Illinois Institute of Natural Resources

**State Water Survey Division**

SURFACE WATER SECTION

# GROSS EROSION ASSESSMENT IN THE BLUE CREEK WATERSHED, PIKE COUNTY, ILLINOIS

**Progress Report**

**Submitted to Illinois Environmental Protection Agency**

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# GROSS EROSION ASSESSMENT
# IN
# THE BLUECREEK WATERSHED
# PIKE COUNTY, ILLINOIS

by

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## INTRODUCTION

The Illinois State Water Survey has been working on a project related to sedimentation and erosion assessment on the Blue Creek Watershed in Pike County, Illinois. Two parts of this project are to assess the gross erosion and to monitor sediment transport in the Blue Creek Watershed. The major objectives of the project are to: 1) evaluate gross erosion in the watershed, 2) monitor the stream sediment transport, and 3) evaluate the changes in the stream geometry in the main stem and in the tributaries of Blue Creek. This report focuses on the gross erosion conditions in the watershed.

The erosion assessment was divided into two parts: field data inventory and the data analysis.

The purposes of the gross erosion assessment were to:

1) Inventory the present soil information which includes soil types, soil slopes, slope length, land use, land cover, crop rotation, tillage practices, and pasture and woodland management levels in the watershed.

2) Compute the present soil loss rates in the watershed based on present conditions.

3) Compute soil loss rates based on a few selected management practices to simulate the change of soil loss rates.

## ACKNOWLEDGMENTS

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The field data inventory was performed by Wayne Kinney, Steve Chick, and Edward Johnson of the Pike County Soil Conservation Service. Raynold Herman of the Champaign Soil Conservation Service State Office helped by providing soil information. Many Water Survey employees helped in the preparation of this report. Peter Simshauser and William Fitzpatrick helped in the tabulation of the data. John Brother, Jr., Linda Riggin, and William Motherway prepared the illustrations. Pam Lovett, Katherine Brown, and Lynn Dorner typed the manuscript. Nani Bhowmik and Thomas Davenport reviewed the report.

## STUDY AREA

The Blue Creek Watershed comprises an area of 11 square miles (7,040 acres) in the eastern part of Pike County in west-central Illinois (see figure 1). The upper extremity of the main stem is 6.5 miles north of Pittsfield, Illinois. Lake Pittsfield is located at the lower end of the watershed.

The average annual rainfall on the watershed is 36.50 inches. The average annual snowfall is 22.5 inches. The rainfall is fairly evenly

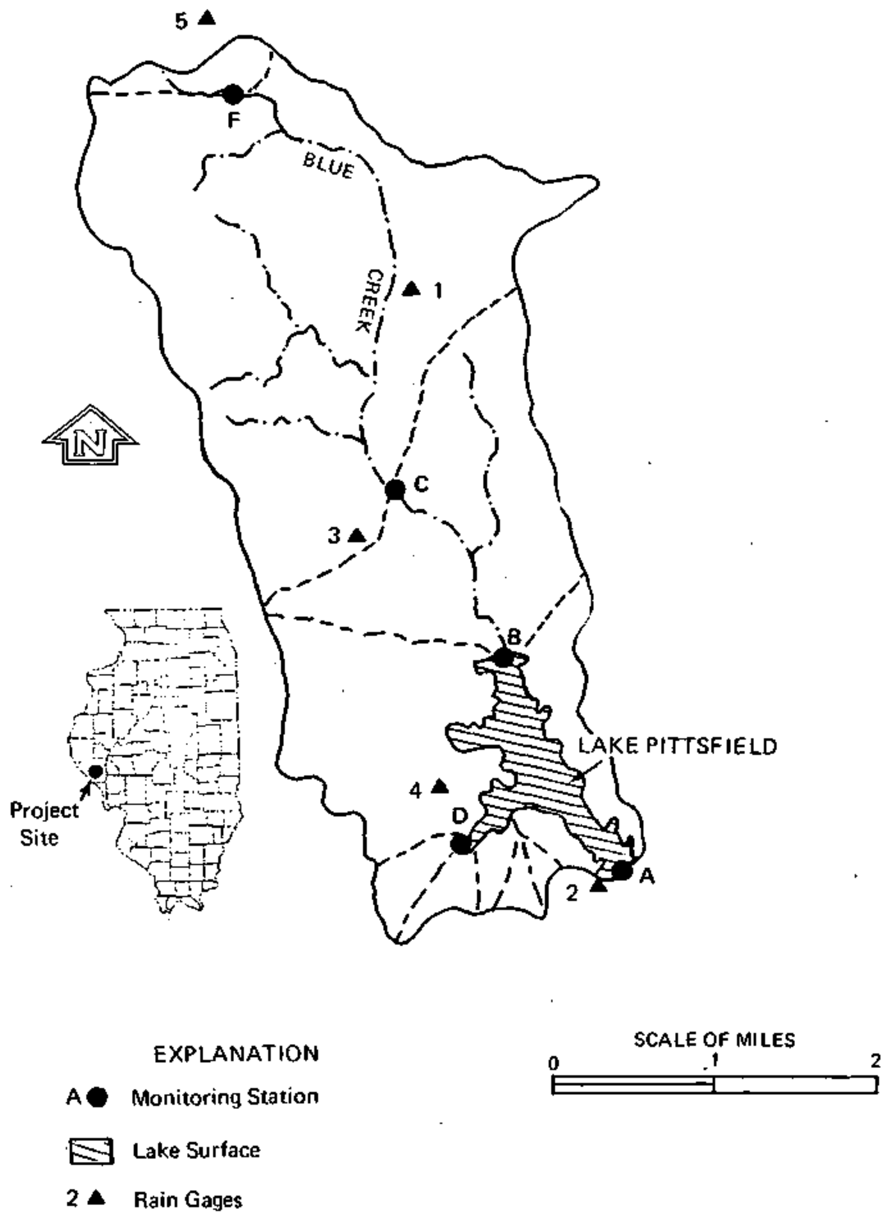


Figure 1. Location of the Stream Monitoring Stations and Raingages in the Blue Creek Watershed, Pike County, Illinois

distributed with the greatest amounts occurring in the months of May, June, and September, and the smallest amounts in the months of January, February, and December. Intensive storms occur at irregular intervals causing heavy floodwater damage and minor gully erosion.

The topography of the western sections of the watershed is characterized by gentle rolling hills and a few level ridge tops which represent the remnants of the maturely dissected Illinoian glacial till plain. The topography of the eastern part of the watershed conforms essentially to preglacial bedrock. The valley is broad and flat with gently sloping valley walls. The gradients of the main stream and the tributaries are moderate.

## Soils on the Watershed

A major portion of the upland soil in Blue Creek Watershed has been developed in moderately thick loess which overlies weathered Illinoian glacial till. Except for a small percentage of prairie soils in the northern part of the watershed, most of the soils have developed under timber vegetation. Soils on the steeply sloping areas adjacent to the stream have developed in either weathered glacial till or limestone residium. Bottom soils are cumulative soils which have developed chiefly from silty deposits derived from erosion of the uplands. The soils in the watershed could be categorized into four general soil groups:

(A) Upland timber soils - Light colored, silt loam soils with moderately slow permeability, occurring on slopes ranging from 1 to 15 percent. These soils were developed in five feet or more of loess over weathered Illinoian till. A typical soil type within the group is Fayette.

(B) Upland Prairie Soils - Dark colored silt loam soils with moderate permeability, occurring on nearly level to gently sloping land. These soils were developed under prairie vegetation in eight feet or more of loess over weathered Illinoian till. Typical Illinois soil types are Muscatine and Tama.

(C) Steeply Sloping Timber Soils - This is a heterogeneous group of soils developed on exposures of weathered glacial till, limestone outcrops, or thin loess. Typical soil type within this group is Hickory.

(D) Bottomland Soils - Dark to moderately dark colored silt loam soils with moderate permeability, occurring on nearly level valley floor. Typical soil types are Orin and Lawson.

A detailed list of soil types and their general soil groups are given in table 1.

## DATA COLLECTION

In order to relate the gross erosion rates from the watershed to the transported sediment, one subwatershed upstream of the suspended sediment Station C (figure 1), located at the Highway 107 bridge, was selected for detailed gross erosion study. A standard SCS Land Resource Inventory method was utilized. In this inventory the subwatershed was divided into 36 quarter sections (160 acres) as basic sampling areas. Within each sampling area, subareas with the same land use were defined as field areas. Within a field area, a series of soil types were delineated on the soil maps and these data were recorded in tabular form. The information for each soil-type-unit consists of the following listed items, and all of the data have been stored in a computer data file. Each number to the left of the listed items indicates the column number where that particular item was recorded. Detailed explanations of the types of information coded under columns 1 through 28 are given in the subsequent paragraphs.

1) Sample number

2) Field number

3) Area (acreage)

Table 1. Soil Types in the Blue Creek Watershed, Pike County, Illinois

| | Soil types | General soil group | Description |
|---|---|---|---|
| 8F2* | Hickory loam | Ct | 18 to 30 percent slopes, eroded, steep and some subsoil within 7 inches of the surface. |
| 8G | Hickory loam | C | Greater than 30 percent slopes, very steep with loam subsurface layer more than 7 inches thick. |
| 16 | Rushville silt loam | A | A grayish brown soil with a gray clayer, mottled subsoil. Formed in loess (no sand or pebbles). This soil is commonly wet in the spring and has very slow permeability. Available moisture capacity is high. Nearly level with a silt loam plow layer. |
| 17A | Keomah silt loam | A | 0 to 2 percent slopes, a light colored soil with a grayish brown silty clay loam subsoil. Formed in loess (no sand or pebbles). The water table is within 3 feet during the wetter part of the season. Permeability is moderately slow and available moisture capacity is high. |
| 17B | Keomah silt loam | A | 2 to 4 percent slopes. Rest of the description is same as 17A. |
| 18A | Clinton silt loam | A | 0 to 2 percent slopes, a light colored moderately well drained soil with a brown, silty clay loam subsoil. Formed in loess (no sand or pebbles). Permeability is moderately slow and available moisture capability is high. |
| 18B | Clinton silt loam | A | 2 to 4 percent slopes. Rest of the description is same as 18A. |
| 18C | Clinton silt loam | A | 4 to 7 percent slopes. Rest of the description is same as 18A. |
| 18D | Clinton silt loam | A | 7 to 12 percent slopes. Rest of the description is same as 18A. |

Table 1 (continued)

| | Soil types | General soil group | Description |
|---|---|---|---|
| 36B | Tama silt loam | B | 2 to 4 percent slopes, a dark, upland soil with brown, silt clay loam subsoil. Formed in loess (no sand or pebbles). Permeability is moderate and available moisture capacity is high. |
| 36C2 | Tama silt loam | B | 4 to 7 percent slopes, eroded. Rest of the description is the same as 36B. |
| 36D2 | Tama silt loam | B | 7 to 12 percent slopes, eroded. Rest of the description is the same as 36B. |
| 41A | Muscatine silt loam | B | 0 to 2 percent slopes, nearly level with silt loam plow layer. A dark, somewhat poorly drained, upland soil with a grayish mottled silty clay loam subsoil. High water table during wet seasons unless tilted. Permeability is moderate and available soil mositure is very high. Nearly level with a silt loam plow layer. |
| 41B | Muscatine silt loam | B | 2 to 4 percent slopes, gently sloping with silt loam plow layer. |
| 61A | Atterberry silt loam | B | 0 to 2 percent slopes, nearly level with a silt loam plow layer. A dark grayish brown soil with grayish mottled silty clay loam subsoil. This soil is commonly wet in the spring. Formed in loess (no sand or pebbles). Permeability is moderate and available moisture capacity is very high. |
| 61B | Atterberry silt loam | B | 2 to 4 percent slopes. Rest of description is the same as 61A. |
| 68 | Sable silty clay loam | B | A dark poorly drained, upland soil with a gray subsoil. This soil is silty clay loam throughout. Permeability is moderate and available moisture capacity is high. |

Table 1 (continued)

| | Soil types | General soil group | Description |
|---|---|---|---|
| 75C | Drury silt loam | A | 0 to 2 percent slope. A light colored, well drained soil with a brown subsoil. It is mainly composed of silt loam; in places has sand grains. Permeability is moderate and available moisture capacity is high. |
| 257A | Clarksdale silt loam | B | 0 to 2 percent slopes, a dark gray soil with a brownish mottled grayish brown silty clay loam subsoil. Formed in loess (no sand or pebbles). Permeability is moderately slow and available moisture capacity is very high. |
| 257B | Clarksdale silt loam | B | 2 to 4 percent slopes, nearly level with a silt loam plow layer. |
| 278A | Stronghurst silt loam | A | 0 to 2 percent slopes, nearly level with silt loam plow layer, a light colored somewhat poorly drained upland soil with gray mottled silty clay loam subsoil. Moderately slowly permeable soil with high available moisture capacity. Commonly wet in early spring. Low in organic matter. |
| 278B | Stronghurst silt loam | A | 2 to 4 percent slopes. Rest of the description is the same as 278A. |
| 279A | Rozetta silt loam | A | 0 to 2 percent slopes, nearly level with a silt loam plow layer, a light colored, moderately well drained, upland soil. With yellowish brown silt clay loam subsoil. Moderately permeable soil with high available moisture capacity. Low in organic matter. |
| 279B | Rozetta silt loam | A | 2 to 4 percent slopes, gently sloping with silt loam plow layer. Rest of the description is the same as 279A. |

Table 1 (continued)

| | Soil types | General soil group | Description |
|---|---|---|---|
| 279C | Rozetta silt loam | A | 4 to 7 percent slope, moderately sloping with silt loam plow layer. Rest of the description is the same as 279A. |
| 280A | Fayette silt loam | A | 0 to 2 percent slopes, nearly level soil with a silt loam plow layer. A light colored, well drained soil with a brown silty clay loam subsoil. Formed in loess (no sand and pebbles). Permeability is moderate and available moisture is high. |
| 280C2 | Fayette silt loam | A | 4 to 7 percent slopes, eroded, moderatley sloping and some subsoil within plow depth. |
| 280D3 | Fayette silt loam | A | 7 to 12 percent slopes, strongly sloping and plow layer mainly subsoil. |
| 280E2 | Fayette silt loam | A | 12 to 18 percent slopes, eroded, moderately steep with a silt loam plow layer. |
| 280E | Fayette silt loam | A | 12 to 18 percent slopes, moderately steep with a silt loam plow layer. |
| 331 | Haymond silt loam | D | A light colored, well drained, bottomland soil with silt loam texture 3 or 4 feet deep. Layers of loam or sandy loam commonly occur below 3 feet. Moderately permeable with very high available moisture capacity. Subject to temporary flooding. |
| 333 | Wakeland silt loam | D | A light colored nearly level, bottomland soil. It is silt loam throughout with a mottled subsoil. The water table is within 3 feet during the wetter part of the season. Permeability is moderate and available water capacity is very high. |

Table 1 (concluded)

| | Soil types | General soil group | Description |
|---|---|---|---|
| 386A | Downs silt loam | A | 0 to 2 percent slopes, moderately dark, moderately well drained, upland soil with yellowish brown silt clay loam subsoil. Moderately permeable with very high available moisture capacity. |
| 386B | Downs silt loam | A | 2 to 4 percent slopes. Gently sloping soil with silt loam plow layer. Rest of the description is the same as 386A. |
| 386C2 | Downs silt loam | A | 4 to 7 percent slopes, eroded, moderately sloping with some subsoil within plow depth. Rest of the description is same as 386A. |
| 386D2 | Downs silt loam | A | 7 to 12 percent slopes, eroded, strongly sloping with some subsoil within the plow layer. Rest of the description is the same as 386A. |
| 415 | Orin silt loam | D | A light colored bottomland soil consisting of 20 to 40 inches of light colored silt loam over dark colored heavy silt loam or medium clay loam. Moderately permeable soil, with very high available moisture capacity. Subject to temporary flooding. Nearly level. |
| 451 | Lawson silt loam | D | A dark, nearly level, bottomland soil. It is silt loam throughout with a mottled subsoil. The water table is within 3 feet during the wetter part of the season. Permeability is moderate and available moisture capacity is high. |

* Each soil type is designated by a number on a soil map and followed by an alphabetical character which represents the slope range and ended by a number which represents the class of thickness of top soil left.

t A = upland timber soils, B = upland prairie soils, C = steeply sloping timber soils, and D = bottomland soils.

4) Slope (percent)

5) Slope length (feet)

6) Land use code

7) Land cover code

8) Crop rotation

9) Conservation practice factor (P)

10) Residues, left (L) and removed (R)

11) Pounds of residues on the surface

12) Tillage, conventional fall (F) or spring (S) plow

13) Conservation tillage codes 1, 2, or 3

14) Woodland stand condition, well (W), medium (M), or poor (P)

15) Woodland percent of forest litter

16) Undergrowth, managed (M) and unmanaged (U)

17) Woodland, tree canopy in percent

18) Grassland, raised canopy in percent

19) Grassland, ground cover in percent

20) Cropping management factor (C)

21) Annual soil loss rates (tons per acre per year)

22) Soil series name

23) Hydrologic soil group, permeable (A), moderately permeable (B), and poorly permeable (C)

24) Soil tolerance value (T) in tons per acre per year

25) Soil erodibility value (K)

26) Urban density, low (L), medium (M), or high (H)

27) Applied conservation practice codes (explained later in text)

28) Needed conservation practice codes (explained later in text)

Each soil type was identified within a sample number and field number in columns 1 and 2. The areas of the soil types in acreage were measured by an electronic digitizer and recorded in column 3. Slopes were determined at the main overland flow direction by using a clinometer and was recorded in column 4. Slope lengths were determined by field measurement and recorded in column 5.

The sixth column of land use codes is as follows:

Code 01 Cropland

02 Farmstead

03 Hayland

04 Pasture

05 Recreation

06 Residential

07 Transportation

08 Wildlife

09 Woodland

10 Commerical development

11 Community

12 Other land which may include surface mining or natural area

In the seventh column, land cover codes are denoted as follows:

Code 01 Corn

02 Sorghum

03 Soybeans

04 Wheat

05 Oats

06 Legume

07 Legume and grass mixed

08 Blue grass

09 Wildlife

10 Bare ground

11 Woodland

In the eighth column, crop rotation was noted based on the field office record and the field experience of the County Soil Conservationists in the area. The ninth column of conservation practices factor (P) was estimated on the basis of SCS technical notes. P values of contouring were assigned as follows.

| Slope | P values |
|---|---|
| 1-2% | 0.6 |
| 2-7% | 0.5 |
| 7-12% | 0.6 |
| 12-18% | 0.8 |
| 18-24% | 0.9 |
| >24% | 1.0 |

Since the main purpose of a terrace is to break the length of slope, it is logical to compute the total soil movement within the terrace interval as equal to contouring along the same slope length when farming operations parallel the terrace. The horizontal terrace spacing is used in determining the slope length factor.

In the tenth column, residue management was classified as residue left (L) and removed (R). In case of residue left, the amount of residue left was recorded in units of 1000 pounds and this was recorded in column 11. In the twelfth column, conventional tillage practices were classified as spring (S) plow and fall (F) plow. In the thirteenth column, conservation tillage is classifed as chisel plow and no-till.

In columns 14 through 17, woodland was described as well (W), medium (M), or poor (P) management level. Also, the percent of forest litter was recorded. The undergrowth of the woodland was described as either managed (M) or un-managed (U) land. The tree canopy percent, type, and height were also recorded.

In columns 18 and 19, grassland was described in terms of raised canopy percent and grassland cover percent.

The data of columns 10 through 19 were used to determine the cropping management factors (C) which were recorded in column 20 for cropland, grassland, or woodland. The annual soil loss rates were computed with the Universal Soil Loss Equation (USLE) and recorded in column 21.

The soil type name was recorded in column 22. Hydrologic soil group is classified as pervious (A), moderately pervious (B), or impervious (C) and recorded in column 23. In each soil series, the allowable tolerance rate, so-called (T) value assigned by SCS for maintaining long-term soil productivity, were recorded in column 24. Soil erodibility, so-called K value, was assigned to each soil series and recorded in column 25. In an urban or suburban area, the urban density was classified as low (L), medium (M), or high (H) and recorded in column 26.

In columns 27 and 28, the applied management practices and the needed management practices were recorded. The practices were coded for each field condition as follows:

| Code | Practice Name |
|---|---|
| 328 | Conservation cropping system |
| 329 | Conservation tillage system |
| 330 | Contour farming |
| 342 | Critical area planting |
| 344 | Crop residue use |
| 362 | Diversion |

| | | |
|---|---|---|
| 410 | | Grade stabilization structure |
| 412 | | Grassed waterway or outlet |
| 472 | | Livestock exclusion |
| 510 | | Pasture and hayland management |
| 512 | | Pasture and hayland planting |
| 585 A | | Countour stripcropping |
| 600 | | Terrace |
| 612 | | Tree planting |
| 645 | | Wildlife upland habitat management |
| 666 | | Woodland improvement |
| 329 | A1 | Conservation tillage system, chisel plow, 1,000-2,000 pounds residue |
| 329 A2 | | Conservation tillage system, chisel plow, 2,000-3,000 pounds residue |
| 329 A3 | | Conservation tillage system, chisel plow, 3,000-4,000 pounds residue |
| 329 | B1 | Conservation tillage system, no-till, 1,000-2,000 pounds residue |
| 329 B2 | | Conservation tillage system, no-till, 2,000-3,000 pounds residue |
| 329 B3 | | Conservation tillage system, no-till, 3,000-4,000 pounds residue |
| 329 B4 | | Conservation tillage system, no-till 4,000-6,000 pounds residue |
| 330 A | | Contour farming |

## DATA ANALYSIS

The land resource inventory was used as a data bank to compute soil loss rates.. The Universal Soil Loss Equation, USLE (Wischmeier and Smith, 1978), was utilized to compute soil loss rate. This equation is expressed as follows:

$$A = RKSLCP$$

where A is the average annual soil loss rate in tons per acre per year, R is the rainfall factor, K'the is soil erodibility factor, S is the steepness factor, L is the slope-length factor, C is the cropping factor, and P is the support practice factor.

The soil loss rates were computed based on each soil type in each sample. Within the same sample unit, the acreage of the same soil type was aggregated. The total amount of gross erosion is the sum of all the gross erosion from each soil type in all field sites. The average erosion rate is defined as the amount of gross erosion divided by the acreage. The standard deviation of the erosion rates in all the field sites has also been computed. The maximum and minimum erosion rates were recorded. The total number of samples are also recorded. All these values are given in table 2.

There are 73 soil types in the subwatershed. The total drainage area in the subwatershed is 3272 acres. Under the present conditions, the total amount of annual gross erosion is 41,096 tons. This is equivalent to an average annual soil loss rate of 12.56 tons per acre per year. However, the average soil loss rates in each soil type does indicate a higher variation. The highest soil loss rate can be as high as 50 tons per acre per year. Even within the same soil mapping unit, the standard deviation can be quite high (table 2 ). In the computation, only the standard

Table 2. Gross Erosion Assessment

| Soil type | Soil map unit | Acreage | Amt. of erosion (tons) | Erosion rate: Average (tons/a/yr) | Erosion rate: Standard* deviation | Erosion rate: Max. | Erosion rate: Min. | Number of samples |
|---|---|---|---|---|---|---|---|---|
| Hickory | 8F1 | 10.4 | - | 0.0 | - | 0.4 | 0.0 | 2 |
| Hickory | 8F2 | 162.5 | 2160 | 13.3 | 42.0 | 157.5 | 0.0 | 37 |
| Hickory | 8G1 | 3.4 | 2 | 0.8 | - | 1.0 | 0.1 | 2 |
| Rushville | 16A1 | 6.7 | 19 | 2.9 | - | 6.5 | 0.0 | 4 |
| Rushville | 16B1 | 0.3 | - | 0.2 | - | 0.2 | 0.2 | 1 |
| Keomah | 17A1 | 10.1 | 27 | 2.7 | - | 4.0 | 0.1 | 3 |
| Keomah | 17B1 | 32.0 | 321 | 10.0 | 3.8 | 16.0 | 6.5 | 5 |
| Clinton | 18A1 | 12.6 | 38 | 3.1 | 1.8 | 5.0 | 0.1 | 5 |
| Clinton | 18B0 | 1.1 | 1 | 0.9 | - | 0.9 | 0.9 | 1 |
| Clinton | . 18B1 | 427.2 | 2737 | 6.4 | 6.3 | 27.0 | 0.0 | 106 |
| Clinton | 18B2 | 32.2 | 578 | 18.0 | - | 32.0 | 0.1 | 3 |
| Clinton | 18C1 | 131.5 | 1305 | 9.9 | 11.8 | 37.0 | 0.0 | 36 |
| Clinton | 18C2 | 298.6 | 4796 | 16.1 | 14.7 | 66.0 | 0.0 | 80 |
| Clinton | 18C3 | 19.5 | 287 | 14.7 | 7.2 | 18.7 | 1.1 | 5 |
| Clinton | 18D1 | 15.6 | 200 | 12.8 | 7.3 | 18.0 | 0.3 | 5 |
| Clinton | 18D2 | 4.3 | 36 | 8.5 | - | 8.5 | 8.5 | 1 |
| Clinton | 18D1 | 0.4 | - | 0.1 | - | 0.1 | 0.1 | 1 |
| Clinton | 18D2 | 51.6 | 798 | 15.5 | 21.0 | 66.0 | 0.0 | 18 |
| Clinton | 18D3 | 102.2 | 2826 | 27.7 | 28.4 | 108.0 | 0.2 | 30 |
| Clinton | 18E2 | 91.5 | 1398 | 15.3 | 31.5 | 98.0 | 0.2 | 28 |
| Clinton | 18E3 | 26.8 | 438 | 16.3 | 35.2 | 94.0 | 0.0 | 10 |
| Clinton | 18F2 | 0.3 | 9 | 33.0 | - | 33.0 | 33.0 | 1 |
| Clinton | 18F3 | 0.5 | 50 | 100.0 | - | 100.0 | 100.0 | 1 |
| Tama | 36A1 | 7.0 | 65 | 9.3 | - | 9.5 | 6.5 | 2 |
| Tama | 36B1 | 109.5 | 1118 | 10.2 | 5.8 | 25.0 | 0.3 | 21 |
| Tama | 36B2 | 1.7 | 10 | 6.2 | - | 7.0 | 0.1 | 4 |
| Tama | 36C2 | 56.5 | 1183 | 20.9 | 10.3 | 25.0 | 0.2 | 11 |
| Tama | 36D2 | 2.6 | 69 | 26.8 | - | 48.0 | 4.0 | 3 |

Table 2. (Continued)

| Soil type | Soil map unit | Acreage | Amt. of erosion (tons) | Erosion rate Average (tons/a/yr) | Standard* deviation | Max. | Min. | Number of samples |
|---|---|---|---|---|---|---|---|---|
| Muscatine | 41A1 | 86.5 | 308 | 3.6 | 1.2 | 5.5 | 0.4 | 17 |
| Muscatine | 41A2 | 0.2 | 1 | 5.5 | - | 5.5 | 5.5 | 1 |
| Muscatine | 41B1 | 0.6 | - | 1.0 | - | 1.0 | 1.0 | 2 |
| Atterberry | 61A1 | 15.7 | 44 | 2.8 | 1.3 | 4.0 | 0.1 | 9 |
| Atterberry | 61B1 | 22.4 | 127 | 5.7 | 6.0 | 15.5 | 1.0 | 8 |
| Sable | 68A1 | 12.4 | 38 | 3.1 | 0.8 | 4.0 | 2.0 | 5 |
| Drury | 75C1 | 1.6 | - | 0.2 | - | 0.2 | 0.2 | 1 |
| Clarksdale | 250C2 | 2.2 | 58 | 26.5 | - | 26.5 | 26.5 | 1 |
| Clarksdale | 257A1 | 27.1 | 135 | 5.0 | - | 5.2 | 4.0 | 2 |
| Clarksdale | 257B1 | 18.3 | 186 | 10.2 | - | 13.0 | 7.0 | 2 |
| Sicily | 258A1 | 12.7 | 17 | 1.4 | - | 1.4 | 1.4 | 1 |
| Sicily | 258B1 | 84.0 | 399 | 4.8 | 5.2 | 17.0 | 0.1 | 22 |
| Sicily | 258B3 | 1.6 | 1 | 0.6 | - | 0.6 | 0.6 | 1 |
| Sicily | 258C1 | 17.2 | 107 | 6.2 | 4.0 | 8.8 | 0.2 | 5 |
| Sicily | 258C2 | 47.8 | 827 | 17.3 | 8.2 | 23.0 | 0.4 | 8 |
| Sicily | 258D2 | 16.8 | 109 | 6.5 | 5.2 | 11.0 | 0.2 | 5 |
| Sicily | 258D3 | 2.6 | 114 | 44.2 | - | 49.0 | 43.0 | 2 |
| Niota | 261A1 | 0.4 | - | 1.0 | - | 1.0 | 1.0 | 1 |
| Stronghurst | 278A1 | 18.1 | 27 | 1.5 | - | 1.9 | 0.1 | 4 |
| Rozetta | 279B1 | 30.0 | 61 | 2.0 | 3.8 | 12.7 | 0.1 | 12 |
| Rozetta | 279C1 | 0.6 | - | 0.2 | - | 0.2 | 0.2 | 2 |
| Rozetta | 279C2 | 19.6 | 110 | 5.6 | 7.4 | 19.3 | 0.2 | 8 |
| Rozetta | 279D2 | 0.2 | 4 | 22.0 | - | 22.0 | 22.0 | 1 |
| Rozetta | 279E2 | 0.4 | 26 | 66.0 | - | 66.0 | 66.0 | 1 |
| Rozetta | 279F2 | 0.2 | 6 | 33.0 | - | 33.0 | 33.0 | 1 |
| Fayette | 280A1 | 6.2 | 44 | 7.1 | - | 15.5 | 2.5 | 2 |
| Fayette | 280B1 | 40.0 | 255 | 6.4 | 6.0 | 15.5 | 0.0 | 19 |
| Fayette | 280C1 | 0.9 | - | 0.2 | - | 0.2 | 0.2 | 1 |
| Fayette | 280C2 | 71.7 | 1334 | 18.6 | 18.1 | 60.0 | 0.5 | 19 |

Table 2. (Concluded)

| Soil type | Soil map unit | Acreage | Amt. of erosion (tons) | Erosion rate | | | | Number of samples |
|---|---|---|---|---|---|---|---|---|
| | | | | Average (tons/a/yr) | Standard* deviation | Max. | Min. | |
| Fayette | 280D2 | 200.3 | 4288 | 21.4 | 47.8 | 300.0 | 0.1 | 55 |
| Fayette | 280D3 | 145.6 | 3527 | 24.2 | 35.2 | 180.0 | 0.0 | 47 |
| Fayette | 280E2 | 105.5 | 1843 | 17.5 | 34.6 | 150.0 | 0.0 | 38 |
| Fayette | 280E3 | 77.5 | 762 | 9.8 | 27.3 | 135.0 | 0.3 | 28 |
| Fayette | 280F1 | 61.4 | 883 | 14.4 | 48.5 | 142.0 | 0.1 | 14 |
| Fayette | 280F2 | 175.6 | 1282 | 7.3 | 25.8 | 160.0 | 0.0 | 49 |
| Fayette | 280F3 | 13.0 | 199 | 15.3 | 15.0 | 40.0 | 1.0 | 8 |
| Fayette | 286C2 | 3.2 | 52 | 16.5 | - | 16.5 | 16.5 | 1 |
| Haymond | 331A1 | 19.1 | 10 | 0.6 | 1.9 | 7.0 | 0.0 | 12 |
| Wakeland | 333A1 | 2.9 | 3 | 1.1 | - | 3.4 | 0.1 | 3 |
| Downs | 386B1 | 65.8 | 571 | 8.7 | 5.6 | 16.5 | 0.0 | 11 |
| Downs | 386C1 | 13.5 | 179 | 13.3 | - | 21.0 | 11.0 | 4 |
| Downs | 386C2 | 62.4 | 1170 | 18.8 | 25.5 | 88.0 | 1.0 | 12 |
| Downs | 386D2 | 39.6 | 1329 | 33.6 | 14.3 | 35.0 | 1.0 | 5 |
| Orin | 415A1 | 80.9 | 106 | 1.3 | 1.4 | 4.8 | 0.1 | 27 |
| Lawson | 451A1 | 16.3 | 32 | 2.0 | 1.8 | 6.0 | 1.0 | 9 |
| | Other | 12.6 | 19 | 1.5 | 3.7 | 15.0 | 0.0 | 20 |
| | Total | 3272 | 41096 | | | | | |

* When the number of samples was less than 8, the standard deviation was not computed.

deviation of those soil mapping units having 8 or more soil samples were considered. The high standard deviations are mostly due to different land use categories.

The soil loss rates were also sorted according to 9 land use categories (table 3). Cropland is the dominant land use covering about 58 percent of the watershed. Table 3 also indicates that the cropland has the highest soil loss rate which is 18.1 tons per acre per year compared with the average of 12.6 tons per acre per year for the whole watershed. The average soil loss tolerance rate (T) in the state is about 5 tons per acre per year. This indicates that the soil loss rate from the cropland is about three times the recommended T value for the state. The second dominant land use is pasture which covers about 20 percent of the watershed (670 acres). The average soil loss from the pasture is 4.4 tons per acre per year which is below the soil loss tolerance value. Farmstead, recreational, residential and hayland areas have relatively small acreages. Their soil loss rates range from 0.2 to 5.5 tons per acre per year. The wildlife and woodland categories cover 238 and 186 acres. The soil loss rates for these categories are 2.9 and 4.9 tons per acre per year, respectively. The other land use categories consist of ideal, natural areas, and small tracts that were not defined in the inventory. All these lands were considered under the "others" category totaling about 188 acres. The average soil rate for this category is 11.9 tons per acre per year.

After the soil loss rates for the present conditions were computed, 10 management practices given in table 4 were considered for application on the watershed. The soil loss rates were computed for these 10 assumed conditions. These results are given in table 5.

If contour plow and conventional tillage with fall plow (alternative #2, table 4) is applied to the cropland, the total amount of gross erosion

Table 3. Gross Erosion Rates for Different Land Uses Under the Present Condition

| Land use | Acreage | Percent of watershed | Total amount of erosion (tons/year) | Erosion rate (tons per acre per year) |
|---|---|---|---|---|
| Cropland | 1889 | 57.7 | 34,141 | 18.1 |
| Farmstead | 18 | 0.6 | 40 | 2.2 |
| Hayland | 73 | 2.2 | 128 | 1.8 |
| Pasture | 670 | 20.5 | 2,941 | 4.4 |
| Recreation | 1.5 | 0.0 | 8.5 | 5.5 |
| Residential | 4.1 | 0.1 | 0.6 | 0.2 |
| Wildlife | 238 | 7.3 | 693 | 2.9 |
| Woodland | 186 | 5.8 | 910 | 4.9 |
| Others | 188 | 5.7 | 2,229 | 11.9 |
| Total | 3272 | 100.0 | 41,096 | 12.6 |

Table 4. Ten Assumed Management Practices and the Associated Cropping Management Factor, C, Conservation Practice Factor, P, and Slope Length, in feet

| | Management practices | Cropping management factor, C | Conservation practice factor, P | Slope length (feet) |
|---|---|---|---|---|
| 1. | Present Conditions - | 0.44 | 1.0 | Actual field measurement value for each soil series |
| 2. | Contour Plowing - conventional tillage, fall plow | 0.44 | % slope / P:<br>0-2 0.6<br>2-7 0.5<br>7-12 0.6<br>12-18 0.8<br>18-24 0.9<br>>24 1.0 | Same as 1 |
| 3. | Spring Plowing - conventional tillage, up and downhill | 0.40 | 1.0 | Same as 1 |
| 4. | Conservation Tillage - with 1500 lb residues | 0.31 | 0.5 | Same as 1 |
| 5. | Conservation Tillage - with 3500 lb residues | 0.16 | 0.5 | Same as 1 |
| 6. | Conservation Tillage - with 6000 lb residues | 0.10 | 0.5 | Same as 1 |
| 7. | Terracing, 90 ft. | 0.44 | Same as 2 | 90 feet |
| 8. | Terracing, 120 ft. | 0.44 | Same as 2 | 120 feet |
| 9. | Terracing, 150 ft. | 0.44 | Same as 2 | 150 feet |
| 10. | Conversion to Pasture, (croplands >15% slope) | Slope<br><15%=.44<br>>15%=.013 | 1.0 | Same as 1 |

Table 5. Computed Soil Loss Rates for Ten Assumed Management Practices

| Alternatives | Gross erosion: Average (t/ac/yr) | Gross erosion: Total (t/yr) | Gross erosion: % reduction | Acreage meeting "T" values: Ac | Acreage meeting "T" values: Pct |
|---|---|---|---|---|---|
| 1. Present Conditions - | 12.6 | 41,096 | - | 1496 | 45.7 |
| 2. Contour Plowing - conventional tillage fall plow | 8.51 | 27,845 | 32 | 1871 | 57.2 |
| 3. Spring Plowing - conventional tillage, | 12.04 | 39,388 | 4 | 1531 | 46.8 |
| 4. Conservation Tillage - 1500 lb residues | 6.32 | 20,690 | 50 | 1991 | 60.5 |
| 5. Conservation Tillage - 3500 lb residues | 4.28 | 14,008 | 66 | 2397 | 73.3 |
| 6. Conservation Tillage - 6000 lb residues | 3.25 | 10,650 | 74 | 2691 | 82.2 |
| 7. Terracing, 90 ft. | 7.34 | 24,008 | 42 | 2054 | 62.8 |
| 8. Terracing, 120 ft. | 7.83 | 26,627 | 38 | 1957 | 59.8 |
| 9. Terracing, 150 ft. | 8.12 | 26,566 | 35 | 1934 | 59.1 |
| 10. Conversion to Pasture, on >15% slope land | 10.50 | 34,358 | 16 | 1583 | 48.4 |

could be reduced to 27,845 tons from the present 41,096 tons. This is 32 percent of the total gross erosion for the entire watershed. The results also show that 57.2 percent or 1871 acres of the watershed could meet the soil tolerance level.

If spring plow and conventional tillage were applied in the watershed (alternative #3, table 4), the total amount of annual gross erosion could be reduced to 39,388 tons or only a 4 percent reduction in the gross erosion rate for the entire watershed. This also indicates that only 46.8 percent of the watershed could meet the "T" value.

If conservation tillage practices with 1500 pounds residue (alternative #4, table 4) were applied to the cropland, the total gross erosion can be reduced to 20,690 tons which is a 50 percent reduction in the present gross erosion rate. This also indicates that 60.5 percent of the land could meet the tolerance value. If the amount of residue is inceased to 3500 pounds and again to 6000 pounds (alternatives #5 and #6, table 4), respectively, the amount of annual gross erosion could be reduced to 14,008 and 10,650 tons which are 66 and 74 percent reductions in the present gross erosion rates, respectively.

If terracing with 90-, 120-, or 150-foot spacings (alternative #7, #8, and #9, table 4) were applied to the cropland, the amount of annual gross erosion could be reduced by 42, 38, and 35 percent of the present condition, respectively. This also means that 62.8, 59.8, and 59.1 percent of the land, respectively, could meet the tolerance level.

The last management practice (alternative #10, table 4), is the conversion of cropland to pasture. If this land use conversion is applied to any cropland with land steeper than 15 percent slope, the amount of annual gross erosion from the total watershed could be reduced by 16 percent of the present level. This indicates that there are only very limited acreages of cropland with slope steeper than 15 percent. It also indicates that only an additional 2.7 percent (45.7 percent for alternative #1 and 48.4 percent for alternative #10) of the land would meet the tolerance value. Any land use conversion applied to the land with less than 15 percent slope will have a significant negative economic impact to the landowners even though the gross erosion rates from the steep areas (>15%) could be reduced drastically.

The relationship between the average gross erosion rate and the percent of land meeting the soil loss tolerance values are plotted in figure 2.

## DISCUSSION

In this study, the amount of gross erosion was estimated only in the area upstream of monitoring station C (figure 1) which is located at Highway 107 bridge. In order to relate this value to the Lake Pittsfield sedimentation rates, it is assumed that the remainder of the watershed also has a similar erosion rate. The total amount of annual gross erosion from the entire lake watershed can be computed to be 86,676 tons [(41,096/3272)(6901)=86,676 tons]. A lake sediment survey for Lake Pittsfield was conducted in 1979 (Bogner, 1979), where the average annual sediment deposition in the lake for the past 18 years (1962 to 1979) was found to be 38,576 tons. In order to estimate the sediment yield from the watershed based on the sedimentation survey of the lake, an estimate of the lake trap efficiency is needed. On the basis of information from Smith et al. (1966) the annual runoff of the Blue Creek Watershed is estimated to be 440 acre-ft per year per square mile. With a drainage area of 11 square miles

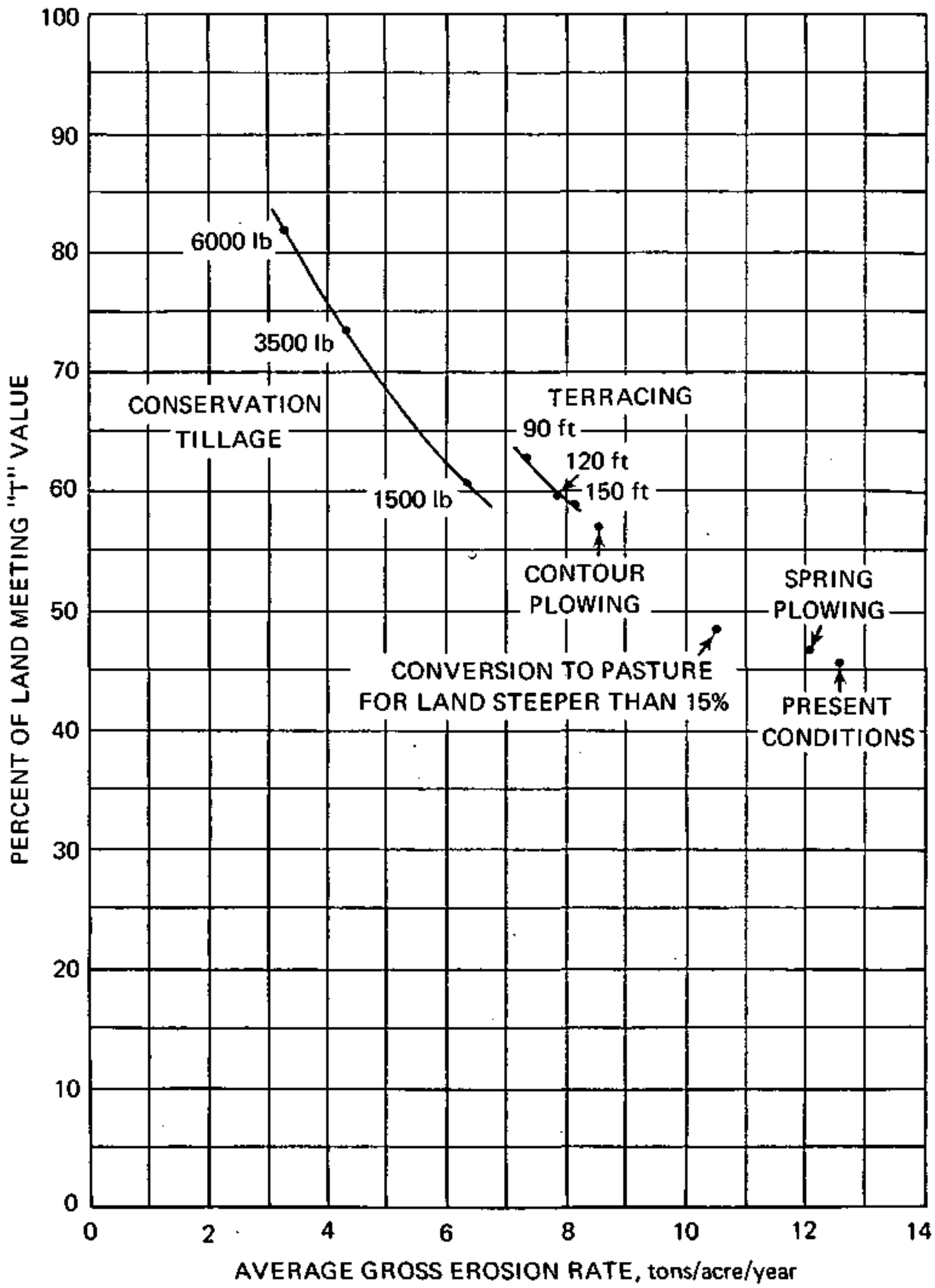


Figure 2. Percent of Land Meeting Soil Loss Tolerance Values Under Different Management Practices

excluding the lake area, the annual inflow into the Pittsfield Lake becomes 4743 acre-feet. The 1979 lake survey (Bogner, 1979) showed the lake capacity to be 2773 acre-feet. Thus, the capacity-inflow ratio (C/I) becomes 0.585. From the Brune reservoir trap efficiency curve (1953), the trap efficiency is estimated to be 93 percent. Therefore, the annual sediment yield of the Blue Creek Watershed would amount to 41,480 tons (38,576/0.93). The delivery ratio is defined as the ratio of sediment yield to the amount of gross erosion. In the Blue Creek Watershed, the delivery ratio would be 48 percent (41,480/86,676). Verification of this value cannot be made until the sediment transport data now being collected is analyzed at the end of the data collection period.

If the gross erosion rate is reduced by implementing the soil conservation practices, as has been outlined previously, the sediment yield can be reduced. However, the net reduction of sediment yield cannot be predicted solely on the basis of the sediment delivery ratio. The sediment transport process is a complicated phenomemon in which particle size, rainfall-runoff pattern, stream gradient, flow hydraulics, spatial distribution of the sediment source areas, and many other factors come into play and ultimately will decide the actual sediment delivery ratio for any watershed. A physically based watershed model needs to be developed to predict the change of sediment yield due to a reduction in gross erosion rates.

## SUMMARY AND CONCLUSIONS

The following work has been completed for the present project.

1. An inventory of the soil information for a subwatershed has been done.

2. The soil inventory data, with the aid of USLE, were used to compute estimates of the gross erosion rate from this selected watershed. Thecomputation indicates that an average of 12.6 tons of sediment was eroding from the subwatershed per year. The total amount of gross erosion from the entire watershed was estimated to be 86,676 tons per year. The sources of gross erosion were also identified.

3. Effects of 9 conservation practices toward the reduction of soil erosion from the subwatershed were investigated. Results show that in some of these practices, a significant reduction in soil erosion from the watershed can be achieved. This analysis also indicates that by utilizing conservation tillage, terracing, or other practices, about 80 percent of the watershed can be brought under control and would meet the soil tolerance level. The remaining 20 percent of the watershed will require land use conversion to meet the soil tolerance level.

4. Lake sedimentation data from Pittsfield Lake was correlated with the estimated gross erosion rate from the watershed to determine the delivery ratio of the sediment. This analysis indicated that the delivery ratio is 48 percent. Sediment transport data presently being collected will be valuable in defining the delivery ratio accurately in the future.

5. A physically based watershed model is needed for predicting the change in sediment yield due to a reduction in gross erosion rate.

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