Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Fort Wainwright Water Treatment Plant Well 4023, Fort Wainwright, Alaska PWSID 310918.6

March 2004

DRINKING WATER PROTECTION PROGRAM REPORT Report 1287
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 Fort Wainwright Water Treatment Plant Well 4023 Fort Wainwright, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability to potential contamination of one of the nine wells making up the public water system serving Fort Wainwright Water Treatment Plant. This Class A (community) water system consists of nine wells in Fort Wainwright, Alaska. This report is an assessment of well 4023 (PWSID 310918.6). The well received a natural susceptibility rating of **High.** This rating is a combination of a susceptibility rating of **Low** for the actual wellheads and a **Very High** rating for the aquifer in which the wells are drawing water from. Identified potential and current sources of contamination for this Fort Wainwright Water Treatment Plant well include: roads, a body shop, a construction trade area, motor supply and repair shops, a welding shop, sewer lines, Class V motor vehicle waste injection wells, a quarry, residential areas, a medical facility, Leaking Underground Storage Tank (LUST) sites, and ADEC-recognized contaminated sites. These 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 system for Fort Wainwright Water Treatment Plant wells received an overall vulnerability rating of **Very High** for bacteria and viruses, **High** for volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, and other organic chemicals, and **Medium** for nitrates and/or nitrites, and synthetic organic chemicals.

FORT WAINWRIGHT WATER TREATMENT PLANT WELLS PUBLIC DRINKING WATER SYSTEM

Fort Wainwright Water Treatment Plant public water system is a Class A (community) water system. This is an assessment of one of the nine wells making up the public drinking water system serving Fort Wainwright. Well 4023 (PWSID 310918.6) is located on the corner of Pine Street and 600th Street in Fort Wainwright, Alaska (T1S, R1W, Section 14) (See Map 1 of Appendix A). Fort Wainwright is located on the southeast side of the town of Fairbanks which is located in the Fairbanks North Star Borough 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 Fairbanks area includes two distinct topographic areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north of this alluvial plain. The Fort Wainwright Water Treatment Plant wells are located in the alluvial plain at an elevation of approximately 450 feet above sea level.

The depth of this well is unknown. Most wells in this area are screened in a combination of sand and gravel, and it is assumed these are also. The alluvial plain consists of alternating layers of silt, sand and gravel up to over 500 feet thick, in some locations overlain by 1 to 10 feet of silt or sandy silt or a few feet of peat (Glass and others, 1996). Discontinuous permafrost (perennially frozen areas) is also common in the alluvial plain. The depth to permafrost in these areas ranges between 2 and 45 feet below the ground surface with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, T.L. 1958. Geology of the Fairbanks (D-2) Quadrangle, Alaska. USGS). Areas with discontinuous permafrost may locally affect the ground water flow directions.

Primarily the Tanana River, but also the Chena River contribute water to this alluvial aquifer. The Chena River typically only contributes water when its stage is high and the Tanana is low (Nelson, 1978). The Tanana River gets approximately 85% of its water from snowmelt of the Alaska Range and 15% from the Yukon-Tanana uplands (Anderson, 1970).

This public drinking water system serves approximately 6,000 residents through approximately 600 service connections.

FORT WAINWRIGHT WATER TREATMENT PLANT WELLS 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 wells is the area that contributes water to the well, the groundwater capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

There are many different ways of calculating the size of capture zones. This assessment uses a combination of two simple groundwater flow equations, the Thiem and uniform flow equations for all groundwater wells screened in unconsolidated material. The orientation of the capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated in this assessment is only a best guess using the information and resources available to us, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture zone are general for the whole alluvial plain and were obtained from various United State Geological Survey (USGS) reports, well logs in the area, and the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

The water table in the area of these Fort Wainwright Water Treatment Plant wells, the area between the Tanana and the Chena Rivers, is primarily influenced by the level of water flow in each river. The capture zones were drawn based on three separate configurations of the water table during various stages of the rivers: a period of high stage in the Chena River (October 14-17, 1986), high stage in the Tanana River (July 16-17, 1987), and low stages in both rivers (March 30-April 3, 1988) (Glass and others, 1996). High water levels in the Chena usually occur in the spring due to runoff from the uplands and in late summer due to rainstorms (Nelson, 1978). The Tanana usually experiences high flow during the hot, dry periods of mid-summer when maximum snowmelt from the Alaska Range occurs (Nelson, 1978). Groundwater in this area generally flows toward the northwest, from the Tanana River to the Chena River, however flow is reversed very near the Chena River during its high stage periods (Glass and others, 1996). These flow reversals are of short duration (i.e. days versus months) and of limited extent, generally within 1000 feet of the river (Nakanishi, et all, 1998).

Because of uncertainties and changing site conditions, a factor of safety is added to the groundwater capture zone to form the drinking water protection area for the well.

The protection areas established for wells are usually separated into four zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the four 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 2 years time-of-travel
C	Less than 5 years time-of-travel
D	Less than 10 years time-of-travel

The time of travel for *contaminants* within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Fort Wainwright Water Treatment Plant wells on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program (DWPP) has completed an inventory of potential and existing sources of contamination within these Fort Wainwright Water Treatment Plant wells protection area. This inventory was completed through a search of agency records and other publicly available information. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other inorganic 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 each

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 combination of toxicity and volume associated with that source. Rankings include:

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

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 inventoried potential and existing sources of contamination with respect to the six contaminant categories.

VULNERABILITY OF FORT WAINWRIGHT WATER TREATMENT PLANT WELLS 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 properties of the aquifer and the presence of other wells or boreholes in the area. 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 the water system's contaminant sample results. Lastly, Chart 4 combines the results of the first three charts to produce 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, cyanide, and other inorganic chemicals, 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 wellhead for the Fort Wainwright Water Treatment Plant wells received a Low Susceptibility rating. It is unknown if the well is capped with a sanitary seal, this assessment assumes a sanitary seal is correctly installed on each of the wells. It is unknown if the land surface is sloped away from the well, this assessment assumes it does. It is also unknown if the well is grouted, this assessment assumed it is not. A sanitary seal prevents potential contaminants from entering the well from the inside while sloping the land surface away from the well and grouting help to prevent potential contaminants from traveling down the outside of the well casing.

The aquifer in the area the Fort Wainwright Water Treatment Plant wells well is completed in received a Very High Susceptibility rating. The highly transmissive aquifer material (sand and gravel) in the area allows contaminants to travel downward from the surface with the precipitation and surface water runoff. The shallow water table allows potential contaminants to come into contact with the water table with little natural filtering where they can disperse quickly. Additionally, wells in the area can provide a quick pathway for contaminants to reach the aquifer. Table 2 summarizes the Susceptibility scores and ratings for Fort Wainwright Water Treatment Plant wells.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	High

The Contaminant Risk has been derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources. 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	50	Very High
Nitrates and/or Nitrites	20	Medium
Volatile Organic Chemicals	40	Very High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	40	Very High
Synthetic Organic Chemicals	10	Low
Other Organic Chemicals	30	High

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

Natural Susceptibility (0 – 50 points)
+
Contaminant Risks (0 – 50 points)
=
Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

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

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

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	80	Very High
Nitrates and/or Nitrites	50	Medium
Volatile Organic Chemicals	70	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	70	High
Synthetic Organic Chemicals	40	Medium
Other Organic Chemicals	60	High

Bacteria and Viruses

The sewer lines in the protection area represent the greatest identified risk of Bacteria and Viruses to this water system.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, it is 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 (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Routine sampling has most recently detected coliforms in the water on 9/4/01 (verified on 9/6/01). Fecal coliform and E. Coli were not detected in the water.

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 very high.

Nitrates and Nitrites

The sewer lines also represent the greatest risk of nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have not been detected in significant concentrations during recent sampling

history for the Fort Wainwright Water Treatment Plant wells.

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 Class V Motor Vehicle Waste disposal wells represent the greatest risk for volatile organic chemical contamination to the well. Class V Motor Vehicle Waste Disposal wells are most commonly septic systems or dry wells servicing a type of motor vehicle repair shop. They have been banned as of April 5, 2000 although existing disposal wells have until January 1, 2007 in most cases to either close or obtain a permit to operate.

Volatile Organic Chemicals have not been detected during routine sampling of this water system. 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 high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The Class V Motor Vehicle Waste Disposal wells and the Machine/metal workshop represent the greatest risk to to heavy metals for this source of public drinking water.

Antimony and Beryllium have been detected in extremely small concentrations with respect to their Maximum Contaminant Levels (MCL). A MCL is the concentration of a contaminant allowed in the drinking water by the Environmental Protection Area (EPA). No other heavy metals were not detected during recent sampling.

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Synthetic Organic Chemicals

The sewer lines, residential area, Class V motor vehicle waste disposal wells, machine/metal work shop, and medical facility all represent a small risk for synthetic organic chemical contamination to the well.

Synthetic Organic Chemicals have not detected in the Fort Wainwright Water Treatment Plant water system.

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

Other Organic Chemicals

The machine/metal workshop represents the greatest risk for other organic chemical contamination to the well.

Other Organic Chemicals have not been detected in the Fort Wainwright Water Treatment Plant water system.

After combining the contaminant risk for other organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Existing Contaminated Sites

There are approximately 9 ADEC-recognized contaminated sites and one Leaking Underground Storage Tank (LUST) site located within the protection area (displayed on Map 2 Appendix C). The locations of these sites are approximate and may be at the center of the zipcode boundaries the actual site is located in. The ADEC Contaminated Sites program has identified, assessed, and is ensuring cleanup of these sites based on their prioritized order. Priority is based on risk to human health and the environment, including risk to public drinking water wells. Specific information on each site can be found on the internet at http://www.dec.state.ak.us/spar/cs/search/csites/csites_search.asp for contaminated sites or http://info.dec.state.ak.us/SPAR/CSP/UST/Search/ for LUST sites or by calling the ADEC Contaminated Sites Program at (907) 269-7658.

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APPENDIX A

Fort Wainwright Water Treatment Plant wells Drinking Water Protection Area Location Map (Map 1)

JOHANSEN EXPRESSWAY
NEW STEESE HIGHWAY
TRAINOR GATE ROAD
RICHARDSON HIGHWAY
BADGER ROAD
DENNIS ROAD
DOYLE DRIVE
BRADWAY ROAD
OLD RICHARDSON HIGHWAY
FLOOD CONTROL LEVEE

310918.9
310918.1
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310918.5

Map 1: Fort Wainwright Drinking Water Protection Areas

PWSID: 310918

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 2,350 4,700 9,400 14,100 Feet

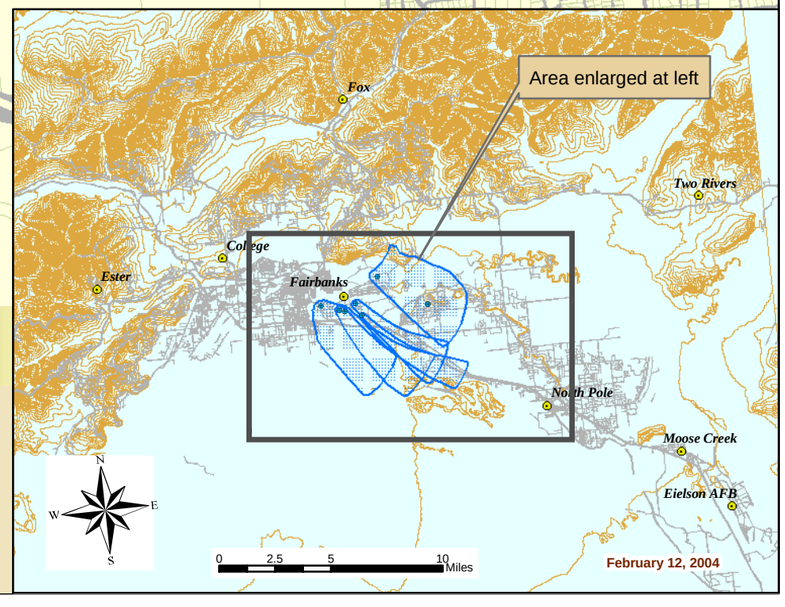
1:56,400

Data Sources:

Parcel, roads - Fairbanks North Star Borough
Water bodies, railroad - Geographic Data Technology
Elevation contours - USGS digital elevation models (DEMs)

Legend

- Zone A *Several months travel time*
- Zone B *Less than 2 years travel time*
- Zone C *Less than 5 years travel time*
- Zone D *Less than 10 years travel time*
- Surface water
- Roads
- Parcels



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Fort Wainwright Water Treatment Plant wells (Tables 1-7)

Table 1

Contaminant Source Inventory for
Ft Wainwright / Wtr Trtmt Plt

PWSID 310918.006

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	A	2	North of Gaffney near Main Gate; FTWW (2P) Bldg 4057; File Number 108.26.010
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-2	A	2	FTWW (2P) Bldg 4247 Site 6; File Number 108.38.036
Highways and roads, paved (cement or asphalt)	X20		A	2	11 roads in Zone A
Body shops (automotive)	C05	C05-1	B	2	701 Williams Gate Road
Construction trade areas and materials	C09	C09-1	B	2	3400 Macarthur Street
Motor/motor vehicle supplies stores	C28	C28-1	B	2	751 Williams Gate Road
Motor /motor vehicle repair shops	C31	C31-1	B	2	391 Old Richardson Highway
Welding shops	C43	C43-1	B	2	3140 Lakeview Drive
Domestic wastewater collection systems (sewer lines or lift stations)	D01		B	2	Estimated 5 sewer lines in Zone B
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	2	701 Williams Gate Road
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-2	B	2	390 E Van Horn
Quarries (sand, gravel, rock, other?)	E10	E10-1	B	2	based on USGS topographic map
Machine and metal work shops	I23	I23-1	B	2	3250 Easy Street
Residential Areas	R01		B	2	Approximately 10 acres of residential area in Zone B
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-3	B	2	North Side Ladd Airfield; FTWW (2P) Bldg. 1599 FTWW-026; File Number 108.38.065
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-4	B	2	10th Street and Gaffney; FTWW Bassett AR Hospital; File Number 108.38.077
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-5	B	2	751 Williams Gate Road; Giant Tire; RecKey 1992310926001
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-6	B	2	Neely Road & 10th Street; FTWW (2P) Bldg. 3562 PX Gas Station; File Number 108.26.025
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-7	B	2	near Power Plant; FTWW (OU-4) Pplant Fly Ash Pond; File Number 108.38.070
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-8	B	2	Neely Road & 11th Street; FTWW (2P) Bldg. 3570 Former PX Gas; File Number 108.38.078
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-9	B	2	South of Bldg 352 NW; FTWW (2P) Bldg 3595 Pplant UST; File Number 108.26.021
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	B	2	3140 Lakeview Drive; Greer Tank & Welding; File Number 100.26.145

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		B	2	11 roads in Zone B
Motor vehicle/general storage yards/facilities	X27	X27-1	B	2	620 Old Richardson Highway #100
Motor vehicle/general storage yards/facilities	X27	X27-2	B	2	3600 Easy Street
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	2	751 Old Richardson Highway

Table 2

Contaminant Source Inventory and Risk Ranking for Ft Wainwright / Wtr Trtmt Plt Sources of Bacteria and Viruses

PWSID 310918.006

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	11 roads in Zone A
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Residential Areas	R01		B	Low	2	Approximately 10 acres of residential area in Zone B
Domestic wastewater collection systems (sewer lines or lift stations)	D01		B	Medium	2	Estimated 5 sewer lines in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	Low	2	701 Williams Gate Road
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-2	B	Low	2	390 E Van Horn
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Medium	2	751 Old Richardson Highway

Table 3

Contaminant Source Inventory and Risk Ranking for Ft Wainwright / Wtr Trtmt Plt Sources of Nitrates/Nitrites

PWSID 310918.006

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	11 roads in Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01		B	Medium	2	Estimated 5 sewer lines in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Residential Areas	R01		B	Low	2	Approximately 10 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Quarries (sand, gravel, rock, other?)	E10	E10-1	B	Low	2	based on USGS topographic map
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Low	2	751 Old Richardson Highway

Table 4

Contaminant Source Inventory and Risk Ranking for Ft Wainwright / Wtr Trtmt Plt Sources of Volatile Organic Chemicals

PWSID 310918.006

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	11 roads in Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01		B	Low	2	Estimated 5 sewer lines in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Residential Areas	R01		B	Low	2	Approximately 10 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Body shops (automotive)	C05	C05-1	B	Medium	2	701 Williams Gate Road
Construction trade areas and materials	C09	C09-1	B	Low	2	3400 Macarthur Street
Motor/motor vehicle supplies stores	C28	C28-1	B	Low	2	751 Williams Gate Road
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	2	391 Old Richardson Highway
Welding shops	C43	C43-1	B	Medium	2	3140 Lakeview Drive
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	High	2	701 Williams Gate Road
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-2	B	High	2	390 E Van Horn
Quarries (sand, gravel, rock, other?)	E10	E10-1	B	Low	2	based on USGS topographic map
Machine and metal work shops	I23	I23-1	B	High	2	3250 Easy Street
Motor vehicle/general storage yards/facilities	X27	X27-1	B	Low	2	620 Old Richardson Highway #100
Motor vehicle/general storage yards/facilities	X27	X27-2	B	Low	2	3600 Easy Street
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Low	2	751 Old Richardson Highway

Table 5

Contaminant Source Inventory and Risk Ranking for Ft Wainwright / Wtr Trtmt Plt

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 310918.006

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	11 roads in Zone A
Residential Areas	R01		B	Low	2	Approximately 10 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Domestic wastewater collection systems (sewer lines or lift stations)	D01		B	Low	2	Estimated 5 sewer lines in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Body shops (automotive)	C05	C05-1	B	Medium	2	701 Williams Gate Road
Construction trade areas and materials	C09	C09-1	B	Low	2	3400 Macarthur Street
Motor/motor vehicle supplies stores	C28	C28-1	B	Low	2	751 Williams Gate Road
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	2	391 Old Richardson Highway
Welding shops	C43	C43-1	B	Low	2	3140 Lakeview Drive
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	High	2	701 Williams Gate Road
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-2	B	High	2	390 E Van Horn
Machine and metal work shops	I23	I23-1	B	High	2	3250 Easy Street
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Low	2	751 Old Richardson Highway

Table 6

Contaminant Source Inventory and Risk Ranking for Ft Wainwright / Wtr Trtmt Plt Sources of Synthetic Organic Chemicals

PWSID 310918.006

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01		B	Low	2	Estimated 5 sewer lines in Zone B
Residential Areas	R01		B	Low	2	Approximately 10 acres of residential area in Zone B
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	Low	2	701 Williams Gate Road
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-2	B	Low	2	390 E Van Horn
Machine and metal work shops	I23	I23-1	B	Low	2	3250 Easy Street
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Low	2	751 Old Richardson Highway

Table 7

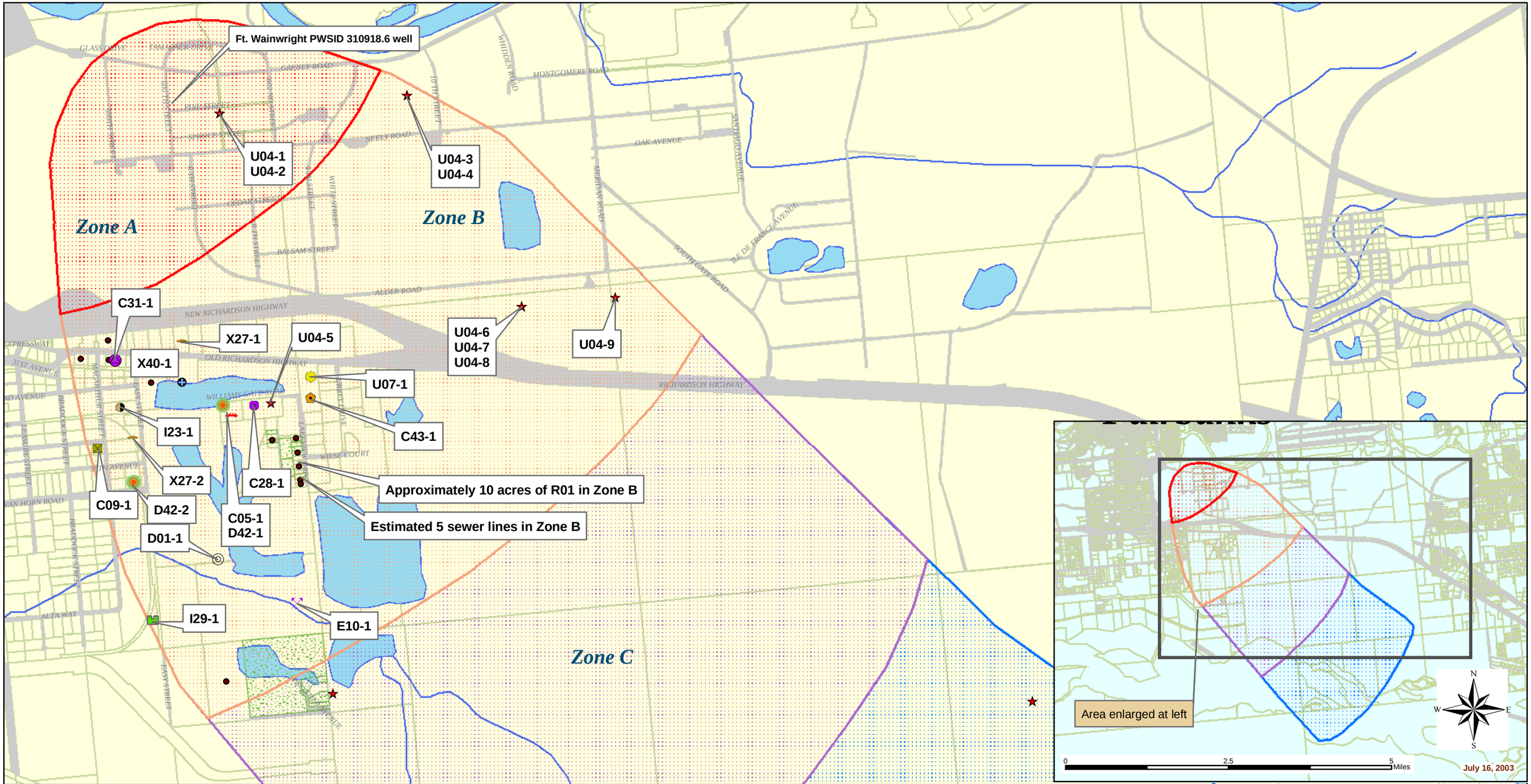
Contaminant Source Inventory and Risk Ranking for Ft Wainwright / Wtr Trtmt Plt Sources of Other Organic Chemicals

PWSID 310918.006

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	11 roads in Zone A
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Residential Areas	R01		B	Low	2	Approximately 10 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	11 roads in Zone B
Domestic wastewater collection systems (sewer lines or lift stations)	D01		B	Low	2	Estimated 5 sewer lines in Zone B
Body shops (automotive)	C05	C05-1	B	Medium	2	701 Williams Gate Road
Construction trade areas and materials	C09	C09-1	B	Low	2	3400 Macarthur Street
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	2	391 Old Richardson Highway
Welding shops	C43	C43-1	B	Low	2	3140 Lakeview Drive
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	Medium	2	701 Williams Gate Road
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-2	B	Medium	2	390 E Van Horn
Quarries (sand, gravel, rock, other?)	E10	E10-1	B	Low	2	based on USGS topographic map
Machine and metal work shops	I23	I23-1	B	High	2	3250 Easy Street
Motor vehicle/general storage yards/facilities	X27	X27-1	B	Low	2	620 Old Richardson Highway #100
Motor vehicle/general storage yards/facilities	X27	X27-2	B	Low	2	3600 Easy Street

APPENDIX C

Fort Wainwright Water Treatment Plant wells Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)



Map 2: Ft. Wainwright Well 4023 Potential Contaminant Sources

PWSID: 310918.6

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 775 1,550 3,100 Feet

1:18,600

NOTE: Locations of DEC-contaminanted sites are approximate
Data Sources:
Parcel, roads - Fairbanks North Star Borough
Water bodies - US Tiger2000 Census Data
Elevation contours - USGS digital elevation models (DEMs)

Legend

- C05, Body shop
- C09, Construction trade area
- C28, Motor supply store
- C31, Motor repair shop
- C43, Welding shop
- D01, Domestic wastewater collection
- D42, Motor Vehicle Waste disposal well
- E10, Quarry
- I23, Machine/metal shop
- I29, Organic chemicals manufacturing
- U04, DEC-recognized contaminated site
- U07, LUST site
- X27, Motor vehicle storage
- X40, Medical facility
- GHU Sewer customers
- Residential area (R01)
- Parcels
- Roads
- Surface water

APPENDIX D

Vulnerability Analysis for Fort Wainwright Water Treatment Plant wells

Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Ft. Wainwright well 4023

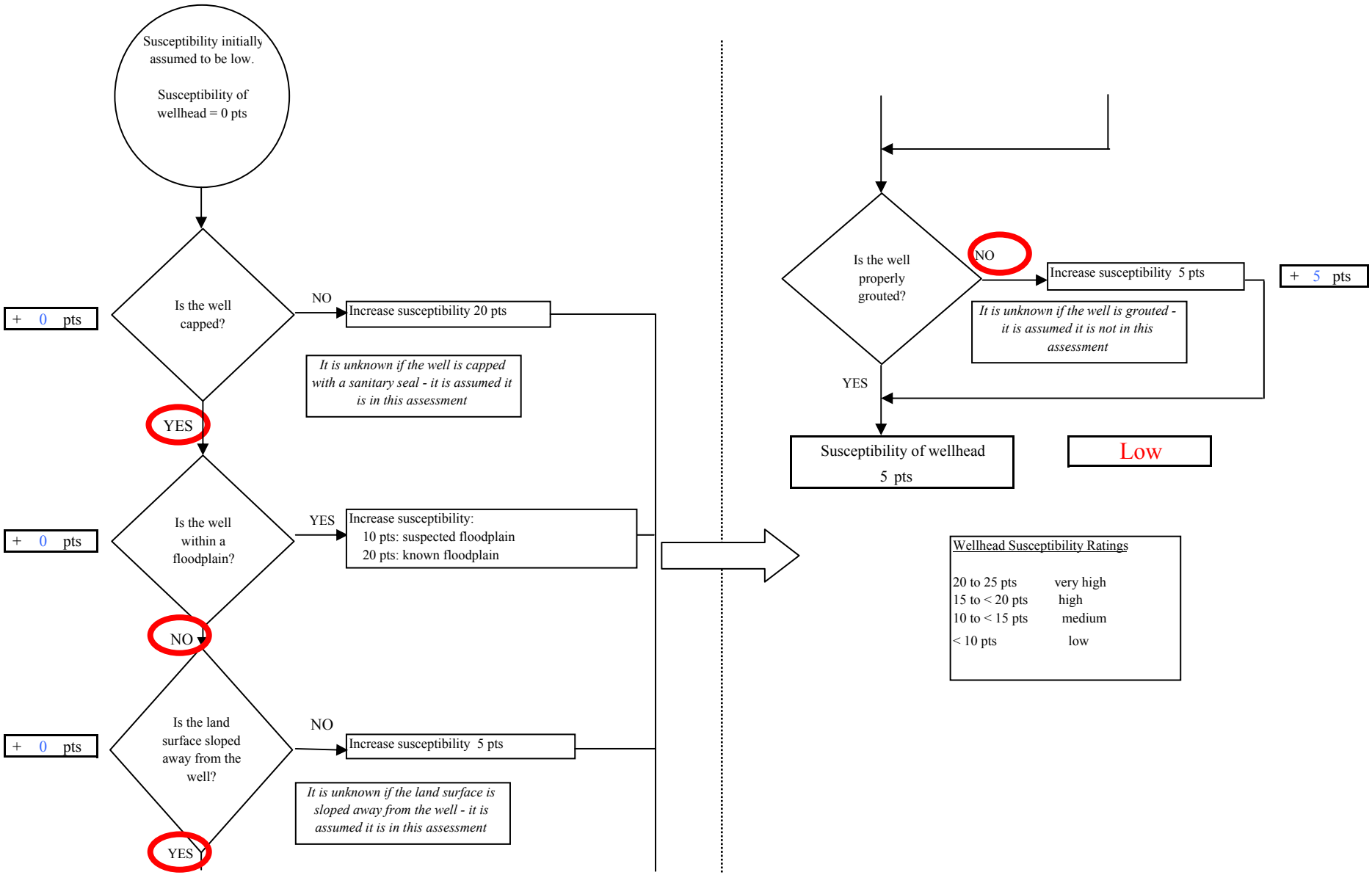


Chart 2. Susceptibility of the aquifer - Ft. Wainwright well 4023

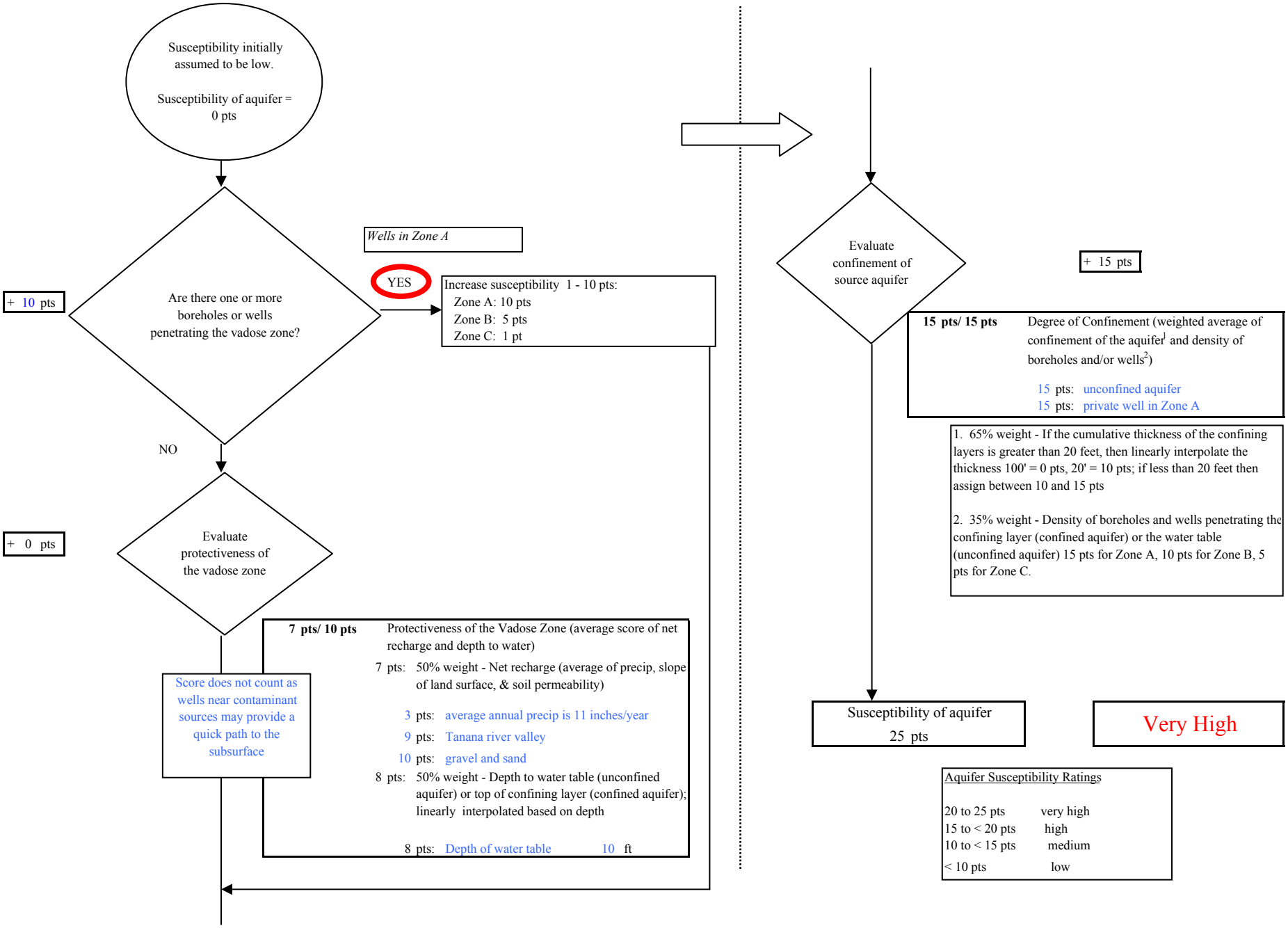
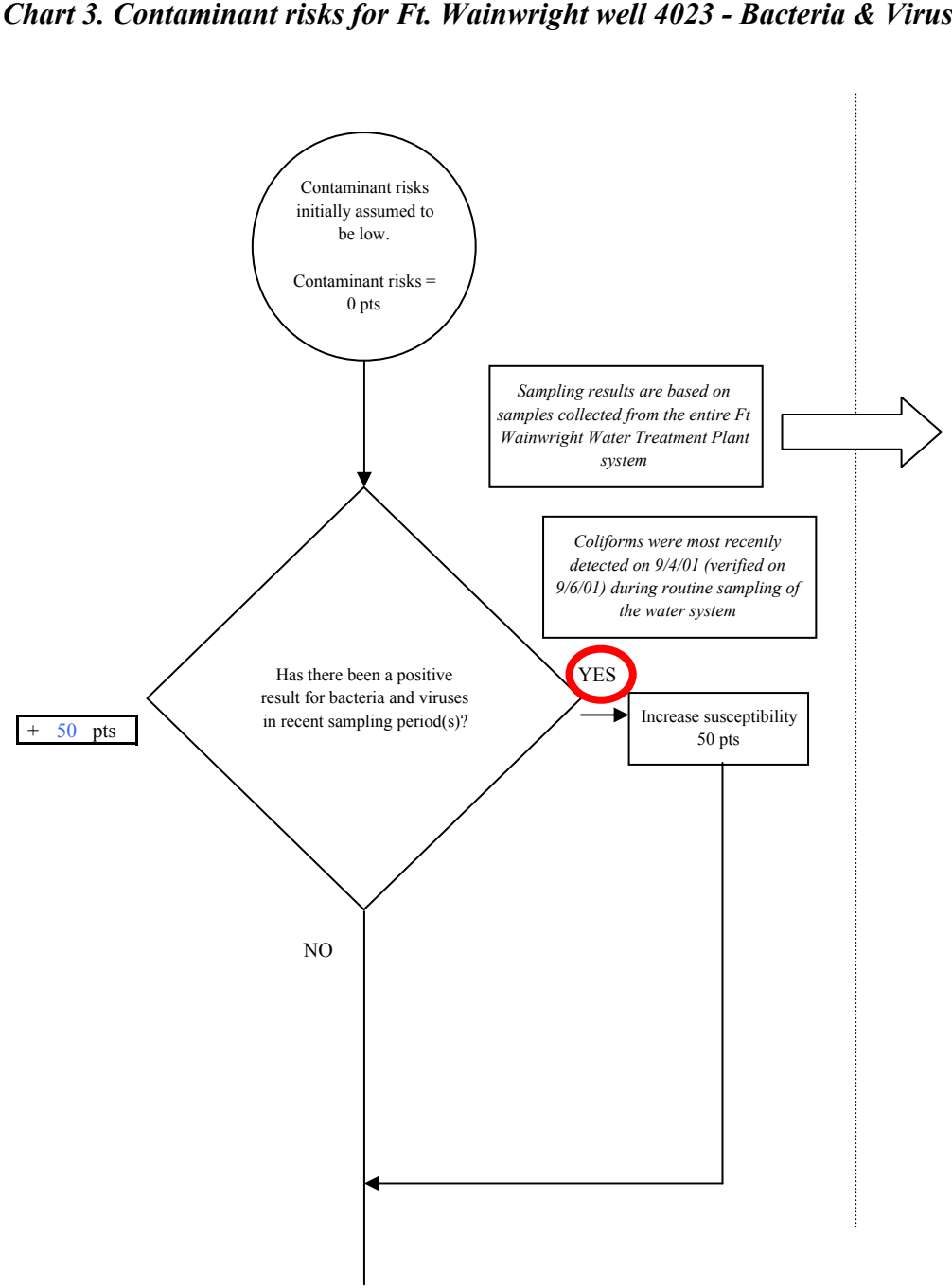
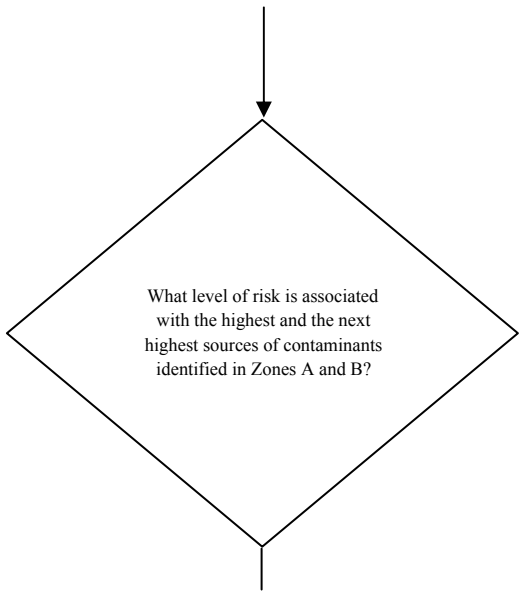


Chart 3. Contaminant risks for Ft. Wainwright well 4023 - Bacteria & Viruses





+ 20 pts

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	1	1
Low(s)	1	5	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 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 Ft. Wainwright well 4023 - Bacteria & Viruses

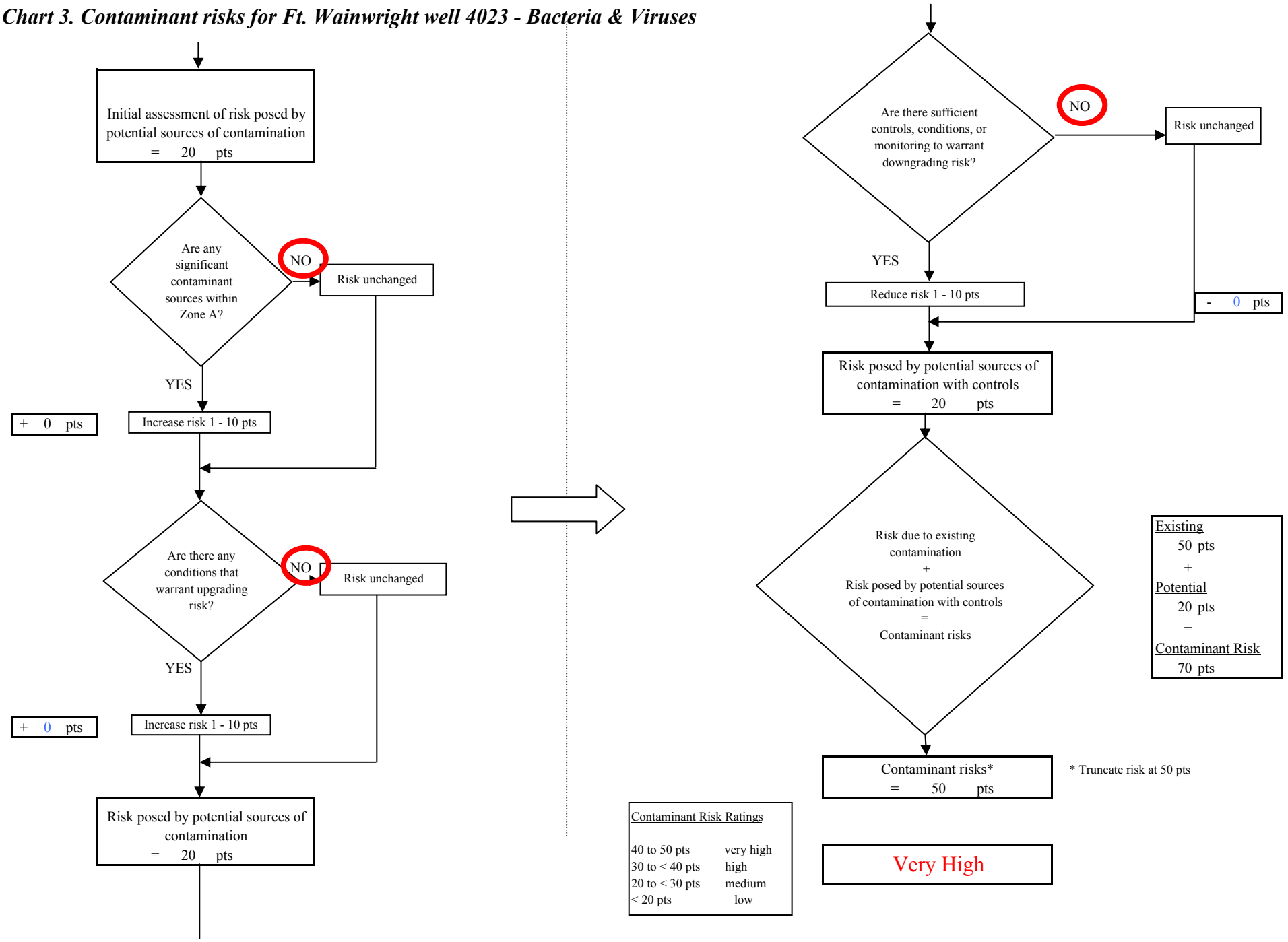


Chart 4. Vulnerability analysis for Ft. Wainwright well 4023 - Bacteria & Viruses

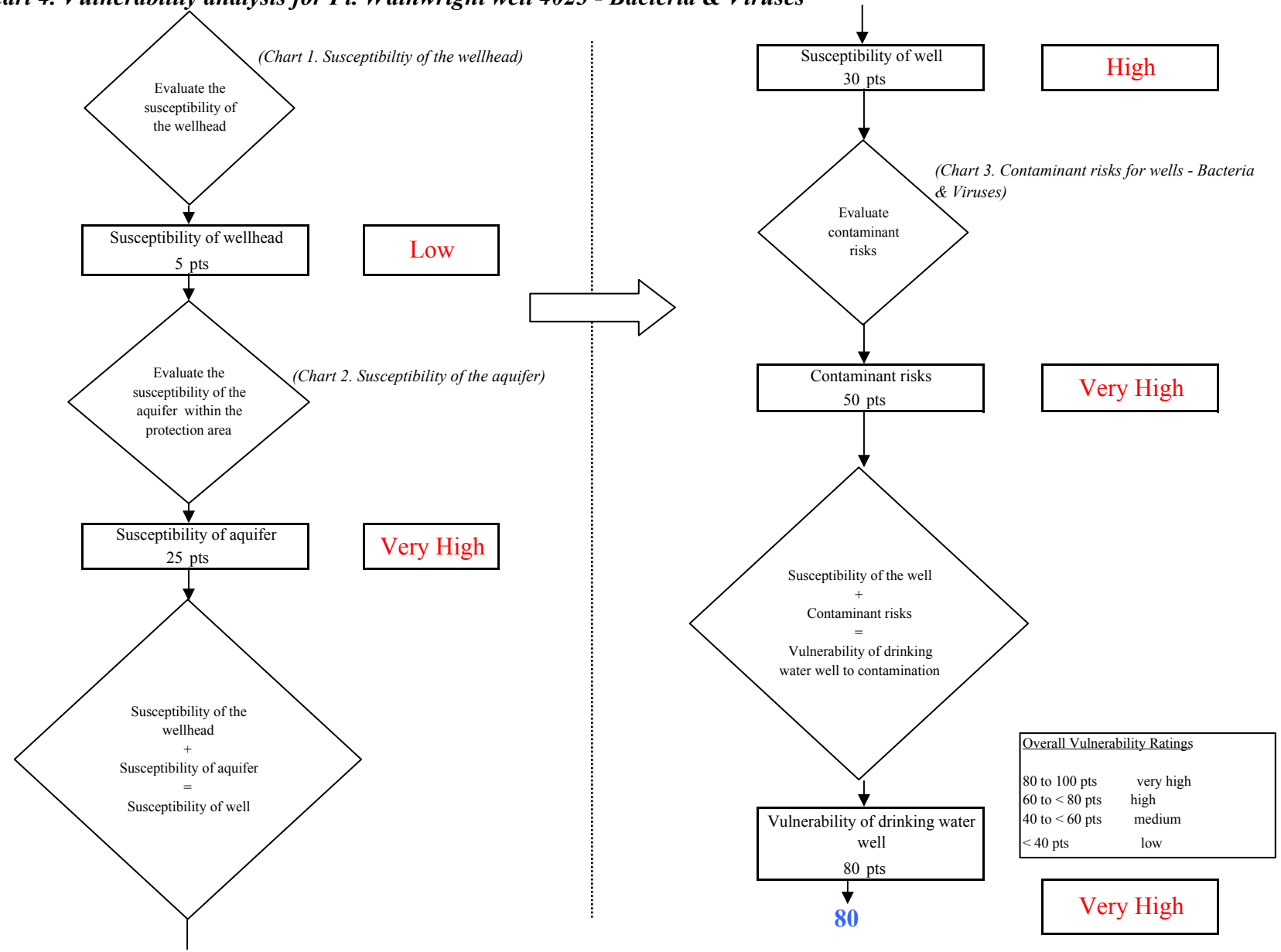


Chart 5. Contaminant risks for Ft. Wainwright well 4023 - Nitrates and Nitrites

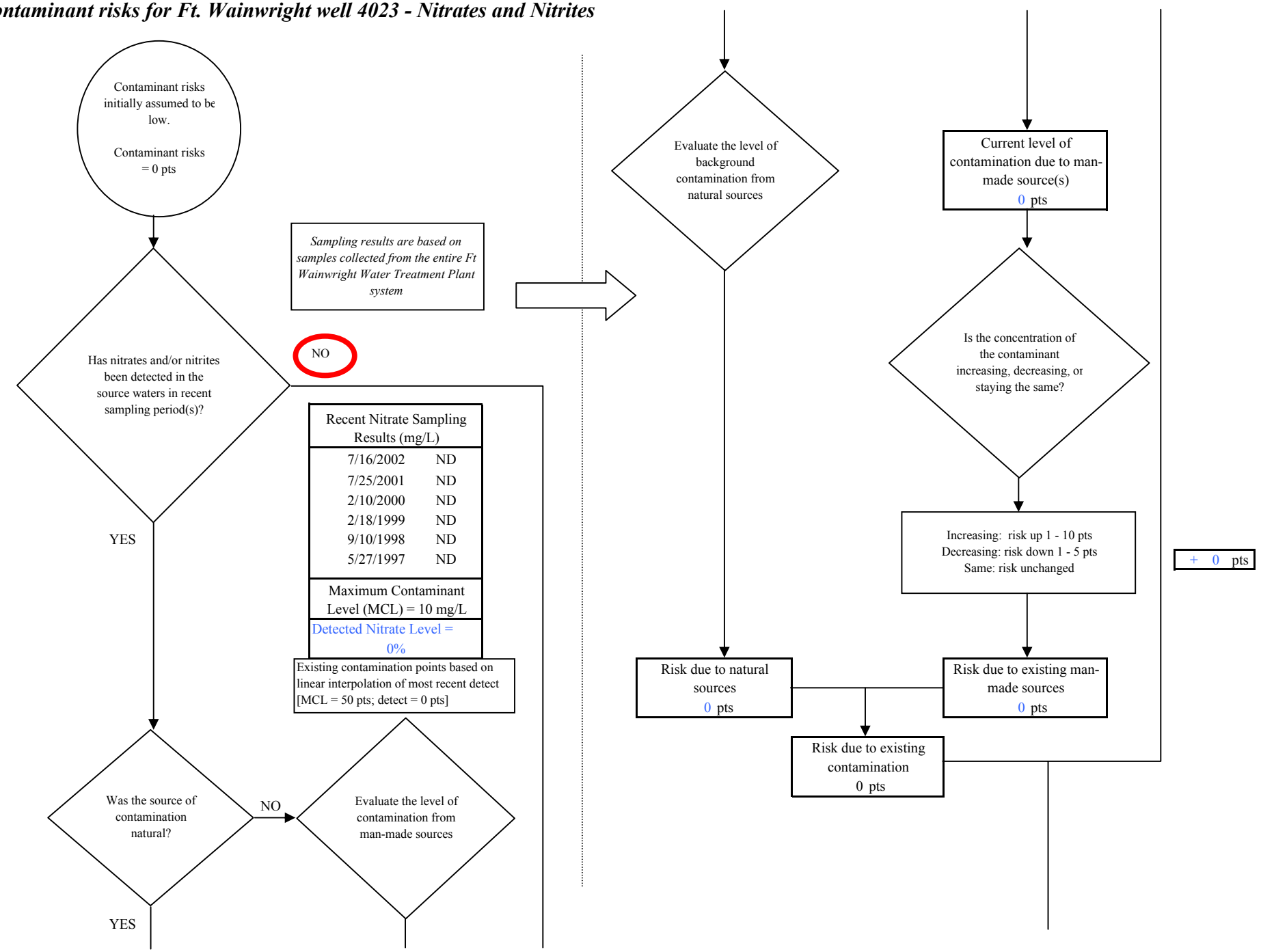


Chart 5. Contaminant risks for Ft. Wainwright well 4023 - Nitrates and Nitrites

+ 20 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)	0	1	1
Low(s)	1	5	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 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.

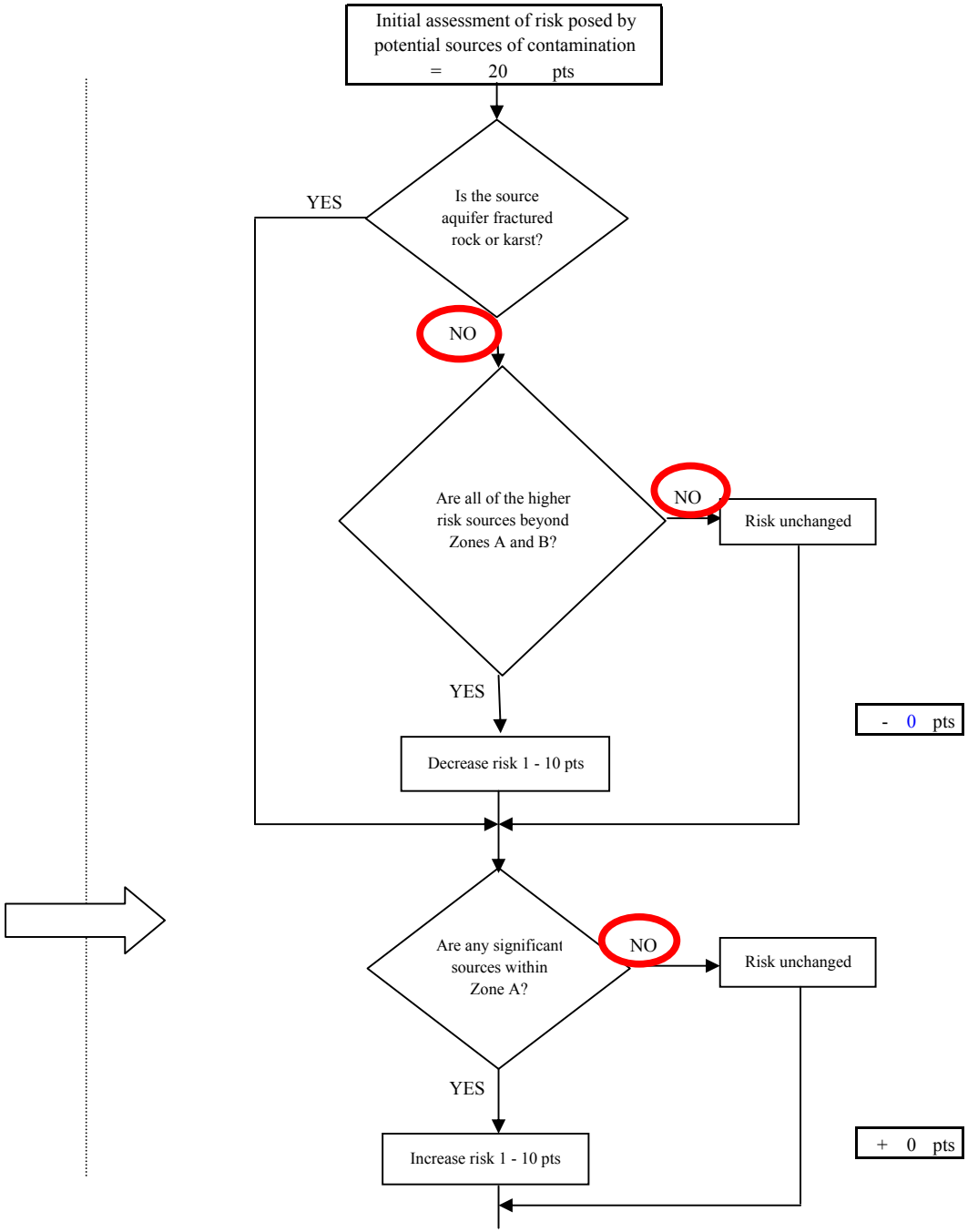
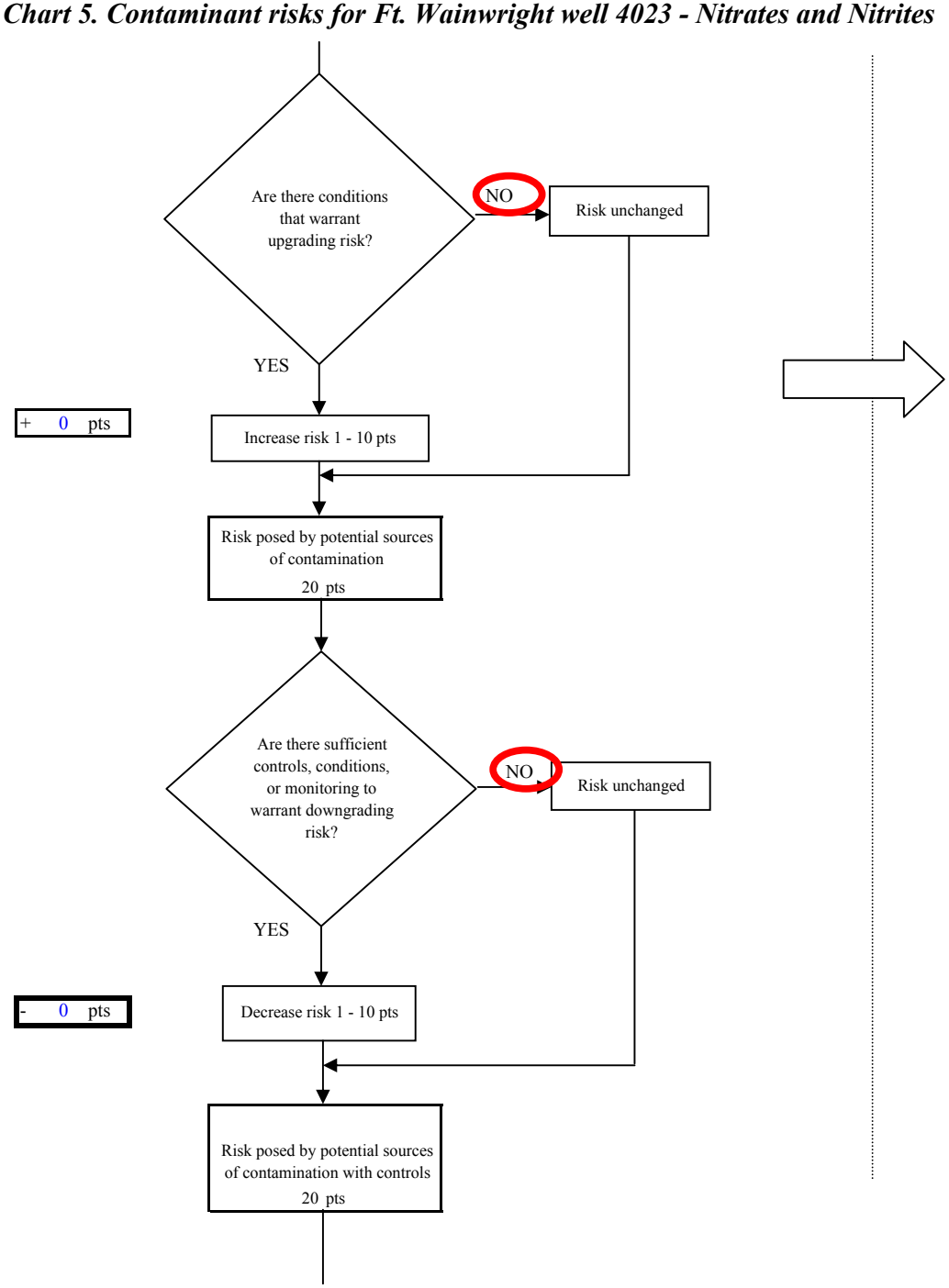


Chart 5. Contaminant risks for Ft. Wainwright well 4023 - Nitrates and Nitrites



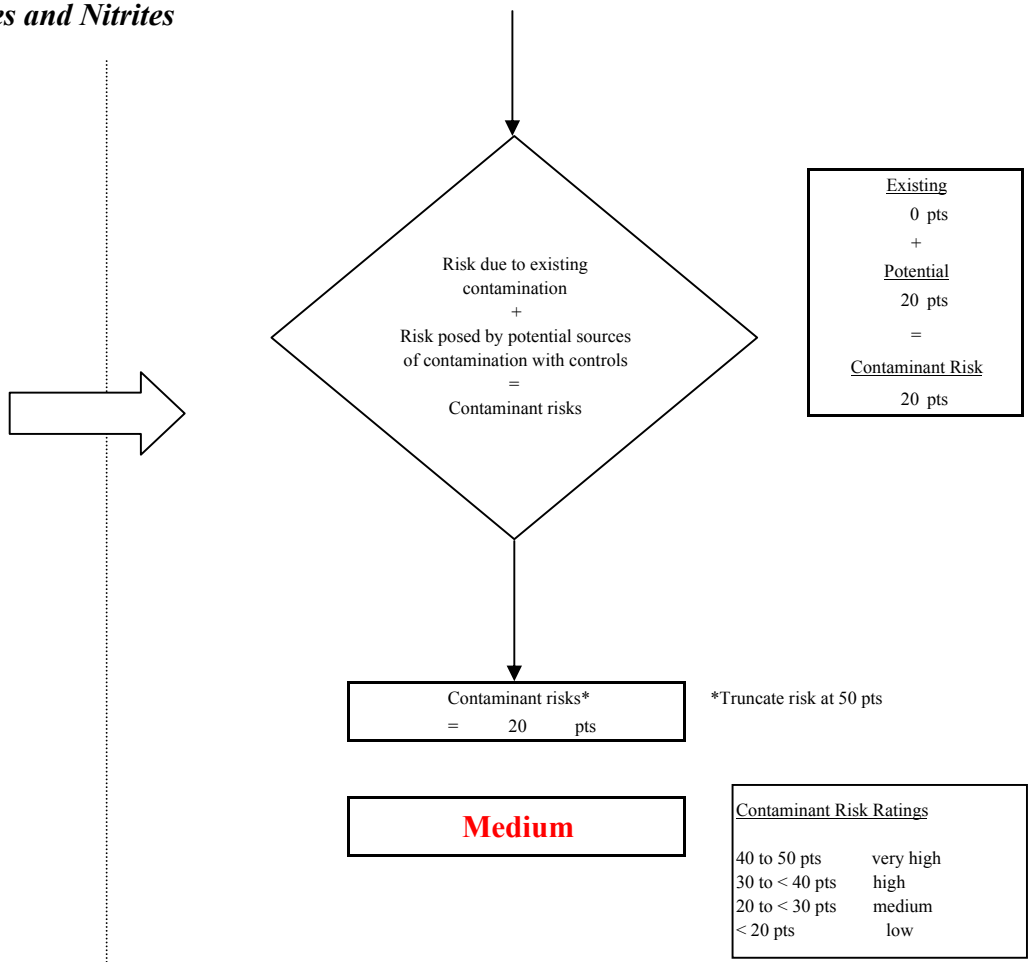


Chart 6. Vulnerability analysis for Ft. Wainwright well 4023 - Nitrates and Nitrites

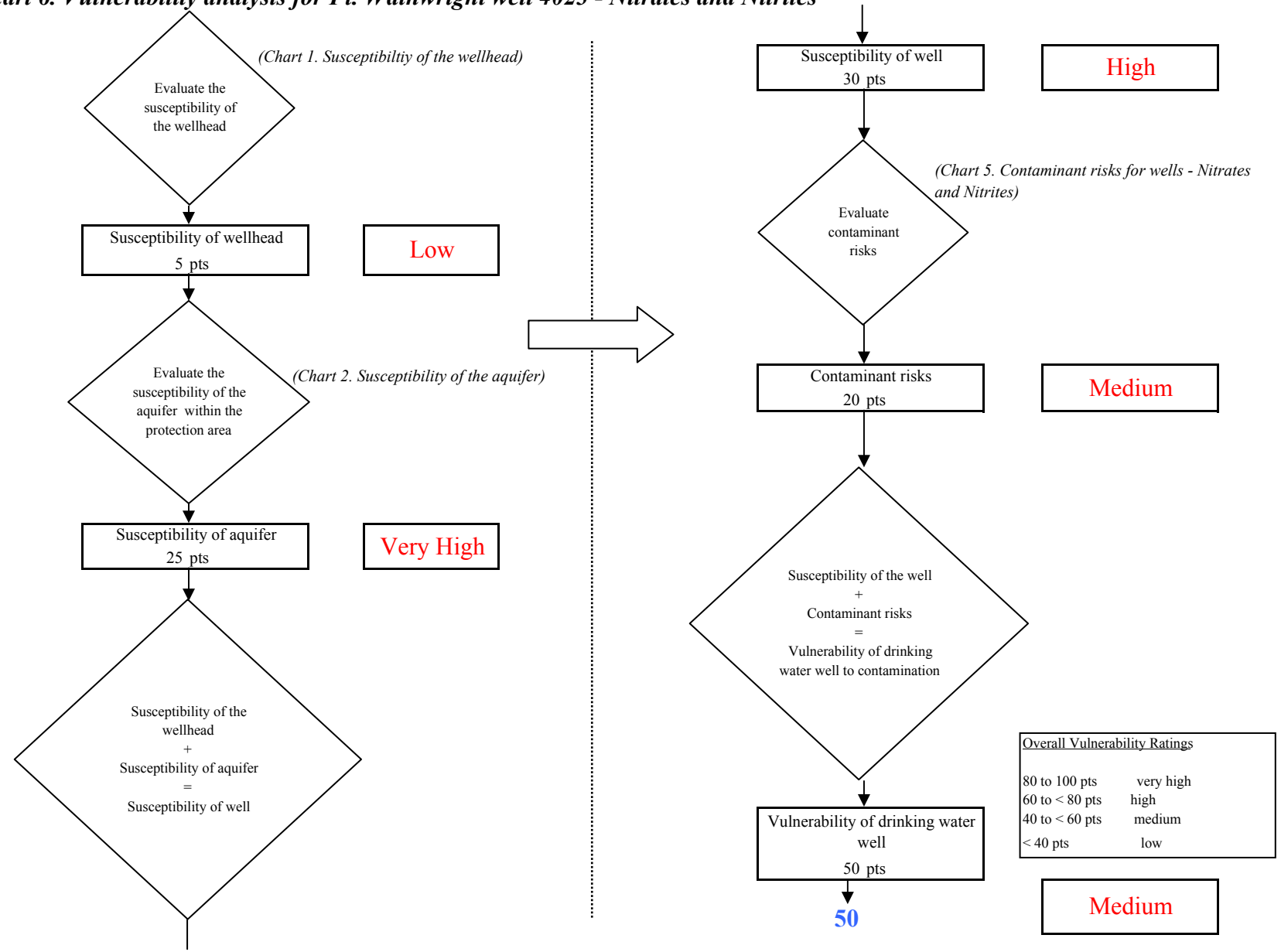


Chart 7. Contaminant risks for Ft. Wainwright well 4023 - Volatile Organic Chemicals

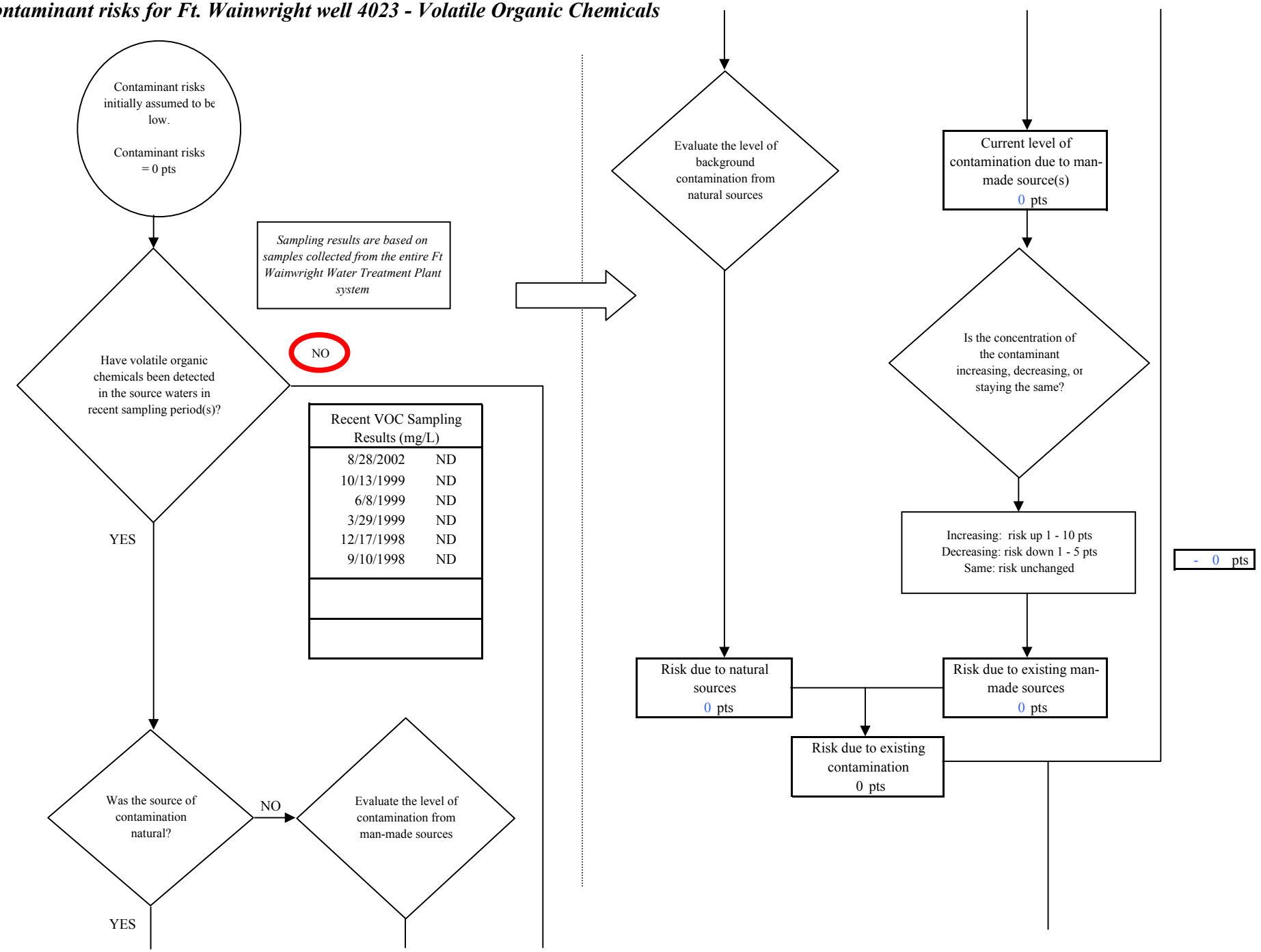


Chart 7. Contaminant risks for Ft. Wainwright well 4023 - Volatile Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	3	3
Medium(s)	0	3	3
Low(s)	1	9	10

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

Matrix Score 40

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

Initial assessment of risk posed by potential sources of contamination = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 7. Contaminant risks for Ft. Wainwright well 4023 - Volatile Organic Chemicals

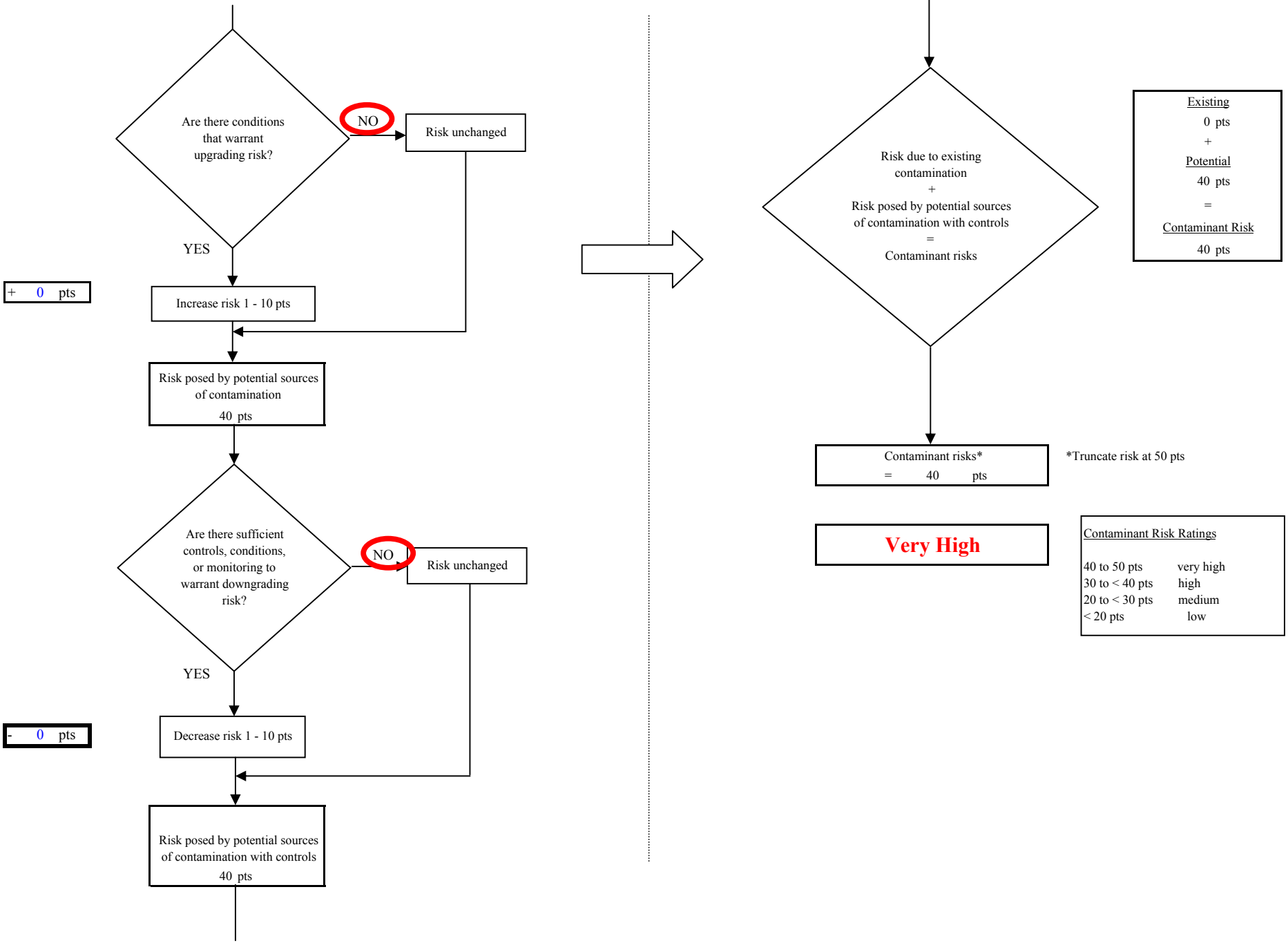


Chart 8. Vulnerability analysis for Ft. Wainwright well 4023 - Volatile Organic Chemicals

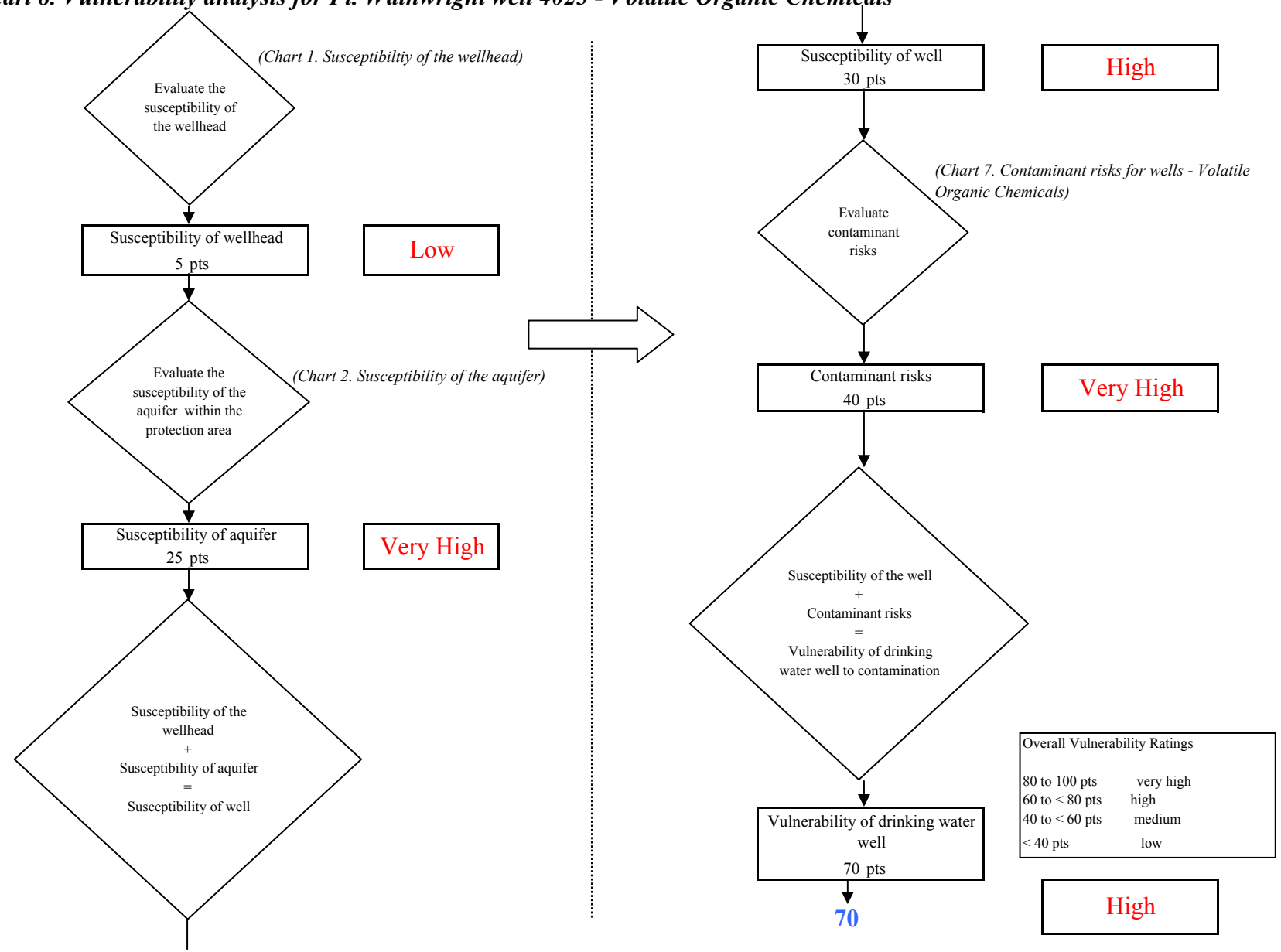


Chart 9. Contaminant risks for Ft. Wainwright well 4023 - Heavy Metals, Cyanide and Other Inorganic Chemicals

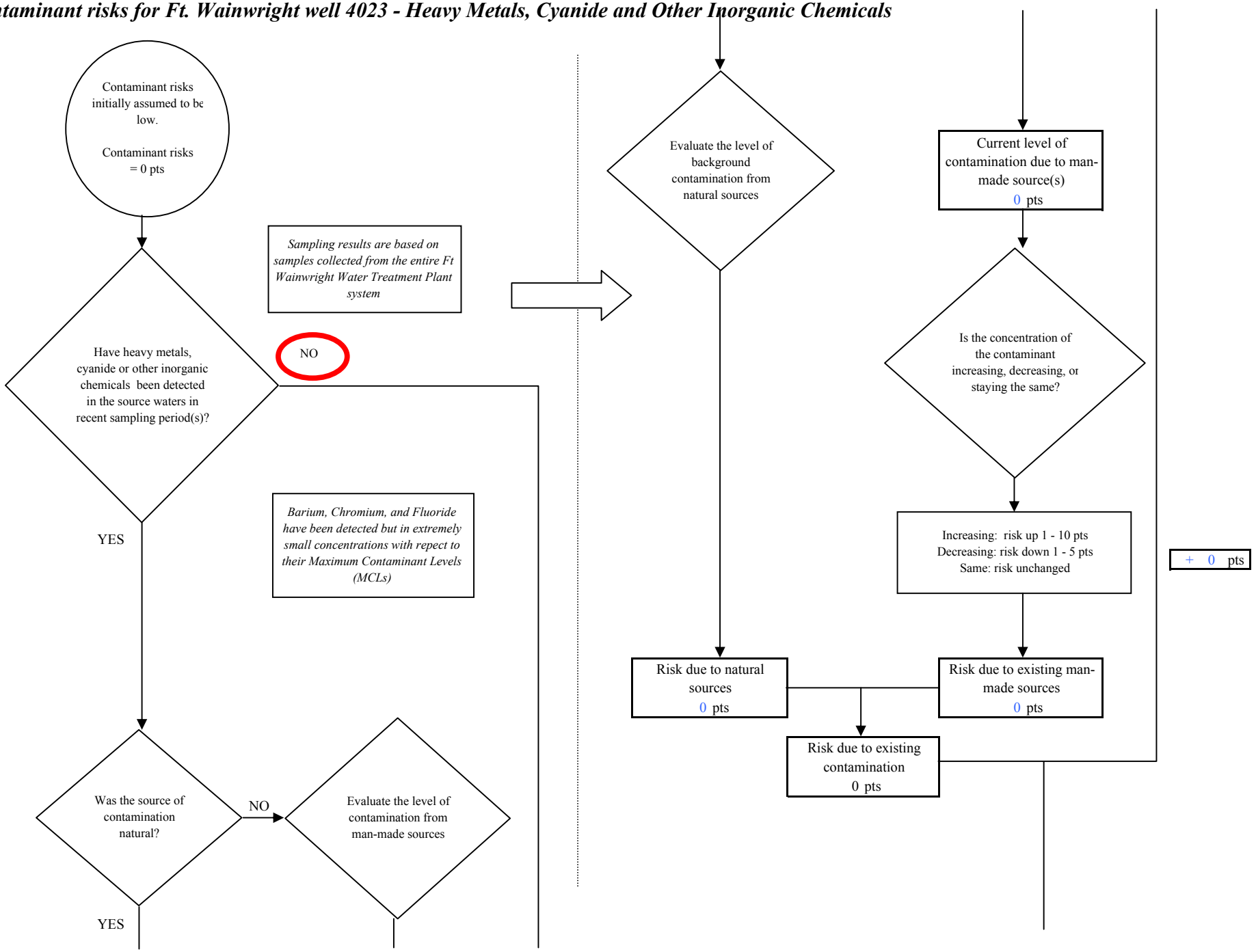


Chart 9. Contaminant risks for Ft. Wainwright well 4023 - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	3	3
Medium(s)	0	2	2
Low(s)	1	7	8

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

Matrix Score 40

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

Initial assessment of risk posed by potential sources of contamination = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 9. Contaminant risks for Ft. Wainwright well 4023 - Heavy Metals, Cyanide and Other Inorganic Chemicals

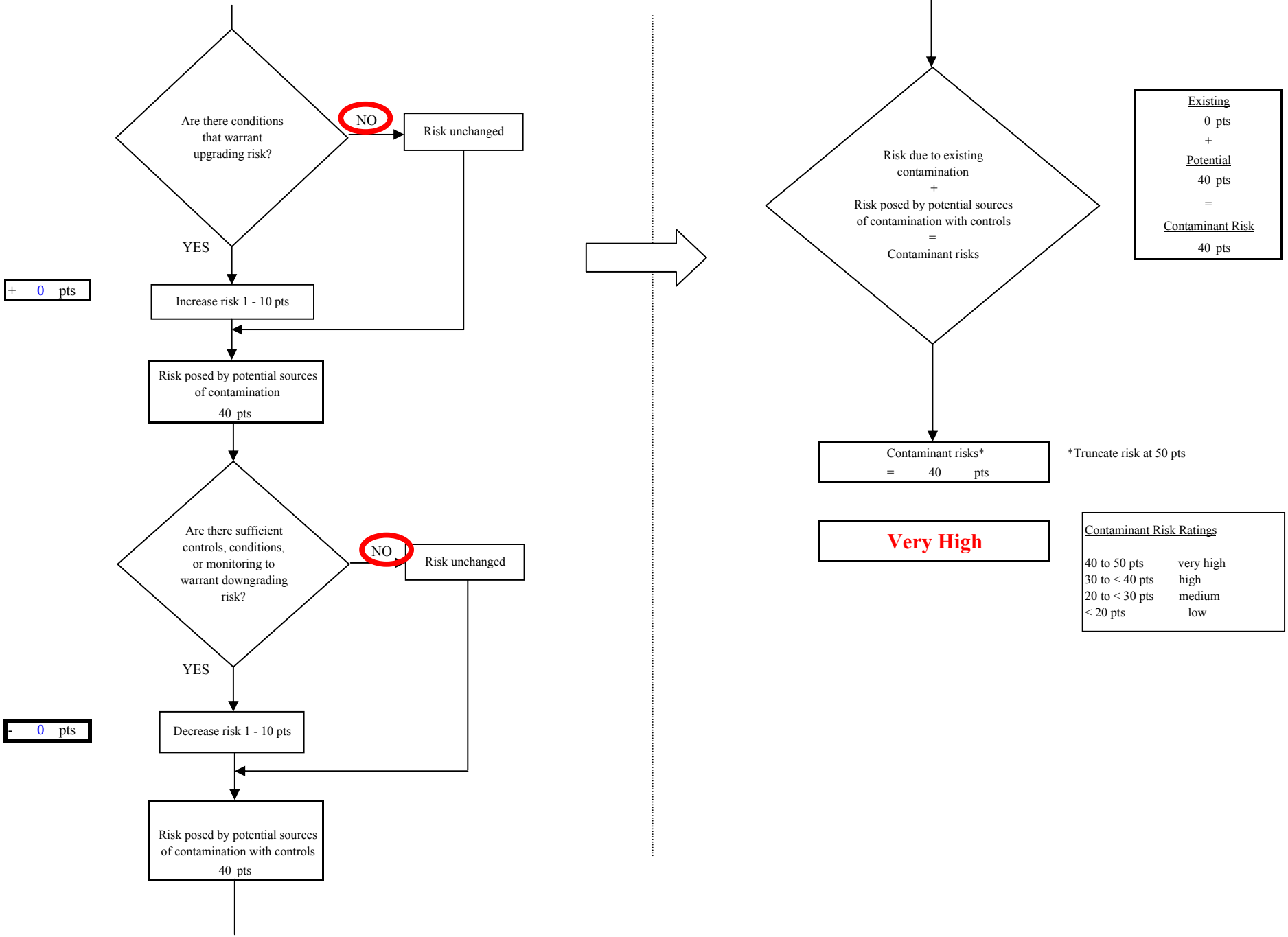


Chart 10. Vulnerability analysis for Ft. Wainwright well 4023 - Heavy Metals, Cyanide and Other Inorganic Chemicals

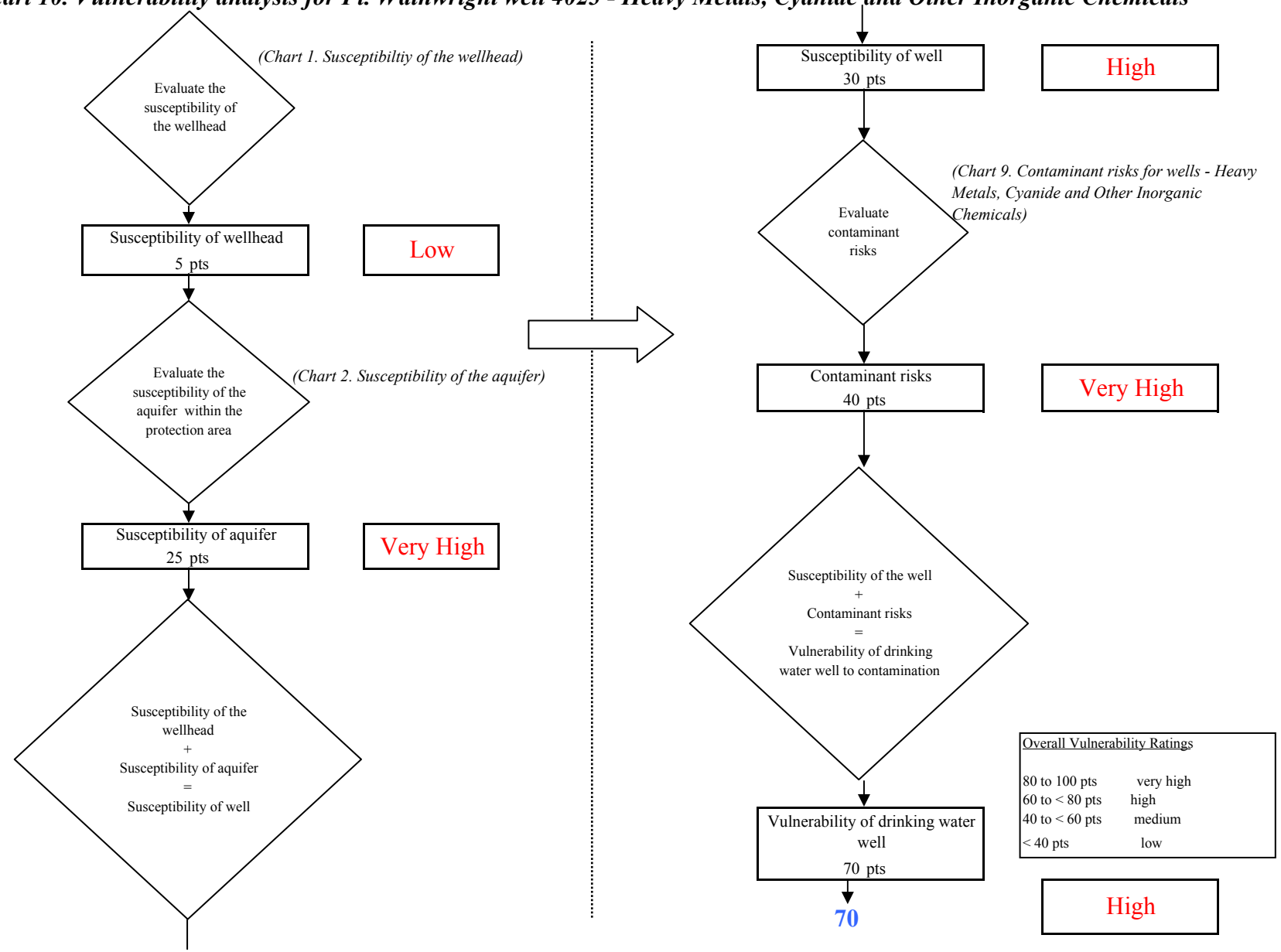


Chart 11. Contaminant risks for Ft. Wainwright well 4023 - Synthetic Organic Chemicals

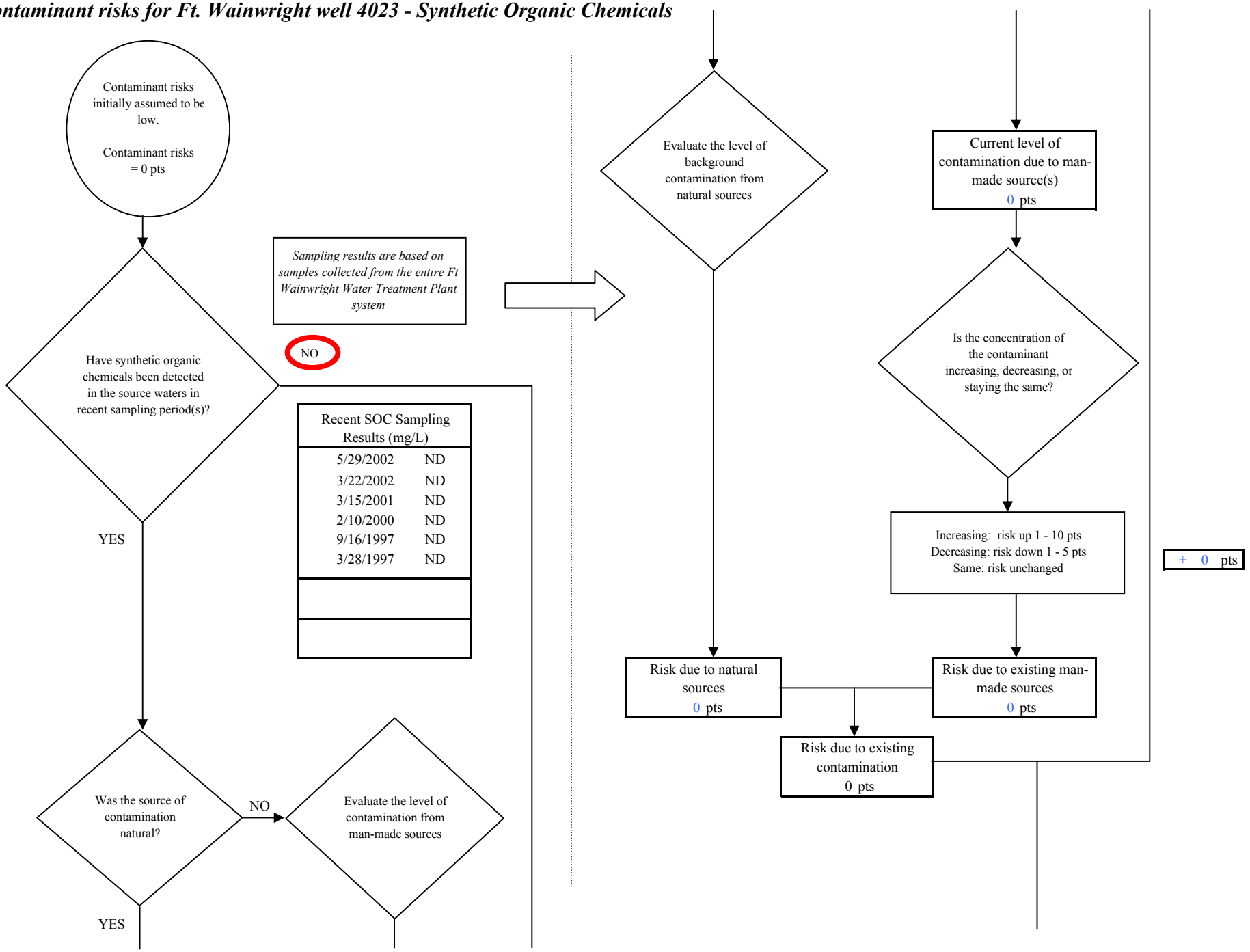


Chart 11. Contaminant risks for Ft. Wainwright well 4023 - Synthetic Organic Chemicals

+ 10 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, 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)	0	0	0
Low(s)	0	6	6

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

Matrix Score 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.

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 11. Contaminant risks for Ft. Wainwright well 4023 - Synthetic Organic Chemicals

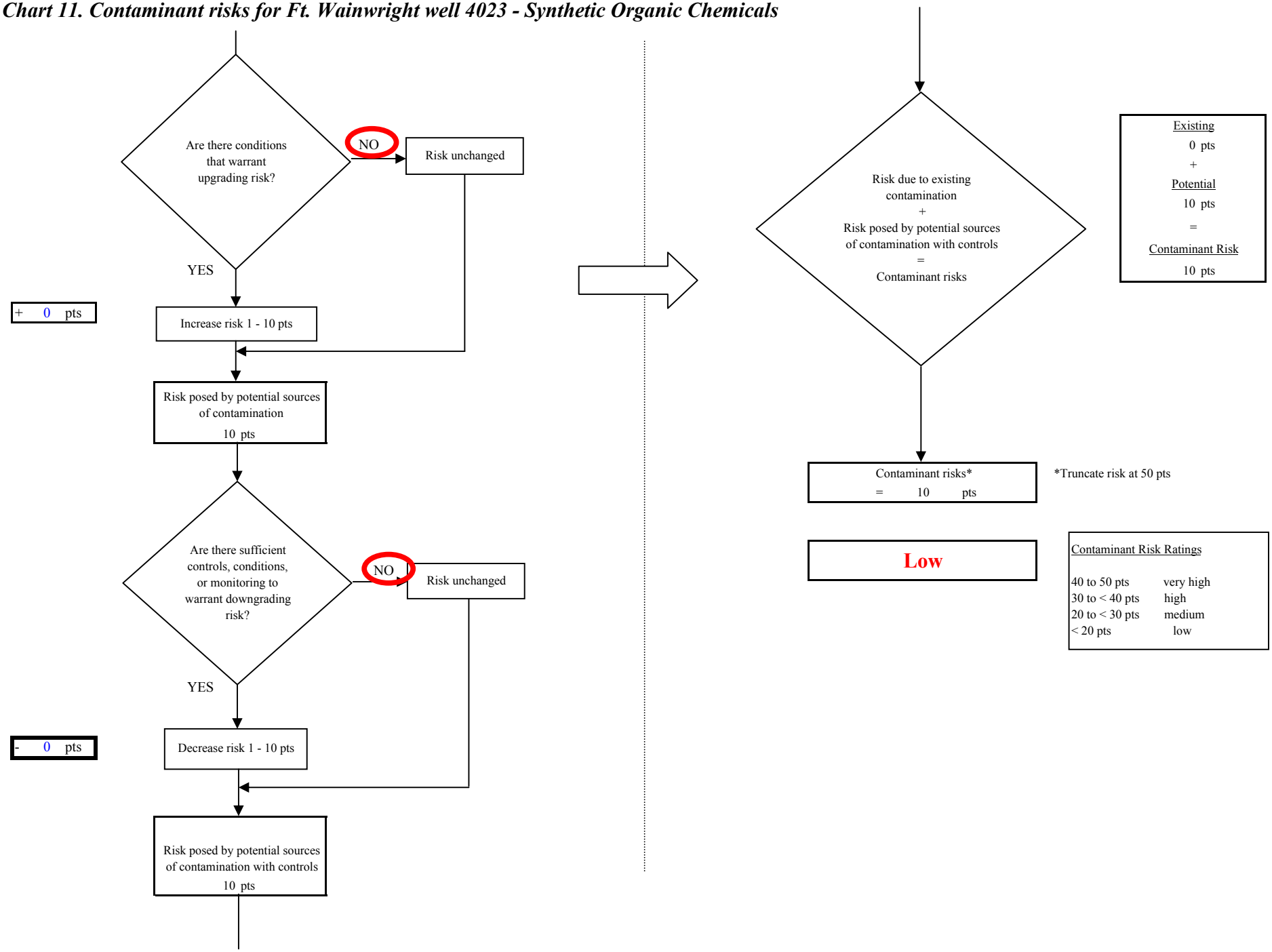


Chart 12. Vulnerability analysis for Ft. Wainwright well 4023 - Synthetic Organic Chemicals

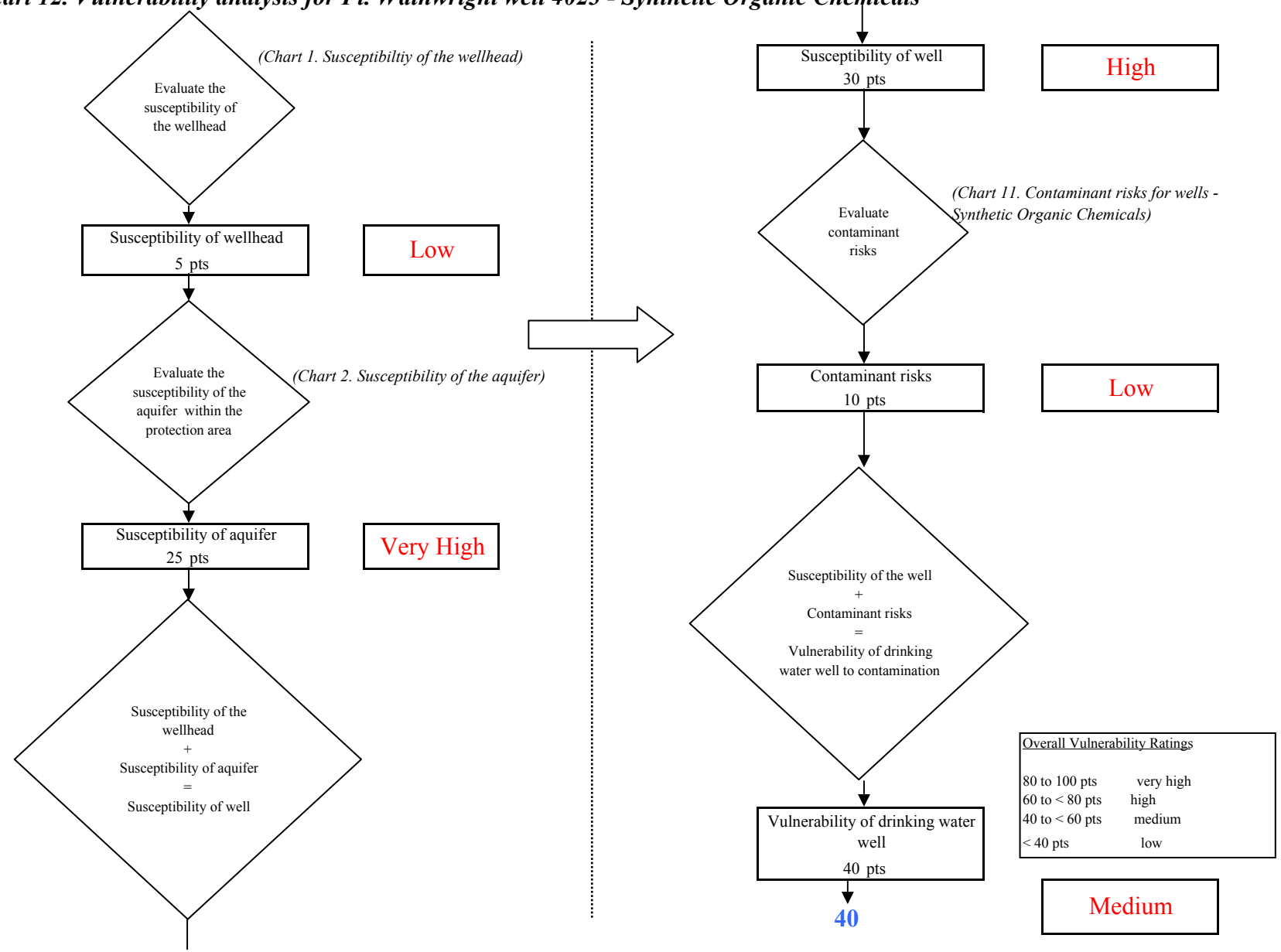


Chart 13. Contaminant risks for Ft. Wainwright well 4023 - Other Organic Chemicals

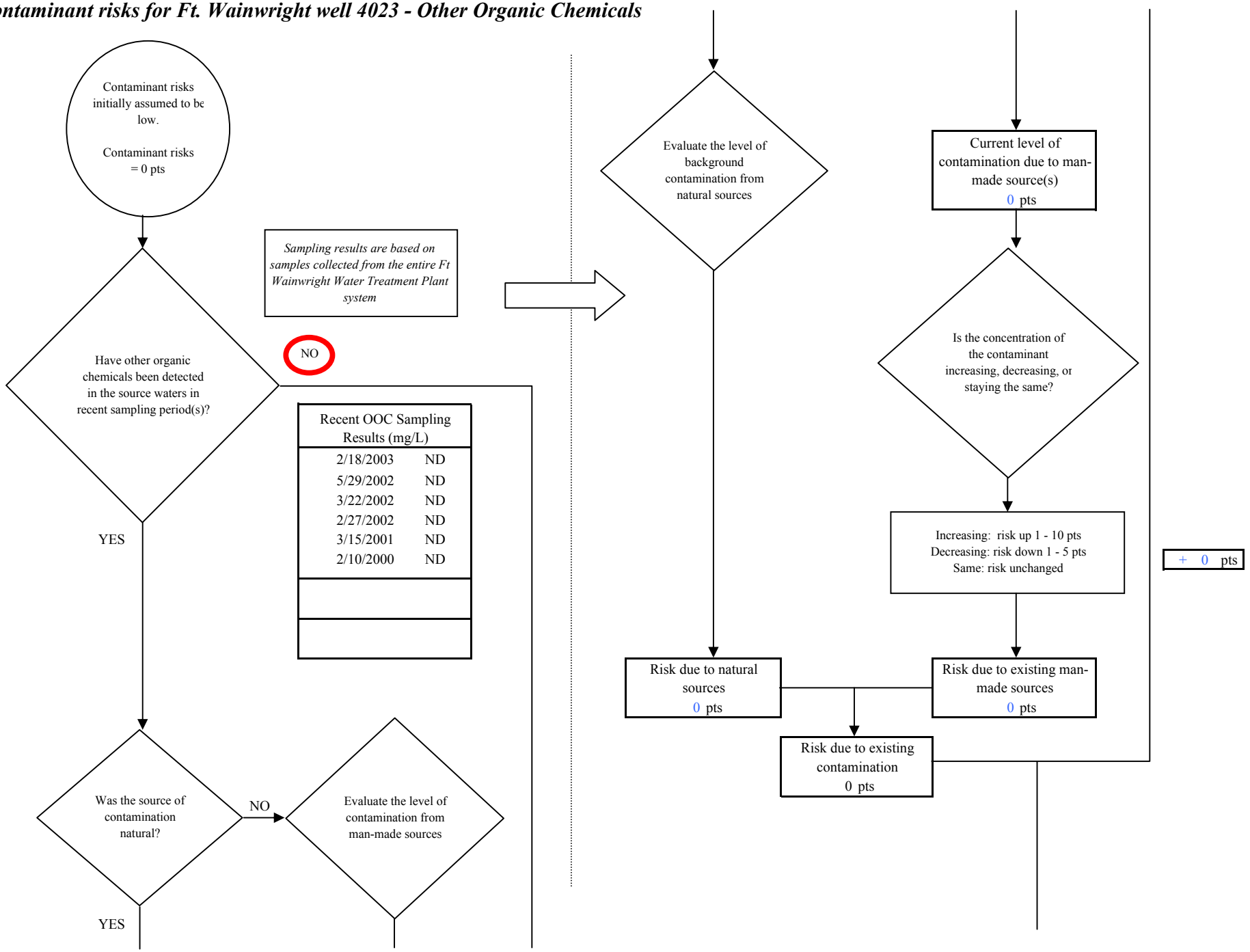


Chart 13. Contaminant risks for Ft. Wainwright well 4023 - Other Organic Chemicals

+ 30 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	1	1
Medium(s)	0	4	4
Low(s)	1	7	8

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

Matrix Score 30

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

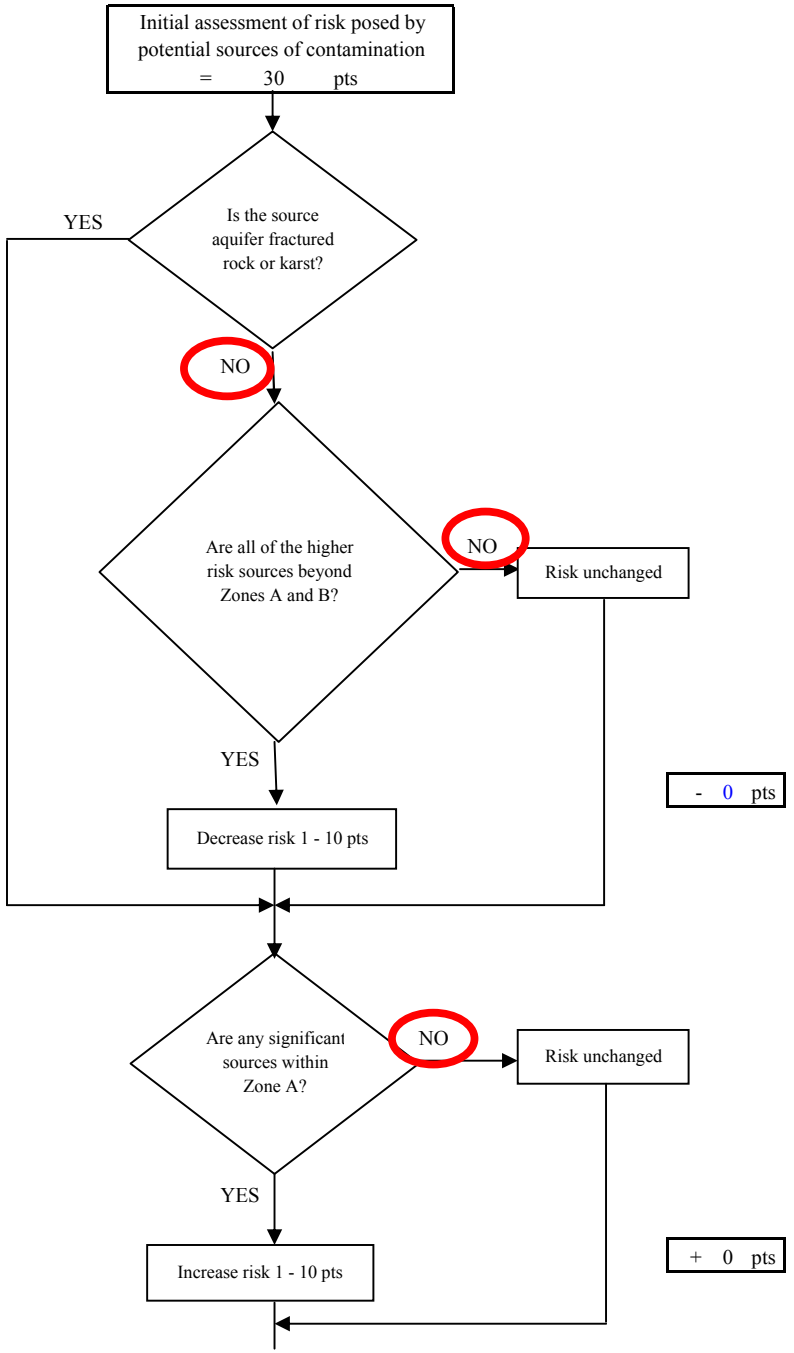


Chart 13. Contaminant risks for Ft. Wainwright well 4023 - Other Organic Chemicals

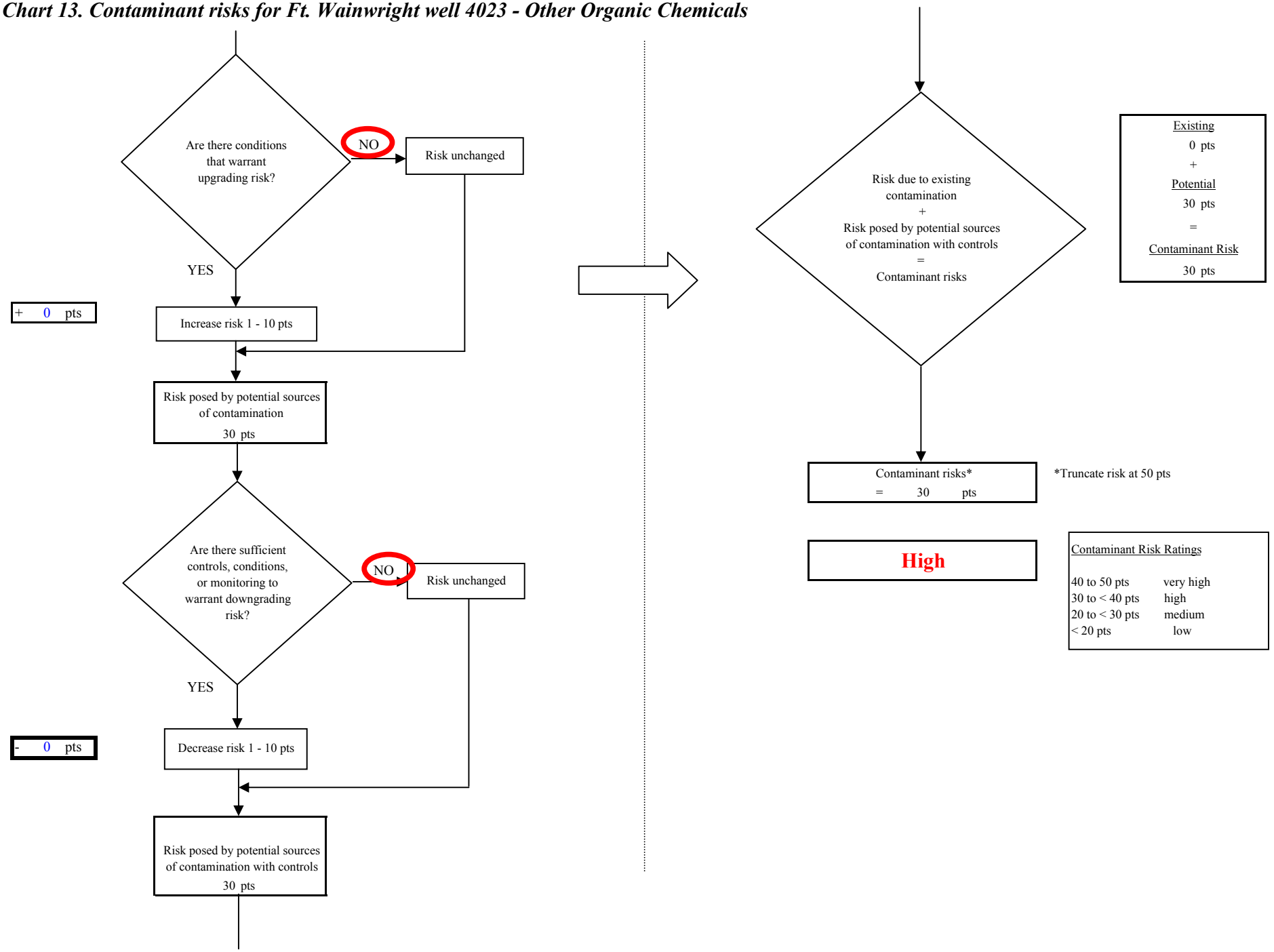


Chart 14. Vulnerability analysis for Ft. Wainwright well 4023 - Other Organic Chemicals