Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Cordova, Alaska

Meals Reservoir Intake

PWSID # 293205.004

September 2004

Drinking Water Protection Program Report #1267

Alaska Department of Environmental Conservation

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

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

CONTENTS

TABLES

APPENDICES

Source Water Assessment for the City of Cordova Water System – Meals Reservoir Intake

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The City of Cordova water system is a Class A (community) water system that obtains water from 5 surface water sources: Murcheson Creek, Orca (Crater Lake), and Heney Creek/Meals Reservoir. Eyak Lake is an emergency backup source. The Meals Reservoir intake is located approximately 0.75-miles south of Cordova and is accessible via Whitshed Road and the Meals Reservoir Trail. Access to the intake area is not restricted. The overall protection area is approximately 0.4 square miles in size and received a susceptibility rating of "**very 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. A road and hiking activity were identified as potential sources of contaminants 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 **"medium"** for nitrates and nitrites, heavy metals, volatile organic chemicals, synthetic organic chemicals, and other organic chemicals; and **"very high"** for bacteria and viruses. 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 Cordova to protect public health.

DRINKING WATER SYSTEM AND AREA OVERVIEW

Cordova (Sec. 28, T015S, R003W, Copper River Meridian) is located at the southeastern end of Prince William Sound in the Gulf of Alaska. The community was built on Orca Inlet, at the base of Eyak Mountain. It lies 52 air miles southeast of Valdez and 150 miles southeast of Anchorage (Please see the inset of Map 1 in Appendix A for location). The current population of Cordova is approximately 2,400 (ADCED, 2003). The Cordova water system is a Class A (community) water system that utilizes water from Murcheson Falls, Heney Creek dam, Meals Reservoir, the Orca Reservoir, and Eyak Lake. The water is treated, but only the Eyak water is filtered. Water storage capacity is 2.1 million gallons. The City operates a piped water and sewer system. Sewage is treated before discharge. Over 90% of homes are fully plumbed. Some homes use individual wells and septic systems (See Map 1 of Appendix A).

Winter temperatures in Cordova average from 17 to 28; summer temperatures average 49 to 63. Annual precipitation is 167 inches, including 80 inches of snowfall (ADCED, 2003).

The Meals Reservoir collects water from the surrounding watershed areas as well as from the 10-inch PVC line coming from the Heney Creek dam. The capacity of the reservoir is approximately 17 million gallons. Water collected at Meals Reservoir flows approximately 0.4-miles via 10-inch PVC pipe to the chlorination facility on Whitshed Road before distribution. The 1997 Sanitary Survey indicates that the Meals Reservoir intake is screened, maintained and inspected as needed. The sanitary survey indicates that the watershed is 40-acres in size, but ADEC estimates the watershed may be as large as 255-acres (0.4-square miles).

MEALS RESERVOIR 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 Meals Reservoir water intake includes each of these Zones, although, due to the size of the watershed, Zones B and C cover the same area (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 Meals Reservoir 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 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	5	
Dilution Capacity	5	
Overall Susceptibility	40	Very 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. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	14	Low
Volatile Organic Chemicals	12	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	12	Low
Synthetic Organic Chemicals	0	Low
Other Organic Chemicals	12	Low

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. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	90	Very High
Nitrates and Nitrites	50	Medium
Volatile Organic Chemicals	50	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Medium
Synthetic Organic Chemicals	40	Medium

Other Organic Chemicals	50	Medium

Bacteria and Viruses

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

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.

Positive bacteria samples have been reported regularly during 2003.

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 "very 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.

Sampling history for the water source indicates that nitrates have been detected at levels below the MCL in samples collected in 1998 through 2002. 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).

Possible sources of nitrates/nitrites could be from human/animal activity along roads, ATV trails, or snowmachine trails located within the protection area.

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 "low" (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 2000-2003, 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.

Possible sources of volatile organic chemicals could be from human/animal activity along roads, ATV trails, or snowmachine trails or from fuel storage tanks located within the protection area.

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

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is "low". Copper and lead have been detected in samples collected during 1998, although in levels below the MCL (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 and not from the source waters. Additional sources of heavy metals could be from activity along roads, ATV trails, or snowmachine trails or from fuel storage tanks located within the protection area.

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

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is "low". After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to synthetic organic chemicals of the source is "medium" (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 2002 and 2003 were negative.

Other Organic Chemicals

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

A possible source of other organic chemicals could be from activity along roads within the protection area.

Review of the historical sampling data indicates that no other organic chemicals have been sampled recently.

Using the Source Water Assessment

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the City of Cordova 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

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

APPENDIX A

Meals Reservoir
Drinking Water Protection Area Location Map
(Map 1)

Orca

Eyak Lake

Meals

Murcheson

Heney Creek

Eyak Lake

Map 1: City of Cordova Drinking Water Protection Area

PWSID: 293205.001,.002,.003,.004,.005

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1 2 4 6 Miles

1:119,949

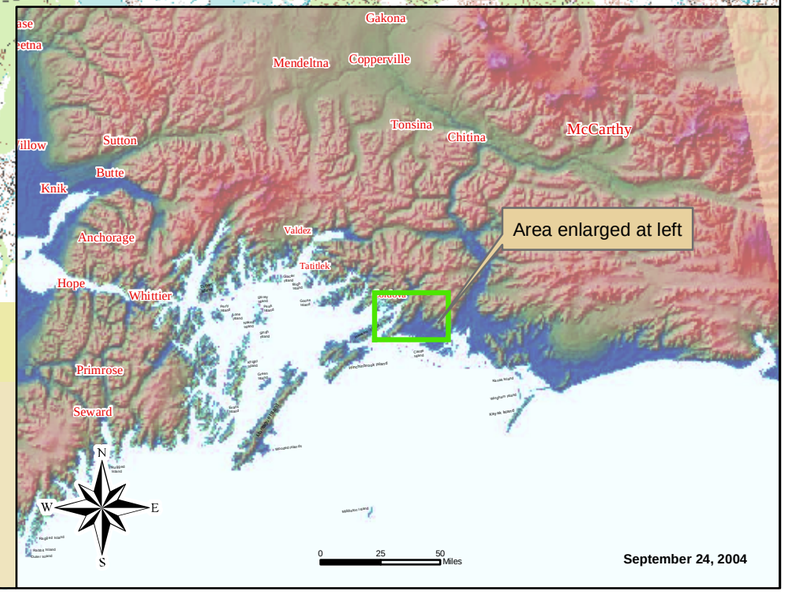
Data Sources:

Background image
- USGS 1:63,000 mapping

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

Legend

- Water Intake Location
- Stream
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area



September 24, 2004

APPENDIX B

Contaminant Source Inventory and Risk Rankings (Tables 1-6)

Table 1

Contaminant Source Inventory for

Cordova City Water - Meals Res.

PWSID 293205.004

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24		A	2	From well inventory information given by the operator.
Dog walking areas/foot trails	X46		A	2	From 1997 sanitary survey report

Table 2

Contaminant Source Inventory and Risk Ranking for Cordova City Water - Meals Res. Sources of Bacteria and Viruses

PWSID 293205.004

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Dog walking areas/foot trails	X46		A	Low	2	From 1997 sanitary survey report
Highways and roads, dirt/gravel	X24		A	Low	2	From well inventory information given by the operator.

Table 3

Contaminant Source Inventory and Risk Ranking for Cordova City Water - Meals Res. Sources of Nitrates/Nitrites

PWSID 293205.004

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Dog walking areas/foot trails	X46		A	Low	2	From 1997 sanitary survey report
Highways and roads, dirt/gravel	X24		A	Low	2	From well inventory information given by the operator.

Table 4

Contaminant Source Inventory and Risk Ranking for Cordova City Water - Meals Res. Sources of Volatile Organic Chemicals

PWSID 293205.004

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	From well inventory information given by the operator.

Table 5

Contaminant Source Inventory and Risk Ranking for Cordova City Water - Meals Res. Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 293205.004

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	From well inventory information given by the operator.

Table 6

Contaminant Source Inventory and Risk Ranking for Cordova City Water - Meals Res. Sources of Other Organic Chemicals

PWSID 293205.004

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	From well inventory information given by the operator.

APPENDIX C

Meals Reservoir
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Water System Intake

Meals Reservoir

X46
Walking area / foot trail

X24
Dirt/Gravel Roads
(Gravel road to landfill)

Eyak Lake

Heney Creek Intake

Murcheson Creek

Scout Lake

Area enlarged at left

Map 2: Potential and Existing Contaminant Sources

PWSID: 293205.004

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1,000 2,000 4,000 Feet

1:18,000

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 stream).

Legend

- Meals Reservoir Intake
- Other Cordova Intake
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area

0 1 2 4 6 Miles

September 24, 2004

APPENDIX D

Vulnerability Analysis and Contaminant Risks
(Charts 1-13)

Chart 1. Susceptibility of the Surface Water Source - City of Cordova Well 4 (Meals Reservoir)

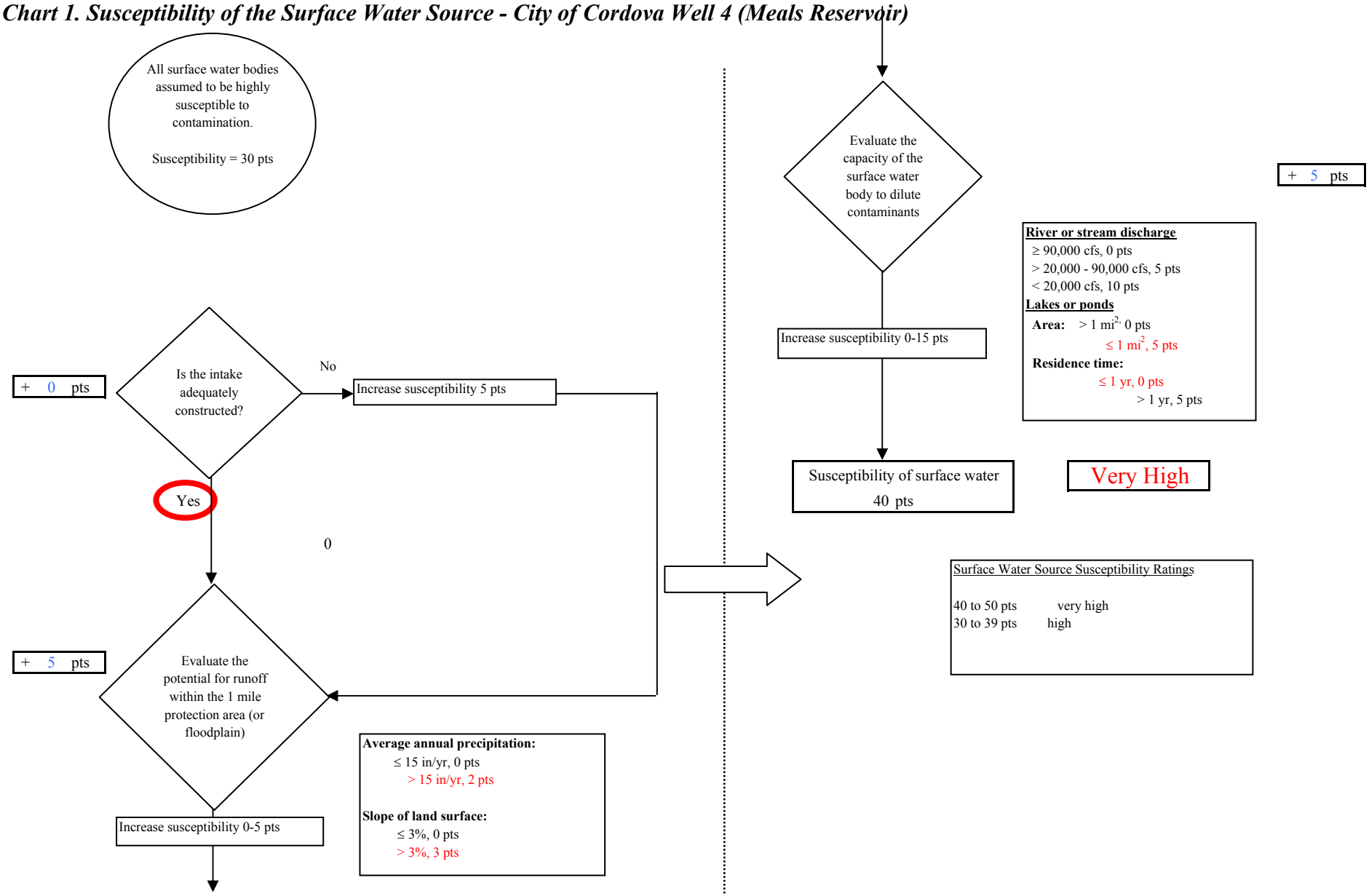
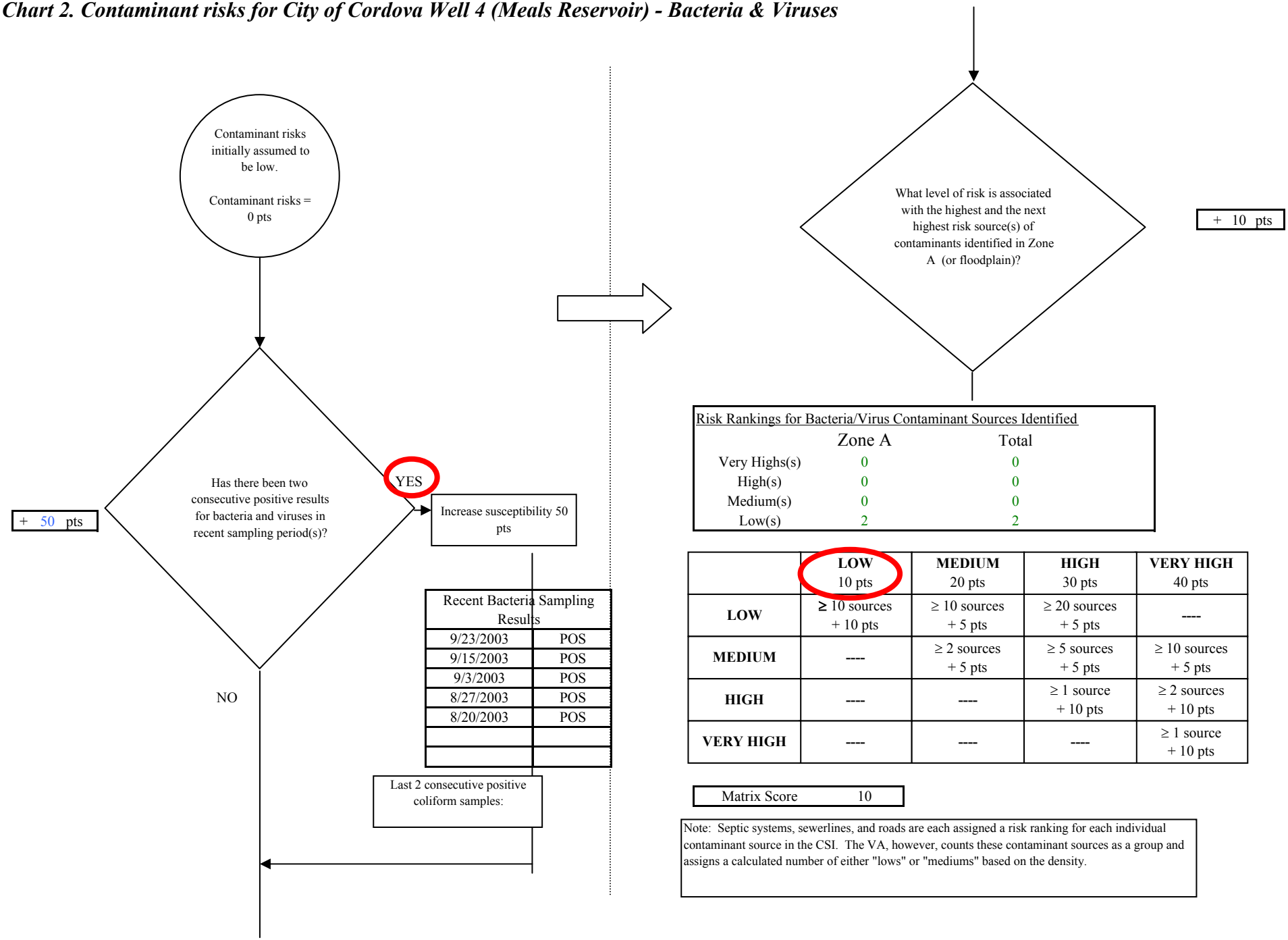


Chart 2. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Bacteria & Viruses



Risk Rankings for Bacteria/Virus Contaminant Sources Identified

	Zone A	Total
Very Highs(s)	0	0
High(s)	0	0
Medium(s)	0	0
Low(s)	2	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 2. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Bacteria & Viruses

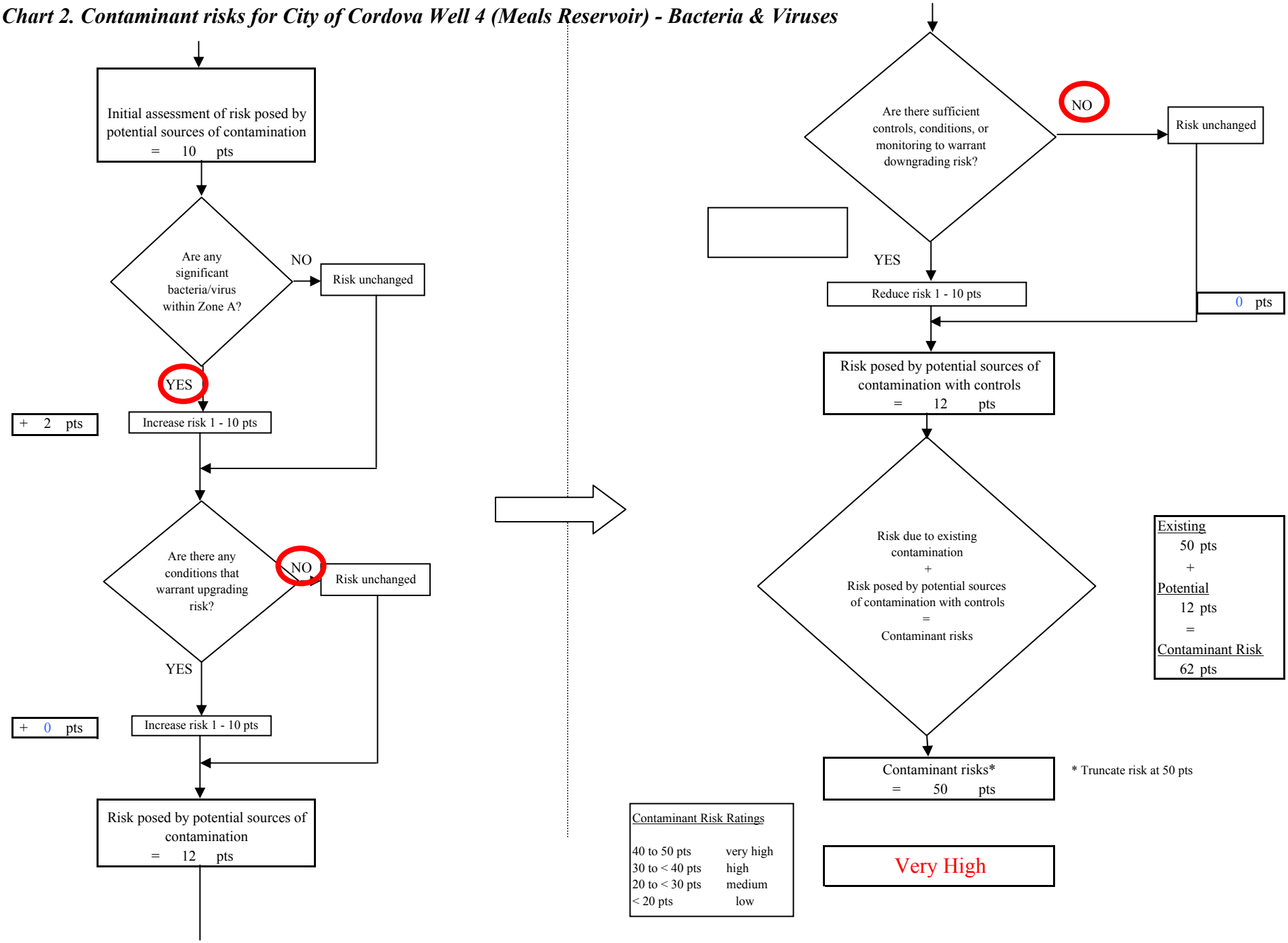


Chart 3. Vulnerability analysis for City of Cordova Well 4 (Meals Reservoir) - Bacteria & Viruses

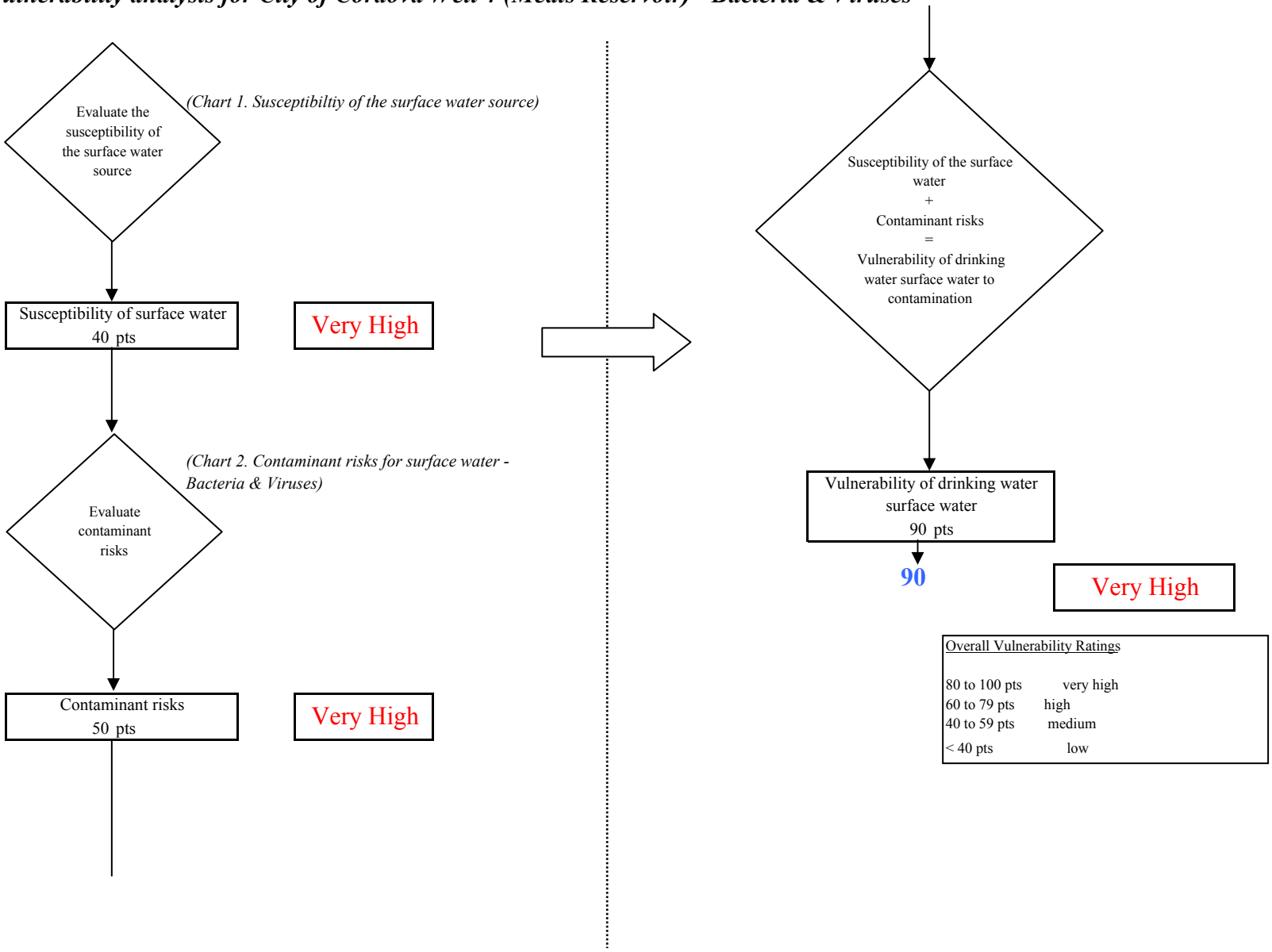


Chart 4. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Nitrates and Nitrites

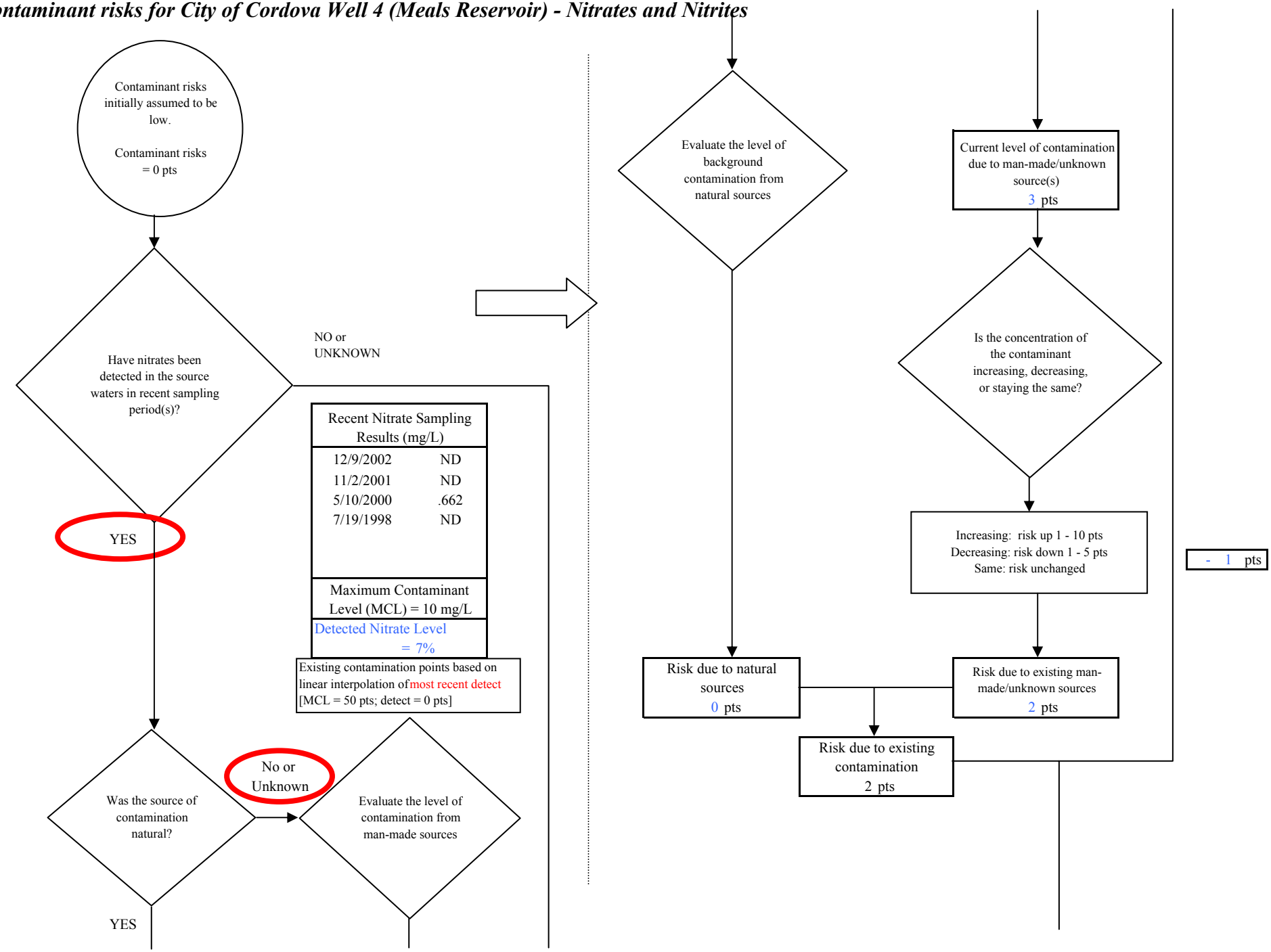
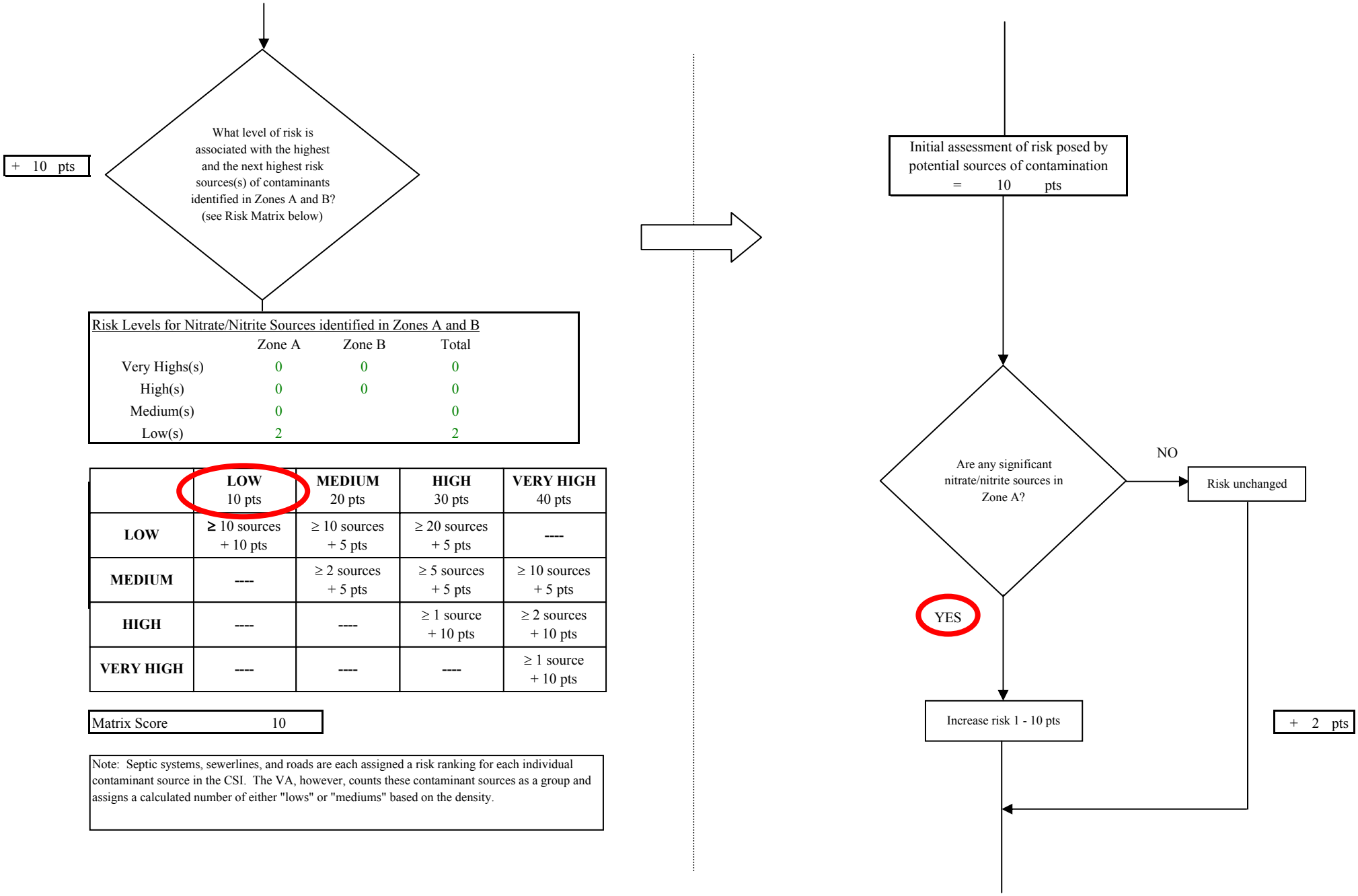


Chart 4. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Nitrates and Nitrites



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)	2		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 4. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Nitrates and Nitrites

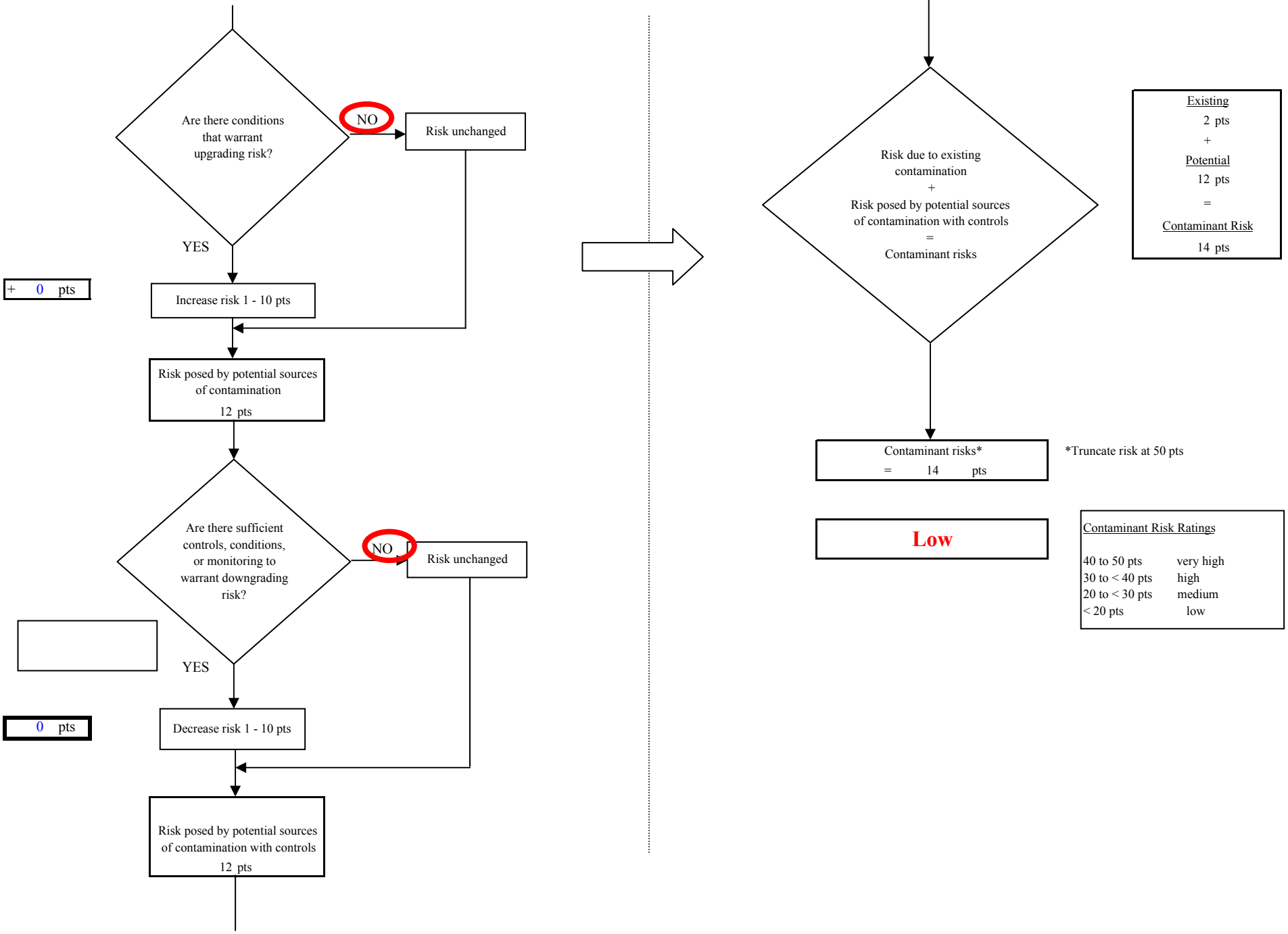


Chart 5. Vulnerability analysis for City of Cordova Well 4 (Meals Reservoir) - Nitrates and Nitrites

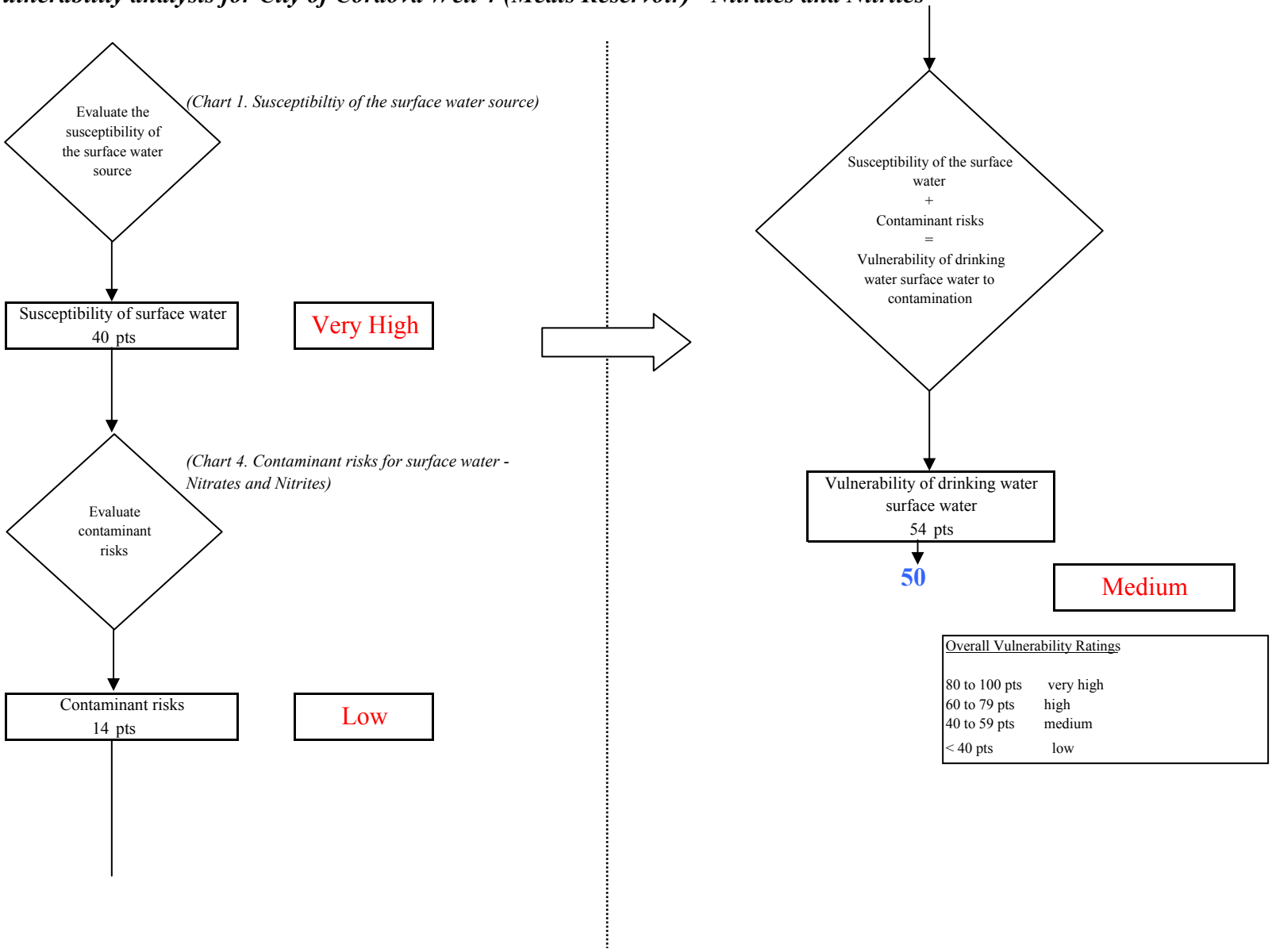


Chart 6. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Volatile Organic Chemicals

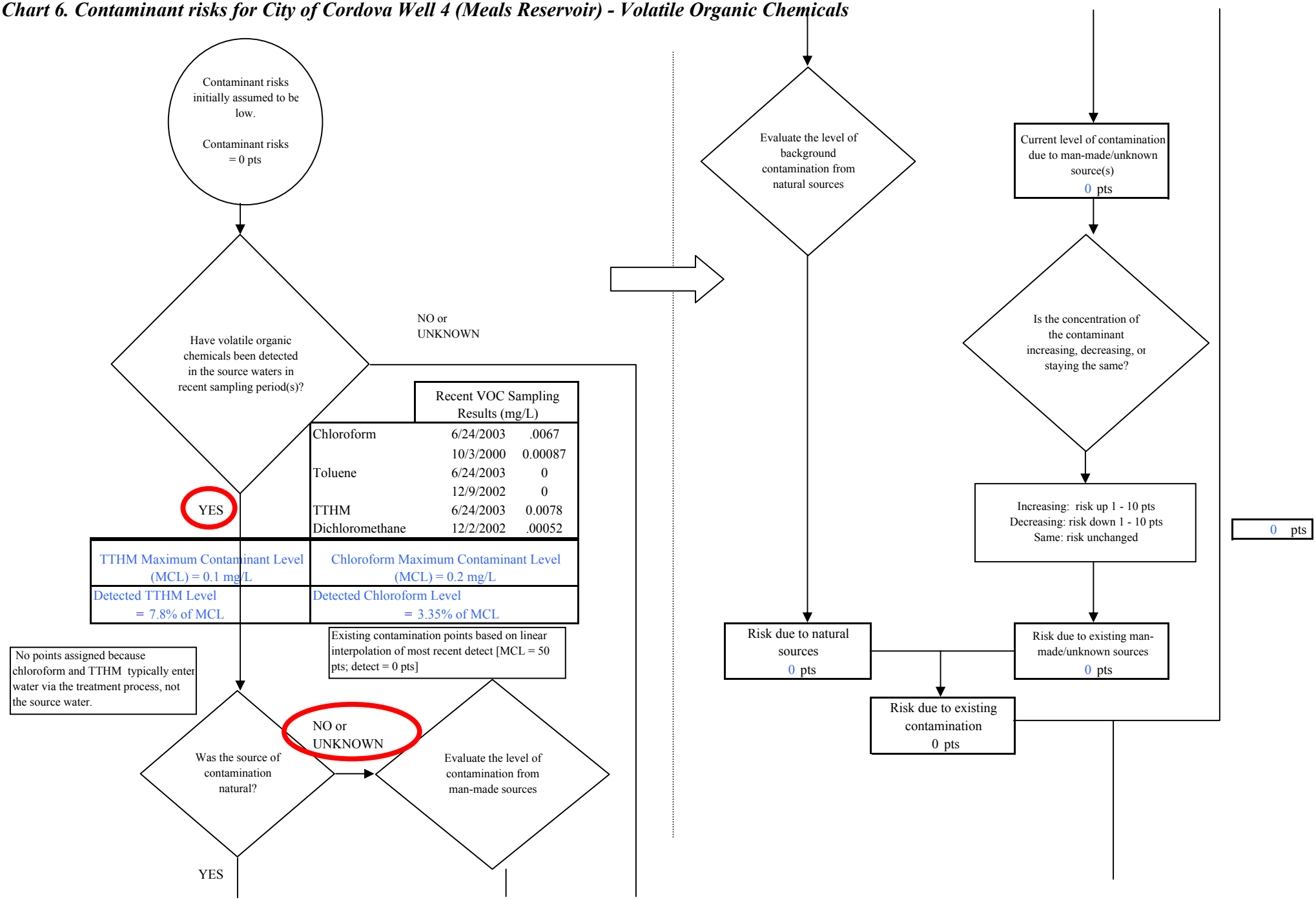


Chart 6. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Volatile Organic Chemicals

+ 10 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 = 10 pts

Are any significant VOC sources in Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 2 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)	0		0
Low(s)	1		1

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

Matrix Score 10

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

Chart 6. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Volatile Organic Chemicals

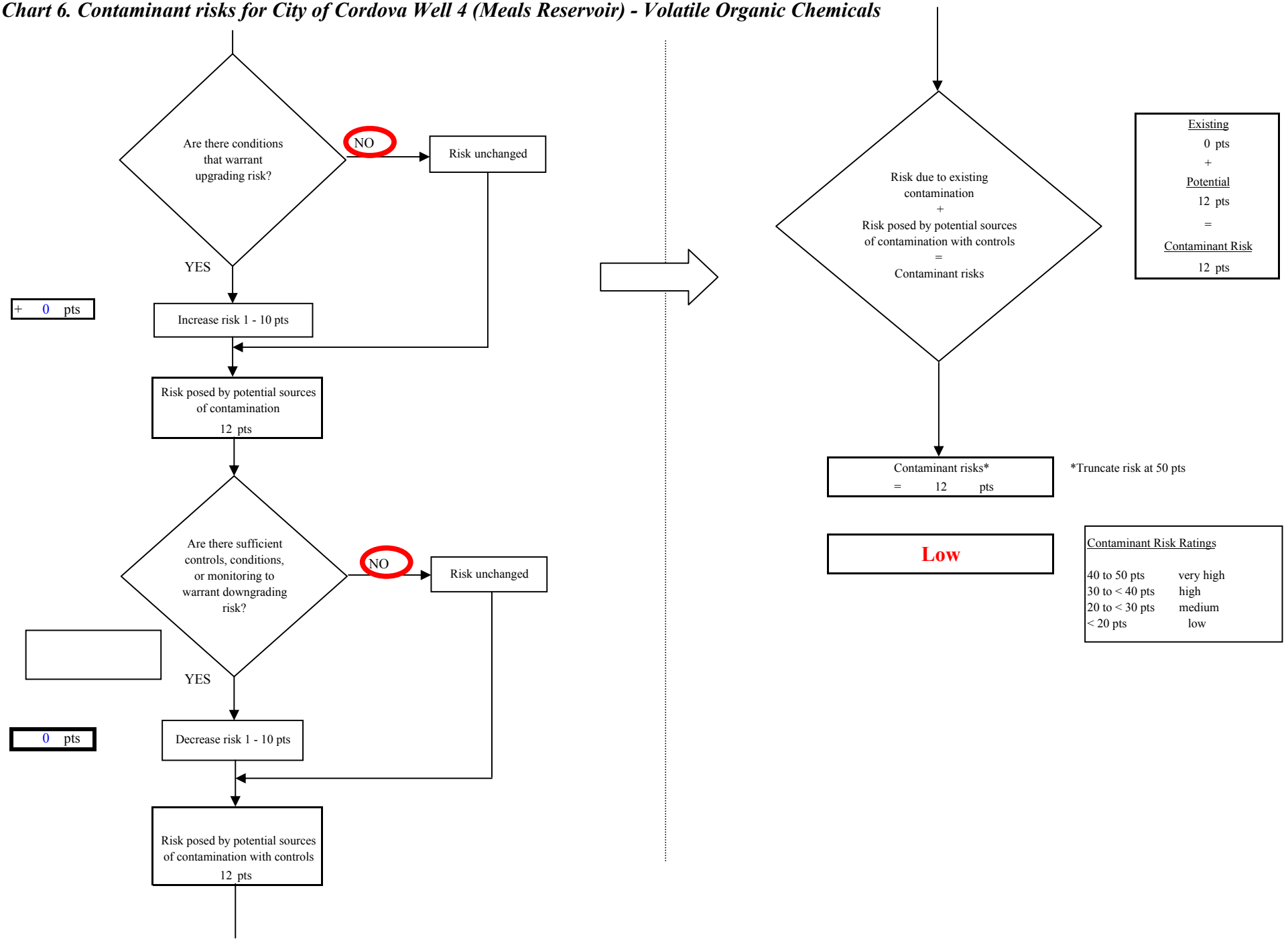


Chart 7. Vulnerability analysis for City of Cordova Well 4 (Meals Reservoir) - Volatile Organic Chemicals

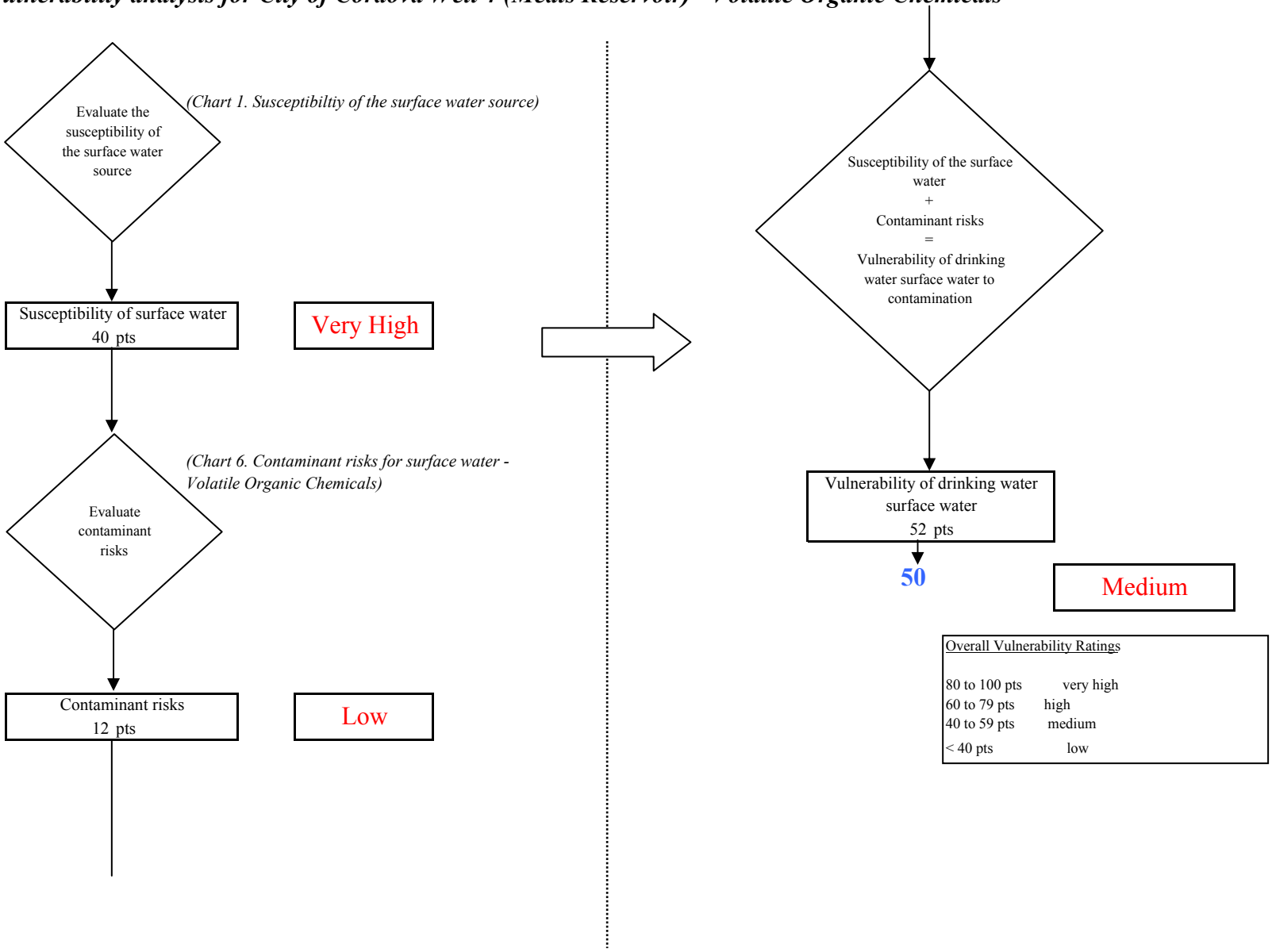


Chart 8. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Heavy Metals, Cyanide and Other Inorganic Chemicals

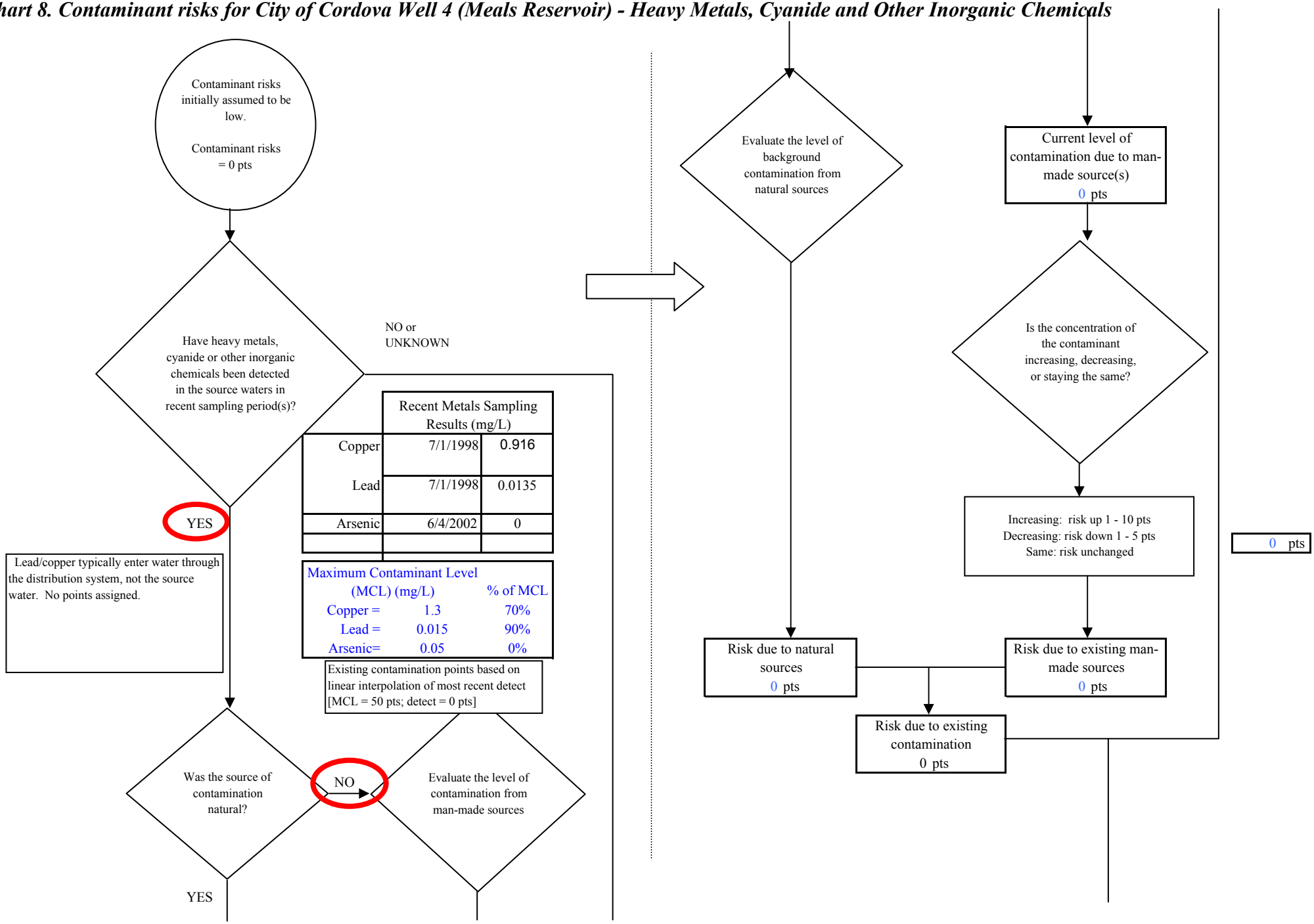
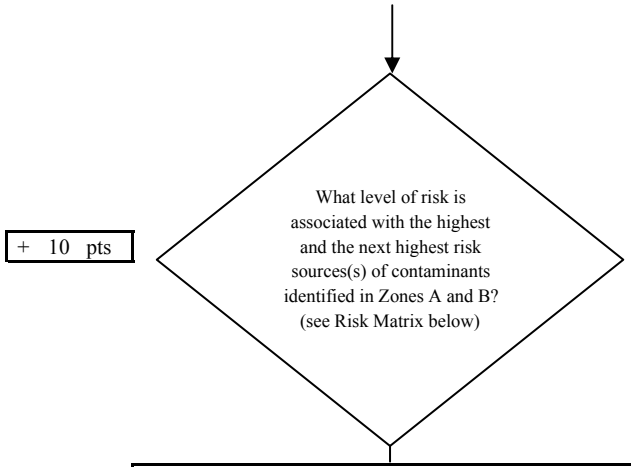


Chart 8. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 10 pts

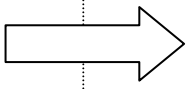
Risk Levels for HM, Cyanide, or OIC Sources identified in Zones A and B

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

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

Matrix Score 10

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



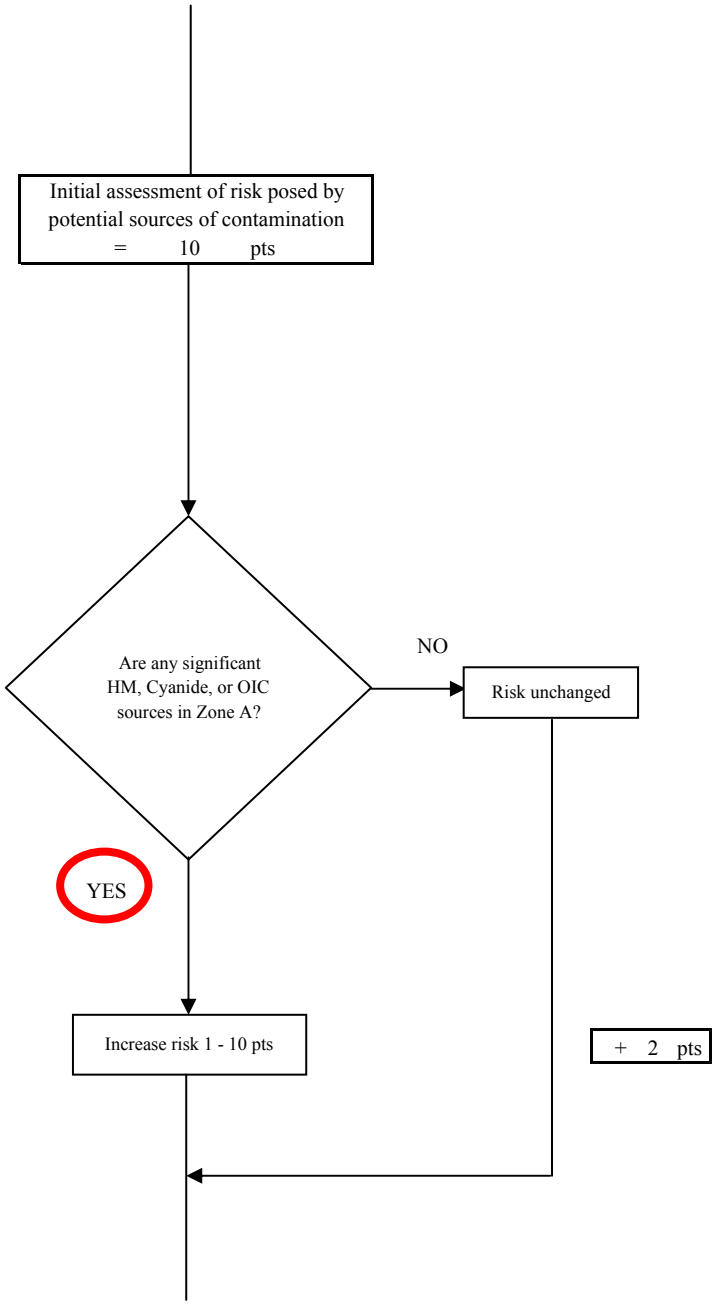


Chart 8. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Heavy Metals, Cyanide and Other Inorganic Chemicals

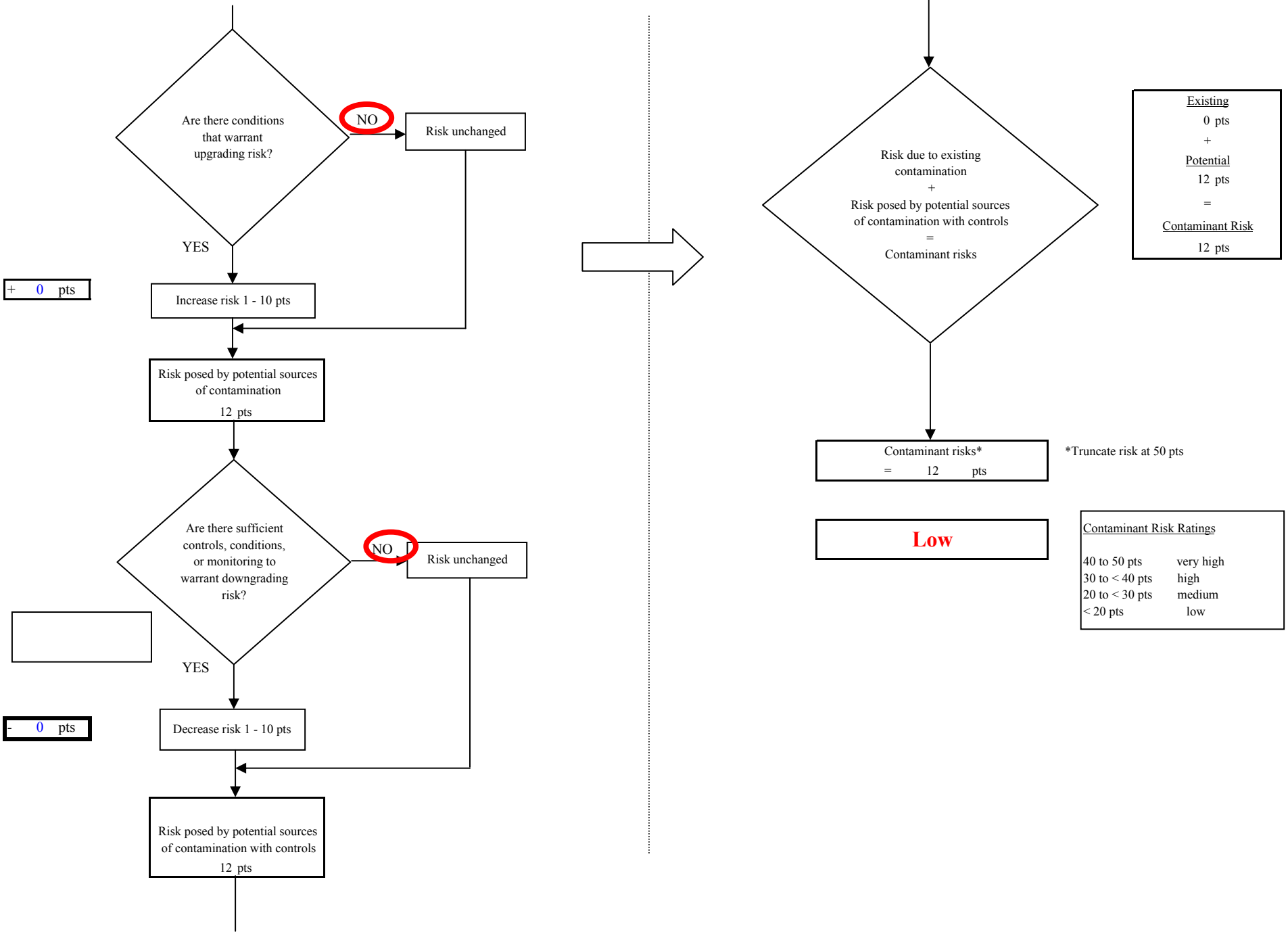


Chart 9. Vulnerability analysis for City of Cordova Well 4 (Meals Reservoir) - Heavy Metals, Cyanide and Other Inorganic Chemicals

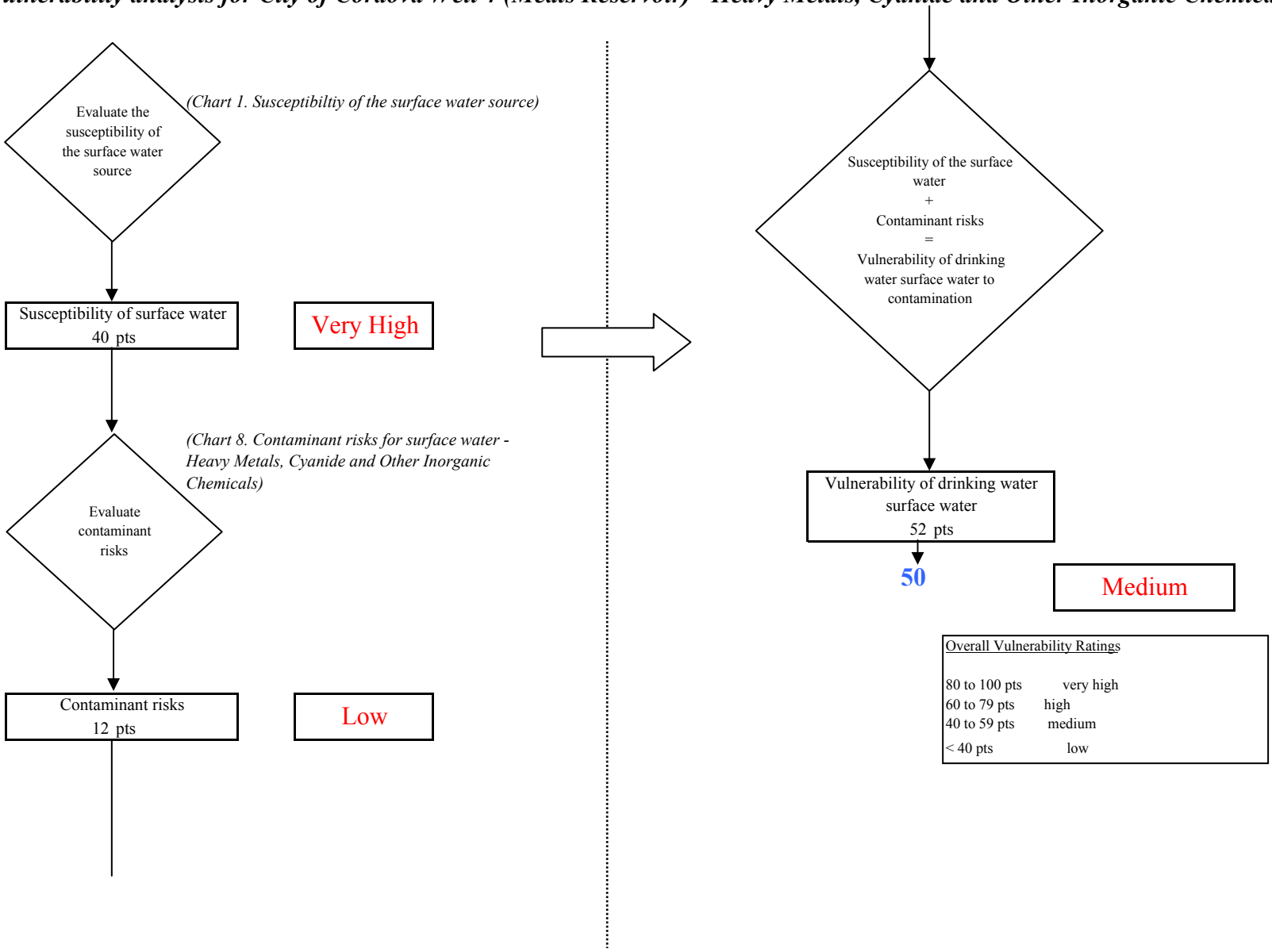


Chart 10. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Synthetic Organic Chemicals

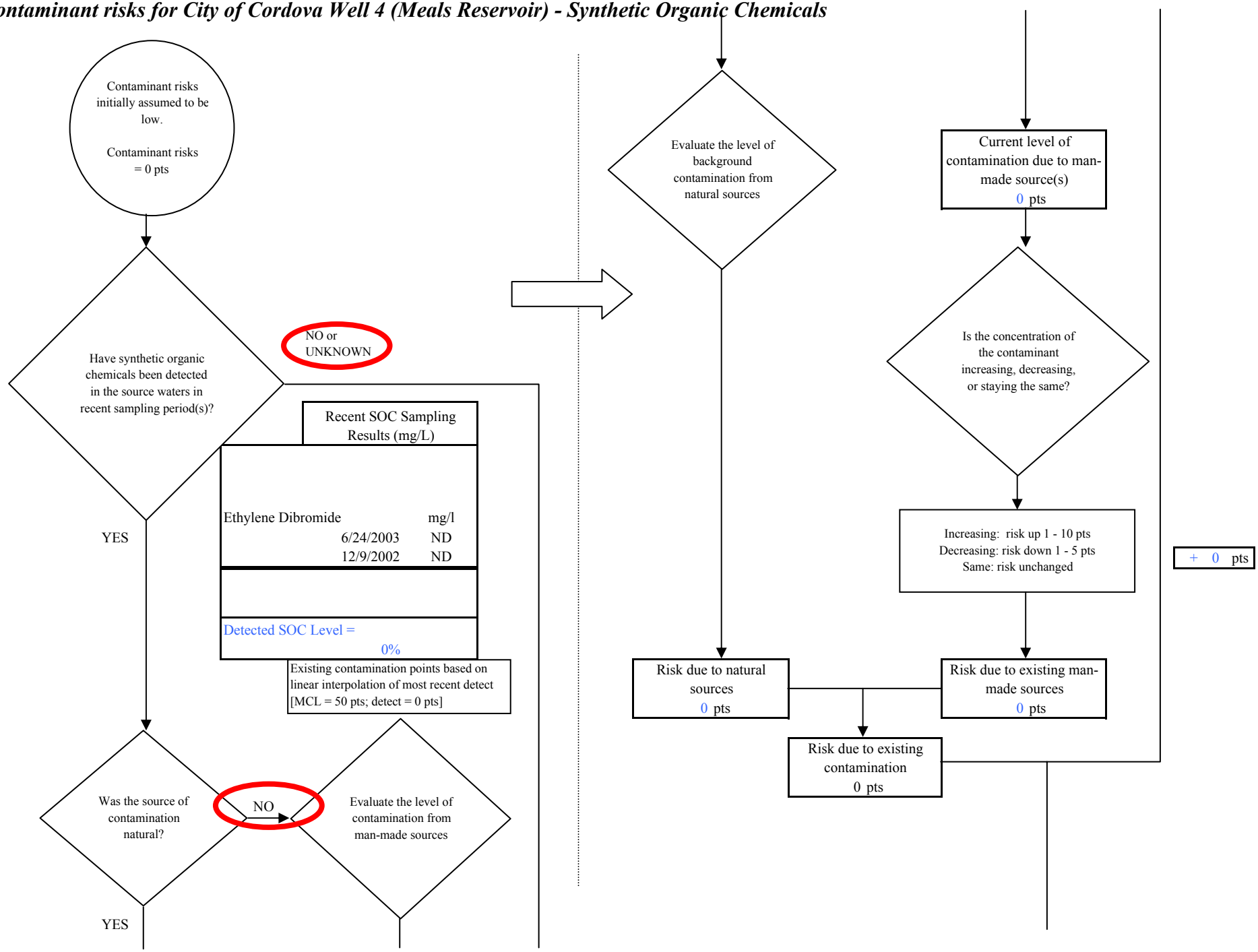
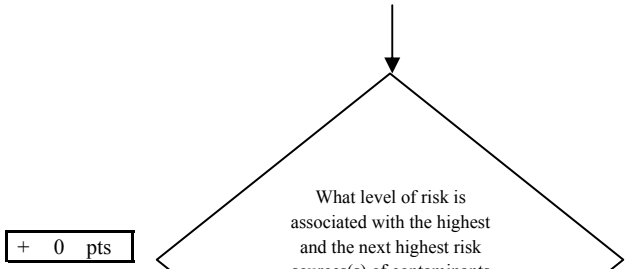


Chart 10. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Synthetic Organic Chemicals



+ 0 pts

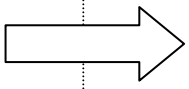
Risk Levels for SOC Sources identified in Zones A and C

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

	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 0

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.



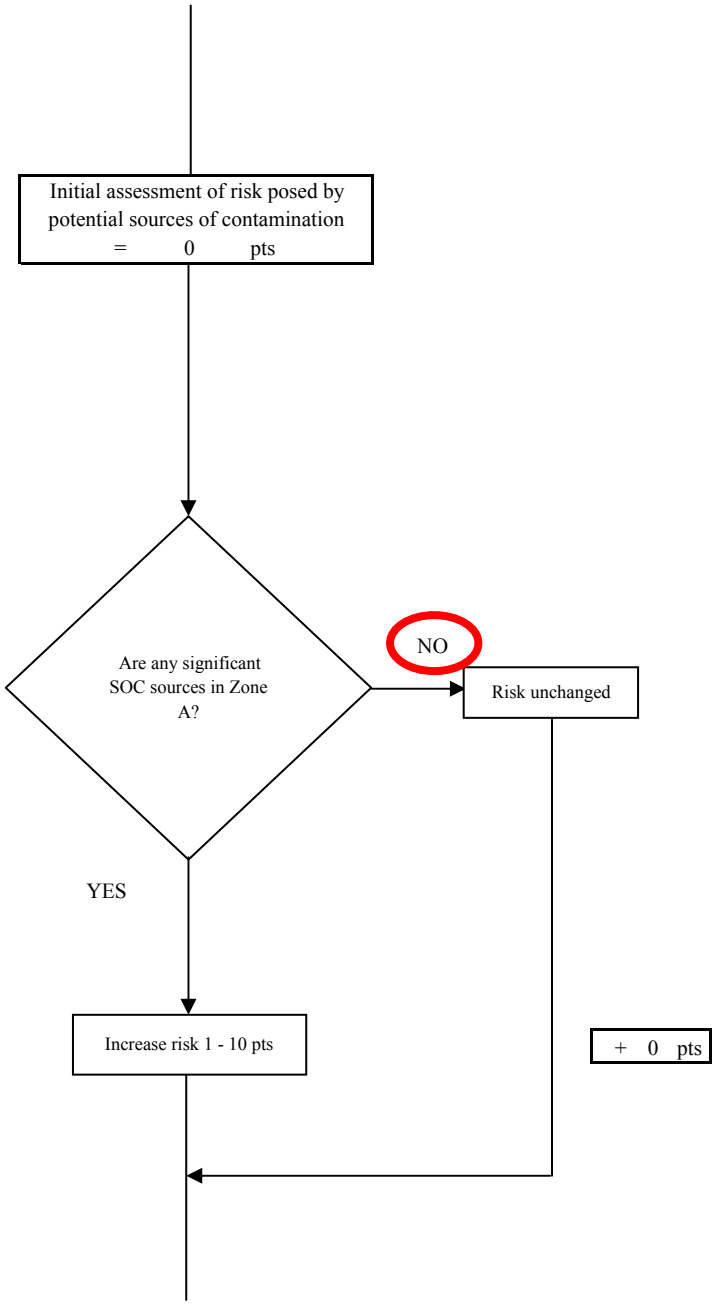


Chart 10. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Synthetic Organic Chemicals

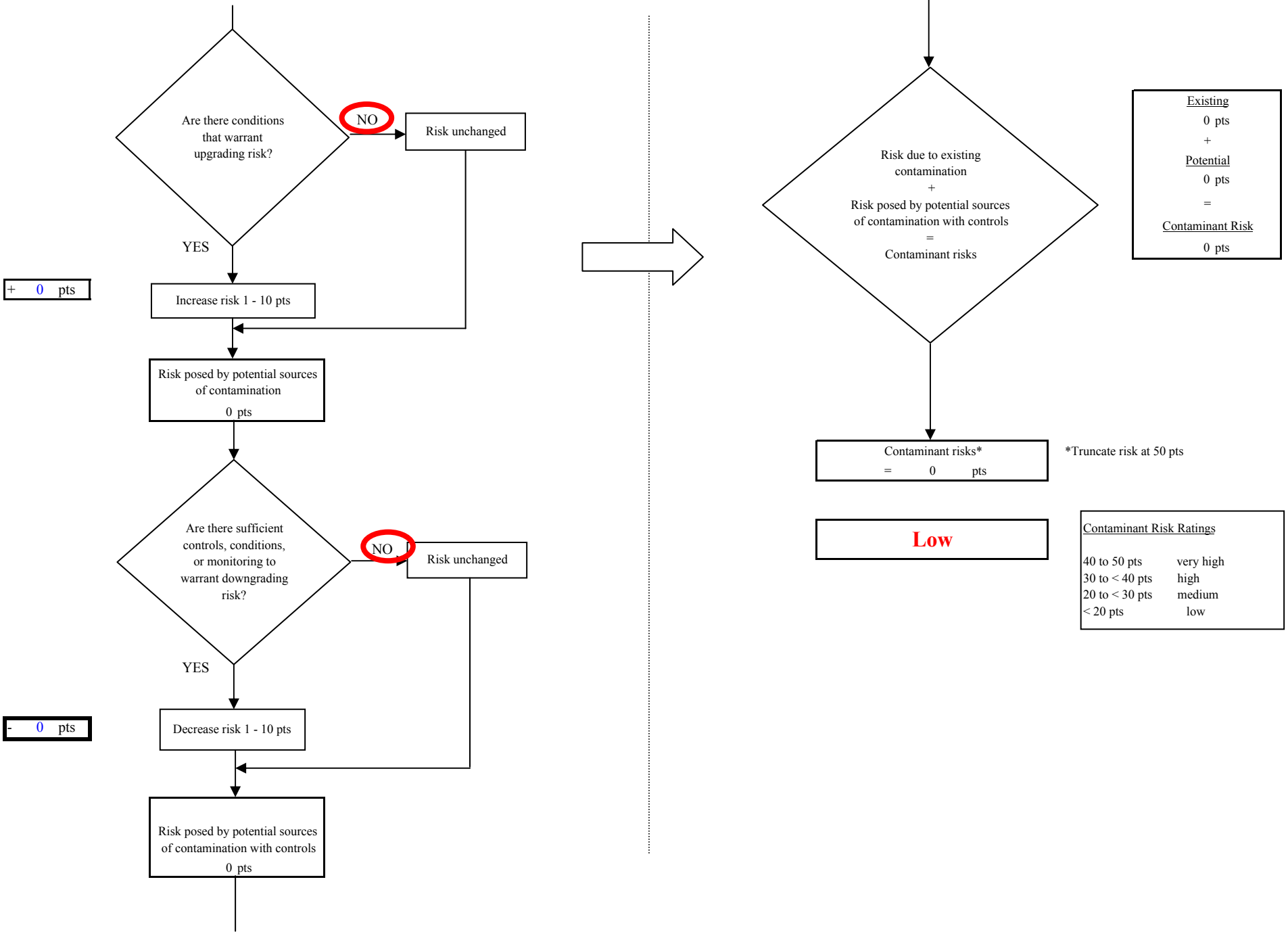


Chart 11. Vulnerability analysis for City of Cordova Well 4 (Meals Reservoir) - Synthetic Organic Chemicals

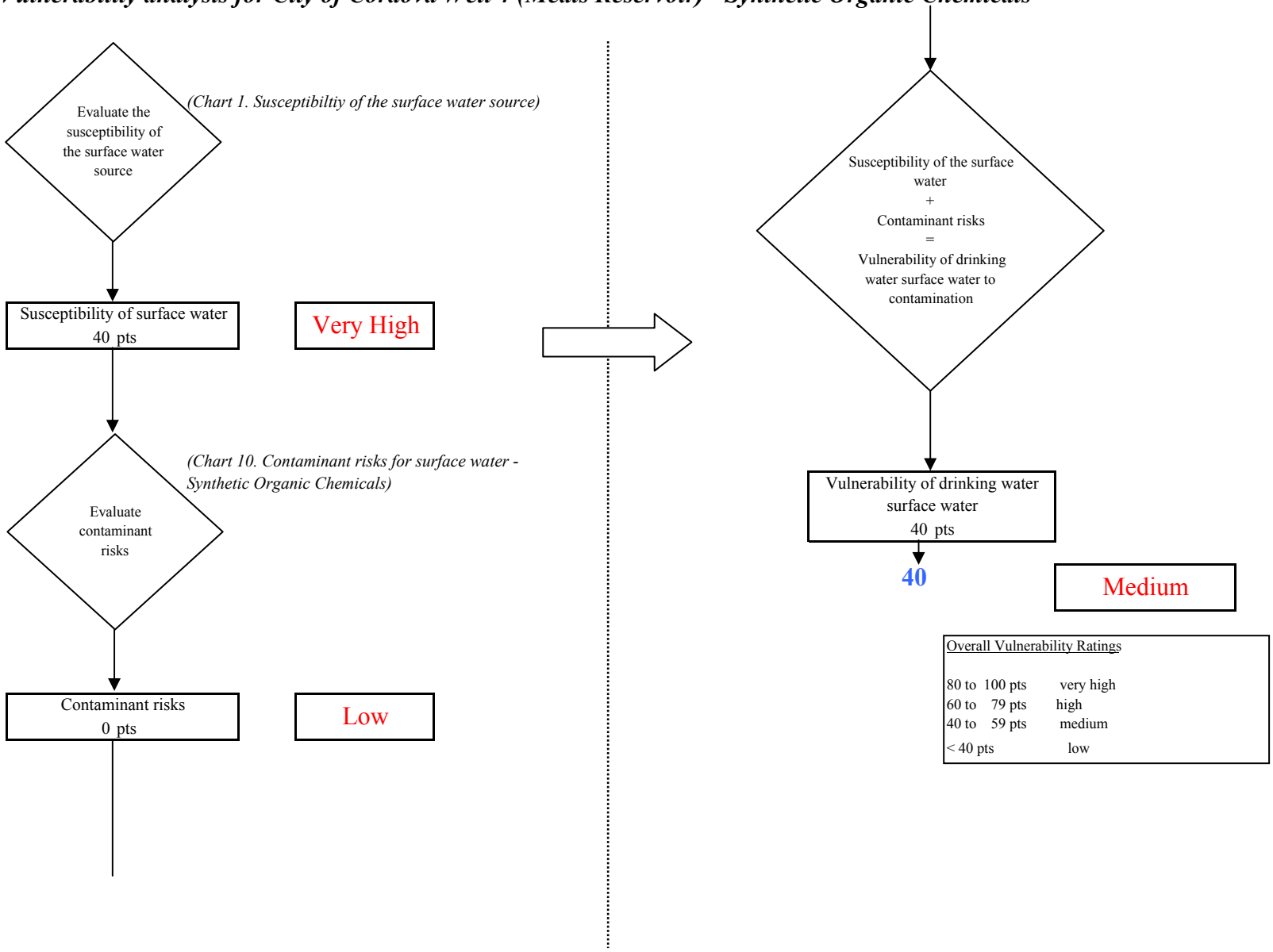


Chart 12. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Other Organic Chemicals

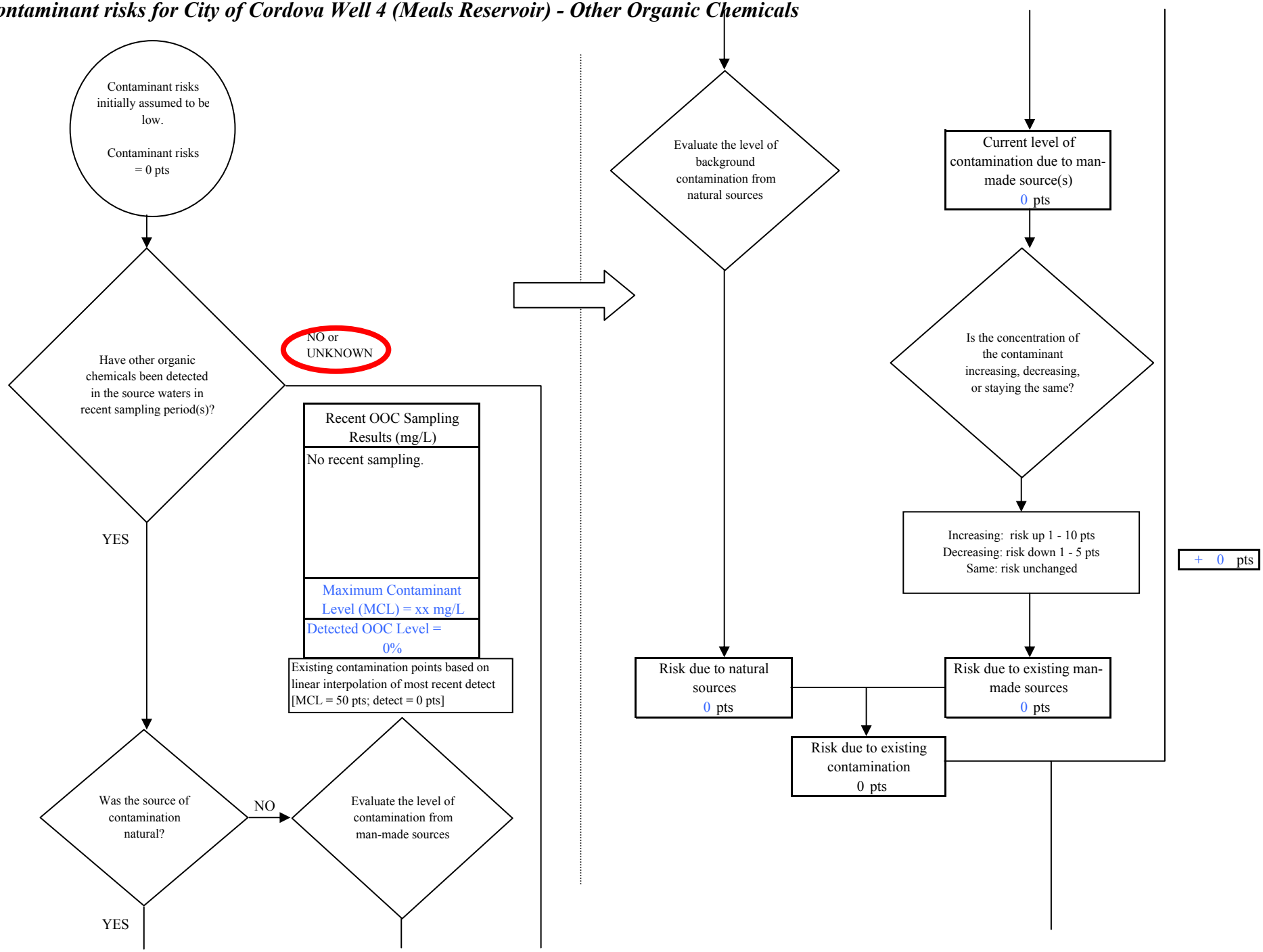
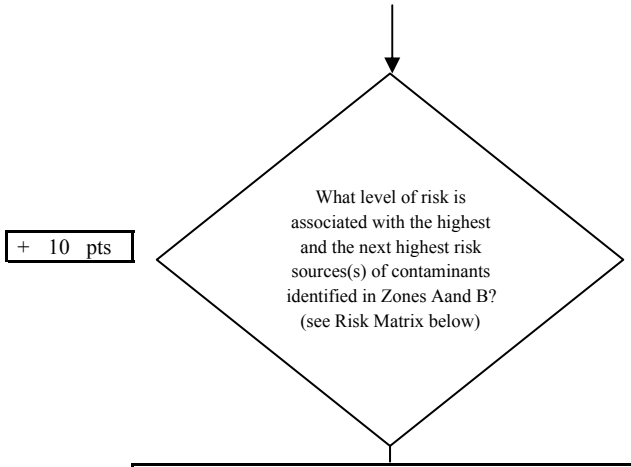


Chart 12. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Other Organic Chemicals



+ 10 pts

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)	0	0	0
Low(s)	1	0	1

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

Matrix Score 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.

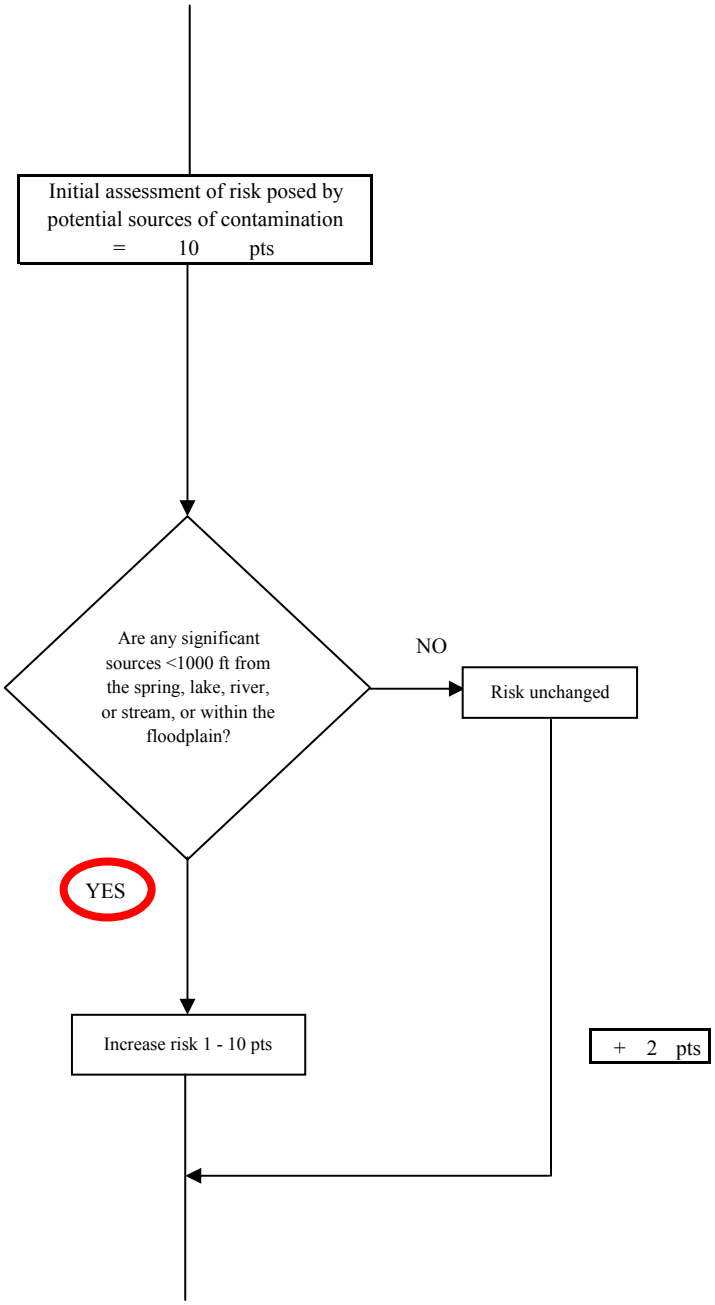


Chart 12. Contaminant risks for City of Cordova Well 4 (Meals Reservoir) - Other Organic Chemicals

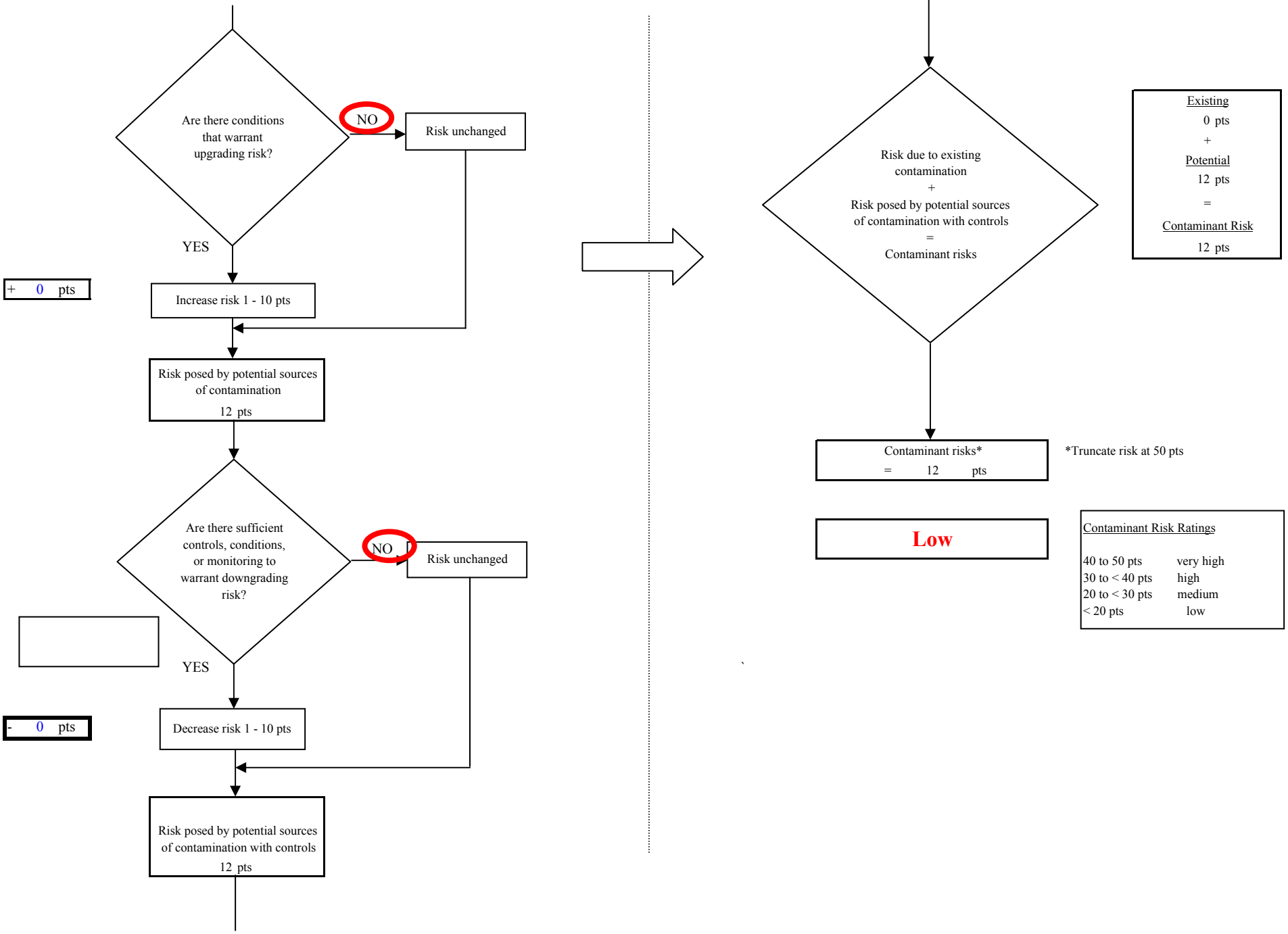


Chart 13. Vulnerability analysis for City of Cordova Well 4 (Meals Reservoir) - Other Organic Chemicals