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DETERMINING THE ECOTOXICOLOGICAL RECOVERY OF BLACK CREEK (WISE COUNTY) AND ELY CREEK (LEE COUNTY) AFTER WATERSHED RESTORATION OF ABANDONED MINE LANDS AND ACID MINE DRAINAGE

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Project Description and Objectives:

The purpose of this research was to evaluate the eco-toxicological status of 2 subwatersheds in southwestern Virginia, now that active remediation of the Abandoned Mine Lands (AML) /Acid Mine Drainage (AMD) sites has occurred.

This project calculated an Ecotoxicological Rating (ETR) for 2 subwatersheds in southwest Virginia that have been severely impacted by AMD. It compared ETR scores before and after installation of AMD treatment systems and extensive remining and remediation of AML sites. The ETR incorporates chemical, toxicological, and ecological data to provide a single number that describes the relative environmental status of a given site within a sub-watershed. Results can be evaluated to determine priorities for future remediation efforts.

Applicability to Mining and Reclamation:

In the Powell River watershed of southwestern Virginia, the two subwatersheds most severely impacted by AMD from abandoned mines were Ely Creek in Lee County and Black Creek in Wise County. In recent years, however, both subwatersheds have been remediated. In the Ely Creek subwatershed, holding ponds and artificial wetland systems (Successive Alkalinity Producing Systems, SAPS) were constructed to remediate AMD. The Black Creek subwatershed has undergone extensive re-mining for coal with active remediation of AML and AMD seeps as part of the mining activities.

ABOVE PHOTO: Aerial photograph of SAPS implemented in Ely Creek.

ABOVE PHOTO: Bean Creek confluence with Ely Creek.

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Applicability to Mining and Reclamation (continued):

Large volumes of acid-producing materials were isolated from hydrologic influence, and new holding ponds were developed to encourage settling of precipitates from those AMD seeps that remain.

An ETR is a metric that can be used to express the results of an integrative subwatershed assessment, such as this study. Techniques used in this project can be employed to evaluate the relative success of AMD remediation projects in similar watersheds. An ETR can be used to evaluate the effectiveness of AMD treatment systems and AML remediation in improving the ecological health of a subwatershed.

Methodology:

Aquatic resources were sampled to assess water and sediment quality and benthic macroinvertebrate status; samples of water and sediments were evaluated for toxicity to standard test organisms using laboratory bioassays; in situ ecotoxicological assessments were conducted using Asian clams, and Ecotoxicological Ratings (ETRs) were compiled for primary sampling points. Sampling and ecotoxicological analyses were conducted at locations that had been previously assessed in most cases; however, some sampling stations were added and others removed in both subwatersheds as needed, in the judgment of the investigators. Analysis of recovery was performed through comparison of current conditions to those which had been documented prior to remediation by earlier studies.

The ETR assigned each station a value on a scale of 1-10 based on 10 different bioassessment/abiotic parameters, Using the weight-of-evidence type approach, a single cumulative value out of 100 points possible became available to characterize the environmental conditions at each station. The higher the point total the less environmentally impacted the station. Reference stations usually have values of 80 to 90 while AMD sites may range from 5 to 60, depending upon the volume and severity of seepage. A percentile ranking was then developed whereby sites that scored 90% (excellent or "A"), 80% (acceptable or "B") and 70% (marginal or "C") would not be considered for future restoration AML/AMD activities. Sites scoring 60 (or "D") and <60% (or "F") were labeled as stressed and severely stressed and would become prime candidates for future restoration activities depending upon the amount of funds available.

Highlights:

Ecotoxicological Ratings in the Ely Creek subwatershed ranged from 23.3 (failing) to 77.8 (marginal). The majority of the sites were classified as recovering or recovered. The ETRs generated from the 2006-2008 study in Black Creek had scores ranging from 77.0 (marginal) to 12.1 (failing). Pre-remediation ETR's were not calculated for Black Creek so recovery could not be assessed. Sensitive aquatic insects (mayflies and stoneflies) were rare to non-existent at all sites in both subwatersheds, including reference sites, most likely due to a severe drought which occurred in 2007. The benthic macroinvertebrate data are thus not considered a reliable indicator of ecosystem health

Results/Findings:

Overall water quality and aquatic life in the Ely Creek subwatershed have been improved, and both sediment and water-column toxicities have been reduced, as a result of the remediation, but some problems remain. Several small seeps in the upper subwatershed, above the SAPS remediation, remain evident but acidity and metals in the stream below the SAPS are well below pre-remediation levels and benthic macroinvertebrates have returned to sites where they were previously absent. The results for Black Creek were mixed. Conductivity was higher than before remediation, but pH values were also higher. Not all of the AMD seeps in the Black Creek subwatershed were remediated; they remain quite toxic. Sediment metal levels in Black Creek are still quite high. Dissolved iron and aluminum remain at high levels in the tributaries but are at acceptable levels in the mainstem. There is a source of toxicity in the lower end of the creek which has yet to be identified.

Website Information:

The final project report can be found at **http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/2005appscience\CompletedProjects/VAEcotoxicologicalCWalker2005.pdf**

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