Appendix 21-D

Baseline, Predicted Incremental Changes, and Predicted Soil Metal Concentrations for Construction Phase of Brucejack Gold Mine Project

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Appendix 21-D. Baseline, Predicted Incremental Changes, and Predicted Soil Metal Concentrations for Construction Phase of Brucejack Gold Mine Project

	BJ018			BJ021			BJ022			BJ025		
Metals	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)
Aluminum	16400	11.3	16411	29100	5.99	29106	20900	5.99	20906	15500	5.99	15506
Antimony	1.97	0.429	2.40	0.520	0.227	0.747	0.530	0.227	0.757	0.610	0.227	0.837
Arsenic	21.1	0.0388	21.1	11.3	0.0205	11.3	9.14	0.0205	9.16	7.96	0.0205	7.98
Barium	115	0.242	115	81.9	0.128	82	67.0	0.128	67.1	47.9	0.128	48.0
Beryllium	0.340	0.0868	0.427	0.440	0.0458	0.486	0.370	0.0458	0.416	0.100	0.0458	0.146
Bismuth	0.100	0.0868	0.187	0.100	0.0458	0.146	0.100	0.0458	0.146	0.100	0.0458	0.146
Cadmium	0.296	0.0111	0.307	0.221	0.00587	0.227	0.391	0.00587	0.397	0.0990	0.00587	0.105
Calcium	4470	90.9	4561	254	48.0	302	434	48.0	482	202	48.0	250
Chromium	30.5	0.0868	30.6	85.3	0.0458	85.3	64.7	0.0458	64.7	68.9	0.0458	68.9
Cobalt	13.1	0.0173	13.1	13.8	0.00912	13.8	10.6	0.00912	10.6	4.81	0.00912	4.82
Copper	28.5	4.50	33.0	31.7	2.37	34.1	31.2	2.37	33.6	17.9	2.37	20.3
Iron	39500	27.7	39528	48900	14.6	48915	33700	14.6	33715	34000	14.6	34015
Lead	10.9	0.138	11.0	8.36	0.0727	8.43	7.12	0.0727	7.19	9.03	0.0727	9.10
Lithium	19.0	0.868	19.9	33.2	0.458	33.7	26.7	0.458	27.2	9.40	0.458	9.86
Magnesium	9790	33.3	9823	8680	17.5	8698	10500	17.5	10518	3860	17.5	3878
Manganese	666	3.00	669	986	1.58	988	510	1.58	512	532	1.58	534
Mercury	0.0956	0.00868	0.104	0.105	0.00458	0.110	0.0677	0.00458	0.0723	0.0489	0.00458	0.0535
Molybdenum	1.71	0.0138	1.72	1.72	0.00727	1.73	1.48	0.00727	1.49	1.53	0.00727	1.54
Nickel	26.3	0.393	26.7	57.6	0.208	57.8	69.0	0.208	69.2	33.1	0.208	33.3
Phosphorus	1120	87.2	1207	903	46.0	949	476	46.0	522	956	46.0	1002
Potassium	570	349	919	1060	184	1244	570	184	754	540	184	724
Selenium	1.17	0.173	1.34	1.07	0.0912	1.16	0.510	0.0912	0.601	0.510	0.0912	0.601
Silver	0.420	0.00389	0.424	0.830	0.00205	0.832	0.820	0.00205	0.822	0.840	0.00205	0.842
Sodium	110	349	459	50.0	184	234	50.0	184	234	50.0	184	234
Strontium	22.9	0.444	23.3	3.76	0.234	3.99	5.88	0.234	6.11	3.50	0.234	3.73
Thallium	0.0890	0.0173	0.106	0.176	0.00912	0.185	0.100	0.00912	0.109	0.136	0.00912	0.145
Tin	1.00	0.0173	1.02	1.00	0.00912	1.01	1.00	0.00912	1.01	1.00	0.00912	1.01
Titanium	953	1.73	955	79.3	0.912	80.2	79.0	0.912	79.9	46.1	0.912	47.0
Uranium	0.585	0.00173	0.587	0.309	0.000912	0.310	0.253	0.000912	0.254	0.108	0.000912	0.109
Vanadium	67.7	0.173	67.9	75.9	0.0912	76.0	50.7	0.0912	50.8	75.2	0.0912	75.3
Zinc	74.5	1.27	75.8	82.4	0.670	83.1	80.8	0.670	81.5	38.7	0.670	39.4

Notes:

[1] Baseline concentrations are from samples collected in 2012 (dry weights).

[2] Equation used to calculate incremental soil concentration is from the US EPA (2005): Cs =100((DEPOSITION/(Zs*BD)))*tD, where Cs = Average soil concentration over exposure duration (mg COPC/kg soil), 100 = Units conversion factor (mg-m^2/kg-cm^2), DEPOSITION = Yearly deposition rate of COPC from model (g/m^{2}year), Zs = Soil mixing zone depth (2 cm), BD = Soil bulk density (1.5 g soil/cm^3 soil), and tD = Time period over which deposition occurrs (2 years).*

[3] Total soil concentration is the sum of the baseline concentration and the incremental concentration.

[4] Sites outside the Air Quality Modeling Domain and country foods LSA are expected to have predicted metal concentrations the same baseline concentrations.

Cs = Average soil concentration over exposure duration (mg COPC/kg soil)

100 = Units conversion factor (mg-m^2/kg-cm^2)

DEPOSITION = Yearly deposition rate of COPC from model (g/m^{2}year)

tD = Time period over which deposition occurrs (2 years)

Zs = Soil mixing zone depth (2 cm)

BD = Soil bulk density (1.5 g soil/cm^3 soil)

Samples where the concentration was below the detection limit were replaced with values of half the detection limit for calculation purposes.

LSA = local study area

Appendix 21-D. Baseline, Predicted Incremental Changes, and Predicted Soil Metal Concentrations for Construction Phase of Brucejack Gold Mine Project

	BJ030			BJ031			SOIL 4			12-7103		
Metals	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)
Aluminum	16900	0.932	16901	12300	23.0	12323	25900	5.99	25906	12200	5.99	12206
Antimony	1.17	0.0353	1.21	0.950	0.872	1.82	0.530	0.227	0.757	2.65	0.227	2.88
Arsenic	13.4	0.00319	13.4	10.6	0.0788	10.7	8.85	0.0205	8.87	24.5	0.0205	24.5
Barium	46.2	0.0199	46.2	48.3	0.491	48.8	95.1	0.128	95.2	87.7	0.128	87.8
Beryllium	0.350	0.00713	0.357	0.320	0.176	0.496	0.260	0.0458	0.306	0.230	0.0458	0.276
Bismuth	0.100	0.00713	0.107	0.100	0.176	0.276	0.100	0.0458	0.146	0.100	0.0458	0.146
Cadmium	0.562	0.000913	0.563	1.15	0.0226	1.17	0.216	0.00587	0.222	0.132	0.00587	0.138
Calcium	3940	7.47	3947	6740	185	6925	595	48.0	643	2330	48.0	2378
Chromium	34.3	0.00713	34.3	25.6	0.176	25.8	72.4	0.0458	72.4	2.18	0.0458	2.23
Cobalt	14.5	0.00142	14.5	10.8	0.0351	10.8	10.1	0.00912	10.1	9.47	0.00912	9.48
Copper	39.3	0.369	39.7	25.9	9.13	35.0	22.9	2.37	25.3	9.78	2.37	12.2
Iron	38200	2.27	38202	29000	56.2	29056	44600	14.6	44615	29500	14.6	29515
Lead	9.70	0.0113	9.71	7.82	0.280	8.10	7.13	0.0727	7.20	10.5	0.0727	10.6
Lithium	24.0	0.0713	24.1	19.1	1.76	20.9	21.4	0.458	21.9	16.8	0.458	17.3
Magnesium	11500	2.73	11503	8320	67.5	8387	6720	17.5	6738	5490	17.5	5508
Manganese	727	0.246	727	687	6.09	693	865	1.58	867	1100	1.58	1102
Mercury	0.0446	0.000713	0.0453	0.0441	0.0176	0.0617	0.102	0.00458	0.107	0.0383	0.00458	0.0429
Molybdenum	1.95	0.00113	1.95	2.00	0.0280	2.03	0.920	0.00727	0.93	1.58	0.00727	1.59
Nickel	41.4	0.0323	41.4	32.4	0.799	33.2	43.4	0.208	43.6	2.69	0.208	2.90
Phosphorus	970	7.16	977	1020	177	1197	463	46.0	509	526	46.0	572
Potassium	280	28.7	309	630	708	1338	530	184	714	660	184	844
Selenium	0.600	0.0142	0.614	0.940	0.351	1.291	0.520	0.0912	0.611	0.100	0.0912	0.191
Silver	0.220	0.000319	0.220	0.220	0.00789	0.228	0.410	0.00205	0.412	0.0500	0.00205	0.052
Sodium	50.0	28.7	78.7	50.0	708	758.1	50.0	184	234	50.0	184	234
Strontium	16.1	0.0365	16.1	39.5	0.901	40.4	5.80	0.234	6.0	20.7	0.234	20.9
Thallium	0.100	0.00142	0.101	0.143	0.0351	0.178	0.0850	0.00912	0.0941	0.136	0.00912	0.1451
Tin	1.00	0.00142	1.00	1.00	0.0351	1.04	1.00	0.00912	1.01	1.00	0.00912	1.01
Titanium	351	0.142	351	377	3.51	381	376	0.912	377	962	0.912	963
Uranium	0.335	0.000142	0.335	0.307	0.00351	0.311	0.215	0.000912	0.216	0.813	0.000912	0.814
Vanadium	57.0	0.0142	57.0	41.1	0.351	41.5	86.6	0.0912	86.7	51.3	0.0912	51.4
Zinc	113	0.104	113	126	2.58	129	64.9	0.670	65.6	49.8	0.670	50.5

Notes:

[1] Baseline concentrations are from samples collected in 2012 (dry weights).

[2] Equation used to calculate incremental soil concentration is from the US EPA (2005): Cs =100((DEPOSITION/(Zs*BD)))*tD, where Cs = Average soil concentration over exposure duration (mg COPC/kg soil), 100 = Units conversion factor (mg-m^2/kg-cm^2), DEPOSITION = Yearly deposition rate of COPC from model (g/m^{2}year), Zs = Soil mixing zone depth (2 cm), BD = Soil bulk density (1.5 g soil/cm^3 soil), and tD = Time period over which deposition occurrs (2 years).*

[3] Total soil concentration is the sum of the baseline concentration and the incremental concentration.

[4] Sites outside the Air Quality Modeling Domain and country foods LSA are expected to have predicted metal concentrations the same baseline concentrations.

Cs = Average soil concentration over exposure duration (mg COPC/kg soil)

100 = Units conversion factor (mg-m^2/kg-cm^2)

DEPOSITION = Yearly deposition rate of COPC from model (g/m^{2}year)

tD = Time period over which deposition occurrs (2 years)

Zs = Soil mixing zone depth (2 cm)

BD = Soil bulk density (1.5 g soil/cm^3 soil)

Samples where the concentration was below the detection limit were replaced with values of half the detection limit for calculation purposes.

LSA = local study area

Appendix 21-D. Baseline, Predicted Incremental Changes, and Predicted Soil Metal Concentrations for Construction Phase of Brucejack Gold Mine Project

	12-7108			12-7162			12-7166			12-7167		
Metals	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)
Aluminum	26600	5.99	26606	23000	5.99	23006	22300	5.99	22306	26100	5.99	26106
Antimony	0.520	0.227	0.747	0.520	0.227	0.747	0.640	0.227	0.867	0.900	0.227	1.13
Arsenic	8.25	0.0205	8.3	10.9	0.0205	10.9	12.4	0.0205	12.4	14.7	0.0205	14.7
Barium	84.5	0.128	84.6	64.1	0.128	64.2	130	0.128	130	83.2	0.128	83.3
Beryllium	0.550	0.0458	0.596	0.100	0.0458	0.146	0.480	0.0458	0.526	0.300	0.0458	0.346
Bismuth	0.100	0.0458	0.146	0.200	0.0458	0.246	0.100	0.0458	0.146	0.100	0.0458	0.146
Cadmium	0.610	0.00587	0.616	0.0980	0.00587	0.104	0.797	0.00587	0.803	0.297	0.00587	0.303
Calcium	790	48.0	838	182	48.0	230	406	48.0	454	1450	48.0	1498
Chromium	60.5	0.0458	60.5	67.3	0.0458	67.3	57.6	0.0458	57.6	69.0	0.0458	69.0
Cobalt	10.3	0.00912	10.3	6.05	0.00912	6.06	13.2	0.00912	13.2	20.6	0.00912	20.6
Copper	54.7	2.37	57.1	17.1	2.37	19.5	30.2	2.37	32.6	30.3	2.37	32.7
Iron	36800	14.6	36815	38700	14.6	38715	34100	14.6	34115	50400	14.6	50415
Lead	7.69	0.0727	7.76	8.82	0.0727	8.89	9.61	0.0727	9.68	10.7	0.0727	10.8
Lithium	25.0	0.458	25.5	11.2	0.458	11.7	26.2	0.458	26.7	35.1	0.458	35.6
Magnesium	7710	17.5	7728	5560	17.5	5578	5160	17.5	5178	8880	17.5	8898
Manganese	612	1.58	614	544	1.58	546	523	1.58	525	1710	1.58	1712
Mercury	0.130	0.00458	0.135	0.0381	0.00458	0.0427	0.0965	0.00458	0.101	0.0506	0.00458	0.0552
Molybdenum	3.96	0.00727	3.97	1.32	0.00727	1.33	1.40	0.00727	1.41	1.88	0.00727	1.89
Nickel	54.2	0.208	54.4	36.1	0.208	36.3	47.0	0.208	47.2	59.4	0.208	59.6
Phosphorus	1200	46.0	1246	1760	46.0	1806	1200	46.0	1246	798	46.0	844
Potassium	910	184	1094	1110	184	1294	1210	184	1394	920	184	1104
Selenium	1.00	0.0912	1.09	0.430	0.0912	0.521	0.890	0.0912	0.981	0.740	0.0912	0.831
Silver	1.12	0.00205	1.122	0.140	0.00205	0.142	1.02	0.00205	1.022	0.570	0.00205	0.572
Sodium	50.0	184	234	50.0	184	234	50.0	184	234	50.0	184	234
Strontium	13.0	0.234	13.2	2.42	0.234	2.7	6.63	0.234	6.9	15.7	0.234	15.9
Thallium	0.141	0.00912	0.150	0.204	0.00912	0.213	0.313	0.00912	0.322	0.173	0.00912	0.182
Tin	1.00	0.00912	1.01	1.00	0.00912	1.01	1.00	0.00912	1.01	1.00	0.00912	1.01
Titanium	105	0.912	106	127	0.912	128	66.9	0.912	68	253	0.912	254
Uranium	0.687	0.000912	0.688	0.123	0.000912	0.124	0.286	0.000912	0.287	0.252	0.000912	0.253
Vanadium	48.7	0.0912	48.8	110	0.0912	110.1	64.7	0.0912	64.8	83.5	0.0912	83.6
Zinc	71.6	0.670	72.3	53.2	0.670	53.9	79.3	0.670	80.0	135	0.670	135.7

Notes:

[1] Baseline concentrations are from samples collected in 2012 (dry weights).

[2] Equation used to calculate incremental soil concentration is from the US EPA (2005): Cs =100((DEPOSITION/(Zs*BD)))*tD, where Cs = Average soil concentration over exposure duration (mg COPC/kg soil), 100 = Units conversion factor (mg-m^2/kg-cm^2), DEPOSITION = Yearly deposition rate of COPC from model (g/m^{2}year), Zs = Soil mixing zone depth (2 cm), BD = Soil bulk density (1.5 g soil/cm^3 soil), and tD = Time period over which deposition occurrs (2 years).*

[3] Total soil concentration is the sum of the baseline concentration and the incremental concentration.

[4] Sites outside the Air Quality Modeling Domain and country foods LSA are expected to have predicted metal concentrations the same baseline concentrations.

Cs = Average soil concentration over exposure duration (mg COPC/kg soil)

100 = Units conversion factor (mg-m^2/kg-cm^2)

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tD = Time period over which deposition occurrs (2 years)

Zs = Soil mixing zone depth (2 cm)

BD = Soil bulk density (1.5 g soil/cm^3 soil)

Samples where the concentration was below the detection limit were replaced with values of half the detection limit for calculation purposes.

LSA = local study area

Appendix 21-D. Baseline, Predicted Incremental Changes, and Predicted Soil Metal Concentrations for Construction Phase of Brucejack Gold Mine Project

	12-7168			12-7169		
Metals	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)	Baseline Soil Concentration[1] (mg/kg)	Predicted Incremental Soil Concentration[2] (mg/kg)	Predicted Total Soil Concentration[3] (mg/kg)
Aluminum	21700	5.99	21706	16000	0.627	16001
Antimony	1.77	0.227	1.99	2.00	0.0237	2.02
Arsenic	40.5	0.0205	40.5	20.1	0.00215	20.1
Barium	77.2	0.128	77.3	79.2	0.0134	79.2
Beryllium	0.365	0.0458	0.411	0.310	0.00480	0.315
Bismuth	0.100	0.0458	0.146	0.100	0.00480	0.105
Cadmium	0.204	0.00587	0.209	0.245	0.000614	0.246
Calcium	2730	48.0	2777	4780	5.02	4785
Chromium	38.9	0.0458	38.9	31.6	0.00480	31.6
Cobalt	7.35	0.00912	7.36	11.8	0.000955	11.8
Copper	76.4	2.37	78.8	27.7	0.248	27.9
Iron	34200	14.6	34215	38300	1.53	38302
Lead	11.9	0.0727	11.9	11.5	0.00761	11.5
Lithium	8.10	0.458	8.56	19.6	0.0480	19.6
Magnesium	4195	17.5	4213	10100	1.84	10102
Manganese	436	1.58	437	548	0.166	548
Mercury	0.225	0.00458	0.230	0.0557	0.000480	0.0562
Molybdenum	1.30	0.00727	1.30	1.83	0.000762	1.83
Nickel	15.1	0.208	15.3	28.0	0.0217	28.0
Phosphorus	1908	46.0	1954	1090	4.82	1095
Potassium	475	184	659	720	19.3	739
Selenium	1.27	0.0912	1.36	0.950	0.00955	0.960
Silver	1.88	0.00205	1.877	0.310	0.000215	0.310
Sodium	50.0	184	234	120	19.3	139
Strontium	25.4	0.234	25.6	24.7	0.0245	24.7
Thallium	0.137	0.00912	0.146	0.0860	0.000955	0.0870
Tin	1.00	0.00912	1.01	1.00	0.000955	1.00
Titanium	883	0.912	884	882	0.0955	882
Uranium	0.821	0.000912	0.821	0.407	0.0000955	0.407
Vanadium	59.3	0.0912	59.4	63.8	0.00955	63.8
Zinc	34.1	0.670	34.7	74.4	0.0701	74.5

Notes:

[1] Baseline concentrations are from samples collected in 2012 (dry weights).

[2] Equation used to calculate incremental soil concentration is from the US EPA (2005): Cs =100((DEPOSITION/(Zs*BD)))*tD, where Cs = Average soil concentration over exposure duration (mg COPC/kg soil), 100 = Units conversion factor (mg-m^2/kg-cm^2), DEPOSITION = Yearly deposition rate of COPC from model (g/m^{2}year), Zs = Soil mixing zone depth (2 cm), BD = Soil bulk density (1.5 g soil/cm^3 soil), and tD = Time period over which deposition occurrs (2 years).*

[3] Total soil concentration is the sum of the baseline concentration and the incremental concentration.

[4] Sites outside the Air Quality Modeling Domain and country foods LSA are expected to have predicted metal concentrations the same baseline concentrations.

Cs = Average soil concentration over exposure duration (mg COPC/kg soil)

100 = Units conversion factor (mg-m^2/kg-cm^2)

DEPOSITION = Yearly deposition rate of COPC from model (g/m^{2}year)

tD = Time period over which deposition occurrs (2 years)

Zs = Soil mixing zone depth (2 cm)

BD = Soil bulk density (1.5 g soil/cm^3 soil)

Samples where the concentration was below the detection limit were replaced with values of half the detection limit for calculation purposes.

LSA = local study area