Final Project Report

Project #1014

Mary D Borehole Abandoned Mine Drainage Remediation Project, Upper Schuylkill Watershed, Schuylkill Township, Schuylkill County, PA

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Department of Environmental Protection

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INTRODUCTION

Abandoned mine drainage (AMD) from the Mary D Borehole contributes iron, manganese, and acidity to the main branch of the Schuylkill River near the village of Mary D, Schuylkill County. The Schuylkill River in Schuylkill County is designated "impaired because of metals" on the 303(d) list. A completed assessment focusing on AMD nonpoint source problems in the Upper Schuylkill River basin ranked the Mary D Borehole as one of the most severe in the watershed (L. Robert Kimball & Associates, 2000). This discharge also is considered a "High Priority Remediation Project" in the EPA approved "Upper Schuylkill River TMDL Watershed Implementation Plan". Hence, this project will reduce AMD loadings from the Mary D Borehole discharge to the Schuylkill River.

This project is the culmination of many years of extremely hard work by numerous private, governmental, and quasi-governmental entities. When the concept of treating the Mary D Borehole project was first envisioned by the DEP-BAMR and the Schuylkill Headwaters Association, Inc. (SHA) the major hurdle to the project was that the only physical space available to construct a passive AMD treatment system was on the Village of Mary D's existing children's baseball field. SHA began to work with numerous entities to have donated a parcel of land and to obtain the required grant funding to construct a new recreation complex for the Village of Mary D with a baseball field, multi-purpose field, walking trail, and skating pond. This project was completed and dedicated in 2008. As part of the Mary D recreation complex project, the SHA was granted a permanent easement by the owners of the old ball field parcel (the Mary D Fire Company) to construct a passive wetland treatment system.

PROJECT DESCRIPTION

This project involved the design and installation of a passive treatment system to treat the AMD discharge from the Mary D Borehole. The treatment system consists of intake piping from the mine borehole, a settling pond that slows the flow of the water so metallic-rich particles can settle out and an aerobic wetland to further distribute the flow. These treatment cells are followed by a limestone vertical flow pond that contains an under-drain network of pipes that directs the flow of water up through the limestone bed before it is discharged back into the Schuylkill River. A final wetland basin serves as a flushing pond to capture metallic-rich particles that settle out within the limestone bed and that are washed out of the bed utilizing the under-drain pipe system and valves.

What was the project supposed to accomplish?

The primary goal of the project was to eliminate AMD (acid and metal) loadings from the Mary D Borehole to the Schuylkill River. The passive treatment system reduces non-point source pollution, improves water quality, and improves wildlife and fisheries habitats.

A secondary benefit of the project was the installation of a dry hydrant for the Mary D Fire Company to obtain water for fighting fires in the area.

What did you actually do & how does it differ from your plan?

The Mary D Borehole AMD Remediation Project was constructed to treat the AMD that flows from the old underground mine workings of the Mary D Mine to the main branch of the Schuylkill

River. The treatment system was designed to completely neutralize the AMD and remove all the iron at average loading rates for the design life of the project (15-20 years). Metals loadings to the Schuylkill River will be reduced accordingly.

The flow rate at the Mary D Borehole ranges from 600 to 2,210 gal/min and averages about 950 gal/min. The discharge water has consistently been acidic (pH 5.7 to 6.3; Hot Acidity -11.8 to -41 mg/L) and contaminated with dissolved metals (Fe = 2.0 to 10.0 mg/L; Mn = 0.7 to 1.6 mg/L; Al = 0.2 to 0.5 mg/L). This equates to 316 pounds of metals per day at high flow.

Design Flow Rates: Design Flow 1,140 gpm (2.54 cfs) 120 % of Average Flow Rate
High Flow 4,500 gpm (10.03 cfs) 200% of High Flow Rate

The Design Flow Rates were compiled from information that was collected by the Pennsylvania Department of Environmental Protection (DEP) and the U.S. Geological Survey (USGS) for evaluating the project feasibility.

The existing mine discharge is a borehole drilled into the underground mine workings approximately 700 feet north of the treatment area and discharging at a surface elevation of approximately 818.66±. The mine discharge is conveyed into an unnamed tributary to the Schuylkill River which conveys the water under Valley Road along the northern and eastern edges of the treatment area before its confluence with the Schuylkill River, which also runs along the southern boundary of the treatment area.

The inlet structure took the above existing conditions under consideration. The inlet structure passes the design flow into the structure through a 7'6" w x 1'6" h weir on the upstream side of the structure. The structure is a modified PA D.O.T. type DH inlet with a 12" intake pipe being the conveyance from the inlet structure to the treatment system. The pipe invert is set 3' above the inlet bottom to create a sump for debris collection. The downstream side of the inlet structure has a 7'6" w x 1'9" h weir which allows any flow over the intake pipe capacity to flow through the structure and down the original channel. Each weir is protected from large debris entering the intake structure by a ¼" diameter bar screen spaced 6" on center. As designed the structure allows a pass-through flow of 8,294 gpm (18.48 cfs). The structure is positioned approximately 25' downstream of the borehole to minimize impacts to the borehole.

The intake line has a gate valve near the intake structure for maintenance purposes. Generally, the intake line proceeds south from the intake structure to the treatment system in the shoulder of Sanderson Street parallel to the existing sanitary sewer line. Several culvert crossings are required along this route; each crossing location maintains a minimum cover of four feet on the intake line and a 1'6" clearance between pipes. Upon crossing Valley Street the intake line crosses the Schuylkill Valley Sewer Authority sanitary sewer line. This crossing is above the sanitary line as the sanitary line is approximately ten feet deep in this location. Also, upon crossing Valley Street the intake line turns approximately 90 degrees to cross under the unnamed tributary to the Schuylkill River. Again, a minimum cover of four feet has been maintained under the stream. Due to grade requirements to get under the stream, the intake line outlet is located at the bottom of the settling pond at elevation 789.00 and then is conveyed vertically upwards by a 24-inch riser pipe to approximately six inches above the water surface elevation. The capacity of the intake line is 3,236 gpm (7.21 cfs) which will help protect the system from high flows. The intake line has been fitted with several cleanouts along its length at critical points for maintenance.

The influent pipe discharges into a settling pond located on the eastern side of the treatment area. The settling pond is six feet deep and has a surface area of approximately 0.41 acres. This small but deep pond acts as a stilling and settling area for the water entering the treatment system. Treatment efficiency is enhanced by spreading the flow out over a wide area rather than keeping it in a concentrated flow which is one of the intentions of this pond. The other primary purpose of this pond is to settle out and remove any ferric iron in the influent water. The berm elevation of the settling pond is set at 797.00. An 8" pond drain with Agri Drain™ structure was installed for use in draining the pond for maintenance.

The wetland cell also has a berm elevation of 797.00 as the wetland cell and the settling pond are one contiguous pond with different depths and share an emergency spillway which conveys flows to the unnamed tributary to the Schuylkill River. The wetland cell consists of a topsoil and mushroom compost bedding and is approximately 1.5 feet deep to promote the growth of aquatic plants. The wetland cell acts as a 0.68 acre settling pond and upon vegetation growth it will also be a filter to remove the ferric iron. The outflow of the wetland cell is conveyed to a 228' trench drain system at a crest elevation of 794.50 which allows for the previously spread out flow to be concentrated for conveyance into the treatment cell.

The treatment cell is a vertical upflow treatment system and is divided into three zones with one 12" pipe per zone that conveys the water to the bottom of the treatment cell for distribution. The distribution is achieved through a perforated pipe network on the bottom of the treatment cell at elevation 784.00. Above the distribution pipes is a five foot deep or 116,265 cubic foot layer of high quality limestone. Water from the pipe network on the bottom percolates upwards through the limestone adding alkalinity to the water. The treated water then exits the treatment cell over a 232' long broad-crested rip-rap lined weir for equal distribution. The water flows down the limestone rip-rap lined treatment cell slope and into the outfall channel for conveyance to the Schuylkill River.

Over time the treatment cell will accumulate iron sediment within the piping and the limestone and therefore it has been configured to be a flushable system. Flushing of the treatment cell will be achieved by opening gate valves on the downstream side of the treatment cell for each of the two zones. Upon opening the valve the water will rush downwards, or backward from the normal flow direction, within the treatment cell and be conveyed to the flushing pond. Opening one valve at a time will achieve a more effective flush for each zone of the treatment cell.

The outfall channel located on the west side of the treatment cell also serves as a bypass for an existing culvert under Valley Road. The outfall channel has been sized to convey the capacity of the existing culvert, the treatment flow, and any precipitation flow with a total of approximately 42 cfs for a 100-year storm to the Schuylkill River.

The last pond, the flushing pond, is not a flow-through pond but rather a 0.76 acre settling pond to settle out the ferric material being flushed from the treatment cell. The pond is constructed in "cut" and has a berm of 784.00. The pond is gravity drained down to an elevation of 780.50 via an 8" drain line and Agri Drain™ control structure, but has a bottom elevation of 780.00. The deeper than gravity drained bottom is required to accommodate one full volume of water flushed from the treatment cell. Having the flushing pond sized to accommodate the treatment cell volume will decrease the likelihood of iron sediment washout during a flushing operation. This pond also has been outfitted with an emergency spillway at a crest elevation of 783.00 with conveyance to the Schuylkill River.

An early test of the system approximately one month after start-up showed a significant increase in the pH of the water through the system with 5.3 at the intake structure and 8.0 at the outfall channel weir. Future monitoring of the treatment system will document the load reductions as they may pertain to TMDLs developed for the watershed. Monitoring will continue to be conducted by SHA in conjunction with the Schuylkill Conservation District and Pa. DEP, Bureau of Abandoned Mine Reclamation (BAMR).

This project meets several needs identified for Pennsylvania's Nonpoint Source Management Program for Resource Extraction (Pennsylvania Department of Environmental Protection, 1999; milestones 1a, b, c, d) and should solve the AMD problem at the Mary D Borehole Discharge.

The project was substantially complete on June 10, 2013 and the system was put into service on that date. The system took approximately one day to fill from the settling pond to the flushing pond. Early testing results indicated all ferrous iron was being converted to ferric iron, which is a form that will settle out of the water, and pH was raised to near neutral at the discharge of the treatment system where it enters the Schuylkill River.

A dry hydrant was installed for fire protection in the surrounding communities.

- **What were your successes & reasons for your success?**

The major success of this project was the fact that we were able to complete a totally passive treatment system that requires minimal maintenance and, thus far, appears to be working very well at removing metals loadings from the Mary D Borehole Discharge. Our experience with similar water conditions at other nearby treatment systems provided us with the data and experience to anticipate operating conditions and place structures that will allow operational flexibility.

- **What problems were encountered & how did you deal with them?**

No unusual events or problems occurred during the construction of the passive treatment system.

- **How did your work contribute to the solution of the original problem?**

Our project has reduced the acidity and metals loadings from the Mary D Borehole Discharge to the Schuylkill River.

- **What else needs to be done?**

Further evaluation of the performance of the treatment system is required to determine the optimum flow rate and maintenance schedule for the system.

- **What are your plans for disseminating results of your work?**

An interpretive exhibit sign has been installed at the project site and a media event was held upon activation of the treatment system on June 10, 2013 and in conjunction with the Schuylkill Action Network's (SAN) AMD Project Tour.

- **How well did your spending align with your budget request?**

Our project spending matched our grant request. During the grant period, additional funding became available and SHA took advantage of the increase in funds to complete the Scope of Work.

Project Report Summary

PROJECT REPORT SUMMARY

The goal of the project was to dramatically reduce abandoned mine drainage (AMD) acid and metals loading from the Mary D Borehole Discharge to the Schuylkill River. The passive treatment system reduces non-point source pollution, improves water quality, and improves wildlife and fisheries habitats.

Photographs

Photo 1: Pre-construction aerial view of project site at the former Mary D baseball field.

Photo 2: Mary D Borehole Discharge drainage channel.

Photo 3: Clearing & grubbing of the project site.

Photo 4: Topsoil stripping of project site for construction of treatment system.

Photo 5: Construction of limestone rip-rap emergency spillway to the Schuylkill River.

Photo 6: Beginning of construction of treatment system.

Photo 7: Construction of flushing pond south of the treatment cell.

Photo 8: Installation of intake piping from the mine borehole beside Twp. Road 505.

Photo 9: Installation of intake structure and temporary by-pass of borehole discharge.

Photo 10: Intake structure installation.

Photo 11: Completed intake structure by-passing 100% of the borehole flow.

Photo 12: Preparing for the stream crossing.

Photo 13: Completed stream crossing.

Photo 14: Outfall channel to Schuylkill River with flow measurement weir in background.

Photo 15: Outfall channel tie-in to existing roadway culvert.

Photo 16: Completed flushing pond.

Photo 17: Piping placement in the bottom of the treatment cell.

Photo 18: Treatment cell intake piping and trench drain construction.

Photo 19: Completed trench drain and treatment cell intake system.

Photo 20: Treatment cell limestone addition.

Photo 21: Completed treatment cell.

Photo 22: Nearly complete settling pond showing the intake riser, dry hydrant, water level control structure and drain and emergency spillway.

Photo 23: Completed settling pond and wetland cell.

Photo 24: System start-up June 10, 2013.

Photo 25: Settling pond and wetland cell filled.

Photo 26: Treatment cell filling.

Photo 27: Treatment cell filled.

Photo 28: Outfall channel.

Photo 29: Completed seeding and mulching of entire project site.

Operation, Maintenance, and Replacement Plans

OPERATION, MAINTENANCE, AND REPLACEMENT PLANS

The treatment system was designed to minimize maintenance. Nevertheless, specific features were incorporated to facilitate adjustments needed to accommodate changes in flow rates and/or the accumulation of precipitated iron-rich sludge. Monitoring for the project is providing data needed to evaluate iron loading rates and the function of the treatment system for possible modifications for long-term performance.

Maintenance will be performed by Schuylkill Headwaters Association, Inc. (SHA) and Schuylkill Conservation District (SCD) and will include such tasks as monitoring water levels in the treatment system; monthly monitoring of the entire system to determine treatment efficiency, cleaning of any grates collecting debris, flushing of the treatment cell, adjustment of the flow control structures as needed and, general observation for erosion as well as removal of debris and sediment.

SHA has established an endowment fund with the Schuylkill Area Community Foundation for operation, maintenance and replacement issues that occur in the future. In addition, if problems arise with the operation of the Mary D Borehole Discharge AMD Treatment System, SHA will apply for funding to make the necessary repairs and changes.

Final Plans