AN UPDATE ON THE CHEAT RIVER RESTORATION[1]

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Abstract. Extensive coal mining in the Cheat watershed that started in the early 20th century has left many streams and parts of the river severely degraded by acid mine drainage. Very little water treatment was conducted until 1977, when the Surface Mining Control and Reclamation Act (SMCRA) was enacted to prevent degradation from water quality from existing mines and funds were created to restore the abandoned mine sites. This was accomplished through bonding and a tax on coal tonnage. Since SMCRA, several once-active sites have been forfeited to the state to pay for the remediation from the bonding program and several of these contribute to the overall problem. The AML fund from the coal tax addresses the pre-law or previous to 1977 sites by funding reclamation on sites that have no legally responsible party.

The headwaters that had escaped damage from mining began seeing the effects of acid precipitation in the late 20th century from Midwest coal fired power plants and many streams lost all alkalinity because of poorly buffered soils. Poor water quality from these streams contributed to the degradation of the river. Because of these activities, much of the lower 25 miles of the watershed were without significant aquatic life by the early 1980s. Reclamation started in the watershed in the early 1980s and many projects have been completed. Not all of the projects addressed AMD; however, water quality has steadily improved over this period and some stream segments have shown significant increases in aquatic life in the past few years. This watershed has been the focus of state and federal agencies, watershed and conservation groups, and efforts are ongoing to further improve the water quality. The Cheat hosts a multitude of recreational activities and this makes continued restoration a high priority.

Additional Key Words: watershed, conservation, water quality.

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[1] Paper was presented at the 2004 National Meeting of the American Society of Mining and Reclamation and The 25th West Virginia Surface Mine Drainage Task Force, April 18-24, 2004. Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

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Proceedings America Society of Mining and Reclamation, 2004 pp 1894-1905
DOI: 10.21000/JASMR04011894

https://doi.org/10.21000/JASMR04011894

Introduction

The Cheat River Watershed covers 1420 square miles and was a free flowing river for all of the 157 mile length until a power dam was built just 3 miles from the mouth in the 1920s to create Cheat Lake. Maps showing the Cheat Watershed location in West Virginia and the major tributaries are shown in Fig. 1 and 2. The headwaters drain some of West Virginia's tallest and most scenic mountains, and historically the river had excellent water quality and an abundance of aquatic life throughout its length. Visitors to the Lower Cheat are both surprised and disappointed by the degradation to the streams caused by acid mine drainage (AMD).

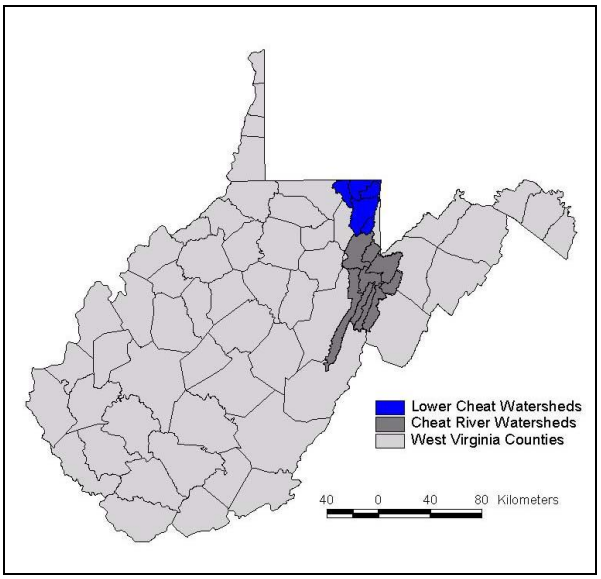

Fig. 1. Cheat Watershed in location in West Virginia. The blue area is heavily mined.

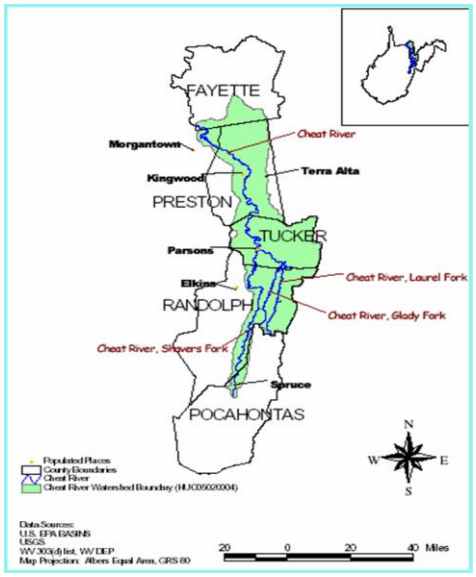

Fig. 2. Cheat Watershed showing major tributaries.

At least 5 watershed groups are active in the watershed and the Friends of the Cheat are actively working to solve the AMD problem in the lower section of the river. Since their organization in 1995, the Friends of the Cheat have organized the River of Promise, a coalition that includes local, state and federal agencies, industry, West Virginia University researchers and conservation groups, that meet and work together to eliminate AMD. This ongoing effort has proved to be effective and is a good model for addressing problems of this magnitude.

A Historic Look at the Cheat

The Cheat was relatively undisturbed by man until late in the 19th century, due to heavily forested and steep terrain, which made roads and settlements in the watershed nearly nonexistent. The Native Americans used the area mainly as a hunting ground and their settlements, if any, would have been temporary. The rivers and streams ran wild, cold and clean and the upper reaches of the Cheat were heavily populated with aquatic life including Native Brook Trout in all streams. The lower Cheat would have had a wider variety of river fish and other aquatic life since it was linked to the Monongahela River. P. Pendleton Kennedy wrote in his Chronicles of the Blackwater in 1851, that Brook Trout were so abundant you could catch hundreds in a short time. He also noted the forest canopy was so dense in places you could not read a map in the daytime. These conditions lasted until the timber industry moved into the watershed in the late 1800s.

Industrialization and the Cheat Watershed

The development of the eastern United States and the Industrial Revolution took a heavy toll on the Cheat watershed. The sawmill and tannery towns were set up in many areas in the late 1800s and these operations denuded the hills by clear cutting all the timber.

A fish kill on the Cheat as far downstream as Rowlesburg in the 1930's was documented in newspapers of the day and was a result of a spill at a tannery in Parsons. By early in the 20th century, very little timber was left in the watershed and most of the mills were gone. Many scars from the timbering days are still evident today, particularly in areas where cable skidders cut deep ruts on the slopes. The loss of all vegetation resulted in major fires and floods along with heavy siltation into the streams and nutrient loss from the soils. Record flooding as far downstream as Pittsburgh resulted in a call for legislative action and the Weeks Law of 1911 started the creation of the Monongahela National Forest to control timber harvest in the mountains.

After the timber was taken to build the major eastern cities, to make paper, or to supply tanneries, it was then the mining of coal that, primarily in the lower end of the Cheat, fed the industrial needs of two world wars followed by the manufacturing growth of the 50s, 60s, and

70s. AMD from all this mining went unchecked until the SMCRA mining laws of 1977 were enacted and mines were required to treat acidic water before discharging into streams. The Cheat watershed, for its contribution to these national efforts, was left with the legacy of many streams without any aquatic life and the mainstem seriously degraded for the last 20 miles and somewhat degraded for about 40 miles.

The first upstream source of AMD into the Cheat is from Beaver Creek into the Blackwater River at Davis, WV. The acidic water from Beaver Creek rendered the famous Blackwater Falls and Canyon section unfit for aquatic life and a major trout fishery was lost in the 1950s. Pendleton Run of Blackwater and the North Fork of Blackwater were also contributors to the lower Blackwater's demise. The problems from the Blackwater caused some degradation of the mainstem Cheat from Parsons downstream to below Rowlesburg.

Between Rowlesburg and Kingwood, streams such as Pringle Run, Lick Run, Heather Run, and Morgan Run all dump their plumes of acidic water and metals into the Cheat and deal a deathblow to most aquatic life. Lick Run alone contributes roughly 18 percent of the total acid load into the Cheat. An example of AMD sources in Lick Run is pictured in Fig. 3. The effect of Lick Run AMD to the Cheat River is illustrated in Fig. 4.

Fig. 3. Open portal with AMD pouring into Lick Run of the Cheat.

Fig. 4. Plume of AMD and metals from Lick Run into Cheat River.

Downstream of Kingwood, the streams of Greens Run and Muddy Creek enter from opposing sides at the entrance to the Cheat Canyon. Muddy Creek is the largest contributor to the acid load in the river at roughly 45 percent of total acidity and metals. A major blowout at the closed T&T mine resulted in forfeiture of the required bonding by the owner and the responsibility for clean-up and treatment became West Virginia Division of Environmental Protection (WVDEP). The thousands of gallons of highly acidic water resulted in a major increase in the acid load into Muddy Creek. This event inspired the formation of the Friends of the Cheat, *a stakeholder organization with the mission to preserve, restore and promote the outstanding natural qualities of the Cheat River watershed.* This major slug of acid into the river caused the loss of boaters into the canyon and hurt the local economy. In addition to the T&T site, there are other forfeited sites affecting Muddy Creek.

Bull Run enters the lower Cheat Canyon section and is virtually dead from AMD as the result of extensive abandoned and forfeited sites on its tributaries.

The other major sub-watershed affected by AMD is the Big Sandy. The Big Sandy also enters the Cheat in the canyon. It is affected by Sovern Run, with several AMD generating sites, and Little Sandy, which has been seriously degraded by over 50 mining operations within its small watershed of 33,000 acres. The River of Promise early on determined the Big Sandy as "low hanging fruit" in the effort to restore a fishery.

The problem of acid precipitation (commonly called acid rain) became evident during the last half of the 20th century and it has affected many Cheat headwater streams. The problem is the result of large coal fired power generating stations, mainly in the Ohio Valley, where the prevailing winds carry the contaminants to the headwaters of the Cheat Watershed. The geology of much of Shavers Fork and other areas contained very little buffering capacity to counteract the acid rain that occurred due to the pollution from coal-fired power plants. Native Trout were lost from some streams as early as 1960 and by 1980 as many as 20 or more streams were without any significant aquatic life. Because most buffering is gone from the soils in many areas, more streams continue to turn acidic each year.

Another issue that affected productivity in the river occurred when a power generating plant was built on the Cheat at Albright, WV in the early 1950s. The cooling of the generators with river water caused thermal problems beyond the tolerance of most fish below the facility in the warm months of summer.

Major Clean up Efforts

Since 1977 over 50 sites have been reclaimed in the Cheat Watershed, mostly by the WVDEP. However, AMD remediation was done sparingly after the mining and reclamation law was passed because reclamation of health and safety problems were higher priorities. The grading and covering of old spoil and closing of mine portals was somewhat beneficial to water quality, as was the natural vegetation of old sites, but significant water quality improvement did not occur until the late 1980s.

The first AMD remediation by the WVDEP in the Cheat was the Webster Refuse on Little Sandy, where an Anoxic Limestone Drain (ALD) was installed in 1988. Another major AMD project was on Cherry Run of Little Sandy in 1996 where an ALD and settling ponds for metals was installed. These two projects have contributed greatly to the recovery of Little Sandy and Big Sandy Creeks. The Cherry Run SAPS is shown in Fig. 5.

Friends of the Cheat are also working on AMD remediation. They have been instrumental in organizing the River of Promise (ROP), a group of state and federal agencies, industry, researchers, academia and conservation groups. The ROP plans projects in the watershed, shares data and research work on existing remediation, and attempts to unify the remediation efforts of different agencies in the watershed. The group's decision to focus on the Big Sandy watershed has helped with this sub-watershed's recovery.

Friends of the Cheat have completed two passive systems on Little Sandy of Big Sandy watershed. These projects were funded through the Environmental Protection Agency (EPA) and the Office of Surface Mining (OSM) Clean Stream Initiative grants. These projects were limestone leach bed and channels at the head of Beaver Creek and another using limestone check dams backed with steel slag at McCarty Highwall on lower Beaver Creek. A picture of the McCarty project is shown in Fig. 6. Improvements to Little Sandy have been significant as represented in Table 1. Approximately 20 miles of streams have been restored in the Little Sandy Watershed.

Fig. 5. Settling ponds and wetlands after an ALD on Little Sandy Creek.

Fig. 6. Limestone and steel slag dam on Beaver Creek of Little Sandy Creek.

Table 1. Water quality and aquatic life in Little Sandy Creek

pH near the mouth	1982 - 4.41	2002 - 6.6
Fish survey near mouth	1989 - no fish	2001 - 14 species

The other major success story is the Blackwater River where a drum liming station was installed in 1994 to treat all the AMD coming from Beaver Creek. This joint project by the (WVDEP) and West Virginia Division of Natural Resources (DNR) restored a trout fishery to the famous Blackwater Falls and Canyon section of the river. This project is funded by 10% of the AML funds paid to West Virginia that are set aside for treatment of AMD. There has also been remediation work done on the North Fork of the Blackwater that contributed to the reduced acid load. Other AMD reclamation sites in the watershed have reduced acid load in the river, but have not restored sub-watersheds. The overall population of fish in the Blackwater before and after the liming station can be seen in Table 2. The drum liming station has restored a major fishery to approximately 7 miles of the Blackwater River and significantly improved 6 additional miles. A picture of the limestone drum station is shown in figure 7. Helicopter trout stocking in the famous Blackwater Canyon is shown in Fig. 8.

Fig. 7. Drum liming station on Blackwater River.

Fig. 8. Stocking trout from a helicopter in restored Blackwater Canyon.

Table 2. Fish population in Blackwater Canyon

Total fish	1994	15 lbs per acre	1999	42.3 lbs per acre

Improvement in the water quality of the headwater streams has been accomplished by dumping high grade limestone sand directly into the streams on an annual basis. This method has shown very good results in overcoming the effects of acid precipitation and many Native Brook Trout Streams have been restored to high quality streams capable of supporting a variety of aquatic life. Most of the limestone additions have been done by the WV Division of Natural Resources (DNR). Trout Unlimited has also contributed to this effort. The Cheat mainstem at Seven Islands, below the Blackwater reclamation and the lime additions to the headwater streams, continues to improve and fish populations have steadily risen as shown in Table 3. Populations of Smallmouth Bass are severely reduced downstream where AMD impacted streams enter the Cheat as shown in Table 4. No historical data is available for the lower survey stations of the river. The Cheat mainstem has been restored for approximately 18 miles as a result of the Blackwater liming station and the additions of lime to the headwater streams.

Table 3. Cheat mainstem fish population data at Seven Islands

Year	1959	1973	1980	1999
lbs per acre	60	27	21	58
#SM bass per acre	166	34	57	289

Table 4. Cheat Smallmouth Bass populations at four stations in 1999

Seven Islands	above Pringle Run	below Morgan Run	Albright WV
289	115	42	12

The Cheat River Watershed Today

The Cheat is a river of great beginnings, draining such places as Snowshoe Mountain at the head of Shavers Fork, the longest of all its forks. The Gandy Creek/Dryfork river system drains from the Sinks of Gandy and much of Spruce Knob recreation area, as well as the western part of the Dolly Sods Wilderness Area. Canaan Valley is the head of the famous Blackwater River and now is home to WV's second National Wildlife Refuge. Other important headwater forks are Glady Fork and Laurel Fork, which are also surrounded by Wilderness Areas. Most of the headwaters begin near 4,000 feet elevation or above and are high gradient streams as they tumble to their confluence with the mainstem. All headwater streams are mostly within the Monongahela National Forest. Major restoration work was performed by the Civilian Conservation Corps from 1933 until 1944.

After the forks come together to form the Cheat mainstem at Parsons, a wide valley forms as the river slows and runs through open country for several miles. Below Rowlesburg the Cheat picks up gradient through the Narrows section and becomes a fast turbulent river and remains this way for most of its length until it enters into Cheat Lake where it is dammed for hydropower.

The Cheat is located within one day's drive of sixty percent of the nation's population and therefore serves as an important recreation center for many people. All of the headwater areas are important recreation areas for nature lovers who enjoy skiing, hiking, camping, trout fishing and spelunking. The lower Cheat also has its admirers, as fishing is still popular on some parts of the river, and whitewater boaters and rafters paddle the plentiful rapids in the lower 25 miles.

There are seven National Forest Recreation Areas and three West Virginia State Parks within the Cheat Watershed.

Cheat AMD Today

WVDEP lists 53 streams in the Cheat Watershed that are impaired by AMD and many of these streams have 2, 3 or even more AMD sites. Included are as many as 73 miles of trout streams and many of these AMD sources dump directly into good quality stream segments. Overall the local economy is being seriously affected by the AMD in the Cheat. The WVDNR considers every mile of trout stream to be worth $40,000 per mile per year, which has quite an economic impact in this area. Warm-water fisheries throughout the watershed are similarly affected.

The AMD water of the Lower Cheat has also had a serious impact on the whitewater industry. According to whitewater industry representatives, nearly 80% reduction in users has been realized on the Cheat since the T&T blowout. A vast majority of users say that AMD is a serious problem in the Cheat Canyon section. This is a multimillion dollar hit on the whitewater outfitters and some have closed shop. Although improvements have been made over the years, much more is needed to restore the boating industry to the lower Cheat.

Another legacy of the coal industry is the loss of ground water quality and quantity. Many communities in the lower Cheat Watershed suffer tainted water from springs and wells. Citizens haul drinking water in jugs and make do with stained fixtures and laundry. Property values are diminished due to lack of good water. Many public water lines have been constructed to alleviate this and many more are needed. These projects are also funded by the AML fund from the coal tax.

In total, the estimates of the economic losses from boating, fishing and other outdoor recreation are very significant and local communities would benefit greatly from a totally restored watershed.

Ongoing Restoration in the Cheat

At this time WVDEP, Office of Surface Mining (OSM), the US Army Corps of Engineers (USACOE) and the Friends of the Cheat are active in reclamation of AMD sites and approximately 10 sites are in some stage of reclamation. The Special Reclamation Division of DEP is working on approximately 40 forfeited mine sites over the next 4 years. These Special Reclamation sites may make up to about 20% of the acid load of the Cheat, and because the water leaving these sites will meet water quality standards, it should show significant positive results on the receiving streams and the river. A new project for FOC is a limestone leach bed and channels, on the North Fork of Greens Run and is shown in Fig. 9. A Special Reclamation project using active Aquafix® technology with settling and finishing ponds, on a forfeited mine site on Morgan Run of the Cheat is shown in Fig. 10.

Fig. 9. Limestone leachbed on Greens Run.

Fig. 10. Aquafix active treatment and settling Ponds on Morgan Run.

The USACOE plans on expanding its AMD efforts in the Cheat over the next few years, and the DEP is planning a treatment system for the T&T site along with continued reclamation of existing abandoned sites. FOC will continue to focus on small acid sources where remediation may restore aquatic life to a stream segment. In addition, FOC's role in River of Promise (ROP) is to attempt to unify the efforts of these agencies and funding sources and seek innovative ways to attract new investment into improving water quality in the watershed.

A clean Cheat River may be several years away, but the results of work on the Blackwater and Little Sandy of Big Sandy give us hope that more streams can be restored in the near future.

The economic and quality of life benefits from such restoration should provide the incentive needed to accelerate the schedule.