UPPER SCHUYLKILL RIVER TMDL WATERSHED IMPLEMENTATION PLAN

Schuylkill County, Pennsylvania

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IDENTIFICATION AND SUMMARY OF PROBLEM AND POLLUTION SOURCES

The Upper Schuylkill River Watershed is located at the headwaters of the Schuylkill River in Schuylkill County, Pa. The area extends from the headwaters of the Schuylkill River near Tuscarora to the confluence of the main stem with the Little Schuylkill River in Port Clinton. The area also includes the entire Little Schuylkill River Watershed located in Schuylkill County, Pa. extending from the headwaters of the Little Schuylkill River near Haddock to the confluence with the Schuylkill River in Port Clinton. The Upper Schuylkill River Watershed is a rural, largely forested watershed, with some agricultural land. Urbanized areas include Pottsville, Minersville, Port Carbon, Saint Clair, New Philadelphia, Middleport, Cressona, Schuylkill Haven, Orwigsburg, Auburn, Tamaqua, and New Ringgold. Development in the watershed is centered in the southern part of Schuylkill County and along the Route 61 and Interstate 81 corridors. Farms consist of mainly pasture and fields of row crops, primarily corn. The majority of the agricultural lands are located in the southern and eastern areas of the watershed.

Abandoned Mine Drainage (AMD)

The major pollution source in the watershed is abandoned mine drainage (AMD), which causes high levels of metals and low pH in the Upper Schuylkill River and a number of its tributaries. The combined drainage area for the entire Upper Schuylkill River Watershed totals +/-264 square miles. The Pa. Department of Environmental Protection (DEP) has listed the Upper Schuylkill River, many tributaries to the river, and West Branch Schuylkill River in 1996 and 2002 on the 303(d) List of Impaired Streams due primarily to abandoned mine drainage. Within the drainage area, a total of 11.17 miles of Mill Creek Watershed, 5.62 miles of Muddy Branch Watershed, 9.02 miles of West Branch Schuylkill River Watershed, 9.43 miles of Panther Creek Watershed, 2.03 miles of Wabash Creek Watershed, and 34.32 miles of Schuylkill River Watershed are listed as impaired by metals, and 31.47 miles of the Little Schuylkill River Watershed are listed as impaired by low pH and metals on the 303(d) listing.

The Upper Schuylkill River Watershed is a very large watershed with a very diverse cultural, historic, economic, and environmental history. Historical land uses throughout the watershed were centered primarily on agricultural activities and transportation, and then adjusted over time to include industrial development, recreational opportunities, and included resource extraction.

Anthracite coal mining was the primary source of resource extraction that took place in the Upper Schuylkill River Watershed. Schuylkill County is found to lie directly over large deposits of anthracite coal. Portions of the Eastern Middle, Western Middle, and Southern Anthracite Coal Fields are found within Schuylkill County. These coal fields lie within the Ridge and Valley Physiographic Province, and generally coal is found in the valleys, but can also be found in the ridges as well. The largest of the three coalfields is the Southern Anthracite Coal Field that stretches across the entire length of Schuylkill County from east to west. The headwaters of the Schuylkill River and its many tributaries are found directly within the Southern Anthracite Coal Field.

Anthracite mining within Schuylkill County and the headwaters of the Schuylkill River was very extensive and prolific. Coal was discovered around 1750, but it wasn't until the early 1800's that anthracite coal became very marketable. Mining began within the headwaters of the Schuylkill River during this time, and spread exponentially across the area. By 1913, 80 million tons of coal was being extracted from the anthracite fields annually, and in 1917 mining activity reached its peak with over 100 million tons being extracted. Large amounts of this coal extraction occurred within the Schuylkill River's headwaters because that is where the coal was found, but also because the river supplied an excellent source of transportation for the coal to markets such as Philadelphia.

Anthracite coal was the fuel for the Industrial Revolution, but there were environmental challenges or problems due to the coal mining. Mining was relatively unregulated until the late 1970's. In 1972, the enactment of Federal Water Pollution Control Act Amendments of 1972 started leading the way to protecting or addressing pollution control measures. It wasn't until 1977, when the Federal Surface Mining Control and Reclamation Act (SMCRA) passed, that mining activities required numerous environmental controls or regulations. Up until 1977 any mining that occurred was basically unregulated and exempt from this law. The vast majority of the mining activities that occurred in the Schuylkill River's headwaters occurred before 1977, and therefore the mining industry was not responsible for any reclamation activities or treating abandoned mine drainage discharges to meet water quality standards.

The impacts of mining activities and abandoned mine drainage have been extensively documented by numerous reports, studies, and watershed assessments. The SHA in cooperation with the SCD completed an extensive watershed assessment on the Upper Schuylkill River and Little Schuylkill River (Kimball, 2000 & 2001). The Upper Schuylkill River assessment targeted only AMD issues and resulted in the identification of 108 AMD discharge/recharge sites. The Little Schuylkill River assessment documented 35 different AMD discharges. The Natural Lands Trust completed a Pa. Department of Conservation and Natural Resources (DCNR) Rivers Conservation Plan in 2001 on the Schuylkill River. The plan addressed AMD issues in the Schuylkill River's headwaters. The Conservation Fund prepared a "State of the Schuylkill River Watershed" report in 2002, which also commented on the AMD issues and discharges within Schuylkill County.

Due to the size of the watershed and the numerous sources of AMD, resources have been focused primarily on AMD remediation projects. Pollution sources such as sediment runoff, abandoned mine drainage from refuse piles, uncontrolled stormwater runoff, raw sewage discharges, and U. S. Environmental Protection Agency (EPA) Superfund sites also have been identified in the Upper Schuylkill River Watershed. The Kimball assessments focused primarily on AMD impacts but an attempt was made to identify locations of other pollution sources as reference information relative to stream evaluation and restoration. However, the Upper Schuylkill River Watershed has not been assessed to determine impairment from sources other than abandoned mine drainage.

Sediment Runoff and Abandoned Mine Drainage from Refuse Piles

In areas of historic mining, vegetation, soil, and rock layers (known as overburden) were stripped away to expose the coal vein. In many cases, this overburden was stockpiled adjacent to the mining operation and remains there still today. These spoil piles are a source of coal fines or culm that, if not properly contained, can runoff into nearby streams covering stream bottoms which serve as habitat for macroinvertebrates. This culm often contains iron pyrite, which negatively impacts not only the stream bottom but also the water column by producing abandoned mine drainage. Several refuse piles within the study area are currently being reprocessed for energy at nearby cogeneration plants. Reprocessing involves mining existing culm piles and mixing the mined material with fluidized bed ash to increase the effectiveness of the material for burning. The final product can then be used in cogeneration plants as fuel. Culm varies in grade for fuel and some piles are more efficient to reprocess than others. Reclamation should decrease the loading to the receiving stream if a site is chosen as being an economically feasible source of fuel for cogeneration. Implementing Best Management Practices (BMPs) on site will also decrease runoff.

Uncontrolled Stormwater Runoff

Development within the Upper Schuylkill River Watershed can produce uncontrolled runoff of stormwater directly to local streams. Soil erosion and sedimentation are accelerated because of the disturbance of stabilized soil. Excavation, construction, subdivision and other activities associated with urbanization all expose erodable soil. The problems caused by increased sedimentation include an increase in the embeddedness of the stream bottom, or the percentage of the stream bottom covered with sediment, variation in stream flow, the alteration of flow/depth regimes, and the formation of islands or point bars in the stream. Each of these factors represents impacts on the health of a stream and the ability of the stream to support aquatic life.

In addition to sedimentation, diverted stormwater from paved roads, parking areas and other infrastructure can increase natural stream flow that may in turn cause bank erosion and channeling. The runoff, usually from roads and parking areas, can also contain varying contaminants. Petroleum hydrocarbons and other fuel related contaminants entering the streams are detrimental to the aquatic life and health of the stream. Additionally, thermal pollution, resulting from the heating of the water as it runs over paved surfaces, can have negative effects on aquatic life, especially on cold-water fisheries.

Stormwater management involves the control of water that runs off the surface of the land from rain or melting ice or snow. The volume, or amount of runoff and its rate of runoff, increases as land development occurs. Pennsylvania's Stormwater Management Act of 1978 (Act 167) provides grant monies to counties to develop stormwater management plans for designated watersheds. Upon completion of the stormwater management plan by the county and approval by Pa. DEP, municipalities in the watershed adopt ordinances consistent with the plan. Developers are then required to follow the local drainage regulations that incorporate the standards of the plan when preparing their land development plan. Currently, there are no municipalities within the Upper Schuylkill River Watershed that have adopted or started the development of Act 167 stormwater management plans. Proper planning and engineering of development is crucial to the maintenance of the watershed. Currently, efforts are being pursued to retrofit existing BMP's that have been found to be ineffective and to develop alternative BMP's (Pennsylvania Handbook of Best Management Practices for Developing Areas, 1988).

Sewage

Raw sewage discharges are a continuing problem in the Upper Schuylkill River Watershed. Most of the boroughs and towns in the watershed have sewage collection pipes from residences and businesses; however, few towns have sewage treatment plants. Many of the piping systems are old and leaky and nearly all discharge raw sewage directly into the creeks and rivers. Leaking on-lot septic systems are also discharging raw sewage. These discharges are usually point source discharges that can be traced to specific discharge locations. An Act 537 sewage assessment was completed for the Upper Main Stem Schuylkill River and construction of a sewage treatment plant was begun in 2004. Two municipal sewage treatment plants discharge treated sewage and leaking septic systems discharge raw sewage to the West Branch Schuylkill River. The boroughs of Brockton, Middleport, New Philadelphia and Cumbola discharge raw sewage into the main stem Schuylkill River. Panther Creek, a tributary to the Little Schuylkill River, has a raw sewage problem from Tamaqua Borough. The village of Branch Dale discharges raw sewage into the Muddy Branch.

The problems created by the discharge of raw sewage include the obvious human health hazards, possible proliferation of fauna, odor, and depletion of the dissolved oxygen content of the stream. In most cases, a healthy stream may be able to overcome the effects of sewage discharge if there is a sufficient supply of oxygen to support an aerobic environment. The bacteria and other organisms in the sewage will cause biochemical decay. However, abandoned mine drainage present in the stream complicates the problem by creating a toxic environment which inhibits self-purification. The microorganisms normally present in the sewage are either destroyed or severely inhibited in their ability to oxidize the waste. In this situation, the sewage remains prevalent in the stream until conditions favorable to self-purification are reached. Efforts to improve infrastructure are being pursued in areas where sewage is still a problem.

Some areas do have sewage treatment plants. Sewage lines from the city of Pottsville extend a mile upstream to Port Carbon and discharge treated sewage into the Schuylkill River. The Borough of Minersville and Cass Township have a sewage treatment plant which discharges into the West Branch Schuylkill River; however, some of the pipes leak and raw sewage is entering the river.

There are several municipal wastewater treatment systems operating within the watershed. These include:

- Coaldale Borough
- Northeastern Schuylkill Joint Municipal Authority
- Rush Township Sewer Authority
- Tamaqua Borough
- Greater Pottsville Area Sewer Authority
- Minersville Sewer Authority
- Schuylkill Haven Municipal Authority
- Cressona Borough Municipal Authority
- Deer Lake Municipal Authority
- Lake Wynonah Municipal Authority

- Orwigsburg Borough Municipal Authority
- Saint Clair Municipal Authority

There are also 19 permitted public and non-public wastewater treatment systems considered minor dischargers (hydraulic design less than 1.0 million gallons per day) and 21 permitted industrial dischargers in the Upper Schuylkill Watershed.

Sewage problems have been reported throughout the watershed with areas of particular concern on Wabash Creek, Panther Creek, Little Schuylkill River, Muddy Branch, West Branch Schuylkill River, and main stem Schuylkill River. Construction and/or upgrades of wastewater treatment plants are taking place at many of these problem areas that will eliminate raw sewage discharges to these streams. New or upgraded wastewater treatment facilities include:

- Branch-Cass Townships Joint Municipal Authority—new
- Delano Township Municipal Authority—new or connecting to existing system
- Greater Pottsville Area Sewer Authority—expansion
- Kline-Banks-McAdoo Regional Authority—new
- New Ringgold Borough Municipal Authority—new
- Schuylkill Valley Sewer Authority—new
- Port Clinton Sewer Authority—new or connecting to existing system

Agriculture Related Impairment (Nutrient and Sediment)

Agricultural production often emits pollutants that affect the quality of water resources. Activities that can contribute to water pollution include confined animal facilities, grazing, plowing, pesticide spraying, irrigation, fertilizing, planting, and harvesting. The major agricultural pollutants that result from these activities are sediment, nutrients, pathogens, pesticides, and salts. Agricultural activities also can damage habitat and stream channels.

One of the most extensive agriculture problems that appropriate BMPs will help prevent is erosion and sedimentation. Excessive sedimentation clouds the water, which reduces the amount of sunlight reaching aquatic plants; covers fish spawning areas and food supplies; and clogs the gills of fish. In addition, other pollutants like phosphorus, pathogens, and heavy metals are often attached to the soil particles and wind up in the water bodies with the sediment. Farmers and ranchers can reduce erosion and sedimentation by 20 to 90 percent by applying management measures to control the volume and flow rate of runoff water, keep the soil in place, and reduce soil transport.

Nutrients such as phosphorus, nitrogen, and potassium, in the form of fertilizers, manure, sludge, irrigation water, legumes, and crop residues, can create nutrient related pollution. When these nutrients are applied to enhance production in excess of plant needs, they can wash into aquatic ecosystems where they can cause excessive plant growth, by which recreation opportunities decrease, drinking water becomes contaminated, and aquatic life can be killed. Farmers can implement nutrient management plans, which help maintain high yields and save money on the use of fertilizers while reducing NPS pollution. In the Upper Schuylkill River Watershed, currently four (4) farms have an approved nutrient management plan.

Confined Animal Facility Operations (CAFO's) can create runoff, which can carry pathogens (bacteria and viruses), nutrients, and oxygen-demanding substances that contaminate shellfishing areas and other major water quality problems. Ground water can also be contaminated by seepage. Farmers can efficiently manage runoff by confining animals to areas or lots and installing appropriate BMPs to contain animal waste. Discharges can be limited by storing and managing facility wastewater and runoff with an appropriate waste management system.

Pesticides, herbicides, and fungicides are used to kill pests and control the growth of weeds and fungus. These chemicals can enter and contaminate water through direct application, runoff, wind transport, and atmospheric deposition. They can kill fish and wildlife, poison food sources, and destroy the habitat that animals use for protective cover. To reduce NPS contamination from pesticides, people can apply Integrated Pest Management (IPM) techniques based on the specific soils, climate, pest history, and crop for a particular field. IPM helps limit pesticide use and manages necessary applications to minimize pesticide movement from the field.

Overgrazing exposes soils, increases erosion, encourages invasion by undesirable plants, destroys fish habitat, and reduces the filtration of sediment necessary for building stream banks, wet meadows, and floodplains. To reduce the impacts of grazing on water quality, farmers and ranchers can adjust grazing intensity, keep livestock out of sensitive areas, provide alternative sources of water and shade, and revegetate rangeland and pastureland (Environmental Protection Agency [EPA], 2004).

In the Upper Schuylkill River Watershed, agriculture is limited in comparison to other watersheds in Schuylkill County. Additionally, agriculture related pollution problems are less visible because of the overwhelming impact of mining related pollution problems. In the Upper Schuylkill River Watershed, only two stream segments have been categorized as impaired due to agriculture/siltation causes. In comparison, 37 stream segments have been listed as impaired due to mining and past mining related practices. A TMDL date for Beaver Creek (a tributary to Cold Run in the Lewistown Valley) the only assessed agriculture impaired stream, is scheduled for 2015.

As stream segments impaired by AMD are improved, agriculture related impairments might become a more visible priority for remediation. Additionally, isolated agriculture related pollution problems should be addressed in concert with the remediation of other prioritized pollution problems. In all cases, appropriate BMPs should be installed and utilized in the remediation of agriculture related pollution.

U. S. EPA Superfund Sites

There are two Superfund Sites within the Upper Schuylkill River Watershed. The McAdoo Associates Site (EPA ID PAD980712616) consists of two areas approximately 1-1/3 miles apart. One area, in the Borough of McAdoo, covers about 1/5 of an acre. This portion of the site is outside of the watershed. The other, in Kline Township, covers 8 acres within the watershed. From 1884 until 1969, this site was mined for anthracite coal. In 1975, McAdoo Associates acquired the property. Waste was stored at these sites from 1978 until 1979, when the state revoked McAdoo's permit to operate. At the time, the McAdoo Borough facility had five underground storage tanks that contained organic hazardous substances. The

Kline Township area, used as a metal reclamation and incineration facility, consisted of approximately 7,000 drums and six aboveground tanks. Soil and groundwater contamination threats existed at both McAdoo locations. Soil was contaminated with heavy metals and low levels of various volatile organic compounds from the former waste storage practices. Remediation of the sites consisted of removal of surface debris and contaminated soil and the placement of clean topsoil and a cap over the area of soil excavation. A manual pump-and-treat system of the contaminated groundwater at the Blaine Street location was installed.

In 1980, the site owner removed the incinerator, the buildings, and three temporary underground storage tanks and sampled the soil. In 1982, the owner removed all surface wastes and visibly contaminated soil to a federally regulated off-site facility. In 1985, the EPA chose a remedy to clean up the site which included removing all surface tanks; excavating contaminated soil, then backfilling the excavated area with clean topsoil; and constructing diversion ditches to prevent off-site surface water from draining into the site. The potentially responsible parties completed excavating the contaminated soil, backfilled the area with clean soil, and capped the site in the spring of 1992. Between 1988 and 1989, the last remaining tank and surface debris were removed. Soil sampling and a mine subsidence study also were conducted.

In 1992, the EPA completed an investigation into the nature and extent of any contamination in the groundwater and off-site surface water. The investigations concluded that no further actions were required to cleanup the contaminated groundwater and off-site surface water. After additional studies, the EPA determined that the Blaine Street location is contaminated with organics. In late 1993, the EPA amended the earlier "no action" decision. During the summer of 1995, the EPA began manually removing and treating contaminated groundwater. The removal and treatment of the contaminated groundwater at the Blaine Street location was completed 2001.

On August 15, 2001, EPA signed the Final Close-out Report for the McAdoo Associates site. A Notice of Intent to De-list the site was published in the Federal Register on October 3, 2001, including a 30-day public comment period. No comments were received and a final Notice of Deletion was published in the Federal Register on December 13, 2001. Groundwater monitoring will continue at the site.

The removal of contaminated materials and soil and the subsequent capping of the area have reduced the potential for exposure to hazardous materials at the McAdoo Associates site, while cleanup activities will address the remaining contamination areas and restore the site to safe levels.

The Eastern Diversified Metals Site (EPA ID PAD980830533) is a 25-acre former wire recycling facility. From 1966 to 1977, the company disposed of approximately 350 million pounds of "fluff" (waste insulation material) in an open pile. This fluff comes from stripping the covers off copper wire. The fluff disposal pile was approximately 40 feet high, 250 feet wide, and 1,500 feet long. In 1974, the company installed a wastewater treatment plant, diversion ditches, a retention basin, and a trench that diverted shallow groundwater to the treatment plant. The surface impoundment associated with the wastewater treatment plant had overflowed at times into a tributary to the Little Schuylkill River. Three miles downstream of the site, the Little Schuylkill River is used for trout fishing and other recreational activities. The Mauch Chunk Formation, one of the most important water-bearing formations in Northeast Pennsylvania, underlies the site. Approximately 1,400 people are served by wells that are within three miles of the site and draw on the Mauch Chunk Formation for their drinking water supply. Lead, phthalate (plastics), polychlorinated biphenyls (PCBs), and dioxin compounds were the principal contaminants in the fluff pile. Contaminants found in both leachate from the fluff pile and sediment consisted of heavy metals, polychlorinated biphenyls, and volatile organic compounds.

The U. S. EPA is overseeing the environmental cleanup of the Eastern Diversified Metals site, which is being carried out by a group of companies that are potentially responsible parties (PRPs) in causing the contamination. Currently, stormwater and runoff from the large pile of contaminated waste is being controlled and treated. This polluted water is cleaned at a newly built on-site treatment plant. Contaminated debris was also removed.

EPA has completely removed the dioxin-contaminated hot spots, and samples show that the cleanup standard has been met. On November 26, 2001, EPA issued a Record of Decision (ROD) for the site that requires the on-site containment of the fluff pile under a multi-layer cap, groundwater monitoring, and institutional controls.

Special Notice Letters were issued to the PRPs on June 21, 2002. The next steps include negotiating a Consent Decree for remedial design/remedial action with the PRPs.

A. Impairment of Water Quality and Aquatic Life

Much of the Upper Schuylkill River Watershed is degraded by AMD discharges from abandoned underground and surface coal mines. Numerous un-reclaimed open surface mines, coal refuse, culm banks, and mine pits divert surface water into the large underground mine pools. Tunnels connect many of the mine pools and discharge high volumes of mine drainage. The Upper Main Stem and the West Branch have mainly alkaline discharges with elevated iron; the Little Schuylkill River watershed has mainly acidic discharges. Iron precipitate coats most stream substrates in the mined areas. A few discharges have high aluminum that precipitates after reaching the surface. Mining is still taking place in the sub-basin, but on a much more limited basis than in the past.

Many small streams in the sub-basin flow into abandoned surface mine pits and spoil piles and disappear into the underground mine workings. Flume diversions were installed years ago in an attempt to prevent streams from entering the underground mine workings. Most of these flumes have deteriorated allowing surface water to infiltrate and increase the volume of discharges from mine openings. Inflows of the degraded Big Creek and Silver Creek and the Mary D and Kaska mine discharge into unnamed tributaries and impact the Upper Schuylkill River. Restoration of the stream channels would lessen the amount of water exiting the mine openings into the receiving streams and in some instances restore aquatic life to these smaller tributary streams.

The upper reaches of the West Branch Schuylkill River are impacted by alkaline discharges from abandoned mine tunnels, including the Otto Mine Discharge at 3,000 gpm and the Pine Knot Tunnel at 4,000 to 15,000 gpm. The major impacts are elevated concentrations of iron, manganese, and occasionally, aluminum. The West Branch Schuylkill River pH is near 7.0; the middle reaches are coated with iron precipitate, which eliminates the majority of the macroinvertebrates; however, a native brook trout population thrives in this area. A naturally reproducing brook and brown trout fishery and a diversity of macroinvertebrates are present in the lower reaches of the West Branch.

The Pa. DEP has an ongoing program to assess the quality of waters in Pennsylvania and identify streams and other bodies of water that do not meet water quality standards (WQSs) as “impaired.” Water quality standards are comprised of the uses (including antidegradation) that waters can support and goals established to protect those uses. Uses include, among other things, aquatic life, human health, and recreation, while the goals are numerical or narrative water quality criteria that express the in-stream levels of substances that must be achieved to support the uses.

In the sub-basins, during a survey by DEP biologists in the summer of 2000, siltation and flow alterations were identified as major pollution causes. Iron precipitate was noted as the major sediment in most of the watersheds. The major pollution source is the extensive abandoned mining; however, a variety of other sources including small residential development, urban runoff and storm sewers, habitat alterations, channelization, upstream impoundments, and road runoff may also impact the sub-basin. No quantitative assessment of these other potential sources has been made due to the overwhelming impact of AMD on the watershed.

Despite the extensive mining in the sub-basin, many sub-watersheds are unimpaired and have naturally reproducing populations of brook trout. The lower 17.59 miles of the Little Schuylkill River and other unimpaired waters are an important recreational resource for the region. The larger unimpaired secondary watersheds include Big Creek, Tumbling Run, Dyer Run, Panther Creek and Beaver Creek both near Cressona, Mahoney Creek, Locust Creek, Indian Creek at Rauschs, and Rattling Run. Other watersheds are unimpaired in their upper sections and provide drinking water for many regional residents.

The Pa. Fish and Boat Commission (PFBC) assessed the West Branch Schuylkill River fishery in 1998, 1999 and 2000. They discovered over 100 native brook trout at two locations on the West Branch and at one location on the Muddy Branch. A mixed brook and brown trout population was found at the mouth of the West Branch. Some tributaries to the West Branch had more trout than the main stem. The highest numbers of trout were captured in the West West Branch, a total of 312 trout in 302 meters of stream near the mouth, and 250 trout in 343 meters of stream just downstream of Schaefer Creek. Several brook trout were also found in the middle reaches of the West Branch near the railroad bridge upstream of Minersville Borough and in the Muddy Branch near the T-564 bridge at the village of Steins. Seven brook trout and several brown trout were captured about one mile downstream of the near-neutral pH, high aluminum Pine Knot/Oak Hill discharge. Total lengths of fish captured throughout the watershed ranged from 2 to 15.7 inches for brook trout and from 3 to 19.6 inches for brown trout. The high numbers of trout were downstream of major deep mine discharges where the pH ranged from 6.8 to 7.1 and the alkalinity was moderate to high (32 to 56 mg/l). The cold water from the deep mine discharges provide ideal temperature conditions for trout.

Several of the above streams that contain populations of native brook trout are listed as impaired on the 303d list. Determination of impairment is based on the macroinvertebrates living in the stream and the habitat. The precipitated metals and the silt covering the substrate adversely affect the invertebrates and limit colonization, thus leading to an impaired designation. The neutral pH and the cold water from the deep mine discharges allow trout to survive and in some cases thrive. The brook trout are mobile and can move up into tributaries to feed or, if conditions worsen, they are able to live in many of these streams as long as the water is cold.

B. Total Maximum Daily Loads (TMDLs)

TMDL calculations have been prepared for segments throughout the Upper Schuylkill River Watershed. They were done to address the impairments noted on the 1996 Pennsylvania 303(d) list, required under the 1972 Clean Water Act, for streams in the Commonwealth to address non-point source pollution in water bodies that are deemed to be "water quality impaired." These are water bodies that do not meet Pa. DEP standards for their designated use. High levels of metals, and in some areas depressed pH, caused these impairments. All impairments resulted from acid drainage from abandoned coalmines.

One of the major components of a TMDL is the establishment of an in-stream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An in-stream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for comparison between observed in-stream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

The TMDL components are expressed as Load Allocations (LAs) that are specified above a point in the stream segments. All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average, total
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL Segments

Pa. DEP, Pottsville District Mining Office is conducting a TMDL for the entire Upper Schuylkill Watershed that is scheduled to be completed by 2007 (verbal comments, Gary Gocek and Mike Hill, November 2004). TMDLs have already been established for Panther Creek, Wabash Creek, Mill Creek, Muddy Branch, and West Branch Schuylkill River. DEP is currently conducting assessment activities to establish TMDLs for the Little Schuylkill River and the Upper Schuylkill River. All TMDL stations appear on watershed map 1-5 in Attachment A.

Panther Creek

Panther Creek originates approximately 0.5 miles east of the Borough of Lansford in Carbon County. The stream flows southwesterly for 6.5 miles until reaching the Little Schuylkill River at Tamaqua. The majority of the watershed has been affected by underground and surface mining activities dating back at least 200 years. There is active mining in the Panther Creek Watershed operated by the Lehigh Coal and Navigation Company (LC&N). LC&N's current mining operation contains two (2) major open pits, Job 111 and Springdale, as well as many acres of abandoned mine land, including abandoned pits, spoil piles, and refuse piles. The entire LC&N mine site of 7,596 acres is contained within Surface Mining Permit No. 543333020, issued August 28, 1985, which overlaps basically the entire Panther Creek Watershed.

The historic deep mining below the natural groundwater level on both sides of the valley has caused the formation of a large pool of acid mine water, named the Tamaqua Mine Pool. In order to keep the operation dry to strip mine coal below the Tamaqua Mine Pool, LC&N pumped the mine pool via large pumps placed within two abandoned deep mine shafts on the north side of the valley. The permitted discharge from the pumping was treated on-site prior to release to Panther Creek. On several occasions, pumping temporarily ceased, due to malfunctions, causing the mine pool to flood and to discharge from an abandoned deep mine opening along Route 309 south of Tamaqua before reaching the Little Schuylkill River. Since February 9, 2001, LC&N has ceased pumping operations due to financial difficulties. The Tamaqua Mine Pool has been discharging at the Route 309 location since May 2001. A temporary treatment facility was constructed by LC&N to treat the water prior to discharge into the Little Schuylkill River.

Panther Creek, a cold water fishery (CWF), is a tributary to the Little Schuylkill River, which eventually flows into the Schuylkill River. Panther Creek (stream code 02252) is identified as Segment 0432 under State Water Plan 3-A. A total of three (3) sample locations (002, 003 and 005) were identified in the TMDL assessment of Panther Creek. Station 002 is an upstream monitoring point on Panther Creek, point 005 is a midstream sample point on Panther Creek, and sampling point 003 is Panther Creek at the mouth of the stream at the confluence with the Little Schuylkill River. All sample points are shown on map 1-5 included in Attachment A. Load reduction calculations are in Table 4 of the TMDL, which is reproduced here in Attachment B. The concentrations of metals and acidity at the sampling points on Panther Creek indicate that the stream is not meeting water quality standards for aluminum, iron, manganese, and pH.

Wabash Creek

The Wabash Creek Watershed is approximately five (5.0) square miles in area. Wabash Creek originates west of the village of Reevesdale and flows northeast 3.2 miles, along Route 209, to the confluence with the Little Schuylkill River in the borough of Tamaqua. The watershed is a narrow valley bordered on the north by Locust Mountain and on the south by Sharp Mountain. The towns of Reevesdale, Newkirk, and Tamaqua are located in the watershed.

The watershed has been extensively mined beginning in the early 1800's and was later surface mined for anthracite coal. When the deep mines ceased operation, they filled with water and formed large mine pools on the north and south sides of Wabash Valley. Abandoned strip mines retained most surface runoff and served to recharge the mine pools. Five (5) deep mine discharges from the two deep mine pools are negatively impacting the water quality and macroinvertebrate community in Wabash Creek. They include the Newkirk Tunnel and Reevesdale No. 1 Drift that drain the mine pool located beneath the surface of Sharp Mountain on the south side of Wabash Valley. The Reevesdale No. 2 Drift, Churn Holes and Combined Flows drain the deep mine pool from Locust Mountain on the north side of Wabash Valley.

Two seep areas also negatively impact the water quality of the Wabash Creek. They include the sites of the former Reevesdale Colliery located south of Reevesdale and the Newkirk Breaker located at the mouth of the Newkirk Tunnel.

Upstream of the mine discharges, in the headwaters of Wabash Creek, the water is alkaline with low concentrations of iron, aluminum and manganese. Downstream in Tamaqua the pH is depressed and precipitated iron and aluminum coat the bottom of the stream. Other current usage of the watershed includes hunting and hiking.

Wabash Creek, a CWF, is a tributary to the Little Schuylkill River, which flows into the Schuylkill River. Wabash Creek (stream code 02251) is identified as Segment 6185 under State Water Plan 3-A. The headwaters of the Wabash Creek are alkaline and exhibit low concentrations of iron, manganese and aluminum commonly associated with abandoned mine drainage. However, as stated above, five (5) discharges from deep mine pools and two seep areas located at former coal processing facilities negatively impact the water quality and macroinvertebrate community in Wabash Creek. Six sample locations (1WB, 2WB, 4WB, 8WB, 11AWB and 11WB) were identified in the TMDL assessment of Wabash Creek. Point 002 is at the headwaters of Wabash Creek, point 2WB is at the Reevesdale No. 2 Drift, point 4WB is at the Reevesdale No. 1 Drift, point 8WB is at the Newkirk Tunnel Outflow, point 11AWB is the inlet to the tunnel under Tamaqua, and point 11WB is the exit of the tunnel under Tamaqua. All sample points are shown on map 1-5 included in Attachment A. Load reduction calculations are in Table 5 of the TMDL, which is reproduced here in Attachment B. The concentrations of metals and acidity at the sampling points on Wabash Creek indicate that the stream is not meeting water quality standards for aluminum, iron, manganese, and pH.

Little Schuylkill River

The Little Schuylkill River Watershed is approximately 53.4 square miles in area. It is located in eastern Schuylkill County, about a mile south of Haddock, Pa. The Little Schuylkill River flows 31.44 miles south from its headwaters near Haddock in Kline

Township, Schuylkill County to its confluence with the Schuylkill River at Port Clinton in West Brunswick Township, Schuylkill County.

The Little Schuylkill River Watershed is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the main stem of the Little Schuylkill River at numerous sources as well as from two tributaries, the Wabash and Panther Creeks. AMD begins near the headwaters from the Silverbrook Discharge. Sources of AMD are nonexistent once the Little Schuylkill River flows south of Sharp Mountain and out of the Southern Anthracite Coalfield.

There are active mining operations in the watershed. All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources, except for one large discharge (NPDES permit #PA0012360).

Abandoned mine areas are dominant in the northern portion of the Little Schuylkill River Watershed. Besides the AMD from Wabash and Panther Creeks, the watershed receives sources of AMD from two topographical basins known as the Silverbrook and Tamaqua Basins. The Silverbrook Basin contains less than one mile of the stream. The Tamaqua Basin, which begins approximately 7.2 miles downstream from the Silverbrook Basin, contains a 1.5-mile reach of the stream.

AMD into the watershed is primarily from deep mine pools, both abandoned and active mines. The largest of these pools is the Silverbrook Mine pool, which underlies most of the Silverbrook Basin.

Smaller deep mine pools are situated on the west side of the Little Schuylkill River at the water gaps north and south of Tamaqua Borough. All five pools extend for some distance into the Wabash Valley and, therefore, drain a portion of the groundwater from this valley.

The land surface in the Silverbrook Basin has been almost completely destroyed by surface and deep mining. Similar activities on both sides of the water gaps at Tamaqua have destroyed the land surface in these areas as well. The Silverbrook Basin has been an area of very extensive deep mining below present water level. As a result of abandonment, 80 to 90% of the deep mine workings are now inundated, forming a huge pool of acid mine water underlying much of the basin.

The headwaters of the Little Schuylkill River are in the Silverbrook Basin and the overflow (Silverbrook Discharge) from the mine pool is a large part of the flow for the river at this point. The point of discharge is on the bank of the stream 200 feet east of State Route 309. The mine flow emanates from the base of a refuse bank, which conceals a possible portal.

Immediately adjacent to the east of the Silverbrook Discharge is an active surface mining permit issued to Northeastern Power Company (NEPCO). The surface mining permit covers 876 acres and consists mainly of loading and transporting existing supplies of coal refuse as fuel for the onsite fluidized bed cogeneration plant. Also, included with the operations is the reclamation of existing onsite abandoned mining areas with placement of coal ash. Immediately adjacent to the west of the Silverbrook Discharge along the bank of the Little

Schuylkill River are two (2) limestone diversion wells constructed by Pa. DEP. The first well was constructed in the spring of 1996 and the second in the fall of 1998.

Within the Tamaqua Basin, a large AMD discharge, the Route 309 Buck Drift Discharge, flows from a buried deep mine opening south of Tamaqua, on the east side of State Route 309 along the north side of Pisgah Mountain (one mile south of the intersection of SR 209 and SR 309 in Tamaqua). The discharge is believed to drain four (4) deep mine pools, named Tamaqua, Greenwood, Rahn and Coaldale, extending from Tamaqua westward to Coaldale (Taylor 1988). On the surface, the discharge is routed into a buried 30-inch pipe before entering the Little Schuylkill River.

Currently, the Pa. DEP's Bureau of Abandoned Mine Reclamation (BAMR) is constructing a wetland complex in the area between the surface and the pipe discharge to provide passive and active treatment for the Rt. 309 Buck Drift Discharge. The project will also backfill and grade approximately 100 acres of abandoned strip mine pits and spoil piles.

There are currently five (5) active coal mining permits in the watershed. All the active mining sites are re-mining permits since they are reclaiming piles of previously unusable culm bank material by turning it into a fuel source. The Lehigh Coal & Navigation Company (LCN) has an NPDES permit that covers outfall No. 005 that is actively discharging and a Waste Load Allocation has been calculated for the TMDL. This discharge is temporary and shall only be effective until LCN has constructed a permanent treatment facility. Premium Fine Coal, Inc. and South Tamaqua Coal Pockets, Inc. both have NPDES permits for erosion and sedimentation. The sedimentation ponds have no recorded discharges, and have not been assigned waste load allocations. It has been determined that effects from sedimentation ponds are negligible because their potential discharges are based on infrequent and temporary events and the ponds should rarely discharge if reclamation and revegetation is concurrent. In addition, sedimentation ponds are designed in accordance with PA Code Title 25 Chapter 87.108 (h) to at minimum contain runoff from a 10-year 24-hour precipitation event.

The Little Schuylkill River is a CWF that flows into the Schuylkill River. Little Schuylkill River (stream code 02202) is identified as Segment 6189 under State Water Plan 3-A. A total of 12 sample locations (LS1 – LS11, LS13) were identified in the initial assessment of the Little Schuylkill River. Eleven (11) sampling sites on the Little Schuylkill, one site on Lofty Creek, one discharge and two previous TMDLs (Panther and Wabash Creeks) were included in Little Schuylkill TMDL calculations. Sample point LS1 is a notched weir on the Little Schuylkill, upstream of diversion wells; point LS2 is a notched weir at Silverbrook outflow, upstream of diversion wells; point LS3 is downstream of diversion wells and a small unnamed tributary; point LS4 is located on Lofty Creek, just upstream of the confluence to Little Schuylkill; point LS5 is upstream of 2 permitted mines (prep plants); point LS6 is on the Little Schuylkill River downstream of mine sites; point LS7 is on the Little Schuylkill River west of Hometown; point LS8 is just downstream of the mouth of Locust Creek; point LS9 is the USGS gauging station on Little Schuylkill, north Tamaqua; discharge point 005 is the LCN Route 309 discharge; point LS10 is just downstream of a very large deep mine discharge piped from SR309; point LS11 is the Little Schuylkill River south of coal fields; and, point LS13 is the most downstream reach of Little Schuylkill River. All sample points are shown on map 1-5 included in Attachment A. Load reduction calculations are in Table 4 of the TMDL, which is reproduced here in Attachment B. The Little Schuylkill River is listed as impaired on the 1996 PA Section 303(d) list for metals, suspended solids, and depressed pH from AMD as being the cause of the degradation to the stream.

Mill Creek

Mill Creek watershed is approximately 17.2 square miles in area. Mill Creek flows 11.2 miles south/southwest from its headwaters near Interstate 81 and Mahanoy City to its confluence with the Schuylkill River in Port Carbon. It is located in central Schuylkill County, Pa. and includes the communities of New Boston, Morea, St. Clair and Port Carbon.

Mill Creek is affected by pollution from AMD that has caused high levels of metals in Mill Creek. Major sources of AMD occur at three (3) abandoned deep mine discharges named the Morea Overflow, Repplier/Buck Mountain, and Pine Forest. Mill Creek has been severely impacted by past mining and flows into abandoned deep mine workings near its headwaters. Mill Creek resurfaces at the Morea Overflow, which is approximately three (3) miles from the point where the stream disappears.

There are a few active mining operations in the watershed. The three (3) major discharges in the watershed are all caused by abandoned mines and are treated as non-point sources because there is no party responsible for the discharges.

The Mill Creek Watershed lies within the Anthracite Upland Section of the Ridge and Valley Province. The upper reach is within a small basin, known as the New Boston Basin, which is in the southern portion of the Western Middle Anthracite Field. The lower reach is in the central portion of the Southern Anthracite Field.

Approximately thirty-two percent (32%) of the area within the watershed is abandoned mine lands, including abandoned pits, deep mine openings, spoil piles, and refuse piles, which were affected and abandoned prior to State and Federal laws and regulations requiring reclamation of surface mines.

Due to the extensive mining, for more than 100 years, most of Mill Creek in the New Boston Basin has been eliminated. Above the disturbed area, stream flow disappears into abandoned deep mine workings approximately 1.4 miles from the headwaters. As stated above, stream flow reappears at the Morea Overflow near the cogeneration plant operated by Wheelabrator Culm SVC, Inc. The cogeneration plant is using the nearby piles of coal refuse for fuel and the coal ash, which is a byproduct, is used to reclaim abandoned pits within the basin. The operator's reclamation goal is to ultimately restore Mill Creek.

Several water supply reservoirs are located outside the coalfields and are feeding tributaries that flow to Mill Creek.

Additional sources of AMD reach Mill Creek in the lower reach of the watershed. The main source of AMD is from two (2) large deep mine discharges known as the Repplier/Buck Mountain and Pine Forest. The lower reach of the watershed also contains the majority of the developed area. About eight percent (8%) of the total Mill Creek Watershed area is developed and most of the development is concentrated near Mill Creek itself.

There is another deep mine opening known as the St. Clair Shaft, located near the borough of St. Clair. Although this opening, now sealed, is not discharging and has not discharged for over 50 years, it will discharge upon the cessation of active pumping of the underlying mine pool. The Reading Anthracite Coal Company, Inc. is pumping this mine pool in order to mine at their Wadesville Pit, a large open pit mine outside the watershed. The mine pool is pumped by large submersible pumps deep within an old mine shaft. The water is discharged into an unnamed tributary to the Schuylkill River. The discharge is authorized by an NPDES permit, which consistently meets effluent limits without treatment. Upon completion of the mining, the pumping will cease and the mine pool will flood and overflow at the St. Clair Shaft. The discharge will eventually reach Mill Creek via St. Clair's stormwater drainage network.

The draft TMDL for Mill Creek consists of load allocations to four sampling sites along the stream (M1, M2, M4 and M6) and 3 abandoned mine discharges (M3, M4A and M5). Point M1 is at the headwaters of Mill Creek; point M2 is at the point where Mill Creek is lost to the mine pool; point M3 is the Morea AMD Discharge where the stream reappears; point M4A is at the Repplier Abandoned Deep Mine Discharge; point M5 is at the Pine Forest Discharge; and point M6 is the mouth of the Mill Creek before it enters the Schuylkill River. All sample points are shown on map 1-5 included in Attachment A. Load reduction calculations are in Table 4 of the TMDL, which is reproduced here in Attachment B. Mill Creek is listed on the 1996 PA Section 303(d) list with metals from AMD being the cause of the degradation to the stream.

<u>Muddy Branch</u>

Muddy Branch watershed is approximately 4.3 square miles in area. It is located in Branch Dale, Pa. in Western Schuylkill County. Muddy Branch flows south from its headwaters just north of Branch Dale to its confluence with the West West Branch Schuylkill River south of Llewellyn in Branch Township, Schuylkill County. The headwaters are accessible from State Route 209 in Branch Dale and turning north on St. Mary Rd. to LR 53072 for approximately 1500 feet.

The Muddy Branch Watershed lies within the Southern Field of the Anthracite Upland Section of the Ridge and Valley Province and is affected by pollution from AMD that has caused high levels of metals in Muddy Branch. There has been extensive historical underground mining throughout the northern portion of the watershed. The main source of AMD is from the Otto Mine Pool, which formed after the Otto Colliery closed down and the workings were allowed to flood. The Otto Mine Pool is estimated to contain 2.265 billion gallons of water (US Bureau of Mines, 1949). The Muddy Branch receives most of its flow and pollution at a major deep mine discharge known as the Otto Primary Discharge near Branch Dale. Along with the Otto Primary Discharge, two other deep mine discharges exist near the headwaters and are known as the Otto Secondary Discharge and the Primrose Slope Discharge. The unnamed tributaries to Muddy Branch are not affected by AMD as water quality data shows no impact and no sources of AMD are know to drain to these tributaries.

Presently, there is one active mining operation in the watershed, White Pine Coal Co., Inc. (see Attachment D). The mine is an open pit operation stripping multiple seams of coal. The surface mining permit (SMP) is referred to as a re-mining SMP since the final reclamation of the site will eliminate previously unregulated strip mining and restore the area to approximate original contour (AOC).

As stated above, three discharges, Otto Primary, Otto Secondary, and Primrose Slope are identified in the SMP and NPDES Permit No. PA0594504 as pre-existing pollution discharges. Since the mining operation is hydrologically connected to these discharges and may be impacted by mining activities authorized under the SMP, baseline pollution loading rates were developed for a hydrologic unit combining the three Otto Mine Pool Discharges. If there is a determination that pollution loading degradation has occurred, the permittee shall then commence treatment in accordance with effluent limits specified in the SMP.

A Fisheries Management Report conducted by the Pa. Fish and Boat Commission (Chikotas and Kaufmann, 2001) for the Muddy Branch found water quality poor based on physical-chemical values and aquatic macroinvertebrate community. The report states that near Station MB5 enough wild brook trout were found to qualify for the Class B biomass category. The report also states an impact from untreated sewage, which is especially noticeable above the Otto Primary Discharge.

An abandoned municipal waste landfill is located just south of Branch Dale near Muddy Branch and the Otto Primary Discharge.

The TMDL for Muddy Branch Creek consists of a load allocation to one (1) sampling site along the main stem of Muddy Branch Creek (MB6), one (1) deep mine discharge (MB3), three (3) mine discharge load allocations (MB1, MB1A and MB2) and two (2) sampling sites along two unnamed tributaries (MB4 and MB5). Sampling site MB2 is at Otto Primary Discharge; site MB1 is at Otto Secondary Discharge; site MB1A is at Primrose Slope Discharge; site MB3 is at a deep mine discharge that enters into Muddy Branch Creek; site MB4 is at an unnamed tributary to Muddy Branch Creek; site MB5 is at an unnamed tributary to Muddy Branch Creek; and site MB6 is at the mouth of Muddy Branch Creek. All sample points are shown on map 1-5 included in Attachment A. Load reduction calculations are in Table 4 of the TMDL, which is reproduced here in Attachment B. Muddy Branch Creek is listed for metals from AMD as being the cause of the degradation to the stream.

West Branch Schuylkill River

The West Branch Schuylkill River Watershed is approximately 21 square miles in area. The watershed is located in central Schuylkill County, Pa. and encompasses many communities that include Minersville, Pottsville, and Cressona. The West Branch Schuylkill River flows east-southeast from its headwaters in the small communities of Glen Dower and Buck Run to its confluence with the Schuylkill River in Schuylkill Haven.

The West Branch Schuylkill River lies within the Southern Anthracite Coal Field, which is part of the Anthracite Upland Section of the Ridge and Valley Province. The West Branch Schuylkill River is affected by pollution from AMD that has caused high levels of metals in the stream. Major sources of AMD occur at two (2) abandoned deep mine discharges named the Pine Knot/Oak Hill Tunnel, and the Oak Hill Boreholes.

There are active mining operations in the watershed and they are considered re-mining permits. The two (2) major discharges in the watershed are caused by abandoned mines and are treated as non point sources. There is a point source discharge from the active Woods Drift underground mine with an NPDES permitted discharge for treatment of mine water. This point source discharge requires a Waste Load Allocation that affects the mouth point of the West Branch Schuylkill River.

The headwaters of the West Branch Schuylkill River are within the Heckscherville Valley, which has been extensively mined since the early 1800's. Historic mining includes abandoned surface pits, deep mine openings, spoil piles, and refuse piles, which were affected and abandoned prior to State and Federal laws and regulations requiring reclamation of surface mines. The extensive mining has altered portions of the original streambed throughout the Heckscherville Valley.

Much of the deep mining in the Heckscherville Valley extended below the water table, which created openings that were susceptible to flooding after abandonment of the mine workings. The deep mines were separate operations called collieries. Barriers of unmined coal separated the collieries. However, over the years these barrier pillars have been mined through or breeched causing the connection of the mine pools. Ultimately, the Pine Knot/Oak Hill Tunnel collectively drains all these mine pools.

The Pine Knot/Oak Hill Tunnel discharges AMD directly into the West Branch Schuylkill River. It is the largest single source of AMD in the entire Upper Schuylkill River Watershed. The Oak Hill Boreholes are another source of AMD that also discharges directly to the West Branch Schuylkill River. The boreholes are an overflow point for several connected mine pools outside the Heckscherville Valley. Sources of AMD are nonexistent once the West Branch Schuylkill River flows south of Sharp Mountain and out of the Southern Anthracite Coalfield.

Raw sewage "gray water" is a problem, especially in the headwaters. Sewage treatment facilities are operated in Minersville and Pottsville.

The TMDL for West Branch Schuylkill River consists of a load allocation to four (4) sampling sites along the main stem of the West Branch Schuylkill River (WB2, WB3, WB4 and WB6), one (1) discharge (WB1), one (1) sampling site along a tributary (WB5) and one waste load allocation (RWS001). Point WB1 is at the Oak Hill Tunnel; point WB2 is on the West Branch Schuylkill River near Duncott; point WB3 is on the West Branch Schuylkill River below the Oakhill Boreholes; point WB4 is on the West Branch Schuylkill River below the confluence of two tributaries; point WB5 is near the mouth of West West Branch Schuylkill River; discharge point RWS001 is at the R. S. & W. Coal Company's Woods Drift Mine; and point WB6 is at the mouth of the West Branch Schuylkill River. All sample points are shown on map 1-5 included in Attachment A. Load reduction calculations are in Table 5 of the TMDL, which is reproduced here in Attachment B. The West Branch Schuylkill River is listed for metals from AMD as being the cause of the degradation to the stream.

<u>Upper Schuylkill River</u>

The Upper Schuylkill River Watershed is approximately 49.4 square miles in area. The watershed is located in central Schuylkill County, Pa. and encompasses many communities that include Pottsville, Schuylkill Haven, and Port Clinton. The Upper Schuylkill River flows east-southeast from its headwaters near the small community of Tuscarora to its confluence with the Little Schuylkill River in Port Clinton.

The Schuylkill River is affected by pollution from AMD that has caused high levels of metals in the Schuylkill River. There are active mining operations in the watershed and they are considered re-mining permits. Major sources of AMD occur at twelve (12) known abandoned deep mine discharges and are treated as non-point sources.

A portion of the Upper Schuylkill River Watershed lies within the Southern Anthracite Coal Field, which is part of the Anthracite Upland Section of the Ridge and Valley Province. This coalfield is the largest of four fields in the entire Anthracite Region and is complexly folded and faulted into an elongated basin. The Anthracite Region ends south of Pottsville.

The headwaters of the river begins within this field and flows over 12 miles before flowing past Pottsville. The headwaters have been extensively mined since the early 1800's. The discovery of anthracite fueled the Industrial Revolution, bringing immigration and further development of many boroughs and "patch towns" which still exist today. Approximately 7.3% of the watershed is developed.

Although the anthracite boom has come and gone, there is still active mining occurring within the watershed. Approximately 7.5% of the 49.4 square mile watershed has been mined. All the active mining sites are re-mining permits, since they are mining and reclaiming previously mined areas.

Many communities within the headwaters still discharge raw sewage to the river. A number of "wildcat" sewers are prevalent in the headwaters with the highest concerns located in the New Philadelphia and Middleport areas (Kimball, 2000). However, construction of sewage collection and treatment facilities began in these areas in 2004.

Aquatic life does exist within the headwaters of the Schuylkill River. Recent fish sampling of the Schuylkill River upstream and downstream of Pottsville identified a mixture of warm water species, with blacknose dace, creek chub, white sucker, and green sunfish most abundant. Small numbers of rainbow, brown, or brook trout were collected at the downstream station, evidence of prior stocking by the Pennsylvania Fish and Boat Commission (Normandeau, 2004).

POLLUTANT LOAD REDUCTIONS REQUIRED TO MEET TMDL

At the time of this plan's preparation, TMDLs have been finalized for Panther Creek, Wabash Creek, Mill Creek, Muddy Branch, and West Branch Schuylkill River. The Upper Schuylkill and the Little Schuylkill River TMDLs are expected to be completed by 2007. Load reductions specified in the five finalized TMDLs and preliminary calculations for the remaining watersheds are shown in Tables 4 and 5 of their respective documents and included in attachment B of this report. All sample points are shown on Map 1-5 included in attachment A. The Upper Schuylkill River is listed for both high metals and low pH, with AMD indicated as the cause of stream degradation.

MANAGEMENT MEASURES REQUIRED TO ACHIEVE PRESCRIBED LOAD REDUCTIONS

A. General Remediation Strategies and Design Standards

As a first step in the recommendation of remediation alternatives for the prioritized sites identified above, a series of broad goals have been established. These goals will be used to assist in the analysis of alternatives and ultimately to assess the performance of the remediation measures.

- The first goal involves the specific chemistry associated with the discharges. This is difficult to summarize since the chemistry will vary with each location, even seasonally, and following precipitation events. However, the general goals for the treatment alternatives will be to achieve typical Title 25 standards for the following parameters at the discharge of each remediation system:

    1. Reduction of iron concentration to less than 1.5 mg/l
    2. Reduction of aluminum concentration to less than .75 mg/l
    3. Reduction of manganese concentration to the extent practical
    4. pH levels with the range of 6.0 – 9.0
    5. Alkalinity exceeding acidity

- The second goal is to increase public awareness of environmental issues and help to restore a sense of pride and community partnership within the watershed. Since the region has a long history of mining and the associated mine discharge problems, citizens have grown used to seeing orange streambeds devoid of life. Environmental change associated with remediation of mine discharge problems will result in an increase in local interest in the streams. A small (but noticeable) change can have a significant impact on community involvement. As such, it will be important to locate the proposed remediation sites in locations where the improvement will be highly visible to the residents.

- The third goal is to establish a recreation corridor along the various waterways to take advantage of the improving environmental conditions in the streams. This will make the improvements more obvious to the public and further expand public awareness of the need for additional improvements. If possible, the remediation techniques should incorporate walking paths with information placards describing the treatment methodologies. In addition, signs identifying those groups responsible for the remediation will pay dividends.

Awareness of the three goals will aid in the selection of remediation strategies for each of the prioritized sites. General strategies, which will be evaluated for each site, will include the following:

1. Elimination of the source of the discharge
2. Passive treatment of collected flows

3. Active treatment of collected flows

Examples of each of these techniques are discussed below:

Elimination of the Sources of Discharge

Where possible, the most cost-effective means of dealing with AMD discharges is to eliminate the source of the discharge. This can involve: capping refuse piles to reduce infiltration through the waste materials, sealing mine openings, preventing upstream recharge of abandoned mines, and reclaiming abandoned sites to eliminate exposed highwalls and deep mine entries. Since these methods are very site-specific, it is difficult to assess their use in this report, and the remainder of the document will generally emphasize the use of passive and active treatment systems. However, it should be noted that these methods should be evaluated for certain sites, especially those where stream flow loss to deep mines has been noted.

Within the Little Schuylkill River watershed, source elimination activities are currently being proposed/studied, and in one case, being implemented. Pa. DEP, BAMR is currently studying the possibility of filling abandoned surface mine pits with river dredge material. The project would involve importing the dredge material and filling pits to levels approximately equal to the original topography. The strip pits under consideration are located south of Panther Creek and east of the Little Schuylkill River. The result of these efforts would hopefully reduce infiltration and may reduce discharge flows along the Little Schuylkill River and Panther Creek.

A second source elimination effort is currently on-going at former stripping pits located in the northeast portion of the watershed. Pa. DEP, in conjunction with the Pennsylvania State University, is currently filling these strip pits with fly ash (by-product of coal fired electrical generating facilities). Fly ash is usually mixed with limestone for purposes of reducing emissions at the generating plant. The resultant material is usually very low acidity (high pH). At the strip pits, this material is being end dumped into the pits, with the eventual goal of reaching original topography. Several test wells are located within the fill and are being used to study the effect of the fly ash on water quality.

Passive Treatment of Collected Flows

There are a host of passive treatment methodologies available for remediation of the discharges identified throughout the watershed. Passive treatment is accomplished primarily via contact with limestone, which tends to raise the pH and neutralize the acidity of the flows. In addition, some passive treatment methods utilize sulfate-reducing bacteria and wetland vegetation to assist with removal of metals. The interaction of the limestone and bacteria can form a complex bio-chemical reaction, which results in a sulfate-reducing environment that promotes the oxidation and precipitation of dissolved metals in the drainage upon aeration. This same process can be achieved in stand-alone wetlands if the influent chemistry is appropriate.

The use of passive treatment is a relatively new process and although there is significant literature available regarding different methods, the systems still tend to be rather experimental in nature. As such, hard design standards have not been generated for these techniques, but various "rules-of-thumb" are included herein for use in sizing the structures.

Passive treatment systems have been shown to be very effective on relatively small discharges, with space of creation of treatment systems identified as the critical issue. As such, for discharges with relatively large flows or flows that tend to fluctuate dramatically during precipitation events, passive treatment may not be appropriate. In addition, passive treatment systems do tend to accumulate metal precipitate, which must be removed periodically, and portions of the treatment system may require cleaning or replacement to remove deposition. Some systems also require a considerable initial "breaking-in" period before the sulfate-reducing bacteria are present in sufficient quantity to aid in treating the influent. There is also frequently an initial biological oxygen demand (BOD) problem with the discharge, resulting from the compost material used within the treatment system, although this problem tends to decrease rapidly.

The following is a brief discussion of various passive treatment techniques, with special emphasis on the site conditions that are appropriate for use of these methods, as well as general design considerations for use.

Aerobic Wetlands – These systems are man-made pools or enhancements of existing swampy areas, which tend to be the simplest and least expensive treatment systems to establish. However, they require influent with a relatively high pH (over 6.0), impermeable bases to limit infiltration, an imported highly organic substrate, and specific wetland vegetation capable of continuous submersion.

The principal function of these systems is the removal of certain metals resulting from the action of aerobic bacterial activity and oxidation. This results in the precipitation of the solution as a metal hydroxide sludge, which settles to the bottom of the wetland. Maintenance may be required periodically to prevent excessive clogging. The oxidation process results in increased acidity and decreased pH, and some limestone neutralization may be required at the outlet prior to discharge.

Aerobic wetland systems require influent pH ranges of between 6.0 and 8.0 and sufficient surface area and retention time for adequate oxidation to permit metal precipitation. Some systems utilize multiple ponds constructed in parallel to spread the flows over a larger area, which makes it easier to maintain the system. Aerobic wetlands are primarily used for the reduction of ferrous iron in concentrations up to 70 mg/l. They have not been shown to be effective on aluminum or manganese concentrations.

Based on the equations presented in the text "*The Science of AMD and Passive Treatment,*" the minimum wetland size is computed as follows:

> (Ac)= (Fe loading / 180) + (Mn loading / 90) + (Acidity / 60)
> (where loadings are listed as lb/day, and the 180, 90 and 60 represent typical lb/ac/day capacity values)

Loadings are computed by multiplying the flow (gpm) by the concentration (mg/l) and then by 0.12 to convert gpm and mg/l to pounds per day. Use of this equation results in a recommended aerial extent of aerobic wetland, although this value must be evaluated to include specific site conditions, including fluctuations in inflow rate, site topography, and site accessibility.

Anaerobic Wetlands – These systems are similar to aerobic wetlands, except that the bio-chemical activity takes place within the thick, oxygen-free organic substrate, consisting of composted organic materials containing high concentrations of iron-reducing bacteria. These bacteria break down the sulfates in the influent, raise the pH level and precipitate some dissolved metals.

They are suitable for use with influent pH as low as 3.0 without additional alkalinity being added to the system, but high dissolved oxygen levels in the influent can be problematic. These systems tend to work well with certain metals (including copper, lead, zinc, cadmium, and iron), but they are inadequate for large concentrations of aluminum or manganese.

Like aerobic systems, anaerobic wetlands are most effective when used to treat small AMD flows of moderate water quality. Hedin, et al ("*Treatment of acid coal mine drainage with constructed wetlands*," 1989) indicate that anaerobic wetland systems for the treatment of net acid influent can be sized based on using a factor of 3.5 grams for acidity/m^2/day.

When used in combination with limestone, anaerobic wetlands are frequently sized to provide a minimum retention time in excess of six hours, but when used independently this value should probably be extended to roughly 24 hours. As such, for a flow of 100 gpm, the anaerobic wetland would be sized to contain roughly 19,250 cubic feet of submerged, composed materials. This would be equivalent to a pond with surface area of approximately 60' x 160' x 2' deep.

If aluminum concentrations are relatively high (greater than l.0 mg/l), a vertical drain system, which incorporates anaerobic wetlands and limestone flow paths, may be more cost-effective. Since the anaerobic activity results in significant metal precipitate, these systems may require periodic cleaning, and the substrate may need to be replaced if the precipitate results in a decrease of bacterial action.

Oxic/Anoxic Limestone Trenches – For the treatment of low pH flows with limited metal content, oxic (in the presence of atmospheric oxygen) channels are highly efficient and inexpensive. These systems utilize open channels filled with high-carbonate crushed limestone, which is less than lime. Since limestone dissolves slowly, it cannot result in overdosing in the treatment system and tends to dissolve more rapidly in poor water quality conditions, which is desirable.

However, if the limestone treatment occurs when the metal content is relatively high and atmospheric oxygen is present, a buildup of metallic hydroxide compounds results on the surface of the stone. This armoring reduces the limestone contact surfaces with a subsequent decrease in effectiveness. When working properly, oxic channels can function for 5-10 years before they require replacement, but if the metal content is fairly high, they may lose effectiveness much more rapidly.

For situations where the metal content is higher than that recommended for oxic channels, anoxic limestone drains can be utilized. These systems typically utilize subsurface trenches, covered by an impermeable cap, to exclude atmospheric oxygen.

Anoxic trenches can be cheap and effective, but the life of the system is a direct function of the influent water quality and carbonate content of the limestone. When the stone has deteriorated to an extent that it has lost its effectiveness, the entire system must be dug up and replaced. If the influent has a significant dissolved oxygen content prior to introduction into the trench, anoxic trenches are less effective, so it is recommended that these trenches be connected directly with mine pools before the discharge has significant contact with the atmosphere.

There is little in the literature regarding sizing of oxic limestone channels since they are easily accessible, and maintenance involves merely replacing the deteriorated stone as required. Anoxic trench maintenance is more problematic since the system is buried throughout its entire length, so sizing is more critical. Based on the equations in "*The Science of AMD and Passive Treatment*," the mass of limestone required (M) is:

M (tons) = (Qpt/Vv) + (QCT/x), where:

Q = flow in m^3/day
p = bulk density of limestone (approx. 145#/cf=2.56 Tons/m^3)
t = retention time in days (generally 15 hours = 0.625 days)
Vv= bulk void ratio of limestone (use 0.48 based on experience)
C = effluent alkalinity concentration
T = design life of drain in days (25 years = 9125 days)
x = $CaCO_3$ content of limestone (use 0.90 for high quality stone)

Limestone Diversion Wells/Ponds – In addition to oxic channels and anoxic trenches, there are applications for other, similar systems. Diversion wells consist of a low dam, which is used to divert flow through a pipe into the top of a cylinder filled with limestone gravel. High velocity flows generated by dropping the flow 5 to 10 feet are flushed through this system to keep the armoring scoured and to encourage degradation of the limestone for very efficient treatment. However, these systems require high maintenance by the nature of the construction, and the gravel must be replaced frequently (as much as twice per month). These systems are best used in conjunction with a wetland or a settling pond to permit settlement of the oxidized metals, but they can be used mid-stream.

Other sites have used limestone ponds, in which seepage from a mine opening is forced to flow vertically upward through a crushed limestone layer to force anoxic conditions. These systems also generally discharge to a settling pond or wetland for deposition of the precipitated metals. Again, this can be a relatively high-maintenance arrangement, and the limestone may have to be replaced frequently.

Limestone treatment is ineffective in situations where the pH is higher than neutral, and armoring of the stones causes a dramatic reduction in the performance of the system if not cleaned periodically. When O_2 is present, or when iron levels are in excess of 5 mg/l, the systems tend to develop armoring rapidly. Armoring can occur even more rapidly if the sulfate levels are in excess of 2,000 mg/l, wherein an insoluble gypsum precipitate occurs.

Vertical Drain Systems – These treatment systems, sometimes referred to as Successive Alkalinity-Producing Systems, combine the bio-chemical properties of anaerobic wetlands and limestone ponds to produce very effective treatment systems. They are generally comprised of a series of ponds placed as follows: a small settling pond used to drop large diameter suspended solids and attenuate peak runoff events; an anaerobic wetland designed to remove O_2 and begin the sulfate reduction process; a "vertical drain" composed of perforated pipes placed at the bottom of a pond overlain with layers of limestone and compost; and a settling pond for the metal precipitate.

Multiple systems can be constructed in series to permit cleaning (by taking one system "off-line") and to allow for peak inflows following precipitation events. If sufficient elevation difference is available between the third and fourth pond, a flushing system can be incorporated to permit periodic cleaning of the perforated pipes and limestone layer. This permits use of vertical drain systems for influent conditions with low pH and high iron and aluminum contents without removal of the limestone for cleaning.

The general approach to sizing vertical drain systems is to create a series of ponds with sufficient volume to permit adequate retention times. For practical purposes, the rule-of-thumb used by the NRCS ("*Design Considerations and Construction Techniques for SAPS*," 1998) for the various ponds is as follows:

- Pond #1 – settling pond – 24 hour retention time
- Pond #2 – anaerobic wetland – 6-8 hour retention time
- Pond #3 - vertical drain – 12 hour retention within the
- Limestone zone (excluding the organic zone above) assuming a
- porosity of 0.48-0.50
- Pond #4 – settling pond – as large as possible given site constraints, with a minimum recommendation of 2-3 days

As discussed in previous sections, limestone is a very efficient means of increasing pH values for acidic influent from AMD sites. However, it tends to deteriorate with time and requires long-term maintenance. The rules-of-thumb identified above are based on the creation of a system with an effective life of 20-25 years, at which time the limestone will probably require replacement. However, there are no existing systems that have been in place for more than 20 years, so this is speculation.

Vertical drain systems are very efficient for flows of approximately 500 gpm, assuming that sufficient room is available to construct ponds large enough to meet the retention time requirements discussed above. The ponds can treat influent with very low pH and relatively high iron, aluminum, and sulfate levels, and if a flushing mechanism has been included in the design, armoring of the limestone and piping can be controlled for many years.

However, the systems require some level of hands-on manipulation, at least initially, to achieve a workable system. This is partially a function of the need for sufficient bacteriological activity to develop a balance of the bio-chemical reactions, and frequent flushing may be required for some months. In addition, there is typically a high BOD discharge from the settling pond in the first few weeks until the compost becomes stabilized.

Active Treatment of Collected Flows

Active treatment of mine discharges has been on-going for hundreds of years with techniques ranging from dilution of the influent to the establishment of sophisticated treatment plants. These methods typically integrate components that employ chemical, biological, and physical processes.

The chemical components involve bringing the flows in contact with alkaline substances to neutralize the acid in the mine discharges through the buffering action of the alkaline materials. Raising the pH of the discharge is often essential for treatment since highly acidic discharges prevent the oxidation and precipitation of metals in settling ponds. Alkaline materials frequently used for pH adjustment include limestone, hydrate lime, quick lime, soda ash briquettes, caustic soda, and anhydrous ammonia. These additives tend to neutralize the acidity of the discharges and permit precipitation of dissolved metals, which can also be removed by application of potassium permanganate, other oxidizing agents, and physical aeration.

In addition to straight chemical reactions, some methods utilize bacteria-induced reduction so that the metal precipitates become stable and settle out. Physical aeration accelerates this process by exposure to large pool surface areas or by use of bubbler systems, waterfalls, or fountains. Larger systems may incorporate several of these techniques.

Since there are currently numerous packaged systems available involving hydrated lime treatment plants or water-wheel addition of caustic soda, which can be designed for specific flows and water quality conditions, it is difficult to recommend a general approach to active treatment of AMD sites.

Active systems tend to require a relatively high annual operation and maintenance (O&M) cost, and this is typically not included in funding available to watershed groups. As such, relatively inexpensive active treatment systems may be very difficult to maintain as compared to passive systems, depending on the source of funding.

B. Constructed Treatment Systems

All of the constructed treatment systems appear on watershed map 2-5 in Attachment A.

- ***Bell Colliery:*** Abandoned mine drainage (AMD) from the Bell Colliery Drift in Schuylkill Township, Schuylkill County, adds metals and acidity to the main branch of the Schuylkill River near its headwaters. Above its confluence with the Bell Discharge, the Schuylkill River runs clear and has a near-neutral pH. Below its confluence, the water and streambed take on a decidedly orange tint due to iron and other metal loadings from the Bell Discharge. Due to the site's ranking in the Upper Schuylkill Watershed Assessment, the SCD applied for and received an EPA 319

Non Point Source Pollution grant to construct and evaluate a system to treat the discharge.

The USGS data collected for the discharge indicated the flow averaged approximately 430 gal/min and the chemistry of the discharge has consistently been acidic with a pH of 3.7 - 4.0 and dissolved metals of Al 0.8-1.1 mg/L; Fe .5-12 mg/L; Mn 1.3-1.5 mg/L.

The project, completed in 2004, consisted of construction and evaluation of two parallel downflow limestone cells followed by a settling pond and an aerobic wetland cell for acid neutralization and reduction of the metals' loadings. Compost was layered over one of the two parallel limestone cells; the other cell was solely composed of limestone. Two separate under drains and outflow pipes were installed beneath the limestone and compost/limestone cells to: (1) enable flushing of accumulated metals from the downflow cells, and (2) allow for comparison of the effectiveness of the different downflow treatment designs. After the water leaves the cells, it enters a settling pond and then a wetland cell where final oxidation, precipitation, and settling of metallic-rich particles occur.

- ***Dyer Run Diversion Well:*** This limestone diversion well was constructed through a Pa. Dept. of Community and Economic Development (DCED) grant administered through Eastern Pa. Coalition for Abandoned Mine Reclamation (EPCAMR). SHA, SCD, EPCAMR, and Minersville Water Authority worked together on this project to improve the quality of the water that is a drinking water source for the residents of the Borough of Minersville. The construction of the diversion well was completed in June 2001 and treats the AMD impacted headwaters of Dyer Run upstream of the Minersville Water Authority reservoir.

- ***Minersville Wetland:*** The Minersville Passive Wetland Treatment System, funded by an EPA 319 grant, is located approximately 1,500 feet northeast of the intersection of S.R. 0901 and Seltzer Road situated in Norwegian Township, Schuylkill County, Pennsylvania. The project site is situated on a D-shaped floodplain property between the Reading, Blue Mountain, & Northern Railroad Company's right-of-way to the east and the West Branch Schuylkill River to the west. Owned by the Reading, Blue Mountain, & Northern Railroad Company, the land has been leased to the SHA for the purposes of creating the passive wetland treatment system to treat water (1 cfs) diverted from the West Branch Schuylkill River that is currently in place today. The SHA retained RETTEW to design, permit, and oversee the construction of this passive wetlands treatment system.

  The water of the West Branch Schuylkill River exhibits a total iron concentration of 5.3 mg/L (PPM), according to laboratory results. Orange staining of the river's cobbles and substrate by iron hydroxide precipitates is further proof that high iron concentrations are fouling the river's ecosystem.

  The constructed wetland treatment system, completed in 2002, consists of a water intake structure on the river (upstream), a settling pond, a passive wetland treatment cell, a water level control structure, and an outfall structure (downstream) to discharge treated water back to the river. The passive wetland treatment system has been designed to primarily decrease iron hydroxide concentrations and, to a lesser degree, manganese and aluminum concentrations found in the river. The goal of the project is to treat 1 cfs of river flow to reduce the current total iron concentration in the river from 5.3 mg/L to a level near Pa. DEP's protective criteria for aquatic life or 1.5 mg/L.

The treatment system design entailed the utilization of a water intake, a settling pond, and an aerobic wetland treatment cell comprised of an impervious clay liner, a one-foot 50/50 mixture of topsoil and alkaline mushroom compost soil, and a broadleaf cattail (*Typha latifolia*) community. The diverted water enters the treatment system via an intake structure, and once treated, is discharged back into the river system through a concrete water-level control structure. The only encroachment within the river channel itself involves permanent installation of the intake and outfall structures along the riverbanks.

Based on the findings of the floodplain study, it was necessary to design and construct a two-foot-high perimeter berm around the wetland treatment system so as to avoid periodic flooding. The berm configuration was considered in the floodplain study and results in a nominal increase in the two-year storm flood elevation of 0.02 feet. Through the construction of the wetland treatment cell, the project actually produced a 0.5-acre emergent wetland area. A 10-foot-wide riparian buffer of woody tree and shrub species along the east bank minimized impacts to the river and its banks.

- ***Newkirk Tunnel - North Dip:*** As previously mentioned, this treatment system comprised of oxic/anoxic trenches and a settling pond was installed by Pa. DEP, BAMR in 2002; however, this system is not working properly and will be fixed.

- ***Otto Colliery Airshaft Discharge:*** (Currently being implemented.) The Otto Colliery Airshaft Discharge (Otto Discharge) near Branch Dale, Schuylkill County, is one of the largest sources of abandoned mine drainage (AMD) in the Schuylkill River Watershed. At its confluence with the Muddy Branch, the Otto Discharge contributes the majority of streamflow to Muddy Branch. Below the confluence, the water and streambed of Muddy Branch take on a decidedly orange tint, owing to iron and other metals loading from the Otto Discharge. Muddy Branch flows eastward from the watershed boundary to the West Branch of the Schuylkill River. Because of metal loading from the Otto Discharge and other AMD sources, the entire West Branch of the Schuylkill River is designated "impaired" on the 303(d) list. A recently completed assessment focusing on nonpoint source pollution in the upper Schuylkill watershed ranked the Otto Discharge as one of the most severe in the watershed because of its high flow and iron concentrations and recommended that its remediation be given high priority.

  RETTEW, the SHA, Trout Unlimited (TU), SCD, and USGS developed a partnership with the landowners, for the successful design, implementation, and evaluation of the treatment system. The project, funded through the EPA 319 program, involved the detailed design, construction, and evaluation of the aerobic passive treatment system.

The three-acre system has a capacity to effectively treat up to 6 cfs or twice the average flow from the Otto Discharge. Flows in excess of 6 cfs will be treated in the treatment system at a reduced detention time and/or diverted around the proposed treatment system. The diversion of extreme flows utilizes the existing Otto Discharge channel. The AMD from the discharge will enter the treatment system through proposed aeration/mixing eductors and/or a secondary intake structure to an oxidation pond, then flow through two wetland filtration cells planted with broadleaf cattail (*Typha latifolia*) and other facultative hydrophytic species, and finally through an underground "oxic limestone drain," and then discharged back into the existing discharge channel prior to confluence with Muddy Branch.

Continuous flow-measuring and recording devices will be utilized to monitor flow rates entering, exiting, and bypassing the treatment system. Weirs were designed to route flow from one cell to the next and to enable the precise, instantaneous measurement of flow rates through the treatment system. The weirs are designed to allow for raising or lowering of the stage (pool level) within each cell for the purpose of controlling the depth and/or detention time. This feature enables the long-term operation of the treatment system at its approximate original (or optimum) capacity, with the possible need for only infrequent excavation of accumulated sludge. On the basis of an average annual iron loading rate of 25,600 kg/yr, or 28.1 ton/yr, and a iron-hydroxide density of 0.177 g/cm^3, approximately 1.2 feet of iron sludge would be expected to accumulate in one acre over ten years. If equally distributed over three acres, the sludge would decrease the depth of each cell by 0.4 feet over ten years. Hence the design incorporates "free board" adjustments to enable increasing of the pool level by approximately 1 foot (minimum) at the oxidation pond and 0.5 feet (minimum) at each wetland cell.

Construction of the treatment system began in November 2004 and will be completed in June 2005.

- ***Pine Forest Mine:*** (Currently being designed through an EPA 319 program grant.) A mine pool discharge high in iron and low in dissolved oxygen, anoxic trenches will be installed to increase the alkalinity of the net acidic flow. The discharge will then be passed through a settling pond and passive wetland treatment systems to remove iron.

- ***Reevesdale No. 2 Outflow:*** (Currently being designed through an EPA 319 program grant.) This outflow is one of several Reevesdale discharges. A BAMR land reclamation project at this discharge did not address water quality. With an average flow of 904 gpm, space adjacent to the site will be used for a passive wetland treatment system.

- ***Rhoersville Stream Restoration:*** Located in the Heckscherville Valley, an unnamed tributary to the West Branch Schuylkill River that originally flowed into a mine pool was redirected away from the old strip mine pit to remain above grade so that surface water would not come in contact with the surrounding rock strata and form AMD. This project was funded through a Regional Watershed Support Initiative Grant from EPCAMR and was completed in March 2002.

- ***Silverbrook Diversion Wells:*** Located near the Interstate 81 and State Route 309 interchange, the Silverbrook Mine discharge was the result of abandonment of an extensive deep mine that became inundated to form a huge mine pool. Recharge of the mine pool is from surface water flow into the deep mine workings through the overlying strip mines and from infiltration. The average discharge from the Silverbrook Mine is approximately 2,000 gpm, which makes it one of the largest discharges and contributors to the headwaters of the Little Schuylkill River Watershed. Pa. DEP, BAMR installed a series of limestone diversion wells in 1996 to divert water from the discharge for treatment of the acidic waters before flowing into the Little Schuylkill River.

- ***Tamaqua Dry Dam:*** The Tamaqua Dry Dam Passive Wetlands Treatment Project is located in the Hometown area of the watershed. The project included the design and construction of a five-acre passive wetland treatment system in the Tamaqua Dry Dam to treat AMD. Construction of the wetland treatment system was funded through the Pa. DER Clean Water Fund and was completed in May 1996.

C. Future Remediation Projects

Priorities have been set to address the various pollution sources in the Upper Schuylkill River Watershed. These priorities were selected based on the Upper Schuylkill and Little Schuylkill watershed assessments, extent of pollutant loadings, visibility in the community, landowner cooperation, and feasibility of constructing a treatment system. As both funding and landowner cooperation are necessary for implementing treatment solutions, the problems are identified as either high or medium priority, rather than in sequential order. This priority list is subject to change and will be adjusted as projects are completed.

Most of the priority sites listed below address mine drainage sources of pollution, as AMD is the greatest degrader of water quality in the watershed. As AMD priorities are addressed, additional pollution sources, including sedimentation and sewage, may become priorities. All of the priority sites appear on watershed map 3-5 in Attachment A.

High Priority

- ***Mary D Mine Outflow:*** *(Receiving Stream - Schuylkill River)* This is a seepage and air shaft discharge on the Upper Schuylkill River near Brockton. This discharge appears as two small streams crossing Route 209 within ½ mile of each other. Both streams have iron precipitate. Fluctuating chemistry and flow makes for a difficult remediation selection. It may be a good candidate for a passive wetland treatment system if sufficient space is available. May check with downstream owner for permission of wetland space. In addition to treating the water, this site has the potential to provide community improvements, as a proposed treatment system would be constructed near a community recreational facility. Examples of possible improvements include hiking trails, providing water for an ice skating facility, and expanded sports fields. There is currently community support for a proposed project.

- ***Oak Hill Mine****: (Receiving Stream – West Branch Schuylkill River)* This discharge provides the majority of flow to the West Branch Schuylkill River north of Minersville. The cold water discharge (3,860 gpm) flows from a complex of 9 separate seep areas, 6 boreholes, and a drainage tunnel. A treatment system of open limestone channels was installed. However, project budget constraints did not allow for maintenance measures to clean out the channels which have become heavily clogged with iron sludge. Smaller discharges downstream of the road could be treated by wetlands to remove iron. This site could benefit from upstream stream and land restoration to reduce water flow into the mine. Despite the heavy iron precipitate covering the stream bottom, the West Branch supports a naturally reproducing population of brook trout downstream of the discharge. Treatment of the discharges should result in reduction of precipitated iron but may also cause a warming of stream water with a potential to affect the trout. A treatment system at this site would not only reduce significant loadings to the river, but would also provide significant visible reduction in iron sediment in the river. Due to various space constrains, an active treatment system may be required. The visibility of these reductions would create an even greater benefit to the nearby communities and revitalization efforts of Schuylkill County.

- ***Pine Forest Mine - Aluminum Discharge:*** *(Receiving Stream – Mill Creek)* The primary discharge from the Pine Forest Mine will be treated by a proposed anoxic limestone treatment system for high iron loading. However, a second discharge from the Pine Forest Mine is high in aluminum. Adding high aluminum loading to the current proposed treatment system will clog the system with aluminum precipitate that is difficult to remove. The water from the aluminum discharge will need to bypass the anoxic treatment system before passing through a settling basin and wetland. Both discharges form a stream that includes a rather large surface drainage which flows into Mill Creek.. The aluminum discharge will need to be captured and piped to the settling pond to prevent treatment of surface runoff water. A potential tre

- ***Pine Knot Tunnel:*** *(Receiving Stream – West Branch Schuylkill River)* This discharge has a high flow (up to 30,000 gpm) and high iron and aluminum concentrations. The Pine Knot discharge has been designated as the top priority for the Schuylkill Action Network Abandoned Mine Drainage team. Issues dealing with the discharge are complex. An engineering study that will include a hydrologic budget will be undertaken. The purpose of this study is to determine courses of action that will first reduce inflow and recharge of the mine pool. Possible treatment systems, both active and passive, will be studied and evaluated for the actual discharge. This large, complex discharge will be difficult and costly to correct.

- ***Silver Creek Mine:*** *(Receiving Stream – Silver Creek)* This mine includes a seepage/tunnel discharge that forms a turquoise-colored ponded upwelling that overflows into Silver Creek west of Middleport. The discharge volume varies considerably but has a high iron concentration and precipitate. Flow data indicates a great deal of fluctuation. Data from DEP-148 and DEP-149 discharge locations would need to be separated and treated separately. Open land is available on both sides of the upwelling for passive treatment wetlands, anoxic limestone drains, and passive wetland treatment systems. The land is owned by as many as three different landowners. Off-road vehicles and large amounts of rubbish and litter also impact the area.

- ***Randolph Discharge:*** *(Receiving Stream -Schuylkill River)* This deep mine discharge flows out from a hillside located along Route 209 just east of the Port Carbon/Palo Alto area and drains into the Schuylkill River on its south bank. The average flow volume is 851 gpm and the discharge has a high iron concentration. Aeration and oxidation of the flow from a series of vertical drops causes a high iron precipitate to form and armor its defined channel located along the floodplain of the Schuylkill River. Space along the river's floodplain appears to be available for the installation of a settling pond and a passive wetland treatment system providing landowner's consent is obtained. Due to the high iron accumulation at this site, possible partnerships with facilities/entities seeking iron oxide material may exist.

- ***Silverbrook Mine:*** *(Receiving Stream - Little Schuylkill River)* Silverbrook Mine has several discharges including the mine tunnel, refuse bank, and the AMD discharge on the east side of Route 309. High flows are difficult to treat (up to 4,000 gpm) and the discharge contains high concentrations of dissolved iron. Currently, two diversion wells are in place but require a lot of maintenance and are not working well. Possible source reduction could take place with the current filling of nearby strip pits. In addition, the State Game Lands downstream could be a potential site for passive treatment wetlands or a vertical drain. Treatment will depend on ability to reduce flows and increase retention times. A feasibility study coupled with surveying work will be necessary to address this discharge.

- ***Sharp Mountain Mine Subsidence Reclamation:*** *(Receiving Stream - Schuylkill River; West Branch Schuylkill River)*A portion of Sharp Mountain located in the City of Pottsville has very dangerous mine subsidences called cropfalls that extend along the contour of the mountain for 2 miles. These subsidences capture all runoff from the mountain ridge on the north side and contribute AMD to the Sherman discharge into the main stem Schuylkill River and to the RS&W drift mine discharge into the West Branch Schuylkill River. The City of Pottsville recently completed two phases of a reclamation project to backfill the cropfalls through funding under Growing Greener and OSM also completed an emergency project. The scope of the project is very large and will require funding for several years to address all of the cropfalls. This project is a priority not only for the prevention of AMD, but also for the severe health and safety hazards.

<u>Medium Priority</u>

- ***Newkirk Tunnel - North Dip:*** *(Receiving Stream – Wabash Creek)* One of several Newkirk Mine Tunnel discharges. A treatment system comprised of oxic/anoxic trenches and a settling pond was installed by Pa. DEP Bureau of Abandoned Mine Reclamation in 2002. However, limited flow is treated and this system needs to be redesigned and implemented. Passive treatment wetlands downstream could be a potential solution.

- ***Eagle Hill Mine:*** *(Receiving Stream - Schuylkill River)* This is a pool discharge from a drift located northeast of Port Carbon which has a high flow (up to 2,250 gpm) with high iron and manganese concentrations. A possible wetland nearby could be enhanced to increase metals reductions. Sewage problems downstream are also a concern.

- ***Reevesdale No. 1:*** *(Receiving Stream – Wabash Creek)* This is a tunnel discharge to Wabash Creek on the west side of Tamaqua. Reasonable flow and sufficient space is available for passive treatment. Another possible solution is the conversion of nearby ponds to a vertical drain system. Land owner cooperation and additional ground truthing is required before treatment selection.

D. Treatment Options for Other Discharges

As treatment systems are constructed and discharges meet applicable water quality criteria for specific treatment parameters, remediated discharges will be removed from this plan and new, untreated discharges will be added from those listed in the assessment reports for the Upper Schuylkill River and Little Schuylkill River watersheds. The following sites include such future potential remediation initiatives to be undertaken and all of these sites appear on watershed map 4-5 in Attachment A.

- ***AMD Discharge on West side of Route 309:*** *(Receiving Stream - Little Schuylkill River)* Located northwest of Hometown, this discharge will also require additional monitoring data for final selection of treatment. Easy access to discharge. Obvious solutions for treatment could include a small wetland or an oxic limestone channel. There appears to be enough space for passive treatment.

- ***Brockton Discharge:*** *(Receiving Stream - Schuylkill River)* A small discharge located on the south side of Route 209 near Brockton. This discharge was ranked in the top 20 in the Kimball assessment of the Upper Schuylkill River Tributaries. Average flow is approximately 350 gpm. More monitoring must be completed in order to determine the type of treatment required.

- ***Fosters Tunnel Discharge:*** *(Receiving Stream - Panther Creek)* This is a small tunnel discharge to Panther Creek located southwest of Coaldale. The small discharge will require additional monitoring data for final selection of treatment. Easy access to discharge. Obvious solutions for treatment could include a small wetland or an oxic limestone channel.

- ***Kaska Mine Outfall:*** *(Receiving Stream - Schuylkill River)* This discharge is comprised of seepage into the Upper Schuylkill River north of New Philadelphia that has a variable flow up to 180 gpm. The principle concern appears to be silt. Low flows represent opportunity for passive wetland treatment by expanding existing small wetland downgradient of the discharge. Sewage problems are also a concern at this location.

- ***Kaska Silt Dam:*** *(Receiving Stream - Schuylkill River)* The silt dam is comprised of the remains of an old coal silt dam that washed out during Tropical Storm Agnes in

1972. Coal refuse piles surround the silt dam. The site is unstable and washes out silt during heavy rains. The silt and refuse pile may be able to be removed for use at a cogeneration plant; however, previous testing indicated the silt and refuse was not of good quality to be used without blending. If the refuse cannot be removed off site, it would have to be stabilized, covered and seeded. An unnamed tributary (with iron precipitate) originates one mile upstream of the silt dam and may need to be stabilized.

- ***Locust Creek:*** *(Receiving Stream – Locust Creek)* Located at the headwaters of Locust Creek, this site also exhibits stream bank erosion and sedimentation problems. Minor stream bank stabilization has occurred, but more work is required to eliminate erosion.

- ***Middleport Mine Discharge:*** *(Receiving Stream - Schuylkill River)* Located south of Middleport along Mountain Road, this discharge originates from an abandoned deep mine opening approx. 1,800 feet south of Middleport, PA, which drains an unmapped mine pool complex. The flow range is 150 - 400 gpm with a pH around 6.0 with low aluminum, elevated iron and some alkalinity. The discharge currently flows into two existing small ponds allowing some of the iron to fall out. A potential passive treatment project could consist of enhancing a wetland area directly below the opening by constructing a small dam upgradient of the two existing ponds. Some aeration of the mine water is occurring naturally due to the discharge being several feet higher than the wetland area. Maintenance would involve cleaning and disposal of sludge from the three ponds.

- ***Sedimentation – Lofty Creek:*** *(Receiving Stream – Lofty Creek)* Located in the headwaters of Lofty Creek, stormwater runoff from Interstate 81 appears to be causing erosion, sedimentation and siltation of the creek. Stream bank stabilization and stream restoration within existing channel is a potential solution. The support of Pa. Dept. of Transportation is required.

- ***Morea Mine****: (Receiving Stream – Mill Creek)* This site is comprised of a strip mine pool overflow in the Mill Creek watershed in West Mahanoy Township. The site is being investigated as a partnering venture for stream reclamation. Passive treatment options are limited due to high flows. Limestone rip-rap for erosion protection could also provide some alkalinity to buffer acidic flows. Resurfacing the stream to prevent discharge is also a potential option. Wheelabrator Frackville Energy Co. lands could be used for a treatment system.

- ***Newkirk Tunnel - South Dip:*** *(Receiving Stream – Wabash Creek)* This is a high flow tunnel discharge located along Wabash Creek just west of Tamaqua. Discharges collect in a pond prior to entering Wabash Creek. Depending on the depth of the pond, possible solutions include modification of the pond to increase oxidation through limestone dosing and addition of an organic substrate.

- ***Repplier Mine Tunnel:*** *(Receiving Stream – Mill Creek)* This discharge along Pa. Route 61 northwest of the Borough of St. Clair, is the largest discharge to Mill Creek. More flow and chemical data is needed to determine potential treatment possibilities. Existing data suggests that a vertical flow reactor treatment system may be possible;

however, little space is available for construction of a treatment system between the discharge and the highway. More area is available across the road, but this is adjacent to a water supply treatment plant.

- ***Various Tunnel Discharges:*** *(Receiving Stream - Little Schuylkill River)* These discharges are located southwest of Tamaqua and drain to the Little Schuylkill River. The discharges have average flows (15-270 gpm), are very acidic, and have average to high iron concentrations. Additional monitoring is required to evaluate impacts, however little space is available for treatment.

E. Land Reclamation

Land reclamation should be conducted wherever possible in conjunction with construction of treatment systems. Reclamation should involve restoring streams to surface flow through land reclamation, filling abandoned surface mine pits and sealing under the new surface channel so that flow remains on the surface. Alkaline material should be added to the backfill material and in-stream in order to raise the pH and alkalinity where required. Reclamation would be of most benefit in the headwaters portion of the Upper Schuylkill River and all of its major tributaries.

Eliminating drainage from abandoned mines and restoring the Upper Schuylkill River and its tributaries to a healthy state represent significant challenges. The vast majority of impacts are from mines and mining practices of the past, predating the 1977 federal Surface Mining Control and Reclamation Act (SMCRA). However, for the past 30 years, both national and state laws require mining companies to develop operation and reclamation plans to eliminate or minimize environmental impacts. Companies are required to reclaim land disturbed by exploration or extraction. Lands are considered reclaimed when the disturbed land is returned to its pre-mining use or another use determined to be beneficial such as a recreation area or wildlife habitat.

Re-mining of previously abandoned mine lands also presents the opportunity for land reclamation. All active mining operations are required to reclaim mined land to its approximate original contour once mining has ended. Active mining is occurring throughout the Upper Schuylkill River Watershed. All the active mining sites are re-mining permits since they are mining and reclaiming previously mined areas. Lists of active mining permits have been taken from each of the TMDLs in the Upper Schuylkill Watershed and are reproduced here in Attachment D.

As protection in case a coal company would become bankrupt or leave a site before reclamation takes place, the company is required to post bond. If a coal company abandons a site, the bond money is handed over to the Bureau of Abandoned Mine Reclamation (BAMR), which essentially steps into the shoes of the operator and reclaims the land just as the operator would have. BAMR already has completed 76 projects in the Upper Schuylkill River Watershed reclaiming thousands of acres of abandoned mine land. In addition, eight (8) BAMR reclamation projects, approximately 950 acres, are either under construction or in the development or design phase. A map of the reclaimed mine land in the Upper Schuylkill River Watershed is available in Attachment C.

The Pa. DEP BAMR has completed over fifteen projects within the Schuylkill River Watershed. Completed projects consist of backfilling strip mine pits, capping or backfilling shafts, razing colliery buildings and removing equipment, constructing AMD passive treatment systems, and conducting investigative drilling projects. The majority of the projects eliminated documented health and safety problems from past coal mining practices. Along with the elimination of the health and safety problems, stream channels have been restored and wetlands were created and/or enhanced.

Currently the Pa. DEP BAMR has approximately five projects scheduled to be completed within the next five years in the Upper Schuylkill River Watershed. Most of these projects will consist of backfilling strip mine pits and re-establishing stream channels and creating and/or enhancing wetlands.

The future of abandoned mine reclamation within the watershed is dependent on many factors. The most significant factor is the reauthorization of the Surface Mining Control and Reclamation Act of 1977. Without the reauthorization of the Act, funds will not be as readily available to perform reclamation activities. Another important factor is the cooperation of the landowners. If landowners within the watershed are reluctant to allow any reclamation on their properties, funding would most likely be shifted to watersheds that have cooperative property owners. The final major factor that may dictate future reclamation work within the watershed is the technical feasibility of any proposed project. Many projects appear to have significant beneficial environmental impacts; however, after more in-depth evaluation of a specific project, it may be determined that the project may not be technically feasible due to physical, economical, and/or social constraints.

TECHNICAL AND FINANCIAL ASSISTANCE NEEDED TO IMPLEMENT BMP'S

A. Estimate of Remediation Costs

Members of the project team are not construction contractors and therefore probable project cost opinions are based solely upon information from AMDTreat, experience with construction, and knowledge of the proposed sites. This requires the project team to make a number of assumptions as to actual conditions which will be encountered on the site; the specific decisions of other design professionals engaged; the means and methods of construction the contractor will employ; the cost and extent of labor, equipment, and materials that the contractor will employ; the contractor's techniques in determining prices and market conditions at the time; and other factors over which the project team has no control. Given these assumptions, which must be made, the project team states that the above probable project cost opinion to be a fair and reasonable estimate for project costs.

Project Name	Design & Permitting	Construction	Total for Construction	Annual Operations and Maintenance
Mary D Mine Outflow	$61,361	$306,805	$368,166	$22,651
Oak Hill Mine	$28,975	$234,873	$263,848	$61,715
Pine Forest - Aluminum Discharge	$104,964	$524,819	$629,783	$55,072
Pine Knot Discharge	$3,653,309	$18,266,546	$21,919,855	$287,659
Silver Creek Mine	$581,209	$2,906,042	$3,487,251	$61,670
Randolph Tunnel	$165,352	$826,761	$992,113	$20,081
Silverbrook Discharge	$603,194	$2,349,363	$2,952,557	$46,809
Newkirk Tunnel-North Dip	$39,589	$356,478	$396,067	$15,897
Eagle Hill Discharge	$332,079	$1,660,394	$1,992,473	$39,400
Reevesdale No. 1	$28,562	$112,658	$141,220	$11,023
TOTAL	**$5,598,594**	**$27,544,739**	**$33,143,333**	**$621,977**

B. Funding Sources

Sources of funding for restoration design and construction have been identified and secured for portions of the required restoration measures. It is expected that these same funding sources will be available for design and construction of the additional treatment systems required.

Funding or in-kind support for watershed restoration and environmental education efforts in the Upper Schuylkill River Watershed has been provided by:

- EPA Section 319 and Watershed Initiative programs.

- OSM Appalachian Clean Streams Initiative, Summer Internship, and Title IV AML programs.
- PA DEP Growing Greener Environmental Stewardship/Watershed Protection and Technical Assistance Grant (TAG) programs.
- PA Department of Community and Economic Development (DCED) grant programs.
- Pa Fish and Boat Commission Water Trail Grant program.
- EPCAMR Regional Watershed Support Initiative.
- Delaware River Basin Commission's proposed use of funds from Exelon Corporation for water quality restoration.
- League of Women Voters of PA Citizen Education Fund's Water Resources Education Network Grant program.
- Philadelphia Water Department environmental education grant program.

C. Additional Support for Watershed Restoration Efforts

- The U.S. Geological Survey provided projection of parameters for design, monitoring, and technical expertise.
- The PA DEP BAMR provided engineering assistance, flow, and water quality data and reclaimed thousands of acres of mine land in the watershed.
- PA DEP Bureau of Watershed Management assisted in providing EPA Section 319 and other funding for mine drainage abatement projects.
- PA DEP Bureau of Mining and Reclamation contributed historical mining data and Scarlift Reports.
- PA DEP District Mining Operations Pottsville Office coordinated and assisted with data collection, acquiring funding for abatement projects and working with the local community, encouraged re-mining, and provided technical assistance.
- The PFBC and USGS conducted aquatic surveys and water monitoring.
- RETTEW Associates, Inc. provided technical assistance for conceptual design and engineering through Growing Greener Grants.
- The Schuylkill Conservation District provided technical assistance in project design, coordinating water quality improvement efforts, data collection, publicity, and in acquiring funding.
- Schuylkill County assisted with GIS mapping and identification of landowners.
- Minersville Water Authority, Duncott Fire Company, Phoenix Park Fire Company, Middleport American Legion, and Tamaqua Community Center hosted public meetings.

PUBLIC INFORMATION AND PARTICIPATION

A. Partners and Stakeholders

The SCD works to improve water quality throughout Schuylkill County. The SCD administers six key water quality protection programs: nutrient management, erosion and sediment pollution control, environmental education, The Chesapeake Bay program, Coastal Non-Point Pollution program, and National Pollution Discharge Elimination System (NPDES) permitting. Conservation districts, sub-units of state government supported by state and county funding, are governed by locally appointed boards of volunteer citizen directors who have a long term interest in the welfare of their communities.

The SHA, Inc. is a watershed group formed in 1997 and dedicated to protecting, preserving and restoring the Schuylkill watershed within Schuylkill County. SHA maintains an active all-volunteer membership with monthly work sessions, regular public meetings and implementation of group projects. A recent project, funded by a Section 319(h) Nonpoint Source Management Grant, constructed large treatment cells and wetlands to remediate the Bell Colliery Mine Discharge, which is the first major source of AMD in the headwaters and was listed as a priority site for remediation in a 2000 assessment report prepared for the SCD. The SHA is also actively collecting flow and sample data on several other discharges in the headwaters for planning of future projects.

EPCAMR is a non-profit organization working in the 16 counties of eastern Pennsylvania coal fields to encourage the reclamation and improvement of land and water affected by past mining practices. EPCAMR seeks to build cooperative initiatives, draws on strengths of individuals and groups, and brings together groups that would normally not work together. EPCAMR organizes watershed groups that eventually seek grant funding to prepare technically sound watershed restoration plans and implement AMD remediation projects.

The Delaware Riverkeeper Network is a nonprofit, membership organization that has worked since 1988 to strengthen citizen protection of the Delaware River and its tributary watersheds. Schuylkill Riverkeeper, a field office of the Delaware Riverkeeper Network, empowers private citizens to take action to protect and restore local streams. Since its founding, Schuylkill Riverkeeper has been working to establish a relationship with private citizens, citizen groups, local government agencies and representatives, and local media in the Schuylkill River's headwaters region.

The Schuylkill Action Network (SAN), formed in 2003, is a group of watershed organizations, water suppliers, industry representatives, and government agencies that work collectively to improve the water quality of the Schuylkill River. The SAN established the Abandoned Mine Drainage Workgroup to reduce large sources of AMD. The workgroup is working within the Pine Knot Tunnel drainage area. The Pine Knot Tunnel is the single largest contributor of AMD in the entire Schuylkill River watershed (Kimball 2000). Efforts in the drainage area are aimed at restoration of infiltration sites and passive treatment.

Watershed restoration efforts have received strong endorsements from U. S. Senators Arlen Specter and Rick Santorum, U. S. Congressman Tim Holden, Pa. Senator James J. Rhoades, Pa. Representatives Bob Allen, David Argall, Mary Ann Dailey, and Neal Goodman, Schuylkill County Board of Commissioners, Schuylkill River Greenway Association, Philadelphia Water Department, The Schuylkill Center for Environmental Education, and the Patrick Center for Environmental Research.

Many local groups or businesses including the Schuylkill Economic Development Corp. (SEDCO), Schuylkill County Conservancy, Retired and Senior Volunteer Program of Schuylkill County, City of Pottsville, Eastern Schuylkill Recreation Commission, Schuylkill County Trout Unlimited, Hawk Mountain Sanctuary Association, Alcoa Engineered Products, Northeastern Power Company, Wheelabrator Frackville Energy Co., and Harriman Coal Corp. have provided additional support and assistance. Landowners that have given approval for construction of treatment systems on their property include Reading Anthracite Company, Blaschak Coal Co., Kuperavage Enterprises, Inc., Branch Township, and Reading and Northern Railroad Company. These groups and landowners are expected to continue their roles in support of the watershed restoration plan.

B. Outreach Activities

Outreach activities are a vital component of improving the overall health of the Upper Schuylkill River Watershed. Additionally, education and outreach will be a critical component in the remediation of the pollution problems of the prioritized sites identified in this report. Various levels of outreach will be required from governmental agencies and nonprofit groups working to alleviate the negative effect of pollution in the Upper Schuylkill River Watershed. Outreach activities must be focused on the general public, area businesses and landowners, farmers, and municipal officials. An overall educational mission must aim to inform these stakeholders of the causes, remediation, and prevention of pollution problems.

The SCD, through its various departments and programs, provides various forms of outreach to all stakeholders in the implementation of remedial actions of pollution problems in the Upper Schuylkill River Watershed. The SCD has active programs promoting the remediation of pollution from agriculture, AMD, erosion and sedimentation, and stormwater runoff. The SCD has a fulltime environmental educator, erosion and sediment control technicians, nutrient management technicians, a watershed specialist, and a county natural resource specialist, who all provide outreach for their respective programs and activities. The SCD provides technical assistance for landowners, municipal officials, farmers, and the general public. The SCD also assists municipalities, farmers, and non-profits obtain grant funding for educational and pollution remediation projects.

The SHA is a local watershed group providing outreach on issues affecting the Upper Schuylkill River Watershed. Public meetings of the SHA are held monthly at the Schuylkill County Agricultural Center, Pottsville, Pa. Pottsville is the seat of county government for Schuylkill County. Major highways, Pa. Route 61 and Pa. Route 209, intersect the city making it easily accessible for citizens throughout the watershed who wish to attend the meetings. The SHA publishes a monthly newsletter entitled Headwaters, gives educational presentations to local civic groups, and maintains a web site at www.pottsville.com/headwaters/. The organization mans a booth at the Bear Creek Festival, an annual environmental festival offered free to the public, and participates in the annual Schuylkill Watershed Congress by presenting lectures and leading field tours of AMD treatment sites. The SHA has also participated in presentations at the annual Statewide Conference on AMD/AMR.

Additionally, organizations such as the Pa. DEP, Delaware Riverkeeper Network, Schuylkill County Chapter of Trout Unlimited, Schuylkill County Conservancy, United States Geologic Service (USGS), and the Schuylkill Action Network (SAN) provide various levels of outreach on issues affecting the Upper Schuylkill River Watershed. Through partnerships and coalitions, the various agencies and organizations listed above will play a critical role in meeting the important need of outreach in the watershed.

Knowledge gained from restoration efforts in the Upper Schuylkill River Watershed will continue to be distributed through the Worldwide Web, PowerPoint presentations, Schuylkill Action Network (SAN) AMD Workgroup, and presentations at the Statewide Conference on AMD/AMR.

Members of the public, local community organizations and the media will be invited to attend meetings and will be provided press releases for important events such as review of final designs, contract bidding, groundbreaking, and dedication of completed treatment systems.

IMPLEMENTATION SCHEDULE AND EVALUATION

A. Implementation Schedule

The following implementation schedule is based upon the assumption that funding is available and approved and that landowner approval is available or has been obtained.

- ***Mary D Mine Outflow***

Apply for Funding	February 2005
Funding Awarded	October 2005
Design & Permitting	November 2005
Begin Construction	Spring, early Summer 2006
Project Completion	Spring 2007

- ***Oak Hill Mine***

Apply for Funding	February 2005
Funding Awarded	October 2005
Design & Permitting	November 2005
Begin Construction	Spring, early Summer 2006
Project Completion	Spring 2007

- ***Pine Forest - Aluminum Discharge***

Apply for Funding	February 2006
Funding Awarded	October 2006
Design & Permitting	November 2006
Begin Construction	Spring, early Summer 2007
Project Completion	Spring 2008

- ***Pine Knot Discharge***

  Due to the size and breadth of this project a defined timeline cannot be established. A workgroup has been formed consisting of U. S. EPA, Pa. DEP, SHA, SCCD, USGS, and various other organizations. This workgroup has begun concentrating on the recharge areas of the discharge. It is anticipated that the reduction of flow will reduce the discharge volume. With the reduction of flow the discharge will become more viable for passive treatment.

- ***Silver Creek Mine***

Apply for Funding	February 2006
Funding Awarded	October 2006
Design & Permitting	November 2006
Begin Construction	Spring, early Summer 2007
Project Completion	Spring 2008

- ***Randolph Tunnel***

Apply for Funding	February 2007
Funding Awarded	October 2007
Design & Permitting	November 2007
Begin Construction	Spring, early Summer 2008
Project Completion	Spring 2009

- ***Silverbrook Discharge***

Apply for Funding	February 2007
Funding Awarded	October 2007
Design & Permitting	November 2007
Begin Construction	Spring, early Summer 2008
Project Completion	Spring 2009

- ***Newkirk Tunnel - North Dip***

Apply for Funding	February 2007
Funding Awarded	October 2007
Design & Permitting	November 2007
Begin Construction	Spring, early Summer 2008
Project Completion	Spring 2009

- ***Eagle Hill Discharge***

Apply for Funding	February 2008
Funding Awarded	October 2008
Design & Permitting	November 2008
Begin Construction	Spring, early Summer 2009
Project Completion	Spring 2010

- ***Reevesdale No. 1***

Apply for Funding	February 2008
Funding Awarded	October 2008
Design & Permitting	November 2008
Begin Construction	Spring, early Summer 2009
Project Completion	Spring 2010

MILESTONES TO DETERMINE IF IMPLEMENTATION MEASURES ARE BEING MET

The implementation projects planned for each year will serve as the implementation milestones of the restoration plan. SHA and the SCD will continue their regular meetings to follow the progress of the implementation plan and to determine if the milestones are being met. Meetings with the Pa. DEP Pottsville District Mining Office will be scheduled as needed after receipt of grants for additional phases of the restoration plan to determine if the milestones associated with those phases are still appropriate.

Progress on the implementation schedule will be noted on a quarterly basis at the SHA regular meetings. Since the mine discharges are large and difficult to treat, and passive treatment technology is experimental in nature, implementation of the next project in line is dependent on the evaluation of the success of the previous project. When construction of a project is complete, the evaluation process will begin and the conceptual designs of the next project will be reconsidered to determine if changes should be made prior to submittal of a proposal for the next grant. Difficulties in successful completion of projects may slow the implementation schedule.

Maintaining the implementation schedule is also dependent on the availability of funds. If funding sources receive less money than expected, then some of the proposed projects may not be funded according to schedule. In addition, competition for the limited grant funds increases every year as more watershed associations develop their own restoration plans and submit proposals for implementation projects. In these cases, the project proposals would be submitted again the following year, but the implementation schedules would have to be changed.

A. Water Quality Monitoring and Evaluation

Treatment systems will continue to be monitored on a regular basis. If performance of individual treatment systems is less than expected, SHA will make adjustments to the treatment systems, as necessary, to try to improve results. Accumulated metals in the passive treatment systems will be flushed regularly to ensure that metals are not being retained in the system. If additional metals reductions or alkalinity increases are determined to be needed at some systems, an evaluation of the design parameters will be made, and changes such as enlargement of treatment ponds or adding treatment or settling ponds could be made. Chemical and physical parameter monitoring should follow the efficiency and progress of each AMD treatment system on a quarterly basis. Aquatic biological surveys will be conducted annually during base flow conditions at selected reaches of receiving streams to determine the effects of treatment systems on the recovery of aquatic life.

SHA and its partners will analyze water quality and benthic macroinvertebrate biometric data. Annual evaluations of performance of installed treatment systems, in-stream load reductions, and restoration of aquatic life will be held through meetings and discussions between SHA, Pa. DEP Harrisburg and Pottsville Offices, consultants, and any other individuals who could provide ideas or assistance in determining how restoration goals may be better achieved. Quarterly progress reports will be completed and submitted to U.S. EPA and placed on the EPCAMR, SCD and SHA web sites.

Since the TMDLs established load reductions for each of the discharges in the Upper Schuylkill River Watershed, these load reductions are the targets to be met in evaluating stream recovery. The Technical Committee will meet annually to evaluate the progress and milestones of the monitoring to determine if these TMDL load reductions are being met. Results of the previous year's monitoring will be used to calculate the loadings and percent reductions the completed projects achieve. The newly calculated loadings will be compared with the overall required TMDL loading reductions for the TMDL points for that discharge. The effects of the individual treatment systems on the watershed will be evaluated by comparisons with the downstream TMDL points. The comparisons and load reduction achievements will be used to determine what type of additional implementation measures are necessary to achieve the desired load reductions or if any improvements to the treatment systems efficiency need to be considered.

B. Remedial Actions

The SHA has assumed operation and maintenance responsibility for all the projects they have implemented in the watershed. The Association has conducted a volunteer water quality monitoring program in the watershed for seven (7) years and has accumulated an impressive water quality database. These data have been very beneficial in the development of new AMD remediation project proposals and the evaluation of how well existing projects are functioning. The Association and its partners are committed to continuing this monitoring for new project development and existing project operation and maintenance.

The SHA has also enlisted the services of numerous partnering agencies to assist with operation and maintenance planning. The SCD and the SHA have developed a very close relationship and continue to partner with project development, grant writing, and water quality monitoring activities. SCD staff members are also committed to the long-term operation and maintenance of the projects that they sponsor. The Conservation District's County Natural Resource Specialist will play a key role in project monitoring and maintenance coordination.

Annual evaluations of performance of installed treatment systems, in-stream load reductions, and restoration of aquatic life will be held through meetings and discussions between the watershed association, Pa. DEP Harrisburg and Pottsville Offices, consultants, and any other individuals who could provide ideas or assistance in determining how restoration goals may be better achieved.

ATTACHMENT A
Upper Schuylkill River Watershed Maps

ATTACHMENT B
Upper Schuylkill River Watershed TMDL Summary Tables

DISCLAIMER: Be advised that the TMDLs for the Little Schuylkill River, and Upper Schuylkill River are available in draft format only. Pollutant loadings contained in these reports are subject to change before the TMDLs become final.

ABBREVIATIONS:
LTA Conc. = Long-term average concentration
WLA = Waste load allocation
LA = Load allocation
NA = Not applicable
ND = Non detection

Table 4. Summary Table—Panther Creek Watershed

		Measured Sample Data		Allowable		Reduction Identified
Station	**Parameter**	**Conc. (Mg/l)**	**Load (Lb/day)**	**LTA Conc. (Mg/l)**	**Load (Lb/day)**	**Percent (%)**
002						
	Al	2.20	4.2	0.20	0.4	91
	Fe	1.44	2.8	0.50	1.0	65
	Mn	1.35	2.6	0.34	0.6	75
	Acidity	20.41	39.1	2.65	5.1	87
	Alkalinity	11.91	22.8			
005						
	Al	0.55	7.4	0.55	7.4	NA
	Fe	1.51	20.3	0.92	12.4	33
	Mn	2.74	36.7	0.30	4.0	88
	Acidity	0.00	0.0	0.00	0.0	NA
	Alkalinity	75.33	1011.6			
003						
	Al	2.40	46.3	0.34	6.5	85
	Fe	2.98	57.6	0.77	15.0	69
	Mn	3.84	74.2	0.46	8.9	77
	Acidity	6.20	119.9	6.20	119.9	NA
	Alkalinity	10.74	207.6			

The TMDL for Panther Creek Watershed consists of load allocations to three (3) sampling sites. The sampling points and their approximate locations are listed below

- 002- upstream monitoring point on Panther Creek
- 005- midstream sample point on Panther Creek
- 003- Panther Creek at the mouth of the stream at the confluence with Little Schuylkill River

Table 5. Summary Table—Wabash Creek Watershed

		Measured Sample Data		Allowable		Reduction Identified
Station	Parameter	Conc. (Mg/l)	Load (Lb/day)	LTA Conc. (Mg/l)	Load (Lb/day)	Percent (%)
1WB						
	Al	0.20	0.4	0.20	0.4	0
	Fe	1.31	2.6	0.38	0.7	71
	Mn	0.86	1.7	0.10	0.2	88
	Acidity	0.00	0.0	0.00	0.0	0
	Alkalinity	25.60	50.2			
2WB						
	Al	1.27	6.2	0.36	1.7	72
	Fe	3.51	17.1	0.49	2.4	86
	Mn	1.50	7.3	0.15	0.7	90
	Acidity	16.49	80.3	0.66	3.2	96
	Alkalinity	1.95	9.5			
4WB						
	Al	0.72	1.1	0.07	0.1	90
	Fe	3.97	5.8	0.40	0.6	90
	Mn	1.28	1.9	0.55	0.8	57
	Acidity	12.55	18.3	1.13	1.6	91
	Alkalinity	7.94	11.6			
8WB						
	Al	7.80	70.7	0.39	3.5	95
	Fe	3.83	34.7	0.96	8.7	75
	Mn	1.94	17.6	0.41	3.7	79
	Acidity	75.45	684.0	2.26	20.5	97
	Alkalinity	4.33	39.3			
11AWB						
	Al	3.29	43.6	0.36	4.8	NA
	Fe	0.67	8.9	0.67	8.9	NA
	Mn	1.15	15.3	0.50	6.6	NA
	Acidity	42.27	561.0	0.00	0.0	NA
	Alkalinity	0.00	0.0			

11WB						
	Al	2.66	46.3	0.35	6.0	NA
	Fe	0.56	9.8	0.56	9.8	NA
	Mn	1.07	18.6	0.55	9.7	NA
	Acidity	21.16	368.2	0.63	11.0	NA
	Alkalinity	1.77	30.7			

The TMDL for Wabash Creek consists of load allocations to six (6) sampling sites. The sampling points and their approximate locations are listed below

- 1WB – Wabash Creek Headwaters
- 2WB – Reevesdale No. 2 Drift
- 4WB – Reevesdale No. 1 Drift
- 8WB– Newkirk Tunnel Outflow
- 11AWB – Inlet to tunnel under Tamaqua
- 11WB – Exit of tunnel under Tamaqua

Table 4. Little Schuylkill River Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
LS1						
Aluminum (lbs/day)	103.83	8.1	0	8.1	95.73	92%
Iron (lbs/day)	129.56	8.3	0	8.3	121.27	94%
Manganese (lbs/day)	26.62	10.7	0	10.7	15.92	60%
Acidity (lbs/day)	1363.34	6.2	0	6.2	1357.14	99.5%
LS2						
Aluminum (lbs/day)	104.03	6.3	0	6.3	97.73	94%
Iron (lbs/day)	333.56	21.7	0	21.7	311.87	93%
Manganese (lbs/day)	31.56	15.3	0	15.3	16.22	51%
Acidity (lbs/day)	2003.11	39.7	0	39.7	1963.39	98%
LS3						
Aluminum (lbs/day)	285.53	27.7	0	27.7	64.35	70%
Iron (lbs/day)	593.42	32.5	0	32.5	127.76	80%
Manganese (lbs/day)	75.61	38.7	0	38.7	4.78	11%
Acidity (lbs/day)	3779.45	194.0	0	194.0	264.92	58%
LS4						
Aluminum (lbs/day)	ND	ND	0	ND	ND	NA
Iron (lbs/day)	ND	ND	0	ND	ND	NA
Manganese (lbs/day)	4.47	4.5	0	ND	ND	NA

Acidity (lbs/day)	1314.96	188.8	0	188.8	1126.12	86%
LS5						
Aluminum (lbs/day)	271.13	34.1	0	34.1	0	0%*
Iron (lbs/day)	429.12	49.4	0	49.4	0	0%*
Manganese (lbs/day)	75.94	45.5	0	45.5	0	0%*
Acidity (lbs/day)	5720.23	421.8	0	421.8	586.91	58%
LS6						
Aluminum (lbs/day)	239.5	37.3	0	37.3	0	0%*
Iron (lbs/day)	314.52	63.1	0	63.1	0	0%*
Manganese (lbs/day)	70.32	49.1	0	49.1	0	0%*
Acidity (lbs/day)	5660.02	452.8	0	452.8	0	0%*
LS7						
Aluminum (lbs/day)	151.21	49.5	0	49.5	0	0%*
Iron (lbs/day)	198.86	198.86	0	ND	ND	NA
Manganese (lbs/day)	107.88	107.88	0	ND	ND	NA
Acidity (lbs/day)	18042.42	2001.4	0	2001.4	10833.78	84%
LS8						
Aluminum (lbs/day)	ND	ND	0	ND	ND	NA
Iron (lbs/day)	127.91	127.91	0	ND	ND	NA
Manganese (lbs/day)	87.39	87.39	0	ND	ND	NA
Acidity (lbs/day)	8310.53	1122.9	0	1122.9	0	0%*
LS9						
Aluminum (lbs/day)	ND	ND	0	ND	ND	NA
Iron (lbs/day)	100.44	100.44	0	ND	ND	NA
Manganese (lbs/day)	60.15	60.15	0	ND	ND	NA
Acidity (lbs/day)	5391.92	1023.2	0	1023.2	0	0%*
Panther Creek						
Aluminum (lbs/day)	46.3	6.5	0	6.5	39.8	86%
Iron (lbs/day)	57.6	15.0	0	15.0	42.6	74%
Manganese (lbs/day)	74.2	8.9	0	8.9	65.3	88%
Acidity (lbs/day)	119.9	119.9	0	ND	ND	NA
LS10						
Aluminum (lbs/day)	587.73	259.8	165.97	93.8	454.12	83%
Iron (lbs/day)	2969.18	441.5	248.96	192.5	2734.08	93%
Manganese (lbs/day)	1617.3	334.1	165.97	168.2	1383.84	89%
Acidity (lbs/day)	26881.61	4539.6	0	4539.6	17973.29	80%
Wabash Creek						
Aluminum (lbs/day)	46.3	6.0	0	6.0	40.3	87%
Iron (lbs/day)	ND	ND	0	ND	ND	NA
Manganese (lbs/day)	18.6	9.7	0	9.7	8.9	48%
Acidity (lbs/day)	369.2	11.0	0	11.0	358.2	97%

LS11						
Aluminum (lbs/day)	699.43	398.7	0	398.7	0	0%*
Iron (lbs/day)	2557.25	628.4	0	628.4	0	0%*
Manganese (lbs/day)	1552.15	353.5	0	353.5	0	0%*
Acidity (lbs/day)	20307.13	3366.7	0	3366.7	24.36	1%
LS13						
Aluminum (lbs/day)	366.14	178.0	0	178.0	30.71	15%
Iron (lbs/day)	1331.18	762.4	0	762.4	0	0%*
Manganese (lbs/day)	653.10	653.1	0	ND	ND	NA
Acidity (lbs/day)	27588.58	4644.6	0	4644.6	6003.54	56%

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.

The TMDL for the Little Schuylkill River consists of load allocations to twelve (12) sampling sites. The sampling points and their approximate locations are listed below

- LS1 – notched weir on Little Schuylkill, upstream of diversion wells
- LS2 – notched weir @ Silverbrook outflow, upstream of diversion wells
- LS3 – downstream of diversion wells and a small unnamed tributary
- LS4 –on Lofty Creek, just upstream of confluence to Little Schuylkill
- LS5 – upstream of 2 permitted mines (prep plants)
- LS6– Little Schuylkill River downstream of mine sites
- LS7 – Little Schuylkill River west of Hometown
- LS8 – just downstream of mouth of Locust Creek
- LS9 – USGS Gaging Station on Little Schuylkill, north Tamaqua
- LS10 – just downstream of a very large deep mine discharge piped from SR309
- LS11 – Little Schuylkill River south of coal fields
- LS13 – end reach of Little Schuylkill River

Table 4. Mill Creek Watershed Summary Table

Parameter	Measured Load	WLA	LA	Load Reduction	% Reduction
M1					
Aluminum (lbs/day)	2.63	0	1.1	1.58	60%
Iron (lbs/day)	ND	0	ND	ND	NA
Manganese (lbs/day)	ND	0	ND	ND	NA
Acidity (lbs/day)	282.83	0	4.6	278.22	98%
M2					
Aluminum (lbs/day)	5.76	0	1.7	2.51	60%
Iron (lbs/day)	ND	0	ND	ND	NA
Manganese (lbs/day)	ND	0	ND	ND	NA
Acidity (lbs/day)	236.51	0	20.4	0.0	0%*
M3					
Aluminum (lbs/day)	270.49	0	33.6	236.90	88%
Iron (lbs/day)	465.71	0	32.6	433.11	93%

Manganese (lbs/day)	101.04	0	43.5	57.59	57%
Acidity (lbs/day)	4454.16	0	0.0	4454.16	100%
M4					
Aluminum (lbs/day)	304.52	0	85.3	0.0	0%*
Iron (lbs/day)	223.78	0	111.9	0.0	0%*
Manganese (lbs/day)	121.27	0	110.4	0.0	0%*
Acidity (lbs/day)	9489.40	0	379.6	4440.03	92%
M4A					
Aluminum (lbs/day)	ND	0	ND	ND	NA
Iron (lbs/day)	578.74	0	46.3	532.44	92%
Manganese (lbs/day)	166.37	0	31.6	134.76	81%
Acidity (lbs/day)	1627.81	0	862.7	765.07	47%
M5					
Aluminum (lbs/day)	12.86	0	4.6	8.23	64%
Iron (lbs/day)	293.42	0	16.8	276.64	94%
Manganese (lbs/day)	97.30	0	12.7	84.65	87%
Acidity (lbs/day)	895.49	0	411.9	483.56	54%
M6					
Aluminum (lbs/day)	394.56	0	138.1	90.06	39%
Iron (lbs/day)	1083.54	0	325.1	0.0	0%*
Manganese (lbs/day)	628.36	0	201.1	176.26	47%
Acidity (lbs/day)	10045.07	0	1305.9	6973.75	84%

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.

The TMDL for Mill Creek consists of load allocations to sixteen (7) sampling sites. The sampling points and their approximate locations are listed below

- M1-Headwaters of Mill Creek
- M2 Mill Creek is lost to mine pool
- M3 Morea AMD Discharge, Stream reappears
- M4 Mill Creek above confluence with Wolf Creek
- M4A Repplier Abandoned Deep Mine Discharge
- M5 Pine Forest Discharge
- M6 The mouth of Mill Creek before it enters Schuylkill River

Table 4. Muddy Branch Creek Watershed Summary Table

Parameter	Measured Load	WLA	LA	Load Reduction	% Reduction
MB1					
Aluminum (lbs/day)	6.44	0	1.2	5.22	81%
Iron (lbs/day)	20.93	0	2.1	18.84	90%
Manganese (lbs/day)	21.78	0	5.0	16.77	77%
Acidity (lbs/day)	10.06	0	10.1	0.0	0%
MB1A					
Aluminum (lbs/day)	66.00	0	1.3	64.68	98%

Iron (lbs/day)	15.08	0	2.7	12.37	82%
Manganese (lbs/day)	22.41	0	3.1	19.27	86%
Acidity (lbs/day)	600.37	0	12.0	588.36	98%
MB2					
Aluminum (lbs/day)	130.63	0	6.0	124.65	95%
Iron (lbs/day)	621.08	0	41.2	579.93	93%
Manganese (lbs/day)	126.91	0	34.3	92.64	73%
Acidity (lbs/day)	51.98	0	52.0	0	0%
MB3					
Aluminum (lbs/day)	NA	0	NA	NA	NA
Iron (lbs/day)	10.87	0	2.1	8.80	81%
Manganese (lbs/day)	4.21	0	2.0	2.19	52%
Acidity (lbs/day)	NA	0	NA	NA	NA
MB4					
Aluminum (lbs/day)	NA	0	NA	NA	NA
Iron (lbs/day)	4.62	0	1.9	2.68	58%
Manganese (lbs/day)	NA	0	NA	NA	NA
Acidity (lbs/day)	81.94	0	25.4	56.54	69%
MB5					
Aluminum (lbs/day)	NA	0	NA	NA	NA
Iron (lbs/day)	NA	0	NA	NA	NA
Manganese (lbs/day)	NA	0	NA	NA	NA
Acidity (lbs/day)	20.49	0	8.2	12.29	60%
WB6					
Aluminum (lbs/day)	71.46	0	10.7	0.00	0%*
Iron (lbs/day)	209.17	0	52.3	0.00	0%*
Manganese (lbs/day)	86.92	0	41.7	0.00	0%*
Acidity (lbs/day)	360.77	0	256.2	0.00	0%*

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.

The TMDL for Muddy Branch consists of load allocations to sixteen (7) sampling sites. The sampling points and their approximate locations are listed below

- MB1-Otto Secondary Discharge
- MB1A – Primrose Slope Discharge
- MB2 Otto Primary Discharge
- MB3 – Deep Mine Discharge enters into Muddy Branch Creek
- MB4 – Unnamed Tributary to Muddy Branch Creek
- MB5 – Unnamed tributary to Muddy Branch Creek
- MB6 – Mouth of Muddy Branch Creek

Table 5. West Branch Schuylkill River Watershed Summary Table

Parameter	Measured Load	WLA	LA	Load Reduction	% Reduction
WB1					
Aluminum (lbs/day)	202.18	0	44.5	157.70	78%
Iron (lbs/day)	976.33	0	117.2	859.17	88%
Manganese (lbs/day)	551.88	0	82.8	469.10	85%
Acidity (lbs/day)	1321.90	0	740.3	581.64	44%
WB2					
Aluminum (lbs/day)	157.38	0	12.6	22.03	64%
Iron (lbs/day)	26.37	0	19.3	0	0%*
Manganese (lbs/day)	222.75	0	13.4	20.04	60%
Acidity (lbs/day)	3812.22	0	381.2	2849.36	88%
WB3					
Aluminum (lbs/day)	333.89	0	136.9	52.21	28%
Iron (lbs/day)	1650.49	0	214.6	1428.81	87%
Manganese (lbs/day)	872.25	0	139.6	523.31	79%
Acidity (lbs/day)	4404.86	0	2070.3	0	0%*
WB4					
Aluminum (lbs/day)	378.68	0	143.9	37.78	21%
Iron (lbs/day)	1651.65	0	379.9	0	0%*
Manganese (lbs/day)	905.44	0	172.0	0.72	0.4%
Acidity (lbs/day)	1347.01	0	1347.0	0	0%
WB5					
Aluminum (lbs/day)	13.31	0	10.8	2.53	19%
Iron (lbs/day)	127.47	0	48.4	79.03	62%
Manganese (lbs/day)	85.86	0	68.7	17.17	20%
Acidity (lbs/day)	NA	0	NA	NA	NA
WB6					
Aluminum (lbs/day)	637.23	2.40	233.4	166.55	42%
Iron (lbs/day)	1592.63	3.60	362.7	20.72	5%
Manganese (lbs/day)	1029.30	2.40	440.2	0	0%*
Acidity (lbs/day)	NA	0	NA	NA	NA

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.

The TMDL for West Branch Schuylkill River consists of load allocations to six (6) sampling sites. The sampling points and their approximate locations are listed below

- WB1 – OakHill Tunnel
- WB2 – On West Branch Schuylkill River near Duncott
- WB3 – West Branch Schuylkill River below the Oakhill boreholes
- WB4 – West Branch Schuylkill River below confluence of two tributaries
- WB5 – Near mouth of West West Branch Schuylkill River
- WB6 – Mouth of West Branch Schuylkill River

Table 5. Upper Schuylkill River Watershed Summary Table (Draft)

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
S1						
Aluminum (lbs/day)	27.95	11.15	0.22	10.93	17.02	61.00
Iron (lbs/day)	16.47	16.47	0.33	16.14	0.33	2.00
Manganese (lbs/day)	25.66	13.87	0.22	13.65	12.01	47.00
Acidity (lbs/day)	1206.38	147.38	0	147.38	1059.00	88.00
S2						
Aluminum (lbs/day)	9.22	3.85	0	3.85	5.37	58.00
Iron (lbs/day)	39.84	3.94	0	3.94	35.90	90.00
Manganese (lbs/day)	13.00	6.11	0	6.11	6.89	53.00
Acidity (lbs/day)	559.74	1.69	0	1.69	558.05	99.70
S2A						
Aluminum (lbs/day)	25.47	11.10	0	11.10	0.00	0.00*
Iron (lbs/day)	42.53	11.58	0	11.58	3.59	24.00
Manganese (lbs/day)	29.51	14.88	0	14.88	0.20	1.00
Acidity (lbs/day)	0.00	0.00	0	ND	ND	NA
S3						
Aluminum (lbs/day)	4.24	1.71	0	1.71	2.53	60.00
Iron (lbs/day)	58.63	7.71	0	7.71	50.92	87.00
Manganese (lbs/day)	16.84	6.30	0	6.30	10.54	63.00
Acidity (lbs/day)	102.19	67.27	0	67.27	34.92	34.00
S4						
Aluminum (lbs/day)	12.97	3.19	0	3.19	9.78	75.00
Iron (lbs/day)	93.84	12.02	0	12.02	81.82	87.00
Manganese (lbs/day)	27.12	14.10	0	14.10	13.02	48.00
Acidity (lbs/day)	837.93	197.98	0	197.98	639.95	76.00
S5						
Aluminum (lbs/day)	42.31	17.64	0	17.64	24.67	58.00
Iron (lbs/day)	3.37	3.37	0	ND	ND	NA
Manganese (lbs/day)	21.26	21.26	0	ND	ND	NA
Acidity (lbs/day)	2156.82	348.83	0	348.83	1807.99	84.00
S6A						
Aluminum (lbs/day)	0.00	0.00	0	0.00	0.00	0.00
Iron (lbs/day)	12.41	1.63	0	1.63	10.78	87.00
Manganese (lbs/day)	1.47	1.47	0	ND	ND	NA
Acidity (lbs/day)	75.72	22.67	0	22.67	53.05	70.00
S6						
Aluminum (lbs/day)	14.41	1.70	0	1.70	12.71	88.00
Iron (lbs/day)	14.55	3.34	0	3.34	11.21	77.00
Manganese (lbs/day)	10.32	2.44	0	2.44	7.88	76.00
Acidity (lbs/day)	205.94	19.72	0	19.72	186.22	90.00

S7						
Aluminum (lbs/day)	31.88	8.63	0	8.63	23.25	73.00
Iron (lbs/day)	435.99	20.01	0	20.01	415.98	95.00
Manganese (lbs/day)	65.26	15.28	0	15.28	49.98	77.00
Acidity (lbs/day)	1138.83	186.52	0	186.52	952.31	84.00
S8						
Aluminum (lbs/day)	8.15	3.83	0	3.83	4.32	53.00
Iron (lbs/day)	148.86	9.88	0	9.88	138.98	93.00
Manganese (lbs/day)	35.05	7.26	0	7.26	27.79	79.00
Acidity (lbs/day)	0.00	0.00	0	ND	ND	NA
S9						
Aluminum (lbs/day)	6.15	1.47	0	1.47	4.68	76.00
Iron (lbs/day)	55.30	4.91	0	4.91	50.39	91.00
Manganese (lbs/day)	14.95	5.00	0	5.00	9.95	67.00
Acidity (lbs/day)	85.90	47.80	0	47.80	38.10	44.00
S10						
Aluminum (lbs/day)	0.00	0.00	0	ND	ND	NA
Iron (lbs/day)	150.75	11.11	0	11.11	139.64	93.00
Manganese (lbs/day)	23.88	7.80	0	7.80	16.08	67.00
Acidity (lbs/day)	0.00	0.00	0	ND	ND	NA
Mill Creek						
Aluminum (lbs/day)	394.56	138.10	0	138.10	256.46	65.00
Iron (lbs/day)	1083.54	325.06	0	325.06	758.48	70.00
Manganese (lbs/day)	628.36	201.08	0	201.08	427.28	68.00
Acidity (lbs/day)	10045.07	1305.86	0	1305.86	8739.21	87.00
S11						
Aluminum (lbs/day)	0.00	0.00	0	ND	ND	NA
Iron (lbs/day)	1.47	1.20	0	1.20	0.27	18.00
Manganese (lbs/day)	1.02	1.02	0	ND	ND	NA
Acidity (lbs/day)	0.00	0.00	0	ND	ND	NA
West Branch Schuylkill River						
Aluminum (lbs/day)	637.23	233.37	0	233.37	403.86	63.00
Iron (lbs/day)	1592.63	362.70	0	362.70	1229.93	77.00
Manganese (lbs/day)	1029.30	440.20	0	440.20	589.10	57.00
Acidity (lbs/day)	0.00	0.00	0	ND	ND	NA
S12						
Aluminum (lbs/day)	0.00	0.00	0	ND	ND	NA
Iron (lbs/day)	2.83	0.93	0	0.93	1.90	67.00
Manganese (lbs/day)	0.98	0.56	0	0.56	0.42	43.00
Acidity (lbs/day)	0.00	0.00	0	ND	ND	NA
S14						
Aluminum (lbs/day)	980.48	314.38	81.95	232.43	121.10	34.00
Iron (lbs/day)	4823.22	1352.85	122.92	1229.93	671.56	35.00
Manganese (lbs/day)	2704.84	1389.34	81.95	1307.39	230.78	15.00
Acidity (lbs/day)	11144.55	8272.48	0	8272.48	0.00	0.00*
S15						

Aluminum (lbs/day)	531.51	271.12	0	271.12	0.00	0.00*
Iron (lbs/day)	1962.81	1429.06	0	1429.06	0.00	0.00*
Manganese (lbs/day)	2142.49	1782.92	0	1782.92	0.00	0.00*
Acidity (lbs/day)	18532.19	10246.17	0	10246.17	5413.95	35.00

*Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.

In the instance that the allowable load is equal to the measured load (e.g. manganese S11), the simulation determined that water quality standards are being met instream and therefore no TMDL is necessary for the parameter at that point.

The TMDL for Upper Schuylkill River consists of load allocations to sixteen (16) sampling sites. The sampling points and their approximate locations are listed below.

- S1 – Headwaters of Schuylkill River near Tuscarora.
- S2 – Bell Tunnel Discharge.
- S2A– Schuylkill River below the Bell Tunnel Discharge.
- S3 – Flow weir at Mary D Overflow.
- S4 – Flow weir at Mary D Boreholes.
- S5 – Big Creek near confluence with Schuylkill River.
- S6A – Middleport Overflow.
- S6 – Flow weir at Kaska Discharge.
- S7 – Flow weir at Silver Creek Discharge.
- S8 – Eagle Hill Discharge.
- S9 – Lucianna Discharge.
- S10 – Randolph Tunnel.
- S11 – Salem Hill Tunnel.
- S12 – Sherman Colliery.
- S14 – Schuylkill River in Landingville at USGS gauging station.
- S15 – Schuylkill River in Port Clinton upstream of the confluence with Little Schuylkill River.

ATTACHMENT C

Upper Schuylkill River Watershed Mine Land Reclamation Projects Map

ATTACHMENT D

Upper Schuylkill River Watershed Active Mining Permits

Mining Permits in the Panther Creek Watershed

Permittee	*Permit Number*	*Status*	*NPDES*
Lehigh Coal and Navigation Company	543333020	Surface re-mining. No NPDES permit.	N/A

Table 2. Mining Permits in the Wabash Creek Watershed

Permittee	*Permit Number*	*Status*	*NPDES*
F&P Coal Company	54840204	Refuse re-mining.	PA0614050
Reily Mineral Resources Inc.	54980101	Surface re-mining.	PA0223921

Table 2. Mining Permits in the Little Schuylkill Watershed

Permittee	*Permit Number*	*Status*	*NPDES*
Mazaika Coal Company	54840209	Coal preparation plant on site. No NPDES permit	N/A
Premium Fine Coal, Inc.	54860204	Coal preparation plant on site. NPDES permit for a sedimentation pond. No reported discharge.	PA0593486
Vito J. Rodino, Inc.	54921601	Coal preparation plant on site. No NPDES permit.	N/A
Northeastern Power Company	54920201	No NPDES permit. Cogeneration plant, refuse reprocessing, and coal ash placement are active on this site.	N/A
South Tamaqua Coal Pockets, Inc.	54830209	Coal preparation plant on site. NPDES permit for a sedimentation pond. No reported discharge.	PA0613631
Lehigh Coal & Navigation Company	54733020	NPDES permit. 2 outfalls are in the Panther Creek Watershed. One temporary effluent discharge	PA0012360

*** NPDES permit PA0012360 has two inactive discharges plus the active 005 discharge.
Permit #s PA0593486 and PA0613631 are permitted for erosion and sedimentation only.

Table 2. Active Mining Permits in Mill Creek Watershed

Permit No.	*Operation and Company Name*	*Operation Status*
54020201	Stoudts Ferry Preparation Co., Inc. Mahanoy Twp Bank Mine	Active refuse reprocessing (spoil bank removal).
54840201	Pagnotti Enterprises, Inc. Shenandoah Area Mine	Active refuse reprocessing.
54950202	Gilberton Coal Co. N. Mahanoy Mine	Active refuse reprocessing and re-mining
54663021	Reading Anthracite Co. Potts Bannon P50 Mine	Active re-mining
54840106	Philadephia City Trustee Girard Estate Packer V Mine	Active re-mining, refuse reprocessing, coal ash and refuse placement
54900205	Wheelabrator Culm SVC, Inc. Morea Cogen	Active cogeneration plant, refuse reprocessing, coal ash placement
54813009	Joe Kuperavage Coal Co. E. Norwegian Mine	Active re-mining
54693047	Pagnotti Enterises, Inc. Morea & New Boston Mine	Active refuse reprocessing and coal ash placement

Table 2. Active Mining Permits in the Muddy Branch Watershed

Permit No.	*Operation and Company Name*	*Operation Status*
54850112	AD Coal Company, Diamond Mine	Site reclaimed.
54900205	White Pine Coal Co., Baby Boy Jarvis Mine	Active open pit mine. NPDES permitted discharge (Subchapter G).
54840207	CLS Coal Company, Maple Spring Mine	No active mining, Stage II reclamation. NPDES permitted (E & S Facilities)

Table 2. Active Mining Permits in West Branch Schuylkill River Watershed

Permit No.	*Operation and Company Name*	*Operation Status*
54773006	Buck Run Mine Reading Anthracite Co.	Active open pit mine. No NPDES permitted discharges.
54773223	Pine Hill Refuse Bank, CLS Coal Co.	Active for reclamation purposes only.
54783702	New St. Nicholas Breaker Reading Anthracite Co.	Active preparation plant and refuse reprocessing (bank removal). NPDES permitted discharges for E & S controls.
54851332	Woods Drift Mine RS&W Coal Co.	Active underground mine. NPDES permitted discharges for treatment of mine water.
54860107	Oak Hill Bank Reading Anthracite Co.	Active bank removal operation. No NPDES permitted discharges.
54860110	Rhoersville Basin Reading Anthracite Co.	Active bank removal operation. No NPDES permitted discharges.
54860205	Marlin Breaker, Cass Contracting Co.	Active bank removal and preparation plant (breaker). No NPDES permitted discharges.
54871303	7 Foot Drift Mine, D & D Coal Co.	Active underground mine.
54890202	Glenworth Bank, Ginther Coal Co.	Site is at Stage III (final) reclamation.
54920202	Sub G Mine, Direnzo Coal Co.	Active bank removal. NPDES permit and Subchapter G permit for a pre-existing pollutional discharge.
54931302	Little Buck Slope Mine, Mine Hill Coal Co. 50	Underground site being reclaimed.

54940202	Direnzo Breaker, Direnzo Coal Co.	Active preparation plant and refuse reprocessing (bank removal). No NPDES permitted discharges.
54921305	Ridge Slope Mine, Three Way Coal Co.	Bond in forfeiture
54871304	Orchard Mine, Mountain Run Enterprises	Site is in Stage II reclamation.
54851305	Buck Mountain Drift Mine, D & F Deep Mine Coal Co.	Active underground mine.
54840105	Mine Hill 7 Mine, Mine Hill Coal Co.	Active surface mine.
54900204	Valley Peat Mine, Valley Peat Humus Co., Inc.	Site is in Stage II reclamation.

Table 2. Active Mining Permits in Upper Schuylkill River Watershed

Permit No.	*Operation and Company Name*	*Operation Status*
54030103	Jett #2 Stripping, Jett Contracting Co	Active stripping operation. NPDES permit and Subchapter G permit for a pre-existing pollutional discharge.
54011301	Seven Foot Slope Mine, Alfred Brown Coal	Recent phase II underground mining permit. Permitted treatment facility has not been built
54693031	Eagle Hill West, Joe Kuperavage Coal Co.	Active stripping operation. No recorded discharge for issued NPDES permit.
54693047	Morea/New Boston Colliery, Pagnotti Enterprises, Inc.	Active bank removal and coal ash placement. No NPDES permitted discharges.
54713002	Wadesville P-33 Mine Reading Anthracite Co.	Active open pit mine. NPDES permit for pumping deep mine complex.
54743208	Lucianne Bank, Ginther Coal Co.	Active breaker and bank recovery. NPDES permit for a silt pond. No record of discharge event.
54773017	Eagle Hill Stripping, K & K Coal Co.	Active stripping operation. No recorded discharge for issued NPDES permit.
54813009	East Norwegian Mine, Joe Kuperavage Coal Co.	Active stripping operation. No NPDES permitted discharges.
54813011	EOJ Mine, EOJ, Inc.	Active for reclamation purposes only. Stage I reclamation (regarded) completed.
54830101	B & M Mine, K & K Coal Co.	Active stripping operation. No recorded discharge for issued NPDES permit.

54830102	Silver Creek Mine, Joe Kuperavage Coal Co.	Site is being reclaimed.
54830103	Mary Davis Mine, K & K Coal Co.	Active stripping operation. No recorded discharge for issued NPDES permit.
54830104	Hardway Serill Mine, Hardway Coal Co.	Active stripping operation. No NPDES permitted discharges.
54830105	Brockton Stripping, Joe Kuperavage Coal Co.	Active stripping operation. No NPDES permitted discharges.
54830109	New Philadelphia Mine, Joe Kuperavage Coal Co.	Active stripping operation. No recorded discharge for issued NPDES permit.
54850104	Bell Mine Tracy Coal Co.	Active strip mine. NPDES permitted discharge for E & S Controls.
54850108	Jett Stripping, Jett Contracting Co.	Active stripping operation. No NPDES permitted discharges.
5485109	S. Kaska Mine, Kristoff & Pacine Coal Co.	Eligible for Stage II Reclamation.
54850201	Eagle Hill Bank, Ginther Coal Co.	Active silt recovery operation. No NPDES permitted discharges.
54850110	Lone Pine Mine, White Pine Coal Co., Inc.	Reclaimed stripping operation.
54851307	Slope No. 1 Mine, Alpine Coal Co., Inc.	Reclaimed deep mine.
54851315	Nowacki Coal Mine, Nowacki Coal Co.	Active underground mine. No NPDES permitted discharges.
54860102	Silver Creek Mine, Gale Coal Co., Inc.	Active for reclamation purposes only. Stage I reclamation (regarded) completed.
54860105	Tuscarora Mine, Kuperavage Enterprises, Inc.	Active stripping and preparation plant. Several NPDES points (E&S) with recorded discharges.
54860108	Wadesville Area Mine Reading Anthracite Co.	Active stripping and support in conjunction with Wadesville P-33 Mine and has a NPDES permit for the same discharge
54870101	Ohlinger & Bushey Mine, Kuperavage Enterprises, Inc.	Active stripping operation. No recorded discharge for issued NPDES permit.
54871304	Orchard Mine, Mountain Run Enterprises	Eligible for Stage II Reclamation.
54900103	EOJ Strip Mine, EOJ, Inc.	Active surface mining site. No NPDES permitted discharges.

54900105	Mary D Mine Tuscarora Mines & Minerals Corp.	Active strip mine. NPDES permitted discharge for treatment/settling pond discharge.
54910204	Koury Bank, Pagnotti Enterprises, Inc.	Active for reclamation purposes only.
54940102	Silver Creek North Mine, Gale Coal Co., Inc.	Active for reclamation purposes only. Stage I reclamation (regarded) completed.
54950101	Eagle Hill South Mine Joe Kuperavage Coal Co.	Active strip mine. No NPDES permitted discharges.
54950102	Middleport Mine, W & W Construction Co.	Reclaimed stripping operation.
54950203	Petrole No. 1, Joseph Petrole	Active for reclamation purposes only.
54970101	Schuylkill Twp. Mine, JC Coal, Inc.	Active stripping operation. NPDES permit and Subchapter G permit for a pre-existing pollutional discharge.
54960301	Walter Mintz Quarry Jean J. & Jean Mintz	Active quarry. No NPDES permitted discharges.
7275SM5	Middleport Quarry Middleport Materials, Inc	Active non-coal operation. NPDES permitted discharge for E&S controls.

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