

Appendix A

Eagle Mine, Eagle River Basin—Metals Standards (taken from Regulation 33, Water Quality Control Commission, Classifications and Numeric Standards for Upper Colorado River Basin and North Platte River, Regulation No. 33, Effective January, 2009. pp. 109-110)

The Hazardous Materials and Waste Management Division and USEPA Superfund Program (Superfund Proponents) proposed site-specific zinc, copper and cadmium standards for segments on the Eagle River within the Eagle Mine Superfund Site. Similarly, CBS Operations Inc (CBS) (formerly Viacom International Inc) proposed a different set of site-specific zinc, copper and cadmium standards for segments on the Eagle River within the Eagle Mine Superfund Site.

After review of the evidence submitted, the Commission adopted the Superfund Proponents' modified proposal for site-specific standards for the Eagle River Segments 5a, 5b, 5c and 7b as described below. These segments are impacted by historical mining activities at the Eagle Mine Superfund Site.

Zinc: A recalculation procedure was used for the aquatic species expected to occur in these segments of the Eagle River. After extensive review of available biological data and toxicity information, the recalculation was based on the following four most sensitive species that are expected to occur in these segments of the Eagle River: *Cottus bairdi* (Mottled Sculpin), *Oncorhynchus* (Rainbow and Cutthroat Trout), *Salmo trutta* (Brown Trout) and *Ranatra elongata* (Water Scorpion). The resulting site-specific recalculated hardness-based equations are:

$$\begin{aligned} \text{Acute} &= 0.978 * e^{0.8537[\ln(\text{hardness})]} + 1.4189 \\ \text{Chronic} &= 0.986 * e^{0.8537[\ln(\text{hardness})]} + 1.2481 \end{aligned}$$

Because these equations rely on Sculpin as the most sensitive species, they are referred to as “sculpin equations.”

An attainability analysis was conducted which showed that it is not feasible to achieve a level of cleanup that would result in attainment of the sculpin equations in Segments 5a, 5b and 7b on a year-round basis. Additional remediation projects have been identified that can be performed at the site. The analysis shows that the identified remediation projects can be expected to result in additional zinc load reduction during March and April, when metals' loading is at its peak. When compared with the species toxicity information, it is clear that the feasible reductions still result in zinc levels that would exceed the standards based on the sculpin equation at some locations during some months. A modified species list without sculpin provided an equation that is based on the following four most sensitive species: *Oncorhynchus* (Rainbow and Cutthroat Trout), *Salmo trutta* (Brown Trout), *Ranatra elongata* (Water Scorpion) and *Limnodrilus hoffmeisteri* (Worm). The resulting recalculated hardness-based equations are:

$$\begin{aligned} \text{Acute} &= 0.978 * e^{0.8537[\ln(\text{hardness})]} + 2.1302 \\ \text{Chronic} &= 0.986 * e^{0.8537[\ln(\text{hardness})]} + 1.9593 \end{aligned}$$

Because these equations rely on rainbow trout as the most sensitive species, they are referred to as “rainbow equations.”

The biological goal for the Eagle Mine Superfund Site is a healthy brown trout fishery. Concurrent biological and water quality monitoring has shown that to achieve that goal, zinc must be maintained at levels better than those indicated by laboratory-based zinc toxicity studies with brown trout, probably because of combined effects with copper. Ongoing monitoring suggests that zinc and copper levels currently achieved by the cleanup are too high in March and April to maintain a healthy brown trout population. The equations based on a modified species list (rainbow equations) are incrementally more stringent than the equations based on brown trout and, at this site, offer a way to address this uncertainty and provide an adequate buffer for brown trout. These levels cannot be attained without additional remediation at the Eagle Mine Superfund Site.

The equations which represent the highest attainable water quality were applied by the Commission when and where the attainability analysis indicated they could be met. The rainbow equations were applied by the Commission to Segments 5a year-round and to segments 5b and 7b from January 1 through April 30. The sculpin equations were applied by the Commission to segment 5c year-round and to segments 5b and 7b from May 1 through December 31.

Copper: Similar to zinc, a recalculation procedure was conducted based on the species that are expected to occur at the site. The resulting species list includes the following as the four most sensitive species: *Ephoron virgo* (Mayfly), *Tubifex tubifex* (Worm), *Plumatella emarginata* (Bryozoan), and *Oncorhynchus* (Rainbow and Cutthroat Trout). The resulting recalculated hardness-based equations are:

$$\begin{aligned}\text{Acute} &= 0.96 * e^{0.9801[\ln(\text{hardness})]} - 1.5865 \\ \text{Chronic} &= 0.96 * e^{0.5897[\ln(\text{hardness})]} - 0.4845\end{aligned}$$

Because these equations rely on *Ephoron virgo* as the most sensitive species, they are referred to as “Ephoron equations.” These recalculated copper standards are attainable and were applied to Segments 5b, 5c and 7b.

For Segment 5a, an attainability analysis was conducted which showed that it is not feasible to reduce copper loads to a level that would result in attainment of the Ephoron equations. The majority of the copper load originates from upstream sources that cannot be controlled at the site. A modified species list, without Ephoron provided an equation that is based on the following four most sensitive species: *Tubifex tubifex* (Worm), *Plumatella emarginata* (Bryozoan), *Oncorhynchus* (Rainbow and Cutthroat Trout) and *Lumbriculus variegatus* (Worm). The resulting modified hardness-based equations are:

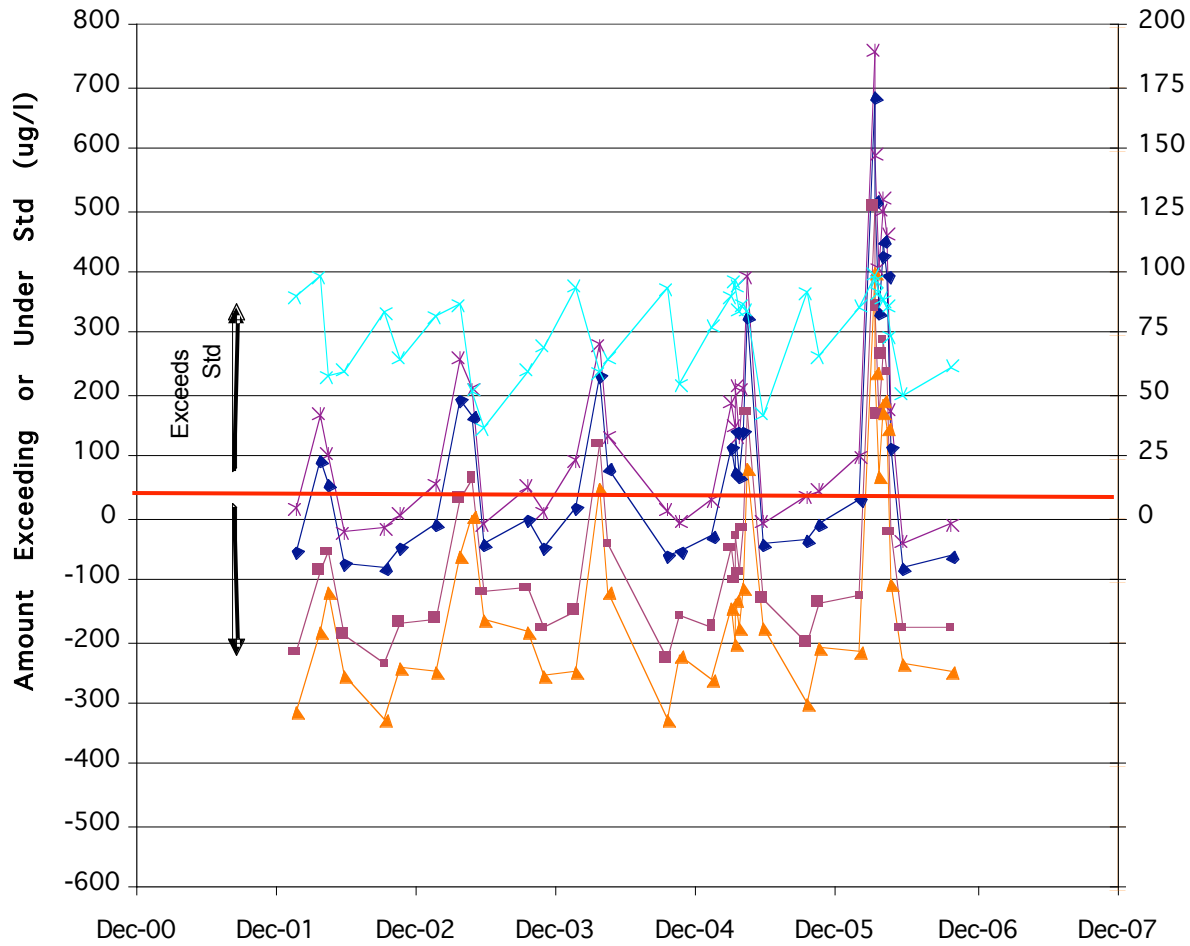
$$\begin{aligned}\text{Acute} &= 0.96 * e^{0.9801[\ln(\text{hardness})]} - 1.1073 \\ \text{Chronic} &= 0.96 * e^{0.5897[\ln(\text{hardness})]} - 0.0053\end{aligned}$$

Because these equations rely on tubifex worms as the most sensitive species, they are referred to as “tubifex equations.” The tubifex equations were applied to Segment 5a.

Eagle River, Segment 5a site-specific standard options

Site ID	Sample Date	Hardness, mg/l	Zn-D TVS	Recalc - Sculpin	Recalc - Rainbows	Recalc - Browns	Zinc result	Exceed TVS	Exc Sculpin std	Exc Rainbow std	Exc Brown Std
E-12A	1/25/02	90	113	183	348	443	130	17	-53	-218	-313
E-12A	3/27/02	98	122	196	373	476	290	168	94	-83	-186
E-12A	4/19/02	57	77	124	236	301	180	103	56	-56	-121
E-12A	5/29/02	60	80	129	245	312	57	-23	-72	-188	-255
E-12A	9/17/02	83	106	171	326	415	90	-16	-81	-236	-325
E-12A	10/22/02	65	86	138	262	334	92	6	-46	-170	-242
E-12A	1/24/03	82	105	169	321	410	160	55	-9	-161	-250
E-12A	3/26/03	86	110	177	337	429	370	260	193	33	-59
E-12A	4/29/03	52	71	114	217	277	280	209	166	63	3
E-12A	5/29/03	36	53	85	161	205	42	-11	-43	-119	-163
E-12A	9/18/03	60	80	129	245	312	130	50	1	-115	-182
E-12A	10/29/03	70	91	147	279	356	100	9	-47	-179	-256
E-12A	1/23/04	94	117	189	360	459	210	93	21	-150	-249
E-12A	3/25/04	59	79	127	242	308	360	281	233	118	52
E-12A	4/16/04	65	86	139	264	336	220	134	81	-44	-116
E-12A	9/16/04	93	117	189	358	457	130	13	-59	-228	-327
E-12A	10/20/04	54	73	118	225	286	66	-7	-52	-159	-220
E-12A	1/14/05	77	100	161	306	390	130	30	-31	-176	-260
E-12A	3/3/05	90	114	184	349	445	300	186	116	-49	-145
E-12A	3/10/05	96	121	194	370	471	270	149	76	-100	-201
E-12A	3/17/05	94	117	189	360	459	330	213	141	-30	-129
E-12A	3/24/05	84	107	173	328	419	240	133	67	-88	-179
E-12A	3/31/05	86	110	177	337	429	320	210	143	-17	-109
E-12A	4/12/05	84	108	174	330	420	500	392	326	170	80
E-12A	5/23/05	42	59	95	181	231	52	-7	-43	-129	-179
E-12A	9/12/05	91	115	185	352	448	150	35	-35	-202	-298
E-12A	10/18/05	65	87	140	265	338	130	43	-10	-135	-208
E-12A	1/31/06	86	109	176	335	427	210	101	34	-125	-217
E-12A	3/9/06	99	123	198	376	479	880	757	682	504	401
E-12A	3/16/06	96	120	194	368	469	710	590	516	342	241
E-12A	3/23/06	91	115	185	352	448	520	405	335	168	72
E-12A	3/30/06	89	112	181	345	439	610	498	429	265	171
E-12A	4/6/06	88	112	180	342	436	630	518	450	288	194
E-12A	4/13/06	86	109	176	334	425	570	461	394	236	145
E-12A	4/20/06	74	96	154	294	374	270	174	116	-24	-104
E-12A	5/22/06	50	69	110	210	267	30	-39	-80	-180	-237
E-12A	9/27/06	61	82	132	251	320	71	-11	-61	-180	-249

Segment 5A Comparison of Zinc Concentrations to Proposed



Standards based on Actual Hardness

Sculpin Eqn

Min 85

Max 198

Avg 159

Rainbow Eqn

Min 161

Max 376

Avg 302

Brown Trout Eqn

Min 205

Max 479

Avg 385

Ambient Water Quality

Min 30

Max 880

Avg 266

Hardness

Min 36

Max 99

Avg 77

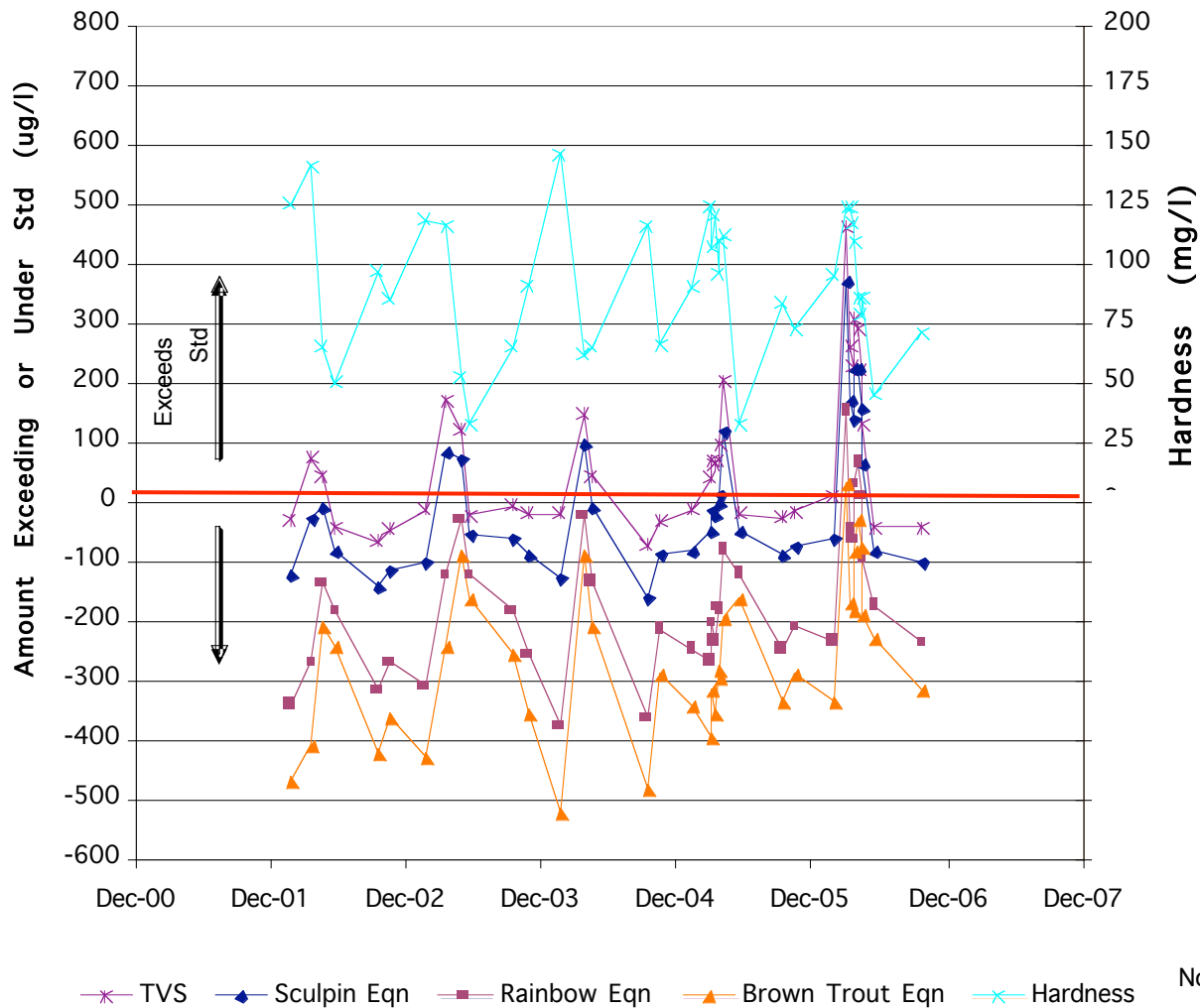
—*— TVS —◆— Sculpin Eqn —■— Rainbow Eqn —▲— Brown Trout Eqn —×— Hardness

Note: Zero on the y-axis equals compliance with the Standard.

Eagle River, Segment 5b site-specific standard options

Site ID	Sample Date	Hardness, mg/l	Zn-D TVS	Recalc - Sculpin	Recalc - Rainbows	Recalc - Browns	Zinc result	Exceed TVS	Exc Sculpin std	Exc Rainbow std	Exc Brown Std
E-15	1/25/02	125	150.24	242	461	587	120	-122	-341	-467	-30
E-15	3/27/02	141	166.20	268	510	650	240	-28	-270	-410	74
E-15	4/19/02	65	86.53	140	265	338	130	-10	-135	-208	43
E-15	5/29/02	50	68.99	111	211	269	27	-84	-184	-242	-42
E-15	9/17/02	97	120.97	195	371	473	53	-142	-318	-420	-68
E-15	10/22/02	85	108.46	175	332	424	63	-112	-269	-361	-45
E-15	1/24/03	118	143.45	231	440	561	130	-101	-310	-431	-13
E-15	3/26/03	116	140.86	227	432	550	310	83	-122	-240	169
E-15	4/29/03	52	71.35	115	219	279	190	75	-29	-89	119
E-15	5/29/03	32	47.66	77	146	186	23	-54	-123	-163	-25
E-15	9/18/03	65	85.64	138	262	334	79	-59	-183	-255	-7
E-15	10/29/03	91	114.70	185	352	448	95	-90	-257	-353	-20
E-15	1/23/04	146	171.23	276	525	669	150	-126	-375	-519	-21
E-15	3/25/04	62	82.34	133	252	322	230	97	-22	-92	148
E-15	4/16/04	65	86.06	139	264	336	130	-9	-134	-206	44
E-15	9/16/04	116	140.86	227	432	550	67	-160	-365	-483	-74
E-15	10/20/04	66	86.99	140	267	340	53	-87	-214	-287	-34
E-15	1/14/05	90	113.38	183	348	443	100	-83	-248	-343	-13
E-15	3/3/05	124	149.32	241	458	584	190	-51	-268	-394	41
E-15	3/10/05	107	131.37	212	403	513	200	-12	-203	-313	69
E-15	3/17/05	120	145.10	234	445	567	210	-24	-235	-357	65
E-15	3/24/05	96	120.05	194	368	469	190	-4	-178	-279	70
E-15	3/31/05	109	133.99	216	411	524	230	14	-181	-294	96
E-15	4/12/05	112	136.60	220	419	534	340	120	-79	-194	203
E-15	5/23/05	33	48.17	78	147	188	28	-50	-119	-160	-20
E-15	9/12/05	83	106.27	171	326	415	80	-91	-246	-335	-26
E-15	10/18/05	72	94.37	152	289	369	79	-73	-210	-290	-15
E-15	1/31/06	95	118.74	192	364	464	130	-62	-234	-334	11
E-15	3/9/06	123	148.60	240	456	581	610	370	154	29	461
E-15	3/16/06	123	148.60	240	456	581	410	170	-46	-171	261
E-15	3/23/06	117	141.79	229	435	554	370	141	-65	-184	228
E-15	3/30/06	109	133.99	216	411	524	440	224	29	-84	306
E-15	4/6/06	86	108.95	176	334	426	400	224	66	-26	291
E-15	4/13/06	79	101.26	163	310	396	320	157	10	-76	219
E-15	4/20/06	86	108.95	176	334	426	240	64	-94	-186	131
E-15	5/22/06	45	62.64	101	192	245	19	-82	-173	-226	-44
E-15	9/27/06	71	92.55	149	284	361	48	-101	-236	-313	-45

Segment 5B Comparison of Zinc Concentrations to Proposed



Note: TVS exceeded in March/April - with one exceedance in January

Standards based on Actual Hardness

Sculpin Eqn

Min 77

Max 276

Avg 184

Rainbow Eqn

Min 146

Max 525

Avg 349

Brown Trout Eqn

Min 186

Max 669

Avg 445

Ambient Water Quality

Min 19

Max 610

Avg 182

Hardness

Min 32

Max 146

Avg 91

Note: Zero on the y-axis equals compliance with the Standard.

Eagle River, Segment 5c site-specific standard options

Site ID	Sample Date	Hardness, mg/l	Zn-D TVS	Recalc - Sculpin	Recalc - Rainbows	Recalc - Browns	Zinc result	Exceed TVS	Exc Sculpin std	Exc Rainbow std	Exc Brown Std
E-22	1/23/04	156	181.20	293	556	777	120	-173	-436	-657	-61
E-22	10/20/04	70	92.09	149	282	395	51	-98	-231	-344	-41
E-22	1/14/05	77	99.90	161	306	428	130	-31	-176	-298	30
E-22	3/3/05	127	152.80	247	469	655	140	-107	-329	-515	-13
E-22	3/10/05	121	146.03	236	448	626	180	-56	-268	-446	34
E-22	3/17/05	125	150.24	242	461	644	170	-72	-291	-474	20
E-22	3/24/05	110	134.93	218	414	579	160	-58	-254	-419	25
E-22	3/31/05	119	144.38	233	443	619	180	-53	-263	-439	36
E-22	4/12/05	100	124.06	200	380	532	270	70	-110	-262	146
E-22	5/23/05	45	63.13	102	193	270	28	-74	-165	-242	-35
E-22	9/12/05	94	118.34	191	363	507	66	-125	-297	-441	-52
E-22	10/18/05	75	97.60	157	299	418	71	-86	-228	-347	-27
E-22	1/31/06	104	128.00	207	392	549	110	-97	-282	-439	-18
E-22	3/9/06	124	149.53	241	459	641	620	379	161	-21	470
E-22	3/16/06	133	158.82	256	487	681	410	154	-77	-271	251
E-22	3/23/06	131	156.27	252	479	670	300	48	-179	-370	144
E-22	3/30/06	126	151.17	244	464	648	360	116	-104	-288	209
E-22	4/6/06	106	130.63	211	401	560	320	109	-81	-240	189
E-22	4/13/06	106	130.63	211	401	560	260	49	-141	-300	129
E-22	4/20/06	77	99.90	161	306	428	210	49	-96	-218	110
E-22	5/22/06	49	67.55	109	207	289	18	-91	-189	-271	-50
E-22	9/27/06	75	97.64	157	299	419	55	-102	-244	-364	-43

Segment 5c, Comparison of Zinc Concentrations to Proposed

Note: TVS exceed in March/April only - with one exceedance in January

Standards based on Actual Hardness

Sculpin Eqn

Min 102

Max 293

Avg 204

Rainbow Eqn

Min 193

Max 556

Avg 387

Brown Trout Eqn

Min 270

Max 777

Avg 541

Ambient Water Quality

Min 18

Max 620

Avg 192

Hardness

Min 45

Note: Zero on the y-axis equals compliance with the Standard.

