Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Talkeetna Alaskan Lodge Drinking Water System, Talkeetna, Alaska

Talkeetna Alaskan Lodge # 225728

DRINKING WATER PROTECTION PROGRAM REPORT *265*
Alaska Department of Environmental Conservation

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By Shannon & Wilson, Inc.

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Source Water Assessment for Talkeetna Alaskan Lodge Source of Public Drinking Water, Talkeetna, Alaska

By Shannon & Wilson, Inc.

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Talkeetna Alaskan Lodge is a Class B (transient/non-community) water system consisting of two wells, south of Talkeetna, Alaska. Identified potential and current sources of contaminants for Talkeetna Alaskan Lodge public drinking water source include: large-capacity and single-family septic systems; roads; residential areas; and airports. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Talkeetna Alaskan Lodge received a vulnerability rating of **Medium** for volatile organic chemicals, **High** for bacteria and viruses, and **High** for nitrates and nitrites.

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system. Shannon & Wilson has been contracted to perform these assessments under the supervision of ADEC.

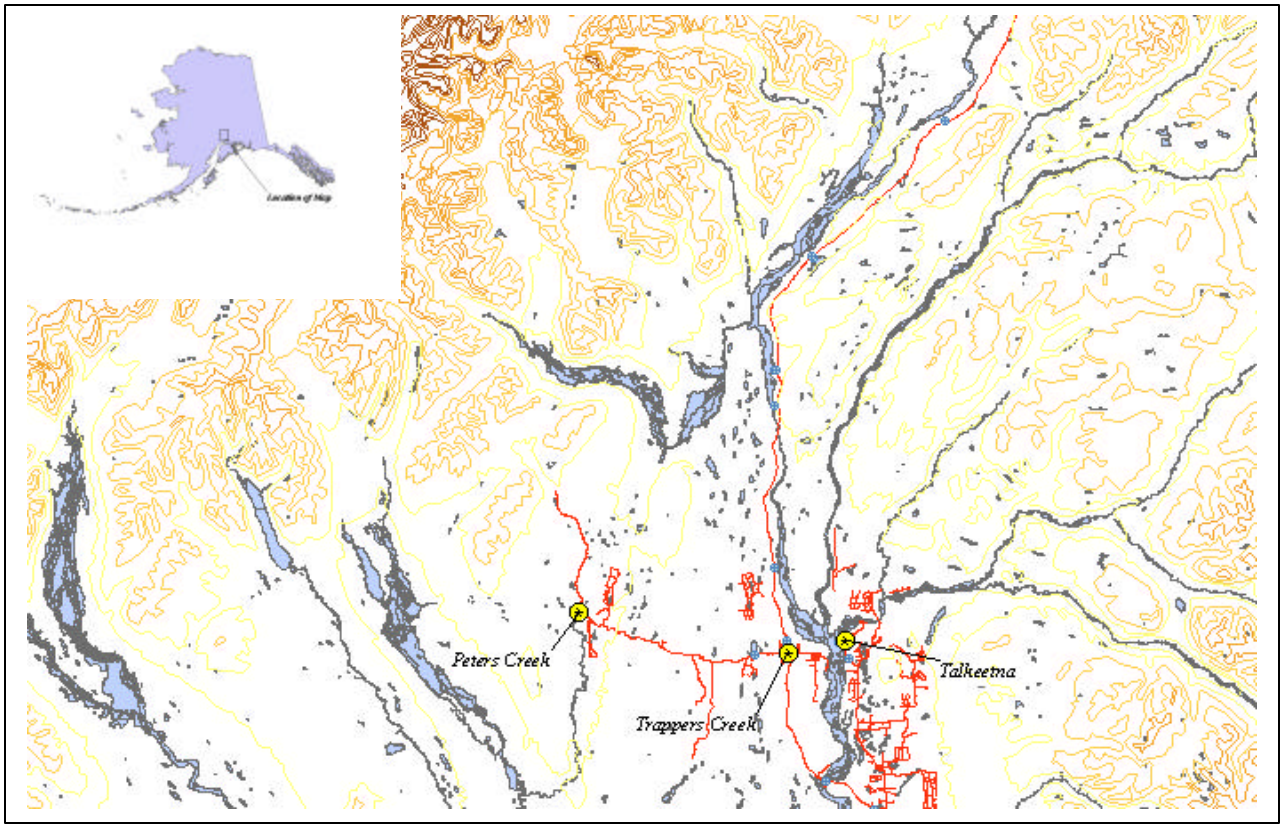


Figure 1. Index map showing the location of the Upper Susitna River Region.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

DESCRIPTION OF THE UPPER SUSITNA RIVER REGION

Location

The Susitna River watershed is the largest watershed in Southcentral Alaska with the community of Talkeetna located at the confluence of the Chulitna, Talkeetna, and Susitna rivers. The area surrounding Talkeetna is shown in Figure 1. Talkeetna is located in the Matanuska-Susitna (Mat-Su) Borough.

Glacial and alluvial forces have shaped the Susitna Region surrounding Talkeetna. These forces have resulted in the broad U-shaped river valleys, lakes, streams and undulating ridges and hills. Landforms in and around the Middle Susitna River Region are typified by the broad river floodplains, low ridges and lowlands.

Precipitation

Talkeetna averages about 30 inches of precipitation per year, including about 107 inches of snowfall.

Topography and Drainage

The area topography varies from about 300 feet to 400 feet within the river floodplains to several thousand feet on the surrounding ridges and mountain flanks.

Groundwater

Although the quality can vary significantly in a short distance, groundwater supplies are generally abundant in the area. Many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are shallow with depths of less than 100 feet to 200 feet. Static water levels in many of these wells are less than 15 feet below the surface. The coarse, alluvial, sandy gravel in the floodplains of the areas streams and rivers provides a large aquifer even in the winter when infiltration is low.

Geology and Soils

Most of the soils in the area provide good sources of sand, gravel and topsoil. The deposition of silt, clay and organic muck in old lakes, oxbows and depressions means that some areas have soil conditions that vary over relatively short distances.

TALKEETNA ALASKAN LODGE PUBLIC DRINKING WATER SYSTEM

Talkeetna Alaskan Lodge is a Class B (transient/non-community) water system. The system consists of two wells at Mile 12.5 Talkeetna Spur Road

According to the well logs completed for the water system, installation of the Well No. 1 occurred on July 1, 1998, to a total depth of approximately 242 feet below ground surface; and Well No. 2 occurred on July June 26, 1998, to a total depth of approximately 222 feet below ground surface, and were completed in 6-inch well casing. It is assumed that the wells were installed with caps providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. It is also assumed that the land surface is appropriately sloped away from the well providing adequate surface water drainage. The wells were grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year-round and serves no residents and more than 200 non-residents.

TALKEETNA ALASKAN LODGE DRINKING WATER PROTECTION AREA

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

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the Drinking Water Protection Area (DWPA). Because a release of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*), and State of Alaska Department of Water Resources. Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DWPA (Please

refer to the Guidance Manual for Class B Public Water Systems for additional information).

The DWPAs established for wells by the ADEC are separated into four zones. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four DWPA zones and the calculated TOT for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2 year TOT
B	Less than the 2 year TOT
C	Less Than the 5 year TOT
D	Less than the 10 year TOT

As an example, water moving through the aquifer in Zone B will reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Talkeetna Alaskan Lodge DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class B public water system assessments, three categories of drinking water contaminants were inventoried, they include:

- Bacteria and viruses;
- Nitrates and/or nitrites; and
- Volatile organic chemicals.

Inventoried potential sources of contamination within Zones A through Zone D were associated with residential and light industrial type activities. The sources are summarized in the tables in Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are 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. Further, contaminant risks are a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the well.

VULNERABILITY OF TALKEETNA ALASKAN LODGE DRINKING WATER SOURCE

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

- Natural susceptibility; and
- Contaminant risks.

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

The well for Talkeetna Alaskan Lodge is completed in an unconfined aquifer setting. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Overall Susceptibility score and rating for Talkeetna Alaskan Lodge.

Table 2. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	18	High
Natural Susceptibility	18	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing or historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	30	High

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally-occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses.' Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

Table 4 contains the overall vulnerability scores (0 – 10) and ratings for each of the three categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability of Talkeetna Alaskan Lodge to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	70	High
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	50	Medium

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

The large-capacity and single-family septic systems; roads; residential areas; and airports create a risk increase for the bacteria and viruses, nitrates and nitrites, and volatile organic compounds.

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system at Talkeetna Alaskan Lodge.

Nitrates and/or nitrites are found in natural background concentration at this site, as elsewhere throughout Alaska. Nitrate concentrations in uncontaminated groundwater are typically less than 2 milligrams per liter (mg/L) and are derived primarily from the decomposition of organic matter in soils, adopted from the U.S. Geological Survey (Wang, et al., 2000).

Sampling history for Talkeetna Alaskan Lodge well indicates that low concentrations of nitrate have been detected (see Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). The maximum reported existing nitrate concentration is approximately 0.749 mg/L or 7% of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Due to the high solubility and weak retention by soil, nitrates are very mobile, moving at approximately the same rate as water. Though existing nitrate contamination was detected at the site, concentrations remain at very safe levels with respect to human health.

The large-capacity and single-family septic systems; roads; residential areas; and airport located in Zones A, B and C, form the greatest risk for volatile organic chemicals.

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Talkeetna Alaskan Lodge. The overall vulnerability of this source to contamination is **Medium** for volatile organic chemicals, **High** for bacteria and viruses, and **High** for nitrates and nitrites. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Talkeetna Alaskan Lodge 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 Talkeetna Alaskan Lodge public drinking water source.

REFERENCES CITED

Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

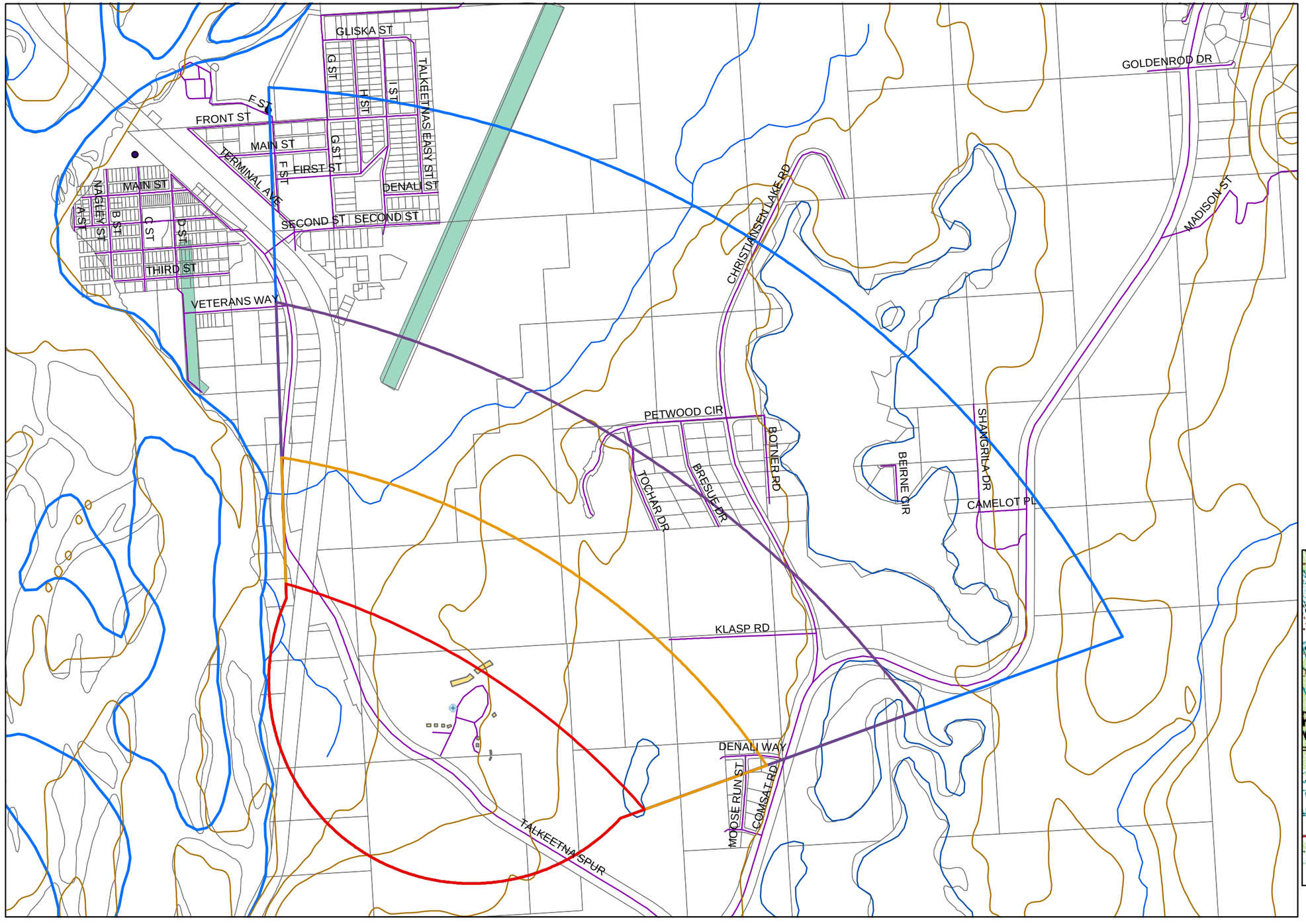
Wang, B., Strelakos, P.M., and Jokela, J.B., 2000, Nitrate source indicators in ground water of the scimitar subdivision, Peters Creek Area, Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 00-4137.

Weather Underground, June 18, 2002, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://www.wunderground.com

APPENDIX A

Talkeetna Alaskan Lodge
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Areas for Talkeetna Alaskan Lodge



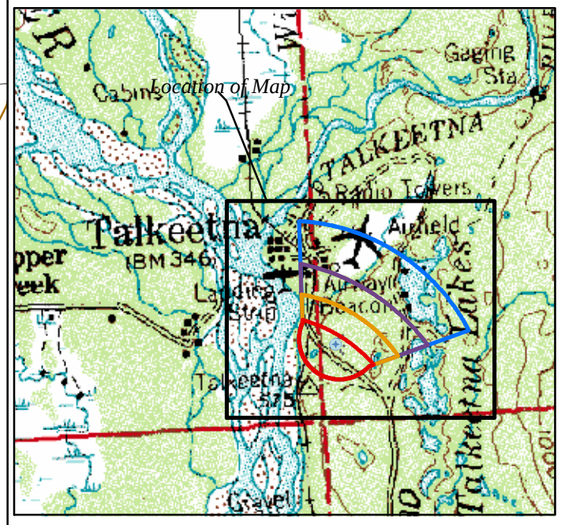
- Talkeetna Alaskan Lodge System
- MSB Roads
- Smaller Rivers
- Main Rivers
- Lakes
- 25 Meter Contours
- MSB Land Parcels
- Airports
- Site Buildings

Zone A Protection Area
Several Months Travel Time

Zone B Protection Area
Less than 2-Years Travel Time

Zone C Protection Area
Less than 5-Years Travel Time

Zone D Protection Area
Less than 10-Years Travel Time



PWSID 225728.001

2,400 1,200 0 2,400 Feet

N W E S

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Talkeetna Alaskan Lodge (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 225728.001***

Talkeetna Alaskan Lodge

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Near 12 Plex Buildings	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	A	West side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	A	East side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	A	Near Employee Housing	3	
Septic systems (serves one single-family home)	R02	R2-1	A	West of Talkeetna Spur	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Talkeetna Spur	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Talkeetna Lodge Access Road	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-5	B	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-6	B	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-7	B	North of Lodge	3	
Residential Areas	R01	R1-1	B	Denali Way Subdivision	2	5 acres of residential area
Septic systems (serves one single-family home)	R02	R2-2	B	End of Klasp Road	3	
Septic systems (serves one single-family home)	R02	R2-3	B	Denali Way	3	
Highways and roads, dirt/gravel	X24	X24-2	B	Denali Way	2	
Highways and roads, dirt/gravel	X24	X24-3	B	Moose Run Street	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-8	C	On Petwood Circle	3	
Residential Areas	R01	R1-2	C	Denali Way and Tochar Drive Area	2	
Septic systems (serves one single-family home)	R02	R2-4-R2-10	C	Residential Septics in Zone C	3	
Airports	X14	X14-1	C	East of Talkeetna Spur	3	
Highways and roads, dirt/gravel	X24	X24-4	C	Klasp Rd	2	
Highways and roads, dirt/gravel	X24	X24-5	C	Comsat Rd	2	
Highways and roads, dirt/gravel	X24	X24-6	C	Christiansen Lake Rd	2	
Highways and roads, dirt/gravel	X24	X24-7	C	Bresue Rd	2	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-8	C	Tochar Drive	2	
Highways and roads, dirt/gravel	X24	X24-9	C	Petwood Circle	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-10	D	Botner Road	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-11	D	Beirne Circle	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-12	D	Shangrila Drive	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-9	D	Christiansen Lake Road	3	

Contaminant Source Inventory and Risk Ranking for

PWSID 225728.001

Table 2

Talkeetna Alaskan Lodge

Sources of Bacteria and Viruses

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	1	Near 12 Plex Buildings	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	A	High	2	West side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	A	High	3	East side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	A	High	4	Near Employee Housing	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-5	B	High	5	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-6	B	High	6	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-7	B	High	7	North of Lodge	3	
Septic systems (serves one single-family home)	R02	R2-1	A	Low	8	West of Talkeetna Spur	3	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	9	Talkeetna Lodge Access Road	2	
Residential Areas	R01	R1-1	B	Low	10	Denali Way Subdivision	2	5 acres of residential area
Septic systems (serves one single-family home)	R02	R2-2	B	Low		End of Klasp Road	3	
Septic systems (serves one single-family home)	R02	R2-3	B	Low		Denali Way	3	
Highways and roads, dirt/gravel	X24	X24-2	B	Low		Denali Way	2	
Highways and roads, dirt/gravel	X24	X24-3	B	Low		Moose Run Street	2	

Contaminant Source Inventory and Risk Ranking for

PWSID 225728.001

Table 3

Talkeetna Alaskan Lodge

Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	1	Near 12 Plex Buildings	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	A	High	2	West side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	A	High	3	East side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	A	High	4	Near Employee Housing	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-5	B	High	5	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-6	B	High	6	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-7	B	High	7	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-8	C	High	8	On Petwood Circle	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-10	D	High	9	Botner Road	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-11	D	High	10	Beirne Circle	3	
Septic systems (serves one single-family home)	R02	R2-1	A	Low		West of Talkeetna Spur	3	
Highways and roads, dirt/gravel	X24	X24-1	A	Low		Talkeetna Lodge Access Road	2	
Residential Areas	R01	R1-1	B	Low		Denali Way Subdivision	2	5 acres of residential area
Septic systems (serves one single-family home)	R02	R2-2	B	Low		End of Klasp Road	3	
Septic systems (serves one single-family home)	R02	R2-3	B	Low		Denali Way	3	
Highways and roads, dirt/gravel	X24	X24-2	B	Low		Denali Way	2	
Highways and roads, dirt/gravel	X24	X24-3	B	Low		Moose Run Street	2	
Residential Areas	R01	R1-2	C	Low		Denali Way and Tochar Drive Area	2	

Contaminant Source Inventory and Risk Ranking for

PWSID 225728.001

Table 3 (continued)

Talkeetna Alaskan Lodge

Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R2-4-R2-10	C	Low		Residential Septics in Zone C	3	
Airports	X14	X14-1	C	Low		East of Talkeetna Spur	3	
Highways and roads, dirt/gravel	X24	X24-4	C	Low		Klasp Rd	2	
Highways and roads, dirt/gravel	X24	X24-5	C	Low		Comsat Rd	2	
Highways and roads, dirt/gravel	X24	X24-6	C	Low		Christiansen Lake Rd	2	
Highways and roads, dirt/gravel	X24	X24-7	C	Low		Bresue Rd	2	
Highways and roads, dirt/gravel	X24	X24-8	C	Low		Tochar Drive	2	
Highways and roads, dirt/gravel	X24	X24-9	C	Low		Petwood Circle	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-12	D	High		Shangrila Drive	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-9	D	High		Christiansen Lake Road	3	

Contaminant Source Inventory and Risk Ranking for

PWSID 225728.001

Table 4

Talkeetna Alaskan Lodge

Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Airports	X14	X14-1	C	High	1	East of Talkeetna Spur	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	Near 12 Plex Buildings	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	A	Low	3	West side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	A	Low	4	East side of Talkeetna Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	A	Low	5	Near Employee Housing	3	
Septic systems (serves one single-family home)	R02	R2-1	A	Low	6	West of Talkeetna Spur	3	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	7	Talkeetna Lodge Access Road	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-5	B	Low	8	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-6	B	Low	9	North of Lodge	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-7	B	Low	10	North of Lodge	3	
Residential Areas	R01	R1-1	B	Low		Denali Way Subdivision	2	5 acres of residential area
Septic systems (serves one single-family home)	R02	R2-2	B	Low		End of Klasp Road	3	
Septic systems (serves one single-family home)	R02	R2-3	B	Low		Denali Way	3	
Highways and roads, dirt/gravel	X24	X24-2	B	Low		Denali Way	2	
Highways and roads, dirt/gravel	X24	X24-3	B	Low		Moose Run Street	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-8	C	Low		On Petwood Circle	3	
Residential Areas	R01	R1-2	C	Low		Denali Way and Tochar Drive Area	2	
Septic systems (serves one single-family home)	R02	R2-4-R2-10	C	Low		Residential Septics in Zone C	3	

Contaminant Source Inventory and Risk Ranking for

PWSID 225728.001

Table 4 (continued)

Talkeetna Alaskan Lodge

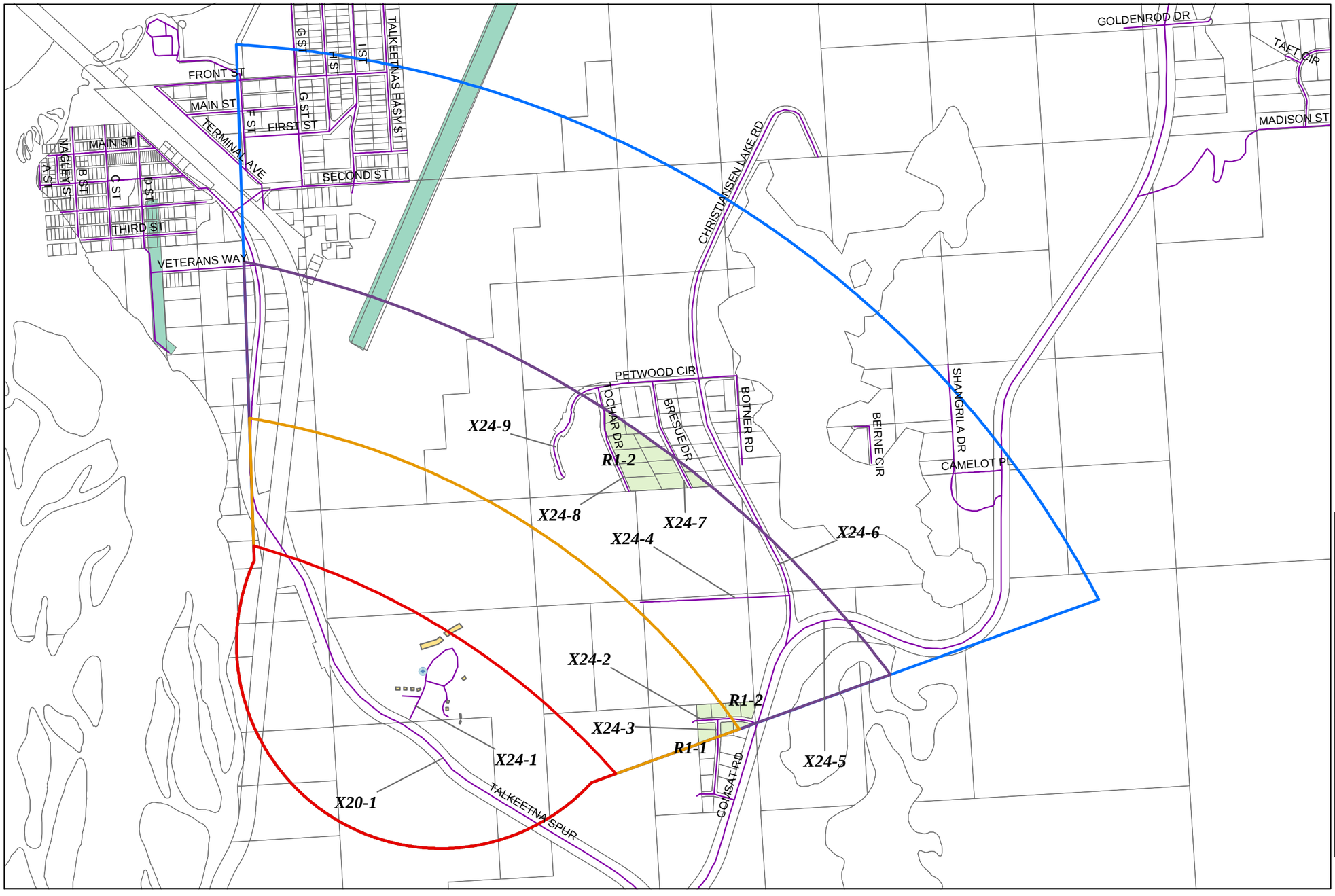
Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-4	C	Low		Klasp Rd	2	
Highways and roads, dirt/gravel	X24	X24-5	C	Low		Comsat Rd	2	
Highways and roads, dirt/gravel	X24	X24-6	C	Low		Christiansen Lake Rd	2	
Highways and roads, dirt/gravel	X24	X24-7	C	Low		Bresue Rd	2	
Highways and roads, dirt/gravel	X24	X24-8	C	Low		Tochar Drive	2	
Highways and roads, dirt/gravel	X24	X24-9	C	Low		Petwood Circle	2	

APPENDIX C

Talkeetna Alaskan Lodge
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-3)

Drinking Water Protection Areas for Talkeetna Alaskan Lodge and Potential and Existing Sources of Contamination



Talkeetna Alaskan Lodge System

MSB Roads

Site Buildings

Airports

MSB Land Parcels

Zone A Protection Area

Several Months Travel Time

Zone B Protection Area

Less than 2-Years Travel Time

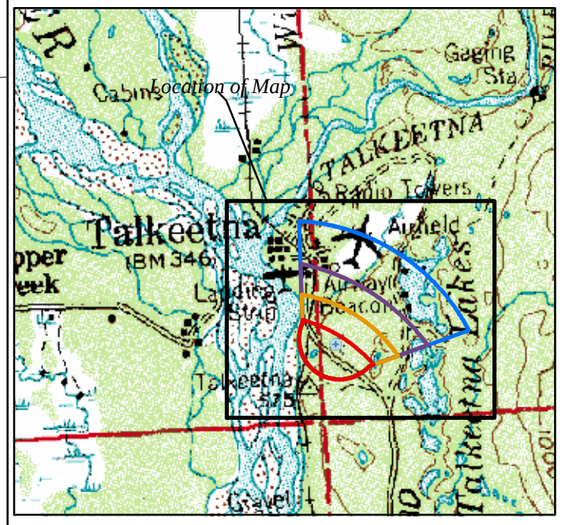
Zone C Protection Area

Less than 5-Years Travel Time

Zone D Protection Area

Less than 10-Years Travel Time

Residential Areas (R1)



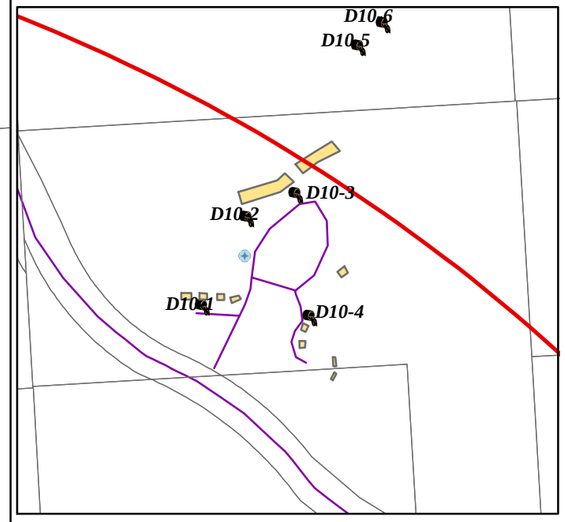
PWSID 225728.001

2,600 1,300 0 2,600 Feet

N W E S

Map 2

Drinking Water Protection Areas for Talkeetna Alaskan Lodge and Potential and Existing Sources of Contamination



Talkeetna Alaskan Lodge System

Large Capacity Septic Systems (D10)

Single Family Septic Systems (R2)

MSB Roads

Site Buildings

Airports (X14)

MSB Land Parcels

Zone A Protection Area

Several Months Travel Time

Zone B Protection Area

Less than 2-Years Travel Time

Zone C Protection Area

Less than 5-Years Travel Time

Zone D Protection Area

Less than 10-Years Travel Time

PWSID 225728.001

2,400 1,200 0 2,400 Feet

N W E S

Map 3

APPENDIX D

Vulnerability Analysis for Talkeetna Alaskan Lodge Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Talkeetna Alaskan Lodge

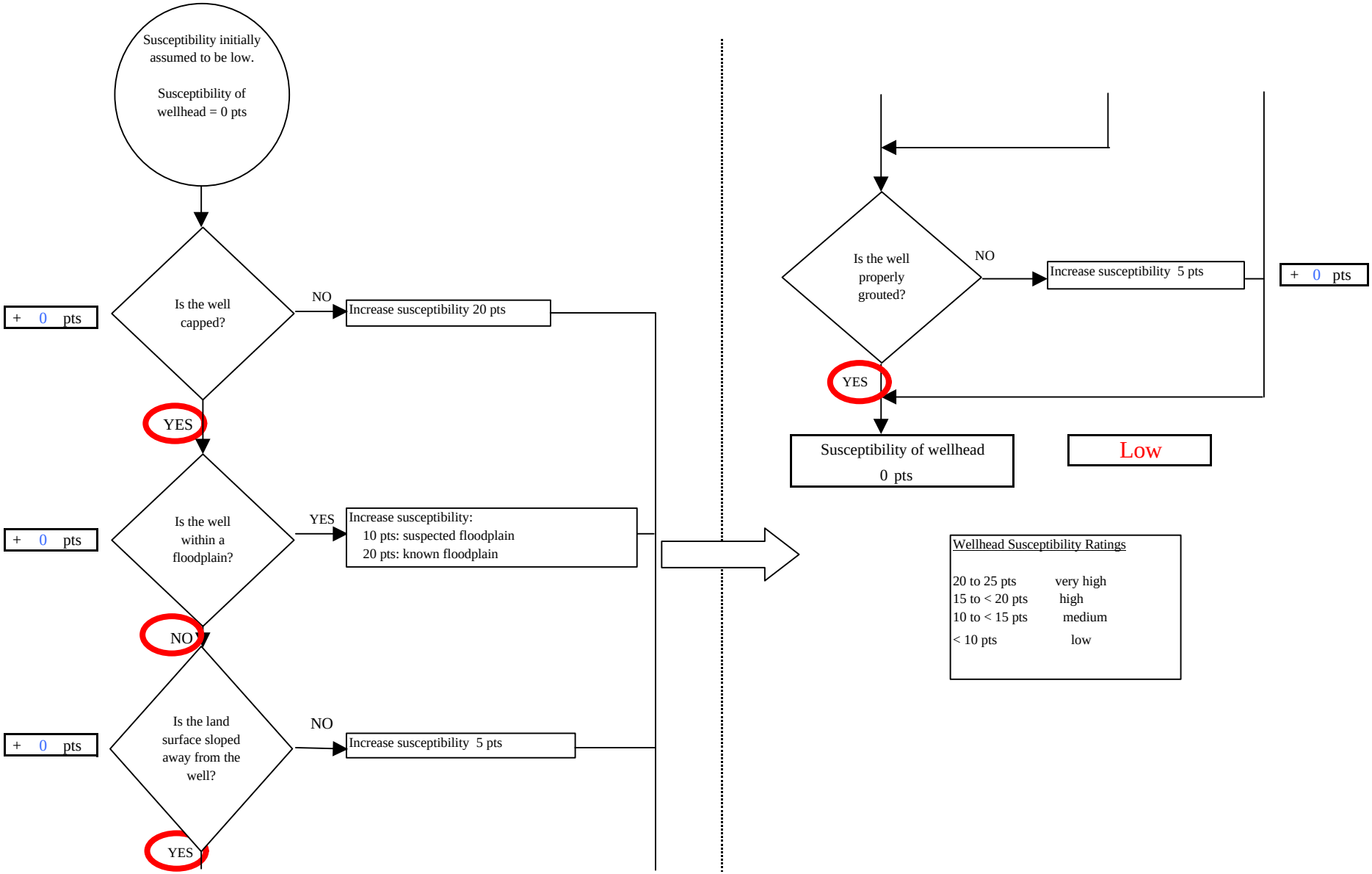


Chart 2. Susceptibility of the aquifer - Talkeetna Alaskan Lodge

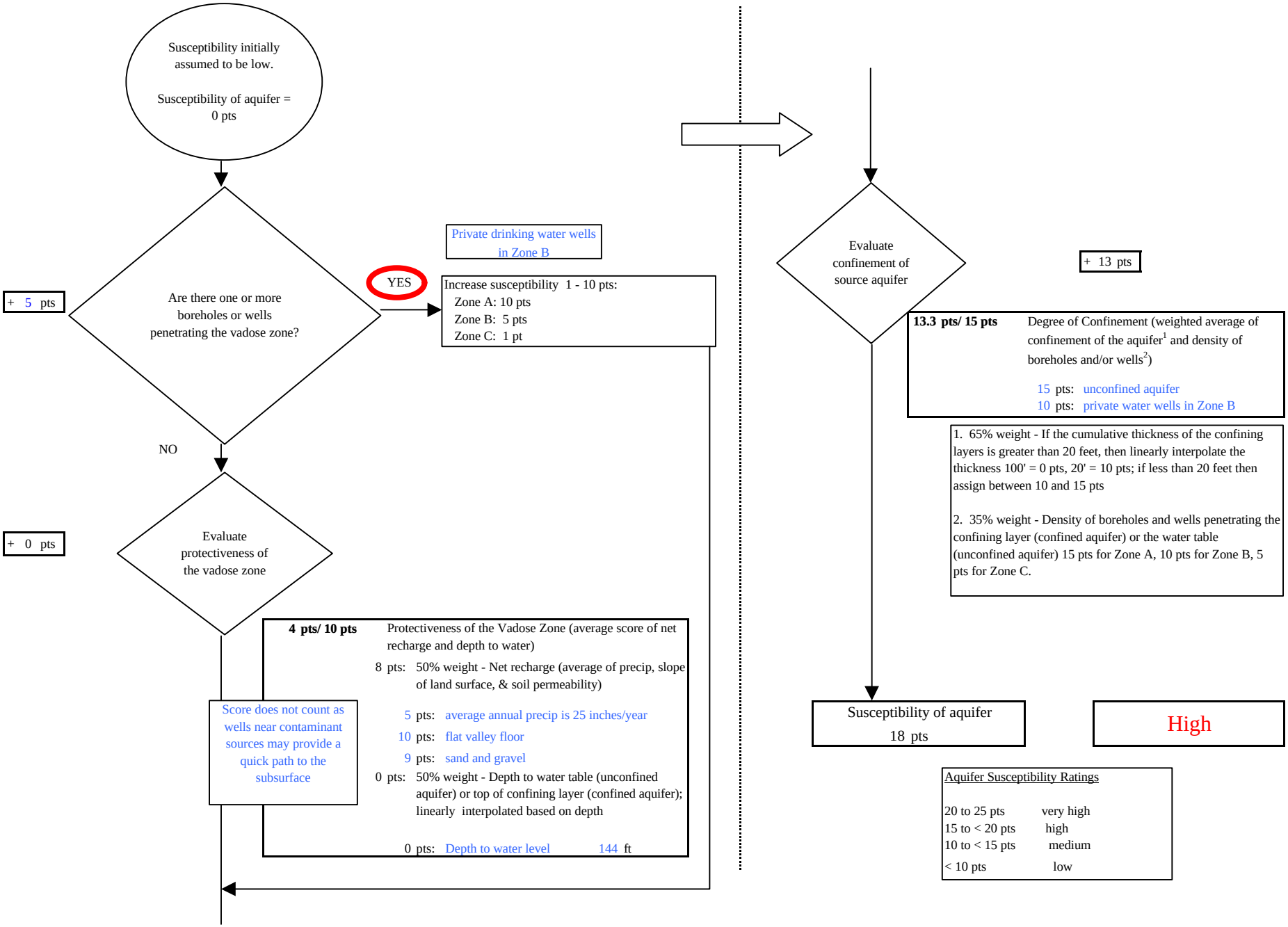
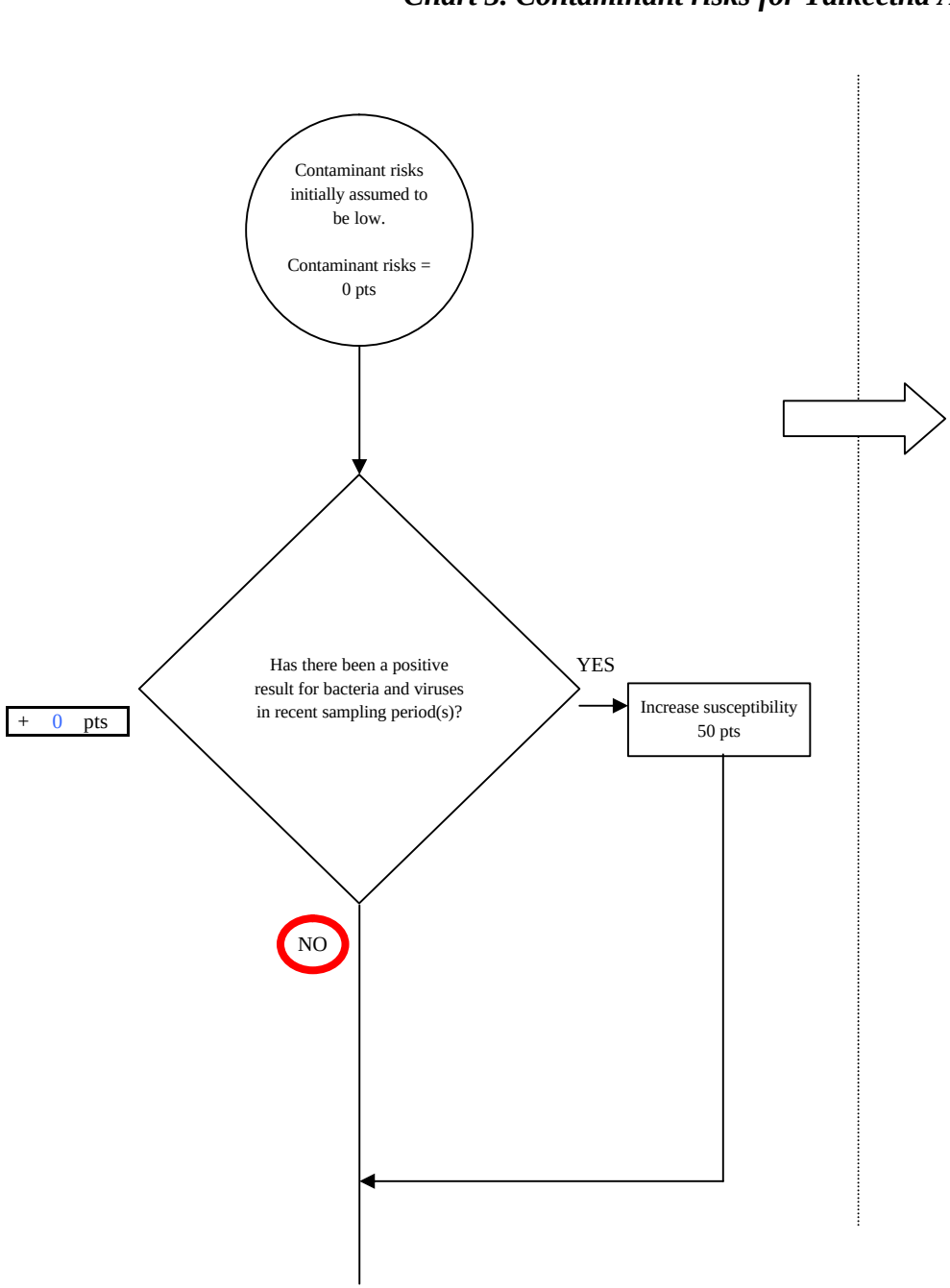
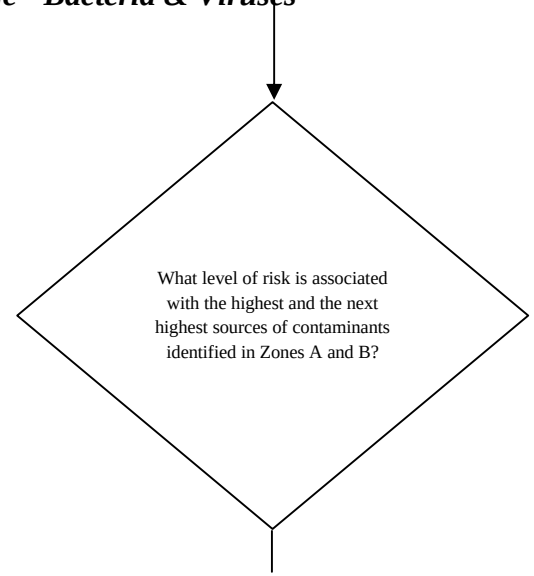


Chart 3. Contaminant risks for Talkeetna Alaskan Lodge - Bacteria & Viruses





+ 40 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	4	3	7
Medium(s)	0	0	0
Low(s)	2	3	5

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	³ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 40

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

Chart 3. Contaminant risks for Talkeetna Alaskan Lodge - Bacteria & Viruses

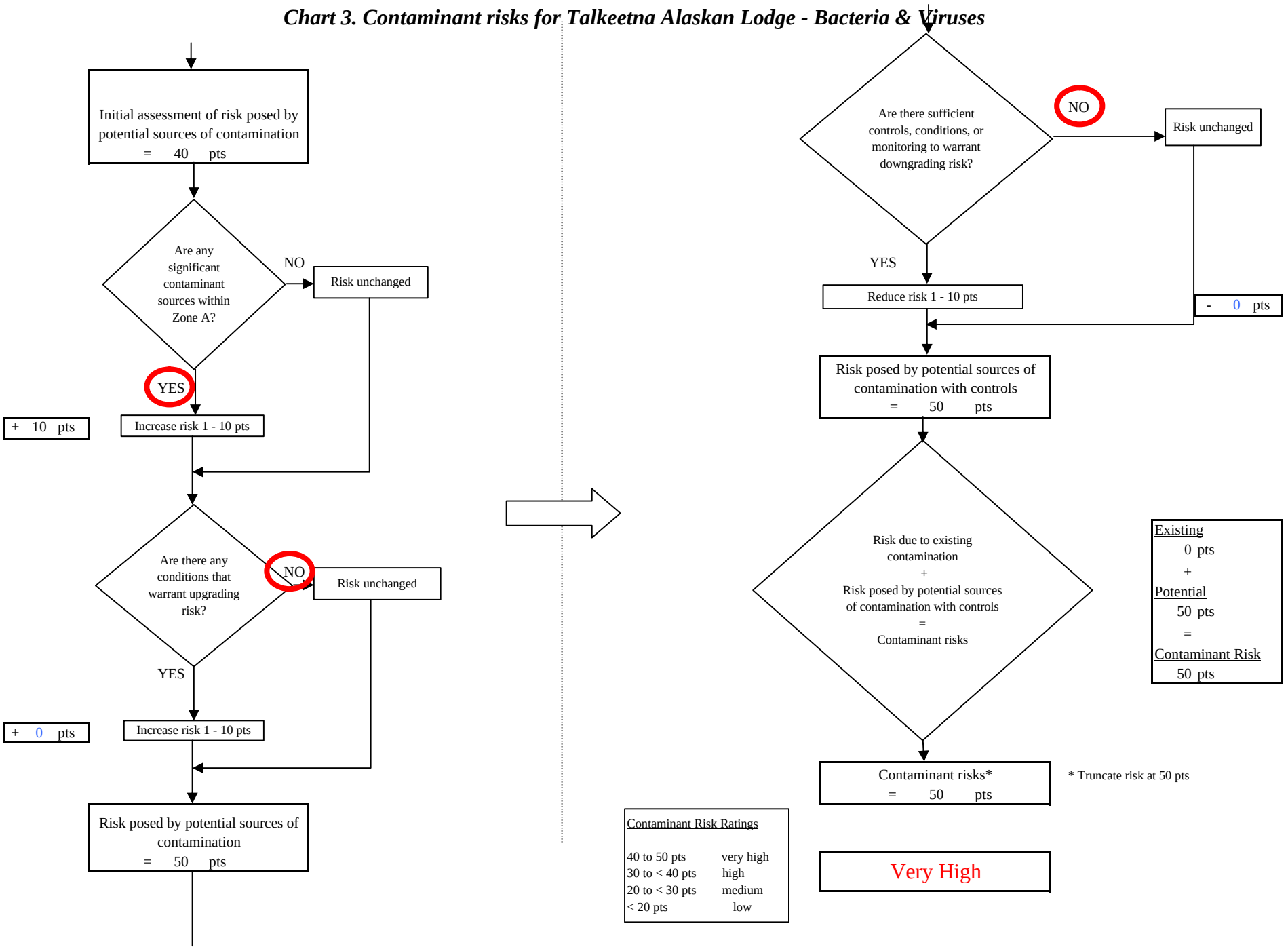


Chart 4. Vulnerability analysis for Talkeetna Alaskan Lodge - Bacteria & Viruses

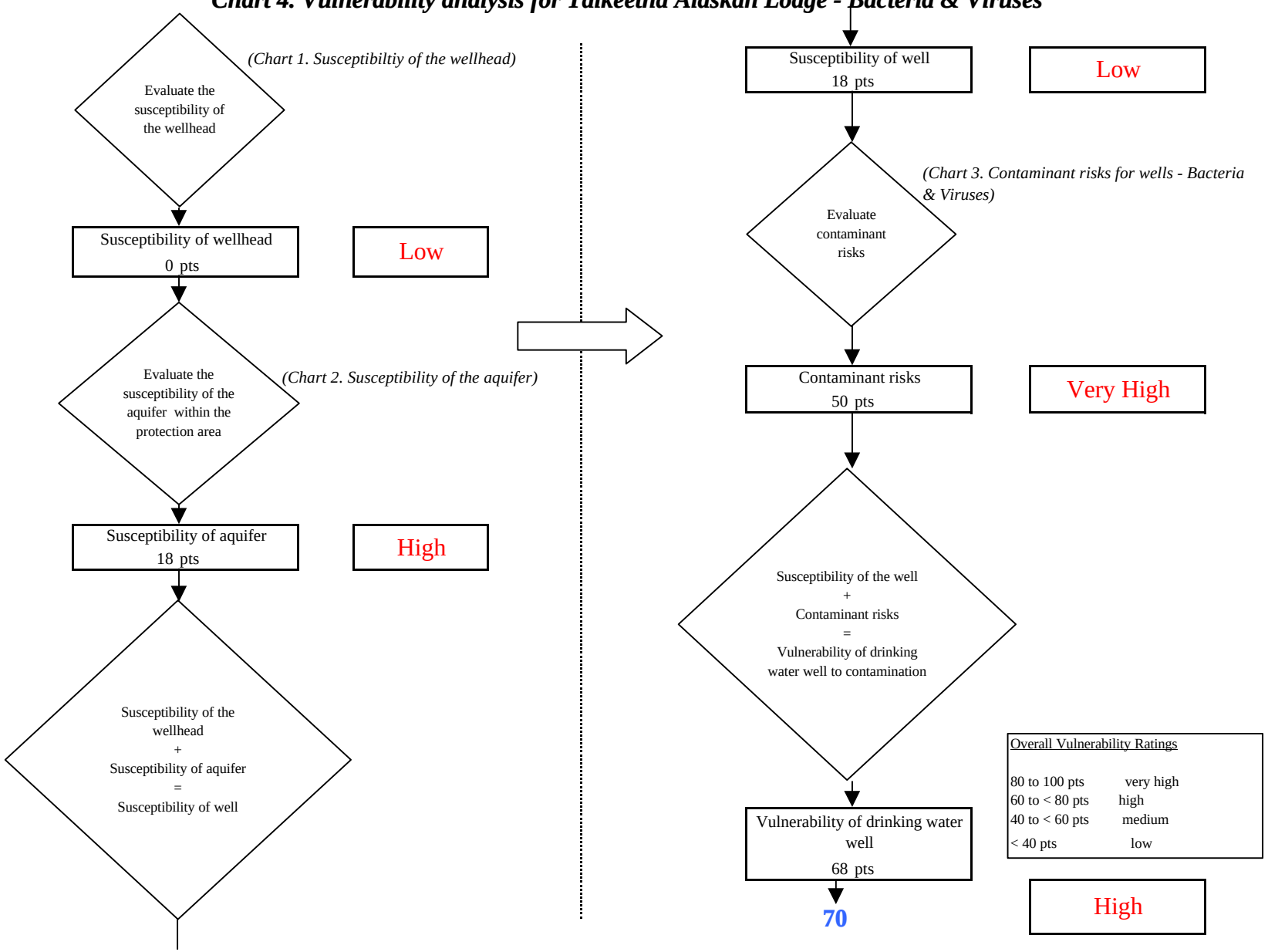


Chart 5. Contaminant risks for Talkeetna Alaskan Lodge - Nitrates and Nitrites

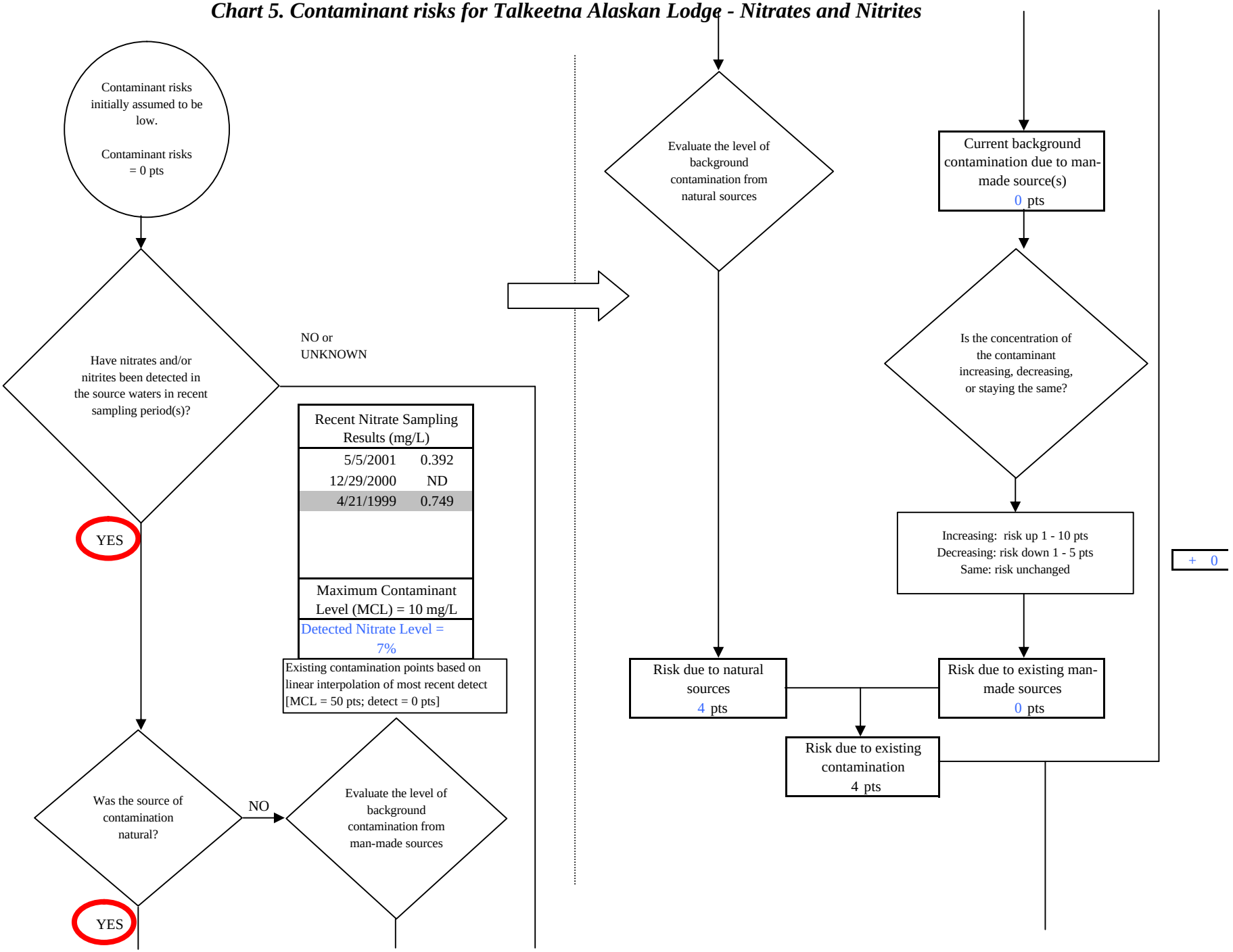


Chart 5. Contaminant risks for Talkeetna Alaskan Lodge - Nitrates and Nitrites

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	4	4	8
Medium(s)	0	0	0
Low(s)	1	5	6

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES

Decrease risk 1 - 10 pts

- 2

Are any significant sources within Zone A?

NO → Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10

Chart 5. Contaminant risks for Talkeetna Alaskan Lodge - Nitrates and Nitrites

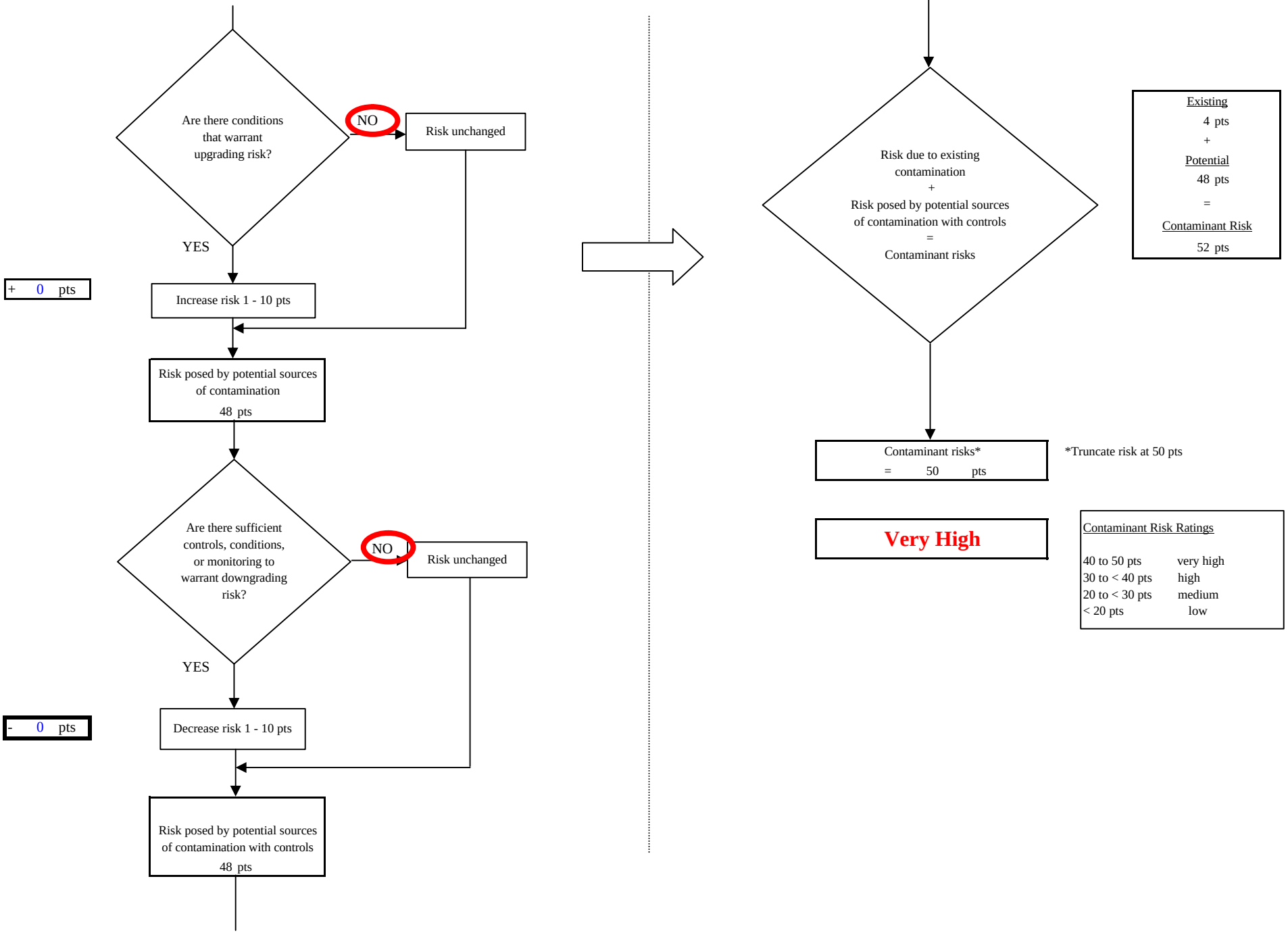


Chart 6. Vulnerability analysis for Talkeetna Alaskan Lodge - Nitrates and Nitrites

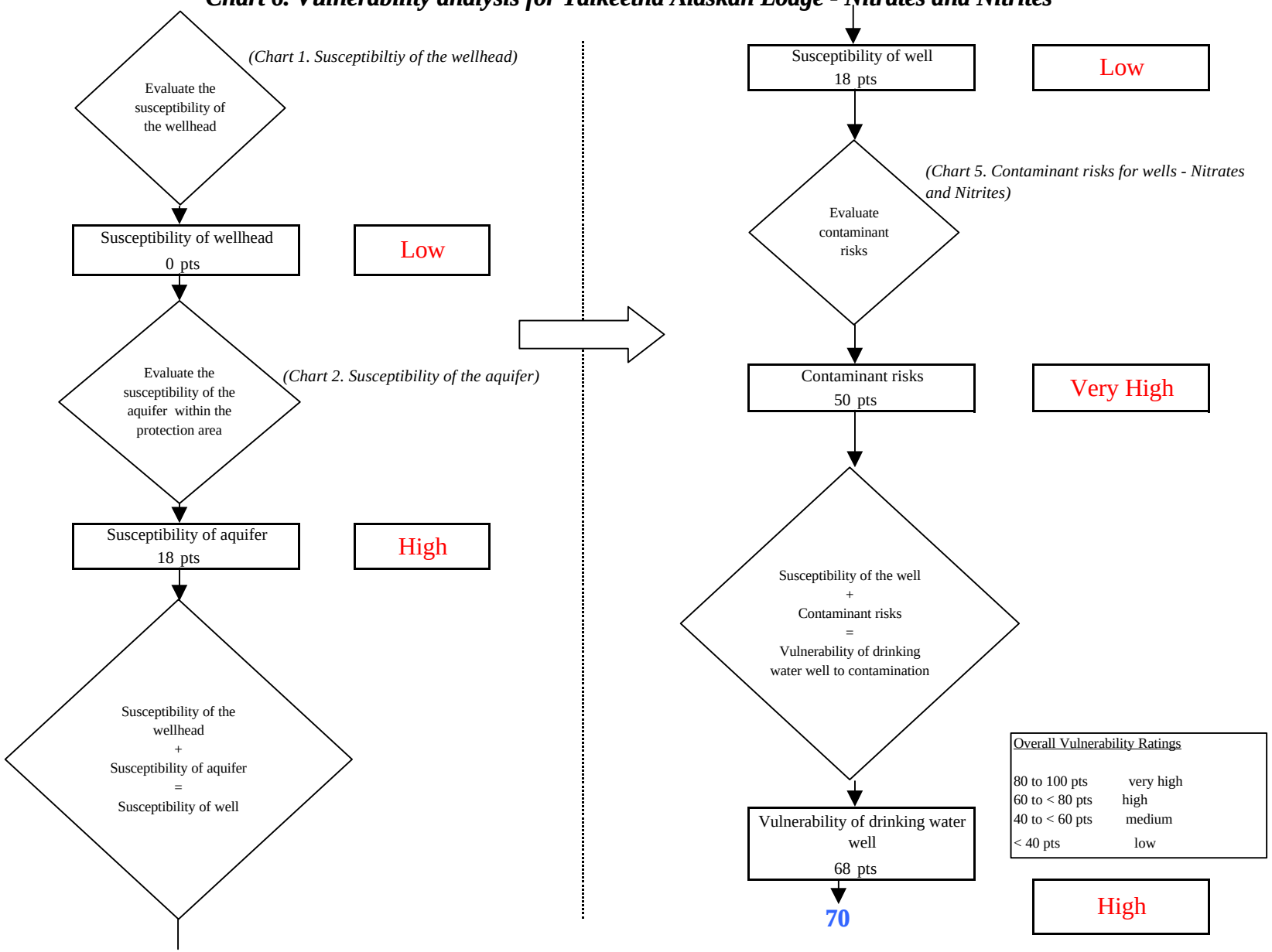


Chart 7. Contaminant risks for Talkeetna Alaskan Lodge - Volatile Organic Chemicals

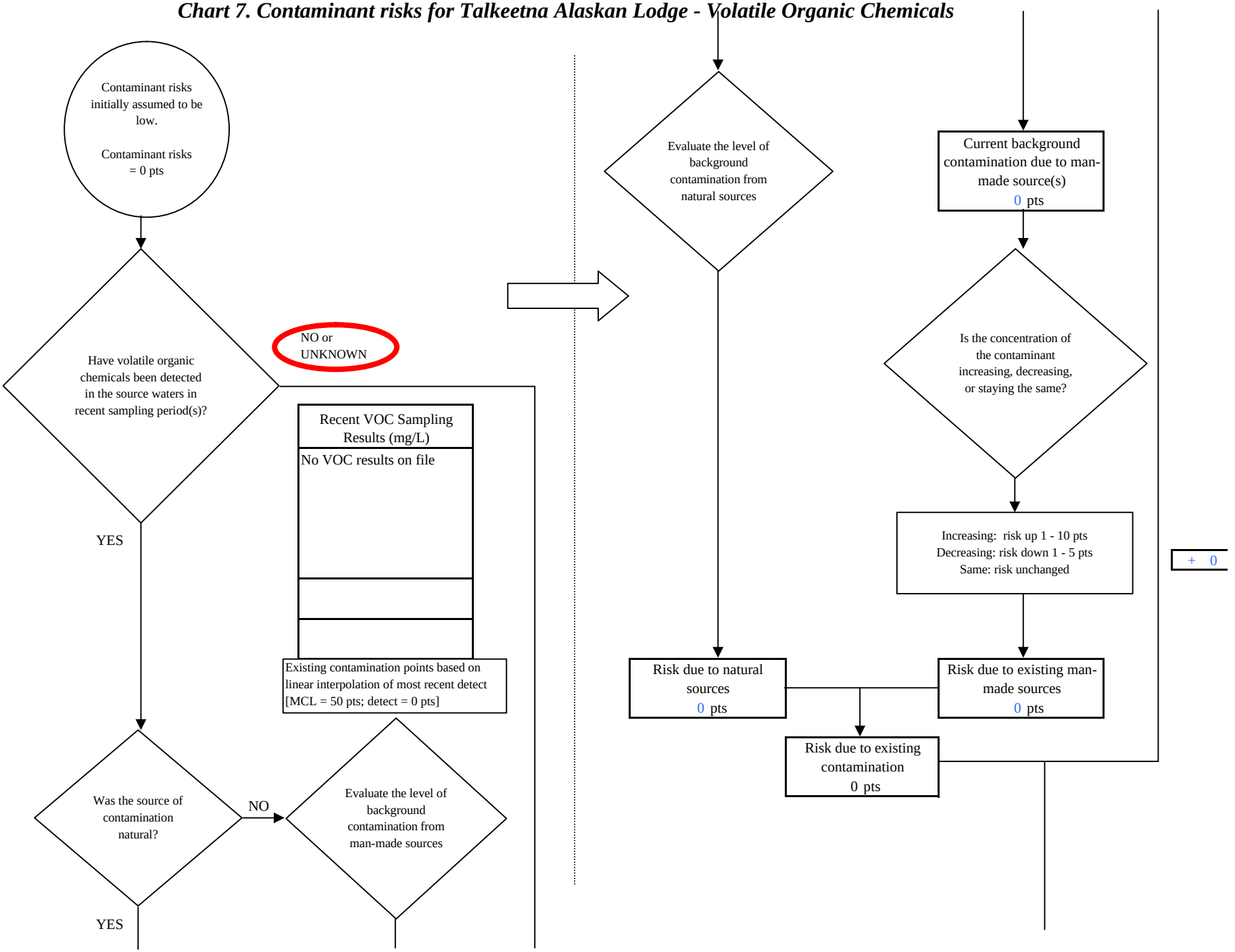


Chart 7. Contaminant risks for Talkeetna Alaskan Lodge - Volatile Organic Chemicals

+ 30 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	1	1
Medium(s)	0	0	0
Low(s)	6	8	14

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 30

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

Initial assessment of risk posed by potential sources of contamination = 30 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

- 2

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 2

Chart 7. Contaminant risks for Talkeetna Alaskan Lodge - Volatile Organic Chemicals

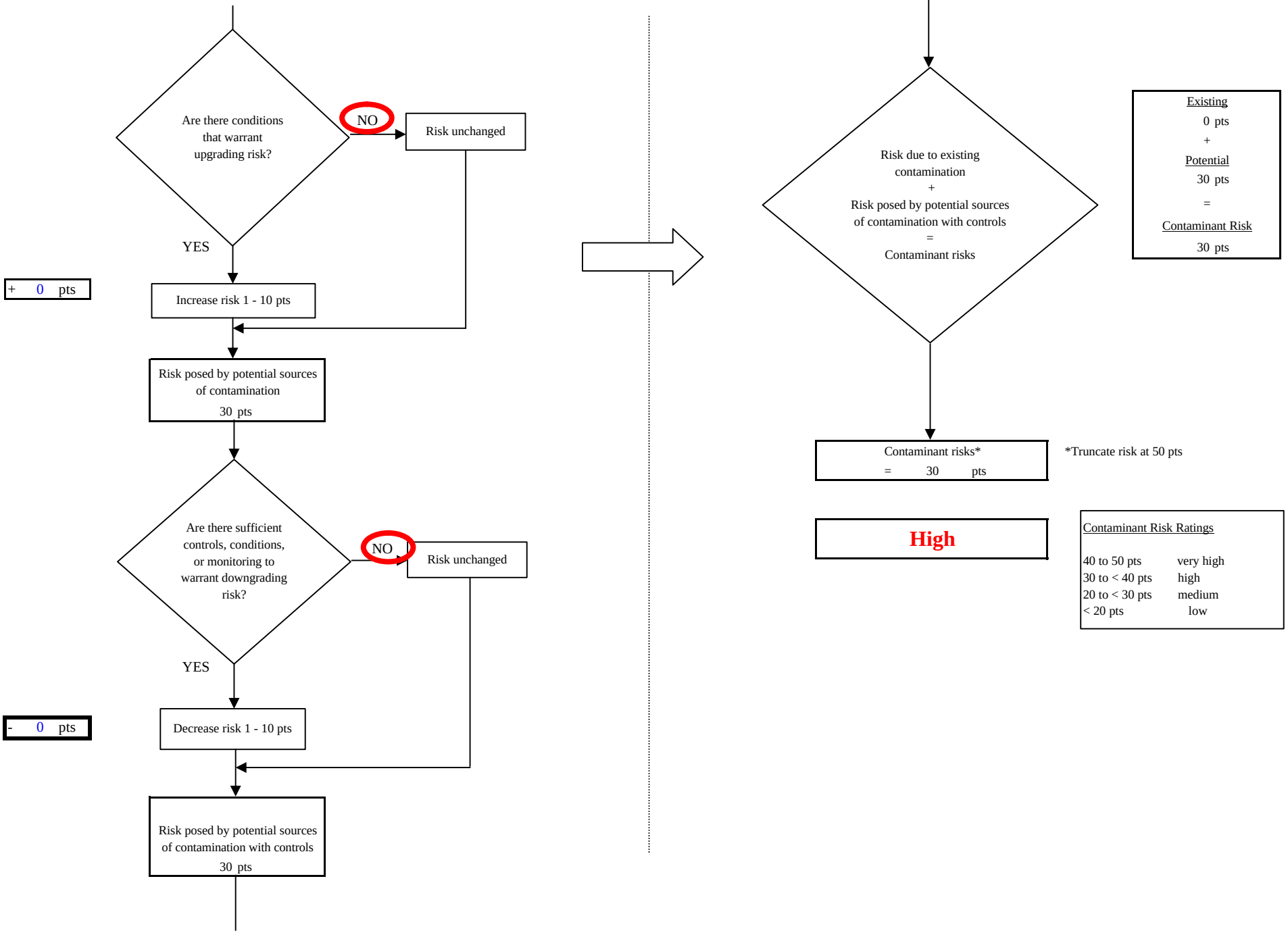


Chart 8. Vulnerability analysis for Talkeetna Alaskan Lodge - Volatile Organic Chemicals