

FINAL VERSION
SITE HAZARD ASSESSMENT
WORKSHEET 1
Summary Score Sheet

SITE INFORMATION:

Spokane Mine
Wannacut Lake
Okanogan County, WA 98855

Section/Township/Range: S10 – T39N – R26E
Latitude: 48.89437
Longitude: -119.53789

Ecology Facility Site ID No.: 2210257

Site scored/ranked for the February, 2012 update: January, 2012

SITE DESCRIPTION (management areas, substances of concern, and quantities):

This site is an abandoned gold, silver, lead, copper, and molybdenum mine, located on privately owned land northwest of Wannacut Lake in Okanogan County. Remains of a mill building and several other structures are still visible on the site, as well as a significant quantity of tailings. Several adits and a waste rock pile are also present.

Michael Hucton, from the Okanogan County Health District, first visited this site on September 7th, 1995. A single soil sample was collected from the tailings area near the mill, with the results given below. A water sample was also collected from adit drainage, with the results also summarized in the table below.

1995 Sampling Results

Analyte	Surface Water Concentrations (ug/l)	Cleanup Level (ug/l)	Tailings Concentrations (mg/kg)	Cleanup Level (mg/kg)
Arsenic	7.4	5.0	5.87	20
Cadmium	<1.7	5.0	30.4	2.0
Chromium	<4.7	50.0	<0.1	2000
Lead	<0.5	15.0	477	250
Mercury	<0.3	2.0	0.113	2.0
Selenium	<6.0	--	<1.88	--
Silver	<4.7	--	1.43	--
Copper	<20.0	--	139	--
Zinc	<20.0	--	532	--
Nickel	20.6	--	<0.268	--
Antimony	<5.0	--	<1.88	--
Beryllium	<0.2	--	2.77	--

Cleanup level values reflect Model Toxics Control Act (MTCA) Method A Cleanup Levels for Ground Water and Method A Soil Cleanup Levels for Unrestricted Land Uses.

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On August 24th, 2011, the site was revisited by Douglas Hale, of Okanogan County Public Health, along with Gerald Goad, property owner. All of the apparent physical features related to the mine and mill workings were mapped with GPS, and photos were taken. One water sample and seven soil samples were collected, and the results were as follows:

2011 Sampling Results

Analyte	SM001 Water (ug/L)	Cleanup Level (ug/L)	SM002 (mg/kg)	SM003 (mg/kg)	Cleanup Level (mg/kg)
Arsenic	<2	5.0	11.65	17.50	20
Barium	16	--	142	91.0	--
Cadmium	3.4	5.0	13.1	10.6	2.0
Chromium	<4.7	50.0	0.88	0.93	2000
Lead	<0.5	15.0	710	590	250
Mercury	<0.3	2.0	0.7174	0.3601	2.0
Selenium	<5	--	<2.5	<2.5	--
Silver	<4.7	--	0.93	1.43	--

Analyte	SM004 Background (mg/kg)	SM005 (mg/kg)	SM006 (mg/kg)	SM007 (mg/kg)	SM008 Background (mg/kg)	Cleanup Level (mg/kg)
Arsenic	5.8	8.7	25.85	15.8	12.50	20
Barium	217	84.0	41.6	64.0	171	--
Cadmium	2.02	11.0	5.10	1.92	1.64	2.0
Chromium	15.3	0.54	1.16	0.97	24.6	2000
Lead	19.8	396	136	118	11.6	250
Mercury	0.0196	0.7050	0.0844	0.1209	<0.015	2.0
Selenium	<2.5	<2.5	<2.5	<2.5	<2.5	--
Silver	<0.25	1.04	<0.25	1.11	<0.25	--

Cleanup level values reflect Model Toxics Control Act (MTCA) Method A Cleanup Levels for Ground Water and Method A Soil Cleanup Levels for Unrestricted Land Uses.

Three main adits sit in close proximity to each other, comprising the primary workings of the site. Most of the waste rock was generated from these openings, at least one of which had standing water in it at the time of inspection. On the slope above the adits, a vertical shaft extends down, presumably tying in with the adits, and is surrounded by an associated waste rock pile. Immediately to the north, another adit and smaller waste rock pile was observed, and in the northeast corner of the property, a fifth adit identified by Mr. Goad as the Crescent Mine was located. This adit also had a small waste rock deposit on the slope below it, as well as standing water in the portal.

A powder magazine with a concrete bulkhead and steel door is located immediate south of the main adits, and a small dry reservoir (approximately 25' x 40') lies downslope to the east. Ruins of the mill building are still visible on site, and below the mill and running to the south is an extensive area of mill tailings (perhaps 220' x 60'), much of which is grown over with brush and second growth timber. Both the mill and the tailings are located on a separate tax parcel from the adits and waste rock piles.

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Main adit and location of water sample SM001.



Concrete and steel door of the old powder magazine.



Vertical ventilation shaft and its associated waste rock pile.



One of the sample locations along the main waste rock pile.

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View of tailings deposit below mill site.



Small reservoir area, with a concrete wall across a low notch in the bedrock formation.

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SPECIAL CONSIDERATIONS (include limitations in site file data or data which cannot be accommodated in the model, but which are important in evaluating the risk associated with the site, or any other factor(s) over-riding a decision of no further action for the site):

Because this site is partially on federally managed lands, the site ranks a 2 when scored in the Air Route as an uncovered waste pile. Since the mill tailings have heavy vegetation covering the site (brush and grasses around the perimeter, and dense second-growth conifer timber throughout), the site was re-scored as a partially covered waste pile. This dropped the Air/Environmental Score from 30.9 to 25.5, reducing the overall rank to 4.

ROUTE SCORES:

Surface Water/Human Health: 7.8
Air/Human Health: 4.3
Groundwater/Human Health: 21.7

Surface Water/Environmental.: 13.1
Air/Environmental: 25.5

OVERALL RANK: 4

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WORKSHEET 2
Route Documentation

1. **SURFACE WATER ROUTE**

- a. List those substances to be considered for scoring: Source: 1,2
Arsenic, cadmium, lead.
- b. Explain basis for choice of substance(s) to be used in scoring.
Soil sample analysis shows arsenic, cadmium, and lead contamination of on-site soils in excess of MTCA Method A Cleanup Levels for Unrestricted Land Use.
- c. List those management units to be considered for scoring: Source 1,2
Contaminated on-site soils.
- d. Explain basis for choice of unit to be used in scoring:
Analytical confirmation of these contaminants in on-site soils.

2. **AIR ROUTE**

- a. List those substances to be considered for scoring: Source: 1,2
Arsenic, cadmium, lead.
- b. Explain basis for choice of substance(s) to be used in scoring:
Soil sample analysis shows arsenic, cadmium, and lead contamination of on-site soils in excess of MTCA Method A Cleanup Levels for Unrestricted Land Use.
- c. List those management units to be considered for scoring: Source: 1,2
Contaminated on-site soils.
- d. Explain basis for choice of unit to be used in scoring:
Analytical confirmation of these contaminants in on-site soils.

3. **GROUNDWATER ROUTE**

- a. List those substances to be considered for scoring: Source: 1,2
Arsenic, cadmium, lead.
- b. Explain basis for choice of substance(s) to be used in scoring:
Soil sample analysis shows arsenic, cadmium, and lead contamination of on-site soils in excess of MTCA Method A Cleanup Levels for Unrestricted Land Use.
- c. List those management units to be considered for scoring: Source: 1,2
Contaminated on-site soils.
- d. Explain basis for choice of unit to be used in scoring:
Analytical confirmation of these contaminants in on-site soils.

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WORKSHEET 4

Surface Water Route

1.0 SUBSTANCE CHARACTERISTICS

1.1 Human Toxicity										
Substance		Drinking Water Standard (µg/L)	Value	Acute Toxicity (mg/kg-bw)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value
								WOE	PF*	
1	Arsenic	10	8	763 (rat)	5	0.001	3	1	1.75	7
2	Cadmium	5	8	225 (rat)	5	0.0005	5	0.8	ND	--
3	Lead	5	8	ND	--	<0.001 NOAEL	10	0.8	ND	--

*Potency Factor

Source: 1, 2, 5

Highest Value: 10

(Max = 10)

Plus 2 Bonus Points? 2

Final Toxicity Value: 12

(Max = 12)

1.2 Environmental Toxicity					
Substance			Acute Water Quality Criteria		Non-Human Mammalian Acute Toxicity
			(µg/L)	Value	(mg/kg) Value
1	Arsenic		360	4	NS --
2	Cadmium		3.9	8	NS --
3	Lead		82	6	NS --

Source: 1, 2, 5

Highest Value: 8

(Max = 10)

1.3 Substance Quantity	
Explain Basis: Tailings and waste rock surface area was measured by GIS, depth estimated on site. 4,168 s.f. x 6' = 25,008 c.f./27 = 926.2 c.y. (waste rock at shaft) 1,590 s.f. x 3' = 4,770 c.f./27 = 176.7 c.y. (waste rock at single adit) 12,442 s.f. x 4' = 49,768 c.f./27 = 1843.3 c.y. (main waste rock) 11,085 s.f. x 2' = 22,170 c.f./27 = 821.1 c.y. (tailings) 3,126 s.f. x 1' = 3,126 c.f./27 = 115.8 (Crescent adit) Total volume estimated at 3,883 cu. yds.	Source: <u>1, 6, 11, 15</u> Value: 8 (Max = 10)

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2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment: Management unit scored as a spills/discharges/contaminated soil at the surface, with ineffectively maintained run-on/runoff controls (vegetated buffer). Explain basis: Surrounding vegetation provides an un-maintained barrier to runoff.	<u>1, 6, 15</u>	<u>4</u> (Max = 10)
2.2	Surface Soil Permeability: Sands/gravels/gravelly sandy loam	<u>1, 3, 6</u>	<u>1</u> (Max = 7)
2.3	Total Annual Precipitation: 11.6 inches (based on Oroville station)	<u>6, 7</u>	<u>1</u> (Max = 5)
2.4	Max 2yr/24hr Precipitation: 1.09 in	<u>6, 14</u>	<u>2</u> (Max = 5)
2.5	Flood Plain: Not in a flood plain	<u>8, 11</u>	<u>0</u> (Max = 2)
2.6	Terrain Slope: $160' / 362' \times 100 = 44.2\%$	<u>11</u>	<u>5</u> (Max = 5)

3.0 TARGETS

		Source	Value
3.1	Overland Distance to Down-Gradient Surface Water: ~5,900 ft. to Wannacut Lk.	<u>11</u>	<u>2</u> (Max = 10)
3.2	Population Served within 2 miles (see WARM Scoring Manual Regarding Direction): $\sqrt{0} = 0$	<u>11</u>	<u>0</u> (Max = 75)
3.3	Area Irrigated by surface water within 2 miles downstream: $0.75 \times \sqrt{\text{acres}} = 0$	<u>9</u>	<u>0</u> (Max = 30)
3.4	Distance to Nearest Down-Gradient Fishery Resource: ~5,900 ft. to Wannacut Lk.	<u>10, 11</u>	<u>3</u> (Max = 12)
3.5	Distance to, and Name(s) of, Nearest Down-Gradient Sensitive Environment(s): ~2,700 ft. to wetlands associated with Wannacut Lk.	<u>10, 11</u>	<u>6</u> (Max = 12)

4.0 RELEASE

Explain Basis: No apparent release.	Source: <u>1, 6, 15</u> Value: 0 (Max = 5)
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WORKSHEET 5

Air Route

1.0 SUBSTANCE CHARACTERISTICS

1.1 Introduction – Review WARM Scoring Manual before scoring

1.2 Human Toxicity										
Substance		Amb. Air Standard (µg/m ³)	Value	Acute Toxicity (mg/ m ³)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value
								WOE	PF*	
1	Arsenic	0.00023	10	ND	--	ND	--	1	50	9
2	Cadmium	0.00056	10	25 (rat)	10	ND	--	0.8	6.1	7
3	Lead	0.5	10	ND	--	ND	--	0.8	ND	--

* Potency Factor

Source: 1, 2, 5

Highest Value: 10

(Max = 10)

Plus 2 Bonus Points? 2

Final Toxicity Value: 12

(Max = 12)

1.3 Mobility (Use numbers to refer to above listed substances)				
1.3.1 Gaseous Mobility		1.3.2 Particulate Mobility		
Vapor Pressure(s) (mmHg)		Soil Type	Erodibility	Climatic Factor
1		Sandy loam	86	1 - 10

Source: NA

Value: NS

(Max = 4)

Source: 3,6

Value: 1

(Max = 4)

1.4 Highest Human Health Toxicity/ Mobility Matrix Value (from Table A-7)

Final Matrix Value: 6

(Max = 24)

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1.5 Environmental Toxicity/Mobility						
Substance		Non-human Mammalian Inhalation Toxicity (mg/m ³)	Acute Value	Mobility (mmHg)	Value	Matrix Value
1	Arsenic	ND	--	ND	--	--
2	Cadmium	25 (rat)	10	(particulate)	1	5
3	Lead	ND	--	ND	--	--

Highest Environmental Toxicity/Mobility Matrix Value (from Table A-7)

Final Matrix Value: 5
(Max = 24)

1.6 Substance Quantity	
Explain Basis: Estimated extent of surface soil contamination = approx. 32,411 sq. ft.	Source: <u>1, 6, 11, 15</u> Value: 6 (Max = 10)

2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment: Waste pile outdoors, and partially covered. (Tailings are covered by heavy brush, scattered forbs, and second-growth timber, creating a partial covering and limiting ability of tailings to become airborne.)	<u>1, 6, 15</u>	8 (Max = 10)

3.0 TARGETS

		Source	Value
3.1	Nearest Population: Approximately 550 ft. to Goad residence (seasonal cabin).	<u>1, 6, 11</u>	10 (Max = 10)
3.2	Distance to [and name(s) of] nearest sensitive environment(s) [fisheries excluded]: Site is located within 500 ft. of federally managed game land (BLM land) .	<u>6, 11</u>	7 (Max = 7)
3.3	Population within 0.5 miles: $\sqrt{\text{pop.}} = 3 \text{ homes} \times 3 \text{ residents} = 9$. $\sqrt{9} = 3$	<u>6, 11</u>	3 (Max = 75)

4.0 RELEASE

Explain Basis for scoring a release to air: None documented	Source: <u>6</u> Value: 0 (Max = 5)
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WORKSHEET 6
Groundwater Route

1.0 SUBSTANCE CHARACTERISTICS

1.2 Human Toxicity										
Substance		Drinking Water Standard (µg/L)	Value	Acute Toxicity (mg/ kg-bw)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value
								WOE	PF*	
1	Arsenic	10	8	763 (rat)	5	0.001	3	1	1.75	7
2	Cadmium	5	8	225 (rat)	5	0.0005	5	0.8	ND	--
3	Lead	5	8	ND	--	<0.001 NOAEL	10	0.8	ND	--

* Potency Factor

Source: 1, 2, 5

Highest Value: 10

(Max = 10)

Plus 2 Bonus Points? 2

Final Toxicity Value: 12

(Max = 12)

1.2 Mobility (use numbers to refer to above listed substances)										
Cations/Anions [Coefficient of Aqueous Migration (K)]					OR Solubility (mg/L)					
1	Arsenic >1.0 = 3									
2	Cadmium >1.0 = 3									
3	Lead 0.1 – 1.0 = 2									

Source: 5, 6

Value: 3

(Max = 3)

1.3 Substance Quantity:										
Explain basis: Approximately 3,883 cu. yds.								Source: <u>1, 6, 15</u>		
								Value: <u>4</u>		
								(Max=10)		

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2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment (explain basis): Waste pile with no liner, no cover, and unmaintained vegetation acting as runoff control ($3 + 2 + 2 + 1 = 8$).	<u>1, 6, 15</u>	<u>8</u> (Max = 10)
2.2	Net precipitation: $6.4'' - 3.0'' = 3.4''$	<u>7</u>	<u>1</u> (Max = 5)
2.3	Subsurface hydraulic conductivity: Sands/gravels/gravelly sandy loam	<u>1, 3, 15</u>	<u>4</u> (Max = 4)
2.4	Vertical depth to groundwater: Nearest well is 178' to ground water.	<u>3, 6</u>	<u>3</u> (Max = 8)

3.0 TARGETS

		Source	Value
3.1	Groundwater usage: Private supply, no alternates available	<u>1, 9, 13</u>	<u>5</u> (Max = 10)
3.2	Distance to nearest drinking water well: ~1,250 ft.	<u>4, 6, 11</u>	<u>4</u> (Max = 5)
3.3	Population served within 2 miles: $\sqrt{\text{pop.}} = 26 \text{ homes} \times 3 \text{ residents} = 81$; $\sqrt{78} = 8.81$	<u>6, 11</u>	<u>9</u> (Max = 100)
3.4	Area irrigated by wells within 2 miles: $0.75 \times \sqrt{\text{acres}} = 0.75 \times \sqrt{85} = 6.91$	<u>4, 6, 9</u>	<u>7</u> (Max = 50)

4.0 RELEASE

		Source	Value
	Explain basis for scoring a release to groundwater: None documented	<u>6</u>	<u>0</u> (Max = 5)

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SOURCES USED IN SCORING

1. Initial Investigation site visit by Michael Huchton, September 7th, 1995.
2. Soil and water sample analysis reports by Cascade Analytical.
3. Soil log(s) on file at Okanogan County Health District.
4. Water Well Reports on file at Okanogan County Health District and/or Washington Department of Ecology.
5. Washington Department of Ecology, Toxicology Database for Use in Washington Ranking Method Scoring, January 1992.
6. Washington Department of Ecology, WARM Scoring Manual, April 1992.
7. See attached table identified as Reference 7.
8. Flood Insurance Rate Maps (FIRM).
9. Ecology Water Rights Information System (WRIS).
10. Washington Department of Fish & Wildlife StreamNet database.
11. GIS data layers provided by Okanogan County Planning Department, composite map is attached as Reference 11.
12. US Census 2010 data.
13. SENTRY Public Water system data from Washington Department of Health.
14. NOAA Atlas II Precipitation Frequency Data Output, site specific estimate.
15. Follow-up visit by Douglas Hale, August 24th, 2011.