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November 29, 2010

Via E-Mail and Overnight Delivery

Peter S. Silva
Assistant Administrator, Office of Water
United States Environmental Protection Agency
1200 Pennsylvania Avenue, N.W., Room 3219
Washington, D.C. 20460

Re: **Recommended Determination of the U.S. Environmental Protection Agency Region III Pursuant to Section 404(c) of the Clean Water Act Concerning the Spruce No 1. Mine, Logan County, West Virginia**

Dear Assistant Administrator Silva:

On behalf of Mingo Logan Coal Company, Inc., we submit the attached comments, Technical Evaluation Document, and supporting information in response and in opposition to the Environmental Protection Agency's Recommended Determination, recommending that EPA withdraw the specification embodied in DA Permit No. 199800436-3 (Section 10: Coal River), which EPA released on October 15, 2010.

Mingo Logan Coal Company, Inc. reserves the right to submit additional comments and technical information to address any additional contentions of EPA identified through this 404(c) process.

Sincerely,

Robert M. Rolfe

Robert M. Rolfe

Enclosures

cc: The Honorable Lisa P. Jackson
Mr. Robert Sussman
Mr. Shawn M. Garvin
Mr. Gregory E. Peck
The Honorable Jo-Ellen Darcy

HUNTON & WILLIAMS

Lt. Gen. Robert L. Van Antwerp, Jr.
Ms. Margaret E. Gaffney Smith
Col. Robert D. Peterson
Ms. Ginger Mullins
Mr. Randy C. Huffman
Mr. Robert G. Jones
Mr. Robert W. Shanks
Mr. B.J. Sturgill, Jr.
Mr. John McDaniel
Mr. Robert G. McLusky

ENVIRONMENTAL PROTECTION AGENCY

Comments in Response and in Opposition to the Recommended Determination of the U.S. Environmental Protection Agency Region III Pursuant to Section 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia

COMMENTS

Mingo Logan Coal Company, Inc.

November 29, 2010

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Exhibit 2: Letter from Peter S. Silva, Assistant Adm'r, U.S. EPA, to Robert W. Shanks, President, Eastern Operations, Arch Coal, Inc. (Oct. 27, 2010)

Exhibit 3: Spruce No. 1 Mine Superimposed on Municipal Boundary of the City of Pittsburgh

Exhibit 4: West Virginia Dep't of Envtl. Prot., *Justification and Background for Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards, 47 C.S.R. 2 §§ 3.2.e and 3.2.i* (Aug. 12, 2010)

Exhibit 5: GEI Consultants, Inc. Ecological Div., *Final Report Technical Review: A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams*, submitted to Nat'l Mining Ass'n (Sep. 2010)

Exhibit 6: GEI Consultants, Inc. Ecological Div., "Primary Technical Concerns with Proposed EPA Conductivity Benchmark" (undated)

Exhibit 7: Letter from Evelyn S. MacKnight, Chief, NPDES Permits Branch, EPA Region III, to Jeffrey Parsons, WVDEP (Oct. 28, 2010)

Exhibit 8: Comparison of Mitigation Plans

Exhibit 9: Photograph of an Active Erosion Control Channel at the Aracoma Coal Mining Site

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Appendix A

CH2M HILL, Technical Evaluation Document Review of USEPA Recommended Determination Spruce No. 1 Mine, West Virginia (Nov. 2010)

Appendix B

Supplemental Materials Relevant to the Recommended Determination

I. Introduction

Mingo Logan Coal Company, Inc. ("Mingo Logan") submits these comments in response to the Recommended Determination (or "RD"), pursuant to the invitation of the U.S. Environmental Protection Agency ("EPA" or "Agency").[1] Because the Recommended Determination finds no support in law or fact, Mingo Logan strongly urges the Administrator to rescind the Recommended Determination.[2]

EPA first provided notice of its intent to revoke Mingo Logan's Section 404 permit in September 2009.[3] The permit, which EPA does not allege has been violated, was issued in 2007 by the U.S. Army Corps of Engineers ("Corps"), following nearly a decade of review and

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[1] Letter from Peter S. Silva, Ass't Adm'r for Water, EPA, to Robert W. Shanks, President, Eastern Operations, Arch Coal, Inc. (Oct. 15, 2010), Exhibit 1. By letter of October 27, 2010, EPA granted Mingo Logan's request for an extension of 30 days to respond to the Recommended Determination. Letter from Peter S. Silva, Ass't Adm. for Water, EPA, to Robert W. Shanks, President, Eastern Operations, Arch Coal, Inc. (Oct. 27, 2010), Exhibit 2. EPA has confirmed that it will issue a Final Determination, affirming, modifying or rescinding the Recommended Determination, by February 22, 2011. 75 Fed. Reg. 69,063, 69,064 (Nov. 10, 2010).

[2] EPA Region III issued the Recommended Determination as well as the Proposed Determination. *See* EPA Region III, Notice, "Proposed Determination to Prohibit, Restrict, or Deny the Specification, or the Use of Specification (Including Withdrawal of Specification), of an Area as a Disposal Site; Spruce No. 1 Surface Mine, Logan County, WV," 75 Fed. Reg. 16,788 (Apr. 2, 2010); EPA Region III, *Recommended Determination of the U.S. Environmental Protection Agency Region III Pursuant to Section 404(c) of the Clean Water Act Concerning the Spruce no. 1 Mine, Logan County, West Virginia* (Sep. 24, 2010), *available at* http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/404c_index.cfm. All use of "EPA" within these comments, as they relate to the Recommended Determination or Proposed Determination, refers to EPA Region III. Now that Region III has issued the Recommended Determination, the Administrator may affirm, modify, or rescind the Recommended Determination. *See* 40 C.F.R. § 231.6.

[3] Letter from William Early, Acting Reg'l Adm'r, EPA Region III, to Col. Robert Peterson, Dist. Eng'r, Corps, Huntington Dist. (Sept. 3, 2009) at 1, Cmt. Ex. 25. After a several month delay, EPA issued a Proposed Determination, detailing the reasons that EPA sought to revoke the permit, and clarifying that EPA relied on precisely the impacts it had repeatedly approved. 75 Fed. Reg. 16,788 (Apr. 2, 2010). After granting itself several more months, EPA issued the Recommended Determination.

evaluation. EPA's action follows the issuance of a Surface Mining Control and Reclamation Act ("SMCRA") permit in 1998, the State of West Virginia's issuance of a Clean Water Act ("CWA") Section 402 permit,[4] authorizing discharges from the mine into downstream waters, and the Corps' years-long evaluation process that included the only Environmental Impact Statement ("EIS") ever prepared for an individual surface mine of this type. All of these actions were taken with EPA's participation and concurrence. Now, more than three years after the issuance of the permit, as Mingo Logan is actively mining the site in an attempt to recoup its decade-long investment, EPA has declared that the impacts that it had approved are now unacceptable, and seeks to revoke the permit.[5]

Mingo Logan previously submitted a detailed comment on EPA's Proposed Determination.[6] In that comment, Mingo Logan explained why EPA has no legal authority to revoke Mingo Logan's Section 404 permit. Mingo Logan also detailed in its initial comments why EPA has no legitimate technical or factual bases to object to the permit, let alone revoke it years after it had been approved. Mingo Logan does not repeat its previous arguments here.

In these comments, Mingo Logan details how the Recommended Determination's factual contentions do not justify EPA's exercise of its Section 404(c) authority.[7] Even assuming for the

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[4] A Section 402 permit is also referred to as a National Pollutant Discharge Elimination System ("NPDES") permit.

[5] It is not a coincidence that in the intervening years the Administration changed party hands, amid promises not to politicize science.

[6] Mingo Logan Coal Company, Inc., *Comments in Response and in Opposition to the Proposed Determination to Prohibit, Restrict, or Deny the Specification, or the Use for Specification (Including Withdrawal of Specification), of an Area as a Disposal Site; Spruce No. 1 Surface Mine, Logan County, West Virginia* (June 3, 2010) (hereinafter "Cmt.").

[7] To that end, Mingo Logan attaches a Technical Evaluation Document, in which CH2M HILL reviews the technical bases of the Recommended Determination. CH2M HILL, "Technical Evaluation Document, Review of USEPA Recommended Determination Spruce No. 1 Mine, West Virginia" (Nov. 2010) (hereinafter "TED2").

sake of argument that EPA has the legal authority to revoke a permit under Section 404(c), and that EPA, not the State of West Virginia, is the arbiter of compliance with the State's water quality standards, the Recommended Determination is factually flawed and legally insufficient to meet EPA's high threshold for acting pursuant to Section 404(c) after a permit has been issued.

Section II of these comments explains that EPA bears a heavy burden under Section 404(c), which only allows EPA to act under narrow circumstances. Congress required EPA to demonstrate that the discharges authorized by the 404 permit will have an unacceptable adverse effect on certain narrowly defined 404(c) resources. Congress did not give EPA unfettered discretion to usurp the Corps's authority under Section 404 and the State's authority under Section 402. Moreover, even EPA recognizes that once a permit has been issued, EPA bears an even higher burden and can act only upon significant new information about significant impacts to 404(c) resources. The remaining sections of these comments demonstrate that EPA has not met that burden.

Section III describes EPA's misplaced concern regarding selenium. The Recommended Determination inexplicably ignores the numerous requirements imposed on Mingo Logan at the Spruce No. 1 Mine, which will prevent impacts from selenium. EPA gives no legitimate reason to doubt the efficacy of the selenium handling measures imposed by the State and the Corps. Instead, EPA ignores the low levels of observed selenium and attempts to predict the effects of the permitted discharges, without any water flow modeling, by relying on discharges from mining activities that had no stringent selenium handling restrictions.

Section IV addresses EPA's mistaken reliance on conductivity and changes in the composition of the macroinvertebrate community. Like selenium, conductivity was also fully considered during the permitting process. As the Corps stated in rejecting EPA's request to

suspend, modify or revoke Mingo Logan's permit, EPA's conductivity argument presents no new information. The science regarding conductivity remains so indeterminate that neither EPA nor West Virginia has adopted a legally meaningful water quality standard for conductivity. To the contrary, West Virginia rejects conductivity as an appropriate measure of water quality or aquatic ecosystem health. Equally important, EPA's flawed prediction that conductivity will adversely affect a subset of macroinvertebrates does not demonstrate an unacceptable adverse effect on wildlife. The macroinvertebrates EPA focuses on are not wildlife. But even if they were, EPA has not demonstrated any disruption in trophic function or reduction in the overall number of macroinvertebrates in Spruce Fork. EPA also provides no data to suggest any impact on higher trophic level biota like fish or birds.

Sections V and VI discuss EPA's implausible concern over golden algae and EPA's half-hearted and ineffectual attempt to manufacture a significant impact to one of the factors actually listed in Section 404(c). As detailed in those sections, EPA's "concerns" about golden algae or significant adverse impacts on salamanders, fish or birds do not even pass the "straight face" test.

Section VII reminds EPA that Mingo Logan's mitigation plan complies with all legal requirements and will assure that the authorized fills will have no unacceptable adverse impacts on wildlife.

Finally, Section VIII notes that because EPA has explicitly abandoned reliance on factors that EPA had relied upon in the Proposed Determination, EPA cannot rely on those factors in its Final Determination.

II. EPA Must Meet a High Standard Under Section 404(c), Especially After a Permit Has Been Issued

A. Congress Provided EPA With Only a Limited Authority Under Section 404(c)

Section 404(c) requires EPA to establish that the "discharge of dredged or fill material" into "waters of the United States":

> will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas.

CWA § 404(c), 33 U.S.C. § 1344(c). EPA must satisfy each of these requirements. *Bersani v. U.S. EPA*, 850 F.2d 36, 40 (2d Cir. 1988) ("The burden of proving that the discharge [of fill material] will have an 'unacceptable adverse effect' is on EPA.") EPA acknowledges this burden. 45 Fed. Reg. 85,336, 85,338 (Dec. 24, 1980) (noting that the EPA Administrator "does have the burden to justify his action" under 404(c)); 44 Fed. Reg. 58,076, 58,080 (Oct. 9, 1979) ("EPA [has] the responsibility of establishing a basis for any subsequent determination of unacceptable adverse effects" on the 404(c) listed resources).

In particular, the statute requires EPA to show that the "discharge of fill material" into "waters of the United States" will have unacceptable adverse effects on very specific resources.[8] Both the text and legislative history of 404(c) make clear that Congress intended 404(c) to be a limited and constrained authority. Indeed, Congress characterized the resources identified in

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[8] EPA may not base its 404(c) action on impacts from 402 discharges; nor may it base its action on impacts caused by non-fill related mining activity occurring outside "waters of the United States." *See Coeur Alaska, Inc. v. Southeast Alaska Conservation Council*, 129 S.Ct. 2458, 2467-68 (2009); Cmt. at 4, 41-43, 105-06. It is clear that the text of Section 404(c) is limited to the resources listed in Section 404(c). *See* 40 C.F.R. § 231.2(e). As Mingo Logan explained in its initial comment, the 404(c) resources are therefore included *to the exclusion* of other resources, areas and concerns. Cmt. at 66-67.

404(c) as "critical areas."[9] The statute also requires EPA to establish that the discharge of fill material into waters of the United States "*will* have an unacceptable adverse effect" on at least one of these critical resources. 33 U.S.C. § 1344(c) (emphasis added). EPA cannot meet this burden based on speculation or possibility, but must establish a strong degree of certainty that the effects "will" occur.

B. EPA's Regulations Can Not Alter the Statutory Requirements Nor Provide EPA Unbounded Discretion

EPA has adopted regulations that implement Section 404(c). *See* 40 C.F.R. pt. 231. In the regulations, EPA acknowledges the Congressional limitations in stating that it "may be exercised only where there is an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding grounds), wildlife or recreational areas."[10] EPA regulations define "unacceptable adverse effect"[11] as an:

> impact on an aquatic or wetland ecosystem which is likely to result in significant degradation of municipal water supplies (including surface or ground water) or significant loss of or damage to fisheries, shellfishing, or wildlife habitat or recreation areas. In evaluating the unacceptability of such impacts, consideration should be given to the relevant portions of the section 404(b)(1) guidelines (40 CFR part 230) ["Guidelines"].

40 C.F.R. § 231.2(e).

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[9] *See* Cmt. at 67-68 (quoting legislative history that describes the 404(c) resources as "critical areas").

[10] 44 Fed. Reg. 14,578, 14,579 (Mar. 13, 1979); RD at 9, 35, 75.

[11] Mingo Logan does not believe that EPA's regulations adequately account for what Congress intended "unacceptable" to mean within the context of 404(c). "Unacceptable," like "significant," is a relative term that must be weighed against the endangerment of the species, the size of the project, and any economic benefit from the project. The word "unacceptable" is either so broad as to not provide EPA with a meaningful standard to apply, or is a relative term that is not adequately accounted for in EPA's regulations. EPA construes "unacceptable" to mean unacceptable to EPA, which if true would be an improper delegation of legislative authority.

Despite reference to the 404(b)(1) guidelines, EPA recognized that Section 404(c) does not incorporate the full range of those guidelines. In fact, EPA originally proposed, but rejected, 404(c) regulations providing that the "404(b)(1) guidelines provide the substantive criteria by which the acceptability of a proposed discharge is to be judged." 44 Fed. Reg. at 14,579. EPA rejected such a broad incorporation because such a standard was "misleading, since the guidelines are concerned with a greater range of resources than 404(c) is. To avoid any misunderstanding [regarding the scope of EPA's definition], the reference now reads, 'the relevant portions of the section 404(b)(1) guidelines.'" 44 Fed. Reg. at 58,078. Accordingly, EPA can not point to the Guidelines *writ large* to inform its findings under 404(c).[12] Finally, EPA's final definition acknowledges that EPA must demonstrate a "significant" adverse effect on one of these critical areas.[13]

C. EPA Has Set a Higher Standard Post-Permit

When EPA published its final 404(c) regulations, its preamble to those regulations wrongly claimed the authority to act after the Corps had issued a Section 404 permit. But in making that claim,[14] EPA recognized that "an important distinction should be drawn" between the agency's 404(c) authority before a permit has been issued and after. EPA stated that:

> it would be inappropriate to use 404(c) after issuance of a permit where the matters at issue were reviewed by EPA without objections during the permit proceeding, or where the matters at issue were resolved to EPA's satisfaction during the permit proceeding, unless substantial new information is first brought to the Agency's attention after issuance.

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[12] *See* Cmt. at 69.

[13] *See* Cmt. at 66. EPA must demonstrate that the authorized discharges will result in an unusual loss or damage to a 404(c) critical area, such that it has serious consequences for the species community or the surrounding ecosystem. Impacts that are routine in the 404 context, or impacts that do not have a significant impact on the species community or surrounding aquatic ecosystem are not "significant."

[14] Mingo Logan disputes this authority. Cmt. § IV.

44 Fed. Reg. at 58,077. EPA expressly acknowledged that it would be wrong to exercise its 404(c) authority where issues were raised and addressed during the permit proceeding. Instead, EPA promised to undertake 404(c) only in situations where there was substantial new information indicating significant impacts to critical 404(c) resources. Accordingly, even under EPA's own view of its regulations, the 404(c) standard pre-permit is high; the standard post-permit is even higher.

As demonstrated below, the Recommended Determination violates EPA's commitment to exercise Section 404(c) sparingly. EPA reviewed all of the matters raised in the Recommended Determination over the course of the extensive permitting process, either in SMCRA, National Environmental Policy Act ("NEPA"), CWA Section 404, 402, and 401 processes, and consented to the issuance of the 404 permit. *See Coeur Alaska, Inc.*, 129 S. Ct. at 2465. The Recommended Decision has not raised any "substantial" new information, but relies entirely on issues that were raised and addressed in the permit proceedings. *See* Letter from Scott Mandirola, Acting Dir., WVDEP, to Col. Robert Peterson, Dist. Eng'r, Corps, Huntington Dist. at 3 (Sep. 25, 2009), Cmt. Ex. 26 (hereinafter "Mandirola Letter") ("This is the most heavily studied and scrutinized surface mining coal operation in the history of [West Virginia]").

Indeed, the Corps recognized EPA's failure to raise new information. In response to EPA's request that the Corps suspend Mingo Logan's 404 permit, pending EPA's 404(c) action, the Corps evaluated the issues raised and stated that "USEPA neither points to any new facts or circumstances nor identifies any significant permit objections which were not earlier considered." Robert D. Peterson, Corps, Memorandum for Record at 22 (Sep. 30, 2009) (refusing to suspend the permit because the Corp's regulations, 33 C.F.R. § 325.7, require that new circumstances or objections be raised), Cmt. Ex. 5. Indeed, even the district court in the

pending litigation acknowledged that the issues raised by EPA are not new. *See Ohio Valley Envtl. Coal. v. U.S. Army Corps of Eng'rs*, Nos. 3:05-0784 and 3:06-0438 slip op. at 3 (S.D. W. Va. Sep. 15, 2009) ("...the EPA letter [of September 3, 2009] does not provide substantial new information regarding the Spruce No. 1 permit.").

III. EPA Fails To Establish That the Permitted Discharges Will Raise Selenium Levels To Cause an Unacceptable Adverse Effect on 404(c) Resources

To base any action under Section 404(c) on concerns about selenium, EPA must demonstrate that the permitted discharges into Pigeonroost and Oldhouse will cause selenium levels that will have unacceptable adverse effect on a 404(c) resource. EPA has not met its burden. EPA provides no information to suggest that selenium levels in Spruce Fork will rise, that existing or likely selenium levels will cause an unacceptable adverse effect on a 404(c) resource, or that EPA's projected rise in selenium levels would be caused by the 404 discharges instead of upland areas of the Spruce No. 1 Mine.

Selenium was carefully examined and addressed during the permitting process. Consequently, the SMCRA permit and the 402 permit impose measures to ensure compliance with the State of West Virginia's selenium criteria, and protect water uses and the aquatic ecosystem. EPA consented to these permit conditions, does not suggest that Mingo Logan has failed to comply with them, and does not demonstrate that the measures will be ineffective. Most importantly, selenium levels are appropriately low in the areas of concern to EPA, and EPA provides no information to suggest that this will change. Instead, EPA bases its entire discussion of selenium on unsupportable comparisons that ignore the measures that Mingo Logan must take to minimize selenium loading downstream.

A. Selenium Was Addressed During the Permitting Process, and EPA Provides No New Information To Justify its Recommended Determination

EPA objected to the initial issuance of the Section 402 permit in 1998, but withdrew its objection upon the addition of several conditions. *See* Cmt. at 28-29. EPA objected to the modification in 2002, but again withdrew its objection after the West Virginia Department of Environmental Protection ("WVDEP") agreed to add selenium monitoring to all of the outlets (including internal outlets, referred to as "on bench structures"), and add the selenium materials handling plan as a condition of the Section 402 permit. *Id.* at 31-32; Letter from Allyn Turner, Dir., Div. of Water Resources, WVDEP, to Jon Capacasa, Acting Dir., Water Prot. Div., EPA Region III (Oct. 28, 2002), Cmt. Ex. 23. As a result, Condition 16 of the Section 402 Permit (from the modification approved June 24, 2003) specifies that a feasibility study will be conducted to identify selenium bearing strata and the locations of the drill holes for testing. EPA did not object to the modification in 2005 that created the current, smaller mine configuration, but instead consented to the existing configuration and surface water control plan. Cmt. at 32-33. WVDEP nonetheless imposed selenium limits on all outfalls from 404 discharges in Pigeonroost and Oldhouse. Cmt. § II.D. EPA had the authority under CWA Section 402(d) to halt the permitting process, but instead consented to the issuance of the permit.[15] Cmt. at 33.

The Corps also thoroughly studied selenium in the 404 permitting process, and EPA raised concerns about selenium levels in the NEPA process, via letter of June 16, 2006. Letter from Donald Welsh, Reg'l Adm'r, EPA Region III, to Ginger Mullins, Chief, Regulatory Branch, Corps, Huntington Dist. (June 16, 2006), Cmt. Ex. 6 at 3. The Corps responded to each of EPA's concerns in the Final EIS ("FEIS"), in supplement to the Corps' own comprehensive

[15] The Section 402 permit was renewed in 2004 and 2007, also without objection from EPA. Cmt. at 33.

consideration of selenium. *See* Draft EIS ("DEIS") (Mar. 2006), page v; Chapter 2, pages 2-42, 2-51, 2-63, 2-68; Chapter 3, pages 3-40, 3-50, 3-52, 3-93 through 3-94, and 3-101, *available at* http://www.lrh.usace.army.mil/_permits/Spruce%20No%201%20Mine%20Draft%20and%20Final%20EIS/Spruce%20Mine%20No%201%20Draft%20EIS%20March%202006/; FEIS (Sep. 2006), Table 2-2 at page 2-103 (Comment EPA-7, EPA-9, EPA-11) *available at* http://www.lrh.usace.army.mil/_permits/Spruce%20No%201%20Mine%20Draft%20and%20Final%20EIS/Spruce%20Mine%20No%201%20Final%20EIS%20-%20September%202006/Spruce%20No%201%20Mine%20FEIS%20-%20September%202006.pdf.

On December 19, 2005, West Virginia issued a water quality certification to Mingo Logan pursuant to CWA § 401. Ltr. from Randy Huffman, Dir., WVDEP, to Ginger Mullins, Chief, Operations & Readiness Div., Corps, Huntington Dist. (Dec. 19, 2005), Cmt. Ex. 9. To do so, West Virginia necessarily determined that the project would not cause or contribute to a violation of the State's water quality standards, including the water quality criteria for selenium. Cmt. Ex. 9 at 2; W. VA. CODE R. §§ 47-2-8; 47-2 App. E. This 401 certification conclusively determined that the project would not violate water quality standards or the state's anti-degradation policy. *See Ohio Valley Envtl. Coal v. Aracoma Coal Co.*, 556 F.3d 177, 208 (4th Cir. 2009), *cert. dismissed*, 2010 WL 3260662 (U.S. Aug. 19, 2010) (No. 09-247, R46-024) (hereinafter "*OVEC*") ("[a] § 401 certification is considered conclusive, and no independent analysis of the certification [by federal agencies] is required"). West Virginia does not expect that the 404 discharges will violate the applicable water quality criteria for selenium and EPA provides no reason to think otherwise. *See* Memorandum for Record at 7, Cmt. Ex. 5.

1. The Section 402 and SMCRA Permits Require Material Handling Techniques Designed To Minimize Selenium Discharges and Set Appropriate Selenium Discharge Limits

The surface water control plan and permit requirements (monitoring and limits) for the Spruce No. 1 Mine require modern material handling and mining techniques such as enhanced erosion control, stormwater management, and selective handling of high-selenium overburden materials. These techniques are designed to prevent unacceptable adverse water quality impacts. As defined in the SMCRA Permit, Spruce No. 1 Mine must follow the requirements of the "Special Handling Plan (SHP) – Potentially Selenium-Toxic Materials" section. Cmt. Ex. 2. The SHP requires that the operation must conduct sampling and analysis for identification of source materials with high selenium-leaching potential. This material must then be segregated and placed in properly designed and constructed "isolation zones" on the mine site for final disposal in designated locations. The isolation zones are designed to minimize the mobility of selenium by reducing its contact with water. The isolation zones consist of a pad composed of non-toxic, non-acidic durable material at least 10 feet in thickness. After the material is placed, it is covered by at least 4 feet of non-toxic alkaline material suitably compacted to reduce its permeability. The zones are then covered with at least 10 feet of ordinary backfill and revegetated in accordance with the approved plan. In accordance with the SHP requirements to document the handling method(s) and disposal location(s) in the isolation zones for this material during mining operations, Mingo Logan Coal Company provides quarterly certification reports to WVDEP.

Importantly, the SHP restricts the placement of fill containing selenium concentrations greater than 1 mg/kg and requires that spoil containing more selenium "(1) Not be placed in close proximity to drainage courses," and "(3) Not be placed within a durable rock fill." TED2 § 3.1.1; SMCRA Permit S-5013-97 – Attachment 0-8, Page 15.1 and 15.2; Cmt. Ex. 2. Thus,

unlike past practices, no materials with significant selenium content will be placed either in a water of the United States or anywhere in an excess spoil valley fill. Rather, the materials will be placed above the mine bench is areas isolated from water flows. Yet the Recommended Decision either ignores these requirements or unjustifiably assumes that Mingo Logan will not comply with them.

The surface water control plan for the Spruce No. 1 Mine, to which EPA consented, also sets permit limits for Outlets 001, 002, 003, and 004, and mandates selenium monitoring at all other outlets.[16] All of the authorized discharges from the permitted fills in Pigeonroost and Oldhouse discharge into Outlets 001, 002, and 003.[17] EPA complains that the Section 402 permit only establishes selenium limits at some outfalls, but does not note that those permit-limited outfalls are the ones that will ultimately discharge downstream of the 404 permitted fills. EPA also seems to misunderstand the creation and function of surface water control plans. For a number of reasons, it is the dominant practice for some outfalls to have limits, and some to have only monitoring.

2. All Available Data Suggests That the Fish Assemblage in Spruce Fork Is Healthy, and Selenium Levels Are Low

EPA's primary concern related to selenium is the fish population downstream of Spruce No. 1 Mine in Spruce Fork. But EPA acknowledges that the fish population in downstream Spruce Fork is "in relatively good condition" and has remained virtually unchanged for the past 60 years despite decades of surface and underground mining upstream and downstream of the

[16] The selenium permit limitations for Outlets 001, 002, 003, and 004 is 4.7 chronic, and 8.2 acute. *See* CH2M HILL, "Technical Evaluation Document Spruce No. 1 Mine, West Virginia" (June 2010), Cmt. App. at 27, Table 1 (hereinafter "TED"); Section 402 Permit No. WV1017021, Cmt. Ex. 12.

[17] Outlet 004 is a vestige of the previous mine plan, to which EPA also consented, which had authorized discharges into White Oak Branch.

Spruce No. 1 Mine. RD at 31, 32, 60. EPA does not present any data for selenium bioaccumulation in fish from Spruce Fork. As a result, the only relevant data points are the selenium levels in Spruce Fork, and the selenium levels in the discharges from the Spruce No. 1 Mine into Spruce Fork. Neither of these supports any concern about selenium.

The levels of selenium discharging into Spruce Fork are low. The average concentrations of selenium below Outlet 028, at the mouth of Seng Camp Creek (Location 302) have been less than 2 µg/L since January 2007. TED2 § 3.1.4. Average concentrations below the discharge of Outlet 017, at the mouth of Pigeonroost Branch (Location 507) have been lower, at 0.77 µg/L. *Id.* Similarly, average concentrations at the mouth of Oldhouse Branch (Location 514) have been lower still, at 0.68 µg/L. *Id.*

Spruce No. 1 Mine's combined impact on Spruce Fork, along with the Spruce Fork watershed upgradient of the mine, can be measured at the point on Spruce Fork just downstream of the three receiving waters. Selenium levels at this point have varied between 0.3 µg/L to 2.45 µg/L, and none of the values exceeded 2.9 µg/L.[18] *Id.* Moreover, not only do the most relevant sampling points demonstrate no cause for concern, the selenium levels related to the Spruce No. 1 Mine have been going down (instead of rising, as EPA contends). RD at 39 n.10, 40, 45. From January 2007 to December 2008, levels have averaged 1.99 µg/L, but since December 2008, the average has been 1.36 µg/L.

B. EPA's Comparison to Dal-Tex and Other Older Mining Sites Is Unjustifiable

EPA relies on comparisons between the Spruce No. 1 Mine and the Dal-Tex Complex to show that selenium levels in Spruce Fork will rise. But differences in mining practices, the

[18] Selenium values recorded in Spruce Fork, downstream of the Spruce No. 1 Mine, have averaged from 0.3 to 2.45 µg/L. None of the maximum values exceeded 2.9 µg/L. Thus, the relevant selenium levels are very low in the portion of Spruce Fork likely to be impacted by discharges from the Spruce No. 1 mine.

extent and manner of coal seam mining, and material handling techniques at the two mine sites render such comparison technically inappropriate.[19] *See* Cmt. at 113-14; TED2 § 3.1.2. Inexplicably, EPA dismisses Mingo Logan's materials handling plan out of hand, with no supporting data, and does not consider that the comparison sites were all mined without materials handling techniques (or any attempt to control selenium).

At the outset of its section on adverse impacts, EPA erroneously argues that "impacts from the Mingo Logan Dal-Tex operation are likely to be a good predictor of impacts [to water quality and aquatic life health] from the Spruce No. 1 Mine." RD at 37. To support this statement, EPA wrongly claims that the Corps agrees, and quotes from the Corps' DEIS section on "Mineral Resources":

> "[t]he past and present impacts to **topography**, **geology**, and **mineral resources** of the previous mining along the western side of Spruce Fork are similar to the anticipated impacts of the Spruce No. 1 Mine, as mining is to occur in the same strata."

Id. (emphasis added). EPA misrepresents that the Corps' statement about the rock and coal to be extracted is an "acknowledge[ment] by the Huntington District Corps of Engineers" that the Corps agrees with EPA's claims regarding comparative impacts to water quality, aquatic life health, and the ecosystem generally. *Id.* Obviously, the Corps said nothing of the sort. *See* DEIS at 3-15. In fact, the Corps wrote in the DEIS that "[o]verall, it would be anticipated that the Spruce No. 1 Mine would only contribute minimally to cumulative impacts on surface water quality." DEIS at v. That EPA begins its presentation of adverse impacts with such a blatant

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[19] The data from Outlet 15 (shown in Figure 10, RD at 43) are not relevant for comparison to potential discharges from the Spruce No. 1 Mine. Outlet 15 at the Dal-Tex Complex is the discharge from an abandoned underground mine in the Coalburg seam that is discharged to an entirely different watershed (Pine Fork, a tributary in the Guyandotte River system). The discharge is not the result of a surface mine or valley fill and does not represent anything similar to what may result from valley fill from the Spruce No. 1 Mine. TED2 § 3.1.2.

misrepresentation foreshadows the lack of technical rigor in the remainder of the Recommended Determination.[20]

1. The Dal-Tex Complex and the Spruce No. 1 Mine Are Not Geographically Comparable

EPA misleadingly suggests that the Spruce No. 1 Mine is geographically comparable to the Dal-Tex Complex. *See* RD at 10.[21] In fact, the Dal-Tex Complex is nearly three times larger than the Spruce No. 1 Mine. The Dal-Tex Complex encompasses approximately 6,630 acres and includes 11 surface mining permits, 9 underground mining permits, and 11 surface ancillary facilities permits. DEIS § 1.1.2. In contrast, the permit area for Spruce No. 1 Mine consists of 2,278 acres, or 34 percent of the area of the Dal-Tex Complex. The significantly larger watershed of the Dal-Tex Complex renders inappropriate EPA's reliance on Dal-Tex data to predict water quality impacts from the Spruce No. 1 Mine.[22] Moreover, the coal seams at the

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[20] EPA actually repeats its reference to this misleading statement at the beginning of its section on macroinvertebrates. *See* RD at 51. Without any analysis or supporting data, EPA uses this deliberate misstatement as the sole basis for its comparison to the Dal-Tex Complex.

[21] To sensationalize this overstatement, EPA includes an absurd overlay of the project boundaries on downtown Pittsburgh, Pennsylvania. *See* RD at 11. As can be seen in Exhibit 3, which portrays the project boundaries over the actual city limits, EPA has grossly misrepresented the size of Pittsburgh to the benefit of its inflammatory superimposition.

[22] A simple back of the envelope calculation suggests that if the Spruce No. 1 Mine is 1/3 the size of the Dal-Tex Complex, it should be expected to have 1/3 of the water quality impacts. And that does not account for the materials handling plan, the site management plan, and the fact that selenium levels from Dal-Tex are coming from the entire mine, not just the authorized discharges. Yet, EPA proposes to compare the Dal-Tex Complex to the Spruce No. 1 Mine on a 1:1 ratio, ignoring important materials handling differences, and assuming, without any support, that all selenium comes from the authorized fills.

Additionally, as Mingo Logan noted in its earlier comments, while the boundaries of its surface mining permit represent one of the larger individual surface mining permits issued by WVDEP, the boundaries of the mining complex are nowhere near as large as many others in the State. At those other operations, smaller individual and adjacent surface mining and Corps' permits reveal much larger overall mining operations. Cmt. at 161.

Spruce No. 1 mine will be mined in a significantly different manner, rendering the comparison to Dal-Tex even less justifiable. TED2 § 3.1.2.

2. Historical Mining at Dal-Tex, Lacking the Benefits of Modern Mining Techniques, Greatly Influences Downstream Impacts

Unlike the Spruce No. 1 Mine watershed, the area around the Dal-Tex Mine Complex has been actively mined since the early 1900s. TED2 § 3.1.2. Within the Left Fork Beech Creek watershed, the site of a modern-era surface operation on the Dal-Tex Mine, about 450 acres had been previously mined. This facility experienced extensive mining predating the passage of SMCRA and was again mined in the 1990s with final reclamation to occur in the 2000s. Mining was restarted in July 2008 on this facility using structures and outfalls constructed in the 1990s. The majority of the mining activities within the Dal-Tex Complex were completed by 1999. At that time, selenium had not been identified as a parameter of concern in the Section 402 permit, so special material handling practices to address selenium were neither required nor implemented. As a result, selenium bearing strata in the rock layers overlying the coal seam were neither identified nor segregated in the mining process. To the extent these materials were in the spoil that was not needed to reclaim the mined area, they ended up in excess spoil valley fills and perhaps in the water courses underlying these fills themselves—where groundwater and surface water infiltration could freely interact with it and leach out the selenium.

Further, some of the mining at Dal-Tex preceded the passage of SMCRA, which created techniques for erosion and sediment control, as well as selective handling processes for specific overburden. *See* Cmt. §§ II.A.; VI.C.2.c. As such, the overburden from the coal seam would have been simply pushed into the valleys or streams. The mining at Dal-Tex that followed the passage of SMCRA still preceded the inclusion of selenium-specific controls in Section 402 permits. And most of the mining did not benefit from the Approximate Original Contour

("AOC")/fill optimization process, which minimizes the amount of overburden placed in the 404 fills. *See* Mandirola Letter at 3, Cmt. Ex. 26. As a result, the selenium levels at the Dal-Tex Complex are significantly greater than would be the case with newer mining practices.[23]

Additionally, extensive underground mining was conducted in the Buffalo B, Middle Coalburg, Upper Stockton, and Five Block seams of the Dal-Tex watershed, which further contribute to selenium levels. All of this mining activity is situated above the drainage and contributes discharges to the surface water system. As such, the Dal-Tex Mine site has multiple and significantly different source areas that provide selenium loading to the watershed than those of the Spruce No. 1 Mine.[24]

C. EPA Ignores Information Provided by Mingo Logan and Provides No Information To Suggest That the Authorized Fills Will Cause Selenium Levels To Rise

EPA vainly attempts to discount the extensive consideration that was given to selenium in the permitting process, discredit the comprehensive surface management plan, and postulate

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[23] By comparison, there has been only a very limited amount of historical mining in and around the Spruce No. 1 Mine. Within the Spruce No. 1 Mine permit boundary, historical underground mining is limited to isolated areas along the eastern perimeter of the project area. As discussed further below, there has also been some surface mining in the Right Fork of Seng Camp, which is not subject to this Recommended Determination. Cmt. § VI.C.2.c.

[24] In addition to its erroneous comparison to the Dal-Tex Complex, EPA attempts to compare the Spruce No. 1 Mine to other (frequently unspecified) "similar projects." *See, e.g.*, RD at 36. As with the comparisons to the Dal-Tex Complex, these comparisons are nullified by geological differences, historical mining practices, and material handling practices. Thus, EPA's comparison of rock cores to Gut Fork Mine ignores the fact that selenium mobilization is expected to be different because of differences in waste handling procedures between the two mines. RD at 37. A marked difference in selenium handling also sharply distinguishes EPA's attempted comparisons to other Mingo Logan mines. RD at 45 n.13. EPA also argues that selenium criterion exceedances at other creeks in the Coal River Sub-basin with similar geology "support a prediction that construction of the Spruce No. 1 Mine as currently authorized will result in elevated levels of selenium in downstream waters." *Id.* at 39 n.10. As with the other comparisons, this is not relevant to the Spruce No. 1 Mine unless EPA can provide evidence that material handling practices used at source areas in those watersheds were similar to those used for the Spruce No. 1 Mine. The Recommended Determination provides no such information.

selenium concerns where none exist. Each of EPA's arguments ignores crucial information. Importantly, EPA provides no reason to doubt that the comprehensive surface management plan will work to effectively limit selenium discharges downstream. Even if EPA were not bound by West Virginia's conclusive Section 401 certification, EPA presents no reason to doubt West Virginia's conclusions.

1. EPA Has Not Shown a Violation of the Applicable Selenium Criteria at the Spruce No. 1 Mine

The Recommended Determination claims that certain outlets at the Spruce No. 1 Mine have violated chronic water quality standards for selenium, and that therefore future violations are expected. RD at 46-47. But the data EPA supplies do not support this assertion. Instead, EPA's argument manifests a fundamental misunderstanding of water quality standards.[25]

a. EPA Conflates the Acute and Chronic Water Quality Criteria

EPA's argument misrepresents and conflates acute and chronic water quality criteria. EPA states that "[a] technical review of the submitted 16 monthly [Discharge Monitoring Report ("DMR")] records for the Spruce No. 1 Outlet 028 document the maximum values exceeded the chronic selenium water quality criteria of 5 µg/L on six occasions . . ." *Id.* at 44.[26] Yet EPA relies on just one or two measurements of selenium levels each month. *See* RD Table 4 at 46;

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[25] As with the Proposed Determination, it appears that EPA is claiming authority over water quality through the Corps' exclusive authority to apply the 404(b)(1) guidelines. EPA begins its section on water chemistry by stating, in part, that "[t]he Section 404(b)(1) Guidelines direct that no permit should issue if the discharge will cause or contribute to violations of applicable water quality standards . . ." RD at 38. However, Section 404 of the CWA dictates that it is the Corps, and not EPA, that has the authority to enforce the 404(b)(1) guidelines. 33 U.S.C. § 1344(b)(1); *see* Cmt. at 69.

[26] The permit establishes selenium limitations for outlets 001, 002, 003, and 004. Those limits are 4.7 µg/L chronic, and 8.2 µg/L acute. *See* TED at 27, Table 1; Section 402 Permit No. WV1017021. Cmt. Ex. 12. There is no permit limitation for Outlets 028 or 017.

RD Fig. 12 at 45.[27] The West Virginia chronic criterion, however, is not intended to measure individual samples. To measure a single instance, the appropriate metric is the acute criterion of 20 µg/L, which is a "[o]ne hour average concentration not to be exceeded more than once every three years on the average, unless otherwise noted." W.VA. CODE R. 47-2-8 (App. E, Table 1 Parameter 8-27). EPA points to not even a single instance of a violation of the acute criterion at either Outfall 028 or Outfall 017. Moreover, even if EPA could show selenium above 20 µg/L at either of these outlets, data from neither outlet is useful to predict any selenium exceedance from the permitted discharges, as explained below.[28] TED2 § 3.1.3.

The West Virginia chronic criterion, which EPA misleadingly represents as 5 µg/L per sampling event, is actually a "[f]our-day average concentration not to be exceeded more than once every three years on the average, unless otherwise noted." W.VA. CODE R. 47-2-8 (App. E,

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[27] The column in Table 4 that EPA labels as the "Sample Date" is actually the "report date." RD at 46. The samples were taken on different days, and this error explains why the chart reflects more than one sample per month, but only one sample day each month. It also explains why every sample date conveniently fell on the last day of each month.

[28] EPA published guidance in 1987 that suggested states should adopt the 5 parts per billion ("ppb") (chronic) and 20 ppb (acute) standards. *See* "Ambient Water Quality Criteria for Selenium-1987" (EPA 440/5-87-008) (cited at 65 Fed. Reg. 35,283, 35,284 (June 2, 2000)). EPA did not itself issue a rule requiring use of these standards until 1995, when it issued them as part of its "Revocation of the Selenium Criterion Maximum Concentration for the Final Water Quality Guidance for the Great Lakes System." *See* 65 Fed. Reg. at 35,283. EPA was sued over that rulemaking. One part of that lawsuit involved a challenge to EPA's acute selenium criterion to protect aquatic life. *See Am. Inst. of Iron & Steel v. EPA*, 115 F.3d 979 ("AISI"), 1003 n.7 (D.C. Cir. 1997); 65 Fed. Reg. at 35,283. The challenge included claims that:

> inorganic selenium has two oxidation states, selenite and selenate, that have different toxicities to aquatic life, and that EPA erred by promulgating a single acute criterion that failed to properly account for the two oxidation states.

65 Fed. Reg. at 35,284. Faced with this challenge, EPA agreed that it should propose a new approach after soliciting public comments. *Id.* Accordingly, EPA moved to remand the acute criterion to allow EPA to propose additions. *Id.* The Circuit Court then issued an order vacating the acute selenium standard after noting that "[t]he regulations are seriously deficient." *AISI v. EPA*, No. 95-1348 (D.C. Cir. Sep. 19, 1996 Order).

Table 1, Parameter 8.27). As a result, EPA presents no data in the Recommended Determination or appendices that shows or suggests that outlet 028 has ever exceeded the chronic selenium water quality criterion.[29] TED2 § 3.1.3.

b. EPA Fails To Demonstrate That the Discharges Authorized in the 404 Permit Caused the Above-Background Selenium Levels

EPA's reliance on selenium discharges from Outlet 028 is misplaced. Outlet 028 is a vestige of a previous mining operation and was included on a previous Section 402 permit. As such, it does not reflect modern mining and material handling techniques. Moreover, the selenium levels noted by EPA do not appear to have originated in the existing 404 fill in Seng Camp Creek. Thus, Outlet 028 does not reflect likely selenium discharges from the authorized fills in Pigeonroost and Oldhouse.

i. Available Data Shows That the Elevated Selenium Loading Does Not Originate in the Existing Fill in Seng Camp Creek

In August 2010, Mingo Logan initiated an investigation to determine the source of elevated selenium concentrations at Outlet 028. Mingo Logan retained Sturm Environmental

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[29] EPA also contends that "[s]elenium concentration in excess of the chronic criterion were also reported from Outlet 017." RD at 45. On September 3, 2009, Outlet 017 recorded a discharge with a selenium concentration of 19.20 µg/L. But this reading is below the acute selenium criterion of 20 µg/L, which is the only criterion that is appropriate in this context (017 does not have a separate permit limit).

Moreover, the selenium levels at Outlet 017 could not come from discharges authorized under the 404 permit that EPA is seeking to revoke. Outlet 017 does not discharge from a valley fill, but from an active mine site into Pigeonroost Branch. EPA has no authority under Section 404(c) to review upland impacts. Upon investigation, it appears that the source of this discharge was impounded water that had been pumped out of a previously mined pit of Upper Stockton coal. TED2 § 3.1.3. This pit was left unreclaimed to provide temporary sediment control, but ultimately had to be dewatered to continue active mining. A water pump was setup in late August 2009 and the pit water was pumped into a sediment ditch that contributed to Outlet 017. The impounded water in these pits is a temporary condition that is being eliminated as mining proceeds.

Services to collect and analyze water samples from designated locations within the Right Fork of Seng Camp Creek in order to isolate the potential sources of selenium found in the discharge from Outlet 028. Sturm collected samples on August 20, 2010, September 24, 2010, and October 8, 2010. TED2 § 3.1.3. On none of these occasions did Sturm find measurable flow from Valley Fill 1A, the lone discharge in Seng Camp that is authorized by the 404 permit at issue. Instead, the flow originated in the material placed in the 1990s, as well as sections of the treatment system that are beyond the scope of the CWA. Thus, the 404 discharges that Mingo Logan has undertaken in Seng Camp do not appear to have contributed any selenium whatsoever to Outlet 028.

ii. Outlet 028 Is Not Indicative of the Discharges Authorized by the Section 404 Permit

EPA refers to the information from Outlet 028 as "data from the portion of the Spruce No. 1 Mine that is already constructed in Seng Camp Creek." RD at 44. This misleading statement implies that Outlet 028 is part of the new construction at Spruce No. 1 Mine, and that the selenium levels there will predict selenium levels from the remainder of Spruce No. 1 Mine. In fact, Outlet 028 is not original to the Spruce No. 1 Mine, and does not benefit from the new mining techniques and materials handling plan that will accrue to the remainder of the outfalls.

Outlet 028 is the discharge from an erosion and sediment control pond – now "existing Pond No. 2" – that was originally constructed in the Right Fork of Seng Camp Creek in the mid-1990s pursuant to Surface Mine Permit S-5070-91 and NPDES (Section 402) Permit No. WV1013289. During the reissuance of the Spruce No. 1 Mine Section 402 permit on August 7, 2007 (Permit No. WV1017021), Outlet 028[30] was transferred to the Spruce permit. Cmt. Ex. 12.

[30] Outlet 028 was Outlet 007 on the original permit, and the outlet numbers changed because there was already an Outlet 007 on the Spruce permit.

The WVDEP added selenium as a "report only" parameter as a function of the transfer. The outlet, the pond, and much of the upstream area in the Right Fork of Seng Camp Creek was disturbed and filled as part of operations in the 1990s.

To re-configure existing Pond No. 2 and construct Pond Nos. 1 and 1AB in anticipation of active mining at Spruce No. 1, Mingo Logan used excess overburden originally placed in the hollow during the 1990s-era mining. Some of the excess spoil from the site development was then placed atop fill material that had previously been placed in the lower portions of the Right Fork of Seng Camp Creek as part of the mid-1990s mining. The Corps determined this activity to be outside the scope of the CWA because all of the construction would occur in areas filled in the 1990s. Thus, current Outlet 028, the ponds, and the related sediment control structures in the Right Fork of Seng Camp Creek were constructed in or of excess spoil material deposited in the watershed in the 1990s. TED2 § 3.1.3.

This is important because at the time of the mining in the mid-1990s, the relevant permits did not impose selenium limits or selective handling processes. As a result, the 1990's disturbance, which accounts for the ponds and the related sediment structures, did not reflect any attempts to locate or selectively handle selenium-bearing rock to prevent the formation of selenium-containing leachate. Thus, it is likely that selenium concentrations at Outlet 028 are the product of the 1990s-era spoil placement in the hollow and its redisturbance in 2006, rather than from a failure of the selenium handling procedures subsequently used at the Spruce No. 1 Mine. *Id.*

2. EPA Does Not Provide Any Data To Support its Claims Regarding Dilutive Capacity

EPA erroneously claims that Pigeonroost and Oldhouse have a significant dilutive capacity that is important to maintain low selenium levels in the mainstem of Spruce Fork. EPA

wrongly concludes that increased selenium concentrations in Pigeonroost Branch, Oldhouse Branch, and Seng Camp Creek[31] will therefore likely cause selenium concentrations in Spruce Fork to increase. RD at 46-47.

EPA provides no data indicating that selenium levels in Spruce Fork will rise, nor does it cite to any. To the contrary, a model of the impact of these two watersheds on Spruce Fork shows that Pigeonroost and Oldhouse have a negligible dilutive effect on the downstream waters. The two streams combined represent only 9.92 percent of the watershed downstream of the Spruce No. 1 Mine. TED2 § 3.1.3. Seng Camp Creek represents only another 2.46 percent, and the watershed only grows as it passes the mine area.

In order for Pigeonroost, Oldhouse and Seng Camp to raise the selenium level of downstream Spruce Fork above the chronic selenium criterion, the average selenium concentration at the three watersheds would have to average 46.85 µg/L. RED2 § 3.1.3. That represents an almost unfathomable selenium level that in many cases is over ten times larger than any observed selenium level in those three streams. Thus, EPA's own data proves that selenium concentrations will not likely exceed the applicable water quality criteria, let alone lead to an unacceptable adverse effect.

3. EPA's Attempt To Discredit the Materials Handling Plan Is Baseless

Without any legitimate support, EPA contends that the materials handling plan "being implemented by Mingo Logan in the Seng Camp Creek watershed has not fully succeeded in preventing exceedance of the numeric water quality criterion for selenium at Outfalls 17 and 28." RD at 45, n.13. There have been no exceedances of the relevant selenium criteria, and neither of

[31] EPA has withdrawn its attempt to revoke Mingo Logan's permit with respect to Seng Camp Creek. As a result, the impacts relevant to this 404(c) action are those of Pigeonroost and Oldhouse alone. It is therefore inappropriate to include Seng Camp Creek in an assessment of potential impacts downstream.

the outlets identified reflect the results of discharges from the permitted fills in Seng Camp Creek. TED2 § 3.1.3. The selenium levels at 028 are caused by old unsegregated mine spoils rather than the construction of Valley Fill No. 1A, with its modern selenium handling techniques. Outfall 017 is equally unrelated to the discharges authorized by the 404 permit, as it is not anywhere close to an existing fill.

a. EPA Compares the Spruce No. 1 Mine to Sites That Were Mined Without Materials Handling Plans.

EPA also disingenuously claims that Mingo Logan has been unable to control selenium with such techniques at other sites. RD at 45 n.13. EPA implies that if Mingo Logan has been unable to control selenium at its other surface mines, despite the use of the same materials handling plan, Mingo Logan cannot be expected to control selenium at Spruce No. 1 Mine. EPA relegates this contention to the bottom of a footnote because EPA must be aware that it is just plain wrong.

All but one of the unnamed facilities for which the extension requests have been made are historical mining operations where active mining and reclamation activities were completed before 2000, and selenium was added as a monitored parameter of concern on a Section 402 permit reissuance after the facility was constructed.[32] *See* RD at 45 n.13. Because these

[32] The only Arch facility that receives drainage from currently active mining and has sought an extension of its NPDES (Section 402) compliance schedule is one of the facilities on the Left Fork of Beech Creek on the Dal-Tex property. This facility experienced extensive mining predating the passage of SMCRA and was again mined in the 1990s with final reclamation to occur in the 2000s. Mining was restarted in July 2008 on this facility using structures and outfalls constructed in the 1990s. Selenium concentrations at Beech Creek are elevated because mining occurred before selenium had been identified as a parameter of concern, so special material handling practices to address selenium were neither required nor implemented during the 1990s. Historical mining explains both the selenium in the discharge waters and selenium in fish tissue samples. *See* RD at 41 n.11.

facilities were completed before 2000, there were no mining or material handling techniques in use to address selenium, and selenium limits had not been added to Section 402 permits.

b. EPA's Estimate of Selenium Loading Relies on Unsupportable Assumptions

In further postulating potentially adverse selenium levels, EPA inexplicably assumes the material to be placed in fills will have a selenium concentration of 2.0 mg/kg. RD App. 4 at 4. Again, this assumption is baseless. The materials handling plan, a condition of the Mingo Logan permit, *requires* that all rock with selenium concentrations over 1 mg/kg will be "back-stacked" in a dry location rather than being placed in the valley fill.

Not only does the assumed value of 2.0 mg/kg ignore the materials handling plan, which is specifically designed to limit the amount of selenium bearing rock, it assumes that Mingo Logan will place the coal it intends to extract into the authorized fills. *Id.* This is not consistent with WVDEP regulations, SMCRA permit conditions, and maximizing yield. TED2§ 3.1.2.

EPA also assumes a K_d value of 0.78, which is unrealistically low.[33] Applicable science suggests that K_d values for selenium ranging from 3.8 to 6.7 ± 1.9 are more appropriate. TED2 § 3.1.2.

Likewise, the record created by EPA does not establish that any posited problemative levels of selenium will result from the actual "fill material" to be placed in waters of the United

[33] The K_d value is technically the sorbed metals concentration divided by dissolved metal concentration. This means it is a representation of the metal that is likely to dissolve in water and pass downstream, relative to the quantity that remains in rock or soil. A K_d value over 1 means that more selenium will remain in the rock than pass downstream, and a K_d value under 1 means that more selenium will pass downstream than will remain the rock. TED2 § 3.1.2.

States by Mingo Logan. Concerns about selenium leaching from upland areas of the mine into waters of the United States are outside the scope of EPA's 404(c) authority.[34]

4. EPA Provides No Relevant Information To Support its Fish Bioaccumulation Projections

The Recommended Determination contends that the discharges authorized by Mingo Logan's 404 permit "are likely to increase selenium loading to the immediate receiving streams and downstream waters," such that the increased selenium levels will have an unacceptable adverse effect on "downstream wildlife populations, including fish population [sic]." RD at 38, 40. EPA provides no support for this conclusion.

EPA seems primarily concerned about the fish population downstream of Spruce No. 1 Mine in Spruce Fork, where there are fish populations that EPA considers to be "in relatively good condition" despite decades of surface and underground mining upstream and downstream of the Spruce No. 1 Mine. *Id.* at 36, 60. There are no data for selenium in fish from Spruce Fork, however, and no data that can be attributable to the Spruce No. 1 Mine. TED2 § 3.1.5.

In a misguided attempt to support its Recommended Determination with bioaccumulation data, EPA incredibly confuses Seng Camp Creek with Seng Creek. RD at 47 n.14. These are two different streams in two entirely different watersheds. Fish have been analyzed from Seng Creek, as reported by WVDEP, but no data are available from Seng Camp Creek. TED2 § 3.1.3. This is at least the second time in this proceeding that EPA has confused Seng Camp Creek with Seng Creek, despite earlier comments from WVDEP, the Corps, and Mingo Logan. *See, e.g.*, Memorandum for Record, at 13, Cmt. Ex. 5; Mandirola Letter at 2, Cmt. Ex. 26.

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[34] In a case involving this very permit, the Fourth Circuit affirmed the United States' position that the scope of its authority under Section 404 is limited to "nothing more than the filling of jurisdictional waters for the purpose of creating an underdrain system for the larger valley fill." *OVEC*, 556 F.3d at 194.

In a further important omission, EPA does not recognize that historical selenium data from discharges similar to those expected at Spruce No. 1 Mine indicate that most, if not all, of the selenium is selenate, which is the most oxidized form and least likely to bioaccumulate in fish. This is based on selenium speciation data collected by CH2M HILL from the discharge of 7 different valley fill ponds at three surface coal mine sites in southwest West Virginia during 2009 and 2010.[35] EPA twice wrongly states that selenate is the most toxic. TED2 § 3.1.3.[36]

IV. EPA Fails To Establish That a Rise in Conductivity or a Change in EPT Composition Will Cause an Unacceptable Adverse Effect on 404(c) Resources

The Recommended Determination also relies on supposed impacts from conductivity and speculative changes in the composition of a subset of macroinvertebrates. EPA wholly ignores that both issues were fully considered during the permit proceeding, and that the mine and drainage plan is designed specifically to address conductivity. EPA also fails to establish a unique correlation between conductivity and the projected changes to the composition of a subset of macroinvertebrates, ignores important ecological factors, like macroinvertebrate abundance and habitat quality, and provides no information to suggest that the authorized fills will cause

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[35] While the discharge limits are based on total recoverable selenium, selenate is the least likely form to bioaccumulate in aquatic organisms in these environments.

[36] EPA cites to "Lemley (1997)" to support its assertion of 4 µg/g in whole-body fish as an effect level for teratogenic development and reproductive failure. RD at 47 n.14. It is unclear which "Lemley" reference is being used because there is no reference in Appendix 5 with that spelling or the correct spelling of the assumed author, "Lemly." However, EPA's support for this 4 µg/g effect level is weak. In the 1997 study to which EPA is presumably referring, Lemly wrote that visual indicators and symptoms were necessary to confirm an adverse effect from tissue concentrations. TED2 § 3.1.5. Thus, by the standards of the Lemly study, this recently reported concentration is not enough to corroborate or draw conclusions of selenium-induced teratogenesis. Moreover, recent reviews report an effect level of about 8 µg/g, which is double EPA's proposed level. *Id.* EPA has also published a draft water quality criterion of 7.91 µg/g, which has not been finalized and has itself drawn considerable criticism. *Id.* Finally, there are no data for selenium in fish from Spruce Fork that can be attributed to Spruce No. 1 Mine in either of the recent reports by WVDEP. TED2 § 3.1.3.

conductivity levels or macroinvertebrate composition changes similar to those at the Dal-Tex Complex. Ultimately, EPA fails to establish an unacceptable adverse effect on 404(c) resources, fails to establish that a change in the makeup of a subset of macroinvertebrates would be a "significant" loss of macroinvertebrates, and fails to establish that either this change in macroinvertebrates or EPA's predicted rise in conductivity will have any impact on aquatic ecosystem health.

A. Conductivity Was Evaluated During the Permit Proceedings, And EPA Presents Nothing New

EPA first raised the issue of conductivity in 2002, in response to the proposed modification of the Section 402 permit. Cmt. at 31-32. EPA withdrew its objections and consented to the modification when WVDEP agreed to adopt conductivity monitoring and spoil handling measures to reduce conductivity. *Id.* at 32. The Corps also considered conductivity during the extensive NEPA review of the 404 permit. *See* DEIS, Chapter 2 at pages 2-42, 2-63 through 2-64; Chapter 3 at pages 3-36, 3-27, 3-81; FEIS, Table 2-2 at pages 2-94 through 2-98, 2-103 (Comments EPA-9, EPA-11). EPA raised the issue of conductivity in its comments on the DEIS, and the Corps addressed EPA's conductivity concerns in the FEIS. *See* FEIS, Table 2-2 at pages 2-94 through 2-98, 2-103 (Comments EPA-9, EPA-11). At that point, EPA could have objected to the issuance of the permit under CWA Sections 404(q) or 404(c), but declined to do so, leaving the Corps' permitting action as the final federal response on conductivity.[37] *See Coeur Alaska, Inc.*, 129 S. Ct. at 2458 (2009).

The SMCRA, 402, and 404 permits, as well as the fill design and construction process, address EPA's conductivity concerns through a number of protective measures designed to

[37] Mingo Logan does not agree or concede that EPA has the authority under CWA Section 404(c) to base its action on an issue that is properly addressed under CWA Section 402.

minimize conductivity, and other water quality and aquatic impacts. Fill material is tested for durability, and acid-producing material is segregated. The West Virginia surface mining regulations require baseline monitoring for total dissolved solids ("TDS") and conductivity, as well as quarterly monitoring. Memorandum for Record at 15, Cmt. Ex. 5. Overburden handling practice and sediment control structures are designed to manage drainage with minimum disruption down stream. *Id.* at 11-12. Mingo Logan must construct the authorized fills in a manner to minimize sediment loads in the stream and maximize sediment control sites. *Id.* at 12. Finally, Mingo Logan has agreed to comprehensive monitoring for total suspended solids, TDS (conductivity), pH, and a series of water-soluble metals. *Id.* As a result, West Virginia issued a 401 certification, which conclusively determines compliance with the State's water quality standards. *See* Letter from Randy Huffman, Dir., WVDEP, to Ginger Mullins, Chief, Operations & Readiness Div., Corps, Huntington Dist. (Dec. 19, 2005) ("401 Certification"), Cmt. Ex. 9; *OVEC*, 556 F.3d at 208 ("A § 401 certification is considered conclusive"); Cmt. § II.C.; Memorandum for Record at 14, Cmt. Ex. 5.

The Recommended Determination repackages those same previously-addressed concerns, but does not raise any new issues or information. Indeed, when EPA asked the Corps to suspend Mingo Logan's 404 permit in this proceeding on conductivity grounds, the Corps stated that EPA had failed to raise any new information, but "rather a new method for evaluating previously considered information." Memorandum for Record at 5, Cmt. Ex. 5. Moreover, of the six sites references in the 2008 Pond study on which EPA relies, five were evaluated by the Corps in the NEPA review. *Id.* at 6. The Corps noted that by eliminating more tolerant species and all other measures of aquatic system quality in its analysis, EPA is asserting an increased likelihood of impairment based on a narrow metric that fails to consider the wide range of factors affecting

wildlife. *Id.* It is only through an exclusive focus of an extremely narrow metric and a failure to consider more tolerant Ephemeroptera, Plecoptera, and Trichoptera ("EPT") species, other measures of macroinvertebrate health, and the wide range of factors affecting aquatic wildlife that EPA is able to claim an increased likelihood of some form of impairment. The Corps found this neither new nor persuasive. *See id.* at 5-6.[38] In short, EPA raises the same concerns here as it did in the permit proceedings, where those concerns were appropriately addressed, with EPA's concurrance.

B. There Is No Enforceable Conductivity Standard for EPA To Apply

The source of EPA's conductivity arguments appears to be an *ad hoc* conductivity limit of 500 µS/cm. *See* Cmt § V.D.1. EPA first proposed its *ad hoc* conductivity limit in April 2010 through the publication of a series of documents.[39] The proposed *ad hoc* conductivity limit has not been subjected to notice and comment, its scientific bases have not been fully vetted, and is neither a Section 303 water quality standard nor a Section 304(a) water quality criterion.[40]

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[38] Indeed, the Corp's response is a comprehensive refutation of EPA's scientific claims surrounding conductivity. *See* Memorandum for Record, Cmt. Ex. 5.

[39] On April 1, 2010, EPA published a series of documents titled *Improving EPA Review of Appalachian Surface Coal Mining Operations Under the Clean Water Act, National Environmental Policy Act, and the Environmental Justice Executive Order* (Apr. 1, 2010), *available at* http://www.epa.gov/Wetlands/guidance/pdf/appalachian_mtntop_mining_detailed.pdf. Among other things, these documents presumptively apply EPA's *ad hoc* conductivity limit to Section 402 and Section 404 permits. On April 12, 2010, EPA published *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams*, which sets forth the basis for EPA's *ad hoc* conductivity limit of 500 µS/cm. *See* http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=220171.

[40] The National Mining Association ("NMA") has brought suit against EPA in the United States District Court for the District of Columbia. Complaint for Declaratory and Injunctive Relief, *NMA v. Jackson*, No. 1:10-cv-01220 (D.D.C. filed July 20, 2010). Mingo Logan agrees with NMA that the series of documents that EPA published in April 2010 must comply with the Administrative Procedure Act ("APA") and go through notice and comment rulemaking procedures. Despite the failure to comply with the APA, EPA is nonetheless applying the *ad hoc*

Moreover, the 404(b)(1) Guidelines, on which EPA bases its authority to review water quality,[41] only permit consideration of the State's water quality standards. *See* Section IV.C.3, *infra*. There is no state numeric water quality standard for conductivity, however, and the State of West Virginia has explicitly rejected consideration of conductivity alone in applying its narrative water quality criteria. Consequently, there is no legally enforceable conductivity standard for EPA to apply.

The proposed conductivity limit is not a water quality standard, as that term is defined under CWA Section 303. As Mingo Logan has explained, the State has primary authority over its own water quality standard program, and in this case West Virginia has not adopted a numeric water quality standard for conductivity. If EPA disagrees with the State on some aspect of its water quality standards, then EPA must make a specific determination that the State's standards are inadequate and thereafter follow a process for promulgating replacement standards. *See* Cmt. § V.D. EPA has not done so.

The proposed conductivity limit is also not a "criteri[on] for water quality," which EPA is authorized to promulgate pursuant to Section 304(a) of the CWA. *See* 33 U.S.C. § 1314(a). EPA has not followed the statutorily-prescribed process for creating a formal criterion, but has instead simply created the proposed conductivity limit for its own purposes, outside of any statutory or regulatory regime. EPA convened a panel of the Science Advisory Board ("SAB") to review the proposed *ad hoc* conductivity limit, and acknowledged in its charge to the SAB panel that it may consider pursuing such 304(a) criteria for conductivity in the future but that the Agency had not yet decided whether or how to do so. In any event, the method used to derive

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conductivity limit to NMA members. This 404(c) action is an excellent example of the unlawful application of EPA's proposed limit.

[41] Mingo Logan disputes this authority. Cmt. § V.D.

the proposed conductivity limit deviates from EPA's standard methodology for establishing 304(a) criteria in a manner that would need to be vetted and reconciled through the statutorily prescribed process for adopting 304(a) criteria.[42] *See* 33 U.S.C. § 1314(a). Based on the panel's draft report, the method will require considerable additional work, data and information before being used for regulatory or permitting purposes.

Because the proposed conductivity limit is neither a Section 303 water quality standard nor a Section 304(a) criterion,[43] EPA is left with the argument that the proposed conductivity limit can be applied through the 404(b)(1) Guidelines. But, as Mingo Logan has explained, only the Corps has the authority to apply the guidelines.[44] Moreover, the 404(b)(1) Guidelines

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[42] EPA's proposed conductivity limit deviates from EPA's standard methodology for deriving water quality criteria in a number of significant ways. By way of example, the report only considers the effects of conductivity on certain invertebrate species and then limits its consideration of possible confounding factors to only one genera of mayfly, Ephemeroptera. The report fails to consider other taxa and does not include the minimum of eight different families of aquatic organisms as required by EPA's standard methodology (such as fish, mussels or aquatic plants). EPA's charge to the SAB was more limited than necessary for peer review of the proposed conductivity limit *as a recommended water quality criterion*. Although outside their charge, the SAB panel made a point of noting the limitations in the data used to derive the conductivity limit and expressed concern that only macroinvertebrate genera were used to develop the limit. "Although the WV database did not include fish, amphibians, or mollusks, it would be instructive to compare the differential response to conductivity among organisms groups when possible." EPA SAB, *Review of Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams* at 10 (Sep. 28, 2010 Draft), *available at* http://yosemite.epa.gov/sab/sabproduct.nsf/ea5d9a9b55cc319285256cbd005a472e/73efd038cd5705ac852577ae004b972c!OpenDocument (hereinafter "SAB Draft Report").

[43] Even assuming that the proposed conductivity limit was an applicable 303 water quality standard (adopted by the State and approved by EPA) or a 304(a) criterion, it would not be independently applicable. Instead, it would need to be assessed and implemented through the State's Section 402 NPDES permit and Section 401 water quality certification for the Corps' Section 404 permit, because they are the exclusive means of regulating downstream water quality under the CWA. These proceedings have come and gone; the State fully assessed compliance with applicable water quality standards and derived limits and conditions in the permits deemed necessary to ensure that those standards will be maintained. EPA cannot second guess the State's decision-making now by reference to a new, *ad hoc* conductivity limit that has neither the force nor effect of law.

[44] Cmt. V.C.1.

specifically exclude consideration of *ad hoc* water quality standards like the proposed conductivity limit.

EPA appears to rest its claimed authority to enforce the 404(b)(1) Guidelines on the phrase "applicable water quality standards," which appears therein. *See* RD at 38. However, EPA has defined the phrase "applicable water quality standards" to mean the water quality standards adopted by a state pursuant to the statutorily prescribed process under Section 303; in this case, West Virginia. *See* 40 C.F.R. § 131.21(d); *Alaska Clean Water Alliance v. Clarke*, No. C96-1762R, 1997 WL 446499 (W.D. Wash. July 8, 1997). As noted above, West Virginia has not adopted a numeric water quality standard for conductivity. Instead, West Virginia has adopted a narrative standard designed to protect the State's designated aquatic life use, and has soundly rejected the use of conductivity as a stand-alone metric for determining compliance with the narrative standard. *See* WVDEP, "Justification and Background for Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards, 47 C.S.R. 2 §§ 3.2.e and 3.2.i" at 5-8 (Aug. 12, 2010) (hereinafter "Justification") (attached as Exhibit 4). Thus, the only "applicable water quality standard" is the State's narrative standard, as interpreted by the state.[45]

Moreover, EPA deliberately excluded consideration of other water quality metrics when adopting the 404(b)(1) Guidelines. EPA initially proposed the 404(b)(1) Guidelines to require compliance with "any applicable State water quality standard, approved or promulgated by EPA under section 303 of the Act, or any applicable water quality criteria promulgated by EPA." 44 Fed. Reg. 54,222, 54,233 (Sep. 18, 1979). In the final 404(b)(1) Guidelines, however, EPA

[45] As Mingo Logan has explained, the State's interpretation is controlling over any competing interpretation by EPA. *Am. Paper Inst., Inc. v. U.S. EPA*, 996 F.2d 346 (D.C. Cir. 1993); Cmt. III.C.

specifically limited the Guidelines to "any applicable state water quality standard," which EPA explained were the State's water quality standards in effect at the time. 45 Fed. Reg. 85,336, 85,343 (Dec. 24, 1980). Thus, EPA rejected consideration of the criterion promulgated by EPA. If the guidelines exclude consideration of 304(a) criteria properly promulgated by EPA, then they surely also exclude consideration of *ad hoc* limits that have not even gone through the 304(a) rulemaking process. Yet, EPA now seeks to include consideration of *ad hoc* limits that lack even the imprimatur of the CWA.

C. EPA Fails To Take into Account Important Indicators of Ecological Health, and Instead Relies on Conductivity and Changes in EPT Composition, Which Are Overly Narrow Indicators of Ecosystem Health

The Recommended Determination wrongly contends that the permitted fills will cause conductivity to rise, and that this rise will cause unacceptably adverse changes in macroinvertebrate communities. EPA overstates the value of conductivity as an indicator of ecological health, misrepresents the potential impacts on the macroinvertebrate community, and fails to show any adverse effect to a 404(c) resource.

The Recommended Determination misrepresents the relationship between conductivity and macroinvertebrates and compounds this error by inappropriately focusing on an extremely narrow change in the composition of a small part of the macroinvertebrate community, to the exclusion of far superior indicators of ecological health, such as the West Virginia Stream Condition Index ("WVSCI"). West Virginia, which has primary authority over its water quality, has rejected EPA's proposed reliance on conductivity and narrow macroinvertebrate composition changes. EPA provides no reason to think these factors represent better, or even good, indicators of aquatic ecosystem health, much less that EPA's predicted impacts will result in an unacceptable adverse effect on 404(c) resources.

1. EPA Focuses on Extremely Narrow Indicators of Aquatic Ecosystem Health

Throughout the Recommended Determination and RD Appendix 1, EPA uses terms like "extirpate," RD at 51, "impact," *id.*, "degrade," *id.* at 52, "diversity," *id.*, "impaired," *id.* at 57, "hinder," *id.* at 58 "taxa loss," RD App. 1 at 16, "richness," *id.* at 6-8, "altered," *id.* at 24, "affected," *id.*, "composition," *id.*, "shifts," *id.* at 27, and "changes," *id.* In fact, Mingo Logan counts at least twenty-five discrete allegations in the Recommended Determination and RD Appendix 1. As a result, EPA's claim regarding the correlation between conductivity and macroinvertebrates is a moving target.[46]

Cleared of all obfuscatory language and argumentation, EPA essentially claims that a rise in conductivity is correlated with a decrease in the total number of a subset of macroinvertebrate species, as well as an increase in more tolerant macroinvertebrate species. *See, e.g.*, RD at 52; RD App. 1 at 26-27, 32. In other words, EPA predicts that subsequent sampling will find fewer individual organisms that are members of a certain subset of macroinvertebrate species, but more individual organisms that belong to other macroinvertebrate species.[47] EPA provides no justification for focusing on this subtle change, which is insignificant, or this small subset of macroinvertebrates, which do not correlate with aquatic ecosystem health.

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[46] As EPA explains, conductivity is simply the ability of a solution to carry an electric current at a specific temperature. RD at 47; TED2 § 3.2.1. It is not a pollutant, but a rough measure of ions or TDS in the water. TED2 § 3.2.1. Conductivity can also be used to measure salinity, because most TDS are technically salts, but it does not provide information related to specific constituents in the water. RD at 47; TED2 § 3.2.1. It has no causative relationship with macroinvertebrates or other organisms. Conductivity can be used as an indicator of water bodies that should be studied in greater detail, but it is not a good measure of aquatic ecosystem health. *See* Section IV.C.3, *infra.*

[47] EPA refers to this phenomena in a number of ways, but it is perhaps best characterized as a change in EPT composition.

a. EPA Focuses on a Narrow Subset of Macroinvertebrates, EPT, and Ignores Other Information

Macroinvertebrates are a large grouping of organisms that lack backbones and are visible to the naked eye. TED2 § 4.1. The overall group of macroinvertebrates consists of approximately thirteen more specific groupings, called "Orders." *Id.* § 3.2.2. Among these are Orders of insects, aquatic worms, crustaceans, and mollusks. *See* EPA, "Benthic Macroinvertebrate Identification," *available at* http://www.epa.gov/bioindicators/html/benthosid.html; WVDEP, *WV Save Our Streams Field Guide to Aquatic Invertebrates*, *available at* http://www.dep.wv.gov/WWE/getinvolved/sos/Documents/Macroinvertebrates/WVSOSAdvanced_MacroGuide.pdf. Individual Orders can be divided further into "Families," which can then be divided further into "Genus." Below Genus is the most specific category, "Species," which represents distinct species of organisms.[48]

The Recommended Determination focuses on just three Orders of insects: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), which are collectively known as "EPT." RD at 52; TED2 § 4.1. Within these Orders are dozens of Families, and even larger numbers of Genus.[49]

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[48] All organisms are organized into this taxonomic classification system, from the broadest grouping down to individual species (Kingdom, Phylum, Class, Order, Family, Genus, Species). All macroinvertebrate species fall under the Kingdom Animalia, the Phylum Arthopoda, Annelida, and Mollusca, and accordingly broader Classes, Orders, Families, and Genus. A "taxa" is a reference to all of one taxonomic category. For example "EPT taxa" refers to all species within the Ephemeroptera, Plecoptera, and Trichoptera Orders.

[49] For example, there are at least twenty-two families of caddisfly, *see* EPA, "Benthic Macroinvertebrate Identification." At the most specific level, there are over 2,000 distinct species of mayfly. TED2 § 4.1.

Thus, EPT represent only a small element of the macroinvertebrate community. As can be seen in Table 6 of the Recommended Determination, EPT species represent fewer than half of all species collected in Pigeonroost and Oldhouse. RD at 53-54. By focusing on EPT alone, EPA ignores ten entire Orders of macroinvertebrates, including Diptera, which are the most diverse group of insects in the aquatic environment, representing 40 percent of the insect taxa. GEI Consultants, Inc. Ecological Division, *Final Report Technical Review: A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams* at 11 (Sep. 2010) (hereinafter "GEI1"), Exhibit 5; RD at 53-54.

But EPA narrows its focus even further within the EPT orders. At some points, EPA limits its analysis to only Ephemeroptera (mayflies) and Plecoptera (stoneflies). RD at 52; RD App. 1 at 7-9 (focusing on only 39, then 9, species). At other points, EPA excludes consideration of several genera of mayfly and caddisfly. RD App. 1 at 7-8. In the development of the Observed/Expected ("O/E") index, for example, EPA ignores the entire insect family Chironomidae, and excludes all taxa that appeared in less than 10 percent of samples. RD App. 1 at 10-11 n.4. EPA also focuses on Ephemeroptera (mayflies) alone at the beginning of Appendix 1, and, as discussed further below, discounts confounders primarily through comparisons to Ephemeroptera. *See* RD App. 1 at 23, 30. Even within Ephemeroptera, EPA often focuses only on the most sensitive species. *See* RD, App. 1 at 6 (discounting genera that appear in Spruce Fork, as well as Pigeonroost and Oldhouse). In sum, the Recommended Determination focuses on an extremely narrow subset of macroinvertebrates, without establishing that a change in the composition of this narrow subset represents an unacceptable adverse effect, or will lead to a material decline in the overall health of the aquatic ecosystem. *See* Justification at 3.

b. A Change in the Composition of EPT Is Not The Same Thing as a Change in Abundance, or a Change in Diversity

As noted above, EPA uses a variety of words to describe both the phenomena and the affected community that make up its claim. This has the effect of confusing EPA's very specific claim regarding a narrow group of macroinvertebrates with a number of related claims. These should not be confused.

Importantly, the Recommended Determination does not claim that the total number of macroinvertebrates located in the streams will decrease. RD App. 1 at 30-31 (admitting that macroinvertebrate "abundance"[50] and density may actually increase). EPA provides no information to suggest that the authorized fills will reduce the abundance of macroinvertebrates in Pigeonroost, Oldhouse, or Spruce Fork. *See* RD at 51-57. In fact, studies of EPT composition changes in response to elevated conductivity have consistently failed to demonstrate a change in the overall abundance of macroinvertebrates. TED2 § 4.1. While certain species may become less abundant, other species become more abundant. EPA also does not establish that the authorized fills will reduce either the abundance of EPT, or the abundance of EPT as a percentage of the total macroinvertebrate community in the streams.[51] Indeed, EPA appears to

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[50] Taxa "abundance," refers to the total number of organisms located in the study area, within that taxonomic category (e.g. mayflies, EPT, macroinvertebrates). In response to the likelihood that the fills will not impact the abundance of macroinvertebrates, and may even increase it, EPA meekly argues that "an increase in these metrics is not always 'beneficial.'" RD App. 1 at 31. EPA provides no factual support for this claim and does not cite to any data or studies.

[51] Percentage of EPT (%EPT) refers to the abundance of organisms within the Orders EPT, relative to the total abundance of macroinvertebrate organisms located in the study area. %EPT has been commonly used as a rough measure of stream and ecosystem health. TED2 § 4.1.

concede that neither the total EPT nor percentage of EPT are likely to diminish.[52] *See* RD App. 1 at 26, 31-32.

One section of the Recommended Determination meekly claims that the authorized discharges will decrease macroinvertebrate "diversity." RD at 52.[53] The term "diversity" refers to the number of unique genus or species located in a specific sample.[54] The primary support that EPA marshals for this claim is a technically inappropriate comparison to the Dal-Tex Complex, which is discussed further below. RD at 55-56; *see* Section IV.D.

A change in EPT composition, which is the Recommended Determination's primary claim, does not necessarily indicate a decrease in diversity of macroinvertebrates or EPT. TED2 § 4.1.1. As EPA concedes, the data shows that a drop in the abundance of certain species would be accompanied by a corresponding increase in the abundance of other species. *See, e.g.*, RD at 52; RD App. 1 at 26-27, 32. And EPA's complete data set shows that different macroinvertebrate species react differently to changes in conductivity. GEI1 at 7; GEI

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[52] EPA claims that %EPT is not a good measure of water quality because streams with poor water quality can also have a high %EPT. RD App. 1 at 26-29. EPA claims that although WVDEP does not rely on %EPT to assess water quality, it uses the WVSCI, "other scores [used in the WVSCI] can be high enough for %EPT to obscure any relationships (i.e., correlations and regression-type analyses) between biological response metrics and stressors." *Id.* at 27. Not only does EPA not explain or support this vague claim, the only example EPA provides shows exactly the opposite. *See id.* at 26-27 (discussing an example of a water body with high %EPT, that nonetheless has a very low WVSCI). This is exactly what you would expect from WVSCI as a more comprehensive measure of water quality. This example shows that a high %EPT does not overwhelm the overall score, but rather that the WVSCI score is not unduly influenced by a single metric, whether it is %EPT or EPT richness.

[53] The primary support that EPA marshals for its claim that macroinvertebrate and/or EPT diversity is likely to decrease at Pigeonroost, Oldhouse, or Spruce Fork is a misguided and unsupportable comparison to the Dal-Tex Complex. RD at 55-56. This technically inappropriate comparison is discussed further below.

[54] For example, one hundred organisms from the same genus or species might constitute high abundance, but relatively low diversity. If the one hundred organisms were each from a different genus, that would constitute high diversity, but the same level of abundance. Diversity is synonymous with "richness."

Consultants, Inc. Ecological Div., "Primary Technical Concerns with Proposed EPA Conductivity Benchmark" at 1 (undated) (hereinafter "GEI2"), Exhibit 6. Some species decrease as conductivity rises, while others increase. In addition, some species decrease when conductivity decreases, which is directly contrary to EPA's proposed correlation.[55] GEI1 at 7. Other species have more complex correlations with conductivity, and increase abundance at a set point of conductivity, or at extreme lows or extreme highs. GEI2 at 1. Thus, species that were not seen in previous samples – either because the species is too uncommon to have appeared in a sample, or because the relevant metric excludes rare species – may appear as conductivity increases. *See, e.g.*, RD App. 1 at 10-11 (excluding species that occur at fewer than 10 percent of sites from consideration in the O/E metric).

2. A Mere Change in EPT Composition Does Not Independently Affect or Measure Aquatic Ecosystem Health

EPA does not establish that its predicted change in EPT composition, which can have many causes, man-made and natural,[56] will adversely affect aquatic ecosystem health, much less specific 404(c) resources. In fact, EPA's own data compels the conclusion that a specific EPT composition is not necessary to support all aquatic life uses.

The composition of EPT (or macroinvertebrates) in a given stream can vary considerably. Indeed, the data presented by EPA shows that the EPT and macroinvertebrate communities vary considerably between Pigeonroost, Oldhouse, and Spruce Fork. RD App. 1 at 6-8. Table 2 in Appendix 1 shows that nine of the nineteen species of Ephemeroptera (mayflies) collected in

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[55] This suggests that factors other than conductivity are influencing macroinvertebrate composition and further calls into question the utility of EPA's proposed conductivity limit.

[56] A change in the composition of EPT in a given stream can result from a number of causes, natural and man-made. TED2 § 3.2.2. Naturally occurring events, such as droughts, floods, and predator-prey interactions, may cause changes in these populations. TED2 § 4.1.3.

Oldhouse and Pigeonroost appeared in only one creek or the other. Similarly, ten of the sixteen species of Plecoptera (stoneflies) appeared in only one stream or the other. *Id.* at 8. The EPT composition in Seng Camp Creek was even more varied, and although EPA did not provide any data on the EPT composition of Spruce Fork, EPA indicated that it likely differs even further and lacks the sensitive EPT upon which the Recommended Decision inappropriately focuses. *See* RD App. 1 at 6-8 (stating that "many" of the mayfly genera found in either Pigeonroost or Oldhouse "have not been collected in Spruce Fork").

A change in the composition of EPT does not represent a reduction in ecological stream function. TED2 § 3.2.2. If species that perform a particular ecological function are reduced in number, they are replaced by other species that fill that niche. TED2 § 4.1.1. Data presented by CH2M HILL in the accompanying report, as well as numerous commenters to EPA's proposed conductivity limit, indicate that mined and unmined streams have approximately the same number of species within each feeding group (trophic level). This indicates that although mined streams saw a change in the composition of EPT, this change did not lead to a substantive change in feeding groups, and those streams did not see a substantive effect on the composition or function of these communities.[57] *Id.* These changes in EPT composition do not indicate degradation of aquatic life health because such changes do not necessarily result in losses in the functions of the EPT community as a whole. *Id.*

Moreover, this change in EPT composition does not indicate any impact on higher trophic level biota, because any decline in one population will be replaced by another that still satisfies the functional demands for the organisms that depend on macroinvertebrates. *Id.* In

[57] EPA counters that the composition of feeding groups may change when the composition of EPT changes. RD App. 1 at 24. One would expect this to be the case, however, and EPA notably does not allege that the *function* of the feeding groups will diminish. *See id.*

fact, EPA makes no allegation that a change in EPT composition will result in an impact on higher trophic level species. This is because fish, birds, and other species that rely on macroinvertebrates are generalists, and are not dependent on a specific species of EPT. After analyzing EPA's data, CH2M HILL concluded that there was no evidence that a change in EPT composition impacts higher trophic level biota. *Id.*

3. West Virginia Uses a Far More Comprehensive Measure of Macroinvertebrate Populations as an Indicator of Ecosystem Health

Conductivity is sometimes used as an indicator of the ionic composition of a waterbody when data on specific constituents are lacking. TED2 § 3.2.1. At most, conductivity can be used as an indicator or heuristic to highlight water bodies that should be studied in greater detail.[58] EPA claims that conductivity is also "a good predictor of aquatic life use impairment." RD at 47-48.[59] In fact, however, conductivity is a poor predictor of impairment.

As the Corps explained, conductivity is far too broad and generic to be useful in managing water quality or ecosystem health. Justification at 2. West Virginia has also rejected conductivity as a stand-alone metric, because "more than a simple conductivity measurement is

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[58] It is not unlike the Body Mass Index ("BMI") that epidemiologists, dieticians, and other health researchers use to assess a healthy body weight. Although it is useful on a population level, in the absence of additional health information, it is not particularly adept at assessing the health of an individual person.

[59] In support of this claim, EPA cites to the Pond et al. 2008 study, which EPA proffers to support the conclusion that conductivity levels above 500 µS/cm are "strongly associated with high probability of degradation of native biota." RD at 48; RD App. 1 at 14. Both West Virginia and the Corps find EPA's reliance on the Pond study misplaced, because it ignores the numerous other important factors supporting aquatic life and is self-fulfilling. *See* Memorandum for Record at 6, Cmt. Ex. 5; Justification at 3. Although EPA claims that conductivity can independently indicate impairment, the study also used conductivity as an indicator of mining disturbance, which is self-serving, and eliminated more tolerant species from the analysis, which in turn increased the likelihood of demonstrating impairment. *See* Memorandum for Record at 6, Cmt. Ex. 5. As the Corps' wrote, the study did not include caddisflies and "eliminated the more tolerant species of mayflies, which lowers the stream's scores and increase the likelihood of an impairment determination." *Id.* at 5-6.

necessary to determine the heath of a stream." *Id.* at 5. Instead, West Virginia uses the WVSCI, among other factors affecting the aquatic ecosystem, to enforce the State's narrative water quality standards. *Id.* at 4.

WVSCI, which was developed under EPA contract, assesses six benthic macroinvertebrates metrics: total number of taxa, total number of EPT taxa, percentage of organisms that are EPT, percentage of organisms that are Chironomidae (midges), percentage of organisms in the top two dominant taxa, and the Hilsenhoff Biotic Index. These six metrics are combined into a single multimetric index, including consideration of algae, invertebrates, fish, stream structure and/or function. Justification at 5. In addition to WVSCI, West Virginia takes a holistic approach and reviews other factors affecting the aquatic ecosystem to enforce its narrative water quality standards. *Id.* at 4.

The Recommended Determination, by contrast, unjustifiably focuses exclusively on a single metric: a change in the composition of EPT. This analysis ignores five of the six macroinvertebrate metrics used in WVSCI, which are designed to give a complete picture of macroinvertebrate health. The Recommended Determination also ignores all of the other metrics reviewed by the State and is a stark contrast to WVSCI's comprehensive assessment of aquatic ecosystem health. Such a narrow focus on a single macroinvertebrate metric is an inappropriate measure of impairment, significant adverse impact, or compliance with narrative water quality standards. *See id.* at 3; Memorandum for Record at 7, Cmt. Ex. 5.

West Virginia does not use a change in EPT composition as an indicator of aquatic ecosystem health or to determine compliance with its narrative water quality standards.

Justification at 3.[60] Unless there is evidence that a change in EPT composition has had a significant adverse impact on the rest of the aquatic ecosystem, a change in EPT composition alone will not result in a violation or degradation of West Virginia's narrative water quality standard. *Id.* at 6. West Virginia analyzed the use of conductivity and a change in EPT composition, and concluded that "EPA's proposed limits are too narrowly focused on a single parameter and single aquatic species to determine the health of the impacted watershed." *Id.* at 7. "An ecosystem does not exist at a single point and, accordingly, its health cannot be assessed at a single point." *Id.* at 3.

EPA's myopic focus on EPT composition obscures the fact that conductivity is poorly correlated with WVSCI scores. West Virginia considers streams that receive a WVSCI score below 60.6 to be impaired. *Id.* at 5. Figure 1, which also appears in the WVDEP Justification document and is similar to one included in the initial CH2M HILL report (TED, Cmt. App.), makes clear that the "correlation" between conductivity and aquatic life use is tenuous at best. *See* Justification at 6.

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[60] EPA claims that "WVDEP has acknowledged that a 'shift' in the macroinvertebrate community can constitute impairment." RD App. 1 at 32 (emphasis omitted). This is refuted by the Justification, and the sentence cited by EPA to support this outlandish claim specifically states that such impairment is best measured by the WVSCI. *Id.*

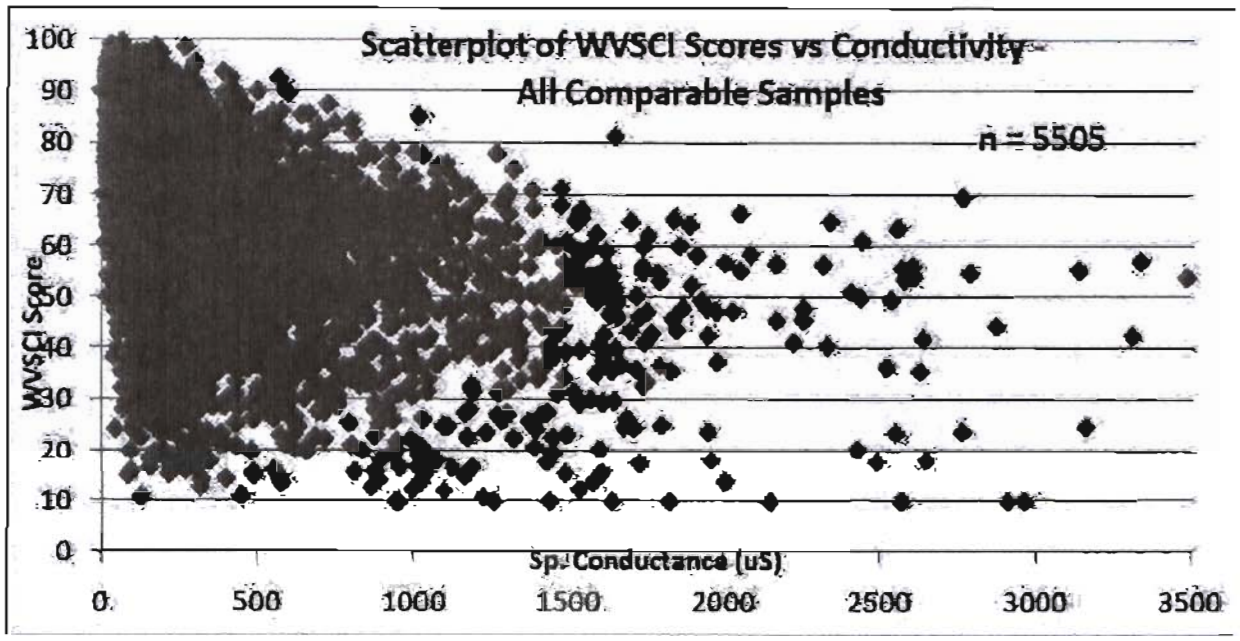

Figure 1. WVSCI Scores and Conductivity. TED2 § 3.2.3.

At very low conductivities, a huge number of streams have WVSCI scores below 60.6, and at a conductivity of 1000 µS/cm – double the *ad hoc* limit proposed by EPA – many streams had WVSCI scores above 60.6.[61] The variability in values for number of taxa is wide, suggesting that other stressors are better predicators of attainment or impairment. *See* Justification at 6 ("native aquatic life is protected at various values and ranges of specific conductance"). Both the Corps and West Virginia find the WVSCI assessment to be a more comprehensive and superior measure of water quality, which correlated poorly with conductivity scores. Memorandum for Record at 6-7, Cmt. Ex. 5; Justification at 6-8. The WVDEP called it a "loose and questionable causal relationship between conductivity and stream impairment," and

[61] A WVSCI score above 68 indicates fill support of aquatic life uses, but West Virginia uses 68 as an impairment threshold in order to account for sampling errors to avoid misclassifications. Justification, at 5. EPA attempts to strengthen the relationship between conductivity and WVSCI scores by unilaterally raising the reference value of 68 to 72. EPA simply asserts, with no supporting data, that a review of all reference sites indicates that the 5th percentile of the reference scores is actually 72. *See* RD App. 1 at 17.

concluded that "regulation solely via an indicator such as specific conductance is not the best way to protect against excursions from [the State's] narrative [water quality] standards." Justification at 6, 8.[62]

Although West Virginia uses WVSCI and other factors to determine "impairment," EPA proposes its own method of determining impairment using the O/E index. *See* RD at 56, RD App. 1 at 14-15. First, EPA declares that the 5th percentile of the reference site scores within the O/E index is an appropriate measure of impairment, because the WVSCI uses the 5th percentile of reference site WVSCI scores to create its impairment threshold. *See id.* This attempt to equate the O/E index and WVSCI ignores the obvious fact that the scores and the indexes themselves *measure completely different things*. Having equated the O/E and WVSCI, EPA declares that 85 percent of the sites in the Pond study with conductivity above 500 µS/cm were "impaired" and that O/E scores below the 5th percentile value represent an "unacceptable adverse effect." RD App. 1 at 11, 14-15. EPA provides no information to suggest that this conflation of O/E with WVSCI is appropriate, and it appears as if EPA has engaged in this exercise in order to circumvent the fact that the appropriate metric for determining impairment, WVSCI score, is poorly correlated with EPA's proposed conductivity limit.

4. EPA's Proposed Correlation Between Conductivity and a Change in EPT Composition Ignores a Wide Range of Confounding Variables

EPA's contention that increased conductivity is strongly correlated with a change in the composition of EPT ignores other factors similarly correlated with a change in the composition

[62] WVDEP adds that under the EPA-approved TMDL process, conductivity does not even become a likely stressor of a stream until it reaches 1075-1532.9 µS/cm, two to three times EPA's recommended limit. Justification at 7.

of EPT.[63] EPA provides no information to suggest that these other factors do not account for some or most of EPA's predicted change in EPT composition. Indeed the data suggests that this is what is occurring.

There are numerous other causes of changes in macroinvertebrate composition that EPA's proposed conductivity limit does not measure. These include changes to dissolved oxygen, hydrology, nutrients, organic-matter, pH, salinity, sediment loads, suspended solids, turbidity, water temperature, habitat, chemical levels, land use, droughts, floods, and interspecies competition, among others. EPA provides no data to suggest that these factors do not influence ecosystem health and the composition of the EPT community.[64] In fact, EPA acknowledges that "habitat can strongly affect" the composition of the macroinvertebrate community. RD App. 1 at 16. This is confirmed by various studies which show that habitat is an important contributor to the health of the aquatic ecosystem.

Despite the importance of habitat, EPA did not adequately analyze habitat as a confounding variable. Instead, EPA's O/E scores were based on sites with uniformly favorable habitat, and are therefore unreliably skewed. Only 5 of the 40 sites studied had habitat scores

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[63] EPA attempts to establish its proposed conductivity limit without any independent laboratory exposure studies. Instead, EPA has picked one metric that is correlated with a change in the composition of EPT (of which there are many) and declared it to be the cause of all observable macroinvertebrate community structure changes in extremely variable environments. EPA has not identified any published study indicating that sensitive invertebrate taxa exhibit acute or significant chronic toxicity at the proposed conductivity limit. If the proposed conductivity limit does have some toxicological significance, then EPA should be able to demonstrate some evidence that the particular EPT species EPA focuses on have a sensitivity to one or more of the water constituents that conductivity measures. Yet, EPA makes no attempt to explain the specific mechanisms of ion toxicity and has provided no toxicological explanation for the supposed causal relationship between the proposed conductivity limit and the specific EPT species.

[64] By merely arguing that conductivity is a *superior* indicator of changes in EPT composition, EPA implicitly concedes that other factors, which are not measured by conductivity, impact EPT composition.

less than 140. TED2 § 3.2.2. Without a representative selection of habitat scores, EPA could not meaningfully assess the impact of habitat on EPT scores. *Id.* This is a significant omission, since habitat is a better predictor of degradation, as measured by WVSCI scores. *Id.*

In order to discount confounding factors, EPA primarily compared those factors to Ephemeroptera (mayflies), and excluded consideration of the rest of the macroinvertebrate community. GEI1 at 21; GEI2; TED2 § 3.2.2.[65] This is inappropriate because the proposed correlation is between conductivity and all three Orders of EPT, not just Ephemeroptera. In order to appropriately address confounders, EPA must analyze their relationship with all of EPT, not simply the one (E) that shows the weakest correlation.

EPA's inappropriate method of discounting confounders also ignores the fact that Ephemeroptera represent only 16.5 percent of the genera in the dataset analyzed by EPA. And as commenters to the proposed conductivity limit have noted, there is no clear relationship between the number of Ephemeroptera genera and conductivity. TED2 § 3.2.2; GEI1 at 20. Figure 2 shows the poor the correlation between Ephemeroptera and conductivity.

[65] To distinguish impoundment as a factor, for example, EPA relies on the correlation between Ephemeroptera and conductivity at impounded sites. RD App. 1 at 23.

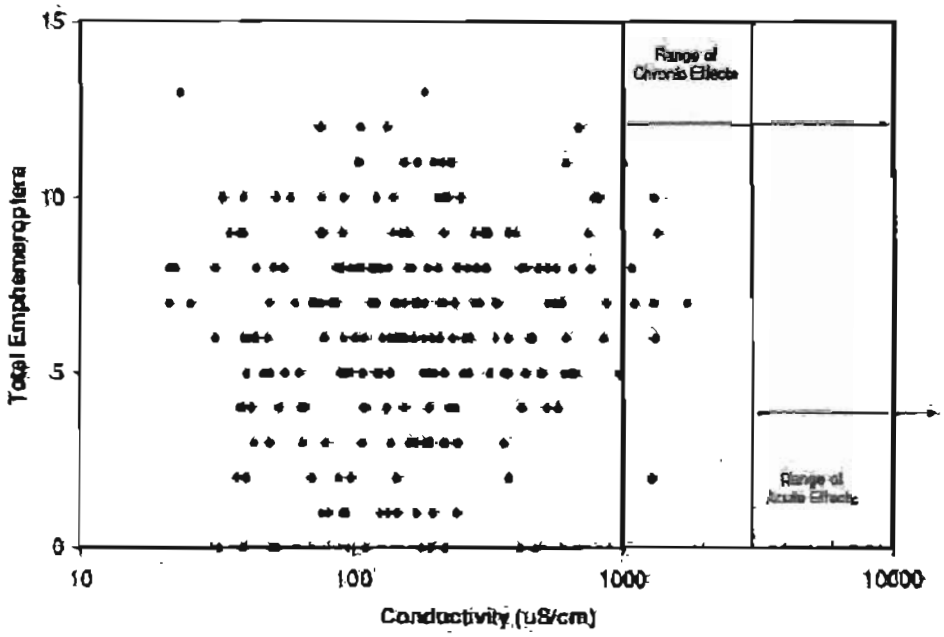

Figure 2. Total Ephemeroptera Genera and Conductivity. TED2 § 3.2.2.

The fact that Ephemeroptera are poorly correlated with conductivity undermines both EPA's analysis of confounders and EPA's proposed conductivity limit itself. If a poor correlation with Ephemeroptera is a sufficient reason to discount confounders, then the same poor correlation with conductivity should eliminate conductivity as well. Such inconsistent evaluation of conductivity and various confounders undermines EPA's proposed conductivity level and calls into question EPA's failure to independently examine other confounders.

D. EPA's Estimate of a Change in EPT Composition Is Based Entirely on an Unsupportable Comparison to the Dal-Tex Complex

EPA generates its projected change in EPT composition by comparing the existing condition of Pigeonroost and Oldhouse to the existing condition of Beech Creek and other receiving streams within the Dal-Tex Complex. RD at 51-58. On that basis, EPA speculates that the condition of Pigeonroost and Oldhouse after the completion of the Spruce No. 1 Mine will

mirror the current condition of Beech Creek. *Id.* at 51. But EPA cannot support any such prediction.

EPA misleadingly contends that "the 2006 Spruce No. 1 EIS states that impacts from the Spruce No. 1 Mine are expected to be similar to those from the Dal-Tex operation." *Id.* As Mingo Logan has explained, the DEIS says no such thing. *See id.* at 37. The quoted language instead refers to similarities in "topography, geology, and mineral resources," not water quality impacts and impacts on the aquatic ecosystem. DEIS at 3-15. Thus, the principal justification for comparing modern day Pigeonroost, Oldhouse and Spruce Fork to modern day Dal-Tex is unsupported by the only material cited by EPA.

Moreover, while the Spruce No. 1 Mine and the Dal-Tex Complex are located in the same area of West Virginia, any similarities end there. As explained above, the Dal-Tex Complex is almost three times as large as the Spruce No. 1 Mine on an acreage basis, includes underground mines, and has been actively mined since the early 1900s, much of it before the passage of SMCRA. TED2 § 3.1.2. Additionally, extensive historical underground mining is situated above the drainage and contributes discharges to the surface water system. As such, the Dal-Tex Mine site has multiple and significantly different source areas. As Mingo Logan has also explained, modern mining practices and techniques further differentiate the Spruce No. 1 Mine, and limit conductivity increases downstream. *See* Section IV.A, *supra*.

Aside from these important differences, EPA's comparison between the Spruce No. 1 subwatershed and the Dal-Tex subwatershed is flawed in its own right. First and foremost, EPA provides no information about the EPT baseline of the Dal-Tex Complex before the extensive historical mining there. As a result, EPA cannot demonstrate that the existing EPT population at the Dal-Tex Complex is the result of mining; much less a result of discharges of fill material

comparable to those authorized by Mingo Logan's 404 permit. Without a baseline, EPA has no basis for its statements like "past mining by Mingo Logan has led to the estimated extirpation of ~70% of the native expected taxa in their adjacent Dal-Tex mine operation." RD at 56.

Moreover, while EPA shows that the species of EPT vary between the Spruce No. 1 subwatershed and the Dal-Tex subwatershed, *see* RD at 53-54, Table 6, EPA's data also shows an equal if not greater variation between species of EPT as between Pigeonroost, Oldhouse and Seng Camp, *see* RD App. 1 at 7-8, Tables 2, 3. This demonstrates how dynamic the EPT populations are, and how additional measures, as reflected in WVSCI, are needed to assess impacts to biotic integrity and wildlife inhabiting streams.

E. EPA Has Not Demonstrated That the Authorized Fills Will Have an Unacceptable Adverse Effect on a 404(c) Resource

EPA may not appropriately consider impacts to macroinvertebrates without demonstrating a resultant, unacceptable adverse impact to a 404(c) resource. As Mingo Logan explained in its initial comment, macroinvertebrates are not "wildlife," within the context of Section 404(c), or are otherwise a 404(c) resource. *See* Cmt. at 90-91. Yet, EPA has presented no information to suggest that an increase in conductivity or a change in EPT composition will adversely effect a 404(c) resource.

Even if macroinvertebrates were a 404(c) resource, EPA presents no evidence that macroinvertebrate or EPT abundance in Spruce Fork will diminish after the Spruce No.1 Mine is fully constructed or that losses of macroinvertebrates or select EPT species in Pigeonroost or Oldhouse Creeks will be significant to the macroinvertebrate community or to aquatic ecosystem health. EPA simply fails to demonstrate any unacceptable adverse impact to macroinvertebrates in the authorized fill or downstream.

1. EPA Provides No Information To Suggest That Trophic Function or Higher Order Biota Will Be Disrupted

Not once in the Recommended Determination does EPA contend that the alleged impacts to macroinvertebrates will have an unacceptable adverse effect on higher trophic level biota, or any 404(c) resource. Nor has EPA established that a change in EPT composition will cause any adverse impacts to predator species or other higher trophic level biota. Indeed, the Recommended Determination does not once claim that a shift in the relative abundance of certain species of EPT is correlated with the populations or health of any of the 404(c) resources. Neither the Pond study, nor EPA's proposed conductivity limit addresses impacts to fish or wildlife.[66]

The Recommended Determination does not provide any data to suggest that a change in EPT composition will disrupt the trophic function of the EPT or macroinvertebrate communities. Any decline in one population of EPT species will be replaced by another that still satisfies the functional demands for the organisms that depend on macroinvertebrates. TED2 § 4.1.1. This is because fish, birds, and other species that rely on macroinvertebrates are generalists, and are not dependent on a specific species of EPT. *Id.*

The most direct evidence that conductivity does not result in adverse effects to such higher trophic resources is that Spruce Fork, which has a conductivity value over 500 μS/cm, and a different distribution of EPT taxa than either Pigeonroost or Oldhouse, has maintained a healthy fish assemblage for the last 60 years. RD at 32, 60; TED2 § 3.2.3.

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[66] The SAB panel pointedly noted that only macroinvertebrate genera were used to develop the proposed conductivity limit, and that "the WV database did not include fish, amphibians or mollusks." SAB Draft Report at 10.

2. EPA Fails To Demonstrate an Unacceptable Adverse Effect Within the Footprint of the Authorized Fill

EPA asserts that the macroinvertebrates that live within the footprint of the authorized fill will be destroyed. RD at 51. But EPA provides no reason to think that the macroinvertebrate community as a whole will suffer any significant effect from this loss. TED2 § 3.2.2; 4.1.1. Instead, EPA simply assumes that any potential loss of certain EPT species within the footprint of the fill will be significant. RD at 51. EPA provides no data to support this assumption. In fact, any loss of EPT in the footprint of the fills will have an inconsequential impact on the macroinvertebrate and EPT community in the area and an inconsequential impact on downstream macroinvertebrate and EPT abundance and diversity. TED2 § 4.1.2. EPA effectively concedes this point when it notes that the macroinvertebrates with which it is concerned are "naturally ubiquitous across the region, not rare, or endangered." RD App. 1 at 32. Any loss of sensitive EPT cannot therefore have any "significant" impact on the species community within the area.

Indeed, such impacts to macroinvertebrates would also be expected at *any* surface mine in the United States, and *any* fill requiring a 404 permit. Macroinvertebrates inhabit all waters of the United States, and any fill placed in such waters will inevitably impact macroinvertebrates to some degree. If EPA could base its 404(c) determination on fill impacts to macroinvertebrates, it would destroy the carefully balanced structure of the 404 permitting process. Section 404(c) would become the rule, not the exception, and would render every 404 permit uncertain and subject to the whim of EPA. This proves too much and greatly exceeds the circumscribed authority that Congress granted EPA under Section 404(c) as a small check in the overall 404 statutory scheme, which explicitly approves the discharge of fill material into waters of the United States.

3. EPA Has Failed To Demonstrate That the Authorized Discharges Will Have an Unacceptable Adverse Effect Downstream[67]

The central thrust of EPA's conductivity and macroinvertebrate argument is that the permitted fills in Pigeonroost and Oldhouse will cause conductivity to rise in those streams and in Spruce Fork, and lead to a change in EPT composition. This argument suffers from several flaws.

First, the flow and watershed contribution of Pigeonroost and Oldhouse to Spruce Fork is nominal. Pigeonroost and Oldhouse constitute only 9.92 percent of the watershed at the point just downstream of the Spruce No. 1 Mine. Moreover, these two streams represent only 6.6 percent of the measureable flow at that point. They are therefore not significant contributors to the Spruce Fork watershed, and do not provide significant dilutive capacity.

Second, EPA concedes that few if any sensitive EPT live in Spruce Fork. RD App. 1 at 6. And few of the tolerant EPT found in Spruce Fork are found in Pigeonroost and Oldhouse. *See* RD App. 1 at 26. Thus, without regard to the permitted fills in Pigeonroost and Oldhouse, whatever sensitive EPT may be in those creeks are not providing any benefit to the EPT composition in Spruce Fork. As a result, EPA cannot demonstrate that any change in the EPT composition in Pigeonroost and Oldhouse will adversely impact the ecological health in Spruce Fork.

Third, EPA does not establish whether any conductivity increase in Spruce Fork will come from the permitted discharges, the upland activities at the mine regulated under SMCRA, or some other factor like habitat change. Conductivity results from rainfall or other water sources running across exposed rock and soil. TED2 § 3.2.1. It does not result from the

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[67] Mingo Logan does not believe that EPA has the authority to base the exercise of its 404(c) authority on downstream impacts, where the downstream discharges are controlled by a permit issued under Section 402. Cmt. V.A.

authorized discharges, per se, and in fact conductivity would be expected to rise somewhat whether the permitted fills were constructed or not.[68] *Id.* All areas of the mine site that would expose rock are potential causes of an increase in conductivity (as are agricultural and forestry operations to name a few). All water on site that is exposed to rock and soil, whether rainfall or underground, is a potential source of increased conductivity. Section 404(c), however, does not give EPA authority over other land uses, such as upland mining activities, or mining point source discharges regulated under Section 402.

Fourth, EPA's data makes clear that a change in EPT composition has numerous potential causes.[69] EPA explicitly concedes that habitat causes such change, and the data suggests that habitat may in fact be a superior indicator. TED2 § 3.2.2. Because EPA cannot show that any projected EPT composition change will be caused by an increase in conductivity, or the water constituents measured by conductivity, EPA cannot base its Recommended Determination on a rise in conductivity.

Fifth, even if EPA could demonstrate that a change in EPT composition resulted from the authorized discharges alone, EPA must still demonstrate that the effect is adverse and significant or unacceptable. EPA cannot show either. All streams have different compositions of EPT, and EPA has admitted that the relevant sensitive EPT are ubiquitous. *See* RD App. 1 at 32. If the

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[68] Elsewhere, EPA has suggested that its concerns about conductivity are raised by any land disturbance which exposes previously unweathered rock to the elements even when no filling is proposed. For example, EPA has opposed draft Section 402 permits for mining ventures over issues concerning conductivity where the only discharges proposed were stormwater discharges from on-bench sediment control structures associated with a highwall mining operation. *See, e.g.*, Letter from Evelyn S. MacKnight, Chief, NPDES Permits Branch, EPA Region III, to Jeffrey Parsons, WVDEP (Oct. 28, 2010), Exhibit 7.

[69] Moreover, EPA cannot demonstrate that the decrease in abundance of certain species represents a loss of those organisms. As the Pond study on which EPA relies acknowledges, a decrease in abundance may simply reflect relocation to a preferable habitat. TED2 § 3.2.2.

species are everywhere, and every stream has a different EPT composition, then a shift in ubiquitous species for two creeks cannot be a significant adverse effect for macroinvertebrates within the region.

V. EPA Has Not Established That Golden Algae Growth Is Likely or Even Plausible

The Recommended Determination claims that the authorized fills:

> "are **likely** to **contribute to** in stream conditions **in or near** Spruce Fork that **may** support the growth of golden algae (*Pyrmnesium parvum*)."

RD at 60 (emphasis added). The numerous caveats in this claim indicate that even EPA does not take it very seriously. And with good reason.

EPA's concerns rest entirely on a bloom that occurred in 2009 in Dunkard Creek, West Virginia, approximately 225 miles from the Spruce No. 1 Mine.[70] In all the years of mining in West Virginia and Pennsylvania, the 2009 incident in Dunkard Creek remains the only documented bloom of this toxic algae associated with a pond and creek downstream from a mine site.

Importantly, Dunkard Creek differs markedly from the area around the Spruce No. 1 Mine in water chemistry and stream conditions. The 2009 algal bloom in Dunkard Creek was associated with a warm pond that fed into the creek during conditions of elevated chloride, sulfate, and conductivity. Dunkard Creek had a conductivity value of over 25,000 µS/cm in the area of the bloom. By contrast, the conductivity values at Spruce No. 1 Mine sites averaged 20 to 440 in 2008 and 2009, or *approximately 50 to 1,000 times less* than the conductivity value at Dunkard Creek during the bloom.

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[70] The operation associated with the Dunkard Creek incident is an underground mine, not a surface mine like the Spruce No. 1 Mine.

The Spruce No. 1 Mine sites are associated with much smaller intermittent headwater streams that are not comparable to the larger permanent Dunkard Creek. TED2 § 4.3.1. More importantly, Dunkard Creek is a chloride-dominated system, unlike the Spruce No. 1 Mine drainages. For example, recently collected water quality data from the outlet pond at the Left Fork of Beech Creek showed a chloride concentration of 15 mg/L, at least 1,000-fold less than in Dunkard Creek during the golden algae bloom, which saw chloride of up to 6,000 mg/L. TED2 § 4.3.1.

In short, EPA's suggestion that stream chemistry at the Spruce No. 1 Mine resembles that of Dunkard Creek misses the mark by a factor of a 100 to 1,000. There is simply no reason to expect the permitted fills to cause a golden algal bloom at the Spruce No. 1 Mine.

VI. EPA's Limited Discussion of Wildlife in the Recommended Determination Fails To Meet EPA's Burden

A. EPA Fails To Demonstrate an Unacceptable Adverse Effect on Salamanders

The Proposed Determination estimated that the permitted fills would potentially extirpate 20 million salamanders. *See* 75 Fed. Reg. 16,788, 16,799 (Apr. 2, 2010). The Recommended Determination reduces that estimated impact to salamanders by 99 percent. RD at 58-59 (estimating that 200,000 stream dwelling salamanders will be buried).

As with macroinvertebrates, EPA overstates its case. Salamanders of the type potentially impacted by the authorized fills *are ubiquitous*. As a result, similar impacts to salamanders would be expected at any surface mine in West Virginia, indeed at many similar projects throughout the United States, such as highway construction and other infrastructure changes. Such impacts are to be expected at *any* fill requiring a 404 permit in a known salamander habitat. As such, EPA's objection based on effects to common ubiquitous salamanders would again undermine the entire 404 program and effectively outlaw these types of permitted discharges.

This is directly contrary to Congress' intent in creating Section 404 of the CWA and authorizing these fills in SMCRA. *See OVEC*, 556 F.3d at 186, 190; Cmt. II.A.

EPA contends that stream salamanders are not expected to return to the Spruce No. 1 Mine site due to the burial of existing habitat and the inadequacy of proposed mitigation to replace the habitat required by these species. RD at 59. As detailed by CH2M HILL in the accompanying report, however, surveys of streamside salamanders conducted in valley fill and reference streams in southern West Virginia indicate that salamander populations are likely to persist in the downstream reaches of Pigeonroost Branch and Oldhouse Branch, with their diversity and abundance dependent in part on the availability of suitable rocky substrates. TED2 § 4.2. Although salamander abundance was greater in the reference streams, salamanders were still abundant in the valley fill streams, and species richness between the two groups was almost identical. *See* TED2 § 4.2.

B. EPA Has Not and Cannot Demonstrate Unacceptable Adverse Effects to Fish

EPA concedes that there are few if any fish in Pigeonroost Branch and Oldhouse Branch. RD at 31 ("only a few species").[71] The potential loss of these few fish, which do not even appear year round, cannot be significant.

EPA further acknowledges that "[t]he fish assemblages in Spruce Fork are in relatively good condition . . . [and] it appears that the fish within Spruce Fork are fairly tolerant of increases in conductivity and total dissolved solids." RD at 60. Thus, the fills in the Seng Camp

[71] EPA has not established the condition precedent that Pigeonroost, Oldhouse, or Spruce Fork contains a "fishery." Section 404(c) only authorizes EPA to withdraw a specification when it determines that there will be an unacceptable adverse effect on a "fishery." 33 U.S.C. § 1344(c). The provision does not mention individual species, meaning that Congress intended 404(c) to protect large-scale resources. It is unreasonable to conclude that Congress included "fishery" along with similar large-scale resources and also intended "fish" to be separately included in wildlife.

Creek subwatershed have not adversely affected fish downstream.[72] EPA presents no reason to expect that fills in Pigeonroost Branch and Oldhouse Branch will cause such an effect. EPA has not established that selenium concentrations in Spruce Fork could conceivably exceed the numeric criterion for selenium, nor cause any significant bioaccumulation or other adverse effect on fish.

C. EPA Fails To Demonstrate an Unacceptable Adverse Effect on Water Dependent Birds

After contending in the Proposed Determination that the authorized fills would have unacceptable adverse effects on six separate species of birds, EPA now only claims that one species may be impacted.[73] Yet, EPA fails to demonstrate that even the remaining species, the Louisiana waterthrush, will suffer any significant adverse impacts from the permitted fills.

The waterthrush is not a federally-listed threatened or endangered species. In fact, although the Louisiana waterthrush has been designated a bird of conservation concern ("BCC") by the U.S. Fish and Wildlife Service, no state-listed or federally-listed threatened or endangered bird species (or candidate species) have been identified in or near the project area and no impacts to any such species are expected.

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[72] The last sentence regarding effects of degraded water quality due to selenium on downstream fish populations is incomplete (sentence cuts off) and is in any event contradicted by EPA's admission that Spruce Fork has fish assemblages "in relatively good condition." RD at 60. Further, there is no evidence of impairment of fish or wildlife populations attributable to selenium discharges from Spruce No. 1 Mine and no reason to expect that there will be any such impairment as discussed above in the section of these comments regarding selenium.

[73] The basis for the Recommended Determination does not include any mention of other bird species, such as those EPA included in the Proposed Determination. This includes the Kentucky warbler, the Cerulean warbler, the Swainson's warbler, worm-eating warblers, and the wood thrush. This is undoubtedly because, as Mingo Logan pointed out, none of these species are considered water-dependent. Thus, the authorized fills into Pigeonroost Branch and Oldhouse Branch do not impact them. Needless to say, Mingo Logan will be prejudiced if EPA reverses course and relies upon these species in the future.

As Mingo Logan discussed in its initial comment, the waterthrush is not likely to be affected by the loss of riparian habitat associated with the Spruce No. 1 Mine. The bird prefers mature deciduous or mixed forests with moderate to sparse undergrowth near rapid-flowing streams with clear water (Cornell University, 2010b). The proposed project area contains young to middle-aged forests with relatively few mature trees. Without suitable habitat, the bird is less likely to nest or roost at the project site.

Also, changes in stream habitats are not likely to significantly affect potential foraging areas used by the waterthrush. The bird's diet is varied and is not composed solely of the more sensitive EPT that are common to headwater streams. TED2 § 4.4. As discussed at length above, EPA has not shown that there will be a decrease in macroinvertebrates or EPT. Recent studies suggest that the relative abundance of all macroinvertebrate taxa was more important than EPT species richness. TED2 § 4.4. Because EPA cannot show that the Louisiana waterthrush inhabits the Spruce No. 1 Mine area, or that its diet depends on the composition of macroinvertebrates, EPA cannot base its 404(c) determination on impacts to the Louisiana waterthrush.

VII. The Permit's Mitigation Requirements Meet All Applicable Legal Requirements, Have a High Likelihood of Successfully Offsetting the Authorized Impacts, and Will Assure That the Overall Impacts Authorized Under the Permit Will Not Have an Unacceptable Adverse Impact on Wildlife

Section V.C of the Recommended Determination alleges that there are "fundamental flaws with the proposed attempts to mitigate for unavoidable environmental impacts of the Spruce No. 1 mine," RD App. 3 at 1, and that the mitigation provided for in the Compensatory Mitigation Plan ("CMP") "is not likely to offset anticipated impacts." RD at 65. However, this permit's robust and comprehensive mitigation requirements are consistent with all applicable regulatory requirements, utilize all available and practicable methodologies for the assessment of

stream functions and mitigation success, provide for the determination of mitigation success based on the adoption of future functional assessment methodologies, and in the event of mitigation failure, require the applicant to undertake corrective action and/or additional mitigation sufficient to meet all performance standards, including the undertaking of stream restoration which has a documented history of success. As a result, the stream mitigation for this permit has a high likelihood of successfully offsetting the authorized impacts.

Before addressing the Recommended Determination's substantive flaws regarding mitigation, Mingo Logan must point out several serious procedural deficiencies. First, the Recommended Determination makes numerous statements that are unsupported by references or documentation, making it impossible for Mingo Logan to engage in meaningful comment on those claims.[74] In addition, the Recommended Determination makes many claims and includes

[74] For example, EPA asserts that "there are alternative configurations that would avoid much of the discharges to Pigeonroost Branch and Oldhouse Branch," RD at 65, but EPA does not provide any information about those alternatives. Mingo Logan cannot give a meaningful response to EPA's assertion because EPA does not explain these "alternative configurations" or how they avoid discharges to the two creeks. In addition, the following are unsupported statements included in the Recommended Determination and Appendix 3 for which a meaningful response cannot be made: (1) "Overall, through onsite visits and biological data collection, Region III conservatively estimates that, within the mine footprints of Right Fork Seng Camp, Pigeonroost, and Oldhouse Branch, over five miles of stream (~ 27,000 feet) are perennial." *Id.* at 67; (2) "Even when the sediment ditches are enhanced for benthic substrata and riparian vegetation, such as through adding boulder clusters every 500-1000 feet, resulting water quality will likely be so degraded that the ditches will not meet or exceed pre-mining water chemistry baselines." *Id.* at 69; (3) "As a result of this degraded water chemistry, these created waterbodies would be unlikely to support the healthy and diverse biological communities that they are intended to replace." *Id.*; (4) The post-mined environment creates "severely altered conditions in stream courses that are not destroyed by valley fills," including "[a]ltered hydrograph with new flow regimes that markedly depart from that under which the streams have evolved" and "[a]ltered timing, temperature and chemical composition of post-mine discharges of water to receiving streams." *Id.* at 70; (5) Some of the regulatory definitions of ephemeral, intermittent and perennial streams "are based on arbitrary watershed areas or flow cutoffs." RD App. 3 at 1; (6) "Most scientists agree that classifying streams by single abiotic or hydrological parameters for assessing aquatic life potential is unsatisfactory . . . ." *Id.*; (7) "[T]he water quality [in on-bench sediment ditches] (e.g., salinity) is so degraded that it could potentially foster the

many citations that were not included in its Proposed Determination[75] and a number of the citations used in the Recommended Determination are not included in the list of references in Appendix 5.[76] As such, Mingo Logan has been deprived of meaningful opportunity to comment on these claims and supporting citations.

Second, EPA fails to articulate a clear relationship between the Recommended Determination and Appendix 3: Mitigation Issues. Several of the claims made in the text of the Recommended Determination are neither supported in the text nor by evidence in Appendix 3.[77] Moreover, Appendix 3 adds several factual contentions that are not articulated in the text of the Recommended Determination as grounds for EPA's recommendation to revoke Mingo Logan's Section 404 permit.[78] Although these contentions do not and cannot form the basis for the

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establishment of toxic Golden Algae." *Id.* at 6; (8) "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." *Id.*; (9) "EPA has observed the following conditions in these sediment ditches, in comparison to natural high-gradient streams: 1) Altered flow regime (e.g. unnaturally low velocities), 2) Altered temperature regime (e.g., extreme high temperatures), 3) Severely contaminated water (e.g., ions, metals), 4) Depauperate and tolerant biota (e.g., typical of roadside ditches/urban swales)." *Id.* at 6-7.

[75] For example, in Appendix 3, EPA claims that there is no evidence that the 71 acres of riparian forest to be restored or created by Mingo Logan will replace lost natural riparian ecosystems. RD App. 3 at 10. Also, EPA contends that the connectivity channels provided for in the Spruce No. 1 Mine permit will not offset buried stream resources. App. 3 at 11.

[76] For instance, "Fritz (2007)" is cited to on page 3 of Appendix 3, but the Appendix 5 list of references only includes "Fritz (2006)." In addition, EPA cites to "(EPA-Wheeling 2007)" in the text of Appendix 3, RD App. 3 at 3, but the Appendix 5 list of references does not include a citation to "(EPA-Wheeling 2007)."

[77] For example, EPA states that "[d]ata show that water quality in these types of sediment ditches in the MTM region is typically highly degraded as a result of water in these ditches percolating through mine spoil," but does not provide any support in the text or in Appendix 3 for this statement or explain which data EPA is referring to. RD at 69.

[78] For instance, in Appendix 3, EPA contends that the enhancement and restoration provided for in the Spruce permit are inadequate to replace the functions at the impacted creeks. RD App. 3 at 9-10. In addition, in Appendix 3, EPA also claims that the riparian forest to be restored or created by Mingo Logan will not replace lost natural riparian ecosystems. *Id.* at 10.

Recommended Determination, for the sake of completeness, Mingo Logan briefly addresses these contentions.

Importantly, EPA does not dispute Mingo Logan's comments in response to the Proposed Determination, that the mitigation required in the 404 permit comports with all applicable legal requirements for compensatory mitigation. Of the regulatory materials for wetland and stream mitigation that were available during the lengthy permitting process,[79] RGL 02-2 was the most detailed and recent explanation of compensatory mitigation requirements and the only one that dealt explicitly with stream mitigation. *See OVEC*, 556 F.3d at 203-04 (relying on RGL 02-2 as the basis for determining the amount of stream compensation). In the absence of standard functional assessment methods for the stream impacts and mitigation during the permitting process,[80] and consistent with RGL 02-2, the mitigation requirements of Mingo Logan's permit

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Also, in the Appendix, EPA contends that the connectivity channels provided for in the Spruce No. 1 Mine permit will not offset buried stream resources. *Id.* at 11. None of these claims are made in the Recommended Determination.

[79] During the permit process, the applicable regulatory requirements for wetland and stream mitigation included the Corps regulations at 33 C.F.R. §§ 320.4(r), 325.4(a) (2007); the 404(b)(1) Guidelines at 40 C.F.R. §§ 230.10(d), 230.70-.77 (2007); the Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines (Feb. 6, 1990), *available at* http://www.epa.gov/Wetlands/regs/mitigate.html ("Mitigation MOA"); and U.S. Army Corps of Engineers Regulatory Guidance Letter 02-2 entitled "Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899" (Dec. 24, 2002), *available at* http://www.usace.army.mil/cecw/pages/rglsindx.aspx ("RGL 02-2").

[80] Since the issuance of this permit, the Interagency Review Team, including the Huntington District, has recently issued the West Virginia Stream and Wetland Valuation Metric (May 13, 2010), *available at* http://www.lrh.usace.army.mil/_kd/go.cfm?destination=Page&Pge_ID=1072 ("SWVM") to be utilized in determining the mitigation credits to be awarded to stream mitigation banks, in-lieu fee programs, and permittee responsible mitigation in West Virginia. Corps Huntington Dist., "Guidance on the West Virginia Interagency Review Team Initiatives Administered in Accordance with the 2008 Final Rule on Compensatory Mitigation for Losses of Aquatic Resources Within the U.S. Army Corps of Engineers, Huntington and Pittsburgh Districts" at 1, 6 (Feb. 1, 2010), *available at*

are based on a linear footage, rather than a functional, basis. Department of the Army Individual Clean Water Act Section 404 Permit Record of Decision for Mingo Logan Coal Company, Spruce Fork No. 1 Mine, File Number 199800436-3 at 33 (Jan. 2007) ("ROD"), Cmt. Ex. 29. Thus, the only compensatory mitigation measure that was required during the permitting process was stream replacement on a one-to-one linear foot basis. *OVEC*, 556 F.3d at 204.[81] The required mitigation for this permit exceeds a 2:1 linear foot ratio and far surpasses the applicable 1:1 ratio for the permitted stream impacts.

EPA nowhere attempts to demonstrate that the permit's required mitigation falls short of these applicable regulatory requirements. Rather, EPA seeks to overturn a mitigation program that fully complies with all applicable standards by simply casting doubt on its likelihood of success. In this process, EPA effectively seeks to override the standards for mitigation applied by the Corps to this permit, defended by the United States in litigation, and affirmed by the Fourth Circuit in *OVEC*, 566 F.3d 177 (4th Cir. 2009).[82] Section 404(c) simply does not confer such authority on EPA.

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http://www.lrh.usace.army.mil/Documents/index.cfm?id=17046&pge_prg_id=11693&pge_id=1072 ("Interagency Guidance on Compensatory Mitigation Rule"); Instruction Document, The West Virginia Stream and Wetland Valuation Metric (Mar. 2, 2010), *available at* http://www.lrh.usace.army.mil/Documents/index.cfm?id=17408&pge_prg_id=11693m&pge_id=1072 ("SWVM Instruction Document").

[81] More than one year after the Corps issued the permit, EPA and the Corps promulgated new mitigation regulations, but, consistent with the Administrative Procedure Act, these subsequent mitigation requirements do not apply to previously issued permits. 73 Fed. Reg. 19,594, 19,608 (Apr. 10, 2008); *see also OVEC*, 556 F.3d at 198 n.14. In any event, as discussed in previous comments, Mingo Logan's permit is consistent with the applicable standard of the agencies' new mitigation regulations because it provides for stream replacement on a one-to-one linear foot basis.

[82] On July 30, 2010, the Army and EPA issued guidance entitled "Assessment of Stream Ecosystem Structure and Function under Clean Water Act Section 404 Associated with Review of Permits for Appalachian Surface Coal Mining," *available at* http://www.epa.gov/owow/wetlands/guidance/pdf/Stream_Guidance_final_073010.pdf ("Stream

Finally, EPA's mitigation discussion focuses solely on the CMP and ignores the permit's numerous and detailed requirements for stream mitigation, which assure that adequate mitigation will occur for the authorized impacts. Specifically, the Corps has imposed a series of mitigation requirements for this permit that: (1) substantially exceed the 1:1 linear foot ratio established in applicable regulatory provisions; (2) establish a robust monitoring program that evaluates the effectiveness of mitigation on physical, chemical, and biological parameters in the mitigated streams; (3) set detailed minimum performance standards that, among other measures, utilize several EPA-developed assessment methods; (4) provide for adjustment of the performance standards to accommodate a new functional assessment method for headwater streams that may be developed or approved by EPA in the future; and (5) direct that corrective and remedial action and/or additional mitigation must be performed if the performance standards are not satisfied, including the undertaking of stream restoration. Most of EPA's arguments reflect EPA's new view that some or all of the required mitigation will fail, but these arguments ignore the permit's comprehensive mitigation requirements that not only establish performance conditions, but require remedial action in the event of failure.

A. The Stream Creation Complies with Applicable Regulations, and EPA Does Not Meet its Burden to Demonstrate That the Mitigation Plan Will Be Unsuccessful

EPA asserts that "[t]here is no evidence in the peer-reviewed literature that the type of stream creation included in the CMP will successfully replace lost biological function and comparable stream chemistry to high quality stream resources, such as the Pigeonroost Branch and Oldhouse Branch." RD at 66. However, this assertion is inconsistent with EPA's recent approval of Section 404 permits for three other sites that use onsite stream creation: Hobet 45,

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Guidance"), but this guidance only applies to "future determinations" on section 404 permit applications. Stream Guidance at 3.

Peg Fork and Pine Creek No. 1. As shown in Exhibit 8, the mitigation plans approved by EPA at each of these sites provide for significant amounts of stream creation. On a linear foot basis, stream creation accounts for approximately the same amount of mitigation for Peg Fork as restoration and enhancement, approximately double the amount of the mitigation for Hobet 45, and more than five times the amount for Pine Creek. In addition, Pine Creek's mitigation plan provides for the creation of 12 intermittent segments and four ephemeral segments of erosion control channels as well as 12 intermittent and four ephemeral connectivity channels—the very forms of stream creation whose efficacy EPA disputes for the Spruce No. 1 Mine permit. In light of the significant amount of stream creation that EPA has approved for these recently permitted sites, it is inconsistent for EPA to maintain that the efficacy of all stream creation included in the Spruce Fork permit has not been demonstrated and is certain to fail. Indeed, EPA bears the burden of establishing that the stream creation required by the permit will not succeed. A few studies conducted at unrelated sites showing that stream creation is difficult do not meet this burden, especially when EPA has recently approved of the use of stream creation in several comparable instances.

In any event, Mingo Logan disagrees with EPA's extreme pessimism about the likelihood of success of the stream creation required by this particular permit.[83] As discussed below, based on prior experience and improvements in mitigation techniques, the stream creation component of its overall mitigation plan will likely succeed.[84]

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[83] As explained in substantial detail in Mingo Logan's previous comments, the mitigation required under this permit consists of stream restoration and enhancements as well as stream creation. The Recommended Determination, in its articulated basis for its proposed 404(c) finding, ignores the restoration and enhancement component of the required mitigation altogether.

[84] *See* Sections VII.D. and H. on erosion control channels and connectivity channels, *infra*.

As explained previously, the mitigation provided for in this permit is entirely consistent with all of the applicable compensatory mitigation requirements.[85] As discussed in previous comments, at the time of permit issuance, all of the applicable regulatory provisions authorized stream creation as an acceptable form of mitigation, and none of them prohibited stream creation.[86] In fact, in virtually identical circumstances to those applicable to this permit, the Fourth Circuit in *OVEC* ruled that creation is an acceptable form of mitigation for headwater streams in Appalachia. *OVEC*, 556 F.3d at 205.

Finally, as explained at great length in Mingo Logan's comments to the Proposed Determination, this permit is replete with conditions which assure that, even if EPA's dire predictions about the failure of the permit's stream creation techniques come to pass, adequate compensatory mitigation will be attained at this site. Recognizing the uncertainty concerning the success of stream mitigation, the Special Conditions establish a robust monitoring program over a minimum of 10 years to evaluate whether the mitigation is satisfying detailed performance standards. If those standards are not met, the Special Conditions require performance of corrective actions, adaptive management, and remedial measures on the mitigated stream segments or at new mitigation sites. Thus, if the stream creation or other mitigation measures fail, as hypothesized by EPA, the Special Conditions clearly require that

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[85] However, in the Recommended Determination, EPA uses language from the new mitigation regulations promulgated by the Corps and EPA over one year after this permit was issued to evaluate the "likely efficacy of the compensatory mitigation proposed for the Spruce No. 1 Mine." RD at 66-67 n.19. EPA's quotation is a thinly veiled attempt to impose standards from the new mitigation regulations on a previously issued permit—an unlawful retroactive application of regulations.

[86] For example, the 404(b)(1) Guidelines provide for "habitat development . . . to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics." 40 C.F.R. § 230.75(d) (2007). Similarly, both the Mitigation MOA and RGL 02-2 describe creation or establishment of new aquatic resources as a permissible form of mitigation. Mitigation MOA, Section II.C.3; RGL 02-2, Section 2.e.1.

Mingo Logan must either revise the existing mitigation plan to meet the success criteria or provide additional mitigation. Special Conditions 18, 19. *See* Cmt. Ex. 1. Such additional mitigation would likely include stream restoration, which the EPA recognizes has a documented history of success. 73 Fed. Reg. at 19,597; TED2 § 5.1.

B. The Current Stream Classification Complies with Applicable Legal Standards and Is Not a Relevant Basis for Judging the Adequacy of Mitigation Required by the Permit

EPA claims that the CMP is based upon a misclassification of impacts to perennial and intermittent streams[87] and that this alleged misclassification "has a critical impact upon the type of mitigation that would be required to offset these impacts." RD at 67. Moreover, EPA believes that "new field studies, using more up-to-date assessment tools, would provide a more accurate representation of the proposed impacts to water resources." RD App. 3 at 1. Mingo Logan has already addressed this issue in its comments on EPA's Proposed Determination. Although EPA asserts that "[d]efinitions of ephemeral, intermittent and perennial streams vary widely among regulatory agencies," *id.*, it does not dispute the applicable regulatory definitions

[87] EPA relies on the 2003 Paybins paper as the basis for its determination that the mitigation provided for in this permit is based on a misclassification of stream resources, contending that the Paybins paper advocates the use of drainage area as the sole basis for determining perennial and intermittent streams. RD App. 3 at 3-5. However, the Paybins study used by EPA does not support EPA's contention. The study was conducted over a limited time period and with some inherent error given the data collection and analysis techniques. TED2 § 5.2. The Paybins study does shed light on the inherent variability of first-order watersheds, but does not justify a definition of perennial or intermittent streams based exclusively on the drainage area acreages utilized by EPA. *Id.* In fact, the author acknowledges "the local conditions for small headwater basins are extremely variable, and relations of these conditions to intermittent and perennial points could not be defined within this limited study." K.S. Paybins, *Flow Origin, Drainage Area, and Hydrologic Characteristics for Headwater Streams in the Mountaintop Coal-Mining Region of Southern West Virginia, 2000-01* at 18, Water Resources Investigation Rpt. 02-4300, U.S. Geological Survey, Charleston, WV (2003), *available at* http://pubs.usgs.gov/wri/wri02-4300/pdf/wri02-4300.book.pdf. Thus, Paybins is a limited study which does not support a redefinition of stream classifications based exclusively on drainage area acreage.

that the Corps used for this permit. The definitions of ephemeral, intermittent, and perennial streams that the Corps used for this permit are currently the only regulatory definitions within the Section 404 program.[88]

Although EPA obliquely critiques the definitions with its assertion that "the presence or absence of continuous surface water alone is not a good predictor of aquatic life potential." RD App. 3 at 1, EPA, does not cite to a regulatory definition which supports either of its asserted grounds for defining perennial and intermittent streams.[89] If EPA disagrees with the existing definitions, it should ask the Corps, the Office of Surface Mining Reclamation & Enforcement ("OSM"), or WVDEP to amend them and apply the amended definitions prospectively. EPA may not, however, impose a new classification scheme retroactively.

During the lengthy permit process, EPA had ample opportunity to object under 404(q) or 404(c) and raise any genuine issue of misclassification prior to the permit issuance. The streams at issue have not changed since that time. And, as is evidenced by EPA's reliance on the 2003 Paybins study, EPA's argument for misclassification is primarily based on information that was available prior to permit issuance.[90] EPA cannot lawfully revisit these issues three years after the permit has been issued.

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[88] The definitions of ephemeral, intermittent, and perennial streams are contained in the Corps nationwide general permit regulations. 72 Fed. Reg. 11,092, 11,196-97 (Mar. 12, 2007).

[89] In addition, EPA has proposed two different and conflicting grounds for classifying streams as perennial rather than using consistent criteria for stream classification. For the Oldhouse Branch, EPA appears to be using a drainage area acreage criterion purportedly based on the Paybins study. RD App. 3 at 2-3. However, for the middle branch of Pigeonroost where the drainage acreage falls below the average threshold espoused by EPA, EPA uses some unarticulated biological criteria. *Id.* at 5. EPA's use of these biological criteria call into question the validity or applicability of the drainage area acreage criterion. In fact, these competing criteria justify the continued use of the existing regulatory definitions of ephemeral, intermittent, and perennial streams until more consistent and definitive results can be obtained.

[90] EPA also cites to on-the-ground field observations in the Spruce No. 1 Mine project area from 1999. RD App. 3 at 3 (citing Green and Passmore, 1999).

Even assuming that EPA could lawfully apply retroactively some new and unarticulated stream classification, at base the classification of the streams is irrelevant to the mitigation required for this particular permit. As described above, applicable regulatory provisions require that "mitigation projects for streams should generally replace linear feet of stream on a one-to-one basis." RGL 02-2, Section 2.d.5. This regulation does not specify that the replacement linear feet of stream should be any specific kind of stream. Nor does the RGL establish a requirement for in-kind replacement for streams. RGL 02-2, Section 2.h. In fact, as the Fourth Circuit ruled when construing the 1:1 linear standard, "[n]othing in the Corps' CWA guidance requires that only in-kind . . . mitigation measures be used." *OVEC*, 553 F.3d at 204.

Furthermore, EPA misunderstands the import of classifying streams and ignores the protective requirements of the permit.[91] Regardless of the applicable regulatory requirements, the Corps has included in this permit numerous performance measures that assess the aquatic life

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[91] EPA further claims that because of the alleged misclassification of streams, "any calculations of debits and credits, and subsequent offsets using the Stream Habitat Unit method ("SHU"), or any other known method or compensation ratio, would be misleading and not fully compensatory for the destroyed natural resources." RD App. 3 at 5. However, there are several fundamental misunderstandings with this statement. First, the SHU is not the basis for establishing compensatory mitigation requirements. As explained in previous comments, the SHU methodology was used in the EIS as one means to gather and assess baseline data on the impacted streams, but it was not used by the Corps to determine the appropriate amount of mitigation. Instead, based on the applicable provisions of RGL 02-2, the Corps based the mitigation on achieving at least a 1:1 ratio between the linear feet of impacted and mitigated streams. Moreover, as discussed more fully in a later section, the permit's performance measures were based on tests which directly or indirectly reflect the chemical and biological condition of the stream including EPA's *A Stream Index for West Virginia Wadeable Streams* (Mar. 28, 2000, revised July 21, 2000), *available at* http://www.dep.wv.gov/WWE/watershed/bio_fish/Documents/WVSCI.pdf ("WVSCI"), and the EPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (2d ed. 1999), *available at* http://water.epa.gov/scitech/monitoring/rsl/bioassessment/index.cfm ("RBP"). The Corps was clear that its permit conditions, not stream classification, are the basis for mitigation performance.

potential in mitigation streams. These performance standards ensure that the mitigation will offset the full range of adverse impacts related to the project, and that if the mitigation is inadequate, corrective actions, adaptive management, remedial measures and/or additional mitigation will be taken on the mitigated stream segments or at new mitigation sites to attain compensatory mitigation. Thus, regardless of the appropriate classification for each of these streams, the permit assures that the lost aquatic life potential and other physical, chemical, and biological functions of the impacted streams will be offset by mitigation that provides comparable aquatic life potential and comparable functions.

Equally telling, even if EPA's new approaches were utilized and stream classification were relevant to the adequacy of mitigation, the result would be the same, i.e., the classification of the mitigation imposed by the permit would fully offset the impacts to Pigeonroost and Oldhouse. As evidenced by the figure in the permit depicting the location of the various forms of mitigation, many of the created streams will be established in the areas close to Oldhouse and Pigeonroost and will likely have drainage areas whose acreages exceed the threshold for perennial streams espoused by EPA. The linear feet of these created streams exceed the linear feet impacted within Oldhouse and Pigeonroost. Thus, under the drainage area acreage-based classification, the mitigation streams are likely to have the same classification as the impacted streams.

C. EPA's Claim That the Permit Does Not Adequately Replace Functional Components of Lost Streams Is Unfounded

EPA claims that the CMP is "based upon an inadequate functional assessment of the impacted resources" and that as a result, the "current CMP does not adequately account for or replace the functional components of the lost streams." RD at 68. In this argument, EPA focuses exclusively on the CMP and the SHU assessment methodology, but as explained in

Mingo Logan's prior comments, the adequacy of mitigation must be based on the entirety of the permit and its conditions, which assure full compensatory mitigation. Furthermore, as discussed in prior comments, EPA misunderstands the role of SHU in this permit process. The Corps did not use the SHU methodology to determine the appropriate amount of mitigation. Rather, the Corps determined the amount of mitigation required based on the requirement to achieve at least a 1:1 ratio between the linear feet of impacted and mitigated streams. Moreover, the SHU methodology was not the determining factor used by the Corps to establish the various mitigation performance and success criteria.

Contrary to EPA's repeated assertions, full replication of all physical, chemical, and biological functions of impacted streams was not the standard for full compensatory mitigation at the time and in the circumstances presented by this permit. Instead, the 1:1 linear foot standard applied at the time of permit issuance under RGL 02-2 and *OVEC*, and remains so even under the subsequently developed mitigation rule. It is undisputed that there was no functional assessment method available prior to the issuance of the Corps permit for the Spruce No. 1 Mine. Instead, the Corps relied on the available and frequently used stream assessment methodologies developed by EPA: the WVSCI and the RBP. As indicated by the RBP, WVSCI, and the *OVEC* court, the RBP and WVSCI operate, at a minimum, as surrogates for assessing physical, chemical, and biological functions of streams. *See* Cmt. at 133-34. With its argument that the mitigation is based on an inadequate functional assessment, EPA is essentially arguing that EPA's own methodologies are inadequate[92] but nowhere in the Proposed Determination,

[92] EPA's attack on the WVSCI is not only contrary to the applicable regulatory requirements, it is also inconsistent with current practices and other provisions of the Recommended Determination. For example, EPA's repudiation of the WVSCI is inconsistent with EPA's approval of the SWVM and with several, individual stream mitigation banks, which use the WVSCI as a basis for determining mitigation credits. SWVM Instruction Document at 2;

Recommended Determination, or the voluminous permit record does EPA present a functional assessment methodology for streams that improves upon these existing methodologies and meets its exacting, theoretical requirements. However, by establishing a performance standard keyed to these EPA methodologies, the Corps has assured that the mitigation will achieve full functional replacement of physical, chemical, and biological functions within the practical limits of assessment methodology in existence during the permit process.

Beyond the numerous existing performance standards, the permit issued to the Spruce No. 1 Mine contains additional and extraordinary assurance of the use of functional assessment in determining mitigation success. As explained in prior comments, the permit contemplates the potential future development of functional assessment protocols for headwater streams in West Virginia and provides that "[u]pon finalizing these stream assessment protocols, the permittee

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TED2 § 5.1. EPA does not explain how the WVSCI can serve as one of the bases for determining mitigation under SWVM and for certain stream mitigation banks but is inadequate as one of the measures for assessing stream mitigation performance for the Spruce No. 1 permit. Moreover, EPA does not explain how the WVSCI is used in an attempt to validate its preferred method for measuring the quality of Oldhouse and Pigeonroost Creeks but is a completely inadequate method for measuring the performance of mitigation streams. RD at 24, 57-58.

Another of the permit's several performance measures is the RBP. In the Recommended Determination, EPA repudiates the validity of EPA's own RBP protocol—a protocol whose use was upheld by *OVEC*—and argues that the Fritz study has shown that the RBP habitat assessment does not account for the total ecological "currency" at the site. RD at 68. Again, this repudiation of the RBP for the Spruce No. 1 Mine is inconsistent with EPA's approval of the SWVM and of several, individual stream mitigation banks, which use the RBP as a basis for determining mitigation credits. SWVM Instruction Document at 2; TED2 § 5.1. Moreover, this repudiation of the RBP by EPA has not been reflected in authoritative headquarters action, such as the official withdrawal of the RBP. Finally, EPA's repudiation of this longstanding methodology cannot be justified by a single study. The Fritz study is quite limited and it does not develop a scientifically-based and practical functional assessment methodology to replace the RBP and other existing assessment methods. The Fritz paper focuses narrowly on a single metric which can be influenced by factors which do not have a strong relationship to a biologically healthy, functioning stream. The Fritz leaf breakdown metric is not the functional assessment methodology EPA is seeking and its narrow, single metric focus is not nearly as indicative of stream functions as the RBP, the multi-factor WVSCI, or the suite of other performance standards imposed on this permit. TED2 § 5.5.

shall use these tools to assess the success of the proposed mitigation sites." Special Condition 22. *See* Cmt. Ex. 1. Thus, if the Corps and EPA agree on a new functional assessment methodology for streams, it will be used to measure the success of the mitigation required under the permit.

D. EPA Does Not Demonstrate That Mitigation in Erosion Control Channels Will Not Succeed

EPA further argues that the proposed conversion of erosion control channels "is unlikely to successfully replace the impacted resources." RD at 69. EPA fails to provide citations to support some of the key points to this argument.[93] Moreover, much of the data that EPA uses to support this claim was known prior to permit issuance and was not the basis of an EPA objection. *E.g.*, RD App. 3 at 6 (citing Kirk (1999); Green (2000)). EPA had ample opportunity during the lengthy permit process to raise any genuine issue about the conversion of erosion control channels prior to the permit issuance but did not do so.

EPA wrongly contends that the use of erosion control channels will not compensate for the loss of high quality stream resources. RD App. 3 at 6. As explained in prior comments, EPA's pessimism on stream creation is unfounded and conflicts with the applicable regulatory requirements. But the short answer is that the Corps designed specific performance measures that will assure replacement of the stream's functions. And, if the degradation that EPA hypothesizes does occur, Mingo Logan will have to perform corrective action, adaptive

[93] For example, EPA states that "[d]ata show that water quality in these types of sediment ditches in the MTM region is typically highly degraded as a result of water in these ditches percolating through mine spoil," but does not provide any citation or explain which data EPA is referring to. RD at 69. In addition, EPA states that "the water quality (e.g., salinity) is so degraded that it could potentially foster the establishment of toxic Golden Algae," without any citation or data to support that statement. RD App. 3 at 6. Because EPA does not cite or identify the studies that provided the basis for these statements, it is not possible to meaningfully evaluate or comment on these claims.

management, remedial measures, and/or additional or alternative mitigation sufficient to provide full compensation.

With respect to the success of erosion control channels as mitigation, one of the key studies upon which EPA relies contradicts EPA's conclusions. The Kirk study concludes: "'If constructed properly, these sediment control ponds and sediment ditches can do a splendid job in removing solids and other water contaminants both by filtration and by precipitation prior to reaching downstream areas.'" TED2 § 5.3. Moreover, beyond contribution to improved quality, the Kirk study also finds that the erosion control channels "'provide aquatic habitats for countless abundances of aquatic insects, amphibians, reptiles, and potentially even fish.'" *Id.*

In fact, a quick review of active erosion control channels prior to mitigation supports the findings of the Kirk study. Exhibit 9 contains a photograph that depicts an active erosion control channel at the Aracoma Coal mining site, which is lined with trees on one side of the channel and herbaceous vegetation on the other. Similarly, at the nearby Dal-Tex property, there are erosion control channels with comparable configurations, lined with trees on one side and herbaceous vegetation on the other side, including wetlands vegetation. Like the channel at Aracoma in Exhibit 9 and the channels at Dal-Tex, the erosion control channels at Spruce No. 1 Mine will be lined with trees and herbaceous vegetation during their active phase. Once mitigation is undertaken, the channel bottoms, banks, and course will be modified as required by the mitigation plan to provide a bottom which is 85 percent free of sediment, bank protection measures, riffle/pool complexes, aquatic habitat structures, and meanders, and the current herbaceous vegetation on one side of the channel will be replaced with native trees and shrubs, leaving a mitigated stream channel with native trees and shrubs along both banks. Special Conditions 8, 9, 10, 11, 19, and 20. *See* Cmt. Ex. 1. As explained in TED2, such in-stream and

riparian habitat correlates strongly to a healthy, functioning stream. TED2 § 5.3. In addition, as explained in a recently issued Regional Guidebook, riparian tree and herbaceous vegetation contribute to biochemical processing and habitat functions. United States Army Corps of Engineers Engineer Research and Development Center, *Operational Draft Regional Guidebook for the Functional Assessment of High-gradient Ephemeral and Intermittent Headwater Streams in Western West Virginia and Eastern Kentucky* (July 2010) ("Regional Guidebook"), *available at* http://www.lrh.usace.army.mil/_kd/go.cfm?destination=ShowItem&Item_ID=19397. Thus, as evidenced by these examples, Mingo Logan has a sound empirical basis for its expectation that the mitigation in and near erosion control channels at Spruce No. 1 Mine will result in a healthy, functioning stream.

In support of its pessimism, EPA cites studies performed by Kirk in 1999 and Green in 2000 and a masters thesis by Gingerich in 2009. Both the Kirk and Green studies were available during the permit proceeding and did not form the basis of an objection by EPA. The Gingerich thesis is not even publicly available today. But in any event, Kirk, Green and Gingerich do not support EPA's conclusion that all created water bodies in mined areas will exceed water quality standards. The Green study evaluated a single erosion channel under conditions that are not representative of the mitigation requirements applicable to the Spruce No. 1 Mine. TED2 § 5.3. The Kirk study and the Gingerich thesis actually support the view that erosion control ditches can provide effective water quality and habitat functions and result in taxa abundance and diversity that support a balanced aquatic community. *Id.* As explained above, the Kirk study finds that erosion control channels perform an excellent job at removing water contaminants and provide aquatic habitats with abundant insects, amphibians, reptiles, and potentially even fish. The Gingerich thesis notes that there can be a macroinvertebrate and amphibian species shift in

erosion control channels, but the abundance and richness of these species remains similar between erosion control channels and reference cites—a condition that supports a balanced aquatic community. *Id.*

Moreover, the examples given by EPA as the basis for its concerns about erosion control channels do not predict conditions at the Spruce No. 1 Mine. RD App. 3 at 6-8. For example, the mean conductivity for the Gingerich data is over 2000 μS/cm and the mean conductivity for the Green data is 2200 μS/cm, both of which are almost triple the worst case average projected by EPA in its conductivity analysis for the Spruce No. 1 site. RD at 51. EPA's examples are inapposite to the stream mitigation required by the Spruce permit because the WVSCI scores are so low at EPA's example sites that, were they to occur at the Spruce No. 1 site, the mitigation would fail the stringent performance criteria and remedial action or alternative mitigation would be required. Thus, the data cited by EPA is neither relevant to the wetland stream creation proposed for Spruce No.1 Mine nor to the permit conditions applicable to Mingo Logan's entire mitigation program.

Finally, EPA contends that erosion control channels "should be considered sources of pollution rather than a mitigation feature" because "[d]ata show that water quality in sediment ditches in previously mined areas is highly degraded." RD App. 3 at 6. However, aside from the fact that EPA's examples are inapposite, EPA has failed to account for the legal requirements applicable to these erosion control channels. Under the Spruce No. 1 Mine permit issued by WVDEP, these erosion control channels cannot be utilized as mitigation structures until they are released from SMCRA regulation. Under Mingo Logan's SMCRA permit, before the channels are released, they must meet all applicable Section 402 effluent limitations without treatment. Thus, contrary to EPA's assertion, the water quality in the erosion control channels will not be

highly degraded because the channels must comply with EPA's own effluent limitations before they will be used as mitigation features.

E. Ecological Services of Headwaters Streams and Upland Watersheds Will Be Restored by the Mitigation Required Under the Permit

The Recommended Determination claims that "[t]he CMP does not account for the loss of ecological services of headwater streams" and that any "[a]ssumptions that much of the structure and function of the pre-mined conditions can be recaptured with mitigation are very optimistic and highly speculative." RD at 69-70. EPA could have raised this claim during the lengthy permit proceeding or in a 404(q) elevation or 404(c) veto prior to the permit issuance, but did not. EPA asserts that the areas upstream of mitigation sites will have been altered to such a degree that mitigation streams will not perform the same biological functions as impacted streams. RD at 70. But this concern is itself speculative and ignores not only the multi-faceted mitigation program imposed on MIngo Logan, which includes stream enhancement, restoration, and creation but also the robust monitoring program contained in the Special Conditions to assess the success of this multi-faceted program at each of the proposed mitigation sites. If the mitigation streams do not perform the functions as assessed by performance criteria, then permit conditions require corrective action, adaptive management, remedial measures and/or additional mitigation to provide assurance of adequate mitigation.

To the extent that EPA contends that there is inadequate mitigation for the loss of upland areas, this concern is outside the scope of the CWA. According to the Congressional scheme, this loss of upland areas due to surface mining is addressed under SMCRA. And, with respect to Spruce No. 1 Mine, the WVDEP has imposed numerous mitigation requirements in the SMCRA permit to compensate for the temporary impacts to upland areas. Moreover, EPA's concern is unfounded, because in order to comply with SMCRA, Mingo Logan must implement a

comprehensive reforestation plan for the upland mined areas at the Spruce site. As such, in post-mining conditions, those areas upgradient of mitigation streams will be vegetated and ultimately forested.

F. EPA's Contention That Stream Restoration and Enhancement Required by the Permit Will Be Unsuccessful Is Unfounded

In the Appendix but not the Recommended Determination, EPA contends that the enhancement and restoration provided for in the Spruce No. 1 Mine permit are inadequate to replace the functions lost at the impacted creeks. RD App. 3 at 9. Much of EPA's claim is based on information that was known prior to the permit's issuance, such as the type of enhancement and restoration techniques to be used in Spruce Fork and Rockhouse Creek. Moreover, EPA's claims that enhancement and restoration are scientifically unfounded, *id.*, are completely belied by the applicable regulatory requirements for stream compensation, which authorize enhancement and restoration as acceptable forms of stream mitigation. For example, RGL 02-2 lists both enhancement and restoration as methods for compensatory mitigation. RGL 02-2, Section 2.h.

As noted in previous comments, EPA has also recognized that stream restoration has a documented history of success.[94] And as explained in the attached report, there is a strong body of evidence indicating the success of stream restoration.[95] TED2 § 5.1. For example, at a site in

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[94] For example, in the new Corps and EPA compensatory mitigation regulations, the agencies note that "[t]here is a growing body of research that documents successful outcomes for stream restoration projects . . . " and that "[s]uccessful outcomes for stream restoration with respect to water quality, habitat creation, species recovery and recreation, have been documented by Baron and others; (2002); Buijse and others (2002); Muotka and Pekka (2002); Nakamura and Kunihiko (2006); and Petersen (1999)." 73 Fed. Reg. at 19596-97.

[95] The success of stream restoration is underscored by several of the completed projects identified by the Canaan Valley Institute at http://www.canaanvi.org/canaanvi_web/streamrestoration.aspx?collection=highlighted_projects&id=599.

Clayton County, Georgia, approximately 4,000 feet of East Jester's Creek was restored between 2003 and 2004 using the Rosgen's natural channel design techniques. Prior to this date, the diversity of the benthic macroinvertebrates was depressed with about 19 species in one study area and 22 species in another study area with an EPT index of about 2. In 2007, after restoration, the macroinvertebrate community showed a marked improvement, with 33 species in one study area and 36 species in another section of East Jester's Creek. The corresponding EPT indices had risen to 9 in one section and 8 in another part of the creek. This reflects a substantial improvement of the habitat and the benthic community. *Id.* Moreover, there are a number of examples of stream mitigation banks that have been approved by EPA and other permitting agencies based on the use of stream restoration and enhancement designs. *Id.* As shown by each of these examples from West Virginia and throughout the country, EPA's pessimism about the efficacy of restoration and enhancement for offsite streams is unfounded. EPA's complaints about the lack of a functional assessment methodology are belied by these mitigation banks, which have been approved by Interagency Review Teams including EPA, because the methods utilized at these approved stream banks to determine credits and assess success (e.g., RBP, WVSCI, Rosgen methods) are among the many performance standards imposed on this permit. Based on this extensive experience on stream restoration and enhancement, Mingo Logan is optimistic that the stream enhancement and restoration required by this permit will succeed.[96] In

[96] Although EPA expresses concern with the restoration activities in Rockhouse Fork due to the presence of several pollutants and conductivity, the restoration in Rockhouse Fork will be effective and provide lift. As explained in TED2, habitat is an important determinant of functioning streams, and Rockhouse Creek and others of similar state, once stabilized, will provide the hydrology necessary to allow current engineering and environmental planning technologies to be applied for the restoration of habitat and functional, biologically diverse streams. TED2 § 5.4. Like the restored streams identified in these numerous reports, which had previously experienced low quality due to inadequate flow, degraded habitat, or chemical

any event, if EPA's dire predictions are correct and the stream restoration and enhancement required by the permit are unsuccessful, the permit conditions require corrective action, adaptive management, remedial measures and/or additional or alternative mitigation to assure adequate compensatory mitigation.

G. The Permit Provides for Adequate Riparian Planting of Native Vegetation

In the Appendix but not the Recommended Determination, EPA claims that there is no evidence that the 71 acres of riparian forest to be restored or created by Mingo Logan will replace lost natural riparian ecosystems. RD App. 3 at 10. This is an entirely new claim neither made during permit issuance, in the Proposed Determination, or in the Recommended Determination, even though the plantings were well known during the permit process. Furthermore, EPA's claim that the re-vegetation plan is inadequate because it includes "non-native" species, *id.*, does not take account of the permit's special conditions. Special Condition 10, which applies to riparian revegetation, specifically requires that Mingo Logan submit a detailed revegetation plan, "**consisting only of native non-invasive species** . . ." Special Condition 10 (emphasis in original). *See* Cmt. Ex. 1. Special Condition 20 underscores this requirement, stating that the planting plan must consist of "species that are non-invasive and native to Logan County." Special Condition 20. *See* Cmt. Ex. 1. Thus, contrary to EPA's unsupported claim, the permit conditions fully provide for adequate riparian planting of native vegetation.

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contamination, Rockhouse Creek can be expected through common mitigation techniques to experience similar levels of restoration.

H. EPA's Pessimism About the Efficacy of Connectivity Channels as Stream Mitigation Is Unfounded

Finally, in the Appendix but not the Recommended Determination, EPA contends that the connectivity channels provided for in the Spruce No. 1 Mine permit will not "offset buried stream resources." RD App. 3 at 11.[97] Again, this is an entirely new claim neither made during permit issuance, in the Proposed Determination, or in the Recommended Determination, even though the location of these channels was well known during the permit proceedings.

As with EPA's views on erosion control channels, EPA's pessimism about the efficacy of connectivity channels as stream mitigation find little support. For example, included in Exhibit 10 are two photographs of a connectivity channel on the nearby Dal-Tex property. The connectivity channel is meandering through the center of each of these photographs. There is substantial tree and herbaceous vegetation on both sides of the connectivity channel providing significant shading, nutrient sources, sediment control, and habitat. As explained in TED2, such habitat correlates strongly to a healthy, functioning stream. TED2 § 5.5. In addition, as explained in the Regional Guidebook, such riparian tree and herbaceous vegetation contribute to biochemical processing and habitat functions. Regional Guidebook at 43. The connectivity channels provided for in the Spruce No. 1 Mine permit will be at least as biologically active as the channel in these photographs. Thus, as evidenced by this example, Mingo Logan has a sound

[97] EPA also claims that the connectivity channels provided for in the Spruce No. 1 Mine permit "are expected to have minimal function for [ ] water quality reasons." RD App. 3 at 11. However, as discussed in the section on erosion control channels, to comply with SMCRA, the water in the connectivity channels must be in compliance with all of the applicable effluent limitations without any prior treatment before they can be used as mitigation. Thus, due to the conditions of the SMCRA permit, the use of these connectivity channels for mitigation are expected to result in a functional stream from a water quality perspective.

empirical basis for its expectation that the mitigation in the connectivity channels at Spruce No. 1 Mine will result in a healthy, functioning stream.[98]

Finally, as discussed throughout these comments, if the connectivity channels do not meet performance criteria, corrective action, adaptive management, remedial measures and/or additional mitigation will be required under the permit.

VIII. EPA Has Waived Reliance on "Other Considerations"

Section VI of the Recommended Determination mentions other concerns that do "not form[] the basis of the Recommended Determination." RD at 8; at 71. Mingo Logan believes that each of these concerns is unfounded. But Mingo Logan relies on EPA's representation that they are not the basis of the Recommended Determination and, therefore, Mingo Logan does not address them in these comments. Mingo Logan will be prejudiced if EPA attempts to rely on one of these "other considerations" in its Final Determination. If, for some reason, EPA decides to rely on one of these factors, Mingo Logan requests an opportunity to respond to those allegations.

IX. Conclusion

EPA has neither the legal authority nor an adequate factual basis to act under 404(c). EPA has not met its burden of demonstrating that the permitted fills in Pigeonroost and Oldhouse

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[98] Additionally, EPA contends that there will be such substantial flow in the connectivity channels that there will be downcutting leading to increased sedimentation and degradation of biological communities. RD App. 3 at 11. However, the problem of excess flow velocity and potential downcutting is frequently encountered at existing streams and hydrologists and stream designers are fully capable of avoiding or minimizing these effects with the appropriate stream meanders, contouring, and amendments. For instance, Rosgen has developed, tested, implemented and monitored numerous projects for nearly four decades of stream restoration projects using a "Natural Channel Design" ("NCD") that has been shown to successfully manage these conditions for streams and channels similar to the connectivity channels proposed for the Spruce No. 1 Mine. With appropriate planning and design following Rosgen's concepts, channel morphology and stream flows can be managed to avoid downcutting for these channels. TED2 § 5.4.

will have an unacceptable adverse effect on any of the 404(c) critical areas. The Administrator should therefore determine that no action under 404(c) is appropriate, rescind the Recommended Determination, and terminate this proceeding.

ENVIRONMENTAL PROTECTION AGENCY

Comments in Response and in Opposition to the Recommended Determination of the U.S. Environmental Protection Agency Region III Pursuant to Section 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia

EXHIBITS

and

APPENDIX A: CH2M HILL, Technical Evaluation Document Review of USEPA Recommended Determination Spruce No. 1 Mine, West Virginia (Nov. 2010)

Mingo Logan Coal Company, Inc.

November 29, 2010

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Exhibit 2: Letter from Peter S. Silva, Assistant Adm'r, U.S. EPA, to Robert W. Shanks, President, Eastern Operations, Arch Coal, Inc. (Oct. 27, 2010)

Exhibit 3: Spruce No. 1 Mine Superimposed on Municipal Boundary of the City of Pittsburgh

Exhibit 4: West Virginia Dep't of Envtl. Prot., *Justification and Background for Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards, 47 C.S.R. 2 §§ 3.2.e and 3.2.i* (Aug. 12, 2010)

Exhibit 5: GEI Consultants, Inc. Ecological Div., *Final Report Technical Review: A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams*, submitted to Nat'l Mining Ass'n (Sep. 2010)

Exhibit 6: GEI Consultants, Inc. Ecological Div., "Primary Technical Concerns with Proposed EPA Conductivity Benchmark" (undated)

Exhibit 7: Letter from Evelyn S. MacKnight, Chief, NPDES Permits Branch, EPA Region III, to Jeffrey Parsons, WVDEP (Oct. 28, 2010)

Exhibit 8: Comparison of Mitigation Plans

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Appendix A

CH2M HILL, Technical Evaluation Document Review of USEPA Recommended Determination Spruce No. 1 Mine, West Virginia (Nov. 2010)

Appendix B

Supplemental Materials Relevant to the Recommended Determination

EXHIBIT 1

Letter from Peter S. Silva, Assistant Adm'r, U.S. EPA, to Robert W. Shanks, President, Eastern Operations, Arch Coal, Inc. (Oct. 15, 2010)

filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
Pursuant to Section 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OCT 15 2010

OFFICE OF
WATER

Mr. Robert W. Shanks
President, Eastern Operations
Arch Coal, Inc.
1 CityPlace Drive, Suite 300
St. Louis, Missouri 63141

Dear Mr. Shanks:

The U.S. Environmental Protection Agency's (EPA) Region III Office has recently completed its Recommended Determination pursuant to section 404(c) of the Clean Water Act (CWA) regarding discharges associated with the Spruce No. 1 Surface Coal Mine in Logan County, West Virginia, as currently authorized by Department of Army (DA) Permit No. 199800436-3 (Section 10: Coal River). The Recommended Determination was signed by Mr. Shawn Garvin, Regional Administrator for EPA Region III, on September 24, 2010. A copy of the Recommended Determination is enclosed. Detailed technical appendices supporting the Recommended Determination will be available today at http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/404c_index.cfm.

The Regional determination recommends that EPA withdraw the specification embodied in DA Permit No. 199800436-3 (Section 10: Coal River) for Pigeonroost Branch and Oldhouse Branch as disposal sites for discharges of dredged and/or fill material for construction of the Spruce No. 1 Surface Mine. The Regional Administrator has based his recommendation upon a finding by Region III that discharges into Pigeonroost Branch and Oldhouse Branch as currently authorized, including those associated with construction of valley fills and sedimentation ponds, will bury approximately 6.6 miles of high quality headwater streams and would be likely to have unacceptable effects on wildlife resources as defined under CWA section 404(c).

The section 404(c) regulations at 40 CFR 231.6 provide that EPA initiate final consultation with you prior to completion of a Final Determination which would affirm, modify, or rescind the Recommended Determination. The regulations include this final consultation period to provide you an opportunity to present additional relevant information for the record, including information about any corrective actions which could be taken to prevent unacceptable adverse effects from the proposed project. In addition, you may use this opportunity to respond to the Recommended Determination to the extent that it raises issues not presented in the Proposed Determination or that it relies on information in the administrative record which was not available to you at the time of

your comments on the Proposed Determination. Information and views already in the administrative record will be considered at EPA Headquarters and need not be resubmitted. As required under the regulations, I request that you provide me with any comments and any notice of intent to take corrective action within fifteen days of the date of this letter.

My office will contact you shortly to schedule a discussion with you regarding our Clean Water Act Section 404(c) review of the Spruce No. 1 mine. We look forward to talking with you. If you have any questions, please have your staff contact my Chief of Staff, Greg Peck, at 202-564-5700.

Sincerely,

Peter S. Silva
Assistant Administrator

Enclosure

cc: Shawn Garvin, EPA Region III
Robert Sussman

EXHIBIT 2

Letter from Peter S. Silva, Assistant Adm'r, U.S. EPA, to Robert W. Shanks, President, Eastern Operations, Arch Coal, Inc. (Oct. 27, 2010)

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Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OCT 2 7 2010

OFFICE OF
WATER

Robert Shanks
President, Eastern Operations
Arch Coal, Inc.
1 City Place Drive, Suite 300
St. Louis, Missouri 63141

Dear Mr. Shanks:

Thank you for the October 22, 2010, letter from Hunton and Williams, LLP representing Arch Coal Company and its subsidiary, Mingo Logan Coal Company. Your letter requests that the U.S. Environmental Protection Agency (EPA) proceed, as soon as possible, to schedule consultation meetings pursuant to Clean Water Act (CWA) section 404(c) regarding EPA's review of the Spruce No. 1 mine and seeks a 30-day extension of the 15-day consultation process outlined in EPA's 404(c) regulations. I am granting your 30-day extension request, which means consultation would conclude by November 29, 2010. We will publish notice of this extension in the *Federal Register*.

EPA will also be in contact with you shortly to schedule discussions regarding the EPA Region III Recommended Determination and to provide you with the opportunity to identify potential corrective actions to reduce anticipated significant adverse environmental effects associated with the Spruce No. 1 mine. We will also invite representatives of the Department of the Army (including the U.S. Army Corps of Engineers) and the State of West Virginia to participate in our meeting with you.

The Recommended Determination finds, based on an extensive analysis of the Corps record and information collected by EPA, that discharges of dredged or fill material to Pigeonroost Branch and Oldhouse Branch, as authorized, would likely result in an unacceptable adverse effect to wildlife. The consultation process provided in EPA's regulations is intended to allow for consideration of corrective actions proposed by the permittee, or other participants in the consultation process, that would prevent such unacceptable effects as determined by EPA. I look forward to meeting with you to consider corrective actions you may choose to propose during our consultation. We will be prepared to share potential alternatives that EPA and your company may wish to further explore. We can also answer questions you may have regarding the Recommended Determination during the consultation process.

Thank you again for your letter, and I hope this response effectively addresses your requests. My Chief of Staff, Greg Peck, will be contacting you shortly to schedule our consultation meeting. Feel free to contact him at 202-564-5700 if you have any additional questions.

Sincerely,

Peter S. Silva
Assistant Administrator

cc: The Honorable Lisa P. Jackson
Mr. Robert Sussman
Mr. Shawn M. Garvin
The Honorable Jo-Ellen Darcy
Lt. Gen. Robert L. Van Antwerp, Jr.
Ms. Margaret E. Gaffney-Smith
Col. Robert D. Peterson
Ms. Ginger Mullins
The Honorable Joe Manchin, III
Mr. Randy C. Huffman
Mr. Robert G. Jones
Mr. B.J. Sturgill, Jr.
Mr. John McDaniel
Mr. Robert G. McLusky
Mr. Robert M. Rolfe
Ms. Deidre G. Duncan

EXHIBIT 3

Spruce No. 1 Mine Superimposed on Municipal Boundary of the City of Pittsburgh

filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
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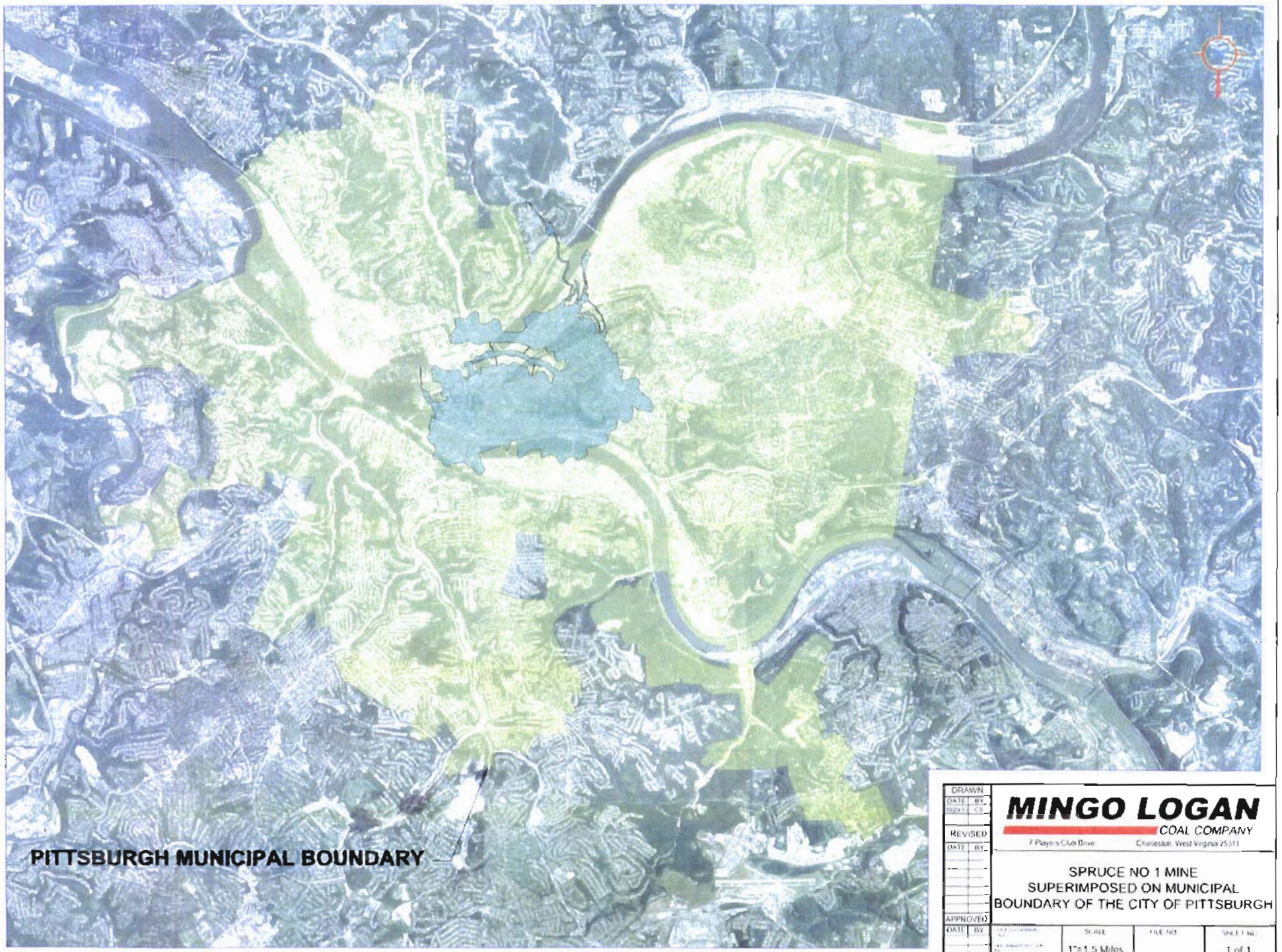
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010



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DATE	BY
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REVISED	
DATE	BY
APPROVED	
DATE	BY

MINGO LOGAN
COAL COMPANY
7 Players Club Drive Charleston, West Virginia 25311

SPRUCE NO 1 MINE
SUPERIMPOSED ON MUNICIPAL
BOUNDARY OF THE CITY OF PITTSBURGH

SCALE	FILE NO	SHEET NO
1"=1.5 Miles		1 of 1

EXHIBIT 4

West Virginia Dep't of Envtl. Prot., *Justification and Background for Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards, 47 C.S.R. 2 § § 3.2.e and 3.2.i* (Aug. 12, 2010)

filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
Pursuant to Section 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010

Release Date: August 12, 2010

west virginia department of environmental protection

Justification and Background for Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards, 47 C.S.R. 2 §§ 3.2.e and 3.2.i

PURPOSE

The West Virginia Department of Environmental Protection ("DEP") adopts this Justification and Background for its "Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards" (the "Guidance"). The Guidance is intended to facilitate compliance with applicable statutory and regulatory requirements and to provide reasonable means of effectuating the intent of the narrative criteria, as well as to enforce the mandate of the Clean Water Act ("CWA") that every permit contain effluent limitations that reflect the practicable pollution reduction a state can achieve.[1]

The Guidance was developed in accordance with the West Virginia Water Pollution Control Act ("WVWPCA"), which states that "the public policy of the State of West Virginia to maintain reasonable standards of purity and quality of the water of the State consistent with (1) public health and public enjoyment thereof; (2) the propagation and protection of animal, bird, fish, aquatic and plant life; and (3) the expansion of employment opportunities, maintenance and expansion of agriculture and the provision of a permanent foundation for healthy industrial development."[2]

As it must, the Guidance also recognizes the intent of the West Virginia Legislature, which has formally resolved as follows:

- That any interpretation and implementation of West Virginia's narrative water quality standards is the responsibility of the West Virginia Department of Environmental Protection;
- That the requirements of the narrative criteria are met when a stream (a) supports a balanced aquatic community that is diverse in species composition; and (b) contains appropriate trophic levels of fish (in streams with sufficient flows to support fish populations); and (c) the aquatic community is not composed only of pollution tolerant species or

[1] *American Paper Institute, Inc. v. United States Environmental Protection Agency*, 996 F.2d 346, 349 (D.C. Cir., 1993)

[2] W. Va. Code § 22-11-2(a).

the aquatic community is composed of benthic invertebrate assemblages sufficient to perform the biological functions necessary to support fish communities within the assessed reach (or, if the assessed reach has insufficient flows to support a fish community, in those downstream reaches where fish are present); and

- That interpretation of West Virginia's narrative water quality standards must faithfully balance the protection of the environment with the need to maintain and expand opportunities for employment, agriculture, and industry as set forth in the Legislature's statement of public policy as contained in the West Virginia Water Pollution Control Act.[3]

BACKGROUND

West Virginia has had primacy of the NPDES program since 1982 and has narrative water quality standards that predate its NPDES primacy. These criteria are found in West Virginia's *Code of State Rules*, which states, in pertinent part, "No significant adverse impact to the chemical, physical, hydrologic, or biological components of aquatic ecosystems shall be allowed."[4]

In light of its goals to advance, wherever attainable, water quality that provides for recreation and the protection and propagation of fish, shellfish, and wildlife,[5] and to assure that surface mining operations are conducted so as to protect the environment,[6] DEP reviewed its NPDES permitting and compliance assessment protocols vis-à-vis West Virginia's narrative water quality standards and solicited public comment regarding these issues. As a result, DEP adopts the Guidance, which describes the procedures DEP will implement in the development of NPDES permits for the coal mining industry. These new procedures shall take effect immediately. In light of the changing nature of the policy concerns addressed herein, this document is intended to be dynamic and will likely be modified in the future as technology and best management practices develop and improve.

While DEP appreciates EPA's recent effort to assist the states in interpreting their various narrative water quality standards, DEP finds that the Guidance is the more appropriate approach for West Virginia for several reasons. First, it involves subject matter uniquely within DEP's expertise and special knowledge. Further, while this document specifically addresses concerns related to the mining industry, it is designed to be adapted in the future to address all discharges to water bodies that will cause, or that have the reasonable potential to cause or contribute to, excursions from water quality standards. Finally, it does not use an overbroad, generic criterion (i.e. conductivity) to set unattainable limits, but instead identifies specific pollutants that can be managed through the inclusion of appropriate whole effluent toxicity ("WET") monitoring and/or limits and best management practices ("BMPs") in NPDES permits, where there is reasonable potential to cause or contribute to excursions from water quality criteria. If the

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[3] H.C.R. 111 (2010 Regular Session).
[4] 47 C.S.R. 2 § 3.2.i
[5] *See* 33 U.S.C. § 1251(a)(2)
[6] *See* 30 U.S.C. § 1202(d)

applicant cannot demonstrate, by means of its chemical and biological monitoring and the control measures outlined in the plans it will submit with its application, that it does not have reasonable potential ("RP") to cause or contribute to an excursion above the narrative criteria, the permit writer should treat new or expanded discharges as if they have RP and include WET limits in the permit, in accordance with 40 C.F.R. § 122.44(d)(1)(v). Alternatively, if the operator identifies toxic pollutants that can be regulated through the use of numeric limits, DEP will put a regulatory control number for those pollutants in the operator's permit.

PROTECTION OF THE AQUATIC ECOSYSTEM

As stated above, the narrative water quality criteria set out in 47 C.S.R. 2 § 3.2.i prohibits the introduction of wastes that cause significant adverse impact to the chemical, physical, hydrologic or biological components of aquatic ecosystems. These criteria are valid components of West Virginia water quality standards that have been properly promulgated by the West Virginia Legislature and approved by the EPA. The phrase "significant adverse impact" is not defined in the CWA or the WVWPCA, the regulations promulgated thereunder or in any literature or guidance published by the EPA. DEP has determined that "significant adverse impact" is more than a change in the numbers or makeup of the benthic macroinvertebrate community in a segment of a water body downstream from a point source discharge. It is, instead, a material decline in the overall health of an aquatic ecosystem.[7] A goal of the CWA and the WVWPCA is to protect the aquatic ecosystem as a whole; it is a holistic standard that requires a holistic approach to ecosystem assessment. In contrast to numeric water quality criteria, which can be applied by analysis of samples of water taken at any discharge or monitoring point in a stream, compliance with a standard that protects the aquatic ecosystem must be assessed in the broader area comprising the ecosystem. An ecosystem does not exist at a single point and, accordingly, its health cannot be assessed at a single point.

The Pond-Passmore Study, upon which EPA relied in the development of its guidance on this subject, concludes that West Virginia's narrative standard is violated by surface coal mining operations based on the Study's application of two biologic assessment tools, the West Virginia Stream Condition Index ("WVSCI") and the draft Genus Level Index of Most Probable Stream Status ("GLIMPSS"), to samples of benthic macroinvertibrate life taken from these streams. This conclusion is flawed for two reasons. First, West Virginia does not use the draft GLIMPSS in its assessment of the biologic health of State streams. Second, these tools are just that – tools. They are not stand-alone determinants of compliance with the narrative standard. Any application of these assessment tools in determining compliance with the narrative standard must faithfully apply the language of the standard itself, which prohibits significant adverse impacts on the chemical, physical, hydrologic or biological components of the aquatic ecosystem. Thus, DEP's Guidance follows long-standing EPA guidance, which indicates that biosurveys cannot fully characterize an entire aquatic community and its many attributes, and accordingly suggests that "State standards should contain biological criteria that consider various components (e.g.

[7] An aquatic ecosystem is a dynamic complex of plant, animal, and microorganism communities and their non-living environment interacting as a functional unit within water. *See,* Coweeta Long Term Ecological Research "Glossary of Terms."

algae, invertebrates, fish) and attributes (measures of structure and/or function) of the larger aquatic community."[8]

Through implementation of the Guidance, DEP continues its existing practice of using WVSCI in addition to consideration of other factors affecting the aquatic ecosystem to enforce its narrative water quality standards. By way of background, WVSCI was developed for EPA by national experts to assess biological integrity in West Virginia's waterways through "careful measurement of the natural aquatic ecosystem and its constituent biological communities,"[9] including the evaluation of benthic macroinvertebrate communities. It was specifically designed for assessment of the biological component of the 47 C.S.R. 2 § 3.2.i narrative criteria and has been used as a tool in developing the Impaired Streams List ("303(d) List") and the TMDLs resulting therefrom for almost a decade.[10] WVSCI acknowledges that "[i]t is the responsibility of West Virginia's [Department] of Environmental Protection to maintain and protect the ecosystem health of the state's waters[,]" and "[i]n keeping with the Clean Water Act and technical guidance from USEPA, DEP developed water quality standards for the protection of ecosystem health."[11]

DEP's Guidance is the appropriate methodology for implementing West Virginia's narrative water quality standards, because it is consistent with the Federal Regulations regarding establishing limitations, standards, and other permit conditions for NPDES programs, and it incorporates a holistic approach to ecosystem assessment and protection. The CWA's implementing regulations require WET testing and limits when the State finds that a discharge has RP to cause or contribute to excursions from water quality standards.

> [W]hen the permitting authority determines . . . that a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a narrative criterion within an applicable State water quality standard, the permit must contain effluent limits for whole effluent toxicity. Limits on whole effluent toxicity are not necessary where the permitting authority demonstrates in the fact sheet or statement of basis of the NPDES permit . . . that chemical-specific limits for the effluent are sufficient to attain and maintain applicable numeric and narrative State water quality standards.[12]

WET testing allows flexibility where appropriate (e.g. allowing time to collect additional data for RP determination to supplement limited data sets) and is consistent with DEP's policy that

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[8] EPA's *Policy on the Use of Biological Assessments and Criteria in the Water Quality Program* (May 1991) ("1991 Policy")

[9] A Stream Condition Index for West Virginia Wadeable Streams, March 28, 2000 (Rev. July 21, 2000) ("Stream Condition Index").

[10] However, a stand-alone WVSCI score has never been the sole determinant of compliance or non-compliance with the narrative standard. This is because WVSCI scores are influenced by many factors (e.g. habitat, geology, and pH).

[11] Stream Condition Index

[12] 40 C.F.R. § 122.44(d)(1)(v)

permittees develop robust monitoring plans with the intention of identifying any causative pollutants and adjusting their methods of operation so that those problems may be remedied before the aquatic community suffers a significant breakdown.

WVSCI considers various components (e.g. algae, invertebrates, fish) and attributes (measures of structure and/or function) of the larger aquatic community. "Because biological integrity is a strong indicator of overall ecological integrity, it can serve as both a meaningful goal and a useful measure of environmental status. . . ."[13] Based on the 5th percentile of reference values, the current WVSCI score that indicates the integrity of a benthic macroinvertebrate community in West Virginia's wadeable streams is 68.0. The threshold for inclusion on the 303(d) List has historically been 60.6. That value subtracts a precision estimate from the 5th percentile of reference values, and its historical use was intended to take into account sampling error and to aid DEP in allocating its resources so as to avoid misclassifying non-impaired waters as impaired. WVSCI and its application in the 303(d) listing process are consistent with methodologies implemented to assess protection of aquatic ecosystems by all of West Virginia's neighboring states.

CAUSATIVE POLLUTANTS / PROTECTIVE THRESHOLDS

EPA has recently set a numeric limit on conductivity at 500 µS/cm, finding that conductivity levels below 300 µS/cm generally will not cause a water quality standard violation and that in-stream conductivity levels above 500 µS/cm are likely to be associated with adverse impacts that may rise to the level of exceedances of narrative state water quality standards.[14] However, DEP's data shows that more than a simple conductivity measurement is necessary to determine the health of a stream. As proof that a number for specific conductance is an inappropriate gauge, FIGURE 1 below illustrates that a stream can have a low level of specific conductance and a WVSCI score firmly within the range for impairment; conversely, a stream can have a high level of specific conductance and a WVSCI score that indicates the stream is above the threshold for impairment. WVSCI scores are affected by many factors: habitat, other uses of the stream and the surrounding land, other pollutants unrelated to conductivity (e.g. fecal coliform), *inter alia*. Certain stream reaches simply cannot attain a "good" WVSCI score because of those factors.

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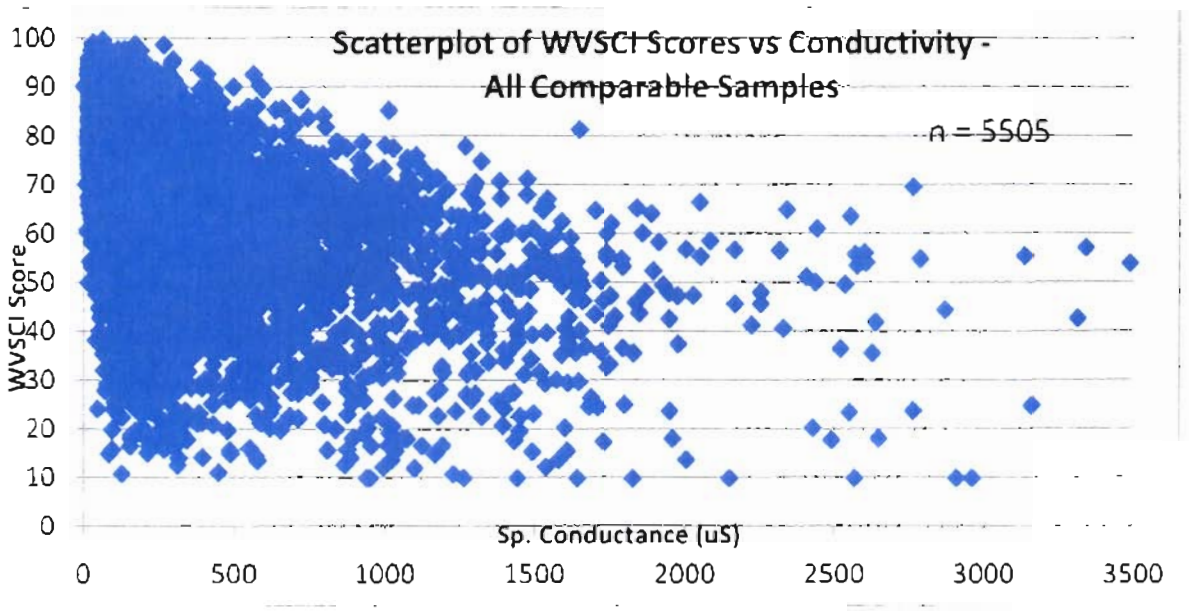
[13] 1991 Policy

[14] EPA's *Detailed Guidance: Improving EPA's Review of Appalachian Surface Coal Mining Operations under the Clean Water Act, National Environmental Policy Act, and the Environmental Justice Executive Order* (April 1, 2010) ("April 1 Memo")



The Pond-Passmore Study found a shift in the benthic macroinvertibrate community downstream from mining activity, but did not otherwise correlate this finding with any significant or adverse impairment of the ecosystem. Where the only impacts to this component of the ecosystem are diminished numbers of certain genera of mayflies, without evidence that this has had any adverse impact of any significance on the rest of the ecosystem, the State cannot say that there has been a violation of its narrative standard. Various scientific studies and evaluations performed by DEP indicate that lowered biological condition is associated with increased ionic strength, but scientists remain less than certain about the specific causative pollutant(s) and the concentration(s) responsible for impairment. Additional uncertainty is present in correlative studies, because the effects of increased ionic strength cannot be completely distinguished from the effects of other stressors that often co-occur (e.g. organic enrichment, sedimentation). In fact, most available information attempts to relate biological condition to a surrogate parameter, such as specific conductance.

Because conductivity represents the combined concentrations of all different dissolved ions, each with potential varying toxic effects, regulation solely via an indicator such as specific conductance is not the best way to protect against excursions from narrative standards. For example, the elevated dissolved pollutants most commonly associated with mining discharges are sulfate and bicarbonate alkalinity. EPA has not published national recommended aquatic life protection criteria for those pollutants. Similarly, chloride, for which West Virginia has adopted EPA's recommended numeric aquatic life protection water quality criteria, may also be present in some cases. But because chloride seldom exists in the absence of sulfates or alkalinity, singular control of chloride cannot be expected to resolve all ionic stress.

DEP has performed a correlative evaluation of benthic condition and specific conductance. This evaluation suggests that native aquatic life is protected at various values and ranges of specific conductance. This finding supports the basic scientific principle that correlation is not cause and effect. Even though the DEP evaluation applied various filters to the

evaluated dataset to address complicating factors listed above, the biological condition of a stream may be different from the condition predicted by specific conductance. In situations such as these, where DEP has determined that it is infeasible to calculate a numeric effluent limit to implement a narrative water quality standard, DEP will include in the permit appropriate WET limits and BMPs to control or abate the discharge of pollutants, in accordance with 40 C.F.R. § 122.44(k)(3).

DEP routinely identifies biological stressors when developing TMDLs for biologically impaired waters. Stressor identification employs a strength-of-evidence approach that considers multiple information sources. Researchers evaluate water quality monitoring data, physical habitat data, field notes, and the composition of the biological assemblage concurrently to identify significant stressors. DEP's most recent stressor identification protocols, as used in the EPA-approved TMDL process, include the guidelines shown in FIGURE 2 below for evaluating water chemistry to determine if ionic strength is a significant stressor:

Candidate Cause	Parameter	Elimination (Rule out stressors at these thresholds)	Strength of Evidence (Evidence for each Candidate Cause as stressor)
		Elimination Threshold	Candidate Stressor Thresholds
4. Ionic strength	Conductivity	< 326.9 umhos	Consider as independent stressor in non-acidic, non-AMD streams, when conductivity values met threshold ranges and sulfates and chloride violate conditions listed as follows. >1533 Definite Stressor 1075-1532.9 Likely stressor 767-1074.9 Possible stressor 517-766.9 Weak stressor 327-516.9 Equivocal or No Trend
	Sulfates	< 56.9 mg/l	>437 Definite Stressor 290-436.9 Likely stressor 202-289.9 Possible stressor 120-201.9 Weak stressor 57-119.9 Equivocal or No Trend
	Chloride	< 60 mg/l	>230.0 Definite Stressor 160.1-229.9 Likely stressor 125.1-160 Possible stressor 80.1-125.0 Weak stressor 60.1-80.0 Equivocal or No Trend

Based on FIGURE 2, it is clear the EPA limits of 300 – 500 µS/cm established in the April 1 Memo are far more stringent than what it has long approved for West Virginia's TMDL process. As shown above, conductivity in the 300 – 500µS/cm range is "Equivocal or No Trend" as a stressor. Conductivity does not even become a "Likely Stressor" of a stream under this EPA-approved approach until it reaches three to five times these limits: 1075-1532.9 µS/cm. This is additional support for the State's conclusion that reliance on the single surrogate of specific conductance to implement and/or enforce the State's narrative water quality standards is improper. It also demonstrates that EPA's proposed limits are too narrowly focused on a single parameter and single aquatic species to determine the health of the impacted watershed.

Only the West Virginia Legislature can adopt a numeric water quality standard for conductivity (or any other pollutant); DEP has no authority to immediately or unilaterally

implement numeric standards. Through adoption of H.C.R. 111, the West Virginia Legislature has given DEP direction as to how it should implement its narrative water quality standards. Even if the Legislature does adopt a numeric standard for conductivity, DEP cannot implement it until after it is approved by the EPA. Based on the loose and questionable causal relationship between conductivity and stream impairment, it remains unclear whether EPA would approve such a numeric limit. EPA's duly promulgated regulation endorses establishment of WET limits where, as here, a state is unable to use a limit for a surrogate parameter. DEP can implement new permitting controls based on the agency's best professional judgment of actions necessary to protect the State's waters using its narrative criteria, with follow-up monitoring and contingencies for unsatisfactory outcomes. Thus, DEP is protecting against excursions from its narrative water quality standards by establishing WET limits and verifying impacts to a stream (or lack thereof) by requiring an extensive, comprehensive monitoring plan for the entire watershed.

GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

FINAL REPORT

Technical Review:

A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams

Submitted to:
National Mining Association
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September 2010
Project 091380

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Executive Summary

On behalf of the National Mining Association (NMA), GEI Consultants, Inc. (GEI) has conducted a technical review of the U.S. Environmental Protection Agency's (EPA) external review draft of *A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams*. In that report, EPA proposed that the correlation between conductivity and benthic macroinvertebrate community structure in Ecoregions 69 and 70 in West Virginia is strong enough that an aquatic life "benchmark" can be derived. EPA also proposed the use of species sensitivity distribution (SSD)-based methods to develop such a benchmark, similar to those used with laboratory-derived toxicity data, to derive numeric ambient water quality criteria for protection of aquatic life and their uses. Based on these two assumptions, EPA used field data from paired stream benthic macroinvertebrate and water quality surveys to derive a proposed aquatic life benchmark of 300 µS/cm conductivity that would be applied to a limited set of specific waters in the Appalachian Region that are dominated by salts of sulfate (SO_4^{2-}) and bicarbonate (HCO_3^-) at circumneutral to mildly alkaline pH.

We believe there are a number of factual, methodological, and conceptual issues that precludes implementation of their proposed benchmark.

First, significantly different, often conflicting, multiple stressor-response profiles are exhibited by the genera used by EPA to derive the conductivity benchmark. These conflicting stressor-response profiles simply do not represent an internally consistent dataset from which to derive a regulatory benchmark using an SSD approach. This is a key fundamental flaw in the approach, as it suggests that either invertebrate genera are exhibiting fundamentally different responses to elevated salinity or, more likely, that factors other than conductivity are much more closely and functionally related to the capture probability of individual genera across the study region. Therefore, using an SSD of extirpation coefficient (i.e., XC_{95}, the 95th percentile of the distribution of a calculated "probability of occurrence" of a genus with respect to conductivity) values based on conflicting stressor-response profiles is a fundamental flaw in their derivation of a regulatory benchmark—this fact, alone, indicates the benchmark should not be used.

Second, there are insufficient data from the scientific literature to rigorously support EPA's conclusion that "conductivities in the region of concern reach levels that are sufficient to cause effects on stream communities" (p. 52, EPA 2010). Although EPA conducted what appears to be a relatively formal causal analysis, the weight of evidence scoring for each causal element was relatively subjective and open to substantially different, and valid, alternative interpretations. While some statistical correlations between conductivity and changes in benthic macroinvertebrate communities exist in locations related to coal mining and valley fill (MTM/VF) activities, there is insufficient evidence in support of salinity ions as the proximate and mechanistic cause of biological impairment. Although elevated salinity

can clearly induce adverse effects on aquatic invertebrates, the taxonomic patterns of sensitivity are not yet clearly defined. Toxicity to ions associated with salinity also varies strongly as a function of specific ion composition and can be mitigated under conditions of elevated hardness. In fact, criteria based on individual ions—rather than those based on composite variables such as conductivity—have already been considered in other states as a preferable regulatory approach that best fits the available scientific information. Given that the ratio of key ions such as sulfate and bicarbonate does not remain constant with increasing conductivity in the West Virginia Department of Environmental Protection (WVDEP) Watershed Assessment Branch Data Base (WABbase)—despite EPA assurances to the contrary in their presentation to the Science Advisory Board (SAB) Committee—conductivity by itself is not a reliable indicator of biological response.

Third, the confounding factors analysis in Appendix B of the EPA benchmark document should not take presumed impacts from conductivity *as a given*—especially with the significant weaknesses identified in our review of Appendix A. Rather, a confounding factors analysis should also include rigorous and independent tests of the primary hypothesis and first determine whether conductivity alone is indeed the best predictor of biological impairment that is causally related in such a way as to justify the proposed benchmark value based on field-collected data. EPA's confounding factor analysis would benefit from a closer evaluation of the following factors, which could provide alternative explanations for patterns in macroinvertebrate community structure relative to MTM/VF activities:

- *Habitat*: EPA's assertion that habitat presented little potential for confounding in their derivation of the conductivity benchmark is flawed. First, the Rapid Bioassessment Protocol (RBP) habitat scores used in EPA's analysis are not the most rigorous measure of habitat quality for benthic macroinvertebrates. Second, RBP habitat scores were shown to be correlated with both conductivity and the biological response (i.e., organism extirpation coefficients). Third, analysis of confounding factors focused almost exclusively on the relationship with Ephemeroptera (mayflies), to the exclusion of the response of the rest of the benthic macroinvertebrate community.

- *Relationship to other invertebrate taxa*: Relationships between all potential stressors (in addition to habitat) and Ephemeroptera were generally cited as reasons to reject the other stressors as potential confounders. There is a clear need to include similar analyses from other members of the entire invertebrate community to conclusively reject (or not reject) additional environmental factors as potential confounding stressors when trying to develop a benchmark to protect all invertebrates, not just mayflies.

- *Influence of rare taxa*: EPA did not sufficiently demonstrate that the taxa identified as rare were rare due to conductivity or any other water quality effect, and not from general rarity itself.

Fourth, we do not agree that EPA's presumed 95% protection level for the conductivity benchmark is ecologically relevant with respect to changes in functional groupings of macroinvertebrate genera. Evaluation of trends in macroinvertebrate community structure and function relative to conductivity found few observed changes in the proportional abundance of functional feeding groups within the regional pool of taxa until conductivity levels exceeded approximately 2,500 µS/cm to 5,000 µS/cm.

Fifth, our analysis of the WABbase dataset used by EPA indicates that conductivity alone is definitely not the most appropriate parameter for explaining the variation observed among the Central Appalachian macroinvertebrate communities with respect to water quality and physical habitat. Rather, contrary to EPA's confounding factor analysis, our own statistical analysis shows that a combination of ionic composition, substrate composition, and channel morphology features may be the most appropriate stressor variables to consider when evaluating the effects of water quality and habitat on invertebrate communities. These analyses also indicate that total taxa and percent EPT abundance are the key response variables to consider when evaluating factors that shape the macroinvertebrate community, as opposed to a singular focus on Ephemeroptera. Additionally, total suspended solids, dissolved oxygen, and fecal coliforms also appear to be other key variables to consider when evaluating these stream sites, as they are strong indicators of other anthropogenic disturbances in the watersheds. It is clear that the use of conductivity alone to build SSDs when there are so many other important variables to consider is another fatal flaw in this benchmark. Specifically, a field-derived benchmark constructed on a single variable like conductivity would only work if no other variables were relevant. This is clearly not the case in the dataset used by EPA.

We conclude that the relationship between conductivity and changes in benthic macroinvertebrate community structure is not reliable enough or singularly strong enough to warrant derivation of a regulatory benchmark at this time. While negative correlations may exist between elevated conductivity and the capture probability of select invertebrate genera, there are also positive correlations and other conflicting patterns, suggesting there is insufficient evidence to conclude that elevated concentrations of ions related to salinity (as measured by conductivity) are responsible for losses of presumed sensitive taxa. For the most part, this lack of evidence is due to the EPA's failure to rigorously or independently test the primary hypothesis that elevated salinity was the best predictor of changes in macroinvertebrate community structure in West Virginia streams associated with MTM/VF activities. Furthermore, insufficient laboratory studies are available to verify either the causal mechanisms or conductivity thresholds that would confirm the proposed benchmark of 300 µS/cm under the specific ion composition of streams in this region. For similar reasons, Illinois, Indiana, and Iowa have rejected the use of total dissolved solids (TDS) or conductivity-based criteria in lieu of criteria for individual ions such as sulfate or chloride.

We also conclude that the use of an SSD of XC_{95} values based on conflicting stressor-response profiles is a fundamentally flawed method for derivation of a regulatory benchmark,

especially when evaluated in concert with analyses that show many other variables are important. Additional study is needed to confirm or refute the hypothesis of the conductivity relationship to aquatic life, both through use of additional statistical hypothesis testing with the existing dataset and additional study of West Virginia streams associated with MTM/VF activities.

Therefore, we believe it is inappropriate and inadvisable to adopt this conductivity benchmark until or unless such additional studies are conducted.

determine whether it represents a scientifically plausible and reliable means of ensuring aquatic life protection.

This report summarizes the results of GEI's technical review of the EPA conductivity benchmark document. The primary scope of this review was to evaluate the overall technical basis of how the conductivity benchmark was derived, with a particular focus on evidence presented by EPA in support of the mechanistic plausibility of using conductivity as the basis for deriving a field-based aquatic life benchmark, and the extent to which confounding factors other than conductivity were addressed. GEI's review also presents an independent statistical evaluation of the ecological factors most likely associated with patterns in benthic macroinvertebrate community structure in West Virginia headwater streams associated with MTM/VF activities. This analysis utilizes the same raw data and field sites used in EPA (2010) to derive the conductivity benchmark, but uses different sets of statistical tools to provide a more robust analysis of the potential impacts of MTM/VF activities.

GEI's technical review consists of the following main elements:

- Summary of the proposed conductivity benchmark and its technical basis
- Summary of GEI's primary concerns with the scientific plausibility and reliability of the proposed conductivity benchmark, including:
  - Diversity of conflicting stressor-response profiles and the use of species-sensitivity distribution methods for benchmark derivation
  - The outcome of the causal analysis, including the plausibility of physiological mechanisms proposed as causes of extirpation of sensitive taxa
  - Analysis of confounding factors other than conductivity
  - Ecological relevance of the protection level intended from the proposed conductivity benchmark
- Independent statistical evaluation of ecological factors most closely associated with patterns in benthic macroinvertebrate community structure.

2.0 Proposed Conductivity Benchmark

2.1 Summary of Proposed Benchmark

EPA (2010) used field data to derive an aquatic life benchmark for conductivity that is intended to be applied only to a limited set of waters in the Appalachian Region that are dominated by salts of SO_4^{2-} and HCO_3^- at circumneutral to mildly alkaline pH (see benchmark definition and limitations below). Conductivity is presented as a surrogate for salinity, which is a property of water that represents the total concentration of dissolved mineral salts or "major ions", including Na^+, Ca^{2+}, Mg^{2+}, K^+, Cl^-, HCO_3^-, CO_3^{2-}, and SO_4^{2-}. One of the basic premises of EPA (2010) is that elevated concentrations of these ions cause physiological stress in macroinvertebrates, ultimately leading to the extirpation of the most sensitive species in waters with conductivity levels that exceed the proposed benchmark of 300 µS/cm. It is not derived using EPA's standard methodology. Instead, the benchmark was derived by a method modeled on EPA's standard methodology for deriving AWQC, except that the methodology was substantially altered for use of field data. Field data were used because EPA stated that sufficient and appropriate laboratory data were not available and "high quality" field data were available to relate conductivity to effects on aquatic life.

The method used in EPA (2010) has the appearance of being based on the 1985 Guidelines primarily because it used the 5th percentile of a species sensitivity distribution (SSD) as the basis for mathematical derivation of the benchmark value. An SSD represents the response of aquatic life as a distribution with respect to exposure and is a widely used statistical approach for derivation of regulatory aquatic life criteria worldwide. It is implicitly assumed that if the exposure level is kept below the 5th percentile of the SSD, at least 95% of tested aquatic species (or their surrogates) comprising the distribution will be protected. In this respect, EPA's data analysis followed the standard methodology in aggregating species to genera and using interpolation to estimate the percentile.

However, the method used in EPA (2010) differs significantly from the 1985 Guidelines in that the points in the SSDs are so-called extirpation concentrations (XCs) rather than median lethal concentrations (LC_{50}s) or chronic response values from exposure to a single chemical. The XC is defined by EPA as the level of exposure above which a genus is "effectively absent" from waterbodies in a region. For this benchmark value, the 95th percentile of the distribution of a calculated "probability of occurrence" of a genus with respect to conductivity was used as a 95th percentile extirpation concentration (XC_{95}). Hence, this aquatic life benchmark for conductivity is expected to avoid the local extirpation of 95% of native species (based on the hazardous concentration [HC_{05}]—the 5th percentile of the SSD) in surface waters that include neutral to alkaline effluents containing a mixture of dissolved ions "dominated by salts of SO_4^{2-} and HCO_3^-"—although no numerical values or "bounds" on the concentrations of these ions were given by EPA in their document.

The chronic aquatic life benchmark value for conductivity derived using all-year data from West Virginia was calculated to be 300 µS/cm. According to EPA (2010), this benchmark is only applicable to specific parts of West Virginia and Kentucky, although they expect it to be applicable to the same ecoregions in Ohio, Pennsylvania, Tennessee, and Maryland (but data from those states have not been analyzed). EPA states that this benchmark could also be appropriate for other nearby regions such as Ecoregion 67, but has only been validated for use in Ecoregions 68, 69, and 70 at this time. However, EPA further states that this benchmark may not apply when the relative concentrations of dissolved ions are not dominated by salts of SO_4^{-2} and HCO_3^- (again, no quantitative indication or bounds were provided on what is meant by "dominated by").

2.2 Analysis of Causal Mechanisms and Confounding Factors

Because numeric aquatic life criteria are based on laboratory toxicity tests from single chemical exposures, the causes of biological impairment (i.e., toxicity) are generally clear, test results are repeatable, and confounding factors are minimized or eliminated under controlled laboratory conditions. However, associations between biological patterns as a function of one or more chemical stressors in the field are not necessarily causal, nor are they free from other factors that may confound or obscure the presumed association. Therefore, EPA conducted a causal assessment (Appendix A of EPA 2010) based on epidemiological approaches (e.g., Hill 1965) and EPA guidance for conducting stressor identification and diagnosis (EPA 2000; www.epa.gov/caddis). From these assessments, EPA concluded that the available evidence indicated that salts, as measured by conductivity, are a common cause of impairment in aquatic macroinvertebrates in the region of concern (i.e., Ecoregions 68 and 69 of West Virginia).

EPA also conducted a confounding factors assessment (Appendix B of EPA 2010) to evaluate the extent to which variables that may co-occur with conductivity might limit or alter their ability to quantify the effects of conductivity (i.e., derive a quantitative benchmark). A weight of evidence approach was used to evaluate each confounding factor and, to the extent possible, test whether removal of confounding factors might alter the ultimate derivation of the conductivity benchmark. EPA concluded that "the effect of confounders was found to be minimal and manageable," and that only the elimination of sites with pH < 6 was needed to remove this potentially significant confounding factor.

whether or not conductivity alone is in fact a strong enough indicator of adverse changes in biological communities to allow for its use in derivation of a regulatory benchmark.

The discussion above provides the highlights of issues that need to be more fully evaluated before the conductivity benchmark is adopted. Below we summarize the key primary technical concerns with the proposed EPA conductivity benchmark, to be discussed in greater detail in this report. These concerns are not presented in any particular order of priority. The rest of this report is focused on four primary questions:

- How might the diversity of conflicting stressor-response profiles exhibited in EPA's SSD of XC_{95} values influence the benchmark value derived from this SSD, and is use of an SSD a valid approach when the stressor-response profiles are not consistent?
- How does the methodology used to derive the conductivity benchmark compare to methods used for typical aquatic life criteria?
- Is the underlying assumed mechanism for impairment—toxicity from ions associated with salinity—mechanistically plausible and is the proposed benchmark value consistent with thresholds obtained in controlled laboratory-based toxicity tests?
- Is the confounding factors analysis convincing, i.e., do we agree that factors correlated with conductivity do not substantially confound or obscure biological relationships with conductivity?
- What is the ecological relevance of the proposed benchmark value?

3.1 Diversity of Conflicting Stressor-Response Profiles

One of the underlying principles governing the use of an SSD to derive biological thresholds is that all of the organisms represented in the distribution exhibit the same type of response to the stressor in question (Posthuma et al. 2002). However, three types of stressor-responses are recognized by EPA (2010), as exemplified in Figure 5 of EPA (2010, p. 30):

- decreasing probability of observation with increasing conductivity,
- increasing probability of observation with increasing conductivity, and
- optimal or "bell-curve" probability of observation with increasing conductivity.

In addition to these three stressor-response profiles, a fourth type not recognized by EPA—but frequently observed in their dataset—is characterized by basically no response or a bimodal, "inverse optimal" response to conductivity (Figure 1).

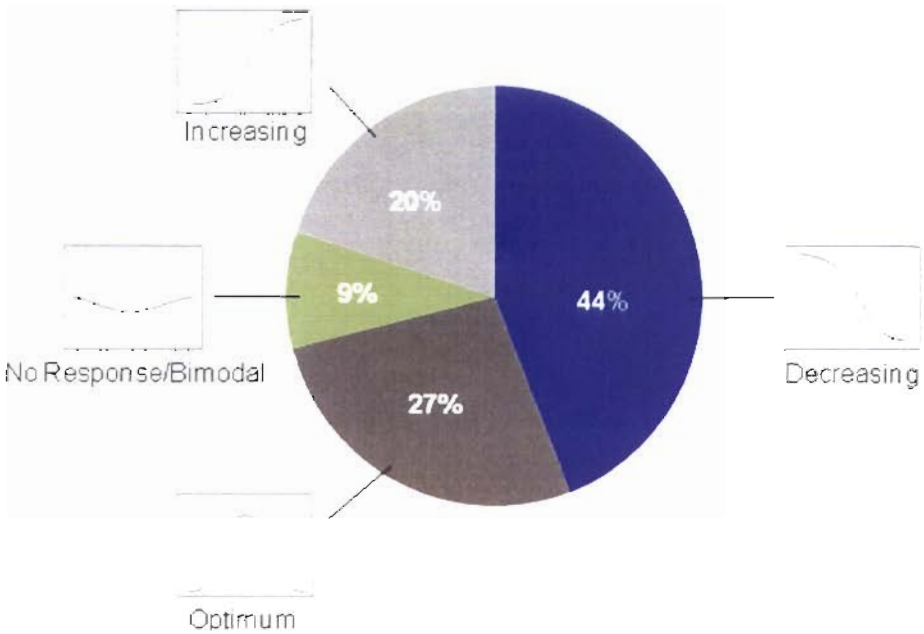

Figure 1: Percentage of genera with different types of stressor-response profiles with respect to conductivity and probability of capture (data from EPA 2010).

A more typical response would be for each of the taxa to respond negatively (e.g., decreased survival, growth, or reproduction) to the presence of a particular contaminant. A graphical representation of this type of response (i.e., the stressor-response profile) would resemble the "decreasing" probability distribution for *Ephemerella* in Figure D-1 of EPA (2010; Figure 2 below), where the y-axis shows the response (i.e., capture probability) and the x-axis shows the concentration of the stressor that is presumably inducing that response (i.e., conductivity). In this case, to be protective, it appears that conductivity should always be below roughly 300 µS/cm.

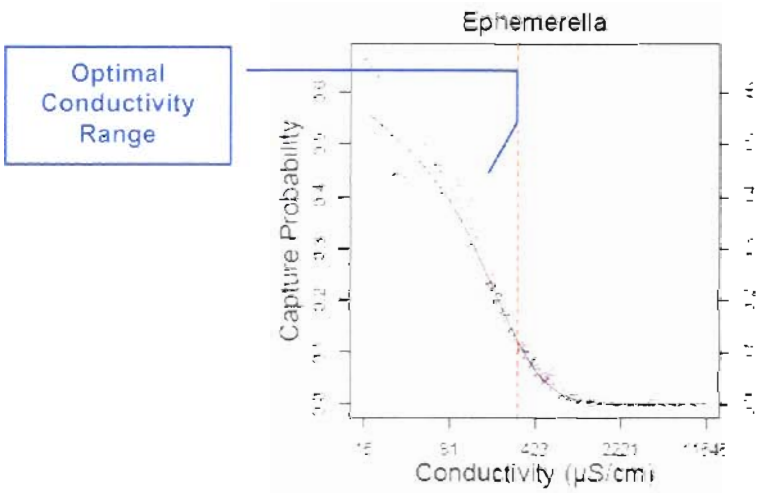

Figure 2: *Ephemerella* capture probability versus conductivity (Figure D-1 from EPA 2010). The approximate conductivity protective of this genus is indicated by the Optimal Conductivity Range.

Under this circumstance, the effect concentration at which a negative response is observed and also corresponds to the desired level of protection can be calculated for each species. The effect concentration can take many forms (e.g., a 10, 20, or 50% effect concentration—often represented as EC_{10}, EC_{20}, EC_{50}—where 10, 20, or 50% of the organisms are adversely affected), but under a decreasing stressor-response profile, the effect concentration will always be on the low end of the x-axis scale (i.e., where the adverse response occurs to a lesser extent). These calculated effect concentrations can then all be compiled into one SSD and the percentile of the distribution that corresponds to the desired level of protection for the community can be derived (e.g., most often the 5th percentile "hazard concentration" or HC_{05}).

Note, however, that this approach to building an SSD is *only valid* when all of the organisms incorporated into the SSD respond similarly to the stressor, since it assumes a protective level set at the lower end of the distribution (i.e., where organisms are more sensitive) will also protect all of the species at the upper end of the distribution (i.e., where organisms are less sensitive). This is simply not the case with the data used by EPA (2010).

For example, some organisms in the EPA analysis appear to respond favorably in the presence of conductivity, as shown in the "increasing" stressor-response profile exhibited by *Hemerodromia* in Figure D-1 of EPA (2010; Figure 3 below). Under this circumstance, to be protective, it appears that conductivity should always be *above* roughly 300 µS/cm—a direct contradiction to the "decreasing" stressor-response profile shown above.

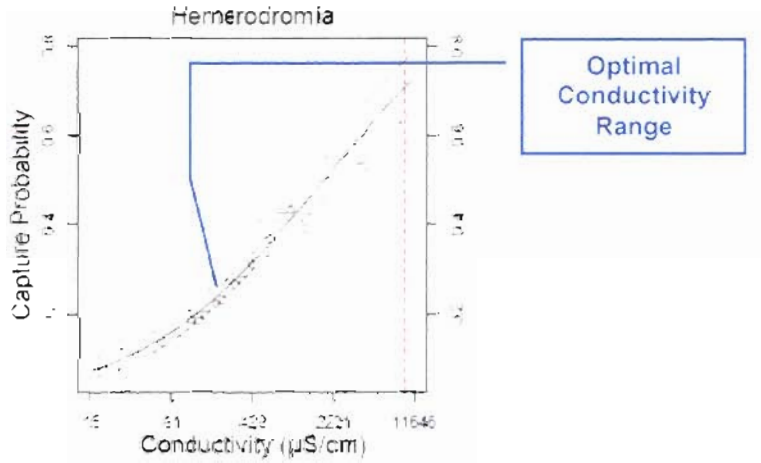

Figure 3: *Hemerodromia* capture probability versus conductivity (Figure D-1 from EPA 2010). The approximate conductivity protective of this genus is indicated by the Optimal Conductivity Range.

Additionally, some organisms appear to respond *negatively* at both the low and high end of the range of conductivity levels, but favorably in the middle of that same range. This "optimum" type of stressor-response profile would resemble that shown in the *Psephenus* panel in Figure D-1 of EPA (2010; Figure 4 below). Here, it would theoretically be necessary to always have conductivity greater than roughly 75 µS/cm and less than roughly 2,500 µS/cm; i.e., one threshold at the low and one at the high end of the x-axis where negative responses are observed.

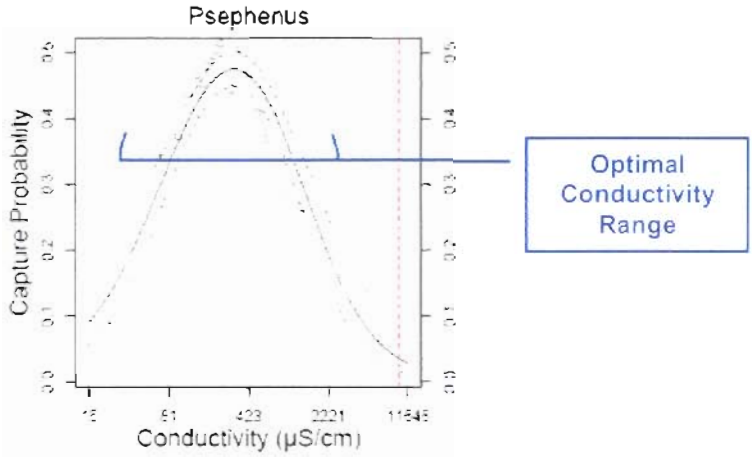

Figure 4: *Psephenus* capture probability versus conductivity (Figure D-1 from EPA 2010). The approximate conductivity protective of this genus is indicated by the Optimal Conductivity Range.

Alternatively, some organisms appear to respond *positively* at both the low and high end of the range of conductivity levels, but poorly in the middle of that same range. This type of "bimodal" stressor-response profile would resemble that shown in the *Diplectrona* panel in Figure D-1 of EPA (2010; Figure 5 below). Here, it would theoretically be necessary to always have conductivity less than roughly 200 µS/cm and greater than roughly 2,000 µS/cm; i.e., two thresholds bracketing the middle of the x-axis to capture the range where negative responses are observed.

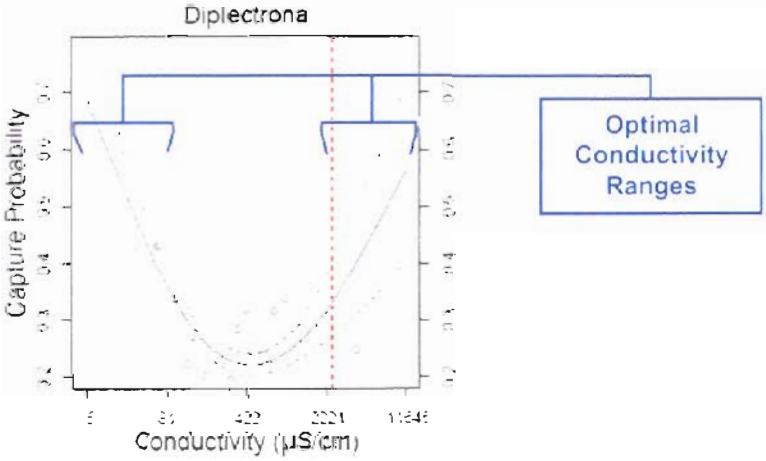

Figure 5: *Diplectrona* capture probability versus conductivity (Figure D-1 from EPA 2010). The approximate conductivity protective of this genus is indicated by the Optimal Conductivity Range.

Finally, some organisms would appear to have very little response to a stressor at all, as shown in the "No-response" *Tvetenia* stressor-response profile in Figure D-1 of EPA (2010; Figure 6 below), making it difficult to identify any kind of effect concentration indicative of a negative response.

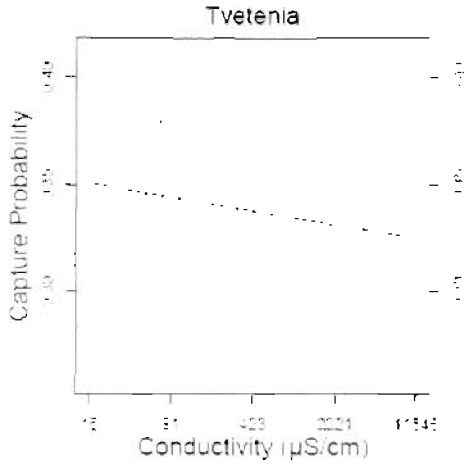

Figure 6: *Tvetenia* capture probability versus conductivity (Figure D-1 from EPA 2010). There does not appear to be an Optimal Conductivity Range for this genus.

In summary, the approximate conductivity concentration necessary to provide a level of protection used by EPA, based on capture probability, for the five stressor-response profiles discussed above would be as follows:

- Decreasing (*Ephemerella*): < 300 µs/cm
- Increasing (*Hemerodromia*): > 300 µs/cm
- Optimum (*Psephenus*): > 75 and < 2,500 µs/cm
- Bimodal (Diplectrona): < 200 and > 2,000 µs/cm
- No response/bimodal (*Tvetenia*): none

As this example shows, there is simply no way to reconcile these widely conflicting stressor-responses into a single benchmark. More specifically, if one accepts that the capture probability curves in Appendix D (EPA 2010) represent actual stressor-response relationships, selecting a protective benchmark at the lower end of the distribution will actually result in organisms with increasing and/or optimal stressor-response profiles ***not*** being protected.

If these types of varied effect concentrations were combined into one SSD and a percentile at the low end of that distribution were selected as the protective benchmark, only the *Ephemerella* would be protected since both *Hemerodromia* and *Psephenus* would require a much higher benchmark to ensure a similar capture probability. In fact, an effect concentration of 80 µs/cm (required for a capture probability of 40% for *Ephemerella*) would correspond to a capture probability of less than 20% for *Hemerodromia* and less than 35% for *Psephenus*. Inversely, an effect concentration of 1400 µs/cm (required for a capture

probability of 40% for *Hemerodromia*) would correspond to a capture probability of zero percent for *Ephemerella*. Thus, for 56% of the total genera that do not follow the classic stressor-response profile, the proposed benchmark of 300 µS/cm could actually be interpreted as harmful—i.e., not protective. As evidenced by their conflicting stressor-response profiles, these organisms would appear to respond to the stressor in fundamentally different ways.

The natural variability of organisms in their response to stressors is to be expected given the corresponding variability in species-specific physiological and ecological mechanisms for responding to stressors in the environment. This phenomenon becomes problematic, however, when trying to establish a single numerical benchmark for protection of a community in which species exhibit multiple stressor-response profiles. This is because, as discussed above, the effect concentration corresponding to a negative response has the potential to exist on both ends of the x-axis (i.e., low end for decreasing, high end for increasing, low and high end for optimum) or even potentially in the middle of the distribution.

It is understood that there is some subjectivity in the interpretation of the shape of the individual stressor-response profiles. However, the increasing, optimum, and decreasing stressor-response profiles are each well represented in the dataset used in the SSD to derive the benchmark (Figure 1), with less than half of the taxa in EPA's final dataset exhibiting the stressor-response profile of decreasing abundance with increasing levels of the presumed stressor. Thus, 56% of the taxa used by EPA to generate their SSD *do not* actually show the classic dose-response of decreasing probability of capture with increasing conductivity—yet were still used by EPA in their SSD calculations. It is not appropriate to say that the proposed benchmark would prevent extirpation of 95% of taxa when 56% of the taxa in the dataset do not exhibit a decreasing stressor-response profile and would potentially be absent if conductivity were restricted to those low conductivity levels.

The EPA dataset includes organisms from numerous taxonomic orders. The best represented groups include Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, and Diptera. Even among these taxa, each of the groups exhibit the multiple conflicting stressor-response profiles noted above, although the Ephemeroptera and Plecoptera were only represented by the decreasing and optimum profiles (Figure 7). Interestingly, the Plecoptera and Trichoptera tended to have higher proportions of decreasing stressor-response profiles than the Ephemeroptera, with 76 and 63%, respectively.

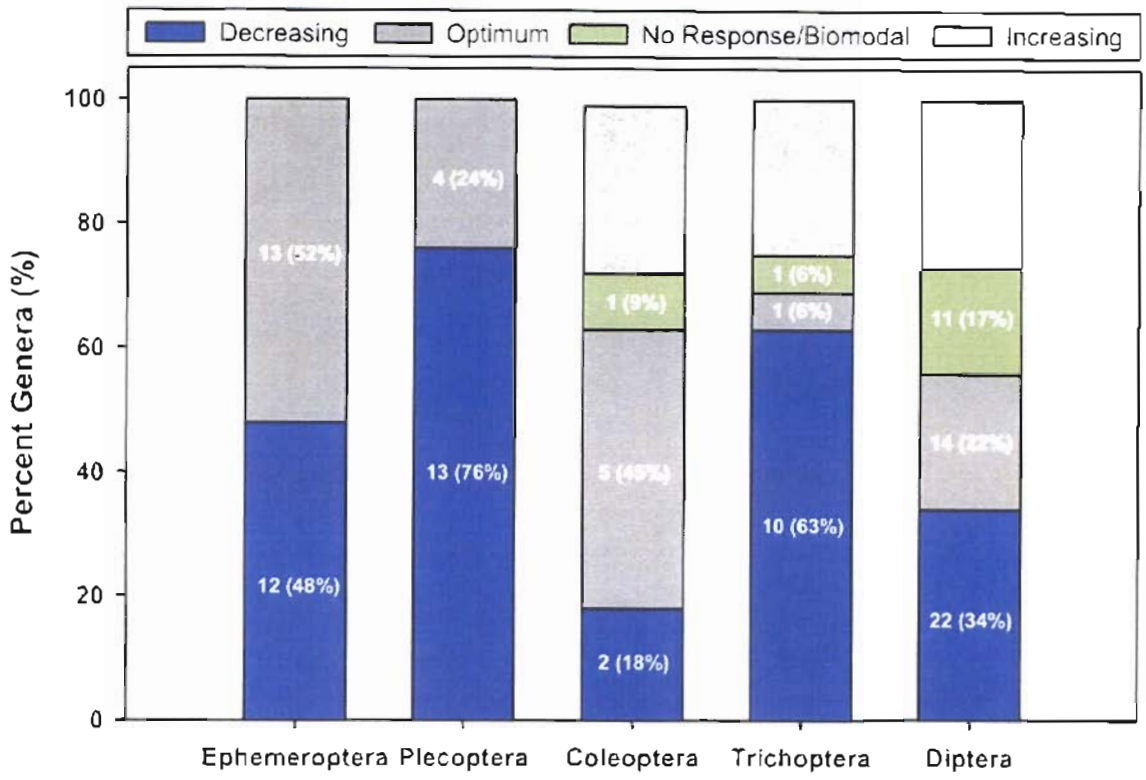

Figure 7: Percent of genera (based on total number of taxa) in selected insect orders with identified stressor-response profiles (data from EPA 2010).

Conflicting stressor-response profiles by individual genera strongly indicate that conductivity is not the dominant or singular stressor that can be shown to limit the entire macroinvertebrate community above a single fixed threshold or benchmark value. This suggests that either different invertebrate genera exhibit fundamentally different responses to elevated conductivity, or factors other than conductivity are more closely and functionally related to the capture probability of individual genera across the study region.

In summary, we believe that there is a fundamental flaw associated with using SSDs to derive an HC_{05} level on the basis of such conflicting stressor-response profiles. An SSD is intended to depict the distribution of sensitivity across numerous genera to a single stressor (Posthuma et al. 2002). However, if some of the genera on the SSD are responding to the stressor in fundamentally different ways (see above), then it is inappropriate to include them in the same SSD. Additionally, since the derivation of this benchmark is based solely on field-derived data, the same stressor (conductivity) may not be accurately depicted in the individual XC_{95}s or the subsequent SSD. Therefore, the use of an SSD of XC_{95} values based on conflicting stressor-response profiles is a fundamentally flawed method for derivation of a regulatory benchmark. This, alone, is grounds for not adopting this benchmark.

3.2 Comparison of Derivation Method to Typical Aquatic Life Criteria

Although EPA (2010) states that methods for derivation of the conductivity benchmark are "based upon" the 1985 Guidelines for derivation of AWQC, the only similarity is that both derive the benchmark/criteria concentration as the 5th percentile of species sensitivities using an SSD. However, the SSDs used for derivation of AWQC are based on controlled laboratory toxicity data from studies in which the stressor (e.g., a toxic chemical) is empirically and unambiguously manipulated in studies that follow standardized and scientifically valid protocols for individual species. The biological endpoints used (based on survival, growth, or reproduction) in AWQC derivation are based on relatively uniform and consistent stressor-response profiles generated from statistical analysis of the laboratory toxicity test data. In other words, even though individual organism "sensitivities" to a given chemical will differ from one another, they all must demonstrate similar kinds of monotonically increasing adverse effects in response to increasing chemical exposure concentrations (i.e., each test must exhibit a consistent "dose-response") to be included in the SSD. In addition, to help ensure that the total range of chemical sensitivities of organisms likely to be encountered in a broad range of field conditions is represented, a minimum database of eight specific types of aquatic organisms (i.e., the "eight family rule") is required before an AWQC can be derived (Stephan et al. 1985).

In contrast, the conductivity benchmark is derived based on a large number of macroinvertebrate genera, but does not represent the total range of aquatic organisms that inhabit these ecosystems. The 1985 Guidelines' eight family rule requires data from fish, planktonic crustaceans, and aquatic plants or algae to ensure protection of all aquatic life, so a benchmark based only on benthic macroinvertebrates will not necessarily represent a concentration that is protective of the entire aquatic ecosystem.

Furthermore, as stated in Section 3.1, the SSD used to derive the conductivity benchmark is not based upon a consistent set of stressor-response profiles. As before, it may be that those genera with narrow optima or increasing stressor-response profiles are, in fact, responding more strongly to something other than conductivity within the ranges of conductivity being observed. Further, it is very clear for those genera that have no response or a bimodal response that their distribution is related to something other than conductivity. Therefore, the use of an SSD of XC_{95} values based on conflicting stressor-respond profiles is a fundamental flaw in the approach proposed by EPA and is not consistent with Stephan et al. (1985).

3.3 Evidence of Causation

It is well known that associations between biological patterns as a function of one or more chemical stressors in the field are not necessarily causal, nor are they free from other factors that may confound or obscure the presumed association. Therefore, EPA conducted a causal assessment (Appendix A of EPA 2010) which was reportedly based on epidemiological

approaches (e.g., Hill 1965, Cormier et al. 2010) and EPA guidance for conducting stressor identification and diagnosis (EPA 2000; www.epa.gov/caddis).

The general elements evaluated in EPA's causal analysis were as follows (adapted from Table A-1 in EPA 2010):

- *Co-occurrence*: Evaluates whether the presumed cause co-occurs with the unaffected entity[1] in space and time
- *Preceding causation and time order*: Evaluates whether each presumed causal relationship is a result of a larger web of cause and effect relationships, and whether the presumed cause precedes the effect in time
- *Interaction*: Evaluates whether the presumed cause physically interacts with the entity in such a way that induces the effect, and results from known and reliable biological or physiological mechanisms
- *Specific alteration*: Evaluates whether the entity is changed by the interaction with the presumed cause
- *Sufficiency*: Evaluates whether the intensity, frequency, and duration of the presumed cause are adequate, and that the entity is susceptible (i.e., will exhibit biological impairment) at the appropriate levels of the presumed cause.

For each of these causal elements, EPA (2010) presented a series of weight of evidence scores to indicate their interpretation of how different lines of evidence support or weaken evidence of causation for that particular element. It was not entirely clear how individual scores were assigned or summarized for each causal element, but they appear to have generally followed guidance from CADDIS, in which a score of "+" indicates evidence that strengthens the case in support of the cause, a score of "-" indicates evidence that weakens the case in support of the cause, and a score of "0" indicates inconclusive evidence. However, EPA did not provide any indication of how summary scores were provided for each causal element, nor did they include "refutation" which is a logical process which recognizes that a causal hypothesis can be falsified (i.e., refuted) with greater confidence than it can be accepted. Unlike CADDIS, EPA (2010) made no apparent attempt to evaluate whether any given line of evidence might have refuted conductivity as the presumed cause of impairment.

While causal analysis is a highly logical and structured process, assigning weights to lines of evidence is a highly subjective task based on professional judgment. Below we summarize and review our impressions of the subjective weighting assignments used by EPA in Appendix A, and offer alternative interpretation of the strength or weakness of each causal element based on our own professional judgment and the data EPA provided.

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[1] In this context, "entity" represents the benthic macroinvertebrate community and presumed loss of sensitive taxa under conditions of elevated salinity or conductivity.

3.3.1 Co-occurrence

Based on a relatively limited set of correlational data from the WABbase and Pond et al. (2008), EPA concludes that "the evidence for co-occurrence of conductivity with biological effects is strong, relevant, consistent, and of high quality and is, therefore conclusive" (p. 45, EPA 2010). However, we do not agree that this evidence is sufficiently strong or consistent, and so is inconclusive to weakly conclusive at best. In particular, the relationships between conductivity and the number of ephemeropteran genera (Figures A-1 and A-2; EPA 2010) exhibit a substantial amount of variability around the regression lines plotted on these figures. Temporal increases in conductivity (Table A-5; EPA 2010) do exist in two sites with permitted mining operations over the same time period. Conductivity did not increase in the unmined Ash Fork. But these data are extremely limited, and invertebrate data are not available for most of times that conductivity was measured. Finally, like the confounding factors analysis in Appendix B (EPA 2010), only conductivity relationships with mayflies were evaluated by EPA. Given the diversity in conductivity-response patterns exhibited by all the taxa in the WABbase (Section 3.1), correlations with conductivity are neither consistent nor strong for many taxa.

Based on our evaluation of co-occurrence as a causal element, we suggest the following adjustments to the weight of evidence scores (Table 1). These scores lead to an overall conclusion that evidence in support of this causal element is neither sufficiently strong nor consistent, and so are inconclusive to weakly conclusive in support of conductivity as a cause of impairment.

Table 1: Summary of evidences and scores for co-occurrence, including alternative interpretations (adapted from Table A-6; EPA 2010).

Type of Evidence	Evidence	EPA Score	Suggested Score
Correlation of Cause and Effect	Ephemeroptera were correlated with conductivity in two studies $r = -0.63$ (see Figure A-1) and $r = -0.90$. This is strong quantitative evidence from multiple studies. *Alternative Interpretation: High variability in Figures A-1 and A-2 exists, and relationships with other taxa are inconsistent.*	+ + +	0
Contingency Table	The contingency table (see Table A-4) provides strong quantitative evidence that high conductivity is strongly associated with severe effects (Ephemeroptera absent at >75% of sites). *Alternative interpretation: Relationships are based only on mayflies, and relationships with other taxa inconsistent.*	+ +	+
Co-occurrence in Paired Watersheds Over Time	24% to 100% difference (see Table A-5) is large and quantitative. *Alternative interpretation: Limited temporal dataset: somewhat inconclusive.*	+ +	0 to +
Overall Score	Relevant, strong, consistent. *Alternative interpretation: Relevant, weak, inconsistent.*	+ + +	0 to +

3.3.2 Preceding Causation

EPA cites several literature sources, as well as data from the WABbase, to conclude that conductivity is consistently elevated downstream of MTM/VF activities in this region. Furthermore, evidence is presented that the waters with elevated conductivity represent a relatively uniform and "characteristic" composition consisting of elevated concentrations of Ca^{2+}, HCO_3^-, Mg^{2+}, and SO_4^{2-} (EPA 2010). We recognize that conductivities can be elevated in waters associated with these activities, but we do not agree that the ionic composition of waters with elevated conductivity is necessarily consistent (Section 3.3.2.1). As we summarize in Table 2, our interpretation of the data supporting preceding causation is relevant and strong, but because ionic composition varies with conductivity, these relationships are not necessarily consistent.

Table 2: Summary of evidences and scores for preceding causation, including alternative interpretations (adapted from Table A-8; EPA 2010).

Type of Evidence	Evidence	EPA Score	Suggested Score
Complete Source-to-Cause Pathway	Sources are present, and no intermediate steps in the pathway are required. *Agree.*	+	+
Correlation of Conductivity with Sources	Figure A-3, $r = 0.61$. This is moderately strong quantitative evidence from the case. *Agree.*	+ +	++
Evidence from Literature	Multiple publications link conductivity to sources in the region and eliminate some other land uses as sources. *Agree.*	+	+
Co-occurrence of Sources and Conductivity	When valley fills are present, conductivity is 12- to 90-fold greater than at unmined sites (see Tables A-5 and A-7). This is strong quantitative evidence from the case. *Agree.*	+ +	++
Characteristic Composition	Ambient mixtures of ions have characteristic compositions that can be associated with particular sources. Most sites with elevated conductivities have compositions characteristic of coal mining with valley fill. This is relevant but quantitatively weak evidence. *Alternative interpretation: Ionic composition not necessarily consistent with elevated conductivity.*	+	-
Overall Score	Relevant, strong, consistent. *Alternative interpretation: Relevant and strong, but not consistent with respect to ionic composition.*	+ + +	++

3.3.2.1 Sulfate—alkalinity relationships

One of EPA's basic premises is that conductivity is a good predictor of biological responses because it is a strong surrogate for ionic stressors, such as sulfate (SO_4^{2-}) and bicarbonate (HCO_3^-), ions that are more functionally related to biological effects. However, this premise is only valid if the relative composition of these ions remains relatively constant regardless of conductivity. This is particularly important because the biological effects of major ions related to salinity are most strongly related to ion composition, not conductivity (Mount et al. 1997; see Section 3.3.5 for additional discussion).

To evaluate this issue, we examined the relationships between conductivity, sulfate, and total alkalinity (the most proximate empirical measure of bicarbonate) for the filtered WABbase dataset ($n = 2,152$). Total alkalinity ($CaCO_3$) measures ($n = 1,370$) were assumed to represent bicarbonate alkalinity, even though values were not converted to bicarbonate fraction using pH in the dataset provided by EPA. Still, the vast majority of sites revealed pH levels between 6 and

8.5 units, indicating total alkalinity would primarily consist of bicarbonate alkalinity.
The relationship between total alkalinity and sulfate indicates there is a shift in the relative dominance of these two ions across the range of available conductivity values. Bicarbonate alkalinity is largely influenced by pH; thus, the relationship exhibits an upper threshold, while sulfate ions continue to increase in concentration (Figure 8). In general, sites that exhibit sulfate concentrations less than 70 mg/L typically revealed that bicarbonate ions were the more dominant ion with respect to these two ions. However, at approximately 70 mg/L there is a shift in the relationship and sulfate ions become more dominant. Overall, given the lack of a true one-to-one relationship between these ions, it is clear they do not "move together" as conductivity increases, in contrast to what EPA said during their presentation to the SAB Committee.

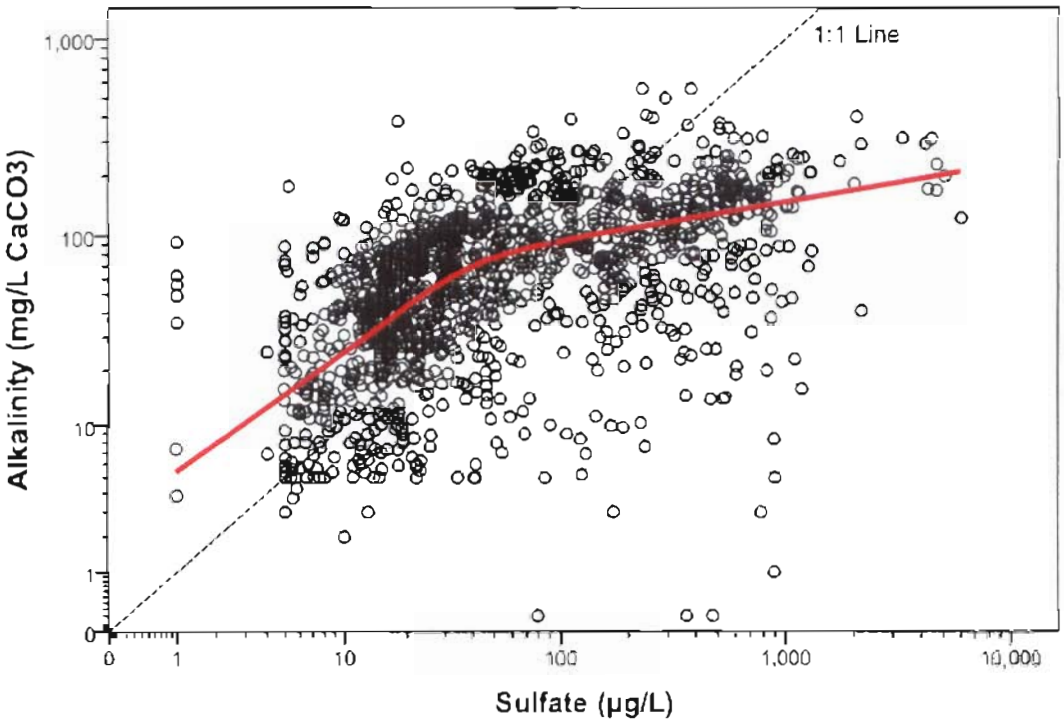

Figure 8: Relationship between total alkalinity and total sulfate in streams of West Virginia, Ecoregions 69 and 70. Locally weighted scatterplot smoothing (LOESS) regression line is based on 66% smoothing function.

To further explore assumption that these ions "move together" with increasing conductivity, a sulfate to total alkalinity ratio was computed for the available samples and plotted with specific conductance (Figure 9). A ratio of 1 indicates a balance between the ions, in terms of mass, a value greater than 1 indicates sulfate is the more dominant ion, and a value less than 1 indicates total alkalinity is more dominant. The LOESS regression (66%) line shows a distinct inflection point in the ratios at approximately 300 µS/cm. The trend in the ratios is slightly negative when conductivity values range between 15 and 300 µS/cm, indicating alkalinity is the more dominant ion at lower conductivity values. In contrast, the trend increases greatly when conductivity is greater than 300 µS/cm, indicating the sulfate ion becomes more dominant as conductivity

increases. This difference in sulfate and alkalinity dominance and their relationship to conductivity indicates that conductivity is not a consistent or reliable surrogate for concentrations of these individual ions. Given that major ion toxicity is a function of ion ratios and total concentration, conductivity is likely to be a poor predictor of toxicity in this dataset.

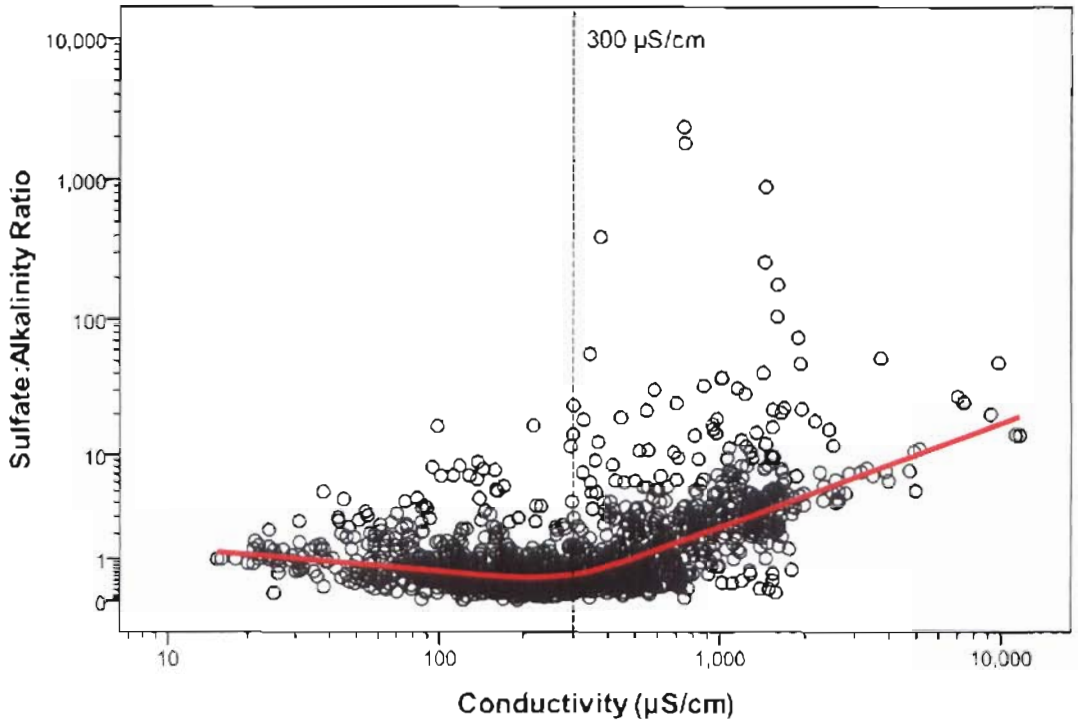

Figure 9: Relationship between total sulfate and total alkalinity ratio and conductivity in streams of West Virginia, Ecoregions 69 and 70. LOESS regression line is based on 66% smoothing function.

3.3.3 Interaction and Physiological Mechanisms

Physiological stress from inorganic ions related to salinity was cited by EPA as one of the most plausible mechanistic reasons supporting use of a conductivity benchmark for macroinvertebrate community impairment. In particular, in Appendix A of EPA (2010), salinity is regarded as the mechanistically plausible, primary cause of macroinvertebrate community impairment. Salinity (and its resulting empirical measure, conductivity) is a property of water that represents the total concentration of dissolved mineral salts or "major ions", including Na^+, Ca^{2+}, Mg^{2+}, K^+, Cl^-, HCO_3^-, CO_3^{2-}, and SO_4^{2-}. One of the basic premises of EPA (2010) is that elevated concentrations of these ions causes physiological stress in macroinvertebrates, ultimately leading to the extirpation of the most sensitive species in waters with conductivity levels that exceed the proposed benchmark of 300 µS/cm.

From the literature they summarize, EPA (2010) concludes that evidence in support of this causal element is relevant, but not case-specific (Table A-9; EPA 2010). To a limited extent we agree with this conclusion, but our interpretation of the physiological literature suggests

relationships between conductivity and specific macroinvertebrate taxa are neither strong nor consistent. Therefore, even though this mechanism may be to some extent plausible, additional study is needed for this to provide conclusive support for this causal element. Our interpretation of the physiological literature is provided below.

3.3.3.1 Effects of salinity on osmoregulation and ionic homeostasis of aquatic organisms

The importance of osmoregulatory mechanisms in maintaining ionic balance (i.e., homeostasis) within all freshwater invertebrates is well documented. Most of the documents cited by EPA in this section are animal physiology and biochemistry books that adequately address the topic. As we discuss below, however, the specific comparative mechanisms of osmoregulatory disruption in different taxonomic groups which might be used to explain differential tolerance to salinity are not yet well understood. Ultimately, we suggest there is a need for further investigation of sub-lethal responses to high salinity exposure for a wide variety of sensitive and tolerant freshwater invertebrate taxa to confirm the mechanistic reasons which might explain taxonomic patterns of sensitivity.

Our review provided additional literature not cited by EPA and discussed active ion absorption by specialized body structures, particularly in snails, mussels, leeches, dragonfly nymphs, crayfish, and some dipteran larvae (Smith 2001). In the insects, these structures include individual chloride cells, fields of chloride cells (known as chloride epithelia), and other absorptive structures on papillae or within the gut system. Individual chloride cells are present in some members of Ephemeroptera, Plecoptera, and Hemiptera, while chloride epithelia are present in some members of Trichoptera, Odonata, and Diptera (Komnick 1977). In addition, some Diptera, Trichoptera, and Coleoptera have intestinal or papillar ion absorption sites (Komnick 1977). Osmoregulation by aquatic invertebrates may also depend upon integument permeability, which varies by taxonomic group (Pennack 1978, cited in Pillard et al. 1999) and age, because older organisms may have thicker and less permeable surfaces (Pillard et al. 1999).

EPA (2010) acknowledged the existence of numerous physiological mechanisms involved in the toxicity of high conductivity waters. EPA (2010) mentioned mortality as one of the effects of elevated salinity, citing Kefford et al. (2003, 2005a). We confirmed the accuracy of the first citation; however, Kefford and Nugegoda (2005) (as the citation appeared in the EPA references section, page 54, not Kefford et al. 2005a which is an incorrect citation) reported sublethal effects (growth and reproduction), and not mortality, from elevated salinity to the fresh water snail *Physa acuta*. EPA (2010) also described sublethal effects from salinity, such as reduced growth, reproduction, and hatching success, citing Clark et al. (2004), but this study showed salinity had opposite effects on two mosquito species, indicating differing or inconsistent physiological responses. A negative effect on growth rate due to increased salinity was observed in *Aedes aegypti*, while increased salinity had a positive effect with increased pupal mass in *Ochlerotatus taeniorhynchus* (Clark et al. 2004).

Several studies suggest tolerance of Diptera and Crustacea to elevated salinity. Dipterans are the most diverse group of insects in the aquatic environment (40% of insect taxa), and they possess morphological adaptations, such the presence of papillae, for regulation of salt concentration (Thorp and Covich 2001). Furthermore, because some dipteran species are capable of hypo-osmotic regulation, they are the only insect order that has successfully colonized highly saline waters (Hart et al. 1991). Some amino acids and carbohydrates in the hemolymph of the mosquito *Culex tarsalis* have an osmoregulatory role, allowing them to adapt to water with increasing salinity (Bradley and Garret 1986, cited in Natochin and Parnova 1987).

Freshwater crustaceans are relatively competent osmoregulators (Thorp and Covich 2001). The extreme tolerance of some freshwater decapods (*Amarinus lacustris*, *Paratya australiensis*, and *Caridina nilotica*) to salinity may be phylogenetically derived (Kefford et al. 2003). Adaptations in decapods include the epicuticular layer of the gill laminae, with a high selectivity to Cl^- and OH^- over all other ions normally present in freshwater and in the hemolymph (Avenet and Lignon 1985). Additionally, cladocerans frequently demonstrate very refined physiological adaptations to elevated salinity, as effective as those of decapods or even teleost fish (Aladin and Potts 1995).

Some studies reported negative effects of elevated salinity or conductivity on some Plecoptera, Nematoda, Oligochaeta, and Hydracarina. Salinity tolerance and osmotic stress were evaluated on the nymphs of the stonefly *Paragnetina media*, where mortality reached 80% in 1.2% NaCl (382 mOsm/L) and survivors after the 72-h exposure had slightly hyperosmotic hemolymph when compared to the exposure medium (Kapoor 1979). Piscart et al. (2006) observed changes in the distribution of macroinvertebrate life history traits (i.e., salinity preferences, maximum size, life cycle duration, reproduction, potential generations per year, respiration, dispersal, and feeding habits) among sites with varying salinity in France. For example, taxa with multivoltine life cycles, asexual reproduction, ovoviviparity, and filter-feeding traits were more frequent at sites with higher salinity levels. The authors concluded that salinity promotes more generalist and permanently aquatic taxa and the reduction of specialized, semi-aquatic taxa (Piscart et al. 2006).

Although several studies (Hassell et al. 2006; Kefford and Nugegoda 2005; Kefford et al., 2004, 2006, 2007) evaluated the effects of elevated salinity on other types of aquatic macroinvertebrates, the authors do not claim conclusive support of negative effects, but rather recommend further testing. In addition, EPA (2010) cited Zalizniak et al. (2007) as stating that reduced population density occurs over generations after elevated conductivity exposure. Based on the journal and article title from the Literature Cited section of EPA (2010), this citation should have been Zalizniak et al. (2009). We were unable to find any statement in Zalizniak et al. (2009) that supports this conclusion.

In summary, osmoregulatory mechanisms for maintaining ionic balance in freshwater invertebrates are well documented. However, the specific comparative mechanisms of

osmoregulatory disruption in each of these taxonomic groups which explain differential tolerance to salinity are not yet well understood. There is a need for further investigation of sub-lethal responses to high salinity exposure for a wide variety of sensitive and tolerant freshwater invertebrate taxa to confirm the mechanistic reasons which might explain taxonomic patterns of sensitivity. Therefore, we conclude that evidence in support of this causal element is relevant and not case-specific, but not necessarily strong or consistent (Table 3).

Table 3: Summary of evidences and scores for interaction and physiological mechanism, with alternative interpretations (adapted from Table A-9; EPA 2010).

Type of Evidence	Evidence	EPA Score	Suggested Score
Mechanism of Exposure	Salts readily dissolve in water and interact directly with aquatic organisms. *Agree.*	+	+
Mechanism of Effect	Many mechanistic studies show that osmoregulation and homeostasis of specific ions are sensitive to disruption, particularly in mayflies. *Alternative interpretation: Taxonomic patterns of sensitivity are not necessarily consistent, and are highly dependent on specific ionic composition of exposure solutions.*	+	0
Direct Evidence	No studies of ionic compensation are available for organisms in the region. *Agree.*	NE	NE
Overall Score	Relevant but not case-specific. *Alternative interpretation: Relevant and not case-specific, but not necessarily strong or consistent.*	+	0 to +

3.3.4 Specific Alteration

3.3.4.1 Sensitivity and tolerance of specific genera to salinity

Section A.2.4 of EPA (2010) cites what they believe to be strong, relevant, and consistent evidence supporting the specific effects of elevated conductivity on benthic invertebrates, particularly for Ephemeroptera. However, as discussed above, there is a lack of physiological studies to explain the specific mechanisms of ion toxicity and the reported higher sensitivity of Ephemeroptera to salinity compared to other macroinvertebrates. As noted above, some studies have found increased sensitivity of Ephemeroptera, Plecoptera, and Trichoptera taxa to higher salinity levels (Kefford et al 2003, 2004); however, there is considerable variability even within these orders, and little is known about the physiological mechanisms that drive the proposed sensitivity of these taxa.

EPA (2010) relied on relatively few studies that evaluated empirical relationships between field occurrence of Ephemeroptera and water chemistry. For example, Pond (2010)

(incorrectly cited in EPA 2010 as Pond 2009) evaluated data from 92 headwater streams in the Appalachian Mountains of Kentucky to explore and describe regional patterns of diversity and distribution of lotic Ephemeroptera in relation to two stressors: coal mining and rural residential land uses. Although Pond (2010) demonstrated a strong correlation between low population densities and taxa richness of mayflies and specific conductance in regions of coal MTM/VF, the study also suggested that other sources of toxicity to mayflies, including exposure to heavy metals, nutrients, organic waste due to bacterial infestation, and a mixture of potentially harmful chemicals, could also have existed. Therefore, Pond (2010) suggested using specific conductance data, in conjunction with a human disturbance metric, to predict mayfly abundance and richness. EPA (2010) also cited Pond et al. (2008), which concluded that MTM/VF causes downstream biological degradation, given the changes on landscape, hydrology, and potential toxicants discharged. However, Pond et al. (2008) also recognized that additional studies are needed to test ambient downstream waters and synthesized waters that would mimic the ionic components downstream of mines but would not contain any other toxicants (e.g., metals).

In summary, the evidence cited by EPA in support of the specific alteration of presumed sensitive taxa (e.g., mayflies) to elevated conductivity is based only on correlations between field abundance and water chemistry (Pond et al. 2008; Pond 2010) and not from experimental studies. In general, there is a lack of physiological or other laboratory studies to explain and/or confirm the sensitivity of the Ephemeroptera, Plecoptera, and Trichoptera taxa to increased salinity. Therefore, it is difficult to conclude from these data whether the presumed effects from conductivity are strong, relevant, consistent, and of high quality (Table 4).

Table 4: Summary of evidences and scores for specific alteration, with alternative interpretations (adapted from Table A-10; EPA 2010).

Type of Evidence	Evidence	EPA Score	Suggested Score
Specificity of Genera	Specific genera are consistently sensitive to conductivity. This quantitative evidence is independently confirmed. *Alternative interpretation: While some taxa appear to be consistent related to conductivity, this is not true for all taxa considered in the benchmark derivation.*	++	0
Specificity of Assemblage	A model based on specific biology discriminated effects of conductivity associated with mining. *Alternative interpretation: Statistical Analysis in Section 4 does not conclude that conductivity is so strongly associated with changes in species composition as opposed to other factors.*	+	-
Overall Score for Interaction	Relevant, independently confirmed, and consistent, but only two types of evidence. *Alternative interpretation: Relevant, but neither strong or consistent.*	++	- to 0

3.3.5 Sufficiency of Exposure

3.3.5.1 Laboratory tests of defined ion mixtures

In Section A.2.5, EPA (2010) evaluated evidence that laboratory-based exposure to salinity would cause adverse effects to invertebrates (especially mayflies) at concentrations near or above the proposed conductivity benchmark.

There are substantial differences in the toxicity of major ion salts; therefore, it would be expected that there would be differing toxicity in waters of different ionic composition (Mount et al. 1997). For example, Pillard et al. (1999) found that K^+, Mg^{2+}, and HCO^{3-} are the most acutely toxic ions to freshwater organisms; however, ion toxicity is not just a function of the total concentration of any one ion, but also of the balance or ratios between individual cations and anions in any given aqueous solution. This was demonstrated by Mount et al. (1997), which found that the most toxic combination of salts was a 1:1 mixture of K_2SO_4 and $KHCO_3$. The LC_{50} values reported for this ion combination were 390 mg/L for *Ceriodaphnia dubia* and 720 mg/L for *Pimephales promelas* (Mount et al. 1997). EPA (2010) reported that each of these LC_{50}s for *C. dubia* and *P. promelas* corresponds to 438 µS/cm and 1,082 µS/cm, respectively, although the basis of their conversion of ionic concentrations to conductivity is not clear.

Toxicity studies in Mount et al. (1997) were used to derive a salinity/toxicity relationship (STR) model to predict the acute toxicity of specific combinations of major ions related to salinity. EPA (2009; with the same result summarized in EPA 2010) used the STR model to

suggest that salt mixtures in some streams below MTM/VF would cause acute lethality in *C. dubia*. However, the STR analysis provided in EPA (2009) does not appear to be entirely correct. EPA (2009) stated that more than 75% mortality is predicted for *C. dubia* using maximum concentrations for ions reported downstream of MTM/VF in Pond et al. (2008); however, one portion of the STR equations listed in EPA (2009), which were apparently used for these calculations, is incorrect[2]. To evaluate this further, we used the maximum ion concentrations from Pond et al. (2008) as inputs to the correct version of the STR model, and found that the predicted mortality for *C. dubia* is actually 57.4%. Regardless, a salt mixture based on the maximum values from a large dataset does not necessarily represent the salt mixture of an actual site or water sample. Therefore, toxicity predictions from a "mixture" based on the maximum concentration of each ion has limited or no environmental relevance

A more relevant approach would be to use the STR model to predict toxicity of actual water sample chemistries from the dataset used to derive the conductivity benchmark. Therefore, for sites in which such data were available, the concentrations of ions needed to run the STR model were compiled from the WVDEP data for all sites used in derivation of the conductivity benchmark. Notably, potassium concentrations were not available for any of these sites, so STR model runs were conducted at the mean "mined" site concentration (9.9 mg K/L) as reported in Pond et al. (2008) to be conservative. These data were then used to predict 48-hr LC_{50} values for *C. dubia* using the STR model (Mount et al. 1997), and plotted against conductivity for the same water samples (Figure 10). Additional STR model runs were also conducted at mean unmined potassium concentrations, but results did not differ substantially, and so are not presented here.

STR model predictions from the natural water chemistries demonstrated a consistent pattern of decreased percent survival when plotted against conductivity, but significant (i.e., < 90% survivorship) mortality only occurred as conductivity values exceeded 1,000 µS/cm (Figure 10). It should be cautioned that the STR model may not accurately predict the toxicity of ions in these mining-impacted natural waters given that empirical effluent and simulated effluent tests cited below suggest chronic lowest observed effect concentrations (LOECs) for *C. dubia* that are three to four times higher than the acute toxicity predictions from the STR model. Additional study is needed to determine the full extent to which the STR model accurately represents chronic toxicity to sensitive organisms.

Other studies not cited in EPA (2010) investigated the toxicity of various ion mixtures to freshwater invertebrates in laboratory waters. Soucek and Kennedy (2005) found that increasing chloride concentrations reduced the toxicity of sulfate to *Hyalella azteca*, and increasing water hardness ameliorated the toxicity of sodium sulfate to both *H. azteca* and

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[2] The equation for *C. dubia* 48-hr mortality in Mount et al. (1997) is in the form of the regression constant, 8.83 *plus* the remaining equation terms, whereas EPA (2009) shows this same equation in their footnote 11 as 8.83 *multiplied by* the remaining equation terms.

C. dubia. Further studies on the relationship between chloride and sulfate showed that increasing chloride reduced sulfate toxicity over the 5-25 mg/L chloride range, but resulted in increasing mortality over the 25-500 mg/L range (Soucek 2007). In addition, it was determined that the STR model does not account for the protective effect of elevated hardness on TDS toxicity (Soucek 2007). While both of these studies concluded that increasing hardness mitigated sulfate toxicity, both tests were conducted using sodium sulfate salts, and so may not fully represent hardness effects in the presence of cations other than sodium. However, Soucek and Kennedy (2005) hypothesized that toxicity mitigation occurred because increasing calcium concentrations would decrease the permeability of epithelial cells to water and ions, thus reducing the energy required for osmoregulation. There is no reason such a mechanism would not also cause hardness mitigation of sulfate toxicity in the presence of cations other than sodium (e.g., potassium), but this has not yet been subject to experimental test.

As a result of this and similar studies, Soucek (2007) stated, "Clearly, any attempt at water quality standard development, whether based on TDS, conductivity, sodium, or sulfate, should incorporate the fact that the water quality parameters like hardness and chloride strongly regulate the toxicity of high TDS solutions." Therefore, any attempts to use conductivity to evaluate the toxicity of specific water chemistries related to elevated conductivity must be interpreted carefully to ensure that the potentially confounding factors of hardness and chloride have been accounted for.

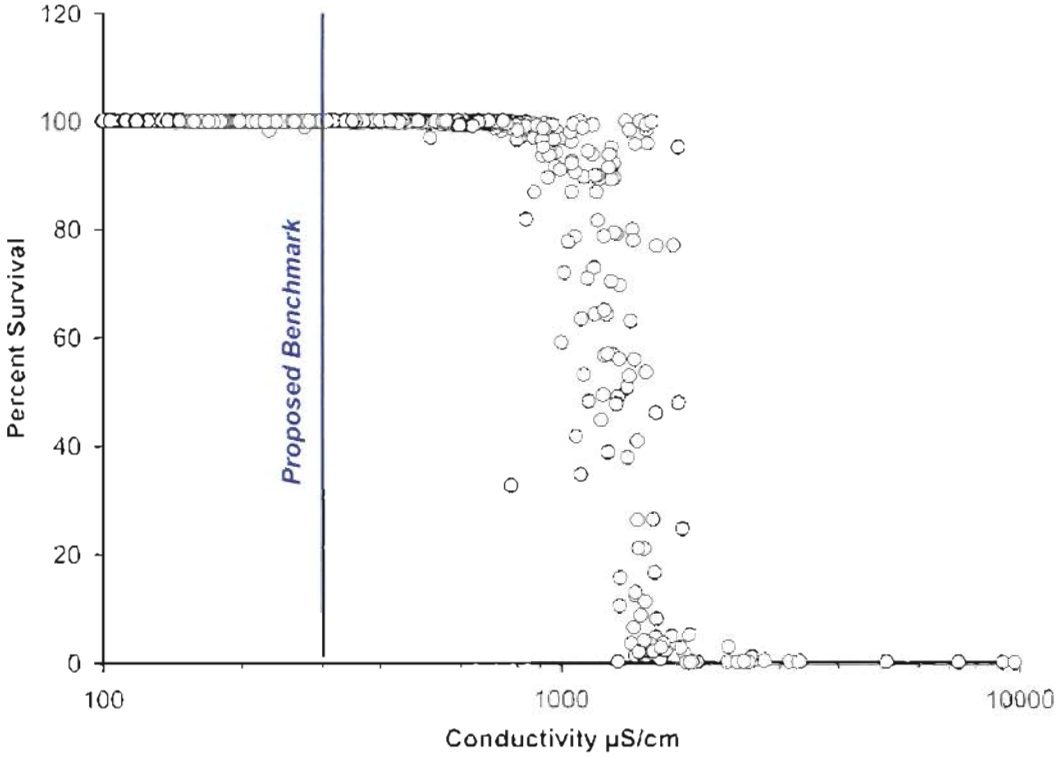

Figure 10: Predicted acute toxicity of natural waters from the WABbase to *Ceriodaphnia dubia* according to the STR model (Mount et al. 1997).

3.3.5.2 Laboratory tests of mine discharges

To evaluate the potential toxicity of coal mine effluents, EPA (2010) cited the Kennedy et al. (2004) study, in which *Isonychia bicolor* mayflies were exposed to simulated coal mine effluent in 7-day tests. The study reported LOECs of 1,562 µS/cm, 966 µS/cm, and 987 µS/cm for mayfly survival at 20°C. These values bracketed the 95th percentile extirpation concentration (XC_{95}) of 1,177 µS/cm, calculated in EPA (2010) for the genus *Isonychia*. However, EPA (2010) failed to include all of the information from Kennedy et al. (2004). In the bioassay test conducted at 12°C on *I. bicolor*, the LOEC for survival was 4,973 µS/cm, which is substantially higher than the calculated XC_{95}. This difference in toxicity can possibly be attributed to the temperature the organisms were accustomed to in the natural environment prior to use in the test, since the organisms used in both the 20°C and 12°C tests were from an over-wintering cohort. Given that the proposed conductivity benchmark is intended to be applied for all times of the year, including tests using various temperatures is important. Additionally, EPA (2010) implied that the *Isonychia* tests were conducted on coal mine discharge waters, when they were actually conducted on simulated effluent.

Effects on *C. dubia* survival and reproduction in 7-day tests were also determined in the Kennedy et al. (2004) study on coal mine effluent and simulated effluent. In the effluent tests, no significant effects on survival were observed at conductivity levels up to 4,730 µS/cm. The LOEC for reproductive effects was observed at 3,254 µS/cm in mine effluent (Kennedy et al. 2004). In simulated effluent, no significant effects on survival occurred up to 4,530 µS/cm and the LOEC for reproductive effects was 3,730 µS/cm. Similarly, chronic effects in simulated effluent tests for which toxicity was most likely attributable to sodium or sulfate (Kennedy et al. 2005) were observed at approximately 3,200 µS/cm in very hard waters (792 mg/L), but as low as approximately 2,000 µS/cm in soft waters (88 mg/L). Kennedy et al. (2003) also conducted 7-day tests on coal processing effluent (from the same sources used in Kennedy et al. 2004) using *C. dubia*. In duplicate tests, the chronic LOECs for *C. dubia* mortality were 4,730 µS/cm and 6,040 µS/cm, and the LOECs for reproduction were 2,910 µS/cm and 3,710 µS/cm.

Echols et al. (2009) also conducted tests on the effects of coal processing effluent on *Isonychia* sp. and *C. dubia*. EPA (2010) provided the LOEC values for *Isonychia* survival, which ranged from 1,508 µS/cm to 4,101 µS/cm; however, *C. dubia* tests conducted in the same study resulted in broadly overlapping LOEC values ranging from 2,132 µS/cm to 4,240 µS/cm (Echols et al. 2009). These data indicate that *Isonychia* and *C. dubia* had similar sensitivities to high conductivity waters, which is contrary to Kennedy et al. (2003, 2004). The variability seen in the tests is not entirely unexpected; salinity tolerance for most species appears to be variable and may fluctuate, depending on abiotic factors such as temperature, pH, and dissolved oxygen (Pillard et al. 1999). Since not all of these factors were reported in Echols et al. (2009), we cannot confirm whether they might have been responsible for some of the variability between tests.

In Echols et al. (2009), three mayfly bioassays and five *C. dubia* bioassays were also run on the coal processing effluent; it is unclear if the studies were concurrent. LOEC values from the three mayfly bioassays ranged from 1,508 µS/cm to 4,101 µS/cm. The final mayfly bioassay exhibited the lowest LOEC, and EPA (2010) attributed this to the dominance of sodium in that test. However, Echols et al. (2009) speculated that the lower LOEC may have been because the mayflies used in that test were from a summer cohort and may have been more sensitive. EPA (2010) also stated that Echols et al. (2009) attributed toxicity to mayflies in all of the studies to salinity because the effluent contained no detectable toxic metals, except for selenium (8.5 µg/L). However, the only effluent that was chemically analyzed (and could therefore support or refute such a claim) was the effluent from the first mayfly bioassay test, which had resulted in the highest LOEC (4,101 µS/cm), and in which there was a poor correlation between survival and conductivity for the first seven days, with improved correlations by day 14 (Echols et al. 2009). The effluent from the two other mayfly studies was not analyzed; therefore, it is unknown if there were any metals or unknown toxicants in the effluent.

Woodward et al. (1985) studied the effects of spent shale leachate on the mayfly *Hexagenia bilineata*. Although this is a different water type than the other studies presented here, it is a multi-ion water with high conductivity; measured ions in this water included B, Ca, K, Li, Mg, Mo, Na, Sr, F, Cl, NO_3, and SO_4. Woodward et al. (1985) reported that magnesium and sulfate represented 81% of the total ions in the leachate. In this study, mayflies were exposed to various dilutions of concentrated leachate and organism survival and growth, i.e., length, were determined at 15 and 30 days. The LOEC values for survival at 15 and 30 days were 2,950 µS/cm and 1,800 µS/cm, respectively (Woodward et al. 1985). There were no significant effects on length in either of the tests. These effect concentrations are comparable to the other mayfly studies previously described.

Some additional conclusions made by the authors in these studies were not reported in EPA (2010). For example, Kennedy et al. (2004) concluded that conductivity levels up to 900 µS/cm appeared to be safe for sensitive benthic invertebrates, based on survival of *Isonychia* in their studies, instream mayfly distributions, and endpoints from previous research. It was further concluded that reductions in the mayfly populations would likely occur between 1,500 to 2,000 µS/cm. Echols et al. (2009) determined that impairment occurred around 1,400 mg/L of total dissolved solids (TDS), which is approximately equivalent to a conductivity level of 2,333 µS/cm.

Therefore, the high levels of variability seen in the results of all of the studies described above further suggest that toxicity cannot easily be predicted from conductivity or TDS concentrations alone. Rather, the toxicity of major ions related to salinity can vary widely as a result of the concentrations and combinations of the ions present (Chapman et al. 2000), as well as other factors not easily compared between tests (Pillard et al. 1999). Short-term chronic toxicity as a function of conductivity in these tests suggested that, although mayflies may indeed be somewhat more sensitive than *C. dubia*, effect levels sometimes overlapped

broadly and were highly variable between tests. Therefore, the available toxicity test data do not support EPA's assertion that toxicity is observed at conductivities that are similar to the XC_{95} values for sensitive taxa.

3.3.5.3 Laboratory tests of ambient waters

Merricks et al. (2007) conducted acute bioassay tests on ambient water from streams below valley fills in West Virginia using *C. dubia*. EPA (2010) stated that LC_{50} values were established for *C. dubia* for some but not all of the waters from Lavender Fork. Three of the eight Lavender Fork sites did have LC_{50} values ranging from 1,763 µS/cm to 2,184 µS/cm; however, EPA (2010) did not mention that 19 other sites were tested, with conductivity levels ranging from 923 µS/cm to 2,720 µS/cm, and only one of the 19 tests resulted in significant effects on *C. dubia*. EPA (2010) concluded that these tests had low relevance to the conductivity benchmark and would underestimate toxicity in the field due to the test species, duration, and endpoint. However, the data in Merricks et al. (2007) demonstrate that toxicity in waters below valley fills, whether acute or chronic, is highly variable and cannot be easily predicted based on conductivity alone. This supports our premise that generic measures of ionic concentration, such as TDS or conductivity, are inadequate for assessing the true potential toxicity of major ions present in waterbodies (Mount et al. 1997; Pillard et al. 1999; Goodfellow et al. 2000).

In addition, the USGS Columbia Environmental Research Center (CERC) is currently conducting U.S. EPA Project No. DW-14-922510010 "Toxicity of Total Dissolved Solids to Appalachian Aquatic Invertebrates" (Kemble 2010). These studies are using reconstituted waters that simulate water chemistry from several locations in West Virginia to more directly evaluate the sensitivity of mayflies and other aquatic invertebrates relative to conductivity. In the project summary for fourth quarter 2009 (October 1 to December 31, 2009), USGS reported the results of tests conducted using three reconstituted waters (Board Tree, Upper Dempsey, Winding Shoals) and a control water on *H. azteca* (amphipod), *Lampsilis siliquoidea* (28-day tests) (mussel), *C. dubia* (7-day test) (zooplankter), and mayflies (14-day test using *Hexagenia* spp., likely a mixture of *H. rigida* and *H. limbata*). All species had acceptable control survival except for mayflies; the researchers reported that mayflies "do not do well" after 14 days in exposures without a sediment substrate. However, on day 8 of the mayfly bioassay tests, control survival was satisfactory at 88% survival; therefore, day 8 data were used for comparison to controls. There were no observed effects on *Hexagenia* or *C. dubia* survival in the Board Tree tests, with conductivity levels ranging from 579 µS/cm to 2,386 µS/cm. In the Upper Dempsey test on *Hexagenia*, there were effects on survival at 961 µS/cm, and for *C. dubia*, effects were seen at 1,817 µS/cm. In the Winding Shoals test, effects on *Hexagenia* survival were observed at 798 µS/cm, but no effects on *C. dubia* survival were seen in conductivities up to 1,828 µS/cm. These preliminary data indicate that in some ionic mixtures, mayflies appear to be slightly more sensitive than *C. dubia*, but in others they exhibit similar sensitivities.

3.3.5.4 Conclusions—sufficiency of exposure

In summary, there are insufficient data from the physiological and toxicology literature to support EPA's conclusion that "conductivities in the region of concern reach levels that are sufficient to cause effects on stream communities" (EPA 2010, p. 52). First, although elevated salinity can clearly induce adverse effects on aquatic invertebrates, the taxonomic patterns of sensitivity are not yet clearly defined. Although laboratory toxicity data exposing mayflies to actual or simulated mining effluents suggest they may be somewhat more sensitive than the most sensitive surrogate test species, *C. dubia*, effect concentrations are highly variable and, in some studies, overlap between species. Toxicity to ions associated with salinity (e.g., sulfate) also varies strongly as a function of specific ion composition and can be mitigated under conditions of elevated hardness. Additional study is needed to confirm the relative sensitivity of macroinvertebrate communities to elevated salinity and the extent to which other water quality variables and major ion composition will influence the consistency of these results. Until such relevant studies are conducted, it is premature to suggest that a quantitative conductivity benchmark is an accurate and direct reflection of ions related to salinity, even if restricting the benchmark to waters in which conductivity is dominated by sulfate and bicarbonate. Therefore, we also do not agree with EPA's conclusions that there is "positive evidence that the conductivity levels observed are sufficient to cause the associated effects" (Table 5).

Table 5: Summary of evidences and scores for sufficiency, with alternative interpretations (Table A-11; EPA 2010).

Type of Evidence	Evidence	EPA Score	Suggested Score
Laboratory Tests of Defined Ion Mixtures	The tests were high quality, but the species and durations have low relevance for determining the conductivity level at which effects occur, and the effect levels are supportive only if assumptions are made about acute/chronic and intertaxa extrapolations. *Alternative interpretation: Differences in ion composition between different test solutions were not properly accounted for, nor were the potential mitigating effects of hardness on sulfate toxicity. STR model predictions from natural waters demonstrated effects at concentrations greatly exceeding the proposed conductivity benchmark even though the model does not incorporate the potential effects of hardness mitigation.*	0	- -
Laboratory Tests of Mine Discharges	This evidence is relevant in that it comes from nonacid mine effluents in the region and includes an ephemeropteran; but the ionic mixtures were somewhat different, the effect was lethality and the durations were short. The results for one set of tests matched the XC_{95} for the test genus, but were higher for the other. *Alternative interpretation: Additional studies obtained showed effects did not occur until conductivity levels in excess of XC_{95} levels.*	+	-
Laboratory Tests of Ambient Waters	These tests showed acute lethality to an apparently resistant species at high conductivity levels. Its relevance is too low to support or weaken. *Alternative interpretation: The effects observed here at higher conductivity levels are no more or less relevant than mine discharge laboratory tests. Therefore, these do not support the presumed effects at lower conductivity levels.*	0	-
Field Exposure-Response Relationships for Ephemeroptera	This is strong evidence because it is highly relevant, was obtained independently in two separate datasets, with moderate to strong correlations. It is not convincing in itself because of the potential for confounding, which is treated in Appendix B. *Alternative interpretation: The potential for confounding is a significant factor that has not yet been fully resolved, and field correlations are not always strong (e.g., Figures A-1 and A-2; EPA 2010).*	+ +	-
Field Exposure-response Relationships for Genera	As conductivity increases, genera are no longer observed. *Alternative interpretation: The potential for confounding is a significant factor that has not yet been fully resolved, and field correlations are not always strong (e.g., Figures A-1 and A-2; EPA 2010).*	++	-

Type of Evidence	Evidence	EPA Score	Suggested Score
General Knowledge	General knowledge indicates that salinity can cause the loss of species but does not indicate that the salinity levels observed in this case are sufficient. *Alternative interpretation: We generally agree with this statement, but the lack of sufficiency does not warrant a score of 0, but rather a score of – because it weakens the case in support of sufficiency.*	0	-
Overall Score	The exposure-response relationships in the field, with some support from laboratory studies, provide positive evidence that the conductivity levels observed are sufficient to cause the associated effects. *Alternative interpretation: It is unclear how EPA concludes such a strong positive score (+++) from mixed conclusions from the various lines of evidence. Our analysis of the available literature suggests a consistent lack of support for sufficiency of the proposed conductivity threshold because most studies suggest effects would occur at much higher conductivities, and ion composition and hardness mitigation have not clearly been accounted for in EPA's analysis. Use of surrogate test species somewhat reduces the relevance of this conclusion.*	+++	- -

3.3.6 Relevant Standards in Other States

It is noteworthy that three other states, Illinois, Indiana, and Iowa, have all rejected conductivity or TDS-based aquatic life standards in lieu of numeric standards for sulfate and chloride that also depend on water hardness. For Iowa, the current final rules (http://www.iowadnr.gov/water/standards/chloride.html) indicate that the existing scientific data support the importance of individual ions over composite variables such as TDS because "chloride and sulfate are better indicators than integral parameters such as TDS, conductivity, and salinity for water quality protection" (IDNR 2009). Similarly, the Illinois EPA proposed a numeric sulfate standard, which was also ultimately approved by EPA, to replace TDS standards for the same technical reasons (Norwest Co. 2010). Indiana proposed essentially the same sulfate and chloride criteria equations, which were also approved by EPA because ". . . the TDS standard currently in place is inappropriate. By definition TDS is a measure of all dissolved solids, yet we know that the toxicity of TDS is exerted by its individual components" (EPA 2008). Therefore, the available scientific information does not support development of regulatory thresholds based on composite variables such as conductivity or TDS, but rather the development of individual numeric criteria for specific ions.

3.3.6.1 Illinois sulfate criteria

To illustrate the outcome of using the single-ion approach preferred by Illinois, the WABbase chemical data were used to derive aquatic life criteria for sulfate as modified by chloride and

hardness. Using this example, the revised Illinois sulfate criteria are based on a range of total hardness and chloride concentrations (Table 6). Given site-specific conditions, sulfate criteria are either set at a constant 500 mg/L for samples exhibiting less than 100 mg/L total hardness, or a constant 2,000 mg/L for samples exhibiting total hardness greater than 500 mg/L and chloride concentrations greater than 5 mg/L. In addition, two equations are used to calculate site-specific sulfate criteria for samples exhibiting total hardness in the range of 100 to 500 mg/L and chloride in the range of 5 to 500 mg/L (Table 6).

The WABbase dataset contained 1,591 samples with paired hardness, chloride, and sulfate values, and represented a wide range of concentrations. Each sample was categorized based on total hardness and chloride concentrations and assigned a sulfate value based on the Illinois sulfate criteria rules (Table 6). The assigned sulfate value was then compared to the measured sulfate value to determine whether the sample achieved the Illinois sulfate criteria. Less than 1% (15 samples) of the WABbase samples exceeded the Illinois sulfate criteria, with the majority of exceedances occurring in the samples with hardness levels greater than 500 mg/L. There are a total of 54 samples exhibiting hardness values greater than 500 mg/L over a range of chloride concentrations, and 14 of these samples exceeded the sulfate criteria. In contrast, 26% of these WABbase samples exceed the proposed conductivity benchmark.

Table 6: Illinois sulfate criteria (mg/L, bold values) based on a range of hardness and chloride ion concentrations. The number of WABbase water samples within each range is identified by n.

Ion Ranges	Chloride <5 mg/L	Chloride 5 to <25 mg/L	Chloride 25 to <500 mg/L	Chloride ≥500 mg/L
Hardness <100 mg/L	**500** n = 696	**500** n = 350	**500** n = 23	**500** n = 0
Hardness 100 to <500 mg/L	**500** n = 113	**Eqn 1** n = 84 *1 of 84 exceeded criteria*	**Eqn 2** n = 270	**2,000** n = 1
Hardness ≥500 mg/L	**500** n = 10 *6 of 10 exceeded criteria*	**2,000** n = 26	**2,000** n = 15 *7 of 15 exceeded criteria*	**2,000** n = 3 *1 of 3 exceeded criteria*
Eqn 1: Sulfate = [-57.478 + 5.79(Hardness) + 54.163(Chloride)] x 0.65				
Eqn 2: Sulfate = [1,276.7 + 5.508(Hardness) – 1.457(Chloride)] x 0.65				

This analysis suggests that using a single ion criteria approach that incorporates the effects of hardness and chloride provides a significantly different indication of which and how many waters are likely to impair aquatic life. While elevated hardness and chloride concentrations are known to ameliorate sulfate toxicity, it is unknown whether the specific ionic composition of streams in West Virginia differs enough from Illinois streams in such a way that would make the single ion approach applicable. Notably, the State of Iowa is also considering adopting the same criteria that EPA and Illinois adopted in 2008. Nonetheless, given the empirical relationships between total hardness, chloride ions, and sulfate toxicity; the single

ion approach warrants closer examination for use in Ecoregions 69 and 70 of West Virginia instead of the proposed conductivity benchmark.

3.3.7 Conclusions—Causal Analysis

Based on our review of this causal analysis (Appendix A), we do not agree that the available evidence rigorously indicates that salts, as measured by conductivity, are a common cause of impairment in aquatic macroinvertebrates in the region of concern (i.e., Ecoregions 68 and 69 of West Virginia). Rather, while some elements of causation can be shown to exist, other elements are weak or inconclusive, and so the underlying hypothesis that salinity ions are the major causes of biological impairment has not yet been subject to sufficient test. Therefore, it is also premature to take it "as a given" that the functional relationship between conductivity and impairment is strong enough so that the confounding factor analysis in Appendix B need only address conductivity confounders (Section 3.4).

3.4 Confounding Factors Analysis

The confounding factors analysis in Appendix B of EPA (2010) uses a weight of evidence approach to evaluate whether environmental factors other than conductivity could substantially interfere with or otherwise bias the presumed relationships between conductivity and biological impairment in West Virginia streams. However, EPA's goal was not to eliminate confounding variables, nor was it an attempt to independently test the hypothesis that conductivity was the best predictor of biological impairment. As stated on page 69 of EPA (2010), "This assessment of confounding takes the result of the causal assessment as a given (*emphasis added*) and attempts to determine whether any of the known potential confounders interfere with estimating effects of conductivity to a significant degree." Furthermore, the confounding factors analysis was based entirely on patterns related to mayfly abundance "(b)ecause the sensitive genera are primarily Ephemeroptera and the endpoint effect is extirpation of 5% of genera…" (EPA 2010, p. 69).

We agree that it is an important and relevant exercise to evaluate the potential influence of confounding factors on the primary factor(s) presumed to be the strongest predictor(s) of biological response and also causally related to the response. As discussed above in Section 3.3, we do not agree that sufficient evidence exists to determine that conductivity is necessarily causally related to extirpation of "sensitive" species at the concentration represented by the proposed benchmark. Nor do we agree that conductivity is the single or best predictor of patterns in macroinvertebrate community structure related to coal MTM/VF activities, especially as manifested by mayfly abundance (see Section 4.0). Therefore, we also do not agree that a confounding factor analysis should take it *as a given* that these are the only or primary relationships that require evaluation. Rather, we contend that a confounding factors analysis should also include rigorous and independent tests of the primary hypothesis by determining whether conductivity is indeed the best predictor of biological impairment that is causally related in such a way as to justify the proposed benchmark value. Indeed, the

causal assessment in Appendix A does not present or evaluate potential causal factors other than conductivity, so the overall analysis presented by EPA (2010) does not thoroughly test alternative hypotheses.

The sections that follow present observations on a selection of confounding factors addressed by EPA in Appendix B that we suggest may correlate with and potentially confound conductivity relationships. We also suggest that these may represent factors that could be as or more important to benthic macroinvertebrate community structure than conductivity and, hence, require a more formal analysis to determine whether they represent viable alternatives to the hypothesis that conductivity is the primary factor responsible for impairment.

3.4.1 Evidence Rejecting Habitat Differences as Possible Cause of Extirpation

The assertion in EPA (2010) that habitat presented little potential for confounding in their derivation of the conductivity benchmark needs considerable additional scrutiny. There are three clear problems with this assertion.

First, the Rapid Bioassessment Protocol (RBP) habitat scores used by EPA in their analyses may not be the most rigorous measure of habitat quality. Rates of mayfly presence were nearly identical between poor quality and high quality habitat at low conductivity levels in the contingency table (Table B-8 of EPA 2010), indicating that RBP habitat scores are not the best predictor of habitat quality for mayflies. This may be because RBP habitat scores are more directed toward identification of fish habitat and they are influenced by a significant level of subjectivity, even if the method itself results in some level of quantification.

Second, the RBP habitat scores were correlated with conductivity and the biological response, i.e., the HC_{05} (Section B.4.1. of EPA 2010). This in itself should suggest that habitat may be a significant confounding factor. Because RBP habitat scores do not appear to tell the whole story, a more detailed analysis of habitat quality and its relationship to the benthic macroinvertebrate community needs to be conducted before EPA can conclusively state that "low RBP was judged to have little effect on the derivation of the 5th percentile hazardous concentration (HC_{05}) for conductivity" (Section B.4.1. of EPA 2010).

Third, as noted below in Section 3.4.2, the analysis of the potential confounding factors in EPA (2010) focused almost exclusively on the response of Ephemeroptera to conductivity levels, to the exclusion of the rest of the benthic macroinvertebrate community. The Ephemeroptera are represented by 25 genera in the database, which is only 16.5% of the total number of genera. Furthermore, while some genera of Ephemeroptera do appear to be sensitive, they do not appear to be the most sensitive genera. Based on the XC_{95} calculations, *Remenus* (a stonefly) and *Lepidostoma* (a caddisfly) are ranked more sensitive than the most sensitive mayfly genus, *Cinygmula*. Because mayflies are not the most sensitive organisms in the database, the other ordinal taxa should be investigated to determine their response to conductivity across gradients of habitat quality. Furthermore, because of the variety of conflicting stressor-response profiles exhibited by all of the genera in the database, it would

be more informative and conclusive to analyze the response of a representative subset of genera representing all of the stressor-response profiles, not just the mayflies, to habitat variables and conductivity.

Even if the RBP habitat scores can appropriately be eliminated as a potential confounding stressor for Ephemeroptera, EPA has not sufficiently demonstrated that habitat (by RBP scores or by a more detailed analysis of habitat quality) can be eliminated as a potential confounding factor to the rest of the benthic macroinvertebrate community.

3.4.2 Rejection of Confounding Factors Based Almost Exclusively on Ephemeroptera (Mayflies)

In EPA (2010), an attempt was made to reject as many potential confounding stressors as possible. However, lack of correlation between number or presence of Ephemeroptera genera and each potential confounding stressor was most often cited in Appendix B as being a strong reason to reject most potential stressors as confounding influences with conductivity. As noted above, Ephemeroptera genera represented only 16.5% of the dataset, yet it does not appear that the other taxonomic orders or the entire invertebrate assemblage were similarly tested to determine their relationships to the potential confounding stressors. Because several taxonomic groups were present in the community, and because the Ephemeroptera genera differed in their responses to conductivity, it is inappropriate to focus only on Ephemeroptera in elimination of potential confounding stressors.

Furthermore, it also does not appear that individual genera were examined to determine their stressor-response to the other potential confounding stressors to eliminate those stressors definitively. If such testing had been conducted for representative genera in the database, it may have been found that many of the genera (particularly those with optimum or increasing stressor-response patterns) were in fact responding to some of the other potentially confounding stressors.

Relationships between all potential stressors and Ephemeroptera were generally cited as reasons to reject the stressors as potential confounders in the analysis that ultimately relates to the entire aquatic benthic community. There is a clear need to include similar analyses from the other invertebrate orders and the entire invertebrate community to conclusively reject the stressors as potential confounding stressors.

3.4.3 Natural Rarity as a Reason for Low Capture Probability

The original, full WVDEP WABbase used by EPA included 559 taxa, of which 498 were identified to genus; the others were identified to family or were "slashed" taxa (e.g., *Leucrocuta/Nixe*). Because EPA (2010) restricted the database with several filters (e.g., particular ecoregions, pH, months, years, watershed size, sulfate dominance instead of chloride, etc.), 328 aquatic macroinvertebrate genera (59%) from West Virginia were excluded from analysis.

EPA (2010) attempted to control for the effect of rare taxa by including only those taxa that had been collected in at least one reference site and at least 30 general sites; therefore, 18 additional genera were excluded from analysis because they were never found at a reference site (EPA 2010, Table 3, p. 26). There were 2,145 samples represented in the total dataset, based on Table 2 on page 26 (EPA 2010). According to Figure 2 (EPA 2010, p. 28), there were 97 reference samples from 70 individual sites used in EPA (2010), although page 7 of EPA (2010) said there were 70 reference sites. Therefore, if a genus had a collection probability of at least 1.0% in the reference sites and at least 1.4% in the general sites, it was considered to be common enough to include in the SSD. The number of occurrences of each genus in the reference samples was provided in Appendix C of EPA (2010).

Even though the number of taxa included would necessarily be constrained (Table 7), it would have been more appropriate for EPA to have controlled for the effects of rare taxa by including in their SSD only those genera that had a high capture probability in the reference sites. Such an approach would be analogous to a laboratory study in which mortality in the control is a major determinant of the validity of a study. In discussing criteria development, the 1985 Guidelines stated that "data should usually be rejected if they are from . . . tests in which too many organisms in the control treatment died or showed signs of stress of disease. . . ." Many laboratory studies are rejected for inclusion in a criterion calculation because mortality in the control exceeded a certain percentage. Although "too many organisms" was not specifically defined in the 1985 Guidelines, many criteria we are familiar with used cutoffs near 20% mortality (or 80% survival) in the controls. EPA (2010) considered a 1% collection probability in reference sites to be acceptable, but a 1% survival rate in a laboratory test would clearly not be acceptable.

Table 7:
Number of genera available for SSD calculation based on capture probability in reference samples.

Capture Probability in the Reference Samples	Number of Genera Included
All	151
>1%	138
>5%	100
>10%	75
>20%	49
>50%	14

The most sensitive taxon in the database, the stonefly *Remenus*, had a calculated XC_{95} of 101 µS/cm. This taxon was found in three of the reference samples (3%) and 35 of the general samples (1.6%). Even though there were 38 data points (excluding non-detects) used to derive a stressor-response relationship, it is clear that the genus is rare even in reference streams where conductivity levels are low. It cannot be clearly demonstrated that the relationship observed in *Remenus* of a decreasing capture probability with increasing conductivity is accurate when there is only a 3% probability of capture in reference streams. (Using the laboratory control analogy, this is similar to only 3% survival in the control—a result that would strongly invalidate a study.) Furthermore, *Remenus* is so rare that nothing is known about the biology of the nymphs, except limited information on timing of emergence

from collection records (Stewart and Stark 2002). There is not sufficient information for EPA (2010) to assume that high conductivity levels are responsible for the rarity of *Remenus* when it is naturally rare in the general population.

A total of 72 taxa (48%) had a higher capture probability in the general sites than in the reference sites (Figure 11). Of those taxa, the difference between the two probabilities was less than a full percentage point in many taxa; however, 27 taxa had a capture probability at least 5% higher in the general sites than in the reference sites. The largest difference was in the chironomid genus complex *Cricotopus/Orthocladius*, which was not used in the calculations. The second largest difference was in *Stenelmis*, which had a capture probability of 51% in the general sites, but only a 13% capture probability in the reference sites (difference = 38%).

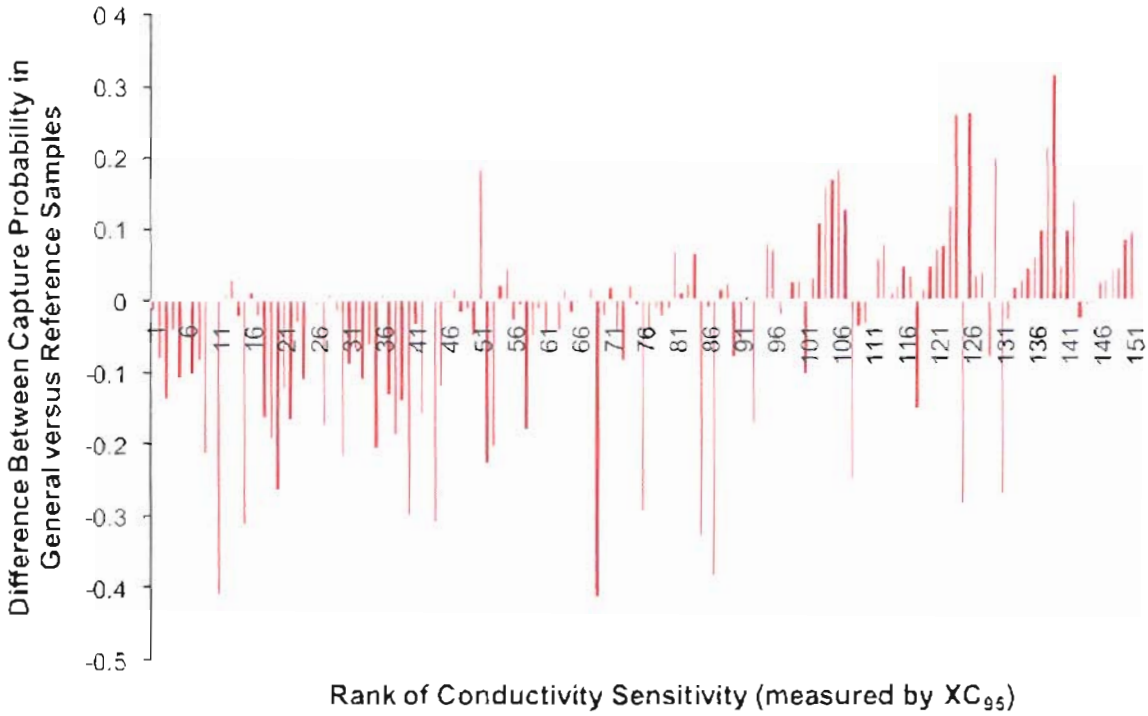

Figure 11: Difference between capture probability in general versus reference samples, ranked by sensitivity to conductivity. Positive values indicate that the genus had a higher capture probability in general samples than in reference samples.

A plausible argument against excluding rare taxa from the SSD would be that the taxon is rare because of the stressor. However, this argument would not be valid if the taxon is naturally rare, a phenomenon that could be analyzed using its capture probability in reference sites. EPA (2010) did not sufficiently demonstrate that the rare taxa were rare due to conductivity or any other water quality effect, and not from general rarity itself.

3.5 Ecological Relevance of Presumed Impairment as a Function of Conductivity

The ultimate protection goal of EPA's proposed conductivity benchmark is to determine a conductivity level that, if not exceeded, would prevent extirpation of 95% of the aquatic macroinvertebrate genera. This is similar to the protection goals of numeric criteria for protection of aquatic life and their uses (1985 Guidelines). However, it is important to evaluate the relevance of this protection goal when the criterion or benchmark is derived from a very large number of genera, as is the case with the proposed conductivity benchmark. For even the most data rich numeric criteria, far less than 100—and often less than 20—genera are used to derive the acute and chronic criteria. However, with the conductivity benchmark, 151 genera are used and yet only a few mayfly taxa are truly considered indicative of "sensitivity" to conductivity, potentially requiring protection. In addition, even if one accepts the role of conductivity in being directly correlated with and responsible for loss of taxa at elevated levels, is this 95% protection level ecologically relevant, i.e., do communities in the presence of elevated conductivity lose important ecological functionality?

To address these questions, we evaluated trends in macroinvertebrate community structure and function relative to conductivity from the data presented in EPA (2010). Numerous functional feeding groups (FFGs) were represented in the dataset used in EPA (2010), including filter-collectors, gather-collectors, omnivores, predators, scrapers, shredders, and one piercer. Gather-collectors and predators were the most abundant FFGs. Filter-collectors, gather-collectors, predators, and shredders were each represented by genera with each of the identified and conflicting stressor-response profiles (Table 8). Scrapers were represented by genera in each of the stressor-response profiles except for the profile that increased with respect to increasing conductivity values. Twelve to 27% of the genera in each FFG, except scrapers, exhibit an increasing stressor-response profile, and thus would potentially not be protected by the proposed conductivity benchmark.

Table 8: Number of genera in particular functional feeding groups in identified stressor-response profiles. Piercers and omnivores not included due to low numbers of taxa.

Functional Feeding Group	All	Decreasing	Optimum	No Response/ Bimodal	Increasing
FILTER-COLLECTORS					
Number of genera	15	4 (27%)	5 (33%)	2 (13%)	4 (27%)
GATHER-COLLECTORS					
Number of genera	57	27 (47%)	12 (21%)	6 (11%)	12 (21%)
PREDATORS					
Number of genera	46	22 (48%)	11 (24%)	4 (9%)	9 (20%)
SCRAPERS					
Number of genera	17	6 (35%)	10 (59%)	1 (6%)	0
SHREDDERS					
Number of genera	12	7 (58%)	2 (17%)	1 (8%)	2 (12%)

We conducted an analysis to determine what changes would occur in the FFG balance within the regional taxa pool at various conductivity levels, based on the XC_{95} value for each genus. For example, if the conductivity value was 400 µS/cm, it was assumed for this analysis that all genera with an XC_{95} value less than 400 µS/cm would be extirpated. The trophic balance of the remaining taxa available from the regional taxa pool was then analyzed (Figure 12).

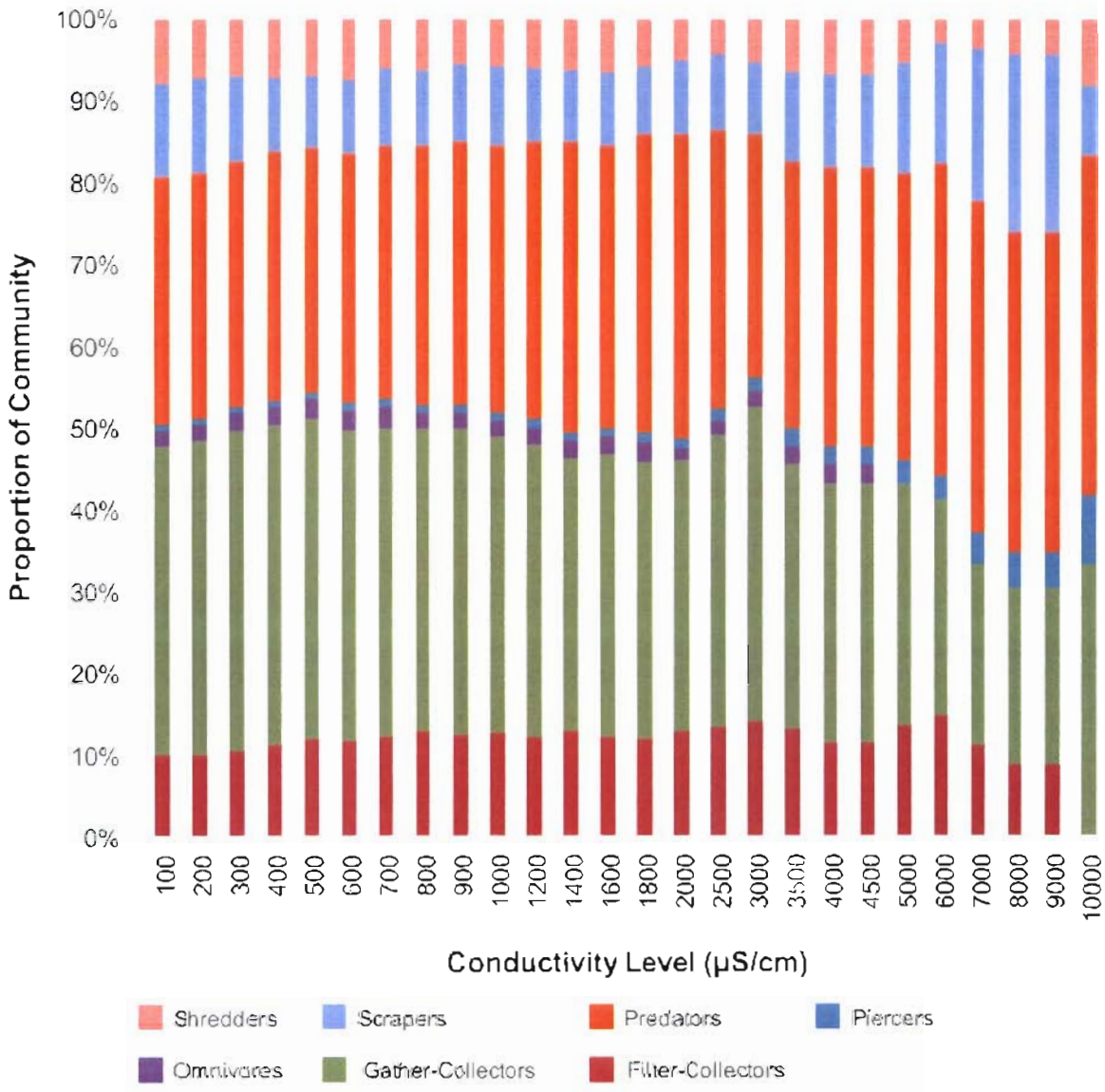

Figure 12: Proportion of generic richness by functional feeding group within the regional taxa pool at varying conductivity levels. All genera with an XC_{95} less than the conductivity level are considered to be unavailable. Note that the x-axis is not evenly divided.

There are few observed changes in the proportional abundance of FFGs within the regional pool of taxa at conductivity levels below approximately 2,500 µS/cm to 5,000 µS/cm. Excluding the omnivores and piercers, which were poorly represented in the first place, the

first major FFG predicted to undergo extirpation of all its member genera was the filter-collectors, when conductivity values exceeded 10,000 µS/cm. This indicates that the functional aspect of the stream community may not change due to conductivity levels above 300 µS/cm, since genera from all FFGs remain available in the regional taxa pool.

4.0 Independent Analysis of Factors Shaping Macroinvertebrate Communities

The conductivity benchmark analysis (EPA 2010) relies on the Pond et al. (2008) and EPA's causal analysis to presuppose as a "given" that conductivity is the best predictor that is functionally and causally related to the response of macroinvertebrate communities in Central Appalachian streams, while disregarding many other factors that may influence community composition. The WVDEP database (WABbase) used by EPA provides an opportunity to examine other possible factors that may shape macroinvertebrate community composition. Therefore, we have conducted an independent analysis based on a data mining approach that considers all of the available information and strives to elucidate key water quality and physical parameters that are most strongly associated with biotic responses.

We used the EPA dataset that was originally extracted from the WABbase (http://oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=496202) as provided by EPA (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=220171). This dataset includes results for 3,286 sampling events representing 3,121 unique Station ID codes. The dataset contains a variety of variables that present site-specific information regarding regional landscape, water quality, and aquatic habitat conditions as well as macroinvertebrate community composition. Following EPA's rationale for excluding samples (EPA 2010, Section 2), the dataset used in our analysis contained 2,152 sampling events representing 2,073 unique Station ID codes. Our attempt to follow EPA's exclusion process resulted in an additional seven sites being included in the data subset. This is different from the EPA's final dataset which contained 2,145 sample events, but when summary statistics for measured water quality parameters as presented in EPA 2010 Table 1 are compared with those calculated from our dataset, the results appear to be nearly identical. Notably, of the 2,152 sampling events selected from the EPA dataset, approximately 43% are missing ion or metal chemistry results, including selenium or dissolved manganese, which were analyzed infrequently.

Our data mining analysis of the subset we generated using EPA's data-exclusion rationale (2,152 events) was based on an integrated approach to identify factors that best describe the observed variability between and among sites, and strongly correlate with each other, rather than trying to establish causal relationships. In the absence of a rigorous study design conducted under controlled experimental conditions, it is more important to identify data relationships rather than attempt to establish cause-effect relationships.

Our integrated data analysis approach relied on a series of statistical analyses that reduced the total number of parameters to a more ecologically meaningful subset of variables with respect to the available data. The original dataset was initially subdivided into independent stressor and dependent response variables. Independent stressor variables in a stream ecosystem include chemical and physical habitat variables, such as metal and ion concentrations in the

water column and the percent substrate composition (Paulson et al. 2001). Dependent response variables were selected to represent the biological component of the stream, such as macroinvertebrate density or taxa richness. The independent stressor variables generally represent a mix of both quantitative (e.g., major ion or metal concentrations) and qualitative (e.g., embeddedness) variables, as well as composite variables (e.g., RBP score, conductivity). Thus, understanding the general categories of each variable also helped reduce the overall list of variables.

The integrated analysis follows a series of statistical procedures (Paulson et al. 2001), as presented below, to identify key variables that can be used to characterize water quality, aquatic habitat, and macroinvertebrate communities.

1. Apply basic statistics
    a. Generate descriptive statistics and data plots
    b. Normalize data as needed to meet statistical assumptions
    c. Compile correlation matrices
2. Identify key stressor and response variables using the following methods:
    a. Principle Components Analysis (PCA)
    b. All Possible Regressions (APR)
    c. Chi-square Automatic Interaction Detection (CHAID)
3. Rank variables according to relative influence
    a. Develop matrix of key independent stressor variables and relationships found in Step 2
    b. Repeat Steps 2 and 3 until the two most influential independent stressor variables are identified for each dependent response variable
4. Fit equation to describe interactions between stressor and response variables
    a. Use three-dimensional modeling program to identify non-linear relationships (*note, as described below, no relationship could be developed that represented a significant portion of the variability in the data.*)

Using the data subset, basic statistical procedures (e.g., Spearman rank correlation, scatter and box plots) were used to evaluate the characteristics of independent stressor and dependent response variables, as well as relationships between the two variable types. All variables were evaluated for approximation of a normal distribution using Shapiro-Wilkes normality tests and Q-Q probability plots. When appropriate, variables were transformed and re-evaluated for fit with an expected normal distribution. A logarithm base10 transformation (log) was used for water quality variables and macroinvertebrate density, while the arcsine-square root transformation was used for variables reported as percentages (e.g., percent fines and percent Ephemeroptera). The water quality variables—temperature and pH, as well as the physical habitat and macroinvertebrate variables such as embeddedness and genera-based metrics—did not require transformation. Two macroinvertebrate metrics (Trichoptera taxa and percent Trichoptera) were not included in the database provided by EPA, so were

calculated based on subtraction of reported Ephemeroptera and Plecoptera metrics from summary EPT results provided in the data subset. Using the basic summary statistics, as well as professional judgment, the entire list of variables was initially reduced to a smaller subset of variables that we believed to be the most ecologically relevant when evaluating factors that explain the variability observed between sites, in terms of macroinvertebrate communities in Central Appalachian streams (Table 9).

Table 9: List of independent stressor and dependent response variables used in the integrated analysis.

Independent Stressor Variables		Dependent Response Variables
Water Quality	**Physical Habitat**	**Macroinvertebrate**
Temperature	Bank stabilization	Clinger taxa, genera
Dissolved oxygen	Bank vegetation	Ephemeroptera, genera
Alkalinity	Undisturbed vegetation	EPT, genera
pH	Channel alteration	HBI, genera
Chloride	Channel flow	Intolerant taxa, genera
Sulfate	Riffle sinuosity	Plecoptera taxa, genera
Total aluminum	Embeddedness	Trichoptera taxa, genera*
Total calcium	Sediment deposition	Total taxa, genera
Total iron	Epifaunal substrate	Density
Total magnesium	Velocity of pool	Percent Chironomidae
Total manganese	Percent fines	Percent Ephemeroptera
Total suspended solids	Percent sand	Percent Ephemeroptera minus Baetidae
Total phosphorus	Percent silt	Percent EPT
Nitrate – Nitrite nitrogen		Percent EPT minus Cheumatopsyche
Fecal coliforms		Percent EPT minus Cheumatopsyche and Baetidae
		Percent Hydropsyche
		Percent Orthocladiinae
		Percent Plecoptera
		Percent Trichoptera*
		Percent Simuliidae
		Percent dominant 5 taxa, genera

* Calculated metric

It is important to note that composite type variables are often not very useful when evaluating biological responses to environmental stressors. For example, the total RBP score for aquatic habitat evaluation may appear to strongly correlate with select biotic responses, yet this index provides little insight into the environmental characteristics that may be influencing biotic communities, because it is comprised of many metrics. To the extent possible, we have excluded such composite independent stressor variables in our data analyses, including conductivity and hardness, because they provide little information above and beyond the individual variables when trying to isolate water quality factors that may be most strongly associated with a biotic response.

4.1 Principal Component Analysis

Principle Component Analysis (PCA) is a variable reduction procedure that helps identify redundancy among numerous variables, and is used to identify groups of observed variables that tend to move together or in opposite directions (Johnson and Wichern, 1992). PCA was used to identify variables that best explained the variability observed between sites and how those variables relate to one another, as well as whether one variable could be used as a surrogate for other variables within each grouping (water quality, physical habitat, macroinvertebrate). When such variables are replaced with a surrogate that explains the same amount of variation, the power of the statistic to identify relationships is maximized (Paulson et al. 2001). An iterative process was used for the PCA analyses, such that all variables from each grouping were loaded into separate PCA models. This initially created three distinct groupings, two for stressor variables and one for response variables. The PCA extraction method was based on a correlation matrix with a varimax rotated solution, pairwise deletion of missing values, and extracted eigenvalues[3] greater than 1.0. The rotated component matrix[4] for each variable grouping was examined, with variables exhibiting coefficients greater than 0.6 considered a significant part of the component. If the component contained multiple significant variables, the Spearman rank correlation values for those variables were also evaluated. If variables were highly correlated (i.e., > 0.6 or < -0.6) with each other, the variable with the largest component coefficient (i.e., heavily weighted) was selected. Up to five components were examined with the most heavily weighted or unique variables (either positive or negative) being selected for inclusion in a subsequent PCA model.

4.1.1 Principal Component Analysis—Water Quality

The goal of this type of evaluation was to understand how the water quality variables "move together" (i.e., are positively or negatively correlated with one another) and to select variables that may be a surrogate for other variables. For example, in the first component, the log transformed variables for total magnesium, sulfate, and total calcium weighted the most heavily (Table 10). This weighting and movement (all positive) of the variables along the first component was to be expected, based on the chemical relationship between all of these variables and their Spearman Rank correlation values. In the second component, the log transformed variables for total iron, total aluminum, and manganese were weighted the most heavily with all variables showing positive movement with each other (Table 10). In the third component, fecal coliforms, pH, and alkalinity revealed the strongest weighting coefficients (Table 10). Temperature and dissolved oxygen were key variables in the fourth component, and moved in opposite directions as is to be expected, while the nutrients—total phosphorus and nitrate-nitrite—were the most heavily weighted variables in the fifth component (Table 10). In

[3] An eigenvalue is a measure of the strength of a principal component axis, the amount of variation along the axis, and ideally the importance of an ecological gradient.

[4] Matrix showing the results of varimax orthogonal rotation that minimizes the number of heavily weighted variables on each principal component.

combination, these variables with the greatest weighting best explained the variability observed between sites in the database.

Table 10: Rotated component matrix for selected water quality variables. Bolded and shaded values denote which variables are considered the most heavily weighted part of the component.

Variable	Component				
	1	2	3	4	5
temp	0.254	-0.092	0.444	**0.620**	-0.035
pH	0.329	-0.303	**0.695**	-0.243	0.056
log_do	-0.033	-0.044	0.064	**-0.882**	-0.045
log_alk	0.556	-0.185	**0.641**	0.065	0.004
log_fecal	0.074	0.299	**0.651**	0.145	-0.074
log_mg_tot	**0.934**	0.067	0.166	0.069	-0.008
log_sulfate	**0.914**	0.031	0.109	0.035	0.020
log_tp	-0.130	0.064	0.157	0.220	**0.745**
log_al_tot	-0.064	**0.815**	-0.036	-0.121	0.087
log_ca_tot	**0.861**	0.067	0.322	0.120	-0.055
log_chloride	0.468	-0.015	0.485	0.080	0.241
log_fe_tot	0.119	**0.856**	0.011	0.100	-0.068
log_mn_tot	0.450	**0.601**	-0.172	0.401	-0.038
log_no23	0.243	-0.071	-0.230	-0.185	**0.738**
log_tss	-0.133	0.548	0.148	-0.097	0.511

The selected variables within the first five components accounted for a total of 72% of the variation observed among sample sites with respect to the water quality variables contained within the WVDEP/EPA dataset (Table 11). Parameters such as calcium, sulfate, and magnesium, along with parameters that characterize overall ionic strength, explained approximately 38% of the variation among sample sites with respect to water quality.

Table 11:
Variance explained by each component for the initial water quality PCA analysis.

Component	Partial and Cumulative Variation	
	% of Variance	Cumulative %
1	23.158	23.158
2	15.364	38.522
3	13.506	52.029
4	10.344	62.373
5	9.654	72.026

The following variables were selected to be surrogates for other less heavily weighted variables in each component and were consequently determined important to include in subsequent PCA analyses:

1. total magnesium
2. total iron
3. pH

4. fecal coliforms
5. dissolved oxygen
6. total phosphorus
7. total suspended solids

We selected TSS even though it did not initially meet our original selection criteria. Based on its relative moderate weighting in two of the five components, as well as its relationship to geological and hydrological underpinnings within the watersheds, we believed this to be an important variable that may influence macroinvertebrate communities.

The seven selected water quality variables were subsequently loaded into a second PCA model, with the same evaluative process being performed on the rotated component matrix. The rotated component matrix converged in the first two components, with the first component comprised of the log transformed variables—total magnesium (0.800), pH (0.692), and fecal coliform (0.638). In the second component, the log transformed variables for total iron (0.698) and dissolved oxygen (0.661) weighted the most heavily, while total suspended solids (0.780) and total phosphorus (0.743) were considered part of the third component.

The final water quality variables that were selected to be included in the overall PCA model evaluating relationships between water quality, habitat, and macroinvertebrate variables were:

1. total magnesium—also surrogate for Ca, SO_4, pH
2. fecal coliforms
3. total iron—also surrogate for Al and Mn
4. dissolved oxygen—also surrogate for temperature, and
5. total suspended solids—also surrogate for TP

4.1.2 Principal Component Analysis—Physical Habitat

The iterative PCA process described above was also performed using the independent physical habitat stressor variables. The initial PCA model using physical habitat characteristics extracted four components, with the first component being comprised of sediment deposition (0.832), embeddedness (0.735), riffle sinuosity (0.675), and epifaunal substrate (0.643), all of which exemplify substrate quality in these watersheds. The second component included undisturbed vegetation (0.855), bank vegetation (0.833), and channel alteration (0.755), all of which are characteristic of riparian habitat. The third component included the arcsine-square root transformation for percent fines (0.950), percent sand (0.844), and percent silt (0.678), which characterize substrate composition. The fourth component only included channel flow, which had a weighting coefficient of 0.810. These four components accounted for a total of 66% of the variation observed among sample sites with respect to physical habitat conditions. The first component accounted for approximately 20% of the variation in physical habitat observed among sample sites.

From our initial analysis, we selected the following physical habitat variables to be included in a subsequent PCA analysis:

1. sediment deposition
2. undisturbed vegetation
3. percent fines, and
4. channel flow

The second physical habitat PCA extracted two components with sediment deposition (0.795) and percent fines (-0.769) weighted heavily and in opposite directions in the first component, even though they are not strongly correlated (Spearman, -0.376). Channel flow (0.909) weighted heavily in the second component. All three variables were selected to be included in the overall PCA model evaluating relationships between water quality, habitat, and macroinvertebrate variables.

4.1.3 Principal Component Analysis—Macroinvertebrates

The initial macroinvertebrate PCA model resulted in four components being extracted (Table 12), with the first component comprised of the arcsine-square root transformations for the percent EPT variable and its derivatives, along with percent Ephemeroptera and its derivatives, percent Chironomidae, and the genera-based Hilsenhoff Biotic Index (HBI). Even though the genera-based HBI is not very informative from the standpoint of identifying key macroinvertebrate response variables, it is informative from a community health perspective. The second component weighted the genera-based metrics for total taxa, clinger taxa, EPT taxa and its derivatives Ephemeroptera and Trichoptera taxa, as well as intolerant taxa and arcsine-square root transformed percent dominant 5 taxa (negative weighting). The third component was comprised of the arcsine-square root transformed percent Trichoptera, percent Hydropsyche, and the genera-based Trichoptera taxa, all of which characterize the caddisfly assemblage. The fourth component only included the log transformed macroinvertebrate density variable. All four components explained a total of 76% of the variation observed in sample sites with respect to the macroinvertebrate metrics contained in the WVDEP/EPA dataset. The first component, which was mainly comprised of EPT metrics and a Chironomidae metric, accounted for approximately 31% of the variation among sample sites with respect to macroinvertebrates.

Table 12: Rotated component matrix for selected macroinvertebrate variables. Bolded and shaded values denote which variables are considered the most heavily weighted part of the component.

Variable	Component			
	1	2	3	4
G_Clinger Taxa	0.265	**0.836**	0.261	0.176
G_Ephemeroptera Taxa	0.424	**0.622**	-0.355	0.323
G_EPT	0.502	**0.819**	-0.085	0.048
G_HBI	**-0.722**	-0.373	0.053	0.359
G_IntolTaxa	0.459	**0.753**	-0.157	-0.215
G_PlecopteraTaxa	0.457	**0.603**	-0.316	-0.332
G_TricopteraTaxa	0.165	0.532	**0.649**	0.036
G_Tot_Taxa	-0.007	**0.922**	0.006	0.015
log_density	0.162	0.104	0.063	**0.603**
arcsin_pct_chiron	**-0.790**	0.010	-0.260	-0.122
arcsin_pct_ephem	**0.637**	0.202	-0.383	0.471
arcsin_pct_ephembaet	**0.891**	0.255	-0.025	-0.200
G_Clinger Taxa	0.265	**0.836**	0.261	0.176
G_Ephemeroptera Taxa	0.424	**0.622**	-0.355	0.323
arcsin_pct_ept	**0.906**	0.145	0.226	0.070
arcsin_pct_eptchemat	**0.921**	0.217	-0.044	-0.040
arcsin_pct_eptchematbaet	**0.890**	0.255	-0.025	-0.200
arcsin_pct_hydrosych	0.062	-0.106	**0.929**	0.114
arcsin_pct_orthoclad	-0.584	-0.025	-0.263	-0.191
arcsin_pct_plecopt	0.536	0.338	-0.334	-0.524
arcsin_pct_tricopt	0.140	-0.027	**0.949**	0.093
arcsin_pct_simul	-0.139	-0.019	0.054	0.399
arcsin_pct_dom5	0.026	**-0.822**	-0.030	0.021

The percent EPT was strongly correlated with percent Chironomidae (Spearman, -0.686) and the EPT derivatives; therefore, the percent EPT variable was selected from the first component. Similarly, the genera-based total taxa (total taxa) was strongly correlated with the percent dominant 5 taxa (Spearman, -0.789), clinger taxa (Spearman, 0.763), Ephemeroptera taxa (Spearman, 0.625), EPT taxa (Spearman, 0.724), and intolerant taxa (Spearman, 0.662); therefore, the total taxa metric was selected from the second component. The third component was comprised of caddisfly metrics; thus, the most heavily weighted variable of percent Trichoptera was selected. From our initial macroinvertebrate PCA, we selected the following variables to be included in a subsequent PCA analysis:

1. percent EPT
2. genera-based total taxa
3. percent Trichoptera, and
4. density

The second macroinvertebrate PCA extracted two components with the arcsine-square root transformed variables of percent Trichoptera (0.801) and percent EPT (0.785) weighting in the first component and the total taxa (0.940) being heavily weighted in the second component. These two components explained approximately 64% of the variation observed among sample sites with respect to macroinvertebrate metrics. The percent EPT variable was selected from the first component due to its inclusion of both mayflies and stoneflies, and total taxa was also selected for inclusion in the overall PCA model evaluating relationships between water quality, habitat, and macroinvertebrate variables.

4.1.4 Principal Component Analysis—Overall

As a result of the individual PCAs described above, a total of 10 variables were selected for inclusion in the overall PCA to evaluate the relative importance of key water quality (5), physical habitat (3), and macroinvertebrate (2) variables in characterizing sample sites with respect to the available data. The PCA extracted four components (Table 13), with the first component weighting the log transformed total magnesium with total taxa, and the second component weighting sediment deposition and arcsine-square root transformed percent fines. The log transformed total suspended solids and total iron were strongly weighted in the third component. Channel flow and log transformed dissolved oxygen were weighted heavily in the fourth component. These four components explained approximately 55% of the variation observed among sampling sites with respect to the available dataset.

Table 13: Rotated component matrix for the overall PCA including water quality, physical habitat, and macroinvertebrate variables. Bolded and shaded values denote which variables are considered the most heavily weighted part of the component.

Variable	Component			
	1	2	3	4
log_mg_tot	**0.797**	-0.123	-0.063	-0.048
log_fecal	0.497	-0.110	0.264	-0.057
log_fe_tot	0.183	-0.267	**0.760**	0.113
log_do	-0.077	0.090	-0.181	**0.752**
log_tss	-0.059	0.096	**0.820**	-0.077
Sed_Dep	-0.074	**0.781**	-0.053	0.072
arcsin_pct_fine	0.057	**-0.817**	0.037	-0.040
Chan_Flow	0.049	0.038	0.188	**0.803**
arcsin_pct_ept	-0.492	0.419	-0.080	0.083
G_Tot_Taxa	**-0.726**	-0.078	0.025	-0.094

The first component in the overall PCA indicates that total macroinvertebrate taxa is moving in the opposite direction of major ions such as magnesium, indicating a strong relationship between the response of the macroinvertebrate community and ionic chemistry. In the initial water quality PCA, total magnesium was selected as a surrogate for sulfate, calcium, and pH, which may also be important factors to consider regarding biological response. The second

component indicates that substrate characteristics also are an important factor when trying to explain the variation observed among sample sites in Central Appalachian streams. Lastly, total suspended solids, total iron, channel flow, and dissolved oxygen also appear to be important factors to consider when evaluating these stream site conditions. Notably, the percent EPT metric did not weight heavily in any of the components, although its coefficients for both the first and second component indicate this metric may be weakly related to ionic chemistry and substrate conditions.

The key variables identified in the PCA analyses were retained and placed into a matrix for further evaluation with results from the All Possible Regressions and Chi-square Automatic Interaction Detection. This matrix will be used to refine the key variables for inclusion in a three dimensional model to evaluate the non-linear relationships between water quality, physical habitat, and macroinvertebrate metrics.

4.2 All Possible Regressions

All Possible Regressions (APR) is another iterative method that combines one dependent response variable with many independent stressor variables, using all possible combinations of the stressor variables, to maximize the variance explained in the response variable. This data mining approach identifies the best single variable or subset of variables that explains the most variation observed in the biological response variable. For this analysis, the total taxa and percent EPT variables were selected as the biological response variables, as identified in the PCA analysis. All of the independent stressor variables identified in Table 9 were initially included in each of the water quality and physical habitat APR models. Similar to the PCA approach, the water quality variables and physical habitat variables were first analyzed independently then combined in an overall APR model for each biological response variable. The R-squared (R^2) and root mean square error for each APR model were reviewed to identify a model with the largest R^2 and smallest error term, while minimizing the variable count (Figure 13). The goal of APR analysis is to identify the smallest subset of variables that explains most of the variation, rather than to provide a predictive equation for the subset of variables.

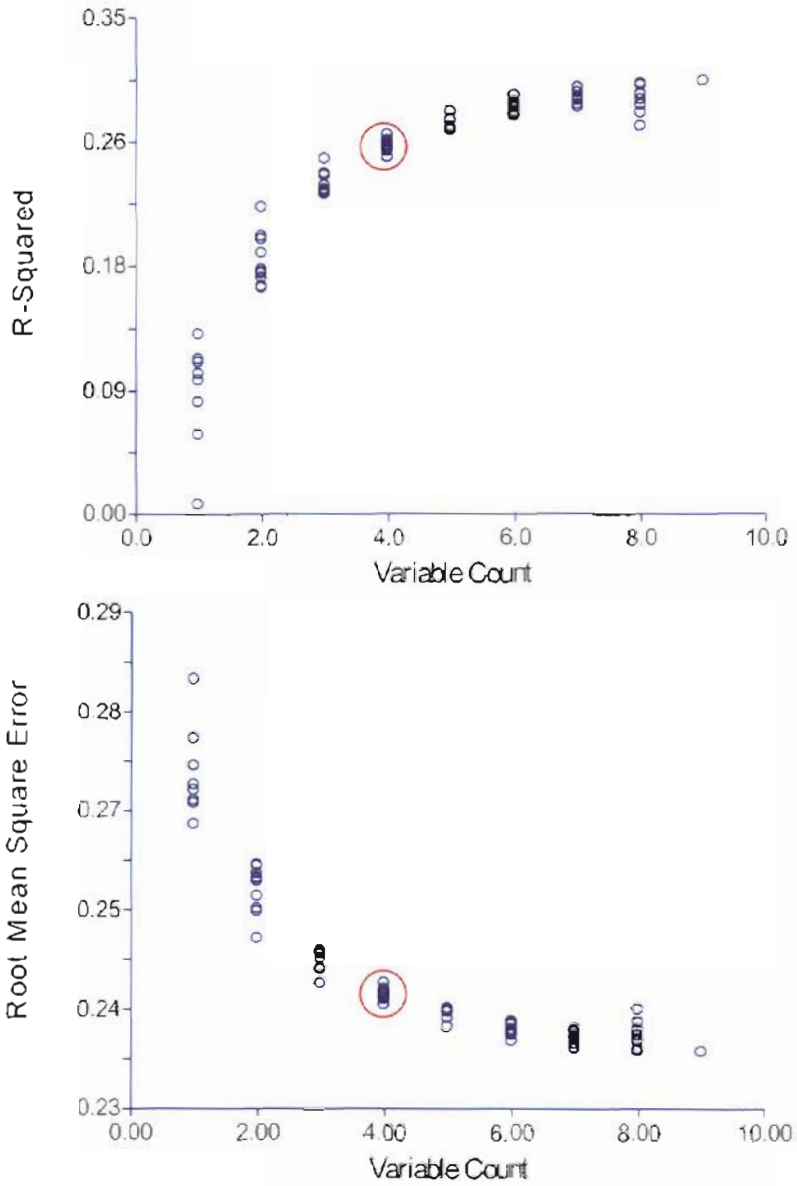

Figure 13: Example of an APR model that maximizes the R-squared and minimizes the root mean square term when four independent stressor variables are selected (red circles). An APR model with 5 or more variables would not substantially increase the R-squared value or substantially minimize the root mean square term.

When the total taxa metric was regressed with the water quality variables, the best fit APR model was based on three variables that included log transformed alkalinity, sulfate, and total aluminum. However, these three variables only explained approximately 17% of the total variation observed in total taxa. The maximum amount of variation explained by any of the models was only 19%. The best fit physical habitat-based total taxa APR weighted four variables: bank stabilization, undisturbed vegetation, channel alteration, and embeddedness, although the maximized R^2 was even lower at 9%.

The six variables identified as contributing to the best fit APR models for macroinvertebrate total taxa were combined for an overall APR analysis. The best fit model using both water quality and physical habitat variables weighted three variables: undisturbed vegetation, channel alteration, and log transformed sulfate, and accounted for approximately 21% of the variation observed in total taxa.

The APR analysis of the transformed percent EPT with water quality variables resulted in a best fit model containing five variables: fecal coliform, total aluminum, total calcium, chloride, and total manganese, and accounted for approximately 24% of the variation observed in the percent EPT. The maximum amount of variation that could be explained using all water quality variables was 27%. The physical habitat APR resulted in a best fit model that included undisturbed vegetation, embeddedness, epifaunal substrate, and percent fines, which explained 16% of the variation in the percent EPT metric. When these water quality and habitat variables were combined in an overall APR analysis, the best fit model included five variables: epifaunal substrate, log transformed fecal coliforms, total aluminum, chloride, and total manganese. This model accounted for 28% of the variation observed in the percent EPT variable.

4.3 Chi-square Automatic Interaction Detection

Chi-square Automatic Interaction Detection (CHAID) is a nonparametric exploratory model used to evaluate contingent relationships between a dependent variable and a series of independent stressor variables, including non-linear relationships (Paulson et al. 2001). CHAID selects a subset of stressor variables that best predicts the dependent variable, and presents these variables in a decision tree. The decision tree starts with the dependent variable and progressively splits into smaller branches (nodes) based on groupings of the stressor variables that best predict the dependent variable. CHAID is a sequential fitting algorithm similar to a forward stepwise model, although the decision to split or combine independent variables is dependent or contingent upon earlier effects, rather than simultaneously as in regression analysis. Both the dependent and independent variables were raw untransformed values treated as interval scale variables, rather than nominal or ordinal variables.

Similar to the PCA and APR analyses, an iterative process was used to evaluate both water quality and physical habitat variables independently, and then select a subset of variables from each analysis to be combined in a final decision tree for each dependent variable. Individual CHAID models were developed for total taxa and percent EPT, which included all of the water quality or physical habitat parameters listed in Table 9. Thus, four separate CHAID decision trees were created: two for total taxa (water quality and physical habitat tree) and two for percent EPT (water quality and physical habitat tree). Each decision tree was evaluated and the most important independent stressor variables were selected from each analysis (Table 14). The independent stressor variables listed for each dependent variable were included in a combined CHAID model to evaluate the relationships between both types of stressor variables and the biological response variable

Table 14:
Selected water quality and physical habitat variables for each dependent variable based on CHAID analyses.

Water Quality	Physical Habitat
Genera-based Total Taxa	
Sulfate	Channel alteration
Total magnesium	Embeddedness
Dissolved oxygen	Channel flow
Temperature	Percent fines
pH	Undisturbed vegetation
	Epifaunal substrate
	Sediment deposition
Percent EPT	
Fecal coliforms	Epifaunal substrate
Total manganese	Channel alteration
pH	Percent fines
Dissolved oxygen	Bank Vegetation
	Riffle sinuosity

When evaluating a CHAID decision tree, the first variable after the dependent response variable is considered the most important stressor in the tree (Figure 14). The CHAID decision tree presented in Figure 14 is the combined water quality/physical habitat CHAID model for percent EPT. In this model, epifaunal substrate is the most important stressor variable (parent Node 0) for percent EPT. The box at each node shows the mean percent EPT value, the standard deviation for percent EPT, the number and percentage of sites with epifaunal substrate values in the listed range, and the predicted percent EPT at such sample sites. The nodes that branch from parent Node 0 (child nodes), list ranges of epifaunal substrate values (in brackets), such that Node 1 represents sample sites that scored less than or equal to 9.0 for epifaunal substrate. As epifaunal substrate scores increase (range from 0 to 20), the mean percent EPT value generally increases with each node. This response in percent EPT is to be expected, because as epifaunal substrate values increase, the quality of the habitat measure transitions from poor to optimal conditions. Sample sites that scored relatively high in this metric present a wide variety of natural structures in the stream, including fallen trees, large rocks, and cobble, all of which create a more complex habitat for aquatic life (Barbour et al. 1999).

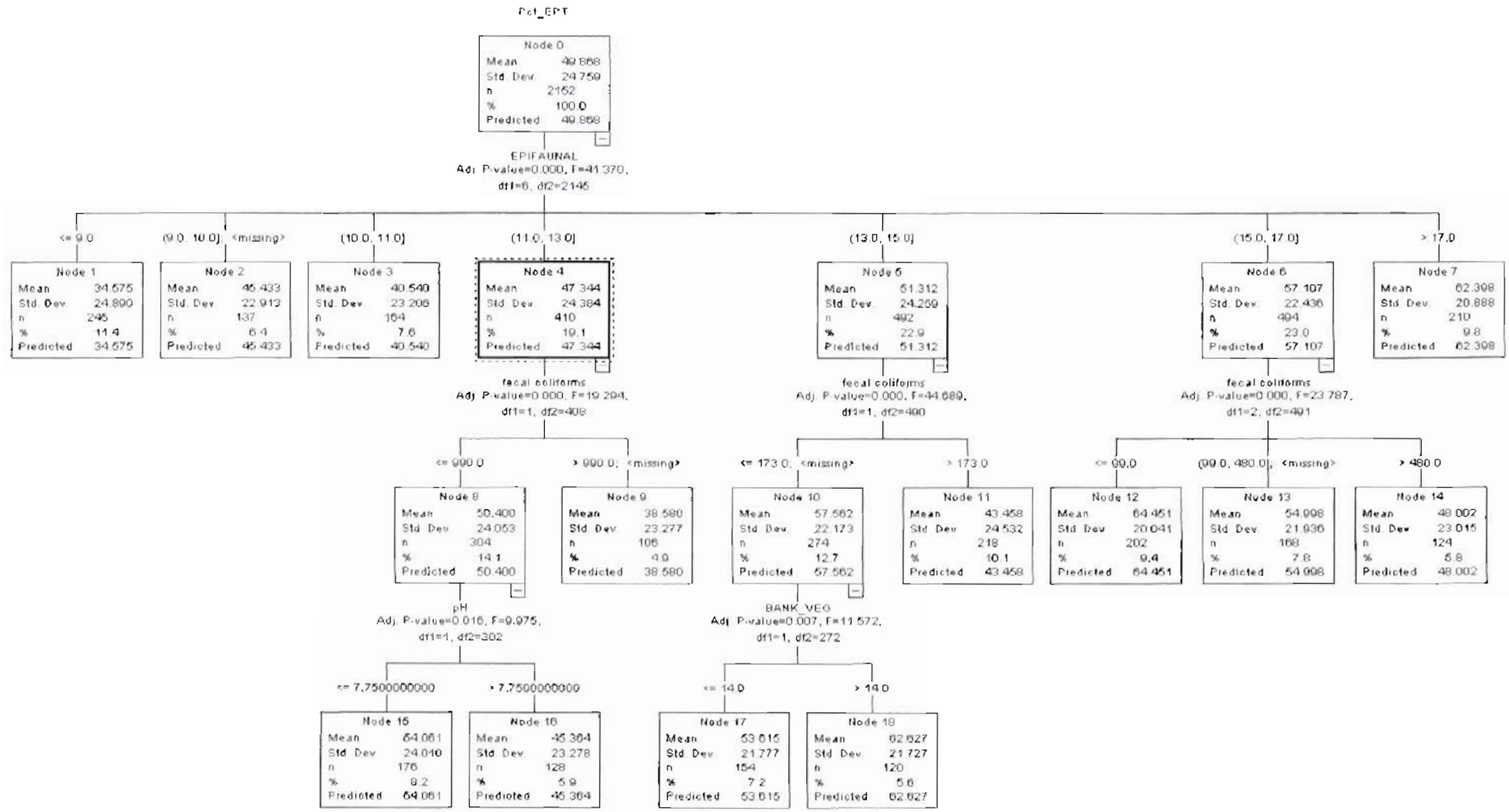

Figure 14: The combined water quality and physical habitat CHAID tree for percent EPT.

Based on the information provided within Nodes 1-3, approximately 25% of the sample sites are categorized as having marginal to poor epifaunal substrate habitat (i.e., scored less than 11); thus, the habitat is less than desirable for benthic invertebrates, especially EPT taxa.

The second most important variable in the percent EPT CHAID analysis is fecal coliforms, which branch from three of the epifaunal substrate nodes. At sites that scored greater than 11 for epifaunal substrate (i.e., suboptimal to optimal), fecal coliform is an important secondary measure that influences the percent EPT metric. Sites that scored 11-13 for epifaunal substrate (Node 4) and exhibited fecal coliform levels less than or equal to 999 cfu/ml also exhibited a greater percent EPT value (50.4%) as compared to sites with fecal coliforms greater than 999 cfu/ml (38.6%). This relationship is consistent among all of the sample sites, such that greater levels of fecal coliforms result in a lower percent EPT value. This relationship suggests that other anthropogenic disturbances may be affecting the EPT taxa. Additional factors that influence percent EPT CHAID analysis are pH and bank vegetation, which branch out from two of the fecal coliform nodes. These factors appear to influence invertebrate communities in streams that scored 11-15 for epifaunal substrate (i.e., suboptimal range) and contained relative low fecal coliform levels.

The combined water quality/physical habitat CHAID model for total taxa showed that sulfate concentration was the most important stressor variable (Figure 15). The model distinguished seven child nodes for sulfate concentrations, with the mean total taxa ranging from approximately 21 taxa for nodes that exhibited sulfate concentrations greater than 504 mg/L, to 31 taxa for nodes that exhibited concentrations less than 9.8 mg/L. However, these seven nodes essentially represent a breakpoint between sample sites that exhibit sulfate concentrations less than 61 mg/L or greater than 61 mg /L (i.e., between nodes 4 and 5).

In general, the mean total taxa ranged from 26 to 31 taxa for nodes that exhibited sulfate concentrations less than 61 mg /L. This range in sulfate concentrations is very similar to that observed for Level 1 Reference sites, which ranged from the detection limit to 65 mg/L. For the nodes representing sulfate concentrations greater than 61 mg/L, the mean total taxa ranged from 21 to 23 taxa. While mean total taxa varies by approximately 10 taxa across the full range of concentrations, the variability in mean total taxa for nodes representing concentrations greater than 61 mg/L is considerably less.

Notably, CHAID analysis excludes any missing dependent variable data, but includes all independent data, even if there is a missing value for one of the independent variables. For example, there are 2,152 valid total taxa values; however, there are only 1,370 valid sulfate values. CHAID analysis considers the total taxa information for the 782 samples with missing sulfate data, and treats them as a separate predictor category. The separate predictor category is compared to the existing nodes and merged with the node that is the most similar (denoted by <missing>). For example, the samples with missing sulfate values were combined with Node 4, because the mean total taxa values were the most similar.

Secondary stressor variables for the combined total taxa model include total magnesium and channel alteration. These two variables are important variables to consider when sulfate concentrations are generally less than 61 mg/L. For sample sites characterized by Node 4, channel alteration is important to consider because this metric provides information regarding large-scale changes in the shape of the channel, such as channelization or bank stabilization using rip-rap (Barbour et al. 1999). Channel alteration values less than or equal to 10 (Figure 15, Node 10) represent poor to marginal conditions for this metric, whereas values greater than 16 represent optimal conditions for this metric. The total taxa metric responds predictably to channel alteration, such that poor to marginal conditions result in fewer total taxa when compared to optimal conditions. Other factors that influence total taxa are embeddedness and epifaunal substrate conditions. Both of these variables characterize the available substrate conditions, a critical consideration for benthic invertebrates.

4.4 Summary of PCA, APR, and CHAID Analyses

Our analyses indicate that a single composite parameter, like conductivity, is not the most appropriate parameter when trying to explain the variation observed among the Central Appalachian macroinvertebrate communities with respect to water quality and physical habitat. Rather, some combination of ionic composition, substrate, and channel features may be the most appropriate stressor variables to consider.

These analyses also indicate that total taxa and percent EPT abundance are the key response variables to consider when evaluating factors that shape the macroinvertebrate community, as opposed to a singular focus on Ephemeroptera.

Additionally, total suspended solids, dissolved oxygen, and fecal coliforms appear to be key variables to consider when evaluating these stream sites, as they are strong indicators of other anthropogenic disturbances in the watersheds.

Despite EPA's underlying assumption that conductivity is the key driver in structuring macroinvertebrate community composition in the Central Appalachian streams, our analyses indicate that it is more appropriate to evaluate multiple possible stressors, including the specific ions that comprise the measure of specific conductance (Table 15). Furthermore, it is also important to consider substrate characteristics and habitat disturbance when evaluating macroinvertebrate responses.

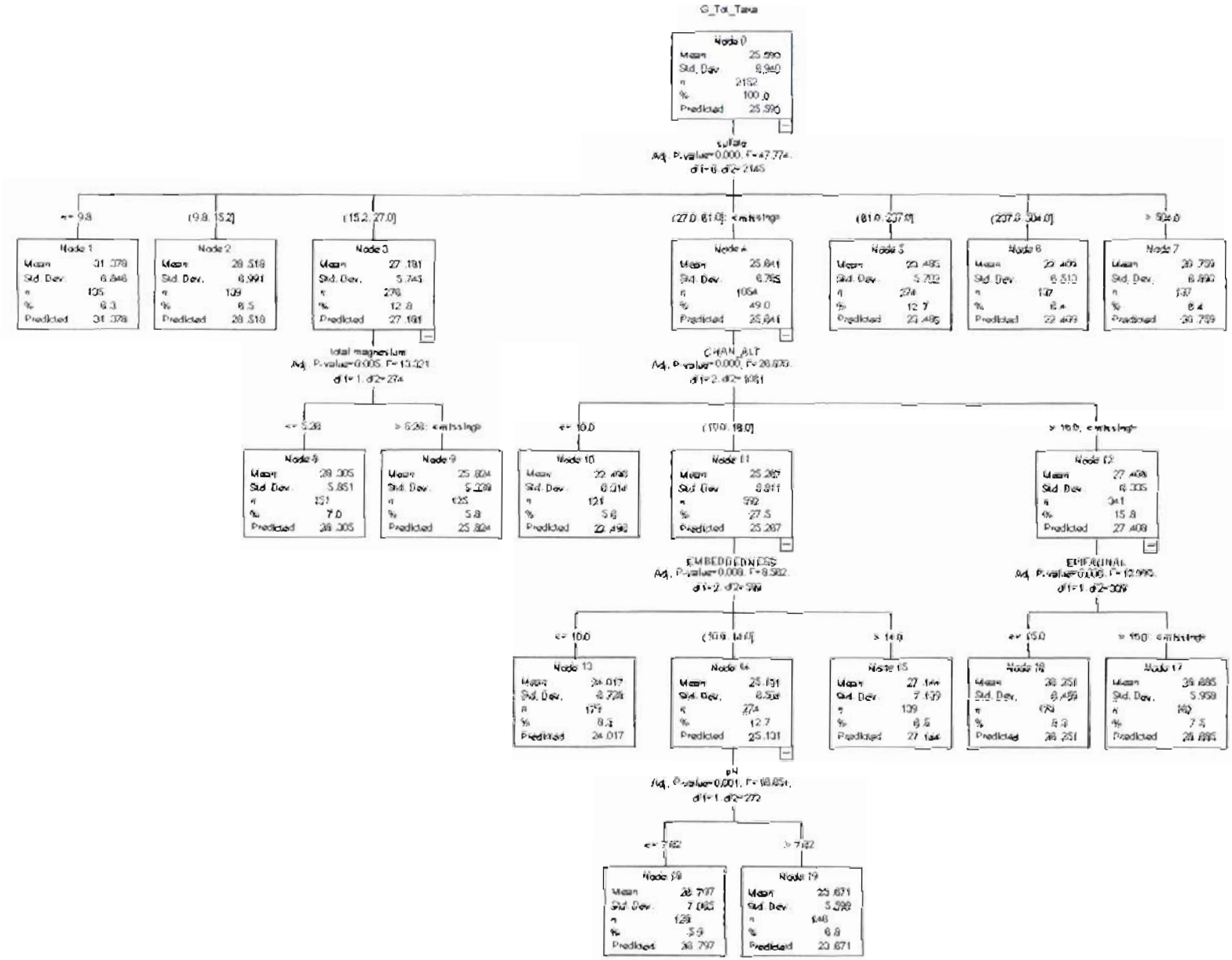

Figure 15: The combined water quality and physical habitat CHAID tree for total taxa.

Table 15: List of independent stressor variables considered important in the data reduction approach when evaluating stream sites and the two dependent response variables (genera-based total taxa and percent EPT).

Principal Component Analysis	All Possible Regressions	Chi-square Automatic Interaction Detection
Genera-based Total Taxa		
Total magnesium	Undisturbed vegetation	Sulfate
Percent fines	Channel alteration	Channel alteration
	Sulfate	Total magnesium
		Embeddedness
		Epifaunal substrate
Percent EPT		
Percent fines	Undisturbed vegetation	Epifaunal substrate
Total magnesium	Epifaunal substrate	Fecal coliforms
Total suspended solids	Fecal coliforms	Bank vegetation
	Chloride	pH
	Total manganese	

The list of independent stressor variables represents the most important variables and their relative ranking of importance for each analysis. For example, the PCA model that considered percent EPT along with the key water quality and physical habitat variables revealed that percent fines and total magnesium weighted heavily in the first component and in the opposite direction of percent EPT. The total suspended solids weighted heavily in the second component. Thus, these three variables are considered important factors that influence the percent EPT metric. Similarly, for the total taxa APR model, three important factors, including undisturbed vegetation, channel alteration, and sulfate, were sequentially weighted into the APR model, indicating that of the three variables, undisturbed vegetation explained the most variation in the model.

The list of independent stressor variables were reviewed for their commonality among analyses, as well as their relative influence on each dependent response variable. The variables were then ranked to determine the most influential stressor variables for each biological response variable (Table 16). For example, based on our data reduction approach, channel alteration and sulfate concentration are the two most influential variables with respect to total taxa, while epifaunal substrate cover and fecal coliform concentrations are the two most influential variables with respect to percent EPT. The two primary stressor variables for each biological response variable are related to both physical habitat and water quality conditions, although ionic composition appears to be more influential on total taxa than percent EPT. The relative influence of fecal coliforms on percent EPT indicates that other anthropogenic disturbances are important factors to consider with respect to the benthic macroinvertebrate assemblages in Ecoregions 69 and 70 of West Virginia.

Table 16: Matrix of sorted and ranked independent stressor variables for two dependent response variables (genera-based total taxa and percent EPT).

Principal Component Analysis	All Possible Regressions	Chi-square Automatic Interaction Detection
Genera-based Total Taxa		
1	Channel alteration	Channel alteration
2	Sulfate	Sulfate
3 Total magnesium		Total magnesium
4	Undisturbed vegetation	
5 Percent fines		
6		Embeddedness
7		Epifaunal substrate
Percent EPT		
1	Epifaunal substrate	Epifaunal substrate
2	Fecal coliforms	Fecal coliforms
3 Percent fines		
4	Undisturbed vegetation	
5 Total magnesium		
6		
7 Total suspended solids		
8		Bank vegetation
9	Chloride	
10	Total manganese	
11		pH

Based on the results of the PCA, APR, and CHAID analyses, the top two ranked stressor variables for each biological response variable were included in a 3-dimensional model (TableCurve 3D v4.0.01) to evaluate the non-linear relationships. Total taxa was modeled as a function of channel alteration and sulfate, while percent EPT was modeled as a function of epifaunal substrate cover and fecal coliforms. The best fit model for total taxa explained 21% of the variation observed in this metric, while the model for percent EPT explained only 14%. While the data reduction analyses provide insight into the key variables that influence total taxa and percent EPT, the outcome of the 3-dimensional modeling is not surprising. It is well known that multiple physicochemical and physical habitat characteristics elicit a variety of biological responses, thus a poorly fit model that explains little variation in a community composition metric is not unexpected.

Despite the poor 3-dimensional modeling outcome, this data reduction approach indicates that physical habitat characteristics such as channel alteration, epifaunal substrate cover, and other sediment-based metrics are important factors to consider, in addition to ionic composition (e.g., sulfate and total magnesium), when evaluating macroinvertebrate responses. Additionally, the fecal coliforms variable indicates that other anthropogenic disturbances may play a key role in EPT composition of West Virginia streams.

5.0 Summary and Conclusions

The EPA (2010) conductivity benchmark represents a fundamentally different application of an SSD approach than is typically used for derivation of regulatory criteria or benchmarks. In particular, the proposed conductivity benchmark is based on field surveys and correlations between the stressor and biological response in uncontrolled field environments, with multiple species present and all possible biotic (predation/competition/etc.) and abiotic (temperature/flow/season/etc.) interactions occurring. There are several aspects to using a field-based approach that may greatly limit the scientific reliability of using this approach to set specific regulatory thresholds for a composite water quality measurement such as conductivity. The primary disadvantages of using field data result from the fact that exposures are not controlled, and so the causal nature of the relationship between conductivity and the associated biological responses are very difficult to evaluate. As we describe in this report, EPA's arguments supporting the mechanistic plausibility of conductivity as the (virtually only) cause of "impairment" are not convincing, and so cast considerable doubt on the overall reliability of the conductivity benchmark.

Furthermore, any chemical or biological variables that are correlated with conductivity or the biotic response may confound the presumed relationship between conductivity and biological impairment. To address this, EPA (2010) conducts a relatively formal, yet not convincing, analysis of causal mechanisms and confounding factors. EPA concludes that although plausible confounding factors likely exist, their influence is not *strong enough* to prevent use of the conductivity benchmark as presented in this document. The evidence cited by EPA as supporting the causes of impairment related to conductivity is relatively weak and inconsistent. Therefore, it is as yet an unanswered question as to whether or not conductivity—as opposed to other potentially explanatory factors—is in fact the best and most reliable indicator of adverse changes in biological communities in this region.

The following discussions summarize the major conclusions from each element of our review.

5.1 Conflicting Stressor Response Profiles Preclude Benchmark Derivation

Multiple conflicting stressor-response profiles are exhibited by the genera used in EPA (2010) to derive the conductivity benchmark and, thus, do not represent an internally consistent dataset from which to derive a regulatory benchmark. This suggests that either different invertebrate genera exhibit fundamentally different responses to elevated conductivity, or factors other than conductivity are more closely and functionally related to the capture probability of individual genera across the study region. Therefore, the inclusion of all taxa from the dataset, regardless of their stressor-response profile to conductivity, is inappropriate for the derivation of a benchmark based on an SSD approach. Indeed, for taxa that exhibit

increasing capture probabilities with increasing conductivity, it is possible that extirpation of these species would occur at low conductivities, so the benchmark would clearly not be "protective" with respect to their presence in stream sites in the region.

Therefore, we contend that the use of an SSD of XC_{95} values based on conflicting stressor-respond profiles is a fundamentally flawed method for derivation of a regulatory benchmark.

5.2 Evidence of Causation

There are insufficient data from the scientific literature to support EPA's conclusion that "conductivities in the region of concern reach levels that are sufficient to cause effects on stream communities" (EPA 2010, p. 52). Although EPA conducted a relatively formal causal analysis, the weight of evidence scoring for each causal element was relatively subjective and open to reasonable alternative interpretation. First, although elevated conductivity can clearly induce adverse effects on aquatic invertebrates, the taxonomic patterns of sensitivity are not yet clearly defined. Although laboratory toxicity data exposing mayflies to actual or simulated mining effluents suggest they may be somewhat more sensitive than the most sensitive surrogate test species, *C. dubia*, effect concentrations are highly variable and, in some studies, overlap between species. Toxicity to ions associated with conductivity also varies strongly as a function of specific ion composition and can be mitigated under conditions of elevated hardness. In fact, criteria based on individual ions—rather than those based on composite variables such as conductivity—have already been implemented in other states as a preferable regulatory approach that best fits the available scientific information.

5.3 Confounding Factors Analysis

The confounding factors analysis in Appendix B of EPA (2010) was clearly not an attempt to eliminate true confounding variables, nor was it an attempt to independently test the hypothesis that conductivity was the best predictor of biological impairment. We do not agree that a confounding factor analysis should take it *as a given* that these are the only relationships that require evaluation. Rather, we contend that a confounding factors analysis should also include rigorous and independent tests of the primary hypothesis and first determine whether conductivity is indeed the best predictor of biological impairment that is causally related in such a way as to justify the proposed benchmark value.

We further suggest that elements of EPA's confounding factor analysis would benefit from a closer evaluation to determine whether any of the following factors could provide alternative explanations for patterns in macroinvertebrate community structure relative to MTM/VF activities:

- *Habitat*: There are three clear problems with EPA's assertion that habitat presented little potential for confounding in their derivation of the conductivity benchmark needs additional scrutiny. First, the RBP habitat scores used by EPA in their analyses may not be the most rigorous measure of habitat quality. Second, the RBP

habitat scores were correlated with conductivity and the biological response (i.e., the HC_{05} value). Third, the analysis of potential confounding factors in EPA (2010) focused almost exclusively on the relationship of Ephemeroptera to habitat metrics, to the exclusion of the rest of the benthic macroinvertebrate community.

- *Confounding factors analysis conducted exclusively with Ephemeroptera*: Relationships between all potential stressors (in addition to habitat) and Ephemeroptera were generally cited as reasons to reject the stressors as potential confounders in the analysis that ultimately relates to the entire aquatic benthic community. There is a clear need to include similar analyses from other members of the entire invertebrate community to conclusively reject (or not reject) additional environmental factors as potential confounding stressors.

- *Influence of rare taxa*: EPA (2010) attempted to control for the effect of rare taxa by including only those taxa that had been collected in at least one reference site and at least 30 general sites. It would have been more appropriate for EPA to have controlled for the effects of rare taxa by including in their SSD only those genera that had a high capture probability in the reference sites. A plausible argument against excluding rare taxa from the SSD would be that the taxon is rare because of the stressor. However, this argument would not be valid if the taxon is naturally rare, a phenomenon that could be analyzed using its capture probability in reference sites. EPA (2010) did not sufficiently demonstrate that the rare taxa were rare due to conductivity or any other water quality effect, and not from general rarity itself.

5.4 Ecological Relevance of Presumed Impairment

The ultimate goal of EPA's proposed conductivity benchmark is to determine a conductivity level that, if not exceeded, would prevent extirpation of 95% of the aquatic macroinvertebrate genera. However, it is important to evaluate the relevance of this protection goal when the criterion or benchmark is derived from a very large number of genera, as is the case with the proposed conductivity benchmark. Even if one accepts the role of conductivity in being directly correlated with and responsible for loss of taxa at elevated conductivity, is this 95% protection level ecologically relevant, i.e., do communities in the presence of elevated conductivity lose important ecological functionality?

We evaluated trends in macroinvertebrate community structure and function relative to conductivity from the data presented in EPA (2010). There are few observed changes in the proportional abundance of functional feeding groups within the regional pool of taxa at conductivity levels below approximately 2,500 µS/cm to 5,000 µS/cm. This indicates that the functional aspect of the stream community may not change due to conductivity levels above 300 µS/cm, since genera from all functional feeding groups remain available in the regional taxa pool.

5.5 Independent Statistical Analysis

Our analyses of the WABbase dataset indicate that conductivity alone is not the most appropriate parameter when trying to explain the variation observed among the Central Appalachian macroinvertebrate communities with respect to water quality and physical habitat. Rather, ionic composition, substrate composition, and channel features may be the most appropriate stressor variables to consider. These analyses also indicate that total taxa and percent EPT abundance are the key response variables to consider when evaluating factors that shape the macroinvertebrate community, as opposed to a singular focus on Ephemeroptera. Additionally, total suspended solids, dissolved oxygen, and fecal coliforms appear to be key variables to consider when evaluating these stream sites, as they are strong indicators of other anthropogenic disturbances in the watersheds.

5.6 Conclusions

We conclude that the relationship between conductivity and changes in benthic macroinvertebrate community structure is neither strong nor reliable enough to warrant derivation of a regulatory benchmark at this time. For the most part, this is because EPA (2010) did not rigorously or independently test the primary hypothesis that elevated salinity (as measured by conductivity) was the best predictor of changes in macroinvertebrate community structure in West Virginia streams associated with MTM/VF activities. Rather, most of the analysis conducted in EPA (2010) takes it as a given that conductivity is the best predictor. Furthermore, insufficient laboratory studies are available to confirm either the causal mechanisms or conductivity thresholds that would confirm the proposed benchmark of 300 µS/cm under the specific ion composition of streams in this region. For similar reasons, Illinois, Indiana, and Iowa have rejected the use of TDS or conductivity-based criteria in lieu of criteria for individual ions such as sulfate or chloride.

More importantly, the use of an SSD of XC_{95} values based on conflicting stressor-response profiles is a fundamentally flawed method for derivation of a regulatory benchmark. EPA (2010) contends that this approach is appropriate "because sufficient and appropriate laboratory data were not available and because high quality field data were available to relate conductivity to effects on aquatic life in streams and rivers." We agree that sufficient and appropriate laboratory data are not available, but a preferred approach would be to generate such data as could be used for derivation of aquatic life criteria using standard methods (Stephan et al. 1985). This would avoid the use of conflicting stressor-response profiles in deriving the HC_{05} benchmark value, and would also help to confirm or refute the causal linkages between elevated concentrations of salinity and biological impairment to invertebrates. We disagree, however, that the field data rigorously support the hypothesis that conductivity is the best predictor of changes in benthic macroinvertebrate community structure in West Virginia streams. Additional study is needed to confirm or refute this hypothesis, both through use of additional statistical hypothesis testing with the existing dataset, and through additional study of West Virginia streams associated with coal MTM/VF activities.

Therefore, we strongly believe that it is inappropriate and inadvisable to adopt a conductivity benchmark until or unless such additional study is conducted

5.7 Response to EPA Science Advisory Board Charges to Reviewers for the Conductivity Benchmark Report

EPA released the following charges to reviewers on the SAB for their meeting to discuss the conductivity benchmark on July 20 – 22, 2010 (Slimak 2010). To further summarize the review presented in this report, we provide suggested responses to these charge questions.

Charge Question 1: The datasets used to derive a conductivity benchmark (described in Section 2 of this report) were developed primarily by two central Appalachian states (WV and KY). Please comment on the adequacy of these data and their use in developing a conductivity benchmark.

> *Response: In terms of data quality, the dataset is generally acceptable. However, its use to derive a conductivity benchmark is not appropriate. First, multiple conflicting stressor-response profiles are exhibited by the genera used in EPA (2010) to derive the conductivity benchmark and, thus, do not represent an internally consistent dataset from which to derive a regulatory benchmark. Second, the use of field data to derive a benchmark greatly limits the scientific reliability of using this approach to set specific regulatory thresholds for a composite water quality measurement such as conductivity. In addition, most of the analyses conducted by EPA take it as a given that conductivity is the best predictor. Our independent analyses indicate this is not the case.*

Charge Question 2: The derivation of a benchmark value for conductivity was adapted from EPA's methods for deriving water quality criteria. The water quality criteria methodology relies on a lab-based procedure, whereas this report uses a field-based approach. Has the report adapted the water quality criteria methodology to derive a water quality advisory for conductivity using field data in a way that is clear, transparent and reasonable?

> *Response: While their document appears clear and wansparent, we do not believe the approach is reasonable and does not appropriately follow water quality criteria methodology. It is simply not appropriate to use a SSD approach with data representing conflicting stressor-response profiles. Nor were factors other than conductivity fully or adequately evaluated, and so the benchmark "takes it as a given" that conductivity is the best or most appropriate predictor of biological impairment.*

Charge Question 3: Appendix A of the report describes the process used to establish a causal relationship between the extirpation of invertebrate genera and levels of conductivity. Has the report effectively made the case for a causal relationship between species extirpation and high levels of conductivity due to surface coal mining activities?

Response: No, the report has not adequately made this case. The report did not adequately test the primary hypothesis that conductivity is the best predictor of impairment. While the causal analysis followed a logical process, weight of evidence conclusions were subjective and alternative scorings are supportable. Additional laboratory studies are also needed with appropriate test durations and species to confirm or refute sensitivity to conductivity of the appropriate ionic composition, and under appropriate conditions of hardness. In addition, potential for habitat, temperature, flow and other abiotic, as well as biotic, parameters to be important predictors of benthic invertebrate community structure are poorly addressed.

Charge Question 4: In using field data, other variables and factors have to be accounted for in determining causal relationships. Appendix B of the report describes the techniques for dealing with confounding factors. Does the report effectively consider other factors that may confound the relationship between conductivity and extirpation of invertebrates? If not, how can the analysis be improved?

Response: No, the report does not effectively consider other factors, but rather takes it as a given that conductivity is the appropriate and primary stressor of interest. See report and comments from CQ3 for suggestions for improvement

Charge Question 5: Uncertainty values were analyzed using a boot-strapped statistical approach. Does the SAB agree with the approach used to evaluate uncertainty in the benchmark value? If not, how can the uncertainty analysis be improved?

Response: We did not evaluate this specifically, but this generally seemed reasonable, although the effect of the uncertainty—which was often quite large for any particular genus in the SSD—was not addressed in the final benchmark. Nor was the issue of conflicting stressor-response profiles addressed in their approach.

Charge Question 6: The field-based method results in a benchmark value that the report authors believe is comparable to a chronic endpoint. Does the Panel agree that the benchmark derived using this method provides for a degree of protection comparable to the chronic endpoint of conventional ambient water quality criteria?

Response: Not necessarily. These are not really directly comparable, except that field populations clearly are impacted by and integrate survival, growth, and reproduction. Field populations also affected by and integrate acute endpoints as well. As a practical matter, comparison to chronic endpoints may be most appropriate, but chronic endpoints are still largely organismal endpoints, whereas the field data integrate population and community (even

ecosystem) level impacts that combine all possible combinations of abiotic and biotic interactions.

Charge Question 7: As described, the conductivity benchmark is derived using central Appalachian field data and has been validated within Ecoregions 68, 69, and 70. Under what conditions does the SAB believe this method would be transferable to developing a conductivity benchmark for other regions of the United States whose streams have a different ionic signature?

Response: Until or unless this conductivity benchmark can be validated (we believe it has not been), it is not at all appropriate to consider transferring this method to other regions—or even apply to these regions. In particular, until the effects of all stressors, such as different ionic signatures and hardness and other potential and likely stressors such as habitat, temperature, and flow are better understood for a wide range of species, it is very premature to extrapolate this method of using field correlations for only conductivity from one region to another region.

Charge Question 8: The amount and quality of field data available from the states and the federal government have substantially increased throughout the years. In addition, the computing power available to analysts continues to increase. Given these enhancements in data availability and quality and computing power, does the Panel feel it feasible and advisable to apply this field-based method to other pollutants? What issues should be considered when applying the method to other pollutants?

Response: This is not so much a question of data availability or computing power, but rather whether or not we can rigorously determine whether individual chemical stressors are powerful and reliable enough predictors of biological response—separate from all the other components of an organism's environment—and whether these responses are causal. This requires taking hypotheses generated from large datasets, "data mining", and objectively testing these hypotheses to ensure the patterns are reliable and causally related. To date, we have not yet seen this done adequately for any stressor, including iron, nutrients, or conductivity. So, no, this field-based method should not be applied to other pollutants, just like it should not be applied to conductivity.

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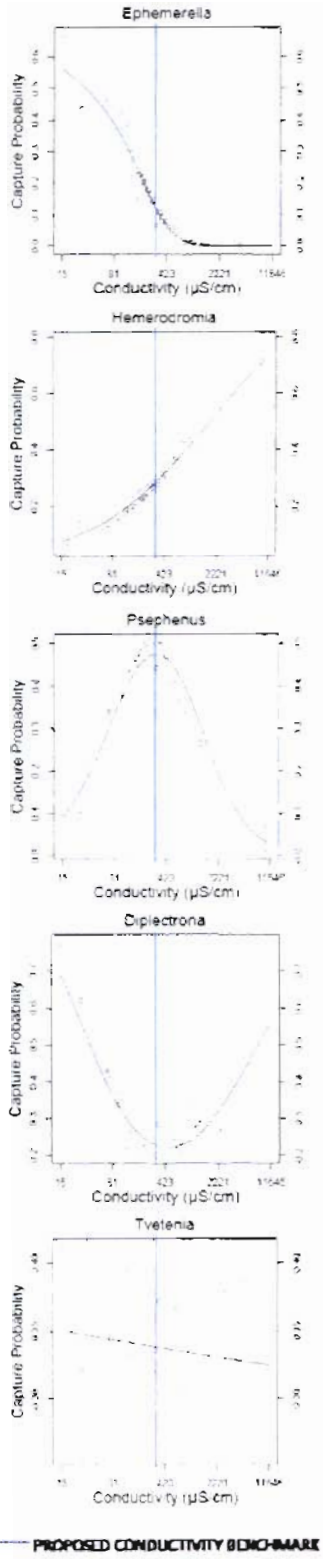
EXHIBIT 6

GEI Consultants, Inc. Ecological Div., "Primary Technical Concerns with Proposed EPA Conductivity Benchmark" (undated)

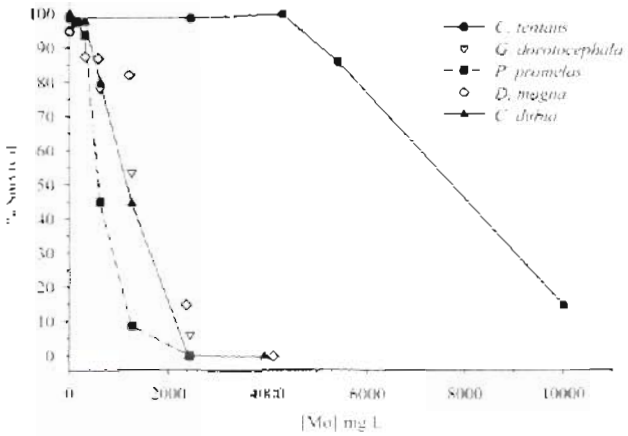
filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
Pursuant to Section 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010

Primary Technical Concerns with Proposed EPA Conductivity Benchmark

1. Issues with conflicting stressor-response profiles and species-sensitivity methods



- As outlined in GEI (2010), the prime underlying principle governing the use of a species-sensitivity distribution (SSD) is that all of the organisms in the distribution exhibit a consistent response to the stressor.
- Specifically, each of the taxa should respond negatively to the stressor – only differing in their degree of sensitivity – as shown below (Canton et al. 2010).



- However, as illustrated to the left (from EPA 2010), there are five different ways the organisms used to derive EPA's benchmark respond to conductivity.
  - These differences do not reflect varying levels of sensitivity over a consistent response profile – rather, they are fundamentally different types of stressor-response profiles.
- These five stressor-response profiles provide substantially different answers to the question "*what conductivity concentration is necessary to provide the level of protection used by EPA?*"
  - Decreasing (*Ephemerella*): <300 µs/cm
  - Increasing (*Hemerodromia*): >300 µs/cm
  - Optimum (*Psephenus*): >75 <u>and</u> <2,500 µs/cm
  - Bimodal (*Diplectrona*). <200 <u>and</u> >2,000 µs/cm
  - No response/bimodal (*Tvetenia*): *None needed*
- There is no way to reconcile these widely conflicting stressor-responses into a single benchmark protective of the entire macroinvertebrate community.

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2. **Issues with EPA's "causal analysis"**

   - Although EPA conducted a relatively formal causal analysis, the weight of evidence scoring for each causal element was relatively subjective and open to clearly reasonable alternative interpretations.
   - The taxonomic patterns of sensitivity to conductivity are not yet clearly defined.
     - Although laboratory toxicity data exposing mayflies to actual or simulated mining effluents suggest they may be somewhat sensitive, effect concentrations are highly variable.
   - Toxicity to ions associated with conductivity also varies strongly as a function of specific ion composition and can be mitigated under conditions of elevated hardness.

3. **Issues with EPA's confounding factor analysis**

   - EPA assumed conductivity as a "given" – then tried to see if other factors changed that assumption, when, in fact, a confounding factors analysis should include rigorous and independent tests of the primary hypothesis. In other words, EPA should first determine whether conductivity is indeed the best predictor of biological impairment that is causally related in such a way as to justify the proposed benchmark value.
   - EPA's confounding factor analysis would benefit from a closer evaluation to determine whether other factors could provide alternative explanations for patterns in macroinvertebrate community structure relative to coal mining/valley fill activities:
     - *Habitat*: There are three problems with EPA's assertion that habitat presented little potential for confounding in their derivation of the conductivity benchmark:
       - First, the RBP habitat scores used by EPA in their analyses may not be the most rigorous measure of habitat quality.
       - Second, the RBP habitat scores are correlated with both conductivity and the biological response.
       - Third, EPA's analysis of potential confounding habitat factors focused almost exclusively on the relationship of Ephemeroptera, to the exclusion of the rest of the benthic macroinvertebrate community.
     - *In fact, their confounding factors analysis was conducted exclusively with Ephemeroptera*:
       - Relationships between all potential stressors (in addition to habitat) and Ephemeroptera were generally cited as reasons to reject the stressors as potential confounders in the analysis that ultimately relates to the entire aquatic benthic community.
       - There is a clear need to include similar analyses from other members of the invertebrate community to conclusively reject additional environmental factors as potential confounding stressors.
     - *Influence of rare taxa*: EPA attempted to control for the effect of rare taxa by including only those taxa that had been collected in at least one reference site and at least 30 general sites.
       - It may have been more appropriate to have controlled for the effects of rare taxa by including in their SSD only those genera that had a high capture probability in the reference sites.
       - A plausible argument against excluding rare taxa from the SSD would be that the taxon is rare because of the stressor. However, this argument would not be valid if the taxon is naturally rare, a phenomenon that could be analyzed using its capture probability in reference sites.

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4. Issues with ecological relevance of the proposed conductivity benchmark

- GEI evaluated trends in macroinvertebrate community structure and function relative to conductivity using the data presented in EPA (2010). There are few observed changes in the proportional abundance of functional feeding groups within the regional pool of taxa at conductivity levels below approximately 2,500 µS/cm to 5,000 µS/cm.
- EPA's proposed conductivity benchmark does not evaluate any other type of aquatic life, so levels of protection for the entire aquatic community is unknown.

Independent Statistical Evaluation

In addition to the aforementioned technical concerns associated with a detailed review of EPA (2010), GEI conducted an independent statistical evaluation of ecological factors most closely associated with patterns in benthic macroinvertebrate community structure using the WABbase dataset; i.e., the same West Virginia database used to derive EPA's proposed conductivity benchmark (GEI 2010). GEI's analysis indicated the following:

- Conductivity alone is not the most appropriate parameter when trying to explain the variation observed among the Central Appalachian macroinvertebrate communities with respect to water quality and physical habitat.
- Rather, a combination of ionic composition, substrate composition, and channel features appear to be more appropriate stressor variables to consider.
    - Total suspended solids, dissolved oxygen, and fecal coliforms appear to be additional variables to consider, as they are strong indicators of other anthropogenic disturbances in the watersheds.
- These analyses also indicate that other metrics like total taxa and percent EPT abundance, may be better response variables, as opposed to a singular focus on Ephemeroptera.

References

Canton SP, Guenzel LG, Pargee S. 2010 Acute and chronic toxicity of molybdenum to the fathead minnow and four aquatic invertebrates. *In preparation*.

GEI Consultants, Inc. (GEI). 2010. Final Technical Review: A Field-based Aquatic Life Benchmark for Conductivity. Available at http://www.nma.org/pdf/legal/092110_gei.pdf. GEI Consultants, Inc., Denver, CO.

U.S. Environmental Protection Agency (EPA) 2010. *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams*. Draft EPA/600/R-10/023A. U.S Environmental Protection Agency, Washington, DC.

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EXHIBIT 7

Letter from Evelyn S. MacKnight, Chief, NPDES Permits Branch, EPA Region III, to Jeffrey Parsons, WVDEP (Oct. 28, 2010)

filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
Pursuant to Section 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

OCT 28 2010

Mr. Jeffrey Parsons
West Virginia Department of Environmental Protection
Division of Mining & Reclamation
601 57th Street SE
Charleston, WV 25304

Re: WV NPDES No. WV1024540 – New
White Wine Mining Venture, LLC
Opus Highwall Mine No. 1
SMCRA No. S300710
EPA Receipt Date – September 28, 2010

Dear Mr. Parsons:

Pursuant to Section 402 of the Clean Water Act, 40 CFR § 123.44, the *Memorandum of Agreement Regarding the Administration and Enforcement of the National Pollutant Discharge Elimination System (NPDES) in West Virginia (1982)* (MOA), the U.S. Environmental Protection Agency (EPA) Region III received the draft permit cited above. This action is for a new surface mine encompassing 21.60 acres discharging to Slaughter Creek. The Permit rationale indicates that this proposed mine is considered the "1st-Permit-In" under the West Virginia Department of Environmental Protection's (WVDEP) antidegradation process. For the reasons described below, we consider this submittal incomplete; therefore, we are issuing an interim objection consistent with the MOA and 40 CFR § 123.44(d)(2). Once we receive the information requested and a revised draft permit, we will reinitiate our review.

Based on the best information available to EPA, projects with predicted conductivity values below 300 µS/cm generally are not likely to cause water quality violations or significant degradation of the aquatic ecosystem. Discharges with levels of conductivity above 500 µS/cm generally are likely to be associated with adverse impacts that could cause or contribute to significant degradation and/or excursions from narrative water quality criteria. Baseline water quality (BWQ) data reviewed included samples demonstrating levels of conductivity, total dissolved solids (TDS) and sulfates that are consistent with levels potentially associated with biological impairment. The rationale page indicates that BWQ Station No. BWQ-1788-50 was used to assign wasteload allocations and final effluent limits for outfalls 002, 003 and 004. This BWQ station exhibited specific conductivity ranging from 76.4 µS/cm to 636 µS/cm with an average of 163.91 µS/cm; sulfates ranging from 28.76 mg/l to 204.34 mg/l with and average of 56.22 mg/l. BWQ Station No. BWQ-1787-50 was used to assign wasteload allocations and final limits for outfalls 001, 005, 006 and 007. This BWQ exhibited specific conductivity ranging from

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188.00 µS/cm to 756 µS/cm with an average of 530.75 µS/cm; TDS ranging from 112 mg/l to 524 mg/l with an average of 353.50 mg/l; sulfates ranging from 82.02 mg/l to 350.79 mg/l with and average of 193.01 mg/l.

Given that this permit is considered the "1st-Permit-In" and BWQ data indicate that existing specific conductivity levels already approach and occasionally exceed 500 µS/cm, we request that instream and effluent monitoring be required to evaluate at a minimum, total dissolved solids (TDS), specific conductivity (SC), calcium, magnesium, bicarbonate, chlorides and sulfates. In addition, we also request that the permit record include baseline and annual West Virginia Stream Condition Index (WVSCI) scoring for the instream monitoring locations and that the monitoring program required by Section D, paragraph 3 include instream biological monitoring using WVSCI, EPA's Rapid Bioassessment protocols, and any other methodologies employed or accepted by WVDEP to assess attainment of biological use for purposes of Section 303(d) during the life of the permit. We recommend that the baseline information in the record and required instream biological monitoring identify taxa to the genus level.

WVDEP has stated that all the outfalls proposed by this facility are precipitation induced discharges associated with on-bench sediment structures and that it do not expect to have elevated mineralization/ions in the discharge. Based on this assumption, WVDEP has concluded that this facility does not have reasonable potential to exceed the West Virginia narrative water quality standards. However, WVDEP has not submitted any documentation with this draft permit to support the above assumption. EPA's regulations at 40 CFR § 122.45 establish for calculation NPDES permit conditions. 40 CFR §122.45(e) states that discharges which are non-continuous shall be described and limited considering: the frequency of discharge; total mass; maximum rate of discharge of pollutants during the discharge; and prohibition or limitation of specified pollutants by mass, concentration, or other appropriate measure. Therefore, EPA considers this an incomplete submittal. Accordingly, this letter represents an interim objection to issuance of this permit and our review under the MOA will recommence once we have received this documentation.

EPA recognizes that in certain fact-specific circumstances, instream conductivity levels greater than 500 µS/cm may not cause adverse impacts to the biological community. To the extent that is believed to be the case here, characterization of the effluent should include an analysis of the ionic matrix and whether the effluent will be dominated by calcium, magnesium, bicarbonate , sulfate and chloride. Where instream background conditions are limestone-dominated, that also should be noted. In addition, analysis should be provided as to whether the native aquatic community is similar to that studied in the *Benchmark Conductivity Study* and in Pond, G.J., M. E. Passmore, F.A. Borsuk, L. Reynolds, and C. J. Rose. 2008, *Downstream effects of mountaintop coal mining: comparing biological conditions using family- and genus-level macroinvertebrate bioassessment tools*, J. N. Am. Benthol. Soc. 27(3):717–737. Any analysis based on differences of the native aquatic community should include a review of taxa (at the genus level) at applicable reference sites within the region.

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This draft permit should not be issued until WVDEP addresses the above issues. If you have any questions concerning this matter, please call me at 215-814-5717 or call Francisco Cruz at 215-814-5734.

Sincerely,

Evelyn S. MacKnight

Evelyn S. MacKnight, Chief
NPDES Permits Branch (3WP41)
Water Protection Division

cc: Thomas L. Clarke, WV DEP
Jon M. Capacasa, EPA Region 3

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EXHIBIT 8

Comparison of Mitigation Plans

filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
Pursuant to Section 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010

EXHIBIT 9

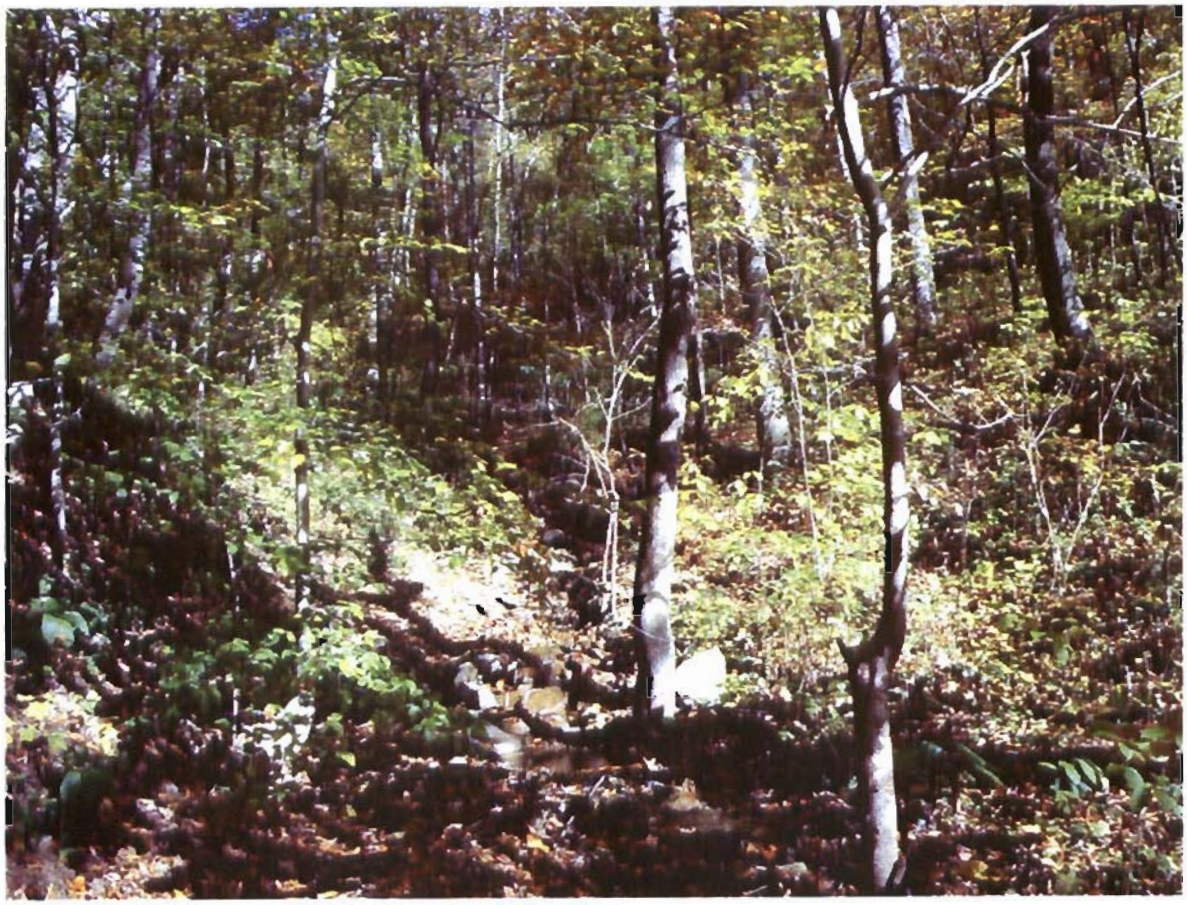
Photograph of an Active Erosion Control Channel at the Aracoma Coal Mining Site

filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
Pursuant to Section 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010

EXHIBIT 10

Photographs of a Connectivity Channel on the Dal-Tex Property

filed with the Comments in Response and in Opposition to the
Recommended Determination of the U.S. Environmental Protection Agency Region III
Pursuant to Section 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia
Submitted by Mingo Logan Coal Company, Inc.
November 29, 2010



Final

Technical Evaluation Document

Review of USEPA Recommended Determination
Spruce No. 1 Mine, West Virginia

Prepared for

Mingo Logan Coal Company, Inc.

November 2010

CH2MHILL

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Acronyms and Abbreviations

AOC	Approximate Original Contour
CFS	cubic feet per second
CMP	Comprehensive Mitigation Plan
DMR	Discharge Monitoring Report
DOB	Downstream Oldhouse Branch
DSF	downstream Spruce Fork
EC	electrical conductivity
EC_{10}	10 percent effect concentration
EPT	Ephemeroptera, Plecoptera, and Trichoptera
EPZ	erosion protection zone
IFAA	Interim Assessment Approach for High Gradient Streams
µg/L	microgram per liter
mg/kg	milligram per kilogram
mg/L	milligram per liter
MTM	mountain-top mining
NCD	Natural Channel Design
NED	National Elevation Dataset
NPDES	National Pollutant Discharge Elimination System
O/E	Observed/Expected
RBP	Rapid Bioassessment Protocol
RD	Recommended Determination
SHP	Special Handling Plan
SHU	Stream Habitat Unit
SI	Stressor Identification
SMCRA	Surface Mining Control and Reclamation Act
TDS	total dissolved solids
uS/cm	microSiemens per centimeter
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USF	Upstream Spruce Fork
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VF	valley fill

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WET	whole effluent toxicity
WVDEP	West Virginia Department of Environmental Protection
WVSCI	West Virginia Stream Condition Index

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1.0 Introduction

This document provides CH2M HILL's technical review of the United States Environmental Protection Agency, Region III, (USEPA) Recommended Determination (RD) issued by USEPA pursuant to Section 404(c) of the Clean Water Act concerning the Spruce No. 1 Mine. This document analyzes USEPA's RD by reviewing the permitting record and other information (including site-specific data and published literature) relevant to the issues raised in the RD. This document addresses each of the topics evaluated in Section V of the RD (Basis for Recommended Determination).

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2.0 Characteristics and Functions of the Potentially Affected Resources

2.1 Stream Characteristics

In its RD, USEPA characterizes Pigeonroost Branch and Oldhouse Branch as healthy stream systems supporting diverse aquatic communities, as defined by the characteristics of their benthic macroinvertebrate communities. USEPA summarizes survey results for the streams that would be directly affected by the Spruce No. 1 Mine (Pigeonroost Branch, Oldhouse Branch, and Seng Camp Creek); White Oak Branch (a nearby stream not affected by the Spruce No. 1 Mine); and streams affected by mining operations at the Dal-Tex Mine complex. The key data sources generically identified by USEPA include the Programmatic EIS, the Spruce No. 1 Mine EIS, and the WVDEP monitoring database. However, data sources frequently are not referenced by a specific citation throughout Section IV.A of the RD (e.g., there are few citations for taxa richness percentile ranks and no sources are identified in RD Tables 1 and 2).

Although Pigeonroost Branch and Oldhouse Branch support healthy benthic macroinvertebrate communities, as indicated by the West Virginia Stream Condition Index (WVSCI), they are clearly not uniquely diverse or distinctive among other unmined headwater streams in the West Virginia mountaintop mining region. This region lies in the Cumberland Mountains of the Central Appalachian Plateau and predominantly drains northwest to the Ohio River. USEPA (Green et al., 2000) evaluated stream conditions in several watersheds across this region and found that most of the unmined sites surveyed met expectations for healthy streams based on the WVSCI. More specifically, these streams were in "Very Good" or "Good" condition with respect to the West Virginia reference condition.[1] The unmined sites included Oldhouse Branch and nine other sites. In addition, several mined sites were characterized as healthy streams based on the WVSCI. The mined sites included Pigeonroost Branch and four other sites. Thus, USEPA's own survey results clearly demonstrate that multiple healthy streams supporting diverse aquatic communities occur in the Central Appalachian ecoregion.

The RD (pp. 20-24) refers to numbers of mayfly, stonefly, and total genera in samples from Oldhouse Branch and Pigeonroost Branch as indicating especially high diversity in these streams. However, USEPA neither provides the supporting genus-level data nor compares the data to other unmined streams in the Central Appalachian ecoregion. Thus, USEPA's observations about percentile ranks of taxa richness cannot be evaluated based on facts readily available in the record, including its own previous evaluation (Green et al., 2000).

Benthic metrics reported by USEPA (Green et al., 2000; Appendix 2) for unmined stream sites across the mountaintop mining region indicate that benthic macroinvertebrate diversity in Oldhouse Branch and Pigeonroost Branch is not unique for the ecoregion. For instance, samples collected in spring 1999, winter 2000, and spring 2000 from Oldhouse Branch (Station MT42) and Pigeonroost Branch (Station MT45) yielded 4 or 5 mayfly families (Ephemeroptera taxa)

[1] Scores >78-100 indicate very good conditions, comparable to WVDEP reference sites; scores 70-78 indicate good conditions, comparable to below-average WVDEP reference sites (Green et al., 2000).

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(Table 2-1). Comparable numbers of mayfly families (up to 6) were found in samples from 10 other unmined and mined sites in the USEPA data set. Comparable numbers of total taxa and Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa also were found in samples from several other sites.

TABLE 2-1
Benthic Macroinvertebrate Family-level Metrics for Unmined and Mined Stream Sites in the Central Appalachian Ecoregion

Station ID	Stream/Basin	Class	Season	Total Taxa	EPT Taxa[a]	WVSCI	Ephem. Taxa[b]
MT02	Rushpatch Branch/ Mud River	Unmined	Spring 1999	25	13	70.40	5
			Winter 2000	23	14	86.87	5
			Spring 2000	19	11	85.24	4
MT03	Lukey Fork/Mud River	Unmined	Spring 1999	21	12	75.95	5
			Winter 2000	19	13	96.45	5
			Spring 2000	22	14	93.10	6
MT107	Left Fork/Island Creek	Unmined	Spring 2000	13	10	80.48	3
MT13	Spring Branch of Ballard Fork/Mud River	Unmined	Spring 1999	21	13	86.27	5
			Winter 2000	15	10	91.33	3
			Spring 2000	20	12	90.35	5
MT39	White Oak Branch/Spruce Fork	Unmined	Spring 1999	22	16	86.97	6
			Winter 2000	18	10	67.80	4
			Spring 2000	20	13	90.25	6
MT42	***Oldhouse Branch/Spruce Fork***	***Unmined***	***Spring 1999***	***21***	***13***	***94.88***	***5***
			Winter 2000	***26***	***17***	***91.45***	***4***
			Spring 2000	***20***	***13***	***90.18***	***4***
MT50	Cabin Branch/Island Creek	Unmined	Spring 1999	25	17	85.39	5
			Winter 2000	21	14	95.87	4
			Spring 2000	15	9	86.42	5
MT51	Cabin Branch/Island Creek	Unmined	Spring 1999	16	11	81.35	5
			Winter 2000	13	8	78.56	4
			Spring 2000	12	8	79.85	4
MT91	Rader Fork/Twentymile Creek	Unmined	Spring 1999	12	7	72.66	3
			Winter 2000	17	10	77.62	4
			Spring 2000	20	14	84.64	4
MT95	Neil Branch/Twentymile Creek	Unmined	Spring 1999	22	17	84.28	5
			Winter 2000	19	13	90.44	4
			Spring 2000	18	12	82.54	4
MT106	NNT to Sugartree/Mud River	Mined	Spring 2000	17	10	82.76	3
MT45	***Pigeonroost Branch/Spruce Fork***	***Mined***	***Spring 1999***	***20***	***12***	***86.49***	***5***
			Winter 2000	***21***	***12***	***94.15***	***4***
			Spring 2000	***17***	***10***	***82.58***	***4***
MT79	Davis Fork/Clear Fork	Mined	Spring 1999	24	16	82.40	5
			Winter 2000	20	15	81.10	4
			Spring 2000	17	13	80.07	3
MT81	Sycamore Creek/Clear Fork	Mined	Spring 1999	18	11	82.25	4
			Winter 2000	23	16	81.35	4
			Spring 2000	21	14	77.00	5

Source: USEPA data provided by Green et al. (2000).

[a] EPT refers to aquatic insects of the orders Ephemeroptera, Trichoptera, and Plecoptera.

[b] Ephem. = Ephemeroptera.

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Genus-level macroinvertebrate survey results presented by Pond et al. (2008) show that communities similar in diversity to Oldhouse Branch and Pigeonroost Branch are found in other unmined streams in the Central Appalachian region of West Virginia. EPT generic richness and Ephemeroptera generic richness were comparable among the unmined sites (Rushpatch, Spring, and White Oak Creeks), as summarized in Table 2-2. The number of mayfly (Ephemeroptera) genera averaged 8, with a maximum of 9, comparable to the genus-level diversity found in Oldhouse Branch (RD, p. 20). These data further demonstrate that Oldhouse Branch and Pigeonroost Branch are not unique in macroinvertebrate diversity among other unmined headwater streams in the ecoregion.

TABLE 2-2
Benthic Macroinvertebrate Genus-level Metrics for Three Unmined Stream Sites in the Central Appalachian Ecoregion

Metric	Unmined Stream					
	Rushpatch		Spring		White Oak	
	1999	2006	1999	2006	2000	2007
Total generic richness	42	40	33	37	32	30
EPT generic richness	17	19	17	21	17	20
Ephemeroptera generic richness	9	7	8	8	9	8

Source Pond et al. (2008)

In conclusion, macroinvertebrate survey results reported for streams throughout the West Virginia mountaintop mining region clearly show that numerous streams support healthy aquatic communities, with EPT and Ephemeroptera diversity similar to Oldhouse Branch and Pigeonroost Branch. Further, Oldhouse Branch and Pigeonroost Branch are similar in EPT and Ephemeroptera taxa richness to other unmined headwater streams – and even some mined headwater streams – in the Central Appalachian Region.

2.2 Stream Functions

USEPA believes that because Oldhouse Branch and Pigeonroost Branch support "least degraded" macroinvertebrate communities, they are valuable in and of themselves and for the functions they perform within the context of the Spruce Fork sub-watershed and the Coal River sub-basin (RD, p. 19). However, USEPA has not demonstrated the value of the functions provided by these streams to these larger watersheds, nor has it shown that changes in these functions could result in unacceptable adverse impacts to downstream aquatic communities. Together, the Oldhouse Branch (596.65 acres) and Pigeonroost Branch (1,478.69 acres) watersheds cover an area of 2,075.34 acres or 3.24 square miles, which represents only 2.6 percent of the Spruce Fork sub-watershed (126.4 square miles [RD, p. 22]) and 0.4 percent of the Coal River sub-basin (891 square miles [RD, p. 22]). Hence, the functional role these two headwater streams play in the Spruce Fork ecosystem is small. As characterized by USEPA (RD, p. 32), the fish assemblage in Spruce Fork downstream of the Spruce No. 1 Mine is in relatively good condition and the species occurring there have not changed appreciably over the last 60 years. Moreover, as shown above, Oldhouse Branch and Pigeonroost Branch are not unique in their macroinvertebrate diversity for the region, are minor contributors to the local watersheds,

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and no federal or state protected species of wildlife are known to occur in these streams that would be affected by the project.

In conclusion, drainage area relationships indicate that Oldhouse Branch and Pigeonroost Branch play only small functional roles in the context of the Spruce Fork and Coal River watersheds. Changes to these functional roles, therefore, would not result in unacceptable impacts to downstream fish assemblages in Spruce Fork, which USEPA acknowledges are in relatively good condition.

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3.0 Effects on Water Chemistry

3.1 Selenium

3.1.1 History of USEPA's Consideration of Selenium at the Spruce No.1 Mine and Adoption of Plan to Avoid Selenium Discharges

Although USEPA expresses concern about discharges of selenium downstream from the Spruce No. 1 Mine, it appears not to have taken into account the various permit conditions that must be followed to minimize any such effects. Instead, USEPA relies heavily on increased selenium levels in streams carrying discharges from previous mining operations in which such selenium-minimizing techniques were not used. Further, USEPA points to no evidence that the permit conditions meant to minimize selenium contributions to affected watersheds, with which it previously agreed, will not effectively prevent discharges of selenium from the permitted valley fills.

On May 24, 2002, USEPA issued a general objection letter pursuant to Part II.E.2 of the Memorandum of Agreement between USEPA and the State of West Virginia. The letter stated that USEPA would provide the West Virginia Department of Environmental Protection (WVDEP) with the grounds for a specific objection, or withdraw this general objection "as soon as we are able to make a proper determination."

USEPA issued a letter on July 30, 2002, that outlined its specific objection and conditions necessary for withdrawal of its objection including:

1. "Permit monitoring conditions, satisfactory to USEPA, for selenium, conductivity, and sulfates must be included for Oldhouse, White Oak, and Pigeonroost Branches and for sedimentation pond discharges serving valley fills on these streams, as well as the sedimentation pond serving the valley fill on the unnamed tributary of Pigeonroost Branch.

2. The biological monitoring plan for Oldhouse, White Oak, and Pigeonroost Branches, as described in the special conditions of the 1999 permit, must be reevaluated and modified where determined necessary by USEPA in order to provide a comprehensive assessment of aquatic life impacts and any correlation with sedimentation pond effluent levels.

3. A condition must be included in the permit that requires a feasibility study of techniques for handling spoil material and drainage, including the consideration of treatment, which would minimize the potential for stream impairment and elevated levels of selenium, conductivity, and sulfates in streams below valley fills, during both operation and reclamation. The study must also include an evaluation of the feasibility of identifying and providing special handling of selenium-bearing minerals to minimize selenium levels in drainage resulting from valley fills. A report on the study findings must be provided within a year after permit issuance and may be used in consideration of future permit requirements."

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WVDEP responded to USEPA's specific objection in a letter dated October 28, 2002, that stated "Condition No. 16 has been added to address the concern over the possibility of high selenium content in certain strata and the feasibility to special handle such material during mining."

By letter dated December 03, 2002, USEPA withdrew its objection, stating "We are satisfied that steps will be taken to address the issues raised in the objection, based on the revised NPDES permit submitted on October 28, 2002, and our recent discussions with you and staff members of the WVDEP. We appreciate your cooperation in resolving our concerns and look forward to working with you and WVDEP staff members on other environmental matters of mutual concern."

It should be noted that the permit at this time encompassed 2,914 acres, compared to the original proposal for more than 3,000 acres and the current 2,278 acres; it also included a fill in White Oak Branch that was subsequently deleted with application of the Approximate Original Contour (AOC)/Fill Minimization procedure. Clearly, USEPA acknowledged that its concerns about a much larger mining operation than that currently proposed had been resolved to its satisfaction.

Condition 16 of National Pollutant Discharge Elimination System (NPDES) Permit WV1017021 (from the modification approved June 24, 2003) specifies that a feasibility study will be conducted to identify selenium-bearing strata and the locations of drill holes to be used for testing. This approach was followed in the sampling for the Spruce No. 1 Mine (Sturm Environmental Services 2010). In addition, the material handling plan (WVDEP Permit S-5013-97 – Attachment O-8, Pages 15.1 and 15.2 to the NPDES permit) contains this specific language about placement of fill containing selenium concentrations greater than 1 mg/kg (milligram per kilogram):

"Potentially acid or toxic material will:

1. Not be placed in close proximity to drainage courses.
2. Be placed such that a minimum of ten feet of non-toxic, non-acidic, durable material separates the potentially toxic material from the floor of the basal seam and at least four feet of non-toxic alkaline material covers the isolated material.
3. Not be placed within a durable rock fill.
4. Be separated from the final regraded surface by a minimum of ten feet of overburden with an excess neutralization potential.
5. Be handled and placed in accordance with time and acreage requirements of the contemporaneous reclamation plan."

No other concerns about selenium were expressed by USEPA in the NPDES permit and no objections were expressed by the Applicant with respect to implementing these permit conditions.

Additionally, as discussed below in Section 3.1.2, the Surface Mining Control and Reclamation Act (SMCRA) Permit for the Spruce No. 1 Mine requires implementing a special handling plan for potentially selenium toxic materials. These plans were designed, with USEPA's concurrence, to avoid unacceptable selenium discharges from the Spruce

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No. 1 Mine. They should be taken into account when evaluating the potential impacts from the permitted valley fills in Pigeonroost and Oldhouse branches. However, USEPA appears to ignore these measures.

3.1.2 Comparison of Spruce No. 1 to Dal-Tex and Other Mines

Throughout Section V of the RD, USEPA states, without providing appropriate technical justification, that impacts from the Dal-Tex operation are likely to be a good predictor of impacts from the Spruce No. 1 Mine. In support of its position, USEPA attempts to correlate historical selenium data from the Dal-Tex Mine with the potential for water quality exceedances at the Spruce No. 1 Mine. Comparing these data is technically inappropriate because of differences in mining practices, the extent and manner of coal seam mining, and the different material handling techniques at the two mine sites. The technical problems with the USEPA approach are described below and on pp. 28-29 of the Technical Evaluation Document (CH2M HILL 2010), which was previously provided to USEPA.

In its RD, USEPA has ignored the substantive differences between historical Dal-Tex practices and those to be employed, per current mining permit requirements, at the Spruce No. 1 Mine that USEPA previously evaluated and agreed with. Contrary to USEPA's contention, impacts from the Dal-Tex operation are not good, or even appropriate, predictors of the likely impacts from the permitted valley fills at the Spruce No. 1 Mine.

Differences in Mining Practices

The amount and type of historical mining activities within the Dal-Tex Mine and the Spruce No. 1 Mine watersheds are significantly different. As documented in the EIS (U.S. Army Corps of Engineers [USACE], 2006), the area around the Dal-Tex Mine has been actively mined since the early 1900s. Impacts from these historical mining activities continue to influence the quality of the receiving streams in and around the Dal-Tex Mine. These impacts relate to mining practices in use before the enactment of the SMCRA in 1977 (i.e., pre-Law) and are significantly greater than would be the case with newer mining practices.

For example, in pre-Law mining, the overburden from the coal seam was simply pushed into the valleys or streams. Techniques for erosion control, sedimentation control, and selective handling of acidic or toxic overburden material were either non-existent or were not implemented. Within the Left Fork Beech Creek watershed, the site of a modern-era surface operation on the Dal-Tex Mine, about 450 acres of pre-Law disturbance existed before the present-day mining activities were initiated.

Additionally, extensive underground mining was conducted in the Buffalo B, Middle Coalburg, Upper Stockton, and Five Block seams of the Dal-Tex watershed. All of this mining activity is situated in the Dal-Tex drainage and contributes discharges to the surface water system. As such, the Dal-Tex Mine site has multiple and significantly different source areas that provide selenium loading to the watershed than those of the Spruce No. 1 Mine.

By comparison, the area around the Spruce No. 1 Mine has not been actively mined and the impacts from historical mining activities are much more limited. Within the Spruce No. 1 Mine permit boundary, historical underground mining is limited to isolated areas along the eastern perimeter of the project area. This consists of an area within the Upper Stockton Seam that was initially mined pre-Law and then re-mined in the late 1980s/early 1990s.

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The extent of the Dal-Tex excavation was far greater than that proposed for Spruce Mine No. 1. As such, it created more active operating areas, which resulted in increased disturbance that could increase selenium mobilization when compared to the Spruce No. 1 Mine. These conditions, in conjunction with the lack of a specific material handling plan for selenium-enriched overburden at the Dal-Tex operation, increased the potential for weathering and leaching of selenium from the Dal-Tex operation compared to the proposed Spruce No. 1 Mine operation.

Another difference in the mining practices between the Dal-Tex complex and the Spruce No. 1 Mine was the use of the AOC/Fill Optimization Process Guidance Document procedures for the Spruce No. 1 Mine. The AOC process optimizes overburden placement by maximizing the amount of spoil placed on the bench and minimizing the amount placed in valley fills. Thus, unlike the process proposed for the Spruce No. 1 Mine, selenium-bearing material was placed directly in the valley fills at Dal-Tex. Additionally, the Dal-Tex valley fills were larger per unit of overburden moved to access the coal.

Differences in Coal Seams

Although the same coal seams/horizons are proposed to be developed for the Spruce No. 1 Mine as for the Dal-Tex Mine, the extent of the development is different. The Spruce No. 1 Mine operation will involve mountain-top mining (MTM) through the Upper Stockton horizon in the eastern portion of the project area and through the Middle Coalburg horizon in the western portion of the project area. Mining within the Buffalo Seam horizon will be limited to incidental contour mining within the designated fill areas. On the Dal-Tex Mine operation, by comparison, a significant portion of the Left Fork Beech Creek area was mountain-top mined through the Buffalo Seam horizon. This difference in relation to the Buffalo Seam is significant in that there will be less disturbance of strata below the Middle Coalburg, where selenium concentrations sometimes are greater than 1 mg/kg.

Figure 3-1 shows the location and extent of the mineral removal areas within the Left Fork of Beech Creek at the Dal-Tex facilities. The area depicted on the map shows about 274 acres of mineral removal area that would be defined as unreclaimed and unregraded contour mining highwalls. About 450 acres of pre-SMCRA disturbance exist within the Left Fork Beech Creek watershed, consisting of 274 acres of disturbance associated with the mineral removal area and the balance being spoils from the mineral removal area that were pushed over the outslopes of the existing ground, rather than being segregated to manage selenium discharges.

The drill hole location map (Figure 3-2) shows drill holes that have been tested and analyzed for selenium content in the various strata, along with a graphical representation of the correlation of the selenium horizons on the Spruce No. 1 Mine and the Left Fork Beech Creek mining area (Figures 3-3 through 3-6). The color-coded strata depicted for drill hole DT0805 (Figure 3-3) indicate the horizons that were mined within the Left Fork Beech Creek area prior to August 1, 1977. The color coding coincides with the mining areas on the map showing the pre-1977 mining. Included for reference are the geologic sections as submitted to the WVDEP for both operations (Figures 3-3 through 3-6). This again indicates the lack of comparability between Dal-Tex and Spruce No. 1 Mine operations.

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Differences in Material Handling Techniques

Placing overburden strata with selenium concentrations equal to or greater than 1.0 mg/kg within a fill area is prohibited by current WVDEP regulations and permit conditions. Strata that would generate these values are indicated in Figure 3-3 in red text. Materials that meet the fill criteria with respect to selenium concentrations are shown in blue text. The results of the exploration and testing show that direct correlations between the geochemical characteristics of the Spruce No. 1 Mine and the Dal-Tex operation are inappropriate for relating the selenium characterizations, and that many of the horizons that were pushed into the underlying valleys from the pre-Law surface mining within Left Fork Beech Creek would have been prohibited from placement in the fills under modern era mining restrictions (as they are for the Spruce No. 1 Mine).

At the time Dal-Tex Mine was permitted and coal was mined, selenium had not been identified as a parameter of concern in the NPDES discharge permit, so special material handling practices to address selenium were neither required nor implemented. Most Dal-Tex mining activities within the Beech Creek watershed were discontinued in 1999. By contrast, the Spruce No. 1 Mine will include modern material handling and mining techniques such as enhanced erosion control, stormwater management, and selective handling of high-selenium overburden materials. These techniques are designed to prevent unacceptable adverse water quality impacts and were previously accepted by USEPA.

As defined in the SMCRA permit, the Spruce No. 1 Mine must follow the requirements of the "Special Handling Plan (SHP) - Potentially Selenium-Toxic Materials" section. The SHP requires that the operation conduct sampling and analysis for identification of source materials with high selenium-leaching potential. This material must then be segregated and placed in properly designed and constructed "isolation zones" on the mine site for final disposal in designated locations. The requirement to place the material on the mine site means that it must be located on top of a pad constructed on the mine bench rather than in an excess spoil disposal area. The isolation zones are designed to minimize the mobility of selenium by reducing its contact with water. The isolation zones consist of a pad composed of non-toxic, non-acidic durable material at least 10 feet in thickness. After the material is placed, it is covered by at least 4 feet of non-toxic alkaline material suitably compacted to reduce its permeability. The zones are then covered with at least 10 feet of ordinary backfill and revegetated in accordance with the approved plan. By following these plans, selenium-bearing materials are kept out of any stream channel.

The Mingo Logan Coal Company conducted drilling and selenium analysis at three onsite locations in accordance with Condition 16 of the NPDES permit and submitted the results (shown in Figure 3-3) to WVDEP on January 3, 2008 (Burdette, 2008, personal communication). Mingo Logan Coal Company provides quarterly certification reports to WVDEP per the SHP requirements to document the handling method(s) and disposal location(s) in the isolation zones for this material during mining operations (Quarterly Certification Letters initiated 2nd Quarter 2009).

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FIGURE 3-1
Left Fork of Beech Creek

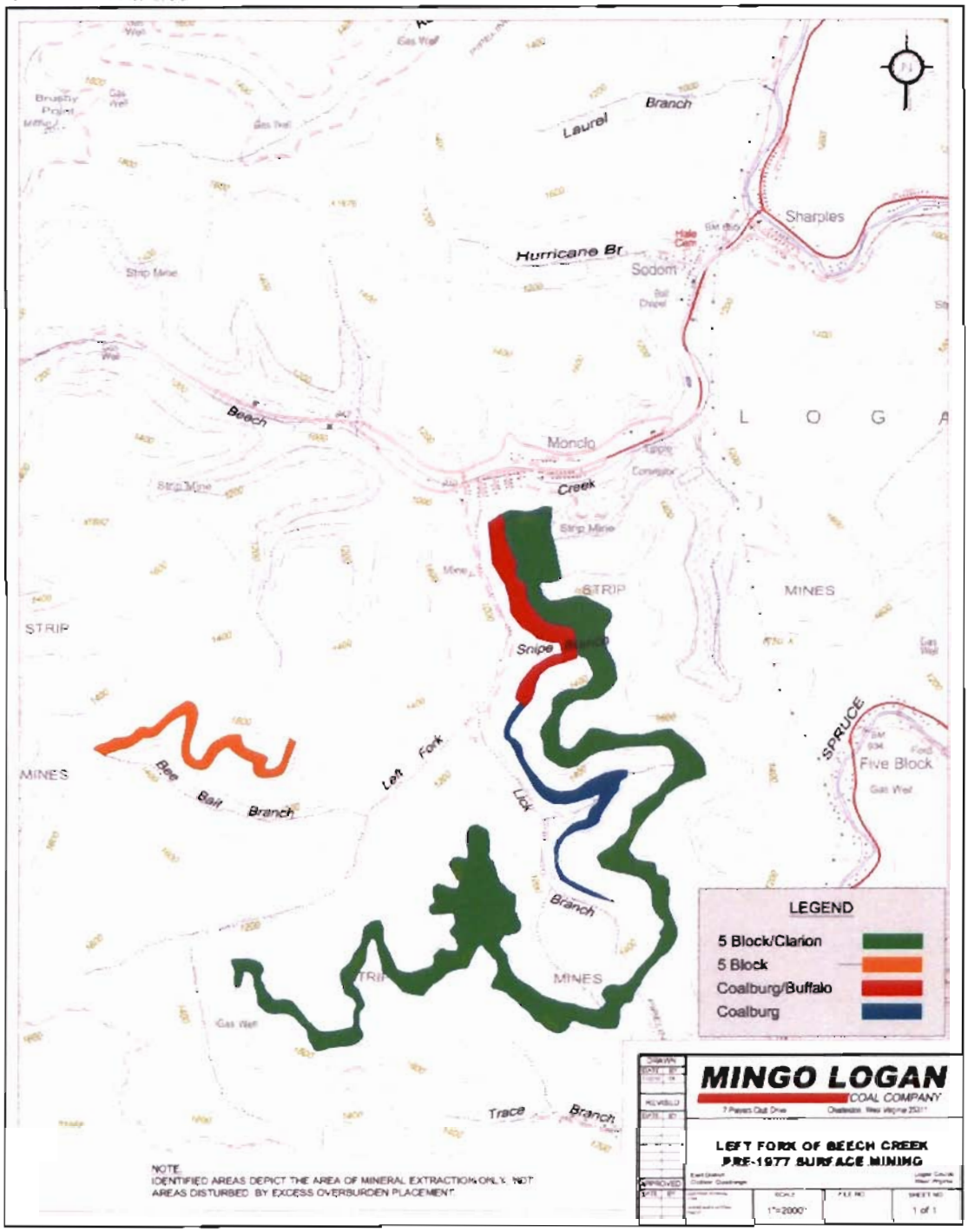

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FIGURE 3-2
Drill Hole Location Map

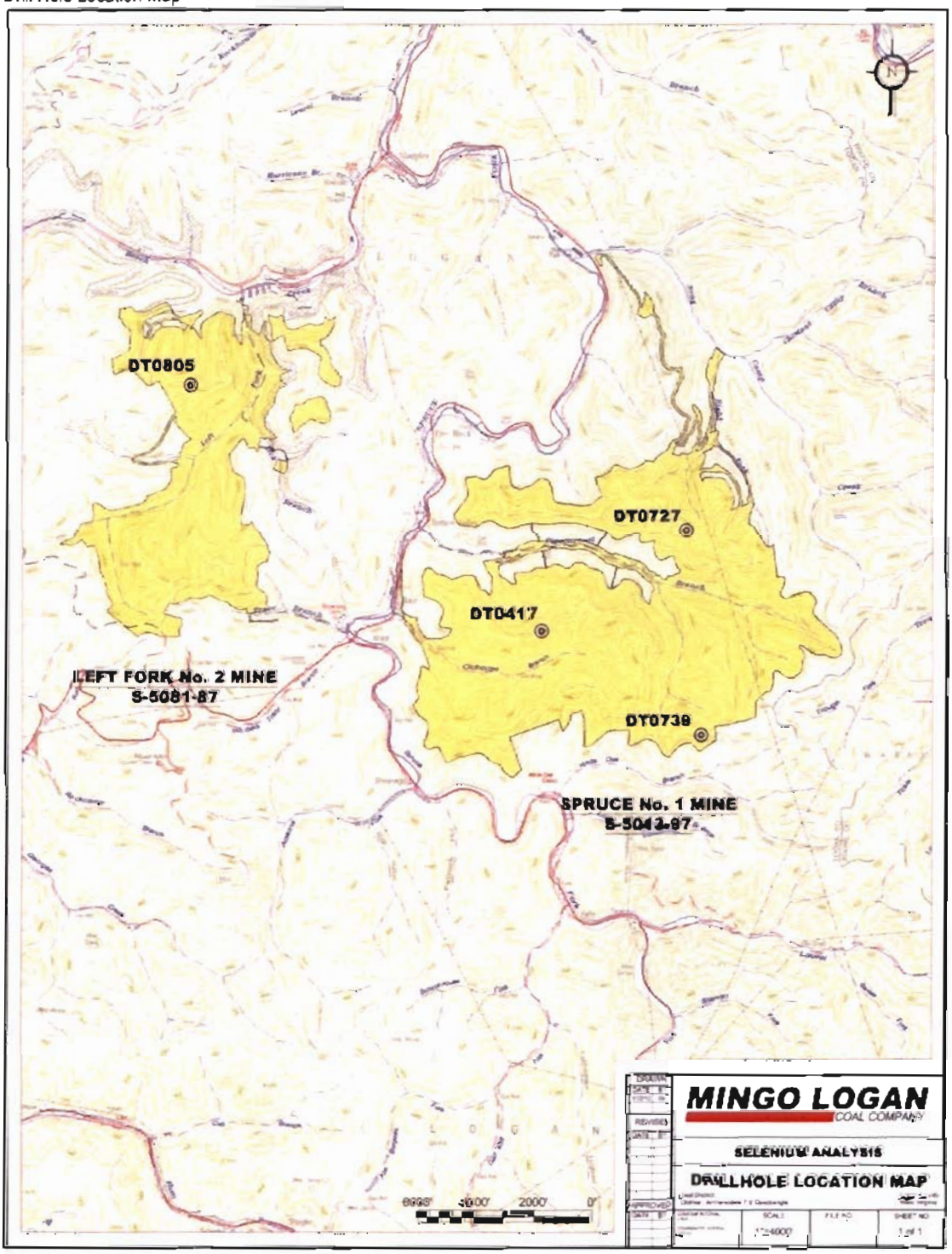

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FIGURE 3-3

Relationship between Selenium Bearing Strata on the Spruce No. 1 Mine compared to Dal-Tex Left Fork Mining Areas

Mingo Logan Coal Company

Spruce No.1 Mine

Relationship between Selenium Bearing Strata on the Spruce No. 1 Mine compared to Dal-Tex Left Fork Mining Areas

Seam	Strata Location	Spruce: DT0727 (RF Camp) Thickness (ft)	Selenium (mg/kg)	Strata Type	Spruce: DT0738 (RF Pigeonroost) Thickness (ft)	Selenium (mg/kg)	Strata Type	Spruce: DT0417 (Oldhouse) Thickness (ft)	Selenium (mg/kg)	Strata Type	Left Fork Operations: DT0806 Thickness (ft)	Selenium (mg/kg)	Strata Type
Middle K-Seam		0.60	1.88	Carb	Above Top of Hole			Above Top of Hole			Above Top of Hole		
	Top	4.30	0.24	SS	6.20	4.47	BSH	3.10	0.62	SS/SH	1.88	[illegible]	SS
Upper S Block													
	Floor	3.40	1.09	Clay/SH	0.40	0.60	Fireclay	0.50	9.81	DSH	0.25	[illegible]	DSH
											0.25	[illegible]	Coal
	Top				1.20	0.18	SH				1.29	[illegible]	DSH
Middle S Block													
	Floor				0.70	1.12	Carb				0.50	5.80	DSH
	IB	0.50	1.61	SH	3.10	0.58	SH	1.90	0.07	SH	6.00	0.06	SS
	Top	2.20	0.60	SH	0.90	0.09	SS	0.50	9.81	DSH	1.90	0.93	SH
Lower S Block													
	Floor	0.60	0.56	DSH	0.70	2.74	Carb	1.00	0.92	SH	0.50	1.24	SH
	Top	2.20	0.60	SH									
Upper Clarion Hole											0.35	0.12	Coal
											1.75	0.47	Clay
											0.25	3.77	BSH
	Top	0.50	0.56	DSH							0.35	0.75	SS
		0.50	1.93	SH							1.75	0.46	DSH
		0.40	0.87	Carb							0.50	0.98	BSH
		0.80	0.72	SSH									
		0.40	3.46	Carb									
		1.30	0.87	DSH									
Top Clarion													
	Floor	0.50	4.02	DSH							0.50	1.34	SH
		1.00	1.03	SH									
	Top	0.50	4.02	DSH							3.00	0.23	SH
		1.00	1.03	SH									
T.S. "Clarion Hanger"													
	Top	0.30	9.14	BSH	0.50	6.70	SH	1.70	0.46	SS	0.50	5.06	DSH
		0.50	1.16	DSH									
Upper Stockton 1													
	Floor	0.50	1.16	DSH	3.20	0.55	SS	1.00	0.85	Clay	0.50	3.98	BSH
Upper Stockton 2													
	Floor	2.70	0.53	SSBSH	0.20	0.90	SS	5.00	0.05	SS	0.25	3.54	BSH
	Top	0.30	4.35	BSH	0.20	0.90	SS	5.00	0.03	SS	5.00	0.03	SS
Upper Stockton 3													
	Floor	0.80	1.54	BSH	0.50	1.03	Clay	5.00	0.03	SS	5.00	0.03	SS
	Top	0.50	3.11	BSH	0.30	4.28	BSH	0.30	3.00	DSH	3.90	0.08	SS
Middle Stockton 1													
	Floor	0.80	3.27	BSH	1.30	0.60	Fireclay	1.20	1.84	SH	1.82	0.74	Fireclay
	Top	5.00	0.06	SS	3.50	0.10	SS	0.30	3.00	DSH	5.00	0.60	SSBSH
Middle Stockton 3													
	Top	3.70	0.20	SS	0.80	4.20	BSH	1.20	5.63	DSH	2.45	0.97	BSH
Lower Stockton													
	Floor	0.50	3.43	Clay	0.50	1.16	Clay	0.40	4.00	Clay	0.25	6.75	DSH
											0.25	5.18	Carb
	Top	Below Bottom Hole			1.40	0.32	DSH	0.90	1.23	SH	[illegible]	[illegible]	DSH
Upper Coalburg 2													
	Floor				1.70	0.59	DSH	0.70	2.36	SH	[illegible]	[illegible]	Carb
Upper Coalburg 4													
	Floor							3.70	0.35	SSBSH	[illegible]	[illegible]	DSH
											1.75	[illegible]	DSH
	Top				1.20	1.84	SH	5.00	0.27	SS	2.04	[illegible]	SH
Middle Coalburg													
	Floor				0.60	0.07	Fireclay	1.00	0.14	SSBSH	0.60	1.25	Fireclay
	Top				0.50	1.63	SH	1.20	0.72	DSH	0.50	0.63	DSH
Lower Coalburg													
	Floor				0.60	0.50	Fireclay	0.90	1.73	DSH	0.50	0.24	DSH
								0.50	2.22	Carb	0.90	0.84	Fireclay
								1.00	0.91	DSH	1.90	0.86	SS/SH
	IB				5.90	< 0.20	SS	2.40	1.49	DSH	1.14	2.15	BSH
	Top												
Stiles A													
	Floor							3.20	0.20	SHSS	0.85	0.82	SH
											1.80	1.64	Carb
	Top				0.60	1.14	DSH	0.50	1.29	DSH	0.95	0.96	SSBSH
Stiles B													

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FIGURE 3-4
Geologic Column

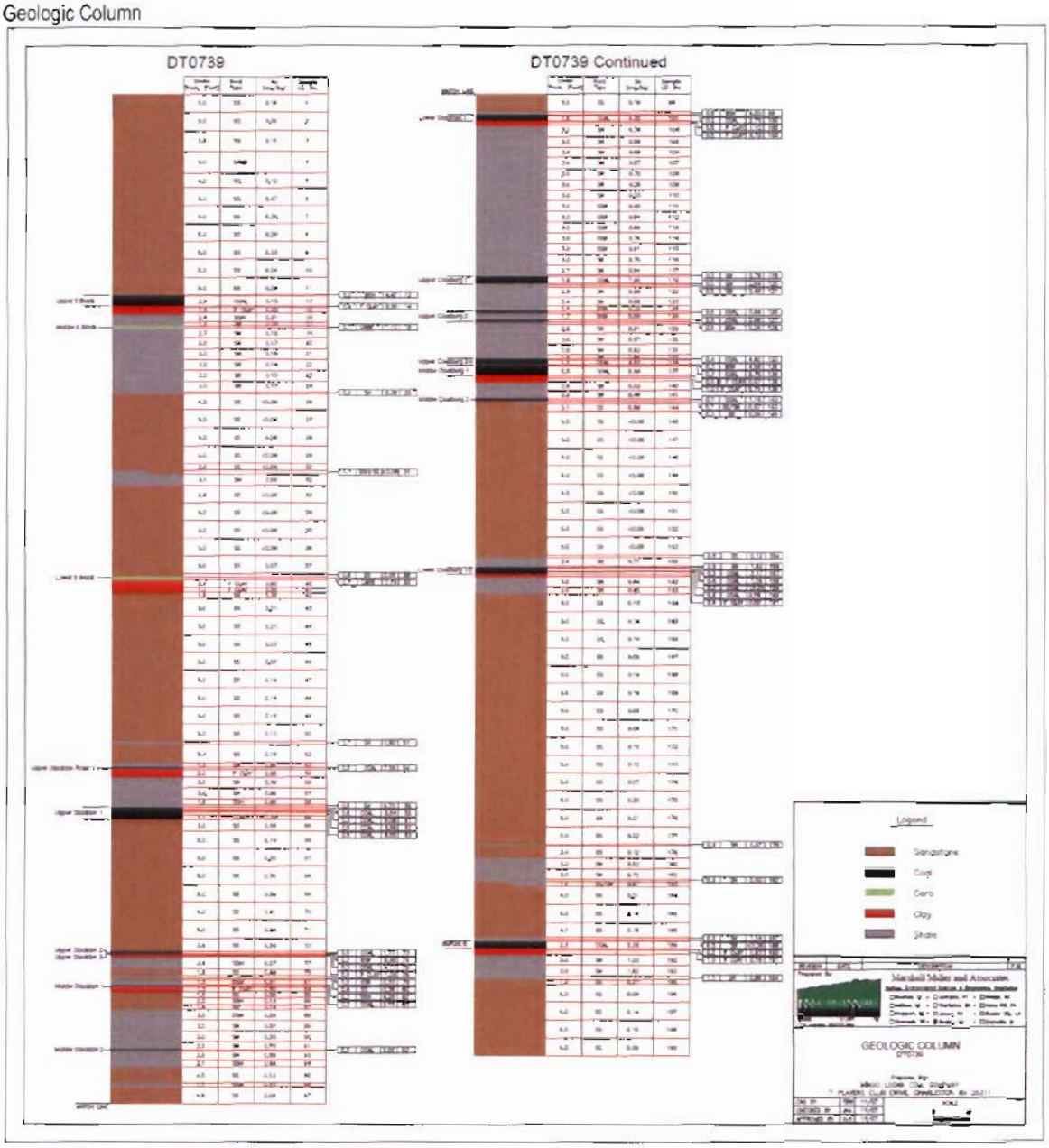

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FIGURE 3-5
Geologic Column part 2

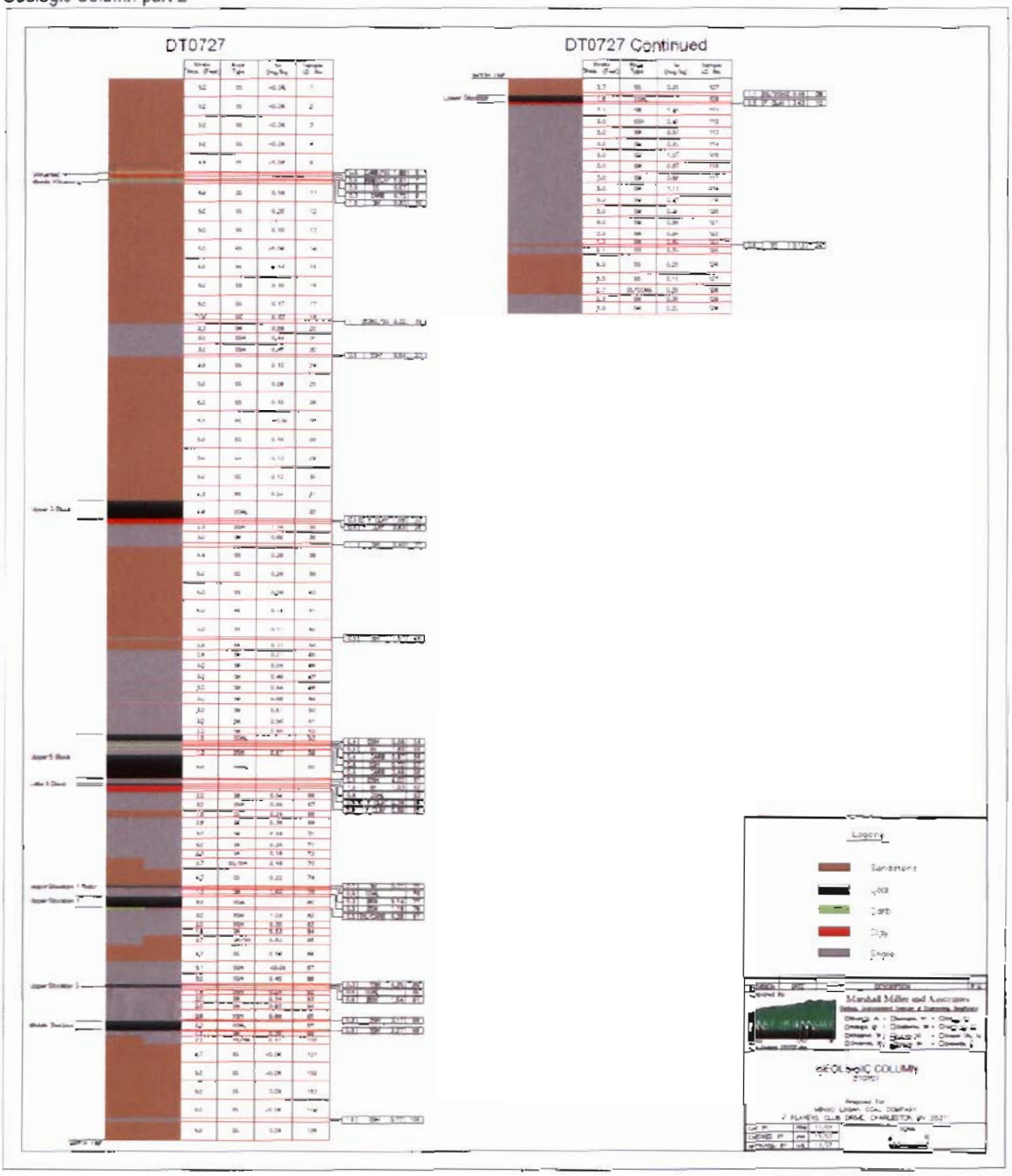

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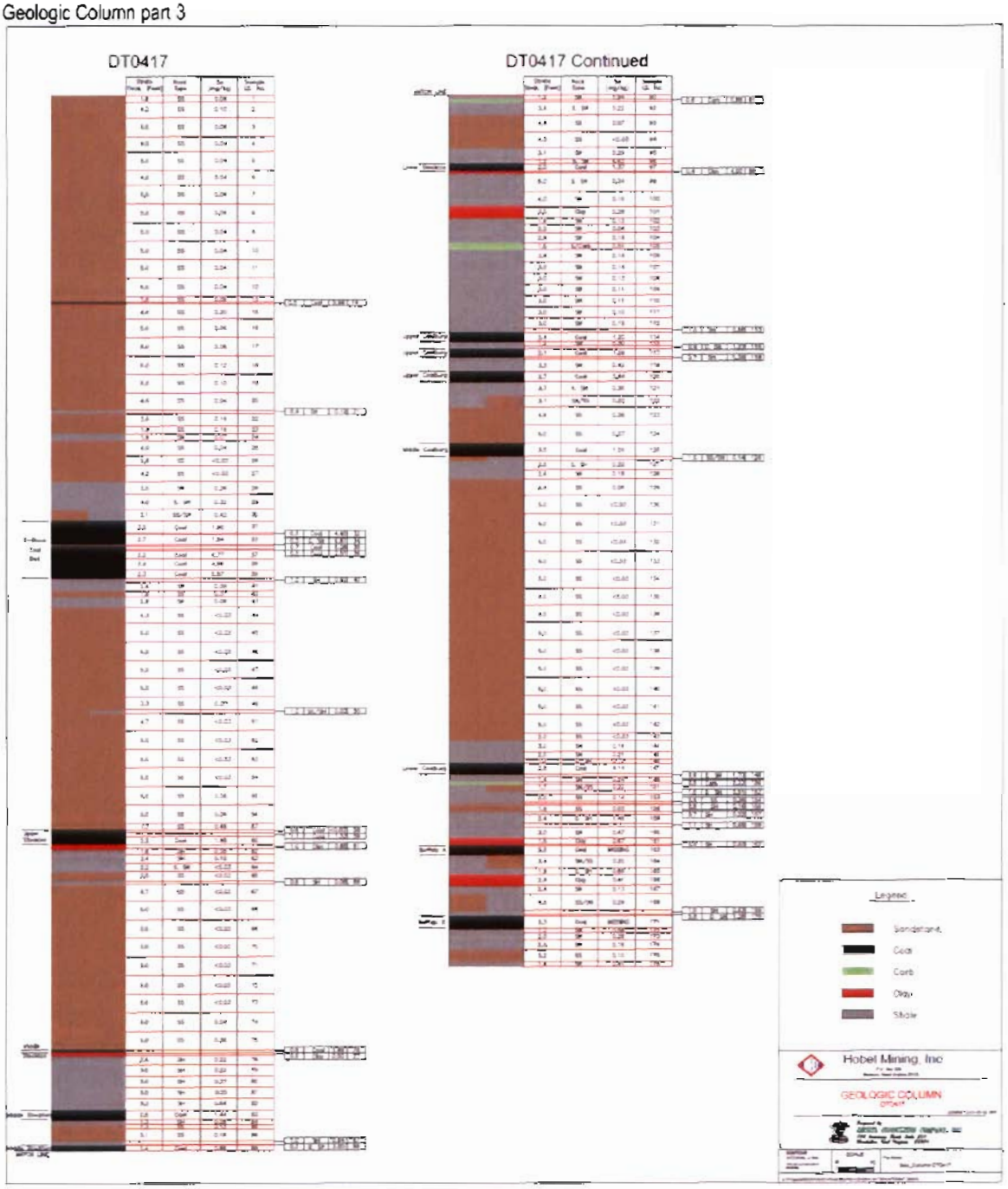
FIGURE 3-6
Geologic Column part 3



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lower K_d values indicate that selenium is likely to dissolve from the rock and be transported with the water. For example, a K_d greater than 1 indicates that most of the selenium will remain with the rock, and a K_d less than 1 indicates the selenium will be highly mobile. The USEPA calculation for leaching potential uses a K_d value of 0.78 and an assumed selenium concentration of 2.0 mg/kg for the potential material to be placed in fills. This is overly conservative for two reasons: 1) the assumed K_d used is very low (as discussed immediately below), and 2) USEPA assumes that waste rock will have an average selenium concentration that is twice the permitted maximum (1 mg/kg, as discussed above).

USEPA cites Kaplan and Serne (1995), stating that "The effective range of Se-K_d values in the ambient vadose zone of sediments is 0 to 0.78." Within Appendix A of the cited report (Kaplan and Serne 1995), the authors list K_d values for selenium ranging from 2.2 to 18, as used in USEPA risk assessments. It is not apparent why USEPA chose to use a K_d of 0.78 in its calculation for the Spruce No. 1 Mine in relation to the information presented in the USEPA-referenced Kaplan and Serne report. However, it does not appear to be appropriate.

Further, Kaplan also contributed to a report entitled "Radionuclide Distribution Coefficients for Sediments Collected from Borehole 299-E17-21: Final Report for Subtask 1a." This report (Kaplan et al., 1998) identifies a mean selenium K_d value of 6.73 (Table 4, p. 7 of that report). Table 7, page 10 of that report identifies K_d values for selenium of 3.8 as conservative and 6.7 ± 1.9 as best. A subsequent report "Partition Coefficients for Metals in Surface Water, Soil and Waste" (Allison and Allison 2005) identifies a mean selenium K_d value of 3.6.

The selenium K_d that USEPA uses in its RD is defined as follows:

$$K_d = \frac{\text{sorbed metal concentration (mg/kg)}}{\text{dissolved metal concentration (mg/L)}} = \frac{S}{D}$$

To determine the relationship between S and D for multiple K_d relationships, it is possible to develop equations using substitution:

$$K_d = \frac{S}{D}$$

Solving for S:

$$S = K_d : D$$
$$X = S + D$$

where X = metals concentration in the selected medium

substituting for S:

$$X = (K_d : D) + D$$
$$D = X / (1 + K_d)$$
$$S = X - D$$

Solving the above for various K_d factors using input from Table 3-1 yields the following results.

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TABLE 3-1
Factors for K_d Calculation

K_d	S (mg/kg)	D (mg/L)
0.78	X – D	X / 1.78
3.8	X – D	X / 4.8
6.7	X – D	X / 7.7
18	X – D	X / 19

mg/L = milligram per liter

Where S = sorbed metals concentration (mg/kg)
and D = dissolved metal concentration (mg/L)
X = metal concentration in mg/kg

Substituting values for X yields the following results:

When K_d = 0.78

X (mg/kg)	2.0	0.25	0.16	0.08
D (mg/L)	1.12	0.14	0.09	0.04
S (mg/kg)	0.88	0.11	0.07	0.04

When K_d = 3.8

X (mg/kg)	2.0	0.25	0.16	0.08
D (mg/L)	0.42	0.05	0.021	0.017
S (mg/kg)	1.58	0.20	0.0131	0.04

When K_d = 6.7

X (mg/kg)	2.0	0.25	0.16	0.08
D (mg/L)	0.26	0.03	0.02	0.010
S (mg/kg)	1.74	0.22	0.14	0.070

When K_d = 18

X (mg/kg)	2.0	0.25	0.16	0.08
D (mg/L)	0.11	0.01	0.01	0.004
S (mg/kg)	1.89	0.24	0.15	0.076

The X values used above are the weighted selenium concentrations (mg/kg) from the actual drill hole data from the Spruce No. 1 Mine permit, in addition to the 2.0-mg/kg value incorrectly assumed by USEPA as a "conservative estimate" of selenium concentration in valley-filled materials (Appendix 4, pp. 4-5). WVDEP regulations, along with material handling plans in the Spruce No. 1 Mine SMCRA permit and NPDES permit, as previously approved for issuance by the USEPA, prohibit placement of coal and potentially toxic

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material within durable rock fills. In conclusion, USEPA's assumption of selenium concentrations of 2 mg/kg and a K_d of 0.78 bears little relationship to the anticipated conditions for the Spruce No. 1 Mine.

Assumptions Concerning Placement of High-Selenium Waste in Valley Fills

USEPA assumes that selenium will likely leach from valley fills at concentrations greater than the chronic water quality criterion of 5 µg/L (microgram per liter) (Appendix 4, p. 5, top). In making that assumption, USEPA ignores the available information and data previously provided (e.g., as defined in the SMCRA Permit requirements of the "Special Handling Plan (SHP) – Potentially Selenium-Toxic Materials" section) that contradict the assumptions used for USEPA's calculation of selenium that would leach from the permitted valley fills into "streams and/or groundwater" on the previous page.

USEPA also assumes that much of the coal will end up in the waste rock piles. This is an unreasonable assumption on the part of USEPA, as it is contrary to plans for limiting the amount of coal in "wasted" material and is not consistent with WVDEP regulations, SMCRA permit conditions, and maximizing yield from the mine. Further, rock with selenium concentrations greater than 1 mg/kg will be segregated and isolated in a dry location rather than being placed in the valley fill (as discussed above). The result is that the actual selenium concentration in the blended waste rock to go into the valley fill will be well below 1 mg/kg, based on the low concentrations in most strata. Thus, the USEPA estimates of potential selenium leaching and associated downstream effects are greatly overestimated in several parts of the RD.

Size and Watershed Differences

As described in the EIS (USACE, 2006), the Dal-Tex complex encompasses about 6,630 acres and includes 11 surface mining permits, 9 underground mining permits, and 11 surface ancillary facility permits. In contrast, the permit area for the Spruce No. 1 Mine consists of 2,278 acres, or only 34 percent of the area of the Dal-Tex complex.

Because the Dal-Tex complex covers a larger watershed area than the combined Pigeonroost Branch and Oldhouse Branch watersheds of the Spruce No. 1 Mine (RD, Figure 7), consideration of watershed size is important to evaluating the potential downstream water quality impacts in Spruce Fork attributable to tributary inflow from the Spruce No. 1 Mine. USEPA refers several times in the RD to eliminating freshwater dilution contributions from both tributaries. In modeling post-mining conductivity levels in Spruce Fork, USEPA uses drainage area as a weighting factor. In contrast, it is unclear whether and how USEPA specifically considered drainage area in its assessment of post-mining concentrations of selenium in Spruce Fork.

Conclusions Concerning Comparisons to Other Mine Sites

USEPA indicates that it has evaluated "similar projects" for which "available data and literature documenting effects" were "consulted." (RD, pp. 36- 37); however, no specific references are provided. CH2M HILL is not aware of any data from mining operations subject to the strictures of Condition 16 and the SHP indicating that harmful discharges of selenium from valley fills have occurred.

For the reasons discussed above regarding the permit requirements imposed on the Spruce No. 1 Mine for selenium, USEPA's observation that selenium concentrations in other creeks

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in the Coal River Sub-Basin have been greater than the selenium criterion (RD, p. 39, footnote 10) is not relevant to the Spruce No. 1 Mine.

3.1.3 Projected Flow Data

Potential for Selenium Level to Increase in Spruce Fork

CH2M HILL's flow-based estimations of the effects of filling activity at the Spruce No. 1 Mine on downstream water quality are presented below. This evaluation indicates that it is unlikely that concentrations in any of the streams in the Spruce Mine No. 1 drainage will be greater than the water quality criteria for selenium. Therefore, we cannot support the USEPA assertion (RD, pp. 46-47) that increased selenium concentrations in Pigeonroost Branch, Oldhouse Branch, and Seng Camp Creek will cause concentrations in Spruce Fork to increase. In fact, USEPA provides no evidence in its RD or other documents related to the proposed operation that selenium concentrations would be greater than the chronic numeric criterion of 5 µg/L downstream from the Spruce No. 1 Mine.

USEPA likewise provides no support for its contention that selenium levels would exceed the West Virginia chronic water quality criterion for selenium "... in Spruce Fork." (RD pp. 46-47). Further, USEPA provides no rebuttal to the discussion in Section 3.3.4.2, pp. 26-27 of the Technical Evaluation Document (CH2M HILL, 2010) that was previously provided to USEPA indicating that this is not expected to occur. USEPA refers only to Table 14 in Appendix 2 of the RD, but this table shows values only for Spruce Fork farther upstream in the watershed (USF), where it is a very small stream and potentially more directly affected by mining.

The downstream Spruce Fork (DSF) site (Table 15 of Appendix 2) is larger and more representative of Spruce Fork below the Spruce No. 1 Mine. The average selenium concentration from January 2007 to December 2008 at Location 300/DSF was 1.99 µg/L; since December 2008, the average was 1.36 µg/L (DMR values reported by Mingo Logan Coal Company, various dates).

Additionally, the assumed selenium concentrations in Seng Camp Creek, Pigeonroost Branch and Oldhouse Branch that are required to reach the chronic water quality criterion (5 µg/L) at DSF are all well above the maximum selenium concentrations recorded in each of the streams in question; in some cases, they are an order of magnitude greater. Thus, using USEPA data, Spruce No. 1 Mine operations do not result in anticipated selenium concentration problems.

Current conditions at selected sites are shown in Tables 3-2, 3-3, and 3-4 below. The sites were selected to correspond to monitoring sites used by USEPA in its watershed-based estimation of filling effects. The site locations are shown in Figure 3-7.

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TABLE 3-2
Summary of Water Monitoring Data

Site	Flow (CFS)		Selenium (µg/L)		Watershed Acres	% Watershed at DSF
	Av.	Max	Av.	Max		
Site 300/DSF Spruce Fork below confluence with Seng Camp Creek	32.38	1,741.86	1.5	27.6[a]	20,923.32	100
Site 302/DSCB Mouth Seng Camp	4.01	94.85	1.6	8.7	3,276.69	15.66
Site 301 Spruce Fork above confluence with Seng Camp Creek	24.74	150.28	1.2	13.0	17,622.73	84.23
Site 507 Mouth of Pigeonroost Branch	1.38	10 26	0.8	4.6	1,478.69	7.07
Site 514 Mouth of Oldhouse Branch	0 76	7.26	0.7	3.6	596.65	2.85
Site 028 Right Fork of Seng Camp Creek	0 36	2.43	5.9	14.8	513.90	2.46
∑ Sites 507, 514, 028	2.50	19 95	1.50	5.48[b]	2,589.24	12.37

[a] This maximum measured selenium concentration on August 6, 2008 is an anomaly; the concentration on July 29, 2008 was 0.60 µg/L and on August 11, 2008 it was 0.80 µg/L. A similar anomalous reading was recorded on February 26, 2007 (22.3 µg/L) when much lower concentrations were measured immediately before (February 20; 1.10 µg/L) and after that date (March 7; 0.60 µg/L). No other concentrations at this location were greater than 10 µg/L among 230 samples since August 2005.

[b] Flow-weighted

CFS = cubic feet per second

TABLE 3-3
% Flow Contribution to Site DSF
Based Upon Recorded Flow

Site	Av. Flow (CFS)	Av. %	Max Flow (CFS)	Max %
302	4.01	12 38	94.85	5.45
301	24.74	76.41	150.28	8.63
507	1.38	4 26	10.26	0.59
514	0.76	2.35	7.26	0.42
028	0.36	1.11	2.43	0 14
∑ Sites 507, 514, 028	2.50	7.72	19.95	1.15

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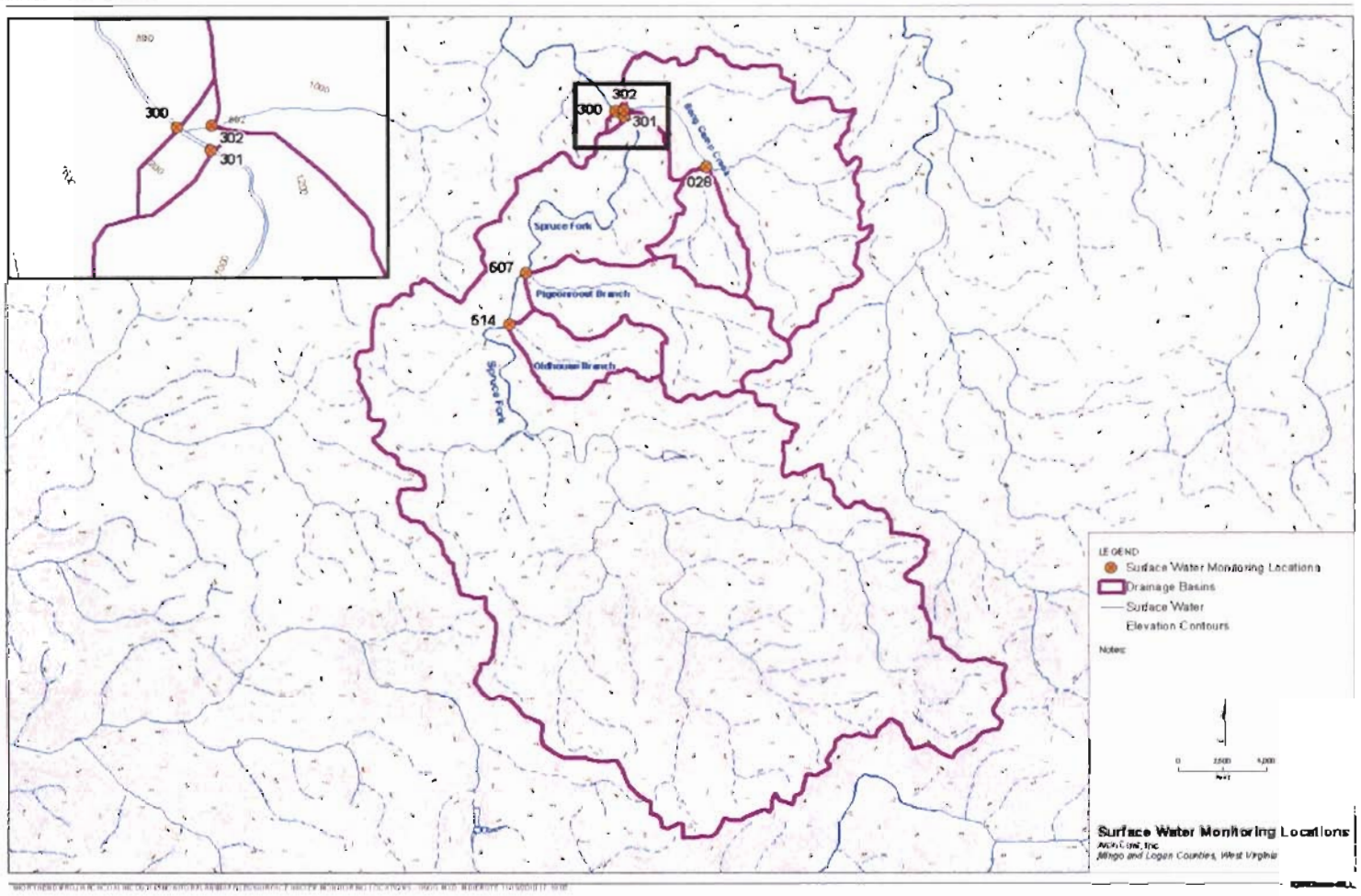
FIGURE 3-7
Surface Water Monitoring Locations



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Using average flow and average selenium concentration are given in Table 3-4.

TABLE 3-4
Average Baseline Conditions

Site	Flow (CFS) X Selenium (µg/L)
300/DSF	48 57
507	1.104
514	0 532
028	2.124

The effect of Pigeonroost Branch, Oldhouse Branch, and the Right Fork of Seng Camp Creek on the downstream selenium concentration at site can be expressed by the equation:

$$\overline{C} = \sum (C)i\ (Q)i$$

Where $\overline{C}$ = discharge-weighted total selenium concentration, in µg/L;
(C)i = instantaneous constituent concentration on property, in limits as above; and
(Q)i = discharge, in cubic feet per second (CFS) at the time of observation.

Therefore, the dilution effect of Pigeonroost Branch, Oldhouse Branch and the Right Fork of Seng Camp Creek on site DSF can be expressed as follows:

$$(C_{DSF})\ (Q_{DSF}) - [(C_{507})\ (Q_{507}) + (C_{514})\ (Q_{514}) + (C_{028})\ (Q_{028})]$$

Where C_{DSF}, C_{507}, C_{514} and C_{028} = Av. Selenium concentration at site n
Q_{DSF}, Q_{507}, Q_{514} and Q_{028} = Av. Flow (CFS) at site n

C_{DSF} X Q_{DFS} without the effects of the above-mentioned three watersheds is now expressed as (using values from Table 3-4):

$$(C_{DSF})(Q_{DSF}) = 48.57 - [1.104 + 0.532 + 2.124] = 44.76$$

the resultant average flow (in CFS) would be (values from Table 3-2):

$$Q_{DSF} = 32.38 - (1.38 + 0.76 + 0.36) = 29.88$$

and the average selenium concentration at site DSF would calculate as:

44.76 / 29.88 = 1.498 µg/L compared to the recorded average value of 1.50,

which includes the contribution of the three watersheds, indicating that the dilution effect of the three watersheds is negligible.

Using an assumed selenium concentration, the downstream effect can be calculated by substituting 5.0 µg/L (the chronic water quality criterion) and 10.0 µg/L (one-half the acute water quality criterion), respectively, as the concentration for each watershed as follows:

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At site DSF using 5.0 µg/L as the average selenium concentration at sites 507, 514 and 028:

Flow X Selenium = 44.76 + [(1.38) (5.0) + 0.76 (5.0) + 0.36 (5.0)]
= 44.36 + 12.50
= 57.26

The average selenium concentration at DSF would then be expressed as:

$$C_{DSF} = \frac{57.26}{\sum Q_{DSF}}$$
$$= 57.26 / 32.38_{CFS}$$
$$= 1.77\ \mu g/L$$

At site DSF using 10.0 µg/L as the average selenium concentration at sites 507, 514 and 028:

Flow X Selenium = 44.76 + [1.38 (10.0) + 0.76 (10.0) + 0.36 (10.0)]
= 44.76 + 25.0
= 69.76

and the average selenium concentration at DSF would be:

$$C_{DSF} = \frac{69.76}{\sum Q_{DSF}}$$
$$= 69.76 / 32.38$$
$$= 2.15\ \mu g/L$$

To create a situation where the selenium concentration at site 300/DSF averages 5.0 µg/L, the average selenium concentration at the three watersheds would have to average 46.85 µg/L.

Flow X Selenium = 44.76 [1.38 (46.85) + 0.76 (46.85) + 0.36 (46.85)]
= 44.76 + 117.14
= 161.90

and the average selenium concentration at DSF would be:

$$C_{DSF} = \frac{161.90}{\sum Q_{DSF}}$$
$$= 161.90/ 32.38 = 5.0\ \mu g/L$$

None of the available data suggest that such high selenium concentrations would occur in Oldhouse Branch or Pigeonroost Branch as a result of the permitted Spruce No. 1 Mine valley fills.

3.1.4 Measured Selenium Values Downstream from Spruce No. 1 Mine

Measured selenium concentrations downstream from the Spruce No. 1 Mine are low. USEPA does not acknowledge the available site-specific data and instead relies on selenium concentrations in different West Virginia drainages. This is not technically valid with respect to evaluating anticipated Spruce No. 1 Mine effects because there is no evidence of such effects in the streams immediately downstream from the Spruce No. 1 Mine. Streams in which selenium concentrations occur in water and fish in the range associated with the effects described by USEPA in the RD receive drainage from mines where historical

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practices were very different from those at the Spruce No. 1 Mine. In reaching its conclusions, USEPA does not consider well-documented site-specific information.

As described on pp. 25-26 of the Technical Evaluation Document (CH2M HILL, 2010) provided to USEPA, Mingo Logan Coal Company collects in-stream monitoring data for selenium at NPDES Location 302/DSCB, just downstream from the Spruce No. 1 Mine site. No recorded DMR values during this period were greater than the chronic water quality standard measured at the mouth of Seng Camp Creek (Mingo Logan Coal Company). To the contrary, since December 2008,[2] the average selenium concentration at the mouth of Seng Camp Creek, Location 302/DSCB, was 1.36 µg/L.

USEPA relies extensively on readings from Outlet 28, which do not reflect downstream conditions where the fish are located, rather than Location 302. The valley fill sediment pond in the Right Fork of Seng Camp Creek (Pond 2, where Outlet 028 is located) is situated about 87 feet from the creek (Figure 3-8). The discharge flows parallel to Seng Camp Creek and enters the creek at a point about 470 feet upstream from a 15-foot-diameter culvert, through which the entire Seng Camp Creek watershed is directed. The sampling station at the mouth of Seng Camp Creek 302/DSCB is located downstream from the culvert.

The average selenium concentration recorded at the mouth of Seng Camp Creek, starting from the January 2007 issuance of the USACE Spruce No. 1 Mine permit to when Outlet 028 started to discharge in December 2008, was 1.96 µg/L (48 samples from NPDES Location 302/DSCB [Mingo Logan Coal Company, various dates]). The average selenium concentration at this location since then has decreased to about 1.36 µg/L (41 samples from NPDES Location 302/DSCB [Mingo Logan Coal Company, various dates]).

Of the 89 samples collected at Location 302/DSCB since January 2007 (permit issuance), no selenium values were greater than the acute water quality standard of 20 µg/L.[3] The maximum was 8.7 µg/L, and only two samples (2.2 percent) were above the chronic water quality standard (5 µg/L). These values do not violate the NPDES permit, nor do they mean that Seng Camp Creek is impaired as a result of selenium concentrations. To the contrary, under the West Virginia assessment methodology, as approved by USEPA, the percentage is well below the 10 percent threshold for designating a water body as impaired.

Most of Seng Camp Creek downstream from the existing pond flows through a culvert installed to accommodate the adjacent Mountain Laurel Complex (Figure 3-8). At the first location (300/DSF) where USEPA has noted the presence of a significant fish population (in Spruce Fork), the contributions of selenium from operations in Seng Camp Creek are negligible. The average selenium concentration from January 2007 to December 2008 at Location 300/DSF was 1.99 µg/L; since December 2008, the average was 1.36 µg/L. As noted above, the average selenium concentration from January 2007 to December 2008 at Location 302/DSCB (mouth of Seng Camp Creek) was 1.96 µg/L; the average since December 2008 was 1.36 µg/L.

[2] USEPA improperly (for reasons discussed below) relies extensively on readings from Outlet 28, which began in December 2008.

[3] There is no permit limit at this stream location, so the comparison is to the West Virginia water quality standard.

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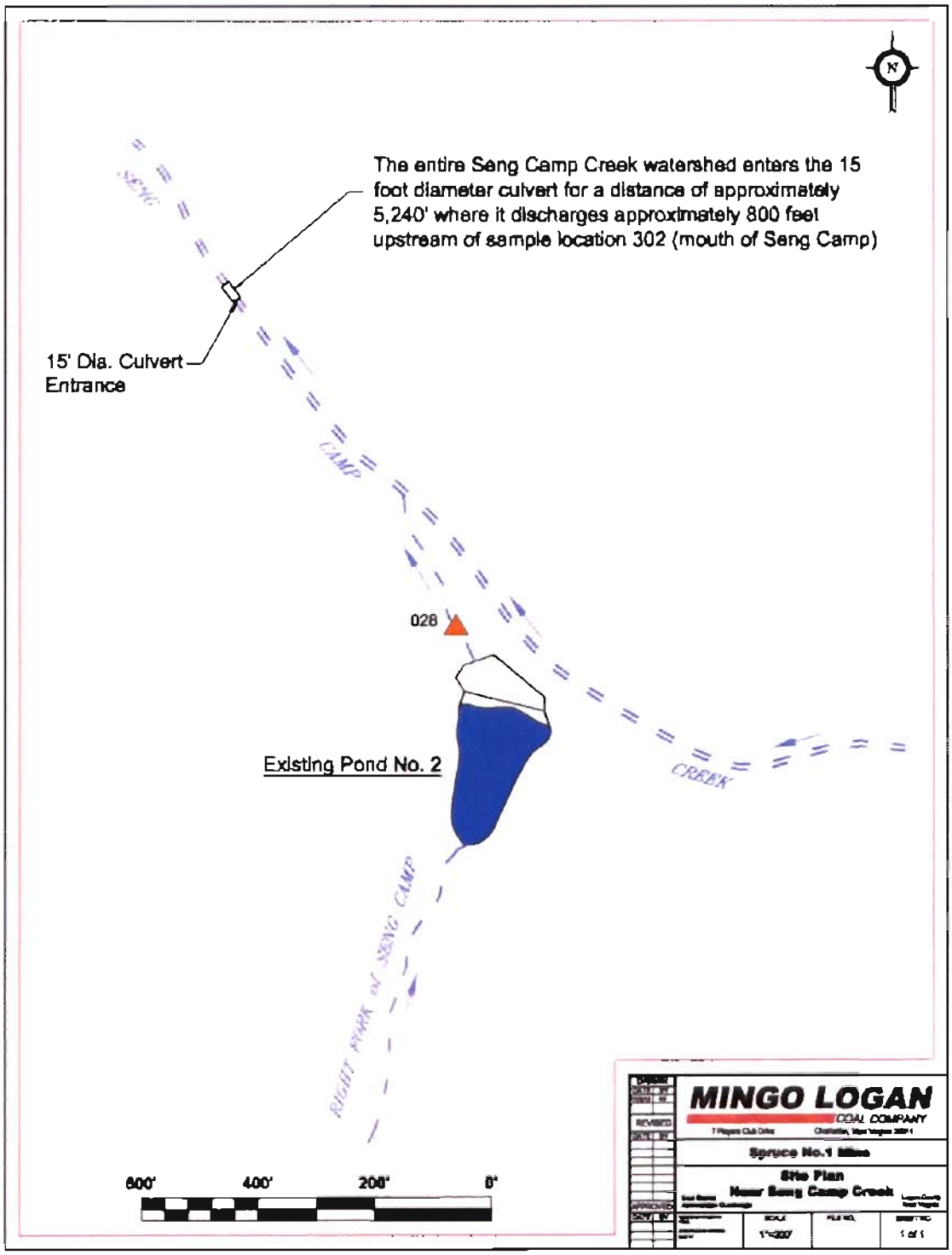
FIGURE 3-8
Site Plan Near Seng Camp Creek



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Similarly, average concentrations at the mouth of Oldhouse Branch (Location 514/DOB; 0.68 µg/L) and Pigeonroost Branch (Location 507/DPB; 0.77 µg/L) have been less than 2 µg/L and the maximum has been consistently less than the 5 µg/L chronic water quality standard. Therefore, there is no apparent cause for selenium-related concern at any of these monitoring points.

USEPA acknowledges that Spruce Fork (the first stream segment receiving Spruce No. 1 Mine drainage where fish are present) has fish assemblages "in relatively good condition" and to have remained generally unchanged over the past 60 years (RD, pp. 32 and 60). In doing so, USEPA contradicts its own expressed concern about effects of degraded water quality due to selenium on downstream fish populations. Further, USEPA presents no evidence of impairment of fish or wildlife populations attributable to selenium discharges from the Spruce No. 1 Mine.

Finally, it is important to note that selenium speciation data from valley fill pond discharges in the region indicate that most, if not all, of the selenium is selenate, which is the most oxidized form and the form least likely to bioaccumulate in fish (Besser et al., 1993).[4] Selenium speciation data collected by CH2M HILL from the discharge of seven different valley fill ponds at three surface coal mine sites in southwest West Virginia during 2009 and 2010.

Relationship of Outfall 028 and 017 Results to USEPA-predicted Spruce No. 1 Mine Effects

USEPA contends that data collected from the portion of the Spruce No. 1 Mine already constructed in Seng Camp Creek indicate that the construction of valley fills in Pigeonroost Branch and Oldhouse Branch will result in discharges of elevated levels of selenium (RD, p. 44). USEPA's data, as presented in Figure 12 and Table 4 of the RD, do not support this contention. None of the values used by USEPA in Table 4 are from Spruce Fork; rather, they are from Outlets 017 and 028, which date from previous mining operations.[5] These data reflect the effects of historical placement of waste in the drainage without consideration for selenium management, not the results of fill activity in Pigeonroost Branch and Oldhouse Branch, which must comply with the NPDES and SMCRA permit conditions, as discussed above in Section 3.1.2.

Additionally, when evaluating the data, it is important to properly apply West Virginia water quality standards. USEPA mistakenly compares the maximum concentrations to the chronic criterion (5 µg/L) rather than the appropriate maximum WV criterion (20 µg/L).

Outfall 28

As described above, Outfall 28 is not an appropriate location for determining the potential effects on fish from selenium from the valley fills thus far constructed. Nevertheless, because USEPA relies heavily on measurements from Outfall 28, we address those readings here in some detail even though Outlet 028 does not have permit limits for selenium

[4] While the discharge limits are based on total recoverable selenium, selenate is the least likely form to bioaccumulate in aquatic organisms in these environments.

[5] The data from Outlet 15 (shown in RD Figure 10) are not relevant for comparison to potential discharges from the Spruce No. 1 Mine. Outlet 15 at the Dal-Tex Mine is the discharge from an abandoned deep shaft in the Coalburg seam that is discharged to an entirely different watershed (Pine Fork, a tributary in the Guyandotte River system). The discharge is not the result of MTM and does not represent anything similar to what may result from valley fill from the Spruce No. 1 Mine.

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(Table 3-5). The maximum value at Outfall 28 was greater than the maximum permit limit applied to other outlets (8.2 µg/L) only twice (see Table 4 of the RD). These readings do not indicate any violation of water quality standards and, in any event, do not indicate the likely results of discharges from the permitted valley fills in Oldhouse Branch and Pigeonroost Branch because they are not related to Spruce No. 1 Mine valley fill activity.

In October 2006, Mingo Logan started to construct an access/haul road and associated sediment ponds in the Right Fork of Seng Camp Creek. This work consisted of re-configuring existing Pond No. 2 and constructing Pond Nos. 1 and 1AB, all of which were in areas filled in the 1990s and thereby determined by the USACE during the Spruce Permit process to be outside the scope of the Clean Water Act (locations shown on Figure 3-9).

Construction work in 2006-07 on all three ponds was accomplished using excess overburden originally placed in the hollow during the 1990s-era mining. Some of the excess spoil from 2006-era road construction and site development was placed atop fill material that had previously been placed in the lower portions of the Right Fork of Seng Camp Creek as part of the mid-1990s mining. The remainder of the road development excess spoil was used in 2007 to create the "erosion protection zone" (EPZ) at the toe of Valley Fill 1A, as required by the Spruce No. 1 Mine surface mining permit.

As a result, the ponds in the Right Fork of Seng Camp Creek were constructed in or of excess spoil material deposited in the watershed in the 1990s, before Mingo Logan or any other coal operator knew that selenium was a potential issue or took steps to locate and selectively handle selenium-bearing rock to prevent the formation of selenium-containing leachate. Thus, selenium concentrations at Outlet 028 are in large part the product of the 1990s-era spoil placement in the hollow and its redisturbance in 2006, rather than from a failure of the selenium handling procedures subsequently used at the Spruce No. 1 Mine. In fact, recent sampling (described below) suggests precisely this – that the selenium detected at Outlet 028 from Pond No. 2 is largely attributable to these old unsegregated mine spoils or non-fill-related conditions rather than to the more modern selenium handling techniques used at the Spruce No. 1 Mine and in the construction of Valley Fill No. 1A.

Mingo Logan Coal Company initiated an investigation in August 2010 to determine the source of elevated selenium concentrations in the discharge from Outlet 028. As noted above, this outlet is the discharge from an erosion and sediment control pond that was originally constructed in the Right Fork of Seng Camp Creek in the mid-1990s per Surface Mine Permit S-5070-91 and NPDES permit WV1013289. This Pond is identified as "Existing Pond 2" on Figure 3-9. Outlet 028 was transferred to NPDES permit WV1017021 on August 7, 2007. Much of the area upstream from Pond No. 2 in the mainstream of Seng Camp Creek was disturbed and filled as part of operations in the 1990s.

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FIGURE 3-9
Excerpt from Stream Delineation Map

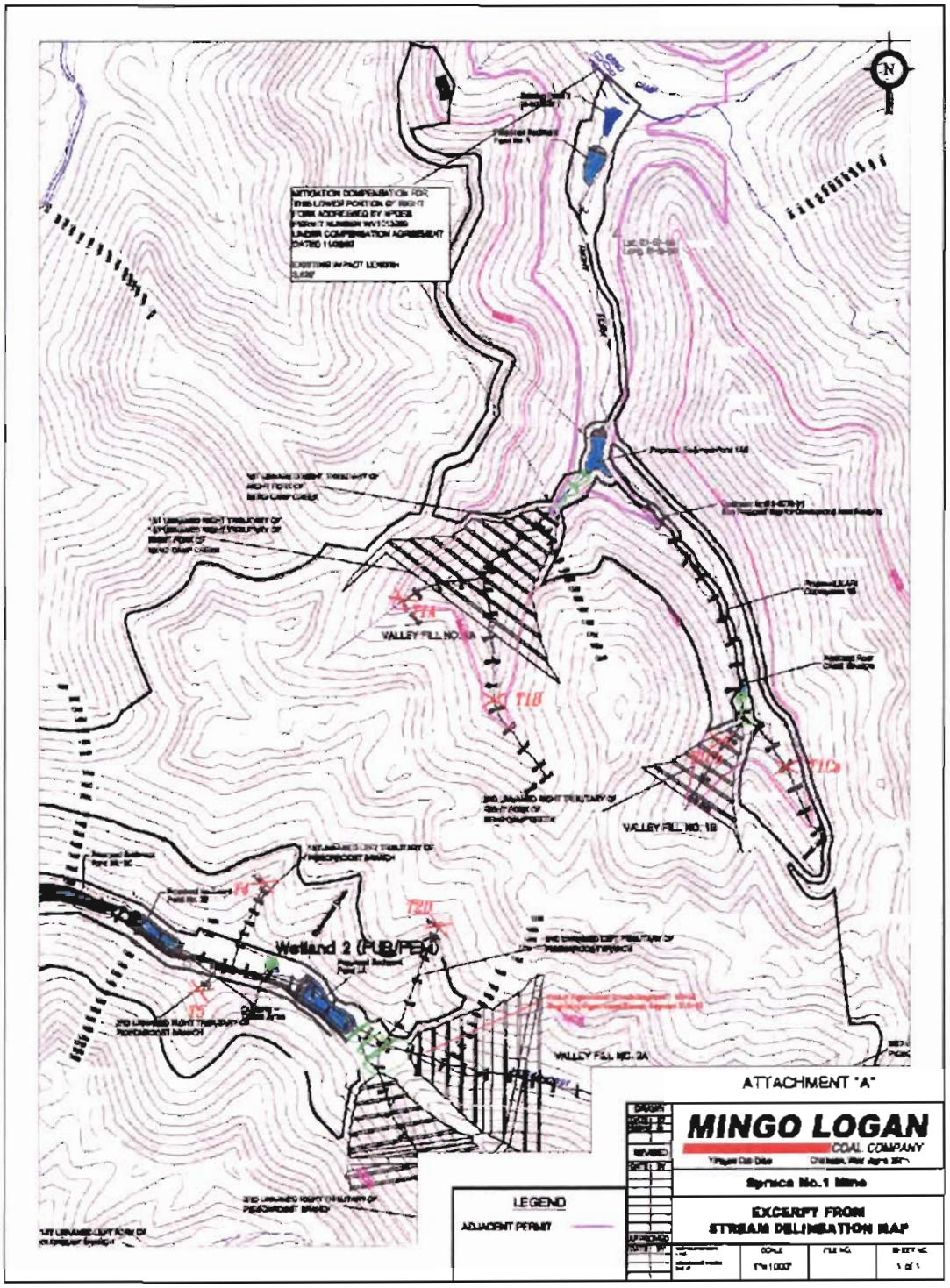

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TABLE 3-5
Mingo Logan Coal Company, NPDES Permit WV1017021, Outlet Information

Outfall	Type of Structure	Status	Notes & Comments	Selenium Limitations	
				Av. Month	Max Daily
001	In-Stream Pond	Not Constructed		4.70	8.20
002	On Bench Structure	Not Constructed		4.70	8.20
003	In-Stream Pond	Not Constructed		4.70	8.20
004	On Bench Structure	Not Constructed		4.70	8.20
005	On Bench Structure	Not Constructed		Report Only	Report Only
006	On Bench Structure	Not Constructed		Report Only	Report Only
007	On Bench Structure	Not Constructed		Report Only	Report Only
008	On Bench Structure	Not Constructed		Report Only	Report Only
009	On Bench Structure	Not Constructed		Report Only	Report Only
010	On Bench Structure	Not Constructed		Report Only	Report Only
012	On Bench Structure	Not Constructed		Report Only	Report Only
014	On Bench Structure	Not Constructed		Report Only	Report Only
015	On Bench Structure	Temporary Structure *4	*2	Report Only	Report Only
017	On Bench Structure	Temporary Structure *4	*3	Report Only	Report Only
018	On Bench Structure	Not Constructed		Report Only	Report Only
019	On Bench Structure	Not Constructed		Report Only	Report Only
020	On Bench Structure	Not Constructed		Report Only	Report Only
021	On Bench Structure	Not Constructed		Report Only	Report Only
022	On Bench Structure	Not Constructed		Report Only	Report Only
023	On Bench Structure	Not Constructed		Report Only	Report Only
024	On Bench Structure	Not Constructed		Report Only	Report Only
025	On Bench Structure	Not Constructed		Report Only	Report Only
026	On Bench Structure	Not Constructed		Report Only	Report Only
027	On Bench Structure	Not Constructed	*5	Report Only	Report Only
028	In-Stream Pond	Constructed		Report Only	Report Only
029	On Bench Structure	Not Constructed	*1	Report Only	Report Only
031	On Bench Structure	Constructed	*1	Report Only	Report Only
032	On Bench Structure	Not Constructed	*1	Report Only	Report Only
033	On Bench Structure	Not Constructed		Report Only	Report Only

NOTES.

*1 Outlets 029, 031, and 032 discharge into non-jurisdictional areas in the Right Fork of Seng Camp, ultimately discharging through Outlet 028. Except for Outlet 031, these structures are not constructed No discharge recorded at Outlet 031.

*2 Outlet 015 is the discharge from a temporary structure in the active area. Discharge is to non-jurisdictional area in Spruce Fork. No reported discharges.

*3 Outlet 017 is the discharge from a temporary structure in the active area. Discharges to non-jurisdictional areas in Pigeonroost Branch. One reported discharge.

*4 Structures are classified as temporary. During mining, the structures are reconstructed as excavation proceeds to underlying seams.

*5 Based upon available information, it is unclear if this discharge is directly to jurisdictional waters.

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Mingo Logan retained Sturm Environmental Services to collect and analyze water samples from designated locations within the Right Fork of Seng Camp Creek in order to isolate the potential sources of selenium found in the discharge from Outlet 028. The locations of these samples are shown on Figures 3-10 and 3-11, and are described as follows:

Site	Description
SCABL	In-stream monitoring site situated on the Left Fork of the Right Fork of Seng Camp Creek immediately adjacent to and prior to entering Pond 1AB
SCABR	Right Fork of Seng Camp Creek at the toe of the EPZ for Valley Fill 1A, representing the discharge from the filling activities
SC Pond Access Road Ditch	Groundwater seep discharge from the 1990s-era fill material
SC Iron Seep	Groundwater seep from the 1990s-era fill material
SC 15 Inflow	In-channel sample collected prior to entering Sediment Pond No. 1
SC 15-1	Discharge from Sediment Pond No. 1
SC 15-2	Discharge from Sediment Pond No 2 (Outlet 028)

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FIGURE 3-10
Flow Diagram Right Fork of Seng Camp

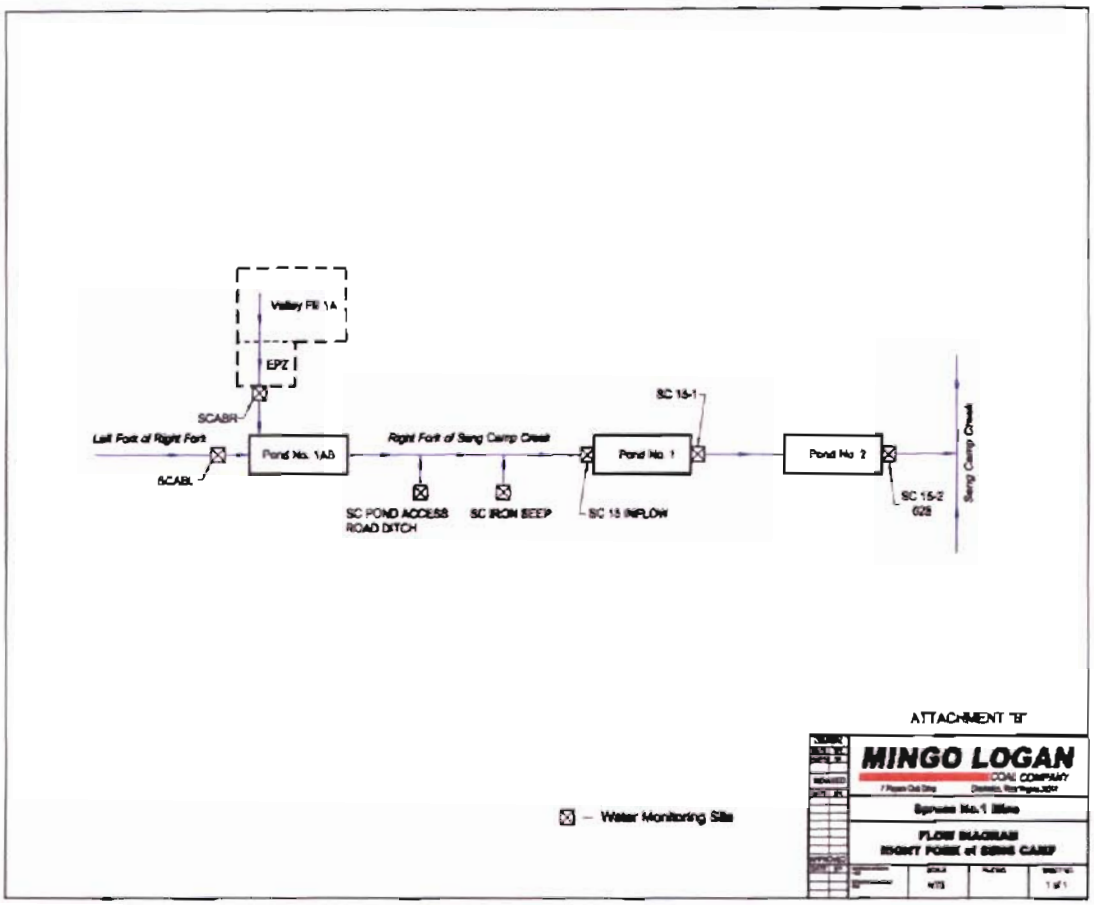

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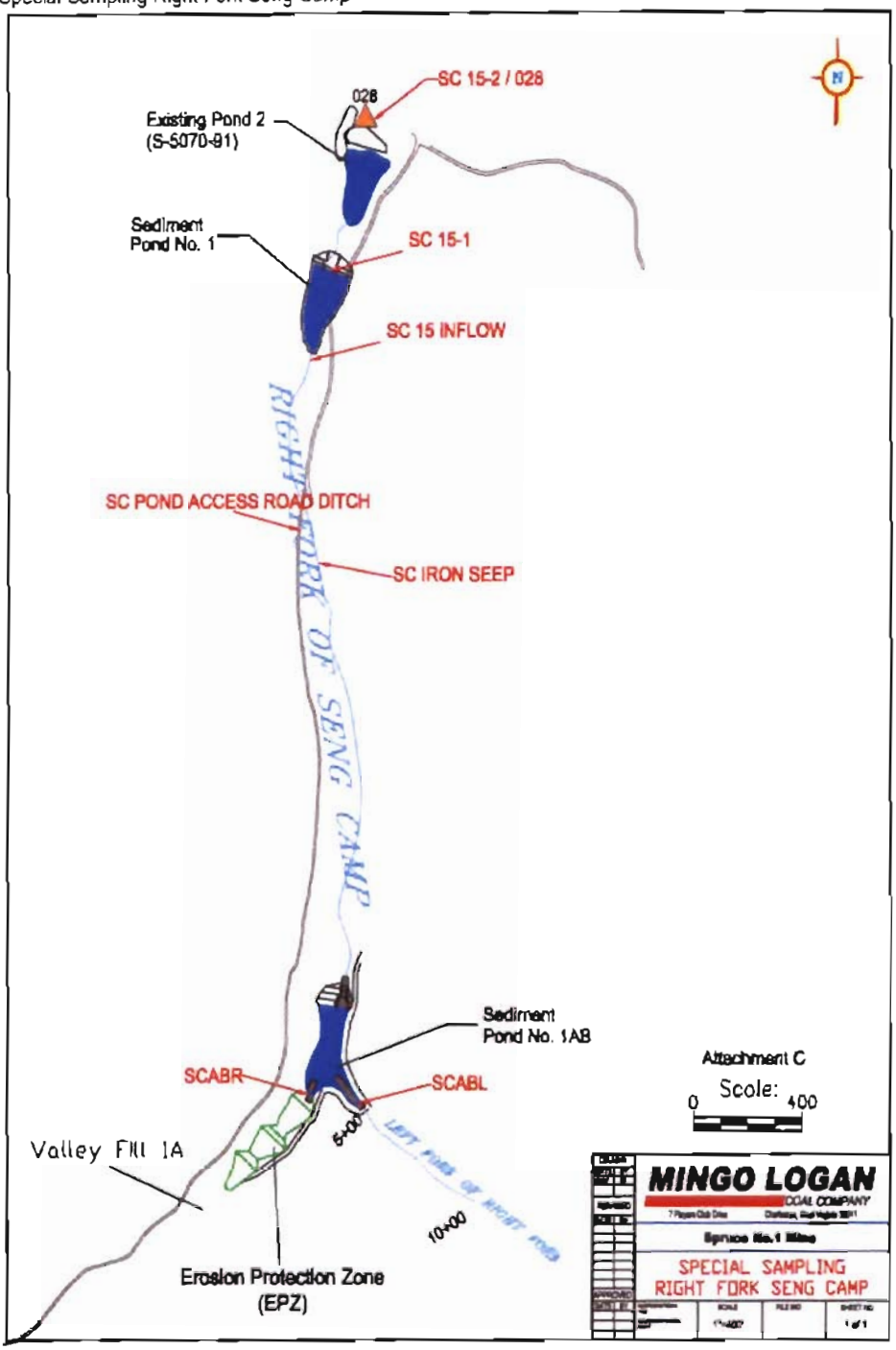
FIGURE 3-11
Special Sampling Right Fork Seng Camp



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Samples were collected during a three-month period from August 2010 through October 2010 with the following results:

August 20, 2010:

As shown in Table 3-6, there was no flow at the monitoring station located between the toe of Valley Fill 1A and Pond No. 1AB (sample location SCABR). Thus, Valley Fill 1A was not contributing selenium to the sediment control system.

The measured selenium concentration entering the system at site SCABL (located in the Left Fork of the Right Fork of Seng Camp Creek as shown on Figures 3-10 and 11) was 8.3 µg/L. There have been no filling activities in the Left Fork of the Right Fork and the perimeter sediment ditches situated on the up-dip side of the active mining area in this watershed were not discharging.

A seep within the 1990s-era fill material located in the former channel of the Right Fork of Seng Camp Creek between Pond 1AB and Pond No. 1 migrates to the surface in the middle portion of the fill area (the site is known as "SC Pond Access RD Ditch"). On this date, the site was discharging at an estimated rate of 182 gallons per minute, with a selenium concentration of 7.0 µg/L. During this period, this site was contributing about 33 percent of the inflow into Sediment Pond No. 1.

During this period, the average selenium concentration entering Pond No. 1 was 6.4 µg/L. It should be noted that Ponds 1 and 2 are equipped with adjustable siphon discharges that are regulated by operation personnel. The discharge from the structures is adjusted based on observed field conditions such that the inflow does not necessarily equal the discharge rate.

September 24, 2010:

The selenium concentration at site SCABL was 5.4 µg/L. Again, there was not any filling activity under the Spruce No. 1 Mine USACE permit contributing to this site, nor were there discharges from the sediment ditches in the watershed. Additionally, site SCABR (discharge from Valley Fill 1A) was again dry. There was no discharge at site SC Pond Access RD Ditch during this period. The selenium concentrations at site SC 15-1 (outlet from Pond No. 1) and SC 15-2/028 (Outlet from Pond 2) showed an increase compared to the inflow to Pond No. 1, indicating that selenium contributions are probably originating from the older fill material composing parts of the ponds and the areas between the two ponds.

October 08, 2010:

Selenium levels were very low, less than 1.0 µg/L at all sites with the exception of SC Iron Seep (1 µg/L), SC 15-1 (4.7 µg/L), and 15-2 (5.5 µg/L). Site SCABR again did not have measurable flow. These results again showed an increase in concentrations as water flowed through the ponds and intervening old fill areas.

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TABLE 3-6
Seng Camp Sampling Results

Cross Reference ID	Flow (gpm)	Field pH Units	pH Units	Field Temp (°F)	Total Alkalinity mg/L $CaCO_3$	Hot Acidity mg/L $CaCO_3$	Min Acidity mg/L $CaCO_3$	Total Sulfate (mg/L)	Total Al (mg/L)	Total Fe (mg/L)	Total Mn (mg/L)	TSS (mg/L)	TDS (mg/L)	Spec. Cond. (µmhos)	Total Se (µg/L)	Diss Se (µg/L)	Diss Al (mg/L)
August 20, 2010																	
SC ABL	244.00	8.5	7.4	68	54	<1	0	111	0.12	0.17	<0.01	7	278	390	8.3	8.1	<0.05
SC ABR	0.00																
SC POND ACCESS RD DITCH	182.00	7.7	6.3	70	108	<1	0	154	0.09	0.15	0.02	9	400	540	7.0	7.0	<0.05
SC 15 IRON SEEP	79.00	6.7	6.2	64	162	<1	0.0	189	<0.05	2.67	4.46	4	461	600	1.6	1.4	<0.05
SC 15 INFLOW	538.00	7.8	6.3	72	99	<1	0	158	0.25	0.36	0.35	10	404	540	6.4	4.6	<0.05
SC 15-1	349.00	8.0	6.4	77	103	<1	0	119	0.13	0.14	0.28	7	334	470	5.0	4.8	<0.05
SC 15-2/028	468.00	7.8	6.4	75	88	<1	0	111	0.33	0.22	0.23	13	326	480	4.8	4.6	0.09
September 24, 2010																	
SC ABL	29.00	8.1	6.2	66	80	<1	0	188	<0.05	0.10	0.04	2	364	450	5.4	5.4	<0.05
SC ABR	0.00																
SC POND ACCESS RD DITCH	0.00																
SC 15 IRON SEEP	94.00	6.5	6.2	63	127	<1	0	279	0.08	8.13	6.66	18	494	670	0.7	<0.6	<0.05
SC 15 INFLOW	235.00	7.7	6.4	68	137	<1	0	327	0.05	0.77	2.72	5	585	720	2.8	2.1	<0.05
SC 15-1	91.00	7.9	6.5	72	136	<1	0	368	<0.05	0.30	1.09	2	597	780	4.5	4.5	<0.05
SC 15-2/028	88.00	8.5	6.6	73	119	<1	0	330	0.05	0.19	0.55	2	590	720	4.8	4.7	<0.05

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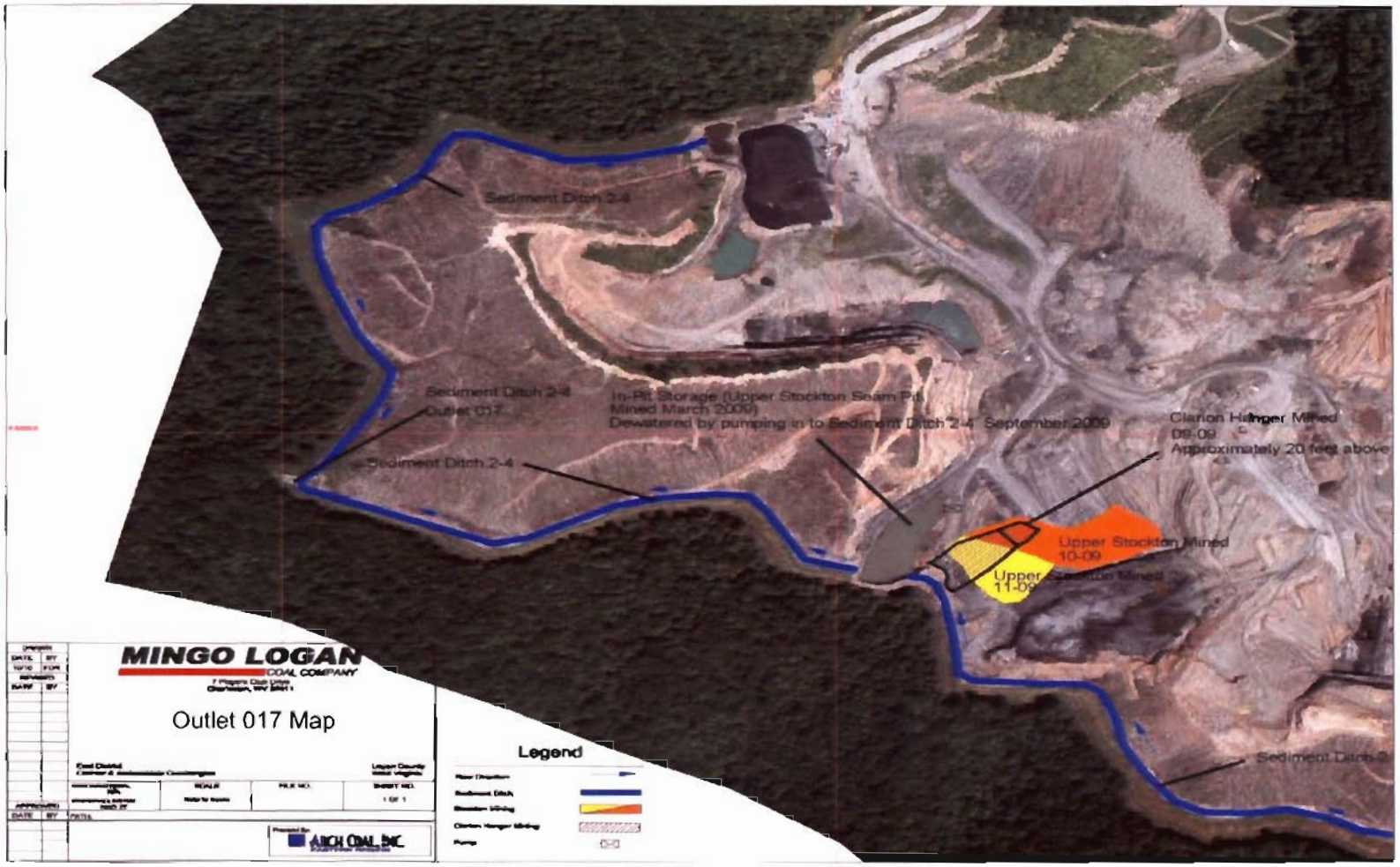

FIGURE 3-12
Outlet 017 Map

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TABLE 3-7 (CONTINUED)
Drill Hole Data
Site Number: DT0727

Sample ID	Depth (Feet)		Strata Thickness (Feet)	Rock Type	Se (mg/kg)	Volume Weighted % Selenium: Total Column	Volume Weighted % Selenium: As per Material Handling Plan
41	165.00	170.00	5.0	SS	0.13	0.650	0.650
42	170.00	175.00	5.0	SS	0.11	0.550	0.550
43	175.00	175.50	0.1	**SH**	**1.61**	0.081	
44	175.50	178.40	2.9	SS	0.14	0.406	0.406
45	178.40	181.00	2.9	SH	0.21	0.609	0.609
46	181.00	184.00	3.0	SH	0.54	1.620	1.620
47	184.00	187.00	3.0	SH	0.49	1.470	1.470
48	187.00	190.00	3.0	SH	0.94	2.820	2.820
49	190.00	193.00	3.0	SH	0.68	2.040	2.040
50	193.00	196.00	3.0	SH	0.51	1.530	1.530
51	196.00	199.00	3.0	SH	0.50	1.500	1.500
52	199.00	201.20	2.2	SH	0.60	1.320	1.320
53	201.20	202.70	1.5	**COAL**		0.000	0.000
54	202.70	203.30	0.6	DSH	0.56	0.336	0.336
55	203.30	203.80	0.5	**SH**	**1.83**	0.915	0.915
56	203.80	204.20	0.4	CARB	0.87	0.348	
57	204.20	205.00	0.8	SSH	0.72	0.576	0.576
58	205.00	205.40	0.4	**CARB**	**3.46**	1.384	1.384
59	205.40	206.70	1.3	DSH	0.87	1.131	1.131
60	206.70	212.70	6.0	**COAL**		0.000	0.000
61	212.70	213.20	0.5	**DSH**	**4.02**	2.010	
62	213.20	214.20	1.0	**SH**	**1.03**	1.030	
63	214.20	215.00	0.8	**COAL**		0.000	0.000
64	215.00	215.50	0.5	D F CLAY	0.34	0.170	0.170
65	215.50	216.40	0.9	F CLAY	0.69	0.621	0.621
66	216.40	218.40	2.0	SH	0.54	1.080	1.080
67	218.40	221.40	3.0	SSH	0.55	1.650	1.650
68	221.40	223.20	1.8	SS	0.24	0.432	0.432
69	223.20	226.00	2.8	SH	0.36	1.008	1.008
70	226.00	229.00	3.0	SH	0.18	0.540	0.540
71	229.00	232.00	3.0	SH	0.25	0.750	0.750
72	232.00	234.30	2.3	SH	0.16	0.368	0.368
73	234.30	237.00	2.7	SS/SH	0.18	0.486	0.486
74	237.00	241.70	4.7	SS	0.22	1.034	1.034
75	241.70	241.90	0.2	SH	0.71	0.142	0.142
76	241.90	242.40	0.5	**COAL**		0.000	0.000
77	242.40	242.70	0.3	**BSH**	**9.14**	2.742	
78	242.70	244.00	1.3	**SH**	**1.62**	2.106	
79	244.00	244.50	0.5	**DSH**	**1.16**	0.580	
80	244.50	247.70	3.2	**COAL**		0.000	0.000
81	247.70	248.20	0.5	**DSH/CARB**	**6.28**	3.140	
82	248.20	251.20	3.0	**DSH**	**1.03**	3.090	
83	251.20	253.20	2.0	DSH	0.35	0.700	0.700
84	253.20	255.00	1.8	SH	0.53	0.954	0.954
85	255.00	257.70	2.7	SH/SS	0.52	1.404	1.404
86	257.70	262.00	4.3	SS	0.18	0.774	0.774
87	262.00	265.10	3.1	SSH	<0.06	0.093	0.093
88	265.10	268.10	3.0	SSH	0.45	1.350	1.350
89	268.10	268.40	0.3	**BSH**	**4.35**	1.305	

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TABLE 3-7 (CONTINUED)
Drill Hole Data

Site Number: DT0727

Sample ID	Depth (Feet)		Strata Thickness (Feet)	Rock Type	Se (mg/kg)	Volume Weighted % Selenium: Total Column	Volume Weighted % Selenium: As per Material Handling Plan
90	268.40	269.00	0.6	COAL		0.000	0.000
91	269.00	269.60	0.6	BSH	1.54	0.924	
92	269.60	271.00	1.4	DSH	0.24	0.336	0.336
93	271.00	273.00	2.0	SH	0.14	0.280	0.280
94	273.00	275.00	2.0	SH	0.83	1.660	1.660
95	275.00	277.60	2.6	DSH	0.96	2.496	2.496
96	277.60	278.10	0.5	DSH	3.11	1.555	
97	278.10	280.40	2.3	COAL		0.000	0.000
98	280.40	280.90	0.5	BSH	3.27	1.635	
99	280.90	282.10	1.2	SH	0.25	0.300	0.300
100	282.10	284.30	2.2	SS/SH	0.11	0.242	0.242
101	284.30	289.00	4.7	SS	<0.06	0.141	0.141
102	289.00	294.00	5.0	SS	<0.06	0.150	0.150
103	294.00	299.00	5.0	SS	0.09	0.450	0.450
104	299.00	304.00	5.0	SS	<0.06	0.150	0.150
105	304.00	305.00	1.0	SSH	0.77	0.770	0.770
106	305.00	310.00	5.0	SS	0.09	0.450	0.450
107	310.00	313.70	3.7	SS	0.20	0.740	0.740
108	313.70	314.80	1.1	SS/CONG	0.46	0.506	0.506
109	314.80	316.40	1.6	COAL		0.000	0.000
110	316.40	316.90	0.5	F CLAY	3.43	1.715	
111	316.90	320.00	3.1	SH	1.46	4.526	
112	320.00	323.00	3.0	SSH	0.49	1.470	1.470
113	323.00	326.00	3.0	SH	0.53	1.590	1.590
114	326.00	329.00	3.0	SH	0.22	0.660	0.660
115	329.00	332.00	3.0	SH	1.07	3.210	
116	332.00	335.00	3.0	SH	0.67	2.010	2.010
117	335.00	338.00	3.0	SH	0.66	1.980	1.980
118	338.00	341.00	3.0	SH	1.13	3.390	
119	341.00	344.00	3.0	SH	0.47	1.410	1.410
120	344.00	347.00	3.0	SH	0.44	1.320	1.320
121	347.00	350.00	3.0	SH	0.66	1.980	1.980
122	350.00	353.00	3.0	SH	0.84	2.520	2.520
123	353.00	354.30	1.3	SH	0.62	0.806	0.806
124	354.30	354.90	0.6	SS	0.13	0.078	0.078
125	354.90	357.00	2.1	SH	0.34	0.714	0.714
126	357.00	362.00	5.0	SS	0.25	1.250	1.250
127	362.00	365.00	3.0	SS	0.10	0.300	0.300
128	365.00	367.70	2.7	SS/CONG	0.29	0.783	0.783
129	367.70	370.00	2.3	SH	0.35	0.805	0.805
130	370.00	373.00	3.0	SH	0.22	0.660	0.660

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at Outlet 17 are similarly not predictive of likely discharges from permitted valley fills in Pigeonroost Branch and Oldhouse Branch.

- It is very important to note that USEPA confuses Seng Creek and Seng Camp Creek (as reflected in footnote 14, RD p. 47); these are two entirely different watersheds. Fish have been analyzed from Seng Creek, as reported by WVDEP (2009), but no data are available from Seng Camp Creek. The high selenium concentrations in water and fish from Seng Creek are considered by USEPA to reflect effects of the Spruce No. 1 Mine, which is not accurate. No available data or literature information have been found that would predict harmful bioaccumulation of selenium in fish in Spruce Fork.

3.2 Total Dissolved Solids/Conductivity

USEPA contends that conductivity increase as a result of mining activity is a major stressor to aquatic communities. This evidence is entirely based on changes or shifts in populations of sensitive species on macrobenthos communities. No evidence is presented in the RD regarding potential impacts of conductivity or total dissolved solids on other aquatic communities such as fish species or salamanders. Potential impacts to these communities are discussed in Section 4. The following discussion focuses on key issues associated with the evidence of conductivity as a stressor to the macroinvertebrate community.

3.2.1 Conductivity Defined

USEPA continues to use conductivity as a basis for its action under 404(c). In Section V.B.1.b of the RD, USEPA provides background on conductivity and concludes this introduction with the statement (on pages 47-48):

> "Conductivity is an excellent indicator of the total concentration of all ions and is also a good predictor of aquatic life use impairment, especially in the ecoregion 69 in which the Spruce No. 1 project is located."

Conductivity is an indicator of the total concentration of ions present in water; however, as discussed in this document, there are readily accessible peer-reviewed analyses that clearly indicate that conductivity alone is a not good predictor of aquatic life use impairment.

Electrical conductivity (EC) is used as an indicator of ionic strength in a water body, often in the absence of, or prior to obtaining, data on specific constituents present in water from analytical tests. It is an easy measurement to make - thus its usefulness as a quick indicator of ionic strength. However, it does not provide information related to the suite of specific constituents in the water that influence water quality (e.g., sulfate, bicarbonate, chloride, and/or a combination of other ions) as it relates to ecological effects. Thus, EC does not provide useful information to assess cause-and-effects relationships because similar conductivity levels may have vastly different concentration of chloride, sulfate, or other ions that influence aquatic species differently.

USEPA indicates in its RD that conductivity is "a good predictor of aquatic life use impairment." The agency further characterizes impacts of conductivity using multiple terms, including changes in "native biota," adverse impacts based on WVSCI scores, genus level impacts to macroinvertebrates, decline in mayfly/stonefly/caddisfly species richness, "extirpation" of macroinvertebrate taxa, native taxa reduction, etc. to support its assertions

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relationship. Calcium, sulfate, and magnesium were correlated with the greatest number of the biotic metrics; TDS and conductivity showed weaker correlations.

In comments on the draft conductivity benchmark document, one reviewer (Redmond, 2010) noted that there is not a clear relationship between the reported number of Ephemeroptera genera and conductivity in the supplemental dataset developed by USEPA, as shown in Figure 3-14. Redmond's analysis indicates that there is no apparent relationship between the occurrence of Ephemeroptera genera and conductivity up to about 2000 uS/cm. The results also indicated that the observations of the occurrence of Ephemeroptera genera were consistent with chronic and acute toxicity thresholds identified through toxicity tests , as also illustrated in Figure 3-14. Other commenters (O'Hayre and Amendola, 2010) note that, in examining Figures A-1 and A-2 in Appendix A of the benchmark document, conductivity is clearly a poor predictor of the number of Ephemeroptera genera present at a sampling site.

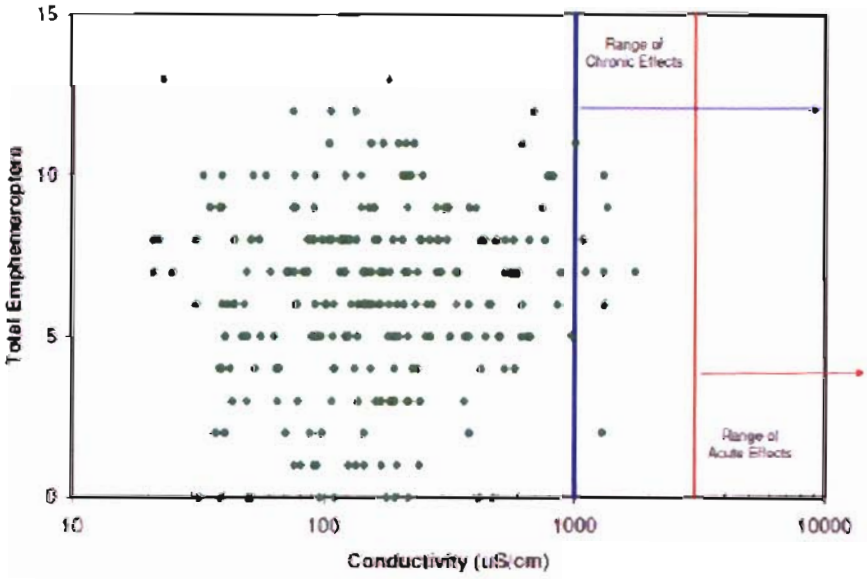

FIGURE 3-14
Total Ephemeroptera Genera and Conductivity Based on USEPA Supplemental Dataset (reproduced from Redmond, 2010)

Similarly, the results of an ongoing study of mined and unmined streams in the Spruce No. 1 Mine project area (the Dal-Tex study), clearly show that there is a poor correlation between EPT and EC, as seen in Figure 3-15.

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TABLE 3-8
Proportional Abundance of Functional Feeding Groups in the Pond/Passmore Study (GEI, 2010)

Functional Feeding Group	Unmined Sites	Low Mining Activity	Moderate Mining Activity	High Mining Activity
Gather-collector	29%	23%	24%	24%
Scraper	14%	17%	4%	8%
Filter-collector	12%	20%	24%	24%
Predator	21%	26%	20%	28%
Shredder	21%	14%	28%	12%
Piercer	2%	0%	0%	4%

TABLE 3-9
Proportional Abundance of Habit Groups in the Pond/Passmore Study (GEI, 2010)

Habit Group	Unmined Sites	Low Mining Activity	Moderate Mining Activity	High Mining Activity
Swimmer	14%	17%	16%	12%
Clinger	62%	71%	68%	80%
Burrower	5%	0%	0%	0%
Sprawler	17%	11%	16%	8%
Climber	2%	0%	0%	0%

USEPA relies on a very narrow metric to attempt to show that streams influenced by mining activity have poor water quality and does not consider the functional groups, characteristics of the biotic community, or types of habitat that are present. By comparison, the WVDEP guidance for interpreting narrative water quality criteria uses a more holistic and comprehensive assessment of the benthic macroinvertebrate community. "DEP has determined that significant adverse impact is more than a change in the numbers or makeup of the benthic macroinvertebrate community in a segment of a water body downstream from a point source discharge. It is, instead, a material decline in the overall health of an aquatic ecosystem" (WVDEP, 2010).

Use of the Term Extirpation

Additionally, USEPA uses a number of terms to describe the potential effect of conductivity on native biota, primarily referring to EPT. It frequently uses the term "extirpated" and calculates "extirpation coefficients" in the draft Conductivity Benchmark Report (USEPA, 2010c). While there are a number of definitions of extirpated in various dictionaries, the most common is "to destroy wholly: or to wipe out." This term, as used by USEPA, is not an ecologically accurate description of what actually occurs in streams affected by mining operations. As explained above, a shift in species can occur without "extirpation" or a reduction in ecological function.

The presence or absence of a particular species, genus, or family of macroinvertebrates in a stream may be due to many reasons, natural or man-induced. The term extirpation is more often used in an ecological sense to indicate the loss of a species from an area that is within the

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range where it used to occur (USFWS, 2010). It is typically applied to threats to a species that result in its total loss or even extinction. As applied in the context proposed by the RD, it would suggest that the impacts of the MTM/VF to these streams were comparable to the extinction of a species.

In cases where there is an absence of a sensitive species below mining activity, or any of a number of other land use changes, the effects of elevated TDS are generally much more subtle than implied by the term "extirpation." It appears more likely that elevated TDS influences the ability of sensitive species to compete with other species, possibly because of a disruption in osmoregulation or other TDS-related factors. While such factors may cause a species shift to a more TDS-tolerant species assemblage, this shift is not "extirpation" within the commonly understood context of the word.

The water body conditions that support the continued occurrence of one or more species vary considerably. The presence or absence of species in a stream segment may be the result of non-toxic physicochemical factors such as habitat degradation. Changes in observed species assemblages from one stream segment to another may not be due to their "extirpation" from the stream as much as to their relocation downstream to areas where the habitat conditions are preferable. Thus if higher conductivity waters at an upstream station are unsuitable for a species due to its inability to osmoregulate adequately, it will drift downstream to areas where habitat or water conditions are more suitable. [7]

This is evidence of this shift in EPT as a result of habitat conditions in data for the unmined and mined streams included in the Dal-Tex study currently being conducted in the Spruce No. 1 Mine region, as summarized in Figure 3-16.

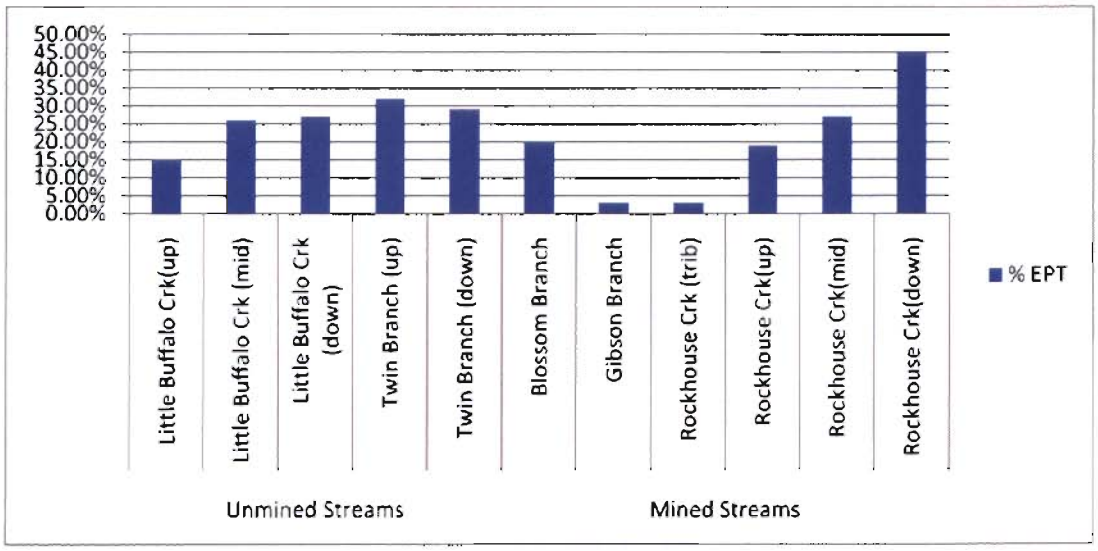

FIGURE 3-16
Percent EPT for Samples collected in Mined and Unmined Streams in the Spruce No. 1 Mine Project Area

[7] Pond acknowledged this drift and actually suggests that "future research should focus on ... investigations of chronic effects on osmoregulation from elevated specific conductance, catastrophic drift with no recolonization....".

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As these data indicate, percent EPT increases substantially as upstream Rockhouse Creek sites are compared with sites further downstream. The percent of EPT in the two stations with better structural habitat (two downstream sites) is higher than, or comparable to, that found for the streams unaffected by mining as seen in Figure 3-16. In fact, there is an obvious progression of sequentially higher EPT percentage from the upstream relatively poor habitat to the downstream station with very good habitat, even though the specific conductivity throughout this entire stream section is higher than 600 uS/cm. This is further discussed in Section 4.1.

The potential for one or more species being absent as a result of other factors, such as increased TDS or degradation of habitat, may cause the replacement of one species by another more suited to the changed conditions. However, this shift in species frequently occurs as a result of many changes in a watershed and is not comparable to the extinction of a species as suggested by the term extirpation.

Habitat Influences Species Present

USEPA's use of conductivity to represent potential TDS impacts to aquatic life over-simplifies the situation and ignores the complex relationships between specific ions, habitat conditions, and biotic response. USEPA suggests in the RD that changes in conductivity alone explain most of the differences in the shift of sensitive species and that factors such as habitat provide little ability to predict taxa reduction. It cites a correlation coefficient value (R^2) of 0.63 between its Observed/Expected (O/E) index and conductivity, but an R^2 score of only 0.28 for this index and RPB habitat scores. What USEPA fails to indicate is that the data set it selected for this analysis minimizes the potential influences of habitat on the O/E scores. Only 5 of the nearly 40 sites had habitat scores less than 140, the range in which a habitat influence on scores would be expected. Given the biased nature of this analysis, it is surprising that even 28 percent of the variability in O/E scores is explained by habitat scores in this dataset.

The complexity of the situation and the potential for confounding influences is actually illustrated quite well by data presented in Appendix 2 to the RD, as shown in Figure 3-17. The figure presents the potential effects of conductivity and habitat scores in relationship to WVSCI scores. USEPA contends that 62 percent of streams with good habitat and conductivity levels in excess of 500 uS/cm are degraded (based on WVSCI scores less than 68). However, the evaluation is based on a wide range of stream habitats, many of which were affected by mining prior to implementation of today's mining requirements.

If the conductivity were as good a predictor of degraded conditions as USEPA suggests, one would expect that 75 to 80 percent or more of streams with conductivity greater than 500 uS/cm would be degraded. The information in Figure 3-17 can just as easily be interpreted to indicate that degradation of aquatic communities in streams that are affected by mining is not inevitable as USEPA suggests, but can be effectively managed. USEPA indicates that there are only slightly more streams that are degraded when habitat conditions are poor, suggesting that water quality is the more important influence. However, the data show that 89 percent of streams with conductivity greater than 500 uS/cm and poor habitat scores are degraded, which is considerably higher than the 62 percent value posited by USEPA in streams that may have had water quality influences other than elevated conductivity. The information in Figure 3-17 also shows that habitat is a better predictor of degradation than conductivity. In streams with conductivity less than 300 uS/cm, those with poor habitat scores were evaluated as degraded at 77 percent of the sites.

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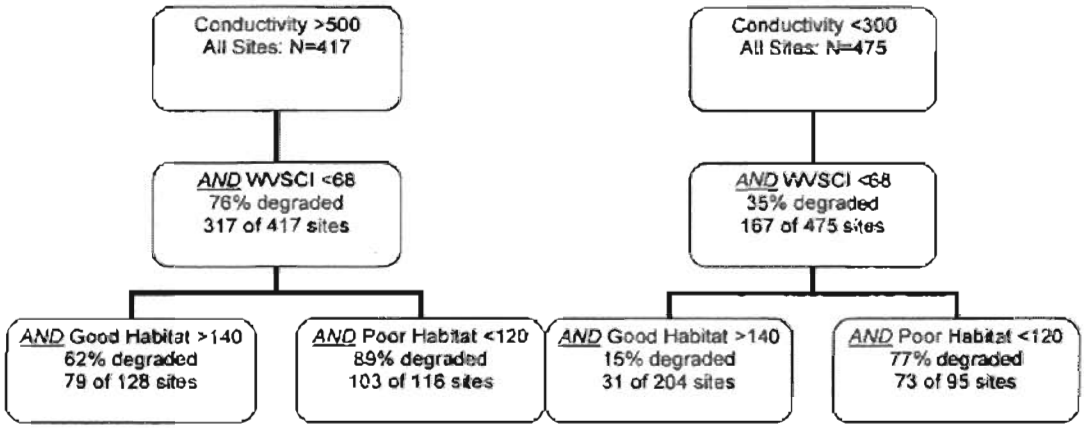

FIGURE 3-17
USEPA's Illustration of the Influence of Conductivity and Habitat on Degradation as measured by WVSCI Scores (USEPA, 2010)

3.2.3 USEPA's Justification for Using 500 µS/cm as a Stream Health Criterion

USEPA has relied on a very narrow indicator (i.e., a shift away from certain EPT genera) to justify use of 500 uS/cm as a level of conductivity that may result in a violation of West Virginia's narrative water quality standard. USEPA has indicated that in-stream conductivity levels above 500 µS/cm are likely to be associated with adverse impacts that may rise to the level of exceedances of narrative state water quality standards (USEPA, 2010 – April 1 guidance letter). In the previous section, information was presented related to the weakness of the USEPA argument, indicating that there is significant variability associated with this relationship between EC and EPT taxa. USEPA clearly did not closely examine other potential causative factors, but surprisingly (particularly given more holistic stream evaluation measures developed by USEPA and WVDEP), attempted to discount factors such as habitat and indicate that conductivity is the primary causative factor in determining the relative ecological health of streams. USEPA also failed to evaluate specific mining practices and stream mitigation that could reduce or eliminate mining activity impacts.

WVDEP specifically addressed the use of conductivity and the lack of accuracy of the 500 uS/cm value used by USEPA to indicate exceeedance of the narrative water quality standard, stressing that more than a conductivity measurement is required to assess the health of a stream. Figure 3-18 (from WVDEP, 2010) clearly demonstrates that the stream health situation is much more complicated than USEPA suggests. It is obvious that there are many sites with low conductivity that are impaired and many sites with elevated conductivity that are not impaired.

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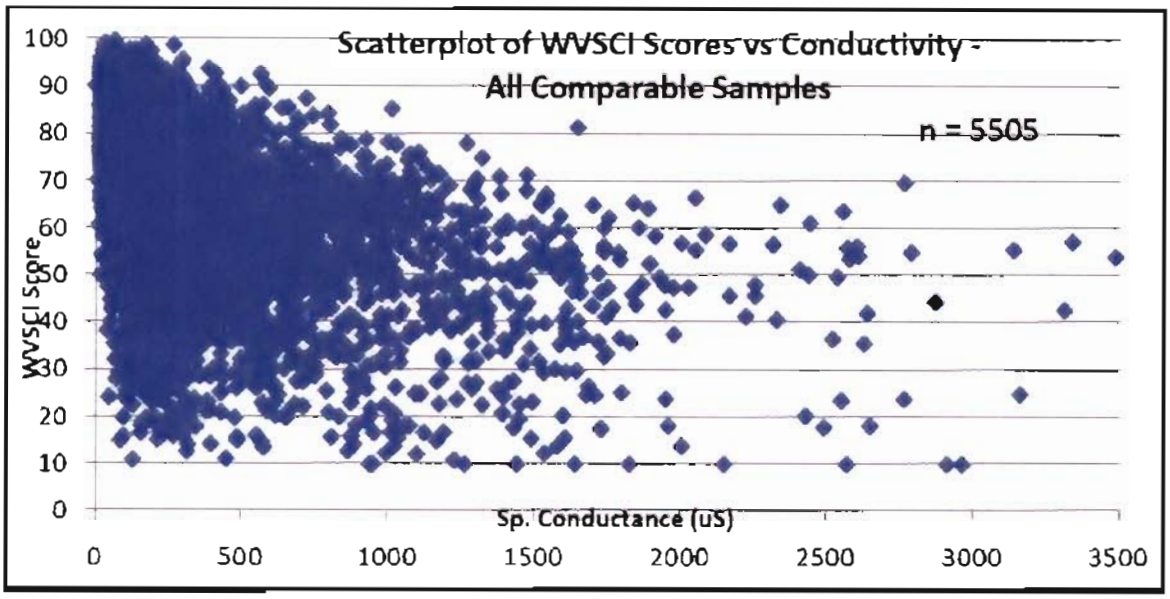

FIGURE 3-18
WVDEP Data on the Lack of Precision for Conductivity in Predicting Impairment based on WVSCI scores (WVDEP, 2010)

WVDEP indicates that USEPA relies on the Pond-Passmore Study, which found a shift in the benthic macroinvertebrate community downstream from mining activity as discussed above. USEPA discussed this shift in terms of "extirpation" of native species, as synonymous with degradation. WVDEP indicates that "where the only impacts to this component of the ecosystem are diminished numbers of certain genera of mayflies, without evidence that this has had any adverse impact of any significance on the rest of the ecosystem, the State cannot say that there has been a violation of its narrative standard." WVDEP indicates lowered biological conditions can co-occur with increased ionic strength, but that there is uncertainty associated with the specific pollutant or pollutants and concentrations causing the effects. WVDEP also indicates that USEPA's correlation studies do not distinguish the effects of increased ionic strength from other stressors. Conductivity measures the potential for toxic effects or other influences on biological communities from a number of ions such as chloride (for which WV has an adopted water quality standard), sulfate, and bicarbonate. Unlike USEPA, WVDEP considers all of these factors in conjunction with habitat and biological assessment information in assessing compliance with its narrative water quality standard. This is a much more holistic and meaningful assessment of stream health than that used by USEPA in its RD.

WVDEP has developed stressor evaluation guidance for impaired streams to evaluate the likelihood of ionic strength being a significant contributor to impairment. Table 3-10 shows the criteria that WVDEP uses to assess potential causes of impairment related to ionic strength.

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TABLE 3-10
WVDEP Criteria for Evaluating Stressors Related to Ionic Strength (WVDEP 2010)

Parameter	Candidate Stressor Thresholds	Evidence for Conductivity as a Cause for Stress
Conductivity[a]	< 326.9 uS/cm	Eliminated as a stressor
	327 - 516.9 uS/cm	Equivocal or no trend
	517 – 766 9 uS/cm	Weak stressor
	767-1074.9 uS/cm	Possible stressor
	1075 – 1532.9 uS/cm	Likely stressor
	> 1533 uS/cm	Definite stressor
Sulfates	< 56.9 mg/L	Eliminated as a stressor
	57 – 119.9 mg/L	Equivocal or no trend
	120 – 201.9 mg/L	Weak stressor
	202 – 289 9 mg/L	Possible stressor
	290 – 416.9 mg/L	Likely stressor
	>417 mg/L	Definite stressor
Chloride	< 60 mg/L	Eliminated as a stressor
	60.1 – 80.0 mg/L	Equivocal or no trend
	80.1 – 125.0 mg/L	Weak stressor
	125.1 – 160.0 mg/L	Possible stressor
	160.1 – 229.0 mg/L	Likely stressor
	>230 mg/L	Definite stressor

[a]Considered as independent stressor in non-acidic, non-acid mine drainage streams, when conductivity values meet threshold ranges and sulfates and chloride violate conditions listed

It is also important to note that portions of Spruce Fork exhibit conductivity levels above 500 uS/cm and that USEPA acknowledges the healthy fish population in Spruce Fork. USEPA has considerably changed its discussion from the analysis presented in the PD related to potential impacts on fish populations. It now indicates in the RD that the fish population in Spruce Fork is relatively healthy and that the rock bass and smallmouth bass that are present there are moderately sensitive species.

USEPA indicated that there was evidence of recreational fishing in 2010 and notes that the species present in Spruce Fork have not changed appreciably in the last 60 years. USEPA concerns for impacts to fish populations as stated in the RD are addressed almost solely to purely hypothetical concerns that Spruce No. 1 Mine operations will create conditions conducive to the occurrence of blooms of toxic golden algae and the potential toxic effects of such algal blooms on fish. Technical issues associated with the weakness of the USEPA argument on the potential for toxic algal blooms are addressed in Section 4.3.1 of this document.

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In conclusion, USEPA has relied on a very narrow indicator (i.e., a shift away from certain EPT genera), to justify use of 500 uS/cm as a level of conductivity that may result in a violation of West Virginia's narrative water quality standard. In contrast, West Virginia has developed a comprehensive weight of evidence approach for evaluating compliance with the narrative water quality standard and has come to the opposite conclusion.

3.2.4 Conclusions Regarding Conductivity

The following conclusions can be made based on the review of USEPA's use of conductivity as an indicator of stream impacts.

- USEPA assertions related to conductivity effects are entirely based on shifts in certain native biota; no suggestion is made in the RD concerning potential impacts of conductivity or total dissolved solids on other aquatic communities such as fish species or salamanders.
- There is strong evidence that calls into question the strength of the relationship in conductivity to effects on sensitive groups such as Ephemeroptera that is the basis of USEPA's assertions regarding impacts to native biota. Several researchers have presented alternative conclusions based on USEPA data using several additional metrics. The data from the Dal-Tex study also call into question the strength of the USEPA-posited relationship between various biotic metrics and conductivity.
- USEPA relies on a very narrow metric to attempt to show that streams influenced by mining activity have poor water quality and does not consider the functional groups or characteristics of the biotic community or types of habitat that are present. However, the shift to more TDS-tolerant species does not represent a reduction of ecological stream function. Commenters on the draft benchmark document, as well as WVDEP, have indicated that stream function and trophic structure are frequently maintained in sites below mining activity (UWAG, 2010; GEI, 2010; WVDEP, 2010).
- The potential for one or more species being absent as a result of other factors, such as increased TDS or degradation of habitat, may cause the replacement of one species by another more suited to the changed conditions. However, this shift in species frequently occurs as a result of many changes in a watershed and is not comparable to the extinction of a species as suggested by the term extirpation.
- USEPA's use of conductivity to represent potential TDS impacts to aquatic life over-simplifies the situation and ignores the complex relationships between specific ions, habitat conditions, and biotic response. USEPA's own data indicates that poor habitat is a better predictor of stream degradation than conductivity.
- USEPA has relied on a very narrow indicator (i.e., a shift away from certain EPT genera), to justify use of 500 uS/cm as a level of conductivity that may result in a violation of West Virginia's narrative water quality standard. In contrast, West Virginia has developed a comprehensive weight-of-evidence approach for evaluating compliance with the narrative water quality standard and has come to the opposite conclusion.

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3.3 Freshwater Dilution

USEPA has made a number of references to impacts associated with the Spruce No. 1 Mine related to a reduction of freshwater inflow in the Spruce Fork watershed. The contention is that this would contribute to water quality degradation. USEPA also models expected conductivity changes in Spruce Fork based on watershed area and uses this analysis as the basis for comments related to potential increases in selenium concentrations in Spruce Fork watershed streams.

While the USEPA approach may seem reasonable for many watershed areas, the historic subsurface mining in the Spruce Fork watershed has substantially altered the hydrology. That is, flow is contributed by a larger area than indicated solely by surface topography, which is the basis for the USEPA analyses. Table 3-11 summarizes surface drainage area for the watershed as well as average flow information.

The discrepancy in flow and watershed area information is apparent in looking at the three tributaries draining the Spruce No. 1 Mine. These tributaries include 12.4 percent of the watershed area contributing to Spruce Fork at site DSF and have an average watershed yield of 0.43 cfs/mi^2. In contrast, the tributaries only contribute approximately 7.7 percent of the average measured flow at site DSF, which has a watershed yield of about 1 cfs/mi^2. This information suggests that the flow in Spruce Fork is receiving additional contributions from historical underground mines. Therefore, USEPA's drainage area-based methodology over-estimates the freshwater inflow contributed by Oldhouse Branch and Pigeonroost Branch.

TABLE 3-11
Comparison of Flow and Watershed Area Information in Spruce Fork Watershed

Site	Flow (CFS)		Watershed Acres	% Watershed at DSF
	Av.	% of Flow at DSF		
Site 300/DSF Spruce Fork below confluence with Seng Camp	32.38	100	20,923.32	100
Site 302/DSCB Mouth Seng Camp	4.01	12.4	3,276.69	15.66
Site 507 Mouth of Pigeonroost Branch	1.38	4.3	1,478.69	7.07
Site 514 Mouth of Oldhouse Branch	0.76	2.3	596.65	2.85
Site 028 Right Fork of Seng Camp	0.36	1.1	513.90	2.46
∑ Sites 507, 514, 028	2.50	7.7	2,589.24	12.37

USEPA estimates that average conductivities in Spruce Fork below Seng Camp "Branch" (actually Seng Camp Creek) could increase by nearly 200 uS/cm (i.e., from 555 uS/cm to 745 uS/cm) as a result of the mining activity at the Spruce No. 1 Mine. The long term average conductivity at site DSF is 518 uS/cm based on data collected by Mingo Logan. If conductivity were to increase in mined area drainages from 500 to 1500 uS/cm, the average conductivity at

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site DSF would be expected to increase to between 542 uS/cm and 619 uS/cm, based on the relative flow contribution of these tributaries to site DSF. These increases are more modest than suggested by USEPA and the resulting conductivity values are in the range that WVDEP would categorize as only a "weak stressor;" i.e., not values that would be a major concern with respect to the ecological function of a stream. It is noted that the USEPA analysis uses maximum values, whereas the stressor evaluation suggested by WVDEP is based on average values.

USEPA also evaluates changes in freshwater inflow and estimated increases in selenium concentration resulting from proposed Spruce No. 1 Mine operations, concluding that selenium levels in the downstream drainage area may exceed the West Virginia water quality standard. In brief, there does not appear to be a technically supportable foundation for the USEPA conclusion.

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4.0 Impacts to Wildlife

4.1 Benthic Invertebrates as Indicators of Water Quality

Aquatic benthic macroinvertebrates include a wide range of species without backbones, visible to the naked eye, that are generally immature stages of different species of insects that live a portion of their life cycle in an aquatic environment. As a community, they consist primarily of larval or pupal stages of flies, mayflies, caddisflies, dragonflies, and stoneflies.

The USEPA RD focuses on a small subset of these macroinvertebrates, specifically on three orders of insects known as Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), which are referred to as EPT. USEPA further emphasizes potential effects on mayflies, considered by USEPA to be the most sensitive of the EPT orders.

To add an ecological perspective to this community, there are 19 families of mayflies, including about 2,000 species (Mandaville, 1999). As adults, these insects only live from a few hours up to a few days. Their habitat preference is for cool streams with high dissolved oxygen. Many have additional and very restrictive habitat requirements that include fast-flowing streams with sediments of a specific size (Mandaville, 1999).

Largely because of their sensitivity to organic pollution, which can reduce the oxygen levels in the water, these species have been labeled by USEPA as "indicators" of water pollution. However, as noted by Mandaville, chemical tolerance of this order is less well known than for other groups. Because they are sensitive to organic pollution affecting oxygen in their environment does not mean that there is a corollary sensitivity to specific conductance. Their sensitivity to oxygen levels is well established and is clearly related to their dependence on habitats that provide cooler, fast flowing water that enhances the concentration of dissolved oxygen in water (McCafferty, 1981).

The conclusion that mayflies are an indicator of water quality changes due to increased conductivity has not been demonstrated. USEPA acknowledges this fact (USEPA 2010a), stating that "unfortunately, it is not always a clear decision to make. Oxygen is only one factor affecting the benthos. Others include toxic chemicals, nutrients, and habitat quality. Some types of stoneflies may actually be found in waters that are not so clean, and likewise some types of worms and midges can be found in cleaner waters. So it is important to understand that there are some more complex methods to make these types of decisions, and to determine whether waters are healthy or polluted for aquatic life." In other words, USEPA acknowledges that there may be factors, such as habitat, that are not related to conductivity and that influence the composition of an aquatic community.

The following sections consider several measures of a benthic macroinvertebrate community that provide a basis for conclusions that habitat plays a greater role in the changes that may be observed in previously mined streams and that even with these changes, the observable functional attributes of the community are retained to provide a diverse, balanced aquatic community. A substantial part of the following section is based on studies conducted during

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seasonal sampling events in streams in the Dal-Tex area that included previously mined and unmined streams.

4.1.1 Aquatic Benthic Community Defined as a Community That Comprises a Diverse Food Web

Benthic Community

The focus of the USEPA RD is on the shift from certain sensitive species within the EPT orders to more tolerant species in streams affected by MTM operations, coupled with the assumption that this is an unacceptable ecological impact. USEPA apparently assumes that all streams should attain the same distribution of EPT species, when in fact, a stream dominated by a few populations of sensitive species might be considered to not represent a balanced aquatic community. As discussed below, a balanced aquatic community of benthic invertebrates is not reflected only by the presence or dominance of certain specific mayflies or other sensitive EPT taxa.

The term "benthic invertebrate community" refers to the diversity of the species that comprise the benthic macroinvertebrates in a stream or other water body, rather than a specific makeup of one group of species such as representatives of a single order or family. In other words a balanced aquatic community is diverse in species composition, contains different trophic levels, and is not composed mainly of strictly pollution-tolerant species nor pollution-sensitive species (such as certain EPT). The different trophic levels refer to species that represent different feeding groups such as filter feeders, grazers, shredders, etc., which, as a benthic macroinvertebrate community, represent important functions in the food web of a stream. They may be predator and/or prey within the community and may perform functions such as breaking down larger materials such as leaves, into smaller particles that can be consumed by other downstream species.

It is generally agreed that, within a balanced community, a shift or change in the presence or numbers of a single species does not necessarily have a substantive effect on the ecological function of the community as a whole, as there will typically be other species that will fill the niche of that species whose numbers may have changed (McGrady-Steed, 2000; Hooper, 2005; Naeem, 1998).

Trophic Levels

As explained above, one measure of a balanced community is the presence of representatives from various trophic or feeding groups within the community. These groups generally are defined based on their feeding behavior or niche they occupy in the community. Their presence or absence can be affected by many variables such as instream cobbles, twigs, etc.; available allochthonous materials from riparian vegetation or leaves; and prey or predators that affect these populations. The trophic levels considered for this study were as follows:

- Filterers/Collectors
- Scrapers
- Collectors/Gatherers
- Shredders
- Piercers

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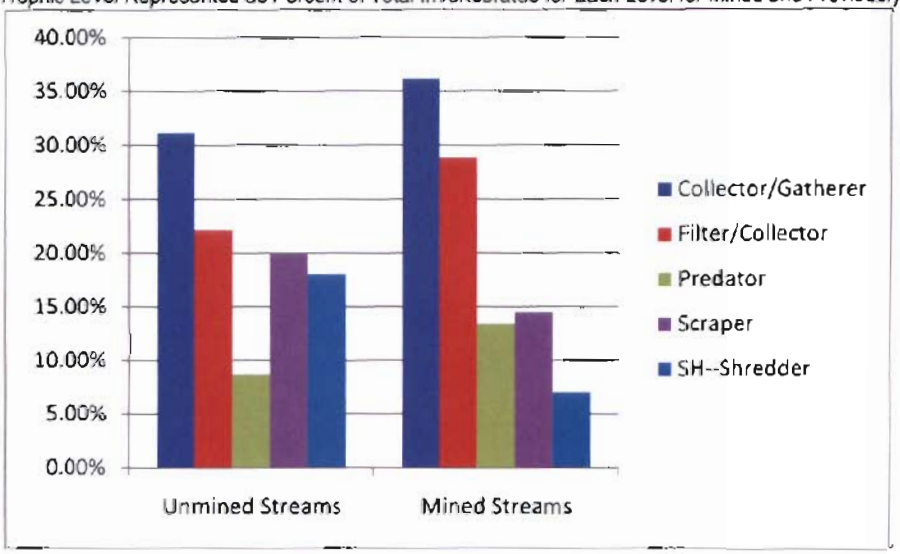
- Predators
- Clingers

The evidence of a balanced aquatic community or food web in previously mined streams is demonstrated by Figure 4-1, which compares the trophic levels found in the Dal-Tex study between previously mined and unmined streams. As this figure illustrates, a broad representation of all the trophic levels is found in all streams studied.

FIGURE 4-1
Trophic Level Represented as Percent of Total Invertebrates for Each Level for Mined and Previously Mined Streams



Figures 4-2 and 4-3 compare the average number of species among all the trophic groups of macroinvertebrates over three sampling events between unmined and previously mined streams.

FIGURE 4-2
Average Numbers of Species by Trophic Level in Unmined Streams

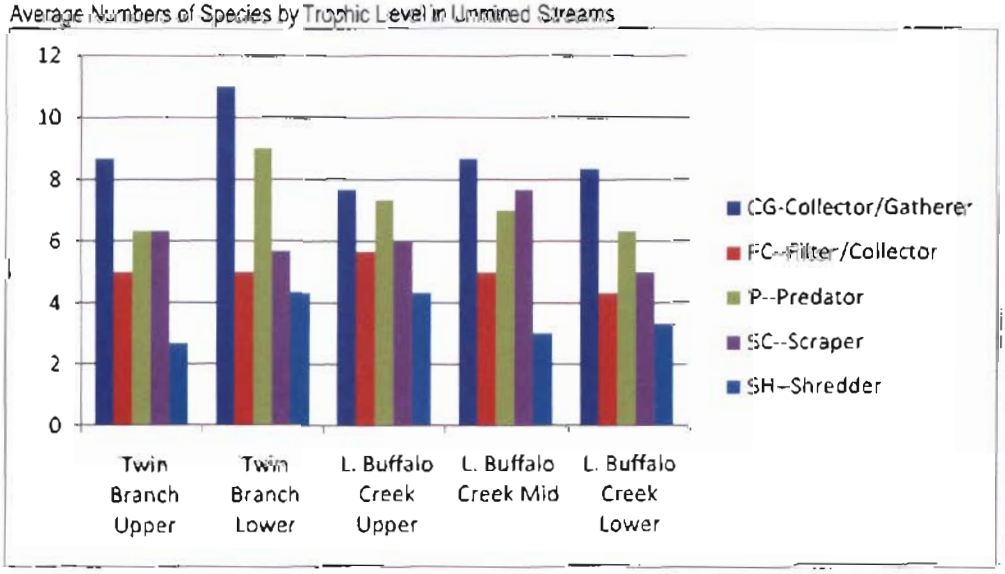


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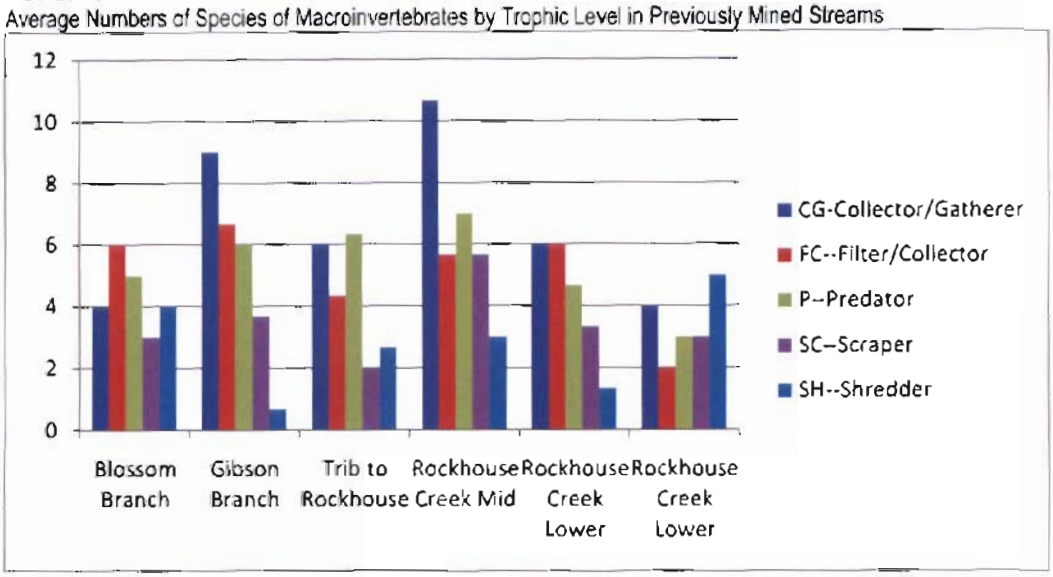
FIGURE 4-3
Average Numbers of Species of Macroinvertebrates by Trophic Level in Previously Mined Streams



These data demonstrate that there is approximately the same representation for each feeding group (trophic level) for the previously mined and unmined streams. This indicates that mining in the headwaters of these streams has not had a substantial effect on the composition or function of these communities nor resulted in a substantive change in trophic levels or feeding groups In other words, even if there had been a shift in species in the previously mined streams, the trophic levels still present in these streams reflect the same functional roles as found in the unmined streams.

Species Shift Related to Habitat Rather Than Water Quality

The USEPA has relied on shifts in composition and abundance of certain selected EPT species but shifts in species composition in previously-mined streams are as likely to reflect lack of appropriate habitat as they are to represent degraded water quality conditions. Many aquatic insects are pre-adapted to a wide variety of stream habitat conditions that result in their occurrence in streams where the habitat may have been modified. By comparison, some of the more "sensitive" species of EPT may be unable to respond to these habitat alterations and do not occur as frequently. The shift to species that are adapted to these altered habitats does not necessarily connote poor water quality. In fact, shifts in community dominance from certain species of mayflies (or other EPT species) to species that are considered to be "tolerant" by USEPA may be a result of a physical factor, such as habitat reduction or sediment impacts, rather than the results of a water quality impact.

Many of the more sensitive species are considered sensitive because they have very narrow ecological requirements such as high dissolved oxygen, fast flowing streams, and low sediment percentages within the substrates they inhabit. Therefore, the argument that USEPA makes that a shift in percent EPT or numbers of mayflies and mayfly species reflects changes that are related to degraded water quality vastly understates the importance habitat plays in supporting the presence of these species. The discussion below reviews the results of the recent Dal-Tex studies conducted in areas similar to the Spruce No.1 Mine area. These include benthic

invertebrates surveys conducted in previously mined and unmined streams, along with characterization of specific functions that they may provide as part of a balanced aquatic community.

The images in Figures 4-4 through 4-7 below show sampling locations and associated habitat differences between four previously-mined streams included in the Dal-Tex field survey that began in September 2009.

FIGURE 4-4
Gibson Branch

FIGURE 4-5
Upstream station on Rockhouse Creek

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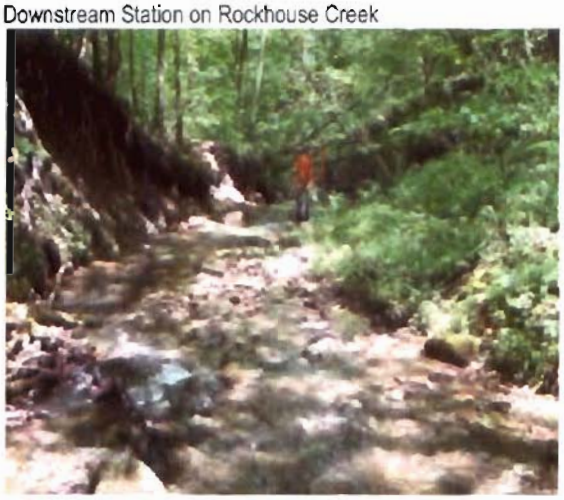
FIGURE 4-6
Blossom Branch

FIGURE 4-7
Downstream Station on Rockhouse Creek



Although all four of these streams are in previously mined areas, there are obvious differences in the habitats. In Figures 4-1 and 4-2, where the streams have been stabilized with rip-rap, there is little riparian habitat or adjacent woody vegetation. By comparison, in Figures 4-3 and 4-4, where streamside habitat includes heavily vegetated riparian zones, the streams have greater structural diversity. Further, although all the stations seen in these images have conductivity values that exceed 600 uS/cm, their biological features reflect the obvious habitat variability between the stations.

For Streams in Figure 4-5 and 4-6, the Dal-Tex study found the following:

- The percent of EPT in these two stations with better structural habitat is higher than, or comparable to, that found for the streams unaffected by mining as seen in Figure 4-8. In fact, there is an obvious progression of sequentially higher EPT percentage from the

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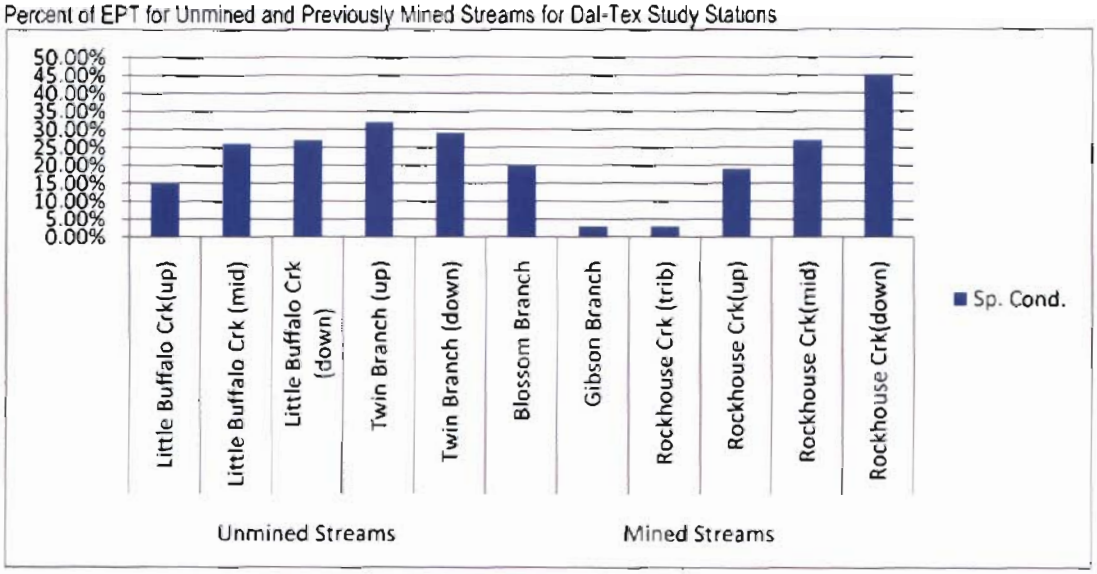
upstream relatively poor habitat to the downstream station with very good habitat, although the specific conductivity throughout this entire stream section is higher than 600 uS/cm.

FIGURE 4-8
Percent of EPT for Unmined and Previously Mined Streams for Dal-Tex Study Stations



- The percentage of shredders, an important feeding group for breaking down allochthonous matter and cycling energy through the system, is as high as, or higher than, that found in the streams unaffected by mining (Figures 4-9 and 4-10).
- Numbers of Plecoptera are as high as, or higher than, those in streams unaffected by mining.
- Numbers of Diptera (many of these species are considered as "pollution-tolerant" and are associated more frequently with impaired streams) in these previously mined streams are as low as, or lower than, the numbers found in streams unaffected by mining (Figure 4-8).

These findings strongly support the conclusion that even though conductivity values are greater than the threshold of 500 uS/cm proposed by USEPA for the previously mined streams, these streams have biological attributes that are indicative of a balanced aquatic community and are not degraded with respect to their ecological function.

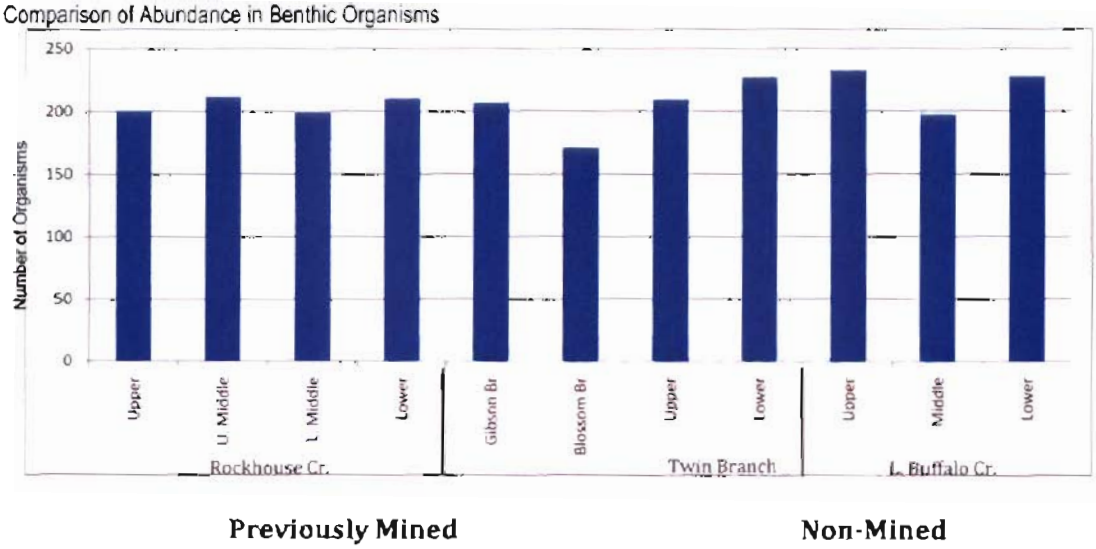
Based on the USEPA and other data reviewed, there is no evidence that the shift from some groups of invertebrate species to others has resulted in negative impacts to higher trophic level biota, nor would that be expected unless there was a significant reduction in total numbers of species or there was a clear link between one or more macroinvertebrate species that were reduced and another species of fish or wildlife that depended on those invertebrate species to complete a normal life cycle.

Abundance of Macroinvertebrates Not Affected by Mining

Abundance of macroinvertebrates is an important criterion because these organisms comprise an important component of the food web for other invertebrates as well as for larger predators such as fish, mammals, and birds. Abundance takes into consideration all individuals, regardless of the order to which they belong, on the premise that most predators consume the

resources available and do not have such narrow feeding behavior that they would be restricted to a single species or even a single higher taxonomic group. Figure 4-9 summarizes the relevant abundance of benthic organisms collected from previously mined and unmined streams. These are site-specific data collected during the ongoing benthic invertebrate Dal-Tex surveys commissioned by Mingo Logan.

FIGURE 4-9
Comparison of Abundance in Benthic Organisms



Previously Mined **Non-Mined**

As these data indicate, the number of individual benthic organisms varies little among the stations and the mined and unmined sections of these streams have similar abundance within the communities. Therefore, this demonstrates there are adequate sources of prey organisms in the stream to sustain higher aquatic trophic levels, as well as those terrestrial organisms that may feed on aquatic macroinvertebrates.

Another indication of the prevalence of adequate numbers of organisms among mined and unmined streams to support the community at large is found by comparing the abundance of adults that emerge from these water bodies and provide food for other terrestrial organisms that may depend on these species. The data from emergence studies for the Spruce No. 1 Mine region are summarized in Figure 4-10.

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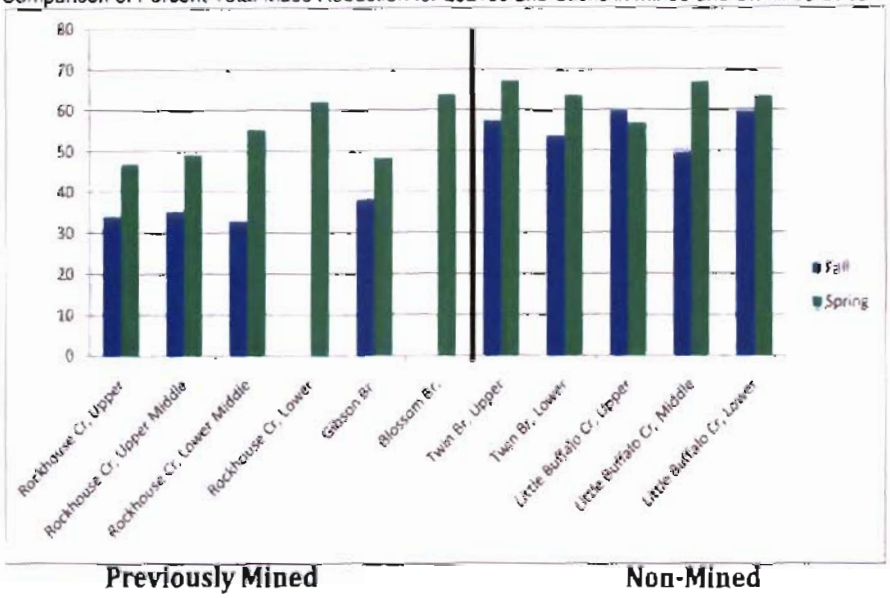
FIGURE 4-11
Comparison of Percent Total Mass Reduction for Leaves and Sticks in Mined and Unmined Streams



West Virginia Stream Condition Index (WVSCI) Demonstrates that Previously Mined Streams Meet Criterion as Unimpaired Streams

The WVSCI consists of six benthic community metrics combined into a single multimetric index. All values are converted to a standard 0 (worst) to 100 (best) point scale and then the six standardized scores are averaged to calculate a final index score ranging from 0.0 to 100.0. Using the distribution of scores from all sites that are considered reference sites, an impairment threshold of 68 has been established by WVDEP. That is, if a stream site receives a WVSCI score greater than 68, it is considered to be unimpaired. However, as described by the WVDEP in its guidance document of August 12, 2010, the threshold for inclusion on the 303(d) list for impaired streams has been reset at 60.6 to take into account that many of their candidate reference sites used to establish this index were eliminated because of additional information on their proximity to upstream point source discharges and an evaluation of anthropogenic activities and disturbances near the candidate sites, as well as sampling error, thereby avoiding misclassifying streams as impaired when they are not. Following this guidance, and using 60.6 as the threshold defining an impaired stream, only the upstream station on Rockhouse Creek in the fall would indicate a potentially impaired stream section. All other streams would be considered unimpaired. This threshold is indicated by the horizontal line on Figure 4-12.

Therefore, based on the guidance from the WVDEP considering the correction for sampling error, there is no indication from these WVSCI values that most of the previously mined streams should be considered impaired.

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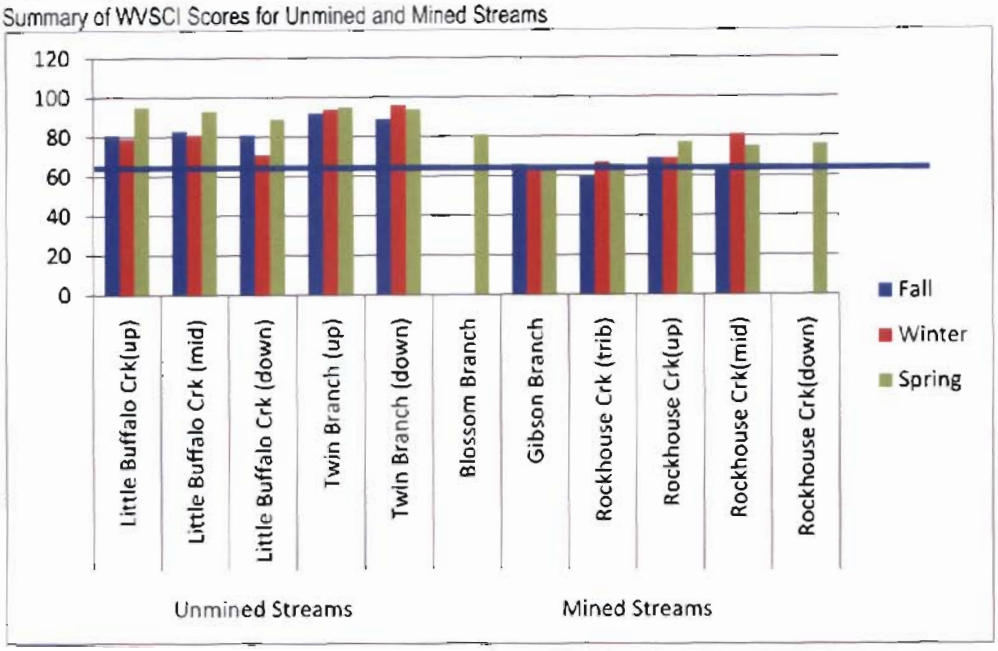
FIGURE 4-12
Summary of WVSCI Scores for Unmined and Mined Streams



As indicated by these data, and using the conservative threshold of a WVSCI of 68, the unmined streams are all considered unimpaired whereas Gibson Branch, the tributary to Rockhouse Creek, and the fall sample event results for the mid-stream station for Rockhouse Creek are below that threshold.

Toxicity is an obvious potential factor that could cause the reduction of one or more species or groups of species in the water bodies investigated. Whole effluent toxicity (WET) testing for previously mined streams in the region that include high EC levels was conducted as part of the Dal-Tex stream surveys. As the results in Table 4-1 show, there was no toxicity found to *Ceriodaphnia dubia*, a species of high sensitivity to toxins, and recommended by the USEPA for both acute and chronic assessment of biological toxicity in water. Therefore, these data indicate that there is no basis for considering these waters as harmful to aquatic life based on toxicity.

4.1.2 Conclusions Regarding Benthic Invertebrates as Indicators of Water Quality

It is important to consider the benthic invertebrate community as a whole when drawing conclusions as to the role these organisms play in the ecosystem or in assessing water quality. The assumption that the replacement of one species by another in the community is an indication of an impact associated with an increase in ionic concentration or that this replacement has a significant impact on the other biological functions that are integral to a

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TABLE 4-1
Toxicity Testing Results for Mined Streams (Rockhouse Creek, Gibson Branch, and Blossom Branch) and Unmined Streams (Little Buffalo Creek) in the Spruce No. 1 Mine Study Area

Species	Sample ID	NOEC (%)	LOEC (%)	IC_{25} (%)
C. dubia	Rockhouse Creek-Lower Mid	100	>100	>100
C. dubia	Rockhouse Creek-Lower New Location	100	>100	>100
C. dubia	Gibson Branch	100 [a]	6.25 [a]	1.51
C. dubia	Blossom Branch	100	>100 [b]	>100
C. dubia	Little Buffalo Creek Upstream	100 [a]	>100 [a]	>100
C. dubia	Little Buffalo Creek Downstream	100 [a]	>100 [a]	>100

[a] = PMSD for test above recommended maximum, suggests potentially insensitive NOEC/LOEC values

[b] = The 12 5% Blossom Branch test concentration did show a statistically significant reduction in reproduction. However, this result was determined to be anomalous.

healthy stream is not based on sound science under controlled conditions nor is it borne out by results of studies conducted in the Spruce No. 1 study area. In fact, the literature and these Dal-Tex studies have shown that:

- A balanced aquatic community is composed of a diverse assemblage of benthic macroinvertebrate populations that form a food web and naturally occurring events, such as droughts, floods, and predator-prey interactions may cause changes in these populations similar to the ones observed in previously mined streams. But within the food web, these changes do not result in losses in the functions of the community as a whole.
- The reduction in numbers of one or more species in previously mined streams is replaced by other species that are preadapted to these conditions and provide an abundant source of food for other invertebrates and vertebrates that depend on these species.
- The trophic feeding groups that are found in previously mined streams are very similar to those in unmined or reference streams and the functions of these trophic levels are maintained even if there are some species that are replaced by others in the food web.
- Habitat appears to be a much more obvious factor influencing the structure of the community and where streams that have been previously mined are allowed to return to more natural conditions with diverse instream and riparian habitat features, the species diversity and distribution of species within the streams mimic very closely those of unmined streams.
- Applying several metrics to the community in previously mined streams, as compared with unmined streams indicates that these previously mined streams, especially where the habitat has been restored to pre-mining conditions, meet the criteria as unimpaired streams with WVSCI scores and EPT percentages similar to what is found for unmined streams.
- Using wood and leaf material as a measure of stream functions demonstrates that these functions are maintained in previously mined streams at approximately the same rates as for unmined streams and the distribution of species that degrade these materials (shredders

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and scrapers) are distributed in approximately the same numbers in previously mined streams as is found in unmined streams.

4.2 Salamanders

The southern Appalachian Mountains region, extending from West Virginia to Georgia, is a center of amphibian species diversity and endemism, particularly at higher elevations, where salamander species in the family Plethodontidae and genus *Plethodon* are especially diverse (Dodd, 1997). Other centers of amphibian diversity and endemism in the southeastern U.S. include: the Atlantic and Gulf of Mexico coastal plains (many salamanders and frogs); the Interior Highlands, including the Boston, Ouachita, and Ozark mountains (many endemic salamanders); and the Edwards Plateau of Texas (many endemic cave and spring salamanders) (Dodd, 1997). West Virginia has 34 species of salamanders (Pauley, 2004).

Salamanders are restricted to aquatic and semi-aquatic habitats such as rivers, creeks, springs, wetlands, and moist forested hillsides. In its RD (p. 59), USEPA maintains that stream salamanders are not expected to return to the Spruce No. 1 Mine site due to the burial of existing habitat and the inadequacy of proposed mitigation to replace the habitat required by these species. USEPA has stated that salamanders will be eradicated under the project and that a key component of the aquatic food web will be lost from the aquatic ecosystems within Pigeonroost Branch and Oldhouse Branch.

Surveys of streamside salamanders conducted in valley fill and reference streams in southern West Virginia indicate that salamander populations may persist in the downstream reaches of Pigeonroost Branch and Oldhouse Branch, with their diversity and abundance dependent in part on the availability of suitable rocky substrates (Williams, 2003; Williams and Wood, 2004). Williams (2003) sampled salamanders in 2001 to characterize the species composition and relative abundance of salamanders in streams below valley fills compared to reference streams not impacted by mining activities. The valley fill sites included Rockhouse Creek in the nearby Dal-Tex Complex, and the reference sites included Pigeonroost Branch in the Spruce No. 1 Mine project area. Although salamander abundance was significantly greater in the reference streams as a group than in the valley fill streams as a group, species richness was similar (7 salamander species in valley fill sites, 8 species in reference stream sites). Rockhouse Creek yielded a mean of 67.50 salamanders per 35-m stream segment, the highest salamander density in the study, compared to a density of 43.00 salamanders per 35-m segment in Pigeonroost Branch. The two segments surveyed in Rockhouse Creek had high abundance of rocks, which provide favorable physical habitat conditions for salamanders where fine sediment has not filled the interstitial spaces (Williams, 2003; Williams and Wood, 2004).

Thus, although USEPA believes that salamanders would likely be lost from the aquatic ecosystem within Pigeonroost Branch and Oldhouse Branch, survey findings downstream of valley fills in nearby Rockhouse Creek (Dal-Tex Complex) indicate that salamander populations may persist in downstream reaches where suitable physical habitat has been preserved.

4.3 Fish

USEPA states that the fish assemblages in Spruce Fork are in relatively good condition, and that the occurrence of relatively few species of fish in the small tributaries of Pigeonroost Branch and Oldhouse Branch is typical of small streams in the Coal River Basin. USEPA's assertion of

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unacceptable adverse impacts to fish relies almost entirely on the threat of golden algae kills and increases in selenium concentrations. The golden algae threat is highly speculative, with no technical analysis related to the Spruce Mine No. 1 site provided as the basis for the USEPA concern. Although USEPA establishes that selenium concentrations would be expected to increase downstream from the Spruce No. 1 Mine, it has not clearly presented data showing that concentrations in Spruce Fork downstream of the Spruce No. 1 Mine would be expected to exceed the numeric criterion for selenium. Further, USEPA presents no substantial evidence of adverse impacts of selenium to fish assemblages in tributary streams draining the Dal-Tex complex. Finally, as demonstrated above, the site-specific data show no cause for concern with respect to selenium concentrations in stream reaches that currently harbor fish populations.

USEPA states in the RD (p. 63) that some studies have shown that mountaintop mining for coal and construction of valley fills has had some harmful effect on the composition of stream fish communities. As evaluated in Mingo Logan's response to USEPA's Proposed Determination (CH2M HILL, 2010), the evidence for effects of valley fills (VFs) on downstream fish communities in the cited studies was limited to third-order and smaller streams. Thus, downstream effects of VFs in the Spruce Mine area would likely be limited to Oldhouse Branch, Pigeonroost Branch, and Seng Camp Creek, which are first- and second-order streams.

However, these streams naturally support few fish populations, and the fish that occur there are mostly habitat-generalist species with populations downstream in Spruce Fork. Consequently, the reduction of fish in these streams would have only minor impacts if any on downstream fish populations. Higher order streams such as Spruce Fork, although downstream from numerous VFs in tributary streams (and downstream of residences), had relatively high IBI scores comparing favorably with unmined and reference conditions, indicating no evidence of the effects of VFs.

In conclusion, USEPA has not provided any substantial information or data regarding IBI scores, threats from golden algae, selenium concentrations, or otherwise which demonstrate that unacceptable adverse impacts to fish would occur in streams downstream of Spruce Mine.

4.3.1 Golden Algae

This section discusses the possibility of a bloom of the toxic alga *Pyrmnesium parvum* in Pigeonroost and Oldhouse Branches as related to future project operations. Excessive growth of this species has been shown to cause fish kills. The primary stated USEPA concerns are the creation of favorable conditions for the alga in relation to potential future increases in EC and the construction of sedimentation ponds. However, the stated USEPA concerns are entirely speculative and are based solely on the toxic bloom that occurred in 2009 in Dunkard Creek, more than 200 miles from the Spruce No. 1 Mine site, in an area of markedly different water chemistry and stream conditions

It is critical to understand the differences between the areas and the rarity of these algal blooms. The 2009 incident in Dunkard Creek was the only documented bloom of this toxic alga associated with a pond and creek downstream from a mine site. No such algal bloom has occurred at Dunkard Creek in 2010, nor had one been documented there prior to 2009. It is apparent that these blooms are rare in both time and space.

The 2009 algal bloom in Dunkard Creek was associated with a warm pond that fed into the creek during conditions of elevated chloride, sulfate, and EC. Dunkard Creek data indicated

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chloride of up to 6,000 mg/L, sulfate of 10,800 mg/L, and an EC of over 25,000 µS/cm in the area of the bloom (Reynolds, 2009). The Spruce No. 1 Mine sites are associated with much smaller intermittent headwater streams that are not comparable to the larger permanent Dunkard Creek. Future mine site activities at the Spruce No. 1 Mine are expected to produce EC values near 619 uS/cm (Section 3.3, above). More importantly, Dunkard Creek is a chloride-dominated system, unlike the Spruce No. 1 Mine drainages. For example, recently collected water quality data from the outlet pond at the left fork of Beech Creek showed a chloride concentration of 15 mg/L, at least a 1000-fold less than in Dunkard Creek during the golden algae bloom. In addition, widespread testing following the 2009 Dunkard Creek bloom failed to find any *Pyrmnesium* in Spruce Fork (WVDEP testing in 2009, unpub. data).

USEPA states that the fish assemblages in Spruce Fork are in relatively good condition, and relatively few species of fish occur in the small tributaries of Pigeonroost Branch and Oldhouse Branch. USEPA's assertion of unacceptable adverse impacts to fish relies almost entirely on the threat of golden algae kills and increases in selenium concentrations. As noted above, the golden algae threat is highly speculative, with no technical analysis related to the Spruce Mine No. 1 site provided as the basis for the USEPA concern. Although USEPA contends that selenium concentrations would be expected to increase downstream from the Spruce No. 1 Mine, it has not presented data showing that concentrations in Spruce Fork downstream of the Spruce No. 1 Mine would exceed the numeric criterion for selenium. Existing data indicate that this is unlikely. Further, USEPA presents no evidence of adverse impacts of selenium to fish assemblages in tributary streams draining the Dal-Tex complex. Finally, as demonstrated above, the site-specific data show no cause for concern with respect to selenium concentrations in stream reaches that currently harbor fish populations.

4.4 Water-dependent Birds

USEPA has expressed concern that the reduction of headwater streams in the project area would negatively affect water-dependent birds, specifically the Louisiana waterthrush. The waterthrush is not a federally-listed threatened or endangered species. In fact, although the Louisiana waterthrush has been designated a bird of conservation concern (BCC) by the USFWS, no state-listed or federally-listed threatened or endangered bird species (or candidate species) has been identified in or near the project area and no impacts to any such species are expected.

Impacts to water-dependent bird species would occur primarily from displacement of suitable habitat. This type of impact is widespread in the region due to a variety of land development activities and is not an impact unique to the proposed mining activities. Despite these widespread impacts, the waterthrush's population appears to be stable. An evaluation of BCC data for West Virginia shows no significant change in the population of the waterthrush between 1980 and 2007 (U.S. Geological Survey [USGS], 2010).

The waterthrush is not likely to be affected by the reduction of riparian habitat associated with the project. The bird prefers mature deciduous or mixed forests with moderate to sparse undergrowth near rapid-flowing streams with clear water (Cornell University, 2010). The proposed project area contains young to middle-aged forests with relatively few mature trees. Without suitable habitat, the bird is less likely to nest or roost at the project site.

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The waterthrush is not likely to be affected by land use changes away from riparian areas at the project site. A recent study found no association between the amount and proximity of surrounding urban land uses and Louisiana waterthrush reproduction. The specialized attributes of streamside habitat and dependence on that habitat make the species less susceptible to land use changes outside of the riparian zone (Mattsson and Cooper, 2009).

Changes in stream habitats downstream during mining and on-site following reclamation are not likely to significantly affect potential foraging areas used by the waterthrush. The bird's diet is varied and is not composed solely of the more sensitive invertebrates (EPT) more common to headwater streams (Cornell University, 2010).

Two recent studies reached similar conclusions about the composition of the waterthrush diet.

Mattson and Cooper (2006), compared the assemblage of benthic macroinvertebrate communities against both stream habitat quality and waterthrush abundance. The presence of the Louisiana waterthrush was positively associated with total macroinvertebrate biomass. The relative abundance of all macroinvertebrate taxa was more important than EPT species richness. In addition to overall abundance of invertebrates, occupancy of waterthrush pairs was found to be positively related to the percent of EPT present. Thus, the bird responds positively to both an increase in the total amount of macroinvertebrates in a stream and a numerical shift in the macroinvertebrate community toward its preferred prey, which coincidentally includes EPT taxa. However, as indicated by Mattson and Cooper (2006), it is unlikely that the species selects streams solely because they contain greater EPT richness.

Mulvihill et al., (2008) examined waterthrush breeding density along acidified and neutral pH streams. Although breeding density was found to be reduced on streams acidified by mine drainage, no difference was found in reproductive success, nest survival, and fecundity between pairs nesting on acidified streams and neutral streams. Breeding birds in acidified stream drainages compensate for reduced prey resources by increasing territory size, foraging in peripheral non-acidified areas, and provisioning young with non-preferred prey. This suggests that the amount of forage available is more important for breeding success than the specific composition of that forage.

Rainfall within the breeding season is a dominant driver of reproduction by riparian-obligate song birds. Survival of young birds during the nesting period is highest during periods of moderate rainfall and is negatively affected by both drought and periods of severe rainfall. Foraging success is negatively affected by a decrease in food supply during droughts. Increased turbidity following severe storms also negatively affects foraging efficiency (Mattsson and Cooper, 2009). This suggests that runoff mitigation measures implemented during and following mining operations may benefit the downstream riparian-obligate bird population. Ponds constructed to control run-off would attenuate flows – maintaining flows during drought conditions and reducing downstream turbidity during severe storm events.

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5.0 Mitigation

5.1 Stream Restoration

USEPA refers to the Stream Habitat Unit (SHU) assessment methodology, but this approach was used only in the draft EIS and dropped from the final CMP in the final EIS. Part of the USEPA reasoning is that very few or no headwater streams have been restored though a phase of monitoring where they can demonstrate success. However, there are restored streams that have met, and continue to meet, the mitigation goals set. Many stream mitigation banks, for example, are based on the successful use of stream restoration designs to achieve an acceptable level of mitigation.

The following are examples of stream mitigation banks that have been approved by USEPA III for credits or are currently planned in West Virginia:

- Davis Branch Stream Mitigation Bank in Raleigh County. This bank consists of approximately 4 miles of stream and used the USEPA RBP method to calculate credits along with the Corps' Interim Assessment Approach for High Gradient Streams (IFAA). Data collection for this mitigation bank will include WVSCI scores to demonstrate success.
- Mud Ruin Stream Mitigation Bank in Jackson County. This bank includes about 3.3 square miles of forested watershed and about 1.5 miles of stream, some of which is ephemeral. Benthic invertebrate assessments and Rosgen methods are being used to evaluate the stream's characteristics and set the design needs for restoration to include flood attenuation, reduction of sediments, and improved aquatic and terrestrial habitats.
- Tygart Valley Wetland and Stream Mitigation Bank in Randolph County. This is a small stream of about ½ mile in length that will use bioengineering to strengthen the stream beds and enhance stream channels as well as enhance habitats and boost riparian vegetation.

The following examples are from the Stream Banking section of the National Mitigation Banking Association:

- Northern Virginia Stream Restoration bank near Reston, VA. There have been 6.4 miles restored to date using natural channel design techniques and planting of native riparian vegetation.
- Forest Creek Stream Mitigation Bank in Orange County, NC. This bank consists of an approximately 2 mile section of restored and preserved stream with functions restored to include nutrient removal, sediment retention, and aquatic and terrestrial habitat.
- Upper Clark Fork Stream Mitigation Bank near Ovando, MT. This was a degraded stream referred to as biologically dead before restoration. Restoration has improved water quality, recovered the salmonid population, and decreased water temperature by 17 degrees C. The length of stream restored is approximately 4 miles.

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- Black Bayou Mitigation Bank in Catahoula Parish, LA. This bank includes 3.7 miles of restored stream riparian buffer to reduce sedimentation, reduce temperature, and restore native habitat.

In addition, a recent successful stream restoration project, East Jesters Creek, has been completed as part of a mitigation bank that illustrates the uplift that can be gained by such a project and the effectiveness of this restoration in increasing the EPT index for this water body. East Jesters Creek is located in Clayton County, Georgia. At this site, approximately 4,000 feet of East Jesters Creek was restored between 2003 and 2004 using the Rosgen's natural channel design techniques. Prior to this date, the diversity of the benthic macroinvertebrates was depressed with about 19 species in one study area and 22 species in another study area with an Ephemeroptera, Plecoptera, and Trichoptera (EPT) index of about 2. In 2007, after restoration, the macroinvertebrate community showed a marked improvement, with 33 species in one study area and 36 species in another section of East Jesters Creek. The corresponding EPT indices had risen to 9 in one section and 8 in another part of the creek. This reflects a substantial improvement of the habitat and the benthic community.

In light of these examples from West Virginia and throughout the country, USEPA's pessimism about the efficacy of restoration and enhancement for offsite streams is unfounded. The USEPA's complaints about the lack of a functional assessment methodology are belied by these mitigation banks, which have been approved by Interagency Review Teams including USEPA, because the methods utilized at these approved stream banks to determine credits and assess success (e.g., RBP, WVSCI, Rosgen methods) are among the many performance standards imposed on this permit.

5.2 Stream Classification

In its RD, USEPA claims a "severe misclassification" of streams within the site and applies a methodology solely based on stream base flow to estimate lengths of intermittent and perennial stream channels. This methodology, as described in Paybins, 2003, differs from that presented in the West Virginia Water Quality Standard applicable in 1999. The consultant responsible for determination of stream classifications followed the WVDEP protocol of the time, with the support of USACE.

The Paybins study, conducted in 2000 and 2001 in the southern portion of West Virginia and published in 2003, defines a perennial channel as continuously flowing with base flow derived from ground water alone. Also defined, an intermittent channel flows only at certain times of the year, indicated by a seasonal lowering of the ground water table. The perennial point, or the transition from intermittent to perennial channel, is where the ground water table intersects the stream channel. The study did not consider ephemeral channels. These definitions are solely based on hydrology and are not inclusive of other stream characteristics such as geomorphology and the ability to support aquatic biota.

USEPA applied the Paybin (2003) study's median drainage area for perennial streams of 40.8 acres in its analysis. However the author acknowledges the inherent variability in the local watersheds of southern West Virginia, stating that results "suggest perennial flow in a stream is controlled by very local climatic and drainage basin conditions at a first-order stream scale. However, the local conditions for small headwater basins are extremely variable, and relations

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of these conditions to intermittent and perennial points could not be defined with this limited study."

Strong correlations were found between rock types and median basin slope that influence the size of the drainage area. For example, streams with watersheds containing a percentage of shale did not exhibit perennial stream flow, as it is likely the shale limited the connection to the ground water table in comparison to characteristics of more porous sandstone also common in the area.

This study was conducted over a limited period of time, two years, and with inherent error given the data collection and analysis techniques. While appropriate sampling times were planned (October to measure low flow for determination of perennial stream start points and late winter for intermittent stream start points), the plan was executed with different field teams and different equipment. The use of different field teams implies that different applications of best professional judgment could influence data. Another factor, watershed size, was calculated using the National Elevation Dataset (NED), which has a 30-meter horizontal accuracy. The effects of this lack of precision in the NED is inflated when applied to small watersheds. When dealing with such small watersheds, the author acknowledges that error may have been introduced for some data points, such as these where intermittent locations were mapped approximately.

In addition, the methodology used to calculate the median perennial watershed size can be questioned. Some sampled streams with no flow were adjacent to similarly sized drainage areas with perennial flow; however, the fact that the same drainage area could produce adjacent streams with perennial flow and no flow indicates that drainage area is not the determining factor of a stream's flow regime in southern West Virginia. Moreover, in some cases, perennial points were determined for a stream in one year but not both. These data points, at 7 sites, were carried forward in the perennial data set analysis even though these streams do not meet the definition of "continuously flowing" channels. The inclusion of these streams also disproportionately influences conclusions related to smaller watersheds.

The author acknowledged the differences between the two years of sampling. Evidence includes the influence of localized rainfall events on the data set, as the watershed size calculated in 2000 (a wetter year) was greater than the watershed calculated using the 2001 data set (a drier year). This difference, a median of 18.0 acres, is almost 50 percent of the overall median size of 40.8 acres, which is quite significant. This median variability of almost 50 percent between the two years of data indicates that this limited data set is not robust enough to be used in predictive analysis, such as how USEPA is applying it.

Hydrologic conditions are quite variable over time, and with only two years of data collected and inconsistent methodology applications, this study does shed light on the inherent variability of first-order watersheds. However, it does not justify a definition of perennial or intermittent streams based on the drainage area acreages utilized by USEPA.

Geological conditions and localized precipitation may be the largest contributing factors to the determination of intermittent and perennial watershed sizes. However, as acknowledged by the author, the local conditions for small headwater basins are quite variable and relations of those conditions to intermittent and perennial points could not be determined with this limited

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study. Thus, the USEPA application of median watershed sizes as the basis to determine stream classifications for the streams at the Spruce No. 1 site is not appropriate.

5.3 Use of Erosion Control Ditches as Mitigation

USEPA contends that erosion control ditches can never be used as part of an overall mitigation plan and cites three studies for the proposition that benthic assemblages in such ditches would be severely impaired. These three studies, however, do not establish that such ditches cannot serve as an effective part of an overall stream mitigation plan. The paper by Kirk (1999) is primarily focused on sediment ponds, but does include some small ditches as part of the evaluation. The conclusion, however, unlike what is suggested by the USEPA, summarizes that: "If constructed properly, these sediment control ponds and sediment ditches can do a splendid job in removing solids and other water contaminants both by filtration and by precipitation prior to reaching downstream areas. They also provide aquatic habitats for countless abundances of aquatic insects, amphibians, reptiles, and potentially even fish. Once mining has ceased in the immediate area, these sedimentation ponds could easily be converted into an aesthetic, attractive, and usable wildlife features with only a few modifications."

The paper by Green et al., (2000) has a primary focus on streams in the mountaintop mining area, but did include as an objective the evaluation of sediment control ditches in the area. They could only find one such ditch in the area that had flowing water, due in part to the drought conditions that were prevalent at the time of their surveys. These conditions also may have accounted for the low dissolved oxygen that was reported for this site. The ditch they surveyed also had not really been carried forward to any substantive level of restoration noting that the site "was more degraded than any site sampled in the study" and thus this one unrestored site examined under drought conditions is not representative of the sediment ditches that would conform to the requirements of the Spruce No. 1 Mine permit.

The Gingerich paper (2009) is actually a thesis that was not publicly available, but a review of the abstract noted that: "Species richness of macroinvertebrates and amphibians remains comparable between mined and reference channels. However, there is a distinct shift from sensitive, lotic taxa to tolerant, lentic taxa." This supports our findings that diversity in such mined channels is high and the shift in species, while evident, would still support a balanced aquatic community.

Thus, contrary to the USEPA's conclusion, one of the studies evaluated a single erosion ditch under conditions that are not representative of mitigation requirements applicable to the Spruce No. 1 Mine. The other two studies actually support the view that erosion control ditches can provide effective water quality and habitat functions and result in taxa diversity, all of which support a balanced aquatic community.

5.4 Mitigation Opportunity in Rockhouse Creek

Rockhouse Creek and others of similar size and condition would appear to offer substantial opportunity for habitat value uplift through applied stream design and construction similar to what is applied for streams that are developed for stream mitigation banks. Commonly used

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stream monitoring metrics that have been applied to these banks, which include in most cases engagement of the USEPA as a member of the Interagency Review Team that approves their construction, include:

- Physical Standards, to include channel design, pattern, profile, and stability
- Geomorphic Variables, to include Rosgen Stream designation and parameters (bankfull width, cross sectional area, entrenchment ratio, etc.)
- Biological Metrics, to include riparian vegetation success criteria, Index of Biotic Integrity, Macroinvertebrate Site Index.

Successful restoration projects that have been used as mitigation banks, once stabilized, provide the hydrology necessary to allow current engineering and environmental planning technologies to be applied for restoration to functional, biologically diverse perennial streams. The features of Rockhouse Creek and Gibson Branch as illustrated in Figures A and B of the previous section, appear to offer the conditions needed to complete a successful restoration and gain the uplift required to restore these streams to the pre-mined aquatic biological functions.

Similar restoration of streams that have been degraded through prior mining activities has been successfully accomplished. This includes site in the western U.S. that include acid mine drainage and far greater disturbance than is anticipated with the streams associated with the proposed Spruce No. 1 Mine or other similar projects in the region. The knowledge and technology for stream restoration has advanced considerably and there are multiple locations around the US where stream restorations similar to the ones required by the permit have been successful. One of these, the Yankee-Vukonich Reclamation Project in New Mexico, was acclaimed in a state award for having "restored the functioning of a stream system and improved water quality."

In response to the concern by the USEPA that connectivity channels have the potential to produce excess flows and downcutting in connectivity channels, Rosgen has developed, tested, implemented, and monitored numerous stream restoration projects for nearly four decades using a "Natural Channel Design" (NCD) that has been shown to successfully manage these conditions for streams and channels similar to the connectivity channels proposed or the Spruce No. 1 Mine (Rosgen 2006). Therefore, with appropriate planning and design, there should be no reason that channel morphology and stream flows cannot be managed to avoid downcutting for these channels.

5.5 Functional Assessment

The Rapid Bioassessment Protocol (RBP) has been used consistently as a metric for assessing stream functions and has been a framework used by the USEPA for many years to assess stream health and provide comparisons between impaired and reference streams. The fact that USEPA has applied RBP as a criterion for stream mitigation banks to meet the goals for successful stream restoration is further indication of the value and benefits it sees in applying this methodology.

The Fritz study cited by USEPA (2010) appears to be focused on trying to apply "rapidly" obtainable metrics to stream functions. The paper attempts to use leaf breakdown, primarily, as a surrogate for healthy stream function. As the paper notes, there are a number of variables that

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affect leaf breakdown, including physical features such as stream flow, as well as the presence within the benthic community of species that shred or otherwise break down these materials. However, the paper is in error in making a broad assertion that because there is no apparent relationship between leaf breakdown and RBP, the RBP values are inadequate for assessing stream functions.

It is clear that the RBP provides a more robust measure of the functional attributes of a stream than can be provided by the single metric of leaf breakdown. The data on leaf and stick breakdown from the ongoing CH2M HILL benthic study indicate that a single species can have substantial impact on leaf breakdown even though one species is not likely to be a primary driver for all the other functions that a healthy stream provides. Thus, the Fritz paper focuses narrowly on a single metric that can be influenced by factors that do not have a strong relationship to a biologically healthy, functioning stream. The Fritz leaf breakdown metric is not the functional assessment methodology the USEPA should be using. Its narrow, single metric focus is not nearly as indicative of stream functions as the multi-factor RBP or the suite of other performance standards imposed in the Spruce No. 1 Mine permit.

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ENVIRONMENTAL PROTECTION AGENCY

Comments in Response and in Opposition to the Recommended Determination of the U.S. Environmental Protection Agency Region III Pursuant to Section 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia

APPENDIX B:
Supplemental Materials Relevant to the Recommended Determination

Volume 1 of 2

Mingo Logan Coal Company, Inc.

November 29, 2010

APPENDIX B

SUPPLEMENTAL MATERIALS RELEVANT TO THE RECOMMENDED DETERMINATION

1. **Memo Re: Review of Relevant Sections of EPA MTM Report**, Prepared by GEI Consultants for Karen Bennett, NMA (July 7, 2010).

    - Preliminary report on EPA's definition and focus on headwaters. Suggests that EPA's definition of headwaters is internally inconsistent and fundamentally flawed, that most valley fills will actually occur above EPA's definition of headwaters, that EPA does not show how headwaters are uniquely important, and that EPA fails to demonstrate a causal relationship between loss of headwaters and water quality.

2. **A White Paper: Comments on "A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams,"** prepared by Norwest Corporation for NMA (July 12, 2010).

    - Discusses errors in EPA's methodology for deriving the conductivity benchmark, and concludes that EPA has failed to demonstrate that there is a causal relationship between conductivity and abundance of specified genera.

3. **NMA Comments Re: "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields" and "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (Sept. 3, 2010).

    - Criticizes the use of conductivity as benchmark, the application of this benchmark to NPDES permits, EPA methodology generally, and EPA's attempt to enforce the conductivity criteria under the CWA.

4. **NMA Comments Re: "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields"** (Sept. 3, 2010).

    - Separate comment criticizing EPA's estimate of headwater stream loss, arguing that EPA lacks legal authority to implement its conclusions and is attempting to rewrite the PEIS, and finding specific fault with sections on selenium and mitigation.

5. **UWAG Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (Sept. 3, 2010).

    - Criticizes both the legal authority of EPA to use the conductivity benchmark and the scientific bases for the conclusion that conductivity is causally related to impairment

6. **Technical Memorandum Re: Proposed Conductivity Benchmark,** Prepared by Aaron Redman, HydroQual for William Adams, Rio Tinto (Aug. 30, 2010).

   - Concludes that the technical basis for the benchmark is weak and faulty in places, and that it must be expanded to include waters that are naturally high in conductivity.

7. **Federal Water Quality Coalition Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (Sept. 3, 2010).

   - Criticizes both the legal authority of EPA to use the conductivity benchmark and the scientific bases for the conclusion that conductivity is causally related to impairment.

8. **NCASI Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (July 9, 2010).

   - Questions several methods and conclusions used by EPA to reach its proposed benchmark.

9. Research Environmental & Industrial Consultants, Inc. **Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams," Prepared for WV Coal Assoc.** (Apr. 7, 2010).

   - Questions several methods and conclusions used by EPA to reach its proposed benchmark.

10. **WVDEP Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams" and "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields"** (July 13, 2010).

    - Takes issue with EPA's characterization of what the benchmark is and how it should be used, why EPA focused on particular genera and regions, and suggests some technical errors.

11. **The Appalachian Wildlife Foundation, Inc. Comments Re: "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields"** (June 9, 2010).

    - Criticizes EPA's characterization of reclamation practices, as well as EPA's conclusions regarding the benefits of reclaimed land to wildlife.

12. **Joint Coal Industry Comments on the Mountaintop Mining/Valley Fill Draft Environmental Impact Statement (PEIS) (Jan. 6, 2004)** (submitted Sept. 8, 2010).

    - Comments submitted in 2004 in response to the MTM DEIS - discusses a number of parallel issues (submitted by NMA in response to the Benchmark report).

13. **Status of the Industry Understanding of the Effects of Mountaintop Mining and Valley Fills on Aquatic Resources**, Prepared by Potesta & Associates, Inc. (May 2006) (submitted Sept. 8, 2010).

    - Report prepared for Jackson Kelly in 2006, in response to criticism from OVEC (submitted by NMA in response to the Benchmark report).

14. **Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards**, WVDEP (Aug. 12, 2010).

Geotechnical
Environmental
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GEI Consultants

Memo

To: Karen Bennett, NMA

From: Steve Canton, Grant De Jong, and Carrie Claytor

Date: July 7, 2010

Re: Review of Relevant Sections of EPA MTM Report

As requested, GEI has reviewed the EPA report on effects of mountaintop mining and valley-fill techniques. Specifically, we are providing our evaluation of key portions relevant to their conclusions on ecological effects.

1.0 Introductory Review and Description of Document

The EPA (2009) report provides their view of the state of the science on the environmental impacts of mountaintop mining and valley fills (MTM/VF) on streams in the central Appalachian coalfields, covering over 48,000 km^2 in West Virginia, Kentucky, Virginia, and Tennessee. MTM/VF techniques were briefly reviewed, and six potential consequences of MTM/VF were cited, including: loss of headwaters and forest resources, impacts on water quality, impacts from aquatic toxicity, impacts on aquatic ecosystems, cumulative impacts from multiple mining operations, and effectiveness of mining reclamation and mitigation.

The conclusions of the report suggest that MTM/VF techniques include the following environmental consequences: 1) springs, intermittent streams, and small perennial streams are permanently lost after burial under fill, 2) water quality (particularly ionic and selenium concentrations) is degraded to toxic levels and this change persists downstream, and 3) the macroinvertebrate and fish communities are consistently and significantly degraded.

EPA (2009) was written very broadly, such that the statements made are generally applicable to nearly any headwater system in the eastern United States, not just limited to the headwater streams considered to be at risk from MTM/VF operations. Where specific information on central Appalachian headwaters streams is promulgated, there is little to indicate that these streams are unique – either in terms of other streams in the eastern United States or from downstream reaches of the same streams.

2.0 Definition of Headwaters and Measure of Loss of Headwaters

There are some significant inconsistencies in how EPA summarizes impacts to headwaters, based on conflicting definitions. EPA (2009) initially defines "headwaters" as the point at which groundwater breaks through to the surface and below which surface erosional processes have formed a channel (p. 12, ll. 15-17). We believe this definition is valid and would add that for intermittent and ephemeral streams, this would also constitute that point where the water from seasonally high groundwater levels or precipitation runoff begins to flow in a defined channel. Using this definition, the surface water downgradient of that point, which is flowing in a defined channel to the confluence with another stream, is therefore the classic interpretation of a "headwater stream."

The EPA initially provides a measure of the impacts to headwaters that is linear; i.e., apparently referring to miles of stream downstream of when a defined channel is formed, with cumulative

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impacts reported in number of miles (as in the data in the third paragraph, p. 12, ll. 27ff). However, EPA then notes that there is a possibility that isolated springs, seeps, and wet areas may also occur upgradient of that point where headwaters are formed. They do not specify whether they believe this is always the case or if it is simply a possibility. Because of this possibility of isolated, upgradient springs, seeps, and wet areas, EPA (2009) subsequently replaces the linear notion of headwaters with that of a watershed area by measuring the entire catchment upgradient of the point where a defined channel is formed that was used to define "headwaters" (p. 13, ll. 3ff). Therefore, even though isolated springs, seeps, and wet areas do not exist in every valley, and even though EPA specifically defined "headwaters" as where a defined channel is formed, they believe the entire watershed area upstream of that point should be included in the estimates of "headwater loss." EPA (2009) did not cite instances where this has occurred in MTM/VF streams – they just say it could be possible.

However, since most, if not all, of the area of the watershed upgradient of the origin of flow is dry, it really cannot constitute a "headwater stream" as defined by EPA. Even if isolated upgradient wet areas exist in a given valley, the rest would be dry land. Therefore, the discussion in EPA (2009) about the area of watersheds covered by valley-fills as a surrogate for headwater stream loss is misleading.

In fact, not only is this misleading, it appears to be factually inaccurate. Paybins (2003), which was cited by EPA (2009), used 36 permitted sites in 2000 - 2001 and estimated that the median watershed area "upstream of the origin of intermittent flows" was 14.5 acres (range: 6.3 – 45.3 acres), and median watershed area "upstream of the origin of permanent flows" was 40.8 acres (range: 10.4 – 150.1 acres). Paybins (2003) also reported that the median size of a valley fill in southern West Virginia was 12.0 acres, according to WVDEP GIS data. The WVDEP GIS data also reported that VFs in West Virginia ranged in size from <1 acre to 480 acres, though it is important to remember that Paybins (2003) was a survey of only 36 sites, and the referenced watershed area upstream of the 480-acre VF may not have been included in that study. The median values discussed above would suggest that valley fills are located upstream of the point at which intermittent flows originate, and few, if any, defined stream channels below the point of origin defined by EPA as the "headwaters" are actually being "buried" under waste rock.

Other data sources discussed in EPA (2009) suggest the contrary. In particular, Table 1 in EPA (2009) said that the average size of the watershed above the approved valley fill toe was 71 acres, ranging up to 3,774 acres. However, again, key information is missing. Specifically, the watershed area upstream of the point of intermittent flow was not reported in EPA (2009), so it really does not "suggest that intermittent and perennial streams are being buried by valley fills," as claimed in EPA (2009 - p. 13, ll. 13-14).

3.0 Biodiversity of Central and Southern Appalachian Headwaters

EPA (2009) stated that the Central and Southern Appalachians are a biodiversity hotspot, as identified by NatureServe and Figure 8 in EPA (2009). However, most of the coal-mining region of southern West Virginia is not located within that hotspot area. This demonstrates that much of the discussion on "biodiversity loss" is irrelevant to streams with MTM/VF operations in West Virginia.

In Section 3.2, Loss of Headwater Ecosystem Biota, EPA (2009) further indicated that the loss of headwater biota on regional biodiversity would be expected to be most severe for taxa that occur only in headwater ecosystems. There are two issues here. First – as noted above, EPA's own calculations indicate that valley fills are, in fact, not burying headwater streams, but rather are located upgradient of the point where headwater streams are formed. Second, EPA (2009) failed to identify any specific invertebrate taxa that are *restricted* to such headwater habitats. Instead, even EPA's analysis shows that many invertebrate taxa are found in both intermittent and perennial streams, as described in EPA (2009) – p. 14, ll. 5-6, 12, 14-15. This indicates that there is very little difference

between the communities of intermittent streams and perennial streams in these systems, and the biotic communities found in intermittent streams are not unique in nature. As such, neither EPA (2009), nor the other papers cited therein can identify a unique assemblage in the headwaters of these streams. Rather, it appears they only assume that these headwater streams provide a sink population for the benthic invertebrates. What is not recognized in EPA (2009) is that these headwaters stream systems may actually serve only as a "facultative" or "opportunistic" habitat for these invertebrates and are not critical for their life histories in any way. Furthermore, the hyporheic zone of streams in West Virginia, suggested to be a sink or refuge for invertebrates by EPA, apparently does not harbor a unique invertebrate assemblage (Angradi et al. 2001).

Finally, it was noted by EPA that other organisms also utilize headwater streams, including diatoms, fungi, salamanders, and fish. For example, it was noted that 30 species of diatoms and 40 species of beneficial fungi were reported from two Appalachian headwater streams, but the report did not indicate if those taxa were restricted to those headwaters to identify the uniqueness of that habitat. Furthermore, one paragraph (p. 16, ll. 14ff) discussed the role of headwater streams as critical habitat for brook trout, even though many of the valleys subjected to MTM/VF in West Virginia are probably fishless due to small size, limited depths, and possibly intermittent flows. Although fish were observed in lower reaches, we did not observe any fish in the headwaters at the origin of surface flow in our own studies. These results also do not identify any unique attributes of the aquatic biological communities of the headwater streams in West Virginia.

4.0 Water Quality

Similar to the section on headwaters, the statements made by EPA on water quality issues are generally applicable to nearly any headwater system in the eastern United States and are not just limited to the headwaters streams considered to be at risk from MTM/VF operations.

Section 4, Impacts on Water Quality, summarizes results from a variety of studies that have evaluated differences in water quality downstream of MTM/VF. The impacts discussed include: alteration of flow, changes in sedimentation, changes in chemical transport and basic water quality parameters, and changes in sediment chemistry. Results and corresponding original studies are generally presented in the context of mined versus unmined areas. This section does not attempt to correlate reported changes in water quality with effects on biota or aquatic ecosystems. Rather, results were generally reported in a factual, straightforward way as they would be in the results section of a scientific paper. Results are presented for findings implicating both negative and positive effects of MTM/VF on water quality, as were results where no significant differences between mined and unmined areas were observed.

In addition to the water quality impacts addressed individually in this section, a discussion of "cumulative impacts" is also included. However, as it relates to the concepts discussed herein, "cumulative impacts" is somewhat a misnomer. One of the main points asserted is that conductivity is often elevated in MTM/VF streams and since conductivity, by definition, is a parameter that integrates the concentrations of many ions into one metric, this is a cumulative impact. Similarly, the "cumulative impact" of depressed iron, manganese, and aluminum concentrations in MTM/VF streams as a consequence of elevated pH (from increased sources of alkaline waters) is discussed in this section. This trend appears to be more of a water chemistry association rather than a cumulative impact. As cumulative impacts were discussed in each of the other sections of the report, it seems a similar evaluation was included in the water quality section only for the sake of convention, especially considering all of the concepts discussed therein were previously mentioned in the 4.3.1 subsection: Changes in chemical transport and basic water quality parameters - pH, matrix ions, metals.

To fully evaluate this section, each of the referenced studies would need to be obtained and critiqued for contextual relevance and technical merit. Such an evaluation was beyond the scope and timing of this work; however some of the topics discussed in this section are also explored in detail in the

conductivity benchmark report in preparation (e.g., our ion toxicity section talks about ion chemistry). Moreover, the water quality data collected by GEI in the spring of 2010 will be used to fully evaluate the concepts discussed in this section. Similarly, these data will also be useful in testing the hypotheses concerning headwater streams discussed above.

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Comments on "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams" EPA/600/R-10/023A

A White Paper

Submitted to:
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1 EXECUTIVE SUMMARY

In March, 2010, the Environmental Protection Agency (EPA) released a report that attempted to derive an aquatic life benchmark for conductivity that would apply to neutral to mildly alkaline waters in the Appalachian Region that are dominated by salts of sulfate and bicarbonate. The report, titled "Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams" is being utilized by EPA as the basis for establishing a water quality benchmark for conductivity that would protect the aquatic life. The study and the calculated benchmark specifically targets coal mining activities in the region. At the request of the National Mining Association, Norwest has prepared this White Paper, which provides an analysis of the scientific basis for the statistical approach used by EPA to develop the proposed conductivity benchmark of approximately 300 µS/cm.

Conductivity is a measure of water's capacity to conduct an electrical current and is correlated with the concentrations of the total dissolved ions or salts in solution (TDS). Appendix A of the Report provides background information and statistical methods used to address the causal assessment between conductivity and abundance of Ephemeroptera (mayfly) genera benthic macroinvertebrates. The causal assessment focused on mayflies because they are "among the most sensitive genera" according to EPA. While EPA asserts that there is a direct or causal relationship between conductivity and number of Ephemeroptera genera based upon field data, it is evident that the abundance of Ephemeroptera genera at sites included in the study is the result of a variety of physical and biological factors that are also weakly correlated with conductivity. Furthermore, laboratory studies do not support a causal relationship at the levels identified by the EPA benchmark. Several citations in the EPA Report identify much higher lowest observable effects concentrations (LOEC) for conductivity values (1,500 to 4,200 µS/cm) for mayflies and other aquatic genera.

An epidemiology approach is used in the causal assessment because the EPA believed that there was insufficient information available from controlled laboratory studies and they believed that they had sufficient field data. This mainly statistical approach is more common to studies of human populations, where laboratory experiments for causal relationships cannot be performed. It should be noted that a common issue in much of the epidemiological literature is that "correlation does not imply causation." While the EPA study found a moderate correlation between conductivity and number of Ephemeroptera genera there is still a wide scatter in the relationship. This together with the relatively high conductivity LOEC values in laboratory studies casts doubt on conductivity as the dominant causal factor for the number of mayfly genera observed at sites included in the study.

In 2006 and 2009, both the Illinois EPA and the Iowa Department of Natural Resources have concluded that it is inappropriate to use TDS or conductivity as a water quality criteria to protect aquatic species because it is the concentration of individual ions rather than conductivity or TDS that is relevant to the toxicity to aquatic organisms. Consequently, the Illinois EPA proposed water quality criteria for specific ions such as sulfate and chloride based on laboratory toxicity studies on aquatic organisms. This approach was approved by USEPA.

In Appendix B of the EPA Conductivity Benchmark study, EPA attempts to support its conclusion that conductivity is the dominant causal factor by a cursory analysis of potential confounders given the *a priori* assumption that conductivity is a cause for the extirpation of Ephemeroptera species. The Causal Analysis/Diagnosis Decision Information System (CADDIS) is an online system developed by EPA to identify the causal factors that are contributing to biological impairment. While a few of these factors were considered by EPA in their statistical analysis of potential confounders, the approach was inadequate because many factors were ignored or were inadequately represented in the statistical approach used by EPA. For example, the effects of habitat on the number of Ephemeroptera genera was examined statistically using the Rapid Bioassessment Protocol (RBP) score derived by the West Virginia Department of Environmental Protection. The RBP is an index of habitat quality but it is not an adequate representation of all the habitat conditions that are favorable or unfavorable to various Ephemeroptera genera. Nevertheless, the EPA analysis still found that this index of habitat quality was correlated with conductivity and with the number of Ephemeropteran genera, but it was subsequently dismissed along with other potential confounders.

EPA's analysis of confounding factors is insufficient and does not represent a rigorous analysis of the true factors affecting the number of Ephemeroptera genera at sites included in the study. Other conditions including channel alteration, the presence of upstream impoundments, dissolved oxygen, and temperature represent well-documented significant factors that need to be evaluated. The causal analysis of biological impairment needs to be performed at each site because multiple stressors can act together to cause impairment and these causal factors vary considerably among sites.

The conductivity benchmark is derived from a Species Sensitivity Distribution (SSD) that EPA generates from the field data based on the assumption that conductivity is the primary and only factor controlling the extirpation of aquatic genera from sampling locations in the study area. There is no scientific basis for this assumption. SSDs are supposed to be generated from **laboratory data** based on actual causal relationships and not from field biomonitoring studies based on moderate correlations.

The EPA attempt to develop a water quality criterion for conductivity from biomonitoring field data is not appropriate and should be replaced by the traditional methods for establishing water quality criterion. The traditional method for establish water quality criteria relies on information from controlled laboratory experiments to identify a direct relationship between organisms' response and exposure concentrations of a water quality constituent without the confounding influences. The biomonitoring approach is not suitable for establishing water quality criteria but is appropriate for detecting generalized and non-specific impairments to biological integrity. An analysis of the likely causes of biological impairment needs to be performed at each site following a structured approach such as that outlined in CADDIS.

The use of the conductivity benchmark as a water quality criterion would actually be detrimental because it would focus on the reduction of conductivity to protect benthic environments, when the cause of impairment at most of the sites is due to other factors, including a change in the flow regime, the presence of an impoundment, changes in the physical structure of the stream bed or changes in the quality and quantity of food resources preferred by various benthic insect genera. Thus, a mining company could invest in water treatment to meet conductivity limits for discharges and find that there is little or no change in the benthic insect genera downstream of the discharge following treatment. Finally, a water quality criterion for conductivity designed to protect biological conditions would result in a substantial increase in the number of streams classified as impaired even though the biomonitoring information does not indicate impairment. Examination of the West Virginia data base indicates that 990 of sites would be designated as impaired based on the EPA conductivity benchmark, while 409 of these sample sites would not be designated as impaired based on biomonitoring. Thus, the benchmark is found to have a 41% error rate as an additional criterion to protect water quality.

2 INTRODUCTION

Norwest Corporation (Norwest) is pleased to provide these technical comments in support of NMA's comments on this precedent-setting approach to establishing water quality criteria proposed by EPA. The "Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams" (herein referred to as the EPA Conductivity Benchmark study) is a significant departure from EPA's regulatory approach for establishing water quality criteria. These comments address the methodologies employed in this document and in particular the causal assessment and related statistical methods and assumptions.

The EPA Conductivity Benchmark study develops a conductivity standard based on a species sensitivity distribution (SSD) that is determined empirically from a manipulated set of field data and not from controlled laboratory experiments. The EPA has calculated the species sensitivity distribution (SSD) based on the erroneous assumption that conductivity is the direct cause for the extirpation of genera from the Ephemeroptera order at levels far below the lowest observed effects concentrations results from controlled laboratory experiments. Upon review of the field data and the literature it is quite clear that the correlation between conductivity and number of Ephemeroptera genera were likely the result of a variety of physical and biological factors that are also weakly correlated with conductivity. The rationale behind using information from controlled laboratory experiments when developing water quality criteria is to identify a direct relationship between organisms' response and exposure concentrations of a water quality constituent without the confounding influences of predation/competition from multiple species along with the influences of habitat, temperature, geology, flow and water chemistry. Furthermore, there is no scientific evidence for conductivity as a toxicity factor to benthic organisms at the low levels of conductivity proposed as the benchmark concentration of 300 µS/cm Toxicity to aquatic organisms can occur at very high conductivity levels and varies depending on the specific aquatic organism and relative mix of ions in the water.

3 CAUSAL ASSESSMENT

Appendix A of the EPA Conductivity Benchmark study states that epidemiological arguments are applied in an attempt to show that mixtures of salts that elevate conductivity in streams in the Mountain and Plateau Regions of Central Appalachia are causing local extirpation of aquatic species. Epidemiology is the study of factors affecting the health and illness of populations. It generally applies to human populations, where laboratory experiments for causal relationships cannot be performed. This epidemiological approach used by EPA relies on statistical tools to establish an association between conductivity levels in a water body and different characteristics of the benthic organisms in the water body, primarily the presence of Ephemeroptera (mayfly) species. It should be noted that a common issue in much of the epidemiological literature is that "correlation does not imply causation."

Data from the West Virginia Department of Environmental Protection in-house Watershed Assessment Branch Data Base (WABbase) was used for both the derivation of the conductivity benchmark and for the causal assessment provided in Appendix A of the EPA Conductivity Benchmark study. The data set from the Kentucky Division of Water (KDOW) was not used in the causal assessment but was used for comparing the results of applying the same methodology to the Kentucky data. A copy of the West Virginia data set was obtained and evaluated by Norwest in preparation of these comments. A copy of the Kentucky data set was not provided.

The causal assessment references toxicity information from the literature involving laboratory studies to support the conductivity benchmark. The cited laboratory studies by Kennedy et al. (2003, 2004, 2005) and by Mount et al (1997) indicate that concentrations of major ions can adversely impact fish and benthic macroinvertebrates but at concentrations substantially higher than the conductivity benchmark proposed by EPA. As discussed in the EPA Conductivity Benchmark study report, the causal assessment for the conductivity benchmark is developed largely on the occurrence of Ephemeroptera (mayflies) genera "because they are among the most sensitive genera". The EPA Conductivity Benchmark study cites the study by Echols et al (2009), which reported a conductivity range from 1,508 to 4,101 µS/cm for the lowest observable effects concentration (LOEC) in laboratory tests of the mayfly *Isonychia bicolor* exposed to water samples that ranged from 13% to 39% coal-mine-processed effluent. This study also reported LOEC values for *Ceriodaphnia dubia* that ranged from 2,132 to 4,240 µS/cm.

Conductivity is a measure of the capacity of water can conduct an electrical current and is correlated with the concentrations of the total dissolved ions or salts in solution (TDS). However, it is the concentration of individual ions rather than conductivity or TDS that is relevant to the toxicity to aquatic organisms. The study by Mount et al. (1997) cited in the EPA Conductivity Benchmark study states that the toxicity of fresh waters with high TDS is dependent on the

species ionic composition of the water. Mount et al. (1997) found that the relative toxicity of major ions in high TDS effluents was: K > HCO3= Mg > Cl > SO4. They also found that the presence of multiple cations reduces the toxicity of Cl, SO4 and K. Also, Chapman et al. (2000) studied toxicity of two mine effluents to early life stages of rainbow trout and Chironomid larvae and concluded that the toxicity is due to the specific combination and concentration of ions and is not predictable from TDS concentrations.

Furthermore, both the Illinois EPA[1] and the Iowa Department of Natural Resources[2] have concluded that it is inappropriate to use TDS or conductivity as water quality criteria based on toxicity to aquatic organisms. The Illinois EPA adopted water quality rules that replaced the TDS water quality standard with a numerical sulfate standard. This revision to the Illinois Water Quality Standards rules regarding sulfate and total dissolved solids were approved by the USEPA on March 19, 2009. In its technical justification, the Illinois EPA states that:

> *"While sulfate was being evaluated, it became increasingly obvious that TDS is a very inappropriate parameter for use in water quality standards. TDS is the sum of all dissolved substances in water and is dominated by the common ions of sulfate, chloride, sodium, calcium, carbonate and magnesium in various proportions. Our investigations into sulfate toxicity reinforced the notion that it makes little sense to have a standard that covers all these substances together when the toxicity of each constituent is really what is important. For example, a TDS concentration of 2,000 mg/L with chloride as the primary anion constituent is acutely toxic to aquatic life, but the same TDS concentration composed primarily of sulfate is nontoxic. With toxicity-based sulfate and chloride standards in force, there should be no need of a TDS standard that is incapable of predicting the threshold of adverse effects to aquatic life."*

On September 17, 2009 the Iowa Environmental Protection Commission adopted and filed amendments to the Commission's Water Quality Standards that removed the TDS site-specific approach and established numerical water quality criteria for chloride and sulfate. In its Responsiveness Summary to the Chloride, Sulfate and TDS Revisions, the Iowa Department of Natural Resources (August 24, 2009) cited "lack of scientific support" as the basis for eliminating

[1] Illinois Environmental Protection Agency. April 2006. "Preliminary Technical Justification for Changing Water Quality Standards for Sulfates, Total Dissolved Solids and Mixing Zones."

[2] Iowa Department of Natural Resources, February 9, 2009 "Water Quality Standards Review: Chloride, Sulfate and Total Dissolved Solids."

the site-specific TDS approach. Further discussion of the lack of scientific support for a TDS water quality standard for protection of aquatic life can be examined in the Iowa Department of Natural Resources, February 9, 2009 "Water Quality Standards Review: Chloride, Sulfate and Total Dissolved Solids."

3.1 EXAMINATION OF THE EPA DATA SET

The data set used in the causal assessment and in developing the conductivity benchmark was manipulated by EPA to exclude samples from a number of locations. The following data exclusions occurred:

- Data outside Ecoregion 69 and 70,
- Samples where the aquatic organisms were not identified to the genus level,
- Samples from drainage areas greater than 155 km2,
- Conductivity was greater than 1,000 µS/cm, the SO4 less than 125 mg/L, and the Cl greater than 250 mg/L, and
- Sites with a pH of less than 6.

First, all samples that were not identified as occurring in either Ecoregion 69 or 70 were excluded. However, if conductivity as a measure of the concentration of dissolved salts in water is the primary factor causing the extirpation of aquatic species the effects should occur elsewhere and the geographic exclusion is not appropriate. This EPA Conductivity Benchmark report states that it is applicable to parts of Kentucky and West Virginia and is expected to be applicable to the same regions in Ohio, Pennsylvania, Tennessee, and Maryland. Next, all samples that did not have measurements of conductivity and aquatic organisms identified to the genus level were excluded as this information was needed to apply the methodology. All samples that were identified as being collected from locations with drainage areas greater than 155 km2 were excluded. The rationale for this exclusion was to eliminate samples from large rivers. Yet there was no explanation of the basis for the 155 km^2 threshold. Furthermore, if conductivity is a primary factor causing the extirpation of aquatic species in the Mountain and Plateau Regions of Central Appalachia, then larger streams should not be excluded from the study. Sample locations were also excluded if the conductivity was greater than 1,000 µS/cm, the SO4 less than 125 mg/L, and the Cl greater than 250 mg/L. This exclusion was applied to eliminate waters dominated by Cl rather than SO4 but there was no explanation for the selection of the exclusion thresholds. Furthermore, there were 149 samples with conductivity levels greater than 1,000 µS/cm that remained in the data set, where the exclusion criteria could not be applied because of lack of information on either SO4 or Cl.

An examination of the complete data set and the correlation with sample exclusions as provided in Figure A-1 of Appendix A of the EPA Conductivity Benchmark study indicates that the data set used in these correlations also excluded sites with a pH of less than 6. These sample exclusions resulted in the highest Spearman correlation between conductivity and the number of Ephemeroptera genera while other exclusions applied in the confounding analysis decreased the Spearman correlation between conductivity and the number of Ephemeroptera genera as shown in Figure A-2 of Appendix A of the EPA Conductivity Benchmark study. Figure A-2 shows that conductivity is a poor predictor for the number of Ephemeroptera genera present at sample sites. If conductivity were a causal factor for number of Ephemeroptera genera one would expect a much stronger relationship after confounding factors have been removed.

The correlations provided in both Figures A-1 and A-2 of Appendix A of the EPA Conductivity Benchmark study show substantial scatter in the relationship between the number of Ephemeropteran genera and conductivity, which casts doubt on the validity of the causal relationship.

There are a number of factors other than conductivity that may affect the number of Ephemeroptera genera present at a sample site. Examination of the data that were used to generate Figure A-1, found that 290 of the sample sites with conductivity levels below the EPA benchmark of 300 µS/cm were designated as biologically impaired based on the West Virginia Stream Condition Index (WVSCI) that is used to assess stream impairment. If conductivity were the primary cause of biological impairment, there would not be this large number (290) of biologically impaired sites with conductivity levels below the benchmark. Also, among the sample sites with conductivity levels below the EPA benchmark, the number of Ephemeroptera genera was 3 or less at 240 of the sample sites. These are sample locations where biological impairment occurs due to environmental conditions or stressors other than conductivity. The specific conditions that are causing biological impairment and limiting the number Ephemeroptera genera at low conductivity have not been assessed in the EPA study. This is due to an approach that focused on the correlation between the number of Ephemeroptera genera and conductivity, and not on identifying the causal factors influencing biological conditions and stream impairment at the specific locations included in the study.

It is logical to conclude that the range of factors that are the cause for biological impairment and limiting the number of Ephemeroptera genera at conductivity levels below the EPA benchmark are also relevant causal factors for impairment at sites with conductivity levels above the EPA benchmark. Furthermore, if the EPA conductivity benchmark is valid, then one would not expect multiple Ephemeroptera genera to occur at sites with conductivity levels higher than the EPA benchmark of 300 µS/cm. Yet it is apparent from an examination of Figure A-1 that multiple Ephemeroptera genera do occur at many sites with conductivity levels well above the EPA

benchmark. As demonstrated in further analysis of the data, one reason that there is some correlation between the number of Ephemeroptera genera and conductivity is that there is some correlation between some of the actual causal factors and conductivity

The use of the EPA conductivity benchmark as a water quality criterion would result in a substantial expansion of the number of streams designated as impaired. The WVSCI is used to identify sites that are impaired with respect to listing under Section 303(D) in the state of West Virginia. If the WVSCI is less than 60.6, the stream at the sample location is designated as biologically impaired. Examination of the EPA data base shows that, at sample locations with conductivity levels above the EPA benchmark, 581 of the sample sites would be designated as biologically impaired while 409 of the sample sites would not be designated as impaired using the WVSCI.

Table 1. Summary of Impairment Classifications that exceed the EPA conductivity Benchmark

Impairment Classification	Number of samples exceeding EPA benchmark	Conductivity (µS/cm)	
		Mean	Maximum
WVSCI Not Impaired	409	611	2,768
WVSCI Impaired	581	1,072	11,646

As shown in Table 1, the mean conductivity for the sites that were not designated as impaired index was 611 µS/cm while the maximum conductivity was 2,768 µS/cm. Thus use of the EPA conductivity benchmark could result in a 41% false designation of impairment with respect to the current designation of biological impairment using the WVSCI Clearly, if conductivity levels above the benchmark were the cause of biological impairment, there would not be this large number (409) of unimpaired sites with conductivity levels above the benchmark.

The contingency table (Table A-4) that was supplied to support the causal assessment examined the ratio of presence or absence of mayflies at sample sites where conductivities were greater than 1,500 µS/cm. This is far above the EPA proposed benchmark of 300 µS/cm and is expected to include sites where particular ions such as bicarbonate, chloride or sulfate may be at concentrations that some Ephemeroptera genera may be affected. Still mayfly species are present at 21.7 % of the sites where conductivity is greater than 1,500 µS/cm. The presence of some Ephemeroptera species at these sites demonstrates that the mix of ions resulting in the high conductivity is not causing the extirpation of these Ephemeroptera species. Furthermore, it is not possible to conclude that at the 78.3 % of the sites where mayfly species were not observed when conductivity was greater than 1,500 µS/cm, that the mix of ions resulting in the high conductivity is the cause of the extirpation of the Ephemeroptera species at all of these sites.

3.2 POTENTIAL CAUSES OF BIOLOGICAL IMPAIRMENT

The Causal Analysis/Diagnosis Decision Information System (CADDIS) is an online system developed by EPA to help conduct causal evaluations for aquatic systems that are designated impaired (Ziegler, Suter, and Kefford, 2007). CADDIS lists the following conditions that could be a potential cause for biological impairment:

- Dissolved oxygen (DO) regime alteration,
- Hydrologic regime alteration (includes flow or depth conditions; timing, duration, frequency etc.),
- Nutrient regime alteration,
- Organic-matter regime alteration,
- pH regime alteration,
- Salinity regime alteration,
- Bed sediment load changes, including siltation,
- Suspended solids and/or turbidity alteration,
- Water temperature regime alteration,
- Habitat destruction,
- Habitat fragmentation (e.g., barriers to movement, exclusion from habitat),
- Physical crushing and trampling,
- Toxic substances,
    - Herbicides and fungicides,
    - Halogens and halides (e.g., chloride, trihalomethanes),
    - Fish-killing agents (e.g., rotenone),
    - Insecticides,
    - Lampricides,
    - Metals,
    - Molluscicides,
    - Organic solvents (e.g., benzene, phenol),
    - Other hydrocarbons (e.g., dioxins, PCBs),
    - Endocrine disrupting chemicals, and
    - Mixed, cumulative effect,
- Interspecies competition,
- Complications due to small populations (e.g., inbreeding, stochastic fluctuation, etc.),
- Genetic alteration (e.g., hybridization),
- Overharvesting or legal, intentional collecting or killing,
- Parasitism,
- Predation,
- Poaching, vandalism, harassment, or indiscriminate killing,

- Unintentional capture or killing (e.g., artillery explosions, roadway casualties),
- Vertebrate animal damage control (includes trapping, shooting, poisoning), and
- Radiation exposure increase (e.g., increased UV radiation).

A few of these factors were considered to some extent by EPA in their statistical analysis of potential confounders but were summarily eliminated from consideration because "effects appear to be minimal given the inevitable variability in sites to which the benchmark would be applied". There are a number of flaws in the causal assessment performed in the EPA Conductivity Benchmark study but a primary flaw is that the analysis of potential causes of biological impairment needs to be performed at each site because of the variability among sites.

Appendix B of the of the EPA Conductivity Benchmark study attempts to support its conclusion that an increase in conductivity is the dominant causal factor in the local extirpation of aquatic genera through an analysis of potential confounders based on the *a priori* assumption that conductivity is a cause for the extirpation of Ephemeroptera species at sites included in the study. The assessment starts with the correlation between conductivity and the number of Ephemeroptera genera and then tries to determine whether any of the measured potential confounders interfere with this correlation.

For example, to assess whether stream habitat may be a potential confounder, they examine a qualitative index of habitat quality, the Rapid Bioassessment Protocol (RBP) score derived by the West Virginia Department of Environmental Protection. As shown in Table B-7 of the EPA Conductivity Benchmark study, the RBP score was found to be moderately correlated (based on EPA assessment criteria for correlation in the Table B-2) with conductivity ($r = 0.29$) and moderately correlated with the number of Ephemeropteran genera ($r = -0.26$). Also, as indicated in Table B-7 of the EPA Conductivity Benchmark study, the correlation between conductivity and the number of Ephemeropteran genera declined from an $r = -0.63$ to $r = -0.50$ when sites with an RBP score of less than 140 were removed from the analysis in an attempt to reduce the influence of poor habitat. Clearly this index of habitat quality is a confounder but it was dismissed in the development of the EPA benchmark along with other potential confounders, except for low pH. Furthermore, the rationale for selection RBP score threshold of less than 140 was not provided

There is also the issue of whether the RBP score is the appropriate measure of habitat quality with respect to mayflies. As noted by GEI (2010), the nearly identical ratios of mayfly presence between poor quality and high quality habitat at low conductivity levels in the contingency table (Table B-8) suggests that that RBP score is not a good indicator of habitat quality for mayflies. The correlation between RBP and conductivity, and the correlation between RBP and Ephemeropteran genera, combined with the presence of mayfly in both poor and high quality

habitat confirms that EPA's analysis of confounding factors is insufficient and does not represent a rigorous analysis of the true cause of Ephemeropteran or mayfly abundance.

In our analysis of the EPA data, the Channel Alteration score alone was found to have a better correlation with conductivity (r=-.31) and with number of Ephemeropteran genera (r = 0.27) than the RPB score. Furthermore, some of the habitat factors that have been found to be directly related to the presence of mayflies, such as the presence of an upstream impoundment, were not considered in the assessment of potential confounders by EPA. Bauernfeind and Moog (2000) indicate that channel alteration, irrigation, and impoundments generally lead to deficiencies in the mesohabitat structures which significantly affect mayfly diversity and abundance. Arnwine, Sparks and James (2006) found that impoundments on small first order to third order streams in Tennessee have adverse affects on the macroinvertebrate community downstream of these impoundments. The most frequent change in the benthic community structure was a loss of the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) Finally, the Technical Memorandum by GEI (2009) cites literature sources that assessed changes in trophic groups occurring downstream of lakes and impoundments. Filter-feeding insects such as hydropsychid tend to be found at higher abundance immediately below impoundments while mayflies typically decrease. These shifts apparently occur as a result of changes in trophic condition or food availability downstream of impoundments with the releases being rich in components fed on by hydropsychid and other filter-feeding organisms.

Furthermore, the EPA data base is not adequate to address the issue of confounding because it does not include all of the potential confounding parameters and it is missing data for some of the confounding parameters. For example for the final data set used by EPA in the conductivity benchmark, fecal coliform counts were missing in 149 of the samples, watershed area and land use designations were missing in 1,441 of the samples, and nutrient information from 1,032 of the samples. Temperature and dissolved oxygen are some of the most important factors influencing the occurrence and distribution of Ephemeroptera larvae (Bauernfeind and Moog, 2000) The EPA report completely failed to address dissolved oxygen as a potential confounding parameter. Perhaps the failure to address influences of dissolved oxygen are due to data limitations that report dissolved oxygen (and temperature) only at the point in time that the benthic sampling is performed. Examination of the EPA data indicates that only four samples had dissolved oxygen values less than 3.5 mg/L. All four samples were collected in August and the number of Ephemeropteran genera was found to be zero or one in these four samples. Dissolved oxygen could also be a factor limiting the number of Ephemeropteran genera but it is not possible to draw further conclusions based on the one-time samples. Likewise, the one-time measurement of temperature precludes the proper assessment of temperature as a confounding parameter. Nevertheless, the EPA report concluded that "elevated temperature does not appear to be associated with the loss of Ephemeroptera". In supporting this statement, the report includes the

Although the EPA Report mentions the on-line CADDIS system, they did not use the tools and step-by-step procedures to assess the conditions causing biological impairment at the specific impaired sites that were included in the data base. Earlier in these comments we summarized many of the potential causes for biological impairment that can act together to cause impairment. CADDIS also provides recommendations and cautions in the application of statistical tools. It states that statistical significance does not equate to biological significance. Statistical analysis does not tell us whether variability in observations is caused by the stressor being analyzed or whether variability in observations is biologically relevant. CADDIS cautions that "*Concluding that a candidate stressor is or is not the cause based on a correlation coefficient is inappropriate because:*

- *Stressors often covary with each other and with natural environmental attributes. A strong relationship between the biological response and candidate cause could reflect a covarying stressor or natural factor other than the candidate cause,*
- *Hypothesis testing was designed for interpreting controlled experiments with replicates and random assignment of treatments, and*
- *Field data from observational studies rarely include replicates and "treatments" are not randomly assigned, therefore even strong associations do not prove causation.*

These cautions in CADDIS have not been adequately addressed in the EPA Conductivity benchmark study.

The XC_{95} conductivity value for the 170 genera that were observed at more than 30 sampling sites in the West Virginia data set was used to develop an SSD based on the assumption that conductivity is the factor that is responsible for the extirpation of aquatic genera at all the sites in the data set. The conductivity benchmark was determined from the SSD as the conductivity level that is not exceeded by the XC_{95} conductivity value for 5% of the 170 genera. The assumption was made that if conductivity levels are below the benchmark, at least 95% of genera will be protected. Thus, the calculated benchmark is directly dependent upon the XC_{95} conductivity value estimated for the 8 genera in the data set with the lowest calculated XC_{95}. These are the genera *Alloperla*, *Cinygmula*, *Drunella*, *Lepidostoma*, *Leptophlebia*, *Pyenspsyche*, *Remenus*, and *Utaperla*. Of these genera, only the mayfly genus *Drunella* was observed at more than 4.5% of the sample sites in the data set. *Drunella* was observed at approximately 8% of the sample sites based on year round data but at less than 1% of the sites based on summer samples.

It appears that these genera with the lowest calculated XC_{95} conductivity values are limited by more than conductivity as they are observed at very few of the sites. It is inappropriate to develop SSDs from field observations of specific genera where the presence and absence of the genera are related to factors other than conductivity. This is the reason why SSDs are calculated from acute or chronic toxicity results from controlled laboratory experiments.

The analysis of uncertainty presented in the EPA Benchmark study is an obfuscation of the actual sources of uncertainty concerning conductivity levels that are protective of aquatic genera in West Virginia. The uncertainty analysis involved a "Bootstrap" method for estimating the variation in the calculated XC95 values for each genus used in the derivation of the benchmark by sampling with replacement from the data set that was used to derive the benchmark. This involved generating 1000 data sets each with 2,145 observations that were obtained by random sampling from the data set with replacement. Thus, the generated data sets will exclude some observations and include duplicates or multiple observations from some of the sample sites. In effect this is a method of massaging the original data in an effort to examine the variation resulting from the observations obtained at each of the sampling sites included in the study. The benchmark conductivity value was then estimated for each of the 1000 "bootstrap samples" in order to generate an estimate of the mean and confidence interval in the benchmark value.

The EPA Conductivity report applied the same methodology to data from the State of Kentucky and obtained a conductivity benchmark estimate of 319 µS/cm with a lower confidence bound of 180 µS/cm and an upper bound of 439 µS/cm. The report implies that that the confidence interval generated from this Bootstrap analysis of these two data sets adequately represents the uncertainty in the conductivity benchmark. The report also states that the sampling variance may be the

largest component of total uncertainty because the confidence intervals for the estimates of the benchmark conductivity from the two data sets overlap.

We strongly disagree with this conclusion. The largest source of uncertainty is in the application of the methodology and assumptions, particularly in the assumption that conductivity is the variable controlling the extirpation of aquatic species in the study area. An indication of the fallacy of this assumption is shown in the uncertainty analysis performed by EPA. Figure 7 of the EPA Conductivity Benchmark study shows the 95% confidence bounds for the XC95 values for the 35 genera with the lowest XC95 value estimated from the West Virginia data set. A copy of that figure is provided below. The bootstrap analysis of the West Virginia data set shows a considerable range in the XC95 values that occur just due to the variation in sampling. For example, the XC95 value calculated for the caddisfly genus *Lepitostoma* varies widely from less than 100 to over 700 µS/cm, due to the random variation in the sampling points as reflected in the bootstrap analysis This high variability in XC95 values calculated for each genus in the data set clearly demonstrates that conductivity is not controlling the extirpation of aquatic species for most of the sampling points in the study area.

The uncertainty analysis does not address many of the other assumptions that were made. For instance, a genus was excluded from the extirpation calculation if it was observed at less than 30 of the 2,145 sampling sites. Perhaps a more appropriate threshold for exclusion is if it was not observed at more than 10% of the sites. This would eliminate the genera that are not commonly observed in the study area. Also, a more appropriate measure of the extirpation of a particular genus would be the XC100 or the conductivity above which observations of a particular genus are not found among the 2,145 sites. This criterion for extirpation should also have been examined in assessing the uncertainty in the calculated benchmark.

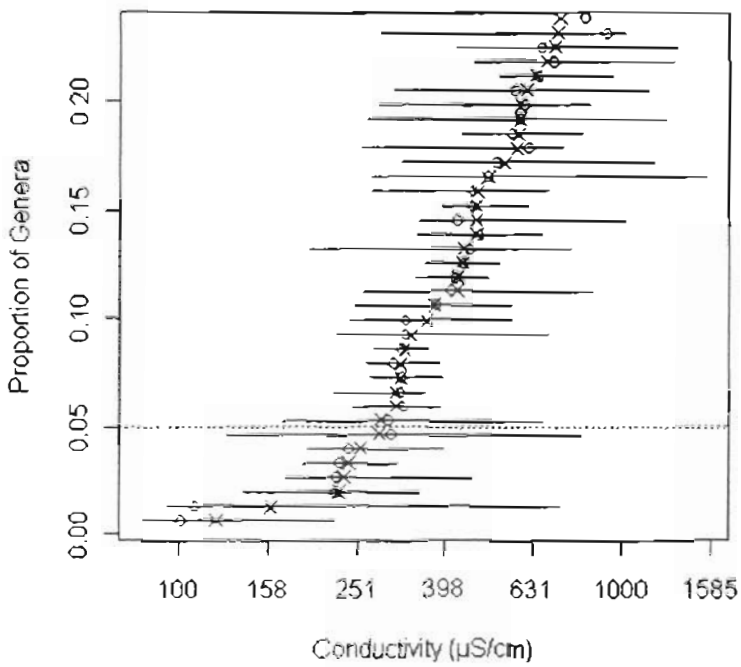

Figure 7 (from USEPA (2010). The cumulative distribution of XC_{95} values for the 35 most sensitive genera (red circles) and the bootstrap-derived means (blue x symbol) and two-tailed 95% confidence intervals (whiskers). (The 5th percentile is shown by the dashed line.)

5 CONCLUSIONS AND RECOMMENDATIONS

There is no scientific basis for the species sensitivity distribution (SSD) that was developed from biomonitoring field data in the EPA Conductivity Benchmark study. There are a multitude of causal factors that explain the extirpation of genera from sampling locations included in the EPA data set, including predation/competition from multiple species, influences of habitat, temperature, geology, flow, dissolved oxygen, water quality, and limited geographic distribution for some genera. The lack of scientific support is also demonstrated by the substantial scatter in the relationship between the number of Ephemeropteran genera and conductivity as shown Figures A-1 and A-2 of Appendix A of the EPA Conductivity Benchmark study and by the wide variability in XC95 values calculated for each genus in the bootstrap analysis of the data as shown in Figure 7 of the EPA Conductivity Benchmark study.

The EPA attempt to develop a water quality criterion for conductivity from biomonitoring field data is not appropriate and should be replaced by the traditional method for establishing water quality criteria. The traditional method for establish water quality criteria relies on information from controlled laboratory experiments to identify a direct relationship between organisms' response and exposure concentrations of a water quality constituent without the confounding influences. The development of the conductivity benchmark based on field data has little more validity than developing a percent woodland benchmark based on field data. It does not address the actual factors that account for the presence or absence of aquatic organisms at a particular site or the causes for biological impairment.

The biomonitoring approach is "best used for detecting generalized and non-specific impairments to biological integrity, and for assessing the severity of those impairments," as noted by Gibson et al. (2000). Chemical and toxicity tests and habitat assessments are needed to identify probable causes of impairment as the basis for corrective measures. An analysis of the likely causes of biological impairment needs to be performed at each site following a structured approach such as that outlined in CADDIS.

The use of the conductivity benchmark as a water quality criterion would actually be detrimental because it would focus on the reduction of conductivity to protect benthic environments, when the cause of impairment at most of the sites is due to other factors, including a change in the flow regime, the presence of an impoundment, changes in the physical structure of the stream bed or changes in the quality and quantity of food resources preferred by various benthic insect genera. The literature shows that the distribution and abundance of mayfly communities are strongly dependent on habitat composition structure and that often mayflies are absent from benthic environments downstream of impoundments. Thus, a mining company could invest in water

treatment to meet conductivity limits for discharges and find that there is little or no change in the benthic insect genera downstream of the discharge following treatment.

Also, a water quality criterion for conductivity designed to protect biological conditions would result in a substantial increase in the number of impaired streams that are impaired with respect to listing under Section 303(D) in the state of West Virginia. As previously discussed, 409 of the sites in the West Virginia data base would be added when current information indicates that these streams are not biologically impaired.

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Office of Environmental Information (OEI) Docket
U.S. Environmental Protection Agency
Mailcode: 2822T
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Honorable Paul Anastas
Assistant Administrator
Office of Research and Development
U.S. Environmental Protection Agency

Honorable Peter S. Silva
Assistant Administrator
Office of Water
U.S. Environmental Protection Agency

Docket ID No. EPA-HQ-ORD-2009-0934

Re: "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields" (EPA/600/R-09/138A) and "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams" (EPA/600/R-10/023A) 75 Fed. Reg. 18,499 (April 12, 2010).

To Whom It May Concern:

The National Mining Association (NMA) submits the following comments on the above-referenced reports that were made available for public comment on April 12, 2010. 75 Fed. Reg. 18,499 (Apr. 12, 2010). NMA is a national trade association that includes the producers of most of the nation's coal, metals, industrial and agricultural minerals; the manufacturers of mining and mineral processing machinery, equipment and supplies; and the engineers and consulting firms, financial institutions and other firms serving the mining industry. NMA's members have a wide variety of surface coal mining operations, including operations in Central Appalachia, and thus will be directly and significantly impacted by the Environmental Protection Agency's (EPA) use of the above-referenced documents.

We are also addressing this comment letter to both Assistant Administrator Paul Anastas of the Office of Research and Development (ORD) and Assistant

Administrator Peter S. Silva of the Office of Water (OW) because, while the documents have been developed by ORD, they are currently being used by the OW when reviewing coal mining permit applications. In addition, the question of the scientific adequacy of the documents is inextricably linked to the requirements of the Clean Water Act (CWA).

In these comments, we first discuss how EPA is currently using its "field-based aquatic life benchmark for conductivity." Second, we discuss NPDES permit regulations and conclude that EPA cannot compel the use of its conductivity criteria under those regulations. Third, we discuss EPA's guidance on the development of aquatic water quality criteria and conclude that EPA's methodology for developing the conductivity criteria is inconsistent with that guidance. Fourth, we discuss the requirements of the CWA and conclude that EPA's conductivity criteria do not meet the requirements of that statute. Finally, we discuss the requirements of EPA's Information Quality Guidelines and conclude that the EPA study—the basis for its new conductivity criteria—does not meet the requirements of that guidance.

Based on our analysis, we request that EPA discontinue use of any conductivity criterion and conduct laboratory tests to develop a scientifically defensible criterion for conductivity or (more likely) specific ions, applying EPA's standard methodology for developing aquatic life water quality criteria.

I. EPA application of its draft conductivity benchmarks

On April 1, 2010, EPA issued memorandum titled: *Detailed Guidance: Improving EPA Review of Appalachian Surface Coal Mining Operations under the Clean Water Act, National Environmental Policy Act, and the Environmental Justice Executive Order* (hereinafter "Detailed Guidance"). In the Detailed Guidance, EPA establishes a range of between 300-500 microSiemens (µS/cm) (a measure of conductivity) as a trigger for close scrutiny by EPA of the permit application and anything approaching or beyond 500 µS/cm as cause for EPA to veto a CWA permit. These conductivity levels rely heavily on one study of West Virginia streams by EPA Region 3 (the Pond-Passmore study) and its observation "that aquatic life at sites with specific conductance greater than 500 µS/cm were observed to have been adversely impacted based on a genus-level multi-metric biological index,"[1] as well as EPA's draft report "*A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams,*" (hereinafter "Conductivity Study") which "recognizes stream-life impacts associated with conductivity." *See* Detailed Guidance at 11.

NMA believes that neither the Pond-Passmore study nor EPA's Conductivity Study are an appropriate basis for establishing presumptively applicable water quality criteria for conductivity in Appalachian States.

[1] Pond G.J., M.E. Passmore, F.A. Borsuk, L. Reynolds, and C.J. Rose. 2008. Downstream effects of mountaintop coal mining: comparing biological conditions using family- and genus-level macroinvertebrate bioassessment tools. Journal of the North American Benthological Society 27:717:737.

With respect to the Pond-Passmore study, on July 13, 2010, we submitted two reports to EPA demonstrating that the relationships identified in Pond-Passmore were based purely on statistical correlations between water quality characteristics and benthic macroinvertebrate community structure and do not represent a formal or mechanistic test of the hypothesis that conductivity (or chemical parameters detected by the composite measure of conductivity) is the primary cause of changes in the macroinvertebrate communities downstream of Mountaintop Mining/Valley Fill (MTM/VF) activities.[2] In fact, the Pond-Passmore study found no evidence that even correlated the results of their multimetric indices with the number of valley fills or with the distance from any valley fill. Absent a correlation, much less the demonstration of a cause-and-effect relationship, that study cannot be used to determine a threshold level for an adverse response to conductivity. Accordingly, this study should not be used to establish a water quality criterion for conductivity. In fact, even the authors of the study note its limitations and recommend further research.

We also believe that EPA's Conductivity Study should not be used to set a conductivity criterion. First, NMA notes that it is inappropriate for EPA to use a report that is currently being reviewed by EPA's Science Advisory Board (SAB), and is marked "DRAFT – DO NOT CITE OR QUOTE." The report also includes the following disclaimer:

> This information is distributed solely for the purpose of predissemination peer review under applicable information quality guidelines. It has not been formally disseminated by the U.S. EPA. It does not represent and should not be construed to represent any Agency determination or policy.

On July 13, 2010, we submitted two reports that provide an extensive critique of the methodology employed and conclusions reached by EPA.[3] As discussed below, these reports demonstrate that the Conductivity Study is flawed and the data presented do not support the conclusions drawn by the author.

NMA encloses with this submission a final version of the comprehensive GEI report that expands on the technical analysis and includes a response to EPA's Science Advisory Board Charges to Reviewers. *Final Report Technical Review: A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Steams, Prepared by GEI Consultants, Inc./Ecological Division (Sept. 2010)*(hereinafter "Final Report"). NMA's Final Report evaluates the overall technical basis of how the conductivity benchmark was derived, with a particular focus on evidence presented

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[2] *See* GEI Consultants, Inc. (GEI). 2009a. Identification of Issues in Regard to the —Pond et al. Study on Effects of Mountaintop Mining and Valley Fill on Benthic Invertebrate Communities. Technical Memorandum, GEI Consultants, Inc., Denver, CO; GEI Consultants, Inc. (GEI). 2009b. Update on Issues for Further Investigation in Regard to the —Pond et al. Study on Effects of Mountaintop Mining and Valley Fill on Benthic Invertebrate Communities. Technical Memorandum, GEI Consultants, Inc. Denver, CO.

[3] Interim Draft Report Technical Review: A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams, Prepared by GEI Consultants, Inc./Ecological Division (hereinafter GEI 2010); A White Paper: Comments on "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Stream," Prepared by Norwest Corporation (hereinafter Norwest 2010).

by EPA in support of the mechanistic plausibility of using conductivity as the basis for deriving a field-based aquatic life benchmark, and the extent to which confounding factors other than conductivity were addressed. In addition, the Final Report presents an independent statistical evaluation of the ecological factors most likely associated with patterns in benthic macroinvertebrate community structure in West Virginia headwater streams associated with MTM/VF activities. This analysis utilized the same raw data and field sites used in EPA (2010) to derive the conductivity benchmark, but uses different sets of statistical tools to provide a more robust analysis of the potential impacts of MTM/VF activities.

Notwithstanding these serious and substantial deficiencies, EPA is using the Pond-Passmore study and the Conductivity Study to create the presumption that "conductivity levels below 300 µS/cm generally will not cause a water quality standard violation and that in-stream conductivity levels above 500 µS/cm are likely to be associated with adverse impacts that may rise to the level of exceedances of narrative state water quality standards." *See* Detailed Guidance at 12. The Detailed Guidance directs the EPA Regions to "work with the permitting authority to ensure that the permit includes conditions that protect against conductivity levels exceeding 500 µS/cm." *Id.* EPA goes so far as to direct its Regional offices to "object to issuance of [a] proposed permit" if it does not satisfy the requirements of the act "as noted" in the Detailed Guidance. *Id.* at 8.

EPA's words and actions confirm that EPA has established a de facto water quality standard for conductivity. In addition to the language in the Detailed Guidance quoted above, EPA is demanding adherence to the conductivity standard in its review of state and federal permit applications for mining:

- On April 2, 2010, EPA issued a *Federal Register* notice proposing to veto the existing section 404 CWA permit for the Spruce Mine in West Virginia. 75 Fed. Reg. 16,788 (Apr. 2, 2010). In the notice, EPA claims that conductivity levels greater than 500 µS/cm have a "[h]igh probability of impairment to native biota," citing, "West Virginia data and scientific literature." *Id.* at 16,802. The technical support document in the docket for this notice makes it clear that the "scientific literature" being referred to is the Pond-Passmore study. Thus, in the context of the permit for the Spruce Mine, EPA has already used a conductivity level of 500 µS/cm as a water quality criterion to support a proposed permit veto.

- On June 21, 2010, EPA sent a letter to the District Engineer of the Huntington District of the U.S. Army Corps of Engineers (Corps) regarding a proposed permit for the Pine Creek Surface Mine. This letter specifically cites the Detailed Guidance and the Conductivity Study as the basis for EPA's review. With respect to conductivity, the letter makes it clear that it considers protective permit limits to be those that "ensure in-stream specific conductivity remains at levels that will not cause or contribute to degradation to water quality, ***including setting threshold limits within the permit of 300 µS/cm and 500 µS/cm.***" *Letter dated June 21, 2010, from John R. Pomponio to Colonel Robert D. Peterson at 2 (emphasis added).* Thus, in the

context of the permit for the Pine Creek Surface Mine, EPA is using 300 µS/cm and 500 µS/cm as water quality criteria, against which the proposed permit is being evaluated.

- On July 13, 2010, Linda Boornazian issued a report to EPA Regions 3, 4 and 5 on a "*Review of Clean Water Act 402 Permitting for Surface Coal Mines by Appalachian States: Findings and Determinations*" (hereinafter "Permit Review"). In this report, EPA states that discharges from Appalachian coal mines have been found to have a high potential to impact aquatic life uses, citing Pond/Passmore. EPA then alleges that none of the permits reviewed incorporated provisions that would implement the relevant narrative water quality standards relating to discharges that increase levels of conductivity, total dissolved solids and sulfates. EPA claims that either whole effluent toxicity limits and/or chemical specific numeric interpretations are required under 40 CFR 122.44(d)(v) and (vi). Of course, such limits are applicable only if a permitting authority (generally the state) determines that the discharge will have a reasonable potential to contribute to an excursion of a water quality standard. It appears that the states have not made such a determination. In fact, Ohio has a chronic criterion for conductivity of 2400 µS/cm and Pennsylvania uses osmotic pressure as a surrogate measure of total dissolved solids. Thus in this report, it appears that EPA is continuing to use 300 µS/cm from the Pond/Passmore study as a water quality standard and assuming that any discharge in excess of that level must be subject to a permit limit.

II. NPDES permitting regulations do not support EPA's use of the Pond-Passmore study and the Conductivity Study

To justify its mandate that states, EPA Regions and the Corps use unpromulgated, and even in the case of the Conductivity Study, unpublished, numeric criteria, the Detailed Guidance labels these studies "relevant information pertaining to a pollutant that may cause or contribute to an excursion above an applicable state narrative water quality standard," citing 40 CFR 122.44(d)(1)(vi). Specifically, the Detailed Guidance states that "during the SAB review process, EPA believes that this report should be considered by Appalachian states as relevant information per 40 CFR 122.44(d)(1)(vi) in implementing applicable state narrative water quality standards in NPDES permits and by Regions in your review of these permits." *See* Detailed Guidance at 12.

Section 122.44(d)(1) of EPA's NPDES permit regulations requires permits to include limits necessary to achieve water quality standards, including state narrative criteria for water quality. However, the requirement to include a permit limitation applies only if the permitting authority has determined that a pollutant has a reasonable potential to cause or contribute to an excursion of a water quality standard. Clause(vi) becomes applicable only after that determination has been made and if the state does not have a water quality criterion for the specific chemical pollutant that is causing or contributing to the excursion. Once those conditions are met, 40 CFR 122.44(d)(1)(vi) provides that the permitting authority

may establish limits based on (A) a calculated water quality criterion; (B) a case-by-case basis using EPA's section 304 criteria supplemented where necessary by "other relevant information;" or (C) an indicator parameter.

EPA's Detailed Guidance does not allow states to follow the process set forth in the NPDES permitting regulations. Instead, EPA's Detailed Guidance usurps state authority to interpret a state's own narrative criteria and presumes that EPA's conductivity standards are applicable criteria. With this presumption, the Detailed Guidance does not apply the conductivity criteria as "relevant information" for setting a limitation after a determination is made that a narrative criterion will be exceeded. Instead, the Detailed Guidance substitutes its conductivity numbers for the narrative criterion itself. This usurpation of an authorized state's authority to interpret its own water quality criteria is not supported by the NPDES permitting regulations

In fact, as discussed below, EPA has issued very specific guidance on how scientifically-defensible water quality criteria are to be developed and EPA regulations and the CWA set forth very specific procedures for the promulgation of water quality standards. In establishing its conductivity criteria and imposing their use on states, EPA Regions and the Corps, EPA has failed to follow its guidance, its regulations and its authorizing statute.

III. EPA's conductivity standards are not consistent with EPA guidance on developing aquatic water quality criteria

According to EPA, the Conductivity Study "applies EPA's standard method for deriving water quality criteria to field measurements." *See* Detailed Guidance at 11. In its request for a review by the Science Advisory Board, EPA claims that its conductivity criteria are "derived by a method modeled on EPA's standard methodology for deriving water quality criteria." *June 11, 2010, Memorandum from Michael Slimak to Vanessa Vu.* A comparison of the Conductivity Study to EPA's standard methodology reveals that EPA's study is not consistent with EPA's standard methodology and, as a result, is not scientifically sound or defensible.

EPA's standard methodology is set forth in EPA's 1985 *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Use* (USEPA 1985) (hereinafter "National Guidelines"). EPA's National Guidelines establish the threshold principles that all aquatic water quality criteria must meet. First, the purpose of the criteria is to protect aquatic organisms and their uses from unacceptable effects. *See* National Guidelines at vi. "Criteria should attempt to provide a reasonable and adequate amount of protection with only a small possibility of considerable overprotection or underprotection." *See* National Guidelines at 5. Proper criteria derivation requires the establishment of a cause-and-effect relationship to ensure that regulation of the pollutant is necessary and will produce the desired effect. *Id.* at 15-16, 21. Thus, "[t]he concentrations, durations, and frequencies specified in criteria are based on biological, ecological, and toxicological data, and are designed to protect aquatic organisms and their uses from unacceptable effects." *Id.* at 16. To develop such criteria, adequate

data must be available or the criteria should not be developed. *Id.* at 5-6. Specifically, there must be adequate data on pollutant levels that cause an unacceptable adverse effect on any of the specified biological measurements. *Id.* at 39. For materials that have a threshold effect, the threshold of unacceptable effect must be determined. *Id.* at 8. In addition, "[c]riteria must be used in a manner that is consistent with the way in which they were derived...." *Id.* at 7.

EPA's Conductivity Study departs from the recommendations of the National Guidelines in significant ways. First, EPA uses field data collected in uncontrolled settings instead of controlled laboratory data. Second, EPA analyzes the species sensitivity distribution (SSD) based on a determination that a species is absent (extirpated) from an ecosystem rather than the median lethal concentration. Third, in evaluating the extirpation of species, the Conductivity Study uses data from too few organisms and from organisms that are rarely found.

A. Criteria should be established using controlled laboratory data

To establish a cause-and-effect relationship, the National Guidelines require measurement of the impacts of pollutants on organisms in a controlled laboratory setting. Criteria are derived based on laboratory toxicity data from studies in which the stressor (*e.g.*, a pollutant) is empirically and unambiguously manipulated in studies that follow standardized and scientifically valid protocols for individual species. The biological endpoints used (based on survival, growth or reproduction) are derived based on relatively uniform and consistent stressor-response profiles generated from the laboratory toxicity tests. In this manner, the National Guidelines allow the development of criteria with a demonstrated cause-and-effect relationship between the stressor (the pollutant) and the response of an aquatic organism. Without these relevant laboratory data, the stressor-response relationship cannot be established, and the National Guidelines requires that the criteria not be developed.

In contrast to the rigorous methodology recommended by the National Guidelines, EPA uses field data, citing a lack of laboratory data.[4] This is a gross departure from the recommendations of the National Guidelines. Specifically, field data are not derived from a controlled setting. A researcher can find associations between the responses of aquatic organisms and the presence of a stressor, but it is not possible to establish a cause-and-effect relationship or to determine at what threshold the stressor creates a response. Significantly, in the field there will be many other factors that affect the organism, so an association or correlation cannot be presumed to establish causation. *See* Norwest 2010 at 16 "It is inappropriate to develop SSDs from field observations of specific genera where the presence and

[4] The National Guidelines say that "it is not feasible to determine national criteria by conducting such field tests [on a wide variety of unpolluted bodies of fresh (or salt) water]. National Guidelines, at 1. Remarkably, the Conductivity Study creates ***new science policy*** for EPA by asserting that "SSDs based on laboratory studies cannot replicate the full range of effects or species interactions that could reasonably be expected to occur in the environment (Suter et al., 2002)." Conductivity Study, at 3

absence of the genera are related to factors other than conductivity. This is the reason why SSDs are calculated from acute or chronic toxicity results from controlled laboratory experiments."

EPA attempts to address this flaw in its study by conducting an analysis of confounding factors. However, that analysis is equally flawed. In short, EPA never tested the validity of its hypotheses that conductivity is the cause of any observed extirpation of organisms and therefore is the best predictor of biological impairment. According to EPA, "this assessment of confounding takes the result of the causal assessment as a ***given*** and attempts to determine whether any of the known potential confounders interfere with estimating the effects of conductivity to a significant degree." Conductivity Study at 69 (*emphasis added*). EPA instead should have conducted rigorous and independent tests of its primary hypotheses. *See* Final Report at 34; Norwest 2010, at 2. EPA's failure to do so is bad science.

EPA also attempts to address this flaw in its study by citing other studies that EPA claims provide support for its presumption that conductivity is the cause of any observed adverse effects. However, the studies cited by EPA do not necessarily support the conclusions for which they are referenced. EPA cites a study by Kefford et al. (2003, 2005) as standing for the proposition that increased salinity results in increased mortality. However, Kefford and Nugegoda (2005) (as the citation appeared in the EPA references section) reported sub-lethal effects (growth and reproduction) and not mortality. EPA cites another study, Clark et al (2004) to support the proposition that salinity has sub-lethal effects, such as reduced growth, reproduction and hatching success. However, this study showed salinity had opposite effects on two mosquito species, indicating differing or inconsistent physiological responses. *See* Final Report at 20.

In fact, the studies cited by EPA in the Conductivity Study on the effects of salinity on other types of aquatic macroinvertebrates do not reach the conclusions that EPA is using them to support. Instead, they recommend further testing. In addition, EPA cited Zalizniak et al. (2007) for the proposition that reduced population density occurs over generations after elevated conductivity exposure. Based on the journal and article title from the "Literature Cited" section of the Conductivity Study, this citation should have been Zalizniak et al. (2009). However, GEI was unable to find any statement in Zalizniak et al. (2009) that supports this conclusion. *See* Final Report at 21.

Additional conclusions made by the authors in the studies cited by EPA that contradict EPA's assumptions were not discussed in the Conductivity Study. For example, Kennedy et al. (2004) concluded that conductivity levels up to 900 µS/cm appeared to be safe for sensitive benthic invertebrates, based on survival of *Isonychia* in their studies, instream mayfly distributions and endpoints from previous research. Kennedy et al. also concluded that reductions in the mayfly populations would likely occur between 1,500 to 2,000 µS/cm. Similarly, Echols et al. (2009) determined that impairment occurred around 1,400 mg/L of total dissolved solids (TDS), which is approximately equivalent to a conductivity level of 2,333 µS/cm. *See* Final Report at 28.

Clearly, the studies do not support EPA's presumption that its conductivity threshold accurately predicts adverse effects. In summary, there are insufficient data from the physiological and toxicology literature to support EPA's conclusion that "conductivities in the region of concern reach levels that are sufficient to cause effects on stream communities." *See* Conductivity Study at 52; Final Report at 64. In fact, EPA's inaccurate characterizations and selective use of the scientific research call into question the scientific rigor of the Conductivity Study.

There are insufficient laboratory studies to confirm either the causal mechanisms or conductivity thresholds that would confirm the proposed benchmark of 300 µS/cm. For similar reasons, Illinois, Indiana and Iowa have rejected the use of total dissolved solids or conductivity-based criteria in lieu of criteria for individual ions such as sulfate or chloride. *See* Final Report at 32; Norwest 2010 at 6.

Lastly, in contrast to the requirements for consistent stressor-response profiles from laboratory tests, the data in the Conductivity Study (Appendix D) show significantly conflicting stressor-response profiles. Such inconsistent, conflicting profiles preclude the use of these data in creating a conductivity benchmark.

EPA needs to conduct a more formal and rigorous analysis to evaluate whether or not conductivity—as opposed to other potentially explanatory factors—is in fact the best and most reliable indicator of adverse changes in biological communities in Central Appalachia. We agree that sufficient and appropriate laboratories are not available, but a preferred approach would be to generate data for the derivation of aquatic life criteria using standard methods. *See* Final Report at 64. Until such relevant studies are conducted, it is premature to suggest that a quantitative conductivity benchmark is an accurate and direct reflection of ions related to salinity.

B. EPA's data on species extirpation do not support its conductivity criterion

The methodology for data analysis for the SSDs used by EPA is "extirpation concentrations (XCs) rather than the median lethal concentrations (LC50s) recommended in the National Guidelines. *See* Conductivity Study at xii. The XC is defined by EPA as the level of exposure above which a genus is effectively absent from a waterbody.

The use of the XC not only deviates from the National Guidelines; the data EPA uses to identify extirpation includes data that do not meet the standards established in the National Guidelines. The National Guidelines state that data should be rejected if they are from tests in which too many organisms in the control treatment died or showed signs of stress or disease. Many laboratory studies are rejected for inclusion in a criterion calculation because mortality in the control exceeded a certain percentage. GEI cites other criteria that used cutoffs near 20 percent mortality (or 80 percent survival) in the controls. *See* Final Report at 37. In contrast, EPA considered a one percent collection probability in reference sites to

be acceptable. EPA even included data from organisms that have only a three percent probability of capture in reference streams. When a species is naturally rare, it is invalid for EPA to conclude that its rarity is due to conductivity levels.

Even assuming that examining species extirpation the field is a valid method of developing a criterion, EPA's conductivity criteria are invalid because EPA's own data do not support its hypotheses. EPA's own data show that the observed numbers of some caddisfly genera decrease when conductivity is increased (44 percent of the dataset). However, other genera exhibit a bell-curve or optimal level of conductivity (27 percent of the dataset), while the observed number of a third set of genera actually increases when conductivity increases (20 percent of the dataset). Finally, another set of genera shows no response or a bimodal response to conductivity (9 percent of the dataset). Thus, 56 percent of the taxa used by EPA to generate its SSD do not actually show the classic dose-response of decreasing probability of capture with increasing conductivity. However, these data were still used by EPA in its SSD calculations. *See* Conductivity Study at 30, Figure 5 and discussion of the data in Final Report at 6-12.

These conflicting stressor-response profiles by individual genera strongly indicate that conductivity is not the single or even the dominant stressor that can be shown to limit the entire macroinvertebrate community above a single fixed threshold or benchmark value. *See* Final Report at 12. Using these data is a fundamentally flawed method for deriving a regulatory benchmark. *Id.* at 12.

C. EPA bases its criterion on too few genera

The Conductivity Study only considers the effects of conductivity on certain invertebrate genera and then limits its consideration of the confounding factors to only one genera of mayfly, *Ephemeroptera*. In contrast, to help ensure that the total range of chemical sensitivities of organisms likely to be encountered in a broad range of field conditions is represented, the National Guidelines require a minimum database of eight specific types of aquatic genera before a criterion can be derived.

Even among the invertebrate species data considered by the Conductivity Study, when evaluating the potentially confounding variables (resulting from the use of field-data as opposed to laboratory data), the study limited its evaluation of these confounding variables to the confounder's effect on *ephemeropteran* genera (mayflies). *Ephemeroptera* were selected, allegedly "because they are among the most sensitive genera." *See* Conductivity Study at 15. The use of data from only invertebrate species and then considering the effects of potentially confounding variables on only one genera of mayfly does not correspond with requirement of the National Guidelines to have data collected from eight different families of aquatic organisms.

EPA has developed a White Paper on Aquatic Life Criteria for Contaminants of Emerging Concern that proposes to interpret and/or adapt the principles found in the 1985 National Guidelines for deriving aquatic life criteria when focusing on contaminants of emerging concern. Included in this White Paper is a proposal to

narrow the number of organisms when developing aquatic water quality criteria. On December 18, 2008, the SAB issued an Advisory on this White Paper, disagreeing with that recommendation. Science Advisory Board, *Advisory on Aquatic Life Water Quality Criteria for Contaminants of Emerging Concern,* EPA-SAB-09-007, (Dec. 18, 2008) (hereinafter "SAB Advisory" or "SAB"). The following section describes the SAB's concerns over EPA's proposal to narrow the requirement to obtain data from eight different families of aquatic organisms:

> The Committee finds that the White Paper contains a comprehensive discussion of the issue of taxonomic coverage for developing aquatic life criteria. [US]EPA's 1985 Guidelines require that data be available for the following organisms: a salmonoid in the class Osteichthyes, a second family in the class Osteichthyes, a third family in the phylum Chordata, a planktonic crustacean, a benthic crustacean, an insect, a family in a phylum other than Arthropoda or Chordata, and a family in any order of insect or other phylum not already represented...In the White Paper, EPA notes these taxonomic coverage requirements but recommends movement to a more "expert judgment" approach that is logical and should address some of the unique properties of [contaminants of emerging concern]. The Committee understands and appreciates the desirability of avoiding the extra work required to develop chronic data for species that are unlikely to be sensitive to certain [contaminants of emerging concern]. On the other hand, *we emphasize that it is equally important to perform adequate testing to ensure protection of aquatic life. Therefore it is important to define what constitutes a sufficiently robust set of chronic data for criteria derivation and also to provide additional guidance concerning the data needed to infer that various taxa are insensitive to chemicals with specific modes of action*...Moreover, because goals for aquatic life criteria should extend to the protection of ecosystems and their services rather than individual targeted organisms or specific subsystems, there is a need to assure that biological assessments adequately address a broad range of taxa and environmental contexts.

See SAB Advisory at 9 (emphasis added).

The SAB specifically notes "[t]here is a need to maintain broad taxonomic coverage for the development of aquatic life criteria." *Id.* at 10. The use of data from only invertebrate species and then considering the effects of potentially confounding variables on only one genera of mayfly does not correspond with the SAB's specific recommendation to "maintain broad taxonomic coverage."

In addition to the National Guidelines, EPA has published literature related to the similar issue of the appropriate development of biological criteria. In the EPA pamphlet "States and Tribes Embrace Bioassessment and Biocriteria for Protecting Streams and Small Rivers," EPA explains "[t]he presence, condition, numbers and types of fish, insects, algae, plants, and other organisms provide direct, accurate information about the health of water bodies" while the:

> [a]ssessment of only one type of animal or plant life leads to only 80-85% effectiveness in identifying aquatic life use attainment or non-attainment. Assessment of a water body's biology can include the analysis of macroinvertebrates (insects), periphyton (algae), or fish life. EPA recommends the use of two or more of these groups of biological assessments.

USEPA, Office of Water, States and Tribes Embrace Bioassessment and Biocriteria for Protecting Streams and Small Rivers, EPA-822-F-03-005 (2003). This document also suggests that the collection of data from only one genera of mayflies is insufficient to make a conclusion about appropriate aquatic life criteria.

Under the National Guidelines, if all required data are not available, a numerical criterion should not be derived "except in special cases." *See* National Guidelines at 26. Thus, in order to comply with the National Guidelines, the EPA must develop all necessary data identified in the Guidelines, which includes data from at least eight different families of aquatic life. *Id.* at 23.

D. EPA's conductivity criteria are not good predictors of biological impairment

Under the National Guidelines, aquatic water quality criteria are not supposed to result in either over- or under-protection. *See* National Guidelines at 5. However, it is clear that this could be the result of EPA's conductivity criteria. For example, in West Virginia there are 409 waterbodies that are not impaired using West Virginia's stream classification index, but that have conductivity levels above EPA's criterion of 300 µS/cm. On the other hand, there are 290 waterbodies that are classified as impaired by West Virginia that do meet EPA's conductivity criterion. Accordingly, EPA's conductivity criterion is not a good predictor of biological impairment. *See* Norwest 2010 at 8-9.

In fact, EPA's data do not support the assertion that EPA's conductivity criteria are even ecologically relevant. Fewer than 20 genera of mayflies may be sensitive to conductivity, based on EPA's data. According to GEI, if you look at the macrointertebrate community as a whole by functional feeding groups, there are few observed changes at conductivity levels between 2500 to 5000 uS/cm. The first major functional feeding group to undergo extirpation of all its member genera is the filter-collectors, when conductivity values exceed 10,000 µS/cm. *See* Final Report at 41.

IV. EPA has not lawfully promulgated scientifically defensible conductivity standards

EPA calls these criteria "new numeric water quality values for conductivity." *See* Detailed Guidance at 7. In the public announcement of the Detailed Guidance, Administrator Jackson called the criteria "standards." However, 300 and 500 µS/cm have not been adopted by any Appalachian state as numeric water quality standards.

Generally, states have narrative standards relating to conductivity. For example, Kentucky's narrative standard provides that "total dissolved solids or specific conductance shall not be changed to the extent that the indigenous aquatic community is adversely affected." However, rather than determining if a discharge actually results in an adverse impact, EPA is requiring states to assume an adverse impact based on the new conductivity criteria set forth in the Detailed Guidance. EPA has no authority to do this.

The CWA vests authority for the development of water quality standards in the states that are authorized to implement the act. Water quality standards have two main components: designated uses and criteria to protect those uses. *See* CWA section 303(c). State water quality standards are subject to EPA review and approval. All of the states in Appalachia are authorized to carry out the CWA permit program, including establishing water quality standards. This means that EPA has no authority to establish water quality standards in any Appalachian state unless the Administrator of EPA "determines that a new or revised standard is necessary to meet the requirements of the Act." *See* CWA section 303(c)(4)(B). EPA has not made any such determination with respect to the water quality standards of any Appalachian State.

EPA is subject to the requirements section 303(c)(4)(B) of the CWA and its implementing regulations at 40 C.F.R. part 131 when developing water quality standards. Specifically, state water quality criteria must be "necessary to protect the [designated] uses." *See* 40 C.F.R. 131.2. Criteria also must be based on "sound scientific rationale." *See* 40 C.F.R. 131.11(a). Numeric criteria should be based on EPA's section 304(a) guidance, section 304(a) guidance modified to reflect site-specific conditions or "other scientifically defensible methods." *See* 40 C.F.R. 131.11(b). In addition, narrative criteria may be established where numeric criteria cannot, or to supplement numeric criteria. *Id.*

By failing to establish impairment thresholds, EPA's proposed criteria cannot be shown to be "necessary to protect [designated] uses," as required by 40 C.F.R. 131.2. By failing to demonstrate cause-and-effect, these criteria are not based on "sound scientific rationale," as required by 40 C.F.R. 131.11(a). As a result, EPA's proposed criteria are not scientifically defensible, as required by 40 C.F.R. 131.11(b).

EPA cannot show that its proposed numeric criteria are "necessary to protect [designated] uses" because it cannot even demonstrate what effect its proposed criteria will have on a designated use. Absent a showing of a cause-and-effect relationship between the proposed criteria and a biological response in the water body, EPA also cannot demonstrate that its proposed numeric criteria are based on "sound scientific rationale" or "scientifically defensible methods."

In fact, as discussed above, EPA cannot even demonstrate that its conductivity criteria will have a beneficial effect on designated uses because 20 percent of the total genera examined actually increased when conductivity increased. Based on

these data, it could be concluded that EPA's proposed benchmark of 300 µS/cm will be harmful to some organisms. Accordingly, EPA's conductivity criteria do not meet CWA requirements.

V. The Conductivity Study fails to comply with EPA's Information Quality Guidelines

In accordance with the Data Quality Act, EPA has developed *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency* (Information Quality Guidelines or Guidelines).[5] Because EPA has disseminated its Conductivity Study without appropriate pre-dissemination review, and because that study is not accurate, reliable and unbiased, EPA must cease using the Conductivity Study to establish limits in permits under the CWA.

EPA issued its Information Quality Guidelines to ensure and maximize the quality of all disseminated information, particularly with respect to the information's objectivity, utility and integrity. The review of EPA's Conductivity Study provided above makes clear that EPA's misinterpretation of previous studies and failure to apply a weight-of-the-evidence approach to analyzing the science underlying the Conductivity Study violates the guidelines. This is particularly true because the Conductivity Study is "influential" information and therefore is subjected to an even more rigorous standard of quality.

A. The Conductivity Study qualifies as "influential" information

"Influential" information, which is information that will have a clear and substantial impact on important public policies or private sector decisions, must "adhere to a rigorous standard of quality" and "should be subject to a higher degree of quality."[6] As noted in the guidelines, information that supports policy documents, like EPA's Detailed Guidance, as well as information that addresses "precedent-setting or controversial scientific or economic issues," is considered influential. Further, certain "disseminated information that may have a clear and substantial impact on important public policies or private sector decisions" is also influential and subject to the higher degree of quality standard.

EPA is citing this study as justification for actions that EPA is currently taking on permits regarding mountaintop mining activities. Thus, there can be no question that the statements made by EPA in the Conductivity Study are highly influential; therefore, the underlying information must be of higher quality.

B. "Influential" EPA information must pass a two-step quality test

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[5] United States Environmental Protection Agency, *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency*, EPA/260R-02-008 (Oct. 2002) *available at* http://www.epa.gov/quality/informationguidelines/documents/EPA_InfoQualityGuidelines.pdf (Information Quality Guidelines).

[6] *Id.* at 20.

For "influential" information, such as the Conductivity Study, EPA has adopted a two-pronged approach to ensure that influential information will meet rigorous quality standards. First, EPA determined that when evaluating environmental problems it would apply a:

> *"weight-of-the-evidence" approach that considers all relevant information and its quality, consistent with the level of effort and complexity of detail appropriate to a particular risk assessment."*[7]

Second, EPA adapted the quality principles in the Safe Drinking Water Act Amendments (SDWA) of 1996 to ensure the objectivity of influential scientific information, as follows:

> (A) The substance of the information is accurate, reliable and unbiased. This involves the use of: (i) the best available science and supporting studies conducted in accordance with sound and objective scientific practices, including, when available, peer reviewed science and supporting studies; and (ii) data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies the use of the data).[8]

EPA has not followed its own approach for assuring that the Conductivity Study, as "influential" information, is based on "accurate, reliable and unbiased" information. As discussed above, in the Conductivity Study, EPA has misrepresented results of some scientific studies and has ignored findings that do not support its own conclusions. In fact, EPA's own data do not support its conclusions. A full examination of the flaws of the Conductivity Study is found in the reports NMA submitted on July 13, 2010, and September 3, 2010.[9]

C. EPA has disseminated the Conductivity Study without complying with the Information Quality Guidelines

As noted above, EPA has released the Conductivity Study for pre-dissemination review with the following disclaimer:

> This information is distributed solely for the purpose of predissemination peer review under applicable information quality guidelines. It has not been formally disseminated by the U.S. EPA. It does not represent and should not be construed to represent any Agency determination or policy.

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[7] Id. at 21.

[8] *Id.* at 22.

[9] GEI 2010; Norwest 2010; Final Report.

However, notwithstanding this disclaimer, EPA has disseminated the study and is relying on it for regulatory decision-making. *See, e.g.*, Detailed Guidance at 11-12; Letter dated June 21, 2010, from John R. Pomponio to Colonel Robert D. Peterson.

EPA's reliance on the Conductivity Study violates the agency's own Information Quality Guidelines. Accordingly, EPA must cease using the Conductivity Study for making any permitting or other regulatory decisions.

V. Conclusion

In summary, EPA has focused on limited number of genera of macroinvertebrates, counted the number of these macroinvertebrates found below MTM/VFs, assumed that if any genera (even rare genera) are missing then conductivity levels must be the cause, and used these data to establisha water quality criterion for conductivity. Further, EPA is now mandating that states, EPA Regions and the Corps use these new criteria in CWA permitting decisions.

As discussed above, EPA's conductivity criteria are not scientifically defensible and do not comply with EPA's Information Quality Guidelines. EPA has no legal basis to compel states, EPA Regions and the Corps to use them. In fact, EPA has created impermissible and irrational administrative presumptions when developing its conductivity criteria, as there is no "sound or rational connection between the proved and inferred facts." *Sec'y of Labor v. Keystone Coal Mining Corp.*, 151 F.3d 1096, 1100 (D.C. Cir. 1998). Accordingly, the conductivity criteria are unlawful and should be set aside.

Sincerely,

Karen Bennett, Vice President, Environmental Affairs
National Mining Association

September 3, 2010

Office of Environmental Information (OEI) Docket
U.S. Environmental Protection Agency
Mailcode: 2822T
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Honorable Paul Anastas
Assistant Administrator
Office of Research and Development
U.S. Environmental Protection Agency

Honorable Peter S. Silva
Assistant Administrator
Office of Water
U.S. Environmental Protection Agency

Attention Docket ID No. EPA-HQ-ORD-2009-0934

Re: Notice of Public Comments on "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields" (EPA/600/R-09/138A) 75 Fed. Reg. 18,499 (April 12, 2010)

To Whom It May Concern:

The National Mining Association (NMA) appreciates the opportunity to provide comments on the above referenced report (The Report), which was made available for public comment on April 12, 2010. 75 Fed. Reg. 18,499 (Apr. 12, 2010). NMA is a national trade association that includes the producers of most of the nation's coal, metals, industrial and agricultural minerals; the manufacturers of mining and mineral processing machinery, equipment and supplies; and the engineering and consulting firms, financial institutions and other firms serving the mining industry. The issues discussed in this report are extremely important to NMA's members because all coal extraction methods—both surface mining *and* underground mining—employed in the Central Appalachian region and beyond will be severely affected by the recommendations of this report.

We are also addressing this comment letter to both Assistant Administrator Paul Anastas of the Office of Research and Development (ORD) and Assistant Administrator Peter S. Silva of the Office of Water (OW) because, while the documents have been developed by ORD, they are currently being used by OW when reviewing coal mining permit applications. In addition, the question of the scientific adequacy of the documents is inextricably linked to the requirements of the Clean Water Act (CWA).

NMA's comments identify fatal flaws with EPA's report. First, the large number of inaccuracies and apparent confusion about the focus of the report casts doubts about the integrity of its conclusions. Second, EPA appears to be attempting to revise conclusions of the Department of the Interior lead, multi-agency 2005 Programmatic Environmental Impact Statement (PEIS) without following proper procedures. Finally, the scope of the report inappropriately includes an analysis of impacts to areas outside the regulatory jurisdiction of the EPA and conflicts with the Corps and EPA's regulations.

Specific Comments

1. The EPA (2009) report is fatally flawed

a. Scope of the report is ill-defined

EPA states that the report "assesses the state of the science on environmental impacts of mountaintop mines and valley fills (MTM-VF) on streams in the Central Appalachian Coalfields."[1] However, EPA's generalized use of the key phrase "mountaintop mining" or "MTM-VF," a term that has no meaning under the Surface Mining Control and Reclamation Act (SMCRA), renders it impossible to discern if any genuine concerns exist with a specific mining practice, or if the concerns raised should be generally applied to all surface mining. EPA's failure to clearly define what specific mining practice is the focus of the analysis calls into question the credibility of the report and limits the ability to draw any meaningful conclusions from the report.

The term "mountaintop removal" is mentioned one time in SMCRA but is not expressly defined. An exception to otherwise applicable reclamation standards, however, may be granted for the surface mining of coal where the mining operation will "remove an entire coal seam or seams running through the upper fraction of a mountain, ridge, or hill . . . by removing all of the overburden and creating a level plateau or a gently rolling contour with no highwalls remaining." It is these concepts—the mining of an *entire* seam through part of a mountain or ridge

[1] (U.S. EPA 2009).

resulting in a *plateau* without any remaining *highwall*—that implicitly identifies and explicitly authorizes the mountaintop removal method of surface mining.[2]

With respect to valley fills, all forms of coal mining and coal preparation activities create fills. In addition to valley fills associated with surface mining activities, coal preparation facilities, and underground mines utilize fills (refuse storage areas) in connection with the storage of rock, dirt, and coal particles that are separated from coal during the cleaning process. However, the EPA Report fails to consider the significant impact that implementation of the Report's recommendation will have on the ability of coal preparation facilities and underground mines to construct and utilize refuse storage areas.

Fills are a necessity to coal mining operations in Central Appalachia for two reasons. First, any rock removed from its original geological formation will expand upon being broken and then placed on the surface. The simplest illustration of this truth is to think of a brick and the volume it occupies. Break the brick into many pieces and it will occupy a larger space. The second reason that fills are necessary in mining is that any two geometric planes—such as the sides of a hill—that are adjacent and inverted will form a valley from which water will flow. Because any type of mining is apt to need some flat area on which to stage operations, even an underground mine is likely to create a fill.

Even when attempting to distinguish MTM-VF from other types of surface coal mining, EPA erroneously relies on factors such as the "scale" of the operation. The report's assumption that full extraction surface mines have effects that differ from other coal mining simply because of the large surface scale is unsupported. For example, the report states that although "other forms of mining can also produce small fills, valley fills resulting from mountaintop removal are by far the largest."[3] EPA provides no analysis to support this statement nor does EPA explain by what criteria is a "large" fill distinguishable from a "small" fill. For example, does the author mean the length of stream covered by a valley fill, or is the description intended to mean the number of cubic yards of excess spoil material deposited in the valley?

Moreover, neither is the amount of excess fill material produced an indicator of mining practice nor should it be used to predetermine impact. Contrary to EPA's assertions, no clear relationship exists between the volume of coal removed and the number of acres of land disturbed. For example, Office of Surface Mining (OSM) statistics identified on page 16 of the report indicate that approximately three times the number of acres in Kentucky have been disturbed by mining as compared to West Virginia. Although the statistical information is too limited to allow a detailed analysis, the numbers presented do not make sense if EPA's assumption is factual. West Virginia has mined more coal over the last two decades than Kentucky.[4] West

[2] 30 USC § 1265(c)(2).

[3] U.S. EPA 2009 at Page 5.

[4] Energy Information Administration

Virginia operations have utilized more large scale mining equipment such as draglines that are necessary for full extraction surface mining than in Kentucky over the same period. If the assertion that full extraction surface mines create larger fills and more land disturbance is true, then the statistics cited in the report should logically show that more acres in West Virginia than Kentucky should be identified as disturbed. However, just the opposite is reported. This inconsistency calls into question the underlying assumption that surface mining methods that do not remove an entire seam of coal across an entire ridge disturb fewer acres of land per unit of coal removed. EPA's use of these parameters as a means to focus its analysis suggests that EPA is either confused about what it wants to examine or suggests that all mining, particularly in steep sloped areas, is implicated.

b. EPA's estimate of headwater stream loss is factually inaccurate

First, it is important to note that EPA's Report conflicts with information underlying the EPA 2005 PEIS, published just five years ago, including 30 comprehensive scientific studies conducted over a span of four years, which found that despite the size of these MTM operations, about 98 percent of the streams in the study are not directly impacted by MTM. EIS III D-2. Only slightly more than one percent of streams are actually filled, and many of those "streams" consist of areas that either flow only intermittently for part of the year, or are dry channels that contain water only immediately after a rainstorm. *Id.* It appears that EPA's concerns focus on the filling ofone percent of ephemeral drainages or headwater streams.

But EPA's use of conflicting definitions in trying to analyze these impacts results in statements that are generally applicable to nearly any headwater system in the eastern United States and not just limited to those considered to be impacted by MTM/VF operations. Where specific information on relevant central Appalachian headwater streams is referenced, there is little to indicate that these streams are unique from other streams in the eastern United States or even from downstream reaches of the same streams. (*See* Steve Canton, GEI Consultants, Inc., Review of Relevant Sections of EPA MTM Report, July 7, 2010, attached). The result is a drastic overstatement of the measure of loss of headwaters as well as the impact from mining.

At NMA's request, GEI Consultants, Inc./Ecological Division conducted a review of EPA's report and provided NMA with an evaluation of key portions relevant to conclusions on ecological effects. We incorporate that report into these comments by attachment and draw your specific attention to Part 2.0 Definition of Headwaters and Measure of Loss of Headwaters. In short, GEI Consultants concludes that EPA's measure of impacts to headwater streams stated in the report is not only misleading, but factually inaccurate. *See* Canton at page 2.

According to GEI's review, EPA's calculation of loss of headwaters by using the area of watersheds covered by valley-fills as a surrogate for headwater stream loss is misleading. EPA initially provides a measure of the impacts to headwaters that is linear; i.e. apparently referring to miles of stream downstream from where a defined channel is formed, with cumulative impacts reported in number of miles.

However, EPA then notes that there is a possibility that isolated springs, seeps and wet areas may also occur upgradient of that point where headwaters are formed. Based on this possibility of isolated, upgradient springs, seeps and wet areas, EPA subsequently replaces the linear notion of headwater streams with an aerial concept by measuring the entire catchment upgradient of the point where a defined channel is formed that was used to define headwater stream. Therefore, even though isolated springs, seeps and wet areas do not exist in every valley, and even though EPA specifically defined headwaters as where a defined channel is formed, EPA calculates the entire watershed area upstream of that point in its estimates of headwater loss to overstate any impacts. Putting aside the jurisdictional issue of whether EPA has the authority to regulate areas upland of a defined stream channel that may or may not contain "waters of the United States," this methodology EPA utilizes to inflate the loss of headwaters is extraordinarily misleading. A more detailed explanation of why EPA's methodology is factually incorrect is included in the attached July 7, 2010, Technical Memorandum prepared by Steve Canton, GEI Consultants, Inc. at page 2.

Further, GEI's Memo at Part 3.0 finds that EPA's statements that the Central and Southern Appalachians are a biodiversity hotspot are irrelevant in this context because most of the coal mining region of southern West Virginia is not even located within that hotspot area. Therefore, GEI report concludes, much of the discussion on "biodiversity loss" is irrelevant to streams with MTM/VF operations in the study area.

EPA's conclusions in Section 3.2 of the report indicate that the loss of headwater biota and the effects on regional biodiversity would be expected to be most severe for taxa that occur only in headwater ecosystems. However, EPA's own calculations indicate that valley fills are, in fact, not burying headwater streams, but rather are located above of the point where headwater streams are formed. Second, EPA failed to identify any specific invertebrate taxa that are restricted to such headwater habitats. Instead, even EPA's analysis shows that many invertebrate taxa are found in both intermittent and perennial streams, as described in EPA Report at p. 14 II. 5-6, 12, 14-15. This data indicates that there is very little difference between the communities of intermittent streams and perennial streams in these systems, and the biotic communities found in intermittent streams are not unique in nature. Neither EPA nor any of the papers EPA cites can identify a unique assemblage of invertebrate taxa in the headwaters of these streams. For these reasons, this entire analysis is irrelevant to EPA's report.

c. The report draws faulty conclusions from studies cited

An analysis of EPA's literature citations reveals a number of glaring errors. In many instances, EPA used citations to support assertions that are not supported by the referenced document. Various examples of these inconsistencies are contained in the attached Appendix 1.

Perhaps the most striking example is found in sections of the report dealing with the alleged affects of coal mining on amphibians and reptiles. According to the

report, amphibians and reptiles suffer adverse effects caused by loss of habitat as a result of coal mining. Examination of the source text demonstrates that these authors never exclusively refer to those areas of West Virginia or adjacent states where coal is mined and none of the three texts EPA cites are focused exclusively on that portion of West Virginia that is the subject of the report. Each of the source texts instead refers to a much broader area, the "Southern Appalachian Mountains." However, EPA inappropriately uses these conclusions as support for the conclusions in this report. It appears that EPA simply assumed that references in these studies to "Southern Appalachian Mountains" could be construed to be the same area as the EPA study area, "Central Appalachia". Therefore, it is inaccurate and misleading for EPA to ascribe those effects identified in the source texts to surface coal mining in the study area.

The following examples further illustrate this problem. On page 13, EPA states that, "nearly 10% of global salamander diversity is found within streams of the Southern Appalachian Mountains." The statement is attributed to Green and Pauley, 1987.[5] The source text, however, describes salamanders throughout the entire state of West Virginia and not any specific region. The report itself at page 7 is clear to delineate specific counties in Central and Southern West Virginia that are the subject of its review, and exclude several counties in the northern part of the state and Pennsylvania where coal is mined. The source text cited states, "Salamanders occur in the North Temperate Zone of the Old World, in South America, Central America, and in North America. There are 9 families, about 60 genera, and about 300 living species recognized. In West Virginia, there are 5 families, 11 genera, and 28 species known."[6] The implication of the report that these species are a matter of peculiar concern stemming from mining is not substantiated by the cited study. This same issue is raised in comments submitted to the Science Advisory Board on July 22, 2010.

Similarly, on page 14, EPA states," The effects of the loss of headwater biota on regional biodiversity would be expected to be most severe for taxa that occur only in headwater ecosystems, including intermittent streams (Morse et al., 1993; Morse et al., 1997; Hakala and Hartman, 2004).[7] The authors cited, however, "recognize the southern Appalachian Mountains as the region covered by the Blue Ridge and the Ridge and Valley physiographic provinces from Maryland and West Virginia southward into Georgia and Alabama." This is an area far greater in size than the four states that are the subject of the report.

Finally, also on page 14, the report states, "[h]igh levels of genetic diversity in geographically distinct lineages of the spring-endemic Brownback Salamander (*Eurycea aquatica*, Plethodontidae) have recently been described in the Southern

[5] Green, NB; Pauley, TK. (1987), "Amphibians and reptiles in West Virginia." Pittsburgh, PA: University of Pittsburgh Press.
[6] *Id.* at 45.

[7] Morse, JC; Stark, BP; McCafferty, WP. (1993) "Southern Appalachian streams at risk – implications for mayflies, stoneflies, caddisflies, and other aquatic biota." Aqua Conserv Marine Freshw Ecosys 3:293–303.

Appalachian Mountains (Timpe et al., 2009).[8] "Here, we test these competing hypotheses using mitochondrial (mt) and nuclear (nuc) DNA sequences of a thorough sampling of salamanders from springs and streams throughout the Ridge and Valley and Appalachian Plateau (i.e., Cumberland Plateau and Highland Rim) of Alabama and Georgia. . . . We discuss our results in the context of the largely unrecognized biodiversity and endemism of spring-dwelling species in this region, which are currently threatened by multi-causal habitat destruction." The source text is clear that the subject area of the study is far removed from the Central Appalachian coal mining counties that are the subject of the report. Indeed, West Virginia is never even identified in this text. Moreover, whatever "multi-causal habitat destruction" is at work in the region studied by these authors, coal mining was not among them.

2. EPA attempts to rewrite conclusions of the 2005 programmatic environmental impact statement (PEIS)

MTM-VF practices have been extensively and continuously studied and analyzed since the enactment of SMCRA. For example, in 1979, EPA authored a report concluding the MTM is actually environmentally desirable, and that head of hollow fills can reduce adverse environmental impacts. [9] Ten years later, in 1989, the Department of the Interior prepared a report to Congress on MTM. This report concluded that "no significant evidence of widespread or routine violations of State and Federal water quality standards" and that "on balance ... the positive impacts of MTM can outweigh the negative impacts. [10] And in 2005 EPA was the author of a multi-agency programmatic Environmental Impact Statement (PEIS) that was conducted by several federal agencies and the WV Department of Environmental Protection (DEP) to examine the impacts of surface mining in Appalachia.[11] EPA's 2010 report is in direct conflict with two decades of study conducted by several state and federal regulatory agencies and appears intended to rewrite the conclusions of the PEIS. We have attached a copy of NMA and state coal associations Jan. 6, 2004, joint comments which show that these are not new issues EPA is raising nor has EPA provided significant new information in its report that has not already been comprehensively studied. Therefore, EPA's goal must be to revise the conclusions of the PEIS through issuance of this study.

EPA's water quality concerns are based in large part on a 2008 report authored by staff biologists in the agency's Wheeling, W.Va., field office titled *Downstream Effects of Mountaintop Coal Mining: Comparing biological Conditions Using Family and Genus Level Macroinvertebrate Tools.*[12] Despite EPA's claims that this report,

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[8] Timpe, EK; Graham, SP; Bonett, RM. (2009) Phylogeography of the Brownback Salamander reveals patterns of local endemism in Southern Appalachian springs. Mol Phylogen Evol 52(2):368–376.

[9] Environmental Assessment of Surface Mining Methods: head-of-Hollow Fill and Mountaintop Removal, Interagency Energy/environment R&D Program Report; U.S. EPA (July 1979).

[10] "State of West Virginia Governor's Task Force on MTM and Related Practices," (December 1998).

[11] U.S. Enviromental Protection Agency, et al. Programmatic MTM/VF Environmental Impact Statement 2005.

[12] Pond G.J., M.E. Passmore, F.A. Borsuk, L. Reynolds, and C.J. Rose. 2008. Downstream effects of mountaintop coal mining: comparing biological conditions using family- and genus-level macroinvertebrate bioassessment tools. Journal of the North American Benthological Society 27:717:737. Page 2.

commonly referred to as Pond-Passmore, represents "new information" regarding the downstream impacts of mining activities, the study presents no such new information. It simply presents existing information and data in the context of an assessment tool (that is not endorsed by any agency) that appears to be specifically designed to overstate the effects of mining on a downstream watershed. NMA has completed a comprehensive review of the Pond-Passmore study and on July 13, 2010, we submitted two reports to EPA demonstrating that the relationships identified in Pond-Passmore were based purely on statistical correlations between water quality characteristics and benthic macroinvertebrate community structure and do not represent a formal or mechanistic test of the hypothesis that conductivity is the primary cause of changes in the macroinvertebrate communities downstream of MTM/VF activities.[13] A copy of each of these two reports is attached.

Furthermore, mining and valley fill construction and its effect on downstream benthic communities has been well-documented. The 2005 multi-agency programmatic Environmental Impact Statement (PEIS) was conducted by several federal agencies and the WV Department of Environmental Protection (DEP) to examine the impacts of surface mining in Appalachia.[14] EPA was a primary author and the publishing agency for this PEIS. Included in the PEIS findings and conclusions are several statements relevant to EPA's contention that new information exists with respect to aquatic impacts from coal mining.

The following conclusions are included in the 2005 PEIS:

> Overall, the abundance of macroinvertebrates was found to be similar in upstream and downstream stations or to be slightly higher in downstream stations.[15]
>
> Biological conditions in the mined sites generally represented very good conditions...[16]
>
> Watershed impacts directly attributable to mining and fills could not be distinguished from impacts due to other types of human activity. [17]

The conclusions of these government-sponsored studies have been further confirmed by independent research:

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[13] See GEI Consultants, Inc. (GEI). 2009a. Identification of Issues in Regard to the Pond et al. Study on Effects of Mountaintop Minig and Valley Fill on Benthic Invertebrate Communities. Technical memorandum, GEI Consultants, Inc., Denver, CO; GEI Consultants, Inc. (GEI). 2009b. Update on Issues for Further Investigation in Regard to the Pond et al. Study on Effects of Mountaintop Mining and Valley Fill on Benthic Invertebrate Communities. Technical Memorandum, GEI Consultants, Inc. Denver, CO.

[14] U.S. Enviromental Protection Agency, et al. Programmatic MTM/VF Environmental Impact Statement 2005.

[15] U.S. Environmental Protection Agency, et.al. Programmatic MTM/VF Environmental Impact Statement. Pg. III. D-9. 2005.

[16] Ibid. Pg. III.D-12.

[17] Ibid. Pg. II.C-74.

> Neither the changes in the biological community, nor the changes in the water chemistry in the filled sites appear to have a significant adverse impact on the stream function with respect to downstream segments. The most significant changes in the biological community appear to be a shift in the functional feeding groups toward more filter feeding organisms. This typically occurs in streams whenever ponds, dams or municipal discharges are present. The increased abundance at these sites, which likely results from the increased food sources, indicates that sufficient food is available to support a benthic community at these locations and downstream.[18]
>
> With no anticipated water quality impairments downstream of the proposed mining and valley fill activities, there should be no long term impacts downstream of mining and valley fill construction after the temporary impacts associated with disturbances in the watershed have abated. These temporary impacts, such as sedimentation from timbering and earth disturbance and the presence of sediment ponds, will be addressed via best management practices, engineered controls (isolation of materials, materials handling plan) and the NPDES permit. Based on the findings of Hendricks (1999), the EPA's most recent Mountaintop Mining Environmental Impact Statement (MTM EIS), the MTM EIS Supplemental Study conducted by POTESTA and research presented by Merricks (2003), where functional benthic macroinvertebrate communities were documented downstream of valley fills, no significant impacts to streams are anticipated.[19] Overall, the benthic macro-invertebrate community was not significantly hindered by the drainages originating from the hollow fills [valley fills].[20]

Perhaps the most important conclusion of the PEIS was that "...the EIS studies did not conclude that impacts documented below MTM/VF operations cause or contribute to significant degradation of waters of the U.S."[21]

Since the PEIS resulted in the agencies jointly concluding that mining operations were not causing significant degradation and the Pond-Passmore report is nothing more than a restatement of existing data through a new interpretative assessment method, NMA fails to understand how EPA's conclusions with respect to the impacts from MTM/VF can differ from the findings of the PEIS regarding significant degradation. Yet it appears EPA now wants to take a different position.

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[18] Supplemental Quantitative Benthic Macro invertebrate Studies Implemented in Conjunction with the U.S. EPA Mountaintop Mining/Valley Fill Environmental Impact Statement Study. Potesta & Associates, September 2003.
[19] Dr. Mindy Armstead, Response to Expert Reports on the Statement of Findings of the United States Corps of Engineers and Compensatory Mitigation Plans... 2007
[20] Evaluation of Hollow Fill Drainages and Associated Settling Ponds on Water Quality and Benthic Macro invertebrates Communities of Virginia and West Virginia. T. Chad Merricks, Donald Cherry, Carl Zipper. Department of Biology, Virginia Polytechnic Institute and State University, 2006.
[21] U.S. Environmental Protection Agency, et.al. Programmatic MTM/VF Environmental Impact Statement. Pg II.D-9.

If rewriting the jointly developed conclusions of the 2005 PEIS via production of EPA's "report" is the goal, then EPA would need to complete a supplemental EIS. A simple study, such as the one EPA has done here, falls short of what is required by law.

A supplemental EIS reviews the findings in an existing EIS. A supplement is only required when it is necessary to update an existing EIS because of either "substantial changes in the proposed action" or the development of "significant new circumstances or information" pertaining to that action or its impacts. 40 C.F.R. § 1502.9(c)(1). Agencies "[s]hall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement unless alternative procedures are approved by the Council on Environmental Quality." 40 C.F.R. § 1502.9(c)(4). Therefore, the procedure for preparing a supplemental EIS is the same as the procedure for preparing a draft and final EIS (except for scoping).

An agency can review an existing EIS without preparing a supplemental EIS. Specifically, courts have upheld agency use of supplementary information reports ("SIRs") and similar procedures for the purpose of determining whether new information or changed circumstances require the preparation of a supplemental EIS.[22] *See Price Rd. Neighborhood Ass'n v. United States Dep't of Transp.*, 113 F.3d 1505, 1510 (9th Cir. 1997). Courts have permitted agencies to use SIRs for this purpose, in part because NEPA and the CEQ regulations are silent on the issue of how agencies are to determine the significance of new information. *Id.* at 1510. However, once an agency determines that new information is significant, it must prepare a supplemental EIS; SIRs cannot serve as a substitute. *Idaho Sporting Congress Inc. v. Alexander*, 222 F.3d 562, 566 (9th Cir. 2000). If the document prepared by EPA here is being used for the purpose of evaluating *the significance of* new information or changed circumstances then EPA would not be required to prepare a supplemental EIS and follow NEPA procedures. However, if EPA determines that the information from the report is significant, then EPA would be required to prepare a supplemental EIS.

If it is determined that EPA is using a report to correct supposed deficiencies in an EIS, then it is inconsistent with NEPA for EPA to use this report, as opposed to a supplemental EIS. *Id.* at 567. NEPA is a procedural statute, and courts have held that "agency action taken without observance of the procedure required by law will be set aside." *Metcalf v. Daley*, 214 F.3d 1135, 1141 (9th Cir. 2000). Once again, agencies "[s]hall prepare, circulate, and file a supplement to a[n environmental impact] statement *in the same fashion* ... as a draft or final statement." 40 C.F.R. § 1502.9(c)(4) (emphasis added). NMA concludes that the information or disinformation from the report is significant by its very adverse impacts on the surface coal mining industry. Thus, EPA must prepare a supplemental EIS.

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[22] NEPA imposes on federal agencies a continuing duty to supplement existing EAs and EISs in response to "significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. § 1509(c)(1)(ii); *see also Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 372-373 (1989).

3. Other flaws in the report

a. Observed effects of selenium on aquatic life do not correspond with literature cited

The report states that "coal mining has been a chronic source of selenium, because selenium is a naturally occurring element in certain coal seams and associated strata, particularly in Southern West Virginia." This statement is misleading based on what is known about selenium toxicity. EPA itself acknowledges that studies have shown that diet is the primary route of exposure that controls chronic toxicity to fish and that if organisms are provided with an uncontaminated diet, then exceedingly high water concentrations, possibly above the acute criterion, are needed to elicit effect. What EPA's report fails to acknowledge is that many of these coal seams have been mined for decades, and long before a water quality criterion for selenium was promulgated by EPA, yet many coal mining watersheds have fish populations similar to those in watersheds where mining has not occurred. This suggests that the harm EPA assumes must result from mining selenium laden coal seams has been over-predicted.

Also missing from the report is any discussion about EPA's imminent issuance of guidance suggesting that the agency has concluded that a water-based criterion is not the most appropriate for measuring selenium toxicity because diet is the most important route of exposure for chronic toxicity.[23]

EPA's revised approach would instead be based on a concentration of selenium in fish eggs with the water column value being used as a threshold to determine if fish egg examination is necessary. Since the report recommends further study, some explanation as to how the proposed revised standard would be implemented would be useful.

Another omission that is perplexing is the failure to distinguish between the different valent forms of selenium that have been the subject of previous investigation. For example, the selenium found in coal ash concentrated in an impoundment is the valent form (+4) normally referred to as selenite. It is the subject of numerous papers prepared by one scientist, Dennis Lemly, Ph.D., who is identified in the report. The valent form of selenium that is discharged from most surface coal mining operations is the valent form (+6) known as selenate. Both forms are known to become available to aquatic wildlife through diet. Nevertheless, the effects observed by Dr. Lemly in the coal ash impoundment in many of his papers have not been observed in the flowing streams into which most mines discharge. The valent form of selenite is generally believed to be more biologically available than the valent form of selenate. Conducting experiments to validate this observation would be a worthy topic of study, but it is not proposed. Likewise, whether the receiving body of water is flowing or standing is also of practical concern, but it is not identified as a topic of further investigation. In fact, we

[23] See Draft Aquatic Life Water Quality Criteria for Selenium 2002, EPA contract No. 68-C6-0036 (March 2002 Draft).

understand EPA's guidance will establish different acceptable levels of selenium in flowing versus non-flowing systems. This issue needs to be addressed in the context of the MTM-VF report.

Expert testimony on the issue of selenium and its effects on aquatic life was presented at a trial in federal court in Huntington, W. Va., during the week of Aug. 9, 2010. Peter Chapman, the author of papers identified in the report, has been designated as expert witness by one party in the case.[24] Before proceeding with any plan of study, it would be worthwhile to secure the testimony of these experts for the purpose of developing any future examination of the effects of selenium. The conclusions of the report, as now written, assume that such effects exist and that future study is intended merely for the purpose of verifying those assumptions. Such a conclusion is contrary to the "good science" that EPA has insisted it will employ in all of its work.

b. EPA lacks a legal basis for regulating the filling of most small tributary channels and streams

The report bases its objections to current mining practices upon the alterations and effects to small tributary channels and streams. Although the report uses the expression "streams," it also acknowledges that what EPA is really focused on amounts to small erosional channels in the upper-most reaches of a mountain. The agency likewise views the act of mining that physically alters the land surface as equally detrimental: "When the mountaintop is removed, so are the intermittent streams, springs and small perennial streams that comprise the headwaters of rivers."[25]

The CWA is crystal clear that valley fill construction is permissible under Federal and State law. The Fourth Circuit Court of Appeals has clearly held that this is true because: (1) EPA's and the Corps' interpretation of "fill material," which expressly included coal mining overburden placement in waters of the U.S. (including the "streams" at issue here), was a reasonable interpretation of the CWA; and (2) SMCRA anticipates that excess spoil from MTM "could and would" be placed in waters of the U.S.[26]

EPA's and the Corps' authority is limited to the narrow issue of discharges of dredged or fill material into areas that qualify as waters of the United States ("jurisdictional waters"). See 33 U.S.C. 1344; *Valley Environmental Coalition v. Aracoma Coal Company*, 556 F.3d 177 (4th Cir. 2009) (*"OVEC"*) , 556 F.3d. at 195; 40 C.F.R. 230.2. EPA is not authorized to consider non-fill related discharges, impacts to non-jurisdictional waters or impacts to uplands. Yet much of the report is focused on these extraneous impacts. *See* discussion on EPA's calculation of headwater stream loss for a good example.

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[24] Although Dr. Lemly was originally identified as an expert witness in the case, he has been withdrawn as a witness and an affidavit and report that he previously provided in the matter have been stricken by the court.

[25] Report at 70.

[26] See Kentuckians for the Commonwealth v. Rivenburgh, 317 F.3d. 425, 443 (4th Cir. 2003).

NMA believes there are serious questions as to whether the streams that are the subject of the report would qualify as jurisdictional waters under the CWA. *Solid Waste Agency of N. Cook County v. U.S. Army Corps of Eng'rs,* 531 U.S. 159 (2001) ("SWANCC"); *Rapanos v. United States*, 547 U.S. 715 (2006). Yet EPA assumes these waters are jurisdictional and would require a permit.

Even if the streams in question would qualify as jurisdictional waters, EPA may not consider potential impacts to upland forests. *OVEC*, 556 F.3d. at 194. Yet much of the focus of the report, such as large-scale deforestation and effects on terrestrial wildlife, etc., suggests otherwise. Congress has entrusted the protection of these resources to OSM and delegated states under SMCRA.

d. Criticism of mitigation applied in context of mining is inconsistent with and contradicts EPA's mitigation policy

EPA's criticism of the mitigation techniques used in mining is inconsistent with and contradicts EPA's own mitigation policy adopted in 2008 and conflicts with the U.S. Court of Appeals for the Fourth Circuit upholding the Corps' permit review procedures and analysis with regard to making mitigation determinations.[27] The report claims a lack of evidence that onsite mitigation by constructed channels or wetlands has replaced or will replace the lost ecosystem functions and biodiversity.[28] However, mitigation is not required to replace ecosystem functions and biodiversity. [29] In fact, EPA's Mitigation Rule recognizes that certain compensatory mitigation projects will not succeed in replacing ecosystem functions and biodiversity lost or altered as a result of mining activities.[30] While it is the ultimate goal of EPA to have "no net loss" of aquatic resources, EPA acknowledged in its Mitigation Rule that the policy is meant to apply to the program overall and is not a permit specific policy.[31] Contrary to this concept, the report insinuates that stream mitigation that does not completely replace ecosystem functions and biodiversity is improper—a position that is not found anywhere in the law or governing regulations.

The report unfairly focuses on unsuccessful stream mitigation and notes that there is no substantive evidence that stream restoration will replace lost functions and biodiversity. However, in direct conflict, EPA's Mitigation Rule stresses that there is a growing body of research that documents successful outcomes for stream restoration projects.[32] Specifically, the Mitigation Rule cites successful outcomes

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[27] Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. 19,594 (Apr. 10, 2008) (to be codified at 40 C.F.R. pt. 230); hereinafter "Mitigation Rule".

[28] Report at 2.

[29] See Ohio Valley Environmental Coalition v. Aracoma Coal Company, 556 F.3d 177 (4th Cir. 2009).

[30] 73 Fed/ Reg 19594, 19,605 (Apr. 10, 2008).

[31] Id.

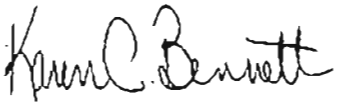
[32] *Id.* at 19,596.

with respect to water quality, habitat creation, species recovery and recreation.[33] EPA has not provided an explanation for what has changed since its 2008 analysis of stream mitigation to justify statements to the contrary in the report and a complete disregard of the body of literature that documents successful mitigation projects and the environmental benefits they produce. EPA's inconsistency and unbalanced approach to the stream mitigation discussion in the report warrants explanation.

Conclusion

For all these reasons, NMA concludes that EPA should withdraw the report until such time as the erroneous and misleading information included in the report are corrected, consistent with scientifically sound information. EPA should not use any part of the report in the context of reviewing or commenting on any coal mining related permits until such time as the accuracy of the report is revisited. Finally, EPA should follow proper procedures consistent with NEPA, e.g., preparing a supplement EIS for the PEIS, and the APA prior to making any changes to the current regulatory framework for surface and underground coal mining.

Sincerely,



Karen Bennett, Vice President, Environmental Affairs
National Mining Association

[33] *Id.* at 19,597.

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September 3, 2010

Office of Environmental Information (OEI) Docket
Mail Code 2822T
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

Comments on EPA's Draft Report: A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams
Docket ID No. EPA-HQ-ORD-2009-0934

Dear Sir/Madam:

Attached are the comments of the Utility Water Act Group on EPA's Draft Report: A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams.

Please call me if you have any questions.

Sincerely,

Brooks M. Smith

Attachment

UWAG
Utility Water Act Group©

COMMENTS OF THE UTILITY WATER ACT GROUP (UWAG) ON EPA'S DRAFT REPORT: A FIELD-BASED AQUATIC LIFE BENCHMARK FOR CONDUCTIVITY IN CENTRAL APPALACHIAN STREAMS

Docket ID No. EPA-HQ-ORD-2009-0934
75 Fed. Reg. 18,499 (April 12, 2010)

September 3, 2010

Utility Water Act Group (UWAG)[1] appreciates this opportunity to comment on EPA's draft report "*A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams*" (EPA/600/R-10/023A), which was released for public review on April 12, 2010 (75 Fed. Reg. 18499) (defined here as the "Benchmark Report"). As described in more detail below, UWAG has significant legal and technical concerns about the Benchmark Report, as well as its immediate, indiscriminate use for permitting purposes.

In addition to the comments presented here, UWAG is a member of the Federal Water Quality Coalition and endorses the Coalition's separate comments. UWAG also endorses the National Mining Association's comments and related technical reports, as presented to EPA and EPA's Science Advisory Board ("SAB"). While UWAG's members typically do not engage in the types of coal mining activities immediately subject to EPA's Benchmark Report, they do rely on the coal produced from those activities to supply much of the Nation's energy needs and thus will be indirectly affected by EPA's action. Moreover, if applied to other regions and industries, as contemplated by EPA, the Benchmark Report could have direct and adverse effects on UWAG's members.

The Benchmark Report establishes a "chronic aquatic life benchmark value" for conductivity of 300 μS/cm, applicable to parts of West Virginia and Kentucky, and "expected to

[1] UWAG is a voluntary, *ad hoc*, non-profit, unincorporated group of 212 individual energy companies and three national trade associations of energy companies: the Edison Electric Institute, the National Rural Electric Cooperative Association, and the American Public Power Association. The individual energy companies operate power plants and other facilities that generate, transmit, and distribute electricity to residential, commercial, industrial, and institutional customers. The Edison Electric Institute is the association of U.S. shareholder-owned energy companies, international affiliates, and industry associates. The National Rural Electric Cooperative Association is the association of nonprofit energy cooperatives supplying central station service through generation, transmission, and distribution of electricity to rural areas of the United States. The American Public Power Association is the national trade association that represents publicly owned (municipal and state) energy utilities in 49 states representing 16 percent of the market. UWAG's purpose is to participate on behalf of its members in EPA's rulemakings under the CWA and in litigation arising from those rulemakings.

be applicable to the same regions of Ohio, Pennsylvania, Tennessee and Maryland." Report at p. xiii. EPA derived this value using a novel, field-based adaptation of EPA's standard methodology for deriving water quality criteria. Report at p. xii.

EPA's conductivity value does not "represent any Agency determination or policy" and remains subject to independent review by the Science Advisory Board ("SAB").[2] Moreover, as a matter of law, EPA's conductivity value is neither a recommended water quality criterion under Section 304(a) of the Clean Water Act, nor a binding water quality criterion under Section 303 of the Act.[3] However, EPA has directed federal and state permitting authorities to apply this new conductivity value as if it has ***immediate and presumptive legal effect***. *See, e.g., EPA's Detailed Guidance: Improving EPA Review of Appalachian Surface Coal Mining Operations under the Clean Water Act, National Environmental Policy Act, and the Environmental Justice Executive Order*, April 1, 2010 (defined here as the "April 1 Guidance"):

> During the SAB review process, EPA believes that [the Benchmark Report] should be considered by Appalachian states as relevant information per 40 CFR Section 122.44(d)(1)(vi) in implementing applicable state narrative water quality standards in NPDES permits, and by Regions in your review of these permits.

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[2] When EPA released the Benchmark Report, it did so with an explicit caveat: "[t]his information is distributed solely for the purpose of predissemination peer review under applicable information quality guidelines. It has not been formally disseminated by the U.S. EPA. It does not represent and should not be construed to represent any Agency determination or policy." EPA also committed to subject both the Benchmark Report and a related literature compendium, "*The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields*," (EPA/600/R-09/138A), to review by an independent panel convened by the SAB.

[3] EPA has not issued a determination or proposal under Section 303(b) or (c), which serves as a prerequisite to establishing binding federal criteria. Moreover, EPA has conceded that the Benchmark Report does not qualify as a 304(a) criterion. In fact, as part of its presentation to the SAB, EPA noted that "looking to the future," the Agency would "consider need for additional conductivity reviews for other locations and ***need for 304(a) criteria for conductivity***." Presentation of Denise Keehner, Director, Office of Wetlands, Oceans and Watersheds, July 20, 2010 (emphasis added).

> As a general matter, EPA expects that the conductivity impacts of projects with predicted conductivity levels below 300 µS/cm generally will not cause a water quality standard violation and that in-stream conductivity levels above 500 µS/cm are likely to be associated with adverse impacts that may rise to the level of exceedances of narrative state water quality standards.
>
> ***
>
> For purposes of Section 230.10(c) of the Guidelines, the Regions should consider the [Benchmark Report] when examining whether a draft 404 permit is likely to result in significant degradation of waters of the U.S.
>
> ***
>
> Projects projected to increase conductivity levels above 300 µS/cm should include permit conditions requiring adaptive remedial action to prevent conductivity levels from rising....

April 1 Guidance at pp. 12 and 22.

UWAG has grave concerns about EPA circumventing the criteria-setting provisions of the Clean Water Act, deviating from its standard method, and then forcing federal and state permitting authorities to conform their permitting actions with EPA's views without regard to the process safeguards that form the core of the Clean Water Act, Administrative Procedures Act, and U.S. Constitution.

1. **EPA's conductivity value has no legal effect and cannot be used to interpret state standards or assign permit limits.**

Congress gave EPA two opportunities to establish water quality criteria. Under Section 303 of the Clean Water Act, EPA may adopt binding criteria when a state fails to meet its triennial review obligations or adopts a water quality standard that EPA believes to be inconsistent with the Act.[4] Alternatively, under Section 304 of the Act, EPA may adopt

[4] Earlier this year, EPA did so in connection with numeric nutrient criteria for lakes and flowing waters in the State of Florida. *See* 75 Fed. Reg. 4174 (January 26, 2010).

recommended criteria that reflect the "latest scientific knowledge" available to the Agency. Such recommended criteria are not binding on states and are not directly enforceable. Rather, states may consider them in setting their own binding criteria, and also may consider them when assigning water quality-based effluent limits to discharges deemed by a state to have reasonable potential to violate narrative water quality standards.[5]

EPA has not pursued either of these statutory opportunities here. Instead, EPA has derived a novel "benchmark value" that conforms with neither Section 303 nor Section 304 and, in turn, has no legal effect. The inherent problem with EPA's action is that the Agency ***expects*** its benchmark value to have legal effect, and, in fact, has instructed EPA regions and states to give it such effect.

In the April 1 Guidance, EPA advises regions and states to use the conductivity value to interpret state narrative water quality standards for the purpose of assigning water quality-based effluent limits necessary to protect those standards. But this usurps state authority in two fundamental ways. First, states have primary authority to interpret their own narrative standards. A state's interpretation trumps any competing federal interpretation, so long as the state's interpretation is supported by substantial evidence. *Am. Paper Inst., Inc. v. U.S. EPA*, 996 F.2d 346 (D.C. Cir. 1993).[6] Second, water quality-based limits are only necessary if a state first

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[5] *See* 40 CFR §131.11(b) ("In establishing criteria, States should: (1) Establish numerical values based on: (i) 304(a) Guidance; or (ii) 304(a) Guidance modified to reflect site-specific conditions; or (iii) Other scientifically defensible methods; (2) Establish narrative criteria or criteria based on biomonitoring methods where numerical criteria cannot be established to supplement numerical criteria."); *see also* 40 CFR §122.44(d)(1)(vi)(A), (B) and (C) (authorizing states to establish WQBELs to protect narrative standards using (1) a proposed State criterion or an explicit State policy or regulation; (2) EPA's 304(a) criteria, supplemented where necessary by other relevant information; or (3) an indicator parameter for the pollutant of concern).

[6] The only exception is where more than one state's standards are at issue. *See, e.g.*, *Champion Int'l Corp. v. U.S. EPA*, 648 F. Supp. 1390 (W.D N.C. 1986), *vacated and remanded on jurisdictional grounds at* 850 F.2d 182 (4th Cir. 1988) (upholding EPA's interpretation of North Carolina's narrative water quality standard for color to a discharge that impacted both North Carolina and Tennessee waters);

determines that a discharge has a reasonable potential to cause or contribute to an excursion of a water quality standard. Upon such a determination, EPA's conductivity value ***could*** serve as "other relevant information" for a state to consider in deriving a limit to protect a narrative standard. But until such a determination, EPA's conductivity value is irrelevant.

If EPA wants its conductivity value to have legal effect, then it must either promulgate the value as a water quality criterion (subject to all applicable process safeguards) or defer to a state to consider it (among other regulatory options) in permit proceedings involving discharges that a state determines, on a case-by-case basis, to have reasonable potential. EPA cannot circumvent the criteria-setting process, then usurp a state's authority to interpret its own standards, and then presume that an entire category of otherwise lawful discharges will violate the state's standards unless they receive limits based on EPA's otherwise unlawful conductivity value. To do so would be to turn the statute -- not to mention good government and common sense -- on its head.

2. EPA's Benchmark Report reflects a number of technical issues that must be resolved before the conductivity value is used or applied.

A. Ambiguous geographic applicability of conductivity benchmark

All of the field data that supported EPA's conductivity value were taken from field studies conducted in West Virginia (and then validated using data from Kentucky that were just recently released for public review). The Agency's final recommendation, however, is that the conductivity value be implemented at surface mining locations in Ecoregions 68, 69, and 70. While UWAG believes that the Agency's attempt to "parameterize" the conductivity value by major salt types (sulfate as dominant anion and bicarbonate as dominate cation) may be a

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see also Dioxin/Organochlorine Ctr. v. Rasmussen, No. C93-33D, 1993 WL 484888 (W.D.Wash. Aug. 10, 1993)

reasonable first step, the lack of similar field conductivity-biological response data in other geographic areas within the three ecoregions is a weakness to the benchmark's potential applicability.

One issue that states will likely need to address is the applicability of the conductivity value when the major anion and cation are not similar to the field studies used by EPA when deriving the benchmark. For example, in headwater streams affected by brine water having chloride as the dominant anion, is the proposed conductivity value of 300 µS/cm appropriate? What is the amount of departure from the sulfate and bicarbonate-dominated water quality (used to derive the benchmark) that is acceptable? In the Executive Summary of the Benchmark Report, the Agency states on page xiii that the 300 µS/cm value "... may not apply when the relative concentrations of dissolved ions are not dominated by salts of SO_4^{-2} and HCO_3^-." This statement is not satisfactory from either a technical or regulatory implementation standpoint.

B. Field-Based Methodology Issues

EPA's field-based approach represents a significant departure from the methodology the Agency currently uses to develop meaningful toxicological thresholds for specific chemicals or constituents. Before the methodology can be "finalized" by EPA, UWAG believes that outcomes of the methodology should be critically compared to other assessment tools. Toward that end, UWAG urges EPA to answer the following questions, all of which bear on whether EPA's approach is sufficiently robust to be used for use attainment decisions with a high degree of certainty:

1. How does the conductivity value compare with multimetric biological index scores that have been calibrated (and sometimes adopted) by states? What is the biological significance of the proposed conductivity value being exceeded in a particular

water body? Is it suggestive or indicative of a water body not meeting the "fishable" Clean Water Act goal? Does it implicitly or explicitly imply aquatic life use non-attainment? Is the conductivity benchmark still applicable when a state's own biological monitoring study shows the presence of conductivity-sensitive mayfly taxa (*e.g.*, genera having extirpation concentration - or EX_{95} - values of less than 1,000 μS/cm) at sites with measured conductivity values higher than 300 or 500 μS/cm?

2. How "cross-cutting" is the conductivity value across tiered aquatic life uses? Is it appropriate for states to implement the conductivity value indiscriminately across tiered aquatic life uses that range from "exceptional" to "water quality or habitat limited"? As an example, how would the Agency expect a state with multiple tiered aquatic life uses (*e.g.*, the State of Ohio) to implement the conductivity value? Would it be appropriate for the proposed benchmark to be implemented for water bodies that typically do not have mayfly taxa present?

3. How does the conductivity value compare with instream toxicity assessments? What is EPA's expectation when the conductivity value is maintained in a stream and samples are collected for toxicity testing using standard test organisms? Should the samples not be acutely and chronically toxic, or just acutely toxic? A key weakness of the methodology and resulting conductivity value is the lack of any cross-validation through the use of other, complimentary assessment tools that, in fact, EPA encourages states to implement to assess aquatic life use attainment.

4. What role does site-specific acclimation or adaptation have in the implementation of the conductivity benchmark? Does EPA acknowledge the fact that conductivity-sensitive mayfly genera may be present (and abundant) in stream settings where ambient

conductivity levels exceed 500 µS/cm on a long-term basis? Shouldn't an instream biological study be conducted to confirm or refute EPA's expectation that certain sensitive taxa should be extirpated at conductivity levels higher than 300 µS/cm?

C. Lack of toxicological validation

UWAG finds it very troubling that EPA makes no attempt to validate or "ground truth" the proposed benchmark by using independent laboratory exposure studies. The stringency of the field-based conductivity value (by itself) should have compelled the Agency to, at minimum, compare the proposed threshold with published laboratory studies where freshwater aquatic life were exposed to individual salts, salt mixtures, or surrogate measures (*e.g.*, total dissolved solids or specific conductivity). Very frequently, laboratory-derived toxicity thresholds for specific chemicals are found to be overly protective when the *in-situ* response of aquatic life to the same measured chemical is evaluated. This pattern, however, seems to be ***reversed*** regarding the conductivity value. UWAG can find no published studies indicating that sensitive invertebrate taxa exhibit acute or significant chronic toxicity at the proposed conductivity value.

If the proposed conductivity value does have toxicological significance, then there should be some evidence that mayflies - or other EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa - are relatively sensitive to dissolved salts (whether individually or in combination). Attached as Appendix 1 is a recent compilation of aquatic toxicity data (obtained from EPA) for freshwater organisms exposed to chloride. Table 3 lists the ranked sensitivity from most tolerant (the damselfly *Agria sp.*; Genus Mean Acute Value of 21,570 mg/L Cl) to most sensitive (fingernail clam, *Sphaerium sp.*; Genus Mean Acute Value of 1,089 mg/L Cl). The second most sensitive taxa regarding exposure to chloride is *Ceriodaphnia dubia*. The Species Mean Acute Value for this species is 1,598 mg/L Cl. It should be noted that the toxicity test results listed for aquatic

insects in Table 3 (caddis flies, stoneflies) indicate that these taxa are considerably more tolerant to chloride exposure compared to many other species (Genus Mean Acute Values greater than 4,000 mg/L Cl).

Using all of the acute toxicity data (which was normalized to a hardness value of 300 mg/L $CaCO_3$), EPA calculates a Criterion Maximum Concentration value of 678 mg/L chloride. *See* page 6 of Table 3. While a direct chloride-to-conductivity comparison cannot be made in terms of chemical composition (though in some water bodies in Ecoregions 68, 69, and 70 chloride may be the predominant anion), the calculated CMC value is more than ***two times*** the Agency's conductivity benchmark of 300 µS/cm. We reiterate our point that EPA has provided no toxicological basis for the proposed conductivity value in terms of direct cause and effect.

UWAG has attached a summary of a study that was conducted by a UWAG member company, American Electric Power ("AEP"), regarding potential acute toxicity using actual effluent and artificially-mixed samples that were intended to "mock" anticipated effluent quality after installation of a flue gas desulfurization system at eight coal-fired power plants located in the Midwest. *See* Appendix 2. Standard acute toxicity tests with *Ceriodaphnia dubia* and fathead minnow were conducted on all treatment solutions, and a comprehensive analysis of individual salts, TDS, trace metals, and conductivity was conducted. Table 1 of the report indicates results of acute toxicity testing: percent mortality in the artificially mixed instream waste concentration water, percent mortality in the effluent or "mock" or "salt spike" effluent, and the resulting LC_{50} values for each test. Table 3 indicates concentrations of total hardness, alkalinity, pH, and conductivity measured at the beginning of each test.

The measured conductivity values in the various tests ranged from 430 to 11,850 µmhos/cm. All of the tests in which there was ***no mortality*** in the *Ceriodaphnia dubia* acute test

(*i.e.*, 100% survival) are circled in Table 3. Daphnids are known to be more sensitive to dissolved salts compared to fathead minnow, thus only the results for *Ceriodaphnia* were considered. A total of 22 tests resulted in 100% survival of *Ceriodaphnia*. The ***range*** of measured conductivity values in these tests was 430 to 4,450 µmhos/cm. The average and median conductivity value for all of the tests that resulted in 100% survival for *Ceriodaphnia* was 1,737 and 1,297 µmhos/cm, respectively. This case study provides compelling evidence that a sensitive freshwater aquatic species (likely to be more sensitive than any mayfly taxa regarded by EPA as conductivity-sensitive based on the West Virginia studies) is not adversely affected by conductivity values that approach or exceed 1,000 µmhos/cm.

In summary, the use of a limited number of taxa to elucidate a field-based "no effect" criterion value for conductivity is not only a significant departure from the Agency's methodology for deriving criteria for aquatic life (a process that requires incontrovertible cause and effect relationships based on controlled laboratory studies), but the proposed criterion is woefully lacking in any toxicological basis and/or underpinnings.

D. Lack of conductivity effects in other field studies

The response of pollution-intolerant aquatic insects to measured conductivity (and other pollutant) levels in field studies has been reported in several publications. Here, UWAG discusses a case study concerning the response of mayflies to conductivity in a long-term biological monitoring study conducted by AEP. Blaine Creek is a 5th order tributary of the Big Sandy River in eastern Kentucky. The Blaine Creek watershed is in the Western Allegheny Plateau Ecoregion (Ecoregion 70) while most of the Big Sandy drainage system falls in the Central Appalachians Ecoregion (Ecoregion 69). The upper (headwater) portion of Blaine Creek was impacted historically by brine contamination, as a result of oil and gas drilling operations.

These effects were mitigated in the 1980s and 1990s through Kentucky agency enforcement action. AEP operates a coal-fired power plant on the Big Sandy River. Fly ash produced during coal combustion at this plant is routed to a large settling impoundment. The treated fly ash water is discharged to Blaine Creek at a location approximately 3 miles upstream of the Big Sandy River confluence. AEP biologists conducted chemical and biological monitoring (fish and benthic macroinvertebrates) in Blaine Creek from the early 1970s to 2000. Three sampling sites were located for long-term monitoring: a headwater site, a site just upstream of the fly ash pond discharge, and a site just downstream of the fly ash pond discharge. The primary goal of the monitoring study was to evaluate potential adverse effects of the treated fly ash discharge.

A summary of the long-term chemical and biological studies conducted in the stream was provided in Van Hassel et al. (1988). This is attached as Appendix 3. Mean measured conductivity values at the three locations during 1981 – 1985 were 1,869 µmhos/cm at the headwater site, 991 µmhos/cm at the site just upstream of the fly ash discharge, and 1,055 µmhos/cm at the site downstream of the discharge (*see* Table 2 of publication). A total of nine mayfly genera were collected from the three sites: *Baetis, Pseudocloeon, Heptagenia, Stenonema, Ephemerella, Tricorythodes, Caenis, Baetisca, and Ephemera.* In the CB technical guidance document, EPA lists the conductivity extirpation concentration for all of these taxa except for *Pseudocloeon*:

Mayfly Genus	U.S. EPA Conductivity Extirpation concentration (µmhos/cm)
Baetis	1,383
Heptagenia	313
Stenonema	729
Ephemerella	302
Tricorythodes	2,006
Caenis	3,884
Baetisca	918
Ephemera	736

For five of the eight mayfly genera listed above, EPA's calculated extirpation concentration is considerably lower than measured conductivity values at Blaine Creek sites ***where these taxa were found, often on a frequent temporal basis.*** These taxa include *Heptagenia, Stenonema, Ephemerella, Baetisca, and Ephemera.* Thus, for a stream within the geographic range that EPA believes the conductivity value of 300 µS/cm could be implemented, UWAG provides evidence that the sensitivity of certain mayfly genera to conductivity exposure is markedly ***overestimated*** by EPA compared to field studies in an eastern Kentucky stream.

An updated analysis of the Blaine Creek chemical and biological monitoring data is provided. For sample years 1986 - 1999, Table 1 indicates measured conductivity values at the time of sampling, number of mayfly taxa per sample, total number of mayflies (all genera) per sample, total taxa richness, and the number of mayfly genera that have extirpation concentration values of less than 1,000 µmhos/cm (as reported by U.S. EPA, EPA/600/R-10/023A). Each of these parameters is given for the sampling site upstream of the fly ash pond discharge, and the site located downstream of the discharge. [NOTE: all of the data up to 1990 were submitted to the Kentucky Department of Environmental Protection, Division of Water, in a document entitled "Request and Justification for Copper and Selenite Site-Specific Water Quality Criteria for Blaine Creek, Under KAR 5:031(9)," submitted by AEP on May 19, 1992. The conductivity and mayfly data from 1992 to 1999 are from in-house reports compiled by AEP].

In Table 1, measured conductivity values ranged from 135 - 1,430 µhmos/cm. Conductivity values were uniformly higher at the downstream site, indicating the influence of the fly ash pond discharge. The total number of mayfly genera collected in each sample was no greater than four. While total mayfly richness is not exemplary in any way, it should be noted that the predominant substrate in Blaine Creek consists of shifting sand.

Figure 1 indicates a plot of measured conductivity values versus the number of mayfly genera collected (both upstream and downstream sites combined). The very weak correlation coefficient (r = -0.19) indicates no suggestion of correlation between conductivity and mayfly richness. The graph suggests that mayfly richness decreases at conductivity concentrations equal to or greater than about 1,000 µmhos/cm. Figure 2 shows the same plot for the downstream site only. Again, the relationship between the variables shows a very weak correlation coefficient (r = -0.03), and a suggestion that mayfly richness at the downstream site decreases at conductivity levels at or about 1,000 µhmos/cm. Thus, in Blaine Creek, mayfly richness is insensitive to conductivity concentrations less than about 1,000 µhmos/cm.

Figure 3 indicates a plot of measured conductivity versus total macroinvertebrate richness. Total taxa richness is a community parameter often used to assess potential adverse water quality effects. There is virtually no statistical relationship between the two variables (correlation coefficient value = -0.15). Even at conductivity measurements greater than 1,000 µhmos/cm, total taxa richness is relatively unaffected. This provides some evidence that, at least in Blaine Creek, there would be no expected effects on macroinvertebrate community composition at a conductivity concentration between 300 - 500 µhmos/cm.

Figure 4 shows a plot of measured conductivity versus the total number of mayflies counted in a sample (all general combined). There is a suggestion that total mayfly abundance may be lowered at conductivity levels greater than 900 µhmos/cm. It should be noted, however, that the total number of mayflies often reflects one, or sometimes two, particular abundant genera present at the time of sampling (asymmetrical abundance among taxa). Lastly, Figure 5 indicates a plot between measured conductivity values and the number of mayfly genera collected that have, according to EPA, a conductivity extirpation concentration value (95th percentile) less than 1,000

µhmos/cm. A total of five mayfly genera have been collected in Blaine Creek that have extirpation concentration values of less than 1,000 µhmos/cm. Four of these taxa have extirpation levels of less than 800 µhmos/cm. Figure 5 indicates that, for any given sample, the number of mayfly genera collected that are conductivity-sensitive ranges from zero to two. Like the other figures, there is no apparent decrease in the biological parameter response at conductivity levels less than 1,000 µhmos/cm. In summary, in contrast to EPA's finding that biological impairment would be expected to occur at stream conductivity concentrations that exceed 300 µhmos/cm, studies in Blaine Creek, Kentucky clearly indicate that both mayfly richness and total macroinvertebrate richness are unaffected at measured instream conductivity concentrations less than, or equal to, 1,000 µhmos/cm.

In summary, UWAG believes that there are significant technical and scientific deficiencies in: 1) the process used by EPA to derive the conductivity value; and 2) the lack of any demonstrated toxicological basis, which ***is an explicit requirement*** in the Agency's guidelines for deriving water quality criteria for aquatic life. UWAG encourages the Agency to conduct further studies and analyses in order to address these technical issues.

Table 1.

Blaine Creek, Kentucky Conductivity and Mayfly Data for Biological Studies Conducted During 1986 - 1999. Source: American Electric Power, Columbus, OH

note: benthic macroinvertebrates collected using circular depletion sampler (1991 - 1995; Van Hassel et al., 1988); Hester-Dendy samplers used for 1995 sample.

note: site "UP FAP" is location just upstream of fly ash pond discharge (dominant anion is chloride). Site "Down FAP" is downstream of fly ash pond discharge (chloride and sulfate anion concentrations relatively equal)

Sample date	Sample location	Conductivity level (uhmos/cm)	No. mayfly Species	Total mayfly abundance	No. mayfly genera w/ EX95 value < 1,000 umhos/cm
Jun 21 1995	UP FAP	168	2	13	1
Sep 6 1995	UP FAP	145	2	85	1
Jul 28 1994	UP FAP	144	2	104	1
Sep 20 1994	UP FAP	150	3	258	1
Aug 26 1993	UP FAP	186	3	41	2
Oct 6 1993	UP FAP	182	2	109	2
Jun 9 1999	UP FAP	172	4	101	1
Jun 11 1992	UP FAP	135	2	13	1
Aug 10 1992	UP FAP		2	69	1
April 18 1986	UP FAP	780	0	0	1
Aug 15 1986	UP FAP	661	0	0	0
Oct 23 1986	UP FAP	655	4	18	0
Oct 15 1987	UP FAP	458	3	30	1
Oct 13 1988	UP FAP	950	0	0	1
Nov 15 1989	UP FAP	200	4	11	0
June 22 1990	UP FAP	257	2	44	2
Oct 4 1990	UP FAP	307	4	197	2
July 24 1991	UP FAP	212	4	57	1
Jun 21 1995	Down FAP	403	2	8	
Sep 6 1995	Down FAP	913	3	394	1
Jul 28 1994	Down FAP	735	4	229	1
Sep 20 994	Down FAP	465	4	113	2
Aug 26 1993	Down FAP	810	3	4	2
Oct 6 1993	Down FAP	814	3	11	1
Jun 9 1999	Down FAP	811	6	52	1
Jun 11 1992	Down FAP	300	2	11	1
Aug 10 1992	Down FAP	935	3	15	0
April 18 1986	Down FAP	788	2	48	2
Aug 15 1986	Down FAP	1083	2	2	1
Oct 23 1986	Down FAP	932	0	0	0
Oct 15 1987	Down FAP	969	3	33	0
Oct 13 1988	Down FAP	1,430	1	2	1
Nov 15 1989	Down FAP	255	1	3	0
June 22 1990	Down FAP	327	2	27	1
Oct 4 1990	Down FAP	884	2	51	1
July 24 1991	Down FAP	628	2	30	1

Figure 1

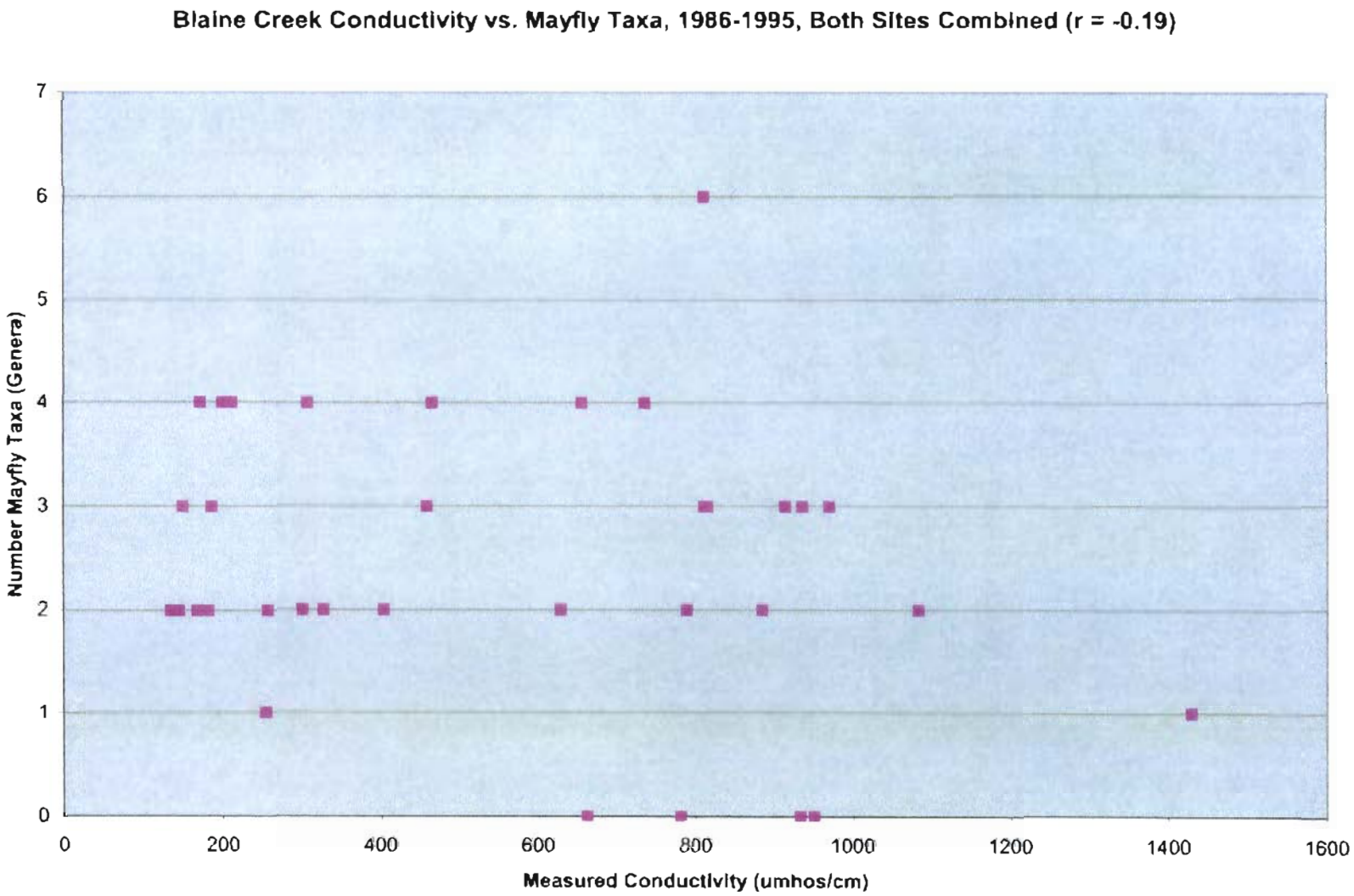

Blaine Creek Conductivity vs. Mayfly Taxa, 1986-1995, Both Sites Combined (r = -0.19)
Number Mayfly Taxa (Genera)
0
1
2
3
4
5
6
7
0
200
400
600
800
1000
1200
1400
1600
Measured Conductivity (umhos/cm)

Figure 2

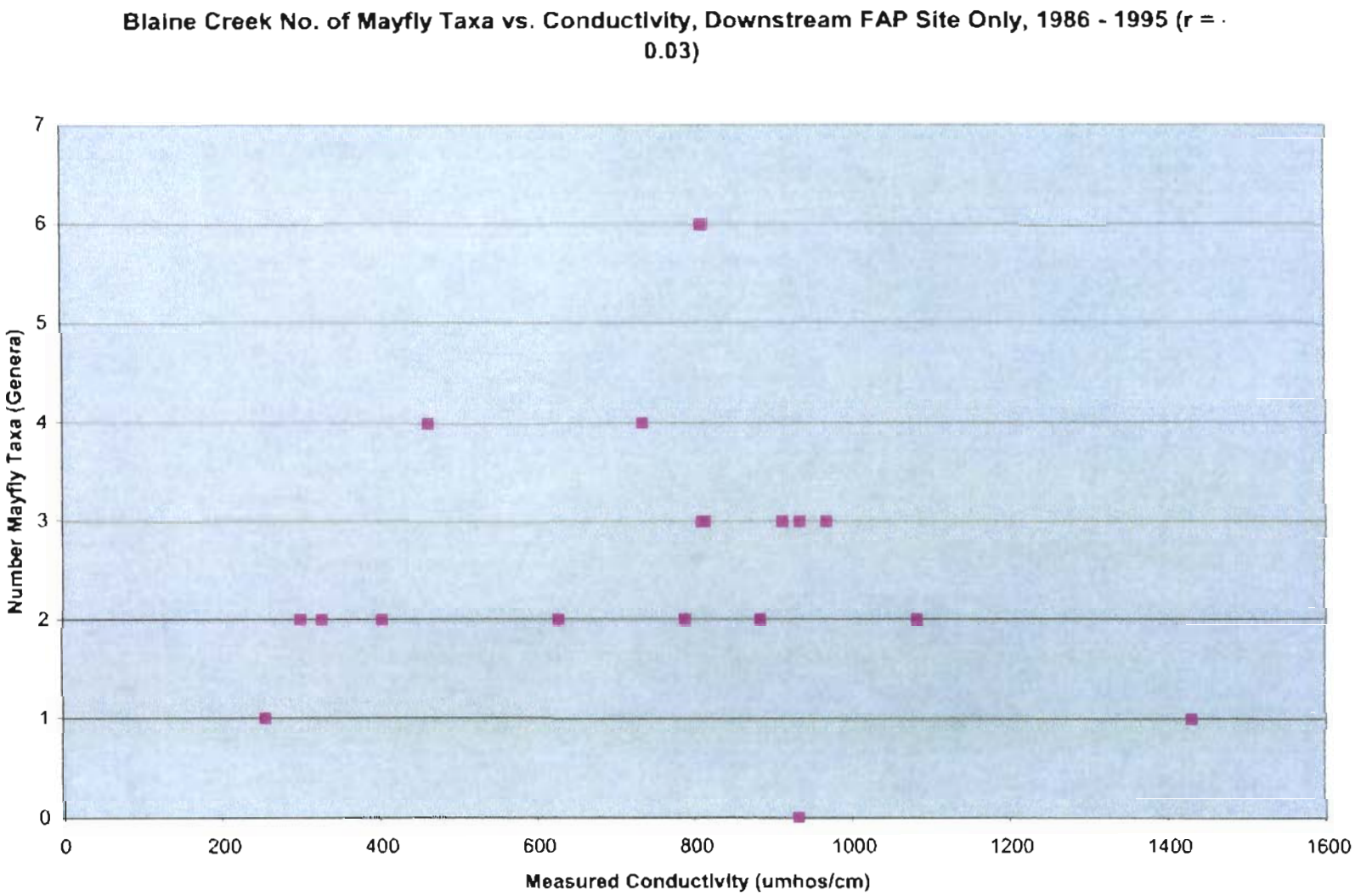

Blaine Creek No. of Mayfly Taxa vs. Conductivity, Downstream FAP Site Only, 1986 - 1995 (r = -0.03)
Number Mayfly Taxa (Genera)
0
1
2
3
4
5
6
7
0
200
400
600
800
1000
1200
1400
1600
Measured Conductivity (umhos/cm)

Figure 3

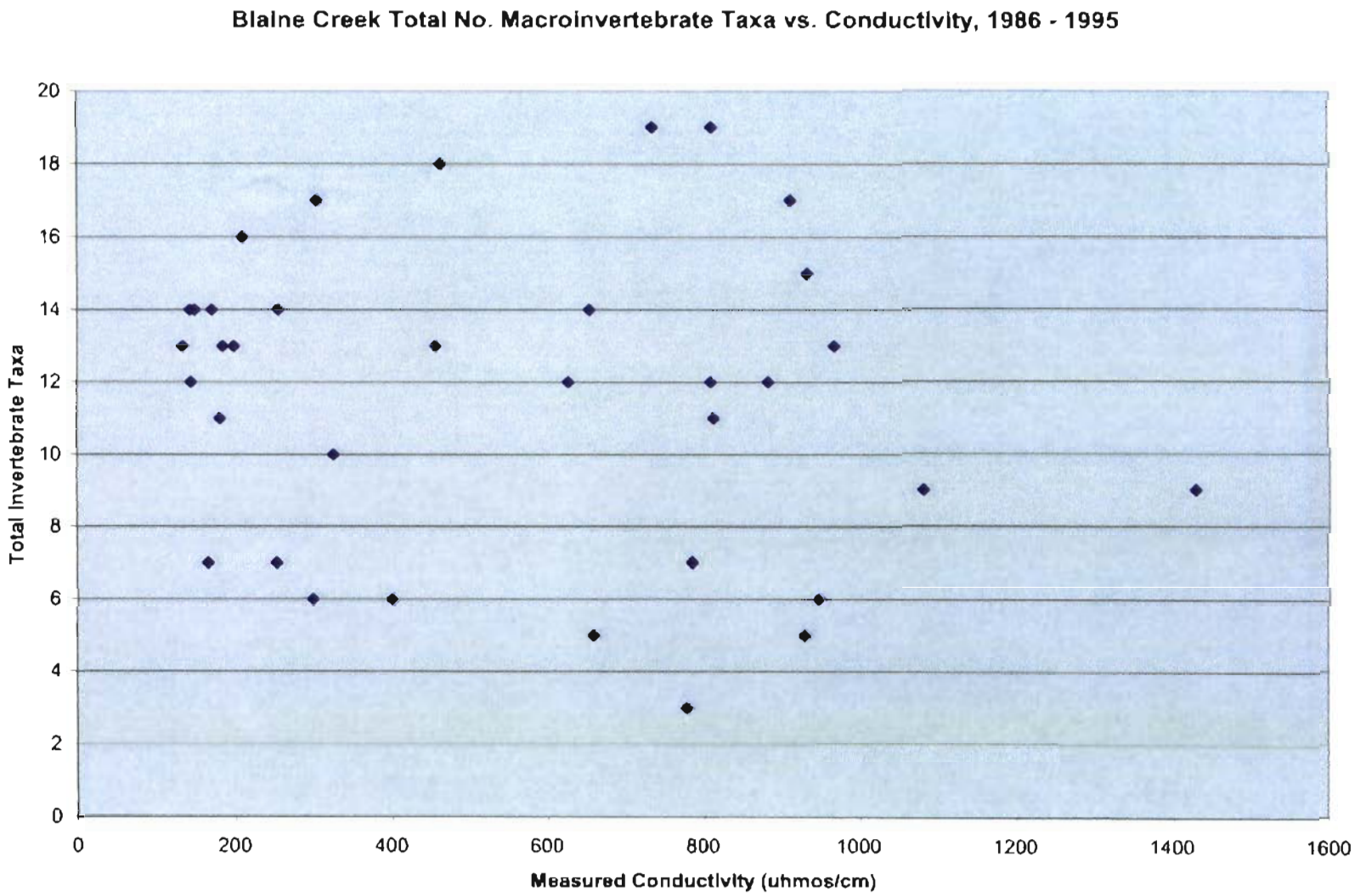

Blaine Creek Total No. Macroinvertebrate Taxa vs. Conductivity, 1986 - 1995
Total Invertebrate Taxa
0
2
4
6
8
10
12
14
16
18
20
0
200
400
600
800
1000
1200
1400
1600
Measured Conductivity (uhmos/cm)

Figure 4

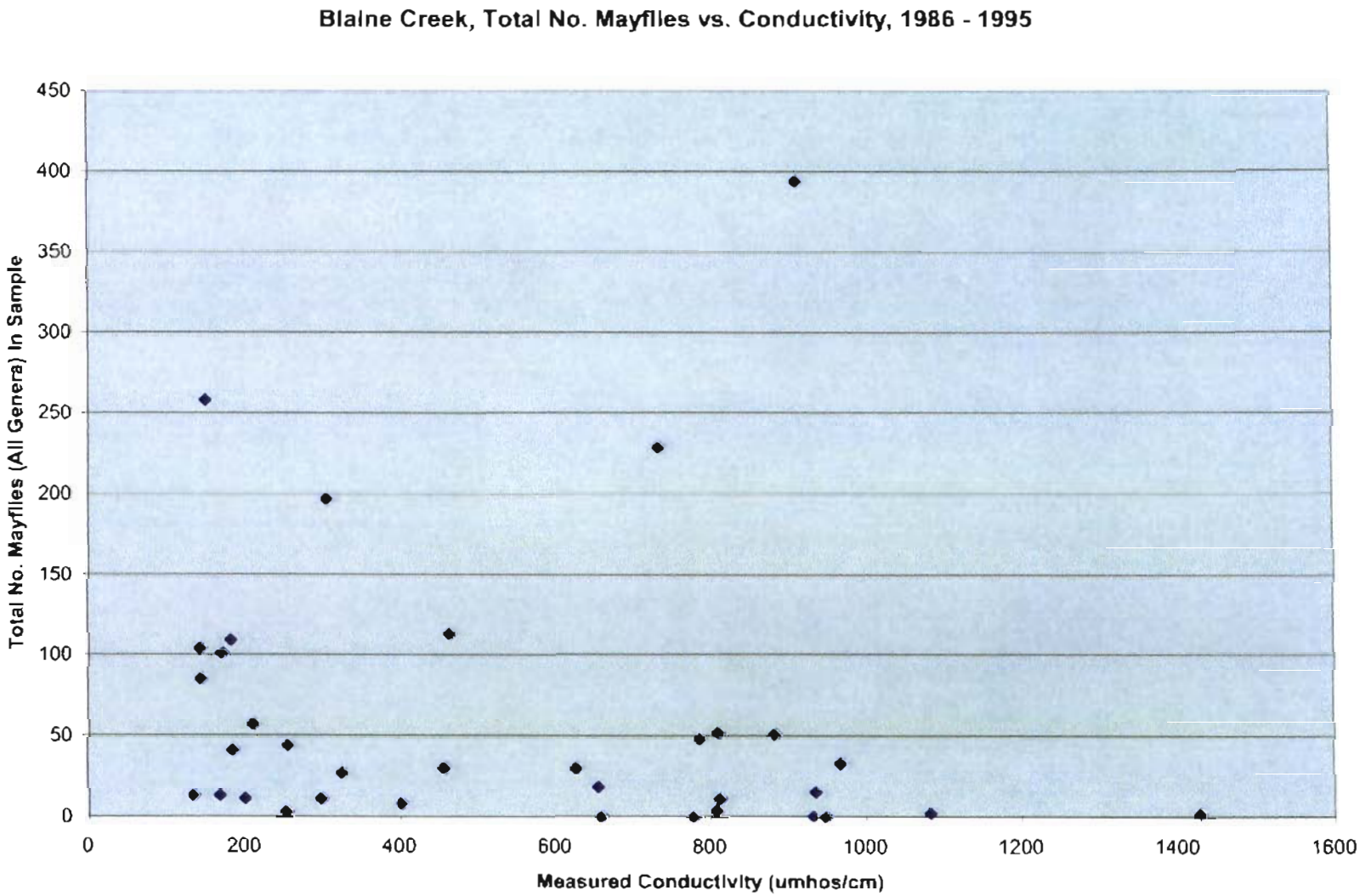
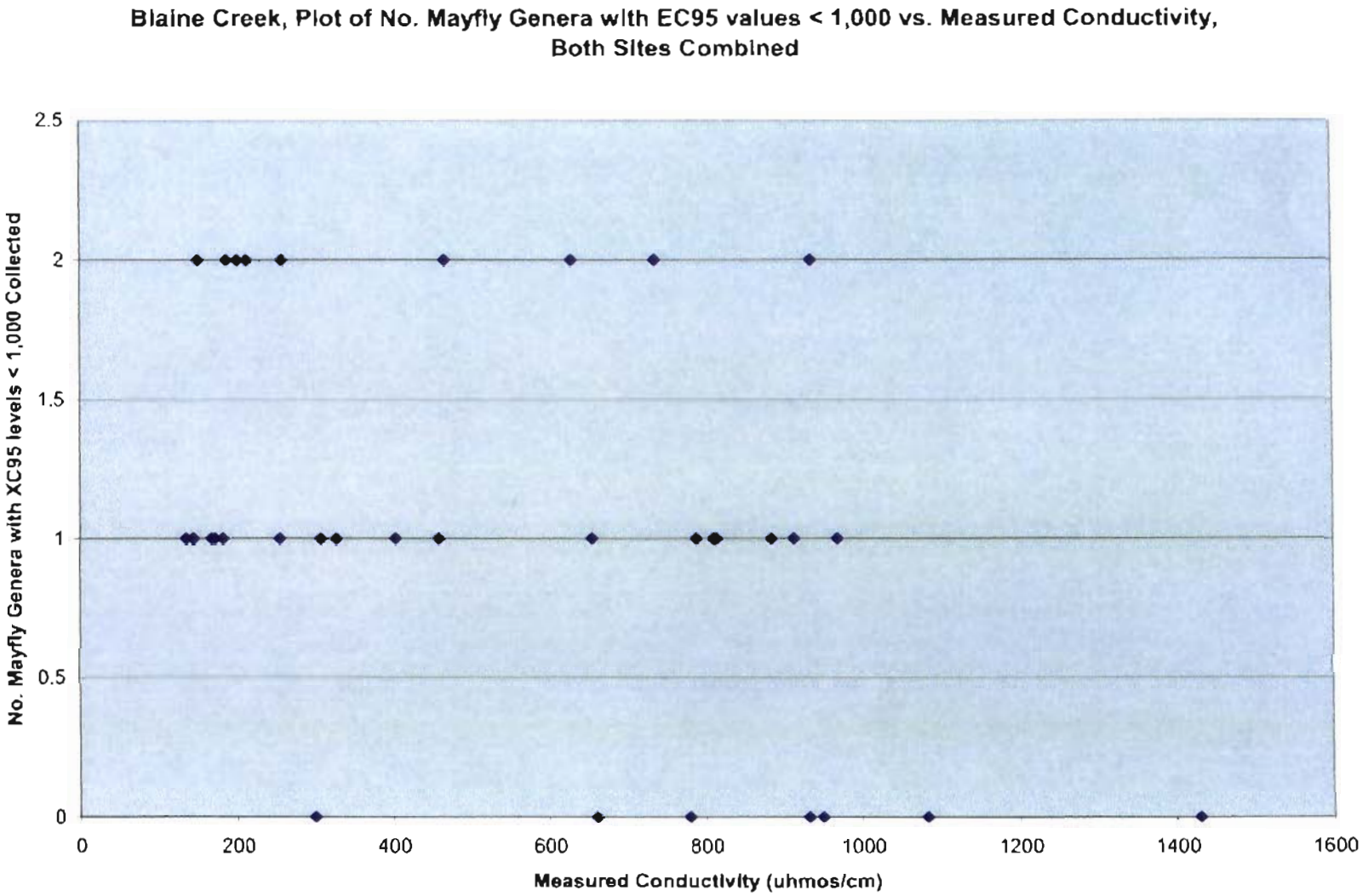

Blaine Creek, Total No. Mayflies vs. Conductivity, 1986 - 1995
Total No. Mayflies (All Genera) In Sample
450
400
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
1200
1400
1600
Measured Conductivity (umhos/cm)

Figure 5


Blaine Creek, Plot of No. Mayfly Genera with EC95 values < 1,000 vs. Measured Conductivity, Both Sites Combined
No. Mayfly Genera with XC95 levels < 1,000 Collected
2.5
2
1.5
1
0.5
0
0
200
400
600
800
1000
1200
1400
1600
Measured Conductivity (uhmos/cm)

Procedure D for Chloride

Table 3

(based on toxicity tests on sodium chloride)
(GMAVs and SMAVs are normalized to hardness = 300 mg/L)
(GMAVs and SMAVs are expressed as mg chloride/L)
(see footnotes a and b)

Rank	GMAV	Genus	Species	SMAV	SMACR
29	21570	Agria	Damselfly, Agria sp.	21570	
	18647	Cambarus	Crayfish, Cambarus sp.	18647	
	18190	Anquilla	American eel, Anquilla rostrata	18190	
	17144	Fundulus	Plains killifish, Fundulus kansae	17144	
	17082	Libellulidae*	Dragonfly, Libellulidae	17082	
	13430	Gasterosteus	Threespine stickleback, Gasterosteus aculeatus	13430	
	11432	Gambusia	Mosquitofish,	11432	

		Gambusia affinis		
11026	Carassius	Goldfish, Carassius auratus	11026	
10770	Oncorhynchus	Rainbow trout, Oncorhynchus mykiss	10770h	7.308
10324	Notropis	Red shiner, Notropis lutrensis	10324	
10001	Lepomis	Green sunfish, Lepomis cyanellus	11479	
		Bluegill, Lepomis macrochirus	8713c	
-----	Chironomus	Midge, Chironomus attenuatus	——	
8565	Ameiurus	Black bullhead, Ameiurus melas	8565	
6868	Pimephales	Fathead minnow, Pimephales promelas	6868f	15.17i
6346	Tubifex	Tubificid worm, Tubifex tubifex	6346	
5955	Asellus	Isopod, Asellus communis	5955	
5780	Erpobdella	Leech,	5780	

		Erpobdella punctata	
4987	Hyalella	Amphipod, Hyalella azteca	4987
4777	Limnodrilus	Tubificid worm, Limnodrilus hoffmeisteri	4777
4739	Helisoma	Snail, Helisoma campanulata	4739
4678	Pseudacris	Chorus frog, Pseudacris sp.	4678
----	Gammarus	Amphipod, Gammarus pseudolimnaeus	----
----	Crangonyx	Amphipod, Crangonyx sp.	----
----	Nemoura	Stonefly, Nemoura trispinosa	----
----	Lepidostoma	Caddisfly, Lepidostoma sp.	----
----	Parapsyche	Caddisfly, Parapsyche sp.	----
4541	Diaptomus	Copepod, Diaptomus clavipes	4541
3884	Lirceus	Isopod,	3884

			Lirceus fontinalis		
	3603	Physa	Snail, Physa gyrina	3344	
			Snail, Physa heterostropha	3882	
	3059	Gyraulus	Snail, Gyraulus circumstriatus	2466	
			Snail, Gyraulus parvus	3794	
	2901	Villosa	Mussel, Villosa delumbis	3593	
			Mussel, Villosa iris	2343	
4	2666	Lampsilis	Mussel, Lampsilis fasciola	2734	
			Mussel, Lampsilis siliquoidea	2599	
3	2343	Daphnia	Cladoceran, Daphnia ambigua	1681	4.148
			Cladoceran, Daphnia magna	3987d	1.974

			Cladoceran, Daphnia pulex	2018g	3.952
2	1598	Ceriodaphnia	Cladoceran, Ceriodaphnia dubia	1598c	>2.470j
1	1089	Sphaerium	Fingernail clam, Sphaerium simile	1148	
			Fingernail clam, Sphaerium tenue	1033	

* Name of family, not name of genus.

a. Section IV.I of the 1985 Guidelines says: "For each species for which at least one acute value is available, the Species Mean Acute Value should be calculated as the geometric mean of the results of all flow-through tests in which the concentrations of test material were measured. For a species for which no such result is available, the SMAV should be calculated as the geometric mean of all available acute values, i.e., results of flow-through tests in which the concentrations were not measured and results of static and renewal tests based on initial concentrations (nominal concentrations are acceptable for most test materials if measured concentrations are not available) of test material." The guidance presented in section IV.I of the 1985 Guidelines seems inappropriate for chloride because chloride is different from most pollutants for which aquatic life criteria are derived. Chloride is very soluble in water, does not oxidize or reduce, is not volatile, does not degrade, does not sorb to test chambers, test organisms, food, or waste products, is not complexed by materials that commonly occur in water, is not involved in a pH-dependent equilibrium in water, and does not precipitate in waters in which aquatic organisms commonly occur.

   i. For chloride, as long as the concentration of dissolved oxygen is sufficiently high, it seems appropriate to give static and renewal acute tests the same weight as flow-through acute tests in the derivation of the SMAV for a species.

   ii. For chloride, it seems inappropriate to give measured acute tests a weight of 1 and unmeasured acute tests a weight of 0 when both are available for the derivation of the SMAV for a species. For example, if there is a choice between one measured acute test on chloride and three unmeasured acute tests in three different laboratories, the three tests are probably preferable to the one test, but if the choice is between one measured acute test and two unmeasured acute tests in two different laboratories, the one test is probably preferable. Thus, for a species for which both measured and unmeasured acute tests are available for chloride, it seems appropriate to give measured acute tests a weight of 2.5 and unmeasured acute tests a weight of 1 when the SMAV is calculated.

The conclusions described above concerning chloride were developed during discussions among Charles Delos, Charles Stephan, and Glen Thursby. For other pollutants, different conclusions concerning the relative merits of static, renewal, and flow-through acute toxicity tests and the relative merits of measured and unmeasured acute toxicity tests are likely to be more appropriate.

b. A "greater than" acute value for the brown trout (Salmo trutta) is not in this table because it is too low to be a useful "greater than" value.

c. For Ceriodaphnia dubia, the acute values from Hoke et al. (1992) are considered outliers. The geometric mean is 1466 for Mount et al. (1997), 2086 for U.S. EPA (1991), 1936 for WISLOH (2007), and 1419 for GLEC and INHS (2008).
SMAV = antilog ([log 1466 + log 1891 + log 2086 + log 1936 + log 1960 + 2.5(log 1336) + 2.5(log 1419)]/10) = 1598.

d. For Daphnia magna, the acute value from Khangarot and Ray (1989) was considered an outlier. The values of 3809 (Mount et al. 1997), <3178, (Anderson 1946), 2784 (Anderson 1948), and 3817 and 4235 (Biesinger and Christensen 1972) were not used. A geometric mean of 3673 was calculated from the limits given by Seymour et al. (1997). The geometric mean is 4005 for Hoke et al. (1992) and 3969 for Davies and Hall (2007). The SMAV is 3987, which is the geometric mean of 4005, 5481, 3673, 2828, 4466, 3962, and 3969.

e. Bluegill: SMAV = antilog ([2.5(log 7689) + log 11910]/3.5) = 8713.

f. Fathead minnow: SMAV = antilog ([log 3155 + 2.5(log 8651) + 2.5(log 9466) + log 5103 + log 5064]/8) = 6868.

g. Daphnia pulex: SMAV = antilog ([2.5(log 1936) + log 2237]/3.5) = 2018.

h. Rainbow trout: SMAV = antilog ([2.5(log 10143) + log 12511]/3.5) = 10770.

i. Not used in calculations because, even though the acute and chronic tests were in the same document, different dilution waters were used in the tests.

j. The SMACR for Ceriodaphnia dubia is the geometric mean of 1.508, >3.841, and 2.601.

FAV = 1355 mg chloride/L

CMC = FAV/2 = 677.5 mg chloride/L

The five SMACRs (7.308, 4.148, 1.974, 3.952, and >2.438) that are available for use in calculations result in three GMACRs:

7.308	Oncorhynchus
3.187	Daphnia
>2.470	Ceriodaphnia

The 1985 Guidelines require ACRs for species in three different families, but Daphnia and Ceriodaphnia are in the same family. However, even though the ACR for the fathead minnow should not be used in calculations because the acute and chronic tests using the fathead minnow were performed in different dilution waters, the fathead minnow ACR can be considered a qualitative ACR and used to satisfy the MDRs because chloride is not likely to be complexed or sorbed or detoxified by organic or inorganic constituents of the dilution water.

The GMACRs for Oncorhynchus and Daphnia are consistent with the "greater than" GMACR for Ceriodaphnia and the GMACRs are within a factor of ten. Therefore, the Final ACR = 4.826, which is the geometric mean of the GMARCs for Oncorhynchus and Daphnia. This would give FCV = FAV/FACR = (1355 mg chloride/L)/4.826 = 280.8 mg chloride/L. However, this approach is contraindicated because the GMACRs (including the unused GMACR for Pimephales) indicate that the GMACR increases as the GMAV increases.

The GMACR for Daphnia is consistent with the "greater than" GMACR for Ceriodaphnia, so the GMACR for Daphnia can be used as the FACR. Therefore, FACR = 3.187 and FCV = FAV/FACR = (1355 mg chloride/L)/3.187 = 425.2 mg chloride/L.

CCC = FCV = 425.2 mg chloride/L.

The CMC and CCC given above are for hardness = 300 mg/L. The equation that was used to normalize the acute values can be used to make the CMC and CCC dependent on hardness. The resulting equations for the CMC and CCC are:

$$\text{CMC} = (677.5 \text{ mg chloride/L})\ (\text{hardness}/300)^{0.217736}$$
$$= (195.7 \text{ mg chloride/L})\ (\text{hardness})^{0.217736}$$

At hardness = 300 mg/L, CMC = 677.5 mg chloride/L.

$$\text{CCC} = (425.2 \text{ mg chloride/L})\ (\text{hardness}/300)^{0.217736}$$
$$= (122.8 \text{ mg chloride/L})\ (\text{hardness})^{0.217736}$$

At hardness = 300 mg/L, CCC = 425.2 mg chloride/L.

Derivation of an Alternative FCV

Even though the above derivation of FCV = 378.1 mg chloride /L follows the procedure described in the 1985 Guidelines, there is an alternative approach that is justified on the basis of the "good science" clause in section XII.B of the 1985 Guidelines. This approach is based on the fact that the four low SMACRs for chloride were obtained with invertebrates, whereas the high SMACR was obtained with a vertebrate. This can be interpreted to mean that vertebrates have a higher ACR, on the average, than invertebrates, especially because the qualitative ACR for the fathead minnow is 15.17. Therefore, a vertebrate ACR and an invertebrate ACR can be used with the GMAVs to calculate a predicted Genus Mean Chronic Value for each genus, and then a FCV can be calculated directly from the predicted GMCVs. This approach calculates and uses a predicted chronic value for each genus for which an acute value is available and probably does a better job of taking into account the chronic sensitivities of both vertebrates and invertebrates to chloride. The relevant data and calculations are presented on the next few pages.

The FACR of 3.187 derived above was derived from all of the acceptable ACRs for invertebrates. The only acceptable ACR for a vertebrate is 7.308. A predicted GMCV can be calculated from each GMAV by using 3.187 as the invertebrate ACR and using 7.308 as the vertebrate ACR.

Table of predicted GMCVs for Chloride

(GMAVs and pGMCVs are expressed as mg chloride/L)
(ranked according to predicted GMCVs)

Rank	GMAV	Genus	Species	pGMCV
29	21570	Agria	Damselfly, Agria sp.	6768
	18647	Cambarus	Crayfish, Cambarus sp	5851
	17082	Libellulidae*	Dragonfly, Libellulidae	5360

18190	Anquilla	American eel, Anquilla rostrata	2489
6346	Tubifex	Tubificid worm, Tubifex tubifex	1991
----	Chironomus	Midge, Chironomus attenuatus	----
5780	Erpobdella	Leech, Erpobdella punctata	1814
13430	Gasterosteus	Threespine stickleback, Gasterosteus aculeatus	1838
17144	Fundulus	Plains killifish, Fundulus kansae	2346
11026	Carassius	Goldfish, Carassius auratus	3460
4987	Hyalella	Amphipod, Hyalella azteca	1565
5955	Asellus	Isopod, Asellus communis	1869
4777	Limnodrilus	Tubificid worm, Limnodrilus hoffmeisteri	1499
4739	Helisoma	Snail, Helisoma campanulata	1487

10770	Oncorhynchus	Rainbow trout, Oncorhynchus mykiss	1474
11432	Gambusia	Mosquitofish, Gambusia affinis	1564
----	Gammarus	Amphipod, Gammarus pseudolimnaeus	----
----	Crangonyx	Amphipod, Crangonyx sp.	----
----	Nemoura	Stonefly, Nemoura trispinosa	----
----	Lepidostoma	Caddisfly, Lepidostoma sp.	----
----	Parapsyche	Caddisfly, Parapsyche sp.	----
3884	Lirceus	Isopod, Lirceus fontinalis	1219
10001	Lepomis	Green sunfish, Lepomis cyanellus	1368
		Bluegill, Lepomis macrochirus	
3603	Physa	Snail, Physa heterostropha	1131

		Snail, Physa gyrina	
4541	Diaptomus	Copepod, Diaptomus clavipes	1425
2901	Villosa	Mussel, Villosa delumbis	910.3
		Mussel, Villosa iris	
10324	Notropis	Red shiner, Notropis lutrensis	1413
3059	Gyraulus	Snail, Gyraulus circumstriatus	959.8
		Snail, Gyraulus parvus	
2666	Lampsilis	Mussel, Lampsilis fasciola	836.5
		Mussel, Lampsilis siliquoidea	
8565	Ameiurus	Black bullhead, Ameiurus melas	1172
6868	Pimephales	Fathead minnow, Pimephales promelas	939.8

4	2343	Daphnia	Cladoceran, Daphnia ambigua	735.2
			Cladoceran, Daphnia magna	
			Cladoceran, Daphnia pulex	
3	4678	Pseudacris	Chorus frog, Pseudacris sp.	640.1
2	1598	Ceriodaphnia	Cladoceran, Ceriodaphnia dubia	501.4
1	1089	Sphaerium	Fingernail clam, Sphaerium simile	341.7
			Fingernail clam, Sphaerium tenue	

* Name of family, not name of genus.

FCV based on predicted GMCVs = 417.8 mg chloride/L at hardness = 300 mg/L.

$$CCC = (417.8 \text{ mg chloride/L})\ (\text{hardness}/300)^{0.217736}$$
$$= (120.7 \text{ mg chloride/L})\ (\text{hardness})^{0.217736}$$

At hardness = 300 mg/L, CCC = 417.8 mg chloride/L.

Procedure D for Chloride

Table 1

(based on toxicity tests on sodium chloride)
(Acute Values and Normalized Acute Values are expressed as mg chloride/L)

Normalized Acute Values were calculated by normalizing the Acute Values to hardness = 300 mg/L using the following equation:

$$NAV = (AV)\ (300/Hardness)^{0.217736}$$

This equation is based on regression analysis of results of toxicity tests concerning the effect of hardness on the acute toxicity of chloride to C. dubia. The hardness of 300 mg/L is arbitrary; any other hardness would have worked equally well. NAVs could not be calculated for all AVs because assumed hardnesses were not used. Some of the hardnesses are nominal, not measured.

Species	Method	Chemical	Hardness (mg/L)	Sulfate (mg/L)	Acute Value	Normalized Acute Value	Reference
Tubificid worm, Limnodrilus hoffmeisteri	S,U	Sodium chloride	100	----	3761	4777	Wurtz and Bridges 1961
Tubificid worm, Tubifex tubifex	S,M	Sodium chloride	52 220	57.9 58.9	4278 6008	6266 6428	GLEC and INHS 2008
Leech, Erpobdella punctata	S,U	Sodium chloride	100	----	4550	5780	Wurtz and Bridges 1961
Mussel, juvenile Villosa delumbis	S,M	Sodium chloride	169.5	162.7	3173	3593	Bringolf et al. 2007

Mussel, juvenile Villosa iris	R,M	Sodium chloride	169.5	162.7	2069	2343	Wang 2007
Mussel, juvenile Lampsilis fasciola	S,M	Sodium chloride	169.5	162.7	2414	2734	Bringolf et al. 2007
Mussel, juvenile Lampsilis siliquoidea	R,M	Sodium chloride	169.5	162.7	1905	2157	Wang 2007
Mussel, juvenile Lampsilis siliquoidea	S,M	Sodium chloride	169.5	162.7	2766	3132	Bringolf et al. 2007
Fingernail clam, Sphaerium simile	S,M	Sodium chloride	51 192	59.9 61.7	740 1100	1088 1212	GLEC and INHS 2008
Fingernail clam, Sphaerium tenue	S,U	Sodium chloride	100 20	---- ----	667 698	847.3 1259	Wurtz and Bridges 1961
Snail, Physa gyrina	F,M	Sodium chloride	84.8	81.4	2540	3344	Birge et al. 1985
Snail, Physa heterostropha	S,U	Sodium chloride	100 100 100 20	---- ---- ---- ----	2123 3094 3761 2487	2697 3930 4777 4485	Wurtz and Bridges 1961
Snail, Physa sp.	S,M	Sodium chloride	22	15	3247hp	5735	Clemens and Jones 1954
Snail, Physa sp.	S,U	Sodium chloride	----	----	>3000p	----	Williams et al. 2000
Snail,	S,U	Sodium	100	----	1941	2466	Wurtz and Bridges 1961

Gyraulus circumstriatus		chloride					
Snail, Gyraulus parvus	S,M	Sodium chloride	56 212	60.9 59.7	3078 3009	4436 3245	GLEC and INHS 2008
Snail, Helisoma campanulata	S,U	Sodium chloride	100	----	3731	4739	Wurtz and Bridges 1961
Cladoceran, Ceriodaphnia dubia	S,U	Sodium chloride	84.8	81.4	1189bri 1042bri	1566 1372	Mount et al. 1997
Cladoceran, Ceriodaphnia dubia	R,U	Sodium chloride	74.1	----	1395	1891	Cowgill and Milazzo 1990
Cladoceran, Ceriodaphnia dubia	S,U	Sodium chloride	39.2	4.6	507 447	789.7 696.2	Hoke et al. 1992
Cladoceran, Ceriodaphnia dubia	S,U	Sodium chloride	39.2 39.2 39.2 39.2 339.0	4.6 4.6 4.6 4.6 325.4	1395 1638 1274 1395 1698	2173 2551 1984 2173 1653	USEPA 1991
Cladoceran, Ceriodaphnia dubia	S,U	Sodium chloride	84.8 169.5	81.4 162.7	1677c 1499c	2208 1697	WISLOH 2007
Cladoceran, Ceriodaphnia dubia	S,U	Sodium chloride	84.8	81.4	1413e	1860	Valenti et al. 2007
Cladoceran, Ceriodaphnia dubia	S,M	Sodium chloride	67.1	64.4q	964	1336	Harmon et al. 2003
Cladoceran,	S,M	Sodium	30	78.7	947	1563	GLEC and INHS 2008

Ceriodaphnia dubia		chloride	44	75.9	955	1451	
			96	73.7	1130	1448	
			180	67.7	1609	1798	
			400	78.7	1491	1400	
			570	76.2	1907	1658	
			800	75.5	1764	1425	
			25	69.9	1007	1730	
			49	67.8	767	1138	
			95	70.3	1369	1758	
			194	69.9	1195	1314	
			375	68.9	1687	1607	
			560	68.3	1652	1442	
			792	70.9	1909	1545	
			280	28.1	1400	1421	
			280	59.6	1720	1746	
			280	117	1394	1415	
			280	239	1500	1523	
			280	482	1109	1126	
			280	729	1206	1224	
			279	22.9	1311	1332	
			276	49.7	1258	1281	
			283	107	1240	1256	
			281	229	1214	1231	
			290	461	1199	1208	
			278	694	1179	1199	
Cladoceran, Daphnia ambigua	S,M	Sodium chloride	67.1	64.4q	1213	1681	Harmon et al. 2003
Cladoceran, Daphnia magna	S,U	Sodium chloride	84.8	81.4	2893brs	3809	Mount et al. 1997
Cladoceran,	S,U	Sodium	240	----	621	651.9	Khangarot and Ray 1989

Daphnia magna		chloride					
Cladoceran, Daphnia magna	S,U	Sodium chloride	39.2 39.2 39.2	4.6 4.6 4.6	3038 2726 2053	4732 4246 3198	Hoke et al. 1992
Cladoceran, Daphnia magna	-,-	Sodium chloride	----	----	1008k 3319m	---- ----	Cowgill 1987
Cladoceran, Daphnia magna	S,U	Sodium chloride	108.7	13	<2548	<3178	Anderson 1946
Cladoceran, Daphnia magna	S,U	Sodium chloride	108 7	13	2232i	2784	Anderson 1948
Cladoceran, Daphnia magna	S,U	Sodium chloride	41.5	31.2	3563	5481	Dowden and Bennett 1965
Cladoceran, Daphnia magna	S,M	Sodium chloride	45.3	3.9v	2529a,f 2806b,f	3817 4235	Biesinger and Christensen 1972
Cladoceran, Daphnia magna	S,U	Sodium chloride	169.5	162.7	>2669 <3943d	>3022 <4465	Seymour et al. 1997
Cladoceran, Daphnia magna	S,U	Sodium chloride	46	3.9v	1880	2828	USEPA 1991
Cladoceran, Daphnia magna	S,U	Sodium chloride	169.5	162.7	3944c	4466	WISLOH 2007
Cladoceran, Daphnia magna	S,U	Sodium chloride	84.8	81.4	3009e	3962	Valenti et al. 2007

Cladoceran, Daphnia magna	S,U	Sodium chloride	106	102	3136 3222 3137	3933 4041 3935	Davies and Hall 2007
Cladoceran, Daphnia pulex	S,M	Sodium chloride	84.8	81.4	1470	1936	Birge et al. 1985
Cladoceran, Daphnia pulex	S,U	Sodium chloride	84.8 84.8 84.8 84.8	81.4 81.4 81.4 81.4	1159 1775 1805 2242	1526 2337 2377 2952	Palmer et al. 2004
Copepod, Diaptomus clavipes	S,M	Sodium chloride	22	15	2571h	4541	Clemens and Jones 1954
Isopod, Asellus communis	S,U	Sodium chloride	100 20	---- ----	5004 3094	6356 5580	Wurtz and Bridges 1961
Isopod, Lirceus fontinalis	F,M	Sodium chloride	84.8	81.4	2950	3884	Birge et al. 1985
Amphipod, Hyalella azteca	S,U	Sodium chloride	102.5	98.4	3947	4987	Lasier et al. 1997
Amphipod, Gammarus pseudolimnaeus	S,U	Sodium chloride	---	---	>3000	----	Williams et al. 2000
Amphipod, Crangonyx sp.	S,U	Sodium chloride	---	---	>3000	----	Williams et al. 2000
Crayfish, Cambarus sp.	S,M	Sodium chloride	22	15	10557h	18647	Clemens and Jones 1954

Dragonfly, Libellulidae	S,M	Sodium chloride	22	15	9671h	17082	Clemens and Jones 1954
Damselfly, Agria sp.	S,U	Sodium chloride	100 20	---- ----	14558 13952	18492 25160	Wurtz and Bridges 1961
Stonefly, Nemoura trispinosa	S,U	Sodium chloride	----	----	>3000	-----	Williams et al. 2000
Caddisfly, Lepidostoma sp.	S,U	Sodium chloride	----	----	>3000	-----	Williams et al. 2000
Caddisfly, Parapsyche sp.	S,U	Sodium chloride	----	----	>3000	-----	Williams et al. 2000
Midge, Chironomus attenuatus	S,U	Sodium chloride	----	----	4850	-----	Thornton and Sauer 1972
American eel, Anquilla rostrata	S,U	Sodium chloride	42.4	40.7	10846	16607	Hinton and Eversole 1978
American eel, Anquilla rostrata	S,U	Sodium chloride	42.4	40 7	13012	19924	Hinton and Eversole 1979
Goldfish, Carassius auratus	S,M	Sodium chloride	148.8	----	9465	11026	Threader and Houston 1983
Red shiner, Notropis lutrensis	S,M	Sodium chloride	22	15	5771g 5920g	10193 10456	Clemens and Jones 1954
Fathead minnow, Pimephales promelas	S,U	Sodium chloride	39.2 39.2 339.0	4.6 4.6 325.4	2790 2123 2244	4346 3307 2185	USEPA 1991

Fathead minnow, Pimephales promelas	F,M	Sodium chloride	84.8	81.4	6570	8651	Birge et al. 1985
Fathead minnow, Pimephales promelas	S,M	Sodium chloride	22	15	5288g 5431g	9340 9593	Clemens and Jones 1954
Fathead minnow, Pimephales promelas	S,U	Sodium chloride	84.8	81.4	3876br	5103	Mount et al. 1997
Fathead minnow, Pimephales promelas	S,U	Sodium chloride	84.8 169.5	81.4 162.7	4167c 4127c	5487 4673	WISLOH 2007
Black bullhead, Ameiurus melas	S,M	Sodium chloride	22	15	4849g	8565	Clemens and Jones 1954
Rainbow trout, Oncorhynchus mykiss	S,U	Sodium chloride	22.4	----	>485j	>853.3j	Camargo and Tarazona 1991
Rainbow trout, Oncorhynchus mykiss	F,M	Sodium chloride	46	3.9v	6743	10143	Spehar 1986,1987
Rainbow trout, Oncorhynchus mykiss	R,U	Sodium chloride	284	---	12363	12511	Vosyliene et al. 2006
Brown trout, Salmo trutta	S,U	Sodium chloride	22.4	---	>607j	>1068j	Camargo and Tarazona 1991
Plains killifish, Fundulus kansae	S,M	Sodium chloride	22	15	9706g	17144	Clemens and Jones 1954
Mosquitofish, Gambusia affinis	S,M	Sodium chloride	22	15	6472g	11432	Clemens and Jones 1954

Mosquitofish, Gambusia affinis	S,U	Sodium chloride	---	14.9	9099	----	Al-Daham and Bhatti 1977
Threespine stickleback, Gasterosteus aculeatus	R,M	Sodium chloride	84.8	81.4	10200b	13430	Garibay and Hall 2004
Green sunfish, Lepomis cyanellus	S,M	Sodium chloride	22	15	6499g	11479	Clemens and Jones 1954
Bluegill, Lepomis macrochirus	F,M	Sodium chloride	84.8	81.4	5840	7689	Birge et al. 1985
Bluegill (3.7 g), Lepomis macrochirus	S,U	Sodium chloride	44.3	15.5	7853	11910	Academy of Natural Sciences 1960; Patrick et al. 1968; Trama 1954
Chorus frog, Pseudacris sp.	R,M	Sodium chloride	84.8	81.4	3553	4678	Garibay and Hall 2004

a = not fed. (All tests not marked "a" or "b" were unfed tests.)
b = fed.
c = mean of at least 15 LC50s.
d = range of several toxicity tests.
e = mean of 32 tests.
f = not used because there is reason to suspect that the daphnids might have been unhealthy.
g = tables 4, 7, and 9, except for tests at 28C in table 4.
h = tables 8 and 11; Daphnia pulex tests were not used because test duration was 96 hr.
i = test duration was 64 hr.
j = no deaths in 196 hr.
k = selenium deficient.
m = selenium sufficient
p = not used in calculation of GMAV because the species is unknown and so it is not known how to combine this acute value with the acute values for which the species are known.

q = calculated using the formula for reconstituted water and the reported average measured hardness.
r = concentrations were measured in stock solutions.
s = not acclimated to the dilution water.
t = might not have been acclimated to the dilution water.
v = based on analyses of samples of Lake Superior water taken in the spring and fall of 2008.

Supplementary information concerning the results of toxicity tests on chloride

1. The atomic weights used are those given on the website of the National Institute of Standards and Technology:
   Calcium = 40.078
   Carbon = 12.011
   Chlorine = 35.453
   Hydrogen = 1.008
   Iron = 55.845
   Magnesium = 24.305
   Nitrogen = 14.007
   Oxygen = 15.999
   Potassium = 39.098
   Sodium = 22.990
   Sulfur = 32.065

2. The molecular weights used are:
   $CaCl_2$ = 110.984 (63.89 % chloride) (36.11 % calcium) (Cl/Ca = 1.769)
   $CaCl_2 \cdot 2H_2O$ = 147.014 (27.26 % calcium) (48.23 % chloride)
   $CaCO_3$ = 100.086 (40.04 % calcium)
   CaO = 56.077 (71.47 % calcium)
   $Ca(NO_3)_2$ = 164.086 (24.42 % calcium)
   $Ca(NO_3)_2 \cdot 4H_2O$ = 236.146 (16.97 % calcium)
   $CaSO_4$ = 136.139 (70.56 % sulfate)
   $CaSO_4 \cdot 2H_2O$ = 172.169 (55.79 % sulfate) (23.28 % calcium) (20.93 % water)
   $FeCl_3 \cdot 6H_2O$ = 270.294 (39.35 % chloride)
   H_2O = 18.015
   KCl = 74.551 (47.56 % chloride) (52.44 % potassium) (Cl/K = 0.9068)
   K_2SO_4 = 174.257 (55.13 % sulfate)
   $MgCl_2$ = 95.211 (74.47 % chloride) (25.53 % magnesium) (Cl/Mg = 2.917)
   $MgSO_4$ = 120.366 (79.81 % sulfate) (20.19 % magnesium)
   $MgSO_4 \cdot 7H_2O$ = 246.471 (38.97 % sulfate) (9.86 % magnesium)
   NaCl = 58.443 (60.66 % chloride) (39.34 % sodium) (Cl/Na = 1.542)
   Na_2SO_4 = 142.041 (67.63 % sulfate)

$Na_2SO_4 \cdot 10H_2O$ = 322.191 (29.81 % sulfate)
SO_4 = 96.061

3. Hardness (as $CaCO_3$) = (100.086/40.078)(Ca) + (100.086/24.305)(Mg) = 2.497(Ca) + 4.118(Mg)

4. Trama (1954), Cairns and Scheier (1959), Academy of Natural Sciences (1960), and Patrick et al. (1968) all reported results of toxicity tests that were performed at the Academy of Natural Sciences of Philadelphia with the bluegill in dilution waters that were very similar:

	mg/L
KCl	20
Na_2SiO_3	20
$NaHCO_3$	40
$MgSO_4 \cdot 7H_2O$	40
$Ca(NO_3)_2$	30*
$CaCO_3$	10
K_2HPO_4	10 or 2
Fe^{+++} (as ferric citrate)	4 or 0.4

Ca = 11.3 mg/L
Mg = 3.9 mg/L
Hardness = 44.3 mg/L as $CaCO_3$
Chloride = 9.5 mg/L
Sulfate = 15.5 mg/L

*Long after the tests of concern were performed, this was reported to be 40 mg/L of $Ca(NO_3)_2 \cdot 4H_2O$

5. Freeman (1953), Freeman and Fowler (1953), Fairchild (1955), Dowden (1960), Dowden (1962), and Dowden and Bennett (1965) all contained information regarding toxicity tests performed at Louisiana State University in Baton Rouge, but several different dilution waters were used. Dowden and Bennett (1965) tried to clarify the most important dilution waters used, but the citations given for the waters on page 1310 need to be clarified. Reference 4 is the correct citation for "Standard Reference Water" (SRW), but the correct citation for "Reference Dilution Water" (RDW) is reference 6 (not reference 3) and reference 3 should be cited for "glass-wool filtered University Lake Water (ULW). ULW is considered an unacceptable dilution water because it is from "a small drainpipe-fed lake on the campus of Louisiana State University" (Dowden 1960). The compositions of SRW and RDW are:

SRW	mg/L
$MgSO_4 \cdot 7H_2O$	71.

K_2SO_4	6.5
$MnSO_4 \cdot 4H_2O$	0.2
$CaCl_2 \cdot 2H_2O$	18.6
$NaHCO_3$	25.
NH_4NO_3	3.
$K_2HPO_4 \cdot 3H_2O$	1.1
CaO	32.2
$Na_2SiO_3 \cdot 9H_2O$	62.6
$FeCl_3 \cdot 6H_2O$	1.2

Ca = 23.0 mg/L
Mg = 7.0 mg/L
Hardness = 86.2 mg/L as $CaCO_3$
Chloride = 9.4 mg/L
Sulfate = 31.2 mg/L

RDW	mg/L
$CaCl_2$	110
$NaHCO_3$	110
NaCl	100
$MgSO_4 \cdot 7H_2O$	60
KCl	20

Ca = 39.7 mg/L
Mg = 5.9 mg/L
Hardness = 123.4 mg/L as $CaCO_3$
Chloride = 140.4 mg/L
Sulfate = 23.4 mg/L

6. When known, the concentration of chloride in dilution water was negligible in tests on chloride.

7. Karraker (2007) says that "road salt" contains sodium chloride, sodium ferrocyanide, heavy metals, and often sand or cinder. Results of toxicity tests on "road salt" were not used.

8. If tests in a document using some species had acceptable control mortalities but other tests in the same document using other species had unacceptable control mortalities, the tests using species with unacceptable control mortalities were not used. The general policy is that tests in a document using different species should be evaluated on a species-by-species basis, not on a document-by-document basis.

9. Hyalella azteca appears to be especially sensitive to some pollutants when the concentration of chloride is low, e.g., lower than 25 mg/L. This should not affect the sensitivity of this species to chloride.

10. Grizzle and Mauldin (1995; 24-hr tests using striped bass) and Lasier et al. (2006; 7-day survival tests using Ceriodaphnia dubia) reported that calcium and/or magnesium reduced the toxicity of chloride, but sufficient data are not available to make a chloride criterion dependent on hardness or on the concentration of calcium and/or magnesium. In contrast, McGregor et al. (1986) reported that the toxicity of NaCl was not significantly affected by hardness. Davies and Hall (2007) reported that the Ca-Mg ratio did not affect the toxicity of either NaCl or KCl to D. magna.

11. Mount et al. (1997) reported that the toxicities of sodium and calcium salts to C. dubia, D. magna, and the fathead minnow are primarily attributable to the corresponding anion.

12. Results of 96-hr toxicity tests using juvenile freshwater mussels were used if the methodology, etc., were acceptable, but results of tests using glochidia of freshwater mussels were not used. Acute (e.g., 96-h) toxicity tests using juvenile freshwater mussels are rather standard acute toxicity tests and can be evaluated using, for example, ASTM Standard E729. In contrast, acute toxicity tests using glochidia of freshwater mussels require special consideration because free-living glochidia must attach to a host in order to survive, and they typically attach within seconds to days. In addition, for a specific species and a specific toxicant, the glochidia 6-h EC50 might be substantially higher than the 24-h EC50. It is known that free-living glochidia of several species can remain viable for up to about ten days, depending on the species and on the percent viability that is considered acceptable. However, it is not known how fast glochidia of individual species usually attach to a host, and this is important because the glochidia EC50 for some toxicants and species is quite dependent on the duration of the toxicity test. Thus, a very important question is "What species-specific toxicity-test duration is ecologically relevant for glochidia?"

13. Section IV.C of the 1985 Guidelines says: "Except for tests with saltwater annelids and myside, results of acute tests during which the test organisms were fed should not be used, unless data indicate that the food did not affect the toxicity of the test material." Section XII.B of the 1985 Guidelines says: "On the basis of all available pertinent laboratory and field information, determine if the criterion is consistent with sound scientific evidence. If it is not, another criterion, either higher or lower, should be derived using appropriate modifications of these Guidelines." Appendix 1 demonstrates that results of fed acute tests on chloride should be used and should be given preference over unfed tests when the test organisms are cladocerans.

14. Some data presented in Table 1 of USEPA (1988) have been changed:
    a. Several values differ because of roundoff differences.
    b. USEPA (1988) used results of short acute tests for the reasons given on pages 2 and 3 (see also Lowell et al. 1995), but results of short tests are not used here because short acute tests sometimes give higher LC50s than standard tests.
    c. Data from Dowden (1961, which should be 1960) and Kostecki and Jones (1983) are not used here because of the dilution water used in the tests.
    d. The test results from Trama (1954) are also given in Academy of Natural Sciences (1960) and Patrick et al. (1968).
    e. Hamilton et al. (1975) did not adequately acclimate the midges.
    f. Fed acute tests were not used in USEPA (1988), but fed tests are used here and are given preference over unfed tests when the test organisms are cladocerans.

(Acute values are expressed as mg chloride/L; quotients of acute values do not have units)

	Acute Values				Ratios of Acute Values				
	NaCl	CaCl2	MgCl2	KCl	Ca/Na	Mg/Na	K/Na	K/Mg	Mg/Ca
C. dubia Mount fed	1189	1169	655	300	0.98	0.55	0.25	0.46	0.56
D. magna Mount fed	2893	1770	990	314	0.61	0.34	0.11	0.32	0.56
D. magna B&C fed	2806	821	939	150	0.29	0.33	0.05	0.16	1.14
D. magna B&C unfed	2529	92	408	84	0.04	0.16	0.03	0.21	4.43
D. magna K&R unfed	621	679		128	1.09		0.21		
D. magna Anderson unfed (64 hr tests)	2232	588	551	205	0.26	0.25	0.09	0.37	0.94
D. magna D&B unfed	3563	1920	2755		0.54	0.77			1.43
T. tubifex Khangarot	1204	497		737	0.41		0.61		
Fathead minnow Mount fed	3876	2958	1579	418	0.76	0.41	0.11	0.26	0.53

Mosquitofish A&B unfed	9099	5196	<2378	0.57	<0.26
Bluegill Trama unfed	7853	6804	956	0 87	0.12

Appendix 2

ADVENT
ENVIRON

WHOLE EFFLUENT TOXICITY STUDY OF FLUE GAS DESULPHURIZATION EFFLUENTS

Prepared for

AEP OHIO
A unit of American Electric Power

AMERICAN ELECTRIC POWER
Columbus, Ohio

Prepared by

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April 2007

FLUE GAS DESULPHURIZATION PROJECT TOXICITY TESTING

1.0 INTRODUCTION AND BACKGROUND

Acute Whole Effluent Toxicity (WET) testing was conducted to assess potential effluent toxicity if a new high-salinity Flue Gas Desulphurization (FGD) process waste stream is routed to wastewater treatment ponds at several AEP facilities. The FGD waste stream (chloride purge stream, or CPS) is produced when excess chlorides (in addition to other dissolved salts and trace metals) is "purged" from the FGD absorber vessel FGD-simulated wastewater samples from the following plants were tested: Cardinal (Brilliant, OH), Mitchell (Moundsville, WV), Mountaineer (New Haven, WV), Clifty Creek (Madison, IN), Kyger Creek (Addison, OH), Amos (St. Albans, WV), Muskingum River (Beverly, OH), and Conesville (Coshocton, OH).

Effluent samples were collected and shipped overnight to the ADVENT-ENVIRON Ecotoxicology Laboratory. Tests were conducted with effluent, mock effluent, and salt-spiked effluent.

2.0 TOXICITY TESTING PROCEDURES

Whole effluent toxicity (WET) tests consisted of 48 hour and 96 hour acute tests with *C. dubia* and fathead minnow (*Pimephales promelas*), respectively. Test methods followed US Environmental Protection Agency (USEPA) protocols (USEPA, 2002). The primary control for each test was river water, with a secondary control of moderately hard laboratory water. Effluents, whether actual, mock, or salt-spiked, were tested at their In-stream Waste Concentration (IWC) and at 100% effluent using each site's river water for dilution and control water.

Mock effluents (i.e., laboratory control water to which salts, or salts and metals were added) were prepared based on available background analytical data for each effluent and the projected water chemistry with FGD process water. There were two types of mock effluent tests: Tier 1 (projected FGD salt, or salt and metal additions) and Tier 2 (1.5 to 2 times the Tier 1 additions). Salt-spiking tests (i.e., salt, or salt and metals added to effluents) were based on the background analytical data and projected water

chemistry for each facility. The metals added to effluents were arsenate and selanite. The other proposed additions (aluminum and copper) were not added since the projected levels were below concentrations known to cause acute toxicity. Most of the background water chemistry data were not available to ADVENT-ENVIRON until the testing had begun or was completed. Estimates were used in many cases when determining the salt, or salt and metal additions for each effluent. Some of the choices of salts selected to make mock effluents were dependent on the solubility of the salt, especially when high projected sulfate concentrations precluded the use of calcium sulfate due to its poor solubility. Salt-spiking tests were also evaluated for Tier 1 and Tier 2 salt addition levels.

3.0 RESULTS

Tables 1, 2, and 3 list LC50 values, mortality values in selected exposures, and analytical results for all tests. A brief summary of each facility's result follows. For brevity, the Tier 1 and Tier 2 salt, or salt and metal additions are indicated as "1" or "2" following each test designation. Unless otherwise noted, all control organisms met test acceptability criteria. For all sites, the calculated LC50 values were above the IWC values when LC50 values were greater than 100% effluent. Attachment 1 presents the raw data and statistics for each test. Attachment 2 presents chain-of-custody forms for each facility and recent laboratory reference toxicant data. Attachment 3 consists of the chemical data supplied by Dolan Laboratory for each facility.

AMOS

Fathead Minnow Test Results: The Amos Plant effluent (Outfall 003), Mock 1, and Salt-spike 1 toxicity tests indicated LC50 values greater than 100% effluent for fathead minnows. The Mock 2 and Salt-spike 2 toxicity tests indicated LC50 values of 71.5% and 80.3%, respectively; lower than 100% effluent, but much higher than the IWC of 20% effluent (i.e. would not cause toxicity following dilution to the IWC). These data indicate that the current effluent is not acutely toxic to the fathead minnow at 100% effluent, and only Tier 2 level FGD conditions would cause acute toxicity in 100% effluent. However, the additional toxicity is not sufficient to cause toxicity at the 20% IWC

of the Amos discharge. The IWC represents a mixture of Outfall 003 and Kanawha River water using default mixing assumptions.

C. dubia **Test Results**: The Amos effluent indicated a *C. dubia* LC50 value of greater than 100% effluent. Although the Mock 1 and 2 LC50 values (44.7% and 38.8%, respectively) and the Salt-spike 1 and 2 LC50 values (42.9% and 44.7%, respectively) were below 100%, they were still above the IWC of 20% effluent. These data indicate that while FGD additions would increase final effluent toxicity to *C. dubia*, it is not sufficient to cause toxicity at the IWC under either the Tier 1 or Tier 2 scenarios.

Comparison of the fathead minnow and *C. dubia* data for the Tier 1 and Tier 2 additions (mock effluent and salt-spiking tests) indicates higher sensitivity of *C. dubia*. (i.e., the Tier 1 and 2 additions resulted in fathead minnow LC50 values above those of *C. dubia* for both tier conditions) This is consistent with the known higher sensitivity of *C. dubia* to salts relative to the fathead minnow.

CARDINAL

Fathead Minnow Test Results. Tests conducted with the Cardinal Plant effluent indicated possible pathogen interference in the river water diluent. The pathogen effects were present throughout the test, infecting the river water controls and the secondary moderately hard water controls. No other moderately hard laboratory water controls tested on the same date indicated these effects, and the laboratory water effects are apparently a result of cross-contamination in this test only. More than the acceptable 10% mortality was observed in the river water and moderately hard water controls. Regardless, the fathead minnow tests with the Cardinal effluent and all mock and salt-spiked effluents indicated no acute toxicity at the 100% effluent levels. These data indicate that FGD additions to the effluent should not result in non-compliance with acute WET limits for this site.

C. dubia **Test Results**: The *C. dubia* tests with the Cardinal effluent and all mock and salt-spiked effluents indicated no acute toxicity (LC50 values greater than 100% effluent) and thus it is expected that meeting acute WET limits for this discharge (if applicable)

would not be problematic. Comparison of the Amos and Cardinal Tier 1 and Tier 2 additions' toxicity to *C. dubia* also indicates higher toxicity under projected Amos FGD conditions.

CLIFTY CREEK

Fathead Minnow Test Results: Tests conducted with the Clifty Creek plant effluent and all mock and spiked effluents indicated LC50 values greater than 100% effluent. There was some mortality observed in the test concentrations, but mortality was less than 50 percent. Once again, the control organisms indicated pathogen interference, but test results indicate likely compliance with projected IWC-based WET limits of 20% effluent.

***C. dubia* Test Results:** There was no acute mortality in the effluent, mock, or spiked effluent tests with *C. dubia*. The LC50 values were all greater than 100% effluent, and also indicate likely compliance at projected IWC-based WET limits. The amount of toxicity was insufficient to generate LC50 values below 100% effluent to either species with Tier 1 or Tier 2 salt additions.

CONESVILLE

Fathead Minnow Test Results: Tests with Conesville effluent indicated an LC50 value of greater than 100% effluent. The river water control organisms met test acceptability criteria, and did not exhibit the mortality that was observed in other river water controls. The mock effluents and salt-spiked effluents indicated some acute mortality less than 40%, but not enough to generate an LC50 value in any exposures. The mock effluents and Tier 1 salt-spiked test indicated 25 percent or less mortality, and only the Tier 2 salt-spiked test indicated 40% mortality.

***C. dubia* Test Results:** The *C. dubia* tests with effluent, mock 1, and spiked-effluent indicated LC50 values of greater than 100% effluent. Testing with the mock Tier 2 effluent produced an LC50 value of 86.4% effluent. All LC50 values were greater than the IWC of 20% effluent.

KYGER CREEK

Fathead Minnow Test Results: The fathead minnow toxicity test results indicated pathogen interference with all control and effluent-exposed organisms. Although toxicity was observed in all test concentrations and controls, LC50 values were greater than 100% effluent for all tests except the Tier 2 mock effluent (LC50 value 93.3%) The mortality in all other tests ranged from 15 to 40 percent. All LC50 values were greater than the IWC of 50% effluent.

C. dubia **Test Results:** No mortality was observed for any of the *C. dubia* toxicity tests except for the Tier 2 mock and Tier 2 salt-spiked test (resulting LC50 values approximately 71% effluent). Regardless, all LC50 values were above the 50% IWC value, indicating compliance with projected WET limits.

MITCHELL

Fathead Minnow Test Results: The fathead minnow toxicity tests with Mitchell plant effluent and mock effluents indicated LC50 values of greater than 100% effluent. The salt-spiked effluent tests indicated an LC50 value of greater than 100% effluent for the Tier 1 test, but an LC50 value of 44.7% for the Tier 2 salt-spiked effluent. All LC50 values were above the IWC of 20% effluent.

C. dubia **Test Results:** The LC50 value for the *C. dubia* test with Mitchell plant effluent was greater than 100% effluent. No mortality was observed in the effluent at either the 100% or IWC concentration of 20% effluent. However, the mock effluents indicated LC50 values of 44.7% and less than 20% at respective Tier 1 and Tier 2 levels. An LC50 value of 44.7% effluent was observed for Tier 1 and Tier 2 salt-spiking tests (the reason for this is unknown). With the exception of the Tier 2 mock effluent test, all LC50 values were greater than the IWC of 20% effluent.

MOUNTAINEER

Fathead Minnow Test Results: The toxicity test with Mountaineer Plant effluent indicated an LC50 value of greater than 100% effluent. The mock effluent indicated similar LC50 values of approximately 85% effluent at the Tier 1 and Tier 2 spiking levels. This may be an artifact of the pathogen interference in these tests. The Tier 1 salt-spiked effluent tests indicated LC50 values of greater than 100% effluent, but an LC50 value of less than 20% effluent for the Tier 2 salt-spiked test. All tests except the Tier 2 salt-spiked test indicate projected compliance at the IWC of 20% effluent. These effects may be due to the combined effects of the salt addition and pathogens noted in the test.

***C. dubia* Test Results:** The LC50 value for the *C dubia* test was greater than 100% effluent. No mortality was observed in the effluent at either the 100% exposure or the 20% IWC concentration. However, the mock effluents indicated LC50 values of less than the IWC of 20% effluent. Mortality of *C. dubia* in the test concentration of 20% of Mock 1 and 2 effluents reached 60% and 100% mortality, respectively. The salt-spiked effluent tests indicated LC50 values of 44.7% (Tier 1) and 36.6% (Tier 2). Although the salt-spiked effluent tests indicate toxicity near the IWC of 20% effluent, only the mock effluent tests indicate potential non-compliance at the IWC. This effluent received the highest levels of spiked fluoride. The projected fluoride concentrations (210 mg/L and higher) are similar to a previously reported acute toxicity value of 250 mg/L to *Daphnia magna*. (Fieser, A.H. et al, 1986 and LeBlanc, G.A., 1980)

MUSKINGUM RIVER

Fathead Minnow Test Results: The fathead minnow tests with Muskingum River Plant effluent indicated LC50 values of greater than 100% effluent for all tests conducted. However, the control organisms appeared to be infected by a pathogen that caused mortality in the river water controls and some of the test concentrations. The toxicity data indicate compliance with projected WET limits at the IWC of 10% effluent.

***C. dubia* Test Results:** The Muskingum effluent was not acutely toxic to *C. dubia* at 100% effluent. The Tier 1 mock and salt-spiked effluents were also not acutely toxic to

C. dubia at 100% effluent. However, the Tier 2 mock and salt-spiked effluents had LC50 values of 31.6% effluent, but still greater than the IWC of 10% effluent.

SUMMARY

In summary, none of the existing coal ash pond effluents induced acute toxicity to the fathead minnow or *C. dubia* sufficient to result in LC50 values of less than 100% effluent. Projected FGD chemical additions did not increase WET to either test organism (Tier 1 or Tier 2 levels) for effluent samples from Cardinal and Clifty Creek plants.

Acute toxicity to fathead minnow increased mainly at the Tier 2 level additions, except for the Mountaineer Plant test where the Tier 1 level addition in mock effluent indicated an LC50 value of 85.1% effluent. This test also had pathogen interference, which may have contributed to the observed toxicity. The Mountaineer Tier 2 level salt-spike test indicated a fathead minnow LC50 value lower than the site's corresponding IWC (20% effluent). The relatively high toxicity observed in the Mountaineer Plant salt-spiking tests may be anomalous given the pathogen interference. Re-running these tests may resolve this discrepancy. Ultimately, WET tests using full scale FGD-influenced wastewater would be necessary to confirm projected results.

Acute toxicity to *C. dubia* increased in three of the eight Tier 1 level mock and salt spiked effluent additions (Amos, Mitchell, and Mountaineer), in five of the eight Tier 2 salt-spiked effluents, and in six of the eight Tier 2 level mock effluents. Taken with the fathead minnow data, these data reflect the higher sensitivity of *C. dubia* to salts and metals. The *C. dubia* data also indicated fairly good agreement between the mock and salt-spiked effluent test results. The Mitchell and Mountaineer tests indicated the highest toxicity to *C. dubia* due to FGD additions, and were the only sites with toxicity sufficient to be potentially non-compliant with projected IWC-based WET limits. The projected concentrations of fluoride may be of concern in these effluents. At the time of sampling and testing, the measured fluoride values for current Mitchell and Mountaineer effluents indicated 0.25 mg/L and 0.77 mg/L of fluoride, respectively.

All other plant effluents, mock effluents, and salt-spiked effluents indicated some degree of toxicity, but not enough to generate LC50 values of less than the IWC for each facility. There were cases of fathead minnow mortality due to pathogen interference, and this could have caused or contributed to some mortality in effluent exposures. However, even with pathogen infections to fish, most of the plant effluents did not indicate increased toxicity at the additional salt or salt and metals concentrations that would cause LC50 values to be less than the IWC for each plant. As expected, *C. dubia* were more sensitive to the salt additions. Additional *C. dubia* testing of the Mitchell effluent may also be warranted as it and the Mountaineer Plant are the only sites where FGD additions exceeded IWC-based WET limits, albeit only under Tier 2 conditions.

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Table 2. Major Ion Analysis for AEP Power Plants

Plant Name	Water Source	Cations (mg/L) Calcium	Magnesium	Sodium	Potassium	Anions (mg/L) Chloride	Sulfate	Alkalinity	Sum Major Ions	Measured TDS
Amos	Intake	19	8	20	3	18	38	59	164	131
	003 CP discharge	42	17	41	6	38	140	78	361	326
	Tier 1	122	854	53	5	2497	293	140	3964	
	Tier 2	183	1283	53	5	3746	438	140	5847	
Clifty Creek	Intake	35	11	19	3	27	46	64	204	190
	002	45	13	22	5	30	98	78	291	269
	Tier 1	307	107	22	0	311	737	59	1542	
	Tier 2	461	160	22	0	466	1105	59	2272	
Mountaineer	Intake	30	8	20	3	29	54	40	184	182
	001	137	36	101	14	108	398	108	870	925
	Tier 1	292	549	47	0	1600	700	123	3311	
	Tier 2	438	823	70	0	2400	1050	185	4966	
Conesville	upstream	54	17	7	6	41	82	105	305	410
	001	56	28	18	9	30	127	60	327	335
	Tier 1	366	72	53	7	218	878	140	1735	
	Tier 2	915	181	53	7	534	2194	140	4025	
Kyger	upstream	139	19	37	13	58	332	36	635	644
	005 FA pond	114	57	27	7	31	264	42	542	502
	Tier 1	248	233	8	5	772	594	22	1913	
	Tier 2	620	658	8	5	1924	1485	22	4722	
Cardinal	upstream	29	8	18	3	28	47	43	173	190
	001	32	9	18	3	27	48	43	180	180
	Tier 1	54	34	7	0	98	130	18	340	
	Tier 2	135	84	7	0	244	325	18	813	
Muskingum	upstream	46	14	15	8	24	49	84	238	223
	002 Unit 5 AP discharge	171	30	58	16	75	418	59	827	836
	Tier 1	473	242	65	15	735	1113	172	2815	
	Tier 2	1169	620	65	15	1836	2783	172	6659	
Mitchell	river water	24	6	16	8	21	37	40	149	162
	001 Bottom AP discharge	39	10	66	10	95	96	40	356	372
	Tier 1	405	492	26	5	1441	970	69	3408	
	Tier 2	607	738	26	5	2159	1455	69	5059	

Ca:Mg ratio 1:1 or less.

Table 3. Water Chemistry Comparison

Water Type	A-E Hardness mg/L	Dolan Hardness mg/L	A-E Alkalinity mg/L	Dolan Alkalinity mg/L	A-E pH s.u.	Dolan pH s.u.	A-E Conductivity umhos/cm
Amos Effluent	84	172	162.4	78	7.8	7.40	554
Amos Mock 1	3000		125		8.59		8510
Amos Salt Spike 1	4000		100		7.73		7940
Amos Mock 2	6000		125		8.55		12850
Amos Salt Spike 2	2600		85		7.86		11850
Cardinal Effluent	168	114	44	43	7.68		449
Cardinal Mock 1	2664		30		7.47		574
Cardinal Salt Spike 1	336		33		7.58		728
Cardinal Mock 2	608		30		7.47		1297
Cardinal Salt Spike 2	520		40		7.45		1164
Clifty Creek Effluent	152	165	121	78	8.17	7.90	430
Clifty Creek Mock 1	3000		55		8.65		2160
Clifty Creek Salt Spike 1	3900		55		8.03		2300
Clifty Creek Mock 2	4500		50		8.55		3230
Clifty Creek Salt Spike 2	4500		55		8.01		3110
Conesville Effluent	256	255	75	60	7.72	7.00	533
Conesville Mock 1	1220		120		8.22		2340
Conesville Salt Spike 1	1392		200		8.03		2740
Conesville Mock 2	2500		135		8.14		4330
Conesville Salt Spike 2	2920		360		7.85		5840
Kyger Effluent	300	350	43	42	8.54	6.80	772
Kyger Mock 1	1640		28		7.68		3320
Kyger Salt Spike 1	1400		51		8.03		3030
Kyger Mock 2	4140		15		7.47		7740
Kyger Salt Spike 2	3248		44		7.99		6480
Mitchell Effluent	136	138	48	40	7.74	6.80	568
Mitchell Mock 1	3000		55		9.06		5870
Mitchell Salt Spike 1	3900		55		7.74		6520
Mitchell Mock 2	4500		50		8.52		8810
Mitchell Salt Spike 2	4500		55		7.71		8990
Muskingum Effluent	488	549	85	59	8.37	7.90	1265
Muskingum Mock 1	3800		155		8.20		4450
Muskingum Salt Spike 1	4000		80		8.12		4250
Muskingum Mock 2	5600		155		8.17		9410
Muskingum Salt Spike 2	8500		90		8.01		8530
Mountaineer Effluent	492	486	125	108	8.26	7.70	1468
Mountaineer Mock 1	3300		85		7.99		6250
Mountaineer Salt Spike 1	2300		115		7.79		6380
Mountaineer Mock 2	4000		110		8.26		9030
Mountaineer Salt Spike 2	3300		120		7.73		8760

Table 1. LC50 Values for FGD Study Effluents

Sample ID	Test Date	Effluent						Tier 1 Stock Effluent						Tier 2 Stock Effluent						Tier 1 Bulk Spiked Effluent						Tier 2 Bulk Spiked Effluent					
		FM			CD			FM			CD			FM			CD			FM			CD			FM			CD		
		IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)	IWC Percent Mortality	100% Percent Mortality	LC50 Value (%)
Ames (IWC = 20%)	6/6/2000	10	10	>100	5	0	>100	5	10	>100	0	100	44.7	10	80	71.5	15	100	34.8	25	20	>100	15	100	42.6	5	80	46.5	0	100	44.7
Cardinal (IWC = 5%)	7/25/2000	30	30	>100*	5	5	>100	20	20	>100*	5	0	>100	35	10	>100*	0	0	>100	35	10	>100*	0	0	>100	45	30	>100*	0	0	>100
Little Creek (IWC = 20%)	8/8/2000	20	20	>100*	0	0	>100	20	20	>100*	5	0	>100	15	35	>100*	0	10	>100	10	80	>100*	0	0	>100	30	40	>100*	0	0	>100
Gatewood (IWC = 20%)	7/13/2000	5	0	>100	5	0	>100	5	15	>100	0	0	>100	25	20	>100	5	55	38.4	10	0	>100	0	5	>100	15	40	>100	0	15	>100
Hyco (IWC = 80%)	7/28/2000	30	40	>100*	0	0	>100	40	75	>100*	0	0	>100	50	50	73.3*	0	100	76.7	20	35	>100*	0	0	>100	15	25	>100*	0	05	72
Mitchell (IWC = 20%)	8/8/2000	35	35	>100	5	0	>100	30	25	>100	0	100	44.7	25	15	>100	85	100	<20	20	10	>100	0	100	44.7	45	65	44.7	0	100	44.7
Mountaineer (IWC = 20%)	8/23/2000	15	15	>100*	0	0	>100	5	55	71.7	80	100	<20	0	50	76.1	100	100	<20	10	45	>100*	0	100	44.7	35	65	>100*	20	100	56.4
Washington (IWC = 20%)	7/19/2000	10	20	>100*	0	0	>100	15	30	>100*	0	15	>100	15	25	>100*	0	100	31.6	10	20	>100*	0	15	>100	0	35	>100*	0	100	35.6

*Control failure due to a natural pathogen in river water
BOLD - LC50 Values greater than 100 percent effluent
Blue - LC50 Value less than 100 percent effluent
Red - LC50 Values less than the IWC

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TECHNICAL MEMORANDUM

TO:	WILLIAM ADAMS, PH.D. RIO TINTO	DATE:	AUGUST 30, 2010
		RE:	PROPOSED CONDUCTIVITY BENCHMARK
FROM:	AARON REDMAN	FILE:	RIOT.006

The U.S. EPA has proposed a new water quality standard based on conductivity to protect aquatic life in the Appalachian mountain regions, namely ecoregions 69 and 70 (EPA 2010). The comments in this memorandum will address the technical basis of the proposed standard:

1) The technical approach to deriving the proposed conductivity standard is limited due to a lack of causal relationship and a high degree of variability the field data;
2) The proposed standard did not consider natural waters throughout the Appalachian states (WV, KY, TN, PA, MD), which can have conductivities greater than the proposed standard;
3) The proposed standard did not include municipal wastewater treatment plants in the region that have discharges with conductivities that are commonly above the proposed standard.

Approach

Acute and chronic effect levels for high ionic strength solutions were identified through focused searches of the peer-reviewed literature and State and Federal water quality standards. Water quality data were collected for waste water treatment plant from the EPA Permit Compliance System (http://www.epa.gov/enviro/html/pcs/pcs_query_java.html) as well as the USGS water quality (http://infotrek.er.usgs.gov/nawqa_queries/swmaster/index.jsp) database. Total dissolved solids (TDS) measurements were used to estimate conductivity levels using standard relationships (McNeil and Cox 2000; Standard Methods 1997).

Conductivity (µS/cm) = TDS (mg/L) * 1.7 (1)

Comments on technical approach of U.S. EPA 2010

Measurements of conductivity are really a measure of the total ion composition (e.g., Ca, Na, Cl, SO_4, HCO_3, etc) in water (McNeil and Cox 2000; Standard Methods 1997). The proposed conductivity standard implies that there are potential effects due to major ions found in the waters in the study area (EPA 2010). The field-based approach to establishing stressor-response relationship can be useful as part of a larger weight of evidence approach to demonstrate effects in the field. However, the approach is subject to a high degree of variability due to the uncertainty in the physical, biological and chemical factors found in field datasets. Biological, chemical and physical factors such as seasonal and spatial variations in temperature, habitat quality and/or food web dynamics can affect field populations of aquatic organisms.

In order to demonstrate a linkage between the observed correlations with conductivity the stressor-response must be supported by multiple lines of evidence where there are clear causal relationships. For example, effects data that were derived under carefully controlled exposure conditions in order to identify the contributions from confounding influences of multiple stressors. In this case, the observed correlations between biological indices and conductivity should be ground-truthed against measured effect levels from controlled exposures such as standardized laboratory toxicity tests.

Variability

Comparisons to laboratory-derived benchmarks provide a means for evaluating field observations that often exhibit considerable variability inherent in natural settings. This is particularly important when trying to establish causal relationships from correlations. The correlations between the observed biological metrics and conductivity are not strong and warrant further analysis. For example, Figure 1 (i.e., figure A-1 from EPA 2010) shows that ecological community composition exhibit a high degree of variability and does not exhibit a strong correlation with conductivity. Furthermore, the confidence intervals displayed on Figure 1 do not appear to be consistent with the data (e.g., too narrow) and the text does not explain how these were derived.

A comparison between Total Taxa and Conductivity using data provided in the supplemental material: 'METRICS_ENV.XML' does not show a trend that would suggest that conductivity is impairing the number of species found in these streams (Figure 2). A further comparison of the total number of *Ephemeroptera* species does not show any clear response with respect to conductivity (Figure 3). For example, the number of *Ephemeroptera* species range from 0 to 13 across the entire range of conductivity, which varies over two orders of magnitude from 20 to 1700 µS/cm with no discernable trends in this subset of the data. A stressor-response with respect to conductivity is not evident in the dataset, which is explained by the fact that the measured conductivities are far below measured effect levels (see Table 1, Figure 4 below).

The variability observed in these datasets underscores the importance of using multiple and strong lines of evidence to discern effects from natural variability. The confounding influence due to habitat quality, food web dynamics, seasonal patterns and a number of other factors can be substantial and is difficult to account for in the observed relationships between the ecological metrics and conductivity.

The analyses in Appendices A and B attempt to address these issues and uses a series of decision tables to organize the analysis. However, many of the ranking and scoring criteria are subjective and open to interpretation from the researcher. For example, the correlation between cause and effect is weak as discussed in these comments but is scored highly in Table A-6 and A-8 (EPA 2010). Laboratory-derived effect levels do support the idea that elevated salt concentrations can be toxic and are correlated with conductivity. However, toxic effects are only seen at high levels (typically >1,000 µS/cm, Table 1, Figure 4), which are generally well above the conductivities measured in the EPA 2010 study that are being assigned as the stressor variable.

Table A-11 (EPA 2010) summarizes the weight of evidence analysis and is similarly subjective. The variability in the dataset likely contributes to the lack of clear stressor-responses between the observed abundance and conductivity and, therefore, does not suggest a strong causal relationship, but receives high scores. The use of toxicity tests conducted with whole mine effluents can be used as supporting evidence but is similarly inconclusive. Mine waters are very complex and contain a number of stressors including elevated major ions, trace metals, variable pH and redox conditions; therefore conductivity may not be a good benchmark upon which to evaluate the potential for toxicity in these waters. Despite these concerns conductivity received high scores in support of the proposed water quality standard. Laboratory tests should be given stronger negative scores, which would dramatically lower the overall score and substantially weaken the linkage analysis in EPA 2010.

Confounding effects were analyzed in Appendix B. Due to the inter-related nature of the field-based assessment it is not always possible to control for potential confounding effects but they must be acknowledged. Factors such as Habitat Quality were found to be correlated with conductivity and biological response but were discounted because they were judged to have little effect on the derivation of

the HC05 (i.e. Table B-7, "Approach 6. Removal of Confounder"). The results of the analysis for potential confounders appear to be somewhat subjective and ambiguous, and should therefore be more carefully explained. Temporal and seasonal variation was not assessed. Replicates between seasons should be discussed.

Additional data visualization should be performed to demonstrate the role of the possible confounding influences that are addressed in Appendix A and B. The analysis should be based on common biological metrics throughout to ensure consistency between the proposed stressors (e.g., conductivity) that are being evaluated.

Laboratory data

A brief literature review was conducted to identify toxicity tests for aquatic invertebrates that have been performed under controlled conditions. A few report acute toxicity tests for commonly used organisms (e.g., *Daphnia magna, Ceriodaphnia dubia*, Mount et al 1997; Soucek and Kennedy 2005; Weber-Scannell and Duffy 2007; Davies and Hall 2007) while others report on species common to Australia (Kefford et al 2004; Hassell et al 2006; Zalizniak et al 2006), Europe (Goncalves et al 2007) and South Africa (Slaughter et al 2008). These data are compiled in Table 1.

A comparison between laboratory-derived toxicity data and the field-derived extirpation concentrations (XC95, e.g., point at which toxic effects begin to occur) are given in Figure 4. Most acute effects concentrations occur between 3,000 and 20,000 µS/cm, which is comparable to 2,000-10,000 mg/L as a total dissolved salt concentration. These levels are at least an order of magnitude above the conductivities measured in EPA 2010. Chronic effect levels range typically from 1,000 to 10,000 µS/cm, also, well above the field-derived XC95 for the lower end of the distribution.

Furthermore, typical acute to chronic ratios are <2 (range 11-1.1) indicative of the very narrow margin between acute and chronic effects (Figure 5). This is likely due to the ability of most organisms to regulate their internal salt levels. These two lines of evidence suggest that the conductivity levels in the streams that were surveyed are likely not sufficiently high to unambiguously explain the observed effects reported in EPA 2010.

Few of the organisms identified in the EPA 2010 study have been tested under laboratory conditions. It is assumed that the range of species sensitivity for these organisms is similar to those that have been studied under laboratory conditions. However, this remains a data gap and sensitive organisms should be tested under controlled conditions for comparison to the proposed benchmark.

The role of ion bioavailability has, also, not been addressed in the proposed standard (EPA 2010). Increasing hardness appears to have an effect on the observed toxicity of chloride (Soucek 2007), which may be related to the relative abundance of Calcium and Magnesium in the test waters (van Dam et al 2007; Davies and Hall 2007; McCollough 2006) and Mount et al (1997) shows that certain ion pairs may interact with each other to affect the observed toxicity. These studies suggest that toxicity due to elevated salt levels is more complex than can be explained solely with conductivity.

Furthermore, the use of EPA standard recipe waters in laboratory toxicity testing has been in use extensively (U.S. EPA 1993). These standard recipe waters span a range from very soft to very hard waters (Figure 6, Table 2) and have measured conductivities that range from 93 to 972 µS/cm. Measured conductivities in standard, EPA-recipe reconstituted waters routinely are above 300 µS/cm and exhibit acceptable control mortality (e.g., >=90%, Table 2) for several sensitive tests organisms including fish,

algae and aquatic invertebrates (Table 2). It is, therefore, not likely that conductivities as low as 300 µS/cm can cause toxic effects as suggested but EPA (2010).

The use of modeling to constrain and further characterize the potential for major ions to cause toxicity should be continued or considered as an alternative to the use of conductivity. There are no mechanistic models to address this issue though there are a few empirically-derived statistical models derived with multiple linear regressions (Mount et al 1997; Pillard et al 2002) for some aquatic organisms.

Other routes of exposure

The study did not address potential impacts from other important routes of exposure and related stressors. For example, sediment or porewater stressors were not evaluated but remain an important route of exposure for many benthic invertebrates. Trace metals concentrations were measured sporadically in the study but primarily in water, though companion studies provide some information on trace metals in this region (Pond et al 2008; Bryant et al 2002). However, these data are of limited usefulness since sediment organic carbon and acid-volatile sulfide were not measured. So it is not possible to provide mechanistic evaluation of the contribution of sediment-associated metals to the observed correlations and so remains an important and under-evaluated potential contributor.

Conductivity survey

Major ions can be introduced to natural waters through a variety of sources including other permitted discharges, evapo-concentration and natural erosion of minerals at a watershed scale. A survey of natural waters and permitted discharges was performed for several locations within ecoregions 69 and 70 as well as elsewhere across the U.S. (Figure 7). Many natural waters in the Western Mountain states and the Appalachian Mountain states have conductivities that are in excess of the proposed standard of 300 µS/cm (Figure 8, Table 3). Also, a survey of data collected at USGS stations within EcoRegions 69 and 70 show that approximately 80% of measurements are greater than the proposed standard. There is a substantial portion of the regional waters are in excess of the proposed standard (Figure 9, Table 4) and should be factored into the analysis since the proposed standard is intended for application throughout these two regions. Many of these stations are downstream of municipalities and would be affected by their local urban environments.

Municipal wastewater discharges can be another significant source of elevated conductivity in receiving waters. A survey of several WWTP facilities throughout the Western Mountain states and Appalachian Mountain States shows that all 30 of the facilities surveyed have effluents with conductivities greater than the proposed standard (Figure 10, Table 5). The proposed standard was derived primarily in remote areas of those downstream of mining sites (EPA 2010). However, the role and potential effects of WWTP in the field-based approach has not been explored such that the proposed standard may be too narrowly defined and not representative of ecoregions 69 and 70.

Conclusion

The technical basis for the proposed standard is weak and requires more rigorous comparisons of the observed correlations with laboratory-derived benchmarks to better address the apparent variability in the datasets. Field data is highly variable, presumably due to a combination of environmental factors (e.g., temperature, habitat, etc), and where possible an analysis of variability between replicates should performed. A recent EPA Science Advisory Board, addressing similar issues in the Stressor-Response analysis of nutrient criteria (EPA-SAB-10-006), advocated the use of conceptual models to organize data and provide additional transparency in the decision process. In this case it would discuss the basis that EPA 2010 used for the selection of conductivity are the stressor of concern. The proposed benchmark should be expanded to include waters that are naturally high in conductivity as well as waters that are

downstream of municipal WWTP, which often have effluents with conductivities greater than the proposed Benchmark. The proposed Benchmark does not appear to be sufficiently robust for regulatory use.

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Acknowledgements

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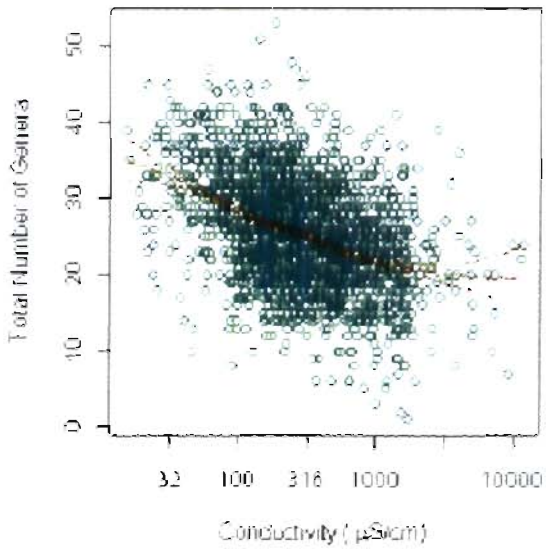


Figure 1 (copy of Figure A-1 from EPA 2010).

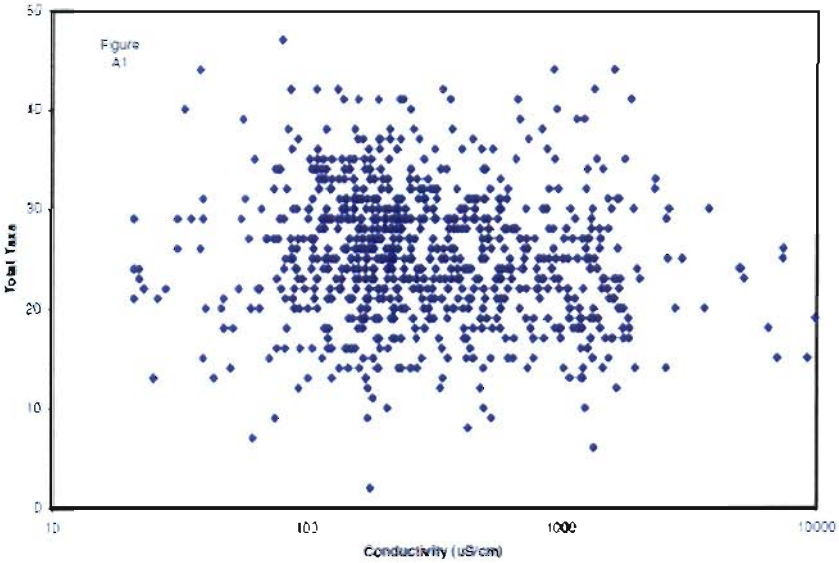


Figure 2. Total Taxa and conductivity from supplementary data files (EPA 2010 http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=220171).

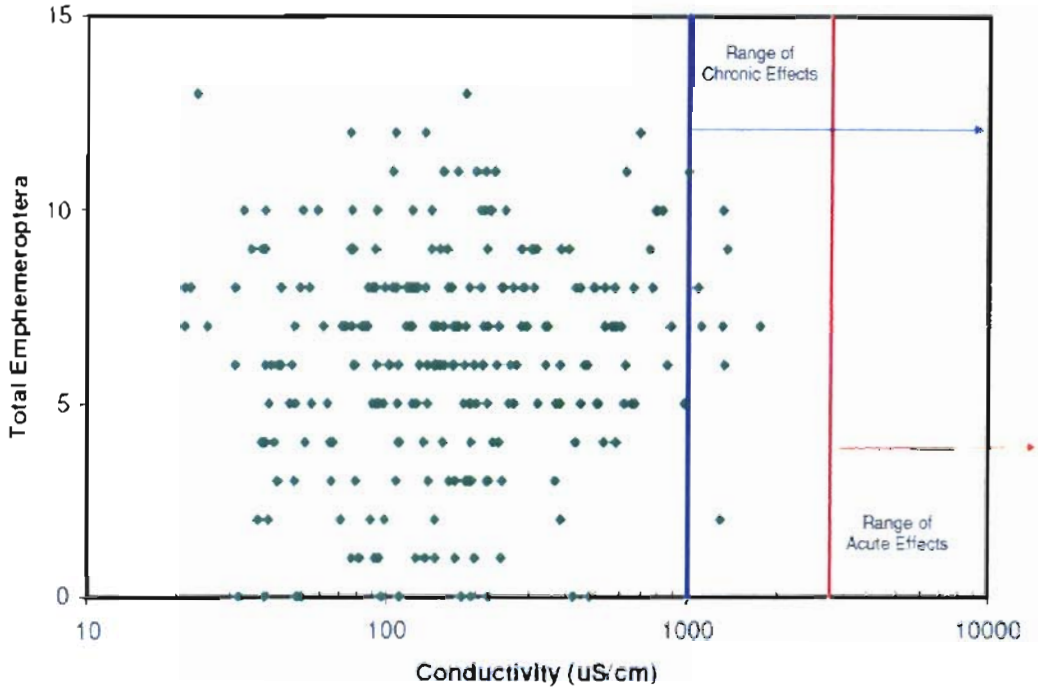


Figure 3. Total Ephemeroptera genera and conductivity from supplementary data files (EPA 2010 http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=220171). Effects data from Table 1 and Figure 4.

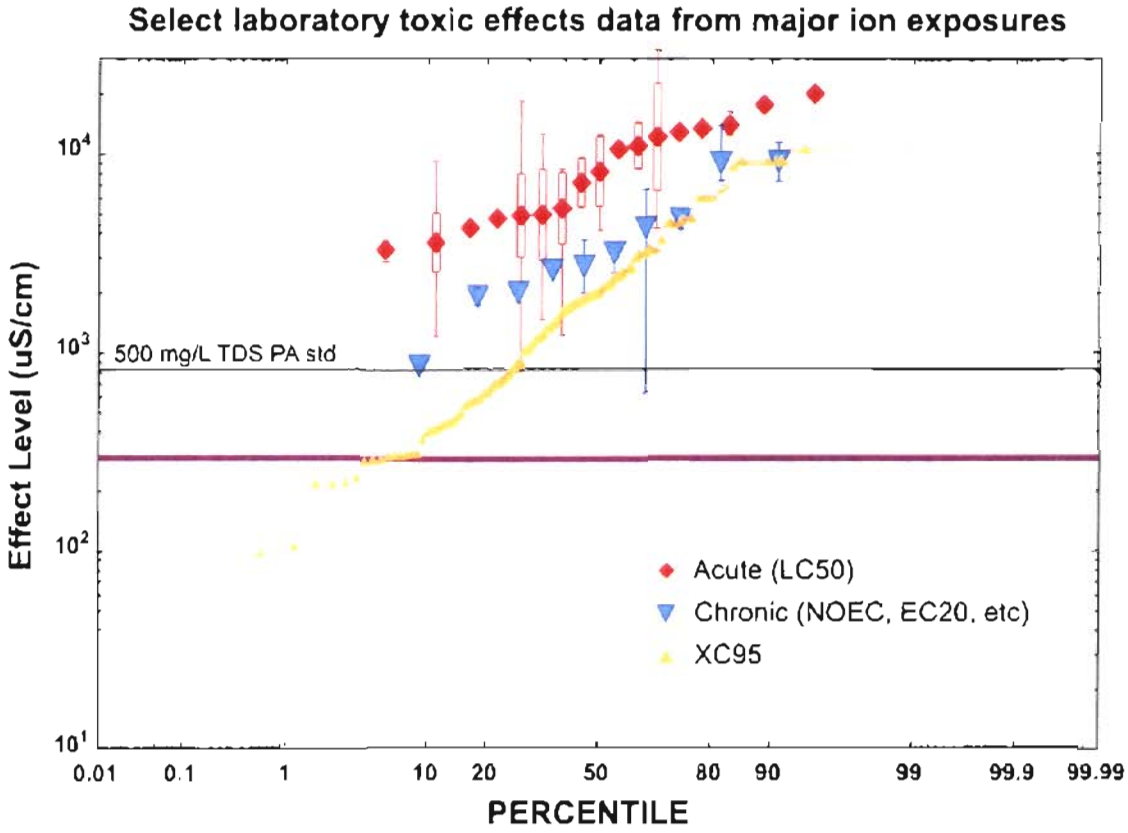


Figure 4. Comparison of laboratory-derived effects concentrations (Acute and Chronic) for well-defined salt mixtures (see Table 1). Field-derived XC95 (EPA 2010) are also given for comparison The horizontal lines correspond to the proposed standard (300 µS/cm) and TDS standard for Pennsylvania. Effects data are grouped by organism and display the median, range and inner quartiles of the reported effects concentrations for HCO_3, SO_4, Cl salts and defined mixtures including dilute seawater. K salts were not included in this comparison. Volumetric concentrations (e.g., mg/L) were converted to an estimated conductivity using a factor of 1.7.

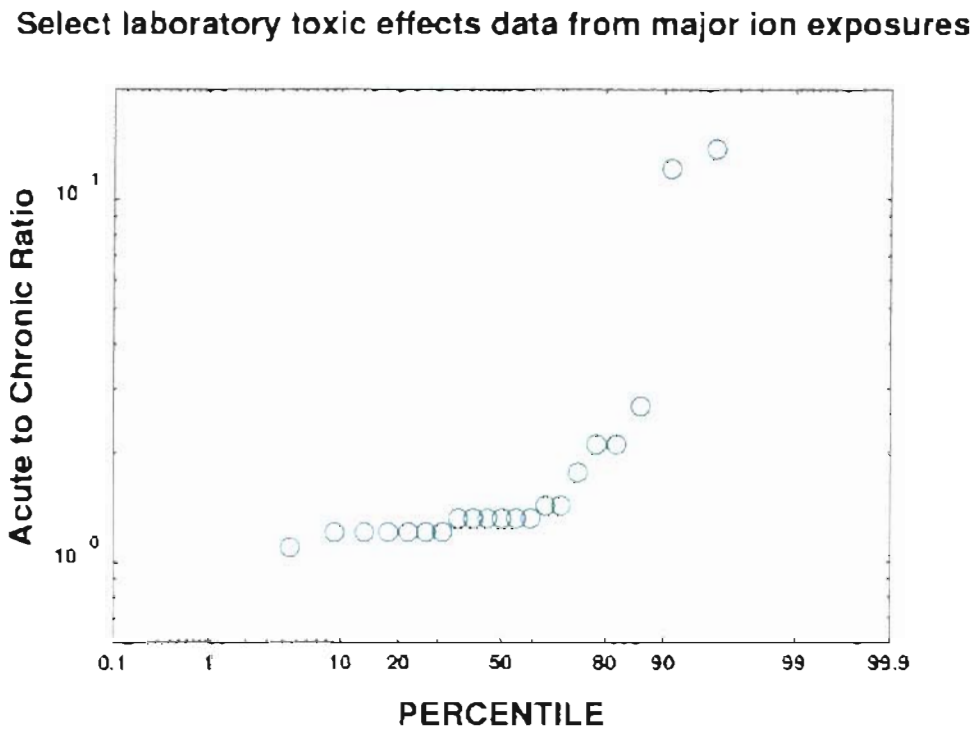


Figure 5. Acute to Chronic Ratios for exposures to major ions (Table 1).

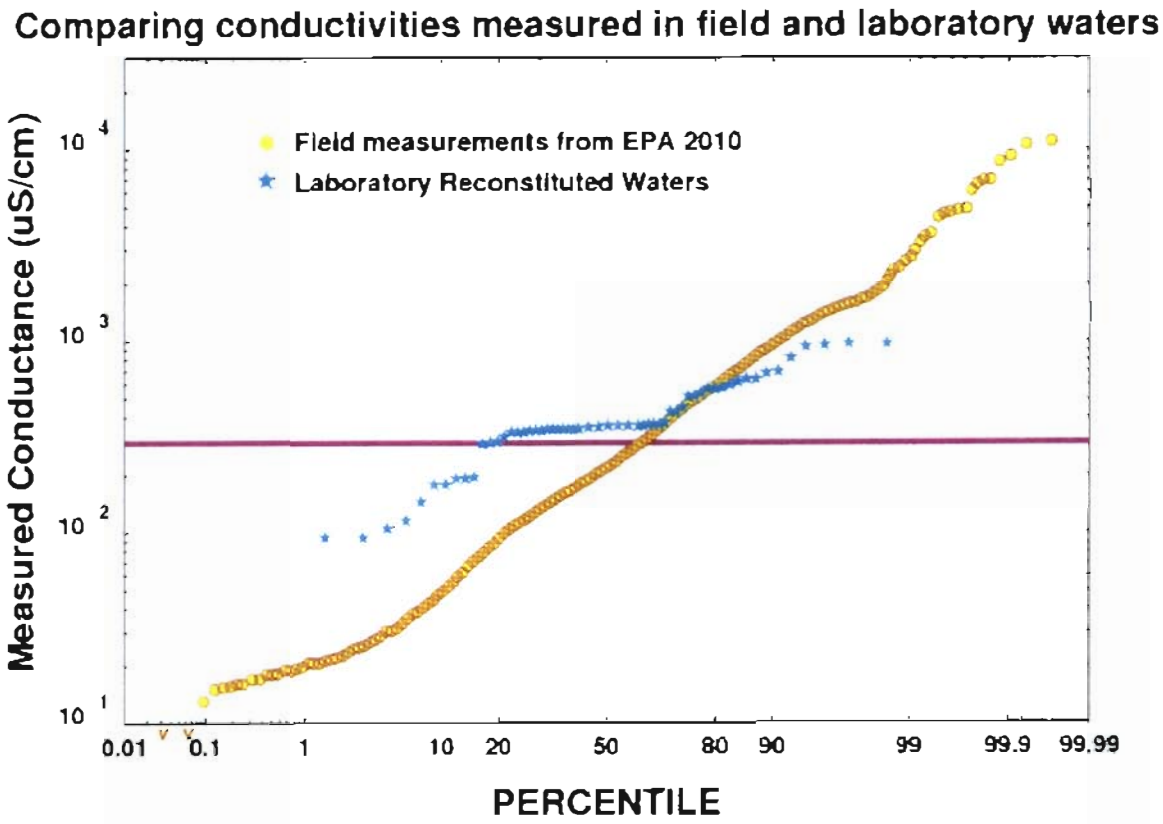


Figure 6. Comparison of conductivities measured in the field (EPA 2010) and in standard EPA-recipe reconstituted waters used in toxicity test controls (Table 2).

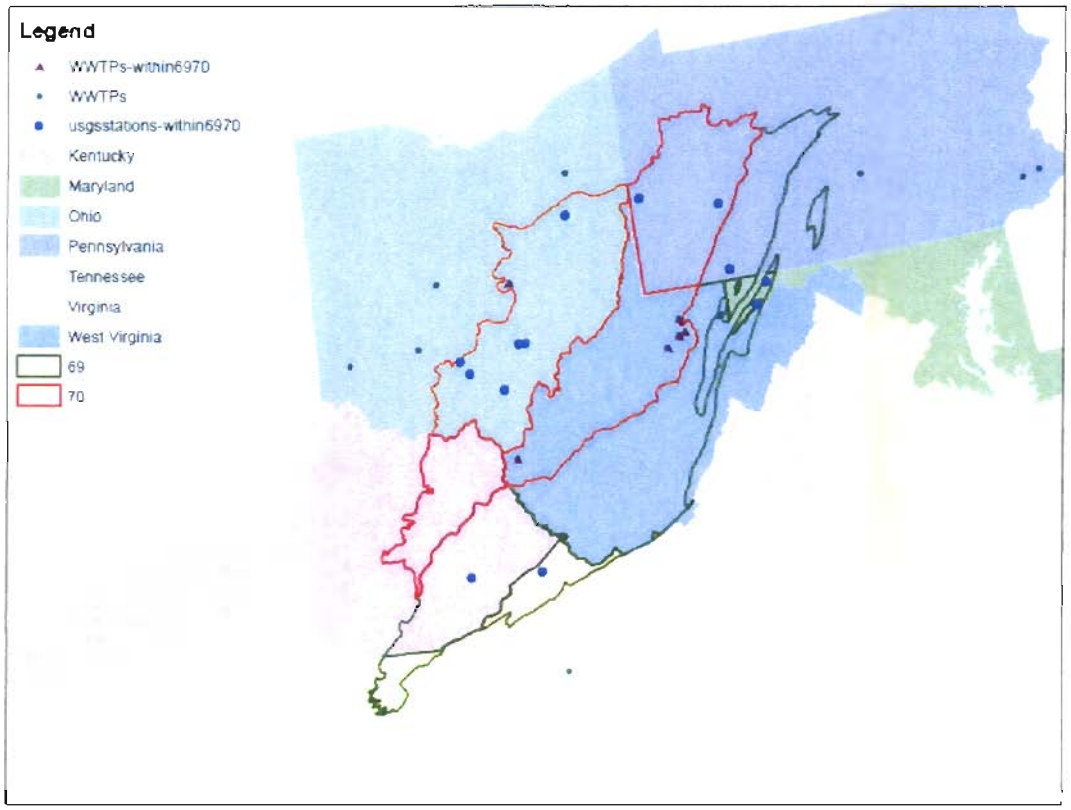


Figure 7 Map of USGS and WWTP stations surveyed within ecoregion 69 and 70.

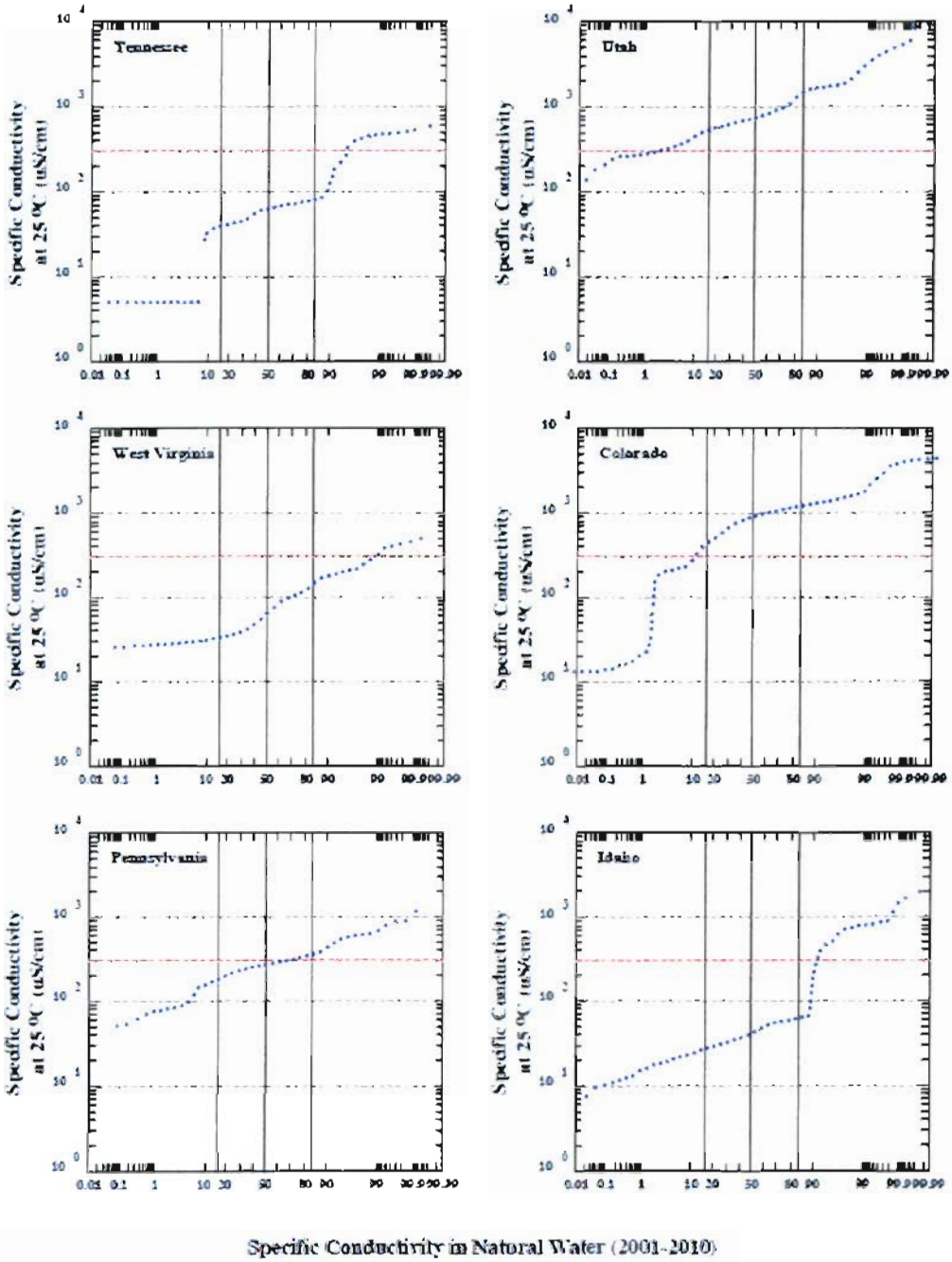


Figure 8 Summary distribution of available conductivity measurements collected in STORET and USGS water quality databases. Horizontal red line is the proposed standard (EPA 2010). Table 2 contains list of stations surveyed.

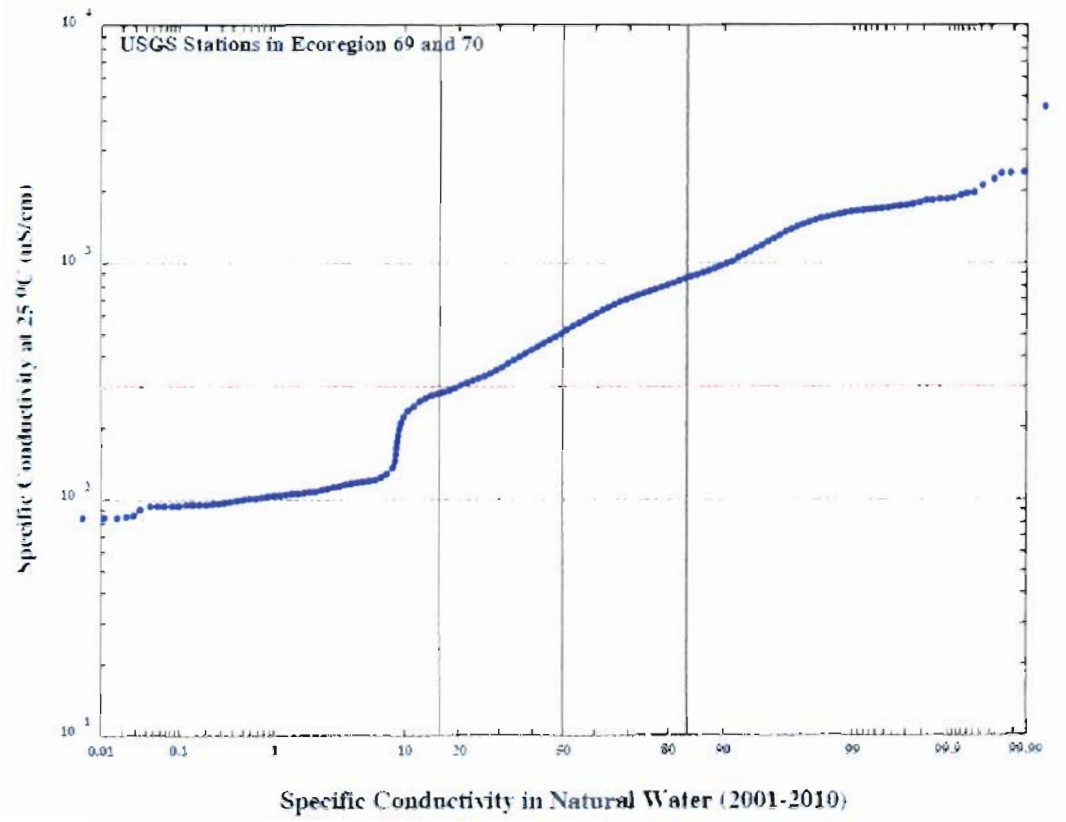
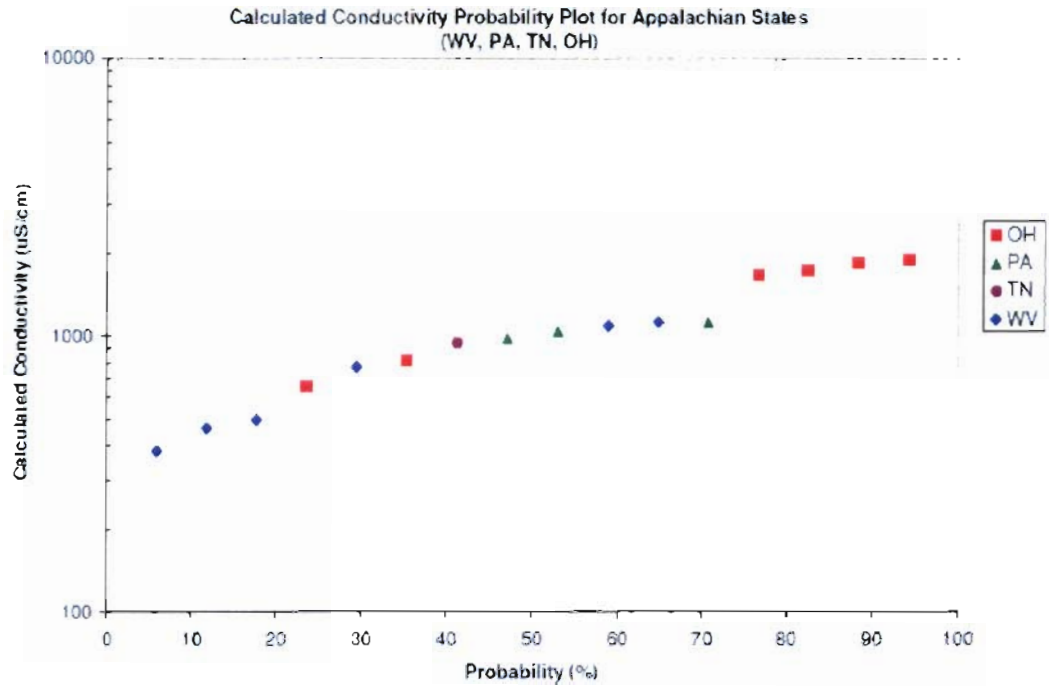


Figure 9. Summary of Conductivity measurements collected from 13 USGS stations in EcoRegions 69 and 70. See Table 3.



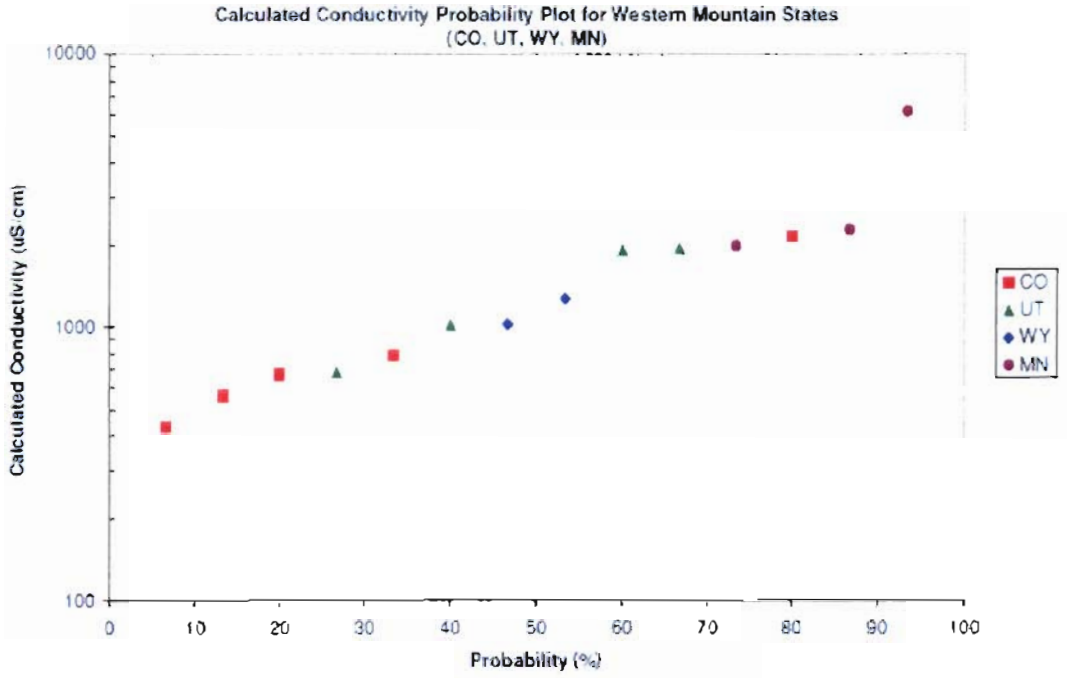


Figure 10. Summary of Municipal WWTP effluent conductivity levels for Appalachian Mountain States (upper panel) and Western Mountain States (Lower panel). See Table 4.

Table 1. Summary of laboratory-derived toxicity data

Entry	Species	Endpoint	Acute or Chronic	Ionic Composition	Effect Level	Parameter	Units	Reference	Notes	ACR	Estimated Conductivity (uS/cm)
1	Chironomus tentans	Growth	Acute	CaSO4	2089	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		3551
2	Chironomus tentans	survival	Acute	CaSO4	1750	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		2975
3	Chironomus tentans	survival	Acute	CaSO4	2240	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		3808
4	Chironomus tentans	survival	Acute	CaSO4	2035	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		3460
5	Chironomus tentans	IC20	Chronic	CaSO4	1598	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		2717
6	Hexagenia bilineata	survival	Chronic	Several	2270	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		3859
7	Hexagenia bilineata	survival	Chronic	Several	1230	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		2091
8	Ceriodaphnia dubia	survival	Acute	NaCl	835	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		1420
9	Ceriodaphnia dubia	survival	Acute	NaCl	735	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		1250
10	Daphnia magna	survival	Acute	NaCl	5015	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		8526
11	Daphnia magna	survival	Acute	NaCl	5000	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		8500
12	Daphnia magna	survival	Acute	NaCl	4000	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		6800
13	Daphnia magna	survival	Acute	NaHCO3	1400	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		2380
14	Daphnia magna	survival	Acute	NaHCO3	1150	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		1955
15	Daphnia magna	survival	Acute	NaHCO3	1780	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		3026
16	Daphnia magna	survival	Acute	NaHCO3	2200	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		3740
17	Daphnia magna	survival	Acute	NaHCO3	1250	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		2125
18	Daphnia magna	survival	Acute	NaHCO3	1160	TDS	mg/L	Weber-Scannell and Duffy 2007	Table 1		1972
19	Daphnia magna	survival	Acute	Na2SO4	1194	TDS	mg/L	Davies and Hall 2007	Table 2		2030
20	Daphnia magna	survival	Acute	Na2SO4	3203	TDS	mg/L	Davies and Hall 2007	Table 2		5445
21	Daphnia magna	survival	Acute	NaCl	3136	TDS	mg/L	Davies and Hall 2007	Table 2		5331
22	Daphnia magna	survival	Acute	KCl	994	TDS	mg/L	Davies and Hall 2007	Table 2		1690
23	Hyalella azteca	survival	Acute	Na2SO4	2101	TDS	mg/L	Davies and Hall 2007	Table 2		3572
24	Daphnia magna	survival	Acute	NaCl	5.9	TDS	g/L	Goncalves et al 2007	Table 1	1.2	10030
25	Daphnia magna	reproduction	Chronic	NaCl	5	TDS	g/L	Goncalves et al 2007	Table 1		8500
26	Daphnia longispina	survival	Acute	NaCl	2.9	TDS	g/L	Goncalves et al 2007	Table 1	1.3	4930
27	Daphnia longispina	reproduction	Chronic	NaCl	2.2	TDS	g/L	Goncalves et al 2007	Table 1		3740
28	Daphnia magna	NOEC	Chronic	NaCl	4.55	TDS	g/L	Goncalves et al 2007	Table 3		7735
29	Daphnia longispina	NOEC	Chronic	NaCl	1.55	TDS	g/L	Goncalves et al 2007	Table 3		2635
30	Daphnia longispina	survival	Acute	NaCl	2.9	TDS	g/L	Goncalves et al 2007	Table 4		4930
31	Daphnia magna	survival	Acute	NaCl	8.3	TDS	g/L	Goncalves et al 2007	Table 4		14110
32	Daphnia magna	survival	Acute	NaCl	11.3	TDS	g/L	Goncalves et al 2007	Table 4		19210

Table 1. Summary of laboratory-derived toxicity data

Entry	Species	Endpoint	Acute or Chronic	Ionic Composition	Effect Level	Parameter	Units	Reference	Notes	ACR	Estimated Conductivity (uS/cm)
33	Daphnia magna	survival	Acute	NaCl	0.49	TDS	g/L	Goncalves et al 2007	Table 4		833
34	Daphnia magna	survival	Acute	NaCl	7.3	TDS	g/L	Goncalves et al 2007	Table 4		12410
35	Daphnia magna	survival	Acute	NaCl	5.9	TDS	g/L	Goncalves et al 2007	Table 4		10030
36	Daphnia carinata	survival	Acute	Seawater	7.7	TDS	g/L	Goncalves et al 2007	Table 4		13090
37	Daphnia carinata	survival	Acute	Seawater	5.3	TDS	g/L	Goncalves et al 2007	Table 4		9010
38	Daphnia carinata	survival	Acute	NaCl	0.9	TDS	g/L	Goncalves et al 2007	Table 4		1530
39	Daphnia carinata	survival	Acute	NaCl	2.2	TDS	g/L	Goncalves et al 2007	Table 4		3740
40	Daphnia carinata	survival	Acute	NaCl	1.7	TDS	g/L	Goncalves et al 2007	Table 4		2890
41	Daphnia thomsoni	survival	Acute	NaCl	8.25	TDS	g/L	Goncalves et al 2007	Table 4		14025
42	C. cornuta	survival	Acute	NaCl	2.6	TDS	g/L	Goncalves et al 2007	Table 4		4420
43	Daphnia longispina	reproduction	Chronic	NaCl	2.2	TDS	g/L	Goncalves et al 2007	Table 4	1.3	3740
44	Daphnia magna	reproduction	Chronic	NaCl	8.57	TDS	g/L	Goncalves et al 2007	Table 4	1.3	14569
45	Daphnia magna	reproduction	Chronic	NaCl	5	TDS	g/L	Goncalves et al 2007	Table 4	1.2	8500
46	Cloeon sp	survival	Acute	Seawater	21	Conductivity	mS/cm	Hassell et al 2006	Table 1		21000
47	Centropilum sp	survival	Acute	Seawater	10	Conductivity	mS/cm	Hassell et al 2006	Table 1		10000
48	Cloeon sp	survival	Chronic	Seawater	2.1	Conductivity	mS/cm	Hassell et al 2006	Table 1	10.0	2100
49	Centropilum sp	survival	Chronic	Seawater	0.89	Conductivity	mS/cm	Hassell et al 2006	Table 1	11.2	890
50	Micronecta piccanina	survival	Acute	Seawater	4.3	Conductivity	mS/cm	Kefford et al 2004	Table 1		4300
51	Burnupia stenochorias	survival	Acute	Seawater	11	Conductivity	mS/cm	Kefford et al 2004	Table 1		11000
52	Euthralus elegans	survival	Acute	Seawater	14	Conductivity	mS/cm	Kefford et al 2004	Table 1		14000
53	Caridina nilotica	survival	Acute	Seawater	34	Conductivity	mS/cm	Kefford et al 2004	Table 1		34000
54	Daphnia carinata	survival	Acute	Seawater	11	Conductivity	mS/cm	Kefford et al 2004	Table 2		11000
55	Micronecta piccanina	survival	Acute	Seawater	13	Conductivity	mS/cm	Kefford et al 2004	Table 2		13000
56	Physa acuta	survival	Acute	Seawater	15	Conductivity	mS/cm	Kefford et al 2004	Table 2		15000
57	Caridina nilotica	survival	Acute	Seawater	35	Conductivity	mS/cm	Kefford et al 2004	Table 2		35000
58	Euthralus elegans	survival	Acute	Seawater	17	Conductivity	mS/cm	Kefford et al 2004	Table 2		17000
59	Daphnia carinata	survival	Acute	NaCl	4.5	Conductivity	mS/cm	Kefford et al 2004	Table 2		4500
60	Micronecta piccanina	survival	Acute	NaCl	11	Conductivity	mS/cm	Kefford et al 2004	Table 2		11000
61	Physa acuta	survival	Acute	NaCl	8.7	Conductivity	mS/cm	Kefford et al 2004	Table 2		8700
62	Caridina nilotica	survival	Acute	NaCl	16	Conductivity	mS/cm	Kefford et al 2004	Table 2		16000
63	Euthralus elegans	survival	Acute	NaCl	13	Conductivity	mS/cm	Kefford et al 2004	Table 2		13000
64	Caridina nilotica	survival	Acute	Na2SO4	11	Conductivity	mS/cm	Kefford et al 2004	Table 2	1.4	11000
65	Euthralus elegans	survival	Chronic	Seawater	12	Conductivity	mS/cm	Kefford et al 2004	Table 2	1.7	12000

Table 1. Summary of laboratory-derived toxicity data

Entry	Species	Endpoint	Acute or Chronic	Ionic Composition	Effect Level	Parameter	Units	Reference	Notes	ACR	Estimated Conductivity (uS/cm)
66	Euthralus elegans	survival	Chronic	NaCl	7.7	Conductivity	mS/cm	Kefford et al 2004	Table 2		7700
67	Notalina fulva	survival	Acute	Seawater	18.46	TDS	mS/cm	Zalizniak et al 2006	Table 1		18460
68	Micronecta robusta	survival	Acute	Seawater	13.4	TDS	mS/cm	Zalizniak et al 2006	Table 1		13400
69	Centroptilum sp	survival	Acute	Seawater	5.58	TDS	mS/cm	Zalizniak et al 2006	Table 1		5580
70	Hyalella azteca	survival	Acute	Na2SO4	747.52	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW		1271
71	Hyalella azteca	survival	Acute	Na2SO4	4168.3	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW		7086
72	Ceriodaphnia dubia	survival	Acute	Na2SO4	2993	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW		5088
73	Ceriodaphnia dubia	survival	Acute	Na2SO4	3687.96	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW		6270
74	Hyalella azteca	survival	LC10	Na2SO4	382.52	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW	2.0	650
75	Hyalella azteca	survival	LC10	Na2SO4	3190.1	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW	1.3	5423
76	Ceriodaphnia dubia	survival	LC10	Na2SO4	2568.14	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW	1.2	4366
77	Ceriodaphnia dubia	survival	LC10	Na2SO4	3235.36	TDS	mg/L	Soucek and Kennedy 2005	Table 2. RMHRW	1.1	5500
78	Hyalella azteca	survival	Acute	Na2SO4	2993	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW		5088
79	Hyalella azteca	survival	Acute	Na2SO4	4380	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW		7446
80	Hyalella azteca	survival	Acute	Na2SO4	4301.16	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW		7312
81	Hyalella azteca	survival	Acute	Na2SO4	4634.04	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW		7878
82	Hyalella azteca	survival	Acute	Na2SO4	5133.36	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW		8727
83	Hyalella azteca	survival	Acute	Na2SO4	4800.48	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW		8161
84	Hyalella azteca	survival	LC10	Na2SO4	2568.14	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW	1.2	4366
85	Hyalella azteca	survival	LC10	Na2SO4	3172.58	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW	1.4	5393
86	Hyalella azteca	survival	LC10	Na2SO4	3487.94	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW	1.2	5929
87	Hyalella azteca	survival	LC10	Na2SO4	4006.24	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW	1.2	6811
88	Hyalella azteca	survival	LC10	Na2SO4	4077.78	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW	1.3	6932
89	Hyalella azteca	survival	LC10	Na2SO4	3718.62	TDS	mg/L	Soucek and Kennedy 2005	Table 3. RMHRW	1.3	6322
90	Daphnia magna	survival	Acute	NaCl	4770	TDS	mg/L	Mount et al 1997	Table 3		8109
91	Daphnia magna	survival	Acute	Na2SO4	4580	TDS	mg/L	Mount et al 1997	Table 3		7786
92	Daphnia magna	survival	Acute	NaHCO3	1640	TDS	mg/L	Mount et al 1997	Table 3		2788
93	Daphnia magna	survival	Acute	KCl	660	TDS	mg/L	Mount et al 1997	Table 3		1122
94	Daphnia magna	survival	Acute	K2SO4	720	TDS	mg/L	Mount et al 1997	Table 3		1224

Table 1. Summary of laboratory-derived toxicity data

Entry	Species	Endpoint	Acute or Chronic	Ionic Composition	Effect Level	Parameter	Units	Reference	Notes	ACR	Estimated Conductivity (uS/cm)
95	Daphnia magna	survival	Acute	KHCO3	650	TDS	mg/L	Mount et al 1997	Table 3		1105
96	Daphnia magna	survival	Acute	CaCl2	2770	TDS	mg/L	Mount et al 1997	Table 3		4709
97	Daphnia magna	survival	Acute	CaSO4	1970	TDS	mg/L	Mount et al 1997	Table 3		3349
98	Daphnia magna	survival	Acute	MgCl2	1330	TDS	mg/L	Mount et al 1997	Table 3		2261
99	Daphnia magna	survival	Acute	MgSO4	1820	TDS	mg/L	Mount et al 1997	Table 3		3094
100	Daphnia magna	survival	Acute	NaCl/Na2SO4	5700	TDS	mg/L	Mount et al 1997	Table 3		9690
101	Daphnia magna	survival	Acute	NaCl/NaHCO3	2950	TDS	mg/L	Mount et al 1997	Table 3		5015
102	Daphnia magna	survival	Acute	Na2SO4/NaHCO3	3180	TDS	mg/L	Mount et al 1997	Table 3		5406
103	Daphnia magna	survival	Acute	KCl/K2SO4	740	TDS	mg/L	Mount et al 1997	Table 3		1258
104	Daphnia magna	survival	Acute	KCl/KHCO3	740	TDS	mg/L	Mount et al 1997	Table 3		1258
105	Daphnia magna	survival	Acute	K2SO4/KHCO3	630	TDS	mg/L	Mount et al 1997	Table 3		1071
106	Daphnia magna	survival	Acute	CaCl2/CaSO4	2950	TDS	mg/L	Mount et al 1997	Table 3		5015
107	Daphnia magna	survival	Acute	MgCl2/MgSO4	1510	TDS	mg/L	Mount et al 1997	Table 3		2567
108	Daphnia magna	survival	Acute	NaCl/KCl	3930	TDS	mg/L	Mount et al 1997	Table 3		6681
109	Daphnia magna	survival	Acute	NaCl/CaCl2	5250	TDS	mg/L	Mount et al 1997	Table 3		8925
110	Daphnia magna	survival	Acute	NaCl/MgCl2	3070	TDS	mg/L	Mount et al 1997	Table 3		5219
111	Daphnia magna	survival	Acute	KCl/CaCl2	2450	TDS	mg/L	Mount et al 1997	Table 3		4165
112	Daphnia magna	survival	Acute	KCl/MgCl2	2020	TDS	mg/L	Mount et al 1997	Table 3		3434
113	Daphnia magna	survival	Acute	CaCl2/MgCl2	4390	TDS	mg/L	Mount et al 1997	Table 3		7463
114	Daphnia magna	survival	Acute	Na2SO4/K2SO4	4610	TDS	mg/L	Mount et al 1997	Table 3		7837
115	Daphnia magna	survival	Acute	Na2SO4/MgSO4	7980	TDS	mg/L	Mount et al 1997	Table 3		13566
116	Daphnia magna	survival	Acute	K2SO4/CaSO4	1200	TDS	mg/L	Mount et al 1997	Table 3		2040
117	Daphnia magna	survival	Acute	K2SO4/MgSO4	2210	TDS	mg/L	Mount et al 1997	Table 3		3757
118	Daphnia magna	survival	Acute	CaSO4/MgSO4	6470	TDS	mg/L	Mount et al 1997	Table 3		10999
119	Daphnia magna	survival	Acute	NaHCO3/KHCO3	1040	TDS	mg/L	Mount et al 1997	Table 3		1768
120	Ceriodaphnia dubia	survival	Acute	NaCl	1960	TDS	mg/L	Mount et al 1997	Table 2		3332
121	Ceriodaphnia dubia	survival	Acute	Na2SO4	3080	TDS	mg/L	Mount et al 1997	Table 2		5236
122	Ceriodaphnia dubia	survival	Acute	NaHCO3	1020	TDS	mg/L	Mount et al 1997	Table 2		1734
123	Ceriodaphnia dubia	survival	Acute	KCl	630	TDS	mg/L	Mount et al 1997	Table 2		1071
124	Ceriodaphnia dubia	survival	Acute	K2SO4	680	TDS	mg/L	Mount et al 1997	Table 2		1156
125	Ceriodaphnia dubia	survival	Acute	KHCO3	630	TDS	mg/L	Mount et al 1997	Table 2		1071
126	Ceriodaphnia dubia	survival	Acute	CaCl2	1830	TDS	mg/L	Mount et al 1997	Table 2		3111
127	Ceriodaphnia dubia	survival	Acute	CaSO4	1910	TDS	mg/L	Mount et al 1997	Table 2		3247

Table 1. Summary of laboratory-derived toxicity data

Entry	Species	Endpoint	Acute or Chronic	Ionic Composition	Effect Level	Parameter	Units	Reference	Notes	ACR	Estimated Conductivity (uS/cm)
128	Ceriodaphnia dubia	survival	Acute	MgCl2	880	TDS	mg/L	Mount et al 1997	Table 2		1496
129	Ceriodaphnia dubia	survival	Acute	MgSO4	1770	TDS	mg/L	Mount et al 1997	Table 2		3009
130	Ceriodaphnia dubia	survival	Acute	NaCl/Na2SO4	2070	TDS	mg/L	Mount et al 1997	Table 2		3519
131	Ceriodaphnia dubia	survival	Acute	NaCl/NaHCO3	1890	TDS	mg/L	Mount et al 1997	Table 2		3213
132	Ceriodaphnia dubia	survival	Acute	NaCl/KCl	1560	TDS	mg/L	Mount et al 1997	Table 2		2652
133	Ceriodaphnia dubia	survival	Acute	NaCl/K2SO4	1660	TDS	mg/L	Mount et al 1997	Table 2		2822
134	Ceriodaphnia dubia	survival	Acute	NaCl/KHCO3	1360	TDS	mg/L	Mount et al 1997	Table 2		2312
135	Ceriodaphnia dubia	survival	Acute	NaCl/CaCl2	3030	TDS	mg/L	Mount et al 1997	Table 2		5151
136	Ceriodaphnia dubia	survival	Acute	NaCl/CaSO4	2430	TDS	mg/L	Mount et al 1997	Table 2		4131
137	Ceriodaphnia dubia	survival	Acute	NaCl/MgCl2	2380	TDS	mg/L	Mount et al 1997	Table 2		4046
138	Ceriodaphnia dubia	survival	Acute	NaCl/MgSO4	3250	TDS	mg/L	Mount et al 1997	Table 2		5525
139	Ceriodaphnia dubia	survival	Acute	Na2SO4/NaHCO3	2630	TDS	mg/L	Mount et al 1997	Table 2		4471
140	Ceriodaphnia dubia	survival	Acute	Na2SO4/KCl	1730	TDS	mg/L	Mount et al 1997	Table 2		2941
141	Ceriodaphnia dubia	survival	Acute	Na2SO4/K2SO4	1590	TDS	mg/L	Mount et al 1997	Table 2		2703
142	Ceriodaphnia dubia	survival	Acute	Na2SO4/KHCO3	1300	TDS	mg/L	Mount et al 1997	Table 2		2210
143	Ceriodaphnia dubia	survival	Acute	Na2SO4/CaCl2	3940	TDS	mg/L	Mount et al 1997	Table 2		6698
144	Ceriodaphnia dubia	survival	Acute	Na2SO4/CaSO4	4940	TDS	mg/L	Mount et al 1997	Table 2		8398
145	Ceriodaphnia dubia	survival	Acute	Na2SO4/MgCl2	2520	TDS	mg/L	Mount et al 1997	Table 2		4284
146	Ceriodaphnia dubia	survival	Acute	Na2SO4/MgSO4	3190	TDS	mg/L	Mount et al 1997	Table 2		5423
147	Ceriodaphnia dubia	survival	Acute	NaHCO3/KCl	1140	TDS	mg/L	Mount et al 1997	Table 2		1938
148	Ceriodaphnia dubia	survival	Acute	NaHCO3/K2SO4	1000	TDS	mg/L	Mount et al 1997	Table 2		1700
149	Ceriodaphnia dubia	survival	Acute	NaHCO3/KHCO3	800	TDS	mg/L	Mount et al 1997	Table 2		1360
150	Ceriodaphnia dubia	survival	Acute	NaHCO3/CaCl2	2640	TDS	mg/L	Mount et al 1997	Table 2		4488
151	Ceriodaphnia dubia	survival	Acute	NaHCO3/CaSO4	1040	TDS	mg/L	Mount et al 1997	Table 2		1768
152	Ceriodaphnia dubia	survival	Acute	NaHCO3/MgCl2	1510	TDS	mg/L	Mount et al 1997	Table 2		2567
153	Ceriodaphnia dubia	survival	Acute	NaHCO3/MgSO4	1670	TDS	mg/L	Mount et al 1997	Table 2		2839
154	Ceriodaphnia dubia	survival	Acute	KCl/K2SO4	480	TDS	mg/L	Mount et al 1997	Table 2		816
155	Ceriodaphnia dubia	survival	Acute	KCl/KHCO3	480	TDS	mg/L	Mount et al 1997	Table 2		816
156	Ceriodaphnia dubia	survival	Acute	KCl/CaCl2	1730	TDS	mg/L	Mount et al 1997	Table 2		2941
157	Ceriodaphnia dubia	survival	Acute	KCl/CaSO4	1580	TDS	mg/L	Mount et al 1997	Table 2		2686
158	Ceriodaphnia dubia	survival	Acute	KCl/MgCl2	1270	TDS	mg/L	Mount et al 1997	Table 2		2159
159	Ceriodaphnia dubia	survival	Acute	KCl/MgSO4	1060	TDS	mg/L	Mount et al 1997	Table 2		1802
160	Ceriodaphnia dubia	survival	Acute	K2SO4/KHCO3	390	TDS	mg/L	Mount et al 1997	Table 2		663

Table 1. Summary of laboratory-derived toxicity data

Entry	Species	Endpoint	Acute or Chronic	Ionic Composition	Effect Level	Parameter	Units	Reference	Notes	ACR	Estimated Conductivity (uS/cm)
161	Ceriodaphnia dubia	survival	Acute	K2SO4/CaCl2	1820	TDS	mg/L	Mount et al 1997	Table 2		3094
162	Ceriodaphnia dubia	survival	Acute	K2SO4/CaSO4	1130	TDS	mg/L	Mount et al 1997	Table 2		1921
163	Ceriodaphnia dubia	survival	Acute	K2SO4/MgCl2	1040	TDS	mg/L	Mount et al 1997	Table 2		1768
164	Ceriodaphnia dubia	survival	Acute	K2SO4/MgSO4	1480	TDS	mg/L	Mount et al 1997	Table 2		2516
165	Ceriodaphnia dubia	survival	Acute	KHCO3/CaCl2	1810	TDS	mg/L	Mount et al 1997	Table 2		3077
166	Ceriodaphnia dubia	survival	Acute	KHCO3/CaSO4	1560	TDS	mg/L	Mount et al 1997	Table 2		2652
167	Ceriodaphnia dubia	survival	Acute	KHCO3/MgCl2	860	TDS	mg/L	Mount et al 1997	Table 2		1462
168	Ceriodaphnia dubia	survival	Acute	KHCO3/MgSO4	940	TDS	mg/L	Mount et al 1997	Table 2		1598
169	Ceriodaphnia dubia	survival	Acute	CaCl2/CaSO4	3050	TDS	mg/L	Mount et al 1997	Table 2		5185
170	Ceriodaphnia dubia	survival	Acute	CaCl2/MgCl2	2600	TDS	mg/L	Mount et al 1997	Table 2		4420
171	Ceriodaphnia dubia	survival	Acute	CaCl2/MgSO4	3690	TDS	mg/L	Mount et al 1997	Table 2		6273
172	Ceriodaphnia dubia	survival	Acute	CaSO4/MgCl2	2370	TDS	mg/L	Mount et al 1997	Table 2		4029
173	Ceriodaphnia dubia	survival	Acute	CaSO4/MgSO4	5610	TDS	mg/L	Mount et al 1997	Table 2		9537
174	Ceriodaphnia dubia	survival	Acute	MgCl2/MgSO4	1490	TDS	mg/L	Mount et al 1997	Table 2		2533
175	Caridina nilotica	survival	Acute	NaCl	2.58	TDS	g/L	Slaughter et al 2008	Table 2		4380
176	Caridina nilotica	survival	Acute	Na2SO4	2.67	TDS	g/L	Slaughter et al 2008	Table 2		4533
177	Caridina nilotica	growth	Chronic	NaCl	1.30	TDS	g/L	Slaughter et al 2008	Table 2	2.0	2210
178	Caridina nilotica	growth	Chronic	Na2SO4	1.07	TDS	g/L	Slaughter et al 2008	Table 2	2.5	1819

Table 2. EPA standard recipe waters and measured conductance.

Water Type	Hardness (mg/L)	Conductivity (µS/cm)	Survival (%)	Organism	Test Type	Reference
Reconstituted EPA recipe waters	96	351	>=90	*C. dubia*	7-d Chronic	PMTX/OSU[a]
Reconstituted EPA recipe waters	100	344	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	100	357	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	96	353	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	96	360	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	104	348	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	100	353	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	100	345	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	104	358	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	100	359	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	48	190	>=90	*Aelolsoma sp*	14-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	52	192	>=90	*Aelolsoma sp*	14-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	116	450	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	172	570	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Other reconstituted waters	103	342	>=90	Zebrafish	ELS	PMTX/OSU
Other reconstituted waters	84	287	>=90	*C tentans*	Life cycle	PMTX/OSU
Other reconstituted waters	120	348	>=90	Zebrafish	Acute	PMTX/OSU
Other reconstituted waters	54	196	>=90	*Aelolsoma sp*	Chronic	PMTX/OSU
Other reconstituted waters	100	302	>=90	Zebrafish	Acute	PMTX/OSU
Other reconstituted waters	109	348	>=90	Fathead minnow	ELS	PMTX/OSU
Other reconstituted waters	115	363	>=90	Rainbow trout	ELS	PMTX/OSU
Other reconstituted waters	108	363	>=90	*C dubia*	Chronic	PMTX/OSU
Other reconstituted waters	118	375	>=90	Fathead minnow	Acute	PMTX/OSU
Other reconstituted waters	100	336	>=90	Fathead minnow	Acute	PMTX/OSU
Other reconstituted waters	108	359	>=90	Fathead minnow	7-d Chronic	PMTX/OSU
Other reconstituted waters	64	424	>=90	Algae	Chronic	PMTX/OSU
Other reconstituted waters	184	587	>=90	*Lymnaea stagnalis*	Acute	PMTX/OSU
Other reconstituted	95	315	>=90	Zebrafish	ELS	PMTX/OSU

waters						
Other reconstituted waters	176	607	>=90	*Lymnaea stagnalis*	Chronic	PMTX/OSU
Other reconstituted waters	89	292	>=90	*C tentans*	Life cycle	PMTX/OSU
Other reconstituted waters	104	339	>=90	*H azteca*	Chronic	PMTX/OSU
Hardness tests with Mn	26	93	>=90	Fathead minnow	7-d Chronic	PMTX/OSU
Hardness tests with Mn	50	176	>=90	Fathead minnow	7-d Chronic	PMTX/OSU
Hardness tests with Mn	100	336	>=90	Fathead minnow	7-d Chronic	PMTX/OSU
Hardness tests with Mn	200	638	>=90	Fathead minnow	7-d Chronic	PMTX/OSU
Hardness tests with Mn	26	93	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Hardness tests with Mn	50	176	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Hardness tests with Mn	100	336	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Hardness tests with Mn	200	638	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Hardness series run in Pat Davies' lab in CO	27.9	115	>=90	Brown trout	ELS	PMTX/OSU
Hardness series run in Pat Davies' lab in CO	200	365	>=90	Brown trout	ELS	PMTX/OSU
Hardness series run in Pat Davies' lab in CO	460	690	>=90	Brown trout	ELS	PMTX/OSU
Hardness series run in Pat Davies' lab in CO	24.7	105	>=90	Rainbow trout	ELS	PMTX/OSU
Hardness series run in Pat Davies' lab in CO	195	361	>=90	Rainbow trout	ELS	PMTX/OSU
Hardness series run in Pat Davies' lab in CO	466	703	>=90	Rainbow trout	ELS	PMTX/OSU
Natural water from N slope AK	156	370	>=90	*C. dubia*	7-d Chronic	PMTX/OSU
Natural water from N slope AK	156	370	>=90	Fathead minnow	7-d Chronic	PMTX/OSU
Reconstituted EPA recipe waters	46	144	90	*Drunella grandis*	Acute	GEI
Reconstituted EPA recipe waters	97	347	100	*Ceriodaphnia dubia*	Chronic	GEI
Reconstituted EPA recipe waters	97	346	100	*Ceriodaphnia dubia*	Chronic	GEI
Reconstituted EPA recipe waters	98	363	100	*Ceriodaphnia dubia*	Acute	GEI
Reconstituted EPA recipe waters	98	348	100	*Ceriodaphnia dubia*	Chronic	GEI
Reconstituted EPA recipe waters	100	352	100	*Ceriodaphnia dubia*	Chronic	GEI
Reconstituted EPA recipe waters	118	565	100	*Daphnia magna*	Acute	GEI
Reconstituted EPA recipe waters	132	428	100	*Ceriodaphnia dubia*	Chronic	GEI
Reconstituted EPA recipe waters	162	512	92	*Isoperla spp.*	Acute	GEI
Reconstituted EPA recipe waters	165	571	100	*Daphnia magna*	Acute	GEI
Reconstituted EPA recipe waters	167	538	100	*Ceriodaphnia dubia*	Chronic	GEI
Reconstituted EPA recipe waters	170	511	80	*Drunella grandis*	Acute	GEI
Reconstituted EPA	260	831	100	*Drunella grandis*	Acute	GEI

recipe waters						
Reconstituted EPA recipe waters	270	945	97.5	*Daphnia magna*	Acute	GEI
Reconstituted EPA recipe waters	300	972	97.5	*Daphnia magna*	Acute	GEI
Reconstituted EPA recipe waters	300	953	90	*Ceriodaphnia dubia*	Chronic	GEI
Reconstituted EPA recipe waters	308	972	100	*Daphnia magna*	Acute	GEI

[a] Unpublished laboratory data (controls) from Parametrix/Oregon State University

[b] Unpublished laboratory data (controls) from GEI, Inc.

Table 3. Compilation of USGS stations surveyed
http://infotrek.er.usgs.gov/nawqa_queries/swmaster/index.jsp

State Code	County	Staid	Place Name
CO	ADAMS	06720500	SOUTH PLATTE RIVER AT HENDERSON CO
		394839104570300	SAND CREEK AT MOUTH NR COMMERCE CITY CO
		394921105015701	LITTLE DRY CK BL LOWELL ST NR WESTMINSTER CO
	ARAPAHOE	06711565	SOUTH PLATTE RIVER AT ENGLEWOOD CO.
		393613104511401	COTTONWOOD CK AB NEWARK WY AT GREENWOOD VILLAGE CO
	BOULDER	06721500	NORTH ST. VRAIN CREEK NEAR ALLENS PARK CO.
		06724000	ST. VRAIN CREEK AT LYONS CO.
		395554105085601	ROCK CREEK ABV ROCK CREEK PKWY AT SUPERIOR CO
		395707105100401	COAL CREEK ABV MCCASLIN RD AT SUPERIOR CO
		395958105113501	DRY CREEK ABV BASELINE RD NR BOULDER CO
		400000105125400	S BOULDER CR AT BASELINE ROAD NR BOULDER COLO
		400023105142301	BEAR CR ABV WELLMAN FEEDER CANAL AT BOULDER CO
		400217105123701	BOULDER CREEK BLW 61ST STREET NR BOULDER CO
		400607105094401	DRY CREEK BLW NIWOT RD AT NIWOT CO
		400630105215801	JAMES CREEK NEAR JAMESTOWN CO
		400810105071301	LEFT HAND CREEK ABV PIKE RD AT LONGMONT CO
		400855105090501	DRY CREEK BLW AIRPORT RD NR LONGMONT CO
	CLEAR CREEK	06718300	CLEAR CREEK ABV JOHNSON GULCH NR IDAHO SPRINGS CO
	DENVER	06713500	CHERRY CREEK AT DENVER CO.
		06714000	SOUTH PLATTE RIVER AT DENVER CO.
		394107105021001	SANDERSON GULCH ABV LOWELL AVE AT DENVER
		394409105020501	LAKEWOOD GULCH ABV KNOX ST AT DENVER CO
	EAGLE	09065500	GORE CREEK AT UPPER STATION NEAR MINTURN CO
		09066510	GORE CREEK AT MOUTH NEAR MINTURN CO
	GARFIELD	09095300	DRY FORK AT UPPER STATION NEAR DE BEQUE CO.
	GUNNISON	09112200	EAST RIVER BELOW CEMENT CREEK NR CRESTED BUTTE CO
		09112500	EAST RIVER AT ALMONT CO
		09119000	TOMICHI CREEK AT GUNNISON CO
		383103106594200	GUNNISON RIVER AT CNTY RD 32 BELOW GUNNISON CO
		383126106475600	TOMICHI CK. BLW. COCHETOPA CK. NR. PARLIN CO
		384950106544200	EAST RIVER ABOVE SLATE RIVER NR CRESTED BUTTE
		385240106583600	SLATE RI ABOVE COAL CR NEAR CRESTED BUTTE
	JEFFERSON	393557105033101	DUTCH CREEK AT WEAVER PARK NR COLUMBINE VALLEY CO
		393948105053501	BEAR CREEK BL ESTES RD AT LAKEWOOD CO
		394553105075101	LENA GULCH AT LEWIS MEADOWS PARK AT WHEAT RIDGE CO
		394629105063101	CLEAR CREEK BLW KIPLING AT WHEAT RIDGE CO
		394919105074601	RALSTON CREEK ABV SIMMS AT ARVADA CO
		395324105035001	BIG DRY CK BL HYLAND CR AT WESTMINSTER CO
	LARIMER	06733000	BIG THOMPSON RIVER AT ESTES PARK CO.
		06752000	CACHE LA POUDRE RIV AT MO OF CN NR FT COLLINS CO
		06752280	CACHE LA POUDRE RIV AB BOXELDER CRK NR TIMNATH CO
		402114105350101	BIG THOMPSON BL MORAINE PARK NR ESTES PARK CO
		402549105043101	DRY CREEK AT US 287 AT LOVELAND CO
		403035105035301	MAIL CREEK NR MOUTH AT FORT COLLINS CO
		403048105042701	FOSSIL CR AT COLLEGE AVE AT FT COLLINS CO

Table 3. Compilation of USGS stations surveyed
http://infotrek.er.usgs.gov/nawqa_queries/swmaster/index.jsp

State Code	County	Staid	Place Name
		403308105001601	BOXELDER CREEK AT MOUTH NR FORT COLLINS CO
		403356105024001	SPRING CREEK AT EDORA PARK AT FT COLLINS CO
		404200105145600	CACHE LA POUDRE R AB NF NR FT. COLLINS CO.
	MESA	09095500	COLORADO RIVER NEAR CAMEO CO.
		09152500	GUNNISON RIVER NEAR GRAND JUNCTION CO.
		09163500	COLORADO RIVER NEAR COLORADO-UTAH STATE LINE
	MONTROSE	09128000	GUNNISON RIVER BELOW GUNNISON TUNNEL CO
	MORGAN	06759910	SOUTH PLATTE RIVER AT COOPER BRIDGE NR BALZAC CO
	OURAY	09146200	UNCOMPAHGRE RIVER NEAR RIDGWAY CO.
	SAGUACHE	08227000	SAGUACHE CREEK NEAR SAGUACHE CO
	SEDGWICK	06764000	SOUTH PLATTE RIVER AT JULESBURG CO
	WELD	06731000	ST. VRAIN CREEK AT MOUTH NEAR PLATTEVILLE CO.
		06744000	BIG THOMPSON RIVER AT MOUTH NEAR LA SALLE CO.
		06752500	CACHE LA POUDRE RIVER NEAR GREELEY CO.
		06753990	LONETREE CREEK NEAR GREELEY CO.
		06754000	SOUTH PLATTE RIVER NEAR KERSEY CO
		400925105023201	SPRING GULCH AT SANDSTONE RANCH PK NR LONGMONT CO
ID	BANNOCK	13073000	PORTNEUF RIVER AT TOPAZ ID
		13075000	MARSH CREEK NR MCCAMMON ID
		13075320	MINK CREEK ABV KINNEY CREEK NR POCATELLO ID
	BEAR LAKE	10039500	BEAR RIVER AT BORDER WY
		10044000	BEAR RIVER AT HARER ID
		10055500	BEAR LAKE AT LIFTON NEAR ST. CHARLES ID
		10068500	BEAR RIVER AT PESCADERO ID
		421249111042001	THOMAS FORK AT MOUTH NR BORDER WY
		421457111162201	BEAR RIVER NR DINGLE ID
		421819111213301	MUD LAKE OUTLET CANAL NR MONTPELIER ID
		421943111220601	OVID CREEK NR OVID ID
		422835111243801	STAUFFER CREEK NR GEORGETOWN ID
		422843111221601	GEORGETOWN CREEK AT GEORGETOWN ID
		423545111311301	EIGHT MILE CREEK AT EIGHTMILE RDD NR SODA SPRINGS
		423621111343001	BAILEY CREEK NR SODA SPRINGS ID
	BLAINE	13140800	BIG WOOD RIVER AT STANTON CROSSING NR BELLEVUE ID
		13140900	WILLOW CREEK NR SPRING CR RANCH NR BELLEVUE ID
		13141070	ROCK CREEK ABOVE EAGLE SPRING NEAR BELLEVUE ID
		13147900	LITTLE WOOD RIVER AB HIGH FIVE CREEK NR CAREY ID
		13150200	STALKER CREEK NEAR GANNETT ID
	BONNER	12392155	LIGHTNING CREEK AT CLARK FORK ID
	BONNEVILLE	13057940	WILLOW CREEK BL TEX CREEK NR RIRIE ID
	CAMAS	13141500	CAMAS CREEK NR BLAINE ID
	CARIBOU	10075000	BEAR RIVER AT SODA SPRINGS ID
		10079500	BEAR RIVER AT ALEXANDER ID
		13063000	BLACKFOOT RIVER AB RESERVOIR NR HENRY ID
		422943111473901	DENSMORE CREEK AT MOUTH NEAR THATCHER ID
		423215111474501	BEAR RIVER AT BLACK CANYON NEAR TURNER ID
		423859111365901	BEAR RIVER ABV SODA POINT RES. AT SODA SPRINGS ID
		423922111370401	SODA CREEK AT MOUTH AT SODA SPRINGS ID

Table 3. Compilation of USGS stations surveyed
http://infotrek.er.usgs.gov/nawqa_queries/swmaster/index.jsp

State Code	County	Staid	Place Name
	CASSIA	13078000	RAFT RIVER AB ONEMILE CREEK NR MALTA ID
		13082300	MARSH CREEK NR ALBION ID
		13082500	GOOSE CREEK AB TRAPPER CREEK NR OAKLEY ID
		13083000	TRAPPER CREEK NR OAKLEY ID
		13088510	BIG COTTONWOOD CREEK NEAR OAKLEY ID
		13091995	ROCK CREEK AT USFS FOOTBRIDGE NR ROCK CREEK ID
	ELMORE	13154400	CLOVER CREEK NR KING HILL ID
		13154500	SNAKE RIVER AT KING HILL ID
	FRANKLIN	10092700	BEAR RIVER AT IDAHO-UTAH STATE LINE
		420050111512601	WORM CREEK AT 800 E NR FRANKLIN ID
		420129111555901	WESTON CREEK AT MOUTH NR WESTON ID
		420549111545901	BEAR RIVER BEAR RIVER NEAR PRESTON ID
		420600111554901	FIVE MILE CREEK NR PRESTON ID
		420716111555201	DEEP CREEK AT MOUTH NR PRESTON ID
		420821111544401	BATTLE CREEK NEAR PRESTON ID
		420959111495301	BEAR RIVER AT HWY 30 NR RIVERDALE ID
		421128111463501	MINK CREEK AT MOUTH NEAR PRESTON ID
		421519111452101	BEAR RIVER BLW ONEIDA RESERVOIR NR ONEIDA ID
		422428111433201	TROUT CREEK AT THATCHER ID
		422430111435901	BEAR RIVER NEAR THATCHER ID
		422714111431501	WHISKEY CREEK AT HWY 34 NR THATCHER ID
	FREMONT	13055000	TETON RIVER NR ST ANTHONY ID
	GOODING	13095175	BRIGGS SPRING AT HEAD NEAR BUHL ID
	JEROME	13089500	DEVILS WASHBOWL SPRING NR KIMBERLY 10S 18E 04AAD1S
		13090999	BLUE LAKES SPRING BEL PUMP PLANT NR TWIN FALLS ID
		13091000	BLUE LAKES SPRING NR TWIN FALLS ID 09S 17E 28DBA1S
	KOOTENAI	12413860	COEUR D ALENE RIVER NR HARRISON ID
		12419000	SPOKANE RIVER NR POST FALLS ID
	SHOSHONE	12413000	NF COEUR D ALENE RIVER AT ENAVILLE ID
		12413370	EF PINE CREEK ABV NABOB CR NEAR PINEHURST ID
		12413445	PINE CREEK BLW AMY GULCH NR PINEHURST ID
		12413470	SF COEUR D ALENE RIVER NR PINEHURST ID
		12413875	ST JOE RIVER AT RED IVES RANGER STATION ID
	TWIN FALLS	13092300	NORTH COTTONWOOD CREEK NR ROGERSON ID
		13092747	ROCK CREEK AB HWY 30/93 XING AT TWIN FALLS ID
		13093478	CEDAR DRAW AT CLOVER ROAD (3900 N.) NEAR FILER ID
		13094680	MUD CREEK ABOVE CLEAR CREEK NEAR BUHL ID
		13107200	SALMON FALLS CK @ LILY GRADE XING NR CASTLEFORD ID
PA	ALLEGHENY	03083500	YOUGHIOGHENY RIVER AT SUTERSVILLE PA
		03086000	OHIO RIVER AT SEWICKLEY PA
	BERKS	01470779	TULPEHOCKEN CR NR BERNVILLE PA
	BUCKS	014649007	LITTLE NESHAMINY C AT VALLEY ROAD NR NESHAMINY PA
	CHESTER	01472100	PIGEON CREEK NEAR PARKER FORD PA
		01472157	FRENCH CREEK NEAR PHOENIXVILLE PA
	CUMBERLAND	01571500	YELLOW BREECHES CREEK NEAR CAMP HILL PA
	DAUPHIN	01570500	SUSQUEHANNA RIVER AT HARRISBURG PA
	LACKAWANNA	01447120	LEHIGH RIVER NEAR GOULDSBORO PA

Table 3. Compilation of USGS stations surveyed http://infotrek.er.usgs.gov/nawqa_queries/swmaster/index.jsp			
State Code	County	Staid	Place Name
	LEHIGH	01451800	JORDAN CREEK NEAR SCHNECKSVILLE PA
	MIFFLIN	01564997	KISHACOQUILLAS CREEK AT LUMBER CITY PA
	MONROE	01440304	BRODHEAD CREEK NEAR MOUNTAINHOME PA
		01442550	MARSHALLS CREEK NEAR MARSHALLS CREEK PA
		01447530	TOBYHANNA CREEK AT WARNERTOWN PA
	NORTHAMPTON	01454700	LEHIGH RIVER AT GLENDON PA
	PERRY	01567000	JUNIATA RIVER AT NEWPORT PA
		01568000	SHERMAN CREEK AT SHERMANS DALE PA
	PHILADELPHIA	01474500	SCHUYLKILL RIVER AT PHILADELPHIA PA
	PIKE	01432512	SHOHOLA CREEK AT SHOHOLA PA
		01434000	DELAWARE RIVER AT PORT JERVIS NY
		01438302	VANDERMARK CREEK AT MOUTH AT MILFORD PA
		01438396	SAWKILL CREEK 2000 FT AB MOUTH AT MILFORD PA
		01438712	RAYMONDSKILL CR BL SWALE BROOK NR SILVER SPRING PA
		01438890	DINGMANS CR BL FULMER FALLS NR DINGMANS FERRY PA
		01439400	TOMS CREEK AT EGYPT MILLS PA
		01439680	LITTLE BUSHKILL CREEK AT BUSHKILL PA
	WAYNE	01427203	EQUINUNK CREEK AT EQUINUNK PA
		01427702	CALKINS CR 1200 FT AB MOUTH AT MILANVILLE PA
		01428750	WEST BRANCH LACKAWAXEN RIVER NEAR ALDENVILLE PA
		01431250	MIDDLE CREEK AT HAWLEY PA
		01431600	WALLENPAUPACK CREEK AT EAST STERLING PA
	YORK	01574000	WEST CONEWAGO CREEK NEAR MANCHESTER PA
TN	BEDFORD	03598250	NORTH FORK CREEK NEAR POPLINS CROSSROADS TN
	COCKE	03467609	NOLICHUCKY RIVER NEAR LOWLAND
	FAYETTE	07030392	WOLF RIVER AT LAGRANGE TN
	GILES	03584600	ELK RIVER AT PROSPECT TN
	GREENE	03466208	BIG LIMESTONE CREEK NEAR LIMESTONE TN
	HAMILTON	03568000	TENNESSEE RIVER AT CHATTANOOGA TN
	HICKMAN	03601684	LICK CREEK ABOVE LITTLELOT TN
		03604200	CANE CREEK AT FARMERS EXCHANGE TENN
	HUMPHREYS	03603000	DUCK RIVER ABOVE HURRICANE MILLS TN
		03605710	BIG RICHLAND CREEK NEAR WAVERLY TN
	LAWRENCE	03585263	EAST FORK SUGAR CREEK AT PEACH TN
		03588260	KNOB CREEK NEAR WESTPOINT TENN
	LEWIS	03603693	LITTLE BUFFALO RIVER NEAR HOHENWALD TN
	LINCOLN	035825882	CANE CREEK NEAR HOWELL TN
	MORGAN	03539778	CLEAR CREEK AT LILLY BRIDGE NEAR LANCING TN
	SHELBY	07031692	FLETCHER CREEK AT SYCAMORE VIEW ROAD AT MEMPHIS
	TIPTON	07030050	HATCHIE RIVER AT RIALTO TN
	WAYNE	035941395	INDIAN CREEK AT THREE CHURCHES TN
		03594180	HARDIN CREEK AT CLIFTON JUNCTION TN
		03594263	BEECH CREEK NEAR TURNBO HOLLOW NEAR CLIFTON TN
UT	BOX ELDER	10118000	BEAR RIVER NEAR COLLINSTON UT
		10126000	BEAR RIVER NEAR CORINNE UT
		413537112074301	MALAD RIVER SOUTH OF BEAR RIVER CITY
		414255112065901	BEAR RIVER AT U-30 CROSSING

Table 3. Compilation of USGS stations surveyed http://infotrek.er.usgs.gov/nawqa_queries/swmaster/index.isp			
State Code	County	Staid	Place Name
	CACHE	10102200	CUB R NR RICHMOND UTAH
		10115200	LOGAN RIVER BLW BLACKSMITH FORK NR LOGAN UTAH
		414048111495101	BLACKSMITHSFORK AT 2900 S. NR MILLVILLE UT
		414308111564101	LITTLE BEAR AT 600 S. NR MENDON UT
		414314111553801	SPRING CREEK AT 600 S. NEAR LOGAN UT
		414541111544201	LOGAN WWTP OUTFLOW NR LOGAN UT
		414615111544301	SWIFT SLOUGH AT 1300 EAST NR LOGAN UT
		414712111571901	LITTLE BEAR RIVER AT 3000N BENSON MARINA
		414804111543401	BEAR RIVER NEAR BENSON UT
		414805111533001	HOPKINS SLOUGH NR BENSON UT
		415020111582701	NEWTON CREEK AT MOUTH NEWTON UT
		415834111485901	SPRING CREEK NR COVE UT
	DAVIS	410041111581101	BAER CREEK AT FRONTAGE ROAD KAYSVILLE UT
		410231111565001	HOLMES CREEK AT MAIN STREET LAYTON UT
	EMERY	09315000	GREEN RIVER AT GREEN RIVER UT
	GRAND	09180500	COLORADO RIVER NEAR CISCO UT
	RICH	413010111072701	SALERATUS CREEK NR WOODRUFF UT
		413127111092001	GENE'S CREEK AT WOODRUFF UT
		413916111110501	BIG CREEK AT HWY 89 NR RANDOLPH UT
		414009111082101	BEAR RIVER AT RANDOLPH UT
		414317111093201	OTTER CREEK NR RANDOLPH UT
		414637111042501	BEAR RIVER ABV BRIDGER CREEK AT HWY 30 NR LEEFE WY
	SALT LAKE	10167800	LITTLE COTTONWOOD CREEK @ CRESTWOOD PARK @ SLC
		10168000	LITTLE COTTONWOOD CREEK @ JORDAN RIVER NR SLC
		10171000	JORDAN RIVER @ 1700 SOUTH @ SALT LAKE CITY UT
		10172200	RED BUTTE CREEK AT FORT DOUGLAS NEAR SLC UT
		404000111515801	BIG COTTONWOOD CREEK AT 900 EAST SLC UT
		404143111500101	MILL CREEK AT 2000 EAST SLC UT
		404218111525601	MILLCREEK AT 300 EAST SLC UT
		404317111503601	PARLEYS CREEK AT SUGARHOUSE PARK SLC UT
		404430111495301	EMIGRATION CREEK AT 1300 SO SLC UT
	SAN JUAN	09379500	SAN JUAN RIVER NEAR BLUFF UT
	SUMMIT	10011500	BEAR RIVER NEAR UTAH-WYOMING STATE LINE
		404026111273001	SILVER CREEK ABOVE RICHARDSON FLAT UT
	WEBER	411407111580501	OGDEN RIVER AT WASHINGTON AVE OGDEN UT
		411413111554601	OGDEN RIVER AT VALLEY DRIVE OGDEN UT
WV	HARDY	01608000	SOUTH FORK SB POTOMAC RIVER NEAR MOOREFIELD WV
		01610400	WAITES RUN NEAR WARDENSVILLE WV
	JEFFERSON	01618000	POTOMAC RIVER AT SHEPHERDSTOWN WV
	MONROE	03183500	GREENBRIER RIVER AT ALDERSON WV
	MORGAN	01611500	CACAPON RIVER NEAR GREAT CACAPON WV

Table 4. USGS water quality stations within EcoRegion 69 and 70		
State	Site_Number	Site_Name

MD	1598650	SAND SPRING RUN AT FROSTBURG, MD
PA	3043810	Conemaugh River below Conemaugh Dam, PA
PA	3081000	Youghiogheny River below Confluence, PA
PA	3108490	Ohio R ab Montgomery Dam & Locks at Ohioview, PA
OH	3121850	Huff Run at Mineral City OH
OH	3158200	Monday Creek at Doanville OH
OH	3159246	Sunday Creek below Millfield OH
OH	3201980	Little Raccoon Creek near Ewington OH
OH	3231500	Scioto River at Chillicothe OH
OH	3234500	Scioto River at Higby OH
VA	3208500	RUSSELL FORK AT HAYSI, VA
WV	1595800	NORTH BRANCH POTOMAC RIVER AT BARNUM, WV
KY	3277500	NORTH FORK KENTUCKY RIVER AT HAZARD, KY

Table 5. Summary of Municipal WWTPs surveyed.

State	Plant Name	Receiving Stream	Avg. Flow (mgd)	Total Dissolved Solids (mg/L)			Calc. Avg. Conductivity (uS/cm)
				Max	Min	Avg.	
Appalachian							
WV	Baker's Ridge	Monongahela River	0.03	661	661	661	1124
WV	Town of Blacksville	Dunkard/Monongahela	0.01	527	382	455	773
WV	City of Fairmont	Monongahela River	5.62	419	221	272	462
WV	City of Morgantown	Monongahela River	10.92	928	365	640	1088
WV	Salem	Salem Fork	0.49	320	236	291	495
WV	Town Worthington	West Fork River	0.12	234	216	225	383
PA	Amity Township	Schuylkill River	2.33	671	552	612	1040
PA	Telford Boro Authority	Indian Creek	0.75	732	590	661	1124
PA	University Joint Authority	Spring Creek	5.02	669	502	577	981
TN	Elizabethton STP	Watauga River	2.4	641	465	553	940
OH	City of Eaton	Seventeile Creek	2.3	974	974	974	1656
OH	City of Ironton	Ohio River	1.90	672	271	384	653
OH	Marysville WRF	Mill Creek	2.59	1420	804	1103	1875
OH	City of Newark	Licking River	8.19	1378	703	1072	1822
OH	City of Springfield	Mill Creek	0.05	594	388	475	808
OH	Upper Tascarawas WWTP	Tascarawas River	2.70	1100	996	1007	1712
Average						*623*	*1038*
5th Percentile						*260*	*442*
50th Percentile						*594*	*1010*
95th Percentile						*1080*	*1835*
Standard Deviation						*284*	*483*
Western Mtn							
CO	Eagle River	Eagle River	2.00	635	314	460	781
CO	Breckenridge San. District	Dillon Reservoir	0.86	580	80	328	558
CO	City of Delta	Gunnison River	0.94	1564	16	1230	2135
CO	City of Gunnison	Gunnison River	0.79	434	340	391	665
CO	Three Lakes San. District	Willow Creek	0.5	252	252	252	428
UT	Anderson Geneva LLC	Utah Lake	4.57	699	412	596	1013
UT	City of Moab	Colorado River	0.74	400	400	400	680
UT	Price Ri. Water District	Price River	1.38	1420	899	1120	1905
UT	St. George City	Virgin River	7.60	1463	643	1137	1933
WY	City of Green River	Green River	1.19	774	310	612	1016
WY	Kemmerer-Diamondville	Hams Fork River	0.53	881	628	743	1263
MN	Albert Lea WTF	Shellrock River	4.74	1170	1150	1157	1966
MN	Cold Spring	Sauk River	0.68	2538	979	1328	2258
MN	Winnebago	Blue Earth River	0.41	4715	1792	3612	6140
Average						957	1624
5th Percentile						301	512
50th Percentile						677	1140
95th Percentile						2127	3617
Standard Deviation						852	1449

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Federal Water Quality Coalition

September 3, 2010

Via E-mail to: ORD.Docket@epa.gov
Office of Environmental Information (OEI) Docket
U.S. Environmental Protection Agency
Mail Code: 2822T
1200 Pennsylvania Ave., NW
Washington, DC 20460

RE: Comments on *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams* (EPA/600/R-10/023A)
Docket ID No. EPA-HQ-ORD-2009-0934

Ladies and Gentlemen:

The Federal Water Quality Coalition (Coalition) is pleased to provide the following comments on the draft report entitled *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams* (EPA/600/R-10/023A) (the Draft Report), which the U.S. Environmental Protection Agency (EPA) issued on April 12, 2010. 75 *Fed. Reg.* 18499.

The Coalition is a group of industrial companies, municipal entities, agricultural parties, and trade associations that are directly affected, or which have members that are directly affected, by regulatory decisions made under the federal Clean Water Act. The Coalition members, for purposes of these comments, are as follows: Alcoa, Inc., American Chemistry Council, American Coke and Coal Chemicals Institute, American Forest & Paper Association, American Iron and Steel Institute, American Petroleum Institute, Association of Idaho Cities, City of Superior (WI), Coeur D'Alene Mines Corporation, Edison Electric Institute, Ford Motor Company, Freeport-McMoRan Copper & Gold, Inc., General Electric Company, Hecla Mining Company, Indiana Coal Council, Mid America CropLife Association, National Association of Home Builders, Olin Corporation, Orange County Sanitation District, Pharmaceutical EHS Sustainability Council, Rubber Manufacturers Association, Utility Water Act Group, Western Coalition of Arid States, and Weyerhaeuser Company.

Members of the Coalition have facilities in, and hold National Pollutant Discharge Elimination System (NPDES) permits containing discharge limits for receiving waters in, the areas potentially affected by the Draft Report. In addition, the Draft Report states that "[i]t may also be appropriate for other nearby regions" (*see* Draft Report at xiii), and EPA has indicated, at a recent Science Advisory Board meeting, that it may seek to use the technical approach in the Draft Report in other regions of the country. Therefore, the Coalition members have a direct interest in the matters addressed in the report.

The Coalition appreciates the opportunity to provide comments on the Draft Report. In these comments, the Coalition discusses certain legal, policy, technical, and procedural

concerns associated with the Draft Report. The Coalition recommends that EPA discontinue the use of any presumptive conductivity criterion. Instead, EPA should conduct laboratory tests to develop scientifically defensible criteria for particular ions of concern, using EPA's standard methods for establishing water quality criteria, and then publish those levels as recommended criteria, which States could then consider in setting water quality standards and then developing water quality-based permit limits. The Coalition believes that EPA's Draft Report is an inappropriate basis for establishing presumptively applicable water quality criteria for conductivity in the Appalachian States, and should not be used to set water quality standards, to determine if permit limits are necessary, or to calculate those permit limits.

I. Legal and Policy Concerns

A. EPA's Use of the Draft Report Is Not Authorized By NPDES Permitting Regulations.

The Coalition is concerned that EPA lacks the authority to require use of the conductivity benchmark in the manner described in the Draft Report. EPA regulations require permits to include effluent limitations as necessary to achieve applicable water quality standards, including state narrative standards. In the absence of a numeric water quality criterion for a specific chemical pollutant, the state must first interpret its narrative standard, using that interpretation to determine whether the discharge of that pollutant has a reasonable potential to cause or contribute to an excursion above that standard. 40 C.F.R. § 122.44(d)(1). Only if such "reasonable potential to exceed" the narrative exists can the state impose an effluent limitation, based on (1) a calculated water quality criterion; (2) a case-by-case analysis using EPA criteria promulgated under CWA § 304, supplemented where necessary by "other relevant information;" or (3) an indicator parameter. 40 C.F.R. § 122.44(d)(1)(vi).

Using the conductivity benchmark contained in the Draft Report as "other relevant information" to establish an effluent limitation after the state has determined that such a limit is necessary might be appropriate under the regulations. EPA's intended application of the conductivity benchmark, however, circumvents the required regulatory process. Rather than allowing the state to exercise its authority to interpret its own validly-adopted and EPA-approved narrative standards in determining whether an NPDES limit is necessary, EPA apparently intends to use the conductivity benchmark as a complete substitute for the state's judgment. This is inappropriate and not authorized by the regulations. If EPA or the states believe that a particular conductivity value must be achieved to support applicable designated uses, that value must first be promulgated as a valid water quality criterion, and then applied through the permit process. Use of the conductivity benchmark as a *de facto* water quality standard, which is then used to justify imposing permit limits and to calculate the actual binding limits, is simply not authorized by the Clean Water Act.

B. EPA Has Not Lawfully Promulgated the Conductivity Benchmark as a Scientifically Defensible Water Quality Standard.

Generally, States have adopted narrative standards that govern conductivity. For example, Kentucky's narrative standard provides that "total dissolved solids or specific conductance shall not be changed to the extent that the indigenous aquatic community is adversely affected." 401 KAR 10:031. However, rather than determining whether a discharge actually results in an adverse impact, the Coalition is concerned that EPA will be requiring States to assume an adverse impact based on the new conductivity benchmark set forth in the Draft Report. EPA has no

authority to do this.

The Act vests authority for development of water quality standards with the States that are authorized to implement the Act. Water quality standards have two main components: designated uses and criteria to protect those uses. 33 U.S.C. § 303(c). State water quality standards are subject to EPA review and approval.

All of the states in the central Appalachian region are authorized to carry out the Act's permit program, including establishing water quality standards. This means that EPA has no authority to establish water quality standards in any Appalachian state unless the EPA Administrator "determines that a new or revised standard is necessary to meet the requirements of the Act." 33 U.S.C. § 303(c)(4)(B). EPA has not made any such determination with respect to the water quality standards of any Appalachian state.

Where EPA develops water quality standards under § 303(c)(4)(B) of the Act, EPA is subject to the requirements of that section and its implementing regulations at 40 C.F.R. Part 131. Specifically, State water quality criteria must be "necessary to protect the [designated] uses." 40 C.F.R. § 131.2. Criteria also must be based on "sound scientific rationale." 40 C.F.R. § 131.11(a). Numeric criteria should be based on EPA's § 304(a) guidance, § 304(a) guidance modified to reflect site-specific conditions, or "other scientifically defensible methods." 40 C.F.R. § 131.11(b). In addition, narrative criteria may be established where numeric criteria can not, or to supplement numeric criteria. 40 C.F.R. § 131.11(b).

EPA cannot show that its proposed conductivity benchmark is "necessary to protect [designated] uses" because (as discussed below) it cannot demonstrate what effect the benchmark would have on a designated use. Without a showing of a cause-and-effect relationship between the benchmark and a biological response in the water body, EPA also cannot show that the benchmark is based on "sound scientific rationale" or "scientifically defensible methods." Accordingly, EPA's conductivity benchmark does not comply with Clean Water Act procedures, and does not meet the Act's substantive requirements either.[1]

II. Scientific Concerns

The Coalition has identified a number of serious scientific concerns with the Draft Report, which are described in detail below.[2]

A. Any Adopted Conductivity Criteria Should Be Established Using Data from Controlled Laboratory Toxicity Studies.

EPA's 1985 Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses (the "National Guidelines") incorporate a "good science clause" that allows the use of technically defensible methods other than the conventional toxicity test-based approach to derive water quality criteria. *National Guidelines* at 21. The field

[1] In addition, EPA has not met its obligations under its own information quality guidelines –in particular, as to the requirements for "utility" and "transparency." *"Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility and Integrity of Information Disseminated by the Environmental Protection Agency,"* http://www.epa.gov/quality/informationguidelines/documents/EPA_InfoQualityGuidelines.pdf.
[2] Specific concerns regarding the statistical techniques used by EPA are set forth in Appendix A.

data approach used to derive the conductivity benchmarks purports to follow the National Guidelines.

However, the field data that EPA used to derive the proposed benchmarks in the Draft Report do not directly measure causal effects, as would be provided by toxicity test data under the more controlled experimental conditions of a laboratory toxicity test. Many variables unrelated to conductivity impact species presence and absence in streams, and direct causality cannot be determined with the approach used by EPA here.

For example, habitat quality, especially as it relates to siltation, could be much more important than conductivity in limiting benthic macroinvertebrate populations. Likewise, heavy predation by other organisms also may be a limiting factor. Neither of these is appropriately accounted for in the EPA study—all effects are inappropriately presumed to be caused by conductivity.

In contrast to the rigorous methodology recommended by the National Guidelines, EPA here uses field data, citing a lack of laboratory data. *See Draft Report* at 3. This is a significant departure from the National Guidelines' recommendations. Field data are not derived from a controlled setting. The lack of laboratory tests on conductivity severely impairs the ability to draw meaningful scientific conclusions about the appropriate level of that parameter to address toxicity.

B. The National Guidelines Require Data From Eight Types of Aquatic Organisms.

EPA's Draft Report only considers the effects of conductivity on certain invertebrate genera, and limits its consideration of confounding factors to only one genera of mayfly, *Ephemeroptera*. In contrast, to help ensure that the total range of chemical sensitivities of organisms likely to be encountered in a broad range of field conditions is represented, the National Guidelines require a minimum database of eight specific types of aquatic genera before a criterion can be derived. *National Guidelines at 23.*

Under the National Guidelines, if all required data are not available, a numerical criterion should not be derived "except in special cases." *National Guidelines* at 26. EPA has provided no reason why conductivity presents a "special case." Thus, in order to comply with the National Guidelines, EPA must develop all necessary data identified in the National Guidelines, which includes data from at least eight different families of aquatic life. *Id.* at 23.

C. The Effects of Conductivity Depend Upon The Particular Ions Present And Their Ratios.

Conductivity is a very generic indicator of ions in water, and any deleterious effects of increased conductivity are highly dependent upon the specific ions present that comprise that conductivity, and the ratios of ion concentrations present. General conductivity is too gross a measurement to reflect ion-specific effects, except in ranges of conductivity much higher than the proposed benchmark of 300 uS/cm.

Some anions, such as chloride and sulfate, would be contributors to conductivity in a given stream. However, chloride and sulfate toxicity is known to be decreased by increasing water hardness, yet EPA failed to account for this effect in the Draft Report. The Draft Report's assessment only is applicable, at best, to very specific eco-regions and only to water chemistries

dominated by sulfate and bicarbonate.

The Coalition agrees with the July 9, 2010 comments of the National Council for Air and Stream Improvement, Inc. (NCASI), which indicate that calculated median lethal concentrations (LC50s) are highly variable, clearly dependent upon ion composition, and trending in the opposite way from what one would expect if conductivity were a viable surrogate for toxic response.

In addition, the Coalition believes that EPA should determine whether its species sensitivity determination (SSD) approach meets the definition of other allowable approaches under the National Guidelines. The SSD approach applied here is an observation-based approach, and does not meet the basic tenets supporting the use of toxicity test data inherent in the National Guidelines. The field-based approach uses the presence or absence of organisms in a stream (combined with the observed conductivity level of the stream) to set a conductivity level that is supposed to be protective of 95% of the species that should be present. This method provides an initial assessment of possible conductivity of concern, but does not establish causality. Follow-up toxicity testing using standard test conditions, prepared to mimic Appalachian stream major ion conditions, should be conducted to confirm causality and effects in the range of conductivity proposed as the Appalachian streams benchmark.

D. EPA's Practice of Removing Samples With pH of Less Than 6 To Eliminate Effects of Dissolved Metals Is Ineffective.

EPA's practice of removing samples with a pH of less than 6 to eliminate the effects of dissolved metals does not accomplish that result, since each metal has its own phase distribution with pH, and some metals are more soluble and available in free ion form as pH increases. In order to obtain accurate sampling results, EPA needs to actually measure the metals concentrations instead.

E. EPA's Benchmark Level of 300 uS/cm Is Not An Accurate Measure Of Toxicity.

The cladoceran *Ceriodaphnia dubia* has been widely documented to be highly sensitive to ions comprising conductivity. This assessment includes comparisons to benthic macroinvertebrates such as those assessed in field studies used to derive the proposed benchmark of 300 uS/cm. However, the conductivity of standard laboratory waters used to raise and test *C. dubia* is above 300 uS/cm. For example, EPA moderately hard water conductivity is in the range of 300 to 350 uS/cm, and hard water in which *C. dubia* thrive has a conductivity of approximately twice that of moderately hard water. The proposed benchmark of 300 uS/cm is highly inconsistent with widely documented levels of conductivity known to be innocuous to a highly sensitive invertebrate.

In addition, in EPA distribution curves, species are commonly present when conductivity values are over 300 uS/cm, which shows that EPA's approach here is flawed.[3] In addition, many streams with conductivity levels over 300 uS/cm have healthy benthic communities, again indicating that EPA's benchmark level—by itself—is not a reliable indicator of whether certain

[3] For example, in Figure D-1 of the Draft Report, benthic invertebrates of various genera were observed in streams with conductivity values well above 300 uS/cm. Specifically, *Remenus* and *Lepidostoma* were commonly present at conductivity conditions of 423 uS/cm, and occurred at conductivity conditions above 2,221 uS/cm.

waters are healthy. For example, a review of the Tennessee Department of Environment and Conservation (TDEC) ecoregion reference stream database on unimpaired streams indicated that conductivity values in those healthy streams were sometimes well above 800 uS/cm. Many streams in the TDEC database for ecoregions similar to those in the West Virginia and Kentucky databases have conductivity values in the range of 500 to 600 uS/cm. EPA's proposed benchmark does not align with known higher conductivity conditions that do not cause biological effects to sensitive invertebrates.[4]

There are insufficient data from the physiological and toxicology literature to support EPA's conclusion that "conductivities in the region of concern reach levels that are sufficient to cause effects on stream communities." Draft Report, at 52. Moreover, there are insufficient laboratory studies to confirm either the causal mechanisms or conductivity thresholds necessary to support the proposed benchmark of 300 µS/cm. For these reasons, Illinois, Indiana, and Iowa have rejected the use of total dissolved solids or conductivity-based criteria in lieu of criteria for individual ions such as sulfate or chloride.

EPA needs to conduct a more formal and rigorous analysis to evaluate whether conductivity—as opposed to other factors—is, in fact, the best and most reliable indicator of adverse changes in biological communities in the Appalachian region. The Coalition agrees that sufficient and appropriate laboratory data are not available at this time, but a preferred approach would be to generate the data necessary to support the derivation of aquatic life criteria using standard methods. Until these studies are conducted, it is premature to suggest that a quantitative conductivity benchmark is an accurate and direct reflection of ions related to salinity.

F. EPA's Data On Species Extirpation Do Not Support Its Conductivity Benchmark.

The National Guidelines recommend the use of median lethal concentrations (LC50s) for data analysis. *Draft Report* at xii. In developing its conductivity benchmark, EPA has disregarded that recommendation, and instead has used extirpation concentrations (XCs). The XC is defined by EPA as the level of exposure above which a genus is effectively absent from a waterbody.

The data EPA has used to identify extirpation include data that do not meet the standards established in the National Guidelines. The National Guidelines state that data should be rejected if they are from tests in which too many organisms in the control treatment died or showed signs of stress or disease. In contrast, EPA considered a 1% collection probability in reference sites to be acceptable. EPA even included data from organisms that have only a 3% survival rate in reference streams. When a species is naturally rare, it is invalid for EPA to conclude that its rarity is due to conductivity levels.[5]

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[4] Similarly, a study of streams in the coal mining regions of Alabama concluded that "conductivity is not a good indicator of whether Alabama streams have a healthy and diverse assemblage of benthic macroinvertebrates." Davenport, L.J. and Morse, Kevin J., *"An Assessment of Conductivity and Benthic Macroinvertebrate Health and Diversity in Alabama Streams in Region 68"* (August 2010) at 2 (copy attached). The report found that the studied streams, with healthy and diverse communities, had conductivity levels ranging from 992 to 2,820 uS/cm. Id.

[5] In addition, we have concerns with the methodology used to develop the SSD distribution. The species list to be included in the SSD distribution should be based upon presence at the 75th percentile or greater level of the reference sites, not whether its presence is in a minimum of 30 of the 75 reference sites (less than 50%). This approach limits the database and excludes from the species list many organisms that are

G. The Sampling Periods Were Broken Up Incorrectly.

According to the Draft Report, the sampling periods used by EPA were broken up into March-June and July-October. It appears that particularly in Region 69 the number of samples was significantly greater in the July-October period, so much so that it was still evident in the total sample distribution for both regions (60 and 70). Given that macroinvertebrates have distinct life histories, growth and emergence, this difference may have affected the numbers of species and total macroinvertebrates in the samples. For example, it is possible that the organisms were too small to be collected, that their cycles were not caught by the sampling times, or other similar factors. Much of the detail associated with this issue is not included in the Draft Report.[6]

H. EPA's Conductivity Benchmark Is Not A Good Predictor of Biological Impairment.

Under the National Guidelines, aquatic water quality criteria are not supposed to result in either over- or under-protection. *National Guidelines* at 5. However, EPA's conductivity benchmark could result in both of those errors. For example, in West Virginia there are 409 waterbodies that are not impaired using West Virginia's stream classification index, but that have conductivity levels above EPA's criterion of 300 µS/cm. On the other hand, there are 290 waterbodies that are classified as impaired by West Virginia that do meet EPA's conductivity criterion. Accordingly, EPA's conductivity benchmark is not a good predictor of biological impairment, and could readily lead to overprotecting or underprotecting aquatic populations.

I. The Coalition Supports The Conclusions of Other Technical Reports Regarding EPA's Conductivity Benchmark.

The Coalition has reviewed and analyzed the report entitled, "Interim Draft Report: Technical Review: A Field-based Aquatic Life Benchmark for Conductivity In Central Appalachian Streams," prepared by GEI Consultants, Inc. and submitted to the National Mining Association, dated July 12, 2010 (hereinafter GEI Report). The Coalition agrees with the conclusions set forth in the GEI Report (at pages ES-1 through ES-3), including the following[7]:

- "[M]ultiple stressor-response profiles are exhibited by the genera used by EPA to derive the conductivity benchmark and, thus, do not represent an internally consistent dataset from which to derive a regulatory benchmark using an SSD approach."

- GEI's preliminary data analyses "indicate that conductivity alone is not the most appropriate parameter when trying to explain the variations observed among the Central

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common to the streams and potentially present at higher conductivity levels than considered deleterious by the current approach.

[6] We also have concerns regarding whether the data used by EPA was for representative years. The database used was for stream surveys conducted from 1999 to 2007. Those were drought years in much of the United States. EPA needs to assess whether this was the case for the Appalachian region surveyed. If so, use of those surveys could have resulted in a skewed database.

[7] In addition, a number of the concerns raised elsewhere in these comments are based in part on information provided in the GEI report and in the comments that have been submitted to EPA by the National Mining Association. The Coalition supports those comments and submittals.

Apppalachian macroinvertebrate communities with respect to water quality and physical habitat. Rather, ionic composition, substrate, and channel features may be the most appropriate stressor variables to consider."

- "We conclude that the relationship between conductivity and changes in benthic macroinvertebrate community structure is neither strong nor reliable enough to warrant derivation of a regulatory benchmark at this time."

J. General Scientific Concerns

Beyond the specific scientific issues identified above, the Coalition also has the following general concerns with the Draft Report, which should be addressed by EPA before it takes any further action on the issues covered in that report:

- EPA's Draft Report does not contain enough detail on key elements of the Agency's analysis, such as the Kentucky data that are supposed to validate EPA's approach.
- In addition, much of the documentation supporting the Draft Report is contained in other documents, such that the Draft Report is difficult to evaluate as a whole.
- The Draft Report does not clearly define the scope of the waters to which the 300 uS/cm benchmark would be appropriate to apply.

III. Conclusion

For the reasons discussed above, EPA's draft conductivity benchmark is not legally sound or scientifically defensible. EPA should not proceed further in finalizing or implementing that benchmark. Instead, to the extent that new or revised water quality criteria are necessary to address the concerns noted by EPA, the Agency should use its standard, recognized methods for using laboratory data to develop water quality criteria for specific ions of concern.

We hope that these comments from the Coalition will be useful to the Agency as it finalizes the Draft Report. Please feel free to call if you have any questions or would like any additional information regarding the issues raised in these comments.

Sincerely yours,

Fredric P. Andes
Coordinator

Federal Water Quality Coalition

STATISTICAL CONCERNS REGARDING CONDUCTIVITY BENCHMARK APPROACH

1) The weighting scheme used to construct each genus-specific distribution of extirpation concentrations is flawed. While it eliminates one source of bias, it creates another. An alternative approach is suggested that, together with what is contained in the Draft Report, will provide more definitive results.

Explanation: For a given genus, g, the inner sum in the denominator counts the number of samples in bin i that contain genus g. Now $w_i = 1/n_i$ and $n_i = M_i$, the number of samples in bin i (so the use of two symbols for the same thing is confusing). So, the product of w_i and the inner sum of the denominator is the proportion of the samples in bin i that contain genus g. Correspondingly, the product of w_i and the inner sum of the numerator is the proportion of the samples in bin i that contain genus g and have conductivity less than x. It is evident then that $0 \leq F(x) \leq 1$ for all x, $F(-\infty)=0$, $F(\infty)=1$, and F is continuous from the left. F is thus a distribution function. The weighting scheme gives the same weight to all bins regardless of how many samples they contain. While this removes a bias towards more heavily sampled bins, it introduces a bias towards less heavily sampled bins. To see this, consider two bins, one sampled 1000 times and the other sampled once. The weighting scheme gives equal weight to both bins. There is no benefit to having sampled some bin more frequently. In colloquial terms, the lazy sampler is according the same value as the hard working sampler. While the need to not bias towards the more heavily sampled bins seems laudable, the cure may be worse than the disease.

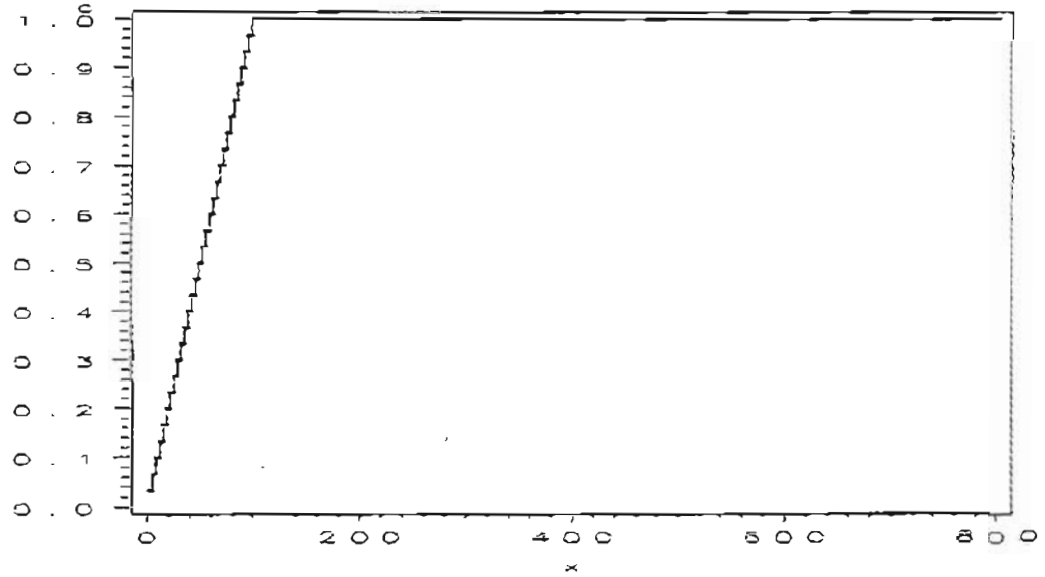
It is not entirely clear why these bins were 0.048 log conductivity units wide. Presumably, the total range of log(conductivity) values was divided by some convenient number and 0.048 was the result. Figure 3, page 28, seems to confirm a range of approximately 0 to slightly more than 4 for log(conductivity) for samples collected March-October. Were that range divided by 85, one would get 0.048. This begs the question of why 85, but that is not terribly important. What is important is that Figure 3 makes clear that bins closer to the extremes of the range are much less frequently sampled than bins towards the middle of the range. An alternative scheme that would address both types of bias discussed above would be to divide the conductivity range into bins of equal sampling frequency (with some adjustment to accommodate tied values). These bins would be unequal in width on a log scale, but there is no inherent problem with that. The downside would be apparently cruder distribution functions towards the extremes. Whether this would be better or worse than what was done is not obvious. It would have been helpful to compare results from both ways to determine what differences might arise. If no appreciable differences in XC95 values result, that would provide greater confidence in the conclusions. If there were appreciable differences, that would cast doubt on the validity of the XC95 values and all subsequent calculations.

2) The methodology for constructing distributions for individual genera is flawed in another way, especially for less sampled genera, that can generate artificially low XC95

values, which in turn would lower the HC5 estimate from the species sensitivity distribution.

Explanation: If an infrequently sampled genus is mostly sampled at low conductivity sites, then the XC95 value for that genus may be artificially low. To illustrate, say there are 28 samples at conductivity < 100 µS/L, 1 at 100, and 1 at 800 and in the latter sample, the genus is extirpated but it thrives in all other samples. XC95 for this genus is 100 µS/L, which is a poor reflection of the data.[See plot below.] There should be a requirement on the distribution of conductivities in samples for any genus included. This could be done in several ways. For example, by comparing XC95 as indicated to XC95 from a trimmed dataset with the highest and lowest 5-10% of observations omitted, examples such as just described would be revealed and could be eliminated or evaluated in a different manner. Something along these lines was done to investigate possible confounders.

Example Problem Distribution



3) The analysis of potential confounding variables is simplistic and very likely to miss all but the simplest sorts of confounding. Multivariate statistical tools for evaluating confounding are dismissed by EPA on superficial, misleading, and inadequate grounds.

Explanation: This is the one-parameter-at-a-time approach. It suggests a strong relationship independent of confounders but in fact, this checks only for simple confounding and ignore the possibility of confounding with, say, a linear function of individual "confounders", none of whom may be strongly correlated or associated with the effect on Ephemeroptera.

Principal component or discriminant analysis could be an important tool in developing understanding of more complex dependencies. It is unfortunate that EPA does not

address either approach, as it would either demonstrate that the one-at-a-time approach to confounding is adequate or identify more complex confounding relationships that should be addressed. Even multi-variable regression might be valuable. In the natural environment, many factors act in combination and can produce effects no one of the factors causes by itself. The evaluation of confounders used in this report is interesting and useful but too limited to be considered definitive.

4) The confidence interval for the derived HC5 value contains conductivity values observed in more than 25% of the reference streams and the HC5 value itself is only 28% higher than the 75th percentile of the reference streams. This suggests that the valley fill streams must meet a requirement that an appreciable percent of reference streams fail to meet.

Explanation: The 75th percentile of undisturbed conductivity values, 234 µS/cm, is very close to the HC5 value derived 300 µS/cm. This suggests the HC5 value is unrealistic. Is the 95th percentile from undisturbed streams above HC5? If so, this would seem to make the whole exercise absurd. The second set of samples included impaired sites and cannot be called background. The 25th percentile from this sample is meaningless. The additional discussion of this approach given in section 5.5, page 16, does little to alleviate the concern raised here. While it is clear that the maximum conductivity value found in undisturbed streams may not be representative, there is a lot of range between the 75th and 100th percentiles. The report does not indicate how many reference streams were used in the 75th percentile calculation.

ncasi

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July 9, 2010

Office of Environmental Information (OEI) Docket
Mail Code: 2822T
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW.,
Washington, DC 20460

RE: Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams
Docket ID No. EPA–HQ–OW–2010–0315.

Dear EPA,

The National Council for Air and Stream Improvement (NCASI) is pleased to submit comments concerning EPA's draft report titled *A field-based aquatic life benchmark for conductivity in central Appalachian streams* (EPA/600/R-10/023A, March 2010). NCASI is an independent, non-profit research institute that focuses on environmental topics of interest to the forest products industry. Members of NCASI represent over 90% of the pulp and paper production and more than 60% of the lumber and wood panel production in the United States. In its capacity as a research organization, NCASI has a long history of collaboration with EPA on the use of sound science needed for the development and implementation of responsible environmental management practices. Evidence of this ongoing collaboration is the selection of NCASI scientists as participants in numerous EPA and other panels including, recently, the Extended SAB Ecological Processes and Effects Committee, the FAC on Detection and Quantitation, and Secretary of Agriculture's Forestry Research Advisory Committee.

NCASI considers it an honor that EPA has again selected a NCASI scientist, Dr. Douglas McLaughlin, to participate on an EPA panel, the Advisory Panel on Ecological Impacts Associated with Mountaintop Mining and Valley-Fills. While NCASI members are not expected to be directly affected by decisions which are based on the ecological effects of mining and valley-filling operations, the science basis for the draft conductivity benchmark might be extended to other streams which have other sources of conductivity. To this end, and recognizing the challenges of developing useful field-based benchmarks of water quality effects, NCASI members are hopeful that the Advisory Panel will consider a number of topics related to the proposed benchmark to the extent that the scientific methods might be applied elsewhere for conductivity or other water quality targets. These suggestions are presented below.

Consistency of Science-Based Approach for Developing Field-Derived Values. Earlier this year, the Extended SAB Ecological Processes and Effects Committee (SAB EPEC) convened regarding derivation of numeric nutrient criteria and provided recommendations to EPA concerning the use of in-stream, effects-based data for developing water quality targets. The Advisory Panel should consider the recommendations of the EPEC as they may pertain to the methods used for establishing a conductivity benchmark. More specifically, we would encourage EPA and the Advisory Panel to consider ways to explicitly align the approach used to develop this benchmark value for conductivity with comments provided to EPA by the SAB EPEC following their review of EPA's draft "Empirical Approaches For Nutrient Criteria Derivation." Many of the scientific challenges are similar, i.e., characterizing a stressor response relationship using statistical or other methods, and supporting cause and effect through the use of detailed conceptual models and a weight of evidence approach. An over-arching concern is that field-derived values reflect cause-effect relationships and are predictive, within a specified level of uncertainty, of designated use impairment. The draft conductivity benchmark document appears to address a number of the SAB EPEC's concerns about the draft nutrient guidance. However, maximizing consistency among the approaches used to evaluate field data in order to derive regulatory thresholds for water quality parameters would be of great value to the water quality management community.

Quantitative Characterization of Uncertainty in the Benchmark Value in Relation to Background Levels. Although it is not possible to characterize all factors that contribute to uncertainty in the water quality impacts associated with a benchmark value, for certain factors, such as variability in aquatic toxicity test results or, in the case of the conductivity benchmark, extirpation concentrations, it is possible to provide quantitative uncertainty estimates. The draft conductivity benchmark document provides a characterization of the benchmark uncertainty, and we support the author's effort to do so. We would encourage the SAB Panel to review this approach carefully as it may represent an approach that has applications to other water quality parameters. Further, the SAB Panel should provide guidance on how to compare this uncertainty estimate with the range of conductivities expected in background or reference streams as part of the assessment of cause-effect weight of evidence.

Approaches for Benchmark Validation. Validation of the conductivity benchmark is important to the utility of the benchmark as a water quality management tool, and the inclusion of a section in the draft conductivity benchmark document devoted to this topic (Appendix E) is to be commended. However, Appendix E appears to present very few details of the analysis of data from Kentucky that is used to support the validation of the West Virginia conductivity benchmark and the field based approach. The Advisory Panel should carefully review information related to validation of the benchmark, including the presentation and analysis of raw data, not only to evaluate the science in support of validation of this particular benchmark but to provide guidance on the validation of other field-based benchmarks that may be proposed in the future.

Role of Laboratory Assays in the Derivation of Field-Based Water Quality Benchmarks. Confirmation testing of cause-effect toxicity due to conductivity using laboratory assays is possible, appropriate, and necessary as part of the weight of evidence process. Natural systems are complex environments with the distribution and relative abundance of taxa driven by the independent and cumulative influence of abiotic variables and biotic interactions. Although the available data has suggested that conductivity may be a variable contributing to extirpation of certain taxa in the study streams, other environmental variables

may also play a role in the distribution of species in the dataset. The Advisory Panel should strongly consider the value of laboratory tests examining the effect of conductivity alone. Such data are important to building a weight of evidence that the relationship between conductivity and macroinvertebrate patterns in the study streams reflects cause and effect and to substantiate conductivity thresholds of the most sensitive taxa.

The Mount et al. 1997 study referenced in the report is a good example of the importance of laboratory studies in evaluating cause-effect relationships and toxicity thresholds. The Mount et al. study was initiated, in part, because the researchers recognized that integrative parameters such as total dissolved solids, conductivity, and salinity are "not robust predictors of toxicity for a range of water qualities." During the study, more than 2900 acute bioassay tests were conducted using laboratory waters composed of ionic species common in natural waters (Na^+, Ca^{2+}, K^+ Mg^{2+}, Cl^-, HCO_3^-, SO_4^{2-}). While the study did not originally include conductivity measurements, the conductivity of the test solutions was reconstructed using the raw data (provided by Dr. Mount) and an analysis undertaken to explore relationships between conductivity and aquatic toxicity. That analysis is provided here, as Attachment 1, for consideration by the Advisory Panel. Among the findings from this assessment were that calculated LC_{50} concentrations were highly variable, clearly dependent upon ion composition, and trended in a manner opposite to that which would be expected if conductance were a viable surrogate for toxic response. NCASI would be happy to make the raw data from this study available to the Advisory Panel.

<u>Characteristics of Stream Ecosystems to Which the Proposed Benchmark Would Apply.</u> The benchmark report is mostly clear concerning the characteristics of streams from which data were used for purposes of deriving the benchmark. However, the report is not as clear as to specific limitations on the applicability of the benchmark. For example, the benchmark was derived from streams with drainage area less than 155 square kilometers. Should application of the benchmark be limited to only such streams? As another example, the report indicates that the benchmark was derived using data from steams where conductivity was dominated by carbonate and sulfate. However, no specific limits as to the concentrations of these ions are recommended to guide the application of the benchmark to other regions or flowing water ecosystems.

We hope that EPA and the Advisory Panel find these suggestions helpful.

Respectfully submitted,

Paul Wiegand

Paul Wiegand
NCASI Vice President – Water Quality

ATTACHMENT 1

Review of Bioassay Data in Mount et al.[1] Relative to Estimated Conductance of Test Solutions and LC_{50} Concentrations

The Florida Department of Environmental Protection (FDEP) is considering revision of the existing water quality criteria for specific conductance. The conductance criteria being considered were developed through an analysis of field data collected in Florida waters. The analysis employed was quantile regression, supported by a separate conditional probability analysis. A cause-effect relationship assumption between conductance and aquatic toxicity is implicit to these analyses. FDEP has indicated that it has not undertaken or identified in the literature any controlled studies that quantify a linkage between conductance and aquatic toxicity in the conductance range being considered as water quality criteria[2]. In previous comments to FDEP, NCASI indicated that conductance is not, and would not be expected to be, a robust indicator of toxicity to aquatic life within the ranges being considered by FDEP.

A paper published in 1997 by Mount et al. provides support for these comments and has been provided to FDEP. The Mount et al. study was initiated, in part, because the researchers recognized that integrative parameters such as total dissolved solids, conductivity, and salinity are "not robust predictors of toxicity for a range of water qualities." During the study, more than 2900 acute bioassay tests were conducted using laboratory waters composed of ionic species common in natural waters (Na^+, Ca^{2+}, K^+ Mg^{2+}, Cl^-, HCO_3^-, SO_4^{2-}). In response to our inquiry, Dr. Mount provided to NCASI the bioassay test data developed in the study. Conductance was not measured during the study. However, estimates of specific conductance for each test solution could be made based on the ion concentrations of the test waters which were carefully controlled during the study. Such estimates were generously provided to NCASI by Dr. Rich Pawlowicz of the University of British Columbia. Conductance estimates were made using a procedure recently published by Dr. Pawlowicz in *Limnology and Oceanography: Methods*[3].

The availability of estimated conductance values for the bioassay test solutions makes possible a quantitative assessment of the utility of conductance as a predictor of toxicity for species studied by Mount et al. That assessment is presented here in three forms: plots of bioassay test data vs. conductance, a plot of LC_{50} data presented by Mount et al. (his Tabled 2 and 3) and estimated conductance, and Poisson regression analysis comparing the utility of a model based only on conductance and one based on the concentration of ions in test solutions.

In reviewing the analyses presented below, it will be observed that the conductance values for the test solutions are, generally, much higher than the criterion being considered by FDEP. The estimated conductance values for the test water solutions ranged between about 300 µS/cm (conductance of the moderately hard reconstituted water used for standard bioassay testing) to more than 10,000 µS/cm.

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[1] Mount, D.R., Gulley, D.D., Hockett, J.R., Garrison, T.D., and Evans, J.M. 1997. Statistical models to predict the toxicity of major ions to *Ceriodaphnia dubia*, *Daphnia magna*, and *Pimephales promelas* (fathead minnows). *Environmental Toxicology and Chemistry*. 16:2009-2019.

[2] The criteria are expressed relative to conductance of the background water. Criteria in the range of 250 to 1050 µS/cm are possible for waters with background levels of less than 700 µmhos/cm. Criteria for waters with background conductance levels greater than 700 µmhos/cm would be 50% greater than background.

[3] Pawlowicz, R. 2008. Calculating the conductivity of natural waters. *Limnology and Oceanography: Methods*. 6:489-501.

Bioassay Test Data vs. Conductance

Figures 1 to 3 show the test data for the 96-hour fathead minnow, 48-hour *D. magna*, and 48-hour *C. dubia* bioassays vs. conductance. Plots for shorter test durations are not presented but are similar in appearance. Figures 4 to 6 show the same data presented in the prior figures but at a scale of conductance values between 0 and 3000 µS/cm. The plots suggest that reliable predictions of organism mortality are unlikely to be made except for very high conductance values. In Figure 1, for example, 100% survival of fathead minnows was observed at conductance values up to 10,000 µS/cm, while 0% survival was sometimes (though infrequently) observed at conductance values less than 2000 µS/cm. *C. dubia* appeared to be more sensitive at higher conductance values but 100% survival was observed at conductance values near 6000 µS/cm in some tests while 0% survival was sometimes observed at conductance values less than 2000 µS/cm.

Plot of LC_{50} Data and Conductance

Figures 7, 8, and 9 show the LC_{50} data presented in Tables 2 and 3 of the Mount et al. paper plotted against the estimated conductance of the test solution. In these figures, the LC_{50} values for the 96-hour fathead minnow and 48-hour *D. magna* and *C. dubia* bioassays are plotted for the ion pairings used for the test solutions. The figures illustrate the variability in LC_{50} values as a function of the ion composition of the test solution. For example, Figure 7 shows that the LC_{50} values are observed to range over an order of magnitude depending on the ion composition of the test solution. The conductance values of the test solutions also range over an order of magnitude. If conductance were a robust indicator of bioassay response, the general trend of the conductance data would reflect generally higher conductance levels for lower LC_{50} concentrations. In fact, just the opposite is seen in all three figures. The more toxic salt solutions (lower LC_{50} concentrations) tend to have lower conductance values and the less toxic salt solutions (higher LC_{50} concentrations) have higher conductance values. These figures clearly show that conductance is not a useful indicator of toxicity for the species tested.

Poisson Regression Analysis

In the original work, Mount et al. developed models using logistic regression. These models suggested, for instance, that potassium ion concentration was more important than sodium ion concentration with respect to bioassay response. The results of the Mount et al. analysis yielded models that accounted for roughly 80% of the variably in the test data using the concentration of individual ions or variables based on ion presence and concentration.

Using the data provided by Dr. Mount we applied a related statistical procedure, Poisson regression, to compare a model based only on conductance values to one based on the ion composition of test solutions. In setting up the model we treated each test species separately but combined the data for the various test durations by assigning a time variable as a count of individual organism survival for each test duration. For fathead minnow data, for example, survival of each organism for each bioassay was assigned 0=dead at 24 hours, 1=dead at 48 hours, 2=dead at 96 hours, and 3=alive at 96 hours. *D. magna* and *C. dubia* data were expanded similarly, but for values of 0, 1, and 2, owing to test durations of 24 and 48 hours for these bioassays. Before proceeding, we verified that the single ion models showed results similar to those

found by Mount using logistic regression, i.e., ions ranked from most to least effect on toxicity were K^+, Mg^{2+}, HCO_3^-, Cl^-, SO_4^{2-}, Na^+, and Ca^{2+}.

The comparison of a model using only conductance with one using all ion concentrations is shown in Table 1 in terms of Akaike Information Criterion (AIC) values and R^2 values. The AIC values are relative measures of model performance (and thus not comparable between organisms). As rough rules of thumb, AIC differentials of less than 2 suggest that two models will perform similarly, while differentials of greater than 10 suggest that model performance is not close and the model with the larger AIC should be discarded[4].

Table 1. Comparison of Model Performance

	Model for Ions Only		Model for Conductance Only	
	AIC	R^2	AIC	R^2
Fathead Minnow	6266	0.280	8021	0.077
C. dubia	23561	0.198	25098	0.145
D. magna	5850	0.259	6510	0.174

As shown in the table, the AIC values for the conductance-only models are always much larger than those for the models using individual ion concentrations. Similarly, the R^2 values indicate the model using ion composition explain more of the variation in the data than do the models using only conductance. It should be noted that the R^2 values shown in Table 1 are much lower than those reported in the Mount et al. paper. This is likely the result of differences in the procedures for calculating R^2 values[5] and Mount's rather thorough treatment of alternative models, including the use of derived variables, as compared to our assessment of just two model cases. Regardless, R^2 values for Poisson models should be given less weight in favor of AIC values that are well-defined in statistical theory.

Summary

The data presented in the Mount et al. paper provide information underscoring the importance of ion composition, not merely the overall ion concentration, to the bioassay response of test organisms. By coupling the data from the Mount et al. study with estimated conductance values for the test solutions, the potential utility of conductance as a surrogate for toxic response can be seen more directly. The three assessments provided here show that conductance values of test solutions used in these controlled laboratory experiments, particularly those in the range of 0 to 3000 µS/cm, did not appear to predictably correspond with bioassay results. Calculated LC_{50} concentrations were highly variable, clearly dependent

[4] Burnham, K.P. and Anderson, D.R. (1998). Model Selection and Multimodel Inference: A Practical Information – Theoretic Approach, second ed. Springer. p. 70.

[5] R^2 values in Table 1 were calculated using a method described by Shtatland, Kleinman and Cain in *One more time about R^2 measures of fit in logistic regression*. www.lrz-muenchen.de/~wlm/ST004.pdf. Procedures used by Mount et al. were not provided in the paper.

upon ion composition, and trended in a manner opposite to that which would be expected if conductance were a viable surrogate for toxic response. Finally, the development of statistical models showed that one based on conductance performed much more poorly than one based on ion composition of the test solution. Taken together, the analyses provided here tend to support the conclusion in Mount et al. that conductivity is not a robust predictor of toxicity for a range of water qualities.

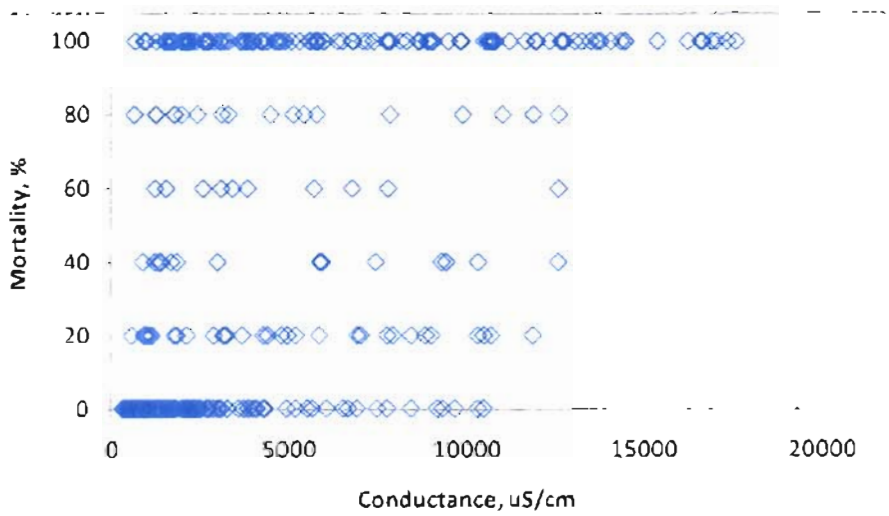

Figure 1. Conductance v. Fathead Minnow 96-hour Mortality

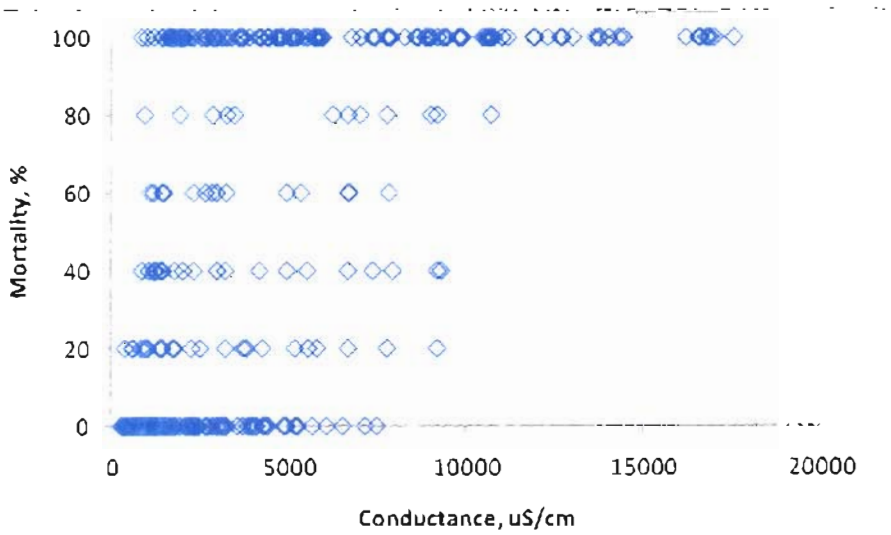

Figure 2. Conductance v. *D. magna* 48-hour Mortality

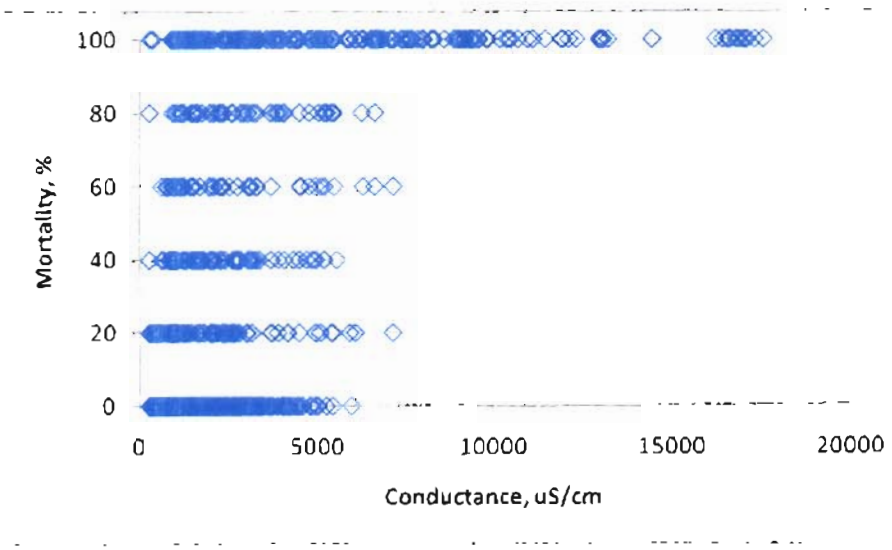

Figure 3. Conductance v. *C. dubia* 48-hour Mortality

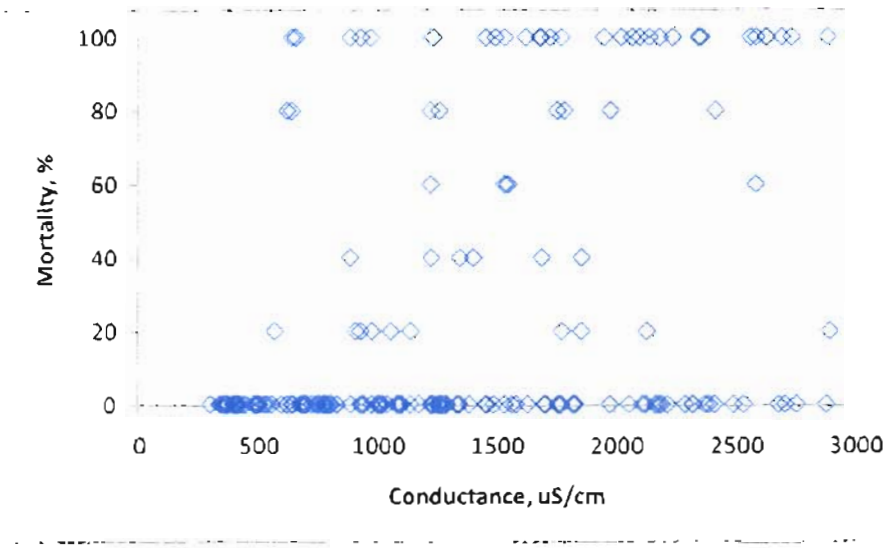

Figure 4. Conductance v. *Fathead Minnow* 96-hour Mortality
(conductance scale 0-3000 µS/cm)

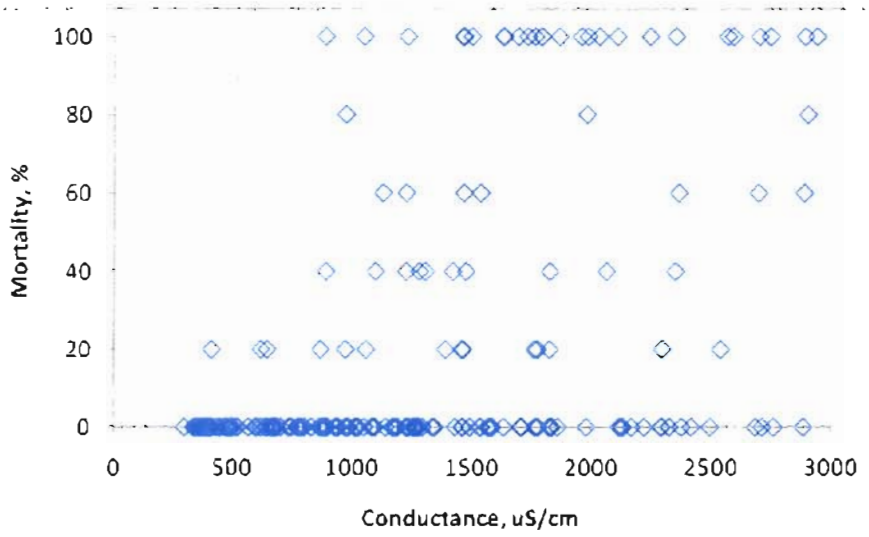

Figure 5. Conductance v. *D. magna* 48-hour Percent Mortality (conductance scale 0-3000 µS/cm)

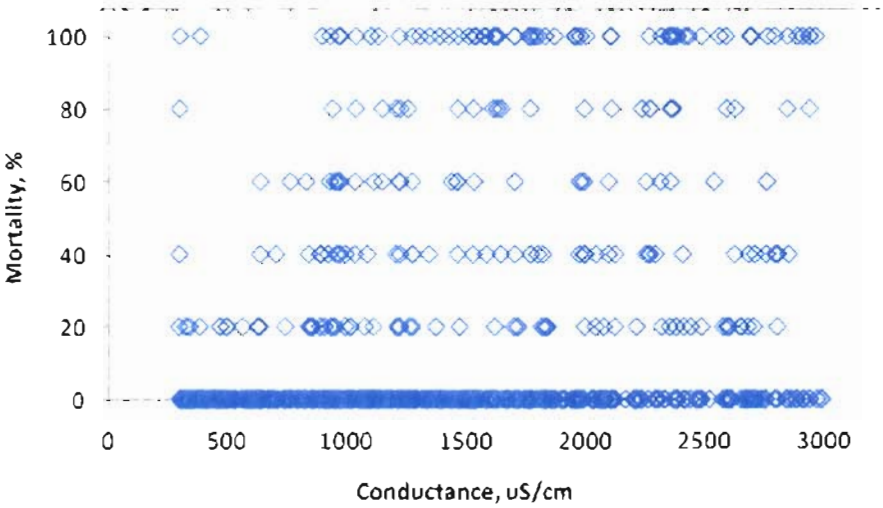

Figure 6. Conductance v. *C.dubia*48-hour Mortality (conductance scale 0-3000 µS/cm)

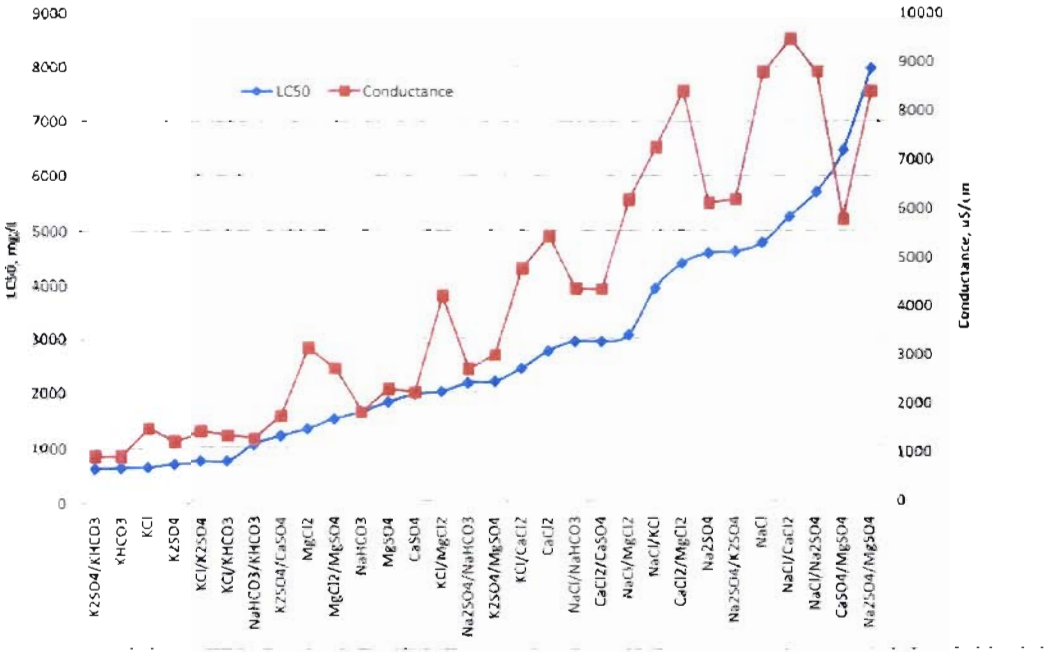

Figure 7. *Daphnia magna* LC_{50} Concentrations for Ion Pairs (sorted by LC_{50}, lowest to highest)

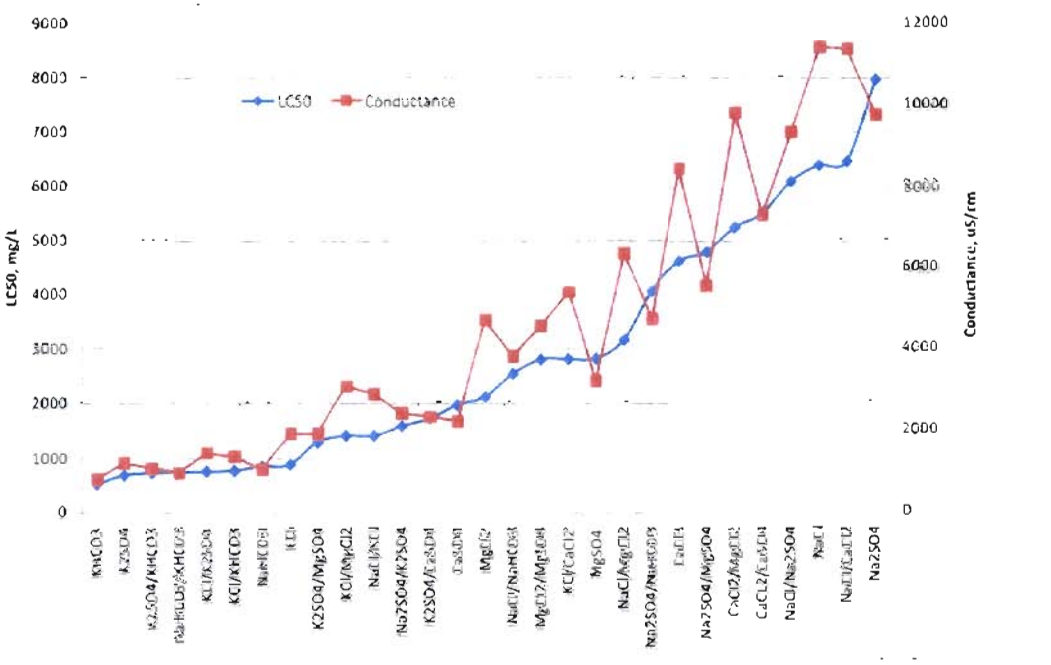

Figure 8. Fathead Minnow LC_{50} Concentrations for Ion Pairs (sorted by LC_{50}, lowest to highest)

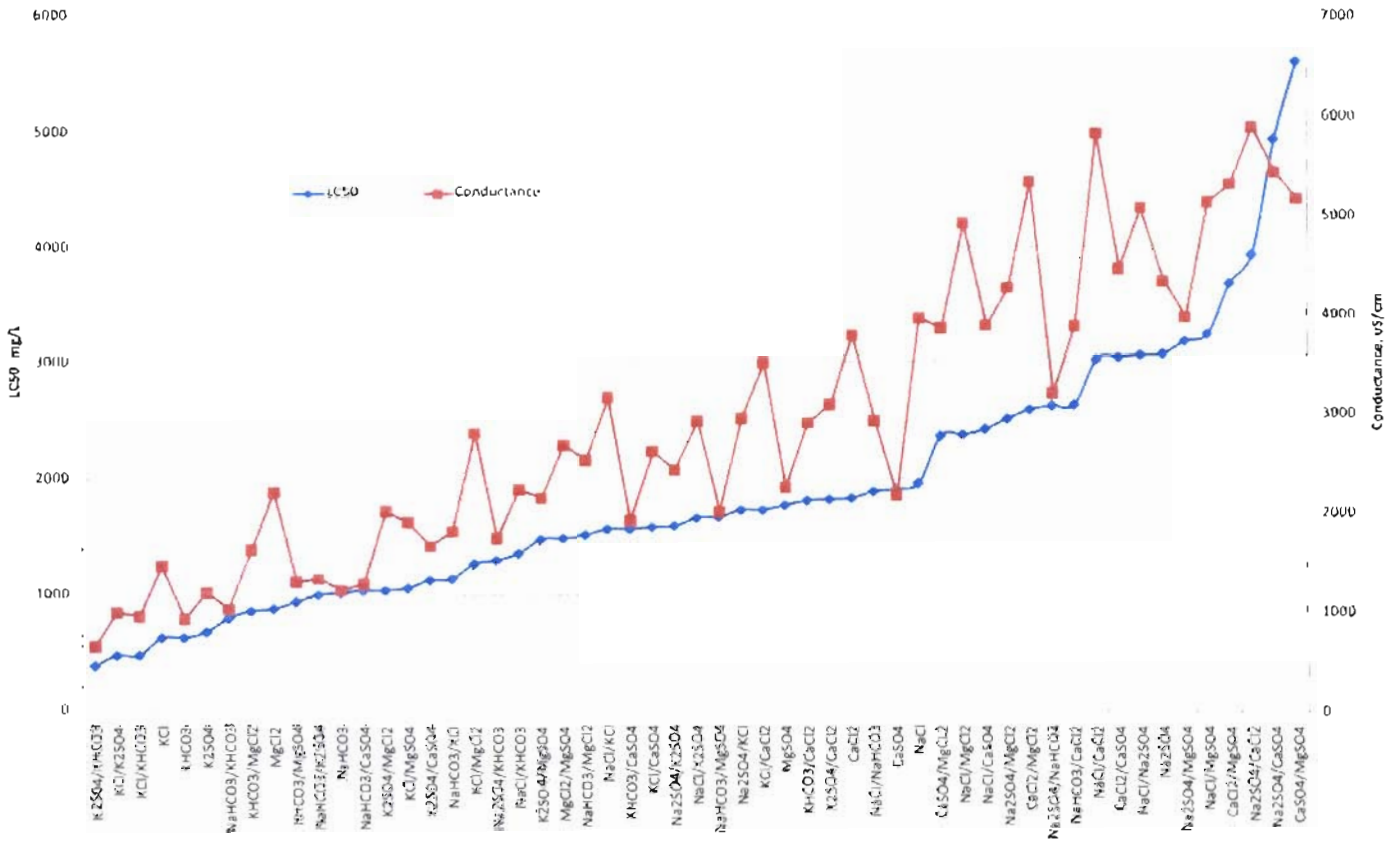

Figure 9. *Ceriodaphnia dubia* LC_{50} Concentrations for Ion Pairs (sorted by LC_{50}, lowest to highest)

APPENDIX B

SUPPLEMENTAL MATERIALS RELEVANT TO THE RECOMMENDED DETERMINATION

1. **Memo Re: Review of Relevant Sections of EPA MTM Report,** Prepared by GEI Consultants for Karen Bennett, NMA (July 7, 2010).

   - Preliminary report on EPA's definition and focus on headwaters. Suggests that EPA's definition of headwaters is internally inconsistent and fundamentally flawed, that most valley fills will actually occur above EPA's definition of headwaters, that EPA does not show how headwaters are uniquely important, and that EPA fails to demonstrate a causal relationship between loss of headwaters and water quality.

2. **A White Paper: Comments on "A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams,"** prepared by Norwest Corporation for NMA (July 12, 2010).

   - Discusses errors in EPA's methodology for deriving the conductivity benchmark, and concludes that EPA has failed to demonstrate that there is a causal relationship between conductivity and abundance of specified genera.

3. **NMA Comments Re: "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields" and "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (Sept. 3, 2010).

   - Criticizes the use of conductivity as benchmark, the application of this benchmark to NPDES permits, EPA methodology generally, and EPA's attempt to enforce the conductivity criteria under the CWA.

4. **NMA Comments Re: "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields"** (Sept. 3, 2010).

   - Separate comment criticizing EPA's estimate of headwater stream loss, arguing that EPA lacks legal authority to implement its conclusions and is attempting to rewrite the PEIS, and finding specific fault with sections on selenium and mitigation.

5. **UWAG Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (Sept. 3, 2010).

   - Criticizes both the legal authority of EPA to use the conductivity benchmark and the scientific bases for the conclusion that conductivity is causally related to impairment

6. **Technical Memorandum Re: Proposed Conductivity Benchmark**, Prepared by Aaron Redman, HydroQual for William Adams, Rio Tinto (Aug. 30, 2010).

   - Concludes that the technical basis for the benchmark is weak and faulty in places, and that it must be expanded to include waters that are naturally high in conductivity.

7. **Federal Water Quality Coalition Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (Sept. 3, 2010).

   - Criticizes both the legal authority of EPA to use the conductivity benchmark and the scientific bases for the conclusion that conductivity is causally related to impairment.

8. **NCASI Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams"** (July 9, 2010).

   - Questions several methods and conclusions used by EPA to reach its proposed benchmark.

9. Research Environmental & Industrial Consultants, Inc. **Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams," Prepared for WV Coal Assoc.** (Apr. 7, 2010).

   - Questions several methods and conclusions used by EPA to reach its proposed benchmark.

10. **WVDEP Comments Re: "A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams" and "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields"** (July 13, 2010).

    - Takes issue with EPA's characterization of what the benchmark is and how it should be used, why EPA focused on particular genera and regions, and suggests some technical errors.

11. **The Appalachian Wildlife Foundation, Inc. Comments Re: "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields"** (June 9, 2010).

    - Criticizes EPA's characterization of reclamation practices, as well as EPA's conclusions regarding the benefits of reclaimed land to wildlife.

12. **Joint Coal Industry Comments on the Mountaintop Mining/Valley Fill Draft Environmental Impact Statement (PEIS) (Jan. 6, 2004)** (submitted Sept. 8, 2010).

    - Comments submitted in 2004 in response to the MTM DEIS - discusses a number of parallel issues (submitted by NMA in response to the Benchmark report).

13. **Status of the Industry Understanding of the Effects of Mountaintop Mining and Valley Fills on Aquatic Resources**, Prepared by Potesta & Associates, Inc. (May 2006) (submitted Sept. 8, 2010).

    - Report prepared for Jackson Kelly in 2006, in response to criticism from OVEC (submitted by NMA in response to the Benchmark report).

14. **Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards**, WVDEP (Aug. 12, 2010).

ENVIRONMENTAL PROTECTION AGENCY

Comments in Response and in Opposition to the Recommended Determination of the U.S. Environmental Protection Agency Region III Pursuant to Section 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia

APPENDIX B:
Supplemental Materials Relevant to the Recommended Determination

Volume 2 of 2

Mingo Logan Coal Company, Inc.

November 29, 2010

REIC

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April 7, 2010

WV Coal Association
P.O. Box 3923
Charleston, WV 25339
Attn: Mr. Jason Bostic

RE: Comments to the EPA's "A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams".

Mr. Bostic:

Below are my initial comments after reading the EPA's paper on a benchmark for conductivity for Appalachian streams.

Article is noted as being a "Draft", and one should not cite it or quote from it.

Executive Summary. Rather "reaching" to state that the benchmark for conductivity of 300 µs/cm derived from West Virginia is expected to be applicable to same regions in OH, PA, TN, and MD, but the very "data from those states have not been analyzed" (Page xiii).

Additionally, EPA states in the ES that the data were derived from "all-year data". This statement seems to go against a recent statement from EPA Region 3 that recently critiqued our sampling dates as being "on the very first (April 15) and very last day (Oct 15) of the appropriate index period for WVSCI". For this reason, should not the EPA have only utilized samples from well within this 6-month window, and not included ones collected outside of this sampling period?

1.2. APPROACH. To generate the species sensitivity distributions (SSDs), the EPA used laboratory toxicity tests to estimate the levels of conductivity which would be toxic to each Genera of aquatic insect. On Page 2, Line 28, the EPA states that they based the SSDs on "laboratory toxicity tests", but on Page 3; Line 1, the EPA states that "for the conductivity benchmark, the SSDs are derived from field data". Which was it? Also, was the hardness of the test solution adjusted to mimic the very hard waters typically found below mining operations? The elevated hardnesses would "mask" some toxicity effect of most chemical constituents in-the-field, thus the typical levels of conductivity (or other contaminants) toxicity would be higher in-the-field compared to laboratory derived toxicity.

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2.2 DATA SOURCES. Chemical, physical, and/or biological samples were collected from 3,286 distinct locations during the sampling years 1999-2007.

2.2. DATA SET CHARACTERISTICS. Biological sampling usually occurred once per sampling period (March through October) with the WVDEP (1996-2007) sampling protocol. Repeat samples from the same location were minimal, and were not excluded from the data set. REI Consultants was recently criticized by EPA Region 3 for NOT excluding repeat samples, a sampling practice referred to as "pseudoreplication".

Several data points were excluded from the SSD calculations for various reasons; some for proper reasons, but others for reasons which this reviewer feels that they should not have been excluded. These include those data sets excluded 1) due to high levels of chlorides (Page 6; Line 27), and 2) for organisms where the Genus was NOT located at WVDEP Tier 1 reference sites (Page 6; Line 33). This is an obvious fault of the SSD calculations, and represented close to 10% of the overall genera. Other examples of data excluded which were deemed to be inappropriate to this reviewer were that genera were excluded when they appeared at less than 30 of the sampling locations. These could have been organisms which appeared in close to 40% (30 of the 75 reference sites) of the sites sampled, but were nevertheless excluded. Lastly, sites were excluded if they had a pH level < 6. This is very misleading as many undisturbed headwater streams contain low pH levels depending upon streamflow, season, and riparian cover species. These sites should definitely NOT have been excluded as the organisms inhabiting these reaches would be adapted to the lower pH levels, and likely higher conductivity levels, in naturally-acidic, undisturbed waters.

3. METHODS. The EPA's own definition of extirpation is defined "as the depletion of a <u>population</u> to the point that it is no longer a viable resource or is unlikely to fulfill its <u>function</u> in the ecosystem (U.S. EPA, 2003)" (Page 8; Line 11). The key words are obvious to this reviewer as "population" and "function". The "population" of organisms must be affected to the point to where the resource is unable to fulfill a particular "function", such as convert leaf or detrital material into finer particulate organic matter (FPOM). The EPA has fully mis-construed the definition within this paper to target individual genera, and NOT the full population as referred to in their own definition of extirpation. Loss of individual genera do NOT necessarily alter the overall function of the stream as those genera remaining may be able to fulfill the targeted function. In essence, to re-iterate, loss of a few ultra-sensitive genera of aquatic insects will NOT alter the overall health, stability, or function of a stream. Those taxa adapted to thrive in somewhat less than optimal water quality, will continue to provide the same functions as those taxa not present due to their inability to survive in less than pristine water quality.

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Extirpation levels of conductivity were derived even when some genera occurred at high conductivity levels (Page 9; Lines 15-23). This is manipulation of the data to provide an extirpation level of conductivity to an organism that obviously can tolerate higher conductivity levels. Period.

3.2. TREATMENT OF POTENTIAL CONFOUNDERS. As this reviewer described above, exclusion of sites with low pH should not have occurred as in many of these instances, the low pH may be due to a natural series of events, and the organisms inhabiting these streams are adapted to them (Page 10; Line 5).

The EPA removed sites which scored < 135 (out of 200) on the EPA Rapid Bioassessment Protocol habitat score. They state that this removed "marginal" habitat conditions as a cause (Page 10; Line 17). However, the "Marginal" category ranges from a score of 60 to 109. The next higher-quality category is "Sub-Optimal" which ranges from a score of 110 to 159. Removal of sites which scored less than 135 would have removed not only all "Marginal" scoring sites, but all those sites scoring mid-way into the "Sub-Optimal" category. While this reviewer understands the reasoning of removing "Poor" to "Marginal" habitat sites from the calculation of the XC95 values due to confounding effects, only sites scoring < 109 should have been eliminated, not < 135.

Removing sites with fecal coliform >400 colonies/100mL (Page 10; Line 20) appears to have removed well over half of the data set since the median value for fecal coliform was 175 colonies/100mL and the 75th percentile was 600 colonies/100mL (Page 25; Table 1). This data should have been included.

3.5. ESTIMATING BACKGROUND. Background conductivity was different for the spring season compared to the summer season. There was also almost a two-fold increase in background conductivity between Ecoregion 69 compared to Ecoregion 70 (Page 12; Lines 4-13). For this reason, the data between Ecoregions should have been separated by region, AND by season, and different extirpation levels should have been established between the regions and seasons. This is a very serious error, as there are undoubtably major differences between the ecoregions, which were not addressed.

5.1. SELECTION OF INVERTEBRATE GENERA. As this reviewer has stated previously, inclusion of genera which are found at sites with only minimal disturbance as defined by reference sites causes the calculated overall value used for the extirpation level of conductivity to be severely low. We feel that this was a gross error in the calculation of the extirpation level, and should be corrected by adding in ALL genera collected at ALL 1,271 probability-based samples collected from Ecoregions 69 and 70.

In response to the EPA's observation that the summertime HC_{05} was higher than the springtime HC_{05}, the EPA's deduction that certain genera "clearly do not tolerate those conductivities in the spring" is misguided (Page 15; Line 36). The reason that the HC_{05} was higher in the summertime was due to those sensitive genera were not collected as they had already emerged during springtime (sensitive mayflies), and would not be expected to be present. It was not a result of them not being able to tolerate the higher conductivities; only that they are normally not present during the summertime.

5.3. INCLUSION OF REFERENCE SITES. EPA states that "if high quality (i.e. reference) sites are not included in the data set, effects on sensitive species will not be incorporated into the benchmark" (Page 16; Line 20). This reviewer completely agrees with this statement. However, the opposite is also true in that if lower quality sites are not included in the data set, effects on the more facultative and tolerant genera will not be incorporated into the benchmark. Thus, the EPA has left out a very large proportion of the overall benthic community which inhabits the streams surveyed for this paper. If it is a goal to protect the aquatic community, and not merely the ultra-sensitive genera, then all genera should be included within the data set. Including only the sensitive organisms, collected at only the best reference sites, and then stating that the goal was to protect 95% of the genera found in the streams in Ecoregions 69 & 70 is completely biased. Include all genera collected, from all sampling locations, and then set the overall extirpation level to protect 95% of all genera. EPA used only the "best 75% of the reference values" (Page 17; Line 10) and "the 35 most sensitive genera" (Page 30; Figure 7) which again, is completely biased, unscientific, and manipulative, at-best.

A.2.4.1. Specificity of Genera. The EPA makes a comment that the findings of Pond *et al.* (2008) were consistent with analyses of data from Kentucky (Page 49; Line 7). The data from Pond *et al.* (2008) was part of the same data utilized by EPA from Kentucky.

A.2.5.1. Laboratory Tests of Defined Ion Mixtures. The EPA contends that conductivity levels of toxicity tests of daphnia and fathead minnow using potassium sulfate and potassium carbonate were considerably lower (438 and 1,082 µs/cm) than levels of conductivity measured "below some valley fills which were greater than 4,000 µs/cm" (Page 40; Lines 32 - Page 41; Line 3). The EPA misses the point in that the bulk of the conductivity of mine waters is primarily comprised of calcium and magnesium, and very little potassium, and that these constituents are much less toxic than potassium.

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B.4.2. Organic Enrichment. EPA states that "the data show no indication of significant confounding associated with fecal coliform counts and effects attributed primarily to organic enrichment (see Tables B-9 and B-10)" (Page 72; Line 10). Then, why did the EPA eliminate all data which had fecal coliform counts > 400 colonies/100mL? As stated by this reviewer previously, this data should have been included within the dataset utilized for the calculation of the extirpation levels.

B.5. Summary of Actions Taken to Address Potential Confounding. EPA states that "low pH is a potential confounder, but sites with pH < 6 were removed from the data set when calculating the benchmark value" (Page 75). They go on to state that the influence of selenium could not be evaluated due to poor data and should be investigated. It appears odd to this reviewer that out of the numerous chemical constituents found in large concentrations in mine waters such as aluminum, iron, manganese, etc., that selenium be continually mentioned within this paper. Especially when "toxic levels of selenium appear to be relatively uncommon" (Page 75; Line 29). If selenium is further investigated, and found to be a potential confounder, will these data be eliminated from the calculation of the XC values?

Figures D-1. Surely more individuals were collected than what are illustrated in these graphs? Of 1,271 samples, only 19 Drunella, 19 Isoperla, 15 MacCaffertium, 19 Leptophlebia, 19 Epeorus, and 21 Ephemerella were observed? If the dots represent the presence of at least one individual at that particular conductivity level, then the graphs still appear to be lacking data as surely there were more than 15 – 21 separate conductivity levels at which the above genera were present. These graphs should include all individuals, or at least a point on the chart at which some individuals of the selected genera were collected per conductivity. Again, the graphs appear to be lacking most of the data collected.

Sincerely,

Ed J. Kirk

Ed J. Kirk
Director - Biological Division
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RE: Comments to the EPA's "A Field-based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams" (Continued).

Article is noted as being a "Draft", and one should not cite it or quote from it.

Executive Summary. The benchmark for conductivity, 300 µS, concluded by this report to extirpate 5% of the species found in mined areas of Appalachia is misleading. Genera of insects have been left out that are common, some even native, to the area in question. Nearly all of these taxa left out are known to be tolerant. Manipulation of the data to include only the most sensitive taxa present in the region invalidate the results achieved by this experiment.

2.2. DATA SOURCES. On page 6 lines 3 through 6, EPA states "All contracted analyses for chemistry and macroinvertebrate identification follow WV's internal quality control and quality assurance protocols. This is a well-documented, regulatory database. We judged the quality assurance to be excellent based on the database itself, supporting documentation, and experience of EPA Region 3 personnel." This statement is bold considering that WV-DEP contracts Third Rock Consultants, LLC out of Lexington, KY for all macroinvertebrate identifications. If this data is going to be used for purposes of legislature, WV-DEP should be required to submit a minimum of 10% of their data to other consultants, preferably those located in the state of West Virginia, for QA/QC purposes. Certain genera (especially those in the Family Chironomidae) could very easily be misidentified on a regular basis by the same taxonomists from the same consultant, even if in-house QA/QC protocols are followed and effective. These possible misidentifications suggest problems with the data presented in this report.

2.3. DATA SET CHARACTERISTICS. It seems interesting that the 18 taxa listed in Table 3 on page 26 are almost all facultative/tolerant genera. Only the single genus Nanocladius of the Family Chironomidae was considered to be on the higher end of the sensitive range with a rating of 3 reported for the region (with 10 being the most tolerant and 0 being the most sensitive). In fact, the mean tolerance (taken from Appendix B of the "RBP for Use in Streams and Wadeable Rivers", Genus Tokunagaia not listed and not included in the mean) for the reported 17 taxa was a 5.86 and would be considered tolerant. Numerous other genera have also been eliminated from this study, but a list of these genera is not reported. EPA states that 213 genera occurred at the 75 reference sites, yet settle for using 128 and 129 genera for the studies performed in Ecoregions 69 and 70, respectively. It seems that if all genera were included, not just the most sensitive taxa and/or what EPA considers to be indicative of an unimpaired "reference" worthy taxa, the benchmark level for conductivity that is determined by this study would certainly increase.

3.0. METHODS. The definition of extirpation used in this report states "as the depletion of a population to the point that it is no longer a viable resource or is unlikely to fulfill its function in the ecosystem". This definition stresses the importance of the function which the population performs. So which is more important, presence/absence of all (greater than 95%) native taxa of insects or the function of the stream? This report submitted by the EPA attacks the fact that valley fill mining operations cause the loss of sensitive taxa of aquatic insects, and does not assess whether or not the function of the stream has been altered. Does the loss of the most sensitive taxa of insects due to elevated conductivity actually change the function of the stream? It seems more information is needed to make this determination. A relevant example: Mayflies serve mainly as gatherer/collectors and as a source of food for both vertebrate and invertebrate predators. When a certain species of mayfly is eliminated from a stream reach due to elevated conductivity, or whatever reason, does the stream's function change? Yes the mayflies may have been eliminated and the stream seems different just in that sense, but has it really been impaired and/or its function altered or eliminated all together? Won't other less sensitive taxa of insects (e.g., Oligochaetes & Chironomidae that serve mainly as gatherer/collectors and a viable food source for the same predators as the mayflies) take the place and function of the missing mayfly? Isn't this how evolution works and how adaptation occurs? Alterations in the environment, whether man-made or natural, force species to adapt. Some compete and some do not. Human activity is certainly a catalyst, but species extirpation is a naturally occurring process. The reviewer found it unclear why Oligochaetes were not included in this study. Many Oligochaete species are specifically aquatic and known to be semi to extremely tolerant. It appears that their exclusion, like the other tolerant genera, was left out on purpose to keep the conductivity benchmark low?

5.1. SELECTION OF INVERTEBRATE GENERA. On page 15, lines 17 through 18, EPA states "In this particular case, using all genera including invasive species would increase HC_{05} by only 2% in the full year data set." Where is the proof behind this statement? The reviewer is skeptical to believe this low of a number. EPA continues with "We restricted genera used in analysis to those recorded at a minimum of 30 sampling sites to reduce the chance that an apparent extirpation is due to sampling variance and to increase the likelihood that the models and exploratory analyses for potential confounding are reasonably strong." Was this 30 sampling sites taken from the whole of 3,286 locations, meaning less than 1% of the sites contained these genera? Or, is it 30 sampling sites from the 75 reference sites, meaning less than 40% of the sites contained these genera? There's a big difference here, but no clarification was found in the report, by the reviewer. Also, couldn't extirpation occur as a result of sampling variance for a genus that isn't one of the least common in occurrence? It seems less likely, but is still possible. The opinion of the reviewer is that sampling variance should merely be accounted

for and reported, instead of data being removed from the calculations to try and prevent confounding due to sampling variance.

5.5. BACKGROUND. On page 17, line 4 the EPA uses a reading of 234 µS as a background conductivity level for Ecoregion 70. The benchmark of 300 µS set by this report as a limit for "impairment" is only 28% greater than this background level. One would think that a few shovels of dirt could potentially elevate a nearby stream that already has a conductivity of 234 µS to 300 µS.

A.2.5.2. Laboratory Tests of Mine Discharges. The references mentioned in this section are shaky at best with regards to scientific merit when authors assume results. The selenium level of 8.5 µg/L could easily have been the culprit that killed *Isonychia bicolor*. Salinity, however, was "likely" the cause? Possible, but so is the likelihood that the toxicity was indeed due to high selenium levels.

A.2.7. Evaluation of the Body of Evidence. Statements made in this section such as, "The loss of genera...is rare when conductivity is low (+++)." are completely unfounded and more often than not, untrue. The extirpation, invasion, and redistribution of species of insects both aquatic and terrestrial are controlled by many, many different variables, some are naturally occurring and some are a result of human influence. Different species of insects are constantly battling for resources and niches available for them to inhabit and in-turn reproduce to further their species. Natural Selection determines which species compete and continue to reproduce and which do not, not human manipulation. Broad statements made in this section implicate human activity as the sole reason for increased conductivity levels in these Appalachian headwater streams, and determine that this increase in conductivity is the sole cause that affects the loss of aquatic genera. The variables that affect the genera present in these headwater streams are far greater than what is assessed, or even taken into consideration, in this study published by the EPA. More data and more calculations will be required to understand the "true" affects of mining operations on Appalachian headwater streams. However, the reviewer agrees that the negative effects of high conductivity on certain sensitive taxa of aquatic macroinvertebrates are apparent. The reviewer also agrees that mining operations often elevate conductivity in nearby streams, especially those downstream from valley fills. The proof for these statements is readily available, but further assumptions are needed to link mining operations to the extirpation of aquatic genera present in Appalachian headwater streams. This report submitted by the EPA does not provide the necessary proof to back up such an assumption.

Appendix C. Page 95, line 30 lists Chironomus as present at a single reference site, yet page 26, table 3 states that Chironomus was "excluded from the 95th percentile extirpation concentration calculation because they never occurred at reference sites." Which data table is the reviewer to

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believe? It again seems interesting that a mistake was made by not included a genera that has an HC_{95} of >11,646 µS (the highest levels tested), even when the genera was in fact present at a reference site. Just including the 17 taxa that remain, the average XC_{95} was approximately 4,750 µS for these unincorporated genera. EPA states on page 67, lines 23 through 24 "Nor is the goal to equate the levels of confounders to an ideal or pristine level", but that seems to be exactly what has taken place in this study.

E.3. DATASET CHARACTERISTICS. On page 159 through 160, lines 35 through 1 EPA states "KDOW collects 4-0.5 m^2 kick samples in riffle/run habitat and composites them to yield a 1 m^2 sample." Is this merely a typo, or does 4 times 0.5 really add up to 1? The reviewer finds these types of mistakes unacceptable for a document that could potentially be used for purposes of legislature.

E.4. CONCLUSIONS. EPA continues with "Based on the similar results, we judged the method to be robust. The same aquatic life benchmark appears to be applicable to West Virginia and Kentucky streams in Ecoregions 68, 69, and 70."

Table E-3. Comparisons of the sensitive genera and XC_{95} values. EPA claims that West Virginia and Kentucky have comparable benchmarks for aquatic life, yet most genera XC_{95} values for the state of Kentucky are vastly different for the exact same genus in the state of West Virginia. For example, Wormaldia (the third most sensitive Kentucky genus) has an XC_{95} of 161 µS in the state of Kentucky, but an XC_{95} of 1,533 µS in the state of West Virginia. Oulimnius (the eighth most sensitive Kentucky genus) has an XC_{95} of 378 µS in Kentucky and 2,791 µS in West Virginia. The average percent difference in XC_{95} score from Kentucky to West Virginia, just for the top 10 most sensitive genera, would be approximately 177.6% difference. To the reviewer this seems to be indicative of regions that have different benchmark levels for aquatic life.

Sincerely,

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Joe Manchin III, Governor
Randy C. Huffman, Cabinet Secretary
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July 13, 2010

Office of Environmental Information (OEI) Docket
(Mail Code: 2822T)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW.
Washington, DC 20460

Dear Sir/Madam:

The West Virginia Department of Environmental Protection (DEP) appreciates this opportunity to comment on the U.S. Environmental Protection Agency's (EPA) recent draft reports, "**A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams**" (hereinafter the "Benchmark Document") and "**The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields**" (hereinafter the "Effects Document").

As the agency in West Virginia with permitting program delegation under both the federal Surface Mining Control and Reclamation Act and the federal Clean Water Act, DEP has a keen interest in the information contained in both documents. Further, much of the information used in the aforementioned documents is based on data generated by DEP, thus allowing us to provide a unique perspective on the data, its interpretation, and ultimately its use in a regulatory framework.

DEP staff was briefed on both documents June 1, 2010 in Wheeling, West Virginia. We thank EPA staff for their participation and EPA management for making their time available. Regardless of methodology used to determine a conductivity value, whether use of the Species Sensitivity Distribution or evaluating correlations of biological metrics with water quality, the answer is similar: In order to protect the native benthic macroinvertebrate assemblage that has evolved in the naturally low ionic strength waters of the Appalachian Mountains, the amount of dissolved ions must be kept reasonably low. How or what percentage of native taxa should be protected may be a matter of public debate, but the science does indicate increases in select dissolved ions result in the loss of native species.

Again, West Virginia is pleased to provide comments on the draft reports and stands ready to answer any questions you may have about our comments. Should you have questions, please contact Patrick Campbell of my staff 304-926-0499 x1046, or email patrick.v.campbell@wv.gov and he can direct your inquiry to the appropriate person.

Sincerely,

Randy C. Huffman
Cabinet Secretary

RCH/pcc

BENCHMARK DOCUMENT COMMENT

Relative to the Benchmark Document, DEP's comment is provided in two parts, the first relating primarily to the water quality standard processes, and the second being more technical in nature.

Our first and most significant comment is related to the manner in which the 300 µS/cm conductivity value was offered for use. Early in the process the value was referred to by EPA staff as a standard, later the terminology changed to a benchmark. EPA may have indeed recognized that a true water quality standard must be scientifically valid, adopted by a state and then approved for use by EPA before being used in the Clean Water Act regulatory process. EPA cannot expect a state to apply this benchmark absent completion of the entire standard setting processes. In absence of an approved numeric water quality standard, federal regulations at 40 C.F.R.§ 122.44 offer other options for protecting narrative water quality standards.

Along those lines a water quality standard consists of a criterion, an exposure duration, and an exceedance frequency. As an example, EPA's recommended national chronic criterion for zinc is 120 µg/l (@ hardness = 100 mg/l), the exposure duration is a four day average, and the exceedance frequency is not to be exceeded more than once every three years. The Benchmark Document did state the recommendation was as a chronic criterion, but did not provide recommendations on exposure duration or frequency of exceedance. Before urging states to adopt this recommended threshold as bonafide water quality criteria we urge EPA to address these shortfalls. Citing EPA's own reference material (Stephan et al., 1985) "A statement of a criterion as a number that is not to be exceeded any time or place is not acceptable because few, if any, people who use criteria would take it literally and few, if any, toxicologists would defend literal interpretation."

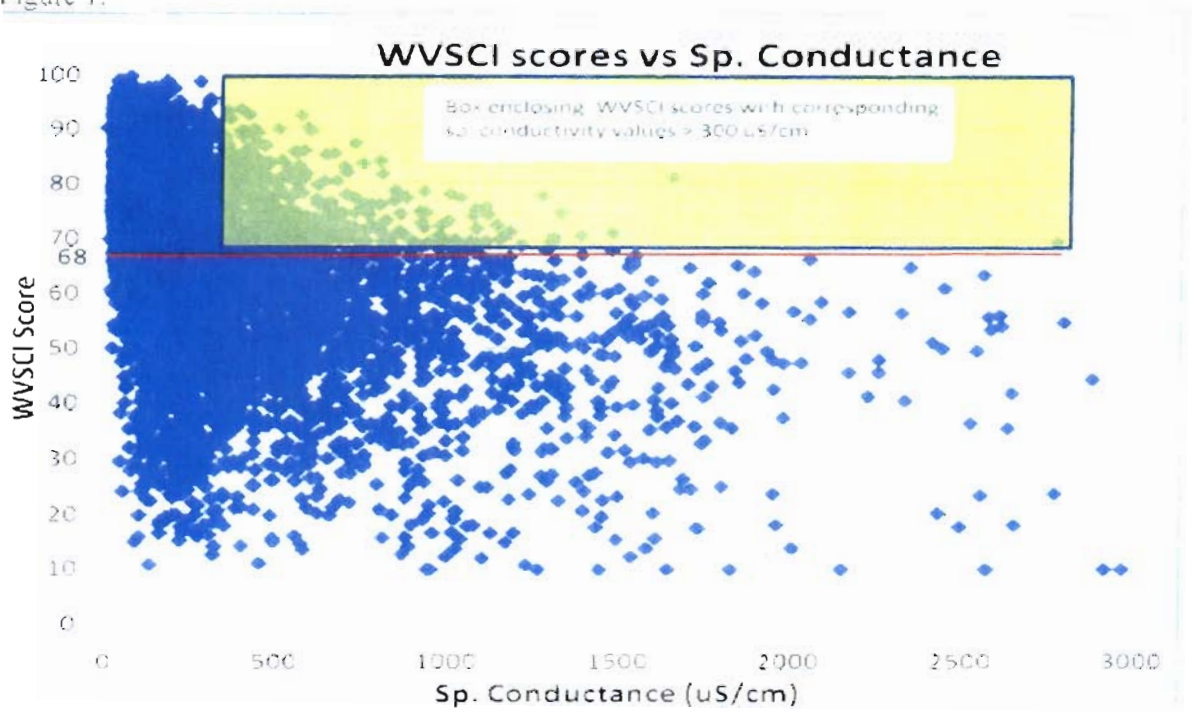
EPA does acknowledge that use of field data to derive a criterion is a new approach. With respect to benthic macroinvertebrate data, most (if not all) states use some type of benthic macroinvertebrate index score to judge impairment. As such we believe it may be more appropriate for a state to develop ways to protect its index impairment thresholds as opposed to targeting a specific conductivity value range as suggested in the Benchmark Document. Should we blindly implement the recommended benchmark value, twelve of our reference sites have had conductivity measurements greater than 300 and thus may be classified as impaired due to exceedance of the conductivity threshold (See Table 1). Based on this information, the suggested benchmark is perhaps exceedingly protective.

Table 1:

Stream Name	Stream Code / milepoint	Ref. Type	Date	Sp. Conductance	WVSCI
Sims Run	WVO-75 @ mp 0.5	Level II	7/12/2000	379	68.34
Coon Run	WVO-76 @ mp 0.7	Level I	7/12/2000	379	81.88
Sugar Run	WVO-77-E-0.5 @ mp 0	Level II	7/11/2000	306	73.7
Middle Bowman Run	WVO-77-G @ mp 0.2	Level II	6/28/2000	424	72.65
Upper Bowman Run	WVO-77-I @ mp 1.2	Level II	7/10/2000	383	72.64
North Fork/Kings Creek	WVO-98-A @ mp 0	Level II	8/27/2001	405	74.12
Lower Bowman Run	WVO-77-F @ mp 1.7	Level I	5/30/2002	502	79.73
Birch River	WVKE-76 @ mp 10.6	Level II	10/1/2002	306	79.42
Whiteoak Run	WVO-102-A @ mp 0	Level II	7/7/2000	302	83.34
Whiteoak Run	WVO-102-A @ mp 0	Level II	12/13/2000	331	93.18
Middle Bowman Run	WVO-77-G @ mp 0.2	Level II	7/19/2006	508	79.61
Upper Bowman Run	WVO-77-I @ mp 0.6	Level II	7/19/2006	529	80.35
Little Grave Creek	WVO-84 @ mp 6.6	Level II	5/26/2004	347	81.63

Further we find that many sites can have conductivities greater than 300 µS/cm while still having West Virginia Stream Condition Index Scores in the non-impaired (>68) category. See Figure 1.

Figure 1.



Our information contains 1,985 benthic macroinvertebrate samples collected at sites with conductivity values above 300 µS/cm. Approximately one in four of these samples (507 of 1,985 or 25.5%) have WVSCI scores greater than 68.

Another significant concern with the Benchmark Document is its inherent focus on Ecoregions 68, 69 and 70. We understand fully that the information used to develop the document was generated in the subject Ecoregions and thus its potential applicability is obvious. Yet we cannot understand why EPA would not believe the findings are applicable outside these Ecoregions in waters with similar chemistry. The simple point being these sensitive genera should likewise be sensitive to bicarbonate and sulfate dominated waters in all other parts of the country. To illustrate this potential we reviewed EPA's information collected as part of the recent probabilistic National Streams Assessment and described in the National Stream Report available to the public. The three tables used were labeled *wsa_benint_genus_ts_final_part1.csv*... *part2.csv* and *wsa_siteinfo_ts_final.csv* (http://www.epa.gov/owow/streamsurvey/web_data.html). Upon examination of this dataset we found that the 8 most sensitive taxa in West Virginia were found in equal amounts, or more commonly, in 24 other states (pink shading). (See Table 2)

Given the information in Table 2, we submit that EPA should be pursuing a benchmark conductivity value for other states with these sensitive organisms as well. We assume EPA's answer is that the current data is only applicable to these Ecoregions, but then we would ask when and how will EPA proceed to develop similar studies in the other states with these genera? These genera are present and worthy of protection in all states, not just those states having parts of Ecoregions 68, 69, and 70. It is logical to think that this document can be applied elsewhere, and should it go forward, we would encourage EPA to broaden its applicability.

With the exception of ecoregionally based nutrient criteria, which were offered simultaneously for fourteen Ecoregions (encompassing the lower 48 states), we know of no other nationally recommended criteria specific to one particular region or group of regions. Even then, these nutrient documents were to be used as "...as a starting point for states, authorized tribes and others to develop more refined nutrient criteria, as appropriate, using EPA waterbody-specific technical guidance manuals and other scientifically defensible approaches" (EPA, 2002).

We also note that on page 27, while the document clearly shows its potential application to the parts of Virginia that are in Ecoregion 69, Virginia was not mentioned in the pertinent text on pages xiii and 29.

Table 2.

STATE	# of Samples	ALLOPERLA	CINYGMULA	DRUNELLA	LEPIDOSTOMA	LEPTOPHLEBIA	PYCNOPSYCHE	REMENUS	UTAPERLA	# of taxa found per state (of WV's 8 most sensitive)
ALABAMA	22				5		4			2
ARIZONA	68		3	1	6					3
ARKANSAS	32				1		1			2
CALIFORNIA	205		80	116	152					3
COLORADO	93		36	44	17					3
CONNECTICUT	8			1	3		3			3
DELAWARE	6						1			1
GEORGIA	16			1	4		2			3
IDAHO	67		59	70	46					3
IOWA	45					1				1
KENTUCKY	24				2		2			2
LOUISIANA	26				1					1
MAINE	21				17		1			2
MARYLAND	16						1			1
MASSACHUSETTS	5			1	3		1			3
MICHIGAN	26				12	4	6			3
MINNESOTA	30				5		1			2
MISSOURI	25				1		1			2
MONTANA	87		34	36	25		1			4
NEVADA	75		7	8	23					3
NEW HAMPSHIRE	10	1			9		3			3
NEW JERSEY	7				3		1			2
NEW MEXICO	17		5	6	12					3
NEW YORK	33			4	12		2			3
NORTH CAROLINA	19			4	5	1	6			4
NORTH DAKOTA	90						1			1
OHIO	26						2			1
OKLAHOMA	31	1				1				2
OREGON	140		61	86	89					3
PENNSYLVANIA	31			1	5		3			3
RHODE ISLAND	2			1	1		1			3
SOUTH CAROLINA	6				1					1
SOUTH DAKOTA	118				4		2			2
TENNESSEE	24				1	2	7			3
TEXAS	41						1			1
UTAH	101		38	40	33					3
VERMONT	10	1			6	2				3
VIRGINIA	51			1	11	2	7			4
WASHINGTON	115		103	103	67					3
WEST VIRGINIA	**15**			**1**	**5**		**2**			**3**
WISCONSIN	38				12	15	6			3
WYOMING	94		20	33	23		3			4
# of States where collected		3	11	20	35	8	28	0	0	
Sum of sites	1916	3	446	558	622	28	72	0	0	

REFERENCES

Stephan, CE; Mount, DI; Hanson, DJ; et al. (1985) Guidelines for deriving numeric National Water Quality Criteria for the protection of aquatic organisms and their uses. U.S. Environmental Protection Agency, Washington, D.C. PB85-227049. Available online at http://www.epa.gov/waterscience/criteria/library/85guidelines.pdf.

EPA Fact Sheet (2002) Ecoregional Nutrient Criteria http://www.epa.gov/waterscience/criteria/nutrient/ecoregions/files/jan03frnfs.pdf

Benchmark Document – Technical Comments

- As communicated to EPA verbally on June 1, 2010, the organisms identified in the West Virginia dataset as mayflies of the genera Leptophlebia are likely actually Paraleptophlebia. One contract lab appears to have misidentified the genera within the Leptophlebiid family. Excluding this lab, the percentage of all Leptophlebiidae identified to genus level (from comparable collection efforts in ecoregions 69 and 70) identified as Paraleptophlebia was 93% with only 5.3 % identified as Leptophlebia.

Percentages of Leptophlebia identified to 2 genera		
	% Identified as Paraleptophlebia	% Identified as Leptophlebia
Excluding lab in question	93	5.3
Lab in question	0	96.4

If one assumes that the organisms identified by the lab in question were Paraleptophlebia and not Leptophlebia, it would change the exclusion concentration (XC_{95}) closer to the value for Paraleptophlebia (439). This change would result in a small increase in the HC_{05} value.

- There appear to be several errors in the table of Extirpation Concentration Values, Appendix C. For several genera, the number of occurrences for Spring and Summer don't come close to equaling the number for all samples (N listed in table under 'Both'). Psephenus, for example, N_sp is 329, N_su is 39, and the N_both is 853. Other genera for which the numbers do not add up are: Pseudochironomus (N_sp = 524, N_both = 31); Bezzia Palpomyia; and Bezzia.

	Genus	Both			Spring		Summer	
		XC_{95}	N	Ref.	XC_{95}	N	XC_{95}	N
130	Psephenus	>9,790	853	36	1,473	329	2,553	39
131	Pseudochironomus	>11,646	31	2			7,370	524

- Also relating to Appendix C, the differences between extirpation values for all seasons and the spring or summer seasons appear larger than can logically explained for some taxa. For Lepidostoma and Leptophlebia, the XC_{95} value for all seasons is 109 and 224 respectively. For the spring only season, the XC_{95} values jump up to 796 and 805, respectively. These increases cannot be that large considering that over 80 percent of the

'Both season' data are part of the spring season dataset. Obviously the high conductivities encountered by these taxa in the spring should also be included in the 'Both' seasons calculations

	Genus	Both			Spring		Summer	
		XC_{95}	N	Ref.	XC_{95}	N	XC_{95}	N
82	Lepidostoma	109	88	12	796	74		
83	Leptophlebia	224	85	8	805	70		

- The paper states that the conductivity benchmark applies to waters at circum-neutral to mildly alkaline pH. If EPA's intent is to limit the applicability of the benchmark value to certain pH levels, then this value should be provided.

- Relative to Appendix B we would encourage EPA to thoroughly examine the potential confounding effects of upstream ponds on the sensitive genera. We believe that in many of the samples used in this analysis, upstream sediment and or treatment ponds may be present. DEP has noted changes towards a more filter feeding benthic community immediately downstream of ponds impoundments. The potential exists for some of the loss of sensitive taxa in higher conductivity waters to be from the impounding effects on the stream, not necessarily the increase in dissolved ions.

- Another potential confounding factor in need of examination involves lower spring conductivity values being associated with depressed benthic communities, when in fact the benthic community health may have actually been impacted in previous periods of low water when conductivities were presumably much higher. A resultant false spring conductivity-low benthic score relationship may be the unintended consequence

COMMENT ON EFFECTS DOCUMENT

As this Effects Document is a review of peer reviewed literature DEP's comment is limited to those areas findings which are incorrectly interpreted, outdated or otherwise not believed representative of agency experience. Our comment on this document is offered on a page and line basis.

Page 1, Line 27. We are aware of toxicity tests indicating chronic toxicity downstream of MTM-VF sites, but as EPA states on p.35, Section 5.1, only one peer-reviewed study has examined acute toxicity. Since science is validated by repeatability, we would suggest EPA clarify in the Executive Summary that these are the results of only one study.

Page 4, Line 22. We note that approximately 86 % of all acres permitted for surface mining in West Virginia in the last five years have post mining land uses that are compliant with the Forestry Reclamation Approach (FRA) (see, below). The FRA requires the upper reclaimed layer be left uncompacted to facilitate tree growth. The document should be updated to reflect this fact, otherwise the reader is left to believe all mine sites are still reclaimed in this manner.

Page 4, Line 24. Water is not directed towards the fill area. In fact, West Virginia state regulations (as well as comparable federal regulations) require the exact opposite. The West Virginia Surface Mining Reclamation Rule 38 CSR § 2 – 14.14 mandates, "[s]urface water runoff from the fill and from surrounding areas shall be diverted away from the fill and into stabilized channels…"; requires a mine operator to "prevent water infiltration into the fill", and provides "surface water runoff from areas above and adjacent to the fill shall be diverted into properly designed and constructed stabilized diversion channels which have been designed using best current technology to safely pass the peak runoff…."

Page 6, Line 10. This is an incorrect restating of West Virginia's water quality standards. The word, "hydraulic", should be replaced with "hydrologic".

Page 12, Line 8. We do not believe it accurate to state that we lose streams from mountaintops. Streams in hollows have indeed been filled, but not mountaintops.

Page 15, Line 16. The effect of incremental stream losses is something that can be addressed through mitigation as part of the Clean Water Act section 404 permitting process. EPA and the Army Corps of Engineers adopted a comprehensive set of regulations to address mitigation in 2008.

Page 16, Line 18. Due to ambient temperature limitations, brook trout habitat rarely exists in the mountaintop mining zone of West Virginia. Therefore, we believe it inaccurate to characterize headwater streams in the MTM zone as being dominated by brook trout fisheries.

Page 17. The report's title indicates it is a study on effects to the aquatic ecosystem, while this page ventures into the non-aquatic effects on timber harvesting related to the mine sites. Either the scope of the title should be expanded or this information should be removed.

Page 21, Line 16. Again we believe this statement of past practices is misleading. Modern reforestation practices are contributing to outstanding tree growth.

Page 22, Line 6. The discussion of storm water runoff and its effects, including flooding, which begins here does not reflect regulatory reality in West Virginia. Since 2004, West Virginia state regulations have required each surface mining operation to conduct a storm water runoff assessment (SWROA) before a permit is issued. 38 CSR § 2 - 5.6. No permit will be issued unless, according to analysis and modeling, "[t]e worst case during mining and post-mining evaluations must show no net increase in peak runoff compared to the pre-mining evaluation." 38 CSR § 2 – 5.6.a.3. In addition, runoff monitoring plans are required so the analysis and modeling can be validated and any necessary changes in the operation to prevent increases in peak runoff can be imposed.

It should also be noted that, the last paragraph of page 22 sensationalizes the flooding that occurred downstream of two the three sites studied by saying that the flooding that occurred there was to the level that it would only naturally occur every 50 to 100 years. The rainfall listed for the storms studied was 7.6cm to 15cm (3" to 6") **in a 5 to 6 hour period**. This amount of rain is equal to or greater than a 100 year storm in West Virginia's coal producing regions. The average **24 hour**, 100 year storm event for Boone, Logan, Mingo, and McDowell counties of West Virginia is around 5.5 inches of rain. Flooding is not unusual in watersheds when the precipitation that falls is equal to or greater than a 100 year storm.

Page 35. In general we found this section to be very informative and look forward to continued development of studies related to the toxicity of mine and other high dissolved solids effluents.

Page 63, Secn. 7.2. This section is also outdated in comparison to the current regulatory approach in West Virginia and the Appalachian region. Years ago, West Virginia adopted a more effective forestry reclamation approach, based on the leading forestry research in the Appalachian region. In 2004 West Virginia and other Appalachian states signed on to the Appalachian Regional Reforestation Initiative and adopted the forestry

reclamation approach (FRA). This approach is based upon sound science and is an approach that lessens competition from grasses, reduces compaction, retains the original topsoil (and, thus, the seed bank) and requires the planting of native hardwood trees.

In the last five years, approximately 86% of the acreage permitted in West Virginia has a post mining land use that is FRA compliant.

Page 70, Line 33. Again, we note only where temperature limitations are not present.

Page 101. We note and question the absence of comparable information from Tennessee and Virginia.

Comments to the EPA on the Document titled,
"The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields", Docket ID No. EPA=HQ-ORD-2009-0934.

June 9, 2010

Submitted by: David Ledford, President and CEO
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1005 South Main Street, Suite 104
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The Appalachian Wildlife Foundation (AWF) is a 501-c-3, non-profit wildlife conservation organization committed to ecological restoration in the Appalachian region and has a focus on the restoration of wildlife and habitat within the context of energy development, particularly surface mining for coal. We are submitting the following comments on the EPA document, "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields" (EPA/600/R–09/138A) and Docket ID No. EPA–HQ–ORD 2009–0934.

Our comments do not address all aspects of the EPA document, and we are not offering a line-by-line critique. Our comments are in reference to the statements that are made referring to the "preferred" methods for reclamation of a mine site.

Here is an excerpt from page 61 of the document;

> "Reclamation to forested land uses, which are preferred over pasture or hay land uses, may take longer but are more consistent with the SMCRA and CWA (U.S. EPA, 2003, 2005; Skousen et al., 2006)".

Here is an excerpt from page 64;

> "As a result of these studies and reports, reforestation of mined land is emerging as the 'best practices' post mining land use option, especially in mined areas that previously supported high-quality natural forests (U.S. EPA, 2003, 2005)".

While pasture and hay land uses are legal and recognized post mining land uses (PMLU) for surface mines, Fish and Wildlife Habitat is also a legal and very widely prescribed post mining land use. Under the PMLU of Fish and Wildlife Habitat, anywhere from 30% to 80% of the mine site is reforested to some extent. The percentages can vary from state to state and how the state or federal regulations are interpreted by industry and regulators. The EPA document seems to make the assumption that a mine is either reclaimed as 100% grassland or reforested, with no combination of each.

Stating that "reclamation to forested land uses" is preferred, or that "reforestation of mined land is emerging as the 'best practices' post mining land use option" is a value statement and not an objective, scientific observation. We are dealing with private lands and the objectives of the landowner have to be respected. Even when the landowner does not have a specific wildlife habitat or land use objective beyond the mining activity, there are often many other partners or parties that have preferences as to how mine sites are reclaimed.

In the southeastern coalfields of Kentucky there is a wild elk herd that numbers more than 10,000. In 2009 and 2010 more than 46,000 people paid $10 to apply for a chance to obtain an elk tag and hunt elk. The economic impacts and activity around the Kentucky elk herd are growing every year and affecting hundreds of thousands of people. These animals are thriving on mine sites reclaimed with grasses and forbs, and trees in many places. At the time of this writing, Virginia is on the way to launching an elk restoration effort in their coal fields, Tennessee has an elk herd of 400 animals in their coal fields, and West Virginia will one day be an elk state as well. Elk are native to every state in the lower 48 except for Florida and a couple of states in the Northeast. The restoration of elk to the Appalachians is a tremendous success story and these animals are thriving on reclaimed mine lands.

Along with elk in Appalachia, the coal fields of Kentucky, West Virginia, Virginia and Tennessee have experienced the restoration and return of wild turkeys, white-tailed deer, black bears, river otters, beavers, and wood ducks. Biologists from these state agencies will tell you that the highest populations of game species like deer and turkeys are within the landscapes impacted by mining. A spring day visit to reclaimed mine lands is often greeted by the whistling of Northern bobwhite quail, and the songs of many grassland and shrub habitat songbirds that are experiencing significant range-wide population declines. The list includes species like Grasshopper sparrows, Prairie warblers, Indigo buntings, Golden-winged warblers, Eastern Meadowlarks, and Horned larks. Birds of prey such as Short-eared owls, Northern Harriers, and several hawk species are common.

With this said, there are many situations when reforesting more of the mined landscape would actually benefit edge and even a "grassland" species like elk. A permitted area might be in a landscape where there has already been extensive mining and reclamation with grasses and forbs, and reforesting the entire permit area might be needed to meet the habitat needs of even edge species. Concurrently, if the objective of the landowner is oriented towards ruffed grouse, forest songbirds or bat species, then complete reforestation would be the preferred option. So, one cannot make a blanket statement that reforestation is the "preferred" reclamation practice.

As is mentioned in the EPA document, the US Office of Surface Mining launched the Appalachian Regional Reforestation Initiative (ARRI). This effort has been very successful in researching and developing techniques to improve tree growth and survival on mine sites. By using the Forest Reclamation Approach (FRA) of site preparation, research and experience has demonstrated remarkable results at growing trees. The FRA involves eliminating excessive surface compaction, ground cover competition, and inappropriate growth medium, then

planting high value hardwood trees. The FRA offers many options and opportunities for wildlife habitat restoration on mine sites.

However, there has been very little research and monitoring done on wildlife habitat restoration using these methods. ARRI has received little or no input from the wildlife conservation community and not a single state wildlife agency is a cooperator in this effort. While we believe that the tree planting and site preparation technology that has been developed through ARRI efforts can be very valuable tools to use in ecological restoration efforts, there are other issues to consider including the landscape context and the human dimensions factor.

Conclusion

The AWF is looking forward to working with EPA and other partners in seeking ecological restoration solutions for the coalfields of the Appalachians. Here are some bullet points as to what we believe needs to be done and what we are working to accomplish.

- Through a literature review being conducted by the University of Tennessee, we are compiling all the scientific information that can be found regarding upland wildlife response to reclaimed mines in the eastern United States. We are including the Illinois Basin coal fields because the plant and wildlife species are very similar to what is found in the Appalachians.

- We need to gather human dimensions data from the residents of the coalfields of Kentucky, Virginia and West Virginia to learn more about the wildlife and habitat restoration they would like to see on mines in their neighborhoods.

- We want to help landowners and mining companies choose a wildlife habitat objective.

- With this information, and with the Appalachian state wildlife agencies' State Wildlife Grant Action Plans, we want to develop a landscape default template for choosing a wildlife habitat objective when the landowner has no preference.

- We offer technical assistance to the mining industry and to landowners to help them design mine reclamation plans to meet their objectives.

- We will be working with OSM and ARRI to ensure that wildlife ecology and habitat needs are a high priority in that initiative.

- As we help implement wildlife habitat reclamation plans we want to follow up with long term monitoring and research to gather data needed for adaptive management and continuous improvement of reclamation techniques.

Thank you for this opportunity to comment.

January 6, 2004

Mr. John Forren
U.S. EPA (3EA30)
1650 Arch Street
Philadelphia, PA 19103
mountaintop.r3@epa.gov

RE: Joint Coal Industry Comments on the Mountaintop Mining/Valley Fill Draft Environmental Impact Statement

Dear Mr. Forren:

Coal Operators and Associates, the Kentucky Coal Association, the National Mining Association , the Ohio Coal Association, and the West Virginia Coal Association appreciate the opportunity to share our views on this Draft Environmental Impact Statement (EIS) on Mountaintop Mining and Valley Fills (hereinafter, "MTM") in Central Appalachia. This issue is extremely important to our members because many of them utilize coal extraction methods that require the construction of head of hollow fills and valley fills in their coal mining operations in the study area. As recognized by the EIS, MTM operations are generally the most economical and efficient forms of surface mining in this area. EIS III I-1.

Using valley and head of hollow fills in this region is absolutely necessary, because when mining is conducted in steep slope areas such as Appalachia, the volume of the spoil material is significantly greater than the volume of the

overburden excavated from its original geological location.[1] This is true whether the mining methods are mountaintop mining, contour mining, or even, in many instances, when creating the necessary surface area to begin and support an underground mine. Consequently, the excess spoil must be placed in valley and head of hollow fills. MTM is a major factor in coal production in this area, and accounts for ¼ to 1/3 of Appalachian coal production, and about 95% of the surface mining in West Virginia. EIS III I-23; III N-1. A brief description of the signatory trade associations to these comments follows.

Coal Operators & Associates, Inc. (COA) is a trade association that represents nearly 300 member companies involved in the ownership, leasing, mining, transportation and preparation of coal in Eastern Kentucky; or, supply goods and/or services to the coal mining industry. Our members mine by both surface and underground mining methods and represent the majority of coal mined in Eastern Kentucky.

The Kentucky Coal Association (KCA) is a non-profit corporation whose membership includes large and small, surface and underground coal operators in both the eastern and western Kentucky coal fields. KCA's membership also

[1] The volume of spoil is greater than the overburden that is excavated because the material swells by as much as 25% when it is removed. *See Bragg v. Robertson*, 248 F.3d 275, 286 (4th Cir. 2001), cert. denied, 122 S.Ct. 920 (2002); *See also Illinois South Project, Inc. v. Hodel*, 884 F. 2d 1286, 1292 (7th Cir. 1988)(recognizing that overburden from mining may swell in the range of 15-40% depending on how compact it was in its natural state).

includes a wide range of businesses associated with the coal industry. The KCA seeks to promote the best interests of the Kentucky coal industry.

The National Mining Association (NMA) is a national trade association that includes the producers of most of the nation's coal, metals, industrial and agricultural minerals; the manufacturers of mining and mineral processing machinery, equipment and supplies; and the engineering and consulting firms, financial institutions and other firms serving the mining industry.

The Ohio Coal Association is a non-profit trade association that is dedicated to representing Ohio's underground and surface coal mining production. Today, the Association represents close to FORTY coal producing companies and over FIFTY Associate Members, which include suppliers and consultants to the mining industry, coal sales agents and brokers and allied industries. As a united front, the Ohio Coal Association is committed to advancing the development and utilization of Ohio coal as an abundant, economic and environmentally sound energy source.

The West Virginia Coal Association (WVCA) is a State coal trade association representing the interests of companies engaged in the extraction of coal in the State of West Virginia. WVCA's producing members account for 98% of the Mountain State's underground and surface coal production. WVCA also represents 250 associate members that supply an array of services to the mining industry in West Virginia. These associate members include permitting

consultants, engineering firms, mining equipment manufacturers, coal transportation companies, coal consumers and land and mineral holding companies. WVCA's primary goal is promoting the continued viability of the West Virginia coal industry by supporting and facilitating environmentally responsible coal removal and processing through reasonable, equitable, and achievable State and Federal policy and regulation.

Our comments are divided into several sections that will convey our views. First, we will provide some background information on the statutory and regulatory framework for mining in general and MTM in particular, under which our members operate. Second, we provide extensive general comments on the EIS. This section explains how the EIS shows that MTM has minimal individual and cumulative effects on the environment, highlights some of the significant positive aspects of MTM, and discusses its programmatic nature. The document will demonstrate that, based on the evidence in the EIS record, the best alternative to select would be Alternative III, including an explanation of why Nationwide Permits (NWP) under Clean Water Act (CWA) Section 404 are appropriate in most cases for coal mining operations including mountaintop mining, and why individual permits are normally not appropriate in most MTM situations. Next, our comments analyze all 17 action items contained in the EIS. Third, we provide a section of specific comments on aquatic, terrestrial, and community impacts of MTM.

I. Background

a. Mining in General, and MTM in Particular, is Very Heavily and Closely Regulated, but is also Expressly Sanctioned by Federal Law

Mining is one of the most heavily regulated industries in American history. There are several statutes that specifically regulate mining, and many other general laws that are applicable to mining operations. Just some of the most significant Federal laws include the Surface Mining Control and Reclamation Act (SMCRA), the Clean Water Act (CWA), the Clean Air Act (CAA), the Endangered Species Act (ESA), and the Mine Safety and Health Act. In addition to all of these laws, and the thousands of pages of Federal rules in the Code of Federal Regulations pursuant to these laws that are designed to protect the environment and the public, there are hundreds of State laws that regulate mining.

There are also several provisions in these laws and regulations that apply even tougher standards for some of the activities that take place at MTM operations. Although the law sets tough standards for operators mining in these areas, the indisputable logical corollary to this is that Congress has specifically sanctioned MTM by enacting these provisions. Some of these provisions include SMCRA sections 515(b)(3)(requiring restoration of approximate original contour); 515(b)(22)(governing excess spoil placement); and 515(c)(2) and (3)(expressly

discussing MTM techniques). *See also* Office of Surface Mining (OSM) regulations at 30 C.F.R. 785.14 (MTM); 30 C.F.R. Part 824 (MTM); 30 C.F.R. § 780.29 (stream channel diversions); 30 C.F.R. 816.57 (Stream Buffer Zone Rule); 30 C.F.R. § 816.72 (Disposal of Excess Spoil in Valley Fills); 30 C.F.R. § 816.151(d)(5)(relocation of natural stream channels). The EIS itself recognizes that "Congress acknowledged the necessity of valley fill construction in streams [in SMCRA § 515(b)(22)]." EIS II D-2.

OSM regulations also recognize the necessity of mining in or near streams. 30 C.F.R. § 816.43 expressly allows and regulates the diversion of streams. MTM and mining in or near streams is presumed necessary and valid by Congress and the regulatory agencies, such as the OSM, so long as adverse effects to offsite areas are minimized. There are additional protections in the law for areas that are designated as unsuitable for mining. In extraordinary circumstances, States may designate specific areas in § 522(a)-(d) of SMCRA, if the evidence in the record supports such findings by the State government. *See also* 30 C.F.R. §§ 761-764.

Given all of these statutory and regulatory requirements that must be met, mining operations produce volumes of analyses and plans before they are issued a permit to build a mine. During this process, the public is provided with numerous opportunities to provide input and comment on the permit application, and may object to the regulatory authority. 30 U.S.C. §§ 1263-1264. Even after the permit

is issued, Federal and State laws provide for regular monthly and quarterly inspections of surface coal mining operations to ensure their compliance with applicable laws, regulations, mine plans, and their permit conditions. 30 C.F.R. Part 842; 30 C.F.R.§ 840.11. In addition, mines are subject to inspection following any citizen complaint giving rise to a concern that a violation of SMCRA or regulations has occurred. 30 C.F.R. § 842.12.

The CWA, like SMCRA, is also crystal clear that valley fill construction for excess spoil placement is permissible under Federal and State law. Environmental groups have repeatedly tried and failed to convince appellate courts that MTM is somehow illegal based on misguided interpretations of the CWA, SMCRA, and their implementing regulations. However, the 4th Circuit Court of Appeals has clearly held that such a view of the law is wrong because: (1) EPA's and COE's interpretation of "fill material," which expressly included coal mining overburden placement in waters of the U.S. (including the streams at issue in the EIS), was a reasonable interpretation of the CWA; and (2) SMCRA anticipates that excess spoil from MTM "could and would" be placed in waters of the U.S.[2]

As the EIS correctly notes, both the CWA and SMCRA recognize that incursions and disturbances of streams are frequently unavoidable. EIS II C-30. Congress, the administrative agencies, and the courts all recognize that Federal

law anticipates that excess spoil will be placed in streams. **The real question is not whether MTM or excess spoil placement is permissible, but rather how to regulate it.** Therefore, the question is not what happens to the stream segment that is filled, but whether the downstream impacts or impacts to areas outside the permit area are so significant that they cannot be avoided or satisfactorily mitigated. With this background and this issue in mind, we next turn to an examination of MTM, how it has been analyzed over the years, and what this most recent EIS teaches us about MTM.

b. MTM/VFs have been Studied for Decades, and those Studies Have Consistently Demonstrated that they Are Acceptable Mining Methods

As demonstrated above, Congress was well aware of MTM/VF techniques when it enacted the SMCRA legislation, and recognized the legitimacy of these practices through Federal law. MTM/VF practices have been extensively studied and analyzed since that time as well. For example, in 1979, EPA authored a report concluding that MTM is actually environmentally desirable, and that head of hollow fills can reduce adverse environmental impacts. EPA concluded[3] that:

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[1] *See Kentuckians for the Commonwealth v Rivenburgh*, 317 F. 3d. 425, 443 (4th Cir. 2003).

[3] *Environmental Assessment of Surface Mining Methods: Head-of-Hollow Fill and Mountaintop Removal, Interagency Energy/Environment R&D Program Report* (hereinafter: "*EPA EA of Surface Mining Methods*"); U.S. EPA (July 1979) p. 6.

(1) Mountaintop removal mining is an environmentally desirable surface mining technique in the steep sloped terrain of southwestern West Virginia and eastern Kentucky when conducted in compliance with existing reclamation criteria; and

(2) Head-of-hollow fill reclamation can reduce environmental impacts occasionally associated with other reclamation practices such as contour regrading in steep terrain or downslope spoil casting. Specifically, these improvements are realized in erosion and sedimentation control, spoil stabilization, revegetation success and land use potential.

In 1989, the Department of Interior prepared a report to Congress on mountaintop mining. This report found that OSM and other Federal agencies are committed to studying the environmental impacts of MTM thoroughly. One of the key studies[4] attached to the Congressional report, the WV Governor's Report, found that "numerous regulatory programs are in place to assure protection of State water quality," and also found "...no significant evidence of widespread or routine violations of State and Federal water quality standards..." *See WV Governor's Report* at ENV9-10. It concluded that, "On balance...the positive

[4] "*State of West Virginia Governor's Task Force on Mountaintop Mining and Related Practices,*" (December 1998)(hereinafter "WV Governor's Report").

impacts of mountaintop removal mining can outweigh the negative impacts." *See Id.* at People-7.

The current EIS contains an additional 30 studies on MTM/VF, and continues the trend of careful and continuous study, evaluation, and improvement of MTM/VF practices. A summary and analysis of the contents of this latest comprehensive analysis of MTM/VF is explained below.

II. General Comments on the EIS

a. The EIS Demonstrates that in Most Areas of Concern, MTM Does Not Raise Significant Issues

Inspector Gregory:

"Is there any other point to which you would wish to draw my attention?"

Holmes: "To the curious incident of the dog in the night-time."

"The dog did nothing in the night-time."

"That was the curious incident," remarked Sherlock Holmes.

From "The Adventure of Silver Blaze" by Arthur Conan Doyle

i. Overall Impacts of MTM

The EIS commissioned 30 comprehensive scientific studies over a span of four years to determine the impact of MTM on the study area, which includes parts of four different States in Appalachia. Based on this information, it is clear that the overall impact of MTM on the study area is not significantly adverse. For example, studies found that despite the size of these MTM operations, about 98% of the streams in the study are not directly impacted by MTM. EIS III D-2. Only slightly more than 1% of streams are actually filled, and many of those "streams[5]" consist of areas that either flow only intermittently for part of the year, or are dry channels that contain water only immediately after a rainstorm[6]. The EIS acknowledges that its estimates of potential future stream losses are overstated because they do not take into account avoidance, minimization, and mitigation already required by the 2002 Nationwide Permit (NWP) 21. EIS IV B-3. Such estimates are probably even more inflated, given that changes to the status quo made by any of the three Alternatives would improve environmental protection and better coordinate the CWA and SMCRA. EIS II B-1. The studies also found that even when aggregating all MTM activity over the past decade, about 97% of the study area was undisturbed by MTM. EIS II C-62. Finally, the evidence shows that MTM has been decreasing, both in numbers and in average size in recent years. EIS II C-5.

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[5] Regulatory agencies, such as the COE, define "streams" much more broadly than the general public does. More common definitions of the term say it includes only "A body of *running* water;" or "a steady current of a fluid." (emphasis added) *See* American Heritage Dictionary, 2nd Edition.

[6] In Kentucky and Virginia, many of the fills are not valley fills but rather head of hollow fills impacting only stretches of ephemeral streams.

In addition to the fact that these overall impacts are minimal, one must recognize that "...surface mining is a temporary use of the land and, with proper mining and reclamation techniques, the land is not irretrievable for a variety of future land uses." EIS IV F-1. Therefore, many of the impacts listed above, such as forest fragmentation will ultimately be a temporary phenomena.

ii. Specific Impacts of MTM Found Insignificant

1. Air Quality Impacts

The EIS found that air quality concerns were not an issue with MTM. MTM has not been considered a major source of air pollution since it does not meet the criteria for major source air quality permits under Title V of the CAA. EIS III V-3. Moreover, except for ozone, monitoring stations reported good air quality for all criteria air pollutants. EIS III V-1. OSM regulations already specifically require an air pollution control plan. 30 C.F.R. § 780.15.

In addition, the Mine Safety and Health Administration (MSHA), maintains separate air monitoring requirements for mining operations to protect mine workers, and has established enforceable exposure limits for respirable coal dust. EIS III V-4 MSHA regulations also require every mine to submit a ventilation

system and methane and dust control plan every six months. *Id.* Finally, MSHA is required by statute to make surprise inspections of every surface mine in the United States at least twice each year. 30 U.S.C. § 813(a).

2. Impacts to Land, Blasting, Stability, Scenery, and Forest Cover Are Insignificant

The studies found that land use is not a significant issue because "existing regulatory controls are adequate to address the issue." EIS II A-7. Likewise, blasting is not considered a significant issue with MTM because the studies concluded that "existing regulatory controls provide adequate protections from coal mining related blasting impacts on public safety and structures including wells." EIS II A-6. The EIS found that stability of valley fills is not a significant issue because there were "very low occurrences of stability failures, and those identified failures were generally minor in nature and posed no risk to public safety." EIS II A-8. Finally, the EIS found that scenery and culturally significant landscapes have statutory and regulatory controls that are adequate to address the issue. *Id.*

The EIS explains that only 3.4% of the forested land in the study area was changed to grassland by surface mining[7] over the past ten years (in WV, Valley

[7] For example, the EIS predicts that if MTM continues at its current rate, there may be a potential loss of up to 3.4% of the salamander population in the study area. EIS Appendix I at 92-93. Although we do not necessary concede that losses would be this dramatic, even if the estimate is correct, the EIS predicts that

Fills (VF) account for only 0.7% of forest loss). EIS Appendix I at V. Therefore, MTM does not have a significant adverse effect on forest cover, particularly when one considers that some of this land will be reforested through reclamation, which will be further facilitated by pending changes in OSM rules to encourage tree planning. Statistics from the EIS show that there is actually more forest cover today than there was in 1950.[8] EIS III R-2. In addition, this land will eventually revert to forest through natural succession. EIS IV A-4.

The EIS concludes that "...impacts to soils from MTM/VF are not irreversible and that over time, soils similar to those that existed prior to mining are likely to be re-established on reclaimed mine sites." EIS IV C-7. In addition, providing grassland areas and edge habitat in this region will have positive environmental benefits for many species that require diverse habitats to flourish. EIS Appendix I at 15. Fragmented forests have more edge habitat, and the creation of more edge habitat often corresponds to an increase in local species diversity as "edge" species are attracted to the region. EIS Appendix I at 43.

3. Exotic and Invasive Species are not Invading; Threatened and Endangered Species are not Threatened

there would still be an abundant salamander population of over 35 billion in the study area—or about 100 salamanders for every man, woman, and child in the United States.

[8] This trend is continuing. Data from the U.S. Forest Service indicates that the average cubic feet of forest growth exceeds the average annual rate of forest loss for ALL states in the region. EIS IV C-2.

The studies found no evidence that MTM has contributed to the spread of invasive and exotic species in Southern WV. EIS III F-16; Handel 2001. Nor is there a significant issue regarding the Endangered Species Act (ESA). The biological opinion issued in 1986 states that "...surface coal mining conducted in accordance with properly implemented State and Federal regulatory programs under SMCRA would not be likely to jeopardize the continued existence of listed or proposed species, or result in the destruction or adverse modification of designated or proposed critical habitats." EIS IV D-5. Another EIS study says that "...ample forest will remain in the West Virginia portion of the study area to maintain relatively high PEC[9] scores, [but] impacts to many forest interior bird species are likely to occur." EIS Appendix I at 90. Finally, the EIS notes that "there are no significant differences among the No Action Alternative and Alternatives I, II, and III in terms of their ability to protect [threatened and endangered] species." EIS IV D-7.

4. Water Issues are not Significant

The EIS found that flooding due to MTM is not a significant concern. The EIS found that downstream flooding potential is not significantly increased by existing mining practices so long as approved drainage control plans are properly

[9] PEC stands for potential ecological condition, and is a value calculated to determine the ecological health of a defined landscape scale, usually a watershed level, but this cumulative impact study did so on a State

applied. EIS IV I-7; Appendix H. In addition, "...valley fills do not seem to be causing excessive sediment deposition on the first and second order streams." EIS III D-8. "...[T]he substrate characteristics of the filled, filled/residential, and mined classes were not substantially different from the unmined class." EIS III D-13. In other words, the EIS found no significant sediment problem that could be attributed to MTM. Finally, "the EIS studies did not conclude that impacts documented below MTM/VF operations cause or contribute to significant degradation of waters of the U.S." EIS II D-9.

The EIS suggests that changes in water chemistry downstream from MTM operations are cause for concern. EIS III D-7. First, with respect to USEPA's water chemistry data, the USEPA identified problems with the quality assurance/quality control (QA/QC) implemented during the collection and analysis of the water chemistry data, causing all the water chemistry data to be called into question.[10] Assuming these QA/QC issues do not change the overall conclusion that significant differences exist between the filled and unmined sites and between the filled/residential and unmined sites, supplemental studies conducted in conjunction with the MTM/VF EIS studies conclude that neither the changes in the biological community, nor changes in water chemistry in the filled sites appear to have significant adverse impacts on the stream function with respect to

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by State level. According to the EIS, PEC is an effective measure of biologic integrity. EIS Appendix I at 17.

downstream segments. Instead, these studies found sites influenced by mining continue to support abundant populations with representatives of all the functional feeding groups and stream function does not appear compromised at these sites.[11]

Second, the evidence does not show a clear impact on the study streams by the mountaintop mining/valley fill activities. To the contrary, the data establishes that MTM/VF activities result in changes in water chemistry and biological communities typical of any large scale development project, e.g. road construction or residential development. Such changes in community structure are more likely the result of changes in temperature regimes, typical whenever ponds, dams or municipal discharges are present. *Id.* Therefore, it is fair to say that any statement in the EIS attributing a cause and effect to a single activity where others such as temperature or ponds which provide a different food source are playing a role must be considered with caution. In addition, it should also be noted that USEPA reported studies compare a mined site on a third, fourth or fifth order stream with an unmined site on a first or second order stream. No unmined sites were selected on third, fourth or fifth order streams. Changes in water chemistry and biological communities between first or second order streams and third or fourth order streams are expected. USEPA failed to consider changes associated with

[9] These problems are discussed in the report "A Survey of the Water Quality of Streams in the Primary Region of Mountaintop/Valley Fill Coal Mining" (April 8, 2002).
[11] Arch Coal Supplemental MTR/VF EIS Study Report, April 2002.

increasing stream order in data interpretation and presentation to the public. This flaw in the data must be addressed in the Final EIS.

Finally, concerns about elevated selenium at test sites are minimized when considered in light of the latest scientific data on aquatic toxicity of selenium. EPA's current nationally recommended chronic criterion for selenium (5ug/l in the water column) and 20 ug/l acute criterion have been adopted by many States and utilized in water quality standards programs. However, based upon the latest scientific knowledge on selenium toxicity, EPA made a decision to update the acute and chronic criteria for selenium and published, in March 2002, a draft selenium criteria document.[12] EPA's draft document proposes a revised freshwater acute criterion (185 *ug/l*) in the water column and 7.9 ug/g (dry weight) in fish tissue that is considerably higher than the current national criterion. It is important to note that in some geographic areas in the study area background levels of total Se exceed 20 ppb, yet no acute toxic effects are observed. Therefore, the levels of concern expressed in the EIS studies become much less significant when considered pursuant to the agency's proposed revised criteria.

The EIS found that "Overall, the abundance of macroinvertebrates was found to be similar in upstream and downstream stations or to be slightly higher in

[12] See *Draft Aquatic Life Water Quality Criteria for Selenium 2002*, EPA Contract No. 68-C6-0036 (March 2002 Draft).

downstream stations. EIS III D-9. This strongly suggests that MTM operations are not having an adverse impact on downstream water quality. Likewise, the studies note that: "Biological conditions in the mined sites generally represented very good conditions, although a few sites did score in the good and poor range." EIS III D-12. This strongly suggests that MTM can be conducted with minimal effects on the environment, provided that appropriate mitigation techniques are applied.

Environmentalists have alleged that all of the above areas are at severe risk due to MTM. As explained above and in the EIS, the scientific data from the 30 comprehensive studies does not support the environmentalists' alarmist predictions. At the end of the day, the EIS observed that: "Watershed impacts directly attributable to mining and fills could not be distinguished from impacts due to other types of human activity." EIS II C-74. As Sherlock Holmes observed, the "dog that didn't bark" is a clue in and of itself.

b. The EIS Demonstrates that MTM has Numerous Positive Benefits that Suggest it Should be Permitted

i. MTM has Provided Environmental Benefits

MTM has resulted in improvements in water quality in several areas. Studies commissioned by the EIS have found that MTM resulted in improvements

in pH, iron, and manganese levels downstream. EIS III D-7. As the EIS notes, "the Appalachian coalfields provide almost limitless opportunities for watershed improvement." EIS IV B-9. Such opportunities are presented both in the form of remining operations, which can greatly improve water quality and improve public safety be removing highwalls, as well as mitigation conducted as part of the MTM process.

Runoff and groundwater are stored in valley fills. EIS IV B-4. Valley fills hold approximately 7 times more water as their pre-mining counterparts. EIS III H-4. This water is slowly released downstream, increasing base flows, lowering peak discharges, and moderating water temperatures. EIS IV B-6. An increase in base flow may eliminate intermittent flow, improving an intermittent stream to a perennial stream.

MTM activity also creates ponds. The EIS recognizes that functions of man made ponds exist and may be considerable, and may tend to limit the effect of disturbances on the downstream watersheds. EIS III C-18 & 20; Wallace B. in EPA et al. March 20, 2000. Wetland areas are being created at reclaimed mine sites. It is anticipated that wetland acreage has actually increased as a result of these steep slope [MTM] activities. EIS III D-19. These newly created wetland habitats, in conjunction with results from other mining reclamation efforts, have created habitat, such as grasslands, edge habitat, and scattered ponds that are

important for game species such as wild turkey, bobwhite quail, ruffed grouse, and white tailed deer. EIS III F-11. Some forest edge and grassland species (certain reptiles, birds, mammals, raptors, etc.) are positively impacted by the terrestrial habitat diversity created by MTM. EIS II C-75. The EIS documents that there has been an increase in the abundance of edge and grassland bird species at reclaimed MTM sites. EIS III F-7.[13]

ii. MTM has Provided Economic and Social Benefits

MTM has provided immeasurable economic and social benefits to one of the poorest regions of the United States. These mines provide high paying jobs, economic activity for other businesses, taxes for governments and schools, roads (EIS III J-2), and land that, in certain cases, can be used for commercial development.

The population in the study region is exceptionally poor. According to the Census, over 1/3 of the residents in 24 counties in the study area are below the poverty level. EIS III P-2. What the study area lacks in personal income, it makes up for in natural resources. The area contains over 28.5 billion tons of coal. EIS ES-2 MTM/VF operations are generally the most economical and efficient forms of surface mining in steep slope Appalachia and provide for the highest possible

[13] See also Wood and Edwards, 2001; Canterbury 2001.

recovery of multiple coal seams. EIS III I-1. Such operations may be able to mine as many as 18 seams. EIS III J-1. At current rates of coal production, this area could produce coal for the next 100 years.

One of the many benefits of these MTM operations are the high paying jobs and taxes created by the activity. Mining made up more than 10% of employment in a number of the study area counties. EIS III Q-5. Impacts are even greater in certain regions of the study area. Whereas MTM operations account for about ¼ to 1/3 of Appalachian coal production, in southern West Virginia, about 95% of the surface mining is done by the MTM method. Such impacts are also reflected in the tax revenues of these areas. For example, in West Virginia, 90% of the severance taxes come from coal. EIS III Q-10. Surface mining is particularly important to the economies of Boone, Logan, and Mingo counties. EIS III Q-13.

iii. Unnecessary Limitations on MTM Will Cause Both Economic and Environmental Harm

Unnecessary limitations on MTM in the study area would have significant adverse consequences, for the economy, the people of the region, government, and the environment. The EIS recognizes that if mining costs increase too greatly in the study area, mining employment would drop and tax revenue from coal would decline. Other studies have found that prohibiting valley fills in West Virginia would cause State tax revenues to decline by as much as $168 million annually,

plus an additional $83 million drop in County tax collections.[14] Commensurate school closings, and diminished State and government services would occur. EIS IV I-2. The EIS also recognized comments in the record stating that local governments depend on revenues and taxes in order to provide police and fire protection, ambulance service, and education. EIS I-20. Impacts to the private sector would be even greater, resulting in the loss of over 15,000 jobs and a $2.4 billion decrease in economic output in West Virginia. *See* Marshall Study, cited *supra*. The EIS does not offer any significant economic activity that would replace MTM if it were lost.

Moreover, "if coal in the study area is rendered economically unrecoverable, it may never be mined..." EIS IV F-1. This would be contrary to what is best for the environment, because it would waste natural resources and require coal to be mined somewhere else that may not involve the most economical and efficient form of surface mining that does not provide for the highest possible recovery of multiple coal seams. EIS III I-1. As early as 1979, EPA has stated that MTM may be preferable to other forms of mining, such as contour mining: "Mountaintop removal may serve as an excellent alternative to contour mining in these mountainous areas primarily because of the potential for reduced environmental impact, improved reclamation, increase land value,

[14] *See "The Fiscal Implications of Judicially Imposed Surface Mining Restrictions in West Virginia,"* Marshall University Center for Business and Economic Research, (February 2001).

expanded land use potential and total resource recovery." *EPA EA of Surface Mining Methods* at p. 25. In addition, the Marshall study also found that mining firms would be "extraordinarily unlikely" to replace lost MTM tonnage with additional coal mined underground. Indeed, a policy that did not maximize utilization of our coal resources would actually violate OSM's regulations, which provide that surface mining activities must be conducted to maximize the utilization and conservation of the coal so that reaffecting the land in the future is minimized. *See* 30 C.F.R. § 816.59.

Finally, the EIS fails to address impacts to national security if the amount of coal reserves noted elsewhere in this document are excluded from recovery. There is no consideration for this Administration's National Energy Strategy, aimed at securing energy independence for the United States. This strategy relies heavily on the continued use of this nation's abundant coal resources as a low-cost and reliable source of energy.

c. The EIS is Programmatic in Nature

The agreement to prepare the EIS is contained in a settlement agreement that resolved Federal claims in the case of *Bragg v. Robertson*, 54 F.Supp. 2d 653 (S.D. WV 1999). The stated purpose of the EIS is:

> "...to consider developing agency policies, guidance, and coordinated agency decision-making processes to minimize, to the maximum extent practicable, the adverse environmental effects to waters of the United States and to fish and wildlife resources affected by mountaintop mining operations, and to environmental resources that could be affected by the size and location of excess spoil disposal sites in valley fills."

64 Fed. Reg. 5778 (February 5, 1999).

The EIS is not specific to any particular action, but rather is a "Programmatic EIS" in that it evaluates broad Federal actions such as the adoption of new or revised agency program guidance, policies, or regulations. An EIS is not itself "final agency action" subject to judicial review. Standing alone, it does not establish any rights, obligations, or other legal consequences.[15] A programmatic EIS is essentially procedural in nature and not substantive. In the future, policies will be finalized and rules promulgated based on information and analysis contained in the EIS, but the EIS itself does not change any current laws or regulations. Future actions proposed as an outgrowth of this EIS may require independent or supplemental NEPA analysis.

[15] *See Bennett v. Spear*, 520 U.S. 154, 177 (1997).

The EIS has done exactly what it is supposed to have done—it has considered various policies, guidance, and coordinated agency decision-making processes to minimize the impacts of MTM to the extent practicable. Accordingly, in the framework of this programmatic EIS, we turn now to a discussion of Alternative III, and why we believe that it should be selected as the best Alternative in the Final EIS.

d. Alternative III is Preferable

Although the EIS states that "the alternatives were developed with the objective that each would satisfy the requirements of the CWA and SMCRA," EIS II B-1, and each would likewise "improve environmental protection and better coordinate implementation of the CWA and SMCRA..." *Id.*, Alternative III is the most preferable alternative for the following reasons.

i. Alternative III Will Produce the Best Decisions, Which Will Improve the Environment

The EIS correctly observes that: "[Alternative III] would provide clear environmental performance targets for industry, stakeholders, and regulators based on combined analyses of SMCRA and CWA performance standards, a better basis for decisions and findings by SMCRA regulators, and an improved ability for States, with more knowledge about environmental resources within their borders,

local conditions, etc., to set priorities for mitigation." *Id.* The EIS also recognizes that the U.S. Army Corps of Engineers (COE) does not have staff with mining engineering background as OSM does, and that CWA § 404 minimization alternative analyses involve a knowledge of mine planning theory and practice, as well as operational feasibility to determine if all practicable alternatives have been considered. EIS IV I-17. Therefore, Alternative III is the most logical choice because the Federal regulatory personnel with the best knowledge about the subject will more frequently be in a lead role in making environmental decisions.

ii. Coordination will Also Yield Better Decisionmaking

Alternative III is based on a joint permit application that will provide for concurrent review, which will result in better decisionmaking. It will enhance the coordinated regulatory processes by serving as the platform for evaluation of compliance with SMCRA and CWA Sections 401, 402, and 404 programs. EIS II C-22. Although a single permit application would be used, each agency would remain responsible for ensuring that all statutory and regulatory responsibilities in SMCRA and the CWA are met, further enhancing environmental protections. A memorandum of agreement (MOA) and field operating procedures (FOP) will further enhance coordination and decisionmaking. EIS II C-25-26.

SMCRA requires that Federal and State agencies, such as OSM, State regulatory authorities, and the COE, coordinate implementation of their programs and cooperate "to the greatest extent possible" in order to minimize duplication, delays, and conflict. 30 U.S.C. §§ 1211(c)(12) & 1292(c); 30 C.F.R. § 773.5. The CWA likewise mandates the agencies minimize duplication.[16] Alternative III is clearly the best option to fulfill this statutory mandate, because it would minimize duplication by promoting "a single lead agency with coal mining regulatory expertise for permitting and a framework for efficient, environmentally responsible production of energy resources." EIS II B-15. Requiring both an individual permit (IP) and a SMCRA review would be duplicative and inefficient, unless it is determined necessary by the COE in a particular situation, and justified by the particular circumstances.

iii. Alternative III Correctly Presumes the NWPs are Appropriate in Most Cases

Data from the EIS demonstrates that the vast majority of MTM operations are currently authorized pursuant to NWP 21. For example, in West Virginia from 1990-2002, 81 NWPs have been issued for MTM operations, versus only 5 individual permits (IP). EIS II C-46. The COE has been independently applying the statutory requirements of the CWA over this time, and has concluded 94% of

[16] 33 U.S.C. § 1303(a); 33 C.F.R. § 322.2(f)(2); *See also WV Governor's Report* at ES-4 ("[COE, FWS, OSM & EPA] should be encouraged...to cooperate in resolving outstanding mountaintop removal issues.").

the time that NWPs are appropriate. Environmental organizations have repeatedly challenged approval of these permits, and have repeatedly lost their claims in Federal courts.[17] Therefore, it is apparent that Alternative III is the most appropriate alternative, because it establishes the regulatory paradigm that will most often produce the correct decision.

iv. Balancing Environmental, Economic, and Technical Considerations

Alternatives are considered not only with regard to their impact on the environment, but also on technical and economic factors. For example, one of the primary purposes of SMCRA is to "assure that the coal supply essential to the Nation's energy requirements and to its economic and social well being is provided and strike a balance between protection of the environment...and the Nation's need for coal as an essential source of energy." 30 U.S.C. § 1202(f). Agencies are required to follow all Congressional mandates, including those in SMCRA and other laws. Since the comprehensive analysis concluded that: "the environmental benefits of the three alternatives are very similar," EIS II B-13, the agencies should select Alternative III because it is the best alternative that also fulfills other statutory mandates by minimizing the adverse impacts to the

[17] *See Bragg v. Robertson, 72 F. Supp. 2d 642, 658 (S.D. W. VA 1999); vacated, Bragg v. West Virginia Coal Association, 248 F.3d 275 (2001); cert. denied, 122 S.Ct. 920 (2002); See also Kentuckians for the Commonwealth v. Rivenburgh*, 317 F. 3d. 425 (4th Cir. 2003).

economy. This approach is also consistent with NEPA and regulations by the Council on Environmental Quality (CEQ), which allow agencies to consider economic and technical issues: "An agency may discuss preferences among alternatives based on relevant factors, including economic and technical considerations and agency statutory missions." 40 C.F.R. § 1505.2(b); 42 U.S.C. § 4332(B).

v. Why NWPs are Appropriate for MTM

1. COE Asserts that NWP are Appropriate for MTM

The COE reauthorizes its nationwide permits (NWPs) every five years. In all of its previous actions, and particularly in its most recent reauthorization, the COE clearly stated that NWP 21 is appropriate for MTM: "...this [NWP 21] permit is designed for use by mountaintop mining operations as well as other surface coal mining activities. 67 Fed. Reg. 2042 (January 15, 2002). The COE also states that "...valley fills may be pursued under the current regulations." *Id.* at 2039. The COE, through NWP 21, ensures that surface coal mining activities do not cause more than minimal adverse effects to the aquatic environment after considering mitigation. *Id.*

The COE believes that NWP are appropriate and useful for expediting the processing of permits provided there is adequate compensatory mitigation. Id at

2043. The COE found that proposed projects under NWP 21 are generally located at the upper limits of the watersheds and are therefore not interfering with aquatic species migration. *Id.* Moreover, the COE is ensuring that such projects are avoiding and minimizing impacts to the extent practicable and providing adequate mitigation, especially in the form of enhancement or rehabilitation of existing streams through stabilizing old mined sites to reduce sedimentation and acidic water releases. Such activities can result in substantial improvement in downstream water quality and aquatic habitat within a watershed. *Id.* These findings are consistent with those of the EIS, which found that Appalachian coalfields provide almost limitless opportunities for watershed improvement. EIS IV B-9. The EIS also agrees that mitigation could not only offset, but enhance aquatic resources. *Id.* Finally, the COE recognizes that coal mining is different than many other activities authorized under NWPs, because coal mining projects are thoroughly reviewed for environmental impacts under several other authorities. *Id.* at 2042.

2. There are many protections built into the NWP framework

There are many protections available under NWP 21 to ensure protection of aquatic resources. Such protections are always evolving and improving, as necessary. For example, just last year, the COE made two changes to NWP 21. First, the COE now requires a specific written determination by the District

Engineer (DE), on a case-by-case basis, that the proposed activity complies with the terms and conditions of this NWP, and that adverse effects to the aquatic environment are minimal both individually and cumulatively, after consideration of any required mitigation before any project can be authorized. 67 Fed. Reg. 2038. Second, the COE clarified specifically in the NWP 21 that the agency will require mitigation when evaluating surface coal mining activities in accordance with General Condition 19. The COE also will now address direct and indirect effects to the aquatic environment from the regulated discharge of fill material in its § 404 review.

Furthermore, under Alternative III, the COE retains discretion to (1) require an individual permit if the adverse individual or cumulative effects on the aquatic environment will be more than minimal after mitigation; (2) add regional conditions on a watershed, regional, or geographic basis; or (3) suspend, modify, or revoke authorizations under a NWP. NWPs do not authorize any activity that is likely to jeopardize the continued existence of a threatened or endangered species as listed or proposed for listing under the ESA, or to destroy or adversely affect the designated critical habitat of such species. Not only does the COE have substantial discretion to regulate NWPs, but EPA is also authorized to veto any § 404 permit. EIS II C-8; CWA § 404(c).

vi. IPs Are Duplicative and Unnecessary in Most Cases Because SMCRA Provides Comprehensive Information on all Aspects of Mining for Use by COE in § 404 Reviews

The COE, pursuant to CWA § 404, is limited to regulating the placement of fill material in waters of the United States, and the scope of its analysis is limited to impacts on aquatic resources. However, SMCRA provides much broader coverage through several statutory and regulatory provisions, through which OSM protects fish, wildlife, and the hydrologic balance. Indeed, that is why NWP 21 is the only "programmatic" Nationwide Permit—that is, a general permit directly tied to another environmental regulatory program that already comprehensively regulates the authorized activities. As the COE has repeatedly found, SMCRA adequately addresses environmental concerns and provides similar protections for aquatic resources as the § 404 program requirements. [18] The language of NWP 21 has always tied the authorization directly to those activities that are "authorized by [OSM] or States with approved programs under Title V or [SMCRA]." *See* 51 Fed. Reg. 41026, 41256 (November 13, 1986); 67 Fed. Reg. 2020, 2081 (January 15, 2002). A number of these SMCRA protections are discussed below.

SMCRA § 515(b)(10) requires operators to "minimize the disturbances to the prevailing hydrologic balance at the mine site and in associated offsite areas and to the quality and quantity of water in surface and ground water systems..."

[18] *See* 56 Fed. Reg. 14598, 14604 (April 10, 1991); 56 Fed. Reg. 59110, 59124 (November 22, 1991).

In addition, § 515(b)(24) provides that operators must minimize disturbances and adverse impacts of operations on fish, wildlife, and related environmental values to the extent possible using best technology currently available (BTCA).

For permit applications, SMCRA also requires information on maps, mining plans, watersheds, climatological factors, geological information regarding overburden strata, coal seams, aquifers, the water table, spoil, topsoil, blasting, natural drainways, and chemical analyses. 30 U.S.C. § 1257(b). Further information is required for the mine's reclamation plan. 30 U.S.C. § 1258.

In addition, SMCRA § 507(b)(11) requires a determination of the probable hydrologic consequences of the mining and reclamation operations, both on and off the mine site. This section results in information collected on the hydrologic regime, quantity and quality of water in surface and underground water systems, information on dissolved and suspended solids, and such other data as required to assess the probable cumulative impacts (set forth in a Cumulative Hydrologic Impact Analysis, or "CHIA"). *See also* 30 C.F.R. § 780.21.

All of this information is available to the COE to assist in making its required determinations pursuant to its authority under CWA § 404. Because SMCRA provides such comprehensive information regarding the mine, and because Alternative III provides numerous avenues for coordination between

OSM and COE, it would be unnecessary, duplicative, and contrary to Congressional intent to require lengthy individual permits as the norm, as is likely under Alternative I. Moreover, courts have observed that they will not uphold presumptions, such as Alternative I, that are counterfactual.[19]

vii. OSM Will Promulgate Rules to Fill any Regulatory Gaps

OSM will issue rulemakings (Action 3.3 and Action 7) and an MOA to ensure that any gaps, including § 404 data collection, impact prediction, and alternative analysis, including avoidance and minimization are addressed. EIS II C-23. These actions include amending the "stream buffer zone" rule and the OSM regulations on the placement of excess spoil. We strongly support these regulatory changes by OSM that are more fully explained in Section II(e)(iii) & (vii) of our comments, *supra*.

e. Discussion of Specific EIS Action Items (EIS II C)

The EIS proposes seventeen specific action items. Our comments on these Action items are provided below.

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[19] *NMA v. Babbitt*, 172 F.3d 906, 913 (D.C. Cir. 1999)(we do not see how a counterfactual procedural device could be justified even as a matter of policy); *See Allentown Mack Sales & Serv., Inc. v. NLRB, 522 U.S. 359, 118 S. Ct. 818, 828, 139 L. Ed. 2d 797 (1998).*

i. Action Item 1: Regulatory Alternatives

As explained in great detail in Section II(d). of our comments, we strongly support Action 1.3, commonly referred to as "Alternative III."

ii. Action Item 2: Consistent Stream Definitions

We support this action. Like the definition of "fill material" that was clarified by the COE and EPA in 2000, creating consistent definitions of streams would be beneficial so that the same definitions would apply to various regulatory programs. This would lead to greater efficiency, better coordination, and consequently better environmental analysis, decisionmaking, and consistency among the various programs.

iii. Action Item 3: Clarification of the Stream Buffer Zone Rule

We strongly support this action.

SMCRA has never mentioned, let alone mandated, a requirement that there needs to be a "buffer zone" around a stream. Quite the contrary, SMCRA is

replete with references to mining near, under, and/or through streams. Instead of prohibiting stream disturbance altogether, the law requires an effort to minimize adverse effects *outside the permit area and downstream*. *See, e.g.* SMCRA §§ 515(b)(10(B)(i)(prevent to the extent possible using BTCA additional contributions of suspended solids to streamflow or runoff outside the permit area); 515(b)(22)(D)(allowing disposal in springs, natural water courses or wet weather seeps as long as drains are constructed); 516(b)(9)(B)(focusing on limiting additional contribution of suspended solids to streamflow outside the permit area); 516(b)(11)(minimize, to the extent possible using BTCA disturbances & adverse impacts of operations on fish & wildlife); 516(c)(allowing mining under perennial streams, except where imminent danger to human inhabitants exists). Congress reiterated its concerns in SMCRA's legislative history, which emphasized that Congress was not primarily concerned with the footprint of MTM VFs, but rather with the downstream impact, both in terms of safety to populations and the environment. *See* Senate Report No. 95-128, 1st Session, p. 83.

The original purpose of the stream buffer zone (SBZ) rule was to protect a stream from sediment bearing water flowing from the disturbed area. See 44 Fed. Reg. 30619 (May 25, 1979). This purpose confirms the fact that the rule was never meant to apply to valley fills in the first place. Instead, it was directed at mining near a stream. As OSM recognized in its 1983 rule, "It is impossible to conduct surface mining operations without disturbing a number of minor natural

streams, including some which contain biota." 48 Fed. Reg. 30313 (June 30, 1983).

The CWA, as well as OSM regulations, provide ample protection for streams. CWA § 404 permits provides extensive protection, including mitigation requirements that are beyond that required by SMCRA. In addition, almost a dozen other SMCRA regulations provide protection for the hydrologic balance and fish & wildlife.[20] The SBZ rule is therefore not only redundant, but worse, its vague language has resulted in unnecessary and costly litigation, permit delays, and uncertainty in the SMCRA regulatory programs. Therefore, this rule needs to be eliminated, or at the very least, properly clarified.

iv. Action Item 4: Advanced Identification Designation (ADID)

We strongly oppose this action. This action is unnecessary and duplicative, because authority already exists under SMCRA to designate areas that are unsuitable for mining. 30 U.S.C. § 1272. These SMCRA provisions are specifically designed for mining, and are more appropriate for use with MTM operations than is an unrelated provision meant to be applied in other contexts. Moreover, both the CWA and SMCRA require agencies to minimize duplication.

[20] *See, e.g.* 30 C.F.R. §§ 816.41-43; 816.45; 816.72, 816.97; 816.150(b)(5); 816.150(d)(1) & (d)(2); 816.151(c)(2); and 816.151(d)(5).

30 U.S.C. § 1292(c) & 1303(a); 33 U.S.C. § 1211(c)(12); 33 C.F.R. § 322.2(f)(2). Such duplicative action is also contrary to the purpose of the EIS, which calls for coordinated agency action.

In addition, ADID regulations have historically been used only for specific geographic locations and not applied to a general class of particular stream segments or water resources. EIS II C-36. ADID designation only occurs following exhaustive site-specific data collection and analysis, and thorough public participation. *Id.* Without these site-specific efforts for each headwater stream, an ADID designation for a broad category of streams would be arbitrary. EIS II D-7.

v. Action 5: Development of New Water Quality Standards

The CWA requires States to review water quality standards (wqs) at least once every 3 years. 33 U.S.C. § 1313(c)(1). The Associations support efforts by States to review and revise wqs as appropriate to ensure they are attainable and that they are based upon the latest scientific knowledge. EPA recognizes that there are a number of factors, water quality and non-water quality, that affect the attainment of the biological integrity of a particular water body, including the amount of human activity resulting in permitted and non-permitted discharges, and

the type and extent of hydrologic modifications.[21] For example, some recent literature suggests the full restoration of natural aquatic life communities may not be feasible in small watersheds with heavily urbanized areas. *Id.* at 23. Likewise, the same may be true for certain water bodies where natural background conditions or irretrievable human-induced conditions prevent attainment. As such, EPA recommends States consider developing a system of tiered aquatic life uses and subcategories which define reasonably attainable biological communities for the impacted areas. Once a refined designated use system is developed, individual water bodies may be assigned refined designated uses, as appropriate, and wqs and water quality criteria (wqc) may be revised accordingly. Such revisions are subject to EPA review and approval and require an appropriate scientific, technical or economic justification for the change. The Associations believe, particularly in light of new scientific evidence suggesting the current national water quality criteria for selenium may be over-protective, that States should undertake a meaningful review of current standards and use designations where credible evidence supports a reanalysis, e.g. such as standard for selenium.

vi. Action 6: Refine Ecological Function Protocols

[21] See EPA Guidance: Coordinating CSO Long-Term Planning With Water Quality Standards Reviews, July 31, 2001.

We support the use of appropriately crafted protocols to assist in determining the effects of MTM operations on ecology. However, such protocols must be based on real evidence and sound science, and not arbitrary numbers created just for the sake of having a threshold limit.

vii. Action 7: Rulemaking on Excess Spoil

We support this rulemaking effort by OSM. We agree that the permit applicant should demonstrate, to the satisfaction of the regulatory authority, that the volume of excess spoil is no more than necessary and that the location and configuration of excess spoil fills will result in the least environmental impact after considering alternative sites and designs. However, consistent with SMCRA § 515(b)(24), the second requirement should be required only *to the extent possible, using BTCA*, since this limitation was imposed by Congress.

viii. Action 8: BMP manual for stream protocol and mitigation

We support this action.

ix. Action 9: Refine and Calibrate Stream Assessment Protocols

We support this action. The protocols should continue to be improved and calibrated as new data becomes available.

x. **Action 10: Incorporate Mitigation/Compensation Monitoring Plans into SMCRA/NPDES inspection schedules. Coordinate SMCRA and CWA requirements to establish financial liability to ensure that reclamation and compensatory mitigation projects are completed successfully.**

We do not understand this action. This action seems to combine and confuse concepts that do not belong together. For example, NPDES does not relate to mitigation. Likewise, there is no bonding under the CWA; rather, bonding is required only under SMCRA, and only for reclamation. NMA filed comments with OSM last year on proposed changes to its bonding regulations. The comments explained that bonds are set to cover certain activities, and cannot be broadened after the fact. There is a serious problem with the availability of reclamation bonds for the mining industry. Also, heaping too much liability on the system risks additional forfeitures, which can ultimately make the overall problem worse. We are not aware of any COE regulations requiring bonding for mitigation associated with NWPs. Therefore, the agencies must be extremely careful in implementing this action.

We cannot provide further comments without more specifics on exactly what is being proposed in this action.

xi. Action 11: Apply Stream Assessment Protocols to Determine On Site Mitigation Requirements

The SMCRA regulatory authority should apply the stream assessment protocols to determine on site mitigation requirements so long as the protocols are realistic and produce realistic assessments. However, certain protocols that have been developed so far are of questionable reliability. For example, the Louisville Protocol has not undergone extensive peer review or public comment, and may contain errors.[22] In addition, permittees should receive credit for SMCRA reclamation towards mitigation requirements.

xii. Action 12: Creation of a Dynamic GIS Database for evaluating and Tracking Aquatic Cumulative Impacts

We support the gathering of additional data to better evaluate and track the cumulative impacts on aquatics. However, we do not agree that such information should be used to establish a "bright line" cumulative impact threshold for feasible CWA § 404 MTM permits. The evidence in the EIS uniformly suggests that such a bright line is inappropriate because there are too many site specific factors, and therefore, the creation of such a line would be arbitrary and capricious. Moreover, the EIS itself found that smaller watershed sizes, by increasing the number of fills

[22] *See* Joint Industry Specific Comments.

constructed, could result in *greater* cumulative impacts, reductions in coal reserves and increases in utility costs. EIS II C-73.

xiii. Action 13: BMP Manual for Growth Media & Reclamation with Trees

We support this action. Studies have shown that changes in reclamation techniques, coupled with modifications to OSM regulations could greatly improve the ability to grow trees on reclaimed land. Moreover, the EIS recognizes that "...impacts to soils from MTM/VF are not irreversible and that over time, soils similar to those that existed prior to mining are likely to be re-established on reclaimed mine sites." EIS IV C-7. Such techniques, if properly applied, can actually be less expensive than current practices. This is an area where OSM rulemaking could make a significant contribution to minimizing the impact of MTM operations by removing existing impediments to planting trees.

xiv. Action 14: Congressional Mandate to Grow Trees

We strongly oppose this action. A one-size-fits-all mandate such as this was not put into SMCRA by Congress in the first place because they recognized that OSM, States, and permittees needed flexibility to address site specific conditions that are most appropriate for the area. Moreover, most surface rights are not owned by mining companies, and therefore permittees cannot normally

force landowners to accept forest cover as the post mining land use. If such an amendment were made to SMCRA, it would remove a big stick from the surface property owners' bundle of rights, and cause takings lawsuits. It would unnecessarily eliminate flexibility that is built into current law. Finally, forcing States to do this may also violate the 10th Amendment to the Constitution. This is an unnecessary and bad idea.

xv. Action 15: Evaluate and Coordinate Dust/Blasting Programs and Develop BMP Manual

The creation of a BMP manual may merit further consideration. However, we oppose the regulatory actions because the EIS shows that "dust and fume emissions from blasting pose no potential health problems outside the permit area. Visible and measurable fugitive dust rarely migrated more than 1000 feet from the actual blast." EIS II C-84. Air quality control plans are already required as part of the SMCRA permit. *See* 30 C.F.R. § 780.15. In addition, MSHA also regulates explosives and blasting. *See* 30 C.F.R. §§ 77.1300-1304.

xvi. Action 16: Flooding Guidelines

We support the concept of non-mandatory guidelines to assist operators in minimizing the potential for off-site flooding, to the extent that guidelines are reasonable. However, we would not support mandatory flooding regulation

because the EIS does not support such action. It found that: (1) the predicted increases in peak flow did not cause flows to leave the banks of the stream channel; and (2) flooding was caused by mine sites that were not following or maintaining their approved drainage control plans. EIS II C-87. This evidence demonstrates that more regulations are not necessary or productive, but rather, the focus should be better compliance with existing rules and regulations at a few operations.

xvii. Action 17: Program Changes to Comply with the ESA

As noted above, the most recent biological opinion issued by FWS says that: "...surface coal mining conducted in accordance with properly implemented State and Federal regulatory programs under SMCRA would not be likely to jeopardize the continued existence of listed or proposed species, or result in the destruction or adverse modification of designated or proposed critical habitats." In addition, the EIS says that: "there are no significant differences among the No Action Alternative and Alternatives I, II, and III in terms of their ability to protect [threatened and endangered] species." EIS IV D-7. Endangered species issues can be adequately addressed on a permit-by-permit basis under existing

regulations. Neither a CWA 404 permit nor a SMCRA permit will be issued if it will result in violations of the ESA.[23]

The following section of the comments will provide detailed comments on specific sections of the EIS.

III. Specific Comments on the MTM EIS

Page II.C-30

> *The extent to which valley fills reduce energy (organic carbon) resources that may be used by downstream aquatic communities is not well known.*

Scientific research has demonstrated that no-net reduction in energy transport or energy availability has occurred. For example, the United States Geological Survey, as part of the National Water Quality Assessment Program, conducted a survey of fish communities to assess biological responses to certain stressors, with an emphasis on mining. Published in 2001, the study found that streams associated with large scale surface mining activity (including one of the streams analyzed in both the EIS benthic and chemistry reports) had high scores in terms of both sensitive individuals and total fish counts:

[23] 33 U.S.C. § 1344(c); 30 C.F.R. § 780.16; 30 C.F.R. § 816.97(b).

Among the Kanawha River streams, Clear Fork at Whitesville, Kelley's Creek at Cedar Grove and Laurel Creek at Hacker Valley ranked among the best sites in several species composition metrics.[24]

If valley fill construction or other mining-related disturbance was impacting the amount of energy available to downstream reaches, according to the positions advocated by participants in the *Value of Headwater Streams Workshop* (EIS Appendix D), a corresponding reduction in fish populations would occur below valley fills. As noted under the same section of the EIS, *"Macroinvertebrate recovery appears to be facilitated provided sufficient food sources and aquatic habitats are available."* The results of the USGS fish survey and the findings of the EIS Cumulative Impact Study (CIS) demonstrate that sufficient energy exists and will continue to exist to provide input for these watersheds and to sustain aquatic function in the downstream reaches of the watershed.

Page II.C-36, Actions 4.1 and 4.2 **Designate Areas Generally Unsuitable for Disposal Referred to as Advanced Identification of Disposal Areas**

Application of this §404 regulatory tool to mining in Central Appalachia would be redundant. Each of the factors identified as part of the ADID process are currently addressed and/or facilitated by other regulatory programs. For instance, premining baseline water quality data is collected and submitted as part of the

[24] U.S. Geological Survey. *Fish Communities and Their Relation to Environmental Factors in the Kanawha River Basin, West Virginia, Virginia, and North Carolina 1997-1998.* 2001

SMCRA and NPDES applications. The public participation avenues that are stressed in the ADID description are an integral part of the SMCRA, §401 and §402 permitting processes. While permit-specific legal challenges are not a matter of routine in the study area, the SMCRA process certainly provides the option of administrative challenge (to an appeals board) and legal challenges to the appropriate state court.

As noted by the COE in earlier rulemaking actions regarding NWP 21, the mining related dredge and fill permits are one of the only permits in the §404 program that are subject to extensive, independent environmental analysis [25]. Mining operations are subject to extensive SMCRA permitting requirements and NPDES requirements. Depending on the activity, other agencies such as the federal Mine Safety and Health Administration can be involved in permitting actions. All these existing environmental programs are subject to federal oversight: OSM in the SMCRA process and EPA in the NPDES process.

In summary, the ADID process would only add to an already comprehensive, expensive and time consuming regulatory process associated mine permitting actions.

Page II.C-37 **Stream Impairment**

> *Studies indicate that aquatic communities downstream of surface coal mining operations and valley fills may be impaired.*
> *(emphasis added)*

[25] 56 Fed. Reg.14598, 14606 (April 10, 1991) "SMCRA provides similar protections for aquatic resources as the § 404 program requirements." See also 56 Fed. Reg. 59110, 59124 (November 22, 1991), COE again acknowledges that § 404 and SMCRA protect the same resources.

Scientific research conducted for this EIS and by mining companies in conjunction with the EIS does not support this statement. The most significant change observed below valley fills was a shift in the benthic community towards more filter-feeding organisms and a reduction in mayfly population. This shift may or may not be directly attributable to valley fill construction or mining activity. OSM found similar community shifts with a distinct reduction in mayfly populations downstream of mining without valley fills:

> **A study was...conducted by OSM on the cumulative off-site impacts from a large area mine in southeastern Ohio over a twelve year period. The location of the study was on the Central Ohio Coal Company (COCCO) property where a dragline was used...Although this study was not in the EIS study area it was included to show how mining activities without valley fills can impact water quality. The chemical analysis of the impacted streams indicated similarly elevated levels of hardness, sulfates, conductivity...**
>
> **Comparative surveys of macro invertebrates...indicate similar results to those in the filled and filled/residential class sites of the MTM/VF studies (i.e.; elevated conductivity, sulfates, hardness and a decline in pollution sensitive species)...It is particularly noteworthy that none of the macro inveterate samples...showed any significant numbers or kinds of mayflies.**
> **EIS III.D-7.**

Since the OSM study cited above was in connection with mining that did not involve valley fills, similar results can be expected with any earth disturbing activity, mining or otherwise.

Neither the decline of the mayfly population or the shift towards filter-feeding organisms impacts stream function downstream. The USGS fish survey found that streams below valley fill and surface mine disturbance supported healthy and diverse fish populations, indicating that sufficient energy exists below filled areas.

> *Total fish species downstream of some filled sites were lower than mined and reference sites. However, fisheries sampling was limited by drought conditions during the study period and the sample populations may not be statistically representative.*

The Associations believe that statements regarding fish impairment are incorrect. As noted above, results of the Fish Report are questionable, and of little value. The USGS fish survey conducted in the same region as the EIS Fish Report found some of the healthiest fish populations downstream of areas subject to large scale mining and valley fill activities. As noted in the subsequent paragraph:

> *The sample size and monitoring periods conducted for the EIS were not considered sufficient to establish firm cause and effect relationships between individual pollutants and the decline in particular macro invertebrate populations. Impairment could not be correlated with the number of fills, their size, age, or construction method.*

When viewed in conjunction with the USGS fisheries report previously cited in our comments it is clear that valley fills and other mining activities are having no adverse affect on the downstream fish communities. <u>The failure of the EIS to state the obvious is a serious flaw and should be addressed in the final EIS</u>.

Page II.C-44, third paragraph under Action 6:

An example of biomonitoring to assess baseline stream health using macro invertebrate data is the West Virginia Stream Condition Index, which was used in some of the aquatic studies conducted for this EIS.

Application of the WV SCI to the southern coalfields of West Virginia is inappropriate. This assessment method was developed using data collected across the State, but an undue emphasis was placed on information collected in the central and northern regions. The conditions in these other regions are quite different that those that exist within the primary region of MTM/VF which rests in the southern portion of the State. A more region specific assessment would account for the natural conditions evident in the West Virginia portion of the study area Further, the results of the WV SCI have been incorrectly interpreted to assign "impairment" to several streams.

Finally, it is inappropriate to conclude that changes are the result of valley fills. For example, OSM's evaluation of a large scale surface mine in Ohio, the Central Ohio Coal Company Study (OSM COCCo. Study) documented similar benthic changes below mining disturbance that did not include valley fill construction. Mayfly taxa were virtually non-existent in this study as well. Because of generally flat terrain of the mined area, OSM COCCo. Study could be characterized as an evaluation of <u>excavation</u> rather than <u>mining</u>, so similar impacts to the mayfly taxa should be expected below any activity that fractures rock and disturbs the soil.

Page II.C-51, NWPs Discussion:

On January 15, 2003 the COE reissued all of its NWPs. Those permits generally identified upper limit thresholds for NWP applicability of each identified activity. In considering the need for thresholds for NWP 21, the COE determined that there was currently no scientific basis for a programmatic threshold. Additionally, the COE believes the coal mining is different from activities authorized under other NWPs in that coal mining projects are reviewed for environmental impacts under other federal authorities.

As noted in this section of the EIS narrative, coal mining is subject to extensive and detailed environmental analyses through the state or federal SMCRA, NPDES and 401 water quality certification programs. Any potential environmental impacts of mining are identified and addressed prior to the issuance of the SMCRA and NPDES permits. These existing permit reviews which occur independent of the §404 permitting process are sufficient to insure that "no more than minimal" impacts will result from the proposed mining operation.

However, the COE made the commitment to re-evaluate the possibility of an upper threshold for NWP 21 after this EIS is completed.

The existence of the SMCRA and NPDES permitting programs, coupled with data collected through the EIS technical studies and other scientific research support a final decision by the COE to assume that all §404 permit applications are eligible for authorization under NWP 21 as advocated under alternative three, and that an upper threshold is not required. Specific evidence to support this approach and alternative are presented under our General Comments.

Page II.C-52, Compensatory Mitigation, General Comment:

The COE encourages applicants to perform compensatory mitigation projects in conjunction with mining operations;

A permanent conservation easement is required for mitigation and coal mine companies frequently do not own the property they are mining.

Requiring permanent conservation easements works at odds with encouraging on-site mitigation performed as part of the reclamation of a mined area and improperly extends the COE's influence beyond its statutory jurisdiction. As the statements cited above acknowledge, coal companies usually do not own the land on which they are mining. Instead, the mining companies lease the right to extract the mineral and the surface of the area reverts back to its owners once extraction and reclamation are completed. Because of this unique land ownership arrangement, the ability of the mine operator to obtain property and execute conservation easements is extremely limited, if not impossible. Unlike other development activities that impact wetlands and require §404 permits, mining is only a temporary land use. Whereas highway, infrastructure and building construction are permanent activities, mining only occurs in an area for a relatively short time. Any mitigation project undertaken for these permanent activities lends itself better to perpetual easements, since property is usually purchased by the permittee in conjunction with these permanent land uses and maintained in perpetuity as simply an extension of that project. Other natural resource extraction activities often coexist with mining, with timbering and natural gas production being the most prevalent activities. These activities, like coal

extraction, are temporary and are usually facilitated through leases, not ownership. Conservation easements could potentially complicate these other extraction activities thereby reducing the land's overall value and presenting a takings situation.

A conservation easement forecloses the possibility of future use or development and eliminates the private property rights retained by the landowner

As with many other particulars to the "wetlands" mitigation requirements it is clear that mining and the temporary nature of coal extraction was never considered in the development of this requirement.

Imposition of a conservation easement is unneeded and duplicative. Any future activity that could impact jurisdictional waters would require §404 authorization from the COE.

Page II.C-73, last paragraph, Establishing Cumulative Impact Thresholds:

> *Based on the fact that there have been 5 individual permit applications compared to the 81 projects approved under NWP 21 in West Virginia, it appears that applicants are designing the majority of MTM/VF proposals to stay below the 250-acre minimal impact threshold and thereby avoid the IP process.*

This statement is presented without any explanation as to the effects of the interim 250-acre NWP/IP permit threshold. Operations in West Virginia redesigned to fall under the 250-acre reduced projected employment and production numbers. A particular operation in Nicholas County West Virginia was redesigned by the permittee to reduce valley fill configurations in order to fall below the 250-acre

watershed restriction. The project's planned recoverable coal reserves were lowered from 25 million tons to 8 million tons.[26]

The EIS technical studies found similar results, which are summarized on page IV.I-3:

> **The economics studies show a direct correlation between fill size and shifts in production due to increased mining costs. The Hill & Associates sensitivity analysis projected reserve reductions of 22 and 45% as well as cost increases of around 8 and 14% when all fills are restricted to 250- and 75 acre watersheds respectively.**
>
> **The Hill & Associates studies generally concluded that smaller fills necessitate less complete extraction but more rapid depletion of the surface mineable reserve base with different equipment types...**

The effects of the 250-acre threshold require more explanation in the EIS as the reader is left with the impression that the limit is impact-free, which it clearly is not: reserve bases are being reduced and the projected life of particular mine sites are being diminished with coincident reductions in employment, state tax collections etc.

Page II.C-45, Fill Minimization, General Comment

The entire discussion of fill minimization in this section overlooks a critical controlling factor in the location and development of mining operations. Coal mining occurs where the coal resource exists. Unlike other land disturbance activities that potentially impact jurisdictional waters, alternatives to filling are

[26] *Bragg v. Robertson*. Civil Action 2:98-636 U.S. District Court for the Southern District of West Virginia,

generally not available to the coal industry. As noted in the Mining Technology section of the EIS, all disturbance for surface or underground mining in the region will result in the generation of spoil. AOC reclamation returns most of this spoil to the mined area, but because of the "swell" factor of fractured overburden, not all the spoil, even under an AOC scenario can be returned to the mined area

Page II.C-47

> *Compensatory mitigation for unavoidable impacts is required by the CWA for both general and individual permits. The amount and type of compensatory mitigation required are determined by the functional assessment of the waters impacted by a specific project; i.e. higher quality streams require more mitigation than lower quality streams. The functions of streams lost through filling can require substantial mitigation as compensation. Consequently, mitigation to replace and restore aquatic functions can be a costly endeavor. Therefore, the cost of mitigation can serve as an incentive to minimize valley fills in aquatic habitats.*

Assuming that exorbitant mitigation requirements will result in fill minimization is a false impression. First, any disturbance, mining or otherwise, in the steep slopes of Central Appalachia will result in the generation of excess spoil. For mined areas, existing SMCRA requirements mandate these areas be restored to AOC unless an alternative land use is justified by the applicant. Even if AOC reclamation occurs based on the swell factor of the interburden and overburden some fill material MUST be placed in a valley fill regardless of mitigation requirements:

> **The primary reason for using valley fills is that the excavation of overburden results in a greater volume of**

Avadavit of William B. Raney.

> **material than was present on the mine site before mining. When bedrock is broken up forming spoil, void spaces are left between the individual rock fragments, causing them to occupy a greater volume than the original, unbroken rock. This expansion is referred to as swell and typically represents a volume increase of about 40 percent. Compaction of the spoil during backfilling partially offsets swell as the rock fragments are squeezed together by the weight of the overlying material, but this shrinkage factor will not completely return the spoil to its solid...volume.**
>
> **Particularly on steep-sloped mine sites, the excess spoil generated by the swell factor cannot be completely backfilled on the mine bench with the construction of potentially unstable slopes or substantial deviation from AOC**
> EIS III.K-3.

The EIS economics technical studies demonstrated that the physical and economic recoverability of a given coal reserve is directly tied to available valley fill opportunities:

> **The economics studies show a direct correlation between fill size and shifts in production due to increased mining costs.**
> EIS IV.I-3.

So, rather than encouraging fill minimization and stream avoidance, draconian mitigation requirements will only increase the cost of mining and act as a de facto programmatic barrier to mining activity in the region, much like the specific watershed acreage restrictions considered but ultimately rejected for inclusion in the EIS.

Another result of excessive mitigation requirements is to discourage post-mining land development. Though lack of suitable, stable land remains a chronic

economic and social problem throughout the study area, mitigation requirements and costs will discourage these post-mining developments.

Site specific conditions may exist that permit the operator to further minimize fill placement beyond the existing AOC requirements if suitable adjacent, attainable areas such as AML benches exist, but the incentive to use these areas is provided in the 404(b)(1) analysis and would be identified in the SMCRA permitting process absent any increased mitigation costs.

Page II. C-52, Compensatory Mitigation, General Comment:

As the EIS properly notes, environmental conditions in the study area provide ample mitigation opportunities:

> *The Appalachian coalfields provide almost limitless opportunities for watershed improvement, following almost 100 years of abandoned mine land (AML) problems. Mine drainage pollution, eroding spoil on the down slope, clogged stream channels, abandoned highwalls and coal refuse areas, and other orphan land problems exceed the capacity of the SMCRA AML Trust Fund. Many of the problems are such low priority that it is unlikely that the AML program will ever address them.*

Acid mine drainage and other stream impacts such as eroding spoil or coal refuse emanating from AML sites is by far the most serious and common water quality problem in the study area. A cursory glance at the 303(d) list of any of the states within the Central Appalachian region reveals hundreds if not thousands of streams identified as impaired from these impacts. The above-cited paragraph is also correct by observing that few, if any of these problems will be alleviated by the current AML program established under SMCRA, where impacts posing

threats to health and safety receive the most attention and funding. While the AML fund may not provide for timely reclamation of sites impacting water quality in the study area it provides an excellent structure to facilitate reclamation and remediation of these areas through mitigation.

Except for Tennessee, all the states currently have an AML program that has been delegated to the state regulatory authority. These state AML programs use allocations from the federal AML fund to complete reclamation of identified pre-SMCRA disturbance. Using this existing structure, operators seeking 404 authorization for valley fill construction would, in cooperation with the state AML agency, identify an AML site(s) that is adversely impacting water quality. The operator would then work with the AML agency to alleviate these impacts. Mitigation credit would be assessed based on the overall improvement to water quality and habitat.

Approaching mitigation from this more practical standpoint will have a substantially greater improvement on the environmental health of the area than will in-kind replacement of headwater streams for several reasons. First, the scopes of potential impacts are not of a severe magnitude. Headwater streams will continue to comprise roughly 60% of total stream length in Central Appalachia and the area will maintain sufficient PEC scores. Second, structures constructed in accordance with SMCRA mandated mining and reclamation standards can serve as onsite mitigation. Research has demonstrated that these SMCRA provide unique habitats (through wetlands) that do no exist in the study area. Third and

most important, improving or preserving the energy transported from headwaters to the downstream system means nothing if other stressors such as AMD and excessive sedimentation impair or eliminate the aquatic habitat. In other words, mitigation efforts that restore, preserve or enhance the energy transport from mined areas means nothing if there are no macroinvertebrates alive downstream to consume this energy. This approach to mitigation is best viewed as a "watershed" approach that results in an overall net environmental benefit.

Similar environmental benefits will be seen from other water quality improvements that can be implemented through mitigation. The second most prevalent water quality problem in the study area results from the lack of public infrastructure. Failing or nonexistent wastewater treatment systems contribute to stream degradation in the region as do crude road crossings, stream bank erosion caused by repeated flooding and residential stream encroachment. Again, using the watershed approach to mitigation, it makes little sense to enhance the energy transport of the mined area through enhanced SMCRA structures or preservation of headwater reaches only to have this energy flow to a downstream area that is severely impacted by fecal coli form, or from another stressor resulting from the lack of infrastructure.

The correction of pre-existing water quality stressors coupled with vast mitigation potential of mining-created wetlands, ponds and side drains make the study area a "gold mine" of mitigation possibilities, and <u>the final EIS should recognize and promote these "nontraditional" mitigation measures.</u>

Page II.C-53, COE Stream Assessment Protocol, General Comment:

The Louisville Stream Assessment Protocol is mentioned throughout this section. Use of a functional assessment may indeed facilitate mitigation decisions, but the value or applicability of the Louisville Protocol is not as established as the discussion in this section presents it to be. Unlike the EPA RBP, the Louisville Protocol has not undergone an extensive peer review or public comment.

The Louisville Protocol is based on an earlier study conducted by the Kentucky Division of Water, so any errors made in this proceeding endeavor will be amplified by application of the Louisville Protocol. Serious questions exist regarding the inclusion/exclusion of particular benthic metrics in the document that may unfairly skew the assessment and the documents' heavy reliance on conductivity.

II. D-1, Alternatives Considered but Not Carried Forward in This EIS, General Comment, entire section:

Both SMCRA and the CWA clearly contemplate fill construction in streams, as noted in our introductory comments. Each of the various specific fill restrictions presented in this section ignores this basic, underlying premise: Mining and valley fill construction is legal and with recent court decisions its legality is crystal clear. Two specific legal challenges have targeted surface mining in Appalachia specifically. *Section I, Purpose and Need* provides a cursory glance at these recent judicial assaults that sought to undue Congressional statutory intent and decades of regulatory interpretation by the very agencies that have prepared this EIS. The

first, styled as *Bragg v.Robertson* was centered on the SBZ of OSM and a similar provision found in West Virginia's state surface mining program. The District Court in this action chose to accept the plaintiff's tortured reading of federal and state mining law that construed the SBZ to prohibit valley fill construction in intermittent and perennial streams. The *Bragg* decision was reversed by the U.S. Court of Appeals for the Fourth Circuit on federalism and jurisdictional questions. A subsequent action was filed in the same Court, this time challenging the COE's interpretation of the CWA to permit valley fill construction under §404. The same District Court this time held, despite years of interpretation to the contrary, that mining spoil was "waste" under the CWA and could not be permitted pursuant to §404. In the decision, the District Court went so far as to dismiss a pending EPA-COE rulemaking that would finally end the confusion surrounding mining spoil and place it firmly within the jurisdiction of the COE as "fill material". This decision too was appealed to the Fourth Circuit and again the Appeals Court reversed. In this case there was no overriding question of jurisdiction and the Appeals Court spoke directly to the legality of surface mining in the context of both SMCRA and the CWA:

> **While SMCRA does not define "fill material", its "excess spoil material," 30 U.S.C. section 1265(b)(22), is defined in the SMCRA regulations as material placed "in a location other than the mined-out area."...And, regardless of whether the fill has a beneficial primary purpose, SMCRA does not prohibit the discharge of surface coal mining excess spoil in waters of the United States.**

> **Indeed, it is beyond dispute that SMCRA recognizes the possibility of placing excess spoil material in waters of the United States...**
> **It is apparent that SMCRA anticipates the possibility that excess spoil material could and would be placed in waters of the United States...**[27]

The Appeals Court decisions in *Bragg* and *KFTC* ,which predate the release of this EIS, have properly recognized Congressional intent and sustained years of regulatory implementation. Consequently, any such alternative contemplated by the agencies seeking to ban valley fills would require a statutory change and reach far beyond the programmatic scope of this EIS.

The watershed specific fill restrictions explained in this section ignore the scale and scope of current and anticipated mining activity in the region and appear to assume that mining and valley fill construction activities were affecting vast regions of the study area, while in fact that is not the case. The CIS has determined, using liberal estimates, that mining and valley fill activity could potentially impact 4.10% of the streams in the study area. The same study found that the dominant land use of the area will continue to be dense, unmanaged forest over: 87.5% of the study area is forecast to remain unchanged when all disturbances including mining are considered. Assuming a worst-case scenario of mining disturbance (no renewed emphasis on reforestation and fill minimization) the same study found that the area would maintain adequate PEC scores to support healthy and abundant terrestrial and aquatic life. So, even absent the scientific

evidence showing the minimal/beneficial effects of mining, the minute scale of disturbance would not justify the sweeping changes and restrictions contemplated under this section.

Page III.C-3, Energy Sources and Plant Communities:

> *Headwater energy sources are important, not only to invertebrates and vertebrates in upper reaches of the watershed, but excess organic carbon is subsequently utilized by life forms in all stream orders down gradient. Since streams have a unidirectional flow, downstream areas are also dependent on upstream areas for portions of their energy.*

This statement leaves the impression that energy can only be supplied by headwater streams. Research conducted by the coal industry in conjunction with the EIS indicates ponds and wetlands constructed during the mine reclamation provide similar, adequate sources of downstream energy:

> **The streams with valley fills have a sediment retention pond located typically in the most upstream reaches of the stream just below the fill area. These ponds carry out a similar function for the upstream reaches of the streams. In the ponds, biological communities are established which are dependent on algal growth, not leaf litter, as a food source. The algae and detrital material flowing from the ponds act as the food source for the downstream communities.**[28]

In addition, upon completion of the reclamation process, vegetation will have returned to the area, replacing the coveted "aquatic-terrestrial interface". Further,

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[27] *Kentuckians for the Commonwealth v. Rivenburgh*, 317F.3d. 425 (4th Cir. 2003).
[28] Arch Coal Supplemental MTR/VF EIS Study Report, April 2002

fisheries research conducted below mining impacted watersheds indicates that healthy and diverse fish populations are thriving. According to the River Continuum Concept that is postulated as the true value of headwater streams, one must assume that sufficient energy input is occurring in the stream to support these downstream communities.

Page III.C-5, Organic Matter Processing, general comment, entire section:

The entire discussion presented in this section is devoted to an explanation of the River Continuum Concept (RCC). This theory suggests the health of an entire river ecosystem is associated with organic energy that is processed in headwater stream reaches and subsequently transported downstream. The RCC forms the basis for many of statements made in the EIS regarding the possible effects of valley fill construction in headwater streams.

The RCC may be inapplicable to the steep-sloped terrain and stream systems of Central Appalachia for several reasons. First, the RCC assumes a pristine environment, which is certainly not the case in the study region:

> **The Appalachian coalfields provide almost limitless opportunities for watershed improvement, following almost 100 years of abandoned mine land (AML) problems. Mine drainage pollution, eroding spoil on the down slope, clogged stream channels, abandoned highwalls and coal refuse areas, and other orphan land problems exceed the capacity of the SMCRA AML Trust Fund. Many of the problems are such low priority that it is unlikely that the AML program will ever address them. EIS page_____**

Second, the RCC assumes that extreme headwater stream reaches provide the only opportunity for energy inputs to the river system through the aquatic-terrestrial

interface that occurs in forested headwater streams. This is not the case in the study area. Research conducted by mining companies confirms that energy inputs continue in mining watersheds regardless of the level of impact in associated headwater areas because most of the streams below mining areas are forested:

> **The cumulative impact study found that over 80% of first to third order streams in the EIS study area are surrounding by forest.**
> EIS III.D-18.

III.D-1, Loss of Linear Stream Length from Filling and Mining Activities Associated with Fills, General Comment

The findings of the EIS technical studies which are referenced in this section further illustrate the need for the agencies to view potential impacts of mountaintop mining in terms of scope and scale. Only 2.05% of the total stream miles have been directly impacted by valley fill construction and mining activities, and projected future impacts will total only 4.10% of the total stream miles within the region. Absent the renewed emphasis placed by the agencies on mitigation, with a preference for on-site, in-kind mitigation, mining will not result in the mass elimination of headwater streams. As the coal industry, SRAs and the COE implement new mitigation techniques in accordance with the recommendations of the EIS, it likely that the stream segments directly impacted by mining will be more than offset by either stream/wetlands creation during reclamation and/or water quality improvement projects undertaken by operators.

Page III.D-2, Loss of Biota under Fill Foot Print or from Mined Areas,

General Comment:

The Associations do not dispute that the biota present within the fill footprint are lost once fill construction has been completed. Based on the results of the CIS, the benthic organisms common in headwater streams that are subject to fill activity are by no means in danger in the study area. With a mere 4.10% of the streams in the study area projected to be impacted by mining operations, sufficient habitat for these macro invertebrates will continue to exist in the study area. The concern for the biota of these streams should not focus on the minute fraction impacted directly by fill construction, but the ability of reclamation and mitigation to replace the function of these benthic species in the overall aquatic system. EIS Appendix D, *Value of Headwater Streams* concludes that the single most important feature of the biota of headwater streams is to provide energy input to support the health of the streams down gradient of the headwater areas. Subsequent technical research has demonstrated that sufficient energy inputs continue to exist below filled areas.

These studies are summarized on page III.D-9 of the EIS:

> **Overall the abundance of macro invertebrates was found to be similar in upstream and downstream stations or to be slightly higher in downstream stations.**

Other industry sponsored research supports this conclusion:

> **Increased abundance at the filled sites, as compared to the unmined sites and the presence of a similar shredder community**

> **indicates that sufficient food is available to support a benthic community and that downstream communities are likely receiving particulate organic material from these more upstream segments.**[29]

This conclusion is confirmed by the USGS Fisheries Study that found some of the healthiest fish populations in watersheds associated with large scale surface mining and valley fill construction.

In summary, it is reasonable to assume that the energy processing and transport will continue. . Mountaintop mining will potentially impact only 4.10% of the total stream miles in the study area, 60% of which are first order headwater streams, dispelling any myth that mining and valley fills are eradicating all headwater streams. Benthic research has demonstrated that abundance remains high below fills and that the ponds and wetlands created during reclamation are providing their own energy inputs to the stream reaches. The USGS fisheries survey confirms the benthic research, finding that heavily surface mined watersheds supported healthy and diverse fish populations.

Page III.D-5, Changes in Downstream Chemistry:

> *Comparisons to AWQC were performed with a subset of the total data set as explained in USEPA (2002a). Selenium concentrations from the filled category exceeded AWQC for selenium at most (13 of 15) sites in this category.*

Finding selenium concentrations above the suggested criteria can be expected given the overall background levels of selenium present in the native soils of the

[29] Arch Coal Supplemental MTR/VF EIS Study Report, April 2002

area. Similar concentrations can be expected below any land disturbing activity in the region:

> **...we see that in the region of MTM/VF mining, the coals can contain an average of 4ppm of selenium, normal soils can average 0.2ppm and the allowable limits are 5 ug/L (0.005 ppm). Disturbing coal and soils during MTM/VF could be expected to result in violations of the stream limit for selenium** [30]

> *While improvements in pH, iron and manganese were seen , median concentrations of sulfates among all sites increased from 38 mg/L to 56 mg/L in the north and, and from 46 mg/L to 77 mg/L in the south.*

The presence of sulfate, as noted in the narrative, is indicative of disturbance, not necessarily mining induced disturbance . This conclusion is confirmed by the presence of similar sulfate levels below a large scale mining operation in Ohio that did not involve fill construction.

> *In the USEPA (2002a) stream chemistry study, selenium was found to exceed AWQC at Filled sites only and was found to exceed AWQC at most filled sites included in the study.*

As noted in previous comments, selenium is inherent in the soils and coal of the region.

> *The existence of selenium concentrations in excess of AWQC at most of the filled sites indicates a potential for impacts to the aquatic environment and possibly to higher order organisms that feed on aquatic organisms.*

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[30] U.S. Environmental Protection Agency. *A survey of the Water Quality of Streams in the Primary Region of Mountaintop/ Valley Fill Coal Mining.* 2002.

This statement is misplaced given the level of understanding relative to selenium impacts and technical research that found healthy aquatic communities in watersheds exceeding the suggested water quality criteria for selenium.

The EIS chemistry study, from which the above cited EIS narratives are drawn, mentions the effects of selenium based on research conducted by Lemely in lotic (non-flowing) habitats, specifically a large pond with extended water retention times. This is a vastly different situation than what exists in the headwater streams of Central Appalachia. Therefore is incorrect to extend the results of the Lemely studies to this EIS.

EPA is currently in the process of revising the suggested water quality standard for selenium. In February 2002 the agency published a draft of these revisions. Among the conclusions and observations included in the draft document are several that are relevant to this EIS and the assertion that detectable selenium concentrations in the water column are indicative of negative impacts.

> **Since the issuance of the 1987 chronic criterion of 5ug/L, considerable information has come forth regarding the route of exposure of selenium to aquatic organisms. Studies have shown that diet is the primary route of exposure that controls chronic toxicity to fish.**
>
> **...diet controls selenium chronic toxicity in the environment and water-only exposures require unrealistic aqueous concentrations in order to elicit a chronic response...**
> ***...a water-based criterion is not appropriate for selenium* because diet is being the most important route of exposure for chronic toxicity.**

> **If the organisms are provided with an uncontaminated diet, then *exceedingly high water concentrations, possibly above the acute criterion, are needed to elicit effects...***
>
> **Sediment has also been proposed as a medium upon which to base the selenium chronic criterion, but because of the patchiness of selenium in sediment and an insufficient amount of data to support a casual link between concentrations of selenium in sediment and the chronic effects observed in fish, a sediment-based criterion was not selected.** [31]

Considering the findings of EPA in the draft revised selenium criteria, that water column concentrations of selenium are not correlated to toxicity in fish and that the natural background of selenium present in the soils of the study area, it is clear that application of the current suggested water quality criteria for selenium should be reconsidered.

The USGS fisheries survey supports both EPA's revised selenium water quality criterion and clearly demonstrates that selenium concentrations in the study area have not impacted the aquatic community in the study area. The EIS chemistry study found detectable levels of selenium on sampling sites within the Clear Fork Watershed:

Site	Selenium Concentration
MT-62	2.8 ug/L
MT-64	13.0 ug/L

Despite these concentrations, the USGS Fisheries Study concluded:

[31] See generally *Draft Aquatic Life Water Quality Criteria for Selenium 2002*, EPA Contract No. 68-C6-0036 (March 2002 Draft).

> **Clear Fork at Whitesville...had good scores in most of the four proportional metrics;**
>
> **Among Kanawha River sites, Clear Fork at Whitesville...scored among the best sites in several structural metrics...**
>
> **Among Kanawha River streams, Clear Fork at Whitesville...ranked among the best sites in several species composition metrics.**[32]

Given the current status of the selenium water quality criteria, the natural background levels of selenium present in the soils of the region and the inability of the EIS studies and other technical research to correlate impairment to any specific parameter verbiage inferring impacts from selenium should be deleted from the final EIS. Thus, the best approach to possible water-quality induced impacts is presented in the final paragraph of the summary and conclusions section:

> **Further evaluation of stream chemistry and further investigation into the linkage between stream chemistry and stream biotic community structure and function are needed to address existing data gaps.**

Page III.D-7, Changes in Downstream Sedimentation (Bed Characteristics)

> *...the mean substrate size class was found to be very similar between unmined, filled, filled residential and mined EIS class sites.*

Data summarized in this section demonstrates that the sediment control requirements of SMCRA are functioning and preventing offsite impairment.

Page III.D-8, Effects to Downstream Biota

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[32] U.S. Geological Survey. *Fish Communities and Their Relation to Environmental Factors in the Kanawha River Basin, West Virginia, Virginia, and North Carolina 1997-1998.* 2001

h.1. Summary of Results from Upstream-Downstream Comparison Type Studies

> *Overall, the abundance of macro-invertebrates was found to be similar in upstream and downstream stations or to be slightly higher in downstream stations.*
>
> *The largest difference seen between upstream and downstream locations was the change in proportion of sensitive groups.*

The results of these studies demonstrate that valley fill construction and mining activity are not having an adverse impact on streams. A mere shift in community structure does not constitute degradation, especially if sufficient energy remains for transport downstream. According to the results of these studies, streams with mining activity in their headwaters are still carrying out the primary function of pristine headwater reaches.

h.2. Results of Comparison of Pre-mining Biotic Conditions to Post-mining Aquatic Communities

> *The authors of this report stated that a qualitative comparison of current to past results suggests that the aquatic macro invertebrate community has undergone a shift to a more tolerant, less sensitive community.*
> *Changes in the downstream station were similar to those seen at the upstream station for abundance and taxa richness. However, the diversity and evenness of the downstream macro invertebrate communities decreased...and the proportion of tolerant organisms increased notably...*

The studies cited in this section analyzed mining and disturbance, not necessarily valley fill construction:

> *These studies did not specifically address the presence of or potential impacts from valley fills.*

This ongoing project confirms the results of other studies referenced or included in this EIS. As in the OSM COCCo Study, a shift was observed in the downstream benthic community that appears commensurate with disturbance of the native rock and soils. This shift cannot be termed impairment however, unless the downstream reaches of the watershed are failing to receive adequate energy inputs. Other studies have confirmed that sufficient energy is being provided by mining-related structures and that no net-reduction in watershed productivity and diversity has occurred.

h.3. Results of A Multivariate Analysis Study on Benthic Invertebrate Communities and Their Responses to Selected Environmental Factors

> Coal mining appeared to influence invertebrate communities through two factors...

h.4. Studies of Macro invertebrate Communities in Stream Sites Located Downstream from Mined/Valley Filled Areas in Comparison to Reference Locations

> *Biological conditions in the unmined sites generally represented a gradient of conditions from good to very good, based on the WV DEP SCI scores...*

The wide variability of the scores on the unmined reference streams demonstrates a known fact that is mysteriously absent from the discussions in the draft EIS. Headwater streams are extremely unstable systems in their natural condition as they rely primarily on rain-induced runoff to sustain life and contribute to the synergy of the aquatic ecosystem:

> One[unmined] site scored in the high-end of the fair range in the summer of 1999, one site scored in the poor range in the fall of 1999, and one site scored in the high-end of the fair range in the winter of 2000.

> *Biological conditions in the filled sites generally represented a gradient of conditions from poor to very good...However, over a third of the time, filled sites scored in the good or very good range over the five seasons.*

This statement is probably the most important contained in the EIS and it deserves more attention and focus. Readily apparent is the reality that filled streams are supporting the aquatic processes that receive so much attention as the source of life throughout the stream system. In a region that suffers from multiple water quality stressors such as AML drainage, lack of infrastructure and failing wastewater treatment systems, the effects of valley fill construction appear negligible.

> *The authors believe water quality explains the wide gradient in the biological conditions at the filled sites.*

The OSM COCCo. Study documented increased conductivity below mining that did not involve valley fill construction, demonstrating that increased conductivity should be expected with any human development (mining, residential or highway construction) or natural disturbance (land slides). Again, the background natural conditions of the area appear to make such situations unavoidable. Any development or improvements that are going to occur in the region are going to involve land disturbance- earth and rock will be excavated, and fills will likely be

built whether it is for mining, roads, schools, housing etc. Based on the research presented in this EIS, all of these activities will be expected to have similar increases in conductivity. Since the inherent geological and topographic features of the area are such that excavation and fill construction is required in connection with development and mining, the question should not be if conductivity is increased, but what effect conductivity has had on the stream system as a whole. In our comments on other sections of the EIS, the Associations have presented the results of studies conducted for the EIS, by coal operators in conjunction with the EIS , independent of the EIS but within the study area and outside of the study area but related to the subject at issue. The bulk of this research documents a ***shift*** in the biologic community below ***disturbance***. There is some question as to how directly this shift can be correlated to particular water column parameters including conductivity:

> **Differences between the benthic macro invertebrate communities in the unmined and filled sites were evident in metrics involving the mayfly population which decreased below the fill sites. Stoneflies were prevalent in these sites, however, indicating that water quality may not be the limiting factor for the absent mayflies as they are both sensitive taxa** [33]

Whatever the cause, it is overly apparent that this change does not correlate to impairment. In fact, by supplying a more constant source of energy to the stream below (though wetland and pond construction), mining may improve the health of the watershed.

Biological conditions in the filled and filled/residential classes were substantially different from the conditions in the unmined class and were impaired relative to conditions in the unmined class, based on the WV SCI scores.

From the results of the EPA Streams study and other related research, it is apparent that the aquatic communities were **different** among the classes, but not impaired:

> **Overall, the filled sites are only significantly different from the unmined sites with respect to the percentage of the population comprised of mayflies.**[34]

As noted in our earlier comments, ponds and wetlands are constructed during the mining process to control sediment and in some instance attenuate flow. These wetlands and ponds influence the composition of the benthic community:

> **Changes in the benthic macro invertebrate community structure below impoundments are well documented...These changes may result from flow constancy, organic loading , temperature changes or a combination of factors...mayflies and stoneflies are often eliminated below impoundments.**[35]

The elimination of the mayfly taxa CANNOT be linked to impairment as the EIS narrative attempts to do:

> **Below the filled sites, the sensitive EPT taxa still comprised an average of 50% of the population.**
> **Also of interest below the fills is the presence of a shredder community very similar to the unmined reference streams...The similar communities in the filled and unmined streams indicate that the downstream reaches of the streams are being supplied**

[33] Arch Coal Supplemental MTR/VF EIS Study Report, April 2002
[34] Arch Coal Supplemental MTR/VF EIS Study Report, April 2002
[35] ibid

with coarse and fine organic material which are the major contribution of headwater reaches described in the river continuum theory.[36]

The cited EIS statement should include a qualifier regarding the stream size sampled in the study. Generally, all of the streams sampled below valley fills were larger streams than those sampled in the unmined/reference class. The unmined reference sites were located on first and second order streams while the filled sites were located on third, fourth and fifth order streams. Changes in the composition of the aquatic community are expected as stream order increases .

Page III.D-15, Impacts of MTM/VF on Fish Assemblages

> *The USGS (2001b) found that stream size and zoogeography masked any potential water quality effects of land use on species composition and relative abundance of fish communities in the area.*

This statement appears to be a weak attempt at explaining away the findings of the USGS fisheries survey. The specific results of this study are enormously important to this EIS. This study determined that one of the healthiest fish communities existed at Whitesville, on the Clear Fork tributary to the Coal River. It is a well-known fact that this watershed has been heavily mined, with most recent extraction occurring in the form of surface mining with valley fills. The EIS Chemistry study found detectable levels of selenium within the watershed, yet the USGS Fisheries Report observes a healthy and diverse fish population.

[36] ibid

The USGS Fisheries Report also designated streams as impaired that were associated with mining activity. However, both of the watersheds are more correctly identified as areas of **historical** mining. Both of these watersheds have identified sources of serious AMD and sedimentation impacts from pre-SMCRA activities.

Page III.D-15:

> *For example, fish collected from one lake downstream of an extensive mining complex in West Virginia were found to contain selenium concentrations much higher than would be expected to occur naturally, indicating that the selenium associated with mining operations occurs in a form that is biologically available for uptake into the food chain (U.S. FWS, unpublished data).*

This reference is entirely inappropriate and should be deleted from the final EIS. First, there is no place for unpublished, un reviewed data in a document of record such as this EIS. Second, "concentrations much higher than would be expected to occur naturally" contradicts assertions made in the EIS chemistry study which recognized that the natural background levels of selenium in the soil, overburden and coal approach the limit established by the current water quality criterion implemented in West Virginia. Third, as this is unpublished data, other possible sources selenium such as non-mining land disturbance cannot be identified.

Page III.D-17 **Studies Relating to Mitigation Efforts for MTM/VF Impacts to Aquatic Systems**

Past efforts at compensatory mitigation have not achieved a condition of no net loss of stream area or functions.

This statement is unqualified, conflicts with subsequent statements made under the same narrative section and should be deleted from the final EIS. A similar prevarication is repeated in the fist paragraph on page III.D-21. Our comments address both statements.

Mining companies have routinely created structures as part of the SMCRA mining and reclamation plan that serve to offset the loss of headwater streams from fill construction. At the same time however, these companies also satisfied the existing COE mitigation requirements imposed by the respective states and not characterized these structures as "mitigation" projects.

In the EIS technical study *A Review of Wetland Resources in the Steep Slope Terrain of West Virginia*, EPA found that few traditional wetlands existed prior to the initiation of surface mining and areas that had no surface mining had no wetlands:

> **...the percentage of vegetated wetlands (PF,PEM,PSS designations) existing in these watersheds is extremely low, representing less than 1/10 of 1% of the watershed in all cases. The majority of the NWI wetlands in these watersheds appear in most cases to be sediment ponds associated with mined sites.**

Other statements in this technical study strive at discounting the value of these created areas by declaring them "unvegetated" wetlands. However, as cited previously in our comments regarding stream function and the biologic condition

Similar conclusions can be regarding the conveyance ditches or "groin" ditches created on valley fills:

> **During the development of this EIS, technical representatives from OSM and from West Virginia have suggested that groin ditches constructed along the edges of fills may represent an opportunity for the in-kind replacement of streams with an intermittent or perennial flow regime. To date, no drainage structures observed appear to have successfully developed into a functioning headwater stream. EIS III.D-18.**

As noted in our preceding comments, reconstructing headwater streams historically never the goal of these structures. Instead, their design and construction was intended to satisfy the hydrologic requirements of SMCRA and to preserve/assure the stability of the valley fill. These functions must remain the primary objective of the ditches, as they are obviously working (no pattern of fill instability identified by the EIS technical studies). However, if these areas could be enhanced as described in this section and continue to assure the stability of the fill area this opportunity should not be ignored, since it would essentially equate to double the length of the original headwater impacted by the valley fill placement. The renewed emphasis on mitigation that has emerged from preparation of the EIS and permeates all the suggested alternative actions must acknowledge the ability of these SMCRA structures to serve as mitigation and the alternatives should include the direction to develop a BMP manual for further enhancing the values that can be provided by these structures.

Other historical, state mitigation measures focused on stream restoration through water quality improvement. As earlier sections of the EIS recognize, the study

improvement should not be summarily dismissed by the draft EIS as cited statement attempts to do and the current mitigation initiatives underway cannot ignore the benefits of this "remediation mitigation".

IV. ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES ANALZED

B. AQUATIC RESOURCES

Page IV.B-2, last paragraph:

> *...the length of stream buried by mining or valley fills displaces the biomass and proportionate amount of energy provided by fine and coarse particulate material leaving a particular reach of headwater stream.*

This fact in unarguable, however there is no indication that sufficient biomass and energy inputs do not occur in the stream reaches below the filled areas.[38] Further as we have identified in previous comments on other sections of the EIS, wetlands and ponds created during the mining process adequately offset this direct loss. The scientific research used to support these comments also indicates that by providing a more constant flow of energy input, these ponds and wetlands may provide superior contributions to the synergy of the stream system below. Since the ponds at the toes of valley fills are constructed commensurate with mining activity, any reduction in energy inputs would only be temporary in nature.

> *Consequently, leaf litter exclusion as a result of MTM/VF may affect productivity downstream due to this terrestrial aquatic relationship.*

There is no argument that valley fill placement eliminates the aquatic-terrestrial interface that exists within the fill footprint area. However, EIS technical studies have determined that some 80% of the streams in the study area are forested, indicating that substantial aquatic-terrestrial zones exists downstream of the headwater reaches that can be directly impacted by fill construction.[39] Further, most of the stream miles in the study area (60%) are headwater streams. Given the minute scale of current and potential mining impacts, adequate aquatic-terrestrial interface areas will continue to exist.

Page IV.B-3

> *The No Action Alternative and action alternatives will not eliminate the loss of stream segments and reduction in organic matter transported downstream. In the absence of standardized testing and research, it is not clear to what extent this direct stream loss indirectly affects downstream aquatic life.*

This statement incorrectly assumes that some reduction the energy transported downstream has occurred despite scientific evidence to the contrary. Similar fallacious statements in preceding sections of the EIS were addressed in detail in our comments on those sections. However, to be complete we will summarize these comments here. The EIS technical studies found a wide range of conditions below valley fills, suggesting that stream health is preserved below fills:

> **Biological conditions in the filled sites generally represented a gradient of conditions from poor to very good...however, over a**

[38] U.S. Fish and Wildlife Service, *The Value of Headwater Streams: Results of a Workshop*. 1999, EIS Appendix D.
[39] Ibid.

third of the time, filled sites scored in the good or very good range.[40]

As we have noted in detail in our comments on other sections of the EIS, the EPA benthic study referenced above did not account for or acknowledge the influence of stream order on benthic populations. Benthic assemblages are expected to be different from 1st and 2nd order streams that are ephemeral and intermittent in nature as were the unmined reference sites opposed to the filled sites in the study which were generally located on 3rd order streams that flowed constantly, possibly as a result of valley fill hydrology.

Industry supported research referenced extensively in our earlier comments has determined that the presence of ponds and wetlands at the toes of fills may provide superior energy inputs through the creation of an aquatic community that processes algae, coupled with increased and constant flow created by fill hydrology.

It is also not evident to what degree reclamation and mitigation (e.g., drainage control and re vegetation) offset this reduction

As with the previous section, this statement assumes that a reduction has occurred in areas of fill construction and our comments above are applicable here as well. As to the ability of mitigation to replace any possible reduction, the industry sponsored research and EIS technical studies suggest that stream reaches below

[40] U.S. Environmental Protection Agency. A Survey of the Condition of Streams in the Primary Region of Mountaintop Mining/Valley Fill Coal Mining. 2000.

discounting or dismissing the lack of differences between the filled and unmined reference streams.

Selenium and zinc were negatively correlated with the WV SCI.

Concerns regarding the applicability of the WV SCI to the southern West Virginia region of the study area have been presented in comments on other sections of the draft EIS.

> *The strongest association with water chemistry suggested that zinc, sodium, and sulfate concentrations were negatively correlated with fish and macro invertebrate impairments*

The value of this statement, aside from presenting inflammatory verbiage, is further questionable given the caveat presented in the Statistical Analysis with regard to fish communities:

> *...these correlations do not imply a causal relationship between the water quality parameters and fish community condition.*

Subsequent statements in the EIS narrative correctly note that the statistical results are far from conclusive and by no means support the sweeping proclamations made in the above cited portions of the EIS:

> **However, the study also concluded that insufficient data existed to determine the temporal nature of the impact or the distance downstream that the impacts persists. Due to the limited scope of the studies performed by the EIS no correlation could be made of downstream impacts with the age, number, and size of mining disturbances and fills, nor could data differentiate impacts of mining, fills or other human activity in a watershed. EIS IV.B-5.**

Also worth noting is that the Statistical Report did not correlate selenium elevations to fish community impacts as the Fisheries Report attempted to do, casting further doubts on the validity of both studies.

The Associations maintain that the balance of EIS technical research has identified a shift in benthic communities, a shift that can be attributed to a number of factors and a shift that is by no means disadvantageous. Similar shifts were found below mining related disturbance that did not involve valley fill activities at a site outside of the EIS study region suggesting that similar results can be expected below any disturbance within the general Appalachian region.

> *Constructing wetlands is a possible mitigation measure for impacts to headwater streams.*

The positive benefits provided by mining created wetlands have been identified in technical studies and summarized in comments on other sections of the draft EIS narrative.

> *Other human development activities, such as logging and other types of excavation, also pose potential threats to the nutrient cycling function, sedimentation, and other physical, chemical, and biological impacts to headwater streams in the EIS study area. However, the permanent nature of filling discussed under direct loss, as compared to the more temporary impacts from forestry suggest that MTM/VF impacts of headwater stream systems may have a longer-term impact on this system, although data do not currently suggest the duration of these impacts.*

This statement fails to consider the scope and scale of potential mining impacts and suffers a flaw that is unfortunately common in this draft EIS: an overbearing concern with the functions provided by headwater streams.

The CIS study has determined that 59,000 miles of streams exist within the study area and that 60% of these streams are headwater areas. The same study estimated that 1.23% of the streams have been impacted by past and current mining and valley fill activity and that 4.10% of the total stream miles could potentially be impacted by future mining. These results confirm that mining is affecting a relatively minute fraction of the total streams within the study area.

Threats, or more properly stressors to watersheds in the study area are well documented. On page IV.B-9 for example, the EIS acknowledges that the Central Appalachian coalfields provide almost limitless opportunities for watershed improvement. These narrative sections concur with an EPA study initiative that predates the draft EIS:

> **In general, the biological assessment results appear to indicate these are poor water quality streams prior to the impact of mining operations and valley fills.** [41]

Given the reality of stream conditions in the region, the focus on the functions of headwater streams seems misplaced. As confirmed by certain sections of this EIS, the streams of the region are impaired by a variety of stressors unrelated to current mining. Therefore the function of the headwater stream (energy input) may be

worthless if the downstream reaches of the watershed are impaired because of other impacts. As we have noted in our earlier comments regarding mitigation, the environmental condition of the study area could have been markedly improved had the massive amount of resources and attention directed by anti-mining groups and the agencies at MTM/VF impacts to headwater streams had been focused on the remediation of existing water quality problems of the region.

Page IV.B-10

> *As a result of all alternatives involving mitigation, there will be a strong disincentive for the applicant to disturb stream segments.*

This statement assumes that practical alternatives to valley fill construction exist for the mining industry and ignores the substantial amount of information collected by the EIS and summarized in the mining technology sections of the document. Because of the very nature of the topography and geology of the study area, the native rock and soil excavated to facilitate mining (both surface and underground) will "swell" and not all of it can be returned to the mined area even under the most rigorous application of SMCRA's AOC mandate. Consequently, some of this excavated material MUST be placed in a valley fill. A "strong disincentive for the applicant to disturb stream segments" already exists through compliance with SMCRA imposed AOC requirements and the 404(b)(1) guidelines of the CWA programs of the COE and EPA. The reality of increased

[41] U.S. Environmental Protection Agency. *Analysis of Valley Fill Impacts Using Macroinvertebrates.* Draft Final Report. 1998.

and what appears to be punitive mitigation requirements will not result in further minimized fills, it will only add yet another economic constraint on the ability to mine coal in this region, since other sections of the EIS narrative and the EIS mine engineering technical studies confirm that the physical and economic recoverability of coal reserves is directly correlated to the amount of fill space available. Another unfortunate result of punitive mitigation measures will be seen in post-mining land use development. The EIS has correctly observed that the lack of stable, flat land remains a substantial barrier to the economic diversification and social stabilization of the region. MTM/VF offers the unique opportunity to create such flat and stable areas at no public cost. However, any area suitable for development will need to be flat, require a variance from the AOC requirements of SMCRA and possibly place more fill material in stream segments. The punitive and overly restrictive mitigation measures contemplated in the EIS such as conservation easements will discourage these types of developments despite a clear and proven economic and social need for their creation. In short, these mitigation measures are more akin to penalizing the citizens and governments of the study area by complicating the private property rights of landowners in the area, frustrating efforts to diversify the economy while at the same time limiting the viability of the coal industry.

Accordingly, the final EIS should focus not on the ability of mitigation to discourage fill placement as fill minimization is already addressed not only through SMCRA but the 404(b)(1) guidelines

Page IV.D-5 d. fish populations, general comment, entire section:

As with other sections of the EIS, the statements in this section fail to account for the scale and scope of mining impacts. If headwater streams are indeed hotbeds of evolution, according the EPA CIS analysis only 4.10% of the streams in the study have or could be affected by mining. Considering that headwater streams comprise the largest portion of the region's streams at 60% of the total stream miles, sufficient areas will remain intact for the occurrence of "natural selection process that may result in the development of new species/subspecies".

Regarding the results of the EIS Fisheries Study, the Associations maintain that this study cannot be relied upon to deduce MTM/VF impacts. The study was extremely limited in scope and compared to patently different areas (New River and eastern Kentucky). The USGS Fisheries Survey found two of the healthiest fish populations in the area studied in watersheds associated with large scale surface mining and valley fill construction.

a. Terrestrial

II. C.

Deforestation (page II.C.-75)

General Comment

Any possible impacts from mining activities must be considered in terms of scope. As paragraphs in this section note, technical studies conducted as part of this EIS

have found that the dominant land use of the area is forestland with 92% of the area being densely forested. Mining has disturbed only about 3% of the region. The same study determined that mining, in conjunction with all human disturbances, would only affect about 11% of the area. Therefore, a large-scale elimination of forested areas is not going to occur in the region. Further, a renewed emphasis is being placed on tree growth as a result of this EIS. Considering that mining offers the opportunity to create soils that are superior to native soils and that tree growth on reclaimed mines is possible if traditional SMCRA imposed barriers to reforestation are addressed, the potential impact estimates are likely liberal and forecast a much greater decrease than will actually occur.

Page II.C-76, first paragraph:

> *Post Mining Land Uses without trees were historically perceived to be easier to achieve and less costly, as well as result in a shorter liability period for release of performance bonds.*

This statement fails to consider all the factors that influence the selection of a PMLU, such agency and community preference and regulatory achievability. As noted in the next paragraph, the reason that reclamation with trees is not more widespread is mainly attributable to SMCRA regulation and requirements related to erosion control and stability.

Page II.C-76, last paragraph.

It is possible other economic incentives could encourage reforestation.

A reference to mitigation should be added to this discussion. As noted elsewhere in the EIS and its appendices, the value of headwater streams subject to valley fill construction is the terrestrial-aquatic interface. Any reforestation initiative that is coupled to a stream restoration/mitigation project would further replace this function. Accordingly, reforestation should be considered when assessing required mitigation, as noted by the first paragraph under section a.1, CWA Program on page II.C-7:

> **The protection and/or restoration of forested riparian habitat as part of aquatic resource enhancement may result in mitigation credit by the COE for CWA section 404 permits.**

Page II.C-83, Action 14, general comment, entire paragraph:

> *Action 14: If Legislative authority is established by Congress or the states, the SMCRA regulatory authorities will require reclamation with trees as the post mining land use.*

Advocating such an action is unwise. As noted in our previous comments, no evidence exists that mining activities will result in massive deforestation of the region. The CIS determined that mining and all other human disturbances will only impact about 11% of the existing forested areas within the study area. Assuming the worst case scenario, that all future mining would result in the replacement of dense forest with other habitats the region will remain 87.5 % forest land.

A programmatic tree growth mandate imposed through Congressional edict would remove the opportunities for mining to create alternative land uses and conditions. Suitable land for development remains one of the greatest social and economic barriers in the region. Mining offers a unique opportunity to improve the usability of lands that are otherwise steeply sloped and undeveloped with little or no additional cost. Economic diversification and social stabilization (by relocating flood prone communities) are real possibilities only if alternative post-mining land uses, other than reforestation, are preserved in the regulatory program.

Page II.C-90, Section 11, Threatened and Endangered Species, General Comment, Entire Section:

As noted in our previous comments, the statements and assumptions fail to consider the scope of the activities in question. The CIS determined that mining affects only a small portion of the study area, which will remain dominated by densely forested areas. The same technical study found that headwater streams comprise 60% of all streams in the region and that mining has the potential to impact only 4.10% of these streams. In preparing the BO, the agencies MUST consider these factors. It is very apparent that neither mining nor any human activity is going to result in massive elimination of existing fish and wildlife habitat.

The EIS terrestrial studies failed to show that current mining and reclamation practices were adversely impacting existing wildlife assemblages. In fact several species thought to be rare and declining in the study region were actually found in

reclaimed areas. For example, the edge effect created by mining disturbance was determined to be a habitat for Cerulean Warblers.

To be adequate, the BO must also consider the positive effects of mining-created habitats for certain species of wildlife. The terrestrial technical studies found several species on reclaimed mined lands that were rare in the study area. Several of these unexpected species are also targeted for conservation efforts. However, at least one of the technical studies went to great lengths to ignore these terrestrial gains. The same mistakes cannot be repeated in the BO if it is to adequately protect T&E species.

Page III.B-11 Last three paragraphs concerning topsoil:

The statements and observations made in these paragraphs imply that topsoil is the most important factor in establishing tree growth. It is common knowledge that the native topsoils of the area are remarkably thin and subject to "wasting" or being destroyed or lost during any efforts to collect and stockpile them for later use. Such statements conflict with EIS technical studies, research conducted independent of the EIS and even statements made in subsequent paragraphs of the narrative.

EIS technical studies have proven that soils created during mining can be of greater value than the existing native soils. An overreaching historical observation that has been confirmed by studies conducted outside of the EIS is that proscriptive SMCRA regulations regarding compaction are the chief detractors to

reforestation on mined areas. As noted in the following paragraphs of the EIS narrative:

> **Prior to the passage of SMCRA, most surface-mined land in the east and Midwest was reclaimed with trees. The quality and productivity of these lands varied, but, in general, reforestation was successful and commercially valuable forests were created. With the implementation of SMCRA-based rules and regulations, the percentage of land reclaimed forest dropped significantly. The rules, as typically interpreted and enforced, resulted in intensely graded landscapes with erosion control provided by herbaceous vegetation. In this post SMCRA environment, reforestation was difficult and productivity of those lands was disappointing.**
>
> **Deep rocky soils with the appropriate chemical composition can be produced through mining and reclamation, and will support forests that are more productive than those supported by the thin natural soils typical of the Appalachian Mountains. EIS III.B-12.**

Page III.F-7, second paragraph:

> *This change in habitat has resulted in a shift in the distribution of birds throughout southern West Virginia* with an increase in the abundance of edge and grassland species at reclaimed mine sites.

While the technical studies do indicate that edge and grassland species are occurring on reclaimed mine sites, it is entirely inappropriate to extrapolate these results into the conclusion that a "shift" has occurred throughout southern West Virginia. As noted in our previous comments, the Cumulative Impact Study <u>DOES NOT</u> indicate that past, current or future mining will eliminate or substantially reduce existing forest cover. West Virginia and the majority of the region will remain dominated by dense forest cover. Further, both the Woods and Edwards

research and the Canterbury research has documented the occurrence of forest interior species in the forest edge habitats created by mining activity, including the presence of species that are of conservation concern. This statement also conflicts with subsequent paragraphs in the EIS narrative:

> **Eighty-four of 92 "probable" or "confirmed" breeding birds, based on data presented by Buckalew and Hall (1994) in the West Virginia Breeding Bird Atlas were confirmed at mountaintop mining sites in southern West Virginia in 1999 and 2000 (Woods and Edwards). The eight species identified by Woods and Edwards (2001) are not associated with habitats associated with mountaintop mining sites (residential and urban habitats)**. EIS III.F-7.

The presence of 84 of the 92 expected species clearly does not indicate a "shift" in the bird community. The Associations suggest that the statement referring to a "shift" in the bird community be deleted since it is unsupported.

Page III.F-7, fourth paragraph under Birds section:

> *Species richness and abundance of songbirds is higher in shrub/pole habitats of mountaintop mining sites than in grasslands, fragmented forest, and intact forest habitats (Woods and Edwards, 2001).*

Page III F-7, fifth paragraph under Birds section:

> *Mountaintop Mining sites are known to support at least ten grassland and shrub bird species not previously listed in the WV BBA (Woods and Edwards). Grassland birds are declining throughout much of the United States. Three grassland species listed as "rare" in West Virginia are known to occupy mountaintop mining sites in southern West Virginia.*

Based on the above referenced statements and the underlying technical research, it is apparent that current mountaintop mining and reclamation practices are creating

habitats that foster terrestrial diversity. EPA's CIS results indicate dense forest will remain the dominant land use of both West Virginia and the region. Unlike the forest habitat, which dominates the study area, grasslands/shrub habitats are rare in West Virginia. This data leads to a logical conclusion that the diversity created by these mining produced habitats far outweighs the site-specific declines observed in the forest-interior species.

> *In general, species richness and abundance are expected to be greatest from diverse habitats like the shrub/pole communities and lowest in the least diverse habitats like grasslands.*

While this statement may be factually correct, it implies bias since intact or dense forest can be expected to be equally less diverse as the grassland areas.

> *It is possible that some of the grassland bird populations on mountaintop mining sites reclaimed with herbaceous cover are existing as "sinks". "Sink populations are maintained by immigration because death rates exceed birth rates.*

This statement is unsupported by the technical research, especially considering the conclusions regarding available breeding habitats for the grasshopper sparrows which are summarized in subsequent sentences in the same narrative paragraph. Further, since the largest habitat of the area is dense forest cover and grasslands is one of smallest, where would the birds be migrating?

Page III.F-8, second paragraph:

> *Some argue that mountaintop mining has the potential to negatively impact many forest songbirds, in particular neotropical migrants, through direct loss and fragmentation of mature forest habitats. Forest interior species...have significantly higher populations (at least one year of the two-*

year study) in intact forests than fragmented forests. Furthermore, cerulean warblers...are more likely to be found in a forested area as distance from a mine increases. These data suggest that forest-interior species are negatively impacted by mountaintop mining through direct loss of forest habitat and fragmentation of the terrestrial environment.

The data presented in the EIS technical studies DO NOT support such a conclusion. Higher populations of forest interior species in intact forests versus fragmented forest in one year of a two year study are far from conclusive.

Page III.F-9 Mammals section

Small mammal species richness does not differ between grassland, shrub/pole, fragmented forest, and intact forest habitats from mountaintop mining sites in southern West Virginia. Small mammal species abundance tends to be greater in grassland and shrub/pole than in fragmented and intact forest habitats.
Of a possible 58 species expected to occur in the study area, 41 were encountered.
The 41 species included 12 salamander species, 10 toad and frog species, 3 lizard species, 13 snake species, and 3 turtle species.

This statement provides even further evidence that mining and current reclamation practices create valuable habitat in the study area that results in mammal diversity as opposed to the dominant land cover of dense forest .

Mountaintop mining results in greater soil disturbance than forest clearing so a longer time may be required for recovery of salamander populations.

While recovery of the salamander populations on mountaintop mining areas may be slower when compared to rates associated with other disturbance, the most important fact is that salamanders do frequent the habitats created by current reclamation.

Page III.F-9 through F-10, Interior Forest Habitat and Area Sensitive Species

Interior forest habitats are relatively rare and easily lost.

This may be a true statement nationally, but is simply not the case in the study area. As previously cited, the CIS found the study area will remain 87.5 percent forested if all future mining impacts are combined with all human disturbances. The CIS also assumes a worst case scenario for mining by assuming that all reclamation areas will be returned to grasslands and no renewed emphasis on tree reclamation will take place.

> *Studies conducted at reclaimed mountaintop mining sites in southern West Virginia have yielded forest interior bird species in shrub/pole and fragmented forest habitats as well as intact forest habitats. However, the abundance of forest interior bird species was significantly lower in fragmented forests than intact forest suggesting a detrimental impact.*

The presence of these traditional forest interior species in the edges and shrub/pole habitats created by the reclamation process do not support the conclusion that forest fragmentation is negatively impacting these species in the study area. The next statement, that interior species were significantly lower in fragmented forest, is not supported by the Woods and Edwards Report. A lower abundance was found for only six of the forest interior species. Six species out of 47 clearly does not support the conclusion that detrimental impact is occurring.

Page III.F-11, second paragraph under Deforestation

It follows that deforestation of large portions of the Appalachians through mountaintop mining is a significant concern from the standpoint forest-dwelling wildlife, in particular, forest interior species.

This statement conflicts with the findings of the CIS and the terrestrial technical studies. The CIS found that abundant habitat will continue to exist in the region even when mining disturbance is assumed to have the greatest impact (no reforestation) and mining is considered along with all other human activities. According to the CIS, the area will remain 87.5% forested. The Woods and Edwards terrestrial technical study found that forest-interior species were present in the fragmented forest area created by mining. As noted in a subsequent paragraph in this same section, a majority of species have the same abundance in the fragmented forest as the intact forest:

> **Furthermore, with the exception of a few rare species, the densities of songbirds on grassland and shrub/pole mountaintop mining sites was similar to that reported in other studies indicating the quality of habitat and availability of resources is similar to the other sites. EIS III.F-11.**

In other words, mining has created habitat favored by these traditionally forest interior species.

The above findings provide evidence that mountaintop mining practices provide favorable conditions for some species. However, these advantages may not surpass the disadvantages these practices have on the sustainability of plants and wildlife in the region.

The technical studies do not indicate that mining and reclamation practices have a disadvantageous effect on plants and wildlife in the region. First, greater growth

rates of trees and plants have been demonstrated to be technically feasible if the traditional SMCRA barrier of over compaction is addressed. Second, the CIS determined that future mining and other disturbances will not result in a dramatic shift in the existing land cover of the region, with 87.5% of the study projected to remain dense forest cover. With regards to wildlife, the technical studies have shown that traditional forest-dependent species are present on reclaimed areas and that grassland and shrub/pole habitat species not associated with study area are also present on reclaimed areas. At worst, mining and reclamation is increasing the biodiversity of the area.

Page III.F-12, first full paragraph, general comment:

The EIS has already acknowledged that existing rules and regulations imposed by SMCRA are the biggest factor preventing reforestation. With the renewed emphasis on reforestation and tree growth that will result from the EIS alternatives, it is reasonable to assume that tree reclamation will increase in the study area. However, if tree reclamation was not advocated in the EIS alternatives, scientific research indicates that these grassland and shrub/pole habitats are supporting a healthy and diverse terrestrial community with species of both forest-interior and grasslands being recorded on reclaimed areas. The CIS has found that neither mining nor any other human activity will result in a massive conversion of the study area from dense forest to another land cover indicator.

Page IV.C-5, first paragraph:

There are also indirect effects related to removal of forest associated with mining. Studies have shown that trees help remove certain elements from our air and sequester them. This process is known as "carbon sequestration."

According to the tables summarized on the pages preceding this paragraph, all the states within the study area will remain dominated by forest cover and continue to provide the valuable carbon sequestration function. Further the U.S. Forest Service's Forest Inventory and Analysis indicates that the average annual cubic feet of forest growth exceeds the average annual rate of forest loss for all states in the region.[42] This information is summarized on page IV.C-2:

> **data, based on the forest census in West Virginia (1989), Virginia (1992), and Tennessee (1999), shows that the average annual cubic feet of forest growth exceeds the cubic feet of forest loss by 10 million cubic feet in Virginia, 241million cubic feet in Tennessee and 257 million cubic feet in West Virginia.**

These growth to loss ratios will increase as new reforestation efforts are implemented by OSM and state regulatory authorities to encourage tree growth on mined areas. Therefore, it is apparent that the carbon sequestration ability of the region will persist and even improve.

Page II.C-87, Flooding, General Comment, entire section:

This section summarizes various site-specific technical evaluations of the flooding potential of surface mining and associated valley fills. Collectively, the results of these various studies lead to one conclusion:

[42] Data for similar cut/growth ratios was not available for Kentucky.

> **...the study findings generally support a conclusion that downstream flooding potential is not significantly increased by existing mining practices so long as approved drainage control plans are properly applied. EIS IV.I-7.**

Any possible increased flow potential from mined and/or filled areas are site-specific issues that must be addressed on a permit-by-permit basis. Because of the wide variability in results where flow increases where detected, no programmatic or endemic conclusions can be drawn, as this section correctly notes:

> **Studies prepared as part of this EIS and other available literature indicates that peak runoff increase or decrease below mining can occur. Site-specific analysis is required based on many factors...**
>
> **It is difficult to generalize mining impacts on runoff. Due to site conditions, increases in peak runoff may not cause or contribute to flooding.**

Other sections of the EIS note that the study area is naturally prone to flooding given the topographic characteristics of the region:

> **The rugged terrain of this region is generally characterized by steep mountain slopes, confined river valleys and narrow ridge tops. EIS III.A-1.**
>
> **Because of the topography and terrain in steep-sloped Appalachia, flooding occurs in severe weather conditions. Draft EIS IV.H-1.**

Repeated, severe flooding has plagued certain areas within the study region for centuries, certainly before the advent of surface mining. The stark reality is that topographic influences lead the area to be more prone to flooding events . These same influences forced residential, infrastructure, transportation and commercial

development into documented floodplain areas. On page III.R-5, the EIS presents the results of the Land Use technical study confirming these observations:

> **The steep slopes and narrow, flood-prone valleys have limited the availability of land parcels suited for large scale development.**

Despite these observed restrictions, development and residential construction as a matter of practicality has occurred in these flood-prone areas, subjecting residents to repeated and unfortunate flooding.

Surface mining provides a unique, no public cost opportunity to alleviate some of these conditions by providing flat, stable land that is far elevated from the "narrow, flood prone valleys" that possess most of residential settlements in the study area. Historically, periods of government attention were focused on relocating flood prone communities to reclaimed, non-AOC surface mined areas. Unfortunately, what would otherwise serve as a tool of stabilization both economically and socially- massive relocation of these areas- has never been succinctly expressed or implemented and emerging environmental restrictions such as excessive mitigation requirements and fill minimization mandates may bar this from ever occurring.

Page III.G-3, General Comment, Peak Flow Study:

The Associations generally agree with the conclusions of the Peak Flow Study, **insofar as the results highlight the need for site-specific permit analysis** as the

decreases and increases in flow indicated by the various models differed for each area analyzed.

The OSM-COE studies presented in this section underscore the reality that an increase in flow does not translate into an increased flood potential. Based on the results of the OSM-COE models, even the highest peak flows indicated by the studies did not cause a rise in water levels that would exceed channel capacities and lead to flooding downstream under the 10 and 100 year scenarios modeled for these areas:

> **...the predicted increases in peak flow would not have caused flooding on the banks outside the receiving stream channel. EIS III.G-4.**
>
> **...increases in peak flow did not cause a rise in water level overtopping the receiving stream channels. EIS III.G-6.**

Even though the water levels predicted by these site-specific analysis increased compared to pre-mining conditions, **these increases DID NOT result in or cause flooding.** As noted on page III.G-6 of this section:

> **Flooding typically occurs only when water levels exceed channel capacities and spread across the floodplain where residential settlements may occur.**

Additionally, as runoff travels farther downstream, any increases in flow become less discernible. Thus, the downstream impact from any possible runoff increase in the headwater areas becomes less pronounced the farther removed a location is from the disturbed area:

> **The influence of changes in the headwater areas will decreases as the point of analysis is moved farther downstream.**

EIS III.G-6.

In terms of results, the actual data from the various studies are only partially presented in Appendix H. While the HEC-HMS computer model data appears in each of the 10 studies, the SEDCAD 4 modeling data presented in the chart on page III.G-5 does not. The SEDCAD 4 models returned results similar to the HEC-HMS, but predictions of peak flow were significantly different under certain conditions. Without the opportunity to review the SEDCAD 4 data in detail, the Associations are without sufficient information to offer specific comments. Unless the supporting data is provided, the SEDCAD 4 results should be removed from the final EIS.

Page III.G-7, Fill Hydrology Study:

The technical study summarized here, *Comparison of Storm Response of Streams in Small, Unmined and Valley-Filled Watersheds* (Appendix H draft EIS) determined that the mined and filled watershed exhibited higher peak flows than the non-mined "control" watershed when rainfall exceeded 1 inch per hour. This veracity of this finding is compromised by the location of the sampling station on the filled watershed. On page seven of the technical study, the USGS indicates that the measurement point for the filled stream was located between the toe of the valley fill and the sediment pond, thereby excluding any possible flow attenuations provided by the sediment pond.

> *During most storms however, peak flow from the unmined watershed exceeded peak from the filled watershed.*

This finding comports with other observations and technical research that generally found sustained base flow and lower peak flows in mined areas results from the hydrologic characteristics of backfilled spoil and valley fills:

> **Creation of valley fill aquifers change the hydrology of streams receiving baseflow from valley fill aquifers by diverting a greater percentage of precipitation into the fill allowing water to be released at a much slower and less intense rate compared to normal storm-induced stream hydrographs. EIS III.H-9.**

On page 20, the authors of the technical study properly observe that:

> **Rainfall-runoff relations on altered landscapes are site specific and reclamation practices that affect storm response may vary among mines.**

This statement further supports the Associations' position that no programmatic conclusions can be drawn with respect to mining and/or valley fill influences on flooding potential.

Page III.G-7, July 2001 Floods Study:

Titled *Comparison of Peak Discharges Among Sites With and Without Valley Fills for the July 8-9 Flood in the Headwaters of Clear Fork, Coal River Basin, Mountaintop Coal-Mining Region, Southern West Virginia*, this study attempted to determine whether mining had any adverse impact in the July 8-9 severe flooding event experienced across central and southern West Virginia including the Clear Fork area.

The basic premise of this study- that there was equal rainfall among the six analyzed basins proved to be incorrect. The flood recurrence intervals (and

therefore rainfall amounts) in the six basins were unequal, compromising any possible conclusions, since a watershed receiving more rainfall is going to exhibit higher runoff than one receiving less rainfall.

Given the confounding factors that have compromised the basic assumptions of the study, the Associations believe the Report offers little of real value and its reference should be deleted from the final EIS.

Page III.G-8, Citizen Complaint Study:

A review of the underlying citizen complaints that support this section confirms past assertions made by the mining industry with respect to flooding: The areas where mining occurs are naturally prone to flooding and provided that the approved drainage control plan is followed and the drainage control system is functioning per regulatory requirements, mining has no adverse impact on either flooding potential or the severity of flooding. Despite 126 complaints in West Virginia from 1995-1999, only **eight** of these complaints resulted in enforcement actions related to drainage control structures. Similar results were found in a review of Kentucky (35 investigations, **five** enforcement actions) and Virginia (three investigations, no enforcement actions) SRA records.

Page III.G-8, Other Studies:

This section presents the results of two state specific studies undertaken in response to specific severe flooding events. This first, *Runoff Analysis of Seng, Scrabble, and Sycamore Creek* was conducted by the West Virginia SRA. The

summarized results of this study confirm the general conclusions of the draft EIS and the suggested alternatives related to flooding potential: Mining can influence the degree of runoff, but the extent to which a decrease or increase may have reduced or increased flooding potential is site specific. The West Virginia coal industry was intimately involved in the preparation and review of this study as one of several stakeholders on the Flooding Advisory Committee, and feels compelled to identify in further detail the findings of this review:

1. Mining may either have a positive or negative effect on total runoff and that effect appears dependent upon the extent to which the original, steep-sloped flood prone terrain and topography of the mined is restored through the reclamation process.
2. In all three of the mined watersheds, the effects of documented, increased flows were relatively small.
3. The rain event of the study period was so intense that flooding would have occurred absent any possible influences from mining activity.
4. No programmatic conclusions was reached in the study regarding runoff increase or decreases attributable to mining activity, as this would require "long-term investigation and analyses , including an investigation of every reach of stream" in the relevant watersheds.

Unlike the West Virginia undertaking, very little information is provided in the EIS with respect to the Kentucky initiative, *Joint OSM-DSMRE Special Study Report on Drainage Control.* This is unfortunate, as the most pertinent conclusion

of this study is one that deserves prominent replication in the EIS because it serves to confirm the results of the other technical research and the ultimate conclusion reached in the draft EIS with respect to this issue:

> **Factual results garnered from the study indicate that the majority of the alleged downstream flooding problems were more a result of localized, extremely heavy precipitation events that led to flash flooding, which would have occurred with or without the mining operations being present.** [43]

III.I-1, Overview of Appalachian Region Coal Mining Methods

> *National industry trends have favored surface mining over underground mining in recent decades, driven by the advent of very large earthmoving equipment, and surface mining now accounts for the majority of nationwide coal production.*

The shift in coal production methods from underground mining to surface mining can be attributed to events that occurred independent of the availability of large equipment. Relatively large scale surface mining has occurred for decades in coal producing regions other than the study area, where surface mining is generally a recent phenomenon that can be attributed to shifting coal markets. In the anthracite fields of Pennsylvania, the lignite regions of Texas and the coal fields of the Midwest large scale surface mining has a history dating back to before the 1950's. By 1971, the amount of coal produced from surface mines exceeded the amount produced from underground mines nationally. Since then, surface mines have accounted for an increasing percentage of the nation's coal production with

[43] *Joint OSM-DSMRE Special Study Report on Drainage Control*, 1999.

much of the increase occurring at western surface mines and in particular mines developed in ~~of~~ the Powder River Basin:

> **Much of the increased coal production in the United States...is from large open pit mines in the western region.**[44]

The coals seams and overburden characteristics in this region make underground mining difficult if not impossible. Unlike coal regions in the southwest, midwest and eastern United States, overburden to coal ratios in the Powder River Basin are extremely low. What overburden material that does exist is unconsolidated, "weak" material better characterized as "soil":

> **...the coal lands of the Western region are underlain by flat lying or gently dipping beds of lignite or sub bituminous coal. Some of the seams of sub bituminous coal are 70 feet thick or more and lie at relatively shallow depths; overburden ratios commonly are 1:1 or less. Thus most of the coal produced in this region is from large surface mines in such seams.**[45]

The second driving force behind a movement towards surface mining can generally be seen in the Central Appalachian study area. With the passage of the 1990 amendments to the CAA, a substantial market was created for steam coal that could satisfy new emission mandates. The coal seams and reserves in Central Appalachia developed as a result of this market demand lend themselves better to surface mining than to underground mining for a number of reasons, including the cost benefits realized from larger surface mining equipment. Prior to passage of the 1990 amendments to the CAA, mining in the study region was largely linked

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[44] U.S. Department of the Interior Office of Surface Mining: *Environmental Impact Statement, Revisions to Permanent Regulatory Program*, 1983.
[45] Ibid.

to metallurgical coal production. These seams are better accessed by underground mining methods as they are deeper in the geologic column than seams associated with steam coal production. Historically, steam coal production in Appalachia was concentrated in the Pittsburgh seam in northern West Virginia and associated more with longwall underground mining. Commensurate with the increased demand for "compliance" stream coal was a precipitous drop in the demand for metallurgical coal production. Reduced domestic coke production, a result of decreased raw steel production and increasingly restrictive emission standards for coke ovens has drastically lowered demand for metallurgical coal.

> *The term "mountaintop mining" used in this EIS encompasses three different kinds of surface mining operations (contour mining, area mining, and mountaintop removal mining) that create valley fills.*

The final EIS should be revised to more fully acknowledge the potential affects the various policy options under consideration will have upon underground coal mining operations. On page III.K-15of the EIS, the agencies identified 719 valley fills that were permitted for underground mines. As this statistic reflects, underground mines in this steep sloped area also require the construction of valley fills. These fills facilitate creation of a flat, level bench that allows access to the coal seam and permits construction of underground support facilities such as ventilation fans, raw coal belts and stockpile areas, bathhouses and electrical installations such as battery charging stations. These benches also serve as "staging areas" for the underground mining operation where supplies are stockpiled and equipment is serviced. Past interim regulatory initiatives such as

the 250-acre watershed restriction on valley fills have applied to fills constructed for underground mining, as will the alternatives considered in this EIS. To provide a true picture of mining in the region and likely results of the various alternatives, underground mining must be included in this and other descriptions contained in the final EIS.

Page III.I-2

> *Current technology achieves nearly the highest possible recovery of the coal reserves beneath a typical tract of Appalachian land; however, this is neither always economically feasible nor acceptable from an environmental standpoint.*

Mining in general and surface mining in particular is one of the most heavily regulated industrial activities in the nation. Several major environmental statutes have jurisdiction over coal extraction, including a single environmental program that was developed by Congress specifically for coal mining. If mining was "not acceptable from an environmental standpoint", the vast statutes and regulations and the various federal and state agencies that regulate this activity would not allow a mining permit to be issued. In fact, this EIS confirms the viability of these existing regulatory programs in that no more than temporary, minimal impacts could be linked to surface mining in the region. A more proper statement would be "not acceptable to some", as this EIS can be attributed not only to misguided litigation but hyperbole surrounding mining and valley fills and exaggerations regarding the scope and scale of these activities within the study area.

Page III.I-3, Underground Mining Methods

Although not directly related to the focus of this EIS on surface mining valley fill impacts, underground mines are part of the overall coal industry within the study area...

The statement above repeats a very serious error already cited by the Associations: the failure to associate underground mining with valley fill construction. This statement also fails to acknowledge to interrelationship of surface mining to underground mining. Many underground mines exist solely to provide blending stock for coal produced through surface mining methods as part of large mining complex much like the one described on page III.I-26. Since surface mined coal is generally of a better quality than coal mined using underground methods (because rock partings and other impurities present in the coal seam can be removed in the pit), many underground mines could not produce a marketable product unless blended with a surface mined product.

Page III.I-26 **Mountaintop Mining Complexes, general comment, entire section:**

This section provides fairly accurate description of current mining and coal processing practices in the Central Appalachian region, with one exception. As with other sections of the EIS, it neglects to mention the interrelationship of underground mining to surface mining. As we have stated previously, raw or unprocessed coal produced by both methods of mining is usually needed to produce a marketable "clean" product that meets the emission and volatile requirements of the customer. Should any either source of raw coal be eliminated,

the ability of the "complex" to provide a greater range of clean coal suitable for a number of applications and customers is reduced:

> **Many deep mines are co-dependent on related surface mines for quality blending requirements and even economic averaging arrangements. Eliminating or reducing the surface mining has direct impact on the viability of the deep mining in these instances.** [46]

III.K-1, Excess Spoil Disposal

There is also concern regarding long-term fill stability

This statement is misleading and it should either be removed from the final EIS or revised to reflect the findings of the EIS Valley Fill Stability technical study. "Concern regarding valley fill stability" was indeed raised during the scoping process of the EIS, although the majority of these public comments appeared to mistake valley fills for coal refuse impoundments. Nevertheless, from these "scoping concerns", OSM initiated a through and comprehensive review of valley fills constructed in the study area to assess any potential stability problems. This technical report concluded:

> **A review and analysis of the data indicates that valley fill instability is neither commonplace nor widespread. Only 22 known cases of instability occurred (all during the mining and reclamation phase) out of more than 4,000 fills constructed in the past eighteen years.** [47]

The results of this technical review led the agencies to conclude that no programmatic action needed to emerge from this EIS. The above referenced

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[46] *EIS Appendix H, Final Report, Coordinated Review of Mountaintop Mining/ Valley Fill EIS Economics Studies, pages 8-9.*

[47] U.S. Department of the Interior Office of Surface Mining, *Long-Term Stability of Valley Fills, Final Report.* Appendix A of the Draft EIS.

statement should be revised to more clearly reflect the conclusions of the technical review.

Page III.K-2:

> *In the late 1970's and early 1980's the durable rock fill method became the predominate excess spoil disposal technique due to the cost efficiencies of the technique.*

As a general matter this statement is correct, but it should be expanded to include safety considerations and the implications for direct stream loss.

Cost considerations drove development of this spoil placement method but other considerations also influenced the move towards durable rock fill construction such as truck haulage. On page IV.I-8, the EIS describes the operational effects of increased backfilling. Similar conclusions could be drawn regarding conventional lift construction with the added dimension of operator safety. Haulage trucks would be transporting spoil down grade on steep roads. Not only would equipment endure increased physical wear in terms of brakes and other essential systems, but instances of haulage accidents could be expected to increase. Conventional lift construction also assures maximum disturbance to the permitted footprint area. Durable rock fills provide the operator with the flexibility to respond to unforeseen geologic conditions and economic factors by discontinuing fill placement and reducing the direct impacts to streams. In convential lift construction, the entire footprint area is constructed during installation of the initial lift.

Page III.K-10, c. Valley Fill Stability

> *There has been anecdotal evidence that valley fill instability (landslides or land slips on fills) are neither commonplace nor widespread; and, that properly constructed valley fills are well-engineered and stable structures.*
>
> *The EIS Steering Committee chartered a study of fill stability to corroborate perception with empirical information.*

The remainder of this section fails to confirm that the technical study corroborated the anecdotal information, even though it was stated goal of the evaluation:

> **A review and analysis of the data indicates that slope movements in valley fills are neither commonplace nor widespread. As of the completion of this study in November 2000, only 20 occurrences of valley fill instability are recorded out of more than 4,000 fills constructed in the past 23 years. While these instances of fill instability might have been "major" as regards the cost of re-engineering and corrective action to mitigate the mass movement, the consequences were not loss of life or significant property damage.**[48]

The technical study also serves to dispel the notion that isolated movement of material on the face of a valley fill equates to "failure" and that the results would not be similar to the effects of the 1972 failure of an un-engineered coal refuse dam at Buffalo Creek, West Virginia:

> **...catastrophic impacts over a great distance down valley...should not occur. An unstable valley fill would not be expected to impact distant areas because:**
>
> **-[Unlike the pre-SMCRA coal dam at Buffalo Creek] fill designs build in a substantial, long-term factor of safety against instability and have specific drainage control measures.**

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[48] Ibid.

> **-No large quantity of water should be present in properly designed valley fills to lubricate the fill material into a flowing mass that could transport for any great distance. The regulations prohibit ponds on fills or fills impounding water behind them. Even improperly designed fills should have minimal impounding potential.**[49]

Despite the overwhelming conclusion of the technical study that valley fills are stable structures, the EIS narrative is misleading, as the results of the technical study are never firmly presented in relationship to first paragraph regarding anecdotal evidence.

Page III.K-2:

> *In the late 1970's and early 1980's the durable rock fill method became the predominate excess spoil disposal technique due to the cost efficiencies of the technique.*

As a general matter this statement is correct, but it should be expanded to include safety considerations and the implications for direct stream loss.

Cost considerations drove development of this spoil placement method but other considerations also influenced the move towards durable rock fill construction such as truck haulage. On page IV.I-8, the EIS describes the operational effects of increased backfilling. Similar conclusions could be drawn regarding conventional lift construction with added the dimension of operator safety. Haulage trucks would be transporting spoil down grade on steep roads. Not only would equipment suffer increased physical wear in terms of brakes and other essential systems, but instances of haulage accidents could be expected to increase.

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[49] Ibid.

Conventional lift construction also assures that maximum impact to downstream areas. Durable rock fills provide the operator with the flexibility to respond to unforeseen geologic conditions and economic factors by discontinuing fill placement and reducing the direct impacts to streams. In conventional lift construction, the entire footprint area is constructed during installation of the initial lift.

Page IV.F-1, Energy, Natural, or Depeletable Resource Requirements

> *The three action alternatives and the No Action Alternative may also provide significant environmental benefit if mitigation proves infeasible in certain locations, causing no mining to occur.*

This statement, as worded is very misleading, ignores the results of the EIS technical studies and should be removed from the final EIS. Inclusion of such a statement assumes that mining and valley fill construction activities have resulted in more than minimal impacts on the environment of the region. This is simply not true. As we have noted throughout our other comments regarding the environmental concerns associated with mining in this area, it is clear that mining and valley fill activities have not, nor will they ever have more than minimal impacts on the environmental and social resources of the study area. What environmental effects have been documented can be characterized as improvements (wildlife diversity has increased, more stable sources of downstream energy have been established, flat, stable, useable land can be created). Absent voluminous studies and data to affirm this position with respect

to individual environmental and social issues, past, current and future mining will only affect a relatively small portion of the Central Appalachian landscape, communities, and streams.

Significant environmental benefit will most certainly never occur in areas where mitigation efforts could have alleviated existing degraded streams through any number of water quality and habitat improvements. These existing environmental detriments, identified elsewhere in the EIS present far greater threats to the overall environmental health and stability of the region than does surface mining and valley fill construction. These existing stressors affect a far greater scale of the region that surface mining has or is forecast to affect, and the environmental degradation associated with such stressors as AML-AMD discharges is far more serious than the loss of a headwater stream.

> *Some limited number of reserves may be recoverable by underground mining or a combination of contour and auger/highwall mining.*

This statement too requires revision to be accurate. One of the pervading mistruths regarding surface mining is that other extraction methods allow removal of the same coal resource. The reality is that most seams currently being mined using surface mining and valley fill extraction methods cannot be recovered using underground mining. The seams are either physically too thin, the overburden too unconsolidated to allow for safe mining or the reserve so isolated or small that underground extraction is either impossible or hopelessly uneconomic.

This statement also fails to acknowledge the dependence of underground mining on valley fill construction. Assuming that the environmental restrictions envisioned under all the EIS alternatives will apply equally to all mining related fill construction (as they have in the past), in the limited situations where an expansion of underground extraction can replace lost surface mine production, this expansion will be constrained by the same restrictions that may ultimately make surface mining implausible:

> **...It is an egregious mistake to ignore impacts of valley limitations on deep mines, especially new ones. First, many deep mines are co-dependent on related surface mines for quality blending requirements and even economic averaging arrangements. Eliminating or reducing the surface mining has a direct impact on the viability of deep mining in these instances. Second, the typical reject rate in Central Appalachia from a wash plant associated with a deep mine is about 50%. Thus, for every one ton of coal mined, one ton of refuse is placed in a valley fill or related impoundment. In fact, the valley fills associated with wash plant refuse are generally among the larger valley fills associated with coal mining (with generally larger watershed) but are fewer in number than surface mining valley fills. Third, the construction of a new deep mine involves other valley fill issues. Often, a new deep mine is accompanied by a new wash plant with a new valley fill for refuse. Plus, in order to "face up" the entrances to the new deep mine, a new valley fill for the mine entrance is typically needed.[50]**

With respect to underground mining, a proper characterization would be "it is unlikely that underground mining can replace surface mining in the extraction these reserves."

[50] EIS Appendix H: Final Report, Coordinated Review of Mountaintop Mining/ Valley Fill EIS Economics Studies..

The second component of this statement, "...a combination of contour and auger/highwall mining" is simply absurd and it ignores the underlying fact behind the entire EIS: The Central Appalachian study region is steep-sloped and any excavation for underground mine development, any variation of surface mining or any other human development activity will result in the generation of spoil that cannot be safely placed anywhere but in a fill. Because of the very nature of the native terrain, with rare exceptions, "fill-less" mining or disturbance is simply not possible. Very isolated opportunities may exist for the placement of generated spoil on adjacent flat areas such as AML benches:

> **Abandoned mine benches, reclaimed mine sites or active mining areas may accommodate some volume of excess spoil...**
> EIS IV.I-2

However, these occurrences would be so rare and dependent on such a wide range of factors that they deserve no mention as a reasonable alternative to valley fill construction. No substantial amount of coal could ever be produced from an operation that was dependent such an area for spoil placement.

Any reference to these two surface mining techniques should be deleted from this statement.

> *...resources in U.S. coal basins within or outside of Appalachia and in other countries exist to offset lost reserves from the study area, if market conditions change for regulatory or other reasons.*

Fortunately, the U.S. has been blessed with an abundant reserve base of recoverable coal resources to feed the energy needs of an expanding and evolving

society. However, not all of these coal resources are equal, and for the agencies preparing this EIS to assume that lost Central Appalachian production can simply be replaced from other regions is a serious error. Coal mined in Central Appalachia represents some the highest quality coal found anywhere in the world. Because it is low in constituents targeted by emission legislation yet high enough in heating properties to satisfy utility input requirements, it may be the most valuable coal in existence. Other regions, particularly the Power River Basin and southwest, produce coal that is generally superior as far as emission standards are concerned. However, resources from these areas fall far short in comparing to the heating properties of coal from the study region.

This EIS has made no effort to analyze the available capacity of the Powder River Basin, both in terms of coal production and more importantly transportation, to assume the burden of energy production should policy and regulation sterilize the substantial coal resources of Central Appalachia.

As for the other regions of Appalachia and the Mid-West, the continued marketability of coal from this region is hampered by emission standards enacted as part of the CAA. As we have noted in our other comments, it was the imposition of these restrictions that ultimately spurred development of the resources being extracted using surface mining and valley fill methods.

Further, there is no domestic substitute source for the metallurgical coal produced in this region. Once the production of industrial and metallurgical coal is lost to Central Appalachia, it is lost to the U.S. compelling reliance on imported coal or

imported finished coke- A truly regretful situation. Reliance on foreign resources can be tolerated where domestic sources are finite or nonexistent (as with petroleum) but in the case of coal, the U.S. has ample reserves, a highly trained, well-compensated workforce and developed infrastructure to facilitate coal extraction. At the same time, mature regulatory programs exist to assure minimal environmental and social impacts of coal mining. Thus, there is simply no palatable excuse, given the minimal effects of mining, for misplaced environmental policy to drive dependence on foreign resources.

> *...economic impacts resulting from decreased coal mining could be locally significant.*

This is a gross understatement and one that requires revision to be accurate. A more proper characterization would be "profound". At the request of the West Virginia legislature, Marshall University conducted an analysis of the economic effects of a severe restriction on surface mining within the state. Published in 2000 this study determined that the economic results of restricting surface mining equated to the effects of the Great Depression: widespread economic and social and devastation and dislocation.[51]

G. Cultural, Historic, and Visual Resources, general comment, entire section:

Central Appalachia is indeed an area of rich culture and history worthy of protecting. However, as the Associations have noted previously, mining will

[51] Marshall University Center for Business and Economic Research. *Coal Production Forecasts and Economic Impact Simulations in Southern West Virginia: A Special Report to the West Virginia Senate Finance Committee.* 2000.

never occur on a scale large enough to eliminate or even substantially impact these values. Localized impacts can, and will occur, but existing regulatory mechanisms exits to protect the resources in these areas. As for community displacement, again localized occurrences are possible, but because of the small scale of mining activity, instances of displacement are no more likely than community displacement in the same region or other areas from publicly funded projects such as flood control and road construction.

H. Social Conditions, general comment, entire section:

The Central Appalachian region faces many social and economic challenges that is without dispute. However, the description of these conditions characterizes these challenges as relatively recent phenomena and leaves the uninitiated with the impression that they are attributable to mining. For decades government programs such as the Appalachian Regional Commission have sought to enhance the social and economic conditions of the study area. Despite all these positive influences such as aggressive highway construction, problems persist:

> **Income statistics from the 1980 and 1990 Censuses indicate that the study area, as a whole, has a starkly lower income than the individual states.**
>
> **Census statistics for 1980 and 1990 depict a poverty problem throughout most of the EIS study area.**
>
> **In twenty-four of the study area counties, over one in every three residents was estimated to live below the poverty level.**
> **EIS IV.H-1.**

These demographic realities further stress the economic and social importance of the coal industry. Coal mining activity creates substantial economic activity through high-paying wages for coal miners and demand for goods and service related directly to coal extraction. The ripple effect of this activity is tremendous and mining is the *only* economic driving force in a majority of the study area:

> **The establishment of a new mine or the expansion of an existing one affects both the economy of the local community where the mine is located and the economy of communities far removed from the mine site. This is because the United States has a highly interdependent economy. What happens in the mining industry eventually impacts many other industries. This is referred to as the ripple or multiplier effect. Recent studies...using an input-output model indicates that the multiplier effect for a new mine is several times the magnitude of production, income and employment of the mine itself. It is estimated that a one dollar increase in coal production stimulates a total of $6.30 of production throughout the economy.**
>
> **Likewise, the creation of one full job in a new or expanded mining operation stimulates the creation of a total of 11 other jobs elsewhere in the economy. As expected, personal income also increases but not in proportion to employment. For every dollar increase in personal income associated with coal mining activity, there is a $4.83 increases in personal income elsewhere in the economy.**[52]

Just as it stimulates economic growth and earnings, the coal industry provides the social infrastructure for much of the region through taxes. The draft EIS summarizes the taxes collected on the coal industry beginning on page III.Q-9.

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[52] U.S. Department of the Interior Office of Surface Mining. *Draft Environmental Impact Statement, Valid Existing Rights*, 1995.

In short, the substantial economic activity created by mining in the region serves to alleviate these existing social problems, and coupled with the opportunities provided by post-mining land use development, offers tangible expectancy for a stable, diversified post-coal economy:

> **Most leaders are also keenly aware that its coal resources are its best sources for leverage of investments needed to build an economy that can flourish after the inevitable decline of coal mining.** EIS IV.h-2.

I. Economic Role of Coal in the Economy

> *As long as coal is required to supply a dominant portion of local and national energy needs, the ability to extract low sulfur coal reserves efficiently and cost effectively will occur somewhere in the nation (or the world) to meet energy demands and clean air standards.*

This statement is key to understanding the effect that increased restrictions will have on the energy security of the nation, particularly the regions and industries that have historically relied on coal supplies from Central Appalachia. Given the current energy needs of the nation, utility, industrial, metallurgical or otherwise, lost production from the study area will replaced by coal from other regions or foreign sources. As we noted previously, the ability of other coal regions in the U.S. to replace this lost production is limited for several reasons. First, the low sulfur coal produced in the west has substantially lower heating values than similar low sulfur Central Appalachian coal. Second, coal from other regions such as the mid-west and northern Appalachia is high in constituents targeted by clean air

legislation. Finally, a substantial portion of production from the study area is used for steel making other industrial applications that demand specific heating, fusion and chemical compositions that can only be found domestically in Central Appalachian coal. Hence it is possible, if not likely that lost production from the study area will be replaced by coal from foreign sources further reducing the energy independence of the nation.

> *Higher mining costs due, in part, to environmental compliance...will result in coal supplies originating from coal basins outside the EIS study area where compliance can occur.*

This statement unfairly conveys the impression that compliance within the study area has not occurred. This is simply not the case, as the EIS demonstrates. The only issue that has been identified is related to new mitigation requirements imposed by revisions to the COE's general permit program and the constantly evolving interpretation of these mitigation requirements by the various COE districts:

> **Increased environmental costs...have not been a constant factor in environmental compliance in the study until the 2002 renewal of NWP 21. EIS IV.I-2.**

As we have noted in our previous comments on other sections of the EIS, application of these new requirements, particularly conservation easements, to the study area is inappropriate and may not be the most environmentally beneficial measures for the region. This statement should be revised in the final EIS to properly reflect this reality.

In instances where coal traditionally supplied from Central Appalachia is replaced by foreign sources, no "environmental compliance can occur" because the agencies have failed to export the vast environmental controls imposed in the study region to foreign coal basins. The statement should be revised to reflect the knowledge that displaced production will likely be supplanted at least in part by coal from other regions of the world that lack the environmental controls of the U.S.

> *New capital will be required to "ret-tool" in order to conduct more contour/auger mining to reduce valley fill sizes, lower mitigation costs and still meet coal market demand.*

As with other sections of the EIS, this statement incorrectly leaves the reader with the impression that these particular mining methods are conducted without valley fill construction and that they are mutually exclusive production methods. Since they are activities that require excavation in the steep-slopes of the study area, these two mining methods by definition will result in valley fill construction. Further, as the EIS notes on page III.I-26, these surface extraction methods usually occur in conjunction with underground and other surface mining developments. All of these mining methods are usually necessary to produce marketable coal:

> **Many mines rely on blending the products of different surface mines or a combination of surface and underground coal to conform to supply contracts for particular coal quality. Also, transportation and coal preparation costs associated with smaller and underground mines are sometimes related to the proximity of larger mines with existing infrastructure. If the infrastructure is not available, new smaller mines may not be practical.** EIS IV.I-4.

A proper revision would delete reference to these two mining methods and associate "re-tooling" costs to the smaller equipment associated with reduced operations and reduced recoverable coal reserves.

...Declines in surface mining production typically result in some amount of commensurate increases in underground production and employment.

This statement requires revision to accurately portray the realities of mining and the anticipated results of new, restrictive environmental policy. As we noted previously the effects of the alternatives contemplated in the EIS will affect underground mining, either directly through valley fill constraints or indirectly by reducing surface mined coal that is blended with underground production to produce a saleable product. Consequently, a short-term increase in underground mining employment may result from a decline in surface mining production, but given the interrelationship of mining methods, any increase will be short-lived. A reduction in surface mining employment will eventually equate to a reduction in all mining employment as the effects of surface mining restrictions are extended to underground mining. The cited statement should be revised in the final EIS to properly reflect this relationship.

> *It is reasonable to assume that required mitigation costs (i.e., to offset valley fills) will result in future MTM designs with reduced valley fill sizes.*

This statement requires revision to properly frame increased mitigation costs within the context of other regulatory requirements imposed by SMCRA and

CWA. As we have noted previously in our comments, maximum fill minimization is already achieved through application of SMCRA's AOC requirement and compliance with the CWA's section 404(b)(1) guidelines. Since there is simply no other way to facilitate coal removal by any extraction method absent the existence of a valley fill, increased mitigation costs will act as punitive measure for unavoidable direct impacts and could unfairly hinder post-mining land uses in a region in serious need of flat developable land. A Revised Version of the sentence would properly acknowledge that operations assure fill minimization by satisfying the AOC mandate of SMCRA and the 404(b)(1) analysis of the CWA. Any further fill reduction that occurs will result from mitigation costs reducing the economic or practical viability of the operation.

The Hill & Associates sensitivity analysis projected....

The Hill & Associates (H&A) work summarized in the EIS provides only a "vision" of what will happen to the mining industry if valley fills are restricted directly (watershed specific prohibition on fills) or indirectly (increased mitigation requirements reducing the viability of a mining operation). The results of the H&A work produced very conservative estimates of the possible effects of fill restrictions because of certain restraints inherent in the model(s).

The H&A analysis relied on another EIS technical study conducted by Resource Technologies Corp. (RTC) known as the "Phase I" economics study, which used macro-GIS models to estimate the amount of available coal recoverable if valley

fills were limited to certain specific watershed acreage. The validity of this analysis is questionable, as the cover sheet to Appendix H notes:

> **Valley fill locations used in the study exceeded the watershed size thresholds established by the study (i.e. fills were placed in watersheds greater than the scenario limits). The Phase I study fill locations were inconsistent with basic engineering principles and typical mining practice to locate fills in valleys as opposed to on hillsides.**
>
> **Further, the phase I study relied on consideration of future mining based on areas where past mining had not occurred. A number of the potential mining sites utilized in the Phase I analysis have subsequently been determined to have been mined, consequently overestimating the available future resources for the Phase I scenarios. The study attempted to take into account mining engineering considerations such as overburden ratios, the volume of resource block, topography, etc., to assess resource recovery feasibility. However, the computer model was not designed, nor did the data exist, to account for every critical mining engineering factor, such as coal quality, mineral and surface ownership conflicts, and other very site-specific elements.**
>
> **The Steering Committee consequently found that the site-specific results of the Phase I Economics study have limitations and should not be relied on to be representative of potential future mining and fill areas...with respect to production change estimates.**
>
> **Despite the study limitations, the computer modeling clearly indicates a trend related to reduction in available valley fill storage and the amount of reserves recoverable. The study illustrates, from a regional perspective, that restricting valley fills to small watersheds would commensurately restrict mining feasibility and minimizes full resource utilization.**

The H&A work, or "Phase II" of the economics analysis, relied on flawed inputs from the Phase I study:

> **Because the Phase II Economic Study used the results if the Phase I Economic Study, the [phase II] study results also have limitations.**

In addition to receiving flawed data from the initial analysis, the H&A work also failed to properly account for the increased mining costs associated with smaller fills:

> **In the original Phase II study, no adjustments in costs were made to reflect changes in material handling and haulage methods resulting from fill restrictions. The costs were also not adjusted to reflect the reality that fill restrictions would likely necessitate a change from large mining equipment to smaller equipment. A shift from fewer larger fills to many smaller fills would require construction costs for additional sediment ponds-not part of the initial Phase II assumptions. Finally, the initial modeling runs in the Phase II Economic Study did not project an increase [in] the required return on investment (ROI) capital, which is estimated to be as high as 20%.**

The serious limitations in the initial Phase II study lead the agencies to commission H&A to conduct a "sensitivity analysis" to more accurately reflect the reality of mine economics:

> **The EIS Steering Committee sanctioned a sensitivity study by Hill and Associates to evaluate these limitations. The sensitivity study was designed to determine how the results of the initial Phase II study would change if a different set of Phase I assumptions and inputs were used. Modeling inputs, drawn from mining experience were used to indicate the direction and the magnitude of Phase II study output change resulting from adjusted sensitivity inputs.**
>
> **The sensitivity runs confirmed earlier results indicating that coal production was sensitive to lower reserve recovery because of smaller fills. Production decreased by approximately 20 percent over the initial study results. The price of coal was somewhat sensitive to the model assumptions adjustments, reflected by**

approximately $2.00 more per ton under the most restrictive scenario over the base scenario. This impact is double that of the original Phase II run for the same scenario.

In summary, the EIS economics studies used super-presumptive models that overestimated recoverable reserves, failed to account for the interrelationship of surface and underground mining and underestimated the economic results.

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PROFESSIONAL BACKGROUND AND EXPERIENCE

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At POTESTA, I am also responsible for conducting ecological risk assessments, toxicity studies, biomonitoring and bioaccumulation studies for NPDES permitting and the development of remediation, recovery and restoration plans. My recent publications include a chapter entitled "In-situ Toxicity Testing of Unionids" in Freshwater Bivalve Ecotoxicology (in Press). My only recent expert witness experience was for Green Valley Coal Company in 2004.

STATUS OF THE INDUSTRY UNDERSTANDING OF THE EFFECTS OF MOUNTAINTOP MINING AND VALLEY FILLS ON AQUATIC RESOURCES

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STATUS OF INDUSTRY UNDERSTANDING OF THE EFFECTS OF MOUNTAINTOP MINING AND VALLEY FILLS ON AQUATIC RESOURCES

1.0 INTRODUCTION

This report was prepared in response to criticism raised by the Ohio Valley Environmental Coalition (OVEC) and its consultants regarding conclusions reached by the United States Army Corps of Engineers (USACE) in its review of mining permits issued to Alex Energy, Elk Run Coal Company, and Aracoma Coal Company. Essentially, those criticisms were that the proposed excess spoil valley fills at those sites would cause substantial and unabatable downstream impacts to aquatic life. This report concludes that the likely impacts to aquatic life will not be significant in the watershed where the mining will be conducteed, even without proposed mitigation efforts, and that the proposed mitigation will generally improve the conditions for benthic macroinvertebrate communities in the watersheds where mining is proposed.

Since the original Bragg versus USACE litigation (1998) much information has been gained regarding the effects of valley fill construction on aquatic resources. Some information has been widely distributed, such as the United States Environmental Protection Agency's (EPA) Mountaintop Mining/Valley Fill Environmental Impact Statement (EIS), while other information has not received much attention, such as National Pollutant Discharge Elimination System (NPDES) monitoring in-stream locations below valley fills. This document describes the available body of scientific data on aquatic impacts from the construction of valley fills and addresses some of the concerns expressed by OVEC and its consultants in comments or reports

produced to date. The main issues which have been raised regarding the effects of valley fills include: the potential loss of nutrients for the aquatic community below valley fills, temperature and flow changes in streams below valley fills, biological community changes below valley fills (particularly from the shredder functional feeding group), the presence of selenium and other metals below valley fills, and increased conductivity and dissolved solids below valley fills. Each of these potential impacts will be discussed in general and with regard to the proposed activities at the Aracoma, Blackcastle, and Republic operations specifically.

2.0 PROJECT SUMMARIES

2.1 Aracoma Coal Company, Inc. – Application No. 199900448

Aracoma Coal Company, Inc. (Aracoma) submitted an application to the USACE Huntington District on December 1, 2004 for a Department of the Army (DA) permit for the discharge of dredge and fill material into waters of the U.S. (jurisdictional waters) in association with the construction, operation, and reclamation of the **Camp Branch Surface Mine**. The project originally proposed construction of seven valley fills which would impact 21,665 linear feet of jurisdictional waters. This plan was modified in accordance with the West Virginia Department of Environmental Protection's (WVDEP) Final Approximate Original Contour (AOC) Guidance Document. As a result of the optimization associated with this guidance, the total number of valley fills was reduced to five (with five associated sediment control structures). The 30-day public notice for the project area was issued on June 27, 2004. Due to the fact that a portion of this permit was found to be eligible for listing under the National Historic Preservation Act of 1996 (NHPA), an additional area was deleted by Aracoma which reduced the total number of fills to four (with four sediment control structures) and the impacts associated with construction

of these fills to approximately 16,939 linear feet (2.14 acres) of jurisdictional waters. The application was considered complete on July 6, 2005.

The construction of the proposed valley fills will result in the permanent discharge of dredge and fill material into approximately 14,762 linear feet (1.86 acres) of intermittent streams and 297 linear feet (0.03 acre) of ephemeral streams for a total permanent impact of 15,059 linear feet (1.89 acres). The proposed valley fills drain contributing watersheds ranging from 89.38 acres to 367.6 acres. Approximately 59.6 million cubic yards of non-toxic, durable material will be discharged within the proposed valley fills. The construction of the proposed sediment control structures will result in the temporary placement of dredge and fill material into 1,880 linear feet (0.25 acre) of jurisdictional waters. The table below details the individual permanent steam impacts and corresponding pertinent information.

The project will disturb approximately 915.9 acres, including 757 acres of mineral removal. The operation will recover bituminous coal reserves from the Middle Kittanning, Five Block, Upper Clarion, Lower Clarion, Stockton A, Stockton, Upper Coalburg, Middle Coalburg, Lower Coalburg, and Buffalo Creek seams. Through construction, operation, and reclamation of the Camp Branch Surface Mine, Aracoma seeks to recover nearly 12.5 million tons of coal from the above-mentioned coal seams over a period of 8-years. The impacts associated with this project are located in Camp Branch of Dingess Run, unnamed tributaries of Dingess Run, and an unnamed tributary of Pine Fork of Ethel Hollow. All of these drainages are located in the Guyandotte River watershed. The proposed disturbance in each watershed is provided in Table 1.

TABLE 1
Permanent and Temporary Impacts Associated with Camp Branch Surface Mine

Proposed Activity	Permanent Intermittent (Ft./Ac)	Permanent Ephemeral (Ft./Ac)	Total Permanent Impacts (Ft./Ac)	Temporary Intermittent (Ft./Ac)	Total Temporary Impact (Ft./Ac)
Fill A	8,823 (1.14)	153 (0.01)	8,976 (1.15)	0	0
Pond 1	0	0	0	650 (0.10)	650 (0.10)
Fill B	2,756 (0.38)	144 (0.02)	2,900 (0.40)	0	0
Pond 2	0	0	0	400 (0.05)	400 (0.05)
Fill C	1,783 (0.21)	0	1,783 (0.21)	0	0
Pond 3	0	0	0	480 (0.06)	480 (0.06)
Fill D	1,400 (0.13)	0	1,400 (0.13)	0	0
Pond 4	0	0	0	350 (0.04)	350 (0.04)
Totals	14,762 (1.86)	297 (0.03)	15,059 (1.89)	1,880 (0.25)	1,880 (0.25)

2.2 Elk Run Coal Company, Inc. – Application No. 200200258 – Sandlick Creek

Elk Run Coal Company, Inc (Elk Run) submitted a Pre-Construction Notification (PCN) to the USACE Huntington District on July 22, 2003 for authorization to discharge dredge and fill material into jurisdictional waters in association with the construction, operation, and reclamation of the **Black Castle Contour Surface Mine** (Blackcastle). The project will result in the construction of nine valley fills which will impact 18,787 linear feet (1.85 acres) of jurisdictional waters in tributaries of Laurel Creek, George Branch, and Sandlick Creek. On May 17, 2004, the District Engineer asserted his discretionary authority to require processing the proposed activities under a Section 404 Clean Water Act (CWA) 404 Standard (Individual) Permit. The 30-day public notice for the project was issued on June 27, 2004. On August 16, 2005 the application was considered complete.

The construction of the proposed valley fills will result in the permanent discharge of dredge and fill material into approximately 11,599 linear feet (1.10 acres) of intermittent streams and 1,802 linear feet (0.142 acre) of ephemeral streams for a total permanent impact of 15,059 linear feet (1.89 acres). The proposed valley fills drain contributing watersheds ranging from 41.5 acres to 180.1 acres. Approximately 59.6 million cubic yards of unspecified, non-toxic, durable material will be generated by this project, of which approximately 2.2 million cubic yards (5.35 percent) will be discharged within the proposed valley fills. The remaining approximate 38.9 million cubic yards (94.65 percent) will be placed on the contour to backfill and eliminate a highwall as well as to comply with the AOC model of March 1999. The proposed operation will also involve removing bituminous coal reserves underlying the stream beds in the hollows proposed to be impacted by Valley Fill Nos. 2, 3, 5, 6, 7, 8, and 9. These proposed mined through areas will permanently impact approximately 2,236 linear feet or 0.146 acre of jurisdictional waters. Although the mined through areas are permanent impacts, the stream segments affected by these activities will be reestablished and restored to their approximate pre-mining locations and contours. The construction of the proposed sediment control structures (ponds) will result in the temporary placement of dredged and fill material into 3,150 linear feet (0.455 acre) of jurisdictional waters. Adverse impacts associated with construction are considered temporary in nature. Additionally, the construction of the proposed valley fills will result in secondary impacts to approximately 2,204 linear feet (0.241 acre) of jurisdictional waters as a result of sediment runoff from the valley fills sites. Table 2 descries these impacts.

The proposed project will be implemented in 12 mining and reclamation phases over a period of 10.6 years. The activities will affect a total of 521.08 surface acres, which includes

approximately 449.17 acres of mineral removal. Elk Run seeks to recover nearly 10.2 million tons of coal from the Buffalo Creek and Coalburg seams. The impacts associated with this project are located in portions of unnamed tributaries of Laurel Creek, George Branch, an unnamed tributary of George Branch, and unnamed tributaries of Sandlick Creek.

TABLE 2

Permanent and Temporary Impacts Associated with Black Castle Contour Surface Mine

Proposed Activity	Permanent Intermittent (Ft./Ac)	Permanent Ephemeral (Ft./Ac)	Total Permanent Impacts (Ft./Ac)	Temporary Intermittent (Ft./Ac)	Secondary Intermittent (Ft./Ac)	Total Temporary Impact (Ft./Ac)
Valley Fill No. 2	1,425 (0.154)	400 (0.028)	1,825 (0.182)	0	0	0
Pond No. 2	0	0	0	436 (0.054)	130 (0.017)	566 (0.071)
Mine Through	0	330 (0.023)	330 (0.023)	0	0	0
Valley Fill No. 3	0	970 (0.078)	970 (0.078)	0	0	0
Mine Through	0	23 (0.005)	23 (0.005)	0	0	0
Valley Fill No. 4	1,481 (0.166)	0	1,481 (0.166)	0	0	0
Pond No. 4	0	0	0	374 (0.043)	221 (0.031)	595 (0.074)
Valley Fill No. 5	707 (0.047)	100 (0.008)	807 (0.055)	0	0	0
Mine Through	229 (0.008)	0	229 (0.008)	0	0	0
Valley Fill No. 6	2,133 (0.231)	0	2,133 (0.231)	0	0	0
Pond No. 6	0	0	0	639 (0.117)	221 (0.029)	860 (0.146)
Mine Through	351 (0.031)	400 (0.022)	751 (0.053)	0	0	0
Valley Fill No. 7	3,130 (0.319)	0	3,130 (0.319)	0	0	0
Pond No. 7	0	0	0	600 (0.076)	0	600 (0.076)
Mine Through	622 (0.042)	163 (0.009)	785 (0.051)	0	0	0
Valley Fill No. 8	925 (0.089)	332 (0.028)	1,257 (0.117)	0	0	0
Pond No. 8	0	0	0	350 (0.057)	285 (0.031)	635 (0.088)
Mine Through	0	68 (0.003)	68 (0.003)	0	0	0

Proposed Activity	Permanent Intermittent (Ft./Ac)	Permanent Ephemeral (Ft./Ac)	Total Permanent Impacts (Ft./Ac)	Temporary Intermittent (Ft./Ac)	Secondary Intermittent (Ft./Ac)	Total Temporary Impact (Ft./Ac)
Valley Fill No. 9	950 (0.058)	0	950 (0.058)	0	0	0
Pond No. 9	0	0	0	200 (0.027)	700 (0.069)	900 (0.096)
Mine Through	50 (0.003)	0	50 (0.003)	0	0	0
Valley Fill No. 10	848 (0.039)	0	848 (0.039)	0	0	0
Pond No. 10	0	0	0	230 (0.033)	647 (0.064)	877 (0.097)
Pond Area	0	0	0	321 (0.048)	0	321 (0.048)
Totals	**12,851 (1.187)**	**2,786 (0.204)**	**15,637 (1.391)**	**3,150 (0.455)**	**2,204 (0.241)**	**5,354 (0.696)**

2.3 Alex Energy, Inc. – Application No. 200400574-1 – Unnamed Tributary to Cabin Creek

Alex Energy, Inc (Alex) submitted an application to the USACE Huntington District for a permit for the discharge of dredge and fill material into waters jurisdictional waters in association with the construction, operation, and reclamation of the **Republic No. 2 Surface Mine** (Republic). The original permit was advertised by public notice on August 30, 2004. Changes to the permit resulted in a subsequent notice on June 14, 2005. The project proposes construction of three valley fills which will impact 12,694 linear feet (1.71 acres) of jurisdictional waters.

The construction of the proposed valley fills will result in the permanent discharge of fill material into approximately 9,918 linear feet (1.01 acres) of seven jurisdictional stream channels. Of this total, approximately 6,819 linear feet of intermittent stream and 3,099 linear feet of ephemeral stream will be impacted. Approximately 576 linear feet (0.41 acre) of intermittent stream channel would be impacted by sediment transport activities (areas of secondary impact). Because of the "swell factor" that causes spoil to expand when it is removed from the mine site

only 85.5 million of the 139.8 million cubic yards of overburden can be placed in the areas from which it will be removed. The remaining 54.3 million cubic yards of material will be placed into valley fills. The construction of the three sediment control structures (ponds) will result in the temporary discharge of fill material into 2,200 linear feet (0.28 acre) of intermittent stream channel. Table 3 describes these impacts.

The overall purpose is to extract approximately 9.5 million tons of coal from the Clarion Seam through the Williamson seams at the site. Of the 753.3 acres of the mining site, 488 acres will be disturbed for coal removal and 265.3 acres will be disturbed in conjunction with support activities such as sediment structures, drainage structures, roads, durable rock fills, etc. The impacts associated with this project are located in portions of unnamed tributaries of Cabin Creek and Long Branch.

TABLE 3
Permanent and Temporary Impacts Associated with Republic No. 2 Surface Mine

Proposed Activity	Permanent Intermittent (Ft./Ac)	Permanent Ephemeral (Ft./Ac)	Total Permanent Impacts (Ft./Ac)	Temporary Intermittent (Ft./Ac)	Secondary Intermittent (Ft./Ac)	Total Temporary Impact (Ft./Ac)
Valley Fill 1	3,357 (0.329)	1,789 (0.193)	5,146 (0.522)	0	0	0
Pond 1A/1B	0	0	0	1,400 (0.208)	0	1,400 (0.208)
Valley Fill 2	1,190 (0.123)	693 (0.077)	1,883 (0.200)	0	325 (0.370)	325 (0.370)
Valley Fill 3	2,272 (0.237)	617 (0.055)	2,889 (0.292)	0	0	0
Pond 2	0	0	0	800 (0.080)	251 (0.036)	1,051 (0.116)
Totals	6,819 (0.689)	3,099 (0.325)	9,918 (1.014)	2,200 (0.288)	576 (0.406)	2,776 (0.694)

3.0 BIOLOGICAL CONDITION OF IMPACTED STREAMS

The physical, biological, and chemical characteristics of tributaries in the Dingess Run (Aracoma), the Laurel Creek (Elk Run), and the Cabin Creek watersheds (Alex) were assessed as part of the 404/401 application process. This information may be found in the following reports which are part of the administrative record:

- **Aracoma -Camp Branch Surface Mine**
  - Benthic Macroinvertebrate, Water Chemistry, Habitat, and Fisheries Studies of Stations Associated with Six Proposed Valley Fills on Ethel Hollow and Dingess Run, 31 August 2000, REI Consultants, Inc.
  - Letter Report Benthic Macroinvertebrate Survey and Surface Water Sampling Ethel Hollow Surface Mine Logan County, West Virginia, January 15, 2001, Civil and Environmental Consultants, Inc.

- **Elk Run – Black Castle Contour Surface Mine**
  - Benthic Macroinvertebrate, Habitat, Water Chemistry Studies of Jurisdictional Waters Associated with Fourteen Proposed Valley Fills at the Black Castle Contour Surface Mine, October 2000, REI Consultants, Inc.
  - Benthic Macroinvertebrate, Habitat, and Water Chemistry Studies of Stations Associated with the Proposed Valley Fills at the Black Castle Contour Surface Mine, November 2001, REI Consultants, Inc.

- Benthic Macroinvertebrate Survey and Surface Water Sampling, Stream Measurement, Delineation and Classification, February 2002, Alliance Consulting, Inc.
- WOPEC. 1997. Elk Run Coal Company Water Treatment Evaluation Sandlick and Laurel Creek Sites, Volumes 1-III. Submitted to Elk Run Coal Company on June 6, 1997.
- WOPEC. 2001. Summary Report of the Effects of Alkaline Fill Material on Water Quality. Submitted to Kermit Fincham of Elk Run Coal Company in January 2003

- **Alex – Republic No. 2 Surface Mine**
  - Benthic Macroinvertebrate, Habitat, Water Chemistry, and Fisheries Studies of Streams Associated with the Four Proposed Valley Fills at the Republic No. 2 Surface Mine, May 2001, REI Consultants, Inc.

4.0 PHYSICAL CHANGES

As part of the 404(b)(1) analysis for these projects, the USACE evaluated the physical and chemical characteristics of the ecosystem. These characteristics are broken down into six components: Substrate (40 CFR 230.20); Suspended particulate/turbidity (40 CFR 230.21); Water (40 CFR 230.22); Current patterns and water circulation (40 CFR 230.23); Normal water fluctuations (40 CFR 230.24); and Salinity gradients (40 CFR 230.25). Because this project will

only involve discharges of dredge or fill material in non-tidal jurisdictional waters; this project will have no effect on salinity gradients.

The substrate within the proposed valley fill sites consists of the stream bottom and banks below the normal flow elevation. Substrate is the organic and inorganic solid materials and includes water and other liquids or gases that fill spaces in between the solids. For this proposed site, substrate is defined as the material from which the actual stream bed is composed (below bankfull) and any material deposited in this zone. This typically includes inorganic material such as cobble, gravel, and other inorganic substrate components. Organic material includes detritus (broken down leaf material), grass, lichens, and larger woody debris that have fallen into the streambed.

The substrate, which is typically composed of bedrock, boulders, cobble, gravel, sand, silt, and clay, has been evaluated at each of the valley fill and sediment control structure sites. The inorganic substrate has been evaluated at most of the impact sites. The composition of the substrate is variable among impact sites for each of the three aforementioned permits. More detailed information may be found in the administrative record or permit applications.

In the footprint of the proposed fills substrate will be buried under several feet of rock. The substrate between the toe of each valley fill and exit channel of the each drainage control structure will receive deposition of sediment from the fill construction and will limit the quality of benthic habitat in that area of the stream during mining. It is likely that the

substrate in the footprint of the proposed sediment control structure will also be altered (as compared to the existing stream channel).

After construction of each valley fill is complete, and vegetation has been established on the disturbed areas, the drainage control structure will be removed and the adversely impacted stream reach restored to appropriate channel geometry and substrate as described in the applicant's Compensatory Mitigation Plan (CMP). Compliance with the CMP is required of Aracoma, Elk Run, and Alex by Special Conditions listed in each permit.

Suspended particulates are materials that consist of fine-grained mineral particles, usually smaller than silt and organic particles. Suspended particulates enter the disposal site primarily as a result of land runoff, flooding, vegetation and plankton breakdown, re-suspension of bottom sediments, and construction activities including dredging and filling. Particulates remain suspended in the water column for variable periods of time as a result of factors such as agitation of the water, particulate specific gravity, particle shape, and physical and chemical properties of particle. Also, physical characteristics of the stream channel that cause agitation of the water (like roughness) influence the amount of material that may be suspended in the water column.

Several state permits were necessary for each of these projects pursuant to Section 401 and 402 of the Clean Water Act and the Surface Mining Control and Reclamation Act. Each of the applicants obtained the required NPDES permit for the proposed projects. Permit conditions require the routing of run-off through sediment and erosion control structures in order to reduce or eliminate suspended solids. Although an increase in suspended particulates may occur during

initial clearing activities within the footprint of the proposed sites for the valley fills and temporary sediment structures, Best Management Practices (BMPs) will be utilized which will include temporary erosion control systems. The proper use of BMPs will reduce particle loading which minimize the increase in turbidity. Additionally, in-stream erosion control systems will also be established and will be limited to material that would degrade and not require removal.

Temporary sediment control structures may include, but not be limited to, temporary silt basins, ditches, ponds, rock toe sediment structures, straw/hay bale fencing, cloth filter fences, compacted earth, sand bags, or other appropriate materials. Monitoring of all outlets where water is discharged from the proposed project area will take place according to each applicant's NPDES permit. These sediment structures, along with the concurrent regrading and revegetation of disturbed areas, will be expected to prevent or minimize the contributions of suspended solids. Sediment pond removal will occur after upstream and upland area reclamation has been accomplished and suspended solids levels of water entering the ponds returns to pre-mining levels. Suspended solids loads to waters outside of the project area will be expected to return to pre-mining conditions. Through out the projects, discharges will be expected to comply with the effluent limits stipulated in the NPDES permit issued by the WVDEP with the implementation of the above-mentioned measures.

Water patterns and circulation are the physical movements of water though an aquatic ecosystem. The excavation, filling, and relocation of ephemeral and intermittent streams in addition to the construction of drainage control structure will alter the circulation and drainage patterns at each of the project sites. The filling activities will occur in phases, and the removal of surface water

features will be offset to the extent practicable at each site. Surface water availability may be impacted by the proposed operation as described below. During the initial stages of mine development, overland runoff (and hence surface water availability) may increase. The increase will be mitigated by engineered sediment structures, which will provide storm runoff retention a more stable discharge rate to the receiving stream. After revegetation is established, surface runoff rates will be expected to stabilize. After mine reclamation, increased infiltration due to topography changes and porosity of the fill, and reduced evapotranspiration due to altered ground cover, may result in minor changes in surface and groundwater availability. As part of the permitting process, the USACE evaluates Attachment J-6 of each applicant's surface mine application (SMA). Strict adherence of the sediment control plan, the reclamation plan and the acid and toxic materials-handling plan (MHP), is required. Therefore, no unacceptable adverse impacts to current patterns or water circulation is anticipated downstream of the temporary sediment control structures.

Normal water fluctuations in the natural aquatic system consist of daily, seasonal, and annual fluctuations in water level. Biological and physical components of aquatic systems may be either adapted to or characterized by these periodic water fluctuations. Normal water fluctuations in the footprint of the valley fill will be permanently altered. The runoff component of the hydrologic balance will be expected to increase due to surface disturbance. This temporary increase in runoff will be routed to properly sized and engineered sediment control structures, which will abate the flow increase and discharge to the receiving streams. Each project's NPDES and Surface Mine Permits require the construction of temporary sediment control measures; in addition to the valley fills' associated sediment control structures (ponds), in

upland areas such as around the perimeter of the mining areas. Discharges from these temporary structures will be directed off the disturbed areas by conveyance ditches. These ditches will either converge with the natural stream channel at the toe of the valley fill or discharge into other natural drainages. The proposed in-stream sediment control structures will be constructed with open exit channels designed to pass the peak discharge from a 25-year 24-hour storm event. The construction of sediment control structures will temporarily impact jurisdictional waters. While these areas will no longer be lotic environments, water flow will not be stagnant and biological communities will utilize and/or colonize these temporary niches. Post-vegetation structures will be removed and water fluctuation levels will be expected to stabilize. Disturbance below the pond (within 100 feet of the stream) will be minimal and existing roadways, where practicable, will be utilized for maintenance and removal of the sediment control structures. No substantial effects will be anticipated to occur on downstream aquatic communities. Upon completion of reclamation, the initial shift in ground cover from forest to tall grass will result in overland runoff returning to the approximate, pre-disturbance values. The evapotranspiration demands upon groundwater will be expected to be reduced from pre-mining conditions, as the shift in vegetation is established.

4.1 Sedimentation

While increased deposition and sedimentation is anticipated with most development or disturbance, the EIS found that an increase in embeddedness and sedimentation is not imminent in the watersheds with valley fills present (FILLED watersheds). Additionally, this document specifically indicates that this is a watershed specific phenomenon. The text states (in regard to bed material) "Particle sizes from streams draining unmined areas in Spruce Fork and Clear Fork

have a similar distribution, but these particle-size distributions are different from those of stream draining unmined areas of both Upper Mud River and Twentymile Creek. The similar and dissimilar particle-size distributions among basins indicate that natural factors, such as localized geology and land slope may have some affect on particle sizes."

A study conducted by the United States Geological Service (USGS) found similar results (Wiley et al, 2001). The USGS evaluated 54 sites in the Spruce Fork, Clear Fork, Mud River, and Twentymile Creek watersheds. Bed material data were collected and evaluated using the particle sizes of the median, 84th percentile, and percentage less than 2 millimeters. The 84th percentile is an arbitrary particle size equal to two standard deviations larger than the mean sized (assuming a normal distribution). High variability between basins indicated that natural factors such as localized geology and land slope may be affecting particle size. In general, sites below fills had a smaller median particle size and a greater number of particles less than 2 millimeters; however, at the 84th percentile each stream type (unmined, valley fill, and mined) had about the same sized particles. This is important because the 84th percentile is related to stream roughness, a component of stream geomorphology/hydrology. The study noted that the distribution among particle sizes at unmined sites located within individual basins were similar. The distribution at unmined sites among all watersheds, were variable. As noted in the EIS, the particle sizes in Spruce Fork and Clear Fork had similar distributions, which were different from those collected in Mud River and Twentymile Creek. The USGS report stated that the variability among basins indicated that natural factors, such as localized geology and land slope may have an affect on particle size. The report also noted a 1988 sediment load study completed in relation to highway construction in southern West Virginia. Road construction in the Appalachians, like mining,

often requires the construction of fills to support road bases and dispose of excess materials. The sediment load study found that loads decreased after revegetation and stabilization of the land disturbance. The authors indicated that similar results may occur below mining valley fills.

It would appear that, like most earth disturbing activities, the potential for sediment runoff and deposition exist, but it is not inevitable. Use of acceptable mining and engineering practices, and compliance with permitting requests through the NPDES will minimize the potential for sediment deposition in streams below the Aracoma, Blackcastle, and Republic operations.

4.2 Stream Flow Alterations

Water flowing from the surface through a valley fill percolates more slowly than a surface route and is discharged to the stream channel over time. The more consistent flow condition this creates was evidenced in the EIS during Summer 1999. Drought conditions saw filled sites having flowing water while most of the reference sites were dry or substantially flow limited. Several recent studies conducted by the USGS have confirmed what was demonstrated in the EIS, that the presence of valley fills increases the base flow of streams likely due to infiltration and retention of the fill. Wiley and others (2001) compared low stream flows between valley filled and unmined sites and demonstrated that valley fill sites have a greater percentage of base stream flows and a lower percentage of storm-flows than unmined sites.

Flow from the valley fills during the hot, dry, summer months can provide refugia for aquatic organisms similar to natural springs which occur in headwater regions. While the flow from a valley fill is the result of anthropogenic activity and is not a natural spring, it may still provide important ecological functions such as aquatic habitat and refugia from temperature extremes

and drought. Valley fills constructed in conjunction with the Aracoma, Blackcastle, and Republic permits would be expected to provide similar ecological functions.

5.0 WATER QUALITY CHANGES

5.1 Temperature

Stream temperatures are variable and dependent on water source, air temperature, canopy cover, stream bed roughness, wind, and other factors. Surface water-fed streams have the most temperature variability both seasonally and daily while spring fed headwater streams with good canopy cover maintain a fairly constant temperature. Spring-fed headwater streams are cooler in summer and warmer in winter due to the groundwater source. They offer refugia for organisms displaced by freezing in the winter and provide aerated, flowing water conditions for aquatic life during hot summer months and droughts. As was discussed previously, water discharging from valley fills simulates spring-fed streams with regard to flow characteristics and also with regard to temperature. The USGS compared stream temperatures in two streams: one approximately 400 feet below a valley fill in a tributary to the Mud River and the other in an unfilled tributary to the Mud River. In addition to finding that the filled stream had a more consistent flow, the USGS found that the filled stream had lower temperature fluctuations (i e., warmer water in the winter and cooler water in the summer) than did the unfilled stream (Wiley, et al. 2001). Thus, the valley-filled stream behaved more like a spring-fed stream than one with a significant surface water component. Dr. Bruce Wallace's response to this observation is unclear. On one hand, he claims that thermal regime is an important influence on the life cycle of aquatic organisms, while on the other observing that the diminished temperature swings provided by springs (and presumably valley fills) provides refuge for organisms that have low tolerance for the upper and

lower temperature spectrum (Wallace Comments on Statement of Findings of Corps for Black Castle (Elk Run), 3&4).

While it may be intuitive that valley fill construction could change the temperature dynamics of a surface flow fed stream to conditions more similar to a groundwater fed stream, the effect may not persist downstream. Temperature differences between unmined and filled sites were not readily apparent in the EIS samplings sites which would indicate that either no differences occurred or that differences were abated upstream of the sampling stations. The filled EIS sampling sites were located downstream of sediment control ponds where the retention time may have been sufficient to bring changes in the water temperatures back to a condition similar to the surface fed reference streams.

Valley fills constructed in conjunction with the Aracoma, Blackcastle, and Republic permits would be expected to provide temperature refugia to aquatic organisms from summer heat and winter freezing. While Wallace has suggested that the temperature alterations below fills could alter reproductive periods for fish or benthic macroinvertebrates, he has not offered any specific claims that he temperature differences recorded by the USGS have, or will cause, any specific impacts.

5.2 Specific Conductivity

In the course of mining, rock is fractured which creates increased surface area for weathering and increases the mineral content of water flowing through overburden material. Increases in the mineral content of water are consistent with all types of mining or development where rock is

disturbed and stacked or replaced whether this is as approximate original contour, gob piles, or valley fills. Increases in some minerals, such as those contributing alkalinity or hardness, may be beneficial to a stream system. Other constituents, such as iron and manganese, may be removed if necessary to prevent water quality impairment. The concentrations of some constituents, such as sulfates, chlorides, and other dissolved solids, can become limiting to the aquatic community in high concentrations. These high concentrations can exist below mining facilities due to the increased weathering of the fractured rock and due to the treatment chemicals used to increase acidic pHs and precipitate metals. The levels which limit aquatic communities are variable depending on the specific elements contributing to dissolved solids concentration.

Specific conductivity is a measure of the ability of water to carry an electric charge and is an indicator of the dissolved ion concentration in the water. There is some evidence that when dissolved solids concentrations (and conductivity) rise to certain levels, taxa richness, particularly Ephemeroptera taxa (EPT) (generally regarded as pollution intolerant aquatic insects) richness, begins to decline.

In general, there is some discrepancy as to the levels of conductivity which would be expected to effect biological communities in streams. The EIS found a correlation between conductivity and West Virginia Stream Condition Index (WVSCI) scores that indicated community limitations begin to be detected at a conductivity of around 850 uS/cm (personal interpretation Green and Childress, 2000 Figure 86 [Figure 1]) while the Kentucky Division of Water (KDOW), in a similar comparison, found limitations in community structure (MBI scores) in the 600-800uS/cm range (personal interpretation of KDOW, 2004 Figure 21[Figure 2]). Other data sets do not

show the same correlation. Argus Energy has been conducting monitoring semi-annually since 1995 in several watersheds with different levels of mining intensity and in different stages of disturbance as part of their "Water Quality Improvement Plan". Their fall data set contains over 200 data points (multiple samples from 47 sites) collected over a 10-year period. In this dataset, there is no correlation between conductivity and WVSCI scores over a range of conductivities reaching as high as 2010uS/cm (Figure 3).

FIGURE 1
Excerpt from EPA's MTM/VF EIS

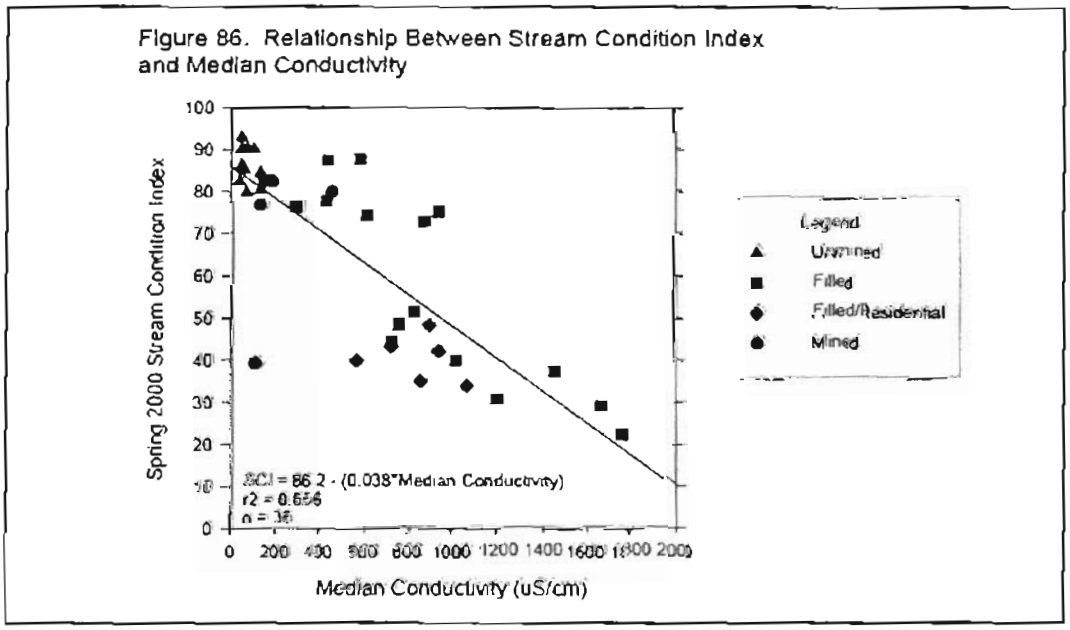


FIGURE 2

Excerpt from Kentucky Division of Water's publication titled: "Effects of Surface Mining and Residential Land Use on Headwater Stream Biotic Integrity in the Eastern Kentucky Coalfield Region"

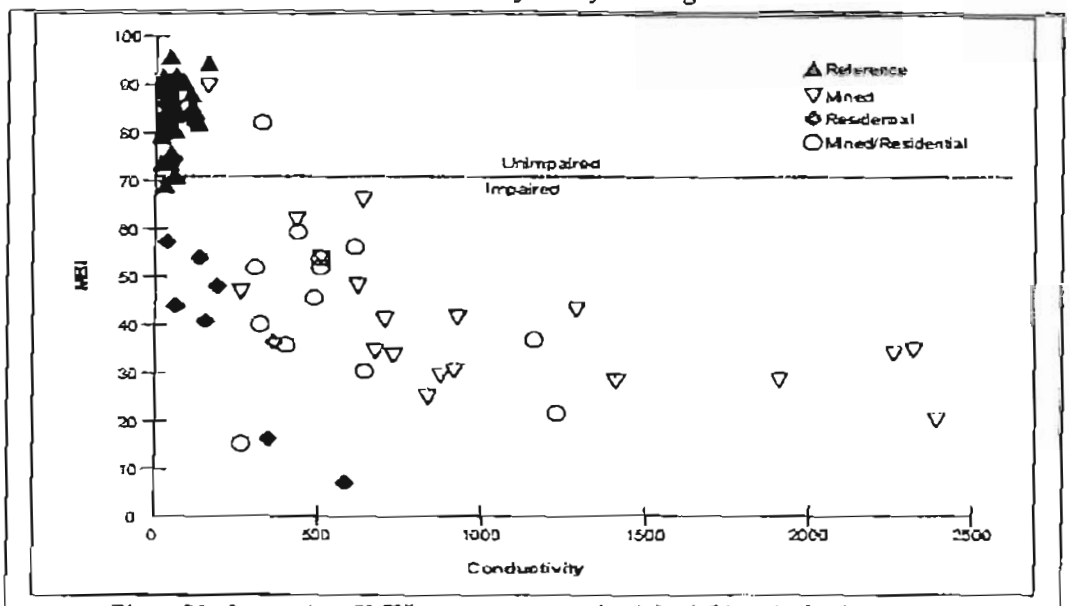
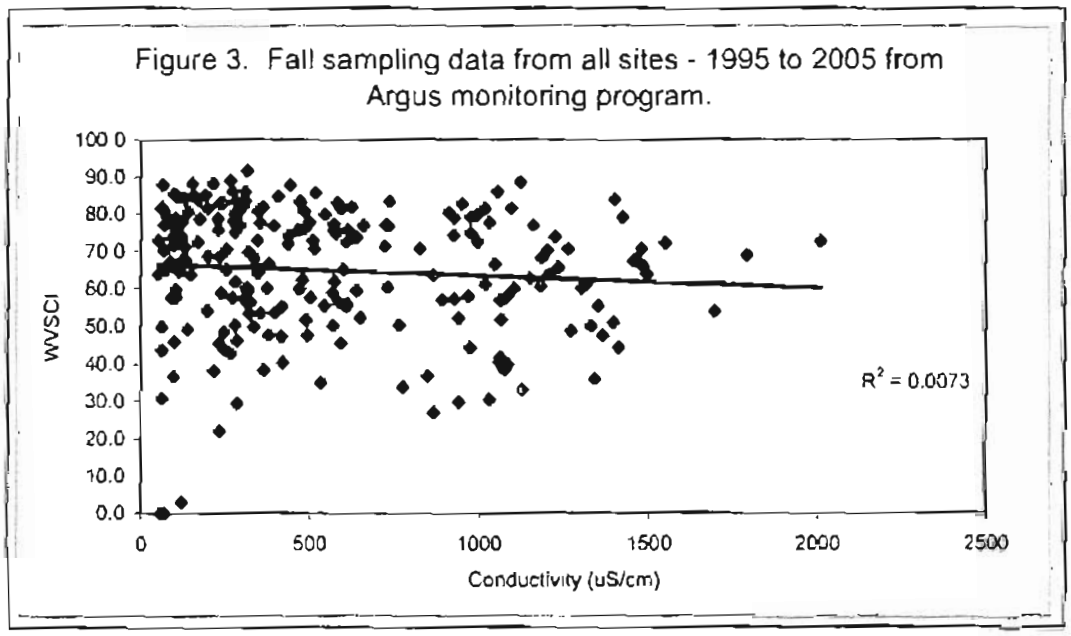


Figure 21. Scatterplot of MBI scores versus conductivity (µS/cm) by land-use category.

FIGURE 3

Excerpt from Argus Monitoring Program

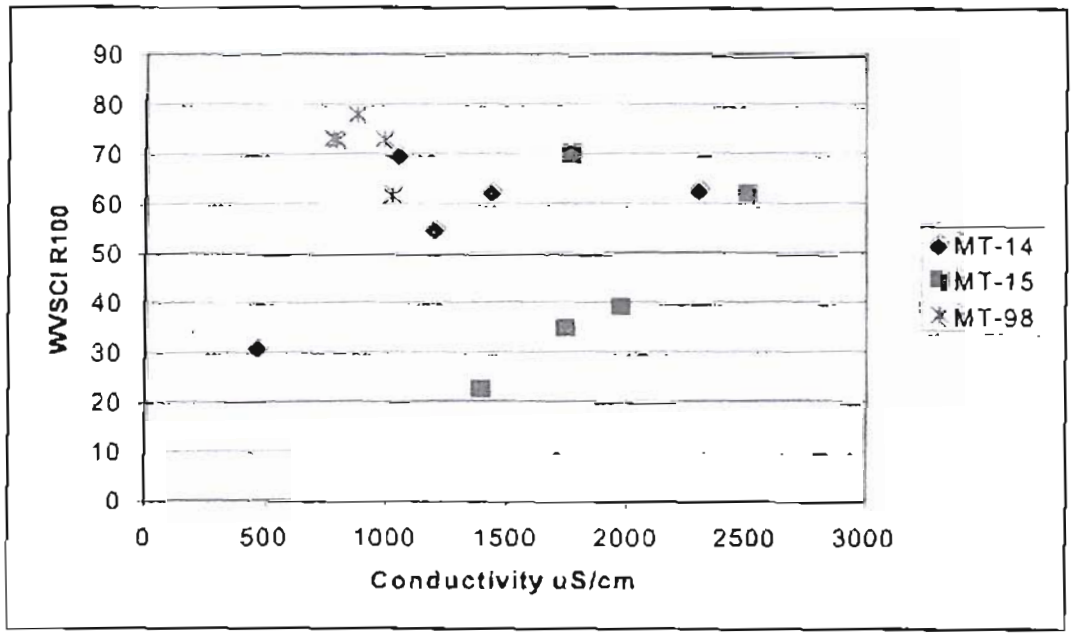


However, while these studies offer generalities regarding the relationship between dissolved solids (which are indicated by conductivity) and invertebrate community structure, reviewing specific information provides additional insight into the effects of valley fills (Figure 5). Ballard Fork of the Mud River Watershed has eight fills which were permitted from 1985 to 1989. A sampling site below the sediment control pond on this stream, MT-14 in the EIS, was sampled five times from Spring 1999 through Spring 2000 and had conductivities ranging from 464 to 2300 uS/cm (Figure 5). The benthic macroinvertebrate community at this site was generally rated as *Fair*, showing some potential impairment on most sampling dates and scored in the *Good* range on one sampling date. The lowest WVSCI score at this site (30.94) corresponded to the lowest conductivity measurement (464 uS/cm).

Stanley Fork, also in the Mud River watershed, has 6 fills with associated sediment control and mining has occurred on all the ridges in the watershed according to the EIS. The mining permits issued in this watershed date from 1988 to 1995. Seasonal sampling for the EIS (Site MT-15) showed the benthic community at this site was poor to good with WVSCI scores ranging from 22.57 to 70.28. Conductivity was generally high at the site ranging from 1,387 to 2500 uS/cm. The highest score at this site, 70.28 which is in the *Good* range, was recorded when the conductivity measured 1,764 uS/cm.

Conductivity at EIS site MT-98 ranged from 773 to 1025 uS/cm. This sampling site was located below six fills but was upstream of the sediment pond. WVSCI scores at this site were *Fair* to *Good* and ranged from 61.98 to 77.9 indicating the potential for healthy benthic macroinvertebrate communities at higher conductivity ratings.

FIGURE 4
WVIS Scores of EIS Sites Plotted with Conductivity



Evaluation of the variability in the range of potential WVSCI scores at differing conductivities indicates two important points. First, there are clearly other factors contributing to structuring macroinvertebrate populations in valley fill influenced watersheds. This is evidenced by the EIS sites scoring ~62 (61.98 to 62.99) for the WVSCI scores with conductivities ranging from 1,000 and 2,500 uS/cm and the 30 to 40 point differences in site scores (note the Argus data also has conductivities of 1,500 to 2,200 uS/cm with WVSCI scores in the *Good* range). Secondly, if conductivity is not the limiting factor in community development, manipulating other variables may improve the overall benthic community structure.

R.E.I. Consultants, Inc. (REIC) conducted a study in October 2005 on Kiah Creek in Wayne County, West Virginia. WVSCI scores above 80 were found in the stream with elevated

conductivity levels (ranging from 940 µS/cm to 1081 µS/cm). In this conductivity range, no direct correlation was indicated between conductivity levels and WVSCI scores (Figure 5). The more important factor affecting community structure in Kiah Creek appears to be habitat as the WVSCI scores are correlated to habitat (Rapid Bioassessment Protocol) scores and specifically the metric describing sediment deposition (Figures 6 and 7).

FIGURE 5

Relationship between Benthic Community Structure and Conductivity in Kiah Creek

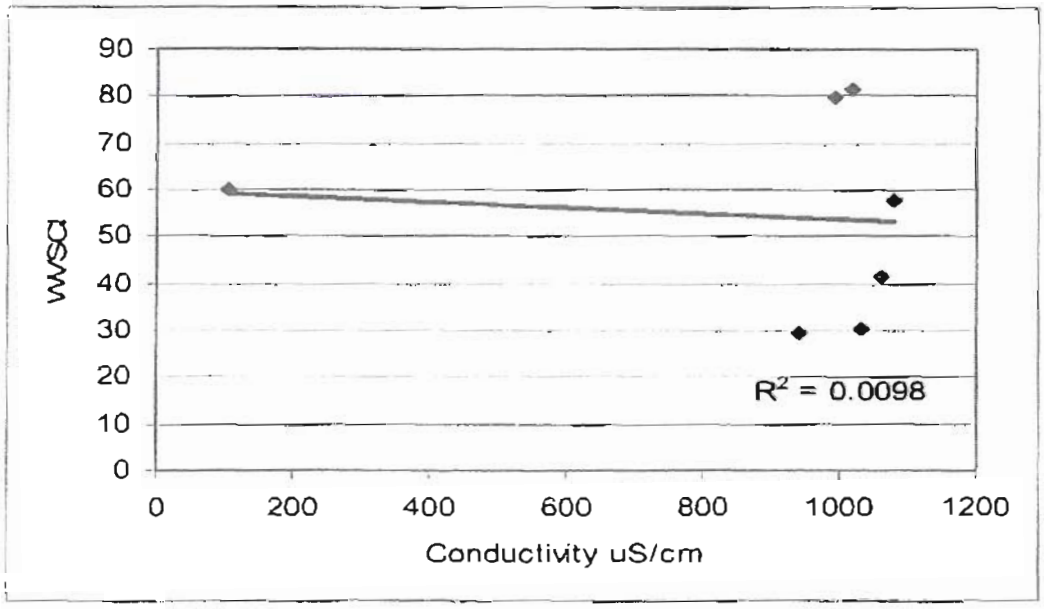


FIGURE 6

Relationship between Benthic Community Structure and Total RBP Habitat Score

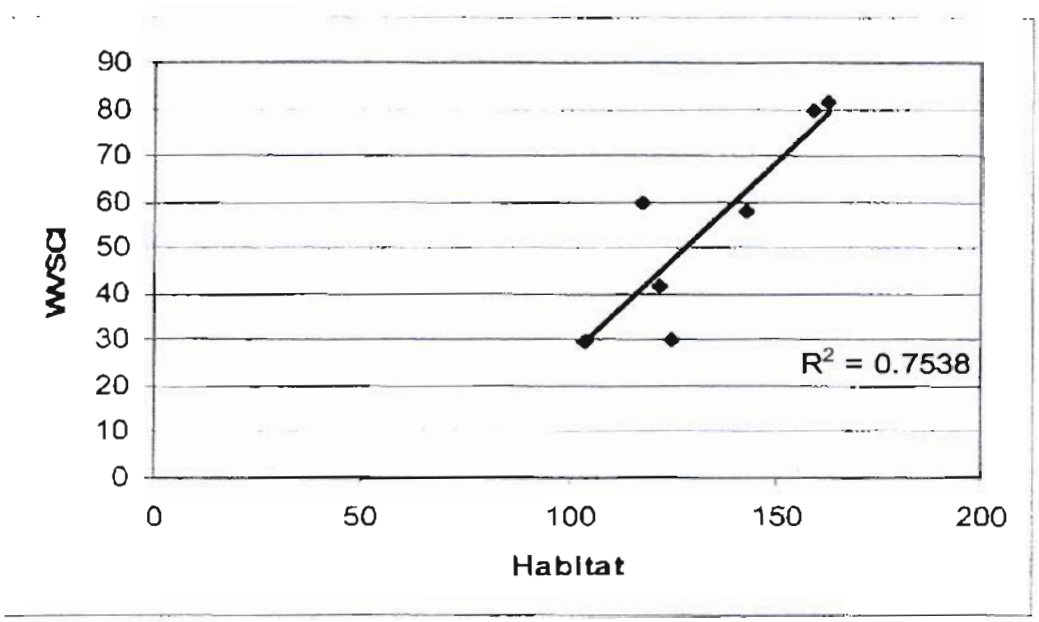
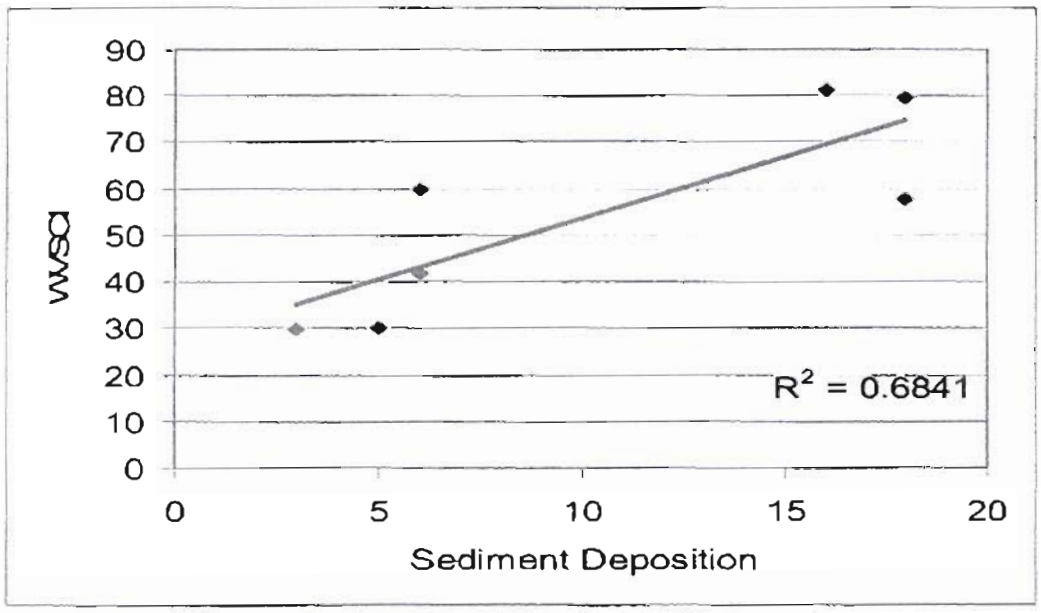


FIGURE 7

Relationship between Benthic Community Structure and Sediment Deposition Metric Score



Thus, the impacts of elevated conductivity are variable over the range of values experienced in the mountaintop mining region of West Virginia. While the benthic macroinvertebrate community may be limited, sites with elevated conductivity may still score in the *Fair* to *Very Good* range and provide ecological services to the in-stream community.

Based on historic mining in the watershed and mining in the adjacent watersheds, post-mining conductivity downstream of Alex Energy's Republic No.2 operation is expected to be in the 600 to 750 uS/cm range. The preceding information would indicate that conductivities in this range will support healthy and diverse macroinvertebrate assemblages. At the Elk Run Blackcastle operations, past mining practices have created conditions which currently require chemical treatment of acid mine drainage. Conductivity and overall water quality are expected to improve following alkaline additions to in-place fills which are producing water currently being treated. Treatment chemicals buffer pH and reduce metal loads, but they also contribute to conductivity and dissolved solids water quality limitations in the watershed. Elk Run has begun employing alkaline spoil to neutralize the acidic spoils "at source," a plan that reportedly has reduced acid mine drainage formation and reduced the need for active chemical treatment. The current permit proposes to continue this practice and a reduction in necessary active treatment is generally expected to improve water quality in the watershed, including elevated conductivity caused by treatment. The Dingess Run watershed where Aracoma's Camp Branch Mine is located has been extensively disturbed by both deep mines and surface mines in multiple coal seams. Generally the overburden and discharges from deep mines and surface mines have been found to be low in iron and alkaline with water quality remaining good in the watershed.

Threshold monitoring near the base of Dingess Run near Stollings shows the water quality within state "in-stream" water quality standards for Warm Water Fisheries.

5.3 Metals

Iron, aluminum, and manganese are the metals generally associated with mining activity. The release of metals from mining activity is minimized through materials-handling plans and overburden handling which minimize acid production and thus leaching of metals and through sediment control, as metals are often associated with sediment. Also, mine discharges are permitted through the NPDES which establishes permit limits for acceptable discharge of metals associated with mining. If mining facilities comply with the MHP and NPDES permit, metals should not be discharged at levels adversely impacting the aquatic community.

Recently there has been attention on the potential release of selenium from mining operations as the chronic water quality criterion for selenium was exceeded in samples collected for the EIS. This criterion is being evaluated and has been proposed to be changed due to problems with its development and because a fish tissue criterion is believed to be more appropriate for evaluating the chronic effects of selenium. Regardless of changes to the criteria, selenium is currently addressed in the permitting process by a MHP which includes isolation of the high selenium layers and through the NPDES permitting process.

All three locations are required to comply with NPDES permit limits for metals.

6.0 NUTRIENT LIMITATIONS

One of the original arguments against valley fills relied on the description of the river continuum concept (Vannote et al, 1980) and the theory that upstream processes structure the downstream communities. Critics of valley fills have relied on this work to argue that fills disproportionately impact leaf shredding macroinvertebrates in a way that will severely diminish the downstream transport of energy in the form of shredded leaf litter, thereby diminishing the ability of downstream reaches to support macroinvertebrates and fish. If streams were functioning only as described by that document, impacting headwater streams would undoubtedly limit streams and rivers below valley fills due to loss of the organic food supply from the upstream waters. Wallace continues to return to this argument despite substantial evidence that it is not the case. While the river continuum concept may be an accurate description of how unperturbed systems would normally function, it doesn't necessarily reflect how disturbed systems would function nor does it indicate that systems not conforming to that model would necessarily be "non-functioning." While studies of valley fills have shown in some cases that the numbers of macroinvertebrate taxa are reduced below fills, they have also shown that the total number of macroinvertebrates is not reduced. In fact, data collected for a quantitative supplemental study to the EIS, which was conducted simultaneously by Potesta & Associates, Inc. (POTESTA), indicated that exactly the opposite was true. POTESTA'S Supplemental Study utilized 23 monitoring stations within three watersheds which were part of the EIS study. During the Winter 2000 index period, the filter feeders and collector groups were greater in the filled and filled/residential sites than in the unmined sites (Figure 8). In the Spring 2000 sampling period, the filter feeders were greater in the filled and filled/residential sites than in the unmined sites (Figure 9). The increase in filter-collectors in the filled and filled/residential groups could be

attributed to increases in the organic inputs. The sources of organic enrichment would likely be domestic inputs at the filled/residential sites and the pond influence at the filled sites. Increases in collectors, particularly filter feeders, below impoundments are well documented in the literature (Allen, 2000; Stanford and Ward, 1979; Petts, 1984). The increase in filter feeders and collector gatherers at filled sites would imply an overabundance of organic material available for the benthic community and a shift to a collector-gather and filter-collector macroinvertebrate benthic community structure. This demonstrates that the concerns that the nutrients would be limited by virtue of filling were either wrong or failed to account for the positive impacts of the sediment ponds that contribute substantially to the food base of the downstream community.

FIGURE 8

Functional Feeding Group Distribution of Benthic Macroinvertebrates Collected at EIS Sites in the Winter 2000 Sampling Period

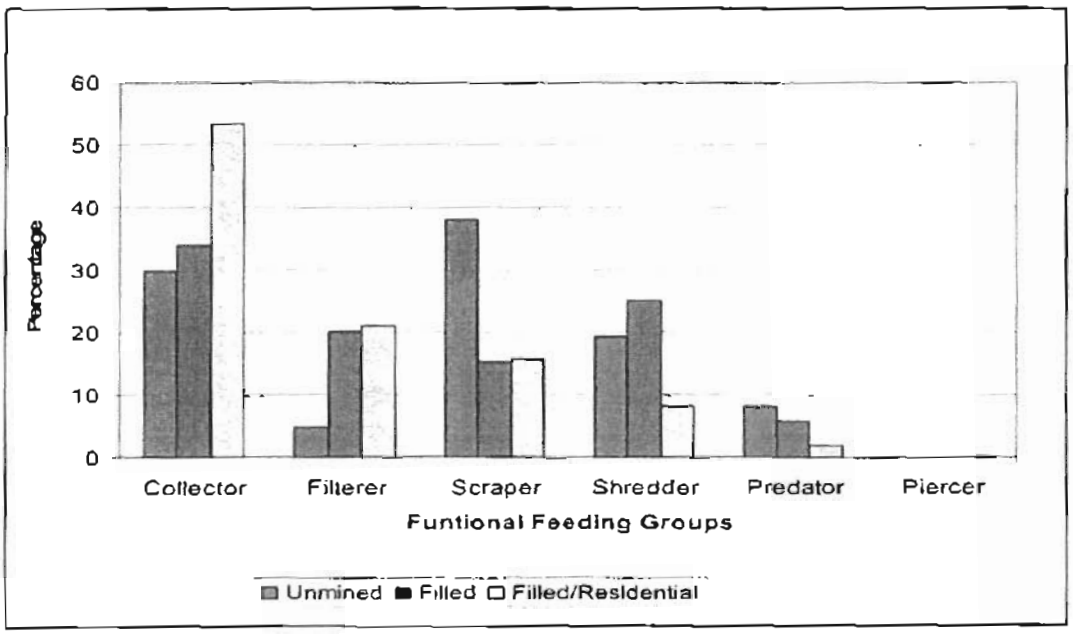
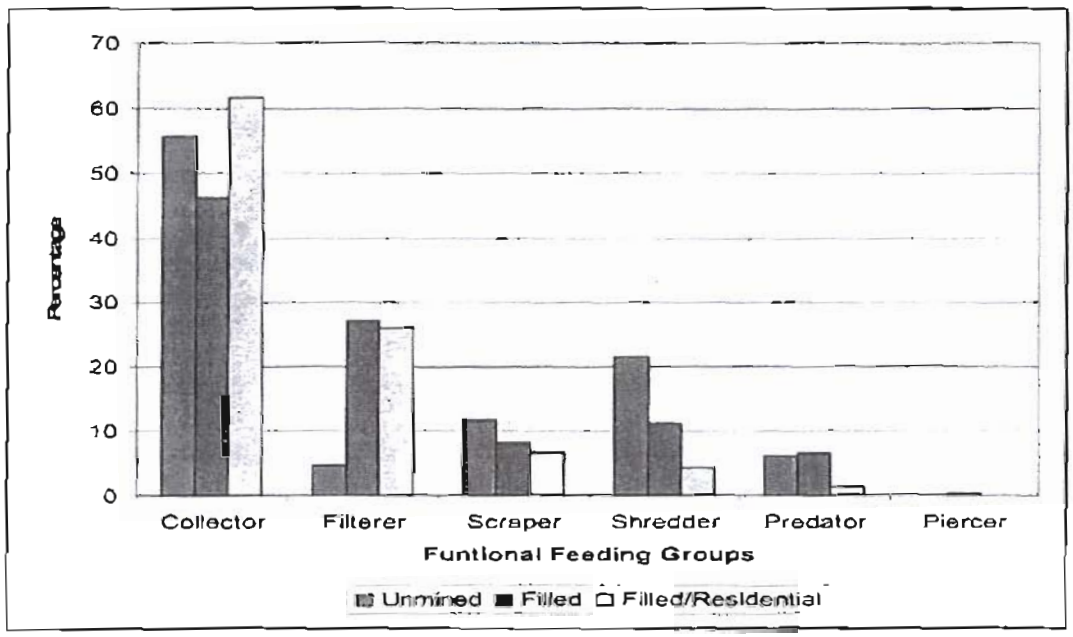


FIGURE 9

Functional Feeding Group Distribution of Benthic Macroinvertebrates Collected at EIS Sites in the Spring 2000 Sampling Period



Supporting the concept that food will not be limited downstream of valley fills was a study conducted in Pigeonroost Branch by Dr. Albert Hendricks of Virginia Tech Biology Department in 1999. Dr. Hendricks looked at the distribution of fine and course particulate organic matter (FPOM and CPOM) and chlorophyll in the stream from the headwaters downstream to the mouth and upstream and downstream of the confluence with Spruce Fork. The study found that there was more FPOM in the lower reaches of Pigeonroost Branch as compared to the upstream reaches (presumably generated in those lower reaches). He concluded from this, and the chlorophyll production in the downstream reaches, that the truncated Pigeonroost Branch existing after valley fill construction would be able to generate energy expected in similarly sized unfilled streams. Dr. Hendricks also noted that the sediment ponds, when constructed, would

contribute to energy production and may increase insect production below the outfalls. This effect was demonstrated in POTESTA's Supplemental Study. Dr. Hendricks also concluded that the fish community of Pigeonroost Branch would likely suffer no impacts from valley fills placed in the watershed based on his comparisons to a post-mining reference site and an expectation of continued productivity in the stream after mining and valley fill construction.

Available information regarding stream productivity indicates there is no expectation that nutrients will be limited in the receiving streams associated with valley fill construction at Republic, Aracoma, or Blackcastle operations. Further, the permits have special conditions which require riparian zones be established after the ponds are removed. While there may be some disturbance when the ponds are reclaimed, it would be temporary until the riparian zone is re-established.

7.0 BIOLOGICAL COMMUNITY CHANGES

7.1 Environmental Impact Statements

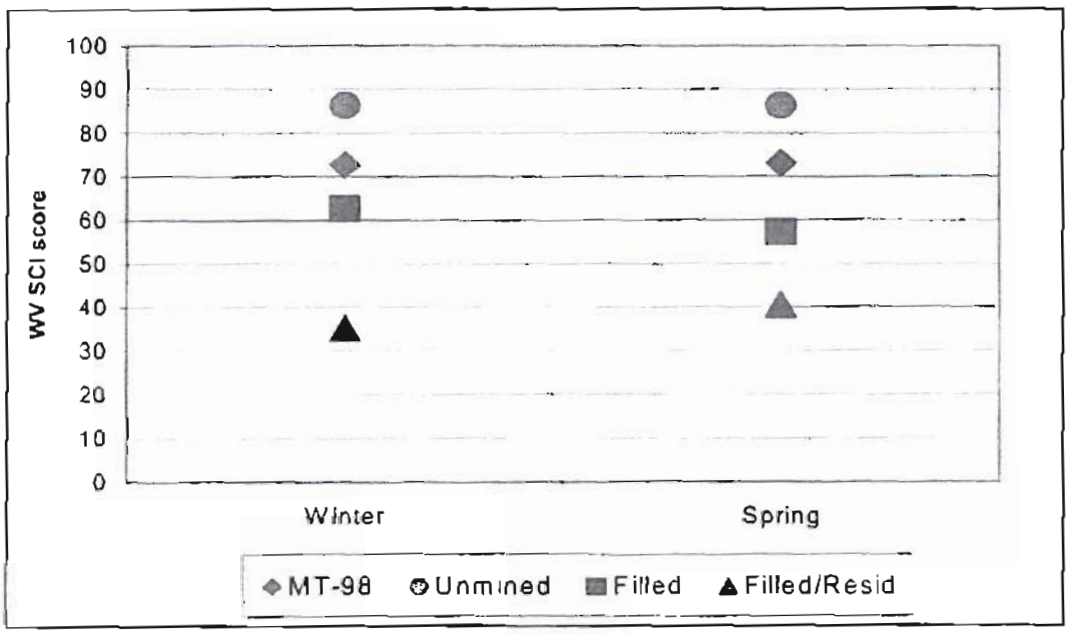
Most available information regarding the effects of valley fills on aquatic communities shows moderate effects in the vicinity of the fills and no discernible downstream effects. In 1984, an environmental assessment of head-of-hollow fills and mountain top removal was conducted by Skelly and Loy for the USEPA. This study found degradation of the benthic macroinvertebrate community following mining at a site in Kentucky; however, the water quality coming off the site would not meet today's water quality standards and was likely responsible for the impairment. In a West Virginia watershed where the water chemistry associated with mining was generally better, the study found that the benthic macroinvertebrate community declined in

richness and the presence of sensitive taxa during mining but appeared to show signs of recovery within 3 years of the mining activity.

Subsequent to this study, an analysis of valley fill impacts on benthic macroinvertebrate communities was conducted by Science Applications International Corporation (1998), again on behalf of the EPA. This document considered three mining influenced watersheds and found improvements in the post mining condition relative to pre-mining evaluations where stream impairment was indicated. The EPA's most recent EIS study included evaluation of the fish and benthic macroinvertebrate communities along with water chemistry and habitat evaluations. The fish study was inconclusive primarily due to insufficient data as a result of droughts and limited reference sites on the necessary stream orders (Stauffer and Ferreri, 2002). The benthic macroinvertebrate surveys indicated substantial variability in the sites below valley fills with WVSCI scores ranging from *Very Poor* to *Very Good* over the five sampling events. A reduction in the richness and abundance of mayflies was identified as a key factor in the reduction of WVSCI scores in valley filled sites as compared with reference sites. A supplemental study conducted by POTESTA indicated the communities below the filled sites were substantially influenced by changes in the available food sources due to the sediment control ponds and that abundance of organisms increased downstream of the ponds. While these studies may have indicated biological community shifts and changes in community structure, generally toward a more tolerant community, loss of aquatic communities has not been demonstrated in the areas immediately below valley fills or in downstream reaches.

The changes of the benthic macroinvertebrate community below valley fill/sediment pond complexes have been well documented in the EIS and the Supplemental Study prepared by POTESTA. However, as the POTESTA study indicated, it was not possible from these studies to discern the impacts of the ponds from potential impacts of the fills. There was only one site in the federal study, MT 98, which was not located below a sediment pond and showed primarily the valley fill effects. This site scored in *Fair* to *Good* range (Figure 4) and was more similar to reference conditions than the other filled sites (Figure 10).

FIGURE 10
Average WVSCI Scores from Each Category in the EIS from Two Sampling Periods Compared with the WVSCI Score from the Filled Sampling Site Not Located below a Sediment Pont, MT-98



While changes in fish community structure below valley fills was not conclusive, it is apparent from the EIS and POTESTA's Supplemental Study that nutrient limitations are not a factor in the

downstream areas below the valley fills. The EIS also demonstrated that temperature differences, suggested to be a problem for fish reproduction, were not evident at sampling sites located downstream of the fills and ponds.

7.2 Additional Studies

7.2.1 Twentymile Creek Watershed

Twentymile Creek is a tributary of the Gauley River with a watershed area of 55,451 acres located in Clay, Fayette, Kanawha, and Nicholas counties of West Virginia. The watershed lies almost entirely in the mountaintop mining region of West Virginia and has limited historic mining with most activity in the watershed occurring recently. Numerous studies have been conducted in the Twentymile Creek watershed to determine the effects of mining in the watershed including the EIS, and long term monitoring from several coal companies which is ongoing. POTESTA summarized the data from available sources to provide a cumulative assessment of the chemical and biological changes in the watershed (POTESTA, 2006). In general, mining related parameters such as sulfates and conductivity have increased as mining as progressed in the watershed. Other parameters, such as iron, manganese, and pH are apparently currently being successfully managed through the NPDES program, as they do not appear to be limiting in the watershed.

Benthic macroinvertebrate communities have shown localized effects of mining in the subwatersheds and on the mainstem but are generally improving despite the mining activity in the watershed. For example, in Robinson Fork only 3 taxa were collected in 1994, however, conditions have improved in this subwatershed with a high of 14 taxa in 1999, despite ongoing

mining activity. A mainstem sampling site just upstream of the confluence with Robinson Fork had only 9 taxa in 1996 and 11 taxa in 1997 but has improved such that 27 taxa were present in 2003 and 2004 and this site is now consistently receiving *Very Good* WVSCI ratings. Similarly, the mainstem sampling site located downstream of the confluence with Robinson Fork had only 7 taxa collected in 1996 and 9 taxa in 1997. This site had 22 and 23 taxa collected in the spring of 2002 and 2003, respectively, showing marked improvement. Of those taxa, 14 and 15 were EPT representatives and the WVSCI scores at this site are consistently in the *Very Good* range.

Similar results are reported for the fish communities in the sub-watersheds of Twentymile Creek indicating effects of mining during the period of active mining. Although the subwatersheds show effects of disturbance during active mining, they appear to recover after reclamation as evidenced in the Rader Fork and Neff Fork sub-watersheds where post mining fish communities had higher abundance and richness than the pre-mining condition. In addition, the active mining in the headwaters of the sub-watersheds does not appear to affect the fish community within the mainstem of Twentymile Creek. This was demonstrated in the mainstem of Twentymile Creek downstream of Hardway Branch where mining was initiated in 2002. The sampling station downstream of the confluence of Hardway Branch had an increase in abundance and diversity during the period of active mining. In addition, taxa that were gained during this time were *Catostomus commersoni*, *Ericymba buccata*, *Hypentelium nigricans*, *and Notropis ludibundus* (23 individuals), and *Notropis telescopus* (65 individuals). Biomass also increased during this period.

7.2.2 Trough Fork Watershed

A study was conducted in the Trough Fork watershed of Kiah Creek in Wayne County, West Virginia to examine the long-term affects of surface mining and valley fill construction on the benthic macroinvertebrate community and water quality. The monitoring period for the study was ten years and included pre-mining monitoring from 1995-1996, active monitoring from 1997 to 1999, and post mining monitoring from 2000 to 2006. Over the course of the active mining phase, six valley fills, 18 sediment ponds, and approximately 40,000 linear feet of sediment and diversion channels were constructed. In addition, approximately 575 acres of land was regraded. The results from the study show that there was an increase in calcium and sodium in the water chemistry due to treatment of the surface waters. In addition, there was an increase in sulfate, magnesium, conductivity, alkalinity, TDS, and harness as the result of mining activities. The benthic macroinvertebrate community demonstrated no difference in total abundance and total number of taxa; however, there was a decline in the percentage of mayflies as the result of mining activity. Despite high conductivity levels (1792 µS in the October 2001 sample) the sampling site still had 19 taxa present and had a WVSCI score of 69. The pre-mining WVSCI scores were *Good* to *Very Good* and are now *Fair* to *Good* (Figure 12 [Figure 11]). It should be noted that drought conditions existed during the 1999-2000 sampling periods and likely contributed to the low scores received during this time period.

FIGURE 11
Excerpt from Kirk and Maggard 2004

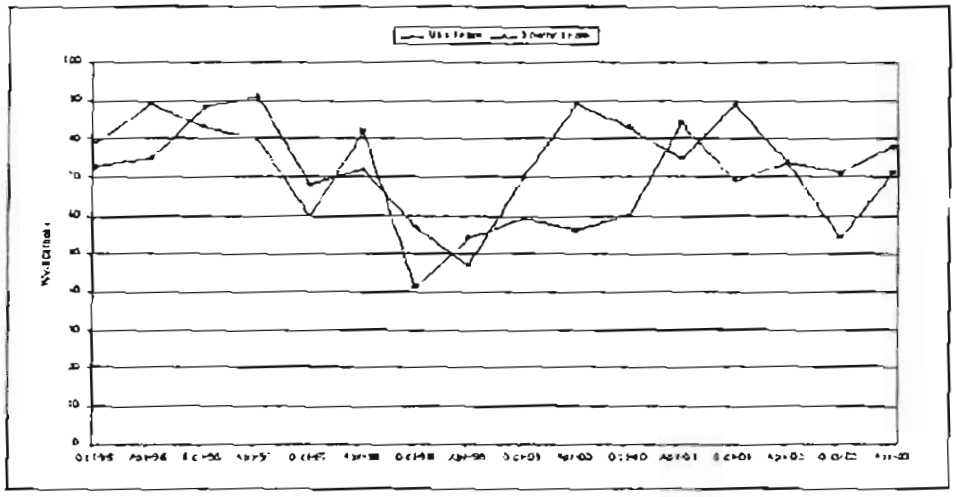


FIGURE 12. WV-SCI scores from Upstream and Downstream stations on Trough Fork, October 1995 through April 2003. Argus Energy, Inc.

7.3 Effects of Proposed Activities

Specific biological community changes expected downstream of Republic's Number 2 Surface Mine may include the reduction of mayfly or other sensitive taxa if conductivities rise to the expected levels. There are no significant effects expected in the fish community downstream of the valley fills although there may be short-term impairments associated with the disturbances when they are ongoing. This should be minimized by engineering controls and through compliance with the NPDES permit. Proposed mitigation activities are expected to improve benthic macroinvertebrate communities in that stream which will have an overall positive effect in the watershed.

Due to the impaired condition of the tributaries of George Branch, and Sandlick Creek, mining and valley-fill construction at the Blackcastle operation should create improved conditions in the watershed. Better water quality below the newly installed fills will support better biological communities than are currently present. More numerous and more sensitive taxa are expected in the receiving streams. Also, loading of dissolved solids should decrease as a result of a reduction in treatment chemicals which will have substantial benefits to downstream water quality.

At Aracoma's Camp Branch Mine, surface water quality remains fairly good despite significant historic mining operations in the watershed. The benthic communities in the streams which will be disturbed are in good condition despite the past disturbances. The currently proposed activities may temporarily limit the aquatic communities downstream of the mining and valley fill operations while active mining is ongoing but are not expected to limit the biota after mining is completed.

7.4 Biological Community Changes Resulting from Mitigation

Biological community changes are also expected in response to mitigation activities associated with the permits. Mitigation is conducted on a watershed scale to maximize the potential for watershed benefits from mitigation efforts. Although there has been some criticism by OVEC that planned mitigation efforts in the stream draining valley-filled areas at the mine sites will provide little or no aquatic benefits, the relationship between habitat and biological communities is well documented and serves as the basis for the development of restoration techniques. Enhancement of habitat in the affected watersheds will have a net positive effect on the biological assemblages in the watershed. Specific improvements in streams receiving similar

treatments have been shown by REIC which has documented biological community improvements in streams where mitigation projects involving bank stabilization and structure improvement have been completed. In one such stream in Fayette County, West Virginia, WVSCI scores improved from 59.4 to 78.1 at one improvement site when habitat scored improved from 115 to 163 just 6 months after restoration. Improvements in the benthic macroinvertebrate community included the appearance of five mayfly taxa despite average conductivities in excess of 850 uS/cm (REIC, 2006).

8.0 STREAM FUNCTION

The purpose of mitigation is to minimize the impacts of fill operations on stream function. Functions of headwater (1st – 3rd order) streams include: providing transition between landscape and larger waterbodies; providing habitat to relatively distinct and diverse invertebrate assemblages; assimilating nutrients, organic matter, and sediments; export of high quality water for water supply, recreation, waste assimilation; flood control; ecological values; connecting surface flow to groundwater resources; and providing thermal refuges in winter and summer (Pond, 2002).

While stream functions may be lost in the area under the fill, they are generally retained, at some level in the drainage structures constructed to move water off the fill and into the stream below the valley fill. For example, the drainage structures function to move water and sediments from the time of construction and will also move organic material after the site is reclaimed and revegetated. There may be differences in the schedule of sediment movement due to differences in peak flow and base flow conditions, however, everything will still move downstream. The

drainage structures and stream below the fill still act as the transition between landscape and larger waterbodies, although the landscape is changed from pre-mining conditions. Nutrients are assimilated in the pond and in the stream channel below the fill as indicated previously in this document although different communities process nutrients differently. Some functions, such as the connection between surface water and groundwater, and providing thermal refugia (and refugia from low flow conditions), may be enhanced due to the presence of the fills.

Stream functions are difficult to measure. What is generally measured are processes which show functions are ongoing. Measuring the rate of photosynthesis indicates nutrients are being up taken and incorporated into a food supply for downstream organisms. Measuring the rate of leaf litter degradation also indicates the upstream reach is functioning to provide a downstream supply of organic material. Similarly, trophic metrics are surrogates for complex processes such as trophic interaction, production, and food source availability (EPA, 1999). Biological assessments conducted using a multimetric approach use structural and functional attributes of the assemblage to characterize condition (EPA, 1998). The WVSCI includes six biological metrics that represent elements of the structure and function of the bottom-dwelling macroinvertebrate assemblage (Tetra Tech, 2000) and thus would be a useful surrogate for processing stream evaluations and evaluating stream function. Generally, direct measures of stream function are not included in evaluations of the conditions; however, biological surveys are routinely performed to evaluate structural and functional aspects of streams.

9.0 MITIGATION

In comments provided by OVECS consultants concerns have been expressed regarding the ability to mitigate headwater stream functions or to recreate headwater channels. As has been described previously, many functions of the headwater streams are not lost as a result of the filling activity or are inherently replaced as a result of the mining plan (such as water and sediment transport or food supply production by the ponds). The functional units of the altered system are not identical to those replaced but the downstream contributions are maintained. Because mitigation for mining projects is conducted on a watershed scale, enhancement of areas with potential to support more productive communities can be maximized. The creation of perennial stream channels is often utilized in restoration projects to create stream length and meanders where no stream previously existed (Harman and Jennings, 2001). The creation of ephemeral and intermittent channels would be similar with the exception that they do not require a water source since ephemeral channels will flow as a result of precipitation events (as well as snow melt) and intermittent channels which flow in response to rain and the changing water table. While it is true that no channel existed there before, substantial changes in the landscape necessitate construction of some water conveyance structures or they would form naturally to move precipitation down gradient toward the stream. Enhancement of those structures to maximize the ecological functions they provide is an important step in minimizing the effects of mining in the watershed. A similar concept is being explored in Ohio where a project funded in part by the Great Lakes Protection Fund, is underway to modify agricultural drainage ditches to provide enhance ecological services in addition their function as drainage ditches. The study thus far has found that, with few exceptions, ditches have developed some natural channel features unassisted and it is believed that enhanced ditches using the two-stage channel design

system will enhance ecological services and reduce sediment and nutrient loading to receiving systems (Ward, OSU website).

Regarding the evaluation of mitigation necessary to compensate for lost services, the USACE in the Huntington District does not have any specific guidelines for stream assessment. Other districts, such as the Norfolk District, utilized abiotic components to assess stream impacts. Norfolk District, based on a review of the literature, selected five variables whose relationship to overall stream health could be established. These variables were then considered analogous to or indicators of stream condition. These parameters were also noted as being predictable, reliable and repeatable, which is important when assessing multiple projects and/or impacts. The Louisville District utilizes a different calculator which uses abiotic and biotic measures or just abiotic measures. While the most robust form of the calculator (or model) utilizes both components (abiotic and biotic), the tool has been developed for use with only the abiotic information. In the development of the Louisville District's protocol, researches noted that the EPA's RBP habitat scores successfully distinguished between reference and test sites. The researchers also noted that the physical habitat parameters proved to be the best discriminator (have the most power) between least disturbed streams and those that were degraded. The strengths of this calculator, as reported by the researchers who developed it, are that it promotes an ecosystem approach and real data is used to calibrate the model (input into the calculator). The Stream Habitat Units utilized by Aracoma, Elk Run or Alex Energy also use the RBP habitat scores to assess relative stream condition.

9.1 Summary of Site Specific Mitigation

Compensation for temporary impacts in Long Branch of Fifteen Mile Fork and unnamed tributaries of Cabin Creek associated with Republic's No. 2 Surface Mine would include restoring each stream channel based on original stream habitat parameters and physical dimensions. A two-stage channel would be constructed after the sediment pond was dewatered and stabilized. The channel would include habitat structures and a 50-foot riparian buffer. Permanent loss of intermittent and ephemeral stream channel would be mitigated by off-site restoration and enhancement activities on perennial and intermittent reach of Long Branch of Fifteen Mile Fork

To compensate for permanent impacts to waters of the U.S., the Elk Run proposes to enhance 18,000 linear feet of Laurel Creek and improve overall water quality within 3,050 linear feet of George Branch and 2,370 linear feet of three unnamed tributaries of Laurel Creek. Lastly, the stream segments (7,590 linear feet) temporarily impacted by sediment pond construction, sediment transport and mined through activities would be restored to their pre- mining conditions. These mitigation measures would be expected to ultimately improve aquatic habitat, diversity and abundance within the Laurel Creek watershed.

Impacts to on-site streams have been minimized to the fullest extent possible at Aracoma's Camp Branch Surface Mine. To compensate for permanent impacts to jurisdictional streams, the applicant proposes to create: approximately 16,512 linear feet of intermittent streams and 2,974 linear feet of ephemeral streams in the Ethel Hollow watershed at the Camp Branch Surface Mine; approximately 1,485 linear feet of ephemeral streams in the Camp Branch

watershed at the Camp Branch Surface Mine; and, 24,375 linear feet of intermittent streams in the Ethel Hollow watershed at the Anna Branch and Anna Branch No. 2 Surface Mines. Lastly, the stream segments (1,880 linear feet) temporarily impacted by sediment pond construction and sediment transport would be restored back to their pre-mining conditions.

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STATUS OF THE INDUSTRY UNDERSTANDING OF THE EFFECTS OF MOUNTAINTOP MINING AND VALLEY FILLS ON AQUATIC RESOURCES

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STATUS OF INDUSTRY UNDERSTANDING OF THE EFFECTS OF MOUNTAINTOP MINING AND VALLEY FILLS ON AQUATIC RESOURCES

1.0 INTRODUCTION

This report was prepared in response to criticism raised by the Ohio Valley Environmental Coalition (OVEC) and its consultants regarding conclusions reached by the United States Army Corps of Engineers (USACE) in its review of mining permits issued to Alex Energy, Elk Run Coal Company, and Aracoma Coal Company. Essentially, those criticisms were that the proposed excess spoil valley fills at those sites would cause substantial and unabatable downstream impacts to aquatic life. This report concludes that the likely impacts to aquatic life will not be significant in the watershed where the mining will be conducteed, even without proposed mitigation efforts, and that the proposed mitigation will generally improve the conditions for benthic macroinvertebrate communities in the watersheds where mining is proposed.

Since the original Bragg versus USACE litigation (1998) much information has been gained regarding the effects of valley fill construction on aquatic resources. Some information has been widely distributed, such as the United States Environmental Protection Agency's (EPA) Mountaintop Mining/Valley Fill Environmental Impact Statement (EIS), while other information has not received much attention, such as National Pollutant Discharge Elimination System (NPDES) monitoring in-stream locations below valley fills. This document describes the available body of scientific data on aquatic impacts from the construction of valley fills and addresses some of the concerns expressed by OVEC and its consultants in comments or reports

produced to date. The main issues which have been raised regarding the effects of valley fills include: the potential loss of nutrients for the aquatic community below valley fills, temperature and flow changes in streams below valley fills, biological community changes below valley fills (particularly from the shredder functional feeding group), the presence of selenium and other metals below valley fills, and increased conductivity and dissolved solids below valley fills. Each of these potential impacts will be discussed in general and with regard to the proposed activities at the Aracoma, Blackcastle, and Republic operations specifically.

2.0 PROJECT SUMMARIES

2.1 Aracoma Coal Company, Inc. – Application No. 199900448

Aracoma Coal Company, Inc. (Aracoma) submitted an application to the USACE Huntington District on December 1, 2004 for a Department of the Army (DA) permit for the discharge of dredge and fill material into waters of the U.S. (jurisdictional waters) in association with the construction, operation, and reclamation of the **Camp Branch Surface Mine**. The project originally proposed construction of seven valley fills which would impact 21,665 linear feet of jurisdictional waters. This plan was modified in accordance with the West Virginia Department of Environmental Protection's (WVDEP) Final Approximate Original Contour (AOC) Guidance Document. As a result of the optimization associated with this guidance, the total number of valley fills was reduced to five (with five associated sediment control structures). The 30-day public notice for the project area was issued on June 27, 2004. Due to the fact that a portion of this permit was found to be eligible for listing under the National Historic Preservation Act of 1996 (NHPA), an additional area was deleted by Aracoma which reduced the total number of fills to four (with four sediment control structures) and the impacts associated with construction

of these fills to approximately 16,939 linear feet (2.14 acres) of jurisdictional waters. The application was considered complete on July 6, 2005.

The construction of the proposed valley fills will result in the permanent discharge of dredge and fill material into approximately 14,762 linear feet (1.86 acres) of intermittent streams and 297 linear feet (0.03 acre) of ephemeral streams for a total permanent impact of 15,059 linear feet (1.89 acres). The proposed valley fills drain contributing watersheds ranging from 89.38 acres to 367.6 acres. Approximately 59.6 million cubic yards of non-toxic, durable material will be discharged within the proposed valley fills. The construction of the proposed sediment control structures will result in the temporary placement of dredge and fill material into 1,880 linear feet (0.25 acre) of jurisdictional waters. The table below details the individual permanent steam impacts and corresponding pertinent information.

The project will disturb approximately 915.9 acres, including 757 acres of mineral removal. The operation will recover bituminous coal reserves from the Middle Kittanning, Five Block, Upper Clarion, Lower Clarion, Stockton A, Stockton, Upper Coalburg, Middle Coalburg, Lower Coalburg, and Buffalo Creek seams. Through construction, operation, and reclamation of the Camp Branch Surface Mine, Aracoma seeks to recover nearly 12.5 million tons of coal from the above-mentioned coal seams over a period of 8-years. The impacts associated with this project are located in Camp Branch of Dingess Run, unnamed tributaries of Dingess Run, and an unnamed tributary of Pine Fork of Ethel Hollow. All of these drainages are located in the Guyandotte River watershed. The proposed disturbance in each watershed is provided in Table 1.

TABLE 1

Permanent and Temporary Impacts Associated with Camp Branch Surface Mine

Proposed Activity	Permanent Intermittent (Ft./Ac)	Permanent Ephemeral (Ft./Ac)	Total Permanent Impacts (Ft./Ac)	Temporary Intermittent (Ft./Ac)	Total Temporary Impact (Ft./Ac)
Fill A	8,823 (1.14)	153 (0.01)	8,976 (1.15)	0	0
Pond 1	0	0	0	650 (0.10)	650 (0.10)
Fill B	2,756 (0.38)	144 (0.02)	2,900 (0.40)	0	0
Pond 2	0	0	0	400 (0.05)	400 (0.05)
Fill C	1,783 (0.21)	0	1,783 (0.21)	0	0
Pond 3	0	0	0	480 (0.06)	480 (0.06)
Fill D	1,400 (0.13)	0	1,400 (0.13)	0	0
Pond 4	0	0	0	350 (0.04)	350 (0.04)
Totals	14,762 (1.86)	297 (0.03)	15,059 (1.89)	1,880 (0.25)	1,880 (0.25)

2.2 Elk Run Coal Company, Inc. – Application No. 200200258 – Sandlick Creek

Elk Run Coal Company, Inc (Elk Run) submitted a Pre-Construction Notification (PCN) to the USACE Huntington District on July 22, 2003 for authorization to discharge dredge and fill material into jurisdictional waters in association with the construction, operation, and reclamation of the **Black Castle Contour Surface Mine** (Blackcastle). The project will result in the construction of nine valley fills which will impact 18,787 linear feet (1.85 acres) of jurisdictional waters in tributaries of Laurel Creek, George Branch, and Sandlick Creek. On May 17, 2004, the District Engineer asserted his discretionary authority to require processing the proposed activities under a Section 404 Clean Water Act (CWA) 404 Standard (Individual) Permit. The 30-day public notice for the project was issued on June 27, 2004. On August 16, 2005 the application was considered complete.

The construction of the proposed valley fills will result in the permanent discharge of dredge and fill material into approximately 11,599 linear feet (1.10 acres) of intermittent streams and 1,802 linear feet (0.142 acre) of ephemeral streams for a total permanent impact of 15,059 linear feet (1.89 acres). The proposed valley fills drain contributing watersheds ranging from 41.5 acres to 180.1 acres. Approximately 59.6 million cubic yards of unspecified, non-toxic, durable material will be generated by this project, of which approximately 2.2 million cubic yards (5.35 percent) will be discharged within the proposed valley fills. The remaining approximate 38.9 million cubic yards (94.65 percent) will be placed on the contour to backfill and eliminate a highwall as well as to comply with the AOC model of March 1999. The proposed operation will also involve removing bituminous coal reserves underlying the stream beds in the hollows proposed to be impacted by Valley Fill Nos. 2, 3, 5, 6, 7, 8, and 9. These proposed mined through areas will permanently impact approximately 2,236 linear feet or 0.146 acre of jurisdictional waters. Although the mined through areas are permanent impacts, the stream segments affected by these activities will be reestablished and restored to their approximate pre-mining locations and contours. The construction of the proposed sediment control structures (ponds) will result in the temporary placement of dredged and fill material into 3,150 linear feet (0.455 acre) of jurisdictional waters. Adverse impacts associated with construction are considered temporary in nature. Additionally, the construction of the proposed valley fills will result in secondary impacts to approximately 2,204 linear feet (0.241 acre) of jurisdictional waters as a result of sediment runoff from the valley fills sites. Table 2 descries these impacts.

The proposed project will be implemented in 12 mining and reclamation phases over a period of 10.6 years. The activities will affect a total of 521.08 surface acres, which includes

approximately 449.17 acres of mineral removal. Elk Run seeks to recover nearly 10.2 million tons of coal from the Buffalo Creek and Coalburg seams. The impacts associated with this project are located in portions of unnamed tributaries of Laurel Creek, George Branch, an unnamed tributary of George Branch, and unnamed tributaries of Sandlick Creek.

TABLE 2

Permanent and Temporary Impacts Associated with Black Castle Contour Surface Mine

Proposed Activity	Permanent Intermittent (Ft/Ac)	Permanent Ephemeral (Ft/Ac)	Total Permanent Impacts (Ft/Ac)	Temporary Intermittent (Ft/Ac)	Secondary Intermittent (Ft/Ac)	Total Temporary Impact (Ft/Ac)
Valley Fill No. 2	1,425 (0.154)	400 (0.028)	1,825 (0.182)	0	0	0
Pond No. 2	0	0	0	436 (0.054)	130 (0.017)	566 (0.071)
Mine Through	0	330 (0.023)	330 (0.023)	0	0	0
Valley Fill No. 3	0	970 (0.078)	970 (0.078)	0	0	0
Mine Through	0	23 (0.005)	23 (0.005)	0	0	0
Valley Fill No. 4	1,481 (0.166)	0	1,481 (0.166)	0	0	0
Pond No. 4	0	0	0	374 (0.043)	221 (0.031)	595 (0.074)
Valley Fill No. 5	707 (0.047)	100 (0.008)	807 (0.055)	0	0	0
Mine Through	229 (0.008)	0	229 (0.008)	0	0	0
Valley Fill No. 6	2,133 (0.231)	0	2,133 (0.231)	0	0	0
Pond No. 6	0	0	0	639 (0.117)	221 (0.029)	860 (0.146)
Mine Through	351 (0.031)	400 (0.022)	751 (0.053)	0	0	0
Valley Fill No. 7	3,130 (0.319)	0	3,130 (0.319)	0	0	0
Pond No. 7	0	0	0	600 (0.076)	0	600 (0.076)
Mine Through	622 (0.042)	163 (0.009)	785 (0.051)	0	0	0
Valley Fill No. 8	925 (0.089)	332 (0.028)	1,257 (0.117)	0	0	0
Pond No. 8	0	0	0	350 (0.057)	285 (0.031)	635 (0.088)
Mine Through	0	68 (0.003)	68 (0.003)	0	0	0

Proposed Activity	Permanent Intermittent (Ft./Ac)	Permanent Ephemeral (Ft./Ac)	Total Permanent Impacts (Ft./Ac)	Temporary Intermittent (Ft./Ac)	Secondary Intermittent (Ft./Ac)	Total Temporary Impact (Ft./Ac)
Valley Fill No. 9	950 (0.058)	0	950 (0.058)	0	0	0
Pond No. 9	0	0	0	200 (0.027)	700 (0.069)	900 (0.096)
Mine Through	50 (0.003)	0	50 (0.003)	0	0	0
Valley Fill No. 10	848 (0.039)	0	848 (0.039)	0	0	0
Pond No. 10	0	0	0	230 (0.033)	647 (0.064)	877 (0.097)
Pond Area	0	0	0	321 (0.048)	0	321 (0.048)
Totals	12,851 (1.187)	2,786 (0.204)	15,637 (1.391)	3,150 (0.455)	2,204 (0.241)	5,354 (0.696)

2.3 Alex Energy, Inc. – Application No. 200400574-1 – Unnamed Tributary to Cabin Creek

Alex Energy, Inc (Alex) submitted an application to the USACE Huntington District for a permit for the discharge of dredge and fill material into waters jurisdictional waters in association with the construction, operation, and reclamation of the **Republic No. 2 Surface Mine** (Republic). The original permit was advertised by public notice on August 30, 2004. Changes to the permit resulted in a subsequent notice on June 14, 2005. The project proposes construction of three valley fills which will impact 12,694 linear feet (1.71 acres) of jurisdictional waters.

The construction of the proposed valley fills will result in the permanent discharge of fill material into approximately 9,918 linear feet (1.01 acres) of seven jurisdictional stream channels. Of this total, approximately 6,819 linear feet of intermittent stream and 3,099 linear feet of ephemeral stream will be impacted. Approximately 576 linear feet (0.41 acre) of intermittent stream channel would be impacted by sediment transport activities (areas of secondary impact). Because of the "swell factor" that causes spoil to expand when it is removed from the mine site

only 85.5 million of the 139.8 million cubic yards of overburden can be placed in the areas from which it will be removed. The remaining 54.3 million cubic yards of material will be placed into valley fills. The construction of the three sediment control structures (ponds) will result in the temporary discharge of fill material into 2,200 linear feet (0.28 acre) of intermittent stream channel. Table 3 describes these impacts.

The overall purpose is to extract approximately 9.5 million tons of coal from the Clarion Seam through the Williamson seams at the site. Of the 753.3 acres of the mining site, 488 acres will be disturbed for coal removal and 265.3 acres will be disturbed in conjunction with support activities such as sediment structures, drainage structures, roads, durable rock fills, etc. The impacts associated with this project are located in portions of unnamed tributaries of Cabin Creek and Long Branch.

TABLE 3

Permanent and Temporary Impacts Associated with Republic No. 2 Surface Mine

Proposed Activity	Permanent Intermittent (Ft./Ac)	Permanent Ephemeral (Ft./Ac)	Total Permanent Impacts (Ft./Ac)	Temporary Intermittent (Ft./Ac)	Secondary Intermittent (Ft./Ac)	Total Temporary Impact (Ft./Ac)
Valley Fill 1	3,357 (0.329)	1,789 (0.193)	5,146 (0.522)	0	0	0
Pond 1A/1B	0	0	0	1,400 (0.208)	0	1,400 (0.208)
Valley Fill 2	1,190 (0.123)	693 (0.077)	1,883 (0.200)	0	325 (0.370)	325 (0.370)
Valley Fill 3	2,272 (0.237)	617 (0.055)	2,889 (0.292)	0	0	0
Pond 2	0	0	0	800 (0.080)	251 (0.036)	1,051 (0.116)
Totals	**6,819 (0.689)**	**3,099 (0.325)**	**9,918 (1.014)**	**2,200 (0.288)**	**576 (0.406)**	**2,776 (0.694)**

3.0 BIOLOGICAL CONDITION OF IMPACTED STREAMS

The physical, biological, and chemical characteristics of tributaries in the Dingess Run (Aracoma), the Laurel Creek (Elk Run), and the Cabin Creek watersheds (Alex) were assessed as part of the 404/401 application process. This information may be found in the following reports which are part of the administrative record:

- **Aracoma -Camp Branch Surface Mine**
  - Benthic Macroinvertebrate, Water Chemistry, Habitat, and Fisheries Studies of Stations Associated with Six Proposed Valley Fills on Ethel Hollow and Dingess Run, 31 August 2000, REI Consultants, Inc.
  - Letter Report Benthic Macroinvertebrate Survey and Surface Water Sampling Ethel Hollow Surface Mine Logan County, West Virginia, January 15, 2001, Civil and Environmental Consultants, Inc.

- **Elk Run – Black Castle Contour Surface Mine**
  - Benthic Macroinvertebrate, Habitat, Water Chemistry Studies of Jurisdictional Waters Associated with Fourteen Proposed Valley Fills at the Black Castle Contour Surface Mine, October 2000, REI Consultants, Inc.
  - Benthic Macroinvertebrate, Habitat, and Water Chemistry Studies of Stations Associated with the Proposed Valley Fills at the Black Castle Contour Surface Mine, November 2001, REI Consultants, Inc.

- Benthic Macroinvertebrate Survey and Surface Water Sampling, Stream Measurement, Delineation and Classification, February 2002, Alliance Consulting, Inc.
- WOPEC. 1997. Elk Run Coal Company Water Treatment Evaluation Sandlick and Laurel Creek Sites, Volumes 1-III. Submitted to Elk Run Coal Company on June 6, 1997.
- WOPEC. 2001. Summary Report of the Effects of Alkaline Fill Material on Water Quality. Submitted to Kermit Fincham of Elk Run Coal Company in January 2003

- **Alex – Republic No. 2 Surface Mine**
  - Benthic Macroinvertebrate, Habitat, Water Chemistry, and Fisheries Studies of Streams Associated with the Four Proposed Valley Fills at the Republic No. 2 Surface Mine, May 2001, REI Consultants, Inc.

4.0 PHYSICAL CHANGES

As part of the 404(b)(1) analysis for these projects, the USACE evaluated the physical and chemical characteristics of the ecosystem. These characteristics are broken down into six components: Substrate (40 CFR 230.20); Suspended particulate/turbidity (40 CFR 230.21); Water (40 CFR 230.22); Current patterns and water circulation (40 CFR 230.23); Normal water fluctuations (40 CFR 230.24); and Salinity gradients (40 CFR 230.25). Because this project will

only involve discharges of dredge or fill material in non-tidal jurisdictional waters; this project will have no effect on salinity gradients.

The substrate within the proposed valley fill sites consists of the stream bottom and banks below the normal flow elevation. Substrate is the organic and inorganic solid materials and includes water and other liquids or gases that fill spaces in between the solids. For this proposed site, substrate is defined as the material from which the actual stream bed is composed (below bankfull) and any material deposited in this zone. This typically includes inorganic material such as cobble, gravel, and other inorganic substrate components. Organic material includes detritus (broken down leaf material), grass, lichens, and larger woody debris that have fallen into the streambed.

The substrate, which is typically composed of bedrock, boulders, cobble, gravel, sand, silt, and clay, has been evaluated at each of the valley fill and sediment control structure sites. The inorganic substrate has been evaluated at most of the impact sites. The composition of the substrate is variable among impact sites for each of the three aforementioned permits. More detailed information may be found in the administrative record or permit applications.

In the footprint of the proposed fills substrate will be buried under several feet of rock. The substrate between the toe of each valley fill and exit channel of the each drainage control structure will receive deposition of sediment from the fill construction and will limit the quality of benthic habitat in that area of the stream during mining. It is likely that the

substrate in the footprint of the proposed sediment control structure will also be altered (as compared to the existing stream channel).

After construction of each valley fill is complete, and vegetation has been established on the disturbed areas, the drainage control structure will be removed and the adversely impacted stream reach restored to appropriate channel geometry and substrate as described in the applicant's Compensatory Mitigation Plan (CMP). Compliance with the CMP is required of Aracoma, Elk Run, and Alex by Special Conditions listed in each permit.

Suspended particulates are materials that consist of fine-grained mineral particles, usually smaller than silt and organic particles. Suspended particulates enter the disposal site primarily as a result of land runoff, flooding, vegetation and plankton breakdown, re-suspension of bottom sediments, and construction activities including dredging and filling. Particulates remain suspended in the water column for variable periods of time as a result of factors such as agitation of the water, particulate specific gravity, particle shape, and physical and chemical properties of particle. Also, physical characteristics of the stream channel that cause agitation of the water (like roughness) influence the amount of material that may be suspended in the water column.

Several state permits were necessary for each of these projects pursuant to Section 401 and 402 of the Clean Water Act and the Surface Mining Control and Reclamation Act. Each of the applicants obtained the required NPDES permit for the proposed projects. Permit conditions require the routing of run-off through sediment and erosion control structures in order to reduce or eliminate suspended solids. Although an increase in suspended particulates may occur during

initial clearing activities within the footprint of the proposed sites for the valley fills and temporary sediment structures, Best Management Practices (BMPs) will be utilized which will include temporary erosion control systems. The proper use of BMPs will reduce particle loading which minimize the increase in turbidity. Additionally, in-stream erosion control systems will also be established and will be limited to material that would degrade and not require removal.

Temporary sediment control structures may include, but not be limited to, temporary silt basins, ditches, ponds, rock toe sediment structures, straw/hay bale fencing, cloth filter fences, compacted earth, sand bags, or other appropriate materials. Monitoring of all outlets where water is discharged from the proposed project area will take place according to each applicant's NPDES permit. These sediment structures, along with the concurrent regrading and revegetation of disturbed areas, will be expected to prevent or minimize the contributions of suspended solids. Sediment pond removal will occur after upstream and upland area reclamation has been accomplished and suspended solids levels of water entering the ponds returns to pre-mining levels. Suspended solids loads to waters outside of the project area will be expected to return to pre-mining conditions. Through out the projects, discharges will be expected to comply with the effluent limits stipulated in the NPDES permit issued by the WVDEP with the implementation of the above-mentioned measures.

Water patterns and circulation are the physical movements of water though an aquatic ecosystem. The excavation, filling, and relocation of ephemeral and intermittent streams in addition to the construction of drainage control structure will alter the circulation and drainage patterns at each of the project sites. The filling activities will occur in phases, and the removal of surface water

features will be offset to the extent practicable at each site. Surface water availability may be impacted by the proposed operation as described below. During the initial stages of mine development, overland runoff (and hence surface water availability) may increase. The increase will be mitigated by engineered sediment structures, which will provide storm runoff retention a more stable discharge rate to the receiving stream. After revegetation is established, surface runoff rates will be expected to stabilize. After mine reclamation, increased infiltration due to topography changes and porosity of the fill, and reduced evapotranspiration due to altered ground cover, may result in minor changes in surface and groundwater availability. As part of the permitting process, the USACE evaluates Attachment J-6 of each applicant's surface mine application (SMA). Strict adherence of the sediment control plan, the reclamation plan and the acid and toxic materials-handling plan (MHP), is required. Therefore, no unacceptable adverse impacts to current patterns or water circulation is anticipated downstream of the temporary sediment control structures.

Normal water fluctuations in the natural aquatic system consist of daily, seasonal, and annual fluctuations in water level. Biological and physical components of aquatic systems may be either adapted to or characterized by these periodic water fluctuations. Normal water fluctuations in the footprint of the valley fill will be permanently altered. The runoff component of the hydrologic balance will be expected to increase due to surface disturbance. This temporary increase in runoff will be routed to properly sized and engineered sediment control structures, which will abate the flow increase and discharge to the receiving streams. Each project's NPDES and Surface Mine Permits require the construction of temporary sediment control measures; in addition to the valley fills' associated sediment control structures (ponds), in

upland areas such as around the perimeter of the mining areas. Discharges from these temporary structures will be directed off the disturbed areas by conveyance ditches. These ditches will either converge with the natural stream channel at the toe of the valley fill or discharge into other natural drainages. The proposed in-stream sediment control structures will be constructed with open exit channels designed to pass the peak discharge from a 25-year 24-hour storm event. The construction of sediment control structures will temporarily impact jurisdictional waters. While these areas will no longer be lotic environments, water flow will not be stagnant and biological communities will utilize and/or colonize these temporary niches. Post-vegetation structures will be removed and water fluctuation levels will be expected to stabilize. Disturbance below the pond (within 100 feet of the stream) will be minimal and existing roadways, where practicable, will be utilized for maintenance and removal of the sediment control structures. No substantial effects will be anticipated to occur on downstream aquatic communities. Upon completion of reclamation, the initial shift in ground cover from forest to tall grass will result in overland runoff returning to the approximate, pre-disturbance values. The evapotranspiration demands upon groundwater will be expected to be reduced from pre-mining conditions, as the shift in vegetation is established.

4.1 Sedimentation

While increased deposition and sedimentation is anticipated with most development or disturbance, the EIS found that an increase in embeddedness and sedimentation is not imminent in the watersheds with valley fills present (FILLED watersheds). Additionally, this document specifically indicates that this is a watershed specific phenomenon. The text states (in regard to bed material) "Particle sizes from streams draining unmined areas in Spruce Fork and Clear Fork

have a similar distribution, but these particle-size distributions are different from those of stream draining unmined areas of both Upper Mud River and Twentymile Creek. The similar and dissimilar particle-size distributions among basins indicate that natural factors, such as localized geology and land slope may have some affect on particle sizes."

A study conducted by the United States Geological Service (USGS) found similar results (Wiley et al, 2001). The USGS evaluated 54 sites in the Spruce Fork, Clear Fork, Mud River, and Twentymile Creek watersheds. Bed material data were collected and evaluated using the particle sizes of the median, 84th percentile, and percentage less than 2 millimeters. The 84th percentile is an arbitrary particle size equal to two standard deviations larger than the mean sized (assuming a normal distribution). High variability between basins indicated that natural factors such as localized geology and land slope may be affecting particle size. In general, sites below fills had a smaller median particle size and a greater number of particles less than 2 millimeters; however, at the 84th percentile each stream type (unmined, valley fill, and mined) had about the same sized particles. This is important because the 84th percentile is related to stream roughness, a component of stream geomorphology/hydrology. The study noted that the distribution among particle sizes at unmined sites located within individual basins were similar. The distribution at unmined sites among all watersheds, were variable. As noted in the EIS, the particle sizes in Spruce Fork and Clear Fork had similar distributions, which were different from those collected in Mud River and Twentymile Creek. The USGS report stated that the variability among basins indicated that natural factors, such as localized geology and land slope may have an affect on particle size. The report also noted a 1988 sediment load study completed in relation to highway construction in southern West Virginia. Road construction in the Appalachians, like mining,

often requires the construction of fills to support road bases and dispose of excess materials. The sediment load study found that loads decreased after revegetation and stabilization of the land disturbance. The authors indicated that similar results may occur below mining valley fills.

It would appear that, like most earth disturbing activities, the potential for sediment runoff and deposition exist, but it is not inevitable. Use of acceptable mining and engineering practices, and compliance with permitting requests through the NPDES will minimize the potential for sediment deposition in streams below the Aracoma, Blackcastle, and Republic operations.

4.2 Stream Flow Alterations

Water flowing from the surface through a valley fill percolates more slowly than a surface route and is discharged to the stream channel over time. The more consistent flow condition this creates was evidenced in the EIS during Summer 1999. Drought conditions saw filled sites having flowing water while most of the reference sites were dry or substantially flow limited. Several recent studies conducted by the USGS have confirmed what was demonstrated in the EIS, that the presence of valley fills increases the base flow of streams likely due to infiltration and retention of the fill. Wiley and others (2001) compared low stream flows between valley filled and unmined sites and demonstrated that valley fill sites have a greater percentage of base stream flows and a lower percentage of storm-flows than unmined sites.

Flow from the valley fills during the hot, dry, summer months can provide refugia for aquatic organisms similar to natural springs which occur in headwater regions. While the flow from a valley fill is the result of anthropogenic activity and is not a natural spring, it may still provide important ecological functions such as aquatic habitat and refugia from temperature extremes

and drought. Valley fills constructed in conjunction with the Aracoma, Blackcastle, and Republic permits would be expected to provide similar ecological functions.

5.0 WATER QUALITY CHANGES

5.1 Temperature

Stream temperatures are variable and dependent on water source, air temperature, canopy cover, stream bed roughness, wind, and other factors. Surface water-fed streams have the most temperature variability both seasonally and daily while spring fed headwater streams with good canopy cover maintain a fairly constant temperature. Spring-fed headwater streams are cooler in summer and warmer in winter due to the groundwater source. They offer refugia for organisms displaced by freezing in the winter and provide aerated, flowing water conditions for aquatic life during hot summer months and droughts. As was discussed previously, water discharging from valley fills simulates spring-fed streams with regard to flow characteristics and also with regard to temperature. The USGS compared stream temperatures in two streams: one approximately 400 feet below a valley fill in a tributary to the Mud River and the other in an unfilled tributary to the Mud River. In addition to finding that the filled stream had a more consistent flow, the USGS found that the filled stream had lower temperature fluctuations (i.e., warmer water in the winter and cooler water in the summer) than did the unfilled stream (Wiley, et al. 2001). Thus, the valley-filled stream behaved more like a spring-fed stream than one with a significant surface water component. Dr. Bruce Wallace's response to this observation is unclear. On one hand, he claims that thermal regime is an important influence on the life cycle of aquatic organisms, while on the other observing that the diminished temperature swings provided by springs (and presumably valley fills) provides refuge for organisms that have low tolerance for the upper and

lower temperature spectrum (Wallace Comments on Statement of Findings of Corps for Black Castle (Elk Run), 3&4).

While it may be intuitive that valley fill construction could change the temperature dynamics of a surface flow fed stream to conditions more similar to a groundwater fed stream, the effect may not persist downstream. Temperature differences between unmined and filled sites were not readily apparent in the EIS samplings sites which would indicate that either no differences occurred or that differences were abated upstream of the sampling stations. The filled EIS sampling sites were located downstream of sediment control ponds where the retention time may have been sufficient to bring changes in the water temperatures back to a condition similar to the surface fed reference streams.

Valley fills constructed in conjunction with the Aracoma, Blackcastle, and Republic permits would be expected to provide temperature refugia to aquatic organisms from summer heat and winter freezing. While Wallace has suggested that the temperature alterations below fills could alter reproductive periods for fish or benthic macroinvertebrates, he has not offered any specific claims that he temperature differences recorded by the USGS have, or will cause, any specific impacts.

5.2 Specific Conductivity

In the course of mining, rock is fractured which creates increased surface area for weathering and increases the mineral content of water flowing through overburden material. Increases in the mineral content of water are consistent with all types of mining or development where rock is

disturbed and stacked or replaced whether this is as approximate original contour, gob piles, or valley fills. Increases in some minerals, such as those contributing alkalinity or hardness, may be beneficial to a stream system. Other constituents, such as iron and manganese, may be removed if necessary to prevent water quality impairment. The concentrations of some constituents, such as sulfates, chlorides, and other dissolved solids, can become limiting to the aquatic community in high concentrations. These high concentrations can exist below mining facilities due to the increased weathering of the fractured rock and due to the treatment chemicals used to increase acidic pHs and precipitate metals. The levels which limit aquatic communities are variable depending on the specific elements contributing to dissolved solids concentration.

Specific conductivity is a measure of the ability of water to carry an electric charge and is an indicator of the dissolved ion concentration in the water. There is some evidence that when dissolved solids concentrations (and conductivity) rise to certain levels, taxa richness, particularly Ephemeroptera taxa (EPT) (generally regarded as pollution intolerant aquatic insects) richness, begins to decline.

In general, there is some discrepancy as to the levels of conductivity which would be expected to effect biological communities in streams. The EIS found a correlation between conductivity and West Virginia Stream Condition Index (WVSCI) scores that indicated community limitations begin to be detected at a conductivity of around 850 uS/cm (personal interpretation Green and Childress, 2000 Figure 86 [Figure 1]) while the Kentucky Division of Water (KDOW), in a similar comparison, found limitations in community structure (MBI scores) in the 600-800uS/cm range (personal interpretation of KDOW, 2004 Figure 21[Figure 2]). Other data sets do not

show the same correlation. Argus Energy has been conducting monitoring semi-annually since 1995 in several watersheds with different levels of mining intensity and in different stages of disturbance as part of their "Water Quality Improvement Plan". Their fall data set contains over 200 data points (multiple samples from 47 sites) collected over a 10-year period. In this dataset, there is no correlation between conductivity and WVSCI scores over a range of conductivities reaching as high as 2010uS/cm (Figure 3).

FIGURE 1
Excerpt from EPA's MTM/VF EIS

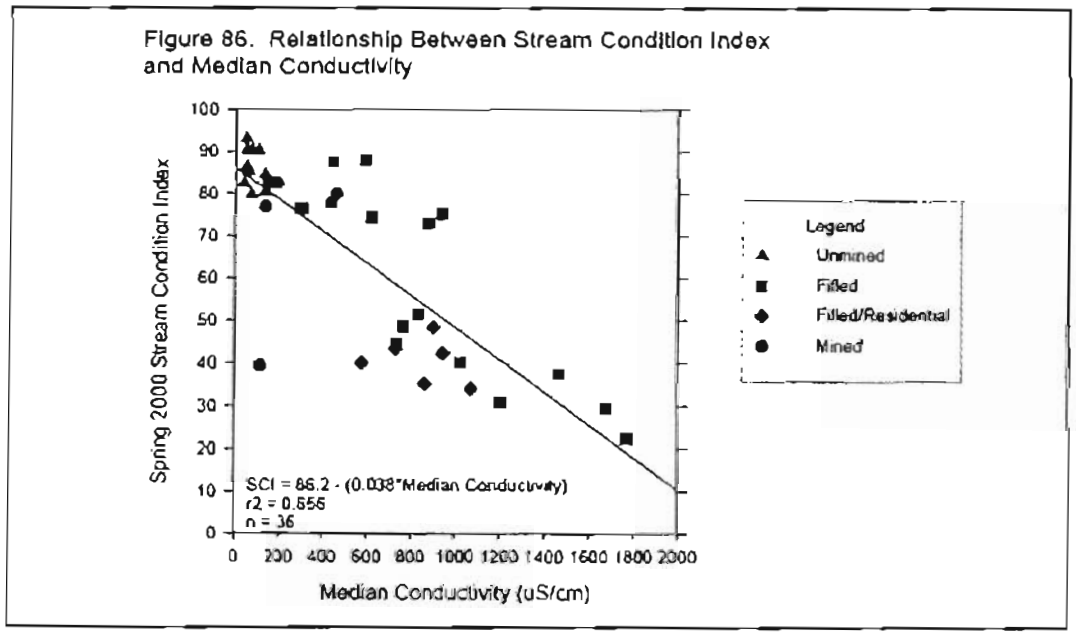


FIGURE 2

Excerpt from Kentucky Division of Water's publication titled: "Effects of Surface Mining and Residential Land Use on Headwater Stream Biotic Integrity in the Eastern Kentucky Coalfield Region"

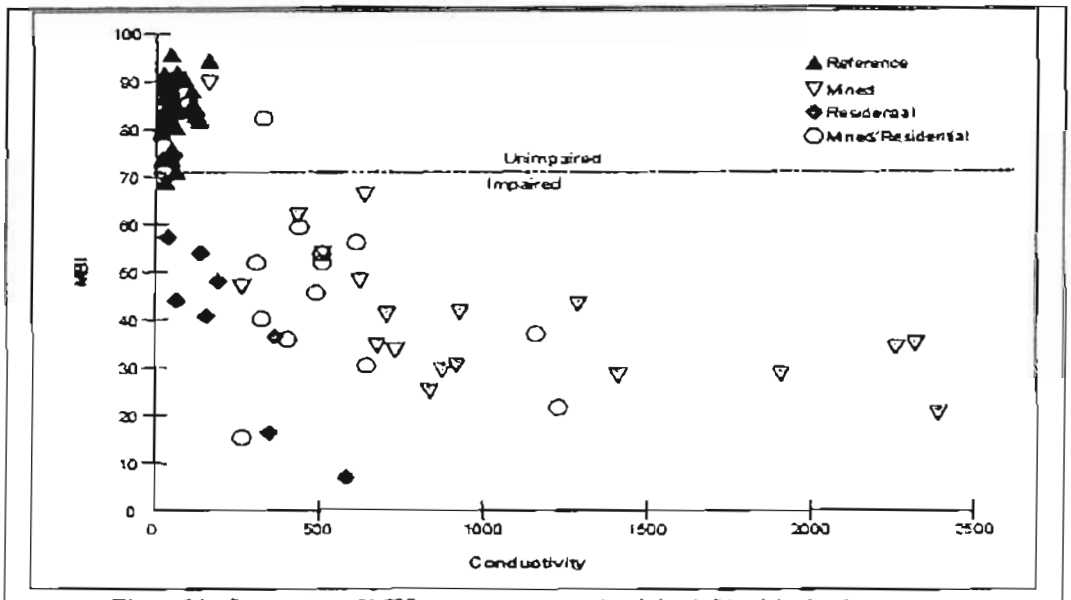
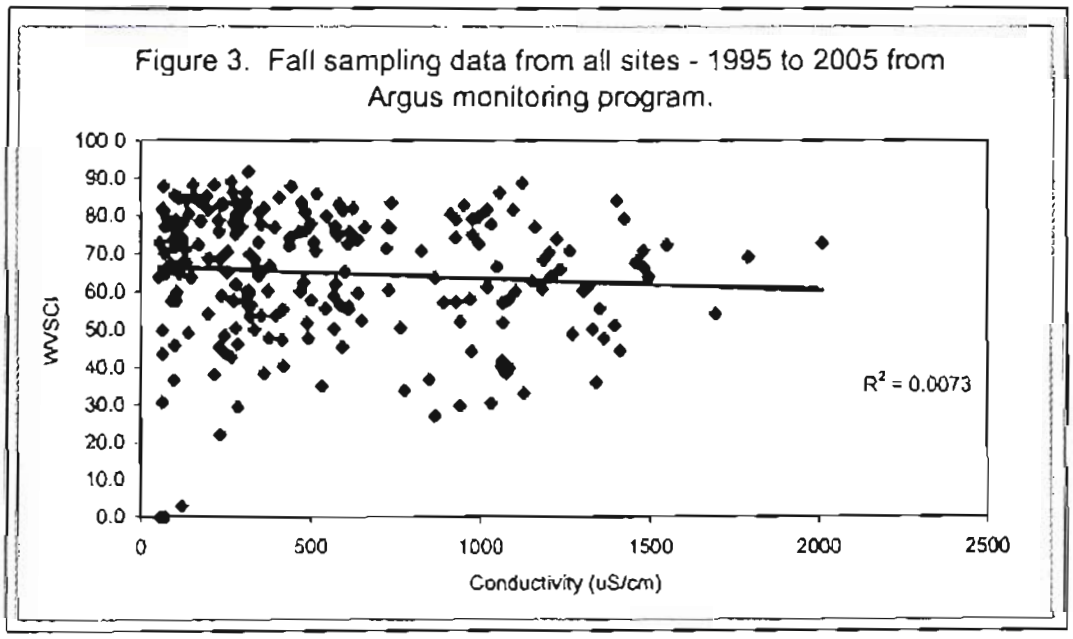


Figure 21. Scatterplot of MBI scores versus condoctivity (µS/cm) by land-use category.

FIGURE 3

Excerpt from Argus Monitoring Program

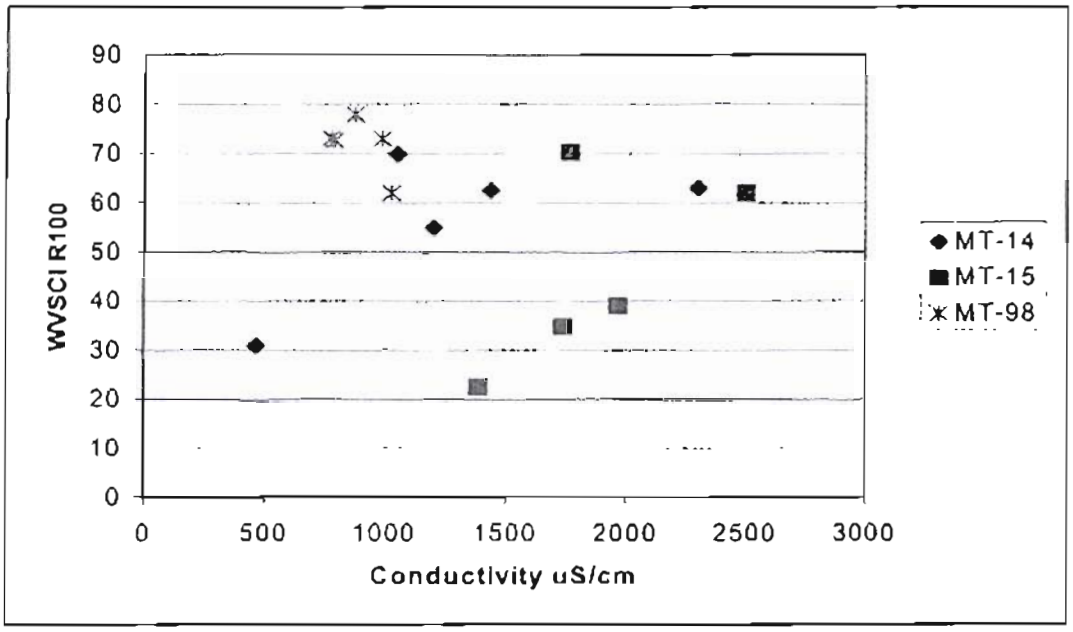


However, while these studies offer generalities regarding the relationship between dissolved solids (which are indicated by conductivity) and invertebrate community structure, reviewing specific information provides additional insight into the effects of valley fills (Figure 5). Ballard Fork of the Mud River Watershed has eight fills which were permitted from 1985 to 1989. A sampling site below the sediment control pond on this stream, MT-14 in the EIS, was sampled five times from Spring 1999 through Spring 2000 and had conductivities ranging from 464 to 2300 uS/cm (Figure 5). The benthic macroinvertebrate community at this site was generally rated as *Fair*, showing some potential impairment on most sampling dates and scored in the *Good* range on one sampling date. The lowest WVSCI score at this site (30.94) corresponded to the lowest conductivity measurement (464 uS/cm).

Stanley Fork, also in the Mud River watershed, has 6 fills with associated sediment control and mining has occurred on all the ridges in the watershed according to the EIS. The mining permits issued in this watershed date from 1988 to 1995. Seasonal sampling for the EIS (Site MT-15) showed the benthic community at this site was poor to good with WVSCI scores ranging from 22.57 to 70.28. Conductivity was generally high at the site ranging from 1,387 to 2500 uS/cm. The highest score at this site, 70.28 which is in the *Good* range, was recorded when the conductivity measured 1,764 uS/cm.

Conductivity at EIS site MT-98 ranged from 773 to 1025 uS/cm. This sampling site was located below six fills but was upstream of the sediment pond. WVSCI scores at this site were *Fair* to *Good* and ranged from 61.98 to 77.9 indicating the potential for healthy benthic macroinvertebrate communities at higher conductivity ratings.

FIGURE 4
WVIS Scores of EIS Sites Plotted with Conductivity



Evaluation of the variability in the range of potential WVSCI scores at differing conductivities indicates two important points. First, there are clearly other factors contributing to structuring macroinvertebrate populations in valley fill influenced watersheds. This is evidenced by the EIS sites scoring ~62 (61.98 to 62.99) for the WVSCI scores with conductivities ranging from 1,000 and 2,500 uS/cm and the 30 to 40 point differences in site scores (note the Argus data also has conductivities of 1,500 to 2,200 uS/cm with WVSCI scores in the *Good* range). Secondly, if conductivity is not the limiting factor in community development, manipulating other variables may improve the overall benthic community structure.

R.E.I. Consultants, Inc. (REIC) conducted a study in October 2005 on Kiah Creek in Wayne County, West Virginia. WVSCI scores above 80 were found in the stream with elevated

conductivity levels (ranging from 940 µS/cm to 1081 µS/cm). In this conductivity range, no direct correlation was indicated between conductivity levels and WVSCI scores (Figure 5). The more important factor affecting community structure in Kiah Creek appears to be habitat as the WVSCI scores are correlated to habitat (Rapid Bioassessment Protocol) scores and specifically the metric describing sediment deposition (Figures 6 and 7).

FIGURE 5

Relationship between Benthic Community Structure and Conductivity in Kiah Creek

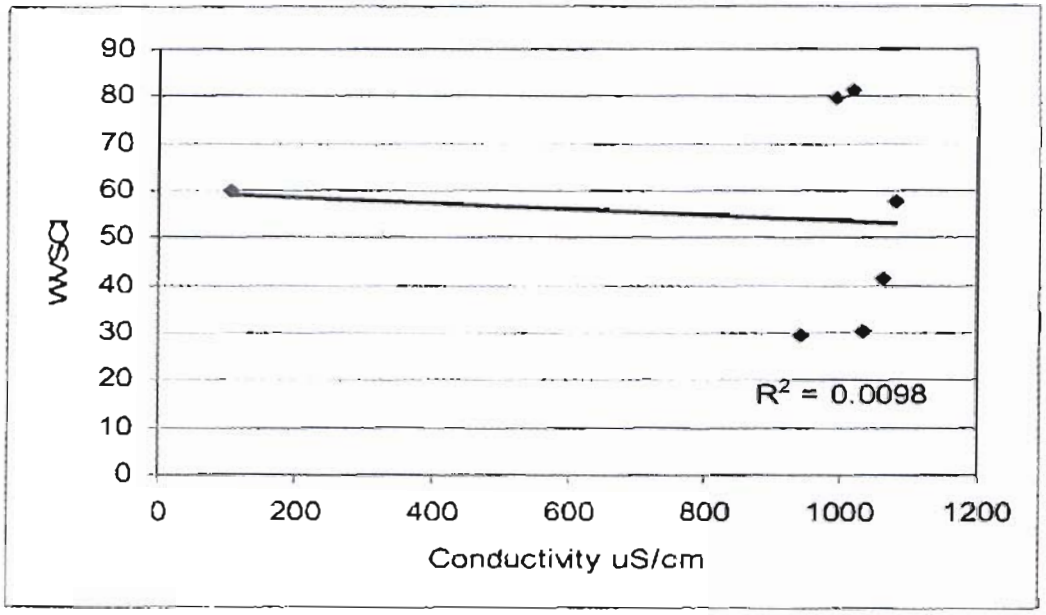


FIGURE 6

Relationship between Benthic Community Structure and Total RBP Habitat Score

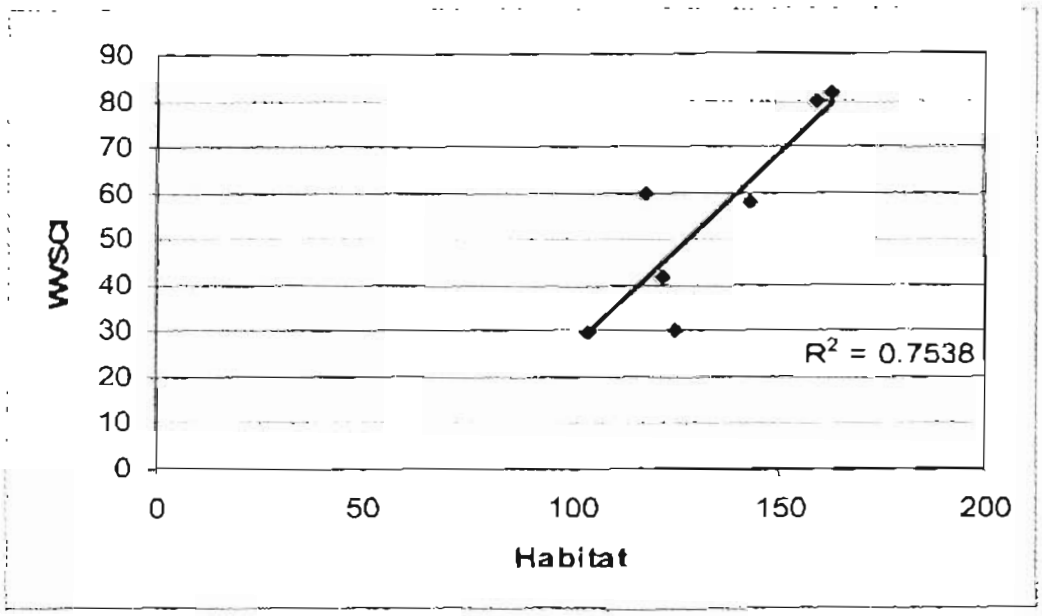
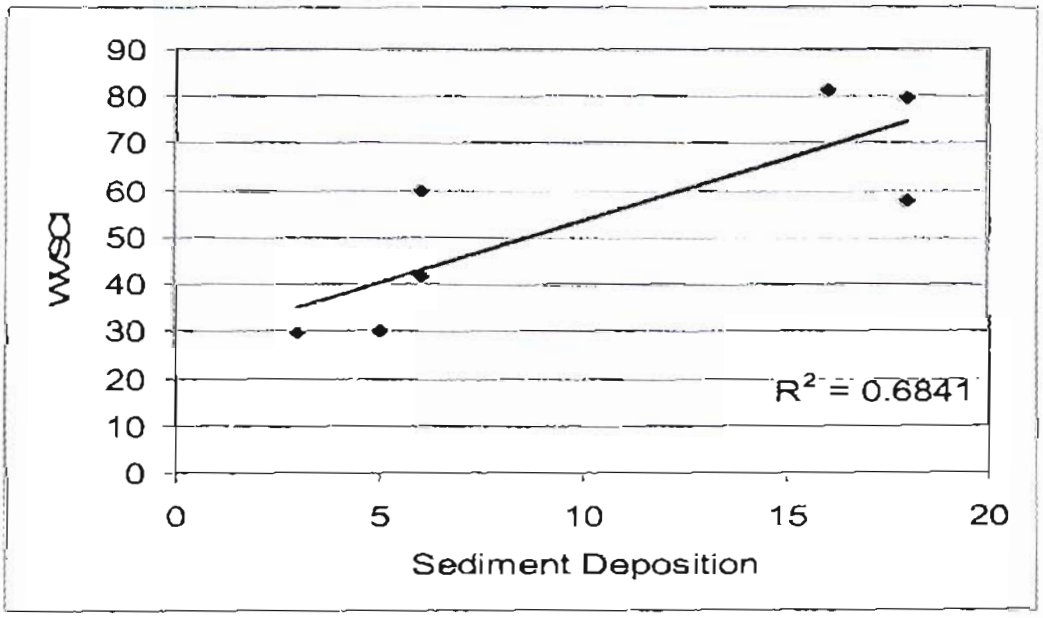


FIGURE 7

Relationship between Benthic Community Structure and Sediment Deposition Metric Score



Threshold monitoring near the base of Dingess Run near Stollings shows the water quality within state "in-stream" water quality standards for Warm Water Fisheries.

5.3 Metals

Iron, aluminum, and manganese are the metals generally associated with mining activity. The release of metals from mining activity is minimized through materials-handling plans and overburden handling which minimize acid production and thus leaching of metals and through sediment control, as metals are often associated with sediment. Also, mine discharges are permitted through the NPDES which establishes permit limits for acceptable discharge of metals associated with mining. If mining facilities comply with the MHP and NPDES permit, metals should not be discharged at levels adversely impacting the aquatic community.

Recently there has been attention on the potential release of selenium from mining operations as the chronic water quality criterion for selenium was exceeded in samples collected for the EIS. This criterion is being evaluated and has been proposed to be changed due to problems with its development and because a fish tissue criterion is believed to be more appropriate for evaluating the chronic effects of selenium. Regardless of changes to the criteria, selenium is currently addressed in the permitting process by a MHP which includes isolation of the high selenium layers and through the NPDES permitting process.

All three locations are required to comply with NPDES permit limits for metals.

6.0 NUTRIENT LIMITATIONS

One of the original arguments against valley fills relied on the description of the river continuum concept (Vannote et al, 1980) and the theory that upstream processes structure the downstream communities. Critics of valley fills have relied on this work to argue that fills disproportionately impact leaf shredding macroinvertebrates in a way that will severely diminish the downstream transport of energy in the form of shredded leaf litter, thereby diminishing the ability of downstream reaches to support macroinvertebrates and fish. If streams were functioning only as described by that document, impacting headwater streams would undoubtedly limit streams and rivers below valley fills due to loss of the organic food supply from the upstream waters. Wallace continues to return to this argument despite substantial evidence that it is not the case. While the river continuum concept may be an accurate description of how unperturbed systems would normally function, it doesn't necessarily reflect how disturbed systems would function nor does it indicate that systems not conforming to that model would necessarily be "non-functioning." While studies of valley fills have shown in some cases that the numbers of macroinvertebrate taxa are reduced below fills, they have also shown that the total number of macroinvertebrates is not reduced. In fact, data collected for a quantitative supplemental study to the EIS, which was conducted simultaneously by Potesta & Associates, Inc. (POTESTA), indicated that exactly the opposite was true. POTESTA'S Supplemental Study utilized 23 monitoring stations within three watersheds which were part of the EIS study. During the Winter 2000 index period, the filter feeders and collector groups were greater in the filled and filled/residential sites than in the unmined sites (Figure 8). In the Spring 2000 sampling period, the filter feeders were greater in the filled and filled/residential sites than in the unmined sites (Figure 9). The increase in filter-collectors in the filled and filled/residential groups could be

attributed to increases in the organic inputs. The sources of organic enrichment would likely be domestic inputs at the filled/residential sites and the pond influence at the filled sites. Increases in collectors, particularly filter feeders, below impoundments are well documented in the literature (Allen, 2000; Stanford and Ward, 1979; Petts, 1984). The increase in filter feeders and collector gatherers at filled sites would imply an overabundance of organic material available for the benthic community and a shift to a collector-gather and filter-collector macroinvertebrate benthic community structure. This demonstrates that the concerns that the nutrients would be limited by virtue of filling were either wrong or failed to account for the positive impacts of the sediment ponds that contribute substantially to the food base of the downstream community.

FIGURE 8
Functional Feeding Group Distribution of Benthic Macroinvertebrates Collected at EIS Sites in the Winter 2000 Sampling Period

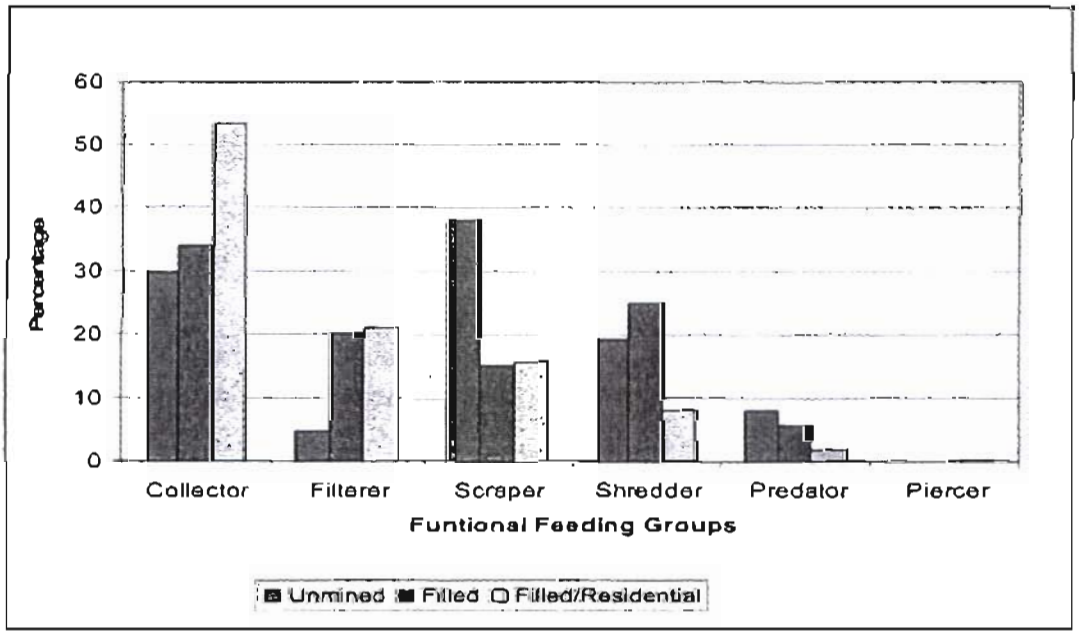
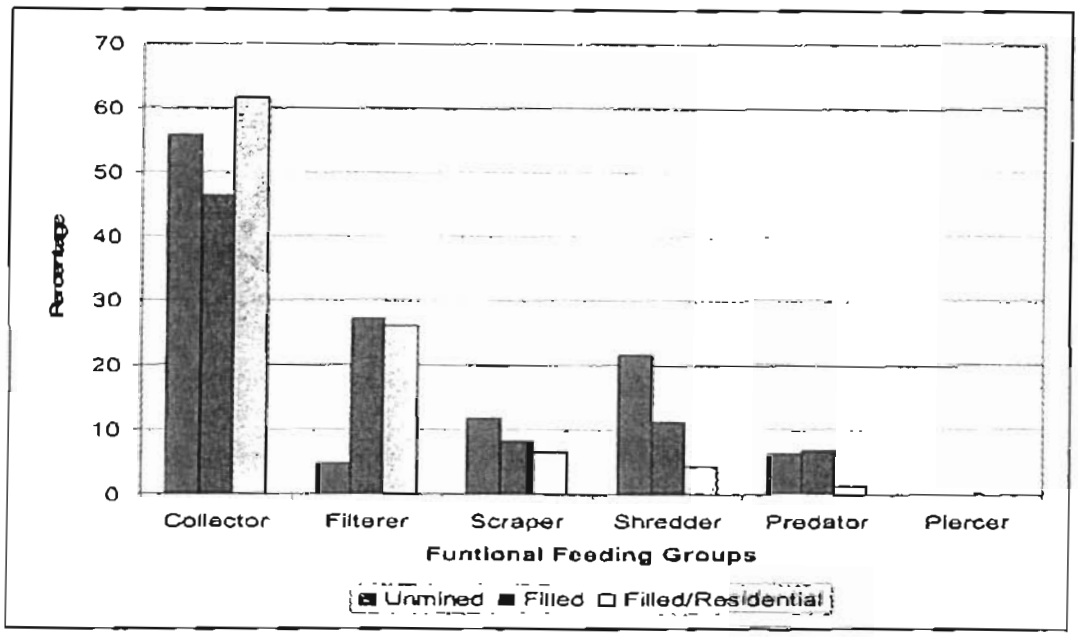


FIGURE 9

Functional Feeding Group Distribution of Benthic Macroinvertebrates Collected at EIS Sites in the Spring 2000 Sampling Period



Supporting the concept that food will not be limited downstream of valley fills was a study conducted in Pigeonroost Branch by Dr. Albert Hendricks of Virginia Tech Biology Department in 1999. Dr. Hendricks looked at the distribution of fine and course particulate organic matter (FPOM and CPOM) and chlorophyll in the stream from the headwaters downstream to the mouth and upstream and downstream of the confluence with Spruce Fork. The study found that there was more FPOM in the lower reaches of Pigeonroost Branch as compared to the upstream reaches (presumably generated in those lower reaches). He concluded from this, and the chlorophyll production in the downstream reaches, that the truncated Pigeonroost Branch existing after valley fill construction would be able to generate energy expected in similarly sized unfilled streams. Dr. Hendricks also noted that the sediment ponds, when constructed, would

contribute to energy production and may increase insect production below the outfalls. This effect was demonstrated in POTESTA's Supplemental Study. Dr. Hendricks also concluded that the fish community of Pigeonroost Branch would likely suffer no impacts from valley fills placed in the watershed based on his comparisons to a post-mining reference site and an expectation of continued productivity in the stream after mining and valley fill construction.

Available information regarding stream productivity indicates there is no expectation that nutrients will be limited in the receiving streams associated with valley fill construction at Republic, Aracoma, or Blackcastle operations. Further, the permits have special conditions which require riparian zones be established after the ponds are removed. While there may be some disturbance when the ponds are reclaimed, it would be temporary until the riparian zone is re-established.

7.0 BIOLOGICAL COMMUNITY CHANGES

7.1 Environmental Impact Statements

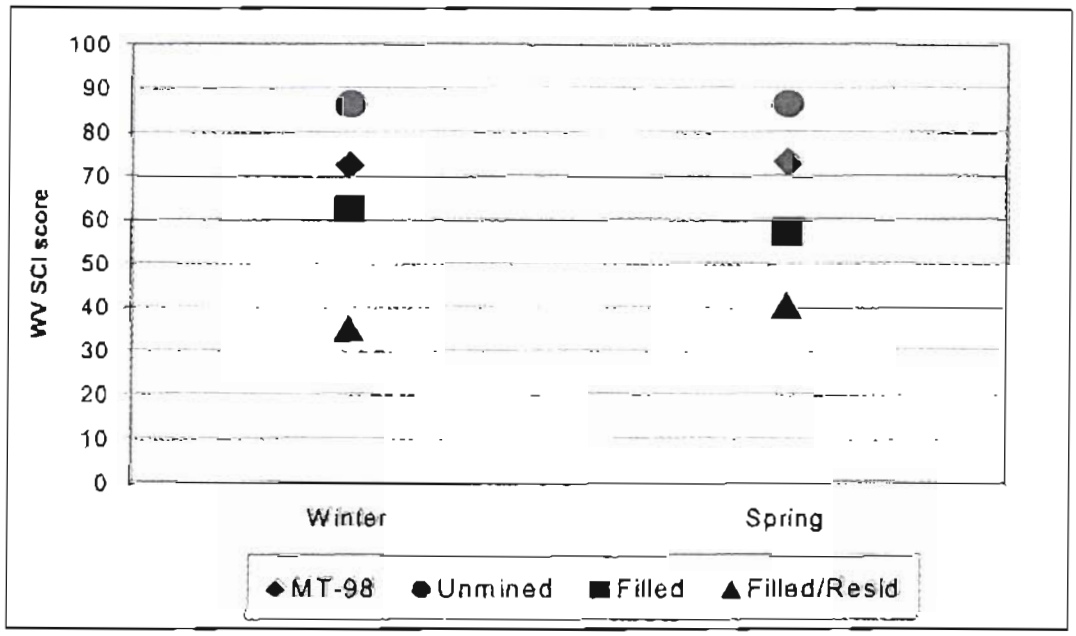
Most available information regarding the effects of valley fills on aquatic communities shows moderate effects in the vicinity of the fills and no discernible downstream effects. In 1984, an environmental assessment of head-of-hollow fills and mountain top removal was conducted by Skelly and Loy for the USEPA. This study found degradation of the benthic macroinvertebrate community following mining at a site in Kentucky; however, the water quality coming off the site would not meet today's water quality standards and was likely responsible for the impairment. In a West Virginia watershed where the water chemistry associated with mining was generally better, the study found that the benthic macroinvertebrate community declined in

richness and the presence of sensitive taxa during mining but appeared to show signs of recovery within 3 years of the mining activity.

Subsequent to this study, an analysis of valley fill impacts on benthic macroinvertebrate communities was conducted by Science Applications International Corporation (1998), again on behalf of the EPA. This document considered three mining influenced watersheds and found improvements in the post mining condition relative to pre-mining evaluations where stream impairment was indicated. The EPA's most recent EIS study included evaluation of the fish and benthic macroinvertebrate communities along with water chemistry and habitat evaluations. The fish study was inconclusive primarily due to insufficient data as a result of droughts and limited reference sites on the necessary stream orders (Stauffer and Ferreri, 2002). The benthic macroinvertebrate surveys indicated substantial variability in the sites below valley fills with WVSCI scores ranging from *Very Poor* to *Very Good* over the five sampling events. A reduction in the richness and abundance of mayflies was identified as a key factor in the reduction of WVSCI scores in valley filled sites as compared with reference sites. A supplemental study conducted by POTESTA indicated the communities below the filled sites were substantially influenced by changes in the available food sources due to the sediment control ponds and that abundance of organisms increased downstream of the ponds. While these studies may have indicated biological community shifts and changes in community structure, generally toward a more tolerant community, loss of aquatic communities has not been demonstrated in the areas immediately below valley fills or in downstream reaches.

The changes of the benthic macroinvertebrate community below valley fill/sediment pond complexes have been well documented in the EIS and the Supplemental Study prepared by POTESTA. However, as the POTESTA study indicated, it was not possible from these studies to discern the impacts of the ponds from potential impacts of the fills. There was only one site in the federal study, MT 98, which was not located below a sediment pond and showed primarily the valley fill effects. This site scored in *Fair* to *Good* range (Figure 4) and was more similar to reference conditions than the other filled sites (Figure 10).

FIGURE 10
Average WVSCI Scores from Each Category in the EIS from Two Sampling Periods Compared with the WVSCI Score from the Filled Sampling Site Not Located below a Sediment Pond, MT-98



While changes in fish community structure below valley fills was not conclusive, it is apparent from the EIS and POTESTA's Supplemental Study that nutrient limitations are not a factor in the

downstream areas below the valley fills. The EIS also demonstrated that temperature differences, suggested to be a problem for fish reproduction, were not evident at sampling sites located downstream of the fills and ponds.

7.2 Additional Studies

7.2.1 Twentymile Creek Watershed

Twentymile Creek is a tributary of the Gauley River with a watershed area of 55,451 acres located in Clay, Fayette, Kanawha, and Nicholas counties of West Virginia. The watershed lies almost entirely in the mountaintop mining region of West Virginia and has limited historic mining with most activity in the watershed occurring recently. Numerous studies have been conducted in the Twentymile Creek watershed to determine the effects of mining in the watershed including the EIS, and long term monitoring from several coal companies which is ongoing. POTESTA summarized the data from available sources to provide a cumulative assessment of the chemical and biological changes in the watershed (POTESTA, 2006). In general, mining related parameters such as sulfates and conductivity have increased as mining as progressed in the watershed. Other parameters, such as iron, manganese, and pH are apparently currently being successfully managed through the NPDES program, as they do not appear to be limiting in the watershed.

Benthic macroinvertebrate communities have shown localized effects of mining in the subwatersheds and on the mainstem but are generally improving despite the mining activity in the watershed. For example, in Robinson Fork only 3 taxa were collected in 1994, however, conditions have improved in this subwatershed with a high of 14 taxa in 1999, despite ongoing

mining activity. A mainstem sampling site just upstream of the confluence with Robinson Fork had only 9 taxa in 1996 and 11 taxa in 1997 but has improved such that 27 taxa were present in 2003 and 2004 and this site is now consistently receiving *Very Good* WVSCI ratings. Similarly, the mainstem sampling site located downstream of the confluence with Robinson Fork had only 7 taxa collected in 1996 and 9 taxa in 1997. This site had 22 and 23 taxa collected in the spring of 2002 and 2003, respectively, showing marked improvement. Of those taxa, 14 and 15 were EPT representatives and the WVSCI scores at this site are consistently in the *Very Good* range.

Similar results are reported for the fish communities in the sub-watersheds of Twentymile Creek indicating effects of mining during the period of active mining. Although the subwatersheds show effects of disturbance during active mining, they appear to recover after reclamation as evidenced in the Rader Fork and Neff Fork sub-watersheds where post mining fish communities had higher abundance and richness than the pre-mining condition. In addition, the active mining in the headwaters of the sub-watersheds does not appear to affect the fish community within the mainstem of Twentymile Creek. This was demonstrated in the mainstem of Twentymile Creek downstream of Hardway Branch where mining was initiated in 2002. The sampling station downstream of the confluence of Hardway Branch had an increase in abundance and diversity during the period of active mining. In addition, taxa that were gained during this time were *Catostomus commersoni*, *Ericymba buccata*, *Hypentelium nigricans*, *and Notropis ludibundus* (23 individuals), and *Notropis telescopus* (65 individuals). Biomass also increased during this period.

7.2.2 Trough Fork Watershed

A study was conducted in the Trough Fork watershed of Kiah Creek in Wayne County, West Virginia to examine the long-term affects of surface mining and valley fill construction on the benthic macroinvertebrate community and water quality. The monitoring period for the study was ten years and included pre-mining monitoring from 1995-1996, active monitoring from 1997 to 1999, and post mining monitoring from 2000 to 2006. Over the course of the active mining phase, six valley fills, 18 sediment ponds, and approximately 40,000 linear feet of sediment and diversion channels were constructed. In addition, approximately 575 acres of land was regraded. The results from the study show that there was an increase in calcium and sodium in the water chemistry due to treatment of the surface waters. In addition, there was an increase in sulfate, magnesium, conductivity, alkalinity, TDS, and harness as the result of mining activities. The benthic macroinvertebrate community demonstrated no difference in total abundance and total number of taxa; however, there was a decline in the percentage of mayflies as the result of mining activity. Despite high conductivity levels (1792 µS in the October 2001 sample) the sampling site still had 19 taxa present and had a WVSCI score of 69. The pre-mining WVSCI scores were *Good* to *Very Good* and are now *Fair* to *Good* (Figure 12 [Figure 11]). It should be noted that drought conditions existed during the 1999-2000 sampling periods and likely contributed to the low scores received during this time period.

FIGURE 11
Excerpt from Kirk and Maggard 2004

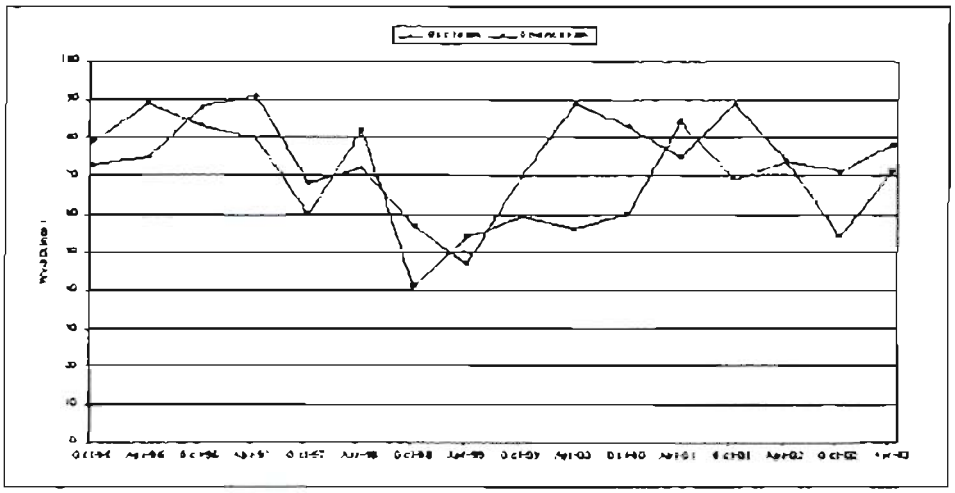


FIGURE 12. WV-SCI scores from Upstream and Downstream stations on Trough Fork. October 1995 through April 2003. Argus Energy, Inc.

7.3 Effects of Proposed Activities

Specific biological community changes expected downstream of Republic's Number 2 Surface Mine may include the reduction of mayfly or other sensitive taxa if conductivities rise to the expected levels. There are no significant effects expected in the fish community downstream of the valley fills although there may be short-term impairments associated with the disturbances when they are ongoing. This should be minimized by engineering controls and through compliance with the NPDES permit. Proposed mitigation activities are expected to improve benthic macroinvertebrate communities in that stream which will have an overall positive effect in the watershed.

Due to the impaired condition of the tributaries of George Branch, and Sandlick Creek, mining and valley-fill construction at the Blackcastle operation should create improved conditions in the watershed. Better water quality below the newly installed fills will support better biological communities than are currently present. More numerous and more sensitive taxa are expected in the receiving streams. Also, loading of dissolved solids should decrease as a result of a reduction in treatment chemicals which will have substantial benefits to downstream water quality.

At Aracoma's Camp Branch Mine, surface water quality remains fairly good despite significant historic mining operations in the watershed. The benthic communities in the streams which will be disturbed are in good condition despite the past disturbances. The currently proposed activities may temporarily limit the aquatic communities downstream of the mining and valley fill operations while active mining is ongoing but are not expected to limit the biota after mining is completed.

7.4 Biological Community Changes Resulting from Mitigation

Biological community changes are also expected in response to mitigation activities associated with the permits. Mitigation is conducted on a watershed scale to maximize the potential for watershed benefits from mitigation efforts. Although there has been some criticism by OVEC that planned mitigation efforts in the stream draining valley-filled areas at the mine sites will provide little or no aquatic benefits, the relationship between habitat and biological communities is well documented and serves as the basis for the development of restoration techniques. Enhancement of habitat in the affected watersheds will have a net positive effect on the biological assemblages in the watershed. Specific improvements in streams receiving similar

treatments have been shown by REIC which has documented biological community improvements in streams where mitigation projects involving bank stabilization and structure improvement have been completed. In one such stream in Fayette County, West Virginia, WVSCI scores improved from 59.4 to 78.1 at one improvement site when habitat scored improved from 115 to 163 just 6 months after restoration. Improvements in the benthic macroinvertebrate community included the appearance of five mayfly taxa despite average conductivities in excess of 850 uS/cm (REIC, 2006).

8.0 STREAM FUNCTION

The purpose of mitigation is to minimize the impacts of fill operations on stream function. Functions of headwater (1st – 3rd order) streams include: providing transition between landscape and larger waterbodies; providing habitat to relatively distinct and diverse invertebrate assemblages; assimilating nutrients, organic matter, and sediments; export of high quality water for water supply, recreation, waste assimilation; flood control; ecological values; connecting surface flow to groundwater resources; and providing thermal refuges in winter and summer (Pond, 2002).

While stream functions may be lost in the area under the fill, they are generally retained, at some level in the drainage structures constructed to move water off the fill and into the stream below the valley fill. For example, the drainage structures function to move water and sediments from the time of construction and will also move organic material after the site is reclaimed and revegetated. There may be differences in the schedule of sediment movement due to differences in peak flow and base flow conditions, however, everything will still move downstream. The

drainage structures and stream below the fill still act as the transition between landscape and larger waterbodies, although the landscape is changed from pre-mining conditions. Nutrients are assimilated in the pond and in the stream channel below the fill as indicated previously in this document although different communities process nutrients differently. Some functions, such as the connection between surface water and groundwater, and providing thermal refugia (and refugia from low flow conditions), may be enhanced due to the presence of the fills.

Stream functions are difficult to measure. What is generally measured are processes which show functions are ongoing. Measuring the rate of photosynthesis indicates nutrients are being up taken and incorporated into a food supply for downstream organisms. Measuring the rate of leaf litter degradation also indicates the upstream reach is functioning to provide a downstream supply of organic material. Similarly, trophic metrics are surrogates for complex processes such as trophic interaction, production, and food source availability (EPA, 1999). Biological assessments conducted using a multimetric approach use structural and functional attributes of the assemblage to characterize condition (EPA, 1998). The WVSCI includes six biological metrics that represent elements of the structure and function of the bottom-dwelling macroinvertebrate assemblage (Tetra Tech, 2000) and thus would be a useful surrogate for processing stream evaluations and evaluating stream function. Generally, direct measures of stream function are not included in evaluations of the conditions; however, biological surveys are routinely performed to evaluate structural and functional aspects of streams.

9.0 MITIGATION

In comments provided by OVECS consultants concerns have been expressed regarding the ability to mitigate headwater stream functions or to recreate headwater channels. As has been described previously, many functions of the headwater streams are not lost as a result of the filling activity or are inherently replaced as a result of the mining plan (such as water and sediment transport or food supply production by the ponds). The functional units of the altered system are not identical to those replaced but the downstream contributions are maintained. Because mitigation for mining projects is conducted on a watershed scale, enhancement of areas with potential to support more productive communities can be maximized. The creation of perennial stream channels is often utilized in restoration projects to create stream length and meanders where no stream previously existed (Harman and Jennings, 2001). The creation of ephemeral and intermittent channels would be similar with the exception that they do not require a water source since ephemeral channels will flow as a result of precipitation events (as well as snow melt) and intermittent channels which flow in response to rain and the changing water table. While it is true that no channel existed there before, substantial changes in the landscape necessitate construction of some water conveyance structures or they would form naturally to move precipitation down gradient toward the stream. Enhancement of those structures to maximize the ecological functions they provide is an important step in minimizing the effects of mining in the watershed. A similar concept is being explored in Ohio where a project funded in part by the Great Lakes Protection Fund, is underway to modify agricultural drainage ditches to provide enhance ecological services in addition their function as drainage ditches. The study thus far has found that, with few exceptions, ditches have developed some natural channel features unassisted and it is believed that enhanced ditches using the two-stage channel design

system will enhance ecological services and reduce sediment and nutrient loading to receiving systems (Ward, OSU website).

Regarding the evaluation of mitigation necessary to compensate for lost services, the USACE in the Huntington District does not have any specific guidelines for stream assessment. Other districts, such as the Norfolk District, utilized abiotic components to assess stream impacts. Norfolk District, based on a review of the literature, selected five variables whose relationship to overall stream health could be established. These variables were then considered analogous to or indicators of stream condition. These parameters were also noted as being predictable, reliable and repeatable, which is important when assessing multiple projects and/or impacts. The Louisville District utilizes a different calculator which uses abiotic and biotic measures or just abiotic measures. While the most robust form of the calculator (or model) utilizes both components (abiotic and biotic), the tool has been developed for use with only the abiotic information. In the development of the Louisville District's protocol, researches noted that the EPA's RBP habitat scores successfully distinguished between reference and test sites. The researchers also noted that the physical habitat parameters proved to be the best discriminator (have the most power) between least disturbed streams and those that were degraded. The strengths of this calculator, as reported by the researchers who developed it, are that it promotes an ecosystem approach and real data is used to calibrate the model (input into the calculator). The Stream Habitat Units utilized by Aracoma, Elk Run or Alex Energy also use the RBP habitat scores to assess relative stream condition.

9.1 Summary of Site Specific Mitigation

Compensation for temporary impacts in Long Branch of Fifteen Mile Fork and unnamed tributaries of Cabin Creek associated with Republic's No. 2 Surface Mine would include restoring each stream channel based on original stream habitat parameters and physical dimensions. A two-stage channel would be constructed after the sediment pond was dewatered and stabilized. The channel would include habitat structures and a 50-foot riparian buffer. Permanent loss of intermittent and ephemeral stream channel would be mitigated by off-site restoration and enhancement activities on perennial and intermittent reach of Long Branch of Fifteen Mile Fork

To compensate for permanent impacts to waters of the U.S., the Elk Run proposes to enhance 18,000 linear feet of Laurel Creek and improve overall water quality within 3,050 linear feet of George Branch and 2,370 linear feet of three unnamed tributaries of Laurel Creek. Lastly, the stream segments (7,590 linear feet) temporarily impacted by sediment pond construction, sediment transport and mined through activities would be restored to their pre- mining conditions. These mitigation measures would be expected to ultimately improve aquatic habitat, diversity and abundance within the Laurel Creek watershed.

Impacts to on-site streams have been minimized to the fullest extent possible at Aracoma's Camp Branch Surface Mine. To compensate for permanent impacts to jurisdictional streams, the applicant proposes to create: approximately 16,512 linear feet of intermittent streams and 2,974 linear feet of ephemeral streams in the Ethel Hollow watershed at the Camp Branch Surface Mine; approximately 1,485 linear feet of ephemeral streams in the Camp Branch

watershed at the Camp Branch Surface Mine; and, 24,375 linear feet of intermittent streams in the Ethel Hollow watershed at the Anna Branch and Anna Branch No. 2 Surface Mines. Lastly, the stream segments (1,880 linear feet) temporarily impacted by sediment pond construction and sediment transport would be restored back to their pre-mining conditions.

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Release Date: August 12, 2010

west virginia department of environmental protection

Permitting Guidance for Surface Coal Mining Operations to Protect West Virginia's Narrative Water Quality Standards, 47 C.S.R. 2 §§ 3.2.e and 3.2.i

INTRODUCTION

The purpose of this Permitting Guidance ("Guidance") is to assist West Virginia Department of Environmental Protection ("DEP") permit writers in developing site-specific National Pollutant Discharge Elimination System ("NPDES") permit conditions for surface coal mining operations using a holistic watershed management approach through the use of biological and chemical monitoring, whole effluent toxicity ("WET") testing, and the development of Aquatic Ecosystem Protection Plans ("AEPP") and, where necessary, Adaptive Management Plans ("AMP") to protect the State's narrative water quality standards. These standards are found in West Virginia's *Code of State Rules*, which states, in pertinent part, "No significant adverse impact to the chemical, physical, hydrologic, or biological components of aquatic ecosystems shall be allowed."[1] These new procedures shall take effect immediately.[2]

This Guidance does not apply to outlets that are primarily precipitation induced, or for which the activities associated with those outlets have been substantially completed.[3]

REASONABLE POTENTIAL ANALYSIS

In deciding which permit conditions to include in a permit, the first thing a permit writer must do is perform a reasonable potential analysis and document the same in the Statement of Basis for the permit. If the applicant cannot demonstrate, by means of its chemical and biological monitoring and the control measures outlined in its AEPP, that it does not have reasonable potential ("RP") to cause or contribute to an excursion above the narrative criteria, the permit writer should treat new or expanded discharges as if they have RP and include WET limits in the permit, in accordance with 40 C.F.R. § 122.44(d)(1)(v).

At permit reissuance, DEP will use all valid and representative data to determine, on a case-by-case basis, whether an existing discharge causes, has the reasonable potential to cause, or contributes to an excursion from the narrative water quality criteria. Where DEP concludes that an existing outlet has RP, the permit will include WET limits. In cases where insufficient data is available to make a determination of RP upon permit reissuance, the permit writer will place WET monitoring requirements and triggers in the permit in order to determine RP (or lack of

[1] 47 C.S.R. 2 § 3.2.i

[2] In light of the changing nature of the policy concerns addressed herein, this document is intended to be dynamic and will likely be modified in the future as technology and best management practices develop and improve.

[3] The term "substantially complete" shall mean that the operation is past the point when measures that could be undertaken under either an AEPP or an AMP could be effective in reducing the operation's impact on the aquatic ecosystem.

RP). If the monitoring shows RP, the permit writer will reopen the permit to include WET limits.

PERMIT CONDITIONS

If the applicant has RP, the permit writer should use best professional judgment to establish permit terms and conditions and determine whether the proposed control measures are sufficient to protect the narrative water quality standards. The permit writer should, depending on the type of permit being issued, establish the following conditions in the permit, each of which is discussed more completely below:

New and Expanded Discharge Permits

- WET Limits
- Chemical Monitoring
- In-Stream Biological Monitoring
- Aquatic Ecosystem Protection Plan (AEPP)
- Adaptive Management Plan (AMP), if necessary
- Reopener Clause

Permits at Reissuance

- WET Monitoring
- Chemical Monitoring
- In-Stream Biological Monitoring
- Aquatic Ecosystem Protection Plann (AEPP)
- Adaptive Management Plan (AMP), if necessary
- Reopener Clause

NEW AND EXPANDED DISCHARGE PERMITS

This Guidance does not apply to outlets that are primarily precipitation induced.

WET Limits

If the applicant cannot demonstrate, by means of its chemical and biological monitoring and the control measures outlined in its AEPP, that it does not have RP, the permit writer should treat new and expanded mining discharges as if they have RP and include WET limits in the permit, as prescribed by 40 C.S.R. § 122.44(d)(1)(v).

The permit writer shall establish WET limits using all applicable rules and guidance, including the EPA's 1991 *Technical Support Document for Water Quality-based Toxics Control* ("TSD").[4] To develop the WET limits, the permit writer shall consider the in-stream waste concentration of the effluent in the immediate receiving stream and calculate it so as to result in no greater than 1.0 chronic toxicity unit (TU_c) and 0.3 acute toxicity unit (TU_a) at the edge of the appropriate mixing zones, where applicable.

[4] EPA/505/2-90-001 PB91-127415

The permittee is required to perform WET testing quarterly. The TSD requires use of the most sensitive available surrogate organism (ceriodaphnia dubia) for chronic toxicity testing of effluents. DEP requires TDS, conductivity, sulfate, and bicarbonate analyses for each aliquot used in WET testing.

If WET testing shows noncompliance with the specified limitations prescribed in the permit, the permittee shall resample and test the effluent within 30 days. If the second test shows compliance, the permittee shall continue WET testing in accordance with the permit requirements. However, if the second test shows noncompliance, the permittee must, within 60 days, submit an AMP (as more fully described below) identifying actions it will take to achieve compliance with the WET discharge limitations. If WET testing shows noncompliance with the specified limitations prescribed in the permit, but the aquatic ecosystem remains healthy (as evidenced by acceptable data retrieved at the biological monitoring stations), the DEP shall reevaluate the WET limits placed in the permit to assure that such limits take into consideration the appropriate dilution factors, mixing, and the effects of the discharge on the downstream monitoring stations.

Chemical Monitoring

In addition to what is required for monitoring associated with the protection of numeric standards, the permit will require twice-per-month effluent monitoring for TDS, specific conductance, sulfate, alkalinity, pH, calcium, magnesium, sodium, and potassium upon commencing the permitted activity. The same sampling suite is required for all established biological assessment stations ("BAS"), as described below. The results of concurrent monitoring of WET, dissolved ions, and biological conditions will provide a wealth of information to guide future decisions and possible refinements to this Guidance.

In-Stream Biological Monitoring

The permit will require the maintenance of acceptable ecosystem health in waters of the State. Biological monitoring will be required prior to, and then regularly over the life of, the permitted activity. An applicant must submit a monitoring plan for agency approval that proposes in-stream BAS that allow a holistic assessment of the aquatic ecosystem and a determination of the impacts of the permitted activity.

The applicant should work with the permit writer and the DEP biologist to establish a monitoring strategy with the most appropriate monitoring locations for a holistic evaluation of the aquatic ecosystem. All biologic sampling shall be done in accordance with the West Virginia Division of Natural Resources' scientific collection permit and DEP's West Virginia Stream Condition Index ("WVSCI") protocol. The applicant shall submit to DEP for approval a monitoring plan that is consistent with WVDEP's Watershed Assessment Branch 2009 Standard Operating Procedures, Chapter 4,[5] which must include the following:

[5] http://www.dep.wv.gov/WWE/watershed/wqmonitoring/Documents/SOP%20Doc/WAB%20SOP.pdf

- An in-stream BAS shall be located at the first appropriate riffle/run habitat downstream of each new outlet in a perennial stream segment. Ideally, the BAS will be located such that future impacts to the stream are attributable solely to the permitted activity.
- Additional stations should be situated on a site-specific basis, but generally should be located upstream and downstream of the confluence of the immediate receiving stream and the stream into which it drains, which allows the aquatic ecosystem's health to be assessed in its entirety.
- If the first available location for a BAS is potentially influenced by other watershed activities and stressors, then a clear link between the permit controls and biological conditions at the station may not be possible. Those scenarios will require baseline documentation of the other potential stressors and tracking of watershed activities over time. The applicant will also have to submit a monitoring plan in accordance with the provisions set forth in "Chemical Monitoring" above.
- Additional monitoring stations may be designated further upstream or downstream at points that are useful in determining the entire aquatic ecosystem's health. Such stations may be beneficial in identifying actions the applicant can take to improve the overall health of the aquatic ecosystem.
- The plan should include chemical and biological monitoring at the BAS prior to the start of the permitted activity.

If the agency finds the condition of the aquatic ecosystem at the assessment stations prior to initiation of the permitted activity to be satisfactory, taking into account all potentially applicable criteria, then the acceptable future biological condition is a WVSCI score greater than or equal to the WVSCI value representing the 5th percentile of reference (currently 68.0). If the agency finds the condition of the aquatic ecosystem at the assessment stations is less than satisfactory, taking into account all potentially applicable criteria, then the applicant shall identify existing conditions within the watershed that may be contributing to the problem. If a TMDL addressing biological impairment for ionic stress is not in effect, a WVSCI score greater than or equal to the baseline value would represent an acceptable future condition.

However, permit writers should be aware that a single point in a stream may not represent the overall health of the aquatic ecosystem. WVSCI is a tool to be used as a primary indicator of stream health, but not the sole criteria; if the WVSCI score suggests a potential problem, DEP shall conduct an assessment of the health of the aquatic ecosystem as a whole. In determining whether a lower WVSCI score represents an unacceptable condition, the DEP will utilize best professional judgment in a manner comparable to the discretion it exercises in listing streams as biologically impaired pursuant to § 303(d) of the Clean Water Act, including a holistic examination of the health of the aquatic ecosystem.

Aquatic Ecosystem Protection Plan (AEPP)

New and expanded discharge permit applications shall include an AEPP for agency review and approval, and the permit writer shall use the control measures outlined therein as part of his or her RP analysis, as outlined more fully above. The permittee shall use

the measures outlined in its AEPP as a means of maintaining the health of the aquatic ecosystem and complying with the State's narrative water quality standards.

An AEPP describes control measures the applicant will implement to achieve WET limitations and minimize adverse biological impacts to the aquatic ecosystem surrounding the permitted activity. The plan should also include controls designed to lower the magnitude of pollutant loading associated with mining activities. If the agency cannot conclude that the proposed measures are reasonably expected to result in compliance, then the permit will not be issued. The applicant should consider all appropriate options when selecting and implementing control measures. Where an initial AEPP fails to achieve WET compliance and acceptable ecosystem conditions, the applicant must amend its AEPP to include additional measures that enable it to comply with WET limits.

The applicant can implement any of a number of controls in an attempt to protect the aquatic ecosystem and to reduce or minimize the ionic strength in the stream. Some examples of control measures that may be included in the AEPP include, but are not limited to, the following:

- Test overburden to determine the material that contains sulfur or other ionic strength-bearing material, so it can be isolated through material handling;
- Minimize the amount of area disturbed at one time;
- Minimize stormwater contact with pulverized material;
- Increase stream buffer zones;
- Minimize fill areas;
- Mine down-dip instead of up-dip;
- Cap fills and spoil so as to minimize pass-through of rain water;
- Revegetate any disturbed areas to minimize runoff;
- Develop a plan to reduce or prevent ionic stress;
- If necessary, conduct TRE/TRI pursuant to EPA's TSD;
- Segregate weathered rock and return to surface;
- Expedite reclamation;
- Enhance riparian plantings;
- Limit the number of active fills;
- Restore natural streams.

Because many of the controls outlined in the AEPP are related to best management practices, they will need to be addressed in the mining permit issued pursuant to the *West Virginia Surface Coal Mining & Reclamation Act* ("Article 3 permit"). The AEPP must be included as an attachment to the NPDES permit application to allow for agency review and evaluation.

Adaptive Management Plan (AMP)

A "new and expanded discharge" permittee shall submit an AMP to DEP within 60 days of failing two WET tests in a 30-day period. An AMP is more than merely monitoring activities and occasionally changing them; it involves exploring alternative ways to meet environmental objectives, predicting the outcomes of alternatives based on the current

state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions.[6] For purposes of this Guidance, the AMP outlines the measures the permittee will take to achieve the chronic toxicity permit limitations (1.0 TU_c). This plan shall include, at a minimum, a thorough review of the AEPP to determine what, if any, changes can be made to the control measures outlined therein that will bring the permittee back into compliance with its WET limits.

The permittee may also implement a Toxicity Reduction Evaluation (TRE)/Toxicity Identification Evaluation (TIE)[7] plan to obtain compliance with final effluent limits or triggers for chronic toxicity. The purpose of a TRE is to investigate the causes and to identify corrective actions for difficult effluent toxicity problems.[8] A TRE is a site-specific study conducted in a stepwise process to narrow the search for effective control measures for effluent toxicity. TREs are designed to identify the causative agents of effluent toxicity, isolate the sources of the toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity. The ultimate objective of a TRE is for the permittee to achieve the limits or requirements for effluent toxicity contained in the permit and thereby attain the water quality standards for the receiving waters.[9]

A TIE is a set of procedures to identify the specific chemicals responsible for effluent toxicity, and TIE methods are an integral part of the protocols for TREs. TIE procedures are performed in three phases: characterization, identification, and confirmation. In each phase, the permittee shall use aquatic organism toxicity tests to track toxicity at each step of the procedure. In most cases, these are abbreviated or shortened toxicity tests.

If the TRE/TIE identifies toxic pollutants that can be regulated through the use of numeric limits, the permit writer shall put a numeric limit for those pollutants in the permit, in accordance with 47 C.S.R. 2 § 9 and 40 C.F.R. § 122.44(d)(1)(vi)(A). If the TRE/TIE does not identify toxic pollutants that can be regulated through the use of numeric limits, the WET limits shall remain in the permit.

Reopener Clause

The permit will contain an explicit reopener clause allowing DEP to modify or revoke the permit if prescribed controls do not attain and maintain applicable water quality standards. The permittee may also request that the permit be reopened if, after a sufficient amount of data has been collected, the agency determines that RP does not exist, and the permittee can request an adjustment to its monitoring activities through a modification of the permit.

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[6] *See*, U.S. Department of the Interior's *Technical Guide: Adaptive Management*

[7] Although TRE/TIE is briefly outlined in this document, permit writers and permittees shall refer to EPA's TSD and the guidance documents listed therein for specific direction on how to conduct these evaluations

[8] EPA's TSD, p. 114

[9] Id.

PERMITS AT REISSUANCE

These permit conditions are only to be established for outlets that are primarily precipitation induced, or for which the activities associated with the outlets are substantially complete at the time of reissuance. If the agency determines at the time of reissuance that permitted outlets have not been constructed, the requirements outlined in "New and Expanded Discharge Permits" above will apply. Otherwise, DEP will establish the following permit conditions:

Wet Monitoring and Limits

Where there is not sufficient WET, chemical, and/or biological assessment data to perform a reasonable potential analysis at permit reissuance, the permit writer will assign WET monitoring to determine reasonable potential to cause or contribute to an excursion above the narrative criteria, as prescribed by 40 C.F.R. § 122.44(d)(1)(ii).

The permit writer will establish WET monitoring triggers using all applicable rules and guidance, including EPA's TSD. In developing the WET trigger, the permit writer will consider the in-stream waste concentration of the effluent in the immediate receiving stream and calculate it so as to result in no greater than 1.0 chronic toxicity unit (TU_c) and 0.3 acute toxicity unit (TU_a) at the edge of the appropriate mixing zones, where applicable.

The permittee is required to perform WET monitoring quarterly. The TSD requires use of the most sensitive available surrogate organism (ceriodaphnia dubia) for chronic toxicity testing of effluents. DEP requires TDS, conductivity, sulfate, and bicarbonate analyses for each aliquot used in WET testing.

If WET monitoring shows an exceedance of the specified triggers prescribed in the permit, the permittee shall resample and test the effluent within 30 days. If the second test shows compliance, the permittee shall continue WET monitoring in accordance with the permit requirements. However, if the second test shows an exceedance, the permittee must, within 60 days, submit an AMP identifying actions it will take to achieve compliance with the WET triggers. The permittee must also submit a permit modification to place WET limits in the permit.

Chemical Monitoring

The permit will require enhanced effluent and receiving water monitoring of dissolved ions for permits upon reissuance.

The permit will require twice-per-month effluent monitoring for TDS, specific conductance, sulfate, alkalinity, pH, calcium, magnesium, sodium, and potassium. The same sampling suite is required for all established stream monitoring stations. The results of concurrent monitoring of WET and dissolved ions testing at the discharge and in-stream monitoring locations will provide a wealth of information to guide future decisions and possible refinements to this protocol.

In-Stream Biological Monitoring

The permit will require the maintenance of acceptable ecosystem health in waters of the State. DEP will require in-stream biological monitoring regularly over the remaining life of the permitted activity. The permittee must submit a monitoring plan for agency approval that proposes in-stream BAS that allow a holistic assessment of the aquatic ecosystem and a determination of the impacts of the permitted activity. To that end, biological monitoring as discussed above may be applied as appropriate.

Adaptive Management Plan (AMP)

A permittee with a reissued permit shall submit an AMP to DEP within 60 days of exceeding two WET triggers in a 30-day period. The AMP shall include appropriate control measures as outlined in "Aquatic Ecosystem Protection Plan" above that are designed to obtain compliance with WET triggers, maintain the health of the aquatic ecosystem, and comply with the State's narrative water quality standards. If the WET testing results continue to exceed the established permit trigger(s), then the permittee has exhibited a reasonable potential to cause or contribute to an excursion above West Virginia's narrative water quality standards (specifically, 47 C.S.R. 2 §§ 3.2.e and 3.2.i), and the permit writer will reopen the permit to impose WET limits. Alternatively, the AMP may allow the permittee to conduct TRE/TIE (as outlined above), in an effort to identify toxic pollutants that can be regulated through the imposition of numeric limits in the permit.

Reopener Clause

The permit will contain an explicit reopener clause allowing DEP to modify or revoke the permit if prescribed controls do not attain and maintain applicable water quality standards. The permittee may also request that the permit be reopened if, after a sufficient amount of data has been collected, the agency determines that RP does not exist, and the permittee can request an adjustment to its monitoring activities through a modification of the permit.

REFERENCES

EPA's *Policy on the Use of Biological Assessments and Criteria in the Water Quality Program* (May 1991)

EPA's *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001 (March 1991)

EPA's *NPDES Permit Writers' Manual*, EPA-833-B-96-003