APPENDIX D

SENSITIVE SOILS AND SEDIMENT DELIVERY POTENTIAL ANALYSES

Appendix D
Sensitive Soils and Sediment Delivery Potential Analyses

Information was collected and processed using Geographic Information System (GIS) computer technology to evaluate sensitive soils and sediment delivery potential on the Black Hills National Forest (BHNF). Soils and sedimentation information is important in transportation planning, as road management activities need to consider the current condition and potential vulnerabilities of the areas(s) where the activities will occur. In this appendix, as throughout this document, numbers and mileages are approximate based upon best available GIS data provided by the BHNF.

Sensitive Soils

The BHNF soils GIS coverage identifies areas prone to erosion based upon soil type. Using this data, sensitive soil potential was determined by calculating the percentage of erosive soils by watershed (Table D-2).

Sediment Delivery Potential

Packer and Christiansen (1964) developed a model to determine buffer distances to prevent sediment delivery to streams. This model was used by the Forest Service to assess risk levels posed by roads for sediment delivery. A small sample of Forest roads was evaluated to determine their Packer and Christiansen model parameters. Reference road locations were stratified across a variety of forest land types and at a variety of distances from streams. While no correlation was found between landtype association and buffer type, a correlation was found between distance and buffer type (Williams, n.d.). Using this information, buffer distances were determined for various road distances from streams.

Three classes of risk were determined. The high-risk buffer distance is the distance where culverts and dips drain directly into the stream or are very close to the stream. Moderate-risk buffers are those road segments within the buffer that the model calculated that would be 83 percent effective at preventing sediment delivery. Low risk roads are those within the buffer that was calculated to be 97 percent effective. The model assumes a 30-foot spacing of surface water drainage opportunities, a distance that would prevent rilling in the road based on assumed conditions.

Field observations of roads in the Black Hills indicate that roads in the moderate or low distances from streams rarely have segments that are delivering sediment and are not hydrologically connected to the stream for most hydrologic events. As the size of hydrologic events increase, roads farther away from the stream will also begin to deliver sediment to the stream. The hazard ratings, therefore, are intended to indicate a risk evaluated at a large scale for long time periods.

To complete the analysis, perennial streams (as surveyed by the South Dakota School of Mines) were buffered at distances specified from model results as shown in Table D-1.

Table D-1. Risk Ratings

Risk	Buffer Normal Soils	Buffer Erosive Soils
3 - High	30 feet	30 feet
2 - Moderate	65 feet	89 feet
1 - Low	95 feet	119 feet

Source: Williams n.d.

Miles of road within the identified risk buffers were then identified for non erosive and erosive soils accordingly for each 6th-order HUC. The results are listed in Table D-2.

Table D-2. Sediment Delivery Potential

HUC6	Area/Square Miles	Erosive Soils Area/Square Miles	Percent Area Erosive	Total Road Miles	Miles of Road on Non-Erosive Soils				Miles of Road on Erosive Soils			
					All	30 (feet)	65 (feet)	95 (feet)	All	30 (feet)	89 (feet)	119 (feet)
101201060201	13.08	5.35	41%	12.42	3.01				9.41			
101201060203	9.71	5.35	55%	14.51	3.00				11.51			
101201060204	8.49	0.21	3%	0.24					0.24			
101201060206	16.31	1.97	12%	7.85	0.59				7.26			
101201060207	44.15	3.23	7%	32.48	2.43				30.05			
101201060208	31.49	1.09	3%	16.05					16.05			
101201060401	48.85	7.21	15%	197.35	11.59	0.65	0.95	0.60	185.76	3.51	8.34	4.19
101201060402	32.40	1.41	4%	107.50	3.72				103.78	0.15	0.53	0.28
101201060403	2.58	1.07	41%	7.74	4.37				3.38			
101201060404	12.81	5.39	42%	31.23	10.99				20.25			
101201060405	13.44	3.79	28%	20.53	3.01				17.52			
101201060406	13.75	7.53	55%	14.17	6.03				8.14			
101201070203	0.07	0.07	99%	0.36	0.36				0.00			
101201070308	17.81	8.96	50%	21.62	5.48				16.14			
101201070401	33.59	6.73	20%	134.68	16.84				117.84			
101201070402	15.86	2.72	17%	56.03	7.53				48.50			
101201070404	78.71	14.64	19%	262.38	34.15	0.58	0.55	0.10	228.23	0.60	0.22	0.02
101201070405	72.24	10.11	14%	267.31	29.21	1.60	1.59	0.52	238.10	4.71	8.90	4.25
101201070407	4.47	0.24	5%	9.87	0.26				9.62			
101201070501	49.27	3.10	6%	172.46	14.55	1.63	1.20	1.04	157.91	2.66	3.76	1.52
101201070502	37.13	12.32	33%	113.92	22.27	0.19	0.42	0.69	91.65	0.28	0.94	0.54
101201070503	37.31	9.12	24%	103.07	11.92				91.16			
101201070504	11.67	3.64	31%	13.50	1.89				11.60			
101201070505	21.87	6.71	31%	52.77	5.87				46.90			
101201090101	55.25	8.47	15%	169.13	8.19	0.05	0.13	0.22	160.95	0.19	1.21	0.51
101201090102	35.54	4.44	12%	24.86	2.71				22.15			
101201090103	24.67	1.28	5%	5.90					5.90			
101201090201	48.05	8.49	18%	189.61	12.05		0.01	0.02	177.55	1.81	5.93	4.85
101201090202	2.09	0.78	37%	8.06	0.90				7.16			
101201090203	1.85	0.36	19%	9.84	0.94				8.90			

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					All	30 (feet)	65 (feet)	95 (feet)	All	30 (feet)	89 (feet)	119 (feet)
101201090204	5.00	1.68	34%	28.76	4.36	0.10	0.43	0.02	24.41	0.84	1.00	0.37
101201090301	76.47	9.62	13%	275.49	5.84	0.05	0.02	0.01	269.65	1.68	7.42	4.62
101201090302	14.54	3.27	22%	80.86	7.65			0.03	73.21	0.56	2.50	1.80
101201090501	57.50	27.94	49%	191.55	51.06	2.85	3.57	2.04	140.49	8.97	14.01	4.14
101201090502	17.38	5.22	30%	92.49	15.16	0.03	0.12	0.18	77.33	0.31	1.25	0.53
101201090503	4.30	1.98	46%	12.54	2.43	0.15	0.13	0.07	10.11	0.45	0.60	0.38
101201090601	67.29	16.51	25%	238.89	21.89	0.75	0.99	1.44	217.00	4.95	13.62	8.43
101201090602	31.73	6.32	20%	124.79	13.03	0.37	0.71	0.88	111.76	1.46	4.25	2.62
101201090603	45.79	15.76	34%	165.26	12.44	0.44	0.44	0.35	152.82	3.78	8.85	4.87
101201090604	26.49	7.11	27%	101.56	12.38	0.68	0.46	0.61	89.18	3.38	6.30	2.47
101201100101	35.21	0.40	1%	107.60	0.48	0.03	0.05	0.08	107.12	0.64	3.09	1.74
101201100102	34.57	4.40	13%	96.00	5.37	0.71	1.02	0.28	90.62	2.17	4.59	1.86
101201100103	34.44	10.05	29%	158.25	33.39	1.47	2.36	2.85	124.86	4.12	9.81	3.23
101201100104	41.69	2.24	5%	126.72	2.51			0.09	124.21	0.71	3.51	4.24
101201100105	50.32	6.70	13%	158.84	12.71	0.30	0.18	0.09	146.12	1.89	4.48	3.17
101201100106	53.94	15.89	29%	157.83	39.82	3.55	4.49	3.01	118.02	7.06	11.79	2.80
101201100107	36.67	5.89	16%	112.02	7.66	0.16	0.12	0.12	104.36	1.76	3.65	1.48
101201100108	33.38	18.32	55%	151.21	62.32	1.74	2.37	1.73	88.88	4.21	7.99	3.30
101201100201	48.10	16.57	34%	250.16	45.26	2.18	1.97	1.17	204.90	8.76	13.02	6.08
101201100202	8.60	2.03	24%	33.62	5.04	0.00	0.01		28.58	0.01	0.01	0.01
101201110101	57.89	0.00	0%	257.91					257.91	1.82	6.17	4.31
101201110102	49.95	4.74	9%	224.25	10.83	0.16	0.58	0.68	213.42	2.79	9.57	5.26
101201110103	15.07	2.12	14%	48.39	6.90	0.46	0.30	0.07	41.49	1.13	1.36	0.69
101201110201	63.43	0.17	0%	302.58					302.58	2.66	6.51	2.91
101201110202	19.84	0.00	0%	69.63					69.63	1.90	3.85	1.26
101201110203	12.98	0.00	0%	33.64					33.64			
101202010701	2.00	0.07	4%	5.11	0.04				5.07			
101202010705	8.35	0.13	2%	22.71	0.04				22.68			
101202010707	9.54	0.07	1%	40.21					40.21	0.37	1.09	0.98
101202010801	3.04	1.68	55%	12.95	6.39				6.55			
101202010804	1.23	0.02	1%	4.89	0.08				4.80			
101202010806	5.18	0.30	6%	16.03	1.16				14.88			
101202010903	17.22	0.41	2%	88.90	0.81				88.09	0.17	1.72	1.95
101202010906	48.38	1.65	3%	211.22	3.84				207.38	2.76	4.76	3.19
101202010907	13.63	0.26	2%	49.68	0.56				49.12			
101202020101	9.13	0.03	0%	32.66					32.66	0.04	0.13	0.10
101202020102	0.16	0.00	0%	0.79					0.79			
101202020103	6.58	0.07	1%	20.68					20.68			
101202020104	2.32	0.00	0%	8.28					8.28			
101202020201	54.41	1.14	2%	155.24	2.50				152.73			
101202020601	61.02	0.32	1%	244.69	0.94				243.76			
101202020602	1.08	0.00	0%	4.49					4.49			

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HUC6	Area/Square Miles	Erosive Soils Area/Square Miles	Percent Area Erosive	Total Road Miles	Miles of Road on Non-Erosive Soils				Miles of Road on Erosive Soils			
					All	30 (feet)	65 (feet)	95 (feet)	All	30 (feet)	89 (feet)	119 (feet)
101202020701	3.54	0.00	0%	4.74					4.74			
101202030101	22.68	2.49	11%	116.24	9.53	0.00	0.09	0.15	106.72	0.57	3.66	2.87
101202030102	15.54	6.84	44%	48.49	18.73	0.11	0.19	0.64	29.76	0.23	1.10	0.00
101202030103	4.36	2.15	49%	17.78	6.66				11.13			
101202030105	20.00	0.00	0%	71.77					71.77			
101202030201	39.09	1.05	3%	159.66	3.99			0.12	155.67			
101202030202	51.66	0.17	0%	225.76	0.89				224.87			
101202030203	56.25	14.32	25%	202.71	46.31	1.81	4.40	2.73	156.40			
101202030204	12.34	1.67	14%	65.81	4.70				61.11			
101202030205	16.36	1.31	8%	52.86	4.20				48.66	3.51	8.34	4.19
101202030301	64.70	1.95	3%	238.49	7.56	0.18	1.10	2.01	230.92	0.15	0.53	0.28
101202030302	49.78	7.39	15%	170.65	22.76	1.06	1.91	3.71	147.89			
101202030303	28.51	1.02	4%	118.28	4.33	0.19	0.68	0.66	113.95			
101202030304	33.69	3.99	12%	141.45	11.78	1.50	1.14	2.50	129.67			
101202030401	3.30	0.02	1%	8.26					8.26			
101202030402	2.85	0.04	1%	12.19	0.13				12.06			
101202030403	9.31	0.00	0%	26.12					26.12			
101202030404	14.34	0.00	0%	43.29					43.29			