USING A BANK EROSION AND DEPOSITION PROTOCOL TO DETERMINE SEDIMENT LOAD REDUCTIONS ACHIEVED FOR STREAMBANK RESTORATIONS

Kathy Bergmann and Jane Fava, Brandywine Valley Association, 1760 Unionville-Wawaset Rd., West Chester, PA 19382
Aaron Clauser, PhD, Clauser Environmental, 312 Deer Trail Drive, Schuylkill Haven, PA 17972

Introduction

The Brandywine Valley Association and volunteer monitors are using a bank erosion and deposition protocol to measure the bank stability above, below and within restoration sites. Erosion and deposition rates have been measured for different stream reaches located within Plum Run, an impaired urbanized watershed. Sediment is the major impairment in the Brandywine Creek and its tributaries. It is estimated that up to two-thirds of the sediment generated in urban watersheds comes from accelerated stream channel erosion and not overland flows. Therefore, determining the changes in erosion and deposition rates after stream restoration work is a valuable tool for evaluating the effectiveness of our projects. This methodology could potentially be adapted for measuring sediment reductions for TMDLs.

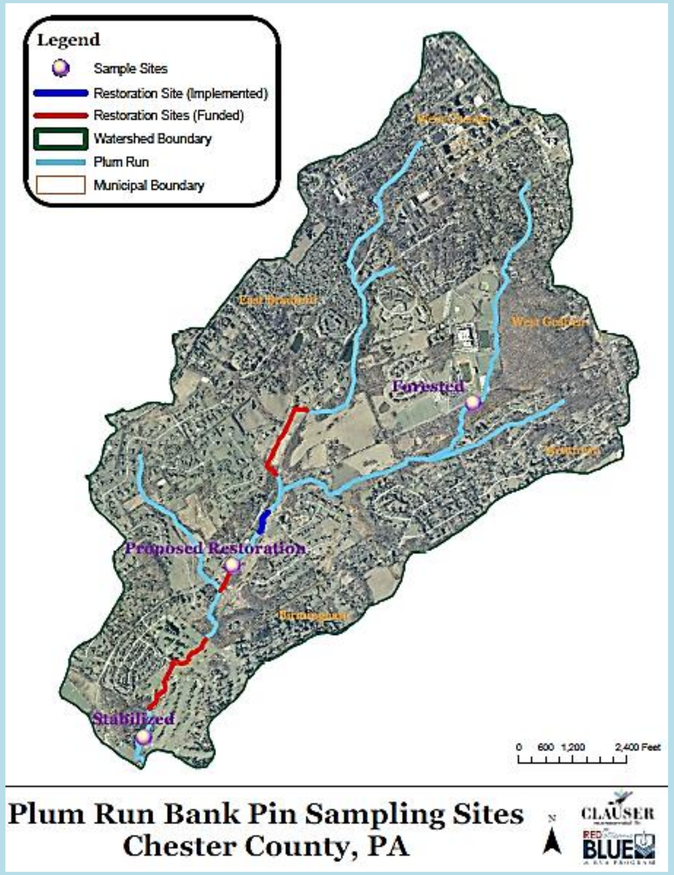
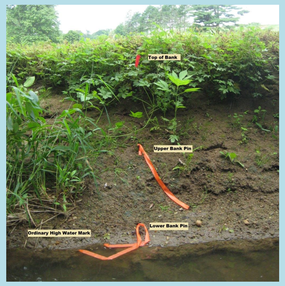


Figure 1 The BVA and Chester County Conservation District have secured funding through the Department of Environmental Protection's Watershed Renaissance Initiative to complete stream restoration projects throughout the Plum Run watershed. Shown on the watershed map are the locations of the completed and proposed stream restoration sites along with the bank pin study areas.

Figure 2
Bank Pin Placement



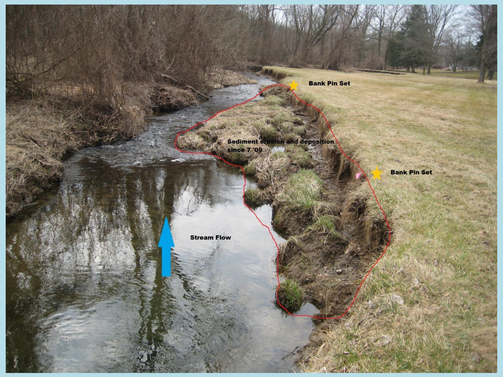


Figure 3
Collapsed bank within proposed restoration site.

Methods

Study areas were selected so that erosion/deposition rates could be determined for streambanks above, below and within stream restoration reaches. Sets of bank pins were installed along one side of a 100 meter stream segment and the pin locations were representative of different bank stabilities including sample points inside meander bends, outside meander bends in both riffle and pool locations. Each set of pins (2 ft. sections of rebar) included a lower pin placed just above the ordinary high water mark, an upper pin placed ½ the distance from the ordinary high water mark to the top of the bank and a third pin marking the top of the bank. The pins were installed so that 2.5 cm of pin was exposed. All study sites within a watershed were measured on the same day and usually at one month intervals, but sampling periods varied due to weather conditions. The rate of change of erosion and deposition at each set of bank pins was determined over time.

Plum Run Yearly Erosion/Deposition Data

Sample Site	Proposed Restoration	Forested	Stabilized
Reach Upper Pin Average Yearly Change Rate (cm/year)	22.484	12.547	5.969
Reach Lower Pin Average Yearly Change Rate (cm/year)	32.623	23.223	22.813
Reach Average Yearly Change Rate (cm/year)	27.553	17.885	14.391

Results

Of the three study areas the proposed restoration reach had the highest yearly erosion/deposition rates for both the upper and lower bank pins. The lowest erosion/deposition rates were seen in the stabilized stream segment at the bottom of the watershed. The forested and stabilized sites had comparable lower pin erosion/deposition rates, but the upper pin rates were considerably different.

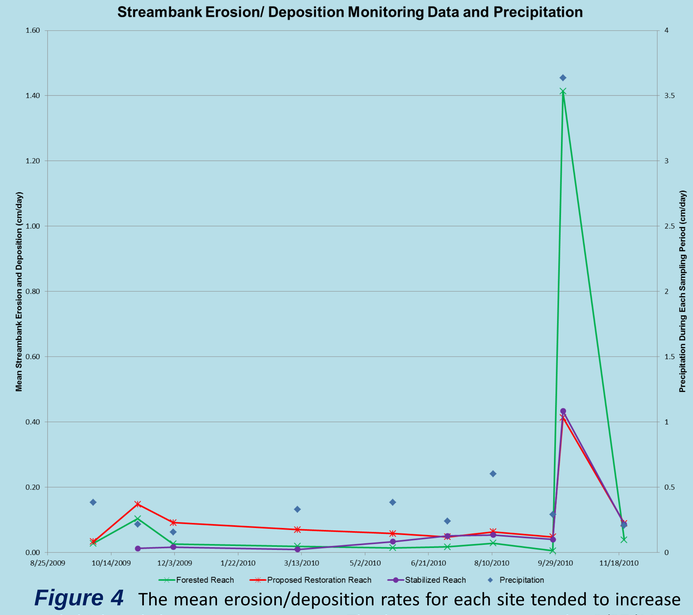


Figure 4 The mean erosion/deposition rates for each site tended to increase with higher daily precipitation rates. The large storm event in the 9/27/11 to 10/5/11 period resulted in the highest erosion/deposition rates overall.

Discussion

Recent studies of developed watersheds suggest that more than two thirds of the sediment generated comes from accelerated stream bank erosion caused by increased stormwater runoff (Chesapeake Sediment Workgroup, Oct., 2006) Plum Run originates in West Chester Borough where there is little or no stormwater management. Maximum erosion/deposition rates were seen with the largest daily rainfall amounts clearly linking the accelerated rates with increased peak flows(Figure 4). The proposed restoration site which showed the highest yearly erosion/deposition rate is downstream from Strodes Mill dam. The very unstable stream banks(Figure 3) in this reach are likely due to the deposition of highly erodible legacy sediments (Trimble,1999).

Data Use

As the BVA implements projects from their Red Streams Blue restoration plans the efficiency of these restorations on reducing bank erosion can be easily monitored with bank pins. The erosion and deposition rates can readily identify the most unstable stream reaches within a watershed so they can be targeted for restoration. The bank pin data can also be used to determine whether stormwater BMPs are reducing peak flows enough to change erosion/deposition rates. In 2006, TMDLs for sediment were established for the Christina Basin. The data generated from this study could be adapted to show sediment load reductions attained with restorations and BMP installation.

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