

FY 2010 Proposal

Darby-Cobbs Watershed Sediment Assessment

Background

The Darby-Cobbs watershed discharges to the Delaware River through the wetlands of the John Heinz National Wildlife Refuge at Tinicum. The watershed encompasses approximately 80 mi² of southeastern Pennsylvania, including parts of Chester, Delaware, Montgomery, and Philadelphia Counties (Figure 1). It can be divided into three subwatersheds: Cobbs Creek, Darby Creek, and Tinicum (Figure 2).

Most of the Darby-Cobbs watershed is highly urbanized and as much as 66% of the surfaces are impervious. The streams and creeks within the watershed have been a consistent problem in terms of storm water runoff, flooding, streambank erosion, ecological degradation, and aesthetics. Previous studies conducted by the City of Philadelphia found that the average estimated contribution of bank erosion to the overall suspended sediment load was 65%. This indicates that bank erosion is a significant source of watershed sediment.

The Philadelphia District began studying this watershed in 1970 and has initiated 20 official studies over the past 39 years. Only one of these projects, gabion streambank reinforcement, was constructed. Most of these projects were initiated by individual municipalities and were terminated because it was not economically feasible to armor relatively small sections of streambank.

Currently, there are five authorized Corps studies in the Darby-Cobbs watershed, four stream restoration projects implemented through a design build authority and the Delaware River Basin Comprehensive Study (currently inactive in Pennsylvania). The District is also currently conducting a Southeastern Pennsylvania Flood Plain Mapping Study (FPMS).

The Darby-Cobbs watershed runs across several boundaries, including 31 municipalities and 4 counties. Many of the municipalities channelized and armored the streams and creeks. These actions, and other contributing factors, unbalanced the sediment equilibrium of the watershed. The effects are increased erosion of adjacent unprotected stream banks, erosion of the stream beds, cutting off access to the floodplain, and increased overall velocity of the stream. A high percentage of impervious surfaces and the corresponding increased stormwater runoff have further compounded the problem.

The Philadelphia District continues to receive complaints and requests for assistance from communities in the Darby-Cobbs watershed. These requests include flood mitigation, repairing eroding streambanks, protecting exposed sewer infrastructure along streambanks, and stream restoration. Requests are typically from municipalities and are specifically for small-scale projects, as they do not have the ability to cost-share the

watershed-wide study that is needed and are only willing to help pay for construction in their immediate area.

Watershed wide-dynamics, including sediment transport, should be investigated in order to identify and prioritize effective projects and to avoid any adverse effects on other parts of this fragile watershed. There is currently no mechanism for completing these tasks. One potential solution is using a non-traditional model to analyze the watershed and identify beneficial project areas. Once ideal project locations are identified, appropriate municipalities could co-sponsor design and construction of the projects.

Project Objectives

The Darby-Cobbs Watershed Sediment Assessment has two objectives. The first objective is to perform a watershed-scale assessment to identify sediment imbalances, determine specific causes of the problems, develop effective design or remediation options, and prioritize potential projects, through the use of models as a decision support tool.

The second objective of the study is to use this information to develop a framework for the restoration of urban watersheds. This framework will be applicable nationwide because watersheds plagued by streambank erosion, excess stormwater input, degraded habitat, conflicting stakeholder interests, and recurrent flooding are not unique to the Darby-Cobbs watershed or the Philadelphia District.

Although many of the problems in urban watersheds are a result of imbalances in the sediment equilibrium, sediment transport is rarely assessed on a watershed scale. This demonstration project provides an opportunity for the Corps to apply unbiased technical expertise to practical issues. It will also demonstrate the utility of a watershed-wide sediment assessment. The products will improve the planning and design of ongoing and future projects (Corps and non-Corps). This will benefit the Corps and many other agencies and stakeholders by developing a modeling tool and method to identify and encourage the effective implementation of projects that will restore an urban watershed.

This study is multipurpose, as it will benefit ecosystem restoration, flood mitigation, and potentially navigation. The Darby-Cobbs watershed discharges to the Delaware estuary at Tinicum Wildlife Refuge and ultimately enters the Delaware Bay. Darby Creek is one of the larger tributaries south of the Schuylkill River. Reducing the suspended sediment input into the estuary will not only have environmental benefits, but will also decrease the amount or frequency of dredging in the area. The significance of this benefit will be investigated as part of this study.

This will be done by coordinating internally and externally to determine the type and quantity of sediment dredged in the Delaware Bay. As part of this fiscal year's effort, a sediment budget will be developed for the Darby Cobbs watershed and sediment profiles

will be taken to determine the location, quantity, and type of material discharging from Darby Creek to the estuary and bay.

A group of 10 municipal and county environmental agencies and watershed groups, including a watershed partnership) was assembled in FY06 to facilitate this study. These groups have played an active role in identification of problems, sharing pertinent data, and conducting public outreach.

Leveraging efforts will continue this fiscal year, as the Pennsylvania Department of Environmental Protection has offered to take sediment samples throughout the watershed, with Corps guidance. In addition, efforts will be leveraged with an ongoing project in the district, the Southeastern Pennsylvania Flood Plain Management Study. The following efforts have been identified as potential crossover activities for this fiscal year:

- creation/resurrection of a hydraulic model
- development of incremental flood mapping for impact analysis
- historic analysis of H&H data
- leveraging of GIS data (majority of collected data will be used for both efforts)

Deliverables

Restoration alternatives will be developed, such as proper stormwater management, storm water retention/ sediment detention areas, barrier removal, etc. These alternatives will be evaluated using a Sediment Impact Assessment Model (SIAM) of the Darby-Cobbs watershed. The result will be a functional decision support tool and comprehensive watershed plan that will recommend appropriate methods for immediate and long-term solutions. This plan may supplement or replace the Feasibility Phase and expedite the time to construction of future Corps projects. The specific project tasks follow:

Phase 1: Preliminary Evaluation (FY06 & FY07)

- Coordinate with multiple stakeholders
- Identify sites representative of various conditions in the watershed
- Assess the watershed with a field investigation
- Assemble, review, and archive existing data

Phase 2: Detailed Assessment (FY07, FY08, FY09, and proposed for FY10)

- Continue coordination with stakeholders
- Detailed historic data evaluation and compilation into hydraulic model
- Develop a sediment budget

Phase 2 (future efforts)

- Perform a watershed-level geomorphic assessment
 - Timeline of watershed and channel modifications (development, percent impervious surface, dams, dam removal, channelization, etc.)
- Identify data gaps and collect additional data

Phase 3: Analysis and Planning (*future efforts*)

- Format data for model input
- Develop restoration alternatives considering the following
 - Hydrology – urbanization of the watershed has increased runoff dramatically. Is the response ongoing? If not, roughly when did the response flatten out? This answer may be different at different points in the watershed.
 - Are channels still incising? Enlarging? Again, the answer may be different in different locations.
 - What is the future no-action scenario?
- Analyze alternatives using Sediment Impact Assessment Model (SIAM) and other models
- Write a comprehensive watershed plan

FY06 Activities

Phase 1 was completed in FY06:

- The District coordinated with multiple municipal and county environmental agencies and watershed groups that work throughout the Darby-Cobbs watershed.
- A 3-day preliminary watershed assessment was conducted with Meg Jonas, a sediment transport expert and hydraulic engineer from the Engineering Research and Development Center (ERDC) Coastal and Hydraulics Laboratory. The team visited 24 different sites throughout the watershed.
- The District compiled historic and current data that was collected by the Corps, watershed groups, the Philadelphia Water Department, and various agencies.
- A site visit report was written.

FY07 Activities

Part of Phase 2 was completed in FY07:

- Compiled data (Corps and non-Corps) taken in the watershed over the past century in collaboration with watershed groups and other partners
- Developed a database
- Digitized old reports
- Compiled hundreds of photos from FY06 site visits

FY08 Activities

Part of Phase 2 was completed in FY08:

- Detailed development of database of reports
 - Worked with partners to ensure we have all existing data
 - Categorized reports based on type of data
 - Georeferenced each report
- Developed interactive map layer- reports
 - Map references locations of each study and report title and links to table describing data available in the report
 - All reports available for public to download
 - Will be used for model development
- Developed interactive map layer- photos
 - ~300 photos from FY06 site visit georeferenced to sites representative of various conditions in the watershed
 - Linked to notes describing site conditions
 - “Virtual tour of watershed”
 - Part of partnering with watershed groups and public outreach
 - Geographically and pictorially documents areas with erosion and deposition

- Made interactive maps part of the District's RSM website
- Developed urban stream pamphlet with feedback from watershed groups
 - Public outreach & education
 - Intended to explain sediment and water transport in easily understood terms
 - Improve public perception of the Corps
 - Increased likelihood of future partnering opportunities
 - More positive view of the Corps' work when our involvement in the watershed increases

FY09 activities

Phase 2 (cont.):

- Completed the website (joint press release with watershed groups will occur this winter)
- Pamphlets were distributed to watershed groups and the local soil and water conservation district in January 2009
 - Watershed groups are distributing to the public
- Identified potential leveraging opportunities (internal and external)

Proposed FY10 activities

- Develop sediment budget
 - Determine location and magnitude of sedimentation & source (bank or bed)
 - Extract sedimentation and cross-section data from existing (georeferenced) reports
 - Measure turbidity or suspended sediment, perform gradation analyses, pebble counts, or estimate channel changes (aggradation or degradation)
 - Will leverage labor with the PA Department of Environmental Protection
- Sort through historic data and build H&H model (efforts will be leveraged with the Southeastern Pennsylvania Flood Plain Mapping Study)
- Assemble the data from the reports and other information – the key items that address hydrology, hydraulics, sediment, channel morphology.
 - Plot profiles (most recent, next most recent, and earliest available). Use HEC-RAS, and plot top-of-bank elevations. Plot exposed sewer lines on here as well – locations and (if known) elevation of exposed pipe.
 - Plot cross-sections (same as above)

- Tabulate the information from different reports by location and time, and determine how it was derived. Evaluate the changes, especially in the one to two year frequency events (the channel-forming discharge will probably be in this range). Include hydrographs, frequency curves, etc.
- Analyze gage data for different time periods to see how much the 1-2 year event changes.
- Use various aspects of old HMS models to determine where each sub-basin stands in the continuum between pristine and fully urbanized.

Table 1. Time and Cost Estimate of Proposed FY10 Activities

Task	Resource	Time Required	Schedule	Cost
Travel to and prep for RSM meetings	NAP Special Studies Section, ERDC CHL	Travel, labor, & per diem costs for 2 people	FY10	\$10,000
Project coordination	NAP Special Studies Section (project management), NAP Floodplains Section (RSM website updates)	Labor for 1 person for ~110 hours and 1 person for 10 hours	Throughout FY10	\$15,000
Sediment budget	NAP ERDC CHL or others (TBD)	Labor for 3 months	3 rd quarter	\$30,000
H&H model	ERDC CHL and district labor (Floodplains Section)	Labor for 6 months	4 th quarter	\$50,000
Total to Complete FY10 Product				\$105,000

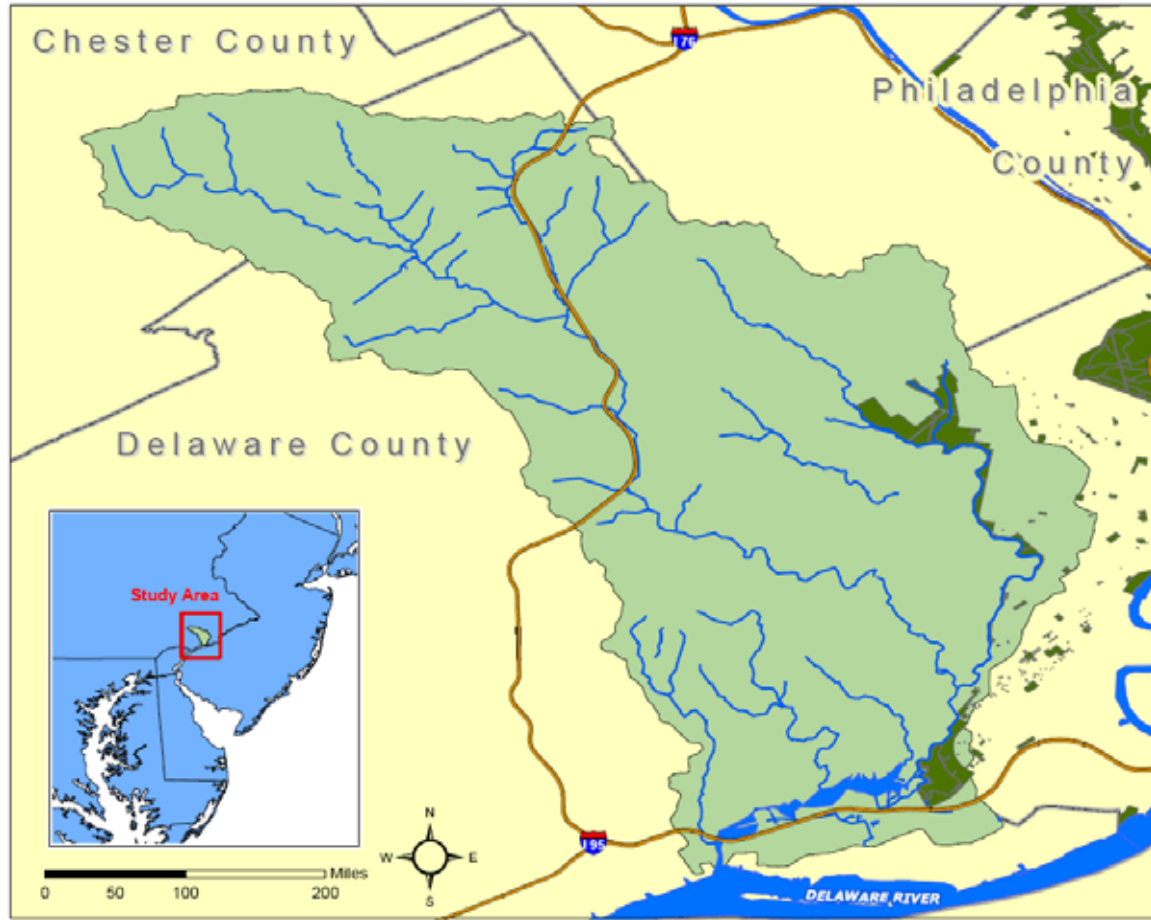


Figure 1. Darby-Cobbs Watershed

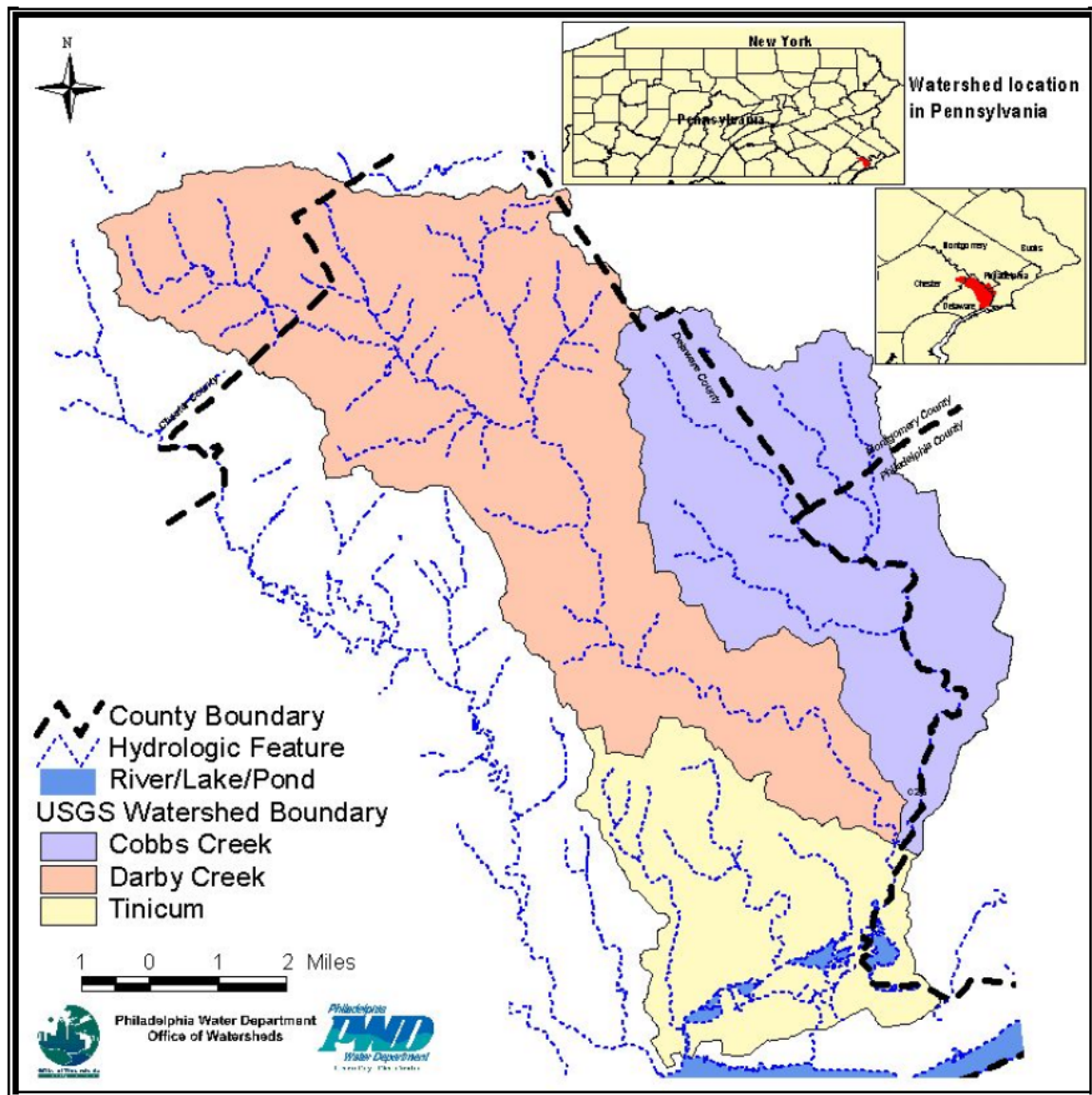


Figure 2. Darby-Cobbs Subwatersheds

Map taken from *Cobbs Creek Integrated Watershed Assessment Plan*, Philadelphia Water Department, Darby-Cobbs Watershed Partnership, October 2004.