
# UNITED STATES AIR FORCE
# 611TH AIR SUPPORT GROUP
# 611TH CIVIL ENGINEER SQUADRON

# JOINT BASE ELMENDORF-RICHARDSON, ALASKA

# DRINKING WATER SOURCE ASSESSMENT

## KING SALMON DIVERT AIRFIELD

## KING SALMON, ALASKA

**DRAFT FINAL**
**MARCH 2022**

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAC | Alaska Administrative Code |
| ADEC | Alaska Department of Environmental Conservation |
| AST | aboveground storage tank |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| BOSS | Base Operational Support Services |
| CCR | Consumer Confidence Report |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| DNR | Alaska Department of Natural Resources |
| DWPG | Drinking Water Protection Group |
| EPA | U.S. Environmental Protection Agency |
| GEI | Goldstream Engineering, Inc. |
| GIS | Geographic Information System |
| GWUDISW | groundwater under the direct influence of surface water |
| HDPE | high-density polyethylene |
| HMCIC | heavy metals, cyanide, and other inorganic chemicals |
| IRP | Installation Restoration Program |
| KSDA | King Salmon Divert Airfield |
| MCL | maximum contaminant levels |
| mg/L | milligram per liter |
| MSL | mean sea level |
| NTNC | Non-Transient, Non-Community |
| O&M | operations and maintenance |
| OOC | other organic contaminants |
| POL | petroleum, oil and lubricant |
| PWS | public water systems |
| PWSID | Public Water System Identification |
| RI/FS | remedial investigation/feasibility study |
| ROD | Record of Decision |
| ROWPU | reverse osmosis water purification unit |

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| SDWA | Safe Drinking Water Act |
| SOC | synthetic organic contaminants |
| SOP | standard operating procedure |
| SWA | Source Water Assessment |
| TCE | trichloroethylene |
| TPH | total petroleum hydrocarbon |
| USACE | U.S. Army Corps of Engineers, Alaska |
| USACHPPM | U.S. Army Center for Health Promotion and Preventative Medicine |
| USAF | U.S. Air Force |
| USGS | U.S. Geological Survey |
| ASRC | Arctic Slope Regional Corporation |
| UST | underground storage tank |
| VOC | volatile organic compounds |
| WTP | Water Treatment Plant |
| WWII | World War II |
| µg/L | micrograms per liter |

# EXECUTIVE SUMMARY

## PURPOSE

The purpose of this assessment is to identify contaminant sources within the King Salmon Divert Airfield (KSDA) drinking water protection area for the active water source and to determine source water susceptibility to potential, current, and historic contaminants within the protected area. This information assists the PWS owner in mitigating water contamination and planning for possible future challenges. This assessment is based on information provided by the USAF, ADEC, and other onsite information collected on August 2021 by Goldstream Engineering, Inc. located in Fairbanks, Alaska

## FINDINGS

KSDA is located in King Salmon, Alaska, on the Katmai Peninsula. Groundwater wells are the source of public drinking water for the area, currently WL0B1, the active well located near the water treatment plant. A backup well (WL005) is located near the water storage tanks. The system is classified as groundwater. The water system is owned by the U.S. Air Force and operated by Arctic Slope Regional Corporation (ASRC under contract to provide Base Operational Support Services (BOSS). The drinking water source protection area was identified by ADEC, with areas divided into Zone A and Zone B. We have no reason to suspect the source water protection area was done incorrectly. Potential, current, and historical sources of contamination were evaluated for the level of threat posed to the drinking water source. The susceptibility of the wellhead and aquifer was also assessed and collectively known as the natural susceptibility of the source water.

The overall vulnerability of the KSDA source water is judged to be low. The well appears to have been constructed properly, and it is currently being maintained to protect the water. There are very few potential sources of contamination within the source protection area designated by ADEC for the active well. Additionally, the water source is further protected by two aquitards that protect the aquifer used for drinking water from potential surface contaminants. As time goes on, the future vulnerability of the source water may change. Therefore, updating this source water assessment further in the future may be prudent.

# 1.0 INTRODUCTION

Goldstream Engineering, Inc. created this Source Water Assessment (SWA) after collecting updated information during an onsite inspection on August 3-5, 2021.

## 1.1 PURPOSE

The purpose of this assessment is to identify contaminant sources within the drinking water protection area and determine source water susceptibility to potential, current, and historic contaminants within the protected area. A review of the natural hydrologic sensitivity has been combined with potential, current, and historic contaminant risks to arrive at an overall decision about the vulnerability of the drinking water source to contamination. This assessment has been completed to assist the U.S. Air Force (USAF) in protecting drinking water at KSDA, King Salmon, AK.

## 1.2 AGENCY ASSISTANCE

Numerous individuals assisted in the development of this assessment. Assistance was received from Joint Base Elmendorf-Richardson, KSDA, U.S. Army Corps of Engineers (USACE), Alaska Department of Natural Resources (DNR), U.S. Geological Survey (USGS), and the Alaska Department of Environmental Conservation (ADEC).

## 1.3 BACKGROUND INFORMATION

A previous Source Water Assessment (SWA) was not identified for this system; therefore, GEI was contracted to create one. This document includes information collected by GEI and a drinking water protection area designated by ADEC in 2014. Source water protection requirements are addressed in ADEC 18 AAC 80.015.

### 1.3.1 Safe Drinking Water Act

The 1986 and 1996 Safe Drinking Water Act Amendments required all states, which have primacy over their drinking water regulations, to assess every public drinking water source in their state. As a result, the U.S. Environmental Protection Agency (EPA) approved Alaska's Drinking Water Protection Program (a combination of Source Water Assessments and Wellhead Protection Programs) in April 2000. The combined program meets the statutory requirements of the State of Alaska, the Safe Drinking Water Act (SDWA), and subsequent amendments [18 Alaska Administrative Code (AAC) 80, 2002; 18 AAC 80.015, 2002]. The ADEC Environmental Health handles the administration of the program, Drinking Water Program, Anchorage, AK.

### 1.3.2 ADEC Drinking Water Program Mission

As part of the EPA's SDWA requirements, the Alaska Drinking Water Program is responsible for requiring public water systems to supply safe drinking water for public consumption that meets minimum federal health-based standards. Alaska has had primary enforcement responsibility of the public water system supervision program (Safe Drinking Water Program) since 1978. ADEC guides owners and operators supervising the public water systems (PWS) on the design, installation, and maintenance of drinking water facilities. In addition, ADEC provides access to office files on local public drinking water systems, technical and compliance assistance, and workshops on regulatory, engineering, and drinking water public health-related issues (ADEC 2008).

### 1.3.3 Source of Drinking Water at KSDA

KSDA is designated as a Non-Transient, Non-Community (NTNC) Public Water System. The primary source of drinking water for KSDA, King Salmon, AK, is groundwater obtained from two potable water wells. WL0B1 is the active well located near the WTP, the main water source. WL005 is a backup well located on the western side of the site, inside Building 650, that can be used for potable water if needed. The drinking water system supplies potable water to military and civilian personnel, workers, contractor personnel, and visitors to King Salmon.

## 1.4 PAST SOURCES OF WATER SUPPLY AT KSDA

Several potable water wells were installed in various locations on the KSDA property. Most of the wells have been abandoned; however, there is little to no documentation on how or when modifications occurred to verify proper decommissioning.

# 2.0 DESCRIPTION OF KING SALMON

King Salmon is located on the north bank of the Naknek River near Bristol Bay on the Katmai Peninsula. KSDA is located near the village of King Salmon, approximately 15 miles upriver from Naknek, which contains the main facility of the Port of Bristol Bay. King Salmon is connected to Naknek by road and the Naknek River. King Salmon is considered remote, with transportation to the area only by airplane or boat. It is about 280 miles from Anchorage, AK.

King Salmon receives its electrical power from the Naknek Electric Association operated by the REA Cooperative. Most wastewater in the area is part of a piped sewage collection system and individual septic systems.

The BOSS Contractor, ASRC, has maintained the facilities and infrastructure in the area since October 1, 2020. Before that date, records were kept by the previous BOSS Contractor, Chugach Federal Services, Inc. (CFSI), since 2003. Current plans for the area are for continued operation under caretaker status.

## 2.1 CLIMATE

The climate in King Salmon is considered marine, with typical moist conditions and temperature variances moderated by the Pacific Ocean. As a result, the climate is milder than expected, considering the area's latitude. The mean annual temperature is around 41 degrees Fahrenheit; the mean annual precipitation is around 19 inches. The average annual snowfall is about 44 inches. Winds typically come from the east and southeast.

## 2.2 GEOLOGY

The terrain surrounding King Salmon is gently rolling, barren tundra with vegetation consisting of mesic to wet shrubs like alder, willow, shrub birch, and sedge tussocks. The lowland of the King Salmon area is bounded by the Kuskokwim Mountains on the north, Ahklun Mountains on the west, and the Aleutian Range to the east (USGS 1994). The nearby Aleutian Range contains peaks that exceed 7,000 feet above sea level.

Deep glacial erosion has occurred in the area, stripping surficial deposits from the underlying bedrock. This bedrock crops out mainly in the vicinity of Naknek Lake. Scattered outcrops consist of plugs, dikes, and lava flows of basaltic composition and subordinate lava flows and breccia of dacitic to andesitic composition (USGS 1994). The King Salmon area is west of Naknek Lake has few outcrops of lava flows, breccias, and lahars, interbedded with volcaniclastic sandstone, conglomerate, and shale (USGS 1994).

The surficial geology of King Salmon consists of thick unconsolidated sediment deposited during the Quaternary glaciation of the Alaska Peninsula. Till and other glacial sediments were deposited by the advance of the Mak Hill glaciation and the Brooks Lake glaciation period. The KSDA area is on outwash deposits of the Brooks Lake age that typically consist primarily of sand and silty sand, with some outwash gravel deposits (USGS 1994).

## 2.3 WATER RESOURCES

### 2.3.1 Surface Water

The King Salmon area is drained primarily by the Naknek River that empties into Kvichak Bay near Naknek. Several lakes, rivers, and streams are found in the area, including Eskimo Creek, which passes through the KSDA area. The lower area of the Naknek River is brackish and influenced by ocean tides up until approximately Rapids Camp. However, the probability of flooding in the area is low due to Naknek Lake's large size, which occupies most of the Naknek River drainage basin.

### 2.3.2 Groundwater

Groundwater is the primary drinking water source in the King Salmon area, including the KSDA PWS. The area's glacial-fluvial sand and gravel deposits comprise the primary aquifer(s). The surface elevations of small lakes decrease toward the Naknek River, indicating that the direction of groundwater flow is to the south toward the river (USGS 1994). Wells in this area are drilled from about 32 feet to 300 feet. Groundwater management zones have been established for KSDA and are:

- Groundwater Zone 1 (OT027) – Base Living Area
- Groundwater Zone 2 (OT028) – Base Industrial Area
- Groundwater Zone 3 (OT029) – North and South Bluffs
- Groundwater Zone 4 (OT030) – Naknek River Storage Area
- Groundwater Zone 5 (OT031) – Landfills & Fire Training Areas
- Former Groundwater Zone 6 – Naknek Recreation Camp 1
- Naknek Recreation Camp II.

There are clay layers within these groundwater zones that separate the three aquifers, A-Aquifer, B-Aquifer, and C-Aquifer (USGS 1994). This is consistent with the well logs for the KSDA potable water wells, other contaminant studies, and monitoring well reports. Based on previous documentation, an approximate 40-foot clay layer (B-Aquitard) exists that separates the A-Aquifer (approximately 15 feet to 83 feet below ground surface) from the C-Aquifer (below 123 feet below ground surface). The potable wells for the KSDA PWS pull water from the C-Aquifer and are drilled to about 165 feet with a well screen (intake) from 143 feet to 158 feet. The active well, WL0B1, source protection area, is located within Groundwater Zone 2.

## 2.4 SUMMARY

King Salmon is remote on the Katmai Peninsula, approximately 280 miles from Anchorage, Alaska. Groundwater is the only source of potable water for this site and is the source currently used.

# 3.0 TECHNICAL APPROACH AND METHODS

A Source Water Assessment is comprised of three essential components that make up the technical approach and method of assessment. The first part of the assessment is delineating the protected area using an accepted means of delineation. The second is the contaminant source inventory involving many different data sources. The third is assessing the overall vulnerability of the water source to contamination.

## 3.1 PROTECTION AREA DELINEATION

The protection areas established for the wells are typically separated into four zones, limited by the source protection area. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. Zones are defined as:

- Zone A – ¼ the distance for the 2-yr. TOT
- Zone B – Less than the 2-yr TOT
- Zone C – Less than the 5-yr TOT
- Zone D – Less than the 10-yr TOT

ADEC completed the drinking water protection delineation areas for Wells WL0B1 and WL005 and last edited on 7/7/2014 according to Alaska ADEC Drinking Water Protection Area maps (Figures B-4 through B-6). This source assessment is for the active well WL0B1 since WL005 is used as a temporary backup in an emergency and a separate source protection area. These delineated protection areas are the most sensitive areas where protection efforts can have the most significant positive impact and most susceptible to adverse impacts from contaminant sources. Therefore, contaminant sources in this area must be inventoried and managed appropriately. For WL0B1, Zone A is a 100-foot radius to the south, extending in a northern direction approximately 600 feet and widening to 450 feet. Zone B commences after Zone A and continues for 1800 feet and widening to 900 feet. Zone C was not delineated.

# Alaska DEC Drinking Water Protection Areas


9/30/2021

Active Public Water System Source Locations Layer

- Community Water System (C)
- Non-Transient Non-Community Water System (NTNC)
- Non-Community Water System (NC)
- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer)
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

1:36,112

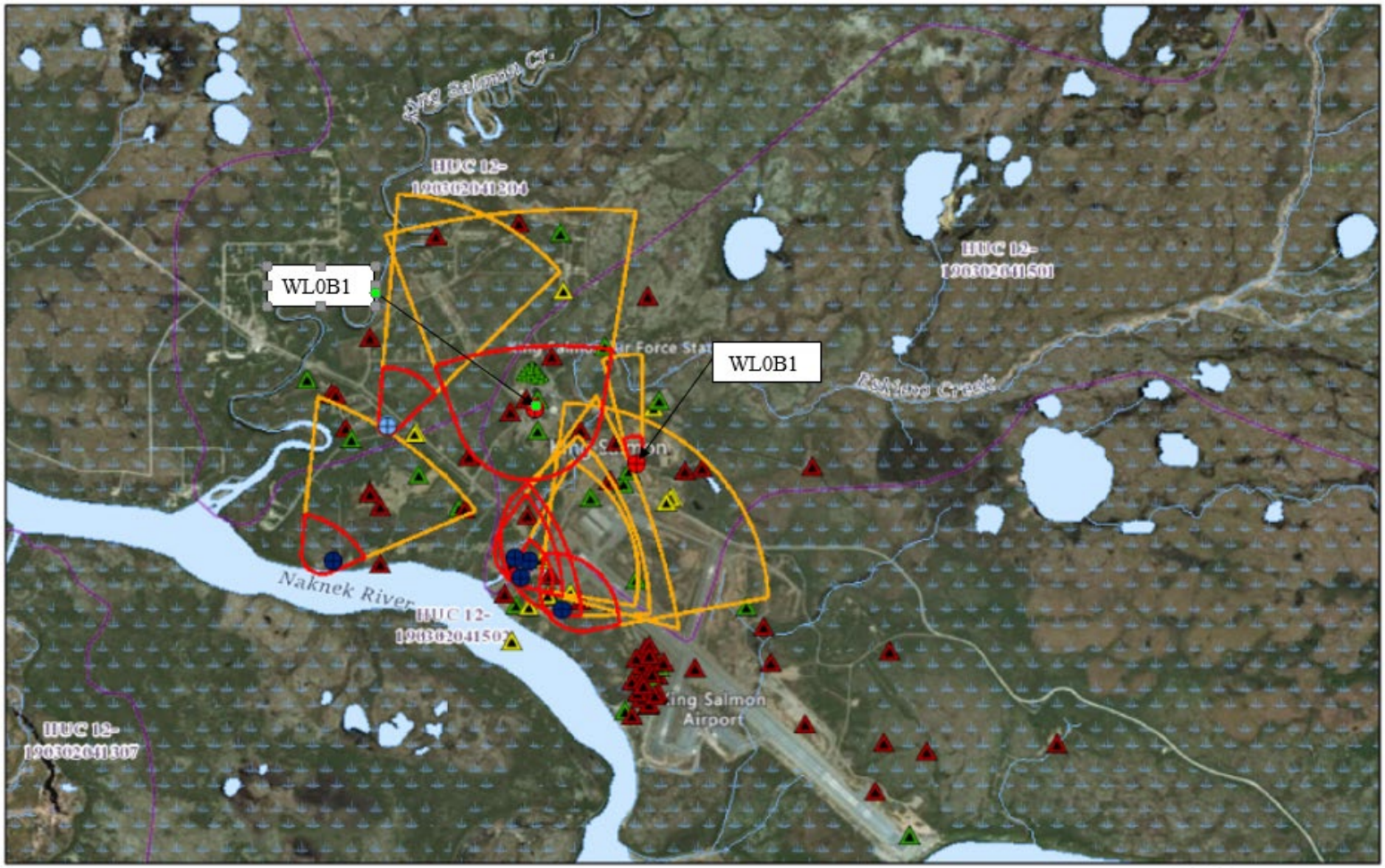
0 0.15 0.3 0.6 mi

0 0.25 0.5 1 km

be Alaska Department of Environmental Conservation – Division of

Figure B-5

# Alaska DEC Drinking Water Protection Areas




9/30/2021

1:72,224

0 0.33 0.65 1.3 mi

0 0.5 1 2 km

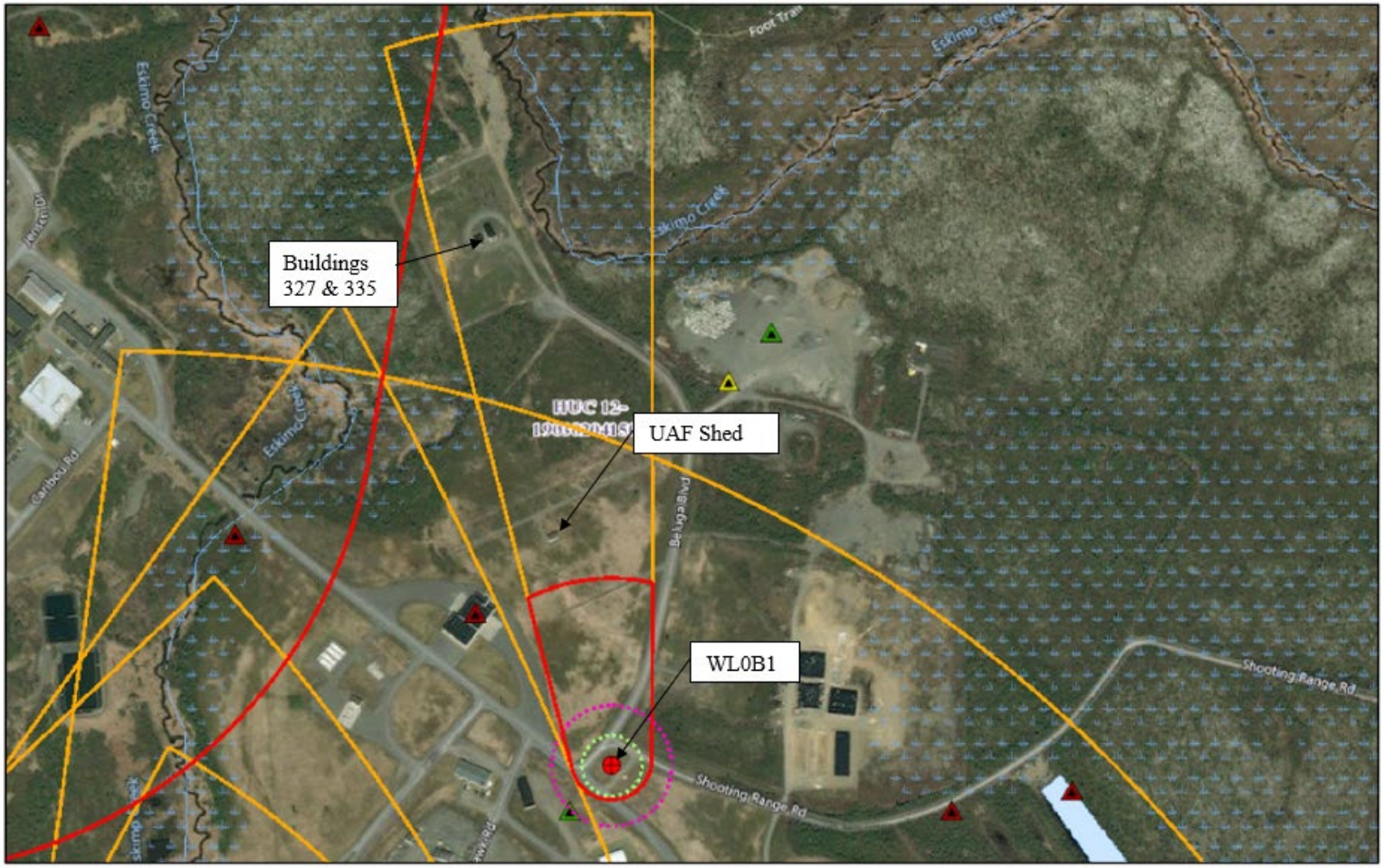
Active Public Water System Source Locations Layer

- Community Water System (C)
- Non-Transient Non-Community Water System (NTNC)
- Non-Community Water System (NC)
- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer)
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

be Alaska Department of Environmental Conservation – Division of

Figure B-4

# Alaska DEC Drinking Water Protection Areas




9/30/2021

Active Public Water System Source Locations Layer

- Community Water System (C)
- Non-Transient Non-Community Water System (NTNC)
- Non-Community Water System (NC)
- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer)
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

1:10,500

0 0.04 0.09 0.18 mi

0 0.07 0.15 0.3 km

be Alaska Department of Environmental Conservation – Division of

Goldstream Engineering, Inc.

Figure B-6

## 3.2 CONTAMINANT SOURCE INVENTORY

The contaminant source inventory identifies potential sources of contamination associated with specific activities, industries, and land uses located within the delineated source water assessment area (Appendix B, Figure B-6).

### 3.2.1 Strategy

Conducting an inventory of current and potential contaminant sources within the drinking water protection area defines the current and potential future risks of contamination (Appendix C, Table C-1). Existing sources (or existing contamination) are those already in the source water which have been pulled into the wells (i.e., detected in a sample).

Existing sources pose a current risk to the water supply at some level. Existing contamination may be artificial (i.e., a spill or leak) or naturally occurring (i.e., metals and nitrates dissolved in source water from the surrounding rock/soil). Potential sources (or potential contamination) may be in the source water or on the ground surface but have not reached the aquifer or well intake; potential sources have not yet contaminated the water supply. Potential sources may be a current structure or activity (i.e., an aboveground storage tank [AST] containing fuel), or it may be historic contamination in the source water that has not yet reached the water supply.

The inventory of current and potential sources at KSDA was gathered by performing fieldwork and a literature search. The fieldwork focused on visually identifying potential sources of contamination at the ground surface. The literature search focused mainly on identifying and documenting historical contamination from past activities at the station.

### 3.2.2 Fieldwork

Fieldwork was accomplished by visual reconnaissance on 3-5 August 2021. The source protection area was surveyed by driving and walking the accessible areas and visually identifying sources of contamination. The visual reconnaissance resulted in an inventory of

contaminant sources in the WL0B1 source protection area. Inventoried sources of contamination included activities, facilities, or structures that use, produce, or store products or waste that can be released, accidentally or by design, in quantities that can significantly impact the source water quality. The contaminant source inventory is located in Appendix D.

### 3.2.3 Literature Search

A literature search was conducted at the AFCEC Administrative Record Website and KSDA for documents, reports, and maps that contain information on the source protection area boundary. They include precipitation, surface and subsurface hydrology, the location and nature of historic contamination, and potential contaminant sources in and around the source protection area. In addition, the 611 Civil Engineer Squadron (CES) at Joint Base Elmendorf-Richardson maintains a library of information about KSDA.

Included in the internet search was the ADEC website for the ADEC Spill Prevention and Response, Contaminated Sites database that was last modified on August 17, 2021. The search focused on the location and nature of known contaminated sites at KSDA. The search results were helpful in assessing the risk to the water source.

### 3.2.4 Update

The fieldwork and literature search data were used to consolidate lists created by USAF, USACPPM, and ADEC of contaminant sources in and around the drinking water protection area. The list was sorted by category of contaminants regulated in drinking water sources.

### 3.2.5 Ranking

The contaminant sources were ranked according to the degree of risk posed to human health based on the volume of contaminants typically associated with the inventoried activity, facility, or structure and the toxicity, persistence, and mobility of contaminants involved. This was accomplished by comparing the inventoried source to the previous ADEC risk-ranking list to determine the rank. Five ranks are defined: very high, high, medium, low, and very low.

## 3.3 ASSESSING VULNERABILITY

The results of the contaminant source inventory, along with information about the gallery's construction and the hydrological characteristics of the source protection area, were used to assess the vulnerability of the drinking water source to contamination
(Appendix C, Table C-2).

ADEC describes vulnerability: natural susceptibility + contaminant risks = vulnerability of surface water source. The components in the equation (natural susceptibility and contaminant risks) are defined by analyses that incorporate various physical/hydrological criteria, including the susceptibility of the wellhead and aquifer. The Alaska regulatory authorities have specified the criteria for the analysis. Each analysis results in a numerical score. The two numerical scores are added together to provide an overall vulnerability for the source water.

A series of flow charts (Appendix F) for conducting the vulnerability assessment and guidance on how to use the charts were provided by the ADEC. The charts provide a structure for evaluating numerous criteria associated with each analysis. Natural susceptibility was assessed by applying the ADEC criteria and using the charts provided by the ADEC to obtain numerical scores for each analysis.

The procedure for evaluating contaminant risk is somewhat different. Six major categories of contaminants are regulated for drinking water sources by the State of Alaska (Appendix C, Table C-1). Contaminant risk was assessed by progressing through the charts six times, once for each category of contaminants, providing a numerical score for each category of contaminant. Then, numerical scores for each of the two analyses (natural susceptibility and contaminant risks) were combined to provide an overall vulnerability for the water source.

# 4.0 SOURCE PROTECTION AREA AND WATER SUPPLY SYSTEM

## 4.1 CURRENT WATER SUPPLY

### 4.1.1 System Information

The current source for the public water system at KSDA is groundwater. The following description of the current system comes from field observations during the August 3-5, 2021, period and desktop research.

### 4.1.2 Class and Identification

The ADEC has identified the KSDA PWS as a non-transient, non-community, groundwater, public water source. The Public Water System Identification (PWSID) number is 260503. The PWS supplies potable water for human consumption, including cooking and bathing.

### 4.1.3 Owner/Operator

The USAF owns the water system, 611th CES/CEAN 10471 20th Street, Suite 337, Joint Base Elmendorf-Richardson, AK, 99506-2200, telephone: (907) 552-5655. Jessica Morris is the 611th CES Water Compliance Manager at Joint Base Elmendorf-Richardson. It is operated and maintained under contract by ASRC as of October 1, 2020. We understand that there was not an ASRC Environmental Manager at the time of our evaluation. The ASRC KSDA Site Operations Manager/Fire Chief is Jason McMichael, and the certified water system operator is Roy Chelf.

### 4.1.4 Status and Operation of Water System

The water system status was active during the field investigation for this study. The system operates every day throughout the year. The contractor, ASRC, employs a minimum of one certified water treatment operator onsite at all times.

### 4.1.5 System Modifications

Modifications to the system have occurred periodically over the years of the water system's existence. It appears that ADEC has approved these modifications.

### 4.1.6 Groundwater Collection System

The active well and primary source for the PWS is Well WL0B1, located next to the WTP (Building 303). The 6-inch diameter well with a bentonite seal pulls water from the C-Aquifer and is drilled to about 165 feet with a well screen (intake) from 143 feet to 158 feet. The static water level is approximately 19 feet below grade, indicating artesian conditions. Water is pumped through a 2-inch HDPE below-grade water line to the WTP. The backup well is WL005, located inside Building 650, and is maintained for use if needed. Based on the well log, WL005 is an 8-inch diameter well that also appears to pull water from C-Aquifer and drilled to a depth of 237 feet. Again, the static water level was noted at 35 feet below grade.

### 4.1.7 Treatment

The raw water is pumped from well WL0B1 to the WTP where the water enters four 30-inch diameter by 72-inch-tall Granulated Activated Carbon (GAC) tanks operated in parallel. The water lines inside the WTP consist mainly of a 4-inch PVC pipe. Three pressure tanks are located before the GAC tanks to maintain pressure throughout the treatment process without short cycling the well pump. Water is then injected with sodium hypochlorite generated from the MIOX unit and enters two contact chambers for iron and manganese oxidation. After the contact chambers, water enters four 30-inch diameter by 87-inch tall Macrolite tanks operated in parallel for iron/manganese removal. Backwash for the GAC and Microlite tanks enters a floor drain with an air gap. The floor drain is connected to a soil absorption system

approximately 105 feet from the WTP. After treatment, filtered water is injected again with sodium hypochlorite generated from the MIOX unit then conveyed through a 4-inch ductile iron pipe to Building 638, where the water storage tanks are located.

### 4.1.8 Storage

After treatment, water is pumped to Building 638, where the storage tanks are located. There are two tanks, ST001 and ST002, that are almost identical and operated parallel. Each storage tank has a 25,000-gallon holding capacity. The well pump is the only pump used in the system, and these storage tanks are pressure vessels, operated more like pressure tanks. From these tanks, water enters the distribution system. In addition, there is a large Fire Suppression Storage Tank located outside of Building 138 that is filled by a manually operated valve located inside Building 138.

### 4.1.9 Distribution System

There are no additional distribution pumps as the well pump produces pressure and flow for the PWS. Water is pumped through the distribution system to the buildings where people work, eat, and sleep. Detailed maps, pipe material, and sizing information are kept at the station for review. Many of the buildings that are not actively being used have been disconnected from service to cut down on the occurrence of dead-end piping.

### 4.1.10 Connections

There are at least 12 service connections associated with the distribution system, including but not limited to the facility headquarters, contractor's offices, fire station, gym, hangars, warehouses, office buildings, shops, fire pump stations, dormitories, and communication buildings. This number will likely reduce in the future as buildings are disconnected and demolished.

### 4.1.11 Cross Connection Control Program

There is an active cross-connection control program that was available at the time of the August 3-5, 2021, onsite investigation. A cross-connection control survey of the devices and the program has been performed. The PWS operator, Roy Chelf, is also certified to test the backflow prevention devices onsite and does this yearly.

### 4.1.12 Population Served

The population consists of 4 residents, 20 non-transients, and 15 transients, for 39 people. It is possible that during a military exercise, the population could increase up to 100 people for a week period, but these exercises are not a common occurrence. The entire population on KSDA is present for work purposes.

### 4.1.13 Water Use

Workers and visitors use the water in the buildings for consumption, cooking, washing, cleaning, firefighting, and other potable purposes. ADEC reports water pressure, quantity, and quality to comply with current regulations.

### 4.1.14 Contingency Plan

Due to the isolation of the C Aquifer, the likelihood of an accidental release of a contaminant reaching the well intake is moderately low. Therefore, the main challenge presented onsite is the loss of power. Power outages in this area are common, and the water system can maintain at least 20 psi during these short-duration outages. According to site personnel, KSDA does not have any backup generators connected to water system components to provide power during extended outages. If contaminants enter the water source aquifer and cannot be treated or removed by the existing treatment components, the water system will need to be evaluated at that time. KSDA currently has ample stored potable water in the water storage tanks and a stored supply of bottled water that could be utilized in the event of a short-term interruption of water production. Additional bottled water would be flown/barged to Naknek and transported to KSDA to meet immediate and interim needs.

### 4.1.15 Emergency Response Plan

In the event of a catastrophe, the main challenge will be the loss of power since power is provided by the Naknek Electric Association operated by the REA Cooperative. There were generators observed onsite, but site personnel indicates that they are not connected to any water system components. The water storage tanks will likely supply pressure to most facilities for a short duration. Alternatively, valves could be closed, and the storage tanks could be used only to fill potable water containers for drinking water purposes. Stored bottled water may also be kept onsite and used. Several barges and flights in the summer months access King Salmon/Naknek areas, so receiving supplies should be less challenging. In the winter months, acquiring supplies is more challenging. Few public water systems in this area have their own backup generators to operate their water system and cannot be relied upon for emergency water. It is suggested that the drinking water emergency plan be re-examined and updated as necessary. It is recommended that the base continue storing bulk and bottled water on site.

## 4.2 SUMMARY

The system has undergone modifications throughout its existence to meet the needs of the USAF and has been maintained to meet permit and regulatory standards. The current system is being appropriately maintained but requires periodic adjustments and modifications to meet changing ADEC requirements and modernized equipment. The ADEC refers to this system as a non-community / non-transient public water system with the PWSID 260503 and has designated the source as groundwater. Currently, the system typically serves about 39 people, although it can increase up to 100 people for a short duration (week) during a military exercise. The potable water is treated, disinfected, stored in tanks, and distributed to various buildings throughout the area.

# 5.0 INVENTORY OF CONTAMINANT SOURCES

Potential, current, and historical sources of contamination were inventoried (Appendix D), and the locations of all inventoried sources were mapped (Figures B-6). Both onsite fieldwork and a records search were used to create the inventory. Potential sources of contaminants were inventoried because they represent the possibility of future contamination. There were no Current or Historical sources of contamination documented within the source protection area of C-Aquifer within the source protection area. However, it has been documented that contamination is present in the A-Aquifer and B-Aquifer of Groundwater Zone 2.

## 5.1 POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination are defined as those that pose a future risk to the drinking water source. For example, an AST that has never leaked is not a current source of contamination, but the tank can leak in the future. Therefore, the tank presents a potential for future contamination.

Potential sources of contamination are mainly associated with the use of three buildings (Buildings 327, 335, and the UAF Shed). In addition, the unpaved roads that traverse the source protection area, the leach field for the water treatment backwash, and the existing contamination that has been found within the A-Aquifer in Groundwater Zone 2. Section 5.2 further details potential sources of contamination. Buildings 327 and 335 have been abandoned and are pending demolition. The UAF Shed consists of electronics that support the UAF Antenna Array.

Dirt/gravel roads run through Zones A and B of the drinking water source protection area. Therefore, there is the possibility of spills contamination due to a transportation incident, releasing hazardous materials directly to the ground and infiltrating downward to groundwater. These spills have the potential to contaminate A-Aquifer and possibly B-Aquifer. However, it is unlikely that contaminants from a spill will reach the intake of the well due to the water source coming from C-Aquifer based on the information we have at the time.

Previous studies indicate that A-Aquifer in Groundwater Zone 2 is contaminated with trichloroethene (TCE), benzene, toluene, ethylbenzene, xylenes, gasoline range organics

(GRO), and recent studies are ongoing to evaluate PFAS and PFC's. Previous studies also indicate hydraulic communication through the aquitard that separates the A-Aquifer and B-Aquifer in Groundwater Zone 1. Since the soil characteristics are relatively similar to Groundwater Zone 2, the same conditions likely occur in Groundwater Zone 2.

Two monitoring wells are located inside the source protection area, CF5MW1901 and MW-707 (near drinking water source well WL0B1). CF5MW1901 consists of a 2-inch diameter PVC casing installed to a depth of approximately 25 feet (A-Aquifer). MW-707 consists of a 2-inch diameter PVC casing installed to a depth of approximately 29 feet (A-Aquifer). We could not find sample data from these two monitoring wells to verify contamination of A-Aquifer within the source protection area. There are no monitoring wells in B-Aquifer or C-Aquifer within the source protection area to verify contamination. No raw water sample results we found for the drinking water well WL0B1.

A leach field that disposes of the backwash water from the water treatment plant is located approximately 105 feet from WL0B1. This leach field is considered a Class V Injection Well based on EPA's definition; "A Class V Injection Well is used to inject non-hazardous fluids underground." This leach field is installed inside the A-Aquifer.

## 5.2 HISTORIC SOURCES OF CONTAMINATION

Historical sources of contamination are defined as sources that have already contaminated the surface or subsurface, particularly groundwater. These situations have usually been discovered and documented, the source removed, and the contamination has typically undergone some form of remediation. For the WL0B1 drinking water protection area, no recorded historical sources of contamination were found in the C-Aquifer.

## 6.0 SORTING AND RANKING CONTAMINANT SOURCES

Potential and historical sources of contamination were sorted and ranked according to the type and level of risk they present. Contaminant sources were sorted into six categories regulated for drinking water sources and then ranked from very high to low.

Contaminant sources were ranked based on guidance from the State of Alaska. In situations where no guidance was given, professional judgment was used. For example, the State of Alaska does not guide ranking contaminated sites or groundwater monitoring wells that may define the lateral and vertical extent of contamination at a site. Therefore, professional judgment was used to rank these contaminant sources based on four factors:

- The lateral and vertical extent, plus the nature and magnitude of the contamination
- The toxicity and volumes associated with a given source
- The number and density of contaminant sources
- The proximity of sources to the infiltration gallery

The six major categories of contaminants are bacteria and viruses, nitrites and nitrates, VOC, heavy metals, synthetic organic contaminants (SOC), and other organic contaminants (OOC). These contaminant categories and the possible sources are listed in Table C-1.

### 6.1 SORTING CONTAMINANT SOURCES

Contaminant sources were sorted into six categories (Table C-1). The results of the sorting produced six tables of inventoried contaminant sources. Each table is for one category of regulated drinking water contaminants.

**Table C-1. Six Major Categories of Contaminants Regulated for Drinking Water Sources.**

| CONTAMINANT CATEGORY | POSSIBLE SOURCE |
|---|---|
| 1. Bacteria/Viruses | Sewage lagoons, septic systems |
| 2. Nitrates/Nitrites | Septic systems, fertilizers, manure piles |
| 3. Volatile Organic Chemicals | Gasoline, fuels, heating oil |
| 4. Heavy Metals | Inorganic chemicals, cyanide, landfills |
| 5. Synthetic Organic Chemicals | Agricultural fields, utility easements, fuels |
| 6. Other Organic Chemicals | Transformers, crude oil, industrial sources |

## 6.2 RANKING CONTAMINANT SOURCES

Contaminant sources were ranked based on the risk criteria mentioned above. Four risk ranks are defined by ADEC: very high, high, medium, and low. All potential sources of contamination received a low score for each risk criteria listed.

## 6.3 SUMMARY

Potential and historic contamination sources at KSDA were sorted into six categories regulated for drinking water sources, then ranked from very high to low risk. Only the sources in Zones A and B were sorted and ranked. The historical sources of contamination were based on water sampling data that we received from ADEC; however, the data may not be from the raw water itself. Each potential source of contamination received a low-risk score.

# 7.0 VULNERABILITY OF DRINKING WATER SOURCE

Vulnerability is a combination of the natural susceptibility and contaminant risks to the drinking water source. The natural susceptibility is the sum of the wellhead and aquifer susceptibilities. The susceptibility of the wellhead is assessed by looking at the construction of the well and its surrounding area. The susceptibility of the aquifer is assessed by looking at naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Contaminant risks range from a value of 0 (no contaminant risk) to 50 (maximum contaminant risk). The equation used to determine natural susceptibility is:

> Susceptibility of the Wellhead (0 to 25 points) + Susceptibility of the Aquifer (0 to 25 points) = Natural Susceptibility (0 to 50 points)

Contaminant risks to a drinking water source depend on the type, density, and distribution of sources. A score of 0 to 50 points is assigned based on the findings of the existing and historical contaminant risks identified in the contaminant risk inventory. Contaminants are separated into six categories, Bacteria/Viruses, Nitrates/Nitrites, Volatile Organic Chemicals, Heavy Metals, Synthetic Organic Chemicals, and Other Organic Chemicals. The equation used to determine the overall vulnerability rating for each category is:

> Natural Susceptibility (0 to 50 points) + Contaminant Risks (0 to 50 points) = Overall Vulnerability (0 to 100 points)

The overall vulnerability score is as follows:

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

## 7.1 VULNERABILITY ASSESSMENT

A series of charts for conducting the vulnerability assessment on the water source was provided by the ADEC. These charts are presented in Appendix F. Chart F-1 shows the susceptibility of the wellhead, and Chart F-2 shows the susceptibility of the aquifer, which sum to be the natural susceptibility. The vulnerability to each category of regulated contaminants is shown in charts F-3a to F-8d.

## 7.2 NATURAL SUSCEPTIBILITY

The susceptibility of the wellhead score was 0 (low) primarily due to the well-being capped and not located within a flood plain. The surface sloped away from the well, and the well was documented as adequately grouted (see Chart F-1). The susceptibility of the aquifer score was 8 (low), mostly due to the thickness of the two aquitards that separate the drinking water aquifer from contamination in the A-Aquifer. These total a natural susceptibility score of 8 points (see Chart F-2). Based on guidance from the ADEC, this score means a low natural susceptibility to contamination.

## 7.3 VULNERABILITY TO BACTERIA /VIRUSES

A water source's vulnerability to bacteria and virus contamination is usually attributed to wastewater release through sewage lagoons or septic systems.

### 7.3.1 Vulnerability Scoring

The overall source water score for vulnerability to bacteria/viruses is 10, with a rating of low (see Charts F-3a through F-3c). The low score results from a low natural susceptibility plus a low risk for bacteria/viruses. There did not appear to be any sewage lagoons or septic systems located within the source protection area. However, there is some uncertainty about the bacteria/viruses contaminant risk, mainly regarding the previous use of buildings 327 and 335, located in Zone B. These buildings have been abandoned and are pending demolition. In addition, the roads within the source protection area are open to the public. Therefore, it is unclear what contaminants may be transported.

A leach field is located approximately 80 feet away from the well that is used to dispose of the backwash water from the water treatment plant. Although technically located outside of the source protection area, it was included due to the proximity to the well. Therefore, it is unlikely that this soil absorption system will increase the risks.

## 7.4 VULNERABILITY TO NITRATES/NITRITES

A water source's vulnerability to nitrates and nitrites contamination is usually attributed to septic systems, fertilizers, and animal manure piles.

### 7.4.1 Vulnerability Scoring

The overall source water score for vulnerability to nitrates/nitrites is 10, with a low rating (see Charts F-4a through F-4d and Table C-2). The low score results from a low natural susceptibility plus a low risk for nitrates/nitrites. There did not appear to be any sewage lagoons or septic systems located within the source protection area. There is uncertainty about the nitrates/nitrites contaminant risk, mainly regarding the previous use of buildings 327 and 335, located in Zone B. These buildings have been abandoned and are pending demolition. In addition, the roads within the source protection area are open to the public. Therefore, it is unclear what contaminants may be transported. A leach field is located approximately 80 feet away from the well used to dispose of the backwash water from the water treatment plant. Although technically located outside of the source protection area, it was included due to the proximity to the well. It is unlikely that this soil absorption system will increase the risk to the well.

## 7.5 VULNERABILITY TO VOLATILE ORGANIC COMPOUNDS

A water source's vulnerability to VOC contamination is usually attributed to a spill of gasoline, fuels, or heating oil in the source protection area.

### 7.5.1 Vulnerability Scoring

The overall source water score for vulnerability to VOC is 10, with a rating of low (see Charts F-5a through F-5d and Table C-2). The low score results from a low natural susceptibility plus a low risk for VOC. There did not appear to be any fuel tanks inside the source protection area. However, several roads within the source protection area are open to the public; therefore, it would be difficult to control the possibility of a fuel leak during transportation. TCE, BTEX, and other contaminants have been documented in A-Aquifer.

## 7.6 VULNERABILITY TO HEAVY METALS, CYANIDE, AND OTHER INORGANIC CHEMICALS

A water source's vulnerability to heavy metals contamination is usually attributed to inorganic chemicals, cyanide, and landfill leaching.

### 7.6.1 Vulnerability Scoring

The overall source water score for vulnerability to heavy metals is 10, with a low rating (see Charts F-6a through F-6d and Table C-2). The low score results from a low natural susceptibility plus a low risk for heavy metals. There did not appear to be any landfills or other potential sources located inside the source protection area; however, several roads within the source protection area are open to the public. Therefore, it would not be easy to control the contaminants that may be transported.

## 7.7 VULNERABILITY TO SYNTHETIC ORGANIC CONTAMINANTS

The overall source water score for vulnerability to SOC's is 10, with a rating of low (see Charts F-7a through F-7d and Table C-2). The low score results from a low natural susceptibility plus a low risk for SOC's. There did not appear to be any potential sources inside the source protection area. However, several roads within the source protection area are open to the public; therefore, it would be difficult to control the contaminants that may be transported. PFAS has been documented within the A-Aquifer in Groundwater Zone 2. There are ongoing efforts to determine the sources and extent of the contamination.

## 7.8 VULNERABILITY TO OTHER ORGANIC CONTAMINANTS

The overall source water score for vulnerability to OOC's is 10, with a rating of low (see Charts F-8a through F-8d and Table C-2). The low score results from a low natural susceptibility plus a low risk for OOC's. There did not appear to be any potential sources within the source protection area. However, there are roads open to the public.

## 7.9 OPTIMIZING ONGOING ACTIVITIES

The source water assessment results can be used to optimize ongoing activities that have the potential to affect the quality of the drinking water source.

## 7.10 FUTURE VULNERABILITY

Although the air station is currently in caretaker status, there are ongoing activities at the facility. Therefore, with continuing activities at KSDA, conditions, structures, activities, and potential sources of contamination may change.

The State of Alaska recommends source water assessment updates for active facilities every 5 years following initial assessments to reflect changes in local conditions. Therefore, it would be prudent to update this source water assessment in 5 years to reflect any changes in local conditions. For example, if buildings 327 and 335 are demolished and removed, this may reduce the overall assessment or may also increase depending on if any contamination is found.

## 7.11 CONTINGENCY WATER SUPPLY

The backup well WL005 may be used as a contingent water source. Although the water source was not included in this source water assessment, more potential sources of contamination likely exist for this well. Water stored inside the storage tanks could be used when there is a power loss. If both wells become contaminated with contaminants that the existing treatment system cannot remove, bottled water may be used. More bottled water could also be flown or barged in to supplement the existing supply.

## 7.12 SUMMARY

The overall vulnerability of the KSDA source water is judged to be low. The well appears to have been constructed properly, and it is currently being maintained to protect the water. There are very few potential sources of contamination within the source protection area designated by ADEC for the active well. Additionally, the water source is further protected by two aquitards that protect the aquifer used for drinking water from potential surface contaminants. As time goes on, the future vulnerability of the source water may change.

# 8.0 RESULTS COMMUNICATION

It is essential that the owners/operators of the water system, consumers of the water produced by the system, and anyone who can preserve or compromise the quality of the water in the system receive the results of this assessment.

## 8.1 USAF COMMUNICATION

Most of these people are USAF personnel and their contractors at Joint Base Elmendorf-Richardson and KSDA. Because of this, it is recommended that Table C-2 (the susceptibility/vulnerability results for the source protection area and raw water source) be published in the CCR.

## 8.2 PUBLIC COMMUNICATION

Typically, Source Water Assessments are distributed to water system owners and operators, local governments, and other entities interested in preserving the quality of the water supply. In addition, the results are posted on the ADEC Drinking Water Protection Program website (www.state.ak.us/dec/water/source) and placed on reserve at a local library in the area of the water system. This document may be distributed to the public to meet the goals of Alaska's drinking water program; however, the document is often only summarized for the public due to security concerns. It is recommended that direct coordination with the ADEC be conducted to determine the appropriate public communication.

# 9.0 SUMMARY

## 9.1 WATER SUPPLY

Groundwater wells are the source of public drinking water for the area. There is currently WL0B1, the active well located near the water treatment plant. In addition, a backup well (WL005) is located near the water storage tanks. The system is classified as groundwater. The water system is owned by the U.S. Air Force and operated by Arctic Slope Regional Corporation (ASRC under contract to provide Base Operational Support Services (BOSS). ADEC identified the drinking water source protection areas divided into Zone A and Zone B. Therefore, we have no reason to suspect the source water protection area was done incorrectly.

## 9.2 DRINKING WATER PROTECTION AREA

The drinking water protection area was identified by ADEC in 2014 and consisted of two zones, Zone A and Zone B. As displayed in Appendix B, Figure B- 6, the source protection area boundary is believed to be hydrologically correct and is the boundary used for this source water assessment.

## 9.3 CONTAMINANT SOURCES

Potential and historical sources of contamination were inventoried, sorted, and ranked according to the type and level of risk they present. Contaminant sources were sorted into six categories regulated for drinking water sources and then ranked very high to very low. Very few potential sources were found.

## 9.4 VULNERABILITY ASSESSMENT

Potential, current, and historic sources of contamination were evaluated for the level of threat posed to the drinking water source. In addition, the susceptibility of the wellhead and aquifer was also assessed and collectively known as the natural susceptibility of the source water.

The overall vulnerability of the KSDA source water is judged to be low. The well appears to have been constructed correctly, and it is currently being maintained to protect the water. There are very few potential sources of contamination within the source protection area designated by ADEC for the active well. Additionally, the water source is further protected by two aquitards that protect the aquifer used for drinking water from potential surface contaminants. As time goes on, the future vulnerability of the source water may change. Therefore, updating this source water assessment further in the future may be prudent.

## 9.5 COMMUNICATION

In order to meet the regulatory requirements of notification to the public about the water source, the Executive Summary of the Source Water Assessment should be published in the annual Consumer Confidence Report (CCR). It is recommended that Table C-2 (the susceptibility vulnerability results for the source protection area and raw water source) and Figure B-1 (the source protection area map) be published in the CCR.

## 10.0 RECOMMENDATIONS

- Should abandoned Buildings 327 and 335 be demolished, any contaminants found during demolition should be reported and evaluated as a potential source of contamination to the well WL0B1.
- We understand that a well is located at Buildings 327/335, which may have been used to provide water to these buildings. Little information is known about this well, such as the construction or depth. We recommend well testing to verify the depth and water samples collected to verify the presence of contamination at the source intake depth. This well may be upgradient from WL0B1, and could potentially be an indicator of future challenges that may be experienced at the active well WL0B1, especially if they are in the same aquifer.
- Place signs that restrict fuel trucks and other hazardous materials from traveling within 200 feet of well WL0B1.
- Coordinate directly with ADEC to determine appropriate public communication. Typically, this assessment is included in the yearly Consumer Confidence Report.
- Publish the Executive Summary, Table C-2, and Figure B-6 in the Consumer Confidence Report (CCR).
- Re-examine the drinking water emergency plan for adequacy.
- Collect raw water samples from WL0B1 every year for contaminants found in A-Aquifer in Groundwater Zone 2.
- Additional monitoring wells that may be potentially installed within the source protection area of Well WL0B1 should be carefully evaluated and designed to protect the groundwater.
- All wells that access the B or C-Aquifers that are not in use should be properly decommissioned. Re-evaluate Drinking Water Source Area in five years.
- A Source Water Assessment should be completed for the Emergency Backup Well WL005.
- Additional recommendations regarding the water system are included in the KSDA PWS Recommendation Letter submitted October 27, 2021, by Goldstream Engineering, Inc.

## 11.0 REFERENCES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# APPENDIX A

## Photo Log

Photo No. 1 WL0B1 and WTP Looking West

Photo No. 2
WL0B1 and WTP Looking East

Photo No. 3 WL0B1 and WTP
Looking Northeast

Photo No. 4 Soil Absorption
System near WTP for the GAC &
Microlite Filter Backwash
View Looking Northwest

Photo No. 5 Monitoring Well 707 in
front of WL0B1 and WTP
View Looking East

Photo No. 6 Source Protection Area
View Looking South


Photo No. 7 Typical Building Double Walled Fuel Tank – Outside of Source Protection Area
View Looking Northeast


Photo No. 8 Building 327 and 335
View Looking Northwest

# APPENDIX B

## Figures


HORIZONTAL SCALE IN FEET

1000 0 1000

THIS VICINITY MAP IS FOR REFERENCE ONLY AS PART OF THE 2021 SANITARY SURVEY.

Figure B-1

GOLDSTREAM ENGINEERING
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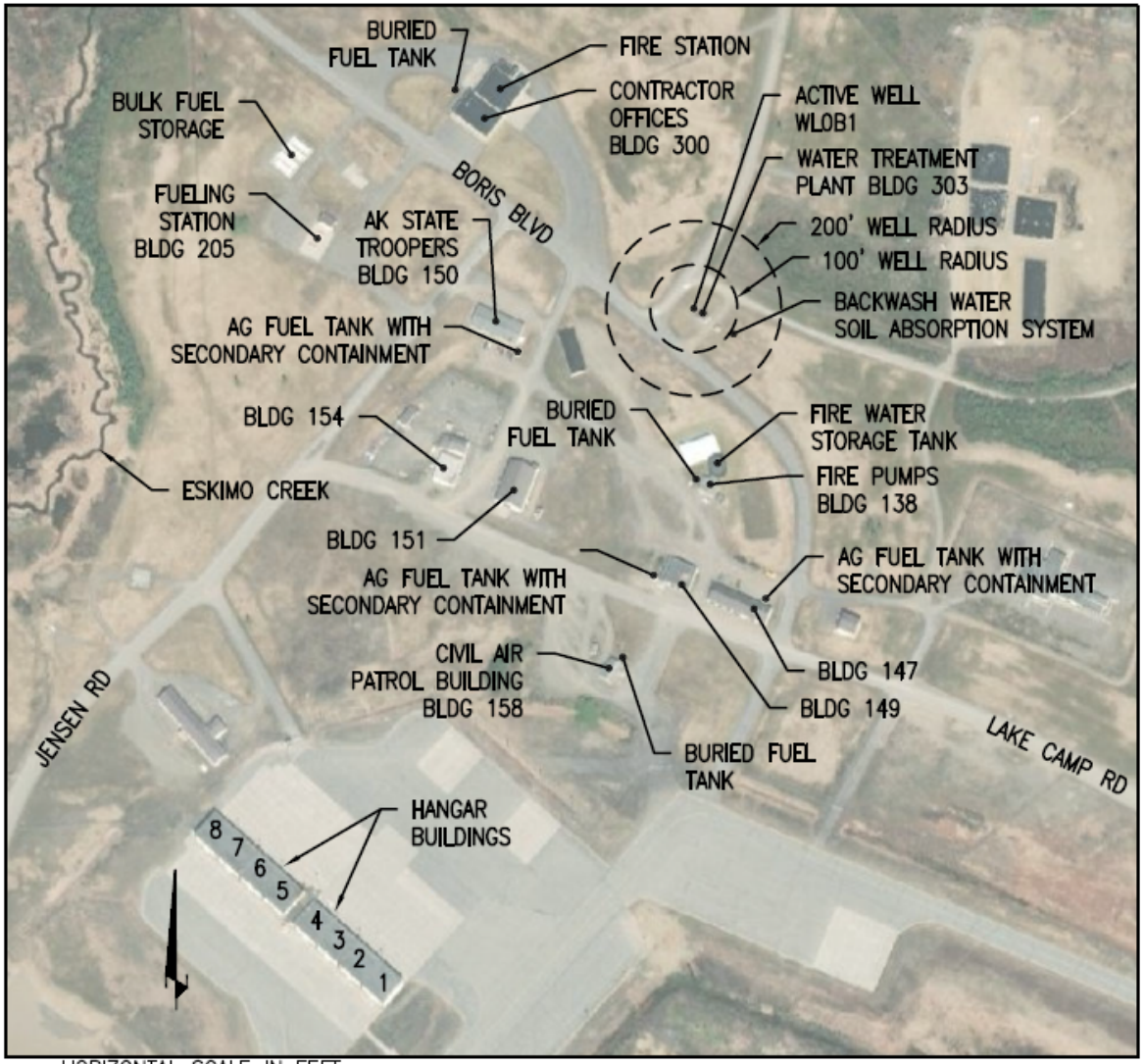
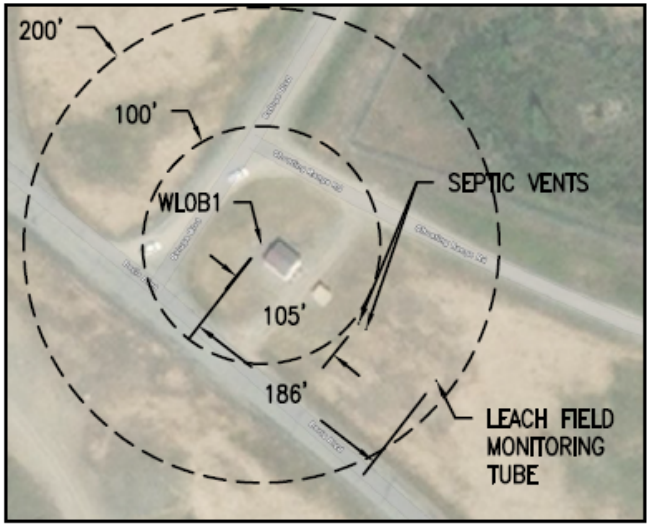
(907) 456-6653 FAX: (907) 456-6654

USAF KING SALMON
VICINITY MAP
2021 SANITARY SURVEY

| | |
|---|---|
| DATE: | 8/16/2021 |
| PROJ MGR: | AH |
| DRAWN: | AH |

C1




ACTIVE WELL WLOB1
SCALE: 1"=150'

HORIZONTAL SCALE IN FEET

400 0 400

THIS VICINITY MAP IS FOR REFERENCE ONLY AS PART OF THE 2021 SANITARY SURVEY.

Figure B-2

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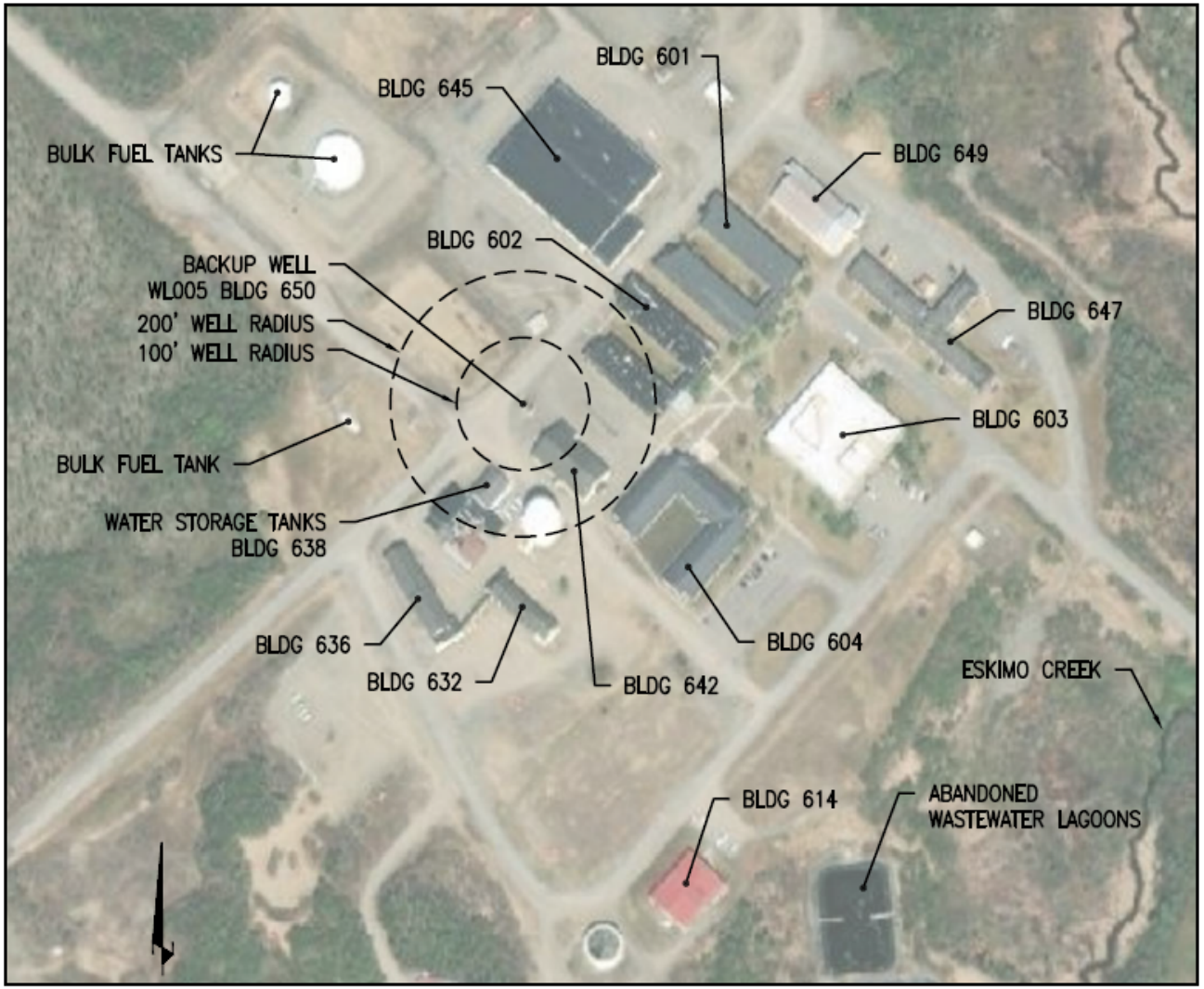
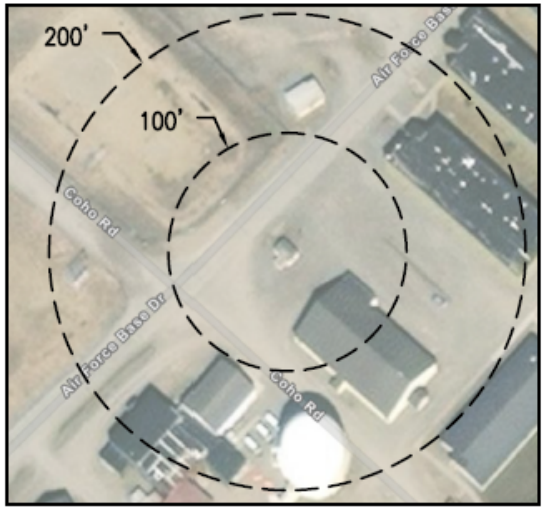
USAF KING SALMON
VICINITY MAP
2021 SANITARY SURVEY

| | |
|---|---|
| DATE: | 8/16/2021 |
| PROJ MGR: | AH |
| DRAWN: | AH |

C2




BACKUP WELL WL005
SCALE: 1"=150'

HORIZONTAL SCALE IN FEET
250 0 250

THIS VICINITY MAP IS FOR REFERENCE ONLY AS PART OF THE 2021 SANITARY SURVEY.

Figure B-3

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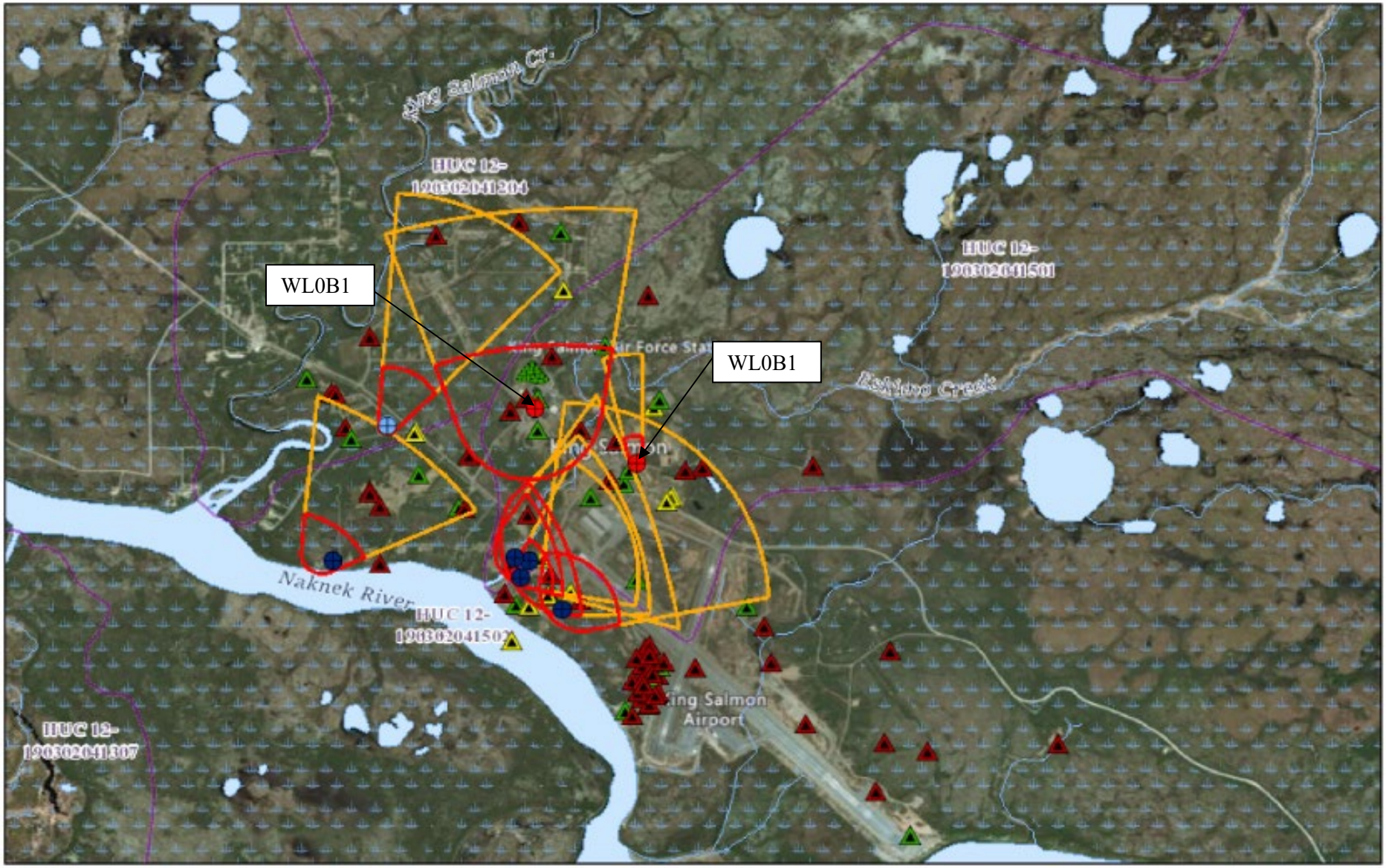
VICINITY MAP
2021 SANITARY SURVEY

DATE: 8/16/2021
PROJ MGR: AH
DRAWN: AH

C3

# Alaska DEC Drinking Water Protection Areas




9/30/2021

Active Public Water System Source Locations Layer

- Community Water System (C)
- Non-Transient Non-Community Water System (NTNC)
- Non-Community Water System (NC)
- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer)
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

1:72,224

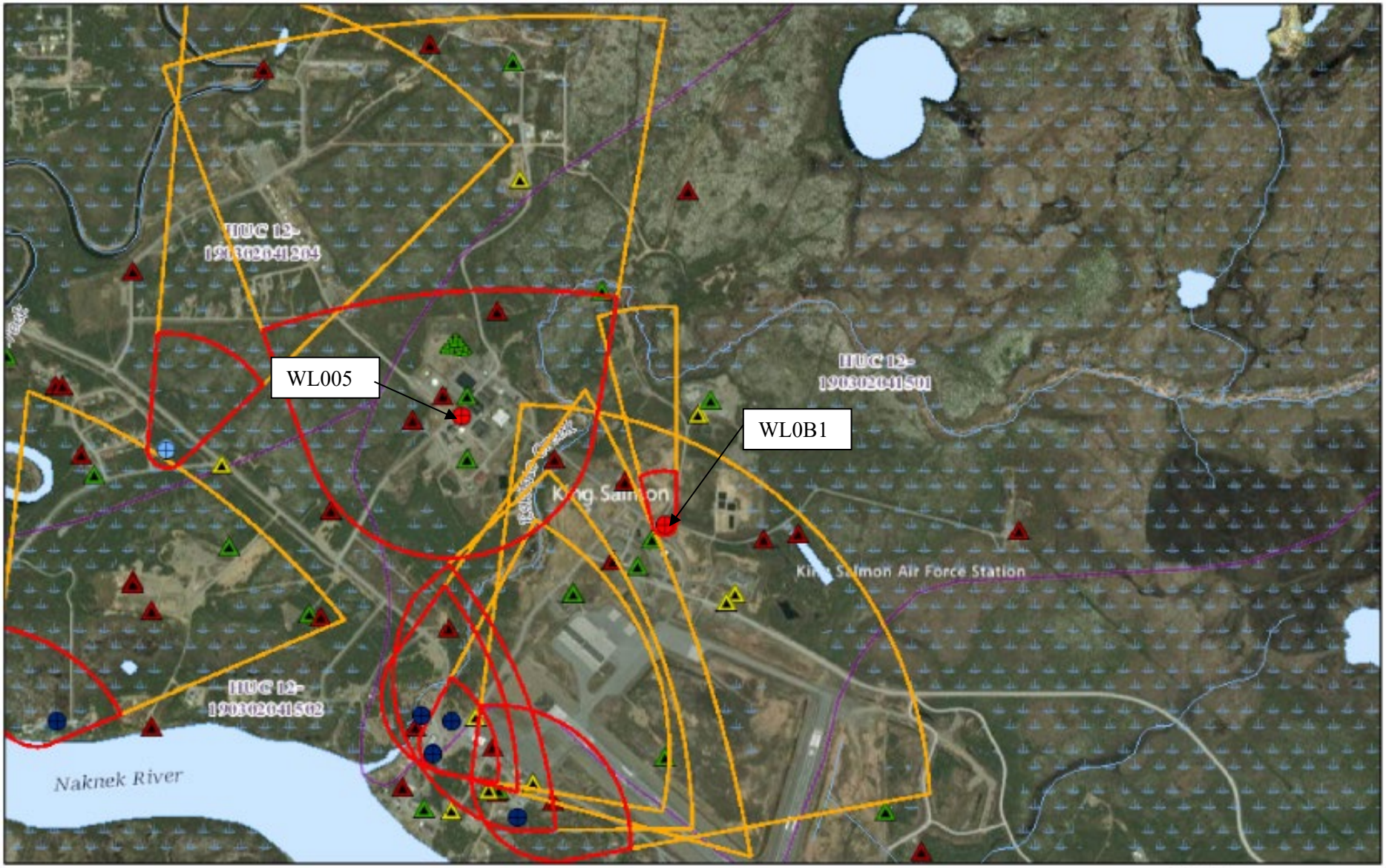
0 0.33 0.65 1.3 mi

0 0.5 1 2 km

be Alaska Department of Environmental Conservation – Division of

Figure B-4

# Alaska DEC Drinking Water Protection Areas




9/30/2021

Active Public Water System Source Locations Layer

- Community Water System (C)
- Non-Transient Non-Community Water System (NTNC)
- Non-Community Water System (NC)
- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer)
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

1:36,112

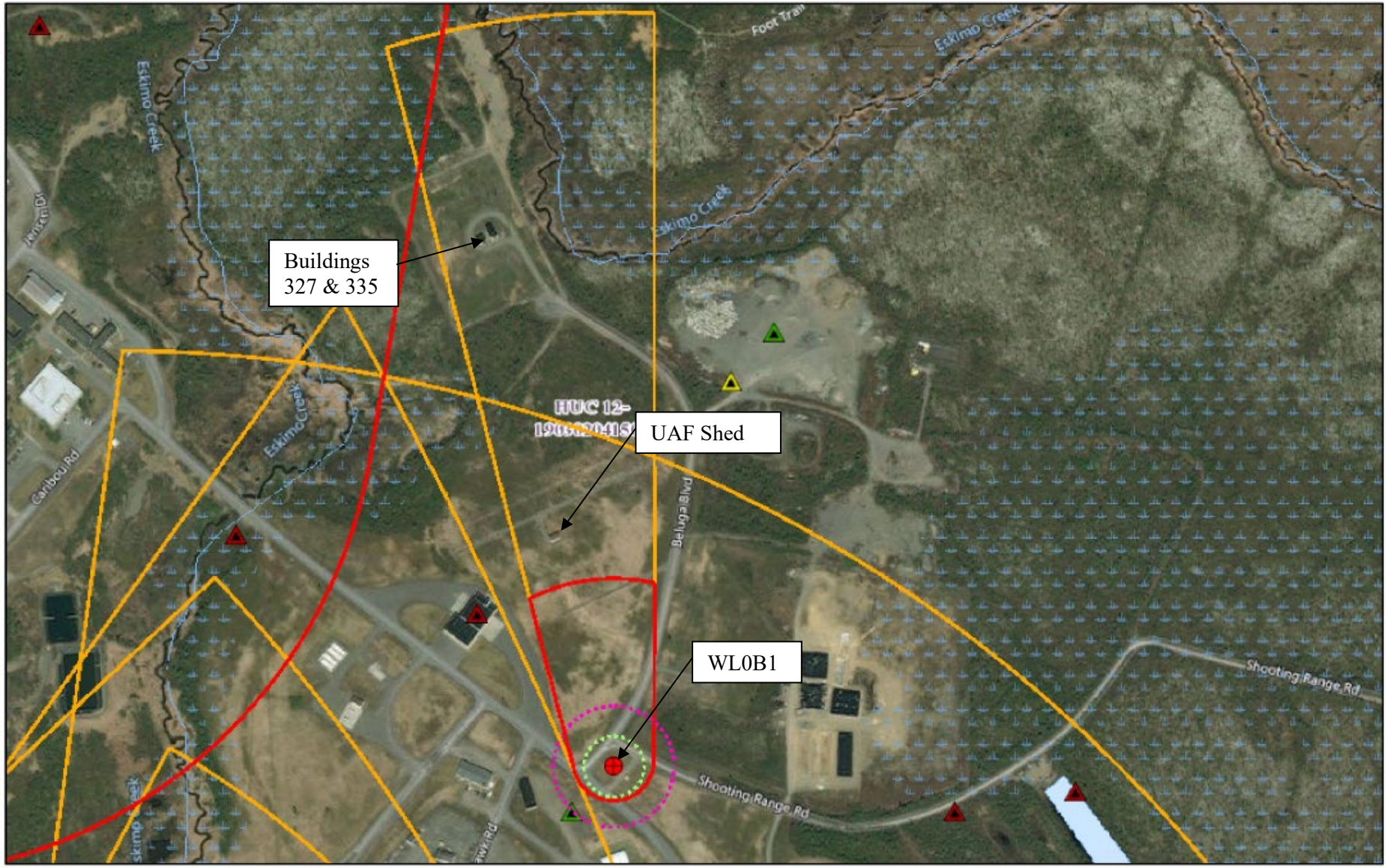
0 0.15 0.3 0.6 mi

0 0.25 0.5 1 km

be Alaska Department of Environmental Conservation – Division of

Figure B-5

# Alaska DEC Drinking Water Protection Areas




9/30/2021

Active Public Water System Source Locations Layer

- Community Water System (C)
- Non-Transient Non-Community Water System (NTNC)
- Non-Community Water System (NC)
- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer)
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

1:10,500

0 0.04 0.09 0.18 mi

0 0.07 0.15 0.3 km

be Alaska Department of Environmental Conservation – Division of

Goldstream Engineering, Inc.

Figure B-6

# APPENDIX C

## Tables

**Table C-1. Six Major Categories of Contaminants Regulated for Drinking Water Sources.**

| CONTAMINANT CATEGORY | POSSIBLE SOURCE |
|---|---|
| 1. Bacteria/Viruses | Sewage lagoons, septic systems |
| 2. Nitrates/Nitrites | Septic systems, fertilizers, manure piles |
| 3. Volatile Organic Chemicals | Gasoline, fuels, heating oil |
| 4. Heavy Metals | Inorganic chemicals, cyanide, landfills |
| 5. Synthetic Organic Chemicals | Agricultural fields, utility easements, fuels |
| 6. Other Organic Chemicals | Transformers, crude oil, industrial sources |

**Table C-2. Summary of Susceptibility /Vulnerability Scores and Ratings for the Water Supply Source Protection Area, KSDA, AK.**

| | Vulnerability Score (points) | Vulnerability Rating |
|---|---|---|
| WELLHEAD SUSCEPTIBILITY | 0 | Low |
| AQUIFER SUSCEPTIBILITY | 8 | Low |
| CONTAMINANT RISKS | | |
| 1. Bacteria/viruses | 10 | Low |
| 2. Nitrates/nitrites | 10 | Low |
| 3. Volatile organic chemicals | 10 | Low |
| 4. Metals, cyanide, other inorganics | 10 | Low |
| 5. Synthetic organic chemicals | 10 | Low |
| 6. Other synthetic organic chemicals | 10 | Low |
| OVERALL VULNERABILITY | 10 | Low |

NOTE: wellhead susceptibility + aquifer susceptibility + contaminant risks = vulnerability.

# APPENDIX D

## Inventory

# APPENDIX D
# CONTAMINANT SOURCE INVENTORY

## TABLE D-1. CONTAMINANT SOURCE (CS) INVENTORY, PWSID 260503, KSDA, AK

| CS Category [1] | CS ID [2] | CS ID tag [3] | Zone[4] | Location [5] | Source of Information | Comments |
|---|---|---|---|---|---|---|
| Current contaminant sources | | | | | | |
| None | N/A | N/A | A & B | N/A | ADEC Contaminated Sites Database | No historical contamination is noted within the WL0B1 Source Protection Delineation Area. |
| Historical contaminant sources – monitoring wells | | | | | | |
| None | N/A | N/A | A & B | N/A | ADEC Contaminated Sites Database | No historical contamination is noted within the WL0B1 Source Protection Delineation Area. |
| Monitoring Well CF5MW1901 | W6 | 1 | A | Approximately 300 feet from WL0B1 | AFC Admin Record | No data found on sample results |
| Monitoring Well MW-707 | W6 | 2 | A | Near WL0B1 well | AFC Admin Record | No data found on sample results |
| Historical contaminant sources – source areas | | | | | | |
| None | N/A | N/A | A & B | N/A | ADEC Contaminated Sites Database | No historical contamination is noted within the WL0B1 Source Protection Delineation Area. |
| Potential contaminant sources | | | | | | |
| Injection Well (Class V) | D10 | 3 | A | 105 feet from WTP | Onsite Observations | Backwash water disposal from GAC and Microlite filters. |
| Dirt/gravel roads | X24 | 4 | A, B | Approximately 0.25 miles of gravel road in source protection area. | Onsite Observations | Beluga Blvd. and Shooting Range Rd. |
| UAF Shed | X27 | 5 | B | 800 feet from WL0B1 | Onsite Observations | Small shed that contains communication equipment for the University of Alaska Fairbanks to support the antenna array. |
| Buildings 327 and 335 | X27 | 6 | B | 1800 feet from WL0B1 | Onsite Observations | Building is abandoned, no longer in use, and pending demolition. |
| GZ2 – A-Aquifer Contamination | | 7 | A, B | Varies, throughout | AFC Admin Record (referenced in report) | Existing contamination may be present in A-Aquifer within source protection area. |

NOTES: 1. Categories are established by. 2. Contaminant source identification numbers (CS ID) are established by ADEC. These numbers correspond to contaminant source numbers in Figure 6. 4. Zones A and B defined in Figure 6. 5. See Figures 1-6.

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# APPENDIX E

## Inventory Ranking

# APPENDIX E
# CONTAMINANT SOURCE SORTING AND RANKING

## TABLE E-1. CS RANKING – SOURCES OF BACTERIA AND VIRUSES, KSDA, AK

| C.S. Category [1] | CS ID [2] | CS ID tag [3] | Zone[4] | Location [5] | Risk Ranking | Comments |
|---|---|---|---|---|---|---|
| Injection Well (Class V) | D10 | 3 | A | 105 feet from WTP | Low | Not a significant source of bacteria/viruses. |
| Dirt/gravel roads | X24 | 4 | A, B | Approximately 0.25 miles of gravel road in source protection area. | Low | Not a significant source of bacteria/viruses. |
| UAF Shed | X27 | 5 | B | 800 feet from WL0B1 | Low | Not a significant source of bacteria/viruses. |
| Buildings 327 and 335 | X27 | 6 | B | 1800 feet from WL0B1 | Low | No longer in use, not a significant source of bacteria/viruses. |
| GZ2 – A-Aquifer Contamination | | 7 | A, B | Varies, throughout | Low | Not a significant source of bacteria/viruses. |

## TABLE E-2. CS RANKING – SOURCES OF NITRATES/NITRITES, KSDA, AK

| C.S. Category [1] | CS ID [2] | CS ID tag [3] | Zone[4] | Location [5] | Risk Ranking | Comments |
|---|---|---|---|---|---|---|
| Injection Well (Class V) | D10 | 3 | A | 105 feet from WTP | Low | Not a significant source of Nitrates/Nitrites. |
| Dirt/gravel roads | X24 | 4 | A, B | Approximately 0.25 miles of gravel road in source protection area. | Low | Not a significant source of Nitrates/Nitrites. |
| UAF Shed | X27 | 5 | B | 800 feet from WL0B1 | Low | Not a significant source of Nitrates/Nitrites. |
| Buildings 327 and 335 | X27 | 6 | B | 1800 feet from WL0B1 | Low | Not a significant source of Nitrates/Nitrites. |
| GZ2 – A-Aquifer Contamination | | 7 | A, B | Varies, throughout | Low | Not a significant source of Nitrates/Nitrites. |

## TABLE E-3. CS RANKING – SOURCES OF VOLATILE ORGANIC CHEMICALS, KSDA, AK

| C.S. Category [1] | CS ID [2] | CS ID tag [3] | Zone[4] | Location [5] | Risk Ranking | Comments |
|---|---|---|---|---|---|---|
| Injection Well (Class V) | D10 | 3 | A | 105 feet from WTP | Low | Not a significant source of VOC's. |
| Dirt/gravel roads | X24 | 4 | A, B | Approximately 0.25 miles of gravel road in source protection area. | Low | Not a significant source of VOC's. |
| UAF Shed | X27 | 5 | B | 800 feet from WL0B1 | Low | Not a significant source of VOC's. |
| Buildings 327 and 335 | X27 | 6 | B | 1800 feet from WL0B1 | Low | Not a significant source of VOC's. |
| GZ2 – A-Aquifer Contamination | | 7 | A, B | Varies, throughout | Low | TCE, BTEX documented in A-Aquifer for GWZ 2. |

## TABLE E-4. CS RANKING – SOURCES OF HEAVY METALS, CYANIDE, AND OTHER INORGANIC CHEMICALS, KSDA, AK

| C.S. Category [1] | CS ID [2] | CS ID tag [3] | Zone[4] | Location [5] | Risk Ranking | Comments |
|---|---|---|---|---|---|---|
| Injection Well (Class V) | D10 | 3 | A | 105 feet from WTP | Low | Not a significant source. |
| Dirt/gravel roads | X24 | 4 | A, B | Approximately 0.25 miles of gravel road in the source protection area. | Low | Not a significant source. |
| UAF Shed | X27 | 5 | B | 800 feet from WL0B1 | Low | Not a significant source. |
| Buildings 327 and 335 | X27 | 6 | B | 1800 feet from WL0B1 | Low | Not a significant source. |
| GZ2 – A-Aquifer Contamination | | 7 | A, B | Varies, throughout | Low | Not a significant source. |

NOTES:
Only those contaminant sources that are inside the drinking water protection area shown on Figure 6 (zones A and B) are in this list.
1. Categories are established by EPA/ADEC.
2. Contaminant source identification numbers (CS ID) are established by EPA/ADEC.
3. These numbers correspond to contaminant source numbers in Figure 6.
4. Zones A and B defined in Figure 6.
5. See Figures 1-6.

## TABLE E-5. CS RANKING – SOURCES OF SYNTHETIC ORGANIC CHEMICALS, KSDA, AK

| C.S. Category [1] | CS ID [2] | CS ID tag [3] | Zone[4] | Location [5] | Risk Ranking | Comments |
|---|---|---|---|---|---|---|
| Injection Well (Class V) | D10 | 3 | A | 105 feet from WTP | Low | Not a significant source of SOC's. |
| Dirt/gravel roads | X24 | 4 | A, B | Approximately 0.25 miles of gravel road in source protection area. | Low | Not a significant source of SOC's. |
| UAF Shed | X27 | 5 | B | 800 feet from WL0B1 | Low | Not a significant source of SOC's. |
| Buildings 327 and 335 | X27 | 6 | B | 1800 feet from WL0B1 | Low | Not a significant source of SOC's. |
| GZ2 – A-Aquifer Contamination | | 7 | A, B | Varies, throughout | Low | PFAS documented in A-Aquifer for GWZ2, investigation ongoing. |

## TABLE E-6. CS RANKING – SOURCES OF OTHER SYNTHETIC ORGANIC CHEMICALS, KSDA, AK

| C.S. Category [1] | CS ID [2] | CS ID tag [3] | Zone[4] | Location [5] | Risk Ranking | Comments |
|---|---|---|---|---|---|---|
| Injection Well (Class V) | D10 | 1 | A | 105 feet from WTP | Low | Not a significant source of other SOC's. |
| Dirt/gravel roads | X24 | 1 | A, B | Approximately 0.25 miles of gravel road in source protection area. | Low | Not a significant source of other SOC's. |
| UAF Shed | X27 | 1 | B | 800 feet from WL0B1 | Low | Not a significant source of other SOC's. |
| Buildings 327 and 335 | X27 | 2 | B | 1800 feet from WL0B1 | Low | Not a significant source of other SOC's. |
| GZ2 – A-Aquifer Contamination | | | A, B | Varies, throughout | Low | Other contaminants documented in A-Aquifer for GWZ2, investigation on going. |

NOTES:
Only those contaminant sources that are inside the drinking water protection area shown on Figure C-10 (zones A and B) are in this list.

6. Categories are established by EPA/ADEC.
7. Contaminant source identification numbers (CS ID) are established by EPA/ADEC.
8. These numbers correspond to contaminant source numbers in Figure 6.
9. Zones A and B defined in Figure 6.
10. See Figures 1-6.

# APPENDIX F

## Flow Charts

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***Chart F-1. Susceptibility of the wellhead - USAF King Salmon***

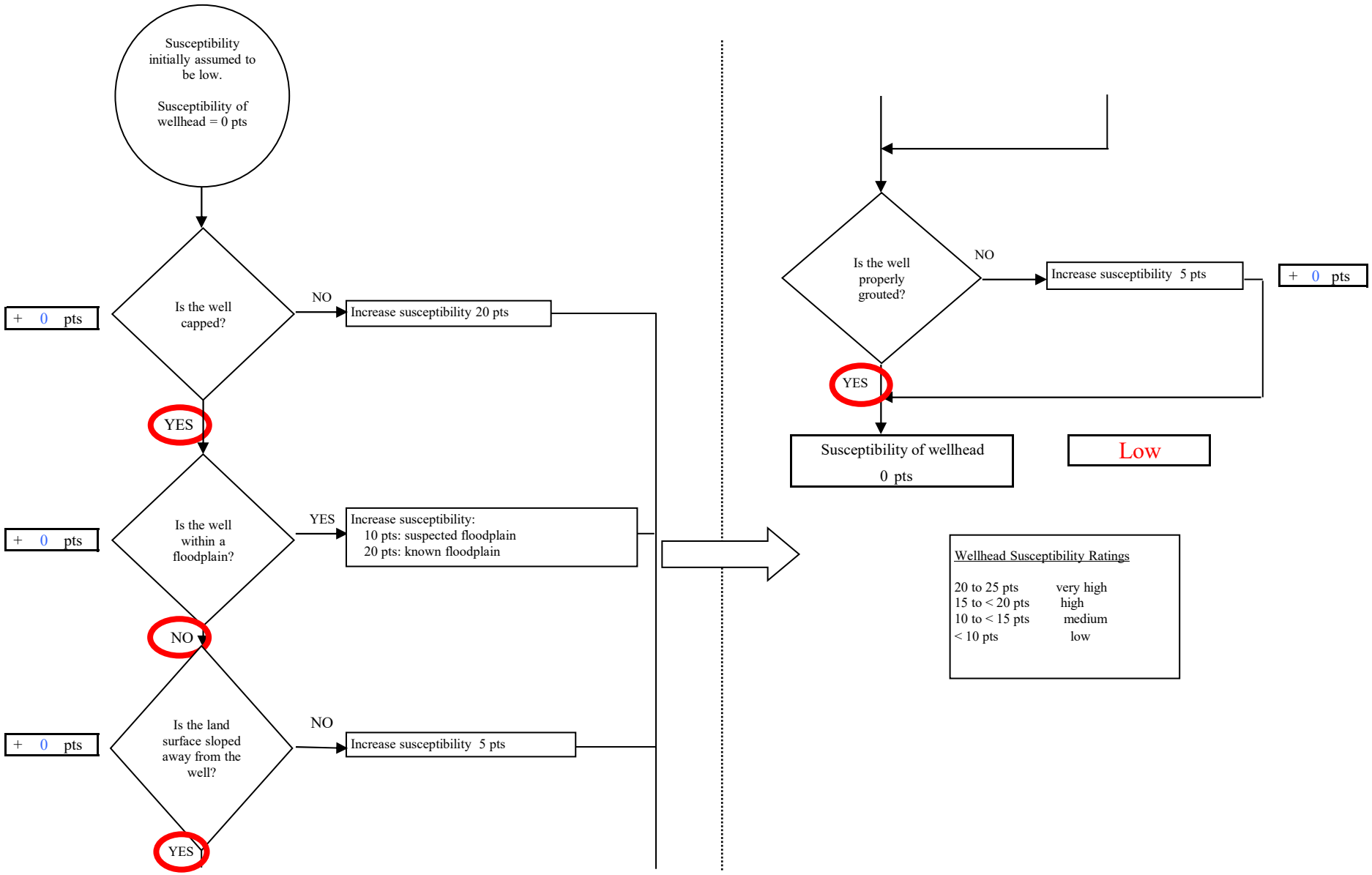


***Chart F-2. Susceptibility of the aquifer - USAF King Salmon***

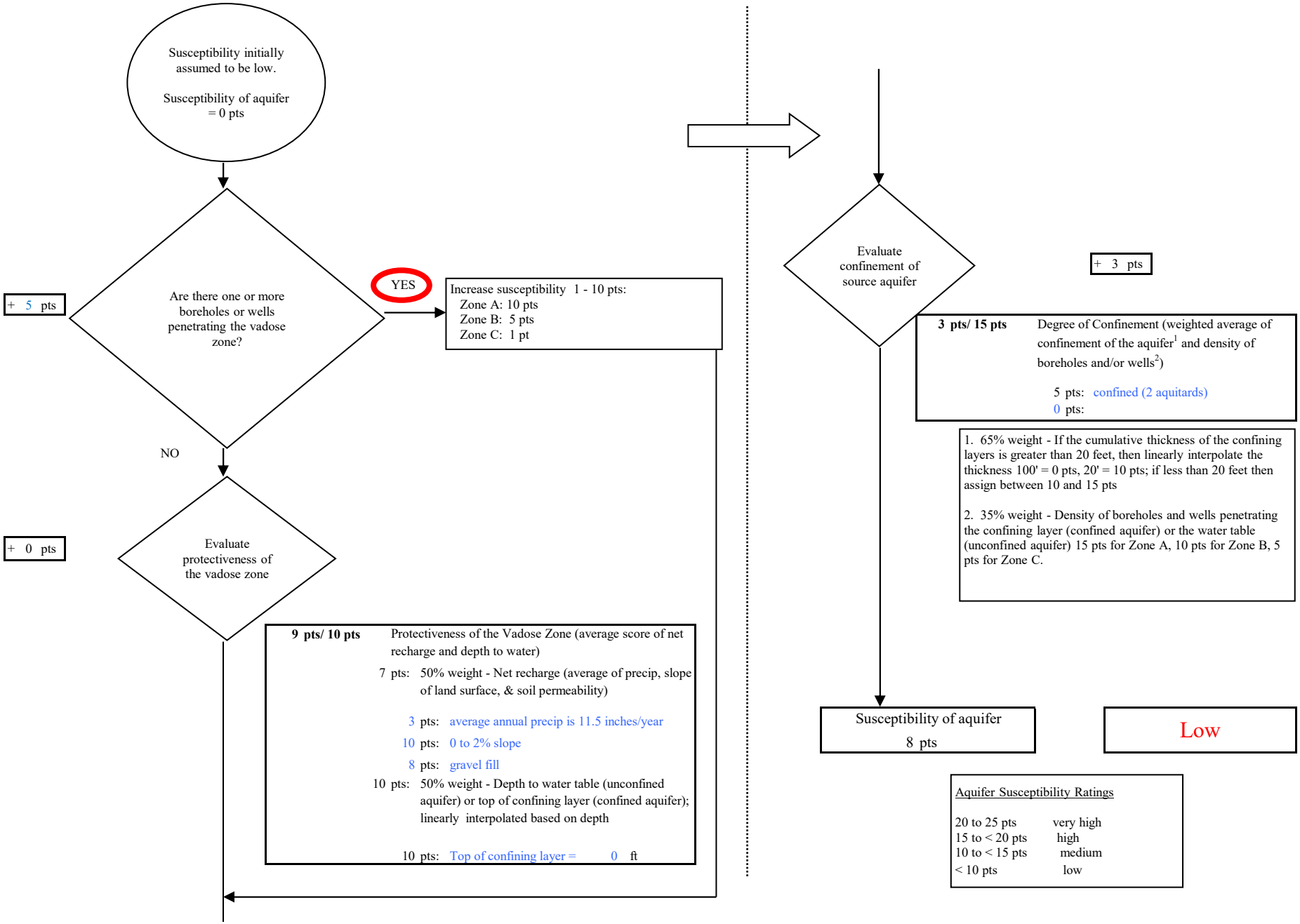
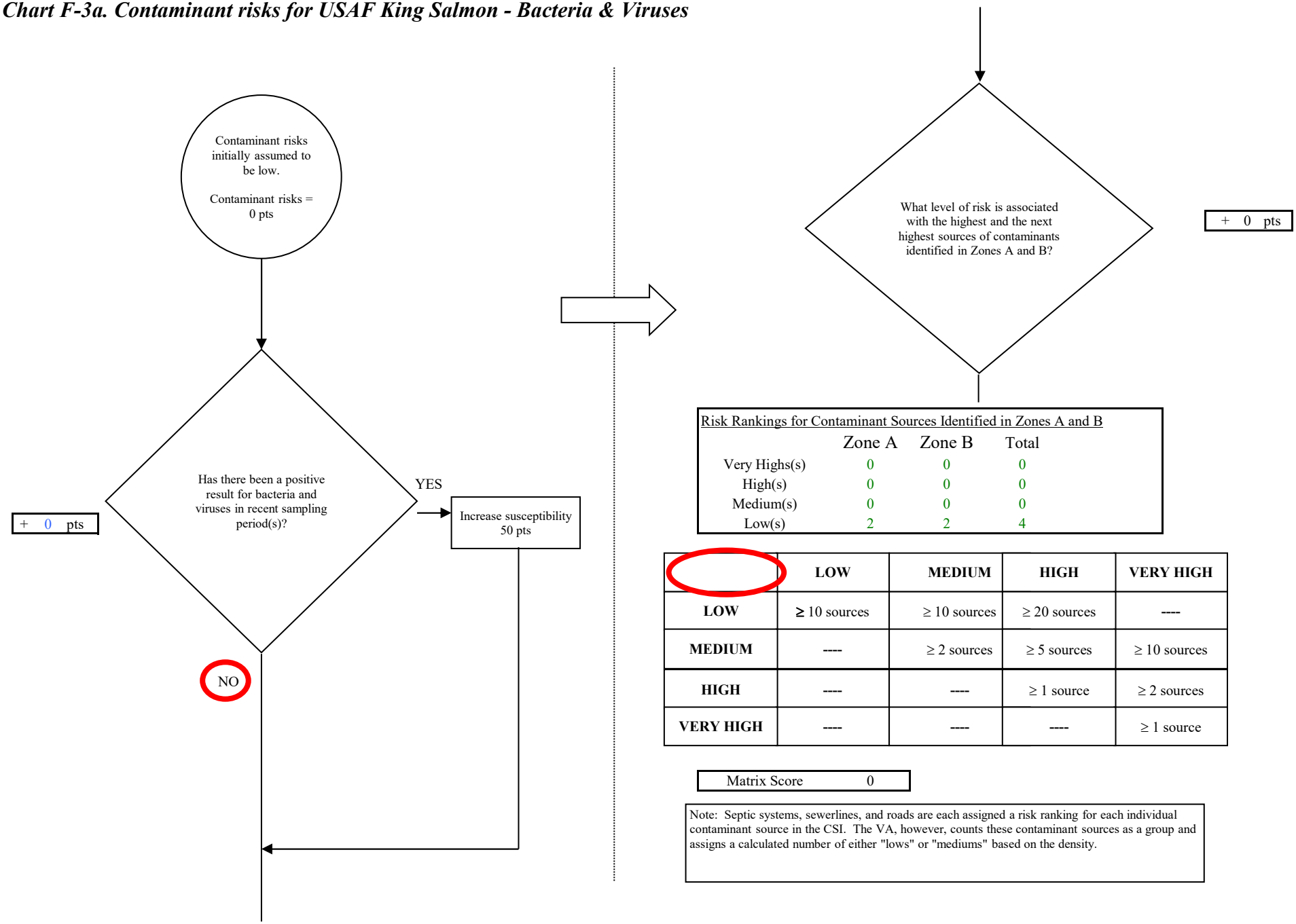


***Chart F-3a. Contaminant risks for USAF King Salmon - Bacteria & Viruses***




Risk Rankings for Contaminant Sources Identified in Zones A and B

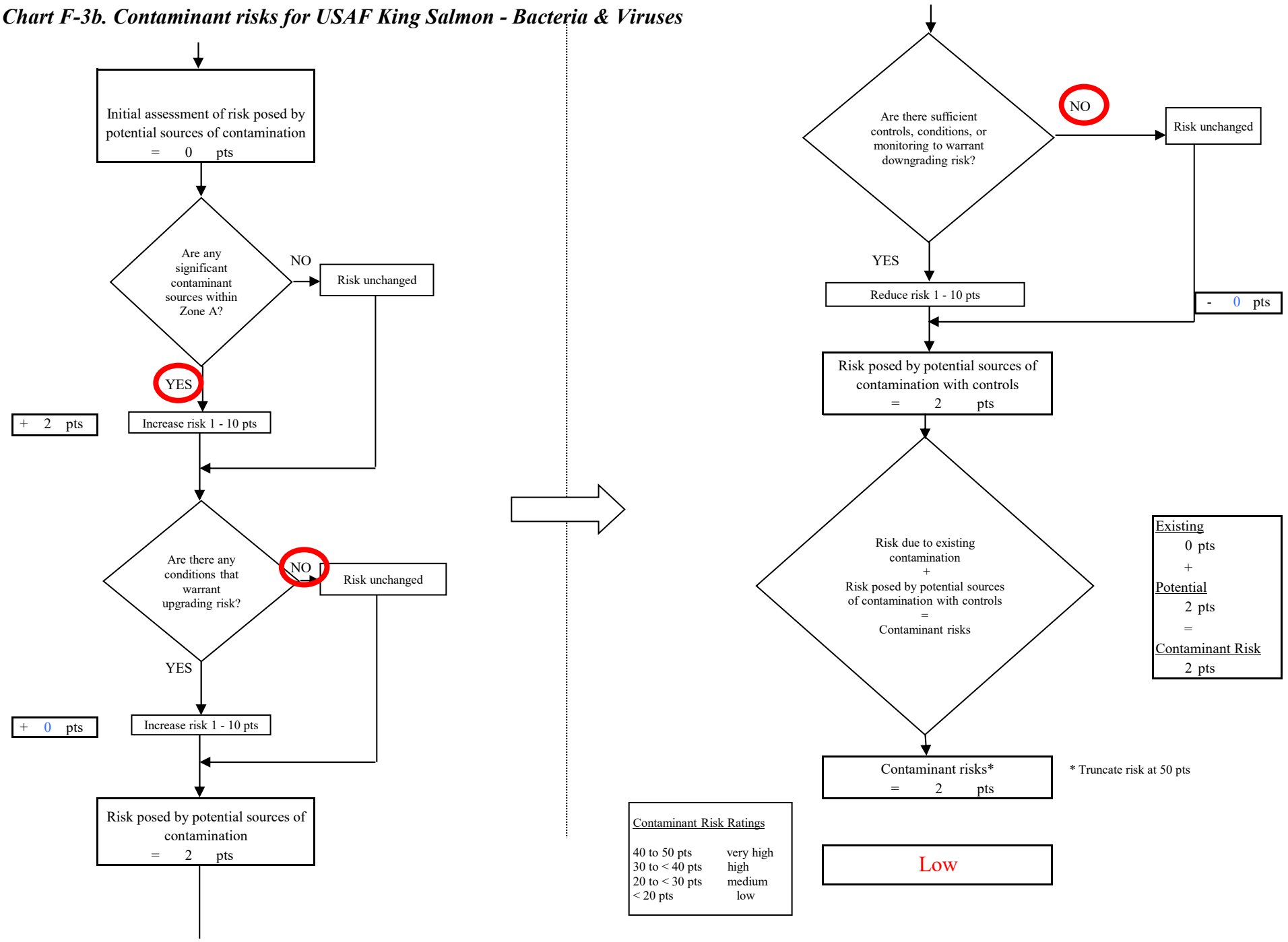
| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 2 | 2 | 4 |

| | LOW | MEDIUM | HIGH | VERY HIGH |
|---|---|---|---|---|
| **LOW** | ≥ 10 sources | ≥ 10 sources | ≥ 20 sources | ---- |
| **MEDIUM** | ---- | ≥ 2 sources | ≥ 5 sources | ≥ 10 sources |
| **HIGH** | ---- | ---- | ≥ 1 source | ≥ 2 sources |
| **VERY HIGH** | ---- | ---- | ---- | ≥ 1 source |

Matrix Score 0

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

## *Chart F-3b. Contaminant risks for USAF King Salmon - Bacteria & Viruses*



## *Chart F-3c. Vulnerability analysis for USAF King Salmon - Bacteria & Viruses*

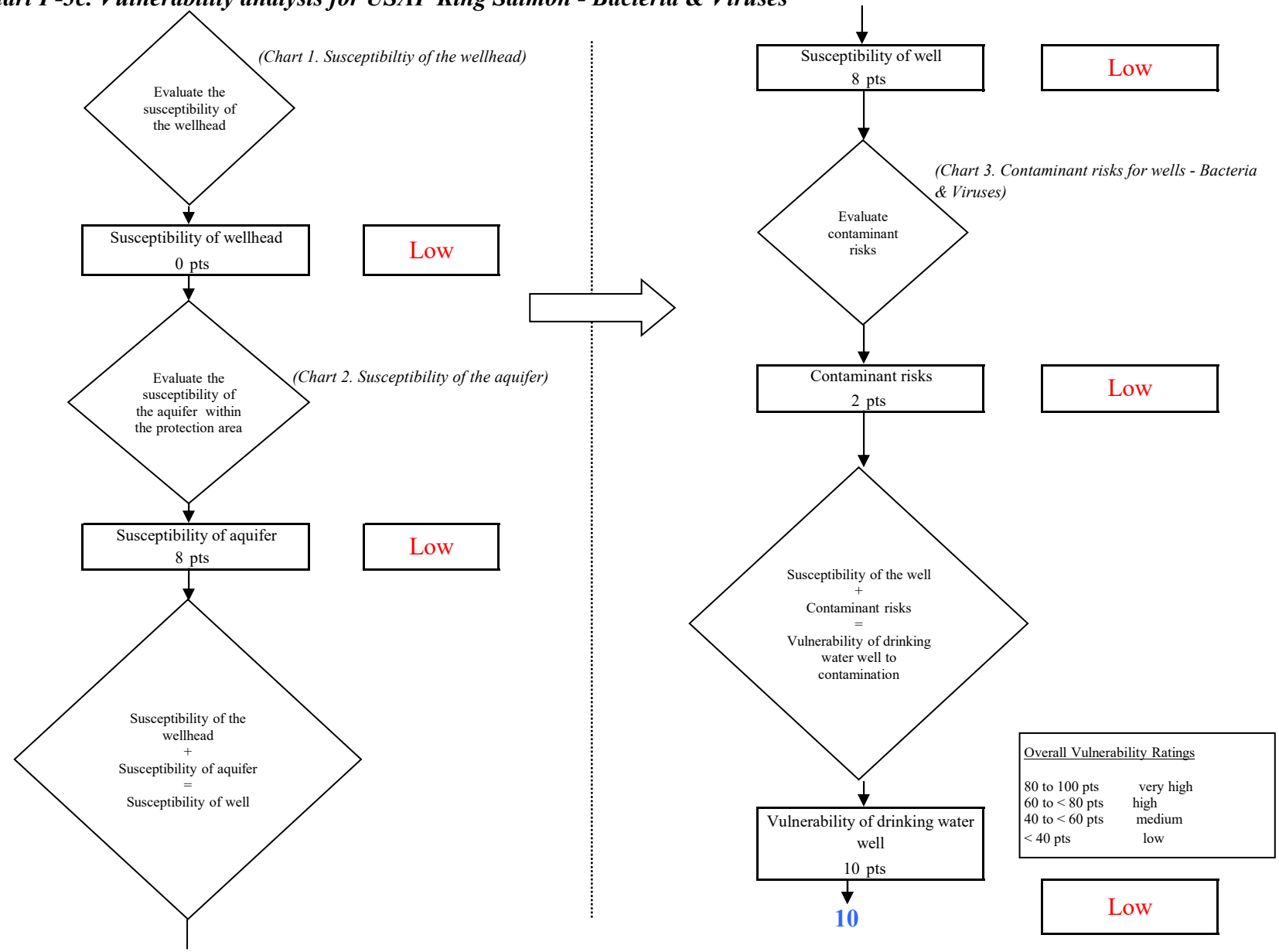
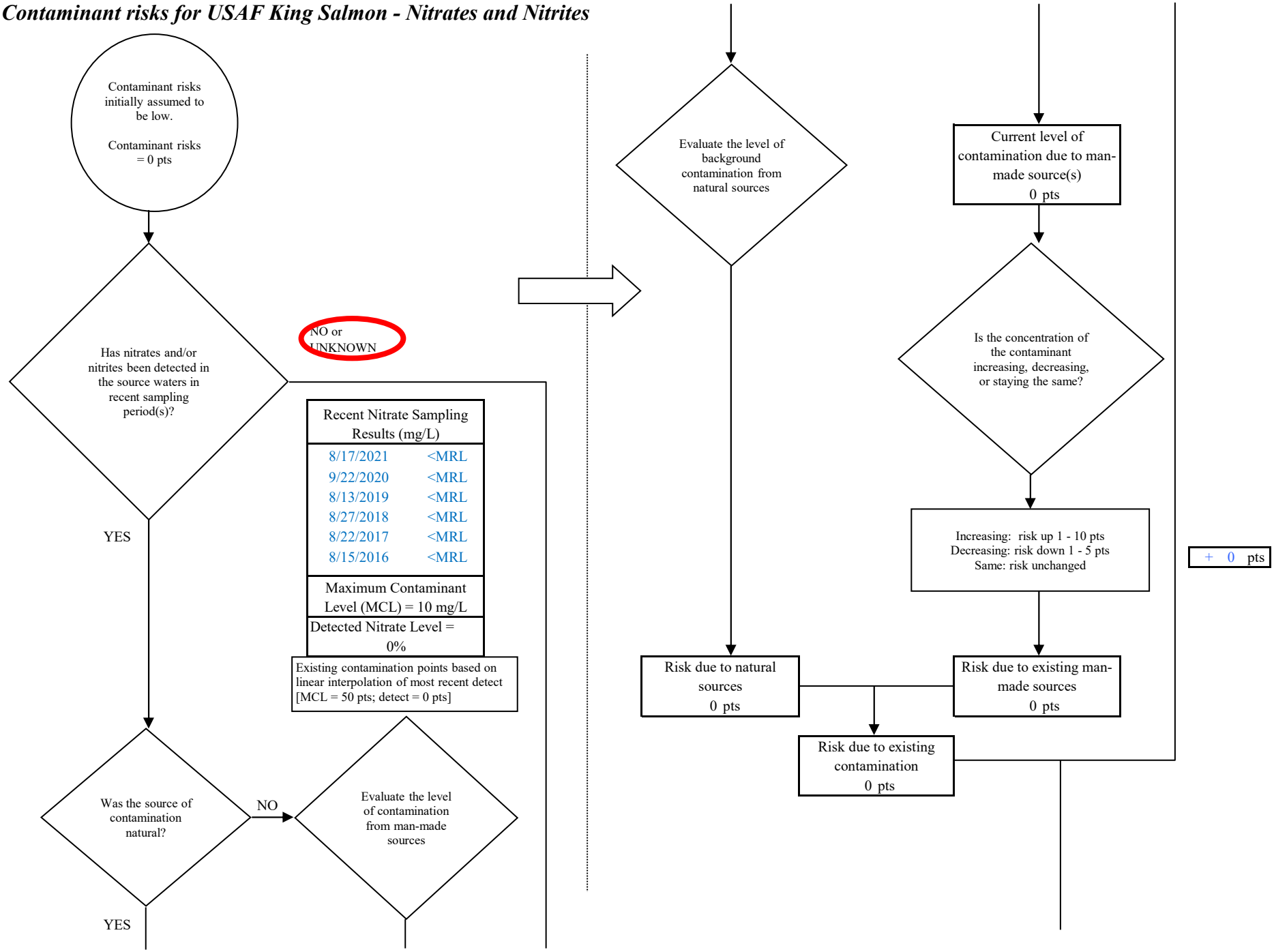


***Chart F-4a. Contaminant risks for USAF King Salmon - Nitrates and Nitrites***



## *Chart F-4b. Contaminant risks for USAF King Salmon - Nitrates and Nitrites*

+ 0 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) | 2 | 2 | 4 |

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

Matrix Score 0

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

Initial assessment of risk posed by potential sources of contamination = 0 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

+ 2 pts

## *Chart F-4c. Contaminant risks for USAF King Salmon - Nitrates and Nitrites*

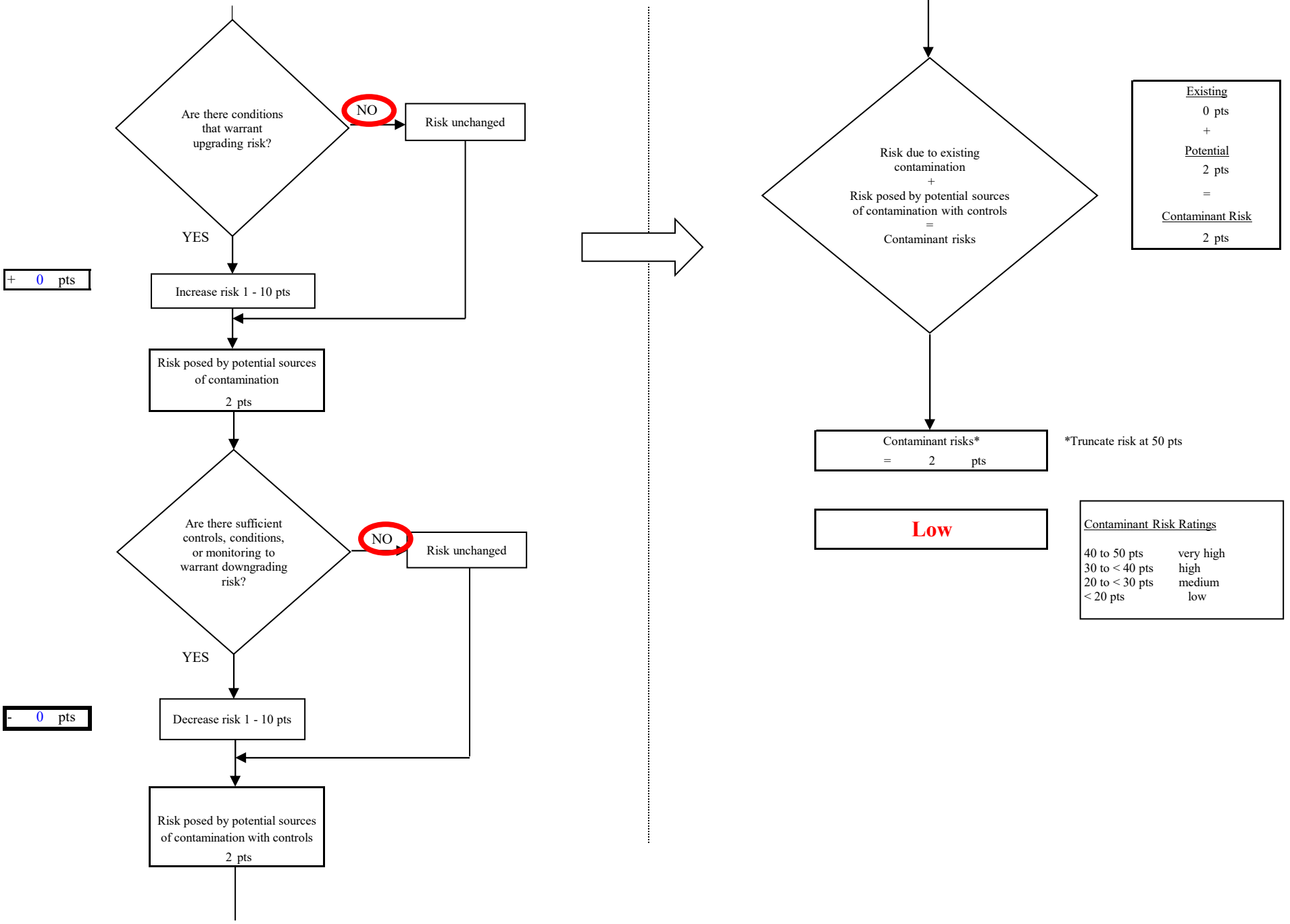
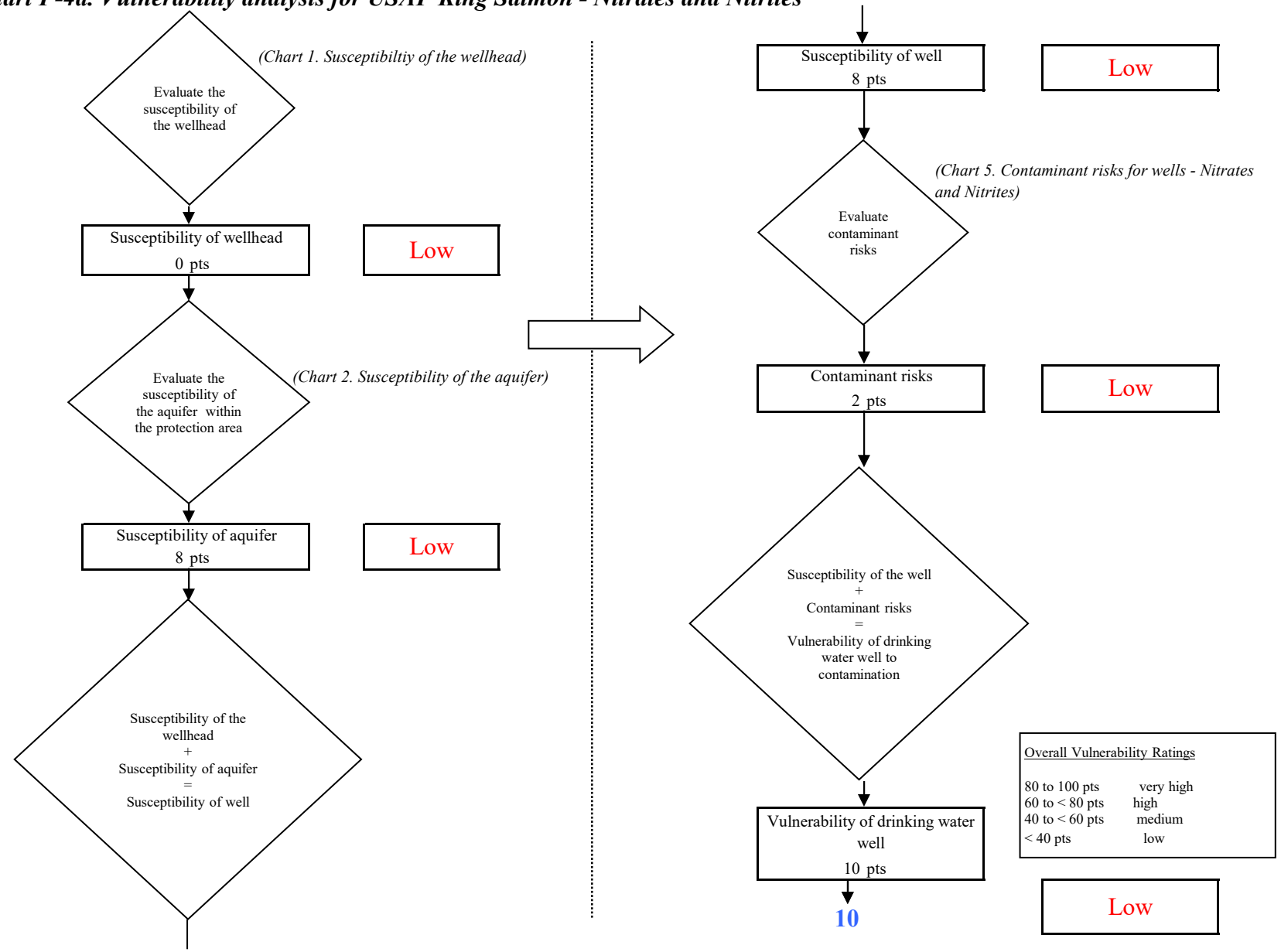
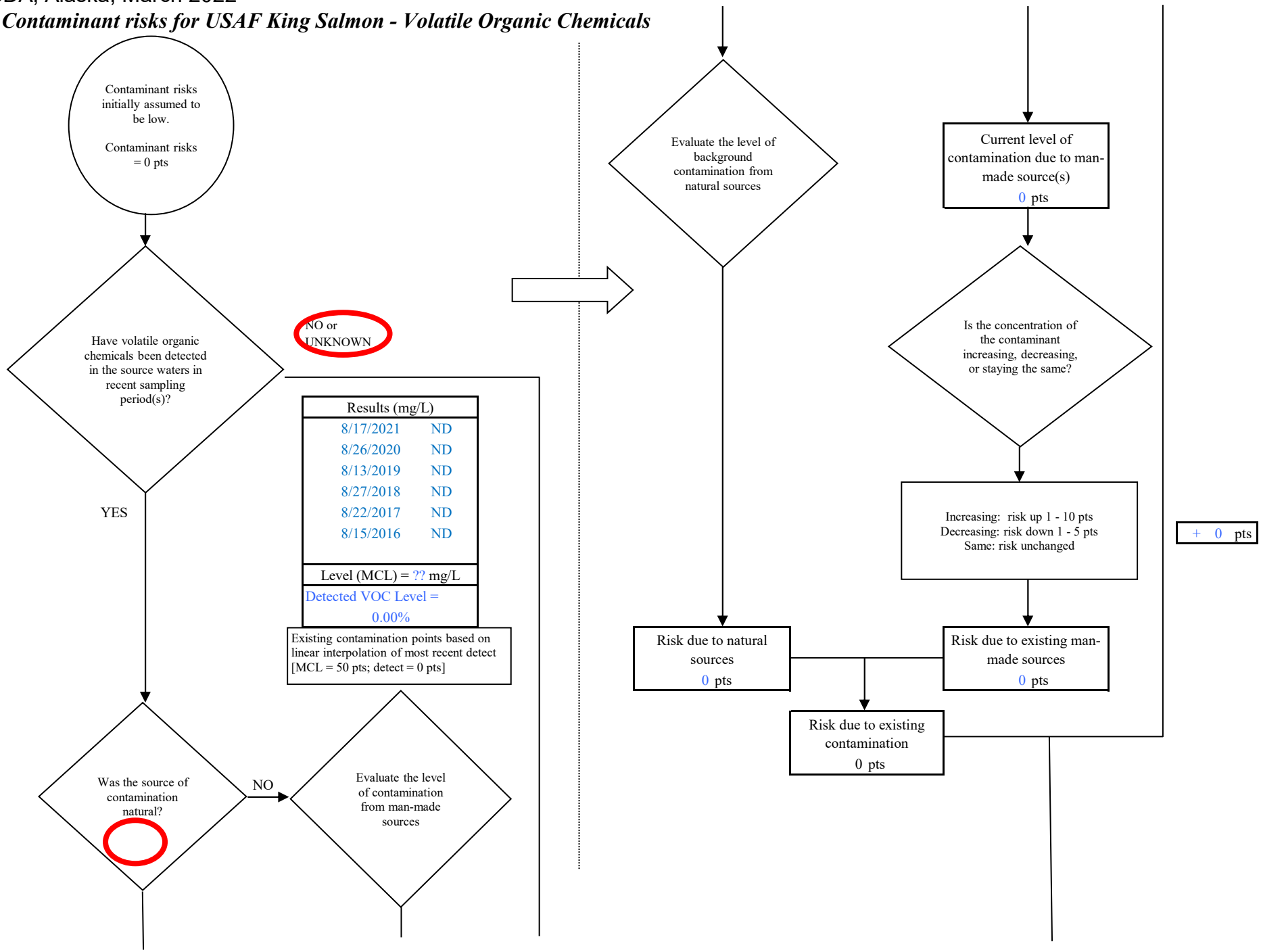


***Chart F-4d. Vulnerability analysis for USAF King Salmon - Nitrates and Nitrites***



KSDA, Alaska, March 2022

***Chart F-5a. Contaminant risks for USAF King Salmon - Volatile Organic Chemicals***



## *Chart F-5b. Contaminant risks for USAF King Salmon - Volatile Organic Chemicals*

+ 0 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) | 2 | 2 | 4 |

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

Matrix Score 0

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

Initial assessment of risk posed by potential sources of contamination = 0 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

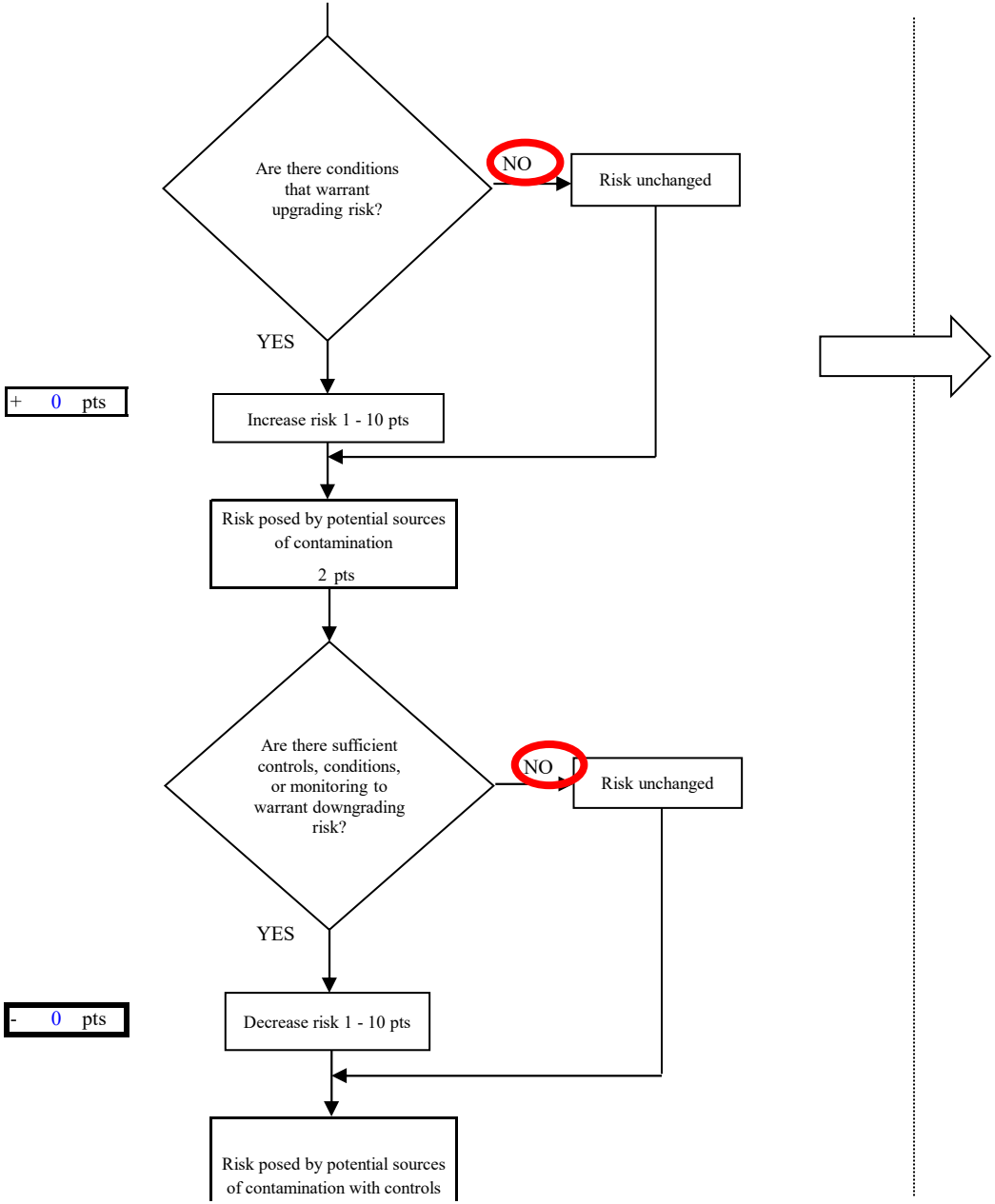
Are any significant sources within Zone A?

NO → Risk unchanged

YES

KSDA, Alaska, March 2022

***Chart F-5c. Contaminant risks for USAF King Salmon - Volatile Organic Chemicals***



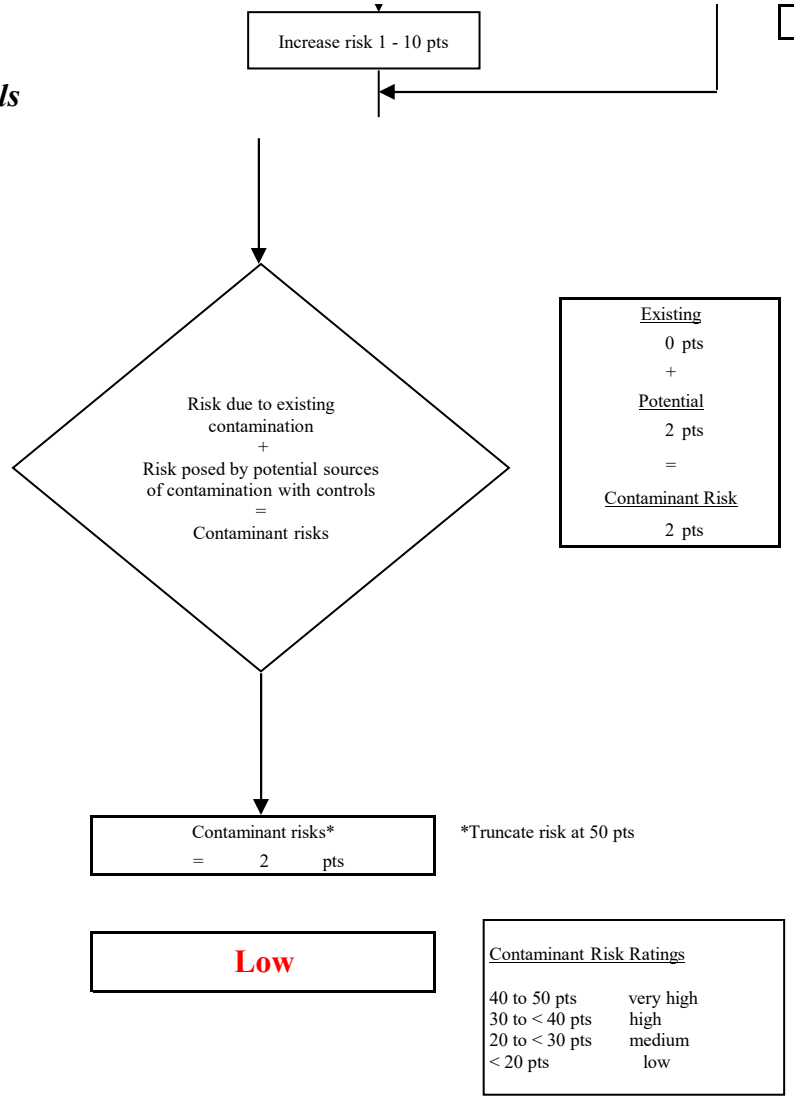



***Chart F-5d. Vulnerability analysis for USAF King Salmon - Volatile Organic Chemicals***

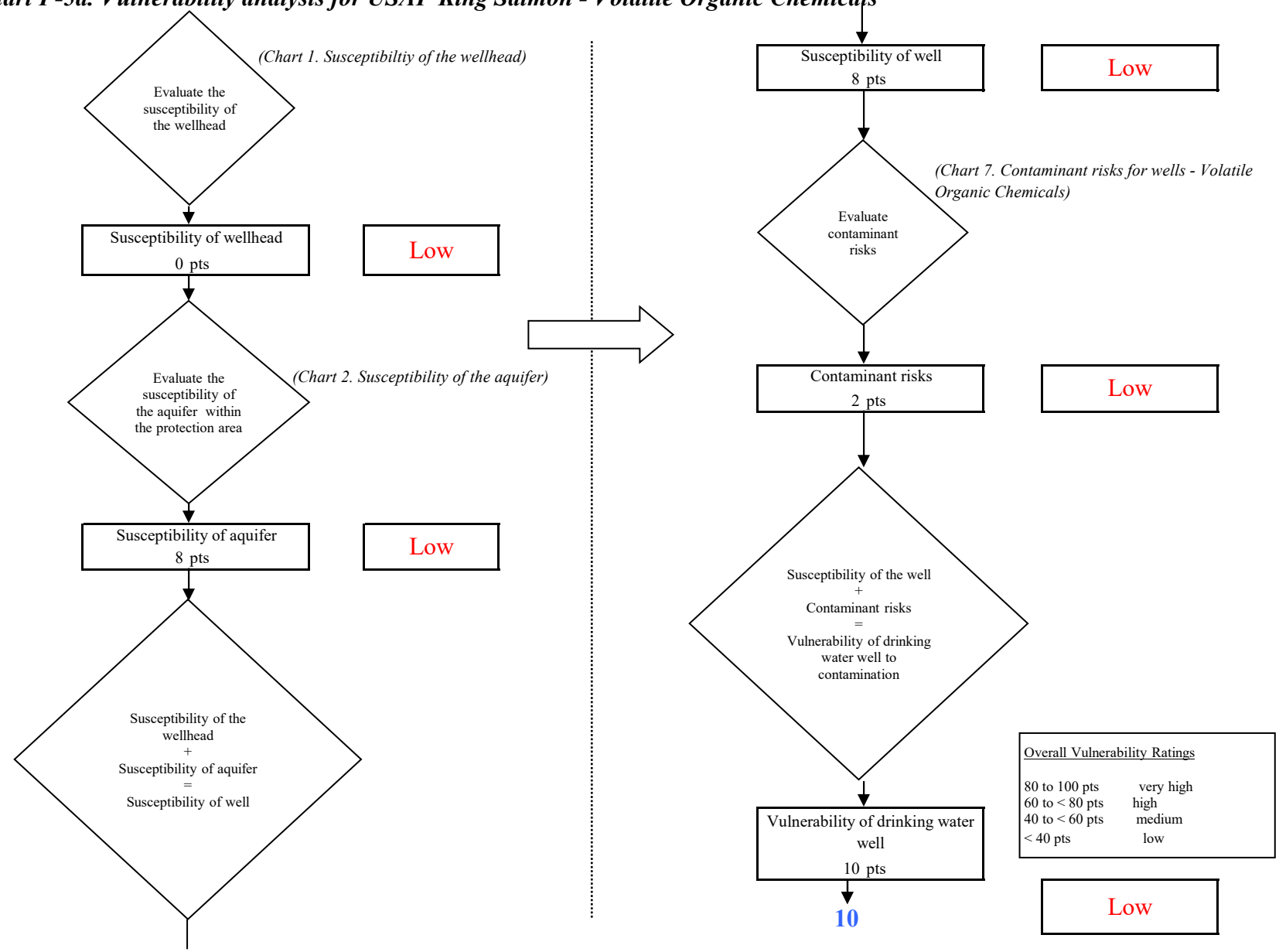


***Chart F-6a. Contaminant risks for USAF King Salmon - Heavy Metals, Cyanide and Other Inorganic Chemicals***

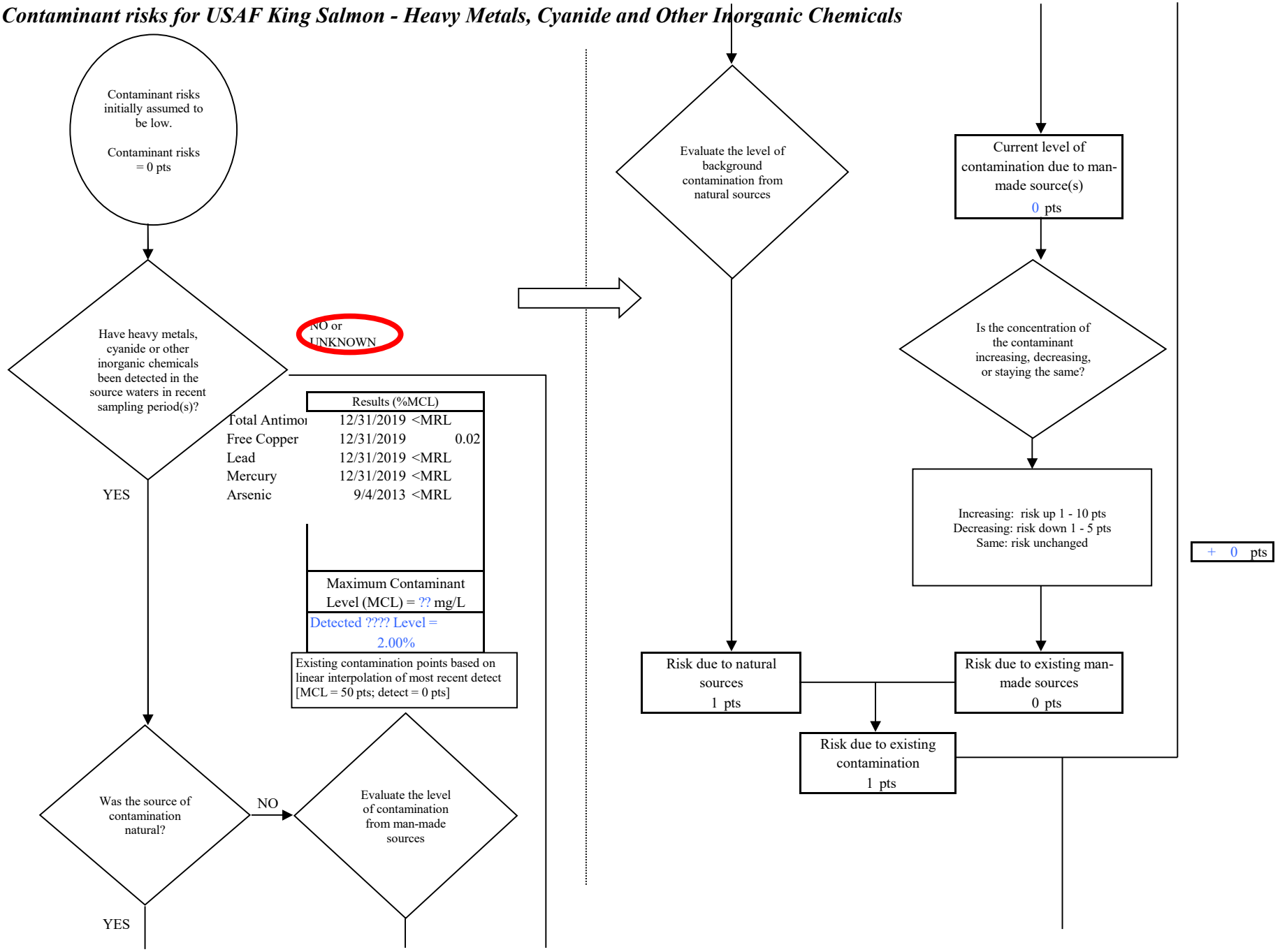
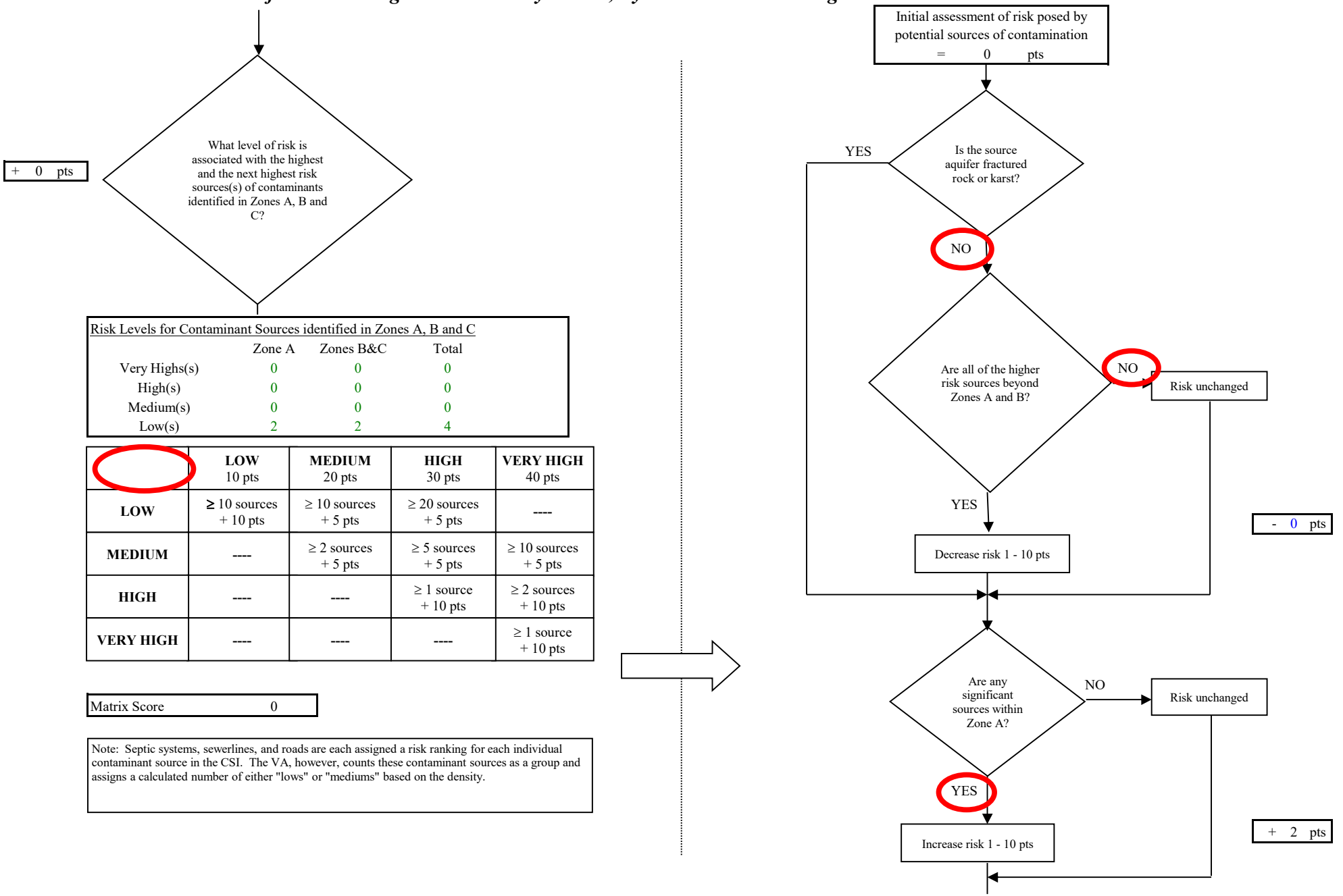


***Chart F-6b. Contaminant risks for USAF King Salmon - Heavy Metals, Cyanide and Other Inorganic Chemicals***




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

| | Zone A | Zones B&C | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 2 | 2 | 4 |

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

Matrix Score 0

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

***Chart 9. Contaminant risks for USAF King Salmon - Heavy Metals, Cyanide and Other Inorganic Chemicals***

KSDA, Alaska, March 2022

***Chart F-6c. Contaminant risks for USAF King Salmon - Heavy Metals, Cyanide and Other Inorganic Chemicals***

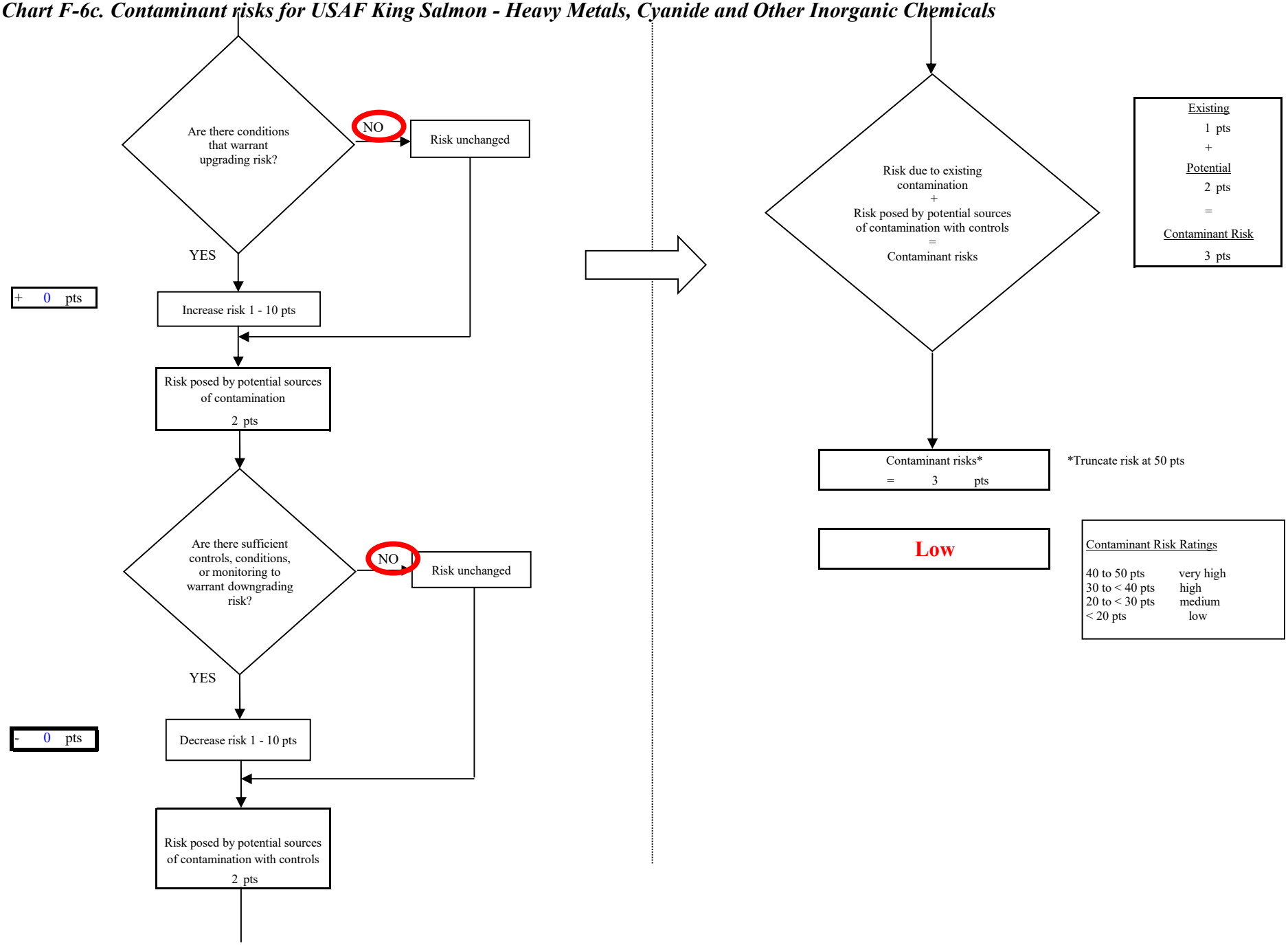
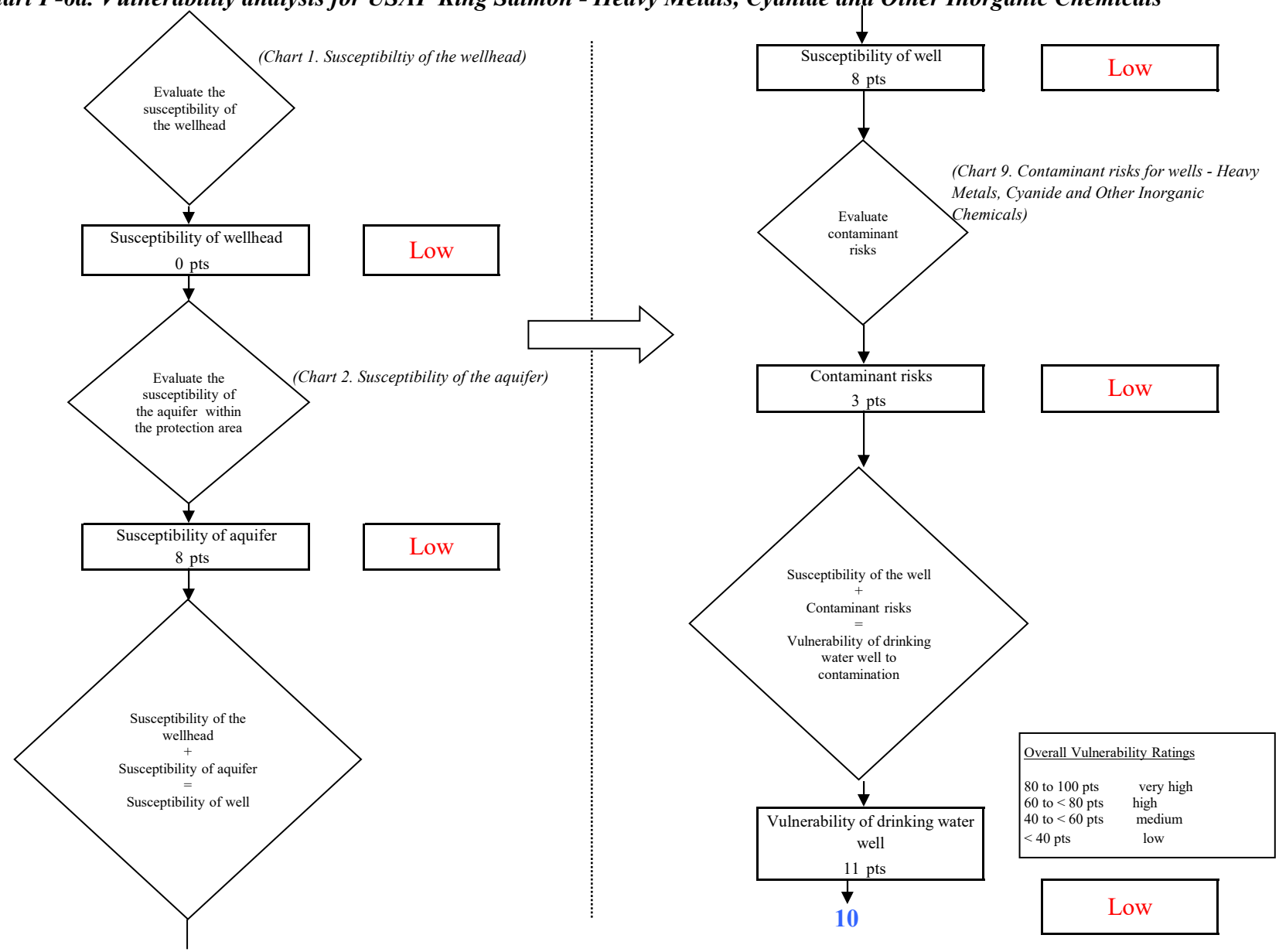
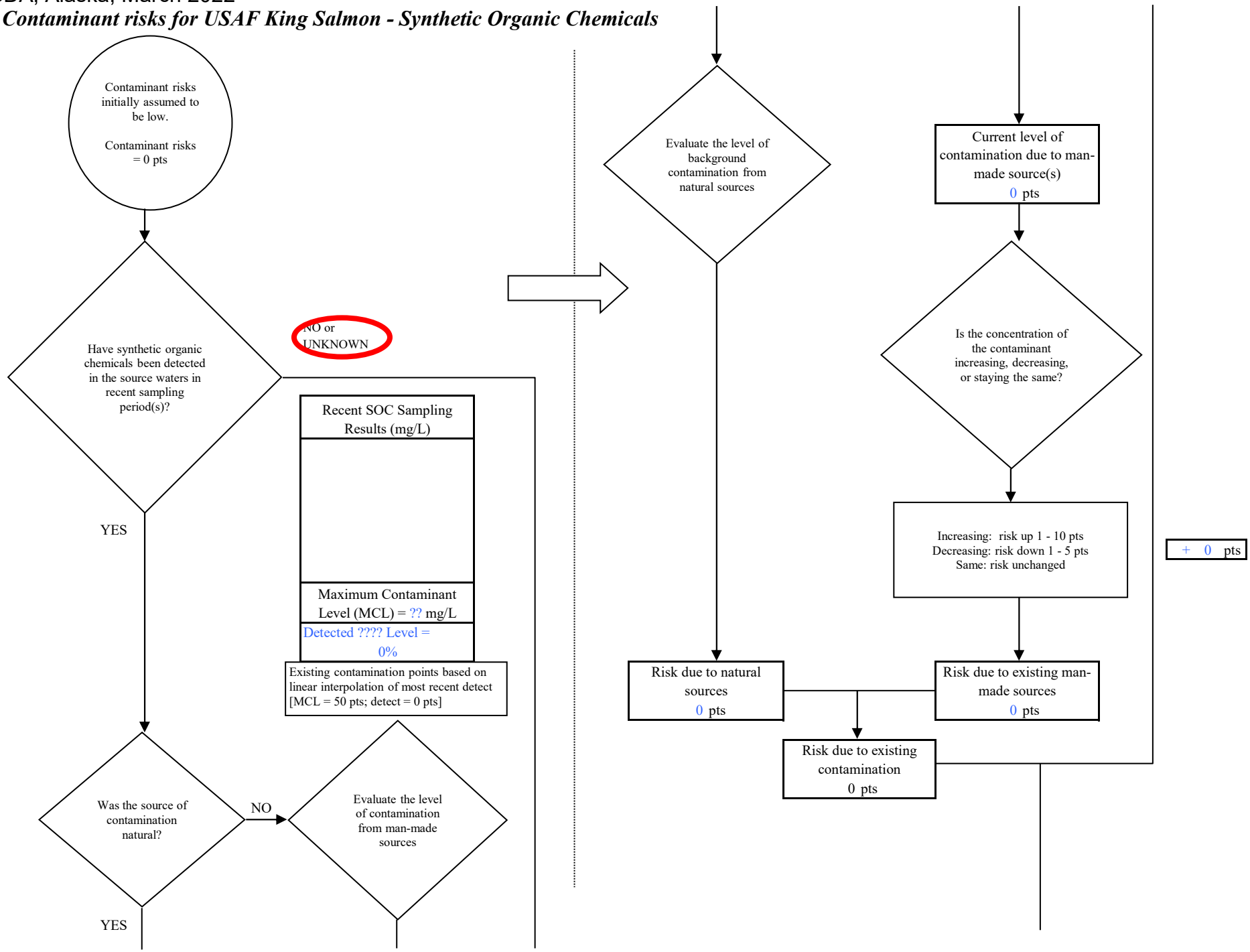


***Chart F-6d. Vulnerability analysis for USAF King Salmon - Heavy Metals, Cyanide and Other Inorganic Chemicals***



KSDA, Alaska, March 2022

***Chart F-7a. Contaminant risks for USAF King Salmon - Synthetic Organic Chemicals***



KSDA, Alaska, March 2022

***Chart F-7b. Contaminant risks for USAF King Salmon - Synthetic Organic Chemicals***

+ 0 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) | 1 | 2 | 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 0

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

Initial assessment of risk posed by potential sources of contamination = 0 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

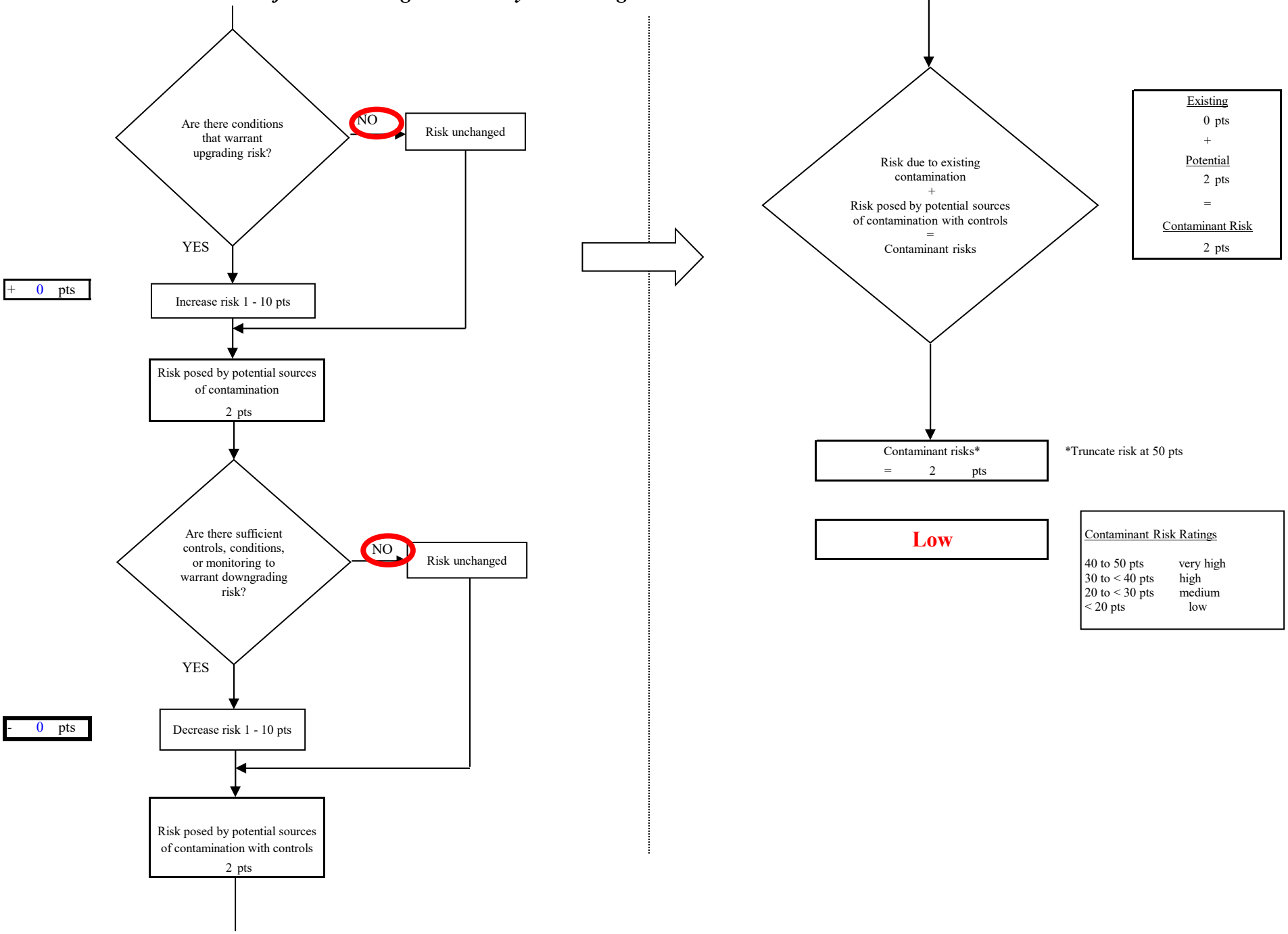
YES

Increase risk 1 - 10 pts

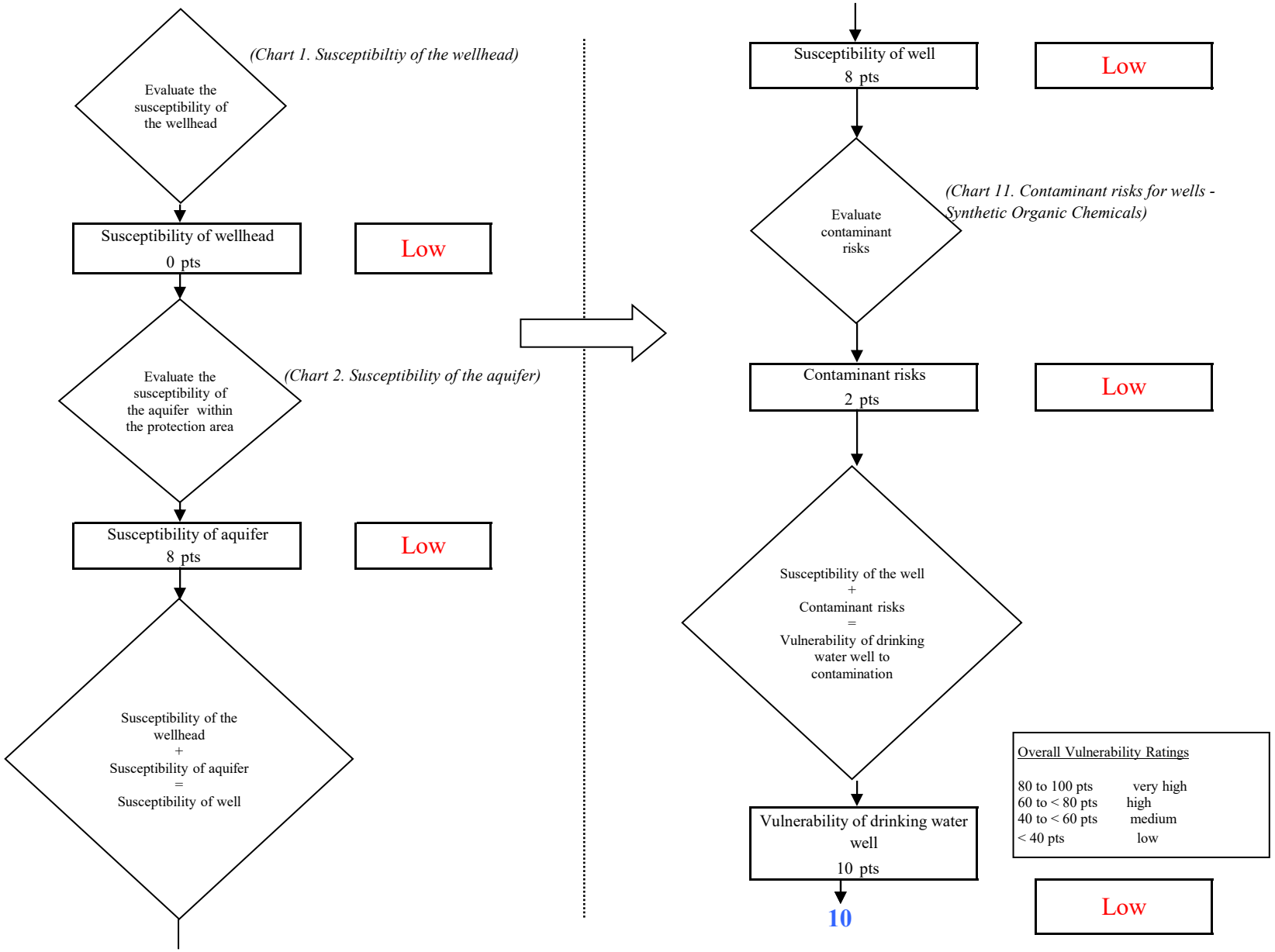
+ 2 pts

KSDA, Alaska, March 2022

***Chart F-7c. Contaminant risks for USAF King Salmon - Synthetic Organic Chemicals***

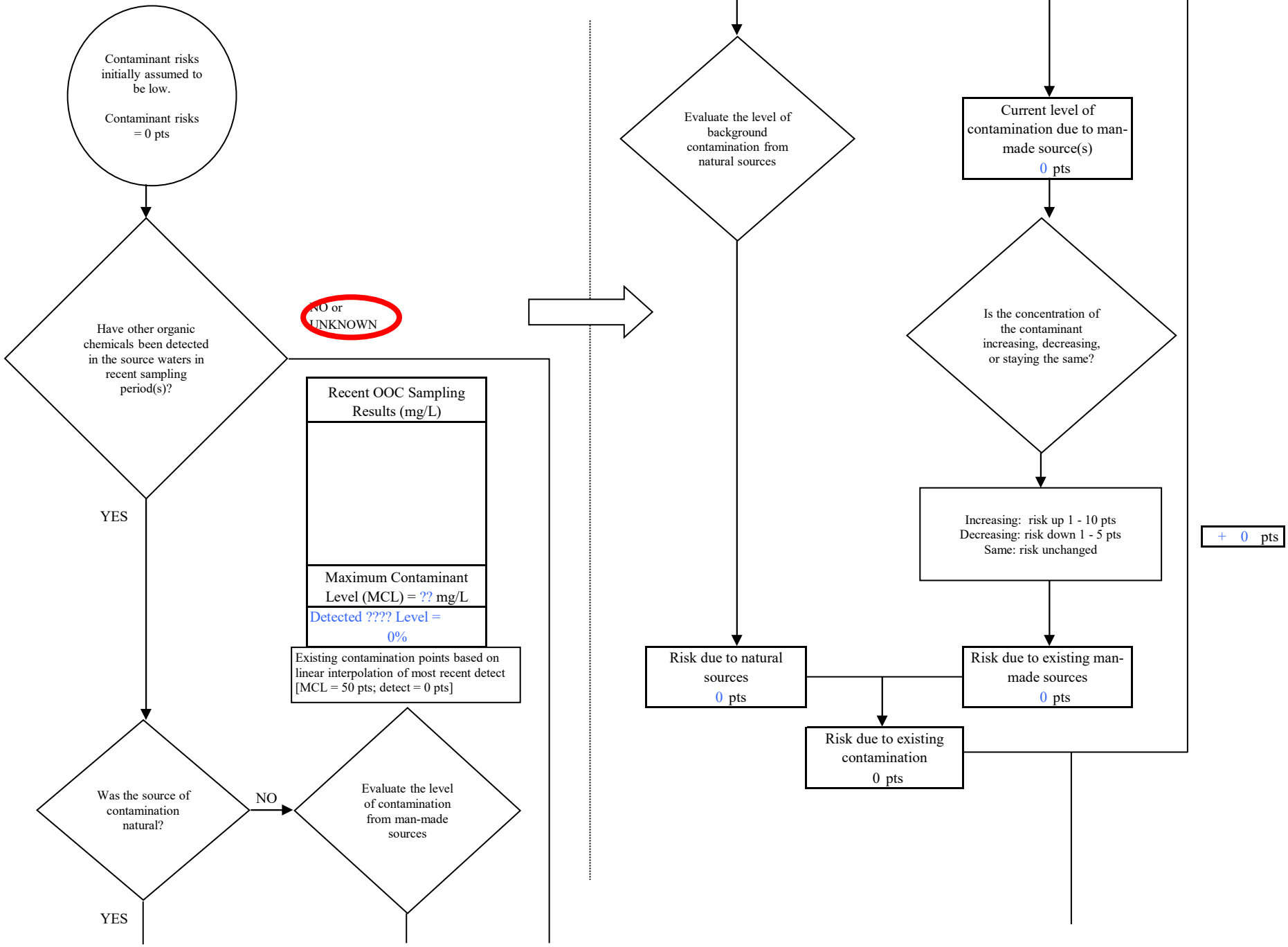


## *Chart F-7d. Vulnerability analysis for USAF King Salmon - Synthetic Organic Chemicals*



KSDA, Alaska, March 2022

***Chart F-8a. Contaminant risks for USAF King Salmon - Other Organic Chemicals***



KSDA, Alaska, March 2022

***Chart F-8b. Contaminant risks for USAF King Salmon - Other Organic Chemicals***

+ 0 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) | 2 | 2 | 4 |

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

Matrix Score 0

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

Initial assessment of risk posed by potential sources of contamination = 0 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

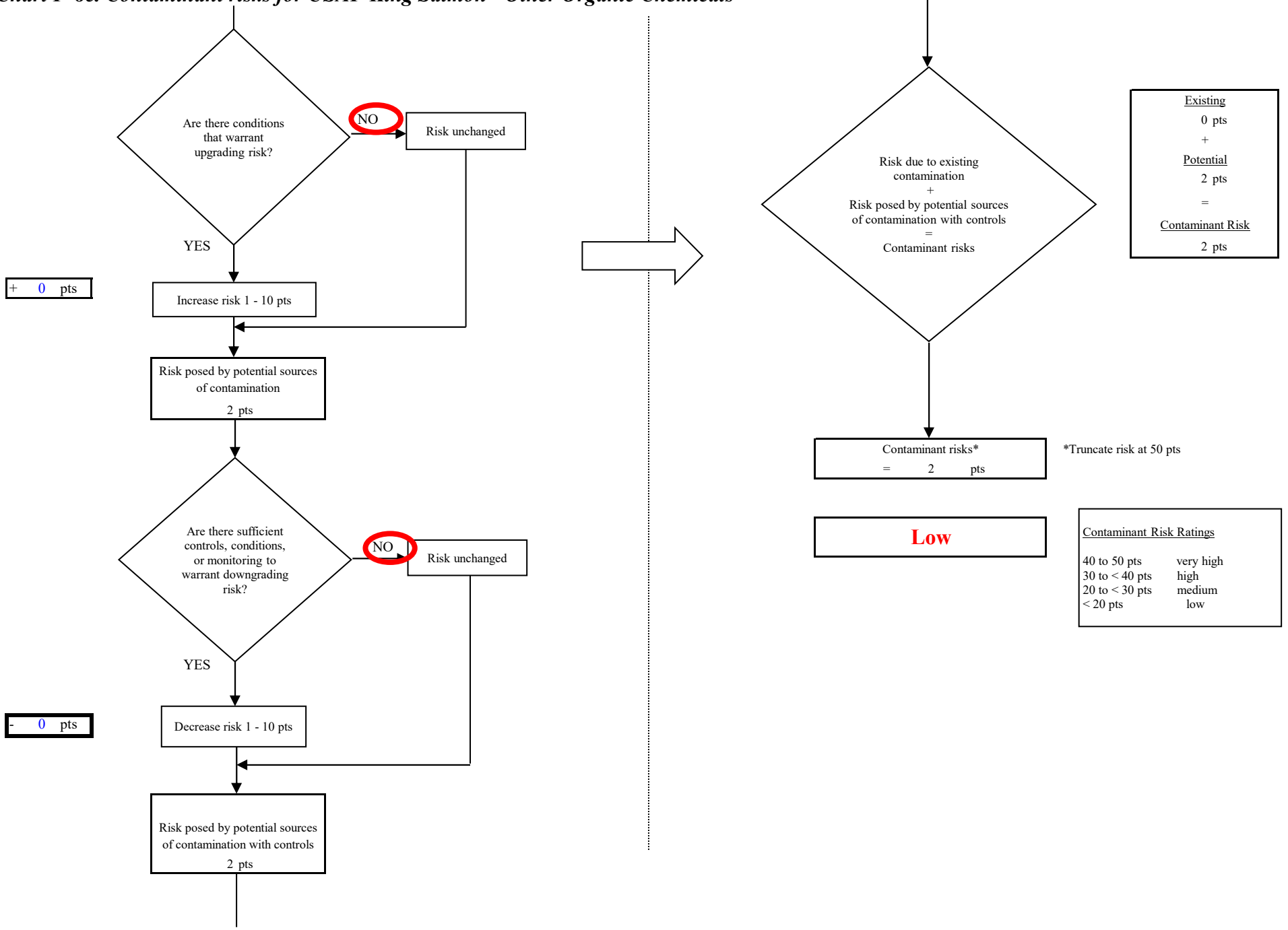
YES

Increase risk 1 - 10 pts

+ 2 pts

KSDA, Alaska, March 2022

***Chart F-8c. Contaminant risks for USAF King Salmon - Other Organic Chemicals***



## *Chart F-8d. Vulnerability analysis for USAF King Salmon - Other Organic Chemicals*