Decision Rationale
Total Maximum Daily Loads
Paint Creek Watershed
For Acid Mine Drainage Affected Segments

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by the state where technology-based and other controls did not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water quality-limited water body.

This document sets forth the United States Environmental Protection Agency's (EPA) rationale for establishing the TMDLs for metals and pH in the Paint Creek watershed. The TMDL was established to address impairment of water quality, caused by mine drainage, as identified in West Virginia's 1996 and 1998 Section 303(d) list of impaired waters.

The following regulatory requirements were considered in establishing the Paint Creek TMDLs:

1. The TMDLs are designed to implement the applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. There is reasonable assurance that the proposed TMDLs can be met.
8. The TMDLs have been subject to public participation.

The following four tables, Table 1 through Table 4, present the pH, aluminum, iron, and manganese TMDLS. The TMDLs are presented in terms of load per year. Divide the presented TMDL by 365 days per year to obtain a TMDL in terms of load per day.

Table 1 - Summary of pH TMDLs[1]

Stream Name	SWS	WLA, Mg/yr $CaCO_3$ equivalents	LA, Mg/yr $CaCO_3$ equivalents	Upstream Contribution, Mg/yr $CaCO_3$ equivalents	TMDL, Mg/yr $CaCO_3$ equivalents	Baseline NPS Load, Mg/yr $CaCO_3$ equivalents	Relative NPS Load Reduction
Paint Creek below Banner Hollow and Jones Branch	1	0	0	16.1713	16.1713	0	0.00%
Paint Creek above Banner Hollow and below Fourmile Fork	3	0	0	43.0172	43.0172	0	0.00%
Paint Creek above Fourmile Fork and below Ash Branch	5	0	0	59.94	59.94	0	0.00%
Paint Creek above Ash Branch and below Toms Branch	7	0	0	125.685	125.685	0	0.00%

Stream Name	SWS	WLA, Mg/yr $CaCO_3$ equivalents	LA, Mg/yr $CaCO_3$ equivalents	Upstream Contribution, Mg/yr $CaCO_3$ equivalents	TMDL, Mg/yr $CaCO_3$ equivalents	Baseline NPS Load, Mg/yr $CaCO_3$ equivalents	Relative NPS Load Reduction
Paint Creek above Toms Branch and below Tenmile Branch	**9**	**0.0329**	**0**	**125.6493**	**125.6822**	**0**	**0.00%**
Tenmile Branch above Long Branch and below Unnamed Tributary	**11**	**0.0019**	**0**	**-40.3017**	**-40.2998**	**71.0703**	**100.00%**
Unnamed Tributary of Tenmile Branch	12	0	-19.5621	0	-19.5621	-19.5621	0.00%
Tenmile Branch above Unnamed Tributary	**13**	**0**	**-20.7396**	**0**	**-20.7396**	**-20.7396**	**0.00%**
Paint Creek above Tenmile Branch and below Laurel Branch	**14**	**0**	**0**	**165.8698**	**165.8698**	**0**	**0.00%**
Paint Creek above Laurel Branch and below Unnamed Branch	**16**	**0**	**0**	**-425.9096**	**-425.9096**	**0**	**0.00%**
Paint Creek above Unnamed Branch and below Hickory Camp Branch	**18**	**0**	**0**	**-425.1224**	**-425.1224**	**0**	**0.00%**
Hickory Camp Branch	**19**	**0**	**-1.4399**	**0**	**-1.4399**	**-1.4327**	**0.50%**
Paint Creek above Hickory Camp Branch and below Cedar Creek	**20**	**0**	**0**	**-423.6825**	**-423.6825**	**0**	**0.00%**
Cedar Creek	**21**	**0**	**0.6322**	**0**	**0.6322**	**6.821**	**90.73%**
Paint Creek above Cedar Creek and below Fifteenmile Creek including unnamed tributaries 1 and 2	**22**	**0**	**0**	**-424.3147**	**-424.3147**	**116.301**	**100.00%**
Fifteenmile Creek	23	0.0086	-10.1211	0	-10.1125	-10.1211	0.00%
Spring Branch	**25**	**0**	**0.1004**	**0**	**0.1004**	**7.3589**	**98.64%**
Skitter Creek	27	0.0577	-7.1882	0	-7.1305	-7.1882	0.00%
Lykins Creek	**33**	**0**	**0**	**0**	**0**	**0**	**0.00%**
Mossy Creek below Lick Fork (Long Branch of Mossy Creek)	37	0	0	-37.9555	-37.9555	0	0.00%
Packs Branch including Big Fork of Packs Branch	47	0	-21.5686	0	-21.5686	-21.5686	0.00%

Subwatershed in bold indicate the stream segments was listed for pH impairments.

[1] Mg/year = metric tons per year

Table 2 - Summary of Aluminum TMDLs[1]

Stream Name	SWS	WLA, Mg/yr	LA, Mg/yr	Upstream Contribution, Mg/yr	TMDL, Mg/yr
Paint Creek below Banner Hollow and Jones Branch	**1**	**0**	**0.5657**	**19.9043**	**20.47**
Paint Creek above Banner Hollow and below Fourmile Fork	**3**	**0**	**0**	**19.8574**	**19.8586**
Paint Creek above Fourmile Fork and below Ash Branch	**5**	**0**	**2.2317**	**17.615**	**19.8467**
Paint Creek above Ash Branch and below Toms Branch	**7**	**0**	**0.2631**	**17.3457**	**17.6088**
Paint Creek above Toms Branch and below Tenmile Branch	**9**	**1.0099**	**0.3911**	**15.912**	**17.313**
Tenmile Branch above Long Branch and below Unnamed Tributary	**11**	**0.06**	**0.012**	**0.0469**	**0.1184**
Unnamed Tributary of Tenmile Branch	12	0	0.017	0	0.0165
Tenmile Branch above Unnamed Tributary	**13**	**0**	**0.03**	**0**	**0.0304**
Paint Creek above Tenmile Branch and below Laurel Branch	**14**	**0**	**0**	**15.309**	**15.3102**
Paint Creek above Laurel Branch and below Unnamed Branch	**16**	**0**	**0**	**14.8106**	**14.8132**
Paint Creek above Unnamed Branch and below Hickory Camp Branch	**18**	**0**	**0**	**14.8075**	**14.8076**
Hickory Camp Branch	**19**	**0**	**0**	**0**	**0.0044**
Paint Creek above Hickory Camp Branch and below Cedar Creek	**20**	**0**	**0.1293**	**14.6738**	**14.8031**
Cedar Creek	21	0	0.014	0	0.0135
Paint Creek above Cedar Creek and below Fifteenmile Creek including unnamed tributaries 1 and 2	**22**	**0**	**0.9552**	**13.705**	**14.6603**
Fifteenmile Creek	**23**	**0.11**	**0**	**0**	**0.114**
Spring Branch	25	0	0.011	0	0.0112
Skitter Creek	**27**	**0.3092**	**0.01**	**0**	**0.3193**
Lykins Creek	**33**	**0**	**0**	**0**	**0.0021**
Mossy Creek below Lick Fork (Long Branch of Mossy Creek)	37	0	0.015	0.0237	0.0383
Packs Branch including Big Fork of Packs Branch	**47**	**0**	**0.06**	**0**	**0.0603**

Subwatershed number in bold indicates the stream segment was listed for aluminum.

[1] Mg/year equals metric tons per year

Table 3 - Summary of Iron TMDLs[1]

Stream Name	SWS	WLA, Mg/yr	LA, Mg/yr	Upstream Contribution, Mg/yr	TMDL, Mg/yr
Paint Creek below Banner Hollow and Jones Branch	1	0	0.421	20.802	21.223
Paint Creek above Banner Hollow and below Fourmile Fork	3	0	0	20.8001	20.8004
Paint Creek above Fourmile Fork and below Ash Branch	5	0	1.4644	19.3336	20.7979
Paint Creek above Ash Branch and below Toms Branch	7	0	0.037	19.2953	19.3323
Paint Creek above Toms Branch and below Tenmile Branch	9	0.7515	0.052	18.4274	19.2307
Tenmile Branch above Long Branch and below Unnamed Tributary	**11**	**0.0445**	**0.017**	**0.1514**	**0.2127**
Unnamed Tributary of Tenmile Branch	12	0	0.069	0	0.0694
Tenmile Branch above Unnamed Tributary	**13**	**0**	**0.082**	**0**	**0.082**
Paint Creek above Tenmile Branch and below Laurel Branch	14	0	0.01	17.286	17.2912
Paint Creek above Laurel Branch and below Unnamed Branch	16	0	0.011	16.083	16.0943
Paint Creek above Unnamed Branch and below Hickory Camp Branch	18	0	0	16.0822	16.0828
Hickory Camp Branch	**19**	**0**	**0.01**	**0**	**0.0084**
Paint Creek above Hickory Camp Branch and below Cedar Creek	20	0	0	16.0699	16.0738
Cedar Creek	21	0	0.031	0	0.0307
Paint Creek above Cedar Creek and below Fifteenmile Creek including unnamed tributaries 1 and 2	22	0	0.3409	15.6983	16.0392
Fifteenmile Creek	**23**	**0.1956**	**0**	**0**	**0.1964**
Spring Branch	24	0	0.01	0	0.0082
Skitter Creek	**27**	0.4471	0.018	14.238	14.7028
Lykins Creek	**33**	0	0.017	8.2933	8.3103
Mossy Creek below Lick Fork (Long Branch of Mossy Creek)	37	0	0.016	0	0.0162
Packs Branch including Big Fork of Packs Branch	**47**	0.0223	0	1.8734	1.8977

Subwatershed number in bold indicates the stream segment was listed for aluminum.

[1] Mg/year equals metric tons per year

Table 4 - Summary of Manganese TMDLs[1]

Stream Name	SWS	WLA, Mg/yr	LA, Mg/yr	Upstream Contribution, Mg/yr	TMDL, Mg/yr
Paint Creek below Banner Hollow and Jones Branch	1	0	2.63e-01	17.8511	18.1142
Paint Creek above Banner Hollow and below Fourmile Fork	3	0	1.19e-06	17.8511	17.8511
Paint Creek above Fourmile Fork and below Ash Branch	5	0	1.31e+00	16.539	17.8508
Paint Creek above Ash Branch and below Toms Branch	7	0	4.11e-03	16.5163	16.5204
Paint Creek above Toms Branch and below Tenmile Branch	9	0.4697	3.81e+00	12.198	16.4737
Tenmile Branch above Long Branch and below Unnamed Tributary	**11**	**0.028**	**1.06e-02**	**0.1244**	**0.1628**
Unnamed Tributary of Tenmile Branch	12	0	4.53e-02	0	0.0453
Tenmile Branch above Unnamed Tributary	**13**	**0**	**7.90e-02**	**0**	**0.079**
Paint Creek above Tenmile Branch and below Laurel Branch	14	0	1.19e-06	11.6653	11.6653
Paint Creek above Laurel Branch and below Unnamed Branch	16	0	2.56e-06	11.0273	11.0273
Paint Creek above Unnamed Branch and below Hickory Camp Branch	18	0	1.36e-07	11.0273	11.0273
Hickory Camp Branch	**19**	**0**	**4.44e-03**	**0**	**0.0044**
Paint Creek above Hickory Camp Branch and below Cedar Creek	20	0	6.03e-02	10.9626	11.0229
Cedar Creek	21	0	2.23e-02	0	0.0223
Paint Creek above Cedar Creek and below Fifteenmile Creek including unnamed tributaries 1 and 2	22	0	4.44e-01	10.496	10.9403
Fifteenmile Creek	**23**	**0.1222**	**1.03e-05**	**0**	**0.1222**
Spring Branch	24	0	6.36e-02	10.3102	10.3738
Skitter Creek	**27**	**0.4328**	**2.64e-04**	**0**	**0.4331**
Lykins Creek	**33**	**0**	**4.85e-06**	**0**	**0**
Mossy Creek below Lick Fork (Long Branch of Mossy Creek)	37	0	5.48e-04	0.0748	0.0753
Packs Branch including Big Fork of Packs Branch	**47**	**0**	**1.85e-03**	**0**	**0.0018**

Subwatershed number in bold indicates the stream segment was listed for aluminum.

[1] Mg/year equals metric tons per year

From this point forward, all references in this approval rationale are found in the TMDL Report.

II. Summary

Table 1-1 presents the 1996 and 1998 Section 303(d) listing information for the water quality-limited segments of Paint Creek watershed. Of the 17 water quality limited segments shown, 10 were first identified on the 1996 Section 303(d) list, 15 are listed for some combination of pH and metals while two are listed for biological criteria only. This TMDL Report does not specifically address the biological impairment as the pH and metal TMDLs may or may not be the cause of the biological impairment. The biological impairment for two water quality limited segments cannot be attributed to active or historical mining activities.

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a margin of safety value. Conditions, available data , and the understanding of the natural processes can change more than anticipated by the margin of safety. The option is always available to refine the TMDL for re-submittal to EPA for approval.

The TMDLs were developed using TAMDL, a computer model developed at West Virginia University, National Mine Land Reclamation Center. The model attributes all pH and metals loading to AML that is not attributable to permitted sources. The model simulates ferrous iron oxidation, manganese oxidation and precipitation, aluminum precipitation, organic material decay, aeration, meteorological heating, and ferric iron sedimentation. Appendix B provides the theoretical basis of TAMDL.

TMDLs or allowable loads were developed for each of the 62 subwatershed segments in the watershed model for pH, iron, aluminum, and manganese. Figure 4-2 shows the Paint Creek TAMDL subwatersheds and the associated stream segment is identified in Appendix F, Table F-2.

III. Background

Paint Creek, a tributary of the Kanawha River, flows in a northerly direction through parts of Raleigh, Fayette and Kanawha counties in south-central West Virginia (Figure 1-1) and has a drainage area of 318 km^2 (123 mi^2). For the past 90 years, surface and deep coal mines have operated in the watershed. Before the implementation of the West Virginia Surface Coal Mining and Reclamation Act (WVSCMRA) and Surface Mining Control and Reclamation Act (SMCRA), little consideration was given to the environmental degradation that resulted from these activities. Currently, the quality of Paint Creek and its tributaries are being negatively impacted by the acidic drainage from those mines that were abandoned prior to the environmental regulations. The environmental impact of this mine drainage is being manifested in depressed stream pH and elevated concentrations of iron, manganese and aluminum.

These TMDLs were established by EPA to fulfill requirements of the 1997 TMDL lawsuit settlement agreement. The 1997 consent decree requires that West Virginia, or the Environmental Protection Agency (EPA) if West Virginia fails to, develop, by September 30, 2001, seven TMDLs priority water quality-limited segments (WQLS) included on the 1996 Section 303(d) list. The Paint Creek main stem is a priority WQLS. In addition, the consent decree required dates for 250 TMDLs for mine drainage impacted WQLS from the section 303(d) list sublist to were extended to between March 31, 2001 and March 31, 2006.

Computational Procedure

Section 3.0 of this TMDL Report discusses the formation of acid mine drainage and discusses point source and non-point source of acid mine drainage. Generally, point sources are permitted mining operations and non-point sources are pre-SMCRA sources such as abandoned mine lands and discharges from abandoned deep mines.

Section 4.0 discusses the technical approach, data sources, and application of the Total Acidic Mine Drainage (TAMDL) model.

IV. Discussions of Regulatory Requirements

EPA has determined that these TMDLs are consistent with statutory and regulatory requirements and EPA policy and guidance. EPA's rationale for establishing these TMDLs is set forth according to the regulatory requirements listed below.

1. The TMDLs are designed to implement the applicable water quality standards.

Parts of Paint Creek are designated as trout streams. The applicable water quality criteria are shown in Table 2-1.

2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs can be expressed in terms of mass per time or by other appropriate measures. TMDLs are comprised of the sum of individual wasteload allocations (WLA) point sources, load allocations (LA) for non-point sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving stream. Conceptually, this definition is denoted by the following equation.

$$TMDL = \sum WLA + \sum LA + MOS$$

For purposes of these TMDLs only, point sources are identified as permitted discharge points from active mining sites and nonpoint sources are discharges from abandoned and reclaimed mine lands which includes such things as tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no National Pollutant Discharge Elimination System (NPDES) permits associated with these areas. As such, the discharges associated with these land uses were assigned load allocations (as opposed to wasteload allocations). The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are unpermitted point source discharges within these land uses. In addition, by approving these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Table 5-2 through 5-5 present, for each subwatershed, the WLA, LA, upstream contribution, TMDL, nonpoint source loads, and percent reduction required in the nonpoint source loads. Table E-1 presents the WLA for each subwatershed allocated among the NPDES permits. Table E-1 allocates the WLA to a specific outfall. A permittee may redistribute the total WLA within a subwatershed as necessary, including to permitted outfalls not shown in Table E-1.

3. The TMDLs consider the impacts of background pollutant contributions.

TAMDL does not consider the impacts of background pollutant loads. All loading beyond what is attributable to permitted point sources is considered to result from abandoned mine lands. It is assumed that loadings from other lands uses do not impair in-stream water quality. A metals/total suspended solids analysis was performed to verify that sediment is not a significant source of metal loading.

Non considering non-abandoned mine land sources adds to the margin of safety.

4. The TMDLs consider critical environmental conditions.

Critical conditions were considered while considering seasonal variations, running the model for several year, from October 1, 1992 to September 30, 1999.

5. The TMDLs consider seasonal environmental variations.

Section 5.4.3 addresses seasonal variations.

6. The TMDLs include a margin of safety.

The Clean Water Act and federal regulations require TMDLs to include a margin of safety (MOS) to take into account any lack of knowledge concerning the relationship between effluent limitations and water quality. EPA guidance suggest two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

An explicit MOS was included by setting the modeling endpoints to 95 percent of the water quality standards, Section 5.1. Also, by considering all nonpoint pollutant loads attributable to AML, an additional implicit MOS was used.

7. There is reasonable assurance that the proposed TMDLs can be met.

Section 6.0 addresses reasonable assurance. There are two primary programs in effect which provide reasonable assurance that the TMDLs will be implemented. Section 6.1.1 discusses the duties of the office of Abandoned Mine Lands and Reclamation and Section 6.1.2 discusses the duties of the Special Reclamation Group. Appendix G describes West Virginia's holistic watershed approach protocol for integrated watershed characterization.

In addition, the next round of NPDES permitting will require that permit limits reflect the individual WLAs. The WLAs will be converted to permit limits using the procedures of EPA's *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991).

8. The TMDLs have been subject to public participation.

Section 7.0 describes the public participation.