Report for 2002CO4B: Quantifying the Effectiveness of Best Management Practices (BMPs) in Controlling Non-Point Source Pollution From Forestland Uses

There are no reported publications resulting from this project.

Report Follows:

SYNOPSIS

Problem and research objectives:

The most direct way to determine Best Management Practice (BMP) effectiveness is to measure sediment produced in areas of implementation, and directly compare this with locations of similar hydrologic inputs in this case directly adjacent the BMP. The BMPs measured in this study were institutional or structural and have a direct connection to Trout Creek, a sediment impaired waterbody. Non-point sources are diffuse and difficult to identify, but BMPs are visible and measurable.

The objectives for this study were: 1) to determine the effectiveness of BMPs on controlling sediment inputs to Trout Creek by measuring on-site soil erosion and comparing this to background data. 2) to determine effectiveness of BMPs by measuring the sediment size distribution in the creek above and below the land use. 3) to determine effectiveness of BMPs by measuring suspended sediment concentrations in the creek above and below the land use. 4) to compare these methods and determine their applicability in determining BMP effectiveness and accuracy.

Methodology

The study area is Trout Creek and its tributaries, located in the Pike-San Isabel National Forest near Colorado Springs, Colorado. Land uses include roads, logging, grazing, and recreation, and BMPs have been implemented for each (Carlson, 2001). All forestland uses in this area may contribute to increased sediment inputs (Gowen, 1981). The creek has also been identified as an area with an exceedance of sediment and targeted for a TMDL (Hageman, 2001). The monitoring effort was at various spatial scales; watershed scale, reach scale, and individual BMP.

Basin Scale

Analyzing sediment yield at the basin scale is important for determining the cumulative effectiveness of all BMPs implemented in the area. This method has been used most widely in research arenas. However if beneficial uses and standards are not being met, this method does not provide a direct linkage to sources of sediment or individual BMPs. Conducting a paired watershed study to determine effectiveness was considered, however watersheds in this area have all been impacted by humans and the variability in basin characteristics may not address the sensitivity in sediment values.

Effectiveness was determined by comparing collected data to ‘natural conditions’. Suspended sediment were collected at each site using a U.S. Geological Survey DH-48 depth integrated sampler, during the discharge measurements, and frequently during storms. The samples were appropriately stored until transferred to the CSU water quality lab for analysis, where they were filtered, and oven dried for total suspended sediment determination. Total sediment load and yield can be calculated, and related to past systematic data as well as ‘natural’ conditions. A USGS gage station now out of commission can provide systematic data on past flows, which can

be related to sediment discharge. Natural yields were estimated from a variety of techniques including climate, infiltration, vegetation, and historic data.

Reach Scale

Often a combination of BMPs are implemented at each land-use site, this complicates the issue of relating individual BMPs to land-use and water quality. The effects of various land-uses that implement BMPs can be determined by an above and below sampling scheme within the creek.

Creek bed particle size distribution at each site were characterized using the zigzag pebble count (Bevenger and King, 1995). This involves zigzagging across the channel moving up-stream, while measuring randomly selected particles' secondary axis. This can better characterize the longitudinal profile of particle distribution. This zigzag scheme may also eliminate some of the spatial bias when only measuring a single cross section.

Individual BMP monitoring

Analyzing the effectiveness of individual BMPs is where research has lacked the most. Most studies have focused on determining effectiveness at the watershed scale, and have ignored the individual BMPs, which isn't helpful for individual BMP technique improvement. This proposed research will focus mainly on analyzing individual BMPs using an on-slope technique to measure erosion and sediment to the stream. This technique, sediment traps, is more appropriate than instream water quality sampling for many reasons. Sediment traps more accurately represent erosion rates by integrating inputs over time, they are less expensive and less time consuming, and they are more appropriate for use by managing agencies (Corner, 1996).

Sediment traps were used to determine individual BMP effectiveness. Trap design consists of a small (~ 12 by 7 in., and 1 in. deep) aluminum tray, placed in the soil at locations of likely runoff. The sampling scheme is systematic and includes 1 site, consisting of 3 locations: a BMP area, a nearby location with the same land-use and similar characteristics but without BMPs, and a control site with no apparent land-uses.

The sediment traps were installed in the spring, and removed in early September. The sampling period was shortened by a wildfire that burned through the study area. The traps were checked weekly, and after each rain event. Samples were collected as needed (not removing the traps), oven dried, and weighed. Comparisons of erosion rates from the BMP location, and the control can quantitatively assess effectiveness. BMPs of the same structure can be compared and generalizations can be made as to their effectiveness, when considering site characteristics and land-uses.

<u>Principal findings and significance</u>

The Forest Service put up informational signs for off-road vehicle users to avoid using certain trails or roads to reduce erosion and aesthetic effects. Sediment traps were used to collect sediment from 10 storms, and the results suggested a significant increase in soil erosion when the signs were in place. The signs seemed to attract ORV users rather than discourage them.

Cattle allotments were fenced and not fenced to assess the effect of fencing on stream reach stability. Fencing significantly reduced the amount of streambank slumping and erosion.

A series of forest road cross drains were monitored for erosion. Sites were paired with and without drain culverts. There was significantly more soil erosion below the culverts. Much of the erosion appeared to be from improperly placed culverts, the outlet being too high created channel knick points.

At the watershed scale, there were no detectable differences between suspended sediment concentrations measured at various point in the watershed above and below the BMPs. Similarly there was no difference between the Wolman pebble count and the estimated mean particle size at any of these points. Individual BMP effectiveness is measurable on-site. The effectiveness of the BMPs at the stream reach and at the basin level was not measurable. The stream selected for this study has a variety of multiple land use activities, however much of the hydrology is controlled by an upstream storage reservoir, thus basin level streamflow responses were not significant. Furthermore, the study was affected by a large wildfire through much of the study are, a significant drought, and the compounding influence of a burgeoning beaver population and associated beaver dams on Trout Creek. Additional research at the watershed or basin level is needed.