Proposed

DUNKARD CREEK WATERSHED TMDL
Greene County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

Revised
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TMDL[1]
Dunkard Creek Watershed
Greene County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 19-G Dunkard Creek								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	8.5	NA	41420	Dunkard Creek	WWF	305(b) Report	RE	metals
1996	6.5	NA	41420	Dunkard Creek	WWF	305(b) Report	RE	other *
1998	8.5	NA	41420	Dunkard Creek	WWF	SWMP	AMD	metals
1998	6.5	NA	41420	Dunkard Creek	WWF	SWMP	AMD	other *
2002	3.6	981116-1330-ALF	41420	Dunkard Creek	WWF	SWMP	AMD	metals suspended solids
2004	3.6	981116-1330-ALF	41420	Dunkard Creek	WWF		AMD	suspended solids metals

*iron precipitate covering stream rocks
Resource Extraction=RE
Warm Water Fish = WWF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD
See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists.* The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Lower Dunkard Creek Watershed (Attachments A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers one segment on this list. Dunkard Creek was listed as impaired for metals as well as iron precipitate. Addressing the metals and acidity impairment will also cover the iron precipitate. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Directions to the Dunkard Creek Watershed

The Dunkard Creek Watershed lies in the southeastern portion of Greene County. It is bounded on the east by the Monongahela River, on the south by the towns of Bobtown and Moffit-Sterling, on the north by Whiteley Creek and on the west by State Game Lands #223. The lower portion of the Dunkard Creek Watershed can be found on the southwestern quarter of the

[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Masontown 7 ½ quadrangle and a small portion of the southeastern portion of the adjacent Garards Fort 7 ½ quadrangle.

Access to this portion of Dunkard Creek can be gained by driving south from Greensboro (or points further to the north such as Brownsville near it's intersection with Route 43) on State Route 88 along the Monongahela River, then west from Route 88 through Moffit-Sterling. The intersection of Route 88 and the road to Moffitt-Sterling lies next to the mouth of Dunkard Creek.

Hydrology and Geology

Most of the watershed is privately held and is partially forested. Land uses include rural residential properties and small villages, minor industrial development, minor agricultural areas and abandoned and active mine lands. The 5000-acre watershed area studied encompasses the lower third of the watershed, mainly east and north of the town of Bobtown.

Dunkard Creek drains into the Monongahela River approximately 1.5 miles north of the town of Dilliner and 2.8 miles north of the PA-WV state line. The Monongahela River at this point supports recreational uses such as boating and some fishing.

The watershed area straddles two Appalachian Physiographic Provinces. The majority of the watershed lies in the Waynesburg Hills Section. A small portion of the eastern-most section of the watershed lies in the Pittsburgh Low Plateau Section. Both sections are strongly dissected by stream valleys – of which Dunkard Creek is a good example. The position of the Monongahela River has helped determine base level for local groundwater systems. The mouth of Dunkard Creek lies at an elevation of approximately 778' MSL. The areas of highest elevation within the study area lie at the extreme northwestern corner of the watershed area at approximately 1500' MSL.

Bedrock geology exposed within the area is composed primarily of members of the upper section of the Conemaugh Group, the entire Monongahela Group and the lower portion of the Waynesburg Formation. Units of the Lower Pittsburgh Limestone through and including the overburden associated with the Waynesburg A coal seam can be identified within the Lower Dunkard Creek watershed.

Structurally, local strata dips to the northwest on an average of three percent. The Lambert Synclinal Axis lies several miles to the north-northwest but terminates north of the study area. Structural determinations were based on drill hole data, cropline investigations and data derived from coal elevations within the numerous deep mines in the area.

Segments addressed in this TMDL

Dunkard Creek is affected by pollution from AMD. This pollution has caused high levels of metals in the watershed. There are numerous active mining operations in the watershed. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Table 3 for TMDL calculations and see Attachment C for TMDL explanations.

Clean Water Act Requirements

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be “fishable” and “swimmable.”

Additionally, the federal Clean Water Act and the Environmental Protection Agency’s (EPA) implementing regulations (40 CFR Part 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);

- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

- States to submit the list of waters to EPA every two years (April 1 of the even numbered years);

- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and nonpoint sources; and

- EPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and EPA had not developed many TMDLs. Beginning in 1986, organizations in many states filed lawsuits against the EPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While EPA has entered into consent agreements with the plaintiffs in several states, other lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the assessed stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates and habitat evaluations. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on habitat scores and a series of narrative biological statements used to evaluate the benthic macroinvertebrate community. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating the TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment and comment period on draft TMDL;

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[2] Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

This watershed reflects the hydrologic impacts by past surface and deep mining operations. In addition, field studies show that intermittent logging has been continuous for at least the last century. Large-scale deep mining on the Pittsburgh and Sewickley coal seams took place within the entire watershed. The Pittsburgh coal crops out along the eastern border of the watershed (~950 feet) and dips to the northwest, lying approximately 750 feet below the surface in the extreme northwestern portion of the sub-watershed. The Sewickley coal crops out at higher elevations (~1050 feet) along the eastern portion of the watershed and also dips to the northwest. Smaller-scale deep mines and surface mines of varying extent on the overlying Pittsburgh rider coal (limited extent), Waynesburg and Waynesburg A coal seams lie scattered across much of the watershed area. Several abandoned, closed and/or active coal refuse sites lie within the Dunkard Creek watershed. Dana Mining's Warwick #3 coal refuse disposal site has two NPDES points for sedimentation ponds. These ponds have been dry or not discharged for several years. Other NPDES points are present within the watershed but lie well outside the target segment. Several of the abandoned sites have post-mining discharges that are untreated. All of the deep mining operations within this section of the watershed are now abandoned; much of the abandoned Pittsburgh deep mines and portions of the Sewickley deep mines are flooded. The Dunkard Creek hydrologic unit Plan developed by the Cambria Office, BAMR, and PADEP in May 2003 identified a number of abandoned deep mine discharges in the Dunkard Creek watershed. Two, points #7 and #8, lie several hundred feet downstream of DUNK03. Several of the abandoned surface mines also have post-mining discharges. The mine drainage (elevated sulfates and variable metals) within portions of the receiving stream and its tributaries is related to these abandoned mine discharges. The main stem of Dunkard Creek is net alkaline with varying concentrations of metals.

Current NPDES permits in the Dunkard Creek Watershed:

AMD Reclamation Inc., Shannopin Mine Dewatering Project, CMAP# 30031601 NPDES# PA0235474
Cobra Mining, LLC, Dunkard Mine No. 2, CMAP#30841309 NPDES# PA0214825
Consolidation Coal Company, Hughes Hollow Slurry Impoundment, CMAP# 30950701 NPDES# PA0215619
Consolidation Coal Company, Humphrey Mine No. 7, CMAP# 30841302 NPDES# PA0213918
Concorde Corp. (Energy Resources Corp of America), Laurita Strip II, SMP# 32B77SM3
Coresco, Inc., Gapen Surface Mine, CSMP# 30010102 NPDES# PA0203017
Dana Mining Company of PA, Inc., Dooley Run Mine, CMAP# 30841320 NPDES# PA0213861
Dana Mining Company of PA, Inc., 4-West Mine, CMAP# 30031301 NPDES# PA0235610
Dana Mining Company of PA, Inc., Titus Mine, CMAP# 30841314 NPDES# PA0215368

AMD Methodology

A two-step approach is used for the TMDL analysis of AMD impaired stream segments. The first step uses a statistical method for determining the allowable instream concentration at the point of interest necessary to meet water quality standards. This is done at each point of interest (sample point) in the watershed. The second step is a mass balance of the loads as they pass through the watershed. Loads at these points will be computed based on average annual flow.

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges or a discharge that has a responsible party, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to non-point sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are point-source impacts alone, or in combination with non-point sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards*, will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

$$PR = \text{maximum } \{0, (1-Cc/Cd)\} \text{ where} \quad (1)$$

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

Cd = randomly generated pollutant source concentration in mg/l based on the observed data

$$Cd = \text{RiskLognorm(Mean, Standard Deviation) where} \quad (1a)$$

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

[3] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5,000 iterations, so that the allowable long-term average (LTA) concentration is:

$$LTA = Mean * (1 - PR99) \text{ where} \tag{2}$$

LTA = allowable LTA source concentration in mg/l

Once the allowable concentration and load for each pollutant is determined, mass-balance accounting is performed starting at the top of the watershed and working down in sequence. This mass-balance or load tracking is explained below.

Load tracking through the watershed utilizes the change in measured loads from sample location to sample location, as well as the allowable load that was determined at each point using the @Risk program.

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

Tracking loads through the watershed gives the best picture of how the pollutants are affecting the watershed based on the information that is available. The analysis is done to insure that water quality standards will be met at all points in the stream. The TMDL must be designed to meet standards at all points in the stream, and in completing the analysis, reductions that must be made to upstream points are considered to be accomplished when evaluating points that are lower in the watershed. Another key point is that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

For pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Statistical procedures are applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for streams affected by low pH from AMD may not be a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Information for the TMDL analysis performed using the methodology described above is contained in the “TMDLs by Segment” section of this report.

Method to Quantify Treatment Pond Pollutant Load

Calculating Waste Load Allocations for Active Mining in the TMDL Stream Segment.

The end product of the TMDL report is to develop Waste Load Allocations (WLA) and Load Allocations (LA) that represent the amount of pollution the stream can assimilate while still achieving in-stream limits. The LA is the load from abandoned mine lands where there is no NPDES permit or responsible party. The WLA is the pollution load from active mining that is permitted through NPDES.

In preparing the TMDL, calculations are done to determine the allowable load. The actual load measured in the stream is equal to the allowable load plus the reduced load.

Total Measured Load = Allowed Load + Reduced Load

If there is active mining or anticipated mining in the near future in the watershed, the allowed load must include both a WLA and a LA component.

Allowed Load (lbs/day) = WLA (lbs/day) + LA (lbs/day)

The following is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits.

Surface coalmines remove soil and overburden materials to expose the underground coal seams for removal. After removal of the coal the overburden is replaced as mine spoil and the soil is replaced for revegetation. In a typical surface mining operation the overburden materials is removed and placed in the previous cut where the coal has been removed. In this fashion, an active mining operation has a pit that progresses through the mining site during the life of the mine. The pit may have water reporting to it, as it is a low spot in the local area. Pit water can be the result of limited shallow groundwater seepage, direct precipitation into the pit, and surface runoff from partially regarded areas that have been backfilled but not yet revegetated. Pit water is pumped to nearby treatment ponds where it is treated to the required treatment pond effluent limits. The standard effluent limits are as follows, although stricter effluent limits may be applied to a mining permit’s effluent limits to insure that the discharge of treated water does not cause in-stream limits to be exceeded.

Standard Treatment Pond Effluent Limits:
Alkalinity > Acidity
6.0 <= pH <= 9.0

$$Fe < 3.0 \text{ mg/l}$$
$$Mn < 2.0 \text{ mg/l}$$
$$Al < 2.0 \text{ mg/l}$$

Discharge from treatment ponds on a mine site is intermittent and often varies as a result of precipitation events. Measured flow rates are almost never available. If accurate flow data are available, they can be used to quantify the WLA. The following is an approach that can be used to determine a waste load allocation for an active mining operation when treatment pond flow rates are not available. The methodology involves quantifying the hydrology of the portion of a surface mine site that contributes flow to the pit and then calculating waste load allocation using NPDES treatment pond effluent limits.

The total water volume reporting to ponds for treatment can come from two primary sources: direct precipitation to the pit and runoff from the unregraded area following the pit's progression through the site. Groundwater seepage reporting to the pit is considered negligible compared to the flow rates resulting from precipitation.

In an active mining scenario, a mine operator pumps pit water to the ponds for chemical treatment. Pit water is often acidic with dissolved metals in nature. At the treatment ponds, alkaline chemicals are added to increase the pH and encourage dissolved metals to precipitate and settle. Pennsylvania averages 41.4 inches of precipitation per year (Mid-Atlantic River Forecast Center, National Weather Service, State College, PA, 1961-1990, http://www.dep.state.pa.us/dep/subject/hotopics/drought/PrecipNorm.htm). A maximum pit dimension without special permit approval is 1500 feet long by 300 feet wide. Assuming that 5 percent of the precipitation evaporates and the remaining 95 percent flows to the low spot in the active pit to be pumped to the treatment ponds, results in the following equation and average flow rates for the pit area.

$$41.4 \text{ in. precip./yr} \times 0.95 \times 1 \text{ ft./12/in.} \times 1500' \times 300'\text{/pit} \times 7.48 \text{ gal/ft}^3 \times 1\text{yr/365days} \times 1\text{day/24hr.} \times 1\text{hr./60 min.} =$$

$$= 21.0 \text{ gal/min average discharge from direct precipitation into the open mining pit area.}$$

Pit water can also result from runoff from the unregraded and revegetated area following the pit. In the case of roughly backfilled and highly porous spoil, there is very little surface runoff. It is estimated that 80 percent of precipitation on the roughly regarded mine spoil infiltrates, 5 percent evaporates, and 15 percent may run off to the pit for pumping and potential treatment (Jay Hawkins, Office of Surface Mining, Department of the Interior, Personal Communications 2003). Regrading and revegetation of the mine spoil is conducted as the mining progresses. DEP encourages concurrent backfilling and revegetation through its compliance efforts and it is in the interest of the mining operator to minimize the company's reclamation bond liability by keeping the site reclaimed and revegetated. Experience has shown that reclamation and revegetation is accomplished two to three pit widths behind the active mining pit area. DEP uses three pit widths as an area representing potential flow to the pit when reviewing the NPDES permit application and calculating effluent limits based on best available treatment technology and insuring that in-stream limits are met. The same approach is used in the following equation, which represents the average flow reporting to the pit from the unregraded and unrevegetated spoil area.

41.4 in. precip./yr x 3 pit areas x 1 ft./12/in. x 1500’x300’/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. x 15 in. runoff/100 in. precipitation =

= 9.9 gal./min. average discharge from spoil runoff into the pit area.

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 21.0 gal./min + 9.9 gal./min. = 30.9 gal./min.

The resulting average waste load from a permitted treatment pond area is as follows.

Allowable Iron Waste Load Allocation:
30.9 gal./min. x 3 mg/l x 0.01202 = 1.1 lbs./day

Allowable Manganese Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

Allowable Aluminum Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

(Note: 0.01202 is a conversion factor to convert from a flow rate in gal/min. and a concentration in mg/l to a load in units of lbs./day.)

There is little or no documentation available to quantify the actual amount of water that is typically pumped from active pits to treatment ponds. Experience and observations suggest that the above approach is very conservative and overestimates the quantity of water, creating a large margin of safety in the methodology. County specific precipitation rates can be used in place of the long-term state average rate, although the margin of safety is greater than differences from individual counties. It is common for many mining sites to have very “dry” pits that rarely accumulate water that would require pumping and treatment.

Also, it is the goal of DEP’s permit review process to not issue mining permits that would cause negative impacts to the environment. As a step to insure that a mine site does not produce acid mine drainage, it is common to require the addition of alkaline materials (waste lime, baghouse lime, limestone, etc.) to the backfill spoil materials to neutralize any acid-forming materials that may be present. This practice of ‘alkaline addition’ or the incorporation of naturally occurring alkaline spoil materials (limestone, alkaline shale or other rocks) may produce alkaline pit water with very low metals concentrations that does not require treatment. A comprehensive study in 1999 evaluated mining permits issued since 1987 and found that only 2.2 percent resulted in a post-mining pollution discharge (Evaluation of Mining Permits Resulting in Acid Mine Drainage 1987-1996: A Post Mortem Study, March 1999). As a result of efforts to insure that acid mine drainage is prevented, most mining operations have alkaline pit water that often meets effluent limits and requires little or no treatment.

While most mining operations are permitted and allowed to have a standard, 1500’ x 300’ pit, most are well below that size and have a corresponding decreased flow and load. Where pit dimensions are greater than the standard size or multiple pits are present, the calculations to define the potential pollution load can be adjusted accordingly. Hence, the above calculated Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered. A large margin of safety is included in the WLA calculations.

The allowable load for the stream segment is determined by modeling of flow and water quality data. The allowable load has a potential Waste Load Allocation (WLA) component if there is active mining or anticipated future mining and a Load Allocation (LA). So, the sum of the Load Allocation and the Waste Load Allocation is equal to the allowed load. The WLA is determined by the above calculations and the LA is determined by the difference between the allowed load and the WLA.

Allowed Load = Waste Load Allocation + Load Allocation
Or
Load Allocation = Allowed Load – Waste Load Allocation

This is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits. This allows for including active mining activities and their associated Waste Load in the TMDL calculations to more accurately represent the watershed pollution sources and the reductions necessary to achieve in-stream limits. When a mining operation is concluded its WLA is available for a different operation. Where there are indications that future mining in a watershed are greater than the current level of mining activity, an additional WLA amount may be included in the allowed load to allow for future mining.

TMDL Endpoints

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

The TMDLs' component makeup will be Load Allocations (LAs) and Waste Load Allocations (WLAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	*Criterion Value (mg/l)*	*Total Recoverable/Dissolved*
Aluminum (Al)	0.75	Total Recoverable

Iron (Fe)	1.50	30 day average; Total Recoverable
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality.

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The waste load allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 3 for each segment are based on the assumption that all upstream allocations are achieved and take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit MOS based on conservative assumptions in the analysis is included in the TMDL calculations.

The allowable LTA concentration in each segment is calculated using Monte Carlo Simulation as described previously. The allowable load is then determined by multiplying the allowable concentration by the flow and a conversion factor at each sample point. The allowable load is the TMDL.

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. The difference between the TMDL and the WLA at each point is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced within a segment in order for water quality standards to be met at the point.

In some instances, instream processes, such as settling, are taking place within a stream segment. These processes are evidenced by a decrease in measured loading between consecutive sample points. It is appropriate to account for these losses when tracking upstream loading through a segment. The calculated upstream load lost within a segment is proportional to the difference in the measured loading between the sampling points.

Table 3. Dunkard Creek Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
DOOL01 – Mouth of Dooley Run						
Aluminum (lbs/day)	0.23	0.23	0	NA	NA	NA
Iron (lbs/day)	0.75	0.75	0	NA	NA	NA
Manganese(lbs/day)	0.27	0.27	0	NA	NA	NA
Acidity (lbs/day)	34.84	34.84	0	NA	NA	NA
DUNK07 – Uppermost segment on Dunkard Creek upstream of Meadow Run						
Aluminum (lbs/day)	ND	NA	87.49	NA	NA	NA
Iron (lbs/day)	532.35	532.35	131.24	NA	NA	NA
Manganese(lbs/day)	44.83	44.83	87.49	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
DUNK06 – Dunkard Creek upstream of UNT 41439						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	459.92	459.92	0	NA	NA	NA
Manganese(lbs/day)	64.04	64.04	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
DUNK05 – Dunkard Creek near Taylortown						
Aluminum (lbs/day)	536.79	250.77	53.142	197.628	286.02	53%
Iron (lbs/day)	952.27	952.27	128.512	NA	NA	NA
Manganese(lbs/day)	210.34	210.34	63.142	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
DUNK04 – USGS gage on Dunkard Creek near Newtown						
Aluminum (lbs/day)	686.50	307.96	0	278.06	92.52	23%
Iron (lbs/day)	1128.41	948.99	0	948.99	179.42	16%
Manganese(lbs/day)	284.73	284.73	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
MUND02 – uppermost sample site on Mundell Hollow						
Aluminum (lbs/day)	0.57	0.57	0	NA	NA	NA
Iron (lbs/day)	0.36	0.36	0	NA	NA	NA
Manganese(lbs/day)	0.21	0.21	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
MUND01 – mouth segment of Mundell Hollow						
Aluminum (lbs/day)	1.18	0.88	0	0.88	0.30	25%
Iron (lbs/day)	0.41	0.41	0	NA	NA	NA
Manganese(lbs/day)	0.15	0.15	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
DUNK03 – Dunkard Creek downstream of Mundell Hollow						
Aluminum (lbs/day)	720.65	499.98	0	499.98	0.00	0%*
Iron (lbs/day)	946.72	946.72	0	NA	NA	NA
Manganese(lbs/day)	376.25	376.25	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
DUNK02 - Dunkard Creek near town of Dunkard						
Aluminum (lbs/day)	777.95	495.81	0	495.81	61.47	11%
Iron (lbs/day)	5857.96	947.44	0	947.44	4910.52	84%
Manganese(lbs/day)	552.20	538.11	0	538.11	14.09	3%
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
DUNK01 – Most downstream segment of Dunkard Creek						
Aluminum (lbs/day)	759.12	528.09	0	528.09	0.00	0%*
Iron (lbs/day)	3725.91	1070.72	0	1070.72	0.00	0%*
Manganese(lbs/day)	471.53	471.53	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
ROCK01 – Sampling site along Rocky Hollow						
Aluminum (lbs/day)	0.26	0.26	0	NA	NA	NA
Iron (lbs/day)	0.43	0.43	0	NA	NA	NA
Manganese(lbs/day)	0.08	0.08	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA

NA = not applicable ND = not detected

In the instance that the allowable load is equal to the existing load (e.g. manganese point DUNK05, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. This is denoted as "NA" in the above table.

Waste Load Allocations were assigned to the permitted mine drainage discharges contained in the Dunkard Creek Watershed. The waste load allocations for Coresco Inc., is calculated using the flow calculated in the Method to Quantify Treatment Pond Pollutant Load multiplied by the permitted BAT limits. The waste load allocations for AMD Reclamation Inc, Concorde Corp. (Energy Resources Corp. of America), Cobra Mining, LLC and Dana Mining Company of PA were calculated using the average discharge flow or design flow multiplied by the permitted BAT limits. No required reductions of the above permit limits are needed at this time. The wasteload allocation for the CWMM CW Morgan Mine was calculated using maximum flow rates and effluent limitations included in the permit. All necessary reductions are assigned to non-point sources.

Consolidation Coal Company, Humphrey Mine No.7 does not receive a WLA because its treatment pond has been reclaimed. Although the NPDES permit is active, the operation is no longer discharging. There is no WLA calculated for Consolidation Coal Company, Hughes Hollow Slurry Impoundment because it is not permitted to discharge from the permit area. Cobra Mining LLC, Dunkard Mine #2 outfall 001 will not receive a WLA since it is not used and therefore no flow.

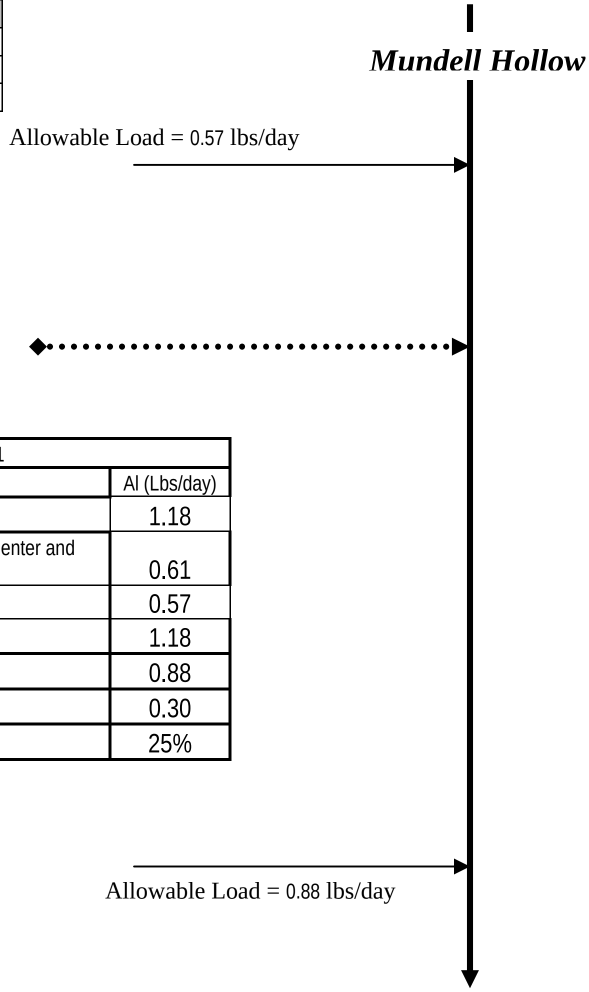
AMD Reclamation Inc, Shannopin Mine Dewatering Project's WLA is being evaluated at the downstream point DUNK07. The outfall is on Shannon Creek far upstream of the first monitoring point in this TMDL. The measured loading at DUNK07 shows that water quality is unimpaired and no reductions are necessary. The treated water aided by dilution does not cause a negative effect at DUNK07, therefore it is recommended that no required reductions of permit limits are currently needed. If impairments are monitored, possible permit reductions may be necessary.

Table 4 Waste Load Allocations in Dunkard Creek Watershed			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
AMD Reclamation Inc. Shannopin Mine Dewatering Proj.	001		
Al	2	5.202	86.769
Fe	3	5.202	130.154
Mn	2	5.202	86.769
Cobra Mining LLC Dunkard Mine #2	002		
Al	1	0.009648	0.081
Fe	1.5	0.009648	0.121
Mn	1	0.009648	0.081
Concorde Corp. Laurita Strip II	1M		
Al	2	0.004896	0.082
Fe	3	0.004896	0.123
Mn	2	0.004896	0.082
	3M		
Al	2	0.000922	0.015
Fe	3	0.000922	0.023
Mn	2	0.000922	0.015
	4M		
Al	2	0.109872	1.833
Fe	3	0.109872	2.749
Mn	2	0.109872	1.833
Coresco, Inc. Gapen Surface Mine	002		
Al	2	0.044496	0.742
Fe	3	0.044496	1.113
Mn	2	0.044496	0.742
	004		
Al	2	0.044496	0.742
Fe	3	0.044496	1.113
Mn	2	0.044496	0.742
	005		
Al	2	0.044496	0.742
Fe	3	0.044496	1.113
Mn	2	0.044496	0.742
	006		

Al	2	0.044496	0.742
Fe	3	0.044496	1.113
Mn	2	0.044496	0.742
	007		
Al	2	0.044496	0.742
Fe	3	0.044496	1.113
Mn	2	0.044496	0.742
Dana Mining Company of PA 4 – West Mine	002		
Al	1	2.0	16.68
Fe	1.5	2.0	25.02
Mn	1	2.0	16.68
Dana Mining Company of PA Titus Mine	001		
Al	2	0.0504	0.841
Fe	3.5	0.0504	1.471
Mn	2	0.0504	0.841
Dana Mining Company of PA Dooley Mine	003		
Al	2	0.0432	0.721
Fe	3	0.0432	1.081
Mn	2	0.0432	0.721
CWMM, LLC, CW Morgan Mine	001		
Al	0.48	3.43*	13.73
Fe	1.5	3.43*	42.90
Mn	0.64	3.43*	18.31
CWMM, LLC, CW Morgan Mine	002		
Al	0.48	1.26*	5.04
Fe	1.5	1.26*	15.76
Mn	0.64	1.26*	6.73
CWMM, LLC, CW Morgan Mine	003		
Al	0.48	2.78*	11.13
Fe	1.5	2.78*	34.78
Mn	0.64	2.78*	14.86

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, aluminum allocations for MUND01 of Mundell Hollow are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains maps of the sampling point locations for reference.

Allocations MUND02	
MUND02	Al (Lbs/day)
Existing Load @ MUND02	0.57
Allowable Load @ MUND02	0.57



ALLOCATIONS MUND01	
MUND01	Al (Lbs/day)
Existing Load @ MUND01	1.18
Difference in measured Loads between the loads that enter and existing MUND01 (MUND01–(MUND02))	0.61
Additional load tracked from above samples	0.57
Total load tracked between MUND02 and MUND01	1.18
Allowable Load @ MUND01	0.88
Load Reduction @ MUND01	0.30
% Reduction required at MUND01	25%

The allowable aluminum load tracked from MUND02 was 0.57 lbs/day. The existing load at MUND02 was subtracted from the existing load at MUND01 to show the actual measured increase of aluminum load that has entered the stream between these upstream sites and MUND01 (0.61 lbs/day). This increased value was then added to the calculated allowable load from MUND02 to calculate the total load that was tracked between MUND02 and MUND01 (allowable loads @ MUND02 + the difference in existing load between MUND02 and MUND01). This total load tracked was then subtracted from the calculated allowable load at MUND01 to determine the amount of load to be reduced at MUND01. This total load value was found to be 1.18 lbs/day; it was 0.30 lbs/day greater then the MUND01 allowable load of 0.88 lbs/day. Therefore, a 25% aluminum reduction at MUND01 is necessary.

Recommendations

Two primary programs provide maintenance and improvement of water quality in the watershed. DEP's efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water quality improvement.

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by BAMR, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania, the United States Office of Surface Mining, the National Mine Land Reclamation Center, the National Environmental Training Laboratory, and many other agencies and individuals. Funding from EPA's 319 Grant program, and Pennsylvania's Growing Greener program have been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

The DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures form subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster's licenses; and administers a loan program for bonding anthracite underground mines and for mine subsidence and administers the EPA Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts. Reclaim PA has the following four objectives.

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources

Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally.

The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas, as the environmental benefit versus cost ratio is generally very high.

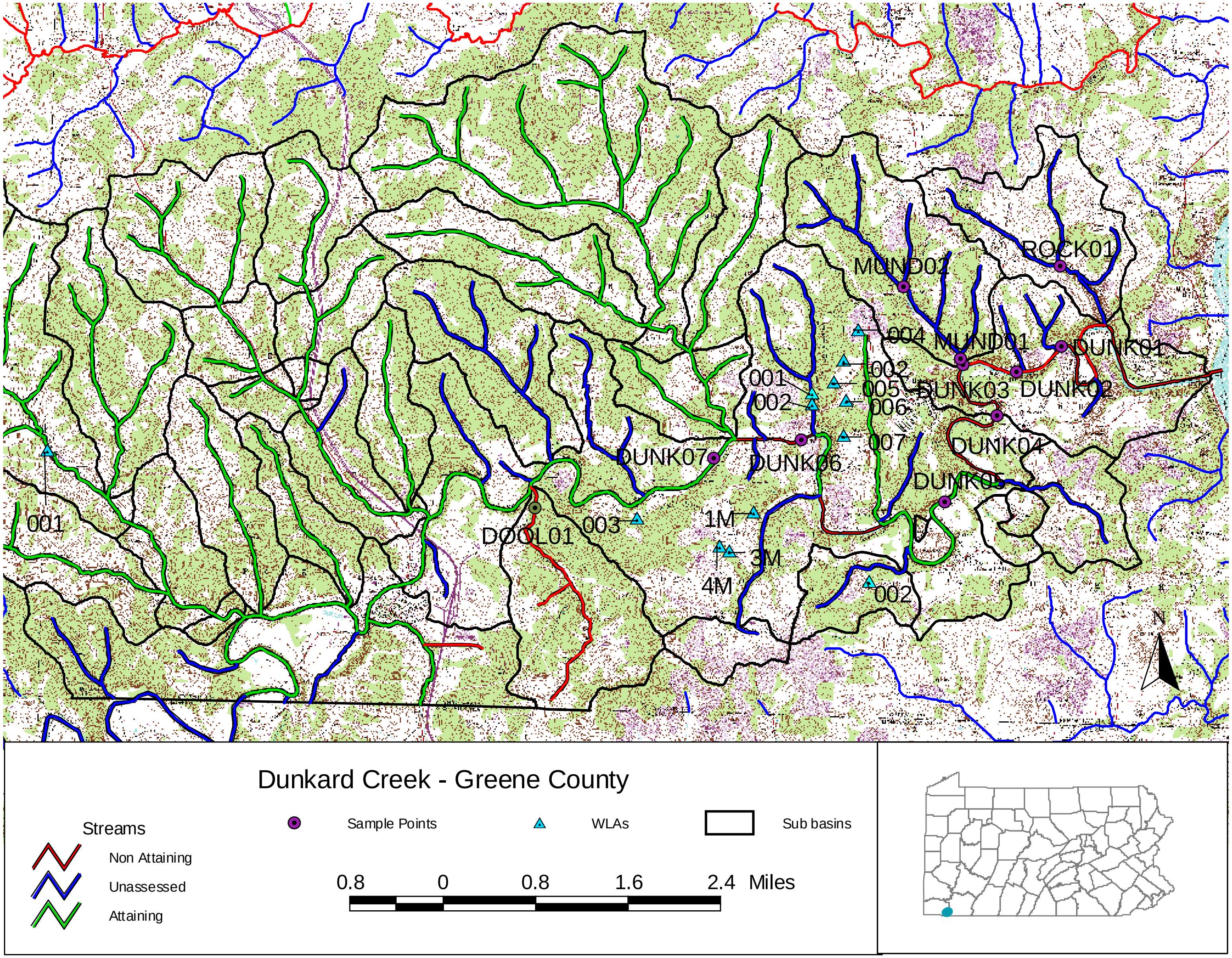
Additional treatment or elimination of the abandoned mine discharges (surface and deep) would improve overall stream and groundwater quality in this section of the watershed. One Growing Greener Grant/319 Grant has been awarded to the local watershed group for a passive treatment of an abandoned deep mine discharge located approximately one mile upstream of DUNK03.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on 11/12/2011. Comments will be accepted until 12/12/2011.

Attachment A

Dunkard Creek Watershed Maps


MUND02
ROCK01
004
MUND01
DUNK01
001
002
005
DUNK03
DUNK02
002
006
007
DUNK04
DUNK07
DUNK06
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1M
DOOL01
3M
4M
002
N
Dunkard Creek - Greene County
Streams
Non Attaining
Unassessed
Attaining
Sample Points
WLAs
Sub basins
0.8
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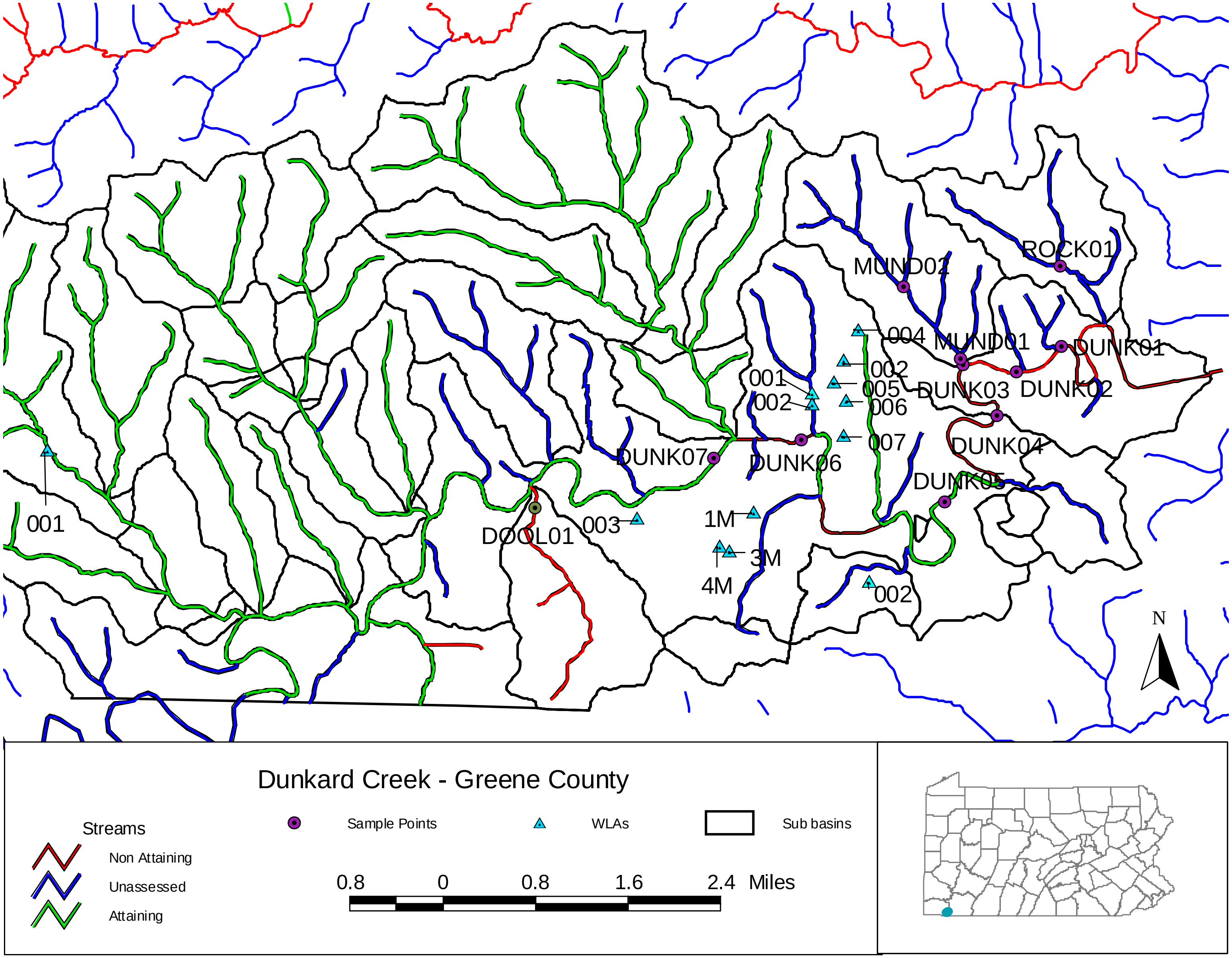
1.6
2.4
Miles



ROCK01
MUND02
004
MUND01
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3M
4M
002
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Dunkard Creek - Greene County
Streams
Non Attaining
Unassessed
Attaining
Sample Points
WLAs
Sub basins
0.8
0
0.8
1.6
2.4
Miles

Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the Pa. Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the USEPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria.

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Reference: *Rose, Arthur W. and Charles A. Cravotta, III 1998. Geochemistry of Coal Mine Drainage. Chapter 1 in Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania. Pa. Dept. of Environmental Protection, Harrisburg, Pa.*

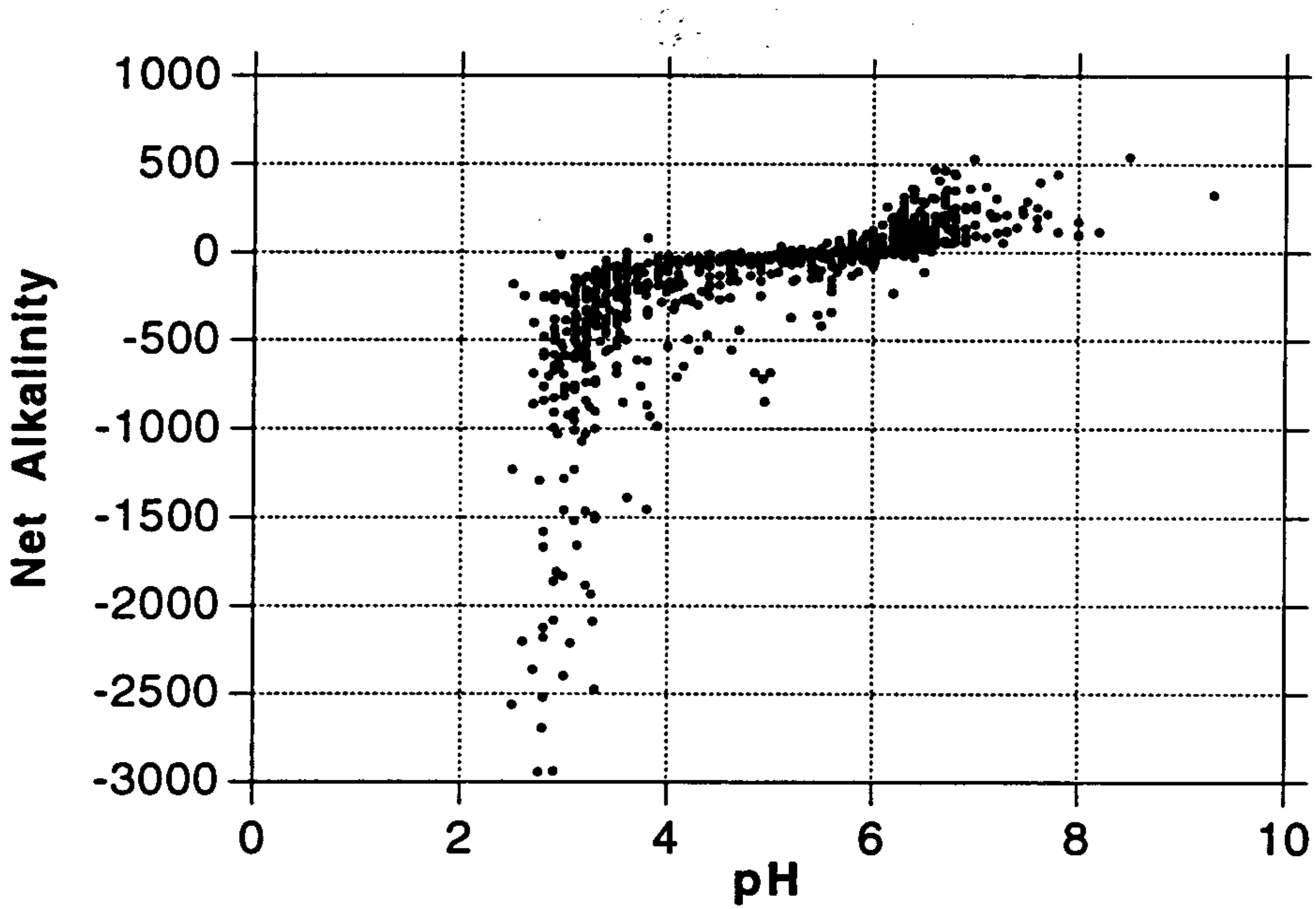


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

Dunkard Creek

The TMDL for Dunkard Creek consists of load allocations to seven sampling sites on Dunkard Creek (DUNK07, DUNK06, DUNK05, DUNK04, DUNK03, DUNK02 and DUNK01), two sites on Mundell Hollow (MUND02 and MUND01), one site on Dooley Run (DOOL01) and one site on Rocky Hollow (ROCK01). Sample data sets were collected throughout 2003 and 2004. All sample points are shown on the maps included in Attachment A as well as on the loading (allowable) schematic presented on the following page.

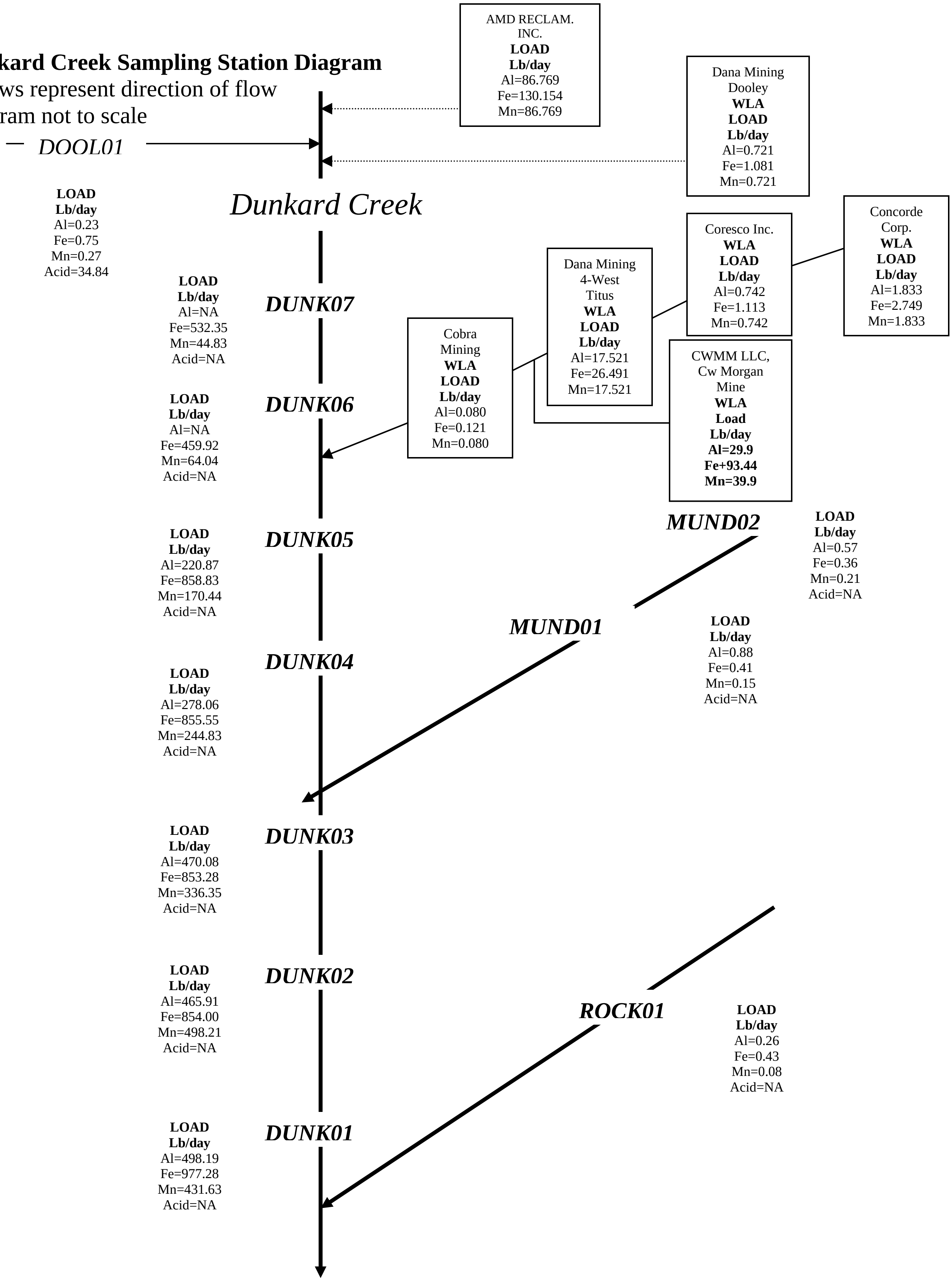
Dunkard Creek is listed on the 1996 PA Section 303(d) list for metals and iron precipitate (other) from AMD as being the cause of the degradation to this stream. Although this TMDL will focus primarily on metal loading to the Dunkard Creek watershed, reduced acid loading analysis will be performed. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each sample point for metals and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was log normally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards. Following is an explanation of the TMDL for each allocation point.

Dunkard Creek Sampling Station Diagram

Arrows represent direction of flow

Diagram not to scale



Dooley Run TMDL Calculation

A TMDL was completed on the Dooley Run Watershed. Dooley Run enters Dunkard Creek above sample point DUNK07. The allowable loads from the last sample point (DOOL01) for Dooley Run are used in the calculation of the Dunkard Creek TMDL.

Table C1. Allocations DOOL01				
DOOL01	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ DOOL01	0.23	0.75	0.27	34.84
Allowable Load @ DOOL01	0.23	0.75	0.27	34.84

Waste Load Allocation – AMD Reclamation Inc, CMAP# 30031601 NPDES# PA0235474

The AMD Reclamation Inc, Shannopin Mine Dewatering Project, CMAP 30031601, NPDES permit no. PA0235474 has a permitted discharge that is evaluated in the calculated allowable loads at DUNK07. Waste load allocations are calculated using the average flow of the discharge and the permitted BAT limits for aluminum, iron and manganese. The following table shows the waste load allocation for this discharge.

This calculated waste load allocation is evaluated downstream at sample point DUNK07. Measured concentrations at DUNK07 show that no reductions are necessary from the observed concentrations. Since these parameters are attaining and the stream at this segment is attaining, the impact from upstream sources is negligible. Therefore, no reductions to the present waste load allocation are necessary at this time.

Table C2. Waste Load Allocations at AMD Reclamation Inc.			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
AMD Reclamation Inc.	001		
Al	2	5.202	86.769
Fe	3	5.202	130.154
Mn	2	5.202	86.769

Waste Load Allocation – Dana Mining Company of PA,Inc CMAP# 30841320 NPDES# PA0213861

The Dana Mining Company of PA, Inc. Dooley Run Mine, CMAP 30841320, NPDES permit no. PA0213861 has a permitted discharge that is evaluated in the calculated allowable loads at DUNK07. Waste load allocations are calculated using the designed flow of the discharge and the permitted BAT limits for aluminum, iron and manganese. The following table shows the waste load allocation for this discharge.

This calculated waste load allocation is evaluated downstream at sample point DUNK07. Measured concentrations at DUNK07 show that no reductions are necessary from the observed concentrations. Since these parameters are attaining and the stream at this segment is attaining, the impact from upstream sources is negligible. Therefore, no reductions to the present waste load allocation are necessary at this time.

Table C3. Waste Load Allocations at Dana Mining Co. of PA, Inc.			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Dana Mining	003		
Al	2	0.0432	0.721
Fe	3	0.0432	1.081
Mn	2	0.0432	0.721

TMDL calculations- DUNK07- Uppermost segment on Dunkard Creek upstream of Meadow Run

The TMDL for sample point DUNK07 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for the upstream segment of Dunkard Creek was computed using water-quality sample data collected at point DUNK07. The average flow, measured at the sampling point DUNK07 (201.57 MGD), is used for these computations. Higher flow values at this sample point are the result of fewer samples collected. There is no affect on downstream calculations due to this sample site being unimpaired.

Sample data at point DUNK07 shows that this Dunkard Creek segment has a pH ranging between 7.6 and 7.9. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

The measured and allowable loading for point DUNK07 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DOOL01 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points DUNK07 and DOOL01 to determine a total load tracked for the segment of stream between DOOL01 and DUNK07. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DUNK07.

All sample data for aluminum, iron and manganese were below water quality criteria. There was no acidic data collected at sample point DUNK07. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C4 shows the measured and allowable concentrations and loads at DUNK07.

Table C4		Measured		Allowable	
Flow (gpm)=	139979.67	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.32	532.4	0.32	532.4

ND = not determined	Manganese	0.03	44.8	0.03	44.8
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	94.10	158191.5		

TMDL calculations- DUNK06- Dunkard Creek upstream of UNT 41439

The TMDL for sample point DUNK06 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Dunkard Creek was computed using water-quality sample data collected at point DUNK06. The average flow, measured at the sampling point DUNK06 (209.41 MGD), is used for these computations. Higher flow values at this sample point are the result of fewer samples collected. There is no affect on downstream calculations due to this sample site being unimpaired.

Sample data at point DUNK06 shows pH ranging between 7.8 and 7.9; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point DUNK06 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DUNK07 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points DUNK07 and DUNK06 to determine a total load tracked for the segment of stream between DUNK06 and DUNK07. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DUNK06.

All sample data for aluminum, iron and manganese were below water quality criteria. There was no acidic data collected at sample point DUNK06. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C5 shows the measured and allowable concentrations and loads at DUNK06.

Table C5		Measured		Allowable	
Flow (gpm)=	145426.67	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.26	459.9	0.26	459.9
ND = not determined	Manganese	0.04	64.0	0.04	64.0
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	97.17	169703.2		

Waste Load Allocations –
CWMM, LLC, CW Morgan Mine, 3 outfalls, CMAP#30101301 NPDES #PA0235971
Cobra Mining, LLC, Dunkard Mine No. 2 CMAP#30841309 NPDES# PA0214825
Coresco, Inc, Gapen Surface Mine CSMP# 30010102 NPDES# PA0203017
Concorde Corp. Energy Resources Corp. of America, Laurita Strip II SMP 32B77SM3
Dana Mining Company of PA, Inc. Titus Mine, CMAP# 30841314 NPDES# PA0215368
Dana Mining Company of PA, Inc. 4-West Mine CMAP# 30031301 NPDES# PA0235610

Coresco, Inc, Gapen Surface Mine, CSMP 30010102, NPDES permit no. PA0203017 has a permitted discharge that is evaluated in the calculated allowable loads at DUNK05. The waste load allocations for Coresco Inc are calculated using the flow calculated in the Method to Quantify Treatment Pond Pollutant Load multiplied by the permitted BAT limits. The following table shows the waste load allocation for these discharges.

The waste load allocations for Dana Mining, Cobra Mining and Concorde Corp. have been calculated using the average flow or designed flow values multiplied by the permit limits. All of these WLAs are being evaluated at DUNK05. The wasteload allocation for the CWMM CW Morgan Mine was calculated using maximum flow rates and effluent limitations included in the permit.

The calculated waste load allocations are evaluated downstream at sample point DUNK05. Measured concentrations at DUNK05 show that iron and manganese do not require reductions. Since these parameters are attaining, the impact from upstream sources is negligible. Therefore, no reductions to the present waste load allocations are necessary at this time.

Table C6. Waste Load Allocations evaluated at DUNK05.							
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)	Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Cobra Mining LLC Dunkard Mine #2	002			**CWMM, LLC, CW Morgan Mine**	001		
Al	1	0.009648	0.081	Al	0.48	3.43*	13.73
Fe	1.5	0.009648	0.121	Fe	1.5	3.43*	42.90
Mn	1	0.009648	0.081	Mn	0.64	3.43*	18.31
Concorde Corp. Laurita Strip II	1M			**CWMM, LLC, CW Morgan Mine**	002		
Al	2	0.004896	0.082	Al	0.48	1.26*	5.04
Fe	3	0.004896	0.123	Fe	1.5	1.26*	15.76
Mn	2	0.004896	0.082	Mn	0.64	1.26*	6.73
	3M			**CWMM, LLC, CW Morgan Mine**	003		
Al	2	0.000922	0.015	Al	0.48	2.78*	11.13
Fe	3	0.000922	0.023	Fe	1.5	2.78*	34.78
Mn	2	0.000922	0.015	Mn	0.64	2.78*	14.86

	4M						
Al	2	0.109872	1.833				
Fe	3	0.109872	2.749				
Mn	2	0.109872	1.833				
Coresco, Inc. Gapen Surface Mine	002			**Dana Mining Company of PA 4 – West Mine**	002		
Al	2	0.044496	0.742	Al	1	2.0	16.68
Fe	3	0.044496	1.113	Fe	1.5	2.0	25.02
Mn	2	0.044496	0.742	Mn	1	2.0	16.68
	004			**Dana Mining Company of PA Titus Mine**	001		
Al	2	0.044496	0.742	Al	2	0.0504	0.841
Fe	3	0.044496	1.113	Fe	3.5	0.0504	1.471
Mn	2	0.044496	0.742	Mn	2	0.0504	0.841
	005						
Al	2	0.044496	0.742				
Fe	3	0.044496	1.113				
Mn	2	0.044496	0.742				
	006						
Al	2	0.044496	0.742				
Fe	3	0.044496	1.113				
Mn	2	0.044496	0.742				
	007						
Al	2	0.044496	0.742				
Fe	3	0.044496	1.113				
Mn	2	0.044496	0.742				

TMDL calculations- DUNK05- Dunkard Creek near Taylortown

The TMDL for sampling point DUNK05 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Dunkard Creek was computed using water-quality sample data collected at point DUNK05. The average flow, measured at the sampling point DUNK05 (166.71 MGD), is used for these computations.

Sample data at point DUNK05 shows pH ranging between 7.4 and 7.8; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point DUNK05 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DUNK06 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points

DUNK06 and DUNK05 to determine a total load tracked for the segment of stream between DUNK05 and DUNK06. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DUNK05.

A TMDL for aluminum at DUNK05 has been calculated. All sample data for iron and manganese were below water quality criteria. There was no acidic data collected at sample point DUNK05. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C7 shows the measured and allowable concentrations and loads at DUNK05. Table C8 shows the percent reduction for aluminum.

Table C7		Measured		Allowable	
Flow (MGD)=	166.71	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.38	536.79	0.17	250.77
	Iron	0.65	952.27	0.65	952.27
ND = not determined	Manganese	0.13	210.34	0.13	210.34
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	94.70	125769.9		

Table C8. Allocations DUNK05	
DUNK05	Al (Lbs/day)
Existing Load @ DUNK05	536.79
Difference in measured Loads between the loads that enter and existing DUNK05	536.79
Additional load tracked from above samples	0.00
Total load tracked between DUNK06 and DUNK05	536.79
Allowable Load @ DUNK05	250.77
Load Reduction @ DUNK05	286.02
% Reduction required @ DUNK05	53%

There was a 536.79 lbs/day increase of aluminum between DUNK06 and DUNK05. The total aluminum load tracked was 536.79 lbs/day. The calculated allowable load was 250.77 lbs/day. A 53%, 286.02 lbs/day of aluminum reduction is needed to achieve the calculated allowable load.

TMDL calculations- DUNK04- USGS gage on Dunkard Creek near Newtown

The TMDL for sampling point DUNK04 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Dunkard Creek was computed using water-quality sample data collected at point DUNK04. The average flow, measured at the sampling point DUNK04 (167.60 MGD), is used for these computations.

Sample data at point DUNK04 shows pH ranging between 7.3 and 7.6; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point DUNK04 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DUNK05 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points DUNK05 and DUNK04 to determine a total load tracked for the segment of stream between DUNK04 and DUNK05. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DUNK04.

A TMDL for aluminum and iron at DUNK04 has been calculated. All sample data for manganese were below water quality criteria. There was no acidic data collected at sample point DUNK04. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C9 shows the measured and allowable concentrations and loads at DUNK04. Table C10 shows the percent reduction for aluminum and iron.

Table C9		Measured		Allowable	
Flow (MGD)=	167.60	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.49	686.5	0.21	307.96
	Iron	0.78	1128.41	0.64	948.99
ND = not determined	Manganese	0.18	284.73	0.18	284.73
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	85.17	113735.8		

Table C10. Allocations DUNK04		
DUNK04	Al (Lbs/day)	Fe (Lbs/day)
Existing Load @ DUNK04	686.50	1128.41
Difference in measured Loads between the loads that enter and existing DUNK04	149.71	176.14
Additional load tracked from above samples	250.77	952.27
Total load tracked between DUNK05 and DUNK04	400.48	1128.41
Allowable Load @ DUNK04	307.96	948.99
Load Reduction @ DUNK04	92.52	179.42
% Reduction required @ DUNK04	23%	16%

There was a 149.71 lbs/day increase of aluminum between DUNK05 and DUNK04. The total aluminum load tracked was 400.48 lbs/day. The calculated allowable load was 307.96 lbs/day. A

23%, reduction or 92.52 lbs/day of aluminum needs to be reduced to achieve the calculated allowable load. There was a 176.14 lbs/day increase of iron between DUNK05 and DUNK04. The total iron load tracked was 179.42 lbs/day greater than the calculated allowable load of 948.99 lbs/day. A 16% iron reduction is required at DUNK04.

TMDL calculations- MUND02- uppermost sample site on Mundell Hollow

The TMDL for sample point MUND02 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for the upstream segment of Mundell Hollow was computed using water-quality sample data collected at point MUND02. The average flow, measured at the sampling point MUND02 (0.38 MGD), is used for these computations.

Sample data at point MUND02 shows that this Mundell Hollow segment has a pH ranging between 8.2 and 8.3. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

All sample data for aluminum, iron and manganese were below water quality criteria. There was no acidic data collected at sample point MUND02. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C11 shows the measured and allowable concentrations and loads at MUND02.

Table C11		Measured		Allowable	
Flow (gpm)=	266.67	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.18	0.6	0.18	0.6
	Iron	0.11	0.4	0.11	0.4
ND = not determined	Manganese	0.07	0.2	0.07	0.2
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	210.67	674.7		

TMDL calculations- MUND01- mouth segment of Mundell Hollow

The TMDL for sampling point MUND01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Mundell Hollow was computed using water-quality sample data collected at point MUND01. The average flow, measured at the sampling point MUND01 (0.77 MGD), is used for these computations.

Sample data at point MUND01 shows pH of 8.2; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point MUND01 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points MUND02 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points MUND02 and MUND01 to determine a total load tracked for the segment of stream between MUND01 and MUND02. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at MUND01.

A TMDL for aluminum at MUND01 has been calculated. All sample data for iron and manganese were below water quality criteria. There was no acidic data collected at sample point MUND01. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C12 shows the measured and allowable concentrations and loads at MUND01. Table C13 shows the percent reduction for aluminum.

Table C12		Measured		Allowable	
Flow (gpm)=	535.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.18	1.2	0.14	0.9
	Iron	0.06	0.4	0.06	0.4
ND = not determined	Manganese	0.02	0.2	0.02	0.2
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	194.33	1248.6		

Table C13. Allocations MUND01	
MUND01	Al (Lbs/day)
Existing Load @ MUND01	1.18
Difference in measured Loads between the loads that enter and existing MUND01	0.61
Additional load tracked from above samples	0.57
Total load tracked between MUND02 and MUND01	1.18
Allowable Load @ MUND01	0.88
Load Reduction @ MUND01	0.30
% Reduction required @ MUND01	25%

There was a 0.61 lbs/day increase of aluminum between MUND02 and MUND01. The total aluminum load tracked was 1.18 lbs/day. The calculated allowable load was 0.88 lbs/day. A 25%, 0.30 lbs/day of aluminum needs to be reduced to achieve the calculated allowable load.

TMDL calculations- DUNK03- Dunkard Creek downstream of Mundell Hollow

The TMDL for sampling point DUNK03 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Mundell Hollow was computed using water-quality sample data collected at point DUNK03. The average flow, measured at the sampling point DUNK03 (169.87 MGD), is used for these computations.

Sample data at point DUNK03 shows pH between 7.3 and 7.6; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point DUNK03 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DUNK04/MUND01 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points DUNK04/MUND01 and DUNK03 to determine a total load tracked for the segment of stream between DUNK03 and DUNK04/MUND01. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DUNK03.

A TMDL for aluminum at DUNK03 has been calculated. All sample data for iron and manganese were below water quality criteria. There was no acidic data collected at sample point DUNK03. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C14 shows the measured and allowable concentrations and loads at DUNK03. Table C15 shows the percent reduction for aluminum.

Table C14		Measured		Allowable	
Flow (MGD)=	169.87	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.51	720.65	0.35	499.98
	Iron	0.63	946.72	0.63	946.72
ND = not determined	Manganese	0.25	376.25	0.25	376.25
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	80.58	109143.3		

Table C15. Allocations DUNK03	
DUNK03	Al (Lbs/day)
Existing Load @ DUNK03	720.65
Difference in measured Loads between the loads that enter and existing DUNK03	32.97
Additional load tracked from above samples	308.84

Total load tracked between DUNK04/MUND01 and DUNK03	341.81
Allowable Load @ DUNK03	499.98
Load Reduction @ DUNK03	-158.17
% Reduction required @ DUNK03	0%

There was a 32.97 lbs/day increase of aluminum between DUNK04/MUND01 and DUNK03. The total aluminum load tracked was 158.17 lbs/day less than the calculated allowable load of 499.98 lbs/day. Since the total aluminum load tracked was less than the calculated allowable load, no reduction is necessary.

TMDL calculations- DUNK02- Dunkard Creek near town of Dunkard

The TMDL for sampling point DUNK02 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Dunkard Creek was computed using water-quality sample data collected at point DUNK02. The average flow, measured at the sampling point DUNK02 (178.02 MGD), is used for these computations.

Sample data at point DUNK02 shows pH ranging between 6.9 and 7.4; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point DUNK02 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DUNK03 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points DUNK03 and DUNK02 to determine a total load tracked for the segment of stream between DUNK02 and DUNK03. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DUNK02.

A TMDL for aluminum, iron and manganese at DUNK02 has been calculated. There was no acidic data collected at sample point DUNK02. Because water quality standards are met, a TMDL for acidity isn’t necessary and is not calculated.

Table C16 shows the measured and allowable concentrations and loads at DUNK02. Table C17 shows the percent reduction for aluminum and iron.

Table C16		Measured		Allowable	
Flow (MGD)=	178.02	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.55	777.95	0.34	495.81
	Iron	4.24	5857.96	0.63	947.44
ND = not determined	Manganese	0.38	552.20	0.37	538.11
NA = not applicable	Acidity	ND	NA	ND	NA

	Alkalinity	77.58	105520.4		

Table C17. Allocations DUNK02			
DUNK02	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)
Existing Load @ DUNK02	777.95	5857.96	552.20
Difference in measured Loads between the loads that enter and existing DUNK02	57.30	4911.24	175.95
Additional load tracked from above samples	499.98	946.72	376.25
Total load tracked between DUNK03 and DUNK02	557.28	5857.96	552.20
Allowable Load @ DUNK02	495.81	947.44	538.11
Load Reduction @ DUNK02	61.47	4910.52	14.09
% Reduction required @ DUNK02	11%	84%	3%

There was a 57.30 lbs/day increase of aluminum between DUNK03 and DUNK02. The total aluminum load tracked was 557.28 lbs/day. The calculated allowable load was 495.81 lbs/day. An 11%, (61.47 lbs/day) reduction of aluminum is needed to achieve the calculated allowable load. There was a 4911.24 lbs/day increase of iron between DUNK03 and DUNK02. The total iron load tracked was 4910.52 lbs/day greater than the calculated allowable load of 947.44 lbs/day. An 84% iron reduction is required at DUNK02. There was a 175.95 lbs/day increase of manganese between DUNK03 and DUNK02. The total manganese load tracked was 14.09 lbs/day greater than the calculated allowable load of 538.11 lbs/day resulting a 3% manganese reduction at DUNK02.

TMDL calculations- DUNK01- Most downstream segment sampled on Dunkard Creek

The TMDL for sampling point DUNK01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Dunkard Creek was computed using water-quality sample data collected at point DUNK01. The average flow, measured at the sampling point DUNK01 (170.90 MGD), is used for these computations.

Sample data at point DUNK01 shows pH ranging between 7.1 and 7.5; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point DUNK01 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DUNK02 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points DUNK02 and DUNK01 to determine a total load tracked for the segment of stream between DUNK01 and DUNK02. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DUNK01.

A TMDL for aluminum and iron at DUNK01 has been calculated. All sample data for manganese were below water quality criteria. There was no acidic data collected at sample point

DUNK01. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C18 shows the measured and allowable concentrations and loads at DUNK01. Table C19 shows the percent reduction for aluminum and iron.

Table C18		Measured		Allowable	
Flow (MGD)=	170.90	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.54	729.2	0.37	498.2
	Iron	2.67	3632.5	0.72	977.3
ND = not determined	Manganese	0.32	431.6	0.32	431.6
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	78.72	107293.0		

Table C19. Allocations DUNK01		
DUNK01	Al (Lbs/day)	Fe (Lbs/day)
Existing Load @ DUNK01	759.12	3725.91
Difference in measured Loads between the loads that enter and existing DUNK01	-18.83	-2132.05
Percent loss due calculated at DUNK01	2.4%	36.4%
Additional load tracked from above samples	495.81	947.44
Percentage of upstream loads that reach the DUNK01	97.6%	63.6%
Total load tracked between DUNK02 and DUNK01	483.81	602.61
Allowable Load @ DUNK01	528.09	1070.72
Load Reduction @ DUNK01	-44.28	-468.11
% Reduction required @ DUNK01	0%	0%

There was an 18.83 lbs/day decrease of aluminum between DUNK02 and DUNK01. The total aluminum load tracked was 495.81 lbs/day. The calculated allowable load was 528.09 lbs/day. Since the total aluminum load tracked from upstream was less than the calculated allowable load, no aluminum reduction is necessary. The total iron load tracked was 947.44 lbs/day. The calculated allowable load was 1070.72 lbs/day. There was a 2132.05 lbs/day decrease of iron between DUNK02 and DUNK01. Since the total iron load tracked from upstream was less than the calculated allowable load, no iron reduction is necessary at DUNK01.

TMDL calculations- ROCK01- Sampling site along Rocky Hollow

The TMDL for sample point ROCK01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for Rocky Hollow was computed using water-quality sample data collected at point ROCK01. The average flow, measured at the sampling point ROCK01 (0.25 MGD), is used for these computations.

Sample data at point ROCK01 shows that this Rocky Hollow segment has a pH ranging between 8.1 and 8.2. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

All sample data for aluminum, iron and manganese were below water quality criteria. There was no acidic data collected at sample point ROCK01. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C20 shows the measured and allowable concentrations and loads at ROCK01.

Table C20		Measured		Allowable	
Flow (MGD)=	171.33	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.13	0.3	0.13	0.3
	Iron	0.21	0.4	0.21	0.4
ND = not determined	Manganese	0.04	0.1	0.04	0.1
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	251.33	517.2		

Margin of Safety

For this study the margin of safety is applied implicitly. A MOS is implicit because the allowable concentrations and loadings were simulated using Monte Carlo techniques and employing the @Risk software. Other margins of safety used for this TMDL analysis include the following:

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.
- An additional MOS is provided because that the calculations were done with a daily Fe average instead of the 30-day average.

Seasonal Variation

Seasonal variation is implicitly accounted for in these TMDLs because the data used represents all seasons.

Critical Conditions

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis.

Attachment D

Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP Section 303(d) narratives that justify changes in listings between the 1996, 1998, 2002 and 2004 list. The Section 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 Section 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 Section 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 Section 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

Attachment E

Water Quality Data Used In TMDL Calculations

Site	Date	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)
DUNK07	3/11/2004	281144	7.9	0.0	70.5	0.07	0.50	0.04
	4/22/2004	107441	7.9	0.0	89.8	<.02	0.18	<.02
	5/18/2004	31354	7.6	0.0	122	<.02	0.27	0.04
	Average	139979.67	7.81	0.00	94.10	0.07	0.32	0.04
	St Dev	128034.51	0.18	0.00	26.02	#DIV/0!	0.17	0.00
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DUNK06	3/11/2004	292084	7.9	0.0	73.5	0.04	0.35	0.05
	4/22/2004	111622	7.9	0.0	92.0	<.02	0.17	<.02
	5/18/2004	32574	7.8	0.0	126	<.02	0.27	0.06
	Average	145426.67	7.88	0.00	97.17	0.04	0.26	0.06
	St Dev	133016.64	0.07	0.00	26.63	#DIV/0!	0.09	0.01
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DUNK05	5/28/2003	163892	7.8	0.0	86.0	0.29	0.43	0.07
	7/2/2003	34370	7.7	0.0	118	0.73	0.81	0.16
	8/21/2003	13812	7.4	0.0	93.0	0.84	0.86	0.28
	3/11/2004	303339	7.6	0.0	68.1	0.03	0.56	0.06
	4/22/2004	114644	7.8	0.0	89.1	<.02	0.50	0.04
	5/18/2004	33456	7.5	0.0	114	0.40	0.72	0.16
	Average	110585.50	7.63	0.00	94.70	0.46	0.65	0.13
	St Dev	110575.62	0.18	0.00	18.62	0.33	0.18	0.09
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DUNK04	5/28/2003	164900	7.6	0.0	81.1	0.54	0.76	0.10
	7/2/2003	33527	7.6	0.0	106	0.66	0.74	0.22
	8/21/2003	14549	7.4	0.0	75.0	0.56	0.56	0.33
	3/11/2004	305204	7.5	0.0	63.8	0.06	0.49	0.08
	4/22/2004	115349	7.6	0.0	84.1	0.13	0.70	0.10
	5/18/2004	33662	7.3	0.0	101	1.0	1.4	0.27
	Average	111198.50	7.52	0.00	85.17	0.49	0.78	0.18
	St Dev	111288.01	0.14	0.00	15.89	0.35	0.32	0.10
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
MUND02	5/28/2003	580	8.2	0.0	165	0.29	0.13	0.16
	7/2/2003	152	8.3	0.0	216	0.15	0.1	0.02
	8/21/2003	68	8.3	0.0	251	0.09	0.11	0.02

	Average	266.67	8.25	0.00	210.67	0.18	0.11	0.07
	St Dev	274.59	0.04	0.00	43.25	0.10	0.02	0.08
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
MUND01	5/28/2003	1245	8.2	0.0	172	0.41	0.08	0.04
	7/2/2003	259	8.2	0.0	200	0.14	0.05	0.02
	8/21/2003	101	8.2	0.0	211	<.02	0.06	0.01
	Average	535.00	8.21	0.00	194.33	0.28	0.06	0.02
	St Dev	619.93	0.03	0.00	20.11	0.19	0.02	0.02
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DUNK03	5/28/2003	165188	7.5	0.0	76.3	0.66	0.77	0.14
	7/2/2003	40373	7.6	0.0	98.5	0.61	0.56	0.31
	8/21/2003	16096	7.3	0.0	65.0	0.42	0.21	0.44
	3/11/2004	305738	7.4	0.0	66.3	0.19	0.63	0.11
	4/22/2004	115550	7.4	0.0	82.2	0.48	0.72	0.15
	5/18/2004	33721	7.3	0.0	95.2	0.70	0.89	0.34
	Average	112777.67	7.42	0.00	80.58	0.51	0.63	0.25
	St Dev	110297.74	0.12	0.00	14.16	0.19	0.24	0.13
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DUNK02	5/28/2003	167060	7.3	0.0	78.6	0.58	2.16	0.18
	7/2/2003	36397	7.4	0.0	93.5	0.87	4.2	0.43
	8/21/2003	14970	6.9	0.0	58.0	0.36	6.8	0.67
	3/11/2004	310112	7.3	0.0	66.6	0.31	2.3	0.16
	4/22/2004	116860	7.2	0.0	79.9	0.68	4.37	0.34
	5/18/2004	34103	7.1	0.0	88.9	0.50	5.6	0.48
	Average	113250.33	7.20	0.00	77.58	0.55	4.24	0.38
	St Dev	112687.87	0.18	0.00	13.36	0.21	1.82	0.19
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DUNK01	5/28/2003	167420	7.4	0.0	78.7	0.67	1.6	0.17
	7/2/2003	33239	7.5	0.0	94.0	0.84	3.4	0.42
	8/21/2003	18241	7.1	0.0	60.0	0.46	3.9	0.58
	3/11/2004	310780	7.3	0.0	65.8	0.35	1.72	0.14
	4/22/2004	117112	7.4	0.0	80.1	0.42	2.27	0.20
	5/18/2004	34177	7.4	0.0	93.7	0.47	3.1	0.39
	Average	113494.83	7.34	0.00	78.72	0.54	2.67	0.32
	St Dev	112825.58	0.15	0.00	13.98	0.18	0.94	0.17
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
ROCK01	5/28/2003	421	8.2	0.0	213	<.02	0.12	0.03
	7/2/2003	65	8.2	0.0	258	0.29	0.38	0.05
	8/21/2003	28	8.1	0.0	283	0.09	0.13	0.04

	Average	171.33	8.16	0.00	251.33	0.19	0.21	0.04
	St Dev	217.01	0.08	0.00	35.47	0.14	0.15	0.01
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DOOL01	5/28/2003	611	7.9	3	129	0.02	0.12	0.09
	7/2/2003	52	7.5	0	165	0.13	0.18	0.02
Latitude:	8/21/2003	16	7.2	2	175	0.09	0.3	0.02
39.74609	3/11/2004	715	7.8	10	112	<.02	0.18	0.16
Longitude:	4/22/2004	566	7.8	22	132	<.02	0.02	<.02
-80.04494	Average	392.00	7.6	7.40	142.60	0.04800	0.16000	0.05800
	St Dev	331.49	0.27	8.99	26.39	0.058907	0.10198	0.066483

Zero has been substituted for the less than detection values in the TMDL calculations

Attachment F

Comment and Response