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Criteria for the Selection of Bank Management Areas as Part of the Mercury Remedy in a Complex River System

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INTRODUCTION

Mercury (Hg) releases to the South River, Virginia, from a former textile plant in Waynesboro, occurred between 1929 and 1950. Historically-released Hg subsequently accumulated in depositional areas along the river and the floodplain, including the river banks. Changes in hydrology and land use practices resulted in erosion and remobilization of the associated Hg within the river channel. Eroding bank soils with elevated Hg concentrations are the largest single source of Hg to the South River, and are being targeted for remediation. Bank Management Areas (BMAs) for the first phase of remediation (Phase 1) were identified to maximize source control, while minimizing potentially adverse impacts to sensitive habitats. The approach used to balance these factors and identify the Phase 1 BMAs is presented.

STUDY SITE

- Tributary of the South Fork of the Shenandoah River (SFSR) and the Shenandoah River (Figure 1)
- Central Valley section of the Valley and Ridge and the Blue Ridge physiographic provinces
- Phase 1 Interim Measures focuses on first two river miles below the former DuPont plant site

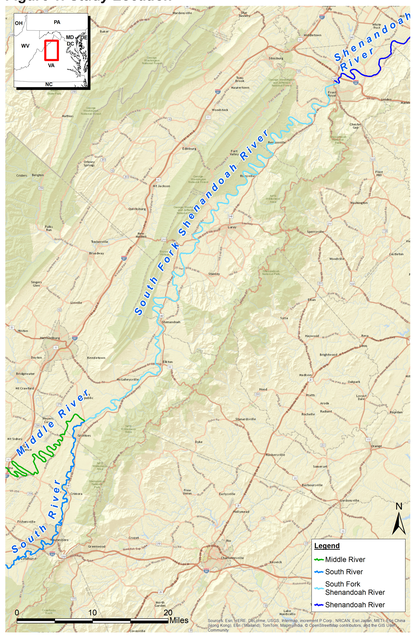
Land Use

- Industrial (0.29 miles)
- Municipal Infrastructure (0.37 miles)
- Public Park/Recreation (0.37 miles)
- Residential (0.22 miles)

Stakeholders/Advisors

- City of Waynesboro
- E.I. du Pont de Nemours and Company (DuPont)
- Members of the South River Science Team
- Virginia Department of Environmental Quality
- Virginia Department of Game and Inland Fisheries
- Region III US Environmental Protection Agency

Figure 1. Study Location



REMEDIAL AND ANCILLARY OBJECTIVES

- Reduce Hg loading from bank erosion/leaching of bank soils
- Decrease the impact of shear stress on banks with high erosion potential
- Improve riparian and near-bank aquatic habitat functions
- Improve access to the river for recreational activities by providing footpaths for public access to the shoreline

METHODS

Weight-of-evidence approach used to identify BMAs within RRM 0 to 2 that contribute majority of Hg loading. Bank treatments selected to minimize adverse ecological impacts.

Weight-of-Evidence

- Bank condition and erosion surveys
- Side-scan light detection ranging (LiDAR) surveys
- Hydrological modeling
- Analytical Hg data

Bank Treatments

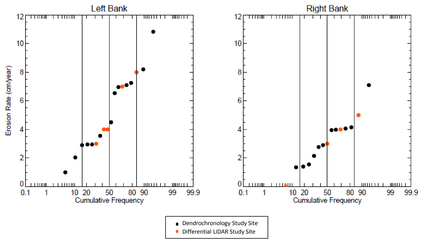
- Institutional controls and monitoring
- Enhanced vegetative stabilization
- Structural stabilization
- Removal and disposal

RESULTS

Bank Erosion

- Calculated based on side-scan LiDAR, analysis of exposed tree roots (dendrochronology), and bank pins (Figure 2)

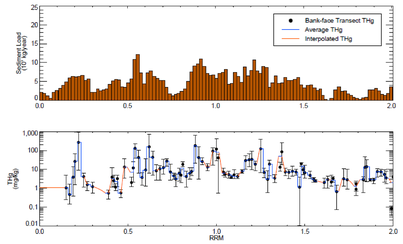
Figure 2. Bank Erosion Rate



Sediment Loading and Hg Concentrations (Figure 3)

- Erosion rates integrated with bank segment length, height, and density data to develop estimates of bank sediment mass loading rates
- Bank soil sampling conducted to characterize the distribution/concentration of Hg in bank soils
  - Surficial (0-5 cm)
  - Cores

Figure 3. Sediment Loads and Hg Concentrations



RESULTS *(continued)*

Hg Loading and BMA Selection

- Phase 1 BMAs account for approximately 90% of Hg loading from bank erosion in RRMs 0 to 2 and represent 25% of the total bank length in this reach (Figure 4)
- Phase 1 Primary and Secondary BMAs (Figure 5):
  - ***Primary:*** Banks with relatively high Hg loading rates (>20 kilograms per mile per year) collectively contribute approximately 50% of the loading from bank erosion in RRMs 0 to 2
  - ***Secondary:*** Banks that contribute an additional 40% of the loading from bank erosion
- Further divided based on land ownership
  - ***1A:*** Public
  - ***1B:*** Private

Figure 4. Cumulative Bank Loading

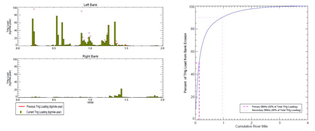
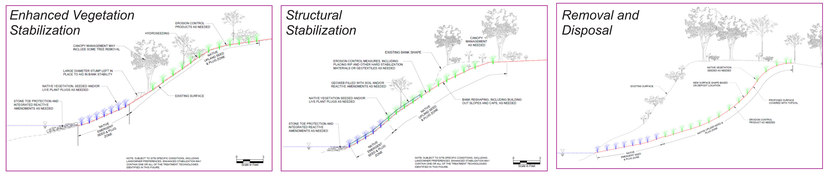


Figure 5. Phase 1 BMAs

Bank Treatments

- Regression analyses used to evaluate site-specific relationships between erosion rate and key factors that may contribute to bank erosion (e.g., peak shear stress)
- Treatments preliminarily determined based on these factors (Figure 6)
- Collaborative design discussions between stakeholders used to determine final BMA-specific bank treatments to be protective of sensitive resources

Figure 6. Example Bank Treatments



DISCUSSION

A flexible decision-making process, which can be adjusted as remediation action outcomes are better understood and as stakeholder preferences are identified and possibly change over time, will be implemented as part of Phase 1 activities. Short- and Long-term monitoring programs are also being implemented to inform Phase 1 interim measures as part of an iterative learning process.

The work described in this poster has been performed in conjunction with the South River Science Team (SRST), a multi-stakeholder group including representatives from local, state and federal governments, academia, environmental groups and DuPont. The SRST is a collaborative team created to provide input into the watershed-level, risk-based assessment framework to address Hg in the system.
www.southriverscienceteam.org