pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Acid Mine Drainage Set-Aside Program

Program Implementation Guidelines

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Abandoned Mine Reclamation Project

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TITLE:	Acid Mine Drainage Set-Aside Program Implementation Guidelines
EFFECTIVE DATE:	September 17, 2016
AUTHORITY:	Federal Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. §§ 1201 – 1328)
POLICY:	The Department of Environmental Protection (DEP) will follow published guidelines in the implementation of the Acid Mine Drainage (AMD) Set-Aside Program.
PURPOSE:	This statement of policy establishes uniform procedures to ensure that the AMD Set-Aside Program is implemented in a scientifically sound and cost effective manner in order to maximize the stream miles restored with the funds available.
APPLICABILITY:	This policy applies to DEP staff involved with implementation of the AMD Set-Aside Program and to the watershed restoration community when seeking AMD Set-Aside funds for projects.
DISCLAIMER:	The policies and procedures outlined in this guidance document are intended to supplement existing requirements. Nothing in the policies or procedures will affect regulatory requirements. The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of the Department to give these rules that weight or deference. This document establishes the framework, within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.
PAGE LENGTH:	70 pages
DEFINITIONS:	The term "acid mine drainage" (AMD) includes both net alkaline and net acid mine drainage.

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Preface

In December 2006, Congress passed comprehensive legislation reauthorizing the Abandoned Mine Land (AML) Program under Title IV of the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The legislation extends federal AML fee collection authority through 2021 at reduced rates, but authorizes funding from other sources to compensate for the reductions, and addresses a host of other provisions to the AML program. The new changes in federal law offer the potential of substantial increases in AML funding to states and tribes, and sharpens the focus of AML reclamation on projects that benefit public health and safety and the environment. In addition, the law authorized continuation and expansion of the provision commonly known as the Acid Mine Drainage[1] (AMD) Set-Aside, which allows any state with an approved reclamation plan to receive and retain a portion of its annual grant to be expended for the abatement of the causes and the treatment of the effects of AMD. The provision now permits a maximum of up to thirty percent (30%) of a state's annual grant to be deposited into a Set-Aside account, an increase from the maximum of up to ten percent (10%) that was previously permitted.

Due to the significant increase in funding for AMD projects, a joint DEP and federal Office of Surface Mining Reclamation and Enforcement (OSMRE) workgroup was established to develop criteria that would guide expenditures of funds received by Pennsylvania's AMD Set-Aside Program for the implementation of mine drainage treatment and/or abatement projects. The main objective of the workgroup was to develop guidelines that ensure the efficient and effective expenditure of AMD Set-Aside Program funding that achieves measurable restoration of watersheds impacted by abandoned coal mine drainage in accordance with the requirements of SMCRA.

With public input, the workgroup developed draft Guidelines that were completed in 2009. While the Guidelines were never formally finalized and adopted, OSMRE and DEP began implementation of their use to guide project selection starting in July 2009. In August 2012, after a departmental re-organization moved the Set-Aside Program from DEP's Bureau of Abandoned Mine Reclamation to the newly formed Bureau of Conservation and Restoration (BCR), a new workgroup was convened to take a second look at the Guidelines. This group consisted of a few original workgroup members from DEP, BCR and OSMRE, a few new members from BCR, and an outside member with a geochemical background and considerable experience designing and evaluating passive treatment systems. The intent was to evaluate how well the Guidelines were working, revise where deemed necessary, finalize after receiving and considering public comments, and publish as a final DEP document. This document is the product of that effort.

These Guidelines will serve as the primary method for evaluating newly proposed watershed restoration plans, and the abatement or treatment projects identified within these hydrologic units. These Guidelines will also be used to evaluate expenditures for operation, monitoring, maintenance, and replacement (O&M) of existing systems. However, these Guidelines are not absolute and will not be the sole basis for every mine drainage project decision. There will also be a transition period in which projects previously committed to by DEP will be completed.

[1] *(NOTE: The term acid mine drainage (AMD) includes both net alkaline and net acid mine drainage)*

Surface Mining Control and Reclamation Act of 1977

Language in the Act

Section 403 of SMCRA establishes the objectives of providing funding to address AML problems. As amended on December 20, 2006, Section 403(a) establishes three funding priorities: the protection of public health, safety, and property from extreme danger of adverse effects of coal mining practices; the protection of public health and safety from adverse effects of coal mining practices; and the restoration of land and water resources and the environment previously degraded by adverse effects of coal mining practices. It is the third priority, commonly referred to as Priority 3 reclamation, which SMCRA authorizes as the basis for setting the objectives for many of the water quality abatement projects funded under the Pennsylvania AML program.

As established under SMCRA Section 403(a)(3), qualifying project expenditures must provide for "the restoration of land and water resources and the environment previously degraded by adverse effects of coal mining practices including measures for the conservation and development of soil, water (excluding channelization), woodland, fish and wildlife, recreation resources, and agricultural productivity." The phrase "restoration of land and water resources and the environment" implies that the proposed water abatement or treatment activities must return a water resource to a restored condition in a reliable and predictable manner. In addition, the inclusion of the term "environment" in the statutory language is an indication that, beyond addressing degraded water quality parameters, specific project objectives must also take into account the restoration of associated biological and hydrologic resources affected by the coal mining practices. The importance of achieving restoration beyond simple water quality improvements is further emphasized under Section 403(a)(3), which includes measures for the conservation and development of soil, woodland, fish and wildlife, recreation resources, and agricultural productivity in the definition of Priority 3 activities.

The restoration of water resources consistent with Priority 3 objectives is not only applicable to traditional AML reclamation projects, it is central to achieving the objectives of the AMD Set-Aside Program established under Section 402(g)(6) of SMCRA . Section 402(g)(6)(A) allows states to receive and retain up to 30% of annual grants to deposit into an AMD abatement and treatment fund. The state may expend these amounts "for the abatement of the causes and the treatment of the effects of AMD in a **comprehensive manner** within qualified hydrologic units affected by coal mining practices."

It is important to note that abating and treating AMD in a "comprehensive" manner within the context of a "qualified hydrologic unit" is a fundamental requirement of the Federal OSM regulations for use of Set-Aside funding. DEP will ensure implementation of this provision by funding AMD projects in watersheds consistent with a watershed plan developed with clear restoration goals that are consistent with the overarching program goals.

Implementation of the AMD Set-Aside Program in Pennsylvania

A. Overarching Program Goals

The public and other resource agencies involved in stream restoration efforts submitted many valuable ideas to the workgroup. After considering this input, DEP concluded that an important component of the workgroup's effort would be to describe the overall direction of the program by developing overarching goals for the AMD Set-Aside Program. Title 25 of the Pennsylvania Code (Environmental Protection), Chapter 93 (Water Quality Standards) sets forth water quality standards for surface waters of the Commonwealth. The workgroup has looked to the standards defined in Chapter 93 to help in developing overarching program goals. This approach also aligns with the requirements in Section 403 of SMCRA. However, recognizing that there is not adequate funding to fully restore all AMD impacted streams in Pennsylvania, DEP has chosen to implement a two-tiered approach based upon the level of biological restoration that can be reasonably achieved. The goal for the Upper Tier is to reach full biological attainment for aquatic life uses, and remove the targeted stream or stream segment from DEP's Impaired Waters list. The Guidelines and criteria required to delist a stream have been developed by DEP using In-stream Comprehensive Evaluation protocols. The goal for the Lower Tier will be a less significant level of biological recovery, focusing primarily on the attainment of a recreational fishery where applicable. Attainment will be determined through fish surveys. A more detailed discussion on each tier is presented below.

The Upper Tier requires a higher level of restoration. Watersheds with minor impairments due to a small number of AMD discharges or AML sites would be reasonable candidates for Upper Tier restoration goals. Headwater streams with no other sources of impairment are likely to be good candidates. An example of an Upper Tier watershed is Sterling Run, a tributary to the West Branch Susquehanna River, in Centre County. The single source of AMD to this remote, forested watershed was addressed with a passive treatment system that is operating very effectively. A recent biological survey has determined that macroinvertebrates meet DEP delisting criteria, and the stream is supporting a reproducing brook trout population. DEP has initiated the process to delist Sterling Run from the Impaired Waters list.

For the majority of watersheds, the Lower Tier is a more reasonable and cost effective goal. This goal will keep restoration costs lower in watersheds where there are many sources of AMD, as well as other conditions that will make full biological attainment extremely difficult. This goal will require in-stream water quality improvements to a level that supports a diversity of fish and macroinvertebrates. Fish surveys will be used to determine if the goal of a recreational fishery has been met. A good example of a watershed meeting Lower Tier goals is the Stonycreek River in Somerset and Cambria counties. Restoration activities have resulted in the establishment of a recreational fishery in over 20 miles of stream that were once too acidic to support life. However, the results of recent macroinvertebrate surveys have indicated that impairment remains and the stream cannot be delisted from DEP's Impaired Waters list.

While the goals are keyed to appropriate levels of biological recovery, water quality parameters are also targeted in order to assure the conditions for the appropriate levels of recovery, as well as to provide pollutant removal targets for stream modeling purposes. For Upper Tier goals, in-stream water quality conditions are expected to be met under all flow conditions. While there may be infrequent exceedances, water quality should be such that full biological recovery is not impaired. For Lower Tier goals, minor exceedances can be expected during some flow conditions, likely low-flow conditions when there may not be adequate assimilation of remaining AMD discharges. However, the stream is expected to be of a quality that can support a fishery under normal flow conditions and a diversity of macroinvertebrate life.

DEP and others attempting to restore watersheds must also consider any other sources of impairment in the watershed, to both water quality and habitat, in evaluating the likelihood of a stream being able to meet restoration goals. For example, if the targeted stream or stream segment has significant agricultural impairments or has been channelized and has poor habitat value, it may not be possible to meet biological restoration goals. In these situations, DEP will evaluate the potential for remediation of the other sources of impairment as part of its decision to expend Set-Aside funding in the watershed. The stream may not qualify for Set-Aside funding if it will not be possible to meet restoration goals without addressing the other sources of impairment, and there are no plans to address the other sources.

The specific overarching goals are as follows:

Upper Tier - The goal for the targeted stream or stream segment is to be delisted from DEP's Impaired Waters list. The following in-stream contaminant concentrations must be met under all flow conditions, with infrequent, minor exceedances that do not adversely impact aquatic life: pH > 6.0, hot peroxide acidity less than zero according to USEPA methods (unless in a naturally acidic headwater stream with a functioning biological community upstream of impairment), total Fe < 1.5 mg/L, total Al < 0.5 mg/L and TDS < 1,500 mg/L. Macroinvertebrate surveys must be completed to determine that the stream meets DEP's delisting criteria (full attainment).

Lower Tier - The goal for the targeted stream or stream segment is to provide for biological restoration, including, where applicable, a recreational fishery. The following in-stream contaminant concentrations must be met during **normal** stream flow conditions: pH > 6.0, hot peroxide acidity less than zero according to USEPA methods (unless in a naturally acidic headwater stream with a functioning biological community upstream of impairment), total Fe < 1.5 mg/L, total Al < 0.5 mg/L and TDS < 1,500 mg/L. Where applicable, fish surveys will be necessary to determine if the recreational fishery criteria have been met. Macroinvertebrate surveys will also be used.

B. Existing Hydrologic Unit Plans and Development of New Qualified Hydrologic Units

Prior to the 2006 re-authorization, SMCRA required the development of Hydrologic Unit Plans (HUPs) as a condition for the expenditure of funds to restore watersheds. The HUP needed to be reviewed and approved by OSMRE prior to the expenditure of Set-Aside funds in that watershed. The re-authorized SMCRA language calls for completing AMD work in a comprehensive manner within "Qualified Hydrologic Units" (QHUs) affected by coal mining practices (Section 402(g)(6)(A)). A QHU means a hydrologic unit - (i) in which the water quality has been significantly affected by AMD from coal mining practices in a manner that adversely impacts biological resources; and (ii) contains land and water that are eligible for SMCRA funding and are the subject of expenditures by the state from either the forfeiture of bonds or other state programs to abate and treat mine drainage (Section 402(g)(6)(A)). The QHU, as defined in the SMCRA 2006 re-authorization, does not require OSMRE review and approval. DEP staff has developed a form to document that a hydrologic unit is "qualified" (see Appendix A). The completed form will be maintained in DEP files and will provide documentation that Set-Aside expenditures meet the above requirements. Positive answers to the questions in "Appendix A" will qualify the watershed as a QHU; however, watershed restoration using Set-Aside funding will be determined based on these guidelines in order to assure the approach is "comprehensive," a restoration plan that meets the objectives of this guidance must be in place.

There are 31 approved QHUs/HUPs currently in place across the Commonwealth (see Appendix B). Future QHUs will be added in a cautious manner, with consideration given to staff and financial resources. DEP views the addition of new QHUs as a commitment to comprehensive restoration. DEP will add new QHUs commensurate with the ability of DEP, in conjunction with watershed partners, to meet restoration goals.

C. Watershed Restoration Plans and/or Proposed Restoration Area

DEP intends to use existing watershed restoration plans to the greatest extent possible when evaluating and scoring watersheds proposed for new QHUs. Most active watershed groups have received funding from Growing Greener and other sources, and have completed restoration plans for their watersheds. It may be necessary for DEP staff to supplement the existing plans with additional data collection, and/or to work with the group to further develop their restoration goals and stream modeling. However, the closer the existing plans match the scoring criteria in this document, the better the chances are for having a watershed approved as a QHU.

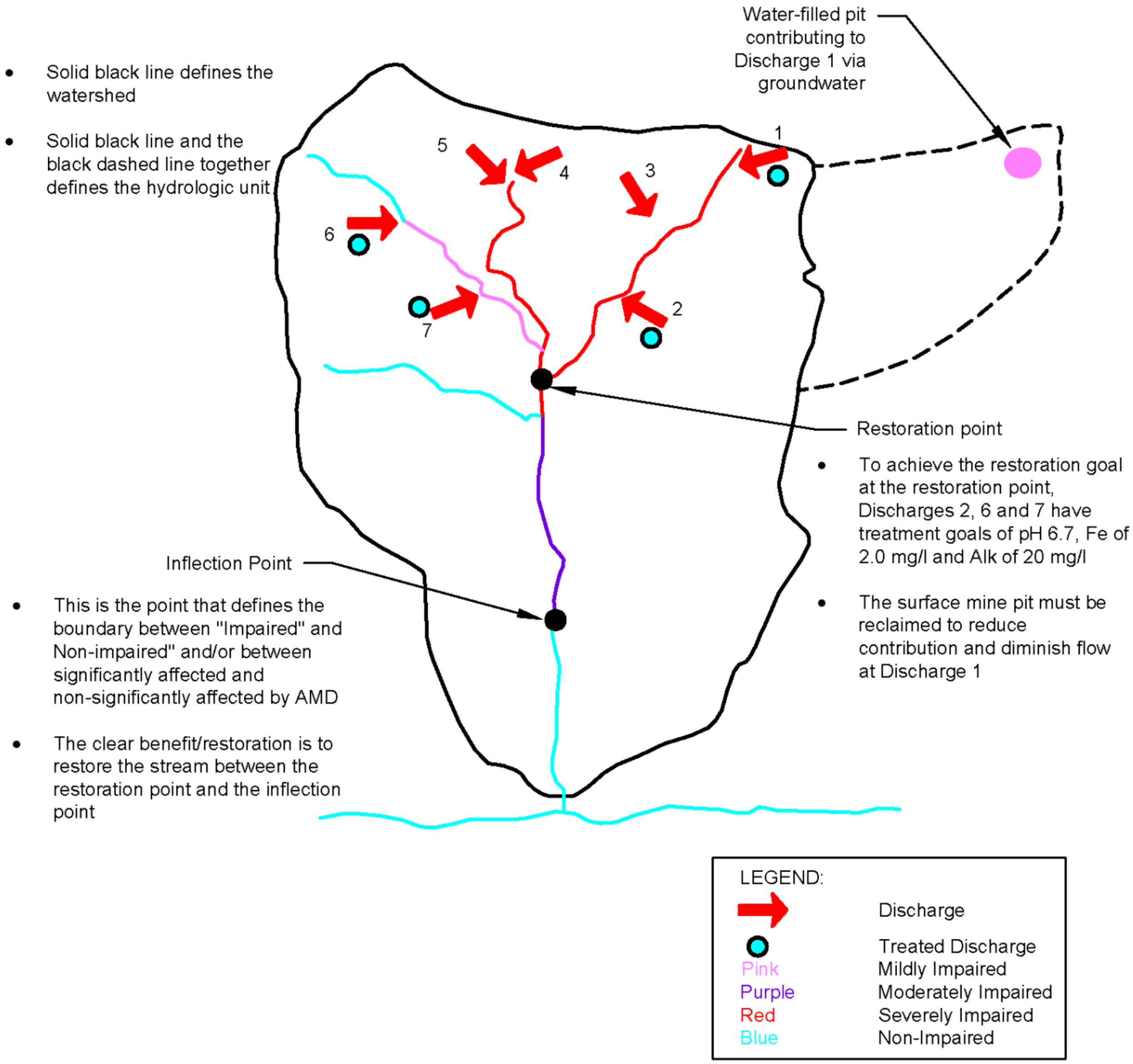
There may be situations in the future where there is an interest in developing a QHU for a watershed where no restoration planning has been completed. In those situations, DEP staff will work with interested parties to collect the data, develop goals, complete modeling, and ensure that all other work needed is performed. Responsibilities will be determined on a case-by-case basis in those situations.

Watershed restoration plans that have been or are being developed by watershed groups, as well as restoration plans developed within DEP, must undergo an evaluation and scoring process to first determine whether the project has a Benefit/Cost Ratio greater than 1.0, and second, to determine the “benefit” of investing Set-Aside funds in the watershed. Before DEP staff proceeds with development of a QHU as defined by SMCRA, documentation must be provided that indicates a Benefit/Cost Ratio that is greater than one (>1), and scoring must determine that restoring the watershed is of “Benefit” to the Commonwealth (see the discussion under “Evaluation and Scoring of Restoration Plans, D. Restoration Plan Benefit Determination,” for an explanation of the use of the term “Benefit” in this document). Existing restoration plan(s) will be used and will be amended where needed to document all necessary information. Once a QHU has been documented and a benefit value assigned, the watershed will be eligible for the expenditure of Title IV AMD Set-Aside funds. DEP will then proceed to work in conjunction with watershed partners to meet the defined restoration goals.

D. Example of Restoration Plan Goals

Figure 1 below provides a pictorial illustration of a watershed restoration plan. For this fictional plan, the local interests, working with DEP staff, first make decisions about restoration goals for the watershed. They decide that it is an important restoration goal to restore the main stem of the stream, between the restoration point shown on the illustration and the end of the impaired segment to Lower Tier goals. They decide that the tributaries receiving Discharges 1, 2, 3, 4 and 5 were so severely impaired, and had such poor habitat due to other activities in the watershed, that restoration of these tributaries is not a goal of the restoration plan. The tributary receiving Discharges 6 and 7 was only mildly impaired and had high quality habitat. Therefore, the goal for this tributary is complete delisting, or an Upper Tier restoration goal. Once these goals are established, further evaluation determines that the goals can be met by treating Discharges 2, 6 and 7, and backfilling a water-filled surface mine pit to reduce the contribution to Discharge 1. Restoration goals are established for the three individual discharges and treatment facilities are designed based on the need to treat to the established restoration goals.

Figure 1 Watershed Example



E. Process for the Evaluation of Restoration Plans for New Qualified Hydrologic Units

Step 1: Development of a restoration plan for the watershed. The plan may be completed by DEP staff, watershed groups, or other interested entities. Components in the plan should include: local support; background data; restoration goals; technological analysis; alternatives analysis (where applicable for proposed new treatment systems); O&M; and a Benefit/Cost Analysis. It is advised that watershed groups, and others evaluating a watershed, collect the data and information needed to evaluate the cost versus benefits prior to fully developing the restoration plan.

Groups interested in developing a restoration plan for Set-Aside consideration must consult with DEP staff prior to plan development and submittal. After consultation, the plan can be finalized and submitted to DEP staff for consideration as a QHU.

Step 2: A watershed group or other entity submits a restoration plan with the documented Benefit/Cost Analysis to DEP.

Step 3: Once DEP receives the plan, staff will first examine the costs verses benefits of the plan based on these <u>Guidelines</u>. If the costs are greater than the benefits, DEP will not consider making the watershed a QHU. If the benefits are greater than the cost, DEP then scores the restoration plan and assigns a benefit value according to the scoring procedures listed in <u>these Guidelines</u>. <u>Before making a final decision on whether a watershed is accepted as a QHU, consideration is also given to whether the watershed falls within program priorities (see below) and staff resource and funding limitations.</u>

Step 4: Once the watershed is accepted as a QHU, the watershed will qualify for AMD Set-Aside funding. Funding for projects within a QHU will be evaluated based on DEP priorities, prior commitments, and available funding (all sources). <u>In most cases, DEP will not consider implementing a restoration plan in an approved QHU (with set aside funding alone), that are not determined to have either "High Benefit" or "Exceptional Benefit" restoration plans.</u>

F. Operation and Maintenance of Existing Active and Passive Treatment Facilities

O&M of treatment systems is a significant concern to both DEP and local watershed groups. The Set-Aside Program is currently the only source of funding for the continued operation of active AMD treatment plants constructed by DEP (see the prioritization in Section G below). In following current DEP policy, local watershed and volunteer groups and/or local government are expected to provide the routine operational needs of passive treatment systems constructed with public funds for watershed restoration. Routine operational needs include: site inspections, sampling (at a minimum, field pH, alkalinity and iron, with an occasional lab suite), flushing, ditch cleaning, and regular debris removal. The groups generally look to DEP to fund more expensive maintenance needs. The Set-Aside fund can be looked upon to potentially meet these needs when the passive treatment systems are within approved HUPs or QHUs. Passive treatment systems that are not within approved HUPs or QHUs are not eligible for Set-Aside funding for any purposes. They will only become eligible if a QHU is developed and a restoration plan is approved for the watershed. Those passive treatment systems that are within watersheds which have not been scored, will not be eligible to receive funds from the Set-Aside program to address O&M needs. Groups will need to identify other sources of funding if major maintenance expenditures are required and determined to be necessary to prevent loss of restored stream miles. One such funding source available to watershed groups for the next few years is the Growing Greener Funded Quick Response Program administered by the Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR). Watershed groups seeking more information about this program should contact WPCAMR or the appropriate District Mining Watershed Manager.

G. Pennsylvania's AMD Set-Aside Program Priorities

From the discussion presented above, DEP has determined that an appropriate prioritization of Set-Aside funded work is as follows:

1. Operate and maintain active treatment plants constructed by DEP, or operated by or on behalf of DEP, within approved HUPs or QHUs.

2. Operate and maintain passive treatment systems constructed by DEP, or operated by or on behalf of DEP, within approved HUPs or QHUs.

3. Evaluate existing HUPs and QHUs to determine whether goals have been met, if not what additional work is needed, or depending on the situation whether these watersheds remain a priority of DEP. If yes, proceed with the completion of projects to accomplish restoration.

4. Develop new QHUs for watersheds, in accordance with these Guidelines and the requirements of SMCRA, where there are restoration plans in place, as well as, a significant financial contribution from other funding sources. These contributions may include treatment systems already constructed, where Set-Aside funding is needed for ongoing O&M, treatment systems planned with funding from other funding sources, or watersheds where there is a significant O&M funding contribution by others (for example, O&M funding that is being provided by the sale of water for Marcellus well development or other uses). These partnerships in watersheds where there are other significant funding sources will allow Set-Aside resources to accomplish more restoration with limited funding.

5. Develop QHUs for **new** watersheds where there has not yet been a significant amount of activity and only a small amount of funding and staff resources will need to be committed (for example, a small watershed that can be restored with the addition of one or two small passive treatment systems).

To the extent practicable, DEP will coordinate with other funding agencies and other watershed partners to complete watershed restoration. However, DEP maintains discretion on determining final priority projects for funding under the Set-Aside Program. **Staff and funding constraints will be considered in all decisions.** Other funding programs or agencies include, but are not limited to, DEP's Growing Greener and 319 Non-Point Source programs, as well as, federal agencies such as the Natural Resources Conservation Service (NRCS) and the Army Corp of

Engineers (ACOE). Other watershed partners may include entities such as Trout Unlimited (TU), Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR), Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR), Foundation for PA Watersheds, Susquehanna River Basin Commission (SRBC), Delaware River Basin Commission (DRBC), other state agencies, and others.

H. Design Criteria for Passive Treatment Systems

Since the inception of passive treatment technology and its subsequent increasing prevalence in mine drainage applications, much advancement in technology has occurred and continues to be developed. At the same time, a number of the original passive treatment technologies have become refined and proven as to what may now be considered typical or standard applications.

DEP is aware that passive treatment system design includes many considerations and features which have become universally common and prudent, whether the technology involved is typical or innovative, while at the same time proven design criteria has come to be developed more specifically for the application of typical passive treatment technologies. Therefore, there is the expectation that any passive treatment system design receiving Set-Aside funding would include, where applicable, the recommended criteria listed in Appendix C - Best Management Practices and Sizing Criteria.

Any development of a proposed passive treatment system design that is to be considered for Set-Aside funding will provide a written narrative justification by the design engineer for the technology selected, whether innovative or typical. Such narrative will include justification of the sizing criteria for all units in a system, and all other choices of design features, citing literature, previous successful systems, and any other sources to substantiate design criteria selections.

I. Initial Benefit/Cost Analysis

A Benefit/Cost Analysis is often used in project evaluations to determine the benefit of a proposed project compared to its cost. The Initial Benefit/Cost Analysis determines a ratio between the net present values of the benefits to the net present value of the costs of restoring a watershed impacted by AMD. This Analysis takes into account all the present and future benefits of restoring a watershed, and compares them to the capital and annual O&M costs over time.

Restoration of a watershed can have many benefits. A very important benefit is restoration of aquatic resources, and, in particular, fisheries. As discussed under restoration goals, returning streams to a sustainable fishery is an overarching goal of the AMD Set-Aside Program. After the impacted watershed is restored to a sustainable fishery, it is expected to generate local tax based income to recreation and tourism business such as hotels, restaurants, and sporting goods stores.

The Pennsylvania Fish and Boat Commission (PFBC) has developed estimates of the economic value that is lost because recreational opportunities are reduced or eliminated on AMD impacted streams throughout the Commonwealth. These values are located in Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015. The tables list the miles of various impacted streams and the estimated Lost Value per year, and are the primary basis for estimating the benefit value of a project. The basins used in the table correlate to the Pennsylvania State Water Plan (SWP). More information about the watersheds can be found at the following web address: www.dep.pa.gov keyword search "state water plan."

When evaluating the length of stream miles being restored, the main stem of the watershed and all significant tributaries that are being restored should be included in the evaluation. If the main stem and the tributaries have different use classifications according to Chapter 93, the recreational use loss estimate should be adjusted to reflect those differences. The PFBC should be contacted to determine the economic value of any streams not found on the list in Appendix D.

Other tangible benefits with known values can also be included, as applicable. Examples may include expected calculated savings to municipal or industrial water supplies; the value of providing low-flow consumptive use water to the SRBC; providing increased water tourism on public lands; generating resources that could be used in other industries (resource recovery); generation of energy, increased property values; or the cost savings realized by the application of new or innovative technology. Land restoration projects can also have benefits that improve water quality in streams, provide permanent benefits for wildlife, or provide opportunities for outdoor recreation if on publicly accessible land.

Costs that are associated with restoring an AMD impacted watershed include the capital cost to construct a treatment system or abatement project, and the anticipated annual O&M cost. Capital costs include the investments or expenditures necessary to construct a new treatment system or abatement project or fully refurbish/rehabilitate an existing system or facility. Capital costs may also include engineering costs, land access or acquisition costs, legal costs, and permitting fees/costs. O&M costs vary depending on the type of capital project constructed to restore the watershed. Some of these costs may include chemicals for active treatment, management of AMD sludge, or the flushing of passive treatment systems. Costs to be included in this analysis are only those costs being covered by public funding. All privately funded costs are exempt from this analysis. For example, if a private company is establishing a trust fund to cover O&M costs for an active treatment plant, those O&M costs don't have to be included in the analysis. In addition, any costs expended prior to the time of the Benefit/Cost Analysis do not need to be counted in the analysis. These expenditures will, however, count as match in the scoring process.

In order to calculate the Benefit/Cost Ratio, a net present value of the benefits and costs must be calculated. A watershed restoration plan will be further analyzed and scored to determine its benefit if the Benefit/Cost Ratio is greater than or equal to one.

The net present benefit value of restoring a watershed should be based on a realistic and reasonable project life span and an inflation-adjusted discount rate. For projects involving passive treatment technologies, a 20-year project life would be typical, and for large-scale active treatment facilities, a 30-year or longer project life would be typical. There are many methods that could be used to develop a capital cost estimate for a project. These could include a detailed engineer's estimate, pertinent cost estimating guides, or cost estimation software. One such software package that is acceptable for developing the capital cost estimate for mine drainage treatment projects is AMDTreat. AMDTreat is available for download at the following web address: amd.osmre.gov.

AMDTreat is a computer application for estimating abatement costs, part of a suite made available through OSMRE's Technical Innovation and Professional Services (TIPS). AMDTreat can assist a user in estimating costs to abate water pollution for a variety of passive and chemical treatment types, including vertical flow ponds, anoxic limestone drains, anaerobic wetlands, aerobic wetlands, bio reactors, manganese removal beds, limestone beds, oxic limestone channels, caustic soda, hydrated lime, pebble quicklime, ammonia, oxidation chemicals, and soda ash treatment systems. The AMD abatement cost model provides over 400 user-modifiable variables in modeling costs for treatment facility construction, excavation, revegetation, piping, road construction, land acquisition, system maintenance, labor, water sampling, design, surveying, pumping, sludge removal, chemical consumption, clearing and grubbing, mechanical aeration, and ditching.

AMDTreat also contains several financial and scientific tools to help select and plan treatment systems. These tools include a long-term financial forecasting module, an acidity calculator, a sulfate reduction calculator, a Langelier saturation index calculator, a mass balance calculator, a passive treatment alkalinity calculator, an abiotic homogeneous Fe^{2+} oxidation calculator, a biotic homogeneous Fe^{2+} oxidation calculator, an oxidation tool, and a metric conversion tool.

AMDTreat was developed cooperatively by DEP, the West Virginia Department of Environmental Protection and OSMRE.

Another resource for completing economic evaluations is the Federal Natural Resource Conservation Service (NRCS) economics website, www.economics.nrcs.usda.gov. This website includes links to updated normalized prices, price indexes, and FY09 Federal Discount Rates. Also, the recently completed "An Economic Analysis for Abandoned Mine Drainage Remediation in the West Branch Susquehanna River Watershed, Pennsylvania" contains a section that focuses on the regional and statewide economic impacts generated from remediation project expenses. The complete report on the West Branch Susquehanna AMD remediation economic benefit analysis can be found at www.dep.pa.gov keyword search "West Branch Susquehanna AMD remediation economic benefit analysis."

The O&M cost value will be evaluated based on the treatment technique. For passive treatment systems, a previous O&M workgroup calculated an estimated annual O&M at four percent (4%) of the project capital costs. Annual O&M for active treatment projects should be estimated based on anticipated labor needs, chemical consumption requirements, power consumption, sludge management, etc.

In some instances, treatment systems may be currently treating mine discharges within a watershed. In these cases the annual O&M costs will be taken into consideration for calculating the net present value cost, and benefits to the receiving stream will be considered for calculating the net present benefit. Capital costs for constructing the existing system will be neglected. The cost value will be calculated by using documented or anticipated O&M costs and discounting those costs to a net present value. The benefit value will be calculated by using values from Appendix D or any other documented benefit values and discounting them to a net present value. The net present values will be calculated by using standard engineering economic practices.

All net present value project benefits within a watershed will be summed and divided by the sum of all net present values costs for the projects in the watershed yielding a Benefit/Cost Ratio for the watershed. The watershed may be further analyzed and scored if the ratio is greater than or equal to one (i.e., benefits/costs > 1.0).

<u>Benefit/Cost Analysis Example No. 1 (For a watershed being restored using passive treatment technology)</u>

The Monastery Run Watershed, located in Unity Township, Westmoreland County in State Water Plan Basin 18-C, is impacted by three (3) AMD discharges within its Fourmile Run tributary. The discharges are to be treated with three aerobic wetlands simply identified as Wetland No. 1, Wetland No. 2 and Wetland No. 3. To determine the value of the benefits of restoring this watershed, the following information was obtained from the Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2006.

Fourmile Run
State Water Plan: 18-C
Miles Impaired: 2
Projected Use: Trout Stocked Fishery (TSF)
Use Rate: 1,100 trips/year
Valuation: $76.14/trip (Adjusted 2006 Valuation Number From Base Year 1989)
Lost Value: 2 miles x 1,100 trip/year/mile x $76.14 trip = $167,508 per year.

The capital costs for treating the discharges are as follows:

Wetland No. 1:	$494,423
Wetland No. 2:	$162,000
Wetland No. 3:	<u>$220,000</u>
Total Capital Cost:	$876,423

For this example, the capital costs shown are the actual capital costs that were incurred to construct the three passive mine drainage treatment systems and are assumed to be the present value capital costs.

The estimated annual O&M costs for the passive system are:

Using the previously discussed O&M Workgroup factor for estimating O&M of 4%, the estimated annual O&M costs would be as follows:

$876,423 x 0.04 = $35,057 per year

Benefits:

The net present value (NPV) of the benefits can be calculated using the uniform series present worth equation:

NPV	=	$A[\{(1+i)^n-1\}/(i(1+i)^n)\ ]$
where A	=	annual calculated benefit or cost
i	=	inflation adjusted discount rate (compounded annually)
n	=	project life span

$[\{(1+i)^{n}-1\}/(i(1+i)^n)\ ]$ = uniform series present worth factor (USPWF)

Note: The uniform series present worth factor for a five percent (5%) inflation-adjusted discounted rate, compounded annually for 20 years is 12.46221.

A table with uniform series present worth factors for various interest rates and time periods is included in Appendix E.

The annual economic lost value of Fourmile Run is the basis of the project's NPV benefit evaluation. The lost value of Fourmile Run was identified above as $167,508 per year. The following parameters are applied to the NPV equation:

n = 20 years
i = 5%
USPWF = 12.46221

Net Present Benefit Value $167,508 x 12.46221 = $2,087,520

Costs:

The NPV of the costs are the capital costs of the project and the annual O&M costs.

Capital costs: The NPV of the capital costs

Wetland No. 1:	$494,423
Wetland No. 2:	$162,000
Wetland No. 3:	$220,000
Total Capital Cost:	$876,423

Note: Total capital cost = NPV capital cost

Annual O&M: The estimated annual O&M costs for the passive system is: $876,423 x 0.04 = $35,057 per year. The following parameters are applied to the NPV equation:

n = 20 years
i = 5%
USPWF = 12.46221

Therefore, the project's NPV cost = NPV capital cost + NPV of the O&M
= $876,423 + ($35,057 per year x 12.46221)
= $876,423 + $436,888
= $1,313,311

<u>Benefit/Cost Ratio</u>:

Benefit/Cost Ratio = Total Benefit Value/Total Cost Value
= $2,087,520/$1,313,311 = 1.59
1.59 > 1.0 (Since the benefits outweigh the costs, watershed is acceptable to score)

<u>Benefit/Cost Analysis Example No. 2 (For a watershed being restored using active chemical treatment technology)</u>

The upper Bennett Branch Watershed, located primarily in Huston Township, Clearfield County and Jay Township, Elk County in State Water Plan Basin 8-A, is impacted by 21 AMD discharges. These discharges degrade approximately 10.0 miles of the main stem of Bennett Branch, 1.6 miles of Mill Run, 1.2 miles of Tyler Reservoir Run, 0.2 miles of Fridays Run, 0.9 miles of Tyler Run, and 0.8 miles of Wasko Run. The discharges are all to be collected and conveyed to a centralized active chemical treatment plant to be located near the Village of Hollywood where they will be treated using a dense sludge, hydrated lime treatment process. To determine the value of the benefits of restoring this portion of the watershed, the following information was obtained from Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2006 and Chapter 93, Water Quality Standards of DEP's regulations.

Bennett Branch
State Water Plan: 8-A
Miles Impaired: 10.0 (Stream miles from mouth of Mill Run to mouth of Caledonia Run)
(Note: Significant benefits were expected below Caledonia Run within Bennett Branch but were not accounted for at the time this sample analysis was conducted (2006). The plant became operational in 2012, and has improved 33 miles of stream to the mouth of Bennett Branch enabling it to be stocked with trout.)
Projected Use: Trout Stocked Fishery (TSF)
Use Rate: 1,100 trips per year
Valuation: $76.14 per trip (Adjusted 2006 Valuation Number From Base Year 1989)
Lost Value: 10.0 miles x 1,100 trip/year/mile x $76.14 trip = $837,540 per year

Mill Run, Tyler Reservoir Run, Fridays Run, Tyler Run, and Wasko Run
Miles Impaired: 4.7
Chapter 93 Designation: Cold Water Fishery (CWF)
Assumed Projected Use: Trout Stocked Fishery (TSF)
(Note: These tributaries are not included in the PFBC Recreational Use Loss Estimate Tables)
Use Rate: 1,100 trips per year
Valuation: $76.14 per trip
Lost Value: 4.7 miles x 1,100 trip/year/mile x $76.14 trip = $393,644 per year

Total Lost Value: $1,231,184 per year

The capital costs for treating the discharges are as follows:

Property Acquisition/Easements	$	200,000
Engineering	$	900,000
Collection and Conveyance:	$	3,800,000
Treatment Facility:	$	8,200,000
Total Capital Cost:	$	13,100,000

For this example, the capital costs shown are the estimated capital costs that were determined by the project design firm and are assumed to be the present value capital costs.

The estimated annual O&M costs for the passive system are:

The estimated annual O&M costs as determined by the project design firm are $360,000 per year and the estimated useful life of the treatment plant is 40 years.

Benefits:

As in the previous example, the NPV of the benefits can be calculated using the uniform series, present worth equation, or values extracted from the uniform series present worth value table.

The annual economic lost value of the upper Bennett Branch and tributaries is the basis of the project's NPV benefit evaluation. The lost value of Bennett Branch and tributaries was identified above as $1,231,184 per year. The following parameters are applied to the NPV equation:

n = 40 years
i = 5%
USPWF = 17.159086

Net Present Benefit Value $1,231,184 x 17.159086 = $21,125,992

Costs:

The NPV of the costs is determined by adding the capital cost of the treatment plant and the present value of the annual O&M costs over the 40 year life of the facility.

Capital costs: The NPV of the capital costs

Note: Total capital cost = NPV capital cost = $13,100,000

Annual O&M: The estimated annual O&M cost for the treatment plant is $360,000 per year. The following parameters are applied to the NPV equation:

n = 40 years
i = 5%
USPWF = 17.159086

Therefore, the project's NPV cost = NPV capital cost + NPV of the O&M
= $13,100,000 + ($360,000 per year x 17.159086)
= $13,100,000 + $6,177,271
= $19,277,271

Benefit/Cost Ratio:

Benefit/Cost Ratio = Total Benefit Value/Total Cost Value
= $21,125,992/$19,277,271
= 1.10
1.10 > 1.0 (Since the benefits outweigh the costs, watershed is acceptable to score.)

J. Evaluation and Scoring of Restoration Plans

1. Scoring the Hydrologic Unit Restoration Plan and Projects within the Plan

Hydrologic Unit Restoration Plans and the projects within the plan will be scored on the information provided by the applicant based on the following (see Appendix F for score sheets):

a. Local Support

Local support of watershed restoration is very important to the overall success of restoration projects. Support by local government, environmental groups, and businesses will be necessary to determine and formulate goals, develop a suitable plan, implement the plan, and ensure long-term viability of treatment systems. The ability of these local entities to provide this support will be evaluated largely by the abilities they have already demonstrated in the above areas. In addition, regional or national entities such as Trout Unlimited (TU) and the Susquehanna and Delaware River Basin Commissions are also working on stream restoration and provide needed support. Availability of this support will also be considered in the scoring process. Also, input from other support groups such as the Eastern and Western Pennsylvania Coalitions for Abandoned Mine Reclamation and the Foundation for Pennsylvania Watersheds, will be solicited by DEP and considered in the evaluation of the strength and viability of local grassroots groups.

b. Background Data

The data obtained in this section considers information relating to a restoration plan that describes the watershed, identifies the problem, and explains the project goal(s). See Appendix C for additional discussion.

Background data must be comprehensive enough to be able to clearly define the mine drainage and/or abatement problem and consequently the project goal(s). A determination must be made of what mine drainage restoration and/or abatement is needed so that adequate and applicable background data can be obtained.

A very important aspect of a restoration plan is an evaluation of stream contaminant levels and loadings and a determination of the reductions needed to meet restoration goals. In addition, loadings from proposed projects sites must be determined in order to prioritize projects and determine appropriate abatement/treatment methodologies. Mass balance calculations and comparisons to stream pollutant loads are recommended to aid in prioritizing projects.

A project site assessment is paramount in collecting background data and should include basic site characteristics such as flow measurements, water samples, soil and/or refuse analysis, test borings, archeological and historical resources, and documented property ownership consent. Flow measurements must be collected using scientifically-based methods such as weirs, bucket and stop watch, current velocity meters, or continuous flow recorders. If available, continuous flow recorders are recommended. Measurements shall be collected over time durations that adequately define base flow and peak flow conditions. Statistical summaries of flow measurements should include the minimum, maximum, median, and n-percentile values.

Water samples should be collected at the same time flow measurements are made. Samples should be collected, preserved, and analyzed in accordance with "Standard Methods for the Examination of Water and Wastewater" and/or "U.S. Geological Survey Protocol for Collection and Processing of Surface-Water Samples for the Subsequent Report 94-539." Minimum parameters to sample for should include: field pH, lab pH, total alkalinity (as $CaCO_3$ eq.), net acidity (as $CaCO_3$ eq.), total iron, aluminum, manganese, and sulfate.

Restoration plans should include the results of biological surveys to document the existence and extent of impairment. Surveys should follow established DEP protocols.

Abatement-related projects, such as coal refuse projects, should include additional parameters such as total suspended solids and heavy metals from both upstream and downstream points in order to evaluate the existing negative impacts and expected post-construction results. The collection of coal refuse samples is recommended; collection data should be descriptive enough to determine potential recoverable fuel value.

Abatement projects related to rerouting streams from abandoned deep mine openings or abandoned surface mine pits, should include upstream flow measurements and water quality data in addition to any associated down dip mine discharges.

c. Restoration Goals

The objective or goal of any AMD-related project is to restore land and/or water resources degraded by past mining activities. However, to successfully evaluate and prioritize numerous projects, a well-defined, measurable and comprehensive project treatment or restoration goal must be established. It is important that the restoration goals are well defined, measurable, reasonable, achievable, and permanent. Various scoring criteria focus on evaluating the likelihood that the proposed plan will consistently achieve the restoration goals by accurately predicting the water quality of the effluent.

The restoration goals need to be practical, tangible, and easily measured to facilitate an evaluation of whether treatment or restoration is being achieved after project implementation. A broad or vague restoration goal such as, "The goal of the project is to restore Laurel Run" is not acceptable as it does not provide a defined and tangible attribute that can be used to evaluate if restoration is being achieved.

While restoration goals will be specific to the watershed under consideration, they must also result in meeting either the Upper Tier or Lower Tier overarching goals as defined previously (see Overarching Program Goals section).

Examples of well-defined and measurable restoration goals include, but are not limited to, the following: (1) a numerically-based water quality based in-stream standard; (2) a biologically-based goal assigned to a specific stream reach using accepted biological indices; (3) a goal developed to restore a specific section of stream to a designated use; (4) a thermally-based standard to protect a cold-water fishery while eliminating the effects of AMD; or (5) a hydrology resource restoration goal considering abatement or reduction of a discharge or pollution source. Watershed groups and other planners who are determining goals must keep in mind the overarching goals presented in this document.

d. Technology, Operation, Maintenance, Risk Matrix, Alternatives, and Other Considerations Analyses for Individual Projects

DEP will perform an analysis on all proposed treatment and/or abatement projects within the hydrologic unit to ensure the proposed project will achieve and maintain restoration.

Hydrologic units are likely to have a restoration strategy that includes numerous treatment systems and/or abatement techniques. The treatment systems or abatement strategies are likely to fit into one of six categories:

1. Active Treatment Net Alkaline or Net Acid
2. Passive Treatment of Net Alkaline discharges
3. Passive Treatment of Net Acidic discharges using Anoxic Limestone Drain technology (total Al < 1.0 mg/l, total Fe^{3+} < 1.0 mg/l, and Dissolved Oxygen < 1.0 mg/l.)
4. All other types of Passive Treatment for Net Acidic discharges
5. Innovative Technology
6. Abatement projects.

Generally active treatment is a system which requires some form of mechanical or electrical power to effectively treat the mine water and requires personnel to oversee the system on a regular basis. These systems often include mixers, aerators, and clarifiers and use off site chemicals to adjust the pH and/or aid in sludge management.

It is difficult to develop a fully inclusive definition of passive treatment technology. However, passive treatment is typically a treatment system that:

1. Requires no electrical or mechanical power.
2. Requires in-frequent site visits to ensure successful operation.
3. Requires in-frequent replenishment of chemical reagent.
4. Does not contain a chemical feed system.

Passive treatment typically includes impoundments, structures, or other containers of alkalinity-producing treatment media. Passive treatment may also include manual, solar-operated, electrically-operated, or siphon-operated flushing or draining systems.

A technology, operational, maintenance, risk matrix, alternatives, and other considerations evaluation will be conducted by DEP on all proposed treatment and/or abatement projects within the hydrologic unit. The evaluation will look to ensure the proposed project(s) will achieve and maintain restoration of the watershed.

i. Technology Evaluation

The technology evaluation focuses on evaluating whether the combination of the treatment/abatement scenario and the proposed technology is proven to meet the project goal(s). The evaluation considers if the proposed technology has been used at other locations with similar water chemistry and/or flow rates and has provided an acceptable effluent that met the treatment goals. The evaluation will also appraise whether the proposed technology was sized or manufactured using a science-based approach or other acceptable sizing methodologies. Various methodologies are described in Appendix C – Design and Sizing Criteria; however, the methodologies are not all inclusive. Finally the evaluation will include a review of the constructability of the system and the method of construction management to be used during construction.

ii. Operation Evaluation

The operational evaluation focuses on assessing all aspects of the project's operation(s) to consistently achieve the project goals on a daily basis. The evaluation includes a review of the ease of operation and what resources are required to operate the project. The evaluations will examine how often the system will be monitored to assure goals are being achieved and the extents to which, the system can be modified if goals are not being achieved. The evaluation will finally examine the staffing required to continuously operate the system and the applicant's long term commitment to operation.

iii. Maintenance Evaluation

The maintenance evaluation focuses on assessing all aspects of project maintenance required to consistently achieve the project goals for the expected duration of the project. All projects require some form of maintenance and the evaluation will examine how often and what will be required for the proposed project. The extent of the maintenance will be evaluated along with an examination of the resources required to perform the maintenance. Finally the evaluation will assess how the project can be modified to perform the maintenance while continuing to meet the project goals.

iv. Risk Matrix Evaluation

Projects that fall within Category (4), "All other types of Passive Treatment for Net Acidic discharges," will have the project score adjusted by applying the treatment Risk Analysis Matrix (see Table 1 at end of this section) to the proposed project. The Risk Matrix Analysis is applied to these projects since they generally have a major impact on the overall restoration goal of the hydrologic unit should the project goal not be achieved. Passive treatment technologies designed to treat net acidic water in this category tend not to afford the complete operational control mechanisms required to consistently achieve a defined treatment goal. While some of these passive treatment systems have successfully treated to net alkaline conditions for over a decade, many systems have been plagued with treatment performance issues caused by metal hydroxide precipitate plugging the treatment matrix, short circuiting, design flaws, or construction issues. Some of the design and construction issues can be resolved by diligent construction oversight or by improved treatment technology. Attempts have been made to combat plugging caused by the precipitation of metal precipitates by incorporating flushing mechanisms or by routine mechanical agitation. Even with installed flushing mechanisms, many systems still do not meet treatment goals and/or are prone to premature plugging. If metal precipitate plugging is causing performance issues with passive treatment on net acidic discharges, a reasonable approach is to promote passive treatment on low metal loading discharges. While placing a passive treatment system on a low loading discharge does not automatically guarantee successful treatment, the "risk" of having a premature plugging problem should be reduced. The placement of passive treatment systems on low loading discharges will also aid in the development of design and construction criteria to treat high loading discharges in the future.

The Risk Analysis Matrix (see "Table 1" at end of this section) was developed for two purposes:

- Limit the risk of premature passive treatment failure caused by metal precipitate plugging

- Act as a starting point to evaluate key design criteria that influence treatment success.

The risk matrix will serve as a platform to continuously evaluate system success designed under the criteria listed in Appendix C “Design and Sizing Criteria” and will be adjusted to reflect the outcome of system performance The Risk Analysis Matrix uses the design flow rate and metal concentrations for each treatment cell to assign a risk designation for the proposed system. The focus on metal loading is to exercise caution and flag system proposals that would place passive treatment systems on high metal loading discharges, which can result in premature plugging issues.

The three risk designations are “Low,” “Medium,” and “High.” The companion scoring sheet for this section (see Appendix F) uses the risk designation to adjust the system score. The focus on metal loading per cell is designed to consider plugging, troubleshooting, and maintenance issues. The “per cell” focus of the matrix is to avoid constructing large single treatment cells that are difficult to troubleshoot and rehabilitate without proper design considerations and planning.

The following example illustrates how the risk matrix considers metal loading per cell. If a 150 gpm discharge with a pH of 3 and containing 19 mg/L of iron and 30 mg/L of aluminum is treated in one large cell, the system is considered “High” risk in Table 1. If the discharge is equally split into two parallel cells, the system drops to a “Medium” risk system.

The Risk Analysis Matrix was initially based on an evaluation of the treatment performance of 54 limestone-based passive treatment systems that were treating Category (4) net acidic mine drainage. A database (Datashed.org) that contains information on all publicly-funded passive treatment systems in Pennsylvania was used to create a list of systems that have been in operation for at least five (5) years. The initial Set-Aside workgroup reviewed performance data to determine if a system discharges net acidic water, net alkaline water, or both types of water. The evaluation showed that the majority of the systems that were within the risk designation of “Low” produced net alkaline water after at least five (5) years of operation and the oldest treatment system has produced net alkaline water for eleven (11) years. The evaluation revealed the systems within the category of “Medium” risk contained both net alkaline and net acidic treatment performance; however, overall there were approximately 50 percent (50%) more alkaline sites than acidic sites. The evaluation showed that systems within the “High” risk category contained more systems that discharged net acidic water than net alkaline water.

In the intervening time since development of the Risk Analysis Matrix in 2009, others involved in passive treatment design and construction have expressed concerns to DEP that the matrix will prohibit evolution of passive treatment technology by discouraging treatment of high metal loading discharges. The 2012 workgroup took another look at the systems treating “High” risk discharges, using data collected in statewide “snapshots” done in 2009, 2010, and 2012. Unfortunately, even with the snapshot sampling, very little data was available on many systems, and it was difficult to draw conclusions from this second analysis. However, many systems were discharging net acidic water, at least sometime, and that number was higher for the systems on “High” risk discharges and lower for “Medium” and “Low” risk discharges. In general, the 2012 analysis was not in conflict with the original analysis, and did not provide clear evidence that the risk matrix needed to be adjusted. However, the snapshot data did indicate that several low-flow discharges with very high metals levels were successfully being treated.

A more in-depth follow-up to the initial 2012 data evaluation was completed in 2013 by close evaluation of a number of “High,” “Medium,” and “Low” risk systems, both successful and failing. This evaluation, completed by workgroup member and professor emeritus, Dr. Arthur Rose, determined that failures occur for several reasons, including poor design, poor construction techniques, and inadequate maintenance. The evaluation also determined that, in some cases, systems discharging net acidic water (considered failing systems in the workgroup evaluation) were still providing enough treatment to contribute to overall watershed restoration. The subsequent report recommended more thorough review of system designs and oversight of routine system operations by DEP staff. These recommendations were taken into consideration and are evaluated in the Technology and Operational Evaluations.

In response to the 2012-2013 evaluations, and the observation of greater success with low-flow, high-metal discharges, DEP has opted to evaluate proposed systems on some “High” risk discharges, under a narrow set of circumstances, in a manner that encourages passive treatment improvements with regard to these problematic discharges. The matrix was modified to reflect this change (see asterisk and discussion below Table 1). The change will allow some “High” risk discharges to be labeled “Medium” risk following a rigorous design and O&M plan review. The additional review process is designed to ensure the design, O&M plan, and capability of the treatment operator is sufficient to handle the metals accumulation and avoid poor treatment performance.

It is important to note, however, that the risk matrix will be viewed as a “living document” for project selection and will be refined to reflect the treatment performance of systems built under these criteria using Set-Aside money and as technological advances are made .

Table 1 - Risk Analysis Matrix for Category (4) Passive Treatment Systems

Risk Analysis Matrix				
Summation of Fe and Al Concentration	Design Flow Rate for each treatment cell			
	< 25 gpm	≥ 25 < 50 gpm	≥ 50 < 100 gpm	≥ 100 < 200 gpm
< 5 mg/L	Low	Low	Low	Low
≥ 5 but < 15 mg/L	Low	Medium	Medium	Medium
≥ 15 < 25 mg/L	Low	Medium	Medium	Medium
≥ 25 < 50 mg/L	Medium	Medium	Medium	High
≥ 50 mg/L	High*	High*	High	High
Summation of Fe and Al Concentration	Design Flow Rate for each treatment cell			
	≥ 200 < 400 gpm	≥ 400 < 800 gpm	≥ 800 < 1600 gpm	≥ 1600 gpm
< 5 mg/L	Medium	Medium	Medium	High
≥ 5 but < 15 mg/L	Medium	High	High	High
≥ 15 < 25 mg/L	High	High	High	High
≥ 25 < 50 mg/L	High	High	High	High
≥ 50 mg/L	High	High	High	High

* Systems in consideration for discharges in these two categories will drop to "Medium" risk if the following conditions are met:

- A thorough analysis of the proposed system determines that the design addresses plugging and short-circuiting concerns
- An O&M plan is developed that details added attention to O&M (including identification of personnel who will provide O&M, and identification of responsibilities) to address plugging and short-circuiting concerns and sludge management
- Total treatment system costs are <$400,000 OR the Applicant indicates in writing that they will purchase a performance bond for an amount at least equal to the Engineer's cost estimate for construction and will maintain said bond for a period of no less than five (5) years from the date the system is placed into service.. **The level of performance guaranteed by the bond will be the design standard, which is what will be rated/considered during the evaluation.**

v. Alternatives Analysis Evaluation

An alternatives analysis must be completed for all proposed mine drainage treatment or mine drainage abatement projects with estimated capital costs in excess of $400,000 (the average cost of passive treatment systems in 2013 according the Office of Surface Mining). The purpose of this is to evaluate whether the proposed treatment or abatement method is the most appropriate technologically and most cost effective. At a minimum, an assessment of at least one technologically appropriate passive treatment method and one appropriate active treatment method must be compared. For proposed abatement projects, at least one appropriate treatment option (active or passive) should be evaluated to demonstrate the proposed abatement project is cost effective. Both the initial capital cost and the required ongoing O&M costs should be determined for each alternative and compared on a common basis. The AMDTreat software is an acceptable tool for use in determining costs for completing an alternatives analysis. New or innovative technologies or treatment processes can be evaluated; however, the new or innovative technology must be explained in detail.

The alternatives analysis should also include a discussion of potential treatment system operational issues or failures, the short and long-term implications of a failure and what, if any, contingency plans have been developed to maintain the project goals and benefits in the event of an interruption or decline in performance of the treatment facility or system.

Finally, it is possible that some project sites do not lend themselves to more than one treatment alternative. For such sites, even if the cost is in excess of $400,000, no alternative analysis needs to be completed. However, the reason(s) for not completing the alternatives analysis should be adequately explained and documented.

vi. Other Considerations Evaluation

There are many other factors to be considered in evaluating the individual treatment/abatement plans for the discharges and sites of concern. These are factors that can stop a good project and prevent full implementation of the restoration plan. They include land availability and ownership issues, permitting issues, geotechnical issues, and local resistance. The extent to which these issues have been addressed will be considered in scoring the restoration plan.

viii. Abetment Project Analysis Evaluation

Most Hydrologic Units impaired by mine drainage will require some form of water treatment; however, some units have sites where the mine drainage problem can be reduced or eliminated using abatement practices. These sites are generally gob or spoil piles which leach mine drainage or locations where stream loss is evident. By using abatement practices, these problems can be restored resulting in a reduction of loading to the unit. These types of projects will also be evaluated based on the amount of load reduction that is expected from the abatement project. Projects with higher discharge load reduction will be scored more favorably.

2. <u>Scoring the Benefits of Implementing the Restoration Plan</u>

The evaluation/score is based on the following:

a. Stream Miles Restored and Other Water Resource Benefits

Restoration of a watershed can have many benefits. A very important benefit is restoration of aquatic resources, and, in particular, fisheries. As discussed under the “Restoration Goals” section, returning streams to a sustainable fishery is an overarching goal of the AMD Set-Aside Program. As such, the number of miles of restored stream and the type of fishery restored carry significant weight in the scoring. Restoring water supplies and improving water-based recreational/ tourism opportunities are also very important. Other benefits are less directly tangible and are discussed in the next section.

b. Other Benefits

This section covers items that would not normally fall into any of the previous sections; however, these items could have a positive or negative impact to the project selection. Other benefits may include resource recovery, energy generation, elimination of health and safety hazards, creation of new or improved recreational opportunities, or demonstration of new or innovative technology. This list is not inclusive and other benefits not listed will be considered.

3. Scoring the Costs

a. Capital Costs of Restoration Plan

The evaluation/score is based on the following:

Capital Costs include the investments or expenditures necessary to construct/install a new treatment system or facility, fully refurbish/rehabilitate an existing system or facility, or perform an abatement project. Capital costs also include engineering costs, land access or acquisition costs, legal costs, and permitting fees/costs.

The evaluation of project capital costs includes only the capital cost to construct/rehabilitate the mine drainage treatment system, facility, or abatement project. Ongoing costs such as O&M or the future cost of replacing the system or facility will be evaluated under the "O&M" section. There are many methods that could be used to develop a cost estimate for a project. Methods include a detailed engineer's estimate, pertinent cost estimating guides, or cost estimation software.

The evaluation/score is based on the ratio between all the capital cost for the restoration plan and the total number of stream miles to be restored within the watershed.

b. Non-Title IV Match Money and Projects Completed by Others

Most mine drainage treatment systems and abatement projects are expensive to construct. Even though SMCRA authorizes states to use up to thirty percent (30%) of annual AML grant monies for mine water treatment, the potential maximum available funding falls far short of the amount needed to address all of the existing mine drainage problems in Pennsylvania. Additional funds from other sources can assist with the construction of mine drainage treatment systems and other projects needed to restore watersheds. Additional funds can be obtained from various sources; however, funding can be divided into two general categories: public match money and private match money. Public match money consists of additional funds that typically come from other governmental agencies. Private match money is generally from corporations, individuals, or non-profit groups that are not associated with any governmental agency. Match money from either public or private sources is usually provided at the beginning of a project, and is applied to the initial or capital cost of the project. Match money demonstrates that there are other partners committed to restoring a watershed and allows Set-Aside money to fund work in a greater number of watersheds. As such, the availability of matching funds will be evaluated and scored.

In addition to match money, there are currently many watersheds where treatment systems have already been constructed using non-Title IV money. EPA 319 and PA's Growing Greener programs, as well as several smaller funding sources, have funded construction of numerous projects in watersheds across the Commonwealth. Certainly, there is a benefit in reduced costs to the Title IV program when working in Hydrologic Units where significant construction has already been funded. The scoring process will also reflect this benefit.

c. Operation, Monitoring, Maintenance and Replacement Requirements, and Costs

The treatment of AMD discharges, either passively or actively, and abatement projects require operational needs to be addressed. Operation and Maintenance includes the activities and funding needed to provide for routine monitoring, routine operations, planned maintenance, unplanned minor and significant repairs, and the eventual one-time replacement of components of the system that must be replaced or replenished (for example, electric pumps or compost and lime). The level to which the O&M activities and funding are addressed by sources other than Title IV and other government funding is evaluated during scoring. Projects that do not depend upon government for day-to-day operation and funding of long-term OMR will be scored more favorably. This is especially the case with active treatment plants. Projects that abate, or partially or entirely eliminate a discharge, will be scored higher in this category since these types of projects will have minimal long-term needs.

4. <u>Restoration Plan Benefit Determination</u>

Once a Restoration Plan has been completely evaluated and scored using all of the plan selection criteria, a plan benefit value can be assigned. The table included in Appendix F defines the relationship of a plan's score to the overall plan Benefit. Plans will fall into one of four benefit categories, "Low Benefit," "Moderate Benefit," "High Benefit," or "Exceptional Benefit." In most cases, DEP will not consider funding projects with set aside dollars alone in approved HUPs or QHU's where the restoration plans are not determined to have either "High " or "Exceptional" Benefit.

Appendix A: Qualified Hydrologic Unit Determination

Surface Mining Control and Reclamation Act Amendments of 2006
(*as amended* 30 U.S.C. § 1232(g)(6))

Hydrologic Unit: ______________________

Description of Qualified Hydrologic Unit (unit boundaries, stream segment(s), tributaries included, etc.):

Evaluation under Section 402(g)(6)(A) of SMCRA:

1. Is the above Hydrologic Unit described under a restoration plan that addresses the abatement of the causes and treatment of the effects of AMD in a comprehensive manner?

   Yes _______ No ________

2. Does the restoration plan include the following?

   - Assessment/evaluation of the problem.
   - A scientific analysis of the pollution load and the known source contributions.
   - Realistic, specific, and measurable restoration goals.
   - Identification and prioritization of AML/AMD sites that are adversely affecting water quality.
   - Realistic solutions and measurable treatment goals for discharges proposed for treatment/abatement.

   Yes _______ No ________

   If any of the above is missing from the Restoration Plan, a supplement to the Plan must be attached to this document that addresses missing items.

Evaluation under Section 402(g)(6)(B)(i) of SMCRA:

1. Has the above Hydrologic Unit been significantly affected by acid mine drainage from coal mining practices in a manner that adversely impacts biological resources?

   Yes _______ No ________

2. Describe and provide references for biological data (may include references to TMDL, 303(d) list, watershed assessments or remediation plans, or DEP water and biological sampling):

Evaluation under Section 402(g)(6)(B)(ii) of SMCRA:

1. Does the above hydrologic unit contain land and water that are eligible under Section 404 of SMCRA ("Lands and water eligible for reclamation or drainage abatement expenditures… are those which were mined for coal or which were affected by such mining, wastebanks, coal processing, or other coal mining processes, except as provided for under [Section 411 of SMCRA], and abandoned or left in an inadequate reclamation status prior to *August 3, 1977*, and for which there is no continuing reclamation responsibility under state or other federal laws).

   Yes ________ No _________

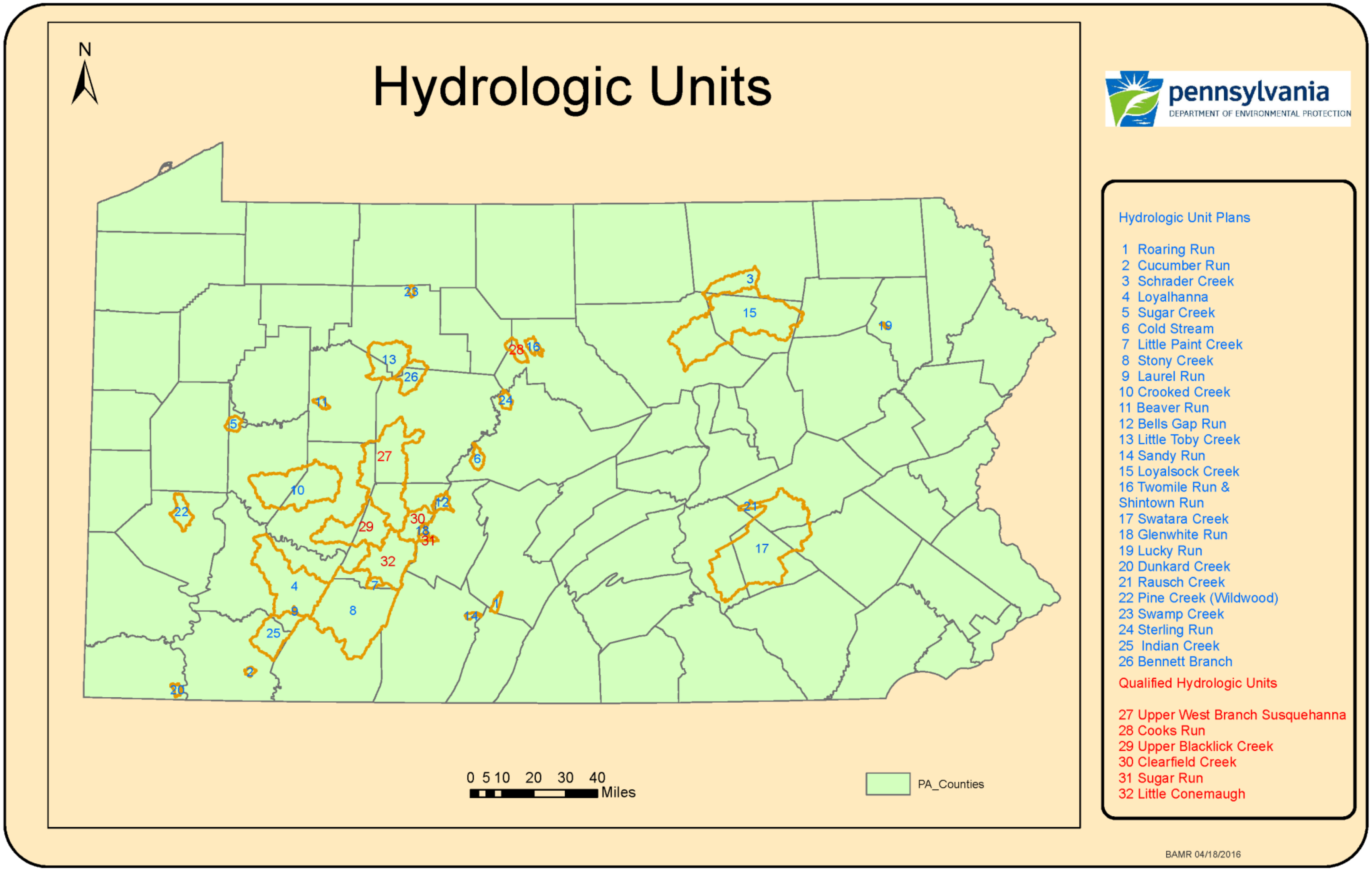
   If yes, provide references and documentation of eligible lands and water (attach applicable signed Eligibility Determinations).

2. Does the above hydrologic unit contain land and water that are the subject of expenditures by the state from the forfeiture of bonds required under Section 509 of SMCRA or from other state sources to abate and treat abandoned mine drainage?

   Yes ________ No _________

   If yes, provide references and documentation of state expenditures to abate and treat AMD.

Appendix B: Map of Existing Approved Hydrologic Units within Pennsylvania (as of April 2016)



Appendix C: Design and Sizing Criteria

A. General Recommendations for Passive Treatment System Design

The following list of BMPs is relevant to any passive treatment system design:

1. Perform pre-design flow measurement and sampling for chemical analysis on the waters to be treated for a monitoring period encompassing one representative hydrologic season which adequately captures both wet and dry weather conditions. At a minimum, conduct such monitoring for a period of 12 months with water sampling and chemical analysis performed monthly. Effort should be made to monitor the correlation of local precipitation to flow data for the waters to be treated. Evaluate whether precipitation for the pre-design monitoring period had been uncharacteristically wet or dry, and take this assessment into consideration for design flow selection.

2. It is highly recommended, and the preference of DEP, that any pre-design flow measurement device(s) be equipped with continuous monitoring capability. Set the frequency of such devices to record flow measurement daily at a minimum. Record continuous documentation of flow throughout the pre-design monitoring period. Such continuous monitoring installations should still be inspected in the field, at a minimum monthly, to ensure all components are maintained and properly functioning. Provide this continuous record of pre-design flow with any passive treatment system design.

3. Include at a minimum, the following parameters for chemical analysis of all pre-design water samples collected at any water source being monitored for treatment:

   Lab Analysis

   pH, alkalinity, hot acidity, total iron, total aluminum, total manganese, sulfate, specific conductance, and total suspended solids

   Field Analysis

   pH at a minimum and field alkalinity is highly recommended

   Analysis of any additional chemical parameters particular to and desirable for design and effective application of the passive technology selected would be required.

4. All laboratory analysis must be completed by a laboratory registered with or accredited by the Pennsylvania Laboratory Accreditation Program (PLAP).

5. Select design flow based upon restoration goals. At a minimum, design for 75th percentile flow as calculated from the pre-design monitoring period flow data set. At the discretion of the designer, increase design flow up to a maximum of 90th percentile flow based upon pre-design monitoring and the designer’s knowledge and understanding of site conditions and restoration goals. Consider the following flow characteristics in the decision for increasing design flow:

Flow Percentile Range		75th	90th
1)	Flow Uniformity	Variable	Consistent
2)	Acidity/Flow Correlation	Inverse	Direct

Prior to finalizing design flow selection, consider also the correlation of precipitation to flow volume and assessment of whether the pre-design monitoring period had been uncharacteristically wet or dry. Provide justification for the final design flow selected, prepared by the designer, including all supporting data and calculations, with any passive treatment system design.

6. Conduct soils and other geotechnical analysis on proposed construction areas to the extent necessary to substantiate the necessary physical properties for the intended use of the site with regard to system design. System components intended to retain water must be designed to prevent leakage of any extent that would interfere with the systems performance or the ability to monitor it. Perform analyses and characterization of on-site soils to determine the adequacy of their use as liners versus the need for synthetic liner material. If soil liners are to be used, perform volume estimates for verification of sufficient on-site soil quantities of the type required. Determine if the presence of bedrock will interfere with system construction as designed. Determine if excavations as designed will intercept groundwater. Address the consequences and actions required if groundwater is intercepted. Such analyses should also include examination for the presence and extents of any underground mining. Included with any passive treatment system design, provide written summary and justification, prepared by the designer, for the soils and geotechnical design selections made, including all supporting data and calculations.

7. Investigate treatment sites, prior to design, for the existence of naturally occurring areas of low pH iron oxidation and precipitation. Analyze any such areas as to their value for possible preservation and inclusion into the treatment scheme. However, the preservation of any such naturally occurring areas should not take precedence or sacrifice the installation of the most effective system design.

8. Design systems for a recommended design life of 20 years. Systems may be considered within a 15 year to 25 year range of design life with justification provided by the designer, including supporting data and calculations. Include such justification with any passive treatment system design for review and approval by the Department.

9. During periods of high flow, allow for limited flow in excess of design flow through the system for treatment without becoming detrimental to system integrity. Be conservative with such excess flow through the system, so as to prevent the dislodging of accumulated precipitates and sludge from within the system, or any other system damage due to high flow. When possible, and to the extent practicable, combine any untreated bypassed flow with treated system effluent, preferably in a scenario where some settling or removal of precipitates may be accomplished prior to discharge within the receiving stream.

10. Provide by design, at a minimum, the capability for flow measurement and water sampling of the system's raw untreated influent and system treated effluent. To the maximum extent practicable, provide the capability for water sampling internally within the system at locations where flow is transferred between system components. Where the opportunity is afforded and to the extent practicable, provide for additional flow measurement internally within the system.

11. Provide access to all monitoring points intended for the purpose of flow measurement and water sample collection. At a minimum, such monitoring points should include system raw untreated influent and system treated effluent. Such access need not necessarily be by vehicle, but should be sufficient in size and nature to ensure that the procedures required for these tasks can be performed accurately, efficiently, and safely. Provide for such access to be reasonable, safe, and unimpeded, and so as to not require special gear, equipment, clothing or footwear or require undue effort or risk. At monitoring points where flow is to be determined by timed collection of flow within a container, provide sufficient space beneath the flow for insertion of an appropriate container. At monitoring points where depth of flow is to be measured or read from a scale or gage, provide access directly to the point where such measurement or reading can be accurately accomplished.

12. To the maximum extent attainable, provide for vehicle access to all areas or components of the system where operation, monitoring, and maintenance are to be involved. For areas where such activities would be expected to involve material transport, heavy equipment, and machinery, access should be designed accordingly with these activities in mind. Provide for all vehicular and equipment access to be safe, stable, solid, and functional. With particular attention to vehicular and equipment access located along the tops of embankments and across slopes, to the maximum extent practicable, provide for a safe, solid, and stable roadway with liberal width and turning radiuses that are manageable and safe. Avoid whenever possible, areas where vehicles or equipment are required to be backed out for long distances in order to exit, and in particular along the tops of embankments or across slopes. Provide site drainage with attention to the prevention of vehicular and equipment access from becoming eroded, saturated, or otherwise unstable and impassable due to water issues.

13. Provide emergency overflow capability for each unit in the system including the use of appropriate lining material for erosion protection using design criteria from the PA DEP E&S BMP Manual (2012).

14. Provide each unit in the system with dewatering capability for purposes of, but not limited to, maintenance and repair.

15. Prevent peripheral surface water of any source unrelated to treatment from entering the treatment system.

16. Prevent the loss of water from within the system and also prevent the subsurface introduction into the system of any external water where the inflow of such water would compromise treatment.

17. Provide within the O&M Plan the sequence of events that would occur during an episode of major system maintenance. Consider the impact of non-treatment during such events and how stated design objectives and restoration goals would continue to be met. Whenever practicable, conduct such system maintenance during periods of low flow unless such action is considered critical or emergency.

18. Incorporate measures, to the maximum extent practicable, for prevention of damage to the system due to wildlife and vandalism.

19. Provide within the O&M Plan, a discussion of whether or not flushing will be used to maintain the system. Provide the reasoning if flushing is not to be used. If flushing is to be used as part of normal system O&M, provide an explanation of the Flushing Plan. The O&M Flushing Plan should explain, at a minimum, what volume is to be flushed, what the duration of flushing will be, how flushing is to be initiated and stopped, and how often flushing is to occur. If feasible, consider a separate pond to receive and retain the flush water and provide information on flush pond sizing, settling time, and method of dewatering. For whatever pond is to be used to receive flush water, if this pond will require attention prior to flushing, such as lowering the water level, highlight and explain such pre-flush activity in the O&M Flushing Plan. All flushing activities, including pre-flush, should be planned and preformed with attention so that existing settled sludge is not disturbed, and that little or no suspended material is transferred out of whatever ponds are utilized for flushing.

    Consider no flushing of systems incorporating mixed media within a single treatment bed, particularly organic media. Provide justification if such treatment beds are utilized and designated for flushing.

20. If required by design or anticipated within the life of a system, provide a plan for sludge removal within the O&M Plan and incorporate required facilities, including access, by design.

B. <u>Recommended Best Management Practices (BMP) for Design Sizing of Systems with Applications of Typical Passive Treatment Technology</u>

The following list of BMPs is applicable to any passive treatment system designs which propose the application of the indicated typical passive treatment technologies:

1. <u>Oxidation/Settling Ponds</u>

    Recommended Sizing Criteria:
    Minimum Retention Time = 24 hours at design flow
    Areal Fe Loading = 10 - 30 $g/m^2/day$

    Distribute the influent across the width of the treatment unit using manifolds, level spreaders, open water forebays, or any other such mechanisms.

2. <u>Aerobic Wetlands</u>

    Recommended Sizing Criteria:
    Maximum Influent Fe = 15 mg/L
    Areal Fe Loading = 7 - 10 $g/m^2/day$

    Distribute the influent across the width of the treatment unit using manifolds, level spreaders, open water forebays, or any other such mechanisms.

    18 inches maximum water depth in order to promote and maintain vegetation growth.

3. Anoxic Limestone Drains (ALD)

Recommended Sizing Criteria:
Dissolved Oxygen, Fe^3 and Al each < 1 mg/L
Minimum Retention Time = 12 – 15 hours at design flow
Limestone (LS) Volume = LS for Retention Time + LS Dissolved Over Design Life

4. Vertical Flow Ponds (VFP)

Recommended Sizing Criteria:
Areal Acidity Loading = 30 - 40 $g/m^2/day$
Minimum Limestone Retention Time = 15 hours at design flow
Limestone (LS) Volume = LS for Retention Time + LS Dissolved Over Design Life

Add 15% to 25% fine limestone by volume to the compost layer.

Distribute the influent across the width of the treatment unit using manifolds, level spreaders, open water forebays, or any other such mechanisms.

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Pennsylvania Fish and Boat Commission

The dollar values listed from 1989 have been converted to 2015 US dollars using the Consumer Price Index (CPI) Inflation Calculator. Convert 1989 or the 2015 US dollar values to the current year from the Bureau of Labor Statistics CPI Inflation Calculator, found online, 10/16/2015, at www.bls.gov/data/inflation_calculator.htm. It is important to note that the CPI changes 12 times per year (once a month) and therefore your results may differ each time to check the data.

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
LITTLE SCHUYLKILL RIVER	3-A	MINING-AB	pH-METALS	25.7	TSF	1100	$46.83	$1,323,884	$90.00	$2,544,300
MILL CREEK	3-A	MINING-AB	pH-METALS	5.5	TSF	1100	$46.83	$283,322	$90.00	$544,500
NESQUEHONING CREEK	2-B	MINING-AB	pH	1.7	TSF	1100	$46.83	$87,572	$90.00	$168,300
NESQUEHONING CREEK	2-B	MINING-AB	pH-METALS	4.3	TSF	1100	$46.83	$221,506	$90.00	$425,700
SWATARA CREEK	7-D	MINING-AB	pH-METALS	5.2	TSF	1100	$46.83	$267,868	$90.00	$514,800
SWATARA CREEK	7-D	MINING-AB	pH-METALS	4.2	TSF	1100	$46.83	$216,355	$90.00	$415,800
SWATARA CREEK	7-D	MINING-AB	pH-METALS	9.8	TSF	1100	$46.83	$504,827	$90.00	$970,200
WICONISCO CREEK	6-C	MINING-AB	pH-METALS	3.2	TSF	1100	$46.83	$164,842	$90.00	$316,800
WICONISCO CREEK	6-C	MINING-AB	pH-METALS	13.5	TSF	1100	$46.83	$695,426	$90.00	$1,336,500
RATTLING CREEK	6-C	MINING-AB	pH-METALS	2.2	TSF	1100	$46.83	$113,329	$90.00	$217,800
WEST BRANCH RATTLING CREEK	6-C	MINING-AB	pH-METALS	5.2	TSF	1100	$46.83	$267,868	$90.00	$514,800
EAST BRANCH RATTLING CREEK	6-C	MINING-AB	pH-METALS	3.8	TSF	1100	$46.83	$195,749	$90.00	$376,200
RAUSCH CREEK	6-C	MINING-AB	pH-METALS	1.7	TSF	1100	$46.83	$87,572	$90.00	$168,300
WEST BRANCH RAUSCH CREEK	6-C	MINING-AB	pH-METALS	3.5	TSF	1100	$46.83	$180,296	$90.00	$346,500
EAST BRANCH RAUSCH CREEK	6-C	MINING-AB	pH-METALS	1.9	TSF	1100	$46.83	$97,875	$90.00	$188,100
MAHANOY CREEK	6-B	MINING-AB	pH-METALS	26.8	TSF	1100	$46.83	$1,380,548	$90.00	$2,653,200
MAHANOY CREEK	6-B	MINING-AB	pH-METALS	25.4	TSF	1100	$46.83	$1,308,430	$90.00	$2,514,600
NORTH MAHANOY CREEK	6-B	MINING-AB	pH-METALS	5.5	TSF	1100	$46.83	$283,322	$90.00	$544,500
SHAMOKIN CREEK	6-B	MINING-AB	pH-METALS	34.7	TSF	1100	$46.83	$1,787,501	$90.00	$3,435,300
LOYALSOCK CREEK	10-B	MINING-AB	pH-METALS	6	TSF	1100	$46.83	$309,078	$90.00	$594,000
BENNETT BRANCH SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	4.8	TSF	1100	$46.83	$247,262	$90.00	$475,200
BENNETT BRANCH SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	24	TSF	1100	$46.83	$1,236,312	$90.00	$2,376,000
BENNETT BRANCH SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	8.8	TSF	1100	$46.83	$453,314	$90.00	$871,200
WEST CREEK	8-A	MINING-AB	pH-METALS	3	TSF	1100	$46.83	$154,539	$90.00	$297,000
WEST CREEK	8-A	MINING-AB	pH-METALS	9	TSF	1100	$46.83	$463,617	$90.00	$891,000
MOSQUITO CREEK	8-D	MINING-AB	pH-METALS	6	TSF	1100	$46.83	$309,078	$90.00	$594,000

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
MOSHANNON CREEK	8-D	MINING-AB	pH-METALS	26.2	TSF	1100	$46.83	$1,349,641	$90.00	$2,593,800
BLACK MOSHANNON CREEK	8-D	MINING-AB	pH-METALS	1	TSF	1100	$46.83	$51,513	$90.00	$99,000
COLD STREAM	8-D	MINING-AB	pH-METALS	1	TSF	1100	$46.83	$51,513	$90.00	$99,000
LAUREL RUN	8-D	MINING-AB	pH-METALS	5.4	TSF	1100	$46.83	$278,170	$90.00	$534,600
LICK RUN	8-C	MINING-AB	pH-METALS	3.7	TSF	1100	$46.83	$190,598	$90.00	$366,300
CLEARFIELD CREEK	8-C	MINING-AB	pH-METALS	27.7	TSF	1100	$46.83	$1,426,910	$90.00	$2,742,300
LITTLE MUDDY RUN	8-C	MINING-AB	METALS	1	TSF	1100	$46.83	$51,513	$90.00	$99,000
BRUBAKER RUN	8-C	MINING-AB	pH-METALS-SULFATES	2	TSF	1100	$46.83	$103,026	$90.00	$198,000
MONTGOMERY RUN	8-B	MINING-AB	pH-METALS	1.9	TSF	1100	$46.83	$97,875	$90.00	$188,100
MONTGOMERY RUN	8-B	MINING-AB	pH-METALS	0.7	TSF	1100	$46.83	$36,059	$90.00	$69,300
ANDERSON CREEK	8-B	MINING-AB	pH-METALS	10.3	TSF	1100	$46.83	$530,584	$90.00	$1,019,700
CATAWISSA CREEK	5-E	MINING-AB	pH-METALS	14	TSF	1100	$46.83	$721,182	$90.00	$1,386,000
CATAWISSA CREEK	5-E	MINING-AB	pH-METALS	4	TSF	1100	$46.83	$206,052	$90.00	$396,000
TOMHICKON CREEK	5-E	MINING-AB	pH	6.3	TSF	1100	$46.83	$324,532	$90.00	$623,700
SCHRADER CREEK	4-C	MINING-AB	pH-METALS	9	TSF	1100	$46.83	$463,617	$90.00	$891,000
TIOGA RIVER	4-A	MINING-AT	pH-METALS	4	TSF	1100	$46.83	$206,052	$90.00	$396,000
RACCOON CREEK	20-D	MINING-AB	pH-METALS	22	TSF	1100	$46.83	$1,133,286	$90.00	$2,178,000
POTATO GARDEN RUN	20-D	MINING-AB	pH-METALS	3.6	TSF	1100	$46.83	$185,447	$90.00	$356,400
BURGETTS FORK (RACCOON CREEK)	20-D	MINING-AB	pH-METALS	5	TSF	1100	$46.83	$257,565	$90.00	$495,000
SEATON CREEK	20-C	MINING-AB	pH-METALS-SULFATES	4	TSF	1100	$46.83	$206,052	$90.00	$396,000
LITTLE CONNOQUENESSING CREEK (BASIN)	20-C	MINING-AT/AB	UNDETERM	2.7	TSF	1100	$46.83	$139,085	$90.00	$267,300
CHARTIERS CREEK	20-F	MINING-AB	pH-METALS	6.5	TSF	1100	$46.83	$334,835	$90.00	$643,500
MILLERS RUN	20-F	MINING-AB	pH-METALS	2.5	TSF	1100	$46.83	$128,783	$90.00	$247,500
TURTLE CREEK	19-A	MINING-AB	pH-METALS	14.5	TSF	1100	$46.83	$746,939	$90.00	$1,435,500
TURTLE CREEK	19-A	MINING-AB	pH-METALS	2	TSF	1100	$46.83	$103,026	$90.00	$198,000

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
BRUSH CREEK	19-A	MINING-AB	pH-METALS	0.5	TSF	1100	$46.83	$25,757	$90.00	$49,500
LONG RUN	19-D	MINING-AB	pH-METALS	4.6	TSF	1100	$46.83	$236,960	$90.00	$455,400
SEWICKLEY RUN	19-D	MINING-AB	pH-METALS	14.3	TSF	1100	$46.83	$736,636	$90.00	$1,415,700
SEWICKLEY RUN	19-D	MINING-AB	pH-METALS	23.7	TSF	1100	$46.83	$1,220,858	$90.00	$2,346,300
LITTLE SEWICKLEY CREEK	19-D	MINING-AB	pH-METALS	1	TSF	1100	$46.83	$51,513	$90.00	$99,000
BUFFALO RUN	19-D	MINING-AB	pH-METALS	1.3	TSF	1100	$46.83	$66,967	$90.00	$128,700
JACKS CREEK	19-D	MINING-AB	pH-METALS-TDS	2.6	TSF	1100	$46.83	$133,934	$90.00	$257,400
GLADE RUN	19-D	MINING-AB	pH-METALS	3.4	TSF	1100	$46.83	$175,144	$90.00	$336,600
INDIAN CREEK	19-E	MINING-AB	pH-METALS	2.9	TSF	1100	$46.83	$149,388	$90.00	$287,100
RASLER RUN	19-E	MINING-AB	pH-METALS-SULFATES	4.7	TSF	1100	$46.83	$242,111	$90.00	$465,300
CASSELMAN RIVER	19-F	MINING-AB	pH-METALS	26	TSF	1100	$46.83	$1,339,338	$90.00	$2,574,000
WHITES CREEK	19-F	MINING-AB	pH-METALS-SULFATES	4	TSF	1100	$46.83	$206,052	$90.00	$396,000
BIGBY CREEK	19-F	MINING-AB	pH-METALS-SULFATES	1.4	TSF	1100	$46.83	$72,118	$90.00	$138,600
BUFFALO CREEK	19-F	MINING-AB	pH-METALS	7.5	TSF	1100	$46.83	$386,348	$90.00	$742,500
PIGEON CREEK	19-C	MINING-AB	pH-METALS-SULFATES	6.2	TSF	1100	$46.83	$319,381	$90.00	$613,800
NORTH BRANCH PIGEON CREEK	19-C	MINING-AB	pH-METALS	3.6	TSF	1100	$46.83	$185,447	$90.00	$356,400
PIKE RUN	19-C	MINING-AB	DISS SOLID	1	TSF	1100	$46.83	$51,513	$90.00	$99,000
REDSTONE CREEK	19-C	MINING-AB	pH-METALS	10.2	TSF	1100	$46.83	$525,433	$90.00	$1,009,800
DUNLAP CREEK	19-C	MINING-AB	pH-METALS	5	TSF	1100	$46.83	$257,565	$90.00	$495,000
GEORGES CREEK	19-G	MINING-AB	pH-METALS	4	TSF	1100	$46.83	$206,052	$90.00	$396,000
MOUNTAIN CREEK	19-G	MINING-AB	pH-METALS	4.1	TSF	1100	$46.83	$211,203	$90.00	$405,900
BIG SANDY CREEK	19-G	MINING-AB	pH-METALS	3.3	TSF	1100	$46.83	$169,993	$90.00	$326,700

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
PLUM CREEK	18-A	MINING-AB	pH-METALS	3.1	TSF	1100	$46.83	$159,690	$90.00	$306,900
BEAVER RUN	18-B	MINING-AB	pH-METALS	2.5	TSF	1100	$46.83	$128,783	$90.00	$247,500
LOYALHANNA CREEK	18-C	MINING-AB	pH-METALS	11.5	TSF	1100	$46.83	$592,400	$90.00	$1,138,500
FOURMILE RUN	18-C	MINING-AB	pH-METALS-SULFATES	2	TSF	1100	$46.83	$103,026	$90.00	$198,000
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	2.9	TSF	1100	$46.83	$149,388	$90.00	$287,100
TWO LICK CREEK	18-D	MINING-AB	pH-METALS	1.4	TSF	1100	$46.83	$72,118	$90.00	$138,600
YELLO CREEK	18-D	MINING-AB	pH-METALS	3	TSF	1100	$46.83	$154,539	$90.00	$297,000
ELK CREEK	18-D	MINING-AB	pH-METALS-SULFATES	7	TSF	1100	$46.83	$360,591	$90.00	$693,000
SOUTH BRANCH BLACKLICK CREEK	18-D	MINING-AB	pH-METALS	3	TSF	1100	$46.83	$154,539	$90.00	$297,000
STONY CREEK	18-E	MINING-AB	pH-METALS	22.7	TSF	1100	$46.83	$1,169,345	$90.00	$2,247,300
BENS CREEK	18-E	MINING-AB	pH-METALS	1.3	TSF	1100	$46.83	$66,967	$90.00	$128,700
SOUTH FORK BENS CREEK	18-E	MINING-AB	pH-METALS	4.7	TSF	1100	$46.83	$242,111	$90.00	$465,300
PAINT CREEK	18-E	MINING-AB	pH-METALS	0.7	TSF	1100	$46.83	$36,059	$90.00	$69,300
BENS CREEK	18-E	MINING-AB	pH-METALS	1	TSF	1100	$46.83	$51,513	$90.00	$99,000
LIMESTONE RUN	17-E	MINING-AB	SULFATE	5.2	TSF	1100	$46.83	$267,868	$90.00	$514,800
SOUTH BRANCH SOUTH FORK PINE CREEK	17-E	MINING-AB	pH-METALS	2.5	TSF	1100	$46.83	$128,783	$90.00	$247,500
PINE RUN	17-D	MINING-AB	pH-METALS-SULFATES	5.2	TSF	1100	$46.83	$267,868	$90.00	$514,800
PINE RUN	17-D	MINING-AB	pH-METALS-SULFATES	1.7	TSF	1100	$46.83	$87,572	$90.00	$168,300
PINE RUN	17-D	MINING-AB	METALS	2.4	TSF	1100	$46.83	$123,631	$90.00	$237,600
LITTLE MAHONING CREEK	17-D	MINING-AB	pH-METALS	2	TSF	1100	$46.83	$103,026	$90.00	$198,000
NORTH BRACH MAHONING CREEK	17-D	MINING-AB	pH-METALS	3.7	TSF	1100	$46.83	$190,598	$90.00	$366,300
REDBANK CREEK	17-C	MINING-AB	pH-METALS-SULFATES	2	TSF	1100	$46.83	$103,026	$90.00	$198,000

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
LEATHERWOOD CREEK	17-C	MINING-AB	METALS HWC-SULFATES	5.9	TSF	1100	$46.83	$303,927	$90.00	$584,100
FIVE MILE RUN	17-C	MINING-AB	METALS HWC-pH	3.5	TSF	1100	$46.83	$180,296	$90.00	$346,500
CLARION RIVER	17-B	MINING-AB	METALS	4.3	TSF	1100	$46.83	$221,506	$90.00	$425,700
TURKEY RUN	17-B	MINING-AB	METALS	7.1	TSF	1100	$46.83	$365,742	$90.00	$702,900
LICKING CREEK	17-B	MINING-AB	pH-SULFATES	5.5	TSF	1100	$46.83	$283,322	$90.00	$544,500
LICKING CREEK	17-B	MINING-AB	pH-METALS	6.3	TSF	1100	$46.83	$324,532	$90.00	$623,700
CHERRY RUN	17-B	MINING-AB	METALS HWC-SULFATES	7.4	TSF	1100	$46.83	$381,196	$90.00	$732,600
DEER CREEK	17-B	MINING-AB	METALS	10.7	TSF	1100	$46.83	$551,189	$90.00	$1,059,300
PINEY CREEK	17-B	MINING-AB	pH-METALS	2.9	TSF	1100	$46.83	$149,388	$90.00	$287,100
PINEY CREEK	17-B	MINING-AB	METALS-SULFATES	11.8	TSF	1100	$46.83	$607,853	$90.00	$1,168,200
REIDS RUN	17-B	MINING-AB	METALS	3.4	TSF	1100	$46.83	$175,144	$90.00	$336,600
LITTLE TOBY CREEK	17-A	MINING-AB	pH-METALS	8	TSF	1100	$46.83	$412,104	$90.00	$792,000
ELK CREEK	17-A	MINING-AB	METALS	6.3	TSF	1100	$46.83	$324,532	$90.00	$623,700
ELK CREEK	17-A	MINING-AB	METALS	9.8	TSF	1100	$46.83	$504,827	$90.00	$970,200
RICHEY RUN	16-G	MINING-AB	DISS SOLID	3.6	TSF	1100	$46.83	$185,447	$90.00	$356,400
LITTLE SCRUBGRASS CREEK	16-G	MINING-AB	METALS HWC-SULFATES	7.5	TSF	1100	$46.83	$386,348	$90.00	$742,500
SCRUBGRASS CREEK	16-G	MINING-AB	pH-METALS-SULFATES	10.8	TSF	1100	$46.83	$556,340	$90.00	$1,069,200
GLADDENS RUN	13-A	MINING-AB	pH-METALS	11.8	TSF	1100	$46.83	$607,853	$90.00	$1,168,200
NORTH BRANCH ROBINSON RUN	20-F	MINING-AB	pH-METALS-SULFATES	4.8	TSF	1100	$46.83	$247,262	$90.00	$475,200
NORTH BRANCH ROBINSON RUN	20-F	MINING-AB	pH-METALS	2.8	TSF	1100	$46.83	$144,236	$90.00	$277,200
LEHIGH RIVER	2-C	MINING-AB	METALS	30.2	TSF/WT	800	$46.83	$1,131,413	$90.00	$2,174,400

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
SAUCON CREEK (SOUTH BRANCH)	2-C	MINING-AB	OTHER	1	TSF/WT	800	$46.83	$37,464	$90.00	$72,000
COOKS RUN (BASIN)	9-B	MINING-AB	pH-METALS	6.8	TSF/WT	800	$46.83	$254,755	$90.00	$489,600
COOKS RUN	9-B	MINING-AB	pH-METALS	3.3	TSF/WT	800	$46.83	$123,631	$90.00	$237,600
BUCK RUN	19-E	MINING-AB	pH-METALS	1.7	TSF/WT	800	$46.83	$63,689	$90.00	$122,400
MEDOW RUN	19-E	MINING-AB	pH-METALS	5.6	TSF/WT	800	$46.83	$209,798	$90.00	$403,200
ELKLICK CREEK	19-F	MINING-AB	pH-METALS-SULFATES	2.7	TSF/WT	800	$46.83	$101,153	$90.00	$194,400
HANNAS RUN	18-C	MINING-AB	pH-METALS-SULFATES	4	TSF/WT	800	$46.83	$149,856	$90.00	$288,000
FERRIER RUN	18-D	MINING-AB	pH-METALS	1.4	TSF/WT	800	$46.83	$52,450	$90.00	$100,800
PENN RUN	18-D	MINING-AB	pH-METALS-SULFATES	3.8	TSF/WT	800	$46.83	$142,363	$90.00	$273,600
SHADE CREEK	18-E	MINING-AB	pH-METALS	7.7	TSF/WT	800	$46.83	$288,473	$90.00	$554,400
SHADE CREEK	18-E	MINING-AB	pH-METALS	2.7	TSF/WT	800	$46.83	$101,153	$90.00	$194,400
DARK SHADE CREEK	18-E	MINING-AB	pH-METALS	2.7	TSF/WT	800	$46.83	$101,153	$90.00	$194,400
QUEMAHONING CREEK	18-E	MINING-AB	pH-METALS	1.9	TSF/WT	800	$46.83	$71,182	$90.00	$136,800
LITTLE CONEMAUGH RIVER	18-E	MINING-AB	pH-METALS	1.4	TSF/WT	800	$46.83	$52,450	$90.00	$100,800
LITTLE CONEMAUGH RIVER	18-E	MINING-AB	pH-METALS	0.6	TSF/WT	800	$46.83	$22,478	$90.00	$43,200
BEAVERDAM RUN	18-E	MINING-AB	pH-METALS	2	TSF/WT	800	$46.83	$74,928	$90.00	$144,000
BEECH CREEK (BASIN)	9-C	MINING-AB	pH-METALS	26	TSF/WT	800	$46.83	$974,064	$90.00	$1,872,000
PINE CREEK	9-A	MINING-AB	pH-METALS	4	TSF/WWF	447	$46.83	$83,732	$90.00	$160,920
PANTHER CREEK	3-A	MINING-AB	pH-METALS	5.7	WT	500	$39.62	$112,917.00	$76.15	$217,028
MONTGOMERT CREEK (UNT)	8-B	MINING-AB	pH-METALS	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
BLACK CREEK	2-B	MINING-AB	pH-METALS	4.7	WT	500	$39.62	$93,107.00	$76.15	$178,953
HAZEL CREEK	2-B	MINING-AB	pH-METALS	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
BUCK MOUNTAIN CREEK	2-B	MINING-AB	pH-METALS	4.4	WT	500	$39.62	$87,164.00	$76.15	$167,530
SANDY RUN	2-A	MINING-AB	pH-METALS	0.1	WT	500	$39.62	$1,981.00	$76.15	$3,808
POND CREEK	2-A	MINING-AB	pH	7	WT	500	$39.62	$138,670.00	$76.15	$266,525

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
SANDY RUN (UNT)	2-A	MINING-AB	pH-METALS-SULFATES	0.4	WT	500	$39.62	$7,924.00	$76.15	$15,230
BAIRD RUN	7-D	MINING-AB	pH-METALS	1.4	WT	500	$39.62	$27,734.00	$76.15	$53,305
WEST BRACH FISHING CREEK	7-D	MINING-AB	pH-METALS	3.6	WT	500	$39.62	$71,316.00	$76.15	$137,070
LOWER RAUSCH CREEK	7-D	MINING-AB	METALS	3.9	WT	500	$39.62	$77,259.00	$76.15	$148,493
LORBERRY CREEK	7-D	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
STUMPS RUN	7-D	MINING-AB	METALS	0.2	WT	500	$39.62	$3,962.00	$76.15	$7,615
MIDDLE CREEK	7-D	MINING-AB	pH-METALS	1.1	WT	500	$39.62	$21,791.00	$76.15	$41,883
GOOD SPRING CREEK	7-D	MINING-AB	pH-METALS	5.8	WT	500	$39.62	$114,898.00	$76.15	$220,835
POPLAR CREEK	7-D	MINING-AB	pH-METALS	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
COAL RUN	7-D	MINING-AB/AT	pH-METALS	1.6	WT	500	$39.62	$31,696.00	$76.15	$60,920
GEBHARD RUN	7-D	MINING-AB	pH-METALS	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
PANTHER CREEK	7-D	MINING-AB	pH-METALS	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
MILLER RUN	11-D	MINING-AB	pH	1.2	WT	500	$39.62	$23,772.00	$76.15	$45,690
SIXMILE RUN	11-D	MINING-AB	pH	3.8	WT	500	$39.62	$75,278.00	$76.15	$144,685
BREWSTER HOLLOW	11-D	MINING-AB	pH-METALS	2.3	WT	500	$39.62	$45,563.00	$76.15	$87,573
SNADY RUN	11-D	MINING-AB	pH	6	WT	500	$39.62	$118,860.00	$76.15	$228,450
LONGS RUN	11-D	MINING-AB	pH	4.9	WT	500	$39.62	$97,069.00	$76.15	$186,568
BEAR LOOP RUN	11-A	MINING-AB	pH-METALS-SULFATES	1.2	WT	500	$39.62	$23,772.00	$76.15	$45,690
BEAVER DAM BRANCH	11-A	MINING-AB	pH-METALS	4.5	WT	500	$39.62	$89,145.00	$76.15	$171,338
SUGAR RUN	11-A	MINING-AB	pH-METALS	6.3	WT	500	$39.62	$124,803.00	$76.15	$239,873
BURGOON RUN	11-A	MINING-AB	pH-METALS	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
KITTANNING RUN	11-A	MINING-AB	pH-METALS	4.2	WT	500	$39.62	$83,202.00	$76.15	$159,915
GLENWHITE RUN	11-A	MINING-AB	pH-METALS	3.2	WT	500	$39.62	$63,392.00	$76.15	$121,840
DOC SMITH RUN	6-C	MINING-AB	pH-METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
SHALE RUN	6-C	MINING-AB	pH-METALS	0.8	WT	500	$39.62	$15,848.00	$76.15	$30,460
STONE CABIN RUN	6-C	MINING-AB	pH-METALS	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
NINE O'CLOCK RUN	6-C	MINING-AB	pH-METALS	0.6	WT	500	$39.62	$11,886.00	$76.15	$22,845

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
BEAR CREEK	6-C	MINING-AB	pH-METALS	4.4	WT	500	$39.62	$87,164.00	$76.15	$167,530
HANS YOST CREEK	6-C	MINING-AB	pH	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
ZERBE RUN	6-B	MINING-AB	pH-METALS	5.8	WT	500	$39.62	$114,898.00	$76.15	$220,835
CRAB RUN	6-B	MINING-AB	pH-METALS	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
SHENANDOAH CREEK	6-B	MINING-AB	pH-METALS	5	WT	500	$39.62	$99,050.00	$76.15	$190,375
CARBON RUN	6-B	MINING-AB	pH-METALS	3.7	WT	500	$39.62	$73,297.00	$76.15	$140,878
COAL RUN	6-B	MINING-AB	pH-METALS	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
QUAKER RUN	6-B	MINING-AB	pH-METALS	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
LOCUST CREEK	6-B	MINING-AB	pH-METALS	1.6	WT	500	$39.62	$31,696.00	$76.15	$60,920
NORTH BRANCH SHAMOKIN CREEK	6-B	MINING-AB	pH-METALS	4.6	WT	500	$39.62	$91,126.00	$76.15	$175,145
LOYALSOCK CREEK	10-B	MINING-AB	pH-METALS	7.4	WT	500	$39.62	$146,594.00	$76.15	$281,755
RED RUN	10-A	MINING-AB	pH-METALS	3.9	WT	500	$39.62	$77,259.00	$76.15	$148,493
OTTER RUN	9-A	MINING-AB	pH-METALS	3.8	WT	500	$39.62	$75,278.00	$76.15	$144,685
LEFT FORK OTTER RUN	9-A	MINING-AB	pH-METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
RIGHT FORK OTTER RUN	9-A	MINING-AB	pH-METALS	0.4	WT	500	$39.62	$7,924.00	$76.15	$15,230
BABBS CREEK	9-A	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
BABBS CREEK	9-A	MINING-AB	pH-METALS	22	WT	500	$39.62	$435,820.00	$76.15	$837,650
WILSON CREEK	9-A	MINING-AB	pH-METALS	2.3	WT	500	$39.62	$45,563.00	$76.15	$87,573
MIDDLE BRANCH BIG RUN	9-C	MINING-AB	pH-METALS	1.1	WT	500	$39.62	$21,791.00	$76.15	$41,883
MIDDLE BRANCH BIG RUN	9-C	MINING-AB	pH-METALS	4.9	WT	500	$39.62	$97,069.00	$76.15	$186,568
EAST BRANCH BIG RUN	9-C	MINING-AB	pH-METALS	4.7	WT	500	$39.62	$93,107.00	$76.15	$178,953
LOGWAY RUN	9-C	MINING-AB	pH-METALS	0.8	WT	500	$39.62	$15,848.00	$76.15	$30,460
NORTH FORK BEECH CREEK	9-C	MINING-AB	pH-METALS	5.9	WT	500	$39.62	$116,879.00	$76.15	$224,643
LITTLE SANDY RUN	9-C	MINING-AB	pH-METALS	2.7	WT	500	$39.62	$53,487.00	$76.15	$102,803
CHERRY RUN	9-C	MINING-AB	pH-METALS	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
LICK RUN	9-B	MINING-AB	pH	3.7	WT	500	$39.62	$73,297.00	$76.15	$140,878
TANGASCOOTACK CREEK	9-B	MINING-AB	pH-METALS	8.4	WT	500	$39.62	$166,404.00	$76.15	$319,830
DRURY RUN (BASIN)	9-B	MINING-AB/AT	pH	14.6	WT	500	$39.62	$289,226.00	$76.15	$555,895
STONY RUN	9-B	MINING-AB	pH-METALS	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
WOODLEY DRAFT RUN	9-B	MINING-AB	pH-METALS	1.7	WT	500	$39.62	$33,677.00	$76.15	$64,728

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
SANDY RUN	9-B	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
TWO MILE RUN	9-B	MINING-AB	pH-METALS	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
MIDDLE BRANCH TWO MILE RUN	9-B	MINING-AB	pH-METALS	2.1	WT	500	$39.62	$41,601.00	$76.15	$79,958
CROWLEY HOLLOW’	9-B	MINING-AB	pH-METALS	3.1	WT	500	$39.62	$61,411.00	$76.15	$118,033
CAMP RUN	9-B	MINING-AB	pH-METALS	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
ROCK RUN	9-B	MINING-AB	pH-METALS	1.2	WT	500	$39.62	$23,772.00	$76.15	$45,690
DENTS RUN	8-A	MINING-AB	pH	6.5	WT	500	$39.62	$128,765.00	$76.15	$247,488
TROUT RUN (UNT)	8-A	MINING-AB	pH-METALS	1.2	WT	500	$39.62	$23,772.00	$76.15	$45,690
SPRING RUN	8-A	MINING-AB	pH-METALS-SULFATES	7.7	WT	500	$39.62	$152,537.00	$76.15	$293,178
BIRCH ISLAND RUN	8-D	MINING-AB	pH-METALS	6.2	WT	500	$39.62	$122,822.00	$76.15	$236,065
LITTLE BIRCH ISLAND RUN	8-D	MINING-AB	pH-METALS	4.3	WT	500	$39.62	$85,183.00	$76.15	$163,723
AMOS BRANCH	8-D	MINING-AB	pH-METALS	1.6	WT	500	$39.62	$31,696.00	$76.15	$60,920
STERLING RUN	8-D	MINING-AB	pH-METALS	7.2	WT	500	$39.62	$142,632.00	$76.15	$274,140
SALTLICK RUN	8-D	MINING-AB	pH-METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
CURLEYS RUN	8-D	MINING-AB	pH-METALS	1.2	WT	500	$39.62	$23,772.00	$76.15	$45,690
GRIMES RUN	8-D	MINING-AB	pH-METALS-SULFATES	2.3	WT	500	$39.62	$45,563.00	$76.15	$87,573
ALDER RUN	8-C	MINING-AB	pH-METALS	10.7	WT	500	$39.62	$211,967.00	$76.15	$407,403
SANDY CREEK	8-C	MINING-AB	pH-METALS-SULFATES	4.2	WT	500	$39.62	$83,202.00	$76.15	$159,915
BIG RUN	8-C	MINING-AB	pH	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
DEER CREEK	8-C	MINING-AB	pH-METALS	5	WT	500	$39.62	$99,050.00	$76.15	$190,375
SURVEYOR RUN	8-C	MINING-AB	pH-METALS	4	WT	500	$39.62	$79,240.00	$76.15	$152,300
LITTLE SURVEYOR RUN	8-C	MINING-AB	pH-METALS	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
TROUT RUN	8-C	MINING-AB	pH	5	WT	500	$39.62	$99,050.00	$76.15	$190,375
TAYLOR SPRINGS RUN	8-C	MINING-AB	METALS HWC	0.4	WT	500	$39.62	$7,924.00	$76.15	$15,230
PINE RUN	8-C	MINING-AB	pH	2.2	WT	500	$39.62	$43,582.00	$76.15	$83,765
FORK RUN	8-C	MINING-AB	pH-METALS	3.8	WT	500	$39.62	$75,278.00	$76.15	$144,685

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
SANBOURN RUN	8-C	MINING-AB	pH-METALS-SULFATES	3.3	WT	500	$39.62	$65,373.00	$76.15	$125,648
NORTH BRANCH UPPER MORGAN RUN	8-C	MINING-AB	pH-METALS	2.7	WT	500	$39.62	$53,487.00	$76.15	$102,803
LITTLE MUDDY RUN	8-C	MINING-AB	pH	4.5	WT	500	$39.62	$89,145.00	$76.15	$171,338
BLUE RUN	8-C	MINING-AB	METALS HWC	1.2	WT	500	$39.62	$23,772.00	$76.15	$45,690
WOODS RUN	8-B	MINING-AB	pH-METALS	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH-METALS	1.7	WT	500	$39.62	$33,677.00	$76.15	$64,728
MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH	0.5	WT	500	$39.62	$9,905.00	$76.15	$19,038
NORTH BRANCH MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
TINKER RUN	8-B	MINING-AB	pH	0.7	WT	500	$39.62	$13,867.00	$76.15	$26,653
MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
HARTSHORN RUN	8-B	MINING-AB	pH-METALS-SULFATES	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
KRATZER RUN	8-B	MINING-AB	pH-METALS	5.1	WT	500	$39.62	$101,031.00	$76.15	$194,183
IRVIN BRANCH	8-B	MINING-AB	METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
LITTLE ANDERSON CREEK	8-B	MINING-AB	pH-METALS	5.7	WT	500	$39.62	$112,917.00	$76.15	$217,028
WILSON RUN (UNT)	8-B	MINING-AB	pH	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
WILSON RUN (UNT)	8-B	MINING-AB	METALS HWC	0.8	WT	500	$39.62	$15,848.00	$76.15	$30,460
NORTH CAMP RUN	8-B	MINING-AB	METALS HWC-SULFATES	2.8	WT	500	$39.62	$55,468.00	$76.15	$106,610
ROCK RUN	8-B	MINING-AB	pH-METALS	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
BEAR RUN	8-B	MINING-AB	pH-METALS	2.9	WT	500	$39.62	$57,449.00	$76.15	$110,418
SOUTH BRANCH BEAR RUN	8-B	MINING-AB	pH-METALS	5.3	WT	500	$39.62	$104,993.00	$76.15	$201,798
CATAWISSA CREEK	5-E	MINING-AB	pH-METALS	23.5	WT	500	$39.62	$465,535.00	$76.15	$894,763
TOMHICKON CREEK	5-E	MINING-AB	pH	4.3	WT	500	$39.62	$85,183.00	$76.15	$163,723
SUGARLOAF CREEK	5-E	MINING-AB	pH	5.5	WT	500	$39.62	$108,955.00	$76.15	$209,413
BLACK CREEK	5-D	MINING-AB	pH-METALS	25.5	WT	500	$39.62	$505,155.00	$76.15	$970,913

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
LITTLE NESCOPECK CREEK	5-D	MINING-AB	pH	9.2	WT	500	$39.62	$182,252.00	$76.15	$350,290
LITTLE NESCOPECK CREEK	5-D	MINING-AB	pH-METALS	5.5	WT	500	$39.62	$108,955.00	$76.15	$209,413
LITTLE NESCOPECK CREEK (UNT)	5-D	MINING-AB	pH-METALS-SULFATES	0.3	WT	500	$39.62	$5,943.00	$76.15	$11,423
NEWPORT CREEK	5-B	MINING-AB	pH	4.8	WT	500	$39.62	$95,088.00	$76.15	$182,760
NANTICOKE CREEK	5-B	MINING-AB	pH	3.6	WT	500	$39.62	$71,316.00	$76.15	$137,070
SOLOMON CREEK	5-B	MINING-AB	pH	2.4	WT	500	$39.62	$47,544.00	$76.15	$91,380
ROARING BROOK	5-A	MINING-AB	pH-METALS	4	WT	500	$39.62	$79,240.00	$76.15	$152,300
POWDERLY CREEK	5-A	MINING-AB	pH-METALS	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
COAL BROOK	5-A	MINING-AB	pH-METALS	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
WILSON CREEK	5-A	MINING-AB	pH-METALS	0.6	WT	500	$39.62	$11,886.00	$76.15	$22,845
LONG VALLEY RUN	4-C	MINING-AB	pH-METALS	1.6	WT	500	$39.62	$31,696.00	$76.15	$60,920
MORRIS RUN	4-A	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
FALL BROOK	4-A	MINING-AB	pH-METALS	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
UNT LITTLE RACCOON RUN	20-D	MINING-AB	pH-METALS	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
CAMBELLS RUN	20-F	MINING-AB	pH-METALS	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
UNT CAMPBELLS RUN	20-F	MINING-AB	pH-METALS	0.8	WT	500	$39.62	$15,848.00	$76.15	$30,460
SAWMILL RUN	20-F	MINING-AB	pH-METALS	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
STREETS RUN	19-A	MINING-AB	pH-METALS	0.7	WT	500	$39.62	$13,867.00	$76.15	$26,653
THOMPSON RUN	19-A	MINING-AB	pH-METALS	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
WELTY RUN	19-D	MINING-AB	pH	7.8	WT	500	$39.62	$154,518.00	$76.15	$296,985
FERGUSON RUN	19-D	MINING-AB	pH-METALS-SULFATES	1.6	WT	500	$39.62	$31,696.00	$76.15	$60,920
POPLAR RUN	19-E	MINING-AB	pH-METALS	2.8	WT	500	$39.62	$55,468.00	$76.15	$106,610
NEWMYER RUN	19-E	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
LAUREL RUN	19-E	MINING-AB	pH-METALS-SULFATES	2.7	WT	500	$39.62	$53,487.00	$76.15	$102,803
CUCUMBER RUN	19-F	MINING-AB	pH-METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
WILSON CREEK	19-F	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
LAUREL RUN	19-F	MINING-AB	pH-METALS	0.8	WT	500	$39.62	$15,848.00	$76.15	$30,460

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
EAST BRANCH COXES CREEK	19-F	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
SHAFER RUN	19-F	MINING-AB	pH-METALS	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
LICK RUN	19-F	MINING-AB	pH-METALS	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
PINEY RUN	19-F	MINING-AB	pH-METALS	2.1	WT	500	$39.62	$41,601.00	$76.15	$79,958
MILLER RUN	19-F	MINING-AB	pH-METALS	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
UNT SALTLICK RUN	19-C	MINING-AB	pH-METALS	0.2	WT	500	$39.62	$3,962.00	$76.15	$7,615
RUSH RUN	19-C	MINING-AB	pH-METALS-SULFATES	2.4	WT	500	$39.62	$47,544.00	$76.15	$91,380
WALLACE RUN	19-C	MINING-AB	pH-METALS-SULFATES	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
CATS RUN	19-G	MINING-AB	pH	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
YORK RUN	19-G	MINING-AB	pH-METALS-SULFATES	6.2	WT	500	$39.62	$122,822.00	$76.15	$236,065
DOOLEY RUN	19-G	MINING-AB	pH-METALS	2.2	WT	500	$39.62	$43,582.00	$76.15	$83,765
LITTLE PLUMB CREEK	18-A	MINING-AB	pH-METALS	4	WT	500	$39.62	$79,240.00	$76.15	$152,300
LITTLE DEER CREEK	18-A	MINING-AB	pH-METALS	5.1	WT	500	$39.62	$101,031.00	$76.15	$194,183
BUFFALO CREEK (UNT)	18-F	MINING-AB	pH-METALS	0.2	WT	500	$39.62	$3,962.00	$76.15	$7,615
THORN RUN	18-B	MINING-AB	pH-METALS	0.7	WT	500	$39.62	$13,867.00	$76.15	$26,653
UNT THORN RUN	18-B	MINING-AB	pH-METALS	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
GETTY RUN	18-C	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
MC CUNE RUN	18-C	MINING-AB	pH-METALS	1.4	WT	500	$39.62	$27,734.00	$76.15	$53,305
UNION RUN	18-C	MINING-AB	pH-METALS	3.2	WT	500	$39.62	$63,392.00	$76.15	$121,840
SAXMAN RUN	18-C	MINING-AB	pH-METALS	4.7	WT	500	$39.62	$93,107.00	$76.15	$178,953
MONASTERY RUN	18-C	MINING-AB	pH-METALS	0.8	WT	500	$39.62	$15,848.00	$76.15	$30,460
ROARING RUN	18-D	MINING-AB	pH-METALS	2.4	WT	500	$39.62	$47,544.00	$76.15	$91,380
REEDS RUN	18-D	MINING-AB	pH-METALS	3.4	WT	500	$39.62	$67,354.00	$76.15	$129,455
TEARING RUN	18-D	MINING-AB	pH-METALS	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
FREEMAN RUN	18-D	MINING-AB	pH-METALS	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
UNT PAINT CREEK	18-E	MINING-AB	pH-METALS	0.5	WT	500	$39.62	$9,905.00	$76.15	$19,038
BABCOCK CREEK (BASIN)	18-E	MINING-AB	pH-METALS	3.5	WT	500	$39.62	$69,335.00	$76.15	$133,263

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
UNT DARK SHADE CREEK	18-E	MINING-AB	pH-METALS	0.6	WT	500	$39.62	$11,886.00	$76.15	$22,845
UNT STONEY CREEK	18-E	MINING-AB	pH-METALS	2.1	WT	500	$39.62	$41,601.00	$76.15	$79,958
FALLEN TIMBER RUN	18-E	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
UNT STONEY CREEK	18-E	MINING-AB	pH-METALS	1.1	WT	500	$39.62	$21,791.00	$76.15	$41,883
OVEN RUN	18-E	MINING-AB	pH-METALS	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
LAMBERTS RUN	18-E	MINING-AB	pH-METALS	3.1	WT	500	$39.62	$61,411.00	$76.15	$118,033
BOONE RUN	18-E	MINING-AB	pH-METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
BOONE RUN	18-E	MINING-AB	pH-METALS	0.6	WT	500	$39.62	$11,886.00	$76.15	$22,845
CLEAR RUN	18-E	MINING-AB	pH-METALS	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
OTTO RUN	18-E	MINING-AB	pH-METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
SULPHUR CREEK	18-E	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
SPRING RUN	18-E	MINING-AB	pH-METALS	2.1	WT	500	$39.62	$41,601.00	$76.15	$79,958
SUGAR RUN	17-E	MINING-AB	pH	0.6	WT	500	$39.62	$11,886.00	$76.15	$22,845
CRAIG RUN	17-E	MINING-AB	SULFATE	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
MCKEE RUN	17-E	MINING-AB	pH-METALS	1.5	WT	500	$39.62	$29,715.00	$76.15	$57,113
HUSKINS RUN	17-E	MINING-AB	SULFATE	2.6	WT	500	$39.62	$51,506.00	$76.15	$98,995
NYE BRANCH	17-D	MINING-AB	METALS	3.7	WT	500	$39.62	$73,297.00	$76.15	$140,878
CAYLOR RUN	17-D	MINING-AB	pH-METALS	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
FOUNDRY RUN	17-D	MINING-AB	pH	1.1	WT	500	$39.62	$21,791.00	$76.15	$41,883
BREWER RUN	17-D	MINING-AB	pH-METALS	1.7	WT	500	$39.62	$33,677.00	$76.15	$64,728
BEECH RUN	17-D	MINING-AB	pH-METALS	1.3	WT	500	$39.62	$25,753.00	$76.15	$49,498
EAST RUN	17-D	MINING-AB	pH-METALS	3.3	WT	500	$39.62	$65,373.00	$76.15	$125,648
NICELY RUN	17-D	MINING-AB	pH-METALS	1.4	WT	500	$39.62	$27,734.00	$76.15	$53,305
EAST BRANCH MAHONING CREEK	17-D	MINING-AB	METALS	8	WT	500	$39.62	$158,480.00	$76.15	$304,600
LAUREL BRANCH RUN	17-D	MINING-AB	pH-METALS	2.8	WT	500	$39.62	$55,468.00	$76.15	$106,610
WEST FORK LEATHERWOOD CREEK	17-C	MINING-AB	METALS HWC-SULFATES	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
LONG RUN	17-C	MINING-AB	SULFATE-METALS	3.1	WT	500	$39.62	$61,411.00	$76.15	$118,033
LEISURE RUN	17-C	MINING-AB	SULFATE-METALS	5.1	WT	500	$39.62	$101,031.00	$76.15	$194,183

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
TOWN RUN	17-C	MINING-AB	METALS HWC	5.5	WT	500	$39.62	$108,955.00	$76.15	$209,413
PINE CREEK	17-C	MINING-AB	METALS HWC	3.2	WT	500	$39.62	$63,392.00	$76.15	$121,840
LITTLE SANDY CREEK	17-C	MINING-AB	pH	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
CLUTCH RUN	17-C	MINING-AB	METALS HWC	3.6	WT	500	$39.62	$71,316.00	$76.15	$137,070
HADDEN RUN	17-C	MINING-AB	METALS HWC	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
BEAVER RUN	17-C	MINING-AB	SULFATE-METALS	6	WT	500	$39.62	$118,860.00	$76.15	$228,450
WELCH RUN	17-C	MINING-AB	pH-METALS-SULFATES	3.5	WT	500	$39.62	$69,335.00	$76.15	$133,263
LUTHERSBURG BRANCH	17-C	MINING-AB	pH-METALS-SULFATES	3.8	WT	500	$39.62	$75,278.00	$76.15	$144,685
NARROWS CREEK	17-C	MINING-AB	METALS	5.5	WT	500	$39.62	$108,955.00	$76.15	$209,413
NORTH BRANCH BEAR CREEK	17-C	MINING-AB	pH-METALS-SULFATES	6	WT	500	$39.62	$118,860.00	$76.15	$228,450
SOUTH BRANCH BEAR CREEK	17-C	MINING-AB	pH-METALS	2.4	WT	500	$39.62	$47,544.00	$76.15	$91,380
ANDERSON RUN	17-B	MINING-AB	pH-METALS-SULFATES	3	WT	500	$39.62	$59,430.00	$76.15	$114,225
LITTLE LICKING CREEK	17-B	MINING-AB	METALS HWC-SULFATES	2.9	WT	500	$39.62	$57,449.00	$76.15	$110,418
BRUSH RUN	17-B	MINING-AB	pH-METALS-SULFATES	7.6	WT	500	$39.62	$150,556.00	$76.15	$289,370
BRUSH RUN (UNT)	17-B	MINING-AB	pH	1.1	WT	500	$39.62	$21,791.00	$76.15	$41,883
GATHERS RUN	17-B	MINING-AB	METALS HWC-SULFATES	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
MILL CREEK	17-B	MINING-AB	METALS	6.1	WT	500	$39.62	$120,841.00	$76.15	$232,258
WHITES RUN	17-B	MINING-AB	pH-METALS	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
DOUGLAS RUN	17-B	MINING-AB	pH-METALS	4.5	WT	500	$39.62	$89,145.00	$76.15	$171,338

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
JONES RUN	17-B	MINING-AB	pH-METALS	3.5	WT	500	$39.62	$69,335.00	$76.15	$133,263
LITTLE MILL CREEK	17-B	MINING-AB	pH-METALS	20	WT	500	$39.62	$396,200.00	$76.15	$761,500
PARKS RUN	17-B	MINING-AB	pH	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
MCGOURVEY RUN	17-B	MINING-AB	pH-METALS-SULFATES	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
CURRY RUN	17-A	MINING-AB	METALS	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
JOHNSON RUN	17-A	MINING-AB	METALS HWC-SULFATES	3.9	WT	500	$39.62	$77,259.00	$76.15	$148,493
ELK CREEK (NORTH BRANCH)	17-A	MINING-AB	METALS	0.8	WT	500	$39.62	$15,848.00	$76.15	$30,460
DAGUSCAHONDA RUN	17-A	MINING-AB	pH-METALS	6	WT	500	$39.62	$118,860.00	$76.15	$228,450
IRON RUN	17-A	MINING-AB	METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
ELK CREEK-SOUTH BR (UNT)	17-A	MINING-AB	METALS	3.6	WT	500	$39.62	$71,316.00	$76.15	$137,070
FOWLER RUN	17-C	MINING-AB	pH-METALS-SULFATES	2	WT	500	$39.62	$39,620.00	$76.15	$76,150
LOCKARD RUN	16-G	MINING-AB	pH-METALS	2.3	WT	500	$39.62	$45,563.00	$76.15	$87,573
SOUTH FORK LITTLE SCRUBGRASS CREEK	16-G	MINING-AB	METALS HWC	1.8	WT	500	$39.62	$35,658.00	$76.15	$68,535
WALLEY RUN	16-F	MINING-AB	pH-METALS	1.9	WT	500	$39.62	$37,639.00	$76.15	$72,343
WALLEY RUN (UNT)	16-F	MINING-AB	pH-METALS	0.9	WT	500	$39.62	$17,829.00	$76.15	$34,268
WEST BRANCH BLUE JAY CREEK	16-E	MINING-AB	METALS	7	WT	500	$39.62	$138,670.00	$76.15	$266,525
N. BR. ROBINSONS RUN (UNT)	20-F	MINING-AB	pH-METALS	0.7	WT	500	$39.62	$13,867.00	$76.15	$26,653
N. BR. ROBINSONS RUN (UNT)	20-F	MINING-AB	pH-METALS	3.5	WT	500	$39.62	$69,335.00	$76.15	$133,263
HALF CROWN RUN	20-F	MINING-AB	pH-METALS	1	WT	500	$39.62	$19,810.00	$76.15	$38,075
SCHUYLKILL RIVER	3-A	MINING-AB	pH-METALS	31.7	WWF	306	$35.18	$341,253.04	$67.61	$655,831
WEST BRANCH SCHUYLKILL RIVER	3-A	MINING-AB	pH-METALS	9	WWF	306	$35.18	$96,885.72	$67.61	$186,198
SUSQUEHANNA RIVER	5-B	MINING-AB	pH-METALS	20	WWF	306	$35.18	$215,301.60	$67.61	$413,773
WEST BRANCH SUSQUEHANNA RIVER	8-B	MINING-AB	pH-METALS	6.8	WWF	306	$35.18	$73,202.54	$67.61	$140,683
WEST BRANCH SUSQUEHANNA RIVER	8-B	MINING-AB	pH-METALS	72.9	WWF	306	$35.18	$784,774.33	$67.61	$1,508,203

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
WEST BRANCH SUSQUEHANNA RIVER	9-B	MINING-AB	pH-METALS	50.6	WWF	306	$35.18	$544,713.05	$67.61	$1,046,846
WEST BRANCH SUSQUEHANNA RIVER	10-D	MINING-AB	pH-METALS	3	WWF	306	$35.18	$32,295.24	$67.61	$62,066
KETTLE CREEK	9-B	MINING-AB	pH-METALS	3	WWF	306	$35.18	$32,295.24	$67.61	$62,066
SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	6.7	WWF	306	$35.18	$72,126.04	$67.61	$138,614
SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	9.1	WWF	306	$35.18	$97,962.23	$67.61	$188,267
CLEARFIELD CREEK	8-C	MINING-AB	pH-METALS	44.2	WWF	306	$35.18	$475,816.54	$67.61	$914,439
LACKAWANNA RIVER	5-A	MINING-AB	pH-METALS	2.6	WWF	306	$35.18	$27,989.21	$67.61	$53,791
TIOGA RIVER	4-A	MINING-AB	pH-METALS	1	WWF	306	$35.18	$10,765.08	$67.61	$20,689
OHIO RIVER	20-E	MINING-AB	pH-METALS	1.6	WWF	306	$35.18	$17,224.13	$67.61	$33,102
OHIO RIVER	20-E	MINING-AB	pH-METALS	1.6	WWF	306	$35.18	$17,224.13	$67.61	$33,102
OHIO RIVER	20-E	MINING-AB	pH-METALS	3.1	WWF	306	$35.18	$33,371.75	$67.61	$64,135
OHIO RIVER	20-E	MINING-AB	pH-METALS	1.8	WWF	306	$35.18	$19,377.14	$67.61	$37,240
OHIO RIVER	20-E	MINING-AB	pH-METALS	2.1	WWF	306	$35.18	$22,606.67	$67.61	$43,446
HARMON CREEK	20-D	MINING-AB	pH-METALS	5	WWF	306	$35.18	$53,825.40	$67.61	$103,443
BRUSH RUN	20-B	MINING-AB	pH-METALS-SULFATES	8.3	WWF	306	$35.18	$89,350.16	$67.61	$171,716
CLARKS RUN	20-B	MINING-AB	pH-METALS	0.8	WWF	306	$35.18	$8,612.06	$67.61	$16,551
DUCK RUN	20-C	MINING-AB	METALS	4.3	WWF	306	$35.18	$46,289.84	$67.61	$88,961
EAST BRANCH WOLF CREEK	20-C	MINING-AB	METALS	6	WWF	306	$35.18	$64,590.48	$67.61	$124,132
LONG RUN	20-C	MINING-AB	METALS	3.3	WWF	306	$35.18	$35,524.76	$67.61	$68,273
BLACKS CREEK	20-C	MINING-AB	pH-METALS	4.8	WWF	306	$35.18	$51,672.38	$67.61	$99,306
CONNOQUENESSING CREEK (UNT)	20-C	MINING-AB	METALS	0.6	WWF	306	$35.18	$6,459.05	$67.61	$12,413
MONTOUR RUN	20-G	MINING-AB	pH-METALS	0.5	WWF	306	$35.18	$5,382.54	$67.61	$10,344
MOON RUN	20-G	MINING-AB	pH-METALS	2.5	WWF	306	$35.18	$26,912.70	$67.61	$51,722
MOON RUN	20-G	MINING-AB	pH-METALS	1.1	WWF	306	$35.18	$11,841.59	$67.61	$22,758
UNT MONONGAHELA RIVER	19-C	MINING-AB	pH-METALS	0.5	WWF	306	$35.18	$5,382.54	$67.61	$10,344
PETERS CREEK	19-C	MINING-AB	pH-METALS	22.3	WWF	306	$35.18	$240,061.28	$67.61	$461,357
FALLEN TIMBER RUN	19-C	MINING-AB	pH-METALS	2.7	WWF	306	$35.18	$29,065.72	$67.61	$55,859
FALLEN TIMBER RUN	19-C	MINING-AB	pH-METALS	1	WWF	306	$35.18	$10,765.08	$67.61	$20,689

Appendix D: Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD for base year 1989 adjusted to 2015

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation 1989 Dollars ($/Trip)[a]	Lost Value ($)	Valuation 2015 Dollars ($/Trip)[b]	Lost Value ($)
TENMILE CREEK	19-B	MINING-AB	pH-SULFATES	5.7	WWF	306	$35.18	$61,360.96	$67.61	$117,925
SOUTH FORK TENMILE CREEK	19-B	MINING-AB	pH-METALS	2	WWF	306	$35.18	$21,530.16	$67.61	$41,377
RUSH RUN	19-B	MINING-AB	pH-METALS-SULFATES	1.3	WWF	306	$35.18	$13,994.60	$67.61	$26,895
PUMKIN RUN	19-B	MINING-AB	pH-METALS	1.8	WWF	306	$35.18	$19,377.14	$67.61	$37,240
WHITELEY CREEK	19-G	MINING-AB	pH-METALS	9	WWF	306	$35.18	$96,885.72	$67.61	$186,198
DUNKARD CREEK	19-G	MINING-AB	OTHER	6.5	WWF	126	$35.18	$28,812.42	$67.61	$55,373
DUNKARD CREEK	19-G	MINING-AB	pH-METALS	8.5	WWF	126	$35.18	$37,677.78	$67.61	$72,410
ALLEGENY RIVER	18-A	MINING-AB	pH-METALS	1.5	WWF	126	$35.18	$6,649.02	$67.61	$12,778
KISKIMINETAS RIVER	18-B	MINING-AB	pH-METALS	13.5	WWF	306	$35.18	$145,328.58	$67.61	$279,297
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	114.5	WWF	306	$35.18	$1,232,601.66	$67.61	$2,368,852
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	1.7	WWF	306	$35.18	$18,300.64	$67.61	$35,171
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	7.9	WWF	306	$35.18	$85,044.13	$67.61	$163,440
STONY CREEK	18-E	MINING-AB	pH-METALS	6.5	WWF	306	$35.18	$69,973.02	$67.61	$134,476
CROOKED CREEK	17-E	MINING-AB	pH	1.1	WWF	306	$35.18	$11,841.59	$67.61	$22,758
CROOKED CREEK	17-E	MINING-AB	pH-METALS	1.6	WWF	306	$35.18	$17,224.13	$67.61	$33,102
COAL BANK RUN	17-E	MINING-AB	pH	0.5	WWF	126	$35.18	$2,216.34	$67.61	$4,259
NORTH BRANCH PLUM CREEK	17-E	MINING-AB	pH	1.1	WWF	126	$35.18	$4,875.95	$67.61	$9,371
STUMP CREEK	17-D	MINING-AB	METALS	0.8	WWF	126	$35.18	$3,546.14	$67.61	$6,815
STUMP CREEK	17-D	MINING-AB	METALS-SULFATES	2.5	WWF	126	$35.18	$11,081.70	$67.61	$21,297
STUMP CREEK	17-D	MINING-AB	METALS	1.2	WWF	126	$35.18	$5,319.22	$67.61	$10,223
WEST FORK (UNT) (02)	17-C	MINING-AB	METALS	0.6	WWF	126	$35.18	$2,659.61	$67.61	$5,111
WEST FORK (UNT)	17-C	MINING-AB	METALS	0.7	WWF	126	$35.18	$3,102.88	$67.61	$5,963
KYLE RUN (UNT)	17-C	MINING-AB	METALS	1.4	WWF	126	$35.18	$6,205.75	$67.61	$11,926
KTLE RUN	17-C	MINING-AB	METALS	0.4	WWF	126	$35.18	$1,773.07	$67.61	$3,408
CLARION RIVER	17-B	MINING-AB	pH-METALS	4	WWF	306	$35.18	$43,060.32	$67.61	$82,755
			TOTAL MILES AMD	**2167**					**TOTAL**	**$124,538,567**

References:

a. Source is the American Fisheries Society, investigation and valuation of fish kills, AFS Special Publication 24. Bethesda, MD. 96 pp. The values per trip were taken from Appendix 3, United States values for Trout applied to Trout Stocked Fishery, Coldwater applied to Wild Trout and Warm water applied to Warm Water Fishery.

b. The dollar values listed in this column have been converted to 2015 US dollars using the Consumer Price Index (CPI) Inflation Calculator. Convert 1989 US dollar values to the current year from the Bureau of Labor Statistics CPI Inflation Calculator, found online, 10/16/2015, at www.bls.gov/data/inflation_calculator.htm.

Appendix E: Uniform Series Present Worth Factors for Various Interest Rates and Periods

Uniform Series Present Worth Factors								
Years	**Interest Rate (%)**							
	1.0	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
5	4.85343	4.78264	4.71346	4.64583	4.57971	4.51505	4.45182	4.38998
10	9.47130	9.22218	8.98259	8.75206	8.53020	8.31661	8.11090	7.91272
15	13.86505	13.34323	12.84926	12.38138	11.93794	11.51741	11.11839	10.73955
20	18.04555	17.16864	16.35143	15.58916	14.87747	14.21240	13.59033	13.00794
25	22.02316	20.71961	19.52346	18.42438	17.41315	16.48151	15.62208	14.82821
30	25.80771	24.01584	22.39646	20.93029	19.60044	18.39205	17.29203	16.28889
35	29.40858	27.07559	24.99862	23.14516	21.48722	20.00066	18.66461	17.46101
40	32.83469	29.91585	27.35548	25.10278	23.11477	21.35507	19.79277	18.40158
45	36.09451	32.55234	29.49016	26.83302	24.51871	22.49545	20.72004	19.15635
50	39.19612	34.99969	31.42361	28.36231	25.72976	23.45562	21.48218	19.76201
Years	**Interest Rate (%)**							
	5.0	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**
5	4.32948	4.27028	4.21236	4.15568	4.10020	4.04588	3.99271	3.94064
10	7.72173	7.53763	7.36009	7.18883	7.02358	6.86408	6.71008	6.56135
15	10.37966	10.03758	9.71225	9.40267	9.10791	8.82712	8.55948	8.30424
20	12.46221	11.95038	11.46992	11.01851	10.59401	10.19449	9.81815	9.46334
25	14.09394	13.41393	12.78336	12.19788	11.65358	11.14695	10.67478	10.23419
30	15.37245	14.53375	13.76483	13.05868	12.40904	11.81039	11.25778	10.74684
35	16.37419	15.39055	14.49825	13.68696	12.94767	12.27251	11.65457	11.08778
40	17.15909	2.85715	3.18226	3.52564	3.88614	4.26244	4.65308	5.05649
45	17.77407	16.54773	15.45583	14.48023	13.60552	12.81863	12.10840	11.46531
50	18.25593	16.93152	15.76186	14.72452	13.80075	12.97481	12.23348	11.56560
Years	**Interest Rate (%)**							
	9.0	**9.5**	**10.0**	**10.5**	**11.0**	**11.5**	**12.0**	**12.5**
5	3.88965	3.83971	3.79079	3.74286	3.69590	3.64988	3.60478	3.56057
10	6.41766	6.27880	6.14457	6.01477	5.88923	5.76777	5.65022	5.53643
15	8.06069	7.82818	7.60608	7.39382	7.19087	6.99671	6.81086	6.63289
20	9.12855	8.81238	8.51356	8.23091	7.96333	7.70982	7.46944	7.24135
25	9.82258	9.43758	9.07704	8.73902	8.42174	8.12361	7.84314	7.57901
30	10.27365	9.83472	9.42691	9.04744	8.69379	8.36371	8.05518	7.76638
35	10.56682	10.08699	9.64416	9.23465	8.85524	8.50304	8.17550	7.87036
40	10.75736	10.24725	9.77905	9.34829	8.95105	8.58389	8.24378	7.92806
45	10.88120	10.34904	9.86281	9.41727	9.00791	8.63080	8.28252	7.96008
50	10.96168	10.41371	9.91481	9.45914	9.04165	8.65802	8.30450	7.97785

Appendix F: Plan Evaluation and Score Sheets

A.1 - Local Support **(Refer to Section K.1.a)**	**Points**	**Score**
Has a local entity formulated goals?	0 - 5	
Has the local entity developed a plan?	0 - 5	
Has the local entity begun plan implementation	0 - 15	
Has the local entity demonstrated success in project implementation? **(1 project = 5 pts., 2 projects = 10 pts., 3 or more = 15 pts.)**	0 - 15	
Does the local entity have a history of reliably providing for long-term O&M? **(1 project, 0-5 pts.; 2-4 projects, 5-15 pts.; > 4 projects, 15-25 pts.; active treatment, additional 10 pts.)**	0 - 35	
Is there a non-local entity involved in restoration? (TU, SRBC, etc.)	0 - 5	
Maximum Section Score	**80**	

A.2 - Background Data **(Refer to Section K.1.b)**	**Points**	**Score**
Does this plan include a watershed map showing major topographic features and pollution sources?	Y=10 N=0	
Are historical, archeological, geological, and biological watershed features described?	0 - 5	
Are the problems in the watershed (such as AMD, sewage, poor habitat, etc.) and the opportunities clearly defined?	0 - 5	
Are AMD sources adequately located and characterized, including mass balance calculations and comparison to stream load?	0 - 10	
Are discharge/abatement projects prioritized based on their contribution to the stream load and location in the watershed?	0 - 10	
Has a biological assessment been completed that uses standard or accepted DEP protocols?	Y=10 N=0	
Are there abatement projects identified that will reduce or eliminate the need for AMD treatment at any of the high loading AMD sites?	0 - 15	
Have low flow or base flow and peak flow and associated chemistry been defined?	Y=5 N=0	
Is flow and chemistry measurement frequency adequate to properly characterize the discharge(s)?	0 - 5	
Has the design flow and chemistry characterization been scientifically and/or statistically determined?	Y=5 N=0	
Have the water samples been analyzed by a certified/acceptable laboratory?	Y=5 N=0	
Have an adequate number of parameters been identified to adequately characterize the AMD and reasonably ensure quality assurance/quality control?	0 - 5	
Maximum Section Score	**90**	

A.3 - Restoration Goals **(Refer to section K.1.c)**	**Points**	**Score**
Are the Restoration Goals well defined (goals clear and concise)?	0 - 5	
Are the Restoration Goals measurable by lab analysis and/or biological surveys?	0 - 5	
Are the Restoration Goals achievable	0 - 10	
Is the targeted area within the watershed clearly described	0 - 5	
Do the Restoration Goals fit well with DEP's overarching goals'?	0 - 10	
No restoration goals have been developed.	-35	
Maximum Section Score	**35**	

A.4 - Technology, Operation, Maintenance, Risk Matrix, Alternatives, and Other Considerations Analyses for Individual Projects - Develop a score for each individual treatment or abatement project covered by the restoration plan. The overall score for the projects in the plan will be the total of the weighted percentage of pollution loading for each individual treatment or abatement project.
***(Refer to Section K.1.d.i.-vii.)*.**

Individual Project Scoring Criteria

Project Name:___________________________________

a. **Technology Evaluation (Refer to section K.1.d.i.)**	**Scoring Type**	**Score**
Has the proposed technology been successively used at other locations with similar water characteristics? *Yes – 15 No - 0*	Fixed	
Is the proposed technology sized or manufactured using a science-based approach and/or as identified in Appendix C? *Yes – 15 No - 0*	Fixed	
Do site conditions allow for proper construction of the proposed project? *Yes – 15 No - 0*	Fixed	
Will the proposed project be inspected during construction? *Full – 15 Partial – 7 None - 0*	Fixed	
Technology Score	60 (max)	

b. **Operational Evaluation (Daily) (Refer to section K.1.d.ii.)**	**Scoring Type**	**Score**
Evaluate the ease of operation and resources required: *Easy – Project is dependent on gravity flow and/or can be operated using simple hand tools. 10 points* *Difficult – Project is dependent on pumps and mechanical apparatuses and special or heavy equipment is needed. 0 points*	Sliding	
How often will the project be monitored? Monitoring includes sampling the water along with examining the project components. *Daily – 10 Weekly – 8 Monthly – 5 Quarterly – 2, Bi-Annual – 1 Yearly - 0*	Fixed	
Number of personnel required to perform routine operations? *1 – 10 pts., 2 – 5 pts., 3 or more – 0 pts.*	Fixed	
Evaluate the commitment to long term operations. *Formal agreement – 10, Verbal commitment – 5, None - 0*	Fixed	
Evaluate how well the project can be adjusted or is sized to continuously meet goals under documented flow and/or chemistry conditions? *10 to 0 points*	Sliding	
Operation Score	50 (max)	

c. **Maintenance Evaluation (Long Term) (Refer to section K.1.d.iii)**	**Scoring Type**	**Score**
Evaluate the degree in which system problems can be identified. *Easy – Important aspects of the project not working properly can be easily identified. 10 points* *Difficult – Important aspects of the project are not visible or well defined making problems difficult to identify. 0 points*	Sliding	
Evaluate how often major maintenance will be required to keep the project operating properly? *Yearly – 0 Every 5 years – 3 Every 10+ years - 10*	Sliding	
Evaluate the extents and resources required to perform maintenance: *Low – Costs are less than 10% of capital cost and minimal heavy equipment is required. 10 points* *High – Costs are greater than 25% of capital costs and/or specialized equipment is required. 0 points*	Sliding	
Can major maintenance be performed while continuing to meet project goals? *Any time – 10 pts. During low flow – 5 pts., Never – 0 pts.*	Fixed	
Maintenance Score	40 (max.)	

d. **Risk Matrix Analysis Evaluation – Category 4 systems only (Refer to Section K.1.d.iv.)**	**Scoring Type**	**Score**
From Table 1, is the project classified as "High Risk"? *Yes – (-60) or n/a*	Fixed	
From Table 1, is the project classified as "High Risk," but has the possibility of being downgraded to "Medium Risk" (*)? *Yes – (--10) or n/a*	Fixed	
From Table 1, is the project classified as "High Risk," but has the possibility of being downgraded to "Medium Risk" (*) with the inclusion of a performance bond? *Yes – 0 points or n/a*	Fixed	
From Table 1, is the project classified as "Medium Risk"? *10 points or n/a*	Fixed	
From Table 1, is the project classified as "Low Risk"? *30 points or n/a*	Fixed	
Risk Matrix Score	30(max)	

e. **Alternative Analysis Evaluation – Capital Costs > $400k (Refer to section K.1.d.v.)**	**Scoring Type**	**Score**
For Treatment projects, at least one appropriate passive and one active system are compared. *Yes – 15, No – 0, or n/a*	Fixed	
For Abatement projects, at least one active or passive system is compared. *Yes – 15, No – 0, or n/a*	Fixed	
Evaluate the extent the analysis discusses potential operational issues with both alternatives. *Issues Identified – 15 Issues not Identified - 0*	Sliding	
Evaluate the extent the analysis discusses potential maintenance issues with both alternatives. *Issues Identified – 15 Issues not Identified - 0*	Sliding	
If cost are ≤ $400k, provide 20 points for section	Fixed	
Alternatives Score	45 (max.)	

Project Name:___________________________________

f. **Other Considerations Evaluation (Refer to section K.1.d.vi.)**	**Scoring Type**	**Score**
Does property owner(s) consent exist for the project site? *Written – 10, Verbal, - 5, None – 0*	Fixed	
Have any soil test or geotechnical evaluations been performed on the project site? *Yes – 5, No – 0*	Fixed	
Have all permits (local, state, and federal) been identified and/or obtained for the project? *Obtained – 10, Identified – 5, No - 0*	Fixed	
Is there documented local and/or public support for the project? *Yes – 10, No – 0*	Fixed	
Is the proposed project located in the 100 yr. flood plain? No – 10, Yes - 0	Fixed	
Has a wetland determination been performed for the project location? *Yes – 10, No- 0*	Fixed	
Other Considerations Score	55 (max)	

g. **Abatement Project Analysis Evaluation (Refer to section K.1.d.vii.)**	**Scoring Type**	**Score**
Will the proposed project eliminate a mine discharge? *Yes – 30 or n/a*	Fixed	
Will the proposed project reduce a discharge's loading more than 50%? *Yes – 25 or n/a*	Fixed	
Will the proposed project reduce a discharge's loading 10 to 50%? *Yes – 10 or n/a*	Fixed	
Will the proposed project reduce a discharge's loading less than 10%? *Yes – 5 or n/a*	Fixed	
The proposed project will not reduce a discharge's loading. *Yes – 0 or n/a*		
Abatement Score	30 (max)	

Weighted summation of all restoration projects within the Restoration Plan (based on % pollution loading).

	Project 1	Project 2	Project 3	Project 4	Project (etc.)
Project Name					
Technology Score					
Operation Score					
Maintenance Score					
Risk Matrix Score					
Alternative Analysis Score					
Other Considerations Score					
Abatement Score					
Total Score (a)					
% Pollution Load (b)					
Weighted Score (a * b)					

Sum of all weighted Individual Project Scores = **Maximum Weighted Section Score = 280** (Risk Matrix will not apply to abatement projects and Abatement Analysis will not apply to treatment projects)	

B.1 Stream Miles Restored and Other Water Resource Benefits (Refer to Section K.2.a)			
Impact	**Stream Miles**	**Points**	**Score**
Minimal	Hydrologic Unit restoration will restore (meet treatment goals in) <1 mile of stream.	0 - 5	
Minor	Hydrologic Unit restoration will restore (meet treatment goals in) 1 - <5 miles of stream.	6 - 10	
Moderate	Hydrologic Unit restoration will restore (meet treatment goals in) 5 - <10 miles of stream.	11 - 15	
Significant	Hydrologic Unit restoration will restore (meet treatment goals in) 10 - <20 miles of stream.	16 - 20	
Very Significant	Hydrologic Unit restoration will restore (meet treatment goals in) ≥20 miles of stream.	21- 25	
Additional	Based on PA Code Ch. 93 Protected Water Uses: Restoration will restore an EV/HQ stream, or	+25	
	Restoration will restore a cold water fishery, or	+15	
	Restoration will restore a warm water fishery or trout stocked fishery	+10	
Maximum Section Score		**50**	

B.2 Other Benefits (Refer to Section K.2.b)		**Points**	**Score**
Additional	Restoration can be reasonably expected to result in the delisting of a stream or portion from the Department's Impaired Waters List (Upper Tier Goals Met)	0 - 10	
Additional	Restoration will provide/improve water supplies for public or industrial use within the restoration area	0 - 10	
Additional	Restoration will provide increased water tourism benefits on public lands	0 - 10	
Additional	Restoration will generate resources that could be used in other industries. Resource recovery should be stated in the goals	0 - 10	
Additional	Restoration will generate energy that could be used in the system or sold off. Energy generation should be stated in the goals of the proposed project	0 - 10	
Additional	Restoration will eliminate documented OSMRE Priority 1 or Priority 2 AML problems. **One P2 Problem = 5** **One P1 Problem = 10** **More Than Two P1 and/or P2 Problems = 20**	0 - 20	
Additional	Restoration involves new or innovative technologies that have been tested and shown to be a successful application. Documentation should be cited on how the technology applies to the problem. No adverse impacts should result.	0 - 5	
	Maximum Section Score	**75**	

C.1 - Capital Costs of Restoration Plan (Refer to Section K.3.a)		Points	Score
Very High Cost	> $1 million / Mile	0 - 5	
High Cost	> $750,000 and < $1 million / Mile	6- 10	
Moderate Cost	> $500,000 and < $750,000 / Mile	11-15	
Low Cost	> $250,000 and < $500,000 / Mile	16-20	
Very Low Cost	< $250,000 / Mile	21- 25	
	Maximum Section Score	25	

C.2 - Non-Title IV Match Money and Projects Completed by Others (Refer to section K.3.b)		Points	Score
High	Greater than 50% of past and proposed treatment/abatement projects have been completed with funding from non-Title IV sources	26 - 50	
Medium	Greater than 25% of past and proposed treatment/abatement projects have been completed OR Greater than 25% of total needed funding has been committed from non-Title IV sources	11 - 25	
Low	Title IV sources will provide >75% of total capital costs needed to complete priority projects	0 - 10	
	Total Section Score	**50**	

C.3 - Operation, Monitoring, Maintenance and Replacement Requirements, and Costs **(Refer to Section K.3.c)**		**Points**	**Score**
Local Support	Routine O&M to be provided by local entity	0 - 10	
Other Support	Routine O&M to be provided by local industry or other private entity (partial – 0 - 5, full – 5 - 10)	0 - 10	
Treatment Funding	A trust fund or legal agreement is in place to fund > 25% of long-term treatment O&M in the watershed from non-Title IV sources	0 - 10	
	A trust fund or legal agreement is in place to fund > 50% of long-term treatment O&M in the watershed from non-Title IV sources	11 - 25	
Abatement	At least 25% of the pollution load to be reduced by abatement projects that will require no long-term O&M	0 - 10	
	At least 50% of the pollution load will be reduced by abatement projects that will require no long-term O&M	11 - 25	
Active Treatment	Active treatment is needed in the watershed and non-Title IV funding source is not identified (at a cost < $100,000/year)	-15	
Active Treatment	Active treatment is needed in the watershed and non-Title IV funding source is not identified (at a cost < $100,000 - $500,00/year)	-35	
Active Treatment	Active treatment is needed in the watershed and non-Title IV funding source is not identified (at a cost > $500,000/year)	-70	
	Total Section Score	**70**	

Score Sheet Summary

Restoration Plan Scoring Criteria	Total Section Score (e)	Maximum Criteria Score (f)	Weighted Percentage (g)	Score [(e)/(f) x(g)]
A.1 - Local Support		80	10	
A.2 - Background Data		90	10	
A.3 - Restoration Goals		35	10	
*A.4.a-g - Technology, Operation, Maintenance, Risk Matrix, Alternatives, and Other Considerations Analyses for Individual Projects (Weighted Sum of all individual projects)		280	15	
B.1 Stream Miles Restored and Other Water Resource Benefits		50	15	
B.2 Other Benefits		75	10	
C.1 - Capital Costs of Restoration Plan		25	10	
C.2 - Non-Title IV Match Money and Projects Completed by Others		50	10	
C.3 - Operation, Monitoring, Maintenance and Replacement Requirements, and Costs		70	10	
Overall Restoration Plan Score				

*These are the combined weighted scores of all projects.

D. Restoration Plan Benefit	**Overall Plan Score**
Exceptional Benefit	> 90 - 100+
High Benefit	> 70 - 90
Moderate Benefit	> 50 - 70
Low Benefit	50 or less

Record of Decision

	Project Selection Criteria	Record of Decision
A.1	Local Support	
A.2	Background Data	
A.3	Restoration Goals	
A.4.a-g	Technology, Operation, Maintenance, Risk Matrix, Alternatives, and Other Considerations Analyses for Individual Projects	
B.1	Stream Miles Restored and Other Water Resource Benefits	
B.2	Other Benefits	
C.1	Capital Costs of Restoration Plan	
C.2	Non-Title IV Match Money and Projects Completed by Others	
C.3	Operation, Monitoring, Maintenance and Replacement Requirements, and Costs	
	Additional Comments	

The evaluator should complete a brief Record of Decision to document reason(s) for scoring and items used as the basis for the evaluation.