APPENDIX C

RISK-BASED CLEANUP LEVEL GOALS USING LEADSPREAD MODEL; POTENTIAL COC SCREENING MATRIX

RISK-BASED CLEANUP LEVEL GOALS USING LEADSPREAD MODEL

APPENDIX C

RISK-BASED CLEANUP LEVEL GOALS USING LEADSPREAD

This appendix evaluates risk-based soil cleanup level goals applicable to the Upper Blackfoot Mining Complex EE/CA using a model developed by the California Department of Toxic Substance Control (DTSC). The DTSC model, referred to as LeadSpread[1], provides an alternative approach from DEQ guidance (Tetra Tech, 1996) for evaluating exposure and the potential for adverse health effects resulting from exposure to lead in the environment. Whereas the DEQ guidance uses a reference dose to quantify lead toxicity, LeadSpread uses a blood-lead level of concern to quantify toxic levels of potential concern. The EPA (1994) recommends that soil concentrations not exceed a level such that a typical child would have greater than 5 percent chance of exceeding 10 µg of lead per deciliter (dL) of blood.

LeadSpread is a tool for estimating blood lead concentrations resulting from exposure to lead via dietary intake, drinking water, soil and dust ingestion, inhalation, and dermal contact. Each of these pathways is represented by an equation relating incremental blood lead increase to a concentration in an environmental medium, using contact rates and empirically determined ratios. The contributions via the five pathways are added to arrive at an estimate of median blood lead concentration resulting from the multi-pathway exposure. Upper ninetieth, ninety-fifth, ninety-eighth, and ninety-ninth percentile blood-lead concentrations are estimated from the median by assuming a log-normal distribution of blood-lead concentrations in the target population and a geometric standard deviation (GSD) of 1.6.

The approach used to assess risk in the EE/CA is to compare site concentrations to levels of potential concern. To remain consistent with this approach, the LeadSpread model output of greatest relevance is the soil concentration that is protective of no more than a 5 percent chance of exceeding 10 µg/dL blood-lead concentration. This value is provided in the PRG-95 column of the Output part of the spreadsheet (see Tables C- 1 and C- 2).

Adjustments to the LeadSpread exposure parameters were needed to determine the PRG-95 values applicable to the exposure conditions used in Section 4 of the EE/CA. The following exposure parameters were modified in Tables C-1 and C-2 to reflect the ATV User/Motorcycle Rider and Gold Panner/Rock Hound exposure scenarios in a manner consistent with that defined in Section 4 of the EE/CA:

- Days per week
- Skin area
- Soil adherence
- Dermal uptake constant
- Breathing rate

[1] LeadSpread 7,the latest version of the DTSC Lead Risk Assessment Spreadsheet, was used. It is available as a Microsoft Excel® spreadsheet tool at http://www.dtsc.ca.gov/AssessingRisk/leadspread.cfm.

The dermal uptake constant is a calculated value. This value determines how much of the lead which comes into contact with a person's skin is absorbed into the body. The approach used is fundamentally different from that used in DEQ guidance. Accordingly, no changes were made to this equation nor to the bioavailability factor. Also, no changes were made to exposure parameters that are not otherwise addressed in DEQ guidance.

Table C-1 addresses the ATV User/Motorcycle Rider exposure scenario for the Blackfoot River Drainage Bottom area. The Input value used for Lead in Soil/Dust is the arithmetic average soil concentration for the Blackfoot River Drainage Bottom area. The Respirable Dust level was determined using DEQ guidance (Tetra Tech, 1996). This approach is consistent with the EE/CA objective to conduct a screening level risk assessment. Moreover, a more detailed, site-specific evaluation of the air pathway is not necessary because the predicted blood-lead levels are well below levels of potential concern and because the inhalation pathway contributes a small percentage of the overall contribution (see the column under Pathways, Pathway contribution, percent in Table C-1 for example). The % Home-grown Produce value was set at zero, since produce gardens are not relevant to the site. The Lead in Air input is the default model value, which is the highest monthly average value observed at any California monitoring site in 1997 and is thought to be a conservative (i.e., high) value for Montana. The Lead in Water input value is set at the action level established under the federal Safe Drinking Water Act, and is therefore the highest value that most people would be expected to be exposed to in drinking water.

Importantly, the only outputs in Table C-1 that are relevant to this assessment are the Occupation values (see Output, BloodPb, Occupation row in Table C-1), which reflect the ATV/Motorcycle scenario as previously described. To help minimize misinterpretation on this issue, the Days per week for Adult and Children is set to zero and "NA" was placed in output cells to indicate they are not applicable. Under the exposure assumptions used, the PRG-95 soil lead concentration in Table C-1 is 15,866 mg/kg. This is the concentration that would ensure that no more than 5 percent of the exposure individuals would have a blood lead level of 10 ug/dL. This value is substantially greater than the value of 3,935 mg/kg used in Table 4-2 of the EE/CA as a human health screening level value.

The PRG-95 soil lead calculation is independent of the soil concentration that is input into the model. Therefore, it provides a risk-based screening level value that can be used to assess all of the exposure areas identified in the EE/CA (Lower Mike Horse Creek, Beartrap Creek, the Upper Blackfoot River, and the Mike Horse Tailings Impoundment). The arithmetic average soil concentrations range from 503 mg/kg to 6,779 mg/kg. These results indicate that lead is not a concern to human health at these sites.

Table C-2 addresses the Gold Panner/Rock Hound exposure scenario. The input values used represent the arithmetic average soil concentration for the Lower Mike Horse area, which is the area identified in the EE/CA where rock hounding is most likely to occur. The approach used to calculate the PRG-95 is consistent with that described above for Table C-1. One difference is that the output for children is potentially applicable for this scenario. DEQ guidance (Tetra Tech, 1996) uses an age-adjusted exposure scenario for the gold panner/rock hound. The approach determines the average level of exposure over a period of time that

includes both children aged 1 to 6 years as well as adults over the age of 18. LeadSpread does not easily support an age adjusted calculation. Therefore, the results for both the occupational and the child scenario are presented. The Pica Child refers to a small percentage of children that have a tendency to ingest handfuls of dirt. The PRG-95 value of 10,829 mg/kg for the adult rock hound is substantially greater than the human health screening level value of 2,200 mg/kg used in Table 4-4 of the EE/CA. The PRG-95 value of 6,310 mg/kg for the child rock hound is also substantially greater than the human health screening level value of 2,200 mg/kg provided in Table 4-4 of the EE/CA. However, The PRG-95 value of 6,310 mg/kg for the child rock hound is less than the average soil lead concentration in the Lower Mike Horse area of 6,779 mg/kg, indicating that greater than 5 percent of the exposed children may have blood-lead concentrations greater than 10 ug/dL.

When interpreting the table results, it should be recognized that the LeadSpread approach assumes a near steady-state relationship between the lead concentration in the soil (and other environmental media that may cause exposure) and the lead concentration in a person's blood. LeadSpread was developed principally to evaluate relatively consistent exposures that typify most residential and occupation scenarios, where exposure occurs nearly every day. Exposure to relatively high lead concentrations over a short duration and at infrequent intervals, as is the case for the Upper Blackfoot site, will not result in steady-state blood-lead concentrations. Lead will be released from the body over time. Therefore, the kinds of toxic effects which are based on chronic exposure and which serve as the basis for EPA's recommended safe blood-lead level may not be well predicted by the model. For this reason, LeadSpread results should be interpreted as very conservative estimates of the potential for adverse health effects as a result of exposure. Unfortunately, models more applicable to exposure conditions at the Upper Blackfoot site are not available.

REFERENCES

EPA, 1994. *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*, Memorandum to Regional Administrators 1 - 10, OSWER Directive 9355.4-12, 1994.

Tetra Tech, Inc. (Tetra Tech), 1996. *Risk-Based Guidelines for Abandoned Mine Sites*, Final Report, Submitted to the State of Montana, Department of Environmental Quality, Abandoned Mine Reclamation Bureau, February.

TABLE C-1. LEADSPREAD MODEL INPUTS AND OUTPUTS FOR THE ATV USER/MOTORCYCLE RIDER[1]

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	2882.0
Lead in Water (ug/l)	15
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	760

OUTPUT	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	NA	NA	NA	NA	NA	NA	NA
BLOOD Pb, CHILD	NA	NA	NA	NA	NA	NA	NA
BLOOD Pb, PICA CHILD	NA	NA	NA	NA	NA	NA	NA
BLOOD Pb, OCCUPATIONA	1.7	3.1	3.7	4.5	5.1	10143	15866

EXPOSURE PARAMETERS	units	adults	children
Days per week	days/wk	0	
Days per week, occupational		0.29	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5800	2900
Skin area occupational	cm^2	5800	
Soil adherence	ug/cm^2	1000	200
Dermal uptake constant	(ug/dl)/(ug/	0.0001	
Soil ingestion	mg/day	240	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	10	6.8
Inhalation constant	(ug/dl)/(ug/	0.08	0.19
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	1296.9	

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PATHWAYS

ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	0.0E+0	0.00	NA	2.3E-5	0.07	4%
Soil Ingestion	0.0E+0	0.00	NA	1.7E-4	0.50	29%
Inhalation, bkgrnd		0.00	NA		0.00	0%
Inhalation	0.0E+0	0.00	NA	2.6E-5	0.07	4%
Water Ingestion		0.84	NA		0.84	49%
Food Ingestion, bkgrnd		0.23	NA		0.23	14%
Food Ingestion	0.0E+0	0.00	NA			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	0.0E+0	0.00	NA		0.00	NA
Soil Ingestion	0.0E+0	0.00	NA	0.0E+0	0.00	NA
Inhalation	0.0E+0	0.00	NA		0.00	NA
Inhalation, bkgrnd		0.00	NA		0.00	NA
Water Ingestion		0.96	NA		0.96	NA
Food Ingestion, bkgrnd		0.54	NA		0.54	NA
Food Ingestion	0.0E+0	0.00	NA		0.00	NA

(1) Lead concentration in soil is the arithmetic average for the Blackfoot River Drainage Bottom. Respirable dust level based on PM10 concentration in DEQ guidance (Tetra Tech, 1996, Table 4-5). Exposure parameters based on DEQ guidance (Tetra Tech, 1996, Table 4-2), where applicable.

TABLE C-2. LEADSPREAD MODEL INPUTS AND OUTPUTS FOR THE GOLD PANNER/ROCK HOUND[1]

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	6779.0
Lead in Water (ug/l)	15
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1

OUTPUT							
	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	3.3	6.0	7.1	8.7	9.9	6922	10829
BLOOD Pb, CHILD	4.9	8.9	10.5	12.8	14.5	3720	6310
BLOOD Pb, PICA CHILD	8.1	14.9	17.6	21.4	24.3	1883	3194
BLOOD Pb, OCCUPATIONA	3.3	6.0	7.1	8.7	9.9	6922	10829

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	0.48	
Days per week, occupational		0.48	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5800	1800
Skin area occupational	cm^2	5800	
Soil adherence	ug/cm^2	1000	1000
Dermal uptake constant	(ug/dl)/(ug/	0.0001	
Soil ingestion	mg/day	240	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	13.3	11.2
Inhalation constant	(ug/dl)/(ug/	0.08	0.19
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	3050.6	

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PATHWAYS						
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	3.8E-5	0.26	8%	3.8E-5	0.26	8%
Soil Ingestion	2.9E-4	1.96	60%	2.9E-4	1.96	60%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Inhalation	7.5E-8	0.00	0%	7.5E-8	0.00	0%
Water Ingestion		0.84	25%		0.84	25%
Food Ingestion, bkgrnd		0.23	7%		0.23	7%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	1.2E-5	0.08	2%		0.08	1%
Soil Ingestion	4.8E-4	3.27	67%	9.7E-4	6.55	80%
Inhalation	1.5E-7	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Water Ingestion		0.96	20%		0.96	12%
Food Ingestion, bkgrnd		0.54	11%		0.54	7%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

(1) Lead concentration in soil is the arithmetic average for the Lower Mike Horse Area. Respirable dust level based on PM_{10} concentration in DEQ guidance (Tetra Tech, 1996, Table 4-4). Exposure parameters based on DEQ guidance (Tetra Tech, 1996, Table 4-2), where applicable.

POTENTIAL COC SCREENING MATRIX

Contaminants of Potential Concern for Soil/Mine Waste and Sediment
UBMC EECA

Lower Mike Horse Creek

		Concentration		Background			
	n	Mean mg/kg	Range mg/kg	MDHES, 1994	PTI, 1994	% Above Detection Limit	COPC yes/no
Al	21	6412	4050-8190	6,980-10,700	9945-23483	100%	No
As	21	246	82-592	8.4-27.2	28-58	100%	yes
Cd	21	65.7	7-283	0.38-0.58	<1.0-21	100%	yes
Cu	21	847	209-2673	5.7-42.7	13-212	100%	yes
Mn	21	3260	531-10305	779-1,010	1281-4653	100%	yes
Pb	21	10022	474-28783	18.1-59.1	105-2643	100%	yes
Zn	21	7776	483-45507	45.9-56.3	158-3435	100%	yes

Tailings Impoundment

		Concentration		Background			
	n	Mean mg/kg	Range mg/kg	MDHES, 1994	PTI, 1994	% Above Detection Limit	COPC yes/no
Al	5	4376	3820-5140	6,980-10,700	9945-23483	100%	No
As	5	278	275-313	8.4-27.2	28-58	100%	Yes
Cd	5	30	19-57	0.38-0.58	<1.0-21	100%	Yes
Cu	5	668	520-815	5.7-42.7	13-212	100%	Yes
Mn	5	7956	2750-10,800	779-1,010	1281-4653	100%	Yes
Pb	5	4492	1600-15,100	18.1-59.1	105-2643	100%	Yes
Zn	5	3,798	2360-7780	45.9-56.3	158-3435	100%	Yes

Dam Face 0 to 6" samples only

	n	Mean mg/kg	Range mg/kg	MDHES, 1994	PTI, 1994	% Above Detection Limit	COPC yes/no
Al	2	4645	3310-5980	6,980-10,700	9945-23483	100%	No
As	2	61.5	32-91	8.4-27.2	28-58	100%	Yes
Cd	2	9.5	<1-18	0.38-0.58	<1.0-21	100%	Yes
Cu	2	166	82-250	5.7-42.7	13-212	100%	Yes
Mn	2	1495	410-2580	779-1,010	1281-4653	100%	Yes
Pb	2	455	290-620	18.1-59.1	105-2643	100%	Yes
Zn	2	1,395	160-2630	45.9-56.3	158-3435	100%	Yes

Beartrap Creek

Concentrated Deposits

		Concentration		Background			
	n	Mean mg/kg	Range mg/kg	MDHES, 1994	PTI, 1994	% Above Detection Limit	COPC yes/no
Al	0	--	--	6,980-10,700	9945-23483	100%	--
As	4	350	266-411	8.4-27.2	28-58	100%	Yes
Cd	4	11	7-12	0.38-0.58	<1.0-21	100%	Yes
Cu	4	747	546-951	5.7-42.7	13-212	100%	Yes
Mn	4	1018	527-1584	779-1,010	1281-4653	100%	No
Pb	4	1870	1746-1992	18.1-59.1	105-2643	100%	Yes
Zn	4	1,933	1131-3125	45.9-56.3	158-3435	100%	Yes

Intermixed Qal/Tailings

Al	0	--	--	6,980-10,700	9945-23483	100%	--
As	15	208	131-242	8.4-27.2	28-58	100%	Yes
Cd	15	23	15-39	0.38-0.58	<1.0-21	100%	Yes
Cu	15	761	487-1153	5.7-42.7	13-212	100%	Yes
Mn	15	1792	777-8565	779-1,010	1281-4653	100%	No
Pb	15	2417	718-7589	18.1-59.1	105-2643	100%	Yes
Zn	15	3,887	1900-7403	45.9-56.3	158-3435	100%	Yes

Blackfoot River

Concentrated Tailings

		Concentration		Background			
	n	Mean mg/kg	Range mg/kg	MDHES, 1994	PTI, 1994	% Above Detection Limit	COPC yes/no
Al	0	--	--	6,980-10,700	9945-23483	100%	--
As	8	190	81-313	8.4-27.2	28-58	100%	Yes
Cd	8	<10	<10-<10	0.38-0.58	<1.0-21	100%	No
Cu	8	374	133-543	5.7-42.7	13-212	100%	Yes
Mn	8	1486	400-3530	779-1,010	1281-4653	100%	No
Pb	8	1960	1273-2739	18.1-59.1	105-2643	100%	Yes
Zn	8	1,047	439-1927	45.9-56.3	158-3435	100%	Yes

Dispersed Fine Tailings

Al	0	--	--	6,980-10,700	9945-23483	100%	--
As	2	282	276-289	8.4-27.2	28-58	100%	Yes
Cd	2	<10	<10-<10	0.38-0.58	<1.0-21	100%	No
Cu	2	445	441-450	5.7-42.7	13-212	100%	Yes
Mn	2	869	658-1081	779-1,010	1281-4653	100%	No
Pb	2	2961	2951-2972	18.1-59.1	105-2643	100%	Yes
Zn	2	870	869-871	45.9-56.3	158-3435	100%	Yes

Coarse Tailings

Al	0	--	--	6,980-10,700	9945-23483	100%	--
As	1	511	--	8.4-27.2	28-58	100%	Yes
Cd	1	125	--	0.38-0.58	<1.0-21	100%	Yes
Cu	1	2936	--	5.7-42.7	13-212	100%	Yes
Mn	1	5786	--	779-1,010	1281-4653	100%	Yes
Pb	1	18402	--	18.1-59.1	105-2643	100%	Yes
Zn	1	22663	--	45.9-56.3	158-3435	100%	Yes

All samples

	n	Mean mg/kg	Range mg/kg				
As	53	249	81-592	8.4-27.2	28-58	100%	Yes
Cd	53	33	7-283	0.38-0.58	<1.0-21	100%	Yes
Cu	53	772	133-2936	5.7-42.7	13-212	100%	Yes
Mn	53	3667	400-10800	779-1,010	1281-4653	100%	Yes
Pb	53	5829	474-28783	18.1-59.1	105-2643	100%	Yes
Zn	53	5174	439-45507	45.9-56.3	158-3435	100%	Yes

Contaminant of Potential Concern