APPENDIX F - TOBACCO RIVER WATERSHED UPLAND SEDIMENT SOURCE ASSESSMENT

This upland sediment modeling appendix is derived from the Tobacco River Watershed Upland Sediment Modeling Final Report (Confluence Incorporated, 2009) prepared by Confluence Consulting for the Kootenai River Network and the Montana Department of Environmental Quality

F1.0 SEDIMENT CONTRIBUTION FROM HILLSLOPE EROSION

F1.1 INTRODUCTION

Upland sediment loading due to hillslope erosion was modeled using the Universal Soil Loss Equation (USLE) and sediment delivery to the stream was predicted using a sediment delivery ratio and a riparian health assessment sediment delivery reduction. This model provided an assessment of existing sediment loading from upland sources and an assessment of potential sediment loading through the application of Best Management Practices (BMPs). For this evaluation the primary BMP evaluated includes the modification in upland management practices and the secondary BMP evaluated includes the modification in riparian health management practices. When reviewing the results of the upland sediment load model, it is important to note that a significant portion of the sediment load is the "natural upland load" and not affected by the application of BMPs to the upland management practices. The assessment methodology did not differentiate between sediment loads with all reasonable BMPs and "natural" loads.

The general form of the USLE has been widely used for erosion prediction in the U.S. and is presented in the National Engineering Handbook (1983) as:

(1) $A = RK(LS)CP$ (in tons per acre per year)

where soil loss (A) is a function of the rainfall erosivity index (R), soil erodibility factor (K), overland flow slope and length (LS), crop management factor (C), and conservation practice factor (P) (Wischmeier and Smith, 1978; Renard, et al., 1997). USLE was selected for the Tobacco River watershed due to its relative simplicity and ease in parameterization and the fact that it has been integrated into a number of other erosion prediction models. These include: (1) the Agricultural Nonpoint Source Model (AGNPS), (2) Areal Nonpoint Source Watershed Environment Response Simulation Model (ANSWERS), (3) Erosion Productivity Impact Calculator (EPIC), (4) Generalized Watershed Loading Functions (GWLF), and (5) the Soil Water Assessment Tool (SWAT) (Doe, et al., 1999). A detailed description of the general USLE model parameters is presented below.

The **R-factor** is an index that characterizes the effect of raindrop impact and rate of runoff associated with a rainstorm. It is a summation of the individual storm products of the kinetic energy in rainfall (hundreds of ft-tons per acre per year) and the maximum 30-minute rainfall intensity (inches per hour). The total kinetic energy of a storm is obtained by multiplying the kinetic energy per inch of rainfall by the depth of rainfall during each intensity period.

The **K-factor** or soil erodibility factor indicates the susceptibility of soil to resist erosion. It is a measure of the average soil loss (tons per acre per hundreds of ft-tons per acre of rainfall intensity) from a

particular soil in continuous fallow. The K-factor is based on experimental data from the standard SCS erosion plot that is 72.6 ft long with uniform slope of 9%.

The **LS-factor** is a function of the slope and overland flow length of the eroding slope or cell. For the purpose of computing the LS-factor, slope is defined as the average land surface gradient. The flow length refers to the distance between where overland flow originates and runoff reaches a defined channel or depositional zone. According to McCuen (1998), flow lengths are seldom greater than 400 ft or shorter than 20 ft.

The **C-factor** or crop management factor is the ratio of the soil eroded from a specific type of cover to that from a clean-tilled fallow under identical slope and rainfall. It integrates a number of factors that effect erosion including vegetative cover, plant litter, soil surface, and land management. The original C-factor of the USLE was experimentally determined for agricultural crops and has since been modified to include rangeland and forested cover. It is now referred to as the vegetation management factor (VM) for non-agricultural settings (Brooks, et al., 1997).

Three different kinds of effects are considered in determination of the VM-factor. These include: (1) canopy cover effects, (2) effects of low-growing vegetal cover, mulch, and litter, and (3) rooting structure. A set of metrics has been published by the Soil Conservation Service (SCS) for estimation of the VM-factors for grazed and undisturbed woodlands, permanent pasture, rangeland, and idle land. Although these are quite helpful for the Tobacco River setting, Brooks (1997)cautions that more work has been carried out in determining the agriculturally based C-factors than rangeland/forest VM-factors. Because of this, the results of the interpretation should be used with discretion.

The **P-factor** or conservation practice factor is a function of the interaction of the supporting land management practice and slope. It incorporates the use of erosion control practices such as strip-cropping, terracing and contouring, and is applicable only to agricultural lands. Values of the P-factor compare straight-row (up-slope down-slope) farming practices with that of certain agriculturally based conservation practices.

F1.2 Modeling Approach

Sediment delivery from hillslope erosion was estimated using a Universal Soil Loss Equation (USLE) based model to predict soil loss, along with a distance based sediment delivery ratio (SDR) and a riparian health assessment to predict sediment delivered to the stream. This USLE based model is implemented as a watershed scale, grid format, GIS model using ArcView v 9.2 GIS software.

Desired results from the modeling effort include the following: (1) annual sediment load from each of the water quality limited segments on the state's 303(d) list, (2) the mean annual source distribution from each land category type, and (3) annual potential sediment load from each of the water quality limited segments on the state's 303(d) list after the application of upland management BMPs. Based on these considerations, a GIS- modeling approach (USLE) was formulated to facilitate database development and manipulation, provide spatially explicit output, and supply output display for the modeling effort.

F1.3 MODELING SCENARIOS

Three management scenarios were evaluated for the Tobacco River watershed. They include: (1) an existing condition scenario that considers the current land cover, management practices, and riparian health in the watershed; (2) an improved grazing and cover management scenario with existing riparian health; and (3) an improved grazing and cover management scenario with improved riparian health management.

Erosion was differentiated into two source categories for each scenario: (1) natural erosion that occurs on the time scale of geologic processes and (2) human caused erosion that is accelerated by human-caused activity. A similar classification is presented as part of the National Engineering Handbook Chapter 3 – Sedimentation (United States Department of Agriculture, 1983). Differentiation is necessary for TMDL planning. Land cover categories considered to be affected by human-caused activity and therefore affected by BMPs within the Tobacco River watershed were pasture/hay, grasslands/herbaceous, cultivated crops, and transitional (logging). All other land cover categories were considered to have "natural erosion."

Well vegetated riparian buffers have been shown to act as filters that help to remove sediment from overland flow. In general, the effectiveness of vegetated riparian buffers is proportional to their width and overall health. MT DEQ completed a riparian health assessment in the Tobacco River watershed, encompassing the Tobacco River mainstem and its primary tributary streams. This information is used to estimate further reduction in the quantity of eroded sediment that is ultimately delivered to the streams. These riparian areas are also considered to be affected by human-caused activity and are therefore subject to improved riparian health management.

F1.4 DATA SOURCES

The USLE model was parameterized using a number of published data sources. These include information from: (1) U.S. Geological survey (USGS), (2) Spatial Climate Analysis Service (SCAS), and (3) Soil Conservation Service (SCS). Additionally, local information regarding specific land cover was acquired from the U.S. Forest Service (USFS) and the Natural Resource Conservation Service (NRCS). Specific GIS coverages used in the modeling effort included the following:

Grid data of the **R-factor** was obtained from the NRCS, and is based on Parameter-elevation Regressions on Independent Slopes Model (PRISM) precipitation data. PRISM precipitation data is derived from weather station precipitation records, interpolated to a gridded landscape coverage by a method (developed by the Spatial Climate Analysis Service of Oregon State University) which accounts for the effects of elevation on precipitation patterns.

Polygon data of the **K-factor** were obtained from the NRCS General Soil Map (STATSGO) database. The USLE K factor is a standard component of the STATSGO soil survey. Soils polygon data were summarized and interpolated to grid format.

The **LS-factor** was derived from 30m USGS digital elevation model (DEM) grid data, interpolated to a 10m pixel. This factor is calculated with the model.

The **C-factor** was estimated using the National Land Cover (NLCD) dataset and using C-factor interpretations provided by the NRCS with input from MT DEQ and USFS. C-factors are intended to be conservatively representative of conditions in the Tobacco River watershed.

The **P-factor** was set to one, as per previous communication with NRCS State Agronomist who suggested that this value is the most appropriate representation of current management practices in the Tobacco River watershed.

The **sediment delivery ratio** was derived by the model for each grid cell based on the observed relationship between the distance from the delivery point to the stream and the percent of eroded sediment delivered to the stream. This relationship was established by Dube, Megahan & McCalmon in their development of the WARSEM road sediment model for the State of Washington.

The **riparian health factor** was derived from a riparian health assessment completed by MT DEQ in the Tobacco River watershed, encompassing the Tobacco River mainstem and its primary tributary streams. Ratings of poor, fair, and good were assigned by the riparian health assessment to the left and right bank of multiple reaches on each surveyed stream.

F2.0 Modeling Methods

A grid was created for each data source, giving consideration to proper stream network delineation, grid cell resolution, etc. A computer model was built using ArcView Model Builder to derive the five factors from model inputs, multiply the five factors and arrive at a predicted sediment production for each grid cell. The model also derived a sediment delivery ratio for each cell, and reduced the predicted sediment production by that factor to estimate sediment delivered to the stream network. The estimated sediment delivered to the stream network was further reduced by using a riparian health factor. Additional details about each model factor are provided in the sections that follow.

F2.1 Tobacco DEM

The digital elevation model (DEM) for the Tobacco River watershed (**Figure F2-1**) is the foundation for developing the LS factor, for defining the extent of the bounds of the analysis area (the Tobacco River watershed and Grave Creek watershed), and for delineating the area within the outer bounds of the analysis for which the USLE model is not valid (i.e. the concentrated flow channels of the stream network). The USGS 30m DEM (level 2) for the Tobacco River was used for these analyses. The DEM was interpolated to a 10m analytic grid cell to render the delineated stream network more representative of the actual size of Tobacco River watershed streams and to minimize resolution dependent stream network anomalies. The resulting interpolated 10m DEM was then subjected to standard hydrologic preprocessing, including the filling of sinks to create a positive drainage condition for all areas of the watershed.

F2.2 R-Factor

The rainfall and runoff factor (i.e. R-factor) grid was prepared by the Spatial Climate Analysis Service of Oregon State University, at 4 km grid cell resolution. For the purposes of this analysis, the R-factor grid was reprojected to Montana State Plane Coordinates (NAD83, meters), resampled to a 10m analytic cell size and clipped to the extent of the Tobacco River watershed, to match the project's standard grid definition (**Figure F2-1**).

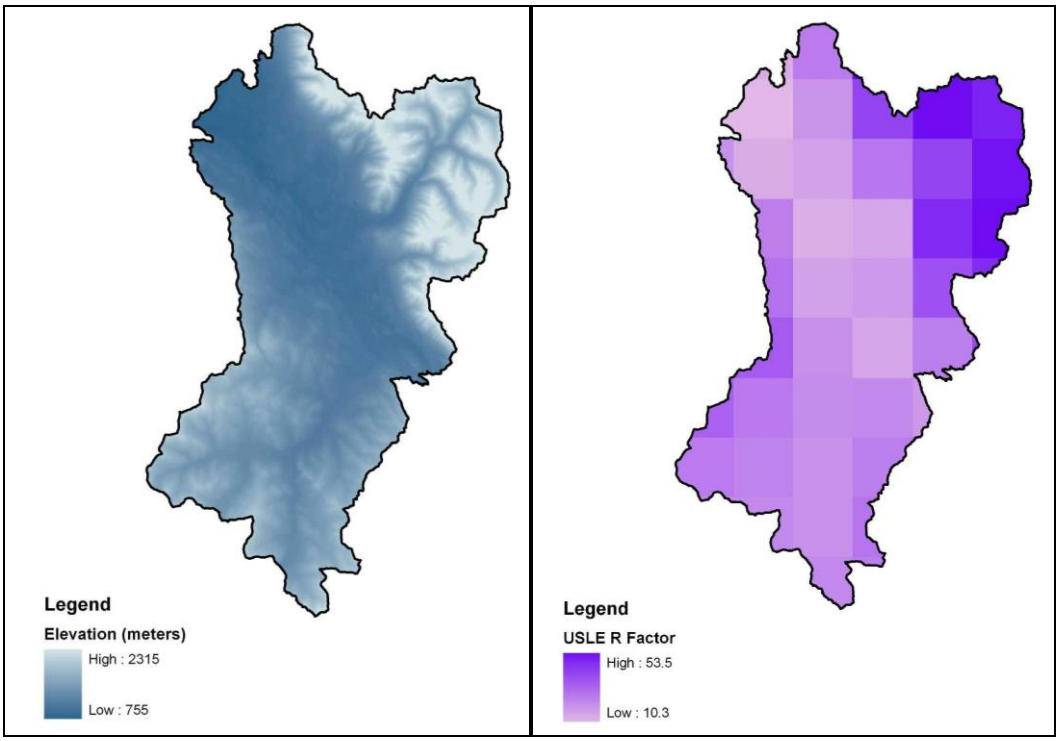


Figure F2-1 Digital Elevation Model (DEM) and R-factor of the Tobacco River Watershed

F2.3 K-Factor

The soil erodibility factor grid was compiled from 1:250K STATSGO data, as published by the NRCS. STATSGO database tables were queried to calculate a component weighted K value for all surface layers, which was then summarized by individual map unit. The map unit K values were then joined to a GIS polygon coverage of the STATSGO map units, and the polygon coverage was converted to a 10m analytic grid for use in this analysis (**Figure F2-2**). SSURGO data were considered for use, due to the higher resolution and age of the SSURGO datasets but were not used because they did not contain the required K-factor.

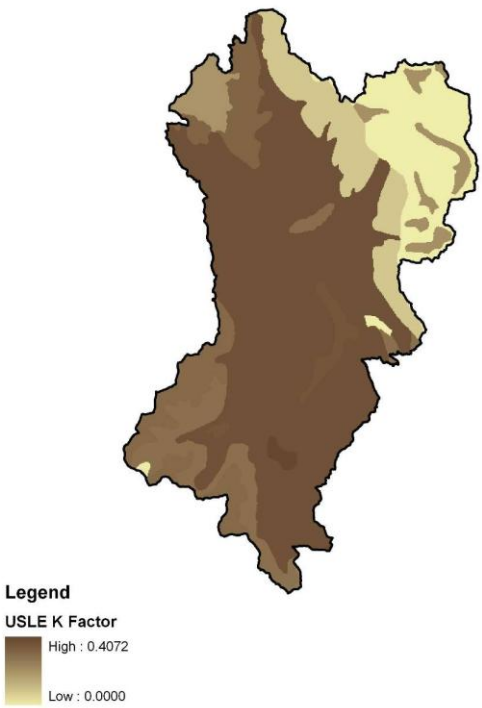


Figure F2-2 ULSE K-factor for the Tobacco River Watershed

F2.4 LS-Factor

The equation used for calculating the slope length and slope factor was that given in the updated definition of RUSLE, as published in USDA handbook #703:

$$LS = S_i (\lambda_i^{m+1} - \lambda_{i-1}^{m+1}) / (\lambda_I - \lambda_{i-1}) (72.6)^m$$

Where:

λ_i = length in feet from top of slope to lower end of ith segment. This value was determined by applying GIS based surface analysis procedures to the Tobacco River watershed DEM, calculating total upslope length for each 10m grid cell, and converting the results to feet from meters. In accordance with research that indicates that, in practice, the slope length rarely exceeds 400 ft, λ was limited to that maximum value.

S_i = slope steepness factor for the ith segment.
= $10.8 \sin \theta + 0.03$ for $\theta < 9\%$
= $16.8 \sin \theta - 0.50$ for $\theta \geq 9\%$

m = a variable slope-length exponent.
= $\beta / (1 + \beta)$

and

B = ratio of rill to interrill erosion.
= $(\sin \theta / 0.0896) / [3.0 (\sin \theta)^{0.8} + 0.56]$

θ = slope angle as calculated by GIS based surface analysis procedures from the Tobacco River watershed DEM.

The LS factor grid was calculated from individual grids computed for each of these sub factors, using a simple ArcView Model Builder script.

F2.5 NLCD

The 2001 National Land Cover Dataset (NLCD) was obtained from USGS for use in establishing USLE C-factors for the Tobacco watershed. The 2001 NLCD is a categorized 30 meter Landsat Thematic Mapper image shot in 2001 (**Figure F2-3**). The NLCD image was reprojected to Montana State plane projection/coordinate system, and resampled to the project standard 10m grid. NLCD land cover classification codes for areas present in the Tobacco watershed are described in **Table F2-1**.

Table F2-1. NLCD Land Cover Classification Codes for Areas Present in the Tobacco Watershed

Code	Description
11	Open Water - areas of open water, generally with less than 25 percent cover of vegetation or soil.
21	Developed, Open Space - Includes areas with a mixture of constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22	Developed, Low Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.
23	Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.
24	Developed, High Intensity - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80-100 percent of the total cover.
31	Barren Land (Rock/Sand/Clay) – Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15 percent of total cover.
41	Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
42	Evergreen Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
43	Mixed Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
52	Shrub/Scrub - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes tree shrubs, young trees in an early successional stage or trees stunted from environmental conditions.

Table F2-1. NLCD Land Cover Classification Codes for Areas Present in the Tobacco Watershed

Code	Description
71	Grasslands/Herbaceous - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80 percent of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
81	Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
82	Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
90	Woody Wetlands - Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
95	Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

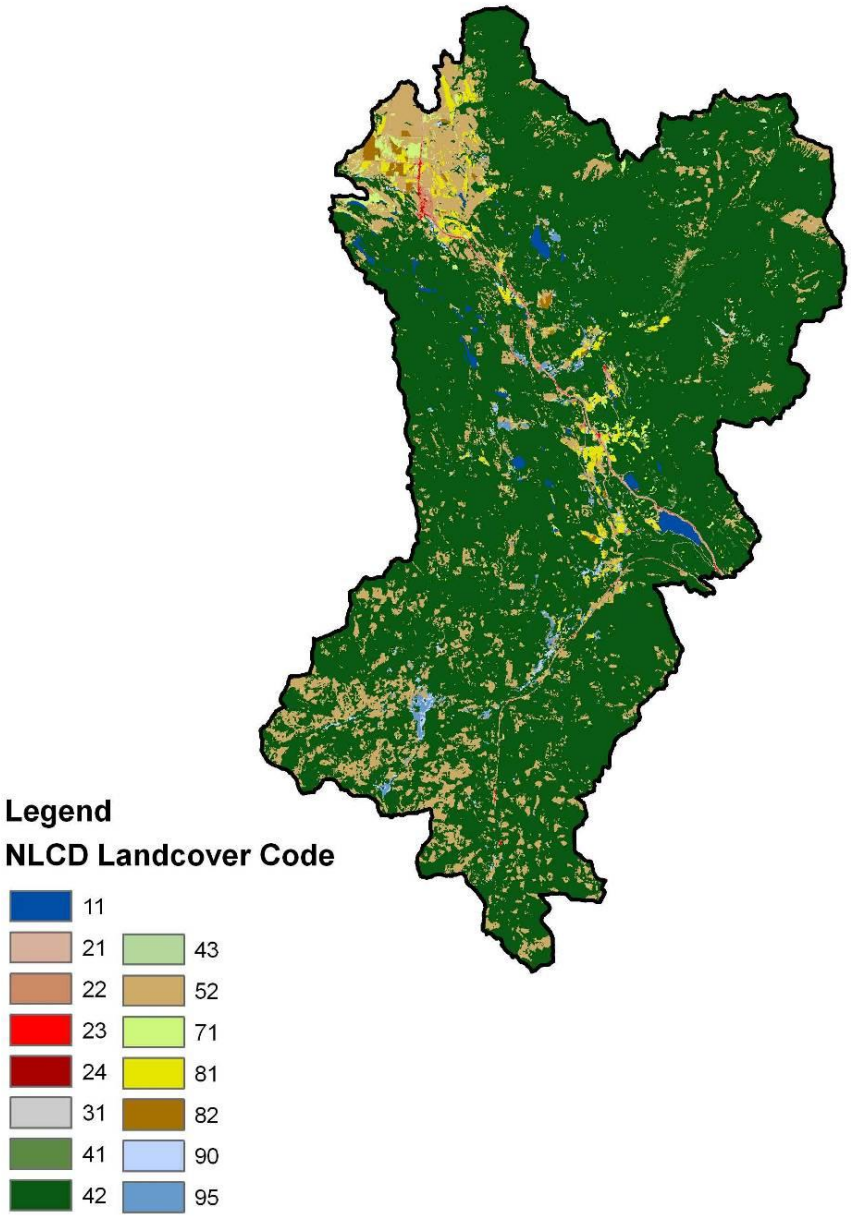


Figure F2-3 NLCD Landcover for the Tobacco River Watershed

F2.6 Logging Adjustment

In general, the land use classification of the NLCD was accepted as is, without ground truthing of original results or correction of changes that may have occurred since the NLCD image was shot. Given that we are looking for watershed and sub-watershed scale effects, the relative simplicity of the land use mix in the Tobacco River watershed, and the relative stability of that land use over the 7 years since the Landsat image was taken that the NLCD is based on, this was considered to be a reasonable assumption. However, The NLCD was modified (**Figure F2-4**) to incorporate logging that has occurred since 2001 and to identify areas that are reforesting over that same period. As with other land uses in the valley, logging is a stable land use, but it is a land use that causes a land cover change that may effect sediment production.

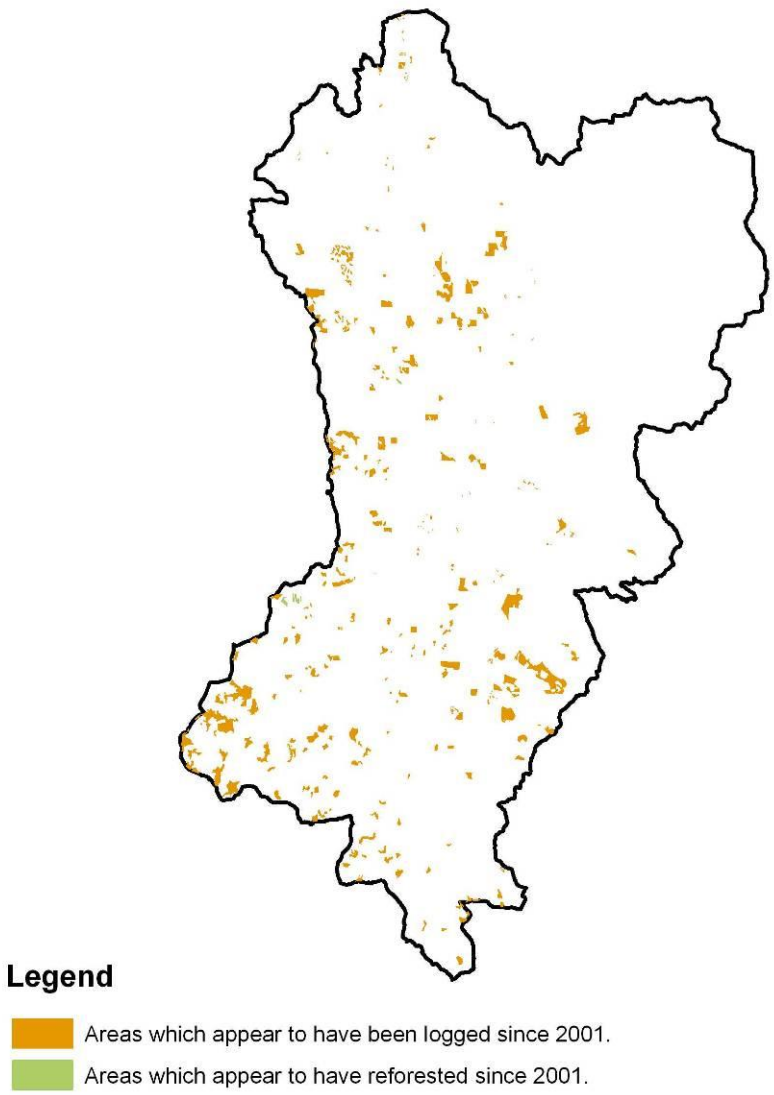


Figure F2-4 Logging areas for the Tobacco River Watershed

Adjustment for logging was accomplished by using harvest record polygons provided by the U.S. Forest Service. Polygons with a harvest date of 2001 or later were selected. Additionally, adjustment for logging on non-USFS property was accomplished by comparing the 2001 NLCD grid for the Tobacco River Watershed with the 2005 NAIP aerial photography. Areas which were coded as a forest type (41, 42 or 43) on the NLCD were digitized and coded as Type 1 (logged) if they appeared to be other than forested (typically bare ground, grassland, or shrubland) on the NAIP photos, there were indications of logging activity (proximity to forest or logging roads, appearance of stands, etc), and they were on non-USFS land.

Adjustment for reforestation was also accomplished by comparing the 2001 NLCD grid for the Tobacco River Watershed with the 2005 NAIP aerial photography. Areas which were coded as something other than forest on the NLCD, but which appeared to be forested on the NAIP photos were digitized and coded as Type 2 (reforesting). For the purposes of sediment generation estimation, both Type 1

(logging) and Type 2 (reforesting) adjustment areas were treated as 'transitional' and classified with the corresponding C-factor. A C-factor slightly higher than a deciduous/evergreen forest was used for logged areas (i.e. transitional) because logging intensity within the watershed is generally low and because practices, such as riparian clear-cutting, that tend to produce high sediment yields have not been used since at least 1991, when the MT Streamside Management Zone (SMZ) law was enacted. Additionally, the USLE model is intended to reflect long-term average sediment yield, and while a sediment pulse typically occurs in the first year after logging, sediment production after the first year rapidly declines (Elliot and Robichaud, 2001; Elliot, 2006; Rice, et al., 1972). The logging C-factor is the same for both management scenarios to indicate that logging will continue sporadically on public and private land within the watershed and will produce sediment at a rate slightly higher than an undisturbed forest. This is not intended to imply that additional best management practices beyond those in the SMZ law should not be used for logging activities.

F2.7 C-Factor Derivation

For purposes of the base (existing conditions) scenario, the following scheme of reclassification was used to derive annualized USLE C-factors from the NLCD land cover classes present in the Tobacco River watershed.

Per **Table F2-2** a C-factor slightly higher than a deciduous/evergreen forest was used for logged areas (i.e. transitional) because logging intensity within the watershed is generally low and because practices, such as riparian clear-cutting, that tend to produce high sediment yields have not been used since at least 1991, when the MT Streamside Management Zone (SMZ) law was enacted. Additionally, the USLE model is intended to reflect long-term average sediment yield, and while a sediment pulse typically occurs in the first year after logging, sediment production after the first year rapidly declines. The logging C-factor is the same for both management scenarios to indicate that logging will continue sporadically on public and private land within the watershed and will produce sediment at a rate slightly higher than an undisturbed forest. This is not intended to imply that additional best management practices beyond those in the SMZ law should not be used for logging activities. The other land use categories were reclassified based on the NRCS table "C-Factors for Permanent Pasture, Rangeland, Idle Land, and Grazed Woodland", which was developed with the assistance and input of local NRCS and USFS employees. A narrative description of the professional judgment involved in the selection of these factors and the NRCS table are provided in **Appendix F, Attachment A**.

To estimate the potential reduction in sediment production that might be accomplished under a best management practices scenario, the model was re-run using a different C-factor reclassification scheme. Relative to the existing conditions C-factor scheme, the BMP C-factor for the 'transitional' land classification was changed to reflect the forest cover that most such areas are transitioning to in the Tobacco River watershed. The 'grasslands/herbaceous', and 'pasture/hay' BMP C-factors were conservatively changed to reflect a 10 percent increase in ground cover over existing conditions. The 'cultivated crops' BMP C-factor was changed to reflect a 20 percent increase in ground cover over existing conditions. These changes result in a C-factor matrix for BMP conditions shown in **Table F2-3**.

Table F2-2. C-factors in the Tobacco River watershed.

NLCD Code	Description	C-Factor Existing Condition	C-Factor Improved Management Condition
21	Developed, Open Space	0.003	0.003
22	Developed, Low Intensity	0.001	0.001
42	Evergreen Forest	0.003	0.003
52	Shrub/Scrub	0.008	0.008
71	Grasslands/Herbaceous	0.020	0.013
81	Pasture/Hay	0.020	0.013
82	Cultivated Crops	0.240	0.150
90	Woody Wetlands	0.013	0.013
95	Emergent Herbaceous Wetlands	0.003	0.003
N/A	Transitional	0.006	0.006
Other	Represents < 1% of watershed area: includes barren land, medium and high intensity development, and deciduous and mixed forest.	Varies	Varies

Table F2-3. Changes in percent ground cover for agricultural land cover types between existing and improved management conditions.

Land Cover	Existing % Ground Cover	Improved % Ground Cover
Grasslands/Herbaceous	75	85
Pasture/Hay	75	85
Cultivated Crops	20	40

F2.8 Sediment Delivery Ratio Factor

A sediment delivery ratio factor was derived by the model for each grid cell based on the observed relationship between the distance from the delivery point to the stream and the percent of eroded sediment delivered to the stream. This relationship was established by Dube, Megahan & McCalmon (2004) in their development of the WARSEM road sediment model for the State of Washington. This relationship was developed by integrating the results of several previous studies (principally those of Megehan and Ketchison) which examined sediment delivery to streams downslope of forest roads. They found that the proportion of sediment production that is ultimately delivered to streams declines with distance from the stream as shown in **Table F2-4**.

Table F2-4. Sediment Delivery vs. Distance

Distance fromCulvert (ft)	Percent of Total Eroded Sediment Delivered
0	100
35	70
70	50
105	35
140	25
175	18
210	10
245	4
280	3
315	2
350	1

We believe the use of this relationship to develop a sediment delivery ratio for a USLE based model is a conservative (i.e. tending toward the high end of the range of reasonable values) estimate of sediment delivery from hillslope erosion, especially in light of the fact that the USLE methodology does not account for gully erosion.

This factor was applied to the results of the USLE model to estimate sediment delivered from hillslope sources, by calculating the flow distance from each cell to the nearest stream channel, and multiplying the sediment production of that cell by the corresponding distance based percentage of delivery.

F2.9 Riparian Health Assessment Based Sediment Delivery Ratio Factor

Well vegetated riparian buffers have been shown to act as filters that help to remove sediment from overland flow. Because of this ability, the influence of riparian corridors on water quality is proportionately much greater than the relatively small area in the landscape they occupy. In general, the effectiveness of vegetated riparian buffers is proportional to their width and overall health.

DEQ completed a riparian health assessment in the Tobacco River watershed, encompassing the Tobacco River mainstem and its primary tributary streams. Ratings of poor, fair, and good were assigned by the riparian health assessment to the left and right bank of multiple reaches on each surveyed stream. The results of this assessment are shown in **Figure 2-5**. This information can be used to estimate further reduction in the quantity of eroded sediment that is ultimately delivered to the streams.

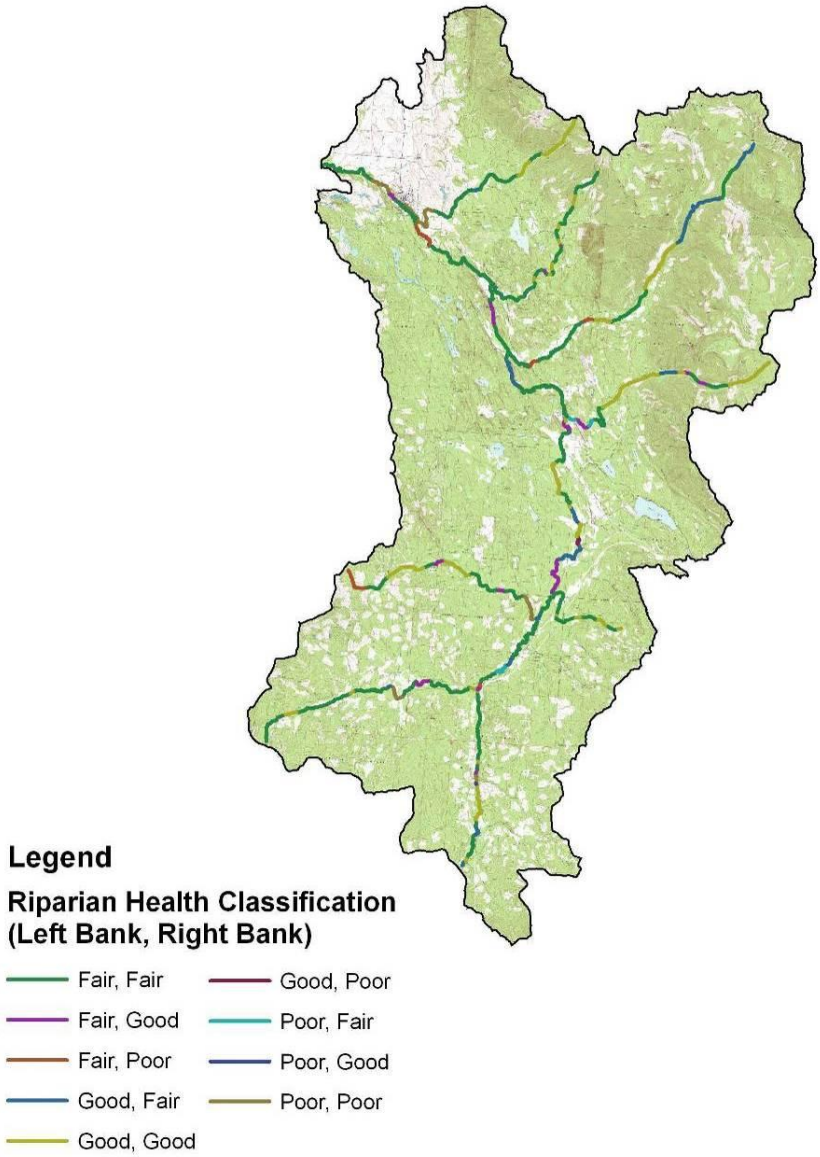
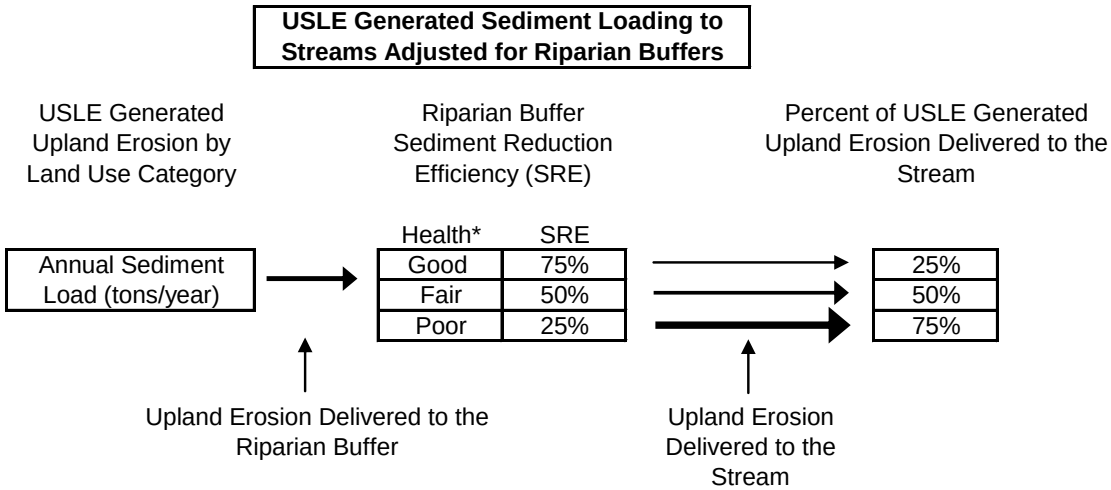


Figure F2-5. Riparian Health Assessment for the Tobacco River and its Primary Tributaries

For this analysis, a sediment reduction efficiency of 75% was assumed to represent the loading condition for a healthy (good) vegetated riparian buffer. With 75% removal, 25% of the USLE generated upland hillslope load is delivered to the stream. As the condition of the riparian buffer declines or is degraded, sediment reduction efficiencies of 50% and 25% are assumed to represent the loading condition for moderately (fair) and heavily (poor) disturbed conditions. That is, as the overall health of the vegetated riparian buffer is degraded, hence reducing its buffering capacity, sediment loading delivered to the stream from upland sources increases (**Figure F2-6**).



*Average health condition of the vegetated riparian buffer

Figure F2-6. USLE Upland Sediment Load Adjusted for Riparian Buffer Capacity

Using these data we computed a length-weighted riparian health score based SDR for each surveyed sub-basin. This was accomplished by tallying the percent of the total bank length of each stream that was rated in each of the three riparian health classes, multiplying by the assumed sediment delivery efficiency reduction for each class (75% for a good buffer condition, 50% for a fair buffer condition, and 25% for a poor buffer condition) and summing for each stream. An example of how this calculation was performed is shown in **Table F2-5**. The riparian health assessment based SDR computed for each surveyed sub-basin for the existing conditions scenario is visually presented via **Figure F2-7**, and all results are presented in **Table F2-6.**

Table F2-5. Example of Calculation of Riparian Health SDR Factor for Upper Fortine Creek

Existing Buffer Condition	Stream Length (mi)	Percent of Total Length	Weighted Sediment Reduction Percentage Existing Conditions
Good	5.6	5.6 / 15.9 = 0.35	0.35 * 0.75 = 0.27
Fair	9.5	9.5 / 15.9 = 0.60	0.60 * 0.50 = 0.30
Poor	0.8	0.8 / 15.9 = 0.05	0.05 * 0.25 = 0.01
Total	5.6 + 9.5 + 0.8 = 15.9	0.35 + 0.60 + 0.05 = 1	0.27 + 0.30 + 0.01 = 0.58

Therefore the sediment delivered to the stream is 1 – 0.58 = 0.42 or 42% of the total calculated sediment load.

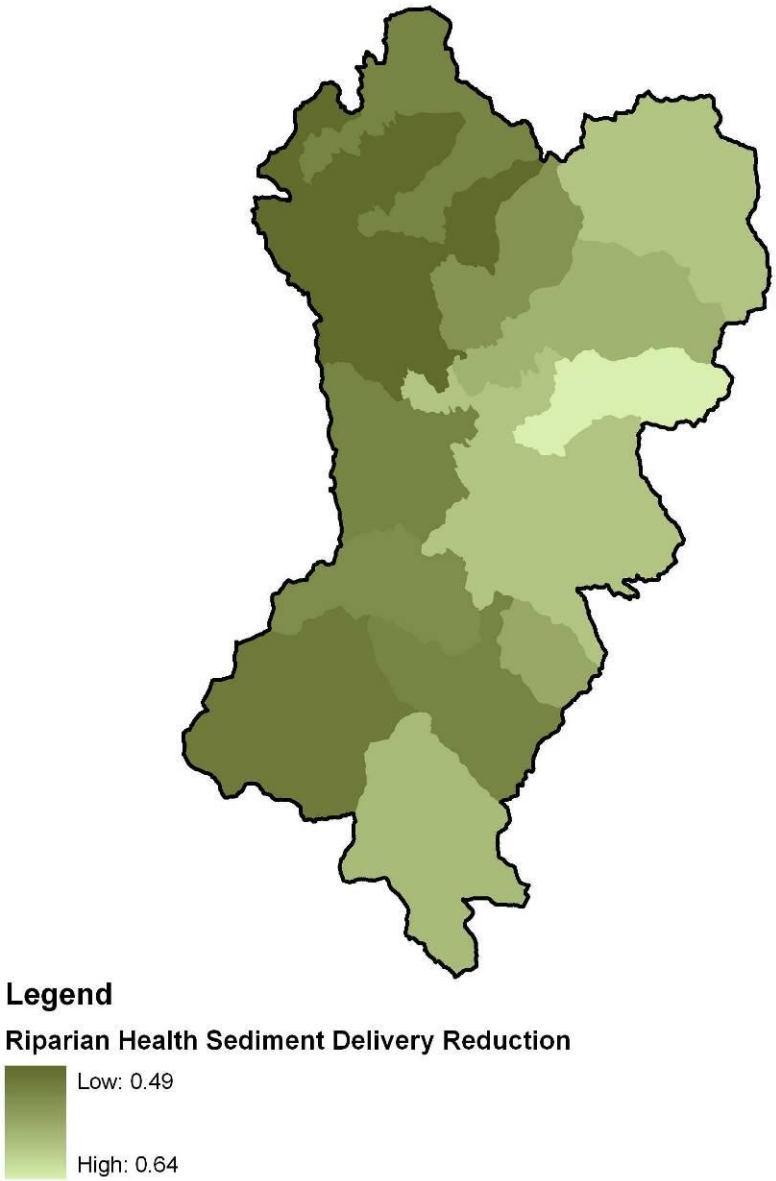


Figure F2-7. Riparian Health Sediment Delivery Reduction for the Tobacco River Watershed

Table F2-6. Sediment reduction percentage based on riparian health assessment.

Sub-basin	Existing Buffer Condition	Stream Length (mi)	Percent of Total Length	Weighted Sediment Reduction Percentage Existing Conditions	Sediment Reduction Percentage BMP Conditions	Change in Sediment Reduction Percentage
Upper Fortine Creek	Good	5.6	35	27		
	Fair	9.5	60	30		
	Poor	0.8	5	1		
	Total	15.9	100	**58**	**69**	**11**

Table F2-6. Sediment reduction percentage based on riparian health assessment.

Sub-basin	Existing Buffer Condition	Stream Length (mi)	Percent of Total Length	Weighted Sediment Reduction Percentage Existing Conditions	Sediment Reduction Percentage BMP Conditions	Change in Sediment Reduction Percentage
Swamp Creek – Lake Creek	Good	2.7	12	9		
	Fair	17.8	80	40		
	Poor	1.8	8	2		
	Total	22.2	100	**51**	**69**	**18**
Middle Fortine Creek	Good	2.2	13	10		
	Fair	13.2	80	40		
	Poor	1.1	7	2		
	Total	16.5	100	**52**	**69**	**17**
Edna Creek	Good	6.4	31	23		
	Fair	10.1	49	25		
	Poor	4.0	19	5		
	Total	20.5	100	**53**	**69**	**17**
Lower Fortine Creek	Good	10.8	37	28		
	Fair	17.8	61	31		
	Poor	0.4	1	0		
	Total	29.0	100	**59**	**69**	**10**
Deep Creek	Good	12.4	58	44		
	Fair	8.2	39	19		
	Poor	0.7	3	1		
	Total	21.3	100	**64**	**69**	**5**
Upper Grave Creek	Good	4.2	38	28		
	Fair	6.9	62	31		
	Poor	0.0	0	0		
	Total	11.1	100	**59**	**69**	**10**
Lower Grave Creek	Good	6.7	33	24		
	Fair	13.1	64	32		
	Poor	0.7	4	1		
	Total	20.6	100	**57**	**69**	**12**
Therriault Creek	Good	3.1	17	13		
	Fair	15.0	83	41		
	Poor	0.0	0	0		
	Total	18.1	100	**54**	**69**	**15**
Tobacco River	Good	1.4	5	4		
	Fair	22.9	84	42		
	Poor	2.9	11	3		
	Total	27.2	100	**49**	**69**	**20**
Sinclair Creek	Good	6.1	29	22		
	Fair	10.3	49	24		
	Poor	4.7	22	6		
	Total	21.1	100	**52**	**69**	**17**
Lime Creek	Good	2.1	24	18		
	Fair	6.6	76	38		
	Poor	0.0	0	0		
	Total	8.7	100	**56**	**69**	**13**

Additionally, a BMP condition of the riparian buffer was estimated. Under this condition, it is assumed that the implementation of BMPs on those activities that affect the overall health of the vegetated riparian buffer increases the watershed scale riparian health condition from its existing condition to 75% of the total stream length with a 'good' riparian health condition and 25% of the total stream length with a 'fair' condition. The concept is that through the application of BMPs, the general health of the vegetated riparian buffer will increase, hence increasing its sediment reduction efficiency. The BMP riparian health assessment based SDR computed for each sub-basin is also presented in **Table F2-6** along with the difference from the existing to the improved condition.

The riparian health assessment was not completed for the Meadow Creek and Indian Creek sub-watersheds. The Indian Creek sub-watershed was assumed to be similar to the Sinclair Creek sub-watershed and assigned a sediment delivery reduction of 52%. The Meadow Creek sub-watershed was assumed to be similar to the Middle Fortine Creek sub-watershed and therefore a sediment reduction of 52% was used.

F2.10 Sub-basins

The Tobacco River watershed boundary and the sub-basin boundaries were defined using the USGS 6th code Hydrologic Unit Codes (HUC) (**Figure F2-8**). Lime Creek is the only 303(d) listed stream that was not represented in the 6th code HUCs. The Lime Creek sub-basin was cut from the Middle Fortine Creek sub-basin using USGS topography as a guide to drainage divides.

Figure F2-8. Sub-basin polygons for the Tobacco River Watershed

F3.0 RESULTS

Figures F3-1, F3-2 and F3-3 present the USLE based hillslope model's prediction of existing and potential conditions graphically. **Table F3-1** presents the prediction of existing and potential conditions numerically, broken out by 6th code HUC (as modified to represent the 303d listed streams) and existing land cover type.

Table F3-2 presents the delivered sediment load totals for the sub-basins and the cumulative totals within the watershed. In **Table F3-1**, the cumulative results for a sub-basin are a sum of the results for that sub-basin plus the sub-basins upstream of it. For example, Middle Fortine Creek is a sum of the results for that sub-basin plus the results for Edna Creek, Lime Creek, Upper Fortine Creek, and

SwampCreek/Lake Creek. The results for Tobacco River represent the total sediment load delivered from the entire watershed.

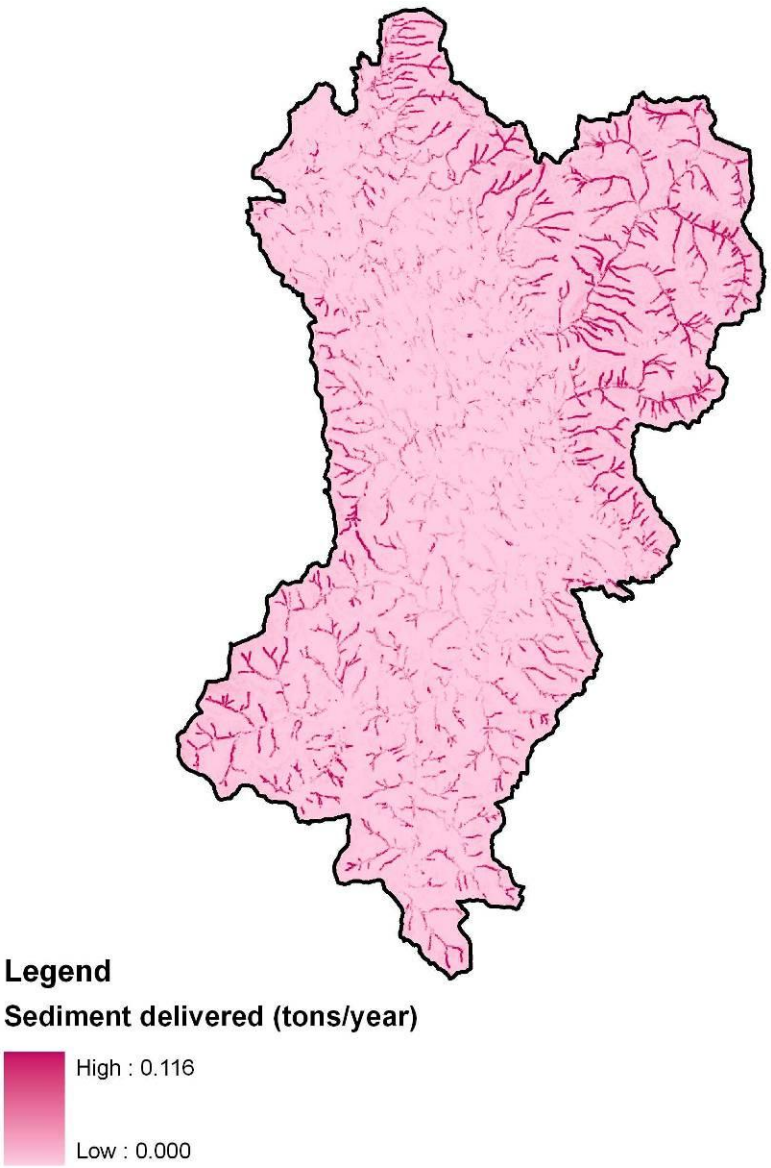


Figure F3-1. Upland Erosion USLE Existing Load Corrected for Existing Riparian Health Condition

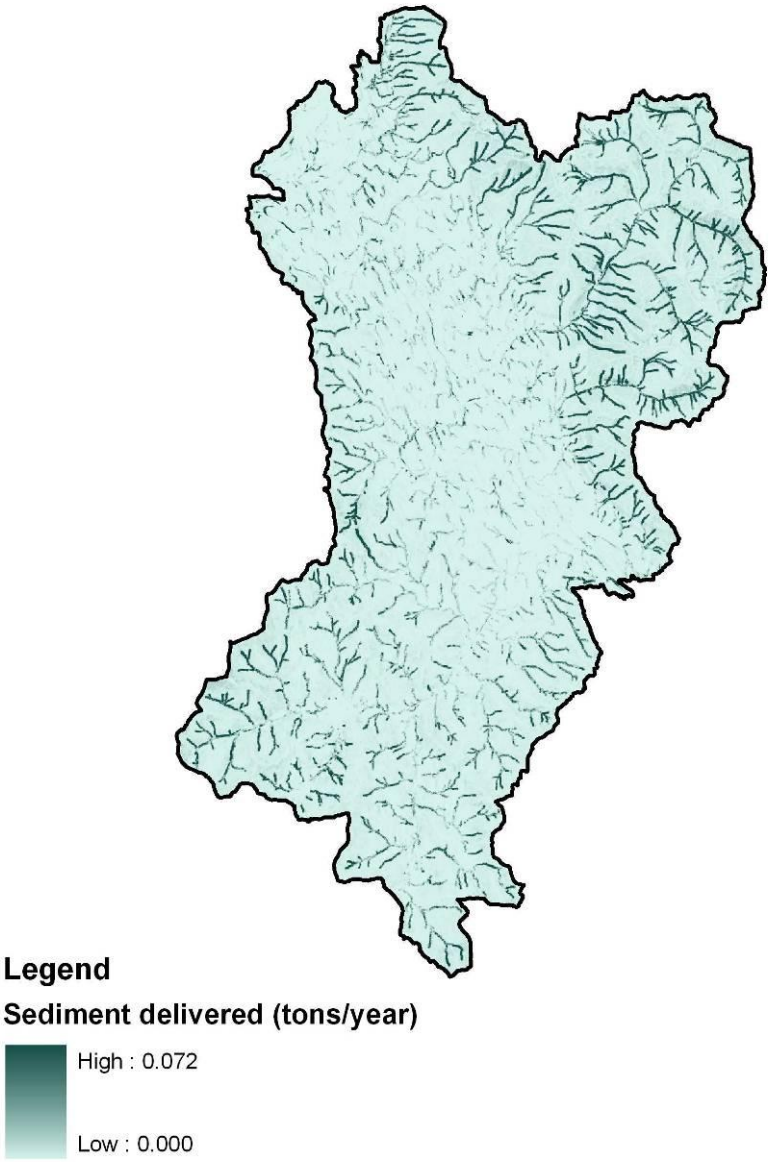


Figure F3-2. Upland Erosion USLE BMP Load Corrected for Existing Riparian Health Condition

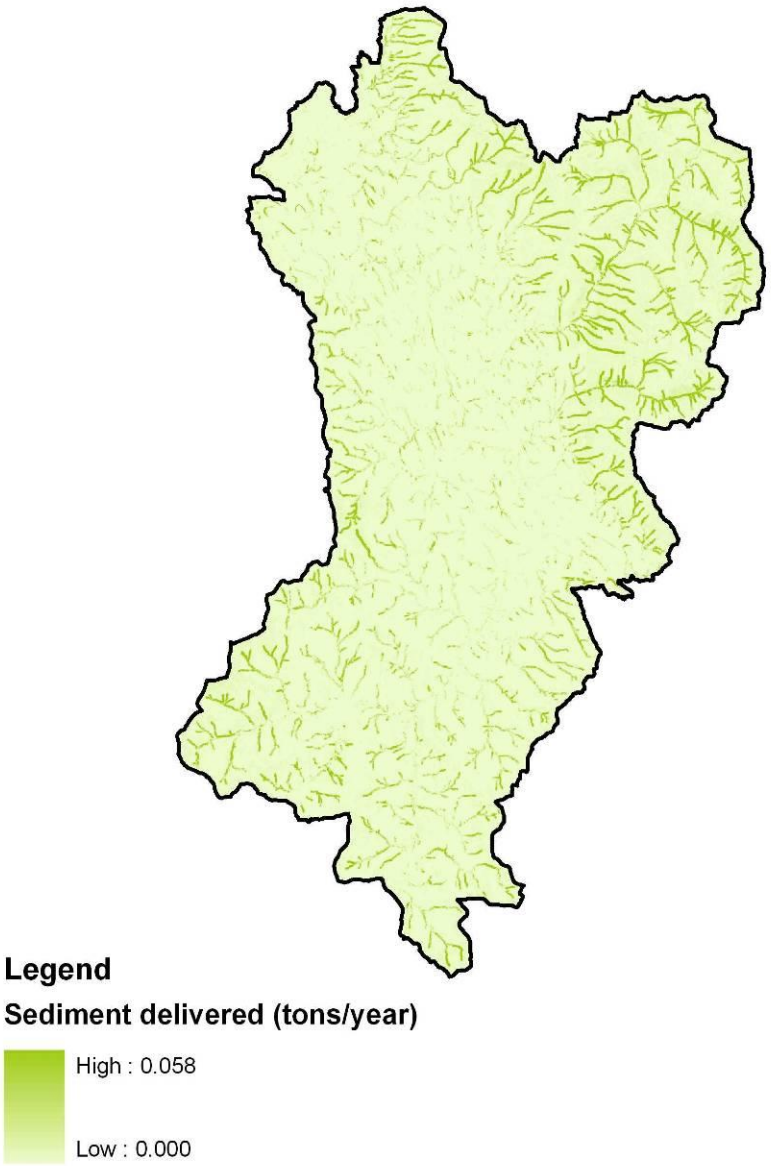


Figure F3-3. Upland Erosion USLE BMP Load Corrected for BMP Riparian Health Condition

Table F3-1. Delivered Sediment Load by Land Cover Type

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2		Scenario 3		
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)	**Upland BMP Load Reduction**	Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)	**Riparian BMP Load Reduction**	**Overall Sediment Load Reduction**
Upper Fortine Creek	Developed, Open Space	15.6	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	32.9	<1	<1	0%	<1	0%	0%
	Evergreen Forest	18,697.5	92.4	92.4	0%	68.2	26%	26%
	Shrub/Scrub	5,256.3	53.6	53.6	0%	39.5	26%	26%
	Grasslands/Herbaceous	33.9	<1	<1	0%	<1	0%	0%
	Pasture/Hay	13.6	<1	<1	0%	<1	0%	0%
	Cultivated Crops	2.0	<1	<1	0%	<1	0%	0%
	Woody Wetlands	89.4	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	72.9	<1	<1	0%	<1	0%	0%
	Transitional	602.5	1.6	1.6	0%	1.2	26%	26%
	Other	17.6	<1	<1	0%	<1	0%	0%
	Total	**24,834**	**150**	**150**	**0%**	**111**	**26%**	**26%**
Swamp Creek – Lake Creek	Developed, Open Space	2.9	<1	<1	0%	<1	0%	0%
	Evergreen Forest	17,900.7	131.4	131.4	0%	83.2	37%	37%
	Shrub/Scrub	7,456.5	102.8	102.8	0%	65.0	37%	37%
	Grasslands/Herbaceous	51.3	<1	<1	0%	<1	0%	0%
	Pasture/Hay	13.4	<1	<1	0%	<1	0%	0%
	Cultivated Crops	4.9	<1	<1	0%	<1	0%	0%
	Woody Wetlands	370.2	3.5	3.5	0%	2.2	37%	37%
	Emergent Herbaceous Wetlands	562.4	<1	<1	0%	<1	0%	0%
	Transitional	2,258.1	14.5	14.5	0%	9.1	37%	37%
	Total	**28,620**	**252**	**252**	**0%**	**160**	**37%**	**37%**

Table F3-1. Delivered Sediment Load by Land Cover Type

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2		Scenario 3		
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)	**Upland BMP Load Reduction**	Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)	**Riparian BMP Load Reduction**	**Overall Sediment Load Reduction**
Lime Creek	Developed, Open Space	4.7	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	25.5	<1	<1	0%	<1	0%	0%
	Evergreen Forest	4,986.9	28.4	28.4	0%	20.0	30%	30%
	Shrub/Scrub	515.5	2.1	2.1	0%	1.5	30%	30%
	Grasslands/Herbaceous	8.6	<1	<1	0%	<1	0%	0%
	Pasture/Hay	47.4	<1	<1	0%	<1	0%	0%
	Cultivated Crops	3.4	<1	<1	0%	<1	0%	0%
	Woody Wetlands	22.2	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	66.6	<1	<1	0%	<1	0%	0%
	Transitional	645.2	4.9	4.9	0%	3.4	30%	30%
	Other	3.8	<1	<1	0%	<1	0%	0%
	Total	**6,330**	**35**	**35**	**0%**	**25**	**29%**	**29%**
Edna Creek	Evergreen Forest	12,040.4	66.3	66.3	0%	43.7	34%	34%
	Shrub/Scrub	1,848.1	25.2	25.2	0%	16.6	34%	34%
	Grasslands/Herbaceous	31.4	1.1	0.7	35%	0.5	34%	57%
	Pasture/Hay	13.5	<1	<1	0%	<1	0%	0%
	Cultivated Crops	3.4	<1	<1	0%	<1	0%	0%
	Woody Wetlands	45.3	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	149.1	<1	<1	0%	<1	0%	0%
	Transitional	582.5	4.3	4.3	0%	2.8	34%	34%
	Total	**14,714**	**99**	**98**	**1%**	**64**	**34%**	**35%**

Table F3-1. Delivered Sediment Load by Land Cover Type

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2		Scenario 3		
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)	**Upland BMP Load Reduction**	Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)	**Riparian BMP Load Reduction**	**Overall Sediment Load Reduction**
Middle Fortine Creek	Developed, Open Space	23.5	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	53.0	<1	<1	0%	<1	0%	0%
	Evergreen Forest	13,315.3	60.7	60.7	0%	39.2	35%	35%
	Shrub/Scrub	2,139.1	19.3	19.3	0%	12.4	35%	35%
	Grasslands/Herbaceous	40.3	<1	<1	0%	<1	0%	0%
	Pasture/Hay	55.9	<1	<1	0%	<1	0%	0%
	Cultivated Crops	4.0	<1	<1	0%	<1	0%	0%
	Woody Wetlands	166.3	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	161.3	<1	<1	0%	<1	0%	0%
	Transitional	976.6	7.1	7.1	0%	4.6	35%	35%
	Other	4.0	<1	<1	0%	<1	0%	0%
	Total	**16,939**	**90**	**90**	**0%**	**57**	**35%**	**37%**
Deep Creek	Developed, Open Space	54.2	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	48.3	<1	<1	0%	<1	0%	0%
	Evergreen Forest	10,814.6	133.3	133.3	0%	114.8	14%	14%
	Shrub/Scrub	463.1	22.5	22.5	0%	19.4	14%	14%
	Grasslands/Herbaceous	263.8	5.1	3.3	35%	2.9	14%	44%
	Pasture/Hay	261.4	2.3	1.5	35%	1.3	14%	44%
	Woody Wetlands	8.2	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	2.0	<1	<1	0%	<1	0%	0%
	Transitional	191.1	<1	<1	0%	<1	0%	0%
	Other	125.1	<1	<1	0%	<1	0%	0%
	Total	**12,232**	**168**	**163**	**3%**	**141**	**14%**	**16%**

Table F3-1. Delivered Sediment Load by Land Cover Type

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2		Scenario 3		
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)	**Upland BMP Load Reduction**	Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)	**Riparian BMP Load Reduction**	**Overall Sediment Load Reduction**
Meadow Creek	Developed, Open Space	2.2	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	3.8	<1	<1	0%	<1	0%	0%
	Evergreen Forest	14,542.4	79.3	79.3	0%	51.2	35%	35%
	Shrub/Scrub	1,393.6	18.6	18.6	0%	12.0	35%	35%
	Grasslands/Herbaceous	69.4	2.0	1.3	35%	0.8	35%	58%
	Pasture/Hay	79.2	1.5	1.0	35%	0.6	35%	58%
	Cultivated Crops	3.0	<1	<1	0%	<1	0%	0%
	Woody Wetlands	67.3	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	227.6	<1	<1	0%	<1	0%	0%
	Transitional	746.8	5.0	5.0	0%	3.3	35%	35%
	Other	3.8	<1	<1	0%	<1	0%	0%
	Total	**17,139**	**108**	**107**	**1%**	**69**	**35%**	**36%**
Lower Fortine Creek	Developed, Open Space	733.3	2.4	2.4	0%	1.8	24%	24%
	Developed, Low Intensity	533.7	<1	<1	0%	<1	0%	0%
	Evergreen Forest	30,507.0	158.6	158.6	0%	119.9	24%	24%
	Shrub/Scrub	2,757.3	21.1	21.1	0%	15.9	24%	24%
	Grasslands/Herbaceous	396.9	7.0	4.5	35%	3.4	24%	51%
	Pasture/Hay	1,263.4	6.7	4.4	35%	3.3	24%	51%
	Cultivated Crops	82.4	2.5	1.6	38%	1.2	24%	53%
	Woody Wetlands	278.2	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	329.6	<1	<1	0%	<1	0%	0%
	Transitional	463.5	1.1	1.1	0%	0.8	24%	24%
	Other	295.0	1.3	1.3	0%	1.0	24%	24%
	Total	**37,640**	**202**	**196**	**3%**	**148**	**24%**	**27%**

Table F3-1. Delivered Sediment Load by Land Cover Type

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2		Scenario 3		
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)	**Upland BMP Load Reduction**	Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)	**Riparian BMP Load Reduction**	**Overall Sediment Load Reduction**
Upper Grave Creek	Evergreen Forest	24,727.2	297.3	297.3	0%	224.8	24%	24%
	Shrub/Scrub	2,838.1	73.0	73.0	0%	55.2	24%	24%
	Grasslands/Herbaceous	58.0	11.7	7.6	35%	5.8	24%	51%
	Pasture/Hay	4.4	<1	<1	0%	<1	0%	0%
	Other	274.3	2.0	2.0	0%	1.5	24%	24%
	Total	**27,902**	**384**	**380**	**1%**	**287**	**24%**	**25%**
Lower Grave Creek	Developed, Open Space	68.2	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	72.0	<1	<1	0%	<1	0%	0%
	Evergreen Forest	17,419.8	252.2	252.2	0%	181.8	28%	28%
	Shrub/Scrub	784.6	20.0	20.0	0%	14.4	28%	28%
	Grasslands/Herbaceous	124.3	3.6	2.3	35%	1.7	28%	53%
	Pasture/Hay	309.9	4.9	3.2	35%	2.3	28%	53%
	Cultivated Crops	51.4	5.5	3.4	38%	2.5	28%	55%
	Woody Wetlands	134.2	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	188.4	<1	<1	0%	<1	0%	0%
	Transitional	18.5	<1	<1	0%	<1	0%	0%
	Other	575.5	8.7	8.7	0%	6.3	28%	28%
	Total	**19,747**	**296**	**291**	**2%**	**210**	**28%**	**29%**

Table F3-1. Delivered Sediment Load by Land Cover Type

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2		Scenario 3		
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)	**Upland BMP Load Reduction**	Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)	**Riparian BMP Load Reduction**	**Overall Sediment Load Reduction**
Therriault Creek	Developed, Open Space	61.7	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	105.3	<1	<1	0%	<1	0%	0%
	Evergreen Forest	11,316.7	84.2	84.2	0%	56.8	33%	33%
	Shrub/Scrub	687.0	5.2	5.2	0%	3.5	33%	33%
	Grasslands/Herbaceous	81.9	4.3	2.8	35%	1.9	33%	56%
	Pasture/Hay	70.8	<1	<1	0%	<1	0%	0%
	Cultivated Crops	116.3	3.2	2.0	38%	1.3	33%	58%
	Woody Wetlands	65.1	1.4	1.4	0%	1.0	33%	33%
	Emergent Herbaceous Wetlands	125.7	<1	<1	0%	<1	0%	0%
	Transitional	670.4	1.9	1.9	0%	1.3	33%	33%
	Other	14.7	<1	<1	0%	<1	0%	0%
	Total	**13,316**	**101**	**98**	**3%**	**67**	**33%**	**34%**
Sinclair Creek	Developed, Open Space	10.6	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	22.2	<1	<1	0%	<1	0%	0%
	Evergreen Forest	6,470.5	63.6	63.6	0%	41.1	35%	35%
	Shrub/Scrub	997.5	7.3	7.3	0%	4.7	35%	35%
	Grasslands/Herbaceous	75.8	2.4	1.5	35%	1.0	35%	58%
	Pasture/Hay	281.8	2.0	1.3	35%	0.8	35%	58%
	Cultivated Crops	15.2	<1	<1	0%	<1	0%	0%
	Woody Wetlands	21.5	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	10.6	<1	<1	0%	<1	0%	0%
	Transitional	36.4	<1	<1	0%	<1	0%	0%
	Other	29.2	<1	<1	0%	<1	0%	0%
	Total	**7,971**	**76**	**74**	**2%**	**48**	**35%**	**37%**

Table F3-1. Delivered Sediment Load by Land Cover Type

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2		Scenario 3		
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)	**Upland BMP Load Reduction**	Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)	**Riparian BMP Load Reduction**	**Overall Sediment Load Reduction**
Indian Creek	Developed, Open Space	73.9	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	38.7	<1	<1	0%	<1	0%	0%
	Evergreen Forest	6,606.4	89.0	89.0	0%	57.5	35%	35%
	Shrub/Scrub	2,815.6	20.7	20.7	0%	13.3	35%	35%
	Grasslands/Herbaceous	512.1	5.5	3.6	35%	2.3	35%	58%
	Pasture/Hay	657.8	6.4	4.2	35%	2.7	35%	58%
	Cultivated Crops	286.1	7.7	4.8	38%	3.1	35%	60%
	Woody Wetlands	26.3	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	12.7	<1	<1	0%	<1	0%	0%
	Transitional	100.5	2.4	2.4	0%	1.6	35%	35%
	Other	42.1	<1	<1	0%	<1	0%	0%
	Total	**11,172**	**132**	**125**	**5%**	**81**	**35%**	**39%**
Tobacco River	Developed, Open Space	308.3	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	556.0	<1	<1	0%	<1	0%	0%
	Evergreen Forest	23,647.6	112.4	112.4	0%	68.3	39%	39%
	Shrub/Scrub	9,155.9	47.7	47.7	0%	29.0	39%	39%
	Grasslands/Herbaceous	1,265.4	9.2	6.0	35%	3.6	39%	60%
	Pasture/Hay	1,222.7	10.7	7.0	35%	4.2	39%	60%
	Cultivated Crops	465.0	13.7	8.6	38%	5.2	39%	62%
	Woody Wetlands	247.4	2.3	2.3	0%	1.4	39%	39%
	Emergent Herbaceous Wetlands	277.4	<1	<1	0%	<1	0%	0%
	Transitional	1,138.5	4.9	4.9	0%	3.0	39%	39%
	Other	227.2	<1	<1	0%	<1	0%	0%
	Total	**38,511**	**202**	**190**	**6%**	**116**	**39%**	**43%**

Table F3-2. Delivered Sediment Load by Land Cover Type Cumulative through the Watershed

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2	Upland BMP Load Reduction	Scenario 3	Riparian BMP Load Reduction	Overall Sediment Load Reduction
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)		Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)		
Upper Fortine Creek	Developed, Open Space	15.6	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	32.9	<1	<1	0%	<1	0%	0%
	Evergreen Forest	18,697.5	92.4	92.4	0%	68.2	26%	26%
	Shrub/Scrub	5,256.3	53.6	53.6	0%	39.5	26%	26%
	Grasslands/Herbaceous	33.9	<1	<1	0%	<1	0%	0%
	Pasture/Hay	13.6	<1	<1	0%	<1	0%	0%
	Cultivated Crops	2.0	<1	<1	0%	<1	0%	0%
	Woody Wetlands	89.4	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	72.9	<1	<1	0%	<1	0%	0%
	Transitional	602.5	1.6	1.6	0%	1.2	26%	26%
	Other	17.6	<1	<1	0%	<1	0%	0%
	Total	**24,834**	**150**	**150**	**0%**	**111**	**26%**	**26%**
Swamp Creek – Lake Creek	Developed, Open Space	2.9	<1	<1	0%	<1	0%	0%
	Evergreen Forest	17,900.7	131.4	131.4	0%	83.2	37%	37%
	Shrub/Scrub	7,456.5	102.8	102.8	0%	65.0	37%	37%
	Grasslands/Herbaceous	51.3	<1	<1	0%	<1	0%	0%
	Pasture/Hay	13.4	<1	<1	0%	<1	0%	0%
	Cultivated Crops	4.9	<1	<1	0%	<1	0%	0%
	Woody Wetlands	370.2	3.5	3.5	0%	2.2	37%	37%
	Emergent Herbaceous Wetlands	562.4	<1	<1	0%	<1	0%	0%
	Transitional	2,258.1	14.5	14.5	0%	9.1	37%	37%
	Total	**28,620**	**252**	**252**	**0%**	**160**	**37%**	**37%**

Table F3-2. Delivered Sediment Load by Land Cover Type Cumulative through the Watershed

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2	Upland BMP Load Reduction	Scenario 3	Riparian BMP Load Reduction	Overall Sediment Load Reduction
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)		Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)		
Lime Creek	Developed, Open Space	4.7	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	25.5	<1	<1	0%	<1	0%	0%
	Evergreen Forest	4,986.9	28.4	28.4	0%	20.0	30%	30%
	Shrub/Scrub	515.5	2.1	2.1	0%	1.5	30%	30%
	Grasslands/Herbaceous	8.6	<1	<1	0%	<1	0%	0%
	Pasture/Hay	47.4	<1	<1	0%	<1	0%	0%
	Cultivated Crops	3.4	<1	<1	0%	<1	0%	0%
	Woody Wetlands	22.2	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	66.6	<1	<1	0%	<1	0%	0%
	Transitional	645.2	4.9	4.9	0%	3.4	30%	30%
	Other	3.8	<1	<1	0%	<1	0%	0%
	Total	**6,330**	**35**	**35**	**0%**	**25**	**29%**	**29%**
Edna Creek	Evergreen Forest	12,040.4	66.3	66.3	0%	43.7	34%	34%
	Shrub/Scrub	1,848.1	25.2	25.2	0%	16.6	34%	34%
	Grasslands/Herbaceous	31.4	1.1	0.7	35%	0.5	34%	57%
	Pasture/Hay	13.5	<1	<1	0%	<1	0%	0%
	Cultivated Crops	3.4	<1	<1	0%	<1	0%	0%
	Woody Wetlands	45.3	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	149.1	<1	<1	0%	<1	0%	0%
	Transitional	582.5	4.3	4.3	0%	2.8	34%	34%
	Total	**14,714**	**99**	**98**	**1%**	**64**	**34%**	**35%**

Table F3-2. Delivered Sediment Load by Land Cover Type Cumulative through the Watershed

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2	Upland BMP Load Reduction	Scenario 3	Riparian BMP Load Reduction	Overall Sediment Load Reduction
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)		Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)		
Middle Fortine Creek*	Developed, Open Space	46.6	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	111.4	<1	<1	0%	<1	0%	0%
	Evergreen Forest	66,940.7	379.3	379.3	0%	254.4	33%	33%
	Shrub/Scrub	17,215.6	202.9	202.9	0%	135.1	33%	33%
	Grasslands/Herbaceous	165.4	3.3	2.2	35%	1.4	33%	57%
	Pasture/Hay	143.8	1.6	1.1	35%	0.7	34%	57%
	Cultivated Crops	17.7	<1	<1	0%	<1	0%	0%
	Woody Wetlands	693.4	5.6	5.6	0%	3.7	35%	35%
	Emergent Herbaceous Wetlands	1,012.3	1.6	1.6	0%	1.1	35%	35%
	Transitional	5,064.9	32.4	32.4	0%	21.4	34%	34%
	Other	25.3	<1	<1	0%	<1	0%	0%
	Total	**91,437**	**629**	**628**	**0%**	**417**	**34%**	**34%**
*Middle Fortine Creek results are a summation of the results of that sub-basin plus Edna Creek, Lime Creek, Upper Fortine Creek, and Swamp Creek/Lake Creek.								
Deep Creek	Developed, Open Space	54.2	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	48.3	<1	<1	0%	<1	0%	0%
	Evergreen Forest	10,814.6	133.3	133.3	0%	114.8	14%	14%
	Shrub/Scrub	463.1	22.5	22.5	0%	19.4	14%	14%
	Grasslands/Herbaceous	263.8	5.1	3.3	35%	2.9	14%	44%
	Pasture/Hay	261.4	2.3	1.5	35%	1.3	14%	44%
	Woody Wetlands	8.2	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	2.0	<1	<1	0%	<1	0%	0%
	Transitional	191.1	<1	<1	0%	<1	0%	0%
	Other	125.1	<1	<1	0%	<1	0%	0%
	Total	**12,232**	**168**	**163**	**3%**	**141**	**14%**	**16%**

Table F3-2. Delivered Sediment Load by Land Cover Type Cumulative through the Watershed

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2	Upland BMP Load Reduction	Scenario 3	Riparian BMP Load Reduction	Overall Sediment Load Reduction
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)		Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)		
Meadow Creek	Developed, Open Space	2.2	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	3.8	<1	<1	0%	<1	0%	0%
	Evergreen Forest	14,542.4	79.3	79.3	0%	51.2	35%	35%
	Shrub/Scrub	1,393.6	18.6	18.6	0%	12.0	35%	35%
	Grasslands/Herbaceous	69.4	2.0	1.3	35%	0.8	35%	58%
	Pasture/Hay	79.2	1.5	1.0	35%	0.6	35%	58%
	Cultivated Crops	3.0	<1	<1	0%	<1	0%	0%
	Woody Wetlands	67.3	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	227.6	<1	<1	0%	<1	0%	0%
	Transitional	746.8	5.0	5.0	0%	3.3	35%	35%
	Other	3.8	<1	<1	0%	<1	0%	0%
	Total	**17,139**	**108**	**107**	**1%**	**69**	**35%**	**36%**
Lower Fortine Creek*	Developed, Open Space	836.3	2.7	2.7	0%	2.0	25%	25%
	Developed, Low Intensity	697.2	<1	<1	0%	<1	0%	0%
	Evergreen Forest	122,804.8	750.4	750.4	0%	540.2	28%	28%
	Shrub/Scrub	21,829.6	265.1	265.1	0%	182.5	31%	31%
	Grasslands/Herbaceous	895.6	17.4	11.3	35%	8.6	24%	51%
	Pasture/Hay	1,747.8	12.1	7.9	35%	5.9	25%	51%
	Cultivated Crops	103.1	3.3	2.0	38%	1.5	27%	54%
	Woody Wetlands	1,047.1	7.0	7.0	0%	4.6	33%	33%
	Emergent Herbaceous Wetlands	1,571.5	2.4	2.4	0%	1.6	33%	33%
	Transitional	6,466.3	43.0	43.0	0%	29.2	32%	32%
	Other	449.2	1.7	1.7	0%	1.3	22%	22%
	Total	**158,449**	**1,106**	**1,094**	**1%**	**778**	**30%**	**30%**

*Lower Fortine Creek results are a summation of the results of that sub-basin plus Middle Fortine Creek, Meadow Creek, and Deep Creek.

Table F3-2. Delivered Sediment Load by Land Cover Type Cumulative through the Watershed

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2	Upland BMP Load Reduction	Scenario 3	Riparian BMP Load Reduction	Overall Sediment Load Reduction
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)		Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)		
Upper Grave Creek	Evergreen Forest	24,727.2	297.3	297.3	0%	224.8	24%	24%
	Shrub/Scrub	2,838.1	73.0	73.0	0%	55.2	24%	24%
	Grasslands/Herbaceous	58.0	11.7	7.6	35%	5.8	24%	51%
	Pasture/Hay	4.4	<1	<1	0%	<1	0%	0%
	Other	274.3	2.0	2.0	0%	1.5	24%	24%
	Total	**27,902**	**384**	**380**	**1%**	**287**	**24%**	**25%**
Lower Grave Creek*	Developed, Open Space	68.2	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	72.0	<1	<1	0%	<1	0%	0%
	Evergreen Forest	42,147.0	549.5	549.5	0%	406.6	26%	26%
	Shrub/Scrub	3,622.7	93.0	93.0	0%	69.6	25%	25%
	Grasslands/Herbaceous	182.3	15.3	10.0	35%	7.4	25%	51%
	Pasture/Hay	314.3	5.0	3.3	35%	2.4	28%	53%
	Cultivated Crops	51.4	5.5	3.4	38%	2.5	28%	55%
	Woody Wetlands	134.2	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	188.4	<1	<1	0%	<1	0%	0%
	Transitional	18.5	<1	<1	0%	<1	0%	0%
	Other	849.9	10.7	10.7	0%	7.8	27%	27%
	Total	**47,649**	**703**	**671**	**1%**	**497**	**26%**	**27%**

*Lower Grave Creek results are a summation of the results of that sub-basin plus Upper Grave Creek.

Table F3-2. Delivered Sediment Load by Land Cover Type Cumulative through the Watershed

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2	Upland BMP Load Reduction	Scenario 3	Riparian BMP Load Reduction	Overall Sediment Load Reduction
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)		Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)		
Therriault Creek	Developed, Open Space	61.7	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	105.3	<1	<1	0%	<1	0%	0%
	Evergreen Forest	11,316.7	84.2	84.2	0%	56.8	33%	33%
	Shrub/Scrub	687.0	5.2	5.2	0%	3.5	33%	33%
	Grasslands/Herbaceous	81.9	4.3	2.8	35%	1.9	33%	56%
	Pasture/Hay	70.8	<1	<1	0%	<1	0%	0%
	Cultivated Crops	116.3	3.2	2.0	38%	1.3	33%	58%
	Woody Wetlands	65.1	1.4	1.4	0%	1.0	33%	33%
	Emergent Herbaceous Wetlands	125.7	<1	<1	0%	<1	0%	0%
	Transitional	670.4	1.9	1.9	0%	1.3	33%	33%
	Other	14.7	<1	<1	0%	<1	0%	0%
	Total	**13,316**	**101**	**98**	**3%**	**67**	**33%**	**34%**
Sinclair Creek	Developed, Open Space	10.6	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	22.2	<1	<1	0%	<1	0%	0%
	Evergreen Forest	6,470.5	63.6	63.6	0%	41.1	35%	35%
	Shrub/Scrub	997.5	7.3	7.3	0%	4.7	35%	35%
	Grasslands/Herbaceous	75.8	2.4	1.5	35%	1.0	35%	58%
	Pasture/Hay	281.8	2.0	1.3	35%	0.8	35%	58%
	Cultivated Crops	15.2	<1	<1	0%	<1	0%	0%
	Woody Wetlands	21.5	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	10.6	<1	<1	0%	<1	0%	0%
	Transitional	36.4	<1	<1	0%	<1	0%	0%
	Other	29.2	<1	<1	0%	<1	0%	0%
	Total	**7,971**	**76**	**74**	**2%**	**48**	**35%**	**37%**

Table F3-2. Delivered Sediment Load by Land Cover Type Cumulative through the Watershed

Sub-basin	Land Cover Classification	Area (acres)	Scenario 1	Scenario 2	Upland BMP Load Reduction	Scenario 3	Riparian BMP Load Reduction	Overall Sediment Load Reduction
			Upland Erosion USLE **Existing** Load Corrected for **Existing** Riparian Health Condition (tons/year)	Upland Erosion USLE **BMP** Load Corrected for **Existing** Riparian Health Condition (tons/year)		Upland Erosion USLE **BMP** Load Corrected for **BMP** Riparian Health Condition (tons/year)		
Indian Creek	Developed, Open Space	73.9	<1	<1	0%	<1	0%	0%
	Developed, Low Intensity	38.7	<1	<1	0%	<1	0%	0%
	Evergreen Forest	6,606.4	89.0	89.0	0%	57.5	35%	35%
	Shrub/Scrub	2,815.6	20.7	20.7	0%	13.3	35%	35%
	Grasslands/Herbaceous	512.1	5.5	3.6	35%	2.3	35%	58%
	Pasture/Hay	657.8	6.4	4.2	35%	2.7	35%	58%
	Cultivated Crops	286.1	7.7	4.8	38%	3.1	35%	60%
	Woody Wetlands	26.3	<1	<1	0%	<1	0%	0%
	Emergent Herbaceous Wetlands	12.7	<1	<1	0%	<1	0%	0%
	Transitional	100.5	2.4	2.4	0%	1.6	35%	35%
	Other	42.1	<1	<1	0%	<1	0%	0%
	Total	**11,172**	**132**	**125**	**5%**	**81**	**35%**	**39%**
Tobacco River*	Developed, Open Space	1,358.9	3.3	3.3	0%	2.4	27%	27%
	Developed, Low Intensity	1,491.5	1.0	1.0	0%	0.7	29%	29%
	Evergreen Forest	212,992.9	1,649.2	1,649.2	0%	1,170.5	29%	29%
	Shrub/Scrub	39,108.3	439.0	439.0	0%	302.6	31%	31%
	Grasslands/Herbaceous	3,013.0	54.2	35.2	35%	24.9	29%	54%
	Pasture/Hay	4,295.1	36.5	23.7	35%	16.1	32%	56%
	Cultivated Crops	1,037.1	33.5	20.9	38%	13.7	35%	59%
	Woody Wetlands	1,541.7	11.8	11.8	0%	7.8	34%	34%
	Emergent Herbaceous Wetlands	2,186.3	3.1	3.1	0%	2.0	34%	34%
	Transitional	8,430.5	52.4	52.4	0%	35.1	33%	33%
	Other	1,612.3	12.7	12.7	0%	9.3	27%	27%
	Total	**277,068**	**2,297**	**2,252**	**2%**	**1,585**	**30%**	**31%**

*Tobacco River results are a summation of the results of that sub-basin plus Lower Fortine Creek, Lower Grave Creek, Indian Creek, Sinclair Creek, and Therriault Creek.

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ATTACHMENT A – ASSIGNMENT OF USLE C-FACTORS TO NLCD LANDCOVER VALUES

The NRCS table "C-Factors for Permanent Pasture, Rangeland, Idle Land, and Grazed Woodland" (**Figure A-1**) was used to develop C-factors for the various land use types as defined by the NLCD database within the Tobacco River watershed. This table uses four sub-factors: the vegetative canopy type and height, the vegetative canopy percent cover, the type of cover that contacts the soil surface, and the percent ground cover to derive a C-factor. The resulting C-factor is very sensitive to the type and percent of ground cover and less sensitive to the type and percent of canopy cover.

The type and percent of canopy cover were determined based on the NLCD land use definition. In some cases the minimum percent canopy cover specified in the land use definition was used and resulted in a conservative C-factor. The type of ground cover was considered to be G (cover is grass, grasslike plants, decaying compacted duff, or litter at least 2 inches deep) for all of the land uses in the Tobacco River watershed. The percent ground cover not only includes the basal plant material, but also gravel and plant litter. The percent ground cover for each of the land uses within the Tobacco River watershed were determined for the existing conditions based on ground cover information from NRCS and USFS employees familiar with the Tobacco River watershed. (**Table A-1**)

Per the best professional judgment of Kenny Kindel with the Kootenai National Forest in Eureka, the existing percent ground cover for the evergreen forest land use was estimated to be 95-100 percent.

Per the best professional judgment of Kirk Sullivan with the NRCS in Eureka, the existing percent ground cover was estimated to be 80% for 'shrub/scrub', 60% for 'grassland/herbaceous', 60% for 'pasture/hay', 60% for 'woody wetlands', and 95-100% for 'emergent herbaceous wetlands'.

Per the best professional judgment of Walter Lujan with the NRCS in Missoula, the existing percent ground cover was estimated to be 90% for 'shrub/scrub', 90% for 'grassland/herbaceous', 90% for 'pasture/hay', 95-100% for 'woody wetlands', 95-100% for 'emergent herbaceous wetlands', and 90% for 'transitional'.

Where there were two estimates of the percent ground cover for the same land use, the average of the two estimates was used.

For the well managed scenario, the percent ground cover was increased by 10% over the existing percentage for the 'grassland/herbaceous' and 'pasture/hay' land uses, and by 20% for the 'cultivated crops' land use. For the 'transitional' land use, the well managed scenario assumed a return to a forest land use in logged areas but logging in currently forested areas, resulting in no change to the C factor. The C-factors for the other land use types were not changed. (**Table A-2**).

Table A-3 provides the C-factors for the remaining minor land use types that make up less than 1% of the watershed. The C-factors for these land uses are the same for both the existing and well managed scenarios. These are the same C-factors previously recommended by Richard Fasching, the NRCS Montana State Agronomist, for other hillslope USLE modeling efforts.

Exhibit MT510.03

"C" Factors for Permanent Pasture, Rangeland, Idle Land, and Grazed Woodland 1/

Vegetal Canopy			Cover that Contacts the Surface (Vegetation, living and dead)					
Type and Height of Raised Canopy 2/	Canopy Cover 3/ %	Type 4/	Percent Ground Cover					
			0	20	40	60	80	95-100
No appreciable canopy		G	.45	.20	.10	.042	.013	.003
		W	.45	.24	.15	.090	.043	.011
Canopy of tall grass, weeds or brushes with average drop fall height of less than 3 feet 5/	25	G	.36	.17	.09	.038	.012	.003
		W	.36	.20	.13	.082	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.075	.039	.011
	75	G	.17	.10	.06	.031	.011	.003
		W	.17	.12	.09	.067	.038	.011
Appreciable brush or bushes (2 m fall ht.)	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.085	.042	.011
	50	G	.34	.16	.085	.038	.012	.003
		W	.34	.19	.13	.081	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.077	.040	.011
Trees but no appreciable low brush (4 m fall ht.)	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.087	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.085	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.083	.041	.011

1/ All values shown assume: 1) random distribution of mulch or vegetation, and 2) mulch of appreciable depth where it exists. Idle land refers to land with undisturbed profiles for at least a period of three consecutive years. Also to be used for burned forest land and forest land that has been harvested less than three years ago.

For grazed woodland with high buildup of organic matter in the topsoil under permanent forest conditions, multiply the table values by 0.7.

2/ Average fall height of waterdrops from canopy to soil surface: m = meters.

3/ Portion of total-area surface that would be hidden from view by canopy in a vertical projection, (a bird's-eye view).

4/ G: Cover at surface is grass, grasslike plants, decaying compacted duff. W: Cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface), and/or undecayed residue.

5/ The portion of a grass or weed cover that contacts the soil surface during a rainstorm and interferes with water flow over the soil surface is included in "cover at the surface." The remainder is included in canopy cover.

Figure A-1 NRCS C-factor table

Table A-1 C-factor for principle land use types in the Tobacco River watershed for existing conditions.

NLCD #	Name	Type and Height of Raised Canopy	Percent Canopy Cover[1]	Type	Percent Ground Cover[2]	C-factor	Percent of Watershed
21	Developed, open space	no appreciable canopy	-	G	95-100	0.003	0.5
22	Developed, low intensity	-	-	-	-	0.001	0.5
42	Evergreen forest	trees	75	G	95-100	0.003	78
52	Shrub/scrub	appreciable brush	25	G	85	0.008	14.2
71	Grassland/herbaceous	no appreciable canopy	-	G	75	0.020	1.1
81	Pasture/hay	no appreciable canopy	-	G	75	0.020	1.6
82	Cultivated crops	no appreciable canopy	-	G	20	0.240	0.4
90	Woody wetlands	trees	25	G	80	0.013	0.6
95	Emergent herbaceous wetlands	tall grass	75	G	95-100	0.003	0.8
N/A	Transitional	no appreciable canopy	-	G	90	0.006	1.7

Notes:
1) Canopy cover percents were selected based on the land cover class definition.
2) Percent ground cover as per conversations with local NRCS and USFS employees.

Table A-2 C-factor for principle land use types in the Tobacco River watershed for well managed conditions.

NLCD #	Name	Type and Height of Raised Canopy	Percent Canopy Cover[1]	Type	Percent Ground Cover[2]	C-factor	Percent of Watershed
21	Developed, open space	no appreciable canopy	-	G	95-100	0.003	0.5
22	Developed, low intensity	-	-	-	-	0.001	0.5
42	Evergreen forest	trees	75	G	95-100	0.003	78.0
52	Shrub/scrub	appreciable brush	25	G	85	0.008	14.2
71	Grassland/herbaceous	no appreciable canopy	-	G	85	0.013	1.1
81	Pasture/hay	no appreciable canopy	-	G	85	0.013	1.6
82	Cultivated crops	no appreciable canopy	-	G	40	0.150	0.4
90	Woody wetlands	trees	25	G	80	0.013	0.6
95	Emergent herbaceous wetlands	tall grass	75	G	95-100	0.003	0.8
N/A	Transitional	no appreciable canopy	-	G	90	0.006	1.7

Notes:
1) Canopy cover percents were selected based on the land cover class definition.
2) Percent ground cover as per conversations with local NRCS and USFS employees.

Table A-3 C-factor for minor land use types in the Tobacco River watershed for all conditions.

NLCD #	Name	C-factor	Percent of Watershed
23	Developed, medium intensity	0.001	0.1
24	Developed, high intensity	0.001	0.01
31	Barren land	0.001	0.1
41	Deciduous forest	0.003	0.3
43	Mixed forest	0.003	0.1

Notes:
Medium and high intensity development land uses are assumed to be the same as barren land.
Deciduous and mixed forest land uses are assumed to be the same as evergreen forest.

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