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TECHNICAL MEMORANDUM

TO: Vicky Peacey, Resolution Copper

FROM: Ted Eary, Enchemica

DATE: July 17, 2018

SUBJECT: Alternative 6 - Skunk Camp: Prediction of Operational Tailings Circuit Solute Chemistry

1 INTRODUCTION

The draft environmental impact statement (DEIS) for the Resolution Copper mine includes assessment of the following tailings storage facility alternatives:

- Alternative 1: No Action
- Alternative 2: Near West Modified Proposed Action
- Alternative 3: Near West Modified Proposed Action – Thin Lift/Pag Cell
- Alternative 4: Silver King Filtered
- Alternative 5: Peg Leg
- Alternative 6: Skunk Camp

Water balances models have been developed for each of these alternatives. These water balance models have been augmented by the addition of chemical balances. The purpose of this memo is to provide a description of the predictions of the chemical balance and resulting solute chemistry for Alternative 6.

2 MODEL SETUP

2.1 Software

The predictive model was developed with a combination of GoldSim (version 12.0) and PHREEQC (Parkhurst and Appelo, 2013; version 3.0). GoldSim was used for the water and chemical mass balance components of the model. PHREEQC was used to simulate reactive processes that affect water chemistry. The WATEQ4F.DAT thermodynamic database was used for the PHREEQC calculations. The chemical portions of the model included calculations for:

- Ca, Mg, Na, K, Cl, HCO_3, SO_4, Si, F, NO_3-N, Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, Ag, Tl, Zn, and pH

The PHREEQC geochemical model was integrated directly into the GoldSim water balance model, so that changes to water chemistry resulting from reactive processes are made at each time step in the simulations and incorporated directly into the simulation results.

2.2 Input Data

A common set of inputs for water chemistry and flow rates from the block cave mine was used for all TSF alternatives. These inputs are described in Enchemica (2018).

2.3 Simulation Period

The simulation period was 41 years, which represents the life of mine per the mine plan of operations. A 3-day time step was used. Both the water balance and PHREEQC calculations are conducted at each time step. A 3-day timestep was found to be short enough prevent potential mass transfer warnings from GoldSim while being long enough to yield reasonably short model run times.

3 WATER BALANCE

A model of the water balance for Alternative 6 was developed by KCB. The boundaries of the KCB water balance model included the West Plant, tailings storage facility (TSF), and seepage collection systems. The details of the water balance relevant to the solute balance are provided in KCB (2018).

3.1 Makeup Water

The KCB water balance model provided calculations of the rate of reclaim water flow to the West Plant and the total demand for additional makeup water needed for ore processing at the West Plant. There are four sources of water for ore processing:

- **Reclaim water**: Excess water pumped from the Pyrite Pond – this flow is provided by the KCB water balance model.
- **Makeup water:**
    - **Ore moisture**: Ore entering the West Plant is estimated to contain 4% by weight of water.
    - **Block cave sump water**: The block cave mine is expected to have an excess amount of water that will be pumped to the surface providing a source of makeup water.
    - **Freshwater**: The demand for makeup water beyond the flow from the block cave mine will be comprised of a mixture of freshwater from the Central Arizona Project canal and well fields.

Figure 3-1 shows simulation results for process water sources. Freshwater makeup is generally the largest water source for ore processing followed by reclaim water, block cave sump water, and ore moisture. At certain times the model indicates low flows of overflow water, such as near the end of mining when the available water as reclaim water and block cave sump water are exceed what would be needed for ore processing at the West Plant. It is assumed the excess water would be managed as either a discharge (if water quality is acceptable) or evaporated.

Each of the makeup water sources has a different chemical composition. The details about the chemical compositions of makeup water are provided in Enchemica (2018).

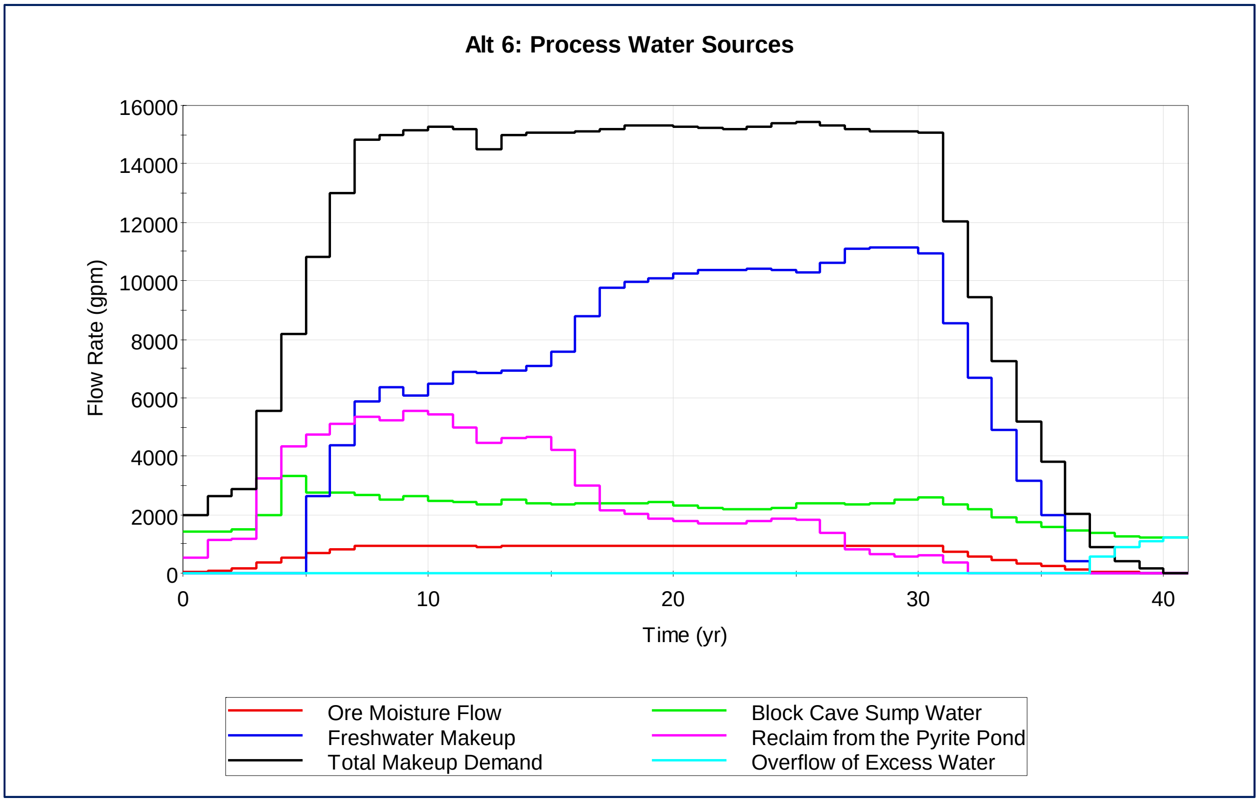

Figure 3-1. Simulation results for process water sources

4 Calculation Sequence for Solute Chemistry

The calculation sequence in the solute model is:

- Chemical loads are defined for all water sources entering the TSF system by multiplication of flow rates times concentrations. Descriptions of the source water chemistries are in Enchemica (2018).
- The chemical loads are converted to concentrations at locations of water mixing and storage.
- The concentrations are equilibrated with PHREEQC for aqueous speciation, solubility, and adsorption. The set of equilibria processes for PHREEQC are described in Enchemica (2018). There are four locations where PHREEQC is applied to produced equilibrated water chemistries:
  - **West Plant**: mixture of water entering the Plant
  - **Embankment**: water contained in the pore space of the embankment
  - **Seepage Collection Ponds**: the water balance lumps all seepage collections ponds into a single water reservoir. Predictions of water chemistry are made for this single reservoir.
  - **Pyrite Pond**: storage of water over the pyrite tailings used for reclaim to the West Plant. The Pyrite Pond and tailings comprise the single source of seepage in the water balance indicated to have the potential to bypass collection systems; hence, designated as Lost Seepage. In the solute balance model, the chemistry of Lost Seepage is assumed to be the same as the equilibrated chemistry determined for the Pyrite Pond. Reactions and mixing of Lost Seepage with groundwater in flow paths from the TSF are not included in the modeling logic.

Transport of Lost Seepage along flow paths is the subject of associated modeling studies by Montgomery and Associates.

- Equilibrated water chemistries are multiplied by flow rates to move chemical loads through the water distribution system.

5 Results

A full set of results from the model are provided in tables below as annual average concentrations. The tables are organized as follows:

- Table 5-1: Pyrite Pond and Lost Seepage

	Ca	Mg	Na	K	Cl	HCO_3	SO_4	Si	F	NO_3-N	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Ag	Tl	Zn	pH	TDS
Year	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
1	75	23	43	29	20	23	339	9.3	1.1	2.0	0.18	0.0006	0.00280	0.011	0.00022	0.13	0.000	0.002	0.002	0.081	0.001697	0.0002	0.01	0.082	0.003	0.009	0.001	0.0002	0.08	7.85	554
2	103	30	56	40	27	28	457	12.0	1.4	2.9	0.35	0.0008	0.00308	0.014	0.00027	0.17	0.000	0.004	0.005	0.136	0.001715	0.0003	0.04	0.118	0.006	0.016	0.003	0.0003	0.15	7.95	744
3	123	31	60	46	30	28	521	13.0	1.5	3.5	0.48	0.0011	0.00277	0.015	0.00028	0.18	0.001	0.008	0.013	0.184	0.001716	0.0003	0.13	0.142	0.015	0.027	0.006	0.0004	0.30	7.95	845
4	148	33	64	55	35	26	598	14.2	1.7	4.0	0.58	0.0019	0.00226	0.016	0.00026	0.20	0.002	0.014	0.027	0.194	0.001715	0.0005	0.27	0.186	0.030	0.047	0.012	0.0008	0.56	7.93	968
5	169	32	68	70	42	26	663	16.0	2.0	3.9	0.76	0.0037	0.00155	0.017	0.00020	0.22	0.004	0.021	0.045	0.194	0.001715	0.0008	0.44	0.260	0.047	0.072	0.018	0.0023	0.86	7.92	1081
6	176	31	73	80	57	25	680	16.2	2.3	3.4	0.94	0.0047	0.00104	0.018	0.00016	0.23	0.005	0.026	0.056	0.194	0.001715	0.0009	0.56	0.314	0.059	0.089	0.022	0.0031	1.05	7.91	1135
7	167	31	78	79	73	26	645	14.6	2.5	2.9	1.11	0.0039	0.00082	0.018	0.00014	0.23	0.005	0.026	0.055	0.194	0.001715	0.0009	0.56	0.315	0.058	0.088	0.022	0.0024	1.04	7.92	1109
8	164	31	82	79	83	26	635	13.7	2.6	2.6	1.23	0.0035	0.00069	0.019	0.00013	0.22	0.005	0.027	0.055	0.194	0.001716	0.0010	0.56	0.317	0.058	0.089	0.022	0.0020	1.04	7.92	1110
9	167	33	86	81	90	27	647	13.4	2.7	2.6	1.31	0.0033	0.00064	0.019	0.00013	0.23	0.005	0.027	0.056	0.194	0.001716	0.0010	0.58	0.325	0.060	0.091	0.023	0.0017	1.06	7.93	1139
10	174	34	89	84	95	27	672	13.6	2.8	2.7	1.32	0.0034	0.00061	0.019	0.00014	0.24	0.005	0.028	0.059	0.194	0.001716	0.0010	0.61	0.338	0.063	0.097	0.024	0.0017	1.12	7.93	1183
11	178	35	92	86	98	27	687	13.8	2.8	2.7	1.31	0.0034	0.00060	0.019	0.00014	0.24	0.005	0.029	0.061	0.194	0.001717	0.0010	0.62	0.347	0.065	0.101	0.025	0.0017	1.14	7.93	1212
12	180	35	94	87	102	27	698	13.9	2.9	2.8	1.31	0.0034	0.00060	0.019	0.00014	0.25	0.005	0.029	0.062	0.194	0.001717	0.0010	0.63	0.352	0.066	0.104	0.025	0.0016	1.15	7.93	1232
13	183	36	97	88	105	27	711	14.0	2.9	2.9	1.31	0.0034	0.00063	0.019	0.00016	0.25	0.005	0.030	0.063	0.194	0.001717	0.0009	0.63	0.357	0.068	0.107	0.025	0.0016	1.15	7.93	1258
14	186	37	100	90	108	27	724	14.3	2.9	3.0	1.29	0.0034	0.00065	0.019	0.00016	0.26	0.005	0.030	0.064	0.194	0.001717	0.0009	0.63	0.363	0.069	0.111	0.026	0.0016	1.16	7.93	1283
15	188	38	101	91	110	27	734	14.5	2.9	3.0	1.27	0.0035	0.00065	0.019	0.00017	0.26	0.005	0.030	0.066	0.194	0.001717	0.0009	0.64	0.368	0.070	0.114	0.026	0.0017	1.16	7.93	1301
16	191	39	104	92	113	26	748	14.6	2.9	3.1	1.24	0.0035	0.00065	0.019	0.00017	0.27	0.005	0.031	0.067	0.194	0.001717	0.0009	0.65	0.373	0.072	0.118	0.026	0.0017	1.18	7.92	1324
17	194	40	107	93	118	26	763	14.9	2.9	3.2	1.21	0.0035	0.00072	0.019	0.00020	0.27	0.006	0.031	0.069	0.194	0.001717	0.0009	0.66	0.377	0.074	0.120	0.027	0.0017	1.21	7.92	1354
18	198	42	113	94	125	26	783	15.3	2.9	3.3	1.19	0.0036	0.00084	0.019	0.00023	0.28	0.006	0.032	0.070	0.194	0.001717	0.0010	0.68	0.379	0.076	0.121	0.027	0.0017	1.24	7.92	1394
19	201	44	118	95	131	26	800	15.6	2.9	3.4	1.17	0.0036	0.00091	0.019	0.00026	0.29	0.006	0.033	0.072	0.194	0.001717	0.0011	0.69	0.382	0.078	0.122	0.028	0.0017	1.28	7.92	1429
20	204	46	123	97	137	26	818	15.9	2.9	3.6	1.14	0.0037	0.00095	0.019	0.00028	0.30	0.006	0.034	0.073	0.194	0.001717	0.0012	0.71	0.388	0.080	0.122	0.028	0.0017	1.31	7.92	1465
21	209	47	128	99	143	26	842	16.3	2.9	3.7	1.11	0.0037	0.00099	0.018	0.00030	0.31	0.006	0.035	0.075	0.194	0.001717	0.0013	0.74	0.397	0.082	0.123	0.029	0.0017	1.35	7.91	1509
22	21	49	13	10	14	26	86	16.	2.9	3.8	1.0	0.0	0.00	0.0	0.00	0.3	0.0	0.0	0.0	0.1	0.001	0.0	0.7	0.4	0.0	0.1	0.0	0.0	1.3	7.	15

	4		3	2	9		7	7			7	038	103	18	032	2	06	36	77	94	717	013	6	07	84	25	29	017	8	91	54
23	218	51	137	104	154	26	888	17.0	2.8	3.9	1.04	0.0038	0.00106	0.018	0.00033	0.33	0.006	0.037	0.078	0.194	0.001717	0.0014	0.78	0.416	0.086	0.125	0.030	0.0017	1.41	7.91	1594
24	221	52	141	106	159	26	905	17.3	2.8	4.0	1.02	0.0038	0.00107	0.018	0.00034	0.34	0.006	0.038	0.079	0.194	0.001717	0.0014	0.80	0.422	0.087	0.125	0.030	0.0017	1.43	7.91	1624
25	224	53	143	107	162	26	917	17.4	2.8	4.0	1.01	0.0038	0.00105	0.018	0.00035	0.34	0.006	0.039	0.080	0.194	0.001717	0.0015	0.82	0.427	0.088	0.125	0.030	0.0017	1.44	7.90	1646
26	226	54	146	108	164	25	929	17.5	2.8	4.0	0.99	0.0039	0.00102	0.018	0.00035	0.35	0.006	0.039	0.080	0.194	0.001717	0.0015	0.83	0.431	0.089	0.125	0.031	0.0017	1.46	7.90	1668
27	231	55	149	110	168	25	949	17.9	2.8	4.1	0.97	0.0040	0.00103	0.018	0.00036	0.36	0.006	0.040	0.082	0.194	0.001718	0.0015	0.86	0.438	0.091	0.126	0.031	0.0018	1.48	7.90	1704
28	239	58	156	114	176	25	986	18.6	2.8	4.3	0.92	0.0041	0.00110	0.018	0.00039	0.37	0.007	0.042	0.085	0.194	0.001718	0.0016	0.89	0.454	0.095	0.130	0.032	0.0018	1.52	7.90	1771
29	248	61	164	118	185	25	1030	19.0	2.8	4.5	0.88	0.0043	0.00120	0.018	0.00043	0.39	0.007	0.044	0.089	0.195	0.001718	0.0017	0.93	0.472	0.099	0.137	0.034	0.0019	1.57	7.89	1849
30	259	64	172	123	194	25	1077	19.3	2.8	4.7	0.83	0.0045	0.00128	0.017	0.00046	0.41	0.007	0.046	0.093	0.195	0.001718	0.0017	0.97	0.491	0.104	0.145	0.035	0.0021	1.61	7.89	1932
31	269	67	180	128	202	24	1123	19.4	2.7	4.9	0.79	0.0047	0.00135	0.017	0.00050	0.43	0.007	0.047	0.096	0.195	0.001718	0.0017	1.01	0.510	0.109	0.154	0.036	0.0022	1.64	7.88	2012
32	284	71	191	135	215	24	1194	19.3	2.7	5.2	0.73	0.0051	0.00147	0.017	0.00055	0.45	0.008	0.050	0.102	0.195	0.001719	0.0018	1.06	0.538	0.116	0.165	0.038	0.0023	1.71	7.87	2134
33	311	78	210	148	235	24	1314	19.3	2.7	5.8	0.65	0.0056	0.00171	0.017	0.00064	0.50	0.008	0.054	0.112	0.195	0.001719	0.0019	1.15	0.586	0.127	0.182	0.041	0.0026	1.84	7.86	2341
34	354	90	240	168	266	23	1505	19.3	2.6	6.8	0.55	0.0064	0.00208	0.016	0.00078	0.57	0.010	0.061	0.127	0.196	0.00172	0.0021	1.31	0.663	0.146	0.209	0.047	0.0031	2.06	7.84	2669
35	397	102	272	186	300	22	1698	19.3	2.6	7.8	0.48	0.0072	0.00289	0.016	0.00094	0.64	0.011	0.068	0.142	0.197	0.001722	0.0024	1.45	0.732	0.164	0.235	0.052	0.0035	2.26	7.83	3002
36	418	111	295	193	324	22	1805	19.2	2.5	8.5	0.45	0.0076	0.00428	0.016	0.00107	0.69	0.011	0.070	0.148	0.197	0.001723	0.0028	1.50	0.751	0.172	0.245	0.053	0.0037	2.31	7.82	3194
37	438	121	320	198	350	22	1911	19.2	2.5	9.1	0.43	0.0079	0.00600	0.016	0.00120	0.74	0.011	0.072	0.152	0.197	0.001723	0.0032	1.55	0.764	0.179	0.252	0.054	0.0039	2.35	7.82	3386
38	486	138	364	216	397	21	2143	19.2	2.5	10.4	0.38	0.0087	0.00804	0.015	0.00145	0.84	0.012	0.078	0.167	0.198	0.001725	0.0039	1.70	0.827	0.199	0.274	0.059	0.0044	2.54	7.80	3792
39	553	160	421	244	458	21	2460	19.1	2.5	12.1	0.32	0.0100	0.01031	0.015	0.00180	0.97	0.014	0.088	0.191	0.198	0.001727	0.0047	1.94	0.926	0.229	0.307	0.066	0.0050	2.85	7.79	4349
40	577	186	488	277	529	21	2697	19.1	2.5	14.3	0.30	0.0114	0.01288	0.015	0.00224	1.11	0.015	0.100	0.220	0.199	0.001727	0.0055	2.24	1.048	0.267	0.348	0.074	0.0057	3.24	7.78	4809
41	573	216	564	319	612	21	2897	19.0	2.6	16.9	0.29	0.0132	0.01574	0.015	0.00279	1.29	0.018	0.114	0.256	0.198	0.001725	0.0065	2.62	1.201	0.315	0.399	0.085	0.0066	3.72	7.79	5240

- Table 5-2: Seepage Collection Ponds
- Table 5-3: Embankment

5.1 Pyrite Pond and Lost Seepage

Examples of model results are shown in Figure 5-1 for Lost Seepage as average annual concentrations for the 41-year operational mine life. For this alternative, Lost Seepage represents seepage from the Pyrite Pond and that bypasses collection systems and enter the bedrock foundation. The Lost Seepage is assumed to have the same water chemistry as its source of the Pyrite Pond. The following observations for the Pyrite Pond-Lost Seepage water chemistry:

- Figure 5-1a - pH: The pH is predicted to range between about 7.8 and 7.9 for the entirety of the 41-year operational mine life.
- Figure 5-1b – major anions: Sulfate is the dominant anion at concentrations from 350 to 2880 mg/L. Chloride is next in importance with concentrations from 20 to 600 mg/L followed by HCO_3 at concentrations from 20 to 28 mg/L, nitrate-N at concentrations from 2 to 16 mg/L, and fluoride at concentrations from 1.0 to 2.9 mg/L.

- Figure 5-1c – divalent metals: Zinc is predicted to have the highest concentrations, ranging between 0.2 and 3.6 mg/L. Copper concentrations are predicted to be relatively constant at about 0.2 mg/L due to equilibrium with malachite. Concentrations of the other divalent metals are not limited by solubility. Nickel and cobalt are predicted to range from 0.02 to 0.3 mg/L. Concentrations of cadmium and lead are predicted to be less than 0.017 and 0.01 mg/L, respectively.
- Figure 5-1d: anionic metals and metalloids: Molybdenum concentrations are the highest for this group at concentrations from 0.2 to 1.2 mg/L. Selenium is next at concentrations from 0.04 to 0.4 mg/L. Arsenic concentrations are lower but variable at concentrations from 0.001 to 0.09 mg/L.

The trends shown in Figure 5-1 are due to the following factors:

- Concentrations of most solutes start out lowest during the early years due to low rates of ore production and a relatively higher amount of freshwater makeup during the initial period of operation.
- Concentrations of most solutes increase during the early years of operations due to evaporation and then tend to remain relatively constant (years 10 to 30) as the ratio of freshwater makeup balances the evaporative losses.
- Concentrations of most solutes reach maximums near the end of the operational period. This result is due to inter-dependent factors: one factor is that the demand for freshwater makeup starts to decrease near the end of the operational period relative to the flow of water from the block cave because the rate of ore production is projected to decrease. Water from the block cave has higher concentrations of most solutes compared to other water sources, resulting in increased concentrations. A second factor is evaporation of water in the Pyrite Pond, which also contributes to increased concentrations once freshwater makeup is decreased near the end of the operational period. A third factor is that freshwater makeup direct to the Pyrite Pond is needed to maintain the water cover over the pyrite tailings. Freshwater makeup has relatively high As concentrations compared to other makeup sources, resulting in a higher rate of increase in As concentrations toward the end of the operation period relative to other solutes.

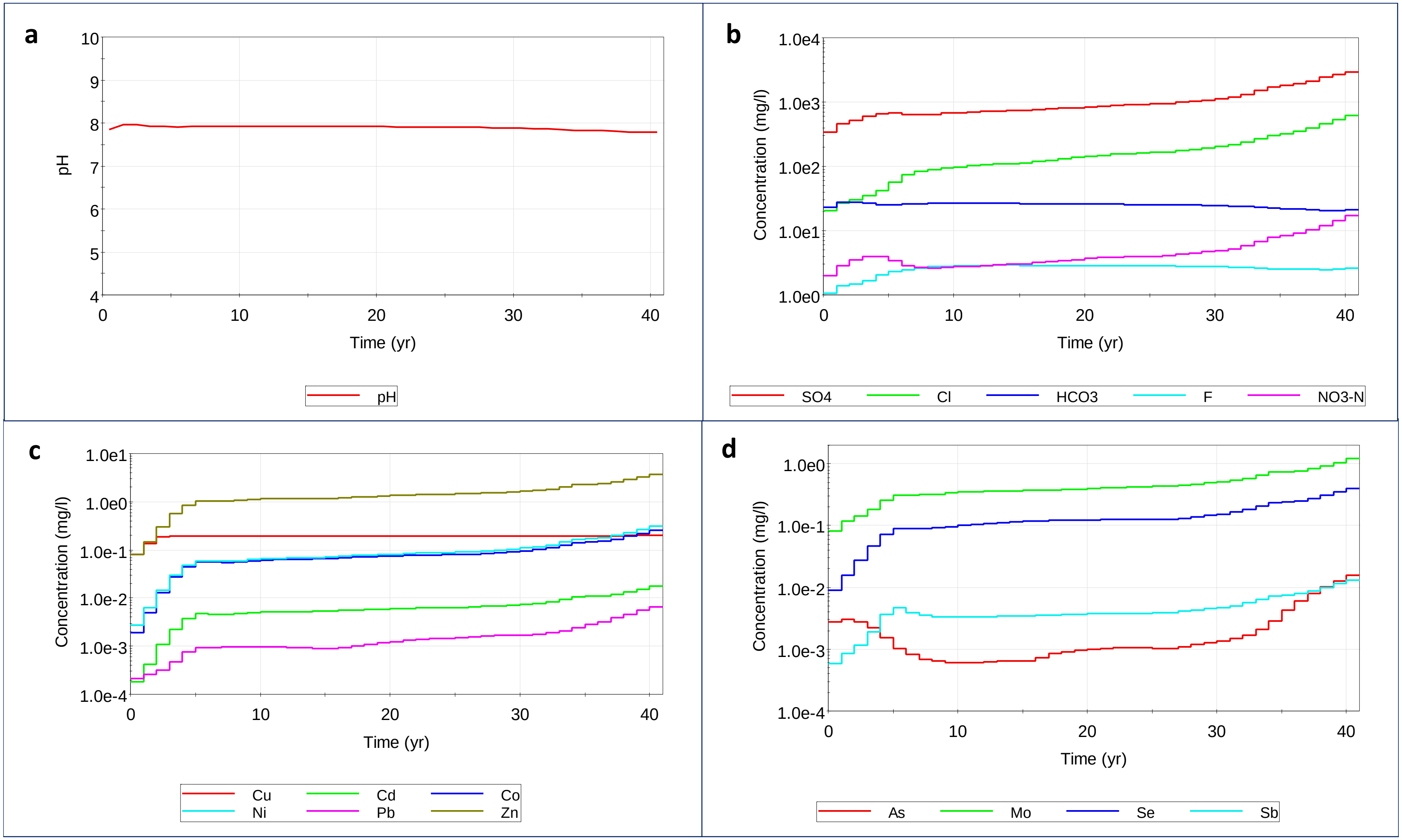

Figure 5-1. Predictions of average annual concentrations in Lost Seepage for a) pH, b) major anions, c) divalent metals, and d) anionic metals and metalloids

Table 5-1. Predictions of average annual concentrations for the Pyrite Pond and Lost Seepage

	Ca	Mg	Na	K	Cl	HCO_3	SO_4	Si	F	NO_3-N	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Ag	Tl	Zn	pH	TDS
Year	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
1	75	23	43	29	20	23	339	9.3	1.1	2.0	0.18	0.0006	0.00280	0.011	0.00022	0.13	0.000	0.002	0.002	0.081	0.001697	0.0002	0.01	0.082	0.003	0.009	0.001	0.0002	0.08	7.85	554
2	103	30	56	40	27	28	457	12.0	1.4	2.9	0.35	0.0008	0.00308	0.014	0.00027	0.17	0.000	0.004	0.005	0.136	0.001715	0.0003	0.04	0.118	0.006	0.016	0.003	0.0003	0.15	7.95	744
3	123	31	60	46	30	28	521	13.0	1.5	3.5	0.48	0.0011	0.00277	0.015	0.00028	0.18	0.001	0.008	0.013	0.184	0.001716	0.0003	0.13	0.142	0.015	0.027	0.006	0.0004	0.30	7.95	845
4	148	33	64	55	35	26	598	14.2	1.7	4.0	0.58	0.0019	0.00226	0.016	0.00026	0.20	0.002	0.014	0.027	0.194	0.001715	0.0005	0.27	0.186	0.030	0.047	0.012	0.0008	0.56	7.93	968
5	169	32	68	70	42	26	663	16.0	2.0	3.9	0.76	0.0037	0.00155	0.017	0.00020	0.22	0.004	0.021	0.045	0.194	0.001715	0.0008	0.44	0.260	0.047	0.072	0.018	0.0023	0.86	7.92	1081
6	176	31	73	80	57	25	680	16.2	2.3	3.4	0.94	0.0047	0.00104	0.018	0.00016	0.23	0.005	0.026	0.056	0.194	0.001715	0.0009	0.56	0.314	0.059	0.089	0.022	0.0031	1.05	7.91	1135
7	167	31	78	79	73	26	645	14.6	2.5	2.9	1.11	0.0039	0.00082	0.018	0.00014	0.23	0.005	0.026	0.055	0.194	0.001715	0.0009	0.56	0.315	0.058	0.088	0.022	0.0024	1.04	7.92	1109
8	164	31	82	79	83	26	635	13.7	2.6	2.6	1.23	0.0035	0.00069	0.019	0.00013	0.22	0.005	0.027	0.055	0.194	0.001716	0.0010	0.56	0.317	0.058	0.089	0.022	0.0020	1.04	7.92	1110
9	167	33	86	81	90	27	647	13.4	2.7	2.6	1.31	0.0033	0.00064	0.019	0.00013	0.23	0.005	0.027	0.056	0.194	0.001716	0.0010	0.58	0.325	0.060	0.091	0.023	0.0017	1.06	7.93	1139
10	174	34	89	84	95	27	672	13.6	2.8	2.7	1.32	0.0034	0.00061	0.019	0.00014	0.24	0.005	0.028	0.059	0.194	0.001716	0.0010	0.61	0.338	0.063	0.097	0.024	0.0017	1.12	7.93	1183
11	178	35	92	86	98	27	687	13.8	2.8	2.7	1.31	0.0034	0.00060	0.019	0.00014	0.24	0.005	0.029	0.061	0.194	0.001717	0.0010	0.62	0.347	0.065	0.101	0.025	0.0017	1.14	7.93	1212
12	180	35	94	87	102	27	698	13.9	2.9	2.8	1.31	0.0034	0.00060	0.019	0.00014	0.25	0.005	0.029	0.062	0.194	0.001717	0.0010	0.63	0.352	0.066	0.104	0.025	0.0016	1.15	7.93	1232
13	183	36	97	88	105	27	711	14.0	2.9	2.9	1.31	0.0034	0.00063	0.019	0.00016	0.25	0.005	0.030	0.063	0.194	0.001717	0.0009	0.63	0.357	0.068	0.107	0.025	0.0016	1.15	7.93	1258
14	186	37	100	90	108	27	724	14.3	2.9	3.0	1.29	0.0034	0.00065	0.019	0.00016	0.26	0.005	0.030	0.064	0.194	0.001717	0.0009	0.63	0.363	0.069	0.111	0.026	0.0016	1.16	7.93	1283
15	188	38	101	91	110	27	734	14.5	2.9	3.0	1.27	0.0035	0.00065	0.019	0.00017	0.26	0.005	0.030	0.066	0.194	0.001717	0.0009	0.64	0.368	0.070	0.114	0.026	0.0017	1.16	7.93	1301
16	191	39	104	92	113	26	748	14.6	2.9	3.1	1.24	0.0035	0.00065	0.019	0.00017	0.27	0.005	0.031	0.067	0.194	0.001717	0.0009	0.65	0.373	0.072	0.118	0.026	0.0017	1.18	7.92	1324
17	194	40	107	93	118	26	763	14.9	2.9	3.2	1.21	0.0035	0.00072	0.019	0.00020	0.27	0.006	0.031	0.069	0.194	0.001717	0.0009	0.66	0.377	0.074	0.120	0.027	0.0017	1.21	7.92	1354
18	198	42	113	94	125	26	783	15.3	2.9	3.3	1.19	0.0036	0.00084	0.019	0.00023	0.28	0.006	0.032	0.070	0.194	0.001717	0.0010	0.68	0.379	0.076	0.121	0.027	0.0017	1.24	7.92	1394
19	201	44	118	95	131	26	800	15.6	2.9	3.4	1.17	0.0036	0.00091	0.019	0.00026	0.29	0.006	0.033	0.072	0.194	0.001717	0.0011	0.69	0.382	0.078	0.122	0.028	0.0017	1.28	7.92	1429
20	204	46	123	97	137	26	818	15.9	2.9	3.6	1.14	0.0037	0.00095	0.019	0.00028	0.30	0.006	0.034	0.073	0.194	0.001717	0.0012	0.71	0.388	0.080	0.122	0.028	0.0017	1.31	7.92	1465
21	209	47	128	99	143	26	842	16.3	2.9	3.7	1.11	0.0037	0.00099	0.018	0.00030	0.31	0.006	0.035	0.075	0.194	0.001717	0.0013	0.74	0.397	0.082	0.123	0.029	0.0017	1.35	7.91	1509
22	214	49	133	102	149	26	867	16.7	2.9	3.8	1.07	0.0038	0.00103	0.018	0.00032	0.32	0.006	0.036	0.077	0.194	0.001717	0.0013	0.76	0.407	0.084	0.125	0.029	0.0017	1.38	7.91	1554
23	218	51	137	104	154	26	888	17.0	2.8	3.9	1.04	0.0038	0.00106	0.018	0.00033	0.33	0.006	0.037	0.078	0.194	0.001717	0.0014	0.78	0.416	0.086	0.125	0.030	0.0017	1.41	7.91	1594
24	221	52	141	106	159	26	905	17.3	2.8	4.0	1.02	0.0038	0.00107	0.018	0.00034	0.34	0.006	0.038	0.079	0.194	0.001717	0.0014	0.80	0.422	0.087	0.125	0.030	0.0017	1.43	7.91	1624
25	224	53	143	107	162	26	917	17.4	2.8	4.0	1.01	0.0038	0.00105	0.018	0.00035	0.34	0.006	0.039	0.080	0.194	0.001717	0.0015	0.82	0.427	0.088	0.125	0.030	0.0017	1.44	7.90	1646
26	226	54	146	108	164	25	929	17.5	2.8	4.0	0.99	0.0039	0.00102	0.018	0.00035	0.35	0.006	0.039	0.080	0.194	0.001717	0.0015	0.83	0.431	0.089	0.125	0.031	0.0017	1.46	7.90	1668
27	231	55	149	110	168	25	949	17.9	2.8	4.1	0.97	0.0040	0.00103	0.018	0.00036	0.36	0.006	0.040	0.082	0.194	0.001718	0.0015	0.86	0.438	0.091	0.126	0.031	0.0018	1.48	7.90	1704
28	239	58	156	114	176	25	986	18.6	2.8	4.3	0.92	0.0041	0.00110	0.018	0.00039	0.37	0.007	0.042	0.085	0.194	0.001718	0.0016	0.89	0.454	0.095	0.130	0.032	0.0018	1.52	7.90	1771
29	248	61	164	118	185	25	1030	19.0	2.8	4.5	0.88	0.0043	0.00120	0.018	0.00043	0.39	0.007	0.044	0.089	0.195	0.001718	0.0017	0.93	0.472	0.099	0.137	0.034	0.0019	1.57	7.89	1849
30	259	64	172	123	194	25	1077	19.3	2.8	4.7	0.83	0.0045	0.00128	0.017	0.00046	0.41	0.007	0.046	0.093	0.195	0.001718	0.0017	0.97	0.491	0.104	0.145	0.035	0.0021	1.61	7.89	1932
31	269	67	180	128	202	24	1123	19.4	2.7	4.9	0.79	0.0047	0.00135	0.017	0.00050	0.43	0.007	0.047	0.096	0.195	0.001718	0.0017	1.01	0.510	0.109	0.154	0.036	0.0022	1.64	7.88	2012
32	284	71	191	135	215	24	1194	19.3	2.7	5.2	0.73	0.0051	0.00147	0.017	0.00055	0.45	0.008	0.050	0.102	0.195	0.001719	0.0018	1.06	0.538	0.116	0.165	0.038	0.0023	1.71	7.87	2134
33	311	78	210	148	235	24	1314	19.3	2.7	5.8	0.65	0.0056	0.00171	0.017	0.00064	0.50	0.008	0.054	0.112	0.195	0.001719	0.0019	1.15	0.586	0.127	0.182	0.041	0.0026	1.84	7.86	2341
34	354	90	240	168	266	23	1505	19.3	2.6	6.8	0.55	0.0064	0.00208	0.016	0.00078	0.57	0.010	0.061	0.127	0.196	0.00172	0.0021	1.31	0.663	0.146	0.209	0.047	0.0031	2.06	7.84	2669
35	397	102	272	186	300	22	1698	19.3	2.6	7.8	0.48	0.0072	0.00289	0.016	0.00094	0.64	0.011	0.068	0.142	0.197	0.001722	0.0024	1.45	0.732	0.164	0.235	0.052	0.0035	2.26	7.83	3002
36	418	111	295	193	324	22	1805	19.2	2.5	8.5	0.45	0.0076	0.00428	0.016	0.00107	0.69	0.011	0.070	0.148	0.197	0.001723	0.0028	1.50	0.751	0.172	0.245	0.053	0.0037	2.31	7.82	3194
37	438	121	320	198	350	22	1911	19.2	2.5	9.1	0.43	0.0079	0.00600	0.016	0.00120	0.74	0.011	0.072	0.152	0.197	0.001723	0.0032	1.55	0.764	0.179	0.252	0.054	0.0039	2.35	7.82	3386
38	486	138	364	216	397	21	2143	19.2	2.5	10.4	0.38	0.0087	0.00804	0.015	0.00145	0.84	0.012	0.078	0.167	0.198	0.001725	0.0039	1.70	0.827	0.199	0.274	0.059	0.0044	2.54	7.80	3792
39	553	160	421	244	458	21	2460	19.1	2.5	12.1	0.32	0.0100	0.01031	0.015	0.00180	0.97	0.014	0.088	0.191	0.198	0.001727	0.0047	1.94	0.926	0.229	0.307	0.066	0.0050	2.85	7.79	4349
40	577	186	488	277	529	21	2697	19.1	2.5	14.3	0.30	0.0114	0.01288	0.015	0.00224	1.11	0.015	0.100	0.220	0.199	0.001727	0.0055	2.24	1.048	0.267	0.348	0.074	0.0057	3.24	7.78	4809
41	573	216	564	319	612	21	2897	19.0	2.6	16.9	0.29	0.0132	0.01574	0.015	0.00279	1.29	0.018	0.114	0.256	0.198	0.001725	0.0065	2.62	1.201	0.315	0.399	0.085	0.0066	3.72	7.79	5240

Table 5-2. Predictions of average annual concentrations for the Seepage Collection Ponds

	Ca	Mg	Na	K	Cl	HCO_3	SO_4	Si	F	NO_3-N	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Ag	Tl	Zn	pH	TDS
Year	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
1	167	50	99	65	45	25	788	16.3	2.3	2.1	0.38	0.0012	0.00234	0.016	0.00013	0.27	0.000	0.004	0.004	0.192	0.001717	0.00041	0.02	0.191	0.006	0.021	0.003	0.0005	0.19	7.90	1249
2	186	50	99	74	48	25	837	17.3	2.4	3.6	0.80	0.0015	0.00098	0.016	0.00011	0.28	0.001	0.009	0.013	0.195	0.001716	0.00038	0.11	0.232	0.015	0.036	0.007	0.0005	0.35	7.90	1332
3	223	49	98	77	50	23	918	17.4	2.3	4.6	0.73	0.0023	0.00077	0.016	0.00012	0.29	0.003	0.020	0.038	0.195	0.001716	0.00057	0.37	0.256	0.040	0.067	0.017	0.0009	0.81	7.86	1453
4	221	43	89	85	53	23	879	18.2	2.5	4.4	0.82	0.0034	0.00045	0.017	0.00009	0.28	0.004	0.026	0.052	0.195	0.001716	0.00079	0.52	0.312	0.055	0.087	0.022	0.0018	1.06	7.87	1410
5	208	37	82	90	53	24	815	18.6	2.6	3.8	0.92	0.0056	0.00031	0.018	0.00007	0.27	0.005	0.029	0.062	0.195	0.001715	0.00106	0.60	0.350	0.064	0.099	0.025	0.0038	1.17	7.88	1325
6	197	35	84	91	68	24	767	17.2	2.7	3.2	1.02	0.0053	0.00024	0.018	0.00007	0.26	0.005	0.030	0.064	0.195	0.001715	0.00106	0.64	0.364	0.067	0.103	0.026	0.0035	1.21	7.89	1281
7	182	34	87	87	83	25	709	15.2	2.8	2.7	1.16	0.0042	0.00020	0.019	0.00006	0.25	0.005	0.029	0.061	0.194	0.001715	0.00103	0.61	0.350	0.063	0.098	0.025	0.0026	1.15	7.90	1218
8	175	33	88	84	90	26	678	13.9	2.8	2.5	1.24	0.0037	0.00018	0.019	0.00006	0.24	0.005	0.028	0.058	0.194	0.001715	0.00101	0.60	0.341	0.061	0.095	0.024	0.0021	1.11	7.91	1184
9	172	33	89	83	94	26	668	13.2	2.8	2.4	1.27	0.0034	0.00018	0.019	0.00006	0.24	0.005	0.028	0.058	0.194	0.001715	0.00099	0.59	0.338	0.060	0.095	0.024	0.0018	1.10	7.91	1174
10	174	34	90	84	96	26	677	13.2	2.8	2.4	1.24	0.0034	0.00017	0.019	0.00006	0.24	0.005	0.029	0.059	0.194	0.001715	0.00097	0.61	0.343	0.062	0.098	0.024	0.0017	1.13	7.91	1190
11	175	34	91	85	98	25	679	13.2	2.8	2.4	1.24	0.0033	0.00017	0.019	0.00006	0.24	0.005	0.029	0.060	0.194	0.001715	0.00095	0.61	0.345	0.063	0.100	0.025	0.0017	1.13	7.91	1197
12	174	34	92	84	99	26	675	12.9	2.8	2.4	1.26	0.0032	0.00016	0.019	0.00006	0.24	0.005	0.029	0.060	0.194	0.001715	0.00091	0.60	0.343	0.063	0.101	0.024	0.0016	1.12	7.91	1193
13	172	34	93	84	101	26	672	12.8	2.8	2.4	1.27	0.0032	0.00016	0.019	0.00006	0.24	0.005	0.028	0.059	0.194	0.001715	0.00087	0.58	0.340	0.062	0.102	0.024	0.0015	1.09	7.91	1190
14	173	35	93	84	102	26	673	12.8	2.8	2.4	1.27	0.0032	0.00015	0.019	0.00006	0.24	0.005	0.028	0.059	0.194	0.001715	0.00084	0.57	0.340	0.062	0.104	0.024	0.0015	1.08	7.91	1194
15	173	35	94	84	103	26	676	12.8	2.8	2.4	1.27	0.0032	0.00014	0.019	0.00006	0.24	0.005	0.028	0.059	0.194	0.001715	0.00082	0.57	0.341	0.062	0.106	0.024	0.0015	1.07	7.91	1199
16	173	35	94	84	103	26	674	12.7	2.8	2.4	1.26	0.0031	0.00016	0.019	0.00006	0.24	0.005	0.028	0.060	0.194	0.001715	0.00080	0.57	0.339	0.063	0.107	0.024	0.0015	1.07	7.91	1197
17	167	34	92	80	101	26	650	12.3	2.8	2.4	1.29	0.0030	0.00026	0.019	0.00009	0.23	0.005	0.027	0.058	0.194	0.001715	0.00079	0.55	0.323	0.061	0.103	0.023	0.0014	1.03	7.91	1158
18	160	33	89	76	99	25	622	11.8	2.7	2.4	1.34	0.0028	0.00036	0.019	0.00011	0.22	0.005	0.026	0.055	0.194	0.001715	0.00079	0.53	0.305	0.059	0.097	0.022	0.0013	0.99	7.91	1112
19	157	33	89	74	99	26	612	11.6	2.7	2.3	1.39	0.0028	0.00036	0.019	0.00012	0.22	0.004	0.025	0.054	0.194	0.001715	0.00081	0.52	0.297	0.058	0.095	0.021	0.0013	0.98	7.92	1096
20	154	33	89	72	99	26	603	11.4	2.8	2.3	1.42	0.0027	0.00036	0.019	0.00011	0.22	0.004	0.025	0.053	0.194	0.001715	0.00083	0.51	0.291	0.057	0.092	0.021	0.0013	0.97	7.92	1084
21	152	33	90	71	100	26	596	11.2	2.8	2.3	1.45	0.0027	0.00036	0.019	0.00012	0.22	0.004	0.025	0.052	0.194	0.001715	0.00085	0.51	0.286	0.056	0.089	0.021	0.0013	0.96	7.92	1075
22	150	33	90	70	101	26	591	11.1	2.8	2.3	1.48	0.0026	0.00036	0.019	0.00011	0.22	0.004	0.025	0.051	0.194	0.001715	0.00087	0.50	0.282	0.055	0.087	0.020	0.0012	0.95	7.92	1068
23	149	33	90	70	101	26	586	10.9	2.8	2.2	1.50	0.0025	0.00036	0.019	0.00012	0.22	0.004	0.025	0.050	0.194	0.001715	0.00088	0.50	0.278	0.054	0.085	0.020	0.0012	0.93	7.92	1062
24	148	33	91	69	102	26	583	10.8	2.8	2.2	1.51	0.0025	0.00036	0.019	0.00012	0.22	0.004	0.025	0.050	0.194	0.001715	0.00090	0.50	0.276	0.053	0.083	0.020	0.0011	0.93	7.92	1058
25	147	33	91	69	103	26	582	10.7	2.8	2.2	1.52	0.0024	0.00036	0.019	0.00012	0.22	0.004	0.025	0.049	0.194	0.001715	0.00091	0.50	0.274	0.053	0.081	0.020	0.0011	0.92	7.93	1057
26	147	33	92	69	103	26	583	10.7	2.8	2.2	1.52	0.0024	0.00036	0.019	0.00012	0.22	0.004	0.025	0.049	0.194	0.001715	0.00092	0.50	0.273	0.053	0.080	0.020	0.0011	0.92	7.93	1059
27	146	33	91	68	103	26	579	10.7	2.8	2.2	1.52	0.0024	0.00040	0.019	0.00013	0.22	0.004	0.025	0.049	0.194	0.001715	0.00093	0.50	0.270	0.053	0.078	0.019	0.0011	0.91	7.92	1052
28	144	33	91	67	102	26	572	10.6	2.8	2.2	1.52	0.0024	0.00045	0.019	0.00014	0.22	0.004	0.024	0.048	0.194	0.001715	0.00093	0.50	0.266	0.052	0.077	0.019	0.0011	0.89	7.92	1041
29	143	33	91	66	102	26	568	10.5	2.8	2.2	1.55	0.0024	0.00044	0.019	0.00014	0.22	0.004	0.024	0.047	0.194	0.001715	0.00091	0.49	0.263	0.051	0.077	0.019	0.0011	0.87	7.92	1035
30	142	33	91	66	103	26	565	10.4	2.8	2.2	1.57	0.0024	0.00044	0.019	0.00014	0.22	0.004	0.024	0.047	0.194	0.001715	0.00088	0.49	0.261	0.051	0.077	0.019	0.0011	0.85	7.93	1032
31	141	33	91	65	103	26	563	10.4	2.8	2.1	1.59	0.0024	0.00045	0.020	0.00014	0.21	0.004	0.024	0.047	0.194	0.001715	0.00085	0.48	0.259	0.051	0.078	0.018	0.0011	0.83	7.93	1028
32	141	33	91	65	102	26	561	10.3	2.8	2.2	1.59	0.0024	0.00052	0.019	0.00016	0.21	0.004	0.024	0.046	0.194	0.001715	0.00082	0.47	0.255	0.050	0.079	0.018	0.0011	0.80	7.93	1023
33	140	33	91	64	101	26	561	10.3	2.7	2.2	1.57	0.0024	0.00061	0.019	0.00018	0.21	0.004	0.023	0.046	0.194	0.001715	0.00079	0.47	0.252	0.050	0.079	0.018	0.0011	0.78	7.92	1022
34	142	34	92	64	102	26	570	10.4	2.7	2.3	1.52	0.0024	0.00072	0.019	0.00021	0.22	0.004	0.023	0.046	0.194	0.001715	0.00077	0.47	0.252	0.051	0.080	0.018	0.0012	0.77	7.92	1035
35	145	35	93	65	102	25	583	10.4	2.6	2.4	1.46	0.0025	0.00089	0.019	0.00025	0.22	0.004	0.023	0.047	0.194	0.001714	0.00077	0.47	0.252	0.053	0.082	0.018	0.0012	0.77	7.91	1054
36	147	36	95	65	102	25	595	10.5	2.5	2.5	1.40	0.0026	0.00111	0.018	0.00029	0.23	0.004	0.023	0.048	0.194	0.001714	0.00079	0.48	0.251	0.054	0.083	0.018	0.0013	0.76	7.90	1071
37	150	37	97	65	103	24	610	10.6	2.4	2.7	1.32	0.0026	0.00146	0.018	0.00034	0.23	0.004	0.023	0.048	0.194	0.001714	0.00082	0.48	0.248	0.056	0.083	0.018	0.0013	0.75	7.89	1092
38	157	40	102	67	108	24	646	10.8	2.3	2.9	1.23	0.0028	0.00183	0.018	0.00040	0.25	0.004	0.024	0.050	0.195	0.001714	0.00091	0.50	0.255	0.059	0.086	0.018	0.0014	0.77	7.89	1151
39	165	42	109	70	115	24	686	10.8	2.2	3.1	1.15	0.0029	0.00218	0.017	0.00046	0.26	0.004	0.025	0.053	0.195	0.001715	0.00100	0.53	0.264	0.062	0.089	0.019	0.0015	0.80	7.88	1219
40	169	46	117	74	123	24	718	10.8	2.2	3.4	1.10	0.0031	0.00254	0.017	0.00052	0.28	0.004	0.026	0.057	0.195	0.001715	0.00112	0.57	0.278	0.067	0.094	0.020	0.0016	0.85	7.88	1279
41	169	49	126	79	133	24	742	10.8	2.2	3.7	1.07	0.0033	0.00293	0.017	0.00060	0.30	0.004	0.028	0.061	0.195	0.001716	0.00124	0.61	0.296	0.073	0.100	0.021	0.0017	0.90	7.88	1330

Table 5-3. Predictions of average annual concentrations for the Embankment

	Ca	Mg	Na	K	Cl	HCO_3	SO_4	Si	F	NO_3-N	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Ag	Tl	Zn	pH	TDS
Year	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
1	209	62	125	82	57	25	994	19.0	2.9	1.9	0.45	0.0014	0.001654	0.017	0.000018	0.339	0.001	0.004	0.005	0.191	0.001692	0.0005	0.0180	0.242	0.006	0.027	0.004	0.0006	0.24	7.88	1566
2	220	59	118	88	57	25	994	19.4	2.9	3.7	0.91	0.0017	0.000169	0.017	0.000023	0.331	0.001	0.010	0.015	0.195	0.001717	0.0004	0.1223	0.277	0.016	0.043	0.008	0.0006	0.41	7.89	1576
3	260	57	115	90	59	23	1078	19.4	2.7	4.9	0.81	0.0027	0.000018	0.017	0.000028	0.336	0.004	0.024	0.044	0.195	0.001717	0.0007	0.4325	0.302	0.046	0.080	0.020	0.0011	0.96	7.86	1700
4	241	47	97	93	58	24	959	19.4	2.7	4.6	0.88	0.0038	0.000010	0.017	0.000032	0.301	0.005	0.029	0.057	0.195	0.001716	0.0009	0.5681	0.342	0.059	0.096	0.024	0.0019	1.16	7.88	1537
5	220	39	87	96	56	24	865	19.4	2.8	3.9	0.96	0.0060	0.000008	0.018	0.000033	0.286	0.006	0.031	0.065	0.195	0.001716	0.0011	0.6391	0.374	0.068	0.106	0.027	0.0041	1.25	7.89	1406
6	206	36	88	96	72	25	801	17.7	2.8	3.2	1.06	0.0055	0.000007	0.018	0.000034	0.271	0.006	0.031	0.067	0.194	0.001716	0.0011	0.6652	0.382	0.069	0.108	0.027	0.0037	1.27	7.90	1339
7	189	35	90	90	86	26	735	15.6	2.9	2.7	1.20	0.0044	0.000006	0.019	0.000033	0.254	0.005	0.030	0.063	0.194	0.001716	0.0011	0.6346	0.364	0.065	0.102	0.026	0.0027	1.20	7.92	1264
8	180	34	91	87	93	26	701	14.2	2.9	2.4	1.29	0.0038	0.000006	0.019	0.000033	0.245	0.005	0.030	0.060	0.194	0.001716	0.0010	0.6138	0.354	0.062	0.099	0.025	0.0021	1.15	7.92	1224
9	178	34	92	86	97	26	690	13.5	2.9	2.4	1.32	0.0035	0.000006	0.019	0.000033	0.243	0.005	0.029	0.060	0.194	0.001716	0.0010	0.6094	0.350	0.062	0.098	0.025	0.0018	1.15	7.93	1214
10	180	35	93	87	99	26	699	13.5	2.9	2.4	1.29	0.0035	0.000005	0.019	0.000033	0.246	0.005	0.030	0.061	0.194	0.001716	0.0010	0.6228	0.356	0.064	0.102	0.025	0.0018	1.17	7.93	1230
11	181	35	94	88	101	26	702	13.4	2.9	2.4	1.29	0.0034	0.000005	0.019	0.000032	0.247	0.005	0.030	0.062	0.194	0.001716	0.0010	0.6251	0.357	0.064	0.104	0.025	0.0017	1.18	7.93	1236
12	179	35	95	87	103	26	696	13.2	2.9	2.4	1.31	0.0033	0.000005	0.019	0.000031	0.246	0.005	0.030	0.061	0.194	0.001717	0.0009	0.6127	0.355	0.064	0.105	0.025	0.0017	1.15	7.93	1231
13	178	35	96	87	104	27	693	13.0	2.9	2.4	1.33	0.0033	0.000005	0.019	0.000030	0.246	0.005	0.029	0.061	0.194	0.001717	0.0009	0.5971	0.352	0.063	0.106	0.025	0.0016	1.13	7.93	1228
14	177	35	96	86	105	27	692	13.0	2.9	2.4	1.33	0.0033	0.000005	0.019	0.000029	0.247	0.005	0.029	0.060	0.194	0.001717	0.0009	0.5867	0.351	0.063	0.108	0.025	0.0016	1.11	7.93	1229
15	178	36	97	87	106	27	694	13.0	2.9	2.4	1.33	0.0033	0.000005	0.019	0.000028	0.248	0.005	0.029	0.061	0.194	0.001717	0.0008	0.5837	0.352	0.063	0.110	0.025	0.0016	1.11	7.93	1233
16	178	36	97	86	107	27	695	13.0	2.9	2.4	1.33	0.0032	0.000005	0.019	0.000028	0.248	0.005	0.029	0.061	0.194	0.001717	0.0008	0.5838	0.351	0.064	0.111	0.025	0.0016	1.11	7.93	1236
17	175	36	97	84	107	27	684	12.7	2.9	2.4	1.37	0.0031	0.000005	0.019	0.000028	0.246	0.005	0.028	0.060	0.194	0.001717	0.0008	0.5721	0.343	0.063	0.109	0.024	0.0015	1.09	7.93	1219
18	171	35	97	82	107	27	668	12.3	3.0	2.3	1.43	0.0030	0.000005	0.020	0.000028	0.242	0.005	0.028	0.059	0.194	0.001717	0.0008	0.5557	0.331	0.061	0.106	0.024	0.0015	1.07	7.94	1195
19	167	35	97	80	107	27	655	12.0	3.0	2.3	1.48	0.0030	0.000005	0.020	0.000028	0.239	0.005	0.027	0.057	0.194	0.001717	0.0009	0.5434	0.322	0.059	0.102	0.023	0.0014	1.06	7.94	1176
20	164	35	96	78	107	27	644	11.8	3.0	2.3	1.52	0.0029	0.000005	0.020	0.000029	0.237	0.005	0.027	0.056	0.194	0.001718	0.0009	0.5332	0.314	0.058	0.099	0.023	0.0014	1.04	7.94	1159
21	162	35	96	76	108	28	635	11.6	3.0	2.2	1.55	0.0028	0.000005	0.020	0.000029	0.235	0.005	0.027	0.055	0.194	0.001718	0.0009	0.5255	0.308	0.057	0.096	0.022	0.0014	1.03	7.95	1146
22	159	35	96	75	108	28	627	11.4	3.0	2.2	1.58	0.0028	0.000005	0.020	0.000030	0.234	0.005	0.027	0.054	0.194	0.001718	0.0009	0.5192	0.302	0.056	0.093	0.022	0.0013	1.01	7.95	1135
23	157	35	97	74	109	28	621	11.2	3.0	2.2	1.61	0.0027	0.000006	0.020	0.000030	0.232	0.004	0.026	0.052	0.193	0.001718	0.0009	0.5147	0.298	0.055	0.091	0.021	0.0013	1.00	7.95	1127
24	156	35	97	73	109	28	617	11.0	3.1	2.1	1.62	0.0026	0.000006	0.020	0.000031	0.232	0.004	0.026	0.052	0.193	0.001718	0.0009	0.5126	0.295	0.054	0.088	0.021	0.0012	0.99	7.95	1121
25	155	35	97	73	110	28	615	11.0	3.1	2.1	1.63	0.0026	0.000006	0.020	0.000031	0.231	0.004	0.026	0.051	0.193	0.001718	0.0010	0.5141	0.293	0.054	0.087	0.021	0.0012	0.98	7.95	1119
26	155	35	98	73	110	28	614	10.9	3.1	2.1	1.64	0.0026	0.000006	0.020	0.000032	0.232	0.004	0.027	0.051	0.193	0.001718	0.0010	0.5169	0.292	0.053	0.085	0.021	0.0012	0.98	7.95	1119
27	154	35	98	72	110	28	613	10.9	3.1	2.1	1.64	0.0026	0.000006	0.020	0.000032	0.232	0.004	0.027	0.051	0.193	0.001718	0.0010	0.5187	0.290	0.053	0.084	0.021	0.0012	0.97	7.95	1117
28	153	35	97	71	110	28	607	10.8	3.1	2.1	1.67	0.0025	0.000006	0.020	0.000032	0.230	0.004	0.026	0.050	0.193	0.001718	0.0010	0.5135	0.286	0.052	0.083	0.020	0.0012	0.95	7.95	1107
29	151	35	97	70	110	28	599	10.6	3.1	2.1	1.70	0.0025	0.000006	0.020	0.000032	0.228	0.004	0.026	0.049	0.193	0.001718	0.0010	0.5051	0.282	0.051	0.082	0.020	0.0012	0.93	7.95	1095
30	149	35	96	69	109	28	592	10.5	3.1	2.0	1.73	0.0025	0.000006	0.020	0.000031	0.226	0.004	0.026	0.048	0.193	0.001718	0.0009	0.4960	0.277	0.050	0.082	0.020	0.0012	0.90	7.96	1084
31	147	34	96	69	108	28	587	10.4	3.1	2.0	1.76	0.0025	0.000006	0.020	0.000030	0.225	0.004	0.025	0.047	0.193	0.001719	0.0009	0.4853	0.274	0.050	0.083	0.020	0.0012	0.87	7.96	1075
32	146	34	96	68	108	28	583	10.4	3.1	1.9	1.78	0.0025	0.000006	0.020	0.000029	0.224	0.004	0.025	0.046	0.193	0.001719	0.0008	0.4723	0.270	0.049	0.083	0.019	0.0012	0.84	7.96	1069
33	145	34	95	67	107	28	580	10.4	3.1	1.9	1.81	0.0025	0.000006	0.020	0.000028	0.223	0.004	0.024	0.045	0.193	0.001719	0.0008	0.4575	0.265	0.048	0.083	0.019	0.0012	0.81	7.96	1062
34	145	34	95	66	106	28	580	10.5	3.1	1.9	1.81	0.0025	0.000006	0.020	0.000027	0.223	0.004	0.024	0.045	0.193	0.001719	0.0008	0.4454	0.262	0.047	0.084	0.019	0.0012	0.79	7.96	1060
35	146	35	95	66	105	28	585	10.6	3.1	1.9	1.80	0.0025	0.000006	0.020	0.000026	0.224	0.004	0.024	0.044	0.193	0.001719	0.0007	0.4368	0.259	0.047	0.085	0.018	0.0013	0.78	7.96	1065
36	148	35	96	66	104	28	593	10.8	3.1	1.9	1.78	0.0026	0.000006	0.020	0.000026	0.227	0.004	0.024	0.044	0.193	0.001719	0.0007	0.4309	0.257	0.046	0.086	0.018	0.0013	0.77	7.96	1075
37	151	36	97	66	102	28	606	11.1	3.1	1.9	1.74	0.0026	0.000006	0.020	0.000026	0.230	0.004	0.024	0.044	0.193	0.001718	0.0007	0.4272	0.257	0.046	0.087	0.018	0.0014	0.76	7.96	1090
38	153	36	97	66	101	28	617	11.4	3.1	1.9	1.71	0.0027	0.000007	0.020	0.000025	0.233	0.0036	0.0234	0.0441	0.193	0.001718	0.0007	0.4231	0.255	0.046	0.087	0.018	0.0015	0.76	7.95	1105
39	154	37	98	66	100	28	623	11.5	3.1	1.9	1.70	0.0027	0.000009	0.020	0.000025	0.235	0.0036	0.0232	0.0437	0.193	0.001718	0.00071	0.41823	0.253	0.046	0.086	0.018	0.0015	0.75	7.95	1111
40	154	37	98	65	100	28	625	11.6	3.1	1.9	1.70	2.8E-03	3.0E-05	2.0E-02	2.5E-05	0.236	3.6E-03	2.3E-02	4.3E-02	1.9E-01	1.7E-03	7.2E-04	4.2E-01	2.5E-01	4.6E-02	8.6E-02	1.8E-02	1.5E-03	7.5E-01	7.95	1114
41	154	36.8	98.1	65.3	99.9	28.0	626	11.59	3.0848	1.8693	1.6948	2.8E-03	5.7E-05	2.0E-02	2.5E-05	0.2361	3.6E-03	2.3E-02	4.3E-02	1.9E-01	1.7E-03	7.2E-04	4.1E-01	2.5E-01	4.6E-02	8.6E-02	1.8E-02	1.5E-03	7.5E-01	7.95	1115

6 REFERENCES

Enchemica (2018) Water Chemistry Inputs for Operational Models of Tailings Circuit Solute Chemistry. Technical Memo from T. Eary (Enchemica) to V. Peacey (Resolution Copper), July 18, 2018.

KCB (2018) GoldSim water balance model, received from Klohn Crippen Berger (KCB) on May 11, 2018 (documentation to be provided in future.)

Parkhurst, D.L. and Appelo, C.A.J. (2013) Description of Input and Examples for PHREEQC Version 3 – A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations. U.S. Geological Survey Techniques and Methods, Book 6, Chapter A43, 497 p, available only at http://pubs.usgs.gov/tm/06/a43.

RESOLUTION
C O P P E R

102 Magma Heights – P.O. Box 1944
Superior, AZ 85173
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July 20, 2018

Ms. Mary Rasmussen
US Forest Service
Supervisor's Office
2324 East McDowell Road
Phoenix, AZ 85006-2496

Subject: Response to Analysis Data Request #1 – Request for Analysis of Tailings Seepage – Item #2 Tailings Solute Modeling.

Dear Ms. Rasmussen,

In partial response to your letter dated March 8, 2018, the following documents are attached as requested:

2. **Tailings Solute Modeling**: It is our understanding that the water balance and geochemical modeling for tailings solute is being updated, specific to each alternative tailings storage facility, and including specific analysis of oxidation potential of the embankment. There is an expectation that modeling would cover both operational and post-closure time frames.

Request: RCM to provide USFS with block cave geochemical modeling.

RCM Response: As requested, please see the attached technical memorandums by Enchemica dated July 17, 2018 for the following tailing storage facilities (TSF):

- *Alternative 2 - Near West Modified Proposed Action: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 3 - Near West Modified Proposed Action – Thin Lift/PAG Cell: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 4 - Silver King Filtered: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 5 - Peg Leg: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 6 - Skunk Camp: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Common Inputs Common to All Operational Models of Tailings Circuit Solute Chemistry*

Overall, there are no substantive differences in predictive solute chemistry for the alternative TSF sites with the exception of Alternative 4 (Silver King). The solute balances are useful tools for TSF alternatives comparison, but it is also worth noting that the model likely over predicts solute chemistry due to several conservative assumptions:

1. No mitigations have been applied to the water chemistry
2. Water from the block cave mine, which has the poorest water quality and highest solute load, has first priority to meet the water demand at the West Plant (concentrator).
3. Makeup water needed at the end of the operational period are sourced from the Pyrite Pond and water from the block cave. The decrease in the amount of freshwater makeup results in less dilution of the combined effects of evaporation and inflow of chemical loads from the block cave.

Once a selected TSF has been identified, additional mitigation approaches may be incorporated as needed.

Sincerely,

Vicky Peacey,

Senior Manager, Environment, Permitting and Approvals; Resolution Copper Company, as Manager of Resolution Copper Mining, LLC

Cc: Ms. Mary Morissette; Senior Environmental Specialist; Resolution Copper Company

Enclosure(s)

Technical Memorandum by Enchemica (2018), *Alternative 2 - Near West Modified Proposed Action: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 3 - Near West Modified Proposed Action – Thin Lift/PAG Cell: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 4 - Silver King Filtered: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 5 - Peg Leg: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 6 - Skunk Camp: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Common Inputs Common to All Operational Models of Tailings Circuit Solute Chemistry*