

Hydrologic Susceptibility and  
Vulnerability Assessment for  
Municipality of Anchorage (MOA) -  
Ship Creek Public Drinking Water  
Source, Anchorage, Alaska

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DRINKING WATER PROTECTION PROGRAM REPORT 13

January 2001

# Hydrologic Susceptibility and Vulnerability Assessment for Municipality of Anchorage (MOA) - Ship Creek Public Drinking Water Source, Anchorage, Alaska

By TRENA K. HALLBACK

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# Hydrologic Susceptibility and Vulnerability Assessment for Municipality of Anchorage (MOA) - Ship Creek Public Drinking Water Source, Anchorage, Alaska

By TRENA K. HALLBACK

## Drinking Water Protection Program Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The Municipality of Anchorage (MOA) Ship Creek Public Water System is a Class A (community) water system consisting of one surface water source. Identified potential and current sources of contaminants for the MOA Ship Creek source are activities associated with recreational trails, gravel roads, wastewater holding tanks, and a contaminated site due to leaking underground fuel storage tanks. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, and other organic chemicals. Overall, MOA's Ship Creek public water system received a vulnerability rating of **Medium** for bacteria and viruses, nitrates and/or nitrites, heavy metals, volatile organic chemicals, other organic chemicals, and synthetic organic chemicals.



Figure 1. Index map showing the location of Ship Creek.

### INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners/operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. This assessment was completed for the MOA's Ship Creek source of public drinking water. This source consists of one surface water body in the Anchorage area (see Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, combines a review of the natural hydrologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for voluntary local protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

### PHYSIOGRAPHY OF THE SHIP CREEK WATERSHED, ALASKA

The Ship Creek watershed is located in southcentral Alaska within the states largest city, Anchorage. This area is bounded on the north, west, and south by two estuaries, Knik and Turnagain Arms of Cook Inlet, and on the east by the Chugach Mountains. Ship Creek lies within the Chugach State Park and begins at an elevation of 5,100 feet, within a glacially carved valley of the Chugach Mountains. The area is structurally complex and composed of variably metamorphosed sedimentary and igneous rocks (Clark, 1972). The upper areas of this valley contain mountainous terrain with bedrock exposures. The lower region contains terrain comprised of glacial outwash and stream deposits.

The vegetation surrounding Ship Creek varies with the elevation. The upper portion of the basin is sparsely forested consisting of sub alpine and alpine vegetation. The middle portion of the basin is partly forested. The lower portion of the basin is industrialized and

commercialized with intermittent green belts. Approximately 29 miles long, Ship Creek occupies an area of 90 square miles and has an average total annual stream discharge of 58,514 cubic feet per second (Bertrand, 1999). Mean annual precipitation is approximately 35 inches per year. Mean daily temperature ranges from 65° F in the summer months to 8° F during winter months, with total snowfall of 71 inches (Western Regional Climate Center, 2000).

**MOA - SHIP CREEK PUBLIC WATER SYSTEM**

The MOA - Ship Creek Public Water System is a Class A (community) water system, which is owned and operated by the Municipality of Anchorage. The Ship Creek source provides water during the summer months or during periods of high water usage and demand. The system receives its water directly from an intake in Ship Creek, located approximately 500 feet above sea level. This water system serves approximately 212,000 residents through multiple service connections.

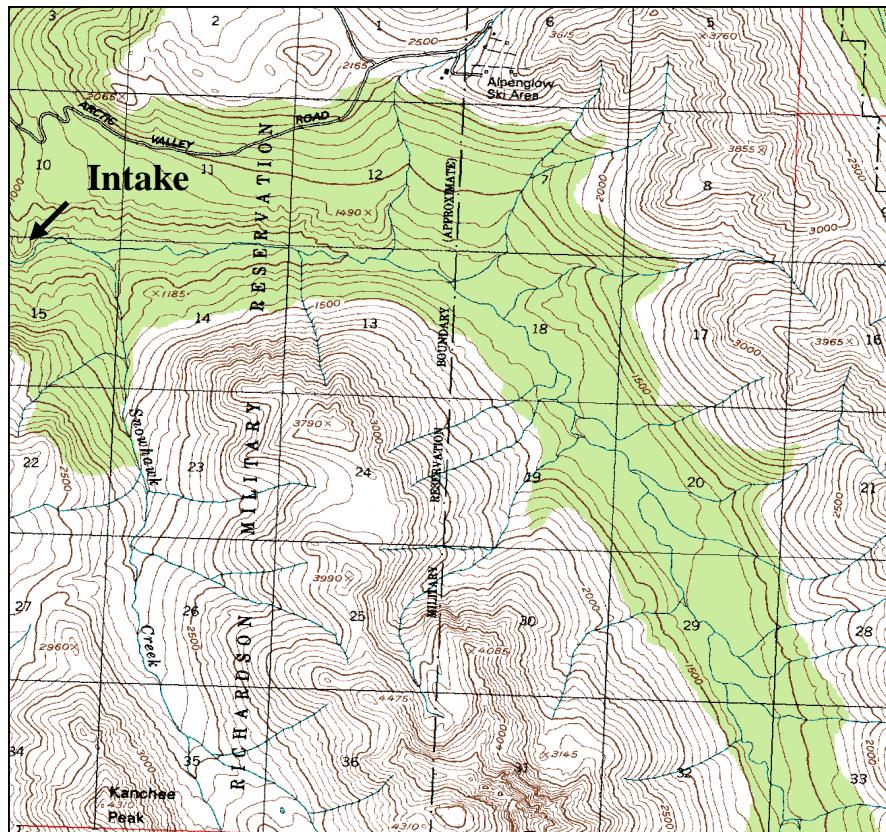
**ASSESSMENT AND PROTECTION AREA FOR MOA - SHIP CREEK**

The Drinking Water Protection and Assessment Areas

that have been established for MOA's Ship Creek public drinking water source are the areas that are most sensitive to contamination. These areas have served as a basis for assessing the risk of the drinking water source to contamination. The zones around the drinking water source are the most critical areas for the preservation of the quality of the water system's drinking water. For simplicity, these areas will be known as the Drinking Water Protection Areas and will serve as the focus for voluntary protection efforts.

Conceptually, surface water flow is downgradient over steep bedrock slopes toward the unconsolidated stream and glacial deposits in the valley. Water enters the stream either through overland flow or through baseflow into the stream. Baseflow is the portion of a stream's discharge or flow from groundwater seeping into the stream.

The Drinking Water Protection Areas established for surface water bodies by the Alaska Department of Environmental Conservation (ADEC) are separated into zones. The Drinking Water Protection Areas for the MOA's Ship Creek source contains three zones, Zone A through Zone C (See Map 1 and Map 2 in Appendix A).



**Figure 2. Map showing the location of the drinking water source intake at Ship Creek.**

These zones identify areas along Ship Creek and its main feeder tributaries. Contaminants released within these areas can potentially pollute the drinking water source. Zone A corresponds to an area within 1000 feet of Ship Creek and its main tributaries. Zone B identifies the area within one mile, and Zone C identifies the entire watershed.

**INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES**

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within MOA's Ship Creek Drinking Water Protection Areas. This survey was completed through a search of agency records, other publicly available information, and verified by the operator of the public water system. Potential sources of contamination to drinking water supplies cover 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 this assessment and all Class A assessments, six categories of drinking water contaminants were inventoried. They include:

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

Map 3 in Appendix B depicts the Contaminant Source Inventory for MOA's Ship Creek. Inventoried potential sources of contamination within Zones A through Zone C are listed in Table 1 of Appendix A. Below is a summary of the contaminant sources inventoried within MOA's Ship Creek protection area:

- Recreation areas;
- Gravel roads;
- Wastewater holding tank; and
- Contaminated site due to leaking underground fuel storage tanks.

These potential contaminant sources present risk for five of the six categories of drinking water contaminants.

**RANKING OF CONTAMINANT RISKS**

Potential and existing sources of contamination have been identified, sorted, and ranked 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. Contaminant risks are further a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the surface water body.

**VULNERABILITY OF MOA - SHIP CREEK SOURCE WATER**

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and
- Contaminant risks.

Each of the six categories of drinking water contaminants are analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

$$\begin{array}{r}
 \text{Natural Susceptibility (0 – 50 points)} \\
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the} \\
 \text{Drinking Water Source to Contamination (0 – 100).}
 \end{array}$$

A score for the susceptibility of the surface water body to contamination is achieved by examining the construction of the intake, potential for runoff, and the capacity of the water body to dilute contaminants. MOA's Ship Creek water source has an inheritant risk simply because it is a surface water body. Surface water generally has more debris and dirt particles (higher turbidity) and biological contamination. Contaminants are able to flow directly into the water source. Table 1 shows the overall susceptibility score and rating for MOA's Ship Creek. Due to the high potential for runoff and the low discharge rate of Ship Creek, it receives a susceptibility rating of High.

**Table 1. Susceptibility of the Surface Water Source to Contamination**

	Score	Rating
Susceptibility	40	High

Contaminant risks to a drinking water source depend on the type, number and/or density, and distribution of contaminant sources. Recreation trails, gravel roads, a wastewater holding tank, and a contaminated site due to leaking underground fuel storage tanks contribute the highest risk for potential contamination to the MOA's Ship Creek source of public drinking water.

A score (0 – 50 points) and rating of Contaminant Risks (See Appendix D) is assigned based on the findings of the Contaminant Source Inventory (Appendix B - Table 1 – Table 6). This portion of the analysis examines any existing or historical contamination that has been detected in the drinking water source through routine sampling. It also reviews contamination that has or may occur within 1000 feet of the surface water body. Table 2 summarizes the Contaminant Risks for each category of drinking water contaminants.

**Table 2. Contaminant Risks**

Contaminant Risks	Score	Rating
Bacteria and Viruses	15	Low
Nitrates and/or Nitrites	12	Low
Volatile Organic Chemicals	10	Low
Heavy Metals, Cyanide, and other Inorganic Chemicals	13	Low
Synthetic Organic Chemicals	0	Low
Other Organic Chemicals	10	Low

Vulnerability of the drinking water source to contamination is the combination of susceptibility of the surface water source and the contaminant risks. Table 3 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants (See Appendix D). Note: scores are rounded off to the nearest five.

The ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals are listed in Tables 2 through 6 in Appendix B.

The Ship Creek Trail extends approximately six miles

along the northeast shore of Ship Creek. This trail poses the highest risk for potential contamination to the creek. The trail is limited to hiking, and has additional routes that extend up into the watershed. The use of this trail is considered low. Other potential sources of contamination include a ski resort, gravel roads, a wastewater holding tank, and a contaminated site due to leaking underground fuel storage tanks.

**Table 3. Overall Vulnerability of MOA - Ship Creek Public Drinking Water System to Contamination by Category**

Category	Score	Rating
Bacteria and Viruses	55	Medium
Nitrates and Nitrites	50	Medium
Volatile Organic Chemicals	50	Medium
Heavy Metals, Cyanide, and other Inorganic Chemicals	55	Medium
Synthetic Organic Chemicals	40	Medium
Other Organic Chemicals	50	Medium

The recreation trail and ski area rank as the highest potential sources of contamination by bacteria and viruses and nitrates and/or nitrites. Bacteria, viruses, nitrates and/or nitrites are detectable in natural background levels for many water systems throughout the area. The sampling history of MOA's Ship Creek water source identifies low concentrations of nitrates. According to ADEC records, existing nitrate concentrations are 7 percent of the maximum contaminant level (MCL) for this contaminant. Activities along the recreation trail have the potential to increase the amount of nitrates moving directly into the water source. The close proximity of the hiking trail to the shores of Ship Creek increases the risk of contamination to the water source. However, due to the low use of the hiking trail the risk to the water source is downgraded.

Further up the watershed lies a 6600-gallon wastewater holding tank. Once every ten days the wastewater holding tank is emptied into a sewage transfer truck and sewage is transported off site. The holding tank is located in Zone C, and because of its distance from Ship Creek it poses a low potential risk.

The existing low-level contamination combined with the low use of the trail has resulted in an overall risk



ranking of Medium for nitrates and/or nitrites.

The same wastewater holding tank and recreation areas pose a potential source of contamination by bacteria and viruses as well. The greatest risks to health are microbiological contamination such as bacteria, viruses, and protozoa. Only a small amount of bacteria and viruses are required to endanger public health. The overall risk ranking for bacteria and viruses is Medium due to the activities related to, and the location of the recreation areas and wastewater holding tank.

In 1990, a 2000-gallon diesel fuel tank was excavated and removed from a building located at the ski resort. During the tank removal, surrounding soil was found to be contaminated with petroleum. ADEC records (File # L76-1.12) indicate 570 cubic yards of soil were excavated to a depth of 20 feet below ground surface, at which point bedrock was encountered. Contamination was evident on the bedrock. The tank was replaced with a 3000-gallon diesel fuel tank and covered with a concrete pad. In 1996, another 4000 cubic yards of soil was excavated to remove residual contamination at this site. In 1999, the tank was removed, and another 250 cubic yards of soil was excavated.

In 1993, the ski resort experienced a surface spill of heating oil when the integrity of a fuel oil pipeline was breached. The contaminated soil was removed to a depth of five feet and transported off site.

These events contribute the highest potential risk of contamination by volatile organic chemicals. The site has been remediated to ADEC standards and is considered closed. This combined with the location and distance away from the creek's shore result in an overall risk ranking of Medium for this category of contaminants.

The areas gravel roads rank as the highest potential source of contamination by heavy metals, cyanide, other inorganic chemicals, and other organic chemicals. Natural background levels of heavy metals exist throughout the Chugach Mountains (Clark and Bartsch 1971). Samples taken (11/04/98) indicate that low levels of mercury and barium were detected. Barium levels at that time were less than 0.5 percent of the MCL. Mercury levels were at approximately 10 percent of the MCL. Recent sampling shows no detectable amounts of these contaminants. The overall risk ranking for heavy metals is Medium.

There are no known potential or existing sources of synthetic organic chemicals within this watershed.

## SUMMARY

A *Source Water Assessment* has been completed for the MOA's Ship Creek public drinking water source. The overall vulnerability for this source to contamination is **Medium** for bacteria and viruses, nitrates and/or nitrites, heavy metals, volatile organic chemicals, synthetic organic chemicals, and other organic chemicals. This assessment of contaminant risks can be used as a foundation for local voluntary efforts as well as a basis for the continuous efforts on the part of the Municipality of Anchorage 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 public drinking water source.

## REFERENCES CITED

- Bertrand, C.M., et. al, 1999, Water Resources Data Alaska Water Year 1998: USGS Water-Data Report AK-98-1.
- Clark, Sandra H.B., 1972, Reconnaissance Bedrock Geologic Map of the Chugach Mountains Near Anchorage, Alaska.
- Clark, Sandra B. and Bartsch, Susan R., 1971, Reconnaissance Geologic Map and Geochemical Analyses of Stream Sediment and Rock Samples of the Anchorage B-7 Quadrangle, Alaska: USGS Open File Report 71-0071.
- Western Regional Climate Center, 2000, December 18, Web extension to the *Western Regional Climate Center* [WWW document]. URL <http://www.wrcc.dri.edu/index.html>

## **APPENDIX A**

### **MOA - Ship Creek Drinking Water Protection Areas**

**Table 1**

**Contaminant Source Inventory for  
MOA Municipality Ship Creek**

**PWSID 210906.018**

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	C	Ft. Richardson Bldg. 8102	2	ADEC File # L76-1.12
Highways and roads, dirt/gravel	X24	X24-1	B, C	Arctic Valley Road	2	
Recreational Trails/areas	X46	X46-1	B, C	Alpenglow Ski Area	2	
Recreational Trails/areas	X46	X46-2	A, B	Ship Creek Trail	2	
Highways and roads, dirt/gravel	X24	X24-2	C	Restricted access road	2	
Wastewater Holding Tank	T22	T22-1	C	Alpenglow Ski Area	2	

Contaminant Source Inventory and Risk Ranking for

*PWSID 210906.018*

*Table 2*

MOA Municipality Ship Creek  
Sources of Bacteria and Viruses

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Recreational Trails/areas	X46	X46-1	B, C	Low	1	Alpenglow Ski Area	2	
Recreational Trails/areas	X46	X46-2	A, B	Low	2	Ship Creek Trail	2	
Wastewater Holding Tank	T22	T22-1	C	Low	3	Alpenglow Ski Area	2	

Contaminant Source Inventory and Risk Ranking for

PWSID 210906.018

Table 3

MOA Municipality Ship Creek

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-1	B, C	Low	1	Arctic Valley Road	2	
Highways and roads, dirt/gravel	X24	X24-2	C	Low	2	Restricted access road	2	

Contaminant Source Inventory and Risk Ranking for

*PWSID 210906.018*

*Table 4*

MOA Municipality Ship Creek

Sources of Nitrates/Nitrites

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Recreational Trails/areas	X46	X46-1	B, C	Low	1	Alpenglow Ski Area	2	
Recreational Trails/areas	X46	X46-2	A, B	Low	2	Ship Creek Trail	2	
Wastewater Holding Tank	T22	T22-1	C	Low	3	Alpenglow Ski Area	2	

Contaminant Source Inventory and Risk Ranking for

PWSID 210906.018

Table 5

MOA Municipality Ship Creek  
Sources of Other Organic Chemicals

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-1	B, C	Low	1	Arctic Valley Road	2	
Highways and roads, dirt/gravel	X24	X24-2	C	Low	2	Restricted access road	2	



Contaminant Source Inventory and Risk Ranking for

PWSID 210906.018

Table 6










MOA Municipality Ship Creek  
Sources of Volatile Organic Chemicals

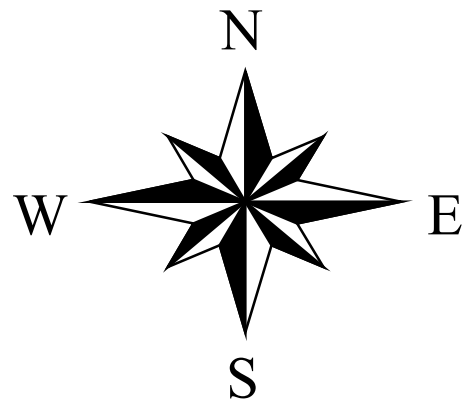
<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	C	Low	1	Ft. Richardson Bldg. 8102	2	ADEC File # L76-1.12
Highways and roads, dirt/gravel	X24	X24-1	B, C	Very Low	2	Arctic Valley Road	2	
Highways and roads, dirt/gravel	X24	X24-2	C	Very Low	3	Restricted access road	2	

## **APPENDIX B**

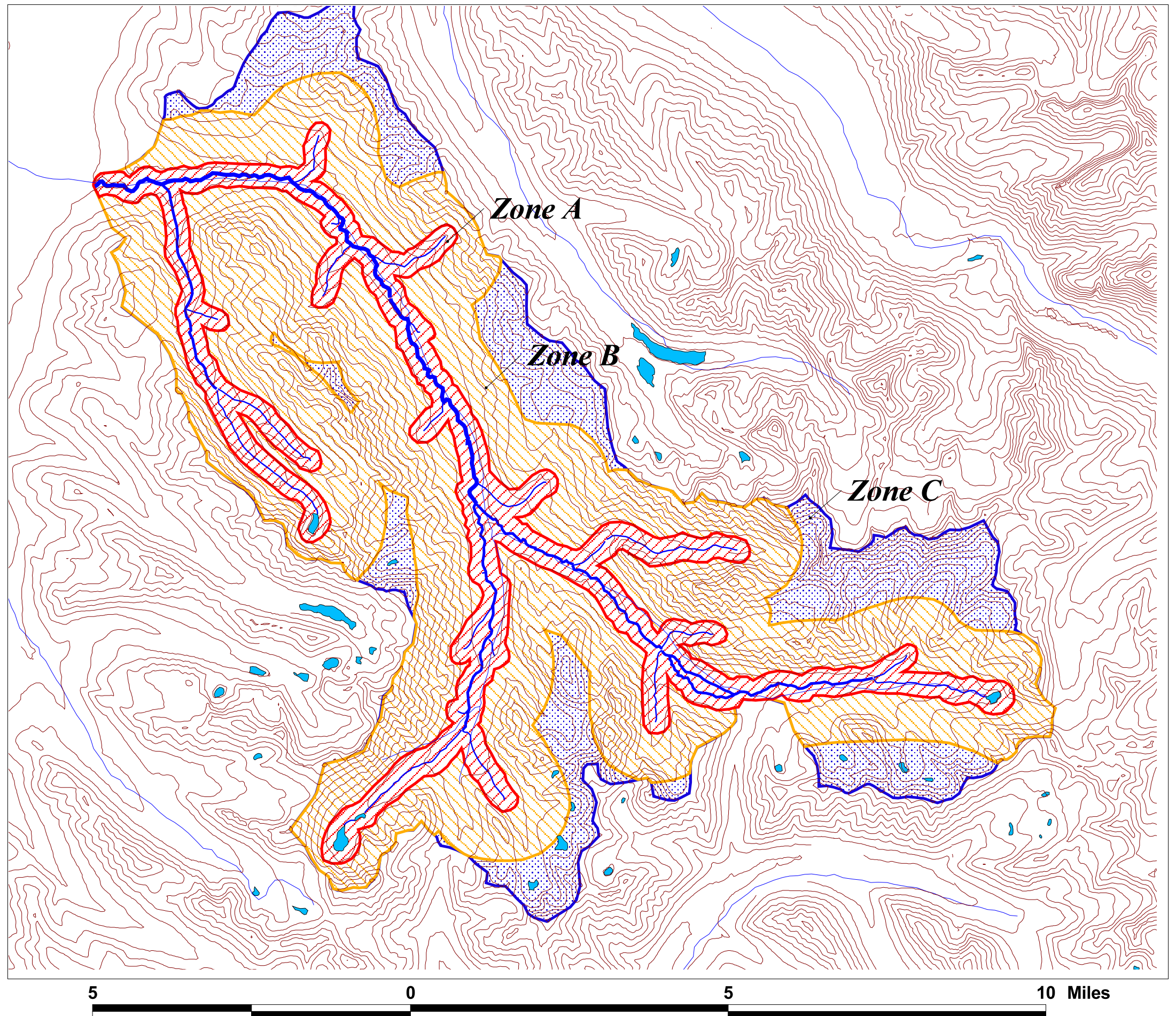
### **Contaminant Source Inventory and Risk Ranking for MOA - Ship Creek**

# MOA Ship Creek PWSID 210906.0018 Drinking Water Protection Areas











-  Elevation Contours
-  Lakes
-  Streams
-  2nd order streams
-  3rd order streams
-  4th order streams
- Zone A**
-  1000 feet from surface water body
- Zone B**
-  1 mile from surface water body
- Zone C**
-  Entire watershed

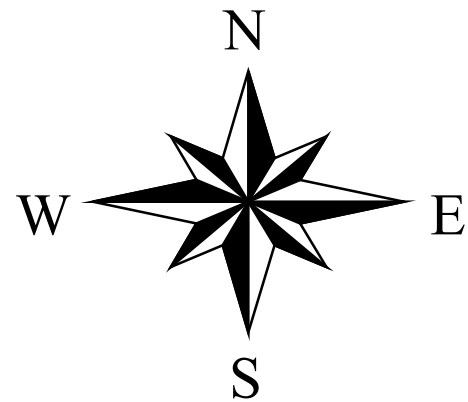


## Map 1

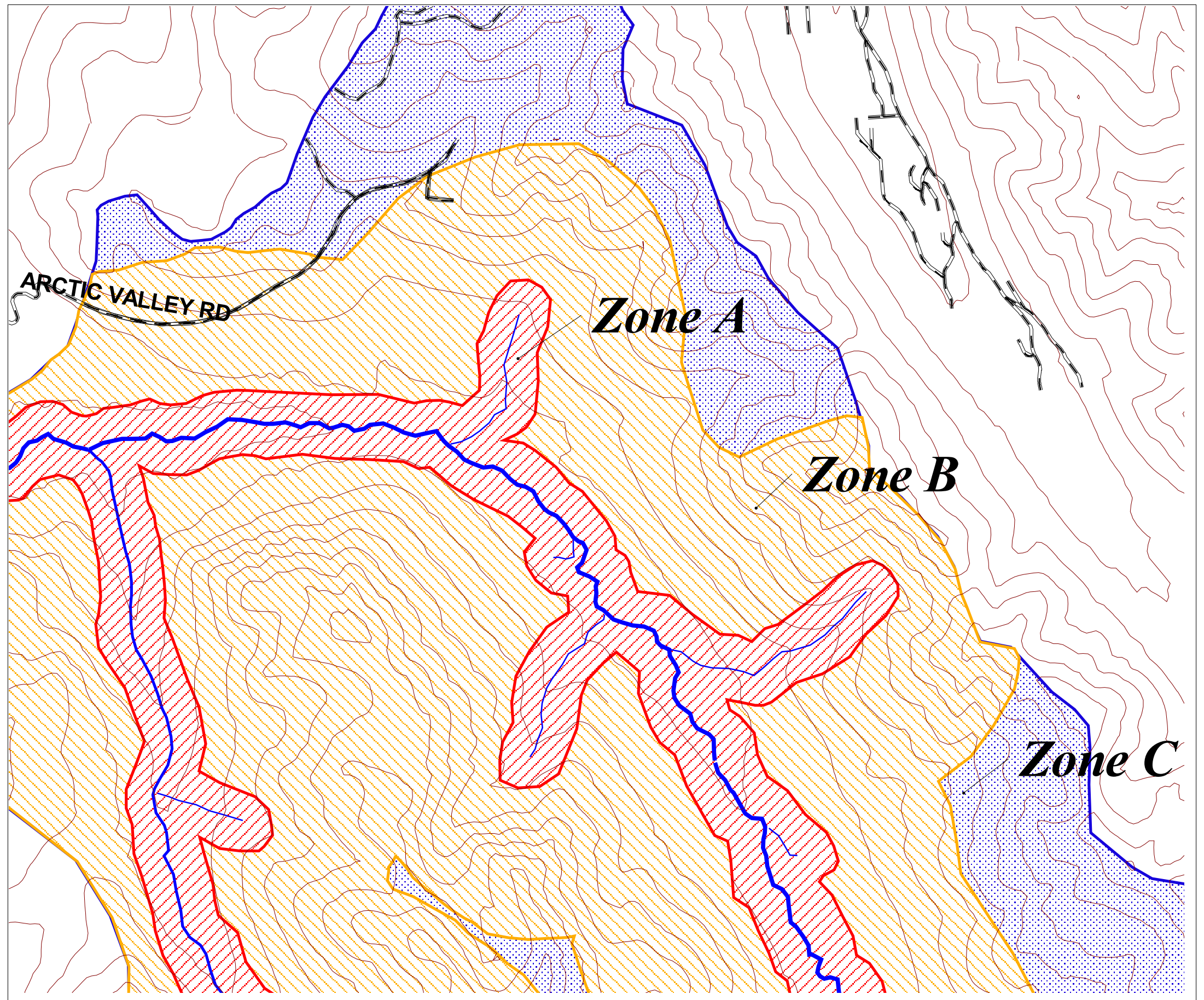


# MOA Ship Creek PWSID 210906.018 Drinking Water Protection Areas

-  Roads
-  Ship creek gravel roads.shp
-  Elevation Contours
-  Lakes
-  2nd order streams
-  3rd order streams
-  4th order streams
- Zone A**
-  1000 feet from surface water body
- Zone B**
-  1 mile from surface water body
- Zone C**
-  Entire watershed



## Map 2

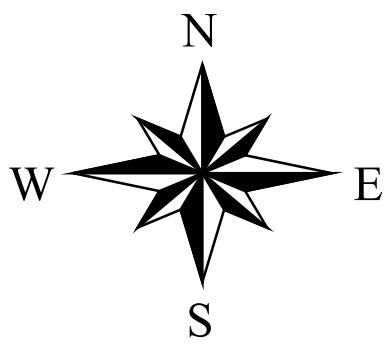


## **APPENDIX C**

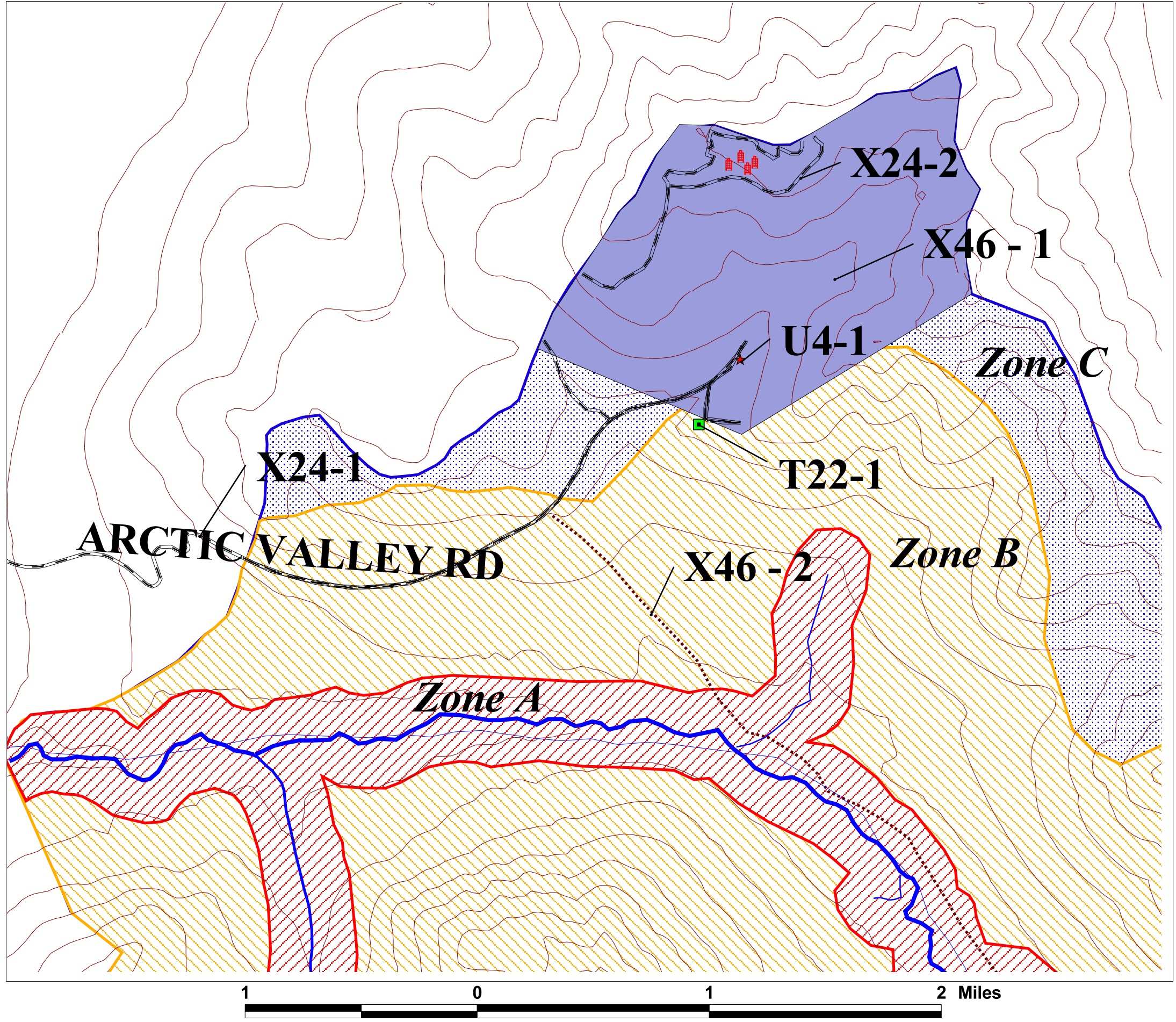
### **MOA - Ship Creek Drinking Water Protection Areas and Potential & Existing Contaminant Sources**

# MOA Ship Creek PWSID 210906.018 Drinking Water Protection Areas and Potential and Existing Contaminant Sources

-  Intake
-  Wastewater Holding Tank
-  Radio towers
-  Streams
-  Restricted access roads
-  Roads
-  Contaminated sites, DEC recognized
-  Railroads
-  Trails
-  Elevation Contours
-  Lakes
-  Recreational trails/area
-  2nd order streams
-  3rd order streams
-  4th order streams
- Zone A  
 1000 feet from surface water body
- Zone B  
 1 mile from surface water body
- Zone C  
 Entire watershed



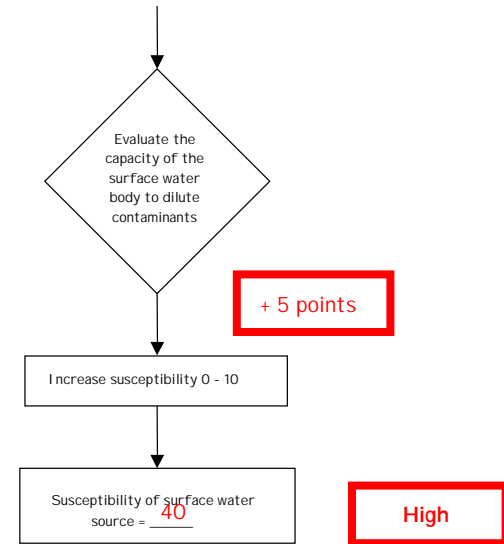
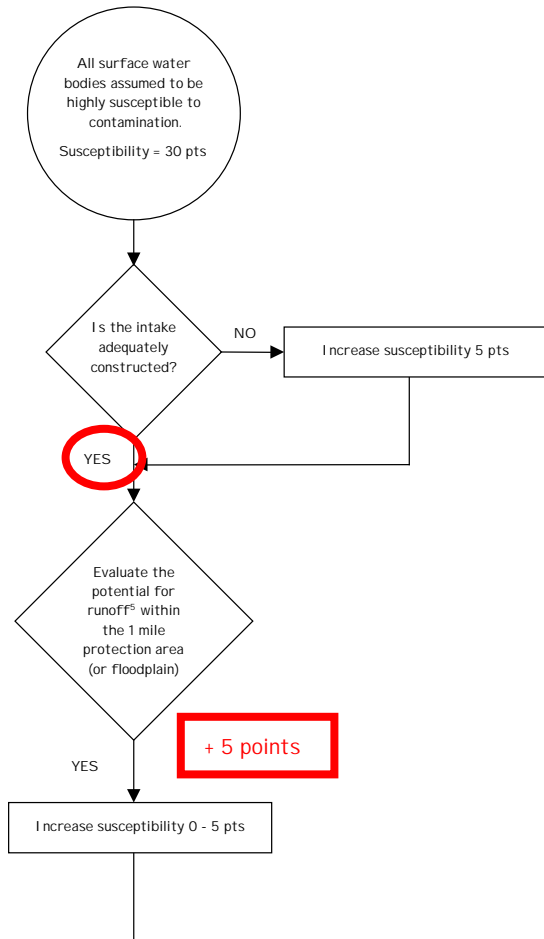
## Map 3



## **APPENDIX D**

### **Vulnerability Analysis for MOA - Ship Creek Public Drinking Water System**

Chart 1. Susceptibility of the Surface Water Source



**5. Potential for Runoff**

**Average annual precipitation:**  
 ≤ 20 in/yr, 0 pts  
 > 20 in/yr, 2 pts

**Slope of land surface:**  
 ≤ 3%, 0 pts  
 > 3%, 3 pts

**6. Capacity to Dilute Contaminants**

<b>Total annual river or stream discharge</b>	<b>Lakes or ponds Area:</b>
> 90,000 cfs, 0 pts	> 1 mi <sup>2</sup> , 0 pts
20,000 - 89,999, 5 pts	≤ 1 mi <sup>2</sup> , 5 pts
< 20,000, 10 pts	<b>Residence time:</b>
	≤ 1 yr, 0 pts
	> 1 yr, 5 pts

**Runoff:**  
 Annual precipitation 35 in. = 2 pts.  
 Slope >3% = 3 pts.

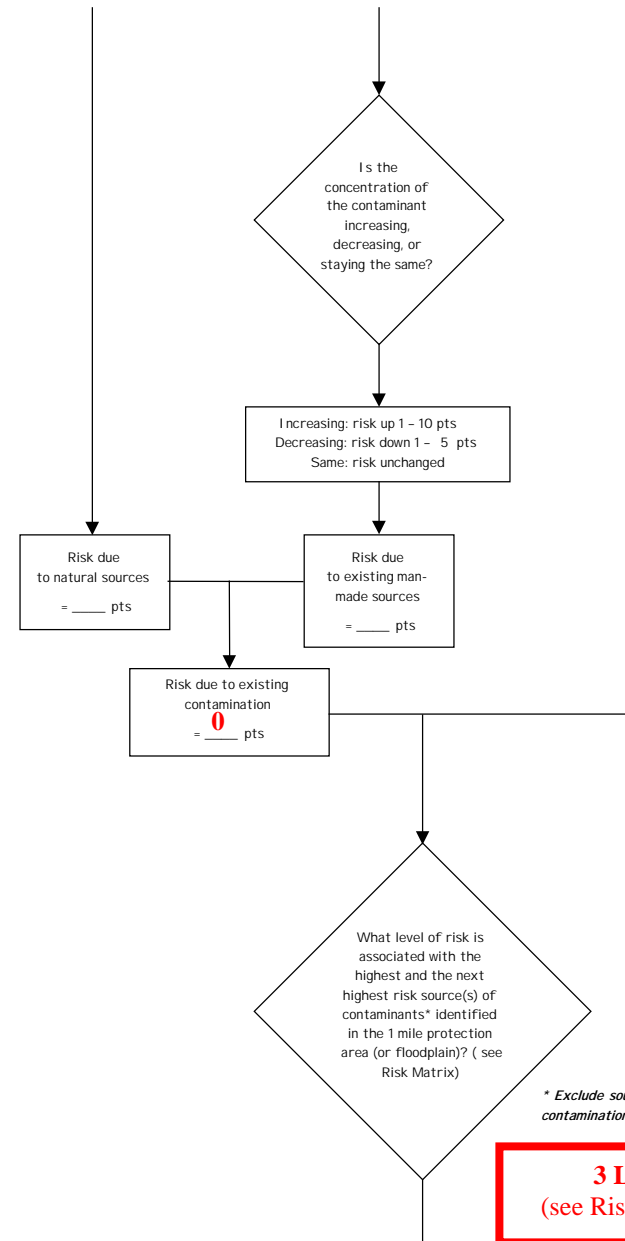
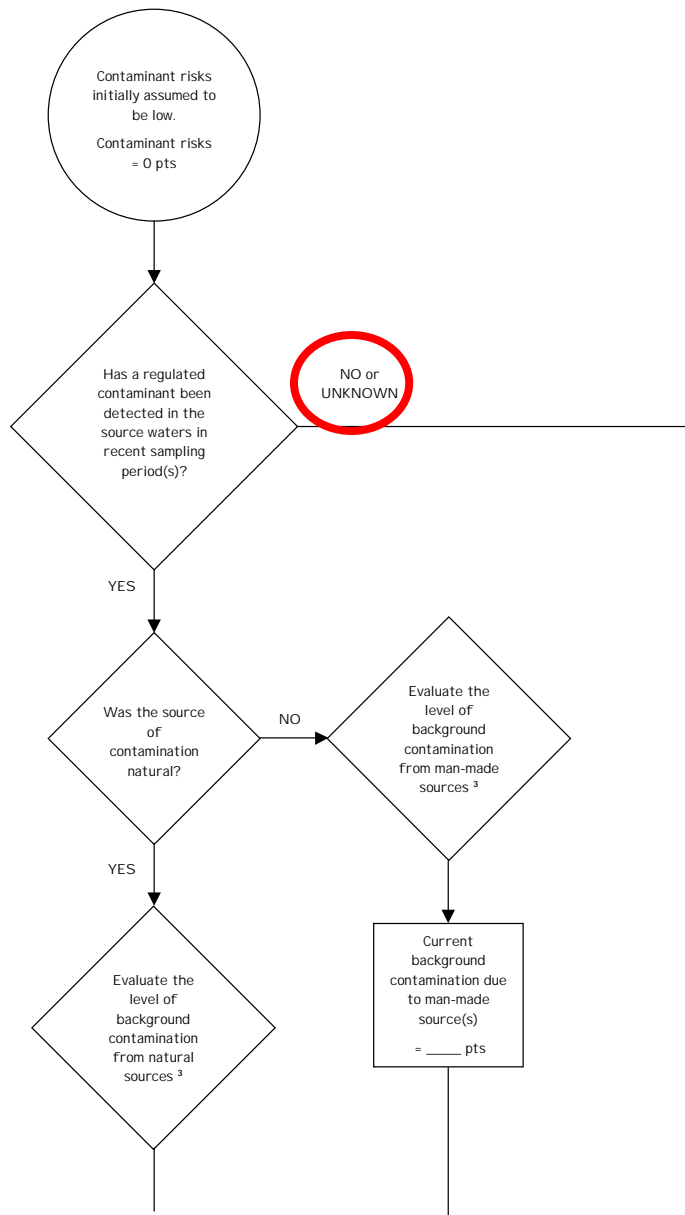
**Surface Water Source Susceptibility Ratings**

40 to 50 pts	very high
30 to < 40 pts	high

**Capacity to Dilute:**  
 Stream discharge 58,514 cfs = 5 pts.



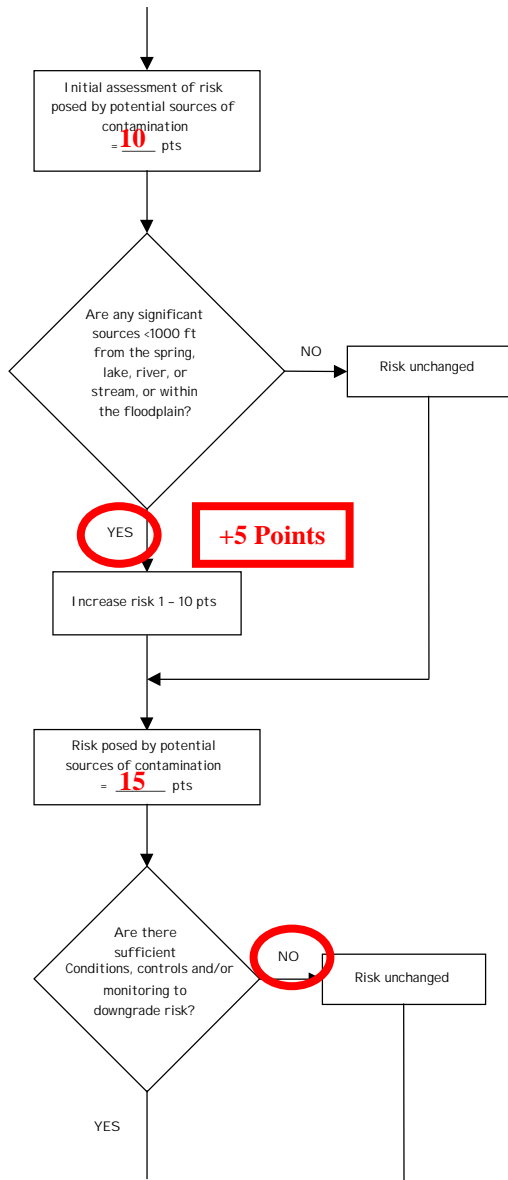
**Chart 2. Contaminant Risks for MOA Ship Creek - Bacteria and Viruses**



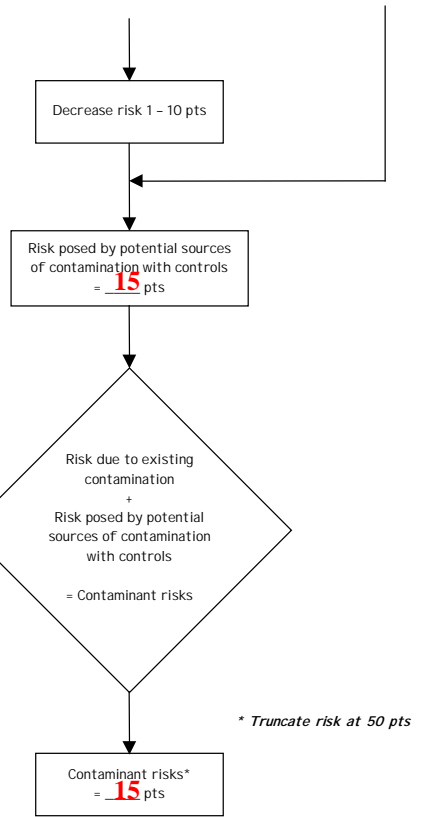
*\* Exclude sources of existing contamination, if known*

**3 Lows  
(see Risk Matrix)**

**Chart 2. Contaminant Risks for MOA Ship Creek - Bacteria and Viruses (Continued)**



Existing contamination = 0 pts  
 +  
 Potential contamination = 15 pts  
 =  
 Contaminant risk of Bacteria and Viruses = 15 pts



**3. Level of Background Contamination**

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

**Contaminant Risk Ratings**

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
<20 pts	low

Low

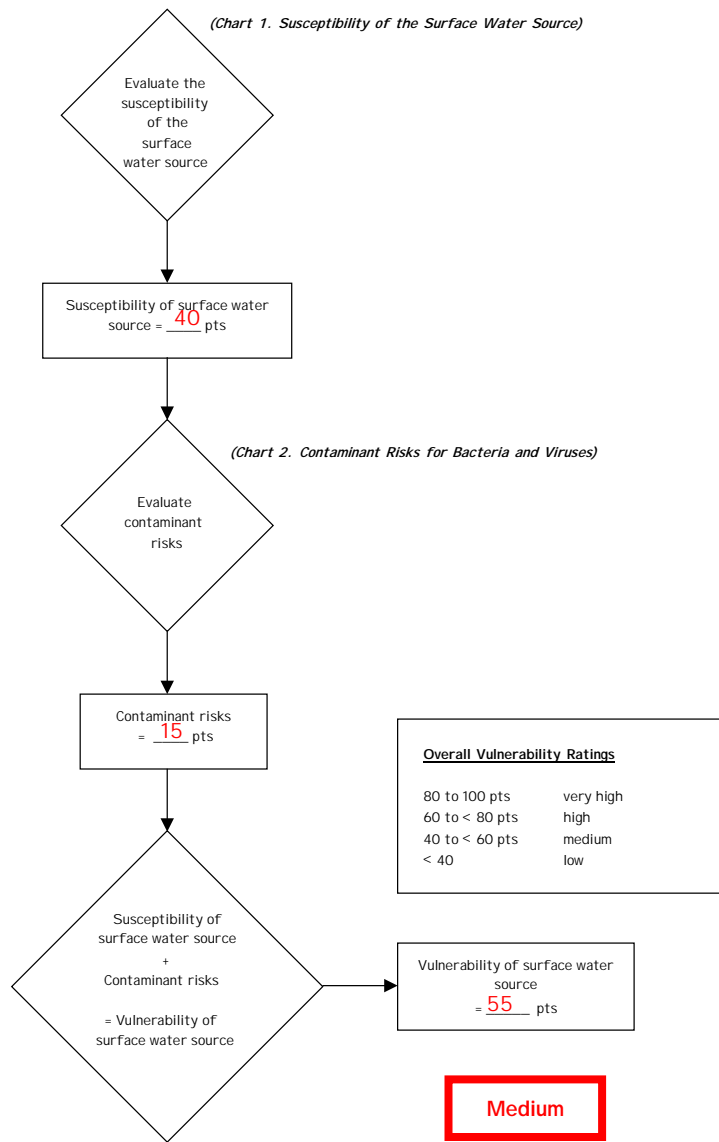
Table 1. Risk Matrix for Contaminant Sources for Bacteria and Viruses - MOA Ship Creek

**Level of Risk Associated with the Highest Risk Sources**

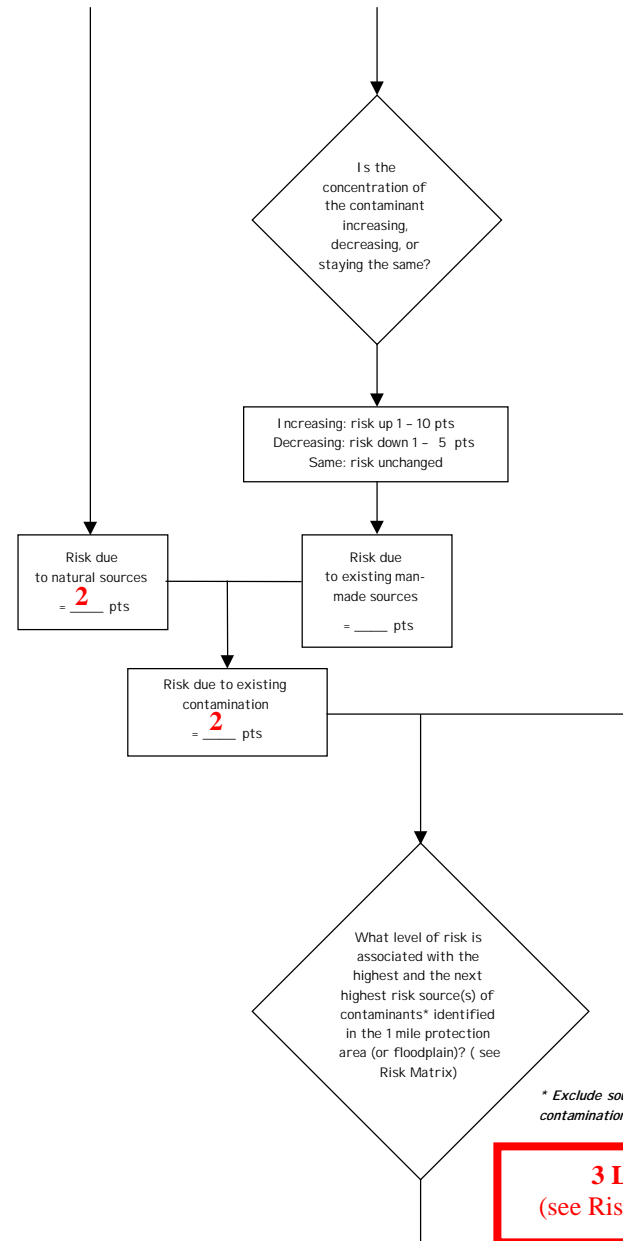
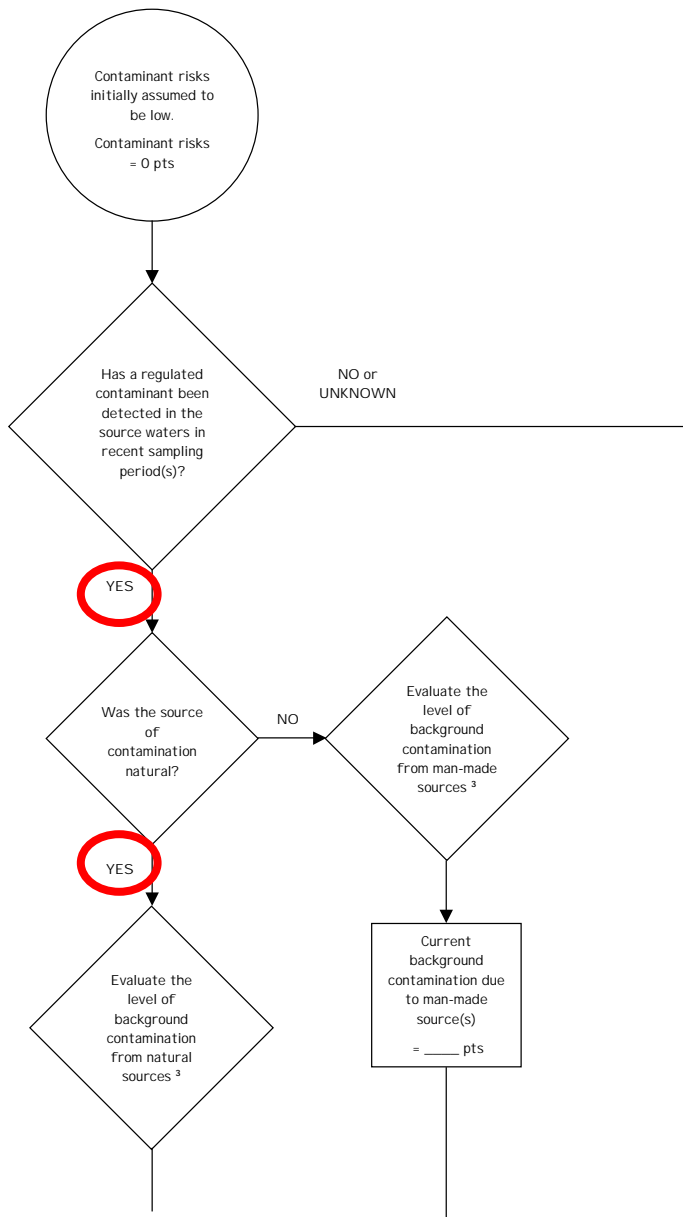
Next Highest Risk Sources(s)

<b>Ship Creek Trail</b>	<b>VERY LOW 5 PTS</b>	<b>LOW 10 pts</b>	<b>MEDIUM 20 pts</b>	<b>HIGH 30 pts</b>	<b>VERY HIGH 40 pts</b>
<b>Very Low</b>	≥ 10 sources + 5 pts	≥ 10 sources + 2 pts	—	—	—
<b>Low</b>	—	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	—
<b>Medium</b>	—	—	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
<b>High</b>	—	—	—	1 source + 10 pts	≥ 2 sources + 10 pts
<b>Very High</b>	—	—	—	—	1 source + 10 pts

Chart 3. Vulnerability Analysis for Bacteria and Viruses - MOA Ship Creek

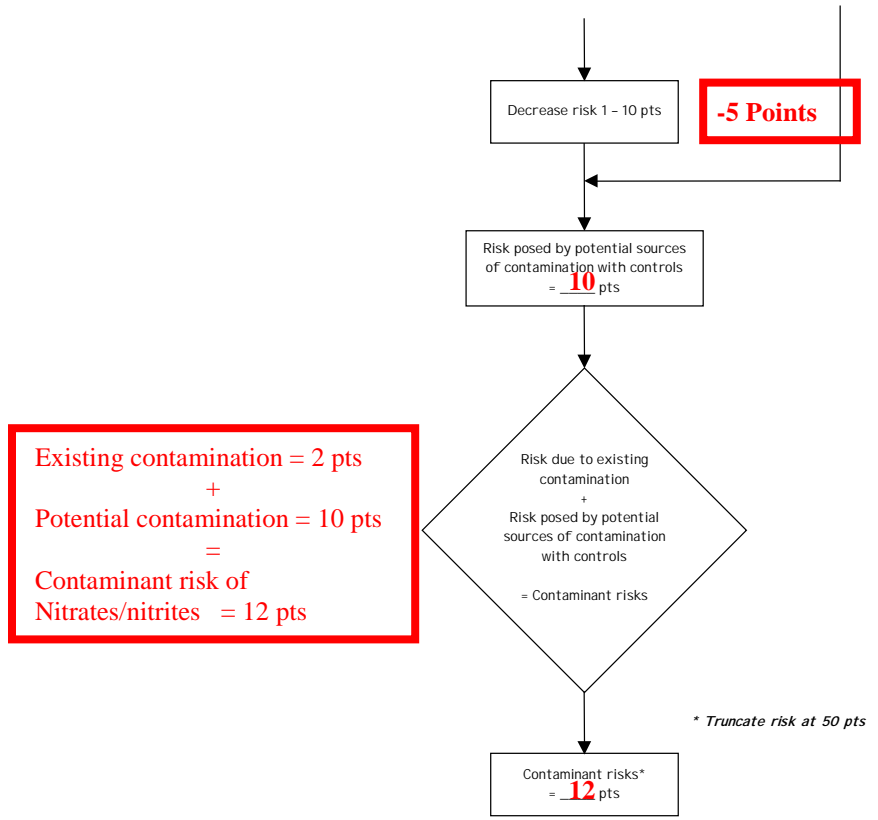
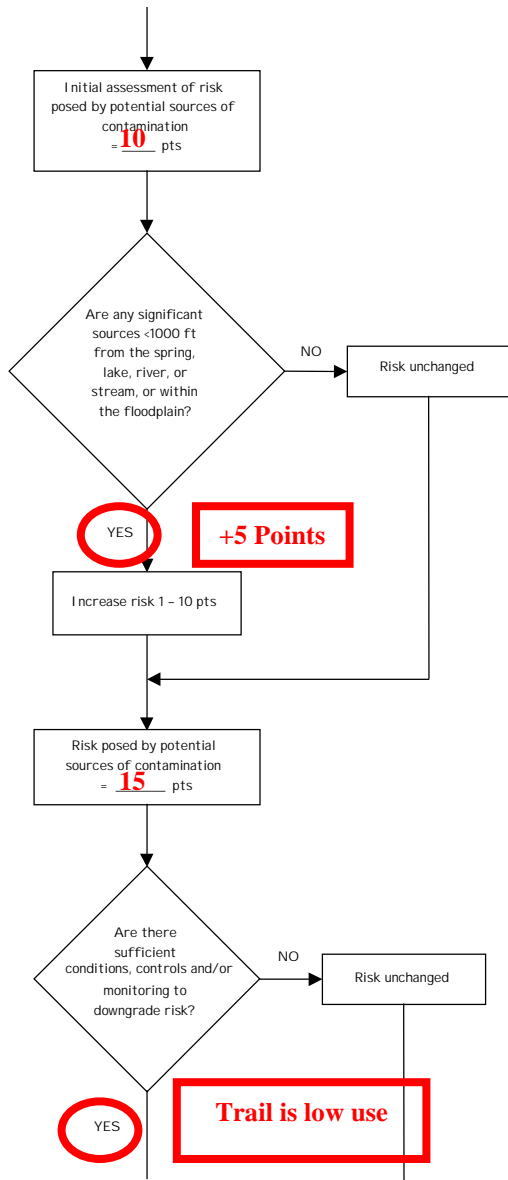


**Chart 4. Contaminant Risks for MOA Ship Creek - Nitrates/nitrites**



**3 Lows**  
(see Risk Matrix)

Chart 4. Contaminant Risks for MOA Ship Creek - Nitrates/nitrites (Continued)



**3. Level of Background Contamination**

> MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19 MCL	0-5 pts

**Contaminant Risk Ratings**

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20	low

Nitrate = .718 m/L  
 Maximum Contaminant Level (MCL) = 10  
 $.718/10 = 0.0718$  of MCL  
 +2 points

Low

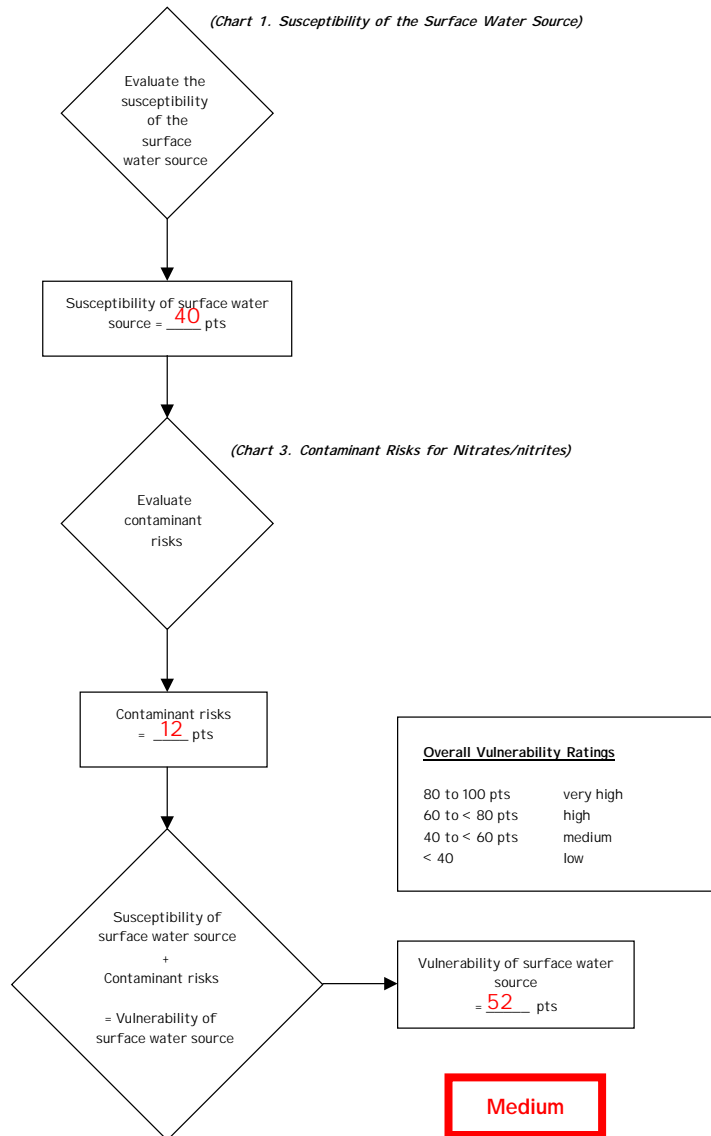
Table 2. Risk Matrix for Contaminant Sources for Nitrates/Nitrites - MOA - Ship Creek

**Level of Risk Associated with the Highest Risk Sources**

**Next Highest Risk Sources(s)**

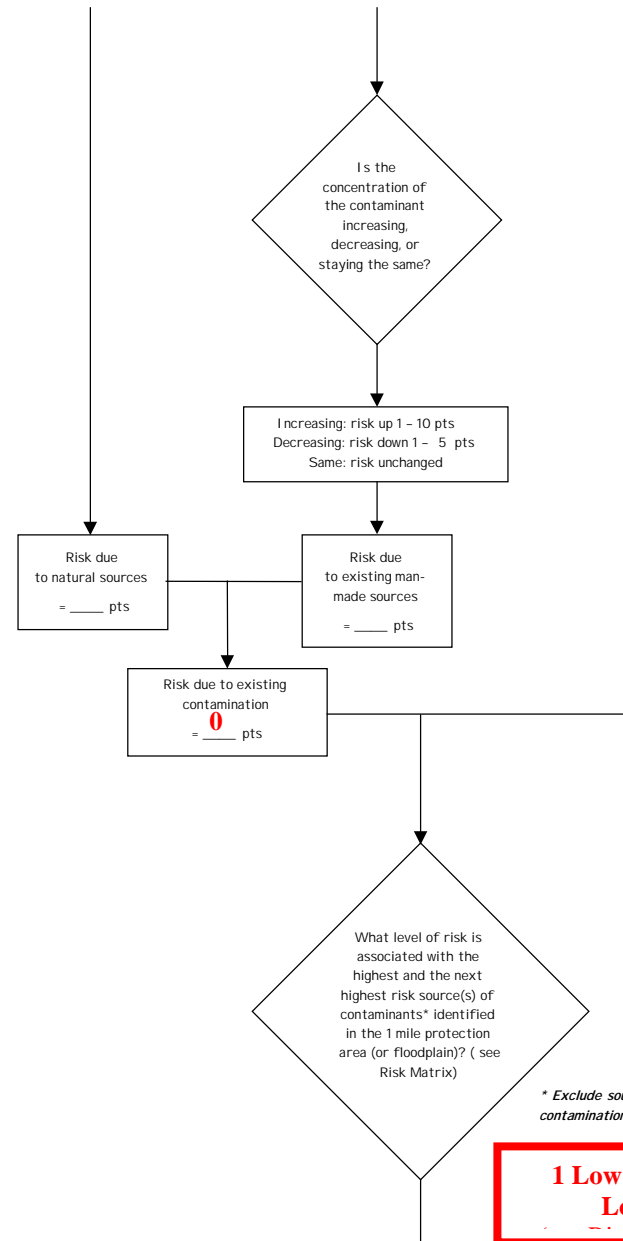
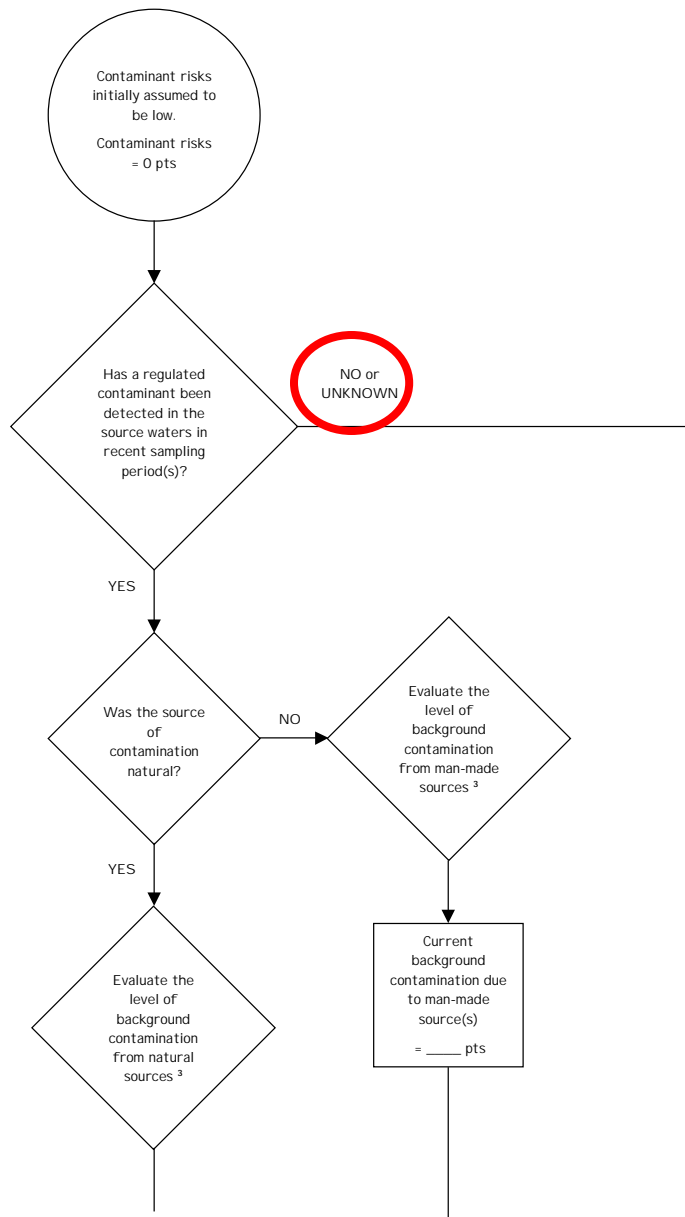
<b>Ship Creek Trail</b>	<b>VERY LOW 5 PTS</b>	<b>LOW 10 pts</b>	<b>MEDIUM 20 pts</b>	<b>HIGH 30 pts</b>	<b>VERY HIGH 40 pts</b>
<b>Very Low</b>	≥ 10 sources + 5 pts	≥ 10 sources + 2 pts	—	—	—
<b>Low</b>	—	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	—
<b>Medium</b>	—	—	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
<b>High</b>	—	—	—	1 source + 10 pts	≥ 2 sources + 10 pts
<b>Very High</b>	—	—	—	—	1 source + 10 pts

Chart 5. Vulnerability Analysis for Nitrates/nitrites- Ft. Richardson Ship Creek





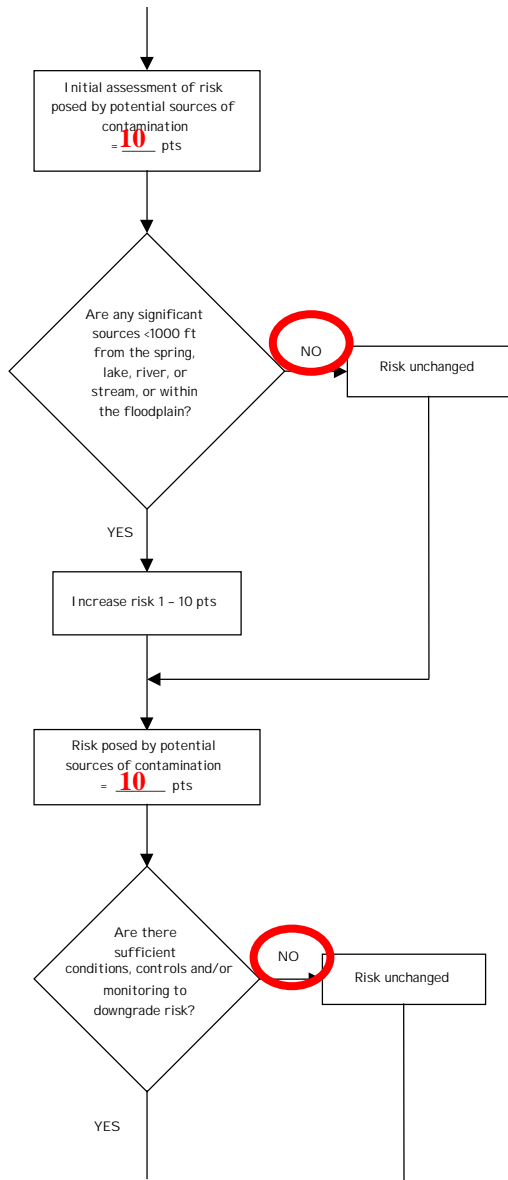
**Chart 6. Contaminant Risks for MOA Ship Creek - Volatile Organic Chemicals**



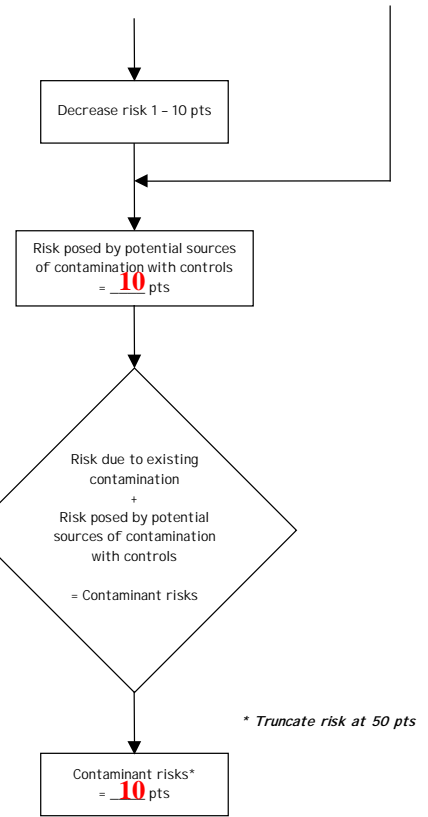
*\* Exclude sources of existing contamination, if known*

**1 Low, 2 Very Low**

Chart 6. Contaminant Risks for MOA Ship Creek - Volatile Organic Chemicals (Continued)



Existing contamination = 0 pts  
+  
Potential contamination = 10 pts  
=  
Contaminant risk of Volatile Organic Chemicals = 10 pts



**3. Level of Background Contamination**

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

**Contaminant Risk Ratings**

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
<20 pts	low

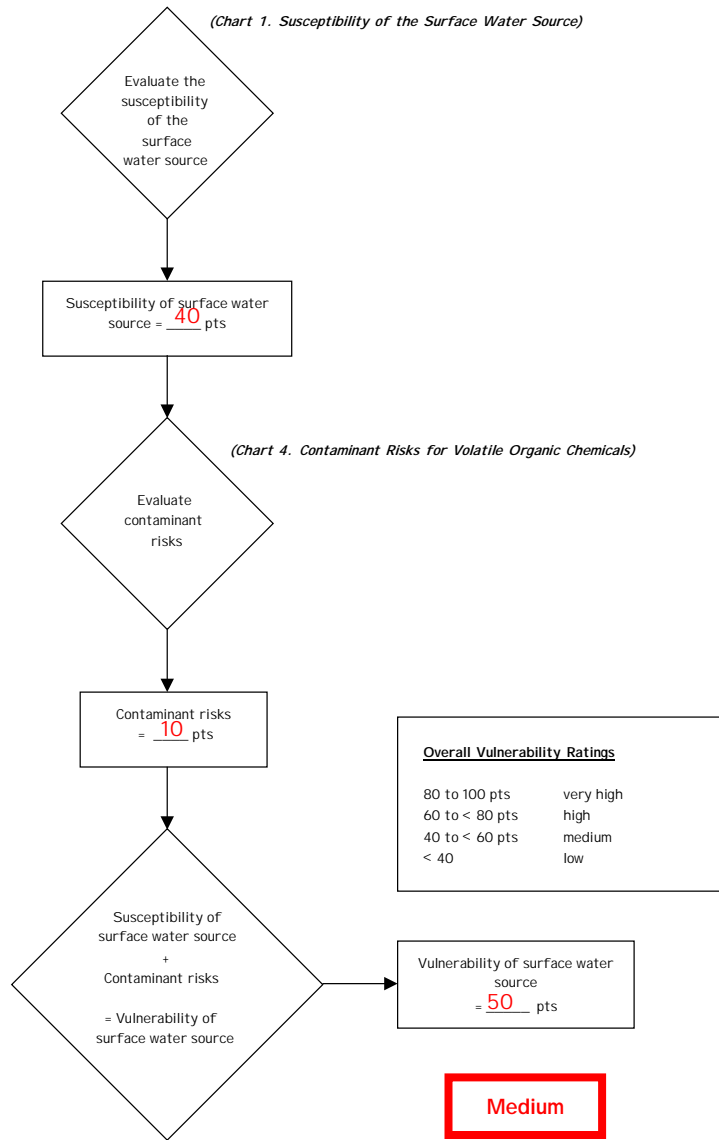
Low

Table 3. Risk Matrix for Contaminant Sources for Volatile Organic Chemicals  
 - MOA Ship Creek

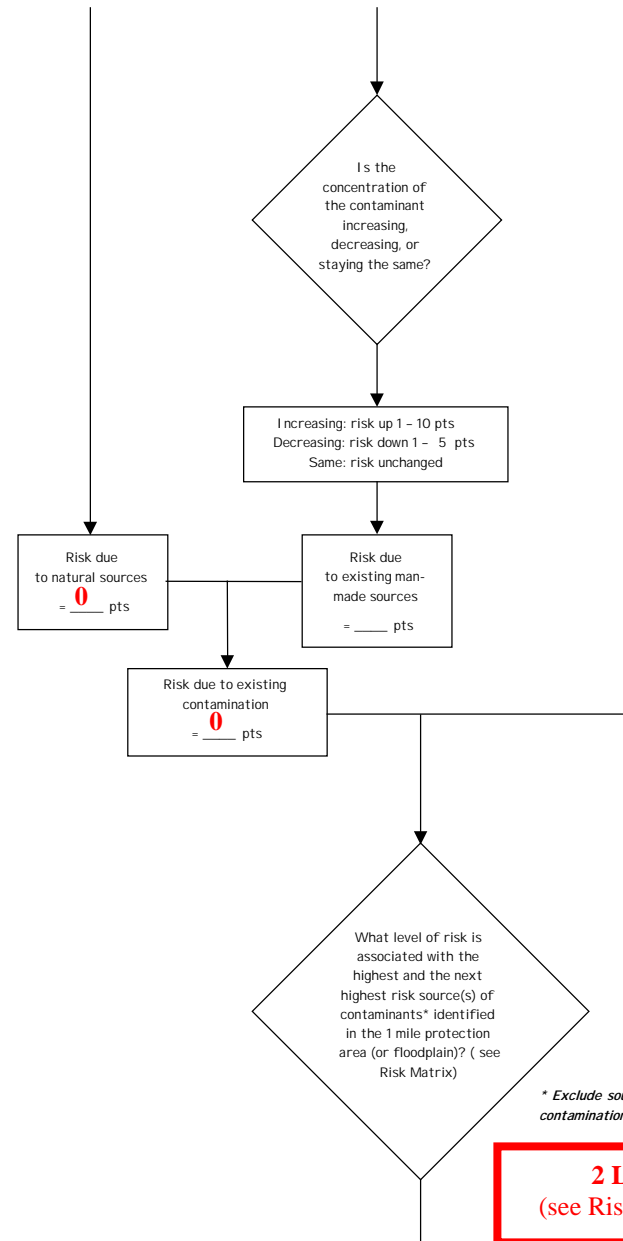
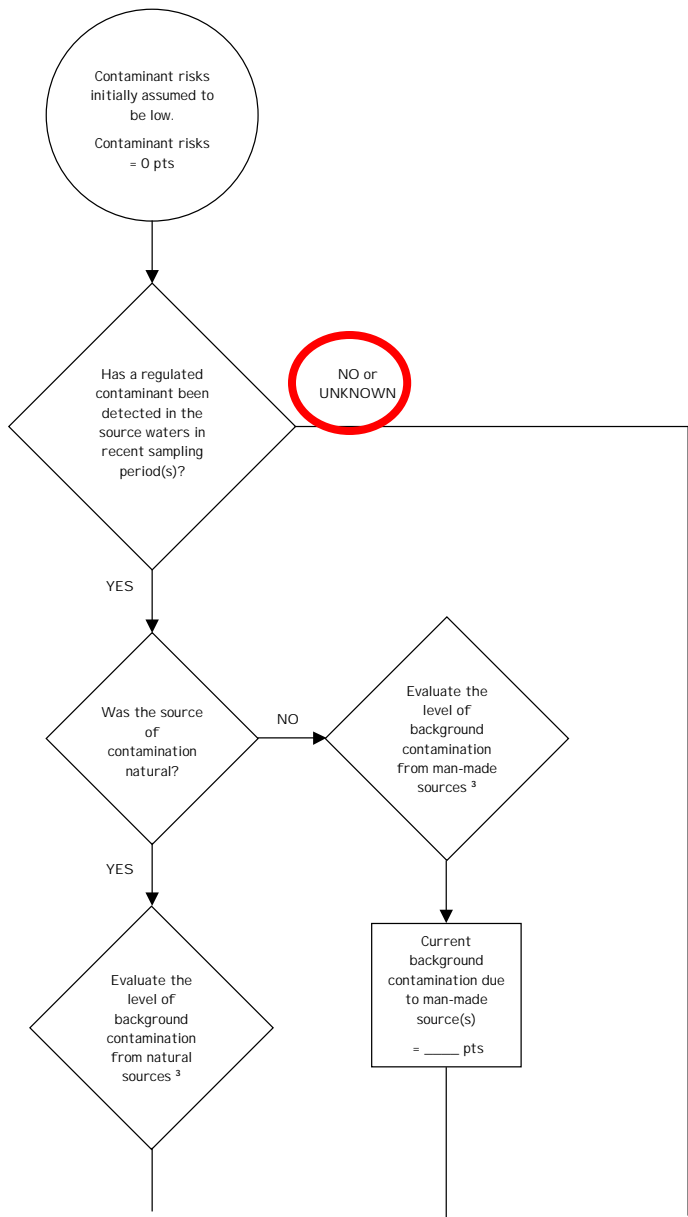
**Level of Risk Associated with the Highest Risk Sources**

<b>Next Highest Risk Sources(s)</b>	<b>Contaminated Site U4-1</b>	<b>VERY LOW 5 PTS</b>	<b>LOW 10 pts</b>	<b>MEDIUM 20 pts</b>	<b>HIGH 30 pts</b>	<b>VERY HIGH 40 pts</b>
	<b>Very Low</b>	≥ 10 sources + 5 pts	≥ 10 sources + 2 pts	—	—	—
	<b>Low</b>	—	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	—
	<b>Medium</b>	—	—	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
	<b>High</b>	—	—	—	1 source + 10 pts	≥ 2 sources + 10 pts
	<b>Very High</b>	—	—	—	—	1 source + 10 pts

Chart 7. Vulnerability Analysis for Volatile Organic Chemicals - MOA Ship Creek



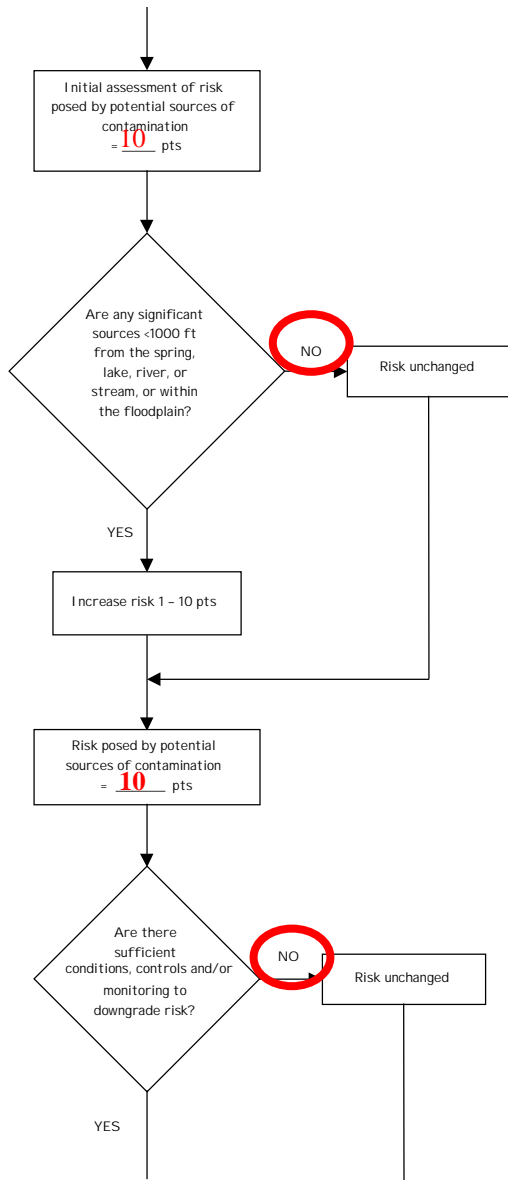
**Chart 8. Contaminant Risks for MOA Ship Creek - Other Organic Chemicals**



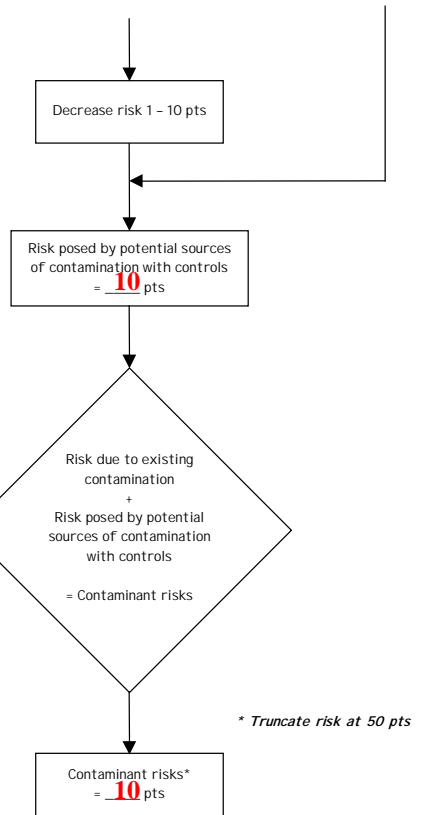
*\* Exclude sources of existing contamination, if known*

**2 Lows  
(see Risk Matrix)**

Chart 8. Contaminant Risks for MOA Ship Creek - Other Organic Chemicals (Continued)



Existing contamination = 0 pts  
 +  
 Potential contamination = 10 pts  
 =  
 Contaminant risk of Other Organic Chemicals = 10 pts



**3. Level of Background Contamination**

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

**Contaminant Risk Ratings**

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
<20 pts	low

Low

Table 4. Risk Matrix for Contaminant Sources for Other Organic Chemicals - MOA Ship Creek

**Level of Risk Associated with the Highest Risk Sources**

**Next Highest Risk Sources(s)**

<b>Arctic Valley Road</b>	<b>VERY LOW 5 PTS</b>	<b>LOW 10 pts</b>	<b>MEDIUM 20 pts</b>	<b>HIGH 30 pts</b>	<b>VERY HIGH 40 pts</b>
<b>Very Low</b>	≥ 10 sources + 5 pts	≥ 10 sources + 2 pts	—	—	—
<b>Low</b>	—	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	—
<b>Medium</b>	—	—	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
<b>High</b>	—	—	—	1 source + 10 pts	≥ 2 sources + 10 pts
<b>Very High</b>	—	—	—	—	1 source + 10 pts

Chart 9. Vulnerability Analysis for Other Organic Chemicals- MOA Ship Creek

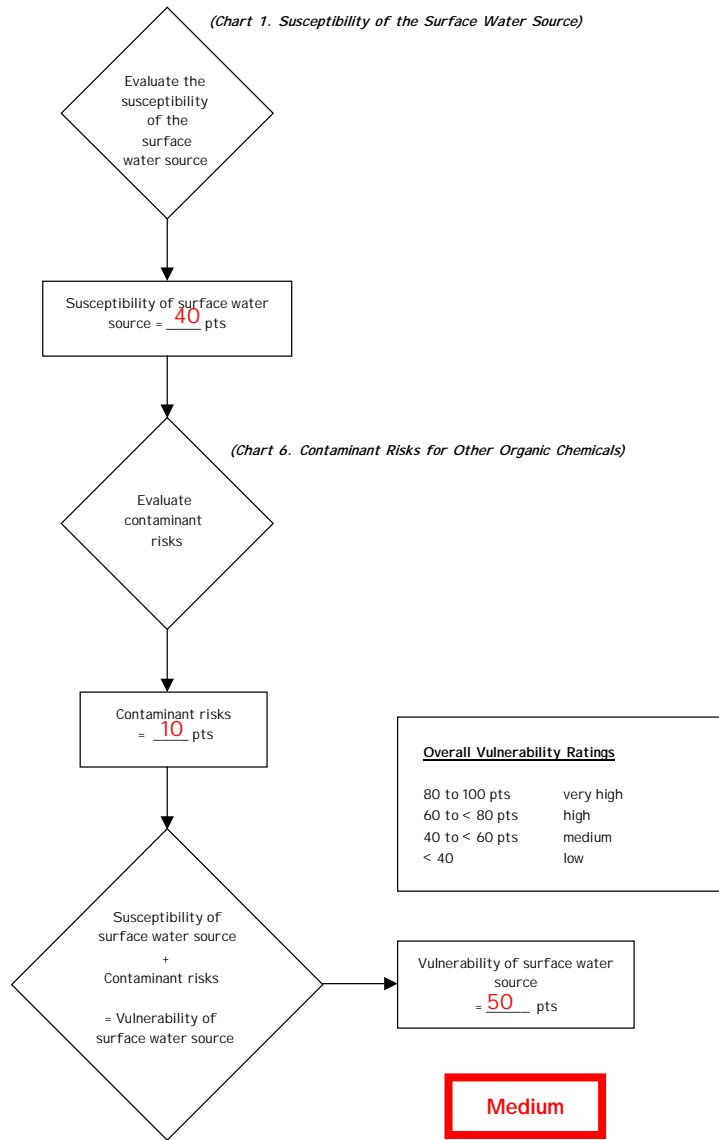
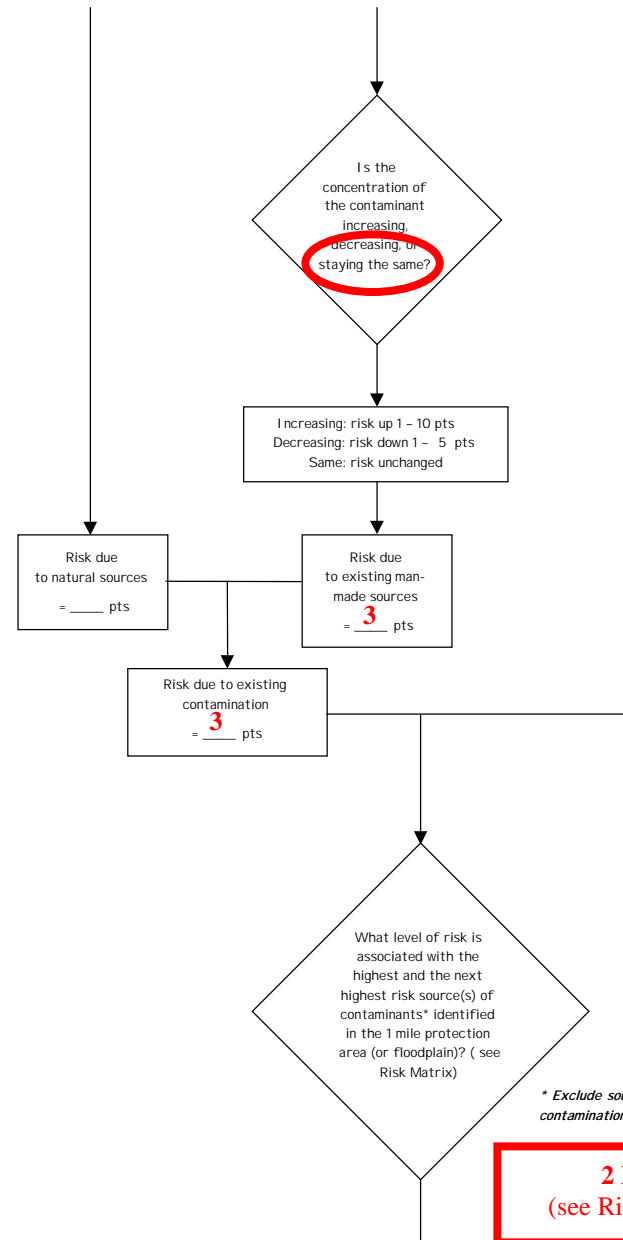
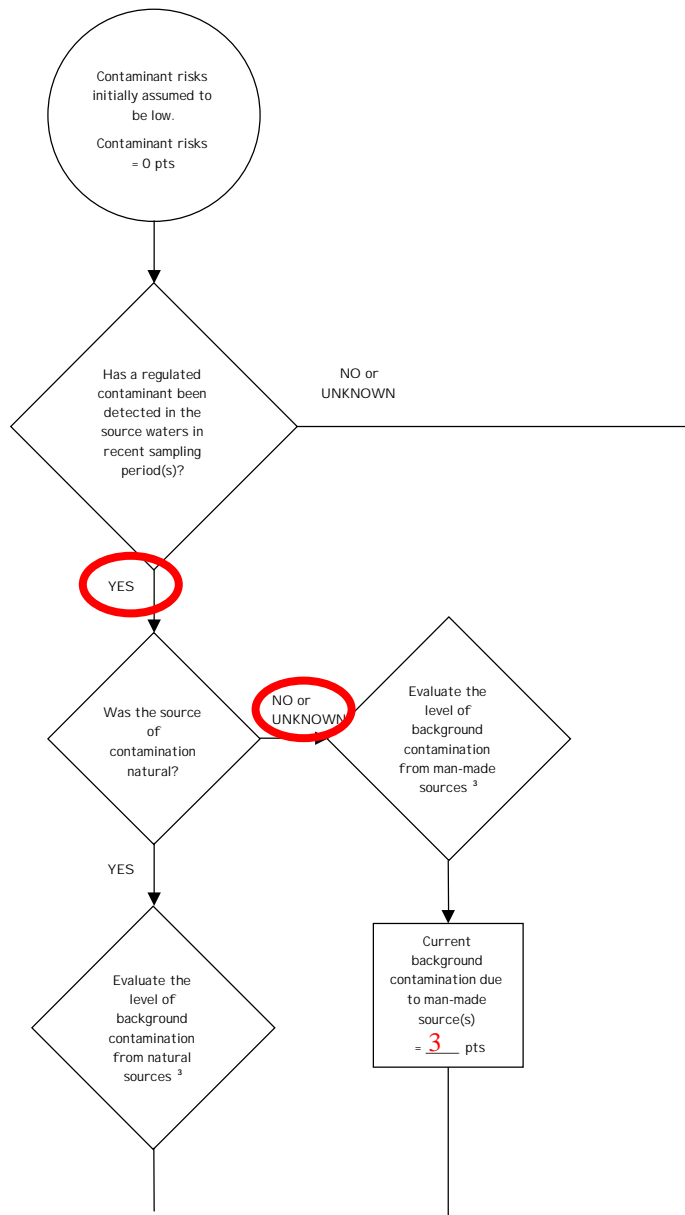




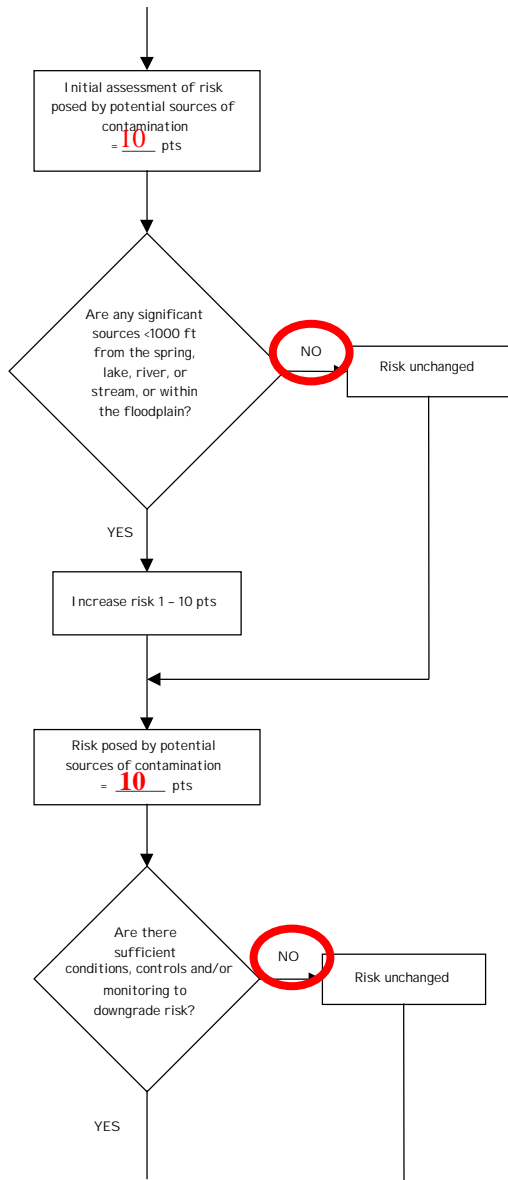
Chart 10. Contaminant Risks for MOA Ship Creek - Heavy Metals



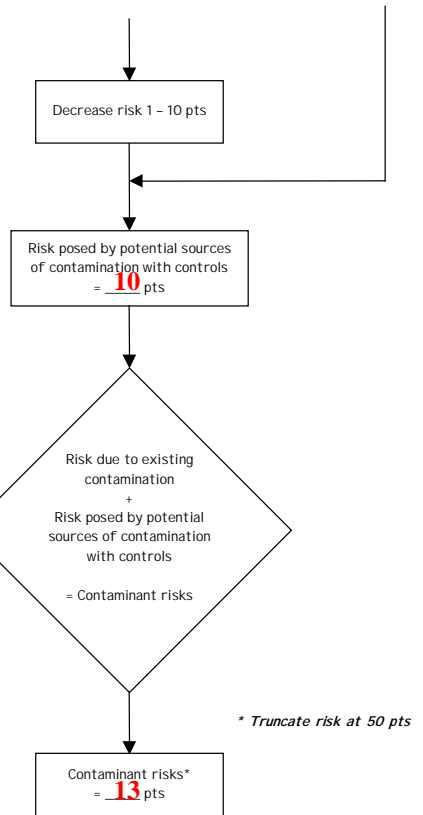
\* Exclude sources of existing contamination, if known

**2 Lows**  
(see Risk Matrix)

Chart 10. Contaminant Risks for MOA Ship Creek - Heavy Metals (Continued)



Existing contamination = 3 pts  
 +  
 Potential contamination = 10 pts  
 =  
 Contaminant risk of Heavy Metals = 13 pts



**3. Level of Background Contamination**

>100 % MCL	50 pts
50% MCL to < MCL	11-49 pts
20% MCL to < 49% MCL	6-10 pts
'detect' to < 019% MCL	0-5 pts

**Contaminant Risk Ratings**

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
<20 pts	low

Mercury = .208 µ/L  
 Maximum Contaminant Level (MCL) = 2 µ/L  
  
 .208/2 = 0.104  
 (10.4%) of MCL  
 +3 points

Low

Table 5. Risk Matrix for Contaminant Sources for Heavy Metals - MOA Ship Creek

**Level of Risk Associated with the Highest Risk Sources**

Next Highest Risk Sources(s)	Arctic Valley Road	VERY LOW 5 PTS	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
	Very Low	≥ 10 sources + 5 pts	≥ 10 sources + 2 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

Chart 11. Vulnerability Analysis for Heavy Metals- MOA Ship Creek

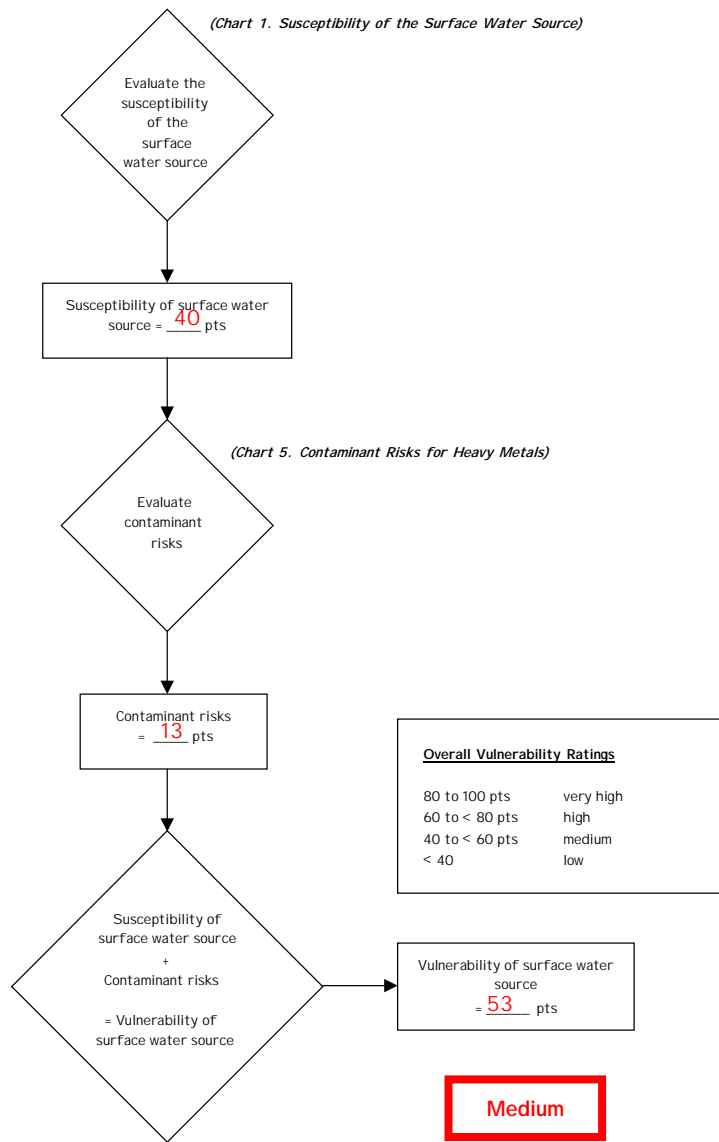


Chart 12. Contaminant Risks for MOA Ship Creek - Synthetic Organic Chemicals

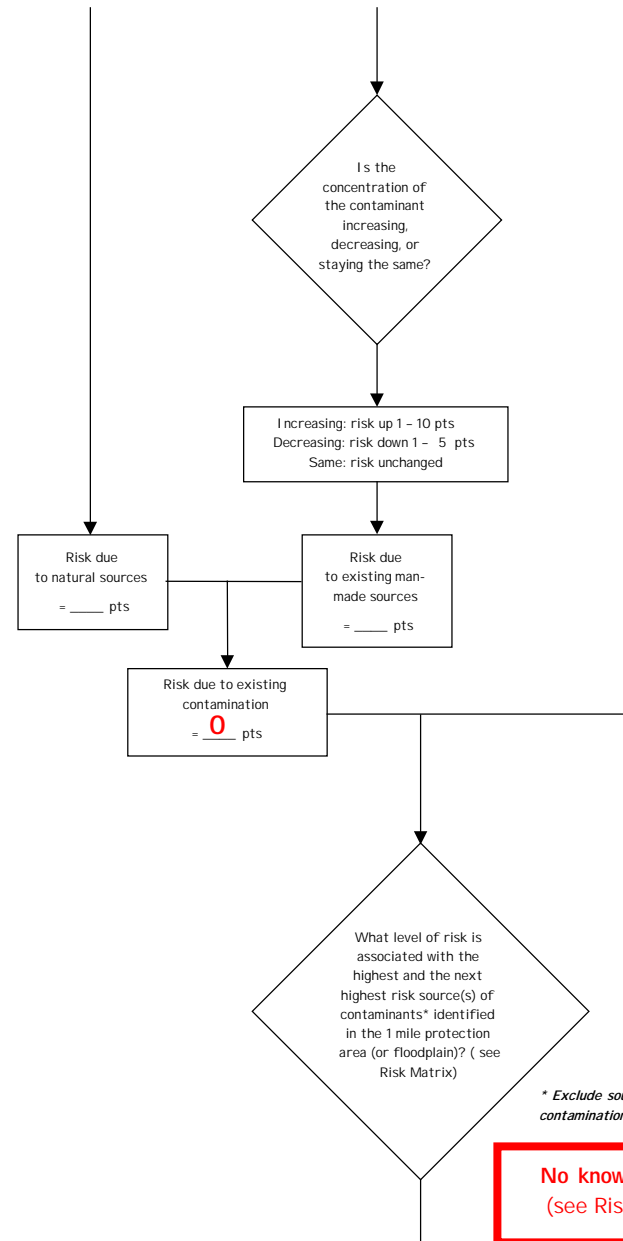
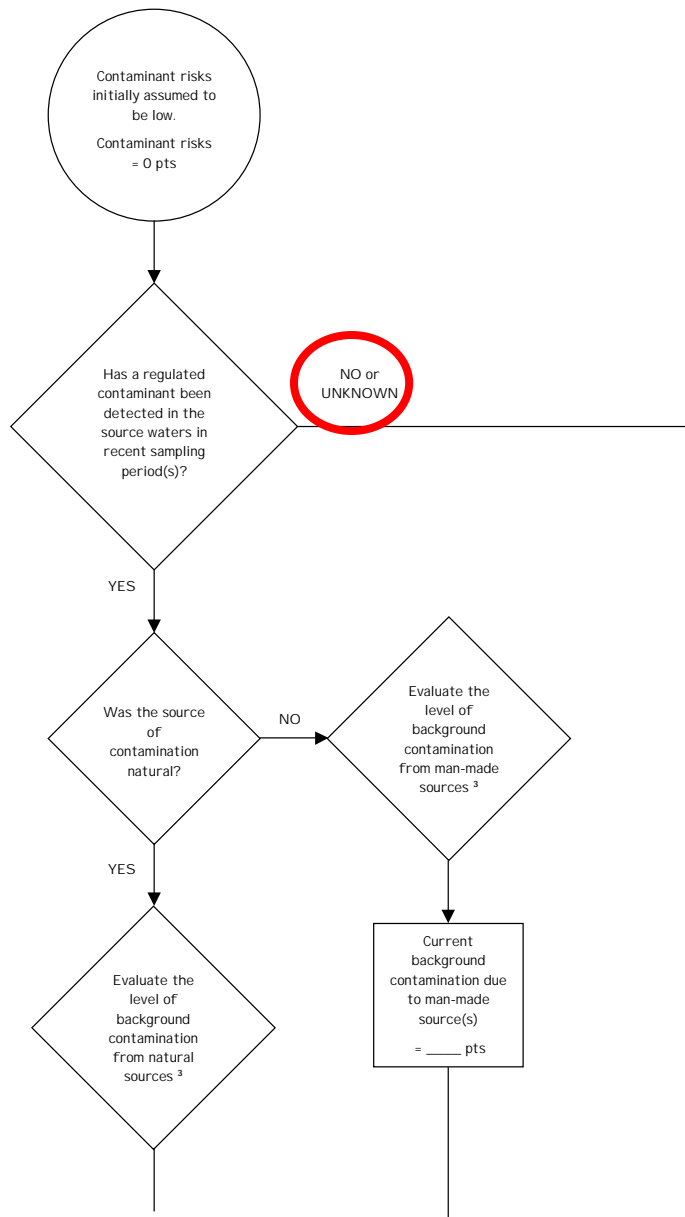
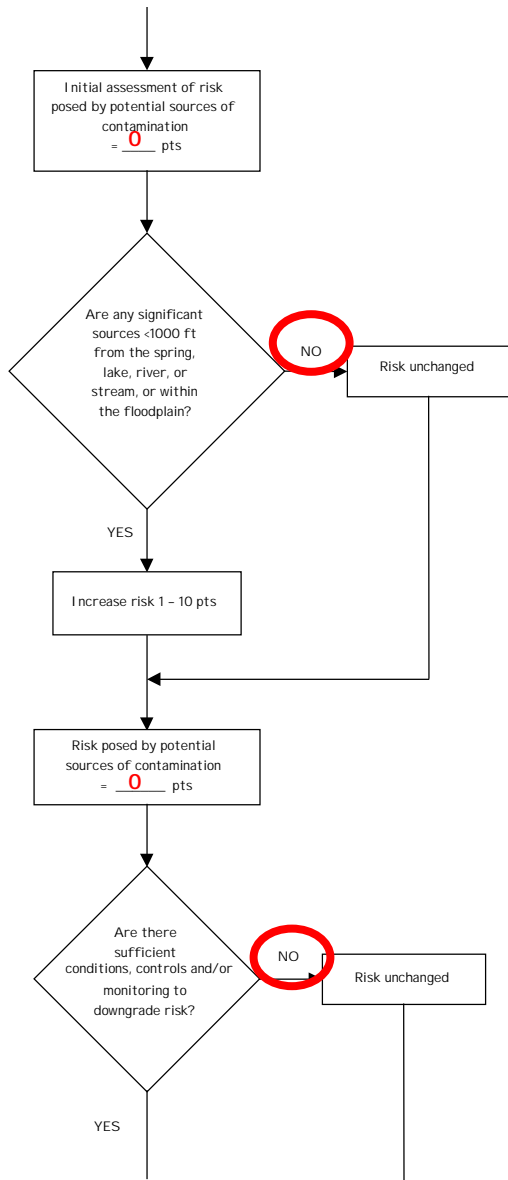
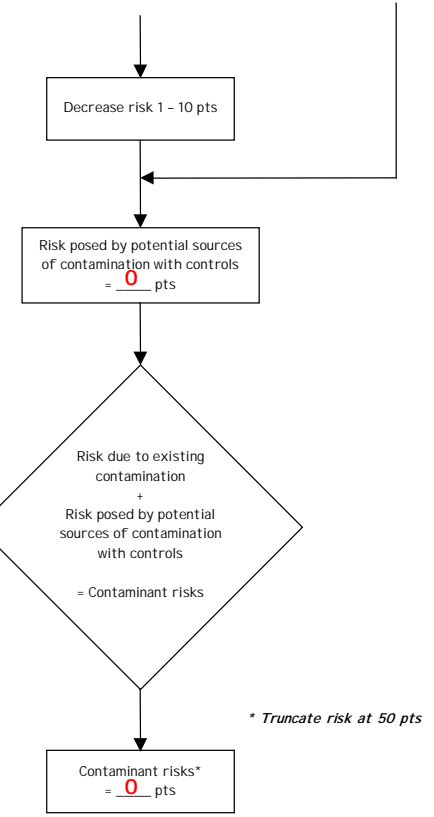


Chart 12. Contaminant Risks for MOA Ship Creek - Synthetic Organic Chemicals (Continued)



Existing contamination = 0 pts  
 +  
 Potential contamination = 0 pts  
 =  
 Contaminant risk of Synthetic Organic Chemicals = 0 pts



**3. Level of Background Contamination**

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

**Contaminant Risk Ratings**

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
<20 pts	low

Low

Chart 13. Vulnerability Analysis for Synthetic Organic Chemicals- MOA Ship Creek

