# Chapter 1

## Erosion, Sedimentation and Stormwater Processes (An Overview)

This chapter presents a simple overview of the processes referred to as erosion, sedimentation and stormwater. If in-depth information is needed on these subjects, other references, including Volume I, should be used.

### Processes

**Erosion** is the process by which the land surface is worn away by the action of water, wind, ice or gravity. Water-related erosion is the primary problem in developing areas of Alabama.

With the exception of shorelines and stream channels where erosion may be rapid and catastrophic, geologic erosion occurs at very slow rates. This natural erosion process, which has taken place over millions of years, has probably occurred at rates comparable to erosion in our forests that have no current disturbances.

The erosion accelerated by the disturbances of humans is referred to as "accelerated erosion" and can be significant and create adverse impacts.

**Sedimentation** is the process that describes soil particles settling out of suspension. Associated with sedimentation is turbidity, a cloudy or muddy condition of water usually resulting from eroded soil suspended in the water column.

**Stormwater** refers to the water flowing over the land during and immediately following a rainstorm.

### Factors Influencing Erosion, Sedimentation and Stormwater

**Erosion** is influenced primarily by climate, topography, soils, and vegetative cover.

*Climate* includes rainfall, wind and temperature. The frequency, intensity and duration of rainfall are the principal aspects of rainfall influencing the volume of runoff and sediment (potential) from a given area. As the volume and intensity of rainfall increase, the ability of water to detach and transport soil particles increases. When storms are frequent, intense, and of long duration, the potential for erosion of bare soils is high. Temperature has a major influence on soil erosion. Frozen soils are relatively erosion resistant. However, bare soils with high moisture content are subject to uplift or "spew", by freezing action, and are usually very easily eroded upon thawing. And temperature is a major factor affecting the species that cover the earth.

*Topography* includes the shape and slope characteristics of an area or watershed and influences the amount and duration of runoff. The greater the slope length and slope gradient, the greater the potential for runoff, erosion and sediment delivery.

*Soils* aspects include soil texture, soil structure, organic matter content and permeability. In addition, in many situations compaction is significant. These aspects greatly determine the erodibility of soil.

Soils containing high percentages of sand and silt are the most susceptible to detachment because they lack inherent cohesiveness characteristics. However, the high infiltration rates of sands either prevent or delay runoff except where overland flow is concentrated. Clearly, well-graded and well-drained sands are usually the least erodible soils in the context of sheet and rill erosion.

Clay and organic matter act as a binder to soil particles thus reducing erodibility. As the clay and organic matter content of soils increase, the erodibility decreases. But, while clays have a tendency to resist erosion, they are easily transported by water once detached.

Soils high in organic matter resist raindrop impact and the organic matter also increases the binding characteristics of the soil.

Sandy and silty soils on slopes and in channels are highly susceptible to gully erosion where flows concentrate because they lack inherent cohesiveness.

*Vegetative cover* is an extremely important factor in reducing erosion at a site. It will:

a. Absorb energy of raindrops.
b. Bind soil particles.
c. Slow velocity of runoff water.
d. Increase the ability of a soil to absorb water.
e. Remove subsurface water between rainfall events through the process of evapotranspiration.

By limiting the amount of vegetation disturbed and the exposure of soils to erosive elements, soil erosion can be greatly reduced.

*Sedimentation* is influenced by the nature of the suspended particles and by the velocity of the runoff.

*Gravel and sand*, the heavier and larger particles, settle out more rapidly than silt and clay particles.

*Silt and clay* particles are easily transported and settle out very slowly.

Slower *velocities* associated with flatter terrain or structures such as silt fence and sediment basins dissipate the energy in runoff and allow sediment to be deposited. However, it is difficult, and perhaps impossible in some instances, to totally eliminate the transport of the clay and silt particles even with the most effective sediment control practices. It is the small soil particles that are suspended in the runoff that have the most effect on turbidity and have the most adverse impacts on water quality.

*Stormwater* (rate and total flow) is influenced by climate, soils, geology, topography, vegetative cover and, most importantly, land use.

Runoff intercepted by *vegetation* and evaporated or transpired is lost from runoff. A small portion of the water that infiltrates into the soil and groundwater is delivered to streams as delayed flow and does not contribute directly to peak stormwater runoff.

As an area becomes *urbanized*, the peak rate of runoff and volume of runoff increase. These effects are caused by: 1) a reduction in the opportunity for infiltration, evaporation, transpiration and depression storage; 2) an increase in the amount of imperviousness; 3) modification of the surface drainage pattern, including the associated development of stormwater management facilities.

## Impacts of Land Development on Water Quality and Water Quantity

Of primary importance to water quality is the "first flush" in a watershed. This term describes the combined actions that erosion, sedimentation and stormwater have on accumulated pollutants (sediment, pesticides, fertilizers, animal wastes, petroleum products and heavy metals). In the early stages of runoff the land surfaces are flushed by the stormwater. This flushing creates a loading of pollutants. Extensive studies in Florida have determined that the first flush equates to the first one inch of runoff which carries 90% of the pollution load from a storm (USGS, 1984). Other studies have suggested that the first one-half inch of runoff provides the “first flush”. “First flush” effects generally diminish as the size of the drainage basin increases and the amount of impervious area decreases.

The potential off-site effects of land development include increased flooding, accelerated erosion of stream systems, increased sediment deposition in both streams and floodplains and adverse impacts on the biological communities associated with the streams and floodplains.

Each progression toward more intensive land use tends to disrupt the ongoing natural processes which protect and preserve water quality and water quantity. Therefore, to ensure future protection of water resources, it is imperative that land uses be managed in a responsible way.

As we reflect on the processes and the potential impact, we recognize the importance of sound site planning, timely and proper installation of the measures planned and the need for long-term maintenance of measures that sustain site stabilization.

If the best available technology is used for planning, design, installation and maintenance of erosion and sediment control and stormwater management the impacts of land development will be minimized.