14 Surface Water Quality

Surface water is a critical component of the biological and physical environment and is protected under the British Columbia *Water Act* (1996b) and the *Canada Water Act* (1985a). Physical and chemical constituents of water are important in determining aquatic ecosystem productivity, fish and aquatic life habitat quality, and toxicity. Water quality in local streams and lakes is highly valued by Nisga'a Nation, First Nations, local people, and the provincial and federal governments. Water quality is determined by a variety of local factors including rock weathering, surface transport, microbial activity, primary and secondary producer communities, and anthropogenic influences. The KSM Project (the Project) design includes surface water diversions, groundwater seepage recovery, collection, treatment and discharge of surface water in contact with the Mine Site, and discharge from the Tailing Management Facility (TMF). A pre-development water quality and toxicity baseline was established to allow the prediction, assessment, and mitigation and management of potential Project-related effects.

14.1 Surface Water Quality Setting

14.1.1 Overview

The baseline stream water quality program focused on the watercourses that could potentially be affected by mining development and operation (the baseline study area) and were selected to coincide with locations where other baseline studies were conducted, including surface water quantity (Chapter 13), aquatic resources (Chapter 15), and fish and fish habitat (Chapter 15). The baseline surface water quality program meets or exceeds the expectations of the *Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators* (BC MOE 2012). Forty-nine stream and river sampling sites and four lakes were included in the baseline water quality program (Figure 14.1-1). Sites in the McTagg, Mitchell, Sulphurets, Bowser, and Unuk drainages were selected to examine the area potentially affected by the proposed Mine Site and associated access roads. Sites in the Bell-Irving, Teigen/Snowbank, and Treaty drainages were selected to address the potential effects of the proposed Processing and Tailing Management Area (PTMA) and associated access roads. Surface water quality baseline information was collected from streams, rivers, and lakes in the baseline study area from 2007 to 2012 (Figure 14.1-1; Appendix 14-A to Appendix 14-C). Sampling sites and analyzed water quality parameters were developed to reflect updates to Project designs and in consultation with regulators, Nisga'a Nation, First Nations, and other members of the Working Group.

During the five-year water quality baseline study (2007 to 2012), over 1,000 water quality samples were analyzed using industry-standard techniques at ALS Environmental Laboratories in Burnaby, British Columbia (BC), which is an accredited environmental laboratory. Sampling procedures, data analysis, and QA/QC followed the principles and procedures outlined in the *British Columbia Field Sampling Manual* (BC MWLAP 2003a). Water quality samples were analyzed for physical parameters (e.g., pH, hardness, turbidity), major anions, nutrients, cyanides, total organic carbon, and total and dissolved metals using the best available detection limits. Selenium speciation analysis of deposit area groundwater seeps and baseline study area streams and rivers was conducted in 2012 to gain a better understanding of the chemical behaviour of selenium in the baseline study area.

Selenium speciation analysis was completed at Applied Speciation and Consulting, LLC in Bothell, Washington. Acute and chronic water toxicity of selected stream sites in both the Mine Site and PTMA was measured using the Environment Canada standard suite of toxicity tests at Nautilus Environmental in Burnaby, BC (see Section 14.1.2.3).

Where applicable, water quality parameters were compared to BC water quality guidelines including working, approved, and draft chronic (30-day average) guidelines for the protection of freshwater aquatic life (BC MOE 2006b, 2006a; Meays and Nordin 2012). Acute (maximum) guidelines were used in the absence of chronic guidelines.

14.1.2 Streams

Water quality samples were collected to characterize the natural spatial and temporal variation present in streams and rivers in the baseline study area. Near-, mid-, and far-field monitoring sites were established upstream and downstream of the proposed mining development, and tworeference sites were selected in adjacent watersheds. The hydrological regime is an important determinant of stream water quality in the Project area. Local streams typically experience a low flow period between November and April, and higher flows between May and October associated with freshet, summer glacial melt, and fall heavy rain events. The hydrological regime affects water quality in two ways: 1) increased discharge during freshet, glacial melt, and heavy rainfall events dilutes concentrations of major ions and total dissolved solids; and 2) increased sediment load and transport during high flow periods leads to increased concentrations of total suspended solids (TSS) and particle-associated metals. To capture the increased variability in water quality during peak flow periods, samples were collected weekly at 10 sites during freshet in 2008 and 2009, and during peak rainfall events in September and October. Baseline data for streams and rivers are included in Appendix 14-A and Appendix 14-B.

The results of the surface water quality baseline study are presented in the sections below for two distinct areas of the Project: the Mine Site and the PTMA.

14.1.2.1 Mine Site

14.1.2.1.1 Water Quality

Twenty-five stream and river water quality sites were monitored in the Mine Site baseline study area from 2007 to 2012. A summary of the Mine Site stream water quality is presented in Table 14.1-1. Most streams near the proposed Mine Site were near-neutral to slightly alkaline, with moderately hard to soft waters, and with low sensitivity to acid inputs. The exception was the upper reaches of Mitchell Creek, where acidic and poorly buffered conditions were a result of naturally occurring acid rock drainage from the highly mineralized deposit area. At the toe of the Mitchell Glacier (site MC1A-US), pH values were occasionally measured below 3.0. The pH of lower Mitchell Creek above the confluence with Sulphurets Creek (site MC2) was frequently 2 to 3 pH units higher than at MC1A-US, indicating an increase in buffering capacity due to mixing with the well-buffered McTagg and Gingras creeks and interactions with neutralizing carbonate minerals. Sulphurets Creek and the Unuk River have a low sensitivity to acid inputs (mean annual alkalinity > 20 mg/L as $CaCO_3$) and typically had near-neutral pH values throughout the year (Table 14.1-1).

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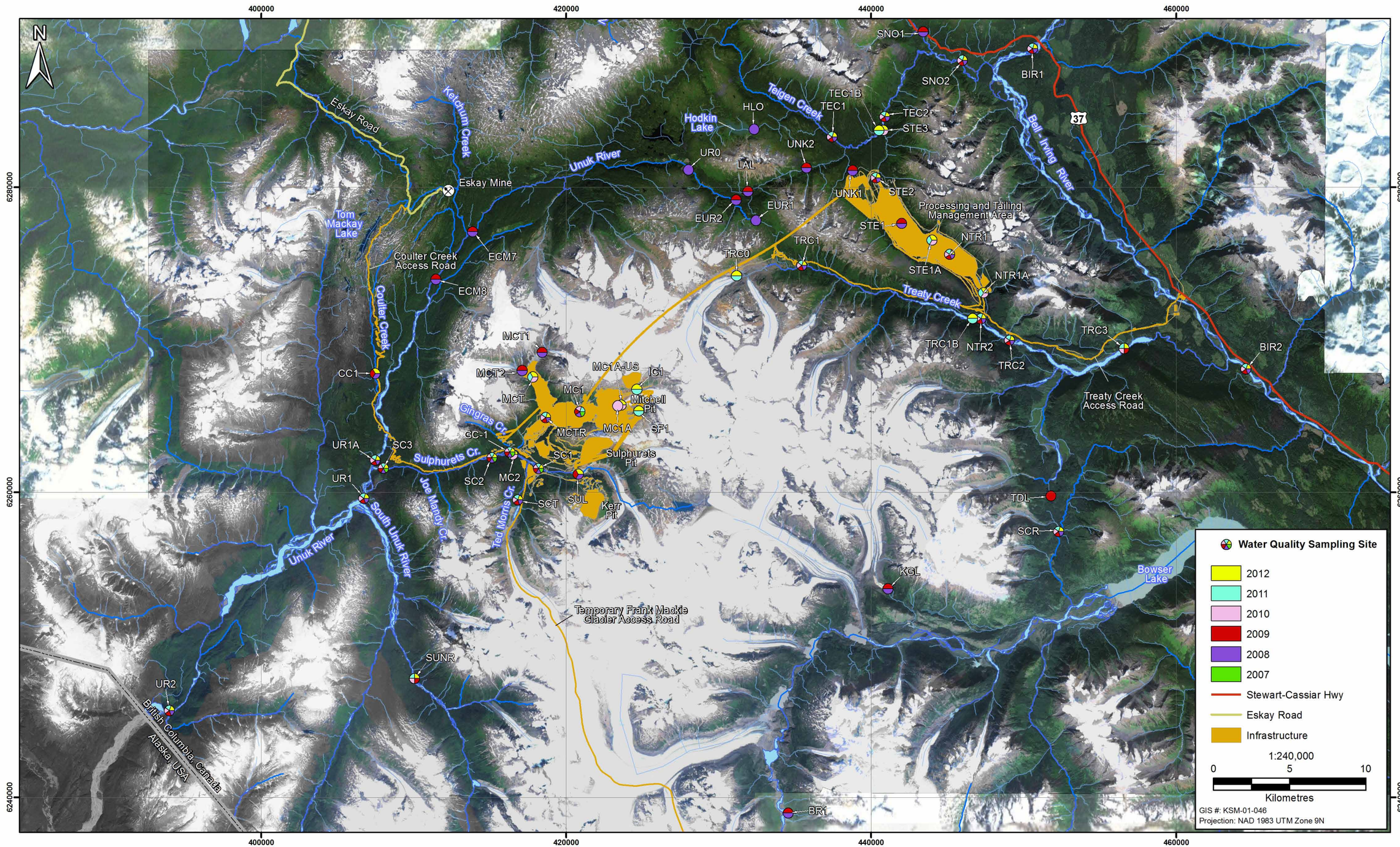

Figure 14.1-1

SEABRIDGE GOLD
KSM PROJECT

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Water Quality Sampling Locations 2007-2012, KSM Project

Table 14.1-1. Water Quality of Streams and Rivers of the Mine Site, KSM Project, 2007 to 2012

	Guidelines for the Protection of Freshwater Aquatic Life		Project Area Watershed	Mine Site Area																	
				Bowser (n = 1 site)				Mitchell (n = 7 sites)				McTagg (n = 4 sites)				Sulphurets (n = 4 sites)				Unuk (n = 9 sites)			
				Nov to Apr (n = 3 samples)		May to Oct (n = 3 samples)		Nov to Apr (n = 33 samples)		May to Oct (n = 91 samples)		Nov to Apr (n = 17 samples)		May to Oct (n = 42 samples)		Nov to Apr (n = 54 samples)		May to Oct (n = 103 samples)		Nov to Apr (n = 42 samples)		May to Oct (n = 105 samples)	
Parameter	BC Chronic (30-day mean)	BC Acute (Maximum)	Units	Mean	Max[1]	Mean	Max[1]	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P
Physical Parameters																							
Colour, True	background-dependent	-	colour unit	2.5	2.5	2.5	2.5	3.8	12.3	13.9	95.8	2.5	2.5	9.7	92.5	2.5	2.5	7.5	64.3	2.7	2.5	5.7	6.6
Conductivity	-	-	uS/cm	218	258	89	118	518	982	381	1005	396	451	166	256	400	473	185	360	229	330	123	215
Hardness (as $CaCO_3$)	-	-	mg/L	104	122	42.0	54.7	203	314	130	261	199	233	92.3	195	188	223	93.7	210	108	154	59.2	106
pH	-	6.5 to 9.0	pH unit	8.09	8.10	7.85	8.01	6.62	8.21	**5.59**	8.18	8.18	8.29	7.92	8.15	8.04	8.18	7.80	8.14	8.01	8.16	7.79	8.14
Total Suspended Solids	background-dependent	-	mg/L	1.5	1.5	61.0	143	36.5	107	202	602	7.1	23.8	81.5	228	10.2	29.1	153	545	3.2	8.0	68.2	299
Total Dissolved Solids	-	-	mg/L	127	151	66	72	348	677	258	691	253	296	114	163	263	322	125	245	139	203	83	131
Turbidity	background-dependent	-	NTU	1.8	2.3	69.2	122	67.2	170	170	363	3.1	11.8	60.9	160	13.6	32.4	118	371	3.4	10.9	50.5	172
Anions and Nutrients																							
Acidity (as $CaCO_3$)	-	-	mg/L	1.3	1.9	2.0	2.8	38.2	188.0	63.3	288.1	1.8	6.0	2.5	4.2	2.9	5.9	3.2	6.0	2.7	5.2	3.0	5.3
Alkalinity, Total (as $CaCO_3$)	descriptive ranges	-	mg/L	77.3	94.8	33.2	39.9	53.6	94.6	16.9	77.1	111.8	132.2	55.5	82.9	82.1	104.8	35.5	68.2	70.5	90.9	39.4	67.7
Ammonia (as N)	temperature- and pH-dependent	temperature- and pH-dependent	mg/L	0.0039	0.0067	0.0025	0.0025	0.0039	0.0100	0.0045	0.0140	0.0025	0.0025	0.0029	0.0051	0.0026	0.0025	0.0036	0.0102	0.0033	0.0051	0.0033	0.0069
Bromide	-	-	mg/L	0.025	0.025	0.025	0.025	0.128	0.621	0.074	0.250	0.054	0.264	0.025	0.025	0.048	0.303	0.025	0.025	0.025	0.025	0.027	0.025
Chloride	150	-	mg/L	0.25	0.25	0.25	0.25	0.66	2.50	0.73	2.50	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.27	0.25	0.25	0.25
Fluoride	-	hardness-dependent	mg/L	0.0333	0.0420	0.0100	0.0100	0.5152	**1.6780**	0.4687	**1.5055**	0.0475	0.0588	0.0228	0.0369	0.1117	0.1884	0.0766	0.1688	0.0533	0.0949	0.0350	0.0671
Nitrate (as N)	3	32.8	mg/L	0.0291	0.0364	0.0124	0.0217	0.0944	0.182	0.0616	0.285	0.102	0.371	0.0436	0.127	0.0860	0.176	0.0561	0.214	0.0909	0.146	0.0499	0.175
Nitrite (as N)	chloride-dependent	-	mg/L	0.0005	0.0005	0.0005	0.0005	0.0013	0.0050	0.0019	0.0080	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0024	0.0005
Ortho-Phosphate (as P)	-	-	mg/L	0.0005	0.0005	0.0008	0.0013	0.0088	0.0517	0.1018	0.6912	0.0015	0.0021	0.0020	0.0033	0.0008	0.0012	0.0012	0.0030	0.0006	0.0014	0.0093	0.0029
Total Phosphate (as P)	-	-	mg/L	0.0016	0.0029	0.0704	0.151	0.435	1.75	1.41	6.96	0.0148	0.0505	0.121	0.314	0.0390	0.0992	0.286	1.01	0.0100	0.0316	0.315	0.493
Sulphate	hardness-dependent	-	mg/L	36.9	45.8	11.1	16.5	199.4	483.4	156.2	464.0	96.2	115.8	35.3	62.5	122.3	146.7	57.4	114.8	46.6	79.7	22.8	47.4
Cyanides																							
Cyanide, Weak Acid Dissociable	0.005	0.01	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide, Total	-	-	mg/L	0.0005	0.0005	0.0005	0.0005	0.0006	0.0008	0.0006	0.0012	0.0005	0.0005	0.0005	0.0005	0.0006	0.0012	0.0006	0.0012	0.0009	0.0019	0.0008	0.0020
Thiocyanate	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon																							
Total Organic Carbon	background-dependent	-	mg/L	0.25	0.25	0.25	0.25	0.33	0.70	0.45	0.92	0.38	0.78	0.43	0.93	0.41	0.74	0.53	1.39	0.76	1.43	1.00	2.40
Total Metals																							
Aluminum (Al)	-	-	mg/L	*0.147*	*0.345*	*2.84*	*4.76*	*2.72*	*9.65*	*5.94*	*16.6*	*0.148*	*0.476*	*2.66*	*6.31*	*0.450*	*1.05*	*4.01*	*10.5*	*0.164*	*0.503*	*2.13*	*8.12*
Antimony (Sb)	-	0.02	mg/L	0.000353	0.000360	0.000493	0.000660	0.000787	0.00173	0.00119	0.00301	0.000504	0.000688	0.000640	0.000967	0.000790	0.00140	0.00120	0.00202	0.00186	0.00332	0.00117	0.00232
Arsenic (As)	-	0.005	mg/L	0.00112	0.00148	0.00248	0.00434	**0.0229**	**0.0795**	**0.0690**	**0.425**	0.00053	0.00121	0.00255	0.00475	0.00211	**0.00574**	**0.0110**	**0.0493**	0.00081	0.00203	**0.00653**	**0.0151**
Barium (Ba)	-	-	mg/L	0.0631	0.0724	0.0828	0.119	0.0309	0.0513	0.156	0.427	0.0255	0.0305	0.0497	0.0990	0.0439	0.0558	0.110	0.283	0.0359	0.0443	0.0568	0.144
Beryllium (Be)	0.0053	-	mg/L	0.00025	0.00025	0.00025	0.00025	0.00096	0.00361	0.00099	0.00442	0.00020	0.00025	0.00024	0.00025	0.00021	0.00025	0.00027	0.00053	0.00020	0.00025	0.00022	0.00025
Bismuth (Bi)	-	-	mg/L	0.00025	0.00025	0.00025	0.00025	0.00027	0.00035	0.00032	0.00054	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00026	0.00025	0.00025	0.00025	0.00035	0.00025
Boron (B)	-	1.2	mg/L	0.005	0.005	0.005	0.005	0.009	0.019	0.006	0.010	0.005	0.005	0.005	0.005	0.006	0.013	0.005	0.005	0.005	0.010	0.005	0.005
Cadmium (Cd)	-	hardness-dependent	mg/L	0.000026	**0.000038**	**0.000089**	**0.000176**	**0.0102**	**0.0406**	**0.00952**	**0.0381**	**0.000138**	**0.000286**	**0.000185**	**0.000475**	**0.00110**	**0.00247**	**0.00132**	**0.00377**	**0.000292**	**0.000873**	**0.325**	**0.000891**
Calcium (Ca)	-	-	mg/L	37.9	43.6	17.8	21.0	72.8	114	41.2	80.6	69.4	85.5	33.2	50.3	67.7	80.8	33.4	65.7	36.4	52.8	19.2	31.4
Chromium (Cr)	-	0.001	mg/L	0.00025	0.00025	**0.00274**	**0.00455**	0.00036	**0.00102**	**0.00142**	**0.00311**	0.00033	0.00070	**0.00283**	**0.00736**	0.00035	0.00084	**0.00371**	**0.00940**	0.00030	0.00078	**0.00348**	**0.0146**
Cobalt (Co)	0.004	0.11	mg/L	0.00017	0.00041	0.00157	0.00297	0.0106	0.0360	0.0140	0.0452	0.00024	0.00074	0.00224	0.00492	0.00143	0.00292	0.00383	0.00937	0.00034	0.00102	0.00244	0.00573
Copper (Cu)	hardness-dependent	hardness-dependent	mg/L	0.00100	0.00205	**0.00802**	**0.0151**	**0.629**	**2.06**	**0.892**	**2.74**	0.00147	0.00477	**0.0113**	**0.0256**	**0.0718**	**0.198**	**0.124**	**0.362**	**0.0185**	**0.0708**	**0.327**	**0.0962**
Iron (Fe)	-	1	mg/L	0.279	0.675	**3.07**	**5.85**	**17.0**	**70.7**	**28.5**	**117**	0.348	**1.16**	**4.43**	**9.63**	**1.75**	**4.39**	**7.86**	**19.8**	0.552	**1.74**	**3.28**	**10.5**
Lead (Pb)	hardness-dependent	hardness-dependent	mg/L	0.000348	0.000863	0.00212	0.00439	0.00734	0.0215	0.0175	0.0564	0.000130	0.000452	0.00145	0.00332	0.000966	0.00256	0.00490	0.0127	0.000366	0.00121	0.00209	0.00732
Lithium (Li)	0.014	0.87	mg/L	0.0025	0.0025	0.0025	0.0025	0.0043	0.0102	0.0052	0.0134	0.0021	0.0025	0.0026	0.0030	0.0023	0.0025	0.0029	0.0071	0.0021	0.0025	0.117	0.0061
Magnesium (Mg)	-	-	mg/L	3.06	3.41	2.32	2.64	6.35	10.7	4.25	9.12	7.64	9.09	4.17	5.74	5.63	6.91	4.11	6.92	4.78	6.18	4.14	7.75
Manganese (Mn)	hardness-dependent	hardness-dependent	mg/L	0.0287	0.0472	0.117	0.216	1.15	**3.63**	0.954	**2.99**	0.0116	0.0340	0.118	0.332	0.181	0.346	0.260	0.570	0.0439	0.108	0.0954	0.289
Mercury (Hg)	0.00002	-	mg/L	0.000005	0.000005	0.000007	0.000010	0.000005	0.000005	0.000019	0.000076	0.000006	0.000007	0.000010	0.000022	0.000005	0.000005	0.000011	0.000030	0.000007	0.000005	0.000036	0.000039
Molybdenum (Mo)	1	2	mg/L	0.00180	0.00198	0.00113	0.00141	0.00386	0.00857	0.00602	0.0234	0.00360	0.00560	0.00235	0.00393	0.00243	0.00332	0.00219	0.00452	0.00149	0.00269	0.00119	0.00184
Nickel (Ni)	-	hardness-dependent	mg/L	0.000377	0.000630	0.00213	0.00383	0.00398	0.00918	0.00472	0.0119	0.00347	0.00785	0.00479	0.00949	0.00188	0.00338	0.00407	0.00953	0.000768	0.00160	0.0132	0.0116
Phosphorus (P)	-	-	mg/L	0.15	0.15	0.23	0.38	0.46	1.48	1.46	6.52	0.15	0.15	0.26	0.58	0.15	0.15	0.34	1.00	0.15	0.15	0.24	0.50
Potassium (K)	-	-	mg/L	0.553	0.583	1.01	1.47	0.933	1.21	1.17	2.40	1.06	1.50	1.23	2.03	1.78	4.52	1.93	4.11	0.820	1.39	0.944	2.16
Selenium (Se)	-	0.002	mg/L	0.00111	0.00127	0.00047	0.00071	**0.00302**	**0.00482**	**0.00392**	**0.0178**	**0.00511**	**0.00722**	**0.00277**	**0.00490**	0.00170	**0.00259**	0.00130	**0.00339**	0.00089	0.00141	**0.321**	0.00118
Silicon (Si)	-	-	mg/L	1.83	2.10	5.44	8.88	3.95	6.42	7.38	16.7	2.49	3.21	6.29	13.5	2.71	3.57	8.02	19.0	2.31	2.78	5.33	15.2
Silver (Ag)	hardness-dependent	hardness-dependent	mg/L	0.000005	0.000005	0.000034	0.000061	0.000016	0.000055	0.000250	0.000570	0.000009	0.000019	0.000063	0.000135	0.000007	0.000016	0.000096	0.000280	0.000007	0.000012	**0.022446**	0.000185

(continued)

Table 14.1-1. Water Quality of Streams and Rivers of the Mine Site Area, KSM Project, 2007-2012 (completed)

	Guidelines for the Protection of Freshwater Aquatic Life		Project Area Watershed	Mine Site Area															
				Bowser (n = 1 site)				Mitchell (n = 7 sites)				McTagg (n = 4 sites)				Sulphurets (n = 4 sites)				Unuk (n = 9 sites)			
				Nov to Apr (n = 3 samples)		May to Oct (n = 3 samples)		Nov to Apr (n = 33 samples)		May to Oct (n = 91 samples)		Nov to Apr (n = 17 samples)		May to Oct (n = 42 samples)		Nov to Apr (n = 54 samples)		May to Oct (n = 103 samples)		Nov to Apr (n = 42 samples)		May to Oct (n = 105 samples)	
Parameter	**BC Chronic (30-day mean)**	**BC Acute (Maximum)**	**Units**	**Mean**	**Max[1]**	**Mean**	**Max[1]**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**
Sodium (Na)	-	-	mg/L	1.0	1.0	1.0	1.0	3.5	5.2	1.4	3.0	1.0	1.0	1.0	1.0	2.2	3.7	1.1	2.2	2.3	3.1	1.1	2.1
Strontium (Sr)	-	-	mg/L	0.183	0.203	0.102	0.124	0.458	0.809	0.263	0.540	0.292	0.340	0.154	0.209	0.375	0.450	0.180	0.349	0.261	0.342	0.156	0.252
Thallium (Tl)	-	0.0003	mg/L	0.00005	0.00005	0.00005	0.00005	0.00005	0.00010	0.00008	0.00022	0.00004	0.00005	0.00005	0.00005	0.00004	0.00005	0.00006	0.00018	0.00004	0.00005	0.00005	0.00010
Tin (Sn)	-	-	mg/L	0.00005	0.00005	0.00007	0.00010	0.00006	0.00010	0.00086	0.00037	0.00005	0.00005	0.00006	0.00012	0.00005	0.00005	0.00008	0.00019	0.00005	0.00005	0.00991	0.00016
Titanium (Ti)	2	-	mg/L	0.013	0.028	0.101	0.197	0.011	0.032	0.146	0.521	0.012	0.032	0.161	0.356	0.016	0.044	0.213	0.642	0.008	0.021	0.110	0.398
Uranium (U)	-	0.3	mg/L	0.000269	0.000329	0.000135	0.000175	0.000845	0.00199	0.00108	0.00320	0.000749	0.000966	0.000316	0.000506	0.000413	0.000717	0.000375	0.000788	0.000147	0.000327	0.000936	0.000342
Vanadium (V)	0.006	-	mg/L	0.0008	0.0013	0.0092	0.0158	0.0034	0.0128	0.0125	0.0321	0.0012	0.0028	0.0139	0.0290	0.0011	0.0030	0.0140	0.0404	0.0007	0.0019	0.0095	0.0378
Zinc (Zn)	hardness-dependent	hardness-dependent	mg/L	0.0017	0.0042	0.0116	0.0208	**0.6672**	**2.7080**	**0.6555**	**2.7400**	0.0091	0.0224	0.0171	**0.0375**	0.0757	**0.1740**	**0.0991**	**0.2843**	0.0208	**0.0644**	0.0260	**0.0775**
Dissolved Metals																							
Aluminum (Al)	pH-dependent	pH-dependent	mg/L	0.0034	0.0040	0.0666	0.127	1.97	9.69	2.74	10.0	0.0039	0.0086	0.0322	0.0789	0.0346	0.0796	0.0502	0.109	0.0243	0.0689	0.0570	0.130
Antimony (Sb)	-	-	mg/L	0.000330	0.000360	0.000233	0.000270	0.000249	0.000529	0.000192	0.000554	0.000471	0.000602	0.000344	0.000430	0.000715	0.00132	0.000592	0.00112	0.00183	0.00341	0.000768	0.00192
Arsenic (As)	-	-	mg/L	0.00076	0.00080	0.00045	0.00059	0.00070	0.00164	0.00556	0.0346	0.00027	0.00035	0.00034	0.00045	0.00020	0.00041	0.00026	0.00072	0.00022	0.00030	0.00060	0.00071
Barium (Ba)	-	-	mg/L	0.0585	0.0636	0.0274	0.036	0.0250	0.0410	0.0406	0.0813	0.0238	0.0269	0.0120	0.0169	0.0394	0.0473	0.0314	0.0420	0.0337	0.0427	0.0226	0.0325
Beryllium (Be)	-	-	mg/L	0.00025	0.00025	0.00025	0.00025	0.00084	0.00374	0.00088	0.00411	0.00021	0.00025	0.00022	0.00025	0.00020	0.00025	0.00021	0.00025	0.00020	0.00025	0.00021	0.00025
Bismuth (Bi)	-	-	mg/L	0.00025	0.00025	0.00025	0.00025	0.00027	0.00036	0.00027	0.00050	0.00026	0.00030	0.00025	0.00025	0.00025	0.00025	0.00026	0.00025	0.00025	0.00025	0.00030	0.00025
Boron (B)	-	-	mg/L	0.005	0.005	0.005	0.005	0.008	0.017	0.005	0.010	0.005	0.006	0.005	0.005	0.006	0.012	0.005	0.005	0.005	0.010	0.005	0.005
Cadmium (Cd)	-	-	mg/L	0.000014	0.000018	0.000009	0.000013	0.00927	0.0422	0.00929	0.0376	0.000107	0.000194	0.000037	0.000091	0.000560	0.00136	0.00065	0.00250	0.000185	0.000450	0.191	0.000463
Calcium (Ca)	-	descriptive ranges	mg/L	36.7	43.2	15.0	19.7	69.8	111	39.4	76.8	67.5	79.4	29.2	43.7	66.2	79.5	31.0	63.2	35.6	52.9	17.8	28.7
Chromium (Cr)	-	-	mg/L	0.00025	0.00025	0.00025	0.00025	0.00020	0.00057	0.00026	0.00087	0.00017	0.00025	0.00021	0.00025	0.00014	0.00025	0.00017	0.00025	0.00015	0.00025	0.00021	0.0003
Cobalt (Co)	-	-	mg/L	0.00005	0.00005	0.00005	0.00005	0.0102	0.0371	0.0125	0.0429	0.00005	0.00006	0.00005	0.00005	0.00105	0.00229	0.00135	0.00451	0.00024	0.00069	0.00023	0.00085
Copper (Cu)	-	-	mg/L	0.00022	0.00029	0.00019	0.00030	0.514	2.12	0.794	2.79	0.00031	0.00059	0.00033	0.00049	0.00462	0.0101	0.00754	0.0107	0.00195	0.00501	0.00264	0.00449
Iron (Fe)	-	0.35	mg/L	0.015	0.015	0.030	0.061	**4.23**	**28.0**	**10.5**	**60.7**	0.015	0.015	0.023	0.064	0.022	0.029	0.064	0.121	0.018	0.041	0.091	0.105
Lead (Pb)	-	-	mg/L	0.000025	0.000025	0.000025	0.000025	0.00409	0.0193	0.00699	0.0350	0.000026	0.000030	0.000028	0.000025	0.000026	0.000025	0.000037	0.000098	0.000031	0.000038	0.000073	0.000200
Lithium (Li)	-	-	mg/L	0.0025	0.0025	0.0025	0.0025	0.0041	0.0101	0.0034	0.0087	0.0021	0.0025	0.0022	0.0025	0.0023	0.0025	0.0022	0.0025	0.0021	0.0025	0.021	0.0025
Magnesium (Mg)	-	-	mg/L	2.91	3.38	1.12	1.42	6.13	10.6	3.37	8.56	7.40	8.90	2.65	4.77	5.41	6.74	2.42	5.10	4.63	6.23	3.09	7.05
Manganese (Mn)	-	-	mg/L	0.0164	0.0182	0.0059	0.0097	1.09	3.56	0.848	2.80	0.0017	0.0040	0.0013	0.0039	0.154	0.319	0.116	0.278	0.0364	0.095	0.0211	0.0782
Mercury (Hg)	-	-	mg/L	0.000007	0.000011	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000007	0.000005	0.000005	0.000005	0.000005	0.000015	0.000005
Molybdenum (Mo)	-	-	mg/L	0.00183	0.00200	0.00093	0.00109	0.00149	0.00315	0.00086	0.00261	0.00351	0.00525	0.00198	0.00294	0.00225	0.00328	0.00138	0.00245	0.00143	0.00249	0.00078	0.00162
Nickel (Ni)	-	-	mg/L	0.000250	0.000250	0.000250	0.000250	0.00372	0.00967	0.00381	0.0103	0.00296	0.00718	0.000885	0.00188	0.00156	0.00308	0.00103	0.00252	0.000562	0.00116	0.00195	0.00133
Phosphorus (P)	-	-	mg/L	0.15	0.15	0.15	0.15	0.15	0.15	0.22	0.79	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.15
Potassium (K)	-	-	mg/L	0.510	0.568	0.221	0.241	0.892	1.09	0.523	0.901	1.02	1.38	0.639	1.00	1.69	4.42	0.906	1.94	0.788	1.41	0.448	0.865
Selenium (Se)	-	-	mg/L	0.00102	0.00118	0.00038	0.00049	0.00229	0.00333	0.00154	0.00425	0.00509	0.00687	0.00259	0.00458	0.00159	0.00227	0.00094	0.00212	0.00088	0.00140	0.0125	0.00102
Silicon (Si)	-	-	mg/L	1.58	1.74	0.75	0.86	3.42	6.22	2.41	4.96	2.23	2.51	1.15	1.79	2.20	2.54	1.21	2.14	2.10	2.56	1.40	2.16
Silver (Ag)	-	-	mg/L	0.000005	0.000005	0.000005	0.000005	0.000009	0.000028	0.000021	0.000091	0.000005	0.000006	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.00962	0.000005
Sodium (Na)	-	-	mg/L	1.0	1.0	1.0	1.0	3.4	5.2	1.3	2.8	1.0	1.0	1.0	1.0	2.1	3.6	1.1	1.0	2.1	3.1	1.0	1.0
Strontium (Sr)	-	-	mg/L	0.177	0.193	0.083	0.102	0.440	0.793	0.249	0.530	0.284	0.323	0.133	0.179	0.367	0.449	0.164	0.334	0.255	0.339	0.144	0.249
Thallium (Tl)	-	-	mg/L	0.00005	0.00005	0.00005	0.00005	0.00005	0.00009	0.00004	0.00010	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005
Tin (Sn)	-	-	mg/L	0.00005	0.00005	0.00005	0.00005	0.00005	0.00007	0.00005	0.00010	0.00005	0.00006	0.00005	0.00005	0.00005	0.00005	0.00006	0.00005	0.00005	0.00005	0.00010	0.00005
Titanium (Ti)	-	-	mg/L	0.005	0.005	0.005	0.005	0.005	0.007	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005
Uranium (U)	-	-	mg/L	0.000264	0.000329	0.000069	0.000093	0.000633	0.00194	0.00080	0.00307	0.000730	0.000919	0.000211	0.000438	0.000332	0.000678	0.000089	0.000311	0.000129	0.000315	0.000057	0.000161
Vanadium (V)	-	-	mg/L	0.0005	0.0005	0.0005	0.0005	0.0006	0.0010	0.0007	0.0010	0.0005	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Zinc (Zn)	-	-	mg/L	0.0005	0.0005	0.0005	0.0005	0.598	2.87	0.634	2.82	0.0060	0.0149	0.0013	0.0029	0.0218	0.0528	0.0301	0.125	0.0084	0.0204	0.0049	0.0191

Notes:

If values were less than the analytical detection limit, half the detection limit was used for calculations.

- indicates no guideline or parameter was not analyzed

[1] the maximum value was calculated instead of the 95th percentile when n < 6

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Total nitrogen concentrations were low and frequently below the analytical detection limit (0.005 mg/L) in streams in the Mine Site. Low but detectable nitrate concentrations were occasionally observed in the lower reaches of McTagg and Mitchell creeks, and in Gingras and Sulphurets creeks and the Unuk River. Total phosphorus concentrations were high and annual means were frequently above the Canadian Council of Ministers of the Environment (CCME) total phosphorus trigger ranges for eutrophic and hyper-eutrophic lakes and rivers (CCME 2004). Ortho-phosphate, however, was frequently below the analytical detection limit (0.001 mg/L), indicating that there was little bioavailable phosphorus and that phosphorus was largely bound to suspended mineral substrates. Total organic concentrations (TOCs) were frequently below the analytical detection limit (0.5 mg/L) in Mine Site streams. Turbidity and TSS concentrations were largely associated with the hydrological regime with increased sediment loads during spring freshet, summer glacial melt, and the fall period of high rainfall. During the high flow season, TSS concentrations in Mitchell Creek were frequently above 200 mg/L, and TSS concentrations in Sulphurets Creek and the Unuk River were typically above 100 mg/L (Table 14.1-1).

Due to the high mineralization of the proposed Project area, peaks in TSS often resulted in increased total metals concentrations as particulate, and particle-bound metals were transported with suspended sediments. Furthermore, metal leaching due to naturally occurring acid rock drainage resulted in total and dissolved metal concentrations in Mitchell and Sulphurets creeks that were frequently higher than BC water quality guidelines for the protection of freshwater aquatic life (Table 14.1-1). Guideline exceedances were most commonly observed for dissolved aluminum, total cadmium, total chromium, total cobalt, total copper, total iron, total lead, total selenium, and total zinc. A table of guideline exceedances is included in Appendix 14-A. Total metal concentrations were typically higher in the high flow season (May to October), reflecting increased TSS concentrations, while dissolved metal concentrations were typically lower in the high flow season, reflecting increased dilution. Metal concentrations generally decreased downstream from Mitchell Creek to Sulphurets Creek to the Unuk River. Water quality in the Unuk River was affected by inflow from Sulphurets Creek, since concentrations of TSS and metals at site UR1, downstream from the confluence, were frequently higher than concentrations at UR1A, upstream from the confluence (Table 14.1-1).

Selenium species were analyzed in groundwater seeps of the Mitchell and Kerr deposit areas and in streams and rivers downstream of the Mine Site in October and December 2012 (Table 14.1-2). Selenium in seeps at the Kerr Deposit (K seeps) was present in the most oxidized form of selenium, selenate (Se(VI)). Seeps and streams in the north Mitchell Creek Valley (MN seeps and stream site IC1) had variable total selenium concentrations and selenium was present as Se(VI). One seep in the south Mitchell Creek Valley (MS-A) had a high total selenium concentration (> 20 ppb) and selenium was present predominantly in reduced forms of selenium, selenite (Se(IV)), and methylseleninic acid (MeSe(IV)). These reduced forms of selenium were observed in upper Mitchell Creek at the toe of the Mitchell Glacier (MC1A-US) in October and December 2012, indicating that the biogeochemical processes resulting in reduced selenium species in seep MS-A are important in the overall selenium geochemistry of the Mitchell Creek Valley. Selenium was present as Se(VI) in lower Mitchell, Sulphurets, and Gingras creeks and the Unuk River, which is expected in oxygenated surface water.

Table 14.1-2. Selenium Species Distribution in Streams, Rivers, and Groundwater Seeps of the Mine Site Area, KSM Project, 2012

Site Name	Date Collected	Selenium Species		
		Se (IV)	Se (VI)	MeSe (IV)
Groundwater Seeps				
MN-A	4-Oct-12	<0.12	3.84	<0.14
MN-C	4-Oct-12	<0.12	0.64	<0.14
MN-D	4-Oct-12	<0.12	<0.23	<0.14
MS-A	4-Oct-12	15.90	0.57	4.09
MS-C1	4-Oct-12	<0.12	<0.23	<0.14
MS-D2	4-Oct-12	<0.12	<0.23	<0.14
MS-I	4-Oct-12	<0.12	0.24	<0.14
K-3A	4-Oct-12	<0.12	0.39	<0.14
K4	4-Oct-12	<0.12	0.36	<0.14
K5	4-Oct-12	<0.12	<0.23	<0.14
Streams and Rivers				
IC1	1-Dec-12	<0.35	1.04	<0.42
MC1A-US	4-Oct-12	1.72	0.30	0.61
MC1A-US	1-Dec-12	<0.35	0.73	0.55
MC1	1-Dec-12	<0.35	1.15	<0.42
MC2	1-Dec-12	<0.35	1.20	<0.42
GC1	1-Dec-12	<0.35	1.79	<0.42
SC1	1-Dec-12	<0.35	0.87	<0.42
SC2	1-Dec-12	<0.35	2.15	<0.42
SC3	1-Dec-12	<0.35	2.01	<0.42
ECM8	1-Dec-12	<0.35	0.65	<0.42
CC1	1-Dec-12	<0.35	1.70	<0.42
UR1A	1-Dec-12	<0.35	0.65	<0.42
UR1	1-Dec-12	<0.35	1.42	<0.42
UR2	1-Dec-12	<0.35	0.66	<0.42
SUNR	1-Dec-12	<0.35	<0.58	<0.42

Notes: < indicates below analytical detection limit
MeSe (IV) is methylseleninic acid

The high suspended sediment load, low concentrations of bioavailable nutrients, and high concentrations of total and dissolved metals identified in Mitchell and Sulphurets creeks and the Unuk River are contributing factors to the poor productive capacity of Mine Site streams (see Section 15.1.3).

14.1.2.1.2 Water Toxicity

Baseline toxicity testing was conducted in July 2009, November 2009, and November 2012 on surface water collected from two sites downstream of the proposed Mine Site (Sulphurets Creek

[SC2] in 2009; Mitchell Creek [MC2] in 2012). These tests were intended to measure the toxicity of naturally occurring water prior to any Project development.

A suite of standard toxicity tests were conducted including two acute tests (four-day rainbow trout acute lethality test and two-day *Daphnia magna* acute lethality test) and four chronic tests (seven-day *Ceriodaphnia dubia* survival and reproduction test, seven-day rainbow trout embryo viability test, seven-day *Lemna minor* growth inhibition test, and three-day *Pseudokirchneriella subcapitata* growth inhibition test). In addition, a 10-day coho salmon embryo viability test was conducted for water collected at SC2 in November 2009. This assay was conducted in response to a request from Nisga'a Nation and government regulators. All tests were conducted by Nautilus Environmental, with the six standard toxicity tests conducted following Environment Canada methodology, and the coho salmon embryo viability test used methodology similar to that of the standard rainbow trout embryo viability assay. The complete reports from Nautilus Environmental, including assay methodologies and raw data, are provided in Appendix 14-D, while a summary of results is included here in Table 14.1-3.

Pre-development toxicity of naturally occurring water was higher in areas downstream of the proposed Mine Site (MC2 and SC2) than downstream of the PTMA (see Table 14.1-6), which is due to higher concentrations of metals in the water in this area. Seasonally, toxic effects associated with pre-development water quality were higher in November (low flow) than freshet (July) at SC2, which is attributed to higher concentrations of dissolved metals during low flow. The most sensitive organisms to toxicity from baseline water quality were *Ceriodaphnia dubia* (reproduction; July 2009) and aquatic plant (growth; November 2009) at SC2 and the invertebrates at MC2 (*D. magna* survival and *C. dubia* growth and survival; November 2012). Fish, both in the acute and chronic tests, were not sensitive to toxic effects associated with baseline water quality at SC2. At MC2, the naturally occurring water in November 2012 was acutely toxic to juvenile rainbow trout fry, while there was no effect on rainbow trout egg mortality. No fish were detected in Mitchell Creek or the upper portion of Sulphurets Creek above the cascades (approximately 200 m from the Unuk River), and low abundance, diversity, and richness of periphyton and benthic invertebrates were observed in these creeks (Chapter 15, Sections 15.1.2 and 15.1.3). These results indicate that the water quality, in combination with poor sediment quality, make Mitchell and upper Sulphurets creeks inhospitable to aquatic life.

14.1.2.2 Processing and Tailing Management Area

14.1.2.2.1 Water Quality

Twenty-two stream and river water quality sites were monitored in the PTMA baseline study area from 2008 to 2012. A summary of the PTMA stream water quality is presented in Table 14.1-4. Two baseline study area reference monitoring sites were monitored from 2007 to 2012 in the South Unuk River and Scott Creek and the data are included in the summary table (Table 14.1-4).

Streams near the PTMA were typically near-neutral to slightly alkaline, with moderately hard to soft waters, and with low sensitivity to acid inputs. The mean annual pH of monitoring sites in Treaty, Teigen, and Snowbank creeks, and the Bell-Irving River were typically between 7.80 and 8.20. The waters of North Treaty, South Teigen, and Teigen creeks were frequently classified as soft (hardness < 60 mg/L) especially during high flow periods, while Treaty Creek and the Bell-Irving River waters were frequently classified as moderately hard (hardness: 61 to 120 mg/L).

Table 14.1-3. Baseline Toxicity Testing Results for Mine Site, KSM Project, 2009 and 2012

Type of Test	Species Used in the Test	Test Endpoint	Mitchell Creek (MC2)		Sulphurets Creek (SC2)			
			November 2012		July 2009		November 2009	
			Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)
Acute toxicity tests	*Oncorhynchus mykiss* (fish)	4-day survival (LC_{50})	Not calculable[a], >100	n/a	>100	n/a	>100	n/a
	Daphnia magna (invertebrate)	2-day survival (LC_{50})	46.7	37.6 to 57.8	>100	n/a	>100	n/a
Chronic toxicity tests	*Ceriodaphnia dubia* (invertebrate)	7-day survival (LC_{50})	39.3	33.2 to 46.6	>100	n/a	>100	n/a
		7-day reproduction (IC_{25})	10	6.0 to 12.8	3.9	0.3 to 36.5	35.5	28.0 to 43.6
	Pseudokirchneriella subcapitata (algae)	Growth (IC_{25})	19.4[b]	13.0 to 26.8	26.1	24.5 to 27.6	>95[b]	n/a
	Lemna minor (aquatic plant)	Frond growth (IC_{25})	>97	n/a	>97	n/a	23.2	n/a
		Frond weight (IC_{25})	>97	n/a	>97	n/a	70.6	24.8 to 100
	O. mykiss (fish embryo)	7-day survival (IC_{25})	>100	n/a	>100	n/a	>100	n/a
	O. kisutch (fish embryo)	10-day survival (IC_{25})	n/d	n/d	n/d	n/d	>100	n/a

Concentrations are expressed in percent as volume of stream water / total volume

LC_{50} is the concentration of naturally-occuring stream water required to cause death in 50% of exposed organisms.

IC_{25} is the concentration of naturally-occuring stream water required to decrease survival, growth, or reproduction by 25% compared to the control group.

>95, >97, or >100 means that the stream water had no effect on the tested endpoint (i.e., stream water was the same as control water).

n/d = not done

Shaded cells indicate an adverse effect of stream water on the measured endpoints

[a] Two LC_{50} tests were done for rainbow trout using water collected from the MC2 sampling site since the first test had an anomalous dose-response curve

[b] Stream water samples stimulated growth of the algae relative to the control group (lab water)

Table 14.1-4. Water Quality in Streams and Rivers of the Processing and Tailings Management Area and Reference Sites, KSM Project, 2007 to 2012

Parameter	Guidelines for the Protection of Freshwater Aquatic Life		Project Area Watershed	Processing and Tailing Management Area												References							
				Treaty (n = 8 sites)				Teigen/Snowbank (n = 12 sites)				Bell-Irving (n = 2 sites)				South Unuk (n = 1 site)				Scott (n = 1 site)			
				Nov to Apr (n = 45 samples)		May to Oct (n = 122 samples)		Nov to Apr (n = 63 samples)		May to Oct (n = 147 samples)		Nov to Apr (n = 16 samples)		May to Oct (n = 16 samples)		Nov to Apr (n = 20 samples)		May to Oct (n = 33 samples)		Nov to Apr (n = 7 samples)		May to Oct (n = 11 samples)	
	BC Chronic (30-day mean)	BC Acute (Maximum)	Units	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P	Mean	95th P
Physical Parameters																							
Colour, True	background-dependent	-	colour unit	2.7	4.5	6.0	19.6	3.2	7.2	6.6	17.0	3.6	7.6	3.1	7.1	2.5	2.5	7.1	50.0	2.9	4.3	3.2	6.3
Conductivity	-	-	uS/cm	262	418	130	264	165	259	103	177	203	283	115	139	225	251	110	198	222	335	137	204
Hardness (as $CaCO_3$)	-	-	mg/L	124	212	63.5	135	73.8	123	48.2	83.0	96.0	132	54.3	67.8	104	119	60.3	115	107	168	62.6	93.8
pH	-	6.5 to 9.0	pH unit	7.96	8.20	7.87	8.21	7.83	8.18	7.83	8.15	8.03	8.18	7.86	8.13	8.02	8.12	7.95	8.19	8.01	8.26	8.04	8.12
Total Suspended Solids	background-dependent	-	mg/L	4.7	21.3	111	524	2.2	5.3	17.8	57.0	6.2	26.0	115	406	3.4	7.3	70.7	276	3.5	7.6	112	187
Total Dissolved Solids	-	-	mg/L	164	281	93	176	99	162	68	112	118	175	82	109	139	158	71	121	131	202	99	134
Turbidity	background-dependent	-	NTU	2.2	5.7	119	545	0.9	1.7	12.8	42.7	5.0	28.7	101	355	0.9	3.1	41.0	158	1.2	3.3	121	199
Anions and Nutrients																							
Acidity (as $CaCO_3$)	-	-	mg/L	2.8	5.9	2.7	5.6	2.8	5.5	2.6	4.7	2.3	5.2	2.7	4.9	2.9	5.5	2.5	4.3	2.2	4.4	2.2	3.8
Alkalinity, Total (as $CaCO_3$)	descriptive ranges	-	mg/L	69.0	107.6	36.2	71.2	40.9	63.3	26.3	45.2	70.1	97.1	38.4	45.0	71.0	79.8	40.5	66.2	68.2	107.8	52.1	85.5
Ammonia (as N)	temperature- and pH-dependent	temperature- and pH-dependent	mg/L	0.0038	0.0100	0.0038	0.0091	0.0031	0.0072	0.0034	0.0084	0.0025	0.0025	0.0040	0.0077	0.0028	0.0028	0.0034	0.0057	0.0025	0.0025	0.0049	0.0157
Bromide	-	-	mg/L	0.033	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Chloride	150	-	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Fluoride	-	hardness-dependent	mg/L	0.0587	0.104	0.0411	0.0800	0.0328	0.0480	0.0240	0.0389	0.0403	0.0478	0.0224	0.0365	0.0742	0.0901	0.0500	0.0710	0.0462	0.0641	0.0224	0.0366
Nitrate (as N)	3	32.8	mg/L	0.218	0.384	0.136	0.540	0.139	0.356	0.0594	0.319	0.158	0.278	0.0370	0.0709	0.236	0.306	0.136	0.376	0.214	0.541	0.0130	0.0240
Nitrite (as N)	chloride-dependent	-	mg/L	0.0005	0.0005	0.0006	0.0010	0.0005	0.0005	0.0012	0.0011	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0009	0.0011	0.0005	0.0005	0.0035	0.0173
Ortho-Phosphate (as P)	-	-	mg/L	0.0016	0.0030	0.0022	0.0051	0.0023	0.0054	0.0015	0.0051	0.0011	0.0020	0.0014	0.0024	0.0005	0.0005	0.0014	0.0024	0.0013	0.0024	0.0057	0.0273
Total Phosphate (as P)	-	-	mg/L	0.0090	0.0280	0.137	0.590	0.0358	0.0158	0.0209	0.0660	0.0093	0.0342	0.122	0.425	0.0040	0.0104	0.0799	0.373	0.0063	0.0163	0.169	0.283
Sulphate	hardness-dependent	-	mg/L	63.7	122	29.0	66.7	38.8	80.2	23.3	43.8	32.6	57.1	17.7	22.1	43.1	50.3	17.6	31.5	43.3	70.4	19.3	36.1
Cyanides																							
Cyanide, Weak Acid Dissociable	0.005	0.01	mg/L	0.0005	0.0005	0.0005	0.0005	-	-	0.0005	0.0006	-	-	-	-	-	-	0.0005	0.0006	-	-	-	-
Cyanide, Total	-	-	mg/L	0.0008	0.0017	0.0010	0.0029	0.0012	0.0022	0.0013	0.0034	0.0011	0.0023	0.0006	0.0013	0.0012	0.0018	0.0007	0.0014	0.0010	0.0024	0.0005	0.0005
Thiocyanate	-	-	mg/L	0.25	0.25	0.74	2.38	-	-	0.62	1.57	-	-	-	-	-	-	0.60	1.18	-	-	-	-
Carbon																							
Total Organic Carbon	background-dependent	-	mg/L	0.87	1.86	1.50	3.46	1.22	2.11	1.65	3.83	1.35	2.20	1.73	4.98	0.48	0.72	0.53	0.97	0.89	1.50	0.48	0.79
Total Metals																							
Aluminum (Al)	-	-	mg/L	*0.127*	*0.478*	*3.46*	*14.8*	0.048	*0.101*	*0.580*	*1.86*	*0.255*	*1.57*	*3.76*	*12.2*	0.048	*0.117*	*1.76*	*5.72*	0.072	*0.278*	*3.10*	*7.54*
Antimony (Sb)	-	0.02	mg/L	0.000240	0.000520	0.000682	0.00274	0.000051	0.000050	0.000056	0.000110	0.000101	0.000208	0.000378	0.00132	0.000086	0.000112	0.000161	0.000256	0.000173	0.000299	0.000533	0.000915
Arsenic (As)	-	0.005	mg/L	0.00057	0.00191	0.00494	**0.0244**	0.00010	0.00018	0.00027	0.00070	0.00023	0.00058	0.00307	**0.0118**	0.00026	0.00036	0.00098	0.00209	0.00030	0.00076	0.00376	**0.00855**
Barium (Ba)	-	-	mg/L	0.0324	0.0534	0.0861	0.326	0.0180	0.0289	0.0193	0.0367	0.0489	0.0657	0.0856	0.215	0.0438	0.0525	0.0474	0.0981	0.0361	0.0526	0.0882	0.157
Beryllium (Be)	0.0053	-	mg/L	0.00020	0.00025	0.00023	0.00040	0.00021	0.00025	0.00019	0.00025	0.00020	0.00025	0.00025	0.00036	0.00020	0.00025	0.00020	0.00025	0.00020	0.00025	0.00019	0.00025
Bismuth (Bi)	-	-	mg/L	0.00027	0.00045	0.00026	0.00025	0.00026	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00024	0.00025	0.00029	0.00043	0.00023	0.00025
Boron (B)	-	1.2	mg/L	0.005	0.005	0.006	0.010	0.005	0.005	0.005	0.005	0.007	0.013	0.009	0.016	0.005	0.005	0.006	0.005	0.006	0.009	0.007	0.018
Cadmium (Cd)	-	hardness-dependent	mg/L	0.000038	**0.000103**	**0.000247**	**0.00115**	0.000008	0.000015	0.000015	**0.000039**	0.000014	0.000027	**0.000120**	**0.000476**	0.000027	**0.000046**	**0.000071**	**0.000198**	0.000023	**0.000041**	**0.000184**	**0.000359**
Calcium (Ca)	-	-	mg/L	39.5	74.0	20.6	40.1	22.1	36.1	13.9	23.0	26.4	41.4	14.3	20.8	39.5	45.2	21.4	36.1	34.7	56.4	22.5	30.9
Chromium (Cr)	-	0.001	mg/L	0.00040	**0.00101**	**0.00540**	**0.0205**	0.00035	0.00069	**0.00216**	**0.00673**	0.00093	**0.00458**	**0.00918**	**0.0290**	0.00032	0.00066	**0.00396**	**0.0110**	0.00022	0.00029	**0.00219**	**0.00482**
Cobalt (Co)	0.004	0.11	mg/L	0.00013	0.00045	0.00244	0.00999	0.00008	0.00016	0.00047	0.00130	0.00018	0.00096	0.00254	0.00867	0.00007	0.00014	0.00139	0.00420	0.00009	0.00024	0.00183	0.00396
Copper (Cu)	hardness-dependent	hardness-dependent	mg/L	0.00171	0.00360	**0.00842**	**0.0372**	0.00054	0.00119	0.00166	0.00453	0.00087	0.00315	**0.00764**	**0.0249**	0.00080	0.00179	**0.00695**	**0.0191**	0.00046	0.00081	0.00346	0.00687
Iron (Fe)	-	1	mg/L	0.240	0.981	**5.04**	**18.7**	0.093	0.235	0.688	**2.26**	0.313	**1.70**	**5.47**	**19.0**	0.065	0.148	**2.19**	**6.63**	0.110	0.461	**4.04**	**9.61**
Lead (Pb)	hardness-dependent	hardness-dependent	mg/L	0.000153	0.000511	0.00338	0.0174	0.000048	0.000139	0.000188	0.000548	0.000093	0.000386	0.00187	0.00719	0.000188	0.000435	0.00381	0.0135	0.000071	0.000239	0.00225	0.00447
Lithium (Li)	0.014	0.87	mg/L	0.0022	0.0025	0.0046	0.0140	0.0021	0.0025	0.0022	0.0025	0.0022	0.0025	0.0053	0.0145	0.0019	0.0025	0.0021	0.0025	0.0022	0.0025	0.0023	0.0034
Magnesium (Mg)	-	-	mg/L	7.05	11.8	4.83	9.67	5.05	9.35	3.40	6.16	7.94	10.3	6.68	10.0	2.19	2.43	2.01	3.30	5.61	7.79	3.13	4.12
Manganese (Mn)	hardness-dependent	hardness-dependent	mg/L	0.0219	0.0671	0.165	0.701	0.0126	0.0620	0.0249	0.0646	0.0164	0.0434	0.124	0.475	0.0029	0.0072	0.0601	0.183	0.0061	0.0232	0.164	0.329
Mercury (Hg)	0.00002	-	mg/L	0.000006	0.000014	0.000020	0.000077	0.000005	0.000005	0.000006	0.000010	0.000005	0.000005	0.000017	0.000056	0.000005	0.000005	0.000006	0.000008	0.000005	0.000005	0.000012	0.000022
Molybdenum (Mo)	1	2	mg/L	0.00106	0.00248	0.00121	0.00356	0.00033	0.00061	0.00029	0.00051	0.00086	0.00110	0.00101	0.00180	0.00754	0.00830	0.00490	0.00689	0.00073	0.00126	0.00098	0.00120
Nickel (Ni)	-	hardness-dependent	mg/L	0.000975	0.00196	0.00771	0.0288	0.000708	0.00130	0.00262	0.00752	0.00143	0.00601	0.0127	**0.0421**	0.000327	0.000703	0.00276	0.00784	0.000504	0.000744	0.00295	0.00651
Phosphorus (P)	-	-	mg/L	0.15	0.15	0.23	0.70	0.15	0.15	0.15	0.15	0.15	0.15	0.21	0.43	0.15	0.15	0.18	0.28	0.15	0.15	0.19	0.35
Potassium (K)	-	-	mg/L	0.341	0.548	0.953	3.01	0.251	0.391	0.306	0.640	0.420	0.716	1.04	2.77	1.39	1.53	1.20	1.83	0.277	0.407	1.18	2.41
Selenium (Se)	-	0.002	mg/L	0.00072	0.00104	0.00069	0.00156	0.00055	0.00143	0.00043	0.00085	0.00084	0.00113	0.00066	0.00096	0.00051	0.00059	0.00029	0.00047	0.00049	0.00083	0.00050	0.00091
Silicon (Si)	-	-	mg/L	2.80	3.33	7.83	24.8	2.30	2.80	2.73	5.40	2.76	5.14	7.66	22.2	2.34	2.49	4.50	11.9	2.45	2.67	6.01	12.2
Silver (Ag)	hardness-dependent	hardness-dependent	mg/L	0.000007	0.000009	0.000083	0.000323	0.000005	0.000005	0.000043	0.000028	0.000006	0.000008	0.000044	0.000153	0.000005	0.000005	0.000748	0.000119	0.000006	0.000010	**0.00167**	**0.00905**

(continued)

Table 14.1-4. Water Quality of Streams and Rivers of the Processing and Tailings Management Area and Reference Sites, KSM Project, 2007-2012 (completed)

	Guidelines for the Protection of Freshwater Aquatic Life		Project Area	Processing and Tailing Management Area										References							
			Watershed	Treaty (n = 8 sites)				Teigen/Snowbank (n = 12 sites)				Bell-Irving (n = 2 sites)				South Unuk (n = 1 site)				Scott (n = 1 site)			
				Nov to Apr (n = 45 samples)		May to Oct (n = 122 samples)		Nov to Apr (n = 63 samples)		May to Oct (n = 147 samples)		Nov to Apr (n = 16 samples)		May to Oct (n = 16 samples)		Nov to Apr (n = 20 samples)		May to Oct (n = 33 samples)		Nov to Apr (n = 7 samples)		May to Oct (n = 11 samples)	
Parameter	**BC Chronic (30-day mean)**	**BC Acute (Maximum)**	**Units**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**	**Mean**	**95th P**
Sodium (Na)	-	-	mg/L	2.3	3.4	1.2	2.2	1.6	2.9	1.0	1.0	2.7	3.6	1.1	1.3	1.0	1.0	1.0	1.0	1.5	2.3	0.9	1.0
Strontium (Sr)	-	-	mg/L	0.315	0.526	0.168	0.289	0.195	0.373	0.124	0.215	0.208	0.287	0.133	0.162	0.323	0.379	0.164	0.269	0.293	0.451	0.157	0.236
Thallium (Tl)	-	0.0003	mg/L	0.00004	0.00005	0.00009	**0.00037**	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00007	0.00018	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00007	0.00014
Tin (Sn)	-	-	mg/L	0.00005	0.00005	0.00056	0.00017	0.00005	0.00005	0.00046	0.00005	0.00006	0.00008	0.00006	0.00008	0.00005	0.00005	0.00217	0.00013	0.00006	0.00009	0.00278	0.01506
Titanium (Ti)	2.0	-	mg/L	0.009	0.030	0.134	0.593	0.005	0.005	0.015	0.057	0.010	0.045	0.091	0.346	0.006	0.012	0.136	0.430	0.005	0.005	0.069	0.163
Uranium (U)	-	0.3	mg/L	0.000061	0.000192	0.000110	0.000397	0.000013	0.000028	0.000012	0.000036	0.000037	0.000055	0.000081	0.000273	0.000844	0.000991	0.000465	0.000795	0.000072	0.000133	0.000117	0.000182
Vanadium (V)	0.006	-	mg/L	0.0007	0.0014	0.0095	0.0404	0.0005	0.0005	0.0017	0.0055	0.0010	0.0044	0.0105	0.0350	0.0005	0.0005	0.0056	0.0169	0.0006	0.0009	0.0067	0.0149
Zinc (Zn)	hardness-dependent	hardness-dependent	mg/L	0.0029	0.0059	0.0276	**0.1040**	0.0014	0.0024	0.0037	0.0110	0.0020	0.0066	0.0208	**0.0743**	0.0014	0.0022	0.0079	0.0241	0.0021	0.0038	0.0194	**0.0375**
Dissolved Metals																							
Aluminum (Al)	pH-dependent	pH-dependent	mg/L	0.0059	0.0170	0.0574	0.142	0.0072	0.0203	0.0401	0.104	0.0075	0.0175	0.169	0.647	0.0056	0.0107	0.0508	0.132	0.0049	0.0092	0.114	0.358
Antimony (Sb)	-	-	mg/L	0.000218	0.000438	0.000233	0.000680	0.000051	0.000050	0.000051	0.000050	0.000092	0.000208	0.000125	0.000380	0.000074	0.000110	0.000094	0.000120	0.000157	0.000282	0.000251	0.000338
Arsenic (As)	-	-	mg/L	0.00016	0.00029	0.00025	0.00063	0.00007	0.00014	0.00007	0.00014	0.00012	0.00018	0.00065	0.00226	0.00022	0.00028	0.00032	0.00041	0.00019	0.00032	0.00066	0.00189
Barium (Ba)	-	-	mg/L	0.0292	0.0470	0.0213	0.0380	0.0172	0.0271	0.0120	0.0214	0.0451	0.0605	0.0402	0.0718	0.0430	0.0516	0.0244	0.0382	0.0344	0.0519	0.0350	0.067
Beryllium (Be)	-	-	mg/L	0.00020	0.00025	0.00019	0.00025	0.00020	0.00025	0.00019	0.00025	0.00020	0.00025	0.00019	0.00025	0.00020	0.00025	0.00020	0.00025	0.00020	0.00025	0.00019	0.00025
Bismuth (Bi)	-	-	mg/L	0.00026	0.00025	0.00026	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00029	0.00043	0.00025	0.00025
Boron (B)	-	-	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.010	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.009	0.005	0.005
Cadmium (Cd)	-	-	mg/L	0.000026	0.000072	0.000022	0.000047	0.000006	0.000010	0.000007	0.000011	0.000008	0.000016	0.000056	0.000206	0.000022	0.000040	0.000021	0.000033	0.000018	0.000032	0.000049	0.000162
Calcium (Ca)	-	descriptive ranges	mg/L	38.5	68.9	18.8	37.5	21.4	34.2	13.5	22.9	25.8	40.6	13.7	19.5	38.3	43.7	20.2	33.7	33.9	55.0	22.1	31.9
Chromium (Cr)	-	-	mg/L	0.00019	0.00025	0.00022	0.0003	0.00022	0.00030	0.00028	0.00044	0.00025	0.00037	0.00044	0.0013	0.00019	0.00025	0.00023	0.0003	0.00016	0.00025	0.00023	0.00045
Cobalt (Co)	-	-	mg/L	0.00005	0.00005	0.00008	0.00013	0.00006	0.00009	0.00006	0.00005	0.00005	0.00005	0.00052	0.00194	0.00005	0.00005	0.00007	0.00016	0.00006	0.00009	0.00024	0.00108
Copper (Cu)	-	-	mg/L	0.00029	0.00049	0.00039	0.00081	0.00034	0.00062	0.00049	0.00099	0.00038	0.00061	0.00167	0.00582	0.00034	0.00054	0.00063	0.00162	0.00037	0.00053	0.00059	0.00230
Iron (Fe)	-	0.35	mg/L	0.016	0.015	0.039	0.095	0.021	0.048	0.033	0.075	0.018	0.034	**0.351**	**1.37**	0.015	0.015	0.042	0.125	0.015	0.015	0.163	**0.731**
Lead (Pb)	-	-	mg/L	0.000026	0.000025	0.000041	0.000079	0.000027	0.000025	0.000030	0.000025	0.000025	0.000025	0.000711	0.00277	0.000028	0.000028	0.000097	0.000396	0.000029	0.000043	0.000403	0.00208
Lithium (Li)	-	-	mg/L	0.0023	0.0025	0.0020	0.0025	0.0021	0.0025	0.0020	0.0025	0.0022	0.0025	0.0022	0.0027	0.0019	0.0025	0.0019	0.0025	0.0022	0.0025	0.0020	0.0025
Magnesium (Mg)	-	-	mg/L	6.83	11.9	3.30	6.48	4.92	9.31	3.04	5.25	7.70	10.1	4.91	6.2	2.10	2.38	1.09	1.85	5.45	7.65	2.30	3.81
Manganese (Mn)	-	-	mg/L	0.0125	0.0392	0.0087	0.0316	0.0097	0.0553	0.0046	0.0149	0.0080	0.0155	0.0409	0.157	0.0005	0.0013	0.0048	0.0132	0.0006	0.0012	0.0336	0.172
Mercury (Hg)	-	-	mg/L	0.000005	0.000005	0.000005	0.000005	0.000006	0.000012	0.000005	0.000005	0.000005	0.000007	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000006	0.000011
Molybdenum (Mo)	-	-	mg/L	0.00103	0.00240	0.00087	0.00223	0.00032	0.00057	0.00027	0.00049	0.00085	0.00107	0.00076	0.00096	0.00746	0.00802	0.00496	0.00675	0.00070	0.00123	0.00093	0.00124
Nickel (Ni)	-	-	mg/L	0.000656	0.00123	0.000539	0.00113	0.000451	0.000836	0.000519	0.000968	0.000533	0.000790	0.00133	0.00430	0.000266	0.000266	0.000263	0.000250	0.000399	0.000605	0.000363	0.000871
Phosphorus (P)	-	-	mg/L	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.18	0.28	0.15	0.15	0.15	0.15	0.15	0.15	0.18	0.32
Potassium (K)	-	-	mg/L	0.308	0.450	0.247	0.337	0.239	0.374	0.187	0.302	0.359	0.418	0.317	0.426	1.35	1.47	0.902	1.36	0.255	0.352	0.226	0.267
Selenium (Se)	-	-	mg/L	0.00071	0.00094	0.00049	0.00066	0.00055	0.00140	0.00040	0.00076	0.00082	0.00115	0.00053	0.00067	0.00050	0.00059	0.00025	0.00044	0.00048	0.00086	0.00045	0.00085
Silicon (Si)	-	-	mg/L	2.60	2.98	1.86	2.71	2.22	2.66	1.73	2.39	2.27	2.46	1.69	2.18	2.26	2.42	1.43	2.13	2.31	2.58	1.10	1.58
Silver (Ag)	-	-	mg/L	0.000005	0.000005	0.000005	0.000009	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000007	0.000014	0.000005	0.000005	0.000005	0.000005	0.000006	0.000009	0.000005	0.000005
Sodium (Na)	-	-	mg/L	2.2	3.3	1.1	1.0	1.6	2.8	1.1	1.0	2.7	3.6	1.0	1.0	1.0	1.0	1.0	1.0	1.4	2.3	1.0	1.0
Strontium (Sr)	-	-	mg/L	0.307	0.537	0.155	0.291	0.189	0.357	0.120	0.215	0.204	0.288	0.124	0.150	0.317	0.373	0.155	0.258	0.289	0.441	0.157	0.244
Thallium (Tl)	-	-	mg/L	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005	0.00004	0.00005
Tin (Sn)	-	-	mg/L	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00006	0.00009	0.00005	0.00005
Titanium (Ti)	-	-	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.005
Uranium (U)	-	-	mg/L	0.000056	0.000175	0.000032	0.000075	0.000012	0.000026	0.000006	0.000014	0.000034	0.000054	0.000025	0.000069	0.000833	0.00101	0.000383	0.000709	0.000068	0.000128	0.000062	0.000092
Vanadium (V)	-	-	mg/L	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0008	0.0017	0.0005	0.0005	0.0005	0.0005	0.0006	0.0009	0.0006	0.0009
Zinc (Zn)	-	-	mg/L	0.0014	0.0031	0.0013	0.0030	0.0012	0.0015	0.0011	0.0015	0.0012	0.0019	0.0045	0.0162	0.0010	0.0015	0.0010	0.0015	0.0013	0.0026	0.0026	0.0107

Notes:

If values were less than the analytical detection limit, half the detection limit was used for calculations.

- indicates no guideline or parameter was not analyzed

[1] the maximum value was calculated instead of the 95th percentile when n < 6

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Nitrogen concentrations were generally low in streams near the PTMA baseline study area. Nitrogen concentrations were highest in Snowbank, Teigen (downstream of Snowbank), and North Treaty creeks, likely reflecting hydrological connections and nutrient loading from wetlands (see Chapter 16). Nitrate was the dominant form of nitrogen. Total phosphorus concentrations were high in Treaty Creek and frequently above the hyper-eutrophic CCME trigger range; however, ortho-phosphate concentrations were frequently below the analytical detection limit (0.001 mg/L), indicating that there was little bioavailable phosphorus. Total phosphorus concentrations were lower in Snowbank, South Teigen, Teigen, and North Treaty creeks, and these streams were frequently classified as mesotrophic. Total phosphorus in the Bell-Irving River at site BIR2 (downstream of Treaty Creek) was typically higher than BIR1 (upstream of Teigen Creek), although there was substantial variability across baseline study years. TOC concentrations for monitoring sites in the PTMA were low and frequently between 1 to 2 mg/L.

TSS and metal concentrations were typically higher in Treaty Creek than in Teigen Creek, reflecting increased sediment loading from glacial melt and mineralization in the upper reaches of Treaty Creek. The Teigen watershed has almost no glacier cover, while 26% of the Treaty watershed is glacierized (see Chapter 13). Guideline exceedances in the Snowbank/Teigen watershed were most commonly observed for total and dissolved aluminum, total cadmium, and total chromium. Guideline exceedances in the Treaty/Bell-Irving watershed were most commonly observed for dissolved aluminum, total cadmium, total chromium, total copper, total iron, and total zinc. A table of guideline exceedances is included in Appendix 14-A. Total metal concentrations were typically higher in the high flow season (May to October), reflecting increased TSS concentrations, while dissolved metal concentrations were typically lower in the high flow season, reflecting increased dilution.

Selenium species were analyzed in streams and rivers downstream of the PTMA in December 2012 (Table 14.1-5). Low selenium concentrations (frequently below detection) were observed, with detectable selenium as Se(VI) in South Teigen Creek only.

Table 14.1-5. Selenium Species Distribution in Streams of the Processing and Tailing Management Area, KSM Project, 2012

		Selenium Species		
Site Name	**Date Collected**	**Se (IV)**	**Se (VI)**	**MeSe (IV)**
STE1A	1-Dec-12	<0.35	1.24	<0.42
STE2	4-Oct-12	<0.35	0.72	<0.42
SNO1	1-Dec-12	<0.35	<0.58	<0.42
TEC1B	1-Dec-12	<0.35	<0.58	<0.42
TEC1B	1-Dec-12	<0.35	<0.58	<0.42
TEC2	1-Dec-12	<0.35	<0.58	<0.42
NTR1A	1-Dec-12	<0.35	<0.58	<0.42
TRC0	1-Dec-12	<0.35	<0.58	<0.42
TRC1B	1-Dec-12	<0.35	<0.58	<0.42

Notes: < indicates below analytical detection limit
MeSe (IV) is methylseleninic acid

The lower suspended sediment load, increased concentrations of bioavailable nutrients, and lower concentrations of total and dissolved metals identified in the Snowbank/Teigen/ Treaty/Bell-Irving watersheds are likely contributing factors to the greater productive capacity of PTMA streams relative to the Mine Site (see Section 15.1.3).

14.1.2.2.2 Water Toxicity

Baseline toxicity testing was conducted in July and November 2009 on surface water collected from sites downstream of the proposed PTMA (South Teigen, STE2; North Treaty, NTR2; Teigen Creek, TEC2; Treaty Creek, TRC2), as well as a reference site on Scott Creek (SCR). These tests were intended to measure the toxicity of naturally occurring water prior to any Project development.

A suite of standard toxicity tests were conducted on the samples collected from STE2, NTR2, and SCR in both July and November 2009, including two acute tests and four chronic tests (see Table 14.1-6). In addition to these tests, a 10-day coho salmon embryo viability test was conducted for all sites sampled during the November 2009 sampling event (STE2, NTR2, TEC2, TRC2, and SCR). The coho embryo viability assay was conducted in response to requests from Nisga'a Nation and government regulators. All tests were conducted by Nautilus Environmental, with the six standard toxicity tests conducted following Environment Canada methodology and the coho salmon embryo viability test used methodology similar to that of the standard rainbow trout embryo viability assay. The complete reports from Nautilus Environmental, including assay methodologies and raw data, are provided in Appendix 14-D, while a summary is included here in Table 14.1-6.

Generally, surface water collected from South Teigen (STE2) or North Treaty (NTR2) creeks had relatively low toxicity compared to the water collected downstream of the Mine Site (see Table 14.1-3). The most sensitive organisms to toxicity from baseline water quality were the algal species (NTR2, STE2) and *Ceriodaphnia dubia* (NTR2 only). Salmonids, both in the acute and chronic tests, were not sensitive to toxicity due to natural water quality. Toxicity was only apparent in water collected from South Teigen or North Treaty creeks during the July 2009 sampling event and not in November 2009 testing. Water from the reference site (SCR) also had significant toxicity to test organisms, including effects on invertebrate reproduction, algae growth, and aquatic plant growth, with effects more prominent in July than in November. Background water quality at these sites, including a reference site, caused toxicity to various aquatic organisms, and the effects appear seasonal in nature. These results indicate that at sites downstream of the proposed PTMA, survival and reproduction of some of the more sensitive aquatic invertebrates may be impaired due to pre-development water quality.

14.1.3 Lakes

Annual water quality samples were collected in two lakes in the baseline study area and two reference lakes from 2008 to 2012. Additional samples were collected during the open water season at Sulphurets Lake in 2012. A summary of the baseline study area lake water quality is presented in Table 14.1-7. Baseline data for lakes are included in Appendix 14-A and Appendix 14-C.

Table 14.1-6. Baseline Toxicity Testing Results for Processing and Tailing Management Area and Scott Creek Reference Site, KSM Project, 2009

Type of Test	Species Used in the Test	Test Endpoint	South Teigen Creek (STE2)				North Treaty Creek (NTR2)			
			July 2009		November 2009		July 2009		November 2009	
			Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)
Acute toxicity tests	*Oncorhynchus mykiss* (fish)	4-day survival (LC_{50})	>100	-	>100	-	>100	-	>100	-
	Daphnia magna (invertebrate)	2-day survival (LC_{50})	>100	-	>100	-	>100	-	>100	-
Chronic toxicity tests	*Ceriodaphnia dubia* (invertebrate)	7-day survival (LC_{50})	>100	-	>100	-	>100	-	>100	-
		7-day reproduction (IC_{25})	>100	-	>100	-	5.4	1.6 to 16.1	>100	-
	Pseudokirchneriella subcapitata (algae)	Growth (IC_{25})	61.7	52.3 to 69.0	>95[a]	-	11.4	9.4 to 14.0	>95[a]	-
	Lemna minor (aquatic plant)	Frond growth (IC_{25})	>97	-	>97	-	>97	-	>97	-
		Frond weight (IC_{25})	>97	-	>97	-	>97	-	>97	-
	O. mykiss (fish embryo)	7-day survival (IC_{25})	>100	-	>100	-	>100	-	>100	-
	O. kisutch (fish embryo)	10-day survival (IC_{25})	n/d	-	>100	-	n/d	-	>100	-

Type of Test	Species Used in the Test	Test Endpoint	Teigen Creek (TEC2)		Treaty Creek (TRC2)		Scott Creek (SCR), Refence Site			
			November 2009		November 2009		July 2009		November 2009	
			Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)	Concentration (% v/v)	Confidence Intervals (% v/v)
Acute toxicity tests	*Oncorhynchus mykiss* (fish)	4-day survival (LC_{50})	n/d	-	n/d	-	>100	n/a	>100	n/a
	Daphnia magna (invertebrate)	2-day survival (LC_{50})	n/d	-	n/d	-	>100	n/a	>100	n/a
Chronic toxicity tests	*Ceriodaphnia dubia* (invertebrate)	7-day survival (LC_{50})	n/d	-	n/d	-	100	n/a	>100	n/a
		7-day reproduction (IC_{25})	n/d	-	n/d	-	19.3	8.8 to 26.2	96.5	87.5 to 100
	Pseudokirchneriella subcapitata (algae)	Growth (IC_{25})	n/d	-	n/d	-	51.1	48.3 to 54.6	>95[a]	n/a
	Lemna minor (aquatic plant)	Frond growth (IC_{25})	n/d	-	n/d	-	21.5	5.9 to 58.6	>97	n/a
		Frond weight (IC_{25})	n/d	-	n/d	-	9.8	1.7 to 35.3	>97	n/a
	O. mykiss (fish embryo)	7-day survival (IC_{25})	n/d	-	n/d	-	>100	n/a	>100	n/a
	O. kisutch (fish embryo)	10-day survival (IC_{25})	>100	-	>100	-	n/d	n/d	>100	n/a

Concentrations are expressed in percent as volume of stream water / total volume

LC_{50} is the concentration of naturally-occurring stream water required to cause death in 50% of exposed organisms.

IC_{25} is the concentration of naturally-occurring stream water required to decrease survival, growth, or reproduction by 25% compared to the control group.

>95, >97, or >100 means that the stream water had no effect on the tested endpoint

n/d = not done

[a] Stream water samples stimulated growth of the algae relative to the control group (lab water)

14.1.3.1 Mine Site

Sulphurets and Knipple Glacier lakes are high altitude, glacier-fed lakes with sparse riparian vegetation and organic inputs. These lakes had near-neutral pH values, soft waters (< 60 mg/L $CaCO_3$), and were moderately-buffered.

Nitrogen concentrations were generally low at Sulphurets and Knipple Glacier lakes. Nitrate at Sulphurets Lake ranged from 0.008 to 0.03 mg/L. Total phosphorus concentrations were highly variable between baseline study years, and Sulphurets and Knipple Glacier lakes were variously classified as mesotrophic, oligotrophic, and ultra-oligotrophic based on CCME trigger ranges(CCME 2004); however, there was little bioavailable phosphorus, as ortho-phosphate was typically below the analytical detection limit (0.001 mg/L). TOC concentrations were frequently below the analytical detection limit (0.5 mg/L).

TSS concentrations were high in glacier-fed Sulphurets and Knipple Glacier lakes, ranging from 10 to 95 mg/L. High total metal concentrations were associated with the high sediment load. Guideline exceedances were frequently observed for dissolved aluminum, total cadmium, total chromium, total copper, total iron, total lead, total silver, and total zinc. A table of guideline exceedances is included in Appendix 14-A.

14.1.3.2 Processing and Tailing Management Area

West Teigen and Todedada lakes are lower altitude lakes with vegetated riparian zones. These had near-neutral pH values, soft waters (< 60 mg/L $CaCO_3$), and were moderately buffered.

Nitrate concentrations were below the analytical detection limit (0.005 mg/L) at West Teigen and Todedada lakes. Total phosphorus concentrations were highly variable between baseline study years, and West Teigen and Todedada lakes were variously classified as meso-eutrophic and oligotrophic based on CCME trigger ranges (CCME 1999); however, there was little bioavailable phosphorus, as ortho-phosphate was typically below the analytical detection limit (0.001 mg/L). TOC concentrations were higher than in Mine Site lakes, reflecting increased allochthonous organic inputs, and ranged from 1 to 4 mg/L.

TSS concentrations were low in West Teigen and Todedada lakes and were frequently below the analytical detection limit (3 mg/L). Total and dissolved metal concentrations were also substantially lower than at Mine Site lakes. West Teigen Lake exceeded the total silver guideline, on occasion. A table of guideline exceedances is included in Appendix 14-A.

14.2 Historical Activities

14.2.1 Mine Site

Historical mining and mineral exploration in the baseline study area and RSA can affect surface water quality in the receiving environment through increased surface disturbance resulting in sedimentation and metal leaching/acid rock drainage (ML/ARD), effluent discharges, and seepage. Historical mining activities that likely affected the baseline study area and RSA include the Granduc Mine, the Sulphurets Project, and the Eskay Creek Mine. The Granduc Mine operated between 1970 and 1978 and between 1980 and 1984 and uncontained tailing materials were washed down the Bowser River Valley into Bowser Lake.

Table 14.1-7. Water Quality in Lakes of the KSM Project Area, 2008 to 2012

Parameter	Guidelines for the Protection of Freshwater Aquatic Life: BC Chronic (30-day mean)	Guidelines for the Protection of Freshwater Aquatic Life: BC Acute (Maximum)	Units	Lake Water Quality: Sulphurets Lake (n = 9 samples) Mean	Sulphurets Lake (n = 9 samples) 95th P	Knipple Glacier Lake (n = 4 samples) Mean	Knipple Glacier Lake (n = 4 samples) Max[1]	West Teigen Lake (n = 3 samples) Mean	West Teigen Lake (n = 3 samples) Max[1]	Todedada Lake (n = 4 samples) Mean	Todedada Lake (n = 4 samples) Max[1]
Physical Parameters											
Colour, True	background-dependent	-	colour unit	2.5	2.5	2.5	2.5	2.5	2.5	4.2	5.9
Conductivity	-	-	uS/cm	131	70	114	118	175	179	147	155
Hardness (as $CaCO_3$)	-	-	mg/L	59	32	53	55	79	81	69	72
pH	-	6.5 to 9.0	pH unit	7.80	8.39	7.85	8.02	7.81	7.96	7.94	8.04
Total Suspended Solids	background-dependent	-	mg/L	34.7	95.1	12.8	12.8	5.9	5.9	3.3	6.6
Total Dissolved Solids	-	-	mg/L	96	59	82	88	103	103	86	95
Turbidity	background-dependent	-	NTU	63.1	121.0	46.5	53.9	2.8	2.8	1.2	1.8
Anions and Nutrients											
Acidity (as $CaCO_3$)	-	-	mg/L	1.7	0.5	2.3	2.9	2.2	2.9	2.9	5.7
Alkalinity, Total (as $CaCO_3$)	descriptive ranges	-	mg/L	29.1	26.0	41.9	44.1	45.7	47.8	54.9	62.6
Ammonia (as N)	temperature- and pH-dependent	temperature- and pH-dependent	mg/L	0.0057	0.0025	0.0025	0.0025	0.0092	0.0144	0.0025	0.0025
Bromide	-	-	mg/L	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Chloride	150	-	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Fluoride	-	hardness-dependent	mg/L	0.0340	0.010	0.0425	0.045	0.0683	0.068	0.0583	0.063
Nitrate (as N)	3	32.8	mg/L	0.029	0.023	0.003	0.003	0.003	0.003	0.003	0.003
Nitrite (as N)	chloride-dependent	-	mg/L	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Ortho-Phosphate (as P)	-	-	mg/L	0.0005	0.0012	0.0005	0.0005	0.0007	0.0011	0.0005	0.0005
Total Phosphate (as P)	-	-	mg/L	0.0382	0.1060	0.0104	0.0160	0.0142	0.0142	0.0066	0.0111
Sulphate	hardness-dependent	-	mg/L	33.0	13	12.8	13	38.2	40	18.8	19
Cyanides											
Cyanide, Weak Acid Dissociable	0.005	0.01	mg/L							0.0005	0.0005
Cyanide, Total	-	-	mg/L	0.0005	0.0005	0.0007	0.0012	0.0008	0.0008	0.0022	0.0026
Thiocyanate	-	-	mg/L								
Carbon											
Total Organic Carbon	background-dependent	-	mg/L	0.25	0.63	0.25	0.25	1.11	1.19	2.97	3.98
Total Metals											
Aluminum (Al)	-	-	mg/L	*1.950*	*3.750*	*1.905*	*2.340*	0.062	0.062	0.027	0.073
Antimony (Sb)	-	0.02	mg/L	0.001620	0.001950	0.000263	0.000263	0.000050	0.000050	0.000050	0.000050
Arsenic (As)	-	0.005	mg/L	0.00360	**0.00789**	0.00122	0.00132	0.00024	0.00024	0.00016	0.00031
Barium (Ba)	-	-	mg/L	0.0780	0.1150	0.0872	0.0976	0.0155	0.0167	0.0177	0.0205
Beryllium (Be)	0.0053	-	mg/L	0.00005	0.00013	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Bismuth (Bi)	-	-	mg/L	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Boron (B)	-	1.2	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Cadmium (Cd)	-	hardness-dependent	mg/L	**0.000086**	**0.000141**	**0.000034**	**0.000038**	0.000006	0.000006	0.000007	0.000012
Calcium (Ca)	-	-	mg/L	22.8	11.9	20.6	21.5	21.9	22.3	18.6	20.4
Chromium (Cr)	-	0.001	mg/L	**0.00149**	**0.00247**	0.00068	0.00089	0.00036	0.00036	0.00025	0.00025
Cobalt (Co)	0.004	0.11	mg/L	0.00113	0.00194	0.00063	0.00080	0.00012	0.00012	0.00005	0.00005
Copper (Cu)	hardness-dependent	hardness-dependent	mg/L	**0.01350**	**0.01320**	0.00141	0.00163	0.00040	0.00040	0.00027	0.00049
Iron (Fe)	-	1	mg/L	**1.940**	**4.950**	**1.498**	**1.820**	0.102	0.102	0.043	0.125
Lead (Pb)	hardness-dependent	hardness-dependent	mg/L	0.002730	0.005840	0.000819	0.001100	0.000068	0.000068	0.000093	0.000198
Lithium (Li)	0.014	0.87	mg/L	0.0016	0.0026	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Magnesium (Mg)	-	-	mg/L	2.21	2.2	1.28	1.4	5.70	5.9	5.94	6.5
Manganese (Mn)	hardness-dependent	hardness-dependent	mg/L	0.0909	0.1650	0.0480	0.0597	0.0154	0.0154	0.0299	0.1010
Mercury (Hg)	0.00002	-	mg/L	0.000016	0.000027	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005
Molybdenum (Mo)	1	2	mg/L	0.00101	0.00069	0.00064	0.00064	0.00022	0.00023	0.00008	0.00011
Nickel (Ni)	-	hardness-dependent	mg/L	0.001860	0.00200	0.000680	0.00072	0.000900	0.00090	0.000603	0.00064
Phosphorus (P)	-	-	mg/L	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Potassium (K)	-	-	mg/L	1.010	1.500	0.986	1.150	0.177	0.196	0.195	0.234
Selenium (Se)	-	0.002	mg/L	0.00032	0.00017	0.00018	0.00026	0.00054	0.00061	0.00008	0.00010
Silicon (Si)	-	-	mg/L	4.75	9.17	3.71	4.40	2.01	2.13	2.42	2.72
Silver (Ag)	hardness-dependent	hardness-dependent	mg/L	0.000043	0.000133	0.000040	0.000040	0.000026	0.000026	0.000005	0.000005
Sodium (Na)	-	-	mg/L	1.0	1.0	1.0	1.0	2.1	2.1	1.8	2.2
Strontium (Sr)	-	-	mg/L	0.125	0.072	0.083	0.083	0.204	0.216	0.279	0.307
Thallium (Tl)	-	0.0003	mg/L	0.00004	0.00006	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Tin (Sn)	-	-	mg/L	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Titanium (Ti)	2.0	-	mg/L	0.056	0.120	0.038	0.045	0.005	0.005	0.005	0.005
Uranium (U)	-	0.3	mg/L	0.000079	0.000106	0.000102	0.000103	0.000005	0.000005	0.000005	0.000005
Vanadium (V)	0.006	-	mg/L	0.0053	0.0104	0.0044	0.0053	0.0005	0.0005	0.0005	0.0005
Zinc (Zn)	hardness-dependent	hardness-dependent	mg/L	0.0130	0.0226	0.0059	0.0074	0.0009	0.0009	0.0008	0.0016
Dissolved Metals											
Aluminum (Al)	pH-dependent	pH-dependent	mg/L	0.0830	0.2760	0.0243	0.0371	0.0030	0.0043	0.0034	0.0069
Antimony (Sb)	-	-	mg/L	0.001000	0.000740	0.000128	0.000128	0.000050	0.000050	0.000050	0.000050
Arsenic (As)	-	-	mg/L	0.00053	0.00117	0.00030	0.00030	0.00019	0.00019	0.00009	0.00016
Barium (Ba)	-	-	mg/L	0.0305	0.0320	0.0493	0.0518	0.0146	0.0167	0.0167	0.0176
Beryllium (Be)	-	-	mg/L	0.00005	0.00005	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Bismuth (Bi)	-	-	mg/L	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Boron (B)	-	-	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Cadmium (Cd)	-	-	mg/L	0.000025	0.000005	0.000006	0.000006	0.000006	0.000006	0.000005	0.000005
Calcium (Ca)	-	descriptive ranges	mg/L	21.1	11.5	19.9	20.8	22.2	22.9	18.1	18.8
Chromium (Cr)	-	-	mg/L	0.00005	0.00022	0.00025	0.00025	0.00025	0.00025	0.00018	0.00025
Cobalt (Co)	-	-	mg/L	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Copper (Cu)	-	-	mg/L	0.00025	0.00059	0.00014	0.00014	0.00020	0.00025	0.00019	0.00021
Iron (Fe)	-	0.35	mg/L	0.015	0.202	0.015	0.015	0.015	0.015	0.015	0.015
Lead (Pb)	-	-	mg/L	0.000025	0.000241	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025
Lithium (Li)	-	-	mg/L	0.0005	0.0003	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Magnesium (Mg)	-	-	mg/L	1.61	0.8	0.80	0.8	5.73	5.9	5.78	6.1
Manganese (Mn)	-	-	mg/L	0.0175	0.0059	0.0045	0.0064	0.0001	0.0001	0.0123	0.0485
Mercury (Hg)	-	-	mg/L	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005
Molybdenum (Mo)	-	-	mg/L	0.00101	0.00059	0.00064	0.00064	0.00024	0.00024	0.00007	0.00009
Nickel (Ni)	-	-	mg/L	0.000250	0.00025	0.000250	0.00025	0.000343	0.00034	0.000500	0.00066
Phosphorus (P)	-	-	mg/L	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Potassium (K)	-	-	mg/L	0.337	0.259	0.243	0.243	0.173	0.210	0.184	0.199
Selenium (Se)	-	-	mg/L	0.00028	0.00013	0.00019	0.00022	0.00060	0.00071	0.00008	0.00010
Silicon (Si)	-	-	mg/L	0.95	1.01	0.70	0.74	1.91	2.06	2.37	2.57
Silver (Ag)	-	-	mg/L	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005
Sodium (Na)	-	-	mg/L	1.0	1.0	1.0	1.0	2.0	2.0	2.1	2.2
Strontium (Sr)	-	-	mg/L	0.119	0.062	0.082	0.082	0.205	0.216	0.273	0.284
Thallium (Tl)	-	-	mg/L	0.00001	0.00001	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Tin (Sn)	-	-	mg/L	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Titanium (Ti)	-	-	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Uranium (U)	-	-	mg/L	0.000047	0.000035	0.000069	0.000069	0.000005	0.000005	0.000005	0.000005
Vanadium (V)	-	-	mg/L	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Zinc (Zn)	-	-	mg/L	0.0015	0.0015	0.0005	0.0005	0.0005	0.0005	0.0006	0.0010

Notes:

If values were less than the analytical detection limit, half the detection limit was used for calculations.

- indicates no guideline or parameter was not analyzed

[1] the maximum value was calculated instead of the 95th percentile when n < 6

The wilp Skii km Lax Ha raised concerns that abandoned exploration drilling sites upstream of Bowser Lake may be affecting drinking water at the Spruce Creek Cabin (Rescan 2012b; Chapters 3 and 30 of the Application/EIS). Advanced exploration and bulk sample mining at the Sulphurets Project between 1986 and 1990 resulted in the placement of waste rock in Brucejack Lake and waste rock deposition along Brucejack Creek, which both drain west to the Sulphurets drainage. The Eskay Creek Mine operated between 1995 and 2008 and tailing materials and waste rock stored in Albino and Tom MacKay lakes and mine site drainage to Ketchum Creek flow to the Unuk River (McGurk 2005).

The baseline study data collected for the proposed KSM Project includes cumulative effects of historical mining and other land-use activities in the baseline study area. Water quality data for relevant monitoring sites from the Sulphurets Project in 1988 (Godin and Chamberlain 1990), Environment Canada monitoring of the Unuk River near the Alaskan border from 1991 to 1993 (Jang and Webber 1996), and baseline water quality monitoring for the previously proposed Kerr-Sulphurets Project (Stantec Consulting Ltd. 2003) were compiled for comparison to the current baseline study (Table 14.2-1).

Physical parameters including hardness, pH, conductivity, and TSS were similar between historical data and the current baseline studies for sites in Sulphurets and Ted Morris creeks and in the Unuk River. Total metals concentrations were also highly similar, although high detection limits in historical data prohibited a direct comparison for some parameters (e.g., molybdenum and selenium). Greater variability was observed for dissolved metal concentrations for parameters with concentrations above analytical detection limits. The limited historical data available suggested that water quality in Sulphurets Creek and Unuk River has remained consistent from the 1980s to present. These results suggest that chemical loading rates from historical mining activities have remained relatively constant over time.

14.2.2 Processing and Tailing Management Area

Historical mining activities in the PTMA were limited to mineral exploration in the upper reaches of Treaty Creek. Historical forestry activities may have affected surface water quality in the baseline study area through increased surface disturbance resulting in sedimentation. The baseline study data completed for the proposed KSM Project includes cumulative effects of the historical forestry and other land use activities in the baseline study area.

14.3 Land Use Planning Objectives

The Project area is situated within the Regional District of Kitimat-Stikine, and is subject to the Cassiar Iskut-Stikine Land and Resource Management Plan (LRMP; BC MFLNRO 2000) and the Nass South Sustainable Resource Management Plan (SRMP; BC MFLNRO 2012). LRMPs are sub-regional, integrated resource plans that establish the framework for land use and resource management objectives and strategies, and provide a basis for detailed management planning. These plans result in several main products including: broad land/coastal use zones delineated on a map; resource management objectives for land/coastal use zones; and broad strategies for integrating resource use, socio-economic analysis, and plan monitoring, implementation, and interpretation mechanisms. SRMPs focus on similar issues and values as LRMPs, but at a more detailed level.

The western portion of the baseline study area falls within the General Management Direction (GMD) of the Cassiar Iskut-Stikine LRMP (BC MFLNRO 2000). Objectives and strategies of the GMD apply throughout the LRMP area, outside of Protected Areas. In addition to the GMD, there are objectives and strategies for area-specific Resource Management Zones (RMZs). The Unuk River RMZ covers an area of 10,000 ha and lies south of Sulphurets Creek along the Unuk River Valley, a small segment of which overlaps the proposed mine access route. The south and central portions of the RSA falls within the Nass South SRMP. Water quality management objectives of both the GMD and Unuk River RMZ of the Cassiar Iskut-Stikine LRMP, and the Nass South SRMP are described in Table 14.3-1. The eastern portion of the RSA, including the PTMA and the portion of the Bell-Irving River within the baseline study area, falls in the Nass land use area, for which no LRMP has been produced to date.

Provincial parks within the baseline study area are administered by the BC Ministry of Environment and the BC Ministry of Forests, Lands and Natural Resource Operations. The baseline study area includes a section of the Unuk River that is included in Border Lake Provincial Park, on the border of Alaska. Border Lake Provincial Park lies within the Unuk RMZ and management planning for Border Lake Provincial Park is described in an approved management direction statement (BC MWLAP 2003b). Current baseline studies within Border Lake Provincial Park are permitted by Authorization #105691. Water-related management objectives are included in Table 14.3-1.

14.4 Spatial and Temporal Boundaries

14.4.1 Spatial Boundaries

The spatial boundaries for the RSA for the water quality effects assessment focused on watersheds that could potentially be affected by mine development and operation, including the Mitchell/Sulphurets/Unuk, Teigen/Snowbank/Bell-Irving, and Treaty/Bell-Irving watersheds. Spatial boundaries for the water quality effects assessment were confined to the downstream limits of predicted changes caused by the proposed Project as determined by water quality modelling. Water quality effects were quantitatively evaluated at the following receiving environment locations (Figure 14.1-1):

1. Mine Site: Sulphurets Creek (SC2 and SC3) and Unuk River (UR1 and UR2).
2. PTMA: Treaty Creek (TRC2), North Treaty Creek (NTR2), South Teigen Creek (STE3), and Teigen Creek (TEC2).

14.4.2 Temporal Boundaries

The water quality effects assessment considered four Project phases: (1) the construction phase, 5 years; (2) the operation phase, 51.5 years; (3) the closure phase, 3 years; and (4) the post-closure phase, including Mine Site reclamation and post-closure maintenance monitoring.

The water quality effects assessment considered seasonal changes in water quantity and quality. Baseline water quality and quantity data and Project design were sufficient to support water quality modelling at a monthly scale during the construction (from Year -1), operation, closure, and post-closure phases.

Table 14.2-1. Comparison of Mine Site Water Quality Baseline Data and Historical Water Quality Data

Parameter	Guidelines for the Protection of Freshwater Aquatic Life		Site Names	SC2		SC3		SCT		UR1A		UR1		UR2	
	BC Chronic (30-day mean)	BC Acute (Maximum)	Years	August 2003	August 2007-2012	August 1988	August 2007-2012	August 2003	August 2007-2012	August 1988	August 2007-2012	August 1988	August 2007-2012	1991-1993	2007-2012
			Units												
Physical Parameters															
Conductivity	-	-	uS/cm	-	-	-	-	-	-	-	-	-	-	138	131
Hardness (as $CaCO_3$)	-	-	mg/L	59.0	48.0	50.7	75.0	54.0	67.8	43.4	50.1	47.9	50.6	58.0	58.5
pH	-	6.5 to 9.0	pH unit	-	-	7.9	8.0	-	-	8.0	8.1	7.9	8.0	7.8	7.8
Total Suspended Solids	background-dependent	-	mg/L	-	-	237	186	-	-	205	112	231	132	-	-
Turbidity	background-dependent	-	NTU	-	-	-	-	-	-	-	-	-	-	20.4	69.8
Anions and Nutrients															
Alkalinity, Total	descriptive ranges	-	mg/L	-	-	31.5	26.0	-	-	38.5	31.5	35.0	37.4	42.3	40.7
Chloride	150	-	mg/L	-	-	-	-	-	-	-	-	-	-	0.40	0.30
Fluoride	-	hardness-dependent	mg/L	-	-	-	-	-	-	-	-	-	-	0.052	0.046
Nitrate (as N)	3	32.8	mg/L	-	-	-	-	-	-	-	-	-	-	0.122	0.127
Sulphate	hardness-dependent	-	mg/L	32.0	26.9	19.0	27.8	19.0	40.0	8.0	11.6	14.0	21.5	20.1	29.6
Cyanides	**temperature- and pH-dependent**	**temperature- and pH-dependent**													
Cyanide,	0.005	0.01	mg/L	-	-	-	-	-	-	-	-	-	-	0.0004	0.0005
Cyanide, Total	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	0.0005	0.0009
Carbon															
Total Organic Carbon	background-dependent	-	mg/L	-	-	-	-	-	-	-	-	-	-	1.27	1.11
Total Metals															
Aluminum (Al)	-	-	mg/L	1.50	4.55	4.41	3.73	3.20	1.19	7.19	3.21	4.80	2.75	1.67	1.58
Arsenic (As)	-	0.005	mg/L	0.00300	0.00597	<0.05	0.00457	0.00200	0.00137	<0.05	0.00459	<0.05	0.00383	0.0017	0.0019
Barium (Ba)	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	0.048	0.053
Beryllium (Be)	0.0053	-	mg/L	-	-	-	-	-	-	-	-	-	-	0.053	0.0002
Cadmium (Cd)	-	hardness-dependent	mg/L	0.0012	0.0010	0.0008	0.0007	0.0003	0.0003	0.0001	0.0001	0.0005	0.0004	0.0006	0.0002
Calcium (Ca)	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	22.1	27.2
Chromium (Cr)	-	0.001	mg/L	<0.002	0.004	<0.005	0.003	0.003	0.002	0.008	0.006	0.006	0.003	0.002	0.002
Cobalt (Co)	0.004	0.11	mg/L	-	-	-	-	-	-	-	-	-	-	0.0013	0.0012
Copper (Cu)	hardness-dependent	hardness-dependent	mg/L	0.120	0.096	0.053	0.073	0.012	0.008	0.008	0.009	0.035	0.044	0.013	0.023
Iron (Fe)	-	1.00	mg/L	4.10	7.63	5.67	6.18	5.20	1.91	7.12	4.57	5.84	4.17	2.58	2.38
Lead (Pb)	hardness-dependent	hardness-dependent	mg/L	0.00270	0.00687	< 0.0005	0.00476	0.00260	0.00313	< 0.0005	0.00285	< 0.0005	0.00347	0.00229	0.00153
Lithium (Li)	0.014	0.87	mg/L	-	-	-	-	-	-	-	-	-	-	0.0019	0.0023
Magnesium (Mg)	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	1.85	2.97
Manganese (Mn)	hardness-dependent	hardness-dependent	mg/L	-	-	-	-	-	-	-	-	-	-	0.067	0.076
Molybdenum (Mo)	1	2	mg/L	<0.002	0.001	<0.01	0.001	<0.002	0.001	<0.01	0.001	<0.01	0.001	0.002	0.002
Nickel (Ni)	-	hardness-dependent	mg/L	-	-	-	-	-	-	-	-	-	-	0.0021	0.0021
Phosphorus (P)	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	0.10	0.12
Potassium (K)	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	0.80	1.25
Selenium (Se)	-	0.002	mg/L	<0.002	0.00085	-	-	<0.002	0.00044					0.00054	0.00066
Silicon (Si)	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	2.2	4.8
Sodium (Na)	-	-	mg/L	-	-	-	-	-	-	-	-	-	-	1.2	1.6
Strontium (Sr)	-	-	mg/L	-	-	-	-	-	-					0.13	0.15
Thallium (Tl)	-	0.0003	mg/L	<0.0002	0.00007	-	-	<0.0002	0.00005	-	-	-	-	-	-
Vanadium (V)	0.006	-	mg/L	-	-	-	-	-	-	-	-	-	-	0.0057	0.0057
Zinc (Zn)	hardness-dependent	hardness-dependent	mg/L	0.091	0.077	0.043	0.062	0.037	0.027	0.019	0.015	0.031	0.038	0.015	0.022
Dissolved Metals															
Aluminum (Al)	pH-dependent	pH-dependent	mg/L	0.051	0.054	<0.05	0.045	0.31	0.054	<0.05	0.075	<0.05	0.056	-	-
Arsenic (As)	-	-	mg/L	<0.002	0.00008	<0.05	0.00007	<0.002	0.0004	<0.05	0.0005	<0.05	0.0002	-	-
Cadmium (Cd)	-	-	mg/L	0.0020	0.0003	<0.0001	0.0003	0.0001	0.0001	<0.0001	0.00001	<0.0001	0.0001	-	-
Chromium (Cr)	-	-	mg/L	<0.002	0.0002	<0.005	0.0001	<0.002	0.0001	<0.005	0.0002	<0.005	0.0002	-	-
Copper (Cu)	-	-	mg/L	0.014	0.0009	< 0.0005	0.0015	0.005	0.0002	< 0.0005	0.0002	< 0.0005	0.0007	-	-
Iron (Fe)	-	0.35	mg/L	0.069	0.015	<0.005	0.015	0.44	0.036	0.032	0.048	0.014	0.015	-	-
Zinc (Zn)	-	-	mg/L	0.078	0.010	<0.002	0.007	0.012	0.002	<0.002	0.001	<0.002	0.004	-	-

Note: - indicates no guideline or parameter was not analyzed in historical data

Table 14.3-1. Water Quality Objectives of the Cassiar Iskut-Stikine Land Resource Management Plan, Nass South Sustainable Resource Management Plan, and Management Direction Statement for Border Lake Provincial Park

Management Direction	Water Quality-related Resource	Water Quality-related Management Objectives
		Cassiar Iskut-Stikine LRMP (BC MFLNRO 2000)
Biodiversity/ Ecosystem Health	Aquatic Ecosystems and Riparian Habitat	Manage activities so that there is no net loss of fish habitat. Conserve riparian habitat by minimizing disturbance to the structural and functional features of riparian habitat, including critical habitat features. Maintain the integrity of watersheds with high fisheries values and domestic water use (licensed and unlicensed). Maintain water quality and quantity for naturally occurring aquatic biota within the natural range of variability.
		Nass South SRMP (BC MFLNRO 2012)
Water	Water Quality	Protect and maintain surface and groundwater to provide a safe and sufficient drinking water supply that supports healthy communities. Maintain water quality, quantity, peak, and low flows within the natural range of variability in rivers, streams, lakes, and wetlands to protect the hydrological integrity of their watersheds (water quality includes temperature, turbidity and chemistry). Maintain ecological functioning of streams, rivers, wetland complexes and lakes, including those that do not support populations of fish. Restore the water quality and hydrologic integrity of damaged watersheds throughout the plan area.
		Management Direction Statement for Border Lake Provincial Park (BC MWLAP 2003)
		Protect the park's natural values (grizzly bear and fish species will be the highest priority).

14.5 Valued Components

Valued components (VCs) are used to focus the Application for an Environmental Assessment Certificate/Environmental Impact Statement (Application/EIS) on the issues of highest concern. To be considered a VC for assessment purposes, a component must be of recognized importance to society, the local community, or the environmental system, and there must be a perceived likelihood that the VC will be affected by the proposed Project.

Surface water quality is a key indicator of environmental health because it is linked to other ecosystem components including fish and fish habitat, aquatic resources (sediment quality, benthos, and periphyton), soil, vegetation, wildlife, and human health. The proposed KSM Project has the potential to affect surface water quality during the construction, operation, closure, and post-closure phases.

Surface water quality was screened for inclusion in the Application/EIS as a VC through a review of relevant regulations and guidelines, literature, and professional experience. Furthermore, VC selection included interests and issues identified through the extensive consultation process with regulators, Nisga'a Nation, First Nations, governments (BC provincial, federal, Aboriginal, and American state and federal), local interest groups, and the general public.

14.5.1 Valued Components Included in Assessment

Surface water quality is a critical component of the biological and physical environment, and degradation of surface water quality could affect other ecosystem components including fish and fish habitat, wildlife and wildlife habitat, vegetation, wetlands, and human health. The construction and operation of mine infrastructure including access corridors, the Mine Site, and the PTMA, have the potential to affect surface water quality. The following regulations, legislation, and regulatory agencies govern the maintenance of water quality and water resources:

- *Water Act* (1996b), British Columbia Ministry of Environment;
- *Canada Water Act* (1985a), Environment Canada;
- *Environmental Management Act* (2003), British Columbia Ministry of Environment;
- *Fisheries Act* (1985b), Fisheries and Oceans Canada;
- Metal Mine Effluent Regulations (SOR/2002-222), Environment Canada;
- *Canadian Environmental Assessment Act* (2012);
- British Columbia *Environmental Assessment Act* (2002), British Columbia Environmental Assessment Office;
- British Columbia Approved and Working Water Quality Guidelines (BC MOE 2006b), British Columbia Ministry of Environment; and
- Environmental Quality Guidelines (CCME 1999), Canadian Council of Ministers of the Environment.

Surface water quality issues and VCs are presented in Table 14.5-1 and were identified through consultation with the following groups:

- federal government agencies including Canadian Environmental Assessment Agency, Environment Canada, Fisheries and Oceans Canada, Natural Resources Canada, Transport Canada, and Health Canada;
- BC provincial government agencies including Ministry of Energy, Mines, and Natural Gas, Ministry of Environment, and the BC Environmental Assessment Office;
- American government agencies including Alaska Department of Natural Resources, Department of the Interior, and the National Marine Fisheries Service;
- Aboriginal groups including the Gitanyow First Nation, Gitanyow Fisheries Authority, the Office of the Gitanyow Hereditary Chiefs, Nisga'a Lisims Government, Skii km Lax Ha, and the Tahltan Central Council and Tahltan Heritage Environmental Assessment Team; and
- the general public and other stakeholders, including the Regional District of Kitimat-Stikine.

Table 14.5-1. Identification and Rationale for Surface Water Quality Valued Component Selection

VC	Identified by*				Rationale for Inclusion
	AG	G	P/S	O	
Surface water quality	x	x	x	x	Surface water quality was identified as a key environmental issue with potential effects on fish and wildlife habitat and human health by the Tahltan Nation, Skii km Lax Ha, Gitanyow First Nation, Nisga'a Nation, Gitxsan Nation, and BC provincial and federal regulatory agencies. Potential effects on water quality have a biological importance to other VCs including fish and wildlife, fish and wildlife habitat, wetlands, vegetation, and human health.

***AG = Aboriginal Group; G = Government; P/S = Public/Stakeholder; O = Other**

14.5.2 Valued Components Excluded from Further Assessment

Surface water quality was selected as a single VC, rather than assessing individual physical or chemical constituents. Therefore, no potential VCs were excluded from further assessment.

14.6 Scoping of Potential Effects for Surface Water Quality

Potential degradation of surface water quality due to the Project has been identified by Aboriginal groups, governments, stakeholders, and the public, as well as through best management practices, scientific literature, and professional judgment. The Project components that have the potential to degrade water quality are detailed in Appendix 14-E and summarized in Table 14.6-1. A detailed description of the potential effects to surface water quality is provided in Section 14.7.

Table 14.6-1. Potential Effects from Project on Surface Water Quality

Project Region	Project Area	Degradation of Surface Water Quality
Mine Site	Camp 3: Eskay Staging Camp	X
	Camp 7: Unuk North Camp	X
	Camp 8: Unuk South Camp	X
	Coulter Creek Access Corridor	X
	Mitchell Operating Camp	X
	McTagg Rock Storage Facility	X
	McTagg Twinned Diversion Tunnels	X
	McTagg Power Plant	
	Mitchell Rock Storage Facility	X
	Camp 4: Mitchell North Camp (for MTT construction)	X
	Mitchell Ore Preparation Complex	X
	Mine Site Avalanche Control	
	Iron Cap Block Cave Mine	X
	Mitchell Pit	X
	Mitchell Block Cave Mine	X
	Mitchell Diversion Tunnels	X
	Upper Sulphurets Power Plant	
	Mitchell Truck Shop	
	Water Storage Facility	X
	Camp 9: Mitchell Initial Camp	X
	Camp 10: Mitchell Secondary Camp	X
	Water Treatment and Energy Recovery Area	X
	Sludge Management Facilities	X
	Sulphurets Laydown Area	X
	Sulphurets-Mitchell Conveyor Tunnel	X
	Sulphurets Pit	X
	Kerr rope conveyor	
	Kerr Pit	X
	Camp 2: Ted Morris Camp	X
	Explosives Manufacturing Facility	
	Temporary Frank Mackie Glacier Access Route	X
	Camp 1: Granduc Staging Camp	X

(continued)

Table 14.6-1. Potential Effects from Project on Surface Water Quality (completed)

Project Region	Project Area	Degradation of Surface Water Quality
Processing and Tailing Management Area	Mitchell-Treaty Twinned Tunnels	X
	Construction Access Adit	X
	Mitchell-Treaty Saddle Area	X
	Camp 6: Treaty Saddle Camp	X
	Camp 5: Treaty Plant Camp	X
	Treaty Operating Camp	X
	Treaty Ore Preparation Complex	X
	Concentrate Storage and Loadout	X
	North Cell Tailing Management Facility	X
	East Catchment Diversion	X
	Centre Cell Tailing Management Facility	X
	South Cell Tailing Management Facility	X
	Treaty Creek Access Corridor	X
	Camp 11: Treaty Marshalling Yard Camp	X
	Camp 12: Highway 37 Construction Camp	X
Off-site Transportation	Highway 37 and 37A	X

Note:
X = interaction between component and effect.

14.6.1 Construction

During construction, water quality effects have the potential to occur through various pathways that ultimately lead to degradation of surface water quality. These pathways are outlined below:

- ML/ARD: potential degradation of water quality from ML/ARD generated from surface disturbances (e.g., access roads, borrow areas, and quarries), waste rock, and pre-production ore stockpiles;
- effluent discharge: potential degradation of water quality through the directed discharge of effluent (e.g., temporary Water Treatment Plants [WTPs], sediment control ponds, lined and unlined muck pads, and the Mine Site WTP);
- sedimentation and erosion: potential degradation of water quality through erosion of surface disturbances leading to sedimentation (e.g., access roads, equipment and material storage yards, laydown areas, closure cover borrow, and till storage areas);
- leaching of blasting residues: potential degradation of water quality through the release of nitrogen as nitrate, nitrite, and ammonia from blasting residues used in construction (e.g., access roads, pre-production ore stockpiles, waste rock, Sulphurets Pit);

- sewage: potential degradation of water quality through seepage from construction camp septic fields;
- spills: potential degradation of water quality through uncontrolled releases of chemicals and fuel;
- seepage: potential degradation of water quality through uncontained seepage below and through dams (e.g., Water Storage dam [WSD], Water Storage Facility [WSF] seepage dam), and from sludge management facilities and landfarms/landfills; and
- atmospheric deposition: potential degradation of water quality through deposition of dust from blasting.

14.6.2 Operation

During operation, water quality effects have the potential to occur through various pathways that ultimately lead to degradation of surface water quality. These pathways are outlined below:

- ML/ARD: potential degradation of water quality from ML/ARD generated from surface disturbances (e.g., access roads, borrow areas, and quarries), dams, waste rock, pit walls, underground workings, and ore stockpiles;
- effluent discharge: potential degradation of water quality through the directed discharge of effluent (e.g., WTP, TMF discharge pipeline, temporary WTPs, sediment control ponds);
- sedimentation and erosion: potential degradation of water quality through erosion of surface disturbances (e.g., access roads, equipment and material storage yards, laydown areas, closure cover borrow and till storage areas) leading to sedimentation;
- leaching of blasting residues: potential degradation of water quality through the release of nitrogen as nitrate, nitrite, and ammonia from blasting residues used in mining operations;
- sewage: potential degradation of water quality through seepage from camp septic fields;
- spills: potential degradation of water quality through uncontrolled release of chemicals, concentrate, and fuel;
- seepage: potential degradation of water quality through uncaptured seepage below and through dams (e.g., WSD, TMF dams, seepage dams), from pits, and from sludge management facilities and landfarms/landfills; and
- atmospheric deposition: potential degradation of water quality through deposition of dust from blasting and crushing activities.

14.6.3 Closure

During closure, water quality effects have the potential to occur through various pathways that ultimately lead to degradation of surface water quality. These pathways are outlined below:

- ML/ARD: potential degradation of water quality from ML/ARD generated from unreclaimed surface disturbances, dams, waste rock, pit walls, and underground workings;

- effluent discharge: potential degradation of water quality through the directed discharge of effluent from the WTP;
- sedimentation and erosion: potential degradation of water quality through erosion of un-reclaimed surface disturbances leading to sedimentation;
- spills: potential degradation of water quality through uncontrolled releases of chemicals and fuel; and
- seepage: potential degradation of water quality through uncaptured seepage below and through dams (e.g., WSD, TMF dams, seepage dams), and from sludge management facilities and landfarms/landfills.

14.6.4 Post-closure

During post-closure, water quality effects have the potential to occur through various pathways that ultimately lead to degradation of surface water quality. These pathways are outlined below:

- ML/ARD: potential degradation of water quality from ML/ARD generated from unreclaimed surface disturbances, dams, waste rock, pit walls, and underground workings;
- effluent discharge: potential degradation of water quality through the directed discharge of effluent from the WTP;
- sedimentation and erosion: potential degradation of water quality through erosion of unreclaimed surface disturbances leading to sedimentation;
- spills: potential degradation of water quality through uncontrolled releases of chemicals and fuel; and
- seepage: potential degradation of water quality through uncaptured seepage below and through dams (e.g., WSD, TMF dams, seepage dams), and from sludge management facilities and landfarms/landfills.

14.7 Potential for Residual Effects on Surface Water Quality

Potential effects on surface water quality were assessed for various Project components using both qualitative methods including a combination of best available data and professional judgment/experience and quantitative water quality modelling.

Two predictive water quality models were developed for the construction, operation, closure, and post-closure phases: the Mine Site model (Appendix 14-F) and the PTMA model (Appendix 14-G). Qualitative/best judgment assessment approaches were used for Project components that were not included in the site water balance (e.g., access roads).

14.7.1 Degradation of Water Quality

14.7.1.1 Assessment of Degradation of Water Quality outside Water Management Structures

14.7.1.1.1 Metal Leaching / Acid Rock Drainage

Acid rock drainage (ARD) occurs when sulphide minerals are exposed to oxygen and water and naturally oxidize without the presence of sufficient quantities of neutralizing minerals. Acidic drainage accelerates the rate of metal leaching (ML). Neutral metal leaching may also occur. ML/ARD has the potential to degrade surface water quality as a result of surface disturbances for construction of camps, access roads, diversion structures, tunnels, borrow areas, and quarries, during mining in the construction (pre-production) and operation phases. Surface disturbances that are not sufficiently reclaimed have the potential to degrade surface water quality in the closure and post-closure phases. ML/ARD within the catchment of the WSF and within the TMF was assessed quantitatively using water quality modelling.

ML/ARD leading to degradation of surface water quality was qualitatively assessed for surface disturbances outside the catchment of the WSF and the TMF, including the Coulter Creek and Treaty Creek access corridors. Surface disturbance and exposure of potentially acid generating (PAG) or currently acid-generating rock and overburden has the potential to release ML/ARD to watercourses along the CCAR and TCAR. The ML/ARD potentials of the CCAR and TCAR were evaluated in the *Access Roads ML/ARD Potential Assessment* (Appendix 10-B), which identified that 32% or 10.6 km of the CCAR and 23% or 10 km of the TCAR have an ML/ARD potential of possible or high. The ML/ARD potential of overburden and non-deposit rock outside the catchment of the TMF and WSF was assessed in Chapter 10 and also indicates that degradation of surface water quality is possible without mitigation. Mitigation for ML/ARD is presented in Section 26.14 and summarized in Section 14.7.2.1.

14.7.1.1.2 Effluent Discharge

Effluent discharges from nine proposed Temporary Water Treatment Plants (TWTPs) have the potential to degrade surface water quality during the construction phase. TWTP locations, design, and unit details are included in *Temporary Water Treatment Plants for KSM Construction Period* (Appendix 4-P). The TWTPs will treat drainage from the tunnel portals and temporary tunnel muck pads. The TWTPs are primarily designed for reduction of TSS; however, dissolved metals and ammonia will also be reduced in concentration. Water treatment at the TWTPs will be achieved through settling, lime and flocculent additions, air sparging, and acid addition as required to meet discharge limits established in consultation with the relevant government agencies.

14.7.1.1.3 Sedimentation and Erosion

Surface disturbance at the Mine Site and PTMA will increase sedimentation and erosion of soils and overburden materials (see Chapter 8). Soil loss associated with erosion, slope failure, burial, excavation, or construction reduces the area available to support vegetation growth and to provide nutrients, carbon, and water cycling. Similarly, changes in site drainage patterns, soil contamination, or alteration of soil attributes such as organic matter content, pH, nutrient availability, and microbial activity, can affect the ecological functionality of ecosystems, and water quality.

Recovery from sedimentation will be more rapid in high-velocity streams relative to wetlands or lakes. Many streams and rivers in the Project area have naturally high sediment loads due to glacial origins, and thus will not be affected to the extent of clear, low-velocity streams.

14.7.1.1.4 Leaching of Blasting Residues

Nitrogen loading to watercourses from blasting residues used outside the catchment of the WSF and TMF has the potential to affect surface water quality during the construction and operation phases. Total nitrogen concentrations were low in streams in the baseline study area (see Section 14.1.2 and Appendix 14-A). Nitrogen loading may increase the potential for eutrophication in nitrogen-limited aquatic systems if there is sufficient phosphorus and other micronutrients for primary production. The effects of nutrient loading on aquatic life are assessed in Chapter 15.

14.7.1.1.5 Sewage

Sewage discharge to the receiving environment from construction and operating camps has the potential to affect water quality in the construction and operation phases, primarily through nutrient loading. Twelve construction camps will have sewage treatment facilities that will include secondary treatment, and effluent will be discharged to either surface water or ground locations in a manner approved by the relevant government agency. Sewage treatment plants were designed to produce effluent quality that is consistent with reclaimed water. Sewage discharges from the operating camps were included in the water quality model (see Section 14.7.1.2). The effects of nutrient loading on aquatic life are assessed in Chapter 15.

14.7.1.1.6 Spills

Spills of petroleum products, reagents, or concentrate have the potential to occur during the construction, operation, closure, and post-closure phases of the Project due to various Project activities. The main risks associated with spills are related to occurrences of low likelihood outside of normal operating conditions and are addressed in Chapter 35, Environmental Effects of Accidents and Malfunctions and Appendix 22-C, *Highways 37 and 37A Traffic Effects Assessment*.

14.7.1.1.7 Atmospheric Deposition

Dust deposition from blasting and other mining activities has the potential to affect surface water quality during the construction, operation, closure, and post-closure phases. An air quality effects assessment was completed in Chapter 7 and the air quality modelling results were used to assess the effect of dust deposition on surface water quality.

14.7.1.2 Predictive Water Quality Modelling

The primary objective of water quality modelling for the KSM Project was to predict the concentrations of chemical species within the Project footprint (e.g., drainage from Rock Storage Facilities (RSFs) and block cave mines, WSF, TMF) and in the surrounding surface waters that will receive direct effluent discharge and/or seepage from Project components. A construction phase water quality model for the Mine Site was developed from the start-up of the WTP in Year -1. An operation, closure, and post-closure phase water quality model for the Mine Site and PTMA was developed for the period of operation from the mill start-up (time = 0 years) to 100 years in the future (approximately 50 years into the post-closure phase).

The water quality model for the Project was developed using a mass balance calculation approach in GoldSim™ to model the volume and flow of water and the concentrations and transport of chemical species as a function of time. GoldSim™ was developed to model complex environmental systems and has been extensively and successfully applied to simulate water resource management, mining operation, contaminant transport, and radioactive waste management. GoldSim™ is a simulation program that includes Project components as "containers" that are made up of "elements." These containers include the formulas, data, conditions and/or operation criteria for different Project components (Appendices 14-F and 14-G).

14.7.1.2.1 General Description of Model Inputs and Assumptions

Water Balance

The Project water management facilities design were based on the Pre-feasibility Study (Tetra Tech 2012) and detailed water management plans developed by Klohn Crippen Berger (KCB) for the Mine Site (Appendix 4-J) and PTMA (Appendix 4-AC). A water mass balance model was developed in GoldSim™ which was used for water quantity and quality predictions (Appendices 14-F and 14-G).

For the environmental effects assessment, the water balance model was calibrated to the observed flows (Appendix 13-A). Where modelled results differed from observed values, the model input parameters were adjusted until the deviation between modelled and observed values was less than 1%.

The Project footprint was divided into catchment and sub-catchment areas for water balance purposes. Diversion efficiencies were estimated based on diversion-specific location considerations and expected seasonal blockages (e.g., avalanches). Climate data used in the development of the water balance was based on climate and hydrology baseline data collected from 2008 to 2011 (Appendices 13-A, 14-F, and 14-G). Annual average precipitation was estimated for each catchment or sub-catchment delineated in the model and was adjusted for orographic effects. Monthly distributions of precipitation were determined through comparison of baseline site-specific data and near-by reference stations. Runoff from precipitation was estimated using an average runoff coefficient and the coefficient and monthly runoff distributions were based on observed stream flow measurements. Mean annual runoff from glacial melt and a monthly distribution of runoff was estimated for glaciated catchments. Mean annual evaporation and monthly distributions were estimated based on lake evaporation at the Topley Landing weather station and were corrected for elevation (Appendices 14-F and 14-G).

Water Chemistry

Model Approach

Changes in water quality due to the proposed Project were assessed by comparing the baseline chemical mass loading from the environment ("baseline case") to the predicted chemical mass loading from Project components (Mine Site and PTMA) and activities ("mine case").

The water quality model is based on a mass balance principle and assumes that:

- mixing of water bodies is instantaneous and complete;

- dissolved components remain in solution unless a mineral solubility control or water treatment is applied; and
- mine operational and engineering components in the model turn on and off instantaneously.

The generalized mass balance equations are:

$$C_{A\text{-}B\,i} = \frac{(C_{A\,i} \times Q_A + C_{B\,i} \times Q_B)}{(Q_A + Q_B)}$$

where:

- CAi and CBi are the concentrations of chemical species i in streams A and B, respectively;
- QA and QB are the flow rates or volumes of water in streams A and B, respectively; and
- $C_{A\text{-}B\,i}$ is the concentration of chemical species *i* in the mixed body of water of streams A and B;

and

$$\sum (Mass\ Loading\ In)_i - \sum (Mass\ Loading\ out)_i = \Delta C_i\ x\ V$$

where:

- ΔC_i is the change in concentration of chemical species *i* in a body of water;
- V is the volume of the body of water; and
- $\sum$(Mass Loading In)$_i$ and $\sum$(Mass Loading out)$_i$ are the sum of masses of chemical species *i* added to, and removed from, the body of water, respectively.

The baseline case considers water quality data and hydrological data collected at the proposed Project site from 2008 to 2012. The baseline case is calculated as the sum of all mass loadings carried by all the flows from the proposed Mine Site to the surrounding receiving environment as follows:

$$Baseline\ Case = \sum (C_{Base} \times Q_{Base})$$

The baseline case represents both historical activities and the natural geochemical loading observed in the baseline study area. The mine case estimates chemical mass loadings from the proposed Project components, including surface disturbance, open pits, RSFs, surface water management, and water treatment, that are modelled based on a mass balance approach.

The effect of the proposed Project activities on the mass loading to the receiving environment is calculated from the difference between the baseline case and the mine case:

$$\Delta(Mass\ Loading) = \sum (C_{Mine} \times Q_{Mine}) - \sum (C_{Baseline} \times Q_{Baseline})$$

Applying the conservative assumption that natural attenuation does not occur on the difference in mass loading (Δ), the concentration downstream of the receiving environment is calculated as:

$$Concentration_{ENV} = (Baseline\ Case + \Delta(Mass\ Loading))/Q_{Mine}$$

Source Terms

Geochemical Loadings

For each Project component in the model, a standard list of parameters was modelled (Table 14.7-1). pH could not be modelled using the mass balance modelling approach. TSS modelling was completed for predictions of sediment quality and the results are presented in Chapter 15 and Appendix 15-L.

Table 14.7-1. Modelled Chemical Parameters

Nutrients		Trace Elements			
Ammonia	NH_4	Silver	Ag	Lithium	Li
Nitrite	NO_2	Aluminum	Al	Magnesium	Mg
Nitrate	NO_3	Arsenic	As	Manganese	Mn
Phosphorus	P	Boron	B	Molybdenum	Mo
Anions		Barium	Ba	Sodium	Na
Bromide	Br	Beryllium	Be	Nickel	Ni
Fluoride	F	Calcium	Ca	Lead	Pb
Sulphate	SO_4	Cadmium	Cd	Antimony	Sb
Chloride	Cl	Cobalt	Co	Selenium	Se
Cyanides		Chromium	Cr	Silicon	Si
Total cyanide	CN	Copper	Cu	Tin	Sn
WAD cyanide	CN_WAD	Copper-cyanide complex	Cu_CN	Strontium	Sr
				Thallium	Tl
		Iron	Fe	Uranium	U
		Mercury	Hg	Vanadium	V
		Potassium	K	Zinc	Zn

Dissolved loadings and concentrations were modelled for Project water management structures. Dissolved loadings from Project components were assumed to be equivalent to total loadings due to designed control of TSS to meet federal and provincial discharge limits (e.g., 15 mg/L TSS). Dissolved loadings from the Project (with the exception of TMF discharge; further details in subsequent section) were combined with total loadings in the receiving environment (from baseline data) to permit evaluation of potential effects on water quality.

For Project components, geochemical source terms for site water were developed based on laboratory and site-specific data. The source terms included in the water quality model are detailed in the model-specific sections below and further descriptions are included in Chapter 10. Thermal stratification for Project components (e.g., pit lakes and TMF) and potential effects on surface water quality were not modelled.

Sewage effluent source terms were developed using water quality data that are typical for the proposed sewage treatment facilities that include secondary treatment and disinfection (Table 14.7-2).

Table 14.7-2. Chemical Composition of Sewage Treatment Plant Effluent

Parameter	Concentration (mg/L)
Al	0.052
As	0.00002
Cd	0.00001
Cr	0.00025
Cu	0.0002
Fe	0.0025
Mo	0.0001
Ni	0.0005
NH_3	10
NO_2	30
NO_3	1.0
P	1.0
Pb	0.00001
U	0.0002
Zn	0.002

Nitrogen loading from leaching of blasting residues was estimated based on the predicted explosives usage during mining. Explosives usage was based on a predicted overall 50/50 emulsion/ammonium nitrate-fuel oil (ANFO) mix (Section 4.7.5) and a powder factor of 0.35, and was therefore dependent on the waste rock (Mine Site nitrogen predictions) and ore production (PTMA nitrogen predictions) schedules (see Chapter 10). Leaching of nitrogen-containing blasting residues was calculated using standard methods for mining operations (Ferguson and Leask 1988). Nitrogen species were calculated using the Ferguson and Leask (1988) distribution of 87% nitrate, 11% ammonia, and 2% nitrite. For explosives consisting of more than 20% slurry (considered analogous to emulsion), total nitrogen was calculated as follows:

$$\textit{Explosive loss as N (kg)} = 0.0094 \times \textit{(projected ANFO use as N, in kg)} + 0.051 \times \textit{(projected emulsion use as N, in kg)}$$

Background surface water and groundwater quality source terms were developed from the five-year database of available baseline data (Sections 12.1 and 14.1; Appendices 11-A, 11-B, 11-C, and 14-A). The baseline locations used for background water quality are shown on Figure 14.7-1. Mean values of water quality data were applied to the model for each month. If baseline data were not collected for a particular month, then data were estimated by interpolation. If baseline data sets were limited, then a constant input of the mean of available data was applied. When baseline water quality data were below the detection limits, concentrations equal to half the detection limit were applied in the model.

Precipitation and evaporation are assumed to be neutral inputs and outputs with no associated chemical loads.

Water Treatment

Water treatment is proposed as mitigation for surface water quality effects at the WTP (Appendix 4-S) and Selenium Treatment Plant (Appendix 4-V) at the Mine Site, and in the Treaty Process Plant (Appendix 4-R) at the PTMA. The laboratory investigations and pilot plant studies completed for these water treatment processes provided estimates of the water quality of the effluent. In the water quality model, the concentrations of chemical species that were effectively reduced by the various water treatment processes are applied as maximum concentrations in the effluent of the relevant Project component. The concentrations of chemical species that were not reduced by the various water treatment processes are modelled as the source feed water in the effluent of the relevant Project component. Further details of water quality mitigation, including water treatment and effluent quality predictions, are presented in Section 14.7.2.

Sensitivity Analysis: Water Quality Model Scenarios

Mine Site and PTMA water quality model results were dependent on a large number of input parameters including operational schedules and mine development in addition to hydrology, climate, and chemical inputs. For the purpose of water quality sensitivity analyses, the mine plan was kept constant for all model scenarios. Groundwater seepage rates and solute transport predictions were kept constant in sensitivity analyses. Background surface water and groundwater quality data for the receiving environment were kept constant in sensitivity analyses in order to isolate the effect of the Project on water quality predictions.

Two key parameters were varied in model sensitivity analyses: the climatic/hydrologic conditions and the geochemical loadings from Project components. Water balances were developed for the base case or average year and a variable case based on observed climate conditions from the last 50 years. The variable case water balance includes extreme events including up to a 1:100 year dry event and a 1:200 year wet event. Two geochemical loading scenarios were considered: the "expected case," which was represented by the average of the particular geochemical source term, and the "upper case," which was represented by the 95th percentile of the particular geochemical source term. When insufficient data were available to assess the variability in the input parameter (e.g., mill supernatant), a constant input was applied. A summary of the four model scenarios is presented in Table 14.7-3.

Table 14.7-3. Water Quality Model Scenarios

Scenario	Water Balance	Geochemical Source Term
Scenario 1	Base case	Expected Case
Scenario 2	Base case	Upper Case
Scenario 3	Variable case	Expected Case
Scenario 4	Variable case	Upper Case

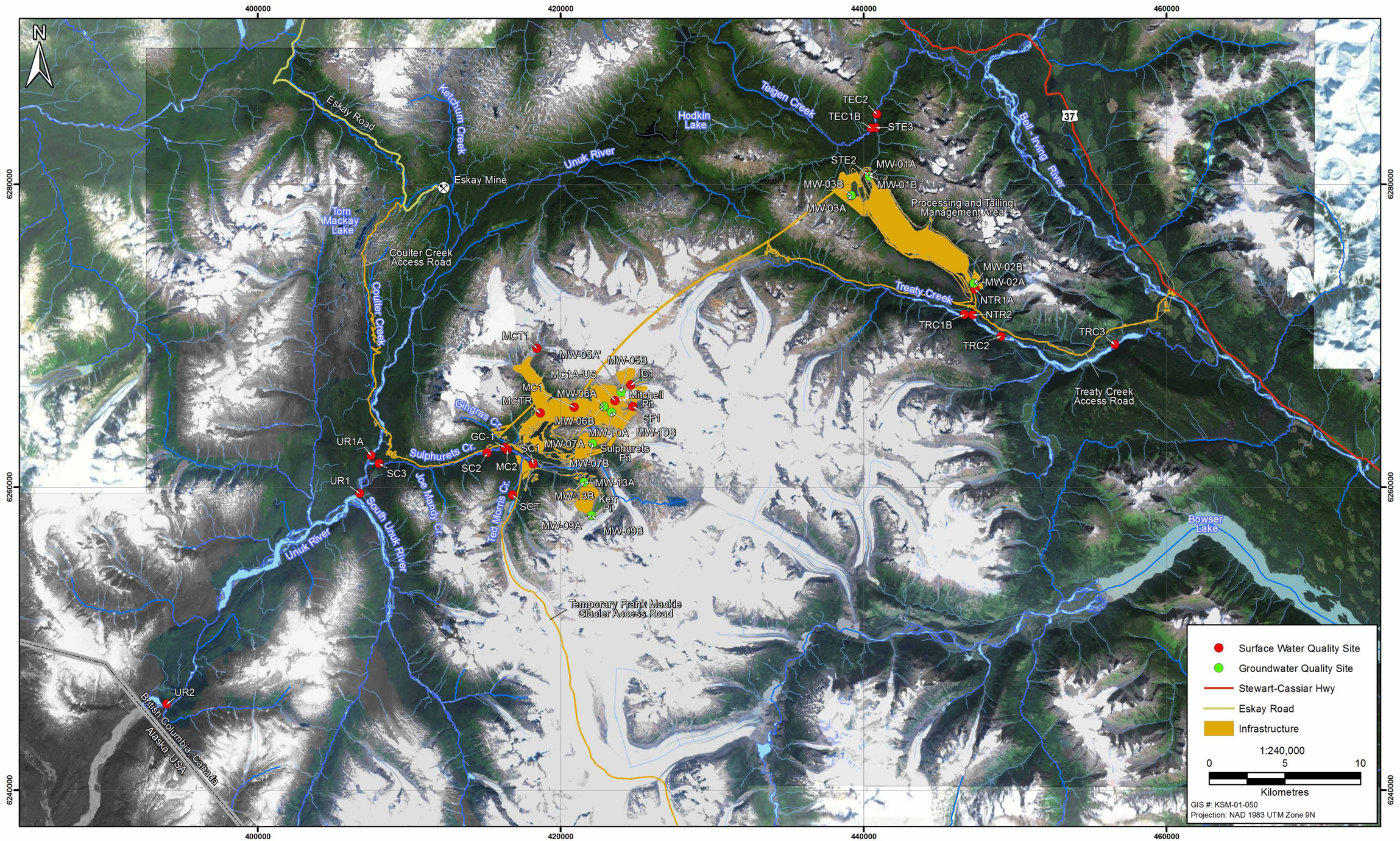

Figure 14.7-1

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Surface Water and Groundwater Quality Baseline Locations Used for Surface Water Quality Modelling

14.7.1.2.2 Mine Site Water Quality Model

The Mine Site water quality model (Figure 14.7-2) was developed using the 2012 Mine Site Water Balance (Appendix 14-F), source term chemistry (Section 10.2), and background water quality (Appendices 11-A, 11-B, 11-C, and 14-A). The water balance was modified to represent baseline observed data. This validation process included comparison to observed stream flows and revision of expected precipitation and runoff coefficients. The objective of this section is to provide documentation of the assumptions, model input parameters, and Mine Site water quality predictions used for assessment of potential effects to surface water quality in the Mine Site receiving environment.

Water Chemistry Model Inputs

Source Terms

Source term chemistry for the Project components were developed from ML/ARD characterization and predictions, background groundwater quality, and background surface water quality. Model inputs are summarized in Table 14.7-4.

Catchment Water

The water quality of diverted surface runoff water for catchment areas was estimated to be equivalent to relevant background surface water quality. Table 14.7-5 identifies the water quality monitoring site data applied to surface runoff.

Mitchell Glacier Sub-ice Water Quality

Water quality modelling indicated the critical importance of diverting good quality non-contact water in the Mitchell Diversion Tunnels (MDT). Natural chemical attenuation processes in the Mitchell Valley are circumvented by the MDT; therefore, a design criterion was established to locate the sub-glacial inlet outside the mineralized zone delineated by the Mitchell Thrust Fault (MTF). Sampling the sub-ice water under the Mitchell Glacier at the proposed location of the inlet to the MDT was not possible with the available drilling and sampling equipment, although attempts were made in the summer of 2012. A groundwater seep (stream site IC1) in the north wall of the Mitchell Valley in an unmineralized zone flows under the Mitchell Glacier and was monitored monthly as part of the surface water quality baseline program from July 2011. Glacial melt in an unmineralized area was measured in the McTagg Valley (site MCT) from 2008. For the water quality model, the sub-ice water quality was conservatively estimated to be 50% site IC1 and 50% site MCT.

Seepage

Hydrogeological modelling was completed to predict the flow paths and conservative solute transport of contact groundwater beyond the WSD and beyond the seepage collection dams that interact with surface water (see Chapters 11 and 12). A small portion of the dispersive plume was predicted to daylight in Sulphurets Creek beyond the seepage dam with an average concentration estimated to be 5% of the WSF source. The flow rate of the contact groundwater beyond the seepage dam was estimated to be 1 L/s. These results were incorporated into the surface water quality model. No other contaminated groundwater sources to surface water were identified through the hydrogeological baseline studies and modelling.

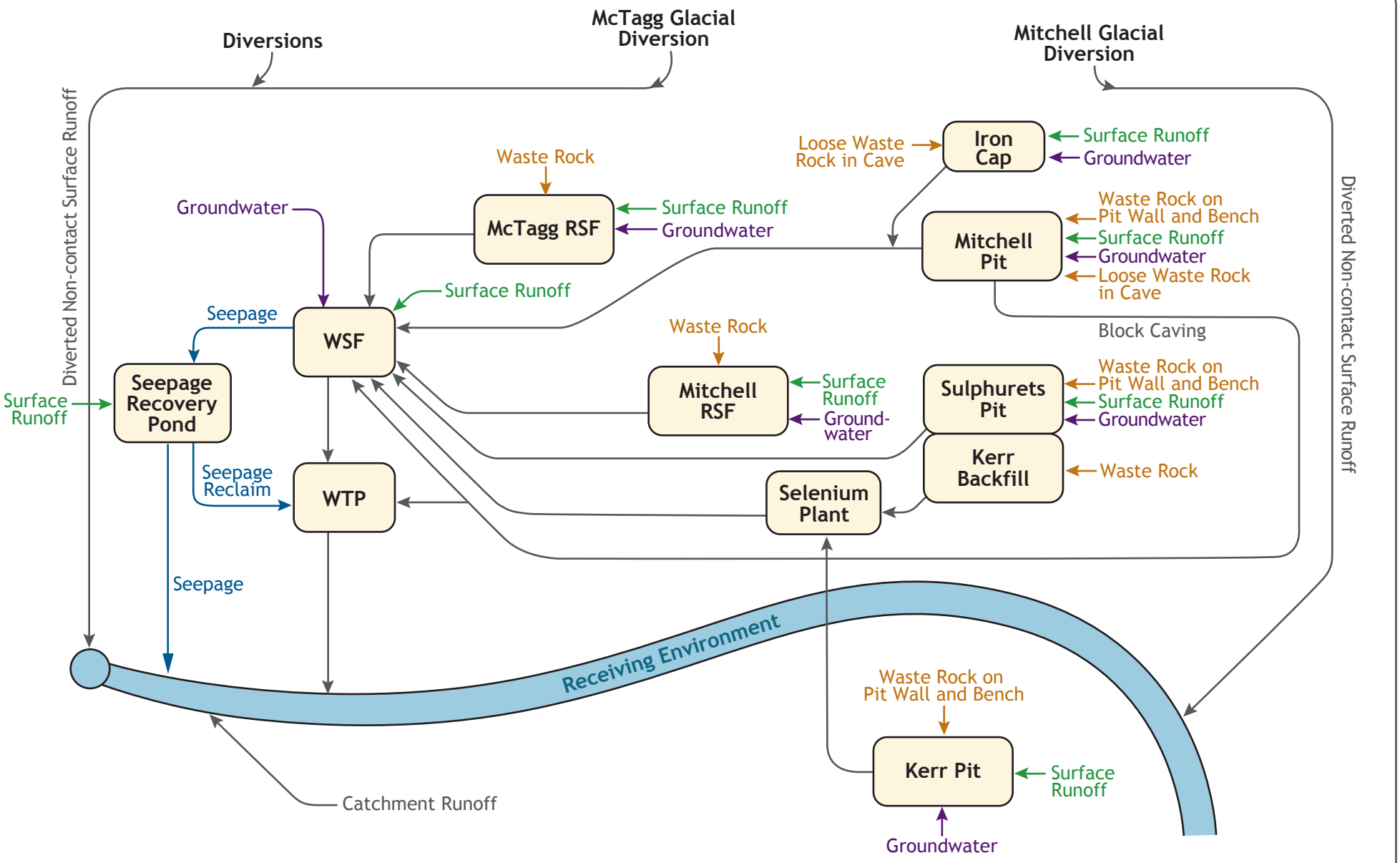

Figure 14.7-2

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Mine Site Water Quality Model Schematic

Figure 14.7-2

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Table 14.7-4. Source Term Chemistry for the Mine Site Water Quality Model

Project Component	Data Source	
	Expected Case	**Upper Case**
Mitchell and McTagg RSFs	Operation: 1) waste rock: scaled humidity cell leach rates (mean values) for model codes identified in the waste rock schedule 2) background groundwater quality 3) undiverted natural catchment (background surface water quality) Closure/Post-closure: 1) waste rock: scaled humidity cell leach rates (mean of steady state rates) for model codes identified in the waste rock schedule 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)	Operation: 1) waste rock: scaled humidity cell leach rates (95th percentile values) for model codes identified in the waste rock schedule 2) background groundwater quality 3) undiverted natural catchment Closure/Post-closure: 1) waste rock: scaled humidity cell leach rates (95th percentile of steady state rates) for model codes identified in the waste rock schedule 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)
Ore Stockpile	Operation: 1) ore: scaled ore humidity cell leach rates (mean values) for model codes identified in the ore schedule	Operation: 1) ore: scaled ore humidity cell leach rates (95th percentile values) for model codes identified in the ore schedule
Kerr Pit	Operation and Closure/Post-closure: 1) pit walls: scaled humidity cell leach rates (mean values) for model codes identified in the waste rock schedule with associated pit wall areas 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)	Operation and Closure/Post-closure: 1) pit walls: scaled humidity cell leach rates (95th percentile values) for model codes identified in the waste rock schedule with associated pit wall areas 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)
Sulphurets Pit	Operation and Closure/Post-closure: 1) pit walls: scaled humidity cell leach rates (mean values) for model codes identified in the waste rock schedule with associated pit wall areas 2) backfill: scaled humidity cell leach rates (mean values) for Kerr waste rock model codes in the waste rock schedule. Chemical loadings from the Sulphurets backfill is calculated for two water streams: a) water that infiltrates the cover or exposed waste rock and is collected in the basal drain; and b) water that runs off the cover or exposed waste rock 3) background groundwater quality 4) undiverted natural catchment (background surface water quality)	Operation and Closure/Post-closure: 1) pit walls: scaled humidity cell leach rates (95th percentile values) for model codes identified in the waste rock schedule with associated pit wall areas 2) backfill: scaled humidity cell leach rates (95th percentile) values) for Kerr waste rock model codes in the waste rock schedule. Chemical loadings from the Sulphurets backfill is calculated for two water streams: a) water that infiltrates the cover or exposed waste rock and is collected in the basal drain; and b) water that runs off the cover or exposed waste rock 3) background groundwater quality 4) undiverted natural catchment (background surface water quality)

(continued)

Table 14.7-4. Source Term Chemistry for the Mine Site Area Water Quality Model (completed)

Project Component	Data Source	
	Expected Case	**Upper Case**
Mitchell Operating Camp	Operation: 1) sewage discharge from the Mitchell operating camp to Sulphurets Creek	Operation: 1) sewage discharge from the Mitchell operating camp to Sulphurets Creek
Mitchell Pit	Operation: 1) pit walls: scaled humidity cell leach rates (mean values) for model codes identified in the waste rock schedule 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)	Operation: 1) pit walls: scaled humidity cell leach rates (95th percentile values) for model codes identified in the waste rock schedule 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)
Mitchell Block Cave Mine	Operation and Closure/Post-closure: 1) pit walls + disturbed materials: scaled humidity cell leach rates (mean values) for Mitchell ore codes 2) background groundwater quality	Operation and Closure/Post-closure: 1) pit walls + disturbed materials: scaled humidity cell leach rates (95th percentile values) for Mitchell ore codes 2) background groundwater quality
Iron Cap Block Cave Mine	Operation and Closure/Post-closure: 1) disturbed materials: scaled humidity cell leach rates (mean values) for Iron Cap ore 2) background groundwater quality	Operation and Closure/Post-closure: 1) disturbed materials: scaled humidity cell leach rates (95th percentile values) for Iron Cap ore 2) background groundwater quality
Mitchell Pit Lake	Closure/Post-closure: 1) pit walls: scaled humidity cell leach rates (mean values) for model codes identified in the waste rock schedule with associated pit wall areas 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)	Closure/Post-closure: 1) pit walls: scaled humidity cell leach rates (95th percentile values) for model codes identified in the waste rock schedule with associated pit wall areas 2) background groundwater quality 3) undiverted natural catchment (background surface water quality)

Table 14.7-5. Catchment Water Quality Estimates

Area	Water Quality Source Term
Surface runoff to Sulphurets and Kerr pits	SC1
Mitchell glacier non-contact runoff and surface runoffs to Mitchell Pit and Mitchell RSF	MC1
Mitchell glacier contact runoff	MC1A-US
Surface runoff from McTagg catchment to McTagg RSF	MCTR
Surface runoff to WSF	MC2
Surface runoff to Iron Cap Block Cave Mine	IC1
Diverted water to lower Mitchell Creek	MCTR
McTagg Twinned Diversion Tunnels	MCT1
Mitchell Diversion Tunnels	Estimated water quality under Mitchell Glacier outside the mineralized zone

Solubility Limits

The water quality model is a conservative mass balance model that assumes that dissolved chemical species remain in solution and that loads are additive. For both expected case and worst-case chemistry model scenarios, solubility limits were applied to the Mine Site water quality model based on site-specific maximums observed in groundwater seeps in deposit areas from 2008 to 2012 (Table 14.7-6). Groundwater seep data are presented in Chapter 10 and Appendix 10-A.

Table 14.7-6. Model Input: Solubility Limits (Mine Site)

Parameter	Concentration (mg/L)
Aluminum	202
Arsenic	1.30
Cadmium	0.245
Cobalt	0.580
Copper	79.2
Iron	2610
Lead	0.610
Manganese	33.5
Molybdenum	1.14
Nickel	0.129
Selenium	0.259
Zinc	15.9
Sulphate	7,380

Selenium Species in the Water Storage Facility

Selenite (Se (IV)) is preferentially removed during high-density sludge (HDS) lime water treatment due to sorption to iron oxyhydroxides and co-precipitation with gypsum (see Section 14.7.2.2; (Elrashidi et al. 1987); therefore, an appropriate estimation of the distribution of selenium species in the WSF is a key factor in predicting selenium concentrations in the receiving environment. The estimated distribution of selenium species in the WSF was based on the selenium speciation data collected from groundwater seeps and in Mitchell Creek at the toe of the Mitchell Glacier (see Section 14.1.2.1). Reduced selenium species (Se (IV) and organic selenium) ranged from 56 to 89% of the total dissolved selenium at the toe of Mitchell Glacier during two sampling events in October and December 2012. Both selenate (Se (VI)) and selenite (Se (IV)) are stable under moderately oxidizing and acidic conditions (Elrashidi et al. 1987), such as would be expected in drainage from acidic waste rock.

The presence of Se (IV), Se(VI), and organic selenium in groundwater seeps and at the toe of the Mitchell Glacier indicate that microbiological communities involved in the reduction and redox cycling of selenium are endemic to the Mitchell Valley and will influence the selenium chemistry of the proposed RSFs. For the purposes of water quality modelling, a conservative estimate of

25% Se (IV) and 75% Se (VI) was selected as the selenium species distribution in the WSF during construction, operation, closure, and post-closure Project phases.

Modelled selenium removal by the HDS WTP was based on the estimated distribution of selenium species in the WSF and the removal efficiencies observed during the pilot plant operation (see Section 14.7.2.2; Appendix 4-S). The pilot plant program indicated that 80% removal of Se (IV) can be expected due to sorption and co-precipitation, which will result in a 20% removal of total dissolved selenium by the HDS WTP.

Mine Site Water Quality: Project Components Excluded from the Model

Overburden, borrow material, and tunnel walls were not included in the model based on professional judgment for the following reasons:

- material volumes were judged to be insignificant compared to other Project components (e.g., RSFs) and therefore effects on water quality would not be measurable; and
- design, mitigation, and management of drainage from these components were assessed to be sufficient to avoid measurable adverse effects on surface water quality.

Table 14.7-7 explains the rationale for developing drainage quality predictions for overburden, borrow material, and tunnel walls. Table 14.7-8 presents the drainage quality predictions for overburden.

Table 14.7-7. Rationale for Drainage Quality Predictions for Mine Site Project Components Excluded from the Water Quality Model

Mine Site Project Component	Rationale for Drainage Quality Prediction
Overburden	Drainage was predicted to be equivalent to the average of SFE data of overburden samples from outside the Mitchell Pit and from the Mitchell RSF foundation. These concentrations are conservative estimates for overburden drainage from the Mine Site given the sample locations near a highly mineralized deposit area.
Borrow Material	Drainage quality was assumed to be meet the BC Water Quality Guidelines for the protection of freshwater aquatic life or background water quality, as appropriate, based on commitments for management and testing of proposed borrow material in the ML/ARD Management Plan (Section 26.14).
Tunnel Walls	Chemical loadings from tunnel walls were assumed to be negligible. Tunnels will be lined in sections where PAG rock is identified.

Notes:
RSF = Rock Storage Facility
SFE = shake flask extraction
PAG = potentially acid-generating

Mine Site Water Quality Predictions

The WSF is designed to store the Mine Site contact water prior to treatment at the WTP and discharge to the receiving environment in lower Mitchell Creek. The WSF will provide a reservoir for the collection and storage of contact water from the Mitchell and McTagg RSFs, water pumped from the open pits and block cave mines, Mitchell Glacier water below the infiltration gallery, and

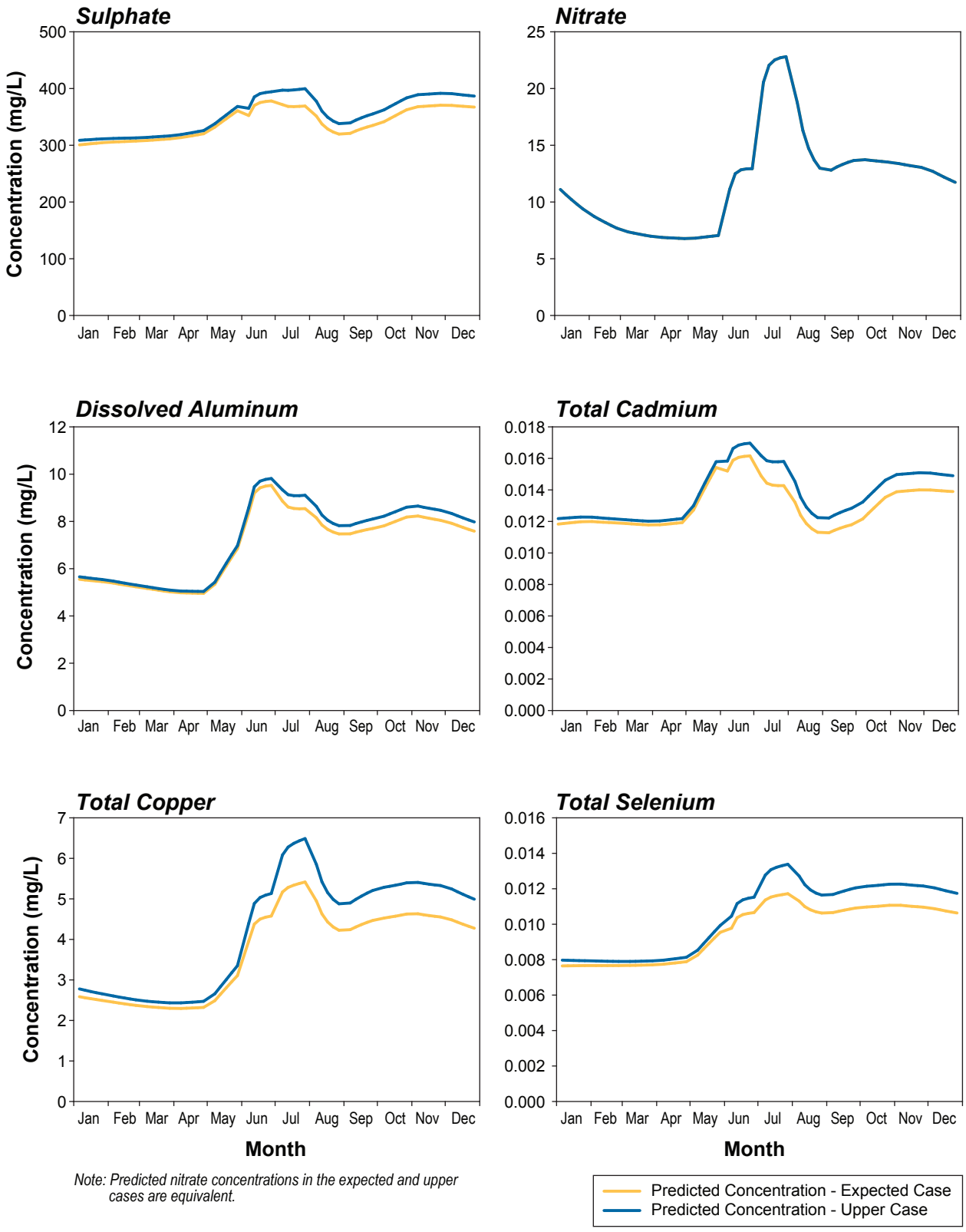
surface runoff. The WSF effectively represents the cumulative geochemical load from the Mine Site prior to water treatment. The WSF was designed to store the probable maximum flood (PMF; see Chapter 4) and water from the WSF will not be discharged without water treatment.

Table 14.7-8. Drainage Quality Predictions for Mine Site Overburden

Parameter	Concentration (mg/L)	Parameter	Concentration (mg/L)
Anions and Nutrients		**Dissolved Metals *(cont'd)***	
Bromide (Br)	0.070	Lead (Pb)	0.0021
Chloride (Cl)	0.63	Lithium (Li)	0.036
Fluoride (F)	0.37	Magnesium (Mg)	24
Nitrate (as N)	5.6	Manganese (Mn)	8.0
Nitrite (as N)	0.018	Mercury (Hg)	0.00005
Sulphate (SO_4)	370	Molybdenum (Mo)	0.0051
Dissolved Metals		Nickel (Ni)	0.025
Aluminum (Al)	0.31	Potassium (K)	8.5
Antimony (Sb)	0.00090	Selenium (Se)	0.034
Arsenic (As)	0.0054	Silicon (Si)	6.6
Barium (Ba)	0.074	Silver (Ag)	0.00025
Beryllium (Be)	0.0025	Sodium (Na)	2.97
Bismuth (Bi)	0.0025	Strontium (Sr)	0.51
Boron (B)	0.011	Thallium (Tl)	0.0001
Cadmium (Cd)	0.0078	Tin (Sn)	0.0005
Calcium (Ca)	118	Titanium (Ti)	0.058
Chromium (Cr)	0.0078	Uranium (U)	0.000069
Cobalt (Co)	0.052	Vanadium (V)	0.0027
Copper (Cu)	0.11	Zinc (Zn)	0.71
Iron (Fe)	0.58		

This section presents the water quality predictions for the WSF for the four model scenarios or sensitivity analyses. A detailed summary of the expected case (scenario 1) water quality predictions for drainage from Mine Site components, including the open pits, block cave mines, and RSFs, are included in Appendix 14-H. Water quality predictions for the water treatment processes (Selenium Treatment Plant and WTP) are presented in Section 14.7.2.2, and water quality predictions for the receiving environment (Sulphurets Creek and the Unuk River) are presented in Section 14.7.3.1.

Figures 14.7-3 to 14.7-7 present the expected and upper-case water quality predictions in the WSF during the construction, operation, closure, and post-closure phases for six chemicals of potential concern (COPC): sulphate, nitrate, dissolved aluminum, total cadmium, total copper, and total selenium. Two water balances, a base case and a variable case including extreme low and high flows, are included. Tables 14.7-9 to 14.7-12 present statistical summaries of water quality in the WSF for the four model scenarios for the construction, operation, closure, and post-closure phases.



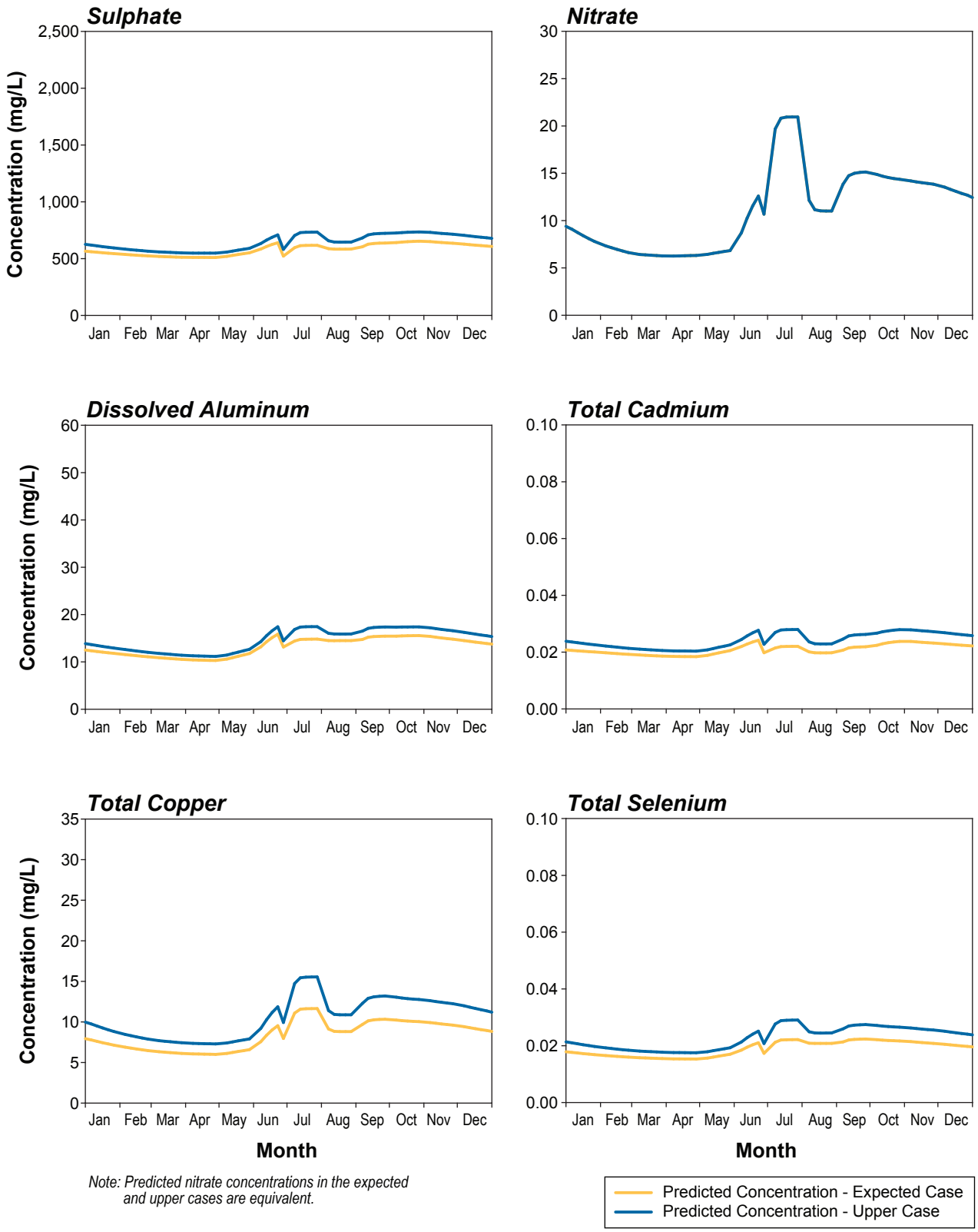
Note: Predicted nitrate concentrations in the expected and upper cases are equivalent.

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Water Storage Facility (Year -1)

Figure 14.7-3

Rescan™ Engineers & Scientists



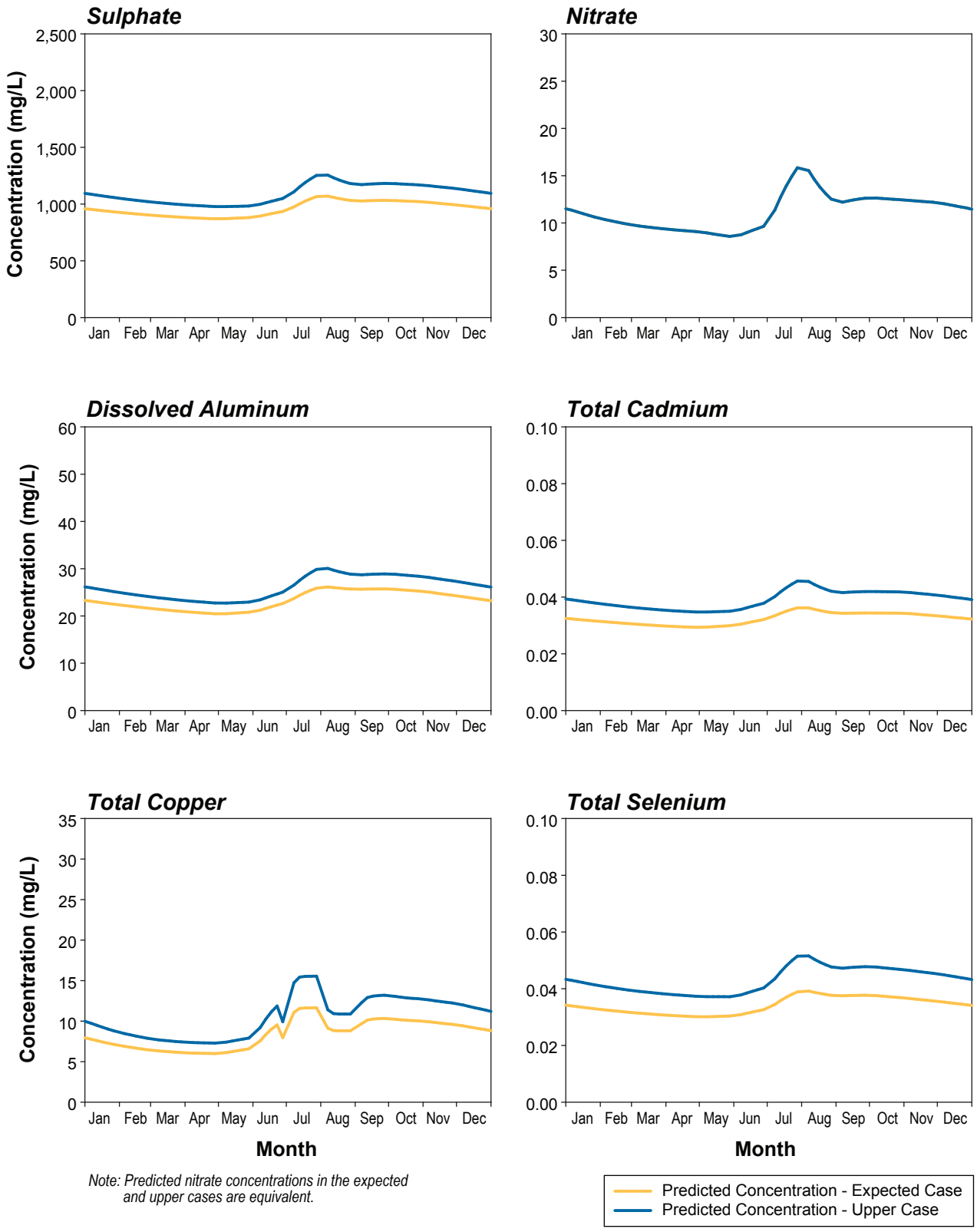
Note: Predicted nitrate concentrations in the expected and upper cases are equivalent.

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Water Storage Facility (Year 5)

Figure 14.7-4

Rescan™ Engineers & Scientists



Note: Predicted nitrate concentrations in the expected and upper cases are equivalent.

SEABRIDGE GOLD
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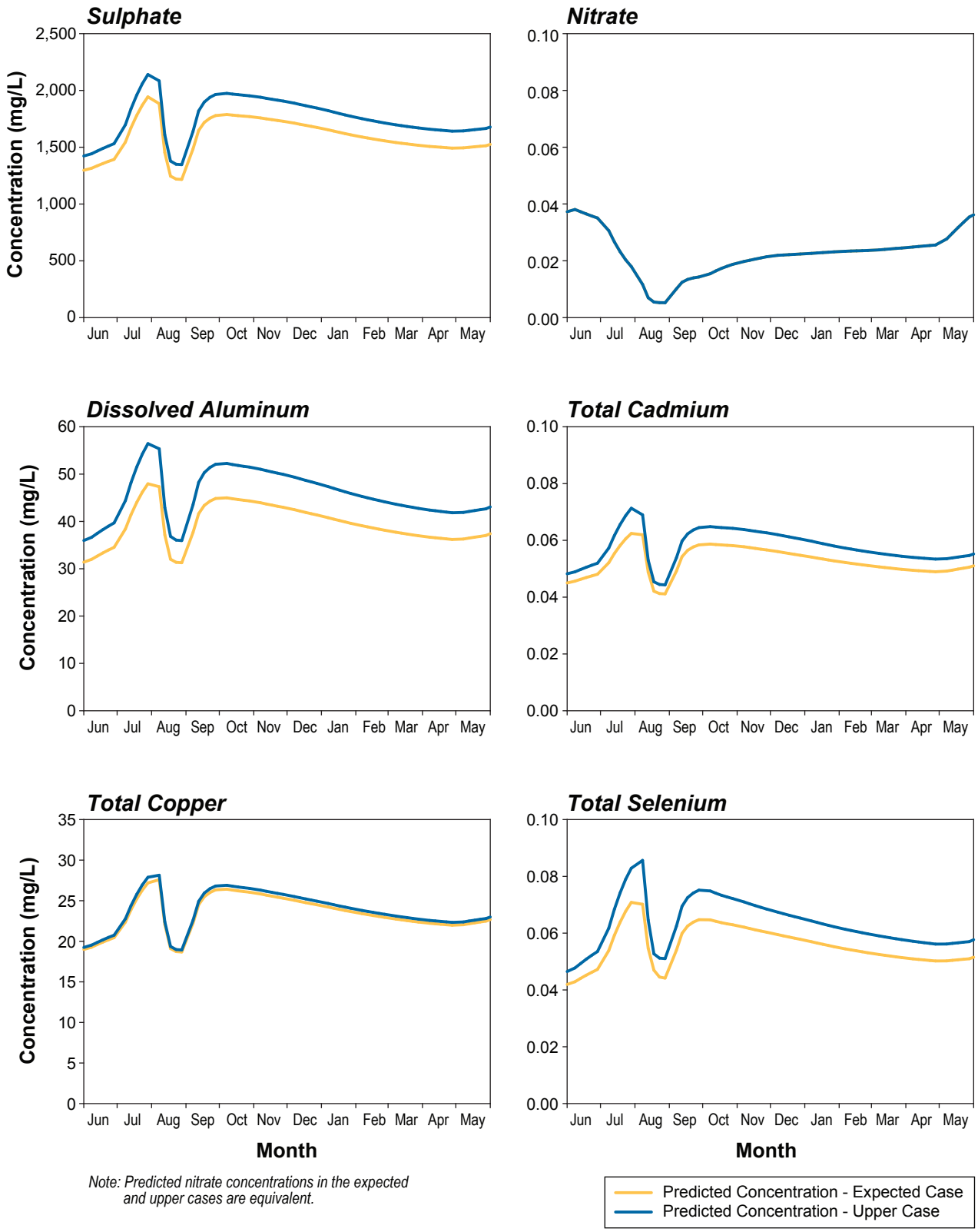
Water Quality Predictions for the Base Case Water Balance: Water Storage Facility (Year 25)

Figure 14.7-5

Rescan™ Engineers & Scientists



Note: Predicted nitrate concentrations in the expected and upper cases are equivalent.

Figure 14.7-6

Water Quality Predictions for the Base Case Water Balance: Water Storage Facility (Year 51.5)

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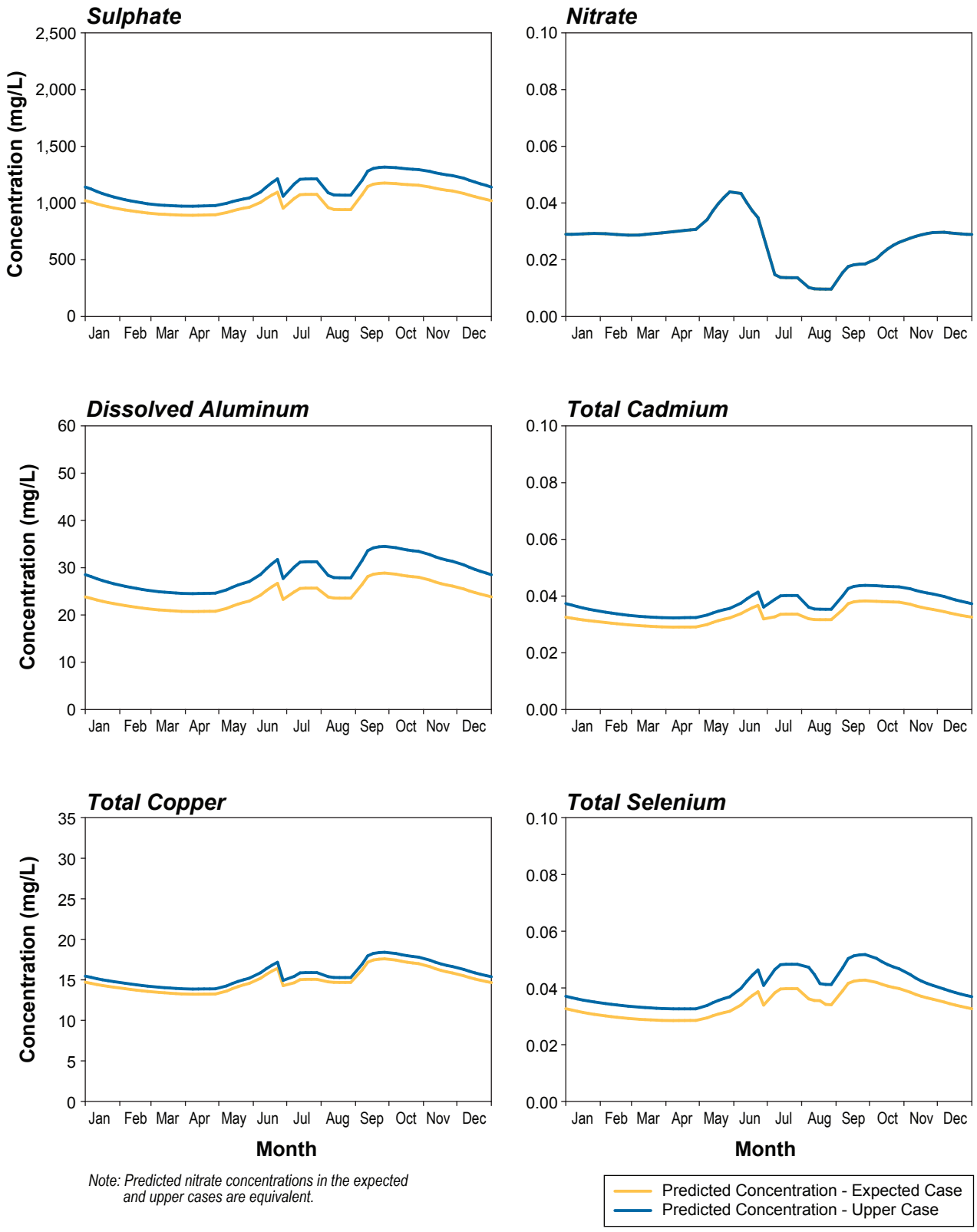

Note: Predicted nitrate concentrations in the expected and upper cases are equivalent.

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Water Quality Predictions for the Base Case Water Balance: Water Storage Facility (Year 65)

Figure 14.7-7

Rescan™ Engineers & Scientists

Table 14.7-9. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Construction Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.24	0.97	0.88	2.62	2.58	0.68	0.69
Chloride (Cl)	3.43	5.47	5.53	9.49	9.19	1.52	0.28
Fluoride (F)	1.51	**2.45**	**2.70**	**4.51**	**4.39**	0.84	0.34
Nitrate (as N)	6.77	11.80	12.48	22.81	22.08	4.31	0.36
Nitrite (as N)	0.0005	0.0015	0.0018	0.0021	0.0021	0.0006	0.41
Total Phosphate (as P)	0.29	0.54	0.45	1.32	1.31	0.29	0.54
Sulphate (SO_4)	**301**	**339**	**338**	**378**	**372**	26	0.08
Total Metals							
Aluminum (Al)	*4.96*	*7.00*	*7.60*	*9.53*	*9.21*	1.47	0.21
Antimony (Sb)	0.0113	0.0199	**0.0212**	**0.0386**	**0.0374**	0.0074	0.37
Arsenic (As)	**0.0220**	**0.0327**	**0.0366**	**0.0424**	**0.0417**	0.0080	0.24
Barium (Ba)	0.167	0.285	0.306	0.534	0.519	0.101	0.36
Beryllium (Be)	0.0019	0.0031	0.0033	0.0056	0.0055	0.0010	0.33
Boron (B)	0.020	0.036	0.039	0.067	0.065	0.014	0.38
Cadmium (Cd)	**0.011**	**0.013**	**0.012**	**0.016**	**0.016**	0.001	0.11
Calcium (Ca)	32.57	52.94	52.87	74.37	73.06	13.99	0.26
Chromium (Cr)	**0.0039**	**0.0056**	**0.0058**	**0.0099**	**0.0096**	0.0016	0.28
Cobalt (Co)	0.022	0.033	0.036	0.047	0.046	0.008	0.25
Copper (Cu)	**2.30**	**3.71**	**4.31**	**5.42**	**5.29**	1.09	0.29
Iron (Fe)	**47.22**	**73.72**	**82.90**	**94.79**	**94.04**	19.52	0.26
Lead (Pb)	0.015	0.023	0.027	0.031	0.031	0.006	0.27
Lithium (Li)	0.012	0.018	0.019	0.032	0.031	0.006	0.31
Magnesium (Mg)	5.84	7.20	6.94	9.82	9.60	0.89	0.12
Manganese (Mn)	1.68	2.14	2.21	**2.75**	**2.68**	0.35	0.17
Mercury (Hg)	0.000021	0.000043	0.000050	0.000087	0.000084	0.000019	0.44
Molybdenum (Mo)	0.023	0.034	0.038	0.044	0.043	0.008	0.24
Nickel (Ni)	0.008	0.009	0.010	0.013	0.012	0.002	0.17
Potassium (K)	4.38	7.44	8.17	14.24	13.79	2.77	0.37
Selenium (Se)	**0.0077**	**0.0097**	**0.0106**	**0.0117**	**0.0115**	0.0015	0.16
Silicon (Si)	9.54	14.68	15.74	26.67	25.88	4.74	0.32
Silver (Ag)	0.000069	0.000150	0.000172	0.000307	0.000299	0.000069	0.46
Sodium (Na)	4.85	8.12	7.77	12.36	12.04	2.46	0.30
Strontium (Sr)	1.08	1.47	1.48	2.48	2.40	0.36	0.24
Thallium (Tl)	**0.00034**	**0.00058**	**0.00064**	**0.00111**	**0.00108**	0.00021	0.37
Tin (Sn)	0.00113	0.00248	0.00287	0.00517	0.00501	0.00117	0.47
Uranium (U)	0.0085	0.0156	0.0174	0.0308	0.0299	0.0063	0.40
Vanadium (V)	0.0055	0.0093	0.0100	0.0176	0.0170	0.0033	0.36
Zinc (Zn)	0.80	0.93	0.91	1.13	1.11	0.11	0.12

(continued)

Table 14.7-9. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Construction Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.24	0.97	0.88	2.62	2.58	0.68	0.69
Chloride (Cl)	7.01	11.50	12.09	21.24	20.55	3.78	0.33
Fluoride (F)	**2.14**	**3.65**	**4.02**	**6.92**	**6.72**	1.35	0.37
Nitrate (as N)	6.77	11.80	12.48	22.81	22.08	4.31	0.36
Nitrite (as N)	0.0005	0.0015	0.0018	0.0021	0.0021	0.0006	0.41
Total Phosphate (as P)	0.29	0.54	0.45	1.32	1.31	0.29	0.54
Sulphate (SO_4)	**309**	**354**	**354**	**400**	**397**	33	0.09
Total Metals							
Aluminum (Al)	*5.04*	*7.27*	*7.98*	*9.82*	*9.48*	1.62	0.22
Antimony (Sb)	**0.0426**	**0.0773**	**0.0836**	**0.1530**	**0.1481**	0.0304	0.39
Arsenic (As)	**0.0242**	**0.0376**	**0.0423**	**0.0523**	**0.0511**	0.0100	0.27
Barium (Ba)	0.281	0.493	0.532	0.944	0.915	0.182	0.37
Beryllium (Be)	0.0060	0.0107	0.0117	0.0206	0.0200	0.0040	0.38
Boron (B)	0.051	0.116	0.134	0.241	0.233	0.056	0.48
Cadmium (Cd)	**0.012**	**0.014**	**0.013**	**0.017**	**0.017**	0.002	0.12
Calcium (Ca)	34.71	54.67	55.16	75.08	73.81	13.24	0.24
Chromium (Cr)	**0.0061**	**0.0098**	**0.0107**	**0.0185**	**0.0179**	0.0034	0.35
Cobalt (Co)	0.024	0.040	0.045	0.061	0.059	0.012	0.31
Copper (Cu)	**2.43**	**4.21**	**4.99**	**6.49**	**6.28**	1.40	0.33
Iron (Fe)	**48.57**	**77.71**	**88.62**	**102.98**	**101.63**	21.60	0.28
Lead (Pb)	0.016	0.034	0.041	0.053	0.051	0.014	0.42
Lithium (Li)	0.015	0.027	0.030	0.051	0.049	0.010	0.37
Magnesium (Mg)	9.08	12.07	12.20	19.96	19.40	2.90	0.24
Manganese (Mn)	1.83	**2.71**	**2.90**	**3.97**	**3.81**	0.71	0.26
Mercury (Hg)	0.000045	0.000099	0.000114	0.000204	0.000198	0.000046	0.47
Molybdenum (Mo)	0.027	0.041	0.045	0.057	0.056	0.010	0.26
Nickel (Ni)	0.008	0.011	0.012	0.016	0.016	0.002	0.22
Potassium (K)	8.88	17.37	19.68	35.12	33.97	7.52	0.43
Selenium (Se)	**0.0079**	**0.0105**	**0.0116**	**0.0134**	**0.0131**	0.0020	0.19
Silicon (Si)	12.00	19.74	21.42	37.06	35.91	6.99	0.35
Silver (Ag)	0.000151	0.000344	0.000401	0.000719	0.000697	0.000166	0.48
Sodium (Na)	6.86	9.81	10.30	13.18	12.84	1.93	0.20
Strontium (Sr)	2.02	3.12	3.30	5.77	5.58	1.02	0.33
Thallium (Tl)	**0.00074**	**0.00151**	**0.00171**	**0.00308**	**0.00298**	0.00067	0.45
Tin (Sn)	0.00236	0.00542	0.00629	0.01144	0.01107	0.00265	0.49
Uranium (U)	0.0293	0.0546	0.0601	0.1086	0.1050	0.0221	0.40
Vanadium (V)	0.0108	0.0191	0.0207	0.0372	0.0359	0.0073	0.38
Zinc (Zn)	0.85	1.06	1.04	1.35	1.33	0.16	0.15

(continued)

Table 14.7-9. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Construction Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.24	0.95	0.84	2.53	2.50	0.65	0.68
Chloride (Cl)	1.80	5.03	5.43	9.26	8.89	1.84	0.37
Fluoride (F)	0.99	**2.34**	**2.66**	**4.41**	**4.26**	0.90	0.38
Nitrate (as N)	3.85	10.68	12.25	22.25	21.36	5.11	0.48
Nitrite (as N)	0.0004	0.0014	0.0017	0.0021	0.0021	0.0006	0.45
Total Phosphate (as P)	0.22	0.50	0.45	1.32	1.30	0.30	0.59
Sulphate (SO_4)	**206**	**335**	**335**	**378**	**372**	38	0.11
Total Metals							
Aluminum (Al)	*4.10*	*6.80*	*7.63*	*9.53*	*9.14*	1.69	0.25
Antimony (Sb)	0.0066	0.0181	**0.0209**	**0.0377**	**0.0361**	0.0087	0.48
Arsenic (As)	**0.0191**	**0.0318**	**0.0369**	**0.0423**	**0.0415**	0.0089	0.28
Barium (Ba)	0.103	0.262	0.304	0.522	0.503	0.119	0.45
Beryllium (Be)	0.0014	0.0029	0.0033	0.0055	0.0053	0.0011	0.39
Boron (B)	0.013	0.033	0.039	0.066	0.063	0.015	0.45
Cadmium (Cd)	**0.009**	**0.013**	**0.012**	**0.016**	**0.016**	0.002	0.12
Calcium (Ca)	32.34	53.79	45.88	82.80	81.57	18.33	0.34
Chromium (Cr)	**0.0020**	**0.0053**	**0.0057**	**0.0096**	**0.0093**	0.0018	0.33
Cobalt (Co)	0.018	0.032	0.036	0.046	0.045	0.009	0.29
Copper (Cu)	**1.84**	**3.59**	**4.30**	**5.36**	**5.22**	1.19	0.33
Iron (Fe)	**43.01**	**71.64**	**84.01**	**94.77**	**94.03**	21.89	0.31
Lead (Pb)	0.013	0.023	0.026	0.031	0.031	0.007	0.30
Lithium (Li)	0.007	0.017	0.019	0.031	0.030	0.006	0.36
Magnesium (Mg)	3.36	7.00	7.07	9.63	9.37	1.22	0.17
Manganese (Mn)	1.10	2.10	2.19	**2.72**	**2.65**	0.40	0.19
Mercury (Hg)	0.000016	0.000041	0.000049	0.000085	0.000082	0.000020	0.50
Molybdenum (Mo)	0.019	0.033	0.038	0.044	0.043	0.009	0.27
Nickel (Ni)	0.005	0.009	0.009	0.013	0.012	0.002	0.20
Potassium (K)	2.74	7.03	8.07	13.90	13.35	3.00	0.43
Selenium (Se)	**0.0055**	**0.0095**	**0.0106**	**0.0117**	**0.0115**	0.0017	0.18
Silicon (Si)	5.57	13.84	15.57	26.06	25.09	5.26	0.38
Silver (Ag)	0.000051	0.000141	0.000170	0.000300	0.000290	0.000074	0.53
Sodium (Na)	3.52	8.37	6.79	14.02	13.94	3.55	0.42
Strontium (Sr)	0.57	1.38	1.46	2.42	2.33	0.42	0.30
Thallium (Tl)	0.00021	**0.00054**	**0.00062**	**0.00109**	**0.00104**	0.00025	0.46
Tin (Sn)	0.00083	0.00234	0.00283	0.00505	0.00484	0.00126	0.54
Uranium (U)	0.0055	0.0145	0.0171	0.0301	0.0289	0.0070	0.49
Vanadium (V)	0.0032	0.0085	0.0099	0.0172	0.0165	0.0038	0.45
Zinc (Zn)	0.64	0.91	0.86	1.13	1.10	0.12	0.13

(continued)

Table 14.7-9. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Construction Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.24	0.95	0.84	2.53	2.50	0.65	0.68
Chloride (Cl)	3.76	10.50	11.92	20.73	19.88	4.49	0.43
Fluoride (F)	1.40	**3.44**	**3.96**	**6.76**	**6.51**	1.47	0.43
Nitrate (as N)	3.85	10.68	12.25	22.25	21.36	5.11	0.48
Nitrite (as N)	0.0004	0.0014	0.0017	0.0021	0.0021	0.0006	0.45
Total Phosphate (as P)	0.22	0.50	0.45	1.32	1.30	0.30	0.59
Sulphate (SO_4)	**210**	**349**	**350**	**398**	**396**	43	0.12
Total Metals							
Aluminum (Al)	*4.18*	*7.06*	*8.01*	*9.81*	*9.40*	1.84	0.26
Antimony (Sb)	**0.0258**	**0.0707**	**0.0820**	**0.1492**	**0.1432**	0.0350	0.50
Arsenic (As)	**0.0207**	**0.0363**	**0.0423**	**0.0520**	**0.0506**	0.0113	0.31
Barium (Ba)	0.171	0.451	0.523	0.921	0.886	0.212	0.47
Beryllium (Be)	0.0039	0.0099	0.0116	0.0201	0.0194	0.0046	0.47
Boron (B)	0.038	0.109	0.132	0.235	0.226	0.059	0.54
Cadmium (Cd)	**0.009**	**0.014**	**0.013**	**0.017**	**0.016**	0.002	0.13
Calcium (Ca)	32.89	55.42	48.18	83.46	82.14	17.64	0.32
Chromium (Cr)	**0.0035**	**0.0092**	**0.0105**	**0.0180**	**0.0173**	0.0038	0.42
Cobalt (Co)	0.020	0.038	0.045	0.060	0.058	0.013	0.34
Copper (Cu)	**1.99**	**4.07**	**4.97**	**6.41**	**6.19**	1.51	0.37
Iron (Fe)	**44.17**	**75.41**	**89.64**	**102.75**	**101.35**	24.11	0.32
Lead (Pb)	0.015	0.033	0.041	0.053	0.050	0.015	0.44
Lithium (Li)	0.010	0.025	0.030	0.049	0.048	0.011	0.43
Magnesium (Mg)	5.05	11.54	12.00	19.52	18.85	3.25	0.28
Manganese (Mn)	1.26	**2.65**	**2.89**	**3.91**	**3.74**	0.75	0.28
Mercury (Hg)	0.000033	0.000093	0.000112	0.000199	0.000191	0.000050	0.53
Molybdenum (Mo)	0.021	0.039	0.045	0.057	0.055	0.012	0.30
Nickel (Ni)	0.005	0.011	0.012	0.016	0.016	0.003	0.25
Potassium (K)	6.23	16.32	19.42	34.27	32.87	8.13	0.50
Selenium (Se)	**0.0058**	**0.0103**	**0.0116**	**0.0133**	**0.0130**	0.0022	0.21
Silicon (Si)	7.30	18.53	21.30	36.19	34.80	7.74	0.42
Silver (Ag)	0.000107	0.000323	0.000397	0.000702	0.000675	0.000178	0.55
Sodium (Na)	4.12	9.94	9.60	14.77	14.61	3.05	0.31
Strontium (Sr)	1.12	2.90	3.26	5.63	5.40	1.17	0.40
Thallium (Tl)	**0.00052**	**0.00141**	**0.00168**	**0.00300**	**0.00288**	0.00073	0.52
Tin (Sn)	0.00168	0.00510	0.00621	0.01116	0.01070	0.00283	0.55
Uranium (U)	0.0185	0.0502	0.0591	0.1059	0.1016	0.0251	0.50
Vanadium (V)	0.0064	0.0175	0.0205	0.0363	0.0348	0.0084	0.48
Zinc (Zn)	0.68	1.03	1.02	1.34	1.32	0.18	0.17

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-10. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.00	0.37	0.23	3.04	1.32	0.45	1.20
Chloride (Cl)	0.28	18.94	19.39	59.92	40.32	13.06	0.69
Fluoride (F)	0.22	**12.75**	**12.61**	**36.67**	**23.89**	6.17	0.48
Nitrate (as N)	0.01	4.16	1.36	26.32	13.46	5.04	1.21
Nitrite (as N)	0.0003	0.0015	0.0016	0.0025	0.0022	0.0006	0.38
Total Phosphate (as P)	0.04	0.39	0.36	1.45	0.60	0.14	0.36
Sulphate (SO_4)	51	**994**	**978**	**1,694**	**1,525**	344	0.35
Total Metals							
Aluminum (Al)	*0.47*	*24.10*	*24.04*	*41.66*	*38.31*	9.11	0.38
Antimony (Sb)	0.0003	**0.0703**	**0.0623**	**0.2366**	**0.1543**	0.0467	0.66
Arsenic (As)	0.0008	**0.1239**	**0.1162**	**0.2351**	**0.2110**	0.0549	0.44
Barium (Ba)	0.008	1.345	1.339	3.845	2.557	0.717	0.53
Beryllium (Be)	0.0003	0.0261	0.0215	0.0905	0.0576	0.0166	0.64
Boron (B)	0.002	0.176	0.161	0.547	0.356	0.098	0.56
Cadmium (Cd)	**0.002**	**0.034**	**0.033**	**0.055**	**0.051**	0.011	0.33
Calcium (Ca)	17.51	78.29	71.92	112.26	110.51	20.34	0.26
Chromium (Cr)	0.0004	**0.0334**	**0.0287**	**0.1095**	**0.0716**	0.0207	0.62
Cobalt (Co)	0.003	0.099	0.105	**0.159**	**0.141**	0.027	0.27
Copper (Cu)	**0.21**	**13.83**	**14.11**	**23.78**	**21.68**	4.80	0.35
Iron (Fe)	**1.31**	**271.27**	**294.30**	**477.92**	**430.66**	109.43	0.40
Lead (Pb)	0.001	0.098	0.102	0.153	0.136	0.028	0.29
Lithium (Li)	0.002	0.097	0.099	0.249	0.167	0.043	0.44
Magnesium (Mg)	1.43	42.43	34.38	141.98	92.30	25.86	0.61
Manganese (Mn)	0.29	**5.49**	**5.68**	**7.80**	**6.99**	1.17	0.21
Mercury (Hg)	0.000002	0.000205	0.000171	0.000671	0.000434	0.000117	0.57
Molybdenum (Mo)	0.001	0.116	0.116	0.203	0.186	0.046	0.40
Nickel (Ni)	0.001	0.028	0.028	0.045	0.043	0.009	0.33
Potassium (K)	0.42	37.09	33.18	115.23	75.25	20.47	0.55
Selenium (Se)	0.0009	**0.0330**	**0.0346**	**0.0589**	**0.0504**	0.0110	0.33
Silicon (Si)	1.15	75.76	71.95	222.06	146.37	39.88	0.53
Silver (Ag)	0.000004	0.001137	0.000887	**0.004117**	0.002626	0.000760	0.67
Sodium (Na)	2.60	27.80	22.87	74.42	52.91	14.16	0.51
Strontium (Sr)	0.14	5.62	4.68	19.68	12.86	3.93	0.70
Thallium (Tl)	0.00002	**0.00255**	**0.00251**	**0.00752**	**0.00500**	0.00146	0.57
Tin (Sn)	0.00005	0.01095	0.01055	0.03083	0.02028	0.00523	0.48
Uranium (U)	0.0005	0.0959	0.0947	0.2828	0.1854	0.0509	0.53
Vanadium (V)	0.0003	0.0448	0.0458	0.1235	0.0817	0.0236	0.53
Zinc (Zn)	0.14	2.59	2.49	4.56	4.07	0.89	0.34

(continued)

Table 14.7-10. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.00	0.37	0.23	3.04	1.32	0.45	1.20
Chloride (Cl)	0.34	44.06	46.86	134.04	89.66	28.66	0.65
Fluoride (F)	0.24	**26.51**	**25.88**	**82.65**	**53.05**	14.43	0.54
Nitrate (as N)	0.01	4.16	1.36	26.32	13.46	5.04	1.21
Nitrite (as N)	0.0003	0.0015	0.0016	0.0025	0.0022	0.0006	0.38
Total Phosphate (as P)	0.04	0.39	0.36	1.45	0.60	0.14	0.36
Sulphate (SO_4)	51	**1,098**	**1,122**	**1,821**	**1,656**	362	0.33
Total Metals							
Aluminum (Al)	*0.47*	*26.98*	*27.27*	*47.46*	*42.94*	10.07	0.37
Antimony (Sb)	0.0007	**0.2259**	**0.1934**	**0.7568**	**0.4917**	0.1439	0.64
Arsenic (As)	0.0008	**0.1550**	**0.1373**	**0.3210**	**0.2773**	0.0717	0.46
Barium (Ba)	0.011	2.864	2.819	8.480	5.595	1.580	0.55
Beryllium (Be)	0.0004	0.0801	0.0790	0.2308	0.1515	0.0421	0.53
Boron (B)	0.003	0.502	0.495	**1.352**	0.893	0.225	0.45
Cadmium (Cd)	**0.002**	**0.039**	**0.040**	**0.061**	**0.056**	0.012	0.30
Calcium (Ca)	17.53	83.93	78.65	115.10	113.85	19.26	0.23
Chromium (Cr)	0.0005	**0.0686**	**0.0649**	**0.2093**	**0.1368**	0.0385	0.56
Cobalt (Co)	0.003	**0.123**	**0.126**	**0.182**	**0.165**	0.031	0.25
Copper (Cu)	**0.21**	**16.45**	**17.31**	**24.94**	**23.10**	4.94	0.30
Iron (Fe)	**1.35**	**311.24**	**333.02**	**543.62**	**478.82**	108.59	0.35
Lead (Pb)	0.001	0.148	0.147	0.226	0.216	0.047	0.32
Lithium (Li)	0.002	0.185	0.186	0.439	0.291	0.075	0.41
Magnesium (Mg)	1.53	92.90	72.34	287.25	211.05	59.46	0.64
Manganese (Mn)	0.29	**7.93**	**7.36**	**12.55**	**11.91**	2.39	0.30
Mercury (Hg)	0.000003	0.000470	0.000406	0.001481	0.000962	0.000256	0.55
Molybdenum (Mo)	0.001	0.133	0.134	0.230	0.212	0.051	0.38
Nickel (Ni)	0.001	0.034	0.035	0.046	0.044	0.008	0.24
Potassium (K)	0.56	89.54	87.97	248.44	163.90	42.80	0.48
Selenium (Se)	0.0009	**0.0391**	**0.0412**	**0.0691**	**0.0568**	0.0122	0.31
Silicon (Si)	1.26	121.75	112.80	366.96	239.86	65.11	0.53
Silver (Ag)	0.000007	0.002397	0.002115	**0.007768**	**0.005003**	0.001372	0.57
Sodium (Na)	2.62	26.39	25.71	53.68	41.78	9.82	0.37
Strontium (Sr)	0.15	14.28	13.27	46.01	30.24	9.04	0.63
Thallium (Tl)	0.00003	**0.00597**	**0.00594**	**0.01556**	**0.01052**	0.00279	0.47
Tin (Sn)	0.00009	0.02508	0.02375	0.07225	0.04735	0.01224	0.49
Uranium (U)	0.0009	**0.3210**	**0.3231**	**0.9524**	**0.6272**	0.1789	0.56
Vanadium (V)	0.0005	0.1327	0.1352	0.3425	0.2259	0.0618	0.47
Zinc (Zn)	0.14	3.47	3.34	5.50	5.37	1.27	0.37

(continued)

Table 14.7-10. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.00	0.32	0.16	3.04	1.27	0.43	1.34
Chloride (Cl)	0.26	22.12	22.11	51.48	43.16	14.71	0.66
Fluoride (F)	0.20	**15.04**	**14.21**	**31.05**	**25.64**	6.87	0.46
Nitrate (as N)	0.01	4.89	1.74	27.17	15.24	5.70	1.17
Nitrite (as N)	0.0003	0.0013	0.0013	0.0026	0.0020	0.0004	0.28
Total Phosphate (as P)	0.04	0.38	0.36	1.41	0.55	0.10	0.26
Sulphate (SO_4)	46	**1,054**	**994**	**1,635**	**1,575**	387	0.37
Total Metals							
Aluminum (Al)	*0.42*	*25.80*	*24.24*	*41.17*	*39.59*	10.38	0.40
Antimony (Sb)	0.0003	**0.0834**	**0.0702**	**0.1993**	**0.1647**	0.0528	0.63
Arsenic (As)	0.0007	**0.1342**	**0.1190**	**0.2273**	**0.2193**	0.0625	0.47
Barium (Ba)	0.008	1.593	1.539	3.276	2.738	0.797	0.50
Beryllium (Be)	0.0002	0.0310	0.0241	0.0749	0.0619	0.0189	0.61
Boron (B)	0.002	0.209	0.181	0.460	0.380	0.110	0.53
Cadmium (Cd)	**0.002**	**0.036**	**0.033**	**0.053**	**0.052**	0.012	0.35
Calcium (Ca)	15.91	77.15	70.60	106.67	102.09	17.35	0.22
Chromium (Cr)	0.0004	**0.0394**	**0.0323**	**0.0920**	**0.0762**	0.0233	0.59
Cobalt (Co)	0.002	0.109	**0.113**	**0.153**	**0.147**	0.030	0.27
Copper (Cu)	**0.19**	**15.15**	**14.91**	**23.15**	**22.64**	5.30	0.35
Iron (Fe)	**1.18**	**295.38**	**297.60**	**468.33**	**454.02**	122.18	0.41
Lead (Pb)	0.001	0.108	0.115	0.160	0.143	0.029	0.27
Lithium (Li)	0.001	0.114	0.115	0.213	0.179	0.047	0.41
Magnesium (Mg)	1.30	49.66	38.35	117.37	98.89	29.24	0.59
Manganese (Mn)	0.26	**5.93**	**6.22**	**8.08**	**7.33**	1.19	0.20
Mercury (Hg)	0.000002	0.000244	0.000195	0.000556	0.000466	0.000132	0.54
Molybdenum (Mo)	0.001	0.125	0.119	0.198	0.195	0.053	0.42
Nickel (Ni)	0.001	0.030	0.029	0.043	0.042	0.009	0.30
Potassium (K)	0.39	43.88	37.52	96.74	80.31	22.91	0.52
Selenium (Se)	0.0009	**0.0361**	**0.0365**	**0.0566**	**0.0544**	0.0129	0.36
Silicon (Si)	1.05	89.39	81.89	188.18	155.56	44.38	0.50
Silver (Ag)	0.000004	0.001356	0.000983	**0.003384**	0.002817	0.000865	0.64
Sodium (Na)	2.42	30.27	25.02	63.16	55.29	14.60	0.48
Strontium (Sr)	0.13	6.60	5.26	16.46	13.78	4.47	0.68
Thallium (Tl)	0.00002	**0.00302**	**0.00289**	**0.00644**	**0.00538**	0.00163	0.54
Tin (Sn)	0.00005	0.01300	0.01209	0.02610	0.02162	0.00575	0.44
Uranium (U)	0.0004	0.1137	0.1080	0.2402	0.1995	0.0569	0.50
Vanadium (V)	0.0002	0.0530	0.0547	0.1044	0.0894	0.0261	0.49
Zinc (Zn)	0.13	2.77	2.56	4.40	4.21	1.01	0.36

(continued)

Table 14.7-10. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.00	0.32	0.16	3.04	1.27	0.43	1.34
Chloride (Cl)	0.31	51.83	53.71	114.77	98.11	32.15	0.62
Fluoride (F)	0.22	**31.43**	**28.94**	**69.52**	**57.12**	16.28	0.52
Nitrate (as N)	0.01	4.89	1.74	27.17	15.24	5.70	1.17
Nitrite (as N)	0.0003	0.0013	0.0013	0.0026	0.0020	0.0004	0.28
Total Phosphate (as P)	0.04	0.38	0.36	1.41	0.55	0.10	0.26
Sulphate (SO_4)	46	**1,174**	**1,162**	**1,763**	**1,714**	404	0.34
Total Metals							
Aluminum (Al)	*0.42*	*29.13*	*27.92*	*45.87*	*44.78*	11.44	0.39
Antimony (Sb)	0.0007	**0.2686**	**0.2183**	**0.6346**	**0.5253**	0.1627	0.61
Arsenic (As)	0.0008	**0.1709**	**0.1442**	**0.3106**	**0.2939**	0.0825	0.48
Barium (Ba)	0.010	3.400	3.207	7.184	5.966	1.765	0.52
Beryllium (Be)	0.0003	0.0950	0.0909	0.1963	0.1630	0.0468	0.49
Boron (B)	0.003	0.596	0.578	1.150	0.958	0.246	0.41
Cadmium (Cd)	**0.002**	**0.041**	**0.042**	**0.059**	**0.057**	0.013	0.31
Calcium (Ca)	15.93	83.77	80.19	110.58	107.13	16.22	0.19
Chromium (Cr)	0.0005	**0.0812**	**0.0738**	**0.1769**	**0.1455**	0.0431	0.53
Cobalt (Co)	0.002	**0.137**	**0.145**	**0.185**	**0.174**	0.033	0.24
Copper (Cu)	**0.19**	**18.01**	**19.21**	**24.17**	**23.61**	5.14	0.29
Iron (Fe)	**1.21**	**339.88**	**352.98**	**528.34**	**508.06**	124.43	0.37
Lead (Pb)	0.001	0.156	0.159	0.222	0.214	0.042	0.27
Lithium (Li)	0.002	0.218	0.238	0.374	0.321	0.081	0.37
Magnesium (Mg)	1.39	108.43	80.94	254.00	218.13	66.09	0.61
Manganese (Mn)	0.26	**8.53**	**7.75**	**12.41**	**11.89**	2.27	0.27
Mercury (Hg)	0.000002	0.000559	0.000465	0.001234	0.001032	0.000287	0.51
Molybdenum (Mo)	0.001	0.144	0.135	0.224	0.217	0.058	0.40
Nickel (Ni)	0.001	0.035	0.037	0.046	0.043	0.007	0.21
Potassium (K)	0.52	106.08	101.33	211.05	175.00	47.08	0.44
Selenium (Se)	0.0009	**0.0437**	**0.0463**	**0.0662**	**0.0623**	0.0141	0.32
Silicon (Si)	1.16	144.15	128.30	309.07	255.68	72.60	0.50
Silver (Ag)	0.000006	0.002855	0.002394	**0.006473**	**0.005334**	0.001542	0.54
Sodium (Na)	2.44	28.47	28.77	48.09	42.55	9.52	0.33
Strontium (Sr)	0.14	16.87	15.21	38.87	32.29	10.19	0.60
Thallium (Tl)	0.00003	**0.00706**	**0.00703**	**0.01364**	**0.01158**	0.00305	0.43
Tin (Sn)	0.00009	0.02981	0.02727	0.06095	0.05049	0.01350	0.45
Uranium (U)	0.0008	**0.3805**	**0.3676**	**0.8122**	**0.6840**	0.2002	0.53
Vanadium (V)	0.0004	0.1571	0.1665	0.2890	0.2479	0.0674	0.43
Zinc (Zn)	0.13	3.61	3.55	5.43	5.21	1.20	0.33

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-11. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0015	0.0020	0.0019	0.0039	0.0033	0.0005	0.27
Chloride (Cl)	22.65	38.57	37.76	67.57	53.73	8.00	0.21
Fluoride (F)	**13.20**	**22.43**	**21.98**	**39.54**	**31.44**	4.72	0.21
Nitrate (as N)	0.01	0.02	0.02	0.04	0.04	0.01	0.33
Nitrite (as N)	0.0003	0.0008	0.0009	0.0015	0.0011	0.0003	0.31
Total Phosphate (as P)	0.11	0.25	0.23	0.68	0.51	0.11	0.43
Sulphate (SO_4)	**1,217**	**1,656**	**1,642**	**2,061**	**1,898**	154	0.09
Total Metals							
Aluminum (Al)	*31.28*	*41.08*	*40.71*	*50.86*	*47.55*	4.03	0.10
Antimony (Sb)	**0.0746**	**0.1261**	**0.1233**	**0.2230**	**0.1768**	0.0268	0.21
Arsenic (As)	**0.1748**	**0.2304**	**0.2279**	**0.2873**	**0.2668**	0.0229	0.10
Barium (Ba)	1.378	2.328	2.278	4.106	3.262	0.492	0.21
Beryllium (Be)	0.0230	0.0392	0.0382	0.0701	0.0560	0.0084	0.21
Boron (B)	0.172	0.290	0.284	0.510	0.406	0.061	0.21
Cadmium (Cd)	**0.041**	**0.055**	**0.054**	**0.066**	**0.062**	0.005	0.09
Calcium (Ca)	69.79	113.26	116.01	129.26	119.82	9.38	0.08
Chromium (Cr)	**0.0321**	**0.0548**	**0.0536**	**0.0957**	**0.0761**	0.0112	0.21
Cobalt (Co)	**0.113**	**0.155**	**0.153**	**0.203**	**0.183**	0.017	0.11
Copper (Cu)	**18.69**	**24.36**	**24.16**	**28.80**	**27.72**	2.07	0.08
Iron (Fe)	**382.32**	**497.81**	**492.68**	**606.40**	**576.90**	48.20	0.10
Lead (Pb)	0.099	0.128	0.127	0.154	0.148	0.012	0.09
Lithium (Li)	0.091	0.155	0.152	0.272	0.216	0.032	0.21
Magnesium (Mg)	34.36	59.25	58.06	102.64	81.90	11.91	0.20
Manganese (Mn)	5.19	**6.92**	**6.86**	**8.37**	**7.87**	0.60	0.09
Mercury (Hg)	0.00017	0.00029	0.00029	0.00052	0.00041	0.00006	0.21
Molybdenum (Mo)	0.164	0.212	0.210	0.250	0.242	0.019	0.09
Nickel (Ni)	0.034	0.047	0.048	0.055	0.052	0.004	0.09
Potassium (K)	34.04	57.96	56.69	101.78	80.88	12.09	0.21
Selenium (Se)	**0.0429**	**0.0580**	**0.0569**	**0.0755**	**0.0702**	0.0067	0.12
Silicon (Si)	74.56	126.71	124.11	223.03	177.26	26.60	0.21
Silver (Ag)	0.00097	0.00163	0.00160	0.00289	0.00229	0.00035	0.21
Sodium (Na)	19.51	36.90	36.87	56.34	46.56	5.49	0.15
Strontium (Sr)	5.43	9.29	9.09	16.19	12.89	1.89	0.20
Thallium (Tl)	**0.00286**	**0.00483**	**0.00473**	**0.00854**	**0.00678**	0.00102	0.21
Tin (Sn)	0.01041	0.01759	0.01721	0.03113	0.02470	0.00374	0.21
Uranium (U)	0.1069	0.1810	0.1771	**0.3204**	0.2543	0.0386	0.21
Vanadium (V)	0.0494	0.0836	0.0819	0.1477	0.1173	0.0177	0.21
Zinc (Zn)	3.17	4.38	4.34	5.76	5.20	0.47	0.11

(continued)

Table 14.7-11. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0015	0.0020	0.0019	0.0039	0.0033	0.0005	0.27
Chloride (Cl)	54.03	91.61	89.65	161.54	128.27	19.33	0.21
Fluoride (F)	**28.87**	**48.91**	**47.88**	**86.46**	**68.66**	10.38	0.21
Nitrate (as N)	0.01	0.02	0.02	0.04	0.04	0.01	0.33
Nitrite (as N)	0.0003	0.0008	0.0009	0.0015	0.0011	0.0003	0.31
Total Phosphate (as P)	0.11	0.25	0.23	0.68	0.51	0.11	0.43
Sulphate (SO_4)	**1,347**	**1,825**	**1,809**	**2,270**	**2,089**	170	0.09
Total Metals							
Aluminum (Al)	*35.97*	*47.61*	*47.11*	*59.95*	*55.40*	4.87	0.10
Antimony (Sb)	**0.2278**	**0.3850**	**0.3763**	**0.6817**	**0.5403**	0.0821	0.21
Arsenic (As)	**0.2202**	**0.3062**	**0.3012**	**0.4149**	**0.3695**	0.0375	0.12
Barium (Ba)	2.867	4.844	4.740	8.566	6.798	1.030	0.21
Beryllium (Be)	0.0827	0.1401	0.1369	0.2488	0.1978	0.0300	0.21
Boron (B)	0.482	0.814	0.797	**1.439**	1.142	0.173	0.21
Cadmium (Cd)	**0.044**	**0.060**	**0.059**	**0.075**	**0.070**	0.006	0.10
Calcium (Ca)	72.32	117.54	120.24	136.80	126.24	9.85	0.08
Chromium (Cr)	**0.0689**	**0.1171**	**0.1145**	**0.2061**	**0.1637**	0.0246	0.21
Cobalt (Co)	**0.128**	**0.180**	**0.177**	**0.236**	**0.222**	0.022	0.12
Copper (Cu)	**18.94**	**24.78**	**24.56**	**29.55**	**28.20**	2.15	0.09
Iron (Fe)	**411.42**	**546.98**	**540.46**	**695.80**	**640.86**	58.32	0.11
Lead (Pb)	0.108	0.142	0.140	0.178	0.165	0.014	0.10
Lithium (Li)	0.178	0.303	0.297	0.533	0.424	0.064	0.21
Magnesium (Mg)	75.17	126.48	123.44	212.68	171.94	24.82	0.20
Manganese (Mn)	6.06	8.16	8.08	**10.16**	9.36	0.77	0.09
Mercury (Hg)	0.00041	0.00069	0.00068	0.00122	0.00097	0.00015	0.21
Molybdenum (Mo)	0.176	0.229	0.227	0.280	0.264	0.022	0.09
Nickel (Ni)	0.034	0.051	0.051	0.057	0.054	0.003	0.07
Potassium (K)	86.86	147.22	144.04	259.97	206.38	31.17	0.21
Selenium (Se)	**0.0478**	**0.0661**	**0.0645**	**0.0885**	**0.0829**	0.0086	0.13
Silicon (Si)	115.43	195.75	191.58	345.37	274.19	41.35	0.21
Silver (Ag)	0.00217	**0.00367**	**0.00359**	**0.00650**	**0.00516**	0.00078	0.21
Sodium (Na)	21.18	39.72	39.57	61.35	50.62	6.03	0.15
Strontium (Sr)	14.78	25.09	24.55	44.19	35.09	5.27	0.21
Thallium (Tl)	**0.00652**	**0.01101**	**0.01078**	**0.01949**	**0.01548**	0.00235	0.21
Tin (Sn)	0.02341	0.03957	0.03870	0.07007	0.05556	0.00844	0.21
Uranium (U)	**0.3749**	**0.6337**	**0.6200**	**1.1227**	**0.8908**	0.1354	0.21
Vanadium (V)	0.1374	0.2323	0.2273	0.4111	0.3263	0.0495	0.21
Zinc (Zn)	4.14	6.00	6.08	6.69	6.37	0.38	0.06

(continued)

Table 14.7-11. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0007	0.0010	0.0010	0.0017	0.0016	0.0003	0.27
Chloride (Cl)	37.90	48.17	47.96	56.44	53.72	4.00	0.08
Fluoride (F)	**22.04**	**28.07**	**27.96**	**32.94**	**31.34**	2.36	0.08
Nitrate (as N)	0.02	0.02	0.02	0.03	0.03	0.00	0.12
Nitrite (as N)	0.0006	0.0008	0.0008	0.0013	0.0010	0.0001	0.15
Total Phosphate (as P)	0.24	0.31	0.29	0.49	0.42	0.05	0.18
Sulphate (SO_4)	**1,450**	**1,743**	**1,742**	**1,885**	**1,874**	94	0.05
Total Metals							
Aluminum (Al)	*35.47*	*43.00*	*43.03*	*46.86*	*46.54*	2.45	0.06
Antimony (Sb)	**0.1237**	**0.1580**	**0.1575**	**0.1856**	**0.1764**	0.0134	0.08
Arsenic (As)	**0.1979**	**0.2422**	**0.2423**	**0.2643**	**0.2624**	0.0142	0.06
Barium (Ba)	2.285	2.914	2.904	3.419	3.252	0.246	0.08
Beryllium (Be)	0.0389	0.0494	0.0491	0.0583	0.0555	0.0042	0.08
Boron (B)	0.285	0.363	0.362	0.426	0.405	0.030	0.08
Cadmium (Cd)	**0.048**	**0.057**	**0.057**	**0.061**	**0.061**	0.003	0.05
Calcium (Ca)	103.85	117.13	118.99	124.16	121.06	4.12	0.04
Chromium (Cr)	**0.0539**	**0.0684**	**0.0680**	**0.0801**	**0.0763**	0.0056	0.08
Cobalt (Co)	**0.136**	**0.166**	**0.166**	**0.181**	**0.180**	0.010	0.06
Copper (Cu)	**20.75**	**25.05**	**25.06**	**27.15**	**26.98**	1.34	0.05
Iron (Fe)	**421.15**	**515.94**	**516.70**	**564.32**	**559.83**	30.11	0.06
Lead (Pb)	0.109	0.132	0.132	0.144	0.143	0.007	0.06
Lithium (Li)	0.153	0.194	0.193	0.227	0.216	0.016	0.08
Magnesium (Mg)	58.47	73.56	73.13	86.05	81.93	5.91	0.08
Manganese (Mn)	6.03	**7.18**	**7.19**	**7.76**	**7.71**	0.37	0.05
Mercury (Hg)	0.00029	0.00037	0.00037	0.00043	0.00041	0.00003	0.08
Molybdenum (Mo)	0.178	0.217	0.218	0.237	0.235	0.012	0.06
Nickel (Ni)	0.043	0.050	0.051	0.053	0.053	0.002	0.04
Potassium (K)	56.92	72.44	72.14	84.96	80.82	6.04	0.08
Selenium (Se)	**0.0501**	**0.0621**	**0.0621**	**0.0684**	**0.0676**	0.0039	0.06
Silicon (Si)	124.43	158.43	157.82	185.88	176.83	13.28	0.08
Silver (Ag)	0.00161	0.00205	0.00204	0.00241	0.00229	0.00017	0.08
Sodium (Na)	36.35	44.11	44.40	50.20	47.72	2.62	0.06
Strontium (Sr)	9.15	11.58	11.51	13.55	12.90	0.95	0.08
Thallium (Tl)	**0.00474**	**0.00605**	**0.00603**	**0.00711**	**0.00676**	0.00051	0.08
Tin (Sn)	0.01725	0.02205	0.02198	0.02590	0.02463	0.00187	0.08
Uranium (U)	0.1773	0.2268	0.2260	0.2665	0.2534	0.0193	0.09
Vanadium (V)	0.0820	0.1047	0.1043	0.1230	0.1170	0.0089	0.08
Zinc (Zn)	3.95	4.73	4.72	5.16	5.11	0.27	0.06

(continued)

Table 14.7-11. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0007	0.0010	0.0010	0.0017	0.0016	0.0003	0.27
Chloride (Cl)	89.80	114.66	114.23	134.57	128.00	9.68	0.08
Fluoride (F)	**47.98**	**61.27**	**61.05**	**71.95**	**68.44**	5.19	0.08
Nitrate (as N)	0.02	0.02	0.02	0.03	0.03	0.00	0.12
Nitrite (as N)	0.0006	0.0008	0.0008	0.0013	0.0010	0.0001	0.15
Total Phosphate (as P)	0.24	0.31	0.29	0.49	0.42	0.05	0.18
Sulphate (SO_4)	**1,594**	**1,920**	**1,919**	**2,078**	**2,066**	105	0.05
Total Metals							
Aluminum (Al)	*41.22*	*50.21*	*50.24*	*54.76*	*54.39*	2.93	0.06
Antimony (Sb)	**0.3776**	**0.4827**	**0.4812**	**0.5672**	**0.5390**	0.0411	0.09
Arsenic (As)	**0.2734**	**0.3379**	**0.3373**	**0.3704**	**0.3680**	0.0215	0.06
Barium (Ba)	4.752	6.070	6.051	7.128	6.777	0.515	0.08
Beryllium (Be)	0.1376	0.1758	0.1752	0.2069	0.1968	0.0150	0.09
Boron (B)	0.798	1.020	1.017	1.198	1.139	0.087	0.08
Cadmium (Cd)	**0.053**	**0.063**	**0.063**	**0.069**	**0.068**	0.003	0.05
Calcium (Ca)	108.20	122.58	124.53	130.14	127.02	4.44	0.04
Chromium (Cr)	**0.1149**	**0.1465**	**0.1459**	**0.1719**	**0.1635**	0.0123	0.08
Cobalt (Co)	**0.163**	**0.199**	**0.199**	**0.218**	**0.217**	0.012	0.06
Copper (Cu)	**21.16**	**25.58**	**25.59**	**27.74**	**27.56**	1.38	0.05
Iron (Fe)	**469.34**	**578.16**	**578.22**	**633.68**	**628.51**	35.32	0.06
Lead (Pb)	0.122	0.149	0.149	0.163	0.162	0.009	0.06
Lithium (Li)	0.297	0.379	0.377	0.444	0.423	0.032	0.08
Magnesium (Mg)	122.89	154.37	154.00	178.67	170.56	12.20	0.08
Manganese (Mn)	7.15	8.58	8.58	9.29	9.24	0.47	0.05
Mercury (Hg)	0.00068	0.00087	0.00086	0.00102	0.00097	0.00007	0.08
Molybdenum (Mo)	0.195	0.239	0.239	0.260	0.258	0.014	0.06
Nickel (Ni)	0.045	0.052	0.053	0.055	0.054	0.002	0.04
Potassium (K)	144.32	184.36	183.67	216.46	205.87	15.60	0.08
Selenium (Se)	**0.0568**	**0.0715**	**0.0716**	**0.0798**	**0.0788**	0.0049	0.07
Silicon (Si)	191.81	244.26	243.42	286.06	272.22	20.42	0.08
Silver (Ag)	**0.00360**	**0.00460**	**0.00459**	**0.00541**	**0.00514**	0.00039	0.09
Sodium (Na)	39.05	47.63	47.87	54.32	51.66	2.91	0.06
Strontium (Sr)	24.63	31.39	31.27	36.84	35.04	2.64	0.08
Thallium (Tl)	**0.01079**	**0.01380**	**0.01376**	**0.01621**	**0.01542**	0.00117	0.09
Tin (Sn)	0.03879	0.04961	0.04945	0.05828	0.05540	0.00422	0.09
Uranium (U)	**0.6205**	**0.7944**	**0.7918**	**0.9334**	**0.8877**	0.0678	0.09
Vanadium (V)	0.2275	0.2911	0.2901	0.3419	0.3252	0.0248	0.09
Zinc (Zn)	5.33	6.15	6.23	6.45	6.42	0.25	0.04

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-12. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0011	0.0019	0.0019	0.0039	0.0024	0.0003	0.18
Chloride (Cl)	15.60	24.28	23.01	68.89	39.17	7.74	0.32
Fluoride (F)	**8.79**	**14.04**	**13.23**	**40.32**	**22.93**	4.62	0.33
Nitrate (as N)	0.01	0.03	0.03	0.04	0.04	0.01	0.33
Nitrite (as N)	0.0004	0.0011	0.0012	0.0016	0.0015	0.0004	0.35
Total Phosphate (as P)	0.09	0.24	0.22	0.61	0.44	0.08	0.34
Sulphate (SO_4)	**873**	**1,027**	**1,007**	**2,091**	**1,173**	148	0.14
Total Metals							
Aluminum (Al)	*20.50*	*24.63*	*23.97*	*51.60*	*28.70*	3.90	0.16
Antimony (Sb)	**0.0484**	**0.0784**	**0.0736**	**0.2274**	**0.1292**	0.0263	0.34
Arsenic (As)	**0.1141**	**0.1371**	**0.1325**	**0.2916**	**0.1592**	0.0219	0.16
Barium (Ba)	0.901	1.453	1.363	4.187	2.381	0.482	0.33
Beryllium (Be)	0.0154	0.0249	0.0233	0.0715	0.0408	0.0081	0.33
Boron (B)	0.114	0.182	0.172	0.520	0.296	0.059	0.33
Cadmium (Cd)	**0.029**	**0.034**	**0.033**	**0.067**	**0.038**	0.005	0.14
Calcium (Ca)	60.72	86.06	89.90	130.99	96.43	10.80	0.13
Chromium (Cr)	**0.0228**	**0.0347**	**0.0329**	**0.0976**	**0.0554**	0.0107	0.31
Cobalt (Co)	0.076	0.095	0.092	**0.206**	**0.113**	0.016	0.17
Copper (Cu)	**12.70**	**15.07**	**14.69**	**29.19**	**17.47**	2.16	0.14
Iron (Fe)	**244.67**	**293.36**	**286.36**	**615.07**	**343.87**	47.33	0.16
Lead (Pb)	0.067	0.085	0.082	0.156	0.107	0.013	0.15
Lithium (Li)	0.062	0.098	0.092	0.277	0.158	0.031	0.32
Magnesium (Mg)	25.06	38.07	36.19	104.64	59.91	11.49	0.30
Manganese (Mn)	3.62	4.31	4.20	**8.49**	**5.03**	0.61	0.14
Mercury (Hg)	0.00011	0.00018	0.00017	0.00053	0.00030	0.00006	0.33
Molybdenum (Mo)	0.108	0.125	0.121	0.254	0.143	0.019	0.15
Nickel (Ni)	0.025	0.031	0.030	0.056	0.038	0.005	0.16
Potassium (K)	23.23	36.41	34.56	103.78	59.00	11.72	0.32
Selenium (Se)	**0.0276**	**0.0348**	**0.0340**	**0.0766**	**0.0422**	0.0062	0.18
Silicon (Si)	49.91	79.54	74.98	227.41	129.46	25.98	0.33
Silver (Ag)	0.00063	0.00102	0.00096	0.00295	0.00168	0.00034	0.33
Sodium (Na)	16.16	25.79	25.41	57.34	32.39	4.72	0.18
Strontium (Sr)	3.85	5.90	5.61	16.50	9.41	1.83	0.31
Thallium (Tl)	**0.00187**	**0.00302**	**0.00283**	**0.00871**	**0.00495**	0.00100	0.33
Tin (Sn)	0.00676	0.01095	0.01028	0.03174	0.01804	0.00367	0.34
Uranium (U)	0.0695	0.1128	0.1058	**0.3267**	0.1856	0.0378	0.34
Vanadium (V)	0.0325	0.0523	0.0492	0.1506	0.0857	0.0173	0.33
Zinc (Zn)	2.20	2.71	2.62	5.85	3.16	0.45	0.16

(continued)

Table 14.7-12. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0011	0.0019	0.0019	0.0039	0.0024	0.0003	0.18
Chloride (Cl)	35.86	57.23	53.94	164.72	93.60	18.88	0.33
Fluoride (F)	**18.89**	**30.51**	**28.66**	**88.17**	**50.11**	10.18	0.33
Nitrate (as N)	0.01	0.03	0.03	0.04	0.04	0.01	0.33
Nitrite (as N)	0.0004	0.0011	0.0012	0.0016	0.0015	0.0004	0.35
Total Phosphate (as P)	0.09	0.24	0.22	0.61	0.44	0.08	0.34
Sulphate (SO_4)	**933**	**1,133**	**1,112**	**2,303**	**1,320**	172	0.15
Total Metals							
Aluminum (Al)	*23.84*	*29.16*	*28.38*	*60.84*	*34.29*	4.62	0.16
Antimony (Sb)	**0.1465**	**0.2390**	**0.2240**	**0.6951**	**0.3948**	0.0806	0.34
Arsenic (As)	**0.1436**	**0.1844**	**0.1786**	**0.4217**	**0.2198**	0.0351	0.19
Barium (Ba)	1.857	3.015	2.826	8.734	4.965	1.010	0.34
Beryllium (Be)	0.0539	0.0879	0.0820	0.2537	0.1444	0.0293	0.33
Boron (B)	0.314	0.507	0.476	**1.467**	0.834	0.169	0.33
Cadmium (Cd)	**0.031**	**0.038**	**0.037**	**0.077**	**0.044**	0.006	0.15
Calcium (Ca)	62.89	89.30	92.09	138.68	100.70	10.87	0.12
Chromium (Cr)	**0.0466**	**0.0736**	**0.0696**	**0.2101**	**0.1194**	0.0238	0.32
Cobalt (Co)	0.086	**0.113**	**0.113**	**0.240**	**0.135**	0.020	0.18
Copper (Cu)	**12.91**	**15.61**	**15.24**	**29.95**	**18.39**	2.24	0.14
Iron (Fe)	**262.98**	**327.96**	**319.07**	**706.27**	**391.44**	55.54	0.17
Lead (Pb)	0.132	0.230	0.227	0.284	0.257	0.020	0.09
Lithium (Li)	0.118	0.190	0.178	0.543	0.309	0.062	0.33
Magnesium (Mg)	50.79	79.70	75.40	216.74	123.21	24.62	0.31
Manganese (Mn)	4.42	6.31	6.02	**10.80**	**8.94**	1.30	0.21
Mercury (Hg)	0.00027	0.00043	0.00040	0.00125	0.00071	0.00014	0.33
Molybdenum (Mo)	0.115	0.136	0.133	0.284	0.157	0.021	0.15
Nickel (Ni)	0.027	0.036	0.038	0.057	0.040	0.005	0.13
Potassium (K)	57.27	91.96	86.56	265.09	150.64	30.45	0.33
Selenium (Se)	**0.0302**	**0.0402**	**0.0391**	**0.0897**	**0.0510**	0.0079	0.20
Silicon (Si)	76.26	122.61	115.28	352.16	200.40	40.45	0.33
Silver (Ag)	0.00141	0.00229	0.00215	**0.00663**	**0.00377**	0.00077	0.34
Sodium (Na)	17.53	27.49	26.74	62.45	35.24	5.17	0.19
Strontium (Sr)	9.88	15.74	14.85	45.06	25.64	5.14	0.33
Thallium (Tl)	**0.00421**	**0.00685**	**0.00642**	**0.01988**	**0.01129**	0.00230	0.34
Tin (Sn)	0.01514	0.02460	0.02307	0.07145	0.04059	0.00828	0.34
Uranium (U)	0.2421	**0.3944**	**0.3695**	**1.1449**	**0.6504**	0.1329	0.34
Vanadium (V)	0.0893	0.1453	0.1359	0.4192	0.2384	0.0485	0.33
Zinc (Zn)	3.19	4.24	4.38	6.78	4.67	0.54	0.13

(continued)

Table 14.7-12. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0004	0.0009	0.0009	0.0026	0.0017	0.0004	0.40
Chloride (Cl)	19.24	29.17	28.67	55.60	39.53	5.41	0.19
Fluoride (F)	**11.18**	**17.01**	**16.72**	**32.48**	**23.07**	3.18	0.19
Nitrate (as N)	0.01	0.02	0.02	0.03	0.03	0.00	0.18
Nitrite (as N)	0.0005	0.0008	0.0008	0.0012	0.0011	0.0002	0.18
Total Phosphate (as P)	0.15	0.27	0.27	0.43	0.35	0.04	0.16
Sulphate (SO_4)	**1,021**	**1,142**	**1,121**	**1,991**	**1,260**	130	0.11
Total Metals							
Aluminum (Al)	*24.71*	*27.83*	*27.38*	*49.57*	*30.20*	3.35	0.12
Antimony (Sb)	**0.0624**	**0.0954**	**0.0937**	**0.1830**	**0.1298**	0.0180	0.19
Arsenic (As)	**0.1358**	**0.1546**	**0.1523**	**0.2792**	**0.1675**	0.0191	0.12
Barium (Ba)	1.160	1.765	1.735	3.372	2.396	0.330	0.19
Beryllium (Be)	0.0200	0.0303	0.0296	0.0577	0.0411	0.0056	0.19
Boron (B)	0.145	0.220	0.217	0.420	0.299	0.041	0.19
Cadmium (Cd)	**0.034**	**0.037**	**0.037**	**0.065**	**0.040**	0.004	0.11
Calcium (Ca)	75.32	84.44	82.94	125.83	94.81	7.04	0.08
Chromium (Cr)	**0.0274**	**0.0415**	**0.0407**	**0.0789**	**0.0563**	0.0077	0.18
Cobalt (Co)	0.094	0.109	0.107	**0.192**	**0.124**	0.013	0.12
Copper (Cu)	**15.31**	**16.91**	**16.61**	**28.86**	**18.16**	1.85	0.11
Iron (Fe)	**295.31**	**332.84**	**326.84**	**600.44**	**356.40**	41.18	0.12
Lead (Pb)	0.083	0.095	0.091	0.154	0.116	0.012	0.12
Lithium (Li)	0.077	0.118	0.116	0.224	0.160	0.022	0.19
Magnesium (Mg)	30.33	45.30	44.46	84.68	60.99	8.10	0.18
Manganese (Mn)	4.37	4.82	4.71	**8.20**	**5.36**	0.54	0.11
Mercury (Hg)	0.00015	0.00022	0.00022	0.00042	0.00030	0.00004	0.19
Molybdenum (Mo)	0.125	0.140	0.137	0.253	0.146	0.017	0.12
Nickel (Ni)	0.027	0.033	0.033	0.054	0.037	0.004	0.11
Potassium (K)	28.88	43.88	43.10	83.70	59.56	8.17	0.19
Selenium (Se)	**0.0349**	**0.0404**	**0.0397**	**0.0725**	**0.0456**	0.0050	0.12
Silicon (Si)	63.30	96.25	94.58	183.26	130.38	17.91	0.19
Silver (Ag)	0.00081	0.00124	0.00122	0.00237	0.00169	0.00023	0.19
Sodium (Na)	18.99	26.83	26.59	48.47	35.06	4.30	0.16
Strontium (Sr)	4.68	7.05	6.93	13.34	9.53	1.29	0.18
Thallium (Tl)	**0.00240**	**0.00366**	**0.00360**	**0.00701**	**0.00498**	0.00069	0.19
Tin (Sn)	0.00872	0.01332	0.01310	0.02554	0.01813	0.00252	0.19
Uranium (U)	0.0897	0.1373	0.1349	0.2629	0.1866	0.0259	0.19
Vanadium (V)	0.0416	0.0635	0.0625	0.1213	0.0863	0.0119	0.19
Zinc (Zn)	2.66	3.08	3.03	5.44	3.48	0.36	0.12

(continued)

Table 14.7-12. Summary Statistics of Water Quality Predictions for the Water Storage Facility (Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0004	0.0009	0.0009	0.0026	0.0017	0.0004	0.40
Chloride (Cl)	45.46	69.33	68.14	132.69	94.18	13.02	0.19
Fluoride (F)	**24.28**	**37.08**	**36.45**	**70.97**	**50.39**	6.98	0.19
Nitrate (as N)	0.01	0.02	0.02	0.03	0.03	0.00	0.18
Nitrite (as N)	0.0005	0.0008	0.0008	0.0012	0.0011	0.0002	0.18
Total Phosphate (as P)	0.15	0.27	0.27	0.43	0.35	0.04	0.16
Sulphate (SO_4)	**1,114**	**1,273**	**1,246**	**2,197**	**1,431**	147	0.12
Total Metals							
Aluminum (Al)	*29.28*	*33.07*	*32.49*	*58.01*	*36.64*	3.86	0.12
Antimony (Sb)	**0.1903**	**0.2911**	**0.2861**	**0.5591**	**0.3965**	0.0552	0.19
Arsenic (As)	**0.1747**	**0.2124**	**0.2092**	**0.3881**	**0.2455**	0.0279	0.13
Barium (Ba)	2.404	3.669	3.607	7.030	4.990	0.691	0.19
Beryllium (Be)	0.0700	0.1070	0.1050	0.2043	0.1451	0.0201	0.19
Boron (B)	0.404	0.617	0.606	1.181	0.839	0.116	0.19
Cadmium (Cd)	**0.038**	**0.042**	**0.042**	**0.073**	**0.047**	0.005	0.11
Calcium (Ca)	78.02	88.34	86.76	131.99	101.29	7.60	0.09
Chromium (Cr)	**0.0583**	**0.0889**	**0.0873**	**0.1694**	**0.1206**	0.0166	0.19
Cobalt (Co)	0.109	**0.130**	**0.128**	**0.228**	**0.154**	0.016	0.12
Copper (Cu)	**15.90**	**17.54**	**17.18**	**29.38**	**19.46**	1.90	0.11
Iron (Fe)	**329.67**	**375.74**	**368.57**	**670.81**	**421.69**	46.12	0.12
Lead (Pb)	0.146	0.247	0.249	0.277	0.263	0.017	0.07
Lithium (Li)	0.151	0.230	0.226	0.438	0.312	0.043	0.19
Magnesium (Mg)	64.31	95.51	94.06	177.52	127.72	16.59	0.17
Manganese (Mn)	5.52	**7.32**	6.81	**11.09**	**10.05**	1.42	0.19
Mercury (Hg)	0.00034	0.00052	0.00052	0.00100	0.00071	0.00010	0.19
Molybdenum (Mo)	0.135	0.153	0.151	0.275	0.163	0.019	0.12
Nickel (Ni)	0.033	0.036	0.035	0.057	0.039	0.003	0.09
Potassium (K)	73.05	111.57	109.66	213.46	151.62	20.97	0.19
Selenium (Se)	**0.0407**	**0.0480**	**0.0468**	**0.0854**	**0.0564**	0.0060	0.12
Silicon (Si)	97.51	148.58	146.05	283.42	201.68	27.65	0.19
Silver (Ag)	0.00182	0.00279	0.00274	**0.00533**	**0.00379**	0.00053	0.19
Sodium (Na)	20.48	28.90	28.63	52.60	37.76	4.68	0.16
Strontium (Sr)	12.50	19.05	18.71	36.31	25.83	3.56	0.19
Thallium (Tl)	**0.00545**	**0.00834**	**0.00819**	**0.01600**	**0.01135**	0.00157	0.19
Tin (Sn)	0.01958	0.02996	0.02945	0.05748	0.04078	0.00567	0.19
Uranium (U)	**0.3136**	**0.4805**	**0.4721**	**0.9210**	**0.6537**	0.0908	0.19
Vanadium (V)	0.1154	0.1768	0.1736	0.3374	0.2398	0.0332	0.19
Zinc (Zn)	3.42	4.21	4.14	6.72	4.53	0.42	0.10

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

During the construction (pre-production) and operation phases, increasing concentrations of many water quality parameters over time in the WSF are a reflection of increased accumulation of waste rock in the RSFs, and therefore an increased chemical loading to the WSF (see Chapter 10 for waste rock release rates). The construction phase water quality predictions (Table 14.7-9) indicate that concentrations of most parameters in the WSF are in the range of an order of magnitude less in Year -1 compared to Year 5. No effect on water quality in the construction phase downstream of the Mine Site is predicted. In the expected case during the operation phase, the predicted mean concentrations of sulphate and copper in the WSF are 994 mg/L and 13.8 mg/L, respectively (Table 14.7-10; Figures 14.7-3 and 14.7-4).

During the closure phase, mean sulphate concentrations are predicted to increase to 1,656 mg/L and mean copper concentrations are predicted to increase to 24.3 mg/L. These increases in concentration represent the larger relative chemical load from the RSFs to the WSF as water of lower concentration is redirected to the Mitchell Pit Lake (Table 14.7-11). The mean post-closure predictions of sulphate and copper in the WSF are 1,027 mg/L and 15.1 mg/L, respectively.

Nitrogen loading to the WSF from blasting residues is predicted to peak at the end of open pit mining at Mitchell and Sulphurets pits (Figure 14.7-5). The reduced explosives use during underground mining is observable in substantially reduced predicted nitrate concentrations in the WSF after Year 30. Nitrite is an intermediate nitrogen species in the oxidation of ammonia to nitrate and is modelled as 2% of the total nitrogen load from explosives. Nitrite concentrations are likely over-estimated as nitrite is rapidly oxidized to nitrate and concentrations of nitrite are usually lower (< 10 ppb) under oxygenated conditions (Mortonson and Brooks 1980; Wetzel 2001) than predicted by the conservative mass-balance modelling approach. For these reasons, water quality effects as a result of nitrite were not assessed.

The mine plan and operation of various water management structures significantly influence the volume of water in the WSF (see Appendix 14-F). As expected, the volume of water in the WSF significantly affects the concentration of water quality parameters. Intra-annual fluctuations in the volume of water in the WSF due to seasonal variability in both inflows (e.g., runoff from RSFs) and pumping rates to the WTP are a significant factor in the month-to-month variability observed in concentrations of water quality parameters.

The maximum annual volume of water in the WSF increases throughout the life of mine until approximately Year 27, and then is relatively consistent to Year 51.5. Water is re-routed during the filling of the Mitchell Pit and creation of the Mitchell Pit Lake resulting in a substantial reduction in water volume in the WSF until Year 55 (Appendix 4-J; KCBL 2012). During the closure phase, chemical loadings from the RSFs continue to report to the WSF, and the resultant increase in concentrations in the WSF reflects the reduced dilution of water routed to Mitchell Pit. Both the predicted geochemical loadings and the base case water balance are static after Year 55, which is reflected in conservative static post-closure water quality predictions for the WSF. The model run was terminated at 100 years; however, a longer model run would not change the post-closure water quality predictions.

In the WSF in the operation phase, the maximum predicted concentrations in the upper case for most trace elements, including selenium, were 10 to 20% higher than in the expected case (e.g., mean selenium concentrations increased from 0.033 to 0.039 mg/L; Table 14.7-10).

Predicted mean variable case water balance simulation concentrations were between 4% and 20% higher than the base case water balance simulations (Tables 14.7-9 to 14.7-12).

Water stored in the WSF will be treated at the HDS lime WTP prior to discharge to the receiving environment and the quality of treated effluent with reference to water quality targets is discussed in Section 14.7.2.2.3.

14.7.1.2.3 Processing and Tailing Management Area Water Quality Model

The PTMA water quality model, Figure 14.7-8, was developed using the 2012 TMF Water Balance (Appendix 14-G), source term chemistry (Chapter 10, Section 10.2), and background water quality (Appendices 11-A, 11-B, 11-C, and 14-A). The water balance was modified to represent baseline observed data. This validation process included comparison to observed stream flows and revision of expected precipitation and runoff coefficients. The objective of this section is to provide documentation of the assumptions, model input parameters, and TMF predictions used for assessment of potential effects to surface water quality in the PTMA receiving environment.

Water Chemistry Model Inputs

Source Terms

Source term chemistry for the Project components were developed from ML/ARD characterization and predictions, tailing supernatant from the metallurgical program, background groundwater quality, and background surface water quality. Source terms are detailed in Chapter 10, Section 10.2, Appendix 10-A, and model inputs are summarized in Table 14.7-13.

Catchment Water

The water quality of diverted surface runoff water for catchment areas was estimated to be equivalent to background surface water quality of the relevant catchment. Table 14.7-14 identifies the water quality monitoring site data applied to surface runoff.

Seepage

Hydrogeological modelling was completed to predict the flow paths and conservative solute transport of contact groundwater beyond the TMF dams and beyond the North, Saddle, and Southeast seepage collection dams that interact with surface water (see Chapters 11 and 12). A small portion of the dispersive plume is predicted to daylight in South Teigen Creek beyond the North Cell seepage collection dam with an average concentration predicted to be 0.5% of the North Cell TMF source. The flow rate of the contact groundwater beyond the North Cell seepage collection dam was estimated to be 6.3 L/s. These results were incorporated into the surface water quality model. No other contaminated groundwater sources to surface water were identified through the hydrogeological baseline studies and modelling.

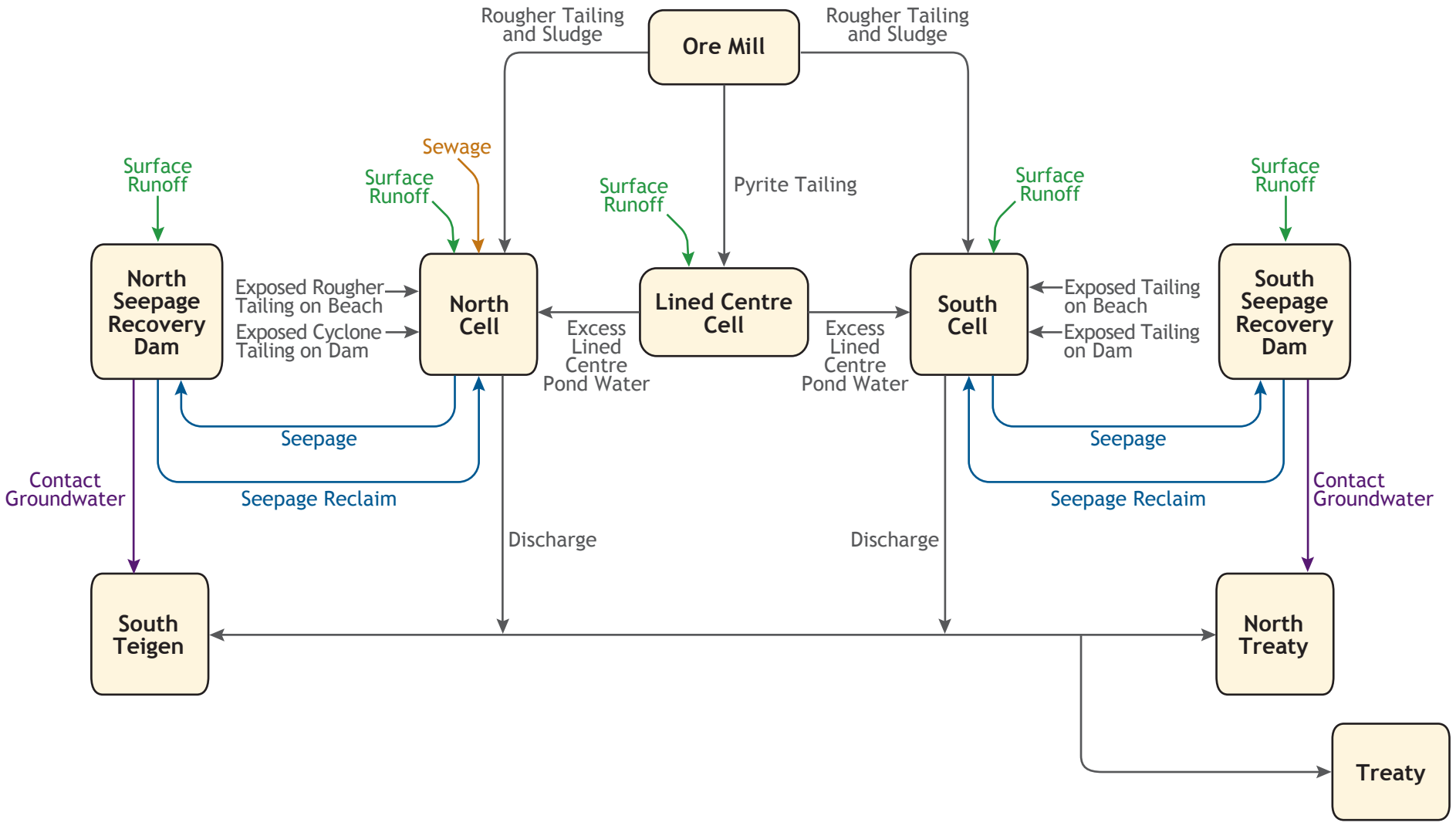

Figure 14.7-8

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Processing and Tailing Management Area Water Quality Model Schematic

Figure 14.7-8

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Table 14.7-13. Source Term Chemistry for the Processing and Tailing Management Area Water Quality Model

Project Component	Data Source	
	Expected Case	**Upper Case**
Process Plant	Operation: 1) Supernatant of sulphide tailing material post-water treatment (cyanide detoxification) 2) Supernatant of rougher tailing material mixed with 0.15% (wt/wt) HDS lime sludge 3) Nitrogen loading is based on the ore production schedule Closure/Post-closure: There will be no chemical contribution from the Process Plant to the TMF during the closure and post-closure phases.	Operation: 1) Supernatant of sulphide tailing material post-water treatment (cyanide detoxification) 2) Supernatant of rougher tailing material mixed with 0.15% (wt/wt) HDS lime sludge 3) Nitrogen loading is based on the ore production schedule Closure/Post-closure: There will be no chemical contribution from the Process Plant to the TMF during the closure and post-closure phases.
North Cell TMF	Operation: 1) undiverted natural catchment (background surface water quality) 2) sewage from the Treaty operating camp Closure/Post-closure: 1) undiverted natural catchment (background surface water quality)	Operation: 1) undiverted natural catchment (background surface water quality) 2) sewage from the Treaty operating camp Closure/Post-closure: 1) undiverted natural catchment (background surface water quality)
Centre Cell TMF	Operation: 1) background groundwater quality 2) undiverted natural catchment (background surface water quality) Closure/Post-closure: 1) background groundwater quality 2) undiverted natural catchment (background surface water quality)	Operation: 1) background groundwater quality 2) undiverted natural catchment (background surface water quality) Closure/Post-closure: 1) background groundwater quality 2) undiverted natural catchment (background surface water quality)
South Cell TMF	Operation: 1) undiverted natural catchment (background surface water quality) Closure/Post-Closure: 1) undiverted natural catchment (background surface water quality)	Operation: 1) undiverted natural catchment (background surface water quality) Closure/Post-Closure: 1) undiverted natural catchment (background surface water quality)
Cyclone Dams	Operation and Closure/Post-closure: 1) humidity cell leach rates (mean values) for Mitchell rougher coarse tailing material	Operation and Closure/Post-closure: 1) humidity cell leach rates (95th percentile values) for Mitchell rougher coarse tailing material
Tailing Beaches	Operation and Closure/Post-closure: 1) humidity cell leach rates (mean values) for tailing material from various deposits	Operation and Closure/Post-closure: 1) humidity cell leach rates (95th percentile values) for tailing material from various deposits

Table 14.7-14. Catchment Water Quality Estimates

Area	Water Quality Source Term
Surface runoff to North Cell TMF and North SRD	STE2
Surface runoff to Centre Cell TMF, South Cell TMF, South SRD, and Saddle SRD	NTR1A
Diversion structures to South Teigen Creek	STE2 and STE3
Diversion structures to North Treaty Creek	NTR1A

Processing and Tailing Management Area Water Quality Predictions

The active flotation tailing pond, either the North Cell TMF or the South Cell TMF, is designed to store tailing water from the flotation tailing stream and surplus water from the lined Centre Cell prior to discharge to the receiving environment (Treaty Creek and Teigen Creek). The two flotation ponds effectively represent the cumulative geochemical load from the PTMA prior to discharge. This section presents the water quality predictions for the North Cell TMF and South Cell TMF for the four model scenarios or sensitivity analyses. The water quality in the flotation tailing cells was compared to MMER criteria (SOR/2002-22) and the BC Pollution Control Objectives (BC MOE 1979) because water from the active flotation cell will be directly discharged to the receiving environment. The BC objectives provide a range of dissolved concentrations for each discharge parameter, while specific discharge targets will be set during the permitting stage. A detailed summary of the expected case (scenario 1) water quality predictions for the Centre Cell is included in Appendix 14-H. Water quality predictions for the receiving environment (Treaty and Teigen watersheds) are presented in Section 14.7.3.1.

Figures 14.7-9 to 14.7-15 present the expected and upper-case water quality predictions in the TMF during the operation, closure, and post-closure phases for six COPC: sulphate, nitrate, dissolved aluminum, total cadmium, total copper, and total selenium. Two water balances, a base case, and a variable case including extreme low and high flows, are included.

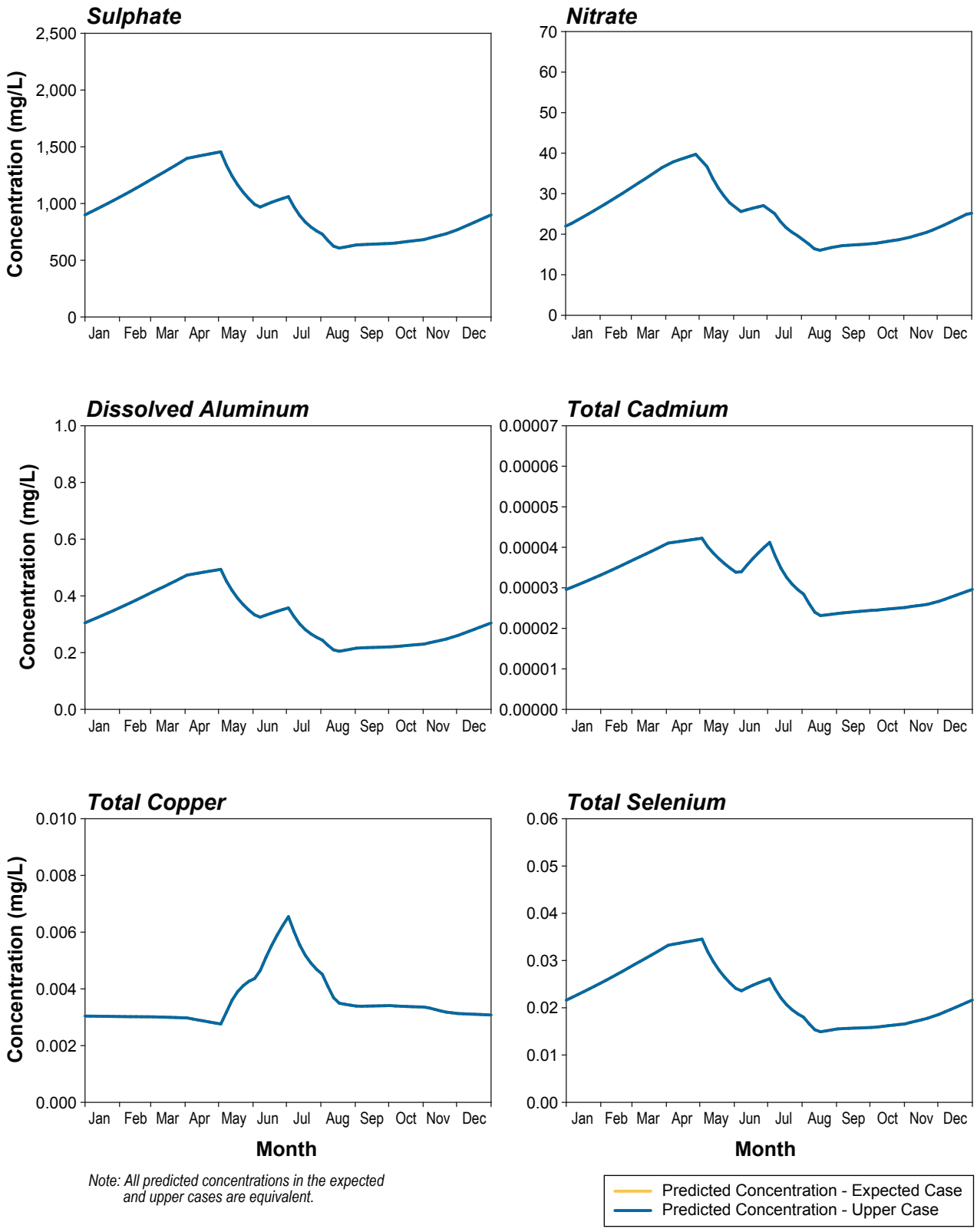
Tables 14.7-15 to 14.7-20 present statistical summaries of water quality in the TMF for the four model scenarios for the operation, closure, and post-closure phases.

North Cell TMF

The upper-case water quality predictions are less than 1% greater than the expected case water quality predictions and are therefore indistinguishable in Figures 14.7-9 to 14.7-12. Predicted mean variable case water balance simulation concentrations were between 5% and 13% higher than the base case water balance simulations (Tables 4.7-15 to 4.7-17).

The 95th percentile concentrations of the expected case water quality predictions were compared to BC Pollution Control Objectives (BC MOE 1979) and MMER maximum authorized monthly mean concentrations (SOR/2002-22) as the North Cell TMF water will be discharged via pipeline to Treaty Creek with no additional water treatment.

TSS concentrations in discharge from the North Cell TMF will be controlled by floating clarifiers in order to meet the MMER regulatory limit of 15 mg/L. Mean annual TSS concentrations in Treaty Creek ranged from 30 to 400 mg/L; therefore, it is likely that TSS concentrations will decrease in Treaty Creek as a result of TMF discharge.



Note: All predicted concentrations in the expected and upper cases are equivalent.

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Water Quality Predictions for Base Case Water Balance: North Cell TMF (Year 5)

Figure 14.7-9

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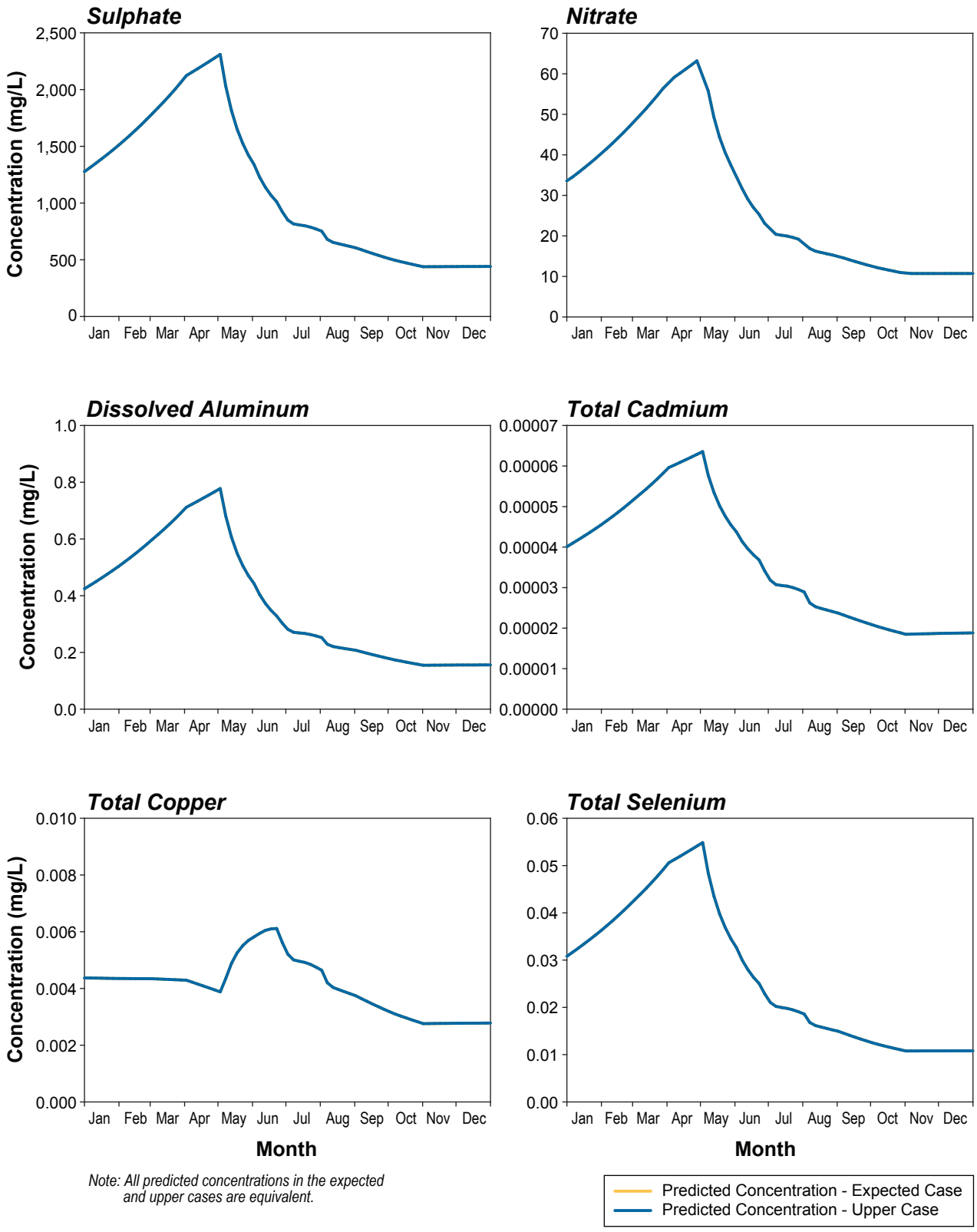

Note: All predicted concentrations in the expected and upper cases are equivalent.

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Water Quality Predictions for Base Case Water Balance: North Cell TMF (Year 25)

Figure 14.7-10

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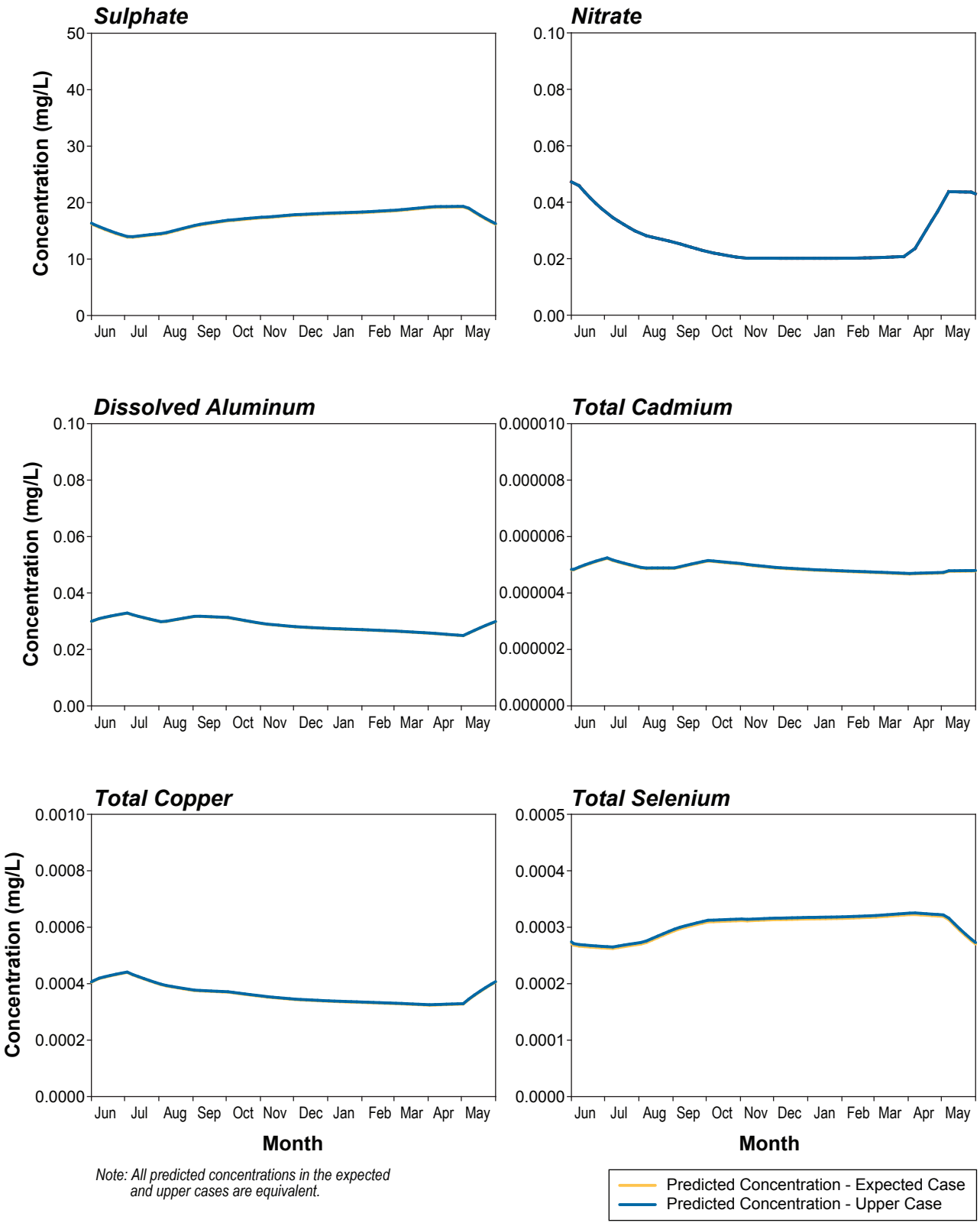

Note: All predicted concentrations in the expected and upper cases are equivalent.

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Water Quality Predictions for Base Case Water Balance: North Cell TMF (Year 51.5)

Figure 14.7-11

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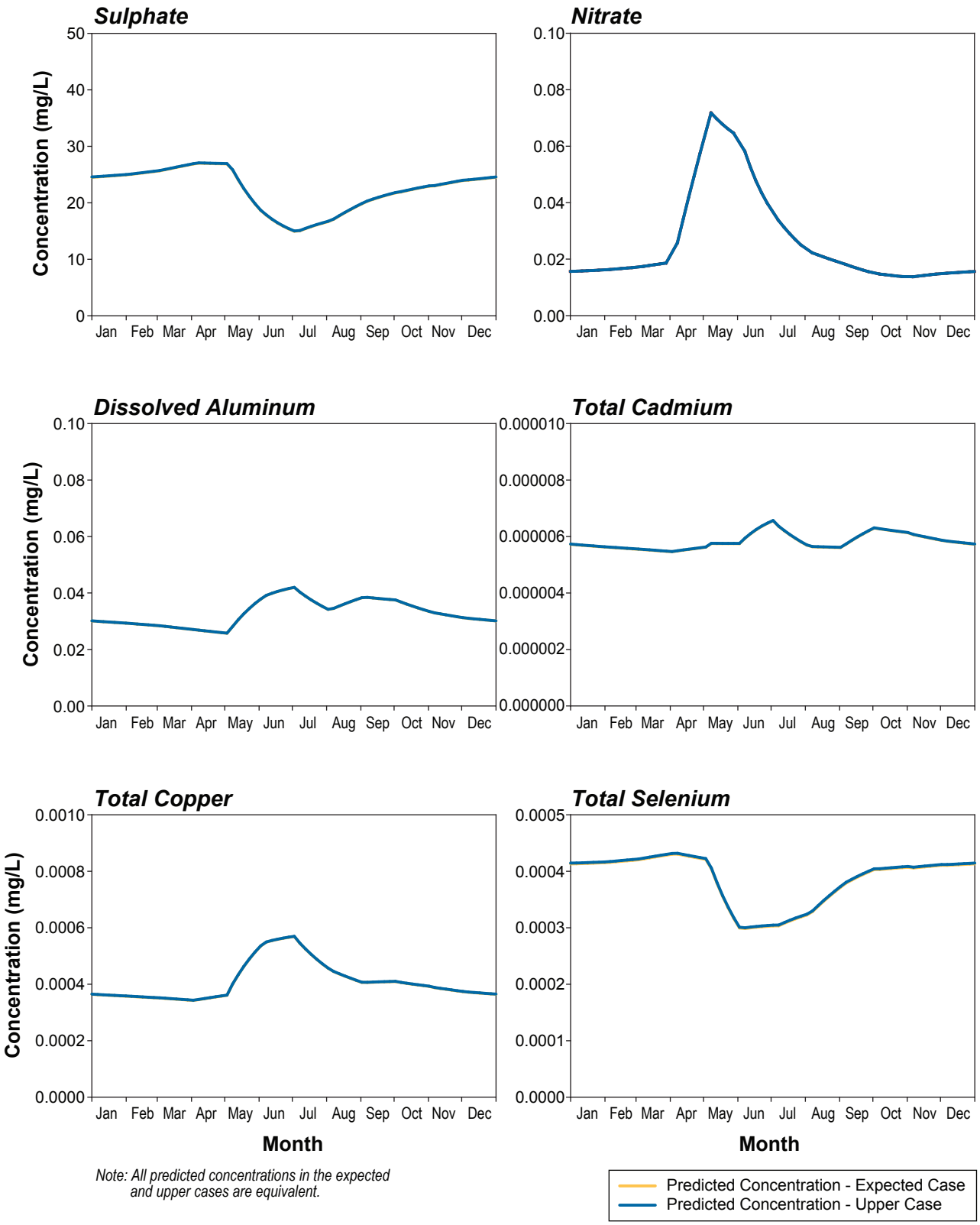

Note: All predicted concentrations in the expected and upper cases are equivalent.

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Water Quality Predictions for Base Case Water Balance: North Cell TMF (Year 65)

Figure 14.7-12

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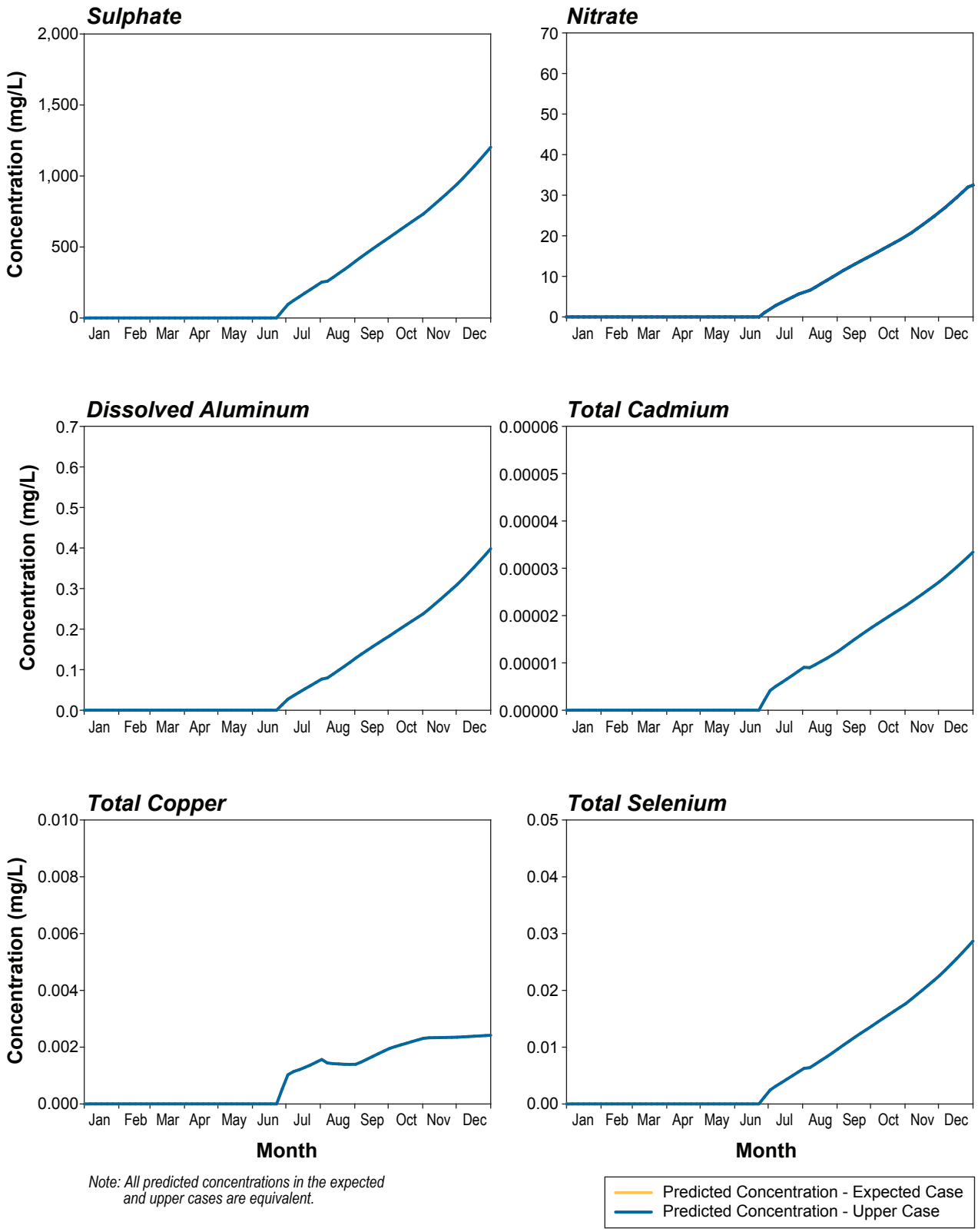

Note: All predicted concentrations in the expected and upper cases are equivalent.

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Water Quality Predictions for Base Case Water Balance: South Cell TMF (Year 25)

Figure 14.7-13

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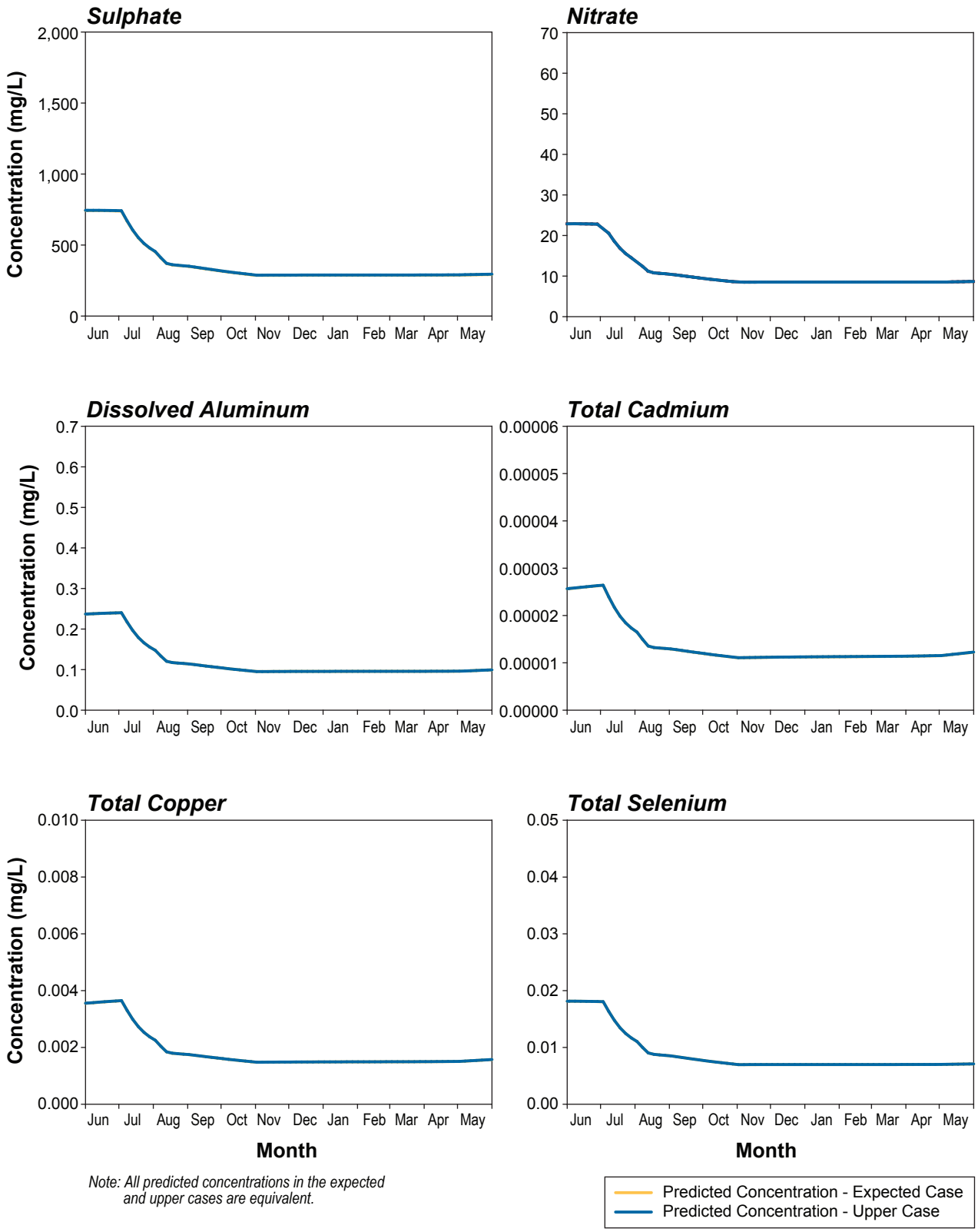


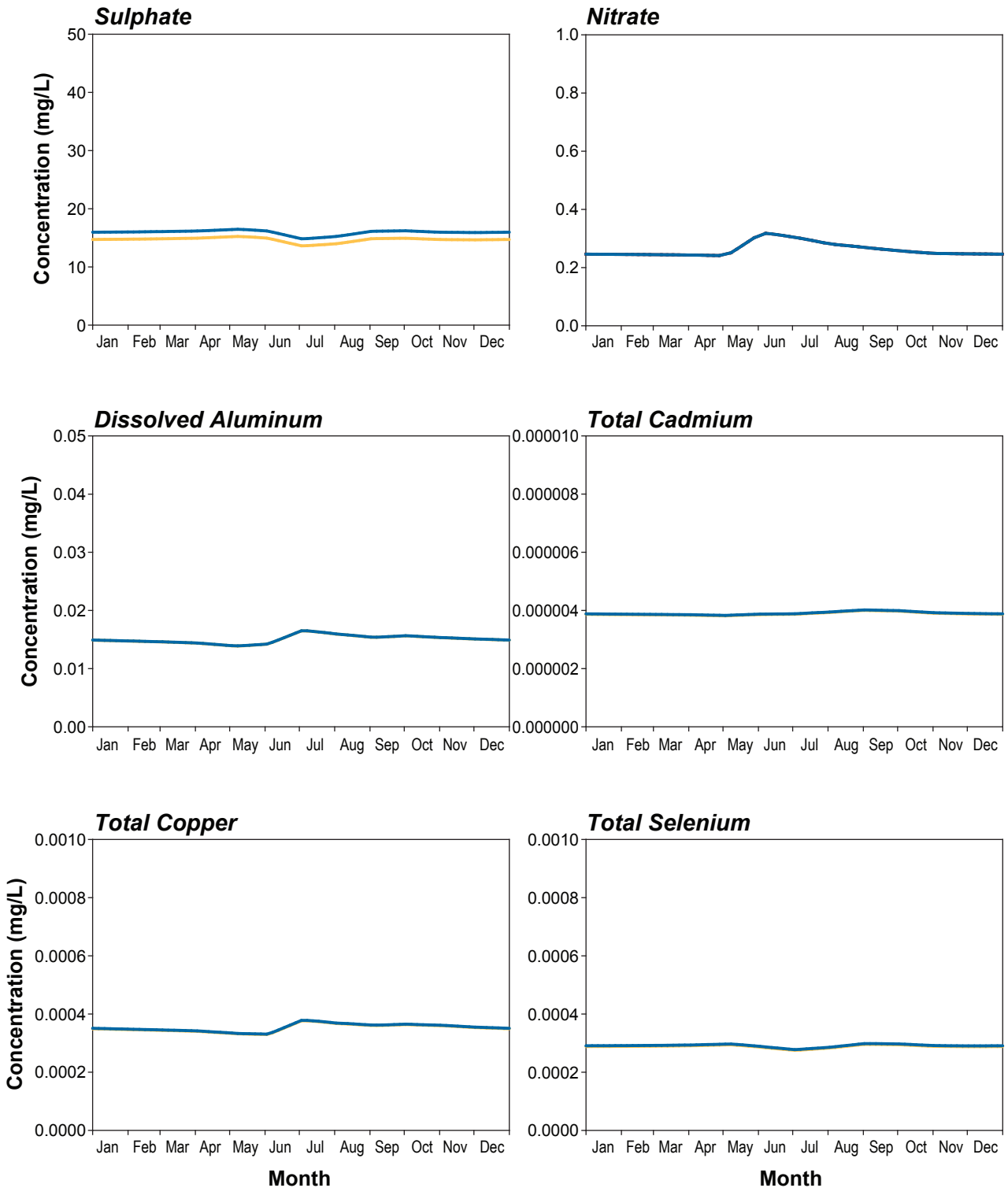
Note: All predicted concentrations in the expected and upper cases are equivalent.

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for Base Case Water Balance: South Cell TMF (Year 51.5)

Figure 14.7-14

Rescan™ Engineers & Scientists



Note: Predicted nitrate, dissolved aluminum, total cadmium, total copper and total selenium concentrations in the expected and upper cases are equivalent.

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for Base Case Water Balance: South Cell TMF (Year 65)

Figure 14.7-15

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Table 14.7-15. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0084	0.7824	0.1355	3.4058	2.4476	0.9089	1.16
Chloride (Cl)	0.11	29.62	11.17	159.89	96.81	35.15	1.19
Fluoride (F)	0.01	1.74	0.66	**9.42**	**5.70**	2.07	1.18
Nitrate (as N)	0.02	11.46	1.98	**63.20**	**38.73**	14.23	1.24
Nitrite (as N)	0.0033	0.1294	0.1222	0.2474	0.1995	0.0416	0.32
Total Phosphate (as P)	0.0001	0.0495	0.0348	0.1872	0.1259	0.0394	0.80
Sulphate (SO_4)	11	**453**	**189**	**2,278**	**1,402**	511	1.13
Cyanide-WAD	0.000004	**0.0106**	0.0076	**0.0464**	**0.0320**	0.0113	1.06
Total Metals							
Aluminum (Al)	0.01	*0.16*	0.07	*0.77*	*0.47*	0.16	0.99
Antimony (Sb)	0.00002	0.00090	0.00047	0.00338	0.00243	0.00093	1.04
Arsenic (As)	0.00003	**0.00859**	0.00331	**0.04585**	**0.02783**	0.01015	1.18
Barium (Ba)	0.003	0.083	0.035	0.411	0.253	0.089	1.07
Beryllium (Be)	0.00001	0.00026	0.00020	0.00068	0.00048	0.00013	0.49
Boron (B)	0.002	0.053	0.021	0.269	0.165	0.059	1.12
Cadmium (Cd)	0.0000004	0.0000174	0.0000095	0.0000629	0.0000412	0.0000143	0.8169144
Calcium (Ca)	5.17	116.49	61.84	300.00	300.00	116.70	1.00
Chromium (Cr)	0.00004	**0.00115**	0.00050	**0.00547**	**0.00338**	0.00117	1.02
Cobalt (Co)	0.00002	0.00078	0.00040	0.00317	0.00207	0.00082	1.05
Copper (Cu)	0.00001	0.00194	0.00135	0.00741	0.00514	0.00174	0.89
Iron (Fe)	0.0003	0.0287	0.0262	0.0589	0.0423	0.0075	0.26
Lead (Pb)	0.00001	0.00022	0.00009	0.00108	0.00066	0.00024	1.09
Lithium (Li)	0.0002	0.0068	0.0033	0.0287	0.0181	0.0062	0.90
Magnesium (Mg)	0.14	5.13	2.91	19.03	12.54	3.90	0.76
Manganese (Mn)	0.001	0.036	0.016	0.169	0.105	0.036	1.01
Mercury (Hg)	0.000002	0.000052	0.000021	0.000269	0.000164	0.000058	1.12
Molybdenum (Mo)	0.0002	0.0481	0.0195	0.2461	0.1507	0.0559	1.16
Nickel (Ni)	0.00004	0.00147	0.00076	0.00583	0.00373	0.00124	0.84
Potassium (K)	0.09	64.79	24.96	346.39	210.25	76.75	1.18
Selenium (Se)	0.0002	**0.0109**	**0.0046**	**0.0541**	**0.0334**	0.0123	1.13
Silicon (Si)	0.04	2.21	1.69	5.91	4.30	1.17	0.53
Silver (Ag)	0.000001	0.000025	0.000011	0.000112	0.000070	0.000025	1.01
Sodium (Na)	0.4	46.5	20.9	218.8	136.5	52.0	1.12
Strontium (Sr)	0.038	1.064	0.447	5.308	3.268	1.163	1.09
Thallium (Tl)	0.000002	0.000080	0.000048	0.000295	0.000190	0.000059	0.74
Tin (Sn)	0.00002	0.00490	0.00184	0.02658	0.01608	0.00583	1.19
Uranium (U)	0.000003	0.000103	0.000040	0.000537	0.000327	0.000117	1.14
Vanadium (V)	0.0002	0.0053	0.0021	0.0269	0.0165	0.0059	1.12
Zinc (Zn)	0.0002	0.0061	0.0028	0.0281	0.0177	0.0063	1.04

(continued)

Table 14.7-15. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0084	0.7824	0.1355	3.4058	2.4476	0.9089	1.16
Chloride (Cl)	0.11	29.62	11.17	159.89	96.81	35.15	1.19
Fluoride (F)	0.01	1.74	0.66	**9.42**	**5.70**	2.07	1.18
Nitrate (as N)	0.02	11.46	1.98	**63.20**	**38.73**	14.23	1.24
Nitrite (as N)	0.0033	0.1294	0.1222	0.2474	0.1995	0.0416	0.32
Total Phosphate (as P)	0.0001	0.0495	0.0348	0.1872	0.1259	0.0394	0.80
Sulphate (SO_4)	11	**454**	**189**	**2,278**	**1,402**	511	1.13
Cyanide-WAD	0.000004	**0.0106**	0.0076	**0.0464**	**0.0320**	0.0113	1.06
Total Metals							
Aluminum (Al)	0.01	*0.16*	0.07	*0.77*	*0.47*	0.16	0.99
Antimony (Sb)	0.00002	0.00090	0.00047	0.00338	0.00243	0.00093	1.03
Arsenic (As)	0.00003	**0.00859**	0.00331	**0.04585**	**0.02783**	0.01015	1.18
Barium (Ba)	0.003	0.083	0.035	0.411	0.253	0.089	1.07
Beryllium (Be)	0.00001	0.00026	0.00020	0.00068	0.00048	0.00013	0.49
Boron (B)	0.002	0.053	0.021	0.269	0.165	0.059	1.12
Cadmium (Cd)	0.0000004	0.0000175	0.0000095	0.0000629	0.0000412	0.0000142	0.82
Calcium (Ca)	5.17	116.56	62.01	300.00	300.00	116.74	1.00
Chromium (Cr)	0.00004	**0.00115**	0.00050	**0.00547**	**0.00338**	0.00117	1.02
Cobalt (Co)	0.00002	0.00078	0.00040	0.00317	0.00207	0.00082	1.05
Copper (Cu)	0.00001	0.00194	0.00135	0.00741	0.00514	0.00174	0.89
Iron (Fe)	0.0003	0.0287	0.0262	0.0589	0.0424	0.0075	0.26
Lead (Pb)	0.00001	0.00022	0.00009	0.00108	0.00066	0.00023	1.09
Lithium (Li)	0.0002	0.0068	0.0033	0.0287	0.0181	0.0062	0.90
Magnesium (Mg)	0.14	5.13	2.91	19.03	12.54	3.90	0.76
Manganese (Mn)	0.001	0.036	0.016	0.169	0.105	0.036	1.00
Mercury (Hg)	0.000002	0.000052	0.000021	0.000269	0.000164	0.000058	1.12
Molybdenum (Mo)	0.0002	0.0482	0.0195	0.2461	0.1507	0.0558	1.16
Nickel (Ni)	0.00004	0.00147	0.00077	0.00583	0.00373	0.00124	0.84
Potassium (K)	0.09	64.79	24.97	346.40	210.25	76.75	1.18
Selenium (Se)	0.0002	**0.0109**	**0.0046**	**0.0541**	**0.0334**	0.0123	1.13
Silicon (Si)	0.04	2.21	1.69	5.91	4.30	1.17	0.53
Silver (Ag)	0.000001	0.000025	0.000011	0.000112	0.000070	0.000025	1.01
Sodium (Na)	0.4	46.5	20.9	218.8	136.5	52.0	1.12
Strontium (Sr)	0.038	1.065	0.448	5.308	3.270	1.164	1.09
Thallium (Tl)	0.000002	0.000080	0.000048	0.000295	0.000190	0.000059	0.74
Tin (Sn)	0.00002	0.00490	0.00184	0.02658	0.01608	0.00583	1.19
Uranium (U)	0.000003	0.000103	0.000041	0.000537	0.000328	0.000117	1.13
Vanadium (V)	0.0002	0.0053	0.0021	0.0269	0.0165	0.0059	1.12
Zinc (Zn)	0.0002	0.0061	0.0028	0.0281	0.0177	0.0063	1.04

(continued)

Table 14.7-15. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0081	0.8322	0.1670	10.1924	2.4692	1.0182	1.22
Chloride (Cl)	0.11	33.64	12.34	277.37	109.17	41.06	1.22
Fluoride (F)	0.01	**1.98**	0.72	**16.36**	**6.43**	2.41	1.22
Nitrate (as N)	0.02	13.09	2.20	**110.32**	**44.03**	16.69	1.27
Nitrite (as N)	0.0033	0.1375	0.1310	0.3637	0.2086	0.0422	0.31
Total Phosphate (as P)	0.0001	0.0518	0.0406	0.1944	0.1244	0.0409	0.79
Sulphate (SO_4)	11	**510**	**209**	**3,885**	**1,578**	592	1.16
Cyanide-WAD	0.000000	**0.0112**	0.0089	**0.0488**	**0.0317**	0.0116	1.04
Total Metals							
Aluminum (Al)	0.01	*0.18*	0.08	*1.31*	*0.53*	0.19	1.04
Antimony (Sb)	0.00002	0.00098	0.00055	0.00511	0.00255	0.00103	1.04
Arsenic (As)	0.00003	**0.00974**	0.00365	**0.07924**	**0.03140**	0.01183	1.21
Barium (Ba)	0.003	0.093	0.038	0.709	0.285	0.104	1.11
Beryllium (Be)	0.00000	0.00027	0.00019	0.00108	0.00054	0.00015	0.54
Boron (B)	0.002	0.059	0.023	0.465	0.186	0.069	1.16
Cadmium (Cd)	0.0000004	0.0000190	0.0000104	**0.0001003**	0.0000463	0.0000163	0.86
Calcium (Ca)	5.16	122.50	70.30	300.00	300.00	121.20	0.99
Chromium (Cr)	0.00004	**0.00129**	0.00054	**0.00939**	**0.00381**	0.00137	1.06
Cobalt (Co)	0.00002	0.00086	0.00045	0.00497	0.00231	0.00092	1.06
Copper (Cu)	0.00001	0.00205	0.00157	0.00771	0.00512	0.00181	0.88
Iron (Fe)	0.0003	0.0296	0.0259	0.0773	0.0435	0.0084	0.28
Lead (Pb)	0.00001	0.00024	0.00010	0.00187	0.00075	0.00027	1.13
Lithium (Li)	0.0002	0.0075	0.0036	0.0481	0.0204	0.0072	0.95
Magnesium (Mg)	0.14	5.56	3.07	31.67	13.91	4.53	0.82
Manganese (Mn)	0.001	0.040	0.017	0.288	0.117	0.042	1.05
Mercury (Hg)	0.000002	0.000059	0.000023	0.000465	0.000185	0.000068	1.16
Molybdenum (Mo)	0.0001	0.0543	0.0220	0.4190	0.1700	0.0646	1.19
Nickel (Ni)	0.00004	0.00161	0.00082	0.00969	0.00419	0.00144	0.89
Potassium (K)	0.08	73.50	27.53	598.59	237.18	89.43	1.22
Selenium (Se)	0.0002	**0.0123**	**0.0051**	**0.0917**	**0.0376**	0.0142	1.16
Silicon (Si)	0.04	2.34	1.71	9.39	4.73	1.35	0.58
Silver (Ag)	0.000001	0.000027	0.000012	0.000190	0.000079	0.000029	1.05
Sodium (Na)	0.4	52.0	23.2	362.4	154.4	59.4	1.14
Strontium (Sr)	0.038	1.195	0.485	9.116	3.677	1.355	1.13
Thallium (Tl)	0.000002	0.000087	0.000049	**0.000492**	0.000215	0.000070	0.80
Tin (Sn)	0.00002	0.00557	0.00203	0.04618	0.01813	0.00681	1.22
Uranium (U)	0.000003	0.000116	0.000044	0.000930	0.000368	0.000137	1.18
Vanadium (V)	0.0002	0.0059	0.0023	0.0465	0.0186	0.0069	1.16
Zinc (Zn)	0.0002	0.0068	0.0031	0.0475	0.0198	0.0073	1.08

(continued)

Table 14.7-15. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0081	0.8322	0.1670	10.1924	2.4692	1.0182	1.22
Chloride (Cl)	0.11	33.64	12.34	277.37	109.17	41.06	1.22
Fluoride (F)	0.01	**1.98**	0.72	**16.36**	**6.43**	2.41	1.22
Nitrate (as N)	0.02	13.09	2.20	**110.32**	**44.03**	16.69	1.27
Nitrite (as N)	0.0033	0.1375	0.1310	0.3637	0.2086	0.0422	0.31
Total Phosphate (as P)	0.0001	0.0518	0.0406	0.1944	0.1244	0.0409	0.79
Sulphate (SO_4)	11	**511**	**210**	**3,885**	**1,579**	592	1.16
Cyanide-WAD	0.000000	**0.0112**	0.0089	**0.0488**	**0.0317**	0.0116	1.04
Total Metals							
Aluminum (Al)	0.01	*0.18*	0.08	*1.31*	*0.53*	0.19	1.04
Antimony (Sb)	0.00002	0.00099	0.00055	0.00511	0.00255	0.00102	1.04
Arsenic (As)	0.00003	**0.00974**	0.00365	**0.07924**	**0.03140**	0.01183	1.21
Barium (Ba)	0.003	0.093	0.038	0.709	0.285	0.104	1.11
Beryllium (Be)	0.00000	0.00027	0.00019	0.00108	0.00054	0.00015	0.54
Boron (B)	0.002	0.059	0.023	0.465	0.186	0.069	1.16
Cadmium (Cd)	0.0000004	0.0000190	0.0000104	**0.0001004**	0.0000463	0.0000163	0.86
Calcium (Ca)	5.16	122.57	70.32	300.00	300.00	121.24	0.99
Chromium (Cr)	0.00004	**0.00129**	0.00054	**0.00939**	**0.00381**	0.00137	1.06
Cobalt (Co)	0.00002	0.00086	0.00045	0.00497	0.00231	0.00092	1.06
Copper (Cu)	0.00001	0.00205	0.00157	0.00771	0.00512	0.00181	0.88
Iron (Fe)	0.0003	0.0296	0.0259	0.0774	0.0435	0.0084	0.28
Lead (Pb)	0.00001	0.00024	0.00010	0.00187	0.00075	0.00027	1.13
Lithium (Li)	0.0002	0.0075	0.0036	0.0481	0.0204	0.0072	0.95
Magnesium (Mg)	0.14	5.56	3.07	31.67	13.91	4.53	0.82
Manganese (Mn)	0.001	0.040	0.017	0.288	0.117	0.042	1.05
Mercury (Hg)	0.000002	0.000059	0.000023	0.000465	0.000185	0.000068	1.16
Molybdenum (Mo)	0.0002	0.0544	0.0220	0.4191	0.1700	0.0646	1.19
Nickel (Ni)	0.00004	0.00161	0.00082	0.00969	0.00420	0.00144	0.89
Potassium (K)	0.09	73.51	27.54	598.60	237.19	89.43	1.22
Selenium (Se)	0.0002	**0.0123**	**0.0051**	**0.0917**	**0.0376**	0.0142	1.16
Silicon (Si)	0.04	2.34	1.71	9.39	4.73	1.35	0.58
Silver (Ag)	0.000001	0.000027	0.000012	0.000190	0.000079	0.000029	1.05
Sodium (Na)	0.4	52.0	23.2	362.4	154.4	59.4	1.14
Strontium (Sr)	0.038	1.196	0.487	9.117	3.679	1.356	1.13
Thallium (Tl)	0.000002	0.000087	0.000049	**0.000492**	0.000215	0.000070	0.80
Tin (Sn)	0.00002	0.00557	0.00203	0.04618	0.01813	0.00681	1.22
Uranium (U)	0.000003	0.000117	0.000044	0.000931	0.000370	0.000137	1.17
Vanadium (V)	0.0002	0.0059	0.0023	0.0465	0.0186	0.0069	1.16
Zinc (Zn)	0.0002	0.0068	0.0031	0.0475	0.0198	0.0073	1.08

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-16. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0014	0.0006	0.0127	0.0069	0.0024	1.74
Chloride (Cl)	0.17	0.17	0.17	0.18	0.18	0.003	0.01
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0004	0.03
Nitrate (as N)	0.02	0.03	0.02	0.05	0.04	0.01	0.32
Nitrite (as N)	0.0014	0.0267	0.0096	0.1474	0.0933	0.032168	1.20
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.01	0.002	0.16
Sulphate (SO_4)	14	17	18	19	19	2	0.09
Cyanide-WAD	0.0003	0.0003	0.0003	0.0004	0.0004	0.00001	0.03
Total Metals							
Aluminum (Al)	0.02	0.03	0.03	0.03	0.03	0.0022	0.08
Antimony (Sb)	0.00004	0.00004	0.00004	0.00004	0.00004	0.000002	0.04
Arsenic (As)	0.00004	0.00004	0.00004	0.00004	0.00004	0.000001	0.02
Barium (Ba)	0.008	0.009	0.009	0.009	0.009	0.00042	0.05
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.03
Boron (B)	0.003	0.003	0.003	0.004	0.004	0.00005	0.01
Cadmium (Cd)	0.0000047	0.0000049	0.0000048	0.0000052	0.0000051	0.0000001	0.03
Calcium (Ca)	7.12	8.40	8.56	9.29	9.25	0.64	0.08
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.02
Cobalt (Co)	0.00003	0.00003	0.00003	0.00004	0.00004	0.0000005	0.01
Copper (Cu)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00003	0.09
Iron (Fe)	0.02	0.02	0.02	0.03	0.03	0.001	0.03
Lead (Pb)	0.00002	0.00002	0.00002	0.00002	0.00002	0.000001	0.04
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00004	0.02
Magnesium (Mg)	1.55	1.83	1.86	2.00	2.00	0.14	0.08
Manganese (Mn)	0.004	0.006	0.006	0.006	0.006	0.00059	0.11
Mercury (Hg)	0.000003	0.000003	0.000003	0.000004	0.000004	0.0000001	0.01
Molybdenum (Mo)	0.0002	0.0002	0.0002	0.0002	0.0002	0.00001	0.04
Nickel (Ni)	0.0004	0.0004	0.0004	0.0005	0.0004	0.00001	0.03
Potassium (K)	0.13	0.13	0.13	0.14	0.14	0.003	0.02
Selenium (Se)	0.0003	0.0003	0.0003	0.0003	0.0003	0.00002	0.07
Silicon (Si)	1.18	1.21	1.21	1.27	1.25	0.02	0.02
Silver (Ag)	0.000003	0.000003	0.000003	0.000004	0.000004	0.0000001	0.01
Sodium (Na)	0.7	0.7	0.7	0.7	0.7	0.01	0.02
Strontium (Sr)	0.069	0.082	0.083	0.090	0.090	0.006	0.08
Thallium (Tl)	0.000030	0.000031	0.000030	0.000033	0.000032	0.000001	0.03
Tin (Sn)	0.00003	0.00003	0.00003	0.00004	0.00004	0.000001	0.01
Uranium (U)	0.000004	0.000004	0.000004	0.000005	0.000005	0.0000002	0.05
Vanadium (V)	0.0003	0.0003	0.0003	0.0004	0.0004	0.00001	0.01
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00003	0.05

(continued)

Table 14.7-16. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0014	0.0006	0.0127	0.0069	0.0024	1.74
Chloride (Cl)	0.17	0.17	0.17	0.18	0.18	0.003	0.01
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0004	0.03
Nitrate (as N)	0.02	0.03	0.02	0.05	0.04	0.01	0.32
Nitrite (as N)	0.0014	0.0267	0.0096	0.1474	0.0933	0.032168	1.20
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.01	0.002	0.16
Sulphate (SO_4)	14	17	18	19	19	2	0.09
Cyanide-WAD	0.0003	0.0003	0.0003	0.0004	0.0004	0.00001	0.03
Total Metals							
Aluminum (Al)	0.03	0.03	0.03	0.03	0.03	0.0022	0.08
Antimony (Sb)	0.00005	0.00005	0.00005	0.00005	0.00005	0.000002	0.03
Arsenic (As)	0.00004	0.00004	0.00004	0.00004	0.00004	0.000001	0.02
Barium (Ba)	0.008	0.009	0.009	0.009	0.009	0.00042	0.05
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.03
Boron (B)	0.003	0.003	0.003	0.004	0.004	0.00005	0.01
Cadmium (Cd)	0.0000047	0.0000049	0.0000049	0.0000052	0.0000051	0.0000001	0.03
Calcium (Ca)	7.14	8.41	8.57	9.30	9.26	0.64	0.08
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.02
Cobalt (Co)	0.00003	0.00003	0.00003	0.00004	0.00004	0.0000005	0.01
Copper (Cu)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00003	0.09
Iron (Fe)	0.02	0.02	0.02	0.03	0.03	0.001	0.03
Lead (Pb)	0.00002	0.00002	0.00002	0.00002	0.00002	0.000001	0.04
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00004	0.02
Magnesium (Mg)	1.55	1.83	1.86	2.00	2.00	0.14	0.08
Manganese (Mn)	0.004	0.006	0.006	0.006	0.006	0.00059	0.11
Mercury (Hg)	0.000003	0.000003	0.000003	0.000004	0.000004	0.0000001	0.01
Molybdenum (Mo)	0.0003	0.0003	0.0003	0.0003	0.0003	0.00001	0.04
Nickel (Ni)	0.0004	0.0004	0.0004	0.0005	0.0004	0.00001	0.03
Potassium (K)	0.13	0.14	0.14	0.14	0.14	0.003	0.02
Selenium (Se)	0.0003	0.0003	0.0003	0.0003	0.0003	0.00002	0.07
Silicon (Si)	1.18	1.22	1.21	1.27	1.26	0.02	0.02
Silver (Ag)	0.000003	0.000003	0.000003	0.000004	0.000004	0.0000001	0.01
Sodium (Na)	0.7	0.7	0.7	0.7	0.7	0.01	0.02
Strontium (Sr)	0.070	0.082	0.083	0.090	0.090	0.006	0.08
Thallium (Tl)	0.000030	0.000031	0.000030	0.000033	0.000032	0.000001	0.03
Tin (Sn)	0.00003	0.00003	0.00003	0.00004	0.00004	0.000001	0.01
Uranium (U)	0.000005	0.000005	0.000005	0.000006	0.000005	0.0000002	0.05
Vanadium (V)	0.0003	0.0003	0.0003	0.0004	0.0004	0.00001	0.01
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00003	0.05

(continued)

Table 14.7-16. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0014	0.0006	0.0134	0.0076	0.0026	1.83
Chloride (Cl)	0.17	0.18	0.18	0.18	0.18	0.003	0.01
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0003	0.02
Nitrate (as N)	0.02	0.03	0.02	0.05	0.04	0.01	0.26
Nitrite (as N)	0.0033	0.0393	0.0194	0.1785	0.1209	0.040383	1.03
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.02	0.002	0.16
Sulphate (SO_4)	14	17	18	19	19	1	0.08
Cyanide-WAD	0.0003	0.0004	0.0004	0.0004	0.0004	0.00001	0.03
Total Metals							
Aluminum (Al)	0.03	0.03	0.03	0.03	0.03	0.0019	0.07
Antimony (Sb)	0.00004	0.00004	0.00004	0.00005	0.00005	0.000001	0.03
Arsenic (As)	0.00004	0.00004	0.00004	0.00004	0.00004	0.000001	0.02
Barium (Ba)	0.008	0.009	0.009	0.009	0.009	0.00035	0.04
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.02
Boron (B)	0.003	0.004	0.004	0.004	0.004	0.00005	0.01
Cadmium (Cd)	0.0000048	0.0000050	0.0000050	0.0000053	0.0000052	0.0000001	0.03
Calcium (Ca)	7.41	8.53	8.66	9.35	9.24	0.54	0.06
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.02
Cobalt (Co)	0.00004	0.00004	0.00004	0.00004	0.00004	0.0000005	0.01
Copper (Cu)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00003	0.08
Iron (Fe)	0.02	0.02	0.02	0.03	0.03	0.001	0.03
Lead (Pb)	0.00002	0.00002	0.00002	0.00002	0.00002	0.000001	0.04
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00003	0.02
Magnesium (Mg)	1.61	1.85	1.88	2.02	2.00	0.12	0.06
Manganese (Mn)	0.005	0.006	0.006	0.006	0.006	0.00049	0.09
Mercury (Hg)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000001	0.01
Molybdenum (Mo)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00001	0.04
Nickel (Ni)	0.0004	0.0004	0.0004	0.0005	0.0005	0.00001	0.03
Potassium (K)	0.13	0.14	0.14	0.14	0.14	0.003	0.02
Selenium (Se)	0.0003	0.0003	0.0003	0.0003	0.0003	0.00002	0.06
Silicon (Si)	1.21	1.24	1.24	1.29	1.28	0.02	0.01
Silver (Ag)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000001	0.01
Sodium (Na)	0.7	0.7	0.7	0.7	0.7	0.01	0.01
Strontium (Sr)	0.072	0.083	0.084	0.091	0.090	0.005	0.06
Thallium (Tl)	0.000031	0.000032	0.000031	0.000033	0.000033	0.000001	0.02
Tin (Sn)	0.00003	0.00004	0.00004	0.00004	0.00004	0.000001	0.01
Uranium (U)	0.000004	0.000005	0.000005	0.000006	0.000005	0.0000003	0.06
Vanadium (V)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00001	0.01
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00003	0.05

(continued)

Table 14.7-16. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0014	0.0006	0.0134	0.0076	0.0026	1.83
Chloride (Cl)	0.17	0.18	0.18	0.18	0.18	0.003	0.01
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0003	0.02
Nitrate (as N)	0.02	0.03	0.02	0.05	0.04	0.01	0.26
Nitrite (as N)	0.0033	0.0393	0.0194	0.1785	0.1209	0.040383	1.03
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.02	0.002	0.16
Sulphate (SO_4)	15	17	18	19	19	1	0.08
Cyanide-WAD	0.0003	0.0004	0.0004	0.0004	0.0004	0.00001	0.03
Total Metals							
Aluminum (Al)	0.03	0.03	0.03	0.03	0.03	0.0019	0.07
Antimony (Sb)	0.00005	0.00005	0.00005	0.00005	0.00005	0.000001	0.03
Arsenic (As)	0.00004	0.00004	0.00004	0.00004	0.00004	0.000001	0.02
Barium (Ba)	0.008	0.009	0.009	0.010	0.010	0.00035	0.04
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.02
Boron (B)	0.003	0.004	0.004	0.004	0.004	0.00005	0.01
Cadmium (Cd)	0.0000048	0.0000050	0.0000050	0.0000053	0.0000052	0.0000001	0.03
Calcium (Ca)	7.42	8.55	8.67	9.36	9.25	0.54	0.06
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000004	0.02
Cobalt (Co)	0.00004	0.00004	0.00004	0.00004	0.00004	0.0000005	0.01
Copper (Cu)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00003	0.08
Iron (Fe)	0.02	0.02	0.02	0.03	0.03	0.001	0.03
Lead (Pb)	0.00002	0.00002	0.00002	0.00002	0.00002	0.000001	0.04
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00003	0.02
Magnesium (Mg)	1.61	1.86	1.89	2.02	2.00	0.12	0.06
Manganese (Mn)	0.005	0.006	0.006	0.006	0.006	0.00049	0.09
Mercury (Hg)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000001	0.01
Molybdenum (Mo)	0.0003	0.0003	0.0003	0.0003	0.0003	0.00001	0.03
Nickel (Ni)	0.0004	0.0004	0.0004	0.0005	0.0005	0.00001	0.03
Potassium (K)	0.13	0.14	0.14	0.14	0.14	0.003	0.02
Selenium (Se)	0.0003	0.0003	0.0003	0.0003	0.0003	0.00002	0.06
Silicon (Si)	1.21	1.24	1.24	1.29	1.28	0.02	0.01
Silver (Ag)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000001	0.01
Sodium (Na)	0.7	0.7	0.7	0.7	0.7	0.01	0.01
Strontium (Sr)	0.073	0.083	0.084	0.091	0.090	0.005	0.06
Thallium (Tl)	0.000031	0.000032	0.000031	0.000033	0.000033	0.000001	0.02
Tin (Sn)	0.00003	0.00004	0.00004	0.00004	0.00004	0.000001	0.01
Uranium (U)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.05
Vanadium (V)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00001	0.01
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00003	0.05

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-17. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0009	0.0009	0.0017	0.0016	0.0004	0.44
Chloride (Cl)	0.17	0.21	0.21	0.21	0.21	0.008	0.04
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0014	0.07
Nitrate (as N)	0.01	0.03	0.02	0.07	0.07	0.02	0.63
Nitrite (as N)	0.0004	0.0005	0.0005	0.0013	0.0005	0.000052	0.11
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.02	0.002	0.20
Sulphate (SO_4)	14	22	23	27	27	4	0.17
Cyanide-WAD	0.0003	0.0004	0.0004	0.0005	0.0005	0.0000	0.06
Total Metals							
Aluminum (Al)	0.02	0.03	0.03	0.04	0.04	0.0045	0.14
Antimony (Sb)	0.00004	0.00005	0.00005	0.00005	0.00005	0.000003	0.07
Arsenic (As)	0.00004	0.00005	0.00005	0.00005	0.00005	0.000002	0.04
Barium (Ba)	0.008	0.011	0.011	0.012	0.012	0.00108	0.10
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000010	0.05
Boron (B)	0.003	0.004	0.004	0.004	0.004	0.00017	0.04
Cadmium (Cd)	0.0000047	0.0000058	0.0000057	0.0000065	0.0000063	0.0000003	0.06
Calcium (Ca)	7.12	10.68	11.07	12.81	12.77	1.54	0.14
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000010	0.05
Cobalt (Co)	0.00003	0.00004	0.00004	0.00004	0.00004	0.0000017	0.04
Copper (Cu)	0.0003	0.0004	0.0004	0.0006	0.0006	0.00007	0.16
Iron (Fe)	0.02	0.03	0.03	0.03	0.03	0.002	0.07
Lead (Pb)	0.00002	0.00002	0.00002	0.00003	0.00003	0.000002	0.08
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00009	0.05
Magnesium (Mg)	1.55	2.33	2.41	2.76	2.75	0.33	0.14
Manganese (Mn)	0.004	0.007	0.008	0.009	0.009	0.00140	0.19
Mercury (Hg)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Molybdenum (Mo)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00002	0.09
Nickel (Ni)	0.0004	0.0005	0.0005	0.0006	0.0006	0.00004	0.08
Potassium (K)	0.13	0.16	0.17	0.18	0.17	0.011	0.07
Selenium (Se)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00005	0.12
Silicon (Si)	1.18	1.48	1.49	1.64	1.61	0.09	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Sodium (Na)	0.7	0.8	0.9	0.9	0.9	0.04	0.05
Strontium (Sr)	0.069	0.104	0.106	0.124	0.123	0.015	0.14
Thallium (Tl)	0.000030	0.000036	0.000036	0.000041	0.000041	0.000002	0.06
Tin (Sn)	0.00003	0.00004	0.00004	0.00004	0.00004	0.000002	0.04
Uranium (U)	0.000004	0.000005	0.000005	0.000005	0.000005	0.0000001	0.02
Vanadium (V)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00002	0.04
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00008	0.10

(continued)

Table 14.7-17. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0009	0.0009	0.0017	0.0016	0.0004	0.44
Chloride (Cl)	0.17	0.21	0.21	0.21	0.21	0.008	0.04
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0013	0.07
Nitrate (as N)	0.01	0.03	0.02	0.07	0.07	0.02	0.63
Nitrite (as N)	0.0004	0.0005	0.0005	0.0013	0.0005	0.000052	0.11
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.02	0.002	0.20
Sulphate (SO_4)	14	22	23	27	27	4	0.17
Cyanide-WAD	0.0003	0.0004	0.0004	0.0005	0.0005	0.00003	0.064
Total Metals							
Aluminum (Al)	0.02	0.03	0.03	0.04	0.04	0.0045	0.14
Antimony (Sb)	0.00005	0.00005	0.00005	0.00006	0.00006	0.000003	0.06
Arsenic (As)	0.00004	0.00005	0.00005	0.00005	0.00005	0.000002	0.04
Barium (Ba)	0.008	0.011	0.011	0.012	0.012	0.00107	0.10
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000010	0.05
Boron (B)	0.003	0.004	0.004	0.004	0.004	0.00016	0.04
Cadmium (Cd)	0.0000047	0.0000058	0.0000058	0.0000065	0.0000063	0.0000003	0.06
Calcium (Ca)	7.14	10.69	11.07	12.82	12.77	1.54	0.14
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000011	0.05
Cobalt (Co)	0.00003	0.00004	0.00004	0.00004	0.00004	0.0000017	0.04
Copper (Cu)	0.0003	0.0004	0.0004	0.0006	0.0006	0.00007	0.16
Iron (Fe)	0.02	0.03	0.03	0.03	0.03	0.002	0.07
Lead (Pb)	0.00002	0.00002	0.00002	0.00003	0.00003	0.000002	0.08
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00009	0.05
Magnesium (Mg)	1.55	2.33	2.41	2.76	2.75	0.33	0.14
Manganese (Mn)	0.004	0.007	0.008	0.009	0.009	0.00140	0.19
Mercury (Hg)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00002	0.08
Nickel (Ni)	0.0004	0.0005	0.0005	0.0006	0.0006	0.00004	0.08
Potassium (K)	0.13	0.16	0.17	0.18	0.18	0.010	0.06
Selenium (Se)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00005	0.12
Silicon (Si)	1.18	1.48	1.49	1.64	1.61	0.09	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Sodium (Na)	0.7	0.8	0.9	0.9	0.9	0.04	0.05
Strontium (Sr)	0.070	0.104	0.106	0.124	0.124	0.015	0.14
Thallium (Tl)	0.000030	0.000036	0.000036	0.000041	0.000041	0.000002	0.06
Tin (Sn)	0.00003	0.00004	0.00004	0.00004	0.00004	0.000002	0.04
Uranium (U)	0.000004	0.000005	0.000005	0.000005	0.000005	0.0000001	0.02
Vanadium (V)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00002	0.04
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00008	0.10

(continued)

Table 14.7-17. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0009	0.0009	0.0021	0.0016	0.0004	0.45
Chloride (Cl)	0.17	0.21	0.21	0.22	0.21	0.008	0.04
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0014	0.07
Nitrate (as N)	0.01	0.03	0.02	0.09	0.07	0.02	0.63
Nitrite (as N)	0.0004	0.0005	0.0005	0.0029	0.0005	0.000151	0.31
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.02	0.002	0.21
Sulphate (SO_4)	14	22	23	28	27	4	0.17
Cyanide-WAD	0.0003	0.0004	0.0004	0.0005	0.0005	0.00003	0.06
Total Metals							
Aluminum (Al)	0.02	0.03	0.03	0.04	0.04	0.0045	0.14
Antimony (Sb)	0.00004	0.00005	0.00005	0.00006	0.00005	0.000003	0.07
Arsenic (As)	0.00004	0.00005	0.00005	0.00005	0.00005	0.000002	0.04
Barium (Ba)	0.008	0.011	0.011	0.012	0.012	0.00108	0.10
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000010	0.06
Boron (B)	0.003	0.004	0.004	0.004	0.004	0.00017	0.04
Cadmium (Cd)	0.0000047	0.0000058	0.0000058	0.0000066	0.0000063	0.0000003	0.06
Calcium (Ca)	7.13	10.70	11.08	13.22	12.74	1.55	0.14
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000011	0.05
Cobalt (Co)	0.00003	0.00004	0.00004	0.00005	0.00004	0.0000017	0.04
Copper (Cu)	0.0003	0.0004	0.0004	0.0006	0.0006	0.00007	0.16
Iron (Fe)	0.02	0.03	0.03	0.03	0.03	0.002	0.07
Lead (Pb)	0.00002	0.00002	0.00002	0.00003	0.00003	0.000002	0.08
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00010	0.05
Magnesium (Mg)	1.55	2.33	2.41	2.86	2.76	0.33	0.14
Manganese (Mn)	0.004	0.007	0.008	0.009	0.009	0.00141	0.20
Mercury (Hg)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Molybdenum (Mo)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00002	0.09
Nickel (Ni)	0.0004	0.0005	0.0005	0.0006	0.0006	0.00004	0.08
Potassium (K)	0.13	0.16	0.17	0.18	0.17	0.011	0.07
Selenium (Se)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00005	0.12
Silicon (Si)	1.18	1.48	1.49	1.68	1.61	0.09	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Sodium (Na)	0.7	0.8	0.9	0.9	0.9	0.04	0.05
Strontium (Sr)	0.070	0.104	0.107	0.129	0.124	0.015	0.14
Thallium (Tl)	0.000030	0.000036	0.000036	0.000041	0.000041	0.000002	0.06
Tin (Sn)	0.00003	0.00004	0.00004	0.00004	0.00004	0.000002	0.04
Uranium (U)	0.000004	0.000005	0.000005	0.000005	0.000005	0.0000001	0.03
Vanadium (V)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00002	0.04
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00008	0.10

(continued)

Table 14.7-17. Summary Statistics of Water Quality Predictions for the North Cell Tailing Management Facility (Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0002	0.0009	0.0009	0.0021	0.0016	0.0004	0.45
Chloride (Cl)	0.17	0.21	0.21	0.22	0.21	0.008	0.04
Fluoride (F)	0.02	0.02	0.02	0.02	0.02	0.0014	0.07
Nitrate (as N)	0.01	0.03	0.02	0.09	0.07	0.02	0.63
Nitrite (as N)	0.0004	0.0005	0.0005	0.0029	0.0005	0.000151	0.31
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.02	0.002	0.21
Sulphate (SO_4)	14	22	23	28	27	4	0.17
Cyanide-WAD	0.0003	0.0004	0.0004	0.0005	0.0005	0.00003	0.06
Total Metals							
Aluminum (Al)	0.02	0.03	0.03	0.04	0.04	0.0045	0.14
Antimony (Sb)	0.00004	0.00005	0.00005	0.00006	0.00006	0.000003	0.06
Arsenic (As)	0.00004	0.00005	0.00005	0.00005	0.00005	0.000002	0.04
Barium (Ba)	0.008	0.011	0.011	0.012	0.012	0.00107	0.10
Beryllium (Be)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000010	0.06
Boron (B)	0.003	0.004	0.004	0.004	0.004	0.00017	0.04
Cadmium (Cd)	0.0000047	0.0000058	0.0000058	0.0000066	0.0000063	0.0000003	0.06
Calcium (Ca)	7.14	10.70	11.09	13.23	12.75	1.55	0.14
Chromium (Cr)	0.0002	0.0002	0.0002	0.0002	0.0002	0.000011	0.05
Cobalt (Co)	0.00003	0.00004	0.00004	0.00005	0.00004	0.0000017	0.04
Copper (Cu)	0.0003	0.0004	0.0004	0.0006	0.0006	0.00007	0.16
Iron (Fe)	0.02	0.03	0.03	0.03	0.03	0.002	0.07
Lead (Pb)	0.00002	0.00002	0.00002	0.00003	0.00003	0.000002	0.08
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.00010	0.05
Magnesium (Mg)	1.55	2.33	2.41	2.86	2.76	0.33	0.14
Manganese (Mn)	0.004	0.007	0.008	0.009	0.009	0.00141	0.20
Mercury (Hg)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00002	0.08
Nickel (Ni)	0.0004	0.0005	0.0005	0.0006	0.0006	0.00004	0.08
Potassium (K)	0.13	0.16	0.17	0.18	0.18	0.011	0.06
Selenium (Se)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00005	0.12
Silicon (Si)	1.18	1.48	1.50	1.68	1.61	0.09	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000004	0.000004	0.0000002	0.04
Sodium (Na)	0.7	0.8	0.9	0.9	0.9	0.04	0.05
Strontium (Sr)	0.070	0.104	0.107	0.129	0.124	0.015	0.14
Thallium (Tl)	0.000030	0.000036	0.000036	0.000041	0.000041	0.000002	0.06
Tin (Sn)	0.00003	0.00004	0.00004	0.00004	0.00004	0.000002	0.04
Uranium (U)	0.000004	0.000005	0.000005	0.000005	0.000005	0.0000001	0.03
Vanadium (V)	0.0003	0.0004	0.0004	0.0004	0.0004	0.00002	0.04
Zinc (Zn)	0.001	0.001	0.001	0.001	0.001	0.00008	0.10

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-18. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.081	1.54	1.74	2.33	2.25	0.66	0.43
Chloride (Cl)	7.20	74.03	73.30	125.25	118.18	27.19	0.37
Fluoride (F)	0.42	**4.34**	**4.28**	**7.36**	**6.95**	1.60	0.37
Nitrate (as N)	1.06	**34.15**	**35.64**	**60.85**	**57.27**	15.96	0.47
Nitrite (as N)	0.0011	0.0039	0.0041	0.0058	0.0052	0.0009	0.24
Total Phosphate (as P)	0.03	0.13	0.14	0.20	0.18	0.03	0.25
Sulphate (SO_4)	**122**	**1,134**	**1,151**	**1,835**	**1,739**	388	0.34
Cyanide-WAD	0.0076	**0.0360**	**0.0382**	**0.0547**	**0.0487**	0.0094	0.26
Total Metals							
Aluminum (Al)	0.036	*0.35*	*0.35*	*0.59*	*0.56*	0.13	0.36
Antimony (Sb)	0.0004	0.0025	0.0028	0.0033	0.0032	0.0007	0.27
Arsenic (As)	0.0022	**0.0216**	**0.0216**	**0.0362**	**0.0342**	0.0078	0.36
Barium (Ba)	0.019	0.194	0.192	0.323	0.306	0.069	0.35
Beryllium (Be)	0.0001	0.0004	0.0004	0.0006	0.0005	0.0001	0.25
Boron (B)	0.013	0.126	0.125	0.211	0.200	0.045	0.36
Cadmium (Cd)	0.0000050	0.0000375	0.0000391	0.0000537	0.0000518	0.0000105	0.28
Calcium (Ca)	38.34	256.55	278.76	300.00	300.00	57.01	0.22
Chromium (Cr)	0.0003	**0.0026**	**0.0026**	**0.0043**	**0.0041**	0.0009	0.35
Cobalt (Co)	0.0003	0.00215	0.00232	0.00296	0.00285	0.00060	0.28
Copper (Cu)	0.0011	0.0056	0.0060	0.0082	0.0073	0.0014	0.25
Iron (Fe)	0.003	0.02	0.02	0.03	0.03	0.00	0.20
Lead (Pb)	0.00005	0.00051	0.00051	0.00085	0.00081	0.00018	0.36
Lithium (Li)	0.002	0.015	0.015	0.023	0.022	0.005	0.32
Magnesium (Mg)	1.10	9.82	9.86	15.09	14.50	2.93	0.30
Manganese (Mn)	0.0079	0.0782	0.0780	0.1300	0.1230	0.0279	0.36
Mercury (Hg)	0.00001	0.00013	0.00012	0.00021	0.00020	0.00005	0.36
Molybdenum (Mo)	0.014	0.124	0.127	0.200	0.189	0.0424	0.34
Nickel (Ni)	0.0004	0.0030	0.0030	0.0047	0.0045	0.0009	0.31
Potassium (K)	16.37	163.55	163.16	273.62	258.35	59.08	0.36
Selenium (Se)	**0.0031**	**0.0278**	**0.0285**	**0.0443**	**0.0420**	0.0093	0.33
Silicon (Si)	0.53	3.91	3.94	5.44	5.17	0.83	0.21
Silver (Ag)	0.000007	0.000058	0.000059	0.000091	0.000087	0.000019	0.33
Sodium (Na)	15.4	123.7	128.8	187.0	178.4	38.6	0.31
Strontium (Sr)	0.262	2.557	2.556	4.206	3.989	0.892	0.35
Thallium (Tl)	0.00002	0.00015	0.00015	0.00023	0.00022	0.00005	0.31
Tin (Sn)	0.0012	0.01221	0.01204	0.02075	0.01957	0.00452	0.37
Uranium (U)	0.00002	0.0002	0.0002	0.0004	0.0004	0.0001	0.36
Vanadium (V)	0.0013	0.0126	0.0125	0.0211	0.0200	0.0045	0.36
Zinc (Zn)	0.002	0.015	0.015	0.023	0.022	0.005	0.32

(continued)

Table 14.7-18. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.081	1.54	1.74	2.33	2.25	0.66	0.43
Chloride (Cl)	7.20	74.03	73.30	125.25	118.18	27.19	0.37
Fluoride (F)	0.42	**4.34**	**4.28**	**7.36**	**6.95**	1.60	0.37
Nitrate (as N)	1.06	**34.15**	**35.64**	**60.85**	**57.27**	15.96	0.47
Nitrite (as N)	0.0011	0.0039	0.0041	0.0058	0.0052	0.0009	0.24
Total Phosphate (as P)	0.03	0.13	0.14	0.20	0.18	0.03	0.25
Sulphate (SO_4)	**122**	**1,135**	**1,152**	**1,836**	**1,740**	389	0.34
Cyanide-WAD	0.0076	**0.0360**	**0.0382**	**0.0547**	**0.0487**	0.0094	0.26
Total Metals							
Aluminum (Al)	0.036	*0.35*	*0.35*	*0.59*	*0.56*	0.13	0.36
Antimony (Sb)	0.0004	0.0025	0.0028	0.0033	0.0032	0.0007	0.27
Arsenic (As)	0.0022	**0.0216**	**0.0216**	**0.0362**	**0.0342**	0.0078	0.36
Barium (Ba)	0.019	0.194	0.192	0.323	0.306	0.069	0.35
Beryllium (Be)	0.0001	0.0004	0.0004	0.0006	0.0005	0.0001	0.25
Boron (B)	0.013	0.126	0.125	0.212	0.200	0.045	0.36
Cadmium (Cd)	0.0000051	0.0000375	0.0000391	0.0000537	0.0000518	0.0000105	0.28
Calcium (Ca)	38.35	256.65	278.85	300.00	300.00	57.00	0.22
Chromium (Cr)	0.0003	**0.0026**	**0.0026**	**0.0043**	**0.0041**	0.0009	0.35
Cobalt (Co)	0.0003	0.00215	0.00232	0.00296	0.00285	0.00060	0.28
Copper (Cu)	0.0011	0.0056	0.0060	0.0082	0.0073	0.0014	0.25
Iron (Fe)	0.003	0.02	0.02	0.03	0.03	0.00	0.20
Lead (Pb)	0.00005	0.00051	0.00051	0.00085	0.00081	0.00018	0.36
Lithium (Li)	0.002	0.015	0.015	0.023	0.022	0.005	0.32
Magnesium (Mg)	1.10	9.83	9.86	15.10	14.51	2.94	0.30
Manganese (Mn)	0.0080	0.0784	0.0782	0.1302	0.1233	0.0279	0.36
Mercury (Hg)	0.00001	0.00013	0.00012	0.00021	0.00020	0.00005	0.36
Molybdenum (Mo)	0.014	0.124	0.127	0.200	0.189	0.0424	0.34
Nickel (Ni)	0.0004	0.0030	0.0030	0.0047	0.0045	0.0009	0.31
Potassium (K)	16.37	163.55	163.17	273.62	258.36	59.08	0.36
Selenium (Se)	**0.0031**	**0.0278**	**0.0285**	**0.0443**	**0.0420**	0.0093	0.33
Silicon (Si)	0.53	3.91	3.94	5.44	5.17	0.83	0.21
Silver (Ag)	0.000007	0.000058	0.000059	0.000091	0.000087	0.000019	0.33
Sodium (Na)	15.4	123.7	128.8	187.0	178.4	38.6	0.31
Strontium (Sr)	0.262	2.560	2.559	4.209	3.992	0.892	0.35
Thallium (Tl)	0.00002	0.00015	0.00015	0.00023	0.00022	0.00005	0.31
Tin (Sn)	0.0012	0.01221	0.01204	0.02075	0.01957	0.00452	0.37
Uranium (U)	0.00002	0.0003	0.0002	0.0004	0.0004	0.0001	0.36
Vanadium (V)	0.0013	0.0126	0.0125	0.0211	0.0200	0.0045	0.36
Zinc (Zn)	0.002	0.015	0.015	0.023	0.022	0.005	0.32

(continued)

Table 14.7-18. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.000	1.56	1.75	2.85	2.31	0.68	0.44
Chloride (Cl)	0.00	75.62	74.81	151.95	120.87	28.33	0.37
Fluoride (F)	0.00	**4.43**	**4.37**	**8.94**	**7.10**	1.67	0.38
Nitrate (as N)	0.00	**34.90**	**36.25**	**73.98**	**58.60**	16.45	0.47
Nitrite (as N)	0.0000	0.0039	0.0041	0.0067	0.0051	0.0010	0.25
Total Phosphate (as P)	0.00	0.13	0.14	0.21	0.18	0.03	0.26
Sulphate (SO_4)	0	**1,156**	**1,164**	**2,203**	**1,782**	403	0.35
Cyanide-WAD	0.0000	**0.0361**	**0.0383**	**0.0574**	**0.0482**	0.0100	0.28
Total Metals							
Aluminum (Al)	0.000	*0.36*	*0.36*	*0.72*	*0.57*	0.13	0.37
Antimony (Sb)	0.0000	0.0026	0.0028	0.0038	0.0033	0.0007	0.27
Arsenic (As)	0.0000	**0.0221**	**0.0220**	**0.0438**	**0.0350**	0.0081	0.37
Barium (Ba)	0.000	0.198	0.196	0.391	0.312	0.072	0.36
Beryllium (Be)	0.0000	0.0004	0.0004	0.0006	0.0005	0.0001	0.26
Boron (B)	0.000	0.129	0.128	0.256	0.205	0.047	0.37
Cadmium (Cd)	0.0000000	0.0000380	0.0000397	0.0000628	0.0000530	0.0000109	0.29
Calcium (Ca)	0.01	257.92	279.41	300.00	300.00	56.59	0.22
Chromium (Cr)	0.0000	**0.0027**	**0.0026**	**0.0052**	**0.0042**	0.0009	0.36
Cobalt (Co)	0.0000	0.00218	0.00235	0.00339	0.00293	0.00062	0.28
Copper (Cu)	0.0000	0.0056	0.0060	0.0085	0.0073	0.0015	0.26
Iron (Fe)	0.000	0.02	0.02	0.04	0.03	0.01	0.21
Lead (Pb)	0.00000	0.00052	0.00052	0.00103	0.00082	0.00019	0.36
Lithium (Li)	0.000	0.015	0.015	0.028	0.022	0.005	0.33
Magnesium (Mg)	0.00	9.99	10.02	18.08	14.81	3.07	0.31
Manganese (Mn)	0.0000	0.0798	0.0795	0.1573	0.1258	0.0290	0.36
Mercury (Hg)	0.00000	0.00013	0.00013	0.00025	0.00020	0.00005	0.37
Molybdenum (Mo)	0.000	0.127	0.128	0.240	0.194	0.0440	0.35
Nickel (Ni)	0.0000	0.0030	0.0031	0.0056	0.0046	0.0010	0.32
Potassium (K)	0.00	166.97	166.06	331.02	264.27	61.50	0.37
Selenium (Se)	0.0000	**0.0283**	**0.0288**	**0.0529**	**0.0430**	0.0096	0.34
Silicon (Si)	0.00	3.95	4.00	6.16	5.30	0.89	0.22
Silver (Ag)	0.000000	0.000059	0.000059	0.000109	0.000089	0.000020	0.33
Sodium (Na)	0.0	125.8	130.3	220.4	182.8	39.9	0.32
Strontium (Sr)	0.000	2.609	2.605	5.080	4.079	0.929	0.36
Thallium (Tl)	0.00000	0.00015	0.00015	0.00028	0.00023	0.00005	0.32
Tin (Sn)	0.0000	0.01247	0.01231	0.02520	0.02002	0.00471	0.38
Uranium (U)	0.00000	0.0003	0.0003	0.0005	0.0004	0.0001	0.37
Vanadium (V)	0.0000	0.0129	0.0128	0.0256	0.0205	0.0047	0.37
Zinc (Zn)	0.000	0.015	0.015	0.028	0.023	0.005	0.33

(continued)

Table 14.7-18. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.000	1.56	1.75	2.85	2.31	0.68	0.44
Chloride (Cl)	0.00	75.62	74.81	151.95	120.87	28.33	0.37
Fluoride (F)	0.00	**4.43**	**4.37**	**8.94**	**7.10**	1.67	0.38
Nitrate (as N)	0.00	**34.90**	**36.25**	**73.98**	**58.60**	16.45	0.47
Nitrite (as N)	0.0000	0.0039	0.0041	0.0067	0.0051	0.0010	0.25
Total Phosphate (as P)	0.00	0.13	0.14	0.21	0.18	0.03	0.26
Sulphate (SO_4)	0	**1,157**	**1,165**	**2,204**	**1,783**	404	0.35
Cyanide-WAD	0.0000	**0.0361**	**0.0383**	**0.0574**	**0.0482**	0.0100	0.28
Total Metals							
Aluminum (Al)	0.000	*0.36*	*0.36*	*0.72*	*0.57*	0.13	0.37
Antimony (Sb)	0.0000	0.0026	0.0028	0.0038	0.0033	0.0007	0.27
Arsenic (As)	0.0000	**0.0221**	**0.0220**	**0.0438**	**0.0350**	0.0081	0.37
Barium (Ba)	0.000	0.198	0.196	0.391	0.313	0.072	0.36
Beryllium (Be)	0.0000	0.0004	0.0004	0.0006	0.0005	0.0001	0.26
Boron (B)	0.000	0.129	0.128	0.256	0.205	0.047	0.37
Cadmium (Cd)	0.0000000	0.0000381	0.0000397	0.0000628	0.0000530	0.0000109	0.29
Calcium (Ca)	0.02	258.02	279.57	300.00	300.00	56.58	0.22
Chromium (Cr)	0.0000	**0.0027**	**0.0026**	**0.0052**	**0.0042**	0.0009	0.36
Cobalt (Co)	0.0000	0.00218	0.00235	0.00339	0.00293	0.00062	0.28
Copper (Cu)	0.0000	0.0056	0.0060	0.0085	0.0073	0.0015	0.26
Iron (Fe)	0.000	0.02	0.02	0.04	0.03	0.01	0.21
Lead (Pb)	0.00000	0.00052	0.00052	0.00103	0.00082	0.00019	0.36
Lithium (Li)	0.000	0.015	0.015	0.028	0.022	0.005	0.33
Magnesium (Mg)	0.00	9.99	10.02	18.08	14.81	3.07	0.31
Manganese (Mn)	0.0000	0.0800	0.0798	0.1576	0.1261	0.0291	0.36
Mercury (Hg)	0.00000	0.00013	0.00013	0.00025	0.00020	0.00005	0.37
Molybdenum (Mo)	0.000	0.127	0.128	0.240	0.194	0.0440	0.35
Nickel (Ni)	0.0000	0.0030	0.0031	0.0056	0.0046	0.0010	0.32
Potassium (K)	0.00	166.98	166.07	331.03	264.28	61.50	0.37
Selenium (Se)	0.0000	**0.0283**	**0.0288**	**0.0529**	**0.0430**	0.0096	0.34
Silicon (Si)	0.00	3.95	4.00	6.16	5.30	0.89	0.22
Silver (Ag)	0.000000	0.000059	0.000059	0.000109	0.000089	0.000020	0.33
Sodium (Na)	0.0	125.8	130.3	220.4	182.8	39.9	0.32
Strontium (Sr)	0.000	2.611	2.608	5.084	4.082	0.930	0.36
Thallium (Tl)	0.00000	0.00015	0.00015	0.00028	0.00023	0.00005	0.32
Tin (Sn)	0.0000	0.01247	0.01231	0.02520	0.02002	0.00471	0.38
Uranium (U)	0.00000	0.0003	0.0003	0.0005	0.0004	0.0001	0.37
Vanadium (V)	0.0000	0.0129	0.0128	0.0256	0.0205	0.0047	0.37
Zinc (Zn)	0.000	0.015	0.015	0.028	0.023	0.005	0.33

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-19. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0042	0.0004	0.0719	0.0256	0.0120	2.88
Chloride (Cl)	2.21	10.94	6.17	47.00	29.90	9.95	0.91
Fluoride (F)	0.14	0.65	0.37	**2.76**	**1.76**	0.58	0.90
Nitrate (as N)	1.18	5.42	3.14	22.89	14.59	4.82	0.89
Nitrite (as N)	0.0004	0.0008	0.0006	0.0025	0.0017	0.0005	0.58
Total Phosphate (as P)	0.01	0.03	0.02	0.09	0.06	0.02	0.60
Sulphate (SO_4)	42	**175**	**104**	**721**	**461**	151	0.86
Cyanide-WAD	0.0012	0.0051	0.0030	**0.0212**	**0.0135**	0.0044	0.87
Total Metals							
Aluminum (Al)	0.02	0.06	0.04	*0.23*	*0.15*	0.05	0.76
Antimony (Sb)	0.0001	0.0004	0.0002	0.0016	0.0010	0.0003	0.85
Arsenic (As)	0.0006	0.0032	0.0018	**0.0137**	**0.0087**	0.0029	0.91
Barium (Ba)	0.012	0.035	0.024	0.129	0.083	0.026	0.73
Beryllium (Be)	0.0001	0.0002	0.0001	0.0003	0.0002	0.0000	0.32
Boron (B)	0.006	0.021	0.013	0.082	0.053	0.017	0.80
Cadmium (Cd)	0.0000035	0.0000079	0.0000058	0.0000256	0.0000168	0.0000048	0.60
Calcium (Ca)	14.25	48.80	30.85	189.63	122.10	38.74	0.79
Chromium (Cr)	0.0002	0.0005	0.0004	**0.0018**	**0.0012**	0.0003	0.67
Cobalt (Co)	0.00008	0.00033	0.00020	0.00134	0.00086	0.00028	0.84
Copper (Cu)	0.0004	0.0010	0.0007	0.0035	0.0023	0.0007	0.69
Iron (Fe)	0.01	0.01	0.01	0.02	0.02	0.003	0.23
Lead (Pb)	0.00003	0.00009	0.00006	0.00033	0.00022	0.00007	0.78
Lithium (Li)	0.001	0.003	0.002	0.010	0.007	0.002	0.61
Magnesium (Mg)	1.49	2.70	2.14	7.34	4.89	1.23	0.46
Manganese (Mn)	0.00333	0.01253	0.00764	0.05022	0.03227	0.01040	0.83
Mercury (Hg)	0.000006	0.000021	0.000013	0.000081	0.000052	0.000017	0.80
Molybdenum (Mo)	0.004	0.018	0.010	0.078	0.050	0.0165	0.91
Nickel (Ni)	0.0003	0.0007	0.0005	0.0021	0.0014	0.0004	0.56
Potassium (K)	4.72	23.97	13.41	103.49	65.80	21.94	0.92
Selenium (Se)	0.0010	**0.0042**	**0.0025**	**0.0176**	**0.0112**	0.0037	0.87
Silicon (Si)	1.33	1.89	1.75	3.72	2.84	0.48	0.26
Silver (Ag)	0.000004	0.000011	0.000008	0.000039	0.000025	0.000008	0.69
Sodium (Na)	3.9	18.3	10.6	77.3	49.3	16.3	0.89
Strontium (Sr)	0.136	0.439	0.285	1.667	1.076	0.338	0.77
Thallium (Tl)	0.000022	0.000041	0.000032	0.000113	0.000076	0.000019	0.47
Tin (Sn)	0.00037	0.00181	0.00102	0.00776	0.00494	0.00164	0.91
Uranium (U)	0.00001	0.00004	0.00002	0.00016	0.0001	0.00003	0.82
Vanadium (V)	0.0006	0.0021	0.0013	0.0082	0.0053	0.0017	0.80
Zinc (Zn)	0.001	0.003	0.002	0.010	0.006	0.002	0.69

(continued)

Table 14.7-19. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0042	0.0004	0.0719	0.0256	0.0120	2.88
Chloride (Cl)	2.21	10.94	6.17	47.00	29.90	9.95	0.91
Fluoride (F)	0.14	0.65	0.37	**2.76**	**1.76**	0.58	0.90
Nitrate (as N)	1.18	5.42	3.14	22.89	14.59	4.82	0.89
Nitrite (as N)	0.0004	0.0008	0.0006	0.0025	0.0017	0.0005	0.58
Total Phosphate (as P)	0.01	0.03	0.02	0.09	0.06	0.02	0.60
Sulphate (SO_4)	43	**176**	**106**	**722**	**462**	151	0.85
Cyanide-WAD	0.0012	0.0051	0.0030	**0.0212**	**0.0135**	0.0044	0.87
Total Metals							
Aluminum (Al)	0.02	0.06	0.04	*0.23*	*0.15*	0.05	0.76
Antimony (Sb)	0.0001	0.0004	0.0002	0.0016	0.0010	0.0003	0.85
Arsenic (As)	0.0006	0.0032	0.0018	**0.0137**	**0.0087**	0.0029	0.91
Barium (Ba)	0.013	0.036	0.024	0.129	0.084	0.026	0.72
Beryllium (Be)	0.0001	0.0002	0.0001	0.0003	0.0002	0.0000	0.32
Boron (B)	0.006	0.021	0.013	0.082	0.053	0.017	0.80
Cadmium (Cd)	0.0000036	0.0000080	0.0000058	0.0000256	0.0000168	0.0000048	0.60
Calcium (Ca)	14.92	49.51	31.69	190.36	122.72	38.73	0.78
Chromium (Cr)	0.0002	0.0005	0.0004	**0.0018**	**0.0012**	0.0003	0.67
Cobalt (Co)	0.00008	0.00033	0.00020	0.00134	0.00086	0.00028	0.84
Copper (Cu)	0.0004	0.0010	0.0007	0.0035	0.0023	0.0007	0.69
Iron (Fe)	0.01	0.01	0.01	0.02	0.02	0.003	0.23
Lead (Pb)	0.00003	0.00009	0.00006	0.00033	0.00022	0.00007	0.77
Lithium (Li)	0.001	0.003	0.002	0.010	0.007	0.002	0.61
Magnesium (Mg)	1.49	2.71	2.15	7.34	4.89	1.23	0.45
Manganese (Mn)	0.00394	0.01319	0.00839	0.05098	0.03287	0.01040	0.79
Mercury (Hg)	0.000006	0.000021	0.000013	0.000081	0.000052	0.000017	0.80
Molybdenum (Mo)	0.004	0.018	0.010	0.078	0.050	0.0165	0.91
Nickel (Ni)	0.0003	0.0007	0.0005	0.0021	0.0014	0.0004	0.56
Potassium (K)	4.74	23.99	13.43	103.51	65.81	21.94	0.91
Selenium (Se)	0.0010	**0.0042**	**0.0025**	**0.0176**	**0.0112**	0.0037	0.87
Silicon (Si)	1.33	1.89	1.75	3.72	2.84	0.48	0.26
Silver (Ag)	0.000004	0.000011	0.000008	0.000039	0.000025	0.000008	0.69
Sodium (Na)	4.0	18.3	10.6	77.3	49.3	16.3	0.89
Strontium (Sr)	0.141	0.445	0.291	1.674	1.082	0.338	0.76
Thallium (Tl)	0.000022	0.000041	0.000032	0.000113	0.000076	0.000019	0.47
Tin (Sn)	0.00037	0.00181	0.00102	0.00776	0.00494	0.00164	0.91
Uranium (U)	0.00001	0.00004	0.00003	0.00016	0.0001	0.00003	0.76
Vanadium (V)	0.0006	0.0021	0.0013	0.0082	0.0053	0.0017	0.80
Zinc (Zn)	0.001	0.003	0.002	0.010	0.006	0.002	0.69

(continued)

Table 14.7-19. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0045	0.0004	0.0747	0.0286	0.0126	2.78
Chloride (Cl)	4.69	16.19	10.94	55.99	38.33	11.84	0.73
Fluoride (F)	0.28	0.96	0.65	**3.29**	**2.25**	0.69	0.72
Nitrate (as N)	2.39	7.95	5.46	27.22	18.65	5.72	0.72
Nitrite (as N)	0.0005	0.0010	0.0008	0.0028	0.0020	0.0005	0.51
Total Phosphate (as P)	0.02	0.03	0.03	0.10	0.07	0.02	0.52
Sulphate (SO_4)	79	**253**	**176**	**852**	**586**	178	0.70
Cyanide-WAD	0.0022	0.0071	0.0049	**0.0239**	**0.0165**	0.0050	0.71
Total Metals							
Aluminum (Al)	0.03	0.09	0.06	*0.27*	*0.19*	0.06	0.64
Antimony (Sb)	0.0002	0.0005	0.0004	0.0018	0.0012	0.0004	0.69
Arsenic (As)	0.0014	0.0047	0.0032	**0.0163**	**0.0112**	0.0035	0.73
Barium (Ba)	0.019	0.049	0.036	0.151	0.105	0.030	0.62
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0003	0.00005	0.29
Boron (B)	0.010	0.030	0.021	0.097	0.067	0.020	0.67
Cadmium (Cd)	0.0000049	0.0000104	0.0000081	0.0000292	0.0000205	0.0000055	0.53
Calcium (Ca)	24.84	71.22	51.01	230.72	159.31	47.29	0.66
Chromium (Cr)	0.0003	0.0007	0.0005	**0.0021**	**0.0014**	0.0004	0.58
Cobalt (Co)	0.00015	0.00047	0.00033	0.00156	0.00107	0.00032	0.69
Copper (Cu)	0.0005	0.0013	0.0010	0.0039	0.0027	0.0008	0.59
Iron (Fe)	0.01	0.01	0.01	0.02	0.02	0.003	0.21
Lead (Pb)	0.00004	0.00012	0.00009	0.00039	0.00027	0.00008	0.65
Lithium (Li)	0.002	0.004	0.003	0.012	0.008	0.002	0.54
Magnesium (Mg)	1.88	3.34	2.77	8.25	5.85	1.40	0.42
Manganese (Mn)	0.00602	0.01805	0.01270	0.05952	0.04106	0.01233	0.68
Mercury (Hg)	0.000010	0.000030	0.000021	0.000096	0.000066	0.000020	0.67
Molybdenum (Mo)	0.008	0.027	0.018	0.093	0.063	0.0196	0.73
Nickel (Ni)	0.0004	0.0009	0.0007	0.0024	0.0017	0.0004	0.50
Potassium (K)	10.17	35.49	23.87	123.20	84.30	26.09	0.74
Selenium (Se)	0.0019	**0.0061**	**0.0042**	**0.0208**	**0.0143**	0.0044	0.71
Silicon (Si)	1.55	2.12	1.95	3.91	2.99	0.48	0.23
Silver (Ag)	0.000006	0.000015	0.000011	0.000045	0.000031	0.000009	0.59
Sodium (Na)	8.0	26.6	18.2	90.9	62.4	19.1	0.72
Strontium (Sr)	0.224	0.617	0.448	1.963	1.358	0.399	0.65
Thallium (Tl)	0.000028	0.000051	0.000042	0.000127	0.000090	0.000022	0.43
Tin (Sn)	0.00078	0.00268	0.00181	0.00925	0.00633	0.00195	0.73
Uranium (U)	0.00002	0.00006	0.00004	0.00019	0.0001	0.00004	0.68
Vanadium (V)	0.0010	0.0030	0.0021	0.0097	0.0067	0.0020	0.67
Zinc (Zn)	0.002	0.004	0.003	0.011	0.008	0.002	0.59

(continued)

Table 14.7-19. Summary Statistics of Water Quality Predictions for the South Cell TMF (Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0045	0.0004	0.0747	0.0286	0.0126	2.78
Chloride (Cl)	4.69	16.19	10.94	55.99	38.33	11.84	0.73
Fluoride (F)	0.28	0.96	0.65	**3.29**	**2.25**	0.69	0.72
Nitrate (as N)	2.39	7.95	5.46	27.22	18.65	5.72	0.72
Nitrite (as N)	0.0005	0.0010	0.0008	0.0028	0.0020	0.0005	0.51
Total Phosphate (as P)	0.02	0.03	0.03	0.10	0.07	0.02	0.52
Sulphate (SO_4)	82	**255**	**178**	**854**	**588**	178	0.70
Cyanide-WAD	0.0022	0.0071	0.0049	**0.0239**	**0.0165**	0.0050	0.71
Total Metals							
Aluminum (Al)	0.03	0.09	0.06	*0.27*	*0.19*	0.06	0.64
Antimony (Sb)	0.0002	0.0005	0.0004	0.0018	0.0012	0.0004	0.69
Arsenic (As)	0.0014	0.0047	0.0032	**0.0163**	**0.0112**	0.0035	0.73
Barium (Ba)	0.019	0.049	0.037	0.152	0.105	0.030	0.61
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0003	0.00005	0.29
Boron (B)	0.010	0.030	0.021	0.097	0.067	0.020	0.67
Cadmium (Cd)	0.0000049	0.0000104	0.0000082	0.0000293	0.0000205	0.0000055	0.53
Calcium (Ca)	25.68	72.07	51.97	231.49	160.01	47.24	0.66
Chromium (Cr)	0.0003	0.0007	0.0005	**0.0021**	**0.0014**	0.0004	0.58
Cobalt (Co)	0.00015	0.00047	0.00033	0.00156	0.00107	0.00032	0.69
Copper (Cu)	0.0005	0.0013	0.0010	0.0039	0.0027	0.0008	0.59
Iron (Fe)	0.01	0.01	0.01	0.02	0.02	0.003	0.21
Lead (Pb)	0.00004	0.00012	0.00009	0.00039	0.00027	0.00008	0.65
Lithium (Li)	0.002	0.004	0.003	0.012	0.008	0.002	0.53
Magnesium (Mg)	1.89	3.35	2.77	8.26	5.86	1.40	0.42
Manganese (Mn)	0.00680	0.01885	0.01360	0.06035	0.04175	0.01229	0.65
Mercury (Hg)	0.000010	0.000030	0.000021	0.000096	0.000066	0.000020	0.67
Molybdenum (Mo)	0.008	0.027	0.018	0.093	0.063	0.0196	0.73
Nickel (Ni)	0.0004	0.0009	0.0007	0.0024	0.0017	0.0004	0.50
Potassium (K)	10.19	35.51	23.90	123.22	84.32	26.09	0.73
Selenium (Se)	0.0019	**0.0061**	**0.0042**	**0.0208**	**0.0143**	0.0044	0.71
Silicon (Si)	1.55	2.12	1.96	3.91	2.99	0.48	0.23
Silver (Ag)	0.000006	0.000015	0.000011	0.000045	0.000031	0.000009	0.59
Sodium (Na)	8.0	26.6	18.2	90.9	62.4	19.1	0.72
Strontium (Sr)	0.231	0.624	0.455	1.970	1.365	0.398	0.64
Thallium (Tl)	0.000028	0.000051	0.000042	0.000127	0.000090	0.000022	0.43
Tin (Sn)	0.00078	0.00268	0.00181	0.00925	0.00633	0.00195	0.73
Uranium (U)	0.00002	0.00006	0.00005	0.00020	0.0001	0.00004	0.63
Vanadium (V)	0.0010	0.0030	0.0021	0.0097	0.0067	0.0020	0.67
Zinc (Zn)	0.002	0.004	0.003	0.011	0.008	0.002	0.59

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-20. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0005	0.0004	0.0011	0.0011	0.0003	0.60
Chloride (Cl)	0.19	0.22	0.19	2.35	0.40	0.16	0.72
Fluoride (F)	0.02	0.03	0.02	0.15	0.03	0.01	0.36
Nitrate (as N)	0.24	0.28	0.25	1.37	0.33	0.08	0.29
Nitrite (as N)	0.0003	0.0004	0.0004	0.0006	0.0004	0.00002	0.05
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.01	0.00	0.07
Sulphate (SO_4)	14	15	15	49	17	2	0.15
Cyanide-WAD	0.0004	0.0004	0.0004	0.0014	0.0004	0.0001	0.17
Dissolved Metals							
Aluminum (Al)	0.01	0.02	0.01	0.03	0.02	0.001	0.07
Antimony (Sb)	0.00004	0.00004	0.00004	0.00012	0.00004	0.00000	0.12
Arsenic (As)	0.00004	0.0001	0.0000	0.0007	0.0001	0.0000	0.95
Barium (Ba)	0.007	0.010	0.010	0.017	0.010	0.001	0.05
Beryllium (Be)	0.0001	0.0001	0.0001	0.0002	0.0002	0.00001	0.08
Boron (B)	0.003	0.004	0.004	0.008	0.004	0.0003	0.07
Cadmium (Cd)	0.0000026	0.0000039	0.0000039	0.0000055	0.0000040	0.0000002	0.05
Calcium (Ca)	7.12	9.22	9.19	18.75	9.48	0.63	0.07
Chromium (Cr)	0.0001	0.0002	0.0002	0.0003	0.0002	0.00001	0.06
Cobalt (Co)	0.00003	0.00004	0.00004	0.00010	0.00004	0.000004	0.10
Copper (Cu)	0.0002	0.0003	0.0004	0.0006	0.0004	0.00002	0.06
Iron (Fe)	0.01	0.01	0.01	0.02	0.01	0.001	0.06
Lead (Pb)	0.00001	0.00002	0.00002	0.00004	0.00002	0.000001	0.06
Lithium (Li)	0.001	0.002	0.001	0.002	0.002	0.0001	0.08
Magnesium (Mg)	1.23	1.88	1.89	2.42	1.95	0.10	0.06
Manganese (Mn)	0.00140	0.00158	0.00156	0.00413	0.00169	0.00017	0.11
Mercury (Hg)	0.000003	0.000004	0.000004	0.000008	0.000004	0.0000003	0.07
Molybdenum (Mo)	0.0002	0.000	0.000	0.004	0.001	0.0003	1.07
Nickel (Ni)	0.0002	0.0004	0.0004	0.0005	0.0004	0.00002	0.05
Potassium (K)	0.18	0.25	0.18	4.92	0.63	0.36	1.44
Selenium (Se)	0.0003	0.0003	0.0003	0.0011	0.0003	0.0001	0.19
Silicon (Si)	1.25	1.97	1.98	2.38	2.02	0.11	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000006	0.000004	0.0000002	0.05
Sodium (Na)	0.8	0.9	0.8	4.4	1.1	0.3	0.29
Strontium (Sr)	0.073	0.098	0.097	0.185	0.100	0.006	0.06
Thallium (Tl)	0.000019	0.000029	0.000028	0.000039	0.000032	0.000002	0.08
Tin (Sn)	0.00004	0.00004	0.00004	0.00040	0.00007	0.00003	0.60
Uranium (U)	0.000005	0.000005	0.000005	0.000014	0.000005	0.000001	0.12
Vanadium (V)	0.0003	0.0004	0.0004	0.0008	0.0004	0.00003	0.07
Zinc (Zn)	0.001	0.001	0.001	0.002	0.001	0.00005	0.05

(continued)

Table 14.7-20. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0005	0.0004	0.0011	0.0011	0.0003	0.60
Chloride (Cl)	0.19	0.22	0.19	2.35	0.40	0.16	0.72
Fluoride (F)	0.02	0.03	0.02	0.15	0.03	0.01	0.36
Nitrate (as N)	0.24	0.28	0.25	1.37	0.33	0.08	0.29
Nitrite (as N)	0.0003	0.0004	0.0004	0.0006	0.0004	0.00002	0.05
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.01	0.00	0.07
Sulphate (SO_4)	15	16	16	52	18	2	0.15
Cyanide-WAD	0.0004	0.0004	0.0004	0.0014	0.0004	0.0001	0.17
Dissolved Metals							
Aluminum (Al)	0.01	0.02	0.01	0.03	0.02	0.001	0.07
Antimony (Sb)	0.00004	0.00004	0.00004	0.00012	0.00004	0.00000	0.12
Arsenic (As)	0.00004	0.0001	0.0000	0.0007	0.0001	0.0000	0.94
Barium (Ba)	0.008	0.010	0.010	0.018	0.011	0.001	0.06
Beryllium (Be)	0.0001	0.0001	0.0001	0.0002	0.0002	0.00001	0.08
Boron (B)	0.003	0.004	0.004	0.008	0.004	0.0003	0.07
Cadmium (Cd)	0.0000026	0.0000039	0.0000039	0.0000055	0.0000040	0.0000002	0.05
Calcium (Ca)	7.75	9.73	9.68	19.88	10.06	0.69	0.07
Chromium (Cr)	0.0001	0.0002	0.0002	0.0003	0.0002	0.00001	0.06
Cobalt (Co)	0.00003	0.00004	0.00004	0.00010	0.00004	0.000004	0.10
Copper (Cu)	0.0002	0.0004	0.0004	0.0006	0.0004	0.00002	0.06
Iron (Fe)	0.01	0.01	0.01	0.02	0.01	0.001	0.06
Lead (Pb)	0.00001	0.00002	0.00002	0.00004	0.00002	0.000001	0.06
Lithium (Li)	0.001	0.002	0.001	0.002	0.002	0.0001	0.07
Magnesium (Mg)	1.23	1.89	1.89	2.43	1.95	0.10	0.06
Manganese (Mn)	0.00187	0.00205	0.00202	0.00517	0.00228	0.00024	0.12
Mercury (Hg)	0.000003	0.000004	0.000004	0.000008	0.000004	0.0000003	0.07
Molybdenum (Mo)	0.0002	0.000	0.000	0.004	0.001	0.0003	1.04
Nickel (Ni)	0.0002	0.0004	0.0004	0.0005	0.0004	0.00002	0.05
Potassium (K)	0.19	0.26	0.19	4.95	0.65	0.36	1.38
Selenium (Se)	0.0003	0.0003	0.0003	0.0011	0.0003	0.0001	0.19
Silicon (Si)	1.25	1.97	1.98	2.38	2.02	0.11	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000006	0.000004	0.0000002	0.05
Sodium (Na)	0.8	0.9	0.8	4.5	1.1	0.3	0.29
Strontium (Sr)	0.078	0.102	0.101	0.193	0.104	0.006	0.06
Thallium (Tl)	0.000019	0.000029	0.000028	0.000039	0.000032	0.000002	0.08
Tin (Sn)	0.00004	0.00004	0.00004	0.00040	0.00007	0.00003	0.60
Uranium (U)	0.000007	0.000007	0.000007	0.000019	0.000009	0.000001	0.13
Vanadium (V)	0.0003	0.0004	0.0004	0.0008	0.0004	0.00003	0.07
Zinc (Zn)	0.001	0.001	0.001	0.002	0.001	0.00005	0.05

(continued)

Table 14.7-20. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0005	0.0004	0.0015	0.0011	0.0003	0.61
Chloride (Cl)	0.18	0.26	0.19	4.84	0.62	0.35	1.33
Fluoride (F)	0.02	0.03	0.02	0.30	0.05	0.020	0.73
Nitrate (as N)	0.22	0.29	0.25	2.59	0.45	0.17	0.58
Nitrite (as N)	0.0003	0.0004	0.0004	0.0007	0.0004	0.00002	0.05
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.01	0.001	0.07
Sulphate (SO_4)	13	16	15	87	20	5	0.33
Cyanide-WAD	0.0004	0.0004	0.0004	0.0024	0.0005	0.00014	0.35
Dissolved Metals							
Aluminum (Al)	0.01	0.02	0.02	0.04	0.02	0.002	0.11
Antimony (Sb)	0.00004	0.00004	0.00004	0.00020	0.00005	0.000011	0.26
Arsenic (As)	0.00004	0.00006	0.00004	0.00139	0.0002	0.00010	1.67
Barium (Ba)	0.008	0.010	0.010	0.024	0.011	0.001	0.09
Beryllium (Be)	0.0001	0.0001	0.0001	0.0002	0.0002	0.00001	0.08
Boron (B)	0.004	0.004	0.004	0.012	0.004	0.0005	0.14
Cadmium (Cd)	0.0000028	0.0000039	0.0000039	0.0000068	0.0000040	0.0000002	0.06
Calcium (Ca)	8.13	9.39	9.22	29.33	10.07	1.31	0.14
Chromium (Cr)	0.0001	0.0002	0.0002	0.0004	0.0002	0.00001	0.07
Cobalt (Co)	0.00004	0.00004	0.00004	0.00017	0.00005	0.000009	0.22
Copper (Cu)	0.0003	0.0004	0.0004	0.0007	0.0004	0.00003	0.07
Iron (Fe)	0.01	0.01	0.01	0.02	0.01	0.001	0.06
Lead (Pb)	0.00002	0.00002	0.00002	0.00005	0.00002	0.000002	0.11
Lithium (Li)	0.001	0.002	0.001	0.003	0.002	0.0001	0.08
Magnesium (Mg)	1.29	1.89	1.90	2.80	1.97	0.10	0.05
Manganese (Mn)	0.00131	0.00163	0.00157	0.00682	0.00189	0.00036	0.22
Mercury (Hg)	0.000004	0.000004	0.000004	0.000012	0.000004	0.0000005	0.13
Molybdenum (Mo)	0.0002	0.0003	0.0002	0.0079	0.0009	0.0006	1.84
Nickel (Ni)	0.0003	0.0004	0.0004	0.0006	0.0004	0.00002	0.05
Potassium (K)	0.17	0.34	0.18	10.39	1.10	0.78	2.32
Selenium (Se)	0.0003	0.0003	0.0003	**0.0020**	0.0004	0.00012	0.40
Silicon (Si)	1.28	1.98	1.99	2.56	2.05	0.11	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000008	0.000004	0.0000003	0.07
Sodium (Na)	0.8	0.9	0.8	8.5	1.5	0.6	0.60
Strontium (Sr)	0.086	0.099	0.098	0.273	0.104	0.011	0.11
Thallium (Tl)	0.000019	0.000029	0.000028	0.000045	0.000032	0.000002	0.08
Tin (Sn)	0.00004	0.00005	0.00004	0.00081	0.00011	0.00006	1.15
Uranium (U)	0.000004	0.000005	0.000005	0.000023	0.000006	0.0000013	0.25
Vanadium (V)	0.0004	0.0004	0.0004	0.0012	0.0004	0.00005	0.14
Zinc (Zn)	0.001	0.001	0.001	0.002	0.001	0.00007	0.07

(continued)

Table 14.7-20. Summary Statistics of Water Quality Predictions for the South Cell Tailing Management Facility (Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0001	0.0005	0.0004	0.0015	0.0011	0.0003	0.61
Chloride (Cl)	0.18	0.26	0.19	4.84	0.62	0.35	1.33
Fluoride (F)	0.02	0.03	0.02	0.30	0.05	0.020	0.72
Nitrate (as N)	0.22	0.29	0.25	2.59	0.45	0.17	0.58
Nitrite (as N)	0.0003	0.0004	0.0004	0.0007	0.0004	0.00002	0.05
Total Phosphate (as P)	0.01	0.01	0.01	0.02	0.01	0.001	0.07
Sulphate (SO_4)	13	17	16	90	22	5	0.31
Cyanide-WAD	0.0004	0.0004	0.0004	0.0024	0.0005	0.00014	0.35
Dissolved Metals							
Aluminum (Al)	0.01	0.02	0.02	0.04	0.02	0.002	0.11
Antimony (Sb)	0.00004	0.00004	0.00004	0.00020	0.00005	0.000011	0.26
Arsenic (As)	0.00004	0.00006	0.00004	0.00139	0.0002	0.00010	1.67
Barium (Ba)	0.009	0.010	0.010	0.025	0.011	0.001	0.09
Beryllium (Be)	0.0001	0.0001	0.0001	0.0002	0.0002	0.00001	0.08
Boron (B)	0.004	0.004	0.004	0.012	0.004	0.0005	0.14
Cadmium (Cd)	0.0000028	0.0000039	0.0000039	0.0000068	0.0000041	0.0000002	0.06
Calcium (Ca)	8.49	9.91	9.71	30.64	10.86	1.39	0.14
Chromium (Cr)	0.0001	0.0002	0.0002	0.0004	0.0002	0.00001	0.07
Cobalt (Co)	0.00004	0.00004	0.00004	0.00017	0.00005	0.000009	0.22
Copper (Cu)	0.0003	0.0004	0.0004	0.0007	0.0004	0.00003	0.07
Iron (Fe)	0.01	0.01	0.01	0.02	0.01	0.001	0.06
Lead (Pb)	0.00002	0.00002	0.00002	0.00005	0.00002	0.000002	0.11
Lithium (Li)	0.001	0.002	0.001	0.003	0.002	0.0001	0.08
Magnesium (Mg)	1.29	1.89	1.90	2.81	1.98	0.10	0.05
Manganese (Mn)	0.00167	0.00211	0.00203	0.00803	0.00260	0.00045	0.21
Mercury (Hg)	0.000004	0.000004	0.000004	0.000012	0.000004	0.0000005	0.13
Molybdenum (Mo)	0.0002	0.0003	0.0002	0.0079	0.0009	0.0006	1.80
Nickel (Ni)	0.0003	0.0004	0.0004	0.0006	0.0004	0.00002	0.05
Potassium (K)	0.18	0.35	0.19	10.42	1.13	0.78	2.24
Selenium (Se)	0.0003	0.0003	0.0003	**0.0020**	0.0004	0.00013	0.40
Silicon (Si)	1.28	1.98	1.99	2.56	2.05	0.11	0.06
Silver (Ag)	0.000003	0.000004	0.000004	0.000008	0.000004	0.0000003	0.07
Sodium (Na)	0.8	0.9	0.8	8.5	1.5	0.6	0.60
Strontium (Sr)	0.090	0.103	0.101	0.283	0.110	0.012	0.11
Thallium (Tl)	0.000019	0.000029	0.000029	0.000045	0.000032	0.000002	0.08
Tin (Sn)	0.00004	0.00005	0.00004	0.00081	0.00011	0.00006	1.15
Uranium (U)	0.000006	0.000008	0.000007	0.000029	0.000010	0.0000017	0.23
Vanadium (V)	0.0004	0.0004	0.0004	0.0012	0.0004	0.00005	0.14
Zinc (Zn)	0.001	0.001	0.001	0.002	0.001	0.00007	0.07

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

The concentrations of MMER-regulated deleterious substances were less than the maximum authorized concentration. The concentrations of water quality parameters including WAD cyanide were less than the lower limit of the BC Pollution Control Objectives with the exception of nitrate (objective: 10 to 25 mg/L; 95th percentile nitrate concentration during operation phase: 39 mg/L; mean of nitrate concentration during operation phase: 12 mg/L; Table 14.7-15). The mass balance modelling approach uses the conservative assumption that no natural attenuation of nutrients through assimilation occurs; therefore, nutrient concentrations are likely over-estimated. The effect of nutrient loading is assessed in Chapter 15, and Section 14.7.3.2 assesses the concentrations of nutrients in the PTMA receiving environment relative to receiving environment objectives. Nitrite is an intermediate nitrogen species in the oxidation of ammonia to nitrate and is modelled as 2% of the total nitrogen load from explosives. Nitrite concentrations are likely over-estimated as nitrite is rapidly oxidized to nitrate and concentrations of nitrite are usually lower (< 10 ppb) under oxygenated conditions (Mortonson and Brooks 1980; Wetzel 2001) than predicted by the conservative mass-balance modelling approach. For these reasons, water quality effects as a result of nitrite were not assessed.

During closure and post-closure phases, the concentrations of water quality parameters are predicted to have substantially decreased due to dilution from surface runoff and precipitation. No parameters are predicted to exceed BC Pollution Control Objectives or BC water quality guidelines for the receiving environment in the closure and post-closure phases. Improved water quality by Year 30 (less than five years after decommissioning of the North Cell TMF) will be suitable for discharge to North Treaty Creek year-round.

South Cell TMF

The South Cell TMF will only be operational after Year 25 and therefore predictions prior to that time period are not included.

The upper-case water quality predictions are less than 1% greater than the expected case water quality predictions and are therefore indistinguishable in Figures 14.7-13 to 14.7-15 with the exception of sulphate in Year 65. Predicted mean variable case water balance simulation concentrations are less than 5% higher than the base case water balance simulations (Tables 4.7-18 to 4.7-20). The 95th percentile concentrations of the expected-case water quality predictions were compared to BC Pollution Control Objectives (BC MOE 1979) and MMER maximum authorized monthly mean concentrations (SOR/2002-22) as the South Cell TMF water will be discharged via pipeline to Treaty Creek with no additional water treatment.

TSS concentrations in discharge from the South Cell TMF will be controlled by floating clarifiers in order to meet the MMER regulatory limit of 15 mg/L. Mean annual TSS in Treaty Creek ranged from 30 to 400 mg/L; therefore, it is likely that TSS concentrations will decrease in Treaty Creek as a result of TMF discharge.

During the operation phase (Table 14.7-18), the concentrations of MMER regulated deleterious substances were less than the maximum authorized concentration. The concentrations of water quality parameters including WAD cyanide were less than the lower limit of the BC Pollution Control Objectives with the following exceptions:

- Nitrate – the mean (34 mg/L) nitrate concentration is predicted to be higher than the discharge objectives range of 10 to 25 mg/L.
- Dissolved aluminum – the 95th percentile (0.56 mg/L) dissolved aluminum concentration is predicted to be higher than the lower limit of the discharge objectives range of 0.5 to 1.0 mg/L. The predicted mean dissolved aluminum concentration (0.35 mg/L) is less than the lower limit of the discharge objectives.

The mass balance modelling approach uses the conservative assumption that no natural attenuation of nutrients through assimilation occurs; therefore, nutrient concentrations are likely over-estimated. Nitrite is an intermediate nitrogen species in the oxidation of ammonia to nitrate and is modelled as 2% of the total nitrogen load from explosives. Nitrite concentrations are likely over-estimated as nitrite is rapidly oxidized to nitrate and concentrations of nitrite are usually lower (< 10 ppb) under oxygenated conditions (Mortonson and Brooks 1980; Wetzel 2001) than predicted by the conservative mass-balance modelling approach. For these reasons, water quality effects as a result of nitrite were not assessed. The effect of nutrient loading is assessed in Chapter 15, and Section 14.7.3.2 assesses the concentrations of nutrients and dissolved aluminum in the PTMA receiving environment relative to receiving environment objectives.

During closure and post-closure phases, the concentrations of water quality parameters are predicted to have substantially decreased due to dilution from surface runoff and precipitation. No parameters are predicted to exceed BC Pollution Control Objectives in the closure and post-closure phases. BC water quality guidelines for the receiving environment are expected to be met within five years of the decommissioning of the South Cell TMF. Improved water quality by Year 55 will be suitable for discharge year-round.

14.7.2 Mitigation for Degradation of Water Quality

Extensive mitigation to avoid degradation of surface water quality was included in the design for the proposed KSM Project. Mitigation includes measures to avoid, reduce, and monitor adverse effects to surface water quality and specific mitigation measures were developed for the various pathways that Project components can potentially interact with surface water quality.

14.7.2.1 Metal Leaching / Acid Rock Drainage

14.7.2.1.1 Project Design Changes

ML/ARD was identified by the KSM Project EA Working Group as a significant concern due to potential effects on water quality, fish and fish habitat, wildlife and wildlife habitat, and human health. A number of Project design changes were made as a result of consultation with the EA Working Group to specifically address ML/ARD concerns. These design changes included:

- elimination of the Sulphurets RSF – metal loading predictions to Sulphurets Creek were reduced by removing a potential source of ML/ARD outside the WSF catchment;
- block cave mining of Mitchell and Iron Cap deposits – modification of the mine plan to include underground mining methods at the Mitchell and Iron Cap deposits reduced the height of the Mitchell Pit highwall by 31% and resulted in a reduction of 1.1 Bt of waste rock (56% reduction in Mitchell waste rock volumes and 99% reduction in Iron Cap waste rock volumes);

- backfilling Sulphurets Pit – crushed Kerr waste rock for transport on a rope conveyor resulted in high predicted selenium concentrations in the WSF. The EA Working Group recommended backfilling Kerr waste rock into the mined out Sulphurets Pit to reduce selenium loading to the WSF (see sections below for further details); and
- selenium ion exchange water treatment plant – a Selenium Treatment Plant to minimize selenium loadings to the receiving environment was included in Project design to address concerns of potential effects on water quality (see sections below for further details).

14.7.2.1.2 Metal Leaching / Acid Rock Drainage Management

The ML/ARD Management Plan (Section 26.14) details the actions to avoid, control, and mitigate ML/ARD in the construction, operation, closure, and post-closure phases of the Project. ML/ARD will be monitored, mitigated, and adaptively managed to avoid adverse effects on surface water quality. Most PAG geologic materials will be stored in an engineered RSF, backfilled into Sulphurets Pit, or stored on lined pads. Some PAG material within the WSF catchment may be left in place or re-handled as required. Material used for construction will be sampled and analyzed at an on-site lab to ensure that only NPAG material is used where drainage may reach the receiving environment.

Adverse effects to water quality as a result of ML/ARD will be monitored through the Aquatic Effects Monitoring Plan (Section 26.18.2). The water quality of drainage and leachate at the Mine Site will be monitored through the effluent quality monitoring outlined in the Water Management Plan (Section 26.17.1.7). A geochemical inventory of waste rock, tailing, and non-deposit material will be maintained as part of the ML/ARD Management Plan, which will allow for adaptive ML/ARD management.

14.7.2.1.3 Water Management

The overall objectives of the Water Management Plan (Section 26.17) are to divert non-contact water around the Project and to collect and treat contact water from the Project. A variety of diversion, collection, and water treatment structures will be required to manage surface water on the KSM Project site. By minimizing the amount of contact water that is produced on the Project site, surface water diversion reduces the volume of water that must be treated. Additionally, surface water diversion decreases the potential for erosion and sediment production by limiting the volume of water that enters a work area.

Design of the Mine Site is described in the report *2012 Geotechnical Design of Rock Storage Facilities and Associated Water Management Facilities* (Appendix 4-J). The primary water management structures and facilities for the Mine Site include:

- Mitchell and McTagg RSFs;
- MDT and McTagg Twinned Diversion Tunnels;
- WSF, WSD, WSF seepage dam, and Water Treatment Plant;
- TWTP (construction period only);
- closure channels (closure and post-closure periods only); and
- erosion and sediment control measures for the facilities listed above.

Water management structures and facilities for the PTMA are described in the *2012 Engineering Design Update of Tailing Management Facility* (Appendix 4-AC). The key water management elements of the TMF are:

- five main diversions around the perimeter of the TMF (Northeast diversion, South diversion, Lower East diversion, Southeast diversion, and Southwest diversion);
- Lower East Diversion Berm;
- East Catchment diversion dam, East Catchment diversion tunnel, and South Teigen Creek maintenance flow pipeline;
- tailing dams and seepage collection dams;
- TWTP, if required (construction period only);
- closure spillways (closure period only); and
- erosion and sediment control measures for the facilities listed above.

Water management for both the Mine Site and the PTMA includes staged discharge to match the natural hydrograph. Hydrological considerations are discussed in Section 14.7.2.2 and in the Water Management Plan (Section 26.17).

14.7.2.1.4 Selenium Management

Selenium was identified as a key COPC for the proposed Project due to potential adverse effects on aquatic life. Management and mitigation of ML/ARD is also applicable to selenium management. Additional mitigation specific for selenium includes segregation of Kerr waste rock as backfill to Sulphurets Pit due to its high selenium leaching potential and operation of an ion exchange Selenium Treatment Plant to treat drainage from the Kerr waste rock.

Sulphurets Backfill

Waste rock from the Kerr Pit will be backfilled into the closed Sulphurets Pit in years 27 to 50 using a bottom-up approach. Figures 14.7-16 and 14.7-17 demonstrate the engineered design in the Sulphurets Pit that will allow for collection of runoff waters. Sulphurets Pit will be dewatered through a basal drain that will capture any infiltration or drainage through the Kerr waste rock. Kerr waste rock will be placed in 50 m lifts with 40 m wide benches. The outer edge of each bench will be lined for a width of 100 m resulting in 60 m of the liner being covered by the subsequent lift.

The benches will have 0.5% slope so water on the benches will drain out towards the edge of each bench. A central collection channel will be located on each bench to capture precipitation on the bench and water that enters the inter-bench sloping area. The water collected in the central collection channel on each bench will be directed along the benches to a 10 m wide rock cut step spillway constructed in the Sulphurets Pit wall from the top of the pit to the bottom. A channel will be built on the Sulphurets Pit bench just above the Sulphurets Pit backfill. This channel will drain water to the rock cut step spillway to prevent runoff from upper Sulphurets Pit walls and benches from flowing onto the lined top of the RSF. The drainage from the Sulphurets Pit and the contained waste rock will be collected in a 10-m wide step spillway and transported by a pipeline to the Selenium Treatment Plant.

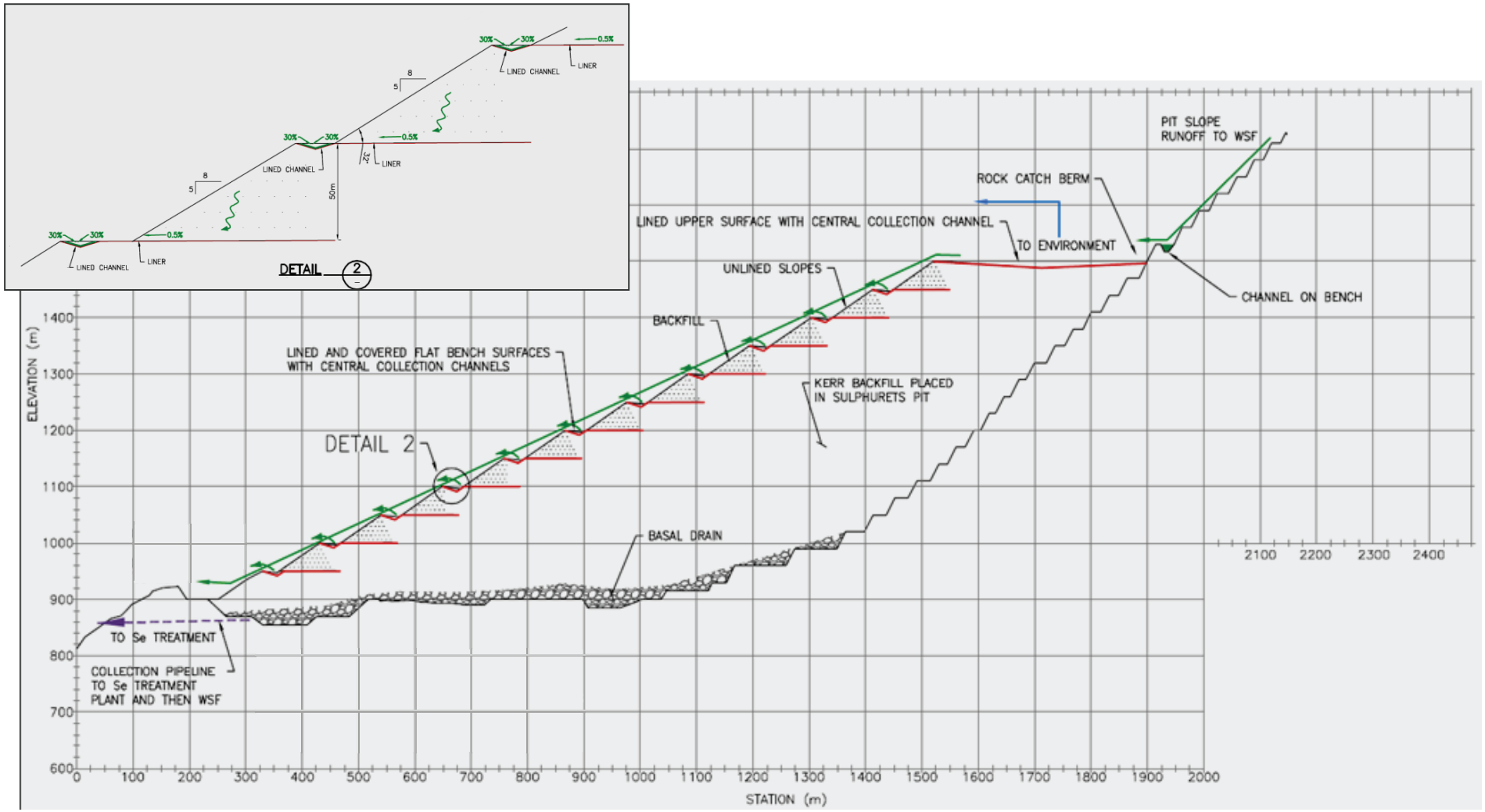

Figure 14.7-16

SEABRIDGE GOLD
KSM PROJECT

Sulphurets Pit Backfill with Kerr Waste Rock

Figure 14.7-16

Rescan™ Engineers & Scientists

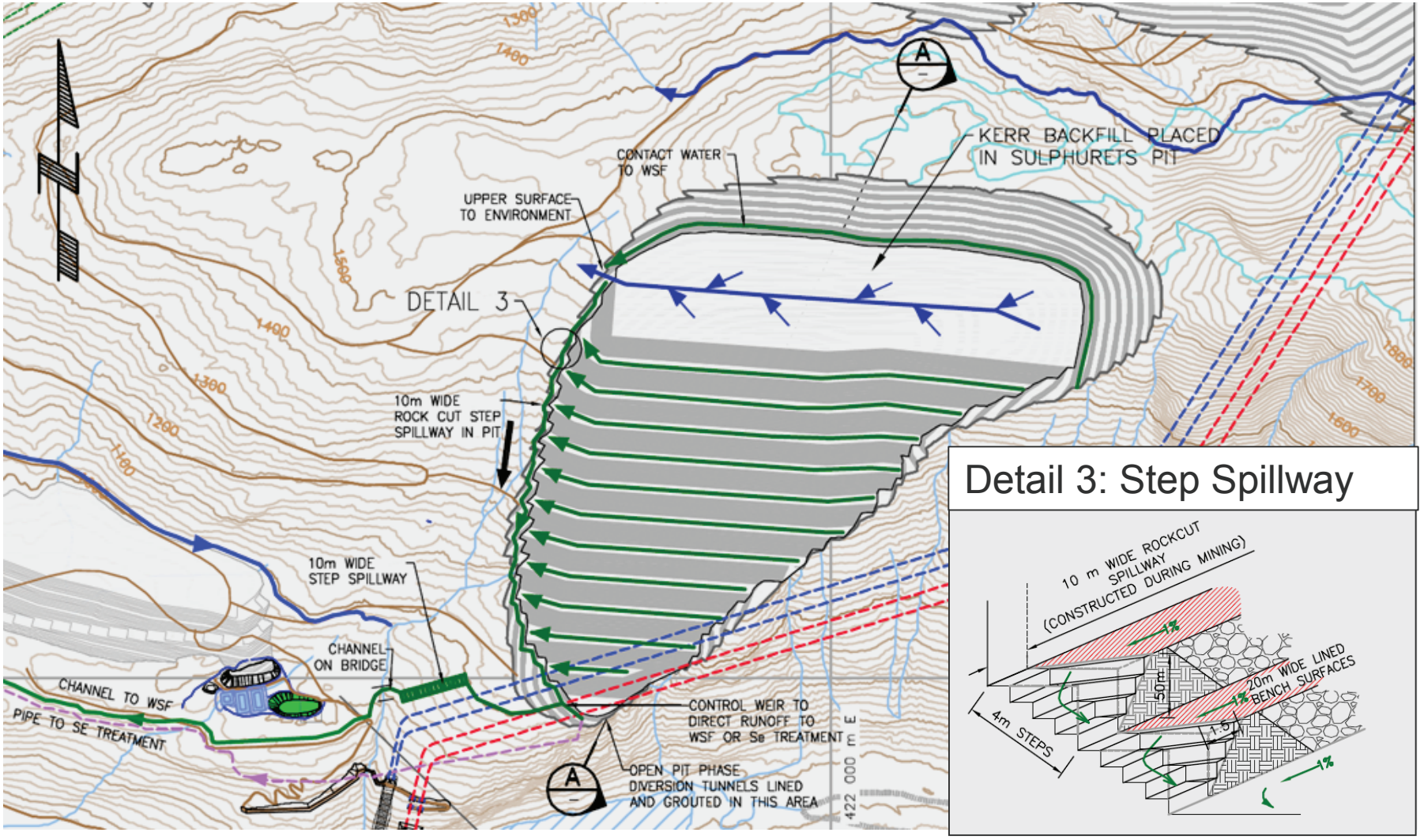

Figure 14.7-17

SEABRIDGE GOLD
KSM PROJECT

Water Management on Kerr Waste Rock

Figure 14.7-17

Rescan™ Engineers & Scientists

Selenium Treatment Plant

Selenium treatment of drainage from Sulphurets backfill is technically feasible using best available technology due to reduced infiltration rates resulting from covering the Kerr waste rock. Preliminary design for a selenium treatment plant was developed by BioteQ Environmental Technologies Inc. (BioteQ 2013). An ion exchange water treatment study was completed with BioteQ's Selen-IX process using synthetic feed water representing the Kerr waste rock leachate to demonstrate both selenium removal and recovery of selenium in the spent regenerant as a solid phase. BioteQ's report including further details is included in Appendix 4-V.

The Selen-IX process was optimized during three phases of the pilot study to select the best resin based on selenium selectivity, resin capacity, and regeneration characteristics. Selenium treatment targeted selenate (Se(VI)) over selenite (Se(IV)) because Se(VI) is the predominant selenium species measured at Kerr Deposit groundwater seeps (Section 14.1.2.1), and some removal of Se(IV) is expected downstream from the Selenium Treatment Plant at the HDS WTP (further details in the following section). A preliminary design basis for a selenium treatment plant with a treatment capacity of 60 L/s and effluent with Se(VI) concentrations less than 1 ppb was developed (BioteQ 2013).

The process flow diagram for the Selenium Treatment Plant is included in Figure 14.7-18. The design basis for the Selenium Treatment Plant and description of process streams is included in Chapter 4. Water from the Sulphurets Pit will report to the Selenium Treatment Plant feed tank for pre-treatment with caustic soda. After reaction in the feed tank, the dilute slurry stream will report to the iron removal stage for solid-liquid separation. The ion exchange circuit will also include multimedia filtration where fine particulates will be captured from the iron stage clarifier overflow. Ion exchange columns, operating in carousel configuration, will be used to remove the selenium from the filtered solution. Effluent from the Selenium Treatment Plant will report to the WSF. Laboratory investigations concluded that iron, selenium, and nitrate concentrations in Kerr waste rock leachate will be reduced (Table 14.7-21). The resin will be regenerated using sodium sulphate (Na_2SO_4). Upon exiting the column the regenerant reports to the selenium reduction stage (BioteQ 2013).

Table 14.7-21. Parameters with Reduced Concentrations from the Selenium Treatment Plant

Parameter	Units	Concentration in Feed Water	Concentration in Effluent
Selenium	µg/L	100	< 1
Iron	mg/L	174	17
Nitrate	mg/L	0.23	< 0.05

A proof of concept study was completed demonstrating that selenium oxyanions in the regenerant could be reduced to elemental selenium in BioteQ's bioreactor. Preliminary estimates indicate that selenium reduction will be 0.55 kg Se/day, which will produce 11.8 kg/day of selenium-rich biomass sludge. Further research is advancing to test alternate physico-chemical methods for selenate reduction (BioteQ 2013).

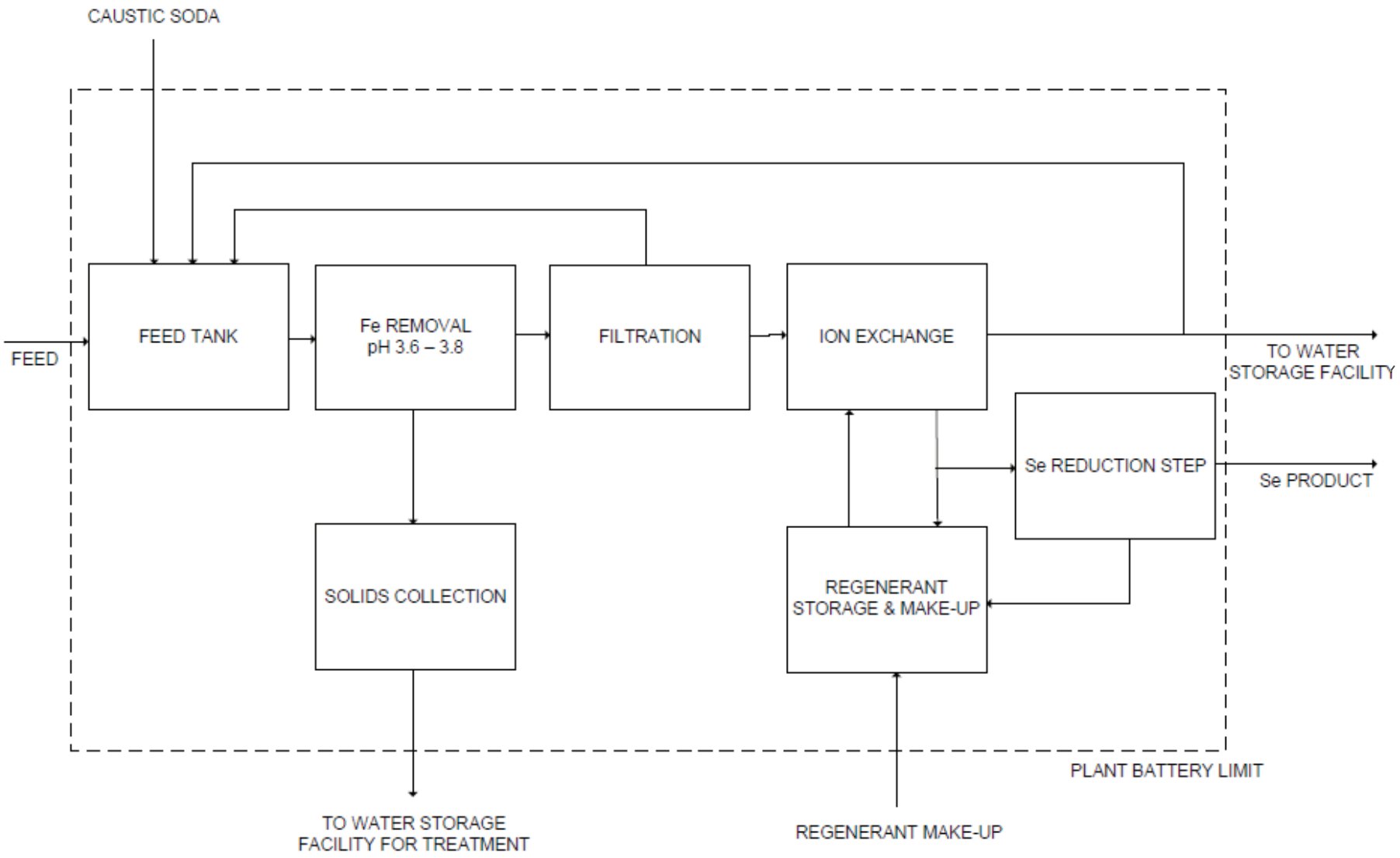

Figure 14.7-18

SEABRIDGE GOLD
KSM PROJECT

Selenium Treatment Plant Flow Diagram

Figure 14.7-18

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14.7.2.2 Effluent Discharge

Mitigation of potential effects to surface water quality due to effluent quality during construction, operation, closure, and post-closure phases will be achieved through water treatment and scheduling discharge to match the natural hydrograph of the receiving environment. Proposed water treatment includes TWTPs, a Mine Site WTP, a Selenium Treatment Plant (discussed in Section 14.7.2.1), and water treatment in the Treaty Process Plant.

14.7.2.2.1 Project Design Changes

Effluent quality was identified by the KSM Project EA Working Group as a significant concern due to potential effects to water quality, fish and fish habitat, wildlife and wildlife habitat, and human health. A number of Project design changes were made as a result of consultation with the EA Working Group to specifically address effluent quality concerns. These design changes included the following:

- Increased WTP capacity – The WTP at the Mine Site was increased in maximum capacity from 3.3 m^3/s to 7.5 m^3/s to allow greater throughput during the high flow season and to minimize effects on water quality in the low flow season.
- Carbon-in-Leach (CIL) tailing disposal into the lined Centre Cell TMF – Although the Treaty Process Plant has a cyanide recovery process in the gold circuit, a marginal amount of cyanide was initially proposed to be discharged into the North and South cells of the TMF. During the pre-application EA process and to ensure compliance with the International Cyanide Management Code, the following design changes were made:
  - construction of a CIL Centre Cell in the TMF to meet the International Cyanide Management Code; and
  - installation of a geomembrane liner in the CIL cell to reduce the potential for contact water seepage to groundwater.
- Re-alignment of the TMF discharge location: In consultation with Nisga'a Nation and First Nations, the TMF discharge was revised to protect high fisheries values in Teigen Creek. Design of the TMF now includes:
  - non-contact diversion ditches on both valley walls to direct flow north into the Teigen watershed to supplement altered flows as a result of the TMF footprint;
  - TMF discharge south into Treaty Creek; and
  - a discharge schedule staged to the natural hydrograph of Treaty Creek to avoid low flow periods and to ensure compliance with receiving environment water quality objectives.

14.7.2.2.2 Temporary Water Treatment Plants

TWTPs will be located at tunnel portals and other key locations during the construction phase. The design of the TWTPs included consideration of a sensible "worst case scenario" for flow rates and predicted chemistry. Discharge objectives for the TWTPs were developed based on other approved Projects in the region and are presented in Table 14.7-22.

Table 14.7-22. Discharge Objectives for Temporary Water Treatment Plants

Parameter	Concentration (mg/L)
TSS	No more than 25 mg/L above the background concentration when the background is less than or equal to 250 mg/L, or no more than 10% above the background concentration when the background is greater than 250 mg/L
Cu	0.05
Fe	0.5
NH_3	10
Pb	0.1
Zn	0.5

Water treatment at the TWTPs is achieved through settling, lime and flocculent additions, air sparging, and acid addition as required to meet discharge limits established during permitting. Design details for TWTPs operated during the construction phase are included in *Temporary Water Treatment Plants for KSM Construction Period* (Appendix 4-P).

14.7.2.2.3 Mine Site Water Treatment Plant

Water collected at the WSF will be pumped to the Mine Site WTP located downstream. The Mine Site WTP will use a conventional HDS lime water treatment process with a maximum treatment rate of 7.5 m^3/s to allow staging of discharge to the natural hydrograph. During the development of the Application/EIS, the water treatment capacity increased from an average of 2.2 m^3/s to 2.5 m^3/s and maximum throughput capacity increased from 3.35 m^3/s to 7.5 m^3/s. The HDS water treatment design work was completed by SGS-CEMI in May 2011. The civil works were designed by Klohn Crippen Berger and the cost estimate was performed by Tetra Tech. In October 2012, Seabridge Gold Inc. commissioned a pilot plant to provide guidance for the design of the HDS water treatment with increased capacity. The pilot plant work was reported in January 2013 by SGSCanada Inc. (Appendix 4-S). Appendix 4-T forms an updated engineering design report based on the latest pilot plant results and provides design and cost estimate for the increased 7.5 m^3/s throughput design capacity. The work builds on the original work from SGS-CEMI, Klohn Crippen Berger, and Tetra Tech.

Water quality predictions for effluent from the WTP were based on a pilot-scale testing program of the HDS process completed by SGS Canada Inc. (Appendix 4-S). Feed water was generated using 10,000 L of water collected from Mitchell Creek at the toe of the Mitchell Glacier and concentrations of dissolved parameters were increased to approximate preliminary estimates of water quality in the WSF. Selenium species present in the feed water were based on the predicted selenium species distribution in the WSF (see Section 14.7.1.2): 50.5% Se (IV), 49.4% Se (VI), and 0.1% organic selenium (MeSe).

Various operating parameters including pH and retention times were optimized during pilot-scale testing. Increasing the pH from 9.5 to 10.5 improved the removal of cobalt, lithium, manganese, and sulphate, without affecting the removal efficiency of other key parameters including arsenic, cadmium, copper, selenium, and zinc. Aluminum concentrations remained high at both pH values tested. Retention time was varied from 20 to 90 minutes. Longer retention times decreased

aluminum concentrations slightly. The largest benefit of an increased retention time was decreased lime and flocculent consumption. At an operating pH of 10.5 and a retention time of 90 minutes, lime consumption decreased 25% to 0.83 kg/m^3 compared to a retention time of 60 minutes. The maximum achieved clarifier underflow slurry density was 19% solids; however, 25% density is predicted to be achievable with a full scale plant as the sludge bed is considerably greater in an industrial size clarifier due to a substantial compression zone. TSS is typically higher in pilot plant clarifier overflow than a full scale plant, but the pilot plant achieved an average TSS of 12 mg/L which is below the MMER maximum authorized monthly mean concentration (Canada 2002) and provincial discharge limits. The pH of the effluent was adjusted to 7.5 following settling using sulphuric acid to reduce dissolved aluminum concentrations and to meet discharge pH requirements (pH 6.5 to 8.5).

The feed water quality, estimated effluent quality post-pH adjustment, and removal efficiencies are presented in Table 14.7-24. The measured effluent quality post-pH adjustment was used to model the effluent quality entering the receiving environment. For parameters where no reduction in concentration was observed as a result of water treatment, no reduction in concentration was applied in the model (e.g., nitrate concentrations in WTP effluent were modelled as equivalent to nitrate concentrations in the WSF).

For most COPC, concentrations in the pilot plant effluent were greater than 90% lower than in the feed water and effluent concentrations were frequently lower than baseline concentrations in Mitchell Creek (Table 14.7-23). Total effluent concentrations were below MMER maximum authorized monthly mean concentrations (Canada 2002) and dissolved concentrations were below the lower limit of BC Pollution Control Objectives (BC MOE 1979), with the exception of selenium.

Selenium concentrations were below the upper limit of BC Pollution Control Objectives (range 0.05 to 0.5 mg/L; (BC MOE 1979). Selenium (IV) and organic selenium were effectively removed (> 85%) by the HDS process, while the concentration of selenium (VI) was unaffected by lime treatment. These results reflect that Se(IV) more readily sorbs to the iron oxyhydroxides produced during the HDS process and is therefore less mobile than Se(VI) (Elrashidi et al. 1987; Martin et al. 2011).

If further attenuation of water quality parameters is required as demonstrated by the results of the Aquatic Effects Monitoring Plan (Chapter 26, Section 26. 18.2), the WTP effluent may be discharged to a constructed wetland that will drain to lower Mitchell Creek (Figure 4.5-67A). Some attenuation of water quality parameters (i.e., nutrients) is expected. The effects assessment and water quality modelling, however, did not consider this potential reduction in concentration of water quality parameters as the constructed wetland will only be implemented as an adaptive management response and may not be required.

14.7.2.2.4 Treaty Process Plant Water Treatment and Cyanide Management

Tailing supernatant from the CIL circuit contains cyanide and elevated concentrations of cyanide-complexed dissolved metals, most significantly copper. Water treatment is proposed to recover cyanide and copper for both economic considerations and to improve discharge water quality. Test work was completed at SGS Research in Lakefield, Ontario, and details are presented in Appendix 4-Y. Cyanide transportation, storage, and use will be consistent with the International Cyanide Management Code.

Table 14.7-23. Mine Site Water Treatment Plant Effluent Quality

Parameter	Units	Mitchell Creek Average Water Quality	Feed Water Quality (Dissolved)	Effluent Quality (Dissolved)	Removal Efficiency (Dissolved)	Effluent Quality (Total)
Physical Parameters						
Hardness (as $CaCO_3$)	mg/L	154	426	1,210	n.a.	1,210
pH	pH unit	6.10	2.68	7.31	n.a.	7.31
Total Suspended Solids	mg/L	119	61.6	12.0	n.a.	12.0
Anions and Nutrients						
Ammonia (as N)	mg/L	0.0042	0.0088	0.0546	n.a.	-
Bromide (Br)	mg/L	0.10	0.42	0.50	n.a.	-
Chloride (Cl)	mg/L	0.69	4.2	b.d.	n.a.	-
Fluoride (F)	mg/L	0.492	1.13	0.20	82.3	-
Nitrate (as N)	mg/L	0.078	0.53	0.55	n.a.	-
Nitrite (as N)	mg/L	0.0016	0.015	b.d.	n.a.	-
Total Phosphate (as P)	mg/L	0.92	0.0884	0.0502	n.a.	-
Sulphate (SO_4)	mg/L	178	1217	1,200	n.a.	-
Metals						
Aluminum (Al)	mg/L	2.36	34.2	0.145	99.6	2.31
Antimony (Sb)	mg/L	0.00022	0.00041	0.00025 [2]	38.4	0.00025 [2]
Arsenic (As)	mg/L	0.00313	0.130	0.00025 [2]	99.8	0.00084
Barium (Ba)	mg/L	0.033	0.088	0.020	77.0	0.021
Beryllium (Be)	mg/L	0.00086	0.00859	0.00025 [2]	97.1	0.00025 [2]
Bismuth (Bi)	mg/L	0.00027	0.0013	0.0013 [2]	n.a.	0.0013 [2]
Boron (B)	mg/L	0.007	0.025	0.025 [2]	n.a.	0.025 [2]
Cadmium (Cd)	mg/L	0.00928	0.0431	0.000108	99.8	0.00022
Calcium (Ca)	mg/L	54.6	130	484	n.a.	482
Chromium (Cr)	mg/L	0.00023	0.0236	0.00426	82.0	0.00467
Cobalt (Co)	mg/L	0.0113	0.499	0.00025 [2]	99.9	0.0013
Copper (Cu)	mg/L	0.654	22.6	0.0046	100.0	0.064
Iron (Fe)	mg/L	7.40	236	0.025 [2]	100.0	0.63
Lead (Pb)	mg/L	0.00554	0.0367	0.00067	98.2	0.056
Lithium (Li)	mg/L	0.0038	0.0121	0.0060	50.8	0.0061
Magnesium (Mg)	mg/L	4.75	24.6	0.71	97.1	0.80
Manganese (Mn)	mg/L	0.971	14.8	0.00302	100.0	0.039
Mercury (Hg)	mg/L	0.000005	0.000024	0.000005 [2]	78.9	0.00003
Molybdenum (Mo)	mg/L	0.00118	0.0569	0.0143	75.0	0.0154
Nickel (Ni)	mg/L	0.00376	0.194	0.0013 [2]	99.3	0.0013 [2]
Potassium (K)	mg/L	0.708	1.80	1.93	n.a.	2.01

(continued)

Table 14.7-23. Mine Site Water Treatment Plant Effluent Quality (completed)

Parameter	Units	Mitchell Creek Average Water Quality	Feed Water Quality (Dissolved)	Effluent Quality (Dissolved)	Removal Efficiency (Dissolved)	Effluent Quality (Total)
Selenium (Se (IV))	mg/L	-	0.061	0.0097	84.6	-
Selenium (Se(VI))	mg/L	0.00192 [1]	0.060	0.065	n.a.	0.068 [3]
Selenium (Se(MeSe))	mg/L	-	0.00061	0.00050 [2]	100.0	-
Silicon (Si)	mg/L	2.91	6.536	0.140	97.9	0.184
Silver (Ag)	mg/L	0.000015	0.00411	0.000025 [2]	99.4	0.000025 [2]
Sodium (Na)	mg/L	2.40	5.31	4.05	n.a.	4.23
Strontium (Sr)	mg/L	0.344	0.776	0.820	n.a.	0.859
Thallium (Tl)	mg/L	0.00005	0.000139	0.000025 [2]	82.0	0.000025 [2]
Tin (Sn)	mg/L	0.00005	0.00094	0.00025 [2]	73.4	0.00025 [2]
Titanium (Ti)	mg/L	0.005	0.867	0.05 [2]	94.2	0.05 [2]
Uranium (U)	mg/L	0.00072	0.00200	0.000025 [2]	98.8	0.000025 [2]
Vanadium (V)	mg/L	0.0006	0.0044	0.0025 [2]	42.9	0.0025 [2]
Zinc (Zn)	mg/L	0.616	3.69	0.0025 [2]	99.9	0.024

Notes:
n.a. indicates concentration reduction was not observed.
b.d. indicates below detection and concentration was not used as an upper limit for effluent quality.
Where concentrations were below detection, half the detection limit was used for calculations or removal efficiencies.
[1] Total dissolved selenium concentrations were monitored for baseline studies in Mitchell Creek .
[2] Concentration in effluent was below detection.
[3]Total selenium concentration only was measured.

The residues from the leach circuit will be pumped to a conventional counter-current decantation washing circuit and then subjected to SART (sulphurization, acidification, recycling, and thickening of precipitates) and AVR (acidification, volatilization, and re-neutralization) processes to recover cyanide and copper from the circuit.

Tailing discharges to the CIL Lined Pond in the Centre Cell TMF will be further treated using activated carbon and the conventional SO_2/AIR process to reduce the weak acid dissociable cyanide (CN_{WAD}) and dissolved copper concentrations to 0.5 mg/L or below. The Centre Cell will be fully lined with an impermeable geomembrane HDPE liner to restrict seepage of tailing water into the groundwater.

The excess water decanted from the Centre Cell to the active flotation tailing pond (either the North Cell or South Cell) will undergo a final polishing step using hydrogen peroxide to ensure that the flotation pond is not unduly loaded with cyanide or copper. The peroxide oxidation step will oxidize any potential residual oxyanions, such as thiosalts, and potentially oxidize organic process chemicals in the water. The target CN_{WAD} and dissolved copper concentration to the main flotation tailing pond is 0.5 mg/L or less.

14.7.2.2.5 Hydrological Considerations

Water quality effects in Sulphurets Creek and the Unuk River will be minimized by storing effluent during the winter low flow periods, minimizing discharge during the winter (< 1 m^3/s), and increasing discharge during freshet and the summer high flow months (to a WTP maximum of 7.5 m^3/s). Peak discharge will occur from June to August each year.

The only discharge to the receiving environment from the TMF will be surplus water from the flotation tailing ponds. Water quality in Treaty Creek will be maintained by storing effluent during the winter low flow periods and scheduling discharge release during the high flow period (May to October) of each year. During the discharge period (May to October), a floating clarifier will be installed in the active flotation tailing pond with the ability to skim surface water and add a flocculent if required to reduce total suspended solids.

Staging discharge to the natural hydrograph in Sulphurets and Treaty creeks takes advantage of the natural dilution capacity and avoids or minimizes changes to water quality during the low flow winter and early spring periods (see Appendix 14-I).

14.7.2.2.6 Effluent Quality Monitoring

Regular monitoring of effluent quality will occur to ensure compliance with effluent permits under the *Environmental Management Act* (2003) and MMER (SOR/2002-22). Water quality analyses will include parameters determined in consultation with relevant government agencies. Further details of effluent quality monitoring are included in the Aquatic Effects Monitoring Plan (Section 26.18.2) and the Water Management Plan (Section 26.17.7.1). On-site performance monitoring prior to effluent discharge will be achieved through waste rock performance monitoring, tailing performance monitoring, and site surface water quality monitoring.

14.7.2.3 Sedimentation and Erosion

Water quality effects for the Mine Site and PTMA due to sedimentation and erosion will be mitigated by implementation of the management actions in the Terrain, Surficial Geology, and Soil Management and Monitoring Plan (Section 26.13) and Water Management Plan (Section 26.17) and monitoring in the Aquatic Effects Monitoring Plan (Section 26.18.2). Due to the common occurrence of steep slopes, terrain stability, erosion, and sedimentation control will be vital during the construction, operation, and closure phases. A detailed erosion monitoring program will be implemented to guide surface maintenance and mitigation efforts during the construction, operation, and closure phases.

During the construction and operation phases, erosion control strategies will include:

- controlling slope erosion by terracing and/or installing fibre logs, geotextiles, erosion control mats, straw, or gravel bags;
- controlling and directing runoff from disturbed areas by grading slopes and ditching;
- minimizing runoff energy by limiting the length and steepness of bare, exposed slopes and by applying appropriate surface drainage techniques (e.g., ditch blocks, ditch surface lining, rip-rap); and

Table 14.7-24. Potential Residual Effects on Surface Water Quality Valued Components Due to Degradation of Water Quality

Timing Start	Project Area(s)	Component(s)	Description of Effect due to Component(s)	Type of Project Mitigation	Project Mitigation Description	Potential Residual Effect	Description of Residuals
VC: Water Quality							
Construction	Mine Site and PTMA	Camps	Degradation of water quality due to sedimentation and erosion, sewage, and spills	Management Practices, Monitoring and Adaptive Management	Implementation of Terrain, Surficial Geology, and Soil Management and Monitoring Plan, Domestic and Industrial Waste Management Plan, and Spill Prevention and Emergency Response Plan	No	
Construction	Mine Site and PTMA	Access Roads and Laydown Areas	Degradation of water quality due to sedimentation and erosion, ML/ARD, leaching of blasting residues, spills, and atmospheric deposition	Management Practices, Monitoring and Adaptive Management	Implementation of Soil and Overburden Management Plan, ML/ARD Management Plan, Spill Prevention and Emergency Response Plan, and Air Quality Management Plan.	Yes	Potential degradation of water quality due to increased TSS, nitrogen, and metal concentrations in streams near access roads.
Construction	Mine Site and PTMA	RSFs, Pits, Block Cave Mines, Ore Preparation Complexes	Degradation of water quality due to ML/ARD, leaching of blasting residues, spills, seepage, and atmospheric deposition	Management Practices, Monitoring and Adaptive Management	Implementation of ML/ARD Management Plan, Spill Prevention and Emergency Response Plan, and Air Quality Management Plan. Diversion tunnels, channels, and ditches are designed to divert water from contact with Project components. Water in contact with RSFs, pits, underground workings, and ore stockpiles will be collected and directed to the WSF, WTP, or Selenium Treatment Plant for water treatment prior to effluent discharge.	No	
Construction	Mine Site and PTMA	Diversions and Tunnels	Degradation of water quality due to ML/ARD and leaching of blasting residues	Management Practices, Monitoring and Adaptive Management	Implementation of Water Management Plan, Water Resources Management Plan, Fish and Aquatic Habitat Management Plan, and ML/ARD Management Plan. Portions of tunnels that are PAG will be lined with concrete.	No	
Construction	Mine Site and PTMA	TWTP and STP	Degradation of water quality due to effluent discharge and sewage	Management Practices, Monitoring and Adaptive Management	Implementation of Fish and Aquatic Habitat Management Plan. Discharge limits for TWT will be set during permitting. Sewage will be treated to reclaimed water quality.	No	
Operation	Mine Site	WSF and WTP	Degradation of water quality due to effluent discharge, ML/ARD, and seepage	Management Practices, Monitoring and Adaptive Management	Implementation of Water Resources Management Plans, Fish and Aquatic Habitat Management Plan, and ML/ARD Management Plan. Effluent from the WSF will be treated at the WTP using the HDS process and discharge limits will be set during permitting. Drainage and runoff from the Sulphurets Pit backfill will be treated at the Selenium Treatment Plant. Effluent discharge from the WSF will be staged to match the natural hydrograph. Seepage collection ponds are designed to maximize capture of seepage through and below the WSD and recovered water will be pumped back to the WSF.	Yes	Potential degradation of water quality due to elevated selenium in effluent.
Operation	PTMA	TMF	Degradation of water quality due to effluent discharge, ML/ARD, and seepage	Management Practices, Monitoring and Adaptive Management	Implementation of Water Resources Management Plans, Fish and Aquatic Habitat Management Plan, and ML/ARD Management Plan. Seepage collection ponds are designed to maximize capture of seepage through and below the North and South dams, and recovered water will be pumped back to the TMF.	Yes	Potential degradation of water quality due to effluent discharge.
Construction	Mine Site	Sludge Management Facilities	Degradation of water quality due to seepage	Management Practices	Seepage will be collected and directed to the WSF.	No	
Construction	Mine Site and PTMA	Ore Preparation Complexes, Conveyors	Degradation of water quality due to atmospheric deposition	Management Practices	Implementation of the Air Quality Management Plan.	No	
Construction	PTMA and Off-site Transportation	Concentrate Storage and Loadout and Hwy 37/37A	Degradation of water quality through spills	Management Practices	Implementation of Spill Prevention and Emergency Response Plan.	No	

- stabilizing water diversion channels and ditches and protecting channel banks with willow, rocks, gabions, or fibre mats.

Some amount of soil erosion will occur, even with the erosion control strategies outlined above. Therefore, where required, sediment control measures will be implemented to ensure the capture of sediments before they are released to the receiving environment. Sediment control measures include installing and/or constructing:

- silt fences;
- straw bales;
- check dams;
- fabric-covered triangular dikes;
- gravel-filled burlap bags;
- sedimentation ponds; and
- rip-rap along channels and ditches.

Turbidity and TSS will be managed to ensure they remain below water quality guidelines. If required, sources of sediment will be identified and short-term erosion control measures (such as the installation of straw bales) will be implemented until long-term mitigation practices can be established.

14.7.2.4 Leaching of Blasting Residues

Degradation of water quality due to nitrogen loading from leaching of blasting residues is mitigated through water treatment during construction and management of explosives spills throughout the construction and operation phases.

TWTPs at various locations including tunnel portals and downstream of temporary PAG tunnel muck stockpiles are designed with air sparging to strip dissolved ammonia from the water. TWTPs are designed to provide ammonia treatment to less than 10 mg/L.

The Spill Prevention and Emergency Response Plan (Section 26.10) will implement documented operation procedures to avoid spills during explosives handling, which will minimize nitrogen loadings.

14.7.2.5 Sewage

Water quality effects for the Mine Site and PTMA due to sewage discharges will be mitigated by implementation of the management actions in the Domestic and Industrial Waste Management Plan (Section 26.6), and monitoring in the Aquatic Effects Monitoring Plan (Section 26.18.2). Each camp will have sewage treatment facilities that will include secondary treatment with disinfection and effluent will be discharged to either surface water or ground disposal locations in an acceptable manner as approved by permit condition. Sewage effluent and sludge disposal systems will have waste containment and runoff control structures to prevent escape of untreated waste to surface water or groundwater systems. Identification and quantification of water quality

effects due to discharges from sewage treatment facilities will occur through implementation of the Aquatic Effects Monitoring Plan (Section 26.18.2).

14.7.2.6 Spills

Potential water quality effects for the Mine Site and PTMA due to emergency spills of chemicals, reagents, fuel, and concentrate will be mitigated by implementation of the management actions in the Spill Prevention and Emergency Response Plan (Section 26.10). The preferred manner to deal with spills is avoidance with appropriate storage, handling, and transportation measures.

If a spill does occur despite the above precautions, timely and safe response is the key to minimizing adverse effects. Spill effects on water quality will be minimized by following the spill emergency response plan.

14.7.2.7 Seepage

Mitigation of potential effects on surface water quality due to seepage below and through dams during construction, operation, closure, and post-closure phases will be achieved through designed seepage collection. Seepage management systems are detailed in the design documents for the Mine Site (Appendix 4-J) and PTMA (Appendix 4-AC).

14.7.2.8 Mine Site

A 25-m high rockfill seepage dam with a core is provided downstream of the WSD to collect seepage from the WSF. Hydrogeological modelling has shown that rising groundwater flow paths are present due to the high terrain surrounding the WSF. These hydraulically confined conditions result in effective collection of the seepage by the seepage collection dam. Four seepage interception tunnels are provided within the abutments of the WSD. The tunnels' purpose is to route seepage within the abutments to the seepage collection dam. Two seepage collection tunnels are provided immediately upstream of the seepage dam grout curtain. Seepage collected in this dam will be routed directly to the WTP.

The bedrock foundations of the main dam and the seepage dam will be grouted with high-performance grout to further reduce seepage. The locations of the WSD seepage interception tunnels have been designed to facilitate construction of the grout curtain. The tunnels can also be used for additional or remedial grouting along the grout curtain beneath the dam core if required in the future. The seepage interception tunnels also allow monitoring of the locations of seepage inflow paths past the grout curtain in order to target remedial grouting to areas of deficiency if required.

14.7.2.8.1 Processing and Tailing Management Area

The TMF is located in a regional and local groundwater discharge zone, and seepage from the TMF will be contained by the steep hydraulic gradients on the valley slopes and seepage mitigation measures such as the cut-off walls under the dams (see Chapter 11 for further details). Seepage and runoff water from each tailing dam will be collected at downstream seepage collection dams and pumped back to the TMF. Collection sumps located upstream of the seepage dams will settle solids transported by runoff or produced by dam construction activities. These sediments will be slurried

at the collection sumps and pumped back into the TMF. Hydrogeological modelling has shown that the North, Southeast, and Saddle seepage collection dams are effective at minimizing the seepage of contact groundwater into the receiving environment.

14.7.2.9 Atmospheric Deposition

Mitigation of potential effects to surface water quality due to atmospheric deposition of dust during construction, operation, closure, and post-closure phases will be achieved through management of fugitive dust emissions as detailed in the Air Quality Management Plan (Section 26.11).

Dust management activities including dust suppression will be implemented on access roads, near crushing facilities and material stockpiles, and for transported materials to limit generation of fugitive dust. These activities will ensure that fugitive dust emissions are compliant with applicable regulations and standards, which will avoid degradation of water quality due to atmospheric deposition.

14.7.2.10 Potential for Residual Effects

The effect of degradation of water quality may result in a residual effect on surface water quality. Proposed mitigation includes minimizing ML/ARD and selenium leaching, water treatment, implementation of best management practices, adaptive management, and monitoring. Various Project components initially considered in the scoping exercise (Section 14.6) as having a potential effect on surface water quality are not considered in the following sections because mitigation is sufficient to avoid potential residual effects (Table 14.7-24).

Effects on surface water quality due to sewage, spills, and atmospheric deposition are considered to be fully mitigated given the proposed management strategies. Despite mitigation, potential residual effects on surface water quality due to ML/ARD and leaching of blasting residues near access roads, sedimentation and erosion, and effluent quality may occur (Table 14.7-24).

14.7.3 Surface Water Quality: Potential Residual Effects due to Degradation of Surface Water Quality

14.7.3.1 Potential Residual Effects outside Water Management Structures

14.7.3.1.1 Metal Leaching / Acid Rock Drainage

There is potential for ML/ARD from access road side slopes and excavated material entering the receiving environment during the construction and operation phases. The ML/ARD Management Plan will minimize effects on surface water quality; however, a lag time between the identification of ML/ARD and the implementation of remedial action cannot be ruled out.

14.7.3.1.2 Leaching of Blasting Residues

Blasting during construction of access corridors is likely to lead to leaching of blasting residues to local watercourses despite the implementation of best management practices and minimization of explosives spills. Water quality guideline exceedances may not occur; however, streams near the proposed access corridors currently have very low nitrogen concentrations so leaching of

blasting residues is likely to increase nitrogen concentrations. The effect of increased nitrogen on aquatic life is assessed in Chapter 15.

14.7.3.1.3 Sedimentation and Erosion

The primary goal of sediment mitigation strategies is to prevent sediment from entering the receiving environment. Although these mitigation and best management strategies are effective in minimizing sedimentation of the receiving environment, these strategies may not fully prevent all sediment entry. Thus, some residual effects due to erosion and sedimentation are expected to occur during the construction and operation phases.

14.7.3.2 Potential Residual Effects due to Effluent Quality

Potential residual effects on water quality in the receiving environment were identified through toxicity testing of effluent (HDS pilot plant and flotation [rougher] tailing supernatant) and the calculation of hazard quotients (HQs) for modelled water quality parameters. In risk assessment, the calculation of HQs can be a useful screening tool for determining the potential for a chemical to cause toxicity in receptors (such as aquatic life, fish, or wildlife species) in the receiving environment (US EPA 1998). HQs are most often calculated as a ratio of the concentration of a chemical (either a measured or predicted concentration) compared to the relevant guideline value. A hazard quotient of greater than 1.0 may indicate a potential for effects in receptors, while a hazard quotient of less than 1.0 is considered to not carry additional risk of toxicity to receptors. This approach was used to screen for potential residual effects related to discharge from either the TMF or Mine Site WTP using predicted water concentrations from the water quality model.

During baseline studies of water quality at the KSM Project (see Section 14.1 and Appendix 14-A), it was found that the concentrations for various parameters naturally exceeded BC water quality guidelines for the protection of aquatic life. In this case, comparison of predicted concentrations from the water quality model to concentrations specified in the guidelines may not be informative since the HQ during baseline studies would already be greater than 1.0. For these metals, the calculation of a hazard quotient based on background concentrations of the metal can provide a good indicator of the potential for incremental change in potential residual effects that may occur due to Project-related activities.

HQs are only useful as a screening tool to determine the potential for residual effects, and they should not be used to assess the magnitude of potential effects (i.e., a HQ of 8 is not necessarily worse than a HQ of 2 (US EPA 1998). For metals where the calculated HQ is > 1.0 (based on the greater of either guideline limits or background concentrations, as appropriate), more detailed consideration of the potential for residual effects is needed. Factors such as uncertainty in guideline limits (e.g., due to safety factors or the underlying studies used to derive the guidelines), the sensitivity of potential receptors in the receiving environment, or other Project-specific information (e.g., uncertainty in the predicted concentrations or other factors that may affect the metal concentration or toxicity) should be considered when determining the true potential for residual effects due to Project activities.

14.7.3.2.1 Mine Site

Potential residual effects on surface water quality for the Mine Site were assessed through toxicity testing of the HDS water treatment pilot plant and through predictive water quality modelling of the receiving environment. The methods and assumption used for water quality modelling are described in Section 14.7.1.2.

Water Treatment Pilot Plant Effluent Toxicity

Effluent generated by the water treatment pilot plant was tested using a standard suite of acute and chronic toxicity tests (Table 14.7-25). Toxicity tests were conducted using laboratory surrogate organisms including a fish (*Oncorhynchus mykiss*), an invertebrate (*Daphnia magna* in the acute test, *Ceriodaphnia dubia* in the chronic test), an aquatic plant (*Lemna minor*), and an alga (*Pseudokirchneriella subcapitata*) following standard Environment Canada methods (see Appendix 14-D for method details).

Table 14.7-25. Pilot Plant Effluent Toxicity Testing, KSM Project

Type of Test	Type of Organism	Species Used in Test	Physiological Endpoint Measured	Concentration (% v/v)	Confidence Intervals (% v/v)
Toxicity Tests 1					
Acute	Fish	*Oncorhynchus mykiss*	Survival (LC_{50})	> 100	n/a
	Invertebrate	*Daphnia magna*	Survival (LC_{50})	16.5	14.5 to 18.8
Toxicity Tests 2					
Acute	Fish	*O. mykiss*	Survival (LC_{50})	> 100	n/a
	Invertebrate	*Daphnia magna*	Survival (LC_{50})	> 100	n/a
Chronic	Algae	*Pseudokirchneriella subcapitata*	Growth (IC_{25})	> 95.2[a]	n/a
	Aquatic plant	*Lemna minor*	Frond growth (IC_{25})	> 97	n/a
			Dry Weight (IC_{25})	> 97	n/a
	Invertebrate	*Ceriodaphnia dubia*	Survival (LC_{50})	66.9	62.7 to 71.5
			Reproduction (IC_{25})	6.4	3.8 to 8.1
	Fish	*O. mykiss*	Embryo viability (IC_{25})	79.5	53.9 to 100

Concentrations are expressed in percent as volume of pilot plant effluent / total volume × 100.
LC_{50} is the concentration of pilot plant effluent required to cause death in 50% of exposed organisms.
IC_{25} is the concentration of pilot plant water required to decrease survival, growth, or reproduction by 25% compared to the control group.
> 95, > 97, or > 100 means that the pilot plant effluent had no effect on the tested endpoint .
[a] Pilot plant effluent stimulated the growth of the algae relative to the control group (lab water).

Effluent was tested on two occasions. The first set of tests (Toxicity Tests 1) included only the fish (*O. mykiss* [rainbow trout]) and invertebrate (*Daphnia magna*) acute toxicity tests, which were carried out within the acceptable holding time for these tests (within five days of sample collection for acute tests). Chronic tests were not done at this time as laboratory capacity was not available to test the sample. The sample for the second set of toxicity tests (Toxicity Tests 2) was submitted approximately one week later and included both acute and chronic tests on the same effluent as the first set of tests. Water chemistry samples were also concurrently collected from the toxicity test samples and these are provided in Table 14.7-26.

Table 14.7-26. Pilot Plant Effluent Water Chemistry Concurrent with Toxicity Testing, KSM Project

Parameter	Toxicity Tests 1 Sample	Toxicity Tests 2 Sample	BC Water Quality Guidelines
Physical Tests, Anions, and Nutrients			
Hardness (as $CaCO_3$)	1,210	1,230	
pH (pH units)	7.31	7.05	
Total Suspended Solids	12.0	20	
Total Dissolved Solids	1,765	1,750	
Turbidity (NTU)	5.46	6.77	
Acidity (as $CaCO_3$)	2.9	5.1	
Alkalinity, Bicarbonate (as $CaCO_3$)	9.30	8.95	
Alkalinity, Carbonate (as $CaCO_3$)	< 1.0	< 1.0	
Alkalinity, Hydroxide (as $CaCO_3$)	< 1.0	< 1.0	
Alkalinity, Total (as $CaCO_3$)	8.85	8.95	
Ammonia, Total (as N)	0.0546	0.0547	1.18
Bromide	< 1.0	< 0.50	
Chloride	< 10	< 5.0	
Fluoride	< 0.40	0.42	variable
Nitrate (as N)	0.55	0.4785	3
Nitrite (as N)	< 0.020	< 0.010	0.02
Orthophosphate (as P)	< 0.0010	< 0.0010	
Total phosphorus	0.0502	0.0089	
Sulphate	1,200	1,185	270
Metals			
Aluminum (dissolved)	0.15	0.25	0.1
Antimony	< 0.00050	< 0.00050	0.02
Arsenic	0.00084	0.00100	0.005
Barium	0.0214	0.0212	1
Beryllium	< 0.00050	< 0.00050	0.0053
Bismuth	< 0.0025	< 0.0025	
Boron	< 0.050	< 0.050	1.2
Cadmium	0.000217	0.0002285	variable
Calcium	482	480.5	
Chromium	0.00467	0.00449	0.001
Cobalt	0.00134	0.00167	0.004
Copper	0.0644	0.0775	0.0025
Iron	0.625	0.7975	1
Lead	0.0563	0.01978	variable
Lithium	0.0061	0.0047	0.096

(continued)

Table 14.7-26. Pilot Plant Effluent Water Chemistry Concurrent with Toxicity Testing, KSM Project (completed)

Parameter	Toxicity Tests 1 Sample	Toxicity Tests 2 Sample	BC Water Quality Guidelines
Metals *(cont'd)*			
Magnesium	0.80	0.865	
Manganese	0.0387	0.04905	variable
Mercury	0.00005	0.00004	0.00002
Molybdenum	0.0154	0.01545	1
Nickel	< 0.0025	< 0.0025	0.15
Phosphorus	< 0.30	< 0.30	
Potassium	2.01	1.895	
Selenium	0.0683	0.06485	0.002
Silicon	0.184	0.1925	
Silver	< 0.000050	0.000040	0.0015
Sodium	4.23	4.37	
Strontium	0.859	0.841	
Thallium	< 0.000050	< 0.000050	0.0003
Tin	< 0.00050	0.00041	
Titanium	< 0.010	0.013	
Uranium	< 0.000050	0.000105	0.3
Vanadium	< 0.0050	< 0.0050	0.006
Zinc	0.024	0.018	variable

Notes:
Units are in mg/L unless otherwise noted.
Metal concentrations are for total metals, unless otherwise noted (i.e., aluminum).
Guidelines where the concentration is variable are hardness dependent.
Shaded cells are parameters in the pilot plant effluent that exceed water quality guidelines.

The toxicity tests were done by preparing a series of solutions containing a percentage (ranging from 0 to 100%) of pilot plant effluent, diluted with laboratory water as required. For each toxicity test, the physiological endpoint was measured for organisms exposed to the various solutions, and the concentration of pilot plant effluent required to cause a 50% decrease in survival (LC_{50}) or a 25% decrease in reproduction or growth (IC_{25}) was calculated.

The effluent was not acutely lethal (as defined under the MMER), as survival of rainbow trout fry was unaffected by effluent exposure (Table 14.7-26). However, the fresh effluent (within the five-day holding time) in Toxicity Tests 1 was acutely lethal to *D. magna*, and the test results indicate that approximately six-fold dilution of the effluent is required to reach the LC_{50} for this organism (i.e., the amount of effluent required to cause mortality in 50% of exposed organisms). Based on the water chemistry, metal toxicity does not appear to be the cause of lethality to *D. magna*, as most metals were below guideline limits or just slightly above the guidelines. While selenium was above guideline limits, it is unlikely that it caused acute lethality since selenium LC_{50} concentrations for most invertebrates are greater than 0.1 mg/L (Nagpal and Howell 2001).

There were elevated concentrations of major ions including calcium and sulphate, which most likely contributed to the mortality of the more sensitive invertebrate due to osmotic stress.

Exposure to the effluent (Toxicity Tests 2) led to chronic effects on survival and reproduction in *C. dubia* (invertebrate) and resulted in slight reduction in rainbow trout embryo viability. The effects on the rainbow trout embryos were mild and would require less than a 1:2 dilution to be ameliorated. Fish are not present until approximately 9 km downstream of the discharge point for the Mine Site WTP and effects would not be expected since substantial dilution of the effluent would occur in Sulphurets Creek. The effects of the effluent on *C. dubia* reproduction indicate that the invertebrate is the most sensitive species and that the effluent would require approximately 15-fold dilution to become non-toxic for this species. The growth of *L. minor* (aquatic plant) was unaffected, while the growth of *P. subcapitata* (algae) was enhanced by exposure to the effluent.

Comparison of the acute test results from Toxicity Tests 1 and Toxicity Tests 2 suggest that the effluent became less toxic over time, as *Daphnia magna* acute lethality decreased over time (Table 14.7-26). However, there were not substantial differences in water chemistry for any of the parameters measured between the two samples that would explain the difference in the observed effect (Table 14.7-27), suggesting that other factors (e.g., metal speciation, slight differences in test conditions) may have contributed to the difference in toxicity.

Receiving Environment Water Quality

Predicted water quality in the receiving environment downstream of the Mine Site was assessed for Sulphurets Creek and the Unuk River in the construction, operation, closure, and post-closure phases. Water quality predictions were compared to both BC water quality guidelines for the protection of freshwater aquatic life and observed background conditions (95th percentile of baseline data for a given month).

Sulphurets Creek

Predictions for site SC2 (Sulphurets Creek at the confluence of Mitchell Creek) are included in Appendix 14-H. The following sections focus on water quality predictions in lower Sulphurets Creek below the cascades (site SC3), which is the first point downstream of the Mine Site where fish have been detected in baseline studies (see Chapter 15). Tables 14.7-28 to 14.7-31 present statistical summaries of water quality in Sulphurets Creek (site SC3) for the four model scenarios for the construction, operation, closure, and post-closure phases.

Figures 14.7-19 to 14.7-26 present the water quality predictions for six COPC during the operation, closure, and post-closure phases of the Project.

Water treatment at the HDS WTP, including settling for TSS control, is predicted to reduce the total concentrations of various metals below baseline conditions (e.g., cadmium, copper, and zinc). HQ calculations were used to screen for potential residual effects. Sporadic hazard quotients greater than 1.0 were calculated for total chromium and total copper during the operation, closure, and post-closure phases. Further investigation indicated that these predictions were a result of uncertainties in the model due to monthly inputs in flow and concentration values; therefore, no residual effects in Sulphurets Creek are expected related to chromium and copper. HQs greater than 1.0 were calculated for dissolved aluminum and total selenium concentrations in all Project phases.

Table 14.7-27. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Construction Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.002	0.099	0.099	0.191	0.175	0.045	0.46
Chloride (Cl)	0.25	0.85	0.82	1.16	1.15	0.20	0.24
Fluoride (F)	0.03	0.08	0.08	0.11	0.11	0.02	0.27
Nitrate (as N)	0.08	1.38	1.25	2.10	2.08	0.42	0.31
Nitrite (as N)	0.0005	0.0007	0.0007	0.0008	0.0008	0.0001	0.18
Total Phosphate (as P)	0.01	0.16	0.11	0.52	0.51	0.15	0.90
Sulphate (SO_4)	39	**105**	**115**	**168**	**167**	37	0.35
Total Metals							
Aluminum (Al)	0.002	*1.69*	*0.36*	*6.95*	*6.95*	2.24	1.33
Antimony (Sb)	0.0004	0.0007	0.0006	0.0012	0.0012	0.0002	0.32
Arsenic (As)	0.0001	0.0024	0.0006	**0.0109**	**0.0109**	0.0031	1.29
Barium (Ba)	0.028	0.062	0.040	0.154	0.154	0.041	0.66
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0004	0.92
Boron (B)	0.005	0.007	0.007	0.008	0.008	0.001	0.10
Cadmium (Cd)	0.000005	**0.00040**	**0.00035**	**0.00123**	**0.00123**	0.00034	0.86
Calcium (Ca)	19.87	48.92	51.66	71.64	71.22	16.09	0.33
Chromium (Cr)	0.0002	**0.0024**	**0.0012**	**0.0084**	**0.0084**	0.0023	0.96
Cobalt (Co)	0.0001	0.001	0.001	0.005	0.005	0.002	1.11
Copper (Cu)	0.0003	**0.03**	0.01	**0.12**	**0.12**	0.04	1.20
Iron (Fe)	0.01	**2.83**	0.72	**11.42**	**11.41**	3.79	1.34
Lead (Pb)	0.000	0.002	0.001	0.006	0.006	0.002	1.23
Lithium (Li)	0.001	0.003	0.003	0.005	0.005	0.001	0.24
Magnesium (Mg)	2.58	4.02	3.97	5.55	5.55	0.73	0.18
Manganese (Mn)	0.00003	0.10	0.06	0.33	0.33	0.10	0.99
Mercury (Hg)	0.000005	0.000007	0.000005	0.000019	0.000019	0.000004	0.63
Molybdenum (Mo)	0.002	0.004	0.004	0.005	0.005	0.001	0.21
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.61
Potassium (K)	1.15	1.75	1.63	2.90	2.90	0.47	0.27
Selenium (Se)	0.0012	**0.0023**	**0.0022**	**0.0035**	**0.0035**	0.0005	0.24
Silicon (Si)	1.56	4.51	2.36	12.58	12.58	3.49	0.77
Silver (Ag)	0.000005	0.000050	0.000011	0.000197	0.000197	0.000064	1.26
Sodium (Na)	1.17	1.81	1.83	2.81	2.81	0.54	0.30
Strontium (Sr)	0.14	0.32	0.35	0.43	0.43	0.10	0.31
Thallium (Tl)	0.00003	0.00005	0.00004	0.00010	0.00010	0.00002	0.44
Tin (Sn)	0.00005	0.00010	0.00010	0.00013	0.00013	0.00002	0.22
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0068	0.0017	0.0303	0.0303	0.0091	1.35
Zinc (Zn)	0.002	0.033	0.026	0.099	0.099	0.027	0.82

(continued)

Table 14.7-27. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Construction Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.002	0.028	0.017	0.199	0.102	0.033	1.15
Chloride (Cl)	0.25	2.98	1.94	12.36	9.34	2.55	0.86
Fluoride (F)	0.03	0.08	0.08	0.12	0.11	0.02	0.27
Nitrate (as N)	0.01	0.37	0.16	2.35	1.25	0.41	1.11
Nitrite (as N)	0.0005	0.0006	0.0006	0.0008	0.0007	0.0001	0.10
Total Phosphate (as P)	0.001	0.13	0.07	0.58	0.52	0.16	1.19
Sulphate (SO_4)	33	**149**	**149**	**237**	**204**	35	0.23
Total Metals							
Aluminum (Al)	0.002	*1.69*	*0.42*	*7.95*	*7.12*	2.24	1.32
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.29
Arsenic (As)	0.0001	0.0025	0.0007	**0.0109**	**0.0104**	0.0030	1.22
Barium (Ba)	0.025	0.063	0.043	0.173	0.157	0.040	0.64
Beryllium (Be)	0.0001	0.0004	0.0002	0.0019	0.0011	0.0004	0.99
Boron (B)	0.005	0.006	0.006	0.009	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.00041**	**0.00037**	**0.00123**	**0.00119**	0.00033	0.80
Calcium (Ca)	19.41	51.40	55.07	74.19	71.11	14.84	0.29
Chromium (Cr)	0.0002	**0.0023**	0.0009	**0.0095**	**0.0086**	0.0025	1.09
Cobalt (Co)	0.0001	0.001	0.001	0.006	0.005	0.002	1.09
Copper (Cu)	0.0003	**0.03**	0.01	**0.12**	**0.12**	0.04	1.14
Iron (Fe)	0.01	**2.86**	0.79	**13.04**	**11.69**	3.78	1.32
Lead (Pb)	0.000	0.002	0.001	0.007	0.006	0.002	1.23
Lithium (Li)	0.001	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.47	4.21	4.17	5.99	5.62	0.85	0.20
Manganese (Mn)	0.00003	0.10	0.07	0.37	0.33	0.09	0.96
Mercury (Hg)	0.000005	0.000007	0.000005	0.000019	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.005	0.004	0.0005	0.14
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.62
Potassium (K)	0.80	1.76	1.67	3.22	2.95	0.51	0.29
Selenium (Se)	0.0010	**0.0039**	**0.0037**	**0.0070**	**0.0064**	0.0013	0.33
Silicon (Si)	1.56	4.62	2.60	14.23	12.86	3.39	0.73
Silver (Ag)	0.000005	0.000050	0.000010	0.000224	0.000201	0.000064	1.30
Sodium (Na)	1.00	1.74	1.63	2.82	2.73	0.49	0.28
Strontium (Sr)	0.14	0.30	0.32	0.43	0.39	0.07	0.23
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.43
Tin (Sn)	0.00005	0.00009	0.00009	0.00014	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0003	0.0005	0.0004	0.0001	0.25
Vanadium (V)	0.0005	0.0068	0.0017	0.0345	0.0310	0.0093	1.38
Zinc (Zn)	0.002	0.034	0.029	0.099	0.095	0.026	0.76

(continued)

Table 14.7-27. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Construction Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.002	0.035	0.019	0.232	0.124	0.042	1.21
Chloride (Cl)	0.25	1.37	0.89	6.19	4.22	1.14	0.83
Fluoride (F)	0.03	0.08	0.08	0.12	0.11	0.02	0.28
Nitrate (as N)	0.01	0.35	0.15	2.50	1.25	0.42	1.18
Nitrite (as N)	0.0005	0.0006	0.0006	0.0008	0.0007	0.0001	0.10
Total Phosphate (as P)	0.00	0.13	0.08	0.58	0.52	0.16	1.21
Sulphate (SO_4)	33	**140**	**138**	**240**	**204**	36	0.26
Total Metals							
Aluminum (Al)	0.002	*1.71*	*0.42*	*8.03*	*7.18*	2.27	1.32
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.30
Arsenic (As)	0.0001	0.0025	0.0007	**0.0113**	**0.0105**	0.0031	1.22
Barium (Ba)	0.025	0.063	0.043	0.175	0.158	0.041	0.64
Beryllium (Be)	0.0001	0.0004	0.0002	0.0021	0.0011	0.0004	0.97
Boron (B)	0.005	0.006	0.006	0.009	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.00041**	**0.00037**	**0.00127**	**0.00119**	0.00033	0.81
Calcium (Ca)	19.29	50.50	54.62	73.54	71.01	15.05	0.30
Chromium (Cr)	0.0002	**0.0023**	0.0009	**0.0096**	**0.0086**	0.0025	1.09
Cobalt (Co)	0.0001	0.001	0.001	0.006	0.005	0.002	1.09
Copper (Cu)	0.0003	**0.03**	0.01	**0.13**	**0.12**	0.04	1.14
Iron (Fe)	0.01	**2.89**	0.81	**13.18**	**11.78**	3.82	1.32
Lead (Pb)	0.000	0.002	0.001	0.007	0.006	0.002	1.23
Lithium (Li)	0.001	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.44	4.22	4.16	6.01	5.65	0.85	0.20
Manganese (Mn)	0.00003	0.10	0.07	0.38	0.34	0.10	0.96
Mercury (Hg)	0.000005	0.000007	0.000005	0.000020	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.005	0.004	0.000	0.14
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.63
Potassium (K)	0.80	1.77	1.69	3.26	2.97	0.52	0.29
Selenium (Se)	0.0010	**0.0033**	**0.0031**	**0.0057**	**0.0053**	0.0010	0.31
Silicon (Si)	1.55	4.66	2.63	14.36	12.95	3.43	0.74
Silver (Ag)	0.000005	0.000050	0.000010	0.000226	0.000203	0.000065	1.30
Sodium (Na)	1.00	1.75	1.64	2.87	2.74	0.50	0.28
Strontium (Sr)	0.14	0.30	0.32	0.44	0.39	0.07	0.23
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.44
Tin (Sn)	0.00005	0.00009	0.00009	0.00015	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0003	0.0005	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0068	0.0017	0.0348	0.0312	0.0094	1.38
Zinc (Zn)	0.002	0.034	0.030	0.102	0.095	0.026	0.77

(continued)

Table 14.7-27. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Construction Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.002	0.035	0.019	0.232	0.124	0.042	1.21
Chloride (Cl)	0.25	2.94	1.83	13.54	9.46	2.61	0.89
Fluoride (F)	0.03	0.08	0.08	0.12	0.11	0.02	0.28
Nitrate (as N)	0.01	0.35	0.15	2.50	1.25	0.42	1.18
Nitrite (as N)	0.0005	0.0006	0.0006	0.0008	0.0007	0.0001	0.10
Total Phosphate (as P)	0.00	0.13	0.08	0.58	0.52	0.16	1.21
Sulphate (SO_4)	33	**146**	**147**	**240**	**205**	36	0.25
Total Metals							
Aluminum (Al)	0.002	*1.71*	*0.42*	*8.03*	*7.18*	2.27	1.32
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.30
Arsenic (As)	0.0001	0.0025	0.0007	**0.0113**	**0.0105**	0.0031	1.22
Barium (Ba)	0.025	0.063	0.043	0.175	0.158	0.041	0.64
Beryllium (Be)	0.0001	0.0004	0.0002	0.0021	0.0011	0.0004	0.97
Boron (B)	0.005	0.006	0.006	0.009	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.00041**	**0.00037**	**0.00127**	**0.00119**	0.00033	0.81
Calcium (Ca)	19.35	51.46	55.36	74.41	71.60	15.15	0.29
Chromium (Cr)	0.0002	**0.0023**	0.0009	**0.0096**	**0.0086**	0.0025	1.09
Cobalt (Co)	0.0001	0.001	0.001	0.006	0.005	0.002	1.09
Copper (Cu)	0.0003	**0.03**	0.01	**0.13**	**0.12**	0.04	1.14
Iron (Fe)	0.01	**2.89**	0.81	**13.18**	**11.78**	3.82	1.32
Lead (Pb)	0.000	0.002	0.001	0.007	0.006	0.002	1.23
Lithium (Li)	0.001	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.44	4.22	4.17	6.01	5.65	0.85	0.20
Manganese (Mn)	0.00003	0.10	0.07	0.38	0.34	0.10	0.96
Mercury (Hg)	0.000005	0.000007	0.000005	0.000020	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.005	0.004	0.000	0.14
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.63
Potassium (K)	0.80	1.77	1.69	3.26	2.97	0.52	0.29
Selenium (Se)	0.0010	**0.0038**	**0.0036**	**0.0070**	**0.0064**	0.0014	0.36
Silicon (Si)	1.55	4.66	2.63	14.36	12.95	3.43	0.74
Silver (Ag)	0.000005	0.000050	0.000010	0.000226	0.000203	0.000065	1.30
Sodium (Na)	1.00	1.75	1.64	2.87	2.74	0.50	0.28
Strontium (Sr)	0.14	0.30	0.32	0.44	0.39	0.07	0.23
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.43
Tin (Sn)	0.00005	0.00009	0.00009	0.00015	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0003	0.0005	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0068	0.0017	0.0348	0.0312	0.0094	1.38
Zinc (Zn)	0.002	0.034	0.030	0.102	0.095	0.026	0.77

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-28. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0334	0.0185	0.2337	0.1210	0.0401	1.20
Chloride (Cl)	0.3	1.4	0.9	5.9	4.0	1.1	0.83
Fluoride (F)	0.03	0.07	0.08	0.11	0.11	0.02	0.27
Nitrate (as N)	0.01	0.43	0.19	2.39	1.36	0.46	1.09
Nitrite (as N)	0.0005	0.0006	0.0006	0.0008	0.0007	0.00006	0.10
Total Phosphate (as P)	0.001	0.133	0.072	0.522	0.518	0.159	1.20
Sulphate (SO_4)	33	**143**	**144**	**226**	**204**	34	0.23
Total Metals							
Aluminum (Al)	0.002	*1.69*	*0.40*	*7.16*	*7.12*	2.22	1.32
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.29
Arsenic (As)	0.0001	0.0025	0.0007	**0.0109**	**0.0104**	0.0030	1.22
Barium (Ba)	0.03	0.06	0.04	0.16	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.92
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000410**	**0.000373**	**0.001232**	**0.001187**	0.000330	0.81
Calcium (Ca)	19.7	50.5	54.5	73.4	70.5	14.6	0.29
Chromium (Cr)	0.0003	**0.0022**	0.0010	**0.0086**	**0.0086**	0.0024	1.09
Cobalt (Co)	0.0001	0.0015	0.0006	0.0051	0.0050	0.0016	1.08
Copper (Cu)	0.0003	**0.0315**	0.0096	**0.1224**	**0.1177**	0.0359	1.14
Iron (Fe)	0.015	**2.845**	0.786	**11.755**	**11.687**	3.734	1.31
Lead (Pb)	0.00003	0.00170	0.00054	0.00631	0.00628	0.00208	1.22
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.5	4.2	4.2	5.6	5.6	0.8	0.20
Manganese (Mn)	0.00003	0.09875	0.06782	0.33502	0.33311	0.09360	0.95
Mercury (Hg)	0.000005	0.000007	0.000005	0.000019	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.005	0.004	0.0004	0.14
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.62
Potassium (K)	1.0	1.8	1.7	3.0	2.9	0.5	0.28
Selenium (Se)	0.0012	**0.0040**	**0.0037**	**0.0071**	**0.0065**	0.0012	0.31
Silicon (Si)	1.6	4.6	2.6	12.9	12.9	3.4	0.73
Silver (Ag)	0.000005	0.000049	0.000010	0.000202	0.000201	0.000064	1.29
Sodium (Na)	1.0	1.7	1.6	2.8	2.7	0.5	0.28
Strontium (Sr)	0.14	0.30	0.32	0.43	0.38	0.07	0.23
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.43
Tin (Sn)	0.00005	0.00009	0.00009	0.00014	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0067	0.0017	0.0311	0.0310	0.0092	1.37
Zinc (Zn)	0.0015	0.0336	0.0291	0.0988	0.0948	0.0257	0.76

(continued)

Table 14.7-28. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0334	0.0185	0.2337	0.1210	0.0401	1.20
Chloride (Cl)	0.3	3.0	1.9	13.0	8.7	2.6	0.86
Fluoride (F)	0.03	0.07	0.08	0.11	0.11	0.02	0.27
Nitrate (as N)	0.01	0.43	0.19	2.39	1.36	0.46	1.09
Nitrite (as N)	0.0005	0.0006	0.0006	0.0008	0.0007	0.00006	0.10
Total Phosphate (as P)	0.001	0.133	0.072	0.522	0.518	0.159	1.20
Sulphate (SO_4)	34	**150**	**153**	**226**	**204**	33	0.22
Total Metals							
Aluminum (Al)	0.002	*1.69*	*0.40*	*7.16*	*7.12*	2.22	1.32
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.29
Arsenic (As)	0.0001	0.0025	0.0007	**0.0109**	**0.0104**	0.0030	1.22
Barium (Ba)	0.03	0.06	0.04	0.16	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.91
Boron (B)	0.005	0.006	0.006	0.009	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000410**	**0.000373**	**0.001232**	**0.001187**	0.000330	0.80
Calcium (Ca)	19.8	51.5	54.6	73.5	71.0	14.6	0.28
Chromium (Cr)	0.0003	**0.0022**	0.0010	**0.0086**	**0.0086**	0.0024	1.08
Cobalt (Co)	0.0001	0.0015	0.0006	0.0051	0.0050	0.0016	1.08
Copper (Cu)	0.0003	**0.0315**	0.0096	**0.1224**	**0.1177**	0.0359	1.14
Iron (Fe)	0.015	**2.845**	0.786	**11.755**	**11.687**	3.734	1.31
Lead (Pb)	0.00003	0.00170	0.00054	0.00631	0.00628	0.00208	1.22
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.26
Magnesium (Mg)	2.5	4.2	4.2	5.6	5.6	0.8	0.20
Manganese (Mn)	0.00003	0.09876	0.06783	0.33503	0.33312	0.09360	0.95
Mercury (Hg)	0.000005	0.000007	0.000005	0.000019	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.005	0.004	0.0004	0.14
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.62
Potassium (K)	1.0	1.8	1.7	3.0	2.9	0.5	0.28
Selenium (Se)	0.0012	**0.0048**	**0.0046**	**0.0085**	**0.0080**	0.0017	0.35
Silicon (Si)	1.6	4.6	2.6	12.9	12.9	3.4	0.73
Silver (Ag)	0.000005	0.000049	0.000010	0.000202	0.000201	0.000064	1.29
Sodium (Na)	1.0	1.7	1.6	2.8	2.7	0.5	0.28
Strontium (Sr)	0.14	0.30	0.32	0.43	0.38	0.07	0.23
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.43
Tin (Sn)	0.00006	0.00009	0.00009	0.00014	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0067	0.0017	0.0311	0.0310	0.0092	1.37
Zinc (Zn)	0.0015	0.0336	0.0291	0.0988	0.0948	0.0257	0.76

(continued)

Table 14.7-28. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0269	0.0121	0.2803	0.1064	0.0375	1.39
Chloride (Cl)	0.3	1.5	0.9	6.0	4.1	1.2	0.86
Fluoride (F)	0.04	0.07	0.08	0.10	0.10	0.02	0.29
Nitrate (as N)	0.02	0.44	0.23	2.50	1.46	0.48	1.10
Nitrite (as N)	0.0005	0.0005	0.0005	0.0007	0.0006	0.00004	0.07
Total Phosphate (as P)	0.001	0.129	0.059	0.524	0.514	0.162	1.25
Sulphate (SO_4)	35	**142**	**136**	**261**	**206**	38	0.27
Total Metals							
Aluminum (Al)	0.002	*1.69*	*0.40*	*7.06*	*7.02*	2.21	1.31
Antimony (Sb)	0.0004	0.0007	0.0007	0.0011	0.0011	0.0002	0.29
Arsenic (As)	0.0001	0.0025	0.0007	**0.0107**	**0.0106**	0.0030	1.23
Barium (Ba)	0.03	0.06	0.04	0.16	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.91
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000411**	**0.000352**	**0.001215**	**0.001202**	0.000332	0.81
Calcium (Ca)	19.7	50.5	55.6	70.9	70.2	14.4	0.29
Chromium (Cr)	0.0002	**0.0022**	0.0008	**0.0085**	**0.0085**	0.0024	1.10
Cobalt (Co)	0.0001	0.0015	0.0006	0.0050	0.0050	0.0016	1.08
Copper (Cu)	0.0003	**0.0315**	0.0098	**0.1207**	**0.1194**	0.0361	1.15
Iron (Fe)	0.015	**2.850**	0.798	**11.605**	**11.532**	3.721	1.31
Lead (Pb)	0.00003	0.00170	0.00054	0.00623	0.00620	0.00207	1.22
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.5	4.2	4.2	5.6	5.6	0.8	0.20
Manganese (Mn)	0.00003	0.09896	0.06753	0.33049	0.32860	0.09303	0.94
Mercury (Hg)	0.000005	0.000007	0.000005	0.000019	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0005	0.15
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.61
Potassium (K)	1.1	1.8	1.7	2.9	2.9	0.5	0.28
Selenium (Se)	0.0012	**0.0040**	**0.0039**	**0.0081**	**0.0064**	0.0014	0.34
Silicon (Si)	1.9	4.6	2.6	12.8	12.7	3.3	0.72
Silver (Ag)	0.000005	0.000050	0.000010	0.000200	0.000199	0.000064	1.28
Sodium (Na)	1.0	1.7	1.6	2.7	2.7	0.5	0.29
Strontium (Sr)	0.14	0.30	0.34	0.39	0.37	0.07	0.23
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.42
Tin (Sn)	0.00005	0.00009	0.00008	0.00014	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0067	0.0016	0.0308	0.0306	0.0091	1.36
Zinc (Zn)	0.0015	0.0338	0.0269	0.0972	0.0962	0.0258	0.76

(continued)

Table 14.7-28. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0269	0.0121	0.2803	0.1064	0.0375	1.39
Chloride (Cl)	0.3	3.2	2.0	13.1	9.3	2.8	0.88
Fluoride (F)	0.04	0.07	0.08	0.10	0.10	0.02	0.29
Nitrate (as N)	0.02	0.44	0.23	2.50	1.46	0.48	1.10
Nitrite (as N)	0.0005	0.0005	0.0005	0.0007	0.0006	0.00004	0.07
Total Phosphate (as P)	0.001	0.129	0.059	0.524	0.514	0.162	1.25
Sulphate (SO_4)	36	**149**	**147**	**261**	**221**	38	0.26
Total Metals							
Aluminum (Al)	0.002	*1.69*	*0.40*	*7.06*	*7.02*	2.21	1.31
Antimony (Sb)	0.0005	0.0007	0.0007	0.0011	0.0011	0.0002	0.29
Arsenic (As)	0.0001	0.0025	0.0007	**0.0107**	**0.0106**	0.0030	1.23
Barium (Ba)	0.03	0.06	0.04	0.16	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.90
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000411**	**0.000352**	**0.001215**	**0.001202**	0.000332	0.81
Calcium (Ca)	19.8	51.6	56.3	72.8	70.8	14.5	0.28
Chromium (Cr)	0.0002	**0.0022**	0.0008	**0.0085**	**0.0085**	0.0024	1.10
Cobalt (Co)	0.0001	0.0015	0.0006	0.0050	0.0050	0.0016	1.08
Copper (Cu)	0.0003	**0.0315**	0.0098	**0.1207**	**0.1194**	0.0361	1.15
Iron (Fe)	0.015	**2.850**	0.799	**11.605**	**11.532**	3.721	1.31
Lead (Pb)	0.00003	0.00170	0.00054	0.00623	0.00620	0.00207	1.22
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.5	4.2	4.2	5.6	5.6	0.8	0.20
Manganese (Mn)	0.00003	0.09897	0.06758	0.33049	0.32861	0.09302	0.94
Mercury (Hg)	0.000005	0.000007	0.000005	0.000019	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0005	0.15
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.61
Potassium (K)	1.1	1.8	1.7	2.9	2.9	0.5	0.28
Selenium (Se)	0.0012	**0.0049**	**0.0048**	**0.0095**	**0.0078**	0.0018	0.37
Silicon (Si)	1.9	4.6	2.6	12.8	12.7	3.3	0.72
Silver (Ag)	0.000005	0.000050	0.000010	0.000200	0.000199	0.000064	1.28
Sodium (Na)	1.0	1.7	1.6	2.7	2.7	0.5	0.29
Strontium (Sr)	0.15	0.30	0.34	0.39	0.37	0.07	0.23
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.42
Tin (Sn)	0.00005	0.00009	0.00008	0.00014	0.00014	0.00003	0.30
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0067	0.0016	0.0308	0.0306	0.0091	1.36
Zinc (Zn)	0.0015	0.0338	0.0269	0.0972	0.0962	0.0258	0.76

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-29. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0035	0.0025	0.0082	0.0082	0.0018	0.53
Chloride (Cl)	0.7	2.3	2.1	5.9	4.5	1.1	0.49
Fluoride (F)	0.04	0.07	0.07	0.10	0.10	0.02	0.30
Nitrate (as N)	0.02	0.07	0.09	0.16	0.15	0.04	0.58
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.00002	0.03
Total Phosphate (as P)	0.001	0.128	0.045	0.568	0.567	0.180	1.41
Sulphate (SO_4)	66	**136**	**130**	**193**	**192**	37	0.27
Total Metals							
Aluminum (Al)	0.002	*1.90*	*0.51*	*8.07*	*8.07*	2.51	1.33
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.34
Arsenic (As)	0.0001	0.0028	0.0011	**0.0118**	**0.0118**	0.0034	1.23
Barium (Ba)	0.03	0.07	0.05	0.17	0.17	0.05	0.67
Beryllium (Be)	0.0001	0.0002	0.0002	0.0011	0.0003	0.0002	0.75
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000441**	**0.000379**	**0.001322**	**0.001321**	0.000365	0.83
Calcium (Ca)	23.3	52.4	56.5	74.4	74.3	14.8	0.28
Chromium (Cr)	0.0004	**0.0023**	0.0009	**0.0095**	**0.0095**	0.0027	1.17
Cobalt (Co)	0.0001	0.0016	0.0007	0.0057	0.0057	0.0018	1.12
Copper (Cu)	0.0003	**0.0354**	**0.0179**	**0.1331**	**0.1330**	0.0403	1.14
Iron (Fe)	0.015	**3.225**	0.994	**13.280**	**13.277**	4.238	1.31
Lead (Pb)	0.00003	0.00189	0.00081	0.00708	0.00708	0.00234	1.24
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.31
Magnesium (Mg)	2.6	4.4	4.4	6.2	6.2	0.9	0.20
Manganese (Mn)	0.00003	0.10898	0.07683	0.37738	0.37731	0.10673	0.98
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.66
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0004	0.13
Nickel (Ni)	0.001	0.003	0.002	0.009	0.009	0.002	0.70
Potassium (K)	1.1	1.9	1.8	3.2	3.2	0.6	0.30
Selenium (Se)	**0.0022**	**0.0041**	**0.0041**	**0.0067**	**0.0062**	0.0012	0.28
Silicon (Si)	1.9	5.0	2.8	14.5	14.5	3.8	0.76
Silver (Ag)	0.000005	0.000054	0.000010	0.000227	0.000227	0.000072	1.32
Sodium (Na)	1.0	1.7	1.5	2.8	2.8	0.5	0.31
Strontium (Sr)	0.15	0.29	0.32	0.38	0.38	0.07	0.25
Thallium (Tl)	0.00003	0.00005	0.00005	0.00011	0.00011	0.00002	0.47
Tin (Sn)	0.00005	0.00009	0.00008	0.00014	0.00014	0.00003	0.35
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.27
Vanadium (V)	0.0005	0.0075	0.0020	0.0350	0.0350	0.0104	1.40
Zinc (Zn)	0.0015	0.0368	0.0311	0.1065	0.1064	0.0288	0.78

(continued)

Table 14.7-29. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0035	0.0025	0.0082	0.0082	0.0018	0.53
Chloride (Cl)	1.3	5.1	4.7	13.7	10.5	2.7	0.53
Fluoride (F)	0.04	0.07	0.07	0.10	0.10	0.02	0.30
Nitrate (as N)	0.02	0.07	0.09	0.16	0.15	0.04	0.58
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.00002	0.03
Total Phosphate (as P)	0.001	0.128	0.045	0.568	0.567	0.180	1.41
Sulphate (SO_4)	66	**136**	**130**	**193**	**192**	37	0.27
Total Metals							
Aluminum (Al)	0.002	*1.90*	*0.51*	*8.07*	*8.07*	2.51	1.33
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.34
Arsenic (As)	0.0001	0.0028	0.0011	**0.0118**	**0.0118**	0.0034	1.23
Barium (Ba)	0.03	0.07	0.05	0.17	0.17	0.05	0.67
Beryllium (Be)	0.0001	0.0002	0.0002	0.0011	0.0003	0.0002	0.75
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000441**	**0.000379**	**0.001322**	**0.001321**	0.000365	0.83
Calcium (Ca)	23.5	52.6	56.7	74.7	74.6	14.8	0.28
Chromium (Cr)	0.0004	**0.0023**	0.0009	**0.0095**	**0.0095**	0.0027	1.17
Cobalt (Co)	0.0001	0.0016	0.0007	0.0057	0.0057	0.0018	1.12
Copper (Cu)	0.0003	**0.0354**	**0.0179**	**0.1331**	**0.1330**	0.0403	1.14
Iron (Fe)	0.015	**3.225**	0.995	**13.280**	**13.277**	4.237	1.31
Lead (Pb)	0.00003	0.00189	0.00081	0.00708	0.00708	0.00234	1.24
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.31
Magnesium (Mg)	2.6	4.4	4.4	6.2	6.2	0.9	0.20
Manganese (Mn)	0.00003	0.10899	0.07685	0.37738	0.37731	0.10673	0.98
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.66
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0004	0.13
Nickel (Ni)	0.001	0.003	0.002	0.009	0.009	0.002	0.70
Potassium (K)	1.1	1.9	1.8	3.2	3.2	0.6	0.30
Selenium (Se)	**0.0023**	**0.0045**	**0.0044**	**0.0075**	**0.0069**	0.0014	0.31
Silicon (Si)	1.9	5.0	2.8	14.5	14.5	3.8	0.76
Silver (Ag)	0.000005	0.000054	0.000010	0.000227	0.000227	0.000072	1.32
Sodium (Na)	1.0	1.7	1.5	2.8	2.8	0.5	0.31
Strontium (Sr)	0.15	0.29	0.32	0.38	0.38	0.07	0.25
Thallium (Tl)	0.00003	0.00005	0.00005	0.00011	0.00011	0.00002	0.47
Tin (Sn)	0.00005	0.00009	0.00008	0.00014	0.00014	0.00003	0.35
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.27
Vanadium (V)	0.0005	0.0075	0.0020	0.0350	0.0350	0.0104	1.40
Zinc (Zn)	0.0015	0.0368	0.0312	0.1065	0.1064	0.0288	0.78

(continued)

Table 14.7-29. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0078	0.0078	0.0017	0.50
Chloride (Cl)	1.3	2.9	2.9	5.5	5.2	1.2	0.40
Fluoride (F)	0.03	0.07	0.08	0.10	0.10	0.02	0.32
Nitrate (as N)	0.02	0.07	0.09	0.15	0.15	0.04	0.58
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.00001	0.02
Total Phosphate (as P)	0.001	0.128	0.047	0.561	0.560	0.179	1.40
Sulphate (SO_4)	83	**136**	**132**	**206**	**205**	30	0.22
Total Metals							
Aluminum (Al)	0.002	*1.89*	*0.50*	*7.84*	*7.83*	2.48	1.31
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.34
Arsenic (As)	0.0001	0.0027	0.0012	**0.0119**	**0.0119**	0.0034	1.24
Barium (Ba)	0.03	0.07	0.05	0.17	0.17	0.04	0.66
Beryllium (Be)	0.0001	0.0002	0.0002	0.0011	0.0003	0.0002	0.76
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.15
Cadmium (Cd)	0.000005	**0.000439**	**0.000379**	**0.001335**	**0.001334**	0.000367	0.83
Calcium (Ca)	24.0	52.6	57.3	73.0	72.9	14.5	0.28
Chromium (Cr)	0.0003	**0.0023**	0.0009	**0.0093**	**0.0093**	0.0027	1.16
Cobalt (Co)	0.0001	0.0016	0.0007	0.0055	0.0055	0.0018	1.12
Copper (Cu)	0.0003	**0.0352**	**0.0178**	**0.1345**	**0.1344**	0.0405	1.15
Iron (Fe)	0.015	**3.203**	0.975	**12.884**	**12.876**	4.178	1.30
Lead (Pb)	0.00003	0.00188	0.00081	0.00689	0.00689	0.00232	1.23
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.31
Magnesium (Mg)	2.7	4.4	4.4	6.0	6.0	0.9	0.20
Manganese (Mn)	0.00003	0.10819	0.07587	0.36622	0.36596	0.10470	0.97
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.67
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0005	0.17
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.70
Potassium (K)	1.1	1.9	1.8	3.2	3.2	0.6	0.30
Selenium (Se)	**0.0028**	**0.0043**	**0.0041**	**0.0070**	**0.0070**	0.0012	0.28
Silicon (Si)	1.9	5.0	2.7	14.1	14.1	3.8	0.75
Silver (Ag)	0.000005	0.000054	0.000010	0.000221	0.000220	0.000071	1.31
Sodium (Na)	1.0	1.7	1.6	2.8	2.8	0.5	0.32
Strontium (Sr)	0.14	0.29	0.32	0.37	0.37	0.07	0.25
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.46
Tin (Sn)	0.00005	0.00009	0.00008	0.00014	0.00014	0.00003	0.34
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.27
Vanadium (V)	0.0005	0.0074	0.0020	0.0340	0.0340	0.0102	1.38
Zinc (Zn)	0.0015	0.0367	0.0312	0.1076	0.1075	0.0288	0.79

(continued)

Table 14.7-29. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0078	0.0078	0.0017	0.50
Chloride (Cl)	2.8	6.6	6.5	12.7	11.9	2.8	0.42
Fluoride (F)	0.03	0.07	0.08	0.10	0.10	0.02	0.32
Nitrate (as N)	0.02	0.07	0.09	0.15	0.15	0.04	0.58
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.00001	0.02
Total Phosphate (as P)	0.001	0.128	0.047	0.561	0.560	0.179	1.40
Sulphate (SO_4)	83	**136**	**132**	**206**	**205**	30	0.22
Total Metals							
Aluminum (Al)	0.002	*1.89*	*0.50*	*7.84*	*7.83*	2.48	1.31
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.34
Arsenic (As)	0.0001	0.0027	0.0012	**0.0119**	**0.0119**	0.0034	1.24
Barium (Ba)	0.03	0.07	0.05	0.17	0.17	0.04	0.66
Beryllium (Be)	0.0001	0.0002	0.0002	0.0011	0.0003	0.0002	0.76
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.15
Cadmium (Cd)	0.000005	**0.000439**	**0.000379**	**0.001335**	**0.001334**	0.000367	0.83
Calcium (Ca)	24.3	52.9	57.6	73.2	73.1	14.4	0.27
Chromium (Cr)	0.0003	**0.0023**	0.0009	**0.0093**	**0.0093**	0.0027	1.16
Cobalt (Co)	0.0001	0.0016	0.0007	0.0055	0.0055	0.0018	1.12
Copper (Cu)	0.0003	**0.0352**	**0.0178**	**0.1345**	**0.1344**	0.0405	1.15
Iron (Fe)	0.015	**3.203**	0.976	**12.885**	**12.876**	4.178	1.30
Lead (Pb)	0.00003	0.00188	0.00081	0.00689	0.00689	0.00232	1.23
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.31
Magnesium (Mg)	2.7	4.4	4.4	6.0	6.0	0.9	0.20
Manganese (Mn)	0.00003	0.10820	0.07589	0.36622	0.36597	0.10469	0.97
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.67
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0005	0.17
Nickel (Ni)	0.001	0.003	0.002	0.008	0.008	0.002	0.70
Potassium (K)	1.1	1.9	1.8	3.2	3.2	0.6	0.30
Selenium (Se)	**0.0030**	**0.0047**	**0.0045**	**0.0078**	**0.0077**	0.0014	0.29
Silicon (Si)	1.9	5.0	2.7	14.1	14.1	3.8	0.75
Silver (Ag)	0.000005	0.000054	0.000010	0.000221	0.000220	0.000071	1.31
Sodium (Na)	1.0	1.7	1.6	2.8	2.8	0.5	0.32
Strontium (Sr)	0.14	0.29	0.33	0.37	0.37	0.07	0.25
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.46
Tin (Sn)	0.00006	0.00009	0.00008	0.00014	0.00014	0.00003	0.34
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.27
Vanadium (V)	0.0005	0.0074	0.0020	0.0340	0.0340	0.0102	1.38
Zinc (Zn)	0.0015	0.0367	0.0312	0.1076	0.1075	0.0288	0.79

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-30. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0033	0.0025	0.0082	0.0070	0.0015	0.45
Chloride (Cl)	0.7	2.1	2.2	5.6	4.1	1.0	0.49
Fluoride (F)	0.04	0.07	0.08	0.10	0.10	0.02	0.28
Nitrate (as N)	0.01	0.07	0.08	0.16	0.15	0.04	0.58
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.00003	0.06
Total Phosphate (as P)	0.001	0.123	0.055	0.568	0.513	0.159	1.29
Sulphate (SO_4)	66	**145**	**143**	**216**	**195**	26	0.18
Total Metals							
Aluminum (Al)	0.002	*1.71*	*0.55*	*8.07*	*7.06*	2.228	1.30
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.28
Arsenic (As)	0.0001	0.0025	0.0014	**0.0118**	**0.0105**	0.0030	1.22
Barium (Ba)	0.03	0.06	0.05	0.17	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.92
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000413**	**0.000377**	**0.001324**	**0.001193**	0.000330	0.80
Calcium (Ca)	23.0	51.1	51.7	74.6	71.5	14.8	0.29
Chromium (Cr)	0.0004	**0.0022**	0.0010	**0.0095**	**0.0085**	0.0025	1.10
Cobalt (Co)	0.0001	0.0015	0.0008	0.0057	0.0050	0.0016	1.07
Copper (Cu)	0.0003	**0.0318**	**0.0237**	**0.1333**	**0.1184**	0.0360	1.13
Iron (Fe)	0.015	**2.885**	**1.020**	**13.282**	**11.594**	3.748	1.30
Lead (Pb)	0.00003	0.00172	0.00095	0.00708	0.00622	0.00209	1.22
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.5	4.2	4.2	6.2	5.6	0.8	0.20
Manganese (Mn)	0.00003	0.09993	0.07586	0.37744	0.33031	0.09369	0.94
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0004	0.13
Nickel (Ni)	0.001	0.003	0.003	0.009	0.008	0.002	0.61
Potassium (K)	1.1	1.7	1.7	3.2	2.9	0.5	0.29
Selenium (Se)	**0.0022**	**0.0038**	**0.0036**	**0.0080**	**0.0052**	0.0009	0.24
Silicon (Si)	1.9	4.7	2.7	14.5	12.8	3.4	0.72
Silver (Ag)	0.000005	0.000050	0.000010	0.000227	0.000199	0.000064	1.28
Sodium (Na)	1.0	1.7	1.5	2.8	2.7	0.5	0.27
Strontium (Sr)	0.15	0.29	0.31	0.38	0.37	0.06	0.22
Thallium (Tl)	0.00003	0.00005	0.00005	0.00011	0.00010	0.00002	0.43
Tin (Sn)	0.00005	0.00009	0.00009	0.00015	0.00014	0.00003	0.32
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0068	0.0021	0.0350	0.0307	0.0092	1.36
Zinc (Zn)	0.0015	0.0339	0.0312	0.1066	0.0954	0.0257	0.76

(continued)

Table 14.7-30. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0033	0.0025	0.0082	0.0070	0.0015	0.45
Chloride (Cl)	1.3	4.8	4.9	13.0	9.6	2.5	0.53
Fluoride (F)	0.04	0.07	0.08	0.11	0.10	0.02	0.28
Nitrate (as N)	0.01	0.07	0.08	0.16	0.15	0.04	0.58
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.00003	0.06
Total Phosphate (as P)	0.001	0.123	0.055	0.568	0.513	0.159	1.29
Sulphate (SO_4)	66	**151**	**151**	**216**	**202**	27	0.18
Total Metals							
Aluminum (Al)	0.002	*1.71*	*0.55*	*8.07*	*7.06*	2.23	1.30
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.28
Arsenic (As)	0.0001	0.0025	0.0014	**0.0118**	**0.0105**	0.0030	1.22
Barium (Ba)	0.03	0.06	0.05	0.17	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.92
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000413**	**0.000377**	**0.001324**	**0.001193**	0.000330	0.80
Calcium (Ca)	23.2	51.4	52.1	74.8	71.7	14.8	0.29
Chromium (Cr)	0.0004	**0.0022**	0.0010	**0.0095**	**0.0085**	0.0025	1.10
Cobalt (Co)	0.0001	0.0015	0.0008	0.0057	0.0050	0.0016	1.07
Copper (Cu)	0.0003	**0.0318**	**0.0237**	**0.1333**	**0.1184**	0.0360	1.13
Iron (Fe)	0.015	**2.885**	**1.020**	**13.282**	**11.594**	3.748	1.30
Lead (Pb)	0.00003	0.00172	0.00095	0.00708	0.00622	0.00209	1.22
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.27
Magnesium (Mg)	2.5	4.2	4.2	6.2	5.6	0.8	0.20
Manganese (Mn)	0.00003	0.09994	0.07588	0.37745	0.33031	0.09369	0.94
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000019	0.000004	0.61
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0004	0.13
Nickel (Ni)	0.001	0.003	0.003	0.009	0.008	0.002	0.61
Potassium (K)	1.1	1.7	1.7	3.2	2.9	0.5	0.29
Selenium (Se)	**0.0023**	**0.0041**	**0.0040**	**0.0089**	**0.0059**	0.0011	0.26
Silicon (Si)	1.9	4.7	2.7	14.5	12.8	3.4	0.72
Silver (Ag)	0.000005	0.000050	0.000010	0.000227	0.000199	0.000064	1.28
Sodium (Na)	1.0	1.7	1.5	2.8	2.7	0.5	0.27
Strontium (Sr)	0.15	0.29	0.31	0.38	0.38	0.06	0.22
Thallium (Tl)	0.00003	0.00005	0.00005	0.00011	0.00010	0.00002	0.43
Tin (Sn)	0.00005	0.00009	0.00009	0.00015	0.00014	0.00003	0.32
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0068	0.0021	0.0350	0.0307	0.0092	1.36
Zinc (Zn)	0.0015	0.0339	0.0312	0.1066	0.0954	0.0257	0.76

(continued)

Table 14.7-30. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0033	0.0025	0.0078	0.0071	0.0015	0.46
Chloride (Cl)	0.9	2.3	2.1	6.2	3.9	0.9	0.41
Fluoride (F)	0.03	0.07	0.07	0.10	0.10	0.02	0.29
Nitrate (as N)	0.02	0.07	0.08	0.15	0.14	0.04	0.56
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.00002	0.04
Total Phosphate (as P)	0.001	0.123	0.048	0.560	0.510	0.161	1.31
Sulphate (SO_4)	82	**145**	**137**	**242**	**216**	30	0.20
Total Metals							
Aluminum (Al)	0.002	*1.73*	*0.52*	*7.84*	*7.03*	2.24	1.30
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.29
Arsenic (As)	0.0001	0.0025	0.0015	**0.0119**	**0.0106**	0.0031	1.23
Barium (Ba)	0.03	0.06	0.05	0.17	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.92
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.15
Cadmium (Cd)	0.000005	**0.000416**	**0.000381**	**0.001336**	**0.001206**	0.000335	0.80
Calcium (Ca)	22.8	50.9	55.1	73.5	70.9	14.5	0.28
Chromium (Cr)	0.0003	**0.0022**	**0.0012**	**0.0094**	**0.0085**	0.0025	1.11
Cobalt (Co)	0.0001	0.0015	0.0008	0.0055	0.0050	0.0016	1.07
Copper (Cu)	0.0003	**0.0321**	**0.0224**	**0.1346**	**0.1198**	0.0366	1.14
Iron (Fe)	0.015	**2.914**	0.947	**12.890**	**11.543**	3.766	1.29
Lead (Pb)	0.00003	0.00173	0.00095	0.00689	0.00620	0.00210	1.21
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.28
Magnesium (Mg)	2.5	4.3	4.2	6.0	5.6	0.9	0.20
Manganese (Mn)	0.00003	0.10081	0.07681	0.36639	0.32887	0.09397	0.93
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000019	0.000004	0.62
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0005	0.15
Nickel (Ni)	0.001	0.003	0.003	0.008	0.008	0.002	0.61
Potassium (K)	1.1	1.7	1.7	3.2	2.9	0.5	0.29
Selenium (Se)	**0.0026**	**0.0039**	**0.0036**	**0.0087**	**0.0058**	0.0009	0.24
Silicon (Si)	1.9	4.7	2.7	14.1	12.7	3.4	0.72
Silver (Ag)	0.000005	0.000050	0.000011	0.000221	0.000199	0.000064	1.28
Sodium (Na)	1.0	1.7	1.6	2.8	2.6	0.5	0.29
Strontium (Sr)	0.14	0.29	0.32	0.37	0.37	0.07	0.24
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.43
Tin (Sn)	0.00006	0.00009	0.00009	0.00014	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0068	0.0021	0.0340	0.0306	0.0092	1.35
Zinc (Zn)	0.0015	0.0342	0.0316	0.1077	0.0965	0.0260	0.76

(continued)

Table 14.7-30. Summary Statistics of Water Quality Predictions for Sulphurets Creek (site SC3; Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0033	0.0025	0.0078	0.0071	0.0015	0.46
Chloride (Cl)	1.7	5.1	4.7	14.4	9.0	2.2	0.44
Fluoride (F)	0.03	0.07	0.07	0.10	0.10	0.02	0.29
Nitrate (as N)	0.02	0.07	0.08	0.15	0.14	0.04	0.56
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.00002	0.04
Total Phosphate (as P)	0.001	0.123	0.048	0.560	0.510	0.161	1.31
Sulphate (SO_4)	82	**151**	**140**	**242**	**232**	33	0.22
Total Metals							
Aluminum (Al)	0.002	*1.73*	*0.52*	*7.84*	*7.03*	2.24	1.30
Antimony (Sb)	0.0004	0.0007	0.0007	0.0012	0.0011	0.0002	0.28
Arsenic (As)	0.0001	0.0025	0.0015	**0.0119**	**0.0106**	0.0031	1.22
Barium (Ba)	0.03	0.06	0.05	0.17	0.16	0.04	0.63
Beryllium (Be)	0.0001	0.0004	0.0002	0.0011	0.0011	0.0003	0.91
Boron (B)	0.005	0.006	0.006	0.008	0.008	0.001	0.15
Cadmium (Cd)	0.000005	**0.000416**	**0.000381**	**0.001336**	**0.001206**	0.000335	0.80
Calcium (Ca)	23.0	51.2	55.8	73.8	71.1	14.4	0.28
Chromium (Cr)	0.0003	**0.0022**	**0.0012**	**0.0094**	**0.0085**	0.0025	1.11
Cobalt (Co)	0.0001	0.0015	0.0008	0.0055	0.0050	0.0016	1.07
Copper (Cu)	0.0003	**0.0321**	**0.0224**	**0.1346**	**0.1198**	0.0366	1.14
Iron (Fe)	0.015	**2.915**	0.947	**12.890**	**11.543**	3.766	1.29
Lead (Pb)	0.00003	0.00173	0.00095	0.00689	0.00620	0.00210	1.21
Lithium (Li)	0.002	0.003	0.003	0.005	0.005	0.001	0.28
Magnesium (Mg)	2.5	4.3	4.2	6.0	5.6	0.9	0.20
Manganese (Mn)	0.00003	0.10083	0.07682	0.36639	0.32888	0.09396	0.93
Mercury (Hg)	0.000005	0.000007	0.000005	0.000021	0.000019	0.000004	0.62
Molybdenum (Mo)	0.002	0.003	0.003	0.004	0.004	0.0005	0.15
Nickel (Ni)	0.001	0.003	0.003	0.008	0.008	0.002	0.61
Potassium (K)	1.1	1.7	1.7	3.2	2.9	0.5	0.29
Selenium (Se)	**0.0028**	**0.0043**	**0.0040**	**0.0097**	**0.0065**	0.0011	0.26
Silicon (Si)	1.9	4.7	2.7	14.1	12.7	3.4	0.72
Silver (Ag)	0.000005	0.000050	0.000011	0.000221	0.000199	0.000064	1.28
Sodium (Na)	1.0	1.7	1.6	2.8	2.6	0.5	0.29
Strontium (Sr)	0.14	0.29	0.32	0.37	0.37	0.07	0.24
Thallium (Tl)	0.00003	0.00005	0.00005	0.00010	0.00010	0.00002	0.43
Tin (Sn)	0.00006	0.00009	0.00009	0.00014	0.00014	0.00003	0.31
Uranium (U)	0.0002	0.0003	0.0004	0.0004	0.0004	0.0001	0.26
Vanadium (V)	0.0005	0.0068	0.0021	0.0340	0.0306	0.0092	1.35
Zinc (Zn)	0.0015	0.0342	0.0316	0.1077	0.0965	0.0260	0.76

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-31. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Construction Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0189	0.0443	0.0439	0.0756	0.0730	0.0179	0.40
Chloride (Cl)	0.39	0.50	0.51	0.59	0.58	0.05	0.11
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.25
Nitrate (as N)	0.39	0.63	0.63	0.85	0.85	0.12	0.19
Nitrite (as N)	0.0005	0.0006	0.0006	0.0006	0.0006	0.0000	0.08
Total Phosphate (as P)	0.02	0.09	0.05	0.48	0.47	0.12	1.33
Sulphate (SO_4)	28	56	64	81	81	19	0.35
Total Metals							
Aluminum (Al)	0.02	*1.80*	*0.47*	*11.78*	*11.78*	3.17	1.76
Antimony (Sb)	0.0009	0.0015	0.0014	0.0023	0.0023	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0013	**0.0123**	**0.0123**	0.0033	1.42
Barium (Ba)	0.032	0.060	0.039	0.225	0.225	0.052	0.87
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.58
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.15
Cadmium (Cd)	0.000005	**0.000231**	**0.000212**	**0.000702**	**0.000702**	0.000202	0.88
Calcium (Ca)	18.82	34.73	36.18	49.14	49.02	10.53	0.30
Chromium (Cr)	0.0004	**0.0030**	**0.0010**	**0.0185**	**0.0185**	0.0049	1.64
Cobalt (Co)	0.0001	0.0013	0.0006	0.0079	0.0079	0.0021	1.60
Copper (Cu)	0.0003	**0.0216**	**0.0143**	**0.0803**	**0.0803**	0.0237	1.10
Iron (Fe)	0.01	**2.97**	**1.41**	**19.25**	**19.25**	5.14	1.73
Lead (Pb)	0.00003	0.00161	0.00095	0.00807	0.00807	0.00216	1.34
Lithium (Li)	0.002	0.003	0.003	0.009	0.009	0.002	0.60
Magnesium (Mg)	2.61	4.25	4.14	8.30	8.30	1.40	0.33
Manganese (Mn)	0.00003	0.08237	0.05037	0.46287	0.46285	0.12156	1.48
Mercury (Hg)	0.000005	0.000010	0.000006	0.000050	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.21
Nickel (Ni)	0.001	0.003	0.002	0.017	0.017	0.004	1.35
Potassium (K)	0.86	1.32	1.06	3.62	3.62	0.71	0.54
Selenium (Se)	0.0008	0.0013	0.0014	0.0017	0.0017	0.0003	0.21
Silicon (Si)	2.01	4.98	2.73	22.40	22.40	5.50	1.11
Silver (Ag)	0.000005	0.000043	0.000010	**0.000270**	**0.000270**	0.000072	1.67
Sodium (Na)	1.07	1.75	1.78	2.59	2.59	0.58	0.33
Strontium (Sr)	0.13	0.25	0.26	0.34	0.34	0.07	0.27
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.62
Tin (Sn)	0.00006	0.00007	0.00006	0.00011	0.00011	0.00001	0.21
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.35
Vanadium (V)	0.0005	0.0078	0.0016	0.0531	0.0531	0.0143	1.84
Zinc (Zn)	0.0015	0.0221	0.0153	0.0601	0.0601	0.0191	0.86

(continued)

Table 14.7-31. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Construction Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0143	0.0091	0.0789	0.0464	0.0145	1.02
Chloride (Cl)	0.26	1.40	0.92	5.96	4.00	1.14	0.81
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.22
Nitrate (as N)	0.01	0.20	0.12	0.90	0.60	0.17	0.87
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.0000	0.04
Total Phosphate (as P)	0.00	0.08	0.04	0.50	0.48	0.13	1.59
Sulphate (SO_4)	24	74	75	100	96	15	0.20
Total Metals							
Aluminum (Al)	0.01	*1.80*	*0.37*	*12.64*	*11.93*	3.20	1.78
Antimony (Sb)	0.0009	0.0015	0.0015	0.0025	0.0023	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0009	**0.0131**	**0.0124**	0.0033	1.42
Barium (Ba)	0.032	0.060	0.040	0.241	0.228	0.053	0.87
Beryllium (Be)	0.0001	0.0003	0.0002	0.0009	0.0006	0.0002	0.62
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000232**	**0.000220**	**0.000728**	**0.000720**	0.000204	0.88
Calcium (Ca)	18.55	35.37	39.38	50.58	48.83	9.45	0.27
Chromium (Cr)	0.0002	**0.0029**	0.0006	**0.0198**	**0.0188**	0.0050	1.70
Cobalt (Co)	0.0001	0.0013	0.0005	0.0085	0.0080	0.0021	1.61
Copper (Cu)	0.0003	**0.0217**	0.0091	**0.0836**	**0.0828**	0.0239	1.10
Iron (Fe)	0.01	**2.98**	**1.23**	**20.65**	**19.50**	5.19	1.74
Lead (Pb)	0.00003	0.00161	0.00072	0.00866	0.00818	0.00218	1.36
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.55	4.33	4.20	8.72	8.37	1.43	0.33
Manganese (Mn)	0.00003	0.08266	0.04821	0.49659	0.46888	0.12261	1.48
Mercury (Hg)	0.000005	0.000010	0.000005	0.000053	0.000050	0.000012	1.18
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.002	0.018	0.017	0.004	1.38
Potassium (K)	0.81	1.32	1.07	3.83	3.65	0.73	0.55
Selenium (Se)	0.0007	0.0020	0.0018	**0.0033**	**0.0029**	0.0005	0.27
Silicon (Si)	2.01	5.02	2.54	23.97	22.69	5.54	1.10
Silver (Ag)	0.000005	0.000043	0.000009	**0.000289**	**0.000273**	0.000073	1.69
Sodium (Na)	1.00	1.73	1.73	2.59	2.51	0.54	0.31
Strontium (Sr)	0.13	0.24	0.26	0.34	0.32	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.62
Tin (Sn)	0.00005	0.00007	0.00006	0.00011	0.00011	0.00002	0.26
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0078	0.0011	0.0569	0.0538	0.0144	1.86
Zinc (Zn)	0.0015	0.0223	0.0156	0.0643	0.0608	0.0192	0.86

(continued)

Table 14.7-31. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Construction Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0168	0.0103	0.1069	0.0587	0.0183	1.09
Chloride (Cl)	0.25	0.72	0.51	3.05	1.88	0.50	0.70
Fluoride (F)	0.03	0.05	0.05	0.07	0.06	0.01	0.22
Nitrate (as N)	0.01	0.19	0.12	0.95	0.59	0.17	0.91
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.0000	0.04
Total Phosphate (as P)	0.00	0.08	0.04	0.51	0.48	0.13	1.61
Sulphate (SO_4)	24	70	71	**100**	93	15	0.22
Total Metals							
Aluminum (Al)	0.01	*1.81*	*0.37*	*12.71*	*11.98*	3.22	1.78
Antimony (Sb)	0.0009	0.0015	0.0015	0.0025	0.0024	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0009	**0.0132**	**0.0125**	0.0033	1.42
Barium (Ba)	0.032	0.060	0.040	0.242	0.229	0.053	0.88
Beryllium (Be)	0.0001	0.0003	0.0002	0.0010	0.0006	0.0002	0.61
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000232**	**0.000220**	**0.000730**	**0.000721**	0.000	0.88
Calcium (Ca)	18.49	34.92	39.22	51.14	48.19	9.55	0.27
Chromium (Cr)	0.0002	**0.0029**	0.0006	**0.0200**	**0.0189**	0.0050	1.70
Cobalt (Co)	0.0001	0.0013	0.0005	0.0086	0.0081	0.002	1.61
Copper (Cu)	0.0003	**0.0218**	0.0092	**0.0840**	**0.0829**	0.02	1.10
Iron (Fe)	0.01	**2.99**	**1.24**	**20.76**	**19.59**	5.22	1.74
Lead (Pb)	0.00003	0.00162	0.00072	0.00871	0.00821	0.002	1.36
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.54	4.33	4.18	8.75	8.40	1.44	0.33
Manganese (Mn)	0.00003	0.08303	0.04828	0.49921	0.47087	0.12	1.48
Mercury (Hg)	0.000005	0.000011	0.000005	0.000053	0.000051	0.000012	1.18
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.002	0.018	0.017	0.004	1.38
Potassium (K)	0.81	1.32	1.07	3.86	3.67	0.73	0.55
Selenium (Se)	0.0007	0.0017	0.0016	**0.0029**	**0.0024**	0.0004	0.24
Silicon (Si)	2.01	5.04	2.54	24.09	22.78	5.57	1.11
Silver (Ag)	0.000005	0.000043	0.000009	**0.000290**	**0.000274**	0.000073	1.69
Sodium (Na)	1.00	1.73	1.73	2.61	2.51	0.54	0.31
Strontium (Sr)	0.13	0.24	0.26	0.34	0.32	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.63
Tin (Sn)	0.00005	0.00007	0.00006	0.00011	0.00011	0.00002	0.27
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.37
Vanadium (V)	0.0005	0.0078	0.0011	0.0572	0.0540	0.0145	1.86
Zinc (Zn)	0.0015	0.0224	0.0155	0.0646	0.0611	0.0193	0.86

(continued)

Table 14.7-31. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Construction Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0168	0.0103	0.1069	0.0587	0.0183	1.09
Chloride (Cl)	0.26	1.39	0.89	6.52	3.96	1.16	0.84
Fluoride (F)	0.03	0.05	0.05	0.07	0.06	0.01	0.22
Nitrate (as N)	0.01	0.19	0.12	0.95	0.59	0.17	0.91
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.0000	0.04
Total Phosphate (as P)	0.00	0.08	0.04	0.51	0.48	0.13	1.61
Sulphate (SO_4)	24	73	73	**103**	95	16	0.21
Total Metals							
Aluminum (Al)	0.01	*1.81*	*0.37*	*12.71*	*11.98*	3.22	1.78
Antimony (Sb)	0.0009	0.0015	0.0015	0.0025	0.0024	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0009	**0.0132**	**0.0125**	0.0033	1.42
Barium (Ba)	0.032	0.060	0.040	0.242	0.229	0.053	0.88
Beryllium (Be)	0.0001	0.0003	0.0002	0.0010	0.0006	0.0002	0.61
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000	**0.000**	**0.000**	**0.001**	**0.001**	0.000	0.88
Calcium (Ca)	18.52	35.31	39.38	51.19	48.70	9.57	0.27
Chromium (Cr)	0.0002	**0.0029**	0.0006	**0.0200**	**0.0189**	0.0050	1.70
Cobalt (Co)	0.000	0.001	0.001	0.009	0.008	0.002	1.61
Copper (Cu)	0.00	**0.02**	0.01	**0.08**	**0.08**	0.02	1.10
Iron (Fe)	0.01	**2.99**	**1.24**	**20.76**	**19.59**	5.22	1.74
Lead (Pb)	0.00003	0.00162	0.00072	0.00871	0.00821	0.002	1.36
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.54	4.33	4.18	8.75	8.40	1.44	0.33
Manganese (Mn)	0.00	0.08	0.05	0.50	0.47	0.12	1.48
Mercury (Hg)	0.000005	0.000011	0.000005	0.000053	0.000051	0.000012	1.18
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.002	0.018	0.017	0.004	1.38
Potassium (K)	0.81	1.32	1.07	3.86	3.67	0.73	0.55
Selenium (Se)	0.0007	0.0019	0.0018	**0.0036**	**0.0029**	0.0006	0.30
Silicon (Si)	2.01	5.04	2.54	24.09	22.78	5.57	1.11
Silver (Ag)	0.000005	0.000043	0.000009	**0.000290**	**0.000274**	0.000073	1.69
Sodium (Na)	1.00	1.73	1.73	2.61	2.51	0.54	0.31
Strontium (Sr)	0.13	0.24	0.26	0.34	0.32	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.63
Tin (Sn)	0.00005	0.00007	0.00006	0.00011	0.00011	0.00002	0.27
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.37
Vanadium (V)	0.0005	0.0078	0.0011	0.0572	0.0540	0.0145	1.86
Zinc (Zn)	0.00	0.02	0.02	0.06	0.06	0.02	0.86

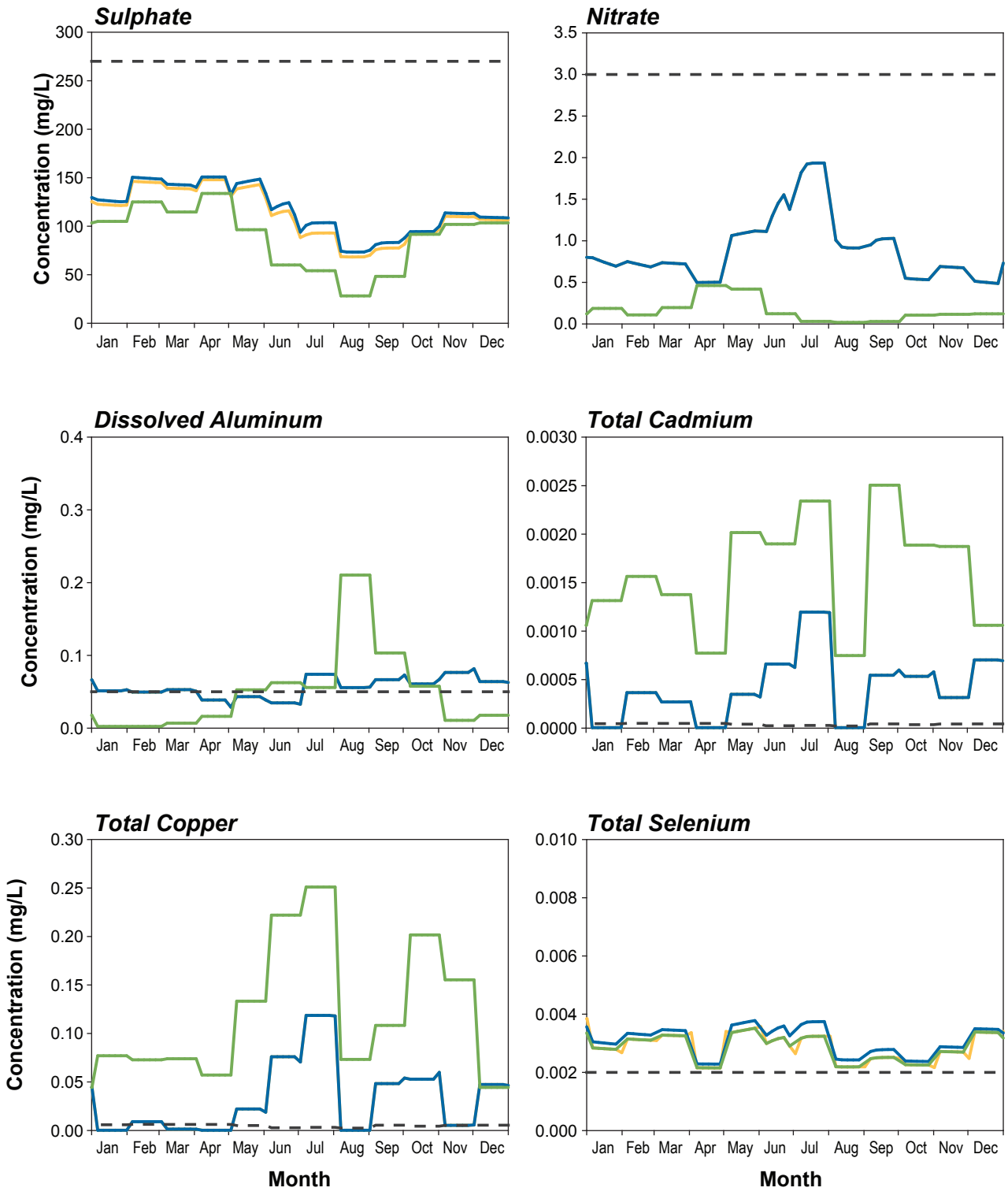
Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.



Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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Water Quality Predictions for the Base Case Water Balance: Sulphurets Creek - Site SC3 (Year 5)

Figure 14.7-19

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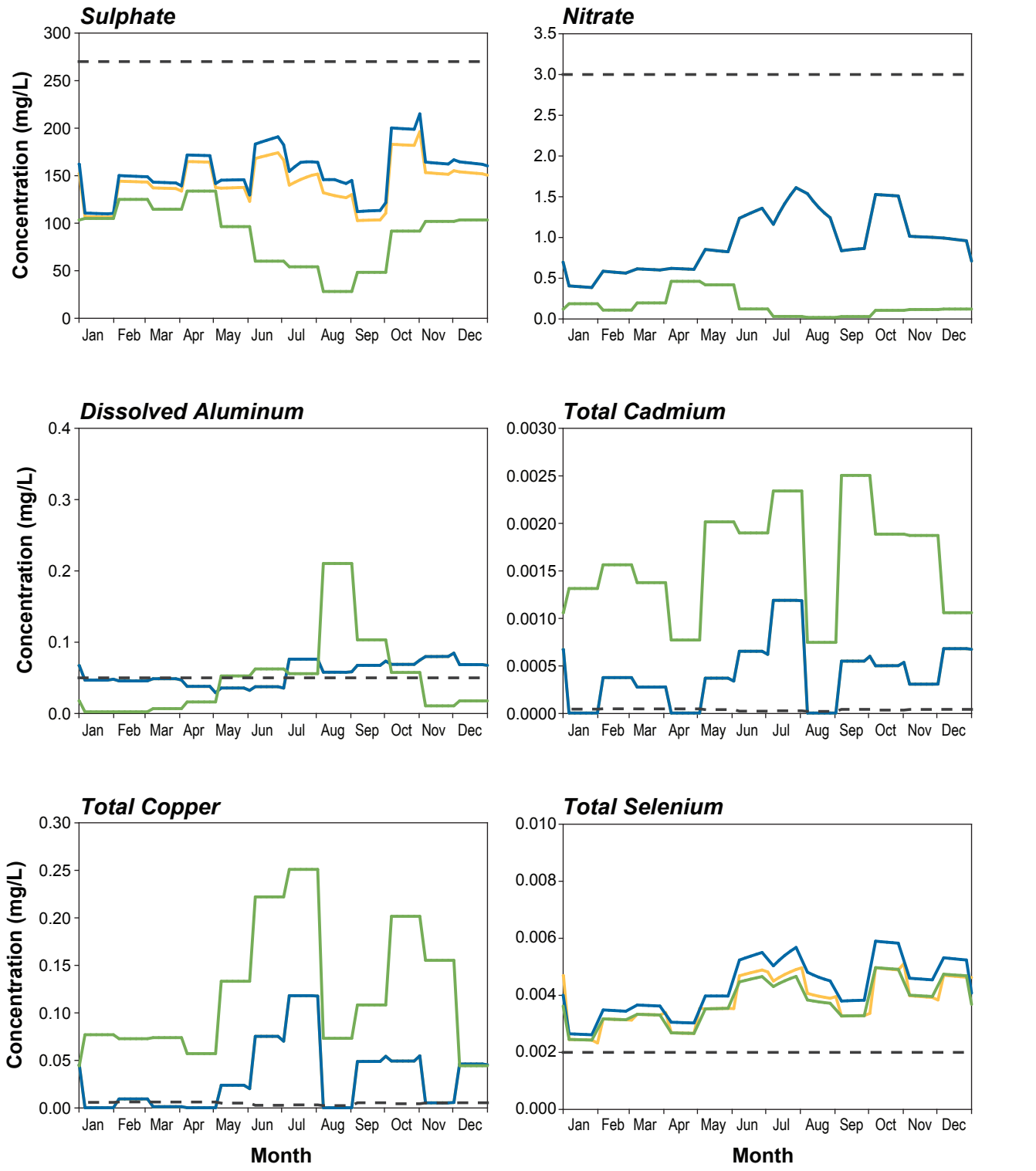

Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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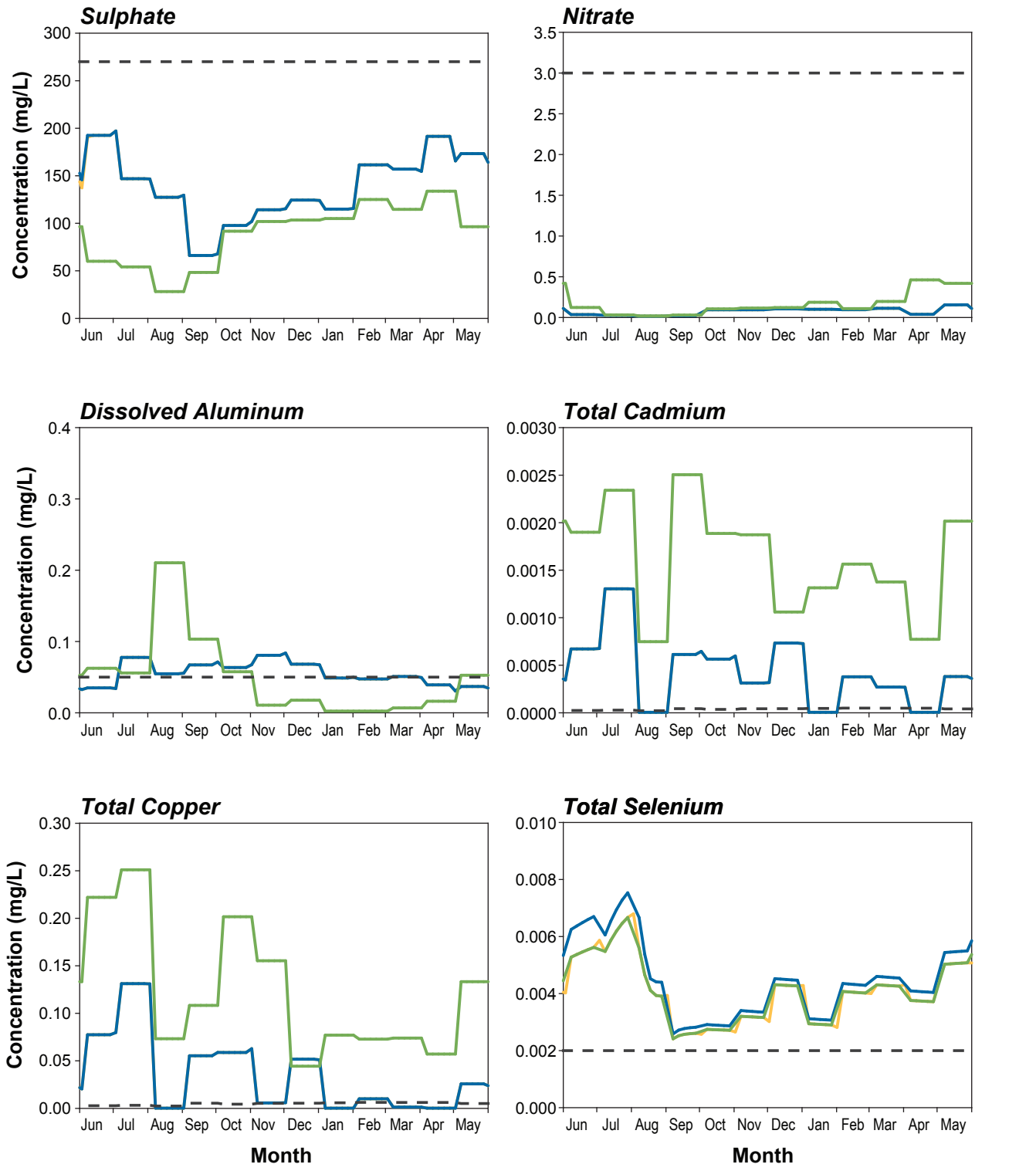
Water Quality Predictions for the Base Case Water Balance: Sulphurets Creek - Site SC3 (Year 25)

Figure 14.7-20

Rescan™ Engineers & Scientists



Note: Predicted sulphate, nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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Water Quality Predictions for the Base Case Water Balance: Sulphurets Creek - Site SC3 (Year 51.5)

Figure 14.7-21

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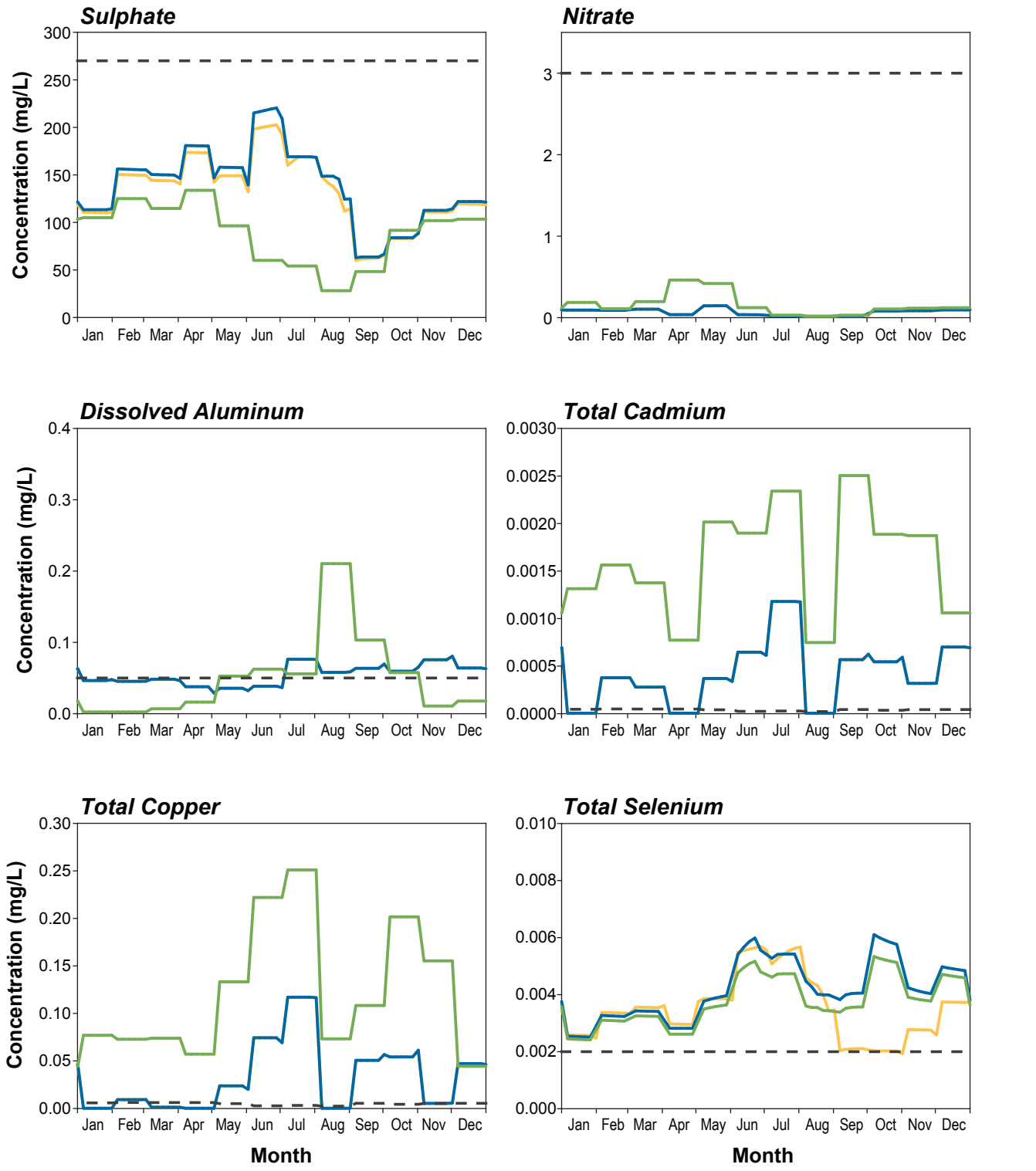

Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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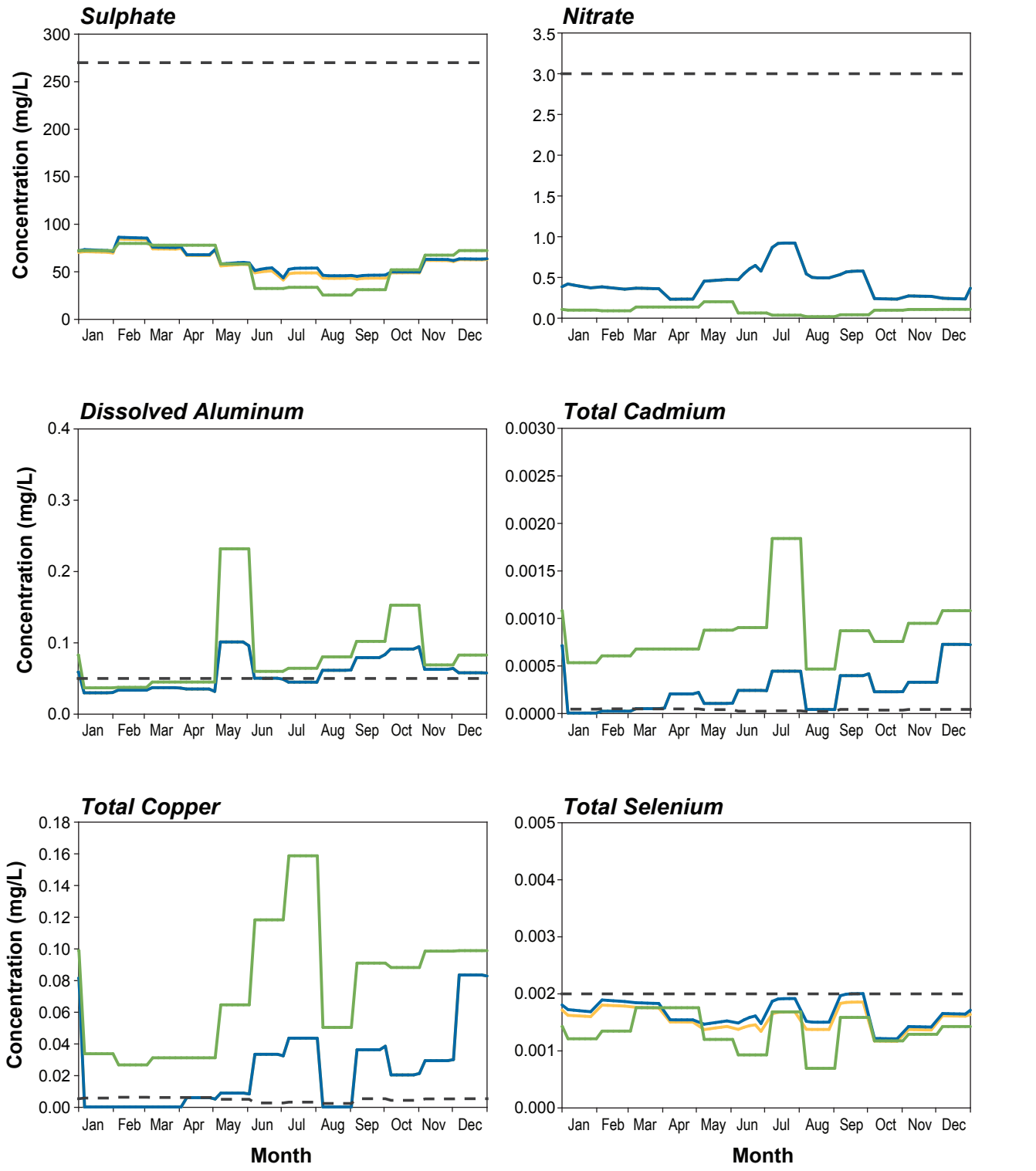
Water Quality Predictions for the Base Case Water Balance: Sulphurets Creek - Site SC3 (Year 65)

Figure 14.7-22

Rescan™ Engineers & Scientists



Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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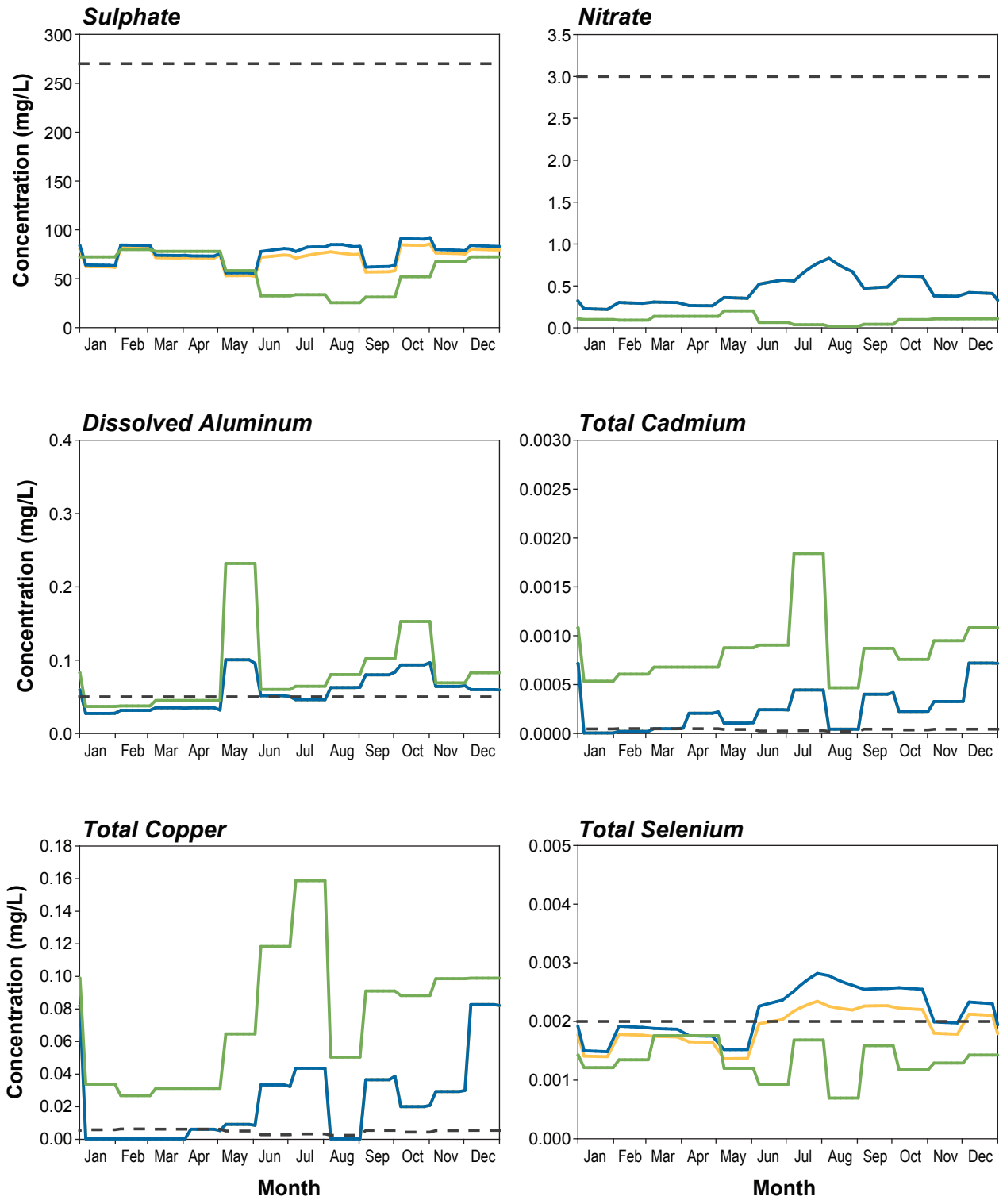
Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR1 (Year 5)

Figure 14.7-23

Rescan™ Engineers & Scientists



Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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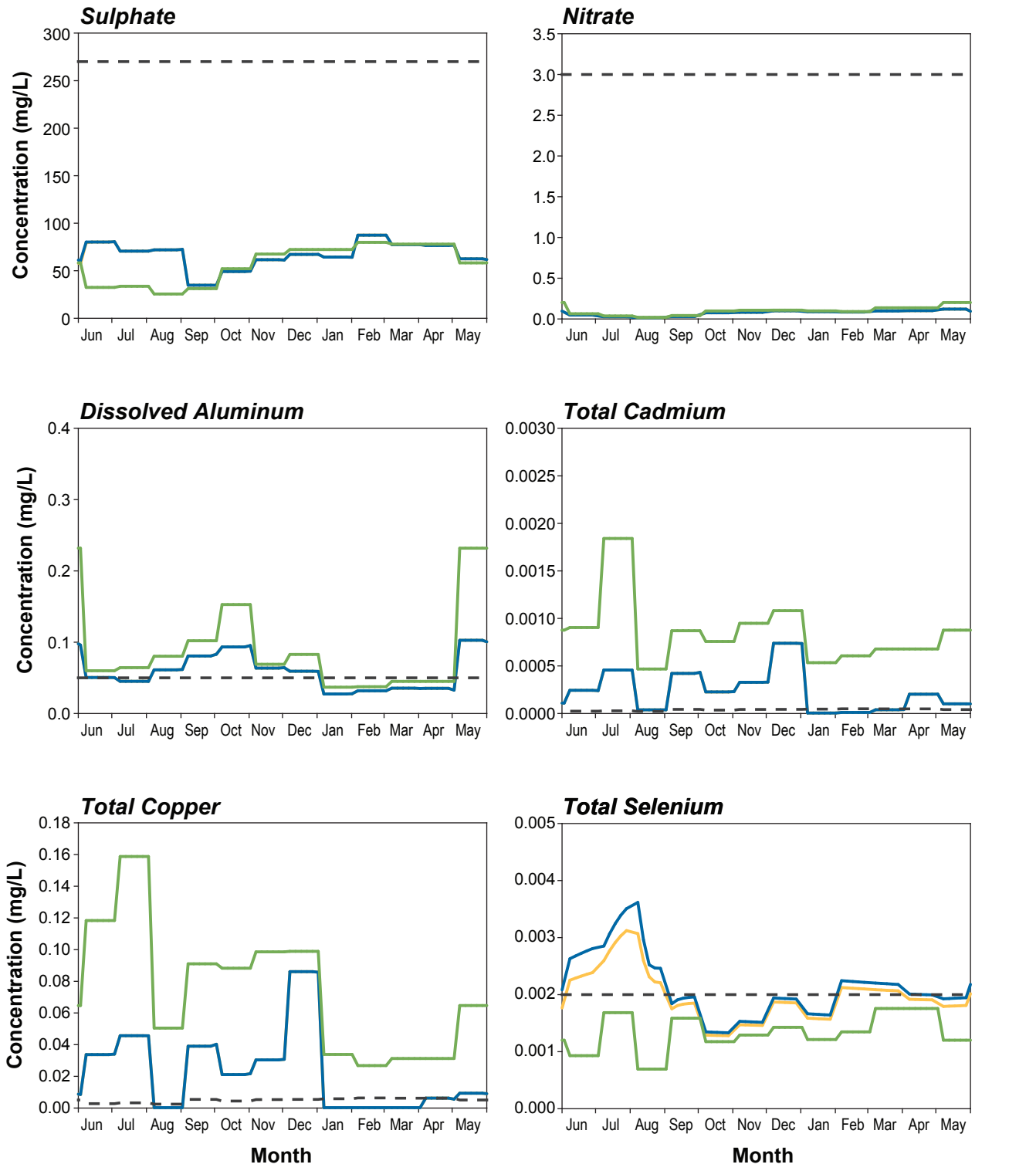
Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR1 (Year 25)

Figure 14.7-24

Rescan™ Engineers & Scientists



Note: Predicted sulphate, nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR1 (Year 51.5)

Figure 14.7-25

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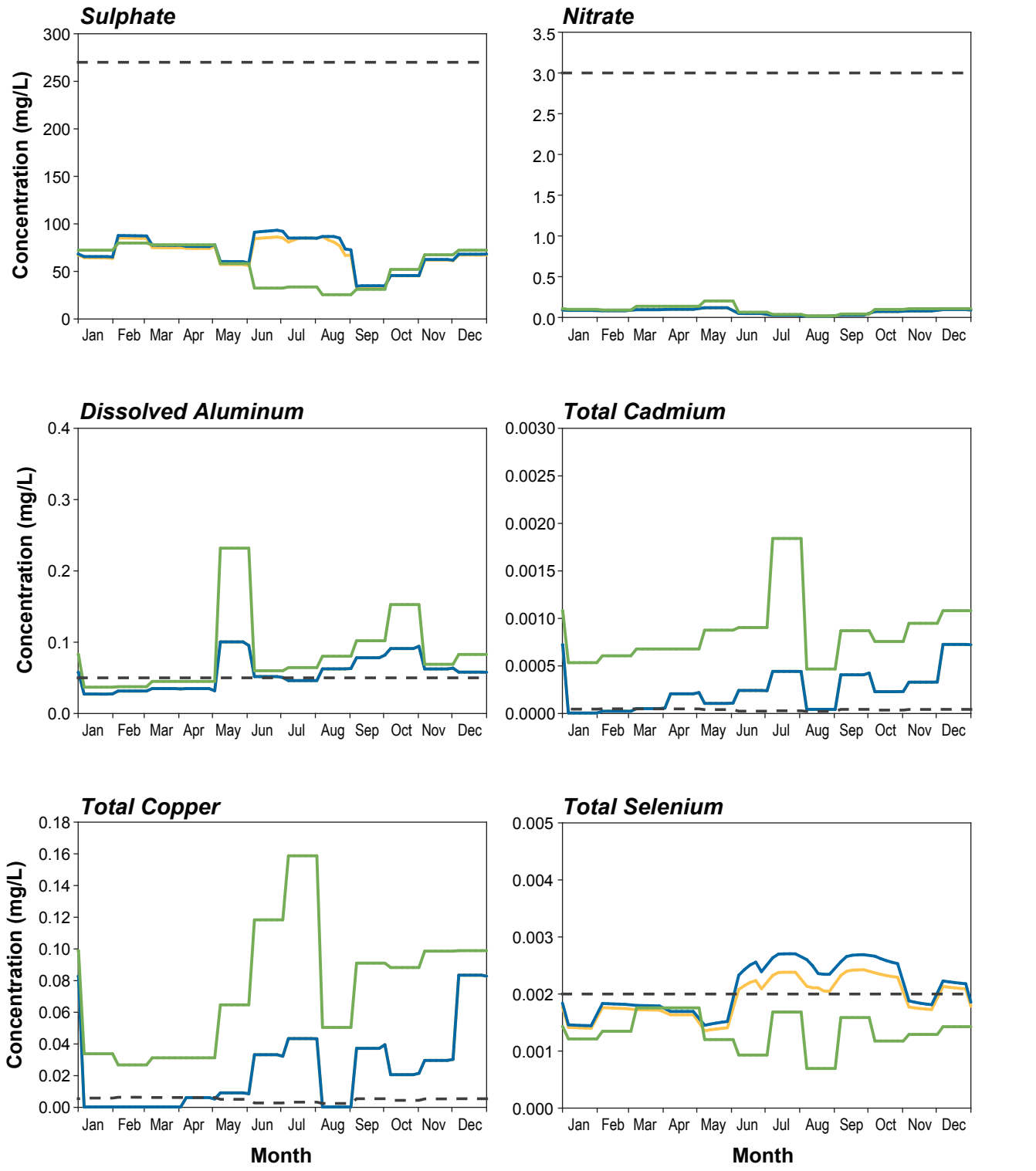

Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR1 (Year 65)

Figure 14.7-26

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Extensive mitigation for management of selenium is included in the Project design including segregation and covering of Kerr waste rock and an ion-exchange Selenium Treatment Plant. Total selenium concentrations, however, are predicted to be higher than BC water quality guidelines (0.002 mg/L) and baseline concentrations throughout the life of the Project. Total selenium concentrations are predicted to increase throughout the operation phase and range from 0.0016 to 0.0076 mg/L in Sulphurets Creek at site SC3. Selenium concentrations will be monitored through the Aquatic Effects Monitoring Plan (Section 26.18.2), which will allow for adaptive management if effects on aquatic life are identified.

Concentrations of some major ions, including sulphate and nitrate, are expected to increase in concentration in the receiving environment downstream of the Mine Site. No water quality guideline exceedances are predicted. The effect of increased nitrogen on aquatic life is assessed in Chapter 15.

In the receiving environment, water quality predictions for the expected- and upper-case water model scenarios are only distinguishable for modelled parameters that are not effectively treated at the HDS WTP. In Sulphurets Creek (SC3), the maximum predicted selenium concentrations in the upper-case model scenarios during the operation phase was 20% higher than in the expected case (0.0071 mg/L [scenario 1] versus 0.0085 mg/L [scenario 2]; Table 14.7-28). Predicted mean variable case water balance simulation concentrations were typically less than 1% different from the base case water balance simulations (Tables 14.7-27 to 14.7-30).

Unuk River

This section presents water quality predictions in the Unuk River at site UR1 (downstream of Sulphurets Creek) and site UR2 (near the BC-Alaska border). Tables 14.7-31 to 14.7-38 present statistical summaries of water quality in the Unuk River for the four model scenarios for the construction, operation, closure, and post-closure phases.

Figures 14.7-27 to 14.7-30 present the water quality predictions for six COPC during the operation, closure, and post-closure phases of the Project.

Potential residual effects on water quality in the Unuk River were only assessed for selenium, given that no other residual effects are predicted upstream in Sulphurets Creek. Selenium concentrations in the Unuk River are predicted to increase throughout the operation phase and range from 0.001 to 0.0033 mg/L at site UR1 and 0.001 to 0.0018 mg/L at site UR2. Selenium concentrations at UR1 were predicted to be below water quality guidelines (HQ < 1.0) for the first 15 years of the operation phase; sporadic concentrations above 0.002 mg/L are within the uncertainty of the model. Selenium concentrations at UR2 were predicted to be below water quality guidelines (HQ < 1.0) throughout all Project phases. No residual effects are therefore predicted for water quality in the Unuk River in Alaska.

Table 14.7-32. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1;Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0165	0.0102	0.1102	0.0588	0.0182	1.10
Chloride (Cl)	0.25	0.73	0.50	2.91	1.78	0.51	0.70
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.22
Nitrate (as N)	0.01	0.22	0.13	0.97	0.64	0.20	0.89
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.0000	0.04
Total Phosphate (as P)	0.00	0.08	0.03	0.48	0.47	0.12	1.59
Sulphate (SO_4)	24	71	72	95	92	14	0.20
Total Metals							
Aluminum (Al)	0.01	*1.79*	*0.37*	*11.97*	*11.93*	3.17	1.77
Antimony (Sb)	0.0009	0.0015	0.0015	0.0024	0.0023	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0008	**0.0125**	**0.0124**	0.0033	1.42
Barium (Ba)	0.032	0.060	0.039	0.229	0.228	0.052	0.87
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.58
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000231**	**0.000207**	**0.000727**	**0.000719**	0.000204	0.88
Calcium (Ca)	18.71	34.94	39.26	49.54	47.99	9.30	0.27
Chromium (Cr)	0.0002	**0.0029**	0.0006	**0.0188**	**0.0188**	0.0049	1.69
Cobalt (Co)	0.0001	0.0013	0.0005	0.0081	0.0080	0.0021	1.60
Copper (Cu)	0.0003	**0.0217**	0.0091	**0.0835**	**0.0828**	0.0239	1.10
Iron (Fe)	0.01	**2.96**	**1.19**	**19.56**	**19.50**	5.14	1.73
Lead (Pb)	0.00003	0.00160	0.00070	0.00820	0.00817	0.00216	1.35
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.62
Magnesium (Mg)	2.55	4.32	4.20	8.39	8.37	1.42	0.33
Manganese (Mn)	0.00003	0.08234	0.04762	0.47027	0.46881	0.12140	1.47
Mercury (Hg)	0.000005	0.000010	0.000005	0.000051	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.001	0.017	0.017	0.004	1.37
Potassium (K)	0.81	1.31	1.07	3.66	3.65	0.72	0.55
Selenium (Se)	0.0008	**0.0020**	0.0019	**0.0034**	**0.0029**	0.0005	0.25
Silicon (Si)	2.01	5.01	2.54	22.75	22.68	5.48	1.09
Silver (Ag)	0.000005	0.000043	0.000009	**0.000274**	**0.000273**	0.000072	1.68
Sodium (Na)	1.00	1.73	1.73	2.59	2.50	0.54	0.31
Strontium (Sr)	0.13	0.24	0.26	0.34	0.32	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.62
Tin (Sn)	0.00005	0.00007	0.00006	0.00011	0.00011	0.00002	0.26
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0077	0.0011	0.0539	0.0538	0.0143	1.85
Zinc (Zn)	0.0015	0.0223	0.0150	0.0610	0.0608	0.0191	0.86

(continued)

Table 14.7-32. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0165	0.0102	0.1102	0.0588	0.0182	1.10
Chloride (Cl)	0.25	1.41	0.93	6.24	3.80	1.16	0.82
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.22
Nitrate (as N)	0.01	0.22	0.13	0.97	0.64	0.20	0.89
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0006	0.0000	0.04
Total Phosphate (as P)	0.00	0.08	0.03	0.48	0.47	0.12	1.59
Sulphate (SO_4)	25	74	76	95	94	14	0.19
Total Metals							
Aluminum (Al)	0.01	*1.79*	*0.37*	*11.97*	*11.93*	3.17	1.77
Antimony (Sb)	0.0009	0.0015	0.0015	0.0024	0.0023	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0008	**0.0125**	**0.0124**	0.0033	1.42
Barium (Ba)	0.032	0.060	0.039	0.229	0.228	0.052	0.87
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.58
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000231**	**0.000207**	**0.000727**	**0.000719**	0.000204	0.88
Calcium (Ca)	18.77	35.37	39.45	49.66	48.37	9.30	0.26
Chromium (Cr)	0.0002	**0.0029**	0.0006	**0.0188**	**0.0188**	0.0049	1.69
Cobalt (Co)	0.0001	0.0013	0.0005	0.0081	0.0080	0.0021	1.60
Copper (Cu)	0.0003	**0.0217**	0.0091	**0.0836**	**0.0828**	0.0239	1.10
Iron (Fe)	0.01	**2.96**	**1.19**	**19.56**	**19.50**	5.14	1.73
Lead (Pb)	0.00003	0.00160	0.00070	0.00820	0.00817	0.00216	1.35
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.62
Magnesium (Mg)	2.55	4.32	4.20	8.39	8.37	1.42	0.33
Manganese (Mn)	0.00003	0.08235	0.04763	0.47027	0.46881	0.12140	1.47
Mercury (Hg)	0.000005	0.000010	0.000005	0.000051	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.001	0.017	0.017	0.004	1.37
Potassium (K)	0.81	1.31	1.07	3.66	3.65	0.72	0.55
Selenium (Se)	0.0008	**0.0023**	**0.0022**	**0.0041**	**0.0035**	0.0007	0.30
Silicon (Si)	2.01	5.01	2.54	22.75	22.68	5.48	1.09
Silver (Ag)	0.000005	0.000043	0.000009	**0.000274**	**0.000273**	0.000072	1.68
Sodium (Na)	1.00	1.73	1.73	2.59	2.50	0.54	0.31
Strontium (Sr)	0.13	0.24	0.26	0.34	0.32	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.62
Tin (Sn)	0.00005	0.00007	0.00006	0.00011	0.00011	0.00002	0.26
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0077	0.0011	0.0539	0.0538	0.0143	1.85
Zinc (Zn)	0.0015	0.0223	0.0150	0.0610	0.0608	0.0191	0.86

(continued)

Table 14.7-32. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0138	0.0071	0.1321	0.0514	0.0175	1.27
Chloride (Cl)	0.25	0.76	0.51	2.33	1.81	0.52	0.69
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.21
Nitrate (as N)	0.01	0.22	0.13	1.19	0.65	0.20	0.90
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.0000	0.03
Total Phosphate (as P)	0.00	0.08	0.02	0.48	0.47	0.13	1.62
Sulphate (SO_4)	25	70	70	**101**	89	13	0.18
Total Metals							
Aluminum (Al)	0.01	*1.79*	*0.37*	*11.88*	*11.84*	3.15	1.76
Antimony (Sb)	0.0009	0.0015	0.0015	0.0023	0.0023	0.0003	0.21
Arsenic (As)	0.0001	0.0023	0.0008	**0.0124**	**0.0123**	0.0033	1.41
Barium (Ba)	0.033	0.060	0.039	0.227	0.227	0.052	0.86
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.58
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000231**	**0.000207**	**0.000725**	**0.000722**	0.000205	0.89
Calcium (Ca)	18.73	34.91	39.07	48.38	47.81	9.12	0.26
Chromium (Cr)	0.0002	**0.0029**	0.0004	**0.0187**	**0.0187**	0.0049	1.70
Cobalt (Co)	0.0001	0.0013	0.0005	0.0080	0.0080	0.0021	1.60
Copper (Cu)	0.0003	**0.0217**	0.0090	**0.0836**	**0.0831**	0.0240	1.10
Iron (Fe)	0.01	**2.96**	**1.17**	**19.43**	**19.36**	5.10	1.73
Lead (Pb)	0.00003	0.00160	0.00071	0.00814	0.00812	0.00215	1.34
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.59	4.33	4.30	8.34	8.31	1.41	0.33
Manganese (Mn)	0.00003	0.08222	0.04748	0.46698	0.46540	0.12064	1.47
Mercury (Hg)	0.000005	0.000010	0.000005	0.000050	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.001	0.017	0.017	0.004	1.37
Potassium (K)	0.82	1.31	1.06	3.65	3.64	0.72	0.55
Selenium (Se)	0.0008	**0.0020**	0.0019	**0.0033**	**0.0030**	0.0005	0.26
Silicon (Si)	2.09	5.00	2.53	22.60	22.52	5.44	1.09
Silver (Ag)	0.000005	0.000043	0.000008	0.000272	0.000271	0.000072	1.68
Sodium (Na)	1.00	1.72	1.71	2.51	2.50	0.54	0.31
Strontium (Sr)	0.13	0.24	0.25	0.32	0.31	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.61
Tin (Sn)	0.00005	0.00006	0.00006	0.00011	0.00011	0.00002	0.27
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0077	0.0010	0.0536	0.0534	0.0142	1.84
Zinc (Zn)	0.0015	0.0223	0.0151	0.0606	0.0604	0.0191	0.86

(continued)

Table 14.7-32. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0138	0.0071	0.1321	0.0514	0.0175	1.27
Chloride (Cl)	0.25	1.49	0.94	4.93	3.83	1.19	0.80
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.21
Nitrate (as N)	0.01	0.22	0.13	1.19	0.65	0.20	0.90
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.0000	0.03
Total Phosphate (as P)	0.00	0.08	0.02	0.48	0.47	0.13	1.62
Sulphate (SO_4)	26	73	74	**101**	95	12	0.17
Total Metals							
Aluminum (Al)	0.01	*1.79*	*0.37*	*11.88*	*11.84*	3.15	1.76
Antimony (Sb)	0.0009	0.0015	0.0015	0.0023	0.0023	0.0003	0.21
Arsenic (As)	0.0001	0.0023	0.0008	**0.0124**	**0.0123**	0.0033	1.41
Barium (Ba)	0.033	0.060	0.039	0.227	0.227	0.052	0.86
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.57
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000231**	**0.000207**	**0.000725**	**0.000722**	0.000205	0.89
Calcium (Ca)	18.80	35.36	39.29	49.57	47.99	9.11	0.26
Chromium (Cr)	0.0002	**0.0029**	0.0004	**0.0187**	**0.0187**	0.0049	1.70
Cobalt (Co)	0.0001	0.0013	0.0005	0.0080	0.0080	0.0021	1.60
Copper (Cu)	0.0003	**0.0217**	0.0090	**0.0836**	**0.0831**	0.0240	1.10
Iron (Fe)	0.01	**2.96**	**1.17**	**19.43**	**19.36**	5.10	1.73
Lead (Pb)	0.00003	0.00160	0.00071	0.00814	0.00812	0.00215	1.34
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.59	4.33	4.30	8.34	8.31	1.41	0.33
Manganese (Mn)	0.00003	0.08223	0.04749	0.46698	0.46540	0.12064	1.47
Mercury (Hg)	0.000005	0.000010	0.000005	0.000050	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.001	0.017	0.017	0.004	1.37
Potassium (K)	0.82	1.31	1.06	3.65	3.64	0.72	0.55
Selenium (Se)	0.0008	**0.0024**	**0.0023**	**0.0040**	**0.0035**	0.0007	0.30
Silicon (Si)	2.09	5.00	2.53	22.60	22.52	5.44	1.09
Silver (Ag)	0.000005	0.000043	0.000008	**0.000272**	**0.000271**	0.000072	1.68
Sodium (Na)	1.00	1.72	1.71	2.51	2.50	0.54	0.31
Strontium (Sr)	0.14	0.24	0.25	0.32	0.31	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.61
Tin (Sn)	0.00005	0.00006	0.00006	0.00011	0.00011	0.00002	0.27
Uranium (U)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0077	0.0010	0.0536	0.0534	0.0142	1.84
Zinc (Zn)	0.0015	0.0223	0.0151	0.0606	0.0604	0.0191	0.86

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-33. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0074	0.0074	0.0017	0.49
Chloride (Cl)	0.40	1.06	0.92	2.74	2.30	0.51	0.48
Fluoride (F)	0.03	0.04	0.05	0.06	0.06	0.01	0.24
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.46
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.01
Total Phosphate (as P)	0.00	0.07	0.02	0.50	0.50	0.13	1.78
Sulphate (SO_4)	35	65	64	87	87	14	0.21
Total Metals							
Aluminum (Al)	0.01	*1.91*	*0.49*	*12.76*	*12.75*	3.42	1.79
Antimony (Sb)	0.0009	0.0015	0.0015	0.0025	0.0025	0.0003	0.23
Arsenic (As)	0.0001	0.0024	0.0014	**0.0132**	**0.0132**	0.0035	1.44
Barium (Ba)	0.033	0.062	0.040	0.242	0.242	0.056	0.90
Beryllium (Be)	0.0001	0.0002	0.0002	0.0006	0.0004	0.0001	0.49
Boron (B)	0.005	0.006	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000234**	**0.000214**	**0.000738**	**0.000738**	0.000214	0.91
Calcium (Ca)	20.53	34.99	35.64	48.73	48.70	9.10	0.26
Chromium (Cr)	0.0002	**0.0030**	0.0008	**0.0200**	**0.0200**	0.0053	1.74
Cobalt (Co)	0.0001	0.0014	0.0006	0.0086	0.0086	0.0023	1.64
Copper (Cu)	0.0003	**0.0228**	**0.0152**	**0.0861**	**0.0861**	0.0250	1.10
Iron (Fe)	0.01	**3.16**	**1.52**	**20.86**	**20.86**	5.54	1.75
Lead (Pb)	0.00003	0.00169	0.00099	0.00872	0.00872	0.00232	1.37
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.67
Magnesium (Mg)	2.64	4.42	4.28	8.85	8.85	1.52	0.34
Manganese (Mn)	0.00003	0.08674	0.05275	0.50097	0.50092	0.13089	1.51
Mercury (Hg)	0.000005	0.000011	0.000006	0.000054	0.000054	0.000013	1.22
Molybdenum (Mo)	0.001	0.002	0.002	0.002	0.002	0.000	0.13
Nickel (Ni)	0.001	0.003	0.002	0.018	0.018	0.005	1.44
Potassium (K)	0.83	1.34	1.06	3.84	3.84	0.77	0.58
Selenium (Se)	0.0011	0.0020	0.0019	**0.0031**	**0.0028**	0.0005	0.23
Silicon (Si)	2.10	5.24	2.88	24.21	24.21	5.93	1.13
Silver (Ag)	0.000005	0.000045	0.000009	**0.000291**	**0.000291**	0.000078	1.72
Sodium (Na)	1.00	1.72	1.70	2.53	2.53	0.57	0.33
Strontium (Sr)	0.14	0.23	0.23	0.32	0.32	0.05	0.23
Thallium (Tl)	0.00002	0.00005	0.00005	0.00016	0.00016	0.00003	0.65
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.28
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.39
Vanadium (V)	0.0005	0.0082	0.0016	0.0575	0.0574	0.0154	1.87
Zinc (Zn)	0.0015	0.0231	0.0160	0.0649	0.0649	0.0204	0.88

(continued)

Table 14.7-33. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0074	0.0074	0.0017	0.49
Chloride (Cl)	0.60	2.18	1.85	6.23	5.17	1.22	0.56
Fluoride (F)	0.03	0.04	0.05	0.06	0.06	0.01	0.24
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.46
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.01
Total Phosphate (as P)	0.00	0.07	0.02	0.50	0.50	0.13	1.78
Sulphate (SO_4)	35	65	64	87	87	14	0.21
Total Metals							
Aluminum (Al)	0.01	*1.91*	*0.49*	*12.76*	*12.75*	3.42	1.79
Antimony (Sb)	0.0009	0.0015	0.0015	0.0025	0.0025	0.0003	0.23
Arsenic (As)	0.0001	0.0024	0.0014	**0.0132**	**0.0132**	0.0035	1.44
Barium (Ba)	0.033	0.062	0.040	0.242	0.242	0.056	0.90
Beryllium (Be)	0.0001	0.0002	0.0002	0.0006	0.0004	0.0001	0.49
Boron (B)	0.005	0.006	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	**0.000234**	**0.000214**	**0.000738**	**0.000738**	0.000214	0.91
Calcium (Ca)	20.65	35.08	35.68	48.82	48.79	9.06	0.26
Chromium (Cr)	0.0002	**0.0030**	0.0008	**0.0200**	**0.0200**	0.0053	1.74
Cobalt (Co)	0.0001	0.0014	0.0006	0.0086	0.0086	0.0023	1.64
Copper (Cu)	0.0003	**0.0228**	**0.0152**	**0.0861**	**0.0861**	0.0250	1.10
Iron (Fe)	0.01	**3.16**	**1.52**	**20.86**	**20.86**	5.54	1.75
Lead (Pb)	0.00003	0.00169	0.00099	0.00872	0.00872	0.00232	1.37
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.67
Magnesium (Mg)	2.64	4.42	4.28	8.85	8.85	1.52	0.34
Manganese (Mn)	0.00003	0.08674	0.05276	0.50097	0.50092	0.13089	1.51
Mercury (Hg)	0.000005	0.000011	0.000006	0.000054	0.000054	0.000013	1.22
Molybdenum (Mo)	0.001	0.002	0.002	0.002	0.002	0.000	0.13
Nickel (Ni)	0.001	0.003	0.002	0.018	0.018	0.005	1.44
Potassium (K)	0.83	1.34	1.06	3.84	3.84	0.77	0.58
Selenium (Se)	0.0011	**0.0021**	0.0020	**0.0036**	**0.0032**	0.0006	0.26
Silicon (Si)	2.11	5.24	2.88	24.21	24.21	5.93	1.13
Silver (Ag)	0.000005	0.000045	0.000009	**0.000291**	**0.000291**	0.000078	1.72
Sodium (Na)	1.00	1.72	1.70	2.53	2.53	0.57	0.33
Strontium (Sr)	0.14	0.23	0.23	0.32	0.32	0.05	0.23
Thallium (Tl)	0.00002	0.00005	0.00005	0.00016	0.00016	0.00003	0.65
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.28
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.38
Vanadium (V)	0.0005	0.0082	0.0016	0.0575	0.0574	0.0154	1.87
Zinc (Zn)	0.0015	0.0231	0.0160	0.0649	0.0649	0.0204	0.88

(continued)

Table 14.7-33. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0073	0.0073	0.0016	0.48
Chloride (Cl)	0.68	1.27	1.26	1.99	1.91	0.47	0.37
Fluoride (F)	0.03	0.04	0.04	0.06	0.06	0.01	0.24
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.46
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.01
Total Phosphate (as P)	0.00	0.07	0.02	0.50	0.49	0.13	1.77
Sulphate (SO_4)	49	65	65	75	74	7	0.11
Total Metals							
Aluminum (Al)	0.01	*1.89*	*0.49*	*12.56*	*12.56*	3.36	1.78
Antimony (Sb)	0.0009	0.0015	0.0015	0.0024	0.0024	0.0003	0.22
Arsenic (As)	0.0001	0.0024	0.0014	**0.0130**	**0.0130**	0.0035	1.42
Barium (Ba)	0.033	0.062	0.040	0.239	0.239	0.055	0.89
Beryllium (Be)	0.0001	0.0002	0.0002	0.0006	0.0004	0.0001	0.49
Boron (B)	0.005	0.006	0.005	0.009	0.009	0.001	0.17
Cadmium (Cd)	0.000005	**0.000234**	**0.000214**	**0.000736**	**0.000736**	0.000213	0.91
Calcium (Ca)	20.82	35.06	36.62	47.91	47.83	8.91	0.25
Chromium (Cr)	0.0002	**0.0030**	0.0009	**0.0197**	**0.0197**	0.0052	1.74
Cobalt (Co)	0.0001	0.0014	0.0006	0.0085	0.0085	0.0022	1.63
Copper (Cu)	0.0003	**0.0227**	**0.0150**	**0.0859**	**0.0859**	0.0250	1.10
Iron (Fe)	0.01	**3.14**	**1.50**	**20.54**	**20.53**	5.44	1.74
Lead (Pb)	0.00003	0.00168	0.00099	0.00859	0.00859	0.00229	1.36
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.67
Magnesium (Mg)	2.67	4.42	4.27	8.73	8.72	1.49	0.34
Manganese (Mn)	0.00003	0.08612	0.05249	0.49328	0.49311	0.12869	1.49
Mercury (Hg)	0.000005	0.000011	0.000006	0.000053	0.000053	0.000013	1.21
Molybdenum (Mo)	0.001	0.002	0.002	0.002	0.002	0.000	0.17
Nickel (Ni)	0.001	0.003	0.002	0.018	0.018	0.005	1.43
Potassium (K)	0.83	1.34	1.06	3.81	3.81	0.76	0.57
Selenium (Se)	0.0016	**0.0020**	**0.0021**	**0.0028**	**0.0027**	0.0004	0.18
Silicon (Si)	2.13	5.22	2.84	23.84	23.83	5.82	1.11
Silver (Ag)	0.000005	0.000045	0.000009	0.000287	0.000287	0.000076	1.70
Sodium (Na)	1.00	1.71	1.71	2.52	2.52	0.57	0.33
Strontium (Sr)	0.13	0.23	0.24	0.31	0.31	0.05	0.23
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.64
Tin (Sn)	0.00005	0.00006	0.00005	0.00011	0.00011	0.00002	0.29
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.38
Vanadium (V)	0.0005	0.0082	0.0016	0.0566	0.0566	0.0152	1.86
Zinc (Zn)	0.0015	0.0230	0.0159	0.0639	0.0639	0.0202	0.88

(continued)

Table 14.7-33. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1; Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0073	0.0073	0.0016	0.48
Chloride (Cl)	1.27	2.69	2.66	4.40	4.21	1.11	0.41
Fluoride (F)	0.03	0.04	0.04	0.06	0.06	0.01	0.24
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.46
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.01
Total Phosphate (as P)	0.00	0.07	0.02	0.50	0.49	0.13	1.77
Sulphate (SO_4)	49	65	65	75	74	7	0.11
Total Metals							
Aluminum (Al)	0.01	*1.89*	*0.49*	*12.56*	*12.56*	3.36	1.78
Antimony (Sb)	0.0009	0.0015	0.0015	0.0024	0.0024	0.0003	0.22
Arsenic (As)	0.0001	0.0024	0.0014	**0.0130**	**0.0130**	0.0035	1.42
Barium (Ba)	0.033	0.062	0.040	0.239	0.239	0.055	0.89
Beryllium (Be)	0.0001	0.0002	0.0002	0.0006	0.0004	0.0001	0.49
Boron (B)	0.005	0.006	0.005	0.009	0.009	0.001	0.17
Cadmium (Cd)	0.000005	**0.000234**	**0.000214**	**0.000736**	**0.000736**	0.000213	0.91
Calcium (Ca)	20.98	35.18	36.74	47.97	47.88	8.85	0.25
Chromium (Cr)	0.0002	**0.0030**	0.0009	**0.0197**	**0.0197**	0.0052	1.74
Cobalt (Co)	0.0001	0.0014	0.0006	0.0085	0.0085	0.0022	1.63
Copper (Cu)	0.0003	**0.0227**	**0.0150**	**0.0859**	**0.0859**	0.0250	1.10
Iron (Fe)	0.01	**3.14**	**1.50**	**20.54**	**20.53**	5.44	1.74
Lead (Pb)	0.00003	0.00168	0.00099	0.00859	0.00859	0.00229	1.36
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.66
Magnesium (Mg)	2.67	4.42	4.27	8.73	8.72	1.49	0.34
Manganese (Mn)	0.00003	0.08613	0.05250	0.49329	0.49311	0.12869	1.49
Mercury (Hg)	0.000005	0.000011	0.000006	0.000053	0.000053	0.000013	1.21
Molybdenum (Mo)	0.001	0.002	0.002	0.002	0.002	0.000	0.17
Nickel (Ni)	0.001	0.003	0.002	0.018	0.018	0.005	1.43
Potassium (K)	0.83	1.34	1.06	3.81	3.81	0.76	0.57
Selenium (Se)	0.0017	**0.0022**	**0.0022**	**0.0031**	**0.0030**	0.0004	0.20
Silicon (Si)	2.13	5.22	2.84	23.84	23.83	5.82	1.11
Silver (Ag)	0.000005	0.000045	0.000009	**0.000287**	**0.000287**	0.000076	1.70
Sodium (Na)	1.00	1.71	1.71	2.52	2.52	0.57	0.33
Strontium (Sr)	0.13	0.23	0.24	0.31	0.31	0.05	0.23
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.64
Tin (Sn)	0.00005	0.00006	0.00005	0.00011	0.00011	0.00002	0.29
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.38
Vanadium (V)	0.0005	0.0082	0.0016	0.0566	0.0566	0.0152	1.86
Zinc (Zn)	0.0015	0.0230	0.0159	0.0639	0.0639	0.0202	0.88

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-34. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1) (Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0074	0.0071	0.0016	0.46
Chloride (Cl)	0.40	1.04	0.96	2.58	2.07	0.47	0.45
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.23
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.46
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.02
Total Phosphate (as P)	0.00	0.07	0.03	0.50	0.47	0.13	1.68
Sulphate (SO_4)	35	72	72	92	89	10	0.13
Total Metals							
Aluminum (Al)	0.01	*1.82*	*0.57*	*12.76*	*11.88*	3.19	1.76
Antimony (Sb)	0.0009	0.0015	0.0015	0.0025	0.0023	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0018	**0.0132**	**0.0124**	0.0033	1.41
Barium (Ba)	0.033	0.060	0.040	0.242	0.227	0.052	0.87
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.58
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000234**	**0.000224**	**0.000738**	**0.000716**	0.000204	0.87
Calcium (Ca)	20.51	35.14	34.36	48.77	48.59	9.39	0.27
Chromium (Cr)	0.0002	**0.0029**	**0.0014**	**0.0200**	**0.0187**	0.0050	1.69
Cobalt (Co)	0.0001	0.0013	0.0006	0.0086	0.0080	0.0021	1.59
Copper (Cu)	0.0003	**0.0219**	**0.0200**	**0.0861**	**0.0821**	0.0239	1.09
Iron (Fe)	0.01	**3.00**	**1.73**	**20.86**	**19.42**	5.16	1.72
Lead (Pb)	0.00003	0.00162	0.00122	0.00872	0.00814	0.00217	1.34
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.57	4.33	4.15	8.85	8.35	1.43	0.33
Manganese (Mn)	0.00003	0.08341	0.05634	0.50101	0.46676	0.12195	1.46
Mercury (Hg)	0.000005	0.000011	0.000007	0.000054	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.002	0.018	0.017	0.004	1.37
Potassium (K)	0.83	1.31	1.08	3.84	3.64	0.72	0.55
Selenium (Se)	0.0011	0.0019	**0.0020**	**0.0032**	**0.0024**	0.0004	0.18
Silicon (Si)	2.10	5.05	3.05	24.22	22.59	5.51	1.09
Silver (Ag)	0.000005	0.000043	0.000011	**0.000291**	**0.000272**	0.000072	1.67
Sodium (Na)	1.00	1.71	1.70	2.53	2.49	0.53	0.31
Strontium (Sr)	0.14	0.23	0.24	0.32	0.31	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00016	0.00015	0.00003	0.62
Tin (Sn)	0.00005	0.00006	0.00006	0.00011	0.00011	0.00002	0.27
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0078	0.0021	0.0575	0.0536	0.0144	1.83
Zinc (Zn)	0.0015	0.0225	0.0167	0.0649	0.0606	0.0191	0.85

(continued)

Table 14.7-34. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1) (Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0074	0.0071	0.0016	0.46
Chloride (Cl)	0.61	2.13	1.94	5.83	4.63	1.14	0.53
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.23
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.46
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.02
Total Phosphate (as P)	0.00	0.07	0.03	0.50	0.47	0.13	1.68
Sulphate (SO_4)	35	75	74	92	92	10	0.13
Total Metals							
Aluminum (Al)	0.01	*1.82*	*0.57*	*12.76*	*11.88*	3.19	1.76
Antimony (Sb)	0.0009	0.0015	0.0015	0.0025	0.0023	0.0003	0.22
Arsenic (As)	0.0001	0.0023	0.0018	**0.0132**	**0.0124**	0.0033	1.41
Barium (Ba)	0.033	0.060	0.040	0.242	0.227	0.052	0.87
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.57
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000234**	**0.000224**	**0.000738**	**0.000716**	0.000204	0.87
Calcium (Ca)	20.62	35.25	34.58	48.86	48.63	9.35	0.27
Chromium (Cr)	0.0002	**0.0029**	**0.0014**	**0.0200**	**0.0187**	0.0050	1.69
Cobalt (Co)	0.0001	0.0013	0.0006	0.0086	0.0080	0.0021	1.59
Copper (Cu)	0.0003	**0.0219**	**0.0200**	**0.0861**	**0.0821**	0.0239	1.09
Iron (Fe)	0.01	**3.00**	**1.73**	**20.86**	**19.42**	5.16	1.72
Lead (Pb)	0.00003	0.00162	0.00122	0.00872	0.00814	0.00217	1.34
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.57	4.33	4.15	8.85	8.35	1.43	0.33
Manganese (Mn)	0.00003	0.08342	0.05635	0.50102	0.46676	0.12195	1.46
Mercury (Hg)	0.000005	0.000011	0.000007	0.000054	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.002	0.018	0.017	0.004	1.37
Potassium (K)	0.83	1.31	1.08	3.84	3.64	0.72	0.55
Selenium (Se)	0.0011	**0.0021**	**0.0021**	**0.0036**	**0.0027**	0.0004	0.21
Silicon (Si)	2.11	5.05	3.05	24.22	22.59	5.51	1.09
Silver (Ag)	0.000005	0.000043	0.000011	**0.000291**	**0.000272**	0.000072	1.67
Sodium (Na)	1.00	1.71	1.70	2.53	2.49	0.53	0.31
Strontium (Sr)	0.14	0.23	0.24	0.32	0.31	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00016	0.00015	0.00003	0.62
Tin (Sn)	0.00005	0.00006	0.00006	0.00011	0.00011	0.00002	0.27
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0078	0.0021	0.0575	0.0536	0.0144	1.83
Zinc (Zn)	0.0015	0.0225	0.0167	0.0649	0.0606	0.0191	0.85

(continued)

Table 14.7-34. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1) (Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0074	0.0070	0.0016	0.46
Chloride (Cl)	0.52	1.08	1.03	2.46	1.72	0.41	0.38
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.22
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.45
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.01
Total Phosphate (as P)	0.00	0.07	0.03	0.49	0.47	0.13	1.69
Sulphate (SO_4)	48	72	71	92	84	7	0.09
Total Metals							
Aluminum (Al)	0.01	*1.82*	*0.58*	*12.56*	*11.85*	3.18	1.75
Antimony (Sb)	0.0009	0.0015	0.0015	0.0024	0.0023	0.0003	0.21
Arsenic (As)	0.0001	0.0023	0.0018	**0.0130**	**0.0123**	0.0033	1.40
Barium (Ba)	0.033	0.060	0.041	0.239	0.227	0.052	0.86
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.58
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000234**	**0.000226**	**0.000736**	**0.000720**	0.000205	0.87
Calcium (Ca)	20.36	35.04	33.87	48.36	48.13	9.18	0.26
Chromium (Cr)	0.0002	**0.0029**	**0.0014**	**0.0197**	**0.0187**	0.0050	1.70
Cobalt (Co)	0.0001	0.0013	0.0006	0.0085	0.0080	0.0021	1.59
Copper (Cu)	0.0003	**0.0220**	**0.0201**	**0.0858**	**0.0826**	0.0240	1.09
Iron (Fe)	0.01	**3.01**	**1.73**	**20.54**	**19.37**	5.15	1.71
Lead (Pb)	0.00003	0.00162	0.00122	0.00860	0.00812	0.00217	1.34
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.60	4.34	4.17	8.73	8.33	1.42	0.33
Manganese (Mn)	0.00003	0.08355	0.05581	0.49340	0.46565	0.12166	1.46
Mercury (Hg)	0.000005	0.000011	0.000007	0.000053	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.002	0.018	0.017	0.004	1.36
Potassium (K)	0.83	1.31	1.07	3.81	3.63	0.72	0.55
Selenium (Se)	0.0016	0.0020	0.0020	**0.0031**	**0.0025**	0.0003	0.15
Silicon (Si)	2.12	5.06	3.08	23.85	22.54	5.49	1.08
Silver (Ag)	0.000005	0.000043	0.000010	0.000287	0.000271	0.000072	1.67
Sodium (Na)	1.00	1.70	1.69	2.52	2.49	0.54	0.32
Strontium (Sr)	0.13	0.23	0.23	0.31	0.31	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.62
Tin (Sn)	0.00005	0.00006	0.00006	0.00011	0.00011	0.00002	0.28
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.36
Vanadium (V)	0.0005	0.0078	0.0021	0.0566	0.0534	0.0144	1.83
Zinc (Zn)	0.0015	0.0226	0.0168	0.0640	0.0604	0.0192	0.85

(continued)

Table 14.7-34. Summary Statistics of Water Quality Predictions for the Unuk River (site UR1) (Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0034	0.0025	0.0074	0.0070	0.0016	0.46
Chloride (Cl)	0.91	2.24	2.13	5.55	3.78	0.97	0.44
Fluoride (F)	0.03	0.05	0.05	0.06	0.06	0.01	0.22
Nitrate (as N)	0.01	0.07	0.08	0.12	0.12	0.03	0.45
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.01
Total Phosphate (as P)	0.00	0.07	0.03	0.49	0.47	0.13	1.69
Sulphate (SO_4)	48	74	73	92	90	8	0.10
Total Metals							
Aluminum (Al)	0.01	*1.82*	*0.58*	*12.56*	*11.85*	3.18	1.75
Antimony (Sb)	0.0009	0.0015	0.0015	0.0024	0.0023	0.0003	0.21
Arsenic (As)	0.0001	0.0023	0.0018	**0.0130**	**0.0123**	0.0033	1.40
Barium (Ba)	0.033	0.060	0.041	0.239	0.227	0.052	0.86
Beryllium (Be)	0.0001	0.0003	0.0002	0.0006	0.0006	0.0002	0.58
Boron (B)	0.005	0.006	0.006	0.009	0.009	0.001	0.16
Cadmium (Cd)	0.000005	**0.000234**	**0.000226**	**0.000736**	**0.000720**	0.000205	0.87
Calcium (Ca)	20.47	35.15	34.04	48.45	48.19	9.13	0.26
Chromium (Cr)	0.0002	**0.0029**	**0.0014**	**0.0197**	**0.0187**	0.0050	1.70
Cobalt (Co)	0.0001	0.0013	0.0006	0.0085	0.0080	0.0021	1.59
Copper (Cu)	0.0003	**0.0220**	**0.0201**	**0.0858**	**0.0826**	0.0240	1.09
Iron (Fe)	0.01	**3.01**	**1.73**	**20.54**	**19.37**	5.15	1.71
Lead (Pb)	0.00003	0.00162	0.00122	0.00860	0.00812	0.00217	1.33
Lithium (Li)	0.001	0.003	0.003	0.009	0.009	0.002	0.63
Magnesium (Mg)	2.60	4.34	4.17	8.73	8.33	1.42	0.33
Manganese (Mn)	0.00003	0.08356	0.05581	0.49340	0.46565	0.12166	1.46
Mercury (Hg)	0.000005	0.000011	0.000007	0.000053	0.000050	0.000012	1.17
Molybdenum (Mo)	0.001	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.001	0.003	0.002	0.018	0.017	0.004	1.36
Potassium (K)	0.83	1.31	1.07	3.81	3.63	0.72	0.55
Selenium (Se)	0.0017	**0.0021**	**0.0022**	**0.0035**	**0.0027**	0.0004	0.17
Silicon (Si)	2.12	5.06	3.08	23.85	22.54	5.49	1.08
Silver (Ag)	0.000005	0.000043	0.000010	**0.000287**	**0.000271**	0.000072	1.67
Sodium (Na)	1.00	1.70	1.69	2.52	2.49	0.54	0.32
Strontium (Sr)	0.13	0.23	0.23	0.31	0.31	0.05	0.22
Thallium (Tl)	0.00002	0.00005	0.00005	0.00015	0.00015	0.00003	0.62
Tin (Sn)	0.00005	0.00006	0.00006	0.00011	0.00011	0.00002	0.28
Uranium (U)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.35
Vanadium (V)	0.0005	0.0078	0.0021	0.0566	0.0534	0.0144	1.83
Zinc (Zn)	0.0015	0.0226	0.0168	0.0640	0.0604	0.0192	0.85

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-35. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Construction Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0101	0.0219	0.0211	0.0385	0.0379	0.0092	0.42
Chloride (Cl)	0.31	0.41	0.38	0.59	0.59	0.09	0.21
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.21
Nitrate (as N)	0.235	0.359	0.356	0.470	0.466	0.062	0.17
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.04
Total Phosphate (as P)	0.0101	0.0579	0.0251	0.2230	0.2218	0.0621	1.07
Sulphate (SO_4)	17	33	34	52	52	11	0.34
Total Metals							
Aluminum (Al)	0.01	*1.45*	*0.59*	*6.29*	*6.29*	1.98	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.25
Arsenic (As)	0.0001	0.0011	0.0006	0.0042	0.0042	0.0012	1.09
Barium (Ba)	0.034	0.050	0.038	0.116	0.116	0.025	0.50
Beryllium (Be)	0.0001	0.0003	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.25
Cadmium (Cd)	0.000005	**0.000061**	**0.000025**	**0.000231**	**0.000231**	0.000074	1.21
Calcium (Ca)	15.83	27.08	28.64	37.32	37.27	7.41	0.27
Chromium (Cr)	0.0003	**0.0024**	**0.0011**	**0.0099**	**0.0099**	0.0029	1.21
Cobalt (Co)	0.00005	0.00090	0.00033	0.00390	0.00390	0.00119	1.31
Copper (Cu)	0.0003	0.0076	0.0056	**0.0311**	**0.0311**	0.0090	1.17
Iron (Fe)	0.01	**1.88**	0.73	**8.61**	**8.61**	2.60	1.39
Lead (Pb)	0.00003	0.00124	0.00049	0.00518	0.00518	0.00157	1.27
Lithium (Li)	0.0006	0.0025	0.0025	0.0047	0.0047	0.0009	0.36
Magnesium (Mg)	2.13	2.81	2.62	4.67	4.67	0.66	0.23
Manganese (Mn)	0.00003	0.04920	0.02370	0.20440	0.20440	0.06326	1.29
Mercury (Hg)	0.000005	0.000015	0.000005	0.000050	0.000050	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.000	0.21
Nickel (Ni)	0.0003	0.0020	0.0010	0.0077	0.0077	0.0023	1.15
Potassium (K)	0.91	1.25	1.19	2.12	2.12	0.32	0.26
Selenium (Se)	0.0006	0.0008	0.0008	0.0009	0.0009	0.0001	0.15
Silicon (Si)	2.48	4.61	3.03	12.62	12.62	3.16	0.68
Silver (Ag)	0.000005	0.000025	0.000010	**0.000103**	**0.000103**	0.000030	1.20
Sodium (Na)	1.00	1.54	1.21	2.66	2.66	0.63	0.41
Strontium (Sr)	0.10	0.16	0.17	0.21	0.21	0.04	0.24
Thallium (Tl)	0.000005	0.000046	0.000049	0.000081	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00006	0.00010	0.00010	0.00001	0.23
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0055	0.0023	0.0229	0.0229	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.006	0.028	0.028	0.009	1.00

(continued)

Table 14.7-35. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Construction Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0081	0.0050	0.0436	0.0249	0.0075	0.93
Chloride (Cl)	0.26	0.84	0.62	3.06	1.92	0.53	0.63
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.19
Nitrate (as N)	0.002	0.163	0.154	0.505	0.354	0.099	0.61
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.0000	0.02
Total Phosphate (as P)	0.0010	0.0521	0.0140	0.2310	0.2210	0.0636	1.22
Sulphate (SO_4)	15	42	41	61	53	8	0.19
Total Metals							
Aluminum (Al)	0.01	*1.44*	*0.20*	*6.56*	*6.34*	1.97	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0005	0.0043	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.038	0.120	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0003	0.0002	0.0005	0.0004	0.0001	0.36
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000061**	0.000017	**0.000231**	**0.000229**	0.000073	1.20
Calcium (Ca)	15.65	27.31	30.54	39.56	36.49	6.76	0.25
Chromium (Cr)	0.0002	**0.0024**	0.0006	**0.0103**	**0.0100**	0.0030	1.23
Cobalt (Co)	0.00005	0.00090	0.00012	0.00406	0.00393	0.00118	1.31
Copper (Cu)	0.0003	0.0076	0.0019	**0.0311**	**0.0308**	0.0088	1.16
Iron (Fe)	0.01	**1.87**	0.42	**8.97**	**8.68**	2.59	1.39
Lead (Pb)	0.00003	0.00123	0.00027	0.00539	0.00521	0.00157	1.27
Lithium (Li)	0.0005	0.0024	0.0025	0.0048	0.0047	0.0009	0.37
Magnesium (Mg)	2.10	2.82	2.64	4.76	4.69	0.66	0.23
Manganese (Mn)	0.00003	0.04892	0.01230	0.21283	0.20591	0.06288	1.29
Mercury (Hg)	0.000005	0.000015	0.000005	0.000051	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.0003	0.0020	0.0007	0.0079	0.0077	0.0023	1.16
Potassium (K)	0.91	1.25	1.18	2.18	2.12	0.32	0.26
Selenium (Se)	0.0005	0.0011	0.0010	0.0017	0.0016	0.0003	0.23
Silicon (Si)	2.48	4.62	2.76	13.10	12.71	3.12	0.68
Silver (Ag)	0.000005	0.000024	0.000006	**0.000107**	**0.000104**	0.000029	1.20
Sodium (Na)	1.00	1.54	1.33	2.66	2.63	0.61	0.39
Strontium (Sr)	0.10	0.16	0.17	0.22	0.20	0.03	0.20
Thallium (Tl)	0.000005	0.000046	0.000050	0.000083	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.25
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0054	0.0011	0.0238	0.0230	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.005	0.028	0.027	0.009	0.99

(continued)

Table 14.7-35. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Construction Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0092	0.0058	0.0548	0.0305	0.0092	1.00
Chloride (Cl)	0.25	0.52	0.45	1.63	0.97	0.23	0.44
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.19
Nitrate (as N)	0.002	0.160	0.141	0.507	0.345	0.099	0.62
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.0000	0.02
Total Phosphate (as P)	0.0010	0.0517	0.0142	0.2316	0.2220	0.0639	1.24
Sulphate (SO_4)	15	39	39	61	51	8	0.20
Total Metals							
Aluminum (Al)	0.01	*1.44*	*0.20*	*6.58*	*6.36*	1.97	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0005	0.0044	0.0042	0.0012	1.09
Barium (Ba)	0.034	0.050	0.038	0.121	0.117	0.025	0.50
Beryllium (Be)	0.0001	0.0002	0.0002	0.0006	0.0004	0.0001	0.36
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000061**	0.000017	**0.000231**	**0.000229**	0.000073	1.20
Calcium (Ca)	15.60	27.08	30.43	39.82	36.33	6.82	0.25
Chromium (Cr)	0.0002	**0.0024**	0.0006	**0.0104**	**0.0100**	0.0030	1.23
Cobalt (Co)	0.00005	0.00090	0.00012	0.00407	0.00394	0.00118	1.31
Copper (Cu)	0.0003	0.0076	0.0019	**0.0313**	**0.0308**	0.0089	1.16
Iron (Fe)	0.01	**1.87**	0.42	**9.00**	**8.70**	2.60	1.39
Lead (Pb)	0.00003	0.00123	0.00027	0.00541	0.00523	0.00157	1.27
Lithium (Li)	0.0005	0.0024	0.0025	0.0048	0.0047	0.0009	0.37
Magnesium (Mg)	2.10	2.82	2.64	4.77	4.69	0.66	0.23
Manganese (Mn)	0.00003	0.04902	0.01228	0.21347	0.20636	0.06306	1.29
Mercury (Hg)	0.000005	0.000015	0.000005	0.000052	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.0003	0.0020	0.0006	0.0079	0.0077	0.0023	1.16
Potassium (K)	0.90	1.25	1.18	2.18	2.13	0.32	0.26
Selenium (Se)	0.0005	0.0010	0.0009	0.0016	0.0013	0.0002	0.20
Silicon (Si)	2.48	4.62	2.76	13.14	12.74	3.13	0.68
Silver (Ag)	0.000005	0.000025	0.000006	**0.000108**	**0.000104**	0.000030	1.21
Sodium (Na)	1.00	1.54	1.33	2.66	2.63	0.61	0.39
Strontium (Sr)	0.10	0.16	0.17	0.22	0.20	0.03	0.20
Thallium (Tl)	0.000005	0.000046	0.000050	0.000083	0.000081	0.000017	0.38
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.25
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0054	0.0011	0.0239	0.0231	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.005	0.028	0.027	0.009	0.99

(continued)

Table 14.7-35. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Construction Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0092	0.0058	0.0548	0.0305	0.0092	1.00
Chloride (Cl)	0.26	0.83	0.61	3.34	1.92	0.54	0.65
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.19
Nitrate (as N)	0.002	0.160	0.141	0.507	0.345	0.099	0.62
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.0000	0.02
Total Phosphate (as P)	0.0010	0.0517	0.0142	0.2316	0.2220	0.0639	1.24
Sulphate (SO_4)	15	41	40	63	53	8	0.20
Total Metals							
Aluminum (Al)	0.01	*1.44*	*0.20*	*6.58*	*6.36*	1.97	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0005	0.0044	0.0042	0.0012	1.09
Barium (Ba)	0.034	0.050	0.038	0.121	0.117	0.025	0.50
Beryllium (Be)	0.0001	0.0002	0.0002	0.0006	0.0004	0.0001	0.35
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000061**	0.000017	**0.000231**	**0.000229**	0.000073	1.20
Calcium (Ca)	15.62	27.26	30.49	39.84	36.49	6.81	0.25
Chromium (Cr)	0.0002	**0.0024**	0.0006	**0.0104**	**0.0100**	0.0030	1.23
Cobalt (Co)	0.00005	0.00090	0.00012	0.00407	0.00394	0.00118	1.31
Copper (Cu)	0.0003	0.0076	0.0019	**0.0313**	**0.0308**	0.0089	1.16
Iron (Fe)	0.01	**1.87**	0.42	**9.00**	**8.70**	2.60	1.39
Lead (Pb)	0.00003	0.00123	0.00027	0.00541	0.00523	0.00157	1.27
Lithium (Li)	0.0005	0.0024	0.0025	0.0048	0.0047	0.0009	0.37
Magnesium (Mg)	2.10	2.82	2.64	4.77	4.69	0.66	0.23
Manganese (Mn)	0.00003	0.04903	0.01229	0.21347	0.20636	0.06306	1.29
Mercury (Hg)	0.000005	0.000015	0.000005	0.000052	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.000	0.15
Nickel (Ni)	0.0003	0.0020	0.0006	0.0079	0.0077	0.0023	1.16
Potassium (K)	0.90	1.25	1.18	2.18	2.13	0.32	0.26
Selenium (Se)	0.0005	0.0011	0.0010	0.0019	0.0016	0.0003	0.25
Silicon (Si)	2.48	4.62	2.76	13.14	12.74	3.13	0.68
Silver (Ag)	0.000005	0.000025	0.000006	**0.000108**	**0.000104**	0.000030	1.21
Sodium (Na)	1.00	1.54	1.33	2.66	2.63	0.61	0.39
Strontium (Sr)	0.10	0.16	0.17	0.22	0.20	0.03	0.20
Thallium (Tl)	0.000005	0.000046	0.000050	0.000083	0.000081	0.000017	0.38
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.25
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0054	0.0011	0.0239	0.0231	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.005	0.028	0.027	0.009	0.99

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-36. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0091	0.0057	0.0569	0.0317	0.0093	1.02
Chloride (Cl)	0.25	0.52	0.46	1.58	0.95	0.23	0.45
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.19
Nitrate (as N)	0.00	0.17	0.15	0.52	0.37	0.11	0.62
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.00001	0.02
Total Phosphate (as P)	0.001	0.05	0.01	0.22	0.22	0.06	1.22
Sulphate (SO_4)	15	40	40	55	51	8	0.19
Total Metals							
Aluminum (Al)	0.01	*1.44*	*0.20*	*6.35*	*6.34*	1.96	1.36
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0005	0.0042	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.038	0.117	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000060**	0.000017	**0.000231**	**0.000229**	0.000073	1.21
Calcium (Ca)	15.77	27.12	30.49	37.55	36.29	6.69	0.25
Chromium (Cr)	0.0002	**0.0024**	0.0006	**0.0100**	**0.0100**	0.0029	1.23
Cobalt (Co)	0.00005	0.00090	0.00012	0.00394	0.00393	0.00118	1.31
Copper (Cu)	0.0003	0.0076	0.0019	**0.0311**	**0.0308**	0.0088	1.16
Iron (Fe)	0.01	**1.87**	0.42	**8.69**	**8.68**	2.58	1.38
Lead (Pb)	0.00003	0.00123	0.00027	0.00522	0.00521	0.00156	1.27
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.10	2.82	2.64	4.69	4.69	0.65	0.23
Manganese (Mn)	0.00003	0.04883	0.01227	0.20626	0.20589	0.06269	1.28
Mercury (Hg)	0.000005	0.000015	0.000005	0.000051	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0006	0.0077	0.0077	0.0023	1.16
Potassium (K)	0.91	1.25	1.18	2.12	2.12	0.32	0.26
Selenium (Se)	0.0005	0.0011	0.0010	0.0019	0.0016	0.0002	0.22
Silicon (Si)	2.48	4.61	2.75	12.73	12.71	3.11	0.67
Silver (Ag)	0.000005	0.000024	0.000006	**0.000104**	**0.000104**	0.000029	1.20
Sodium (Na)	1.0	1.5	1.3	2.7	2.6	0.6	0.39
Strontium (Sr)	0.094	0.157	0.169	0.212	0.197	0.031	0.20
Thallium (Tl)	0.000005	0.000046	0.000050	0.000081	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.25
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0054	0.0011	0.0231	0.0230	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.005	0.028	0.027	0.009	0.99

(continued)

Table 14.7-36. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0091	0.0057	0.0569	0.0317	0.0093	1.02
Chloride (Cl)	0.25	0.85	0.62	3.31	1.86	0.55	0.65
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.19
Nitrate (as N)	0.00	0.17	0.15	0.52	0.37	0.11	0.62
Nitrite (as N)	0.0005	0.0005	0.0005	0.0006	0.0005	0.000009	0.02
Total Phosphate (as P)	0.001	0.05	0.01	0.22	0.22	0.06	1.22
Sulphate (SO_4)	16	42	41	56	53	8	0.18
Total Metals							
Aluminum (Al)	0.01	*1.44*	*0.20*	*6.35*	*6.34*	1.96	1.36
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0005	0.0042	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.038	0.117	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000060**	0.000017	**0.000231**	**0.000229**	0.000073	1.21
Calcium (Ca)	15.81	27.32	30.57	37.57	36.42	6.66	0.24
Chromium (Cr)	0.0002	**0.0024**	0.0006	**0.0100**	**0.0100**	0.0029	1.23
Cobalt (Co)	0.00005	0.00090	0.00012	0.00394	0.00393	0.00118	1.31
Copper (Cu)	0.0003	0.0076	0.0019	**0.0311**	**0.0308**	0.0088	1.16
Iron (Fe)	0.01	**1.87**	0.42	**8.69**	**8.68**	2.58	1.38
Lead (Pb)	0.00003	0.00123	0.00027	0.00522	0.00521	0.00156	1.27
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.10	2.82	2.64	4.69	4.69	0.65	0.23
Manganese (Mn)	0.00003	0.04883	0.01228	0.20626	0.20589	0.06269	1.28
Mercury (Hg)	0.000005	0.000015	0.000005	0.000051	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0006	0.0077	0.0077	0.0023	1.16
Potassium (K)	0.91	1.25	1.18	2.12	2.12	0.32	0.26
Selenium (Se)	0.0006	0.0012	0.0012	**0.0023**	0.0019	0.0003	0.27
Silicon (Si)	2.48	4.61	2.75	12.73	12.71	3.11	0.67
Silver (Ag)	0.000005	0.000024	0.000006	**0.000104**	**0.000104**	0.000029	1.20
Sodium (Na)	1.0	1.5	1.3	2.7	2.6	0.6	0.39
Strontium (Sr)	0.097	0.157	0.169	0.212	0.197	0.031	0.20
Thallium (Tl)	0.000005	0.000046	0.000050	0.000081	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.25
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0054	0.0011	0.0231	0.0230	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.005	0.028	0.027	0.009	0.99

(continued)

Table 14.7-36. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0079	0.0045	0.0677	0.0282	0.0091	1.15
Chloride (Cl)	0.25	0.53	0.47	1.18	0.99	0.23	0.43
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.20
Nitrate (as N)	0.00	0.18	0.15	0.62	0.40	0.12	0.66
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.00001	0.01
Total Phosphate (as P)	0.001	0.05	0.01	0.22	0.22	0.06	1.24
Sulphate (SO_4)	16	40	39	57	51	7	0.17
Total Metals							
Aluminum (Al)	0.005	*1.44*	*0.20*	*6.33*	*6.31*	1.96	1.36
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0005	0.0042	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.038	0.117	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000060**	0.000016	**0.000230**	**0.000230**	0.000073	1.21
Calcium (Ca)	15.79	27.08	30.39	36.35	36.22	6.61	0.24
Chromium (Cr)	0.0002	**0.0024**	0.0005	**0.0100**	**0.0100**	0.0029	1.23
Cobalt (Co)	0.00005	0.00090	0.00012	0.00392	0.00391	0.00117	1.31
Copper (Cu)	0.0003	0.0076	0.0019	**0.0310**	**0.0309**	0.0089	1.16
Iron (Fe)	0.01	**1.87**	0.42	**8.66**	**8.64**	2.58	1.38
Lead (Pb)	0.00003	0.00123	0.00027	0.00520	0.00519	0.00156	1.27
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.11	2.82	2.63	4.68	4.67	0.65	0.23
Manganese (Mn)	0.00003	0.04883	0.01228	0.20529	0.20493	0.06260	1.28
Mercury (Hg)	0.000005	0.000016	0.000005	0.000051	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0006	0.0077	0.0077	0.0023	1.16
Potassium (K)	0.91	1.24	1.18	2.12	2.12	0.32	0.26
Selenium (Se)	0.0006	0.0011	0.0010	0.0019	0.0016	0.0003	0.24
Silicon (Si)	2.53	4.62	2.75	12.68	12.66	3.10	0.67
Silver (Ag)	0.000005	0.000024	0.000005	**0.000104**	**0.000103**	0.000029	1.20
Sodium (Na)	1.0	1.5	1.3	2.6	2.6	0.6	0.39
Strontium (Sr)	0.096	0.156	0.168	0.197	0.196	0.030	0.20
Thallium (Tl)	0.000005	0.000046	0.000049	0.000081	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.25
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0054	0.0010	0.0230	0.0229	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.005	0.028	0.027	0.009	0.99

(continued)

Table 14.7-36. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0079	0.0045	0.0677	0.0282	0.0091	1.15
Chloride (Cl)	0.25	0.88	0.61	2.36	1.96	0.54	0.62
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.20
Nitrate (as N)	0.00	0.18	0.15	0.62	0.40	0.12	0.66
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000007	0.01
Total Phosphate (as P)	0.001	0.05	0.01	0.22	0.22	0.06	1.24
Sulphate (SO_4)	16	41	40	57	52	7	0.17
Total Metals							
Aluminum (Al)	0.005	*1.44*	*0.20*	*6.33*	*6.31*	1.96	1.36
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0005	0.0042	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.038	0.117	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000060**	0.000016	**0.000230**	**0.000230**	0.000073	1.21
Calcium (Ca)	15.83	27.29	30.49	36.48	36.31	6.58	0.24
Chromium (Cr)	0.0002	**0.0024**	0.0005	**0.0100**	**0.0100**	0.0029	1.23
Cobalt (Co)	0.00005	0.00090	0.00012	0.00392	0.00391	0.00117	1.31
Copper (Cu)	0.0003	0.0076	0.0019	**0.0310**	**0.0309**	0.0089	1.16
Iron (Fe)	0.01	**1.87**	0.42	**8.66**	**8.64**	2.58	1.38
Lead (Pb)	0.00003	0.00123	0.00027	0.00520	0.00519	0.00156	1.27
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.11	2.82	2.63	4.68	4.67	0.65	0.23
Manganese (Mn)	0.00003	0.04883	0.01229	0.20529	0.20493	0.06260	1.28
Mercury (Hg)	0.000005	0.000016	0.000005	0.000051	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0006	0.0077	0.0077	0.0023	1.16
Potassium (K)	0.91	1.25	1.18	2.12	2.12	0.32	0.26
Selenium (Se)	0.0006	0.0013	0.0012	**0.0022**	0.0018	0.0004	0.29
Silicon (Si)	2.53	4.62	2.75	12.68	12.66	3.10	0.67
Silver (Ag)	0.000005	0.000024	0.000005	**0.000104**	**0.000103**	0.000029	1.20
Sodium (Na)	1.0	1.5	1.3	2.6	2.6	0.6	0.39
Strontium (Sr)	0.099	0.156	0.168	0.197	0.196	0.030	0.20
Thallium (Tl)	0.000005	0.000046	0.000049	0.000081	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.25
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0054	0.0010	0.0230	0.0229	0.0070	1.29
Zinc (Zn)	0.002	0.009	0.005	0.028	0.027	0.009	0.99

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-37. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0040	0.0006	0.20
Chloride (Cl)	0.31	0.67	0.64	1.44	1.25	0.26	0.39
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.21
Nitrate (as N)	0.00	0.11	0.11	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000002	0.00
Total Phosphate (as P)	0.001	0.05	0.02	0.22	0.22	0.06	1.29
Sulphate (SO_4)	19	37	37	52	52	9	0.25
Total Metals							
Aluminum (Al)	0.005	*1.48*	*0.60*	*6.58*	*6.58*	2.03	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.25
Arsenic (As)	0.0001	0.0011	0.0006	0.0043	0.0043	0.0012	1.09
Barium (Ba)	0.034	0.051	0.039	0.120	0.120	0.026	0.51
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.31
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.25
Cadmium (Cd)	0.000005	**0.000059**	0.000020	**0.000230**	**0.000230**	0.000073	1.24
Calcium (Ca)	16.71	26.96	28.27	36.43	36.42	6.65	0.25
Chromium (Cr)	0.0002	**0.0024**	**0.0011**	**0.0103**	**0.0103**	0.0030	1.25
Cobalt (Co)	0.00005	0.00092	0.00033	0.00408	0.00408	0.00122	1.33
Copper (Cu)	0.0003	**0.0078**	0.0056	**0.0314**	**0.0314**	0.0090	1.16
Iron (Fe)	0.01	**1.93**	0.74	**9.02**	**9.01**	2.68	1.39
Lead (Pb)	0.00003	0.00127	0.00049	0.00540	0.00540	0.00162	1.28
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.38
Magnesium (Mg)	2.12	2.83	2.64	4.81	4.81	0.68	0.24
Manganese (Mn)	0.00003	0.05016	0.02345	0.21352	0.21351	0.06498	1.30
Mercury (Hg)	0.000005	0.000016	0.000005	0.000052	0.000052	0.000017	1.12
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0004	0.17
Nickel (Ni)	0.0003	0.0020	0.0009	0.0080	0.0080	0.0024	1.18
Potassium (K)	0.92	1.25	1.19	2.17	2.17	0.34	0.27
Selenium (Se)	0.0006	0.0011	0.0010	0.0018	0.0014	0.0002	0.23
Silicon (Si)	2.54	4.71	3.06	13.17	13.17	3.24	0.69
Silver (Ag)	0.000005	0.000025	0.000010	**0.000107**	**0.000107**	0.000030	1.22
Sodium (Na)	1.0	1.5	1.2	2.6	2.6	0.6	0.40
Strontium (Sr)	0.099	0.151	0.154	0.196	0.196	0.032	0.21
Thallium (Tl)	0.000005	0.000046	0.000050	0.000084	0.000084	0.000017	0.38
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.19
Vanadium (V)	0.0005	0.0056	0.0023	0.0239	0.0239	0.0072	1.30
Zinc (Zn)	0.002	0.009	0.006	0.028	0.028	0.009	1.01

(continued)

Table 14.7-37. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0040	0.0006	0.20
Chloride (Cl)	0.39	1.18	1.02	3.11	2.65	0.61	0.52
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.21
Nitrate (as N)	0.00	0.11	0.11	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000002	0.00
Total Phosphate (as P)	0.001	0.05	0.02	0.22	0.22	0.06	1.29
Sulphate (SO_4)	19	37	37	52	52	9	0.25
Total Metals							
Aluminum (Al)	0.005	*1.48*	*0.60*	*6.58*	*6.58*	2.03	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.25
Arsenic (As)	0.0001	0.0011	0.0006	0.0043	0.0043	0.0012	1.09
Barium (Ba)	0.034	0.051	0.039	0.120	0.120	0.026	0.51
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.31
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.25
Cadmium (Cd)	0.000005	**0.000059**	0.000020	**0.000230**	**0.000230**	0.000073	1.24
Calcium (Ca)	16.77	27.00	28.30	36.46	36.44	6.63	0.25
Chromium (Cr)	0.0002	**0.0024**	**0.0011**	**0.0103**	**0.0103**	0.0030	1.25
Cobalt (Co)	0.00005	0.00092	0.00033	0.00408	0.00408	0.00122	1.33
Copper (Cu)	0.0003	**0.0078**	0.0056	**0.0314**	**0.0314**	0.0090	1.16
Iron (Fe)	0.01	**1.93**	0.74	**9.02**	**9.01**	2.68	1.39
Lead (Pb)	0.00003	0.00127	0.00049	0.00540	0.00540	0.00162	1.28
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.38
Magnesium (Mg)	2.12	2.83	2.64	4.81	4.81	0.68	0.24
Manganese (Mn)	0.00003	0.05016	0.02345	0.21352	0.21351	0.06498	1.30
Mercury (Hg)	0.000005	0.000016	0.000005	0.000052	0.000052	0.000017	1.12
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0004	0.17
Nickel (Ni)	0.0003	0.0020	0.0009	0.0080	0.0080	0.0024	1.18
Potassium (K)	0.92	1.26	1.19	2.17	2.17	0.34	0.27
Selenium (Se)	0.0006	0.0011	0.0011	**0.0021**	0.0016	0.0003	0.26
Silicon (Si)	2.54	4.71	3.06	13.17	13.17	3.24	0.69
Silver (Ag)	0.000005	0.000025	0.000010	**0.000107**	**0.000107**	0.000030	1.22
Sodium (Na)	1.0	1.5	1.2	2.6	2.6	0.6	0.40
Strontium (Sr)	0.099	0.151	0.154	0.196	0.196	0.032	0.21
Thallium (Tl)	0.000005	0.000046	0.000050	0.000084	0.000084	0.000017	0.38
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.19
Vanadium (V)	0.0005	0.0056	0.0023	0.0239	0.0239	0.0072	1.30
Zinc (Zn)	0.002	0.009	0.006	0.028	0.028	0.009	1.01

(continued)

Table 14.7-37. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0040	0.0006	0.20
Chloride (Cl)	0.48	0.76	0.72	1.14	1.09	0.20	0.26
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.21
Nitrate (as N)	0.00	0.11	0.11	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000002	0.00
Total Phosphate (as P)	0.001	0.05	0.02	0.23	0.22	0.06	1.29
Sulphate (SO_4)	28	37	35	47	47	5	0.15
Total Metals							
Aluminum (Al)	0.004	*1.48*	*0.60*	*6.53*	*6.53*	2.02	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.25
Arsenic (As)	0.0001	0.0011	0.0006	0.0043	0.0043	0.0012	1.09
Barium (Ba)	0.034	0.051	0.039	0.120	0.120	0.026	0.50
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.31
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.25
Cadmium (Cd)	0.000005	**0.000059**	0.000020	**0.000231**	**0.000230**	0.000074	1.24
Calcium (Ca)	16.82	26.99	28.52	36.18	36.17	6.48	0.24
Chromium (Cr)	0.0002	**0.0024**	**0.0011**	**0.0103**	**0.0103**	0.0030	1.25
Cobalt (Co)	0.00005	0.00092	0.00033	0.00404	0.00404	0.00121	1.32
Copper (Cu)	0.0003	**0.0078**	0.0056	**0.0315**	**0.0315**	0.0090	1.16
Iron (Fe)	0.01	**1.93**	0.74	**8.94**	**8.93**	2.67	1.38
Lead (Pb)	0.00003	0.00126	0.00049	0.00536	0.00536	0.00161	1.28
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.38
Magnesium (Mg)	2.13	2.83	2.64	4.78	4.77	0.68	0.24
Manganese (Mn)	0.00003	0.05004	0.02349	0.21168	0.21164	0.06465	1.29
Mercury (Hg)	0.000005	0.000016	0.000005	0.000052	0.000052	0.000017	1.12
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0004	0.16
Nickel (Ni)	0.0003	0.0020	0.0009	0.0079	0.0079	0.0024	1.18
Potassium (K)	0.91	1.25	1.18	2.16	2.16	0.33	0.27
Selenium (Se)	0.0008	0.0011	0.0011	0.0016	0.0015	0.0002	0.20
Silicon (Si)	2.55	4.71	3.07	13.06	13.06	3.22	0.68
Silver (Ag)	0.000005	0.000025	0.000010	**0.000107**	**0.000107**	0.000030	1.21
Sodium (Na)	1.0	1.5	1.2	2.6	2.6	0.6	0.40
Strontium (Sr)	0.094	0.151	0.156	0.194	0.194	0.031	0.21
Thallium (Tl)	0.000005	0.000046	0.000050	0.000083	0.000083	0.000017	0.38
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0056	0.0023	0.0237	0.0237	0.0072	1.29
Zinc (Zn)	0.002	0.009	0.006	0.028	0.028	0.009	1.01

(continued)

Table 14.7-37. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0040	0.0006	0.20
Chloride (Cl)	0.79	1.41	1.25	2.39	2.25	0.53	0.38
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.21
Nitrate (as N)	0.00	0.11	0.11	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000002	0.00
Total Phosphate (as P)	0.001	0.05	0.02	0.23	0.22	0.06	1.29
Sulphate (SO_4)	28	37	35	47	47	5	0.15
Total Metals							
Aluminum (Al)	0.004	*1.48*	*0.60*	*6.53*	*6.53*	2.02	1.37
Antimony (Sb)	0.0006	0.0007	0.0006	0.0012	0.0012	0.0002	0.25
Arsenic (As)	0.0001	0.0011	0.0006	0.0043	0.0043	0.0012	1.09
Barium (Ba)	0.034	0.051	0.039	0.120	0.120	0.026	0.50
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0003	0.0001	0.31
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.25
Cadmium (Cd)	0.000005	**0.000059**	0.000020	**0.000231**	**0.000230**	0.000074	1.24
Calcium (Ca)	16.91	27.05	28.58	36.20	36.18	6.46	0.24
Chromium (Cr)	0.0002	**0.0024**	**0.0011**	**0.0103**	**0.0103**	0.0030	1.25
Cobalt (Co)	0.00005	0.00092	0.00033	0.00404	0.00404	0.00121	1.32
Copper (Cu)	0.0003	**0.0078**	0.0056	**0.0315**	**0.0315**	0.0090	1.16
Iron (Fe)	0.01	**1.93**	0.74	**8.94**	**8.93**	2.67	1.38
Lead (Pb)	0.00003	0.00126	0.00049	0.00536	0.00536	0.00161	1.28
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.38
Magnesium (Mg)	2.13	2.83	2.64	4.78	4.77	0.68	0.24
Manganese (Mn)	0.00003	0.05004	0.02349	0.21169	0.21164	0.06465	1.29
Mercury (Hg)	0.000005	0.000016	0.000005	0.000052	0.000052	0.000017	1.12
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0004	0.16
Nickel (Ni)	0.0003	0.0020	0.0009	0.0079	0.0079	0.0024	1.18
Potassium (K)	0.91	1.25	1.19	2.16	2.16	0.33	0.27
Selenium (Se)	0.0008	0.0012	0.0011	0.0017	0.0016	0.0003	0.21
Silicon (Si)	2.55	4.71	3.07	13.06	13.06	3.22	0.68
Silver (Ag)	0.000005	0.000025	0.000010	**0.000107**	**0.000107**	0.000030	1.21
Sodium (Na)	1.0	1.5	1.2	2.6	2.6	0.6	0.40
Strontium (Sr)	0.094	0.151	0.156	0.194	0.194	0.031	0.21
Thallium (Tl)	0.000005	0.000046	0.000050	0.000083	0.000083	0.000017	0.38
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0056	0.0023	0.0237	0.0237	0.0072	1.29
Zinc (Zn)	0.002	0.009	0.006	0.028	0.028	0.009	1.01

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-38. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0040	0.0006	0.20
Chloride (Cl)	0.29	0.67	0.62	1.36	1.14	0.21	0.31
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.19
Nitrate (as N)	0.002	0.10	0.09	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000005	0.01
Total Phosphate (as P)	0.00	0.05	0.03	0.22	0.22	0.06	1.26
Sulphate (SO_4)	19	40	40	52	49	5	0.12
Total Metals							
Aluminum (Al)	0.005	*1.46*	*0.99*	*6.58*	*6.32*	1.97	1.35
Antimony (Sb)	0.0006	0.0007	0.0007	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0007	0.0043	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.039	0.120	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000061**	**0.000028**	**0.000230**	**0.000229**	0.000073	1.20
Calcium (Ca)	16.78	27.16	26.04	36.50	36.47	6.70	0.25
Chromium (Cr)	0.0002	**0.0024**	**0.0016**	**0.0103**	**0.0100**	0.0030	1.23
Cobalt (Co)	0.00005	0.00091	0.00054	0.00408	0.00392	0.00118	1.30
Copper (Cu)	0.0003	0.0077	**0.0092**	**0.0314**	**0.0309**	0.0089	1.16
Iron (Fe)	0.01	**1.89**	**1.02**	**9.02**	**8.66**	2.59	1.37
Lead (Pb)	0.00003	0.00125	0.00070	0.00540	0.00520	0.00157	1.26
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.11	2.82	2.62	4.81	4.68	0.66	0.23
Manganese (Mn)	0.00003	0.04952	0.03482	0.21353	0.20530	0.06293	1.27
Mercury (Hg)	0.000005	0.000015	0.000005	0.000052	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0013	0.0080	0.0077	0.0023	1.15
Potassium (K)	0.91	1.25	1.18	2.17	2.12	0.32	0.26
Selenium (Se)	0.0006	0.0011	0.0011	0.0017	0.0013	0.0002	0.17
Silicon (Si)	2.54	4.65	3.32	13.18	12.68	3.12	0.67
Silver (Ag)	0.000005	0.000025	0.000015	**0.000107**	**0.000104**	0.000030	1.20
Sodium (Na)	1.0	1.5	1.1	2.6	2.6	0.6	0.39
Strontium (Sr)	0.099	0.155	0.145	0.197	0.197	0.030	0.19
Thallium (Tl)	0.000005	0.000046	0.000050	0.000084	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0055	0.0036	0.0239	0.0230	0.0070	1.28
Zinc (Zn)	0.002	0.009	0.006	0.028	0.027	0.009	0.99

(continued)

Table 14.7-38. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0040	0.0006	0.20
Chloride (Cl)	0.39	1.18	0.95	2.91	2.40	0.54	0.46
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.19
Nitrate (as N)	0.002	0.10	0.09	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000005	0.01
Total Phosphate (as P)	0.00	0.05	0.03	0.22	0.22	0.06	1.26
Sulphate (SO_4)	19	42	41	52	50	5	0.11
Total Metals							
Aluminum (Al)	0.005	*1.46*	*0.99*	*6.58*	*6.32*	1.97	1.35
Antimony (Sb)	0.0006	0.0007	0.0007	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0007	0.0043	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.039	0.120	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000061**	**0.000028**	**0.000230**	**0.000229**	0.000073	1.20
Calcium (Ca)	16.85	27.21	26.08	36.52	36.48	6.67	0.25
Chromium (Cr)	0.0002	**0.0024**	**0.0016**	**0.0103**	**0.0100**	0.0030	1.23
Cobalt (Co)	0.00005	0.00091	0.00054	0.00408	0.00392	0.00118	1.30
Copper (Cu)	0.0003	0.0077	**0.0092**	**0.0314**	**0.0309**	0.0089	1.16
Iron (Fe)	0.01	**1.89**	**1.02**	**9.02**	**8.66**	2.59	1.37
Lead (Pb)	0.00003	0.00125	0.00070	0.00540	0.00520	0.00157	1.26
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.11	2.82	2.62	4.81	4.68	0.66	0.23
Manganese (Mn)	0.00003	0.04952	0.03482	0.21353	0.20530	0.06293	1.27
Mercury (Hg)	0.000005	0.000015	0.000005	0.000052	0.000051	0.000017	1.11
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0013	0.0080	0.0077	0.0023	1.15
Potassium (K)	0.92	1.25	1.18	2.17	2.12	0.32	0.26
Selenium (Se)	0.0006	0.0011	0.0011	0.0019	0.0015	0.0002	0.20
Silicon (Si)	2.54	4.65	3.32	13.18	12.68	3.12	0.67
Silver (Ag)	0.000005	0.000025	0.000015	**0.000107**	**0.000104**	0.000030	1.20
Sodium (Na)	1.0	1.5	1.1	2.6	2.6	0.6	0.39
Strontium (Sr)	0.099	0.155	0.145	0.197	0.197	0.030	0.19
Thallium (Tl)	0.000005	0.000046	0.000050	0.000084	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0055	0.0036	0.0239	0.0230	0.0070	1.28
Zinc (Zn)	0.002	0.009	0.006	0.028	0.027	0.009	0.99

(continued)

Table 14.7-38. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0039	0.0005	0.20
Chloride (Cl)	0.38	0.68	0.65	1.31	0.99	0.18	0.26
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.20
Nitrate (as N)	0.002	0.10	0.09	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000003	0.01
Total Phosphate (as P)	0.00	0.05	0.03	0.22	0.22	0.06	1.26
Sulphate (SO_4)	28	40	39	50	49	5	0.12
Total Metals							
Aluminum (Al)	0.004	*1.46*	*0.98*	*6.53*	*6.32*	1.97	1.35
Antimony (Sb)	0.0006	0.0007	0.0007	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0007	0.0043	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.039	0.120	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000061**	**0.000028**	**0.000230**	**0.000230**	0.000073	1.20
Calcium (Ca)	16.69	27.11	26.82	36.41	36.34	6.63	0.24
Chromium (Cr)	0.0002	**0.0024**	**0.0016**	**0.0103**	**0.0100**	0.0030	1.23
Cobalt (Co)	0.00005	0.00091	0.00054	0.00404	0.00391	0.00118	1.30
Copper (Cu)	0.0003	0.0077	**0.0092**	**0.0315**	**0.0310**	0.0089	1.16
Iron (Fe)	0.01	**1.90**	**1.03**	**8.94**	**8.64**	2.60	1.37
Lead (Pb)	0.00003	0.00125	0.00070	0.00536	0.00519	0.00157	1.26
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.11	2.83	2.63	4.78	4.68	0.65	0.23
Manganese (Mn)	0.00003	0.04961	0.03490	0.21171	0.20502	0.06297	1.27
Mercury (Hg)	0.000005	0.000015	0.000005	0.000052	0.000051	0.000017	1.12
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0013	0.0079	0.0077	0.0023	1.15
Potassium (K)	0.91	1.24	1.18	2.16	2.12	0.32	0.26
Selenium (Se)	0.0008	0.0011	0.0010	0.0017	0.0014	0.0002	0.17
Silicon (Si)	2.54	4.65	3.33	13.06	12.66	3.13	0.67
Silver (Ag)	0.000005	0.000025	0.000015	**0.000107**	**0.000103**	0.000030	1.20
Sodium (Na)	1.0	1.5	1.1	2.6	2.6	0.6	0.40
Strontium (Sr)	0.094	0.154	0.152	0.196	0.196	0.031	0.20
Thallium (Tl)	0.000005	0.000046	0.000050	0.000083	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0055	0.0036	0.0237	0.0229	0.0070	1.28
Zinc (Zn)	0.002	0.009	0.006	0.028	0.028	0.009	0.99

(continued)

Table 14.7-38. Summary Statistics of Water Quality Predictions for the Unuk River (site UR2; Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0040	0.0039	0.0005	0.20
Chloride (Cl)	0.57	1.22	1.05	2.79	2.02	0.47	0.38
Fluoride (F)	0.02	0.04	0.04	0.05	0.05	0.01	0.20
Nitrate (as N)	0.002	0.10	0.09	0.26	0.26	0.07	0.64
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.000003	0.01
Total Phosphate (as P)	0.00	0.05	0.03	0.22	0.22	0.06	1.26
Sulphate (SO_4)	28	41	40	50	49	5	0.12
Total Metals							
Aluminum (Al)	0.004	*1.46*	*0.98*	*6.53*	*6.32*	1.97	1.35
Antimony (Sb)	0.0006	0.0007	0.0007	0.0012	0.0012	0.0002	0.24
Arsenic (As)	0.0001	0.0011	0.0007	0.0043	0.0042	0.0012	1.08
Barium (Ba)	0.034	0.050	0.039	0.120	0.117	0.025	0.49
Beryllium (Be)	0.0001	0.0002	0.0002	0.0004	0.0004	0.0001	0.34
Boron (B)	0.005	0.006	0.005	0.010	0.010	0.001	0.24
Cadmium (Cd)	0.000005	**0.000061**	**0.000028**	**0.000230**	**0.000230**	0.000073	1.20
Calcium (Ca)	16.76	27.16	26.92	36.44	36.36	6.60	0.24
Chromium (Cr)	0.0002	**0.0024**	**0.0016**	**0.0103**	**0.0100**	0.0030	1.23
Cobalt (Co)	0.00005	0.00091	0.00054	0.00404	0.00391	0.00118	1.30
Copper (Cu)	0.0003	0.0077	**0.0092**	**0.0315**	**0.0310**	0.0089	1.16
Iron (Fe)	0.01	**1.90**	**1.03**	**8.94**	**8.64**	2.60	1.37
Lead (Pb)	0.00003	0.00125	0.00070	0.00536	0.00519	0.00157	1.26
Lithium (Li)	0.000	0.002	0.003	0.005	0.005	0.001	0.37
Magnesium (Mg)	2.11	2.83	2.63	4.78	4.68	0.65	0.23
Manganese (Mn)	0.00003	0.04961	0.03490	0.21171	0.20502	0.06297	1.27
Mercury (Hg)	0.000005	0.000015	0.000005	0.000052	0.000051	0.000017	1.12
Molybdenum (Mo)	0.002	0.002	0.002	0.003	0.003	0.0003	0.15
Nickel (Ni)	0.0003	0.0020	0.0013	0.0079	0.0077	0.0023	1.15
Potassium (K)	0.91	1.24	1.18	2.16	2.12	0.32	0.26
Selenium (Se)	0.0009	0.0011	0.0011	0.0019	0.0015	0.0002	0.19
Silicon (Si)	2.54	4.65	3.33	13.06	12.66	3.13	0.67
Silver (Ag)	0.000005	0.000025	0.000015	**0.000107**	**0.000103**	0.000030	1.20
Sodium (Na)	1.0	1.5	1.1	2.6	2.6	0.6	0.40
Strontium (Sr)	0.094	0.154	0.152	0.196	0.196	0.031	0.20
Thallium (Tl)	0.000005	0.000046	0.000050	0.000083	0.000081	0.000017	0.37
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00002	0.26
Uranium (U)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.18
Vanadium (V)	0.0005	0.0055	0.0036	0.0237	0.0229	0.0070	1.28
Zinc (Zn)	0.002	0.009	0.006	0.028	0.028	0.009	0.99

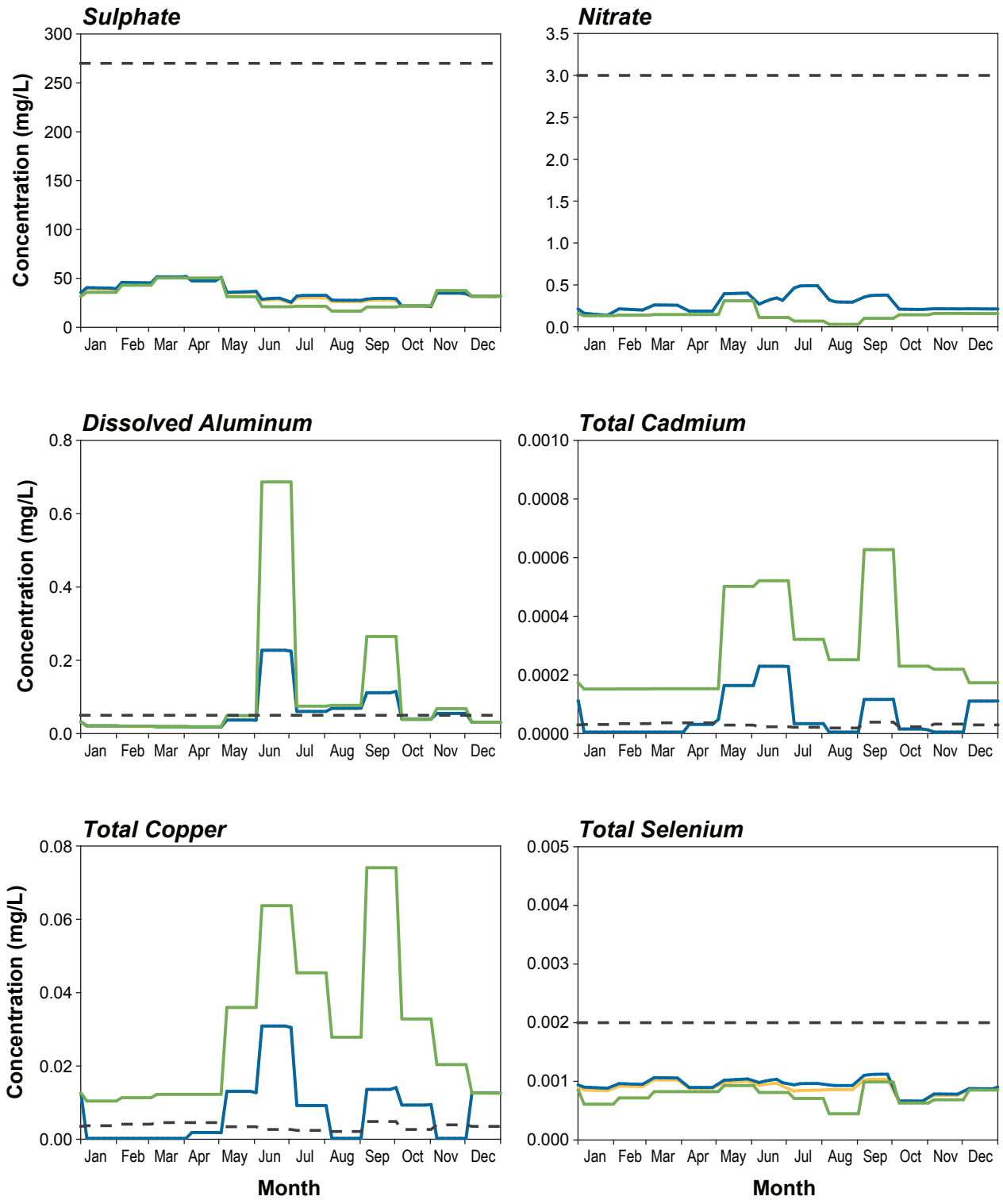
Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.



Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

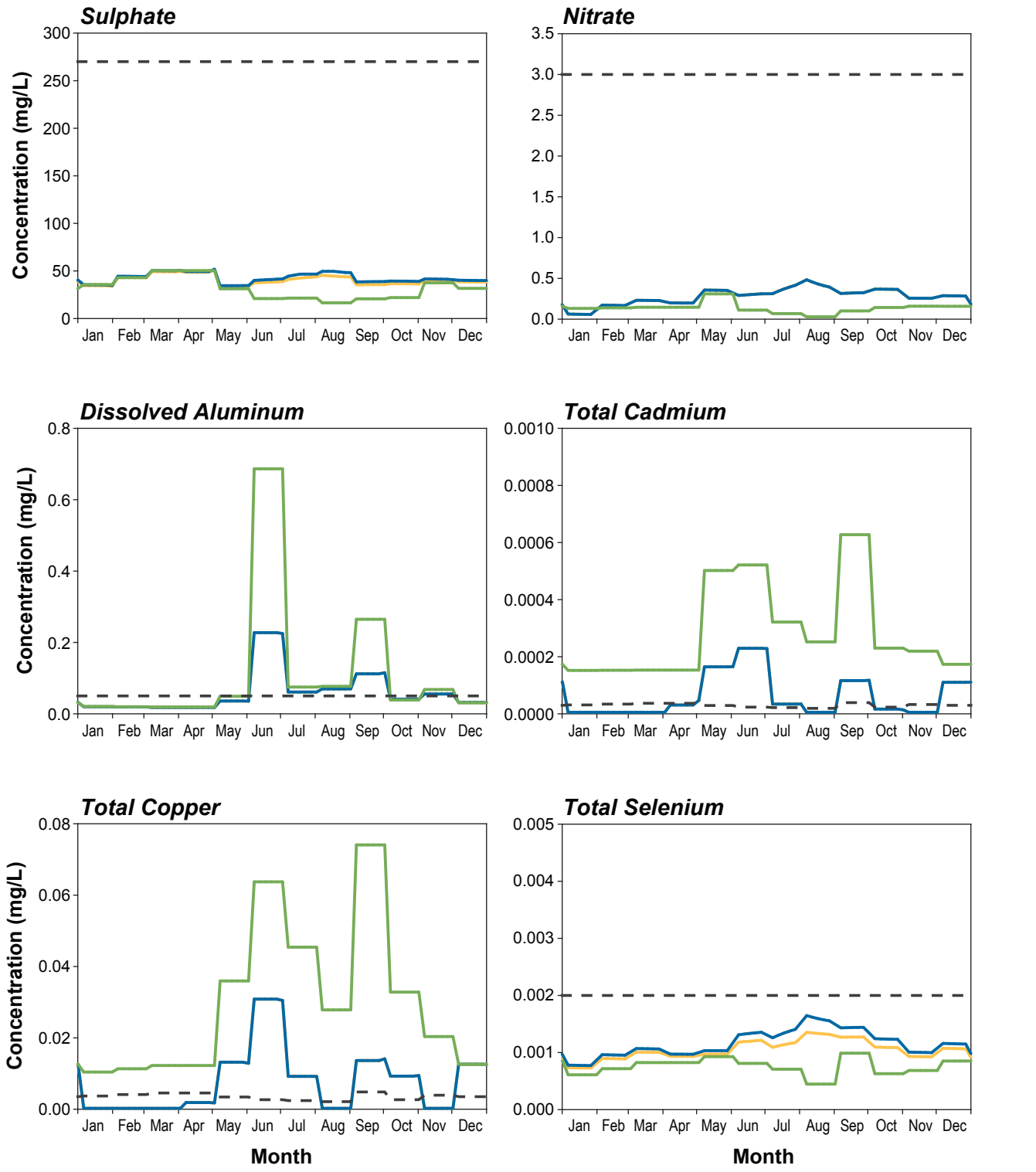
- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR2 (Year 5)

Figure 14.7-27

Rescan™ Engineers & Scientists



Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

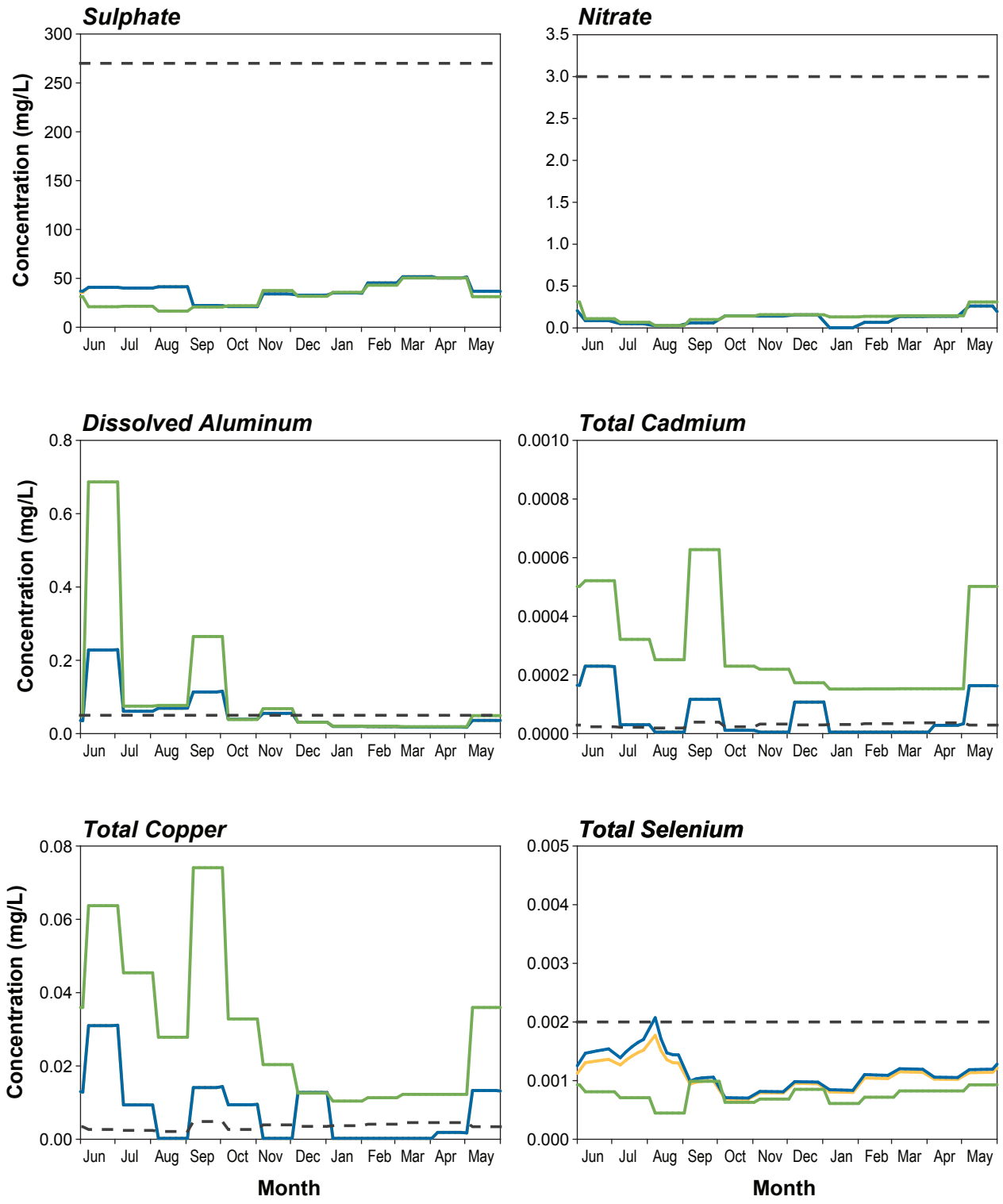
- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR2 (Year 25)

Figure 14.7-28

Rescan™ Engineers & Scientists



Note: Predicted sulphate, nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

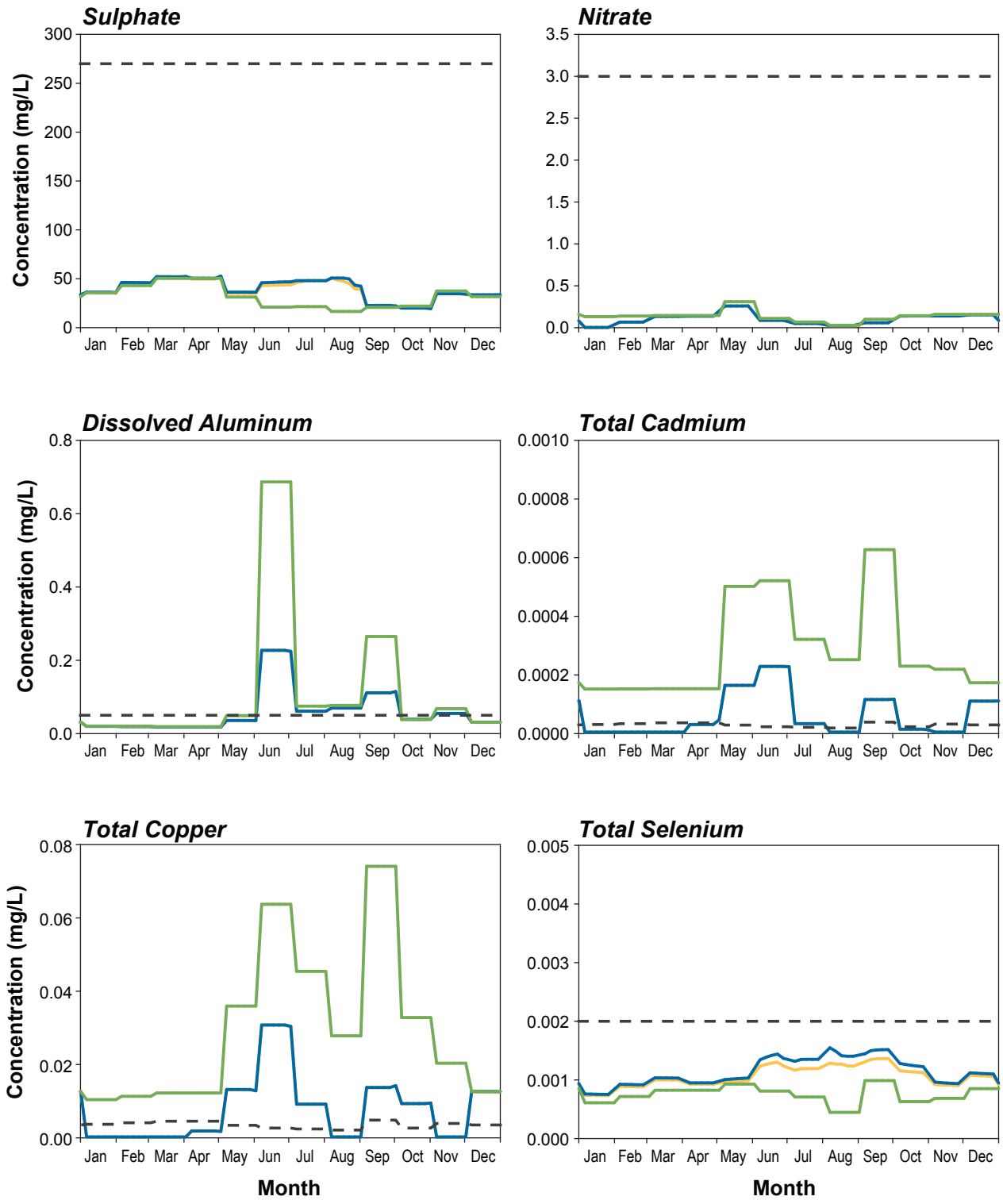
- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR2 (Year 51.5)

Figure 14.7-29

Rescan™ Engineers & Scientists



Note: Predicted nitrate, dissolved aluminum, total cadmium, and total copper concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Unuk River - Site UR2 (Year 65)

Figure 14.7-30

Rescan™ Engineers & Scientists

In the Unuk River, the maximum predicted selenium concentrations in model scenario 2 during the operation phase at site UR1 was 0.0041 mg/L (compared to 0.0034 in the expected case). At site UR2, the maximum predicted selenium concentration in model scenario 2 was 0.0023 mg/L (compared to 0.0017 in the expected case). Predicted mean variable case water balance simulation concentrations were typically within 2% of the base case water balance simulations (Tables 14.7-31 to 14.7-38). No additional water quality concerns were identified through the model sensitivity analysis.

Marine Environment

Potential water quality residual effects on the marine environment were assessed at the request of BC MOE. The BC selenium water quality guideline for marine aquatic life is 0.002 mg/L. Concentrations in the Unuk River at the BC-Alaska border are predicted to be less than 0.002 mg/L; therefore, no residual effects due to selenium are predicted for the marine environment.

14.7.3.2.2 Processing and Tailing Management Area

Potential residual effects on surface water quality for the PTMA were assessed through toxicity testing of tailing supernatant and through predictive water quality modelling of the receiving environment. The methods and assumption used for water quality modelling are described in Section 14.7.1.2.

Tailing Supernatant Toxicity Testing

In December 2012, tailing supernatant was assessed for toxicity using a suite of standard acute and chronic toxicity tests. Cycloned rougher tailing is the type of material that may be used in dam construction at the KSM Project and toxicity testing of supernatant from this type of material is recommended in the *BC Water and Air Baseline Guidance Document for Mine Proponents and Operators* as part of the characterization of cyclone tailing sands (BC MOE 2012).The tested sample was a supernatant generated from dry coarse rougher tailing produced during earlier metallurgical testing, reconstituted with a mixture of process water and laboratory water to obtain a slurry (2:1 ratio of water to solids). The slurry was allowed to settle for 48 hours and the supernatant was removed and submitted to Nautilus Environmental for toxicity testing.

Toxicity tests were conducted using laboratory surrogate organisms including a fish (*Oncorhynchus mykiss*), an invertebrate (*Daphnia magna* in the acute test, *Ceriodaphnia dubia* in the chronic test), an aquatic plant (*Lemna minor*), and an alga (*Pseudokirchneriella subcapitata*) following standard Environment Canada methods (see Appendix 14-D for method details). The rainbow trout embryo test was not conducted since appropriate test organisms were not available at the time the testing was carried out in mid-December.

The toxicity tests were done by preparing a series of solutions containing a percentage (ranging from 0 to 100%) of tailing supernatant, diluted with laboratory water as required. For each toxicity test, the physiological endpoint was measured for organisms exposed to the various solutions, and the concentration of tailing supernatant required to cause a 50% decrease in survival (LC_{50}) or a 25% decrease in reproduction or growth (IC_{25}) was calculated. Results of the toxicity tests are summarized in Table 14.7-39 and the original laboratory reports from Nautilus Environmental are included as Appendix 14-D. Water chemistry samples were also concurrently collected from the toxicity test samples and these are provided in Table 14.7-40.

Table 14.7-39. Results of Tailing Supernatant Toxicity Testing, KSM Project

Type of Test	Type of Organism	Species Used in Test	Physiological Endpoint Measured	Concentration (% v/v)	Confidence intervals (% v/v)
Acute	Fish	*Oncorhynchus mykiss*	Survival (LC_{50})	> 100	n/a
	Invertebrate	*Daphnia magna*	Survival (LC_{50})	> 100	n/a
Chronic	Algae	*Pseudokirchneriella subcapitata*	Growth (IC_{25})	> 95.2[a]	n/a
	Aquatic plant	*Lemna minor*	Frond growth (IC_{25})	> 97	n/a
			Dry Weight (IC_{25})	> 97	n/a
	Invertebrate	*Ceriodaphnia dubia*	Survival (LC_{50})	> 100	n/a
			Reproduction (IC_{25})	2.4	1.7 to 4.6

Notes:
n/a = not applicable
Concentrations are expressed in percent as volume of tailing supernatant / total volume.
LC_{50} is the concentration of tailing supernatant required to cause death in 50% of exposed organisms.
C_{25} is the concentration of tailing supernatant required to decrease growth or reproduction by 25% compared to the unexposed control group.
[a] Tailing supernatant stimulated the growth of the algae relative to the control group (lab water).

Table 14.7-40. Tailing Supernatant Water Chemistry Concurrent with Toxicity Testing, KSM Project

Parameter	Tailing Supernatant	Guidelines	Parameter	Tailing Supernatant	Guidelines
Physical Tests, Anions, and Nutrients			**Physical Tests, Anions, and Nutrients *(cont'd)***		
Hardness (as $CaCO_3$)	272		Bromide	< 0.25	
pH (pH units)	7.46		Chloride	8.4	
Total Suspended Solids	24.0		Fluoride	0.42	1.7
Total Dissolved Solids	483		Nitrate (as N)	0.055	3
Turbidity (NTU)	28.4		Nitrite (as N)	0.0108	0.02
Acidity (as $CaCO_3$)	2.4		Orthophosphate (as P)	< 0.0010	
Alkalinity, Bicarbonate (as $CaCO_3$)	29.3		Total Phosphorus	0.561	
Alkalinity, Carbonate (as $CaCO_3$)	< 1.0		Sulphate	293	270
			Metals		
Alkalinity, Hydroxide (as $CaCO_3$)	< 1.0		Aluminum (dissolved)	0.01	0.1
			Antimony	0.00053	0.02
Alkalinity, Total (as $CaCO_3$)	29.3		Arsenic	0.00053	0.005
			Barium	0.0520	1
Ammonia, Total (as N)	< 0.0050	1.23	Beryllium	< 0.00010	0.0053

(continued)

Table 14.7-40. Tailing Supernatant Water Chemistry Concurrent with Toxicity Testing, KSM Project (completed)

Parameter	Tailing Supernatant	Guidelines	Parameter	Tailing Supernatant	Guidelines
Metals *(cont'd)*			**Metals *(cont'd)***		
Bismuth	< 0.00050		Nickel	0.0008	0.15
Boron	0.05	1.2	Phosphorus	0.46	
Cadmium	0.000810	0.000079	Potassium	18.40	
Calcium	97		Selenium	0.0033	0.002
Chromium	0.00054	0.001	Silicon	2.360	
Cobalt	0.00030	0.004	Silver	0.000033	0.0015
Copper	0.0076	0.0025	Sodium	21.60	
Iron	0.641	1	Strontium	0.716	
Lead	0.00107	0.015	Thallium	0.000046	0.0003
Lithium	0.0040	0.096	Tin	0.0001	
Magnesium	5.67		Titanium	0.016	
Manganese	0.0724	1.8	Uranium	0.000331	0.3
Mercury	< 0.000010	0.00002	Vanadium	0.0014	0.006
Molybdenum	0.0157	1	Zinc	0.006	0.144

Notes:
Units are in mg/L unless otherwise noted.
Metal concentrations are for total metals, unless otherwise noted (i.e., aluminum).
Shaded cells are parameters in the pilot plant effluent that exceed water quality guidelines.

The tailing supernatant was not acutely lethal to either rainbow trout or *D. magna*, nor were there effects on *L. minor* or *P. subcapitata* in the chronic toxicity tests (Table 14.7-41). *C. dubia* was the most sensitive species tested and, while there were no effects from tailing supernatant exposure on survival, reproduction of the invertebrate was impaired. Tailing supernatant may require a dilution of approximately 1:50 in order to ameliorate the potential for toxicity to *C. dubia*. Most metals and other parameters were below BC guideline limits except sulphate and selenium, which were slightly above guideline limits (Table 14.7-41). Cadmium was approximately 10 times higher than the BC water quality guideline and may have contributed to the observed effects on *C. dubia* reproduction.

Receiving Environment Water Quality

North Treaty and Treaty Creeks

Due to the complex morphology of Treaty Creek, an assessment was completed of the length of the mixing zone. Treaty Creek is a braided creek and it was determined that the use of either a 2D or 3D mixing model was not of sufficient complexity to account for the morphologic variability at the site. The salt dilution gauging technique was selected as an appropriate field method for determining minimum mixing lengths in the creek. Salt dilution is a simple and reliable method of calculating current velocity rates in channels that are sufficiently steep and turbulent (Spence and McPhie 1997; Hudson and Fraser 2002; Moore 2004; Hudson and Fraser 2005).

Table 14.7-41. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0039	0.0025	0.0112	0.0081	0.0022	0.56
Chloride (Cl)	0.25	0.25	0.25	0.26	0.25	0.0004	0.00
Fluoride (F)	0.01	0.03	0.03	0.05	0.05	0.01	0.29
Nitrate (as N)	0.002	0.28	0.22	0.98	0.84	0.27	0.95
Nitrite (as N)	0.0005	0.0099	0.0005	0.0775	0.0572	0.01920	1.93
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.88
Sulphate (SO_4)	9	24	24	48	45	10	0.40
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0006	0.00004	0.07
Total Metals							
Aluminum (Al)	0.01	*0.39*	0.07	*1.41*	*1.27*	0.43	1.11
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00002	0.34
Arsenic (As)	0.0001	0.0004	0.0001	0.0038	0.0030	0.0008	1.89
Barium (Ba)	0.017	0.022	0.021	0.032	0.029	0.004	0.17
Beryllium (Be)	0.0002	0.0002	0.0003	0.0004	0.0003	0.00003	0.13
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.22
Cadmium (Cd)	0.000007	0.000014	0.000012	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	8.05	14.20	13.26	28.44	25.89	5.03	0.35
Chromium (Cr)	0.0002	**0.0014**	0.0006	**0.0051**	**0.0040**	0.0014	0.99
Cobalt (Co)	0.00005	0.00030	0.00008	0.00109	0.00094	0.00031	1.03
Copper (Cu)	0.0003	0.0011	0.0007	0.0038	0.0031	0.0009	0.79
Iron (Fe)	0.01	0.49	0.35	**1.69**	**1.33**	0.48	0.98
Lead (Pb)	0.00003	0.00015	0.00011	0.00049	0.00039	0.00013	0.86
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.09
Magnesium (Mg)	1.79	3.06	2.87	5.81	5.36	0.89	0.29
Manganese (Mn)	0.00022	0.01646	0.01145	0.05046	0.04515	0.01473	0.89
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.32
Molybdenum (Mo)	0.0003	0.0004	0.0004	0.0007	0.001	0.0001	0.19
Nickel (Ni)	0.0003	0.0015	0.0007	0.0056	0.0045	0.0015	0.97
Potassium (K)	0.19	0.33	0.30	0.56	0.53	0.09	0.28
Selenium (Se)	0.0004	0.0007	0.0006	0.0012	0.0010	0.0002	0.28
Silicon (Si)	1.52	2.75	2.55	4.70	4.25	0.70	0.25
Silver (Ag)	0.000005	0.000052	0.000005	**0.000636**	**0.000503**	0.000147	2.84
Sodium (Na)	1.0	1.2	1.0	2.2	2.1	0.4	0.33
Strontium (Sr)	0.076	0.140	0.130	0.271	0.251	0.049	0.35
Thallium (Tl)	0.000031	0.000047	0.000050	0.000062	0.000054	0.000006	0.13
Tin (Sn)	0.00005	0.00111	0.00005	0.01527	0.01201	0.00355	3.20
Uranium (U)	0.000005	0.000011	0.000009	0.000027	0.000023	0.00001	0.60
Vanadium (V)	0.0005	0.0014	0.0005	0.0039	0.0035	0.0011	0.78
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.65

(continued)

Table 14.7-41. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0039	0.0025	0.0112	0.0081	0.0022	0.56
Chloride (Cl)	0.25	0.25	0.25	0.26	0.25	0.0004	0.00
Fluoride (F)	0.01	0.03	0.03	0.05	0.05	0.01	0.29
Nitrate (as N)	0.002	0.28	0.22	0.98	0.84	0.27	0.95
Nitrite (as N)	0.0005	0.0099	0.0005	0.0775	0.0572	0.01920	1.93
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.88
Sulphate (SO_4)	9	24	24	48	45	10	0.40
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0006	0.00004	0.07
Total Metals							
Aluminum (Al)	0.01	*0.39*	0.07	*1.41*	*1.27*	0.43	1.11
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00002	0.34
Arsenic (As)	0.0001	0.0004	0.0001	0.0038	0.0030	0.0008	1.89
Barium (Ba)	0.017	0.022	0.021	0.032	0.029	0.004	0.17
Beryllium (Be)	0.0002	0.0002	0.0003	0.0004	0.0003	0.00003	0.13
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.22
Cadmium (Cd)	0.000007	0.000014	0.000012	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	8.05	14.21	13.26	28.44	25.89	5.03	0.35
Chromium (Cr)	0.0002	**0.0014**	0.0006	**0.0051**	**0.0040**	0.0014	0.99
Cobalt (Co)	0.00005	0.00030	0.00008	0.00109	0.00094	0.00031	1.03
Copper (Cu)	0.0003	0.0011	0.0007	0.0038	0.0031	0.0009	0.79
Iron (Fe)	0.01	0.49	0.35	**1.69**	**1.33**	0.49	0.98
Lead (Pb)	0.00003	0.00015	0.00011	0.00049	0.00039	0.00013	0.86
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.09
Magnesium (Mg)	1.79	3.06	2.87	5.81	5.36	0.89	0.29
Manganese (Mn)	0.00022	0.01648	0.01145	0.05053	0.04515	0.01474	0.89
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.32
Molybdenum (Mo)	0.0003	0.0004	0.0004	0.0007	0.001	0.0001	0.19
Nickel (Ni)	0.0003	0.0015	0.0007	0.0056	0.0045	0.0015	0.97
Potassium (K)	0.19	0.33	0.30	0.56	0.53	0.09	0.28
Selenium (Se)	0.0004	0.0007	0.0006	0.0012	0.0010	0.0002	0.28
Silicon (Si)	1.52	2.75	2.55	4.70	4.25	0.70	0.25
Silver (Ag)	0.000005	0.000052	0.000005	**0.000636**	**0.000503**	0.000147	2.84
Sodium (Na)	1.0	1.2	1.0	2.2	2.1	0.4	0.33
Strontium (Sr)	0.076	0.140	0.130	0.271	0.251	0.049	0.35
Thallium (Tl)	0.000031	0.000047	0.000050	0.000062	0.000054	0.000006	0.13
Tin (Sn)	0.00005	0.00111	0.00005	0.01527	0.01201	0.00355	3.20
Uranium (U)	0.000005	0.000011	0.000009	0.000027	0.000023	0.00001	0.60
Vanadium (V)	0.0005	0.0014	0.0005	0.0039	0.0035	0.0011	0.78
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.65

(continued)

Table 14.7-41. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0038	0.0025	0.0106	0.0081	0.0022	0.56
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.0000	0.00
Fluoride (F)	0.01	0.03	0.03	0.05	0.05	0.01	0.29
Nitrate (as N)	0.002	0.28	0.22	0.98	0.84	0.27	0.95
Nitrite (as N)	0.0005	0.0098	0.0005	0.0693	0.0555	0.01901	1.93
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.88
Sulphate (SO_4)	9	24	24	48	45	10	0.41
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0006	0.00004	0.07
Total Metals							
Aluminum (Al)	0.01	*0.39*	0.07	*1.41*	*1.26*	0.43	1.11
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00002	0.34
Arsenic (As)	0.0001	0.0004	0.0001	0.0038	0.0030	0.0008	1.89
Barium (Ba)	0.016	0.022	0.021	0.032	0.029	0.004	0.17
Beryllium (Be)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00003	0.12
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.22
Cadmium (Cd)	0.000007	0.000014	0.000012	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	8.00	14.19	13.26	28.44	25.89	5.04	0.35
Chromium (Cr)	0.0002	**0.0014**	0.0006	**0.0051**	**0.0040**	0.0014	0.99
Cobalt (Co)	0.00005	0.00030	0.00008	0.00109	0.00094	0.00031	1.03
Copper (Cu)	0.0003	0.0011	0.0007	0.0038	0.0031	0.0009	0.79
Iron (Fe)	0.01	0.49	0.34	**1.69**	**1.33**	0.48	0.98
Lead (Pb)	0.00003	0.00015	0.00011	0.00049	0.00039	0.00013	0.86
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.09
Magnesium (Mg)	1.78	3.06	2.87	5.81	5.36	0.89	0.29
Manganese (Mn)	0.00022	0.01637	0.01145	0.04759	0.04515	0.01467	0.90
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.32
Molybdenum (Mo)	0.0003	0.0004	0.0004	0.0007	0.001	0.0001	0.19
Nickel (Ni)	0.0003	0.0015	0.0007	0.0056	0.0045	0.0015	0.97
Potassium (K)	0.19	0.33	0.30	0.56	0.53	0.09	0.28
Selenium (Se)	0.0004	0.0007	0.0006	0.0012	0.0010	0.0002	0.28
Silicon (Si)	1.51	2.74	2.55	4.70	4.25	0.70	0.25
Silver (Ag)	0.000005	0.000052	0.000005	**0.000636**	**0.000503**	0.000147	2.84
Sodium (Na)	1.0	1.2	1.0	2.2	2.1	0.4	0.33
Strontium (Sr)	0.076	0.140	0.130	0.271	0.251	0.049	0.35
Thallium (Tl)	0.000030	0.000047	0.000050	0.000062	0.000054	0.000006	0.13
Tin (Sn)	0.00005	0.00111	0.00005	0.01527	0.01201	0.00355	3.20
Uranium (U)	0.000005	0.000011	0.000008	0.000027	0.000023	0.00001	0.60
Vanadium (V)	0.0005	0.0014	0.0005	0.0039	0.0035	0.0011	0.78
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.65

(continued)

Table 14.7-41. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0038	0.0025	0.0106	0.0081	0.0022	0.56
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.0000	0.00
Fluoride (F)	0.01	0.03	0.03	0.05	0.05	0.01	0.29
Nitrate (as N)	0.002	0.28	0.22	0.98	0.84	0.27	0.95
Nitrite (as N)	0.0005	0.0098	0.0005	0.0693	0.0555	0.01901	1.93
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.88
Sulphate (SO_4)	9	24	24	48	45	10	0.40
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0006	0.00004	0.07
Total Metals							
Aluminum (Al)	0.01	*0.39*	0.07	*1.41*	*1.26*	0.43	1.11
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00002	0.34
Arsenic (As)	0.0001	0.0004	0.0001	0.0038	0.0030	0.0008	1.89
Barium (Ba)	0.016	0.022	0.021	0.032	0.029	0.004	0.17
Beryllium (Be)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00003	0.12
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.22
Cadmium (Cd)	0.000007	0.000014	0.000012	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	8.00	14.19	13.26	28.44	25.89	5.04	0.35
Chromium (Cr)	0.0002	**0.0014**	0.0006	**0.0051**	**0.0040**	0.0014	0.99
Cobalt (Co)	0.00005	0.00030	0.00008	0.00109	0.00094	0.00031	1.03
Copper (Cu)	0.0003	0.0011	0.0007	0.0038	0.0031	0.0009	0.79
Iron (Fe)	0.01	0.49	0.34	**1.69**	**1.33**	0.48	0.98
Lead (Pb)	0.00003	0.00015	0.00011	0.00049	0.00039	0.00013	0.86
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.09
Magnesium (Mg)	1.78	3.06	2.87	5.81	5.36	0.89	0.29
Manganese (Mn)	0.00022	0.01638	0.01145	0.04759	0.04515	0.01468	0.90
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.32
Molybdenum (Mo)	0.0003	0.0004	0.0004	0.0007	0.001	0.0001	0.19
Nickel (Ni)	0.0003	0.0015	0.0007	0.0056	0.0045	0.0015	0.97
Potassium (K)	0.19	0.33	0.30	0.56	0.53	0.09	0.28
Selenium (Se)	0.0004	0.0007	0.0006	0.0012	0.0010	0.0002	0.28
Silicon (Si)	1.51	2.74	2.55	4.70	4.25	0.70	0.25
Silver (Ag)	0.000005	0.000052	0.000005	**0.000636**	**0.000503**	0.000147	2.84
Sodium (Na)	1.0	1.2	1.0	2.2	2.1	0.4	0.33
Strontium (Sr)	0.076	0.140	0.130	0.271	0.251	0.049	0.35
Thallium (Tl)	0.000030	0.000047	0.000050	0.000062	0.000054	0.000006	0.13
Tin (Sn)	0.00005	0.00111	0.00005	0.01527	0.01201	0.00355	3.20
Uranium (U)	0.000005	0.000011	0.000009	0.000027	0.000023	0.00001	0.60
Vanadium (V)	0.0005	0.0014	0.0005	0.0039	0.0035	0.0011	0.78
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.65

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

The salt dilution method is based on a known mass or concentration of common salt (sodium chloride, NaCl) that is introduced into the water at an upstream release point along a stream channel. The salt is rapidly diluted with water from the natural mixing processes that occur along a stream. The introduced mass of salt forms a well-mixed plume that travels downstream. The specific conductivity of the water is then measured at a point sufficiently downstream to ensure that full mixing of the salt has occurred. The measured specific conductivity value is then used to calculate the salt concentration at that location. The procedure results in a salt wave, similar in shape to a storm hydrograph. The characteristics of the salt wave depend on the flow conditions at the time of measurement. The discharge is calculated as the mass of salt added to the stream divided by the area under the curve. The salt dilution method can yield results that are comparable to the conventional velocity-area procedure when used in the appropriate situations. Conductivity probes were placed on both banks and full mixing was assumed to occur when the readings of the two probes were within 10% of each other.

During each trial, a conductivity probe was placed downstream at the known distance of full mixing, approximately 1.5 km downstream. This probe acted as a control and was used to determine whether or not the tracer plume was fully mixed before the slug passed by the other probes at each trial location. One injection point near the proposed discharge pipe location was used. At each trial location, two conductivity probes were set in order to compare the measured discharge from each probe with the control probe downstream. Based on mixing results from each tracer injection trial location, it was determined that the minimum reach length needed for the discharge plume to be fully mixed under moderate to low flow conditions is approximately 900 m. The surface water quality effects assessment was completed for Treaty Creek downstream of the edge of the mixing zone.

This section presents water quality predictions in Treaty Creek (site TRC2) and North Treaty Creek (site NTR2). Tables 14.7-41 to 14.7-46 present statistical summaries of water quality in North Treaty and Treaty creeks for the four model scenarios for the operation, closure, and post-closure phases.

Figures 14.7-31 to 14.7-42 present the water quality predictions for six COPC during the operation, closure, and post-closure phases of the Project.

Concentrations of some metals are predicted to be reduced below baseline conditions (e.g., dissolved aluminum, total cadmium, and total copper). HQ calculations were used to screen for potential residual effects. No HQs greater than 1.0 were calculated for Treaty Creek or North Treaty Creek. Selenium and mercury concentrations were occasionally greater than baseline concentrations in the operation, closure, and post-closure phases; however, no concentrations greater than water quality guidelines were predicted. The effect on aquatic life of increased selenium and mercury concentrations was assessed in Chapter 15.

In North Treaty Creek (NTR2) and Treaty Creek (TRC2), the maximum predicted concentrations in the upper-case model scenarios during the operation phase were less than 1% higher than in the expected case. Predicted mean variable case water balance simulation concentrations were less than 5% higher than the base case water balance simulations (Tables 14.7-41 to 14.7-46).

Table 14.7-42. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0032	0.0025	0.0096	0.0096	0.0020	0.62
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.0000	0.00
Fluoride (F)	0.01	0.03	0.02	0.05	0.05	0.01	0.34
Nitrate (as N)	0.002	0.29	0.23	0.98	0.98	0.30	1.02
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.00025	0.43
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.05	0.01	0.99
Sulphate (SO_4)	9	24	24	48	48	11	0.44
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0007	0.00004	0.09
Total Metals							
Aluminum (Al)	0.01	*0.46*	*0.20*	*1.41*	*1.41*	0.51	1.12
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00003	0.38
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0038	0.0010	1.92
Barium (Ba)	0.017	0.023	0.022	0.032	0.032	0.004	0.19
Beryllium (Be)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00003	0.13
Boron (B)	0.005	0.005	0.005	0.010	0.010	0.001	0.26
Cadmium (Cd)	0.000007	0.000015	0.000012	**0.000031**	**0.000031**	0.000007	0.49
Calcium (Ca)	8.31	14.62	14.12	28.44	28.44	5.70	0.39
Chromium (Cr)	0.0002	**0.0016**	0.0009	**0.0051**	**0.0051**	0.0016	1.01
Cobalt (Co)	0.00005	0.00035	0.00016	0.00109	0.00109	0.00037	1.05
Copper (Cu)	0.0003	0.0012	0.0009	0.0038	0.0038	0.0010	0.83
Iron (Fe)	0.01	0.51	0.24	**1.69**	**1.69**	0.56	1.10
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00049	0.00016	0.90
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.10
Magnesium (Mg)	1.86	3.15	3.01	5.81	5.81	0.99	0.32
Manganese (Mn)	0.00022	0.01541	0.00847	0.04759	0.04759	0.01642	1.07
Mercury (Hg)	0.000005	0.000007	0.000006	0.000013	0.000013	0.000002	0.35
Molybdenum (Mo)	0.0004	0.0005	0.0005	0.0007	0.001	0.0001	0.20
Nickel (Ni)	0.0003	0.0017	0.0010	0.0056	0.0056	0.0017	1.01
Potassium (K)	0.21	0.36	0.31	0.56	0.56	0.11	0.31
Selenium (Se)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.29
Silicon (Si)	1.64	2.85	2.54	4.70	4.70	0.80	0.28
Silver (Ag)	0.000005	0.000061	0.000007	**0.000636**	**0.000636**	0.000174	2.85
Sodium (Na)	1.0	1.2	1.0	2.1	2.1	0.4	0.35
Strontium (Sr)	0.076	0.143	0.134	0.271	0.271	0.055	0.38
Thallium (Tl)	0.000031	0.000049	0.000050	0.000062	0.000062	0.000007	0.15
Tin (Sn)	0.00005	0.00132	0.00005	0.01527	0.01527	0.00422	3.19
Uranium (U)	0.000005	0.000012	0.000007	0.000027	0.000027	0.00001	0.68
Vanadium (V)	0.0005	0.0016	0.0008	0.0039	0.0039	0.0013	0.82
Zinc (Zn)	0.002	0.003	0.002	0.008	0.008	0.002	0.69

(continued)

Table 14.7-42. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0032	0.0025	0.0096	0.0096	0.0020	0.62
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.0000	0.00
Fluoride (F)	0.01	0.03	0.02	0.05	0.05	0.01	0.34
Nitrate (as N)	0.002	0.29	0.23	0.98	0.98	0.30	1.02
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.00025	0.43
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.05	0.01	0.99
Sulphate (SO_4)	9	24	24	48	48	11	0.44
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0007	0.00004	0.09
Total Metals							
Aluminum (Al)	0.01	*0.46*	*0.20*	*1.41*	*1.41*	0.51	1.12
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00003	0.38
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0038	0.0010	1.92
Barium (Ba)	0.017	0.023	0.022	0.032	0.032	0.004	0.19
Beryllium (Be)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00003	0.13
Boron (B)	0.005	0.005	0.005	0.010	0.010	0.001	0.26
Cadmium (Cd)	0.000007	0.000015	0.000012	**0.000031**	**0.000031**	0.000007	0.49
Calcium (Ca)	8.31	14.62	14.12	28.44	28.44	5.70	0.39
Chromium (Cr)	0.0002	**0.0016**	0.0009	**0.0051**	**0.0051**	0.0016	1.01
Cobalt (Co)	0.00005	0.00035	0.00016	0.00109	0.00109	0.00037	1.05
Copper (Cu)	0.0003	0.0012	0.0009	0.0038	0.0038	0.0010	0.83
Iron (Fe)	0.01	0.51	0.24	**1.69**	**1.69**	0.56	1.10
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00049	0.00016	0.90
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.10
Magnesium (Mg)	1.86	3.15	3.01	5.81	5.81	0.99	0.32
Manganese (Mn)	0.00022	0.01541	0.00847	0.04759	0.04759	0.01642	1.07
Mercury (Hg)	0.000005	0.000007	0.000006	0.000013	0.000013	0.000002	0.35
Molybdenum (Mo)	0.0004	0.0005	0.0005	0.0007	0.001	0.0001	0.20
Nickel (Ni)	0.0003	0.0017	0.0010	0.0056	0.0056	0.0017	1.01
Potassium (K)	0.21	0.36	0.31	0.56	0.56	0.11	0.31
Selenium (Se)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.29
Silicon (Si)	1.64	2.85	2.54	4.70	4.70	0.80	0.28
Silver (Ag)	0.000005	0.000061	0.000007	**0.000636**	**0.000636**	0.000174	2.85
Sodium (Na)	1.0	1.2	1.0	2.1	2.1	0.4	0.35
Strontium (Sr)	0.076	0.143	0.134	0.271	0.271	0.055	0.38
Thallium (Tl)	0.000031	0.000049	0.000050	0.000062	0.000062	0.000007	0.15
Tin (Sn)	0.00005	0.00132	0.00005	0.01527	0.01527	0.00422	3.19
Uranium (U)	0.000005	0.000012	0.000007	0.000027	0.000027	0.00001	0.68
Vanadium (V)	0.0005	0.0016	0.0008	0.0039	0.0039	0.0013	0.82
Zinc (Zn)	0.002	0.003	0.002	0.008	0.008	0.002	0.69

(continued)

Table 14.7-42. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0032	0.0025	0.0096	0.0096	0.0020	0.62
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.0000	0.00
Fluoride (F)	0.01	0.03	0.02	0.05	0.05	0.01	0.34
Nitrate (as N)	0.002	0.29	0.23	0.98	0.98	0.30	1.02
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.00025	0.43
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.05	0.01	0.99
Sulphate (SO_4)	9	24	24	48	48	11	0.44
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0007	0.00004	0.09
Total Metals							
Aluminum (Al)	0.01	*0.46*	*0.20*	*1.41*	*1.41*	0.51	1.12
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00003	0.38
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0038	0.0010	1.92
Barium (Ba)	0.017	0.023	0.022	0.032	0.032	0.004	0.19
Beryllium (Be)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00003	0.13
Boron (B)	0.005	0.005	0.005	0.010	0.010	0.001	0.26
Cadmium (Cd)	0.000007	0.000015	0.000012	**0.000031**	**0.000031**	0.000007	0.49
Calcium (Ca)	8.31	14.62	14.12	28.44	28.44	5.70	0.39
Chromium (Cr)	0.0002	**0.0016**	0.0009	**0.0051**	**0.0051**	0.0016	1.01
Cobalt (Co)	0.00005	0.00035	0.00016	0.00109	0.00109	0.00037	1.05
Copper (Cu)	0.0003	0.0012	0.0009	0.0038	0.0038	0.0010	0.83
Iron (Fe)	0.01	0.51	0.24	**1.69**	**1.69**	0.56	1.10
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00049	0.00016	0.90
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.10
Magnesium (Mg)	1.86	3.15	3.01	5.81	5.81	0.99	0.32
Manganese (Mn)	0.00022	0.01541	0.00847	0.04759	0.04759	0.01642	1.07
Mercury (Hg)	0.000005	0.000007	0.000006	0.000013	0.000013	0.000002	0.35
Molybdenum (Mo)	0.0004	0.0005	0.0005	0.0007	0.001	0.0001	0.20
Nickel (Ni)	0.0003	0.0017	0.0010	0.0056	0.0056	0.0017	1.01
Potassium (K)	0.21	0.36	0.31	0.56	0.56	0.11	0.31
Selenium (Se)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.29
Silicon (Si)	1.64	2.85	2.54	4.70	4.70	0.80	0.28
Silver (Ag)	0.000005	0.000061	0.000007	**0.000636**	**0.000636**	0.000174	2.85
Sodium (Na)	1.0	1.2	1.0	2.1	2.1	0.4	0.35
Strontium (Sr)	0.076	0.143	0.134	0.271	0.271	0.055	0.38
Thallium (Tl)	0.000031	0.000049	0.000050	0.000062	0.000062	0.000007	0.15
Tin (Sn)	0.00005	0.00132	0.00005	0.01527	0.01527	0.00422	3.19
Uranium (U)	0.000005	0.000012	0.000007	0.000027	0.000027	0.00001	0.68
Vanadium (V)	0.0005	0.0016	0.0008	0.0039	0.0039	0.0013	0.82
Zinc (Zn)	0.002	0.003	0.002	0.008	0.008	0.002	0.69

(continued)

Table 14.7-42. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0032	0.0025	0.0096	0.0096	0.0020	0.62
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.03	0.02	0.05	0.05	0.01	0.34
Nitrate (as N)	0.002	0.29	0.23	0.98	0.98	0.30	1.02
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.00025	0.43
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.05	0.01	0.99
Sulphate (SO_4)	9	24	24	48	48	11	0.44
Cyanide-WAD	0.0005	0.0005	0.0005	0.0007	0.0007	0.00004	0.09
Total Metals							
Aluminum (Al)	0.01	*0.46*	*0.20*	*1.41*	*1.41*	0.51	1.12
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.00003	0.38
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0038	0.0010	1.92
Barium (Ba)	0.017	0.023	0.022	0.032	0.032	0.004	0.19
Beryllium (Be)	0.0002	0.0002	0.0003	0.0003	0.0003	0.00003	0.13
Boron (B)	0.005	0.005	0.005	0.010	0.010	0.001	0.26
Cadmium (Cd)	0.000007	0.000015	0.000012	**0.000031**	**0.000031**	0.000007	0.49
Calcium (Ca)	8.31	14.62	14.12	28.44	28.44	5.70	0.39
Chromium (Cr)	0.0002	**0.0016**	0.0009	**0.0051**	**0.0051**	0.0016	1.01
Cobalt (Co)	0.00005	0.00035	0.00016	0.00109	0.00109	0.00037	1.05
Copper (Cu)	0.0003	0.0012	0.0009	0.0038	0.0038	0.0010	0.83
Iron (Fe)	0.01	0.51	0.24	**1.69**	**1.69**	0.56	1.10
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00049	0.00016	0.90
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0002	0.10
Magnesium (Mg)	1.86	3.15	3.01	5.81	5.81	0.99	0.32
Manganese (Mn)	0.00022	0.01541	0.00847	0.04759	0.04759	0.01642	1.07
Mercury (Hg)	0.000005	0.000007	0.000006	0.000013	0.000013	0.000002	0.35
Molybdenum (Mo)	0.0004	0.0005	0.0005	0.0007	0.001	0.0001	0.20
Nickel (Ni)	0.0003	0.0017	0.0010	0.0056	0.0056	0.0017	1.01
Potassium (K)	0.21	0.36	0.31	0.56	0.56	0.11	0.31
Selenium (Se)	0.0004	0.0007	0.0007	0.0012	0.0012	0.0002	0.29
Silicon (Si)	1.64	2.85	2.54	4.70	4.70	0.80	0.28
Silver (Ag)	0.000005	0.000061	0.000007	**0.000636**	**0.000636**	0.000174	2.85
Sodium (Na)	1.0	1.2	1.0	2.1	2.1	0.4	0.35
Strontium (Sr)	0.076	0.143	0.134	0.271	0.271	0.055	0.38
Thallium (Tl)	0.000031	0.000049	0.000050	0.000062	0.000062	0.000007	0.15
Tin (Sn)	0.00005	0.00132	0.00005	0.01527	0.01527	0.00422	3.19
Uranium (U)	0.000005	0.000012	0.000007	0.000027	0.000027	0.00001	0.68
Vanadium (V)	0.0005	0.0016	0.0008	0.0039	0.0039	0.0013	0.82
Zinc (Zn)	0.002	0.003	0.002	0.008	0.008	0.002	0.69

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-43. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0031	0.0025	0.0096	0.0084	0.0017	0.54
Chloride (Cl)	0.25	0.27	0.25	0.53	0.39	0.0509	0.19
Fluoride (F)	0.01	0.03	0.02	0.05	0.04	0.01	0.31
Nitrate (as N)	0.002	0.28	0.24	0.98	0.85	0.24	0.84
Nitrite (as N)	0.0005	0.0006	0.0005	0.0016	0.0013	0.00023	0.38
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.73
Sulphate (SO_4)	9	23	22	56	41	9	0.40
Cyanide-WAD	0.0005	0.0008	0.0005	0.0047	0.0029	0.0008	0.94
Total Metals							
Aluminum (Al)	0.01	*0.39*	*0.29*	*1.41*	*1.17*	0.43	1.10
Antimony (Sb)	0.0001	0.0001	0.0001	0.0003	0.0002	0.00004	0.48
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0032	0.0008	1.83
Barium (Ba)	0.017	0.023	0.022	0.032	0.030	0.004	0.17
Beryllium (Be)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00003	0.12
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.23
Cadmium (Cd)	0.000006	0.000013	0.000011	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	7.37	13.62	13.24	29.17	24.58	4.80	0.35
Chromium (Cr)	0.0002	**0.0013**	0.0010	**0.0051**	**0.0043**	0.0013	0.99
Cobalt (Co)	0.00005	0.00033	0.00020	0.00112	0.00092	0.00031	0.93
Copper (Cu)	0.0003	0.0012	0.0009	0.0039	0.0032	0.0008	0.72
Iron (Fe)	0.01	0.55	0.36	**1.69**	**1.53**	0.46	0.84
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00043	0.00013	0.78
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0003	0.11
Magnesium (Mg)	1.68	2.82	2.73	5.81	4.98	0.81	0.29
Manganese (Mn)	0.00022	0.01545	0.00992	0.04759	0.04064	0.01318	0.85
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.29
Molybdenum (Mo)	0.0003	0.0006	0.0005	0.0025	0.002	0.0004	0.67
Nickel (Ni)	0.0003	0.0015	0.0012	0.0056	0.0047	0.0014	0.95
Potassium (K)	0.20	0.43	0.35	1.52	0.99	0.24	0.57
Selenium (Se)	0.0004	0.0007	0.0006	0.0015	0.0010	0.0002	0.30
Silicon (Si)	1.59	2.61	2.35	4.70	4.15	0.68	0.26
Silver (Ag)	0.000005	0.000055	0.000008	**0.000636**	**0.000564**	0.000155	2.82
Sodium (Na)	1.0	1.5	1.1	5.4	3.5	0.8	0.55
Strontium (Sr)	0.076	0.131	0.122	0.271	0.235	0.045	0.34
Thallium (Tl)	0.000027	0.000045	0.000044	0.000062	0.000059	0.000007	0.16
Tin (Sn)	0.00005	0.00120	0.00005	0.01527	0.01354	0.00377	3.15
Uranium (U)	0.000005	0.000013	0.000010	0.000027	0.000025	0.00001	0.53
Vanadium (V)	0.0005	0.0014	0.0010	0.0039	0.0033	0.0011	0.77
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.63

(continued)

Table 14.7-43. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0031	0.0025	0.0096	0.0084	0.0017	0.54
Chloride (Cl)	0.25	0.27	0.25	0.53	0.39	0.0509	0.19
Fluoride (F)	0.01	0.03	0.02	0.05	0.04	0.01	0.31
Nitrate (as N)	0.002	0.28	0.24	0.98	0.85	0.24	0.84
Nitrite (as N)	0.0005	0.0006	0.0005	0.0016	0.0013	0.00023	0.38
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.73
Sulphate (SO_4)	9	23	22	56	42	9	0.40
Cyanide-WAD	0.0005	0.0008	0.0005	0.0047	0.0029	0.0008	0.94
Total Metals							
Aluminum (Al)	0.01	*0.39*	*0.29*	*1.41*	*1.17*	0.43	1.10
Antimony (Sb)	0.0001	0.0001	0.0001	0.0003	0.0002	0.00004	0.48
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0032	0.0008	1.83
Barium (Ba)	0.017	0.023	0.022	0.032	0.031	0.004	0.17
Beryllium (Be)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00003	0.12
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.23
Cadmium (Cd)	0.000006	0.000013	0.000011	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	7.45	13.71	13.34	29.32	24.67	4.80	0.35
Chromium (Cr)	0.0002	**0.0013**	0.0010	**0.0051**	**0.0043**	0.0013	0.99
Cobalt (Co)	0.00005	0.00033	0.00020	0.00112	0.00092	0.00031	0.93
Copper (Cu)	0.0003	0.0012	0.0009	0.0039	0.0032	0.0008	0.72
Iron (Fe)	0.01	0.55	0.36	**1.69**	**1.53**	0.46	0.83
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00043	0.00013	0.78
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0003	0.11
Magnesium (Mg)	1.68	2.83	2.73	5.81	4.98	0.81	0.29
Manganese (Mn)	0.00022	0.01607	0.01054	0.04759	0.04130	0.01317	0.82
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.29
Molybdenum (Mo)	0.0003	0.0006	0.0005	0.0025	0.002	0.0004	0.67
Nickel (Ni)	0.0003	0.0015	0.0012	0.0056	0.0047	0.0014	0.95
Potassium (K)	0.20	0.43	0.35	1.52	0.99	0.24	0.56
Selenium (Se)	0.0004	0.0007	0.0006	0.0015	0.0010	0.0002	0.30
Silicon (Si)	1.59	2.61	2.35	4.70	4.15	0.68	0.26
Silver (Ag)	0.000005	0.000055	0.000008	**0.000636**	**0.000564**	0.000155	2.82
Sodium (Na)	1.0	1.5	1.1	5.4	3.5	0.8	0.55
Strontium (Sr)	0.076	0.131	0.123	0.271	0.235	0.045	0.34
Thallium (Tl)	0.000027	0.000045	0.000044	0.000062	0.000059	0.000007	0.16
Tin (Sn)	0.00005	0.00120	0.00005	0.01527	0.01354	0.00377	3.15
Uranium (U)	0.000005	0.000014	0.000011	0.000029	0.000027	0.00001	0.49
Vanadium (V)	0.0005	0.0014	0.0010	0.0039	0.0033	0.0011	0.77
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.63

(continued)

Table 14.7-43. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0031	0.0025	0.0096	0.0084	0.0017	0.54
Chloride (Cl)	0.25	0.27	0.25	0.62	0.43	0.0641	0.23
Fluoride (F)	0.01	0.03	0.02	0.06	0.04	0.01	0.32
Nitrate (as N)	0.002	0.28	0.24	0.98	0.85	0.24	0.84
Nitrite (as N)	0.0005	0.0006	0.0005	0.0017	0.0013	0.00023	0.39
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.73
Sulphate (SO_4)	9	23	22	59	41	9	0.41
Cyanide-WAD	0.0005	0.0009	0.0005	0.0054	0.0032	0.0009	1.03
Total Metals							
Aluminum (Al)	0.01	*0.39*	*0.29*	*1.41*	*1.17*	0.43	1.10
Antimony (Sb)	0.0001	0.0001	0.0001	0.0003	0.0002	0.00004	0.52
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0032	0.0008	1.82
Barium (Ba)	0.017	0.023	0.022	0.032	0.030	0.004	0.17
Beryllium (Be)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00003	0.12
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.23
Cadmium (Cd)	0.000006	0.000013	0.000011	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	7.32	13.68	13.25	30.10	24.59	4.84	0.35
Chromium (Cr)	0.0002	**0.0013**	0.0010	**0.0051**	**0.0043**	0.0013	0.99
Cobalt (Co)	0.00005	0.00033	0.00020	0.00116	0.00092	0.00031	0.93
Copper (Cu)	0.0003	0.0012	0.0009	0.0040	0.0032	0.0008	0.72
Iron (Fe)	0.01	0.55	0.36	**1.69**	**1.53**	0.46	0.83
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00043	0.00013	0.78
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0003	0.11
Magnesium (Mg)	1.67	2.83	2.72	5.81	4.98	0.81	0.29
Manganese (Mn)	0.00022	0.01551	0.00989	0.04759	0.04071	0.01318	0.85
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.29
Molybdenum (Mo)	0.0003	0.0006	0.0005	0.0029	0.002	0.0005	0.75
Nickel (Ni)	0.0003	0.0015	0.0012	0.0056	0.0047	0.0014	0.95
Potassium (K)	0.20	0.44	0.35	1.77	1.09	0.28	0.64
Selenium (Se)	0.0004	0.0007	0.0006	0.0016	0.0011	0.0002	0.31
Silicon (Si)	1.59	2.62	2.34	4.70	4.15	0.68	0.26
Silver (Ag)	0.000005	0.000055	0.000008	**0.000636**	**0.000563**	0.000155	2.82
Sodium (Na)	1.0	1.5	1.0	6.1	3.8	0.9	0.61
Strontium (Sr)	0.076	0.131	0.122	0.271	0.235	0.045	0.34
Thallium (Tl)	0.000027	0.000045	0.000044	0.000062	0.000059	0.000007	0.16
Tin (Sn)	0.00005	0.00120	0.00005	0.01527	0.01354	0.00377	3.15
Uranium (U)	0.000005	0.000013	0.000010	0.000028	0.000025	0.00001	0.53
Vanadium (V)	0.0005	0.0014	0.0010	0.0039	0.0033	0.0011	0.77
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.63

(continued)

Table 14.7-43. Summary Statistics of Water Quality Predictions for North Treaty Creek (site NTR2; Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0031	0.0025	0.0096	0.0084	0.0017	0.54
Chloride (Cl)	0.25	0.27	0.25	0.62	0.43	0.06	0.23
Fluoride (F)	0.01	0.03	0.02	0.06	0.04	0.01	0.32
Nitrate (as N)	0.002	0.28	0.24	0.98	0.85	0.24	0.84
Nitrite (as N)	0.0005	0.0006	0.0005	0.0017	0.0013	0.00023	0.39
Total Phosphate (as P)	0.00	0.01	0.01	0.05	0.04	0.01	0.73
Sulphate (SO_4)	9	23	22	59	42	9	0.40
Cyanide-WAD	0.0005	0.0009	0.0005	0.0054	0.0032	0.0009	1.03
Total Metals							
Aluminum (Al)	0.01	*0.39*	*0.29*	*1.41*	*1.17*	0.43	1.10
Antimony (Sb)	0.0001	0.0001	0.0001	0.0003	0.0002	0.00004	0.52
Arsenic (As)	0.0001	0.0005	0.0002	0.0038	0.0032	0.0008	1.82
Barium (Ba)	0.017	0.023	0.022	0.033	0.031	0.004	0.17
Beryllium (Be)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00003	0.12
Boron (B)	0.005	0.005	0.005	0.010	0.009	0.001	0.23
Cadmium (Cd)	0.000006	0.000013	0.000011	**0.000031**	**0.000026**	0.000006	0.46
Calcium (Ca)	7.38	13.77	13.34	30.26	24.68	4.85	0.35
Chromium (Cr)	0.0002	**0.0013**	0.0010	**0.0051**	**0.0043**	0.0013	0.99
Cobalt (Co)	0.00005	0.00033	0.00020	0.00116	0.00092	0.00031	0.93
Copper (Cu)	0.0003	0.0012	0.0009	0.0040	0.0032	0.0008	0.72
Iron (Fe)	0.01	0.55	0.36	**1.69**	**1.53**	0.46	0.83
Lead (Pb)	0.00003	0.00017	0.00013	0.00049	0.00043	0.00013	0.78
Lithium (Li)	0.002	0.002	0.002	0.003	0.003	0.0003	0.11
Magnesium (Mg)	1.67	2.83	2.72	5.81	4.98	0.81	0.29
Manganese (Mn)	0.00022	0.01614	0.01046	0.04759	0.04136	0.01318	0.82
Mercury (Hg)	0.000005	0.000007	0.000005	0.000013	0.000011	0.000002	0.29
Molybdenum (Mo)	0.0003	0.0006	0.0005	0.0029	0.002	0.0005	0.75
Nickel (Ni)	0.0003	0.0015	0.0012	0.0056	0.0047	0.0014	0.95
Potassium (K)	0.20	0.44	0.35	1.78	1.09	0.28	0.64
Selenium (Se)	0.0004	0.0007	0.0006	0.0016	0.0011	0.0002	0.31
Silicon (Si)	1.59	2.62	2.34	4.70	4.15	0.68	0.26
Silver (Ag)	0.000005	0.000055	0.000008	**0.000636**	**0.000563**	0.000155	2.82
Sodium (Na)	1.0	1.5	1.0	6.1	3.8	0.9	0.61
Strontium (Sr)	0.076	0.132	0.123	0.271	0.236	0.045	0.34
Thallium (Tl)	0.000027	0.000045	0.000044	0.000062	0.000059	0.000007	0.16
Tin (Sn)	0.00005	0.00120	0.00005	0.01527	0.01354	0.00377	3.15
Uranium (U)	0.000005	0.000014	0.000012	0.000030	0.000027	0.00001	0.49
Vanadium (V)	0.0005	0.0014	0.0010	0.0039	0.0033	0.0011	0.77
Zinc (Zn)	0.002	0.003	0.002	0.008	0.007	0.002	0.63

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-44. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0127	0.0105	0.1246	0.0362	0.0164	1.29
Chloride (Cl)	0.25	0.48	0.25	3.07	1.43	0.47	0.98
Fluoride (F)	0.02	0.07	0.07	0.20	0.11	0.02	0.34
Nitrate (as N)	0.01	0.24	0.19	1.37	0.47	0.18	0.76
Nitrite (as N)	0.0005	0.0021	0.0007	0.0124	0.0074	0.002	1.12
Total Phosphate (as P)	0.004	0.13	0.04	0.46	0.44	0.13	1.03
Sulphate (SO_4)	22	61	73	**101**	99	24	0.39
Cyanide-WAD	0.0005	0.0007	0.0005	0.0029	0.0016	0.0004	0.53
Total Metals							
Aluminum (Al)	0.06	*3.20*	*1.56*	*10.36*	*10.00*	3.19	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0044	0.0033	**0.0144**	**0.0141**	0.0042	0.93
Barium (Ba)	0.031	0.091	0.100	0.205	0.201	0.053	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.19
Boron (B)	0.005	0.006	0.005	0.013	0.008	0.001	0.23
Cadmium (Cd)	0.000033	**0.000231**	**0.000162**	**0.000802**	**0.000775**	0.000204	0.88
Calcium (Ca)	19.85	40.29	44.45	78.76	77.53	16.41	0.41
Chromium (Cr)	0.0002	**0.0052**	**0.0022**	**0.0170**	**0.0165**	0.0052	1.00
Cobalt (Co)	0.00005	0.00230	0.00117	0.00793	0.00770	0.00228	0.99
Copper (Cu)	0.0006	0.0090	0.0100	**0.0243**	**0.0235**	0.0071	0.79
Iron (Fe)	0.12	**4.76**	**2.74**	**17.02**	**16.45**	4.87	1.02
Lead (Pb)	0.00008	0.00319	0.00197	0.01064	0.01030	0.00307	0.96
Lithium (Li)	0.002	0.005	0.002	0.012	0.012	0.003	0.61
Magnesium (Mg)	5.07	7.35	7.75	10.25	10.12	1.43	0.19
Manganese (Mn)	0.016	0.152	0.088	0.503	0.491	0.136	0.89
Mercury (Hg)	0.000005	0.000020	0.000018	0.000052	0.000051	0.000015	0.73
Molybdenum (Mo)	0.001	0.002	0.002	0.007	0.004	0.0010	0.51
Nickel (Ni)	0.0009	0.0075	0.0034	0.0245	0.0237	0.0069	0.92
Potassium (K)	0.30	1.49	0.60	8.16	4.11	1.44	0.97
Selenium (Se)	0.0006	0.0010	0.0010	0.0019	0.0017	0.0003	0.31
Silicon (Si)	2.59	7.46	4.33	17.85	17.32	4.80	0.64
Silver (Ag)	0.000005	0.000057	0.000040	0.000178	0.000173	0.000052	0.91
Sodium (Na)	1.0	2.4	2.5	6.5	3.3	0.9	0.37
Strontium (Sr)	0.141	0.285	0.321	0.478	0.472	0.098	0.35
Thallium (Tl)	0.000035	0.000086	0.000050	0.000229	0.000223	0.000052	0.60
Tin (Sn)	0.00005	0.00010	0.00005	0.00056	0.00028	0.00009	0.87
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0090	0.0043	0.0297	0.0288	0.0088	0.98
Zinc (Zn)	0.002	0.025	0.016	0.092	0.089	0.024	0.96

(continued)

Table 14.7-44. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2;Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0127	0.0105	0.1246	0.0362	0.0164	1.29
Chloride (Cl)	0.25	0.48	0.25	3.07	1.43	0.47	0.98
Fluoride (F)	0.02	0.07	0.07	0.20	0.11	0.02	0.34
Nitrate (as N)	0.01	0.24	0.19	1.37	0.47	0.18	0.76
Nitrite (as N)	0.0005	0.0021	0.0007	0.0124	0.0074	0.0024	1.12
Total Phosphate (as P)	0.004	0.13	0.04	0.46	0.44	0.13	1.03
Sulphate (SO_4)	22	61	73	**101**	99	24	0.39
Cyanide-WAD	0.0005	0.0007	0.0005	0.0029	0.0016	0.0004	0.53
Total Metals							
Aluminum (Al)	0.06	*3.20*	*1.56*	*10.36*	*10.00*	3.19	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0044	0.0033	**0.0144**	**0.0141**	0.0042	0.93
Barium (Ba)	0.031	0.091	0.100	0.205	0.201	0.053	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.19
Boron (B)	0.005	0.006	0.005	0.013	0.008	0.001	0.23
Cadmium (Cd)	0.000033	**0.000231**	**0.000162**	**0.000802**	**0.000775**	0.000204	0.88
Calcium (Ca)	19.85	40.29	44.45	78.76	77.53	16.41	0.41
Chromium (Cr)	0.0002	**0.0052**	**0.0022**	**0.0170**	**0.0165**	0.0052	1.00
Cobalt (Co)	0.00005	0.00230	0.00117	0.00793	0.00770	0.00228	0.99
Copper (Cu)	0.0006	0.0090	0.0100	**0.0243**	**0.0235**	0.0071	0.79
Iron (Fe)	0.12	**4.76**	**2.74**	**17.02**	**16.45**	4.87	1.02
Lead (Pb)	0.00008	0.00319	0.00197	0.01064	0.01030	0.00307	0.96
Lithium (Li)	0.002	0.005	0.002	0.012	0.012	0.003	0.61
Magnesium (Mg)	5.07	7.35	7.75	10.25	10.12	1.43	0.19
Manganese (Mn)	0.016	0.153	0.088	0.503	0.491	0.136	0.89
Mercury (Hg)	0.000005	0.000020	0.000018	0.000052	0.000051	0.000015	0.73
Molybdenum (Mo)	0.001	0.002	0.002	0.007	0.004	0.0010	0.51
Nickel (Ni)	0.0009	0.0075	0.0034	0.0245	0.0237	0.0069	0.92
Potassium (K)	0.30	1.49	0.60	8.16	4.11	1.44	0.97
Selenium (Se)	0.0006	0.0010	0.0010	0.0019	0.0017	0.0003	0.31
Silicon (Si)	2.59	7.46	4.33	17.85	17.32	4.80	0.64
Silver (Ag)	0.000005	0.000057	0.000040	0.000178	0.000173	0.000052	0.91
Sodium (Na)	1.0	2.4	2.5	6.5	3.3	0.9	0.37
Strontium (Sr)	0.141	0.285	0.321	0.478	0.472	0.098	0.35
Thallium (Tl)	0.000035	0.000086	0.000050	0.000229	0.000223	0.000052	0.60
Tin (Sn)	0.00005	0.00010	0.00005	0.00056	0.00028	0.00009	0.87
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0090	0.0043	0.0297	0.0288	0.0088	0.98
Zinc (Zn)	0.002	0.025	0.016	0.092	0.089	0.024	0.96

(continued)

Table 14.7-44. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0107	0.0055	0.1203	0.0296	0.0131	1.22
Chloride (Cl)	0.25	0.44	0.25	3.59	1.25	0.41	0.94
Fluoride (F)	0.02	0.07	0.07	0.22	0.10	0.02	0.33
Nitrate (as N)	0.01	0.22	0.18	1.38	0.47	0.17	0.77
Nitrite (as N)	0.0005	0.0021	0.0005	0.0130	0.0076	0.0024	1.17
Total Phosphate (as P)	0.004	0.13	0.04	0.46	0.44	0.13	1.03
Sulphate (SO_4)	22	60	73	**101**	99	24	0.41
Cyanide-WAD	0.0005	0.0006	0.0005	0.0032	0.0014	0.0003	0.50
Total Metals							
Aluminum (Al)	0.06	*3.21*	*1.56*	*10.36*	*10.02*	3.21	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0044	0.0033	**0.0144**	**0.0141**	0.0042	0.94
Barium (Ba)	0.031	0.091	0.100	0.205	0.201	0.053	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.19
Boron (B)	0.005	0.006	0.005	0.014	0.008	0.001	0.22
Cadmium (Cd)	0.000033	**0.000231**	**0.000162**	**0.000802**	**0.000777**	0.000204	0.88
Calcium (Ca)	19.80	40.12	44.45	78.76	77.53	16.54	0.41
Chromium (Cr)	0.0002	**0.0052**	**0.0022**	**0.0170**	**0.0165**	0.0052	1.00
Cobalt (Co)	0.00005	0.00230	0.00117	0.00793	0.00771	0.00229	1.00
Copper (Cu)	0.0006	0.0090	0.0100	**0.0243**	**0.0236**	0.0072	0.79
Iron (Fe)	0.12	**4.78**	**2.74**	**17.02**	**16.49**	4.89	1.02
Lead (Pb)	0.00008	0.00320	0.00197	0.01064	0.01032	0.00308	0.96
Lithium (Li)	0.002	0.005	0.002	0.012	0.012	0.003	0.61
Magnesium (Mg)	5.07	7.35	7.75	10.25	10.12	1.43	0.20
Manganese (Mn)	0.016	0.152	0.088	0.503	0.491	0.137	0.90
Mercury (Hg)	0.000005	0.000020	0.000018	0.000052	0.000051	0.000015	0.73
Molybdenum (Mo)	0.001	0.002	0.002	0.007	0.004	0.0009	0.48
Nickel (Ni)	0.0009	0.0075	0.0034	0.0245	0.0238	0.0069	0.92
Potassium (K)	0.30	1.39	0.60	9.25	4.01	1.30	0.94
Selenium (Se)	0.0006	0.0010	0.0009	0.0019	0.0017	0.0003	0.31
Silicon (Si)	2.59	7.47	4.33	17.85	17.35	4.82	0.64
Silver (Ag)	0.000005	0.000057	0.000040	0.000178	0.000173	0.000052	0.91
Sodium (Na)	1.0	2.3	2.4	6.7	3.3	0.9	0.38
Strontium (Sr)	0.141	0.283	0.321	0.478	0.472	0.100	0.35
Thallium (Tl)	0.000035	0.000086	0.000050	0.000229	0.000223	0.000052	0.60
Tin (Sn)	0.00005	0.00010	0.00005	0.00065	0.00026	0.00008	0.82
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0090	0.0043	0.0297	0.0288	0.0088	0.98
Zinc (Zn)	0.002	0.025	0.016	0.092	0.089	0.024	0.96

(continued)

Table 14.7-44. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2;Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0107	0.0055	0.1203	0.0296	0.0131	1.22
Chloride (Cl)	0.25	0.44	0.25	3.59	1.25	0.41	0.94
Fluoride (F)	0.02	0.07	0.07	0.22	0.10	0.02	0.33
Nitrate (as N)	0.01	0.22	0.18	1.38	0.47	0.17	0.77
Nitrite (as N)	0.0005	0.0021	0.0005	0.0130	0.0076	0.0024	1.17
Total Phosphate (as P)	0.004	0.13	0.04	0.46	0.44	0.13	1.03
Sulphate (SO_4)	22	60	73	**101**	99	24	0.41
Cyanide-WAD	0.0005	0.0006	0.0005	0.0032	0.0014	0.0003	0.50
Total Metals							
Aluminum (Al)	0.06	*3.21*	*1.56*	*10.36*	*10.02*	3.21	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0044	0.0033	**0.0144**	**0.0141**	0.0042	0.94
Barium (Ba)	0.031	0.091	0.100	0.205	0.201	0.053	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.19
Boron (B)	0.005	0.006	0.005	0.014	0.008	0.001	0.22
Cadmium (Cd)	0.000033	**0.000231**	**0.000162**	**0.000802**	**0.000777**	0.000204	0.88
Calcium (Ca)	19.80	40.12	44.45	78.76	77.53	16.54	0.41
Chromium (Cr)	0.0002	**0.0052**	**0.0022**	**0.0170**	**0.0165**	0.0052	1.00
Cobalt (Co)	0.00005	0.00230	0.00117	0.00793	0.00771	0.00229	1.00
Copper (Cu)	0.0006	0.0090	0.0100	**0.0243**	**0.0236**	0.0072	0.79
Iron (Fe)	0.12	**4.78**	**2.74**	**17.02**	**16.49**	4.89	1.02
Lead (Pb)	0.00008	0.00320	0.00197	0.01064	0.01032	0.00308	0.96
Lithium (Li)	0.002	0.005	0.002	0.012	0.012	0.003	0.61
Magnesium (Mg)	5.07	7.35	7.75	10.25	10.12	1.43	0.20
Manganese (Mn)	0.016	0.152	0.088	0.503	0.491	0.137	0.90
Mercury (Hg)	0.000005	0.000020	0.000018	0.000052	0.000051	0.000015	0.73
Molybdenum (Mo)	0.001	0.002	0.002	0.007	0.004	0.0009	0.48
Nickel (Ni)	0.0009	0.0075	0.0034	0.0245	0.0238	0.0069	0.92
Potassium (K)	0.30	1.39	0.60	9.25	4.01	1.30	0.94
Selenium (Se)	0.0006	0.0010	0.0009	0.0019	0.0017	0.0003	0.31
Silicon (Si)	2.59	7.47	4.33	17.85	17.35	4.82	0.64
Silver (Ag)	0.000005	0.000057	0.000040	0.000178	0.000173	0.000052	0.91
Sodium (Na)	1.0	2.3	2.4	6.7	3.3	0.9	0.38
Strontium (Sr)	0.141	0.283	0.321	0.478	0.472	0.100	0.35
Thallium (Tl)	0.000035	0.000086	0.000050	0.000229	0.000223	0.000052	0.60
Tin (Sn)	0.00005	0.00010	0.00005	0.00065	0.00026	0.00008	0.82
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0090	0.0043	0.0297	0.0288	0.0088	0.98
Zinc (Zn)	0.002	0.025	0.016	0.092	0.089	0.024	0.96

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-45. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0054	0.0034	0.0164	0.0164	0.0044	0.82
Chloride (Cl)	0.25	0.36	0.25	2.12	0.82	0.28	0.78
Fluoride (F)	0.02	0.06	0.07	0.15	0.08	0.02	0.28
Nitrate (as N)	0.02	0.20	0.14	0.94	0.47	0.16	0.80
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.42
Total Phosphate (as P)	0.00	0.13	0.10	0.45	0.45	0.14	1.04
Sulphate (SO_4)	23	59	66	**101**	**101**	25	0.43
Cyanide-WAD	0.0005	0.0006	0.0005	0.0016	0.0009	0.0002	0.31
Total Metals							
Aluminum (Al)	0.06	*3.26*	*2.83*	*10.20*	*10.19*	3.26	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	0.0042	**0.0142**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.101	0.203	0.201	0.053	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.006	0.005	0.010	0.007	0.001	0.17
Cadmium (Cd)	0.000033	**0.000235**	**0.000216**	**0.000790**	**0.000790**	0.000209	0.89
Calcium (Ca)	20.46	40.07	40.10	78.76	78.76	17.05	0.43
Chromium (Cr)	0.0002	**0.0053**	**0.0038**	**0.0168**	**0.0168**	0.0053	1.00
Cobalt (Co)	0.00005	0.00233	0.00196	0.00782	0.00781	0.00232	1.00
Copper (Cu)	0.0006	0.0091	0.0101	**0.0239**	**0.0239**	0.0073	0.79
Iron (Fe)	0.12	**4.84**	**4.21**	**16.76**	**16.76**	4.97	1.03
Lead (Pb)	0.00008	0.00325	0.00294	0.01049	0.01048	0.00313	0.96
Lithium (Li)	0.002	0.005	0.004	0.012	0.012	0.003	0.61
Magnesium (Mg)	5.20	7.40	7.89	10.25	10.25	1.47	0.20
Manganese (Mn)	0.016	0.154	0.135	0.497	0.495	0.138	0.90
Mercury (Hg)	0.000005	0.000020	0.000018	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.002	0.004	0.003	0.0006	0.36
Nickel (Ni)	0.0009	0.0077	0.0057	0.0242	0.0242	0.0071	0.92
Potassium (K)	0.30	1.22	0.90	5.36	2.86	1.01	0.83
Selenium (Se)	0.0007	0.0010	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.63	7.55	6.57	17.61	17.60	4.90	0.65
Silver (Ag)	0.000005	0.000058	0.000054	0.000176	0.000175	0.000053	0.91
Sodium (Na)	1.0	2.2	2.4	4.1	3.3	0.8	0.37
Strontium (Sr)	0.146	0.283	0.292	0.478	0.478	0.103	0.36
Thallium (Tl)	0.000035	0.000086	0.000067	0.000226	0.000226	0.000053	0.61
Tin (Sn)	0.00005	0.00008	0.00005	0.00040	0.00018	0.00006	0.69
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0091	0.0077	0.0293	0.0292	0.0090	0.99
Zinc (Zn)	0.002	0.026	0.023	0.091	0.091	0.025	0.96

(continued)

Table 14.7-45. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0054	0.0034	0.0164	0.0164	0.0044	0.82
Chloride (Cl)	0.25	0.36	0.25	2.12	0.82	0.28	0.78
Fluoride (F)	0.02	0.06	0.07	0.15	0.08	0.02	0.28
Nitrate (as N)	0.02	0.20	0.14	0.94	0.47	0.16	0.80
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.42
Total Phosphate (as P)	0.00	0.13	0.10	0.45	0.45	0.14	1.04
Sulphate (SO_4)	23	59	66	**101**	**101**	25	0.43
Cyanide-WAD	0.0005	0.0006	0.0005	0.0016	0.0009	0.0002	0.31
Total Metals							
Aluminum (Al)	0.06	*3.26*	*2.83*	*10.20*	*10.19*	3.26	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	0.0042	**0.0142**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.101	0.203	0.201	0.053	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.006	0.005	0.010	0.007	0.001	0.17
Cadmium (Cd)	0.000033	**0.000235**	**0.000216**	**0.000790**	**0.000790**	0.000209	0.89
Calcium (Ca)	20.49	40.08	40.11	78.76	78.76	17.05	0.43
Chromium (Cr)	0.0002	**0.0053**	**0.0038**	**0.0168**	**0.0168**	0.0053	1.00
Cobalt (Co)	0.00005	0.00233	0.00196	0.00782	0.00781	0.00232	1.00
Copper (Cu)	0.0006	0.0091	0.0101	**0.0239**	**0.0239**	0.0073	0.79
Iron (Fe)	0.12	**4.84**	**4.21**	**16.76**	**16.76**	4.97	1.03
Lead (Pb)	0.00008	0.00325	0.00294	0.01049	0.01048	0.00313	0.96
Lithium (Li)	0.002	0.005	0.004	0.012	0.012	0.003	0.61
Magnesium (Mg)	5.20	7.40	7.89	10.25	10.25	1.47	0.20
Manganese (Mn)	0.016	0.154	0.135	0.497	0.495	0.138	0.90
Mercury (Hg)	0.000005	0.000020	0.000018	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.002	0.004	0.003	0.0006	0.36
Nickel (Ni)	0.0009	0.0077	0.0057	0.0242	0.0242	0.0071	0.92
Potassium (K)	0.30	1.22	0.90	5.36	2.86	1.01	0.83
Selenium (Se)	0.0007	0.0010	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.63	7.55	6.57	17.61	17.60	4.90	0.65
Silver (Ag)	0.000005	0.000058	0.000054	0.000176	0.000175	0.000053	0.91
Sodium (Na)	1.0	2.2	2.4	4.1	3.3	0.8	0.37
Strontium (Sr)	0.146	0.283	0.292	0.478	0.478	0.103	0.36
Thallium (Tl)	0.000035	0.000086	0.000067	0.000226	0.000226	0.000053	0.61
Tin (Sn)	0.00005	0.00008	0.00005	0.00040	0.00018	0.00006	0.69
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0091	0.0077	0.0293	0.0292	0.0090	0.99
Zinc (Zn)	0.002	0.026	0.023	0.091	0.091	0.025	0.96

(continued)

Table 14.7-45. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0054	0.0034	0.0164	0.0164	0.0044	0.82
Chloride (Cl)	0.25	0.40	0.25	2.71	1.00	0.35	0.90
Fluoride (F)	0.02	0.06	0.07	0.19	0.08	0.02	0.31
Nitrate (as N)	0.02	0.22	0.16	1.23	0.47	0.18	0.83
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.42
Total Phosphate (as P)	0.00	0.13	0.10	0.45	0.45	0.14	1.04
Sulphate (SO_4)	23	60	70	**101**	**101**	25	0.42
Cyanide-WAD	0.0005	0.0006	0.0005	0.0018	0.0010	0.0002	0.34
Total Metals							
Aluminum (Al)	0.06	*3.27*	*2.83*	*10.20*	*10.20*	3.26	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	0.0042	**0.0143**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.101	0.203	0.202	0.054	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.006	0.005	0.011	0.007	0.001	0.19
Cadmium (Cd)	0.000033	**0.000235**	**0.000216**	**0.000791**	**0.000790**	0.000209	0.89
Calcium (Ca)	20.71	40.24	40.40	78.76	78.76	16.93	0.42
Chromium (Cr)	0.0002	**0.0053**	**0.0038**	**0.0168**	**0.0168**	0.0053	1.00
Cobalt (Co)	0.00005	0.00233	0.00196	0.00783	0.00782	0.00233	1.00
Copper (Cu)	0.0006	0.0092	0.0101	**0.0240**	**0.0239**	0.0073	0.79
Iron (Fe)	0.12	**4.85**	**4.21**	**16.77**	**16.77**	4.98	1.03
Lead (Pb)	0.00008	0.00325	0.00293	0.01050	0.01049	0.00314	0.96
Lithium (Li)	0.002	0.005	0.004	0.012	0.012	0.003	0.62
Magnesium (Mg)	5.20	7.41	7.89	10.25	10.25	1.47	0.20
Manganese (Mn)	0.016	0.154	0.136	0.498	0.496	0.139	0.90
Mercury (Hg)	0.000005	0.000021	0.000018	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.002	0.005	0.003	0.0007	0.41
Nickel (Ni)	0.0009	0.0077	0.0058	0.0242	0.0242	0.0071	0.92
Potassium (K)	0.30	1.30	0.95	6.66	3.13	1.15	0.88
Selenium (Se)	0.0007	0.0010	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.63	7.56	6.57	17.62	17.61	4.91	0.65
Silver (Ag)	0.000005	0.000058	0.000054	0.000176	0.000176	0.000053	0.91
Sodium (Na)	1.0	2.2	2.4	5.0	3.3	0.8	0.37
Strontium (Sr)	0.146	0.284	0.295	0.478	0.478	0.102	0.36
Thallium (Tl)	0.000035	0.000086	0.000067	0.000226	0.000226	0.000053	0.61
Tin (Sn)	0.00005	0.00009	0.00005	0.00050	0.00021	0.00007	0.78
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0091	0.0077	0.0293	0.0293	0.0090	0.99
Zinc (Zn)	0.002	0.026	0.023	0.091	0.091	0.025	0.96

(continued)

Table 14.7-45. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2) (Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0054	0.0034	0.0164	0.0164	0.0044	0.82
Chloride (Cl)	0.25	0.40	0.25	2.71	1.00	0.35	0.90
Fluoride (F)	0.02	0.06	0.07	0.19	0.08	0.02	0.31
Nitrate (as N)	0.02	0.22	0.16	1.23	0.47	0.18	0.83
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.42
Total Phosphate (as P)	0.00	0.13	0.10	0.45	0.45	0.14	1.04
Sulphate (SO_4)	23	60	70	**101**	**101**	25	0.42
Cyanide-WAD	0.0005	0.0006	0.0005	0.0018	0.0010	0.0002	0.34
Total Metals							
Aluminum (Al)	0.06	*3.27*	*2.83*	*10.20*	*10.20*	3.26	1.00
Antimony (Sb)	0.0003	0.0007	0.0007	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	0.0042	**0.0143**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.101	0.203	0.202	0.054	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.006	0.005	0.011	0.007	0.001	0.19
Cadmium (Cd)	0.000033	**0.000235**	**0.000216**	**0.000791**	**0.000790**	0.000209	0.89
Calcium (Ca)	20.71	40.24	40.41	78.76	78.76	16.93	0.42
Chromium (Cr)	0.0002	**0.0053**	**0.0038**	**0.0168**	**0.0168**	0.0053	1.00
Cobalt (Co)	0.00005	0.00233	0.00196	0.00783	0.00782	0.00233	1.00
Copper (Cu)	0.0006	0.0092	0.0101	**0.0240**	**0.0239**	0.0073	0.79
Iron (Fe)	0.12	**4.85**	**4.21**	**16.77**	**16.77**	4.98	1.03
Lead (Pb)	0.00008	0.00325	0.00293	0.01050	0.01049	0.00314	0.96
Lithium (Li)	0.002	0.005	0.004	0.012	0.012	0.003	0.62
Magnesium (Mg)	5.20	7.41	7.89	10.25	10.25	1.47	0.20
Manganese (Mn)	0.016	0.154	0.136	0.498	0.496	0.139	0.90
Mercury (Hg)	0.000005	0.000021	0.000018	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.002	0.005	0.003	0.0007	0.41
Nickel (Ni)	0.0009	0.0077	0.0058	0.0242	0.0242	0.0071	0.92
Potassium (K)	0.30	1.30	0.95	6.66	3.13	1.15	0.88
Selenium (Se)	0.0007	0.0010	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.63	7.56	6.57	17.62	17.61	4.91	0.65
Silver (Ag)	0.000005	0.000058	0.000054	0.000176	0.000176	0.000053	0.91
Sodium (Na)	1.0	2.2	2.4	5.0	3.3	0.8	0.37
Strontium (Sr)	0.146	0.284	0.295	0.478	0.478	0.102	0.36
Thallium (Tl)	0.000035	0.000086	0.000067	0.000226	0.000226	0.000053	0.61
Tin (Sn)	0.00005	0.00009	0.00005	0.00050	0.00021	0.00007	0.78
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.48
Vanadium (V)	0.0005	0.0091	0.0077	0.0293	0.0293	0.0090	0.99
Zinc (Zn)	0.002	0.026	0.023	0.091	0.091	0.025	0.96

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-46. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0053	0.0034	0.0164	0.0162	0.0043	0.82
Chloride (Cl)	0.25	0.25	0.25	0.33	0.26	0.01	0.02
Fluoride (F)	0.02	0.06	0.05	0.08	0.08	0.02	0.29
Nitrate (as N)	0.01	0.15	0.11	0.47	0.46	0.14	0.94
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.41
Total Phosphate (as P)	0.00	0.13	0.15	0.45	0.45	0.14	1.03
Sulphate (SO_4)	22	57	53	**101**	99	26	0.46
Cyanide-WAD	0.0005	0.0005	0.0005	0.0010	0.0008	0.0001	0.17
Total Metals							
Aluminum (Al)	0.06	*3.29*	*4.10*	*10.25*	*10.25*	3.28	1.00
Antimony (Sb)	0.0003	0.0007	0.0008	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	**0.0050**	**0.0142**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.101	0.202	0.202	0.054	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000033	**0.000236**	**0.000266**	**0.000794**	**0.000794**	0.000210	0.89
Calcium (Ca)	19.93	39.27	33.67	78.76	77.64	16.92	0.43
Chromium (Cr)	0.0002	**0.0054**	**0.0054**	**0.0169**	**0.0169**	0.0053	1.00
Cobalt (Co)	0.00005	0.00235	0.00275	0.00786	0.00785	0.00234	1.00
Copper (Cu)	0.0006	0.0092	0.0101	**0.0241**	**0.0240**	0.0073	0.79
Iron (Fe)	0.12	**4.90**	**5.61**	**16.86**	**16.86**	5.01	1.02
Lead (Pb)	0.00008	0.00327	0.00388	0.01054	0.01054	0.00315	0.96
Lithium (Li)	0.002	0.005	0.005	0.012	0.012	0.003	0.62
Magnesium (Mg)	5.15	7.33	7.75	10.25	10.11	1.42	0.19
Manganese (Mn)	0.016	0.154	0.183	0.497	0.497	0.139	0.90
Mercury (Hg)	0.000005	0.000020	0.000017	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.001	0.003	0.003	0.0004	0.26
Nickel (Ni)	0.0009	0.0077	0.0081	0.0243	0.0243	0.0071	0.92
Potassium (K)	0.30	0.99	1.12	2.23	2.15	0.63	0.64
Selenium (Se)	0.0006	0.0009	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.61	7.59	8.80	17.69	17.69	4.94	0.65
Silver (Ag)	0.000005	0.000059	0.000068	0.000176	0.000176	0.000053	0.91
Sodium (Na)	1.0	2.0	2.1	3.6	3.3	0.9	0.43
Strontium (Sr)	0.142	0.276	0.245	0.478	0.472	0.103	0.37
Thallium (Tl)	0.000034	0.000087	0.000083	0.000227	0.000227	0.000053	0.61
Tin (Sn)	0.00005	0.00007	0.00005	0.00010	0.00010	0.00002	0.30
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.49
Vanadium (V)	0.0005	0.0092	0.0112	0.0294	0.0294	0.0090	0.98
Zinc (Zn)	0.002	0.026	0.029	0.091	0.091	0.025	0.96

(continued)

Table 14.7-46. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0053	0.0034	0.0164	0.0162	0.0043	0.82
Chloride (Cl)	0.25	0.25	0.25	0.33	0.26	0.01	0.02
Fluoride (F)	0.02	0.06	0.05	0.08	0.08	0.02	0.29
Nitrate (as N)	0.01	0.15	0.11	0.47	0.46	0.14	0.94
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.41
Total Phosphate (as P)	0.00	0.13	0.15	0.45	0.45	0.14	1.03
Sulphate (SO_4)	23	57	53	**101**	99	26	0.46
Cyanide-WAD	0.0005	0.0005	0.0005	0.0010	0.0008	0.0001	0.17
Total Metals							
Aluminum (Al)	0.06	*3.29*	*4.10*	*10.25*	*10.25*	3.28	1.00
Antimony (Sb)	0.0003	0.0007	0.0008	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	**0.0050**	**0.0142**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.101	0.202	0.202	0.054	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000033	**0.000236**	**0.000266**	**0.000794**	**0.000794**	0.000210	0.89
Calcium (Ca)	19.96	39.27	33.68	78.76	77.65	16.93	0.43
Chromium (Cr)	0.0002	**0.0054**	**0.0054**	**0.0169**	**0.0169**	0.0053	1.00
Cobalt (Co)	0.00005	0.00235	0.00275	0.00786	0.00785	0.00234	1.00
Copper (Cu)	0.0006	0.0092	0.0101	**0.0241**	**0.0240**	0.0073	0.79
Iron (Fe)	0.12	**4.90**	**5.61**	**16.86**	**16.86**	5.01	1.02
Lead (Pb)	0.00008	0.00327	0.00388	0.01054	0.01054	0.00315	0.96
Lithium (Li)	0.002	0.005	0.005	0.012	0.012	0.003	0.62
Magnesium (Mg)	5.15	7.33	7.75	10.25	10.11	1.42	0.19
Manganese (Mn)	0.016	0.154	0.183	0.498	0.497	0.139	0.90
Mercury (Hg)	0.000005	0.000020	0.000017	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.001	0.003	0.003	0.0004	0.26
Nickel (Ni)	0.0009	0.0077	0.0081	0.0243	0.0243	0.0071	0.92
Potassium (K)	0.30	0.99	1.12	2.23	2.15	0.63	0.64
Selenium (Se)	0.0006	0.0009	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.61	7.59	8.80	17.69	17.69	4.94	0.65
Silver (Ag)	0.000005	0.000059	0.000068	0.000176	0.000176	0.000053	0.91
Sodium (Na)	1.0	2.0	2.1	3.6	3.3	0.9	0.43
Strontium (Sr)	0.142	0.276	0.245	0.478	0.472	0.103	0.37
Thallium (Tl)	0.000034	0.000087	0.000083	0.000227	0.000227	0.000053	0.61
Tin (Sn)	0.00005	0.00007	0.00005	0.00010	0.00010	0.00002	0.30
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.49
Vanadium (V)	0.0005	0.0092	0.0112	0.0294	0.0294	0.0090	0.98
Zinc (Zn)	0.002	0.026	0.029	0.091	0.091	0.025	0.96

(continued)

Table 14.7-46. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0053	0.0034	0.0164	0.0162	0.0043	0.82
Chloride (Cl)	0.25	0.25	0.25	0.43	0.27	0.01	0.04
Fluoride (F)	0.02	0.06	0.05	0.08	0.08	0.02	0.29
Nitrate (as N)	0.01	0.15	0.11	0.47	0.46	0.14	0.94
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.41
Total Phosphate (as P)	0.00	0.13	0.15	0.45	0.45	0.14	1.03
Sulphate (SO_4)	23	57	53	**101**	99	26	0.46
Cyanide-WAD	0.0005	0.0005	0.0005	0.0011	0.0008	0.0001	0.18
Total Metals							
Aluminum (Al)	0.06	*3.29*	*4.10*	*10.26*	*10.25*	3.28	1.00
Antimony (Sb)	0.0003	0.0007	0.0008	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	**0.0050**	**0.0142**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.102	0.202	0.202	0.054	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000033	**0.000236**	**0.000266**	**0.000795**	**0.000794**	0.000210	0.89
Calcium (Ca)	20.01	39.27	33.72	78.76	77.64	16.92	0.43
Chromium (Cr)	0.0002	**0.0054**	**0.0054**	**0.0169**	**0.0169**	0.0053	1.00
Cobalt (Co)	0.00005	0.00235	0.00275	0.00787	0.00785	0.00234	1.00
Copper (Cu)	0.0006	0.0092	0.0101	**0.0241**	**0.0240**	0.0073	0.79
Iron (Fe)	0.12	**4.90**	**5.61**	**16.87**	**16.86**	5.01	1.02
Lead (Pb)	0.00008	0.00327	0.00388	0.01055	0.01054	0.00315	0.96
Lithium (Li)	0.002	0.005	0.005	0.012	0.012	0.003	0.62
Magnesium (Mg)	5.14	7.33	7.75	10.25	10.11	1.42	0.19
Manganese (Mn)	0.016	0.154	0.183	0.498	0.497	0.139	0.90
Mercury (Hg)	0.000005	0.000020	0.000017	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.001	0.003	0.003	0.0004	0.26
Nickel (Ni)	0.0009	0.0077	0.0081	0.0243	0.0243	0.0071	0.92
Potassium (K)	0.30	1.00	1.12	2.24	2.15	0.63	0.64
Selenium (Se)	0.0007	0.0009	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.61	7.59	8.81	17.70	17.69	4.94	0.65
Silver (Ag)	0.000005	0.000059	0.000068	0.000177	0.000176	0.000053	0.91
Sodium (Na)	1.0	2.0	2.1	3.7	3.3	0.9	0.43
Strontium (Sr)	0.143	0.276	0.245	0.478	0.472	0.103	0.37
Thallium (Tl)	0.000034	0.000087	0.000083	0.000227	0.000227	0.000053	0.61
Tin (Sn)	0.00005	0.00007	0.00005	0.00012	0.00010	0.00002	0.30
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.49
Vanadium (V)	0.0005	0.0092	0.0112	0.0294	0.0294	0.0090	0.98
Zinc (Zn)	0.002	0.026	0.029	0.091	0.091	0.025	0.96

(continued)

Table 14.7-46. Summary Statistics of Water Quality Predictions for Treaty Creek (site TRC2; Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0053	0.0034	0.0164	0.0162	0.0043	0.82
Chloride (Cl)	0.25	0.25	0.25	0.43	0.27	0.01	0.04
Fluoride (F)	0.02	0.06	0.05	0.08	0.08	0.02	0.29
Nitrate (as N)	0.01	0.15	0.11	0.47	0.46	0.14	0.94
Nitrite (as N)	0.0005	0.0006	0.0005	0.0014	0.0014	0.0002	0.41
Total Phosphate (as P)	0.00	0.13	0.15	0.45	0.45	0.14	1.03
Sulphate (SO_4)	23	57	53	**101**	99	26	0.46
Cyanide-WAD	0.0005	0.0005	0.0005	0.0011	0.0008	0.0001	0.18
Total Metals							
Aluminum (Al)	0.06	*3.29*	*4.10*	*10.26*	*10.25*	3.28	1.00
Antimony (Sb)	0.0003	0.0007	0.0008	0.0017	0.0017	0.0004	0.59
Arsenic (As)	0.0003	0.0045	**0.0050**	**0.0142**	**0.0142**	0.0042	0.94
Barium (Ba)	0.032	0.091	0.102	0.202	0.202	0.054	0.59
Beryllium (Be)	0.0002	0.0003	0.0003	0.0004	0.0004	0.0001	0.20
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000033	**0.000236**	**0.000266**	**0.000795**	**0.000794**	0.000210	0.89
Calcium (Ca)	20.05	39.28	33.72	78.76	77.65	16.92	0.43
Chromium (Cr)	0.0002	**0.0054**	**0.0054**	**0.0169**	**0.0169**	0.0053	1.00
Cobalt (Co)	0.00005	0.00235	0.00275	0.00787	0.00785	0.00234	1.00
Copper (Cu)	0.0006	0.0092	0.0101	**0.0241**	**0.0240**	0.0073	0.79
Iron (Fe)	0.12	**4.90**	**5.61**	**16.87**	**16.86**	5.01	1.02
Lead (Pb)	0.00008	0.00327	0.00388	0.01055	0.01054	0.00315	0.96
Lithium (Li)	0.002	0.005	0.005	0.012	0.012	0.003	0.62
Magnesium (Mg)	5.14	7.33	7.75	10.25	10.11	1.42	0.19
Manganese (Mn)	0.016	0.154	0.183	0.498	0.497	0.139	0.90
Mercury (Hg)	0.000005	0.000020	0.000017	0.000051	0.000051	0.000015	0.74
Molybdenum (Mo)	0.001	0.002	0.001	0.003	0.003	0.0004	0.26
Nickel (Ni)	0.0009	0.0077	0.0081	0.0243	0.0243	0.0071	0.92
Potassium (K)	0.30	1.00	1.12	2.25	2.15	0.63	0.64
Selenium (Se)	0.0007	0.0009	0.0009	0.0017	0.0017	0.0003	0.30
Silicon (Si)	2.61	7.59	8.81	17.70	17.69	4.94	0.65
Silver (Ag)	0.000005	0.000059	0.000068	0.000177	0.000176	0.000053	0.91
Sodium (Na)	1.0	2.0	2.1	3.7	3.3	0.9	0.43
Strontium (Sr)	0.143	0.276	0.245	0.478	0.472	0.103	0.37
Thallium (Tl)	0.000034	0.000087	0.000083	0.000227	0.000227	0.000053	0.61
Tin (Sn)	0.00005	0.00007	0.00005	0.00012	0.00010	0.00002	0.30
Uranium (U)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.49
Vanadium (V)	0.0005	0.0092	0.0112	0.0294	0.0294	0.0090	0.98
Zinc (Zn)	0.002	0.026	0.029	0.091	0.091	0.025	0.96

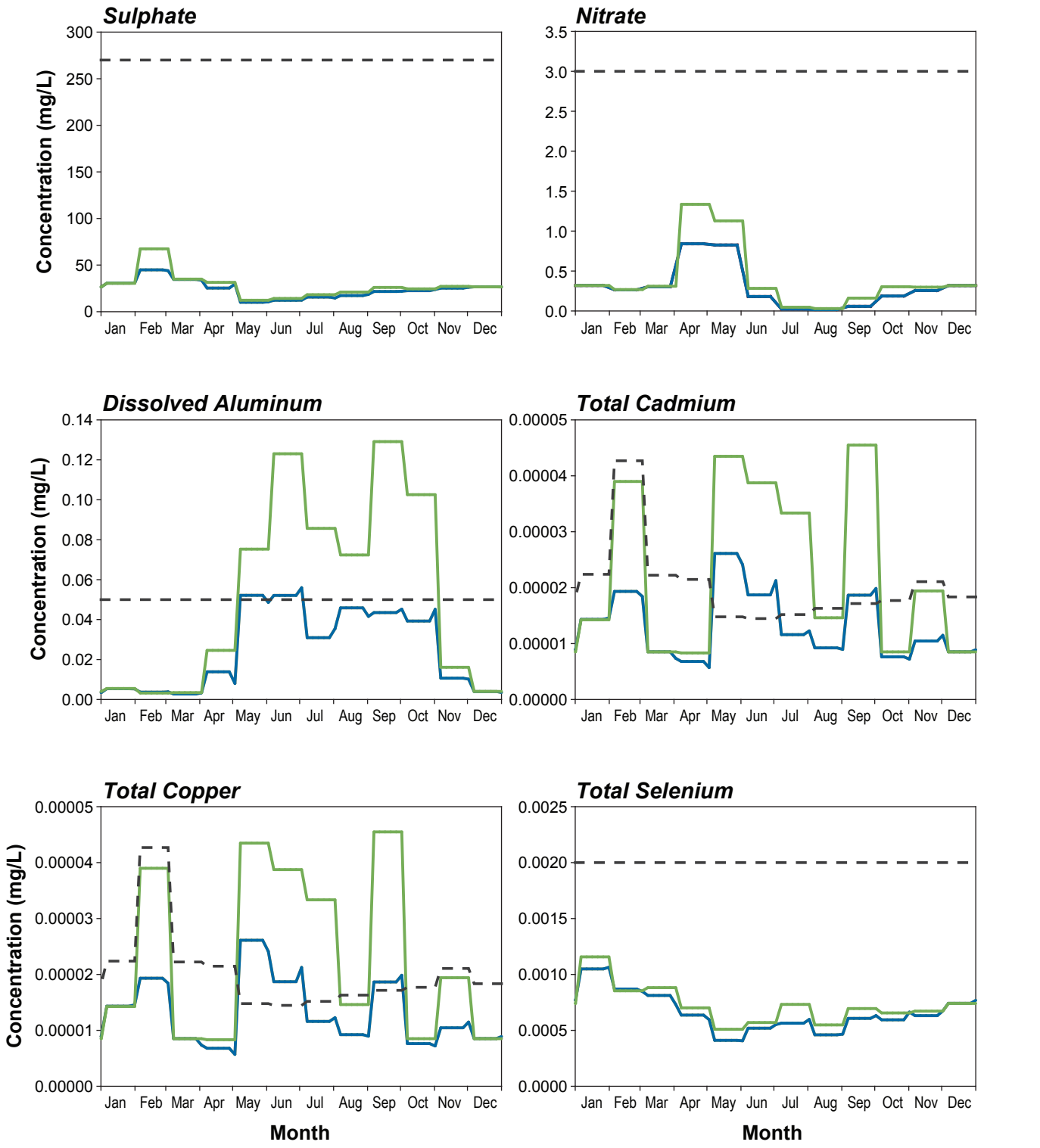
Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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Water Quality Predictions for the Base Case Water Balance: North Treaty Creek - Site NTR2 (Year 5)

Figure 14.7-31

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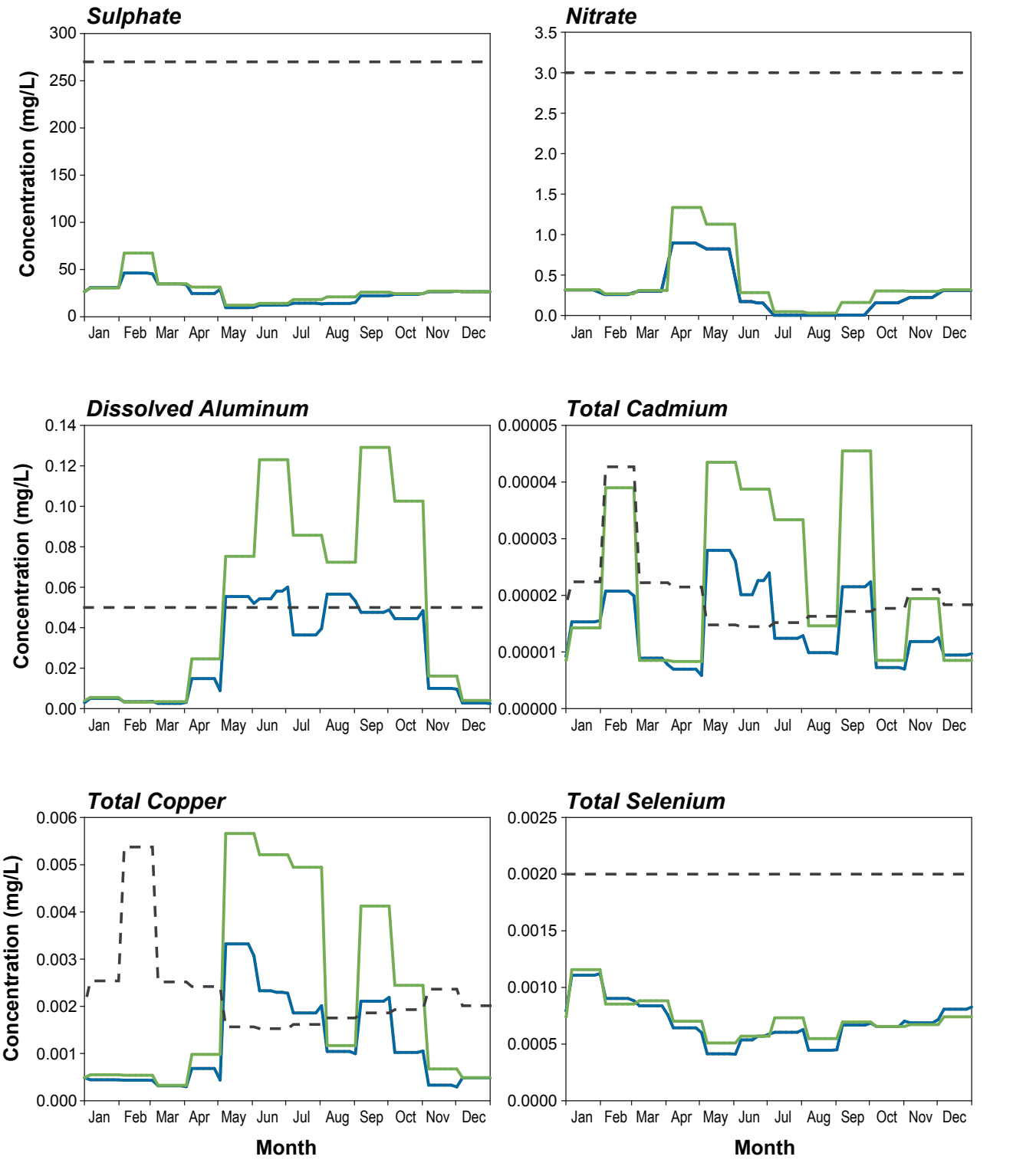

Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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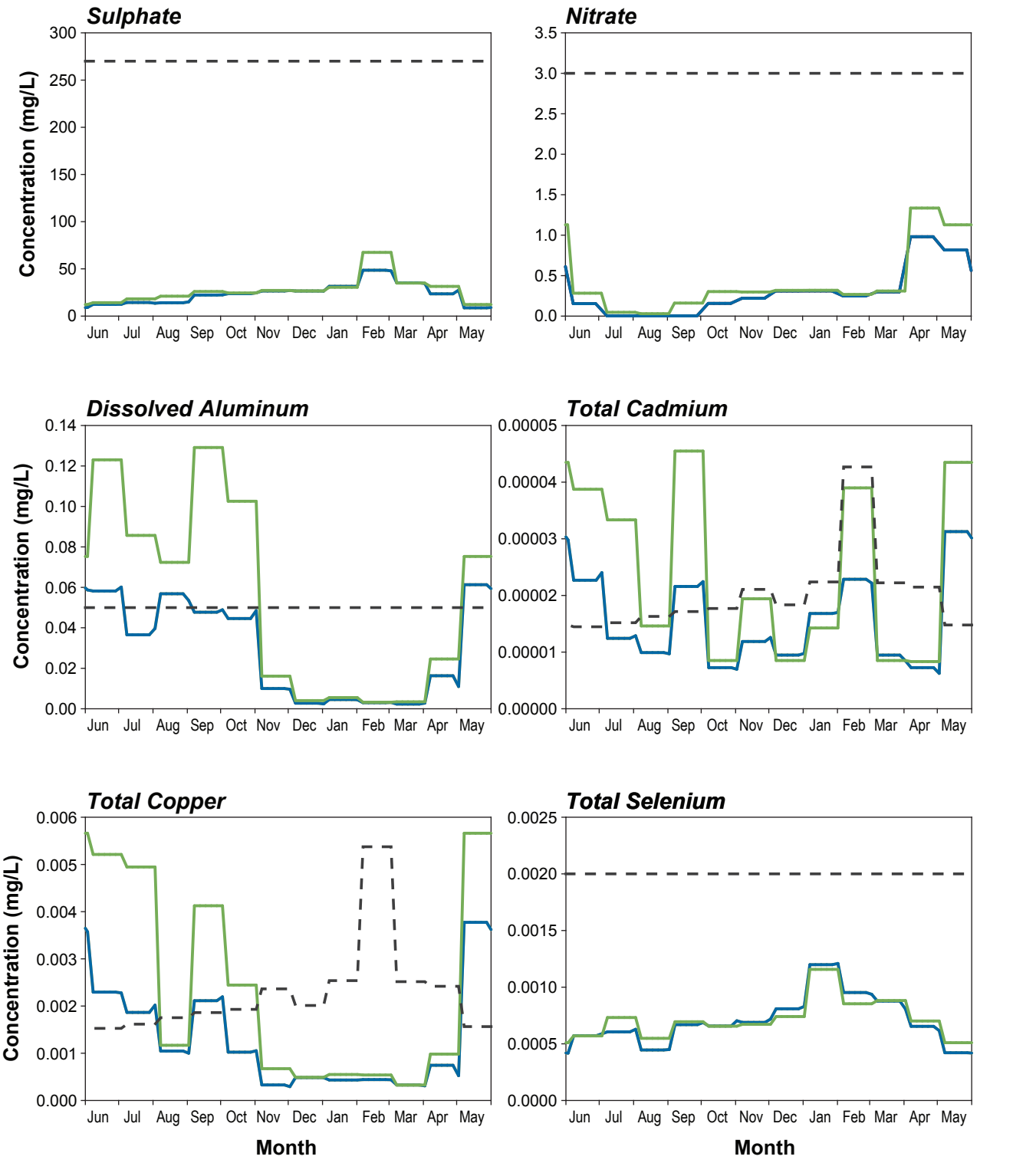
Water Quality Predictions for the Base Case Water Balance: North Treaty Creek - Site NTR2 (Year 25)

Figure 14.7-32

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

Figure 14.7-33

Water Quality Predictions for the Base Case Water Balance: North Treaty Creek - Site NTR2 (Year 51.5)

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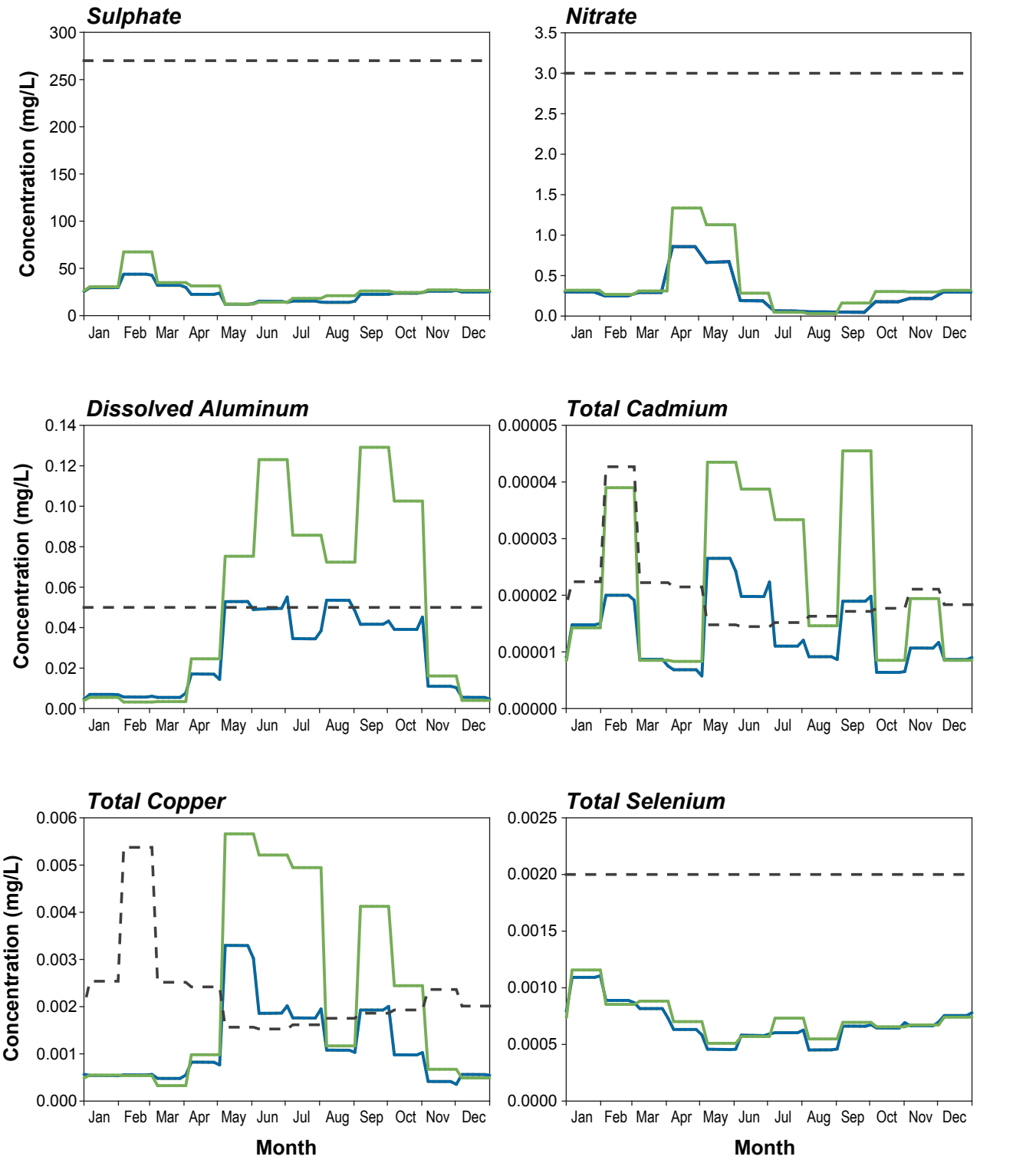

Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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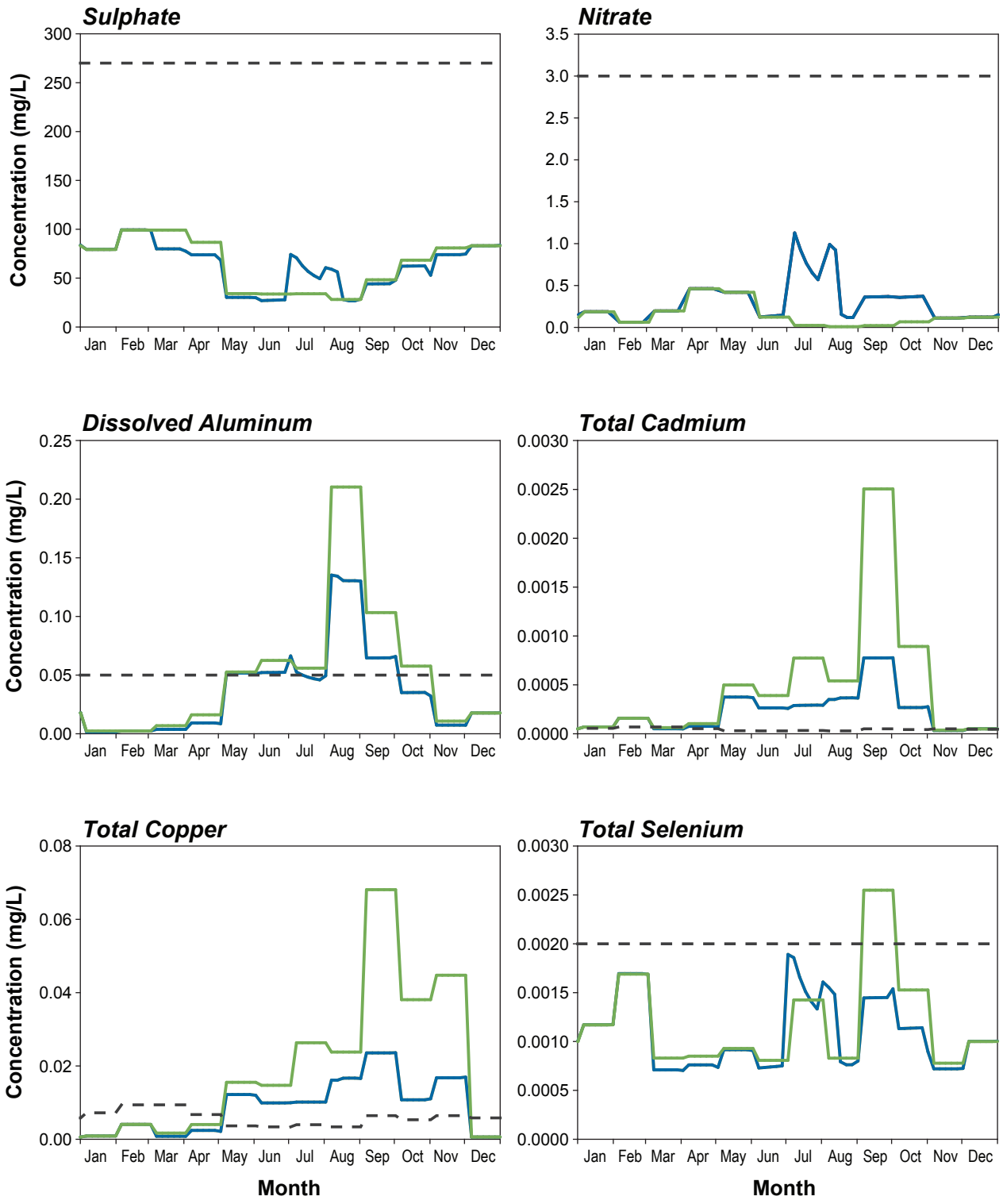
Water Quality Predictions for the Base Case Water Balance: North Treaty Creek - Site NTR2 (Year 65)

Figure 14.7-34

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

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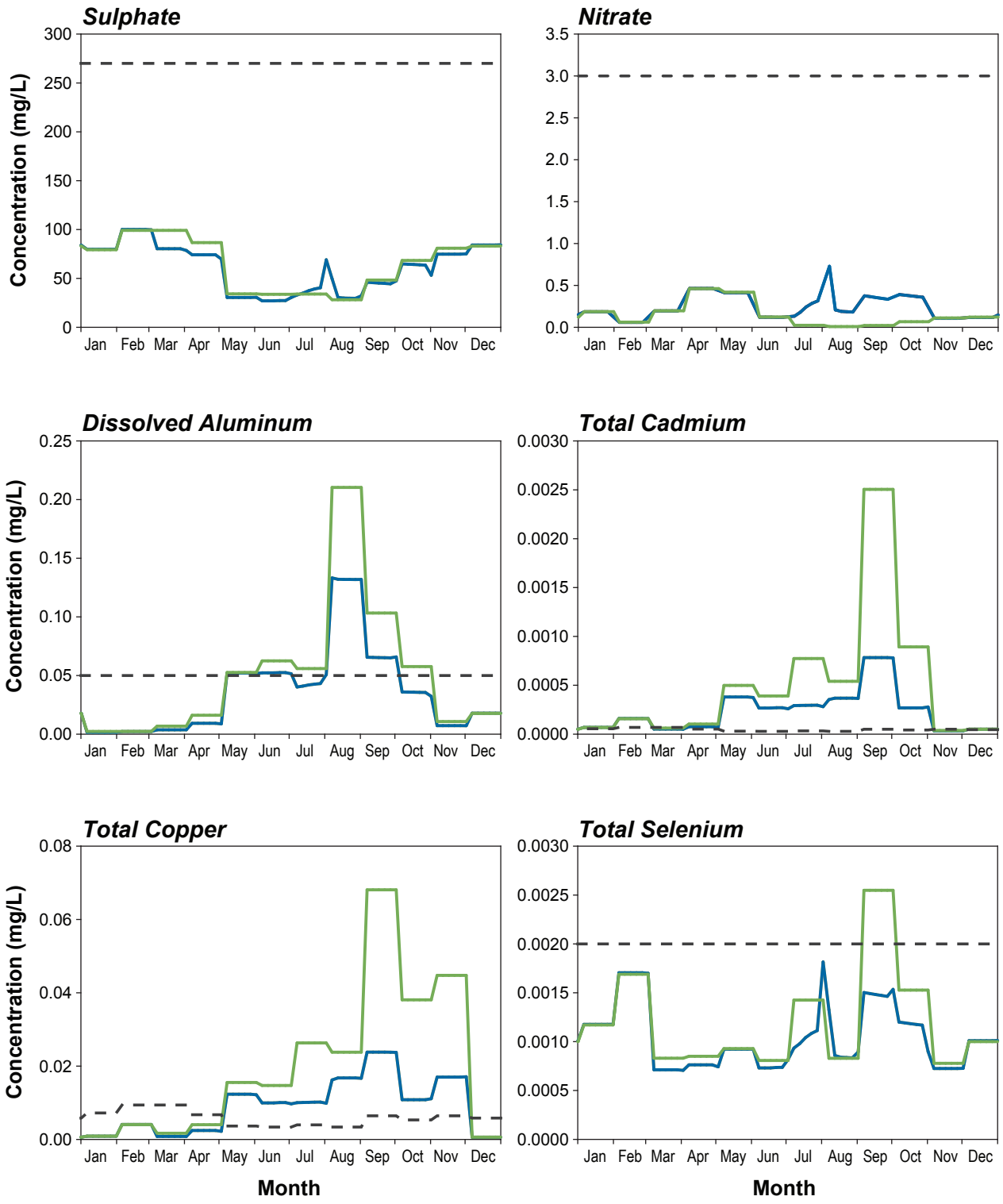
Water Quality Predictions for the Base Case Water Balance: Treaty Creek - Site TRC2 (Year 5)

Figure 14.7-35

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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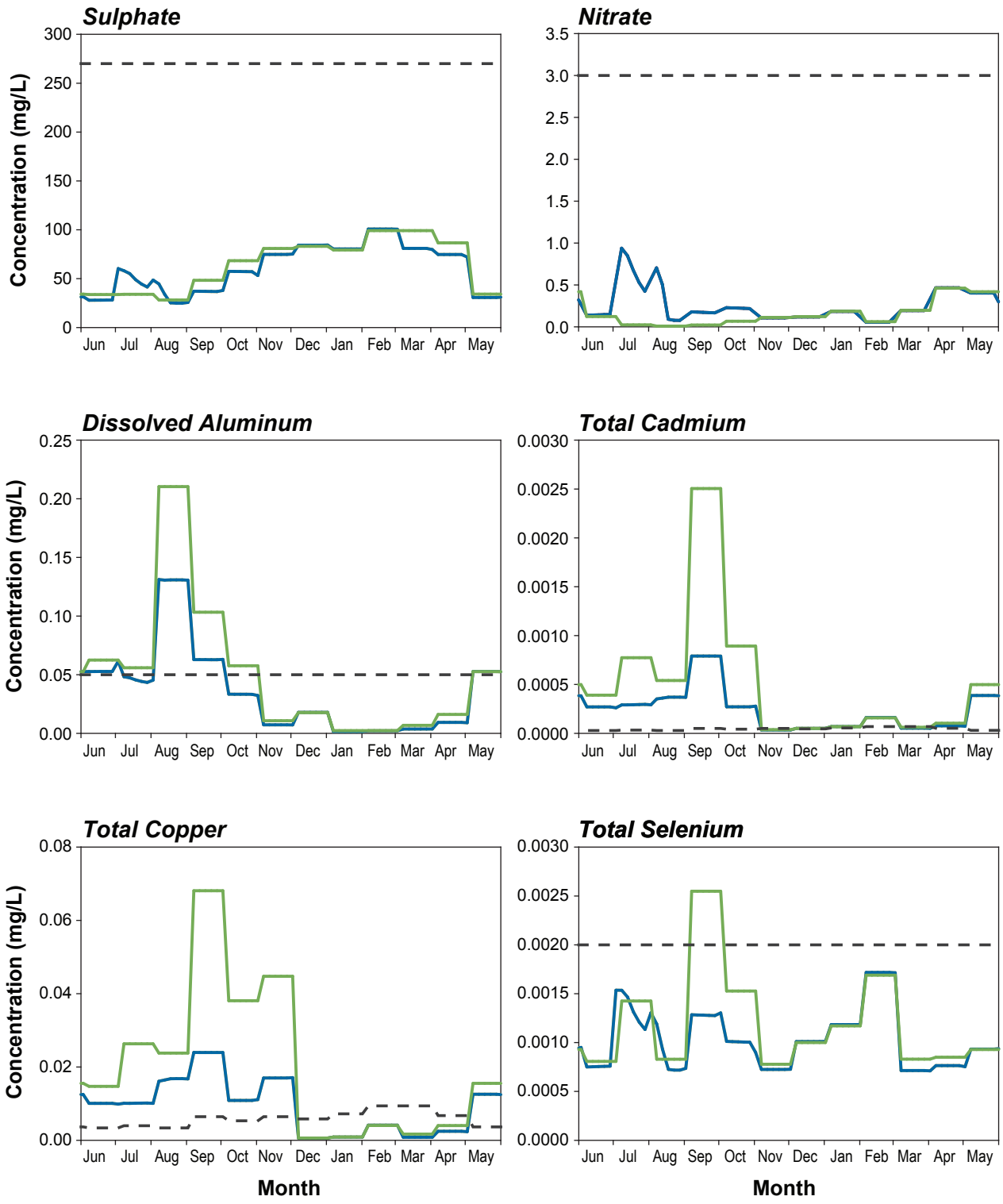
Water Quality Predictions for the Base Case Water Balance: Treaty Creek - Site TRC2 (Year 25)

Figure 14.7-36

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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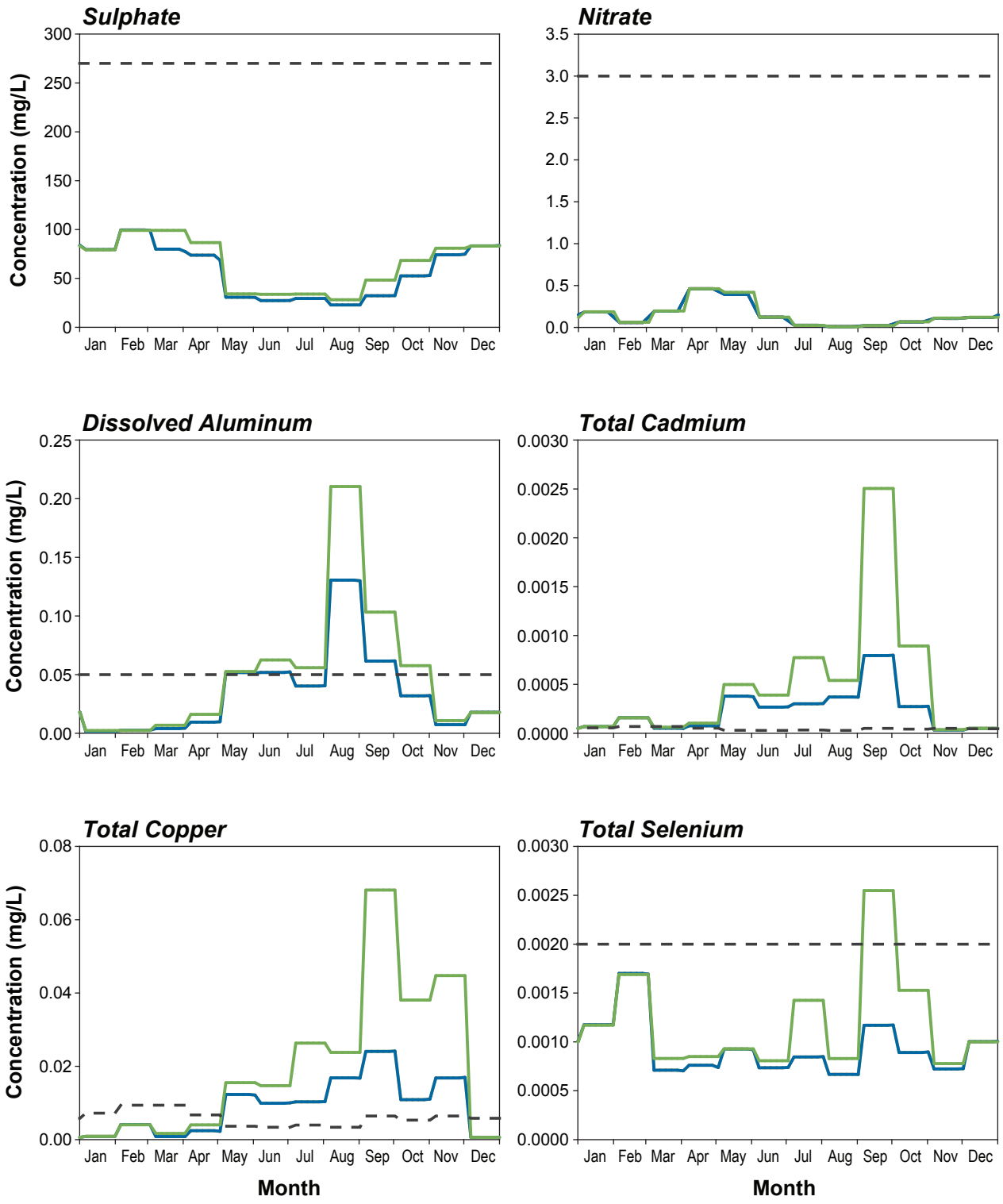
Water Quality Predictions for the Base Case Water Balance: Treaty Creek - Site TRC2 (Year 51.5)

Figure 14.7-37

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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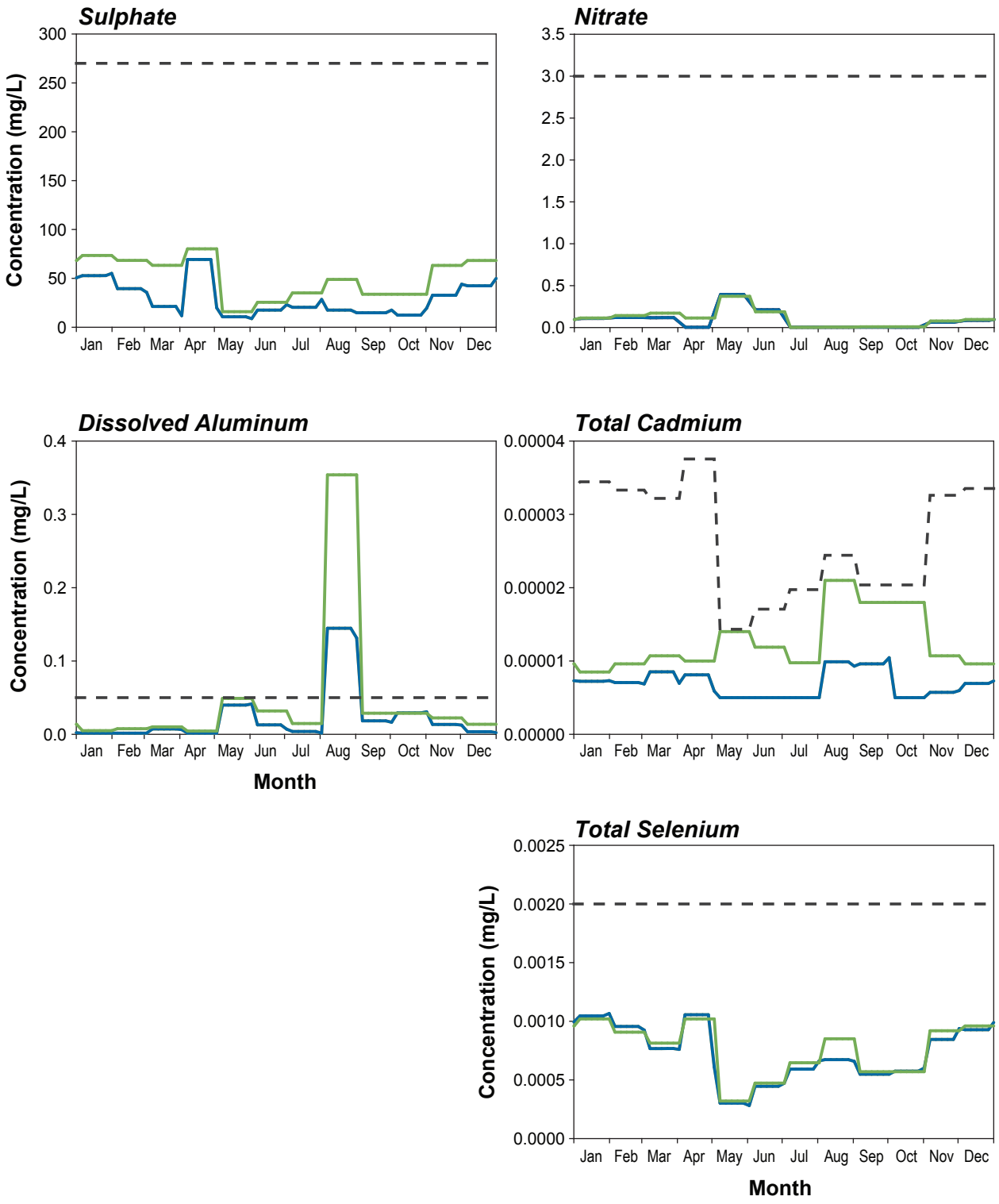
Water Quality Predictions for the Base Case Water Balance: Treaty Creek - Site TRC2 (Year 65)

Figure 14.7-38

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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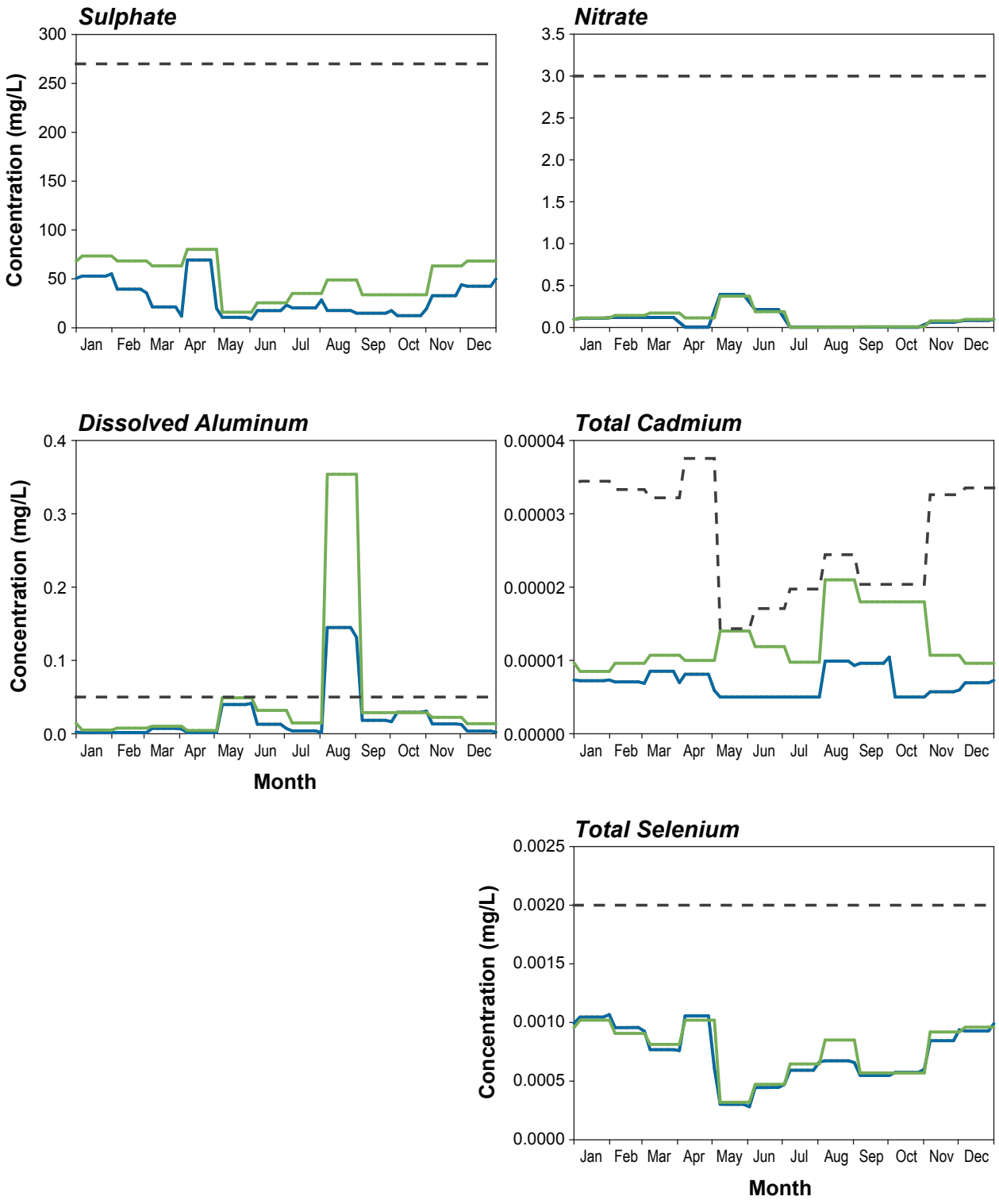
Water Quality Predictions for the Base Case Water Balance: South Teigen Creek - Site STE3 (Year 5)

Figure 14.7-39

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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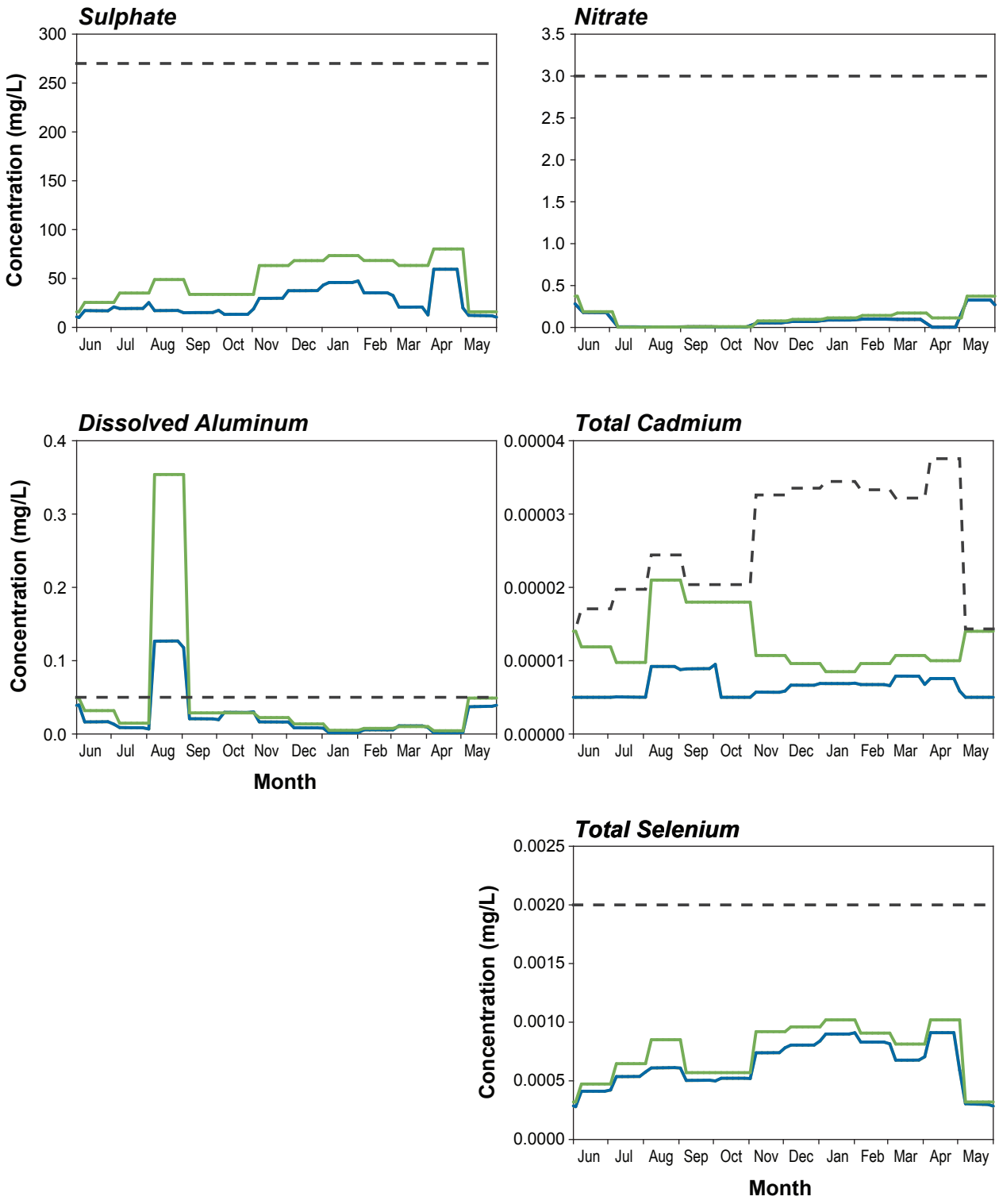
Water Quality Predictions for the Base Case Water Balance: South Teigen Creek - Site STE3 (Year 25)

Figure 14.7-40

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

Figure 14.7-41

Water Quality Predictions for the Base Case Water Balance: South Teigen Creek - Site STE3 (Year 51.5)

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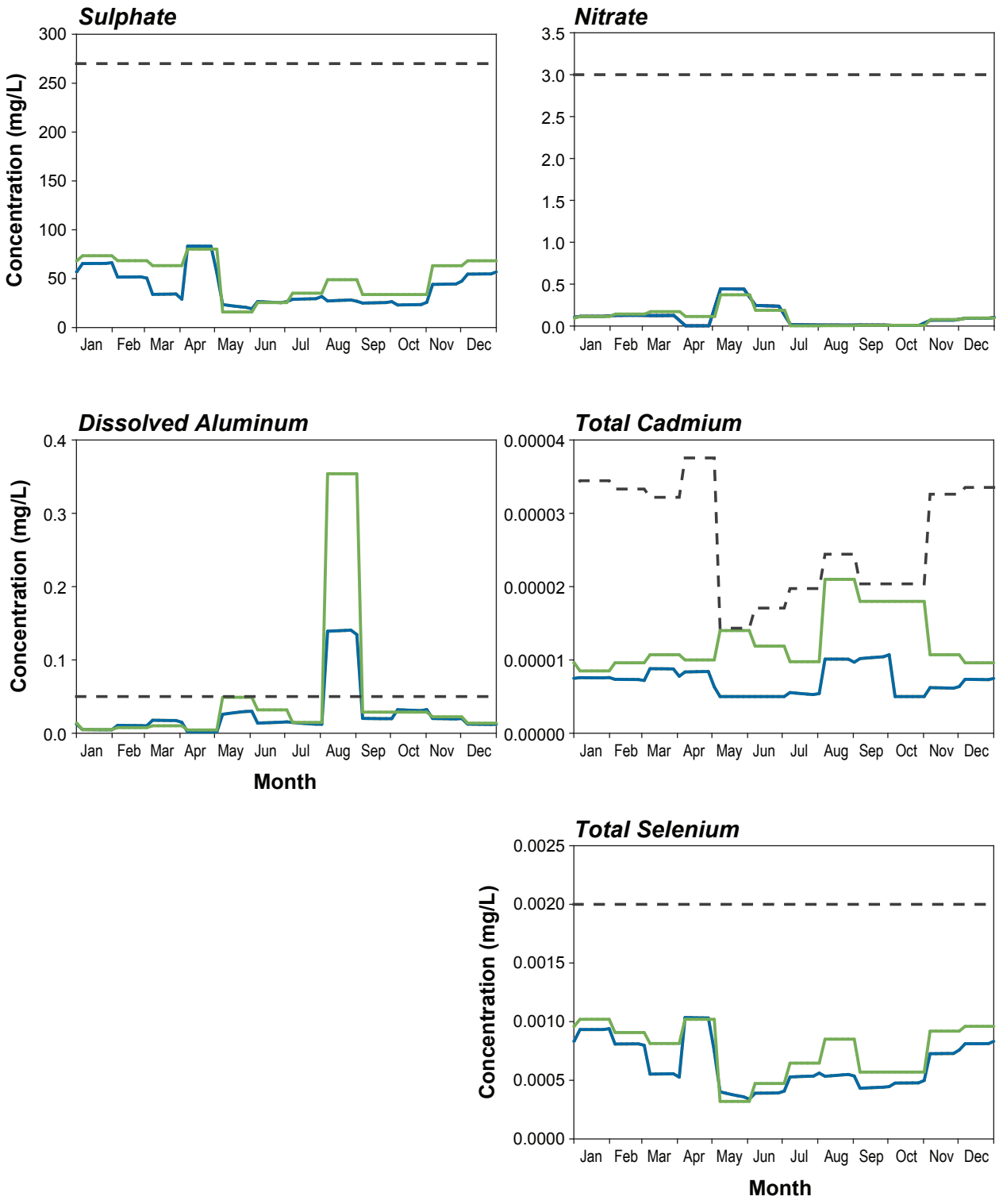

Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

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Water Quality Predictions for the Base Case Water Balance: South Teigen Creek - Site STE3 (Year 65)

Figure 14.7-42

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The presence of oxyanions in discharge from the TMF was identified as a concern by BC MEM (see Chapter 3). The generation of thiosalts, or sulphur oxyanions, is influenced by sulphide mineralogy and sulphide mineral content of the ore (Negeri et al. 1999). Flotation of pyrrhotitic ore produces more thiosalts than pyritic ore at pH values typical for flotation (Negeri et al. 1999). Thiosalts generation for the relatively low sulphide content, pyrite ore of the KSM Project deposits is not expected to be significant. Chemical oxygen demand of rougher tailing supernatant was < 30 mg/L suggesting that both thiosalts and organic process chemicals were relatively low in concentration. The SO_2/air water treatment proposed for the CIL tailing for cyanide detoxification has also been demonstrated to effectively oxidize thiosalts to sulphate in laboratory tests of synthetic solutions (Ferron, Feasby, and Dymov 1998). Natural attenuation by microbial oxidation in the TMF will likely reduce any residual concentrations of both thiosalts and organic process chemical to levels that will not pose a risk to downstream water quality (Dinardo 2003).

South Teigen and Teigen Creeks

This section presents water quality predictions in South Teigen Creek (site STE3) and Teigen Creek (site TEC2). Tables 14.7-47 to 14.7-52 present statistical summaries of water quality in South Teigen and Teigen creeks for the four model scenarios for the construction, operation, closure, and post-closure phases.

Figures 14.7-43 to 14.7-46 present the water quality predictions for six COPC during the operation, closure, and post-closure phases of the Project.

Concentrations of some metals are predicted to be reduced below baseline conditions (e.g., dissolved aluminum and total cadmium). HQ calculations were used to screen for potential residual effects. Sporadic HQs greater than 1.0 were calculated in South Teigen Creek for total chromium, total copper, and total iron during the operation, closure, and post-closure phases. Further investigation indicated that these predictions were a result of uncertainties in the model due to monthly inputs in flow and concentration values; therefore no residual effects in South Teigen Creek are expected related to chromium, copper, and iron. Increases in selenium concentrations in South Teigen Creek over background were predicted during the operation, closure, and post-closure phases. The potential for bioaccumulation in aquatic life is assessed in Chapter 15. No HQs greater than 1.0 were calculated for Teigen Creek.

In South Teigen Creek (STE3) and Teigen Creek (TEC2), the maximum predicted concentrations in the upper-case model scenarios during the operation phase were less than 1% higher than in the expected case. Predicted mean variable case water balance simulation concentrations were less than 1% higher than the base case water balance simulations (Tables 14.7-47 to 14.7-52). No additional water quality concerns were identified through the model sensitivity analysis.

Table 14.7-47. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0053	0.0041	0.0006	0.21
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.24
Nitrate (as N)	0.00	0.09	0.07	0.39	0.39	0.11	1.20
Nitrite (as N)	0.0005	0.0039	0.0005	0.0381	0.0299	0.00924	2.38
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	1.20
Sulphate (SO_4)	9	29	21	69	69	17	0.59
Cyanide-WAD	0.00050	0.00051	0.00050	0.00059	0.00059	0.00002	0.04
Total Metals							
Aluminum (Al)	0.00	*0.33*	0.01	*1.78*	*1.77*	0.57	1.72
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0006	0.0006	0.0002	1.18
Barium (Ba)	0.007	0.020	0.019	0.034	0.034	0.007	0.33
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.49
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000010	0.000010	0.000002	0.25
Calcium (Ca)	9.31	21.79	20.97	35.92	35.89	7.49	0.34
Chromium (Cr)	0.0001	**0.0012**	0.0002	**0.0059**	**0.0058**	0.0018	1.47
Cobalt (Co)	0.00005	0.00019	0.00005	0.00088	0.00088	0.00025	1.30
Copper (Cu)	0.0003	0.0011	0.0009	0.0032	0.0032	0.0008	0.76
Iron (Fe)	0.01	0.34	0.01	**1.65**	**1.65**	0.52	1.54
Lead (Pb)	0.00003	0.00008	0.00003	0.00037	0.00037	0.00010	1.20
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0003	0.15
Magnesium (Mg)	2.08	4.89	4.53	7.70	7.70	1.55	0.32
Manganese (Mn)	0.00003	0.00534	0.00003	0.03416	0.03203	0.00966	1.81
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.000	0.000	0.000	0.001	0.001	0.0001	0.25
Nickel (Ni)	0.0003	0.0013	0.0003	0.0056	0.0055	0.0017	1.27
Potassium (K)	0.12	0.30	0.26	0.65	0.65	0.14	0.46
Selenium (Se)	0.0002	0.0007	0.0007	0.0011	0.0011	0.0002	0.32
Silicon (Si)	1.35	2.45	2.22	4.20	4.19	0.74	0.30
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.8	1.5	3.4	3.4	0.9	0.48
Strontium (Sr)	0.094	0.243	0.239	0.431	0.431	0.095	0.39
Thallium (Tl)	0.000005	0.000031	0.000030	0.000050	0.000050	0.000018	0.57
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.01
Uranium (U)	0.000005	0.00002	0.00002	0.00003	0.00003	0.00001	0.47
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.15
Zinc (Zn)	0.002	0.002	0.002	0.007	0.007	0.002	0.70

(continued)

Table 14.7-47. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0053	0.0041	0.0006	0.21
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.24
Nitrate (as N)	0.00	0.09	0.07	0.39	0.39	0.11	1.20
Nitrite (as N)	0.0005	0.0039	0.0005	0.0381	0.0299	0.00924	2.38
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	1.20
Sulphate (SO_4)	9	29	21	69	69	17	0.59
Cyanide-WAD	0.00050	0.00051	0.00050	0.00059	0.00059	0.00002	0.04
Total Metals							
Aluminum (Al)	0.00	*0.33*	0.01	*1.78*	*1.77*	0.57	1.72
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0006	0.0006	0.0002	1.18
Barium (Ba)	0.007	0.020	0.019	0.034	0.034	0.007	0.33
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.49
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000010	0.000010	0.000002	0.25
Calcium (Ca)	9.31	21.80	20.97	35.92	35.89	7.49	0.34
Chromium (Cr)	0.0001	**0.0012**	0.0002	**0.0059**	**0.0058**	0.0018	1.47
Cobalt (Co)	0.00005	0.00019	0.00005	0.00088	0.00088	0.00025	1.30
Copper (Cu)	0.0003	0.0011	0.0009	0.0032	0.0032	0.0008	0.76
Iron (Fe)	0.01	0.34	0.01	**1.65**	**1.65**	0.52	1.54
Lead (Pb)	0.00003	0.00008	0.00003	0.00037	0.00037	0.00010	1.20
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0003	0.15
Magnesium (Mg)	2.08	4.89	4.53	7.70	7.70	1.55	0.32
Manganese (Mn)	0.00003	0.00535	0.00003	0.03420	0.03203	0.00966	1.81
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.000	0.000	0.000	0.001	0.001	0.0001	0.25
Nickel (Ni)	0.0003	0.0013	0.0003	0.0056	0.0055	0.0017	1.27
Potassium (K)	0.12	0.30	0.26	0.65	0.65	0.14	0.46
Selenium (Se)	0.0002	0.0007	0.0007	0.0011	0.0011	0.0002	0.32
Silicon (Si)	1.35	2.45	2.22	4.20	4.19	0.74	0.30
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.8	1.5	3.4	3.4	0.9	0.48
Strontium (Sr)	0.094	0.243	0.239	0.431	0.431	0.095	0.39
Thallium (Tl)	0.000005	0.000031	0.000030	0.000050	0.000050	0.000018	0.57
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.01
Uranium (U)	0.000005	0.00002	0.00002	0.00003	0.00003	0.00001	0.47
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.15
Zinc (Zn)	0.002	0.002	0.002	0.007	0.007	0.002	0.70

(continued)

Table 14.7-47. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0055	0.0041	0.0006	0.21
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.24
Nitrate (as N)	0.00	0.09	0.07	0.39	0.39	0.11	1.20
Nitrite (as N)	0.0005	0.0039	0.0005	0.0443	0.0303	0.00945	2.40
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	1.20
Sulphate (SO_4)	9	29	21	69	69	17	0.59
Cyanide-WAD	0.00050	0.00051	0.00050	0.00059	0.00059	0.00002	0.04
Total Metals							
Aluminum (Al)	0.00	*0.33*	0.01	*1.78*	*1.77*	0.57	1.72
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0006	0.0006	0.0002	1.18
Barium (Ba)	0.007	0.020	0.019	0.034	0.034	0.007	0.33
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.49
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000010	0.000010	0.000002	0.25
Calcium (Ca)	9.31	21.80	20.97	35.92	35.90	7.49	0.34
Chromium (Cr)	0.0001	**0.0012**	0.0002	**0.0059**	**0.0058**	0.0018	1.47
Cobalt (Co)	0.00005	0.00019	0.00005	0.00088	0.00088	0.00025	1.30
Copper (Cu)	0.0003	0.0011	0.0009	0.0032	0.0032	0.0008	0.76
Iron (Fe)	0.01	0.34	0.01	**1.65**	**1.65**	0.52	1.54
Lead (Pb)	0.00003	0.00008	0.00003	0.00037	0.00037	0.00010	1.20
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0003	0.15
Magnesium (Mg)	2.08	4.89	4.53	7.70	7.70	1.55	0.32
Manganese (Mn)	0.00003	0.00534	0.00003	0.03435	0.03203	0.00966	1.81
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.000	0.000	0.000	0.001	0.001	0.0001	0.25
Nickel (Ni)	0.0003	0.0013	0.0003	0.0056	0.0055	0.0017	1.27
Potassium (K)	0.12	0.30	0.26	0.65	0.65	0.14	0.45
Selenium (Se)	0.0002	0.0007	0.0007	0.0011	0.0011	0.0002	0.32
Silicon (Si)	1.35	2.45	2.22	4.20	4.19	0.74	0.30
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.8	1.5	3.4	3.4	0.9	0.48
Strontium (Sr)	0.094	0.243	0.239	0.431	0.431	0.095	0.39
Thallium (Tl)	0.000005	0.000031	0.000030	0.000050	0.000050	0.000018	0.57
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.01
Uranium (U)	0.000005	0.00002	0.00002	0.00003	0.00003	0.00001	0.47
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.15
Zinc (Zn)	0.002	0.002	0.002	0.007	0.007	0.002	0.70

(continued)

Table 14.7-47. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0055	0.0041	0.0006	0.21
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.24
Nitrate (as N)	0.00	0.09	0.07	0.39	0.39	0.11	1.20
Nitrite (as N)	0.0005	0.0039	0.0005	0.0443	0.0303	0.00945	2.40
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	1.20
Sulphate (SO_4)	9	29	21	69	69	17	0.59
Cyanide-WAD	0.00050	0.00051	0.00050	0.00059	0.00059	0.00002	0.04
Total Metals							
Aluminum (Al)	0.00	*0.33*	0.01	*1.78*	*1.77*	0.57	1.72
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0006	0.0006	0.0002	1.18
Barium (Ba)	0.007	0.020	0.019	0.034	0.034	0.007	0.33
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.49
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000010	0.000010	0.000002	0.25
Calcium (Ca)	9.31	21.80	20.97	35.92	35.90	7.49	0.34
Chromium (Cr)	0.0001	**0.0012**	0.0002	**0.0059**	**0.0058**	0.0018	1.47
Cobalt (Co)	0.00005	0.00019	0.00005	0.00088	0.00088	0.00025	1.30
Copper (Cu)	0.0003	0.0011	0.0009	0.0032	0.0032	0.0008	0.76
Iron (Fe)	0.01	0.34	0.01	**1.65**	**1.65**	0.52	1.54
Lead (Pb)	0.00003	0.00008	0.00003	0.00037	0.00037	0.00010	1.20
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0003	0.15
Magnesium (Mg)	2.08	4.89	4.53	7.70	7.70	1.55	0.32
Manganese (Mn)	0.00003	0.00535	0.00003	0.03439	0.03203	0.00966	1.81
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.000	0.000	0.000	0.001	0.001	0.0001	0.25
Nickel (Ni)	0.0003	0.0013	0.0003	0.0056	0.0055	0.0017	1.27
Potassium (K)	0.12	0.30	0.26	0.65	0.65	0.14	0.45
Selenium (Se)	0.0002	0.0007	0.0007	0.0011	0.0011	0.0002	0.32
Silicon (Si)	1.35	2.45	2.22	4.20	4.19	0.74	0.30
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.8	1.5	3.4	3.4	0.9	0.48
Strontium (Sr)	0.094	0.243	0.239	0.431	0.431	0.095	0.39
Thallium (Tl)	0.000005	0.000031	0.000030	0.000050	0.000050	0.000018	0.57
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.01
Uranium (U)	0.000005	0.00002	0.00002	0.00003	0.00003	0.00001	0.47
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.15
Zinc (Zn)	0.002	0.002	0.002	0.007	0.007	0.002	0.70

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-48. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0051	0.0043	0.0005	0.20
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.21
Nitrate (as N)	0.002	0.078	0.062	0.326	0.326	0.091	1.17
Nitrite (as N)	0.0005	0.0052	0.0021	0.0288	0.0162	0.0060	1.16
Total Phosphate (as P)	0.001	0.007	0.004	0.023	0.023	0.006	0.96
Sulphate (SO_4)	12	27	20	59	59	14	0.53
Cyanide-WAD	0.00050	0.00050	0.00050	0.00054	0.00054	0.00001	0.02
Total Metals							
Aluminum (Al)	0.00	*0.28*	0.02	*1.43*	*1.43*	0.47	1.69
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0005	0.0005	0.0001	1.10
Barium (Ba)	0.010	0.020	0.019	0.031	0.031	0.006	0.28
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.43
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000009	0.000009	0.000001	0.22
Calcium (Ca)	10.90	19.51	19.26	30.64	30.63	6.16	0.32
Chromium (Cr)	0.0001	**0.0011**	0.0002	**0.0047**	**0.0047**	0.0015	1.43
Cobalt (Co)	0.00005	0.00017	0.00005	0.00072	0.00072	0.00021	1.22
Copper (Cu)	0.0003	0.0010	0.0008	0.0027	0.0027	0.0007	0.71
Iron (Fe)	0.09	0.42	0.17	**1.52**	**1.52**	0.45	1.08
Lead (Pb)	0.00003	0.00008	0.00003	0.00031	0.00031	0.00009	1.09
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.000	0.13
Magnesium (Mg)	2.43	4.37	4.26	6.57	6.57	1.27	0.29
Manganese (Mn)	0.00003	0.00784	0.00263	0.03416	0.03381	0.01016	1.30
Mercury (Hg)	0.000005	0.000009	0.000005	0.000023	0.000023	0.000007	0.79
Molybdenum (Mo)	0.0002	0.0003	0.0004	0.0005	0.0005	0.0001	0.22
Nickel (Ni)	0.0003	0.0012	0.0004	0.0046	0.0046	0.0014	1.20
Potassium (K)	0.15	0.27	0.23	0.54	0.54	0.11	0.42
Selenium (Se)	0.0003	0.0006	0.0006	0.0009	0.0009	0.0002	0.29
Silicon (Si)	1.56	2.24	2.04	3.60	3.59	0.60	0.27
Silver (Ag)	0.000005	0.000007	0.000005	0.000018	0.000018	0.000004	0.63
Sodium (Na)	1.0	1.6	1.3	2.9	2.9	0.7	0.42
Strontium (Sr)	0.109	0.216	0.205	0.363	0.363	0.078	0.36
Thallium (Tl)	0.000005	0.000030	0.000030	0.000046	0.000046	0.000016	0.52
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000017	0.000019	0.000026	0.000026	0.000007	0.43
Vanadium (V)	0.0005	0.0012	0.0005	0.0042	0.0042	0.0012	1.06
Zinc (Zn)	0.002	0.002	0.002	0.006	0.006	0.001	0.62

(continued)

Table 14.7-48. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0051	0.0043	0.0005	0.20
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.21
Nitrate (as N)	0.002	0.078	0.062	0.326	0.326	0.091	1.17
Nitrite (as N)	0.0005	0.0052	0.0021	0.0288	0.0162	0.0060	1.16
Total Phosphate (as P)	0.001	0.007	0.004	0.023	0.023	0.006	0.96
Sulphate (SO_4)	12	27	20	59	59	14	0.53
Cyanide-WAD	0.00050	0.00050	0.00050	0.00054	0.00054	0.00001	0.02
Total Metals							
Aluminum (Al)	0.00	*0.28*	0.02	*1.43*	*1.43*	0.47	1.69
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0005	0.0005	0.0001	1.10
Barium (Ba)	0.010	0.020	0.019	0.031	0.031	0.006	0.28
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.43
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000009	0.000009	0.000001	0.22
Calcium (Ca)	10.91	19.51	19.26	30.64	30.63	6.16	0.32
Chromium (Cr)	0.0001	**0.0011**	0.0002	**0.0047**	**0.0047**	0.0015	1.43
Cobalt (Co)	0.00005	0.00017	0.00005	0.00072	0.00072	0.00021	1.22
Copper (Cu)	0.0003	0.0010	0.0008	0.0027	0.0027	0.0007	0.71
Iron (Fe)	0.09	0.42	0.17	**1.52**	**1.52**	0.45	1.08
Lead (Pb)	0.00003	0.00008	0.00003	0.00031	0.00031	0.00009	1.09
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.000	0.13
Magnesium (Mg)	2.43	4.37	4.26	6.57	6.57	1.27	0.29
Manganese (Mn)	0.00003	0.00787	0.00266	0.03420	0.03385	0.01016	1.29
Mercury (Hg)	0.000005	0.000009	0.000005	0.000023	0.000023	0.000007	0.79
Molybdenum (Mo)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.21
Nickel (Ni)	0.0003	0.0012	0.0004	0.0046	0.0046	0.0014	1.20
Potassium (K)	0.15	0.27	0.23	0.54	0.54	0.11	0.42
Selenium (Se)	0.0003	0.0006	0.0006	0.0009	0.0009	0.0002	0.29
Silicon (Si)	1.56	2.24	2.04	3.60	3.59	0.60	0.27
Silver (Ag)	0.000005	0.000007	0.000005	0.000018	0.000018	0.000004	0.63
Sodium (Na)	1.0	1.6	1.3	2.9	2.9	0.7	0.42
Strontium (Sr)	0.109	0.216	0.205	0.363	0.363	0.078	0.36
Thallium (Tl)	0.000005	0.000030	0.000030	0.000046	0.000046	0.000016	0.52
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000017	0.000019	0.000026	0.000026	0.000007	0.42
Vanadium (V)	0.0005	0.0012	0.0005	0.0042	0.0042	0.0012	1.06
Zinc (Zn)	0.002	0.002	0.002	0.006	0.006	0.001	0.62

(continued)

Table 14.7-48. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3;Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0052	0.0044	0.0006	0.21
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.21
Nitrate (as N)	0.002	0.078	0.063	0.328	0.327	0.092	1.17
Nitrite (as N)	0.0008	0.0075	0.0040	0.0344	0.0204	0.0074	1.00
Total Phosphate (as P)	0.001	0.007	0.004	0.024	0.023	0.006	0.94
Sulphate (SO_4)	12	27	20	59	59	14	0.53
Cyanide-WAD	0.00050	0.00050	0.00050	0.00054	0.00054	0.00001	0.02
Total Metals							
Aluminum (Al)	0.00	*0.28*	0.02	*1.43*	*1.43*	0.47	1.68
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0005	0.0005	0.0001	1.10
Barium (Ba)	0.010	0.020	0.019	0.031	0.031	0.006	0.28
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.43
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000009	0.000009	0.000001	0.22
Calcium (Ca)	10.91	19.55	19.33	30.65	30.62	6.13	0.31
Chromium (Cr)	0.0001	**0.0011**	0.0002	**0.0047**	**0.0047**	0.0015	1.43
Cobalt (Co)	0.00005	0.00017	0.00005	0.00072	0.00072	0.00021	1.22
Copper (Cu)	0.0003	0.0010	0.0008	0.0027	0.0027	0.0007	0.71
Iron (Fe)	0.10	0.42	0.17	**1.52**	**1.52**	0.45	1.08
Lead (Pb)	0.00003	0.00008	0.00003	0.00031	0.00031	0.00009	1.09
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.000	0.13
Magnesium (Mg)	2.43	4.38	4.27	6.58	6.57	1.27	0.29
Manganese (Mn)	0.00003	0.00786	0.00266	0.03425	0.03397	0.01019	1.30
Mercury (Hg)	0.000005	0.000009	0.000005	0.000023	0.000023	0.000007	0.79
Molybdenum (Mo)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.21
Nickel (Ni)	0.0003	0.0012	0.0004	0.0046	0.0046	0.0014	1.19
Potassium (K)	0.15	0.27	0.23	0.54	0.54	0.11	0.42
Selenium (Se)	0.0003	0.0006	0.0006	0.0009	0.0009	0.0002	0.29
Silicon (Si)	1.56	2.25	2.05	3.60	3.60	0.61	0.27
Silver (Ag)	0.000005	0.000007	0.000005	0.000018	0.000018	0.000004	0.63
Sodium (Na)	1.0	1.6	1.3	2.9	2.9	0.7	0.42
Strontium (Sr)	0.109	0.216	0.206	0.363	0.363	0.078	0.36
Thallium (Tl)	0.000005	0.000030	0.000030	0.000047	0.000047	0.000016	0.52
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000017	0.000019	0.000026	0.000026	0.000007	0.43
Vanadium (V)	0.0005	0.0012	0.0005	0.0042	0.0042	0.0012	1.06
Zinc (Zn)	0.002	0.002	0.002	0.006	0.006	0.001	0.62

(continued)

Table 14.7-48. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0052	0.0044	0.0006	0.21
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.000	0.00
Fluoride (F)	0.01	0.01	0.01	0.02	0.02	0.003	0.21
Nitrate (as N)	0.002	0.078	0.063	0.328	0.327	0.092	1.17
Nitrite (as N)	0.0008	0.0075	0.0040	0.0344	0.0204	0.0074	1.00
Total Phosphate (as P)	0.001	0.007	0.004	0.024	0.023	0.006	0.94
Sulphate (SO_4)	12	27	20	59	59	14	0.53
Cyanide-WAD	0.00050	0.00050	0.00050	0.00054	0.00054	0.00001	0.02
Total Metals							
Aluminum (Al)	0.00	*0.28*	0.02	*1.43*	*1.43*	0.47	1.68
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0001	0.0001	0.0005	0.0005	0.0001	1.10
Barium (Ba)	0.010	0.020	0.019	0.031	0.031	0.006	0.28
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.43
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.001	0.13
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000009	0.000009	0.000001	0.22
Calcium (Ca)	10.91	19.55	19.33	30.65	30.63	6.13	0.31
Chromium (Cr)	0.0001	**0.0011**	0.0002	**0.0047**	**0.0047**	0.0015	1.43
Cobalt (Co)	0.00005	0.00017	0.00005	0.00072	0.00072	0.00021	1.22
Copper (Cu)	0.0003	0.0010	0.0008	0.0027	0.0027	0.0007	0.71
Iron (Fe)	0.10	0.42	0.17	**1.52**	**1.52**	0.45	1.08
Lead (Pb)	0.00003	0.00008	0.00003	0.00031	0.00031	0.00009	1.08
Lithium (Li)	0.002	0.002	0.002	0.002	0.002	0.0003	0.13
Magnesium (Mg)	2.43	4.38	4.27	6.58	6.57	1.27	0.29
Manganese (Mn)	0.00003	0.00789	0.00270	0.03429	0.03402	0.01020	1.29
Mercury (Hg)	0.000005	0.000009	0.000005	0.000023	0.000023	0.000007	0.79
Molybdenum (Mo)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.21
Nickel (Ni)	0.0003	0.0012	0.0004	0.0046	0.0046	0.0014	1.19
Potassium (K)	0.15	0.27	0.24	0.54	0.54	0.11	0.42
Selenium (Se)	0.0003	0.0006	0.0006	0.0009	0.0009	0.0002	0.29
Silicon (Si)	1.56	2.25	2.05	3.60	3.60	0.61	0.27
Silver (Ag)	0.000005	0.000007	0.000005	0.000018	0.000018	0.000004	0.63
Sodium (Na)	1.0	1.6	1.3	2.9	2.9	0.7	0.42
Strontium (Sr)	0.109	0.216	0.206	0.363	0.363	0.078	0.36
Thallium (Tl)	0.000005	0.000030	0.000030	0.000047	0.000047	0.000016	0.52
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000017	0.000019	0.000027	0.000026	0.000007	0.42
Vanadium (V)	0.0005	0.0012	0.0005	0.0042	0.0042	0.0012	1.06
Zinc (Zn)	0.002	0.002	0.002	0.006	0.006	0.001	0.62

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-49. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0050	0.0050	0.0007	0.25
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.02	0.02	0.03	0.03	0.00	0.20
Nitrate (as N)	0.002	0.103	0.070	0.444	0.441	0.121	1.17
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.00
Total Phosphate (as P)	0.001	0.011	0.007	0.033	0.032	0.008	0.78
Sulphate (SO_4)	12	40	29	83	83	19	0.47
Cyanide-WAD	0.0005	0.0005	0.0005	0.0008	0.0008	0.0001	0.16
Total Metals							
Aluminum (Al)	0.00	*0.36*	0.03	*1.82*	*1.82*	0.60	1.67
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0002	0.0001	0.0006	0.0006	0.0002	1.19
Barium (Ba)	0.010	0.023	0.021	0.038	0.038	0.007	0.31
Beryllium (Be)	0.0001	0.0002	0.0003	0.0003	0.0003	0.0001	0.35
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000010	0.000010	0.000002	0.26
Calcium (Ca)	10.90	18.60	15.82	33.00	32.98	6.21	0.33
Chromium (Cr)	0.0001	**0.0013**	0.0003	**0.0059**	**0.0059**	0.0019	1.48
Cobalt (Co)	0.00005	0.00021	0.00005	0.00091	0.00091	0.00027	1.29
Copper (Cu)	0.0003	0.0012	0.0010	0.0033	0.0033	0.0008	0.73
Iron (Fe)	0.09	0.81	0.51	**2.24**	**2.23**	0.58	0.72
Lead (Pb)	0.00003	0.00011	0.00005	0.00041	0.00041	0.00011	1.08
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.000	0.17
Magnesium (Mg)	2.43	4.23	3.71	7.28	7.28	1.30	0.31
Manganese (Mn)	0.00003	0.02293	0.01950	0.05688	0.05494	0.01266	0.55
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.0002	0.0003	0.0004	0.0006	0.0005	0.0001	0.26
Nickel (Ni)	0.0003	0.0014	0.0005	0.0056	0.0056	0.0018	1.24
Potassium (K)	0.13	0.27	0.21	0.62	0.62	0.15	0.54
Selenium (Se)	0.0003	0.0006	0.0005	0.0010	0.0010	0.0002	0.33
Silicon (Si)	1.39	2.16	1.92	4.07	4.06	0.84	0.39
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.6	1.0	3.3	3.3	0.8	0.47
Strontium (Sr)	0.109	0.214	0.168	0.418	0.418	0.085	0.40
Thallium (Tl)	0.000005	0.000027	0.000025	0.000046	0.000041	0.000013	0.50
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000021	0.000023	0.000033	0.000033	0.000009	0.44
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.16
Zinc (Zn)	0.002	0.003	0.002	0.007	0.007	0.002	0.72

(continued)

Table 14.7-49. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0050	0.0050	0.0007	0.25
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.02	0.02	0.03	0.03	0.00	0.20
Nitrate (as N)	0.002	0.103	0.070	0.444	0.441	0.121	1.17
Nitrite (as N)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.00
Total Phosphate (as P)	0.001	0.011	0.007	0.033	0.032	0.008	0.78
Sulphate (SO_4)	12	40	29	83	83	19	0.47
Cyanide-WAD	0.0005	0.0005	0.0005	0.0008	0.0008	0.0001	0.16
Total Metals							
Aluminum (Al)	0.00	*0.36*	0.03	*1.82*	*1.82*	0.60	1.67
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0002	0.0001	0.0006	0.0006	0.0002	1.19
Barium (Ba)	0.010	0.023	0.021	0.038	0.038	0.007	0.31
Beryllium (Be)	0.0001	0.0002	0.0003	0.0003	0.0003	0.0001	0.35
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000010	0.000010	0.000002	0.26
Calcium (Ca)	10.91	18.61	15.82	33.00	32.98	6.21	0.33
Chromium (Cr)	0.0001	**0.0013**	0.0003	**0.0059**	**0.0059**	0.0019	1.48
Cobalt (Co)	0.00005	0.00021	0.00005	0.00091	0.00091	0.00027	1.29
Copper (Cu)	0.0003	0.0012	0.0010	0.0033	0.0033	0.0008	0.73
Iron (Fe)	0.09	0.81	0.51	**2.24**	**2.23**	0.58	0.72
Lead (Pb)	0.00003	0.00011	0.00005	0.00041	0.00041	0.00011	1.08
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.000	0.17
Magnesium (Mg)	2.43	4.23	3.71	7.28	7.28	1.30	0.31
Manganese (Mn)	0.00003	0.02297	0.01954	0.05692	0.05498	0.01266	0.55
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.0002	0.0004	0.0004	0.0006	0.0006	0.0001	0.25
Nickel (Ni)	0.0003	0.0014	0.0005	0.0056	0.0056	0.0018	1.24
Potassium (K)	0.13	0.27	0.21	0.62	0.62	0.15	0.54
Selenium (Se)	0.0003	0.0006	0.0005	0.0010	0.0010	0.0002	0.33
Silicon (Si)	1.39	2.16	1.92	4.07	4.06	0.84	0.39
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.6	1.0	3.3	3.3	0.8	0.47
Strontium (Sr)	0.109	0.214	0.168	0.418	0.418	0.085	0.40
Thallium (Tl)	0.000005	0.000027	0.000025	0.000046	0.000041	0.000013	0.50
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000021	0.000024	0.000033	0.000033	0.000009	0.43
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.16
Zinc (Zn)	0.002	0.003	0.002	0.007	0.007	0.002	0.72

(continued)

Table 14.7-49. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0050	0.0050	0.0007	0.25
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.02	0.02	0.03	0.03	0.00	0.20
Nitrate (as N)	0.002	0.103	0.071	0.448	0.441	0.121	1.17
Nitrite (as N)	0.0005	0.0005	0.0005	0.0007	0.0005	0.0000	0.01
Total Phosphate (as P)	0.001	0.011	0.007	0.033	0.032	0.008	0.78
Sulphate (SO_4)	12	40	30	84	83	19	0.47
Cyanide-WAD	0.0005	0.0005	0.0005	0.0008	0.0008	0.00008	0.16
Total Metals							
Aluminum (Al)	0.00	*0.36*	0.03	*1.82*	*1.82*	0.60	1.67
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0002	0.0001	0.0006	0.0006	0.0002	1.19
Barium (Ba)	0.010	0.023	0.021	0.038	0.038	0.007	0.31
Beryllium (Be)	0.0001	0.0002	0.0003	0.0003	0.0003	0.0001	0.35
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000011	0.000010	0.000002	0.26
Calcium (Ca)	10.91	18.61	15.82	33.19	32.94	6.21	0.33
Chromium (Cr)	0.0001	**0.0013**	0.0003	**0.0059**	**0.0059**	0.0019	1.48
Cobalt (Co)	0.00005	0.00021	0.00005	0.00091	0.00091	0.00027	1.29
Copper (Cu)	0.0003	0.0012	0.0010	0.0033	0.0033	0.0008	0.73
Iron (Fe)	0.09	0.81	0.51	**2.25**	**2.23**	0.58	0.72
Lead (Pb)	0.00003	0.00011	0.00005	0.00041	0.00041	0.00011	1.08
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.000	0.17
Magnesium (Mg)	2.43	4.23	3.71	7.33	7.27	1.30	0.31
Manganese (Mn)	0.00003	0.02297	0.01944	0.05879	0.05521	0.01269	0.55
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0006	0.0005	0.0001	0.26
Nickel (Ni)	0.0003	0.0014	0.0005	0.0056	0.0056	0.0018	1.24
Potassium (K)	0.13	0.27	0.21	0.62	0.62	0.15	0.54
Selenium (Se)	0.0003	0.0006	0.0005	0.0010	0.0010	0.0002	0.33
Silicon (Si)	1.40	2.16	1.90	4.09	4.06	0.84	0.39
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.6	1.0	3.3	3.3	0.8	0.47
Strontium (Sr)	0.109	0.214	0.168	0.420	0.417	0.085	0.40
Thallium (Tl)	0.000005	0.000027	0.000026	0.000046	0.000041	0.000013	0.50
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000021	0.000023	0.000034	0.000033	0.000009	0.44
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.16
Zinc (Zn)	0.002	0.003	0.002	0.007	0.007	0.002	0.72

(continued)

Table 14.7-49. Summary Statistics of Water Quality Predictions for South Teigen Creek (site STE3; Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0028	0.0025	0.0050	0.0050	0.0007	0.25
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.01	0.02	0.02	0.03	0.03	0.00	0.20
Nitrate (as N)	0.002	0.103	0.071	0.448	0.441	0.121	1.17
Nitrite (as N)	0.0005	0.0005	0.0005	0.0007	0.0005	0.0000	0.01
Total Phosphate (as P)	0.001	0.011	0.007	0.033	0.032	0.008	0.78
Sulphate (SO_4)	12	40	30	84	83	19	0.47
Cyanide-WAD	0.0005	0.0005	0.0005	0.0008	0.0008	0.00008	0.16
Total Metals							
Aluminum (Al)	0.00	*0.36*	0.03	*1.82*	*1.82*	0.60	1.67
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.00
Arsenic (As)	0.0001	0.0002	0.0001	0.0006	0.0006	0.0002	1.19
Barium (Ba)	0.010	0.023	0.021	0.038	0.038	0.007	0.31
Beryllium (Be)	0.0001	0.0002	0.0003	0.0003	0.0003	0.0001	0.35
Boron (B)	0.005	0.005	0.005	0.008	0.008	0.001	0.16
Cadmium (Cd)	0.000005	0.000007	0.000007	0.000011	0.000010	0.000002	0.26
Calcium (Ca)	10.91	18.61	15.82	33.19	32.94	6.21	0.33
Chromium (Cr)	0.0001	**0.0013**	0.0003	**0.0059**	**0.0059**	0.0019	1.48
Cobalt (Co)	0.00005	0.00021	0.00005	0.00091	0.00091	0.00027	1.29
Copper (Cu)	0.0003	0.0012	0.0010	0.0033	0.0033	0.0008	0.73
Iron (Fe)	0.09	0.81	0.51	**2.25**	**2.23**	0.58	0.72
Lead (Pb)	0.00003	0.00011	0.00005	0.00041	0.00041	0.00011	1.08
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.000	0.17
Magnesium (Mg)	2.43	4.23	3.71	7.33	7.27	1.30	0.31
Manganese (Mn)	0.00003	0.02302	0.01948	0.05882	0.05527	0.01269	0.55
Mercury (Hg)	0.000005	0.000009	0.000005	0.000028	0.000028	0.000008	0.89
Molybdenum (Mo)	0.0002	0.0004	0.0004	0.0006	0.0006	0.0001	0.25
Nickel (Ni)	0.0003	0.0014	0.0005	0.0056	0.0056	0.0018	1.24
Potassium (K)	0.13	0.27	0.21	0.62	0.62	0.15	0.54
Selenium (Se)	0.0003	0.0006	0.0006	0.0010	0.0010	0.0002	0.33
Silicon (Si)	1.40	2.16	1.90	4.09	4.06	0.84	0.39
Silver (Ag)	0.000005	0.000007	0.000005	0.000021	0.000021	0.000005	0.73
Sodium (Na)	1.0	1.6	1.0	3.3	3.3	0.8	0.47
Strontium (Sr)	0.109	0.214	0.168	0.420	0.417	0.085	0.40
Thallium (Tl)	0.000005	0.000027	0.000026	0.000046	0.000041	0.000013	0.50
Tin (Sn)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00000	0.00
Uranium (U)	0.000005	0.000021	0.000024	0.000034	0.000033	0.000009	0.43
Vanadium (V)	0.0005	0.0013	0.0005	0.0051	0.0051	0.0015	1.16
Zinc (Zn)	0.002	0.003	0.002	0.007	0.007	0.002	0.72

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-50. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Operation Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0048	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.49	0.25	0.02	0.07
Fluoride (F)	0.02	0.02	0.03	0.03	0.03	0.01	0.23
Nitrate (as N)	0.01	0.12	0.14	0.29	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0020	0.0005	0.0130	0.0084	0.0031	1.56
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	0.88
Sulphate (SO_4)	11	22	24	27	27	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00052	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.04	*1.09*	*1.09*	0.30	1.43
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.011	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.00003	0.15
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	0.000019	0.000019	0.000004	0.48
Calcium (Ca)	8.87	17.62	18.06	26.71	26.70	4.73	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00071	0.00071	0.00019	1.10
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.60
Iron (Fe)	0.01	0.24	0.07	**1.24**	**1.24**	0.34	1.42
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.84
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0004	0.17
Magnesium (Mg)	2.34	4.15	4.59	5.43	5.43	0.99	0.24
Manganese (Mn)	0.00003	0.00697	0.00161	0.03625	0.03608	0.01035	1.48
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.06
Molybdenum (Mo)	0.000	0.000	0.000	0.000	0.000	0.0001	0.18
Nickel (Ni)	0.0003	0.0011	0.0006	0.0042	0.0042	0.0011	0.96
Potassium (K)	0.18	0.25	0.25	0.33	0.33	0.04	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.68	2.26	2.23	3.23	3.23	0.34	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.7	1.7	0.3	0.24
Strontium (Sr)	0.076	0.142	0.151	0.180	0.180	0.032	0.22
Thallium (Tl)	0.000025	0.000041	0.000039	0.000050	0.000050	0.000008	0.18
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.23
Uranium (U)	0.000006	0.00001	0.00001	0.00002	0.00002	0.000004	0.30
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0006	0.73
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.45

(continued)

Table 14.7-50. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Operation Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0048	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.49	0.25	0.02	0.07
Fluoride (F)	0.02	0.02	0.03	0.03	0.03	0.01	0.23
Nitrate (as N)	0.01	0.12	0.14	0.29	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0020	0.0005	0.0130	0.0084	0.0031	1.56
Total Phosphate (as P)	0.003	0.01	0.00	0.03	0.03	0.01	0.88
Sulphate (SO_4)	11	22	24	27	27	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00052	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.04	*1.09*	*1.09*	0.30	1.43
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.011	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.00003	0.15
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	0.000019	0.000019	0.000004	0.48
Calcium (Ca)	8.87	17.62	18.06	26.71	26.70	4.73	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00071	0.00071	0.00019	1.10
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.60
Iron (Fe)	0.01	0.24	0.07	**1.24**	**1.24**	0.34	1.42
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.84
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0004	0.17
Magnesium (Mg)	2.34	4.15	4.59	5.43	5.43	0.99	0.24
Manganese (Mn)	0.00003	0.00697	0.00161	0.03626	0.03608	0.01035	1.48
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.06
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.0001	0.18
Nickel (Ni)	0.0003	0.0011	0.0006	0.0042	0.0042	0.0011	0.96
Potassium (K)	0.18	0.25	0.25	0.33	0.33	0.04	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.68	2.26	2.23	3.23	3.23	0.34	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.7	1.7	0.3	0.24
Strontium (Sr)	0.076	0.142	0.151	0.180	0.180	0.032	0.22
Thallium (Tl)	0.000025	0.000041	0.000039	0.000050	0.000050	0.000008	0.18
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.23
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.30
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0006	0.73
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.45

(continued)

Table 14.7-50. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Operation Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0048	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.49	0.25	0.02	0.07
Fluoride (F)	0.02	0.02	0.03	0.03	0.03	0.01	0.23
Nitrate (as N)	0.01	0.12	0.14	0.29	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0020	0.0005	0.0141	0.0084	0.0031	1.57
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	0.88
Sulphate (SO_4)	11	22	24	27	27	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00052	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.04	*1.09*	*1.09*	0.30	1.43
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.011	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.00003	0.15
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	0.000019	0.000019	0.000004	0.48
Calcium (Ca)	8.87	17.63	18.06	26.71	26.70	4.73	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00071	0.00071	0.00019	1.10
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.60
Iron (Fe)	0.01	0.24	0.07	**1.24**	**1.24**	0.34	1.42
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.84
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0004	0.17
Magnesium (Mg)	2.34	4.15	4.59	5.43	5.43	0.99	0.24
Manganese (Mn)	0.00003	0.00697	0.00161	0.03635	0.03608	0.01035	1.48
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.06
Molybdenum (Mo)	0.000	0.000	0.000	0.000	0.000	0.00005	0.18
Nickel (Ni)	0.0003	0.0011	0.0006	0.0042	0.0042	0.0011	0.96
Potassium (K)	0.18	0.25	0.25	0.33	0.33	0.04	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.68	2.26	2.23	3.23	3.23	0.34	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.7	1.7	0.3	0.24
Strontium (Sr)	0.076	0.142	0.151	0.180	0.180	0.032	0.22
Thallium (Tl)	0.000025	0.000041	0.000039	0.000050	0.000050	0.000008	0.18
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.23
Uranium (U)	0.000006	0.00001	0.00001	0.00002	0.00002	0.000004	0.30
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0006	0.73
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.45

(continued)

Table 14.7-50. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Operation Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0048	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.49	0.25	0.02	0.07
Fluoride (F)	0.02	0.02	0.03	0.03	0.03	0.01	0.23
Nitrate (as N)	0.01	0.12	0.14	0.29	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0020	0.0005	0.0141	0.0084	0.0031	1.57
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	0.88
Sulphate (SO_4)	11	22	24	27	27	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00052	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.04	*1.09*	*1.09*	0.30	1.43
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.011	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0001	0.0002	0.0002	0.0003	0.0003	0.00003	0.15
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	0.000019	0.000019	0.000004	0.48
Calcium (Ca)	8.87	17.63	18.06	26.71	26.70	4.73	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00071	0.00071	0.00019	1.10
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.60
Iron (Fe)	0.01	0.24	0.07	**1.24**	**1.24**	0.34	1.42
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.84
Lithium (Li)	0.001	0.002	0.002	0.003	0.003	0.0004	0.17
Magnesium (Mg)	2.34	4.15	4.59	5.43	5.43	0.99	0.24
Manganese (Mn)	0.00003	0.00697	0.00161	0.03635	0.03608	0.01035	1.48
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.06
Molybdenum (Mo)	0.000	0.000	0.000	0.000	0.000	0.00005	0.18
Nickel (Ni)	0.0003	0.0011	0.0006	0.0042	0.0042	0.0011	0.96
Potassium (K)	0.18	0.25	0.25	0.33	0.33	0.04	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.68	2.26	2.23	3.23	3.23	0.34	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.7	1.7	0.3	0.24
Strontium (Sr)	0.076	0.142	0.151	0.180	0.180	0.032	0.22
Thallium (Tl)	0.000025	0.000041	0.000039	0.000050	0.000050	0.000008	0.18
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00010	0.00001	0.23
Uranium (U)	0.000006	0.00001	0.00001	0.00002	0.00002	0.000004	0.30
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0006	0.73
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.45

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-51. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0040	0.0040	0.0004	0.16
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.02	0.02	0.03	0.03	0.01	0.23
Nitrate (as N)	0.01	0.12	0.13	0.28	0.28	0.08	0.66
Nitrite (as N)	0.0005	0.0023	0.0009	0.0114	0.0085	0.0026	1.13
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	0.85
Sulphate (SO_4)	12	21	24	26	26	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.20*	0.06	*1.04*	*1.04*	0.29	1.42
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.58
Barium (Ba)	0.012	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0004	0.09
Cadmium (Cd)	0.000005	0.000008	0.000006	0.000019	0.000019	0.000004	0.47
Calcium (Ca)	9.21	17.27	17.55	25.81	25.80	4.59	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0036**	**0.0036**	0.0010	1.10
Cobalt (Co)	0.00005	0.00017	0.00006	0.00068	0.00068	0.00019	1.08
Copper (Cu)	0.0004	0.0008	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.27	0.10	**1.23**	**1.23**	0.33	1.22
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.82
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.000	0.16
Magnesium (Mg)	2.41	4.05	4.27	5.25	5.25	0.95	0.23
Manganese (Mn)	0.00090	0.00812	0.00310	0.03625	0.03614	0.01007	1.24
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.000000	0.06
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.18
Nickel (Ni)	0.0003	0.0011	0.0006	0.0040	0.0040	0.0010	0.94
Potassium (K)	0.18	0.24	0.24	0.32	0.32	0.03	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.73	2.22	2.21	3.14	3.14	0.32	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000010	0.000010	0.000002	0.30
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.3	0.22
Strontium (Sr)	0.080	0.140	0.150	0.175	0.175	0.031	0.22
Thallium (Tl)	0.000027	0.000041	0.000039	0.000049	0.000049	0.000007	0.18
Tin (Sn)	0.00005	0.00005	0.00005	0.00009	0.00009	0.00001	0.22
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.29
Vanadium (V)	0.0005	0.0009	0.0005	0.0026	0.0026	0.0006	0.72
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.44

(continued)

Table 14.7-51. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0040	0.0040	0.0004	0.16
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.02	0.02	0.03	0.03	0.01	0.23
Nitrate (as N)	0.01	0.12	0.13	0.28	0.28	0.08	0.66
Nitrite (as N)	0.0005	0.0023	0.0009	0.0114	0.0085	0.0026	1.13
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	0.85
Sulphate (SO_4)	12	21	24	26	26	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.20*	0.06	*1.04*	*1.04*	0.29	1.42
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.58
Barium (Ba)	0.012	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0004	0.09
Cadmium (Cd)	0.000005	0.000008	0.000006	0.000019	0.000019	0.000004	0.47
Calcium (Ca)	9.21	17.27	17.55	25.81	25.80	4.59	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0036**	**0.0036**	0.0010	1.10
Cobalt (Co)	0.00005	0.00017	0.00006	0.00068	0.00068	0.00019	1.08
Copper (Cu)	0.0004	0.0008	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.27	0.10	**1.23**	**1.23**	0.33	1.22
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.81
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.000	0.16
Magnesium (Mg)	2.41	4.05	4.27	5.25	5.25	0.95	0.23
Manganese (Mn)	0.00091	0.00813	0.00311	0.03626	0.03615	0.01007	1.24
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.000000	0.06
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.18
Nickel (Ni)	0.0003	0.0011	0.0006	0.0040	0.0040	0.0010	0.94
Potassium (K)	0.18	0.24	0.24	0.32	0.32	0.03	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.73	2.22	2.21	3.14	3.14	0.32	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000010	0.000010	0.000002	0.30
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.3	0.22
Strontium (Sr)	0.080	0.140	0.150	0.175	0.175	0.031	0.22
Thallium (Tl)	0.000027	0.000041	0.000039	0.000049	0.000049	0.000007	0.18
Tin (Sn)	0.00005	0.00005	0.00005	0.00009	0.00009	0.00001	0.22
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.29
Vanadium (V)	0.0005	0.0009	0.0005	0.0026	0.0026	0.0006	0.72
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.44

(continued)

Table 14.7-51. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0040	0.0040	0.0004	0.16
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.02	0.02	0.03	0.03	0.005	0.23
Nitrate (as N)	0.02	0.12	0.13	0.28	0.28	0.08	0.66
Nitrite (as N)	0.0006	0.0029	0.0014	0.0125	0.0090	0.0028	0.98
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	0.84
Sulphate (SO_4)	12	21	24	26	26	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.20*	0.06	*1.05*	*1.05*	0.29	1.42
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.58
Barium (Ba)	0.012	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0004	0.09
Cadmium (Cd)	0.000005	0.000008	0.000006	0.000019	0.000019	0.000004	0.47
Calcium (Ca)	9.23	17.28	17.57	25.81	25.81	4.59	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0036**	**0.0036**	0.0010	1.10
Cobalt (Co)	0.00005	0.00017	0.00006	0.00068	0.00068	0.00019	1.08
Copper (Cu)	0.0004	0.0008	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.27	0.10	**1.23**	**1.23**	0.33	1.21
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.81
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.0003	0.16
Magnesium (Mg)	2.42	4.05	4.27	5.25	5.25	0.95	0.23
Manganese (Mn)	0.00089	0.00813	0.00311	0.03631	0.03622	0.01009	1.24
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.06
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.18
Nickel (Ni)	0.0003	0.0011	0.0006	0.0040	0.0040	0.0010	0.94
Potassium (K)	0.18	0.24	0.24	0.32	0.32	0.03	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.73	2.22	2.21	3.14	3.14	0.32	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000010	0.000010	0.000002	0.30
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.3	0.22
Strontium (Sr)	0.080	0.140	0.150	0.175	0.175	0.031	0.22
Thallium (Tl)	0.000027	0.000041	0.000039	0.000049	0.000049	0.000007	0.18
Tin (Sn)	0.00005	0.00005	0.00005	0.00009	0.00009	0.00001	0.23
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.29
Vanadium (V)	0.0005	0.0009	0.0005	0.0026	0.0026	0.0006	0.72
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.44

(continued)

Table 14.7-51. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2;Closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0040	0.0040	0.0004	0.16
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.02	0.02	0.03	0.03	0.005	0.23
Nitrate (as N)	0.02	0.12	0.13	0.28	0.28	0.08	0.66
Nitrite (as N)	0.0006	0.0029	0.0014	0.0125	0.0090	0.0028	0.98
Total Phosphate (as P)	0.00	0.01	0.00	0.03	0.03	0.01	0.84
Sulphate (SO_4)	12	21	24	26	26	5	0.24
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.20*	0.06	*1.05*	*1.05*	0.29	1.42
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.58
Barium (Ba)	0.012	0.016	0.016	0.021	0.021	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0004	0.09
Cadmium (Cd)	0.000005	0.000008	0.000006	0.000019	0.000019	0.000004	0.47
Calcium (Ca)	9.23	17.28	17.57	25.81	25.81	4.59	0.27
Chromium (Cr)	0.0002	0.0009	0.0003	**0.0036**	**0.0036**	0.0010	1.10
Cobalt (Co)	0.00005	0.00017	0.00006	0.00068	0.00068	0.00019	1.08
Copper (Cu)	0.0004	0.0008	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.27	0.10	**1.23**	**1.23**	0.33	1.21
Lead (Pb)	0.00003	0.00008	0.00006	0.00028	0.00028	0.00007	0.81
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.0003	0.16
Magnesium (Mg)	2.42	4.05	4.27	5.25	5.25	0.95	0.23
Manganese (Mn)	0.00090	0.00814	0.00312	0.03632	0.03623	0.01009	1.24
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.06
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.17
Nickel (Ni)	0.0003	0.0011	0.0006	0.0040	0.0040	0.0010	0.94
Potassium (K)	0.18	0.24	0.24	0.32	0.32	0.03	0.14
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.18
Silicon (Si)	1.73	2.22	2.21	3.14	3.14	0.32	0.15
Silver (Ag)	0.000005	0.000006	0.000005	0.000010	0.000010	0.000002	0.30
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.3	0.22
Strontium (Sr)	0.080	0.140	0.150	0.176	0.175	0.031	0.22
Thallium (Tl)	0.000027	0.000041	0.000039	0.000049	0.000049	0.000007	0.18
Tin (Sn)	0.00005	0.00005	0.00005	0.00009	0.00009	0.00001	0.23
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.29
Vanadium (V)	0.0005	0.0009	0.0005	0.0026	0.0026	0.0006	0.72
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.44

Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.

Table 14.7-52. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Post-closure Phase)

Scenario 1: Expected Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0042	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.03	0.02	0.03	0.03	0.01	0.22
Nitrate (as N)	0.01	0.13	0.12	0.30	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0012	0.0005	0.0085	0.0085	0.0022	1.89
Total Phosphate (as P)	0.003	0.010	0.005	0.032	0.032	0.008	0.81
Sulphate (SO_4)	12	24	26	30	29	6	0.23
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.07	*1.10*	*1.10*	0.30	1.41
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.012	0.016	0.016	0.022	0.022	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	**0.000020**	0.000019	0.000004	0.48
Calcium (Ca)	9.20	16.94	17.01	25.81	24.91	4.31	0.25
Chromium (Cr)	0.0002	0.0009	0.0004	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00072	0.00072	0.00020	1.09
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.34	0.16	**1.37**	**1.36**	0.35	1.01
Lead (Pb)	0.00003	0.00009	0.00006	0.00030	0.00029	0.00007	0.80
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.0003	0.17
Magnesium (Mg)	2.41	4.00	3.88	5.25	5.07	0.90	0.22
Manganese (Mn)	0.0009	0.0114	0.0066	0.0405	0.0401	0.0101	0.88
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.05
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.18
Nickel (Ni)	0.0003	0.0012	0.0006	0.0042	0.0042	0.0011	0.94
Potassium (K)	0.18	0.24	0.24	0.33	0.33	0.04	0.15
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.16
Silicon (Si)	1.70	2.20	2.18	3.21	3.21	0.35	0.16
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.2	0.21
Strontium (Sr)	0.079	0.135	0.144	0.175	0.169	0.027	0.20
Thallium (Tl)	0.000024	0.000041	0.000041	0.000049	0.000048	0.000007	0.17
Tin (Sn)	0.00005	0.00006	0.00005	0.00009	0.00009	0.00001	0.23
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.29
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0007	0.74
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.46

(continued)

Table 14.7-52. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Post-closure Phase) (continued)

Scenario 2							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0042	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.03	0.02	0.03	0.03	0.01	0.22
Nitrate (as N)	0.01	0.13	0.12	0.30	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0012	0.0005	0.0085	0.0085	0.0022	1.89
Total Phosphate (as P)	0.003	0.010	0.005	0.032	0.032	0.008	0.81
Sulphate (SO_4)	12	24	26	30	30	6	0.23
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.07	*1.10*	*1.10*	0.30	1.41
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.012	0.016	0.016	0.022	0.022	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	0.000020	0.000019	0.000004	0.48
Calcium (Ca)	9.20	16.94	17.02	25.81	24.91	4.31	0.25
Chromium (Cr)	0.0002	0.0009	0.0004	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00072	0.00072	0.00020	1.09
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.34	0.16	**1.37**	**1.36**	0.35	1.01
Lead (Pb)	0.00003	0.00009	0.00006	0.00030	0.00029	0.00007	0.80
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.0003	0.17
Magnesium (Mg)	2.41	4.00	3.88	5.25	5.07	0.90	0.22
Manganese (Mn)	0.0009	0.0114	0.0066	0.0405	0.0401	0.0101	0.88
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.05
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.17
Nickel (Ni)	0.0003	0.0012	0.0006	0.0042	0.0042	0.0011	0.94
Potassium (K)	0.18	0.24	0.24	0.33	0.33	0.04	0.15
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.16
Silicon (Si)	1.70	2.20	2.18	3.21	3.21	0.35	0.16
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.2	0.21
Strontium (Sr)	0.079	0.135	0.144	0.175	0.169	0.027	0.20
Thallium (Tl)	0.000024	0.000041	0.000041	0.000049	0.000048	0.000007	0.17
Tin (Sn)	0.00005	0.00006	0.00005	0.00009	0.00009	0.00001	0.23
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.28
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0007	0.74
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.46

(continued)

Table 14.7-52. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Post-closure Phase) (continued)

Scenario 3							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0043	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.03	0.02	0.03	0.03	0.01	0.22
Nitrate (as N)	0.01	0.13	0.12	0.30	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0012	0.0005	0.0085	0.0085	0.0022	1.89
Total Phosphate (as P)	0.003	0.010	0.005	0.032	0.032	0.008	0.81
Sulphate (SO_4)	12	24	26	30	29	6	0.23
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.07	*1.11*	*1.10*	0.30	1.41
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.012	0.016	0.016	0.022	0.022	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	**0.000020**	0.000019	0.000004	0.48
Calcium (Ca)	9.12	16.94	17.01	25.81	24.91	4.31	0.25
Chromium (Cr)	0.0002	0.0009	0.0004	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00072	0.00072	0.00020	1.09
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.34	0.16	**1.37**	**1.37**	0.35	1.01
Lead (Pb)	0.00003	0.00009	0.00007	0.00030	0.00029	0.00007	0.80
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.0003	0.17
Magnesium (Mg)	2.41	4.00	3.88	5.25	5.07	0.90	0.22
Manganese (Mn)	0.0009	0.0114	0.0066	0.0410	0.0401	0.0101	0.88
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.05
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.18
Nickel (Ni)	0.0003	0.0012	0.0006	0.0043	0.0042	0.0011	0.94
Potassium (K)	0.18	0.24	0.24	0.33	0.33	0.04	0.15
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.16
Silicon (Si)	1.70	2.20	2.18	3.22	3.21	0.35	0.16
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.2	0.21
Strontium (Sr)	0.078	0.135	0.144	0.175	0.169	0.027	0.20
Thallium (Tl)	0.000024	0.000041	0.000041	0.000049	0.000048	0.000007	0.17
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00009	0.00001	0.23
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.29
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0007	0.74
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.46

(continued)

Table 14.7-52. Summary Statistics of Water Quality Predictions for Teigen Creek (site TEC2; Post-closure Phase) (completed)

Scenario 4: Upper Case							
Parameter	**Minimum**	**Mean**	**Median**	**Maximum**	**95th Percentile**	**Standard Deviation**	**Coefficient of Variation**
Anions and Nutrients							
Ammonia (as N)	0.0025	0.0027	0.0025	0.0043	0.0042	0.0005	0.18
Chloride (Cl)	0.25	0.25	0.25	0.25	0.25	0.00	0.00
Fluoride (F)	0.02	0.03	0.02	0.03	0.03	0.01	0.22
Nitrate (as N)	0.01	0.13	0.12	0.30	0.29	0.08	0.66
Nitrite (as N)	0.0005	0.0012	0.0005	0.0085	0.0085	0.0022	1.89
Total Phosphate (as P)	0.003	0.010	0.005	0.032	0.032	0.008	0.81
Sulphate (SO_4)	12	24	26	30	29	6	0.23
Cyanide-WAD	0.00050	0.00050	0.00050	0.00050	0.00050	0.00000	0.00
Total Metals							
Aluminum (Al)	0.01	*0.21*	0.07	*1.11*	*1.10*	0.30	1.41
Antimony (Sb)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.09
Arsenic (As)	0.0001	0.0001	0.0001	0.0004	0.0004	0.0001	0.59
Barium (Ba)	0.012	0.016	0.016	0.022	0.022	0.002	0.13
Beryllium (Be)	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003	0.14
Boron (B)	0.005	0.005	0.005	0.007	0.007	0.0005	0.09
Cadmium (Cd)	0.000005	0.000009	0.000006	**0.000020**	0.000019	0.000004	0.48
Calcium (Ca)	9.12	16.94	17.01	25.81	24.91	4.31	0.25
Chromium (Cr)	0.0002	0.0009	0.0004	**0.0038**	**0.0038**	0.0010	1.11
Cobalt (Co)	0.00005	0.00018	0.00006	0.00072	0.00072	0.00020	1.09
Copper (Cu)	0.0004	0.0009	0.0006	0.0022	0.0022	0.0005	0.59
Iron (Fe)	0.05	0.34	0.16	**1.37**	**1.37**	0.35	1.01
Lead (Pb)	0.00003	0.00009	0.00007	0.00030	0.00029	0.00007	0.80
Lithium (Li)	0.001	0.002	0.002	0.002	0.002	0.0003	0.17
Magnesium (Mg)	2.41	4.00	3.88	5.25	5.07	0.90	0.22
Manganese (Mn)	0.0009	0.0114	0.0066	0.0410	0.0401	0.0101	0.88
Mercury (Hg)	0.000005	0.000005	0.000005	0.000006	0.000006	0.0000003	0.05
Molybdenum (Mo)	0.0002	0.0003	0.0003	0.0003	0.0003	0.00005	0.17
Nickel (Ni)	0.0003	0.0012	0.0006	0.0043	0.0042	0.0011	0.94
Potassium (K)	0.18	0.24	0.24	0.33	0.33	0.04	0.15
Selenium (Se)	0.0002	0.0004	0.0004	0.0005	0.0005	0.0001	0.16
Silicon (Si)	1.70	2.20	2.18	3.22	3.21	0.35	0.16
Silver (Ag)	0.000005	0.000006	0.000005	0.000011	0.000011	0.000002	0.31
Sodium (Na)	1.0	1.2	1.0	1.6	1.6	0.2	0.21
Strontium (Sr)	0.078	0.135	0.144	0.175	0.169	0.027	0.20
Thallium (Tl)	0.000024	0.000041	0.000041	0.000049	0.000048	0.000007	0.17
Tin (Sn)	0.00005	0.00006	0.00005	0.00010	0.00009	0.00001	0.23
Uranium (U)	0.00001	0.00001	0.00001	0.00002	0.00002	0.000004	0.28
Vanadium (V)	0.0005	0.0009	0.0005	0.0027	0.0027	0.0007	0.74
Zinc (Zn)	0.002	0.002	0.002	0.004	0.004	0.001	0.46

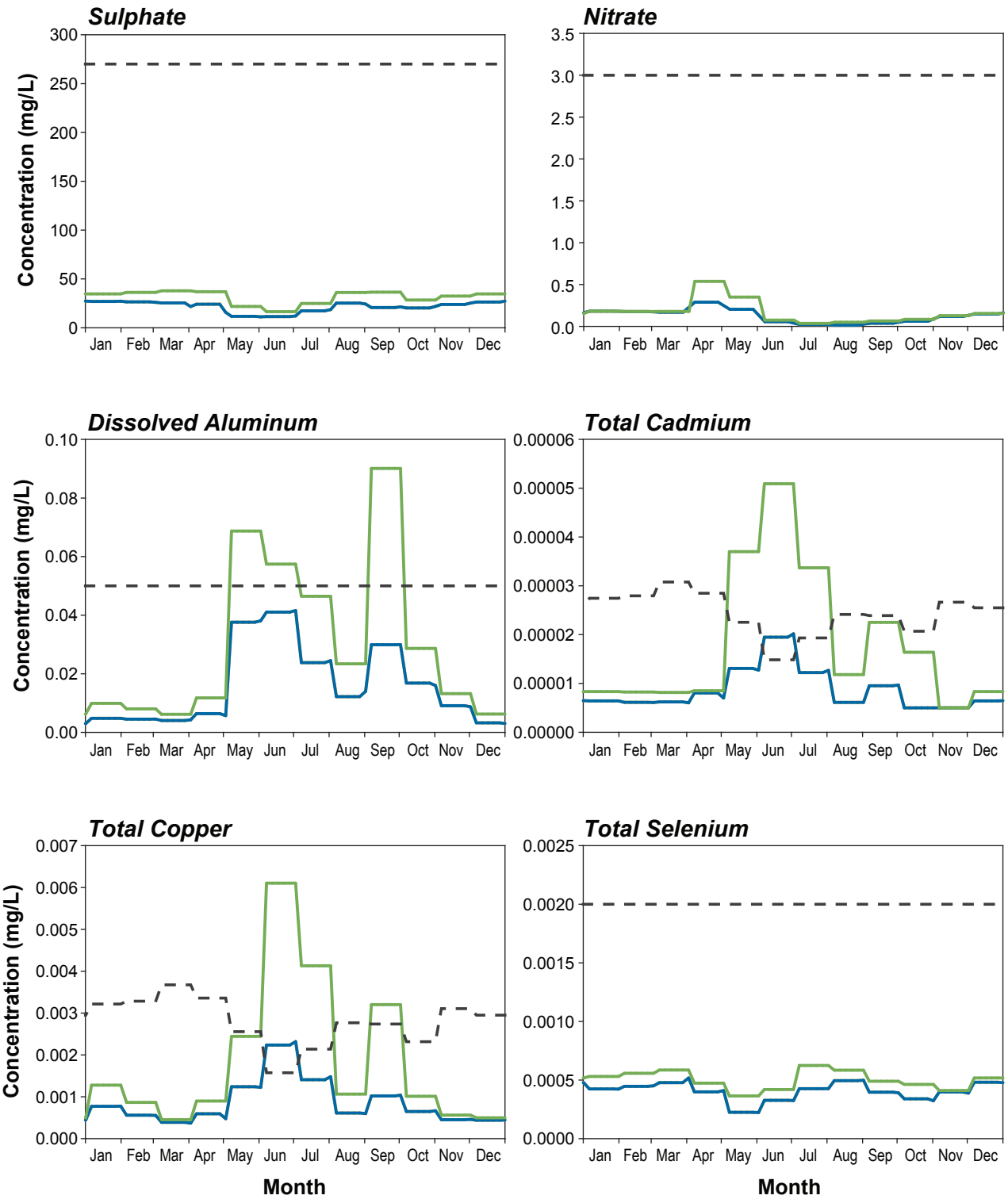
Notes:

All measured values are in units of mg/L.

Grey highlighted values exceed BC chronic water quality guidelines; bold values exceed BC acute water quality guidelines.

For pH-dependent guidelines, pH was assumed to be > 6.5.

For total aluminum, italic values exceed CCME pH-dependent water quality guidelines.



Note: All predicted concentrations in the expected and upper cases are equivalent.

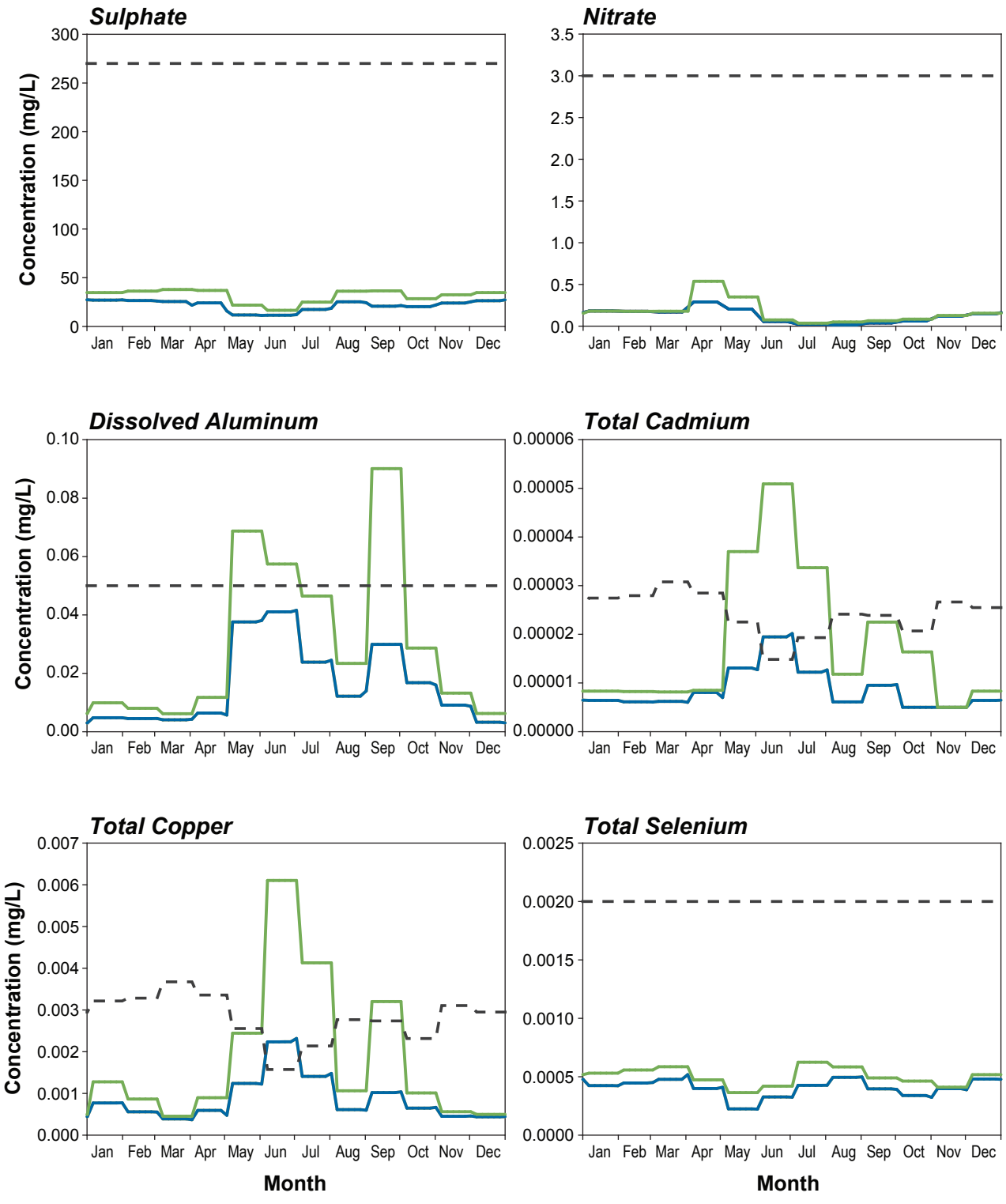
- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Teigen Creek - Site TEC2 (Year 5)

Figure 14.7-43

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

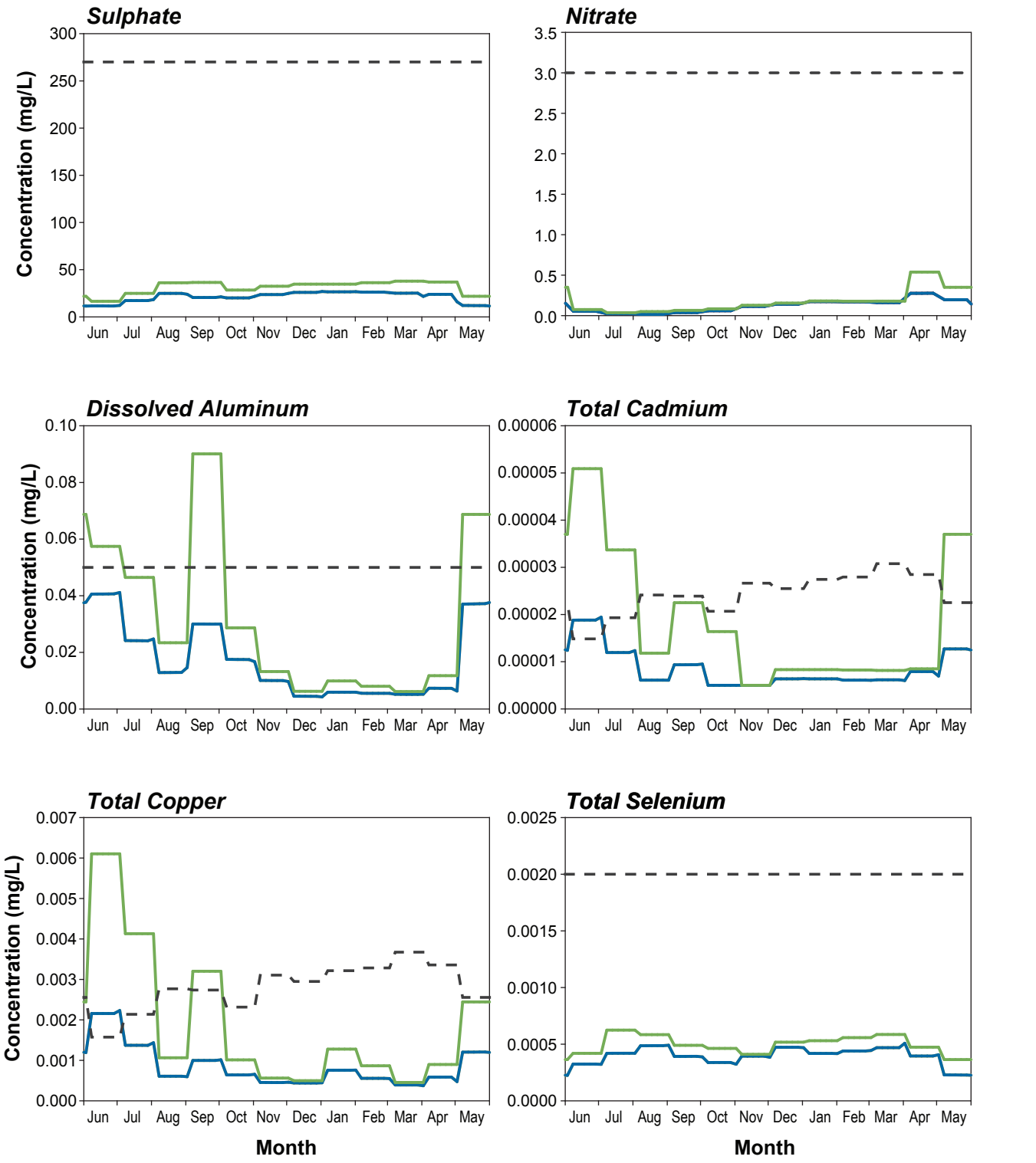
- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Teigen Creek - Site TEC2 (Year 25)

Figure 14.7-44

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

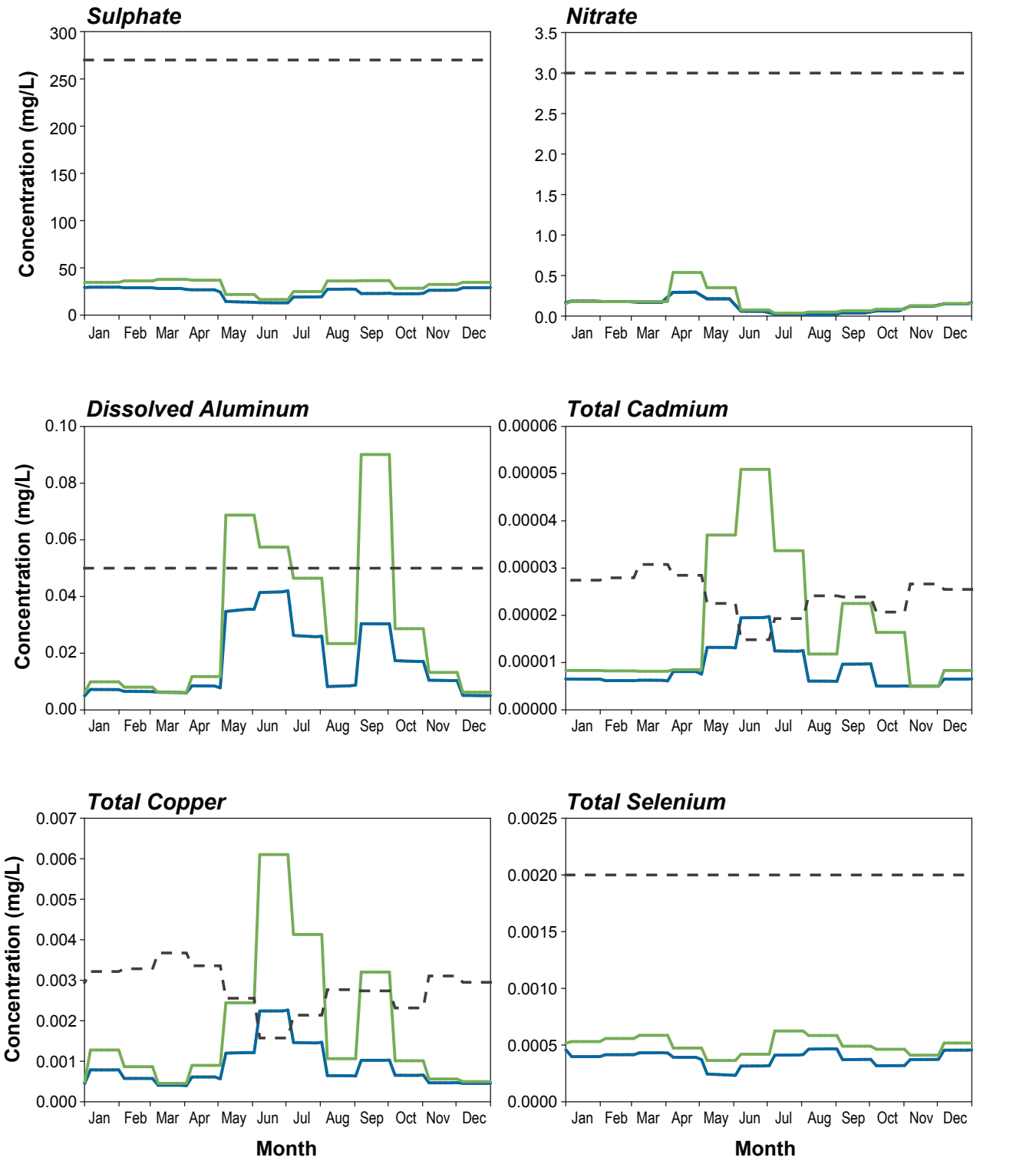
- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Teigen Creek - Site TEC2 (Year 51.5)

Figure 14.7-45

Rescan™ Engineers & Scientists



Note: All predicted concentrations in the expected and upper cases are equivalent.

- Predicted Concentration - Expected Case
- Predicted Concentration - Upper Case
- Baseline Concentration (mean 2007 to 2012)
- BC Water Quality Guideline for the Protection of Freshwater Aquatic Life

SEABRIDGE GOLD
KSM PROJECT

Water Quality Predictions for the Base Case Water Balance: Teigen Creek - Site TEC2 (Year 65)

Figure 14.7-46

Rescan™ Engineers & Scientists

Bell-Irving River

The spatial boundary of the water quality model did not extend to the Bell-Irving River. Water quality in both Teigen and Treaty creeks, however, meets water quality guidelines and for most parameters is within the natural range of variability (i.e., less than the 95th percentile of baseline conditions) 5 to 10 km upstream of the Bell-Irving River. These results indicate that there will be no residual effect on surface water quality in the Bell-Irving River.

14.8 Significance of Residual Effects for Surface Water Quality

Potential residual effects of the Project on surface water quality were identified in Section 14.7. The significance was determined for residual effects of the Project on surface water quality from the following Project components and activities:

- drainage from the Coulter Creek and Treaty Creek access corridors;
- sedimentation and erosion from the Mine Site and the PTMA;
- effluent discharge from the Mine Site WTP;
- effluent discharge from the North Cell TMF; and
- effluent discharge from the South Cell TMF.

Residual effects on surface water quality for watercourses near the access corridors, Sulphurets Creek, Unuk River, and Treaty and Teigen watersheds are described in the following sections.

14.8.1 Residual Effect Descriptors for Surface Water Quality

The following section (14.8.2) assesses the significance of predicted Project-related adverse effects on surface water quality. The assessment considered the results of surface water quality, fish and fish habitat, and aquatic life baseline studies, the results of predictive water quality modelling, relevant legislation and standards, scientific literature, and professional experience/judgement. The criteria and definitions used to assess significance of the residual effects are presented in Table 14.8-1.

The magnitude of the effect is determined through comparison of expected case predicted water quality to baseline conditions (at a monthly scale) and BC 30-day mean water quality guidelines for the protection of freshwater aquatic life. Where baseline conditions in the receiving environment were observed to exceed the BC water quality guidelines, the 95th percentile of baseline data was used as the threshold value based on consultation with BC MOE. The upper limit to the range of natural variation was defined as the 95th percentile of baseline data.

The geographic extent of the effect is defined by the receiving environment. The local extent is confined to the Project footprint, the landscape extent includes Sulphurets Creek (Mine Site) and Teigen and Treaty creeks (PTMA), while the regional extent includes the Unuk River (Mine Site) and the Bell-Irving River (PTMA).

The definitions of duration and frequency are based on the length of Project phases and occurrence of the effect.

The reversibility of the effect is based on the source of the effect. Reversible effects are resolvable upon removal of a point source, while irreversible effects are predicted to remain indefinitely upon removal of the point source.

The context of the effects is dependent on the aquatic habitat value for a specific geographic area. For example, Sulphurets Creek has low aquatic habitat and fisheries value, while the Unuk and Bell-Irving rivers and Treaty and Teigen creeks have higher aquatic habitat and fisheries value.

14.8.2 Residual Effects Assessment for Surface Water Quality

The residual effects assessment for surface water quality near access corridors, in Sulphurets Creek, in the Unuk River, and in Treaty and Teigen watersheds is presented in the following sections and summarized in Table 14.8-2.

14.8.2.1 Degradation of Surface Water Quality due to Sedimentation and Erosion

While sediment and erosion control mitigation measures will be implemented (see Section 14.7.2.3), sedimentation of streams near the Project during the construction and operation phases is likely to occur at some point (Henley et al. 2000).

The magnitude of the effects is high because the increased total suspended solids as a result of sedimentation is likely to be greater than water quality guidelines and above the range of natural variation. The extent of the residual sedimentation effect will be landscape as increased TSS is likely to reach both the near- and mid-field receiving environment. Sedimentation events will be of medium duration and will occur sporadically during all Project phases. Implementation of the sediment control measures outlined in Section 14.7.2.3 will reverse the effect of sedimentation on surface water quality. The context is high because of potential effects to valued fish and fish habitat. The probability that the effect will occur is high and the confidence in the effects assessment is high.

Considering the above description, the effect of sedimentation and erosion on surface water quality was assessed as **not significant (minor).**

14.8.2.2 Degradation of Surface Water Quality near Access Corridors

ML/ARD mitigation, explosives management, and sediment and erosion control as described in Chapter 26 and in Section 14.7.2 will prevent significant degradation of surface water quality near access corridors. It is likely, however, that some water quality degradation in watercourses near the access corridors will occur at some point during the life of the Project given the potential for ML/ARD and sedimentation and erosion (Huckabee, Goodyear, and Jones 1975; Forman and Alexander 1998; Henley et al. 2000). Water quality responses to road run-off include increased concentrations of metals and salinity, but tend to be temporary and localized (Forman and Alexander 1998).

Table 14.8-1. Definitions of Significance Criteria for Surface Water Quality Residual Effects

Timing *What phase of the Project is the effect associated with?*	**Magnitude** *(negligible, low, medium, high)*	**Geographic Extent** *(local, landscape, regional, beyond regional)*	**Duration** *(short-term, medium-term, long-term, far future)*	**Frequency** *(once, sporadic, regular, continuous)*	**Reversibility** *(reversible short-term, reversible long-term, or irreversible)*	**Context** *(ecological resilience and/or unique attributes) (low, neutral, high)*	**Probability** *(low, medium, high)*	**Confidence** *(low, medium, high)*	**Significance** *(Not Significant: minor, moderate; Significant: major)*	**Follow-up Monitoring** *(Not required, required)*
Construction	**Negligible.** There is no detectable change from baseline conditions.	**Local.** The effect is limited to the project footprint.	**Short term**. The effect lasts approximately 1 year or less.	**Once.** The effect occurs once during any phase of the project.	**Reversible short-term:** An effect that can be reversed relatively quickly.	**Low**. The valued component for a specific geograpahic area is considered to have little to no unique attributes and/or there is high resilience to imposed stresses.	**Low.** An effect is unlikely but could occur.	**Low** (< 50% confidence). The cause-effect relationship between the project and its interaction with the environment is poorly understood; data for the project area may be incomplete; uncertainty associated with synergistic and/or additive interactions between environmental effects may exist. High degree of uncertainty.	**Not Significant (minor).** Residual effects have no or low magnitude, local geographical extent, short or medium-term duration, and occur intermittently, if at all. There is a high level of confidence in the conclusions. The effects on the VC (at a population or species level) are indistinguishable from background conditions (i.e., occur within the range of natural variation as influenced by physical, chemical, and biological processes). Land use management objectives will be met. Follow-up monitoring is optional.	**Not Required**
Operations	**Low.** The magnitude of effect is within the range of natural variation and/or is well below a guideline or threshold value.	**Landscape.** An effect extends beyond the project footprint to the near- or mid-field receiving environment.	**Medium term.** The effect lasts from 1 to 11 years.	**Sporadic.** The effect occurs at intermittent intervals during any phase of the project.	**Reversible long-term:** An effect that can be reversed after many years.	**Neutral.** The valued component for a specific geograpahic area is considered to have some unique attributes, and/or there is neutral (moderate) resilience to imposed stresses.	**Medium.** An effect is likely but may not occur.	**Medium. (**50 – 80% confidence): The cause-effect relationship between the project and its interaction with the environment is not fully understood, or data for the project area is incomplete: moderate degree of uncertainty.	**Not Significant (moderate).** Residual effects have medium magnitude, local, landscape or regional geographic extent, are short-term to chronic (i.e., may persist into the far future), and occur at all frequencies. Residual effects on VCs are distinguishable at the population, community, and/or ecosystem level. Ability of meeting land use management objectives may be impaired. Confidence in the conclusions is medium or low. The probability of the effect occurring is low or medium. Follow-up monitoring of these effects may be required.	**Required**
Closure	**Medium.** The magnitude of effect approaches the limits of natural variation and/or is below or equal to a guideline or threshold value.	**Regional.** The effect extends across the Regional Study Area.	**Long term.** The effect lasts between 12 and 70 years.	**Regular.** The effect occurs on a periodic basis during any phase of the project.	**Irreversible.** The effect cannot be reversed.	**High.** The valued component for a specific geograpahic area is considered to be unique, and/or there is low resilience to imposed stresses.	**High**. An effect is highly likely to occur.	**High**. There is greater than 80% confidence in understanding the cause-effect relationship between the project and its interaction with the environment, and all necessary data is available for the project area. There is a low degree of uncertainty.	**Significant (Major).** Residual effects have high magnitude, regional or beyond regional geographic extent, are chronic (i.e., persist into the far future), and occur at all frequencies. Residual effects on VCs are consequential (i.e., structural and functional changes in populations, communities and ecosystems are predicted). Ability to meet land use management objectives is impaired. Probability of the effect occurring is medium or high. Confidence in the conclusions can be high, medium, or low. Follow-up monitoring is required.	
Post-closure	**High.** The magnitude of effect is predicted to differ from baseline conditions and exceed guideline or threshold values so that there will be a detectable change beyond the range of natural variation (i.e., change of state from baseline conditions).	**Beyond Regional**. The effect extends possibly across or beyond the province.	**Far Future. The** effect lasts more than 70 years.	**Continuous.** An effect occurs constantly during any phase of the Project.						

Table 14.8-2. Summary of Residual Effects on Surface Water Quality

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
Degradation of water quality due to sedimentation	All	Construction	High	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality due to sedimentation	All	Operations	High	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Construction	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Operations	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Closure	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Post-closure	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality in Sulphurets Creek (elevated selenium).	Mine Site	Operations	High	Landscape	Long	Continuous	Reversible long-term	Low	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Sulphurets Creek (elevated selenium).	Mine Site	Closure	High	Landscape	Medium	Continuous	Reversible long-term	Low	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Sulphurets Creek (elevated selenium).	Mine Site	Post-closure	High	Landscape	Far future	Continuous	Reversible long-term	Low	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR1; elevated selenium).	Mine Site	Operations	High	Landscape	Long	Continuous	Reversible long-term	Neutral	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR1; elevated selenium).	Mine Site	Closure	High	Landscape	Medium	Continuous	Reversible long-term	Neutral	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR1; elevated selenium).	Mine Site	Post-closure	High	Landscape	Far future	Continuous	Reversible long-term	Neutral	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR2; elevated selenium).	Mine Site	Operations	Medium	Regional	Long	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR2; elevated selenium).	Mine Site	Closure	Medium	Regional	Medium	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR2; elevated selenium).	Mine Site	Post-closure	Medium	Regional	Far future	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required

(continued)

Table 14.8-2. Summary of Residual Effects on Surface Water Quality (completed)

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	TMF	Operations	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	TMF	Closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	TMF	Post-closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	TMF	Operations	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	TMF	Closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	TMF	Post-closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Overall Residual Effect	All	Post-closure	Medium	Regional	Far future	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required

The magnitude of the effect is medium because changes are likely be detectable relative to baseline conditions, but are likely to be within the range of natural variation and/or be below water quality guidelines. The effect is described as landscape because it will be confined to the near-field receiving environment. Water quality changes due to road runoff will be of medium duration and will occur sporadically during all Project phases. Implementation of mitigation and adaptive management measures will reverse the effect of road runoff on surface water quality. The context of the effect is high because water quality near the access corridors has high aquatic life or fisheries values (Unuk River and Treaty Creek). The probability of the effect occurring is high, and the confidence in the effects assessment is high.

Considering the above description, the significance determination for the effect of degradation of water quality near access roads is assessed as **not significant (minor)**.

14.8.2.3 Degradation of Water Quality in Sulphurets Creek

Project design changes, ML/ARD mitigation, and water management as described in Chapter 26 and in Section 14.7.2 have minimized degradation of surface water quality in Sulphurets Creek. A Project-related effect on water quality due to increased selenium concentrations, however, is predicted in the operation, closure, and post-closure phases.

The magnitude of the effect is high because selenium concentrations are predicted to be higher than baseline conditions and to exceed a guideline or threshold value beyond the range of natural variation ("change of state from baseline conditions"). The effect is described as landscape because it will be confined to the near-field receiving environment. The duration of the effect is described as medium to far-future depending on the phase of the Project. Effects are predicted to extend into the far-future in post-closure. The frequency is continuous because concentrations increase over time and elevated concentrations are predicted in the operation, closure, and post-closure phases. The effect is reversible long-term because water quality will improve over time when the source is resolved or removed, but ML/ARD in the RSFs is predicted to occur into the far-future. The context of the effect is low because Sulphurets Creek has low aquatic life or fisheries values. Given the inherent uncertainty of modelling water quality into the far-future, the probability of the effect occurring is medium and the confidence in the effects assessment is medium.

Due to the description of the effect above, the significance determination for the effect of degradation of water quality in Sulphurets Creek is assessed as **not significant (moderate)**.

14.8.2.4 Degradation of Water Quality in Unuk River

Project design changes, ML/ARD mitigation and water management as described in Chapter 26 and in Section 14.7.2 have minimized degradation of surface water quality in the Unuk River. Selenium concentrations, however, are predicted to be greater than both the background concentrations and water quality guidelines at site UR1 below the confluence with Sulphurets Creek, indicating degradation of water quality in the operation, closure, and post-closure phases of the Project. Selenium concentrations are predicted to be below water quality guidelines at site UR2 at the BC-Alaska border.

For site UR1, the magnitude of the effect is high because the effect is predicted to differ from baseline conditions and exceed a guideline or threshold value beyond the range of natural variation ("change of state from baseline conditions"). The effect is described as landscape because it will be confined to the mid-field receiving environment. The duration of the effect is described as medium to far-future depending on the phase of the Project. Effects are predicted to extend into the far-future in post-closure. The frequency is continuous because elevated concentrations are predicted in the operation, closure, and post-closure phases. The effect is reversible long-term because water quality will improve over time when the source is resolved or removed, but ML/ARD in the RSFs is predicted to occur into the far-future. The context of the effect is neutral because the resident fish population, Dolly Varden, may be less sensitive to selenium toxicity than other fish species (McDonald et al. 2010). Qualitatively, an increase in concentration of selenium in the water may increase the concentration of the metal in fish tissue; however, there is a high degree of uncertainty evaluating the effect of increased concentrations of selenium in water. Given the inherent uncertainty of modelling water quality into the far-future, the probability of the effect occurring is medium and the confidence in the effects assessment is medium.

Due to the description of the effect above, the significance determination for the effect of degradation of water quality in the Unuk River at site UR1 is assessed as **not significant (moderate)**.

For site UR2, the magnitude of the effect is medium because the effect is predicted to differ from baseline conditions, but not exceed the water quality guideline. The effect is described as regional because the effect will be measurable 35 km downstream of the Mine Site. The duration of the effect is described as medium to far-future depending on the phase of the Project. Effects are predicted to extend into the far-future in post-closure. The frequency is continuous because elevated concentrations are predicted in the operation, closure, and post-closure phases. The effect is reversible long-term because water quality will improve over time when the source is resolved or removed, but ML/ARD in the RSFs is predicted to occur into the far-future. The context of the effect is high because of the higher fisheries value in the Unuk River at the Alaskan border and the implications of transboundary environmental effects. Given the inherent uncertainty of modelling water quality into the far-future, the probability of the effect occurring is medium and the confidence in the effects assessment is medium.

Due to the description of the effect above, the significance determination for the effect of degradation of water quality in the Unuk River at site UR2 is assessed as **not significant (moderate)**.

14.8.2.5 Degradation of Water Quality in Treaty Watershed

Water management as described in Chapter 26 and in Section 14.7.2 have minimized degradation of surface water quality in the Treaty watershed. Occasional quotients greater than 1.0 are calculated for dissolved aluminum and dissolved iron; however, these are artifacts of a mass balance model that does not simulate mineral precipitation and analytical uncertainty for values close to the analytical detection limit. Nitrogen loading is predicted to occur above baseline nutrient concentrations and the effect on aquatic life is assessed in Chapter 15. The concentrations of various other parameters are predicted to be greater than baseline conditions, but do not exceed water quality guidelines.

For North Treaty and Treaty creeks (sites NTR2 and TRC2), the magnitude of the effect is medium to low because the effect is predicted to differ from baseline conditions, but not to exceed a guideline or threshold value beyond the range of natural variation. The effect is described as landscape because it will be confined to the near- and mid-field receiving environment. The duration of the effect is described as medium to long depending on the phase of the Project. Effects are predicted to extend approximately a decade into post-closure. The frequency is sporadic because intermittent effects are predicted in the operation, closure, and post-closure phases. The effect is reversible short-term because an effect on water quality are not predicted past the first decade of post-closure. The context of the effect is high. Given the inherent uncertainty of modelling water quality into the far-future, the probability of the effect occurring is medium and the confidence in the effects assessment is medium.

Due to the description of the effect above, the significance determination for the effect of degradation of water quality in the Treaty watershed is assessed as **not significant (minor)**.

14.8.2.6 Degradation of Water Quality in Teigen Watershed

Water management as described in Chapter 26 and in Section 14.7.2 have minimized degradation of surface water quality in the Teigen watershed. Occasional quotients greater than 1.0 are calculated for total chromium, total copper, and total iron in South Teigen Creek only; however, these are artifacts of a mass balance model that does not simulate mineral precipitation and analytical uncertainty for values close to the analytical detection limit. Nitrogen loading is predicted to occur above baseline nutrient concentrations and the effect on aquatic life is assessed in Chapter 15. The concentrations of various other parameters are predicted to be greater than baseline conditions, but do not exceed water quality guidelines.

For South Teigen Creek, the magnitude of the effect is low because the effect is predicted to differ from baseline conditions, but not to exceed a guideline or threshold value beyond the range of natural variation. The effect is described as landscape because it will be confined to the near- and mid-field receiving environment. The duration of the effect is described as medium to long depending on the phase of the Project. Effects are predicted to extend approximately a decade into post-closure. The frequency is sporadic because intermittent effects are predicted in the operation, closure, and post-closure phases. The effect is reversible short-term because an effect on water quality is not predicted past the first decade of post-closure. The context of the effect is high. Given the inherent uncertainty of modelling water quality into the far-future, the probability of the effect occurring is medium and the confidence in the effects assessment is medium.

Due to the description of the effect above, the significance determination for the effect of degradation of water quality in South Teigen Creek is assessed as **not significant (minor)**.

14.8.2.7 Overall Effect on Surface Water Quality

The overall effect on surface water quality was determined based on the regional scale effect on water quality at post-closure observed at site UR2. Therefore, the overall significance determination is assessed as **not significant (moderate)**.

14.9 Potential Cumulative Effects for Surface Water Quality

The cumulative effects assessment (CEA) considers the potential effects on surface water quality that are likely to result from the combination of the residual effects of the KSM Project and the effects of other projects and/or activities that have spatial and/or temporal linkages with the KSM Project.

Residual effects of the KSM Project for surface water quality are predicted for the Coulter Creek and Treaty Creek access corridors, Sulphurets Creek, the Unuk River, and the Treaty watershed.

14.9.1 Scoping of Cumulative Effects

14.9.1.1 Spatial Linkages with Other Projects and Human Actions

Cumulative effects scoping considered past, present, and future actions for watersheds downstream of the KSM Project (Figure 14.9-1). Residual water quality effects from the KSM Project are predicted for the Sulphurets-Unuk and Treaty watersheds. Cumulative effects associated with the proposed development of the KSM Project and past, present, and future human actions were assessed for those watersheds. Effects on water quality due to past human actions were included in the baseline data collected for the KSM Project environmental effects assessment and were thus implicitly assessed in the Project-specific effects assessment. Past human actions with a spatial linkage to potential water quality effects include:

- the past producing Eskay Creek Mine; and
- the advanced exploration activity associated with the Sulphurets Project.

Advanced exploration and bulk sample mining at Sulphurets Project between 1986 and 1990 resulted in the placement of tailing materials in Brucejack Lake and waste rock deposition along Brucejack Creek which both drain west to the Sulphurets drainage. The Eskay Creek Mine operated between 1995 and 2008 and tailing materials and waste rock stored in Albino and Tom MacKay lakes and mine site drainage to Ketchum Creek flow to the Unuk River. Further detail on the effect of past human actions on the water quality baseline is provided in Section 14.2. The data available indicate that chemical loadings from these Projects are constant; therefore, no additional water quality effects are expected to interact with residual effects from the KSM Project in the future.

The Granduc Mine operated between 1970 and 1978 and between 1980 and 1984 and uncontained tailing materials were washed down the Bowser River Valley into Bowser Lake. No water quality effects from the Granduc Mine are expected to interact with residual effects from the KSM Project; therefore, the Granduc Mine was excluded from the surface water quality CEA.

Present and future human actions with potential spatial linkages include:

- the proposed Treaty Creek Hydroelectric Project;
- the proposed Snowfield Project; and
- the proposed Brucejack Mine.

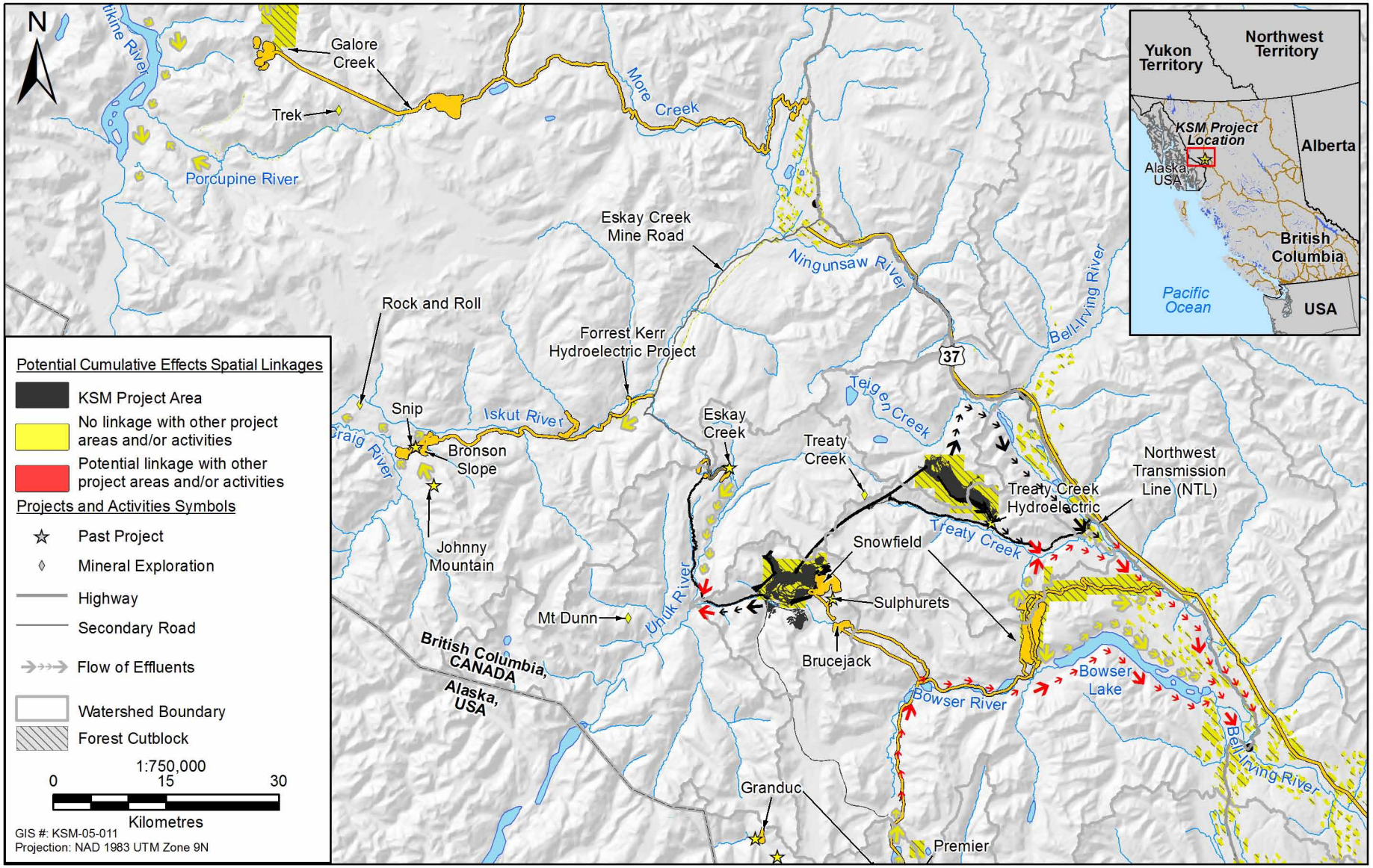


Figure 14.9-1

SEABRIDGE GOLD
KSM PROJECT

KSM Cumulative Effects Issue Scoping: Potential Spatial Linkages for Surface Water Quality

Figure 14.9-1

Rescan
Engineers & Scientists

The NTL will be an approximately 344 km electricity transmission line (BC Hydro 2012). The 287-kilovolt capacity line will generally follow the Highway 37 corridor, running from the Skeena Substation at Terrace and connecting with a new substation near Bob Quinn Lake and will pass within about 10 km of the KSM Project along the Bell-Irving River (BC Hydro 2012). BC Hydro received an EA Certificate in February 2011 and construction began in January 2012. The project is expected to be operational in 2014 (BC Hydro 2012). The transmission line will extend the existing provincial electrical grid into northwestern British Columbia, making mining, power, and other resource projects in these remote regions more economically feasible (BC Hydro 2012). No water quality effects from the NTL are expected to interact with residual effects from the KSM Project; therefore, the NTL was excluded from the surface water quality CEA.

The Treaty Creek Hydroelectric Project is anticipated to be located immediately south of the PTMA. The project is still in the very early planning stages and no data on expected water quality effects are available. This Project was excluded from the surface water quality CEA given the likely small-scale nature of this project and the absence of technical information.

The proposed Brucejack Mine is located immediately east of the KSM Project and entered the BC Environmental Assessment process in 2012. The Brucejack Mine is an underground gold and silver mining operation targeting two deposits. The mine life is projected to be a minimum of 16 years, with anticipated commencement of operations in 2016 (Tetra Tech 2011). Approximately 5 Mt of waste rock will be produced throughout the mine life, with 2 Mt of waste rock stored sub-aqueously in the southwest corner of Brucejack Lake. An estimated 8 Mt of flotation tailing material will additionally be deposited in Brucejack Lake. Brucejack Lake drains west into the Sulphurets/Unuk watershed (Rescan 2012a). Water quality effects from the Brucejack Mine have the potential to interact with residual effects from the KSM Project; therefore, the Brucejack Mine was included in the surface water quality CEA.

The Snowfield Project is located immediately adjacent to the KSM Project, such that the Snowfield property may be influenced by KSM access plans for the area (Snowden 2012). The Snowfield deposit area drains downstream to Mitchell Creek (Tetra Tech 2010) which is upstream of the proposed WSF for the KSM Project. A Preliminary Economic Assessment was completed in 2010 that explored the value of combining the Brucejack Mine and Snowfield Project (Tetra Tech 2010). The Snowfield Project proponent has no current plans to advance development; therefore, the Snowfield Project was excluded from the surface water quality CEA.

14.9.1.2 Temporal Linkages with Other Projects and Human Actions

Temporal linkages for past human actions within the watersheds potentially affected by the proposed KSM Project were considered in the development of the baseline program for the KSM Project. Past human actions with a temporal linkage to potential water quality effects include:

- the past producing Eskay Creek Mine; and
- the advanced exploration activity associated with the Sulphurets Project.

Temporal linkages for present and future human actions were considered for present and reasonably foreseeable projects that were already identified as having spatial linkages to the KSM

Project given the long-term time scale of water quality effects predicted for the KSM Project. Present and future human actions with potential temporal linkages with the KSM Project include:

- the proposed Brucejack Mine.

Table 14.9-1 summarizes linkages between the KSM Project and other projects and activities that are considered in the surface water quality CEA.

14.9.2 Cumulative Effects Assessment for Surface Water Quality

The CEA for surface water quality considered past, present, and future projects with a spatial and temporal linkage with the KSM Project as summarized in Table 14.9-2.

14.9.2.1 Project-specific Residual Effects on Surface Water Quality that Are Not Likely to Result in Cumulative Effects

Degradation of water quality along the Coulter Creek and Treaty Creek access corridors and in the Treaty watershed are not likely to result in cumulative effects because there is no spatial or temporal linkage with other projects or activities for those geographic areas.

14.9.2.2 Cumulative Effect of Degradation of Water Quality

A residual effect on water quality in the Sulphurets-Unuk watershed due to increased selenium concentrations was predicted for the KSM Project. This residual effect is predicted to be not significant (moderate) with mitigation (Section 14.8.2). The magnitude of the residual effect in Sulphurets Creek and in the Unuk River is high, with a medium magnitude residual effect in the Unuk River at the BC-Alaska border. Increased selenium loading from the Brucejack Mine has the potential to increase concentrations of selenium in Sulphurets Creek and the Unuk River, which could result in a cumulative effect of a greater magnitude in the Unuk River at the BC-Alaska border. Estimations of water quality effects from the Brucejack Project Description (Rescan 2012a) submitted to the BC EAO were used to quantify the additional selenium loading.

Project-specific Cumulative Effects Mitigations for Degradation of Water Quality

Extensive mitigation to avoid degradation of surface water quality was included in the design for the proposed Project. Mitigation includes measures to avoid, reduce, and monitor adverse effects to surface water quality and specific mitigation measures were developed for the various pathways that Project components can potentially interact with surface water quality. Section 14.7.2 provides detail on Project water quality mitigation. In summary, water quality effects for the Project will be primarily mitigated through water management including diversion of non-contact water and collection and treatment of contact water. Effluent discharges from the WSF and the TMF will be staged to the natural hydrograph to minimize water quality effects.

Water quality monitoring and adaptive management are expected to minimize water quality effects throughout the construction, operation, closure, and post-closure phases.

Table 14.9-1. Summary of Potential Linkages between KSM Project and other Human Actions in regards to Surface Water Quality

	Action/Project	Past	Present	Future
Past Projects	Eskay Creek Mine	X; drainage to Unuk watershed	NL	NL
	Granduc Mine	NL	NL	NL
	Johnny Mountain Mine	NL	NL	NL
	Kitsault Mine (Closed)	NL	NL	NL
	Snip Mine	NL	NL	NL
	Sulphurets Project	X; drainage to Sulphurets/Unuk watershed	NL	NL
	Swamp Point Aggregate Mine	NL	NL	NL
Present Projects	Forrest Kerr Hydroelectric	NL	NL	NL
	Long Lake Hydroelectric	NL	NL	NL
	NTL (Northwest Transmission Line)	NL	NL	NL
	Red Chris Mine	NL	NL	NL
	Wolverine Mine	NL	NL	NL
Reasonably Foreseeable Future Projects	Arctos Anthracite Coal Mine	NL	NL	NL
	Bear River Gravel	NL	NL	NL
	Bronson Slope Mine	NL	NL	NL
	Brucejack Mine	NL	NL	X; drainage to Sulphurets/Unuk watershed
	Galore Creek Mine	NL	NL	NL
	Granduc Copper Mine	NL	NL	NL
	Kitsault Mine	NL	NL	NL
	Kutcho Mine	NL	NL	NL
	McLymont Creek Hydroelectric	NL	NL	NL
	Schaft Creek Mine	NL	NL	NL
	Snowfield Project	NL	NL	NL
	Storie Moly Mine	NL	NL	NL
	Turnagain Mine	NL	NL	NL
	Treaty Creek Hydroelectric	NL	NL	NL
Land Use Activities	Agricultural Resources	NL	NL	NL
	Fishing	NL	NL	NL
	Guide Outfitting	NL	NL	NL
	Resident and Aboriginal Harvest	NL	NL	NL
	Mineral and Energy Resource Exploration	NL	NL	NL
	Recreation and Tourism	NL	NL	NL
	Timber Harvesting	NL	NL	NL
	Traffic and Roads	NL	NL	NL

NL = No Linkage (no spatial and temporal overlap, or potential effects do not act in combination)

X = Potential spatial and temporal linkage with project or action

Table 14.9-2. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Surface Water Quality

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Eskay Creek Mine	Sulphurets Project	Brucejack Mine
Degradation of Water Quality	Possible Interaction	Possible Interaction	Possible Interaction

Other Project/Activity Mitigations to Address Degradation of Water Quality

Mitigation of water quality effects by present and future projects is expected to occur though implementation of best management practices (BMPs) and proven mitigation strategies. The Brucejack Mine is proposing a combination of sub-aqueous disposal and backfill to underground workings for waste rock and tailing material. An HDS lime water treatment system is proposed as a contingency to address potential water quality effects in the Sulphurets/Unuk watershed (Rescan 2012a).

Determination of Potential for Residual Cumulative Effect and Significance

The Brucejack Project Description identifies the potential for local, low-magnitude effects on water quality (Rescan 2012a). The cumulative effect on water quality from the Brucejack Mine will not influence the descriptors used in the assessment of Project-specific residual effects as concentrations of selenium in the Sulphurets-Unuk watershed are not expected to increase above the Project-specific predictions as a result of cumulative water quality effects. Therefore, there will be no residual cumulative effects. The significance determination of cumulative residual effects was assessed as **not applicable (N/A)** in Table 14.9-3.

14.9.2.3 Overall Cumulative Effect on Surface Water Quality

No residual cumulative effects on surface water quality are predicted.

14.10 Summary of Assessment of Potential Environmental Effects on Surface Water Quality

Table 14.10-1 presents a summary of the assessment of potential environmental effects on surface water quality.

14.11 Surface Water Quality Conclusions

The hydrological regime is an important determinant of stream water quality in the Project area. Typical local streams experience a low-flow period between November and April, and higher flows between May and October associated with freshet, summer glacial melt, and fall heavy rain events. The hydrological regime affects water quality in two ways:

- increased flows during freshet, glacial melt, and heavy rainfall events dilute concentrations of major ions and total dissolved solids; and
- increased sediment load and transport during high-flow periods lead to increased concentrations of total suspended solids (TSS) and particle-associated metals.

Streams near the Mine Site and PTMA have distinct surface water quality. Metal leaching due to naturally occurring ARD is associated with total and dissolved metal concentrations in Mitchell and Sulphurets creeks that are frequently higher than levels set in BC water quality guidelines for the protection of freshwater aquatic life. The high suspended sediment load, low concentrations of bioavailable nutrients, and high concentrations of total and dissolved metals identified in Mitchell and Sulphurets creeks and the Unuk River are contributing factors to the poor productive capacity of Mine Site streams. The lower suspended sediment load, increased concentrations of bioavailable nutrients, and lower concentrations of total and dissolved metals identified in the Snowbank, Teigen, Treaty, and Bell-Irving watersheds are contributing factors to the greater productive capacity of PTMA streams relative to the Mine Site.

Managing water quality poses a considerable challenge to the Proponent. Extensive mitigation, including substantial design changes, at the Mine Site is proposed to minimize effects on surface water quality due to predicted increased selenium concentrations, including:

- implementation of environmental management plans (most significantly the Water Management Plan [Section 26.17] and ML/ARD Management Plan [Section 26.14]);
- backfilling the Sulphurets Pit in lined benches with Kerr waste rock, which is high in selenium;
- treating drainage from Kerr waste rock at an ion-exchange Selenium Treatment Plant;
- treating contact water stored in the WSF at an HDS lime WTP with a maximum capacity of 7.5 m^3/s; and
- staging discharge to match the natural hydrograph.

The proposed mitigation cannot eliminate the Project-related residual effect on water quality, and the environmental effects assessment identified the following residual effects: degradation of surface water quality due to sedimentation and erosion, ML/ARD and dissolution of blasting residues near access corridors, and increased selenium concentrations due to effluent discharge.

Predictive water quality modelling into the far-future has an inherent level of uncertainty. To address this uncertainty, different model scenarios considered the range of possible geochemistry (both expected and upper case), the average water balance based on five years of baseline data, and a variable water balance with extreme dry and wet years. Selenium concentrations are predicted to be higher than BC water quality guidelines for the protection of freshwater aquatic life in Sulphurets Creek and 1.5 km downstream in the Unuk River during the operation, closure, and post-closure phases. Water quality guidelines are predicted to meet water quality guidelines at a regional scale at the BC-Alaska border, 35 km downstream of the proposed Mine Site. No concentrations higher than either baseline or guidelines are predicted for the receiving environment downstream of the proposed PTMA.

Based on the environmental effects assessment, the residual effect for the Mine Site is assessed as **not significant (moderate)**, and the residual effect for the PTMA is assessed as **not significant (minor).**

Table 14.9-3. Summary of Residual Cumulative Effects on Surface Water Quality

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Level Adjusted by CE				
Degradation of water quality due to sedimentation	none	Construction	High	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	High	N/A	High	High	Not Significant (Minor)	N/A	Not Required	N/A
Degradation of water quality due to sedimentation	none	Operations	High	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	High	N/A	High	High	Not Significant (Minor)	N/A	Not Required	N/A
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	none	Construction	Medium	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	High	N/A	High	High	Not Significant (Minor)	N/A	Not Required	N/A
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	none	Operations	Medium	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	High	N/A	High	High	Not Significant (Minor)	N/A	Not Required	N/A
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	none	Closure	Medium	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	High	N/A	High	High	Not Significant (Minor)	N/A	Not Required	N/A
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	none	Post-closure	Medium	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	High	N/A	High	High	Not Significant (Minor)	N/A	Not Required	N/A
Degradation of water quality in Sulphurets Creek (elevated selenium).	Brucejack Mine	Operations	High	N/A	Landscape	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Sulphurets Creek (elevated selenium).	Brucejack Mine	Closure	High	N/A	Landscape	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Sulphurets Creek (elevated selenium).	Brucejack Mine	Post-closure	High	N/A	Landscape	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Unuk River (UR1; elevated selenium).	Brucejack Mine	Operations	High	N/A	Landscape	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	Neutral	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Unuk River (UR1; elevated selenium).	Brucejack Mine	Closure	High	N/A	Landscape	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Neutral	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Unuk River (UR1; elevated selenium).	Brucejack Mine	Post-closure	High	N/A	Landscape	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Neutral	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Unuk River (UR2; elevated selenium).	Brucejack Mine	Operations	Medium	N/A	Regional	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Unuk River (UR2; elevated selenium).	Brucejack Mine	Closure	Medium	N/A	Regional	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A

(continued)

Table 14.9-3. Summary of Residual Cumulative Effects on Surface Water Quality (completed)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Level Adjusted by CE				
Degradation of water quality in Unuk River (UR2; elevated selenium).	Brucejack Mine	Post-closure	Medium	N/A	Regional	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	High	Low	Not Significant (Moderate)	N/A	Required	N/A
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	none	Operations	Medium	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Medium	N/A	High	N/A	Not Significant (Minor)	N/A	Required	N/A
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	none	Closure	Low	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Medium	N/A	High	N/A	Not Significant (Minor)	N/A	Required	N/A
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	none	Post-closure	Low	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Medium	N/A	High	N/A	Not Significant (Minor)	N/A	Required	N/A
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	none	Operations	Low	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Medium	N/A	High	N/A	Not Significant (Minor)	N/A	Required	N/A
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	none	Closure	Low	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Medium	N/A	High	N/A	Not Significant (Minor)	N/A	Required	N/A
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	none	Post-closure	Low	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Medium	N/A	High	N/A	Not Significant (Minor)	N/A	Required	N/A
Overall Effect	All	Post-closure	Medium	N/A	Landscape	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	High	N/A	Not Significant (Moderate)	N/A	Required	N/A

Note: CE = Cumulative Effect

Table 14.10-1. Summary of Assessment of Potential Environmental Effects on Surface Water Quality

Valued Component	Phase of Project	Potential Effect	Key Mitigation Measures	Significance Analysis of Project Residual Effects	Significance Analysis of Cumulative Residual Effects
Surface Water Quality	All	Degradation of water quality	Use of BMPs and implementation of environmental management plans; backfilling Sulphurets Pit; Selenium Treatment Plant; Mine Site WTP; staging discharge from both the Mine Site and TMF to minimize effects on water quality in the low flow season	Not significant (moderate)	N/A

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