

APPENDIX E - TOTAL MAXIMUM DAILY LOADS (TMDLs)

E.1 SEDIMENT

E.1.1 OVERVIEW

A percent reduction based on average yearly loading was used as the primary approach for expressing the sediment TMDLs within this document because there is uncertainty associated with the loads derived from the source assessment, and using the estimated sediment loads alone creates a rigid perception that the loads are absolutely conclusive. However, in this appendix the TMDL is expressed using daily loads to satisfy an additional EPA required TMDL element. Daily loads should not be considered absolutely conclusive and may be refined in the future as part of the adaptive management process. The TMDLs may not be feasible at all locations within the watershed but if the allocations are followed, sediment loads are expected to be reduced to a degree that the sediment targets are met and beneficial uses are no longer impaired. It is not expected that daily loads will drive implementation activities.

E.1.2 APPROACH

The preferred approach for calculating daily sediment loads is to use a nearby water quality gage with a long-term dataset for flow and suspended sediment. Because the gage on the Kootenai River is downstream of the Libby Dam and the hydrology of the river is altered by the dam, data from USGS gage on the Fisher River near Libby (#12302055) will be used to calculate daily sediment loads. A sediment rating curve was developed using daily flow and suspended solids load data collected from 1967 through 1976, which is the only period of record with available daily suspended sediment data (**Figure E-1**). Sediment load records during January of 1974 were removed from the rating curve because these values corresponded to an extreme flood event that was not deemed representative of typical conditions in the Kootenai-Fisher project area. The daily mean discharge based on 42 years of record (1968-2010) at the USGS gage was then plugged into the equation for the sediment rating curve to get a daily suspended sediment load. Although the suspended sediment load is only a portion of the total load from the source assessment, it provides an approximation of the relationship between sediment and flow in the Kootenai-Fisher project area. Based on the sum of the calculated daily sediment loads, a daily percentage relative to the annual suspended sediment load was calculated for each day. The daily percentages were then applied to the total average annual loads associated with the TMDL percent reductions from **Section 5.0** to determine the average daily load.

To conserve resources, this appendix contains daily loads for Wolf Creek as an example. As discussed in **Section 5.6.3.4**, the TMDL for Wolf Creek is a 29% reduction in the total average annual sediment load, which is roughly equivalent to 4,575 tons/year. The daily percentages discussed above were then multiplied by the annual load of 4,575 tons to get a daily expression of the Wolf Creek TMDL (**Figure E-2**, **Table E-1**). For all other waterbodies, daily TMDLs may be derived by using the daily percentages in **Table E-2** and the TMDLs expressed as an average annual load, which are discussed in **Section 5.6.3** and presented in **Table E-2**. The daily loads are a composite of the allocations, but as allocations are not feasible on a daily basis, they are not contained within this appendix. If desired, daily allocations may be obtained by applying allocations provided in **Section 5.6.3** to the daily load.

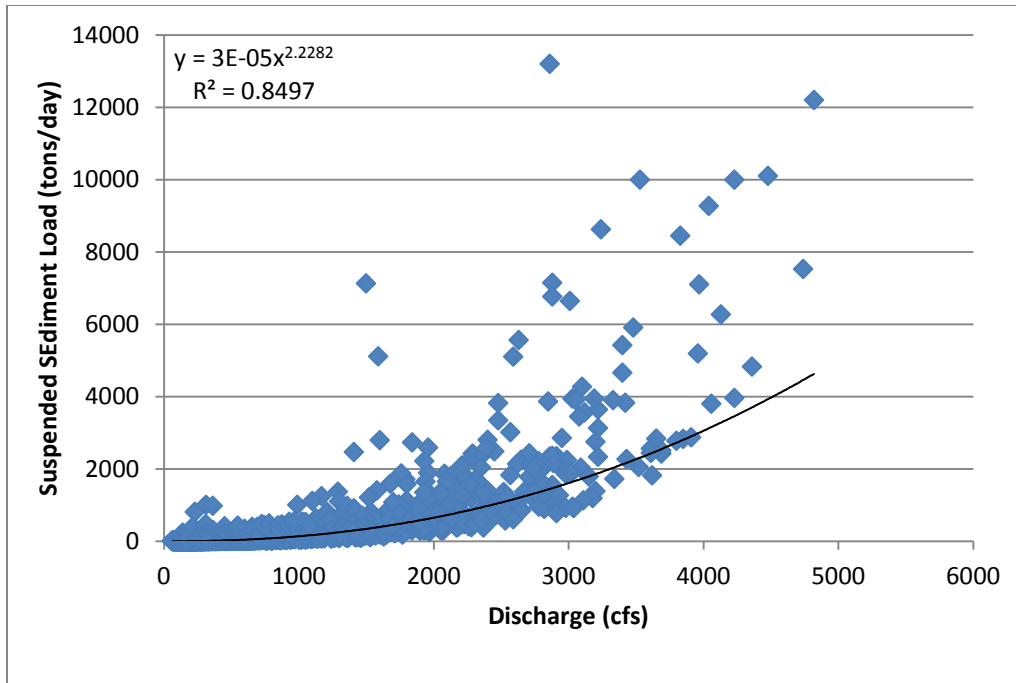


Figure E-1. Sediment Rating Curve for Fisher River based on USGS gage 12302055

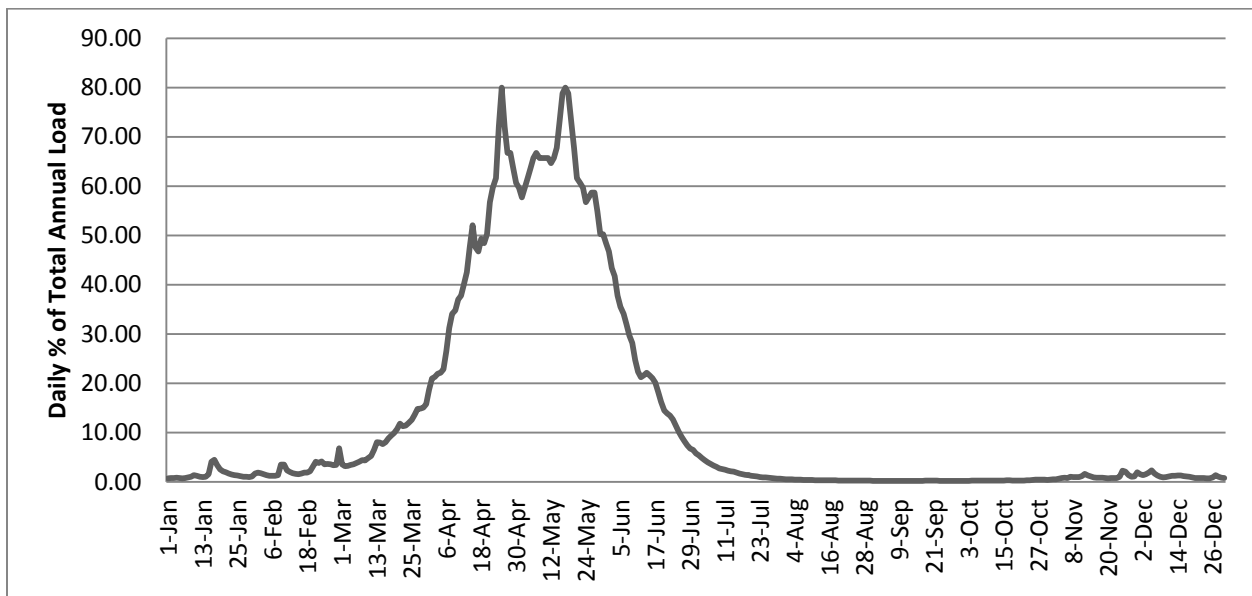


Figure E-2. TMDL for Wolf Creek

Table E-1. Daily Sediment TMDL for Wolf Creek

Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)	Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)
Jan	1	0.02	0.75	Feb	13	0.04	1.79
Jan	2	0.02	0.80	Feb	14	0.04	1.67
Jan	3	0.02	0.81	Feb	15	0.03	1.60
Jan	4	0.02	0.85	Feb	16	0.04	1.72
Jan	5	0.02	0.81	Feb	17	0.04	1.91
Jan	6	0.02	0.76	Feb	18	0.04	1.94

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Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)	Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)
Jan	7	0.02	0.78	Feb	19	0.05	2.20
Jan	8	0.02	0.95	Feb	20	0.07	3.12
Jan	9	0.02	1.09	Feb	21	0.09	4.15
Jan	10	0.03	1.37	Feb	22	0.08	3.84
Jan	11	0.03	1.28	Feb	23	0.09	4.17
Jan	12	0.02	1.08	Feb	24	0.08	3.58
Jan	13	0.02	1.02	Feb	25	0.08	3.66
Jan	14	0.02	1.08	Feb	26	0.08	3.62
Jan	15	0.04	1.61	Feb	27	0.07	3.37
Jan	16	0.09	4.15	Feb	28	0.08	3.50
Jan	17	0.10	4.49	Mar	1	0.15	6.82
Jan	18	0.07	3.41	Mar	2	0.08	3.58
Jan	19	0.06	2.53	Mar	3	0.07	3.23
Jan	20	0.05	2.18	Mar	4	0.07	3.25
Jan	21	0.04	1.97	Mar	5	0.08	3.50
Jan	22	0.04	1.72	Mar	6	0.08	3.60
Jan	23	0.03	1.53	Mar	7	0.08	3.84
Jan	24	0.03	1.38	Mar	8	0.09	4.10
Jan	25	0.03	1.32	Mar	9	0.10	4.45
Jan	26	0.03	1.18	Mar	10	0.10	4.40
Jan	27	0.02	1.10	Mar	11	0.11	4.81
Jan	28	0.02	1.05	Mar	12	0.12	5.31
Jan	29	0.02	1.03	Mar	13	0.14	6.52
Jan	30	0.02	1.12	Mar	14	0.18	8.06
Jan	31	0.04	1.72	Mar	15	0.18	8.03
Feb	1	0.04	1.94	Mar	16	0.17	7.68
Feb	2	0.04	1.81	Mar	17	0.18	8.06
Feb	3	0.03	1.57	Mar	18	0.19	8.87
Feb	4	0.03	1.40	Mar	19	0.21	9.47
Feb	5	0.03	1.29	Mar	20	0.22	9.97
Feb	6	0.03	1.25	Mar	21	0.23	10.72
Feb	7	0.03	1.25	Mar	22	0.26	11.82
Feb	8	0.03	1.39	Mar	23	0.25	11.34
Feb	9	0.08	3.56	Mar	24	0.25	11.46
Feb	10	0.08	3.56	Mar	25	0.26	11.98
Feb	11	0.05	2.36	Mar	26	0.28	12.64
Feb	12	0.04	2.01	Mar	27	0.30	13.63
Mar	28	0.32	14.8	May	10	1.44	65.7
Mar	29	0.33	14.9	May	11	1.44	65.7
Mar	30	0.33	15.1	May	12	1.44	65.7
Mar	31	0.35	15.8	May	13	1.41	64.7
Apr	1	0.41	18.7	May	14	1.44	65.7
Apr	2	0.46	21.0	May	15	1.48	67.8
Apr	3	0.47	21.3	May	16	1.60	73.2
Apr	4	0.48	21.9	May	17	1.72	78.8
Apr	5	0.48	22.2	May	18	1.75	80.0
Apr	6	0.50	22.9	May	19	1.72	78.8

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Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)	Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)
Apr	7	0.58	26.6	May	20	1.60	73.2
Apr	8	0.68	31.2	May	21	1.48	67.8
Apr	9	0.74	34.1	May	22	1.35	61.6
Apr	10	0.76	34.8	May	23	1.33	60.6
Apr	11	0.81	37.0	May	24	1.30	59.6
Apr	12	0.83	37.8	May	25	1.24	56.7
Apr	13	0.88	40.1	May	26	1.26	57.7
Apr	14	0.93	42.5	May	27	1.28	58.7
Apr	15	1.04	47.6	May	28	1.28	58.7
Apr	16	1.14	52.0	May	29	1.20	54.8
Apr	17	1.04	47.6	May	30	1.10	50.2
Apr	18	1.02	46.7	May	31	1.10	50.2
Apr	19	1.08	49.3	Jun	1	1.06	48.5
Apr	20	1.06	48.5	Jun	2	1.02	46.7
Apr	21	1.10	50.2	Jun	3	0.95	43.4
Apr	22	1.24	56.7	Jun	4	0.91	41.7
Apr	23	1.30	59.6	Jun	5	0.83	37.8
Apr	24	1.35	61.6	Jun	6	0.78	35.5
Apr	25	1.58	72.1	Jun	7	0.74	34.1
Apr	26	1.75	80.0	Jun	8	0.70	31.9
Apr	27	1.58	72.1	Jun	9	0.65	29.7
Apr	28	1.46	66.7	Jun	10	0.62	28.2
Apr	29	1.46	66.7	Jun	11	0.54	24.8
Apr	30	1.39	63.6	Jun	12	0.49	22.3
May	1	1.33	60.6	Jun	13	0.46	21.3
May	2	1.30	59.6	Jun	14	0.47	21.6
May	3	1.26	57.7	Jun	15	0.48	22.2
May	4	1.30	59.6	Jun	16	0.47	21.6
May	5	1.35	61.6	Jun	17	0.46	21.1
May	6	1.39	63.6	Jun	18	0.44	20.2
May	7	1.44	65.7	Jun	19	0.40	18.3
May	8	1.46	66.7	Jun	20	0.35	16.2
May	9	1.44	65.7	Jun	21	0.32	14.5
Jun	22	0.30	13.9	Aug	4	0.01	0.5
Jun	23	0.29	13.5	Aug	5	0.01	0.5
Jun	24	0.28	12.7	Aug	6	0.01	0.5
Jun	25	0.25	11.5	Aug	7	0.01	0.5
Jun	26	0.22	10.2	Aug	8	0.01	0.5
Jun	27	0.20	9.1	Aug	9	0.01	0.4
Jun	28	0.18	8.3	Aug	10	0.01	0.4
Jun	29	0.16	7.5	Aug	11	0.01	0.4
Jun	30	0.15	6.8	Aug	12	0.01	0.4
Jul	1	0.14	6.5	Aug	13	0.01	0.4
Jul	2	0.13	5.8	Aug	14	0.01	0.4
Jul	3	0.12	5.4	Aug	15	0.01	0.3
Jul	4	0.11	4.9	Aug	16	0.01	0.3
Jul	5	0.10	4.4	Aug	17	0.01	0.3

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Jul	6	0.09	4.0	Aug	18	0.01	0.3
Jul	7	0.08	3.7	Aug	19	0.01	0.3
Jul	8	0.07	3.3	Aug	20	0.01	0.3
Jul	9	0.07	3.1	Aug	21	0.01	0.3
Jul	10	0.06	2.8	Aug	22	0.01	0.3
Jul	11	0.06	2.7	Aug	23	0.01	0.3
Jul	12	0.05	2.5	Aug	24	0.01	0.3
Jul	13	0.05	2.3	Aug	25	0.01	0.3
Jul	14	0.05	2.2	Aug	26	0.01	0.3
Jul	15	0.05	2.1	Aug	27	0.01	0.3
Jul	16	0.04	1.9	Aug	28	0.01	0.3
Jul	17	0.04	1.7	Aug	29	0.01	0.3
Jul	18	0.03	1.6	Aug	30	0.01	0.3
Jul	19	0.03	1.5	Aug	31	0.01	0.3
Jul	20	0.03	1.4	Sep	1	0.01	0.3
Jul	21	0.03	1.3	Sep	2	0.01	0.3
Jul	22	0.03	1.2	Sep	3	0.01	0.3
Jul	23	0.02	1.1	Sep	4	0.01	0.3
Jul	24	0.02	1.0	Sep	5	0.01	0.2
Jul	25	0.02	1.0	Sep	6	0.01	0.2
Jul	26	0.02	0.9	Sep	7	0.01	0.2
Jul	27	0.02	0.9	Sep	8	0.01	0.2
Jul	28	0.02	0.8	Sep	9	0.01	0.2
Jul	29	0.02	0.7	Sep	10	0.01	0.2
Jul	30	0.02	0.7	Sep	11	0.01	0.2
Jul	31	0.01	0.7	Sep	12	0.005	0.2
Aug	1	0.01	0.6	Sep	13	0.005	0.2
Aug	2	0.01	0.6	Sep	14	0.005	0.2
Aug	3	0.01	0.6	Sep	15	0.005	0.2
Sep	16	0.005	0.2	Oct	29	0.01	0.5
Sep	17	0.01	0.2	Oct	30	0.01	0.5
Sep	18	0.01	0.2	Oct	31	0.01	0.4
Sep	19	0.01	0.3	Nov	1	0.01	0.5
Sep	20	0.01	0.3	Nov	2	0.01	0.6
Sep	21	0.01	0.3	Nov	3	0.01	0.6
Sep	22	0.01	0.3	Nov	4	0.01	0.7
Sep	23	0.01	0.3	Nov	5	0.02	0.8
Sep	24	0.01	0.3	Nov	6	0.02	0.9
Sep	25	0.01	0.3	Nov	7	0.02	0.8
Sep	26	0.01	0.3	Nov	8	0.02	1.1
Sep	27	0.01	0.3	Nov	9	0.02	1.0
Sep	28	0.01	0.2	Nov	10	0.02	1.0
Sep	29	0.01	0.2	Nov	11	0.02	1.0
Sep	30	0.01	0.2	Nov	12	0.03	1.2
Oct	1	0.005	0.2	Nov	13	0.04	1.7
Oct	2	0.01	0.2	Nov	14	0.03	1.3
Oct	3	0.01	0.3	Nov	15	0.02	1.1

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Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)	Month	Day	Daily % of annual load	Wolf Creek TMDL (tons/day)
Oct	4	0.01	0.3	Nov	16	0.02	0.9
Oct	5	0.01	0.3	Nov	17	0.02	0.9
Oct	6	0.01	0.3	Nov	18	0.02	0.9
Oct	7	0.01	0.3	Nov	19	0.02	0.8
Oct	8	0.01	0.3	Nov	20	0.02	0.8
Oct	9	0.01	0.3	Nov	21	0.02	0.7
Oct	10	0.01	0.3	Nov	22	0.02	0.8
Oct	11	0.01	0.3	Nov	23	0.02	0.8
Oct	12	0.01	0.3	Nov	24	0.02	0.8
Oct	13	0.01	0.3	Nov	25	0.02	1.1
Oct	14	0.01	0.3	Nov	26	0.05	2.3
Oct	15	0.01	0.3	Nov	27	0.05	2.1
Oct	16	0.01	0.3	Nov	28	0.03	1.4
Oct	17	0.01	0.3	Nov	29	0.02	1.1
Oct	18	0.01	0.3	Nov	30	0.03	1.2
Oct	19	0.01	0.3	Dec	1	0.04	2.0
Oct	20	0.01	0.3	Dec	2	0.03	1.6
Oct	21	0.01	0.3	Dec	3	0.03	1.4
Oct	22	0.01	0.3	Dec	4	0.03	1.6
Oct	23	0.01	0.3	Dec	5	0.04	1.9
Oct	24	0.01	0.3	Dec	6	0.05	2.4
Oct	25	0.01	0.3	Dec	7	0.04	1.7
Oct	26	0.01	0.4	Dec	8	0.03	1.3
Oct	27	0.01	0.5	Dec	9	0.02	1.1
Oct	28	0.01	0.5	Dec	10	0.02	1.0
Dec	11	0.02	1.0				
Dec	12	0.03	1.1				
Dec	13	0.03	1.2				
Dec	14	0.03	1.2				
Dec	15	0.03	1.3				
Dec	16	0.03	1.3				
Dec	17	0.03	1.2				
Dec	18	0.03	1.1				
Dec	19	0.02	1.1				
Dec	20	0.02	1.0				
Dec	21	0.02	0.8				
Dec	22	0.02	0.8				
Dec	23	0.02	0.8				
Dec	24	0.02	0.8				
Dec	25	0.02	0.8				
Dec	26	0.02	0.8				
Dec	27	0.02	1.0				
Dec	28	0.03	1.4				
Dec	29	0.02	1.1				
Dec	30	0.02	0.9				
Dec	31	0.02	0.8				

Table E-2. Sediment TMDLs expressed as an average annual load (tons/year)

Stream Segment	Waterbody #	TMDL expressed as average annual load (tons/year)
LAKE CREEK , Bull Lake outlet to mouth (Kootenai River)	MT76D002_070	3,818
LIBBY CREEK , from the highway 2 bridge to mouth (Kootenai River)	MT76D002_062	4,234
RAVEN CREEK , headwaters to mouth (Pleasant Valley Fisher River)	MT76C001_030	81
WOLF CREEK , headwaters to mouth (Fisher River)	MT76C001_020	4,575

