pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Acid Mine Drainage Set-Aside Program

Program Implementation Guidelines

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Conservation and Restoration

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TITLE:	Acid Mine Drainage Set-Aside Program Program Implementation Guidelines
EFFECTIVE DATE:	Upon publication of notice as final in the *Pennsylvania Bulletin*
AUTHORITY:	Federal Surface Mine Control and Reclamation Act
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 shall affect regulatory requirements. The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of DEP 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:	66 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 to 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 OSM 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, the DEP began implementation of their use to guide project selection starting in July 2009. In August 2012, after a DEP re-organization moved the Set-Aside Program form 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 OSM, 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 outcome 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 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.

Surface Mining Control and Reclamation Act

Language in the Act

Section 403 of the Federal 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

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

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 activity.

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 SMCRA 402(g)(6). 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. These amounts can be expended by the state "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. Pa. Code, Title 25, 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 decided to use 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 lesser 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 allows 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, 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, with infrequent, minor exceedances that do not adversely impact aquatic life: pH > 6.0, alkalinity > acidity (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, alkalinity > acidity (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 OSM 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 OSM 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. 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. The DEP will add new QHUs commensurate with the ability of the DEP, 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 "worth" 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 "High" or "Exceptional Worth" to the Commonwealth (see the discussion under "Evaluation and Scoring of Restoration Plans, D. Restoration Plan Worth Determination," for an explanation of the use of the term "worth" 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, 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.

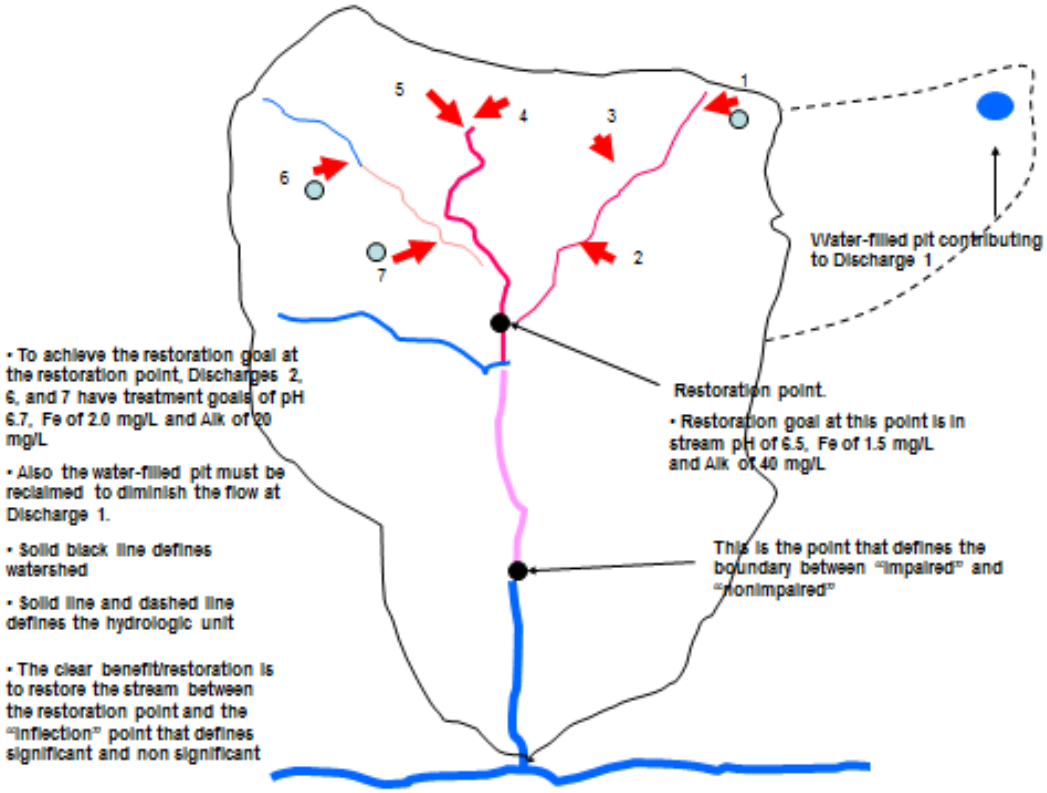


Figure 1 - Watershed Example

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 the 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 the benefits of the plan based on the these Guidelines. 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 according to the scoring procedures listed in these Guidelines. In most cases, DEP will not consider developing a QHU in watersheds that are not determined to have either "High Worth" or "Exceptional Worth." 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.

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.

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 the watershed is determined to be of "High" or "Exceptional Worth" when scored by the process described later in this document and a QHU is developed for the watershed. Those passive treatment systems that are within watersheds which have not been scored, or have been scored and determined to be of "Low" or "Moderate" worth, 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 concluded 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 and decide whether goals have been met, what additional work is needed, or whether these watersheds are no longer a priority of DEP. Proceed with completion of projects to accomplish restoration if the hydrologic units are still a DEP priority.

4. Develop new QHUs for "High" and "Exceptional Worth" 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** "High" or "Exceptional Worth" 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), 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 of the opinion that passive treatment system design includes many considerations and features which are 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 proposed passive treatment system design for consideration of Set-Aside funding will provide written narrative justification by the design engineer for the technology selected, whether innovative or typical. Such narrative will include justification of 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 2006. 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, including an interactive map of the SWP basins, can be found at the following web address: www.pawaterplan.dep.state.pa.us/statewaterplan/docroot/WaterAtlasLinks.aspx.

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 will be further analyzed and scored to determine its worth 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 OSM'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 OSM.

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.wbsrc.org/plansandprojects.html or www.tu.org/westbranch.

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 only the annual O&M costs will be taken into consideration for calculating the net present value. The cost value will be calculated by using documented or anticipated O&M costs and discounting those costs to a net present value. The net present value 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).

Benefit:Cost Analysis Example No. 1
(For a watershed being restored using passive treatment technology)

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 Stream Degraded by AMD 2006.

Fourmile Run
State Water Plan: 18-C
Miles Impaired: 2
Projected Use: Trout Stocked Fishery (TSF)
Use Rate: 1,100 trips/year
Valuation: $67.26/trip
Lost Value: 2 miles x 1,100 trip/year/mile x $67.26 trip = $147,972 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:	$220,000
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 12.4622.

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 $147,972 per year. The following parameters are applied to the NPV equation:

n = 20 years
i = 5%
USPWF = 12.4622

Net Present Benefit Value $147,972 x 12.4622 = $1,844,057

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 = 12.4622

Therefore, the project's NPV cost = NPV capital cost + NPV of the O&M
= $876,423 + ($35,057 per year x 12.4622)
= $876,423 + $436,887
= $1,313,310

Benefit:Cost Ratio:

Benefit:Cost Ratio = Total Benefit Value/Total Cost Value
= $1,844,057/$1,313,310 = 1.40
1.40 > 1.0 (Since the benefits outweigh the costs, watershed is acceptable to score)

Benefit:Cost Analysis Example No. 2
(For a watershed being restored using active chemical treatment technology)

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 Stream Degraded by AMD 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 are expected below Caledonia Run within Bennett Branch but are not accounted for in this sample analysis)
Projected Use: Trout Stocked Fishery (TSF)
Use Rate: 1,100 trips per year
Valuation: $67.26 per trip
Lost Value: 10.0 miles x 1,100 trip/year/mile x $67.26 trip = $739,860 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: $67.26 per trip
Lost Value: 4.7 miles x 1,100 trip/year/mile x $67.26 trip = $347,734 per year

Total Lost Value: $1,087,594 per year

The capital costs for treating the discharges are as follows:

Collection and Conveyance:	$ 3,800,000
Treatment Facility:	$ 8,200,000
Total Capital Cost:	$ 12,000,000

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 $1,087,594 per year. The following parameters are applied to the NPV equation:

n = 40 years
i = 5%
USPWF = 17.159086

Net Present Benefit Value $1,087,594 x 17.159086 = $18,662,119

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 = $12,000,000

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
= $12,000,000 + ($360,000 per year x 17.159086)
= $12,000,000 + $6,177,271
= $18,177,271

Benefit:Cost Ratio:

Benefit:Cost Ratio = Total Benefit Value/Total Cost Value
= $18,662,119/$18,177,271
= 1.03
1.03 > 1.0 (Since the benefits outweigh the costs, watershed is acceptable to score.)

K. Evaluation and Scoring of Restoration Plans

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

Hydrologic Unit Restoration Plans will be scored 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 the goals, develop a good 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 shown 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. This support will also be considered in the scoring process. Input from other support groups such as the Eastern and Western Pennsylvania Coalitions for Abandoned Mine Reclamation and the Foundation

for Pennsylvania Watersheds, will also be solicited 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.

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 for 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 highwall 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. The technological analysis 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. Local goals that closely support the appropriate overarching goal will be scored favorably.

d. Technological and Alternative Analysis for Individual Projects

i. Technological Analysis

A technological analysis will be conducted 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; (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, and (6) Abatement projects. It is difficult to develop a fully inclusive definition of passive treatment technology. However, passive treatment is typically not a treatment system that: (1) requires electrical or mechanical power; (2) requires frequent site visits to ensure successful operation; (3) requires frequent replenishment of chemical reagent, or (4) contains a chemical feed system. Passive treatment may include 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.

The technological evaluation focuses on evaluating whether the combination of the treatment/abatement scenario and the proposed technology is proven to provide consistent treatment. The operational evaluation focuses on evaluating all aspects of system operation, including the ease of operation and reliability of the system to consistently achieve the treatment goal. The maintenance evaluation focuses on evaluating all aspects of system maintenance, including the ability to maintenance the treatment system while still being able to achieve the treatment goal. Except for Category (4), the overall score for an individual treatment project is the summation of the scores for the three evaluations.

ONLY projects that fall within Category (4), "All other types of Passive Treatment for Net Acidic discharges," will have the final score adjusted by applying the treatment Risk Analysis Matrix (see Table 1 at end of this section) to the proposed project. The overall technological analysis score for a hydrologic unit is calculated by averaging all of the individual project scores. Passive treatment technologies designed to treat net acidic water in this category are subject to an additional evaluation since they do not afford the complete operational control mechanisms required to consistently achieve a defined treatment goal and because of the treatment performance of existing treatment systems. 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 provide poor treatment 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 Risk Analysis Matrix (see Table 1 at end of this section) was developed for two purposes: to limit the risk of premature passive treatment failure caused by metal precipitate plugging and to 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 and will be adjusted to reflect the outcome of system performance. The risk matrix is only used to adjust the overall treatability score of systems categorized as Category (4). **The matrix is not used to adjust the score of the other five treatment categories.** 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 treatability 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 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 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 at times, 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.

In response to the 2012-2013 evaluations, and the observation of greater success with low-flow, high-metal discharges, DEP has agreed 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 still be seen as a starting point for project selection and will be periodically **reviewed and refined** to reflect the treatment performance of systems built under these criteria using Set-Aside money.

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, and that 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 accumulation; total treatment system costs are <$400,000.

ii. Alternatives Analysis

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.

iii. Other Considerations

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, site geotechnical issues, and local resistance. The extent to which these issues have been addressed will be considered in scoring the restoration plan.

2. Scoring the Benefits of Implementing the Restoration Plan

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

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, 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.

The evaluation of project capital costs includes only the capital cost to construct the mine drainage treatment system of facility. 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.

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

Most mine drainage treatment systems 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, requires that operational needs 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 not have long-term needs.

4. Restoration Plan Worth Determination

Once a project has been completely evaluated and scored using all of the project selection criteria, a project worth can be assigned. The table included in Appendix E defines the relationship of a project's score to the overall project worth. Projects will fall into one of four worth categories, "Low Worth," "Moderate Worth," "High Worth," or "Exceptional Worth." In most cases, DEP will not consider funding mine drainage projects in watersheds that are not determined to have either "High Worth" or "Exceptional Worth."

Appendix A: Qualified Hydrologic Unit Determination

Surface Mining Control and Reclamation Act Amendments of 2006

Hydrologic Unit: _____

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

Section 402(g)(6)(A):

1. Is the above Hydrologic Unit is 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 includes 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.

Section 402(g)(6)(B)(i):

1. Has the above Hydrologic Unit has 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):

Section 402(g)(6)(B)(ii):

1. Does the above hydrologic unit contains land and water that are eligible under Section 404: Lands and water eligible for reclamation or drainage abatement expenditures under this title 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, and abandoned or left in an inadequate reclamation status prior to the date of enactment of this Act [*August 3, 1977*], and for which there is no continuing reclamation responsibility under state or other federal laws).

   Yes _____ **No** _____

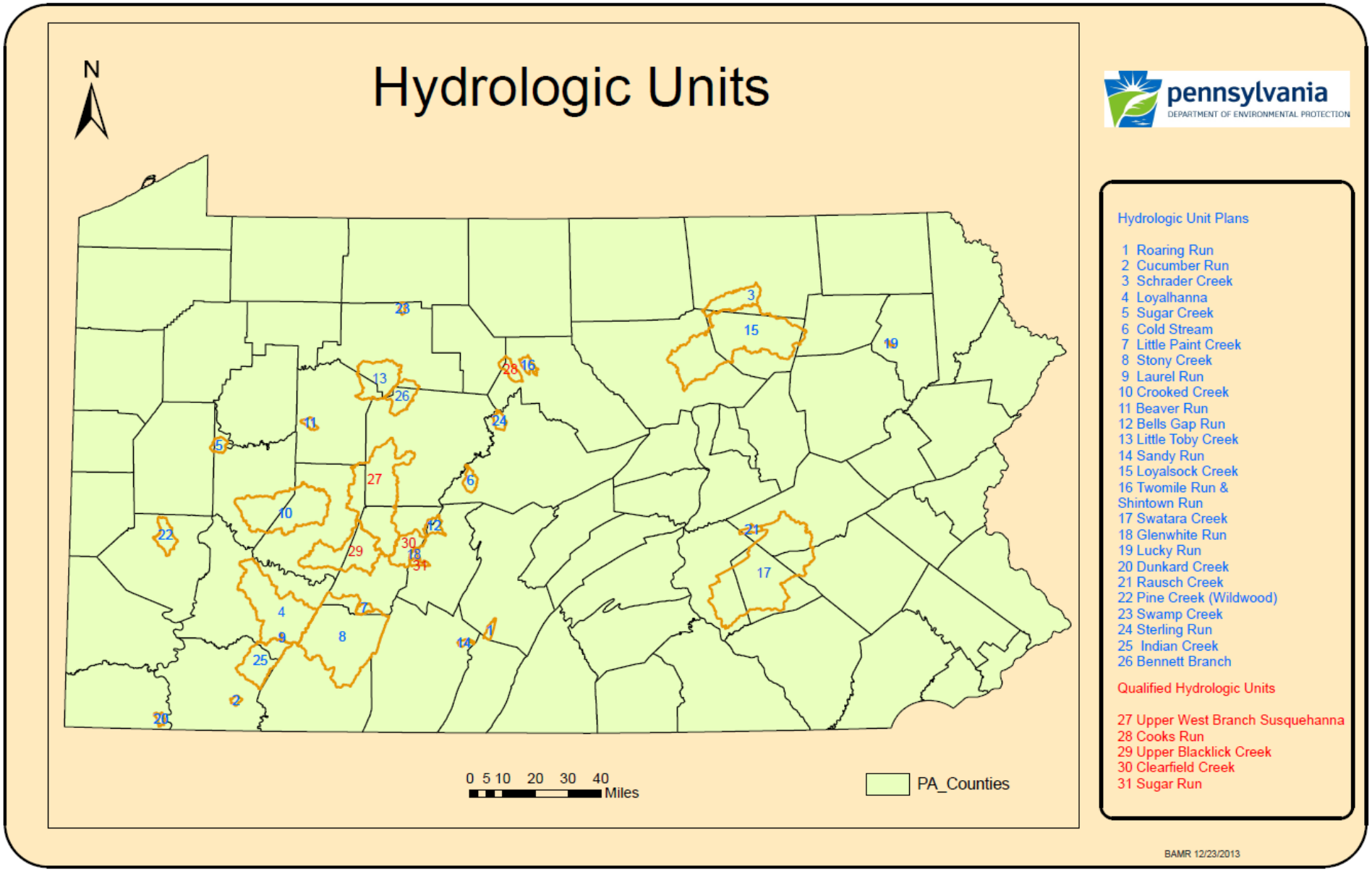
   If yes, provide references and documentation of eligible lands and water (attach applicable signed Eligibility Determinations).

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 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 December 2013)



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 the 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 expected as required.

4. Perform any laboratory analysis only 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

In concluding 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 as to substantiate intended and necessary physical properties of the site with regard to system design. For any system components intended to retain water, prevent leakage of any extent that would interfere with system performance or ability to monitor. 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 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 directly by vehicle, but should provide that the procedures required for these tasks may 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 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. Recommended Best Management Practices (BMP) for Design Sizing of Systems with Applications of Typical Passive Treatment Technology

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. Oxidation/Settling Ponds

    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. Aerobic Wetlands

    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 = 1 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 2006 with 2013 Inflation Multiplier of 1.16

Pennsylvania Fish and Boat Commission

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
LITTLE SCHUYLKILL RIVER	3-A	MINING-AB	pH-METALS	25.7	TSF	1100	$78.02	$2,205,671
MILL CREEK	3-A	MINING-AB	pH-METALS	5.5	TSF	1100	$78.02	$472,031
NESQUEHONING CREEK	2-B	MINING-AB	pH	1.7	TSF	1100	$78.02	$145,900
NESQUEHONING CREEK	2-B	MINING-AB	pH-METALS	4.3	TSF	1100	$78.02	$369,042
SWATARA CREEK	7-D	MINING-AB	pH-METALS	5.2	TSF	1100	$78.02	$446,284
SWATARA CREEK	7-D	MINING-AB	pH-METALS	4.2	TSF	1100	$78.02	$360,460
SWATARA CREEK	7-D	MINING-AB	pH-METALS	9.8	TSF	1100	$78.02	$841,073
WICONISCO CREEK	6-C	MINING-AB	pH-METALS	3.2	TSF	1100	$78.02	$274,636
WICONISCO CREEK	6-C	MINING-AB	pH-METALS	13.5	TSF	1100	$78.02	$1,158,621
RATTLING CREEK	6-C	MINING-AB	pH-METALS	2.2	TSF	1100	$78.02	$188,812
WEST BRANCH RATTLING CREEK	6-C	MINING-AB	pH-METALS	5.2	TSF	1100	$78.02	$446,284
EAST BRANCH RATTLING CREEK	6-C	MINING-AB	pH-METALS	3.8	TSF	1100	$78.02	$326,130
RAUSCH CREEK	6-C	MINING-AB	pH-METALS	1.7	TSF	1100	$78.02	$145,900
WEST BRANCH RAUSCH CREEK	6-C	MINING-AB	pH-METALS	3.5	TSF	1100	$78.02	$300,383
EAST BRANCH RAUSCH CREEK	6-C	MINING-AB	pH-METALS	1.9	TSF	1100	$78.02	$163,065
MAHANOY CREEK	6-B	MINING-AB	pH-METALS	26.8	TSF	1100	$78.02	$2,300,077
MAHANOY CREEK	6-B	MINING-AB	pH-METALS	25.4	TSF	1100	$78.02	$2,179,924
NORTH MAHANOY CREEK	6-B	MINING-AB	pH-METALS	5.5	TSF	1100	$78.02	$472,031
SHAMOKIN CREEK	6-B	MINING-AB	pH-METALS	34.7	TSF	1100	$78.02	$2,978,084
LOYALSOCK CREEK	10-B	MINING-AB	pH-METALS	6	TSF	1100	$78.02	$514,943
BENNETT BRANCH SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	4.8	TSF	1100	$78.02	$411,954
BENNETT BRANCH SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	24	TSF	1100	$78.02	$2,059,770
BENNETT BRANCH SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	8.8	TSF	1100	$78.02	$755,249
WEST CREEK	8-A	MINING-AB	pH-METALS	3	TSF	1100	$78.02	$257,471
WEST CREEK	8-A	MINING-AB	pH-METALS	9	TSF	1100	$78.02	$772,414
MOSQUITO CREEK	8-D	MINING-AB	pH-METALS	6	TSF	1100	$78.02	$514,943
MOSHANNON CREEK	8-D	MINING-AB	pH-METALS	26.2	TSF	1100	$78.02	$2,248,583
BLACK MOSHANNON CREEK	8-D	MINING-AB	pH-METALS	1	TSF	1100	$78.02	$85,824
COLD STREAM	8-D	MINING-AB	pH-METALS	1	TSF	1100	$78.02	$85,824
LAUREL RUN	8-D	MINING-AB	pH-METALS	5.4	TSF	1100	$78.02	$463,448
LICK RUN	8-C	MINING-AB	pH-METALS	3.7	TSF	1100	$78.02	$317,548
CLEARFIELD CREEK	8-C	MINING-AB	pH-METALS	27.7	TSF	1100	$78.02	$2,377,318
LITTLE MUDDY RUN	8-C	MINING-AB	METALS	1	TSF	1100	$78.02	$85,824
BRUBAKER RUN	8-C	MINING-AB	pH-METALS-SULFATES	2	TSF	1100	$78.02	$171,648
MONTGOMERY RUN	8-B	MINING-AB	pH-METALS	1.9	TSF	1100	$78.02	$163,065
MONTGOMERY RUN	8-B	MINING-AB	pH-METALS	0.7	TSF	1100	$78.02	$60,077
ANDERSON CREEK	8-B	MINING-AB	pH-METALS	10.3	TSF	1100	$78.02	$883,985
CATAWISSA CREEK	5-E	MINING-AB	pH-METALS	14	TSF	1100	$78.02	$1,201,533
CATAWISSA CREEK	5-E	MINING-AB	pH-METALS	4	TSF	1100	$78.02	$343,295
TOMHICKON CREEK	5-E	MINING-AB	pH	6.3	TSF	1100	$78.02	$540,690
SCHRADER CREEK	4-C	MINING-AB	pH-METALS	9	TSF	1100	$78.02	$772,414

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
TIOGA RIVER	4-A	MINING-AT	pH-METALS	4	TSF	1100	$78.02	$343,295
RACCOON CREEK	20-D	MINING-AB	pH-METALS	22	TSF	1100	$78.02	$1,888,123
POTATO GARDEN RUN	20-D	MINING-AB	pH-METALS	3.6	TSF	1100	$78.02	$308,966
BURGETTS FORK (RACCOON CREEK)	20-D	MINING-AB	pH-METALS	5	TSF	1100	$78.02	$429,119
SEATON CREEK	20-C	MINING-AB	pH-METALS-SULFATES	4	TSF	1100	$78.02	$343,295
LITTLE CONNOQUENESSING CREEK (BASIN)	20-C	MINING-AT/AB	UNDETERM	2.7	TSF	1100	$78.02	$231,724
CHARTIERS CREEK	20-F	MINING-AB	pH-METALS	6.5	TSF	1100	$78.02	$557,854
MILLERS RUN	20-F	MINING-AB	pH-METALS	2.5	TSF	1100	$78.02	$214,559
TURTLE CREEK	19-A	MINING-AB	pH-METALS	14.5	TSF	1100	$78.02	$1,244,445
TURTLE CREEK	19-A	MINING-AB	pH-METALS	2	TSF	1100	$78.02	$171,648
BRUSH CREEK	19-A	MINING-AB	pH-METALS	0.5	TSF	1100	$78.02	$42,912
LONG RUN	19-D	MINING-AB	pH-METALS	4.6	TSF	1100	$78.02	$394,789
SEWICKLEY RUN	19-D	MINING-AB	pH-METALS	14.3	TSF	1100	$78.02	$1,227,280
SEWICKLEY RUN	19-D	MINING-AB	pH-METALS	23.7	TSF	1100	$78.02	$2,034,023
LITTLE SEWICKLEY CREEK	19-D	MINING-AB	pH-METALS	1	TSF	1100	$78.02	$85,824
BUFFALO RUN	19-D	MINING-AB	pH-METALS	1.3	TSF	1100	$78.02	$111,571
JACKS CREEK	19-D	MINING-AB	pH-METALS-TDS	2.6	TSF	1100	$78.02	$223,142
GLADE RUN	19-D	MINING-AB	pH-METALS	3.4	TSF	1100	$78.02	$291,801
INDIAN CREEK	19-E	MINING-AB	pH-METALS	2.9	TSF	1100	$78.02	$248,889
RASLER RUN	19-E	MINING-AB	pH-METALS-SULFATES	4.7	TSF	1100	$78.02	$403,372
CASSELMAN RIVER	19-F	MINING-AB	pH-METALS	26	TSF	1100	$78.02	$2,231,418
WHITES CREEK	19-F	MINING-AB	pH-METALS-SULFATES	4	TSF	1100	$78.02	$343,295
BIGBY CREEK	19-F	MINING-AB	pH-METALS-SULFATES	1.4	TSF	1100	$78.02	$120,153
BUFFALO CREEK	19-F	MINING-AB	pH-METALS	7.5	TSF	1100	$78.02	$643,678
PIGEON CREEK	19-C	MINING-AB	pH-METALS-SULFATES	6.2	TSF	1100	$78.02	$532,107
NORTH BRANCH PIGEON CREEK	19-C	MINING-AB	pH-METALS	3.6	TSF	1100	$78.02	$308,966
PIKE RUN	19-C	MINING-AB	DISS SOLID	1	TSF	1100	$78.02	$85,824
REDSTONE CREEK	19-C	MINING-AB	pH-METALS	10.2	TSF	1100	$78.02	$875,402
DUNLAP CREEK	19-C	MINING-AB	pH-METALS	5	TSF	1100	$78.02	$429,119
GEORGES CREEK	19-G	MINING-AB	pH-METALS	4	TSF	1100	$78.02	$343,295
MOUNTAIN CREEK	19-G	MINING-AB	pH-METALS	4.1	TSF	1100	$78.02	$351,877
BIG SANDY CREEK	19-G	MINING-AB	pH-METALS	3.3	TSF	1100	$78.02	$283,218
PLUM CREEK	18-A	MINING-AB	pH-METALS	3.1	TSF	1100	$78.02	$266,054
BEAVER RUN	18-B	MINING-AB	pH-METALS	2.5	TSF	1100	$78.02	$214,559
LOYALHANNA CREEK	18-C	MINING-AB	pH-METALS	11.5	TSF	1100	$78.02	$986,973
FOURMILE RUN	18-C	MINING-AB	pH-METALS-SULFATES	2	TSF	1100	$78.02	$171,648
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	2.9	TSF	1100	$78.02	$248,889
TWO LICK CREEK	18-D	MINING-AB	pH-METALS	1.4	TSF	1100	$78.02	$120,153
YELLOW CREEK	18-D	MINING-AB	pH-METALS	3	TSF	1100	$78.02	$257,471
ELK CREEK	18-D	MINING-AB	pH-METALS-SULFATES	7	TSF	1100	$78.02	$600,766

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
SOUTH BRANCH BLACKLICK CREEK	18-D	MINING-AB	pH-METALS	3	TSF	1100	$78.02	$257,471
STONY CREEK	18-E	MINING-AB	pH-METALS	22.7	TSF	1100	$78.02	$1,948,199
BENS CREEK	18-E	MINING-AB	pH-METALS	1.3	TSF	1100	$78.02	$111,571
SOUTH FORK BENS CREEK	18-E	MINING-AB	pH-METALS	4.7	TSF	1100	$78.02	$403,372
PAINT CREEK	18-E	MINING-AB	pH-METALS	0.7	TSF	1100	$78.02	$60,077
BENS CREEK	18-E	MINING-AB	pH-METALS	1	TSF	1100	$78.02	$85,824
LIMESTONE RUN	17-E	MINING-AB	SULFATE	5.2	TSF	1100	$78.02	$446,284
SOUTH BRANCH SOUTH FORK PINE CREEK	17-E	MINING-AB	pH-METALS	2.5	TSF	1100	$78.02	$214,559
PINE RUN	17-D	MINING-AB	pH-METALS-SULFATES	5.2	TSF	1100	$78.02	$446,284
PINE RUN	17-D	MINING-AB	pH-METALS-SULFATES	1.7	TSF	1100	$78.02	$145,900
PINE RUN	17-D	MINING-AB	METALS	2.4	TSF	1100	$78.02	$205,977
LITTLE MAHONING CREEK	17-D	MINING-AB	pH-METALS	2	TSF	1100	$78.02	$171,648
NORTH BRACH MAHONING CREEK	17-D	MINING-AB	pH-METALS	3.7	TSF	1100	$78.02	$317,548
REDBANK CREEK	17-C	MINING-AB	pH-METALS-SULFATES	2	TSF	1100	$78.02	$171,648
LEATHERWOOD CREEK	17-C	MINING-AB	METALS HWC-SULFATES	5.9	TSF	1100	$78.02	$506,360
FIVE MILE RUN	17-C	MINING-AB	METALS HWC-pH	3.5	TSF	1100	$78.02	$300,383
CLARION RIVER	17-B	MINING-AB	METALS	4.3	TSF	1100	$78.02	$369,042
TURKEY RUN	17-B	MINING-AB	METALS	7.1	TSF	1100	$78.02	$609,349
LICKING CREEK	17-B	MINING-AB	pH-SULFATES	5.5	TSF	1100	$78.02	$472,031
LICKING CREEK	17-B	MINING-AB	pH-METALS	6.3	TSF	1100	$78.02	$540,690
CHERRY RUN	17-B	MINING-AB	METALS HWC-SULFATES	7.4	TSF	1100	$78.02	$635,096
DEER CREEK	17-B	MINING-AB	METALS	10.7	TSF	1100	$78.02	$918,314
PINEY CREEK	17-B	MINING-AB	pH-METALS	2.9	TSF	1100	$78.02	$248,889
PINEY CREEK	17-B	MINING-AB	METALS-SULFATES	11.8	TSF	1100	$78.02	$1,012,720
REIDS RUN	17-B	MINING-AB	METALS	3.4	TSF	1100	$78.02	$291,801
LITTLE TOBY CREEK	17-A	MINING-AB	pH-METALS	8	TSF	1100	$78.02	$686,590
ELK CREEK	17-A	MINING-AB	METALS	6.3	TSF	1100	$78.02	$540,690
ELK CREEK	17-A	MINING-AB	METALS	9.8	TSF	1100	$78.02	$841,073
RICHEY RUN	16-G	MINING-AB	DISS SOLID	3.6	TSF	1100	$78.02	$308,966
LITTLE SCRUBGRASS CREEK	16-G	MINING-AB	METALS HWC-SULFATES	7.5	TSF	1100	$78.02	$643,678
SCRUBGRASS CREEK	16-G	MINING-AB	pH-METALS-SULFATES	10.8	TSF	1100	$78.02	$926,897
GLADDENS RUN	13-A	MINING-AB	pH-METALS	11.8	TSF	1100	$78.02	$1,012,720
NORTH BRANCH ROBINSON RUN	20-F	MINING-AB	pH-METALS-SULFATES	4.8	TSF	1100	$78.02	$411,954
NORTH BRANCH ROBINSON RUN	20-F	MINING-AB	pH-METALS	2.8	TSF	1100	$78.02	$240,307
LEHIGH RIVER	2-C	MINING-AB	METALS	30.2	TSF/WT	800	$78.02	$1,885,002
SAUCON CREEK (SOUTH BRANCH)	2-C	MINING-AB	OTHER	1	TSF/WT	800	$78.02	$62,417
COOKS RUN (BASIN)	9-B	MINING-AB	pH-METALS	6.8	TSF/WT	800	$78.02	$424,438
COOKS RUN	9-B	MINING-AB	pH-METALS	3.3	TSF/WT	800	$78.02	$205,977
BUCK RUN	19-E	MINING-AB	pH-METALS	1.7	TSF/WT	800	$78.02	$106,109

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
MEADOW RUN	19-E	MINING-AB	pH-METALS	5.6	TSF/WT	800	$78.02	$349,537
ELKLICK CREEK	19-F	MINING-AB	pH-METALS-SULFATES	2.7	TSF/WT	800	$78.02	$168,527
HANNAS RUN	18-C	MINING-AB	pH-METALS-SULFATES	4	TSF/WT	800	$78.02	$249,669
FERRIER RUN	18-D	MINING-AB	pH-METALS	1.4	TSF/WT	800	$78.02	$87,384
PENN RUN	18-D	MINING-AB	pH-METALS-SULFATES	3.8	TSF/WT	800	$78.02	$237,186
SHADE CREEK	18-E	MINING-AB	pH-METALS	7.7	TSF/WT	800	$78.02	$480,613
SHADE CREEK	18-E	MINING-AB	pH-METALS	2.7	TSF/WT	800	$78.02	$168,527
DARK SHADE CREEK	18-E	MINING-AB	pH-METALS	2.7	TSF/WT	800	$78.02	$168,527
QUEMAHONING CREEK	18-E	MINING-AB	pH-METALS	1.9	TSF/WT	800	$78.02	$118,593
LITTLE CONEMAUGH RIVER	18-E	MINING-AB	pH-METALS	1.4	TSF/WT	800	$78.02	$87,384
LITTLE CONEMAUGH RIVER	18-E	MINING-AB	pH-METALS	0.6	TSF/WT	800	$78.02	$37,450
BEAVERDAM RUN	18-E	MINING-AB	pH-METALS	2	TSF/WT	800	$78.02	$124,835
BEECH CREEK (BASIN)	9-C	MINING-AB	pH-METALS	26	TSF/WT	800	$78.02	$1,622,849
PINE CREEK	9-A	MINING-AB	pH-METALS	4	TSF/WWF	447	$78.02	$139,503
PANTHER CREEK	3-A	MINING-AB	pH-METALS	5.7	WT	500	$66.06	$188,276.70
MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH-METALS	1.3	WT	500	$66.06	$42,940.30
BLACK CREEK	2-B	MINING-AB	pH-METALS	4.7	WT	500	$66.06	$155,245.70
HAZEL CREEK	2-B	MINING-AB	pH-METALS	1.9	WT	500	$66.06	$62,758.90
BUCK MOUNTAIN CREEK	2-B	MINING-AB	pH-METALS	4.4	WT	500	$66.06	$145,336.40
SANDY RUN	2-A	MINING-AB	pH-METALS	0.1	WT	500	$66.06	$3,303.10
POND CREEK	2-A	MINING-AB	pH	7	WT	500	$66.06	$231,217.00
SANDY RUN (UNT)	2-A	MINING-AB	pH-METALS-SULFATES	0.4	WT	500	$66.06	$13,212.40
BAIRD RUN	7-D	MINING-AB	pH-METALS	1.4	WT	500	$66.06	$46,243.40
WEST BRACH FISHING CREEK	7-D	MINING-AB	pH-METALS	3.6	WT	500	$66.06	$118,911.60
LOWER RAUSCH CREEK	7-D	MINING-AB	METALS	3.9	WT	500	$66.06	$128,820.90
LORBERRY CREEK	7-D	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
STUMPS RUN	7-D	MINING-AB	METALS	0.2	WT	500	$66.06	$6,606.20
MIDDLE CREEK	7-D	MINING-AB	pH-METALS	1.1	WT	500	$66.06	$36,334.10
GOOD SPRING CREEK	7-D	MINING-AB	pH-METALS	5.8	WT	500	$66.06	$191,579.80
POPLAR CREEK	7-D	MINING-AB	pH-METALS	0.9	WT	500	$66.06	$29,727.90
COAL RUN	7-D	MINING-AB/AT	pH-METALS	1.6	WT	500	$66.06	$52,849.60
GEBHARD RUN	7-D	MINING-AB	pH-METALS	1.9	WT	500	$66.06	$62,758.90
PANTHER CREEK	7-D	MINING-AB	pH-METALS	1.8	WT	500	$66.06	$59,455.80
MILLER RUN	11-D	MINING-AB	pH	1.2	WT	500	$66.06	$39,637.20
SIXMILE RUN	11-D	MINING-AB	pH	3.8	WT	500	$66.06	$125,517.80
BREWSTER HOLLOW	11-D	MINING-AB	pH-METALS	2.3	WT	500	$66.06	$75,971.30
SANDY RUN	11-D	MINING-AB	pH	6	WT	500	$66.06	$198,186.00
LONGS RUN	11-D	MINING-AB	pH	4.9	WT	500	$66.06	$161,851.90
BEAR LOOP RUN	11-A	MINING-AB	pH-METALS-SULFATES	1.2	WT	500	$66.06	$39,637.20
BEAVER DAM BRANCH	11-A	MINING-AB	pH-METALS	4.5	WT	500	$66.06	$148,639.50

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
SUGAR RUN	11-A	MINING-AB	pH-METALS	6.3	WT	500	$66.06	$208,095.30
BURGOON RUN	11-A	MINING-AB	pH-METALS	3	WT	500	$66.06	$99,093.00
KITTANNING RUN	11-A	MINING-AB	pH-METALS	4.2	WT	500	$66.06	$138,730.20
GLENWHITE RUN	11-A	MINING-AB	pH-METALS	3.2	WT	500	$66.06	$105,699.20
DOC SMITH RUN	6-C	MINING-AB	pH-METALS	1.5	WT	500	$66.06	$49,546.50
SHALE RUN	6-C	MINING-AB	pH-METALS	0.8	WT	500	$66.06	$26,424.80
STONE CABIN RUN	6-C	MINING-AB	pH-METALS	1.8	WT	500	$66.06	$59,455.80
NINE O'CLOCK RUN	6-C	MINING-AB	pH-METALS	0.6	WT	500	$66.06	$19,818.60
BEAR CREEK	6-C	MINING-AB	pH-METALS	4.4	WT	500	$66.06	$145,336.40
HANS YOST CREEK	6-C	MINING-AB	pH	1	WT	500	$66.06	$33,031.00
ZERBE RUN	6-B	MINING-AB	pH-METALS	5.8	WT	500	$66.06	$191,579.80
CRAB RUN	6-B	MINING-AB	pH-METALS	1.3	WT	500	$66.06	$42,940.30
SHENANDOAH CREEK	6-B	MINING-AB	pH-METALS	5	WT	500	$66.06	$165,155.00
CARBON RUN	6-B	MINING-AB	pH-METALS	3.7	WT	500	$66.06	$122,214.70
COAL RUN	6-B	MINING-AB	pH-METALS	3	WT	500	$66.06	$99,093.00
QUAKER RUN	6-B	MINING-AB	pH-METALS	1.3	WT	500	$66.06	$42,940.30
LOCUST CREEK	6-B	MINING-AB	pH-METALS	1.6	WT	500	$66.06	$52,849.60
NORTH BRANCH SHAMOKIN CREEK	6-B	MINING-AB	pH-METALS	4.6	WT	500	$66.06	$151,942.60
LOYALSOCK CREEK	10-B	MINING-AB	pH-METALS	7.4	WT	500	$66.06	$244,429.40
RED RUN	10-A	MINING-AB	pH-METALS	3.9	WT	500	$66.06	$128,820.90
OTTER RUN	9-A	MINING-AB	pH-METALS	3.8	WT	500	$66.06	$125,517.80
LEFT FORK OTTER RUN	9-A	MINING-AB	pH-METALS	1.5	WT	500	$66.06	$49,546.50
RIGHT FORK OTTER RUN	9-A	MINING-AB	pH-METALS	0.4	WT	500	$66.06	$13,212.40
BABBS CREEK	9-A	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
BABBS CREEK	9-A	MINING-AB	pH-METALS	22	WT	500	$66.06	$726,682.00
WILSON CREEK	9-A	MINING-AB	pH-METALS	2.3	WT	500	$66.06	$75,971.30
MIDDLE BRANCH BIG RUN	9-C	MINING-AB	pH-METALS	1.1	WT	500	$66.06	$36,334.10
MIDDLE BRANCH BIG RUN	9-C	MINING-AB	pH-METALS	4.9	WT	500	$66.06	$161,851.90
EAST BRANCH BIG RUN	9-C	MINING-AB	pH-METALS	4.7	WT	500	$66.06	$155,245.70
LOGWAY RUN	9-C	MINING-AB	pH-METALS	0.8	WT	500	$66.06	$26,424.80
NORTH FORK BEECH CREEK	9-C	MINING-AB	pH-METALS	5.9	WT	500	$66.06	$194,882.90
LITTLE SANDY RUN	9-C	MINING-AB	pH-METALS	2.7	WT	500	$66.06	$89,183.70
CHERRY RUN	9-C	MINING-AB	pH-METALS	0.9	WT	500	$66.06	$29,727.90
LICK RUN	9-B	MINING-AB	pH	3.7	WT	500	$66.06	$122,214.70
TANGASCOOTACK CREEK	9-B	MINING-AB	pH-METALS	8.4	WT	500	$66.06	$277,460.40
DRURY RUN (BASIN)	9-B	MINING-AB/AT	pH	14.6	WT	500	$66.06	$482,252.60
STONY RUN	9-B	MINING-AB	pH-METALS	1.3	WT	500	$66.06	$42,940.30
WOODLEY DRAFT RUN	9-B	MINING-AB	pH-METALS	1.7	WT	500	$66.06	$56,152.70
SANDY RUN	9-B	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
TWO MILE RUN	9-B	MINING-AB	pH-METALS	1.9	WT	500	$66.06	$62,758.90

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
MIDDLE BRANCH TWO MILE RUN	9-B	MINING-AB	pH-METALS	2.1	WT	500	$66.06	$69,365.10
CROWLEY HOLLOW'	9-B	MINING-AB	pH-METALS	3.1	WT	500	$66.06	$102,396.10
CAMP RUN	9-B	MINING-AB	pH-METALS	2	WT	500	$66.06	$66,062.00
ROCK RUN	9-B	MINING-AB	pH-METALS	1.2	WT	500	$66.06	$39,637.20
DENTS RUN	8-A	MINING-AB	pH	6.5	WT	500	$66.06	$214,701.50
TROUT RUN (UNT)	8-A	MINING-AB	pH-METALS	1.2	WT	500	$66.06	$39,637.20
SPRING RUN	8-A	MINING-AB	pH-METALS-SULFATES	7.7	WT	500	$66.06	$254,338.70
BIRCH ISLAND RUN	8-D	MINING-AB	pH-METALS	6.2	WT	500	$66.06	$204,792.20
LITTLE BIRCH ISLAND RUN	8-D	MINING-AB	pH-METALS	4.3	WT	500	$66.06	$142,033.30
AMOS BRANCH	8-D	MINING-AB	pH-METALS	1.6	WT	500	$66.06	$52,849.60
STERLING RUN	8-D	MINING-AB	pH-METALS	7.2	WT	500	$66.06	$237,823.20
SALTLICK RUN	8-D	MINING-AB	pH-METALS	1.5	WT	500	$66.06	$49,546.50
CURLEYS RUN	8-D	MINING-AB	pH-METALS	1.2	WT	500	$66.06	$39,637.20
GRIMES RUN	8-D	MINING-AB	pH-METALS-SULFATES	2.3	WT	500	$66.06	$75,971.30
ALDER RUN	8-C	MINING-AB	pH-METALS	10.7	WT	500	$66.06	$353,431.70
SANDY CREEK	8-C	MINING-AB	pH-METALS-SULFATES	4.2	WT	500	$66.06	$138,730.20
BIG RUN	8-C	MINING-AB	pH	1	WT	500	$66.06	$33,031.00
DEER CREEK	8-C	MINING-AB	pH-METALS	5	WT	500	$66.06	$165,155.00
SURVEYOR RUN	8-C	MINING-AB	pH-METALS	4	WT	500	$66.06	$132,124.00
LITTLE SURVEYOR RUN	8-C	MINING-AB	pH-METALS	2	WT	500	$66.06	$66,062.00
TROUT RUN	8-C	MINING-AB	pH	5	WT	500	$66.06	$165,155.00
TAYLOR SPRINGS RUN	8-C	MINING-AB	METALS HWC	0.4	WT	500	$66.06	$13,212.40
PINE RUN	8-C	MINING-AB	pH	2.2	WT	500	$66.06	$72,668.20
FORK RUN	8-C	MINING-AB	pH-METALS	3.8	WT	500	$66.06	$125,517.80
SANBOURN RUN	8-C	MINING-AB	pH-METALS-SULFATES	3.3	WT	500	$66.06	$109,002.30
NORTH BRANCH UPPER MORGAN RUN	8-C	MINING-AB	pH-METALS	2.7	WT	500	$66.06	$89,183.70
LITTLE MUDDY RUN	8-C	MINING-AB	pH	4.5	WT	500	$66.06	$148,639.50
BLUE RUN	8-C	MINING-AB	METALS HWC	1.2	WT	500	$66.06	$39,637.20
WOODS RUN	8-B	MINING-AB	pH-METALS	3	WT	500	$66.06	$99,093.00
MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH-METALS	1.7	WT	500	$66.06	$56,152.70
MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH	0.5	WT	500	$66.06	$16,515.50
NORTH BRANCH MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH	0.9	WT	500	$66.06	$29,727.90
TINKER RUN	8-B	MINING-AB	pH	0.7	WT	500	$66.06	$23,121.70
MONTGOMERY CREEK (UNT)	8-B	MINING-AB	pH	1.5	WT	500	$66.06	$49,546.50
HARTSHORN RUN	8-B	MINING-AB	pH-METALS-SULFATES	3	WT	500	$66.06	$99,093.00
KRATZER RUN	8-B	MINING-AB	pH-METALS	5.1	WT	500	$66.06	$168,458.10
IRVIN BRANCH	8-B	MINING-AB	METALS	1.5	WT	500	$66.06	$49,546.50
LITTLE ANDERSON CREEK	8-B	MINING-AB	pH-METALS	5.7	WT	500	$66.06	$188,276.70
WILSON RUN (UNT)	8-B	MINING-AB	pH	1.8	WT	500	$66.06	$59,455.80
WILSON RUN (UNT)	8-B	MINING-AB	METALS HWC	0.8	WT	500	$66.06	$26,424.80

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
NORTH CAMP RUN	8-B	MINING-AB	METALS HWC-SULFATES	2.8	WT	500	$66.06	$92,486.80
ROCK RUN	8-B	MINING-AB	pH-METALS	3	WT	500	$66.06	$99,093.00
BEAR RUN	8-B	MINING-AB	pH-METALS	2.9	WT	500	$66.06	$95,789.90
SOUTH BRANCH BEAR RUN	8-B	MINING-AB	pH-METALS	5.3	WT	500	$66.06	$175,064.30
CATAWISSA CREEK	5-E	MINING-AB	pH-METALS	23.5	WT	500	$66.06	$776,228.50
TOMHICKON CREEK	5-E	MINING-AB	pH	4.3	WT	500	$66.06	$142,033.30
SUGARLOAF CREEK	5-E	MINING-AB	pH	5.5	WT	500	$66.06	$181,670.50
BLACK CREEK	5-D	MINING-AB	pH-METALS	25.5	WT	500	$66.06	$842,290.50
LITTLE NESCOPECK CREEK	5-D	MINING-AB	pH	9.2	WT	500	$66.06	$303,885.20
LITTLE NESCOPECK CREEK	5-D	MINING-AB	pH-METALS	5.5	WT	500	$66.06	$181,670.50
LITTLE NESCOPECK CREEK (UNT)	5-D	MINING-AB	pH-METALS-SULFATES	0.3	WT	500	$66.06	$9,909.30
NEWPORT CREEK	5-B	MINING-AB	pH	4.8	WT	500	$66.06	$158,548.80
NANTICOKE CREEK	5-B	MINING-AB	pH	3.6	WT	500	$66.06	$118,911.60
SOLOMON CREEK	5-B	MINING-AB	pH	2.4	WT	500	$66.06	$79,274.40
ROARING BROOK	5-A	MINING-AB	pH-METALS	4	WT	500	$66.06	$132,124.00
POWDERLY CREEK	5-A	MINING-AB	pH-METALS	1.9	WT	500	$66.06	$62,758.90
COAL BROOK	5-A	MINING-AB	pH-METALS	1.9	WT	500	$66.06	$62,758.90
WILSON CREEK	5-A	MINING-AB	pH-METALS	0.6	WT	500	$66.06	$19,818.60
LONG VALLEY RUN	4-C	MINING-AB	pH-METALS	1.6	WT	500	$66.06	$52,849.60
MORRIS RUN	4-A	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
FALL BROOK	4-A	MINING-AB	pH-METALS	2	WT	500	$66.06	$66,062.00
UNT LITTLE RACCOON RUN	20-D	MINING-AB	pH-METALS	0.9	WT	500	$66.06	$29,727.90
CAMBELLS RUN	20-F	MINING-AB	pH-METALS	2	WT	500	$66.06	$66,062.00
UNT CAMPBELLS RUN	20-F	MINING-AB	pH-METALS	0.8	WT	500	$66.06	$26,424.80
SAWMILL RUN	20-F	MINING-AB	pH-METALS	3	WT	500	$66.06	$99,093.00
STREETS RUN	19-A	MINING-AB	pH-METALS	0.7	WT	500	$66.06	$23,121.70
THOMPSON RUN	19-A	MINING-AB	pH-METALS	3	WT	500	$66.06	$99,093.00
WELTY RUN	19-D	MINING-AB	pH	7.8	WT	500	$66.06	$257,641.80
FERGUSON RUN	19-D	MINING-AB	pH-METALS-SULFATES	1.6	WT	500	$66.06	$52,849.60
POPLAR RUN	19-E	MINING-AB	pH-METALS	2.8	WT	500	$66.06	$92,486.80
NEWMYER RUN	19-E	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
LAUREL RUN	19-E	MINING-AB	pH-METALS-SULFATES	2.7	WT	500	$66.06	$89,183.70
CUCUMBER RUN	19-F	MINING-AB	pH-METALS	1.5	WT	500	$66.06	$49,546.50
WILSON CREEK	19-F	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
LAUREL RUN	19-F	MINING-AB	pH-METALS	0.8	WT	500	$66.06	$26,424.80
EAST BRANCH COXES CREEK	19-F	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
SHAFER RUN	19-F	MINING-AB	pH-METALS	2	WT	500	$66.06	$66,062.00
LICK RUN	19-F	MINING-AB	pH-METALS	1.8	WT	500	$66.06	$59,455.80
PINEY RUN	19-F	MINING-AB	pH-METALS	2.1	WT	500	$66.06	$69,365.10
MILLER RUN	19-F	MINING-AB	pH-METALS	1.3	WT	500	$66.06	$42,940.30

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Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
UNT SALTLICK RUN	19-C	MINING-AB	pH-METALS	0.2	WT	500	$66.06	$6,606.20
RUSH RUN	19-C	MINING-AB	pH-METALS-SULFATES	2.4	WT	500	$66.06	$79,274.40
WALLACE RUN	19-C	MINING-AB	pH-METALS-SULFATES	1.3	WT	500	$66.06	$42,940.30
CATS RUN	19-G	MINING-AB	pH	1.5	WT	500	$66.06	$49,546.50
YORK RUN	19-G	MINING-AB	pH-METALS-SULFATES	6.2	WT	500	$66.06	$204,792.20
DOOLEY RUN	19-G	MINING-AB	pH-METALS	2.2	WT	500	$66.06	$72,668.20
LITTLE PLUMB CREEK	18-A	MINING-AB	pH-METALS	4	WT	500	$66.06	$132,124.00
LITTLE DEER CREEK	18-A	MINING-AB	pH-METALS	5.1	WT	500	$66.06	$168,458.10
BUFFALO CREEK (UNT)	18-F	MINING-AB	pH-METALS	0.2	WT	500	$66.06	$6,606.20
THORN RUN	18-B	MINING-AB	pH-METALS	0.7	WT	500	$66.06	$23,121.70
UNT THORN RUN	18-B	MINING-AB	pH-METALS	0.9	WT	500	$66.06	$29,727.90
GETTY RUN	18-C	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
MC CUNE RUN	18-C	MINING-AB	pH-METALS	1.4	WT	500	$66.06	$46,243.40
UNION RUN	18-C	MINING-AB	pH-METALS	3.2	WT	500	$66.06	$105,699.20
SAXMAN RUN	18-C	MINING-AB	pH-METALS	4.7	WT	500	$66.06	$155,245.70
MONASTERY RUN	18-C	MINING-AB	pH-METALS	0.8	WT	500	$66.06	$26,424.80
ROARING RUN	18-D	MINING-AB	pH-METALS	2.4	WT	500	$66.06	$79,274.40
REEDS RUN	18-D	MINING-AB	pH-METALS	3.4	WT	500	$66.06	$112,305.40
TEARING RUN	18-D	MINING-AB	pH-METALS	2	WT	500	$66.06	$66,062.00
FREEMAN RUN	18-D	MINING-AB	pH-METALS	0.9	WT	500	$66.06	$29,727.90
UNT PAINT CREEK	18-E	MINING-AB	pH-METALS	0.5	WT	500	$66.06	$16,515.50
BABCOCK CREEK (BASIN)	18-E	MINING-AB	pH-METALS	3.5	WT	500	$66.06	$115,608.50
UNT DARK SHADE CREEK	18-E	MINING-AB	pH-METALS	0.6	WT	500	$66.06	$19,818.60
UNT STONEY CREEK	18-E	MINING-AB	pH-METALS	2.1	WT	500	$66.06	$69,365.10
FALLEN TIMBER RUN	18-E	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
UNT STONEY CREEK	18-E	MINING-AB	pH-METALS	1.1	WT	500	$66.06	$36,334.10
OVEN RUN	18-E	MINING-AB	pH-METALS	1.8	WT	500	$66.06	$59,455.80
LAMBERTS RUN	18-E	MINING-AB	pH-METALS	3.1	WT	500	$66.06	$102,396.10
BOONE RUN	18-E	MINING-AB	pH-METALS	1.5	WT	500	$66.06	$49,546.50
BOONE RUN	18-E	MINING-AB	pH-METALS	0.6	WT	500	$66.06	$19,818.60
CLEAR RUN	18-E	MINING-AB	pH-METALS	1.3	WT	500	$66.06	$42,940.30
OTTO RUN	18-E	MINING-AB	pH-METALS	1.5	WT	500	$66.06	$49,546.50
SULPHUR CREEK	18-E	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
SPRING RUN	18-E	MINING-AB	pH-METALS	2.1	WT	500	$66.06	$69,365.10
SUGAR RUN	17-E	MINING-AB	pH	0.6	WT	500	$66.06	$19,818.60
CRAIG RUN	17-E	MINING-AB	SULFATE	1	WT	500	$66.06	$33,031.00
MCKEE RUN	17-E	MINING-AB	pH-METALS	1.5	WT	500	$66.06	$49,546.50
HUSKINS RUN	17-E	MINING-AB	SULFATE	2.6	WT	500	$66.06	$85,880.60
NYE BRANCH	17-D	MINING-AB	METALS	3.7	WT	500	$66.06	$122,214.70
CAYLOR RUN	17-D	MINING-AB	pH-METALS	0.9	WT	500	$66.06	$29,727.90
FOUNDRY RUN	17-D	MINING-AB	pH	1.1	WT	500	$66.06	$36,334.10

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BREWER RUN	17-D	MINING-AB	pH-METALS	1.7	WT	500	$66.06	$56,152.70
BEECH RUN	17-D	MINING-AB	pH-METALS	1.3	WT	500	$66.06	$42,940.30
EAST RUN	17-D	MINING-AB	pH-METALS	3.3	WT	500	$66.06	$109,002.30
NICELY RUN	17-D	MINING-AB	pH-METALS	1.4	WT	500	$66.06	$46,243.40
EAST BRANCH MAHONING CREEK	17-D	MINING-AB	METALS	8	WT	500	$66.06	$264,248.00
LAUREL BRANCH RUN	17-D	MINING-AB	pH-METALS	2.8	WT	500	$66.06	$92,486.80
WEST FORK LEATHERWOOD CREEK	17-C	MINING-AB	METALS HWC-SULFATES	3	WT	500	$66.06	$99,093.00
LONG RUN	17-C	MINING-AB	SULFATE-METALS	3.1	WT	500	$66.06	$102,396.10
LEISURE RUN	17-C	MINING-AB	SULFATE-METALS	5.1	WT	500	$66.06	$168,458.10
TOWN RUN	17-C	MINING-AB	METALS HWC	5.5	WT	500	$66.06	$181,670.50
PINE CREEK	17-C	MINING-AB	METALS HWC	3.2	WT	500	$66.06	$105,699.20
LITTLE SANDY CREEK	17-C	MINING-AB	pH	2	WT	500	$66.06	$66,062.00
CLUTCH RUN	17-C	MINING-AB	METALS HWC	3.6	WT	500	$66.06	$118,911.60
HADDEN RUN	17-C	MINING-AB	METALS HWC	1.9	WT	500	$66.06	$62,758.90
BEAVER RUN	17-C	MINING-AB	SULFATE-METALS	6	WT	500	$66.06	$198,186.00
WELCH RUN	17-C	MINING-AB	pH-METALS-SULFATES	3.5	WT	500	$66.06	$115,608.50
LUTHERSBURG BRANCH	17-C	MINING-AB	pH-METALS-SULFATES	3.8	WT	500	$66.06	$125,517.80
NARROWS CREEK	17-C	MINING-AB	METALS	5.5	WT	500	$66.06	$181,670.50
NORTH BRANCH BEAR CREEK	17-C	MINING-AB	pH-METALS-SULFATES	6	WT	500	$66.06	$198,186.00
SOUTH BRANCH BEAR CREEK	17-C	MINING-AB	pH-METALS	2.4	WT	500	$66.06	$79,274.40
ANDERSON RUN	17-B	MINING-AB	pH-METALS-SULFATES	3	WT	500	$66.06	$99,093.00
LITTLE LICKING CREEK	17-B	MINING-AB	METALS HWC-SULFATES	2.9	WT	500	$66.06	$95,789.90
BRUSH RUN	17-B	MINING-AB	pH-METALS-SULFATES	7.6	WT	500	$66.06	$251,035.60
BRUSH RUN (UNT)	17-B	MINING-AB	pH	1.1	WT	500	$66.06	$36,334.10
GATHERS RUN	17-B	MINING-AB	METALS HWC-SULFATES	1.8	WT	500	$66.06	$59,455.80
MILL CREEK	17-B	MINING-AB	METALS	6.1	WT	500	$66.06	$201,489.10
WHITES RUN	17-B	MINING-AB	pH-METALS	2	WT	500	$66.06	$66,062.00
DOUGLAS RUN	17-B	MINING-AB	pH-METALS	4.5	WT	500	$66.06	$148,639.50
JONES RUN	17-B	MINING-AB	pH-METALS	3.5	WT	500	$66.06	$115,608.50
LITTLE MILL CREEK	17-B	MINING-AB	pH-METALS	20	WT	500	$66.06	$660,620.00
PARKS RUN	17-B	MINING-AB	pH	1	WT	500	$66.06	$33,031.00
MCGOURVEY RUN	17-B	MINING-AB	pH-METALS-SULFATES	1.9	WT	500	$66.06	$62,758.90
CURRY RUN	17-A	MINING-AB	METALS	1.8	WT	500	$66.06	$59,455.80
JOHNSON RUN	17-A	MINING-AB	METALS HWC-SULFATES	3.9	WT	500	$66.06	$128,820.90
ELK CREEK (NORTH BRANCH)	17-A	MINING-AB	METALS	0.8	WT	500	$66.06	$26,424.80
DAGUSCAHONDA RUN	17-A	MINING-AB	pH-METALS	6	WT	500	$66.06	$198,186.00
IRON RUN	17-A	MINING-AB	METALS	1	WT	500	$66.06	$33,031.00
ELK CREEK-SOUTH BR (UNT)	17-A	MINING-AB	METALS	3.6	WT	500	$66.06	$118,911.60

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
FOWLER RUN	17-C	MINING-AB	pH-METALS-SULFATES	2	WT	500	$66.06	$66,062.00
LOCKARD RUN	16-G	MINING-AB	pH-METALS	2.3	WT	500	$66.06	$75,971.30
SOUTH FORK LITTLE SCRUBGRASS CREEK	16-G	MINING-AB	METALS HWC	1.8	WT	500	$66.06	$59,455.80
WALLEY RUN	16-F	MINING-AB	pH-METALS	1.9	WT	500	$66.06	$62,758.90
WALLEY RUN (UNT)	16-F	MINING-AB	pH-METALS	0.9	WT	500	$66.06	$29,727.90
WEST BRANCH BLUE JAY CREEK	16-E	MINING-AB	METALS	7	WT	500	$66.06	$231,217.00
N. BR. ROBINSONS RUN (UNT)	20-F	MINING-AB	pH-METALS	0.7	WT	500	$66.06	$23,121.70
N. BR. ROBINSONS RUN (UNT)	20-F	MINING-AB	pH-METALS	3.5	WT	500	$66.06	$115,608.50
HALF CROWN RUN	20-F	MINING-AB	pH-METALS	1	WT	500	$66.06	$33,031.00
SCHUYLKILL RIVER	3-A	MINING-AB	pH-METALS	31.7	WWF	306	$58.61	$568,575.28
WEST BRANCH SCHUYLKILL RIVER	3-A	MINING-AB	pH-METALS	9	WWF	306	$58.61	$161,425.16
SUSQUEHANNA RIVER	5-B	MINING-AB	pH-METALS	20	WWF	306	$58.61	$358,722.58
WEST BRANCH SUSQUEHANNA RIVER	8-B	MINING-AB	pH-METALS	6.8	WWF	306	$58.61	$121,965.68
WEST BRANCH SUSQUEHANNA RIVER	8-B	MINING-AB	pH-METALS	72.9	WWF	306	$58.61	$1,307,543.79
WEST BRANCH SUSQUEHANNA RIVER	9-B	MINING-AB	pH-METALS	50.6	WWF	306	$58.61	$907,568.12
WEST BRANCH SUSQUEHANNA RIVER	10-D	MINING-AB	pH-METALS	3	WWF	306	$58.61	$53,808.39
KETTLE CREEK	9-B	MINING-AB	pH-METALS	3	WWF	306	$58.61	$53,808.39
SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	6.7	WWF	306	$58.61	$120,172.06
SINNEMAHONING CREEK	8-A	MINING-AB	pH-METALS	9.1	WWF	306	$58.61	$163,218.77
CLEARFIELD CREEK	8-C	MINING-AB	pH-METALS	44.2	WWF	306	$58.61	$792,776.89
LACKAWANNA RIVER	5-A	MINING-AB	pH-METALS	2.6	WWF	306	$58.61	$46,633.93
TIOGA RIVER	4-A	MINING-AB	pH-METALS	1	WWF	306	$58.61	$17,936.13
OHIO RIVER	20-E	MINING-AB	pH-METALS	1.6	WWF	306	$58.61	$28,697.81
OHIO RIVER	20-E	MINING-AB	pH-METALS	1.6	WWF	306	$58.61	$28,697.81
OHIO RIVER	20-E	MINING-AB	pH-METALS	3.1	WWF	306	$58.61	$55,602.00
OHIO RIVER	20-E	MINING-AB	pH-METALS	1.8	WWF	306	$58.61	$32,285.03
OHIO RIVER	20-E	MINING-AB	pH-METALS	2.1	WWF	306	$58.61	$37,665.87
HARMON CREEK	20-D	MINING-AB	pH-METALS	5	WWF	306	$58.61	$89,680.64
BRUSH RUN	20-B	MINING-AB	pH-METALS-SULFATES	8.3	WWF	306	$58.61	$148,869.87
CLARKS RUN	20-B	MINING-AB	pH-METALS	0.8	WWF	306	$58.61	$14,348.90
DUCK RUN	20-C	MINING-AB	METALS	4.3	WWF	306	$58.61	$77,125.35
EAST BRANCH WOLF CREEK	20-C	MINING-AB	METALS	6	WWF	306	$58.61	$107,616.77
LONG RUN	20-C	MINING-AB	METALS	3.3	WWF	306	$58.61	$59,189.23
BLACKS CREEK	20-C	MINING-AB	pH-METALS	4.8	WWF	306	$58.61	$86,093.42
CONNOQUENESSING CREEK (UNT)	20-C	MINING-AB	METALS	0.6	WWF	306	$58.61	$10,761.68
MONTOUR RUN	20-G	MINING-AB	pH-METALS	0.5	WWF	306	$58.61	$8,968.06
MOON RUN	20-G	MINING-AB	pH-METALS	2.5	WWF	306	$58.61	$44,840.32
MOON RUN	20-G	MINING-AB	pH-METALS	1.1	WWF	306	$58.61	$19,729.74
UNT MONONGAHELA RIVER	19-C	MINING-AB	pH-METALS	0.5	WWF	306	$58.61	$8,968.06
PETERS CREEK	19-C	MINING-AB	pH-METALS	22.3	WWF	306	$58.61	$399,975.67
FALLEN TIMBER RUN	19-C	MINING-AB	pH-METALS	2.7	WWF	306	$58.61	$48,427.55

Recreational Use Loss Estimates for Pennsylvania Streams Degraded by AMD 2006

Stream Name	SWP	Cause	Pollutant	Miles	Projected Use	Use Rate (Trips/Year)	Valuation ($/Trip)	Lost Value ($)
FALLEN TIMBER RUN	19-C	MINING-AB	pH-METALS	1	WWF	306	$58.61	$17,936.13
TENMILE CREEK	19-B	MINING-AB	pH-SULFATES	5.7	WWF	306	$58.61	$102,235.93
SOUTH FORK TENMILE CREEK	19-B	MINING-AB	pH-METALS	2	WWF	306	$58.61	$35,872.26
RUSH RUN	19-B	MINING-AB	pH-METALS-SULFATES	1.3	WWF	306	$58.61	$23,316.97
PUMPKIN RUN	19-B	MINING-AB	pH-METALS	1.8	WWF	306	$58.61	$32,285.03
WHITELEY CREEK	19-G	MINING-AB	pH-METALS	9	WWF	306	$58.61	$161,425.16
DUNKARD CREEK	19-G	MINING-AB	OTHER	6.5	WWF	126	$58.61	$48,005.52
DUNKARD CREEK	19-G	MINING-AB	pH-METALS	8.5	WWF	126	$58.61	$62,776.45
ALLEGHENY RIVER	18-A	MINING-AB	pH-METALS	1.5	WWF	126	$58.61	$11,078.20
KISKIMINETAS RIVER	18-B	MINING-AB	pH-METALS	13.5	WWF	306	$58.61	$242,137.74
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	114.5	WWF	306	$58.61	$2,053,686.75
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	1.7	WWF	306	$58.61	$30,491.42
CONEMAUGH RIVER	18-C	MINING-AB	pH-METALS	7.9	WWF	306	$58.61	$141,695.42
STONY CREEK	18-E	MINING-AB	pH-METALS	6.5	WWF	306	$58.61	$116,584.84
CROOKED CREEK	17-E	MINING-AB	pH	1.1	WWF	306	$58.61	$19,729.74
CROOKED CREEK	17-E	MINING-AB	pH-METALS	1.6	WWF	306	$58.61	$28,697.81
COAL BANK RUN	17-E	MINING-AB	pH	0.5	WWF	126	$58.61	$3,692.73
NORTH BRANCH PLUM CREEK	17-E	MINING-AB	pH	1.1	WWF	126	$58.61	$8,124.01
STUMP CREEK	17-D	MINING-AB	METALS	0.8	WWF	126	$58.61	$5,908.37
STUMP CREEK	17-D	MINING-AB	METALS-SULFATES	2.5	WWF	126	$58.61	$18,463.66
STUMP CREEK	17-D	MINING-AB	METALS	1.2	WWF	126	$58.61	$8,862.56
WEST FORK (UNT) (02)	17-C	MINING-AB	METALS	0.6	WWF	126	$58.61	$4,431.28
WEST FORK (UNT)	17-C	MINING-AB	METALS	0.7	WWF	126	$58.61	$5,169.83
KYLE RUN (UNT)	17-C	MINING-AB	METALS	1.4	WWF	126	$58.61	$10,339.65
KTLE RUN	17-C	MINING-AB	METALS	0.4	WWF	126	$58.61	$2,954.19
CLARION RIVER	17-B	MINING-AB	pH-METALS	4	WWF	306	$58.61	$71,744.52
			TOTAL MILES AMD	**2167**			**TOTAL**	**$107,981,227**

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	**Points**	**Score**
Has a local entity formulated goals, developed a plan, and begun plan implementation? **(none = 0 pts., formulated goals = 5 pts., developed plan = 10 pts., begun plan implementation = 10-25 pts.)**	0 - 25	
Does the local entity have experience 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 - 25	
Is there a non-local entity involved in restoration? (TU, SRBC, etc.)	0 - 5	
Total Section Score	**70**	

A.2 - Background Data	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, 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 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 priority 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	
Total Section Score	**90**	

A.3 - Restoration Goals	Points	Score
Restoration goals are: (1) well-defined; (2) measurable (by lab analysis or bio survey); (3) achievable; (4) the targeted area is clearly described; and (5) the goals fit well with DEP's overarching goals. **(Decrease score by 5 pts. for each of the above components that are missing.)**	0 - 25	
No restoration goals have been developed.	-25	
Total Section Score	**25**	

Develop a Technology Analysis score for each individual treatment or abatement project covered by the restoration plan. The overall score for the projects in the plan will be based on a weighted average of the individual scores multiplied by the percentage of pollution loading for each individual treatment or abatement project.

Individual Project #_____

A.4.a - Technology Analysis for Individual Treatment Projects		
Technological Evaluation	**Points**	**Score**
Evaluate whether the recommended technology has successfully been used at numerous locations under treatment scenarios similar to the proposed project.	0 - 20	
Evaluate whether (or the degree that) the proposed treatment system/facility was sized or manufactured using a science-based approach or other accepted sizing methodologies.	0 - 20	
Technological Evaluation Subtotal	**40**	
Operational Evaluation	**Points**	**Score**
Evaluate the prospects that the recommended treatment system/facility will achieve the treatment/abatement goals for the duration of the design life.	0 - 20	
Evaluate whether the proposed treatment system/facility can be operated and maintained to consistently achieve the treatment/abatement goals.	0 - 20	
Evaluate whether the proposed treatment system/facility can be manipulated to achieve treatment/abatement goals under varying flow, chemistry, and operational conditions.	0 - 20	
Operational Evaluation Subtotal	**60**	
Maintenance Evaluation	**Points**	**Score**
Evaluate the ease with which the proposed treatment system/facility can be evaluated for operational problems (ease of troubleshooting).	0 - 20	
Evaluate whether the proposed treatment system/facility can be easily maintained or rehabilitated if the treatment/abatement goals are not being achieved.	0 - 20	
Maintenance Evaluation Subtotal	**40**	

Individual Project #_____

A.4.a - (continued) **Technology Analysis for Individual Treatment Projects**		
Application of Risk Matrix Table **(Only required for treatment technology Category [4] - all other types of Passive Treatment for Net Acidic Discharges).**	**Points**	**Score**
The proposed treatment system/facility has a "**High**" risk according to the Risk Matrix Table.	Yes - -80 No - 0	
The proposed treatment system/facility has a "**Medium**" risk according to the Risk Matrix Table.	Yes - -40 No - 0	
The proposed treatment system/facility has a "**Low**" risk according to the Risk Matrix Table.	Yes - 0	
Risk Matrix Subtotal, if applicable	----------	

A.4.a - (continued) **(Alternate) -Technology Evaluation for Individual Abatement Projects (for projects that do not include treatment)**	**Points**	**Score**
The proposed project is an ***abatement project*** that will ***eliminate*** a discharge or its effects on water quality or quantity.	106 - 140	
The proposed project is an ***abatement project*** that will ***significantly reduce (> 50%)*** a discharge or its effects on water quality or quantity.	71 - 105	
The proposed project is an ***abatement project*** that will ***reduce (> 10 up to 50%)*** a discharge or its effects on water quality or quantity.	36 - 70	
The proposed project is an ***abatement project*** that will ***likely reduce*** a discharge or its effects on water quality or quantity.	0 - 35	
Abatement Subtotal	**140**	

Individual Project #_____

A.4.a - (continued) **Technology Analysis for Individual Treatment Projects***	**Points**	**Score**
Technological Evaluation Subtotal	40	
Operational Evaluation Subtotal	60	
Maintenance Evaluation Subtotal	40	
Risk Matrix Subtotal **(score only if applicable)**	----	
Individual Project #____ Score	140	(a)
A.4.a (Alternate) - Technology Analysis for Individual Abatement Projects*		
Individual Project #____ Score	140	(a)

Individual Project #____ percentage of pollution loading		**(b)**

Use additional sheet(s) for each individual treatment or abatement project covered by the restoration plan.

*Individual projects will receive a score for either A.4.a if they are treatment projects or for A.4.a (Alternate) if they are abatement projects.

A.4.a - (continued) **Treatment or Abatement Technological Analysis Project Compilation**				
Individual Project Number	**Individual Project Score** **(a)**	**Maximum Project Score** **(b)**	**Percentage of Pollution Loading** **(c)**	**Total Weighted Individual Project Score** **[a/b x c]**
Project #1		140		
Project #2, if applicable		140		
Project #3, if applicable		140		
Project #4, if applicable		140		
Project #5, if applicable		140		
Project #6, if applicable		140		
Project #7, if applicable		140		
Etc.				
			Total Section Score (Sum of total weighted individual project scores)	

Develop an Alternative Analysis for each individual treatment or abatement project covered by the restoration plan. The overall score for the projects in the plan will be based on a weighted average of the individual scores multiplied by the percentage of pollution loading for each individual treatment or abatement project.

Individual Project #_____

A.4.b – Alternatives Analysis		**Points**	**Score**
Poorly analyzed and/or presented	A poorly completed alternatives analysis fails to provide the project evaluator with enough information to adequately assess that the best approach is being proposed for a specific project.	0 - 10	
Adequate	An adequately completed alternatives analysis meets the minimum requirement of evaluating at least one passive treatment option and one active treatment option. However, the evaluation leaves the project evaluator with questions or inadequate information to completely assess that the best approach is being proposed for a specific project.	11- 20	
Analyzed in detail and clearly presented	A detailed and clearly presented alternatives analysis provides the project evaluator with adequate information to completely assess that the best approach is being proposed for a specific project. All applicable treatment approaches are evaluated, presented, and discussed.	21 - 25	
Not required	No alternatives analysis is needed or warranted (Project cost <$250,000 or other documented reason(s).	25	
	Individual Project #____ Score	**25**	**(c)**

A.4.b - (continued) **Alternative Analysis Project Compilation**				
Individual Project Number	**Individual Project Score** **(a)**	**Maximum Project Score** **(b)**	**Percentage of Pollution Loading** **(c)**	**Total Weighted Individual Project Score** **[a/b x c]**
Project #1		25		
Project #2, if applicable		25		
Project #3, if applicable		25		
Project #4, if applicable		25		
Project #5, if applicable		25		
Project #6, if applicable		25		
Project #7, if applicable		25		
Etc.				
Total Section Score (sum of total weighted individual project scores)				

Develop an Other Considerations sheet for each individual treatment or abatement project covered by the restoration plan. The overall score for the projects in the plan will be based on a weighted average of the individual scores multiplied by the percentage of pollution loading for each individual treatment or abatement project.

Individual Project #_____

A.4.c - Other Considerations for Individual Projects		**Points**	**Score**
1.	Is adequate land available to construct properly sized treatment systems?	Yes - (+5) No - (-100)	
2.	Does written or verbal property owner consent exist for the properties where treatment systems will be needed?	Written - +5 None - -100 Verbal - 0	
3.	Have any soil test pits and/or geotechnical evaluations been identified and/or performed on-site?	Yes - +5 No - 0	
4.	Have any environmental permit requirements been identified or any permits obtained?	Obtained - +5 Not Evaluated - -10 Identified - 0	
5.	Is there documented local and/or public project support?	Yes - +5 No - -5	
6.	For sites containing coal refuse material, has the material been tested or evaluated for fuel value and marketability?	Yes - +5 No - 0 not applicable - +5	
7.	Will the project result in restored stream miles or reclaimed acreage on public lands?	Yes - +5 No - 0	
	Individual Project #____ Score	**35**	**(d)**

A.4.c - (continued) **Other Considerations Project Compilation**				
Individual Project Number	**Individual Project Score** **(a)**	**Maximum Project Score** **(b)**	**Percentage of Pollution Loading** **(c)**	**Total Weighted Individual Project Score** **[a/b x c]**
Project #1		35		
Project #2, if applicable		35		
Project #3, if applicable		35		
Project #4, if applicable		35		
Project #5, if applicable		35		
Project #6, if applicable		35		
Project #7, if applicable		35		
Etc.				
Total Section Score (sum of total weighted individual project scores)				

B. Benefits			
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 Restoration will restore a cold water fishery, or Restoration will restore a warm water fishery or trout stocked fishery.	+25 +15 +10	
Additional	Restoration can be reasonably expected to result in the delisting of a stream or portion from the Department's Impaired Waters List.	0 - 5	
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 a documented OSM Priority 1 or 2 problem **(P2 = 0-5, P1 = 5-10, Multiple = 10-15)**.	0 - 15	
Additional	Restoration involves new or innovative technologies. Documentation should be cited on how the technology applies to the problem. No adverse impacts should result.	0 - 5	
	Total Section Score	**25**	

C.1 - Capital Cost (Cost of Restoration Plan - All Projects)		Points	Score
Very High Cost	> $10.0 million	0 - 5	
High Cost	> $5.0 million and < $10.0 million	6- 10	
Moderate Cost	> $3 million and < $5.0 million	11 - 15	
Low Cost	> $1 million and < $3 million	16 - 20	
Very Low Cost	< $1 million	21 - 25	
	Total Section Score	25	

(move C2 up to just under C1 when formatting)

C.2 - Non-Title IV Match Money and Projects Completed by Others		Points	Score
High	Greater than 50% of priority projects have been completed with funding from non-Title IV sources	25 - 50	
Medium	Greater than 25% of priority projects have been completed OR Greater than 25% of total needed funding has been committed from non-Title IV sources	6 - 15	
Low	Title IV sources will provide >75% of total capital costs needed to complete priority projects	0 - 5	
Additional	Add points if any of match is from a private source	0 - 25	
	Total Section Score	**50**	

C.3 - Matching Funds for Operation and Maintenance		Points	Score
Local Support	Routine O&M to be provided by local entity	0 - 10	
Other Support	Maintenance needs 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 needs 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 needs 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 no non-Title IV funding source is identified (at a cost < $100,000/year)	-15	
Active Treatment	Active treatment is needed in the watershed and no non-Title IV funding source is identified (at a cost < $100,000 - $500,00/year)	-35	
Active Treatment	Active treatment is needed in the watershed and no non-Title IV funding source is 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		70	10	
A.2 - Background Data		90	10	
A.3 - Restoration Goals		25	5	
*A.4.a - Technological Analysis		140	15	
*A.4.b - Alternatives Analysis		25	5	
*A.4.c - Other Considerations		35	5	
B. Benefits		25	15	
C.1 - Capital Costs		25	15	
C.2 - Match Money and Projects Completed by Others		50	10	
C.3 - Matching Funds for Operation and Maintenance		70	10	
Overall Restoration Plan Score				

*These are the combined weighted scores of all projects.

Record of Decision

	Project Selection Criteria	Record of Decision
A.1	Local Support	
A.2	Background Data	
A.3	Restoration Goals	
A.4.a	Technological Analysis	
A.4.b	Alternatives Analysis	
A.4.c	Other Considerations	
B.	Benefits	
C.1	Capital Costs	
C.2	Match Money and Projects Completed by Others	
C.3	Matching Funds for Operation and Maintenance	
	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.

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