New York Procedures for Calculating Streambank Erosion

Introduction

The calculation of streambank erosion rates differs from the Universal Soil Loss Equation (USLE) calculation of sheet and rill erosion as there are no nationally developed formulas, charts, graphs, tables, or other information derived from scientific analysis. The following personnel in New York as a representative means of quantifying streambank erosion.

Methodology

Most of the data required to calculate streambank erosion, such as bank length and height, can be easily obtained through field observation and/or actual measurement. The key factor, which rarely can be accurately measured without the employment of long duration studies, is the recession rate or rate in feet at which the eroding streambank recedes on an annual basis. The determination of this annual recession rate is based on several factors, some of which rely on the judgement of the individual conducting the survey. These recession rate factors and how they relate to stream bank erosion are described in detail below:

1. Soil Texture: Soils with a high percentage of clay (high plasticity) are generally less susceptible to high rates of streambank erosion than noncohesive silts, sands, and gravels. A streambank with high clay content may give the appearance of being in an eroding condition, however, because little to no vegetation cover will grow there. In general, susceptibility to erosion increases as soil texture becomes more coarse and cohesiveness decreases.

2. Stream Alignment: As the curvature of an eroding bank becomes greater, so does the rate of erosion. Erosion will usually be confined to the outside edge of the curved section. Significant erosion does not generally occur along straight sections of streams. The highest erosion rates are found in stream sections with a high percentage of curvature.

3. Vegetation at Top of Bank: Large trees and/or thick woody vegetation tightly bordering streambanks usually prevents erosion. Some bank protection is provided by the tree root systems. Shallow rooted vegetation or complete lack of vegetation provides no protection and therefore indicates higher erosion rates.

4. Stream Gradient: The higher or larger the stream gradient, the greater the rate of flow and the greater the potential for streambank erosion.

5. Slope of the Eroding Bank: The slope of an eroding bank is an indictor of erosion rate. A vertical slope or undercut bank generally means a high rate of erosion. This will usually be combined with overhanging vegetation at the top of the bank, held there only by the root structure, or in wooded areas, by leaning or fallen trees. The lesser the slope of the eroding bank, the lower the erosion rate.

6. Slope of Inside Depositional Bar: The width of a stream generally remains the same. As erosion occurs on the outside edge of a bend in a stream, deposition occurs on the inside. The slope of this depositional bar is an indicator of the rate of erosion. A slight slope is indicative of a rapid rate of erosion. An additional indicator is the presence or absence of vegetation on the depositional bar. A lack of vegetation signifies a rapid erosional rate.

All of these factors are considered in determining the proper values to enter into the equation for calculating the Recession rate. The values are contained in Tables 8 and 9.

Determining Erosion Rates

On the inventory sheet, complete the heading. Be sure to adequately identify the location of each eroding bank, as you may need to refer to this data in the future. Record the length, in feet, of the eroding bank. Record the height of the eroding bank in feet. If the bank is sloping or parabolic, estimate an average height. Record each factor used to determine the recession rate.

Use the information gathered on the inventory sheet to complete the worksheet for calculating streambank erosion. Complete the heading and enter recession rate values in Tables 8 and 9 for each factor. Multiply all factor values together to obtain the recession rate.

The total volume of soil displaced can be calculated by multiplying length x height x recession rate. To convert the volume to tons of soil displaced annually, multiply the volume displaced by the soil bulk density found in Table 6 and divide the result by 2,000.

Table 6
Approximate Unit Weights
by Soil Texture Class[1]

Soil Texture Class	Dry Density Lbs./Ft.[3]
Clay	70-95
Silty clay, silty clay loam	75-100
Sandy clay, loam, sandy loam	80-105
Clay loam, silt, silt loam	85-100
Sandy clay loam, loamy sands, sands	95-110
Gravelly sands, sandy or silty gravels, gravels	115-130

NOTE: Calculate Total "gross erosion" before and after planned treatment and record acres treated. To determine amount of change, "after" is subtracted from "before" to determine reduction. The change may be stated in tons per acre by dividing the total tons reduced by the acreage of the field or treatment unit for which the computation was made. Data should be recorded in a manner that avoids misinterpretation. Calculations should be for the same area throughout. All figures will be expressed in whole tons

CAUTION: This method is designed to produce an estimated soil loss.

[1] Data and estimates from published soil surveys, laboratory data, and soil interpretation records are to be used where available. More detailed guides on estimating unit weights will soon be available. Parent materials, soil consistency, soil structure, pore space, soil texture, content of coarse fragments all have influence on unit weight.

Table 8
New York Streambank Recession Rate Factors

Factor Description	Value
T - Soil Texture (subsoil)[1]	
fine textured - clay, silty clay, silty clay loam	0.03
medium textured - sandy clay, loam, silt loam, sandy clay loam	0.06
coarse textured - loamy sands, sands, gravels	0.10
S - Stream Alignment	
straight to slightly curved	0.03
moderately curved	0.06
sharply curved (90^o)	0.10
V - Top of Bank Vegetation	
trees	0.03
weeds, grass, shrubs	0.06
crop, pasture, urban lawn	0.10
G - Stream Gradient	
slight (few to no riffles)	0.03
moderate (balance of pools and riffles)	0.06
high (primarily riffles)	0.10
B1 - Slope of Eroding Bank	
Slight (3:1 or less)	0.03
Moderate (3:1 but < 1:1)	0.06
Severe (1:1 to vertical)	0.10
B2 - Slope of Inside Depositional Bar	
steep (3:1)	0.03
moderate (< 3:1 but > 10:1)	0.06
slight (>10:1)	0.10

[1] **Soil textures are broken down according to plasticity as shown on the Streambank Erosion Inventory Form. The texture of the subsoil in this case is the average for the layer between 10 and 40 inches. Soils with plastic to moderately plastic conditions have less of a tendency to slough than those with slight to no plasticity.**

Table 9
New York Roadbank Recession Rate Factors

Factor Description	Value
T - Soil Texture (subsoil)	
fine textured - clay, silty clay, silty clay loam	0.03
medium textured - sandy clay, loam, silt loam, sandy clay loam	0.06
coarse textured - loamy sands, sands, gravels	0.10
B1 - Slope of Eroding Bank	
Slight (3:1 or less)	0.03
Moderate (3:1 but < 1:1)	0.06
Severe (1:1 to vertical)	0.10
V - Bank Vegetation	
Trees, grass, shrubs; shaded forest environment	0.03
slight grass cover, few trees	0.06
none	0.10
D1 - Drainage to Bank Slope	
none	0.03
Internal (seeps)	0.06
Direct (over bank)	0.10
D2 - Drainage at Base of Slope	
none	0.03
intermittent (road ditch)	0.06
Permanent flow	0.10

Streambank Erosion Inventory Form

Watershed:_____ Stream: _____
Reach: _____ County: _____
Date: _____ Evaluator: _____

General Information

Bank # _____ Left ____ Right ____ Length of Eroding Bank (ft.) _____
Average Height of Eroding Bank (ft.) _____ Adjacent Land Use _____
If, pasture: fenced _____ unfenced _____ Machine Access: yes _____ no _____

Recession Rate Factors
(check one for each factor)

Soil Texture

___ Fine Textured - Plastic to moderately-plastic.
___ Medium Textured - Slight to moderately plastic.
___Coarse Textured - Non-plastic

Stream Alignment

___Straight to Slightly Curved
___Moderately Curved
___Sharply Curved (> or = 90^{o})

Vegetation at Top of Bank

___Trees
___Weeds, Grass, Shrubs
___Crop, Pasture, Urban (lawn)

Stream Gradient

___Slight (few to no riffles)
___Moderate (balance of pools and riffles)
___High (primarily riffles)

Slope of Eroding Bank

___Slight (3:1 or less)
___Moderate (3:1 but < 1:1)
___Severe (1:1 to vertical)

Slope of Inside Depositional Bar

___Severe (< 3:1)
___Moderate (< 3:1 but > 10:1)
___Slight (< 10:1)

Remarks:

New York Procedures for Calculating Roadbank Erosion

Roadbank erosion calculations are similar to calculations for streambank erosion. Factors to consider in determining recession rates include soil texture, existing vegetative cover, and bank slope. Additional factors to consider are the presence or absence of flowing water at the base of the bank, the possibility of over bank flow from the drainage area above the bank, or the presence of seepage and/or slump areas on the face of the slope.

Recessional rates for roadbanks are much lower than for stream banks. Eroded material from the top of the bank may become depositional material at the base. Any estimated recession rate must be applied over the entire face of the bank. Calculations for cubic feet of eroded material and conversion to tons are the same as for streambank erosion.

Roadbank Erosion Inventory Form

Watershed:_____ Road: _____
County: _____ Town: _____
Date: _____ Evaluator: _____

General Information

Bank # _____ Length of Eroding Bank (ft.) _____

Average Height of Eroding Bank (ft.) _____ Adjacent Land Use _____

Recession Rate Factors
(check one for each factor)

Soil Texture

___ Fine Textured - Plastic to moderately-plastic.
___ Medium Textured - Slight to moderately plastic.
___Coarse Textured - Non-plastic

Slope of Eroding Bank

___Slight (3:1 or less)
___Moderate (3:1 but < 1:1)
___Severe (1:1 to vertical)

Bank Vegetation

___ Grass, Trees, and Shrubs
___Slight Grass Cover, Few Trees
___ None

Drainage to Bank Slope

___Direct (over bank)
___Internal (seeps)
___None

Drainage at Base of Slope

___ Permanent Flow
___Intermittent (road ditch)
___None

Remarks:

Worksheet for Calculating Streambank and Roadbank Erosion

Name _____ Date _____
Location _____ Streambank or Roadbank
County _____ Bank no. _____

1. Length (L) of eroding banks (ft.)
L = _____

2. Average height (H) of eroding bank (ft.)
H = _____

3a. Recession Rate (streambanks) (Table 8)

	Value
T - Soil Texture	_____
S - Stream Alignment	_____
V - Bank Vegetation	_____
G - Stream Gradient	_____
B1- Slope of Eroding Bank	_____
B2- Slope of inside depositional bar	_____

RRs = T * S * V * G * B1 * B2 = _____

3b. Recession Rate (roadbanks) (Table 9)

T - Soil Texture	_____
B1- Slope of Eroding Bank	_____
V - Bank Vegetation	_____
D1 - Drainage to Bank Slope	_____
D2 - Drainage at Base of Slope	_____

RRr = T * B1 * V * D1 * D2 = _____

To calculate the volume of soil displaced (VD):

VD = L * H * RRr [1 x 2 x (3a or 3b)]
VD = _____ cu. Ft./year

To convert VD to tons of soil displaced (TD):

TD = VD * soil bulk density (Table 6) / 2000 lbs./ton = TD = VD * BD/2000
TD = _____ tons/year