

Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Village Texaco,
Tok, Alaska
PWSID #381545

DRINKING WATER PROTECTION PROGRAM REPORT NO. 926

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 Village Texaco, Tok, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Village Texaco is a Class B (transient/non-community) water system consisting of one well. The Village Texaco is located at Mile 1313.5 of the Alaska Highway, Tok, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Village Texaco public drinking water source include gasoline stations (without repair shop); large-capacity septic systems; RV dump stations; underground diesel and gasoline tanks; aboveground heating oil tanks; cement or asphalt highways and roads; and campgrounds and RV parks. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Village Texaco received a vulnerability rating of **High** for bacteria and viruses, and nitrates and nitrites; and volatile organic chemicals.

VILLAGE TEXACO PUBLIC DRINKING WATER SYSTEM

Village Texaco public water system is a Class B (transient/non-community) water system. The system consists of one well at 1313.5 of the Alaska Highway, Tok, Alaska (See Map 1 of Appendix A). Tok is located at the junction of the Alaska Highway and the Tok cutoff to the Glenn Highway, 200 miles southeast of Fairbanks. Tok is called the “Gateway to Alaska” as it is the first major community upon entering Alaska, 93 miles from the Canadian border. The population of Tok is approximately 1,400.

Tok averages about 15 inches of precipitation per year, including 33 inches of snow. Although the quality of the groundwater can vary significantly in a short distance, groundwater supplies are generally abundant in the area. Static water levels in these wells are generally 50 to 80 feet below the surface. The coarse, alluvial, sandy gravel aquifer generally provides sufficient water, even in the winter when infiltration is low.

The Tok area topography varies from about 1,275 feet along the Tanana River to over 5,000 feet in the Alaska Range. Drainages along the Alaska Highway in this area generally flow northwest.

According to a Sanitary Survey dated June 08, 2000, the existing well was installed in 1993 with 6-inch diameter casing to a depth of 98 feet below the ground surface. It is assumed that the length of the well screen is 10 feet.

The Survey indicates that the land surface is sloped away from the well, providing adequate surface water drainage. It is assumed that the well is not grouted according to ADEC standards. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates year round and serves approximately 25 non-residents through one service connection.

VILLAGE TEXACO 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 DWPA 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. The input parameters describing the attributes of the aquifer in this calculation were estimated from information contained in the well logs and/or the Sanitary Survey. Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DWPA (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The DWPA's established for wells by the ADEC are usually separated into four zones. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well.

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

Table 1. Definition of Zones

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

The DWPA for Village Texaco extends approximately 2 miles to southwest of the well. Development in the vicinity of the well extends only through Zone A (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 Village Texaco 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 B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile 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 get to the well.

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

VULNERABILITY OF VILLAGE TEXACO DRINKING WATER SYSTEM

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

- Natural susceptibility; and
- Contaminant risks.

Appendix D contains eight charts, which together form the ‘Vulnerability Analysis’ for a source water assessment for a public drinking water source. Chart 1 analyzes the ‘Susceptibility of the Wellhead’ to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the ‘Susceptibility of the Aquifer’ to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes ‘Contaminant Risks’ for the drinking water source with respect to bacteria and viruses. The ‘Contaminant Risks’ portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the ‘Vulnerability Analysis for Bacteria and Viruses’. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

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

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

+

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

=

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

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

Natural Susceptibility Ratings

40 to 50 pts Very High
30 to < 40 pts High
20 to < 30 pts Medium
< 20 pts Low

We assume the well for the Village Texaco is completed in an unconfined aquifer. Because unconfined aquifers are recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Susceptibility scores and ratings for the Village Texaco.

Table 2. Susceptibility

| | Score | Rating |
|--------------------------------|-------|-----------|
| Susceptibility of the Wellhead | 0 | Low |
| Susceptibility of the Aquifer | 24 | Very High |
| Natural Susceptibility | 24 | Medium |

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

Contaminant Risk Ratings

40 to 50 pts Very High
30 to < 40 pts High
20 to < 30 pts Medium
< 20 pts Low

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

Table 3. Contaminant Risks

| Category | Score | Rating |
|----------------------------|-------|-----------|
| Bacteria and Viruses | 40 | Very High |
| Nitrates and/or Nitrites | 43 | Very High |
| Volatile Organic Chemicals | 50 | Very High |

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings

80 to 100 pts Very High
60 to < 80 pts High
40 to < 60 pts Medium
< 40 pts Low

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

Table 4. Overall Vulnerability

| Category | Score | Rating |
|----------------------------|-------|--------|
| Bacteria and Viruses | 65 | High |
| Nitrates and Nitrites | 70 | High |
| Volatile Organic Chemicals | 75 | High |

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with large-capacity septic systems, paved highways and roads; and single-family septic systems representing the risk to the drinking water well (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. Recent sampling events indicated no consecutive positive results were detected for bacteria and viruses. However, after combining the contaminant risks with the overall natural susceptibility of the well, the vulnerability of the well to contamination by bacteria and viruses is **High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High** with large-capacity septic systems, paved highways and roads; and single-family septic systems representing the risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Sampling history for The Village Texaco indicates that nitrates have been detected in the water, but only in very low concentrations (at 1.57 mg/L on 5/23/97) or 16% of the Maximum Contaminant Level (MCL). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Due to the high solubility and weak retention by soil, nitrates are very mobile, moving at approximately the same rate as water.

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

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High** with a gasoline station, large-capacity septic system, RV dump station, aboveground heating oil tanks, and a campground/RV park creating the only known risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

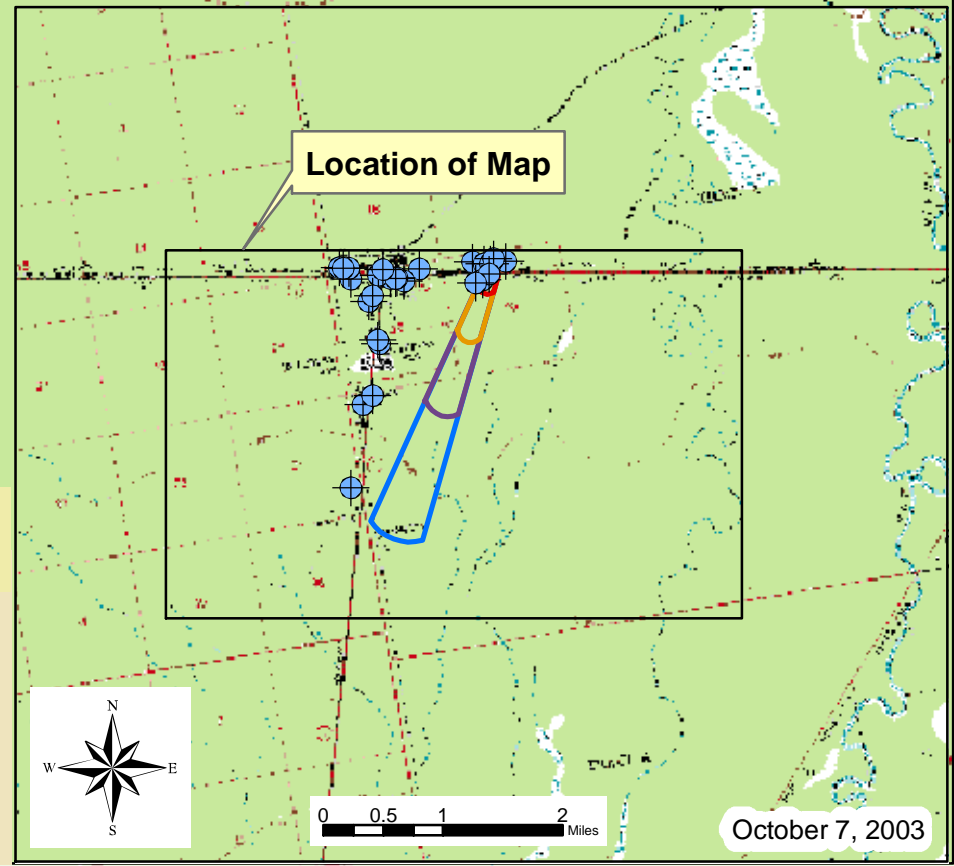
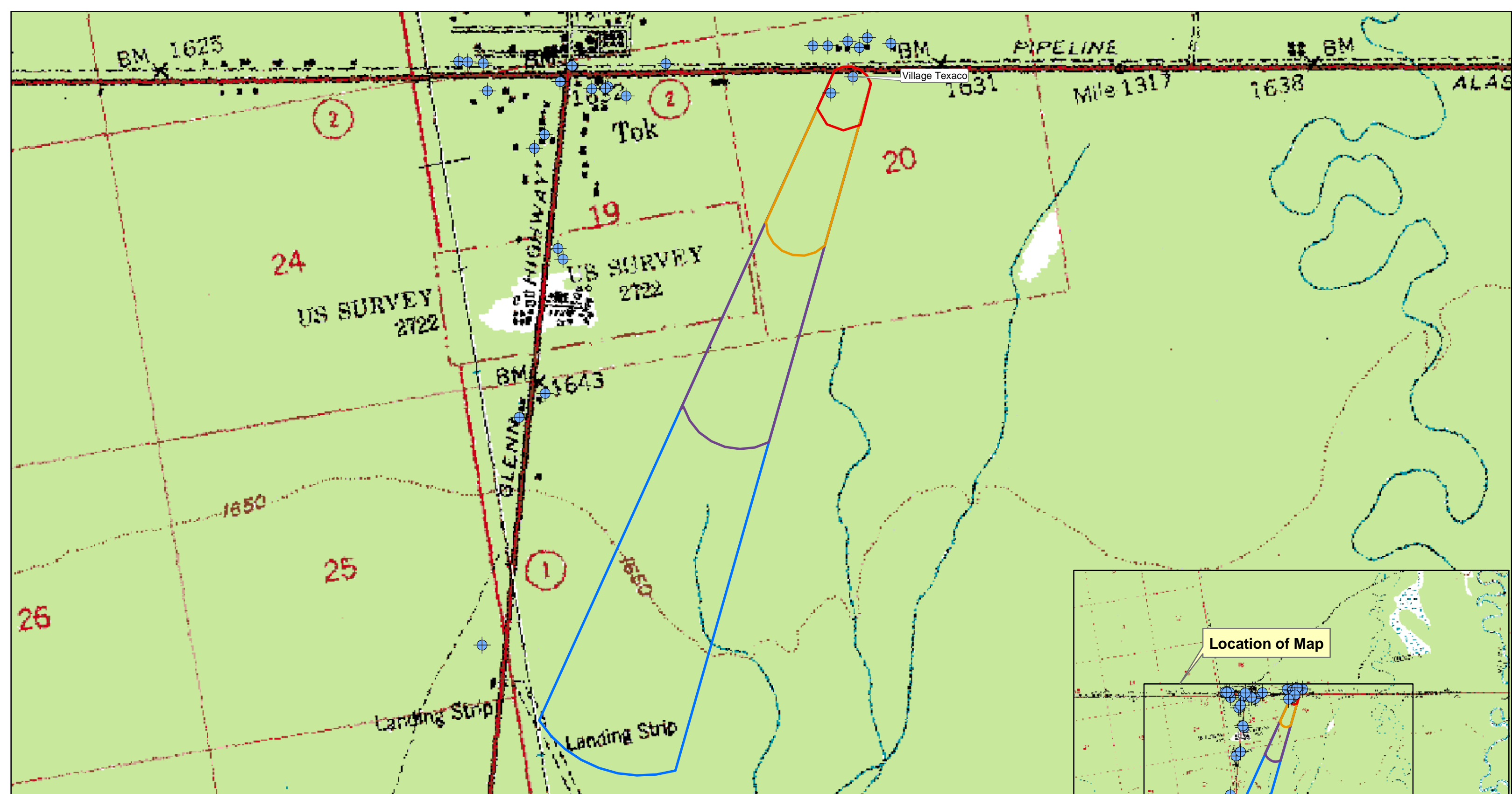
There are no recent sample data available for the drinking water at Village Texaco for volatile organic chemicals. However, after combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination by volatile organic chemicals is **High**.

REFERENCES

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- Alaska Department of Natural Resources, Well Log Tracking System (2002). <<http://info.dec.state.ak.us/welts/Default.asp>> (2003, September 1)
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- Freeze, R. Allen, and John A. Cherry, Groundwater. Englewood Cliffs: Prentice-Hall 1979.
- 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 (2002). <<http://www.epa.gov/safewater/mcl.html#mcls>> (2003, September 1)

APPENDIX A

Village Texaco Drinking Water Protection Area Location Map (Map 1)



Map 1: Village Texaco Drinking Water Protection Areas

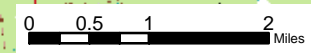
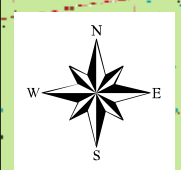
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Data Sources:
Background image - USGS 1:63,000 mapping

- Legend**
- ⊕ Public Drinking Water Systems
 - DWPA Zone A**
Several Months Travel Time
 - DWPA Zone B**
Less than 2 Years Travel Time
 - DWPA Zone C**
Less than 5 Years Travel Time
 - DWPA Zone D**
Less than 10 Years Travel Time



October 7, 2003

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Village Texaco

(Tables 1-4)

Table 1**Contaminant Source Inventory for
Village Texaco****PWSID 381545.001**

| Contaminant Source Type | Contaminant Source ID | CS ID tag | Zone | Map Number | Comments |
|---|------------------------------|------------------|-------------|-------------------|--|
| Laundromats without dry cleaning | C22 | C22-1 | A | 2 | Laundromat without Drycleaner |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-1 | A | 2 | Village Texaco Septic System |
| RV dump stations | D18 | D18-1 | A | 2 | Bullshooter RV Dumpstation |
| Septic systems (serves one single-family home) | R02 | R02-1 | A | 2 | Single Family Septic System for Residence |
| Tanks, heating oil, residential (above ground) | R08 | R08-1 | A | 2 | Residential Heating Oil Tank for Residence |
| Tanks, diesel (above ground) | T06 | T06-1 | A | 2 | Diesel Storage Tank for Village Texaco |
| Tanks, gasoline (above ground) | T10 | T10-1 | A | 2 | Gas Storage Tank for Village Texaco |
| Tanks, gasoline (above ground) | T10 | T10-2 | A | 2 | Gas Storage Tank for Village Texaco |
| Water supply wells | W09 | W09-1 | A | 2 | Private Water Supply Well for Residence |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | 2 | Alaska Highway |
| Campgrounds and RV Parks | X35 | X35-1 | A | 2 | Bullshooter RV Park |

**Contaminant Source Inventory and Risk Ranking for
Village Texaco
Sources of Bacteria and Viruses**

PWSID 381545.001

Table 2

| Contaminant Source Type | Contaminant Source ID | CS ID tag | Zone | Risk Ranking for Analysis | Map Number | Comments |
|---|------------------------------|------------------|-------------|----------------------------------|-------------------|---|
| Laundromats without dry cleaning | C22 | C22-1 | A | Low | 2 | Laundromat without Drycleaner |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-1 | A | High | 2 | Village Texaco Septic System |
| RV dump stations | D18 | D18-1 | A | Low | 2 | Bullshooter RV Dumpstation |
| Septic systems (serves one single-family home) | R02 | R02-1 | A | Low | 2 | Single Family Septic System for Residence |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Low | 2 | Alaska Highway |
| Campgrounds and RV Parks | X35 | X35-1 | A | Low | 2 | Bullshooter RV Park |

**Contaminant Source Inventory and Risk Ranking for
Village Texaco
Sources of Nitrates/Nitrites**

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Table 3

| Contaminant Source Type | Contaminant Source ID | CS ID tag | Zone | Risk Ranking for Analysis | Map Number | Comments |
|---|------------------------------|------------------|-------------|----------------------------------|-------------------|---|
| Laundromats without dry cleaning | C22 | C22-1 | A | Low | 2 | Laundromat without Drycleaner |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-1 | A | High | 2 | Village Texaco Septic System |
| RV dump stations | D18 | D18-1 | A | Low | 2 | Bullshooter RV Dumpstation |
| Septic systems (serves one single-family home) | R02 | R02-1 | A | Low | 2 | Single Family Septic System for Residence |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Low | 2 | Alaska Highway |
| Campgrounds and RV Parks | X35 | X35-1 | A | Low | 2 | Bullshooter RV Park |

**Contaminant Source Inventory and Risk Ranking for
Village Texaco
Sources of Volatile Organic Chemicals**

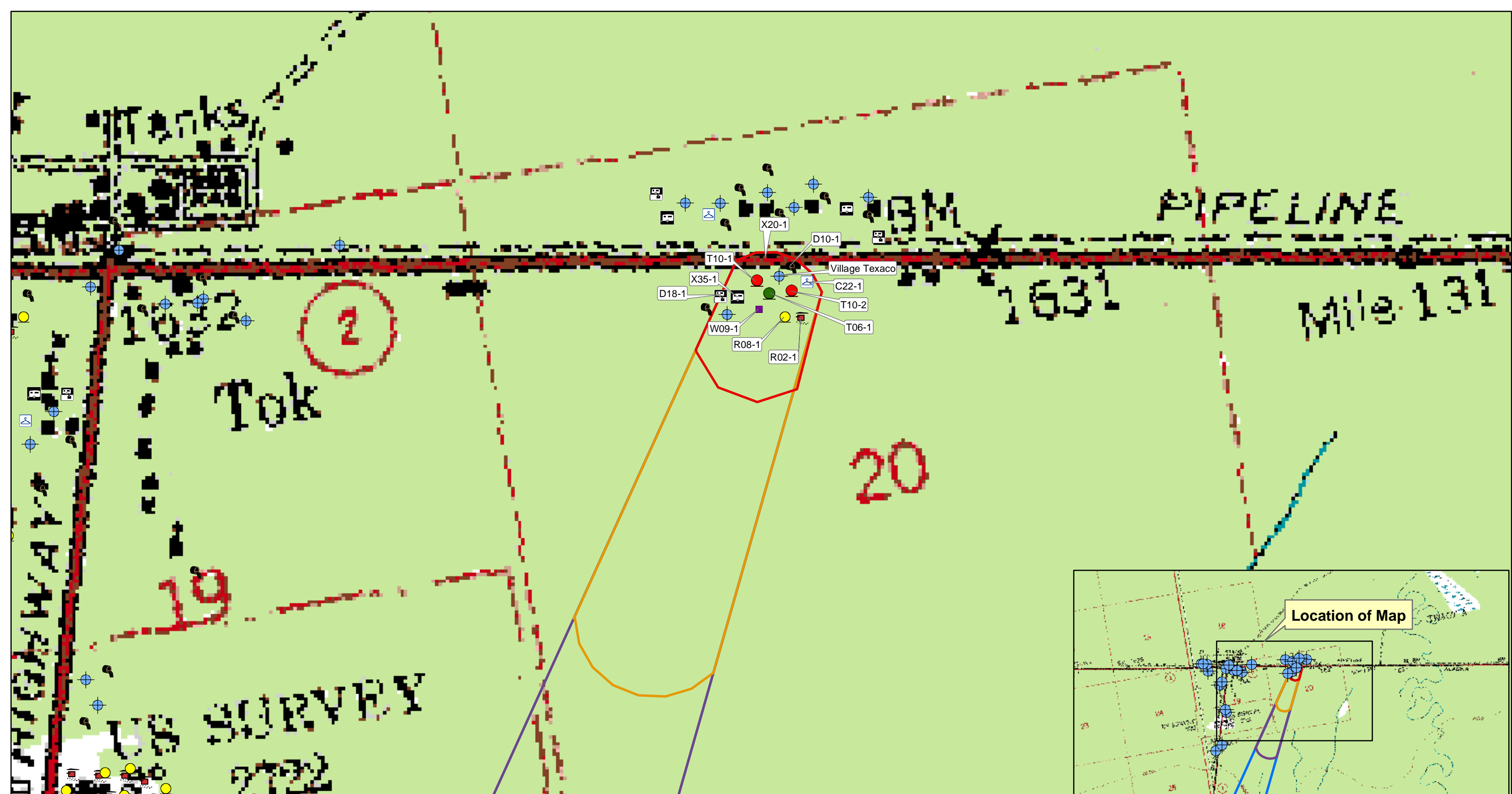
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Table 4

| Contaminant Source Type | Contaminant Source ID | CS ID tag | Zone | Risk Ranking for Analysis | Map Number | Comments |
|---|------------------------------|------------------|-------------|----------------------------------|-------------------|--|
| Laundromats without dry cleaning | C22 | C22-1 | A | Low | 2 | Laundromat without Drycleaner |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-1 | A | Low | 2 | Village Texaco Septic System |
| RV dump stations | D18 | D18-1 | A | Low | 2 | Bullshooter RV Dumpstation |
| Septic systems (serves one single-family home) | R02 | R02-1 | A | Low | 2 | Single Family Septic System for Residence |
| Tanks, heating oil, residential (above ground) | R08 | R08-1 | A | Medium | 2 | Residential Heating Oil Tank for Residence |
| Tanks, diesel (above ground) | T06 | T06-1 | A | Medium | 2 | Diesel Storage Tank for Village Texaco |
| Tanks, gasoline (above ground) | T10 | T10-1 | A | Medium | 2 | Gas Storage Tank for Village Texaco |
| Tanks, gasoline (above ground) | T10 | T10-2 | A | Medium | 2 | Gas Storage Tank for Village Texaco |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Low | 2 | Alaska Highway |
| Campgrounds and RV Parks | X35 | X35-1 | A | Low | 2 | Bullshooter RV Park |

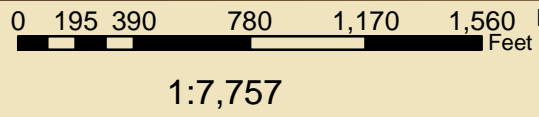
APPENDIX C

Village Texaco Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)



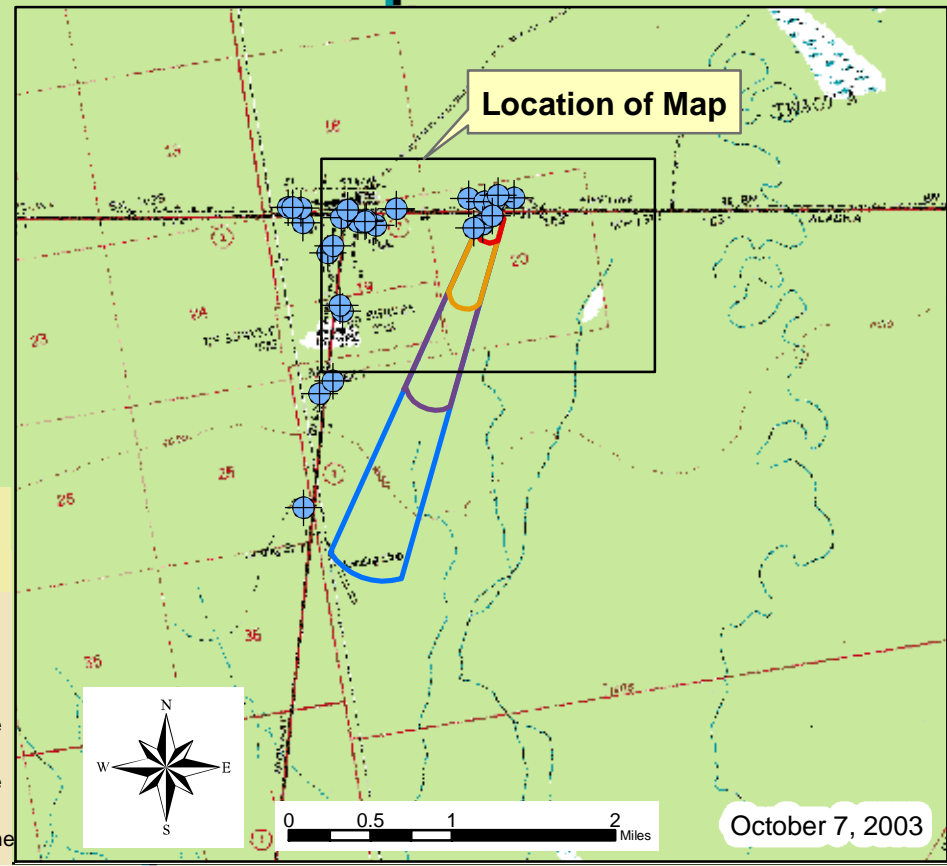
Map 2: Drinking Water Protection Areas for Village Texaco and Potential and Existing Sources of Contamination

PWSID: 381545.001



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

- | | | |
|---|--|--|
| <ul style="list-style-type: none"> Public Drinking Water Systems Laundromat w/o Drycleaning (C22) Large Capacity Septic System (D10) RV Dumpstation (D18) | <ul style="list-style-type: none"> Single Family Septic System (R02) Residential Heating Oil Tank (R08) Above Ground Diesel Storage Tank (T06) Above Ground Gas Storage Tank (T10) Private Water Supply Well (W09) RV Park (X35) | <ul style="list-style-type: none"> DWPA Zone A: Several Months Travel Time DWPA Zone B: Less than 2 Years Travel Time DWPA Zone C: Less than 5 Years Travel Time DWPA Zone D: Less than 10 Years Travel Time |
|---|--|--|



October 7, 2003

APPENDIX D

Vulnerability Analysis for Village Texaco Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Village Texaco

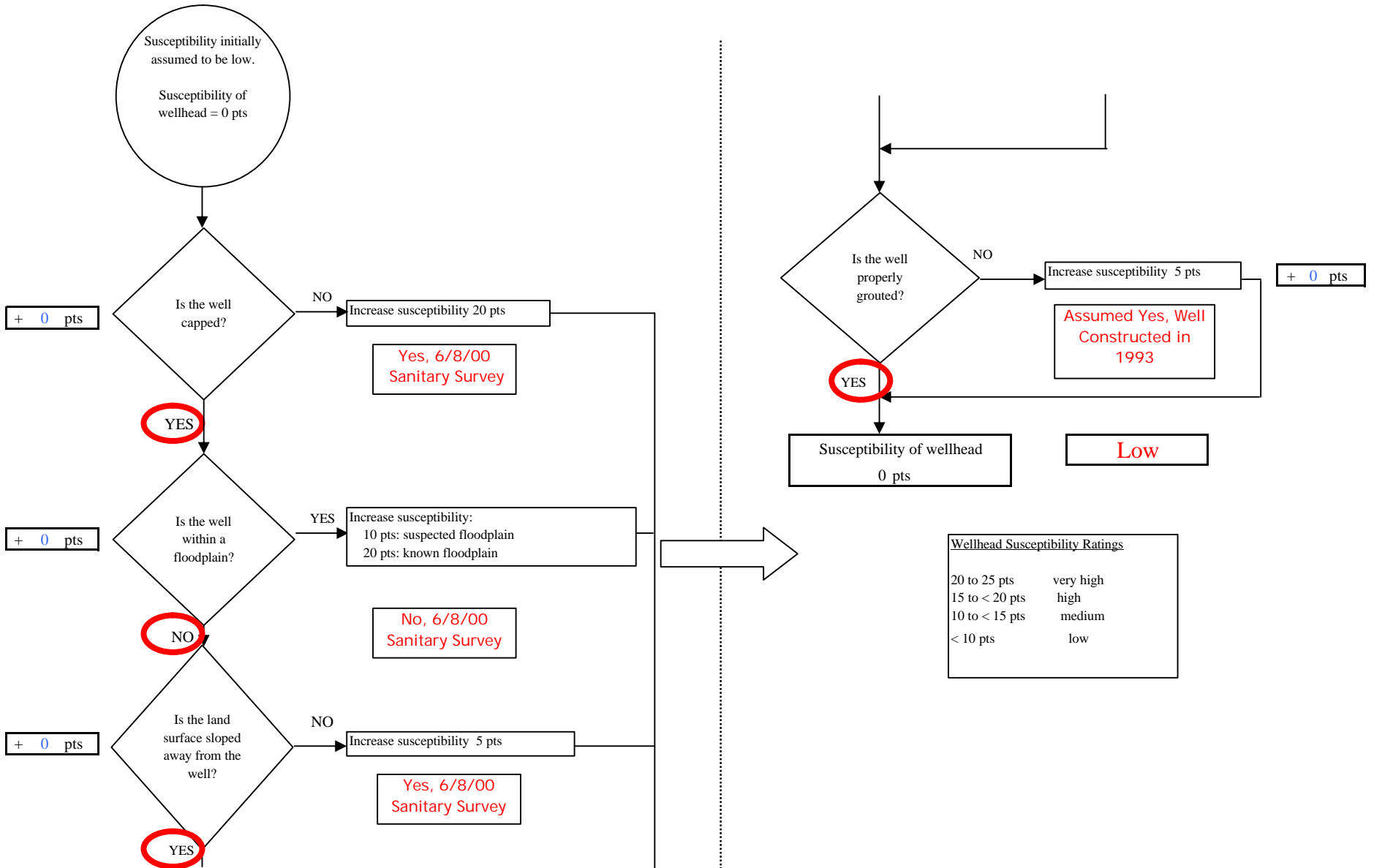


Chart 2. Susceptibility of the aquifer - Village Texaco

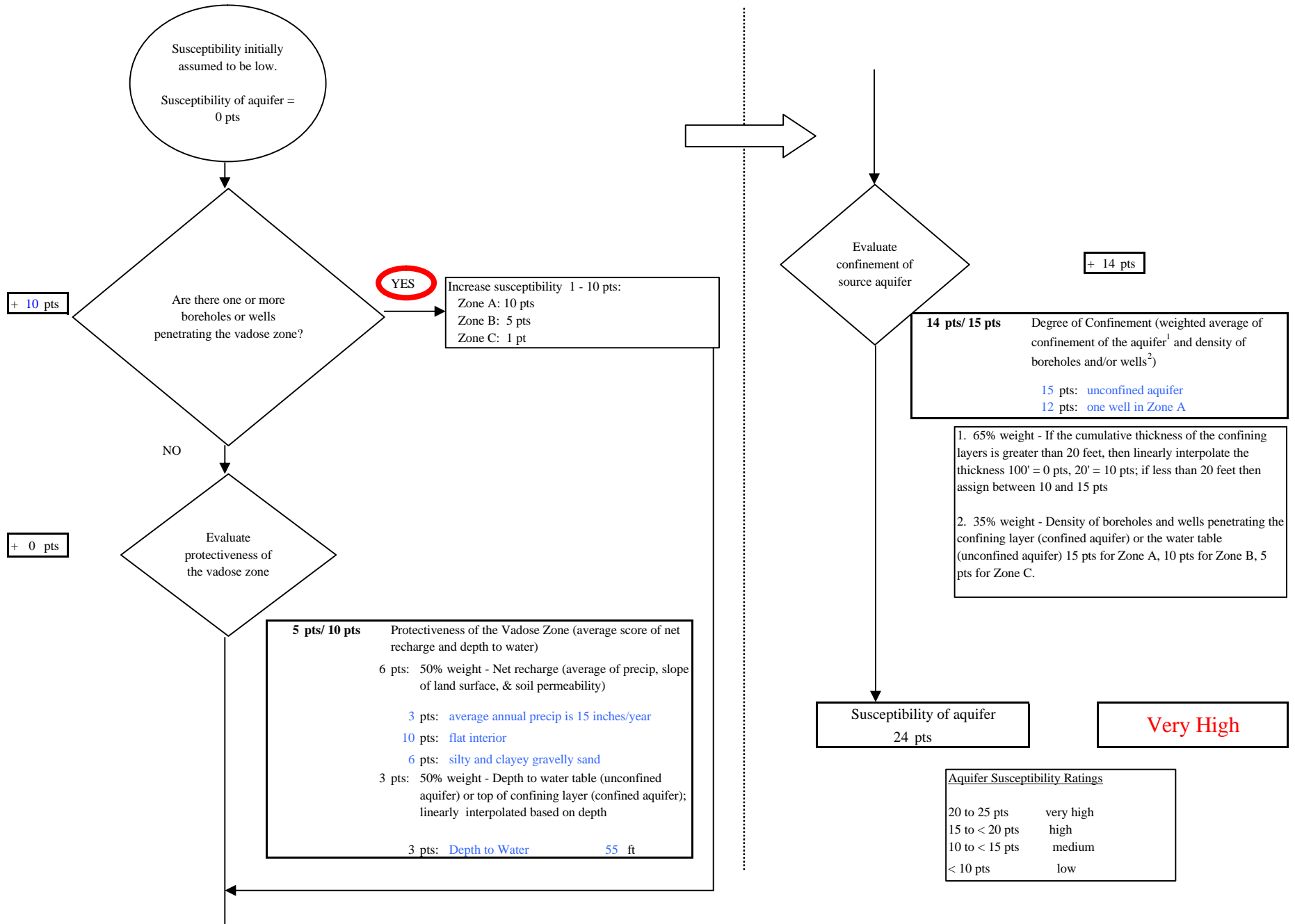


Chart 3. Contaminant risks for Village Texaco - Bacteria & Viruses

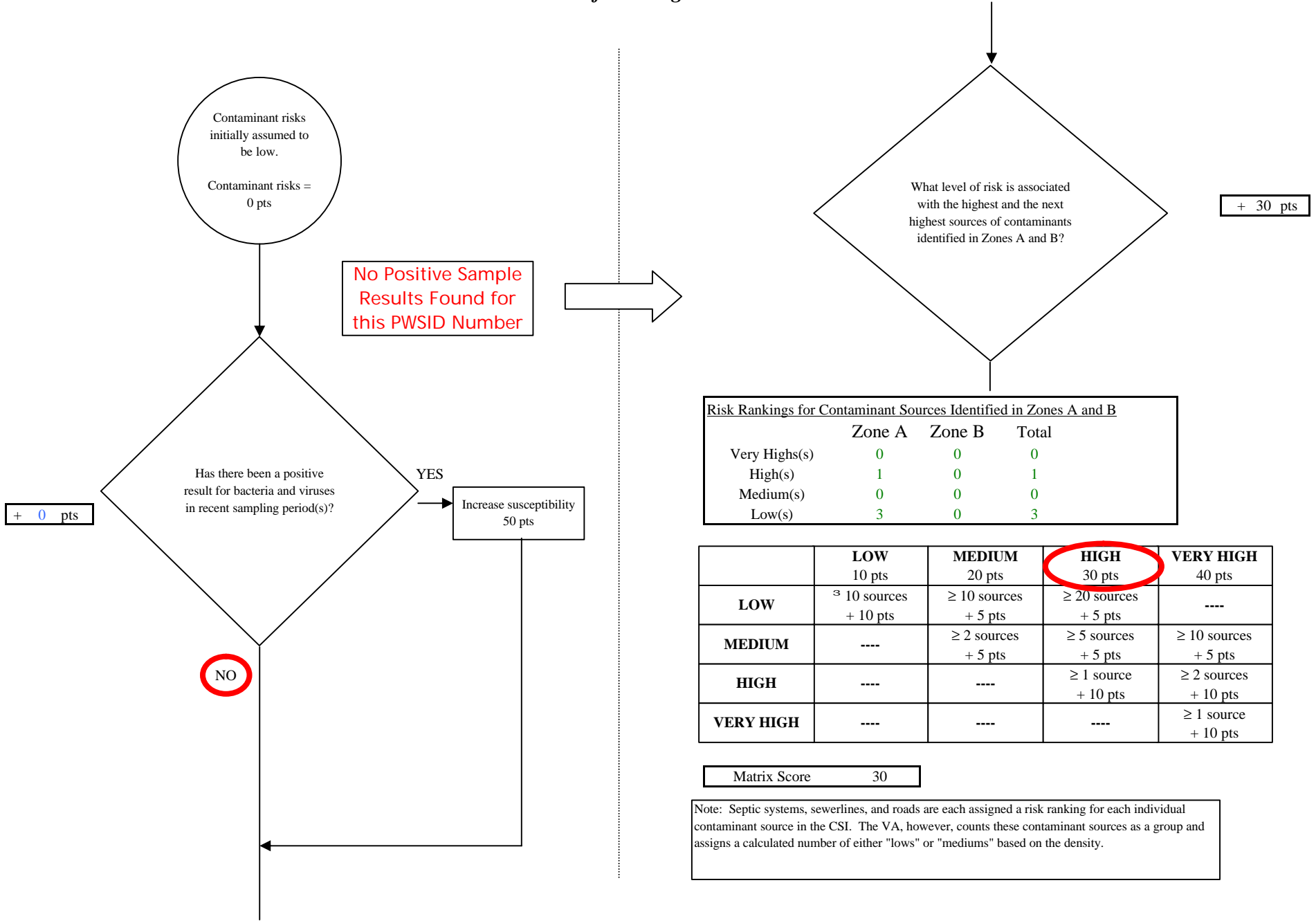
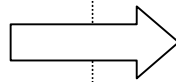
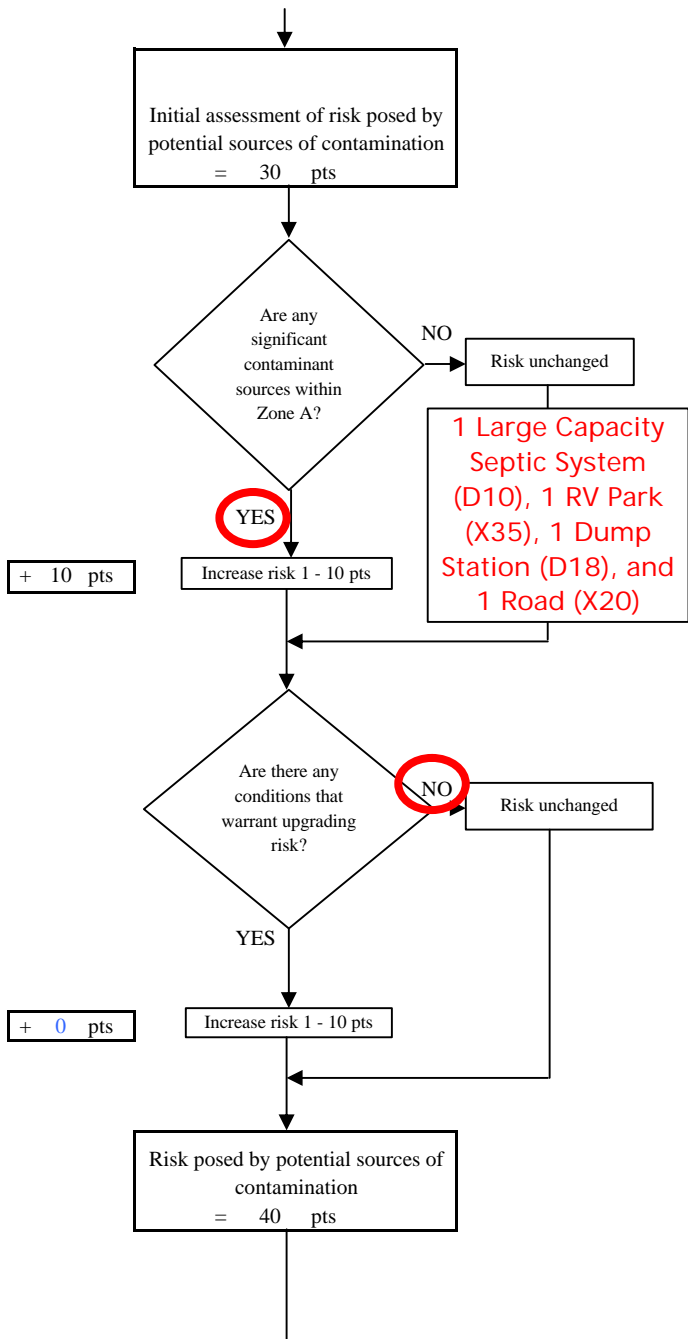


Chart 3. Contaminant risks for Village Texaco - Bacteria & Viruses



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

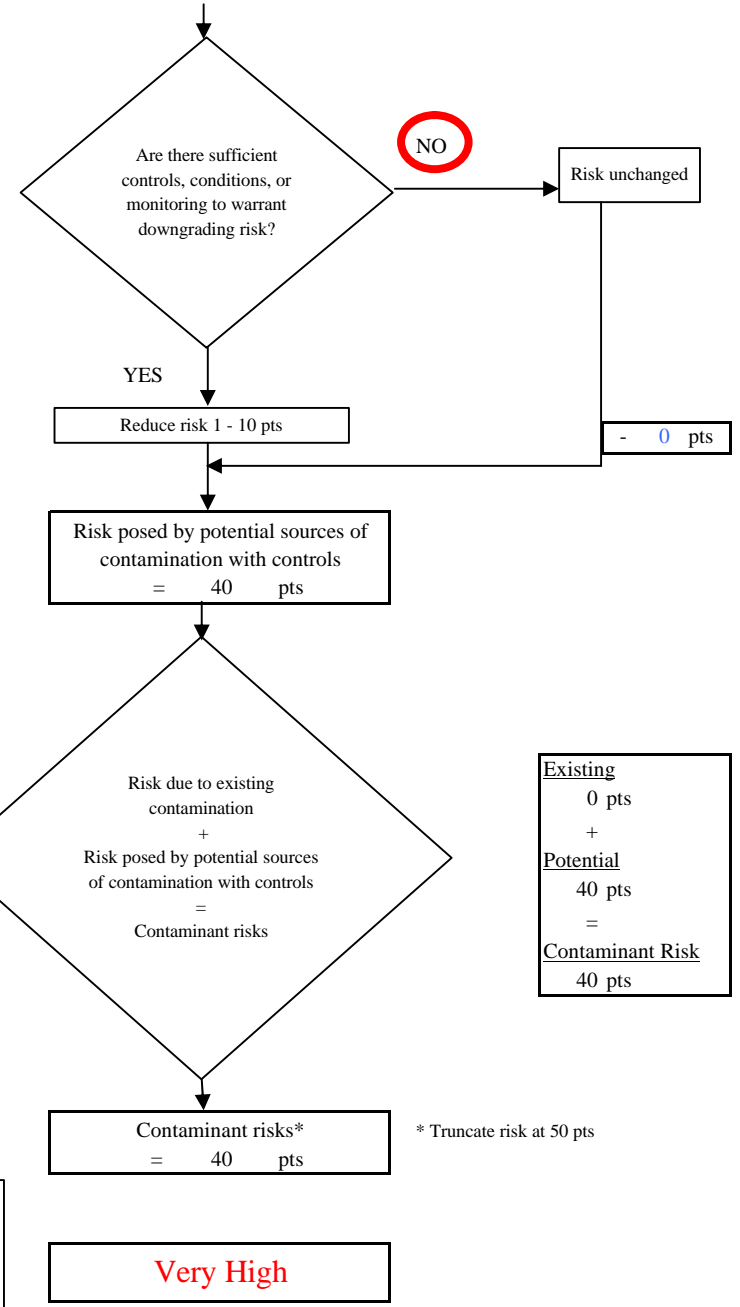


Chart 4. Vulnerability analysis for Village Texaco - Bacteria & Viruses

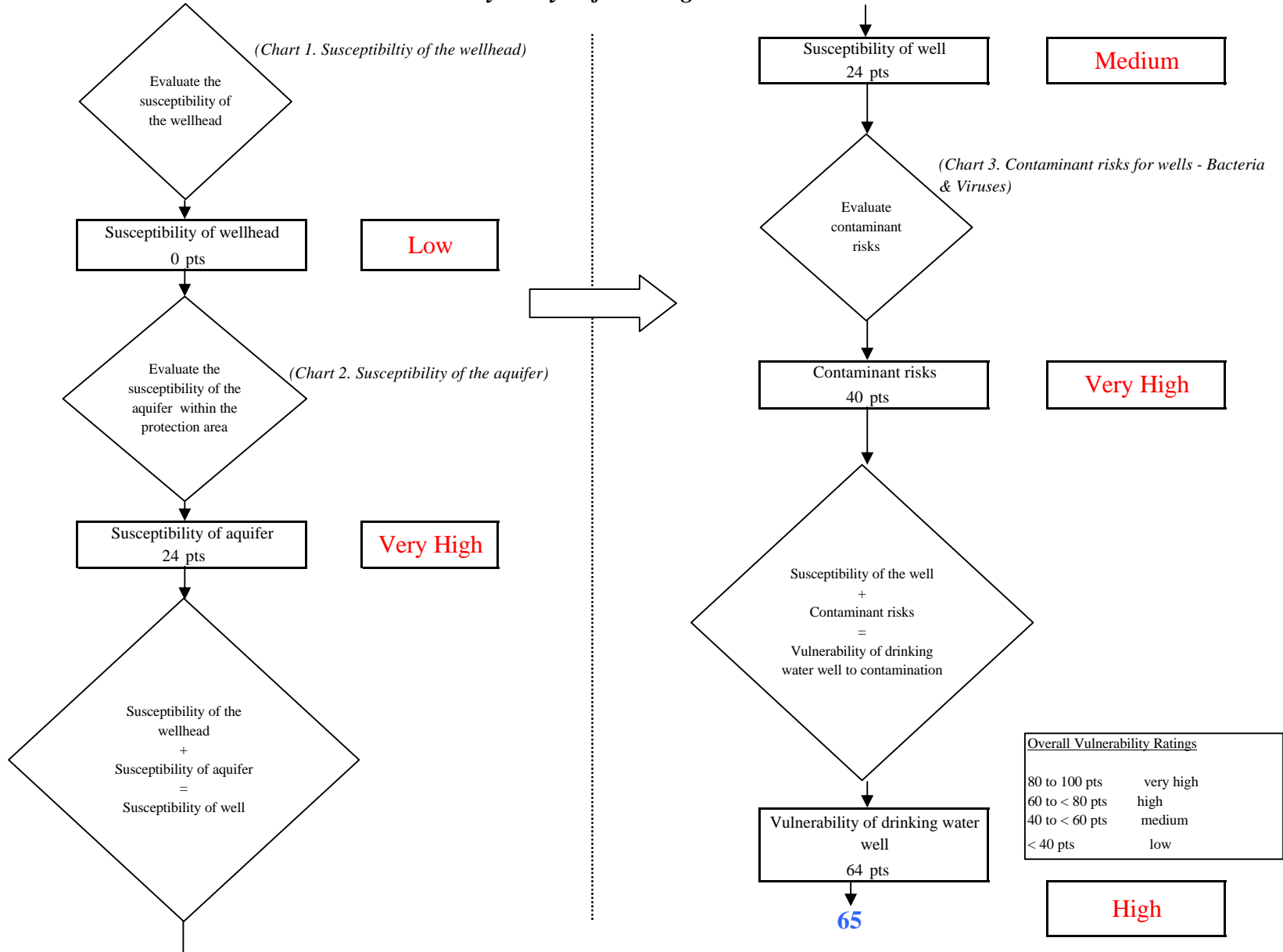


Chart 5. Contaminant risks for Village Texaco - Nitrates and Nitrites

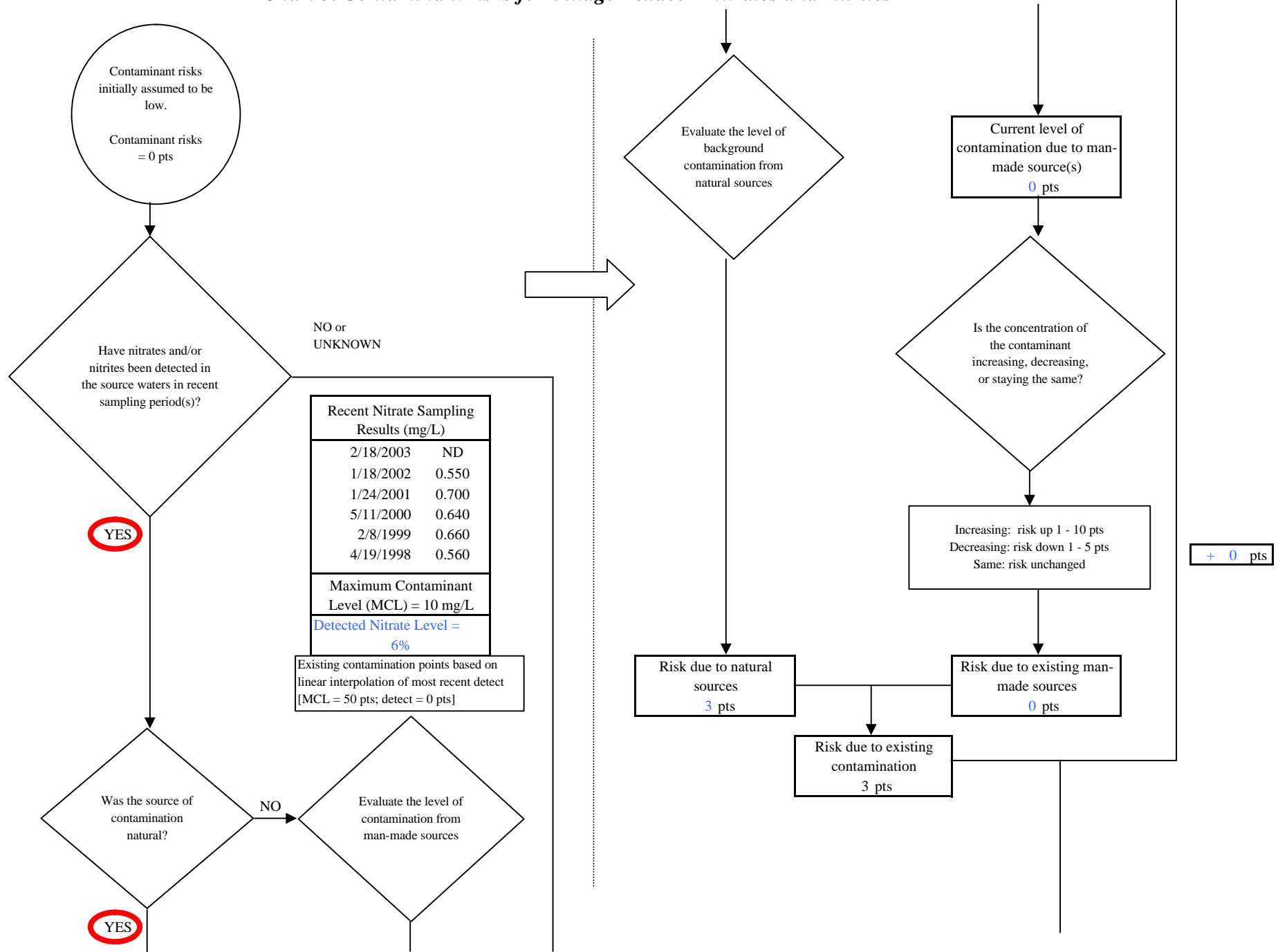


Chart 5. Contaminant risks for Village Texaco - Nitrates and Nitrites

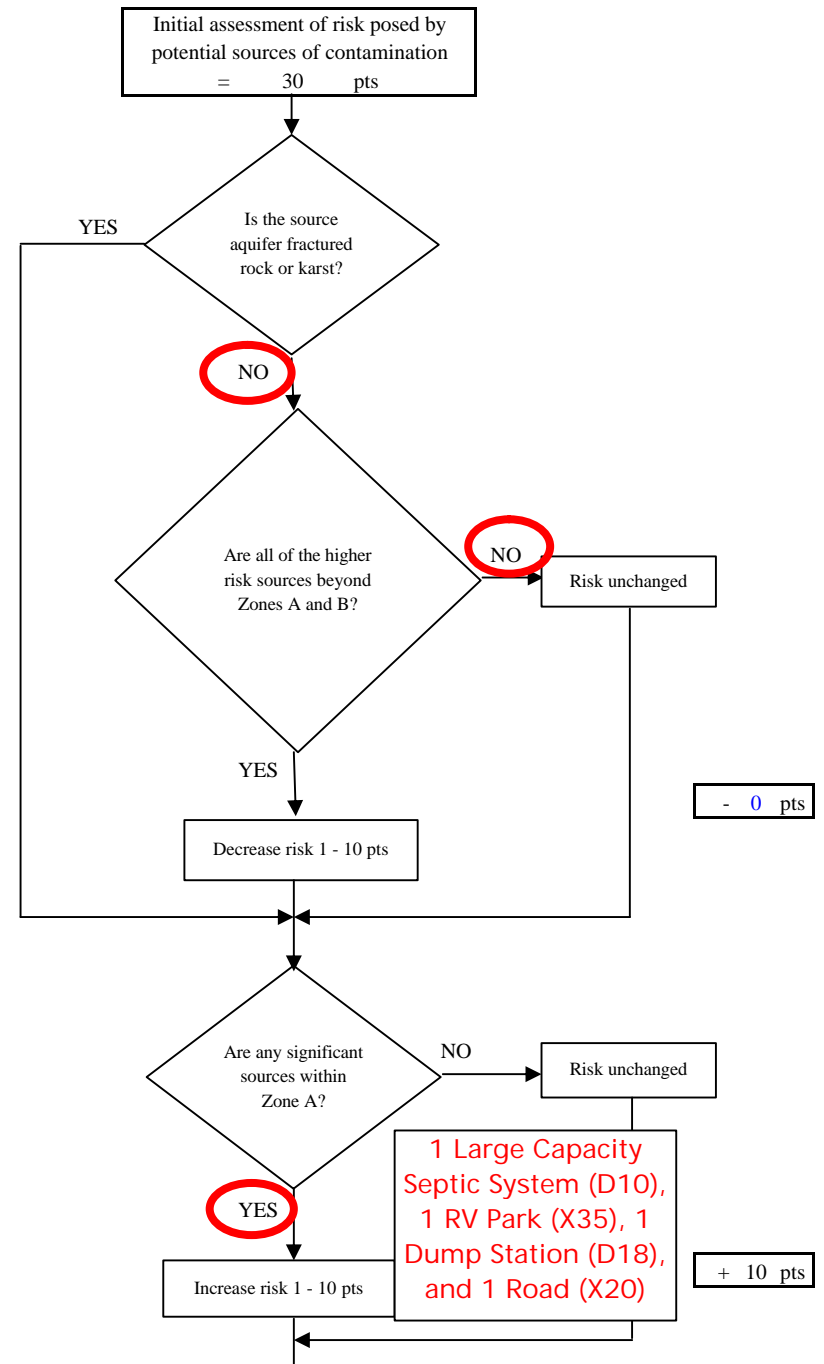
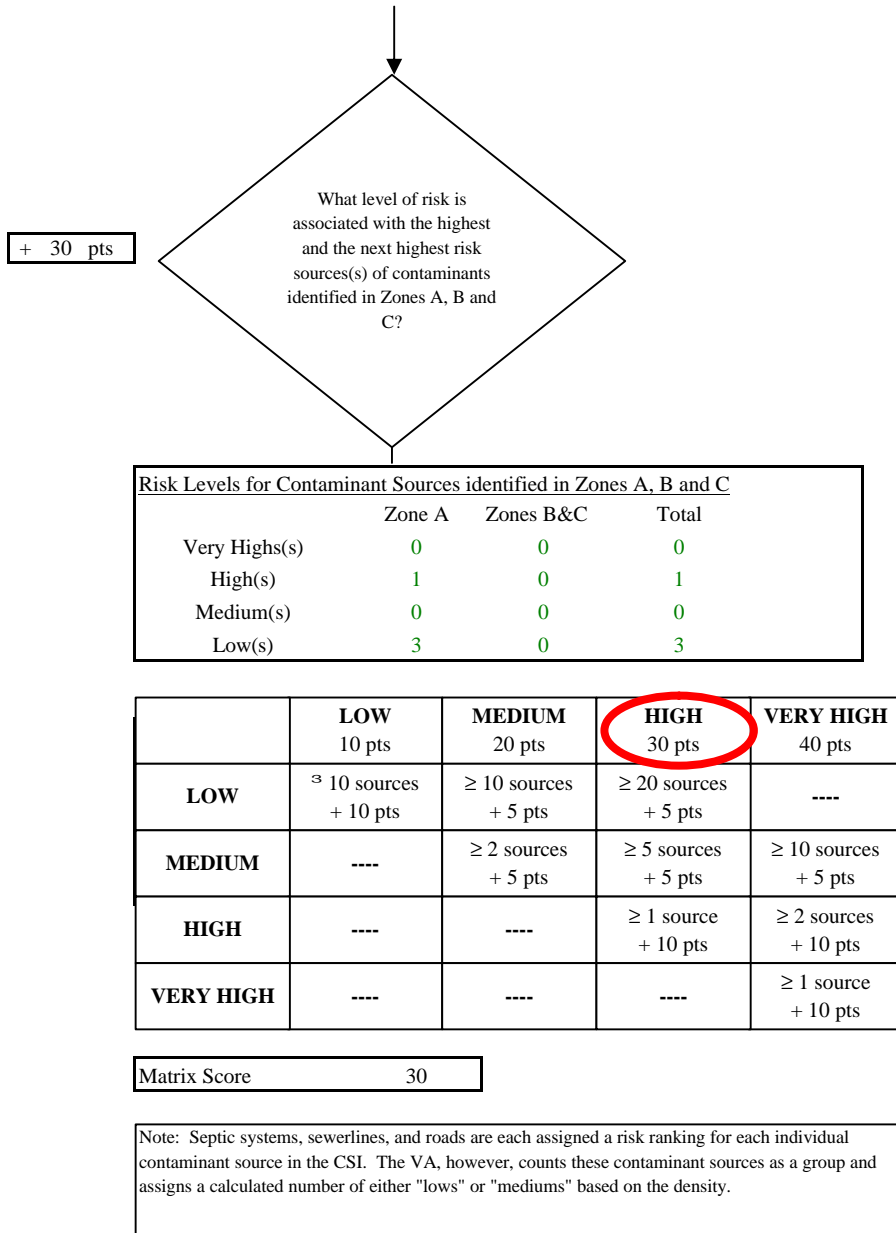


Chart 5. Contaminant risks for Village Texaco - Nitrates and Nitrites

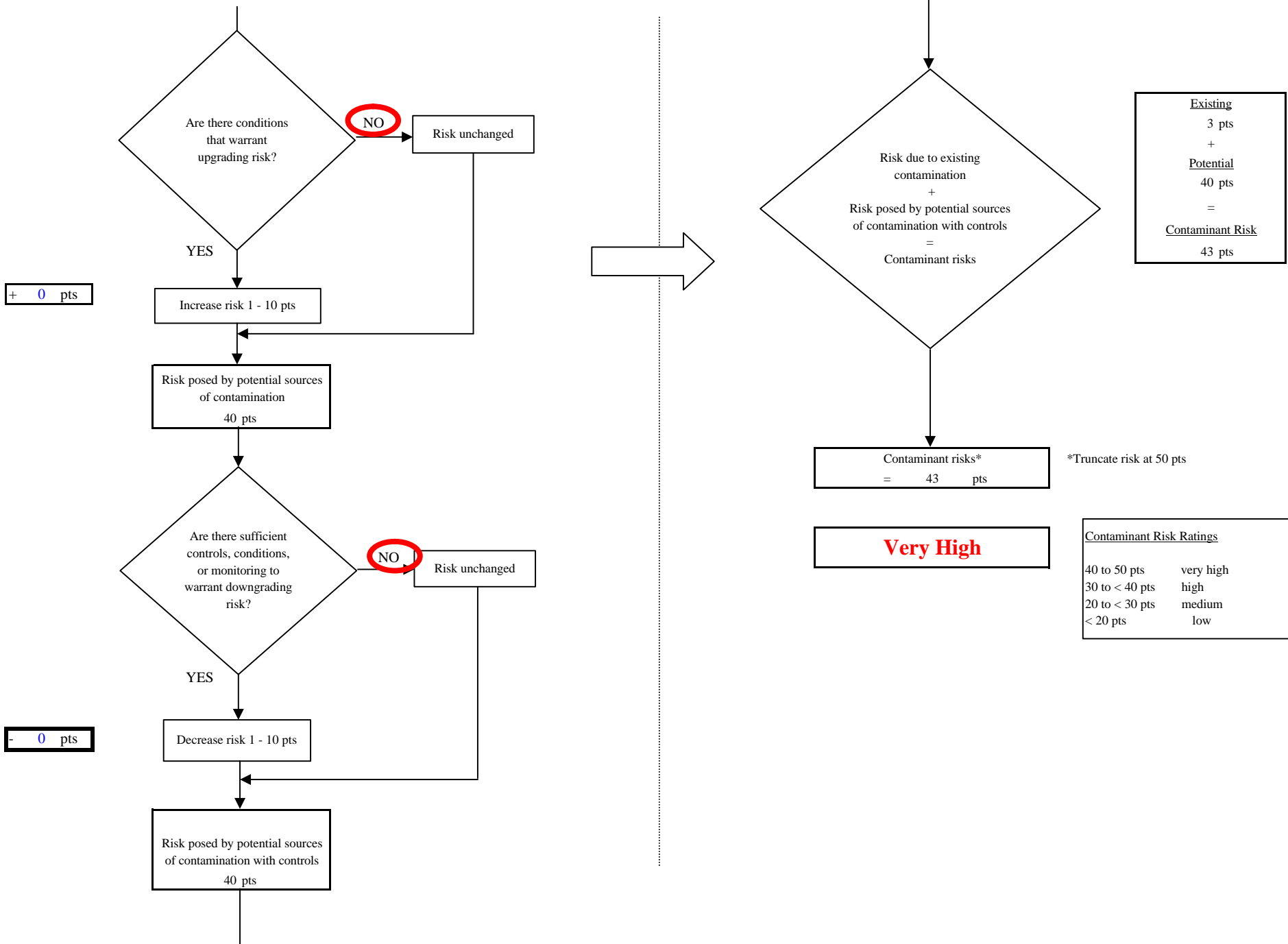


Chart 6. Vulnerability analysis for Village Texaco - Nitrates and Nitrites

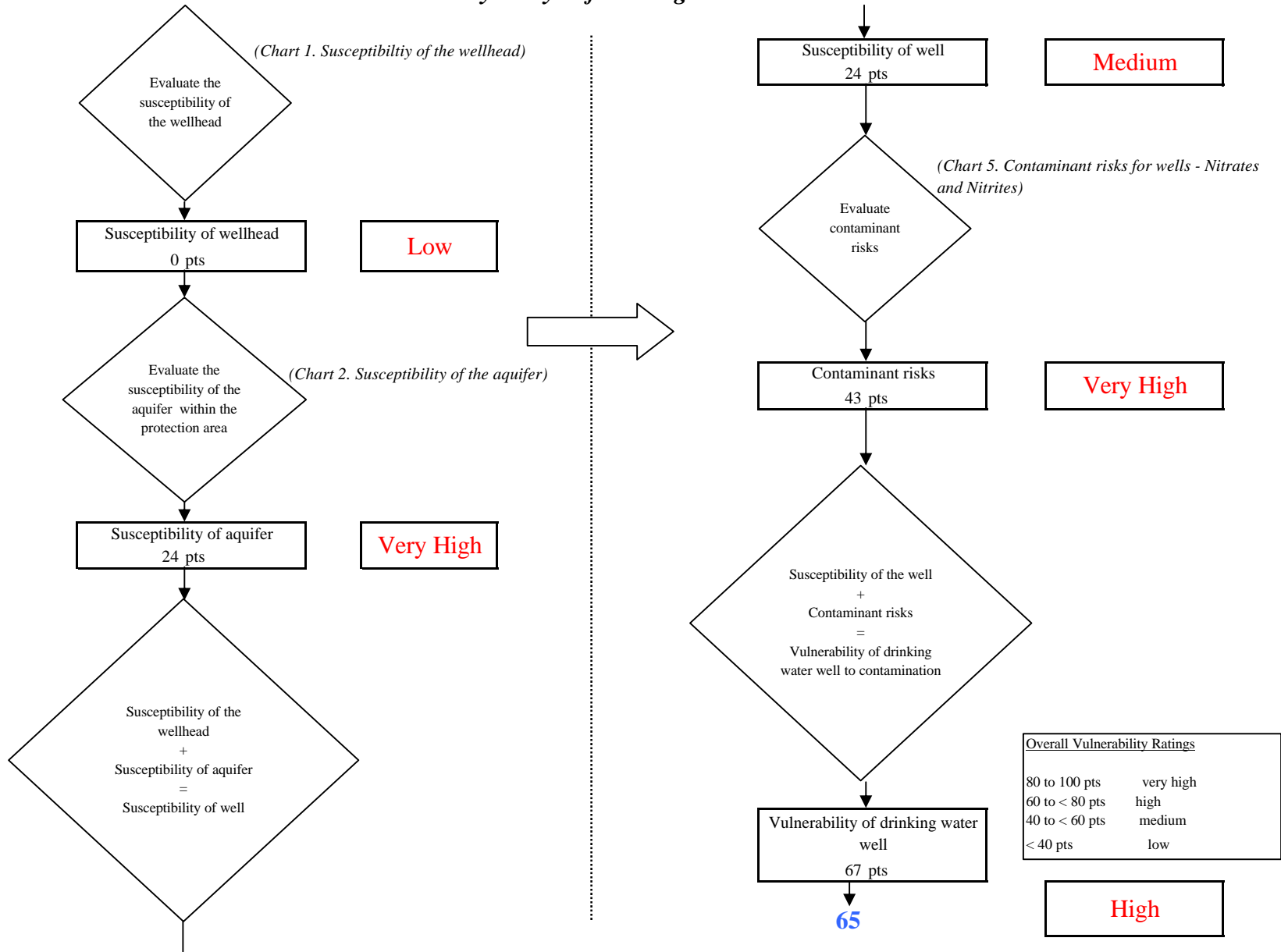


Chart 7. Contaminant risks for Village Texaco - Volatile Organic Chemicals

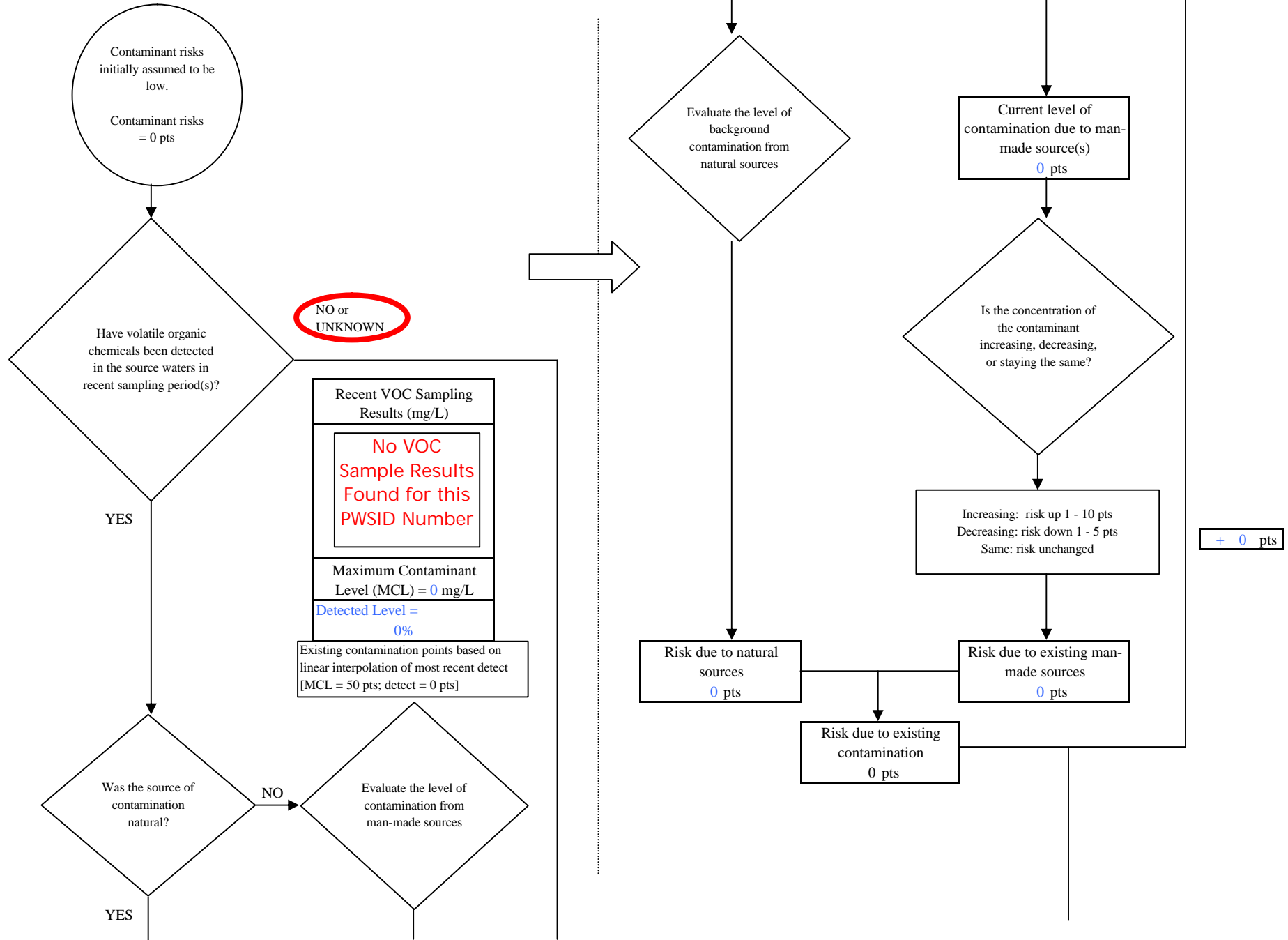


Chart 7. Contaminant risks for Village Texaco - Volatile Organic Chemicals

+ 25 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

| Risk Levels for Contaminant Sources identified in Zones A, B and C | | | |
|--|--------|-----------|-------|
| | Zone A | Zones B&C | Total |
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 4 | 0 | 4 |
| Low(s) | 6 | 0 | 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.

1 Large Capacity Septic System (D10), 1 Laundromat (C22), 1 RV Park (X35), 1 Dump Station (D18), 1 Single Family Septic System (R02), 1 Residential Heating Oil Tank (R08), 1 Diesel AST (T06), 2 Gas AST (T10), and 1 Road (X20)

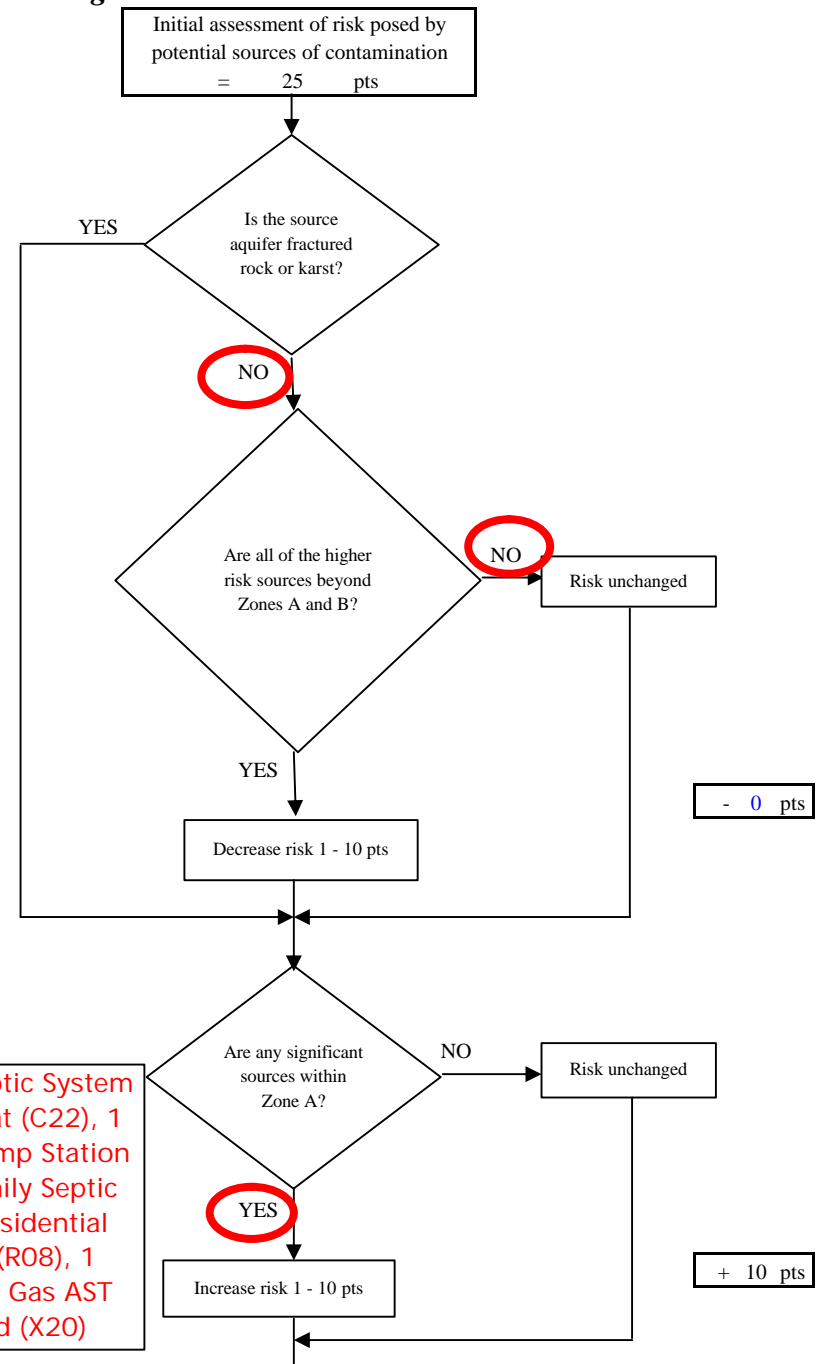


Chart 7. Contaminant risks for Village Texaco - Volatile Organic Chemicals

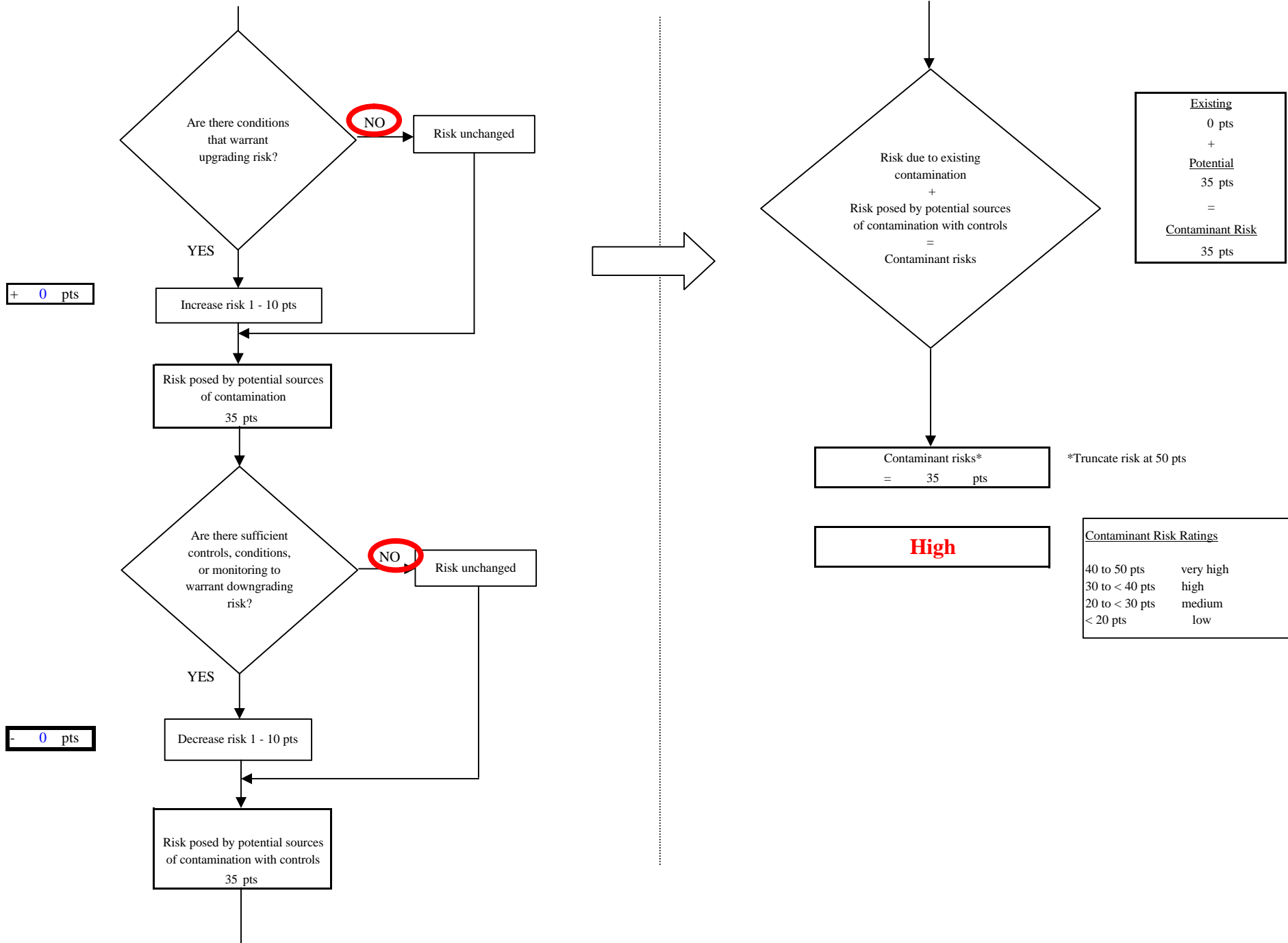


Chart 8. Vulnerability analysis for Village Texaco - Volatile Organic Chemicals

