New River Science Plan

presented at the

New River Technical and Stakeholder Workshop

Knoxville, Tennessee
October 26, 2007

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INTRODUCTION

The New River watershed is notable for its high potential for environmental degradation in close proximity to sensitive biological resources. The 400 square miles of the New River watershed comprise more than one quarter of the drainage area of the Big South Fork National River and Recreation Area, a designated Outstanding National Resource Water that supports 26 mussel species, of which five are federally listed as endangered. In addition, the New River contains designated critical habitat for three endangered mussel species and two endangered or threatened fish species. Coal mining, de-watering of deep mines, oil and gas exploration and extraction, and timber harvesting in the New River Basin create the potential for impairment of waters and subsequent adverse affects on the aquatic fauna of the New River, its tributaries, and waters downstream. Historically, a large portion of coal mining in Tennessee was located in the New River Basin. In 1974, coal production in the New River accounted for 56 percent of Tennessee's total production. Coal mining in the New River basin peaked in the 1970s, dropped to low levels through the 1990s, and has increased since 2003.

Increasing coal production, combined with persistent problems of acid drainage from abandoned mines and an increase in timber harvesting, has generated concern among a wide assortment of State, Federal, and local government agencies, nonprofit organizations, and citizens' groups. One result of this shared concern is the New River Science Plan. The central goals of the science plan are to:

(1) Improve scientific understanding of the New River watershed as an integrated physical and ecological system, and

(2) Improve coordination and collaboration among organizations charged with environmental management, regulation, data collection, and research in the New River watershed.

ISSUES AND SCIENCE GOALS

The central problem addressed by the New River Science Plan is the effect of past and current human activities on the biological and water resources of the New River Basin. This document describes a series of issues identified and developed at meetings of the New River Technical Committee in Knoxville, Tennessee, on September 19 and October 3, 2007. The issues are grouped into four categories, ranked in order of priority by the New River Technical Committee: (A) stresses on biological and water resources from

land disturbance, (B) coordination of data collection and dissemination among State, Federal, and local government agencies, non-governmental organizations, and the public, (C) biological responses to environmental stresses, and (D) linkages between land disturbance and affected resources.

A. Incremental and cumulative stresses from land disturbance

Human activities, such as mining, logging, all-terrain vehicle (ATV) traffic, road construction, and oil and gas exploration and production, have potential to mobilize sediment and other environmental stressors. Relating these activities to biological or hydrologic impairment is complicated by numerous factors, including temporal and spatial variation in the intensity and importance of different activities, and temporal lag between the imposition of a given stress and a subsequent biological or hydrologic response.

Information products

1. Spatial information: Complete land-use coverage of New River basin, including air photos, land-use and land-cover maps updated at regular intervals; detailed soils coverage; high resolution topographic coverage of channel network.
2. Centralized archive of mining and forestry production, permit, and remediation records.
3. Historical and current sediment and other contaminant loads at basin outlet and other key stations at annual, seasonal, and storm resolutions; key stations should include small basins with specified land use.
4. Daily rainfall and runoff records for basin outlet and other key stations, including small basins with specified land use.

Analytical products

1. Narrative synthesis of historical land use, water quality, and ecological health of the New River watershed.
2. Stochastic models of land-use effects on seasonal, annual, and decadal loads of suspended sediment and other contaminants.

B. Data management and coordination

The initiatives outlined in the science plan will require new modes and levels of coordination and collaboration among a large number of public and private entities. A critical component of such collaboration is development of common frameworks for data collection and dissemination. These frameworks need to encompass existing as well as new information.

Organizational needs

1. Establish interagency working group to coordinate data collection, agree on standards and protocols, and share information.
2. Establish centralized data bases, clearing house, or other system to locate and distribute information among agencies and to the public.
3. Scope and fund comprehensive synthesis of historical information relevant to land use and ecological integrity of the New River.
4. Find NGO partners for ongoing citizen outreach program.

Analytical product

1. Develop use-attainability analysis as decision-support tool.

C. Biological response to environmental stress and species sensitivity

Effective management of disturbed basins requires understanding of the effects on biota of varying levels of environmental stress. Critical needs include quantitative information on the tolerance thresholds of species and communities for contaminants, such as fine-grained sediment, metals, and organic compounds, individually and in combination.

Information products

1. Inventory of terrestrial and aquatic communities, including all-taxa biodiversity.
2. Periodic assessments of community composition and ecological health.
3. Catalog of studies relevant to life histories and tolerance thresholds of species of concern.
4. Review of existing sediment- and water-quality data related to biological observations
5. Continuous water-quality and sediment data from a network of sites with biological data.

Analytical products

1. Conceptual models of the response of biota to stresses characterized by varying frequency, intensity, and duration.
2. Relate IBI scores and other ecological metrics to water-quality and sediment data.
3. Refine understanding of the life histories of selected biota.

D. Linkages and delivery of effects to channel

Hillslope and channel processes link upland disturbance to aquatic resources through the transport of sediment and other contaminants. Areas of investigation should include storage and mobilization of sediment along channel beds and banks, distinguishing the relative importance of bed-load and suspended sediment, and improvement of methods for quantifying sediment loads.

Information products

1. Compilation of discharge, sediment, and water-quality data from the USGS Coal Hydrology program.
2. Ongoing continuous discharge and suspended-sediment records.
3. Spatial and temporal variability of coal concentration and particle-size distribution in water column and sediment within the New River channel network.
4. Surveys of geomorphic conditions, including channel geometry, bed and bank composition and stability, and local sediment sources and sinks at different points along the channel network.
5. Water velocity and time of travel for different particle sizes and densities.

Analytical products

1. Implications of coal physical properties, such as specific gravity, for coal-transport analysis.
2. Analytical models of sediment, coal, and contaminant transport in New River and its major tributaries.

INITIATIVES TO ACHIEVE SCIENCE GOALS

Six initiatives were identified as concrete steps towards realizing the New River science goals. The first five initiatives listed below are technical action items designed to improve understanding of the New River watershed as an integrated system. The technical initiatives specifically address: (a) the generation of environmental stresses on the landscape, (b) processes that link environmental stress to aquatic resources, and (c) the responses of aquatic resources to acute, chronic, and cumulative stress. Who implements the technical initiatives and in what order are less important than the need to coordinate implementation to maximize benefits among stakeholders and avoid unnecessary duplication of effort. The sixth initiative provides a framework for such coordination.

A. Develop, calibrate, and verify models of land-use effects on hydrology and ecology of the New River watershed.

Model selection should be based on agreement among technical representatives from major stakeholders.

1. Stochastic models relating land use to seasonal, annual, and decadal loads of suspended sediment and other contaminants. The stochastic models must be scale appropriate to the New River watershed and tributary basins selected for study. The models must incorporate existing climate and hydrologic records as input and calibration data. The models must make falsifiable predictions and reconstructions of contaminant loads across discrete time steps—daily, yearly, decadal, etc.—that can be compared with existing or future hydrologic records tat cover the same time periods.
2. Analytical models of the transport of sediment and other contaminants through specified stream reaches. The analytical models must be scale appropriate, incorporate available hydrologic and water-quality data for input and calibration, and be testable through comparison of model output to measured data.
3. Conceptual models of biological responses to stresses from sediment and other contaminants.

B. Develop historical synthesis of land use, physiography, hydrology, and ecology of the New River watershed.

1. Search available State, Federal, local, and academic archives for relevant maps, aerial photographs, production and regulatory records and other relevant documents;
2. Retrieve, tabulate, graph, and analyze all data from the USGS Coal Hydrology program from the New River watershed and adjacent or otherwise relevant drainage basins;
3. Assemble available biological and hydrologic records for the New River watershed from State, Federal, academic, and nonprofit sources.
4. Integrate the assembled historical data in a narrative report describing historical conditions and trends of land use, hydrology and ecological health in the New River watershed.

C. Establish collaborative interagency hydrologic and biological monitoring programs.

The programs should be designed to complement existing records and to provide calibration and verification data for modeling studies. The monitoring network should include:

1. Real time streamflow, sediment, and water-quality stations selected to cover a representative range of basin size, land use, physiography, and ecological integrity; and
2. Sampling sites for long-term biological surveys and assessments.

D. Regularly update spatial information.

1. Develop system to ensure repeat aerial photography and land-use analysis at least once every 5 years;

2. Establish a plan and routine schedule for regular updates of a minimal set of spatial data.
3. Expand current National Park Service land-cover study to entire New River watershed.

E. Improve data sharing, coordination, and collaboration among stakeholders.

1. Establish and maintain data clearing house;
2. Establish and maintain web page to serve data directly or link to stakeholder web sites.
3. Evaluate ways to improve public access to information and increase public participation in resource stewardship and decision making.

F. Establish Memorandum of Understanding for the New River Technical Advisory Committee (TAC).

The New River TAC should consist of technical staff from stakeholder organizations charged with coordination and oversight of technical initiatives under the New River Science Plan. Responsibilities of the TAC should include:

1. Analyze available models, develop model specifications, and oversee modeling studies.
2. Identify data sets relating land use to environmental quality and facilitate sharing of these data among interested parties.
3. Develop protocols for hydrologic and biologic monitoring networks.
4. Inventory available spatial information, identify minimal set of spatial data sets to be collected, and establish time line and approaches for collecting and maintaining those data sets.
5. Develop specifications for data clearing house and web site and identify appropriate facility to host them.

PARTNERS

Technical staff from the following organizations participated in discussions on which this science plan is based.

National Park Service
The Nature Conservancy
Office of Surface Mining
Tennessee Department of Environment and Conservation
Tennessee Valley Authority
Tennessee Wildlife Resources Agency
U.S. Geological Survey
University of Tennessee, Knoxville