K-STATE Kansas State University

Suspended Solids: A Water Quality Concern for Kansas

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Suspended solids, sometimes referred to as sediments, is the largest single category of water pollutants in Kansas, as measured by volume or weight. Almost all Kansas lakes and streams contain undesirable levels of suspended solids. Through the effects of soil erosion, any unprotected soil surface can be a source of suspended solids. The major source of suspended solids is cropland. Other sources include roadways, ditches, building sites, streambanks, grazinglands, livestock confinement operations, urban areas, and forestlands. Erosion is a natural process, so there will always be some suspended solids in streams. However, implementing best management practices will minimize erosion and improve water quality.

Concerns About Suspended Solids Contamination of Surface Water

Although not considered a human health hazard, suspended solids can lead to undesirable water quality conditions. Turbidity from suspended solids can cloud or "muddy" the water and reduce light penetration. This, in turn, has an adverse effect on fish and other aquatic life by reducing photosynthesis. Suspended solids may carry contaminants, such as nutrients, organic matter, pesticides, and heavy metals. Eventually, sedimentation fills lakes and ponds.

In Kansas, 75 to 90 percent of the phosphorus found in surface waters is derived from suspended solids. Excessive phosphorus concentrations in water can lead to enhanced aquatic plant growth, often referred to as algal blooms. This growth leads to a number of undesirable consequences. For example, when these aquatic plants die and decompose, oxygen in the water is consumed and severe fish kills may occur. Decaying algae and plants also may cause undesirable odors and affect the taste of drinking water.

Suspended solids may clog the gills of fish and reduce spawning, resulting in lower fish populations or a shifting of fish species. Recreational uses of water, such as boating and swimming, may be reduced due to the turbidity of the water.

Understanding Suspended Solids and Sedimentation

Suspended solids typically consist of solid organic or mineral materials in water suspension that are detached and transported (eroded) from their original site. Sedimentation occurs when water carrying soil particles slows enough to allow those particles to settle out. The terms "suspended solids" and "sediment" (or sedimentation) are often used interchangeably. The term "sediments" refers to the particles that have settled out of suspension and are located on the bottom of streams, rivers, and lakes.

Activities that disturb natural vegetation, remove or disturb topsoil, or transform terrain are contributing factors to nonpoint source pollution from suspended solids. Disturbed land is vulnerable to rain and flowing water. Raindrops are responsible for most of the dislodged soil particles from disturbed lands, while storm water runoff creates channels and transports suspended solids to lakes and streams.

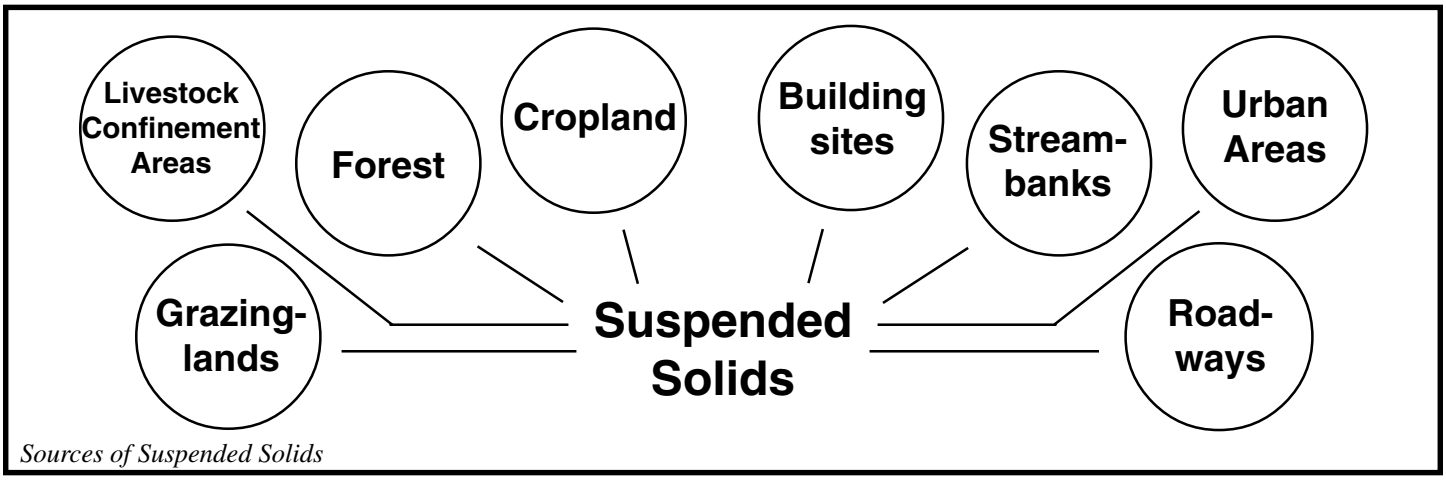
Suspended solid movement is associated with runoff, and is the result of water erosion. Types of water erosion include rill, sheet, gully, channel, and stream bank.

There are three stages in the erosion process:

- Detachment
- Transport
- Deposition

Detachment. The first stage in the process is detachment. Erosion starts with the impact of a raindrop. Raindrops can vary greatly in size from mists that are less than a $^{1}/_{16}$ inch in diameter to large drops greater than $^{1}/_{4}$ inch in diameter. The larger raindrops travel at higher speeds, approaching 20 mph. The subsequent collision with soil breaks the soil aggregate down into its component parts of sand, silt, and clay. Moving water then picks up the smaller particles of silt and clay. The force of flowing water also detaches soil particles and is an important detachment process.

Transport. The second stage of the erosion process is the transport of detached soil particles. The velocity and amount of water, depth of soil, and frequency and duration of precipitation events affect the amount of detachment and distance that the materials are transported. Initial water movement is into the soil, where smaller particles settle out as the water velocity slows, and pores at the soil surface start to plug with finer particles. If rain continues to fall, at rates greater than what the soil can absorb, runoff occurs and the soil particles move with runoff water.



Sources of Suspended Solids

Deposition. The third stage in the process is deposition. Soil particles are deposited when the velocity of the water has slowed enough that it can no longer support them.

Reducing Problems with Suspended Solids

Using soil and water conservation best management practices (BMPs) is essential in reducing suspended solids in surface waters. Various BMPs can reduce erosion at any stage along the way — at detachment, transport, or deposition.

- BMPs for Detachment. The most effective stage to implement BMPs is during detachment, when the soil particle is being detached and taken up by runoff water. BMPs that target detachment include the use of crop residue or vegetative cover to protect the soil from erosion. Increasing vegetative cover reduces the impact of water droplets on the soil surface and slows the rate of water movement across the site, reducing the detachment of soil particles. One of the most successful BMPs for protecting crop fields from erosion has been conservation tillage and no-tillage systems, which leave residue from the previous crop on the surface of the soil. In home landscapes, using mulch around flower beds and garden areas may reduce soil erosion and improve water quality.
- BMPs for Transport. Conservation practices can be used to reduce the amount and velocity of water runoff and reduce suspended solids erosion from fields. A successful example of this is the use of terraces on sloping lands. Terraces reduce the distance water moves downslope and divert water at a reduced slope to grassed waterways or an underground outlet system. By reducing the velocity of flowing water, the energy level of the water is lowered, reducing erosion. Many new urban subdivisions have been designed to handle runoff water from paved surfaces in a similar manner. Flood control routing of water is accomplished by forcing the water to move across steep slopes at an angle, which reduces the grade and therefore the velocity of the moving water.
- BMPs for Deposition. The last resort in controlling erosion is to use practices that allow for deposition or settling out of the soil particles. Anything that slows the water will cause soil particles to settle out. In Kansas, filter strips or buffer areas next to rivers, lakes, and streams have proven effective in removing soil particles from storm water runoff. A filter strip or buffer area is an area of vegetation (grass or trees) used to remove soil particles or other pollutants from water as runoff water flows across the surface of the soil. When located next to a stream or river, the buffer area helps maintain the integrity of the streambank by reducing bank erosion.

The Main Source of Suspended Solids Is Unprotected Cropland

A watershed study in the Kansas-Lower Republican Basin and the Missouri River Basin published in 1992 by the Natural Resources Conservation Service (NRCS) indicated that 67 percent of the total yield of suspended solids in that basin is from sheet and rill erosion occurring primarily on unprotected cropland. By contrast, the combined suspended solids load that comes from streambanks and flood plains is less than 5 percent of the total that enters the Kansas and Missouri River systems. It is clear from this study that the main source of suspended solids is unprotected cropland. Currently in the two basins, only 60 percent of the cropland is considered adequately protected by terraces, waterways, and conservation tillage practices, according to NRCS. Each year, more than 36 million tons of suspended solids are estimated to enter the streams and rivers in this 2-million acre watershed.

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