

Successful Acid Mine Drainage Abatement – Broad Top, PA

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Abstract

Since 1979, forty-two passive Acid Mine Drainage (AMD) treatment systems have been constructed in the Six Mile, Sandy Run and Longs Run watersheds, Broad Top Township, Bedford County, Pennsylvania.

The first AMD treatment system was funded by the Rural Abandoned Mine Program (RAMP) and constructed in 1979. The success of this project and a growing community interest in AMD abatement prompted a watershed study that was completed in 1981. This study identified illegal garbage dumping, sewage and AMD as the major problems in the study area. Broad Top Township has addressed both the garbage and sewage by making garbage disposal affordable to all its residents and by taking ownership of the sewage management practices within the township.

By the mid-1990's, additional RAMP and Bureau of Abandoned Mine Reclamation (BAMR) projects were completed. In 2005, a Watershed Implementation Plan (WIP) was completed for Longs, Sandy and Six Mile Runs. Since then, over \$3.5 million of CWA Section 319 funds and over \$0.5 million of Pa. DEP Growing Greener Grant money has been spent on AMD abatement projects in the watersheds.

All of the systems constructed since 2005 have been designed to treat the high flow discharges for a minimum of 20 years. These AMD discharges vary in quantity and quality from site to site. The design goal of all of the AMD treatment systems is to remove 90% of the metal and acid loads entering the streams. Challenging construction conditions were encountered at most of the treatment sites. A variety of passive treatment technologies have been employed. The technology chosen for each site is tailored for that site based on the chemistry and flow at that particular AMD seep location. In 2014, after construction of 13 AMD treatment systems, Longs Run was delisted in the Pennsylvania Integrated Water Quality Monitoring and Assessment Report (Integrated Report).

History and Projects

Since 1979, 42 passive Acid Mine Drainage (AMD) treatment systems have been constructed in the Six Mile, Sandy Run and Longs Run watersheds, Broad Top Township, Bedford County, Pennsylvania, an area of 48.5 square miles. Funding for these systems came mainly from the Environmental Protection Agency's Section 319 Grants and Pennsylvania Department of Environmental Protection's (PA DEP) Growing Greener Grant program.

The PA DEP issues grants for their Nonpoint Source Management Program through the Growing Greener Plus application process, the four programs covered under Growing Greener Plus, are Growing Greener, 319 Nonpoint Source (NPS), Surface Mining Control and Reclamation Act (SMCRA) Bond Forfeiture, and Abandoned Mine Drainage (AMD) Set-Aside grants. There are a number of program-specific criteria regarding the eligibility of projects focused on AMD remediation: projects to address mining-related issues may be funded from bond forfeiture funds if the site is within a bond forfeiture site, by AMD Set-Aside funds if the project is covered by a Qualified Hydrologic Unit Plan (QHUP) or watershed where a QHUP is being developed; by 319 Nonpoint Source funds if located in areas covered by a 319 Nonpoint Source Watershed Implementation Plan (WIP); and by Growing Greener Watershed Protection funds for a limited number of projects that don't meet the above criteria.

In 1977, under SMCRA, the Rural Abandoned Mine Program (RAMP) was authorized. SMCRA required Abandoned Mine Land Reclamation Funds to be collected through a surcharge placed on each ton of coal mined by either the surface or underground methods. These funds were collected by the Federal Office of Surface Mining. Approximately 50% of the reclamation funds were distributed to the mining states and Tribes with the other 50% being considered the "Secretary's Share". RAMP received approximately 20% of the "Secretary's Share". Funds have not been distributed through the RAMP program since the mid-1990's, and in 2006, SMCRA was amended and the RAMP program was written out of the Act.

In 1979, at an AMD site located near a local church, the first AMD treatment system was constructed in Broad Top Township. This project was constructed using RAMP funding. The high visibility of this project is credited with spurring the interest of the citizens and the township supervisors to explore the recovery of the mine impacted streams in Broad Top Township. Although there was much interest in the success of this AMD treatment project, it took many years for the next AMD treatment project to be constructed.

The growing interest in AMD abatement lead to the development of a watershed study which was completed in 1981. This study was sponsored by the three local conservation districts and relied heavily on community input. The study identified illegal garbage dumping, sewage, and AMD as the major problems in the study area. Unfortunately, it took until the 1990's for the study to gain momentum and concerted efforts to address these problems.

In 1991, a Municipal Solid Waste Landfill began operation in the township and was expanded in 2011. Prior to beginning operation, a Host-Municipality Agreement was signed between the owner of the landfill and Broad Top Township. Under this agreement, the landfill is limited to an average of 700 tons per day with a maximum of 900 tons per day and the landfill is limited as to the type of waste that can be accepted. The Township negotiated numerous clauses into the Agreement that were friendly to the citizens of Broad Top Township. Under the agreement, each landowner is given a \$120 annual property tax credit, free weekly curbside garbage pick-up and free semi-annual bulk item disposal. The landfill operator provides to the Township, free roll-off dumpsters and free disposal of the debris for one demolition project each year. The operator of the landfill also provides an annual donation of \$5,000 to each of the three volunteer fire companies within

the Township. The Township is reimbursed for the hourly wages of their employees during their time on the garbage truck during weekly curbside residential garbage pick-up. The Township receives \$3.50 per ton of waste disposed or a minimum of \$200,000 annually. The negotiated cost per ton is significantly less than the “going rate” for disposal of waste in most Municipal Solid Waste Landfills, but in return, the Township received the concessions mentioned above, as well as stricter environmental requirements than those mandated by the PA DEP. The agreement has virtually eliminated illegal dumping in the watersheds.

In 1995, a Pennsylvania Sewage Facilities Act 537 Plan was completed. Act 537 requires that all Commonwealth municipalities develop and implement comprehensive official plans that provide for the resolution of existing sewage disposal problems, provide for the future sewage disposal needs of new land development, and provide for the future sewage disposal needs of the municipality. These plans address whole municipalities or groups of municipalities working together. Broad Top Township worked cooperatively with Coaldale Borough to develop and implement the plan which included between 800 and 850 homes. The plan included four cluster systems to treat the sewage from approximately 600 homes with the remaining 200+ homes utilizing on-lot systems. Each on-lot system services two to six homes when possible. The unique aspect of Broad Top Township’s plan is that all of the treatment systems, including the on-lot systems, are owned and maintained by Broad Top Township, therefore there are no repair fees charged to the citizens. Each household is charged a monthly maintenance fee of \$20.

This plan has been used as a case study by PA DEP and NANOPDF (an online information dissemination site) as a demonstration to other municipalities as to how an Act 537 Plan can be developed and followed in an economical and effective manner. USCOE Section 313 Program money and other public funding kept the cost low to the residents. Before the implementation of the plan, 75% of the residents had malfunctioning sewage systems. The implementation of this plan has eliminated the nitrate and bacteriological problems in the streams.

After the success of the RAMP project in 1979, three Bureau of Abandoned Mine Reclamation (BAMR) projects were constructed in the upper reaches of Sandy Run. These projects were completed in the mid-1990’s. In 2001, Broad Top Township completed an assessment and remediation plan followed by a Watershed Implementation Plan (WIP) in 2005. Since the completion of the WIP, over \$3.5 million of CWA Section 319 funds and over \$0.5 million of Growing Greener Grant money has been acquired and spent by Broad Top Township in the three watersheds within the township boundaries.

All of the systems constructed since 2005 have been designed to treat the high flow discharges for a minimum of 20 years. These discharges vary from site to site with measured flow rates varying from a low of 3 gallons per minute (gpm) to a high of 300 gpm. The quality of the AMD also varies from site to site, with some sites having dissolved iron concentrations so low as to be non-detectable using standard laboratory equipment, while other sites have concentrations as high as 83.4 mg/l, dissolved aluminum concentrations are in the range between 0.1 mg/l and 33.7 mg/l. Acidity varies from a low of 7.6 mg/l (measured as CaCO₃) to a high of 445.0 mg/l. The design goal of each of the AMD treatment systems is to remove 90% of the metal and acid loads entering the streams.

Construction of these projects often present challenges due to constraints caused by the topography of the construction area and/or the proximity of the AMD seep to the stream channel. Most of the projects had to be “squeezed” into spaces between steep hill sides and flood plain boundaries. Occasionally, the seeps required piping or ditching the AMD hundreds of feet from the source to an area suitable for the construction of an adequately sized system that would be capable of accomplishing the goal of 90% contaminant reduction.

A variety of passive treatment technologies have been employed in the three watersheds. The technology chosen for each site is tailored for that site based on the chemistry and flow at that particular AMD seep location. The list of technologies utilized include: limestone channels, low pH iron removal channels, vertical flow limestone ponds, flushable limestone leach beds, aerobic and anaerobic wetlands, oxidation channels, automatic flushing devices (siphons and motor driven valves) and sediment removal basins.

Longs Run

Thirteen (13) AMD treatment systems were installed in Longs Run, a 5.25-mile tributary to Sandy Run. Periodic studies were conducted by PA DEP and in 2007 the first fish were documented in Longs Run. In 2014, based on data collected by PA DEP, Longs Run was delisted in the Pennsylvania Integrated Water Quality Monitoring and Assessment Report (Integrated Report). The Integrated Report is a comprehensive report of the water quality status of surface waters of the Commonwealth of Pennsylvania. The Integrated Report is comprised of the results of assessments for four protected uses of surface waters, recreation, fish consumption, water supply and aquatic life. Longs Run’s protected use is aquatic life, which is defined as maintaining the flora and fauna indigenous to aquatic habitats. Longs Run was delisted with a Freestone Index of Biological Integrity (IBI) score of 78.3. Generally, any IBI score over 60 is considered to have attained cold water fisheries status.

Sandy Run

The Sandy Run watershed drains a significantly impaired portion of abandoned mine lands located in Broad Top Township in Bedford County, Pennsylvania. The main stem of the stream flows approximately 5.25 miles from its headwaters to its mouth near the town of Hopewell, where it enters the Raystown Branch of the Juniata River. Coal mining played a significant role in the industrial development of the region, and many surface and underground mines were operated in the watershed early in the 20th century. Those mines are now abandoned, many are flooded and discharging into Sandy Run, and a few left spoil piles adjacent to the stream contributing to the contamination of Sandy Run and its tributaries. These abandoned mine land features are significant sources of water pollution within the Sandy Run Watershed. Sandy Run is listed as impaired for both pH and metals on the Integrated Report with a Total Maximum Daily Load (TMDL) established for the watershed as part of the Sandy Run Watershed TMDL.

Nine (9) AMD treatment projects have been completed in the main stem of Sandy Run. Another project is currently under design and will go to construction as soon as permits are acquired. Currently there are no other plans for future construction in Sandy Run, although known AMD sources apparently are having severe impacts on the chemistry of the stream. An unnamed tributary flows into Sandy Run near the discharge point of the newest and most downstream AMD treatment system in Sandy Run. This small tributary is severely impacted by AMD.

The three most upstream projects were constructed by and are the responsibility of BAMR. Based on an assessment conducted in the spring and fall of 2019, the three BAMR projects are all in need of maintenance. The project located highest in the watershed has breached and most of the AMD that the system is designed to treat, is flowing directly into Sandy Run, by-passing the AMD treatment system almost entirely. Of course, the location of this input, has a negative impact on the entirety of Sandy Run.

The other two BAMR projects are not very effective in treating their AMD discharges. One of the sites discharges into the other and the final discharge from that system discharges treated AMD at a pH of 6.2 during low flow and 4.4 during high flow.

The next five treatment systems in Sandy Run, have discharge pH's over 7.0, which is an increase of 4.0 or more at each site. The poorest performing of Broad Top Township's systems in Sandy Run is the last project completed in Sandy Run. It was noted that the new system was not being operated as per design, and was discharging at a pH of 6.55, an increase of over 3.0 standard units. After discussing the proper operation of the system with Broad Top Township staff, the discharge is expected to exceed the numbers measured during the fall 2019 sample collection.

The impacts from the upstream most discharges are seen in the water quality analysis and the biological assessment of Sandy Run to its confluence with the Raystown Branch of the Juniata River. Additionally, the upper reaches of Sandy Run are also highly impacted from sediment. These sediments will not be qualified by the chemical samples collected during the spring and fall of 2019, but the impairment will limit the macroinvertebrate community. The biological assessment of Sandy Run, conducted by Trout Unlimited (TU), shows the results of not only the sediment impairment but also the chemical impairment caused by poorly treated AMD discharges in the upper reaches of the stream. TU's analysis of Sandy Run conclude the benthic macroinvertebrate community and the fish community was found to be impaired due to several potential stressors. TU identified those stressors as AMD impacts, non-point source pollution, and landfill impacts.

Abatement of the impacts of the unnamed tributary and revitalization of the three BAMR systems will remediate the chemical impairments in Sandy Run. An assessment of the sediment and erosion control system at the landfill may identify the source of the high sediment load in Sandy Run which would be the first step in correcting the siltation problem.

Six Mile Run

Twenty (20) AMD treatment systems have been installed in Six Mile Run. The main stem of the stream flows 6.16 miles from its headwaters to its mouth near the town of Defiance, where it enters

the Raystown Branch of the Juniata River. Six Mile Run is listed as impaired for both pH and metals on PA DEP's Integrated List with a Total Maximum Daily Load (TMDL) established for the watershed as part of the Six Mile Run Watershed TMDL.

A study conducted by Skelly and Loy, in the spring and fall of 2017, showed all systems were discharging treated water that had a pH of 6.0 or greater with most discharging treated AMD greater than 6.5 pH. One exception was a system that is located in the bottom portion of the stream as it was discharging treated AMD with a pH of 5.1 during the high flow sampling run conducted in March of 2017. The flow into that system on that date was approximately 50% greater than the system's design flow. More data is needed to determine if the flow on that date was an anomaly or if the data collected prior to design was insufficient and did not provide adequate information to design a system capable of treating the AMD.

The study conducted in 2017 indicated that the chemistry of Six Mile Run is not negatively impacted by any of the discharges from the constructed treatment systems. The pH of Six Mile Run was maintained between 6.0 and 7.3 from the headwaters to below the last constructed system. These data indicate that the constructed AMD treatment systems are accomplishing the goal set forth in the Watershed Implementation Plan developed in 2005.

Preliminary plans have been discussed to address the final AMD in the watershed. This discharge is the lowest in Six Mile Run, approximately 300 meters below the last constructed treatment system. Chemical analysis conducted by Broad Top Township and PA DEP indicate that the chemistry of the main stem of Six Mile Run from below the last treatment system to the mouth is adequate to support fish life, and therefore funding for an additional project may be difficult to secure.

The biological assessment of Six Mile Run, conducted by Trout Unlimited (TU) at the same times as the chemical assessment of the stream and treatment systems, indicate improvements throughout the stream but also indicate that biological impairment still exist. Moderate populations of brown trout were located at several locations along the stream, but no brook trout were found at any of TU's test sites. Young of the year brown trout were found at a few of the test sites, indicating the possibility that breeding may be taking place in Six Mile Run.

Benthic measurements were taken at thirteen sites along the main stem of Six Mile Run. Six metrics were used to determine if the stream met the Aquatic Life Use (ALU) threshold for coldwater fishes, warmwater fishes, and trout stocked fishes. At three of the sites, the ALU was met and at two other sites the ALU was very close to the threshold and TU determined that those sites warranted further evaluation. At the remaining sites, the ALU was not met, nor was it close to the threshold.

Biologic analysis indicated a problem in the area of the system that was found to be discharging treated AMD at a pH below 6.0. The short biological and chemical study and the data collected indicate that the system may be performing below expectations throughout much of the year. This system will be evaluated further in the future to determine if modifications can be made to improve its effectiveness.

In conclusion, much work has been completed in the watersheds within Broad Top Township, but studies indicate that more work is needed if the streams are ever going to approach the condition that existed prior to mining impacts in the watersheds. The studies, especially the studies conducted by TU, direct us to the areas in each stream that are in the most need of attention. Broad Top Township has recently been awarded a grant to fund maintenance on the existing systems. Any maintenance work completed on the existing systems should improve the function of those systems which will improve conditions in the streams allowing for a more robust biologic recovery within the waters of Broad Top Township.