Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Twin Springs Water Drinking Water System, Fairbanks area, Alaska PWSID # 312813

DECEMBER 2002

DRINKING WATER PROTECTION PROGRAM REPORT Report 811
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 Twin Springs Water Source of Public Drinking Water, Fairbanks Area, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Twin Springs Water is a Class A (community) water system consisting of one well along Steele Creek Road north of Chena Hot Springs Road approximately 7 miles northeast of Fairbanks, 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** risk rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Twin Springs Water public drinking water source include: residential septic systems, residential heating oil tanks, roads, and residential areas. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals. Combining the natural susceptibility of the well with the contaminant risk, the public water source for Twin Springs Water received a vulnerability rating of **High** for heavy metals, a **Medium** for bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals, and a **Low** for synthetic organic chemicals and other organic chemicals.

TWIN SPRINGS WATER PUBLIC DRINKING WATER SYSTEM

Twin Springs Water public water system is a Class A (community) water system. The system consists of one well along Steele Creek Road north of Chena Hot Springs Road approximately 7 miles northeast of Fairbanks, Alaska (T1N, R1E, Section 21) (See Map 1 of Appendix A). Fairbanks and its surrounding communities are located in the Fairbanks North Star Borough which is near the center of Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include : College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

The majority of residents in the Fairbanks area use individual wells or hauled water, and septic systems (ADCED, 2002). Heating oil (commonly stored in both above and below ground 275 to 500-gallon tanks) is most commonly used for heating homes and buildings (ADCED, 2002). Refuse is transported to the Fairbanks North Star Borough landfill.

The Fairbanks area includes two distinct topographic areas: the floodplain of the Tanana River and the Chena River, and the uplands north of this floodplain. The well for Twin Springs Water is located in the uplands at an elevation of approximately 700 feet above sea level.

According to the well log for the well, the depth of the well is 60 feet below ground surface (bgs) and is screened in bedrock. Bedrock in this area is predominantly a metamorphosed marine mud deposit, called a pelitic schist. The schist is locally intruded by granitic rocks – granite and quartz diorite. Groundwater in the bedrock is principally contained in fractures. The water wells in this area with the greatest well recharge appear to be in quartz veins, quartzite, and siliceous schist (Nelson, 1978).

Groundwater in the uplands is recharged by local precipitation. Outflow of ground water in the uplands primarily occurs two ways. In areas under artesian pressure (pressure caused by overlying permafrost), water can flow to the surface through thawed conduits within the permafrost. Otherwise groundwater will flow under the permafrost (if present) and out to the groundwater beneath the adjacent flood plain or creek valley (Nelson, 1978).

The most recent Sanitary Survey (4/10/01) indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is also appropriately sloped away from each of the wells allowing surface water and contaminants to drain away from the wells. It also indicates the well has been grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters. The well is not located in a known floodplain.

This system operates year-round and serves approximately 300 residents through 100 service connections.

DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. 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, and will serve as the focus for voluntary protection efforts.

An outline of the immediate watershed was used to determine the size and shape of the protection area for Twin Springs Water. Available geology was also considered to take into account any 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. The protection area for Twin Springs Water is limited by its immediate watershed and includes only Zone A (See Map 1 of Appendix A). The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*), and State of Alaska Department of Water Resources (*Jokela et. al., 1991*).

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

Table 1. Definition of Zones

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

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

An inventory of the potential sources of contamination was completed through a search of agency records and other publicly available information for this water system. 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
- 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 time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well.

Tables 2 through 7 in Appendix B contain the ranking of potential and existing sources of contamination with respect to all six contaminant categories.

VULNERABILITY OF TWIN SPRINGS WATER 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 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. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.

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

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

\+

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

=

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

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

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The well for the Twin Springs Water is completed in an unconfined fractured bedrock aquifer. A thin 15-foot silt layer above the bedrock provides some protection from contaminants traveling downward from the surface with the precipitation and surface water runoff. Ground water can move extremely quickly through fractures within the bedrock, depending on their width, density, connectivity, and direction in the area. The water supply wells upgradient of the well also offer an easy pathway for contaminants to travel down into the aquifer and potentially towards the well. Table 2 shows the Susceptibility scores and ratings for Twin Springs Water.

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	25	Medium
Nitrates and/or Nitrites	28	Medium
Volatile Organic Chemicals	32	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	10	Low
Other Organic Chemicals	10	Low

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	50	Medium
Volatile Organic Chemicals	55	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	75	High
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	35	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is medium with the density of residential septic systems nearest to the well representing the greatest 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. Monitoring samples have all been negative for total coliform, an indicator of harmful bacteria and viruses.

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 medium with the septic systems nearest the well representing the greatest 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 for the Twin Springs Water well indicates that very low concentrations of nitrate have consistently been detected in the drinking water. Recent nitrate concentrations have ranged from 0.540 mg/L to 1.040 mg/L or about 5 to 10% of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water by the Environmental Protection Agency (EPA). Naturally occurring nitrate levels are typically less than 2 mg/l (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 medium.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is high with the density of heating oil storage tanks creating the greatest risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Both underground and above ground heating oil storage tanks are the standard way of heating homes and businesses in the area surrounding Fairbanks. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Regular system maintenance can help prevent many of these harmful fuel leaks.

Benzene, Toluene, and Xylene were detected in concentrations well below their respective MCLs in one sample collected on 4/18/99. All three of these chemicals commonly come from gasoline. A subsequent sample collected one month later on 5/20/99 did not detect these chemicals again. No other volatile organic chemicals were detected 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 very high with the underground storage tanks and the density of septic systems in the protection area creating risk (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

Arsenic was detected above its MCL in it two most recent samples (0.015 mg/L on 5/18/01 and 0.014 mg/L on 6/24/02). According to the EPA "Arsenic occurs naturally in rocks and soil, water, air, and plants and animals. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks, and forest fires, or through human actions. Agricultural applications, mining, and smelting also contribute to arsenic releases in the environment." (EPA, 2002)

Studies have linked long-term exposure to arsenic in drinking water to cancer of the bladder, lungs, skin, kidney, nasal passages, liver, and prostate. Non-cancer effects of ingesting arsenic include cardiovascular, pulmonary, immunological, neurological, and endocrine (e.g., diabetes) effects (EPA, 2002).

Lead and Copper have been consistently detected during the recent sampling. Points were not awarded in the vulnerability analysis for this detection because these chemicals are usually associated with the water system's distribution system.

Other heavy metals were not detected in significant concentrations in their most recent sample on 5/18/01 and 4/18/99. After combining the contaminant risk for heavy metals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is low with the residential activities creating risk. Synthetic Organic Chemicals have never been sampled for in this water system. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to synthetic organic chemicals of the well is low (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

Other Organic Chemicals

The contaminant risk for other organic chemicals is low with the residential activities within the protection area creating the risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals of the well is medium (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D). Other organic chemicals have not been sampled for in Twin Springs Water's drinking water system.

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United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

Wang, B., Strelakos, P.M., Jokela, B., 2000, Nitrate Source Indicators in Groundwater of the Scimitar Subdivision, Peters Creek Area, Anchorage Alaska; U.S. Geological Survey Water Resources Investigations Report 00-4137, 25p.

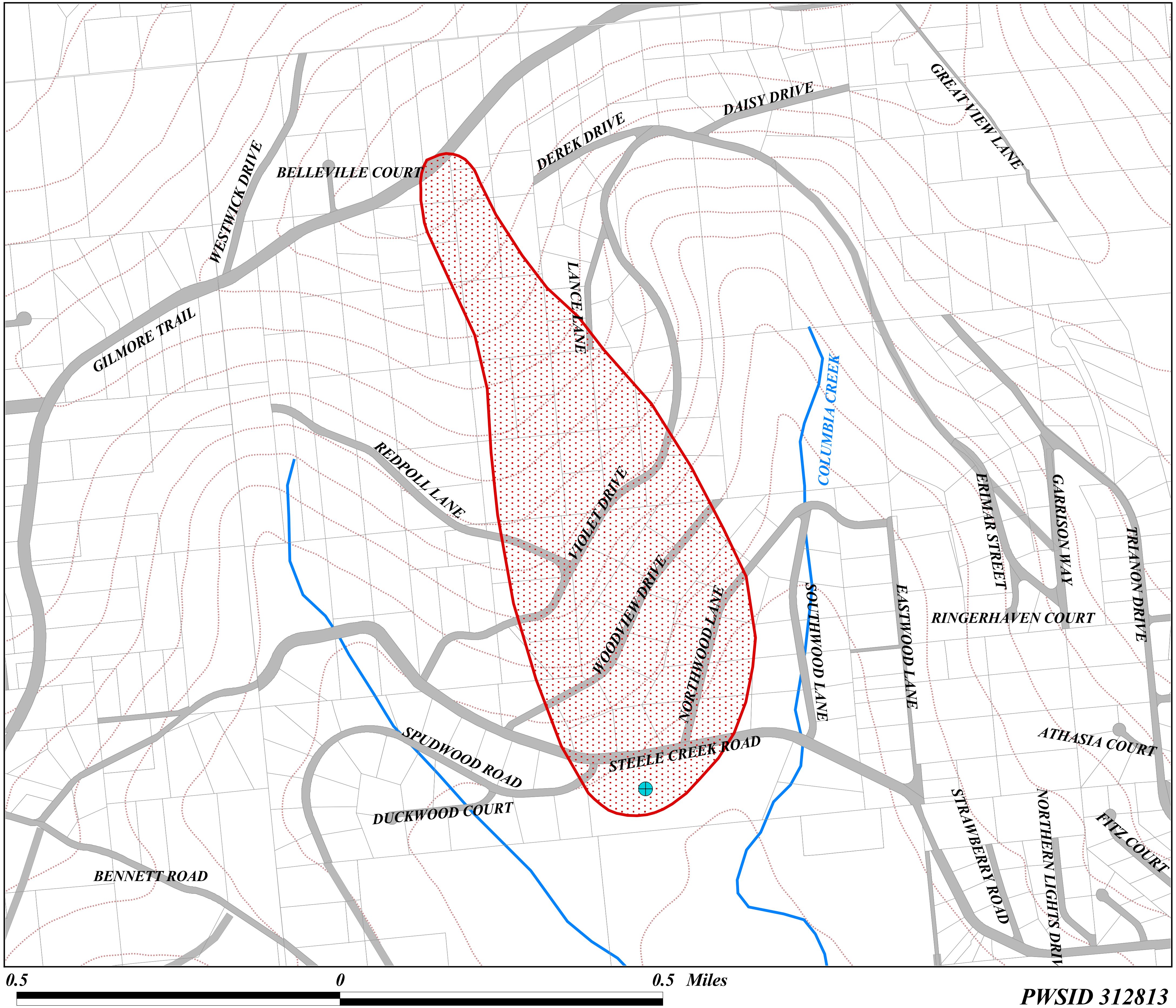
Table 1 — *Contaminant Source Inventory for* **_FNSB - Weller Elementary_** — ***PWSID 310251.001***

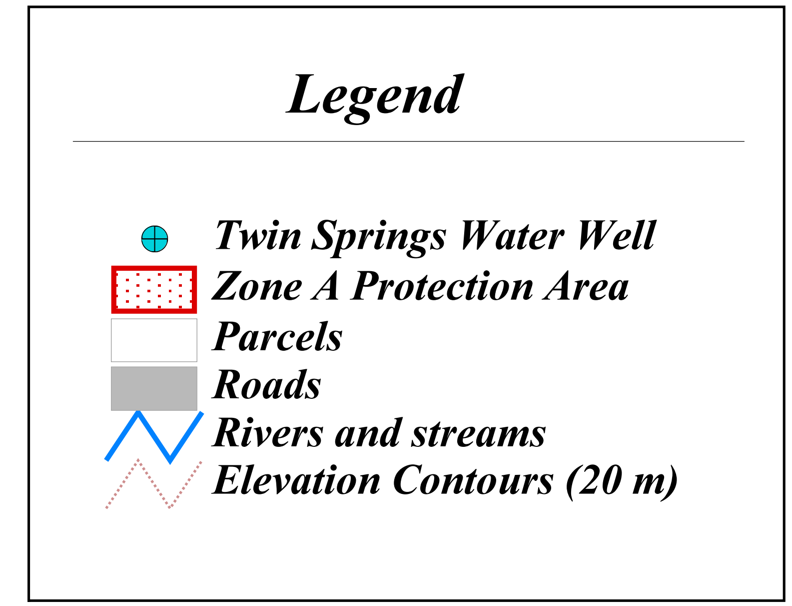
Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Construction trade areas and materials	C09	C09-1	A	2	935 Highland Street
Residential Areas	R01		A	2	Approximately 400 acres of residential area
Septic systems (serves one single-family home)	R02		A	2	Approximately 137 septic systems (approximated by number of parcels designated as residential)
Tanks, heating oil, residential (above ground)	R08		A	2	Approximately 137 heating oil tanks (approximated by number of parcels designated as residential)
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	A	2	Waste oil tank at the Firehouse
Highways and roads, dirt/gravel	X24		A	2	Approximately 11 roads located within the protection area
Firehouses	X38	X38-1	A	2	585 Steele Creek Road

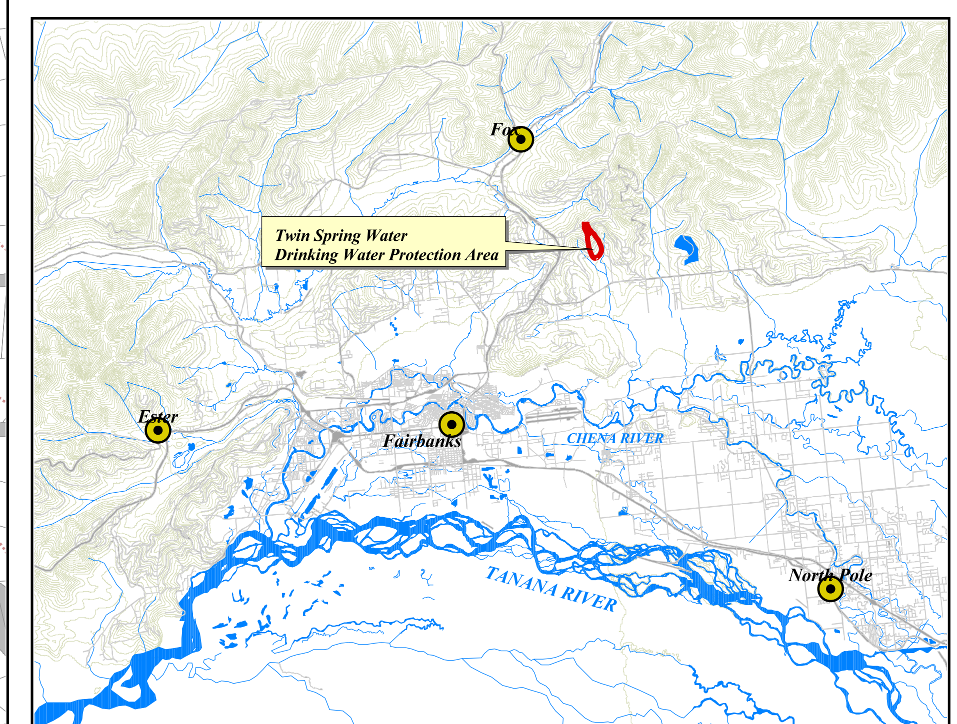
APPENDIX A

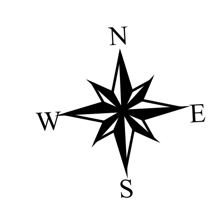
Twin Springs Water
Drinking Water Protection Area Location Map
(Map 1)

Twin Springs Water Drinking Water Protection Area









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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Twin Springs Water (Tables 1-7)

Table 1

Contaminant Source Inventory for
Twin Springs Water

PWSID 312813.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Map Number***	***Comments***
Residential Areas	R01		A	2	Approximately 100 acres of residential area
Septic systems (serves one single-family home)	R02		A	2	Approximately 34 septic systems (approximated by number of parcels designated as residential)
Tanks, heating oil, residential (above ground)	R08		A	2	Approximately 17 tanks (approximated by number of parcels designated as residential)
Tanks, heating oil, residential (underground)	R09		A	2	Approximately 17 tanks (approximated by number of parcels designated as residential)
Highways and roads, dirt/gravel	X24		A	2	5 roads located within the protection area

Table 2

Contaminant Source Inventory and Risk Ranking for Twin Springs Water
Sources of Bacteria and Viruses

PWSID 312813.001

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		A	Low	2	Approximately 34 septic systems (approximated by number of parcels designated as residential)
Highways and roads, dirt/gravel	X24		A	Low	2	5 roads located within the protection area
Residential Areas	R01		A	Low	2	Approximately 100 acres of residential area

Table 3

Contaminant Source Inventory and Risk Ranking for Twin Springs Water Sources of Nitrates/Nitrites

PWSID 312813.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Residential Areas	R01		A	Low	2	Approximately 100 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Approximately 34 septic systems (approximated by number of parcels designated as residential)
Highways and roads, dirt/gravel	X24		A	Low	2	5 roads located within the protection area

Table 4

Contaminant Source Inventory and Risk Ranking for Twin Springs Water Sources of Volatile Organic Chemicals

PWSID 312813.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Tanks, heating oil, residential (underground)	R09		A	Medium	2	Approximately 17 tanks (approximated by number of parcels designated as residential)
Highways and roads, dirt/gravel	X24		A	Low	2	5 roads located within the protection area
Residential Areas	R01		A	Low	2	Approximately 100 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Approximately 34 septic systems (approximated by number of parcels designated as residential)
Tanks, heating oil, residential (above ground)	R08		A	Medium	2	Approximately 17 tanks (approximated by number of parcels designated as residential)

Table 5

Contaminant Source Inventory and Risk Ranking for Twin Springs Water

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 312813.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Tanks, heating oil, residential (underground)	R09		A	Low	2	Approximately 17 tanks (approximated by number of parcels designated as residential)
Septic systems (serves one single-family home)	R02		A	Low	2	Approximately 34 septic systems (approximated by number of parcels designated as residential)
Residential Areas	R01		A	Low	2	Approximately 100 acres of residential area
Highways and roads, dirt/gravel	X24		A	Low	2	5 roads located within the protection area

Table 6

Contaminant Source Inventory and Risk Ranking for
Twin Springs Water
Sources of Synthetic Organic Chemicals

PWSID 312813.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Residential Areas	R01		A	Low	2	Approximately 100 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Approximately 34 septic systems (approximated by number of parcels designated as residential)

Table 7

Contaminant Source Inventory and Risk Ranking for Twin Springs Water
Sources of Other Organic Chemicals

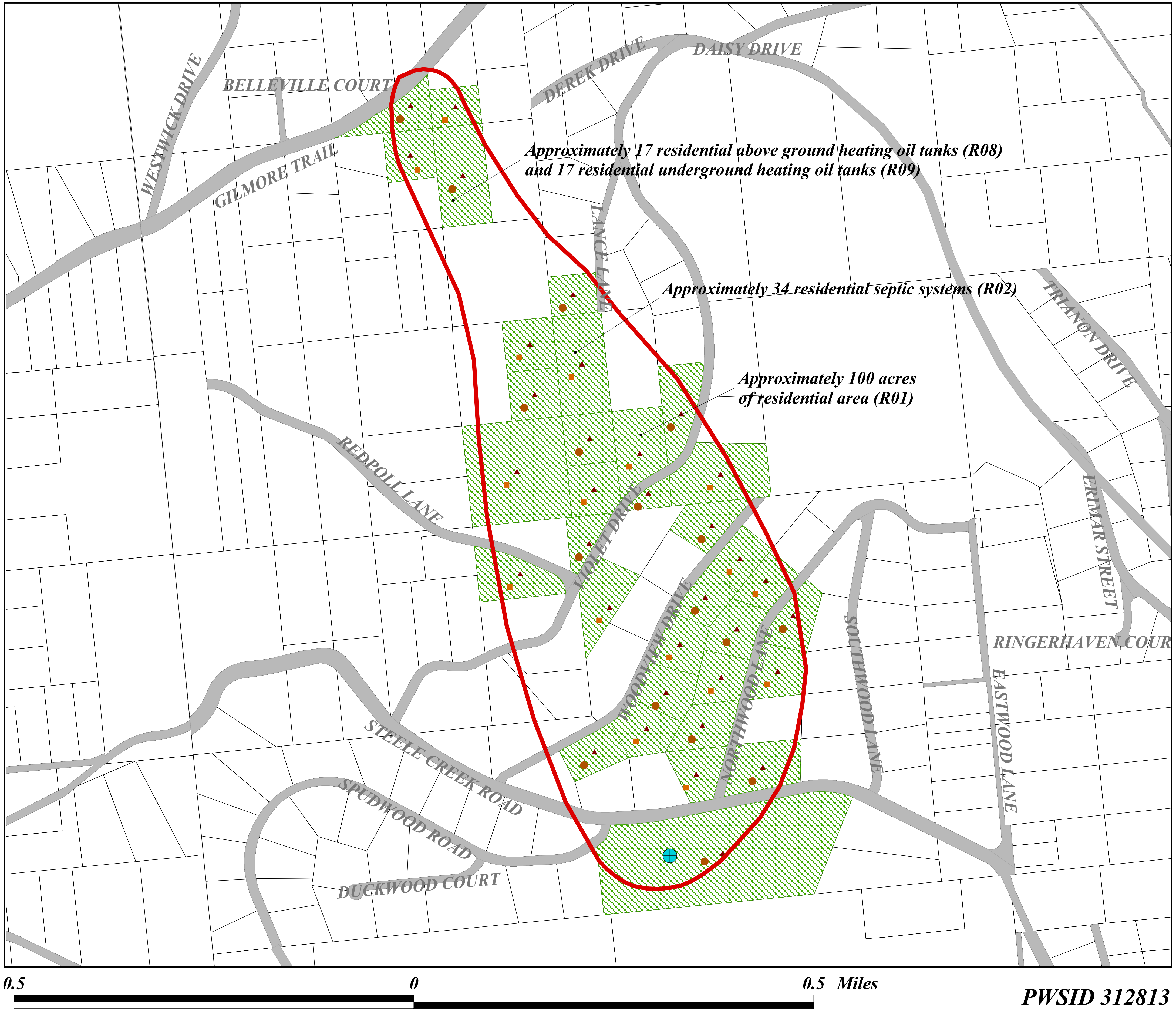
PWSID 312813.001

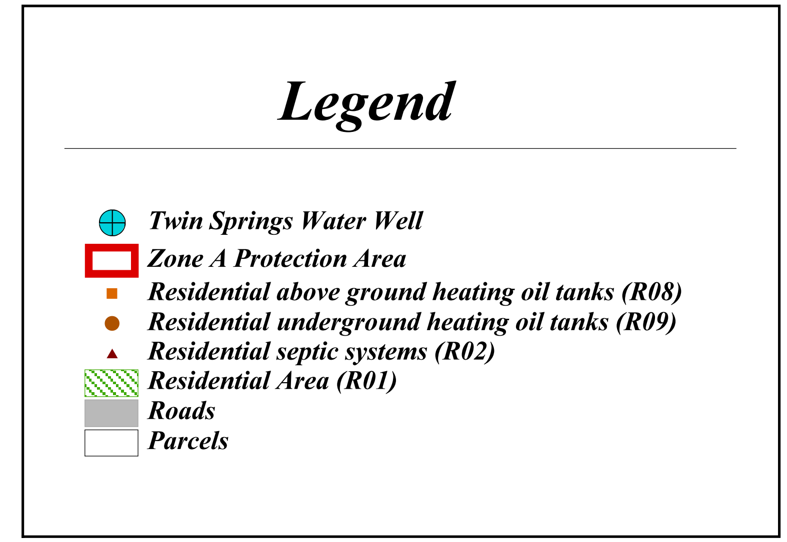
Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Highways and roads, dirt/gravel	X24		A	Low	2	5 roads located within the protection area
Residential Areas	R01		A	Low	2	Approximately 100 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Approximately 34 septic systems (approximated by number of parcels designated as residential)

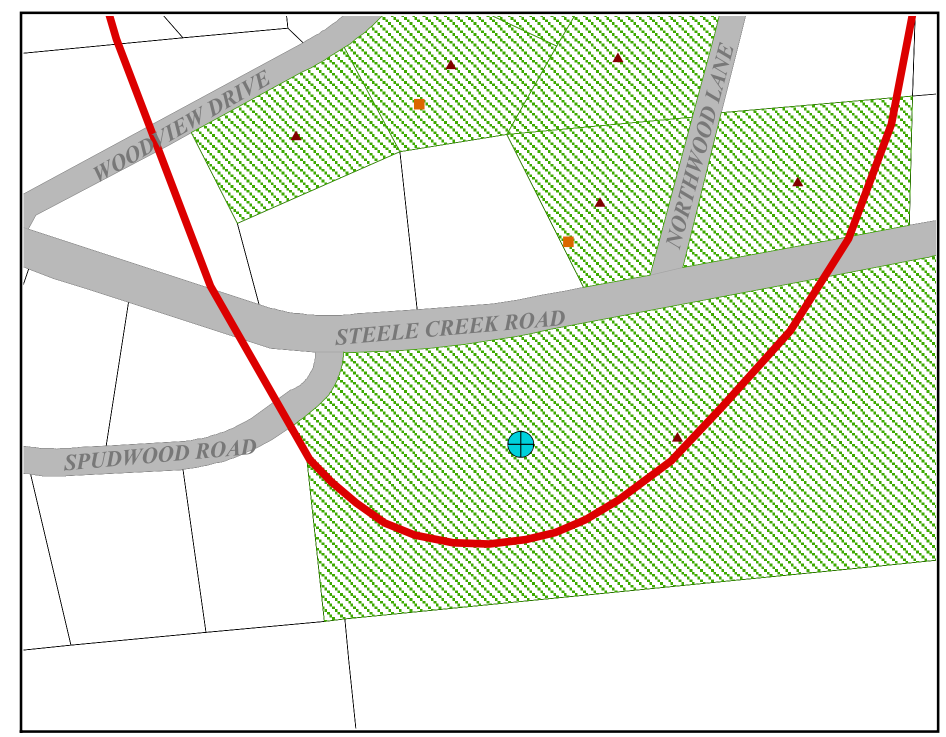
APPENDIX C

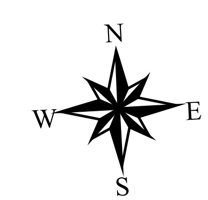
Twin Springs Water
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Twin Springs Water Drinking Water Protection Area with Potential and Existing Contaminant Sources









PWSID 312813

Map 2

APPENDIX D

Vulnerability Analysis for Twin Springs Water Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Twin Springs Water

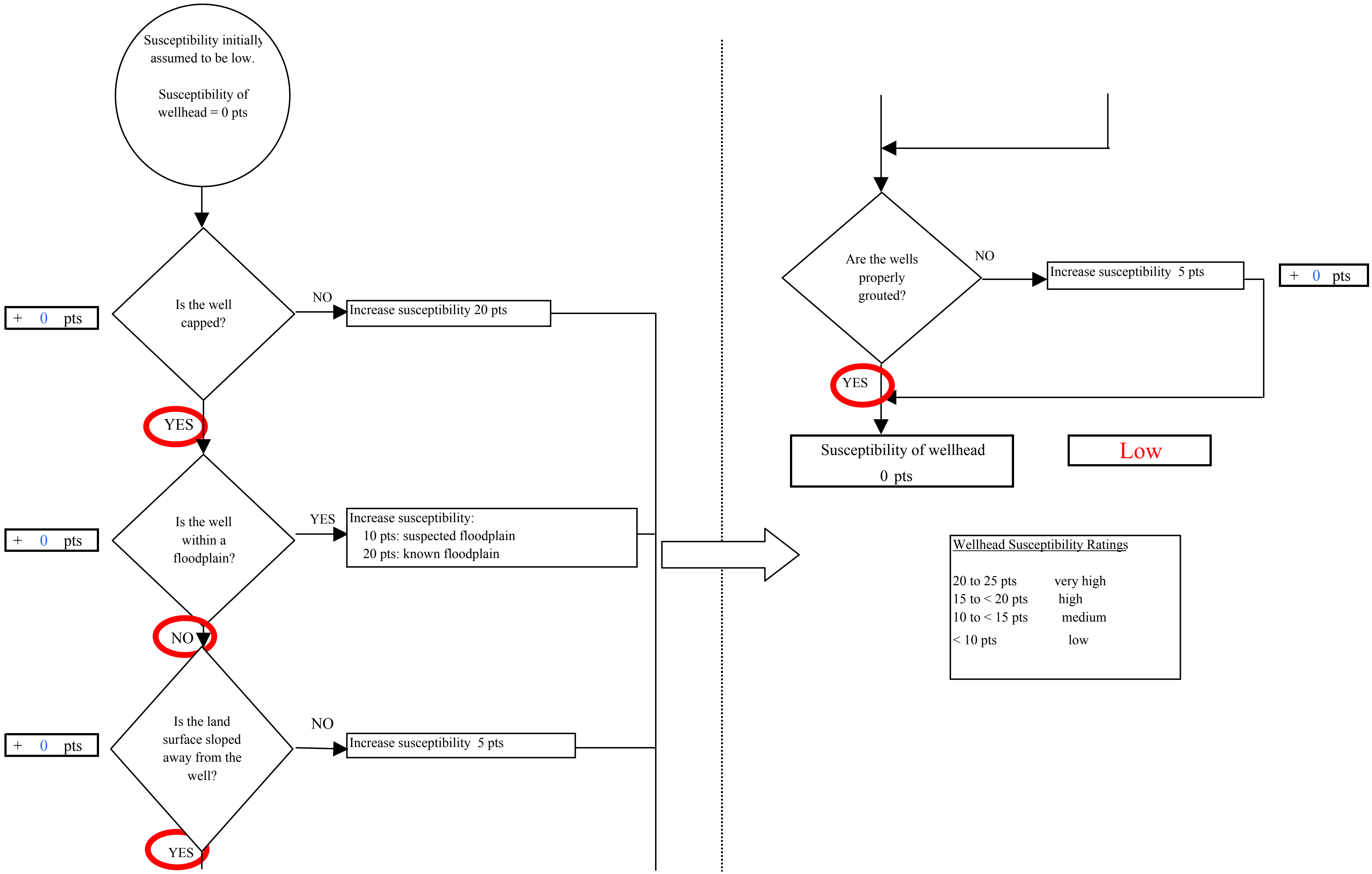


Chart 2. Susceptibility of the aquifer - Twin Springs Water

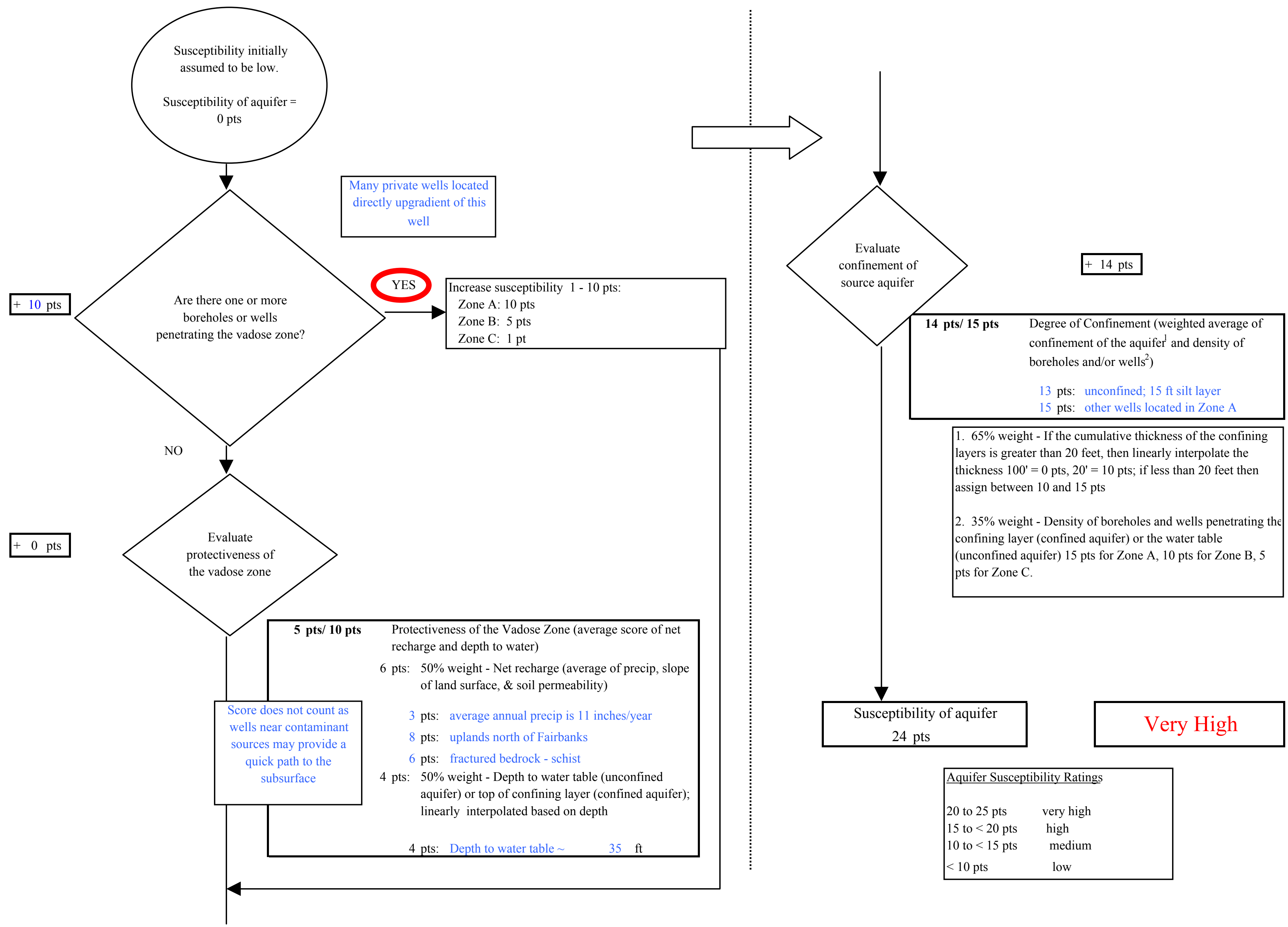
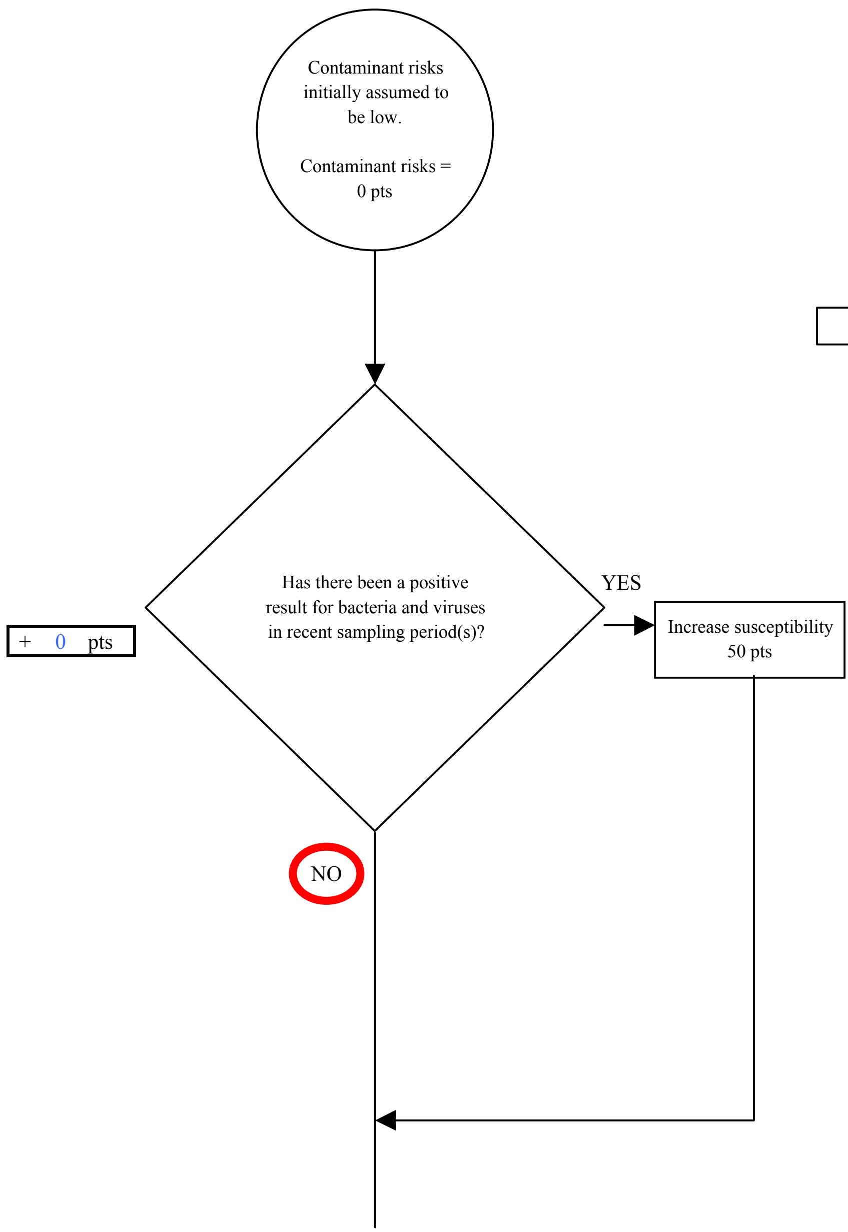
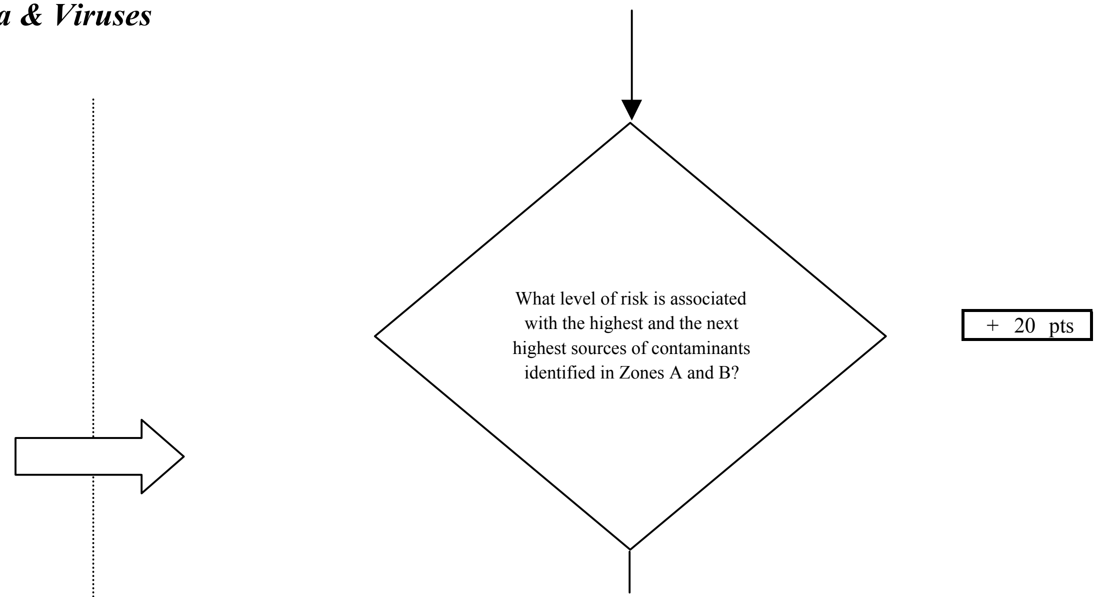


Chart 3. Contaminant risks for Twin Springs Water - Bacteria & Viruses





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	0	0
Medium(s)	0	0	0
Low(s)	37	0	37

	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 3. Contaminant risks for Twin Springs Water - Bacteria & Viruses

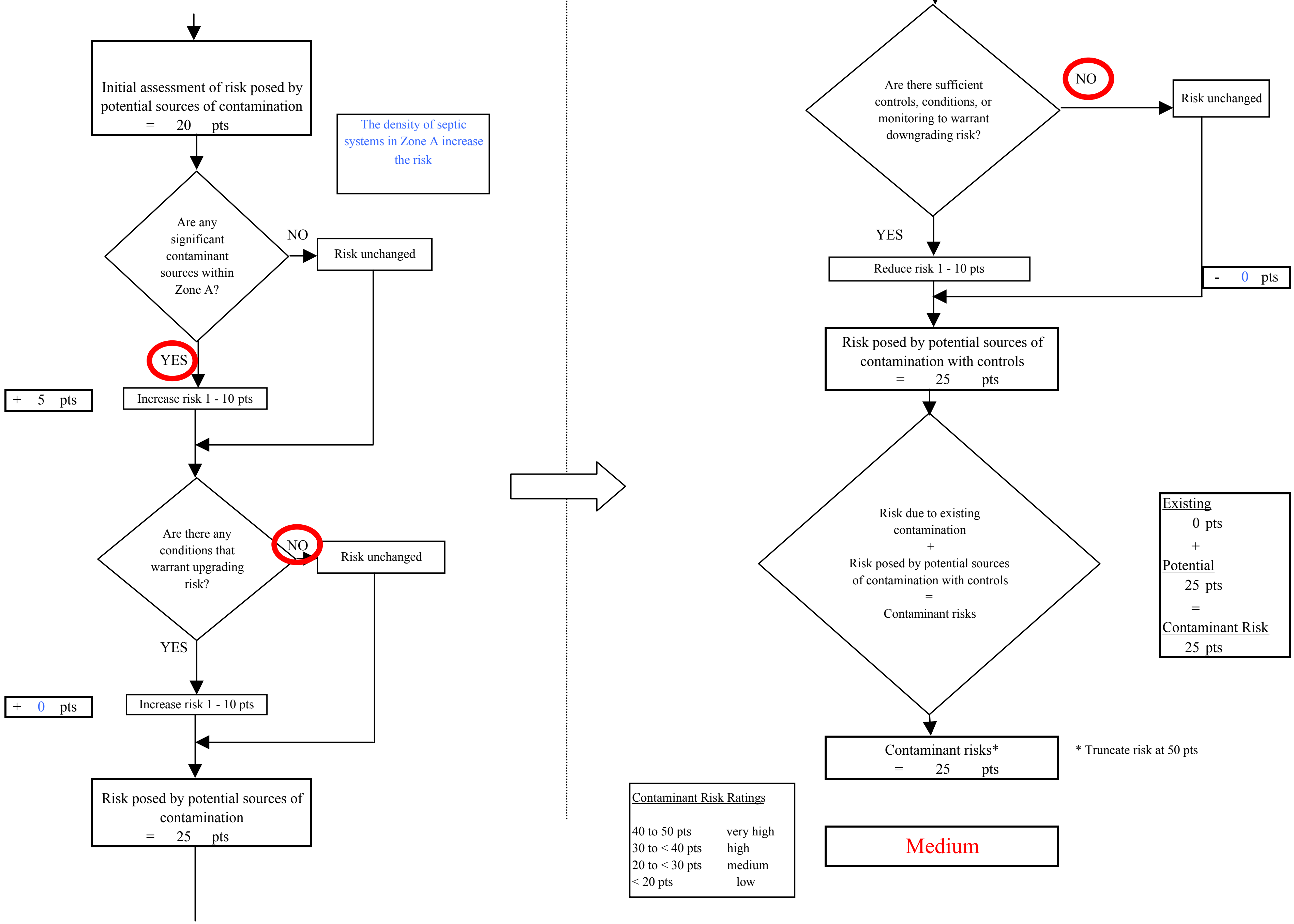


Chart 4. Vulnerability analysis for Twin Springs Water - Bacteria & Viruses

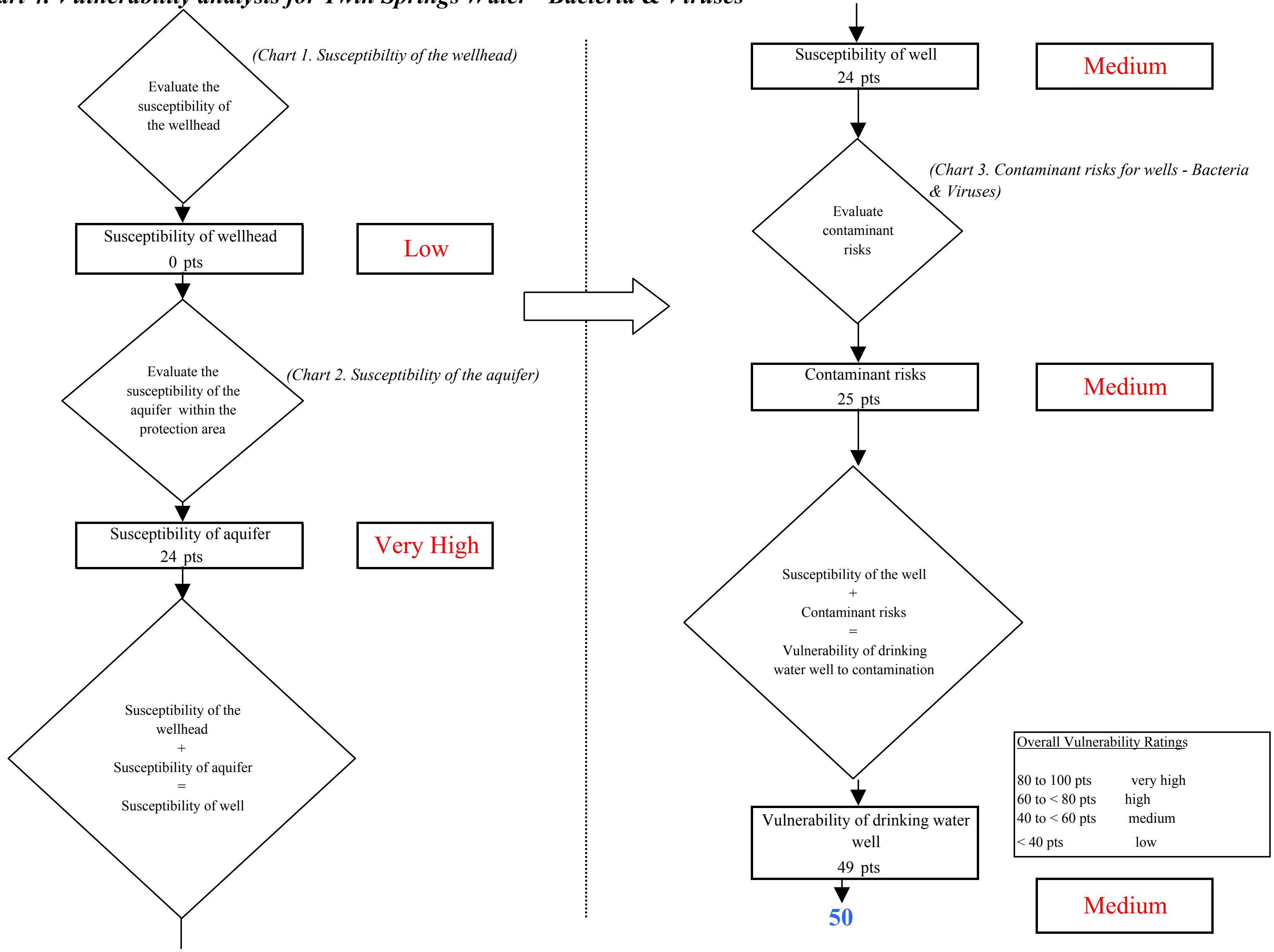
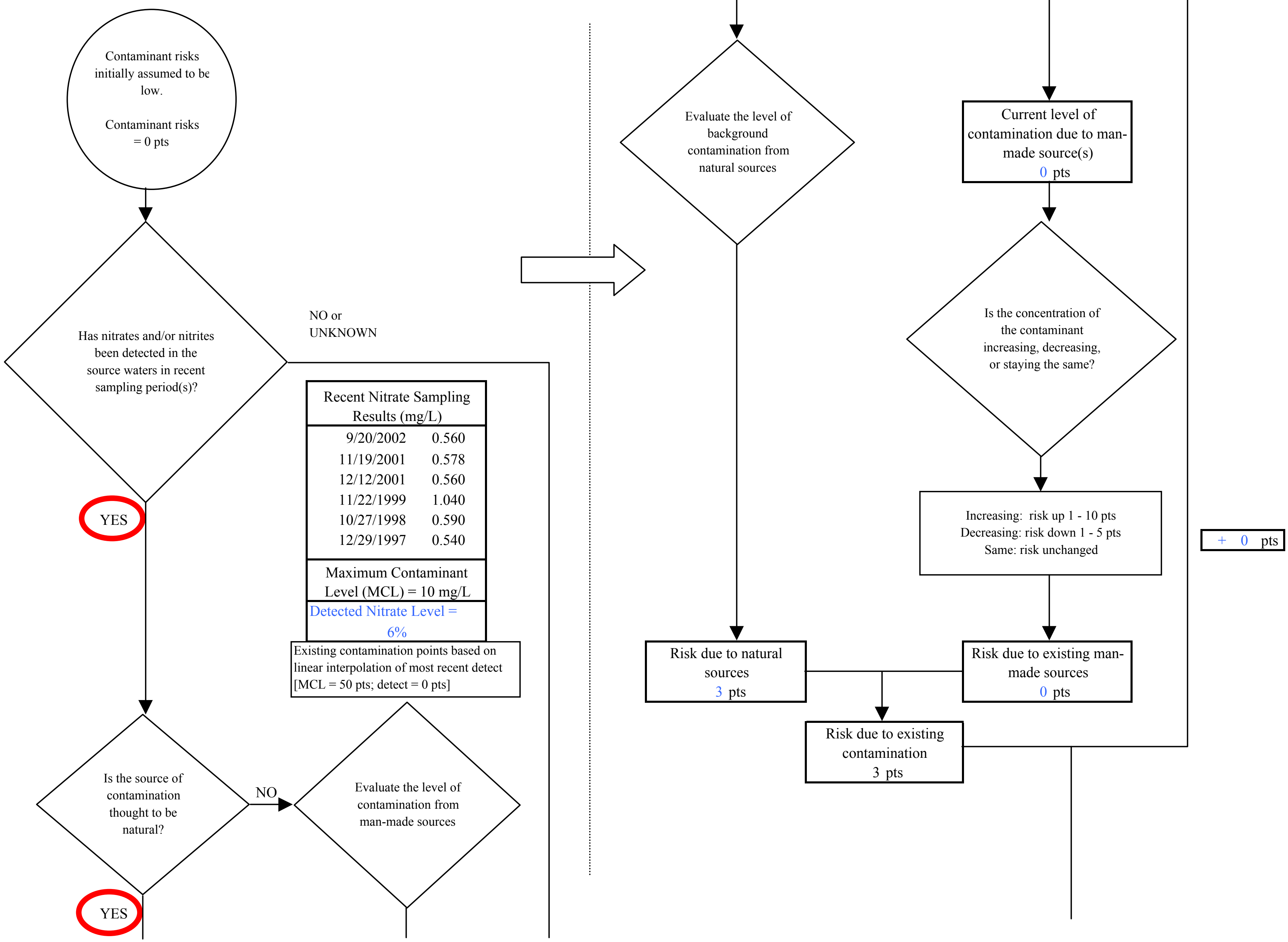
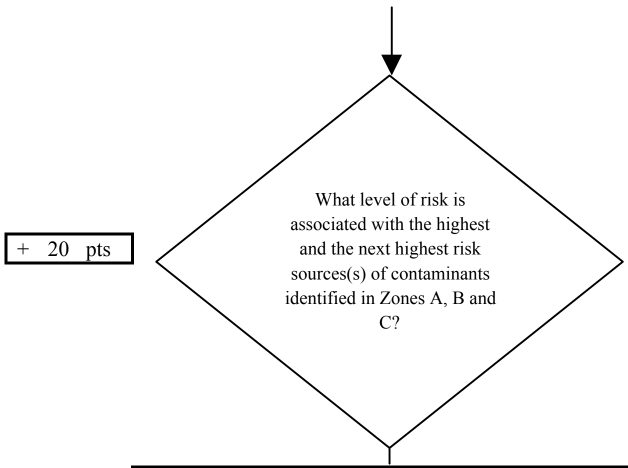


Chart 5. Contaminant risks for Twin Springs Water - Nitrates and Nitrites



Recent Nitrate Sampling Results (mg/L)	
9/20/2002	0.560
11/19/2001	0.578
12/12/2001	0.560
11/22/1999	1.040
10/27/1998	0.590
12/29/1997	0.540
Maximum Contaminant Level (MCL) = 10 mg/L	
Detected Nitrate Level = 6%	

Chart 5. Contaminant risks for Twin Springs Water - Nitrates and Nitrites



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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	37	0	37

	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.

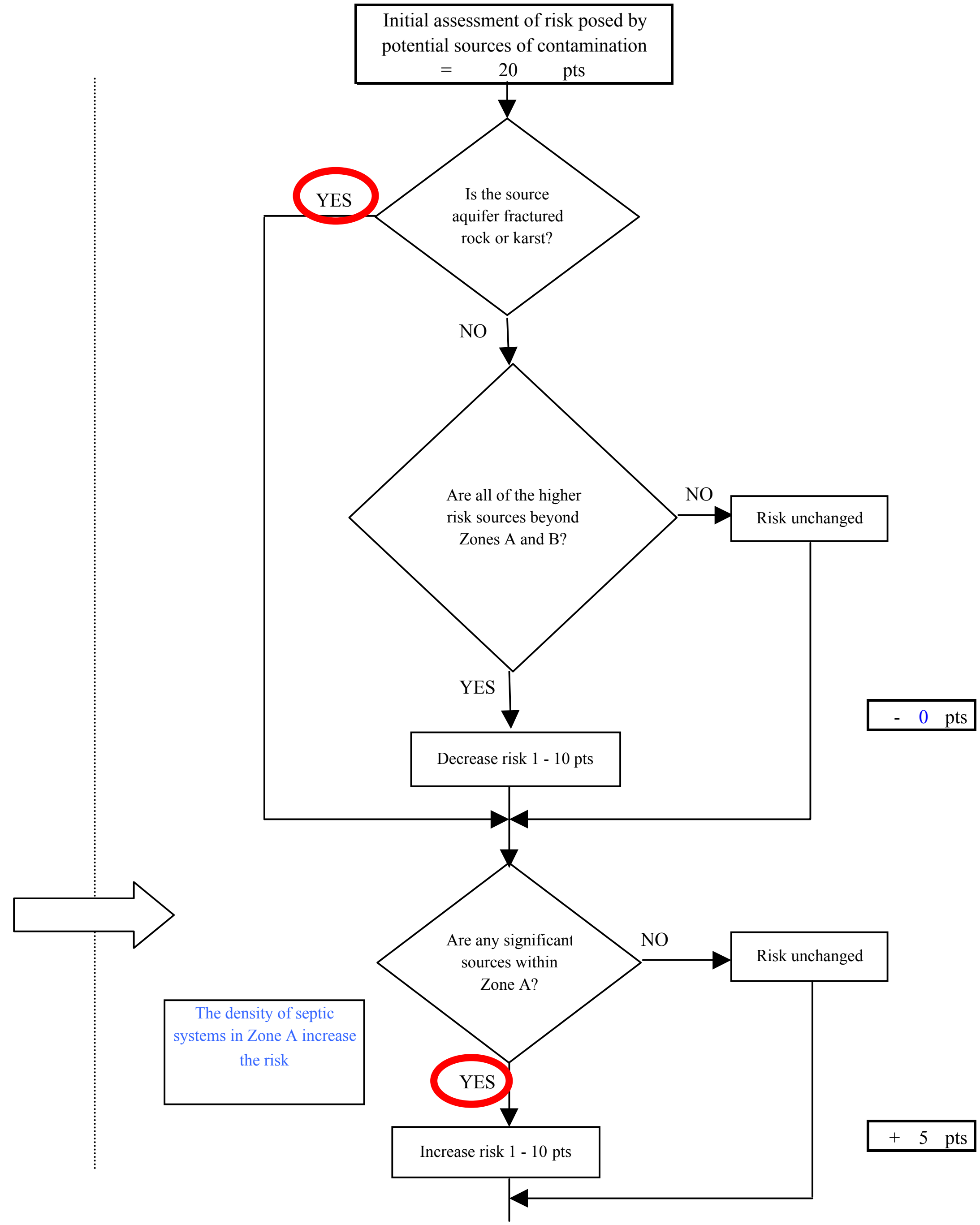


Chart 5. Contaminant risks for Twin Springs Water - Nitrates and Nitrites

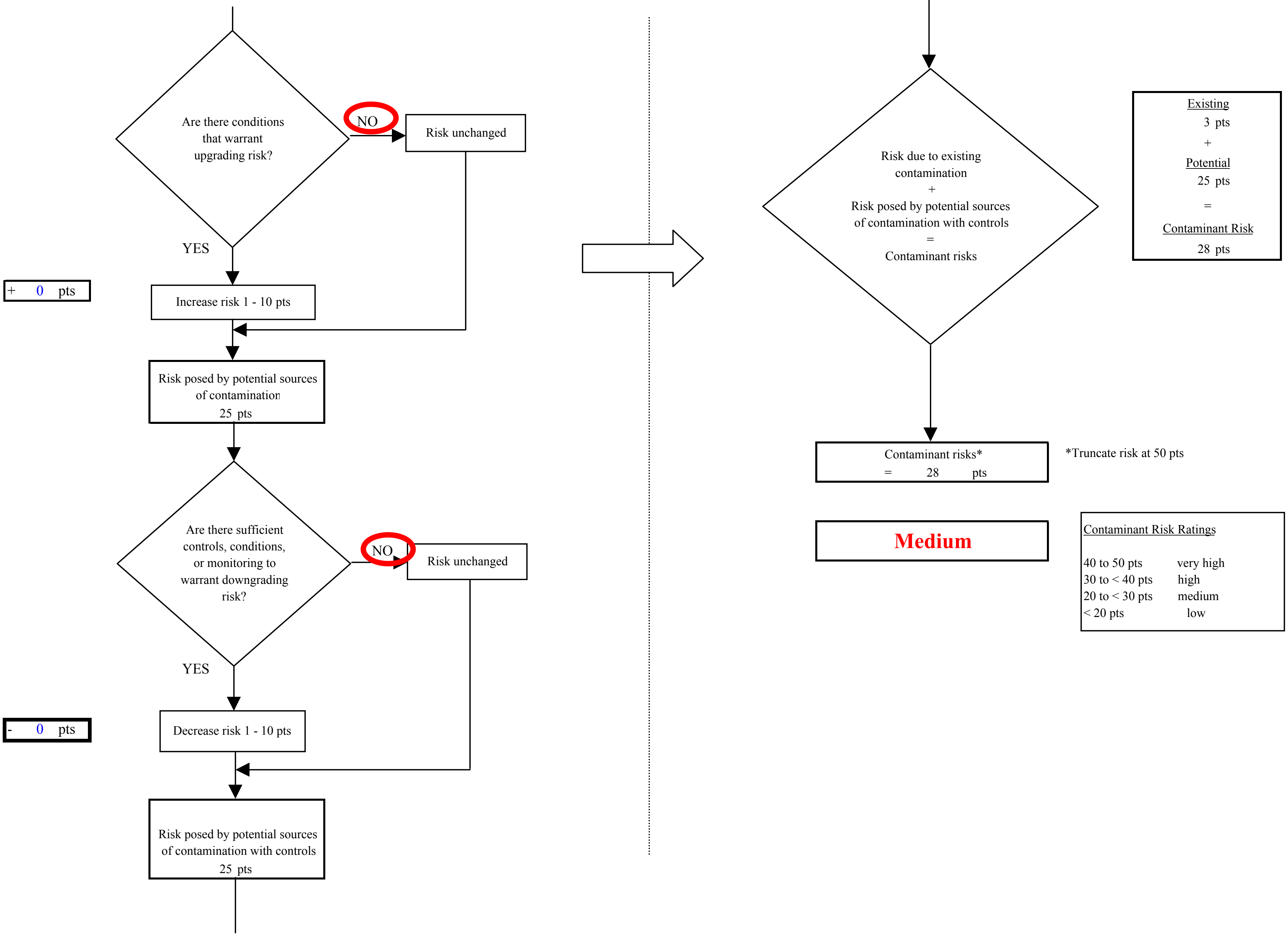


Chart 6. Vulnerability analysis for Twin Springs Water - Nitrates and Nitrites

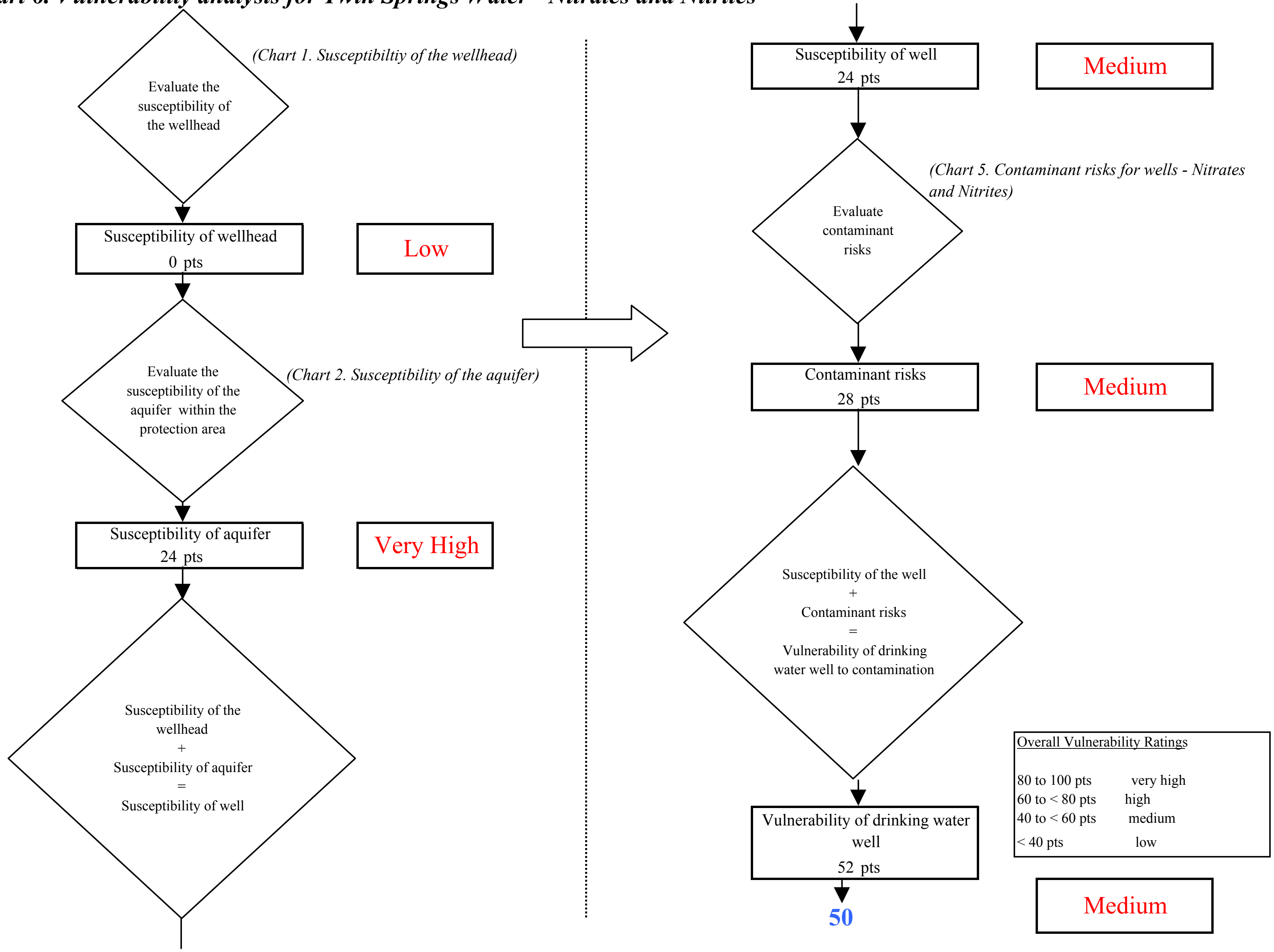


Chart 7. Contaminant risks for Twin Springs Water - Volatile Organic Chemicals

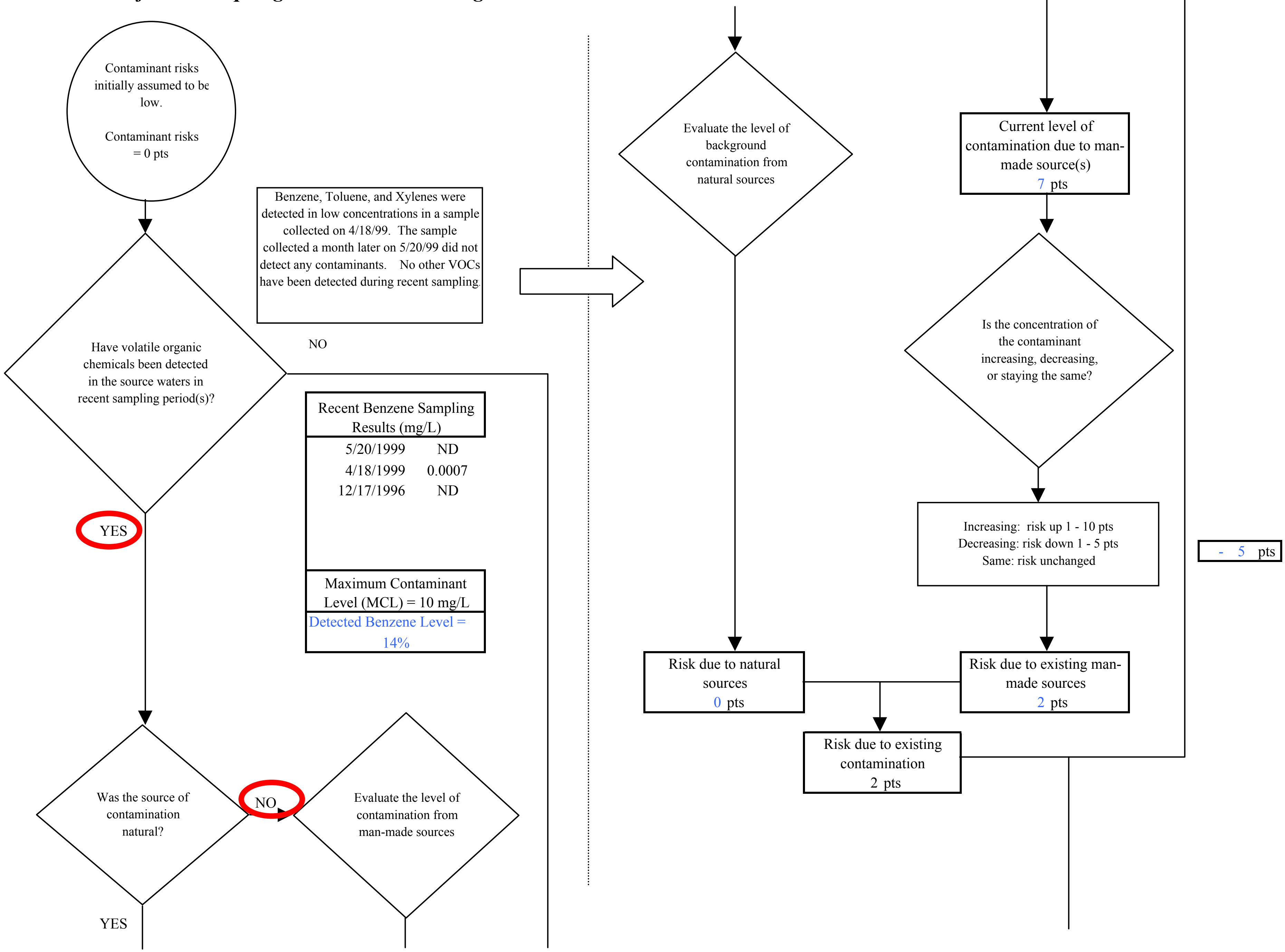
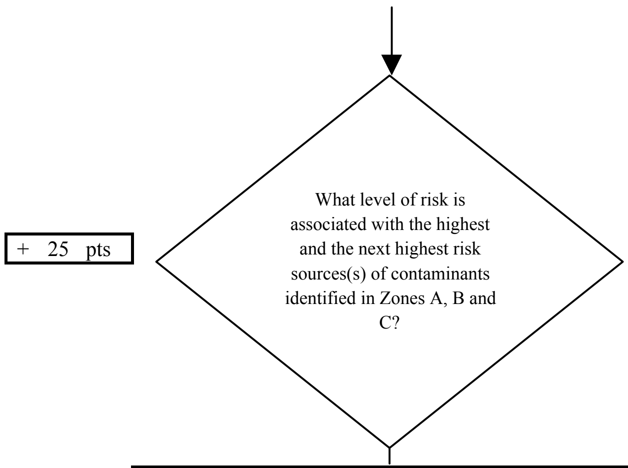


Chart 7. Contaminant risks for Twin Springs Water - Volatile Organic Chemicals



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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	36	0	36
Low(s)	5	0	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 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.

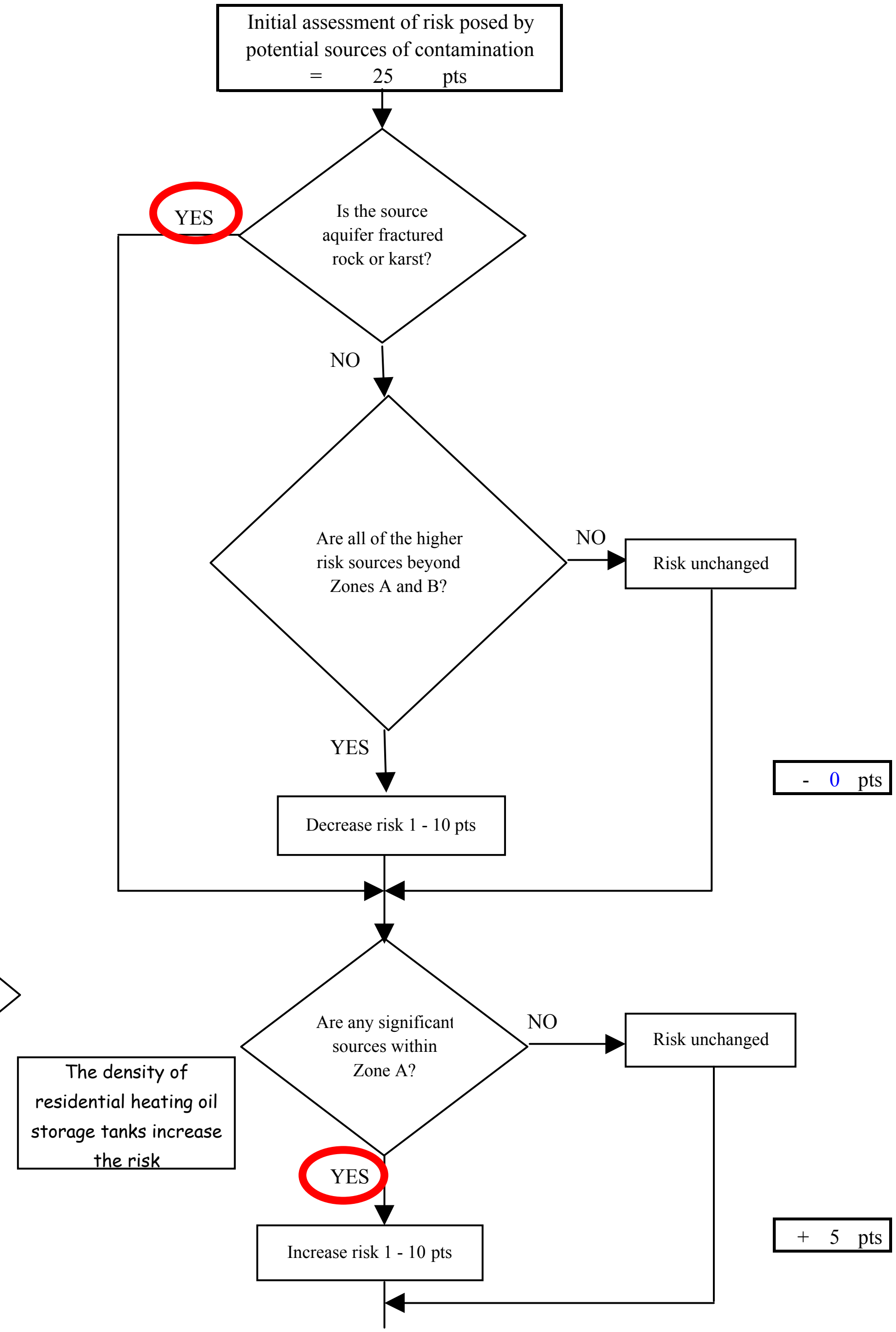


Chart 7. Contaminant risks for Twin Springs Water - Volatile Organic Chemicals

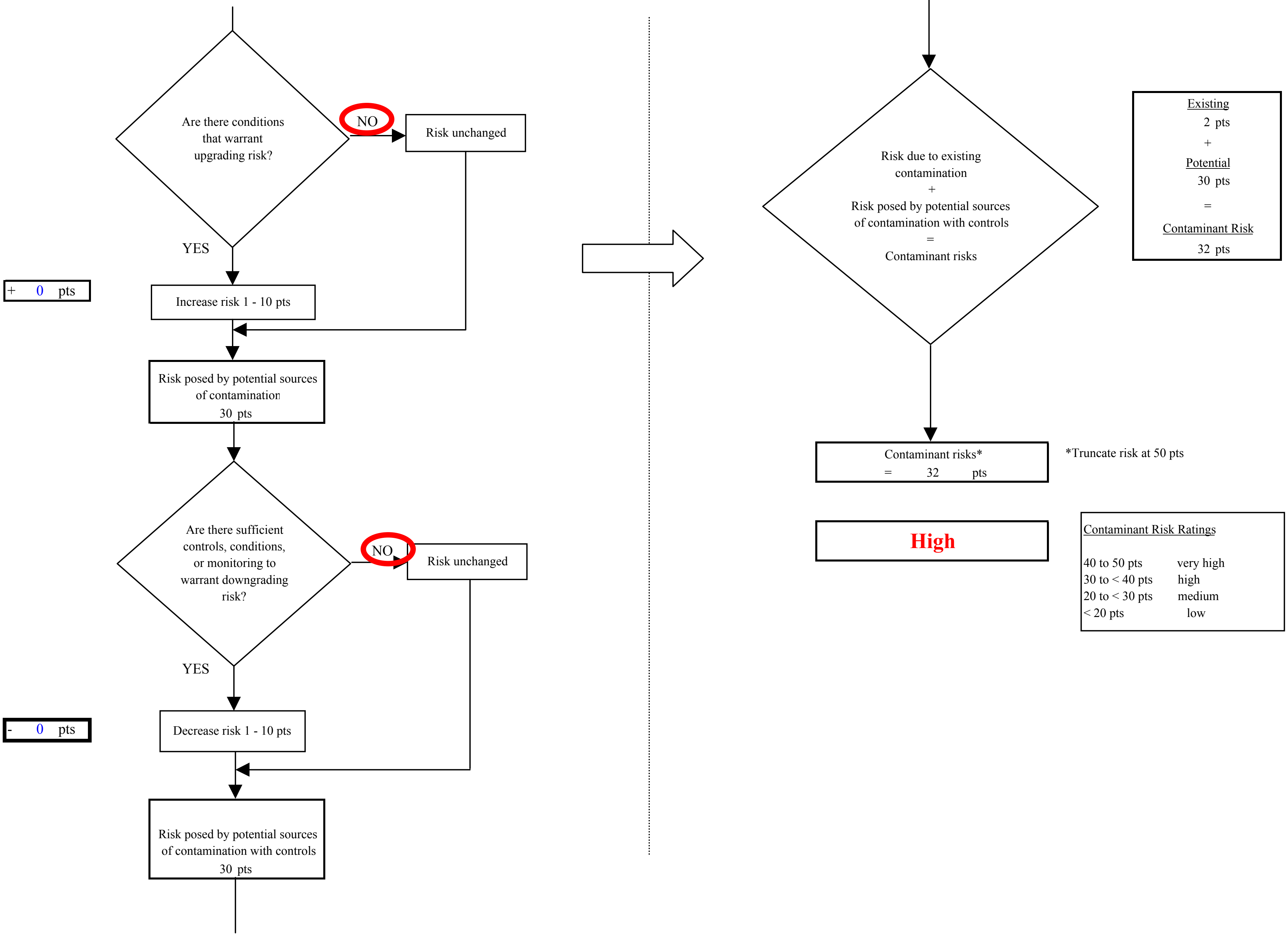


Chart 8. Vulnerability analysis for Twin Springs Water - Volatile Organic Chemicals

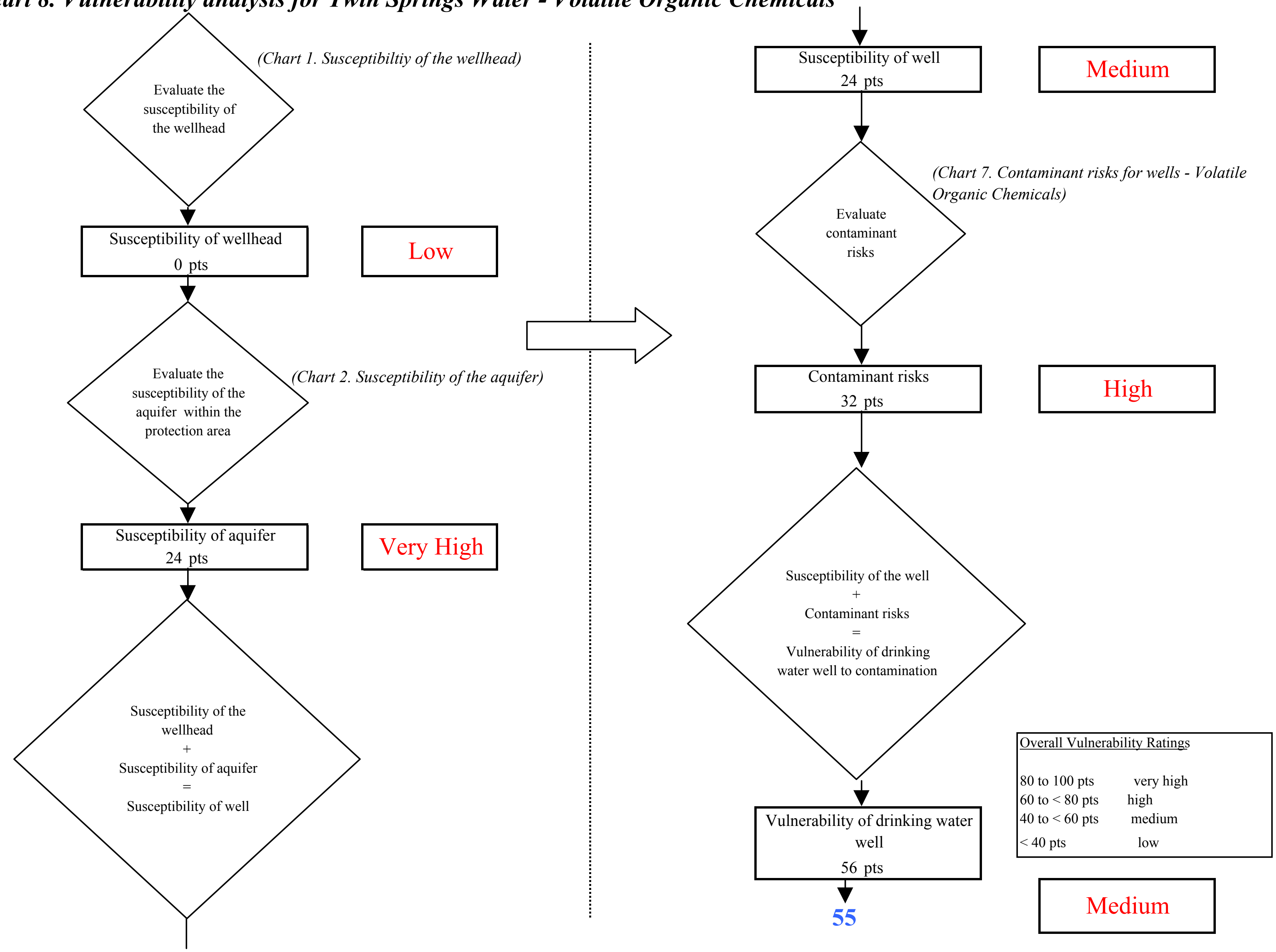


Chart 9. Contaminant risks for Twin Springs Water - Heavy Metals, Cyanide and Other Inorganic Chemicals

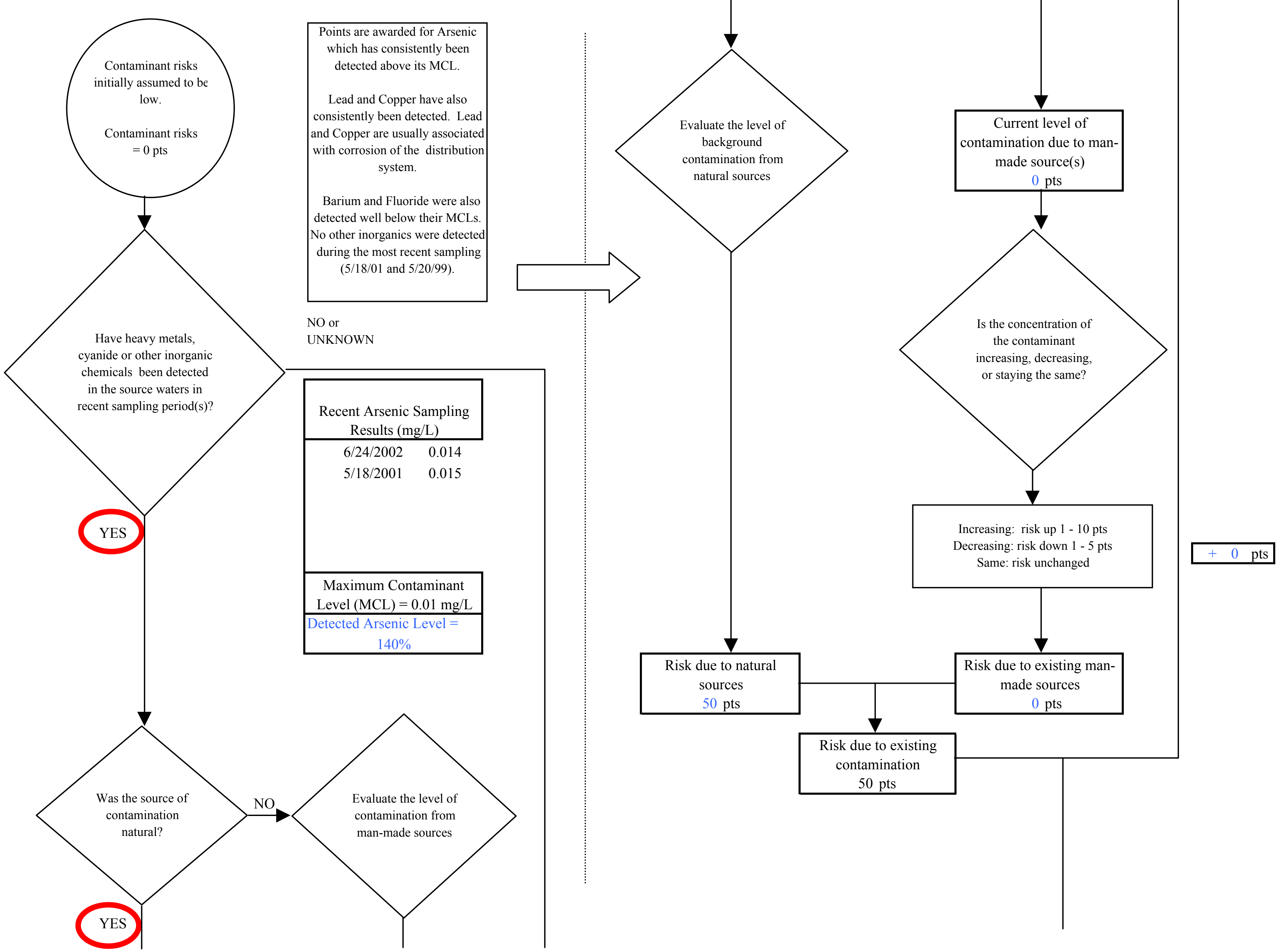
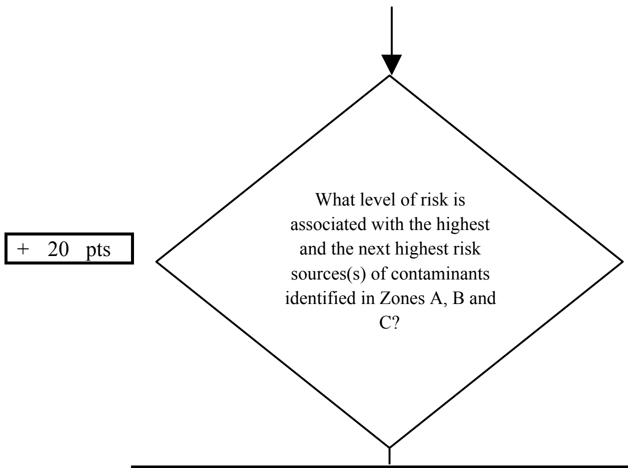


Chart 9. Contaminant risks for Twin Springs Water - Heavy Metals, Cyanide and Other Inorganic Chemicals



Risk Levels for Contaminant Sources identified in Zones A, B and C	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	21	0	21

	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.

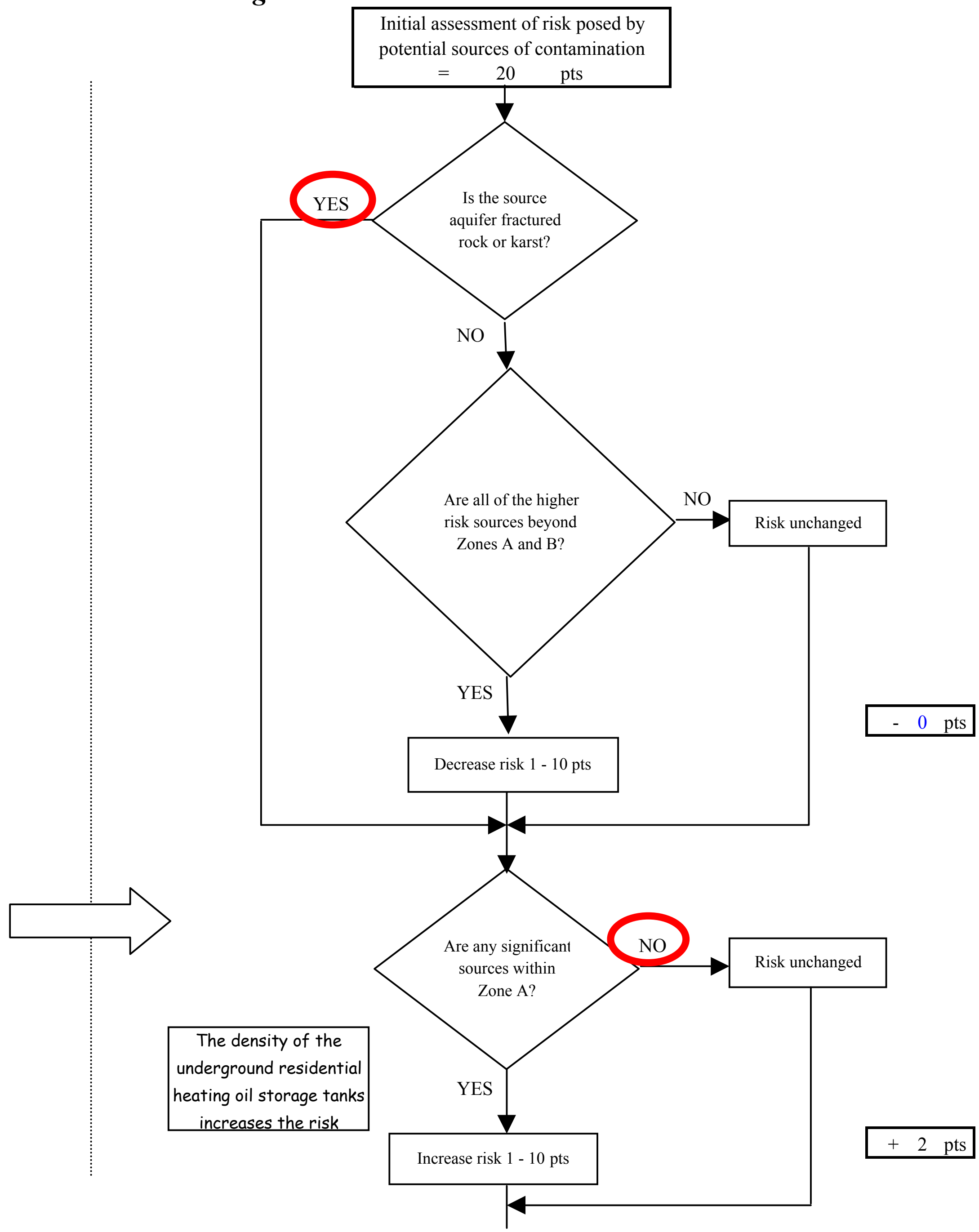


Chart 9. Contaminant risks for Twin Springs Water - Heavy Metals, Cyanide and Other Inorganic Chemicals

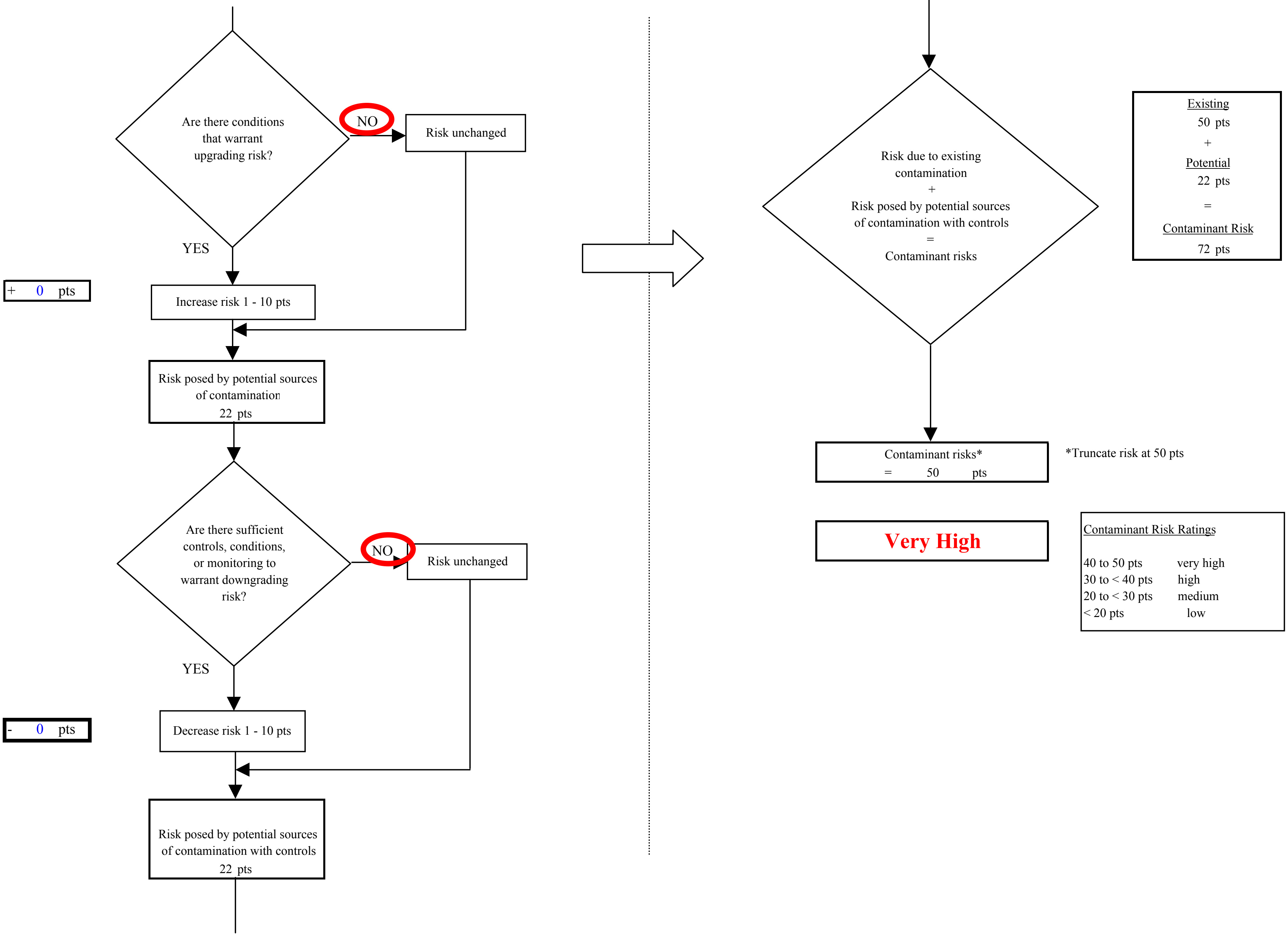


Chart 10. Vulnerability analysis for Twin Springs Water - Heavy Metals, Cyanide and Other Inorganic Chemicals

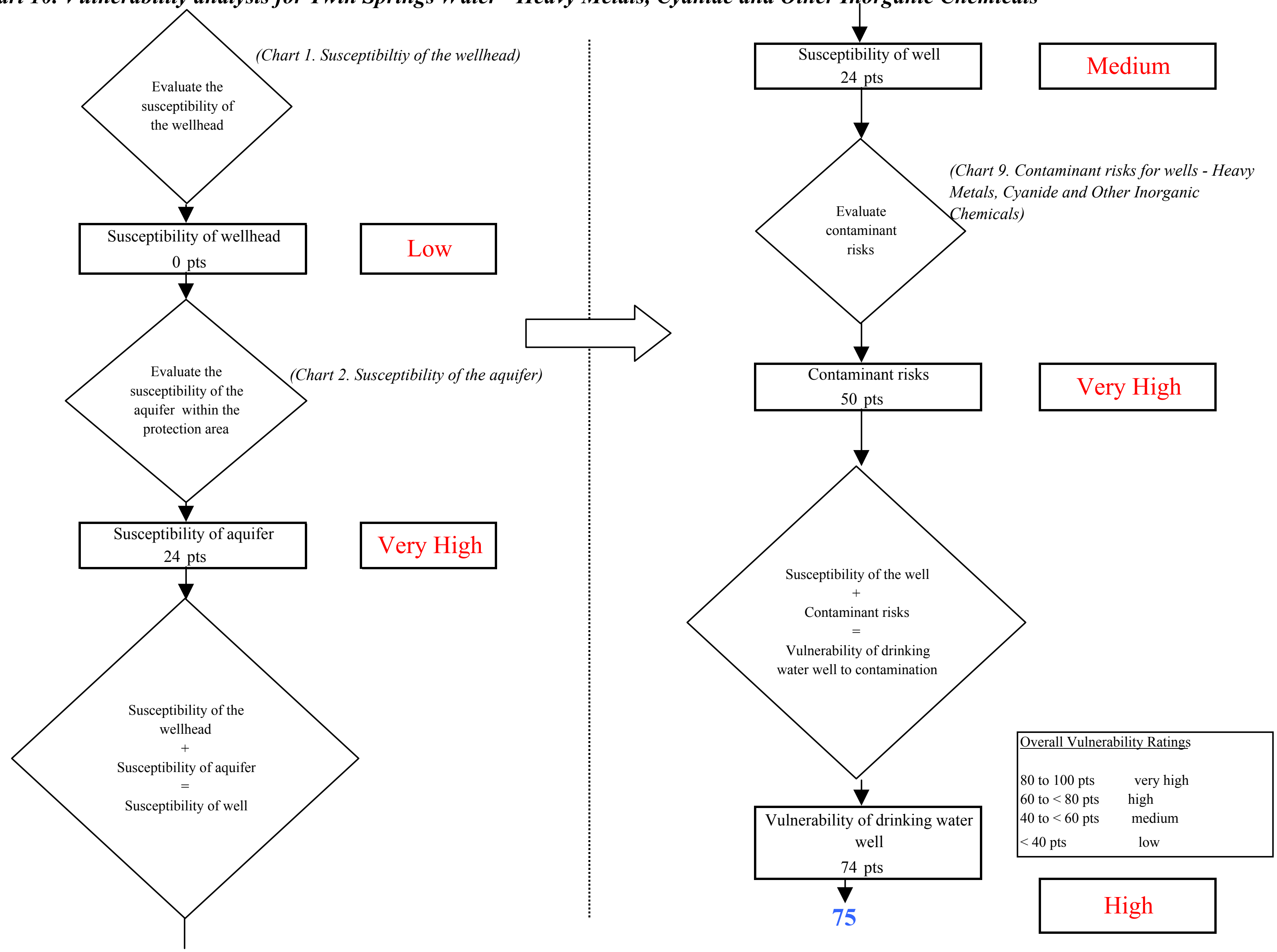


Chart 11. Contaminant risks for Twin Springs Water - Synthetic Organic Chemicals

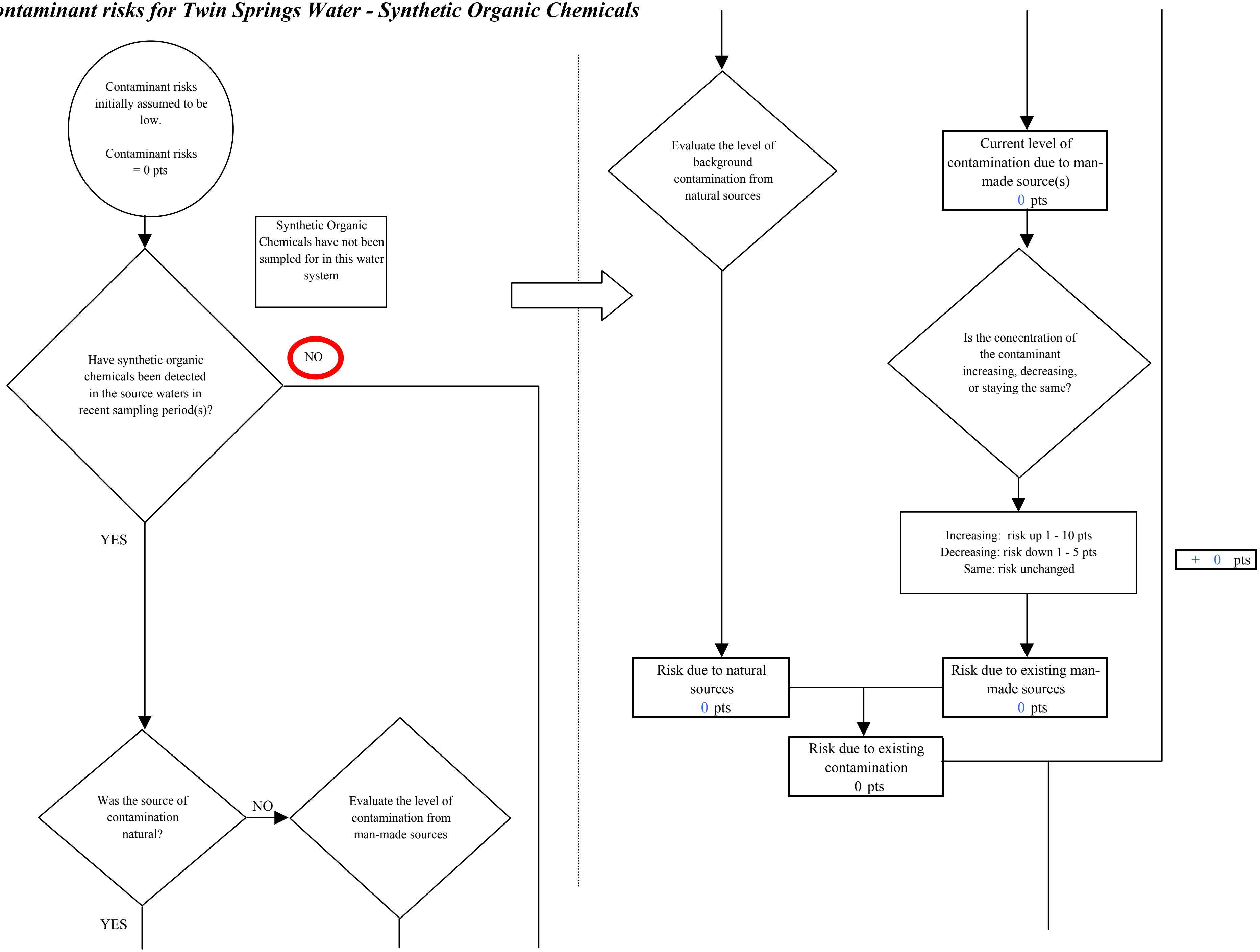
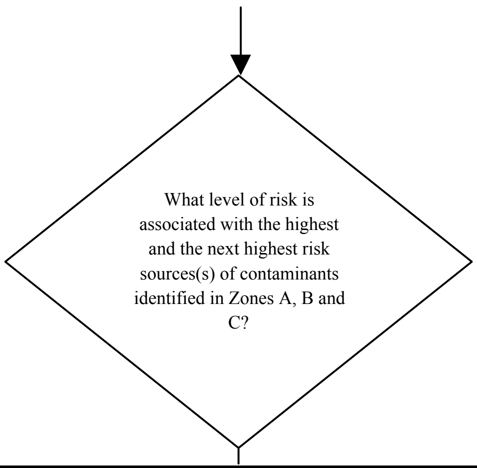


Chart 11. Contaminant risks for Twin Springs Water - Synthetic Organic Chemicals

+ 10 pts



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

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

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

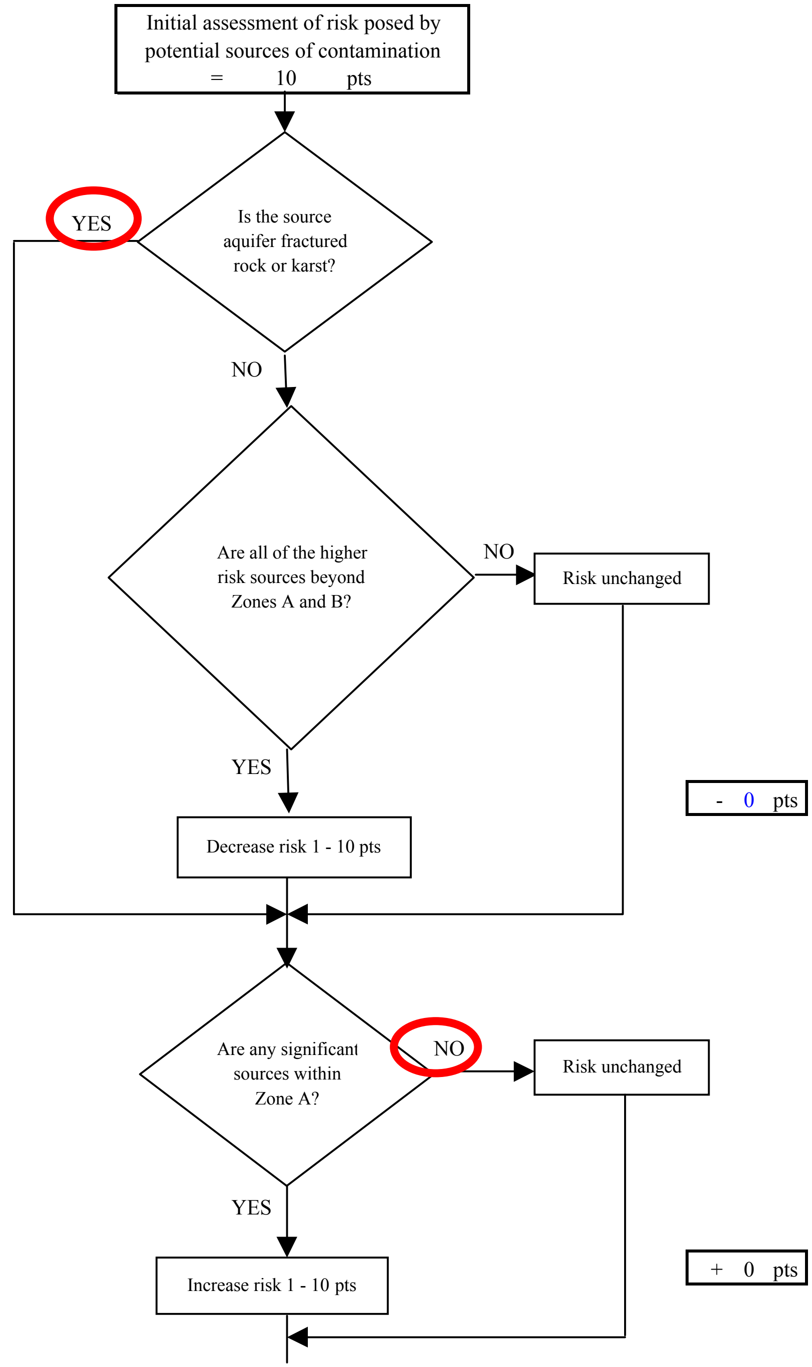


Chart 11. Contaminant risks for Twin Springs Water - Synthetic Organic Chemicals

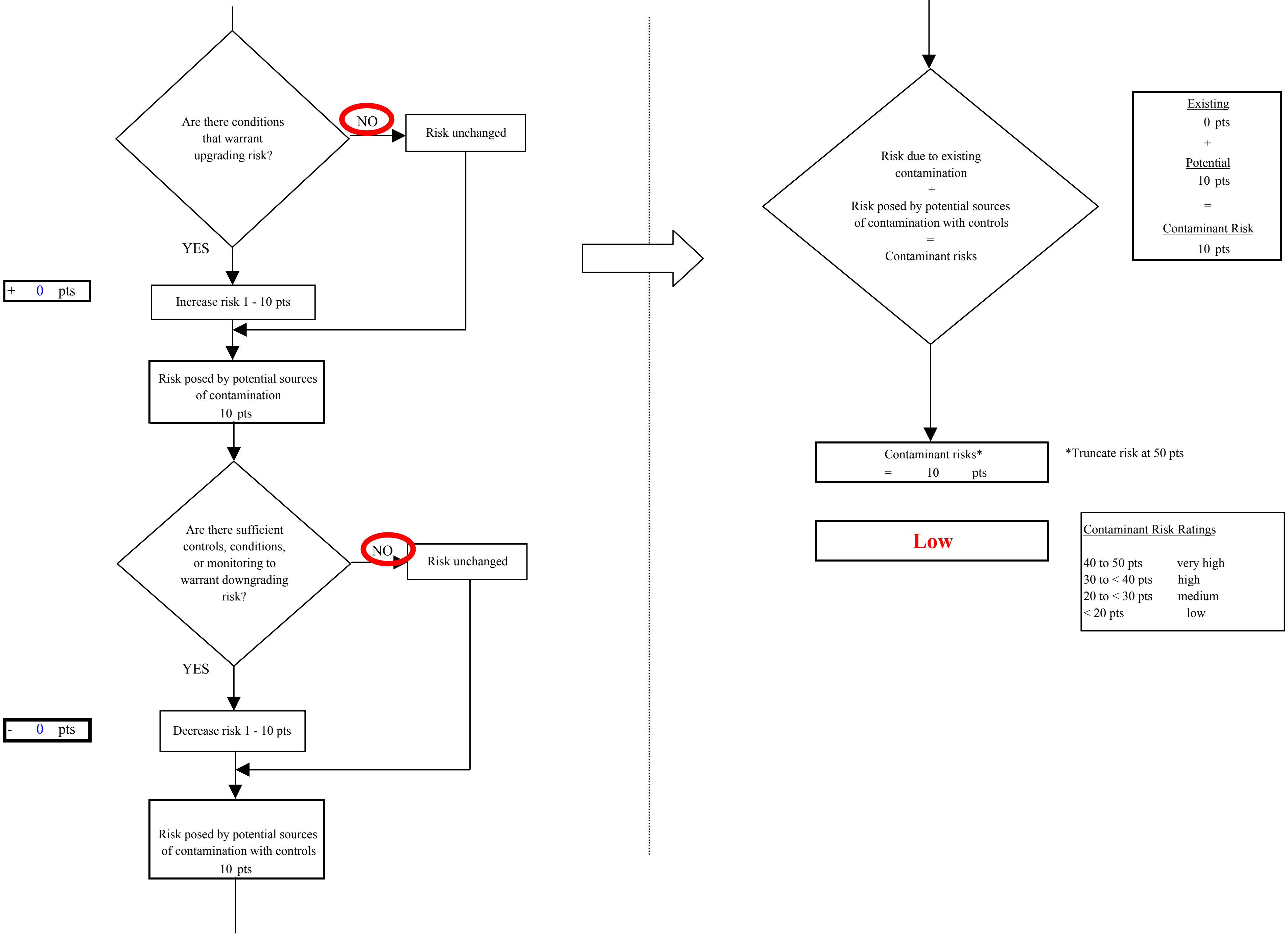


Chart 12. Vulnerability analysis for Twin Springs Water - Synthetic Organic Chemicals

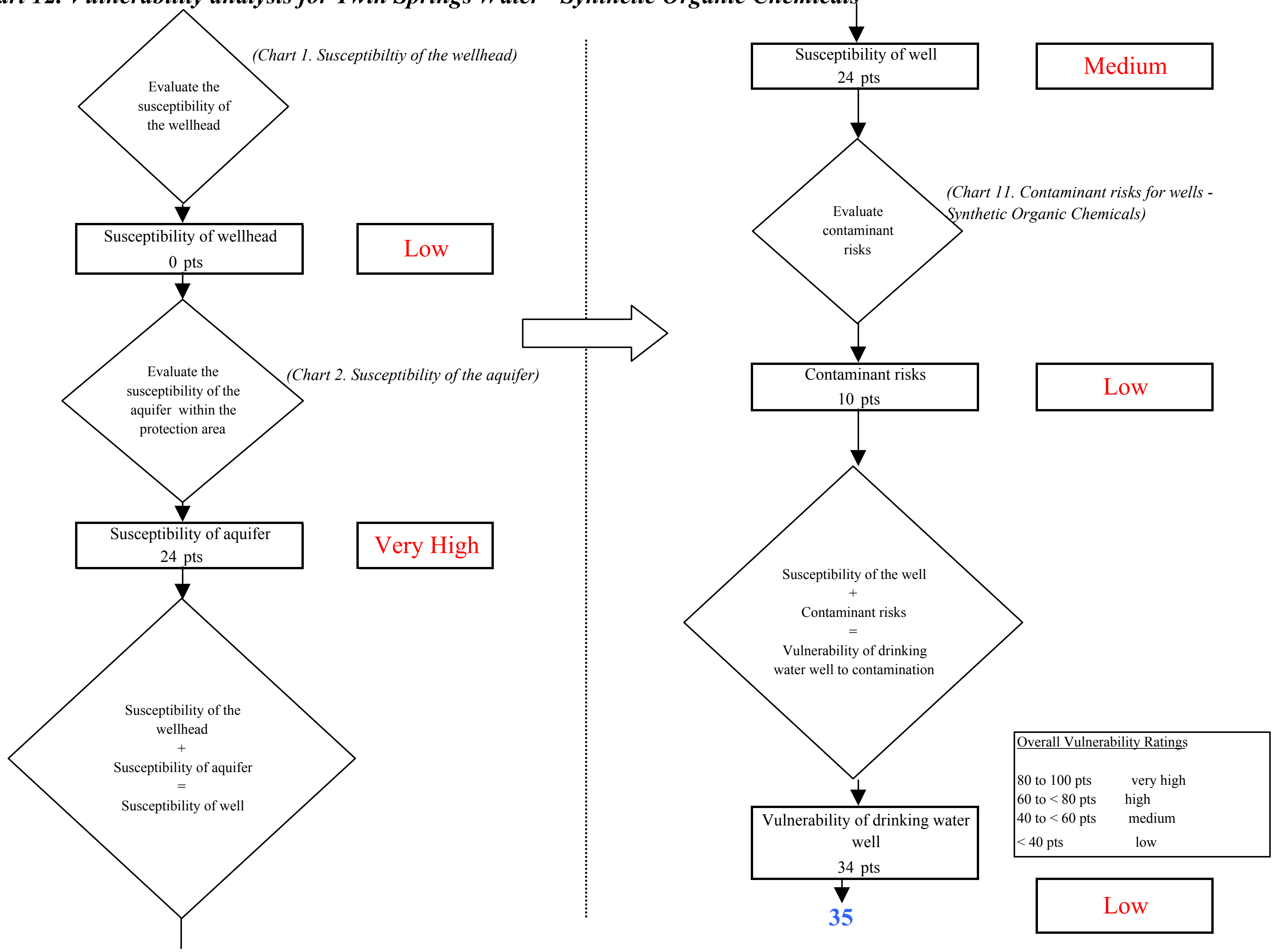


Chart 13. Contaminant risks for Twin Springs Water - Other Organic Chemicals

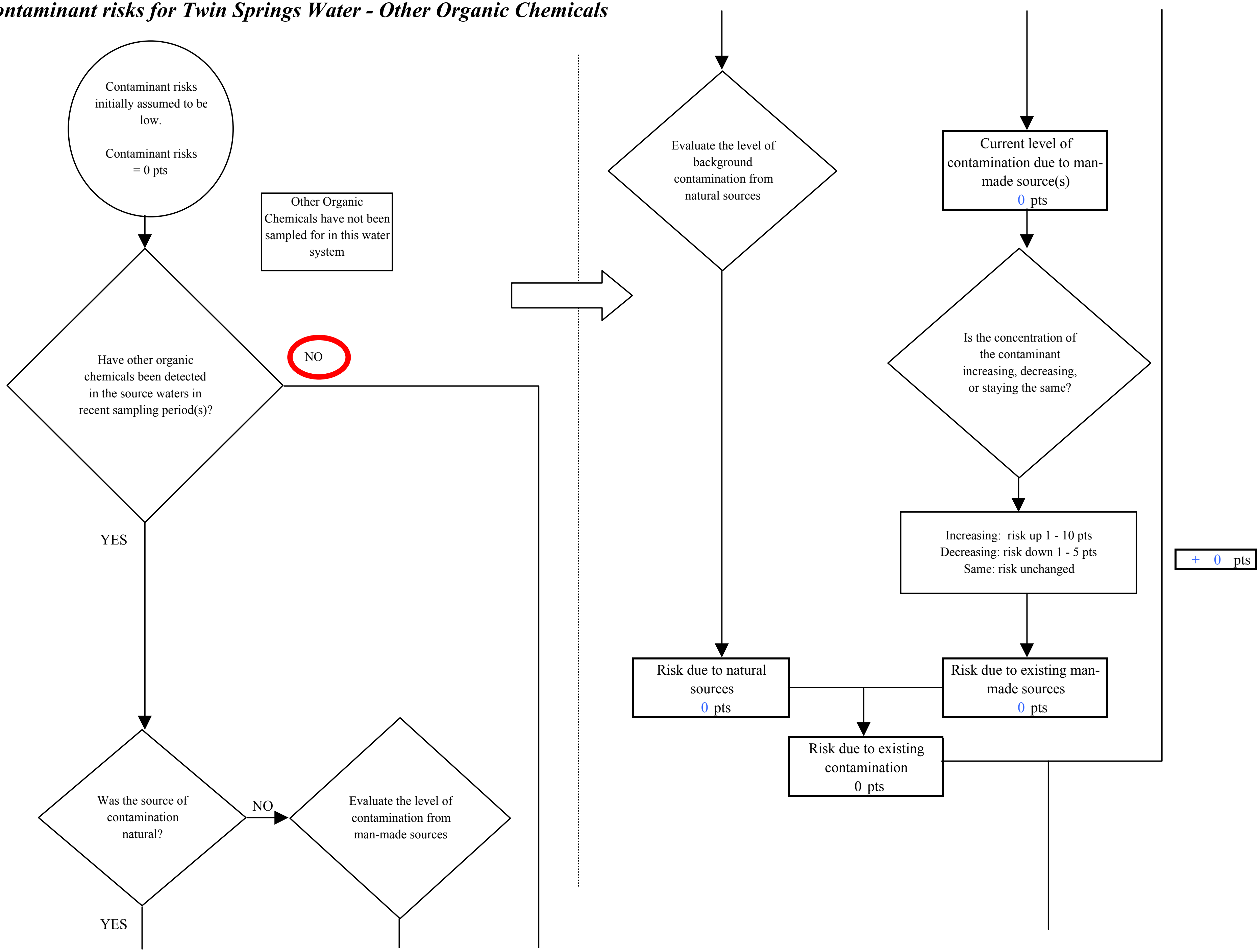
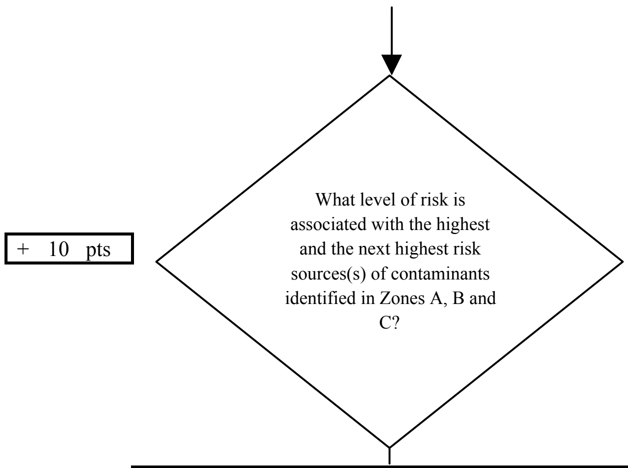


Chart 13. Contaminant risks for Twin Springs Water - Other Organic Chemicals



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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
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 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.

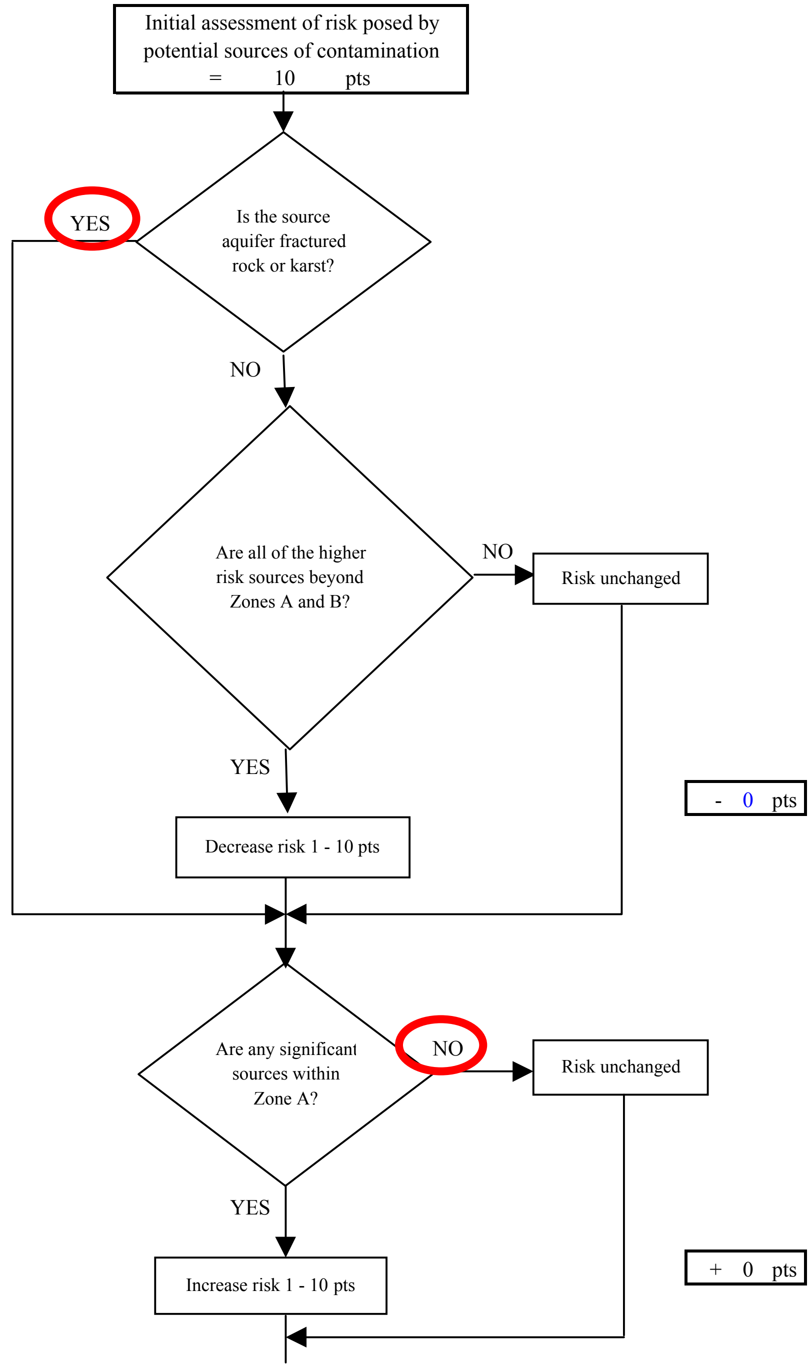


Chart 13. Contaminant risks for Twin Springs Water - Other Organic Chemicals

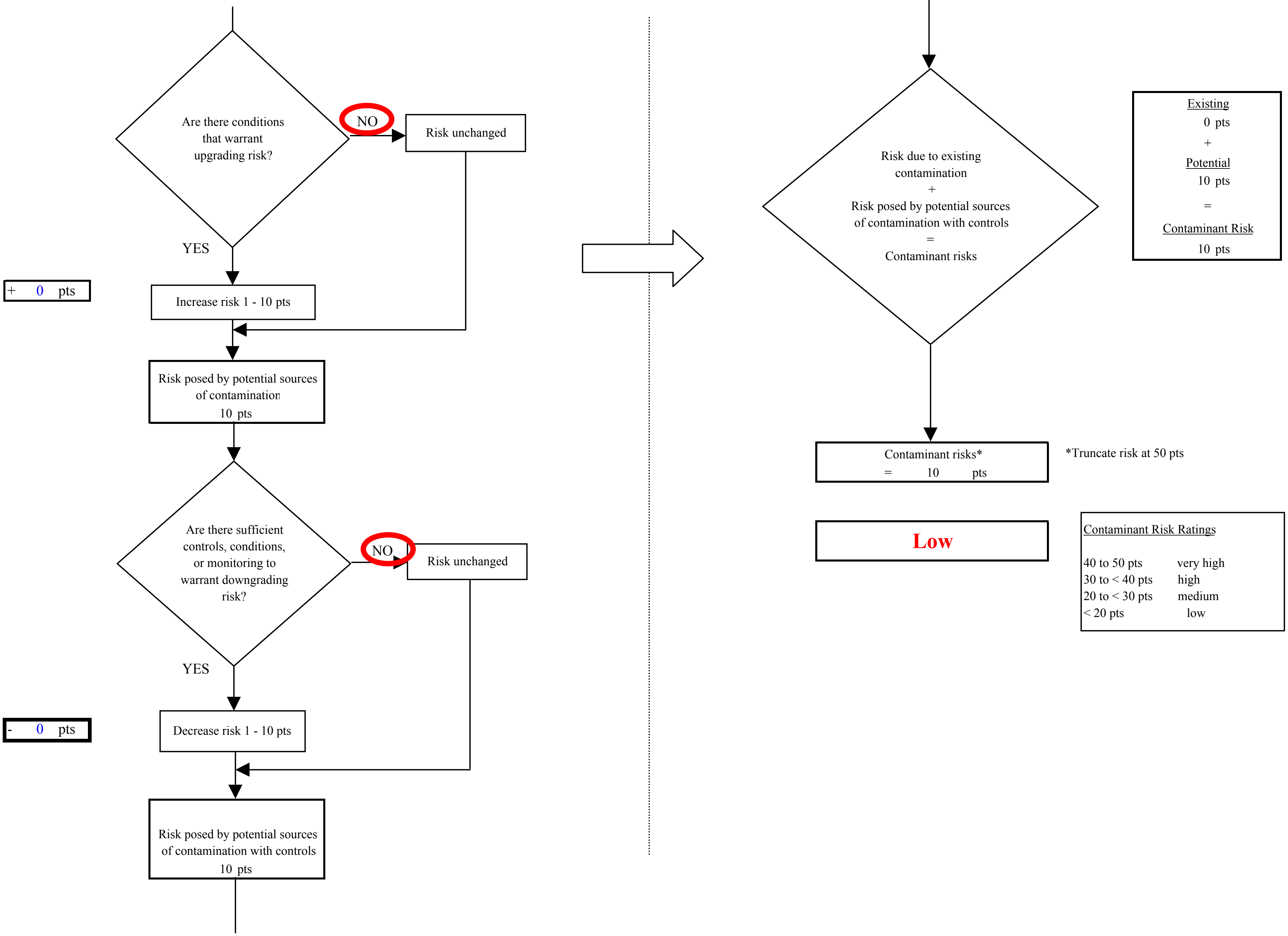


Chart 14. Vulnerability analysis for Twin Springs Water - Other Organic Chemicals