

APPENDIX G

TOTAL MAXIMUM DAILY LOADS

Overview

A percent reduction approach was used for the TMDLs within this document because there is uncertainty associated with the loads derived from the source assessment, and using the estimated sediment loads creates a rigid perception that the loads are absolutely conclusive. However, because daily loads are a required product of TMDL development and percent reductions are most relevant at an annual scale, loads within this appendix are expressed as daily loads. 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.

Approach

The average annual sediment loads determined from source assessments (**Section 5.0**) were used along with historical flow and suspended sediment data from the Shields River to determine average daily sediment loads for the Shields River and Potter Creek. A sediment rating curve was developed using flow and suspended solids data collected from 1999 through 2003 at the USGS gage at Livingston (Station 6195600) (**Figure G-1**).

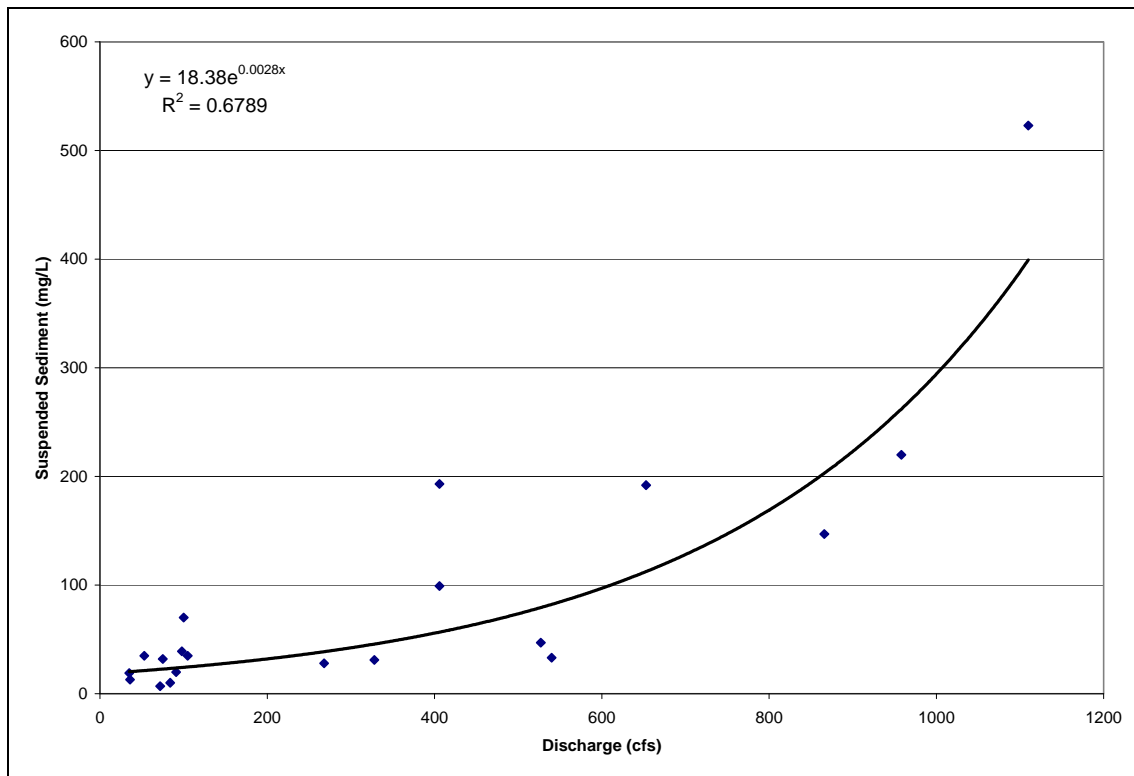


Figure G-1. Sediment Rating Curve for the Shields River

The daily mean discharge based on 28 years of record (1978-2006) at the USGS gage was then plugged into the equation for the sediment rating curve to get a daily suspended sediment value. The suspended sediment value is only a fraction of the total load from the source assessment, but provides an approximation of the relationship between sediment and flow in the Shields River. Based on the sum of the calculated daily sediment values, 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 7.0** for the upper and lower Shields River and Potter Creek (90,000, 151,000 and 8,500 tons/year, respectively) to determine the average daily load (**Figures G-2 through G-4, Table G-1**). The TMDL for the lower Shields incorporates the load from the upper Shields. Although the relationship between sediment in flow is likely different in Potter Creek than in the Shields River, it was used to determine average daily loads because it is the best available data and TMDL implementation activities will not be driven by the daily loads. The daily loads are a composite of the allocations. Daily allocations for roads, upland erosion, and streambank erosion can be calculated for a particular day by multiplying the values in **Table G-2** by that day's average load. For example, the lower Shields River average daily load for January 1 is 36 tons and the allocations are as follows:

- Upland Erosion – 15 tons
- Streambank Erosion – 21 tons
- Unpaved Roads – < 1 ton

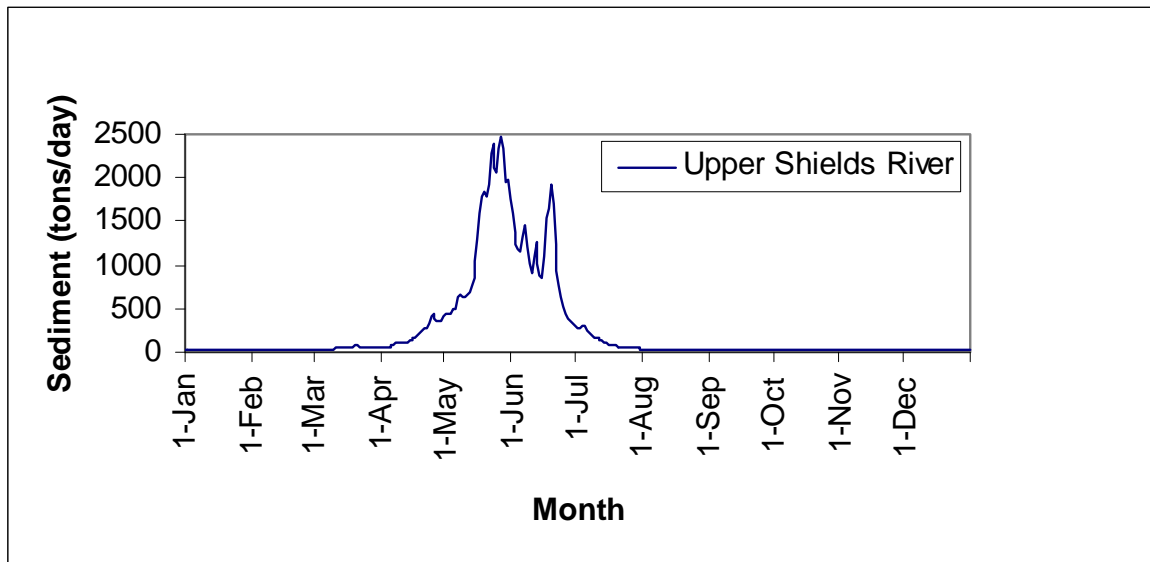


Figure G-2. Average Daily Sediment Load for the upper Shields River

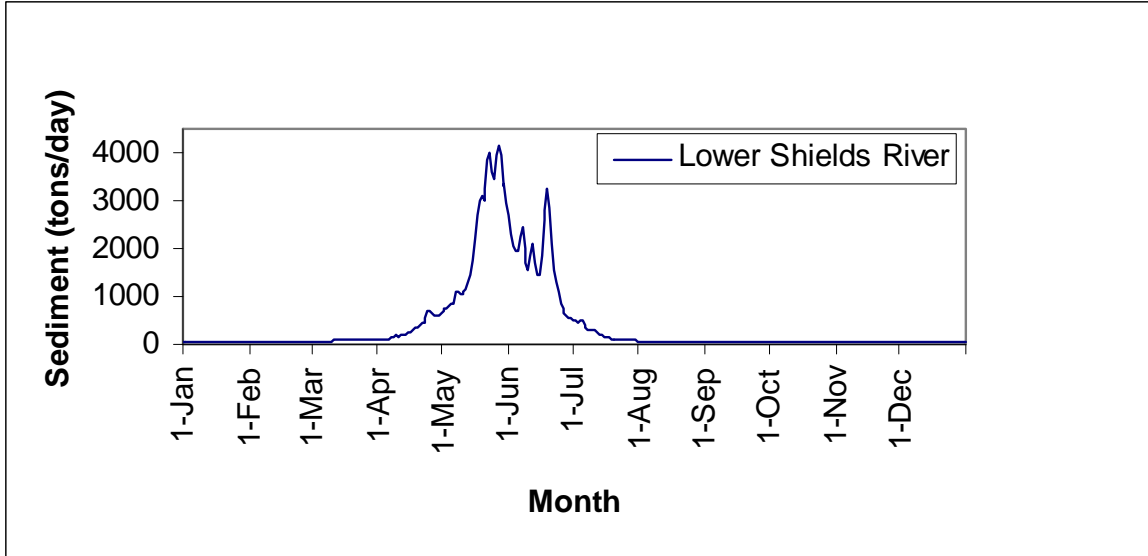


Figure G-3. Average Daily Sediment Load for the lower Shields River

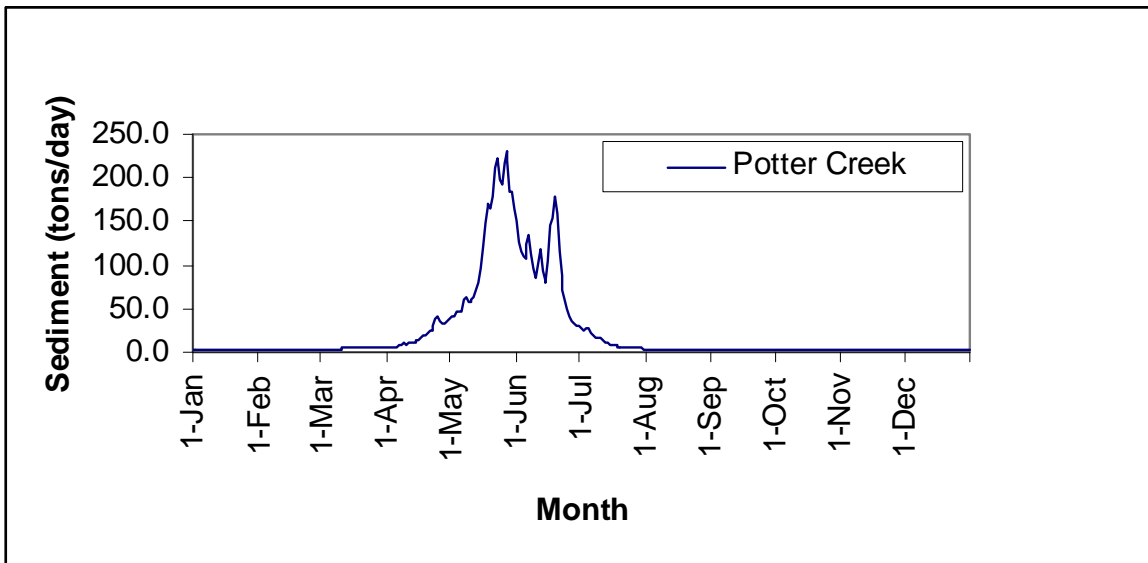


Figure G-4. Average Daily Sediment Load for Potter Creek

Table G-1. Daily TMDL for the Shields River and Potter Creek.

Month	Day	Upper Shields TMDL (tons/day)	Lower Shields TMDL (tons/day)	Potter Creek TMDL (tons/day)	Month	Day	Upper Shields TMDL (tons/day)	Lower Shields TMDL (tons/day)	Potter Creek TMDL (tons/day)
Jan	1	21	36	2	Feb	16	24	40	2
Jan	2	22	37	2	Feb	17	28	48	3
Jan	3	22	38	2	Feb	18	28	47	3
Jan	4	22	37	2	Feb	19	27	46	3
Jan	5	22	37	2	Feb	20	32	54	3
Jan	6	26	43	2	Feb	21	36	60	3
Jan	7	27	46	3	Feb	22	34	57	3
Jan	8	25	43	2	Feb	23	25	42	2
Jan	9	23	39	2	Feb	24	24	40	2
Jan	10	22	38	2	Feb	25	27	46	3
Jan	11	22	37	2	Feb	26	33	55	3
Jan	12	21	36	2	Feb	27	30	50	3
Jan	13	22	36	2	Feb	28	26	44	2
Jan	14	21	36	2	Feb	29	22	38	2
Jan	15	21	36	2	Mar	1	26	44	2
Jan	16	21	36	2	Mar	2	27	46	3
Jan	17	21	35	2	Mar	3	27	46	3
Jan	18	21	36	2	Mar	4	27	46	3
Jan	19	21	35	2	Mar	5	26	43	2
Jan	20	21	36	2	Mar	6	27	45	2
Jan	21	21	35	2	Mar	7	29	49	3
Jan	22	21	35	2	Mar	8	32	54	3
Jan	23	21	35	2	Mar	9	36	60	3
Jan	24	21	35	2	Mar	10	37	62	3
Jan	25	20	34	2	Mar	11	47	79	4
Jan	26	21	35	2	Mar	12	58	97	5
Jan	27	21	35	2	Mar	13	68	115	6
Jan	28	22	37	2	Mar	14	63	107	6
Jan	29	21	35	2	Mar	15	63	106	6
Jan	30	20	34	2	Mar	16	56	94	5
Jan	31	21	35	2	Mar	17	48	82	5
Feb	1	30	51	3	Mar	18	46	77	4
Feb	2	31	52	3	Mar	19	59	99	5
Feb	3	22	37	2	Mar	20	69	117	6
Feb	4	21	35	2	Mar	21	71	120	7
Feb	5	20	34	2	Mar	22	60	100	6
Feb	6	21	35	2	Mar	23	56	95	5
Feb	7	29	49	3	Mar	24	56	95	5
Feb	8	37	63	3	Mar	25	53	89	5
Feb	9	35	59	3	Mar	26	51	86	5
Feb	10	30	51	3	Mar	27	56	95	5
Feb	11	22	36	2	Mar	28	50	85	5
Feb	12	21	36	2	Mar	29	49	82	5
Feb	13	21	36	2	Mar	30	48	82	5
Feb	14	23	39	2	Mar	31	49	82	5
Feb	15	23	39	2	Apr	1	50	85	5
					Apr	2	62	104	6

Table G-1. Daily TMDL for the Shields River and Potter Creek.

Month	Day	Upper Shields TMDL (tons/day)	Lower Shields TMDL (tons/day)	Potter Creek TMDL (tons/day)	Month	Day	Upper Shields TMDL (tons/day)	Lower Shields TMDL (tons/day)	Potter Creek TMDL (tons/day)
Apr	3	66	112	6	May	20	1773	2990	166
Apr	4	64	107	6	May	21	1924	3246	180
Apr	5	60	100	6	May	22	2273	3834	212
Apr	6	71	119	7	May	23	2380	4015	222
Apr	7	90	153	8	May	24	2129	3591	199
Apr	8	100	169	9	May	25	2056	3468	192
Apr	9	104	176	10	May	26	2335	3939	218
Apr	10	101	170	9	May	27	2463	4156	230
Apr	11	105	177	10	May	28	2344	3954	219
Apr	12	110	186	10	May	29	1962	3310	183
Apr	13	118	199	11	May	30	1978	3336	185
Apr	14	130	220	12	May	31	1759	2967	164
Apr	15	149	251	14	Jun	1	1607	2710	150
Apr	16	157	265	15	Jun	2	1365	2302	128
Apr	17	176	297	16	Jun	3	1224	2065	114
Apr	18	197	333	18	Jun	4	1170	1974	109
Apr	19	217	366	20	Jun	5	1142	1927	107
Apr	20	237	399	22	Jun	6	1327	2238	124
Apr	21	263	444	25	Jun	7	1449	2444	135
Apr	22	277	467	26	Jun	8	1199	2023	112
Apr	23	328	554	31	Jun	9	1022	1725	96
Apr	24	406	685	38	Jun	10	914	1542	85
Apr	25	429	724	40	Jun	11	1101	1857	103
Apr	26	386	651	36	Jun	12	1259	2124	118
Apr	27	356	601	33	Jun	13	1006	1696	94
Apr	28	360	607	34	Jun	14	873	1473	82
Apr	29	370	624	35	Jun	15	855	1442	80
Apr	30	399	673	37	Jun	16	1110	1872	104
May	1	429	724	40	Jun	17	1544	2605	144
May	2	439	741	41	Jun	18	1658	2797	155
May	3	452	762	42	Jun	19	1917	3234	179
May	4	488	823	46	Jun	20	1691	2853	158
May	5	490	827	46	Jun	21	1249	2107	117
May	6	508	857	47	Jun	22	929	1568	87
May	7	642	1083	60	Jun	23	769	1297	72
May	8	665	1121	62	Jun	24	642	1083	60
May	9	631	1064	59	Jun	25	515	868	48
May	10	625	1055	58	Jun	26	435	734	41
May	11	653	1102	61	Jun	27	391	660	37
May	12	679	1146	63	Jun	28	366	618	34
May	13	766	1292	72	Jun	29	338	570	32
May	14	851	1436	80	Jun	30	314	530	29
May	15	1039	1753	97	Jul	1	287	483	27
May	16	1295	2185	121	Jul	2	282	476	26
May	17	1588	2678	148	Jul	3	271	458	25
May	18	1787	3014	167	Jul	4	302	510	28
May	19	1829	3086	171	Jul	5	294	495	27
					Jul	6	247	416	23

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Jul	7	212	358	20	Aug	24	29	48	3
Jul	8	188	317	18	Aug	25	29	49	3
Jul	9	169	284	16	Aug	26	29	49	3
Jul	10	171	289	16	Aug	27	29	48	3
Jul	11	168	283	16	Aug	28	28	47	3
Jul	12	145	244	14	Aug	29	28	47	3
Jul	13	130	220	12	Aug	30	28	47	3
Jul	14	114	193	11	Aug	31	27	46	3
Jul	15	100	168	9	Sep	1	27	45	3
Jul	16	91	154	9	Sep	2	27	45	2
Jul	17	82	138	8	Sep	3	26	44	2
Jul	18	76	129	7	Sep	4	26	43	2
Jul	19	72	121	7	Sep	5	26	43	2
Jul	20	66	112	6	Sep	6	26	44	2
Jul	21	65	109	6	Sep	7	26	43	2
Jul	22	58	97	5	Sep	8	25	43	2
Jul	23	54	91	5	Sep	9	26	44	2
Jul	24	50	84	5	Sep	10	26	43	2
Jul	25	47	79	4	Sep	11	26	44	2
Jul	26	52	88	5	Sep	12	30	50	3
Jul	27	62	105	6	Sep	13	32	54	3
Jul	28	55	94	5	Sep	14	31	52	3
Jul	29	48	82	5	Sep	15	30	50	3
Jul	30	45	76	4	Sep	16	28	48	3
Jul	31	41	69	4	Sep	17	28	47	3
Aug	1	38	64	4	Sep	18	28	47	3
Aug	2	35	59	3	Sep	19	29	49	3
Aug	3	33	56	3	Sep	20	30	51	3
Aug	4	31	53	3	Sep	21	31	52	3
Aug	5	31	52	3	Sep	22	31	53	3
Aug	6	31	52	3	Sep	23	31	53	3
Aug	7	27	46	3	Sep	24	31	52	3
Aug	8	27	45	3	Sep	25	31	52	3
Aug	9	27	45	3	Sep	26	30	51	3
Aug	10	26	44	2	Sep	27	31	52	3
Aug	11	25	43	2	Sep	28	33	55	3
Aug	12	26	44	2	Sep	29	32	53	3
Aug	13	26	44	2	Sep	30	31	52	3
Aug	14	26	44	2	Oct	1	35	59	3
Aug	15	25	43	2	Oct	2	35	59	3
Aug	16	26	43	2	Oct	3	35	59	3
Aug	17	26	44	2	Oct	4	36	61	3
Aug	18	25	42	2	Oct	5	38	64	4
Aug	19	25	43	2	Oct	6	36	61	3
Aug	20	25	42	2	Oct	7	35	59	3
Aug	21	25	42	2	Oct	8	35	59	3
Aug	22	31	52	3	Oct	9	35	59	3
Aug	23	31	53	3	Oct	10	35	58	3

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Oct	11	35	59	3	Nov	26	27	46	3
Oct	12	35	59	3	Nov	27	27	45	3
Oct	13	35	59	3	Nov	28	27	45	3
Oct	14	35	59	3	Nov	29	26	44	2
Oct	15	36	61	3	Nov	30	26	44	2
Oct	16	37	62	3	Dec	1	26	44	2
Oct	17	37	62	3	Dec	2	27	45	3
Oct	18	36	61	3	Dec	3	27	46	3
Oct	19	36	61	3	Dec	4	27	46	3
Oct	20	36	61	3	Dec	5	26	44	2
Oct	21	35	59	3	Dec	6	26	44	2
Oct	22	35	59	3	Dec	7	25	42	2
Oct	23	35	59	3	Dec	8	25	42	2
Oct	24	35	59	3	Dec	9	26	44	2
Oct	25	35	59	3	Dec	10	26	44	2
Oct	26	35	59	3	Dec	11	24	41	2
Oct	27	35	58	3	Dec	12	24	41	2
Oct	28	35	58	3	Dec	13	25	43	2
Oct	29	35	58	3	Dec	14	26	43	2
Oct	30	34	57	3	Dec	15	24	41	2
Oct	31	34	57	3	Dec	16	23	39	2
Nov	1	33	55	3	Dec	17	22	37	2
Nov	2	33	56	3	Dec	18	21	36	2
Nov	3	33	56	3	Dec	19	21	35	2
Nov	4	33	56	3	Dec	20	21	35	2
Nov	5	34	57	3	Dec	21	21	36	2
Nov	6	34	57	3	Dec	22	21	35	2
Nov	7	33	56	3	Dec	23	20	34	2
Nov	8	33	55	3	Dec	24	20	34	2
Nov	9	33	56	3	Dec	25	21	36	2
Nov	10	33	55	3	Dec	26	22	38	2
Nov	11	31	52	3	Dec	27	22	37	2
Nov	12	31	52	3	Dec	28	21	35	2
Nov	13	32	54	3	Dec	29	20	34	2
Nov	14	33	55	3	Dec	30	21	36	2
Nov	15	31	52	3	Dec	31	21	36	2
Nov	16	32	54	3					
Nov	17	31	53	3					
Nov	18	32	53	3					
Nov	19	31	53	3					
Nov	20	30	51	3					
Nov	21	29	49	3					
Nov	22	29	48	3					
Nov	23	27	45	2					
Nov	24	27	46	3					
Nov	25	28	47	3					

Table G-2. Daily Allocation Factors for Upland Erosion, Bank Erosion, and Unpaved Roads

They can be multiplied by the average daily loads to get a daily allocation			
Source	Upper Shields	Lower Shields	Potter Creek
Upland Erosion	0.444	0.413	0.556
Streambank Erosion	0.555	0.586	0.443
Unpaved Roads	0.001	0.001	0.001