

Chadwick Ecological Consultants, Inc., 2005

Red River aquatic biological monitoring

2003

Appendices A-D

Prepared for Molycorp, Inc.

APPENDIX A

Fish Length-Frequency Histograms

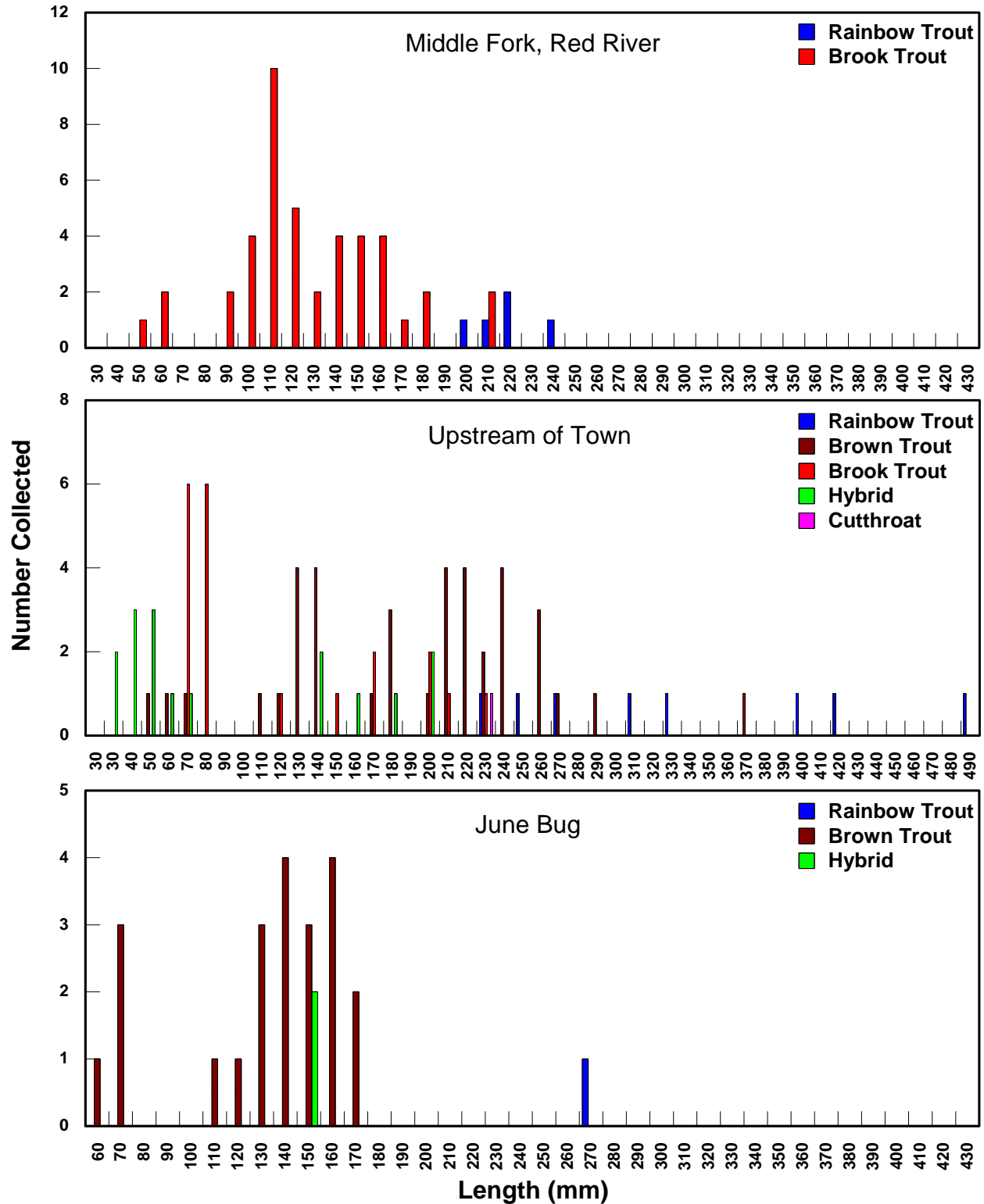


FIGURE A-1: Length frequency histograms of trout collected in the Red River and tributaries in fall 2003.

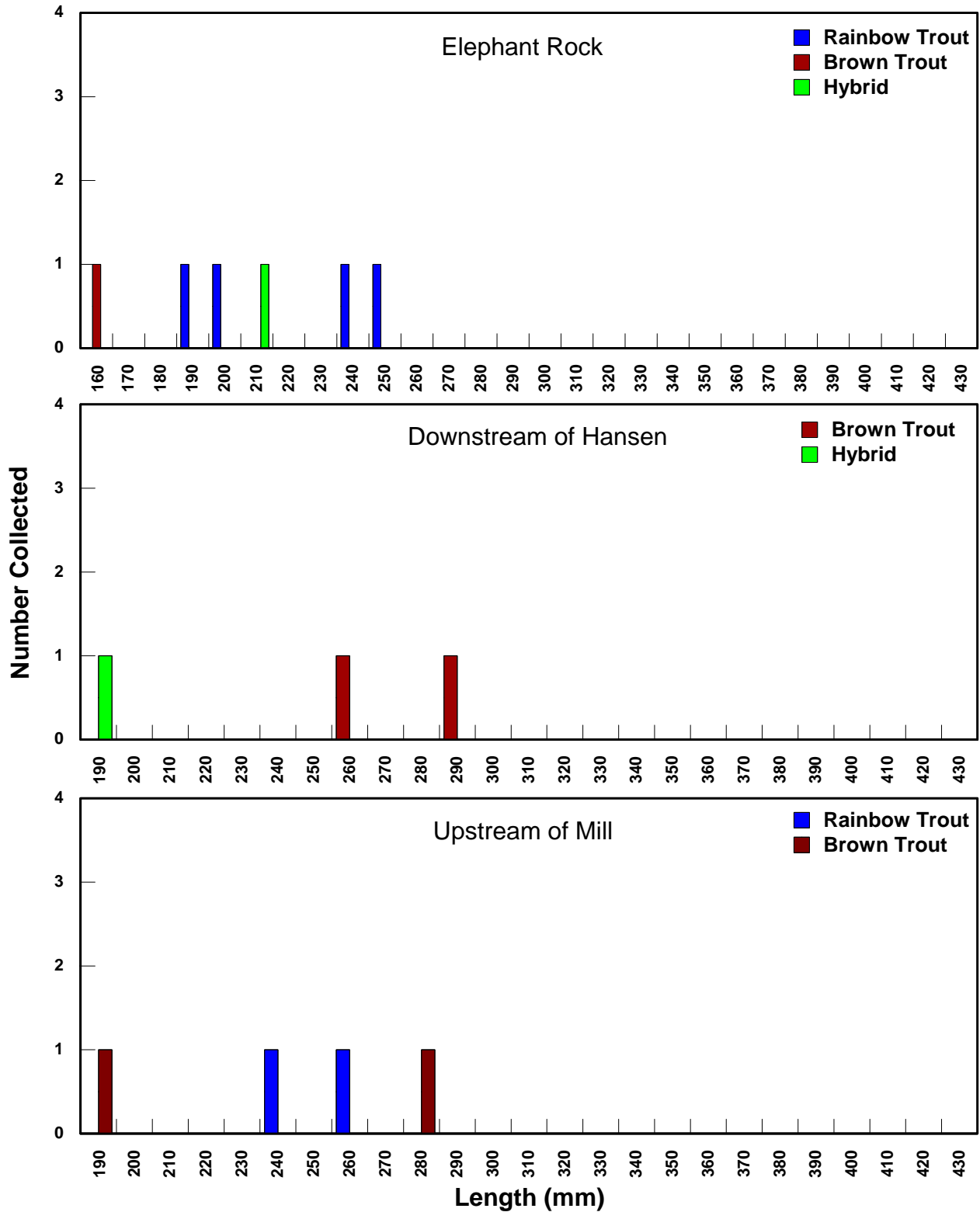


FIGURE A-1: Continued.

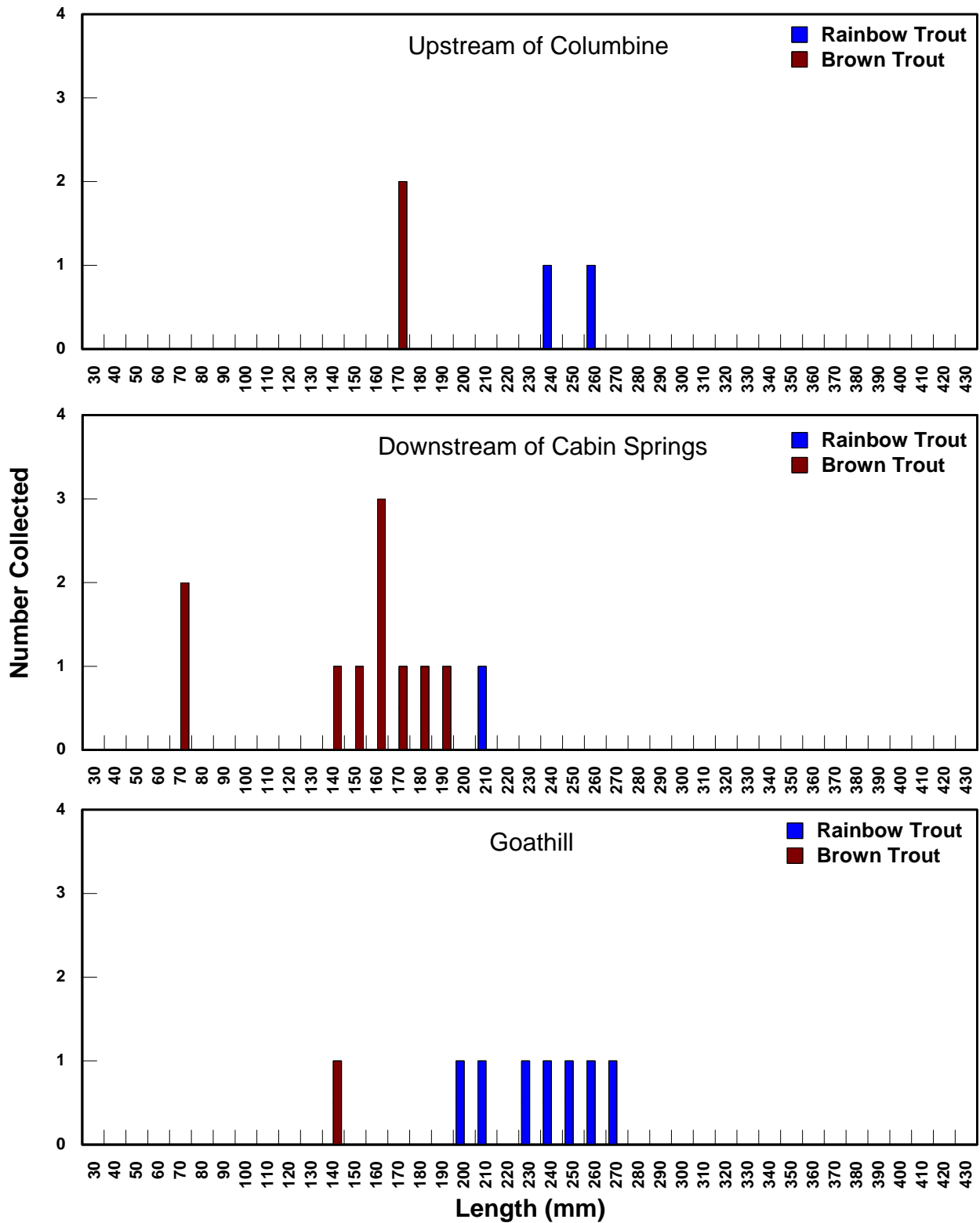


FIGURE A-1: Continued.

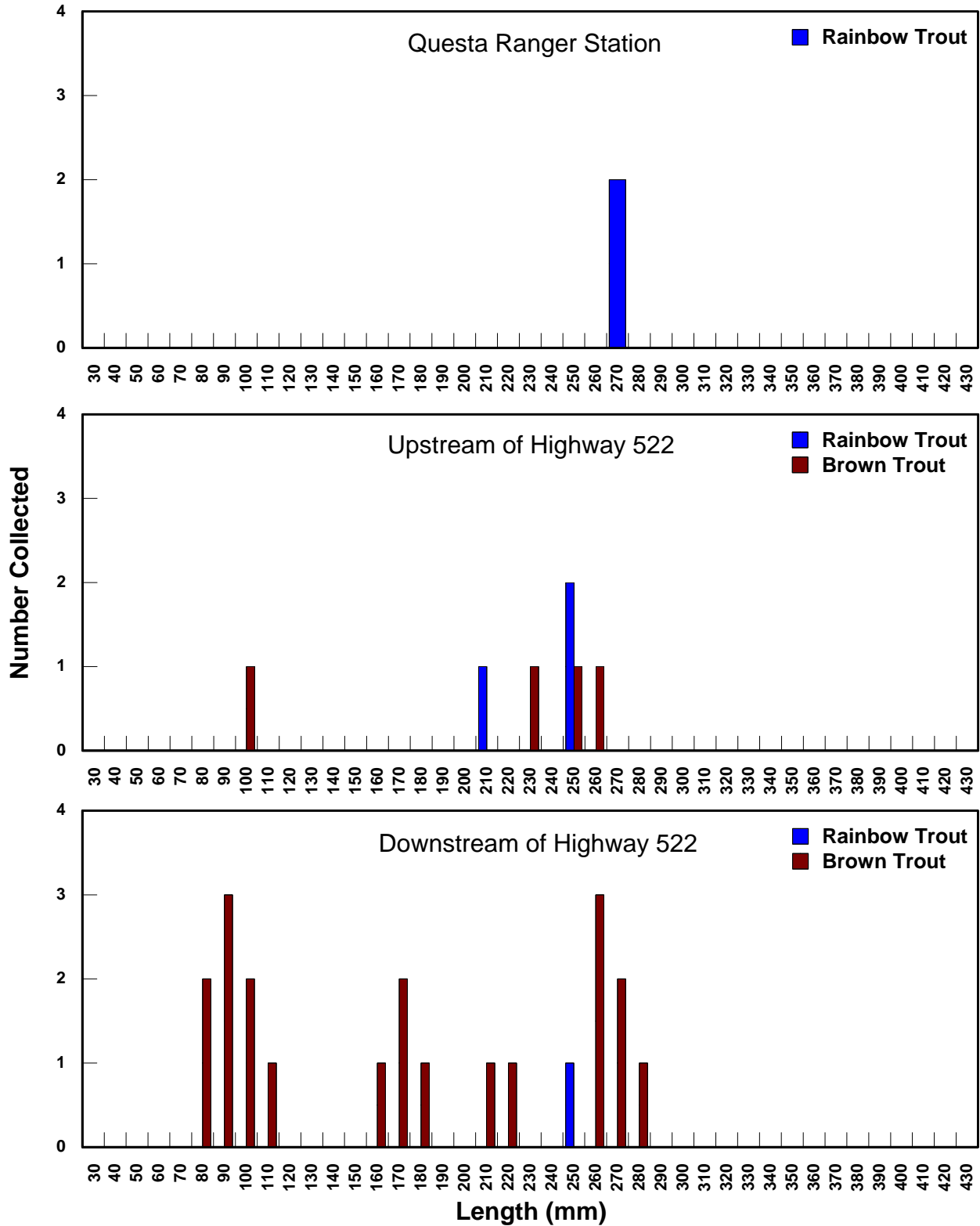


FIGURE A-1: Continued.

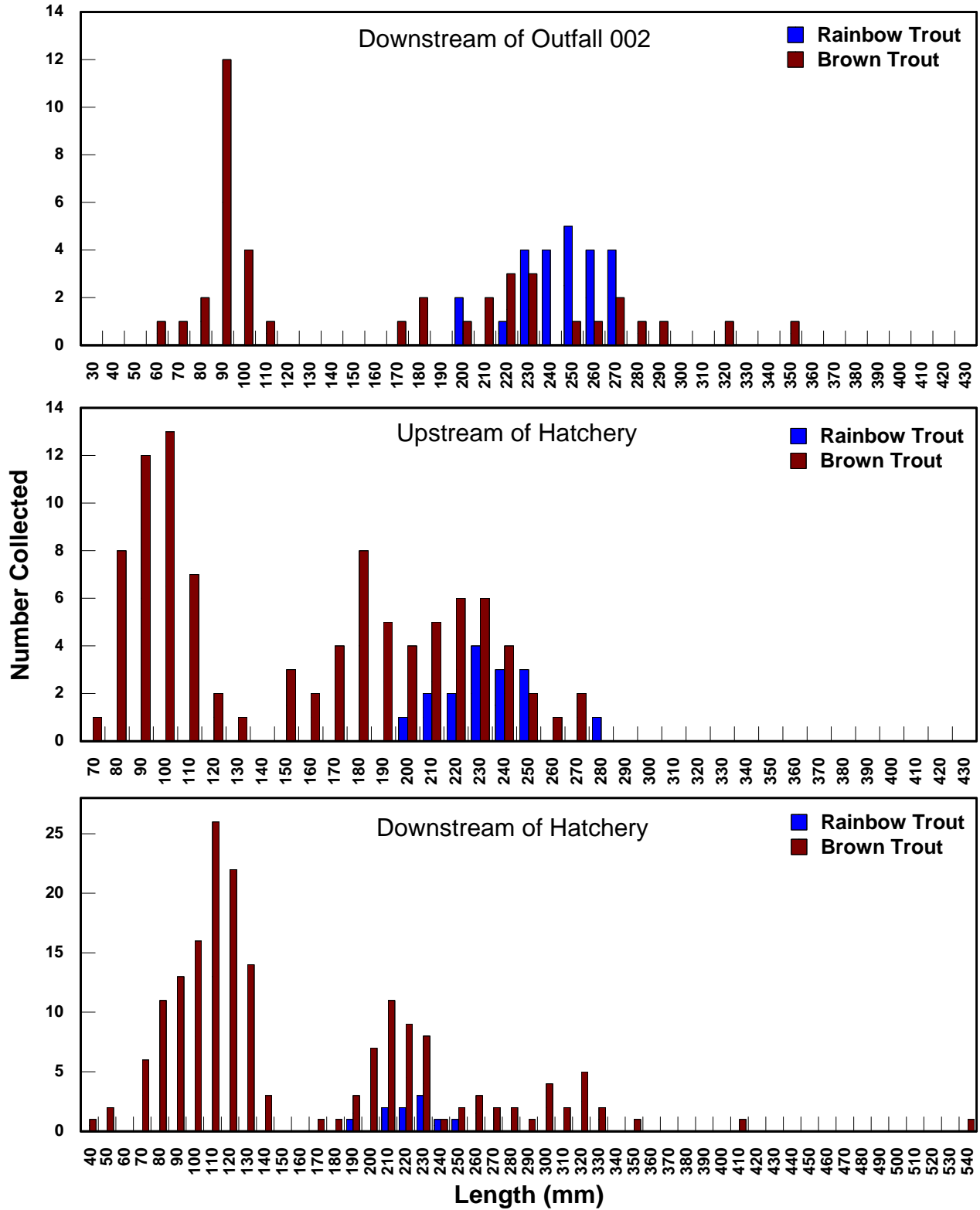


FIGURE A-1: Continued.

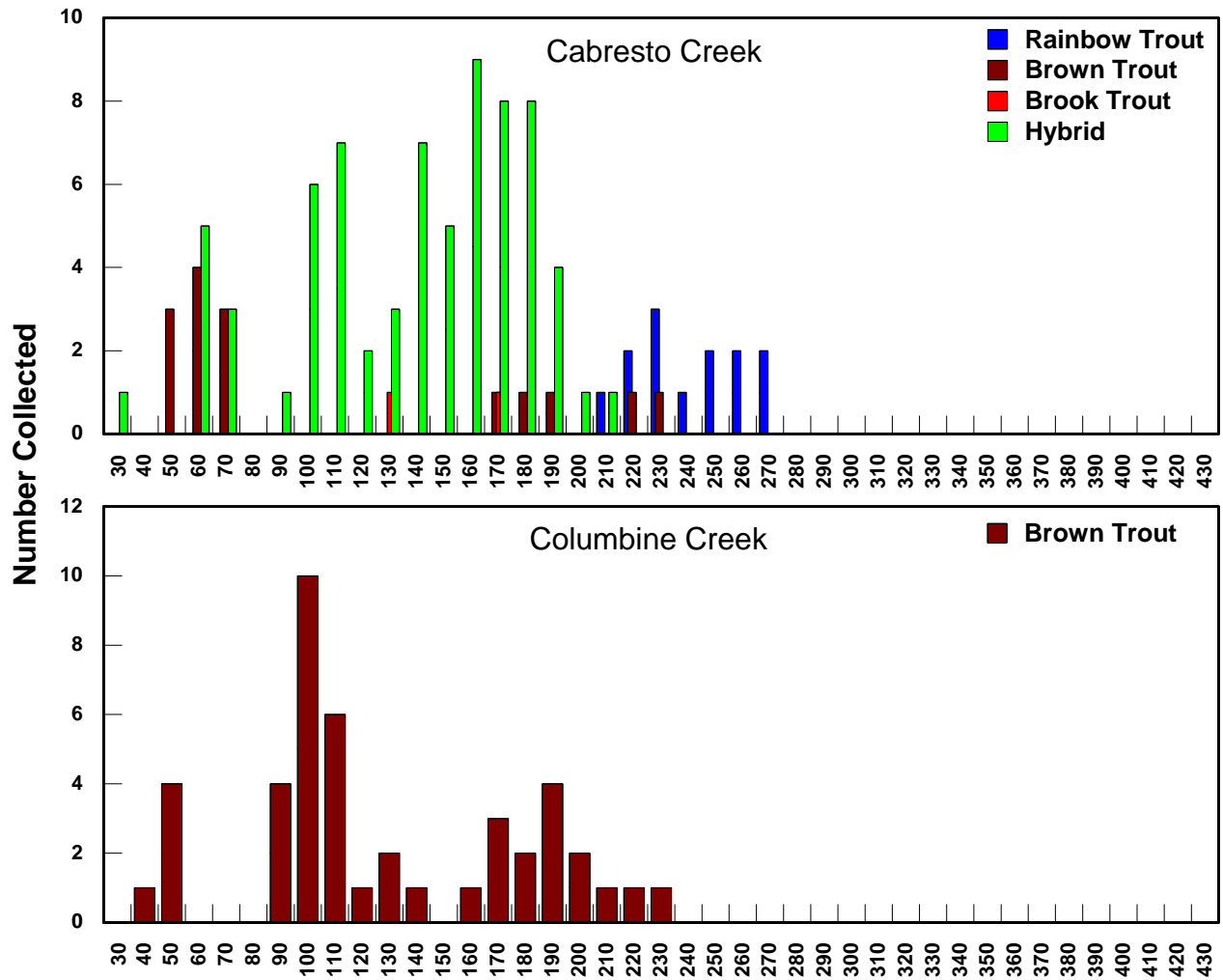


FIGURE A-1: Continued.

APPENDIX B

Fish Tissue Data

TABLE B-1: Summary of number of fish targeted for collection at each study site and the number of fish actually collected in fall 2003.

Site	<u>Young-of-the-Year</u>		<u>Juvenile</u>		<u>Adult</u>	
	Target	Actual	Target	Actual	Target	Actual
<u>Reference Sites - Brown Trout</u>						
Cabresto Creek	3	3	3	3	3	3
Upstream of Town	3	3	3	3	3	3
<u>Red River Downstream of Town - Brown Trout</u>						
June Bug	3	2	3	3	3	0
Elephant Rock	3	1	3	3	3	2
Downstream of Hansen	3	3	3	0	3	0
Upstream of Mill	3	0	3	0	3	0
Upstream of Columbine	3	0	3	3	3	3
Downstream of Cabin Springs	3	1	3	3	3	0
Goathill	3	0	3	1	3	1
Questa Ranger Station	3	0	3	1	3	3
Upstream of Highway 522	3	3	3	0	3	3
Downstream of Highway 522	3	3	3	3	3	3
Downstream of Outfall 002	3	3	3	3	3	3
Upstream of Hatchery	3	3	3	3	3	3
<u>Lakes - Brown Trout</u>						
Upper Fawn Lake	3	0	3	0	3	3
Eagle Rock Lake	3	0	3	0	3	0
<u>Lakes - White Suckers</u>						
Upper Fawn Lake	3*	0	3	3	3	3
Eagle Rock Lake	3*	3*	3	3	3	3

* Composite replicates.

TABLE B-2: Metals concentrations (mg/kg wet weight) in whole-body large (> 8 in) brown trout collected from the study sites, fall 2003. U = values under detection limit. Sites not listed had no large (> 8 in) brown trout collected. Metals not listed were all below detection limits.

Site	Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Mo	Ni	Se	V	Zn
<u>Reference Sites</u>																		
Cabresto Creek	22.4	U	U	U	0.36	0.037	3.2	U	2.3	66	0.13	2.8	0.015	0.17	1.18	0.89	U	33.0
Upstream of Town	353.2	0.17	3.55	0.03	U	0.031	52.0	0.76	4.1	1,010	0.66	33.2	0.009	1.67	26.10	0.69	1.47	32.7
<u>Red River Downstream of Town</u>																		
Elephant Rock	15.5	U	1.24	U	U	0.085	1.1	0.29	2.7	69	0.25	12.1	U	U	0.49	0.74	U	29.4
Upstream of Columbine	U	U	0.68	U	U	0.095	U	U	2.4	21	U	2.6	U	U	U	0.67	U	33.4
Goathill	8.2	U	U	U	U	0.135	13.8	U	U	21	U	3.4	0.020	U	U	0.50	U	38.4
Questa Ranger Station	18.1	U	0.47	U	U	0.182	2.1	U	5.6	34	U	6.6	U	0.10	0.78	0.22	U	39.8
Upstream of Highway 522	8.7	U	0.57	U	U	0.269	2.2	0.18	5.5	64	U	10.7	0.011	0.17	0.84	0.31	U	42.3
Downstream of Highway 522	11.6	U	U	U	U	0.181	0.7	U	U	29	U	8.9	0.015	0.16	0.15	0.20	U	46.9
Downstream of Outfall 002	32.5	U	0.92	0.03	U	0.122	2.4	0.21	U	77	U	21.2	0.016	0.26	0.88	0.56	0.18	47.3
Upstream of Hatchery	U	U	U	U	0.33	0.289	U	0.27	6.9	28	U	11.0	0.021	U	U	0.43	U	50.3
<u>Lakes</u>																		
Upper Fawn Lake	22.4	U	U	U	U	0.036	0.7	U	1.6	23	U	1.1	U	0.09	U	0.62	U	23.4

TABLE B-3: Metals concentrations (mg/kg wet weight) in whole-body small (< 8 in) brown trout collected from the study sites, fall 2003. U = all values under detection limit. Sites not listed had small (< 8 in) brown trout collected. Metals not listed were all below detection limit.

Site	Al	Ba	Be	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Mo	Ni	Se	Zn
<u>Reference Sites</u>															
Cabresto Creek	U	U	U	U	2.7	U	U	25	U	1.3	0.014	U	0.94	0.60	40.5
Upstream of Town	22.6	0.70	U	U	3.7	U	0.9	62	0.34	4.3	U	U	1.60	0.77	36.5
<u>Red River Downstream of Town</u>															
June Bug	21.4	2.10	U	0.270	3.3	0.32	3.9	54	U	6.7	U	0.18	0.93	0.68	44.9
Elephant Rock	17.3	0.81	U	0.157	U	0.23	3.6	97	U	9.2	U	U	0.30	0.72	43.3
Upstream of Columbine	4.6	0.67	U	0.080	U	U	2.1	22	U	3.6	U	0.08	U	0.56	35.0
Downstream of Cabin Spring	U	0.67	U	0.125	U	0.28	2.1	33	U	9.7	0.019	U	U	0.49	42.6
Goathill	16.5	U	U	0.290	U	U	U	33	U	2.1	0.021	U	U	0.94	42.3
Questa Ranger Station	10.7	U	U	0.190	1.1	U	1.8	22	U	2.1	U	U	0.30	0.47	43.4
Downstream of Highway 522	17.5	U	U	0.173	0.7	0.19	U	37	U	7.8	0.018	0.13	0.23	0.29	41.6
Downstream of Outfall 002	33.3	1.00	U	0.187	1.8	0.19	U	66	U	7.8	0.018	U	0.69	0.90	55.0
Upstream of Hatchery	31.7	1.82	0.02	0.170	U	0.44	3.1	113	U	36.6	0.028	U	0.73	0.65	51.8

TABLE B-4: Metals concentrations (mg/kg wet weight) in whole-body YOY brown trout collected from the study sites, fall 2003. U = values under detection limit. Sites not listed had no YOY brown trout collected. Metals not listed were all below detection limit.

Site	Al	Ba	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Mo	Ni	Se	Zn
<u>Reference Sites</u>														
Cabresto Creek	U	U	U	2.7	U	U	45	U	4.1	U	U	0.95	1.09	54.4
Upstream of Town	15.1	U	0.032	1.2	U	0.6	30	0.24	3.9	U	U	U	1.18	36.9
<u>Red River Downstream of Town</u>														
June Bug	24.3	0.93	0.310	2.5	U	4.0	64	U	8.7	U	0.14	0.41	0.77	58.7
Elephant Rock	7.2	U	0.210	U	U	2.2	26	U	5.4	U	U	U	0.61	38.6
Downstream of Cabin Spring	39.1	2.50	0.360	U	U	3.0	87	U	9.6	0.018	U	U	0.78	58.0
Upstream of Highway 522	35.2	1.00	0.380	1.3	U	3.0	62	0.14	6.0	U	0.11	0.57	0.34	59.4
Downstream of Highway 522	36.2	0.83	0.300	0.9	0.18	U	53	U	13.3	0.015	0.11	0.53	0.42	71.1
Downstream of Outfall 002	44.4	1.30	0.217	1.6	U	U	92	U	7.6	0.19	U	0.72	0.97	64.2
Upstream of Hatchery	U	1.33	0.417	U	0.27	2.3	70	U	16.4	0.016	U	U	0.31	71.2

TABLE B-5: Metals concentrations (mg/kg wet weight) in whole-body white suckers collected from Upper Fawn Lake and Eagle Rock Lake, fall 2003. U = values under detection limit. N = no fish collected. Metals not listed were all below detection limit.

Site - Size Class	Al	As	Ba	Be	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Zn
Upper Fawn Lake - YOY	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Eagle Rock Lake - YOY	247.7	0.15	6.07	0.05	0.183	1.8	0.19	4.3	370	1.43	23.7	U	1.53	0.36	43.3
Upper Fawn Lake - Juvenile	42.8	U	2.30	U	0.038	3.0	U	1.7	118	U	18.3	0.12	1.24	0.69	27.7
Eagle Rock Lake - Juvenile	98.9	U	2.27	0.02	0.145	2.9	U	2.3	141	0.51	16.4	U	1.66	0.45	29.8
Upper Fawn Lake - Adult	48.9	U	3.60	U	0.027	2.9	U	1.5	168	U	7.7	0.19	0.76	0.59	23.4
Eagle Rock Lake - Adult	107.4	U	2.37	0.02	0.100	1.4	U	1.8	140	0.53	24.9	U	0.80	0.36	31.9

APPENDIX C

Benthic Invertebrate Tissue Data

TABLE C-1: Metals concentrations (mg/kg wet weight) in composite benthic macroinvertebrates samples collected from the study sites, spring 2003. U = values under detection limit. Metals not listed were all below detection limit.

Site	Al	As	Ba	Be	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	V	Zn
<u>Reference Sites</u>																
Cabresto Creek	78	0.20	1.6	U	0.31	U	U	4.7	124	U	11	0.16	0.4	1.00	U	137
Upstream of Town	250	0.24	4.2	U	0.09	0.7	0.4	4.8	349	0.5	29	0.18	0.4	U	0.57	33
<u>Red River Downstream of Town</u>																
June Bug	474	U	14.7	0.13	2.10	U	2.9	36.1	956	1.1	132	0.23	4.0	U	0.44	165
Elephant Rock	268	U	14.2	0.05	1.20	U	2.6	18.4	479	1.9	103	0.36	3.6	U	0.30	113
Downstream of Hansen	527	U	6.5	0.13	0.82	U	1.6	19.3	365	0.9	37	0.21	1.9	U	U	109
Upstream of Mill	344	U	6.8	0.06	0.51	U	1.6	12.4	281	0.9	47	0.33	2.1	U	U	73
Upstream of Columbine	331	U	11.2	0.05	0.43	U	2.2	11.8	342	1.1	123	0.39	2.5	U	U	62
Downstream of Cabin Spring	209	U	7.9	0.31	0.35	U	1.8	10.4	263	0.8	88	0.31	2.5	U	U	51
Goathill	967	0.25	24.8	0.33	0.76	U	1.3	24.3	776	2.2	55	0.60	4.3	0.46	0.38	114
Questa Ranger Station	1,200	U	11.1	0.35	0.28	U	1.3	27.0	764	1.1	68	0.51	3.0	U	U	60
Upstream of Highway 522	918	0.27	12.4	0.25	0.92	U	2.5	20.4	621	2.0	92	0.35	4.6	0.53	U	138
Downstream of Highway 522	1,000	0.26	12.4	0.26	0.79	U	2.2	22.7	642	1.8	111	0.61	3.9	0.50	0.29	130
Downstream of Outfall 002	854	0.23	10.2	0.22	1.00	U	2.4	25.7	613	1.7	126	4.30	3.1	U	0.33	161
Upstream of Hatchery	886	0.42	12.2	0.23	0.81	U	2.8	21.3	634	2.0	194	2.70	5.6	0.51	0.44	152
<u>Lakes</u>																
Upper Fawn Lake	271	0.43	28.9	0.05	0.48	U	0.9	24.7	537	2.3	68	0.97	2.6	U	0.45	29
Eagle Rock Lake	1,560	0.23	13.7	0.39	0.85	U	3.6	33.8	915	2.8	282	0.87	9.4	U	0.60	116

TABLE C-2: Metals concentrations (mg/kg wet weight) in composite benthic macroinvertebrates samples collected from the study sites, fall 2003.
U = values under detection limit. Metals not listed were all below detection limit.

Site	Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Mo	Ni	Se	V	Zn
<u>Reference Sites</u>																		
Cabresto Creek	127	0.20	4.0	U	U	0.19	4.2	U	U	272	U	18	U	U	2.3	0.96	U	108
Upstream of Town	354	U	6.7	U	U	0.07	0.9	0.3	4.1	526	0.6	41	0.510	U	U	0.47	0.92	25
<u>Red River Downstream of Town</u>																		
June Bug	450	0.23	14.3	0.09	U	0.94	1.0	1.3	32.6	834	U	79	U	0.22	2.8	0.52	0.58	105
Elephant Rock	289	0.25	19.0	0.04	U	1.30	2.4	1.6	23.3	725	2.4	81	U	0.27	3.2	0.40	0.37	97
Downstream of Hansen	498	0.28	23.2	0.11	U	1.10	1.8	1.9	20.1	507	1.5	105	U	U	3.5	0.47	0.26	125
Upstream of Mill	456	0.25	18.7	0.09	U	1.20	U	2.3	18.7	585	1.9	116	U	0.54	3.8	U	0.28	119
Upstream of Columbine	377	0.17	13.4	0.09	U	1.70	U	2.2	16.5	473	1.4	105	U	0.28	2.8	U	U	135
Downstream of Cabin Spring	326	0.20	43.4	0.08	5.6	1.70	U	2.1	13.0	630	1.7	111	0.016	U	2.7	0.43	0.27	108
Goathill	290	0.26	8.7	0.10	2.5	0.47	U	1.0	13.1	440	1.9	74	0.018	0.27	3.8	U	U	81
Questa Ranger Station	863	U	11.6	0.30	U	0.62	0.6	0.8	18.6	472	1.2	59	U	0.35	2.9	U	U	89
Upstream of Highway 522	638	U	15.6	0.18	U	0.72	1.0	1.1	15.6	664	1.8	94	U	0.63	3.4	U	0.33	97
Downstream of Highway 522	610	0.21	20.6	0.17	U	0.77	1.1	1.2	18.4	726	2.0	81	0.017	0.79	3.0	U	0.36	86
Downstream of Outfall 002	651	0.36	19.8	0.17	U	0.82	1.3	1.4	19.1	1,130	5.5	122	0.015	4.00	3.1	0.69	0.52	97
Upstream of Hatchery	154	U	5.0	0.07	3.7	0.47	U	1.2	7.2	178	U	94	U	0.80	2.5	U	U	66
<u>Lakes</u>																		
Upper Fawn Lake	222	0.57	35.0	U	2.8	0.57	U	0.6	23.2	399	1.8	63	0.020	U	1.3	0.66	0.32	29
Eagle Rock Lake	724	U	9.8	0.17	6.5	1.00	U	1.7	36.2	568	2.8	145	U	U	5.0	U	U	119

APPENDIX D

Bryophyte and Algae Tissue Data

TABLE D-1: Metals concentrations (mg/kg wet weight) in aquatic bryophyte samples (from streams) and algae (from lakes) from the study sites, fall 2003. U = values under detection limit. Metals not listed were all below detection limit.

Site	Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Mo	Ni	Se	Si	V	Zn
<u>Reference Sites</u>																			
Cabresto Creek	1,100	0.6	13	0.5	1.4	0.2	6.3	0.7	2	1,990	4.9	83	U	U	5	0.32	U	2.0	49
Upstream of Town	1,030	0.4	21	0.2	U	0.1	2.3	0.8	6	1,670	1.9	190	U	U	2	0.51	U	2.9	15
<u>Red River Downstream of Town</u>																			
June Bug	2,470	1.1	145	1.0	U	5.4	3.0	54.9	149	6,560	7.6	5,880	U	0.1	55	0.70	U	3.6	567
Elephant Rock	2,170	1.1	208	0.5	U	3.6	5.0	63.7	102	4,470	17.2	5,880	U	0.6	58	0.78	0.5	2.6	410
Downstream of Hansen	3,110	0.6	106	0.9	U	2.0	U	50.6	67	3,000	8.0	3,320	U	0.6	43	0.51	U	1.6	400
Upstream of Mill	3,360	1.8	170	0.9	4.1	2.9	U	77.9	99	3,720	10.7	5,750	U	1.1	67	0.77	U	1.8	517
Upstream of Columbine	3,300	1.4	157	0.7	4.0	2.3	U	62.7	83	5,320	13.4	3,920	U	1.3	62	1.00	U	2.5	373
Downstream of Cabin Spring	1,820	0.9	94	0.4	2.3	1.1	U	25.1	40	2,400	6.8	2,210	0.021	1.0	24	0.44	U	1.3	179
Goathill	4,930	1.6	139	2.9	3.6	4.9	U	45.8	102	4,540	11.5	5,610	0.020	1.2	102	1.40	U	2.6	1,610
Questa Ranger Station	5,780	0.9	194	2.1	U	1.8	2.5	15.7	83	5,500	12.3	1,690	U	2.1	38	0.37	U	2.3	401
Upstream of Highway 522	4,060	0.9	120	1.5	U	2.3	2.6	23.1	72	5,540	10.2	2,990	U	3.2	44	U	U	2.2	464
Downstream of Highway 522	3,790	1.0	97	1.3	4.1	1.3	2.2	14.9	59	4,330	66.4	1,690	0.021	2.4	31	0.74	U	2.1	301
Downstream of Outfall 002	2,720	0.8	86	1.0	2.3	1.3	1.8	15.3	45	3,560	9.4	1,650	0.020	16.8	27	1.20	0.5	1.9	255
Upstream of Hatchery	2,810	1.4	127	1.3	9.0	1.8	U	24.7	U	4,790	13.6	3,000	0.019	5.3	56	0.35	U	3.6	422
<u>Lakes</u>																			
Upper Fawn Lake	2,280	2.0	117	0.2	U	1.0	5.6	8.3	32	6,530	28.0	875	U	3.0	16	0.72	U	3.6	111
Eagle Rock Lake	508	0.2	10	0.1	U	0.7	0.6	3.9	9	642	1.8	413	U	U	12	U	U	U	88