

**Abandoned Mine  
Drainage  
Comprehensive  
Strategy**  
**for the**  
**Turtle Creek Watershed**

**Prepared by the  
Turtle Creek Watershed Association  
April 2006**

# **Abandoned Mine Drainage Comprehensive Strategy for the Turtle Creek Watershed**

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**Section One – History**

***Geologic Background:***

Throughout the Turtle Creek watershed, as in many other areas of Pennsylvania, coal mining was an important part of the economy for decades. As these mines played out, they were abandoned by their owners. During active mining, the ever-present ground water was pumped out. When mining ceased, so did pumping. Water began to collect in the mine tunnels and pits and become polluted. As this water enters the water table or is forced to the land surface, the pollutants go with it, contaminating our water supply.

To fully understand how this pollution occurs, we need to understand its geologic origins. The chart below gives an overview of the times during which most of our coal formed.

<b>Era</b>	<b>Period</b>	<b>Began</b>	<b>Development of</b>
Paleozoic	Devonian	405 million years ago	Seed plants on land
	Mississippian	345 million years ago	Fish
	Pennsylvanian	310 million years ago	Reptiles
	Permian	275 million years ago	Amphibians
Mesozoic	Triassic	225 million years ago	Dinosaurs
	Jurassic	180 million years ago	Birds
	Cretaceous	130 million years ago	Flowering plants

Even before the Devonian Period, large coastal swamps were forming over much of the earth. Plants were plentiful and animals were coming on the scene. As these swamp dwellers grew and died year after year, thick peat layers formed on the swamp floors. As land masses rose and fell, these swamps were submerged and various sediment layers would build up, covering the peat. Pressure and heat from the weight of all these other materials would transform the peat to coal.

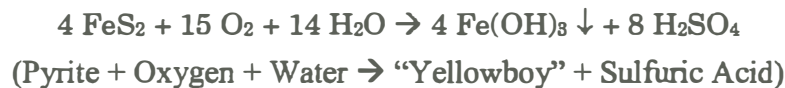
Peat layers that formed early and so were under the most intense pressure became anthracite coal, also known as “hard coal.” Here in Pennsylvania, anthracite deposits are found in the eastern part of the state. The western part of our state sits on top of a large bituminous coal deposit that runs into eastern Ohio, down through West Virginia, Kentucky, Tennessee, and into Alabama. Bituminous coal was under somewhat less pressure than anthracite, and much of it was formed during the Mississippian and Pennsylvanian Periods. Together, these are known as the Carboniferous Period – a time when huge swamps composed of very large plants dominated the coastal regions.

To give an idea of how vast these swamps were and for how long they existed, one foot of coal formed from about six feet of peat. Local coal beds are six to eight feet thick, meaning they came from peat layers more than sixty feet deep.

Even after the Carboniferous Period, coal continued to form. Sub-bituminous coal has been subjected to less pressure than bituminous, so it is a “softer” version. Lignite – a dark brown coal – is softer still.

### ***How Geology Relates to AMD:***

While the peat was forming, sulfur-metabolizing bacteria were at work digesting the sulfur bridges in the proteins of decaying plants and animals. Once free, the sulfur could mix with iron already present to form pyrite – also known as Fool’s Gold for its sparkling flecks. Consequently, we find pyrite layers on top of our coal beds or sandwiched within them. This rock falls into abandoned mines and sits in the water collecting there. When dissolved in this mine water, pyrite’s components of iron and sulfur become the source of the acidity (low pH) that taints our water and the orangish paste (iron hydroxide) that coats our streambeds.



(See Appendix A)

Aluminum is the most plentiful metallic element on earth. In some places, it is found in large bauxite deposits. But in our area, aluminum oxides are simply part of the mix of our soil materials. When acidic water flows through the soil, the oxides are dissolved, and free aluminum ions end up in our streams. When the stream water is of a low or a very high pH, the ions float free. They have no color, so we do not see evidence of them in the water. In this form, aluminum is quite toxic to nearly all living organisms. The result we often see in our smaller streams is long strings of green filamentous algae with no other life present.

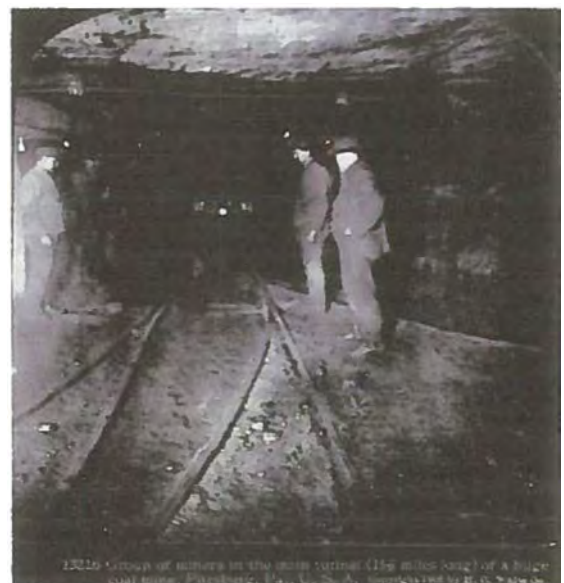
As the pH rises towards neutral, these ions bond with oxygen, once again forming aluminum oxides. This material colors our watershed streams in shades of milky white, green, or blue. Looking at stream water in a cup, tiny bits of the oxide floc are easily seen. In slow moving waters, thin layers of these colored sediments will form on the streambed.

Limestone layers are also found on top of the pyrite. This rock was formed from the shells of countless sea creatures living in the oceans that moved in as the peaty swamps sank. When dissolved, this limestone has a high pH. In abandoned mines where a lot of limestone has fallen, it balances the acidic effects of the sulfur, creating a more neutral pH. Aluminum oxides are less likely to dissolve in the soil. Those that do are more likely to return to the oxide state in the mines and never affect the water table or the surface water.

Other metals present can also dissolve and pollute our water, but fortunately we see less of this in the Turtle Creek watershed than in some surrounding watersheds.

### ***The Local Coal Industry:***

Coal mining historically has been part of the macro and micro economic picture of southwestern Pennsylvania for more than two centuries. Early settlers mined outcrops on Mount Washington on what is today Pittsburgh’s South Side. In the 1800s, larger mines, including many in the Turtle Creek watershed, supplied coal to make coke, a basic steel-making ingredient. Watershed coal was also used to energize industrial turbines, to fuel coal-fired electrical power plants, and to provide heat in thousands of industrial, business, and residential furnaces and stoves.



The mines providing this resource came in all sizes from the larger commercial operations that industry depended upon to the small, backyard mines that one or a few families depended upon. As the demand for coal increased, more people were encouraged to start mining operations. Lack of regulation or oversight meant that extraction was the focus, not safety, not land use, not water contamination, and not any responsibility for the future.

Especially at first, most of these were deep mines using tunnels, then room and pillar extraction methods. Pillars of coal were left in place to help hold up ceilings, and tunnels were somewhat enlarged to become rooms. As the mines played out, the pillars were often removed to maximize production. Some were left in place, especially underneath existing structures. Laws required pillars under buildings, major roadways, and railroads to minimize future subsidence damage on the surface – until 1996 when our state legislature changed the laws to accommodate long wall mining.

While these remaining pillars have afforded support to surface structures, many are crumbling over time. Subsidence – whether from falling mine rooms, failing timbers, compromised pillars, or the lack of pillars – is a recurring problem many places in the watershed.

Gob piles of coal waste products also dot our landscape. These piles may contain inferior coal, coal ash (coal was sometimes burned at the mines as a power supply), sand, clay, rocks, and any other non-usable mining products. Pile materials can be the source of heavy metals that leach out, contaminating ground water and streams. The good news is that some of these piles do contain enough coal to make them useful as fuel at co-generation plants. Those are slowly being trucked away to these plants. Their ash is sometimes returned to the sites, becoming an alkaline cap. Ash can also be mixed with pile material that is not useful as co-gen fuel, but is safe to be used as fill when pH neutralized.



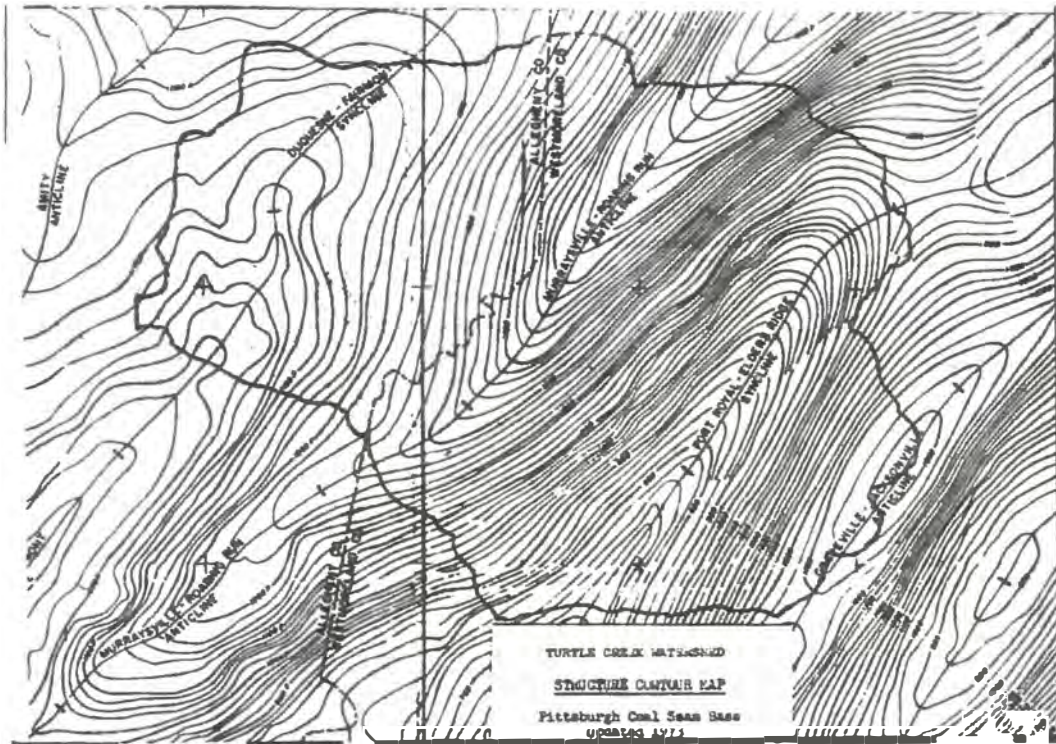
As earth moving equipment became larger, strip mining became more cost-effective, and so more popular, where coal seams were close to the land surface. A variety of sites across the watershed were stripped. As these played out, minimal restoration was required. Consequently, their pits and waste piles blighted sections of the watershed for many years. Many of these sites were filled, then turned into commercial and residential developments. Some of these waste piles are also useful as co-gen fuel. Other pits and piles still exist today, but nature has slowly been reclaiming those.

The federal government passed the Surface Mining Control and Reclamation Act (SMCRA) in 1977, setting restoration guidelines, but most of our local mining activity was over by then. While some reclamation work was done in our watershed, the act contained some loopholes that mining companies took advantage of to reduce the amount of land reclaimed and their expenses for doing so. However, SMCRA established the Abandoned Mine Lands Trust Fund which provides money to states to resolve health and safety issues at abandoned mine sites. The future of this fund is uncertain. Congress ended it in 2004, but has granted two temporary extensions since then. Its ultimate fate is still uncertain.

As time goes on, more and more sites of prior mining activity have been re-mined. Newer technology has widened the types of coal able to be used commercially, thus creating new markets. Often done in conjunction with future development plans, the re-mining process removes safety concerns such as highwalls and fills voids. As an added bonus, it can also eliminate, reduce, and/or treat mine drainage problems.

**Connected Deep Mines:**

Going from west to east (downstream to upstream) across the watershed, there are five major geologic structural folds – the Duquesne Syncline, the Murrysville Anticline, the Irwin Syncline, the Grapeville Anticline, and the Greensburg Syncline – that run northeast to southwest.



There were a total of 25 small mines in the Irwin Syncline. As these mines were closing after World War II, they were physically connected one to another (with two exceptions), creating one large mine pool. Sixteen major discharges were identified, and the goal was to eventually treat the mine water at the three largest in the towns of Irwin, West Newton, and Smithton. (A drawing is found in Section 2, page 8.) The Irwin Mine discharge is in the Turtle Creek watershed.

The two mines not connected were the Delmont and Export Mines, located at the top of the syncline. These have independent mine pools with heavily contaminated water.

### ***The Scarlift Report:***

The foundation for Operation Scarlift, one of the earlier comprehensive planning efforts in the state of Pennsylvania, was laid in 1967 with the referendum creating the Land and Water Reclamation and Restoration Fund. Drainage from thousands of abandoned mines all across the state was heavily polluting thousands of stream miles. A total of \$200 million dollars was dedicated to abandoned mine problems and was used until 1995. (The AML Trust Fund supplemented this money, and it has been the primary source of reclamation revenues in Pennsylvania since then.)

Scarlift was designed by the Pennsylvania Department of Mines and Mineral Industries to identify the major discharges from deep mines, then monitor them to get basic water chemistry and flow data. Once these data were compiled, the state would have an idea of the magnitude of the problem as well as the steps needed to treat the water and their projected costs.

This project was the first such undertaking in the country and yielded a great deal of valuable information still referred to today. Turtle Creek watershed's portion covering mostly its Allegheny County section was completed in 1973 by TCWA, and many of the study's limitations are noted in the text. The remaining Westmoreland County portion was completed in 1978 by Pullman Swindell. (A copy of this material is found in Appendix B.)

As is the case in other parts of the state, comparisons of Scarlift findings with subsequent data show changes in water chemistry over time. For example, in parts of the watershed where adequate limestone overburden has fallen into the mines, previously low pH characteristics have been naturally mitigated underground. This rise in pH towards neutral also has reduced the concentration of dissolved aluminum in the discharges. Precipitation of aluminum oxide is pH dependent, with the greatest activity near pH 6.4. Dissolution increases as pH falls from that point – and to a much lesser extent as it rises.

We note the greatest contrast in mid-syncline places like Irwin, where the pH is now above 5, the discharge is net alkaline, precipitation is occurring in the mine, and very small amounts of dissolved aluminum are reaching the surface. The Delmont and Export Mines are at the top of a syncline where the shallow overburden is sandstone, so their pHs are just above 3 and dissolved aluminum is a major contaminant.

Changes in specific mine discharge sites are also seen, normally occurring in conjunction with subsidence or development. The most striking example in the Turtle Creek watershed is along Lyons Run. Originally draining from three main pipes, subsidence between 1998 and 2000 resulted in one main pipe discharge and hundreds of smaller discharges from seeps and springs. Concept plans to treat the three discharges in this valley evaporated.

### ***U.S. Army Corps of Engineers 905(b) Reconnaissance Studies:***

In anticipation of remediation projects for the Delmont (Borland Farm Road in Murrysville), Export (the Dura-Bond Company in Export), Irwin (Route 993 in North Huntingdon Township), and Lyon's Run/ McCullough Mines discharges (Boxcartown Road in Penn Township), more watershed study was planned. Approved for involvement by the

Corps of Engineers on May 9, 1996, funding for the work would come from the 1998 Energy and Water Development Appropriations Act.

Studies for Upper Turtle Creek, Brush Creek, and Lyons Run were completed, and their recommendations and data have been and are still are being used for AMD remediation projects. (Copies appear in Appendices C, D, and E.)

Each Reconnaissance Study format:

- reviewed prior studies and existing data,
- identified the mine drainage problems present,
- projected future conditions without treatment,
- suggested best locations for treatment,
- proposed treatment options for these locations,
- estimated costs, and
- included appendices of maps and chemical & biological data.

The value of these studies has been demonstrated repeatedly. It is also important to note that in some cases subsequent work to obtain more detailed data has shown substantial differences between the 905(b) study postulations and existing conditions. Conditions and recommendations for the Delmont Mine are most notable in that respect. Recent mine subsidence has significantly altered the Lyons Run Mine situation – including a dramatic increase in the number and volume of discharges.

The lesson here, especially in locations where land issues are crucial, is: performing careful site evaluations is imperative before planning specific remediation projects. Relying upon generalizations in broad brush studies to develop project concepts, cost estimates, or funding applications is not a reliable method. Collecting and analyzing sufficient data to confidently propose a project is expensive and time consuming. However, forging ahead before doing this work sets up problems that are far more expensive and time consuming.

### ***Turtle Creek Watershed River Conservation Plan:***

Funded by a DCNR grant, the River Conservation Plan was completed in 2002. The plan took a comprehensive look at the physical, chemical, biological, governmental, historic, economic, and recreation aspects of the watershed – showing the wide variety of impacts to the range of water quality and water quantity issues faced today. To provide a practical framework, the watershed was divided into fourteen sub-units. Issues in each requiring attention in the near future were defined, and action plans with partners and potential funding sources for each for were developed.

This document is used not only by Turtle Creek Watershed Association. Several of our municipalities also include it in their comprehensive planning and have used it as a resource when applying for recreation or water quality project funding. Monroeville's water quality assessment of Thompson Run, referred to in Section 2 is a good example of this use.

AMD is a problem in twelve of the sub-units – only Haymaker Run and Steel's Run are free of mine drainage. Monitoring and remediation project planning are a part of the twelve sub-unit action plans. The following chart gives a more graphic idea of the extent of this contamination.

(For Volume I of the RCP, please go to [www.tcwa.org/](http://www.tcwa.org/).)



### Turtle Creek Sub-watershed Units

<i>Sub-watershed Unit</i>	<i>Drainage Area (sq. mi.)</i>	<i>Stream Miles</i>
Abers Creek	10.64	24.6
Ardmore Run	3.16	4.9
Lower Brush Creek	17.43	38.8
Upper Brush Creek	26.13	56.4
Bushy Run	13.94	32.7
Dirty Camp Run	3.23	4.7
Haymaker Run	10.97	29.2
Lyons Run	8.78	17.6
Sawmill Run	2.02	2.5
Steel's Run	4.81	10.0
Thompson Run	15.87	30.6
Lower Turtle Creek	10.02	18.2
Middle Turtle Creek	7.43	15.7
Upper Turtle Creek	12.98	29.0
<b>Totals</b>	<b>147.41 square miles</b>	<b>314.9 stream miles</b>
	<b>131.63 mi.<sup>2</sup> impacted</b>	<b>275.7 mi. impacted</b>
	<b>15.78 mi.<sup>2</sup> not impacted</b>	<b>39.2 mi. not impacted</b>

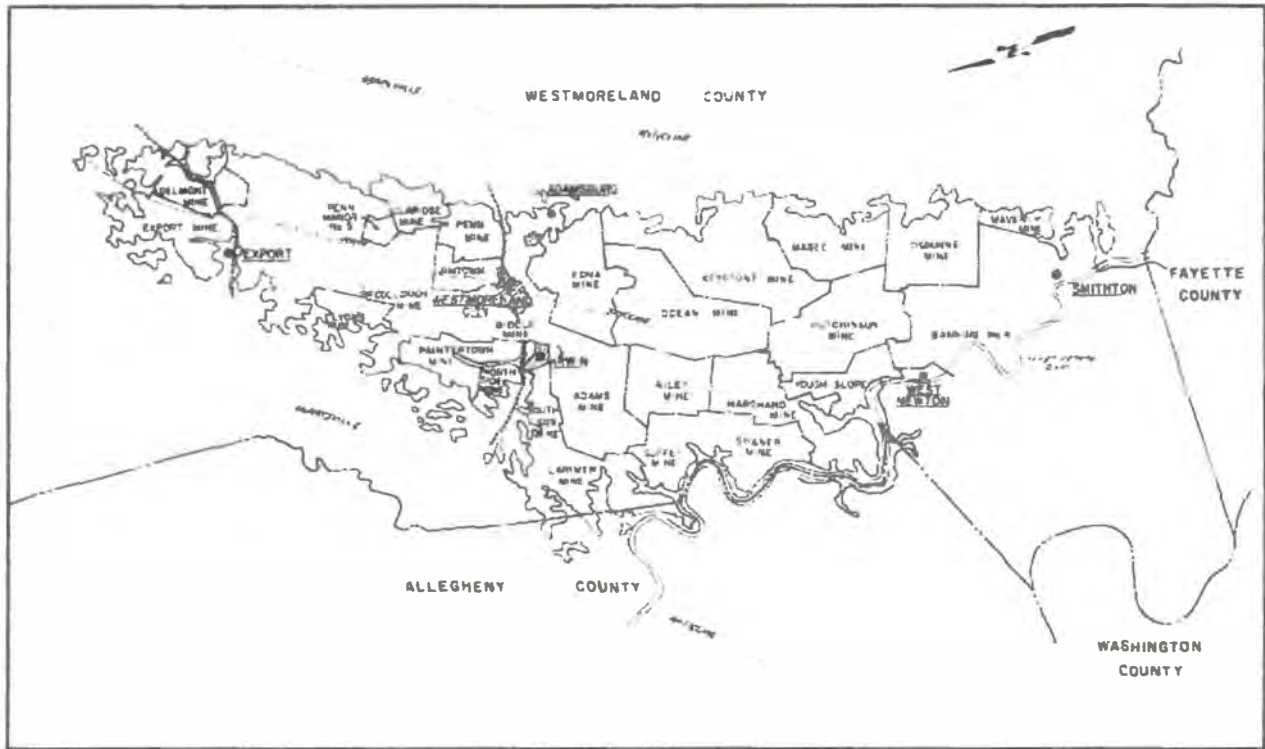
While there is a fair amount of data about different sections of the watershed, a comprehensive water quality assessment has never been done for the entire watershed, but remains a long term goal for TCWA.



## Section Two – Mines and Sources of Discharge Contamination

### *Delmont Mine:*

#### Deep Mines in the Irwin Syncline



Located at the top of the Irwin Syncline (see above – note North), the Delmont Mine is one of the only two of the twenty-five mines in the syncline not to be connected to the combined Irwin Mine pool. In contrast to the advantage of natural limestone mitigation the combined pool has, water quality in the Delmont Mine is without any sort of natural enhancements. The shallow overburden at the top of the syncline is composed almost exclusively of fractured sandstone without the limestone layer found further down dip.

As a result, the water has a pH in the low 3s with alkalinity below 2.0 mg/L. Consequently, the aluminum oxides normally found in the soil are dissociated, and the  $Al^{3+}$  levels range from 9.0 – 12.0 mg/L. Dissolved iron ( $Fe^{2+}$ ) levels range from 35.0 – 45.0 mg/L, and sulfates ( $SO_4^{2-}$ ) from 350 – 450 mg/L.

In the late 1990s, TCWA contracted with a consulting company to evaluate the site and develop Growing Greener Grant applications. Unfortunately, site conditions were not taken from on-site investigation, but were extrapolated from previous erroneous assumptions and flawed data. The resulting concept plans and projected costs were not accurate. As conceived in the applications, the treatment system concept included gob pile removal for use as co-gen fuel, construction of an anoxic limestone drain (ALD) to raise pH and precipitate aluminum underground, along with a primary treatment pond on the pile site to precipitate iron hydroxide. Low coal content of the pile made the material unsuitable for fuel. Higher than expected aluminum values made the mine water unsuitable for an ALD. Fractured sandstone geology made ALD or pond excavation below original grade impossible. Required land acquisition was problematic, so further treatment ponds and a polishing wetland conceived for adjacent property also could not be built.

**Iron hydroxide from discharge**



**Aluminum oxides form as stream pH rises**



CME Engineering took over the project in 2004, completed the comprehensive site evaluation, identified the concept plan flaws, and worked with the Ebensburg Office of the Bureau of Abandoned Mine Reclamation (BAMR) to develop treatment options based upon site conditions and restrictions. As of early 2006, we are awaiting word on funding for more extensive site work to answer some difficult questions. OSM is also willing to help.

At a December 2005 meeting of DEP Deep Mining, Waterways Management, and BAMR personnel; county, WPCAMR, and TCWA personnel; and consultants from three engineering firms, the pros and cons of several treatment ideas were discussed. *In situ* biological treatment was ruled out due to the low pH issues. An upslope system or any sort of successive alkalinity system was ruled out due to the below grade excavation required.

Connecting to the combined mine pool has some practical benefits. The larger mine pool has enough excess alkalinity to neutralize the added water and remove the aluminum. Most likely the water would surface at Irwin, and the Irwin Mine Discharge Project is currently in progress. That treatment system could be sized to accommodate the extra volume, and iron would be recovered there. However, there are also some drawbacks.

The Delmont Mine pool collects under Upper Turtle Creek. The water table is directly linked to this pool, and creek base flow is directly linked to the water table. Plus, with the fractured sandstone overburden, an artesian effect occurs, so water is pushed to the surface and into Turtle Creek. We can measure the discrete discharges we know exist, but we do not know the extent of the mine pool, nor how much that pool contributes to the creek's base flow. As development (and impervious surface) in that area increases, more rainfall runs off and less infiltrates, so base flow is already being impacted negatively.

Both the Franklin Township Municipal Sanitary Authority and the Fish and Boat Commission have a vested interest in maintaining adequate base flow. FTMSA's plant effluent levels are dependent upon base flow. The authority has already spent millions of dollars to insure high water quality so Turtle Creek can be stocked with trout. A significant decrease in base flow will require that millions more be spent, and the accompanying rate increase will not be acceptable to the community. As the stocking agency, the F&BC must advocate for both good water quality and ample base flow to protect their fish. Declines in either parameter mean removal from the stocking list. Loss of recreation options and their economic values are also unacceptable to the community.

Passively treating the mine drainage so that clean water returns to the creek means the treatment site must be downstream about one quarter mile from the discharges to insure the necessary drop in elevation. Open land exists there, but to date, the land has not been for sale. The owner recently passed away, so if the land needed can be purchased from his estate, then this option will be the best to treat water from the Delmont Mine.

Now that we have two major treatment options to pursue based upon actual site conditions, there are still a number of loose ends to tie up from work already done on this project. One of the most pressing involves costs for gob pile removal – especially of concern because the pile sits astride two commercial properties. Myers Coach Lines and L&A Construction agreed to involvement in the project in exchange for the benefits of more usable land their businesses would see. Removal estimates in the original grant application were approximately 17.5% of actual 2002 costs. (Subsequently, fuel prices more than doubled, compounding the cost problem.)

In November of 2002, it became evident to all parties involved that the sum of discrepancies between the grant applications and known site conditions was substantial, and supplemental funds were required to complete the project. None the less, TCWA was encouraged by federal and state agencies to start work as soon as possible to favorably position the project for more funding. Other projects across the state with similar issues had received needed money only after work was underway.

Therefore, while still operating under the original concept plan for an ALD and primary treatment pond constructed at the gob pile site, a disposal site for pile material was located three miles away. Part of the gob pile was removed and used there for structural fill. (Test results showed the pile was composed primarily of ash and lacked toxic metals, making it suitable as fill.)

The bulk of the project was supported by EPA's 319 Fund. Formal requests to make budget revisions based upon actual costs were denied. A Growing Greener Grant funded the rest, and we were able to make budget adjustments within it. However, only about 60% of the pile has been removed – all of that on the L&A property. Now that core borings and monitoring wells have shown aluminum levels too high for an ALD and artesian effects precluding excavation below grade, there is little technical reason to remove the pile. Lack of toxins means there is no health or environmental reason to remove the pile. Consequently, finding the money to remove the pile is difficult. A local clean fill surplus exists from PennDOT's Route 22 expansion project, so there is no demand for our fill. This situation adds an ethical and financial dilemma to an already difficult problem.

### ***Overlying Small Mines***

As happened when smaller mines were created on local farms, there are a number of small, shallow, isolated mine pools overlapping the Delmont and Export Mines. Some of these have created a variety of problems as the area has been developed without addressing the legacy of these mines. What we see more of now are the ill-named Government Funded Construction Contracts (GFCC). The advent of markets for various types and conditions of coal has provided economic incentive to re-mine these sites. As a condition of the permits, the entire sites must be completely restored – all high walls, shafts, voids, and other mining features eliminated. Many times this work removes the sources of water contamination and/or the opportunity to pool in a mine. Provisions must be made to improve water quality of any remaining contaminated discharges.

In contrast to standard Surface Mining Permits (SMP) where only the coal of interest is removed and contractors retain liability for future water problems, GFCCs exchange site restoration for elimination of future liability for water issues.

Several such projects have been completed, and in 2005 TCWA provided supporting documentation for two applications from Coal Loaders (a division of Unionvale Coal Company, Ligonier), one in Murrysville and another in Delmont Borough.

### ***Export Mine:***

Companion to the Delmont, Export is the other independent mine at the top of the Irwin Syncline. With similar water chemistry and discharge volume, designing a workable treatment system is proving to be even more difficult than for the Delmont Mine. The Scarlift Report and other studies favored connecting this mine to the larger Irwin pool. However, there was significant community resistance to that idea. To fully address all local concerns, a 2001 Growing Greener Grant funded comprehensive study of all possible treatment scenarios.

Study findings (next page) showed that passive treatment options are restricted due to a lack of available land nearby. Active treatment options would be expensive to build, but annual operating costs would exceed total construction costs. BAMR would be a good source of construction funds, but no money can be found for operation. With no clean water source nearby, the locally popular idea of dilution is not feasible. Consequently, connecting the mine to the Irwin pool appeared to be the only option possible.

A 2005 Growing Greener Grant was awarded for project design and permitting. As the site of the coal barrier breach to the combined Irwin Syncline mine pool, the condition of the Mellon Mains is critical to project success. One phase of the project will bore holes to the site and use the U.S. Office of Surface Mining's camera to document conditions. If all is well, the design will be based upon this new data. However, in addition to the stability of the mains, two other factors now need to be considered.

The first is the mine pool/base flow connection, and the second is the potential acquisition of land to treat the Delmont Mine discharge. Again, we do not understand the dimensions and volume of the mine pool, nor the full impacts to Turtle Creek base flow of drawing down this pool. If sufficient land can be acquired, it may be possible to passively treat both discharges together. More funding has been requested to explore these aspects.

Also included in the new request are funds to cover extra costs for rights of entry, easements, and other legal issues related to arrangements for the borings.

Another unexpected consideration to designing the Export Mine Discharge Project is the probable construction of a flood control plan by the DEP Bureau of Waterways Engineering for Export Borough. Its goal is to reduce borough flooding problems by 25% by moving a specified volume of water from the eastern border to the western. Unfortunately, the bureau did not include stakeholders' concerns in the initial planning process. While there was some response to seven comment letters in their revised plan to install a pipe below grade running beside Turtle Creek, there is still some question about the impacts of this project upon the ultimate choice of a treatment system for the Export Mine.

**COMPARISON OF EXPORT DISCHARGE REMEDIATION OPTIONS**

REMEDICATION OPTIONS	ADVANTAGES	DISADVANTAGES	CONSTRUCTION COSTS	ANNUAL OPERATION & MAINTENANCE COSTS
<b>Active Treatment</b>				
Treatment Plant	AMD removed Water returned to creek	Perpetual treatment Constant power need Constant chemical need Needs ~ 1 acre site	\$180,000	\$270,000
<b>Passive Treatment</b>				
Successive alkalinity producing system and wetlands	AMD removed	Needs ~ 25 acre site	> \$3,000,000	Not costed
	Water returned to creek	Perpetual treatment		
		Periodic cleaning required Periodic limestone restock		
<b>Divert to Irwin Mine Pool</b>				
Divert through mine to Irwin Mine pool and discharge	AMD removed	Less flow in Upper Turtle Ck.	\$330,000	\$0
	No maintenance	More flow in Brush Ck. (~.1")		
	Little maintenance with valve mechanism	Change in Brush Creek chemistry		
<b>Dilution</b>				
Add water to Turtle Creek to dilute AMD	AMD concentration lower	Needs significant additional water source	Not costed	Not costed
	Base flow higher			
	No treatment	Pollution loading remains		
<b>No Action</b>				
Do nothing	None	No improvement	\$0	\$0

### ***Irwin Mine:***

Named the Irwin Mine discharge, seven thousand gallons of mine water per minute flow out of two pipes underneath Alfieri Metals along Tinker's Run in North Huntingdon Township on its border with Irwin Borough. Due to the connections among many mines in the Irwin Syncline, this water is the combined flow of a number of them, rather than exclusively from the Irwin Mine.



**Two Views of the Irwin Discharge into Tinker's Run at Alfieri's Metals**

Dissolution of fallen limestone overburden in the mines has provided natural alkalinity in the mine pool. Consequently, the pH has been rising over time and now is between 5.5 and 6.0. Previous studies show that thirty years ago, it was between 3.0 and 4.0. Today, alkalinity is between 111.0 and 132.0 mg/L, iron is approximately 70.0 mg/L, and aluminum is below 2.0 mg/L. This situation is amenable to resource recovery of iron oxide as a marketable product.

Moving towards that goal, a three step series of projects is planned – with the first already accomplished. A 2003 Growing Greener Grant funded a feasibility study by Hedin Environmental to evaluate treatment potential for the discharge. A market exists for iron oxide used in pigments, therefore passive resource recovery holds the best promise for an economically sustainable system paying for its own operation and maintenance. Approximately sixty-five acres of land would be required, and this acreage at the proper elevation is found approximately 9,000 feet downstream. The water could be piped this distance along the existing railroad right-of-way already holding other utility infrastructure.

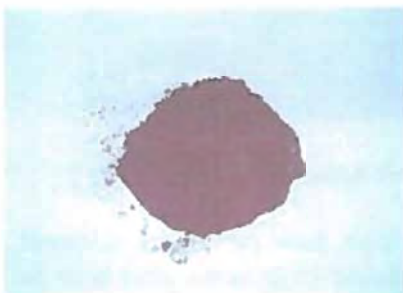
A small on-site processing plant for the collection and final refinement of the iron oxide to pigment grade quality would be staffed by a few workers, so jobs would be created. The constant flow and temperature of the mine water offer some cost-effective advantages for treatment plant operation. Electricity could be generated to run equipment, and heat pumps installed to meet all cooling and heating needs.

It is also possible to create clean water for industrial uses from the contaminated mine water before returning it to Brush Creek. Combined with the electricity and heat pump options, the potential exists for a “green” enterprise zone where small manufacturing companies could use environmentally sustainable practices in their operations.

The second project will turn the concept into a design and obtain necessary project permits. A funding proposal was submitted in May of 2005 to the OSM PA (AML-05) statewide project competition. The Irwin Discharge placed second, but only one project was funded. However, our proposal did generate interest within BAMR, and we were encouraged to apply for Round Eight of Growing Greener. We did so, and are waiting to hear the outcome. In the meantime, BAMR has offered technical assistance with mapping for the project.

Included in this phase of work will be:

- Acquisition of property easements and options to purchase
- Resource delineations
- Site base map
- Treatment plans, 40%
- Final plans and specifications
- Permitting
- Public meetings
- Coordination of treatment system and green enterprise zone activities



**Iron Oxide Powder**

The third project will construct the treatment system and begin operations. This phase is expected to cost \$6-8 million dollars if property values and construction costs do not increase substantially. Iron Oxide Recovery, Inc. is anticipated to handle system operations, maintenance, and repair. With dissolved iron loadings averaging the current figures of over 5,000 pounds per day, the system is expected to generate \$200,000 in gross annual earnings for iron oxide recovery.



**Spreaders Sending Mine Water to Ponds**



**Mine Water Emptying into a Limestone Channel then into the Primary Treatment Pond**



***Blue Lagoon:***



Aptly named the Blue Lagoon, this discharge is located below Business Route 22 in Monroeville and flows directly into Thompson Run. Showing the dearth of information about our discharges, as obviously dangerous as this site is, little has ever been known about it. The pipe seen at left was installed as part of the stormwater drainage system for the Monroeville commercial area. Carrying both storm and mine water, daily aluminum loads are in excess of 200 pounds. The extent of flocky precipitation demonstrates that the lagoon pH is approximately 5.0. The pH of Thompson Run at the confluence is near 6.0.

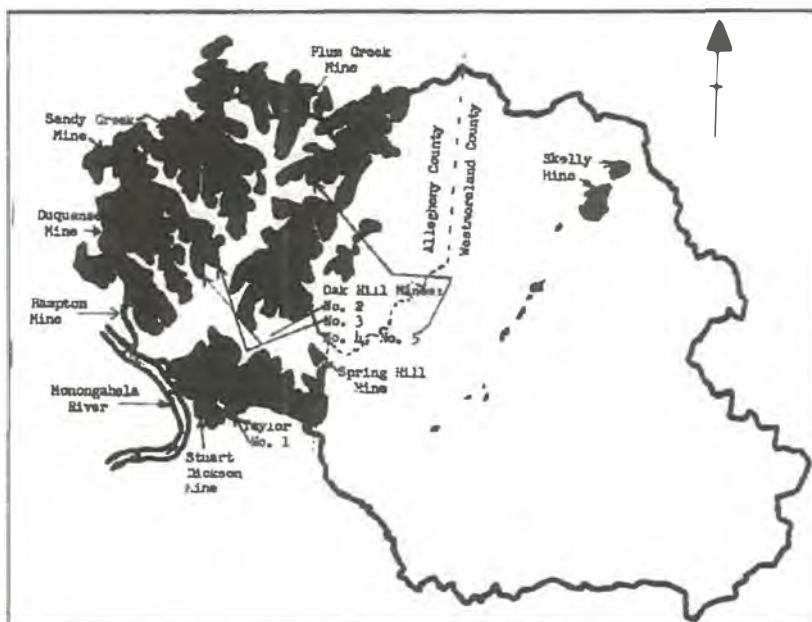
Regardless of any upstream or downstream efforts to remediate other sub-watershed unit mine discharges, as long as this site is not treated, all of Thompson Run downstream of the Blue Lagoon will remain polluted to the point that few life forms could survive. The photo below shows the confluence of the lagoon's discharge with the less polluted Thompson Run. This obvious hazard has health implications for Monroeville and Turtle Creek Borough residents. Contamination of Thompson Run also has economic implications in terms of neighborhood appeal as a place to live and work and of reflected property values.



Once Thompson Run reaches Turtle Creek, the aluminum laden water reacts with a substance as yet unidentified by the DEP to create a green color. At times this green is a deep shade. At others it has been accurately described as looking like lime Kool-Aid. As an anecdotal biological indicator, bass fishing in Turtle Creek above Thompson Run is quite popular among local residents, but few bass are found below.

The specific source of this aluminum remains unknown. As shown in the map, there are a series of mines under the area. The most likely sources of contamination are the Oak Hill #4 and #5 Mines. In any case, commercial construction over the past thirty five years directed several known discharges into the Blue Lagoon collection culvert. It is safely assumed others were also added. The 1973 Scarlift Report recommended fly ash or lime slurry be injected into the mines to raise the pH. This action was never taken, and the window of opportunity has been all but closed by subsequent development.

**Commercial Mines in Eastern Allegheny County**



A 2004 Growing Greener Project sponsored by the Municipality of Monroeville funded the first water quality assessment of the Thompson Run sub-watershed unit. The final report by GAI Consultants noted that the combination of mine water and stormwater increases the difficulty of treating this discharge. While the base flow of mine drainage could in theory be passively treated nearby, the huge volume of stormwater could not. Segregation of flows would be required, but presently this is unrealistic.

The discharge itself and land for future treatment are owned by the Union Railroad. To date, the company has not been interested in granting written permission for sampling or in discussing passive treatment options. The backing of a person or entity of significant stature would be needed to open lines of communication with the railroad. Early in this decade, the community thought such an entity had stepped in.

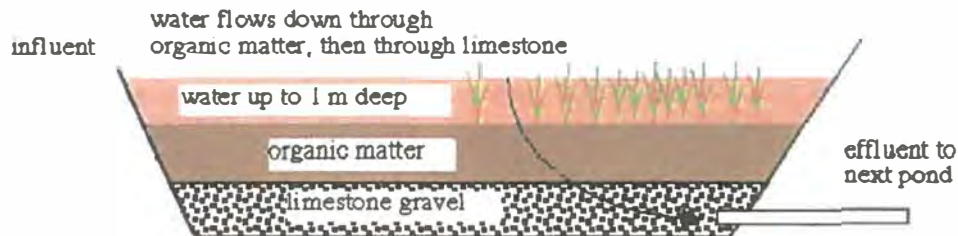
As an incentive for the community to support the Mon-Fayette Expressway (designed to pass over the Thompson Run Valley), the Pennsylvania Turnpike Commission indicated it would treat the discharge as part of the project. However, in 2005 project representatives stated concerns that the budget would not allow purchase of adequate stormwater rights-of-way. There was no longer any possibility for discharge treatment as part of the project. Rapidly growing expressway cost projections threaten its fate.

As technology advances, aluminum recovery will become economically viable, and the Blue Lagoon will be treated. In the meantime, gathering as much data as possible about this discharge and about the rest of the sub-watershed unit is imperative to prepare for comprehensive treatment.

To expand the scope of the Thompson Run assessment, a new grant application was submitted in March of 2006. When funded, this work will provide a better idea of the sources of many of the smaller discharges in the area. Among the thirty sampling sites monitored in the 2004-2005 work, water quality and flow parameters varied enough to suggest more than one mine pool as the source of contamination. We presently have no way

of knowing whether we are dealing with subsidence creating isolated pockets of minewater, or sites from larger mines, smaller mines, or back yard dog holes.

### SAPS - Successive Alkalinity Producing System



The water quality assessment report recommends use of vertical flow reactors (successive alkalinity producing systems) for many of the sampling sites located in residential areas. However, from a practical standpoint the combined construction costs for these systems would be substantial, and the annual operating costs prohibitive. If a treatment method can collect or combine mine pools underground, then treat one discharge in a suitable location, success becomes more likely.

#### Lyons Run Mine:

Lyons Run flows south through central Murrysville and Penn Township, then turning west along the Pennsylvania Turnpike, joining Turtle Creek near the Franklin Township Municipal Sanitary Authority (FTMSA) plant. The Lyons Run Mine operated in the upper areas of the stream and most of the mine water discharges are along Boxcartown Road, crossing the municipal boundary. One of the most damaging aspects of this mining heritage is the aluminum-laden water polluting Lyons Run. In the upper reaches, the pH is low, so the aluminum is in solution and not visible. (In slower moving water, the long, green filamentous algae characteristic of acidic water grows freely.) However, the iron oxide contamination is visible, as shown in the photo above.

#### Lyons Run Near Boxcartown Road



When the U.S. Army Corps of Engineers studied this area in 1998, there were three discrete pipe outfalls, making the valley a good candidate for passive remediation showing substantial economic benefits *versus* expenses of \$10 returned to every \$1 spent.

However, several years later, mine subsidence changed this picture when two of the pipe discharges suddenly became numerous seeps and springs – an example is shown on the next page. (Note the filamentous algae present.) Preliminary evaluation by BAMR suggested that designing and constructing a treatment system for the new conditions would be extremely complicated in comparison to the old conditions.



### Acid Mine Water Seep

the limits of the Turtle Creek watershed, then use that non-profit organization to apply for Growing Greener money. The DEP has been a bit cautious in recent years about this type of direct connection to funnel state money to for-profit companies. Consequently, it did not offer any encouragement to pursue this avenue. Nor was it expected to recommend the Environmental Quality Board approve this concept.

In late 2003, a local developer who owned land in the upper Lyons Run valley hired a consulting company to explore the idea of building a treatment system and performing some streambank restoration work to serve as a “bank” for his own company and others. Their larger developments often required off-site mitigation, which can be a challenging process. Credits from this “bank” could be purchased as needed.

To help fund the treatment system and stabilization, the developer/owner intended to create the Lyons Run Watershed Association within

However, with the proposed project based upon the Corps’ 1998 Reconnaissance Study and its figure of \$1.5 million to construct a treatment system for the three main pipes, the realization that this figure would increase several times over may have been another reason no further interest has been expressed in this option.

In late 2005, TCWA received a technical assistance grant from Trout Unlimited to do another assessment of the valley’s mine discharges. This work began in early 2006 when Hedin Environmental started on the first phase. Walking the stream, locations of high walls, spoil piles, and a railroad loading area were identified. Major outfalls were tested for basic parameters, and their proximity to the seeps and springs noted. The lack of winter and spring precipitation made a difference in the flows.

When considered overall, these data suggested there are still a limited number of mine pools the water is coming from. While there are numerous seeps and springs, they may still in fact be coming from a few sources. High water levels for the past few years may have obscured some of these connections. If this is true, then identifying and treating these larger pools would eliminate the majority of the seeps and springs.

Assessment work will continue throughout the summer of 2006 and a GIS intern for TCWA will create a map of the valley showing the existing mine features and the discharges with their water quality data. Property lines and current ownership information will be provided by Westmoreland County.

Another substantial source of aluminum contamination is located on the Crooks’ farm near the Pennsylvania Turnpike. Like the Blue Lagoon, this discharge has turned a pond (60 feet deep at the center) a deep blue color. Without an obvious mine water source, the pond’s depth suggests it has tapped into the mine under it. Near the shores, the bottom is covered with white aluminum oxide, creating the visual effect of a mini-Caribbean seascape with white sand and azure blue water. This pond empties into a tributary of Byers Run, which follows the turnpike for several miles and flows into Lyons Run at approximately Mile 61.

### **Contaminated Pond on the Crooks' Farm**



Cleanup of mine water in the Lyon's Run upper valley and on the Byers Run will remove the bulk of the aluminum pollution and increase the low pH in Lyons Run. Presently, these pollutants enter Turtle Creek, making it unsuitable for normal aquatic life and for fish stocking more than a mile downstream. This is of consequence because the Pennsylvania Fish and Boat Commission stocks Turtle Creek from just above the Saunders Station Road bridge down

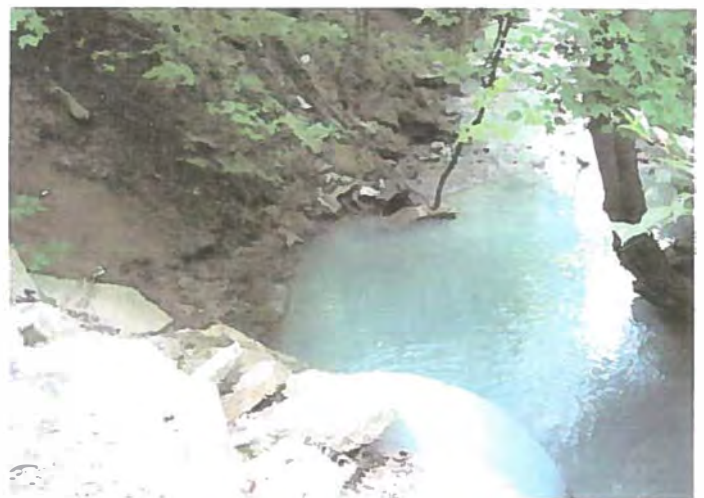
to Trafford. The FTMSA has spent millions of dollars to make their effluent clean enough to allow stocking – diluting the Lyons Run contaminant contributions.

Even so, trout stocking is always threatened. Every year, there is a question as to whether or not the Lyons Run Mine is putting out excess toxins. Water quality measurements are taken daily at Saunders Station from at least the end of March to the end of April to be sure the water is safe for the fish. However, once Lyons Run is clean, stocking on Turtle Creek can be expanded upstream into Murrysville beyond the FTMSA plant. The municipality has long been interested in cleaning up the Lyons Run, Export, and Delmont Mines' contamination and stocking Turtle Creek all the way through Duff Park, a tract of 200 wooded acres.

### ***Chalfant Run, Leak Run, and Sawmill Run:***

These streams share more than just being tributaries of Thompson Run. They are all located in the most urbanized and industrial part of the watershed. As such, they also share common problems resulting from being viewed for generations as little more than conduits for getting rid of various waste products from stormwater runoff to industrial pollutants to sanitary waste water to mine drainage. Sometimes functioning as open pipes, sometimes culverted underground, like Thompson Run these streams receive mine drainage from larger mines and from the little ones, making it difficult to tell the origin of any given discharge.

**Sawmill Run near Brown Avenue**



### Chalfant Run on Rt. 130 at Churchill Country Club



The most likely major sources for much of the mine water are the Sandy Creek Mine and the Oakhill #2, #3, and #4 Mines. However, some water samples also suggest smaller, more isolated sources. As shown in the photo of Sawmill Run above, aluminum contamination is a huge problem here too and ultimately contributes to the Thompson Run pollutant load in its lower reaches. The same can be said of Chalfant Run, shown in the photo to the left.

Due to the lack of any historical information about the discharges deliberately drained underground to these three streams or nearby, development of any large-scale treatment plan is unrealistic at this time. The extent of development in the area may also pose insurmountable challenges to developing a comprehensive treatment plan. It could be that redevelopment of brownfield, industrial, commercial, or high density residential sites might be the key to any viable treatment options.

## Section Three: Conclusions

### ***Recent Funding Opportunities:***

Mine drainage was recognized by more people as a threat to water quality, property values, and quality of life throughout the 1990s. As the economy was improving during that period, funding became available to remediate its sources. Watershed organizations such as TCWA were able to obtain grants through the Growing Greener Grant Program to develop and implement treatment projects. Now that the economy has been suffering, less money is available for this work. Consequently, competition for these funds is growing.

Other complicating factors involve execution of and expenses for the operation, maintenance, and repair tasks required for these systems. Projects completed in the early Growing Greener years often involved little attention to these aspects, or, in some cases the magnitude of these aspects was seriously under-estimated. The ultimate fallout of this situation has been a more realistic look at new passive treatment projects. Incorporating sensible and realistic long term maintenance plans into initial planning has become an important component of developing treatment projects and of grant applications for them.

### ***Water Monitoring Importance:***

Understanding and documenting the need for AMD specific remediation projects has also become a more refined and specific process. Collecting sufficient water quality data of sufficiently high accuracy has historically been the basis of this process, and it remains so today. Without being able to document the discharges, their chemical parameters, their impacts, and the benefits of their cleanup, a project cannot be properly prioritized or designed, and funding cannot be acquired.

TCWA has a total of 67 DEP-approved sampling sites. While we have never been able to have all sites monitored regularly in a comprehensive program, we have had intermittent monitoring at sites of interest by both consulting companies and by volunteers.

For several years, TCWA was able to have its water samples fixed by the volunteers in the field, taken to the Greensburg DEP office, sent to the Harrisburg laboratory, analyzed, and reports sent back electronically. Although it took some dedicated volunteers do the sampling and make the drive to southern Greensburg, we had some who faithfully performed this work.

With budget cutbacks, the DEP lab simply stopped performing these tests. Our budget did not have any funds for private lab testing, and so our volunteers saw little reason to continue their efforts. Finding funds for these analyses is a priority, but we now find ourselves in a Catch 22 situation. Prospective funders want to know that volunteer monitors are in place, yet volunteers are reluctant to make a substantial commitment until they know their samples will be analyzed.



The EASI Program (Environmental Alliance for Senior Involvement) seemed to be a good answer to part of our problems. One existing team has been monitoring two AMD-impacted sites (in Export and Murrysville) for the last year. We have

tried to generate some more interest in having other existing teams looking for new sites choose some of ours. So far, none has decided to accept. We have looked into starting some new teams, but Vintage, the former local program sponsor, was able to provide support for this activity that the new sponsor, the Watershed Assistance Center, is not able to. Consequently, TCWA has not yet been able to get our own program up, running, and ready for training.

***Community and Technical Resources:***

Another important factor in implementing our AMD strategy is maintaining strong relationships and communications with our municipalities. The discharges, old mines, and mine features are affecting their residents, property values, community appeal, and health and safety issues. We also need community support in the form of technical assistance and permitting for our remediation projects.

Agency personnel are another crucial component to successful treatment projects, as are our consulting professionals and academic partners. As with our communities, maintaining strong relationships with these people, and their networks, are key to future project success. With this technical expertise to draw from, TCWA will be better able to choose more progressive means and methods to include in our projects. Exploring the advantages of *in situ* treatment, custom hybridized systems, impacts upon the water table from mine pool drawdown, combining mine pools for treatment, innovative land use for passive treatment, self-generated electricity for active treatment, etc. becomes more likely with a healthy network of these resource people. Proper application of these options and better solutions then also become more likely as a result.

***Desired Results:***

**Clean Streams for Wading and Exploring**





**Clean Streams for Picnicking  
with the Grandchildren**



**Clean Streams for Canoeing & Kayaking**



**Clean Streams for Fish Stocking**



**Clean Streams for Fishing**



**Clean Streams for Safe Drinking Water**



**Illustration Credits:**

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