Rouge River Streamwood Stream Bank Erosion Mitigation Project (RVII-08)
Final Report

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Project Purpose and Objectives

The purpose of the Rouge River Streamwood Stream Bank Erosion Mitigation Project was to mitigate stream bank erosion at a site on the Rouge River utilizing a combination of bank stabilization techniques, thereby improving water quality, aquatic habitat, aesthetics, and public safety. The project is located on the Rouge River between 12 Mile Road and Telegraph Road, in the City of Southfield.

Project Background

This project is a follow-up to the Rouge River Main 1-2 Subwatershed Streambank Inventory Project, which was completed in 2004 under a Rouge Program Office grant. The Rouge Main 1-2 Streambank Inventory Project was designed to identify high priority sites for stream bank stabilization and included nearly 90 miles of the Rouge River and its tributaries in the Main 1-2 subwatershed. More than 2200 locations were characterized and scored for stream bank erosion. The site of this project ranked in the upper 99th percentile of all erosion sites inventoried in the subwatershed.

Project Goals

This project is consistent with the Main 1-2 Subwatershed Management Plan and contributes to several of the goals described in that plan, including:

- *Restore Aesthetically Appealing Conditions* – This project modified an eroding and unsightly section of stream bank along public property resulting in a stable, well-designed and aesthetically improved reach.
- *Improve the River Ecosystem* – By stabilizing the stream bank, this project reduced loading of soil solids to the river, resulting in lower suspended solids and nutrients loading.
- *Minimize the Amount of Soil Erosion and Sedimentation* – This project will reduce soil erosion and will serve as a highly visible demonstration of how eroding stream banks can be stabilized along the Rouge River.
- *Maximize Community Assets Related to the River* – This project is adjacent to public lands owned by the City of Southfield and maintained by the Southfield Department of Parks and Recreation. The stream bank stabilization will not only have significant environmental benefits, but it is located immediately upstream of a bridge that provides public access to this land. The project will protect the bridge from future erosion, thereby protecting future access to this public land.

Project Description

This project stabilized approximately 300 feet of stream bank at the project site. Inspection of the site found extensive erosion of the lower four feet of the bank along much of this reach, with undercutting and destabilization of riparian trees. The downstream limit of the project area is a city-owned bridge, referred to as the Berberian Bridge, which provides access to city lands south of the river. Because the bridge is located on a bend in the river, loss of the bridge would likely lead to accelerated erosion from the inside of the bend. At the upstream limit of the project, erosion is less extensive, possibly due to the presence of clay strata underlying the sandy loam overburden, which is more resistant to erosion.

Preliminary hydraulic analysis of the site indicated that bankfull flow (estimated by the 2-year return interval flow event) produces an average flow velocity of approximately 2 feet per second (fps), while the 10-year event yield an average velocity of approximately 4 fps. Average shear stresses range from 0.08 to 0.22 pounds per square foot (lb/s.f.). These hydraulic conditions indicate that vegetative stabilization techniques were not viable for this site. Furthermore, while bioengineering methods might be effective on the upper banks once they become established, toe scour would continue and the bioengineering materials might not survive if high flows before they are fully established. For this reason, a design that incorporated both hard pure armoring (particularly at the toe and near the bridge abutments) and mixed armoring and bioengineering techniques is recommended.

The final design of the project was completed as the first task if the project and the conceptual design for the project includes the following elements:

- Earthwork to reduce bank slope along the project reach.
- Armoring of the bank toe and the area adjacent to the southeast bridge abutment, a well as any areas that may be particularly susceptible to ice forces.
- Mixed riprap and bioengineering on the intermediate slope.
- Bioengineering stabilization of the upper banks.

<u>Project Cost</u>

Task	Task Cost	Type of Effort
1. Project Administration & Coordination	$10,000	Planning
2. Project Design	$22,000	Design
3. Construction Management	$20,000	Construction
4. Project Construction	$74,000	Construction
Total:	$126,000	

Project Schedule

Task	Schedule
Project Start	February 2007
Project Design	February 2007 – May 2007
Delivery of Draft Design to City	May 2007
Design Review	May 2007 – July 2007
Prepare Design Documents; Bid Procurement; Permits; Construction Preparation	August 2007 – September 2007
Construction	October 2008 – December 2007

Project Design

This task included all work required to take the project from conceptual to final design. Major activities to be completed under this task include:

- Site survey – An accurate topographic survey of the project site is necessary to support hydraulic analysis, project design, and determination of project quantities.
- Hydraulic analysis – A detailed hydraulic analysis will include calculation of flow velocities, water depths and bank shear stresses under a range of flow conditions.
- Engineering design – Upon completion of the hydraulic analysis, engineering design of the project will be completed.
- Design report – A basis of design report will be prepared to document the hydraulic analysis and engineering design for the project.

Beginning in March, 2007 background information was reviewed including wetland reports and other site resource information. A project kick-off meeting was held on March 16, 2007 and soils and surveying activities were scheduled. From April through May, 2007, conceptual design activities began, including research of stabilization techniques. A project meeting to discuss conceptual designs was held on May 10, 2007 in Southfield. Field investigations on trees and vegetation were conducted.

Several different resources were used to design the streambank stabilization project in addition to site-specific data that was collected during the design process. Two resources which are frequently used by many practitioners are listed below.

- Natural Resources Conservation Service. 1996. Chapter 16, Streambank and Shoreline Protection, Part 650, Engineering Field Handbook. 143 pp.

- Transportation Research Board. 2005. Environmentally Sensitive Channel- and Bank-Protection Measures. Report 544. National Cooperative Highway Research Program, Transportation Research Board of the National Academies. 50pp + CD

Part 650 (Chapter 16) of the Natural Resource Conservation Service (NRCS) Field Engineering Handbook is the document believed to be referenced in Attachment A of the grant agreement between Wayne County and the City of Southfield. When originally published, this document set the standard in bioengineering for streambank stabilization. Since its publication, numerous other resources have also become available. The design relied upon several different resources, including those listed above.

The grant agreement clearly required utilization of bioengineering practices to the maximum extent practicable given prevailing site conditions. The design relied on the resources above, experience, survey data, and hydraulic modeling to select a combination of streambank stabilization techniques that, when combined, are capable of controlling lateral streambank erosion, maximizing habitat quality by incorporating live native plant materials (i.e. bioengineering), and minimizing impacts to existing high quality riparian habitat. The use of live native plant materials and biodegradable erosion control blankets are fundamental bioengineering techniques that were incorporated into the design to the extent practicable given site-specific conditions.

The slope of the existing streambank varied from approximately 100 degrees (sub-vertical) to 45 degrees (1:1, v:h) and generally lacked vegetation. As proposed, the streambank was to be stabilized by first grading to flatter slopes ranging from 1:2 to 1:3 (v:h). The slope was varied to avoid removal of mature trees within the riparian corridor. The toe of the regraded slope was stabilized using natural stone to an elevation of 647.0 feet. Live stakes were incorporated into the stone toe as “joint plantings.” Three inches of topsoil salvaged from the site will be spread over the graded portion of the streambank. A native grass and forb seed mix, with annual rye or seed oats as a cover crop, will be applied over the topsoil. A biodegradable erosion control blanket will be installed over the graded portion of the streambank, above the stone toe, once topsoil is placed and seeded. Native grasses, forbs, shrubs, and trees will be salvaged from the site prior to the start of construction in the form of plugs and wrapped root balls. The salvaged plants will be replanted on the streambank and along the top of the streambank within the construction corridor. The plant rescue and replanting will reduce overall impacts on the high quality riparian habitat and result in much quicker vegetation establishment than seeding alone can achieve.

As detailed in the two resources above, bioengineering practices are often combined with harder structural elements to achieve stabilization. In particular, some form of toe stabilization is required. Where necessary to resist erosive forces, toe stabilization is required at least during establishment of vegetation (typically three years). Still, in some cases vegetation alone cannot adequately stabilize the toe even once established. In those cases, permanent toe stabilization must be incorporated. In experience with bioengineering projects that used temporary toe stabilization or modest quantities of riprap to stabilize the toe of streambanks in hydrologically disturbed river systems, lateral streambank erosion and migration continued after temporary measures degraded. This erosion and migration continued after vegetation had become established. The use of bioengineering on the upper slope and incorporating live woody plantings into the riprap significantly reduces the visibility of the riprap toe and reduces environmental effects associated with riprap.

Riprap toe protection to the bankfull flow elevation is a common practice that is combined with bioengineering. The Rouge River in the vicinity of the Streamwood streambank stabilization site presents two challenges to streambank stabilization. First, the magnitude of the two-year event is significant along the outside of the bend. Second, the flashy nature of the Rouge River creates an elevated average high water level that is achieved during typical precipitation events. This flashiness inhibits plant growth below the average high water elevation. Therefore, the design cannot rely on vegetation to stabilize soils below a certain elevation. Field observation indicates that the elevation roughly corresponds with the bankfull discharge, based on observed scour lines, exposed roots, and active streambank stabilization.

The mean cross-sectional velocity of ten cross-sections surveyed through the project reach is 3.4 ft/s; the maximum velocity is 3.9 ft/s. Flow velocity on the outside of meander bends is typically two to three times higher than the average cross-sectional velocity. Given that there are significant local slope conditions that direct flow toward the streambanks, it is estimated that velocity on the outside of the streambank can be 2.5 times higher than the average cross-sectional velocity. Therefore, the design flow velocity could easily be 2.5 times the average reach velocity of 3.4 ft/s, or 6.8 ft/s during the two-year or bankfull flow event. The two-year stage elevation ranges from 646.88 to 647.1 over the length of the streambank treatment area.

Loose stone riprap was also proposed at the two concrete bridge abutments where broken concrete rubble has previously been placed to some extent. More concrete rubble was present on the south abutment than the north. The broken concrete rubble will be removed and replaced with the loose natural stone up to the concrete bridge abutment. Placing riprap to this elevation will protect the abutments up to the 100-year flood elevation. The modeled 100-year flood elevation is 654.33 at the bridge. The loose stone riprap will meet the concrete bridge abutments at a maximum elevation of approximately 652.0 on the north and south sides. Loose stone riprap on the south side will be extended across and up a drainage ditch that parallels the access road and the north bridge abutment. Runoff flowing in this drainage ditch is currently causing streambank erosion along the concrete abutment. The basis of design was submitted to Wayne County and MDEQ in September 2007.

A Threatened and Endangered (T&E) Survey of the site was conducted on July 16, 2007. This was an unanticipated part of the project. During the preliminary site investigations some plant species that may have had the potential to be a T&E were observed in the general area. Therefore, a full T&E Survey was necessary. A final report was submitted to the Michigan Department of Natural Resources on August 13, 2007 and an Endangered Species Permit was issued to the City of Southfield on September 14, 2007, authorizing the transplanting of goldenseal outside the southern project area. The threatened and endangered species were flagged in October, 2007 and. some trees were flagged for transplanting and others were marked for removal.

Construction Management

This task included all work associated with construction management such as:

- Preparation of final design documents (plans and specifications)
- Bid procurement
- Permit procurement

Site construction plans and front-end specifications were developed in August, 2007. Construction specifications were written and finalized and bid documents were delivered to the City of Southfield in September.

A permit application was sent to the Michigan Department of Environmental Quality (MDEQ) on June 14, 2007 and regular follow-up was made with MDEQ to determine permit status. On July 30, 2007, MDEQ requested a hydraulic modeling report which was performed as requested and additional survey cross- sections were conducted to support the modeling effort. A Hydraulic Modeling Report based on the additional modeling was submitted to MDEQ and additional permit fees were provided.

A site meeting to discuss the project and permitting was held with MDEQ in September 2007. MDEQ was also provided with a Federal Emergency Management Agency (FEMA) study and additional information on hydraulics, rock vanes and modeling. Permits were finalized with MDEQ in October, 2007.

An advertisement for bids was issued by the City of Southfield. A mandatory pre-bid meeting was held at the field site located at the end of Streamwood Lane (South of 12 Mile Road, east of Telegraph Road), in Southfield on October 9, 2007 and bids were due to the city on October 15, 2007. Three bids were received and DeAngelis Construction was awarded the contract in October 2007

Project Construction

Under this task, all work associated with construction of stream improvements will be performed, including:

- Earthwork
- Armoring of toe and bridge embankment
- Mixed armor & bioengineering of mid-bank
- Bioengineering of upper bank
- Installation of large woody debris, where feasible, for in-stream habitat.

On October 24, 2007, 61 dormant goldenseal rhizomes were relocated to designated safe areas within the Streamwood site.

The main construction activities took place from December 14-December 21, 2007. On December 14, rock was placed along the north streambank and two debris jams were removed as well as concrete rubble from the slope near the southeast bridge abutment.

On December 19, DeAngelis Construction had graded approximately 125 feet of streambank beginning at the upstream end and approximately 100 feet had received riprap and topsoil.

On December 20, all of the bank grading had been completed, all of the riprap had been installed including the installation of the rock vein within the river, and the equipment access route and pad had been restored. In addition, De Angelis had graded the eastern most portion of the woodland within the construction corridor and had spread some seed in that area.

The equipment access route to the river near the southeast bridge abutment was restored. The slope grade appeared to be consistent with the construction drawings and the toe alignment was consistent with pre-existing conditions. The bank was reconstructed using clay fill from the streambank excavation. Soil and debris was hauled from the site all day. A crew was on-site on December 21 to complete installation of the erosion control blanket, seeding, restoration within the woodlands, and tree planting.

In March 2008, the contractor returned to install all the live staking material and re-transplant some vegetation ground cover that had been moved in the winter. In May 2008 the contractor completed final site restoration activities by grading and restoring areas that were disturbed during construction. Review of the site at this time indicated very good establishment of the vegetation, including the transplanted plants and trees. The live stakes had begun to establish and create the necessary cover. The rock vein installed has remained stable over the strong winter and was deflecting the main river flow as designed back to the center of the channel.