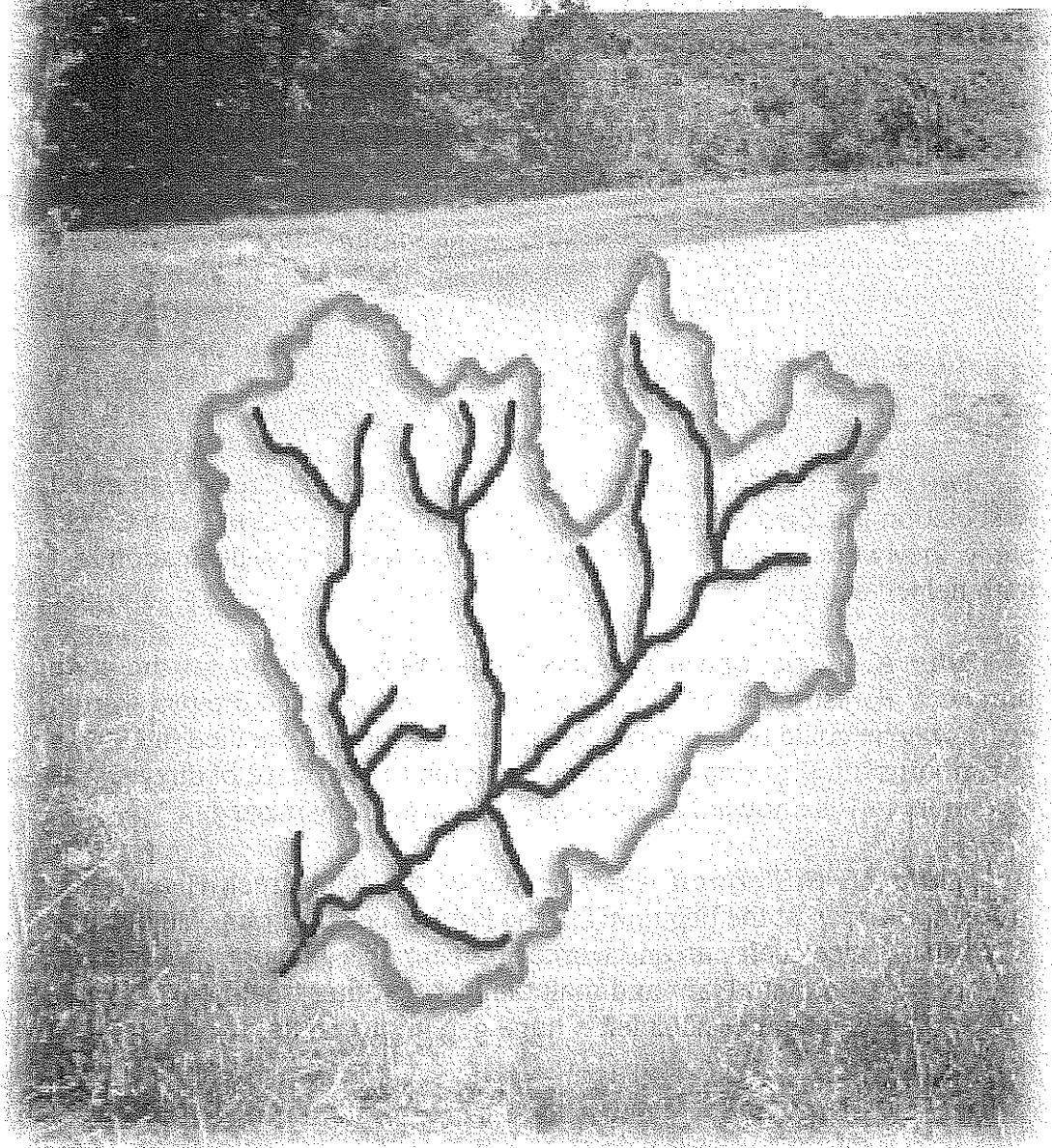


Restored!

*A History of the
Reclamation of the Babb
Creek Watershed from Acid
Mine Drainage Pollution*

by James P. Barr



Charitable Foundations:

Howard Heinz Endowments
— Western Watershed Protection Program
Charles Lindburgh Foundation

Nonprofit Organizations:

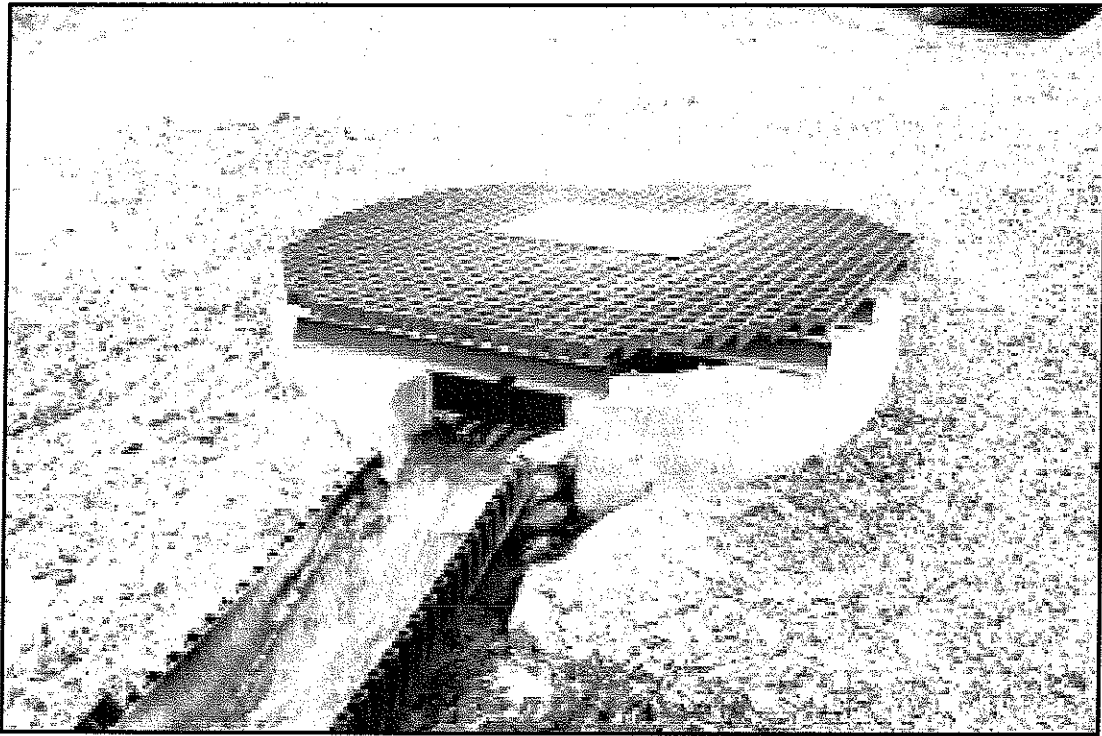
Pa. Environmental Defense Foundation
Pennsylvania Trout
— Doc Fritchie (Dauphin County) Chapter
— Susquehanna Chapter
Pine Creek Headwaters Protection Group
Pine Creek Preservation Association
Slate Run Sportsmen
Arnot Sportsmen

Contractors:

Signor Brothers Enterprises
Gannett Fleming Inc.
Brinjac Engineering
Hedon Environmental
VAPCO Engineering
Roslund Construction
Lewis Welding and Excavating
Schmouder Construction
Jim Ellingham, Electrical Contractor
E. M. Brown Inc.

Individuals:

Too numerous to mention



Lick Creek diversion wells, built in 1990-91

Restored!

A History of the Reclamation of Babb Creek

1 The Beginning

Giant oaks from little acorns grow, the saying goes. The reclamation of Babb Creek began much the same way — with the acorn of an idea in the heart of one man. From that idea, fertilized by a deep love of the central Pennsylvania mountains and watered by a dogged determination to try to save some of our natural resources, grew into an achievement without precedent in this state: the return to life of a significant stream that had been killed by the unthinking actions of previous generations.

In 1989, Robert W. McCullough Jr. of Williamsport was a member of the Pennsylvania Environmental Defense Foundation board of directors. The defense foundation's mission was to bring legal actions against polluters under state and federal laws to force them to quit polluting and to clean up the damage they had done. The group was just the kind of place for McCullough, a retired environmental planner.

In the 1930s, he was an officer in the Harrisburg Hunters and Anglers Club, a fledgling group trying to restore shad and other fishes to the Susquehanna River. In the late 1960s, he help found Pennsylvania Trout, the state council of Trout Unlimited. Later he served as a national director of TU, as a director, environmental chairman and eventually president of the state council. But the Environmental Defense Foundation was a welcome vehicle for McCullough's combative nature and abiding dislike of polluters.

There was no place on earth that McCullough liked better than the Pine Creek Valley of Lycoming and Tioga counties. In spring, he loved to fly-fish Pine Creek's big, wide waters for stocked trout, and when the big creek warmed in summer, he fished the major tributaries at night for the trophy brown trout. Pine Creek's spring mayfly hatches were almost legendary. McCullough knew their progressions by heart almost to the day that each species would appear, and the trout that sought to feed within the range of his fly line when a hatch was on seldom rose twice without feeling the bite of his hook.



Red Run Diversion Well

Then in the late 1970s and early 1980s, the mayfly hatches on the Lycoming County section of the creek gradually diminished steadily. Hatches that once were abundant fell to a few scattered emergences. Some, such as the brown and green drakes, virtually disappeared. That made Bob McCullough sad because it spoiled his fishing, and it made him angry because he was sure that man-made pollution was the cause.

In 1989, with the aid of the Environmental Defense Foundation, McCullough took legal actions against the upstream towns of Wellsboro and Galeton, where the sewage treatment systems were malfunctioning. He also took aim at the Antrim Mining Co., a strip-mining operation at the town of Antrim, south of Wellsboro. After some investigation, foundation legal counsel John E. Childe Jr. filed a complaint in McCullough's name in federal district court in Williamsport, accusing Antrim Mining of increasing acid mine drainage in Babb Creek by breaking into deep mines underlying its stripping operations. Antrim's activities appeared to coincide with the decline of mayflies on lower Pine Creek.

Babb Creek is a major tributary of Pine Creek, entering the main stream at the town of Blackwell, which is the downstream end of the gorge known as the Pennsylvania Grand Canyon. Under normal conditions, Babb Creek provides about 13 percent of Pine Creek's flow.

Underground mining for bituminous coal began the headwaters of Babb Creek before the Civil War and continued through World War II. Several coal seams underlay the watershed and at least six major mine complexes were dug within the watershed and then abandoned. Some surface mining was done, as well. Antrim Mining had the last active mine of any kind in the watershed.

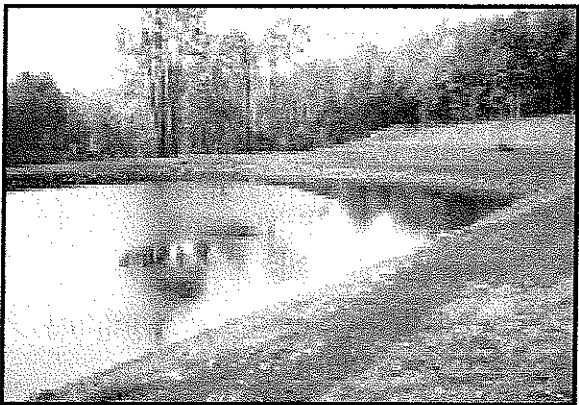
At the end of 1989, Antrim Mining and the Environmental Defense Foundation agreed to settle the federal lawsuit. Antrim agreed to quit mining, reclaim its mine site and contribute money from the Phoenix Resources Landfill that it operated on part of the mined land to a trust fund that would be used to pay for projects to reclaim Babb Creek. The agreement was made into an order of the federal court, under the signature of Judge Malcolm Muir on Jan. 15, 1990.

Antrim made an initial payment of \$25,000 into an account controlled by the Environmental Defense Foundation, which appointed McCullough and another director, James P. Barr of Muncy, to oversee it and plan projects. Subsequently, it would pay 25 cents per ton for each ton of waste dumped at the landfill. Over time the payments could total more than \$4 million, based on the approved capacity of the landfill.

That is when the reclamation of Babb Creek began.

2 The First Diversion Wells

Uncertain where to start, McCullough and Barr contacted Joseph Schueck, a mine inspector in the state Department of Environmental



Arnot #2 Successive Alkalinity-Producing System

Resources who knew about some emerging technologies for acid mine drainage abatement. Informed of the funding available through the trust fund, Schueck and colleague Michael W. Smith took it upon themselves to research the mining history and known conditions of the Babb Creek watershed to determine what could be done.

Schueck and Smith recruited several experts, including Dr. Dean E. Arnold, an assistant professor at Penn State University and an aquatic ecologist for the U.S. Fish and Wildlife Service's Pennsylvania Cooperative Research Unit at the university.

An initial meeting to discuss potential projects in the Babb Creek

watershed was held at Morris in early May 1990. Attending the meeting were McCullough and Barr of PEDF; Schueck and Smith of DER; Dr. Dean E. Arnold, an assistant professor at Penn State University and an aquatic ecologist for the U.S. Fish and Wildlife Service's Pennsylvania Cooperative Research Unit at the Penn State University; John K. Sherwood, Tioga District Forester for the state Bureau of Forestry; Paul Swanson and Steve Kepler of the Fish Commission; Dennis Bernhardt and David Brown of the state Game Commission's Northcentral Region; Dr. Robert Ross, an aquatic biologist with Fish and Wildlife's Asaph Fisheries Research and Development Laboratory; and Ronald Comstock of the Pine Creek Headwaters Protection Group, a Wellsboro-based nonprofit environmental organization primarily focused on stopping the then-proposed expansion of Phoenix Resources' residual waste landfill at Antrim.

A consensus was reached that the best initial project would be construction of a limestone diversion well on the Lick Creek headwaters tributary, which received discharges from several abandoned deep mines just south of the town of Arnot. Parties at the meeting agreed to accept specific roles in planning the project, with the goal of constructing one or more diversion wells in early autumn that year.

Dr. Dean Arnold had discovered a technology used in Scandinavia to increase the alkalinity of acidified streams. The system, called a limestone diversion well, involved a large concrete cylinder into which water from the stream was diverted by piping from an upstream dam. The water was directed vertically into the tank through a central pipe, which discharged near the bottom of the well. The chamber was filled with limestone gravel. Hydraulic action churned the gravel, which chipped into tiny fragments that dissolved, neutralizing the acid and raising the alkalinity of the flow. An experimental model built near Harrisburg worked well on a small acid mine drainage discharge.

Schueck and Barr solicited the cooperation of Dauphin County TU and the Pennsylvania National Guard, which had embarked on a program of using public recreation and environmental projects as training exercises for its engineer units. A primary force in this program was Capt. Chris Cleaver, the Guard's public affairs officer and TU member. Dale Schwalm, a civilian Guard employee, also was at the time president of Dauphin TU and coordinated maintenance of the Stony Creek diversion well.

In August 1990, the project planning met again. Joining the growing list of cooperators were Neil Hedrick, Antrim Mining engineer and representative to the Babb Creek Trust Fund Committee; members of the Susquehanna Chapter of Trout Unlimited; the Pine Creek Preservation Association; and Thomas Finkbiner, proprietor of Wolfe's General Store and Slate Run Tackle Shop in Slate Run. Through consensus, it was decided to build two diversion wells next to each other along a tributary called Lick Creek on State Forest Land about two miles south of the village of Arnot.

The Babb Creek Trust Fund would pay for the materials, the National

Guard would bring in heavy equipment to install the wells, the Bureau of Forestry would provide supervision, Schueck and Dr. Arnold would serve as project engineers, and the volunteer groups would provide labor for construction of the dam and pipeline.



Klondike Mine spoil pile before reclamation

In the course of the discussions, Bob McCullough cautioned participants to not be overly optimistic. The upcoming project would not be “the solution” to Babb Creek’s acid mine drainage. “This watershed is like an innertube with 100 holes in it, and we’re just putting a patch on one of those holes,” he said. Reclamation of Babb Creek would take 10 or 15 years or more, even with steady progress, he said.

National Guard personnel, including Capt. Cleaver and Dale Schwalm, began construction on Oct. 8, 1990. Their mission was to install the two six-foot-diameter reinforced concrete cylinders during the work week. On Saturday, Oct. 13, more than 40 volunteers from the cooperating nonprofits, along with state employees of bureaus of Forestry, Mining and Reclamation and Fish Commission converged on the site, intent on completing construction. A rock dam, lined with heavy plastic, was constructed approximately 350 feet upstream from the wells. Twin lines of 8-inch PVC pipe were laid on the ground surface from dam to the wells, spillways were installed to carry water from the wells back into the stream.

Despite the hard and enthusiastic work of all involved — including four



The First Antrim Treatment Plant

One of the biggest steps forward in the reclamation of Babb Creek occurred in 1991. In a negotiated settlement with DER's bureau of Mining and Reclamation, Antrim Mining Co. constructed a large lime dosing system to treat the discharge from the Antrim #1 deep mine at the village of Antrim. The degrading of that discharge had been the cause of the Environmental Defense Foundation's 1989 lawsuit. The system, which went into operation Dec. 31, 1991, treated nearly 50 percent of the acid load flowing down Wilson Creek into Babb Creek.

The treatment had an almost immediate effect on Pine Creek. Within two years after the system began operating, mayfly hatches began increasing markedly in the creek downstream from Blackwell. The company also continued making regular payments into the Babb Creek Trust Fund.

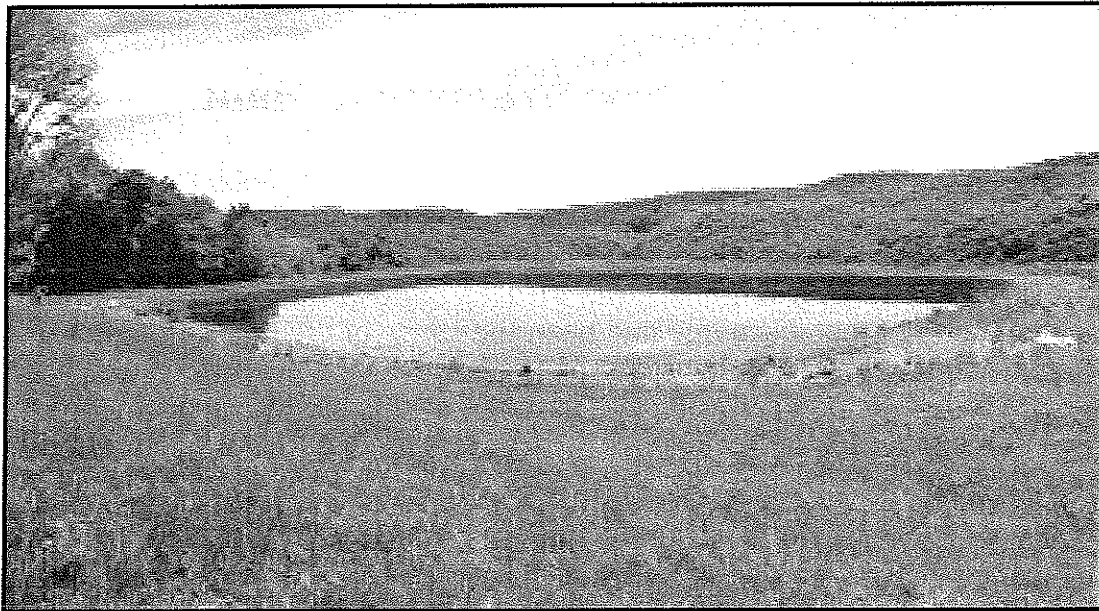
In the summer of 1994, Schueck decided that the next workable project in the watershed would be construction of a small diversion well to treat the Klondike deep mine discharge, which flows into Lick Creek about half a mile below the original diversion wells. Schueck's testing showed that the Klondike discharge, though small, almost completely counteracted the beneficial effects of the original diversion wells on Lick Creek's water chemistry.



*Bob McCullough releases trout in Babb Creek,
June 2000*

Because of the small size of the Klondike discharge, Schueck had to design a downsized diversion well. Rather than using a six-foot-diameter well and eight-inch pipe, he used a four-foot well and four-inch pipe. This system was constructed using DER funds specifically designated to test diversion well technology. It went into operation in July 1994 and has worked almost continuously since.

Another important milestone occurred in 1994. Babb Creek was selected as one of eight watersheds in the state to test a new remediation strategy. The idea behind the "Comprehensive Mine Reclamation Strategy" was to eliminate all sources of acid mine drainage in entire watersheds, rather than spending state and federal funds correcting scattered, individual discharges with no apparent priority or benefit. The program was to be a cooperative effort of the U.S. Bureau of Mines, the Environmental Protection Agency and DER.



Bear Run Vertical Flow Wetland Treatment System

J. Corey Cram, a hydrogeologist with the Bureau of Mining and Reclamation's Hawk Run District Office, was named Babb Creek watershed coordinator under the CMRS program. Cram, one of Dr. Arnold's graduate students, had studied diversion wells for his master's degree thesis.

The Recovery Starts

In April 1995, Tom Finkbiner of Slate Run Tackle Shop, reported sustained, prolific hatches of mayflies on Pine Creek downstream from Blackwell. In May that year, he reported seeing large hatches of Brown and Green Drake mayflies. It was the first Green Drake hatch on lower Pine Creek in at least 15 years, he said. They were back again in 1996.

Cram and Michael Smith, now manager of the Hawk Run District Office, recommended in 1995 that two more wells be constructed on Red Run, another small, acidified tributary of Lick Creek between the original wells and the Klondike. The new wells would treat Red Run's acid load, but more important, they would add more alkalinity to Lick Creek and Babb Creek below it. The wells were constructed in September 1995 with Babb Creek Trust Fund moneys.

With a much greater drop from dam to well, a new nozzle design and a smaller size gravel, these wells chew up limestone at more than twice the rate of the original wells, more than 2,000 pounds each per week. They raised Red Run's pH from about 4.2 to 6.5 or 7.

Meanwhile, additional water analysis was being done by Cram and other Hawk Run District staff. Their testing indicated that the diversion wells had raised the water quality in Babb Creek below Lick Run from the category

of "seriously impacted" to "marginal." Sampling done by Schueck, Arnold and his graduate students found evidence of increasing aquatic invertebrate life in Babb Creek all the way from the Lick Run confluence to the confluence of Wilson Creek, an distance of more than nine miles.

Ed Signor, a member of the Arnot Sportsman's Club who had become a cooperater in the task force, released trout from the club's cooperative nursery into Babb Creek during August 1995, when drought dried up the nursery's water supply. Those trout could still be seen swimming in the stream when the Red Run diversion wells were built two months later.

In December 1995, PEDF working with Mining and Reclamation's Corey Cram, Joe Schueck and Michael Smith put together a grant application for funding under the Comprehensive Mine Reclamation Strategy initiative. The three reclamation experts proposed construction of a combination system, known as a Successive Alkalinity- Producing System (SAPS), to treat the Arnot #2 deep mine discharge in the Lick Creek headwaters about a mile upstream from the original diversion wells. The system, an artificial wetlands combined with an underground anoxic limestone drain, would treat the largest source of acid mine drainage above the diversion wells. It was hope this would allow the wells to add alkalinity to the stream rather than have their limestone used up neutralizing acid.

PEDF and DEP signed a no-bid contract for the Foundation to act as project manager for the SAPS construction. The procedure was used in an effort to save money, compared to the costs of the state contracting out the work itself. DEP committed \$130,000 of the federal-state program funds, the Babb Creek Trust Fund committed \$30,000. Another \$10,000 was requested, and subsequently received, from the Howard Heinz Foundation through its Western Pennsylvania Watershed Improvement Program.

Signor Brothers Contracting began construction in late September 1996 and the system went on line in the last week of December. From the beginning, the SAPS system was extremely successful. It raised the Arnot #2 discharge pH from 3.5 to 7, and sometimes a little higher.

Encouraged by the anecdotal reports of increasing stream life in Babb Creek, the Fish Commission's region supervisor Paul Swanson and Steve Kepler of the agency's Environmental Services Division decided to do a biological survey of the stream above Morris. The survey was conducted on June 18 and 19, 1996. Only minimal, acid-tolerant stream life was found in Babb Creek in a 1990 Fish Commission survey. The 1996 survey found small numbers of minnows at every survey point and increasing numbers of aquatic insects. It was clear the creek was beginning to recover.

In late December 1996, Antrim Mining completed construction of a new treatment system for the Antrim #1 discharge. The system uses gravity flow and lime kiln waste, making it cheaper to operate and, once start-up problems are worked out, more effective than the previous system. The new system should make it much more affordable for Antrim to treat the discharge on a sustained basis.

with the remaining costs being covered by Signors' sale of several thousand tons of coal recovered from the rail grade. The site, nearly half a mile long, was then leveled and planted with grasses and clover, producing a beautiful, green meadow.

— In the summer of 2000, Stott Coal Co. of Ebensburg constructed two large SAPS systems to treat two discharges from the Bear Run mine complex. The work, costing upwards of \$500,000, was done under DEP direction, as compensation for environmental harm done in Stott's mining operations elsewhere in the state. Those discharges were the last remaining on the main stem of Babb Creek upstream of Morris. Bringing them under treatment eliminated acid mine drainage impacts on more than 10 miles of the creek between Arnot and Morris.



Rattler Mine Land reclamation

— With the advent of Pennsylvania's Growing Greener program, BCWA applied for and received two grants during the first grant round in early 2000. It received \$299,000 to pay for a variety of upgrades to the Antrim Treatment Plant and acted as sponsor for the Arnot Sportsmen Club's \$376,000 grant to build a SAPS system on a second discharge from the Arnot #2 mine complex. That discharge drains into a pond that feeds both the Babb Creek headwaters and Johnson Run, a tributary to the Tioga River.

— In the second Growing Greener grant round, BCWA was awarded \$411,000 to pay for the long delayed Rattler Mine project on State Game Lands 269. The project had changed over time. A new technology would be tried — injecting limestone sand into the underground mine tunnels to try to partially treat the acid mine drainage before it reached the surface. SAPS systems then could be used to further raise the pH and precipitate dissolved

metals. Approximately 60 acres of partially reclaimed strip mines and spoil piles associated with the Rattler mines also would be revegetated by applying sewage treatment plant sludge and planting with grasses and trees.

— In the third Growing Greener grant round, BCWA was awarded a \$2.2 million grant to build systems to treat four discharges from the Anna S mine complex, on the mountain west of Route 287 between Morris and Wellsboro. The largest Growing Greener grant ever awarded to that time, it will pay for construction of more than 7 acres of SAPS ponds, sediment basins and constructed wetlands to raise pH and remove dissolved metals from three of the discharges. A set of diversion wells would be constructed to treat the fourth discharge. Together they would form the largest passive AMD treatment complex in the state. They also would treat the last significant AMD sources in the watershed.

BCWA Inc. spent all of 2001, 2002 and 2003 managing the several Growing Greener projects. The Arnot #2 SAPS was completed in June 2001. Work on the treatment plant was finished in June 2003. The reclamation portion of the Rattler Mine Complex project was finished by May 2003, resulting in more than 75 acres of lush new grasslands for wildlife. The limestone sand injection and construction of treatment systems for the discharges continued into October 2003.

Work on some of the treatment cells of the giant Anna S project was nearly completed by December 2003, but bad weather plagued the construction crews from E. M. Brown Inc. of Clearfield and finish work must be completed in the spring, before the Growing Greener contract expires in

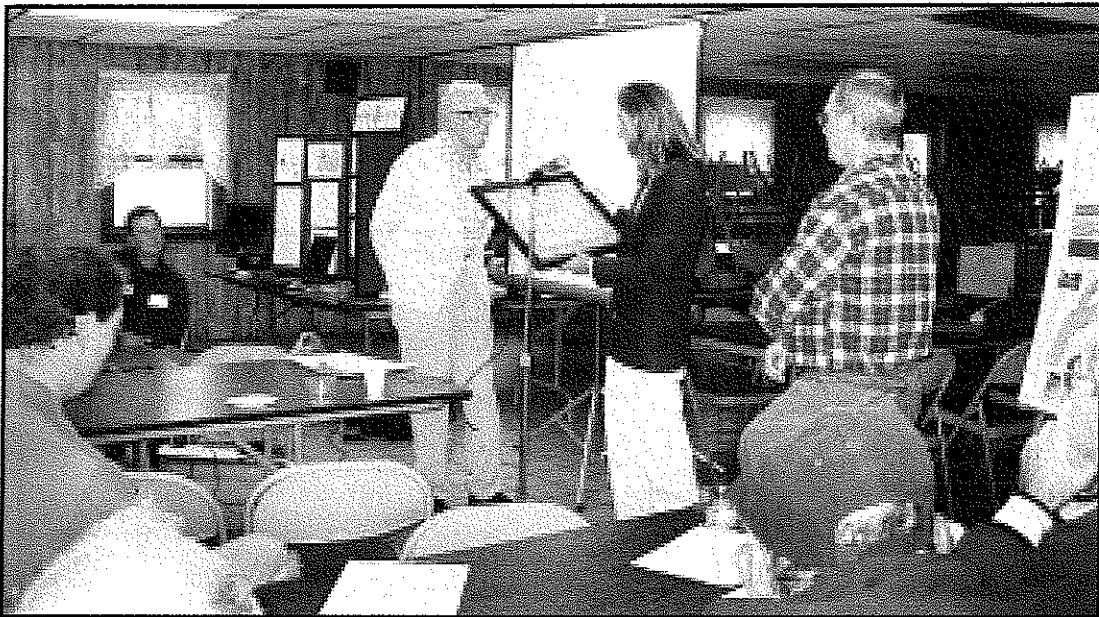


Anna S Mine Treatment System Complex under construction

June. A treatment system for the Mitchell Drift discharge from the Anna S complex also must be built by then.

Although work remains to repair stream banks, reclaim spoil piles and stop sources of erosion and sedimentation, the Anna S project will basically complete the reclamation of Babb Creek. After more than a decade of work and the investment of well over \$10 million from dozens of sources, the program begun so naively and hopefully in early 1990 will have reached its ultimate, seemingly unreachable goal: All acid mine drainage discharges in the watershed will be under treatment, virtually eliminating AMD impacts on Babb Creek and Pine Creek. The challenge afterward will be maintaining the treatment systems to assure they do their jobs for the indefinite future.

In the process, the program inspired hundreds of other citizens to take an interest in reclaiming their local streams and proved that the concept of broad-based, public-private partnerships could achieve real environmental improvements. When it began, Babb Creek was one of just a handful of initiatives, launched by concerned citizens with little more than hopes and dreams. Perceptive state government leaders used those initiatives as models to fashion the Growing Greener program and create a conservation revolution that has yet to see its brightest days.



Bob McCullough presents certificate to DEP Secretary Kathleen McGinty, signifying completion of treatment systems for all acid mine drainage discharges in the Babb Creek Watershed, October 2003.

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