Introduction

Why revisit a subject as ancient as soil erosion? After all, so much has been said and done for several decades to confront this environmental enemy. While substantial progress has been made in redirecting man’s land management activities to reduce the environmental impacts of erosion and off-site sediment delivery, sediment remains the No. 1 nonpoint source (NPS) pollutant in rural environments.

Intensive rainstorms are land-disturbing activities that destroy natural vegetation, remove or loosen topsoil, and transform landscape features. In those areas where intensive rainstorms are common, runoff is increased, and so is erosion. This eroded soil material can contribute significantly to NPS pollution from sediment. Disturbed land is subject to the beating action of raindrops and the energy of flowing water. Raindrops, and wind to a lesser extent in the Southern states, dislodge most of the soil particles that are eroded from disturbed lands. Stormwater runoff moving across the land surface creates channels and transports sediment, which may contain pollutants, to streams, rivers, and other bodies of water. According to estimates by the U.S. Environmental Protection Agency, agricultural and forestry operations are responsible for 50 to 70 percent of the NPS pollution that impairs water quality nationwide. Urban runoff, the next largest NPS, contributes as much as 15 percent. In Alabama, agricultural and forestry operations cause about 40 to 50 percent of the surface NPS problems; mining or resource extraction accounts for an estimated 19 percent; and urban runoff causes about 7 percent.

The information presented in this publication focuses primarily on erosion and sediment production resulting from agricultural operations. Much information is available on sources and impacts of the erosion and sedimentation processes. The listing of references included at the end of this publication under “For More Information” can help direct you to a more in-depth understanding of the subject. Additionally, technical assistance on soil and natural resource conservation is available from a number of state and federal agencies.

The Erosion and Sedimentation Process

Erosion and sedimentation involve the detachment of soil particles by water or wind, the transport of detached soil particles (sediment), and the settling (sedimentation) out of soil particles. Sedimentation occurs when water transporting the eroded soil material loses its speed as it spreads out or reaches flatter surfaces. This decreased flow rate causes suspended particles to settle and causes increased infiltration, which also leaves particles on the surface. These processes may occur several times between the first movement/erosion of the soil and when the particles actually reach a stream, river, lake, or other body of water.

Erosion from the natural forces of water and wind over long periods has provided many natural wonders by dramatically altering the landscape. However, for the most part, this geologic erosion that occurs under natural conditions is relatively low, averaging less than one-half ton of soil loss per acre per year in most areas of the United States. On the other hand, man’s actions that remove plants and disturb the land surface, such as farming, forestry, and mining, can cause erosion rates many times greater than the natural geological process. This accelerated erosion may result in costly and often irreversible harm to the environment.

In Alabama, high-intensity rainfall causes most of the soil erosion. These intense rains and the resultant erosion normally occur in the spring or summer. The weight of water falling within 30 minutes of a moderate thunderstorm may exceed 200,000 pounds (100 tons) per acre. When raindrops strike bare soil at high velocity, they shatter soil granules and clods and detach particles from the soil mass. As the precipitation rate
begins to exceed the intake capacity of the soil, runoff occurs, and soil particles may be transported. Larger, heavier particles such as gravel and sand settle out sooner than smaller, lighter particles such as silt and clay. Clay may stay in suspension for very long periods, travel long distances, and thereby contribute significantly to surface water turbidity.

**Why Be Concerned?**

**Impacts of Erosion and Sedimentation on Water and Environmental Quality**

When soil is properly managed, it can better withstand the natural forces of rain and wind. Most erosion occurs when soil is bare. Soils are protected naturally by vegetative cover, which includes both live plants and dead residues on the surface. When either is removed, the potential for water quality problems increases. The movement of eroded soil into streams and other waterways affects water quality physically, chemically, and biologically. Damage from sediment is expensive, both economically and environmentally. Over time, sediment deposits can destroy fish spawning beds, reduce useful storage volume in reservoirs, clog streams, and make costly filtration necessary for municipal water supplies. Suspended sediment can reduce aquatic plant life and alter a stream's ecology. Additionally, the environmental damage from sediment is often additive, and the effects and costs of off-site sedimentation can be severe, both for those immediately affected and for those who must cope with subsequent problems.

Sediment often carries organic matter, animal or industrial wastes, nutrients, and chemicals. The most troublesome nutrient element for causing water quality problems is phosphorus. In freshwater ecosystems that developed under very low phosphorus conditions, increased additions of phosphorus can stimulate the production of algal blooms. As these algae die, other organisms in the aquatic system decompose and digest them as a food source. In the process, they also use significant amounts of oxygen. If the oxygen level is initially low, the decomposition process can further reduce it to a point that fishkills occur. Phosphorus may originate from such sources as fertilizers, organic matter, and animal manure. Phosphorus is usually very immobile in most soils and tends to concentrate in the top few inches of the soil. It is very susceptible to erosion and likely to be present in sediment.

Sediment also may carry pesticides such as herbicides or insecticides, some of which may be toxic to aquatic plants and animals. The varying chemical properties of pesticides, their solubility, toxicity, and chemical breakdown rate determine the potential damage to water quality. Runoff water can also transport other potentially harmful dissolved chemicals from agricultural fields to bodies of water. Nitrogen, in the form of nitrate (NO₃⁻), may cause human and animal health problems when concentrations exceed 10 milligrams of nitrogen per liter (44 mg of NO₃⁻).

Agricultural operations and other land-disturbing practices that set the stage for erosion and sediment production are well documented. Some of these are listed below.

- **Land preparation activities for crop production** expose large areas of soil that are vulnerable to the erosive forces of rain and wind. Soil loss on cropland can range from less than 1 ton to as much as 100 tons per acre per year, depending on cropping system, conservation practices in place, soil characteristics, landscape features, land slope, rainfall characteristics, and general management.

- **Overgrazed pastures, feedlots, and work areas** around the farmstead are potential sources of sediment and other pollutants that are harmful to water quality. Stormwater can move across these surfaces with sufficient force to transport sizeable soil particles, animal waste products, and other pollutants from machinery service and chemical mixing and loading areas.

- **Areas where livestock have access to streams** for watering, feeding, or shelter are common sources of sediment and animal waste pollutants. Animal traffic can cause damage to streambanks and nearby riparian vegetation (plant life that grows on streambanks).

- **Land clearing and construction activities** can produce more tons of sediment on a per acre basis than most other sources. A sediment loss of 400 tons per acre per year at a construction site is possible on steep, barren areas.

- **Irrigation systems** that are not designed and managed properly can produce significant levels of erosion and sedimentation. When water is applied at a rate higher than a soil’s capacity to absorb it (infiltration), the excess water becomes runoff and has the potential to cause increased erosion.

- **Road construction and maintenance, harvesting, and streambank disturbance** are principal sources of sediment that pollute streams that run in and out of forestry operations. Woodland products are important to the overall economy of many farming operations. However, the woodland ecosystem can be impacted for years when roadsides and streambanks are left to regenerate their vegetative cover without the aid of conservation measures.

**Understanding and Practicing Soil Conservation Management**

**A Self-Assessment**

Understanding soil properties and how to properly manage soils to reduce erosion are essential steps in reducing the damaging effects on water quality from
eroded sediment. The U.S. Department of Agriculture’s Natural Resources Conservation Service (NRCS) has developed numerous practices and measures proven effective in reducing soil loss and erosion to acceptable levels under most conditions. The challenge for the farmer, landowner, and practicing conservationist is to plan and apply that combination of practices appropriate for the particular soil, site, and land use. Much information beyond that mentioned here is available (see “For More Information” in this publication). Professional advice and assistance are also available from NRCS, local Soil and Water Conservation Districts, the Extension System, and a number of other agencies, organizations, and consultants.

The exercise that follows provides an opportunity for all interested individuals to assess their understanding of selected conservation practices and the effectiveness of these practices in reducing soil erosion and sediment production. For those landowners and others involved daily in land use and soil management decisions, the assessment exercise may only serve as a refresher—perhaps, a reminder of practices not applied or erosive situations around the farmstead that should be addressed before they create a water quality problem. Others not directly involved with their property, but who have a genuine concern for its protection, may be motivated to become actively involved in conservation management decisions on their land.

The exercise will be of greater interest and benefit if you have some familiarity with your land and its characteristics. For example, is it more suitable for pasture and timber than row crops? Are there special conditions such as soil type, topography, drainage, nearby streams, lakes, etc., that could benefit from one or more conservation practices? Are there gullies and washes that, if left unchecked, will become a source of sediment and other pollutants for nearby streams and lakes?

The following series of statements will provide you a means for evaluating whether your approach and operating practices will reduce most causes of excess soil erosion. The assessment is purely confidential and solely for your benefit and use. So be hard on yourself. If you are performing a recommended practice, check **Yes.** But if you only perform the practice part of the time, check **No;** this might indicate that it is a practice and risk area that needs more attention. You are encouraged to complete all parts of the assessment that apply to your farm operation and go to the last section, which provides suggestions on how to use your responses to develop a better self-help plan for better soil and water conservation practices. Conservation practices and measures are presented in groups that have application to fairly similar soil management conditions. Conservation agencies and practicing professionals often use these groupings that may be found in other publications on this subject.

### Management Measures

These practices are used to increase ground cover during periods of high erosion, to increase water infiltration, and trap eroded sediment and other pollutants attached to soil particles. Usually, these practices do not involve much additional expense and require no special equipment.

- **Yes**
- **No**

- **Crop Rotations**: I rotate crops on my land.

Crop rotations minimize the number of consecutive years fields are used continuously for row crop production, allowing time for grass, legume, and small grain crops to intervene and reduce long-term erosion. These crops provide a protective soil cover, add organic matter to the soil, and when plowed under, leave the soil with improved water infiltration. Row crops in a rotation sequence with each other can also reduce erosion potential. For example, rotating corn with cotton, peanuts, or soybeans is superior to continuous use of the land for any one crop.

(continued on page 4)
### Cover Crops: I use cover crops on my farmstead.

Cover crops are grown primarily to prevent or reduce erosion during periods of intense rainfall when normal production crops are out of season. These crops reduce loss of nutrients by using them for their own growth. Cover crops such as ryegrass, legumes, and small grains break the impact of raindrops on the soil surface, thereby reducing soil erosion. They shade out seedling weeds, which provide overwintering sites for insects and diseases. Legume cover crops are often plowed under prior to spring planting to add organic matter and nutrients to the soil. Cover crops are essential to provide adequate residue for conservation tillage systems where row crops such as cotton, soybeans, and peanuts produce little residue after harvest.

### Strip-Cropping: I use strip-cropping to minimize erosion.

With strip-cropping, alternating strips of forage or closely grown crops between strips of row crops are used to slow stormwater runoff and trap sediment. The strips serve as filters and slow runoff from heavy rain. Strip-cropping and grassed filters are effective in reducing erosion on slopes where sheet and rill erosion are a problem. Rill erosion is the formation of tiny channels too small to be called gullies. Strip-cropping works best when strips are planted on the contour.

### Contour Cropping: If my land is sloped, I use the practice of contour farming.

The practice of tilling and planting across the slope instead of up and downhill produces miniature channels that prevent runoff from flowing directly downhill. Contour cropping is most effective on deep, permeable soils and gentle slopes. Contouring should always be used in combination with other conservation practices such as terraces, grass waterways, diversions, and strip-cropping.

### Residue Management

Residue management reduces soil disturbance on cropland and makes use of dead plant materials to provide cover and protect soil from the erosive forces of rain and wind. Thirty percent of residue coverage on the soil surface after planting is the minimum amount of residue needed to attain adequate benefits from no-till, strip-till, and mulch-till. Plainly said, “More (residue) is better.”

### No-Till: I use no-till conservation measures.

With this practice, the soil is left undisturbed from the time the previous crop is harvested until the new crop is planted. Nutrients from previous plant residue are left in the soil. Transplanting or seeding is accomplished in a narrow seedbed or slot created by rippled or fluted colters or other specialized equipment. Herbicides are added for weed control, and cultivation is only used in an emergency. The erosion reduction benefit of no-till is directly proportional to the amount of plant residue on the soil surface over the span of the crop rotation. Crops planted with over 90 percent residue cover left on the surface typically have almost no sheet and rill erosion.

### Ridge- or Strip-Till: I use ridge- or strip-till practices.

This practice is similar to no-till. The difference is that planting is on ridges or narrow lanes cleared of residue using colters, sweeps, openers, or row cleaners. Residue is left in the row middles. Weed control is accomplished by using herbicides or cultivation.

### Mulch-till: I use mulch-till to preserve residue on top of the soil.

With this practice, the soil is disturbed prior to planting using chisel plows, spike-toothed harrows, field cultivators, disks, sweeps, etc. Much of the residue remains on top of the soil as mulch. Weed control is accomplished using herbicides or cultivation. Former tillage practices would turn the topsoil upside down, burying almost 100 percent of the residues.
Buffers

The many different types of buffers may be called different names depending on the region. However, their functions are much the same—to protect surface and groundwater quality, to reduce erosion on cropland and streambanks, to serve as a filter for sediment and other pollutants, and to provide protection and cover for livestock and wildlife.

Yes No

❑ ❑ Contour Grass Strips: I use contour grass strips to minimize erosion on sloping land.
These strips are narrow bands of perennial vegetation established across the slope of a crop field and alternated down the slope with strips of crops. Properly designed and maintained, contour grass strips can reduce soil erosion, minimize transport of sediment and other waterborne contaminants, and provide wildlife habitat. Strips may vary in width and frequency and may be used in conjunction with terraces.

❑ ❑ Riparian Buffers: If I have streams on my property, I stabilize streambanks with riparian buffers.
These streamside plantings of trees, shrubs, and grasses block contaminants from both surface water and groundwater before they reach a stream. Riparian buffers also provide streambank stability.

❑ ❑ Filter Strips: I use filter strips to prevent erosion into nearby waterways.
Strips of grass are used to block or trap field sediment, nutrients, organics, biological agents, pesticides, and other potential pollutants before they reach a body of water.

❑ ❑ Field Borders: I use grassy field borders along the sides of croplands.
These are grass-seeded areas along the edges or ends of cropland fields that slow surface water movement, thereby trapping sediment and other pollutants.

Structural Measures

Structural measures are designed primarily to remove excess water from a field with minimum soil loss. This is accomplished by reducing slopes and slope lengths, by increasing infiltration, and by stabilizing waterway channels that carry runoff. Structural measures usually have higher initial costs, require proper design and construction, and are more permanent. Properly maintained, they can also add to the appearance of the landscape, enhance land value, and demonstrate a commitment to conservation management.

Yes No

❑ ❑ Terraces: If I have sloping land, I use terraces to reduce water runoff.
Terraces are channels or ridges built across slopes to intercept runoff water and to shorten the length of a slope. The number and spacing of terraces depend on the soil type, slope, and cropping practices and should be designed by soil conservation practitioners. Improved designs allow easier farming with modern machinery and reduce the number of point rows. Grassed waterways or underground pipe outlets are necessary to remove runoff to a safe drainage area.

❑ ❑ Diversion Terraces: I have diversion terraces on my farmland.
Diversion terraces are terraces especially designed to divert larger flows of water away from buildings, gullies, feeding areas, farm ponds, or fields below long slopes.

❑ ❑ Grass Waterways: I use grass waterways to minimize erosion.
Grass waterways are natural or constructed drain outlets or waterways protected by grass cover. They serve as safe outlets for runoff water from contour rows, terraces, and diversions. They should be designed to be wide and flat so farm machinery can cross them easily, and yet they should have capacity to carry the runoff safely from the watershed above. The waterway channel serving large drainage areas may need reinforcing with rock or permanent structures, especially at its lower end, to prevent gully erosion in the channel.
How Am I Doing?

A Self-Help Action Plan

If you manage land for agricultural production, recreation, conservation, or related uses, you probably already rely on a soil and water conservation management plan or similar named document to guide land use decisions and practices. Even so, these plans need periodic updating, due to changes in cropping systems, shifts in land use from extensive to intensive uses or vice versa, and adjustments in landowner objectives. Changes in ownership and management style, including more active involvement of absentee landowners, can also require new or updated plans to meet management objectives.

Purpose of Plan

Technically, the plan objective is to prevent or reduce erosion and to minimize or stop sediment from leaving the site by either breaking the fall of raindrops or slowing the flow of water with crop residues, cover crops, filter strips, terraces, and other appropriate conservation practices. The plan clearly establishes which control measures are intended to prevent erosion and reduce sediment runoff. The plan helps you decide the correct practices for the location, installation, and maintenance of methods to control anticipated erosion and to prevent sediment from leaving the site. The plan shows field location, design, and the installation schedule for all practices. It is the land user’s road map for preventing soil loss and protecting water resources.

Developing the Plan

Planning should be based on ecosystem principles. Problems and solutions are evaluated so that all interactions are considered. That is, land use, soil management, and conservation practice decisions consider possible impacts on the natural environment and the human condition (economic, social, and cultural) as planning options are developed. The plan for addressing erosion and offsite sedimentation should also consider both obvious and anticipated water quality problems associated with land use decisions for your specific farm site and actions of other neighboring landowners in the watershed that includes your land.

The plan should be based on input from informed sources. Ultimately, however, land-use decision makers must choose the production systems and the combination of conservation practices that complement their operating goals. The most effective of these are conservation tillage practices (no-till, mulch-till, strip-till, and ridge-till) where 30 percent or more of the surface is covered with plant residues after planting; crop or seasonal residue management, involving the use of residue cover between harvest and land preparation; and the use of strip- and contour cropping practices in combination with grassed waterways or underground outlets.

Plan Contents

The erosion/sediment reduction or conservation plan is developed to address the specific conditions of part or all of a designated land area and the agricultural uses being made of the land. The plan should contain basic information needed by decision makers to install and maintain practices identified as best suited to control erosion, keep sediment on site, and reduce the risk of other pollutants being transported along with sediment and runoff. Management systems, including detailed design and recommended practices, are often included in the plan and are categorized by source of pollutants such as soil and sediment, plant nutrients, chemicals, and animal waste.

Additionally, the overall plan typically includes the following:

✓ Maps that delineate the area and fields and where specific practices are targeted
✓ Soil map and interpretations
✓ A listing of best management practices and a schedule for installation or use
✓ Criteria (how to) for installing, operating, and maintaining the structure and/or practice
✓ A listing of sources of technical, financial, contract services, and/or other professional assistance that may be needed to install and maintain practices and systems included in the plan

The plan to control soil erosion and to protect surface and groundwater from pollutants must be supported by the landowner and farm manager’s commitment to put it to work. Even those with good intentions often find that a comprehensive plan takes time to implement. Some practices can be put in place with very little cost to the operator. More costly structural measures and systems to manage sources of other pollutants such as animal waste must wait on adequate resources. Fortunately, some help may be available through state and federal agencies for those that qualify. One federal program that offers assistance is available through the USDA as part of the Conservation Reserve Program (CRP). In Alabama, this program emphasizes the implementation of management practices such as riparian forest buffers, grass filter strips, contour buffer strips, and grassed waterways. Contact your county NRCS office for details. Soil and Water Conservation Districts are entities of state government in each county that can provide cost-share assistance for eligible practices. These districts work closely with the NRCS. The NRCS actually plans out projects, and the Soil and Water Conservation Districts help put those projects on the ground.

Finally, adjustments in agricultural production systems, as well as shifts in land use and urban growth, may necessitate that the soil erosion and sediment reduction plan receive periodic reviews to maintain its relevance to current land management needs in the rural environment.
For More Information

Alabama Cooperative Extension System
http://www.aces.edu
(334) 844-4444
For more information on specific topics, call your county Extension office. Look in your telephone directory under your county’s name to find the number, or go to the Extension Web site and click on County Offices to find your county.

Small Farmers Outreach & Technical Assistance Program
http://saes.aamu.edu/Agb/Farmers.htm
The Small Farm Research Center
P.O Box 356
Normal, AL 35762
(256) 858-4970
The Small Farm Program at the Cooperative State Research, Education, and Extension Service (CSREES), an agency within the U.S. Department of Agriculture (USDA), is committed to meeting the needs of the small farm community.

Farm*A*Syst National Office
http://www.uwex.edu/farmasyst/
(608) 262-0024
Alabama Farm*A*Syst is a partner with the national Farm*A*Syst/Home*A*Syst program, an environmental package designed to help farmers and homeowners evaluate pollution and health risks around their property.

Alabama Department of Environmental Management (ADEM)
http://www.adem.state.al.us/
(800) 533-ADEM
ADEM administers all major federal environmental laws, including the Clean Air, Clean Water, and Safe Drinking Water Acts and federal solid and hazardous waste laws.

U.S. Environmental Protection Agency (EPA)
The National Agriculture Compliance Assistance Center
http://www.epa.gov/agriculture
(888) 663-2155
The Ag Center offers easy-to-understand information about environmental regulations for people in the agricultural community. The Center was established by the EPA with the support of the U.S. Department of Agriculture (USDA). Information is offered about pesticides, animal waste management, groundwater, surface water, tanks/containment, and solid and hazardous waste. The Ag Center also supports regional and state regulatory agencies and can provide referrals for local sources of help.

USDA Cooperative State Research, Education, and Extension Service
(USDA/CSREES)
http://www.reesusda.gov/
(202) 720-7441
CSREES is a program under the U.S. Department of Agriculture (USDA) that helps link research and scientific information at land-grant colleges to families and communities. Areas covered include agriculture, nutrition and health, youth and families, environmental stewardship, and community economic development.

USDA-Natural Resources Conservation Service (NRCS)—Alabama
http://www.al.nrcs.usda.gov/
(334) 887-4539
NRCS is the USDA agency that works at the local level to provide technical assistance to farmers and ranchers to develop conservation systems to reduce erosion, conserve and protect water, and solve other resource problems. Look in your telephone directory for your county NRCS office.

Soil and Water Conservation Districts
http://www.nacdnet.org (National Association)
(334) 745-2511 (Lee County)
Soil and Water Conservation Districts work closely with the NRCS. The NRCS actually plans out projects, and the Soil and Water Conservation Districts help put those projects on the ground. Soil and Water Conservation Districts are located in all of Alabama’s 67 counties. Each year, landowners are offered grant money to help install conservation practices that help protect water quality on farms. Offices are co-located with NRCS offices. Look in your telephone directory under your county’s name to find the number.

Alabama Department of Agriculture and Industries (ADAI)
http://www.agi.state.al.us/
(334) 240-7100
ADAI enforces regulations and provides services for many agriculture-related operations, including the enforcement of both state and federal pesticide regulations, seed testing, agricultural statistics, inspecting and testing food products, providing livestock market news, and working with laboratories to protect animals from disease outbreaks. The agency is located at 1445 Federal Drive in Montgomery. The address is P.O. Box 3336, Montgomery, AL 36109-0336.
The following conservation practice guide sheets are available online:

- AL 329A Residue Management—No-Till and Strip-Till
- AL 329B Residue Management—Mulch-Till
- AL 329C Residue Management—Ridge-Till
- AL 342 Critical Area Planting
- AL 344 Residue Management—Seasonal
- AL 378B Erosion and Sediment Control During Farm Pond Construction
- 386 Field Border (National Guide Sheet)
- AL 391A Riparian Forest Buffer
- AL 412 Grassed Waterway
- AL 472 Use Exclusion—Livestock
- AL 512 Pasture and Hayland Planting
- AL 600 Terraces
- AL 655 Erosion Control on Forest Land

The Farmer’s Guide to the Internet

http://www.rural.org/Farmers_Guide/

Contains links to useful sites for farmers on the Internet.

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USDA-Natural Resources Conservation Service (NRCS)—

Alabama Office http://www.al.nrcs.usda.gov/TECH/ags.html

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