Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Malaspina-Golden Nugget, Anchorage, Alaska
PWSID # 212128.001 and 212128.002

DRINKING WATER PROTECTION PROGRAM REPORT 765

Alaska Department of Environmental Conservation

Source Water Assessment for Malaspina-Golden Nugget Anchorage, Alaska PWSID#210883.001

DRINKING WATER PROTECTION PROGRAM REPORT 765

The Drinking Water Protection Program is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Malaspina-Golden Nugget is a Class A (community) water system consisting of two wells in the Anchorage area. Due to their close proximity and similar depths, the two wells share a protection area. Identified potential and existing sources of contaminants for Malaspina-Golden Nugget Well No.1 and Well No. 2 includes: sewer lines, residential areas, roads, recreation trails, gasoline stations, underground fuel tanks, motor vehicle repair shops, nurseries, golf course, ADEC recognized contaminated sites, open and closed Leaking Underground Storage Tank (LUST) sites, and motor vehicle disposal wells. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals. Overall, Malaspina-Golden Nugget received a vulnerability rating of **Medium** for bacteria and viruses, nitrate/nitrites, inorganic chemicals and other organic chemicals, **High** for volatile organic chemicals and synthetic organic chemicals.

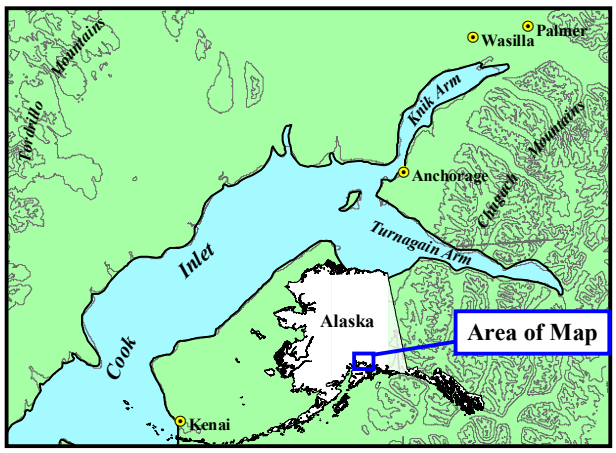

Figure 1. Index map showing the location of Anchorage, Alaska

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 public water system 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 what efforts will be most effective in reducing contaminant risks to your water system.

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 ANCHORAGE AREA, ALASKA

Location

Anchorage, located in south-central Alaska, encompasses 1,698 square miles of land and 264 square miles of water. The area containing a majority of the urban development, commonly referred to as the Anchorage Bowl, encompasses approximately 180 square miles [*Partick, Brabets, and Glass, 1989*] and envelopes the low lands of the area. This area is bounded on the east by the Chugach Mountains and the north, west, and south by the Knik and Turnagain Arm of Cook Inlet (Figure 1). In recent times, urban development has extended eastward along the flanks of the Chugach Mountains. This area, known locally as the Anchorage Hillside, contains development at elevations exceeding 3,700 feet in elevation above sea level.

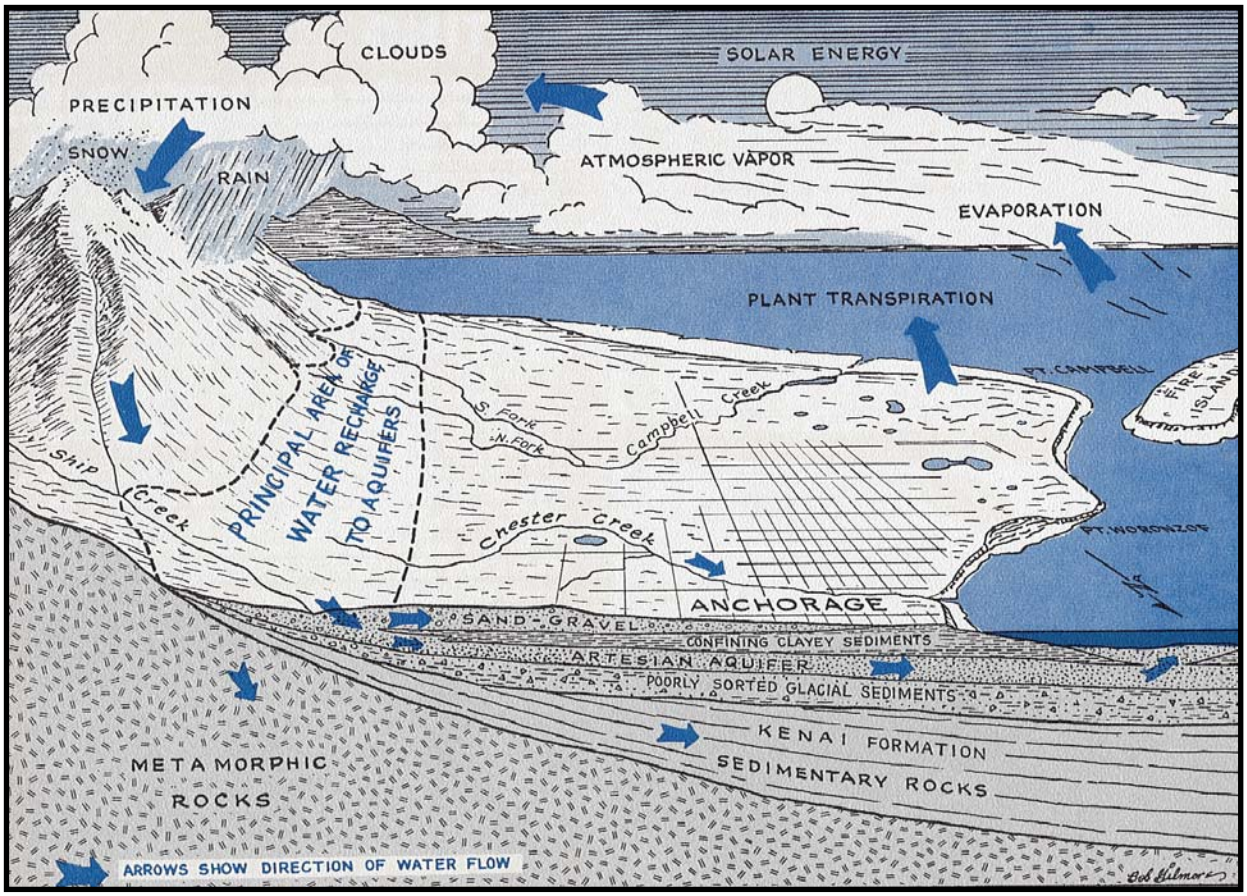

Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

Climate

The Anchorage area climate is somewhat transitional in that it does not experience large daily and annual temperature fluctuations like those experienced in the interior of Alaska nor does it experience high amounts of precipitation typified by gulf coast regions. Mean annual precipitation at the Anchorage International Airport is approximately 16 inches per year. On average, Anchorage receives a total snow accumulation of 69 inches per year. Precipitation generally increases inland toward the Chugach Mountains where annual precipitation may exceed 160 inches per year [*Barnwell, George, Dearborn, Weeks, and Zenone*, 1972]. Mean daily temperature ranges from 65^{o} F during July to 8^{o} F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

Surface elevations in the Anchorage area range from sea level at Knik and Turnagain Arms to well over 5,000 feet in the peaks that bound the area. Glacial moraine and outwash deposits primarily mantle the surface of the Anchorage Bowl.

The backbone of the Chugach Mountains is composed primarily of metamorphic marine and volcanic rocks (bedrock). These high peaks that bound Anchorage's east side are flanked with colluvium or slope deposits. These slope deposits eventually grade into the glacial and stream deposits at lower elevations in the Anchorage Bowl.

In the Anchorage area, two principal groundwater flow systems or aquifers exist (see Figure 2). The upper unconfined aquifer or water-table aquifer is separated from a lower confined aquifer system by layers of silty, clayey glacially derived sediments (confining layer) [*Ulery and Updike*, 1983]. The lower confined aquifer system consists of a series of hydrologically interconnected layers and lenses of gravel, sand and silt that, collectively, form the confined aquifer. The confining layer ranges from 0 to 270 feet thick throughout the Anchorage area and generally thins with increasing distance from Cook Inlet, thus pinching out at the mountain front [*Patrick, Brabets, and Glass*, 1989].

Water enters or recharges these two aquifer systems in several different ways. Along the front of the Chugach Mountains, groundwater seeps from fractures in

bedrock into the sediments. At these higher elevations, rain and snowmelt also enters the sediments. This area along the mountain front is considered the principal recharge area for wells in the Anchorage area. Precipitation in the low lands may also percolate directly into the ground. Lastly, aquifers may also be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). Groundwater flow in the confined aquifer is generally east to west from the mountain front toward Cook Inlet and Turnagain Arm, except in areas where the direction of flow is influenced by large municipal or industrial production wells. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surfacial topography as well as its close connection with surface water bodies.

MALASPINA-GOLDEN NUGGET PUBLIC DRINKING WATER SYSTEM

Malaspina-Golden Nugget is a Class A (community) water system. The system consists of two wells in the Anchorage area. (See Map 1 of Appendix A). The wells are located approximately 100 feet apart and are completed within the same aquifer. Due to their close proximity, the wells were assessed together. The wells are located at an elevation of approximately 175 feet above sea level.

The 1996 Sanitary Survey indicates that the wells are 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. Due to the date that the well was installed it is suspected that the well was not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

Records indicates that the depth of the Well No. 1 and Well No. 2 are 280 feet and 285 feet below surface level, receptively. Well logs for both wells were unavailable. The well log of a system ½ mile north, indicates that there are confining layers from 12-72 feet below the surface. The confining layers may provide protection from contaminates entering the aquifer. However, the clay layers tend to thin out towards the mountains allowing contaminants that enter the subsurface near the base of the mountains to enter the confined aquifer uninhibited by the absence of any protective layer.

This system operates 365 days per year and serves5 500 residents and 100 non-residents through 505 service connections.

MALASPINA-GOLDEN NUGGET 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 releases 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 outline of the immediate watershed was used to determine the size and shape of the DWPA for Malaspina-Golden Nugget. Available geology was also considered 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 A Public Water Systems for additional information).

The DWPAs established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. 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 (*Jokela et. al., 1991*).

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 time-of-travel for each:

Table 1. Definition of Zones

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

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

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

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

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

The sources are displayed on Maps 2 -6 in Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source.

Tables 2 through 7 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF MALASPINA-GOLDEN NUGGETDRINKING WATER SOURCE

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 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)

Table 2 shows the Susceptibility scores and ratings for the wells serving Malaspina-Golden Nugget.

Table 2. Susceptibility of the well

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	13	High
Natural Susceptibility	18	Medium

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 and 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	45	Medium
Nitrates and/or Nitrites	33	High
Volatile Organic Chemicals	42	Very High
Heavy Metals, Cyanide, and		

Other Inorganic Chemicals	27	Medium
Synthetic Organic Chemicals	42	Very High
Other Organic Chemicals	27	Medium

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.
Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	45	Medium
Nitrates and Nitrites	50	Medium
Volatile Organic Chemicals	60	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	45	Medium
Synthetic Organic Chemicals	60	High
Other Organic Chemicals	45	Medium

Bacteria and Viruses
The contaminant risk for bacteria and viruses is medium with sewer lines, parks and roads presenting the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Recent sampling of the well indicates that no bacteria and viruses have been detected. .

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability is medium.

Nitrates and Nitrites
The contaminant risk for nitrates and nitrites is high with sewer lines, parks, roads and residential areas, presenting the most significant risk to the drinking water well.

Recent historical sampling data indicates that nitrates were detected at 6% the maximum contaminant level (MCL) of 10 mg/l during the most recent sampling event (12/15/2000). (See Chart 5 – Contaminant Risks for Nitrates and/or Nitrites in Appendix D.) The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans.

Nitrates and/or nitrites are found in natural background concentration at this site, as elsewhere in Alaska. Other sources of nitrate and/or nitrites are human sewage, livestock manure, especially from feedlots and fertilizers. Due to high solubility and weak retention by soil, nitrates are very mobile often moving at approximately the same rate as water. It is unknown whether the existing contamination is naturally occurring or human influenced. According to the Environmental Protection Agency (USEPA), short-term exposure to levels excessively above the MCL has caused serious illness and sometimes death. Serious illness in infants can occur due to the conversion of nitrate to nitrite by the body, which can interfere with the oxygen-carrying capacity of the childs blood. This can be an acute condition in which health deteriorates rapidly over a period of days. Symptoms include shortness of breath and blueness of the skin. Long term exposure to nitrates and nitrites at levels above the MCL can lead to diuresis, increased starchy deposits and hemorrhaging of the spleen (USEPA, 2001).

Because naturally occurring nitrate levels are typically less than 2 mg/l (or 20% the MCL), it is suspected that the nitrate levels detected are naturally occurring. (Wang, Strelakos, Jokela, 2000).

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

Volatile Organic Chemicals
The contaminant risk for volatile organic chemicals is very high with sewer lines, roads, gasoline stations, under ground fuel tanks, motor vehicle waste disposal wells, LUST sites and ADEC recognized contaminated sites presenting the most significant risk to the drinking water source. (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Recent sampling indicates that no volatile organic chemicals have been detected in the source waters. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the wells, the overall vulnerability of the wells to contamination is high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is medium with sewer lines, roads, residential areas and existing contamination presenting the most significant risk to the drinking water source (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

Sampling indicates that heavy metals, cyanide; other inorganic chemicals have not been detected in source waters. (Chart 9 – Contaminant Risks for Heavy Metals and Other Inorganic Chemicals in Appendix D).

Combining the contaminant risk with the natural susceptibility of the wells leads to an overall vulnerability to heavy metals and other inorganic chemical contamination of medium.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is very high with sewer lines, residential areas, a golf course and a greenhouse presenting the most significant risk. (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D, respectively).

The system has a current waiver from sampling and has not recently sampled. After combining the contaminant risk with the natural susceptibility of the wells, the overall vulnerability to synthetic organic chemicals is high.

Other Organic Chemicals

The contaminant risk for other organic chemicals is medium sewer lines, roads, and motor vehicle repair shops presenting the most significant risk.

The system has a current waiver from sampling and has not recently sampled.

After combining the contaminant risk with the natural susceptibility of the wells, the overall vulnerability to other organic chemicals is medium. (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D, respectively).

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Malaspina-Golden Nugget. The overall vulnerability of this source to contamination is **Medium** for bacteria and viruses, nitrate/nitrites, inorganic chemicals and other organic chemicals, **High** for volatile organic chemicals and synthetic organic chemicals. 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 Malaspina-Golden Nugget 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 Malaspina-Golden Nugget public drinking water source.

REFERENCES

Barnwell, W.W., George, R.S., Dearborn, L.L., Weeks, J.B., and Zenone, C., 1972, Water for Anchorage: an atlas of the water resources of the Anchorage area, Alaska: U.S. Geological Survey Open-File Report, 76 p.

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Ulery, C.A. and Updike, R.G, 1983, Subsurface structure of the cohesive facies of the Bootlegger Cove Formation, Southwest Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 84, 5 p.

Wang, B., Strelakos, P.M., and Jokela, B., 2000, Nitrate Source Indicators In Groundwater of the Scimitar Subdivision, Peters Creek Area, Anchorage Alaska: U.S. Geological Survey Water-Resources Investigations Report 00-4137, 25p.

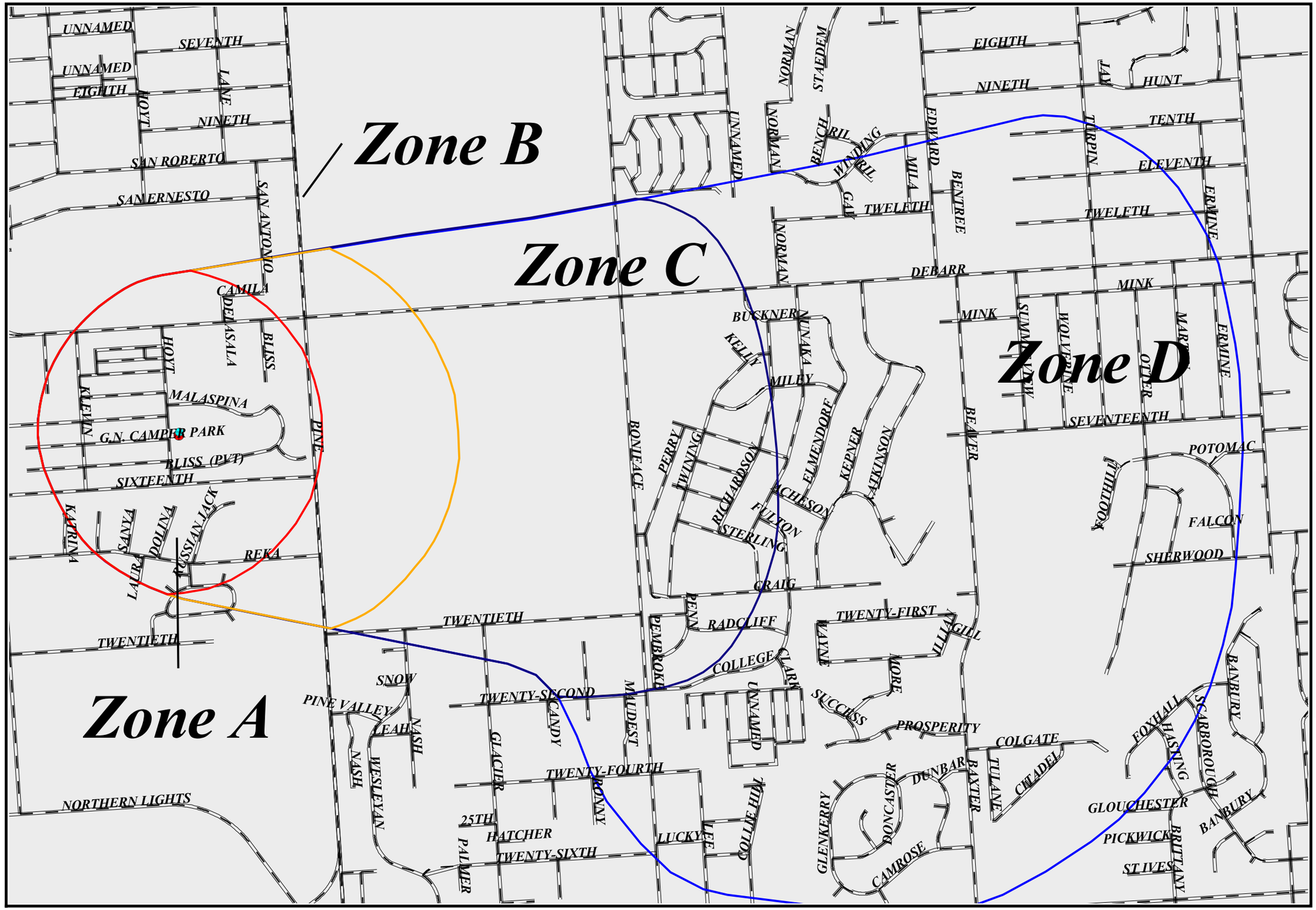
Western Regional Climate Center, 2000, August 24, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://www.wrcc.dri.edu/index.html

U.S. Environmental Protection Agency, 2001, Office of Water. Retrieved August 2002. [WWW document]. URL http://www.epa.gov/safewater/hfacts.html#Inorganic

APPENDIX A

Malaspina-Golden Nugget
Drinking Water Protection Area Location Map
(Map 1)

Drinking Water Protection Area for Glacier Terr Malals Golden Nugget



Legend

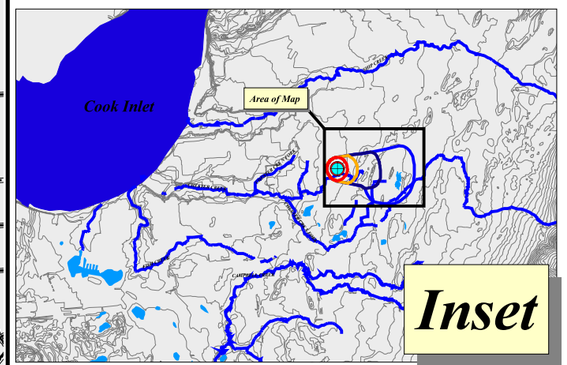
Public Water System
- Well No. 1
- Well No. 2

Zone A Protection Area
- Less than 2 Years 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
- Roads



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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Malaspina-Golden Nugget (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Malaspina Golden Nugget***

PWSID 212128.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Construction trade areas and materials	C09	C9-1	A	3	
Hardware stores	C17	C17-1	A	3	
Motor/motor vehicle supplies stores	C28	C28-1	A	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-9	A	2	9 sewer lines in Zone A
Residential Areas	R01	R1-1	A	3	77 acres
Municipal or city parks (with green areas)	X04	X4-1	A	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-20	A	2	20 roads in Zone A
Dog walking areas/foot trails	X46	X46-1	A	3	
Dog walking areas/foot trails	X46	X46-2	A	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-10	B	2	1 road in Zone B
Residential Areas	R01	R2-2	B	4	9 acres
Golf courses	X02	X2-1	B	3	
Highways and roads, paved (cement or asphalt)	X20	X20-21	B	2	1 road in Zone B
Orchards or nurseries	A10	A10-1	C	4	
Construction trade areas and materials	C09	C9-4	C	4	
Gasoline stations (without repair shop)	C15	C15-1	C	4	
Gasoline stations (without repair shop)	C15	C15-2	C	4	
Gasoline stations (without repair shop)	C15	C15-3	C	4	
Gasoline stations (with repair shop)	C16	C16-1	C	4	
Hardware stores	C17	C17-2	C	4	
Motor /motor vehicle repair shops	C31	C31-01	C	4	
Pharmacies (with on-site wastewater disposal)	C35	C35-1	C	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-11-30	C	2	30 sewer lines in Zone C

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Residential Areas	R01	R2-3	C	4	50 acres
Tanks, diesel (underground)	T08	T8-2	C	4	
Tanks, diesel (underground)	T08	T8-3	C	4	
Tanks, diesel (underground)	T08	T8-4	C	4	
Tanks, diesel (underground)	T08	T8-5	C	4	
Tanks, diesel (underground)	T08	T8-6	C	4	
Closed tanks, diesel (underground)	T09	T09-3	C	4	
Closed tanks, diesel (underground)	T09	T09-4	C	4	
Closed tanks, diesel (underground)	T09	T09-5	C	4	
Closed tanks, diesel (underground)	T09	T09-6	C	4	
Closed tanks, diesel (underground)	T09	T9-1	C	4	
Closed tanks, diesel (underground)	T09	T9-2	C	4	
Tanks, gasoline (underground)	T12	T12-2	C	4	
Tanks, gasoline (underground)	T12	T12-3	C	4	
Tanks, gasoline (underground)	T12	T12-4	C	4	
Tanks, gasoline (underground)	T12	T12-5	C	4	
Tanks, gasoline (underground)	T12	T12-6	C	4	
Tanks, gasoline (underground)	T12	T12-7	C	4	
Tanks, gasoline (underground)	T12	T12-8	C	4	
Closed tanks, gasoline (underground)	T13	T13-1	C	4	
Closed tanks, heating oil, nonresidential (underground)	T17	T17-1	C	4	
Closed tanks, heating oil, nonresidential (underground)	T17	T17-2	C	4	
Tanks, lubricants or other petroleum products (underground)	T20	T20-1	C	4	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-6	C	4	5705 DeBarr Road. CS/L File No. L100.22 Petroleum Contamination
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-1	C	4	5700 Debarr Road. LUST File No.L25.4 Pertoleum release. Site cleaned up to required levels. Priority: Low

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-2	C	4	1905 Nunaka Valley File No. CS68.09 Priority: Medium
Closed Leaking Underground Fuel Storage Tank (LUST) Sites	U08	U8-01	C	4	5705 DeBarr Road. LUST File No. L100.22 Petroleum contamination. Site cleaned up to cleanup levels. Priority: High
Municipal or city parks (with green areas)	X04	X4-2	C	4	
Highways and roads, paved (cement or asphalt)	X20	X20-22-41	C	2	20 roads in Zone C
Dog walking areas/foot trails	X46	X46-3	C	4	
Dog walking areas/foot trails	X46	X46-4	C	4	
Dog walking areas/foot trails	X46	X46-5	C	4	
Dog walking areas/foot trails	X46	X46-6	C	4	
Dog walking areas/foot trails	X46	X46-7	C	4	
Printers, publishers, copiers	C37	C37-1	D	5	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	D	5	
Asphalt and tar processing/storage	I03	I3-1	D	5	
Tanks, diesel (underground)	T08	T8-7	D	5	
Tanks, diesel (underground)	T08	T8-8	D	5	
Tanks, gasoline (underground)	T12	T12-10	D	5	
Tanks, gasoline (underground)	T12	T12-11	D	5	
Tanks, gasoline (underground)	T12	T12-13	D	5	
Tanks, gasoline (underground)	T12	T12-9	D	5	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-4	D	5	Home heating oil release File No. CS96.53 Priority: High Site Closed
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-5	D	5	2308 Maudest Place. File No. CS69.15 Diesel contamination found. Total contamination unknown. Priority: Medium
Closed Leaking Underground Fuel Storage Tank (LUST) Sites	U08	U8-2	D	5	6470 Debarr Road. LUST File No. 10.15 Boring found soil and groundwaer contamination. Priority: High

Table 2

Contaminant Source Inventory and Risk Ranking for Malaspina Golden Nugget Sources of Bacteria and Viruses

PWSID 212128.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R1-1	A	Low	3	77 acres
Municipal or city parks (with green areas)	X04	X4-1	A	Medium	3	
Dog walking areas/foot trails	X46	X46-1	A	Low	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-10	B	Medium	2	1 road in Zone B
Residential Areas	R01	R2-2	B	Low	4	9 acres
Highways and roads, paved (cement or asphalt)	X20	X20-21	B	Low	2	1 road in Zone B
Residential Areas	R01	R2-3	C	Low	4	50 acres

Table 3

Contaminant Source Inventory and Risk Ranking for Malaspina Golden Nugget Sources of Nitrates/Nitrites

PWSID 212128.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Hardware stores	C17	C17-1	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-9	A	Medium	2	9 sewer lines in Zone A
Residential Areas	R01	R1-1	A	Low	3	77 acres
Highways and roads, paved (cement or asphalt)	X20	X20-1-20	A	Low	2	20 roads in Zone A
Municipal or city parks (with green areas)	X04	X4-1	A	Medium	3	
Dog walking areas/foot trails	X46	X46-1	A	Low	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-10	B	Medium	2	1 road in Zone B
Residential Areas	R01	R2-2	B	Low	4	9 acres
Golf courses	X02	X2-1	B	Medium	3	
Highways and roads, paved (cement or asphalt)	X20	X20-21	B	Low	2	1 road in Zone B
Orchards or nurseries	A10	A10-1	C	Medium	4	
Hardware stores	C17	C17-2	C	Low	4	
Pharmacies (with on-site wastewater disposal)	C35	C35-1	C	Low	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-11-30	C	Medium	2	30 sewer lines in Zone C
Residential Areas	R01	R2-3	C	Low	4	50 acres
Highways and roads, paved (cement or asphalt)	X20	X20-22-41	C	Low	2	20 roads in Zone C
Municipal or city parks (with green areas)	X04	X4-2	C	Medium	4	
Dog walking areas/foot trails	X46	X46-3	C	Low	4	
Dog walking areas/foot trails	X46	X46-4	C	Low	4	
Dog walking areas/foot trails	X46	X46-5	C	Low	4	
Dog walking areas/foot trails	X46	X46-6	C	Low	4	

Contaminant Source Inventory and Risk Ranking for Malaspina Golden Nugget Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Dog walking areas/foot trails	X46	X46-7	C	Low	4	

Table 4

Contaminant Source Inventory and Risk Ranking for Malaspina Golden Nugget Sources of Volatile Organic Chemicals

PWSID 212128.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Hardware stores	C17	C17-1	A	Low	3	
Motor/motor vehicle supplies stores	C28	C28-1	A	Low	3	
Construction trade areas and materials	C09	C9-1	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-9	A	Low	2	9 sewer lines in Zone A
Residential Areas	R01	R1-1	A	Low	3	77 acres
Highways and roads, paved (cement or asphalt)	X20	X20-1-20	A	Low	2	20 roads in Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-10	B	Low	2	1 road in Zone B
Residential Areas	R01	R2-2	B	Low	4	9 acres
Golf courses	X02	X2-1	B	High	3	
Highways and roads, paved (cement or asphalt)	X20	X20-21	B	Low	2	1 road in Zone B
Orchards or nurseries	A10	A10-1	C	Low	4	
Gasoline stations (without repair shop)	C15	C15-1	C	High	4	
Gasoline stations (without repair shop)	C15	C15-2	C	High	4	
Gasoline stations (without repair shop)	C15	C15-3	C	High	4	
Gasoline stations (with repair shop)	C16	C16-1	C	High	4	
Hardware stores	C17	C17-2	C	Low	4	
Motor /motor vehicle repair shops	C31	C31-01	C	Medium	4	
Construction trade areas and materials	C09	C9-4	C	Low	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-11-30	C	Low	2	30 sewer lines in Zone C
Residential Areas	R01	R2-3	C	Low	4	50 acres
Closed tanks, diesel (underground)	T09	T09-3	C	Medium	4	
Closed tanks, diesel (underground)	T09	T09-4	C	Medium	4	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Closed tanks, diesel (underground)	T09	T09-5	C	Medium	4	
Closed tanks, diesel (underground)	T09	T09-6	C	Medium	4	
Tanks, gasoline (underground)	T12	T12-2	C	High	4	
Tanks, gasoline (underground)	T12	T12-3	C	High	4	
Tanks, gasoline (underground)	T12	T12-4	C	High	4	
Tanks, gasoline (underground)	T12	T12-5	C	High	4	
Tanks, gasoline (underground)	T12	T12-6	C	High	4	
Tanks, gasoline (underground)	T12	T12-7	C	High	4	
Tanks, gasoline (underground)	T12	T12-8	C	High	4	
Closed tanks, gasoline (underground)	T13	T13-1	C	Medium	4	
Closed tanks, heating oil, nonresidential (underground)	T17	T17-1	C	Medium	4	
Closed tanks, heating oil, nonresidential (underground)	T17	T17-2	C	Medium	4	
Tanks, diesel (underground)	T08	T8-2	C	High	4	
Tanks, diesel (underground)	T08	T8-3	C	High	4	
Tanks, diesel (underground)	T08	T8-4	C	High	4	
Tanks, diesel (underground)	T08	T8-5	C	High	4	
Tanks, diesel (underground)	T08	T8-6	C	High	4	
Closed tanks, diesel (underground)	T09	T9-1	C	Medium	4	
Closed tanks, diesel (underground)	T09	T9-2	C	Medium	4	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-1	C	Low	4	5700 Debarr Road. LUST File No.L25.4 Pertoleum release. Site cleaned up to required levels. Priority: Low
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-2	C	Medium	4	1905 Nunaka Valley File No. CS68.09 Priority: Medium
Highways and roads, paved (cement or asphalt)	X20	X20-22-41	C	Low	2	20 roads in Zone C

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Printers, publishers, copiers	C37	C37-1	D	High	5	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	D	High	5	
Tanks, gasoline (underground)	T12	T12-11	D	High	5	
Tanks, gasoline (underground)	T12	T12-13	D	High	5	
Tanks, gasoline (underground)	T12	T12-9	D	High	5	
Tanks, diesel (underground)	T08	T8-7	D	High	5	
Tanks, diesel (underground)	T08	T8-8	D	High	5	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-5	D	Medium	5	2308 Maudest Place. File No. CS69.15 Diesel contamination found. Total contamination unknown. Priority: Medium

Table 5

Contaminant Source Inventory and Risk Ranking for Malaspina Golden Nugget
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 212128.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Hardware stores	C17	C17-1	A	Low	3	
Construction trade areas and materials	C09	C9-1	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-9	A	Low	2	9 sewer lines in Zone A
Residential Areas	R01	R1-1	A	Low	3	77 acres
Highways and roads, paved (cement or asphalt)	X20	X20-1-20	A	Low	2	20 roads in Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-10	B	Low	2	1 road in Zone B
Residential Areas	R01	R2-2	B	Low	4	9 acres
Highways and roads, paved (cement or asphalt)	X20	X20-21	B	Low	2	1 road in Zone B
Gasoline stations (with repair shop)	C16	C16-1	C	Low	4	
Hardware stores	C17	C17-2	C	Low	4	
Motor /motor vehicle repair shops	C31	C31-01	C	Medium	4	
Pharmacies (with on-site wastewater disposal)	C35	C35-1	C	Low	4	
Construction trade areas and materials	C09	C9-4	C	Low	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-11-30	C	Low	2	30 sewer lines in Zone C
Residential Areas	R01	R2-3	C	Low	4	50 acres
Tanks, gasoline (underground)	T12	T12-2	C	Medium	4	
Tanks, gasoline (underground)	T12	T12-3	C	Medium	4	
Tanks, gasoline (underground)	T12	T12-4	C	Medium	4	
Tanks, gasoline (underground)	T12	T12-5	C	Medium	4	
Tanks, gasoline (underground)	T12	T12-6	C	Medium	4	
Tanks, gasoline (underground)	T12	T12-7	C	Medium	4	
Tanks, gasoline (underground)	T12	T12-8	C	Medium	4	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-22-41	C	Low	2	20 roads in Zone C
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	D	High	5	

Table 6

Contaminant Source Inventory and Risk Ranking for Malaspina Golden Nugget Sources of Synthetic Organic Chemicals

PWSID 212128.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-9	A	Low	2	9 sewer lines in Zone A
Residential Areas	R01	R1-1	A	Low	3	77 acres
Municipal or city parks (with green areas)	X04	X4-1	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-10	B	Low	2	1 road in Zone B
Residential Areas	R01	R2-2	B	Low	4	9 acres
Golf courses	X02	X2-1	B	High	3	
Orchards or nurseries	A10	A10-1	C	High	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-11-30	C	Low	2	30 sewer lines in Zone C
Residential Areas	R01	R2-3	C	Low	4	50 acres
Municipal or city parks (with green areas)	X04	X4-2	C	Low	4	

Table 7

Contaminant Source Inventory and Risk Ranking for Malaspina Golden Nugget Sources of Other Organic Chemicals

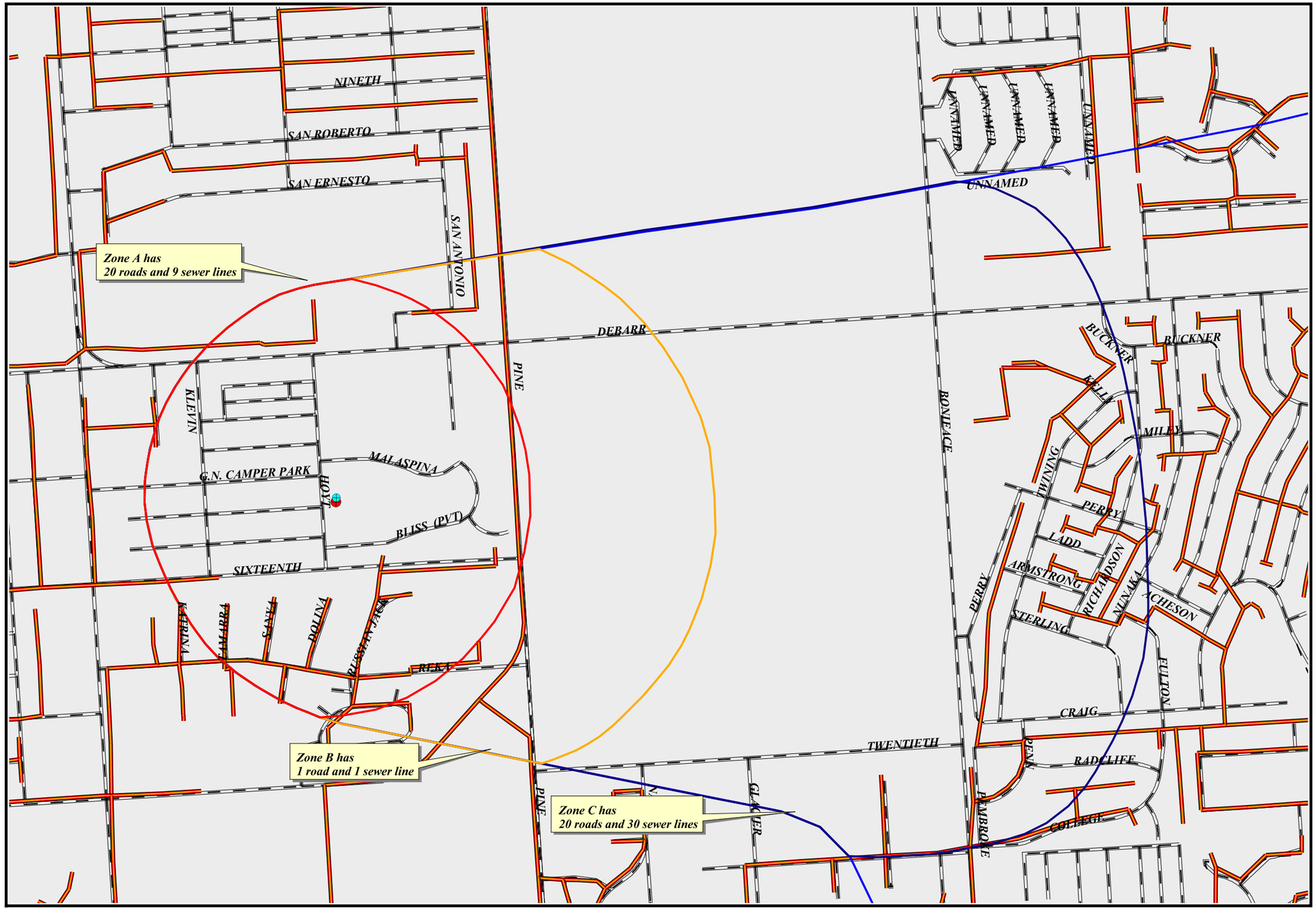
PWSID 212128.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Hardware stores	C17	C17-1	A	Low	3	
Construction trade areas and materials	C09	C9-1	A	Low	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1-9	A	Low	2	9 sewer lines in Zone A
Residential Areas	R01	R1-1	A	Low	3	77 acres
Highways and roads, paved (cement or asphalt)	X20	X20-1-20	A	Low	2	20 roads in Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-10	B	Low	2	1 road in Zone B
Residential Areas	R01	R2-2	B	Low	4	9 acres
Highways and roads, paved (cement or asphalt)	X20	X20-21	B	Low	2	1 road in Zone B
Orchards or nurseries	A10	A10-1	C	Low	4	
Gasoline stations (without repair shop)	C15	C15-1	C	Low	4	
Gasoline stations (without repair shop)	C15	C15-2	C	Low	4	
Gasoline stations (without repair shop)	C15	C15-3	C	Low	4	
Gasoline stations (with repair shop)	C16	C16-1	C	Medium	4	
Hardware stores	C17	C17-2	C	Low	4	
Motor /motor vehicle repair shops	C31	C31-01	C	Medium	4	
Construction trade areas and materials	C09	C9-4	C	Low	4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-11-30	C	Low	2	30 sewer lines in Zone C
Residential Areas	R01	R2-3	C	Low	4	50 acres
Highways and roads, paved (cement or asphalt)	X20	X20-22-41	C	Low	2	20 roads in Zone C
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	D	High	5	
Asphalt and tar processing/storage	I03	I3-1	D	High	5	

APPENDIX C

Malaspina-Golden Nugget
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2 - 5)

Drinking Water Protection Area for Glacier Terr Malas Golden Nugget and Potential and Existing Contaminant Sources



Legend

Public Water System
- Well No. 1
- Well No. 2

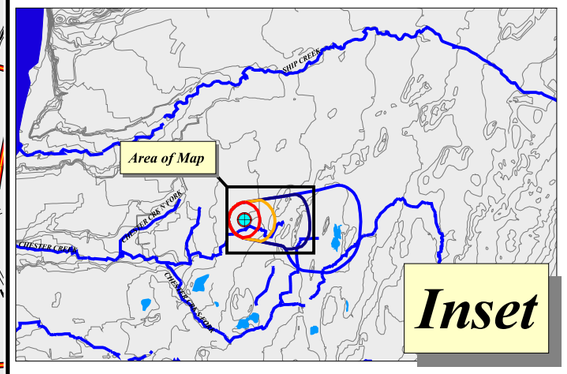
Zone A Protection Area
- Less than 2 Years Travel Time

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

- Sewers (D1)
- Roads



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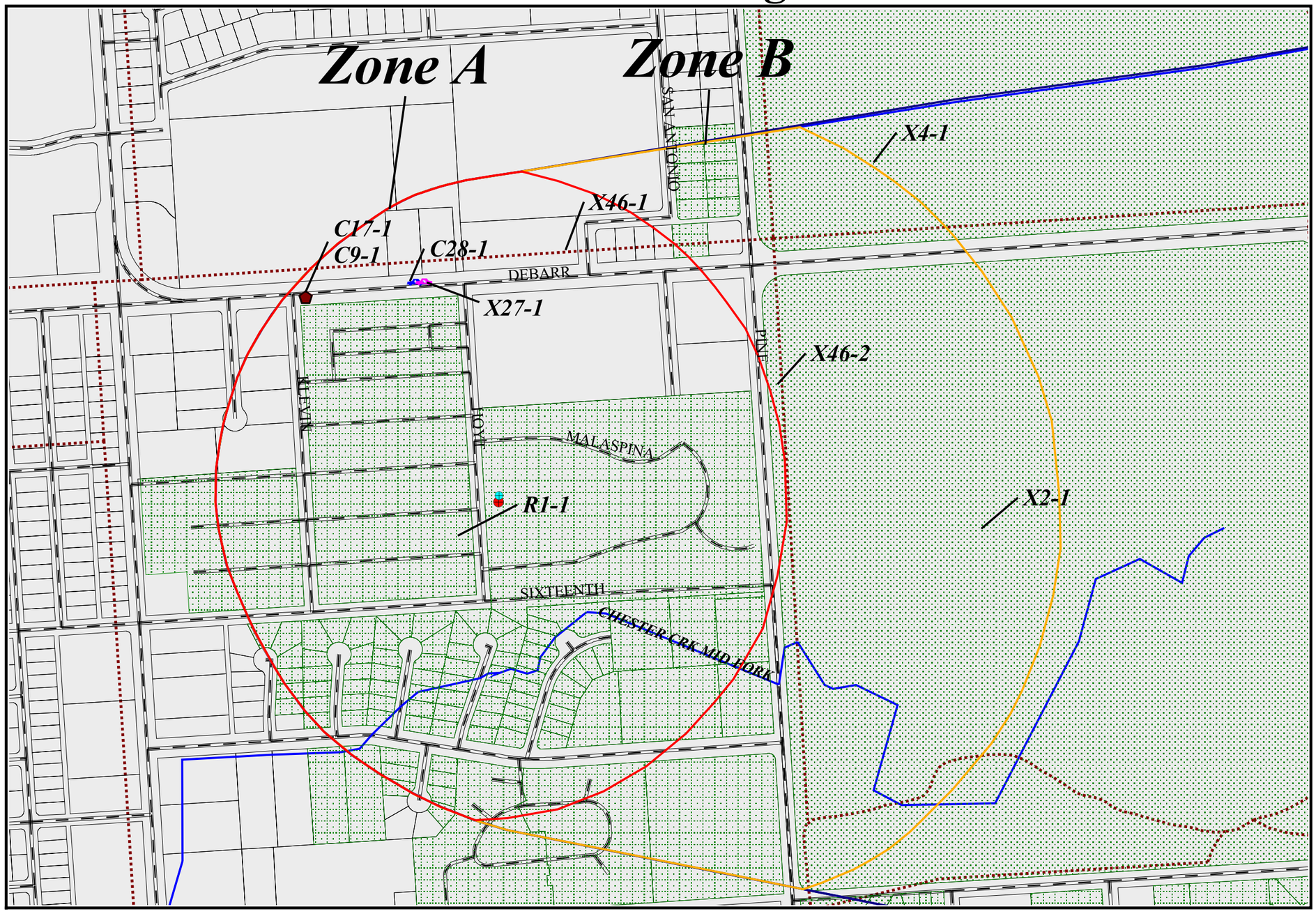
PWSID 212128.001 and 212128.002

Map 2

Drinking Water Protection Area for Glacier Terr Malas Golden Nugget and Potential and Existing Contaminant Sources



Legend

Public Water System
- Well No. 1
- Well No. 2

Zone A Protection Area
- Less than 2 Years Travel Time

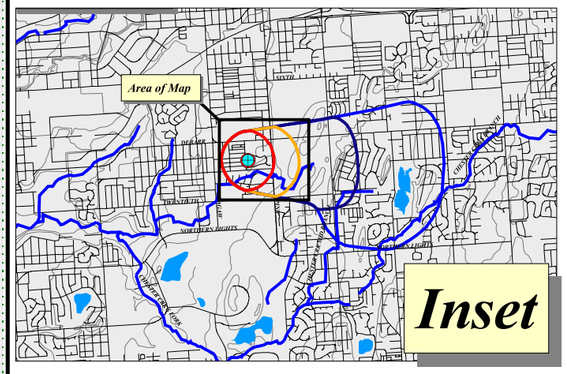
Zone B Protection Area
- Less than 2 Years Travel Time

Zone C Protection Area
- Less than 5 Years Travel Time

Zone D Protection Area
- Less than 10 Years Travel Time

Contaminant Sources
- Hardware stores (C17)
- Motor vehicle supplies store (C28)
- Construction trade areas (C9)
- Motor vehicle/general storage yard (X27)

Identified Land use
- Residential Areas (R1)
- Parks (X4)
- Streams
- Lakes
- MOA Land Parcels
- Roads
- Trails (X46)



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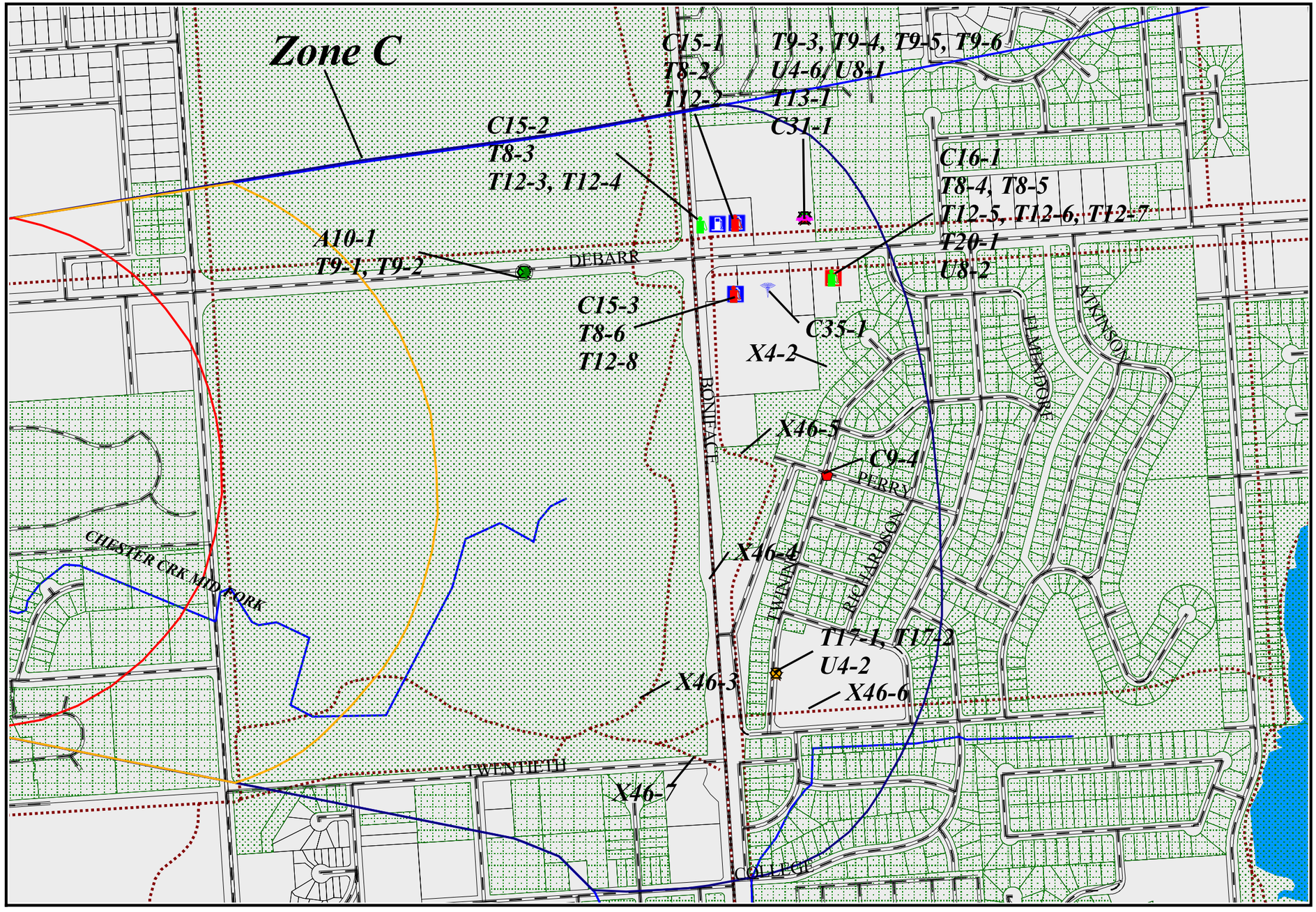
PWSID 212128.001 and 212128.002

Map 3

Drinking Water Protection Area for Glacier Terr Malas Golden Nugget and Potential and Existing Contaminant Sources



Legend

Public Water System
- Well No. 1
- Well No. 2

Zone A Protection Area
- Less than 2 Years Travel Time

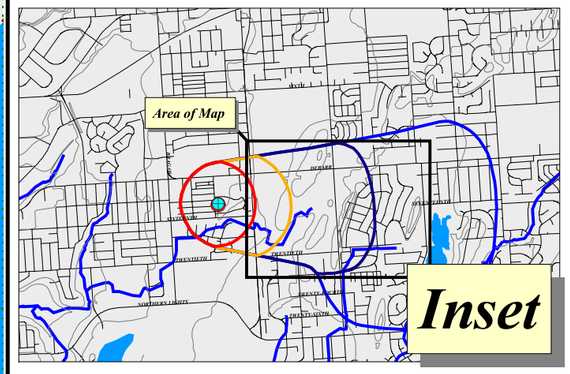
Zone B Protection Area
- Less than 2 Years Travel Time

Zone C Protection Area
- Less than 5 Years Travel Time

Zone D Protection Area
- Less than 10 Years Travel Time

Contaminant Sources
- Orchards or nurseries (A10)
- Gasoline stations (without repair shop) (C15)
- Gasoline stations (with repair shop) (C16)
- Motor vehicle repair shops (C31)
- Pharmacies (C35)
- Construction trade areas (C9)
- Tanks, gasoline (underground) (T12)
- Closed tanks, gasoline (underground) (T13)
- Closed tanks, heating oil (underground) (T17)
- Closed tanks, lubricans or other petroleum products) (T20)
- Tanks, diesel (underground) (T8)
- Closed tanks, diesel (underground) (t9)
- Contaminanted sites, DEC recognized (U4)

Identified Land use
- Residential Areas (R1)
- Parks (X4)
- Lakes
- Streams
- Roads
- Trails (X46)
- MOA Land Parcels



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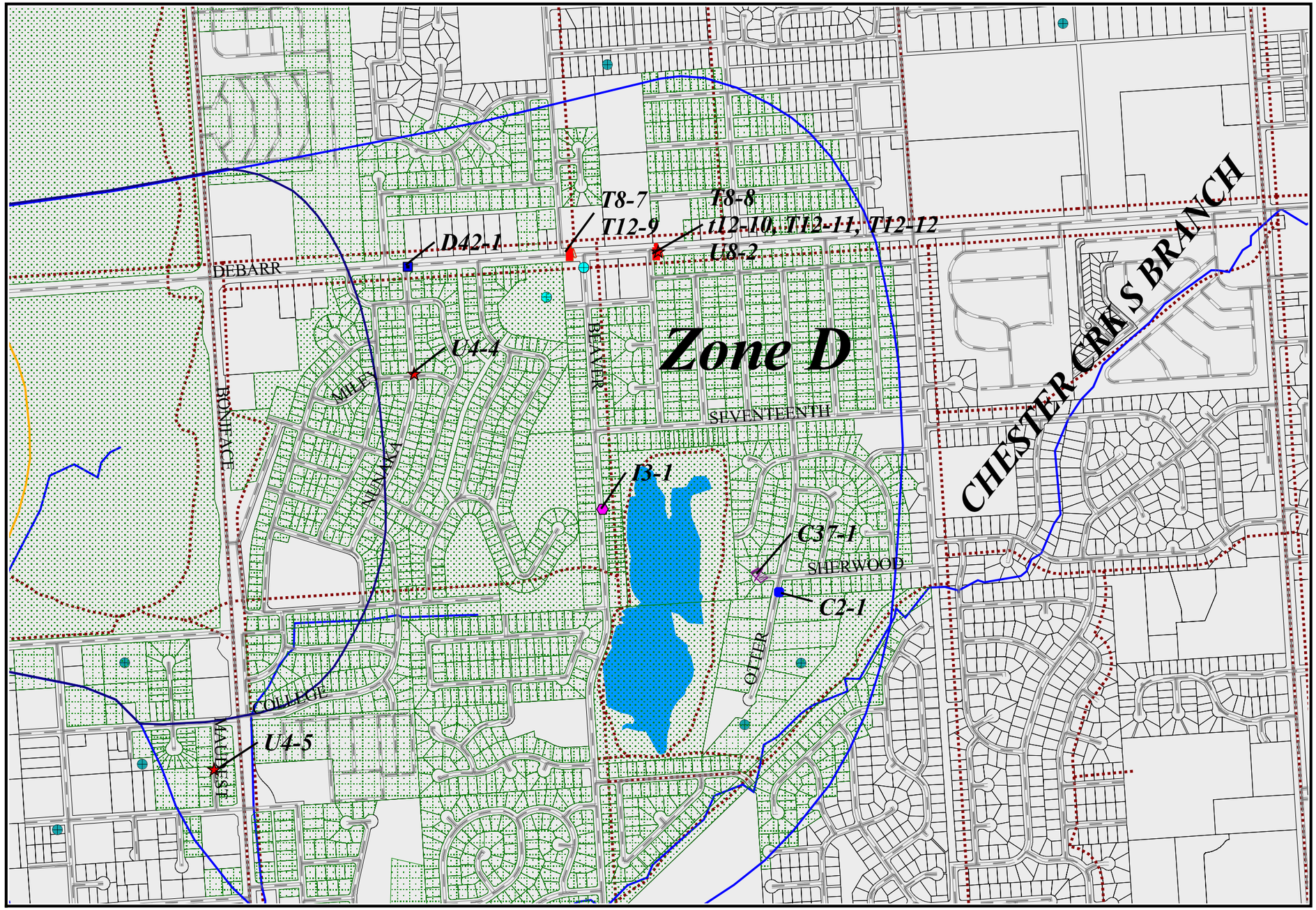
PWSID 212128.001 and 212128.002

Map 4

Drinking Water Protection Area for Glacier Terr Malas Golden Nugget and Potential and Existing Contaminant Sources



Legend

Public Water System
- Well No. 1
- Well No. 2

Zone A Protection Area
- Less than 2 Years Travel Time

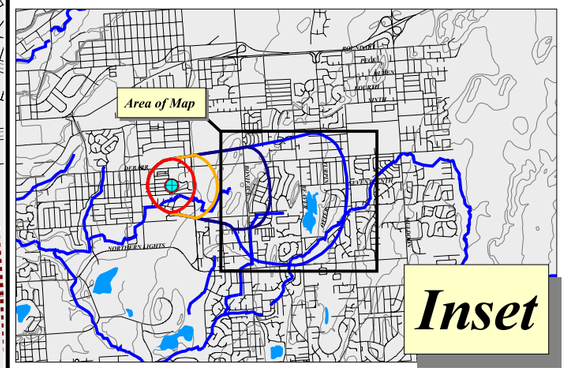
Zone B Protection Area
- Less than 2 Years Travel Time

Zone C Protection Area
- Less than 5 Years Travel Time

Zone D Protection Area
- Less than 10 Years Travel Time

Contaminant Sources
- Agricultural chemical sales/storage (C2)
- Printers, publishers, copiers (C37)
- Injection wells (Class V) motor vehicle waste (D42)
- Asphalt and tar processing/storage (I3)
- Tanks, gasoline (underground) (T12)
- Tanks, diesel (underground) (T8)
- Contaminanted sites, DEC recognized (U4)

Identified Land use
- Residential Areas (R1)
- Parks (X4)
- Private Wells
- USGS Wells
- Roads
- Lakes
- Streams
- Trails (X46)
- MOA Land Parcels



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PWSID 212128.001 and 212128.002

Map 5

APPENDIX D

Vulnerability Analysis for Malaspina-Golden Nugget

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Malaspina-Golden Nugget

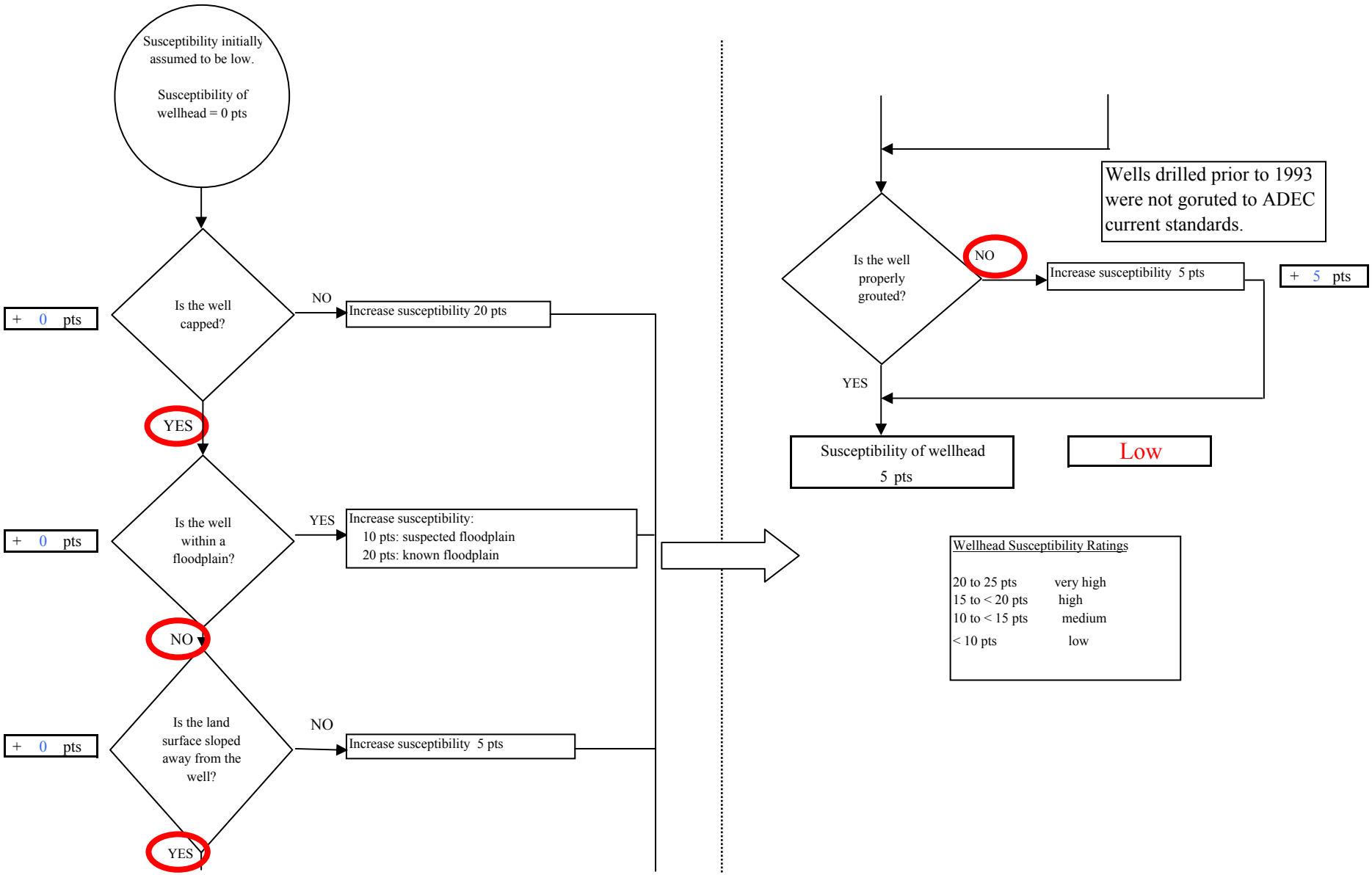


Chart 2. Susceptibility of the aquifer - Malaspina-Golden Nugget

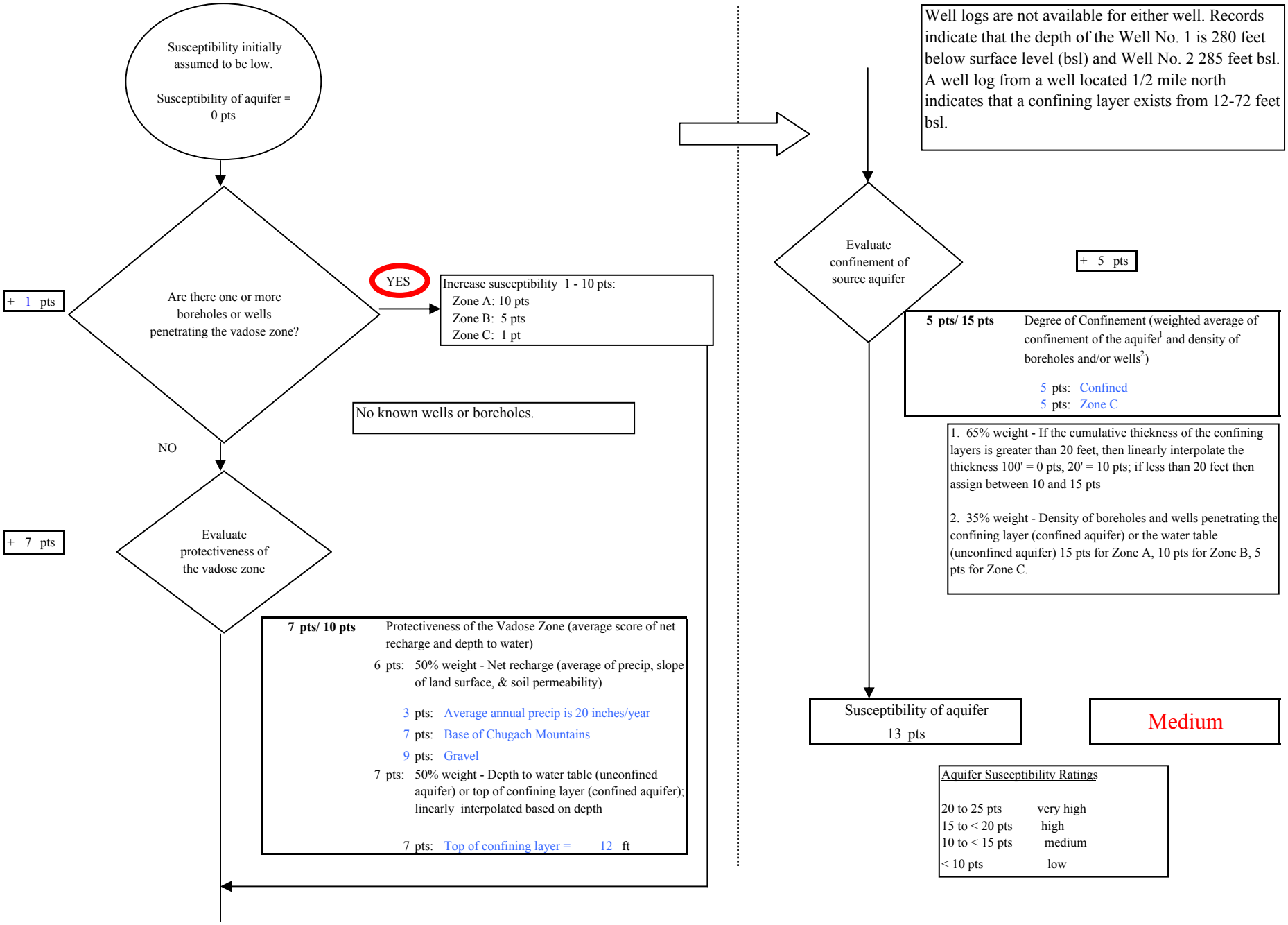
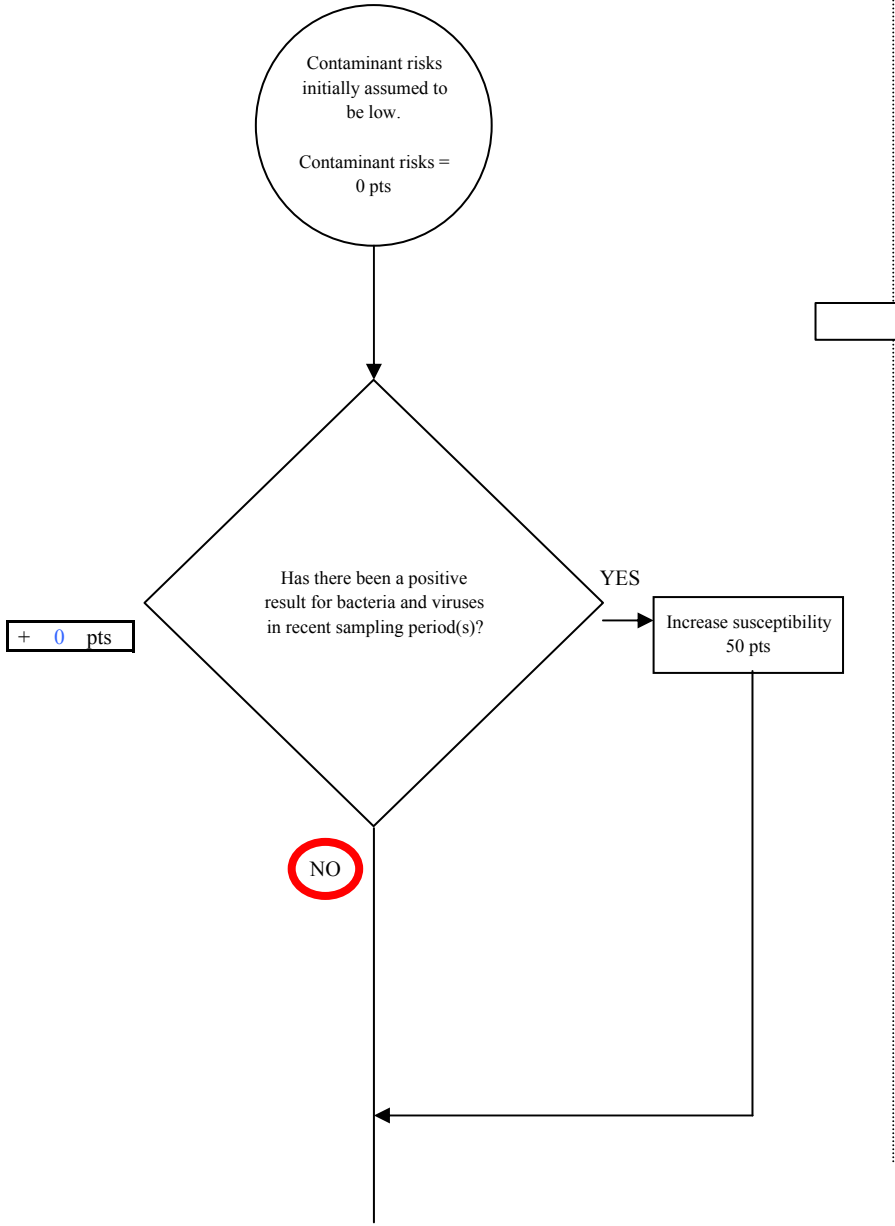
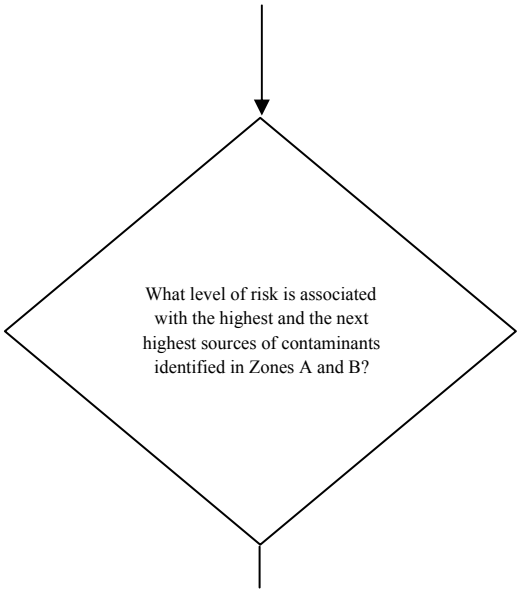


Chart 3. Contaminant risks for Malaspina-Golden Nugget - Bacteria & Viruses





+ 20 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	2	0	2
Low(s)	4	2	6

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

Matrix Score 20

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

Chart 3. Contaminant risks for Malaspina-Golden Nugget - Bacteria & Viruses

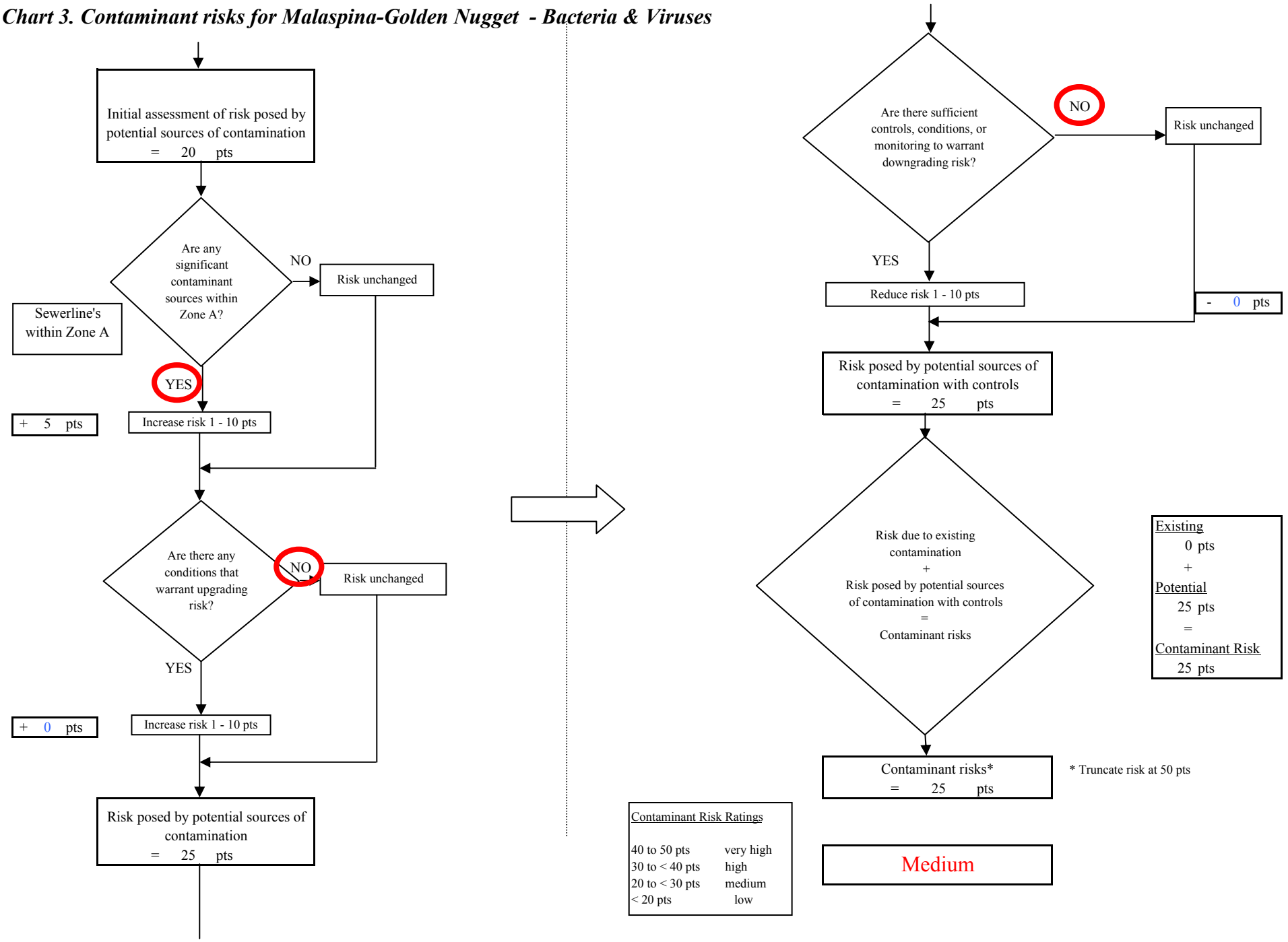


Chart 4. Vulnerability analysis for Malaspina-Golden Nugget - Bacteria & Viruses

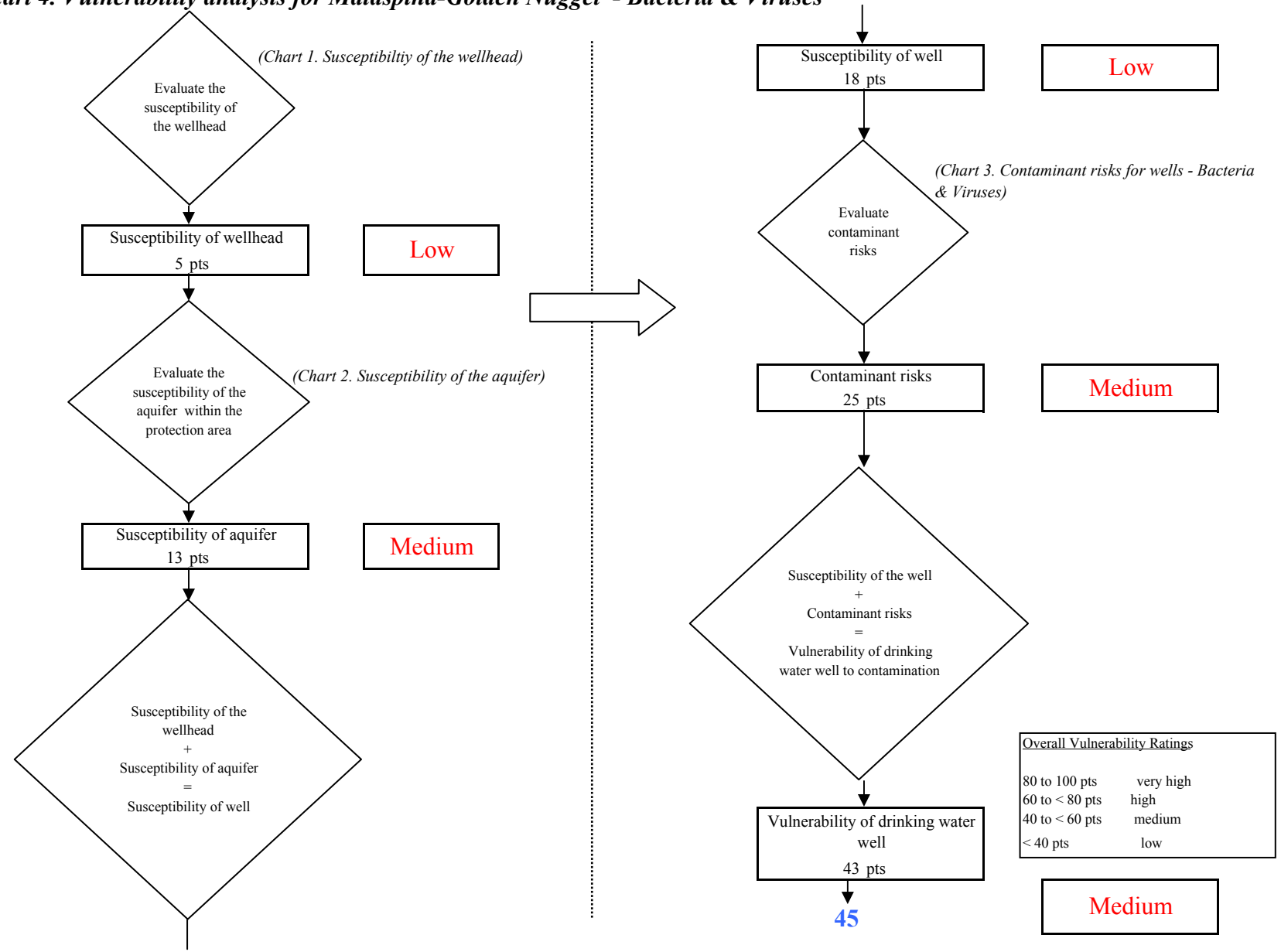


Chart 5. Contaminant risks for Malaspina-Golden Nugget - Nitrates and Nitrites

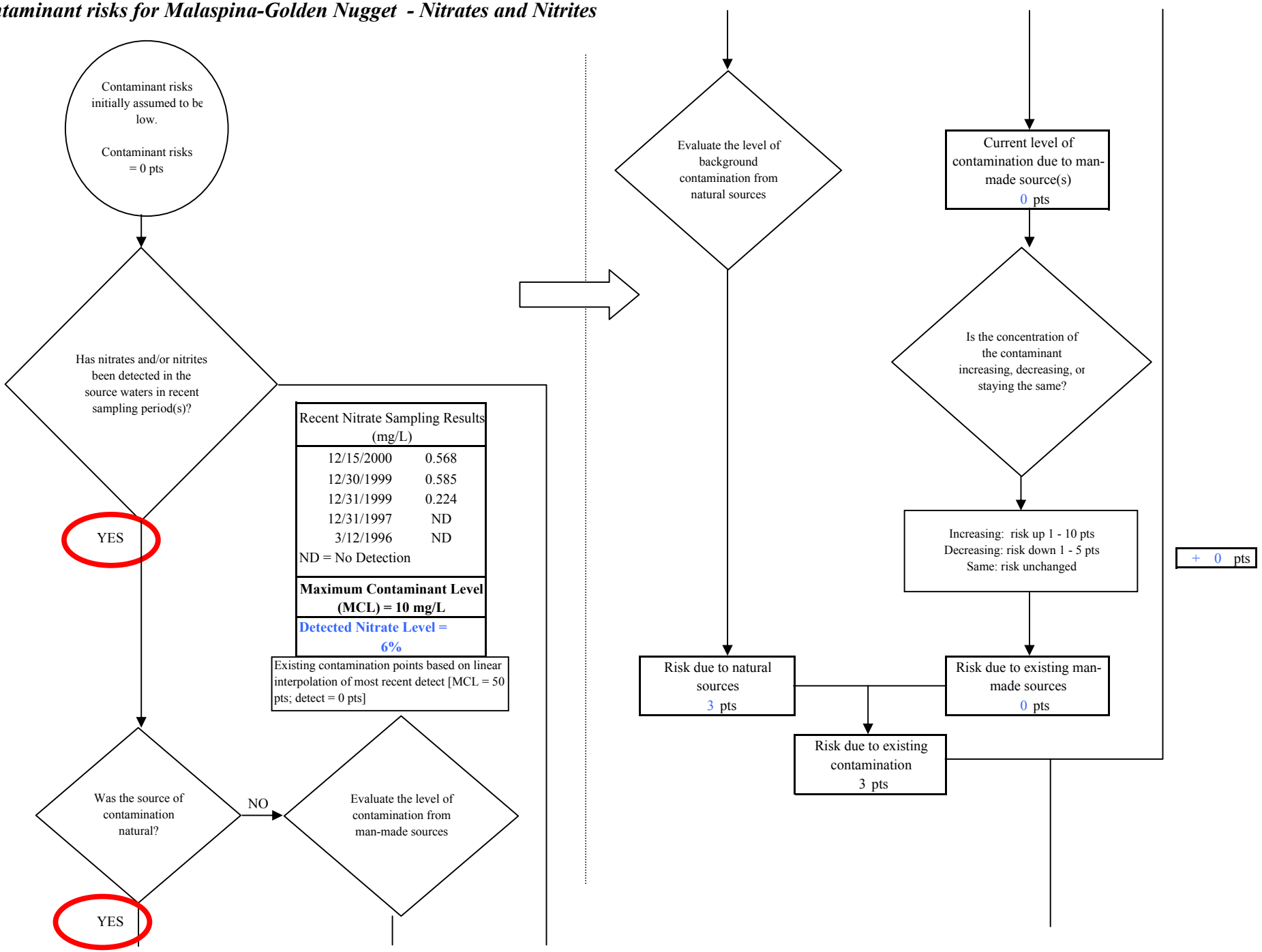


Chart 5. Contaminant risks for Malaspina-Golden Nugget - Nitrates and Nitrites

+ 25 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)	2	3	5
Low(s)	6	11	17

	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 25

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 = 25 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

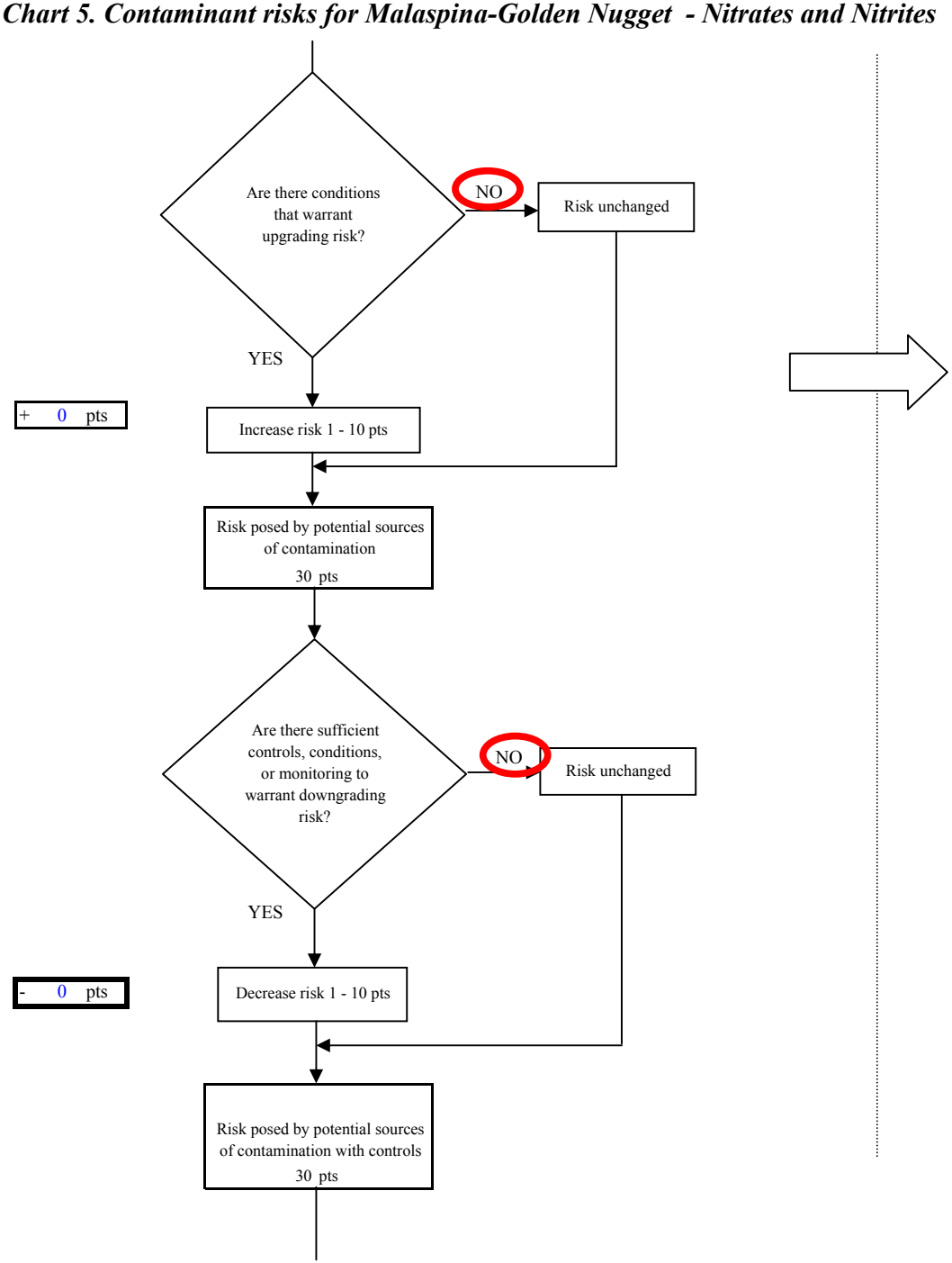
Sewer lines

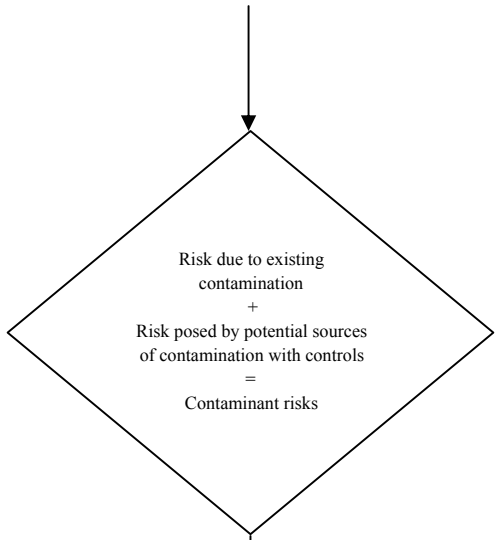
YES

Increase risk 1 - 10 pts

+ 5 pts

Chart 5. Contaminant risks for Malaspina-Golden Nugget - Nitrates and Nitrites





Existing
3 pts
+
Potential
30 pts
=
Contaminant Risk
33 pts

Contaminant risks*
= 33 pts

*Truncate risk at 50 pts

High

Contaminant Risk Ratings

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

Chart 6. Vulnerability analysis for Malaspina-Golden Nugget - Nitrates and Nitrites

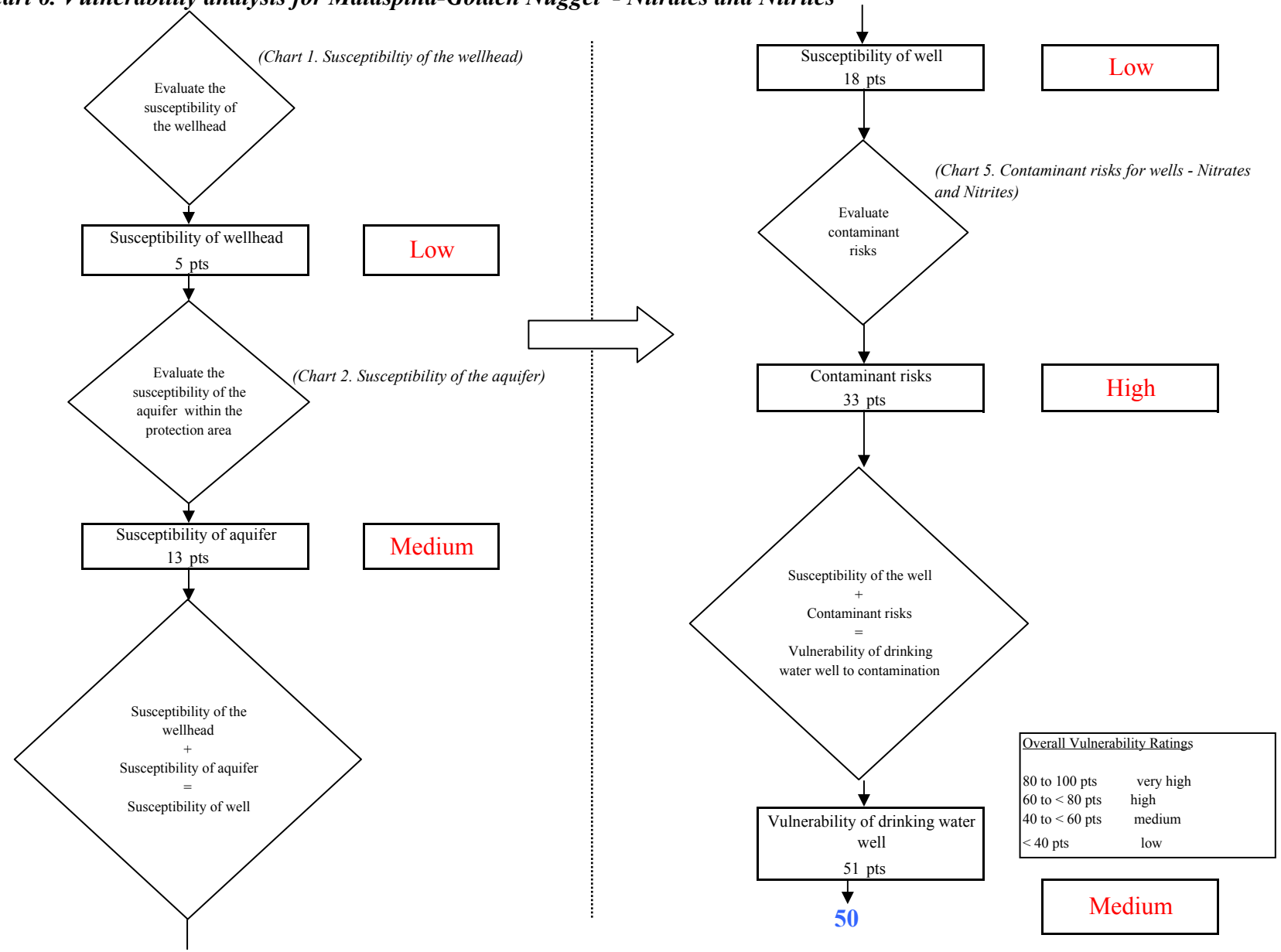


Chart 7. Contaminant risks for Malaspina-Golden Nugget - Volatile Organic Chemicals

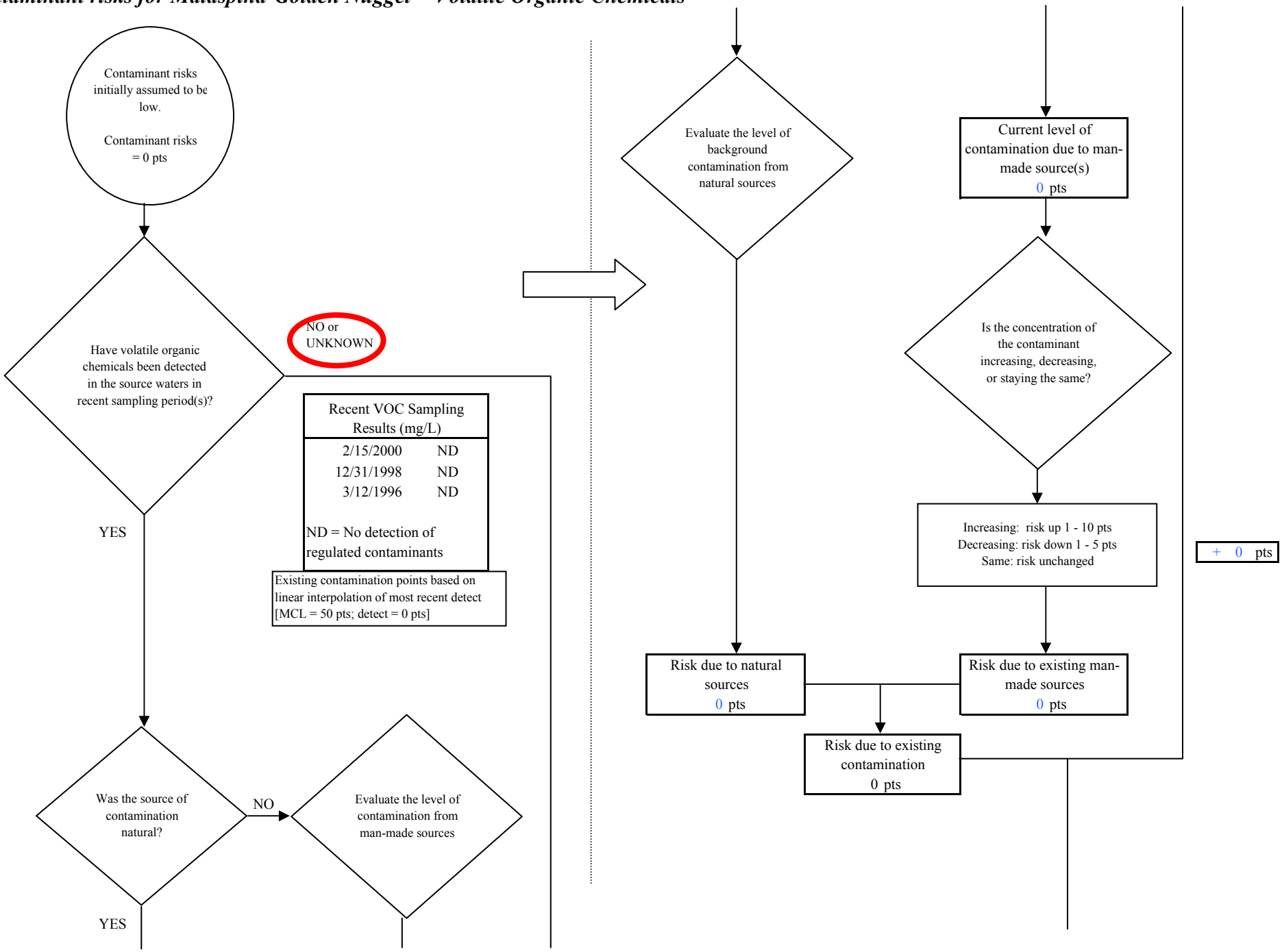


Chart 7. Contaminant risks for Malaspina-Golden Nugget - Volatile Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	16	16
Medium(s)	0	4	4
Low(s)	6	4	10

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

Matrix Score 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Commercial stores

Increase risk 1 - 10 pts

+ 2 pts

Chart 7. Contaminant risks for Malaspina-Golden Nugget - Volatile Organic Chemicals

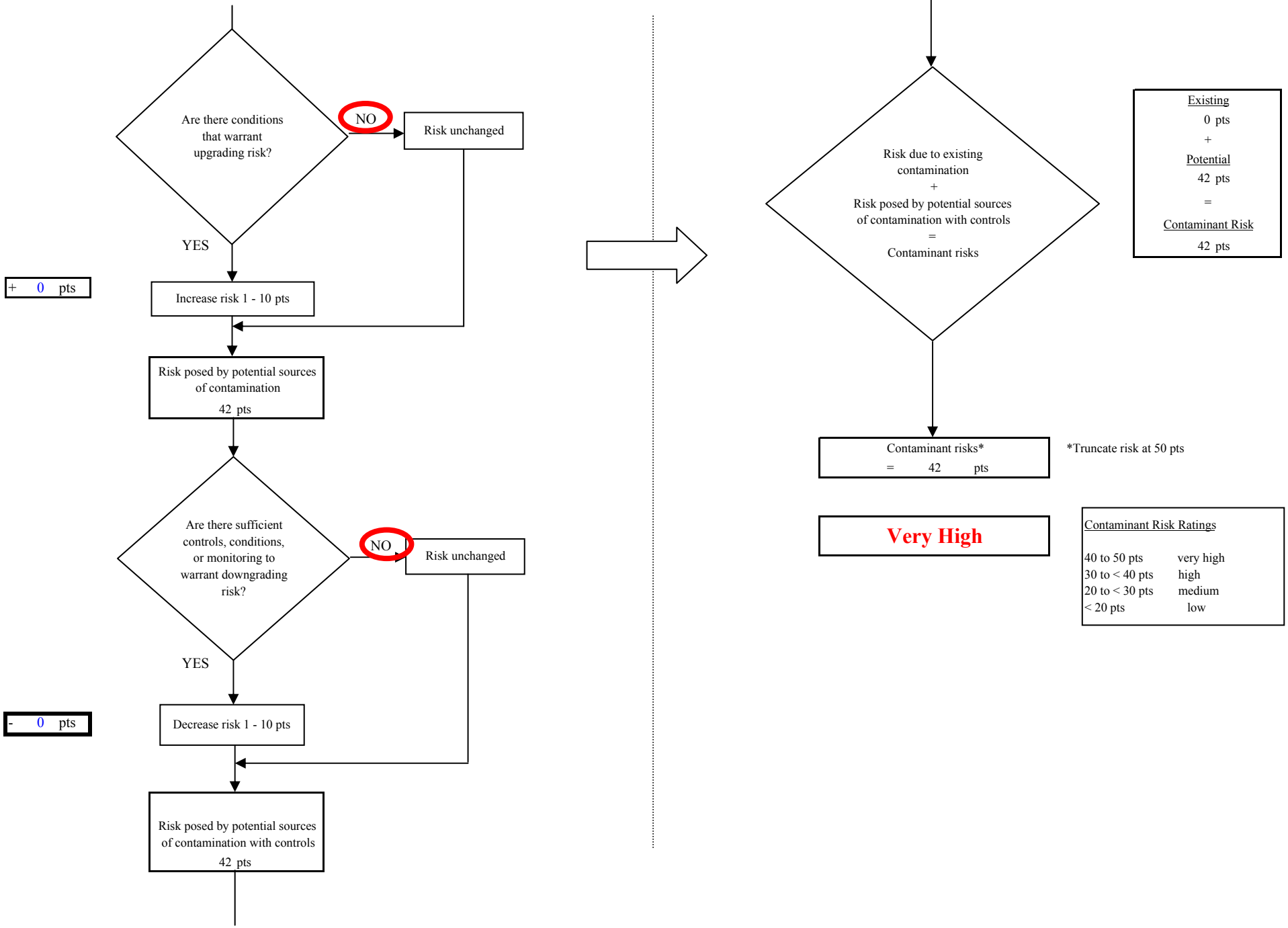


Chart 8. Vulnerability analysis for Malaspina-Golden Nugget - Volatile Organic Chemicals

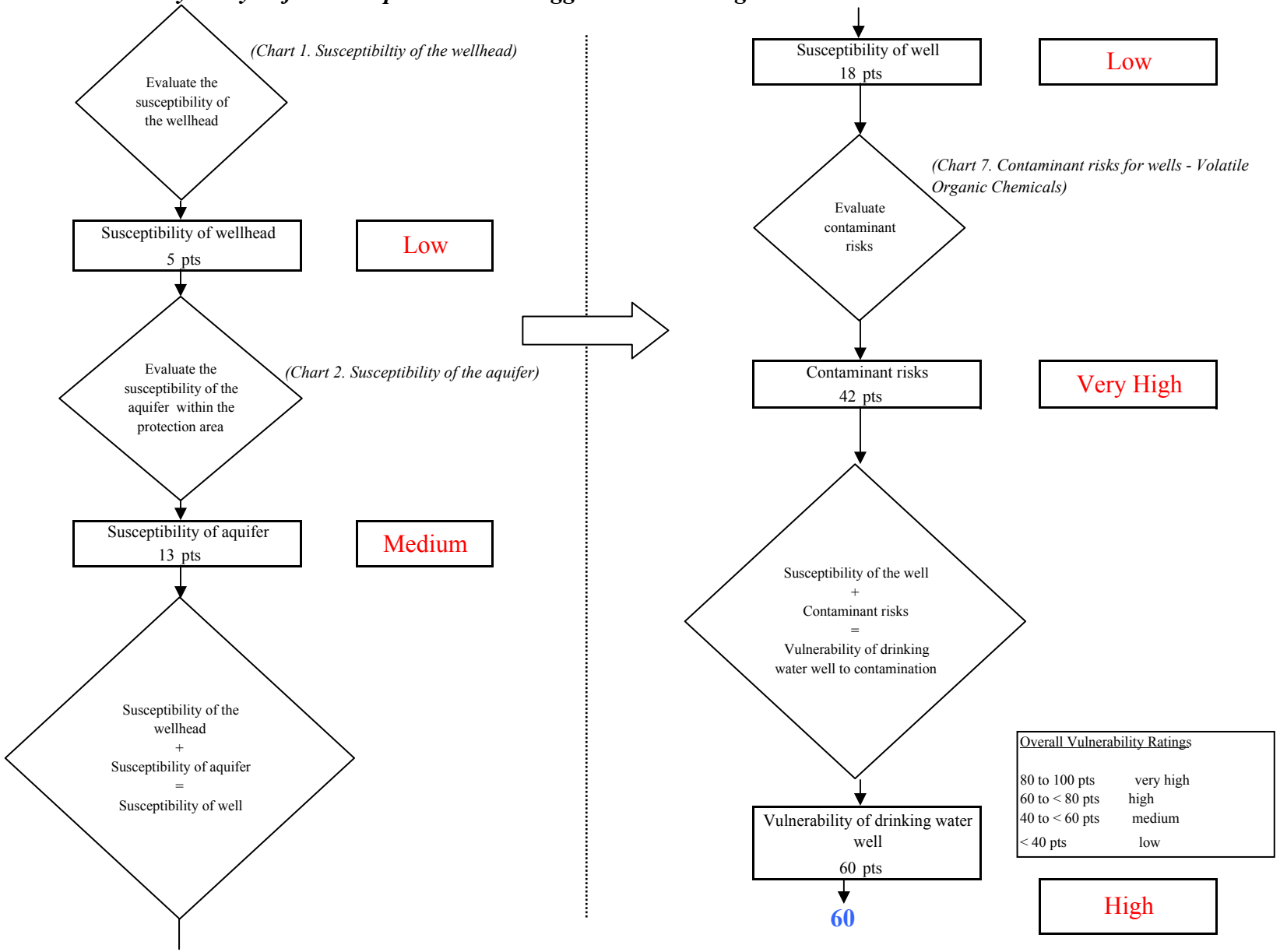


Chart 9. Contaminant risks for Malaspina-Golden Nugget - Heavy Metals, Cyanide and Other Inorganic Chemicals

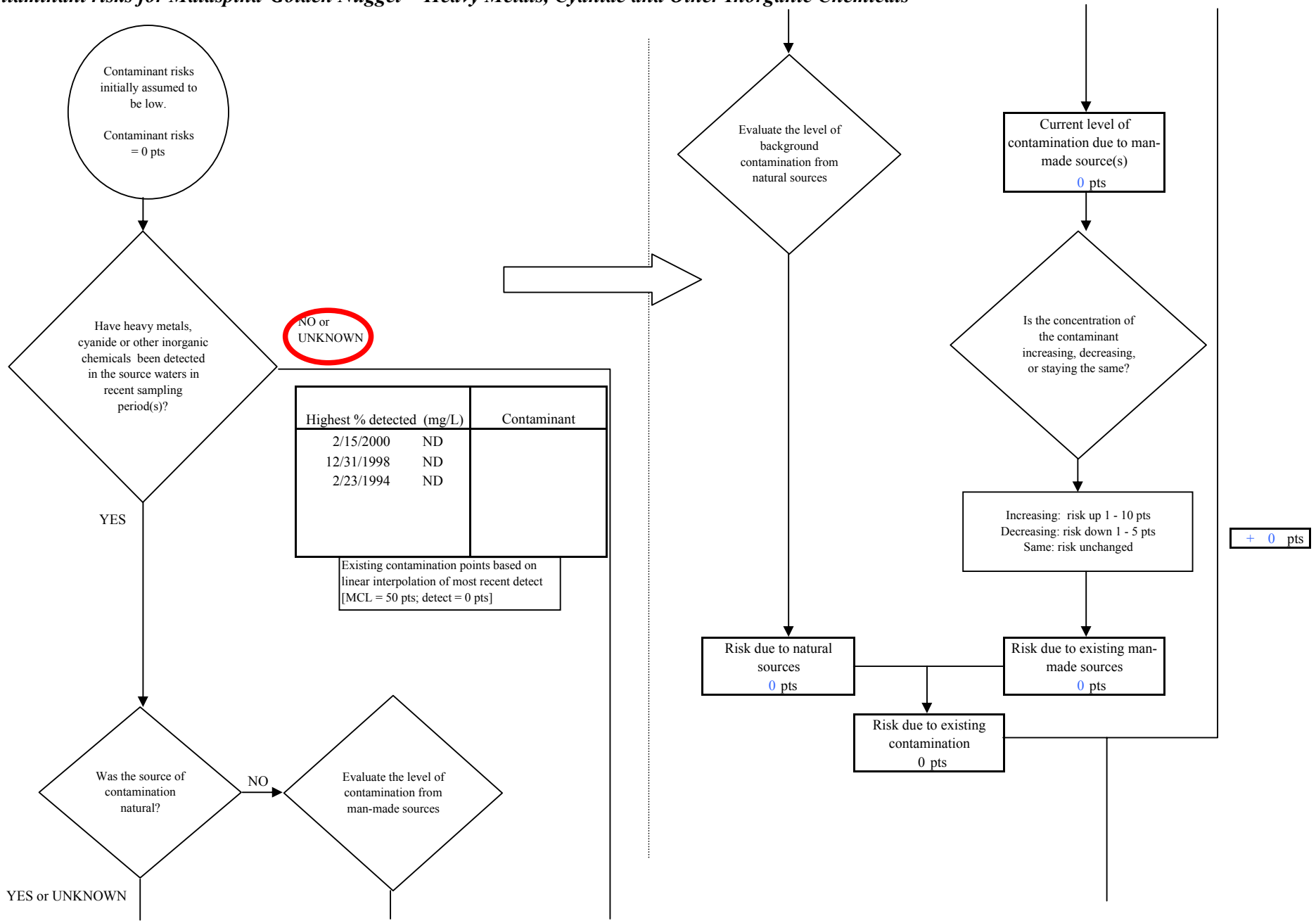


Chart 9. Contaminant risks for Malaspina-Golden Nugget - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 25 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	7	7
Low(s)	4	5	9

	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	25

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 = 25 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

Sewer lines and residential areas

YES → Increase risk 1 - 10 pts

+ 2 pts

Chart 9. Contaminant risks for Malaspina-Golden Nugget - Heavy Metals, Cyanide and Other Inorganic Chemicals

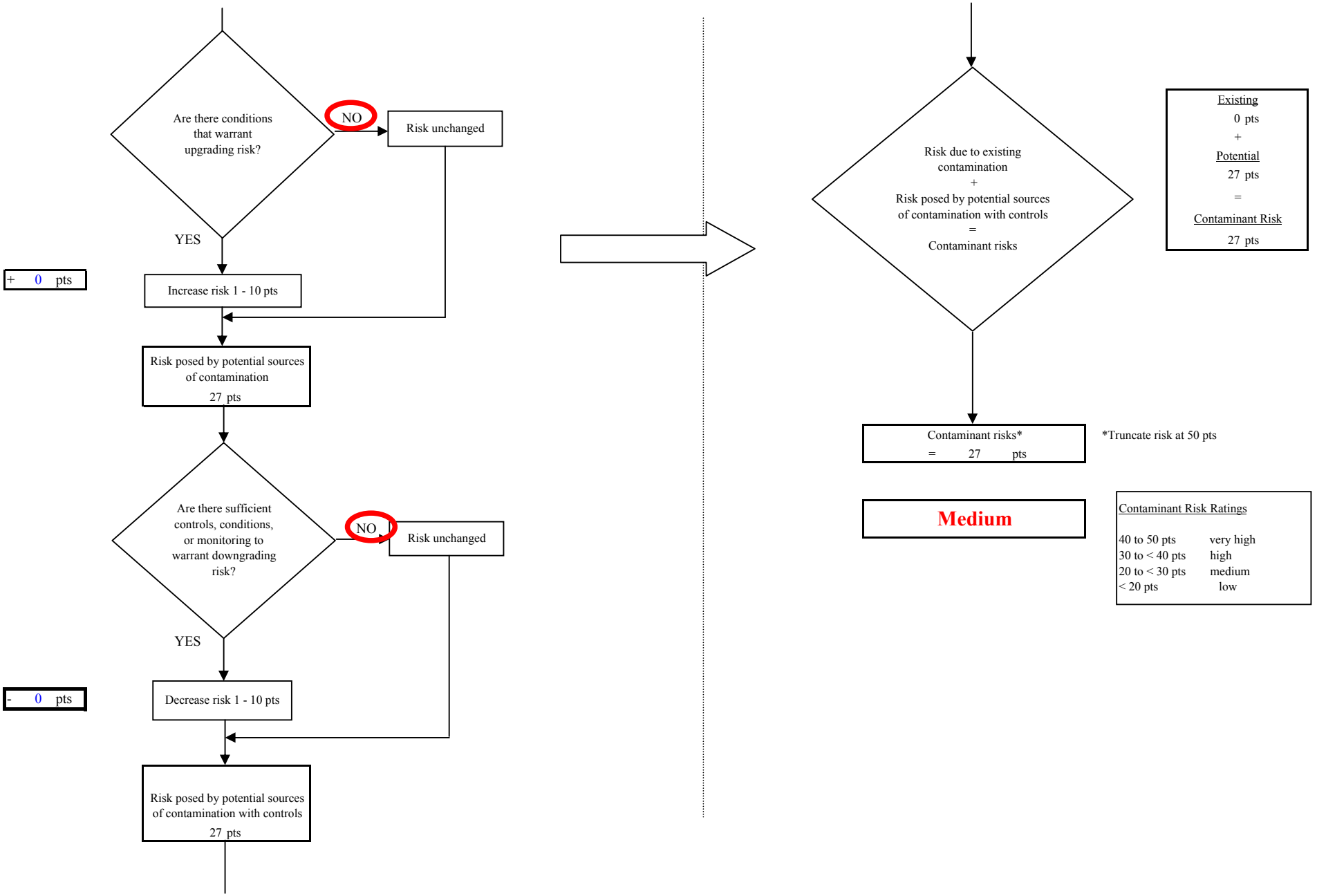


Chart 10. Vulnerability analysis for Malaspina-Golden Nugget - Heavy Metals, Cyanide and Other Inorganic Chemicals

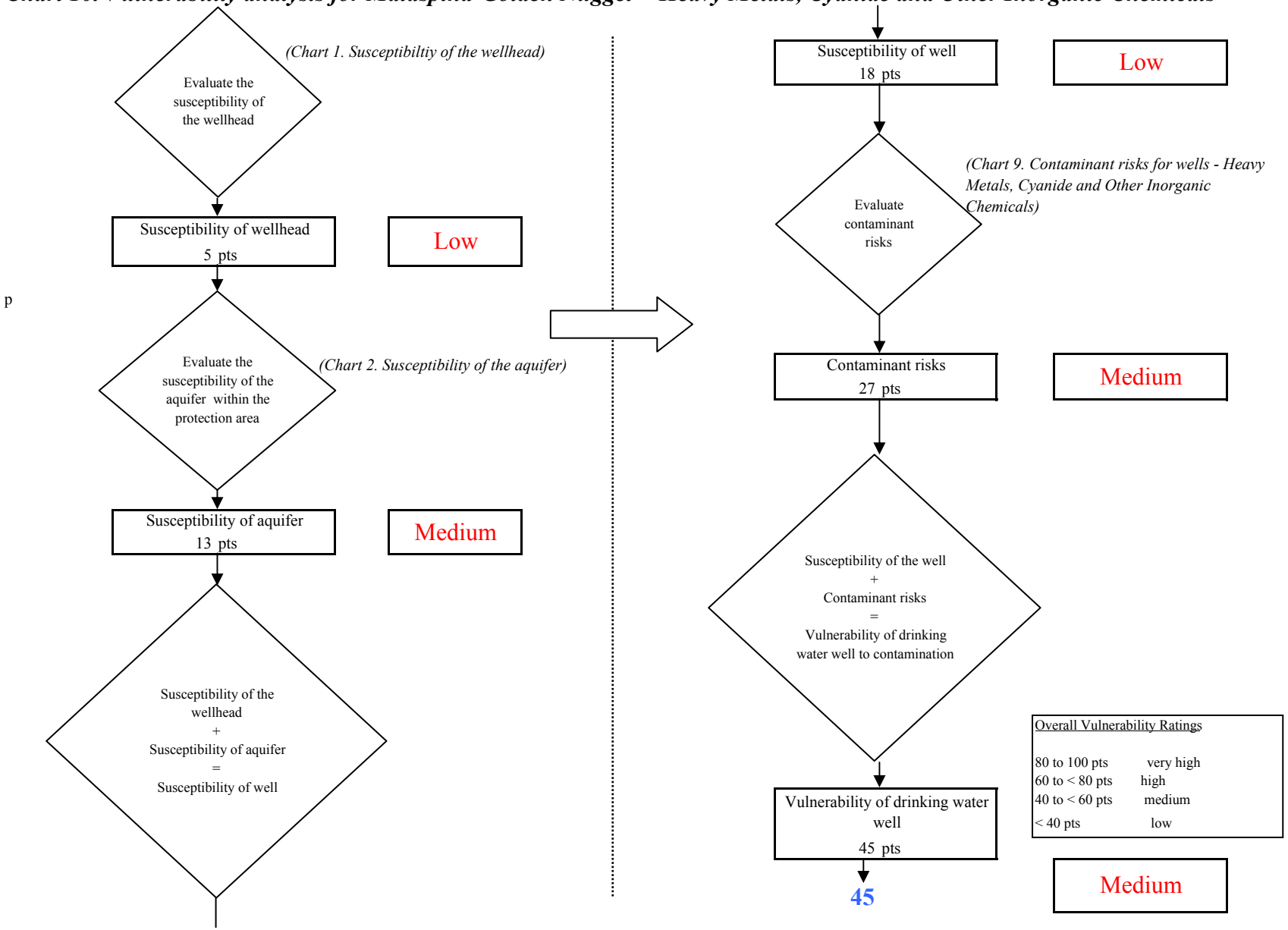


Chart 11. Contaminant risks for Malaspina-Golden Nugget - Synthetic Organic Chemicals

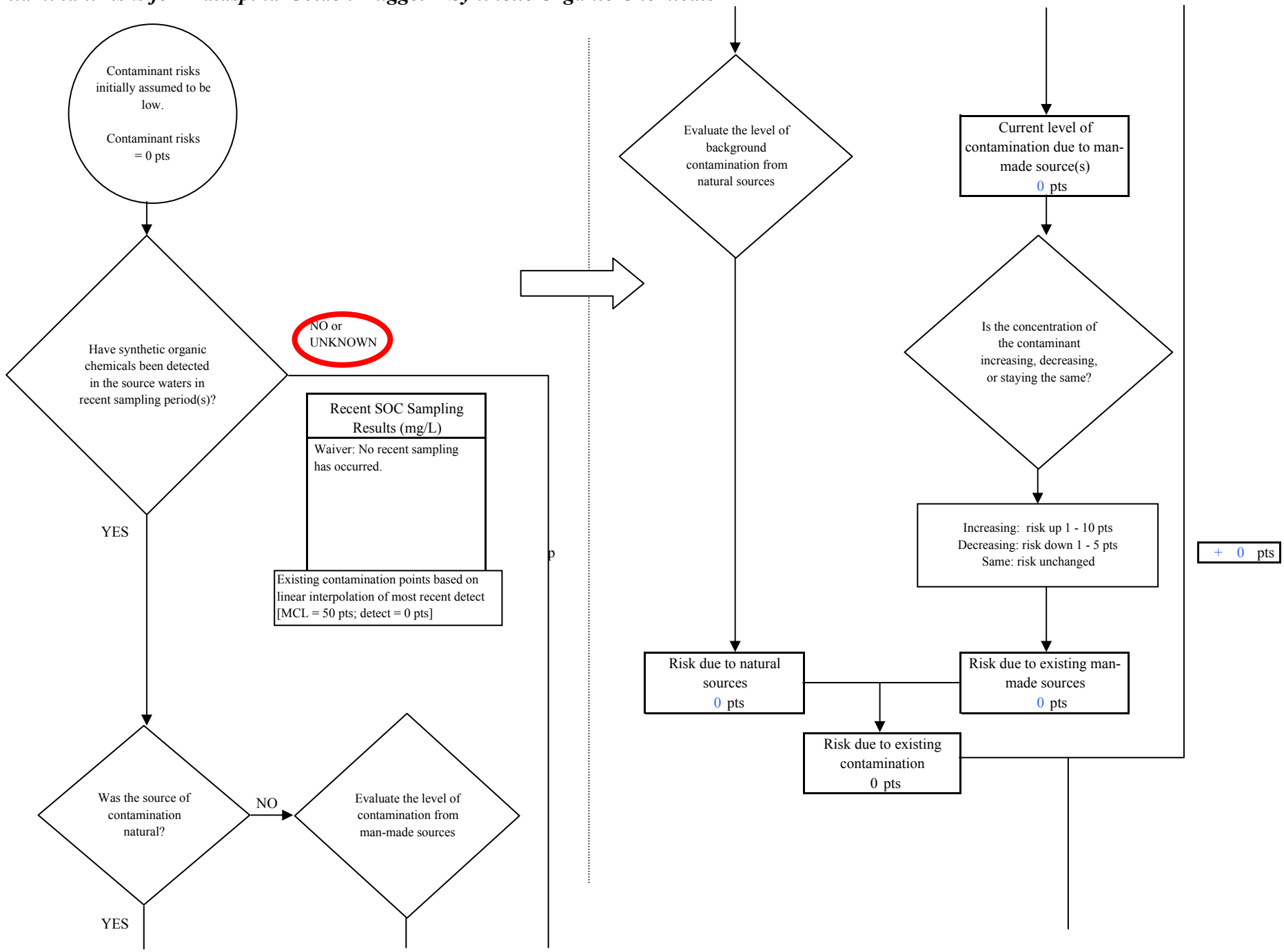


Chart 11. Contaminant risks for Malaspina-Golden Nugget - Synthetic Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	2	2
Medium(s)	0	0	0
Low(s)	3	1	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 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

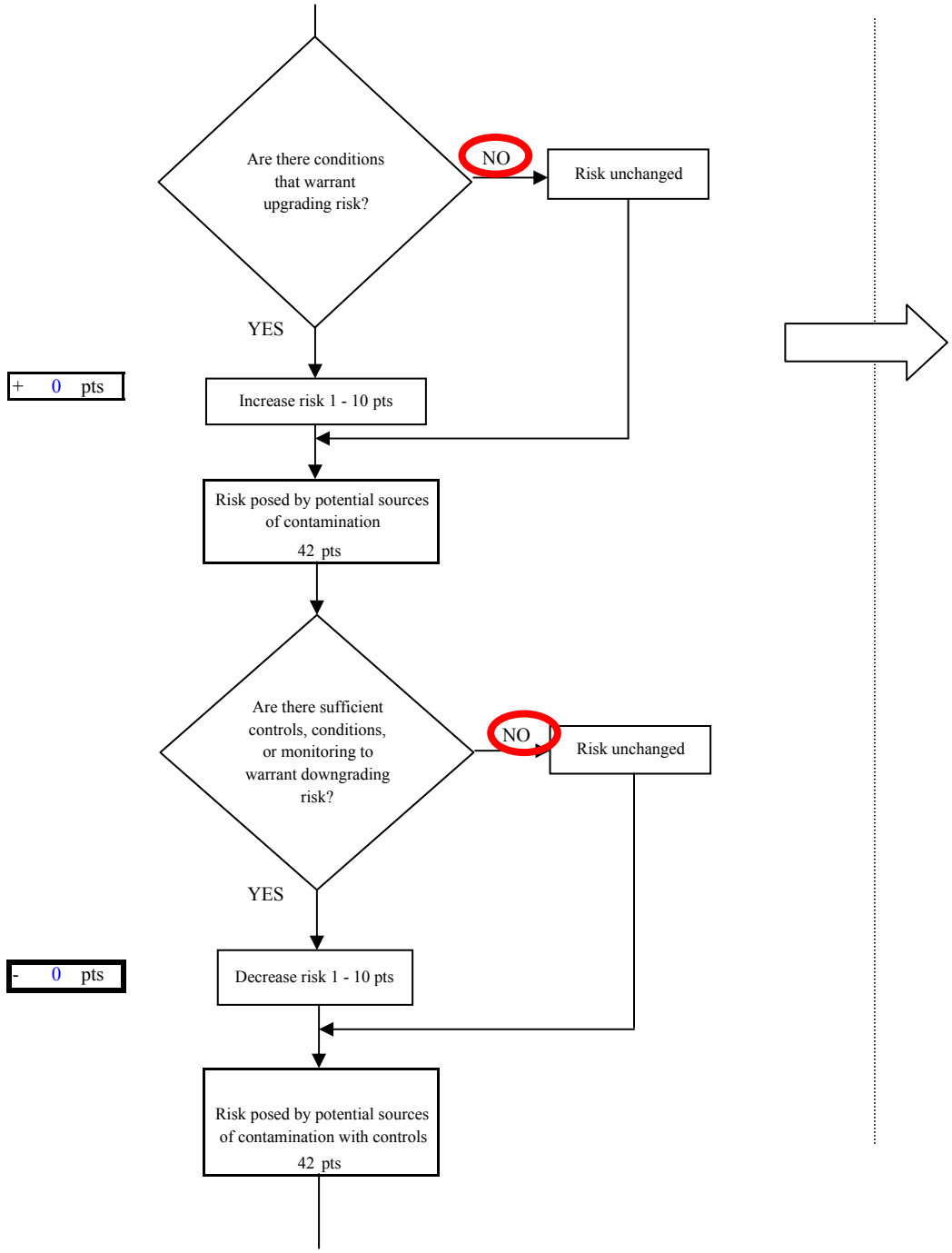
Sewer lines and residential areas

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 11. Contaminant risks for Malaspina-Golden Nugget - Synthetic Organic Chemicals



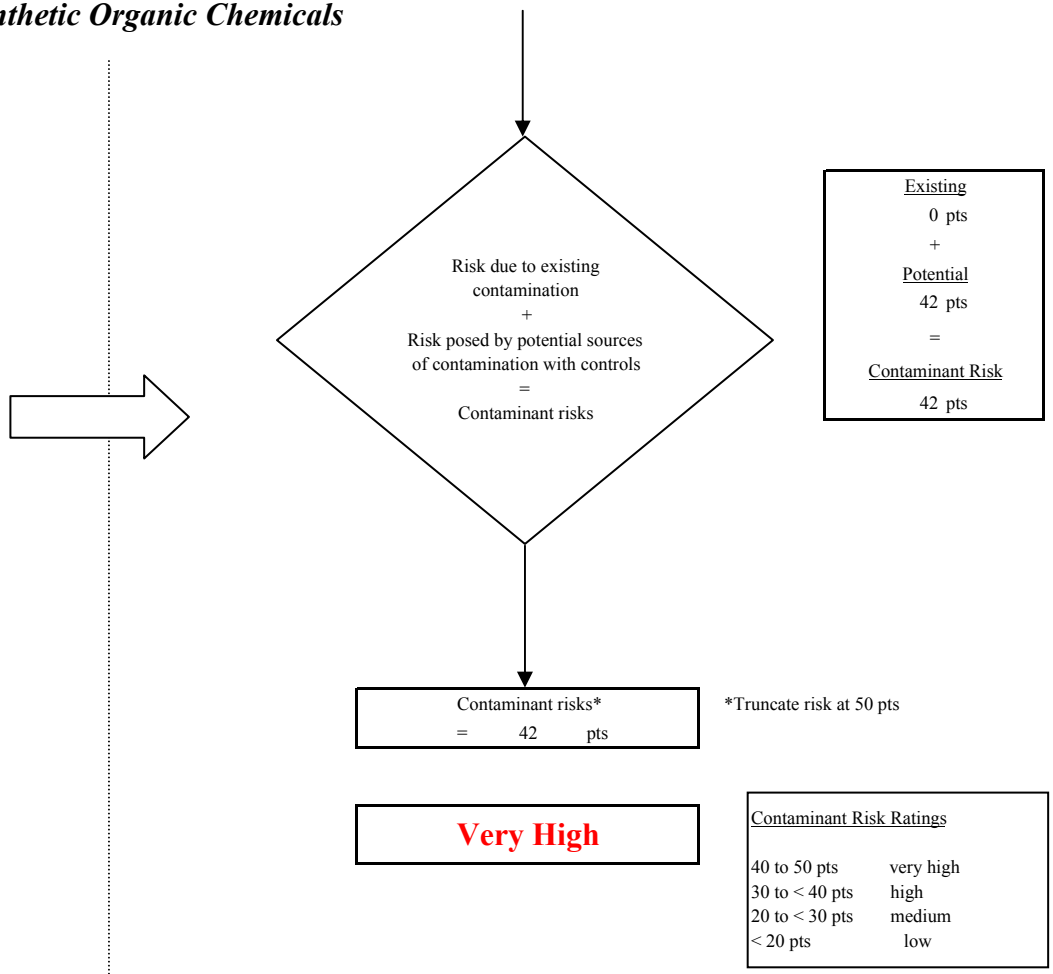


Chart 12. Vulnerability analysis for Malaspina-Golden Nugget - Synthetic Organic Chemicals

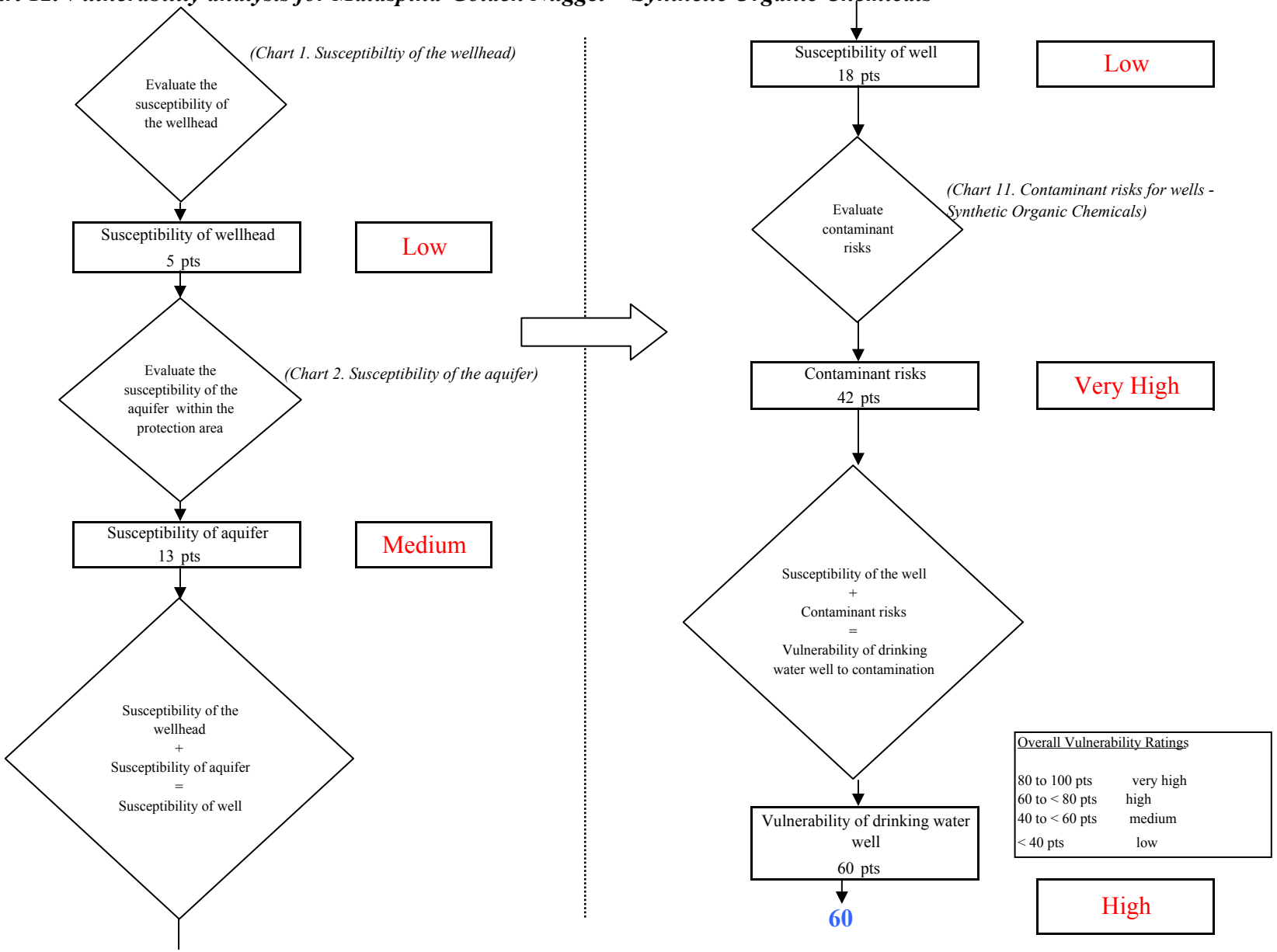


Chart 13. Contaminant risks for Malaspina-Golden Nugget - Other Organic Chemicals

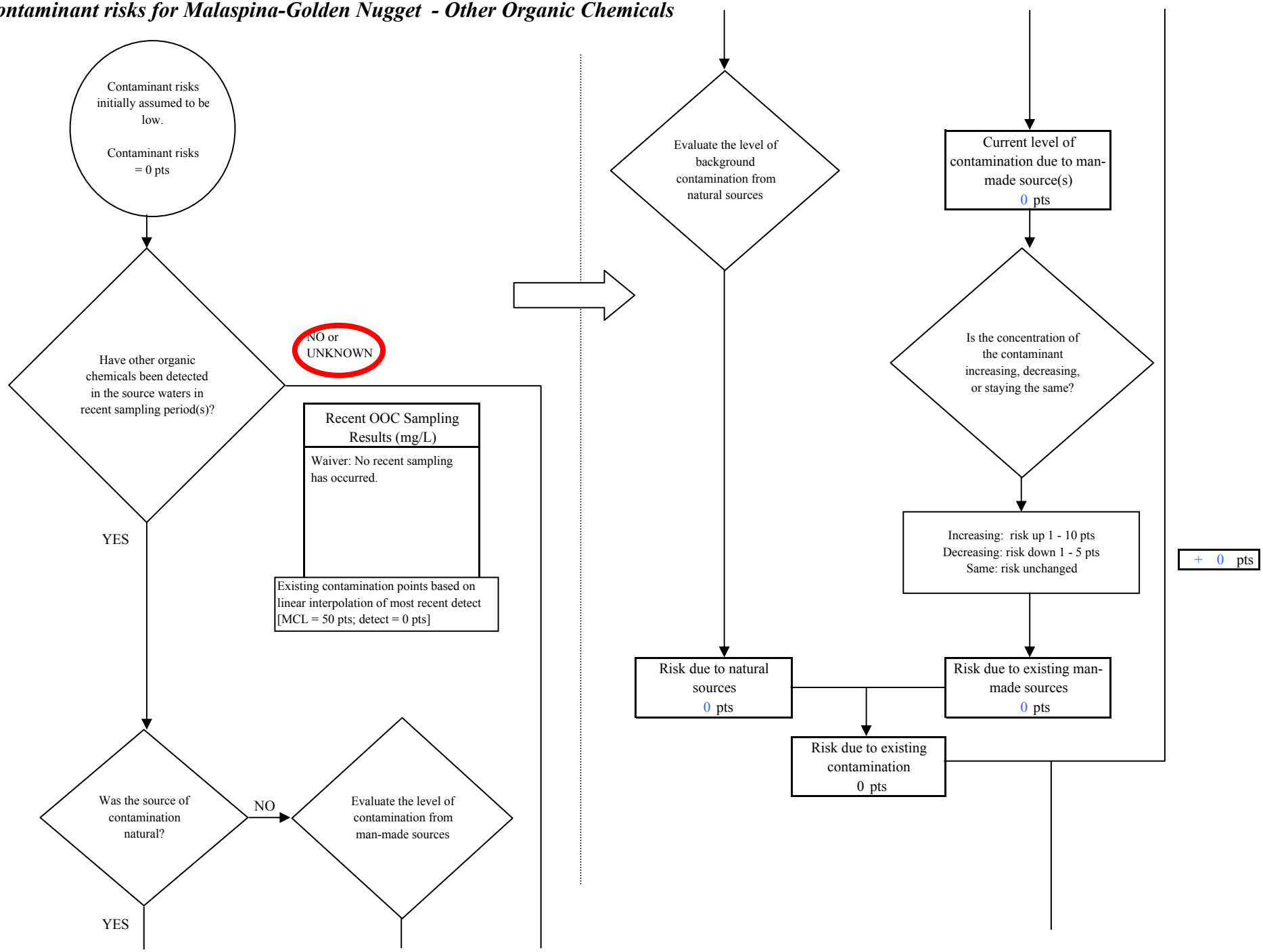


Chart 13. Contaminant risks for Malaspina-Golden Nugget - Other Organic Chemicals

+ 25 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	1	1
Low(s)	4	6	10

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

Matrix Score 25

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 = 25 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

sewer lines and commercial stores

+ 2 pts

Chart 13. Contaminant risks for Malaspina-Golden Nugget - Other Organic Chemicals

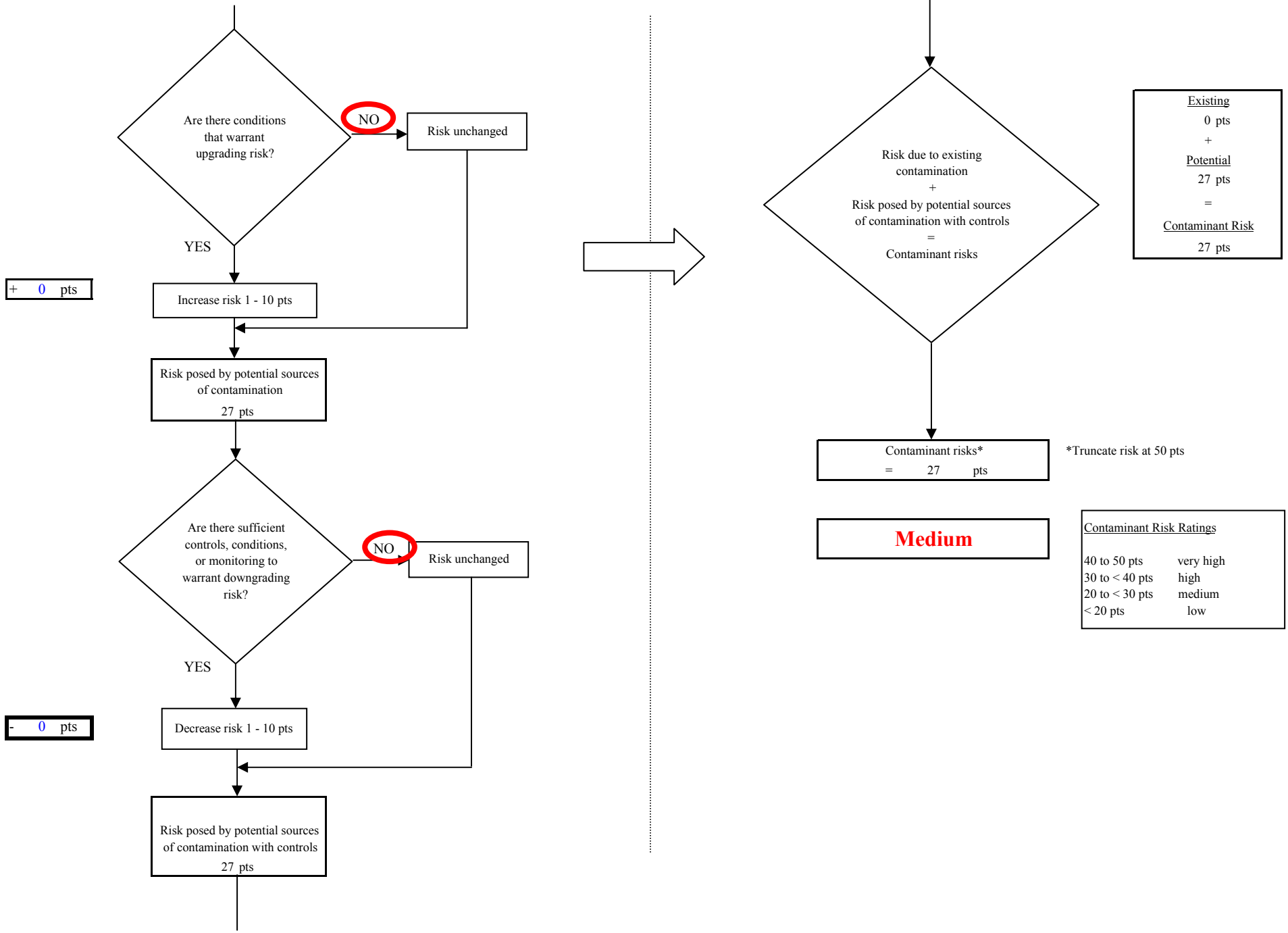


Chart 14. Vulnerability analysis for Malaspina-Golden Nugget - Other Organic Chemicals