APPENDIX H – SEDIMENT TOTAL MAXIMUM DAILY LOADS

H1.0 OVERVIEW

In this appendix the TMDL is expressed using daily loads to satisfy an additional EPA required TMDL element. Daily loads should not be considered absolute limits for a given day 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, pollutant loads are expected to be reduced to a degree that the targets are met and beneficial uses are no longer impaired. It is not expected that daily loads will drive implementation activities.

H2.0 SEDIMENT DAILY LOAD 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. Within the Rock Creek watershed, there are only two long-term gage stations: Middle Fork Rock Creek near Philipsburg MT (12332000) and Rock creek near Clinton MT (12334510). Neither of these gage stations have a continuous daily record of suspended sediment data.

Although no continuous suspended sediment data is associated with these gages, the average daily hydrograph can be used to infer an estimated daily sediment load. A daily sediment load was determined using the means of daily mean values for discharge in cfs per day from the USGS gage station on Middle Fork Rock Creek (12332000). This USGS station was selected to represent the daily variability in flows because it is located on a tributary to Rock Creek and the TMDLs in this document are all tributary streams. It is assumed in this representation that the sediment loads will generally follow the hydrograph, as increased flows often reflect increased runoff that carries sediment from upland erosion and is more likely to influence bank erosion. Therefore, the percentage of the mean of daily mean value for discharge, in relation to the sum of the mean of daily mean discharge values can be derived and applied to the sediment loads for a watershed of interest.

The mean of daily mean values for discharge, in cfs, was calculated based on approximately 75 years of record (October 1, 1937 – September 30, 2012) from the Middle Fork Rock Creek USGS station (**Table H-1**). **Figure H-1** visually represents the average daily percentage of the total yearly discharge for each day of the calendar year.

To conserve resources, this appendix only provides the base data from the USGS stream gage, and the daily percentages of the total annual load. For specific streams, all daily TMDLs may be derived by using the daily percentages in **Table H-2** and the TMDLs expressed as an average annual load, which are discussed in **Section 5.7**. For example, the total allowable annual sediment load for East Fork Rock Creek was estimated to be 1,559 tons per year. To determine the TMDL for East Fork Rock Creek on January 1, this value is multiplied by 0.074% which provides a daily load of 1.15 tons.

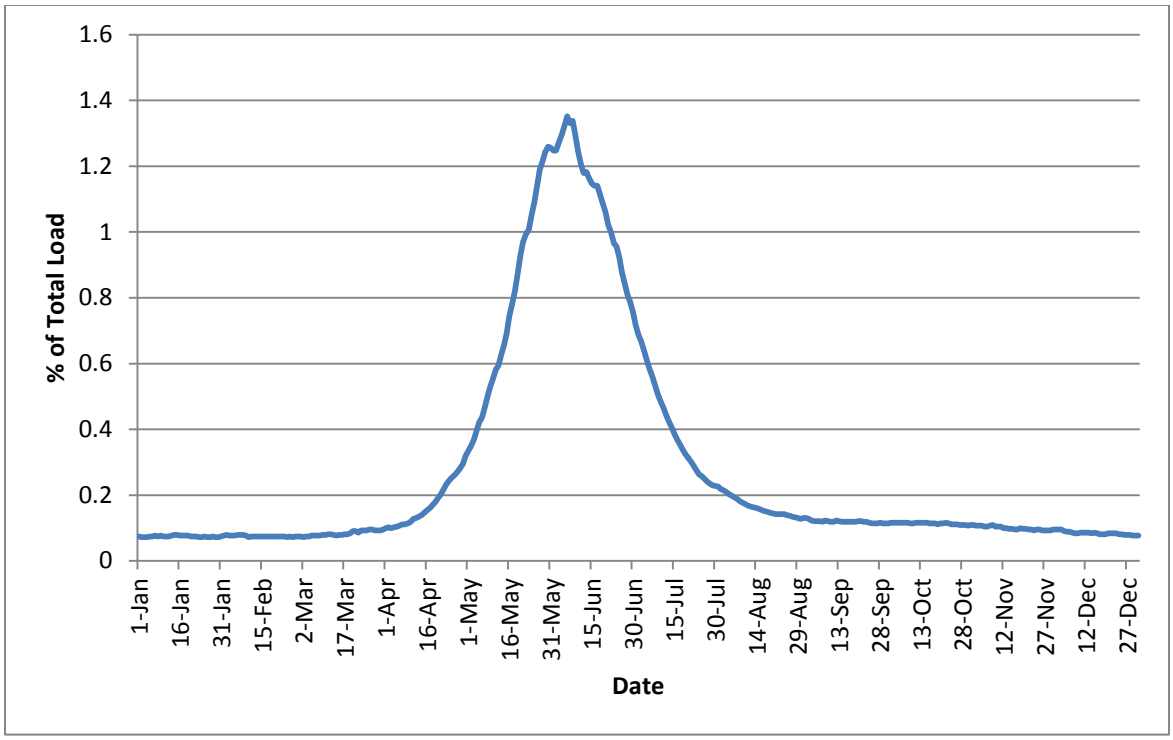

Figure H-1. Average daily percentage of the total mean yearly discharge

Figure H-1 illustrates the shape of the average hydrograph for the Middle Fork Rock Creek, driven by climate and precipitation, and typical of many western Montana streams. In general, it appears that flows (and thereby increased sediment loads) increase in the late spring as winter snowpack in the high elevations melts and drains to the waterways below. Peak flows typically occur in the month of May, followed by a declining hydrograph into August where flows near baseflow levels.

The approach outlined above provides a simple approximation for a reasonable portioning of the total annual load among days throughout the year. It is acknowledged that a direct linear relationship between sediment load and the hydrograph may not exist. Sediment loading is frequently episodic and dependent on many differing physical, climatological, and anthropogenic factors. However, the approach for daily loads in this context does provide us with insight into those times of the year where sediment loading is most likely to occur, and thereby gives us a guide for assessment and management of sediment loading in the watershed.

Table H-1. Mean of daily mean discharge values for each day for 74 - 75 years of record in, cfs (Calculation Period 1937-10-01 -> 2012-09-30)

Day of Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	32	33	32	43	144	536	308	94	56	49	47	41
2	31	34	31	44	150	536	295	92	55	50	46	41
3	31	33	32	43	158	547	287	90	53	50	46	41
4	31	33	32	44	169	557	275	87	52	50	46	39
5	32	33	33	45	181	568	262	85	52	50	45	38
6	32	34	33	46	188	581	251	83	52	50	45	38
7	33	34	33	48	200	572	241	81	51	50	46	37
8	32	34	33	48	215	575	230	78	53	50	47	36
9	33	33	34	49	227	557	218	76	52	49	45	36
10	32	31	34	51	238	535	209	74	51	49	45	37
11	32	32	35	55	250	518	201	72	51	50	45	37
12	32	32	35	56	255	507	191	71	53	50	43	37
13	33	32	34	58	270	508	183	70	52	50	43	37
14	34	32	33	60	281	500	175	69	51	50	42	36
15	34	32	34	63	298	493	167	68	51	50	42	37
16	33	32	34	66	320	490	159	66	51	49	41	36
17	33	32	35	69	336	490	153	65	51	49	41	35
18	33	32	35	73	354	478	146	64	51	49	43	35
19	33	32	36	77	375	467	140	63	51	48	42	35
20	32	32	39	82	400	455	135	62	52	49	42	36
21	32	32	39	87	417	439	130	61	52	49	41	36
22	32	32	37	94	427	429	125	61	51	50	41	36
23	31	32	40	100	433	415	119	61	51	49	40	36
24	31	31	40	105	451	411	113	61	50	48	41	35
25	32	32	40	109	468	396	111	60	49	48	41	35
26	31	31	41	112	488	377	107	59	49	48	40	34
27	31	32	41	116	511	362	104	58	49	47	40	34
28	32	32	40	121	521	348	101	57	50	47	40	34
29	31	34	40	127	534	338	99	56	49	47	40	33
30	31		40	137	541	324	98	55	49	46	41	33
31	32		41		540		97	56		47		33

Table H-2. Percentage of mean of daily mean discharge values per day based on the sum of all mean of daily mean discharge values

Day of Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.074	0.077	0.074	0.100	0.335	1.247	0.717	0.219	0.130	0.114	0.109	0.095
2	0.072	0.079	0.072	0.102	0.349	1.247	0.686	0.214	0.128	0.116	0.107	0.095
3	0.072	0.077	0.074	0.100	0.368	1.273	0.668	0.209	0.123	0.116	0.107	0.095
4	0.072	0.077	0.074	0.102	0.393	1.296	0.640	0.202	0.121	0.116	0.107	0.091
5	0.074	0.077	0.077	0.105	0.421	1.322	0.610	0.198	0.121	0.116	0.105	0.088
6	0.074	0.079	0.077	0.107	0.437	1.352	0.584	0.193	0.121	0.116	0.105	0.088
7	0.077	0.079	0.077	0.112	0.465	1.331	0.561	0.188	0.119	0.116	0.107	0.086
8	0.074	0.079	0.077	0.112	0.500	1.338	0.535	0.181	0.123	0.116	0.109	0.084
9	0.077	0.077	0.079	0.114	0.528	1.296	0.507	0.177	0.121	0.114	0.105	0.084
10	0.074	0.072	0.079	0.119	0.554	1.245	0.486	0.172	0.119	0.114	0.105	0.086
11	0.074	0.074	0.081	0.128	0.582	1.205	0.468	0.168	0.119	0.116	0.105	0.086
12	0.074	0.074	0.081	0.130	0.593	1.180	0.444	0.165	0.123	0.116	0.100	0.086
13	0.077	0.074	0.079	0.135	0.628	1.182	0.426	0.163	0.121	0.116	0.100	0.086
14	0.079	0.074	0.077	0.140	0.654	1.163	0.407	0.161	0.119	0.116	0.098	0.084
15	0.079	0.074	0.079	0.147	0.693	1.147	0.389	0.158	0.119	0.116	0.098	0.086
16	0.077	0.074	0.079	0.154	0.745	1.140	0.370	0.154	0.119	0.114	0.095	0.084
17	0.077	0.074	0.081	0.161	0.782	1.140	0.356	0.151	0.119	0.114	0.095	0.081
18	0.077	0.074	0.081	0.170	0.824	1.112	0.340	0.149	0.119	0.114	0.100	0.081
19	0.077	0.074	0.084	0.179	0.872	1.087	0.326	0.147	0.119	0.112	0.098	0.081
20	0.074	0.074	0.091	0.191	0.931	1.059	0.314	0.144	0.121	0.114	0.098	0.084
21	0.074	0.074	0.091	0.202	0.970	1.021	0.302	0.142	0.121	0.114	0.095	0.084
22	0.074	0.074	0.086	0.219	0.993	0.998	0.291	0.142	0.119	0.116	0.095	0.084
23	0.072	0.074	0.093	0.233	1.007	0.966	0.277	0.142	0.119	0.114	0.093	0.084
24	0.072	0.072	0.093	0.244	1.049	0.956	0.263	0.142	0.116	0.112	0.095	0.081
25	0.074	0.074	0.093	0.254	1.089	0.921	0.258	0.140	0.114	0.112	0.095	0.081
26	0.072	0.072	0.095	0.261	1.135	0.877	0.249	0.137	0.114	0.112	0.093	0.079
27	0.072	0.074	0.095	0.270	1.189	0.842	0.242	0.135	0.114	0.109	0.093	0.079
28	0.074	0.074	0.093	0.282	1.212	0.810	0.235	0.133	0.116	0.109	0.093	0.079
29	0.072	0.079	0.093	0.295	1.242	0.786	0.230	0.130	0.114	0.109	0.093	0.077
30	0.072	0.000	0.093	0.319	1.259	0.754	0.228	0.128	0.114	0.107	0.095	0.077
31	0.074	0.000	0.095	0.000	1.256	0.000	0.226	0.130	0.000	0.109	0.000	0.077