TENNESSEE

EROSION & SEDIMENT CONTROL HANDBOOK

A Guide for Protection of State Waters
through the use of Best Management Practices
during Land Disturbing Activities

TENNESSEE DEPARTMENT OF
ENVIRONMENT AND CONSERVATION

Second Edition

MARCH 2002

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PREFACE

Construction activities near streams, rivers and lakes have the potential to cause water pollution and stream degradation if erosion and sediment controls are not properly installed and maintained. In order to effectively reduce erosion and sedimentation impacts, Best Management Practices (BMP's) must be designed, installed, and maintained on construction sites.

The Tennessee Department of Environment and Conservation, Division of Water Pollution Control has determined that siltation is the leading cause of impairment of streams, rivers and lakes in Tennessee. While certainly not the only source, construction and development activities continue throughout Tennessee, and have been shown to contribute large quantities of sediment to water bodies during precipitation events, if BMP's are not used. Pollution due to siltation can have physical, chemical, biological, and economic impacts to waters. Siltation causes changes in flow patterns, increased water treatment costs, hindrances to navigation, and the increased possibility of flooding. Sediment can also restrict light penetration, transport other pollutants into the water body, smother eggs and nests of fish, and cover stream substrates that provide habitat for fish and aquatic life.

The proper use of BMP's can be effective in preventing erosion and controlling sediment on construction sites. This Erosion and Sediment Control Handbook is designed to provide information to planners, developers, engineers, and contractors on the proper selection, installation, and maintenance of BMP's. The handbook is intended for use during the design and construction of projects that require erosion and sediment controls to protect waters of the state. It also aids in the development of Storm Water Pollution Prevention Plans (SWPPP's) and other reports, plans, or specifications required for participation in Tennessee's water quality regulations.

The use of the words 'shall', 'will', and 'must' within the standards in this handbook is meant to emphasize the guidelines that ensure that the BMP will serve its intended purpose.

This handbook is printed in a loose-leaf format with the intention of allowing periodic updates as technological advancements are made, or errors are corrected. The handbook is available by attending one of the ***Fundamentals of Erosion Prevention and Sediment Control*** or ***Design of Vegetative and Structural Measures for Erosion and Sediment Control*** courses offered by the State of Tennessee. It is also available for download from the Department's web page located at:

www.state.tn.us/environment

or for a fee at one of the Environmental Assistance Centers throughout the state. As updates are developed, they also will be available online at the web page address above.

TDEC's goals in producing the Second Edition of the Erosion and Sediment Control Handbook include:

- Updating the aging first edition;
- Providing current information on erosion and sediment control technology;
- Providing information that will help with the creation of effective Storm Water Pollution Prevention Plans for construction sites;
- Providing information that will assist the site worker in correctly installing and maintaining erosion and sediment controls;
- Providing course material for use in the training and certification courses.

ACKNOWLEDGEMENTS

This handbook is prepared by the Division of Water Pollution Control of the Tennessee Department of Environment and Conservation. Many sources were consulted during the development of this handbook. Various resources are cited, and a references section is provided for the reader. Any omission of a reference in this handbook is unintentional. Permission has been granted to reproduce the information taken from other sources when possible. Any omissions or suggestions should be brought to the attention of the Division.

We are grateful to the Georgia Soil and Water Conservation Commission and the Virginia Division of Soil and Water Conservation for the use of content, layout, and other material from their handbooks.

Numerous other agencies also provided information used in compiling this handbook. These agencies include the Chattanooga Storm Water Management Office, Knoxville Storm Water Management Office, Memphis Storm Water Management Office, Nashville Storm Water Quality Management Program, Tennessee Department of Transportation, Tennessee Division of Natural Heritage, University of Tennessee Agriculture Extension Service, University of Tennessee Water Resources Research Center, and the University of Tennessee Department of Civil and Environmental Engineering. Division of Water Pollution Control personnel provided much assistance with review of drafts of the handbook.

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INTRODUCTION

Soil is formed when chemical, physical, and biological weathering processes break down underlying bedrock. It may take hundreds or thousands of years for one foot of soil to develop. Soils have properties like texture, structure, porosity, and chemistry that are determined by the parent bedrock material, but may also be influenced by the actions we take to alter the soil profile. Soil fertility, or the ability of soil to sustain life, is the product of a combination of those properties. The alteration or destruction of one or more of these properties may have serious adverse effect on the soil's ability to grow stabilizing vegetative cover.

Erosion is the detachment of a portion of the soil profile or soil surface. This can occur by either the impact of raindrops, or by the shear forces of water flowing across the soil surface. Soil particles can be transported a short distance (like the splash from a raindrop impact), or may be transported a longer distance (to the bottom of the slope, or into a water conveyance) before being deposited. The transport and deposition process is called sedimentation.

Erosion and sedimentation are natural processes. These processes occur daily, on all land, as the result of wind, water, ice, and gravity. However, the effect of natural erosion is usually only noticeable on a geologic time scale. The global average, natural geologic rate of soil erosion is about 0.2 tons per acre per year. This is approximately equal to the rate that soil is being created by the weathering of bedrock and parent material. Disturbance of the soil surface, including activities like construction, farming, or logging, greatly increases the amount of sediment loss from the site due to erosion. Soil loss from pastureland averages 1.5 tons per acre per year. Cultivated cropland can lose 20 tons per acre per year. Major land disturbances, such as mines or construction sites, can experience annual soil loss from 150 to 200 tons per acre. Erosion may occur unnoticed on exposed soil even though large amounts of soil are being lost. One millimeter of soil removed from an area of one acre weighs about five tons. Five tons of silty clay loam equates to about 4.5 cubic yards of soil. Lost soil is a lost resource of the property. Lost soil may carry off important nutrients needed for reestablishing effective, attractive vegetation after the site development is complete. If erosion is severe enough, soil might have to be brought in from other locations to regrade eroded areas, or to provide a suitably fertile growing medium for vegetation establishment.

Sediments that escape the site will eventually enter a stream or wetland. Solids suspended in the water column will interfere with the photosynthesis of plant life that form the base of the aquatic system food web. Sediments may carry other pollutants, in the form of metals, pesticides, or nutrients, into streams, or cause organic enrichment of streams, which also disrupts the food web. Suspended sediments increase the costs of drinking-water treatment for municipalities.

Sediment deposition changes the flow characteristics of a water body. These changes may result in physical hindrances to navigation or increased possibility of flooding. Deposits may actually cause further erosion within a water body if the deposit occurs at a critical spot. Sedimentation in wetlands can alter the hydrology or destroy hydric vegetation. Sedimentation that occurs in streams can cover up habitat that certain integral parts of the food web rely on. Certain types of soil particles actually bind to the gills of aquatic insects or fish. Sediment may also smother nesting sites for fish or amphibians, or cover mussel beds that filter significant quantities of pollutants from water that ultimately becomes our drinking water.

The average erosion from a designated area over a designated time may be computed by using the Revised Universal Soil Loss Equation (RUSLE). RUSLE is an erosion model developed by the U. S. Department of Agriculture to help make good decisions in soil conservation planning. It is a set of mathematical equations used to determine what conservation practices might be applied to a landscape to reduce or limit the amount of erosion and sediment loss. The original application for RUSLE was agriculture, primarily cropland production. Subsequent revisions have widened the program's applicability to be useful to other land-disturbing activities like mining, forest management, and construction sites.

The four major factors that RUSLE uses to compute the amount of soil loss from a site are: climate, soil erodibility, topography, and land use. The important climatic variables are the amount of rainfall and the intensity of the rainfall. Soils differ in their inherent erodibility, which is based on the previously mentioned properties: texture, structure, porosity, and chemistry. Climate and soil information are obtained from regionally mapped or surveyed data. Climatic and soil variables are independent of the activities we undertake at a worksite, however, the length of time that a bare area is exposed to precipitation is considered within the climate factor of RUSLE and may considerably affect the soil loss from the worksite. In this way, phasing and sequencing the surface disturbing activities at a worksite reduces the total erosion and reduces the amount of sediment that must be controlled by other means.

Site topography, ground cover, and best management practice (BMP) use are the most variable factors in determining erosion. These three factors are also what we have control over. Slope length, slope steepness, and slope shape are the important components of topography. Much of the work done at construction sites is to change the slope length, steepness, or shape to make the property better suited for development. Obviously, the original vegetation must be disturbed to accomplish this work, however, ground cover is the single most influential variable in determining soil loss. The soil loss from a site that has been graded bare and has no BMP's in use may be 100 times the soil loss from the same site with an average stand of grass present. BMP's can reduce the amount of sediment leaving the site, but no single practice is 100% effective.

There are two types of BMP's. One type, **erosion prevention practices** are ground covers that prevent any of the types of erosion from occurring. Ground covers include vegetation, riprap, mulch, and blankets that absorb the energy of a raindrop's impact and reduce the amount of sheet erosion. Diversions, check dams, slope drains, and storm drain protection, while they may also trap sediment, are primarily used to prevent rill and gully erosion from starting. Rill and gully erosion are more difficult and expensive to repair, and result in greater volumes of sediment to control.

The second type, **sediment control practices** attempt to prevent soil particles that are already being carried in storm waters from leaving the site and entering streams or rivers. Silt fence, sediment traps, sediment basins, check dams, and even vegetative cover are sediment control practices. Of course, all BMP's must be chosen carefully, located and installed correctly, and maintained well to be effective at keeping sediment on a site.

It is important to note that a particular BMP may be an erosion prevention practice, or a sediment control practice, or it may serve both purposes at the same time.

Using RUSLE as our model, we can see that a combination of erosion prevention, consisting of leaving original vegetation whenever possible and reestablishing vegetative cover as quickly as conditions allow, as well as sediment controls, like clean water diversions, silt fences, and sediment basins can prevent sediment loss from a construction site (or any other site) during most storm events. We also see that leaving original vegetation in place for as much of the construction period as possible reduces the opportunity for a precipitation event that occurs to cause significant erosion and soil loss on a worksite.