Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Federal Aviation Administration King Salmon Family Housing Drinking Water System, King Salmon, Alaska

PWSID # 263014.001

August 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1070
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 Federal Aviation Administration King Salmon Family Housing Source of Public Drinking Water, King Salmon, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Federal Aviation Administration King Salmon Family Housing has one Public Water System (PWS) well. The well (PWS No. 263014.001) has been used as a drinking water source since it was drilled in 1996.

The well is a Class A (community and non-transient non-community) water system located near the King Salmon Airport at the King Salmon FAA station in King Salmon, Alaska. Available records indicate that there is secondary storage of drinking water, with a capacity of 88,000-gallons, and that the untreated drinking water source is derived directly from the wellhead. This system operates year-round and serves approximately 244 residents through 34 service connections. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produce a **Low** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: above ground heating oil tanks, an airport, roads, domestic wastewater collection systems, large-capacity septic systems, landfills, DEC recognized contaminated sites, an open leaking underground fuel storage tank (LUST) site, abandoned and monitoring wells, electric power generation, and electric power generation. 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 contaminant categories.

Overall, the water well received a vulnerability rating of **Low** for bacteria and viruses; a vulnerability rating of **Medium** for nitrates and nitrites, and synthetic organic chemicals; and a vulnerability rating of **High** for volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, and other organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The FAA King Salmon Family Housing well is a Class A (community/non-transient/non-community) public water system. The system is located at #52 Beluga Drive in King Salmon, Alaska (Sec. 23, T017S, R045W, Seward Meridian; see Map A of Appendix A). King Salmon is located on the north bank of the Naknek River near Bristol Bay. The community is located about 15 miles upriver from Naknek and 280 miles southwest of Anchorage. The community has a population of 385 (ADCED, 2003). Average annual precipitation in King Salmon is 20 inches, including approximately 45 inches of snowfall. Temperatures range from 42 to 63°F in summer and 29 to 44°F in winter. Temperatures can be as extreme as -46 to 88°F.

The community of King Salmon gets most of their water supply from individual wells. Most households are served by the piped sewage collection system and the remaining households have individual septic tanks (ADCED, 2003). King Salmon receives electrical power from the Naknek Electric Association operated by the REA Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by the Peterson Sanitation Company and trucked to the landfill located at mile five of King Salmon-Naknek Road (ADCED, 2003).

According to information supplied by ADEC for the FAA King Salmon Family Housing PWS, the depth of the primary water well is 140 feet below the ground surface and is screened in a confined aquifer based on available construction details. The well is not located within a floodplain.

A sanitary survey was not available for this PWSID, therefore, it is unknown if the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. Information obtained from the well construction log indicates that the well is grouted according to ADEC regulations. Proper grouting provides added

protection against contaminants traveling along the well casing annulus and into source waters.

The entire Bristol Bay area was formerly covered by glaciers and the topography is representative of a postglacial area. Soils information is limited. Generally, the soils consist of silty sand overlying relatively clean sand. The silty soils are slightly frost-susceptible. Isolated pockets of permafrost are scattered throughout the area (DOWL, 1982).

DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the drinking water protection area (DWPA). Because releases of contaminants within the protection area are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts. An analytical calculation was used to determine the size and shape of the DWPA for the FAA King Salmon Family Housing PWS. The input parameters describing the attributes of the aquifer in this calculation were adopted from Groundwater (Freeze and Cherry, 1979). Available geology and groundwater contours were also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

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 (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

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

The DWPA for the FAA King Salmon Family Housing PWS was determined using an analytical calculation and includes Zones A, B, C, and D (See Map A 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 FAA King Salmon Family Housing DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class 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 C 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 4 in Appendix B 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:

- 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. 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, 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 FAA King Salmon Family Housing's water well is in a confined aquifer. Confined aquifers are less susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the susceptibility scores and ratings for this PWS.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	10	Medium
Natural Susceptibility	15	Low

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	12	Low
Nitrates and/or Nitrites	41	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	44	Very High
Other Organic Chemicals	50	Very High

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

Again, rankings are assigned according to a point score:

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

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the 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	25	Low
Nitrates and Nitrites	55	Medium
Volatile Organic Chemicals	65	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	65	High
Synthetic Organic Chemicals	55	Medium
Other Organic Chemicals	65	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Low**. The risk is primarily attributed to the presence of roads in Zones A and B (see Table 2 – Appendix B).

No positive bacteria counts have been reported in recent (within five years) sampling events (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.

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 **Low**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High**. The risk to this source of public drinking water is primarily attributed to the presence of a large-capacity septic system and abandoned wells in Zone C (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that nitrates have not been detected in recent sampling events. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L; therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

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

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of an airport, diesel tanks, DEC recognized contaminated sites, abandoned wells, an open leaking underground fuel storage tank, and a petroleum product bulk station/terminal located in Zones A, C, and D. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

Detectable concentrations of toluene were reported in sampling events for this public water system. However, the detectible concentrations of toluene

reported in 1998, 2000, 2001, and 2002 were well below the MCL of 1.0 mg/L (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

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 contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Very High**. The risk is primarily attributed to the presence of abandoned wells in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, moderate levels of copper and lead have been detected, but have not exceeded their respective MCLs of 1.3 mg/L and 0.015 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentrations of copper and lead in recent sampling events are not likely to be representative of source water conditions. These two analytes are likely attributed to either the water treatment process or water distribution network; therefore, no risk points were assigned based on the presence of these analytes.

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 contaminant risk for synthetic organic chemicals is **Very High**. The risk is primarily attributed to the presence of abandoned wells in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the FAA King Salmon Family Housing (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

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 contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of a landfill and abandoned wells in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the FAA King Salmon Family Housing (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

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**.

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 FAA King Salmon Family Housing and the community of King Salmon 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.

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APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

APPENDIX B

Contaminant Source Inventory and Risk Ranking (Tables 1-7)

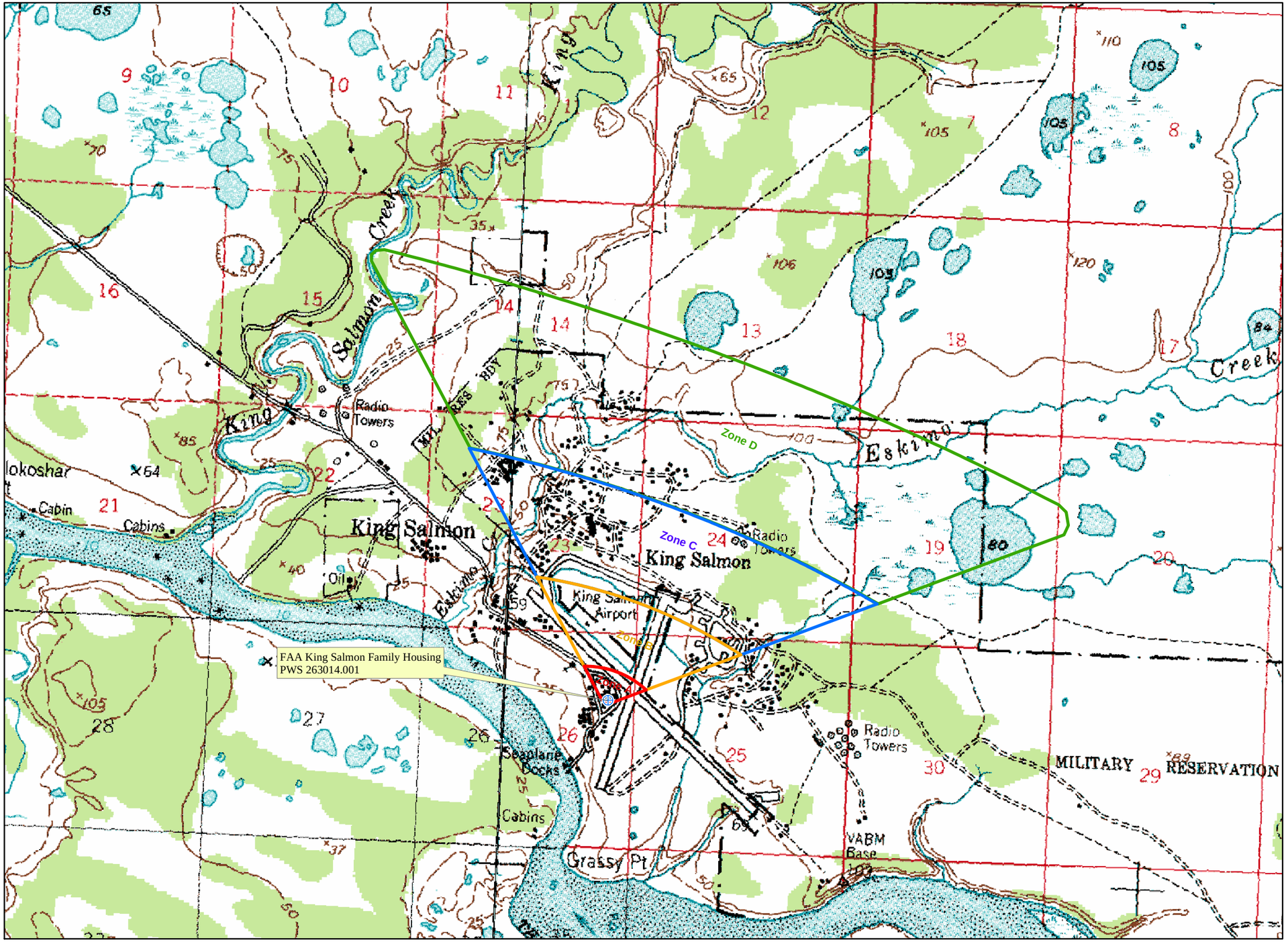
APPENDIX C

Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

APPENDIX D

Vulnerability Analysis for Public Drinking Water Source (Charts 1-14)

Public Water Well System for PWS #263014.001 FAA King Salmon Family Housing



LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

Groundwater Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time

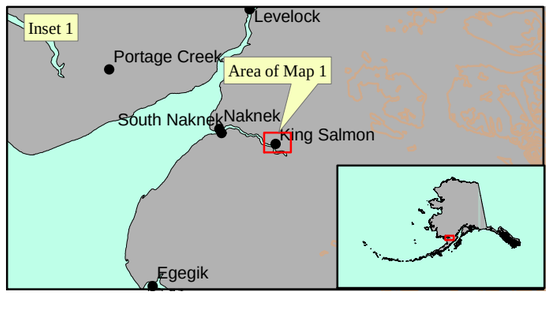
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
United States Geological Survey (USGS)

Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 0.25 0.5 1 1.5 2 Miles

FAA King Salmon East Housing
PWS 263014.001

Appendix A Map A

Table 1

Contaminant Source Inventory for

FAA King Salmon Family Housing

PWSID 263014.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 30 or less residential heating oil tanks in Zone A
Airports	X14	X14-01	A	C	
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-02	B	C	Assume 15 or less residential heating oil tanks in Zone B
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B
Motor /motor vehicle repair shops	C31	C31-01	C	C	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	C	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	C	C	
Landfills (industrial; type of industrial waste?)	D52	D52-01	C	C	
Tanks, diesel (underground)	T08	T08-01	C	C	King Salmon Airport
Tanks, diesel (underground)	T08	T08-02	C	C	King Salmon Airport
Tanks, diesel (underground)	T08	T08-03	C	C	King Salmon Airport
Tanks, diesel (underground)	T08	T08-04	C	C	King Salmon Airport
Tanks, gasoline (underground)	T12	T12-01	C	C	King Salmon Airport
Tanks, gasoline (underground)	T12	T12-02	C	C	King Salmon Airport
Tanks, gasoline (underground)	T12	T12-03	C	C	King Salmon Airport
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	C	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	C	C	King Salmon AS SS11, RecKey #198825X920204, Status: Active, Eskimo Creek Seeps 1 and 2: Contaminants of concern include DRO nad TCE. Placed in Zone C to be conservative as "source of seep is unidentified" (ADEC Contaminated Sites Database)
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	C	C	Releases of gasoline and diesel fuel were reported following a site assessment for the removal of 6 tanks

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Abandoned wells	W01	W01-01	C	C	USAF Chugach Support Services 10 or less abandoned wells in Zone C
Petroleum product bulk station/terminals	X11	X11-01	C	C	
Government vehicle maintenance facilities	X19	X19-01	C	C	
Highways and roads, dirt/gravel	X24	X24-03	C	C	Assume 1-20 roads in Zone C
Pipelines (oil and gas)	X28	X28-01	C	C	USAF Chugach
Electric power generation (fossil fuels)	X36	X36-01	C	C	USAF Chugach
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	D	D	King Salmon Air Station LF05; Reckey: 199025X904004; Status: Active; Estimated 500,000 barrels and other solid waste disposal site from the 1950's to 1970's
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	D	C	King Salmon Air Station LF14; Reckey: 199025X904003; Status: Active; Estimated 500,000 barrels and miscellaneous solid waste disposal area from the early 1940's to the mid-1960's
Monitoring wells	W06	W06-01	D	C	
Monitoring wells	W06	W06-02	D	C	
Monitoring wells	W06	W06-03	D	C	

Table 2

Contaminant Source Inventory and Risk Ranking for FAA King Salmon Family Housing Sources of Bacteria and Viruses

PWSID 263014.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 3

Contaminant Source Inventory and Risk Ranking for FAA King Salmon Family Housing Sources of Nitrates/Nitrites

PWSID 263014.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Airports	X14	X14-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	C	High	C	
Abandoned wells	W01	W01-01	C	High	C	USAF Chugach Support Services 10 or less abandoned wells in Zone C

Table 4

Contaminant Source Inventory and Risk Ranking for FAA King Salmon Family Housing Sources of Volatile Organic Chemicals

PWSID 263014.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 30 or less residential heating oil tanks in Zone A
Airports	X14	X14-01	A	High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-02	B	Medium	C	Assume 15 or less residential heating oil tanks in Zone B
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Tanks, diesel (underground)	T08	T08-01	C	High	C	King Salmon Airport
Tanks, diesel (underground)	T08	T08-02	C	High	C	King Salmon Airport
Tanks, diesel (underground)	T08	T08-03	C	High	C	King Salmon Airport
Tanks, diesel (underground)	T08	T08-04	C	High	C	King Salmon Airport
Tanks, gasoline (underground)	T12	T12-01	C	High	C	King Salmon Airport
Tanks, gasoline (underground)	T12	T12-02	C	High	C	King Salmon Airport
Tanks, gasoline (underground)	T12	T12-03	C	High	C	King Salmon Airport
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	C	High	C	King Salmon AS SS11, RecKey #198825X920204, Status: Active, Eskimo Creek Seeps 1 and 2: Contaminants of concern include DRO nad TCE. Placed in Zone C to be conservative as "source of seep is unidentified" (ADEC Contaminated Sites Database)
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	C	High	C	Releases of gasoline and diesel fuel were reported following a site assessment for the removal of 6 tanks
Abandoned wells	W01	W01-01	C	High	C	USAF Chugach Support Services 10 or less abandoned wells in Zone C
Petroleum product bulk station/terminals	X11	X11-01	C	Very High	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	D	High	D	King Salmon Air Station LF05; Reckey: 199025X904004; Status: Active; Estimated 500,000 barrels and other solid waste disposal site from the 1950's to 1970's

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	D	High	C	King Salmon Air Station LF14; Reckey: 199025X904003; Status: Active; Estimated 500,000 barrels and miscellaneous solid waste disposal area from the early 1940's to the mid-1960's

Table 5

Contaminant Source Inventory and Risk Ranking for FAA King Salmon Family Housing Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 263014.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Airports	X14	X14-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Abandoned wells	W01	W01-01	C	Very High	C	USAF Chugach Support Services 10 or less abandoned wells in Zone C

Table 6

Contaminant Source Inventory and Risk Ranking for FAA King Salmon Family Housing Sources of Synthetic Organic Chemicals

PWSID 263014.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Airports	X14	X14-01	A	Medium	C	
Abandoned wells	W01	W01-01	C	High	C	USAF Chugach Support Services 10 or less abandoned wells in Zone C

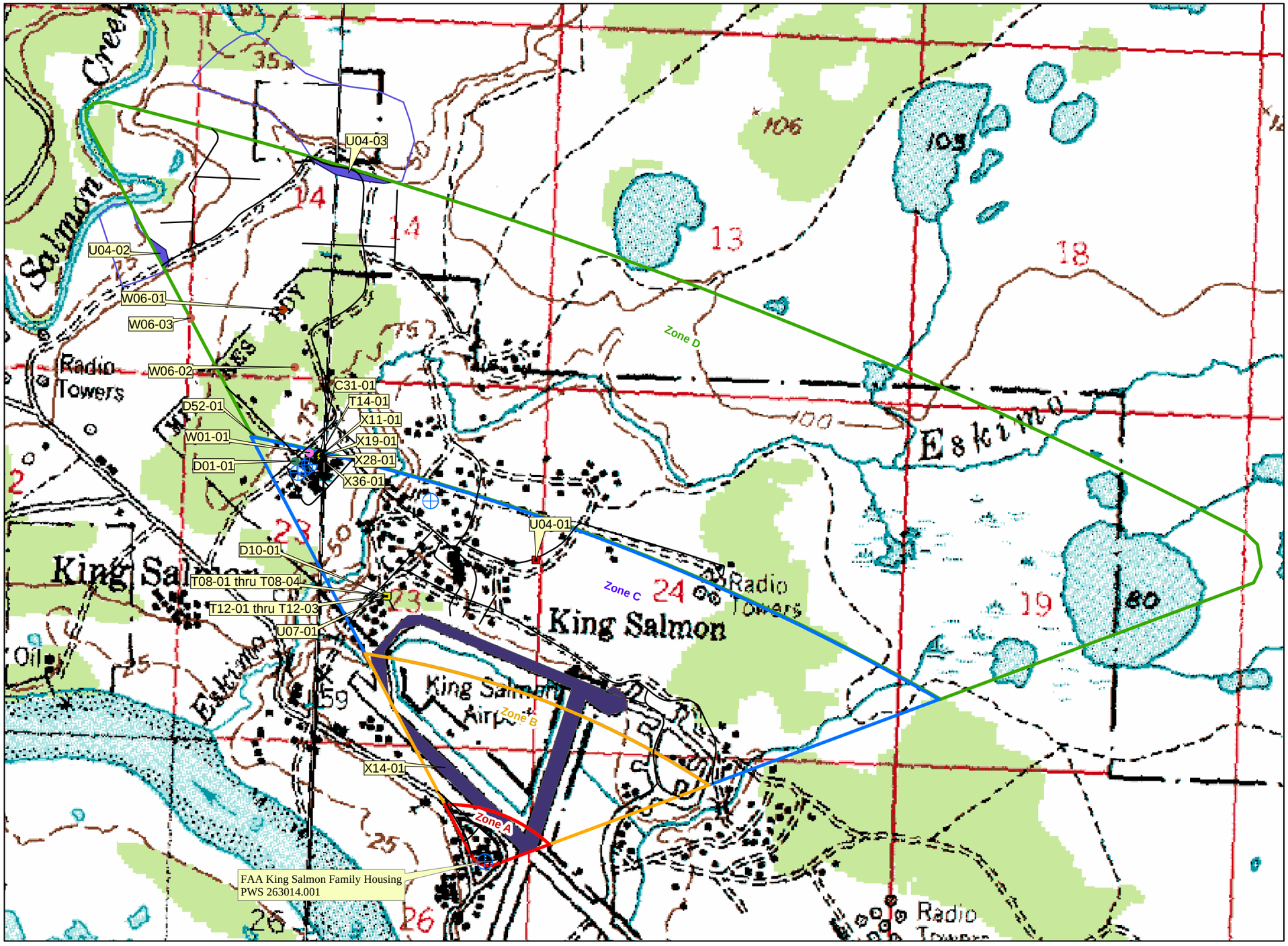
Table 7

Contaminant Source Inventory and Risk Ranking for FAA King Salmon Family Housing Sources of Other Organic Chemicals

PWSID 263014.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Airports	X14	X14-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Landfills (industrial; type of industrial waste?)	D52	D52-01	C	Very High	C	
Abandoned wells	W01	W01-01	C	High	C	USAF Chugach Support Services 10 or less abandoned wells in Zone C
Petroleum product bulk station/terminals	X11	X11-01	C	High	C	
Pipelines (oil and gas)	X28	X28-01	C	High	C	USAF Chugach
Electric power generation (fossil fuels)	X36	X36-01	C	High	C	USAF Chugach

Public Water Well System for PWS #263014.001 FAA King Salmon Family Housing
Showing Potential and Existng Sources of Contamination



LEGEND

Public Water System Well

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Groundwater Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time

Existing or Potential Contaminant Sources

- Motor/motor vehicle repair shops (C31)
- Domestic wastewater collection systems (D01)
- Injection Wells (Class V) Large-Capacity Septic System (D10)
- Tanks Diesel (underground) (T08)
- Tanks Gasoline (underground) (T12)
- Tanks, heating oil, nonresidental (aboveground) (T14)
- Contaminated Sites, DEC Recognized, Non-Superfund, Non-RCRA (U04)
- Open Leaking Underground Fuel Storage Tank (LUST) (U07)
- Abandoned wells (W01)
- Monitoring wells (W06)
- Petroleum product bulk station/terminals (X11)
- Government vehicle maintenance facilities (X19)
- Pipelines (X28)
- Electric power generation (fossil fuels) (X36)
- Airports/Landing Strips (X14)
- Landfills (industrial) (D52)

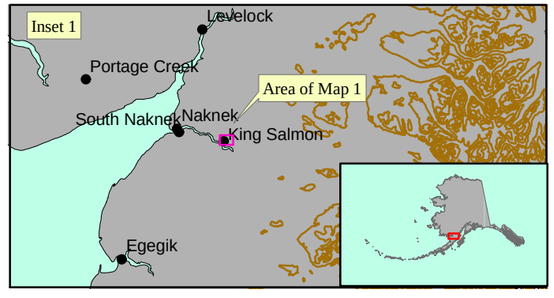
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
United States Geological Survey (USGS)

Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 0.15 0.3 0.6 0.9 1.2 Miles

FAA King Salmon Family Housing
PWS 263014.001

Appendix C Map C

Chart 1. Susceptibility of the wellhead - FAA King Salmon Family Housing (PWS No.263014.001)

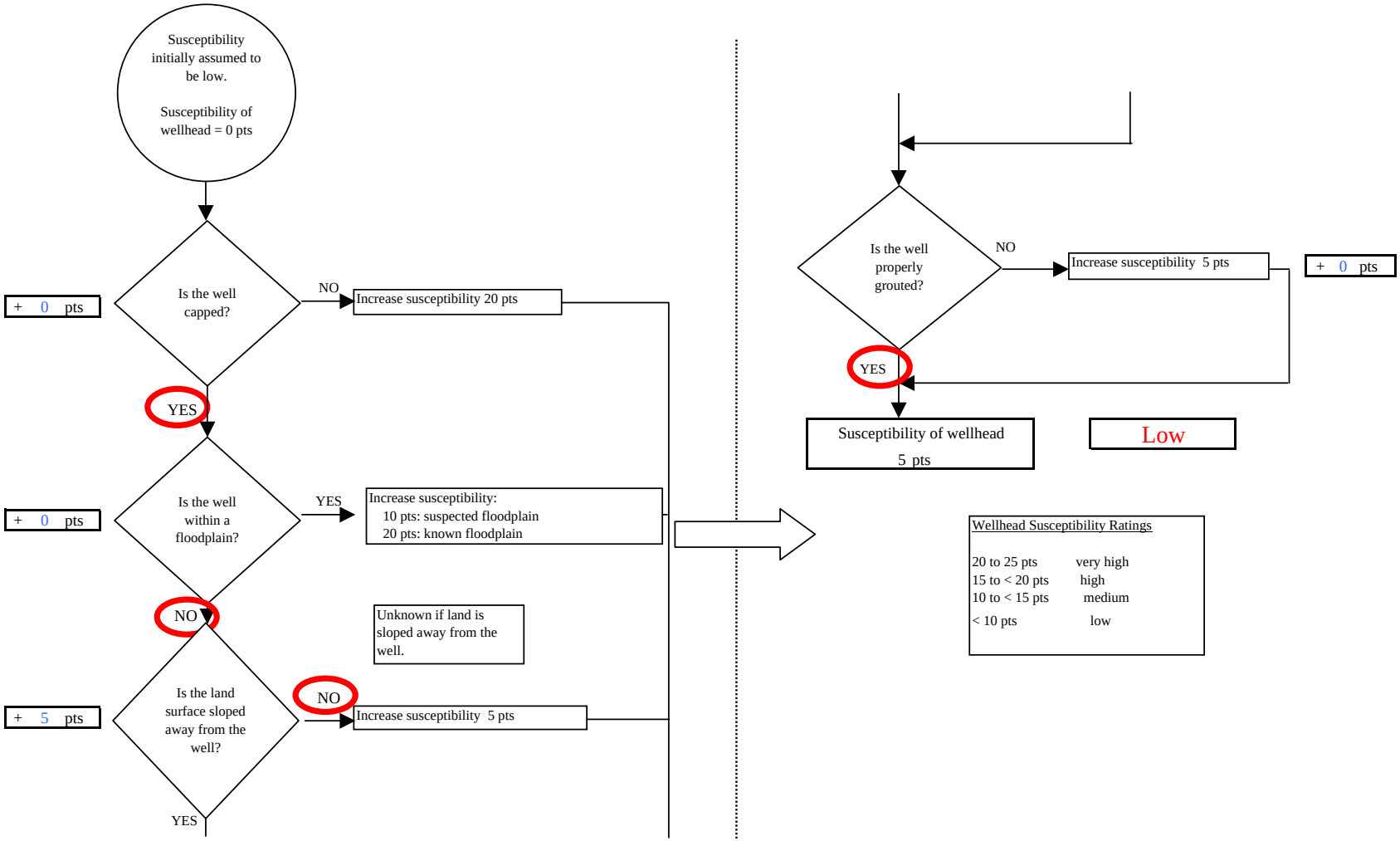


Chart 2. Susceptibility of the aquifer FAA King Salmon Family Housing (PWS No.263014.001)

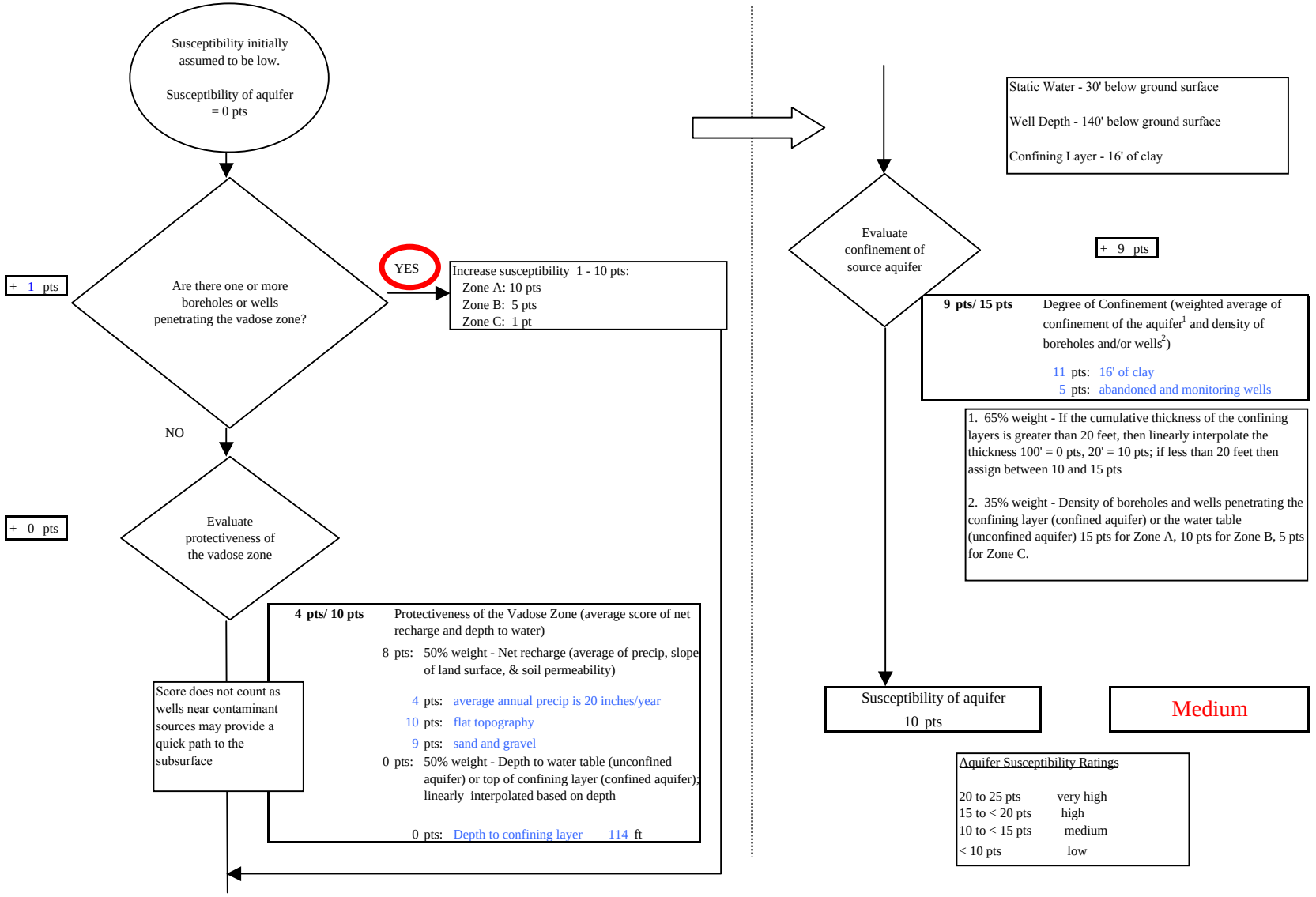
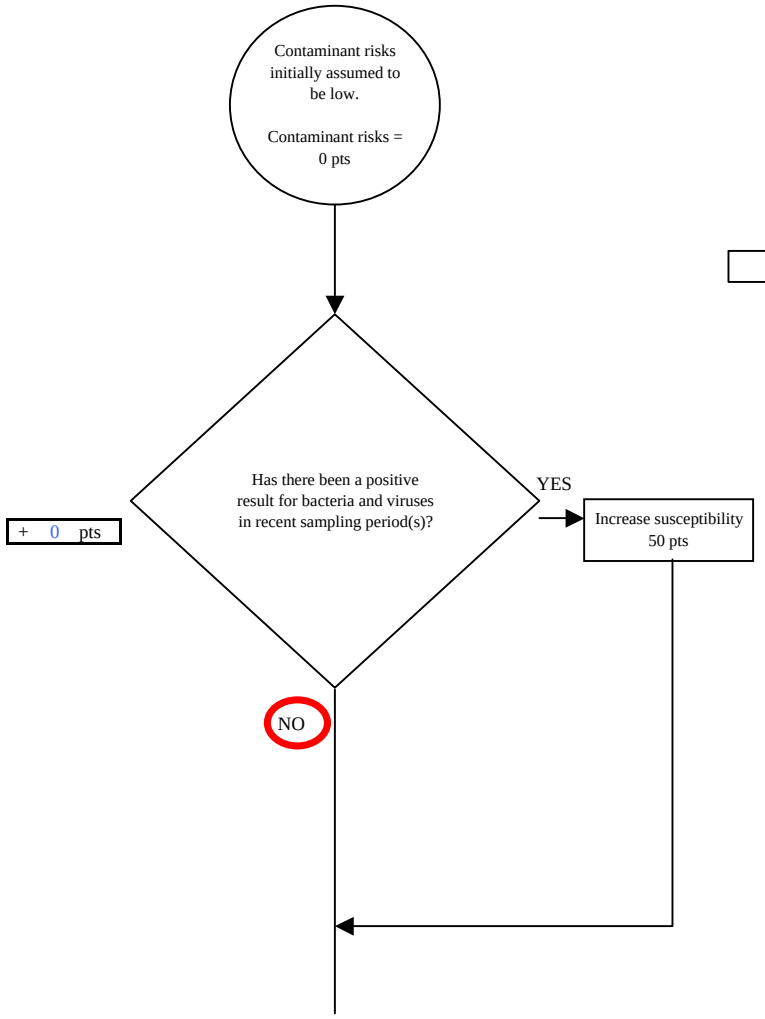
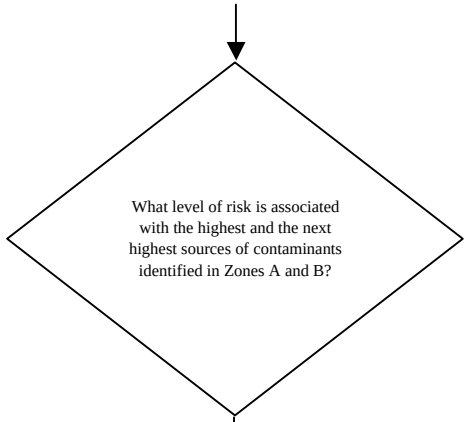


Chart 3. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Bacteria & Viruses





+ 10 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	0	0
Low(s)	1	1	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 3. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Bacteria & Viruses

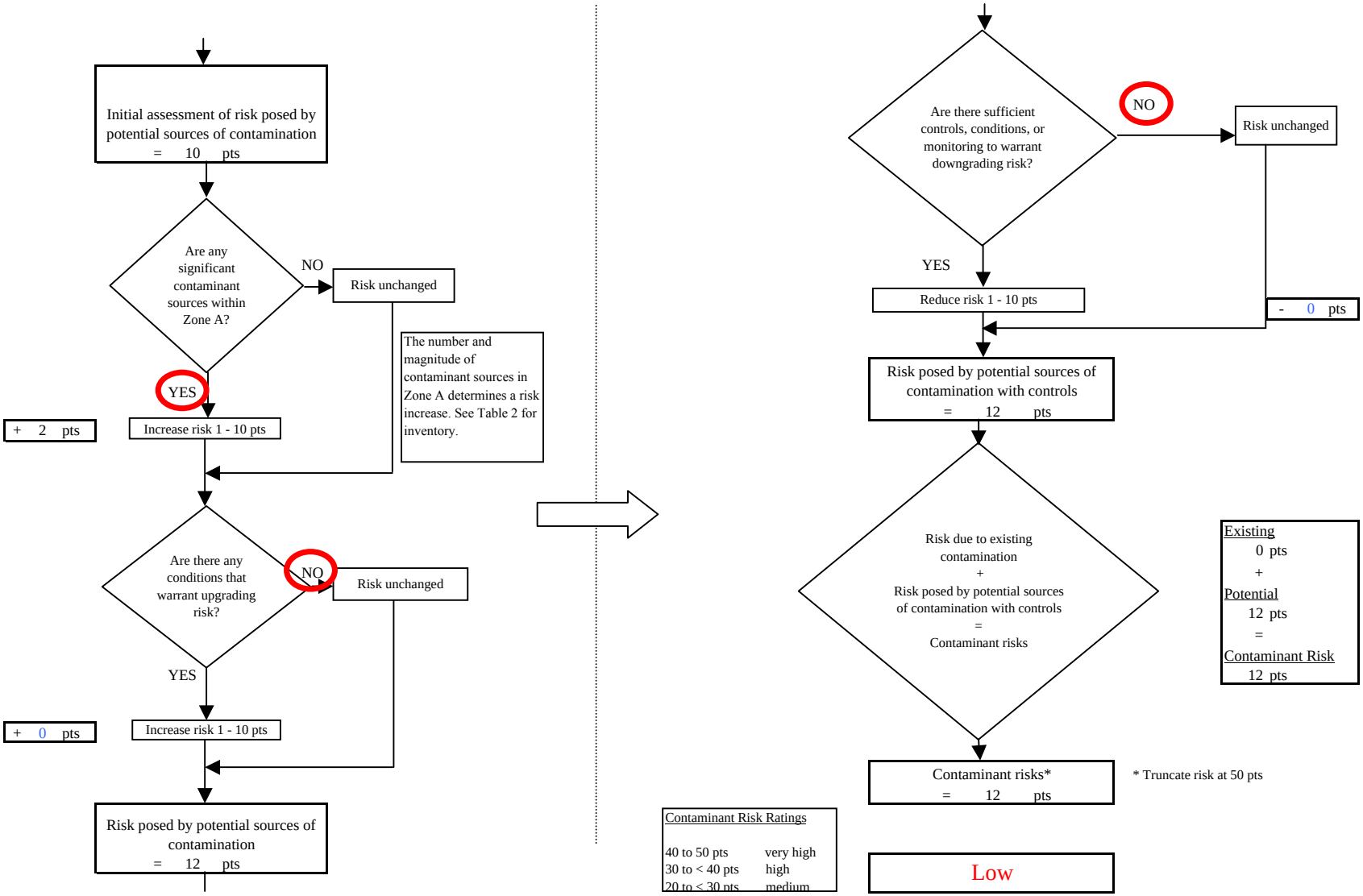


Chart 4. Vulnerability analysis for FAA King Salmon Family Housing (PWS No.263014.001) - Bacteria & Viruses

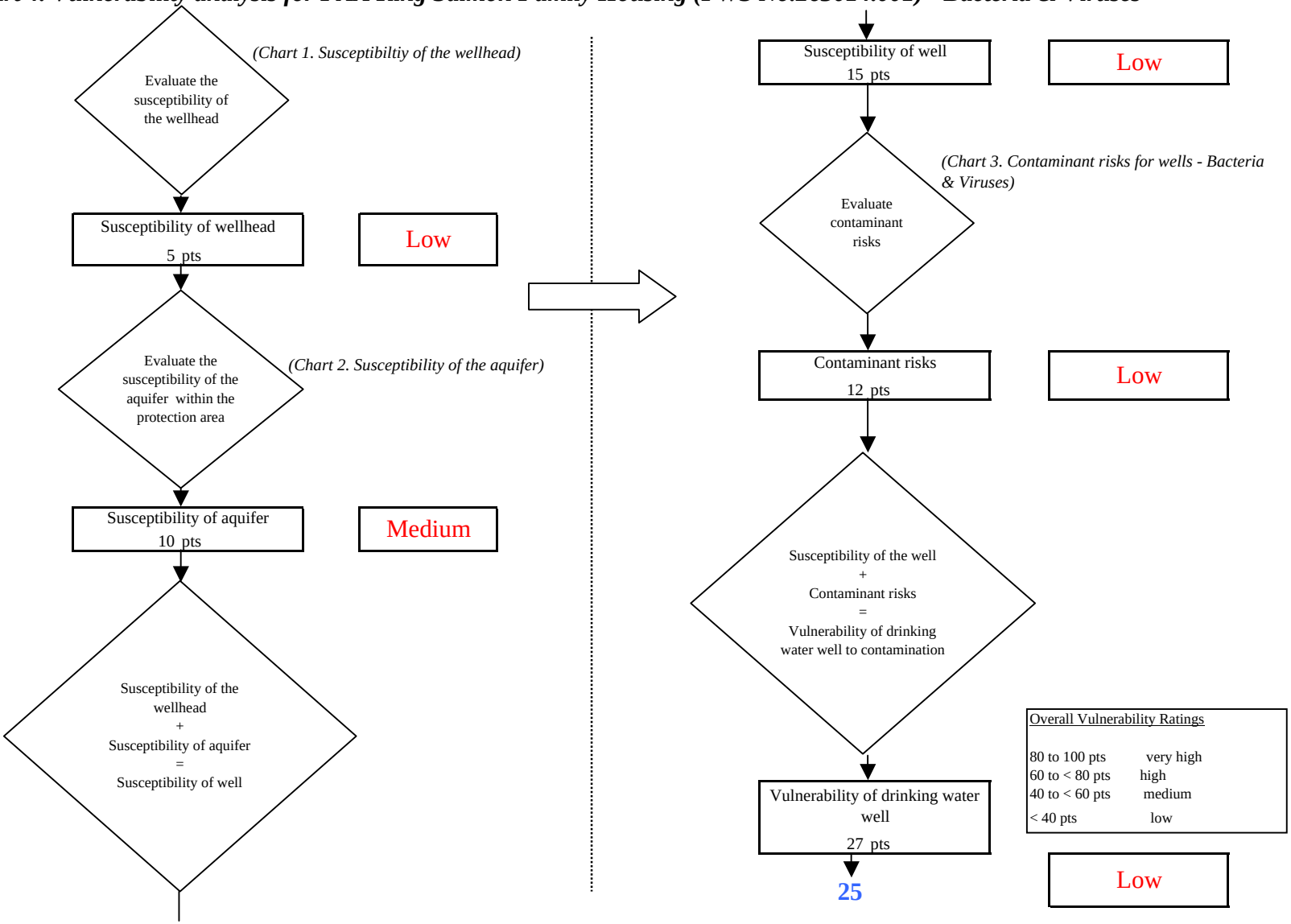


Chart 5. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Nitrates and Nitrites

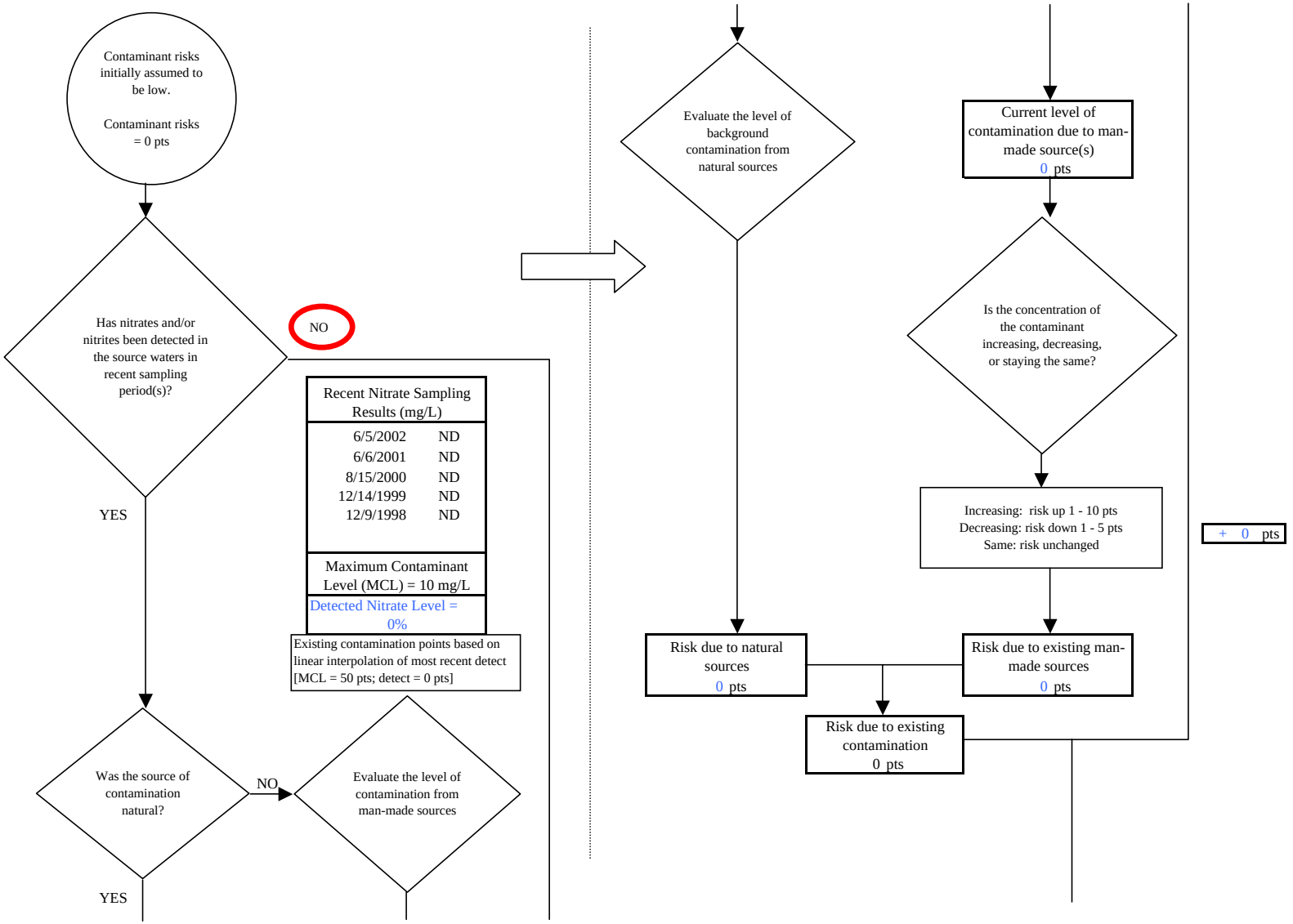


Chart 5. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Nitrates and Nitrites

+ 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	11	11
Medium(s)	0	0	0
Low(s)	2	1	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 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

- 1 pts

Decrease risk 1 - 10 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

+ 2 pts

Increase risk 1 - 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 3 for inventory.

Chart 5. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Nitrates and Nitrites

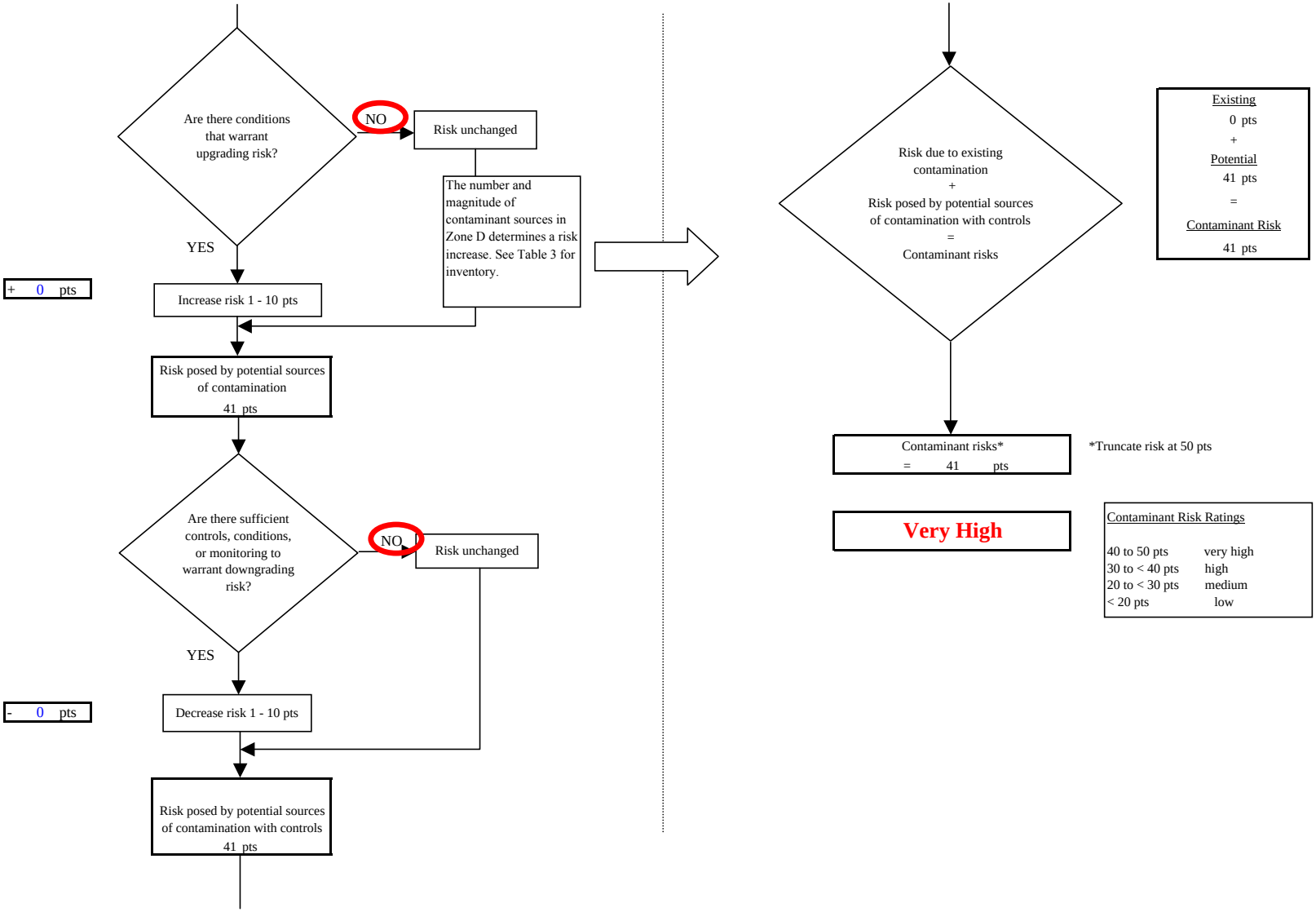


Chart 6. Vulnerability analysis for FAA King Salmon Family Housing (PWS No.263014.001) - Nitrates and Nitrites

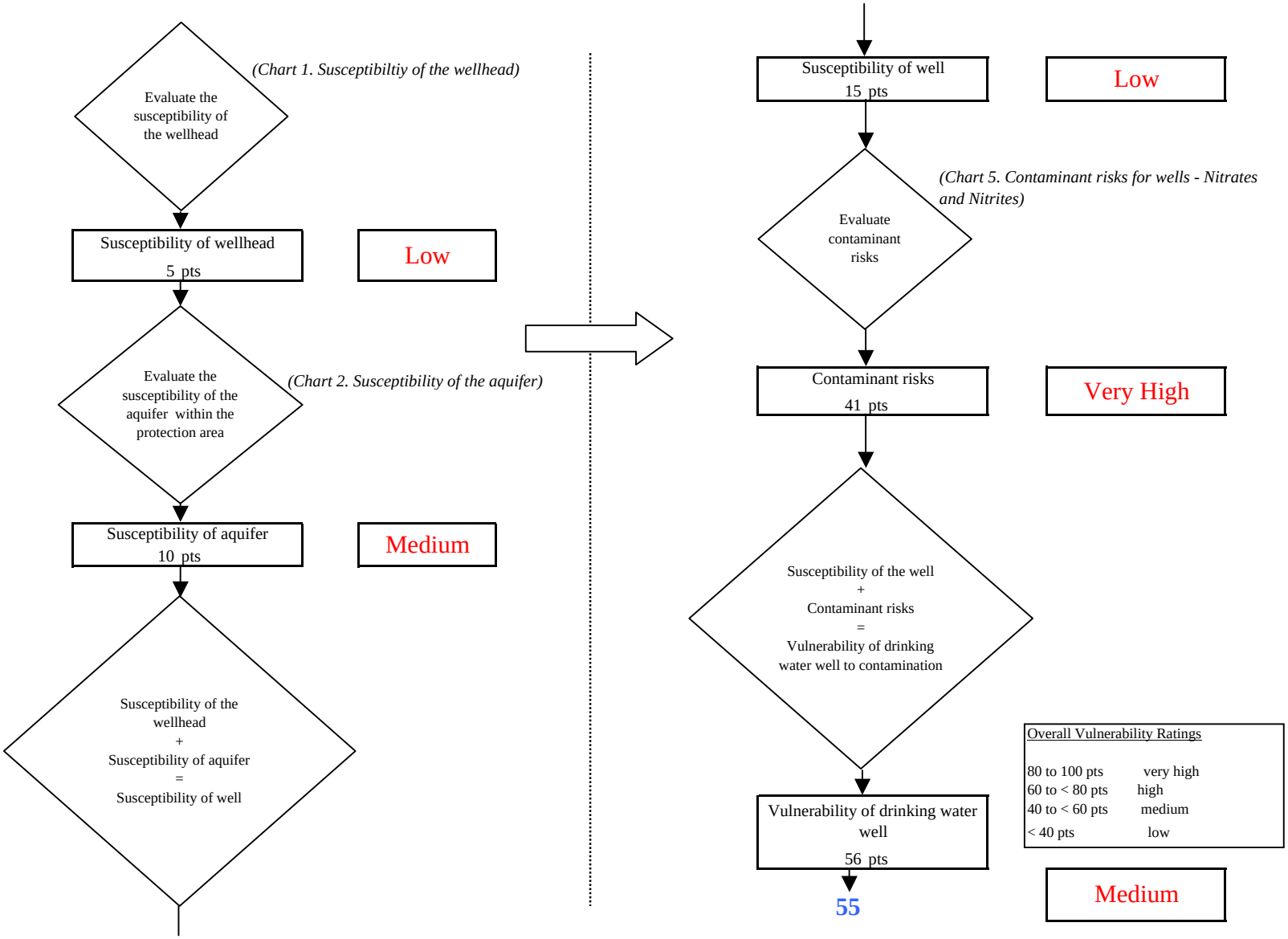


Chart 7. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Volatile Organic Chemicals

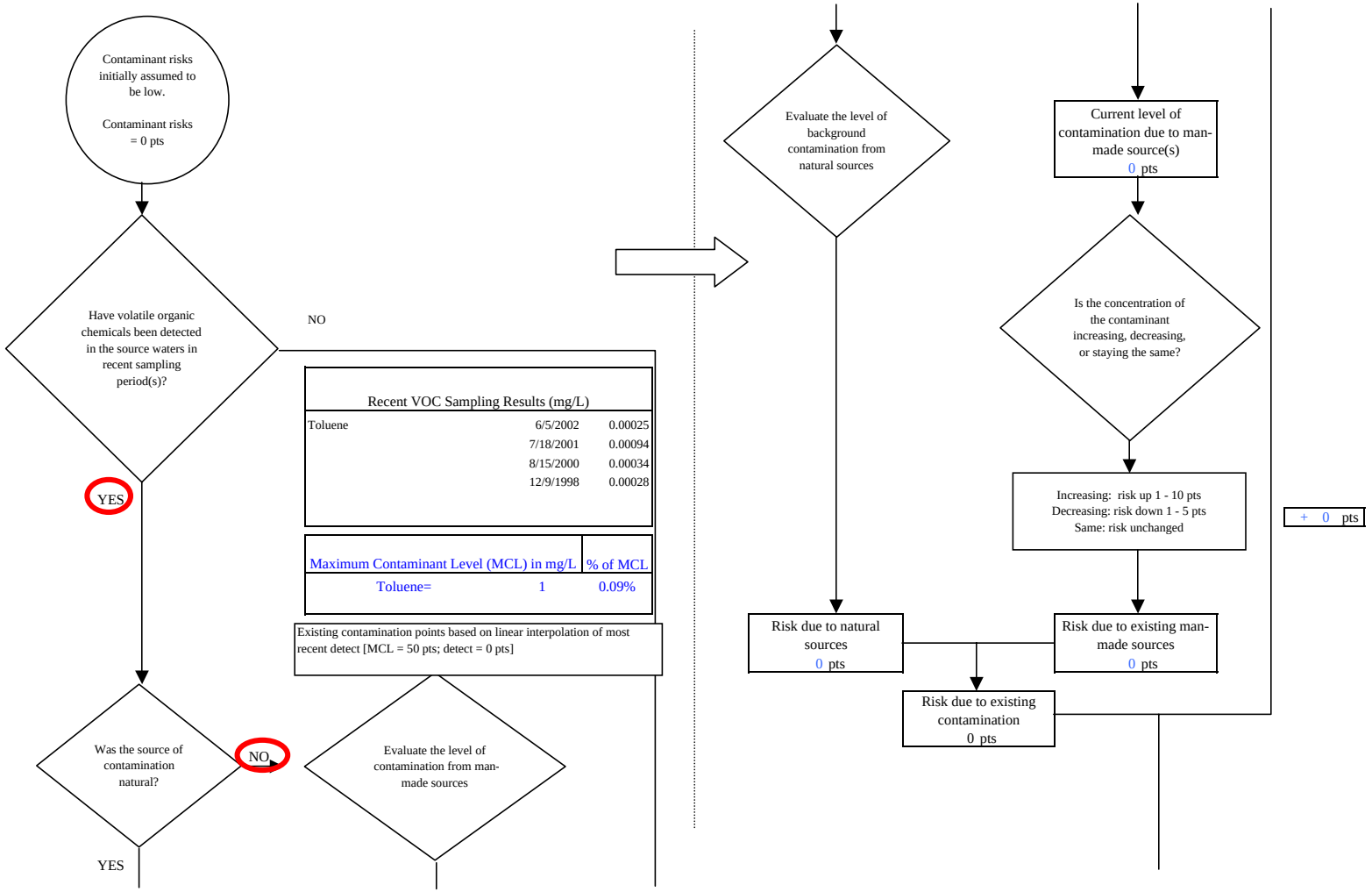


Chart 7. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Volatile Organic Chemicals

+ 50 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	1	1
High(s)	1	19	20
Medium(s)	30	15	45
Low(s)	1	1	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 50

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 = 50 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

- 5 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 4 for inventory.

Chart 7. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Volatile Organic Chemicals

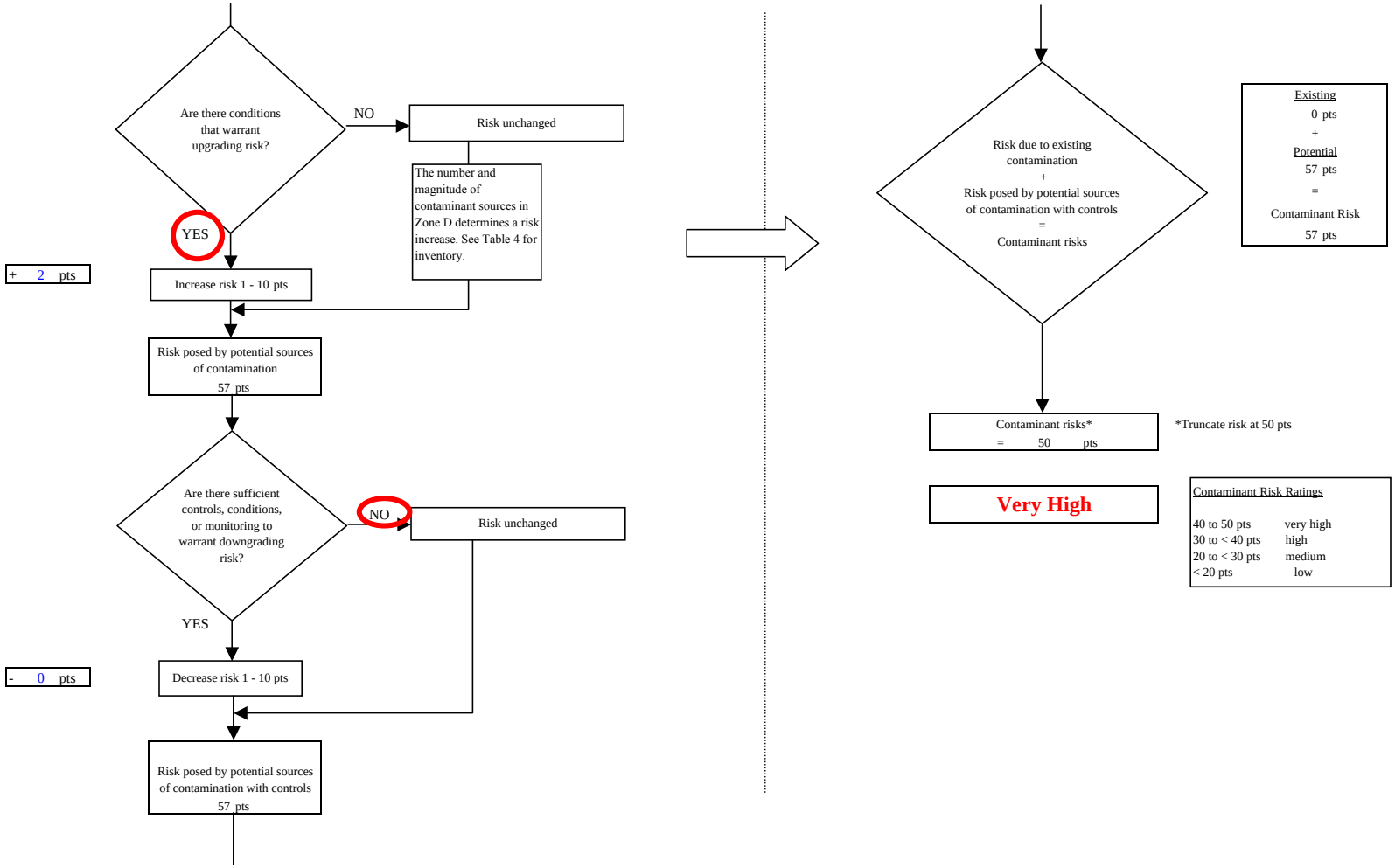


Chart 8. Vulnerability analysis for FAA King Salmon Family Housing (PWS No.263014.001) - Volatile Organic Chemicals

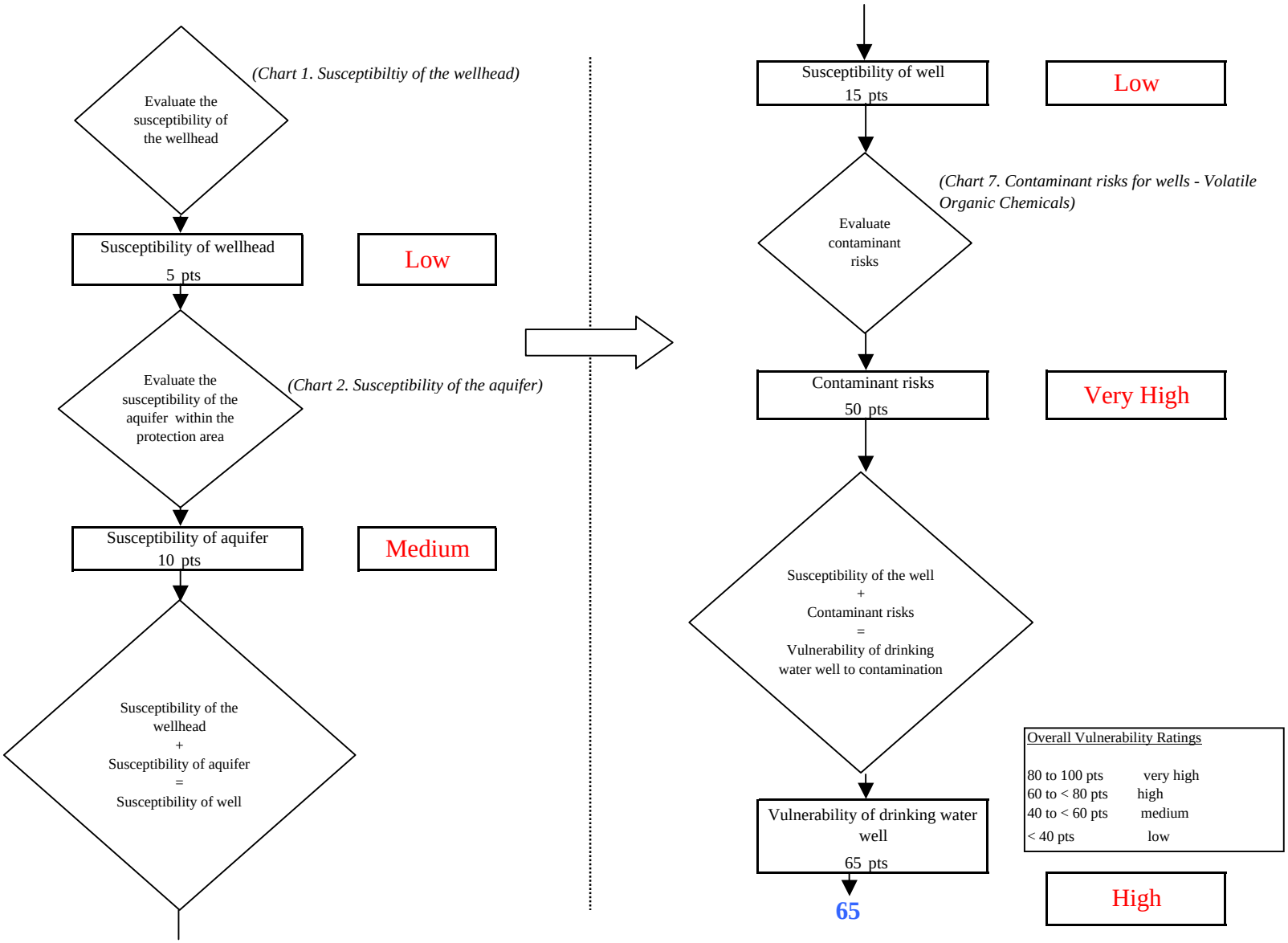


Chart 9. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

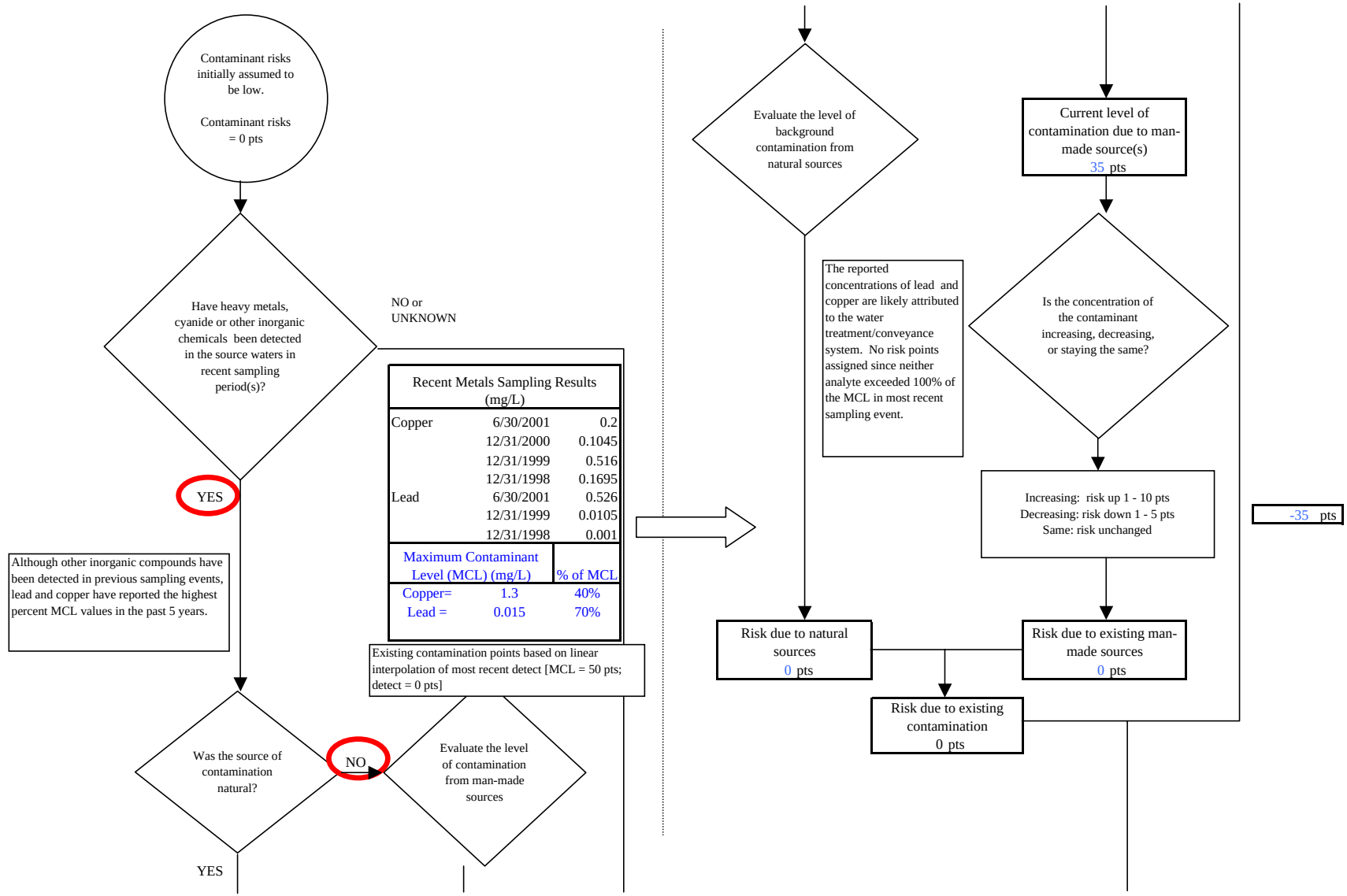


Chart 9. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 50 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	10	10
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	1	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 50

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 = 50 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

- 1 pts

Decrease risk 1 - 10 pts

Are any significant sources within Zone A?

NO → Risk unchanged

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 5 for inventory.

YES

+ 2 pts

Increase risk 1 - 10 pts

Chart 9. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

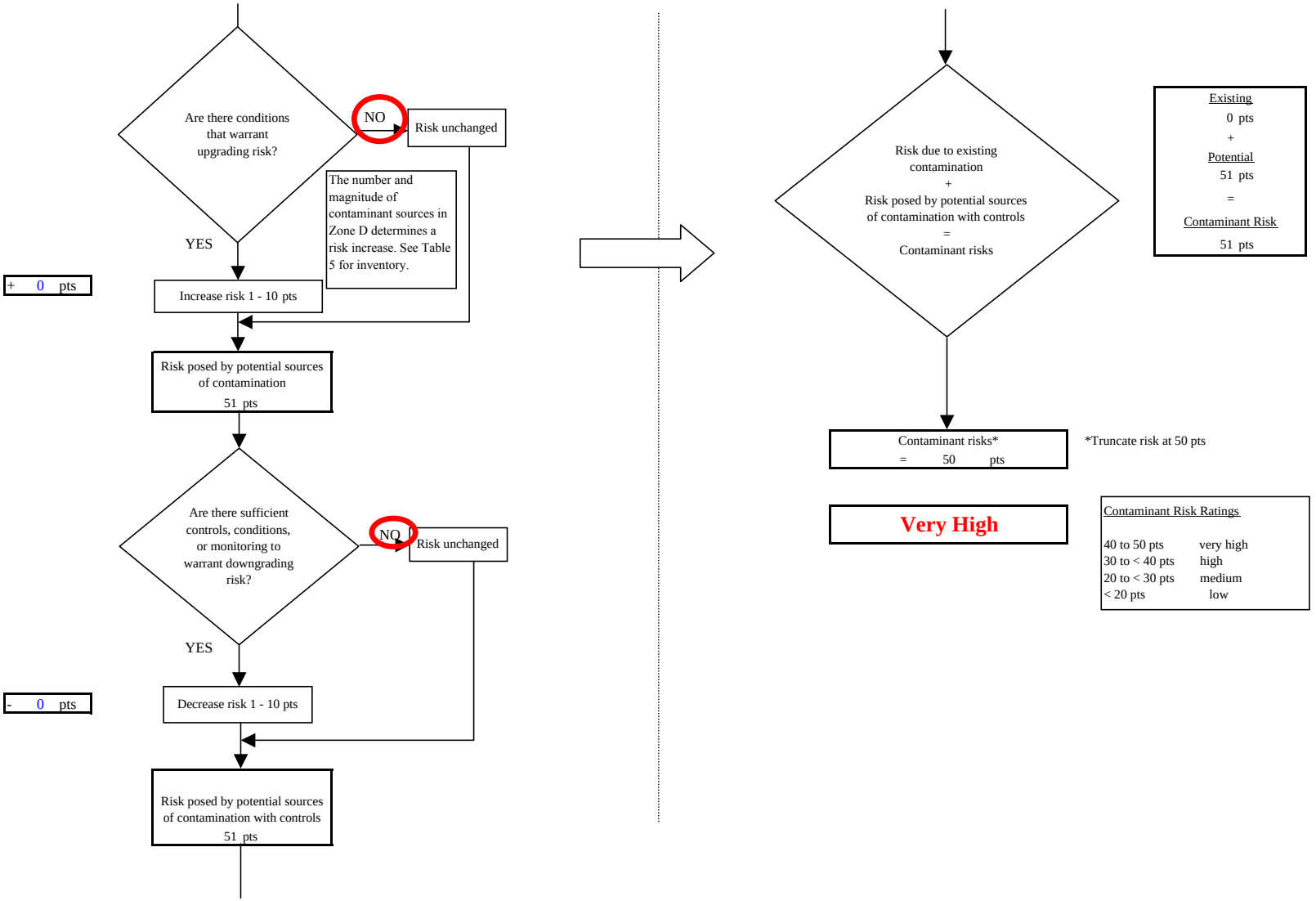


Chart 10. Vulnerability analysis for FAA King Salmon Family Housing (PWS No.263014.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

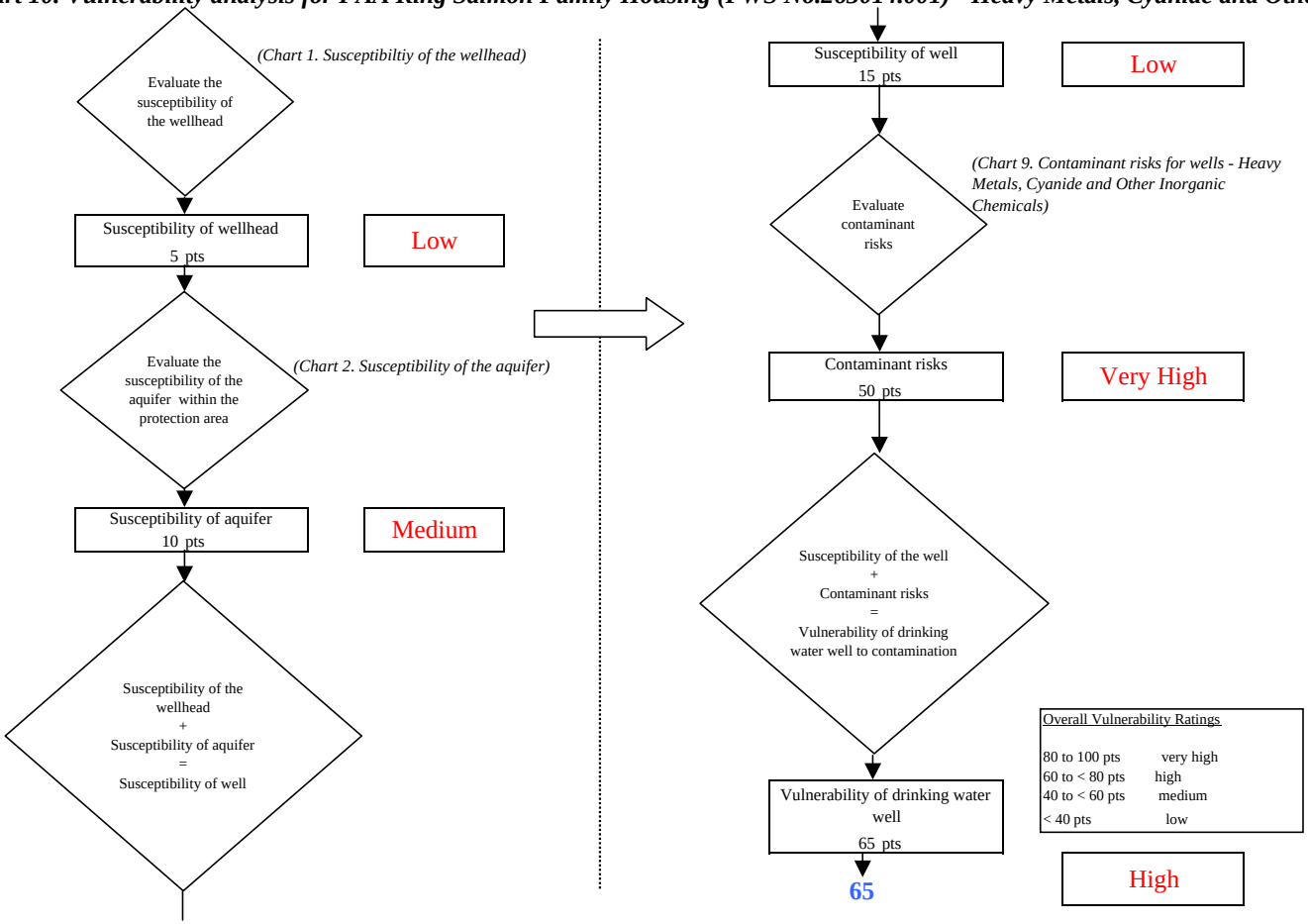


Chart 11. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Synthetic Organic Chemicals

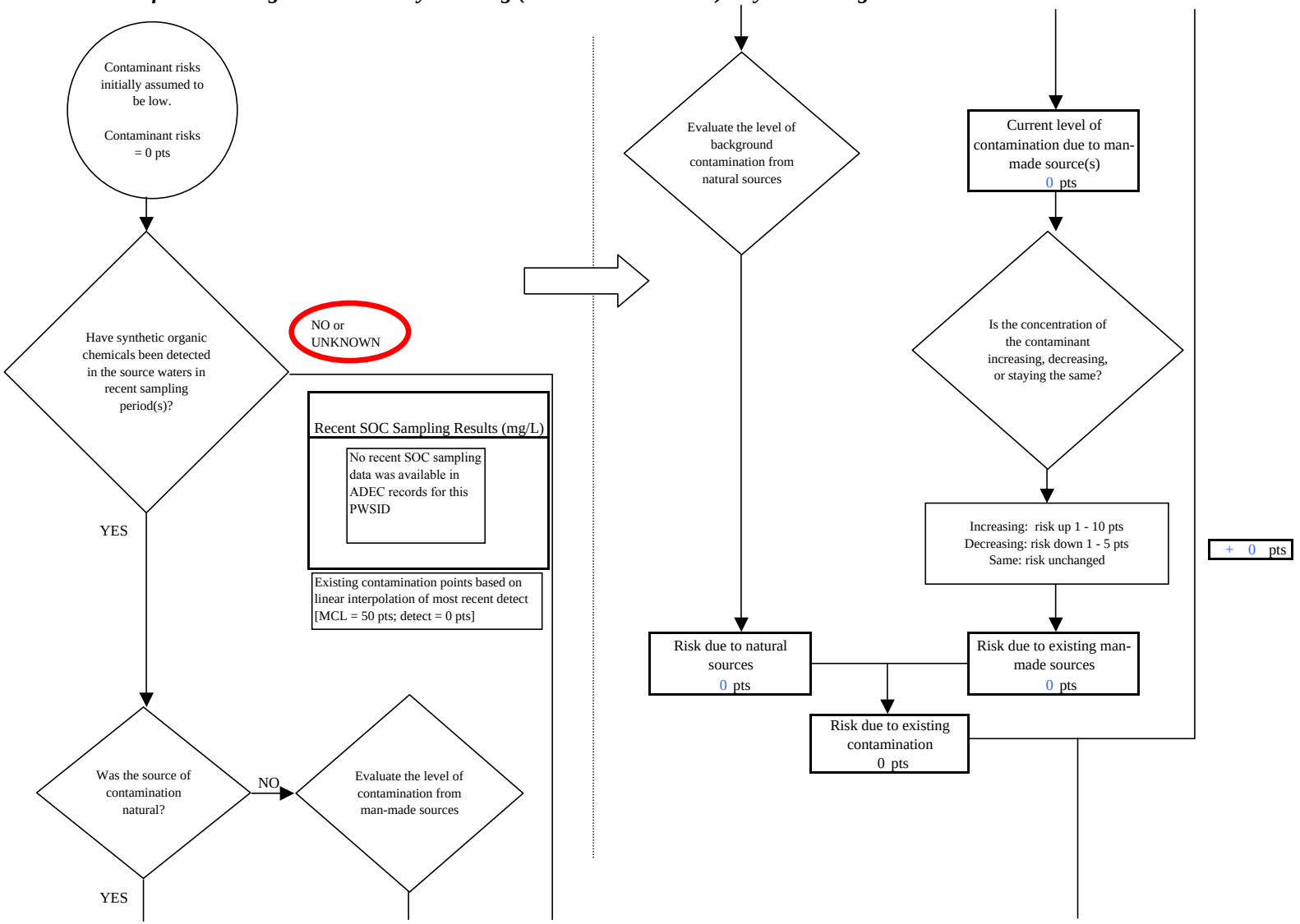
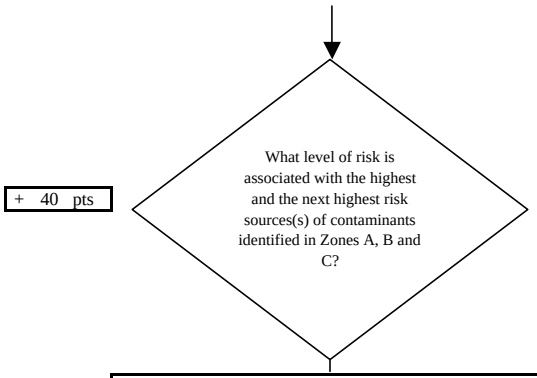


Chart 11. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Synthetic Organic Chemicals



+ 40 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	10	10
Medium(s)	1	0	1
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 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.

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 6 for inventory.

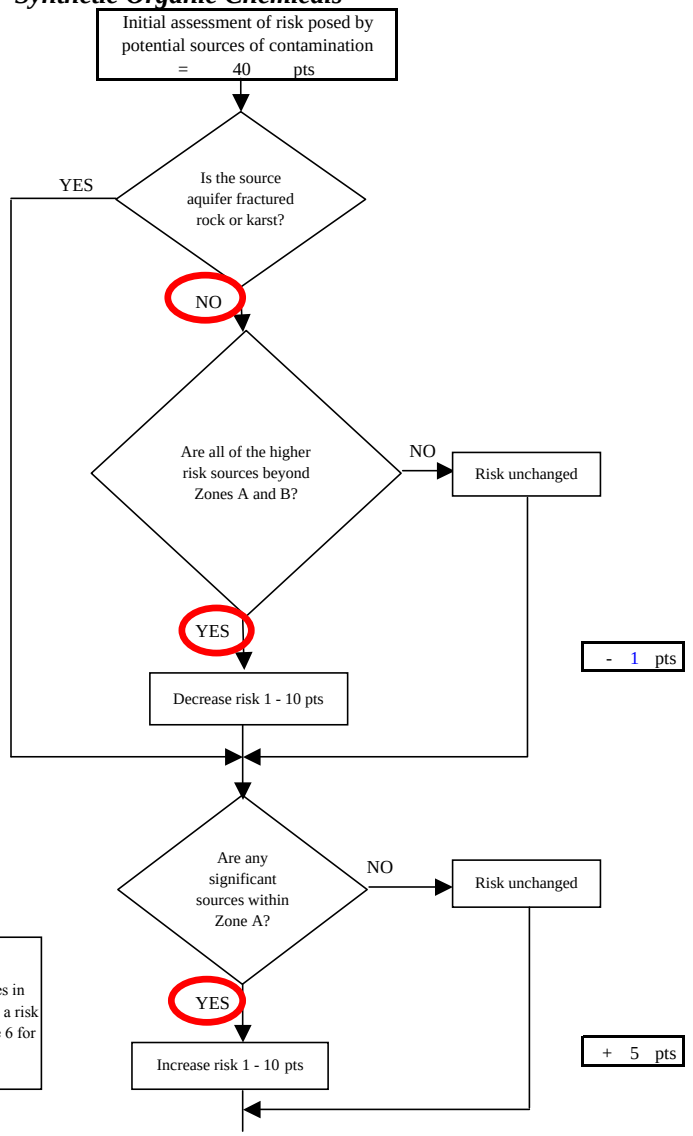


Chart 11. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Synthetic Organic Chemicals

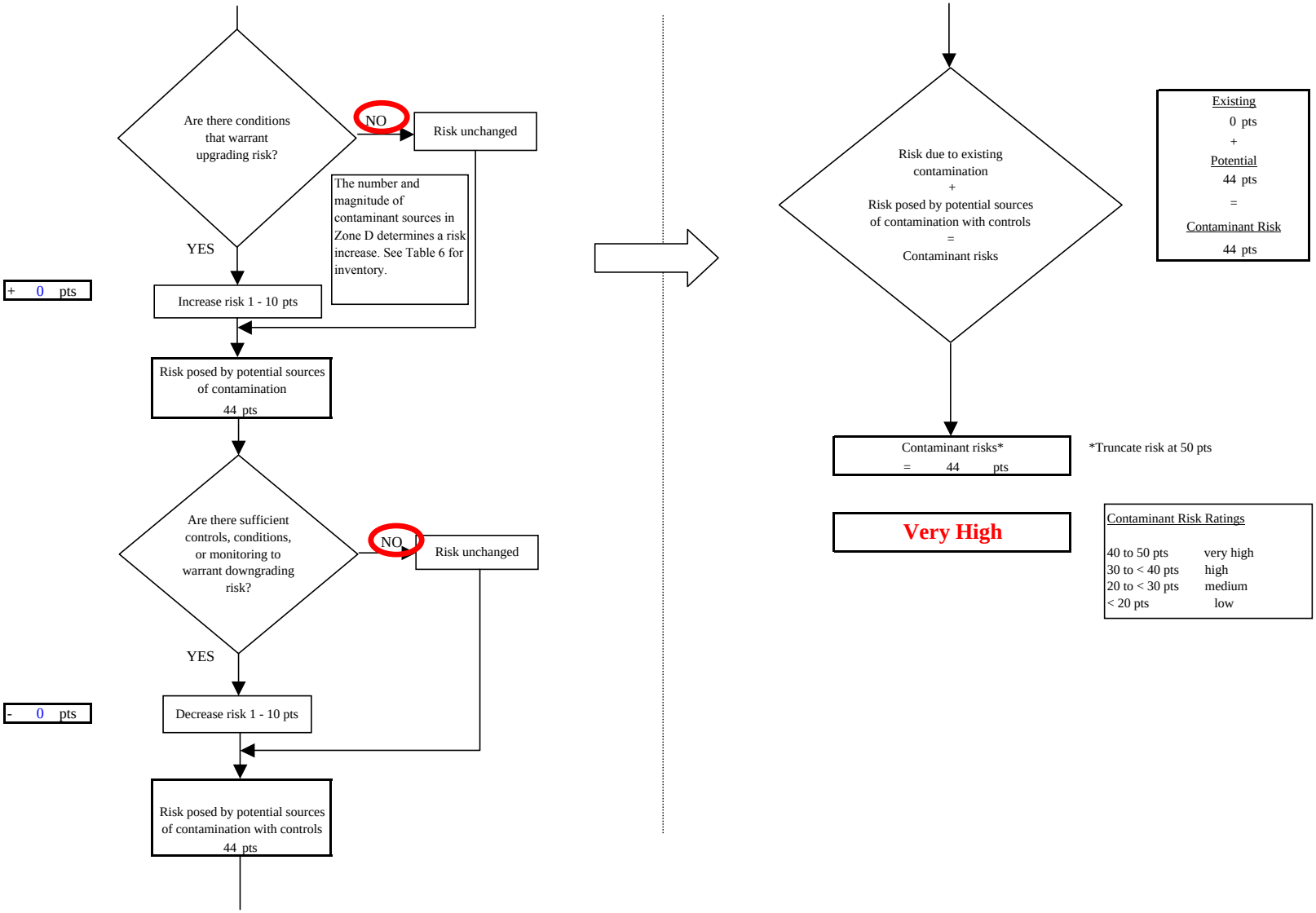


Chart 12. Vulnerability analysis for FAA King Salmon Family Housing (PWS No.263014.001) - Synthetic Organic Chemicals

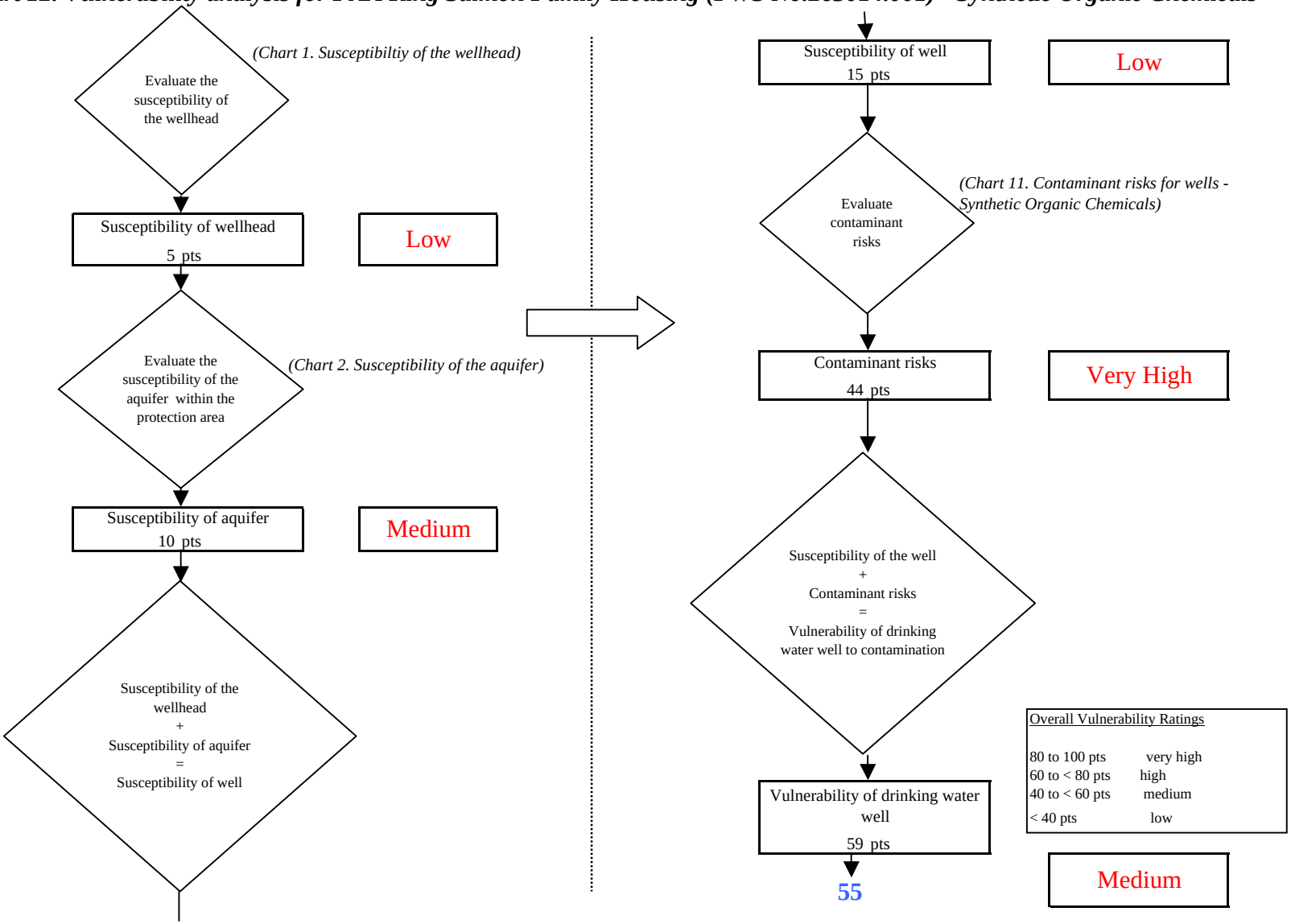


Chart 13. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Other Organic Chemicals

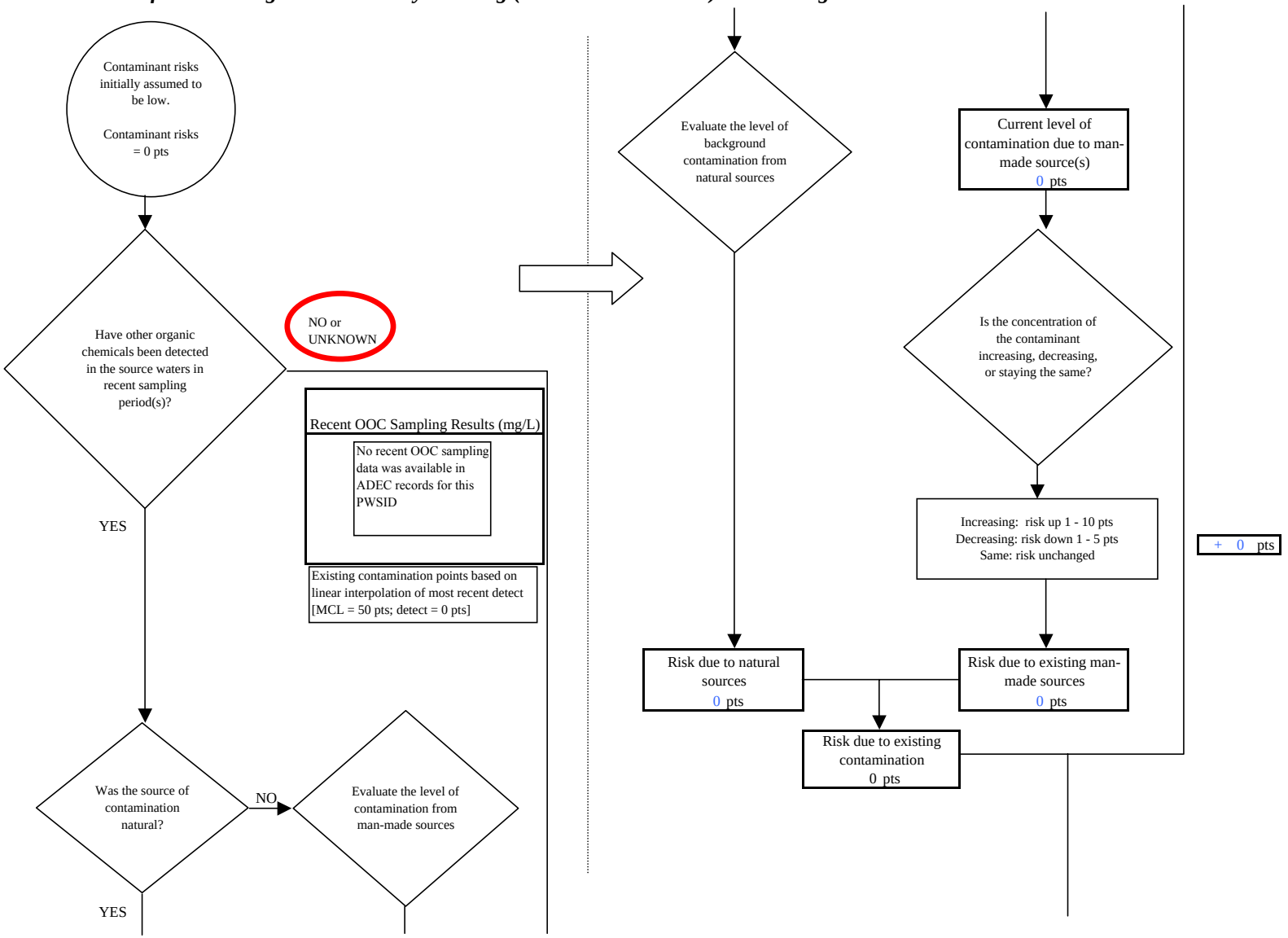
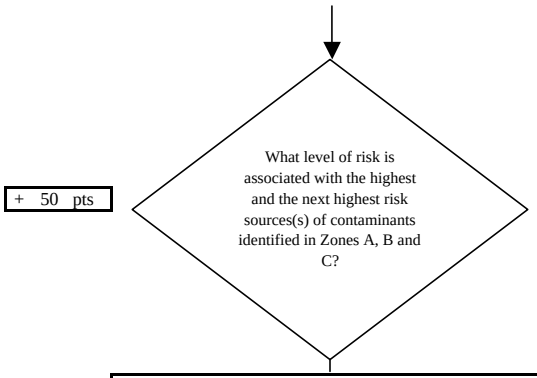


Chart 13. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Other Organic Chemicals



+ 50 pts

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	1	1
High(s)	0	13	13
Medium(s)	1	0	1
Low(s)	1	1	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 50

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.

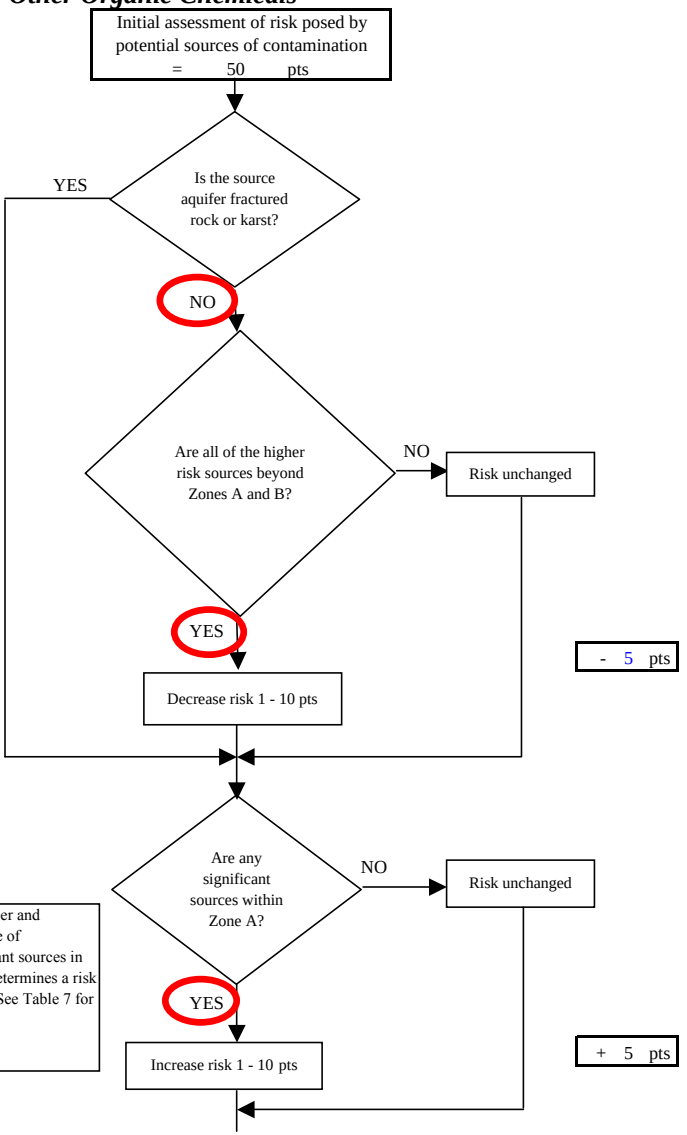


Chart 13. Contaminant risks for FAA King Salmon Family Housing (PWS No.263014.001) - Other Organic Chemicals

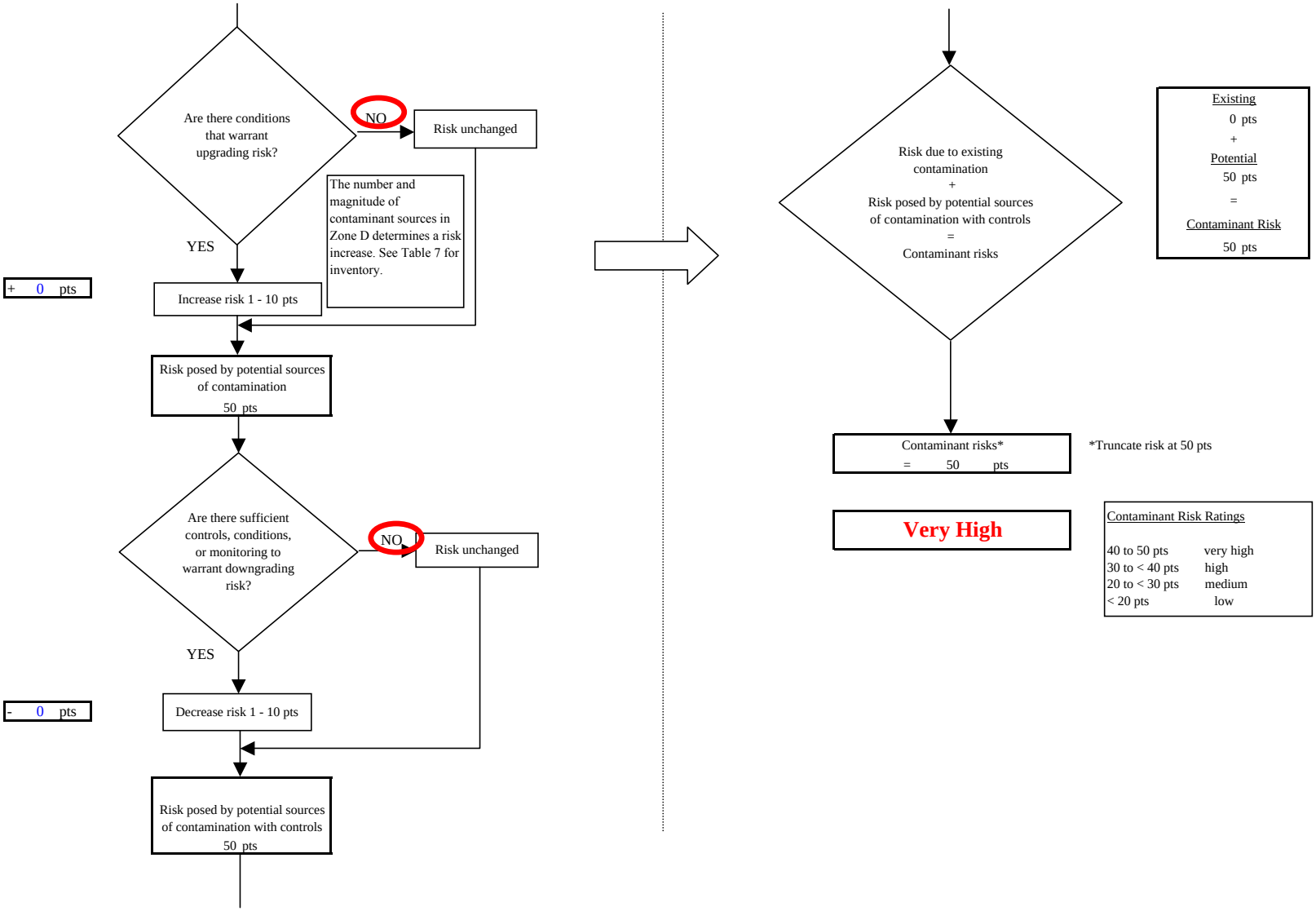


Chart 14. Vulnerability analysis for FAA King Salmon Family Housing (PWS No.263014.001) - Other Organic Chemicals