APPENDIX 3
Compensatory Mitigation

Abstract

EPA has identified five significant flaws in the permittee's plan to mitigate for the environmental impacts of the Spruce No. 1 Mine. Although these flaws are identified and briefly discussed in the Final Determination, additional explanation and clarification is provided herein. These flaws include:

(1) Compensatory mitigation will not replace high quality resources in Pigeonroost Branch and Oldhouse Branch. EPA believes that compensation for the impacts to high quality headwater streams within the Spruce No. 1 Mine area using enhanced on-bench sediment ditches is inappropriate because the resulting aquatic physical, chemical, and biological quality of these "replacement" streams is likely to be highly degraded.

(2) The compensatory mitigation plan is based upon a misclassification of the impacted resources. EPA calculates that approximately 20,000 feet of perennial stream will be impacted, compared to the DA permit estimate of 165 linear feet of perennial waters within the project area. The mitigation plan, therefore, is not designed to compensate for the structure and function of the aquatic resources to be impacted.

(3) The compensatory mitigation plan lacks an adequate functional assessment characterizing the ecological functions performed by streams on the project site, which would inform plans for appropriate compensatory mitigation.

(4) Conversion of erosion control channels would be unlikely to successfully replace the impacted resources. On-site restoration of 7,000 feet and off-site enhancement of 11,000 feet of streams will not provide compensation for impacts to high-quality Pigeonroost and Oldhouse Branches.

(5) The compensatory mitigation plan does not account for the loss of ecological services arising from the interrelationship of the headwater streams and the surrounding terrestrial ecology.

These conclusions are expanded upon in the five Sections below, following the format of and providing additional explanation for the main concerns identified in the Final Determination.

A3.1. The Compensatory Mitigation Plan will not replace high quality resources in Pigeonroost Branch and Oldhouse Branch

The Compensatory Mitigation Plan (CMP)'s actions will not replace the high quality stream resources being impacted. As noted by EPA and the Corps in the preamble to the 2008 Compensatory Mitigation Rule, streams are difficult to replace, therefore stream establishment (creation) and re-establishment should be discouraged.[1] However, the

[1] EPA recognizes that the effective date of the regulations governing compensatory mitigation that were promulgated at 73 Fed. Reg. 19594 (April 10, 2008) is June 9, 2008, and therefore were not in effect when the Corps of Engineers issued DA Permit No. 199800436-3 (Section 10: Coal River). Nevertheless, the above-quoted statement, taken from the preamble to those regulations, represents the most recent regulatory

CMP relies extensively on stream creation and restoration of streams – activities that the preamble notes, based on available evidence, are difficult to replace. The proposed structural restoration and enhancement actions are unlikely to produce significant biological improvement in streams that are chemically polluted by surface coal mining activities. Similarly, the connectivity channels proposed as compensation would be replacing channels that may already be jurisdictional waters. Therefore, these channels may not in fact "create" any streams that do not already exist, and therefore are unlikely to produce significant ecological or functional improvement to the current overall stream network. In addition, the use of created on-bench ditches as mitigation has not been proven to be effective and is discussed further in Section A3.4.

The CMP proposes over 11,000 feet of off-site "enhancement" and over 7,000 feet of off-site "restoration" for adverse stream impacts from the Spruce No. 1 Mine. EPA believes that in this case, using structural stream enhancements (e.g., stream bank protection, adding structural complexity in the form of boulder clusters, j-hooks, vortex rock weirs, etc.) to replace the functions and structure lost from burial of high quality streams on a foot per foot basis is scientifically unfounded. Similarly, the 2,500 feet of "enhancement" activities in Rockhouse Fork will likely gain little biological lift because this stream is chemically polluted from coal mining activities, as demonstrated by high levels of selenium, conductivity and sulfates. Some sections of Spruce Fork proposed for enhancement appear to be physically intact, ecologically functioning streams. The diagrams of enhancement techniques (i.e., vortex weirs, j-hooks, boulder clusters) pictured in Exhibits 7-15 of the CMP that would be deployed in Spruce Fork and Rockhouse do not sufficiently assure that lost headwater stream structure and function will be offset by enhancements in the mitigated stream segments.

The on-site "restored" sections of stream in connection with sedimentation ponds and mine-through areas will also not function like pre-mining streams because of chronic chemical pollution leaching from mine spoil and valley fills (Pond et al. 2008, Fritz et al. 2010). Because water quality limits the diversity, abundance and structure of aquatic communities within affected streams, simply applying a "natural channel design" component and riparian plantings will not re-establish the naturally occurring indigenous wildlife or ecosystem functions that currently exist in Pigeonroost Branch and Oldhouse Branch. EPA is unaware of any documented cases where in-stream structural restoration in the form of "natural channel design" has been shown to restore water quality and biological communities such as those impacted by mine spoil leachate. Instead, these "restored" segments are likely to export degraded water to Spruce Fork and the Little Coal River. This will limit colonization of these streams by aquatic wildlife and cause degradation of downstream wildlife through the export of polluted water.

An additional 26,625 feet of high gradient stream credit is sought for connectivity channels. Connectivity channels are areas where surface water flows from the on-bench ditches, passes through NPDES outfalls, and runs downhill to eventually "form a

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statement by the agencies regarding types and effectiveness of mitigation and summarizes scientific research and literature that is applicable to consideration of the likely efficacy of the compensatory mitigation proposed for the Spruce No. 1 Mine.

hydrological connection to a surface tributary of a navigable water" (USACE 2007). These connectivity channels are simply overflow channels through wooded hill slopes. The premise is that, if properly placed, connectivity channels will enable mine runoff water to travel down natural, steep hill slopes and ephemeral channels and into naturally non-flowing receiving segments. If these connectivity channels are created, they are expected to have minimal function due to the water quality limitations discussed above. Whether created or natural, they will likely receive suspended sediments, metals, and high ion concentrations from the mined area, resulting in further degradation and an inability of these channels to provide meaningful ecological functions and values to replace the affected streams.

After mining, proposed stream drainage areas above the entrance of connectivity channels range between 10 and 97 acres. These subwatersheds could yield considerable water volumes, especially during storm events. Increased storm flow and effluent through the NPDES outlets and into natural channels will likely (1) erode and cause down-cutting in receiving channels which will increase sedimentation to downstream receiving waters, and (2) deliver water of such degraded quality as to impair the resident biological communities. EPA notes that an example of this practice was observed in July 2007 on a field trip with USACE ERDC[2], in which the channel had eroded to bedrock, was highly entrenched, and had virtually no aquatic life. EPA does not believe the connectivity channels proposed for the Spruce No. 1 Mine project will offset buried stream resources and believes they are likely to cause degradation to downstream receiving waters.

The enhancement and restoration proposed for existing streams chemically polluted by surface coal mining activities are unlikely to improve the chemical or biological function of streams on or off the project site. They therefore will not play a meaningful role in replacing the high quality physical, chemical and biological functions performed by Pigeonroost and Oldhouse Branches, which currently have diverse biological communities and contribute high-quality and un-degraded water to the watershed. In addition, compensation credit for connectivity channels and restoration of streams on site after the conclusion of mining are unlikely to result in streams that could meet designated uses for aquatic life support and will likely cause or contribute to water quality degradation downstream.

A3.2. The Compensatory Mitigation Plan is based upon a misclassification of the impacted resources

EPA believes that an adequate compensatory mitigation plan must be based upon an accurate delineation of on-site impacts to ephemeral, intermittent, and perennial stream-types in the Spruce Fork watershed. EPA believes the stream delineations developed for the Spruce No. 1 EIS misclassify many of the streams onsite. Based on the available site information, EPA believes a more accurate representation of the impacts to water resources is described below.

[2] Engineer Research and Development Center (ERDC) is the US Army Corps of Engineers research and development command.

Headwater streams are the small ephemeral, intermittent and perennial tributaries at the head of watersheds. Many scientists agree that classifying streams by a single abiotic or hydrological parameter for assessing aquatic life potential is unsatisfactory for several reasons. First, hydrological parameters vary temporally and seasonally and can be difficult to measure accurately. Second, several abiotic parameters determine whether a stream can support aquatic life (e.g. length of dry period, connectivity through subsurface or interstitial flow, presence and quantity of refugia) (Boulton 1989, Williams and Hynes 1977, Williams 1987). Third, many aquatic invertebrates have generalized adaptations for surviving periods of low or no surface flow (Williams 1996). Biological assemblage data can indicate the long-term hydrological characteristics of streams because many of the species are long-lived and require flowing water for all or part of their life cycles. Consequently EPA often uses biological data in conjunction with hydrologic data to more accurately describe or confirm the long-term hydrologic characteristics of streams.

The USGS documented the flow origin, drainage areas and hydrologic characteristics of perennial and intermittent streams in this region in 2000 and 2001 (Paybins 2003). Results indicated that the median drainage area upstream of the origin of intermittent flow was 14.5 acres. USGS defined the intermittent point (i.e., the boundary between ephemeral and intermittent flow), as the point where base flow begins in the late winter or early spring. The median drainage area upstream of the origin of perennial flow was found to be 40.8 acres. The boundary between intermittent and perennial flow (i.e., the perennial point), was defined by the lowest water table elevation, where base flow begins in the late summer and early August. These median drainage areas were used to delineate the watersheds. Additionally, a flow accumulation model and the National Elevation Dataset (NED) were used to estimate the stream lengths associated with intermittent flow and perennial flow in this region (no attempt was made to model the extent of ephemeral streams). The results of the computer modeling were compared to the medium resolution National Hydrology Dataset (NHD), which is a stream network based on 1:100,000 scale maps.

Concerning the Spruce No. 1 Mine, EPA first compared lengths of stream channel in Pigeonroost Branch and Oldhouse Branch from USGS estimates using drainage area to estimates made in the EIS for these stream reaches. Median drainage areas for ephemeral/intermittent (14.5 acres) and intermittent/perennial (40.1 acres) have been documented by USGS (Paybins, 2003). Moreover further studies by the US EPA Office of Research and Development (Fritz et al. 2006, Fritz et al. 2008), US EPA Region III (Pond and Passmore 2008), and Svec et al. (2005) support that these USGS drainage area estimates are quite reliable for the Cumberland Plateau sub-ecoregion. EPA compared lengths of stream channel in Pigeonroost Branch and Oldhouse Branch from USGS estimates to estimates made by the permittee. Using this information, EPA believes that the project will impact greater lengths of intermittent and perennial stream channels than is currently proposed to be compensated for by the project's CMP.

On-the-ground field observations in the Spruce No. 1 Mine project area also support the conclusion that stream resources have been underestimated. A field reconnaissance by

EPA (accompanied by Sturm Environmental, Inc.) during dry conditions in September 1998 (Green and Passmore 1999) found distinct perennial benthic communities (i.e., long-lived taxa representative of perennial conditions) in the upper reaches of Pigeonroost Branch and Oldhouse Branch. This 1999 EPA report was sent to the Huntington District USACE Regulatory Branch Chief on July 29, 1999 and was subsequently published in the Corps' September 2006 FEIS, but was not used as the basis for the impact calculation or mitigation requirements.

Based on these new scientific studies and previously collected field data, EPA believes that the project will impact previously misclassified segments of intermittent and perennial stream channels. An example of mischaracterization is in Oldhouse Branch. The uppermost ephemeral/intermittent delineation point, referred to as "O1" in Figure A3.1. and "T1" in CMP Exhibit 2, occurs at approximately the 255-acre watershed size. At this watershed size, EPA believes that a strong perennial stream channel is present for thousands of feet upstream of this point. Figure A3.1. shows an excerpt from a 7.5 min USGS topographic map depicting Green and Passmore (1999) study sites, overlain with Paybins (2003) drainage-area derived intermittent and perennial delineations.

EPA compared lengths of stream channel in Pigeonroost Branch and Oldhouse Branch from USGS estimates, to field delineations made by the applicant. It is EPA's determination that at point T1 in Oldhouse Branch, the applicant's demarcation for ephemeral/intermittent found in CMP Exhibit 2, there are approximately 3100 feet of unaccounted-for perennial stream upstream of that point. Moreover, in Oldhouse Branch, an additional 1100 feet in "Second Unnamed Right Tributary" (T2 in CMP Exhibit 2) likely run perennially. By adding the additional distance from T1 down to the toe of the fill, EPA believes that cumulatively there are over 7000 feet of perennial stream channel in Oldhouse Branch alone that will be filled or otherwise eliminated from direct mining impacts. This is in contrast to the less than 200 feet for the entire project as determined by the applicant.

In Pigeonroost Branch, EPA believes that additional stream lengths, which have been classified as ephemeral or intermittent by the applicants, are likely perennial waters based on biological sampling. An EPA study (Green and Passmore 1999) used the WV water quality standards methodology for determining perennial streams and was conducted during a relatively dry, late summer period. In Green and Passmore (1999), EPA categorized two types of perennial streams: Type 1 (flow and indicator biota requiring at least a 6 month life cycle) and Type 2 (non-contiguous surface flow during drought conditions but indicator biota requiring at least a 6 month life cycle). They found Type 1 conditions near the very headwaters of Pigeonroost Branch. Additionally, one site in upper Middle Fork of Pigeonroost Branch (P1 in Figure A3.1.) with a catchment area of only 15 acres was also deemed to be a Type 1 perennial stream.

Overall, through onsite visits and biological data collection, EPA conservatively determined that within the mine footprints of Pigeonroost Branch and Oldhouse Branch approximately 20,000 feet are Type 1 perennial. USACE's permit accounted for 165 feet of perennial waters within the entire project area, misclassifying tens of thousands feet of

perennial waters within the project area. Therefore, any calculations of debits and credits, and subsequent mitigation using these classifications are misleading and do not adequately compensate for the impacted natural resources. This classification is a critical element of ensuring effective compensation for stream structure and function, which include the biota and the organic matter, nutrients, and pollutants retained or loaded to receiving streams. Additional concerns regarding the assessment methods used are discussed below in Section A3.3.

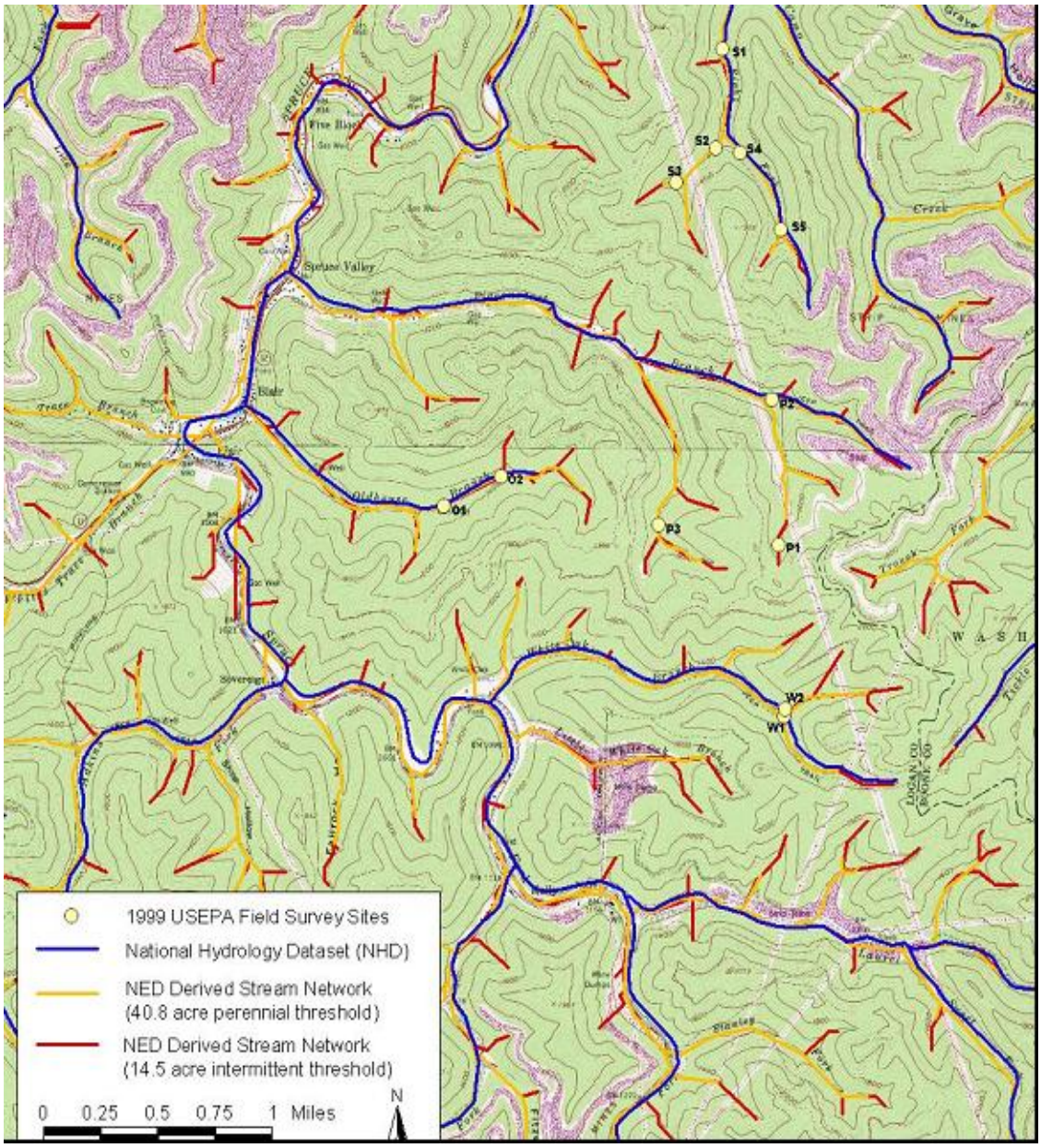

Figure A3.1. Excerpt from USGS 24K topographic map showing EPA sample sites overlain by Paybins (2003) drainage area-derived intermittent and perennial designations. Blue lines are NHD (1:24,000) streams, yellow lines are perennial streams, and red lines are intermittent streams. The magenta areas are mined lands.

A3.3. The Compensatory Mitigation Plan lacks an adequate functional assessment

In addition to being based on a misclassification of resource type, the CMP also is based upon an inadequate functional assessment of the impacted resources. The goal of compensatory mitigation is to replace the aquatic resource structure and function that is lost or adversely affected by authorized activities. Therefore, to ensure that the functions are being replaced, the compensatory mitigation must create or restore streams that sustain comparable biological communities and chemical and physical characteristics and provide comparable physical, chemical and biological functions to the streams that have been impacted (and, in this case, eliminated). In order to ensure adequate replacement of both structure and function, the impacted stream must be accurately assessed and the proposed compensation must be evaluated using comparable standards for assessment. As discussed above, the baseline assessment of the existing and impacted streams on the site missed and misclassified well over twenty thousand linear feet of headwater streams, which prevented the USACE from identifying the appropriate compensation needs of this project. In addition, the assessment method used by the permittee was inadequate and lead to an improper valuation of compensation needs and proposals.

In the CMP the permittee used the Stream Habitat Unit method (SHU) to determine compensatory mitigation debits and credits. SHU only considers the physical characteristics of a stream and ignores the biological and chemical characteristics. This assessment entails a combination of linear lengths of impact, habitat assessment scores, and stream hydrological status. The USFWS expressed this concern in regard to the CMP in their May 30, 2006 comment letter on the DEIS:

> The Stream Habitat Unit (SHU) assessment methodology selected by the applicant only considers the physical characteristics of the stream. It does not include biological or chemical characteristics of the stream. Without those attributes, the assessment does not meet the requirements of a "functional" assessment. The Service recommends that the applicant use an assessment method that incorporates biological and chemical, as well as habitat, characteristics to determine the true function of the stream.

The basis for the SHU, as presented by the CMP, is based on the premise that stream habitat (HAV as scored by EPA's Rapid Bioassessment Protocol (RBP) Habitat Assessment) accounts for the total ecological "currency" at the site. This premise has been demonstrated to be flawed. Studies (e.g., Fritz et al. 2010) have found no correlation between functional measurements and RBP Habitat Assessments. More importantly, the USACE or the permittee did not use existing water chemistry or biological resource measurements as a factor in the SHU's ecological currency of the sites. This shortcoming ignores whether streams actually support biological communities or water quality that can sustain aquatic life, so a biologically dead and chemically toxic stream with proper habitat structure is equivalent to a high quality biologically productive headwater stream that serves as a source of fresh water dilution. This underscores the need for a more thorough investigation of impacts and mitigation offsets.

Although the Corps did not finally rely solely on the SHU for the mitigation requirements, the SHU did form a basis for the permittee's mitigation plan, and the final

approved mitigation did not provide an adequate alternative assessment of stream structure and function that captured stream chemical and biological function. As a result, EPA believes the current CMP does not adequately account for or replace the functional components of the lost streams. Furthermore, EPA does not believe that increased ratios of intermittent or ephemeral streams offset this inadequacy. While DA Permit No. 199800436-3 (Section 10: Coal River) refers to biological success criteria and the use of a yet-to-be developed functional assessment method for mitigation monitoring, permit conditions do not clearly require the replacement of lost biological function and comparable stream chemistry or adequate compensatory mitigation success criteria.

A3.4. Conversion of erosion control channels will not successfully replace the impacted resources

On-bench sediment ditches (sometimes called erosion control structures) are SMCRA-required best management practices (BMPs) to control water and erosion runoff and should not be considered adequate compensation for loss of high quality stream resources such as those in Pigeonroost Branch and Oldhouse Branch. The CMP inappropriately considers on-site sediment ditches equivalent to existing streams, even though these sediment ditches are primarily designed to control extreme hydrologic forces from large storm events and do not replace the range of stream functions that existed prior to mining. Because the natural resources that are being lost are healthy, biologically functioning streams, sediment ditches designed to control and convey water are not likely to replace the diverse ecological services provided by these highly functioning streams. In addition, water quality in sediment ditches in mined areas is typically highly degraded, primarily because ditch water has percolated through mine spoil. Because of the degraded water quality, these channels should be considered potential sources of pollution rather than a compensatory mitigation feature.

In many cases, the sediment ditches would be considered non-attaining in terms of aquatic life uses based on an assessment of benthic communities, and could subsequently be listed as impaired on the state 303(d) list. Data from Kirk (1999a), Green et al. (2000), and Gingerich (2009) strongly suggest that benthic assemblages in these ditches do not resemble those found in natural, high-gradient Appalachian headwater streams like those in Spruce No. 1 Mine area and would be assessed as severely impaired. Moreover, water quality (e.g., salinity) is so degraded that it could potentially foster the establishment of toxic golden algae (Hambright 2010, Roelke et al. 2010, Baker et al. 2009, and Sager et al. 2008).

Sediment ditches do not offset the direct impacts of fill to aquatic macroinvertebrate communities in Oldhouse and Pigeonroost Branches, which are both high quality headwater streams. A comparison of family-level macroinvertebrate data from sediment ditches (Table A3.1.) with data from Pigeonroost and Oldhouse Branches reveals marked differences in species richness and very little taxonomic overlap. Based upon Kirk (1999a) and EPA data, total familial richness in sediment ditches ranged between 4 to 11 taxa, with 0 to 3 families of Ephemeroptera, Plecoptera or Trichoptera (EPT) taxa present. In contrast, total familial richness at Oldhouse and Pigeonroost was 40, with 26

families of EPT taxa present. Of the taxa collected in the sediment ditches, only seven were also present in Oldhouse and Pigeonroost Branch. With regards to the taxa present in the sediment ditches that were not found in Oldhouse and Pigeonroost, Pond et al. (2008) found that these taxa do not generally occur at unmined sites. These data demonstrate that taxonomic assemblages in sediment ditches are not only less diverse than unmined sites, but that they also include a suite of organisms not found in unmined, high quality headwater streams, such as Oldhouse and Pigeonroost. These organisms are not characteristic of a high-quality stream community, such as the wildlife communities currently living in Pigeonroost and Oldhouse Branches.

Table A3.1: Presence/absence of taxa in MTM/VF sediment ditches. Data are compiled from Kirk (1999), except Stanley Fork (collected by US EPA Region III).

Collection Date:		Oct. 8, 1999	Oct. 8, 1999	Oct. 8, 1999	Oct. 8, 1999	Oct. 26, 1999
Site		Vance Branch	Rollem Fork	Left Fork	Honey Branch	Stanley Fork
Method		Ponar	Ponar	Ponar	Ponar	Kick Net
Order	Family	Sediment Ditch	Sediment Ditch	Sediment Ditch	Sediment Ditch	Sediment Ditch
Oligochaeta	Oligochaeta	X	X	X	X	
Basommatophora	Physidae					X
Ephemeroptera	Baetidae	X		X	X	
Ephemeroptera	Caenidae			X		
Trichoptera	Polycentropodidae			X		
Diptera	Ceratopogonidae	X	X	X	X	X
Diptera	Chironomidae	X	X	X	X	X
Diptera	Empididae					X
Diptera	Simuliidae					X
Diptera	Stratiomyiidae					X
Diptera	Tipulidae			X		X
Coleoptera	Dytiscidae	X		X	X	
Coleoptera	Hydrophilidae		X			
Coleoptera	Haliplidae				X	
Odonata	Coenagrionidae			X	X	X
Odonata	Lebellulidae	X		X		
Hemiptera	Mesoveliidae			X		
	Total Richness	**6**	**4**	**11**	**7**	**8**
	EPT Richness	**1**	**0**	**3**	**1**	**0**

As described in Appendix 2 (Section A2.2), most of the benthic wildlife taxa naturally occurring in Oldhouse Branch and Pigeonroost Branch headwaters will not survive in the erosion control ditches proposed for mitigating the loss of headwater streams due to extreme chemical conditions, temperature extremes, and the overall lack of a lotic flow regime common in these ditches (Kirk 1999a). Recent research has shown that stream restoration projects based upon channel design can not only be problematic (Simon et al. 2007), but are also not effective in restoring ecological function and biodiversity (Tullos et al. 2009, Palmer et al. 2009, Fritz et al. 2010). In a study on streams impacted by mountaintop mining/valley fills (MTM/VF), Fritz et al. (2010) found that habitat features and aquatic assemblages were very different in constructed channels than natural

channels, and suggested that constructed channels should not be used for mitigation on-site.

The permit's Special Conditions require that biological scores (i.e., West Virginia Stream Condition Index, WVSCI) and habitat scores (i.e., RBP) be similar to or better than pre-mine conditions in the erosion control ditches. As already noted in Section A3.1., the preamble to the 2008 Mitigation Rule, and the scientific literature, achieving successful mitigation through stream creation – particularly stream creation using erosion control features that are likely to carry polluted water – is difficult to achieve and unlikely to succeed. In light of this evidence, relying upon such mitigation efforts and wholly unrealistic success criteria provides no assurance that these mitigation features will in fact contribute to compensation for high-quality Pigeonroost and Oldhouse Branches.

Given the current knowledge of the physical, chemical and biological conditions in several representative on-bench ditches, it is clear that the biological and chemical conditions of the buried headwater streams will not be replaced by these mitigation measures. Evidence reported below (Figures A3.2.-A3.4.) reveals that the created channels would fail to meet the conditions of the permit for most sites. Even when the sediment ditches are enhanced for benthic substrata and riparian vegetation (e.g., boulder clusters every 500-1,000 ft), the water quality will likely be so degraded that the ditches will not meet or exceed pre-mining WVSCI scores required by the permit's Special Conditions.

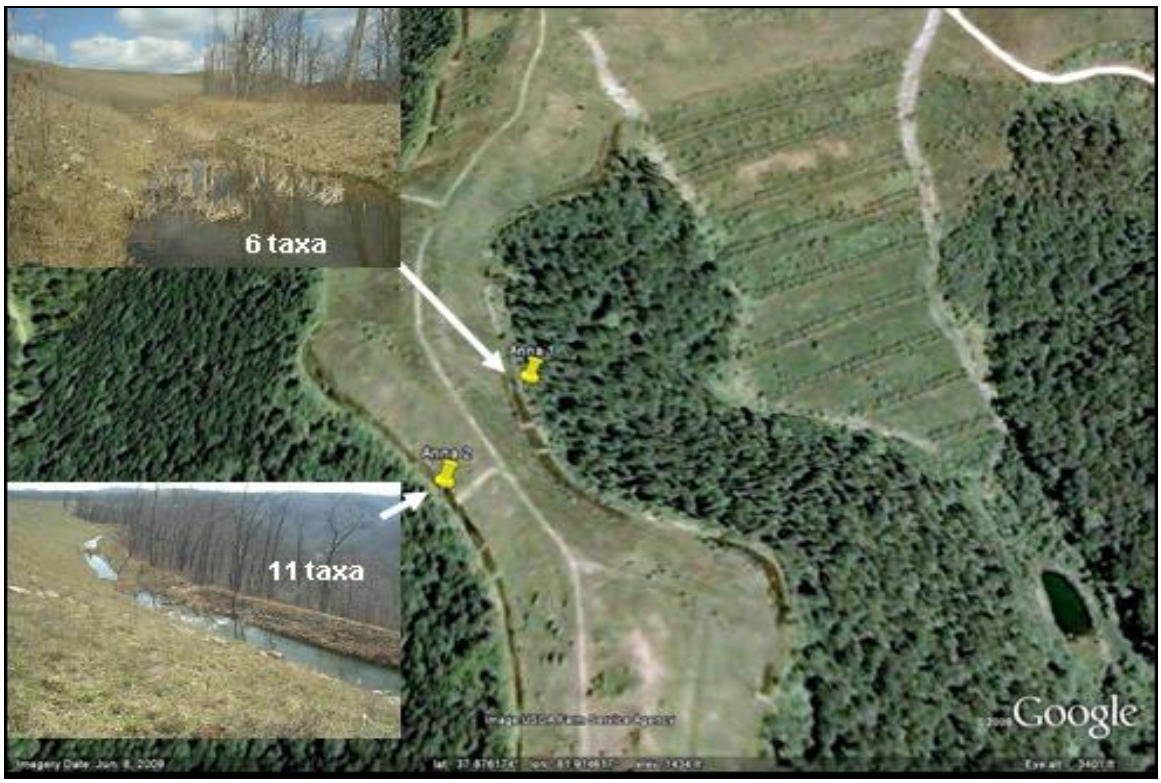

Figure A3.2. Reclaimed sediment ditch: Anna Branch (Logan Co., WV).

Figure A3.3. Reclaimed sediment ditch: Big Horse Creek (Little Coal River basin).

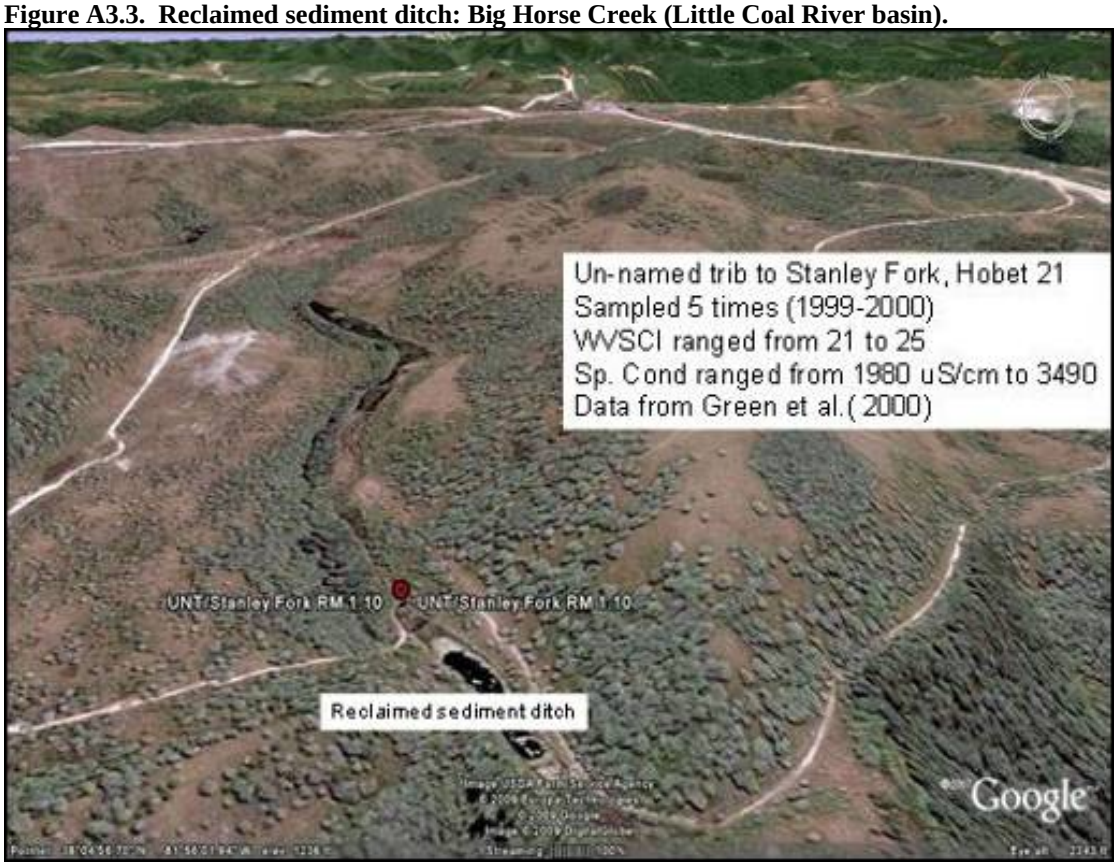

Figure A3.4. Reclaimed sediment ditch on Hobet mine (Mud River basin).

Figures A3.2. and A3.3. above show aerial views of examples of on-bench sediment ditches with accompanying biological and physicochemical data. Gingerich (2009) re-sampled the Hobet mine site nearly 20 years after construction and found only one EPT taxon, with in-channel conductivity still averaging >2200 µS/cm. EPA has observed the following conditions in these sediment ditches, in comparison to natural high-gradient streams:

- Altered flow regime (e.g., unnaturally low velocities);
- Altered temperature regime (e.g., extreme high temperatures);
- Contaminated water (e.g., ions, metals); and
- Depauperate and tolerant biota (e.g., typical of roadside ditches/urban swales).

The CMP indicates that the streams will be "enhanced" by the additional flow from these ditches, changing them from intermittent to perennial. This "enhancement," however, does not serve as in-kind replacement of the natural intermittent streams being filled within the project area and instead replaces a diverse intermittent flow regime with a steady and unnatural perennial flow. Intermittent streams provide valuable ecological functions (in and of themselves and to downstream waters) and many species (including some EPT taxa) rely on intermittent streams as part of their life history strategy. Conversion of naturally intermittent flows to unnatural perennial flows will place naturally occurring fauna at a competitive disadvantage, further contributing to the elimination of this unique wildlife from the watershed. These ditches therefore represent different aquatic systems chemically, biologically and hydrologically; and thus will not compensate for the loss of high-quality Appalachian headwater streams.

Thus, without data showing that this form of stream creation can replace the lost functions of high-quality functional Appalachian headwater streams, there is no basis in the record to allow the use of such on-bench mitigation to compensate for the permanent destruction of high quality streams such as Pigeonroost Branch and Oldhouse Branch. The "high likelihood of failure" scenario that stream creation presents (Bernhardt et al. 2007, Palmer and Bernhardt 2009) means that that the CMP is unlikely to replace the functions of these high quality resources.

A3.5. The Compensatory Mitigation Plan does not account for the loss of ecological services performed by headwater streams

The CMP improperly separates the ecological elements into individual and separate elements with limited treatment of the interconnectedness of the entire ecosystem. EPA believes that a well-designed compensatory mitigation plan in central Appalachia should take into account this terrestrial-aquatic linkage and ensure that restored or created channels do not solely act as water conveyance structures. As noted above, connectivity channels and other features are likely to function largely as a conveyance channel for water flow to downstream waters.

The forested slopes and coves located within the Spruce No. 1 Mine project area are drained by a dendritic mosaic of ephemeral, intermittent and perennial headwater streams

and watercourses. The watershed is inextricably linked with the stream system that drains it. The overwhelming bulk of the organic matter that sustains the stream biota in Spruce Fork is a function of the upstream environment.

The permittee proposes to restore or create 71 acres of riparian forest as part of its reclamation and stream creation and restoration activities. While EPA agrees that planting trees along any newly created stream channels better re-creates pre-mining riparian conditions than no riparian vegetation, EPA has not seen evidence that such practices can effectively replace lost natural riparian ecosystems. Contributions of riparian leaf litter and organic matter to Appalachian headwater streams has been well-established as a critical nutrient contribution to these streams. Because of this fact, and because of deficiencies in the CMP, newly created riparian ecosystems on the Spruce No. 1 project site are expected to be of degraded, poor quality for many years.

Riparian systems created through the CMP are likely to function differently from affected streams because their vegetation communities are likely to differ from those present on the project site. For example, some of the tree species listed in the CMP for riparian revegetation are not native to West Virginia, including Cherrybark Oak (*Quercus pagoda*), Sawtooth Oak (*Q. acutissima*), and Swamp Chestnut Oak (*Q. michauxii*). Out of the 11 tree species listed in the CMP, only two, red maple (*Acer rubrum*) and American sycamore (*Platanus occidentalis*), are found within or near the project area and are therefore suitable choices for riparian planting. From an ecosystem compensation standpoint, most of the proposed tree and shrub species are "non-native" to the ecoregion, and thus not representative of Appalachian headwater areas. Pines (*Pinus* spp.), such as White Pine (*P. strobus*) and Virginia Pine (*P. virginiana*), should not be planted in riparian zones because they are not naturally occurring in headwater riparian zones in the ecoregion, contribute little to benthic organic matter, and have low organic matter breakdown rates (Webster and Benfield 1986). Overall, the re-vegetation plan is inadequate, in terms of creating a healthy riparian forest designed to replace the existing streamside forests within the Spruce No. 1 Mine project area. The current riparian zone consists largely of basswood, beech, tulip poplar, buckeye, sugar maple, white oak and red oak. EPA contends that these resident native species would, at a minimum, be better choices to help replace some structure and function of the headwater stream ecosystem. Without such species, post-mining riparian areas are unlikely to provide nutrient inputs commensurate with those provided by the pre-mining inputs provided by riparian areas of Pigeonroost and Oldhouse Branches. This is likely to result in post-mining stream channels that do not compensate for the functions provided by impacted resources.

In addition to the use of inappropriate tree species, post-mining streams on the mined area are unlikely to achieve similar ecological functions as identified in the CMP. In their pre-mined condition, headwater streams are recipients of allochthonous material (i.e., material originating from outside of the stream system) and surface/subsurface water and groundwater inputs from the surrounding forested communities. The post-mined environment, however, creates severely altered conditions in those stream courses that are not filled with excess spoil. These altered conditions include:

a. Elimination of water and processed organic material from former upstream tributaries buried beneath valley fills. As discussed in Sections A3.1. and A3.4. above, the erosion control features and connectivity channels approved to replace those streams are unlikely to provide similar chemical or biological functions or contributions downstream.

b. Altered contributions of water and allochthonous material from the surrounding upland watershed due to the altered character of the soil and vegetation communities in a post-mine environment.

c. Altered hydrograph with new flow regimes that markedly depart from that under which the streams have evolved as discussed in relation to the connectivity channels and sediment ditches impact on receiving waters in Sections A3.1. and A3.4. above.

d. Altered timing, temperature and chemical composition of post-mine discharges of water to receiving streams.

Summary

The Spruce No. 1 Mine will profoundly alter its immediate watershed and downstream waters. In addition to the direct burial of more than six miles of Pigeonroost and Oldhouse Branches, the post-mining hydrologic landscape will be vastly different from the diverse dendritic stream mosaic characteristic of Appalachian headwater watersheds. Misclassification of the impacted streams via both the omission of impacted streams and the under-representation of perennial stream length leads to inadequate compensation requirements as outlined in the CMP. Similarly, the CMP uses an incomplete assessment method that does not capture chemical or biological function, allowing compensation credit for, among other actions, more than 26,000 feet of "connectivity channels" created by sediment ditch overflows, resulting in the export of degraded water to forested hillsides and contributing to the impairment of downstream aquatic communities. The assumption that much of the structure and function of the pre-mined conditions can be recaptured with the CMP's mitigation is overly optimistic, highly speculative, and extremely unlikely to succeed. The mitigation is therefore unlikely to replace or compensate for the loss of the high quality headwater streams within the project area and the important ecological functions and services they provide.