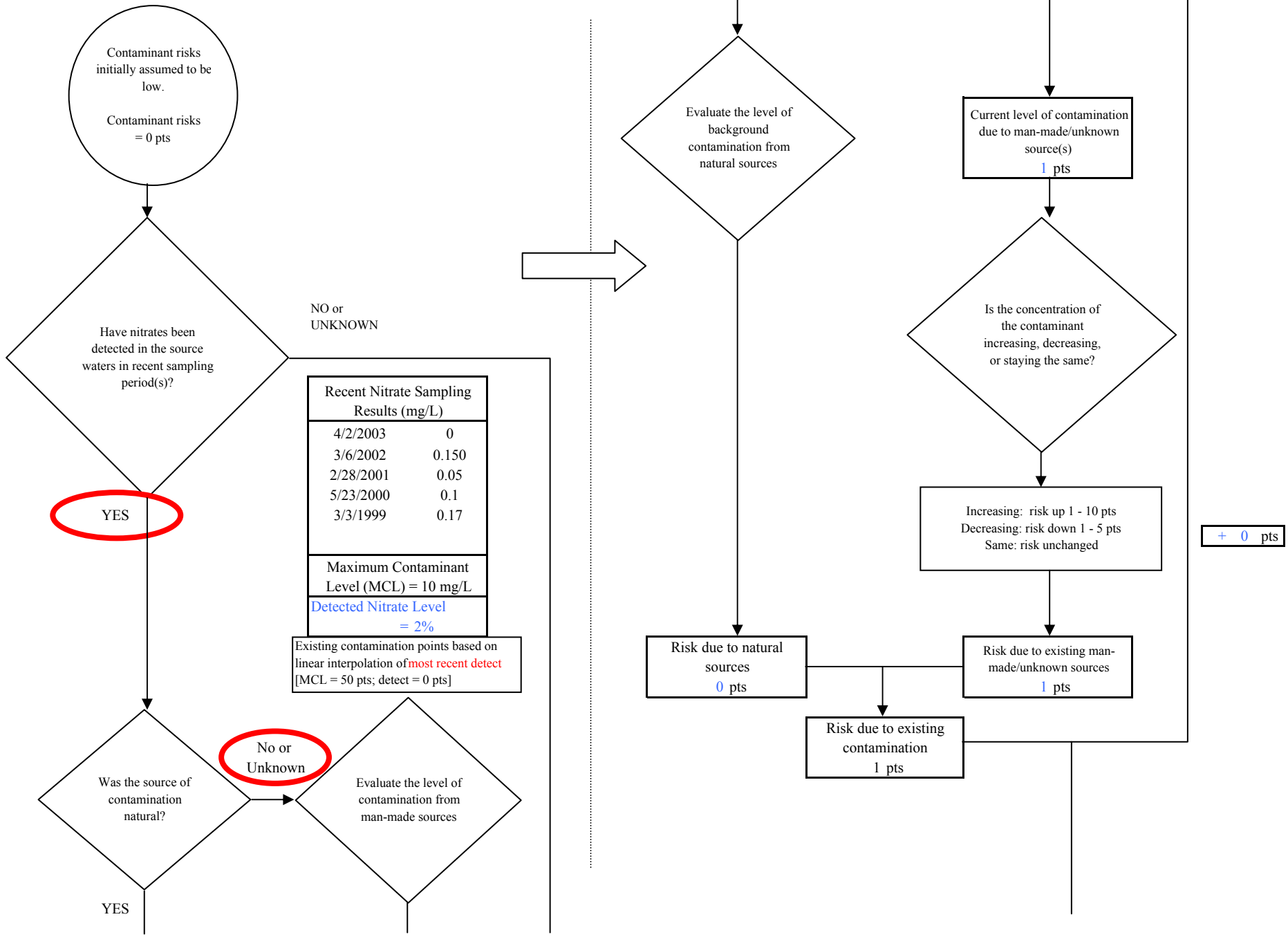
## *Chart 2. Contaminant risks for Barrow Utilities & Elec. Coop. - Bacteria & Viruses*



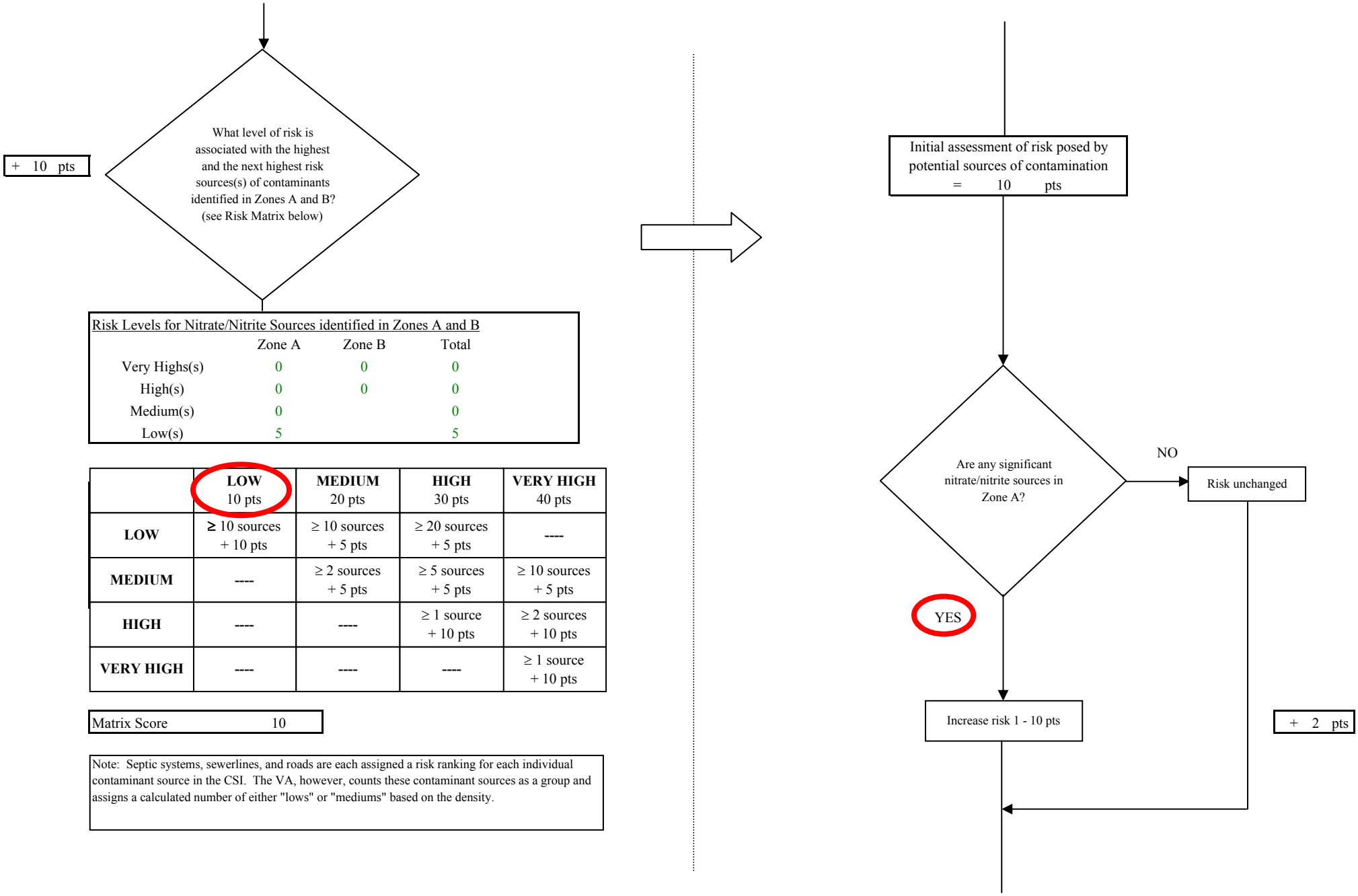
## *Chart 3. Vulnerability analysis for Barrow Utilities & Elec. Coop. - Bacteria & Viruses*



## *Chart 4. Contaminant risks for Barrow Utilities & Elec. Coop. - Nitrates and Nitrites*



## *Chart 4. Contaminant risks for Barrow Utilities & Elec. Coop. - Nitrates and Nitrites*




Risk Levels for Nitrate/Nitrite Sources identified in Zones A and B

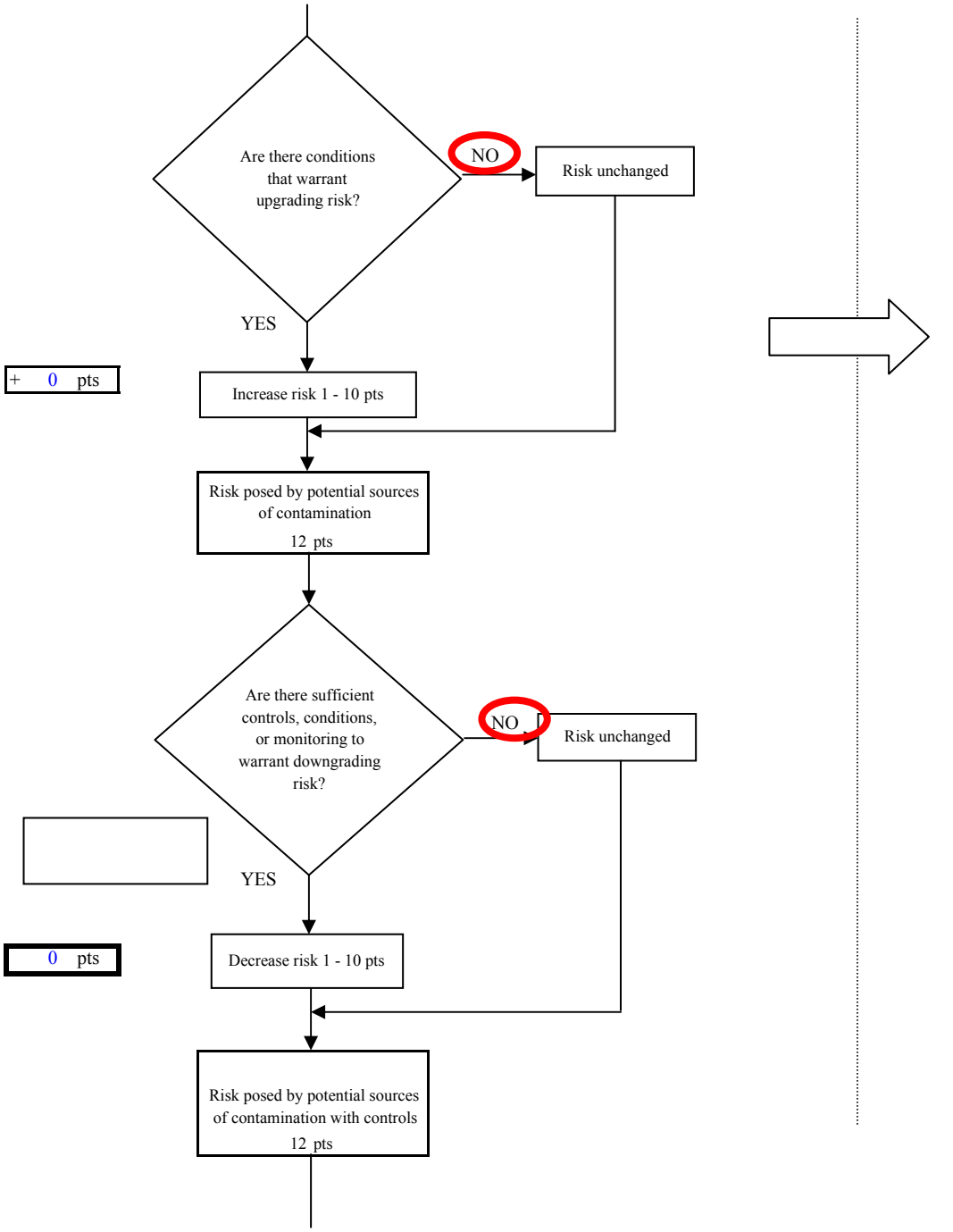
| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 0 | | 0 |
| Low(s) | 5 | | 5 |

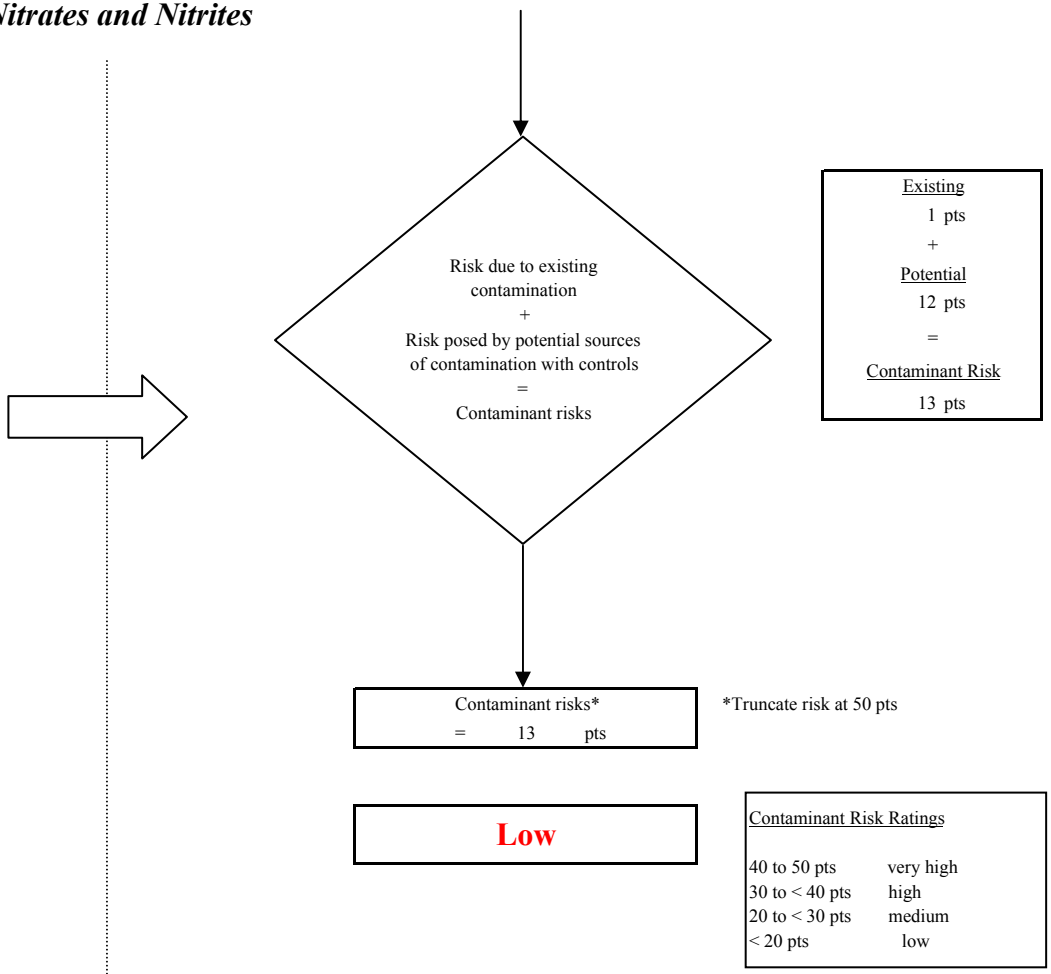
| | **LOW** 10 pts | **MEDIUM** 20 pts | **HIGH** 30 pts | **VERY HIGH** 40 pts |
|---|---|---|---|---|
| **LOW** | ≥ 10 sources + 10 pts | ≥ 10 sources + 5 pts | ≥ 20 sources + 5 pts | ---- |
| **MEDIUM** | ---- | ≥ 2 sources + 5 pts | ≥ 5 sources + 5 pts | ≥ 10 sources + 5 pts |
| **HIGH** | ---- |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

Matrix Score 10

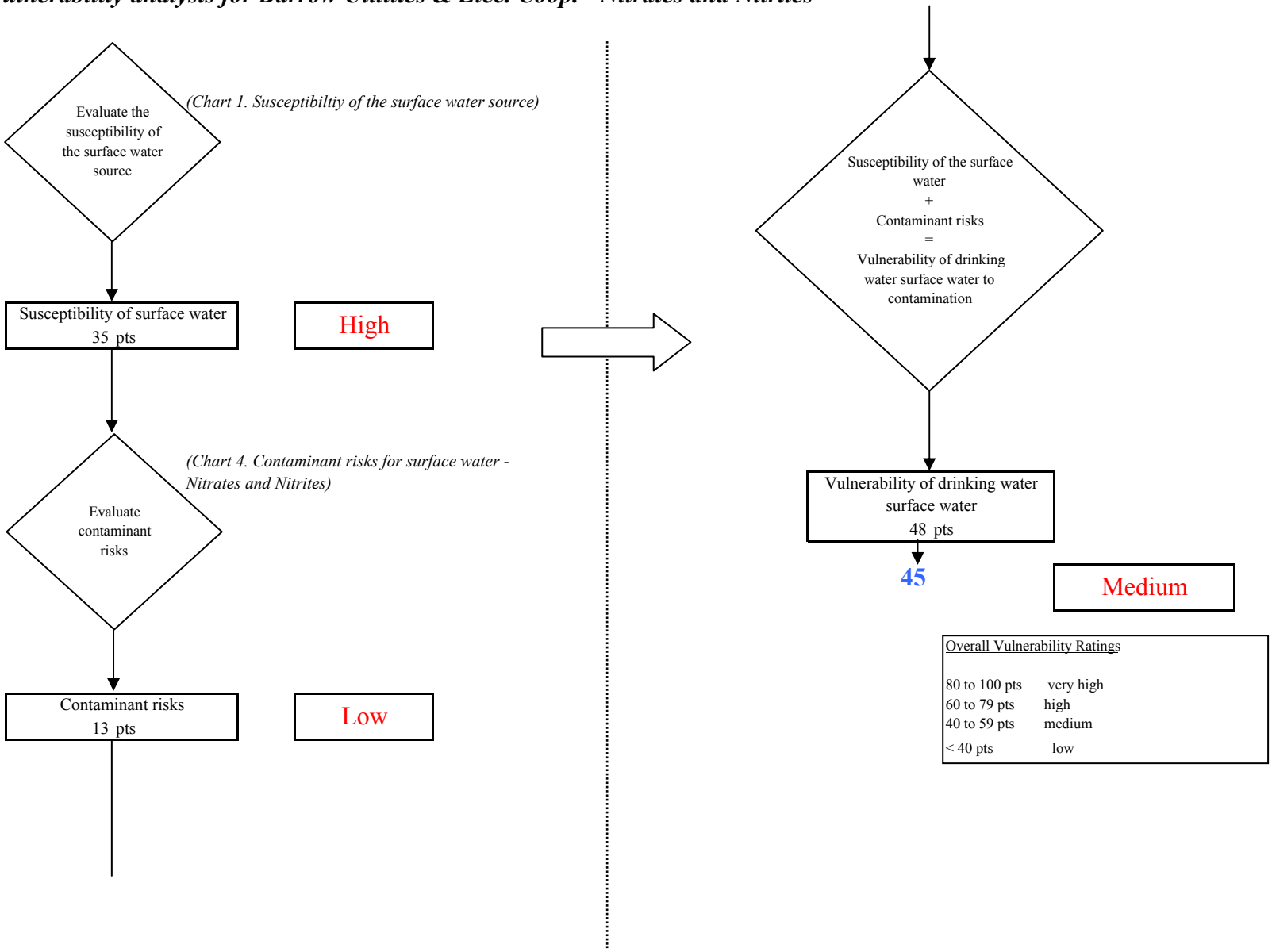
Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

## *Chart 4. Contaminant risks for Barrow Utilities & Elec. Coop. - Nitrates and Nitrites*

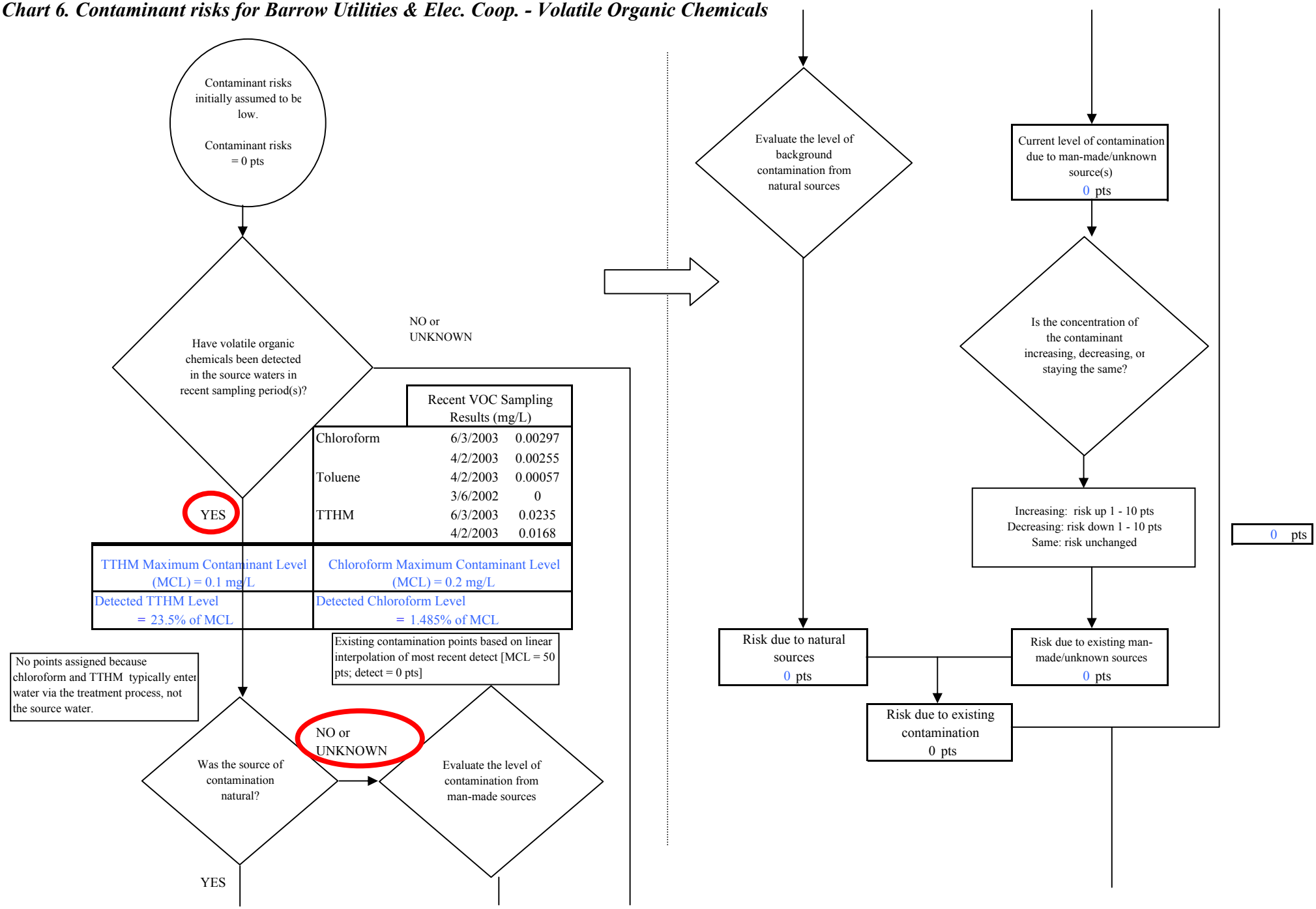


## *Chart 5. Vulnerability analysis for Barrow Utilities & Elec. Coop. - Nitrates and Nitrites*



## *Chart 6. Contaminant risks for Barrow Utilities & Elec. Coop. - Volatile Organic Chemicals*



## *Chart 6. Contaminant risks for Barrow Utilities & Elec. Coop. - Volatile 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 and B? (see Risk Matrix below)

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

Are any significant VOC sources in Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 10 pts

Risk Levels for VOC Sources identified in Zones A and B

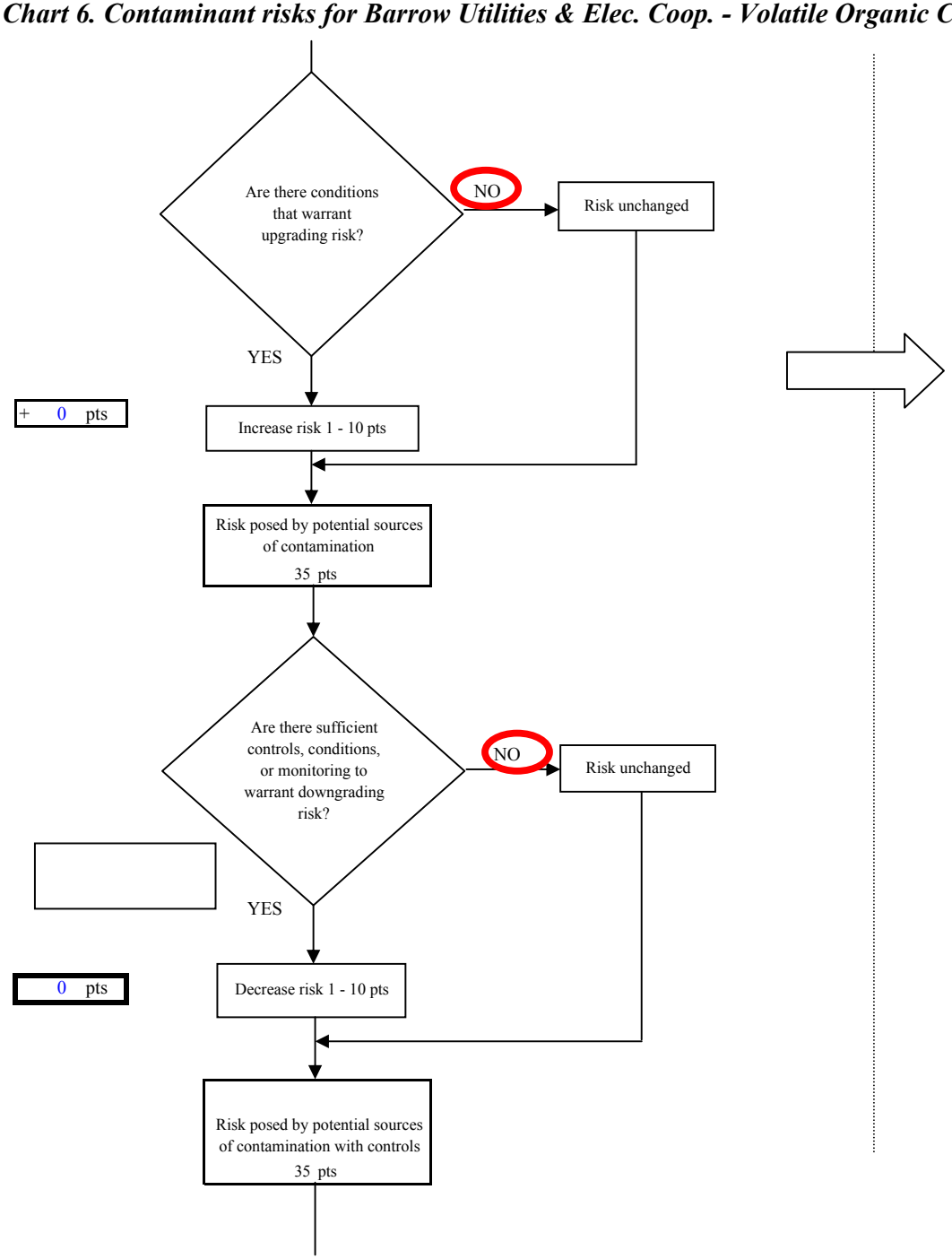
| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 5 | | 5 |
| Low(s) | 6 | | 6 |

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

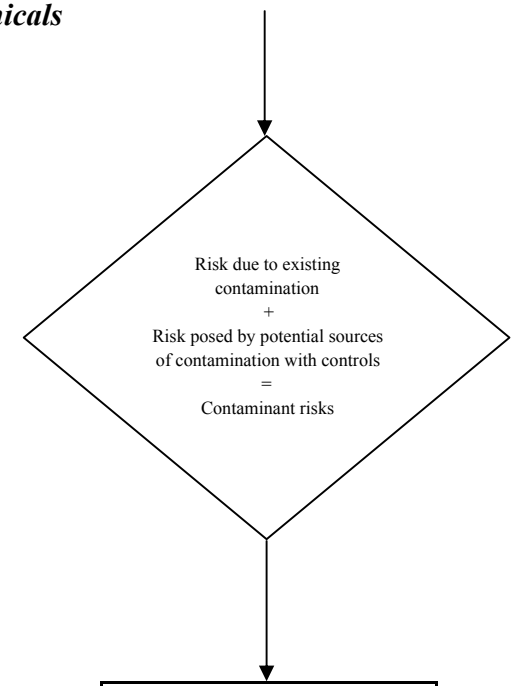
Matrix Score 25

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each 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 6. Contaminant risks for Barrow Utilities & Elec. Coop. - Volatile Organic Chemicals*






Existing
0 pts
+
Potential
35 pts
=
Contaminant Risk
35 pts

Contaminant risks*
= 35 pts

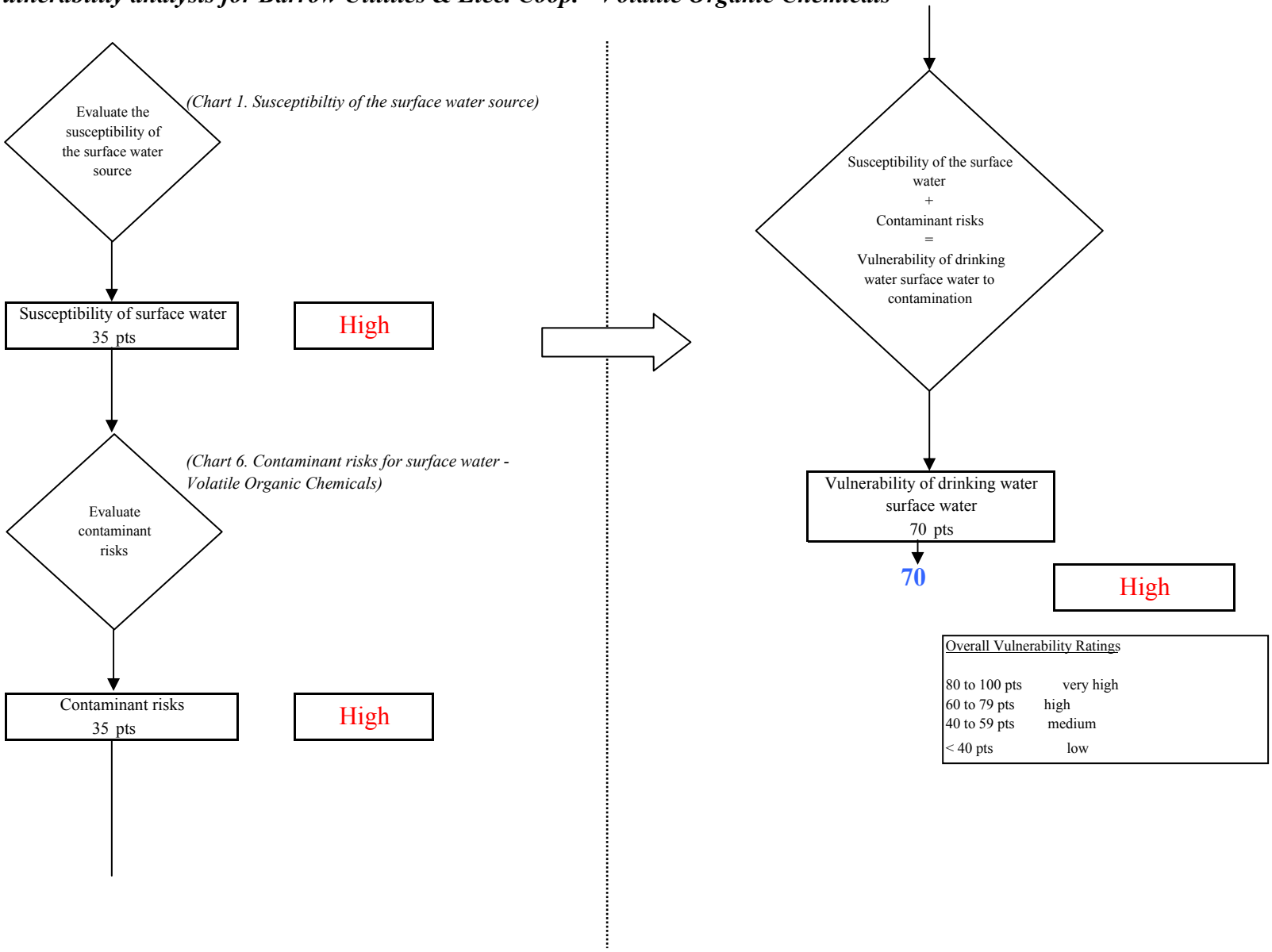
*Truncate risk at 50 pts

**High**

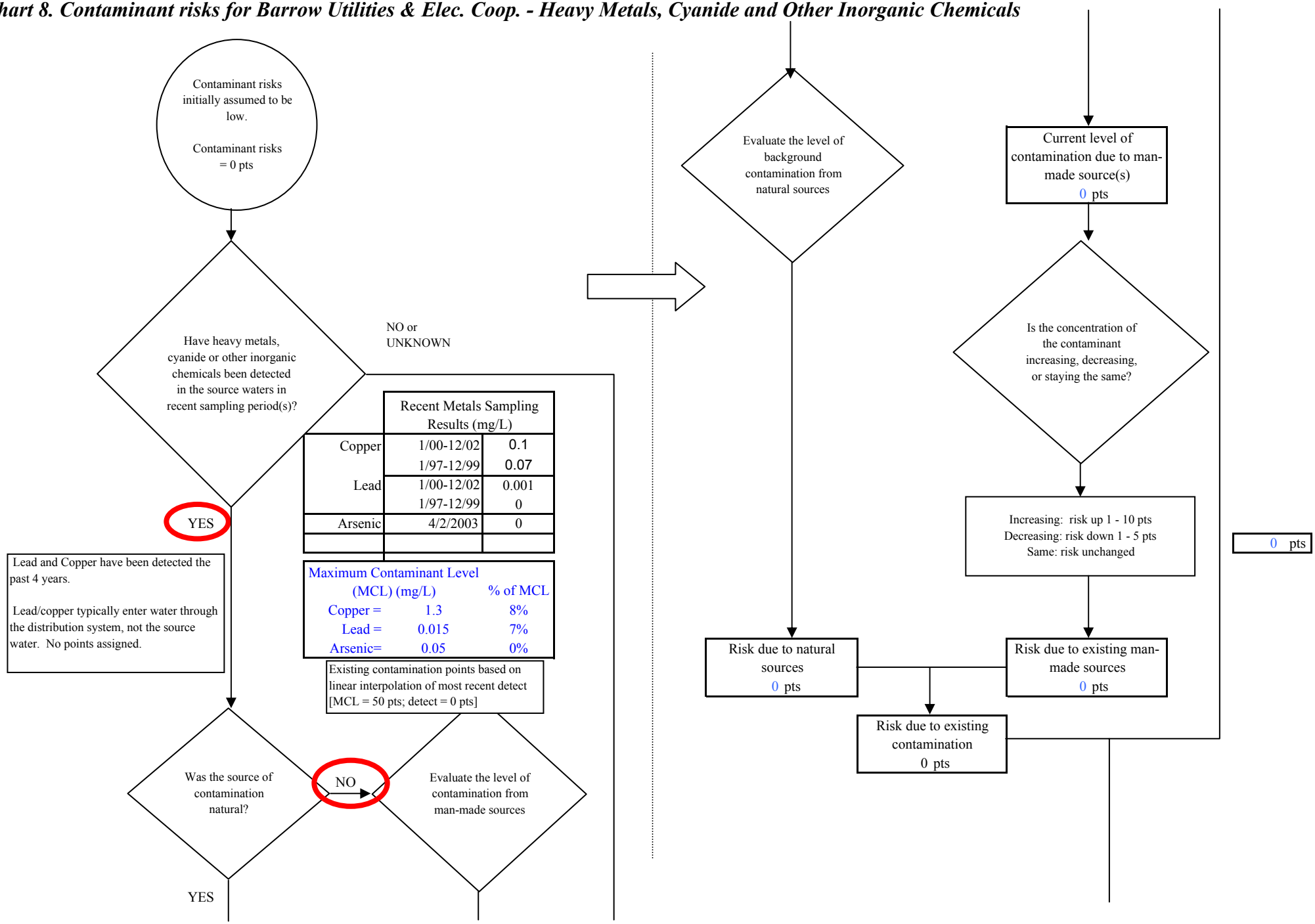
Contaminant Risk Ratings

| | |
|---|---|
| 40 to 50 pts | very high |
| 30 to < 40 pts | high |
| 20 to < 30 pts | medium |
| < 20 pts | low |

***Chart 7. Vulnerability analysis for Barrow Utilities & Elec. Coop. - Volatile Organic Chemicals***



## *Chart 8. Contaminant risks for Barrow Utilities & Elec. Coop. - Heavy Metals, Cyanide and Other Inorganic Chemicals*



## *Chart 8. Contaminant risks for Barrow Utilities & Elec. Coop. - Heavy Metals, Cyanide and Other Inorganic 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 and B? (see Risk Matrix below)

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

Are any significant HM, Cyanide, or OIC sources in Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 10 pts

Risk Levels for HM, Cyanide, or OIC Sources identified in Zones A and B

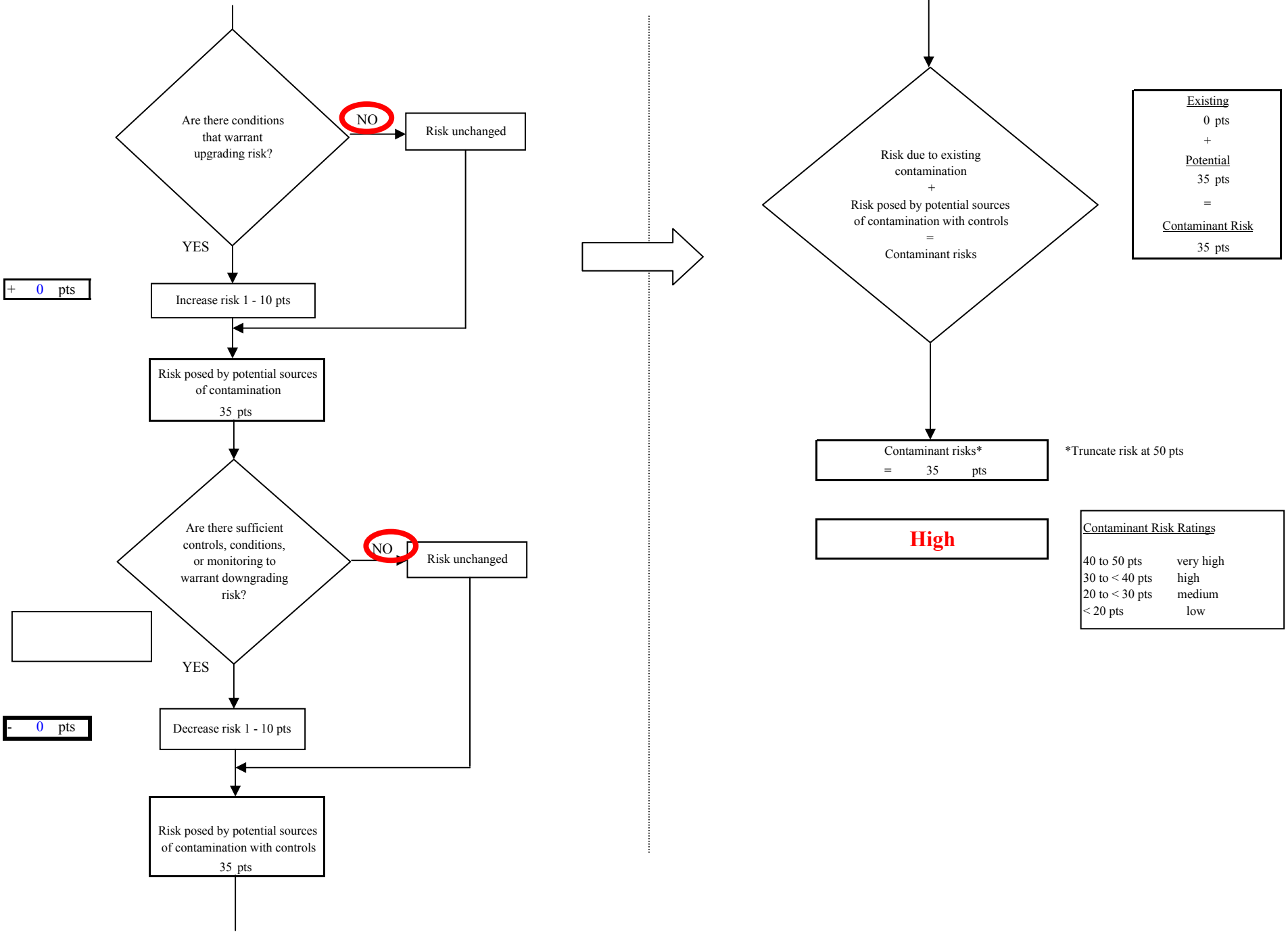
| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 3 | | 3 |
| Low(s) | 6 | | 6 |

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

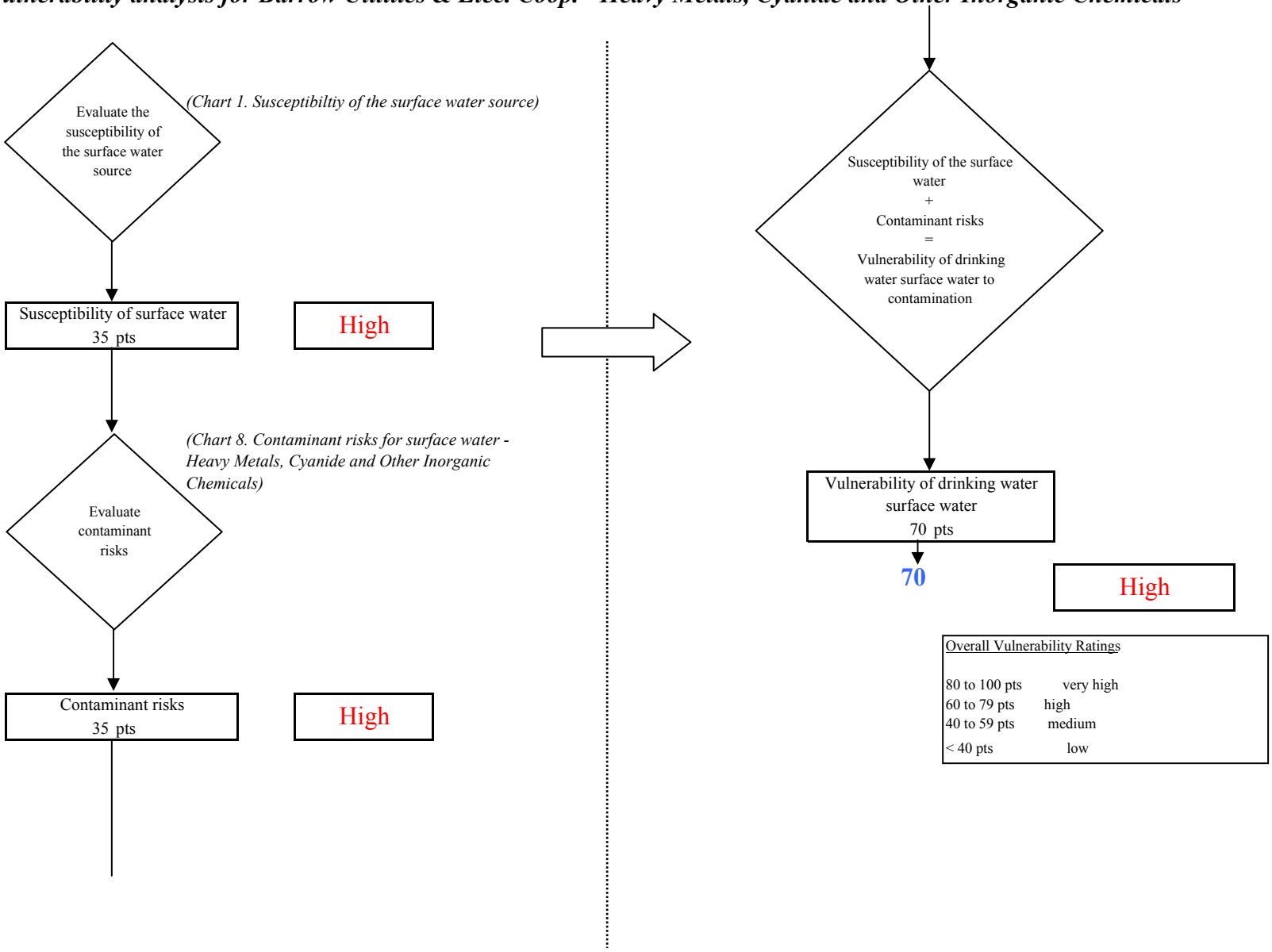
Matrix Score 25

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

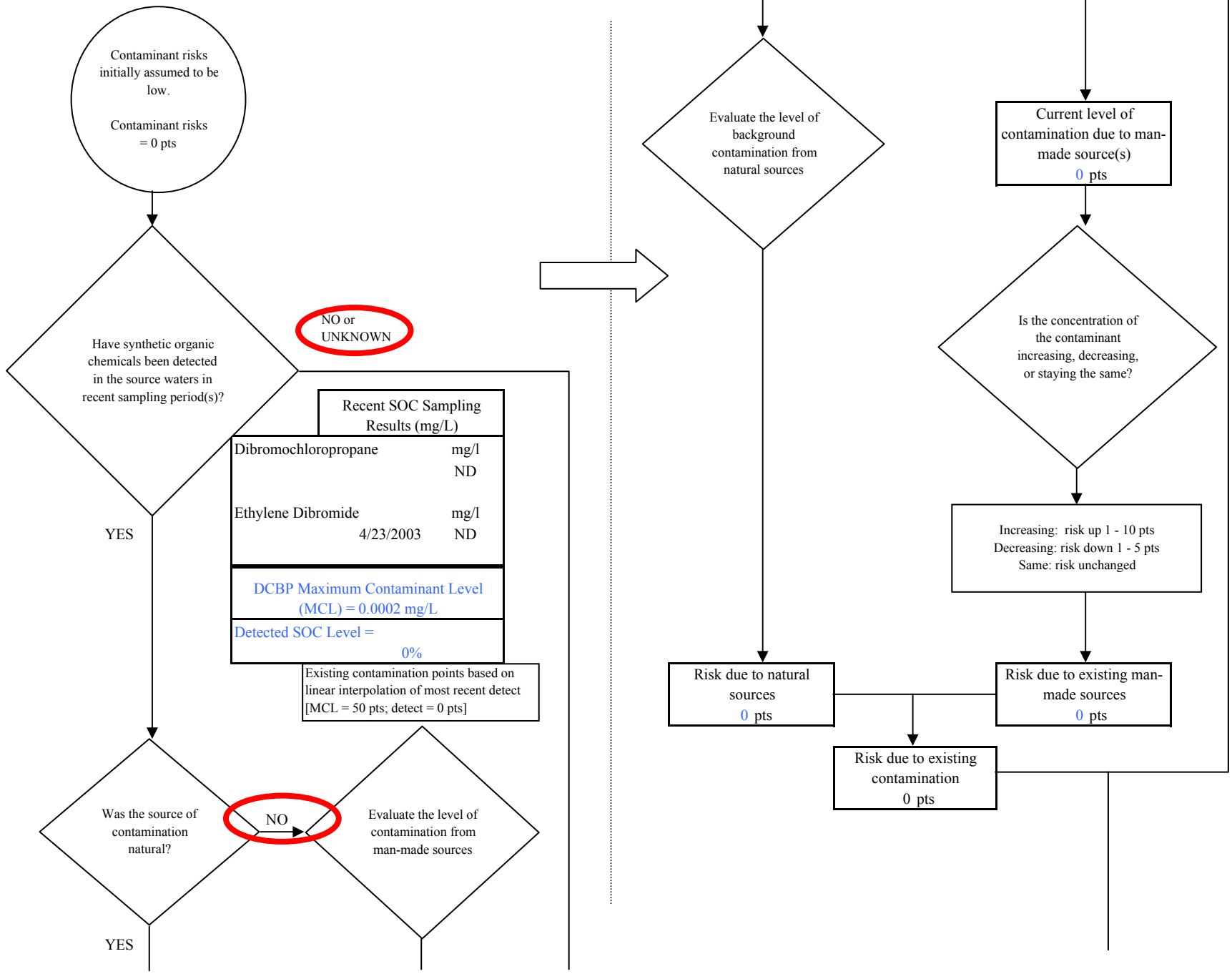
## *Chart 8. Contaminant risks for Barrow Utilities & Elec. Coop. - Heavy Metals, Cyanide and Other Inorganic Chemicals*



## *Chart 9. Vulnerability analysis for Barrow Utilities & Elec. Coop. - Heavy Metals, Cyanide and Other Inorganic Chemicals*



## *Chart 10. Contaminant risks for Barrow Utilities & Elec. Coop. - Synthetic Organic Chemicals*



## *Chart 10. Contaminant risks for Barrow Utilities & Elec. Coop. - 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 and B? (see Risk Matrix below)

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

Are any significant SOC sources in Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 5 pts

Risk Levels for SOC Sources identified in Zones A and C

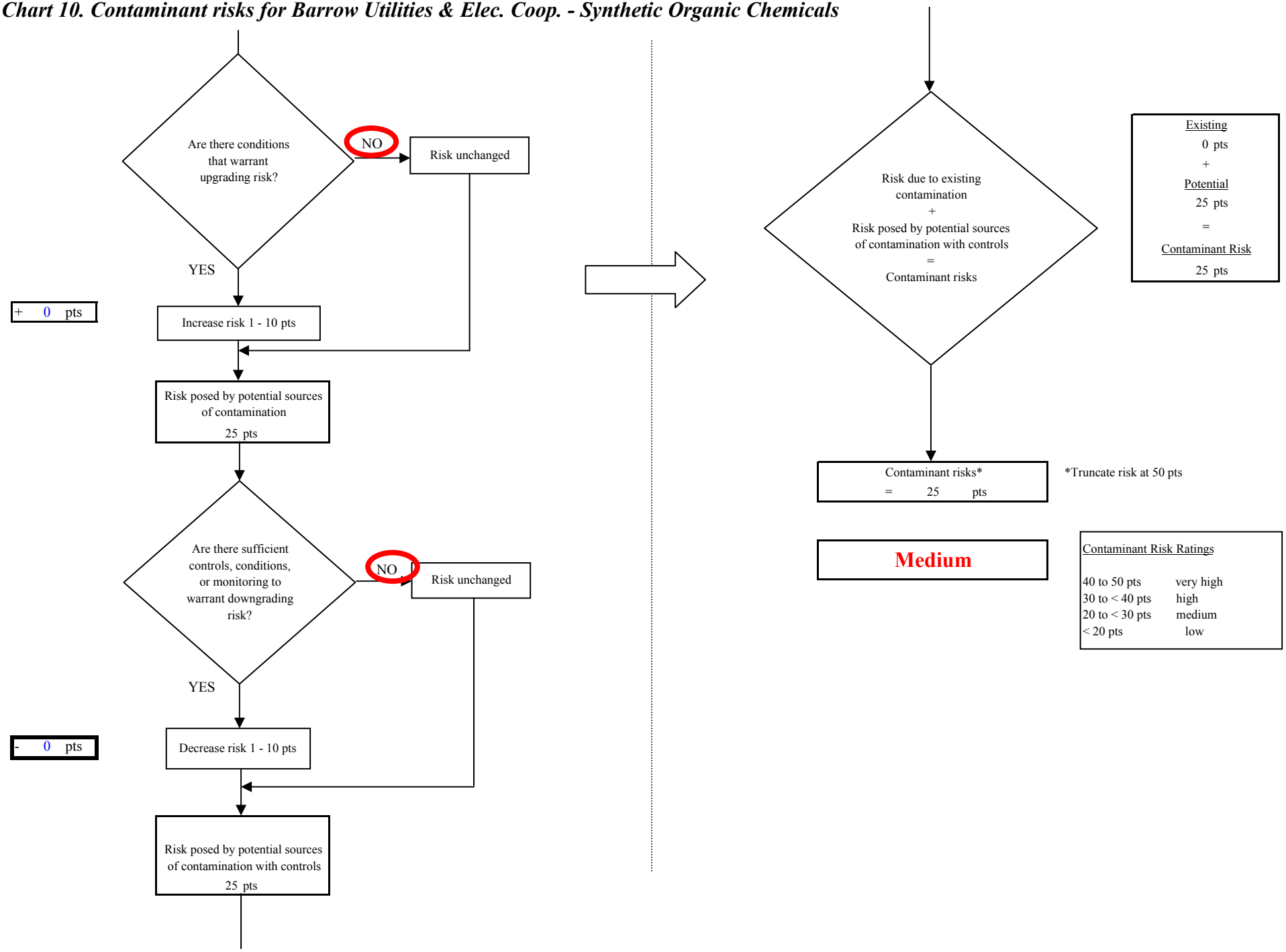
| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 1 | 0 | 1 |
| Low(s) | 1 | 0 | 1 |

| | **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 |

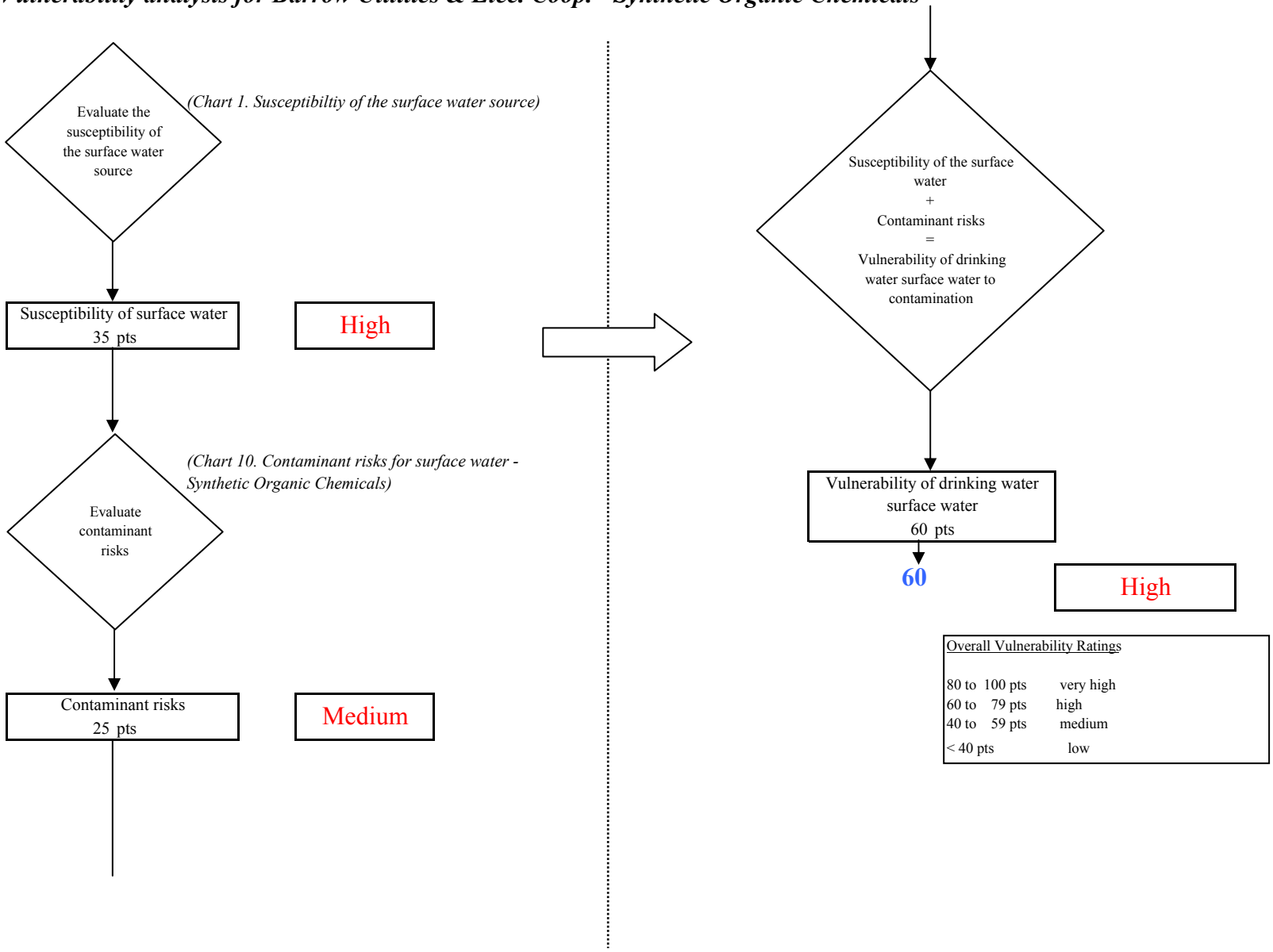
Matrix Score 20

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.

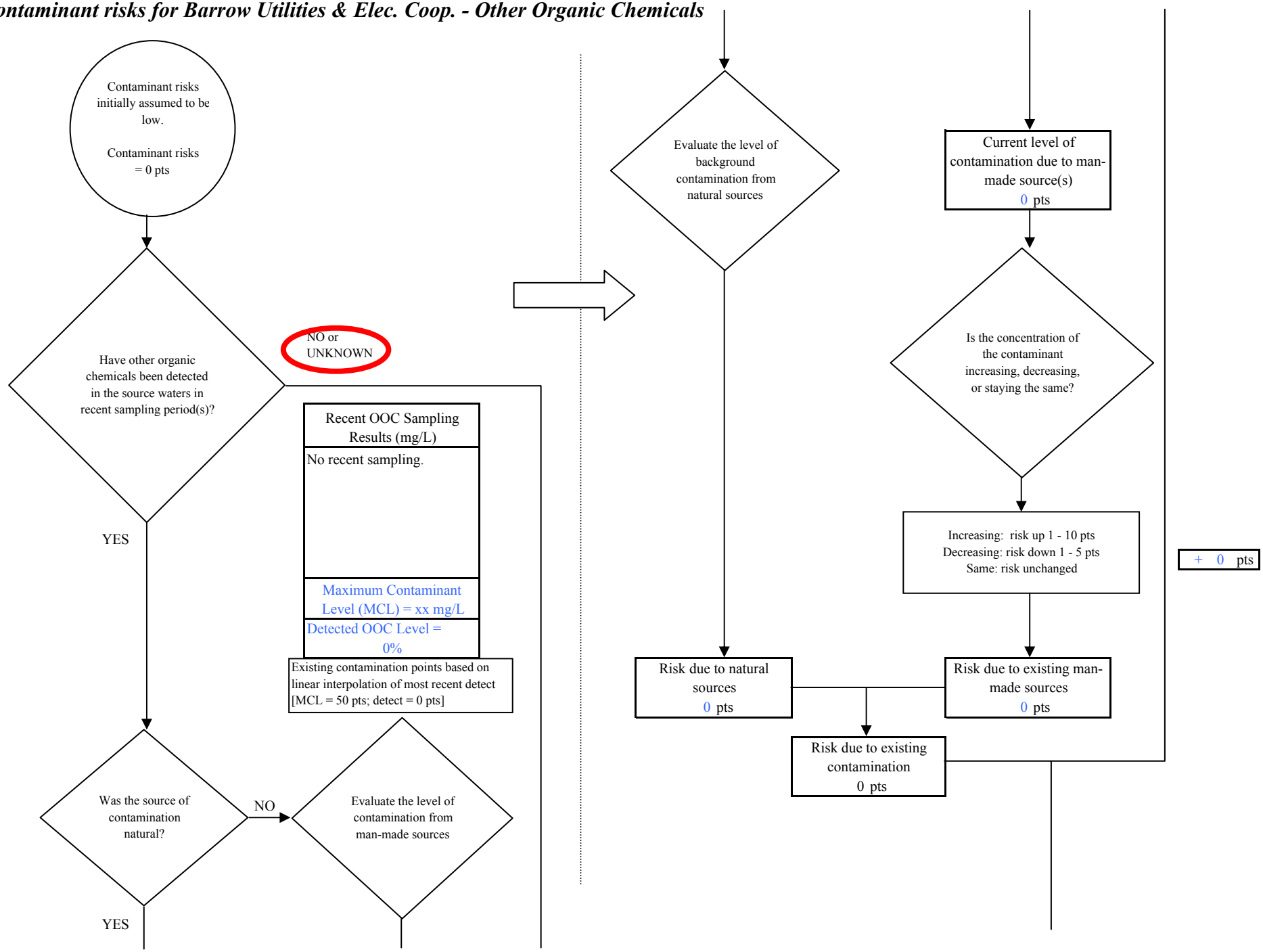
## *Chart 10. Contaminant risks for Barrow Utilities & Elec. Coop. - Synthetic Organic Chemicals*



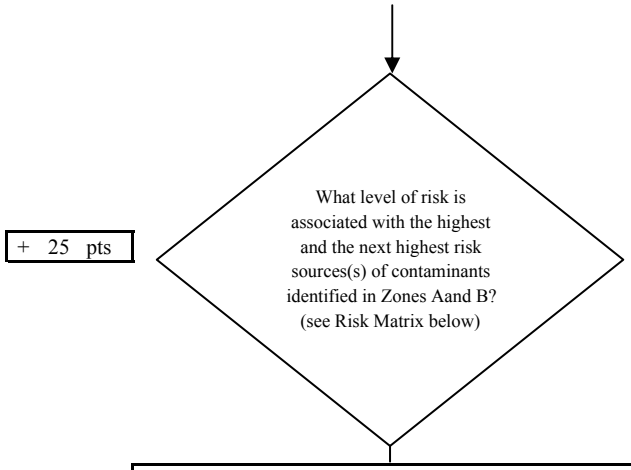
## *Chart 11. Vulnerability analysis for Barrow Utilities & Elec. Coop. - Synthetic Organic Chemicals*



## *Chart 12. Contaminant risks for Barrow Utilities & Elec. Coop. - Other Organic Chemicals*



## *Chart 12. Contaminant risks for Barrow Utilities & Elec. Coop. - Other Organic Chemicals*



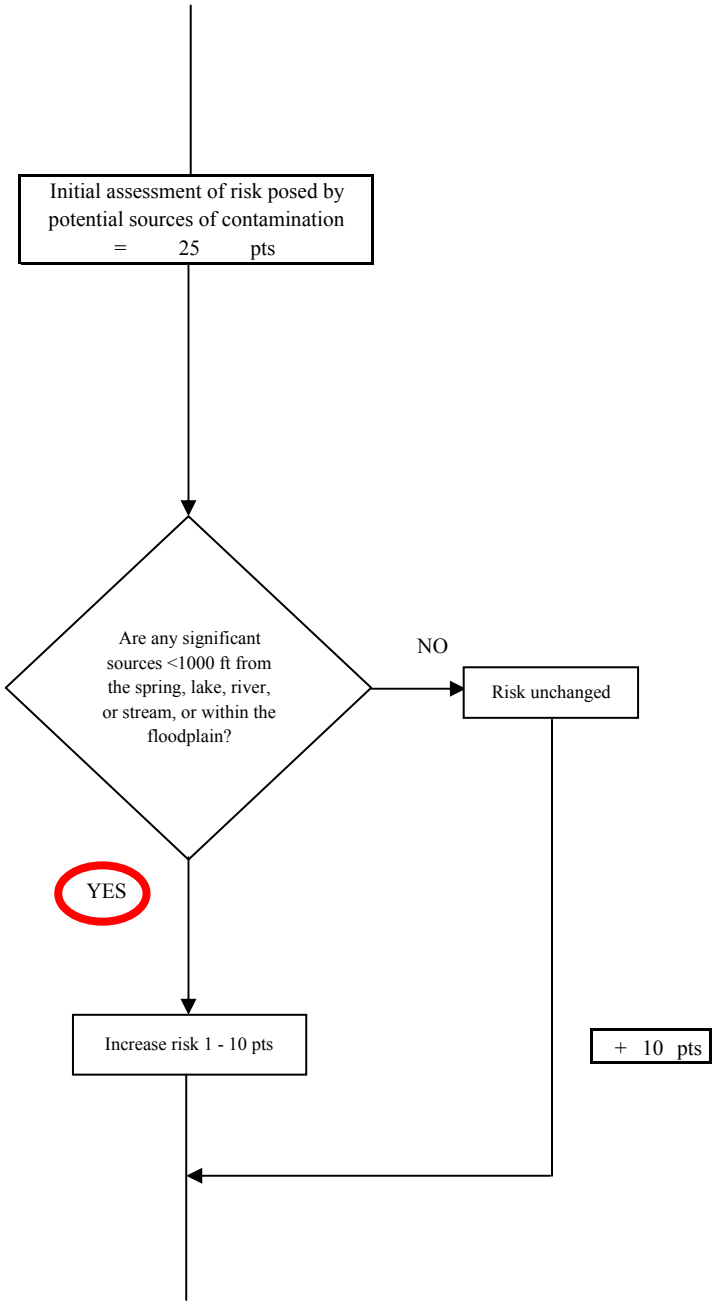

Risk Levels for OOC Sources identified in Zones A and B

| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 6 | 0 | 6 |
| Low(s) | 2 | 0 | 2 |

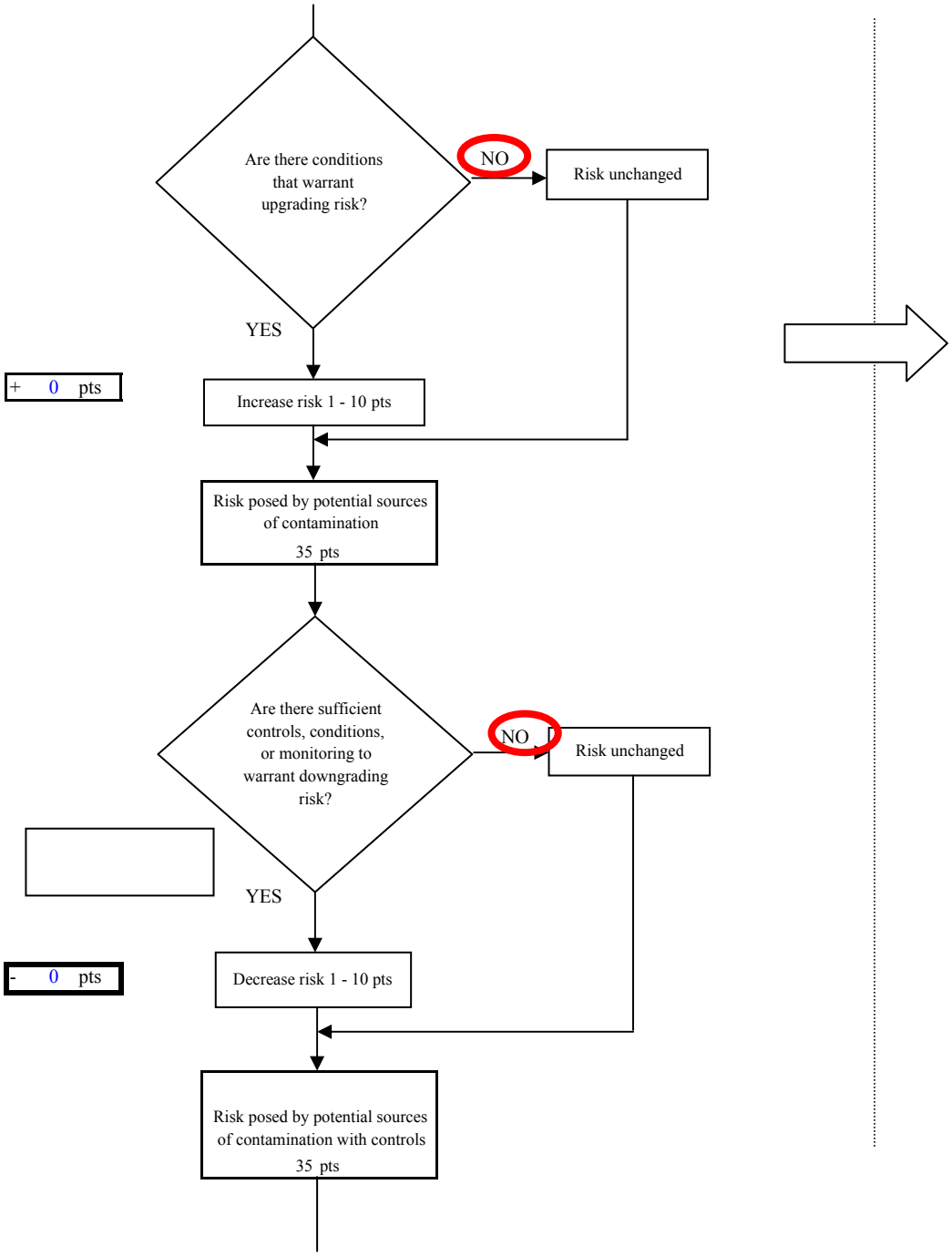
| | **LOW** 10 pts | **MEDIUM** 20 pts | **HIGH** 30 pts | **VERY HIGH** 40 pts |
|---|---|---|---|---|
| **LOW** | ≥ 10 sources + 10 pts | ≥ 10 sources + 5 pts | ≥ 20 sources + 5 pts | ---- |
| **MEDIUM** | ---- | ≥ 2 sources + 5 pts | ≥ 5 sources + 5 pts | ≥ 10 sources + 5 pts |
| **HIGH** | ---- |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

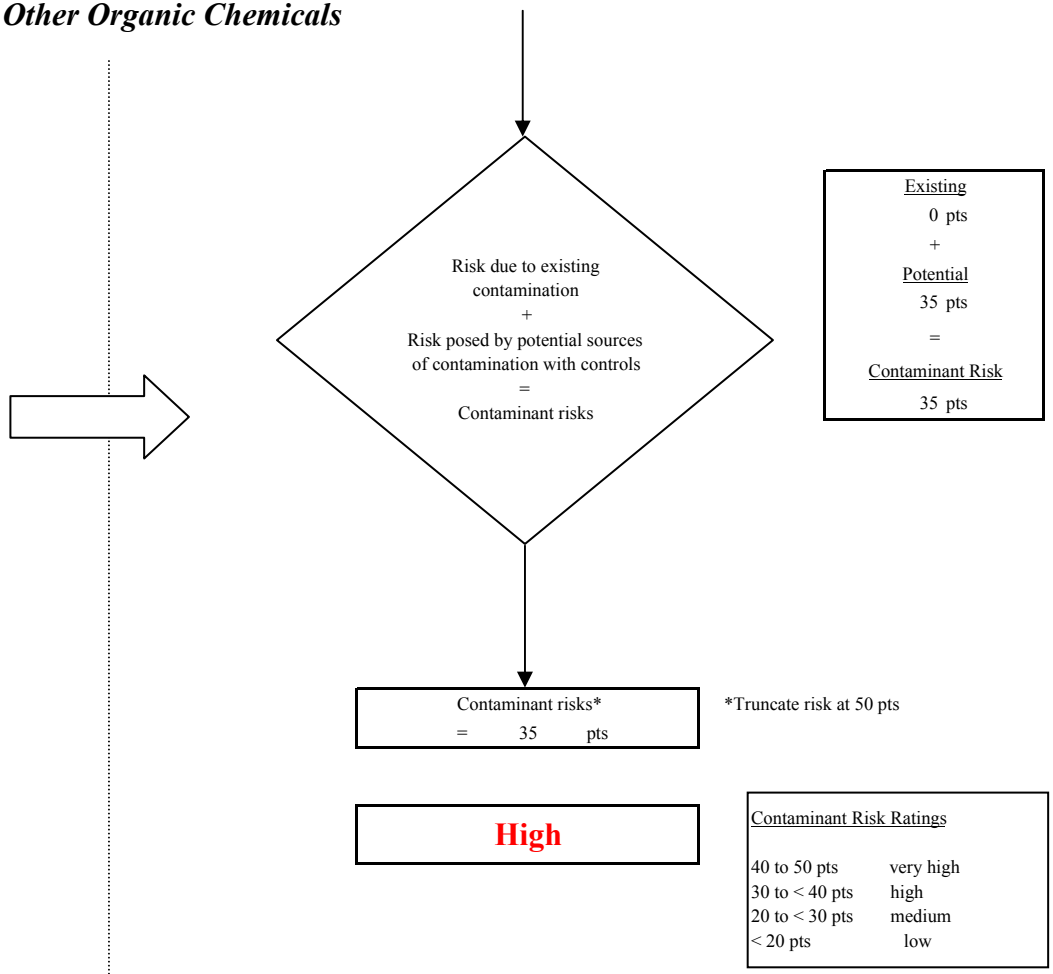
Matrix Score 25

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



## *Chart 12. Contaminant risks for Barrow Utilities & Elec. Coop. - Other Organic Chemicals*



## *Chart 13. Vulnerability analysis for Barrow Utilities & Elec. Coop. - Other Organic Chemicals*