Mine Drainage Treatability and Project Selection Guidelines

Developed jointly by the Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation and the Office of Surface Mining Reclamation and Enforcement, Harrisburg Field Office.

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Preface

Comprehensive legislation reauthorizing the Abandoned Mine Land (AML) program under Title IV of the Surface Mining Control and Reclamation Act of 1977 (SMCRA) was passed by Congress on December 9, 2006, and was signed by President George W. Bush on December 20, 2006. The legislation extends federal AML fee collection authority to 2021 at reduced rates and addresses a host of other provisions to the AML program. The new changes in federal law will result in substantial increases in AML funding to states and tribes and focus AML reclamation on projects that benefit public health and safety and the environment. Also included in the changes is an allowable 30% set-aside for AMD abatement projects, up from a previous maximum of 10%.

The Department of Environmental Protection, in conjunction with the Citizens Advisory Council and the Mining and Reclamation Advisory Board, held ten public town hall meetings in the coal regions of Pennsylvania in May, June and September of 2007. The purpose of the meetings was to receive comments on the revisions brought about by the re-authorization of SMCRA. Written comments were accepted as well. About 340 people attended the ten town hall meetings, generating over 800 pages of transcripts. Many of the comments received dealt with mine drainage issues. The Department is now conducting focus group meetings as a second part of its public outreach efforts. The purpose of the focus group meetings is to examine selected issues that are important to the efficient operation of the abandoned mine reclamation program.

Previous to the public outreach effort, OSM and the DEP began an initiative to evaluate passive treatment systems built with public funds by both government agencies and private entities. The primary purpose of these evaluations was to evaluate the performance (success) of each treatment system; to identify any operational problems; to target systems needing additional troubleshooting or evaluation work; to identify systems needing maintenance or rehabilitation work; to better define appropriate technologies for different classifications of discharges; and to identify applications of technology that may be problematic. As a result of these evaluations and in order to address some of the comments received during the town hall meetings, a joint DEP and OSM workgroup was established to develop treatability criteria and project selection guidelines for Title IV funded mine drainage treatment and/or abatement projects. The main objective of the workgroup is to develop guidelines that ensure the efficient and effective expenditure of AMD set-aside funding that achieves measurable restoration of watersheds impacted by abandoned coal mine drainage in accordance with the requirements of SMCRA.

Once final, the AMD treatability and project selection guidelines will serve as the primary method for evaluating all newly proposed mine drainage projects. However, the guidelines are not absolute and will not be the basis for every mine drainage project decision. There will also be a transition period where projects previously committed to by the DEP will be completed.

Finally, the magnitude of the mine drainage problem in Pennsylvania is extremely great. Estimates to correct the entire AMD problem exceed $5 billion in capital costs alone, and with inflation, the total cost is increasing everyday. With current technology, there would be a tremendous ongoing operation and maintenance cost as well which would reduce the amount that could be spent on capital construction of new treatment systems. At current estimates, Pennsylvania could potentially focus up to $400 million toward AMD problems over the next 15 years which means that many, and in fact a vast majority, of mine drainage problems will not be addressed through the AML Program during this time period.

Surface Mining Control and Reclamation Act

Language in the Act

Section 403 of the federal Surface Mining Control and Reclamation Act (SMCRA) establishes the objectives of providing funding to address abandoned mine lands (AML) problems. As amended on December 20, 2006, section 403(a) establishes three funding priorities, the protection of public health and safety from extreme danger, the protection of public health and safety from adverse effects of past coal mining, and the restoration of land and water resources and the environment. It is the third priority, commonly referred to as Priority 3 reclamation, that must be a 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 pre-degraded condition in a reliable and predictable manner. In addition, the inclusion of the term "environment" in the phrase also indicates that, beyond addressing degraded water quality parameters, expenditures must also take into account biological and hydrologic resources when setting specific project objectives. The importance of achieving restoration beyond simple water quality improvements is further emphasized under Section 403(a)(3) by placing importance on measures for the conservation and development of soil, woodland, fish and wildlife, recreation resources, and agricultural productivity.

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 acid mine drainage 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 acid mine drainage in a **comprehensive manner** within qualified hydrologic units affected by coal mining practices" (bold lettering added). SMCRA then further defines "qualified hydrologic unit" as one (a) in which the water quality has been significantly affected by acid mine drainage from coal mining practices in a manner that adversely impacts biological resources, and (b) contains land and water that are eligible for SMCRA funding and the subject of expenditures by the State from either the forfeiture of bonds or other state programs. The importance of determining whether a given hydrologic unit is "qualifying", and then approaching the restoration of the hydrologic unit in a "comprehensive manner" will impact project selection. A separate workgroup is developing the procedures to be used by the Department to meet these aspects of SMCRA.

While the existence of bond forfeiture sites or other state funding may impose some additional objectives, the basic Priority 3 requirement to restore water resources and the environment remains a core standard when assessing how best to proceed under the AMD Set-Aside program. Projects will be evaluated to determine their ability to achieve these standards.

Extent of AMD Problems in Pennsylvania (Currently over 4,600 miles of streams impacted)

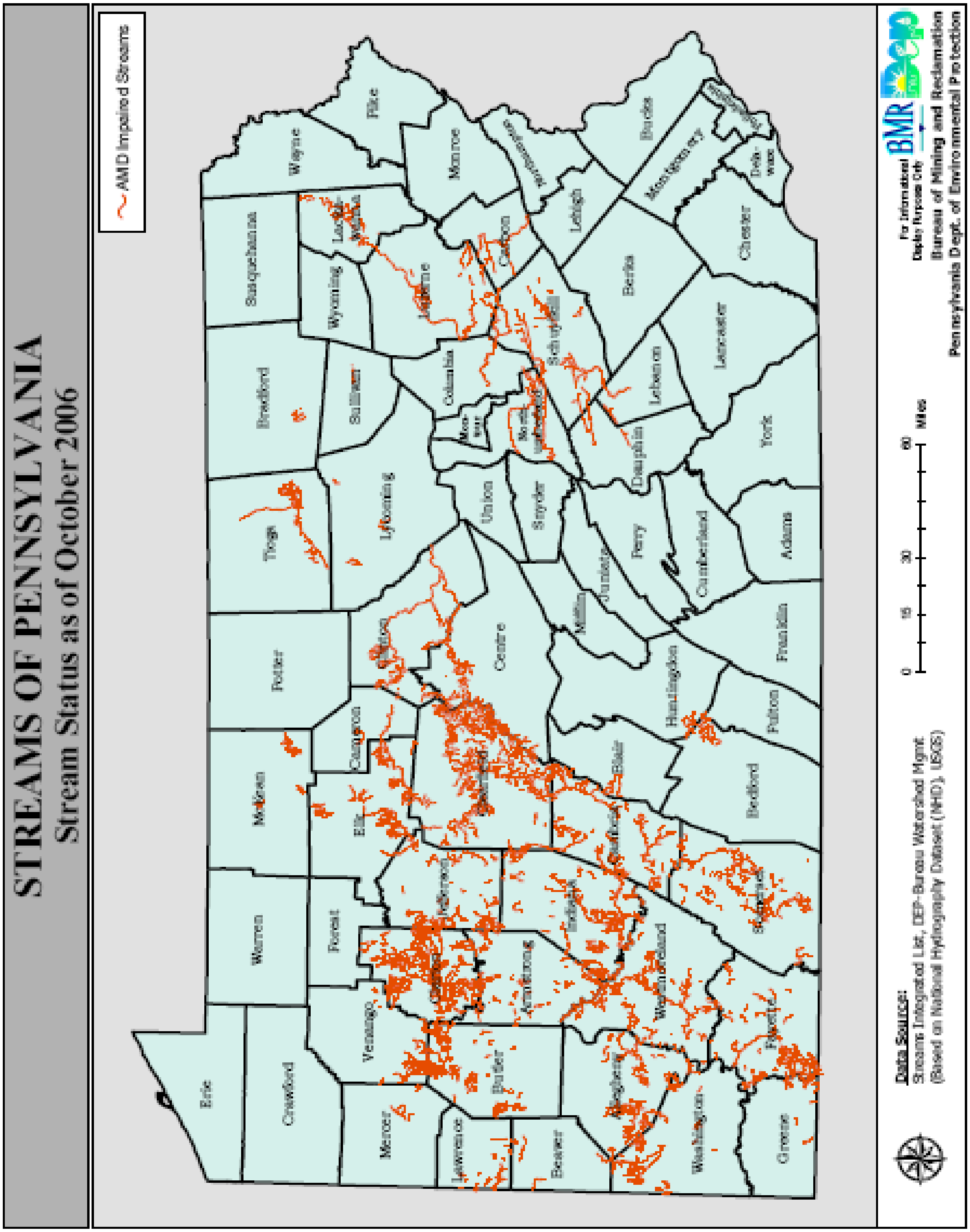

Figure – Location of mine drainage impaired streams in Pennsylvania
(Source: PA-DEP-Bureau of Watershed Management Integrated Streams List – October 2006)

Historical Public Funding Sources for AMD Treatment in Pennsylvania

- PA's "Operation Scarlift" (1968-1980s)
- Federal EPA, Section 319 Program (1980s -)
- Federal NRCS, P.L. 566 Program (1990s -)
- SMCRA, Title IV
    - OSM 10% Set-Aside Program (1993 - 2006)
    - Appalachian Clean Streams Initiative (ACSI) (1996-2007)
    - Watershed Cooperative Assistance Program (WCAP) (1997 -)
    - *New* - OSM 30% Set-Aside Program (2007 -)
- Corps of Engineers, Section 206 Program (1996 -)
- PA's "Growing Greener I & II" Program (2000 -)

Passive Mine Drainage Treatment in Pennsylvania

- Between 1990 and 2007, there have been at least 259 publicly funded passive mine drainage treatment systems constructed in Pennsylvania
    - The average cost of each system was just over $298,000
    - The total capital cost of these systems exceeds $77 million
    - 101 of these projects had all or some funding from Title IV of SMCRA
    - 93 of these projects had all or some funding from the Growing Greener Program
    - 65 of these projects had all or some funding from the EPA 319 Program

- Treatment System Flow Rates (for those systems with influent flow rate data)
    - 40% have average influent flow rates of less than 50 gpm
    - 16% have average influent flow rates between 50 and 100 gpm
    - 28% have average influent flow rates between 100 and 500 gpm
    - 3% have average influent flow rates between 500 and 1,000 gpm
    - 13% have average influent flow rates greater than 1,000 gpm

- Treatment System Acidity Concentration (for those systems with influent quality data)
    - 20% have average influent acidity concentrations of less than 50 mg/L as $CaCO_3$
    - 20% have average influent acidity conc. between 50 and 100 mg/L as $CaCO_3$
    - 54% have average influent acidity conc. between 100 and 500 mg/L as $CaCO_3$
    - 5% have average influent acidity conc. between 500 and 1,000 mg/L as $CaCO_3$
    - 1% have average influent acidity conc. greater than 1,000 mg/L as $CaCO_3$

- Evaluations of numerous passive treatment systems have been completed over the few (2-3) years
    - To evaluate treatment system 'success'
    - To identify operational problems
    - To recommend treatment system maintenance and/or rehabilitation work
    - To better define what technology works and/or what may be problematic
        - To apply the best technology based on mine drainage quality
        - To apply the best technology based on mine drainage flow rate
        - To better predict and plan for operation and maintenance requirements at passive mine drainage treatment systems

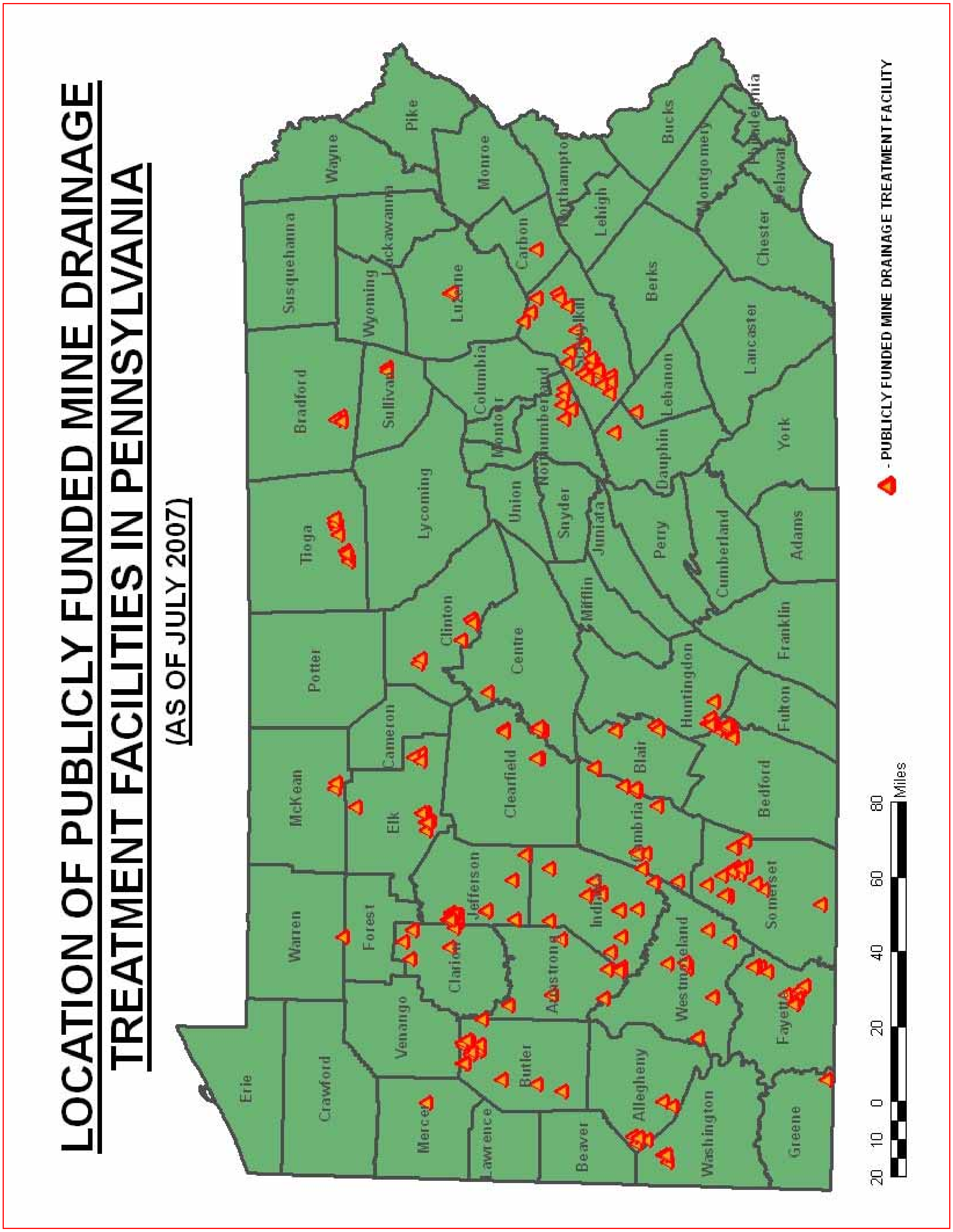

Figure – Location of publicly funded mine drainage treatment facilities in Pennsylvania
(Source: OSM mine drainage treatment system database – July 2007)

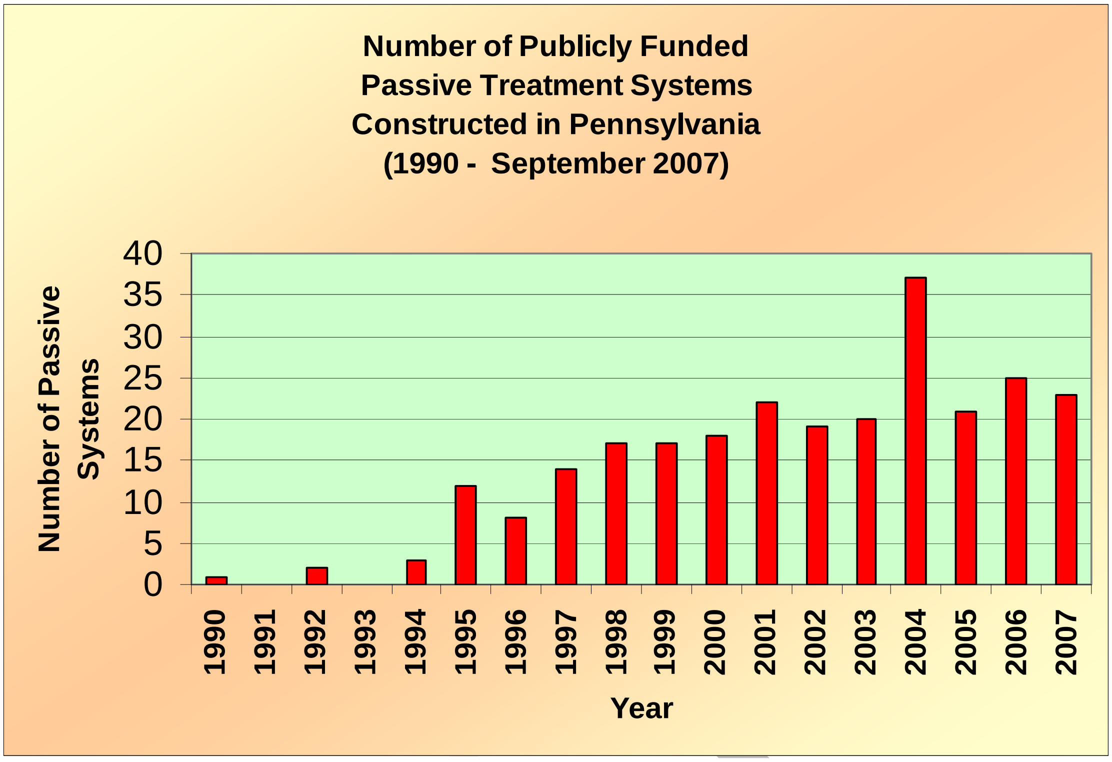

Figure – Number of publicly funded mine drainage treatment facilities constructed in Pennsylvania by calendar year.
(Source: OSM mine drainage treatment system database – July 2007)

Evolution of Mine Drainage Treatment Approach in Pennsylvania

- 1960s and 1970s – Active chemical treatment racilities were the preferred alternative
  - Many treatment plants were built and many more were planned
  - For a variety of reasons, many were abandoned
- 1980s – Mine drainage treatment slowed
  - Primarily due to lack of adequate funding
- 1990s – Passive treatment of AMD became the preferred alternative
  - Many passive treatment systems were built
  - Design guidelines were developed
    - Original design criteria were based on empirical observations
    - As problems arose, engineers developed solutions
    - More research was focused on understanding passive treatment mechanisms
  - The technology was applied to many discharges with very severe water quality exceeding the limits of the technology resulting in poor system performance and even some treatment system failures
  - The realities of O&M requirements and costs began to come to light

- Passive treatment was successfully employed to treat a wide variety of mine drainage discharges
  - Passive treatment systems used for net alkaline discharges were very often highly successful

- o Passive treatment systems used for weakly to moderately acidic discharges were also successful, however, some have operational or maintenance problems
- o Passive treatment systems used for strongly acidic discharges, particularly those with elevated levels of dissolved aluminum, have been less successful and many have operational or maintenance problems

> Many operational problems were related to one of two main issues
- o Short-circuiting of the water through one or more components of the treatment system
- o Over-loading the system resulting in plugging and reduced treatment system performance

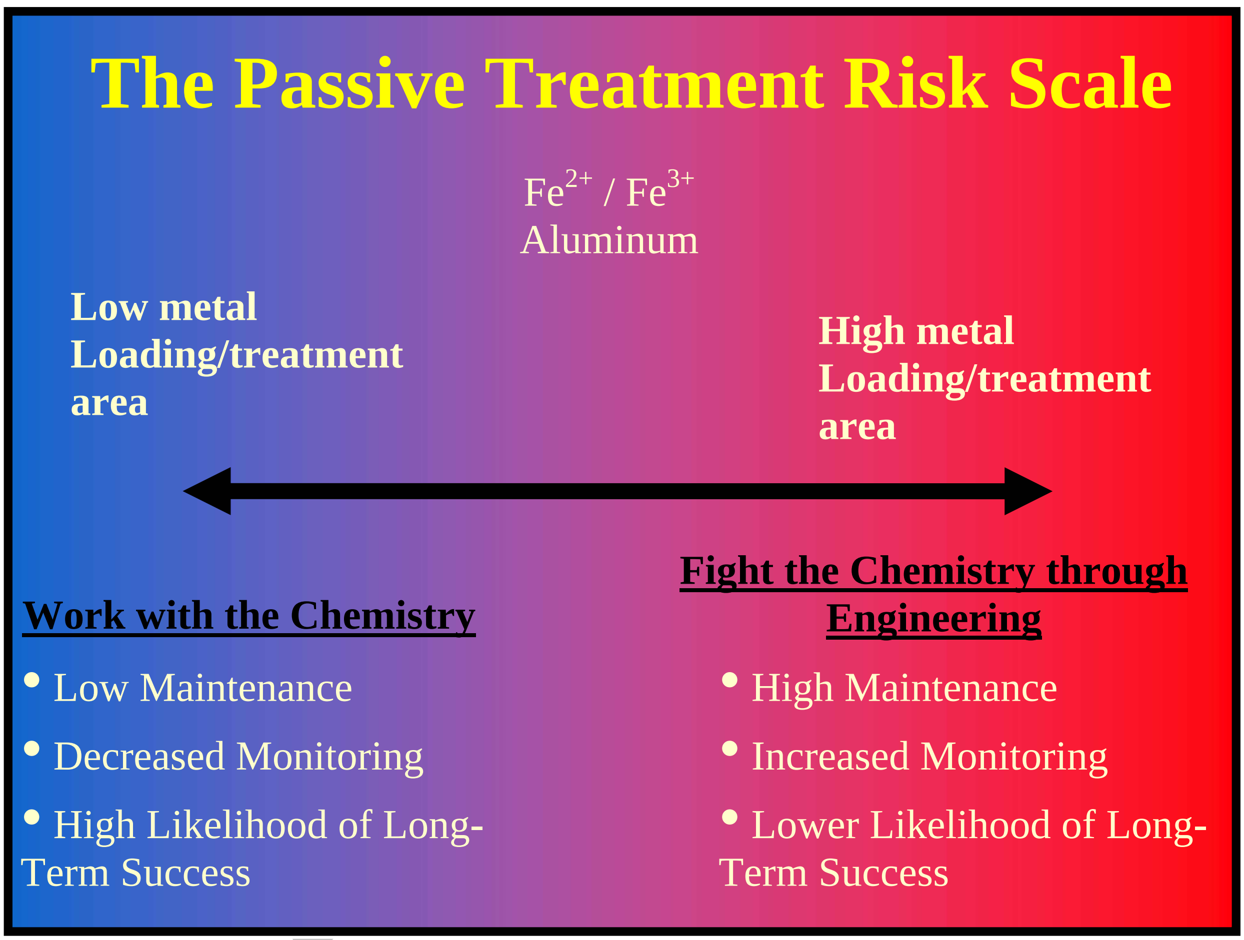

Figure – Passive treatment Risk Scale
(Source: Adapted from OSM-National Technical Training Program Passive Mine Drainage Treatment Workshop Materials – June 2007)

Current Approach to Mine Drainage Treatment Approach in Pennsylvania

> 2000s (Current) – All options are now being considered for AMD treatment
- o Active and semi-active chemical treatment are again being considered (active treatment plants, dosers, and stream dosing similar to WV and MD applications)

- o Passive treatment is still widely used but being scrutinized more due to high capital cost, operation and maintenance requirements, and often unreliable performance
- o Partnering with industry to develop mutually beneficial projects
- o Elimination of AMD through re-mining, special handling or removal of acid forming materials or other means is also being pursued in some cases
- o Consideration for the use of alkaline addition, infiltration reduction and other water management control techniques during land reclamation projects
- o Design criteria and guidelines for all types of treatment continue to evolve

Future Pennsylvania Program Direction

- > Develop more refined selection criteria for passive treatment at acidic discharge sites
- > Develop "treatability" criteria for passive treatment (apply the right or best available technology to each AMD Discharge)
- > Develop program infrastructure for perpetual monitoring and maintenance of treatment systems
- > Continue to refine and develop improved design criteria and guidelines for the various passive treatment technologies
- > Commit to comprehensive restoration of watersheds or portions of watersheds located within qualified hydrologic units that have clearly defined restoration goals and measurable results
    - o Fund passive facilities where the technology is applicable to the discharge
    - o Fund active facilities where there are O & M partners
    - o Fund abatement projects whenever possible, as the preferred method to address mine drainage

Mine Drainage Treatability Criteria

Technological Analysis

Since an objective of the AML fund includes the "*restoration of land and water resources,*" AML money can only be used to fund treatment and abatement projects that will achieve restoration. A treatment or abatement technology evaluation, an operational evaluation, and maintenance evaluation are an extremely critical part in determining whether a project is likely to achieve restoration. Scoring criteria were developed to aid the project reviewer in the three evaluations. The scores for each of three evaluations will be summed and used as the basis for the overall score that represents the treatability section of project selection process. The treatment/abatement technology evaluation focuses on evaluating whether the combination of the treatment/abatement scenario and the proposed technology is "*proven*" to provide treatment. The operational evaluation focuses on the "*reliability*" of the proposed technology to consistently achieve the treatment goals. The maintenance evaluation focuses on the "*predictability*" of the proposed technology to be maintained and fixed when operational issues arise. Treatment or abatement technologies that receive a high *proven, reliable, and predictable* evaluation score are likely to achieve and maintain restoration.

A ***"proven"*** technology is a treatment or an abatement technique that:

(1) is successfully used at numerous locations under treatment scenarios similar to the proposed project;

(2) is sized or manufactured using a science-base approach that can be evaluated;

(3) has a data-supported performance record.

A ***"reliable"*** treatment or abatement technology is one that:

(1) can achieve the treatment/abatement goals > 90% of the design life;

(2) can be operated and maintained to consistently achieve treatment/abatement goals;

(3) can be manipulated to achieve treatment/abatement goals under vary flow, chemistry, and operational conditions;

(4) has a data-supported performance record in scenario(s) similar to the proposed project.

(5) can be operated to achieve varying degrees of treatment;

A ***"predictable"*** technology is a treatment or abatement technology that:

(1) contains troubleshooting capacity;

(2) can be maintained or rehabilitated if the treatment/abatement goals are not being achieved;

(3) has maintenance flexibility built into the treatment scheme.

For the purposes of this document, mine drainage treatment systems can be arranged into five categories: (1) Active Treatment; (2) Passive Treatment of Net Alkaline discharges; (3) Passive Treatment of Net Acidic discharges using anoxic limestone drain technology, (4) All other types of Passive Treatment for Net Acidic discharges, (5) Innovative Technology. Abatement projects are considered separately in a sixth category. This document provides guidance that will be used by project reviewers to evaluate and score a proposed project based on "*proven, reliable, and predictable*" criteria.

Treatment Categories

1. **Active Treatment –** Active treatments commonly contain an electrically, mechanically, or gravity-driven chemical feed system that can be controlled and calibrated to dispense a defined amount of chemical or material to achieve a treatment goal. These systems often require frequent site visits to check on the chemical dispensing system and check on reagent usage. Active treatment technologies commonly dispense an acid-consumptive reagent, an oxidant or a flocculent to achieve a specified level of treatment.

    a. Examples of acid-consumptive reagents - lime, hydrated lime, limestone, sodium hydroxide, magnesium hydroxide, sodium carbonate, and ammonia
    b. Examples of oxidants – oxygen from mechanical aeration, hydrogen peroxide, ozone, chlorine, hypochlorite, and permanganate
    c. Examples of Flocculants – alum, aluminum sulfate, iron chloride, iron sulfate, sodium silicate, and chitosan

    Active treatment technologies commonly used by industry to achieve water quality standards can normally be considered as a "proven" treatment technology. Active treatment can normally achieve this designation because industries commonly use active treatment to achieve a water quality-based standard governed by a regulatory agency. In most cases, water quality standards must be achieved 99% of the time, so commonly deployed active treatment systems in a regulatory environment must be "*proven*" in nature. However, successful treatment scenarios often depend on site-specific conditions even when treatment technologies that are considered proven are used. For example, hydrated lime is often used by industry to achieve treatment under strict conditions. Hydrated lime, the chemical itself, has been shown *proven* to be able to manipulate water chemistry to provide treatment. However, the *reliability* of the hydrated lime delivery and mixing systems can vary in complexity their ability to maintain treatment or restoration goals without maintenance interruption. A hydrated lime treatment system that solely relies on one large settling pond may not be as reliable as a system that contains two operationally-parallel ponds. A single settling pond would have to be continuously desludged (e.g. mudcat) or the treatment would have to be ceased during desluging. A two pond treatment system, working in parallel, would allow for the redirection of mine drainage treatment into the other pond during desludging events, while continuing treatment. Treatment systems that can continue treatment during desludging are more *reliable*, since treatment goals can be continuously achieved. The *reliability* evaluation focuses on the ability to maintain treatment goals. In addition, even if a proposed hydrate lime system can be considered highly *proven* and *reliable*, the *predictability* of a treatment system may still be an issue. For instance, it is difficult to predict when problems may arise with underground injection sludge disposal scheme.

Issues ranging from mine void plugging to sludge recirculation are always possible and the maintenance requirements are difficult to predict and troubleshoot. The maintenance issues with a drying bed and land disposal sludge handling scheme may be more predictable over the long term than with a single point underground mine sludge injection disposal scheme. Since the *predictability* of a treatment system evaluates system maintenance, the maintenance issues with a sodium hydroxide treatment system, containing only a tank, valves, and chemical feed line, are more predictable than a complex hydrated lime treatment system that contains electrically-driven chemical feed, and clarification systems. The *reliability* and *predictability* for a type of treatment is specific to the application of the treatment technology in the proposed treatment scenario.

Reliability and *predictability* evaluation criteria, specific to this section, were not developed because of the countless issues that need to be considered for the evaluation. Instead, examples of relevant types of issues that should be considered during the evaluation are provided for the review team to consider, along with any other pertinent issues that may affect system *reliability* and *predictability*.

Reliability **–** In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *reliability* of an active treatment system to maintain treatment goals:

- Ability to pump a mine pool from more than one borehole;
- Ability to continue treatment during desludging events;
- Ability to achieve treatment goals under varying hydrologic and geochemical conditions (e.g. flexibility of chemical feed system and settling system);
- The complexity of a treatment system (need for additional chemicals other than primary treatment chemical, e.g. polymer)
- Ease of treatment operation;
- The reliance on piping to feed mine drainage or route mine drainage through a treatment system;
- The reliance on pumping.

Predictability **–** In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *predictability* of maintenance on an active treatment system:

- Time frame between chemical replenishment;
- Time frame between desludging events;
- Longevity of sludge storage volume;
- The way sludge is handled;
- The ability to decant sludge ponds;
- Ease of troubleshooting the treatment system.

2. **Passive Treatment of Net Alkaline Discharges**
   a. <u>Discharges containing less than 50 mg/L of dissolved ferrous iron:</u> Passive treatment of net alkaline mine drainage using a combination of wetlands, oxidation ponds, and settling ponds have been *proven* to successfully oxidize and settle dissolved iron to regulatory levels by the coal industry and often require

little maintenance other than routine sludge removal. The iron concentration qualification of 50 mg/L is used distinguish between treatment scenarios that may require a further design consideration for dissolving additional oxygen into the water to fully oxidize all of the dissolved iron. The configuration of many net alkaline treatment systems consist of water discharging from an underground mine and conveyed by a rock channel to an oxidation pond or wetland. The rock splashing and turbulent nature of an effectively-designed rock channel usually provides most of the oxygen requirement necessary to oxidize between 30 and 50 mg/L of ferrous iron. Treatment scenarios that contain more than 50 mg/L of iron must use additional gas transfer techniques, such as, the transfer of oxygen through the air/water interface at the pond surface or the use oxidation channels connecting a series of ponds. Stair-stepping rock channels and other turbulent passive aeration techniques are more efficient at oxygen transfer than using the air/water interface at the pond surface. For this reason, net alkaline treatment scenarios containing more than 50 mg/L of ferrous iron can result in discharging unoxidized iron unless additional design considerations are employed to address the oxygen requirement. If the water contains above 50 mg/L of iron, additional aeration techniques or modeling is needed to evaluate whether the passive treatment design will result in complete oxidation and settling of the iron. It is highly recommended that field oxidation tests are performed to determine the time required to oxidize the iron. Sizing based on the results of site-specific field oxidation tests is preferred over other sizing or modeling methodologies.

Passive Treatment of net alkaline mine drainage containing less than 50 mg/L of iron can be considered a "*proven*" technology as long as the following conditions are satisfied:

i. A statement explaining why field testing will not be used to size the system.
ii. The sizing methodology is published, is science-based, and subject to review.

b. Discharges containing greater than 50 mg/L of dissolved ferrous iron: Passive Treatment of net alkaline mine drainage containing more than 50 mg/L of iron can be considered a "*proven*" technology as long as:

i. The conditions set forth in section 2(a) are satisfied; and
ii. Additional data, modeling, or demonstration is provided that proves the mechanism that will be used to meet the additional oxygen requirements needed to achieve the treatment goals.

Reliability **–** In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *reliability* of a net alkaline passive treatment system to maintain treatment goals:

- Ability to continue treatment during desludging events;
- The treatment system is sized to oxidize and settle the iron concentration to the treatment goal under varying flow, temperature, and pH conditions;
- The sludge storage volume and/or depth is identified for each structure;
- Ease of treatment operation;

- Steps taken to minimize short circuiting.

Predictability **–** In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *predictability* of maintenance on a net alkaline treatment system:

- The steps necessary to remove and dispose of the sludge are identified;
- Time frame between desludging events;
- Ability to monitor sludge accumulation;
- Longevity of sludge storage volume;
- The ability to decant sludge ponds;
- The reliance on piping to feed mine drainage or route mine drainage through a treatment system;
- The reliance on pumping;
- Ease of troubleshooting the treatment system.

3. **Passive Treatment of Net Acidic discharges using anoxic limestone drain technology –** Anoxic limestone drains (ALD) are used to treat net acidic ferrous iron-dominated waters that are void of appreciable quantities of ferric iron and aluminum. When placed on this type of water chemistry, ALDs have been "*proven*" to be successful at passively treating water for many years without frequent maintenance. Because of the geochemistry and physical configuration, ALDs have not been prone to the plugging, short-circuiting, and treatment performance issues that have plagued other types of net acidic passive treatment systems. Because of their field-proven success, ALDs can be normally designated as a "*proven*" treatment technology as long as the following conditions are satisfied:

    1. The discharge contains a dissolved ferrous iron concentration of < 100 mg/L, total aluminum concentration < 1 mg/L, a total ferric iron concentration < 1 mg/L, dissolved oxygen < 0.5 mg/L, and no visible suspended solids in the raw water (or TSS is < 5 mg/L if appreciable iron oxidation did not take place during sampling transport to the lab);

    2. If the dissolved iron concentration is > 100 mg/L, then additional data is required to prove the ALD will consistently treat to net alkaline conditions;

    3. The oxidation ponds are design in accordance with the guidelines set forth in sections 2(a) and 2(b), and

    4. The treatment system is designed using a published science-based sizing methodology or from field-derived data.

    Reliability **–** In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *reliability* of an ALD treatment system to maintain treatment goals:

    - Ability to continue treatment during desludging or rehabilitation events;

- The treatment system is sized to produce net alkaline water under varying hydrologic conditions;
- Flow into the system can be varied, but controlled to the design flow rate;
- System is designed to prevent iron from oxidizing within the system;
- Ease of treatment operation;
- Steps identified to dispose of sludge-coated limestone;
- Steps taken to minimize short circuiting.

Predictability **–** In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *predictability* of maintenance on an active treatment system:

- The steps necessary to rehabilitate the system are identified;
- Time frame between rehabilitation events;
- The reliance on piping to feed mine drainage or route mine drainage through a treatment system;
- The reliance on pumping;
- Ease of troubleshooting the treatment system.

4. **All other types of Passive Treatment for Net Acidic discharges –** It is difficult to develop a fully inclusive definition for this category of passive treatment technology that includes all of the new variants of passive treatment. 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 does include impoundments or containers of alkaline-producing treatment media that contains manual, solar-operated, electrically-operated, or siphon-operated flushing or draining systems. Passive treatment systems also include impoundments or containers of alkaline-producing media that requires sub-annual, annual or multi-annual mechanical maintenance.

   Passive treatment technologies designed to treat net acidic water are not automatically awarded the designation of a *"proven"* treatment technology 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 theses passive treatment systems have successfully treated to net alkaline conditions for over a decade, many systems have been plagued with treatment performance issues due to premature plugging, short-circuiting, and other unknown causes. It appears that many of the performance issues are caused by metal hydroxide precipitate plugging the treatment matrix or from short circuiting, which may be caused by plugging, design, or construction issues. Some of the design and construction issues are resolved by construction oversight or by advancing the design of the technology. Attempts have been made to combat plugging caused by the precipitation of metal precipitates by incorporating flushing mechanisms or by routine mechanical agitation. Many of the flushing mechanisms have still resulted in poor treatment or premature plugging. If metal precipitate plugging is causing performance issues with passive treatment on net acidic discharges, a reasonable approach to defining treatability 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 is reduced. Since low metal loading discharges should limit premature plugging problems, we believe passive treatment is more of a “proven” technology when used to treat low metal loading discharges than when used to treat high metal loading discharges. Therefore, a Risk Matrix Table (*see table at end of this section)* was developed for evaluating and scoring how “proven” the proposed technology is at providing long-term treatment for the proposed treatment scenario. The risk matrix uses flow and water quality to assign a “risk designation” for the proposed treatment scenario. The risk designations range from Very Low to Very High. The lower the risk designation the more “*proven*” passive treatment is for the proposed water quality and quantity. The risk matrix was developed by using a combination of field experience gained from reviewing the treatment performance of passive treatment projects and from professional judgment. The risk matrix will be continuously reviewed and modified to reflect the treatment performance of systems built under these criteria.

While the treatability (*proven*) evaluation is an extremely important part of ensuring a successful project, evaluating the “reliability, and predictability is also important.

Reliability **–** Even if passive treatment is placed on low metal loading discharges, the *reliability* of the system to maintain treatment goals under varying hydrologic regimes may be questionable. The *reliability* of the treatment system to meet the treatment goals is based on the quality of the design data, the site conditions, and the system design. The project developers and designers are responsible for system performance and the *reliability* evaluation helps to assure that consideration is taken to ensure reliable treatment. Reliable treatment is critical to achieving restoration. In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *reliability* of a passive treatment system to maintain treatment goals:

- Ability to continue treatment during desludging or rehabilitation events;
- The treatment system is sized to produce net alkaline water under varying hydrologic conditions;
- The ability to control flow into the system;
- Ability to control system performance;
- Ease of treatment operation;
- Steps taken to minimize short circuiting.

Predictability **–** The ability to predict, control, and fix the cause(s) of poor treatment performance is vital to maintaining restoration. It is difficult to determine when a passive treatment system will no longer achieve its treatment goals. Historically, the design life of these systems has been defined by the longevity of the alkaline reagent to neutralize the design acidity loading, which is commonly 20 to 30 years. However, many treatment systems encounter performance issues long before the specified design life. When a passive treatment system begin to discharge net acidic water, it is difficult to identify the exact cause(s) of the poor performance. Simple troubleshooting techniques, such as visually monitoring the progression of plugging, is difficult for some types of passive treatment systems, such as, vertical flow ponds. Numerous limestone-based passive treatment cells are over an acre in size and some are > 3 acres. Troubleshooting these large systems for retention time issues is difficult and space limitations can make rehabilitating large treatment systems difficult. Even if troubleshooting techniques can identify the problem as short circuiting or plugging, locating the exact location of problem for targeted rehabilitation is difficult. The predictability evaluation ensures that ample thought is given to maintaining treatment performance, troubleshooting system performance, and rehabilitating poorly-performing systems. In addition to the general guidance provided in the introduction section, the following are examples of common issues that will affect the *predictability* of maintenance for a passive treatment system:

- The ability to monitor the progression of system plugging;
- The ability to monitor, prevent, and fix short circuiting;
- Ease of troubleshooting the treatment system;
- The steps necessary to rehabilitate the system are identified;
- Time frame between rehabilitation events;
- The ability to control hydraulic head within the system;
- A plan to dispose of spent compost to limestone;
- The ability to stockpile materials at the site during rehabilitation;
- The ability to quickly drain a treatment system for rehabilitation;
- The size of the treatment cells;
- The reliance on piping to feed mine drainage or route mine drainage through a treatment system;
- The reliance on pumping.

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	Very Low	Very Low	Very Low	Low
> 5 < 15 mg/L	Low	Moderate	Moderate	High
> 15 < 25 mg/L	Low	Moderate	Moderately High	High
> 25 < 50 mg/L	Moderate	Moderately High	High	Very High
> 50 mg/L	Very High	Very High	Very High	Very 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	Moderate	Moderate	Moderately High	Very High
> 5 < 15 mg/L	Very High	Very High	Very High	Very High
> 15 < 25 mg/L	Very High	Very High	Very High	Very High
> 25 < 50 mg/L	Very High	Very High	Very High	Very High
> 50 mg/L	Very High	Very High	Very High	Very High

Risk Matrix Table - Criteria used for the scoring of the *"proven"* evaluation.

5. **Innovative Technology –** Both new treatment technologies and improved versions of existing technologies are being developed. Improved versions of existing technologies should be evaluated using the existing criteria. New technologies that have not been field proven should be evaluated under this section. While <u>Title IV AML money cannot be used for research,</u> innovative technologies that cannot meet the current criteria of

"*proven, reliable, and predictable*" will be considered if it is apparent to the review committee that the technology has a high-likelihood of treatment success. Innovative technologies still need to prove that they will provide treatment, provide reliable treatment, and contain predictable maintenance requirements so that restoration can be achieved and maintained. New treatment technologies that are considered "innovative" will still be evaluated and scored based on the general *proven*, *reliable*, and *predictable* criteria set forth in the Introduction segment of this section.

6. **Abatement Projects –** Mine drainage abatement projects include projects that are focused on reducing or eliminating the source or effect of water quality or quantity issues from past coal-mining activities. This category of projects include, but is not limited to, stream flow diminution caused by underground mining, surface features that contribute water to a mine pool (e.g. water-filled pits), refuse pile removal to eliminate sedimentation issues, and stream channel reconstruction projects. Mine drainage diminution and/or abatement projects will still be evaluated based on the general *proven*, *reliable*, and *predictable* criteria set forth in the introduction of this section. In addition to the general *proven* criteria provided in the introduction, the background data should be sufficient enough to show the cause/effect relationship between the mining feature and the affected water resource. For example, reclamation of a water-filled pit overtop of a deep mine does not automatically result in the elimination or diminution of the deep mine discharge unless the two are hydrologically connected. While reclamation of abandoned pits is needed, set aside money can only be used for water resource reclamation (OSM Priority 3 problems) while Title IV money should be used to abate health and safety issues OSM Priority 1 and 2 problems). For some abatement projects, predicting the amount of hydrologic restoration that will result from the set aside reclamation activity is difficult. Therefore, an evaluation of the background data that proves the cause and effect relationship is warranted to legitimize the use of set aside money on these types of projects.

Project Selection Criteria

SCORING

Problem Assessment/Defining the Problem

Problems must be assessed in a comprehensive manner, using a watershed approach, rather than evaluating an individual site or discharge in isolation. SMCRA requires that Set Aside funding be spent in "qualified hydrologic units". Therefore, any proposed project must be within a qualified hydrologic unit to be considered for funding. There are specific guidelines that must be met for a hydrologic unit to qualify. Also, because SMCRA requires a comprehensive approach, there must be a restoration plan in place for the hydrologic unit that includes the site or discharge being scored and has determined the impact of the site or discharge to the receiving steam.

The proposed individual project is then scored based on the impact of the site or discharge to the receiving stream. Generally, streams must be on the Department's 303(d) list for a discharge to be considered. Section 303(d) of the Federal Clean Water Act requires states to list all impaired waters not supporting designated uses. In lieu of 303(d) listing, aquatic surveys using standard bioassessment protocols must show measurable impairment to aquatic life as a result of the discharge. Both the length of impairment and contribution of the discharge to the pollution load are evaluated when determining a problem score. The following table will be used to score the problem.

	Problem	Points
Minor	Site/Discharge impairs <1 mile of stream and <50% of the pollution load **or** >1 mile and <25% of the pollution load	**0 - 5**
Moderate	Site/Discharge impairs <1 mile of stream and >50% of pollution load **or** >1 mile and >25% of the pollution load	**6 - 10**
Serious	Site/Discharge impairs >1 mile of stream and contributes >50% of the pollution load **or** >2 miles and >25% of the pollution load	**11 - 15**
Very Serious	Site/Discharge impairs >2 miles of stream and contributes >75% of the pollution load **or** >4 miles and contributes >50% of the pollution load **or** >6 miles and >25% of the pollution load	**16 - 20**
Critical	Site/Discharge impairs >4 miles of stream and contributes >75% of the pollution load **or** pollutes >6 miles and contributes >50% of the pollution load	**21 - 25**

Project Specific Treatment or Restoration Goal(s)

The objective or goal of any AMD-related project is to restore land and/or water resources degraded by past mining activity. However to successfully evaluate and prioritize numerous projects a well defined, measurable and comprehensive project treatment or restoration goal must be established. The phrase "restore land and /or water resources" implies that the proposed water abatement or treatment activities will return a water resource to a pre-degraded condition in a reliable and predictable manner. It is important that the restoration goal is well defined, reasonable, achievable, and permanent. The project success scoring criteria is focused on evaluating the likelihood that the proposed plan will consistently achieve the restoration goals by accurately predicting the water quality of the effluent.

The attribute(s) or metric(s) used to define the treatment or restoration need to be practical, tangible, and easily implemented to facilitate an evaluation of whether treatment or restoration is being achieved after project implementation. Vague and implicit restoration goals like, "The goal of the project is to restore Laurel Run" are not preferred as they lack a defined and tangible attribute needed to evaluate if restoration is being achieved.

Examples of well defined and measurable treatment or restoration goals include, but are not limited to, the follow: (1) a numerically-based water quality based standard assigned at the end of the proposed treatment system; (2) a biologically-based goal assigned to a specific stream reach; (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 acid mine drainage; or (5) a hydrology resource restoration goal considering abatement or reduction of a discharge or pollution source.

A restoration or treatment goal may be comprehensive enough to address several different water quality issues at different points within a qualified hydrologic unit. For example, there may be a water-quality based goal of lowering the suspended iron concentration to 0.5 mg/L at stream mile 5.0, a water-quality based goal of raising pH to 6.5 at stream mile 8, while achieving an index of biological integrity (IBI) of greater than 63 throughout stream reaches 7 through 10. A restoration goal such as this provides well-defined goals and metrics by which one can design a plan to achieve restoration of the water resources affected by past coal mining activities. The following table will be used to score or rate project specific treatment or restoration goal(s).

Goal(s)	Criteria	Points
Poorly defined	A poorly defined goal is unclear, ambiguous, or uncertain; and/or is not practical or tangible. Poorly defined goals lack specific numerically or biologically-based water quality effluent or stream data.	0 - 5
Moderate defined	A moderately defined goal is reasonably practical, tangible, is reasonably implemented and contains sufficient measurable scientific information that can be evaluated to see if restoration can be achieved in a reliable and predictable manner. Moderately defined goals contain the same general information as well defined goals but may be lacking in specific detailed numerically or biologically-based water quality effluent or stream data.	6- 15
Well defined	A well defined goal is practical, tangible, is easily implemented and contains measurable scientific information (numerically-based water quality standard such as a TMDL or PA Code Title 25, chapter 87.102 effluent limitations, or a biologically-based index, etc.) that can be evaluated to see if restoration can be achieved in a reliable and predictable manner.	16- 25

Background Data/Restoration Plan

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). A guide for developing restoration plans can be found on the Department's website: http://www.depweb.state.pa.us/abandonedminerec/cwp/view.asp?a=1466&q=457803.

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 of whether mine drainage restoration and/or abatement is needed should be made so that adequate and applicable background data can be obtained.

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 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 low flow or base flow conditions and peak or "snow melt" conditions. Statistical summaries of flow measurements should include the minimum, maximum, median, and n-percentile values.

Water samples should be collected the same time flow measurements are made. Samples should be collected, preserved, and analyzed in accordance with "Standards 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.), ferrous iron, total iron, aluminum, manganese, and sulfate. The desirable parameters to be sampled for to evaluate ion balance checking and geochemical modeling include the minimum parameters above plus: net alkalinity (as CaCO3) calcium, magnesium, sodium, chloride, and potassium.

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. Coal refuse samples are recommended and 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.

The following tables will be used to evaluate and score the background data/restoration plan.

A.	Restoration Plan Evaluation	POINTS	SCORE
1.	Does this plan include a watershed map showing major topographic features and pollution sources?	Yes - 0 - 5 pts. No - -1 pts.	____________
2.	Are historical, archeological, geological, and biological watershed features defined?	Yes - 0 - 5 pts. No - -5 pts.	____________
3.	Are the problems in the watershed (such as AMD, sewage, habitat, etc.) and the opportunities clearly defined?	Yes - 0 - 10 pts. No - -10 pts.	____________
4.	Are acid mine drainage sources adequately located and characterized?	Yes - 0 - 5 pts. No - -1 pts.	____________
5.	Have project expectations been clearly defined? Are project proposals prioritized in a reasonable manner?	Yes - 0 - 10 pts. No - -10 pts.	____________
6.	Are realistic, tangible, and achievable restoration goals established?	Yes - 0 - 10 pts. No - -10 pts.	____________
7.	Is there documented local and/or public project support?	Yes - 0 - 5 pts. No - 0 pts.	____________
8.	Has a protocol for data collection (Quality Assurance Plan) been identified to ensure confidence in data collection?	Yes - 0 - 5 pts. No - -5 pts.	____________
9.	Has operation and maintenance (post-construction) been addressed?	Yes - 0 - 5 pts. No - -5 pts.	____________
10.	Is the project a AMD treatment type project	Yes– go to section B No – go to section C	
		Subtotal	____________

B.	Mine Drainage Characterization Evaluation (Flow and Water Quality) for Restoration Projects	POINTS	SCORE
1.	Has a sampling protocol for flow measurement and water sampling been identified to ensure confidence in data collection?	Yes - 5 – 15 pts. No - 0 pts.	______________
2.	Have low flow or base flow and associated chemistry been defined?	Yes - +5 pts. No - -5 pts.	______________
3.	Has peak flow and associated chemistry been defined?	Yes - +5 pts. No - -5 pts.	______________
4.	Flow and chemistry measurement frequency evaluation:		
	No flow data	-10 pts.	______________
	0 – 6 consecutive monthly samples	0 pts.	______________
	6 – 12 consecutive monthly samples	1 – 5 pts.	______________
	>12 consecutive monthly samples	5 – 10 pts.	______________
	Continuous flow recordings 6 -12 months	5 – 10 pts.	______________
	Continuous flow recordings >12 months	20 pts.	______________
5.	Has the design flow and chemistry characterization been scientifically and/or statistically determined?	Yes - +5 pts. No - -5 pts.	______________
6.	Have the water samples been analyzed by a certified/acceptable laboratory?	Yes - +5 pts. No - 0 pts.	______________
7.	Have an adequate number of parameters been identified to adequately characterize the AMD?	Yes - +5 pts. No - -5 pts.	______________
8.	Have an adequate number of parameters been identified to reasonably ensure QA/QC?	Yes - +5 pts. No - 0 pts.	______________
9.	Does the project include abatement aspects?	Yes - Go to Section C, Question 5 No - Go to Section D	______________
		Subtotal	

C.	**Site Assessment for Abatement Projects ONLY**	**POINTS**	**SCORE**
1.	Has a sampling protocol for flow measurement and water sampling been identified to ensure confidence in data collection?	Yes - 1 - 5 pts. No - 0 pts.	____________
2.	Have the water samples been analyzed by a certified/acceptable laboratory?	Yes - +5 pts. No - 0 pts.	____________
3.	Have an adequate number of parameters been identified to adequately characterize the AMD?	Yes - +5 pts. No - -5 pts.	____________
4.	Have an adequate number of parameters been identified to reasonably ensure QA/QC?	Yes - +5 pts. No - 0 pts.	____________
5.	Is an acceptable amount of upstream and downstream flow and chemistry data provided to adequately define the problem?	Yes - +5 pts. No - -5 pts.	____________
6.	Is an acceptable amount of information regarding sediment loss due to erosion been adequately addressed?	Yes - +5 pts. No - 0 pts.	____________
7.	Are any down dip AMD discharges identified and adequately sampled to determine impacts?	Yes - +5 pts. No - 0 pts.	____________
8.	Flow and chemistry measurement frequency evaluation		
	No flow data		____________
	0 – 6 consecutive monthly samples	0 pts.	____________
	6 – 12 consecutive monthly samples	1 – 5 pts.	____________
	>12 consecutive monthly samples	5 – 10 pts.	____________
	Continuous flow recordings 6 -12 months	10 – 15 pts.	____________
	Continuous flow recordings >12 months	20 pts.	____________
9.	The score can be increased up to a maximum of 15 points if the project eliminates AMD impacts associated with acid forming materials such as coal refuse?	Yes - 1 – 15 pts. No - 0 pts.	____________
		Subtotal	____________

D.	Other Considerations	POINTS	SCORE
1.	Is adequate land available to construct an acceptable treatment system?	Yes - +5 pts. No - -100 pts.	____________
2.	Does property owner consent exist?	Yes - +5 pts. No - -100 pts.	____________
3.	Have any soil test pits and/or geotechnical evaluations been identified and/or performed on-site?	Yes - +5 pts. No - 0 pts.	____________
4.	Have any environmental permit requirements been identified?	Yes - +5 pts. No - 0 pts.	____________
5.	Is there documented local and/or public project support?	Yes - +5 pts. No - -5 pts.	____________
6.	If coal refuse exists, will it be recovered for recoverable fuel use?	Yes - +5 pts. No - 0 pts.	____________
		Subtotal	____________
	(Add points from Sections A, B, C, and D as applicable)	**Total Points**	____________

Project Benefits

Mine drainage treatment or abatement projects could provide many varied benefits. Benefits could include:

- Elimination of an abandoned mine drainage discharge
- Reduction of an abandoned mine drainage discharge (Flow Rate)
- Reduction of an abandoned mine drainage discharge (Contaminant Loading Rate)
- Relocation of an abandoned mine discharge with positive implications
  - Relocation to facilitate treatment
  - Relocation to reduce impact on surface or groundwater
- Restoration of or improvement of AMD impacted surface waters
- Restoration of or improvement of AMD impacted groundwater
- Improvement in drinking water source
- Restoration of drinking water source
- Treatment of AMD for economic development
- Treatment of AMD for industrial use
- Treatment of AMD for potable water source
- Treatment of AMD for resource recovery
  - Metal sludges
- Economic Benefits
  - Employment of construction contractors
  - Fishing
  - Tourism
  - Waterway recreation
  - Increased property values
  - Other outdoor recreation or sightseeing
- Improved aesthetics
- Restoration of a stream to its designated use as defined in the Pennsylvania Code, Title 25, Environmental Protection, Chapter 93, Water Quality Standards
- Thermal pollution abatement
- Reduction or elimination of sedimentation problems
- Reduction in flood potential due to reduced sedimentation
- Reduction in corrosion damage to bridges, culverts, piers and other structures
- Creation of wildlife habitat
- Educational benefits
- Development of community pride
- Re-connection of good or high-quality tributaries or waters upstream to good quality waters below impaired zone.
- Development of local support or grassroots organizations for sustainable projects

Any of the project benefits identified above, or others not listed, can be used to evaluate the benefits of any particular project. The benefits should be tied to their impact on the problems identified in problem assessment section.

The following tables will be used to evaluate and score project benefits.

Assessment of Project Benefits			
	Criteria	**Points**	**Score**
1	A critical or very serious problem will be eliminated	24 - 25	
2	A serious or moderate problem will be eliminated	22 - 23	
3	A minor problem will be eliminated or a critical problem will be substantially (>50%) reduced	20 - 21	
4	A very serious or serious problem will be substantially (>50%) reduced	18 - 19	
5	A moderate or minor problem will be substantially (>50%) reduced	16 -17	
6	A critical mine drainage discharge will be treated (Chapter 87 effluent standards)	14 - 15	
7	A very serious or a serious mine drainage discharge will be treated (Chapter 87 effluent standards)	12 - 13	
8	A moderate or a minor mine drainage discharge will be treated (Chapter 87 effluent standards)	10 - 11	
9	A critical or a very serious mine drainage discharge will be substantially treated (>75%reduction in loading or net alkaline)	8 - 9	
10	A serious or a moderate mine drainage discharge will be substantially treated (>75%reduction in loading or net alkaline)	6 - 7	
11	A minor mine drainage discharge will be substantially treated (>75%reduction in loading or net alkaline)	4 - 5	
12	The score can be increased up to a maximum of 10 points for following project benefits: economic benefits, industrial development, aesthetics, educational benefits, resource recovery, other ancillary project benefits	0 - 10	

Note: *The maximum score for this criterion is 25 points with a possible bonus of up to 10 points for additional benefits as identified in item No. 12 above making the maximum score with all bonus points equal to 35 points.*

Total Score = _______

Application of Technology and Risk Assessment

The following tables will be used to score the application of technology assessment for mine drainage treatment projects. **(Refer to the Mine Drainage Treatability Criteria section for further guidance on the evaluation of applicable technology and risk assessment)**

	Technology Assessment for Treatment Projects		
A.	**Analysis of *"Proven"* Technology**	**POINTS**	**SCORE**
1.	Evaluate the recommended technology successfully used at numerous locations under treatment scenarios similar to the proposed project.	0 – 10 pts.	________
2.	Evaluate whether (or the degree that) the proposed treatment system/facility was sized or manufactured using a science-base approach	0 – 10 pts.	________
3.	Evaluate the data-supported performance record for the proposed treatment system.	0 – 10 pts.	________
4.	Other factors that affect the "Proven" evaluation	-10 – 10 pts.	________
		Subtotal	
B.	**Analysis of *"Reliable"* Technology**	**POINTS**	**SCORE**
1.	Evaluate the likelihood that the recommended treatment system/facility will achieve the treatment/abatement goals for greater than ninety percent (> 90%) of the design life.	0 – 10 pts.	________
2.	Evaluate whether the proposed treatment system/facility be operated and maintained to consistently achieve treatment/abatement goals.	0 – 10 pts.	________
3.	Evaluate whether the proposed treatment system/facility can be manipulated to achieve treatment/abatement goals under varying flow, chemistry, and operational conditions.	0 – 10 pts.	________
4.	Evaluate whether the proposed treatment system/facility has a data-supported performance record in treatment scenario(s) similar to the proposed project.	0 – 10 pts.	________
5.	Evaluate whether the proposed treatment system/facility can be operated to achieve varying degrees of treatment.	0 – 10 pts.	________
6.	Other factors that affect the "Predictability" evaluation.	-10 – 10 pts.	________
		Subtotal	

C.	Analysis of ***"Predictable"*** Technology	POINTS	SCORE
1.	Evaluate whether the proposed treatment system/facility contains the capacity to easily troubleshoot operational problems.	0 – 10 pts.	____________
2.	Evaluate whether the proposed treatment system/facility be easily maintained or rehabilitated if the treatment/abatement goals are not being achieved.	0 – 10 pts.	____________
3.	Evaluate whether the proposed treatment system/facility contains maintenance flexibility built into the treatment scheme?	0 – 10 pts.	____________
4.	Other factors that affect the "Reliability" evaluation	-10 – 10 pts.	____________
		Subtotal	
D.	**Application of Risk Matrix Table** **(For treatment technology category 4. All other types of Passive Treatment for Net Acidic Discharges)**	**POINTS**	**SCORE**
1.	The proposed treatment system/facility has a **very high** risk according to the Risk Matrix Table.	Yes - -120 pts. No - 0 pts.	____________
2.	The proposed treatment system/facility has a **high** risk according to the Risk Matrix Table.	Yes - -90 pts. No - 0 pts.	____________
3.	The proposed treatment system/facility has a **moderately high** risk according to the Risk Matrix Table.	Yes - -60 pts. No - 0 pts.	____________
4.	The proposed treatment system/facility has a **moderate** risk according to the Risk Matrix Table.	Yes - -30 pts. No - 0 pts.	____________
		Subtotal	____________
	(Add points from Sections A, B, C, and D)	**Total Points**	____________

The following tables will be used to score the application of technology assessment for mine drainage abatement projects.

Technology Assessment for Abatement Projects	POINTS
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**

Alternatives Analysis

For all proposed passive mine drainage treatment projects or mine drainage abatement projects with estimated capital costs in excess of $100,000, an alternatives analysis must be completed. 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 operation and maintenance costs should be developed for each alternative and compared on a common basis. The AMDTreat software is an acceptable tool for use in completing an alternatives analysis. New or innovative technologies or treatment processes can be evaluated; however, the uncertainty of new or innovative approach should be discussed 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 could be 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 entirely possible that some project sites do not lend themselves to more than one alternative. For such sites where the estimated project cost is in excess of $100,000, no alternative analysis needs to be completed. However, the reason(s) for not completing the alternatives analysis should be adequately explained and documented. The following table should be used to evaluate the alternatives analysis.

Alternatives Analysis	Criteria	Points
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	25

Project Capital Costs

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 operation and maintenance or the future cost of replacing the system or facility will be evaluated under the "Operation and Maintenance" Section. There are many methods that could be used to develop a 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 cost estimate for mine drainage treatment projects is AMDTreat. AMDTreat is available for download at the following web address: http://amd.osmre.gov/.

AMDTreat, a member of OSM's Technical Innovation and Professional Services (TIPS) suite of software, is a computer application for estimating abatement costs for pollutional mine drainage, commonly referred to as Acid Mine Drainage or AMD(also referred to Acid Rock Drainage or ARD). AMDTreat can assist a user in estimating costs to abate water pollution using a variety of passive and chemical l 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 acid mine drainage 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 the Pennsylvania Department of Environmental Protection, the West Virginia Department of Environmental Protection and the U.S. Office of Surface Mining Reclamation and Enforcement (OSM).

The following table will be used to score or rate project capital costs.

Costs	Criteria	Points
Very High Cost	> $5.0 million	0 - 5
High Cost	> $1.0 million and < $5.0 million	6- 10
Moderate Cost	> $300,000 and < $1.0 million	11-15
Low Cost	> $100,000 and < $300,000	16-20
Very Low Cost	< $100,000	21- 25

Operation, Monitoring and Maintenance Requirements and Costs

The treatment of AMD discharges, either passively or actively, requires that operational needs be addressed. Operation, Maintenance and Replacement (OMR) 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). Therefore, the level to which the activities and funding are addressed by the proposed project affects the scoring of the project. In particular, projects that do not depend upon government for day to day operation and funding of long-term OMR will be scored more favorably. 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. The following table will be used to score OMR.

O&M Plan, O&M Funding and O&M Responsibility Assessment	POINTS
No long-term O&M funding, no or inadequate OMR plan, limited local responsibility;	0 - 5
OMR plan that identifies local responsibility for routine O&M (passive) **or** an entity exists that will provide O&M at an active facility; long-term funding includes government sources **or** a partial government funded trust fund in place.	6 - 10
OMR plan that identifies local responsibility for routine O&M (passive) **or** an entity exists that will provide O&M at an active facility; significant OMR provided by a non-government entity **and/or** trust fund in place that is at least partially funded from non-government sources.	11 – 15
All OMR to be provided by a non-government entity and trust fund in place that is at least partially privately funded.	16 – 20
All OMR to be provided by a non-government entity; OMR fully funded by a non-government funded trust; **or** project will reduce the quantity or improve the quality of a discharge by abatement methods – no treatment required.	21 – 25
Project will entirely eliminate a discharge – no treatment required, therefore no OMR is required.	50

Non-Title IV Matching Funds

Mine drainage systems are expensive to construct and maintain. Even though BAMR can use up to 30% of its annual AML grant for mine water treatment, it is not nearly enough to clean up all the mine drainage problems in Pennsylvania. Additional funds from other sources assist with the construction and maintenance of mine drainage systems. Additional funds can be obtained from various sources; however, it is divided into two general sources. 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 are either one time contributions or continuous (i.e. yearly) contributions to a project. One time contributions are usually given at the beginning of a project and are applied to the initial or capital cost of the project. Continuous contributions are usually less than one time contributions; however, they are used throughout the life of the system and assist with the operation and maintenance costs.

Public Match Money							
% Capital Costs				% Operation and Maintenance Costs			
	No Formal Agreement Points	Formal Agreement Points	Percent of Costs		No Formal Agreement Points	Formal Agreement Points	Percent of Costs
0%	0	0		0%	0	0	
0% to 9%	1-3	3-9		0% to 9%	1-3	3-9	
10% to 24%	4-6	10-14		10% to 24%	4-6	10-14	
25% to 49%	7-8	15-19		25% to 49%	7-8	15-19	
50% or more	9-10	20-25		50% or more	9-10	20-25	
		Score =	______			Score =	______

Private Match Money							
% Capital Costs				% Operation and Maintenance Costs			
	No Formal Agreement Points	Formal Agreement Points	Percent of Costs		No Formal Agreement Points	Formal Agreement Points	Percent of Costs
0%	0	0		0%	0	0	
0% to 9%	1-5	4-10		0% to 9%	1-5	4-10	
10% to 24%	6-8	11-15		10% to 24%	6-8	11-15	
25% to 49%	9-10	16-20		25% to 49%	9-10	16-20	
50% or more	11-12	21-25		50% or more	11-12	21-25	
		Score =	______			Score =	______

Total Score = ______

Intangibles

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. The list is not inclusive and other items not listed can be inserted with a reasonable score.

	Criteria	Points	Score
1	**Public Opposition.** Opposition should be community based and not consist of a few people.	0 to -25	
2	**Permitting Issues.** Significant issues exist that would make obtaining a permit for the proposed project extremely time consuming, very expensive or otherwise difficult. The issues could be T&E species, water, historical or archeological, environmental, E&S, etc.	0 to -25	
3	**Downstream Structures.** The proposed project would adversely affect existing downstream structures and cause potential flooding. The structures may not have the capacity to convey any additional flow generated by the proposed project requiring the structures to be replaced for the project to proceed.	0 to -25	
4	**Legal Issues.** Existing or potential issues that could lead to litigation for the project partners, land owners, and etc.	0 to -25	
5	**Health and Safety Issues.** The proposed project would adversely affect the public health and safety by creating a dangerous or unappealing environment.	0 to -25	
6	**Vandalism.** The proposed project would be constructed in an area that has had numerous occurrences of destructive vandalism to other infrastructures.	0 to -25	
7	**None Identified.**	0	
8	**Governmental In-Kind Services.** These services would be provided by other governmental agencies other than BAMR that would contribute to the project. These services would exclude any monetary contributions.	0 to 25	
9	**Private Industry In-Kind Services.** Services would be provided by private industries that contribute to the project and exclude any monetary contributions.	0 to 25	
10	**Local Support In-Kind Services.** Services would be provided by local non-profit groups who contribute to the project and exclude any monetary contributions.	0 to 25	
11	**Resource Recovery.** The proposed project has the potential to generate resources that could be used in other industries. Resource recovery should be stated in the goals of the proposed project.	0 to 25	
12	**Energy Generation.** The proposed project has the potential to 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 to 25	
13	**Health and Safety Feature Eliminated.** As part of the overall project a documented OSM Priority 1 or 2 problems will also be eliminated by utilizing excess material from the proposed treatment system.	0 to 25	
14	**Additional Recreation.** The proposed project will add or improve recreation in the local community. The additional recreation does not include fishing, boating, or swimming since these are expected recreational benefits of the project.	0 to 25	
15	**Innovative Technology.** The proposed project involves new or innovative technologies. Documentation should be cited on how the technology applies to the problem. No adverse impacts should result from use of the technology.	0 to 25	
16	**Flooding.** The proposed project is at serious risk of routine flooding by an adjacent watercourse.	0 to -25	
17	**Other.** ____	-25 to 25	

Total Score = _________

Individual Project Score Sheet

	Project Selection Criteria	Score (a)	Maximum Criteria Score (b)	Weighted Percentage (c)	Score [(a) / (b) x 100 x (c)]
1	Problem Assessment / Defining the Problem		25	**7%**	
2	Project Goals		25	**12%**	
3	Background Data / Restoration Plan		145	**10%**	
4	Project Benefits		25	**10%**	
5	Application of Technology/Risk Assessment		140	**20%**	
6	Alternatives Analysis		25	**5%**	
7	Project Capital Costs		25	**15%**	
8	Operation, Monitoring, and Maintenance Requirements and Costs		25	**12%**	
9	Non-Title IV Matching Funds		25	**9%**	
10	Intangibles		200	**+/- 5%**	

Total Score = ________

Site Name ____________________
Project or Problem Area Number ____________________
Municipality ____________________
County ____________________
Watershed ____________________
Project Evaluator(s) ____________________
Date Evaluated ____________________
Additional Comments ____________________

Individual Project Record of Decision

	Project Selection Criteria	Record of Decision
1	Problem Assessment / Defining the Problem	
2	Project Goals	
3	Background Data / Restoration Plan	
4	Project Benefits	
5	Application of Technology/Risk Assessment	
6	Alternatives Analysis	
7	Project Capital Costs	
8	Operation, Monitoring, and Maintenance Requirements and Costs	
9	Local Support	
10	Non-Title IV Matching Funds	
11	Intangibles	

Site Name ____

Project or Problem Area Number ____________________________

Municipality ____

County ____

Watershed ____

Project Evaluator(s) _____________________________________

Date Evaluated ____

Additional Comments _____________________________________

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Project 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 following table 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, the Department will not pursue any mine drainage projects unless the project is determined to have either high or exceptional worth.**

Project Worth	Overall Project Score
Exceptional Worth	> 90 – 100+
High Worth	> 70 – 90
Moderate Worth	> 50 – 70
Low Worth	50 or less

Next Steps

The Mine Drainage Treatability and Project Selection Workgroup will be accepting written comments on the draft Mine Drainage Treatability and Project Selection Guidelines until June 27, 2008. Following the conclusion of the comment period, the workgroup will consider all of the comments received and begin to develop final guidelines. The goal of the workgroup is to finalize the guidelines by early August so the Department can present them at Pennsylvania's 2008 Abandoned Mine Reclamation Conference scheduled for August 12-14 in State College. Additionally, another joint PA-DEP/OSM workgroup will be established soon to develop criteria for qualified hydrologic units.

Once final, the Mine Drainage Treatability and Project Selection Guidelines will be incorporated into Pennsylvania's Comprehensive Plan for Abandoned Mine Reclamation (CPAMR). The CPAMR is Pennsylvania's primary tool for evaluating proposed reclamation projects to determine the highest worth projects to fund. A separate focus group is working on other revisions to the CPAMR dealing primarily with health and safety (OSM Priority 1 and 2) AML problems. After all revisions to the CPAMR have been finalized, Pennsylvania will be updating its Abandoned Mine Reclamation Plan and submitting it to OSM for review and approval. This plan outlines how Pennsylvania will implement the AML Program in Pennsylvania and how the

AML Program will satisfy all of the statutory and regulatory requirements imposed on the Commonwealth through SMCRA.

Transitioning to the new "Mine Drainage Treatability and Project Selection Guidelines"

Once final, the Mine Drainage Treatability and Project Selection Guidelines will be the primary method used to evaluate and select mine drainage treatment or abatement projects proposed for SMCRA Title IV funding. However, the guidelines are not absolute and will not be the basis for every mine drainage project decision. There will also be a transition period where projects that the Department has already committed to will be completed or re-evaluated. Several major watershed restoration efforts or cooperative mine drainage treatment efforts that will continue include:

- Lancashire No. 15 Treatment Facility
  (B&T, Duman Treatment Facility Re-location – Cooperative project with SRBC))
- Bennett Branch Restoration (Cooperative project with BBWA & PAWilds)
  - Hollywood Mine Drainage Treatment Facility
  - Other reclamation and/or mine drainage abatement projects
  - Dents Run Restoration (Cooperative project with BBWA & COE-Balt.)
- Wehrum Mine Drainage Treatment Facility (Cooperative project with BCWA)
- Cresson Shaft Mine Drainage Treatment Facility (Cooperative project with SRBC)
- Great Trough Creek (Alvan/Dudley Disappearing Streams)
- Indian Creek Restoration
- Quemahoning Creek Restoration – Hoffman Zion Phase 2 Treatment System
- Two Lick Creek – Diamondville Treatment System
- Deer Creek/Redland Brick Treatment System
- Cooks Run – Fran Contracting, Inc. Treatment System
- Schuylkill River – Mary D Mine Drainage Treatment Project