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USDOI Office of Surface Mining Reclamation and Enforcement

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METHOD DEVELOPMENT FOR WATERSHED SEDIMENT BUDGETS TO SUPPORT THE CHIA/PHC PROCESS: A FOCUS ON SEDIMENT MODELING FOR ESTIMATING SEDIMENT LOADS

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ABOVE PHOTO: Measuring stream discharge in Montgomery Fork following a precipitation event.

Project Description and Objectives:

This project evaluated geomorphic field methodologies and watershed computational models in order to develop a set of protocols that can be used to estimate sediment loads resulting from multiple land-use disturbances, including surface mining, logging, and roads, thereby supporting the needs of state and federal regulators to complete cumulative hydrologic impact assessments (CHIAs). The primary objective was to determine whether geomorphic assessments and sediment models could feasibly be used together as a suite of tools to identify and quantify excessive sediment loads, loads that could lead to biologically impaired streams. Four subwatersheds with varying land-use activities were used in this project.

Applicability to Mining and Reclamation:

Siltation and habitat alteration in rivers and streams have been identified as the principal cause of biological impairment nationally, attributable to land use changes in watersheds that delivery excessive fine sediment to the channels. Protection of water quality and aquatic biota is required under the Surface Mining and Reclamation Act through permitting of mining activities and routine CHIA monitoring. Having a means to estimate watershed sediment budgets by using field geomorphic assessments and sediment modeling tools supports the Office of Surface Mining (OSM), other natural resource agencies, and private companies. Importantly, watershed budget models not only estimate sediment yields, but also distinguish sediment sources per land disturbance type and spatially by locations. They also provide a means to evaluate probable hydrologic consequences (PHC) of surface coal mining with regards to assessing impacts from land disturbances.

Methodology:

Four subwatersheds within Tennessee's New River basin were selected ranging in size from 8.4 to 28.2 square miles. One subwatershed was relatively undisturbed and used as the study's control in order to compare model results to three disturbed watersheds impacted by different land use activities and in varying stages of reforestation. Land use and soils information was previously compiled using current aerial photography and satellite imagery to develop ArcGIS map and Arcview project files. Rapid geomorphic assessments (RGA) and new field methods for fine bed sediment collection in lateral depositional areas were tested. Sediment was also collected from upland disturbed areas to determine if any correlation could be determined between upland sources and streambed sediment located in lateral depositional areas.

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Methodology (continued):

Previously not tested for use in mountainous watersheds, the USDA AnnAGNPS and ConCEPTS models were evaluated as to their applicability in these landscape settings. The AnnAGNPS model used geographical information system (GIS) data developed from land use, elevation, soils, climate, and rainfall to simulate runoff and sediment delivery in each watershed. Likewise, the ConCEPTS model was used to model bank erosion and sediment transport through a surveyed channel reach, selected as a reach of interest. Models were calibrated and validated using stream discharges resulting from stage/discharge relationships and measured suspended solids concentrations collected during the study.

Highlights:

Rapid Geomorphic Assessment (RGA).

The RGA was successfully applied in the study area, distinguishing stable channels from unstable channels. It is used to determine whether or not to use the ConCEPTS model for estimating sediment loads (Figure 1).

Streambed Sampling of Fine Sediments.

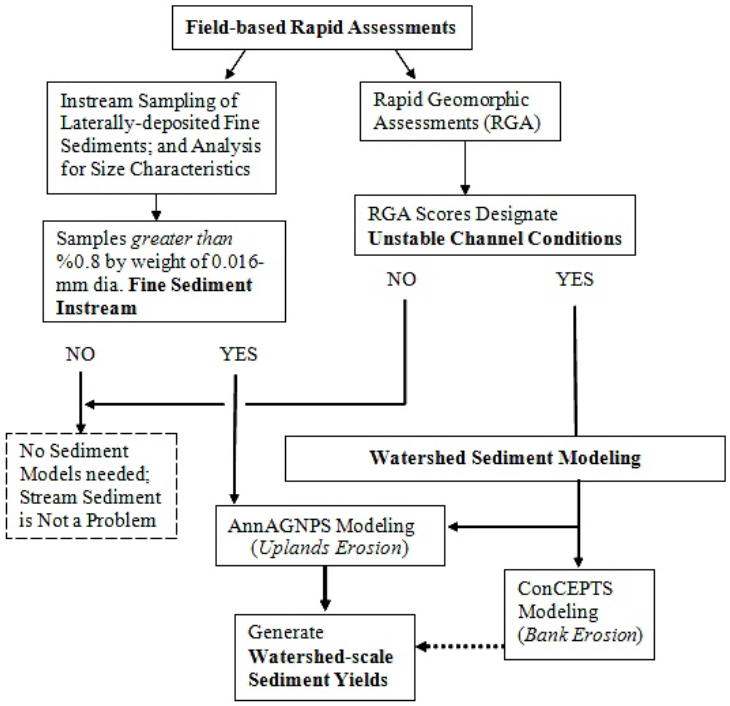
Fine bed sediment samples collected in lateral depositional areas of stream channels appear to be a useful and cost effective means to identify streams potentially impacted by uplands erosion, including coal mining operations. The statistical relationships developed in this study inferred that the AnnAGNPS model was able to simulate instream sediment values representing fine sediment in lateral deposition areas, which has been shown by others to be an indicator of biological impairment.

Sediment Models.

AnnAGNPS model output for daily flows and sediment loads was reasonably verified. Loads could be compared as percent differences among watersheds with varying land uses, and sediment source contributions per land use type in each watershed. The ConCEPTS modeling results found that performance was acceptable and generated estimate of sediment yields from bank erosion in order to support development of watershed sediment budgets.

Results/Findings:

A protocol flowchart consisting of two field-based geomorphic assessments and two sediment models can be used by regulatory and natural resource management staff in assessing channel stability and estimating sediment loadings in watersheds. This protocol forms the basis to create sediment budgets, specifically recognizing all the major contributors of sediment in CHIA subwatersheds, and results can put into context the percent contribution generated from surface mining compared to other land use activities. The AnnAGNPS model can be used during the surface mining permit application process, evaluating the potential impacts from multiple land use scenarios supplying valuable information on specifying permit BMPs.



Above Photo (Figure 1): Protocol flowchart for field-based assessment and sediment modeling tools for developing watershed-scale sediment budgets.

Website Information:

The final project report can be found at **http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/2007/Projects/OSM 2007 Watershed FR.pdf**

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