

What is the Region 5 Model and How do you use it?



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What is the Region 5 Model?


- Basic nutrient reduction model
- Named for the EPA Midwest Region 5
- A model developed by EPA Region 5 and Michigan Dept. of Environmental Quality (DEQ) to measure water quality impacts at the conservation level.

Region 5 Model

[http://it.tetrattech-ffx.com/steplweb/models\\$docs.htm](http://it.tetrattech-ffx.com/steplweb/models$docs.htm)


BMP Efficiency Calculator

(Last updated: 06/30/2010. Please send your comments to STEPL support.)

BMP Efficiency Calculator 1.0 Package 

STEPL 3.1 Installation Package 

(Last updated: 06/30/2010)

STEPL 3.1 User's Manual 

(Last updated: 06/30/2010)

STEPL Example (Microsoft Excel 2000) 

(Last updated: 06/30/2010)

STEPL 2.2 Field Data Entry Sheets 


(Last updated: 07/01/03)

Region 5 Load Estimation Spreadsheet Model (Microsoft Excel) 

(Last updated: 11/23/09)

Region 5 Load Estimation Model User's Manual 

(Last updated: 11/17/05)

Region 5 Load Estimation Model Field Data Entry Sheets 

(Last updated: 07/01/03)



Overview of Model

Assumptions

- The amount of sediment delivered to the edge of the field may be 100% in the case of streambank or gully erosion sites directly on or adjacent to a water body. In the case of upland erosion sites, the percent of soil delivered to the water as sediment will be less than 100%.
- Once the system of BMPs is established, the stabilized condition is assumed to control all the erosion. Therefore the “before” condition is measured in average annual tons of sediment generated (i.e. without treatment), and the “after” condition (after treatment) is assumed to be negligible.
- Phosphorus and nitrogen reductions are assumed to come from reduction in sediment-borne nutrients. Nutrients that are dissolved and carried by runoff waters are not included.

Overview of Model

Strengths and Usefulness

- Estimating sediment and nutrient load reductions illustrates the value and impact of conservation practices and efforts.
- The simplistic nature of the Region 5 Model means that it allows for less technical and complex data entry than many other models.
- It has a lower margin of error than more complex load estimation tools.
- Requires little specialized training and no software.

**Remember: the Region 5 Model only estimates reductions that are tied directly to sediment.*

Overview of Model

- Instructions
- 5 worksheets
 - Gully Stabilization
 - Bank Stabilization
 - Ag Fields and Filter Strips
 - Feedlots
 - Urban Runoff
- Each tab can be used for a several different practices, which are listed on the Instructions tab.
- For more information regarding practices for inputs into the model, a Guidance Document has been developed by the Division of Soil Conservation's Resource Specialists Team Leaders to provide guidelines for data entry into specific worksheets.

Gully Stabilization Worksheet

Sediment Reduction:

Gully Erosion Equation (GEE) =

$$\frac{\text{Top Width(ft.)} + \text{Bottom Width(ft.)}/2 \times \text{Depth(ft.)} \times \text{Length(ft.)} \times \text{Soil Weight(tons/cuft.)}}{\text{Number of Years}}$$

Soil Weight

Note: * The figure for Soil Weight (tons/cuft.) is built into the model once you choose the soil texture on the worksheet. (Found in Exhibit 1 in R5 Manual)

Exhibit 1
Dry Density Soil Weights

SOIL TEXTURAL CLASS	DRY DENSITY
	Tons/Ft3
Sands, loamy sands	.055
Sandy Loam	.0525
Fine sandy loam	.05
Loams, sandy clay loams, sandy clay	.045
Silt loam	.0425
Silty clay loam, silty clay	.04
Clay loam	.0375
Clay	.035
Organic	.011

Gully Stabilization Worksheet

Nutrient Reduction:

Nutrient reduced (lbs/yr) =

Sediment reduced (tons/yr) x Nutrient conc. (lb/lb soil) x 2000 lb/T x correction factor

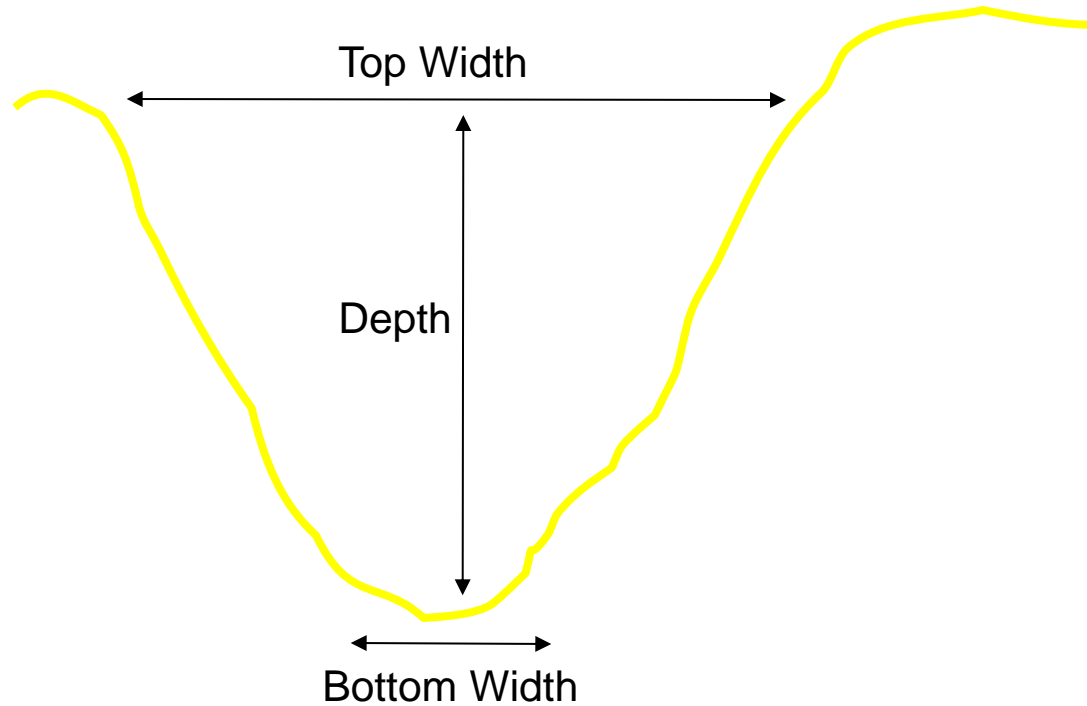
Nutrient Concentrations

The amount of attached phosphorus and nitrogen is calculated based on an overall phosphorus concentration of 0.0005 lbP/lb of soil and an nitrogen concentration of 0.001 lbN/lb of soil. (USDA-ARS researchers, 1980).

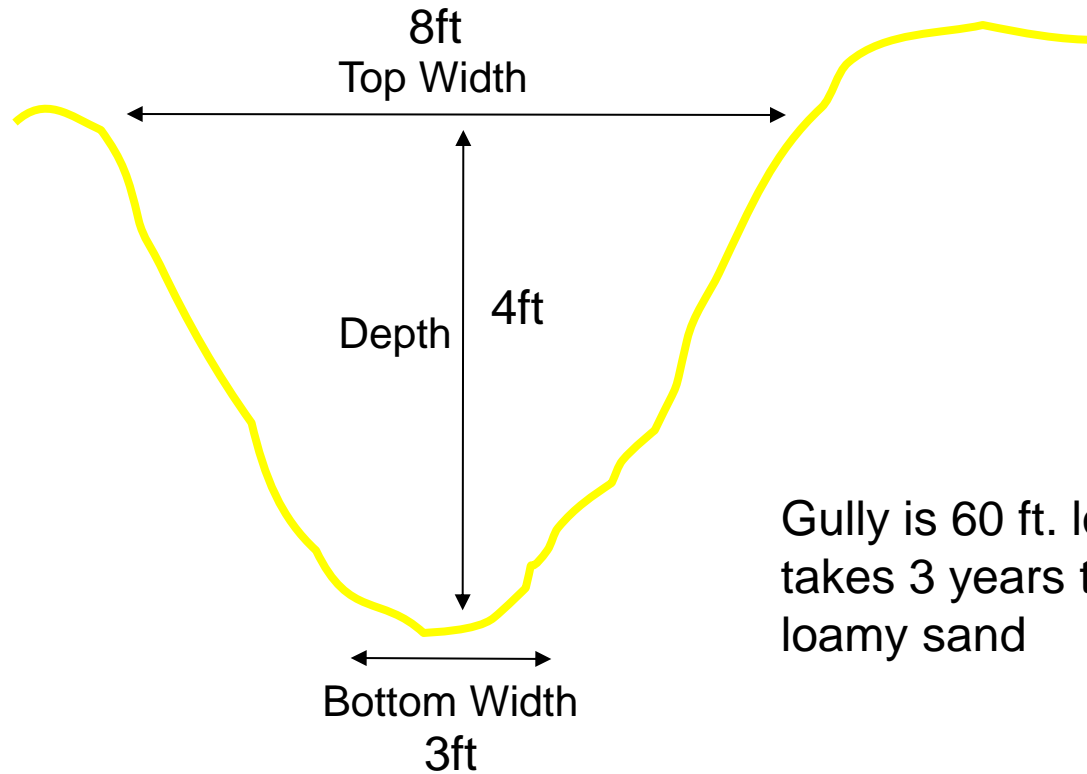
A correction factor is used to better estimate nutrient-holding capacity based on the general soil texture chosen in the model. (Found in Exhibit 2 in R5 Manual, which is shown below)

Correction Factors for Soil Texture

Soil Texture	Correction Factor
Clay	1.15
Silt	1.00
Sand	.85
Peat	1.50



Gully Erosion Equation (GEE) =
Top Width(ft.) + Bottom Width(ft.)/2 x Depth(ft.) x Length(ft) x Soil Weight (tons/ft³)
Number of Years



Gully Erosion Equation (GEE) = $\frac{8\text{ft.} + 3\text{ft.}/2 \times 4\text{ft.} \times 60\text{ft} \times 0.055 \text{ tons/ft}^3}{3} = 24.2 \text{ tons/yr}$

Bank Stabilization Worksheet

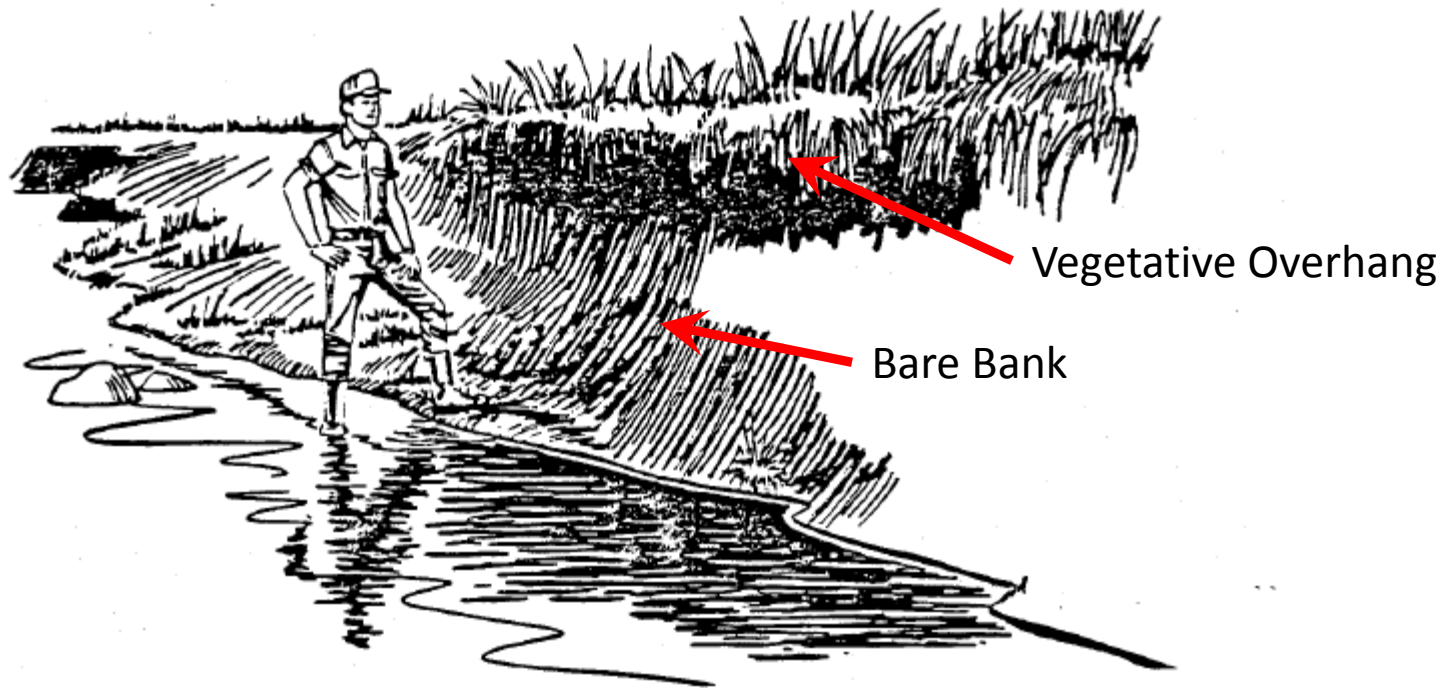
Sediment Reduction:

Channel Erosion Equation (CEE) =

Length(ft.) x Height(ft.) x LRR(ft./yr.) x Soil Weight(tons/cuft.)

- * Lateral Recession Rate (LRR) is the thickness of soil eroded from a bank surface (perpendicular to the face) in an average year.
- * Selecting the lateral recession rate is the most critical step in estimating channel erosion using the direct volume method.

Bank Stabilization Worksheet



* Remember that selecting the Lateral Recession Rate is the most critical step in estimating channel erosion using the direct volume method. Refer to the table on the Bank Stabilization worksheet to select the LRR.

Bank Stabilization Worksheet

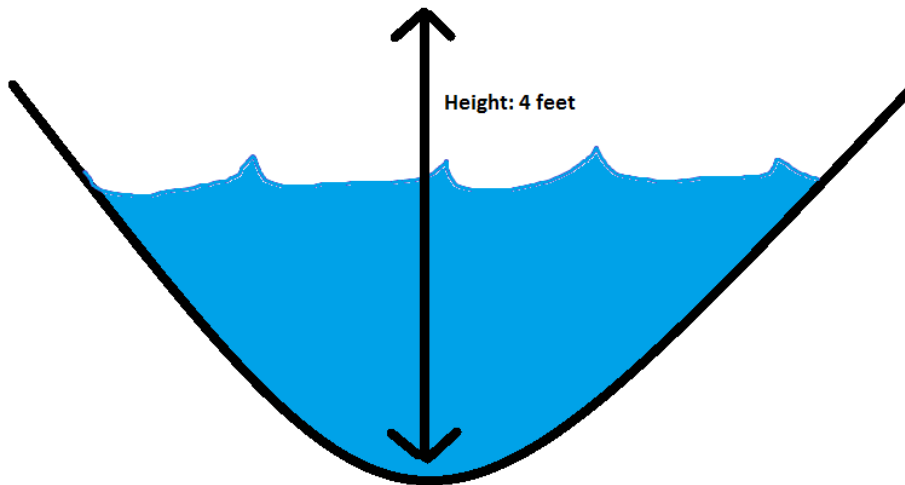
Nutrient Reduction:

Nutrient reduced (lbs/yr) =

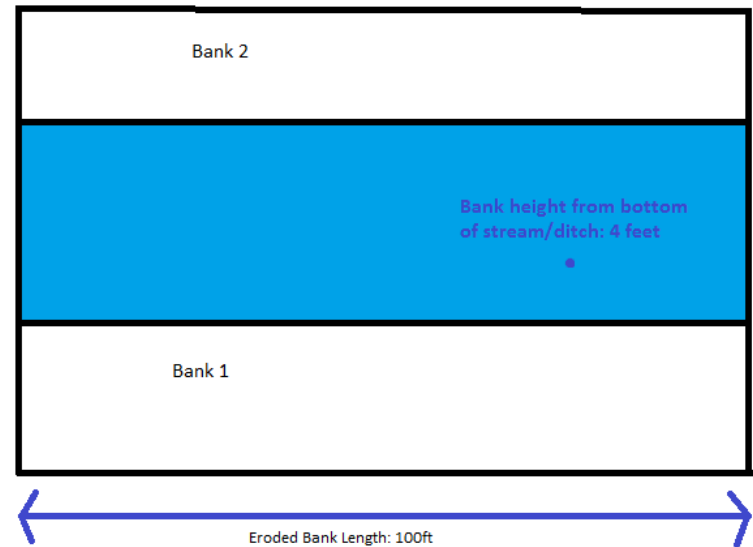
Sediment reduced (tons/yr) x Nutrient conc. (lb/lb soil) x 2000 lb/T x correction factor

Bank Stabilization Worksheet

Streambank Stabilization (cross-section)



Streambank Stabilization (plain view)



Ag Fields & Filter Strip Worksheet

Agricultural Fields

Filter Strips

* The 'Filter Strip' box should only be checked on true filter strips/buffers along bodies of water.

- The Region 5 Model uses RUSLE to determine soil loss, and then uses the soil type and texture along with the RUSLE calculations to determine the sediment and nutrient reductions.

r = rainfall-runoff erosivity factor

k = soil erodibility factor

ls = slope length factor

c = cover management factor

p = practice management factor

Ag Fields & Filter Strip Worksheet

- When choosing the appropriate County, the RUSLE Factors are automatically populated with default numbers.
 - Resources for assistance with RUSLE
 - USDA, Agricultural Research Service (ARS)
 - Indiana Soil and Water Conservation District offices
 - Conservation Practices Guidance for Region 5 Model – ISDA DSC
- Contributing Area
 - The Contributing Area is the acreage of land that drains to the practice and is therefore treated by the practice.
- Guidance Document from the ISDA Division of Soil Conservation

Feedlots Worksheet

- An animal lot refers to an open lot or combination of open lots intended for confined feeding, breeding, raising or holding animals. It is designed as a confinement area in which manure accumulates or where the concentration of animals is such that vegetation cannot be maintained.
- Two assumptions:
 - 1) the feedlot is adjacent to a receiving hydrologic system without any buffer areas
 - 2) installing the animal waste system will prevent any further pollutants from the lot from reaching the hydrologic system.
- Feedlots that cannot show impact to the hydrologic system being protected should not be evaluated with this computation.

Feedlots Worksheet

There are 5 steps on this worksheet:

1. Enter the contributing area in acres of the area contributing polluted water to the discharge point.
2. From the list of percentages, choose the percent of the contributing area that is paved.
3. Enter the State, County and nearest weather station for the location of your project. The model will use the information you've entered so far and will determine the Rainfall in inches and the Curve Number.
4. Enter the number of animals in the lot that corresponds to the animal type and design weight factors in the table.
5. Select your Best Management Practice from list.

* The Load Reductions calculated by Region 5 for Feedlots is the Biochemical Oxygen Demand (BOD), Phosphorus, and Nitrogen. Depending on the type of BMP that you select, there may or may not be a load reduction figured for Nitrogen. Sediment is not calculated in R5 for these type of projects.

Urban Runoff Worksheet

- Urban areas usually have high percentages of hard, impermeable surfaces causing rainwater to collect, and be forced out through a storm drain system. If the drainage system does not connect to a wastewater treatment facility, the rainwater and everything in it travels into local streams and rivers.
- Urban runoff can be attributed to many things:
 - rainfall
 - soil conditions
 - degree of urbanization
- Implementing Best Management Practices (BMPs) in urban areas can reduce the pollutants carried by runoff to the nearby streams and lakes.

Urban Runoff Worksheet

Here is how the Indiana R5 Model figures pollutant reductions for Urban Runoff:

Steps:

- 1) Select BMP in list
- 2) Enter in the table the area in acres of each landuse type in the contributing/drainage area. (Sewered or unsewered refers to the urban areas with or without storm sewers)

Behind the scenes:

The model calculates the pollutant load **before** the BMP based on the land use and the area in acres of that land use.

(Table – Average Pollutant Loading Rates by Urban Land Use Types (lb/ac/yr))

Then it calculates the pollutant load **after** the BMP is implemented.

(Table – BMP Pollutant Removal Efficiencies)

Urban Runoff Worksheet

Behind the Scenes (cont'd):

Calculate the load reduction after the installation of the BMP.

$$\text{*Load reduction (lbs/yr) = Load before BMP – Load after BMP}$$

- Choose values from “Estimated Load and Load Reductions” table.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)		Load after BMP (lbs/yr)		Load Reduction (lbs/yr)
BOD	4,560		2,257		2,303
COD	34,891		20,935		13,956
TSS	72,960		19,699		53,261
LEAD	68		37		31
COPPER	13		U		U
ZINC	100		40		60
TDS	178,930		U		U
TN	1,130		678		452
TKN	457		U		U
DP	36		U		U
TP	76		42		34
CADMIUM	1		U		U

Guidance Document Review

If questions, please feel free to request and review the Guidance Document, as it offers specific notes and inputs on most practices and their respective worksheets.

Practice from SharePoint Conservation Tracking Sheet	Region 5 Model Worksheet	C factor before	C factor after	P factor	Comments
Access Control (472)(number)					Usually this will not need to be captured. Enter 0.0 in SharePoint
Access Road (560)(ft.)	Ag Fields and Filter Strips	0.9 - 0.7	0.2	1.00	May need to contribute
Agrichemical Handling Facility (309) (number)					Enter 0.0 in ?
Agrichemical Mixing Facility (702) (number)					Enter 0.0 in ?
Alley Cropping (311)(acres)					Enter 0.0 in ?
Amendments for Treatment of Agricultural Waste (591)(number)					Enter 0.0 in ?
Anaerobic Digester, Ambient Temperature (365)(number)					Enter 0.0 in ?
Anaerobic Digester, Controlled Temperature (366)(number)					Enter 0.0 in ?
Animal Mortality Facility (318)(number)					Enter 0.0 in ?
Animal Trails and Walkways (575)(ft)	Ag Fields and Filter Strips	0.9 - 0.7	0.2	1.00	Contributing
Aquaculture Fishponds (397)(number)					Enter 0.0 in ?
Brush Management (314)(acres)	Ag Fields and Filter Strips	use default from RS Model	0.10	1.00	Analysis is of type of manure
Clearing and Snagging (326)(acres)					Enter 0.0 in ?
Closure of Waste Impoundments (360)(number)					Enter 0.0 in ?
Composting Facility (317)(number)					Enter 0.0 in ?
Comprehensive Nutrient Management Plan (number)					Enter 0.0 in ?
Conservation Cover (327)(acres)	Ag Fields and Filter Strips	refer to charts on C factor tab		1.00	Contributing cover, use de seeded area total field ac cover.
Conservation Crop Rotation (328)(acres)					Enter 0.0 in ?
Constructed Wetland (656)(acres)	Ag Fields and Filter Strips	use default from RS Model	0.04	1.00	Contributing drainage are

Links to Resources

USDA, Agricultural Research Service (ARS)

<http://www.ars.usda.gov/Research/docs.htm?docid=5971>

Local Soil and Water Conservation District (SWCD) office

<http://www.in.gov/isda/2368.htm>

<http://it.tetratex.com/step1web/models/docs.htm>

Contact Information

Thank You!

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