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September 12, 2011
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This project would not have been possible without the collaboration of all of the organizations and individuals referenced above.
1. Executive Summary

The Achey Mill Dam Removal and Streambank Restoration Project on the East Branch of Swamp Creek, tributary to Unami Creek, was sponsored and managed by the Bucks County Conservation District. Funding for the project was provided by a grant from the Pennsylvania Fish and Boat Commission, with a cost share by the landowner, to remove the breached dam and restore approximately 300 feet of eroded streambank downstream. Bucks County Conservation District contracted with Gleim Environmental Group of John W. Gleim Jr., Excavating Inc. to design, permit, remove the breached dam and stabilize the downstream bank. The project was funded in August 2010 and construction was completed in August 2011.

2. Project Description

2.1 Project Location and Justification

The Achey Mill Dam (D09-006) was an 11 foot high, 200 foot wide concrete run-of-river dam located 0.28 miles upstream of the mouth of the East Branch Swamp Creek, a tributary to Unami Creek, and located approximately 300 feet upstream of the Milford Square Pike bridge (please refer to Appendix A for a USGS quad map denoting the project location). The Unami Creek watershed is approximately 48.8 square miles, and is located primarily in Upper Bucks County. Unami Creek flows in a southwesterly direction and discharges into the Perkiomen Creek, which in turn flows into the Schuylkill River. Currently, the Unami Creek basin, including the East Branch Swamp Creek, is classified as a High Quality (HQ), Trout-Stocking Fishery (TSF) under Pennsylvania Department of Environmental Protection’s (PA DEP) Chapter 93 Water Quality Standards.

Although the main stem of Unami Creek is attaining its Chapter 93 designated uses, several tributaries to the Unami Creek are listed as impaired on the Pennsylvania 303(d) list due to residential stormwater flows, which contribute to in stream siltation and water flow variability. The impacts of stormwater on the Unami are exacerbated by numerous road crossings and dams prior to the confluence with Perkiomen Creek, which alter natural stream morphology and sediment transport processes.

The project consisted of removing the dam and redesigning the stream channel using natural stream channel design methods. The goals of the project were to:

- restore the stream to natural flow conditions;
- restore fish passage and habitat;
- restore and stabilize approximately 300 feet of eroded streambank downstream of the dam;
- minimize the potential recurrence of bank erosion in this location; and
- remove the mid-channel bar and establish a stable channel with hydraulic connectivity to the floodplain.
2.1.1 Benefits of Dam Removal

Although historically useful, today many dams have long outlasted their initial purpose and pose a number of negative impacts on the habitat and water quality of the stream: presenting barriers to fish migration, impeding downstream flow, increasing sedimentation and increasing temperature and decreasing dissolved oxygen upstream of the dams. In addition, the disruption of natural flow and sediment transport associated with impounding the creek leads to a ‘sediment starved’ condition downstream, leading to increased erosive forces downstream of the dam. In addition to the ecological impacts, dams can threaten public safety: in downstream areas should the dam fail during a storm event, in upstream areas due to back up of flood waters and to boating enthusiasts who become trapped in dangerous currents around the dam.

In light of the sheer number of old mill dams in Pennsylvania and in response to the acknowledged negative impacts of dams, the Commonwealth of Pennsylvania has been at the forefront nationally at facilitating dam removals. Pennsylvania has been lauded for taking a proactive approach to dam safety, by educating landowners about the option of dam removal to limit personal liability, for promoting interagency collaboration and developing a streamlined restoration waiver for dam removal projects, as well as for targeting funding specifically toward dam removal projects (American Rivers, 2006). In addition, promoting dam removal is a more fiscally responsible programmatic approach because dam maintenance projects are considerably more costly than removal and require continued maintenance expenses over the lifetime of the dam.

2.1.2 Initial Site Assessment/Existing Conditions

The Bucks County Conservation District (BCCD) became involved in this project in response to a request for technical assistance from the landowner in late 2009. From anecdotal evidence, which was supported by a PA DEP Dam Safety inspection report dated 2001 (Appendix B), the dam naturally breached around 1999 or 2000; however, the dam had not been repaired nor had it been properly removed in the ten years since.

Through the initial site assessment and discussion with the landowner, BCCD learned that the former spillway had directed the channel closer to the right bank while the dam was maintained. Once the dam breached, the upstream sediment load and portions of concrete from the former dam deposited in the center of the channel, directing the force of the water through the breached portion of the dam toward the left bank which caused significant erosion on the downstream left bank. As a result of the scour along the left bank, the stream was completely disconnected from its floodplain downstream of the dam. At the time of the initial assessment, the immediate area downstream of the dam had vertical banks averaging 10 feet in height and significant bank erosion along the left bank to the bridge approximately 300 feet downstream.

Habitat impacts were evident throughout the proposed project area: the extensive streambank erosion was contributing a significant sediment load to the East Branch Swamp Creek. In addition, the remaining portions of the dam and sediment deposition in the channel continued to present a barrier to fish migration in the trout-stocked stream, limiting the available habitat during low flow conditions. A large mid-channel bar extended from 75
feet to 150 feet downstream of the dam. Downstream of the large bar were two more sediment deposits which braided the channel into three shallow branches during low flow conditions. The Milford Square Pike bridge was designed with two arches to accommodate flow, but the right passage is partially obstructed with accumulated sediment, directing all low flow under the left passage. A public safety hazard was also posed by the rate of erosion on the left bank, which was estimated to be taking between 5 and 10 feet of bank per year. During the initial site visit, the distance measured from the corner of the landowner’s house to the top of the left bank was approximately 35 feet. If left unchecked, at the current rate of bank erosion the erosive forces could have undermined the foundation of the house within 3-4 years. In addition, without bank stabilization, the ongoing channel realignment threatened to undermine the left bridge abutment 300 feet downstream of the dam, despite previous measures to stabilize the abutment with riprap.

2.2 Project Planning and Contractor Selection

Bucks County Conservation District, on behalf of the landowner, filed a request for assistance through the Pennsylvania Association of Conservation District’s Engineering Assistance Program for a topographic survey of the stream channel from 100 feet upstream of the dam to the bridge, approximately 300 feet downstream. The survey was completed in January 2010.

Following the survey, a meeting was held on January 21, 2010 on site with BCCD, PA DEP Dam Safety, PA Fish & Boat Commission (PFBC), US Army Corps of Engineers and American Rivers to provide input on the proposed project scope of work, feasibility and potential funding opportunities. As a follow-up to the meeting, Ms. Sara Strassman of American Rivers informed BCCD of the possibility of funding for dam removal projects in the Perkiomen watershed and encouraged BCCD to contact Mr. Carney from PFBC.

During contracting with PFBC for the grant, BCCD investigated local options to import fill for the bank restoration to reduce anticipated project costs and maximize the pending funding. The Quakertown Airport is a permitted site approximately 1 mile away from the project site with 2 large stockpiles of available fill material. BCCD discussed the proposed project with the Airport Authority engineer who presented the proposal to the Airport Authority Board of Directors. The Airport Authority approved the donation of the material to BCCD in July 2010 for the completion of this project, provided the stockpile and access areas were stabilized at the completion of the project.

Once funding was secured, the District contacted firms who have completed similar projects and publicly advertised a pre-bid meeting on site for a design-build project for the dam removal and streambank stabilization. The pre-bid meeting was held in September 2010. BCCD reviewed the proposed scope of work and access constraints with the contractors. Although fifteen firms were represented at the pre-bid meeting; only two companies submitted proposals by the October 2010 due date. Gleim Environmental Group’s proposal demonstrated knowledge of and training in natural stream channel design, showed a strong work history on other dam removal projects and also demonstrated care and attention to detail by addressing all of the items on the request for proposals.
The conceptual plan included in the Gleim proposal included 3 rock vanes that would further protect the bank, deflect and center flows under the left bridge arch (the only one remaining open since the right was partially blocked with sediment) and enhance habitat value. Because the cost of including the rock vanes exceeded the available grant amount, BCCD presented this option to the landowner as an item for potential cost share. The landowner appreciated the potential benefits provided by the inclusion of the rock vanes and opted to contribute the additional funds required to include the option in the final scope of work.

2.3 Project Permitting

Mr. Boyer of Gleim Environmental Group conducted several additional site visits to assess the dimensions of the mid-channel gravel bar in more detail than captured in the PACD site survey, to collect photos for permit applications and to evaluate site access constraints and limitations surrounding a sewer cleanout pipe and municipal water line that appeared to run directly under the property access area to develop a final plan set.

BCCD was advised that two permit applications would be necessary for this project. Gleim Environmental Group prepared and submitted applications for these permits. First, an application for a Restoration Waiver, Waiver 16 under PA DEP Chapter 105 regulations, was needed. BCCD was advised by PA DEP that the waiver could encompass the dam removal, mid-channel gravel bar removal and downstream streambank restoration within one application. The waiver application was filed in early 2011, at which point a review of the Erosion and Sediment Control Plan was included in the Waiver 16 review. Therefore, no Erosion and Sediment Control Plan was required to be submitted for review to BCCD. In addition, a Highway Occupancy permit was required to access the project site with heavy equipment directly from Milford Square Pike.

A few setbacks were encountered during the plan development and permitting phase. First, although a PA One Call was completed during the design phase, no response was received from the water & sewer authorities to provide definitive information on the location and depth of pipes beneath the proposed access area, despite repeated attempts at contact by Mr. Boyer. As a conservative approach, Gleim proposed using steel plates at the access area to distribute the weight of the machinery entering and exiting the site.

In addition, the owner of the former mill approximately 600 feet downstream raised repeated concerns of the potential for increased flooding and/or damage to her property that could result from the completion of the project. The landowner also expressed concern that the property rights to the dam were attached to the mill. BCCD conducted additional research at the County Recorder of Deeds and did not locate any evidence that would support the claim. BCCD corresponded with and met with the mill owner on several occasions; in addition, Mr. Boyer of Gleim Environmental Group met with BCCD and a representative of the downstream landowner. During the meetings, it was stressed that the sediment loss from the bank erosion upstream was likely a primary cause of the extensive
channel deposition and realignment at her property that could not be reversed but hopefully mitigated by the completion of the project.

PA DEP requested minor revisions on the submitted plans, but a final approval of the permit waiver was received on June 28, 2011. A copy of the approved plans is included in Appendix C. As of June 28, the Highway Occupancy Permit had yet to be issued. Upon inquiries with and further inspection by Milford Township, it was discovered that the application had been misfiled at the township office and the permit was issued in short order.

2.4 Project Construction

The project was initiated within the first week of August 2011. BCCD conducted daily checks on site over the two weeks during construction. Work was performed in accordance with the PADEP permit waiver conditions and the approved Erosion and Sediment Control Plan. Construction was completed ‘in the wet’ without a pump around or coffer dam as per the PA DEP approved plans. Equipment mobilization was completed and the construction entrance was installed on August 2, 2011. The former dam and abutments were removed on August 3. The spoils were then used to fill in the scour area on the left bank immediately downstream of the dam. Because the downstream and upstream reaches each had a slope of 1.5% no grade control was deemed necessary at the former dam location.

After the dam was removed, the mid-channel deposition was removed and the material was salvaged to form a base for restoring the left bank and floodplain. A 10 foot wide floodplain and 25 foot wide channel was established to be consistent with the stable, upstream reach. In addition, larger boulders deposited in the channel were salvaged for use as toe protection along the newly restored bank.

Although the plans called for importing and placing approximately 300 cubic yards of fill material to restore the left bank, Mr. Boyer’s investigation at the start of construction noted that approximately 13 additional feet, or approximately 750 tons of sediment, had washed out from the left bank since the PACD Engineering Assistance survey. Nearly twice as much fill was now required to be imported to restore the bank. In addition to the material donated from the Quakertown Airport, Milford Township offered to import material from a nearby site which helped meet the additional need.

Imported fill material was placed and graded to form a 2:1 slope to top of bank. The operators worked downstream from the former dam location placing toe protection along the bank and installing the rock vanes over the next several days using a combination of salvaged and purchased rock material. On August 11, the final toe protection was placed, construction entrance was removed and equipment was demobilized. Seeding, mulching and installation of coir matting on the upper portion of the bank were completed on August 12, and final breakdown of the site was completed on August 15, 2011.

This project was tested by several large storms in short succession soon after construction was completed. Less than one week after construction, a storm resulting in 4 inches of
precipitation passed through the area, which caused some downcutting in the upstream area around an outcropping of bedrock that was left near the former dam location, but the project held with minor adjustments immediately upstream of the project area. Unfortunately, the newly established floodplain and rock vanes were no match for Tropical Storm Irene, which dumped an additional 8 to 9 inches of rain on August 27-28; however, the restored bank and toe protection held through that storm as well. BCCD requested a performance bond from Gleim Environmental Group during the contract negotiations and we hope to initiate the repairs within the next month. Once repairs are complete, volunteers from the Bucks County Chapter of Trout Unlimited have offered to install native planting along the restored bank and in the floodplain. The cost of plant materials was funded by a grant from the TreeVitalize Watersheds program.

3.0 Accomplishments
The Achey Mill Dam Removal project has reduced nonpoint source pollution and erosion in the Unami Creek watershed. The dam removal and subsequent natural stream design mitigation project has:
- reduced sediment loading to the stream due to downstream bank erosion;
- restored natural stream sediment transport;
- improved in-stream aquatic habitat;
- reconnected the stream with its floodplain in the project area;
- improved safety for recreational users of the stream; and
- improved safety for the property owner.

4.0 Works Cited
Appendix A. Project Location Map
Appendix B. PA DEP Dam Inspection Report
Appendix C. Project Plans
Appendix D. As-Builts
Appendix E. Project Photos
Before Construction:

Left bank erosion downstream of dam before dam removal (photo taken September 2009)

Achey Mill Dam before construction (August 2, 2011)
View of mid channel bar and left bank erosion downstream of dam (August 2, 2011)

During Construction:

Removal of right dam abutment (August 3, 2011)
Removal of right dam abutment (August 3, 2011)

Placement and grading of fill along left bank
Bank stabilization – fill placement and toe protection (August 8, 2011)

View looking upstream at former dam location – channel realignment and new floodplain (August 9, 2011)
View looking downstream – final rock vane and access area (August 11, 2011)

View from channel of regraded bank and toe protection in front of house (August 11, 2011)
Post-Construction:

View looking downstream from former dam location during final site stabilization (August 12, 2011)

View looking downstream from former dam location post-construction, following 4 inch rain (August 19, 2011)