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EPA Guilty of Environmental Hyperbole in Mountaintop Mining Veto

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On January 13, 2011, the Environmental Protection Agency (EPA) vetoed the issuance of a Clean Water Act permit by the U.S. Army Corps of Engineers to the Mingo Logan Coal Company for the Spruce No. 1 Mine in Logan County, West Virginia. This is the first time the EPA has used this authority since the Congress passed the Clean Water Act in 1972.¹

We are in the midst of a difficult economy, and EPA's unprecedented action will result in the loss of 250 jobs, paying on average \$62,000, so one would think that the EPA has compelling case against the Spruce No. 1 Mine. Unfortunately, that is not the case.

An audit of the EPA's veto, "Final Determination of the U.S. Environmental Protection Agency Pursuant to 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia ('Final Determination')," reveals some troubling findings.

The document is pure environmental hyperbole. It is riddled with mistakes, incorrect citations, and false certainty. Indeed, virtually all of the EPA's definitive claims about the "unacceptable adverse impacts" to non-insect wildlife are unsupported by the literature it cites. Among the lowlights:

- The EPA's claim that "6.6 miles of high quality stream" will be buried conveniently omits the fact that 99.6 percent of the streams are intermittent or ephemeral, that they scored "below average" on a habitat assessment, and that they fall well short of meeting West Virginia's definition of "high quality" streams.
- The EPA asserts that five species of fish would be buried, despite the fact that no fish were found at the site.
- The EPA commits numerous referencing mistakes, including two direct misquotes. Throughout the document, the EPA draws incorrect conclusions from the literature it cites.

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- The EPA has a serious language problem. Science writing is performed in the conditional. EPA, however, almost uniformly uses the declarative case. As its veto is based on a literature review, the EPA repeatedly infers certainty where there is none.

The EPA has evidence that certain genera of pollution-sensitive insects would be harmed downstream of the Spruce No. 1 Mine, due to increases in salinity discharge from the project. Everything else—including all of the EPA’s claims about amphibians, fish, and birds—is either scientifically unfounded or legally irrelevant. The Appendix addresses these issues in detail.

The EPA’s *Ad Hoc* “Science.” When the EPA first objected to the permit, it was much more honest about the underlying science. In a letter dated September 3, 2009, in which the agency first expressed its Clean Water Act concerns about the Spruce No 1 Mine to the U.S. Army Corps of Engineers, it said:

Since the issuance of the permit in January 2007, new information and circumstances have arisen which justify reconsideration of the permit. Based upon prior research and confirmed in 2008 by research conducted by EPA, we are concerned data were available and was not evaluated. . . . In particular, we are concerned about the project’s potential to degrade downstream water quality, and to cause or contribute to potential excursions of West Virginia’s narrative water quality standards².

The 2008 study cited by the EPA in the letter provided evidence that saline effluent from mountaintop mining operations in Appalachia harmed certain pollution-sensitive insects³. According to the EPA, this “new information” engendered concerns about “the project’s potential to degrade downstream water quality.” In the Final Determination, however, the EPA states that its “conclusion that the Spruce 1 Mine as authorized would cause unacceptable adverse effects on wildlife is not dependent on a conclusion that West Virginia’s water quality standards will be violated at or downstream of the site⁴ Between the September 2009 letter and the January 2011 Final Determination, the EPA changed its justification. In the EPA’s initial objection to the Spruce No. 1 Mine permit, it stated that its concern was the degradation of downstream water quality. And by “degradation,” EPA was referring to the extirpation of certain pollution-sensitive insects. But in its Final Determination, the EPA claims that degraded water quality is not its concern. Instead, it broadened its objections to include “unacceptable adverse impacts” to wildlife caused by the Spruce No. 1 Mine.⁵ What happened?

It appears as if the EPA believed that its initial objection to the Spruce No. 1 Mine—that it would harm pollution-sensitive insects—was not substantial enough to justify an action that would prevent the creation of 250 well-paying jobs. After all, few Americans would rally around an administration that is willing to trade jobs for bugs. So the EPA tried to expand its case against the mine, in order to incorporate “adverse impacts” on birds, amphibians, and fish. This sort of *ad hoc* “science” would explain the EPA’s Final Determination shoddiness in addressing adverse impacts to non-insect wildlife.

Who Governs: EPA or Elected Officials? The EPA is guilty of environmental hyperbole. In its Final Determination, the a alleges “unacceptable adverse impacts” to amphibians, fish, and birds, but strip away all the pseudoscience, and it become evident that the EPA’s veto is based on the project’s adverse impacts on insects that aren’t even endangered species. Why would the

agency go to such lengths? Quite simply, to try to go around West Virginia's elected representatives.

In West Virginia, the people have spoken through their elected officials, and their support of the Spruce No. 1 Mine is unequivocal and adamant. In 2010, by a unanimous vote, the West Virginia State Legislature resolved that its definition of "water quality" are satisfied when "the aquatic community is composed of benthic invertebrate assemblages sufficient to perform the biological functions necessary to support fish communities."⁶ In effect, the Legislature was saying that the State of West Virginia is concerned about insects only insofar as they support fish. It was a direct response to the EPA.

Shortly after the EPA's veto, West Virginia Governor Earl Ray Tomblin (D) led a rally to protest the decision. "We must stand up and show federal regulators that we will not retreat from their unfair actions," he told the crowd. "We will continue the fight not just for the Spruce Number One mine but for every coal miner, coal company and for our way of life."⁷

The State's entire Congressional delegation is also on record with strong denunciations of the EPA's veto. Here's a roundup of statements from their press releases on the matter:

- Senator Jay Rockefeller (D): "I am deeply angered by the EPA's decision to revoke the Spruce Mine permit."⁸
- Senator Joe Manchin (D): "I plan to do everything in my power to fight this decision."⁹
- Representative Nick Rahall (D): "The good news, if there is any, may be that by EPA's finalizing this threatened action, the matter can now be taken before the courts, where I hope it will receive a thorough hearing and expeditious reversal."¹⁰
- Representative Shelley Moore Capito (R): "I respectfully request a legislative hearing on these new water quality requirements as soon as possible."
- Representative David McKinley (R): "This is appalling."¹¹

A unanimous legislature, the governor, the entire Congressional delegation...every single statewide elected official in West Virginia gives priority to job growth over insect-protections. This sentiment extends to the local level, too

- Logan County Administer Roscoe "Rocky" Adkins: "As it is, it's a huge hit and it will cost us a lot of services that will not be provided in our communities."¹²
- Logan County Delegate Rupert Phillips: "It's like the EPA doesn't want us to work. Give us our permits and we can work. Let us work. We are hard-working people and we want to work. Coal have given us our freedom."¹³
- Logan County School Superintendent Wilma Zigmond: "Coal keeps the lights on and our schools running."¹⁴

The people of West Virginia, through their public officials, have expressed their belief that jobs are more important than insects. The EPA is wrong to reverse these priorities.

APPENDIX

In Chapter 5 of its Final Determination, "Basis for Determination," the EPA explains the "unacceptable adverse effects" that justify its decision. Below is table of contents for this

Chapter. For each section in which the EPA makes dubious claims, the following section includes the EPA's thesis (or theses) for that section, taken directly from the text of the document, and then a rebuttal in italics.

V. Basis for Determination

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Unacceptable Adverse Impacts on Wildlife within the Spruce No. 1 Mine Project Area

Throughout the Final Determination, the EPA refers to "The destruction of 6.6 miles of high quality stream habitat."

Several aspects of this claim require clarification. For starters, the EPA is intentionally imprecise about what it means by the word "stream." At first glance, a reader might assume that these "miles of mountain streams" are perennial—that is, they flow year round. In fact, only 0.4 percent (165 feet) of the almost 40,000 feet of "streams" that would be buried by the Spruce No. 1 Mine are perennials. These remaining 99.6 percent of streams are intermittent and ephemeral¹⁵. Throughout the document, the EPA repeatedly refers to the destruction of "6.6 miles of high quality stream habitat," but only once (on page 17) does it acknowledge the classification of those streams.

This is not the first time the EPA has obfuscated this distinction. It was admonished by its Science Advisory Board for being "vague" about the differences among these types of streams in the EPA's literature review of the ecological impacts of mountain top mining the SAB states, "the imprecise characterization of these stream types has a bearing on any

regulatory structure that depends on invertebrate community structure as an indicator of habitat quality”¹⁶).

In Appendix 3¹⁷ of the Final Determination, the EPA suggests that it has believed since 1999 that the U.S. Army Corps of Engineers significantly underestimated the presence of perennial streams within the project area in its Environmental Impact Statement¹⁸, which formed the basis of the EPA’s stream classification in the Final Determination. This is contradicted by the absence of any mention of stream classification issues in the EPA’s official comments to the Corps of Engineers regarding the report.¹⁹

Why would the EPA obfuscate this distinction? The most likely answer is that it wanted to dupe the public, press, and policymakers into believing that these “high quality streams,” as the EPA repeatedly refers to them, are perennials. After all, a flowing stream teeming with wildlife sounds much more impressive than an ephemeral stream that only exists in the wake of storms.

The EPA is also misleading when it describes the streams as “high quality.” A 1998 Habitat Evaluation Procedure for the proposed project area scored the stream habitats 55.6 out of 100, where a rating of 60-69 is “average.” So these “high quality” streams are actually “below average” in terms of habitat quality²⁰

The EPA’s interpretation of “high quality” also conflicts with that of West Virginia. The State Department of Natural Resources defines “high quality streams” as,

- *All streams which are stocked with trout or that contain native trout populations; and*
- *Warm water streams over five miles in length with desirable fish populations and public fishing²¹.*

As there are no fish in the project area, the buried streams are not “high quality,” according to West Virginia’s definition of the term. Indeed, the “high quality” nature of these streams seems to exist only in the mind of the EPA.

Direct Impacts on Macroinvertebrates

“Construction of valley fills and other discharges of dredged or fill material authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will impact the native macroinvertebrate community directly through loss of stream habitat as a result of fill (Final Determination, p. 47).”

This is true: Insects will be buried

“Also, direct burial of these populations will likely affect food webs and the processing and transfer of energy and nutrients downstream.”

This is disputed, and there is sparse scientific literature to confirm it. That is why the EPA Science Advisory Board, advised, “If statements concerning the effects of upstream communities on the structure and productivity of those downstream are made, the EPA should cite studies that have actually demonstrated a material or energetic link.”²² The EPA provides no citations in this section.

Direct Impacts on Salamanders

“Based on literature values (Williams 2003) for mean densities within reference reaches of Pigeonroost Branch, Bend Branch (another tributary of Spruce Fork), and Ash Fork (a tributary of Gauley River) and a 2004 USFWS study in White Oak Branch, EPA estimates aquatic salamander density in Pigeonroost Branch and Oldhouse Branch at approximately 5-6 individuals per square meter along stream channels. The loss of this density over 6.6 miles of stream reflects a substantial loss (Final Determination, p. 48).”

While it's true that salamanders will be buried by the valley fill, as they are ubiquitous in Appalachia, the EPA is exaggerating. The EPA cites Williams 2003²³ for mean densities of salamanders, but that study only examined perennial streams. Of course, salamanders are much less prevalent in intermittent and ephemeral, which comprise 99.6 percent of the buried streams²⁴.

The EPA has a history of overstating the case on the issue of salamander loss. In its proposed determination, the EPA gave a “conservative estimate” that more than 20 million salamanders would be buried²⁵ (. Evidently, this estimate was not “conservative” enough, because the EPA, in its Recommended Determination, concluded that 200,000 salamanders would be buried (Recommended Determination, p 58). Yet even this estimate was not sufficiently “conservative,” because, the EPA dropped any reference to the total salamanders buried. However, in its Final Determination, the EPA incorrectly cites the Williams study. After three revisions, the EPA is still overstating the case!

“It is not expected that stream salamanders will return to the site due to the burial of their existing habitat. Gingerich (2009) found no expected stream salamanders inhabiting 3-20 year-old sedimentation ditches (5 out of 5 mines) in West Virginia mountaintop mining areas. Furthermore the USFWS [U.S. Fish and Wildlife Service] has indicated that, to its knowledge, it has not been demonstrated that salamanders return to mined areas at densities similar to those that occurred prior to mining (Final Determination p. 48).”

Not so. Hamilton, M. S. 2002. Effects of developmental activities on streamside salamander communities in Boone County, West Virginia. M. S. Thesis. Marshall University, Huntington, West Virginia. 81 pp., found that streamside salamanders in a valley fill stream appeared to reach abundance levels similar to that of reference streams.

“Additionally, the loss of these salamanders will have broader food web implications, as they also serve as prey for numerous terrestrial and aquatic species found within the Spruce No. 1 Mine site, including fish, snakes, birds, mammals, turtles, frogs, crayfish and other salamanders (Davic and Welsh 2004) (Final Determination p. 48).

Here is the part in the Davic and Welsh 2004 study that EPA referenced: “Many animals are known to consume salamanders, including birds, mammals, snakes, fishes, turtles, frogs, crayfish, predatory insects, and other salamanders (Petranka 1998).” The authors do not draw any definitive conclusions about the “broader food web implications” that “these” salamanders “will have.”

Moreover, the U.S. Army Corps of Engineers Environmental Impact Statement of the Spruce No 1 Mine finds that the project would have “little impact” and “little effect”²⁶ on white tailed deer, birds, small mammals, amphibians, and reptiles, because, “suitable habitat adjacent to the project area would be available for use by these species.” That is, the animals higher up on the food chain will survive by eating salamanders in any of the thousands of acres encircling the mine that aren’t being mined. The EPA’s claim that the buried salamanders will impact the larger food web is akin to saying that a New York City neighborhood would starve because one pizzeria closed.

Direct Impacts on Fish

“Construction of valley fills and other discharges of dredged or fill material authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will lead to the total loss of over six miles of high quality, least-disturbed in-stream habitat and thus the total loss of five naturally occurring fish populations within the project area.” (Final Determination p. 48)

According to the Environmental Impact Statement (EIS), “No fish species, catadromous or anadromous in nature, were identified as being present within the waters of the proposed project area).²⁷” It is unclear how fish can be “lost” when they are not present.

Direct Impacts on Water Dependent Birds

“The Spruce No. 1 Mine will impact the Louisiana Waterthrush, a water-dependent bird that requires forested headwater streams for foraging on insects and nesting, by eliminating the headwater areas associated with Pigeonroost Branch and Oldhouse Branch... Because it requires riparian woodland habitat to forage for macroinvertebrates along streams, approximately 6.6 miles of Louisiana Waterthrush stream and riparian habitat will be lost due to fill being placed in Pigeonroost Branch and Oldhouse Branch and their tributaries....The Waterthrush is particularly vulnerable to degradation of water quality and aquatic insect communities (Mattsson and Cooper 2006, Mulvihill et al. 2008).” (Final Determination p. 49)

As the EPA notes in its response to comments for its Recommended Determination, “Breeding Waterthrushes nest and forage primarily on the ground along medium- to high-gradient, first- to third-order, clear, perennial headwater streams flowing through closed-canopy forest”²⁸. Perennials, however, account for only 0.4 percent of total buried stream²⁹, and a 1998 Habitat Evaluation Procedure that scored the canopy closure of the streamside as “distinctively low”³⁰) The EPA claims that “6.6 miles of Louisiana Waterthrush stream...will be lost,” but the project area does not comport to what the EPA identifies as Waterthrush habitat. This suggests that the EPA is overstating the case.

Contrary to the EPA’s speculation, an actual study determined that the Waterthrush is not at risk. The U.S. Army Corps of Engineers Environmental Impact Statement concluded that the Spruce No 1 Mine would have “little impact” on game and non-game birds, because thousands of acres of suitable habitat are available to the south and southeast of the proposed project³¹..

The EPA’s citation of Mulvihill et. al. (2008³²) is inappropriate, as that study documents the effects of acidic mine drainage in perennial streams on Louisiana Waterthrushes. The

acidity of effluent from Spruce No. 1 is controlled under the Clean Water Act, and pH has not been cited by the EPA as a concern for this project. In fact, discharge from the project would be basic. As the streams in that study have entirely different water chemistries than the streams impacted by the Spruce No 1 Mine, the EPA shouldn't be drawing comparisons about water quality between the Mulvihill study and this project.

The EPA's citation of Mattson and Cooper (2006³³) is also inappropriate. This research investigated whether or not the presence of Waterthrushes can be used as a cost-effective method of assessing habitats. In no way did the authors test the Waterthrushes "vulnerability" to degraded water quality and macroinvertebrate communities.

In fact, there is reason to believe that the project area might become more habitable for the Louisiana Waterthrush. According to the Environmental Impact Statement, "Valley fills constructed with rock underdrains would be expected to alter the flow regime downstream of valley fills by generally creating a perennial flow pattern from the toes of the valley fills continuing downstream."³⁴ In plain English, this means that the intermittent/ephemeral streams that now dominated the project area will be converted into perennial streams. As is noted above, the Louisiana Waterthrush prefers perennial streams over intermittent ones.

EPA has a troubling history of exaggerating the Spruce No. 1 mine's impacts on birds. In its Proposed Determination, the EPA claimed that the Kentucky warbler, the Cerulean warbler, the Swainson's warbler, worm-eating warblers, and the wood thrush could all be impacted.³⁵ The EPA dropped this claim after it learned, from the coal company, that none of these birds are water-dependent.³⁶

A Legal Note on the EPA's Description of Direct Impacts

As shown, the EPA grossly exaggerated the potential for direct adverse impacts caused by the Spruce No 1 Mine. That said, it is disingenuous for the EPA to cite "direct" impacts as a rationale for vetoing the Spruce No. 1 Mine.

Wildlife impacts, such as the burial of insects and salamanders that are not endangered species, are inherent to economic development in general, and surface coal mining in particular. In the 1977 Surface Mining Control and Reclamation Act, Congress recognized a need to "protect society and environment from the adverse effects of surface coal mining operations," but also to "strike a balance between protection of the environment...and the Nation's need for coal as an essential source of energy."³⁷

In seeking that balance, the law authorizes the construction of valley fills (and, therefore, the burial of streams). The EPA lists "direct" impacts of the Spruce No. 1 Mine as if they were unique and unprecedented, when in fact the EPA has been permitting these "direct" impacts for more than three decades.

The EPA hints that its newfound opposition to these "direct" impacts is based on the large scale of the project, although this is never stated explicitly. If project scale is the reason that Spruce No. 1's "direct" impacts are "unacceptable," then the EPA would have to establish a size threshold by which it could objectively determine when a surface

mine is too big. However, the EPA never does this, so there is no legal reason why it could object to the project's "direct" impacts.

Increases in "Pollution": Selenium

The EPA notes "The State of West Virginia has established a numeric chronic water quality criterion for selenium (5 µg/L four-day average not to be exceeded more than once every three years) to protect instream aquatic life. EPA's conclusion that the Spruce 1 Mine as authorized would cause unacceptable adverse effects on wildlife is not dependent on a conclusion that West Virginia's water quality standards will be violated at or downstream of the site. Rather, reference to this water quality standard provides information and context." (Final Determination p. 51)

Note the lawyerly language. It is repeated throughout the document, and also in the EPA's response to public comments. After citing the fact that West Virginia already has a numeric standard for selenium, the EPA states that its "conclusion" on Spruce No 1 Mine is not in any way dependent on West Virginia standard, even though it was approved by the EPA. In effect, the EPA is saying that it refuses to recognize its own standards. Why would it do that? The answer is that the EPA is trying to avoid having to explain itself. In order to change West Virginia's existing standard, the EPA would have to propose a new standard, and then allow the public to comment, before it could be finalized. This would be an especially contentious process, as there is much debate over the impacts of selenium, and the science is unsettled. Instead of enduring this process, the EPA is simply ignoring West Virginia's water quality standard for selenium. This is a troubling abuse of power.

To add insult to injury, the EPA fails to put forth its criteria for rejecting the selenium standard that it had previously approved. The EPA's explanation is that it intends to prevent "increased loadings of selenium to downstream waters." Does this mean that anything greater than zero is unacceptable, standards be damned? The EPA fails to elucidate.

"Discharges from the Spruce No. 1 Mine Complex project are expected to increase selenium loading to the immediate receiving streams and downstream waters... To evaluate the impact of discharges into Pigeonroost Branch and Oldhouse Branch as authorized by the DA permit, EPA has compared selenium levels in Pigeonroost Branch and Oldhouse Branch with selenium levels in waters that have been impacted by the nearby Dal-Tex operation" (Final Determination p. 52)

The EPA claims that discharges from a neighboring mine, one that is decades older and three times larger than Spruce No 1 Mine, is indicative of the discharges that are expected at the project site. In its response to public comments, the EPA dismisses the size differential "has no relevance,"³⁸ but this makes no sense. Selenium leaches into effluent as water comes into contact with selenium-enriched exposed dirt and rock. The more exposed dirt and rock there is, the more the exposure, which means more selenium leeching. Of course, the amount of exposed dirt and rock is dependent on the size of the mine. The upshot is that size matters: the bigger the mine, the more the selenium. According to Dr. Todd Petty, Associate Professor in the Division of Forestry at West Virginia University, stated, "it is the total mined area that is the predominant cause of reduced conditions downstream"³⁹).

Also, the EPA dismisses out of hand the permit applicant's Material Handling Plan. In order to comply with West Virginia's selenium effluent standard, the permit applicant agreed to segregate the dirt and rock with high concentrations of selenium from dirt and rock with lower concentrations. In its responses to public comments, the EPA explains why it doesn't believe the MHP will be effective⁴⁰). It remains unclear why the EPA didn't voice its objections in 2004 and 2007, when West Virginia updated its 402 NPDES permit⁴¹.

“In addition, EPA has reviewed data from a mining outlet that drains, among other things, discharges from a portion of the Spruce No. 1 Mine that has been constructed in the Seng Camp Creek watershed.” (Final Determination p. 52)

In 2007, the Mingo Logan Coal Company was granted a partial permit to mine a limited area within the proposed Spruce No. 1 project. As part of this partial permit, the applicant built a valley fill. The EPA proposes to use discharge data from this valley fill in order to infer what the discharges would be from the project as a whole. This valley fill is part of the proposed project, so it sounds reasonable to use it for comparison, but there's a catch: At the same site, there is discharge emanating from spoil that was deposited in the 1990s, from a previous mining operation, one that did not use the selenium mitigation techniques that the permit applicant proposed in its Materials Handling Plan. In its responses to public comments, the EPA stated, “EPA is unable to determine whether the concentration at the outfall was consistent with the concentration from flow originating in the material placed in the 1990s.” It dismissed the confounding effects of the pre-existing spoil, but does not refute it⁴².

“In addition to discharges of elevated concentrations of selenium, the project also will have the effect of increasing selenium concentrations in downstream waters by removing Pigeonroost Branch and Oldhouse Branch as sources of dilution that moderate downstream selenium concentrations.” (Final Determination p. 57)

This is a non-sequitur. Decreasing dilution is inherent to increasing selenium discharge, which the EPA already has addressed. In an effort to make its superficial case against the Spruce No. 1 Mine seem stronger than it is, the EPA is trying to make two distinct arguments from one. Regarding selenium, the only question that should matter is whether or not the Spruce No 1 Mine will result in effluent with concentrations of selenium that violates the (EPA-approved) West Virginia numerical water standard.

“In summary, water quality from streams and discharges draining both the Dal-Tex Mine Complex and the current operational portions of the Spruce No. 1 Mine confirm EPA's concern that the Spruce No. 1 Mine, if constructed as authorized, would contribute additional loads of selenium to downstream waters at concentrations that, as a monthly average, will exceed 5 µg/L.” (Final Determination p. 58)

This is misleading. The EPA presents its data on the selenium discharges from the Spruce No. 1 Mine as “monthly averages,” and the “report date” of these “monthly averages” just so happens to fall on the last day of the month for each of the 16 months for which the EPA collected the data. To the reader, this makes it seem as though the EPA measured selenium every day. In fact, the EPA took one to two measurements a month.

Then, the EPA compared these measured selenium readings to West Virginia's chronic water quality standard for selenium (5 µg/L). This is highly misleading, because the West Virginia chronic criterion 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." As such, none of the EPA's selenium measurements from the Spruce No. 1 Mine exceeded this standard, which, again, had been approved by the EPA⁴³.

For perspective, it also bears mentioning that the West Virginia's numeric water quality standard for selenium (5 µg/L), which the EPA chose to ignore, is 10 times less than the EPA's selenium numeric water standard for drinking water (50 µg/L). This is a major reason why selenium is so controversial.

Increase in "Pollution": Total Dissolved Solids

"To understand the water quality impacts from increased total dissolved solids (TDS), it is helpful to understand the relationship between salinity, TDS, and specific conductivity. For purposes of this action, when this document discusses increased conductivity or TDS, it refers to an increase in salinity in otherwise dilute freshwater. ... Salinity is the amount of dissolved salt in a given body of water... Salinity is often expressed in terms of specific conductivity (hereafter referred to as conductivity). Conductivity is the ability of a solution to carry an electric current. ... Construction of valley fills and other discharges of dredged or fill material from the Spruce No. 1 Mine into Pigeonroost Branch and Oldhouse Branch will cause an increase in conductivity and TDS in those receiving waters downstream of such discharges." (Final Determination p. 58)

This is all true: As water is filtered through a valley fill, it comes into contact with dirt and rock, which are dissolved into the water. As a result, the discharge from the valley fill has higher salinity.

Impacts to Macroinvertebrates Due to Changes in Water Chemistry

"Although there is little research on the direct effects of increased selenium loading on aquatic macroinvertebrates, some studies indicate the potential for macroinvertebrate populations to be adversely affected by selenium, even at concentrations below water quality thresholds established to protect fish and bird populations. For example, a review by Debruyne and Chapman (2007) found that the range of selenium water quality thresholds established to protect higher trophic levels consuming selenium-contaminated invertebrates could, in some cases, have substantial toxic effects on invertebrates, including reduced growth, reduced abundance, and mortality. Similarly, this review estimated that sublethal toxic effects can be associated with a range of water concentrations of 1-30 µg Se/L..." (Final Determination p. 61)

The EPA incorrectly references Debruyne and Chapman (2007⁴⁴). In that study, the authors conclude that "Sublethal effects occurred at 1-30 µg Se/g dry weight in invertebrate tissue," whereas the EPA states that the authors found such effects can be associated with "a range of water concentrations of 1-30 µg Se/L." The EPA seems to have confused selenium dry weight in invertebrate tissue with selenium concentrations in water. This is an egregious error. Debruyne and Chapman analyzed the effects of

selenium water concentrations that are at least 20 times the West Virginia water quality standard for selenium. However, EPA was correct to say that “there is little research on the direct effects of increased selenium loading on macroinvertebrates.”

In pages 62-67 of the Final Determination, the EPA makes the case that increased concentrations of total dissolved solids (a.k.a. salinity) downstream of valley fills result in the extirpation of pollution sensitive macroinvertebrates.

This is true. Evidence suggests that valley fills result in the elevated downstream concentrations of salinity, which harms pollution sensitive macroinvertebrate genera, but especially the Mayfly.

However, the scientific literature also demonstrates that there is a consistent replacement of sensitive genera with tolerant genera. Merricks et al (2007)⁴⁵ found that the difference in macroinvertebrate “richness” (a measure of total number of species) at 12 of 16 sample sites downstream of valley fills was statistically insignificant from the reference site (salinity in the sample sites downstream of the valley fill ranged from two to six times the EPA’s benchmark standard). Hartman et al (2005)⁴⁶ was “unable to detect a significant difference in total macroinvertebrate density between fill and reference streams,” where salinity in fill streams ranged from one to three times the EPA’s benchmark standard. And Gingerich (2009)⁴⁷ found that invertebrate richness increased downstream of the fill site. Although certain sensitive insects are harmed by saline discharge from valley fills, neither the total number nor the density of insects is necessarily impacted.

This gets to the crux of the EPA’s dispute with West Virginia. For West Virginia’s governor, State Senate, State House, and the entire Congressional delegation, the loss of pollution sensitive bugs downstream of a valley fill is an acceptable adverse impact of surface mining. For the EPA, however, it is an “unacceptable adverse impact.”

Food Web Effects of Altered Macroinvertebrate Communities

“Project impacts on these aquatic invertebrates will likely alter in-stream functions (e.g., organic matter processing and transport, and nutrient cycling and transport), in part because research has shown that processing rates of terrestrial plant material inputs are reduced in mine-affected streams with altered macroinvertebrate assemblages (Fritz et al. 2010).” (Final Determination p. 68)

The EPA implies certainty where none exists. Fritz et al (2010)⁴⁸ found that “Land use changes associated with mountaintop mining-valley fill have detrimental consequences to headwater stream function.” The relationship between structure and ecological function as it pertains to land use changes caused by surface coal mining in Appalachia is an emerging science, and there is as yet no definitive word on the matter. Gingerich (2009)^{lviii} for example, found that many of the typical headwater ecological functions—including organic matter retention, organic matter decomposition, and production of dissolved and fine particulate organic matter—are retained to some degree at streams impacted by surface coal mining. Moreover, he concluded that connections with downstream ecosystems are poorly understood.

Impacts to Salamanders & Other Herpetofauna Due to Changes in Water Chemistry

“Adverse impacts to salamanders as a result of construction of valley fills and other discharges authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will not be localized to the area to be filled. Because construction of the valley fills and other discharges will increase conductivity and selenium levels in the downstream receiving waters (see Section V.D.1.), salamanders that are not directly buried and killed beneath the fills will also be impacted; directly via exposure to these contaminants and indirectly via impacts of contaminants on food sources and reduced prey abundances. Studies have documented elevated selenium levels in salamander tissue downstream of valley fills and that salamander assemblages were more likely to be impaired downstream of valley fills than in other locations (Patnode, et al. 2005). (Final Determination pp. 68-69)

The EPA claims that “salamanders that are not directly buried...will also be impacted; directly via exposure to these contaminants [conductivity and selenium] ...” There is no evidence that salamanders are directly impaired by conductivity, because no such research has been conducted. This is why EPA cites no literature. Regarding the supposed adverse impact of selenium exposure to salamanders, the EPA cites Patnode et. al. (2005⁴⁹), “Salamander assemblage survey of mercury and selenium contaminated headwater sites in the Appalachian Mountains of Pennsylvania, Virginia, and West Virginia.” Not only is this not a peer reviewed study, it also does not demonstrate the direct impact of selenium on salamanders (as the EPA claims). Rather, Patnode et. al. investigated the impact of mercury and selenium on salamander assemblages. Mercury discharge is not a concern at Spruce No. 1 Mine.

The EPA also claims that, “salamanders...will also be impacted...indirectly via impacts of contaminants on food sources and reduced prey abundances.” Again, the agency provides no research to back this assertion, because there is none. Salamanders are “opportunistic generalists,” which means that they aren’t picky about what they eat. Research (Merricks et al 2007^{xlvi}; Hartman et al 2005^{xlvii}) suggests that total macroinvertebrate diversity and abundance does not decrease downstream of valley fills, so it stands to reason that salamanders will not suffer due to “reduced prey abundances.” In any case, research would have to be performed before the EPA could make such a conclusion.

Impacts to Fish Due to Changes in Water Chemistry

“Fulk et al. (2003) found significant differences in total IBI (IBI is a measure of fish assemblage health) scores between streams that are affected by mines and those that are not.” (Final Determination p. 69)

Fulk et. al. also found that the best IBI scores were at sites downstream of valley fills and also near residential developments, which suggests that the relationship between IBI scores and the presence of a mine upstream is not as definitive as the EPA claims. Indeed, the authors found that the watershed size was the dominant causal variable. They stated, “It was found that Filled, Mined, and Filled/Residential sites in watersheds with areas greater than 10 km² had “fair” to “good” IBI scores, while Filled and Mined sites

in watersheds with areas less than 10 km² often had “poor” IBI scores (Fulk et al. 2003⁵⁰.)” If anything, this study only refutes the EPA’s position. The Spruce Fork watershed is greater than 10 km², so this study would suggest it will maintain its “good” IBI score if the Spruce No 1 Mine is allowed to proceed.

Potential to Promote the Growth of Golden Algae

“Construction of valley fills and other discharges authorized by DA Permit No. 199800436-3 (the Clean Water Act permit for the Spruce No 1 Mine) into Pigeonroost Branch and Oldhouse Branch as authorized will create in-stream conditions in or near Spruce Fork favorable to the growth of golden algae (*Prymnesium parvum*), which releases toxins that kill fish and other gill-breathing aquatic organisms.” (Final Determination p. 70)

*In the proposed determination, the EPA claimed that, “Construction of valley fills and other discharges authorized by DA Permit No. 199800436-3 (the Clean Water Act permit for the Spruce No 1 Mine) into Pigeonroost Branch and Oldhouse Branch as authorized **are likely** to contribute to in stream conditions in or near Spruce Fork that **may support** the growth of golden algae (*Prymnesium parvum*).”⁵¹ Note how the wording has changed. In the recommended determination, the EPA uses equivocal language (“are likely” and “may support,” but in the final determination, the words have been strengthened (“will create” and “favorable” instream conditions), despite the absence of a new citation to research that would lend credence to the EPA’s newfound confidence in the likelihood of conditions of the Spruce No. 1 Mine would favor the growth of *Prymnesium parvum*.*

“*P. parvum* has also been associated with an extensive and severe aquatic life kill in the central Appalachians, in which thousands of fish, mussels and other aquatic organisms were destroyed in Dunkard Creek in West Virginia and Pennsylvania (Roelke et al.2010, Sager et al.2008). During September 2009, biologists reported observations of thousands of dead fish, mussels and salamanders in Dunkard Creek (Hambright 2010).” (Final Determination p. 70)

*The lead sentence is imprecise. It was not the presence, or even the growth, of *P. parvum* that caused the “extensive and severe aquatic life kill.” Rather, it was a harmful algae bloom (HAB) that caused the “life kill.” Such a HAB is the result of runaway, geometric growth of organisms like *P. parvum*. Throughout this section, the EPA conflates the “growth” of *P. parvum*, with algae blooms (i.e., runaway growth), as if they are the same thing. They are not. “Growth” may be ubiquitous (we don’t know yet whether or not *P. parvum* is an invasive species, or whether it has always been present and is simply the beneficiary of anthropogenic influences on waterways), and relatively harmless.*

The EPA is wrong to imply a comparison with the Dunkard Creek incident. Harmful golden algae blooms are associated with high concentrations of salinity, among many other variables. Discharge from the Spruce No 1 Mine would increase salinity. Therefore, the EPA argues, the Spruce No. 1 Mine project increases the risk of algae blooms. But Dunkard Creek had a conductivity value of over 25,000 $\mu\text{S}/\text{cm}$ in the area of the bloom⁵²; by contrast, the EPA “predicts that average conductivity in Spruce Fork downstream of Seng Camp Creek could increase from 552 $\mu\text{S}/\text{cm}$ pre-mining to 748

μS/cm post-mining and maximum conductivity could increase from 960 μS/cm pre-mining to 1228 μS/cm post-mining.” (Final Determination p. 60)

“The factors that are most closely associated with supporting growth of *P. parvum* are believed to be:

- Proximity to a known source of *Prymnesium parvum*.
- TDS in high enough concentrations to support *P. parvum* (estimated to be between 500 and 1000 mg/L (conductivity 714-1428 μS/cm).
- Nutrients in concentrations high enough to initiate a bloom of *P. parvum* (Baker et al. 2009)
- pH greater than 6.5. Risk increases with increasing pH (Baker et al. 2009).
- Areas of habitat that are pooled (large beaver dams, natural residual pools, or manmade ponds)

EPA believes that the Spruce No. 1 Mine will increase the probability that all five factors are met within the Headwaters Spruce Fork sub-watershed, as outlined below.” (Final Determination p. 70)

*The EPA offers no citations to support these “factor[s]...closely associated with supporting growth of *P. parvum*.” The peer reviewed literature offers different “factors.” According to Roelke et al (2011), “Many factors likely contribute to *P. parvum* bloom formation. They include production of chemicals toxic to grazers (Grane’li and Johansson, 2003; Tillmann, 2003; Barreiro et al., 2005; Michaloudi et al., 2009; Brooks et al., 2010), use of alternative energy and nutrient sources through mixotrophy and saprophytic nourishment (Nygaard and Tobiesen, 1993; Skovgaard and Hansen, 2003; Lindehoff et al., 2009), suppression of competitors through allelopathy (Fistarol et al., 2003, 2005; Grane’li and Johansson, 2003; Roelke et al., 2007a; Errera et al., 2008) and resistance to the allelopathic effects of other algae (Suikkanen et al., 2004; Tillmann et al., 2007).”⁵³*

*Moreover, first “factor” is wrong. According to Hambright et al (2010⁵⁴), “*Prymnesium* may not be invasive at all, but simply has shifted from being a rare to a dominant member of the plankton following environmental changes (Countway et al., 2005).” As such, we don’t know if “proximity to source” is a “factor...closely associated with supporting growth of *P. parvum*,” because it might have always been present. These “factors” seem tailor made for surface coal mining.*

Impact on Fish Due to Increased Exposure to Selenium

“Several nearby streams in the Coal River sub-basin have available data that indicate that construction of the Spruce mine and associated discharges can result in impacts to wildlife. According to the WVDEP’s study, “Selenium Bioaccumulation among select stream and lake fishes in West Virginia” (WVDEP 2009), Seng Creek had the highest average water column concentration (27.20 ppb) and a corresponding average fish tissue concentration of 8.16 ppm, while Beech Creek had a water concentration of 12.30 ppb with a corresponding average fish tissue concentration of 7.55 ppm.” (Final Determination pp. 71-72)

The EPA has proposed a whole-body chronic exposure tissue criterion of 7.91 ug/g dry weight selenium. The average tissue concentration of 8.16 ug/g for fish from Seng Creek

only slightly exceeds this standard, while the average tissue concentration of 7.55 ug/g for fish from Beech Creek would meet the EPA's proposed standard. All of the tributaries that drain from the proposed project area have selenium concentrations are below 3 ug/L. Seng Creek, which contained the fish with tissue concentrations of selenium that slightly exceeded the EPA's proposed limit, has average selenium concentrations of 27 ug/L.

So, the EPA is trying to draw conclusions about the impact of Spruce No. 1 mine on the Spruce Fork watershed from a study on how fish from a stream with a significantly different water chemistry have tissue concentrations of selenium that slightly exceed the EPA's proposed standard. This is an unacceptable inference.

“In Seng Creek, creek chub egg/ovary tissue (mean = 19.9 ppm; range = 16.4 - 23.7 ppm; n= 4) and water measurements (mean = 15.8 ug/L; range = 8-45 ug/L; n = 11) indicate that both fish tissue and water numbers would exceed 5 ug/L and these levels have been documented to resulted in unacceptable tissue concentrations in the reproductive tissue. Similarly, water and fish tissue samples from Mud River also show unacceptable impacts to fish. Creek hub egg ovary (composite measurement of 17.6 in egg/ovary tissue) and water measurements (mean = 9.5 ug/L; range = 4-22 ug/L; n = 21) in Mud River show that selenium concentrations exceed 5 ug/L and has resulted in unacceptably high tissue concentrations in fish.” (Final Determination p. 72)

*The EPA attributes this data to the West Virginia Department of Environmental Protection (WVDEP) study, “Selenium Bioaccumulation among select stream and lake fishes in West Virginia” (WVDEP 2009), but this is incorrect. In fact, it is derived from a different WVDEP study, “Selenium-induced developmental deformities among fishes in West Virginia.” (WVDEP 2010). Not only does the EPA mis-cite this research, but it also misquotes it. The EPA states, “In Seng Creek, creek chub egg/ovary tissue (mean = 19.9 ppm; range = 16.4 - 23.7 ppm; n= 4) and water measurements (mean = 15.8 ug/L; range = 8-45 ug/L; n = 11) **indicate that both fish tissue and water numbers would exceed 5 ug/L** and these levels have been documented to resulted in unacceptable tissue concentrations in the reproductive tissue.” It is unclear what this means, because the part in bold makes no sense. Fish tissue concentrations of selenium are measured in the study by ‘parts per million,’ whereas water concentrations are measured in ‘parts per billion.’ In the quote above, the EPA claims that “Seng Creek...measurements indicate that both fish tissue and water numbers would exceed 5 ug/L [parts per billion].” This is sloppy.*

Importantly, that study notes that “these evaluations were not indicative of overall reproductive success or population sustainability, which must be determined via more detailed studies.” Of course, that is exactly what the EPA is doing here. As such, EPA has: (1) failed to cite the study correctly, (2) misquoted the results of the study, and (3) contradicted the study.

Impacts on Water-Dependent Birds Due to Changes in Water Chemistry

“The indirect effects on Louisiana Waterthrush populations are attributable to the loss of aquatic macroinvertebrate food sources and water quality impacts associated with construction of the Spruce No. 1. Mine. ... For example, lower breeding territory densities have occurred along

streams impacted by acid mine drainage more so than along circumneutral streams (Mulvihill 1999, 2008). The driver behind these lower densities is decreased food availability, as acid mine drainage has a similar effect on macroinvertebrate populations as alkaline drainage and salinity (Mulvihill 2008).” (Final Determination p. 72)

The purpose of the Mulvihill (2008^{xxxiii}) study “was to examine how stream acidification affects Louisiana waterthrush population and breeding biology.” The EPA, however, uses the study to draw conclusions about alkaline drainage with relatively high salinity from the Spruce No. 1 Mine. The EPA justifies this comparison by stating that “acid mine drainage has a similar effect on macroinvertebrate populations as alkaline drainage and salinity,” but it does no’t elaborate.

Such a blithe inference is scientifically untenable because of confounding variables. Mulvihill presents one. Although Mulvihill concluded that “Our results suggest that the effects of stream acidification on Louisiana waterthrush could be most directly linked to food shortages, especially of preferred prey,” the study also identified a potential confounding variable—“However, similar effects can occur through calcium shortages (Tilgar, Mand & Magi, 2002). Acid precipitation has been associated with reduced calcium availability in soils and decreased abundance and lower nutritional value of many invertebrate prey species at pH levels below c. 6.5 (Scheuhammer, 1991).”^{xxxiii}

In addition to impacts resulting from the loss of macroinvertebrate food sources, studies also indicate that the Louisiana Waterthrush will be adversely affected by increased exposure to selenium through prey consumption. Since Waterthrush diet is comprised of aquatic and terrestrial insects, as well as small fish and amphibians, where selenium levels are elevated in macroinvertebrate and salamander populations, Waterthrush will be exposed in a majority of their prey (Patnode et al. 2005). (Final Determination p. 73)

Patnode et. al. is not a peer reviewed study, and it investigated the effects of multiple pollutants on salamanders, not just selenium. The study doesn’t mention the Louisiana Waterthrush, much less claim that it “will be exposed [to selenium] in a majority of their prey,” although this is the determination that the EPA accords to the study. Thus, the article cited in no way says what the EPA claims it says.

Notes

¹ EPA Region 3, letter to U.S. Army Corps of Engineers announcing initiation of 404(c) process, October 16, 2009, http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/upload/2009_10_19_wetlands_spruce_1_Oct_16_2009_revie_w_letter.pdf.

² EPA Region 3, letter to U.S. Army Corps of Engineers asking for voluntary withdrawal of Clean Water Act permit, September 3, 2009, <http://www.globalwarming.org/wp-content/uploads/2011/02/september-3-letter.pdf>.

³ G.J. Pond et al, “Downstream effects of mountaintop coal mining: Comparing biological conditions using family- and genus-level macroinvertebrate bioassessment tools,” *Journal of the North American Benthological Society*, Vol. 27, No. 3 (2008), pp. 717-737.

⁴ EPA, *Final Determination of the U.S. Environmental Protection Agency Pursuant to § 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia*, January 13, 2011, p. 51, http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/upload/Spruce_No-1_Mine_Final_Determination_011311_signed.pdf.

⁵ EPA, *Final Determination*, p. 6.

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- ⁶ Friends of Coal, Comments Regarding the Spruce No 1 Mine Permit Revocations, June 2, 2010, <http://www.friendsofcoal.org/20100610251/latest-news/comments-regarding-the-spruce-mine-no-1-permit-revocations.html>.
- ⁷ “Tomblin Announces Coal Rally for Jan. 20,” *The State Journal*, January 14, 2011, <http://statejournal.com/story.cfm?func=viewstory&storyid=92668>
- ⁸ “Rockefeller Fights for West Virginia Surface Coal Mining Jobs.” Senator Jay Rockefeller press statement, January 13, 2011, <http://rockefeller.senate.gov/press/record.cfm?id=330328>.
- ⁹ “SENATOR MANCHIN: EPA’S UNPRECEDENTED AND IRRESPONSIBLE DECISION JEOPARDIZES OUR ECONOMIC RECOVERY AND JOBS,” Senator Joe Manchin press statement, January 13, 2011, <http://manchin.senate.gov/record.cfm?id=330323>.
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- ¹¹ “McKINLEY: “THE EPA HAS GONE TOO FAR – THIS WAR ON COAL MUST STOP,” Rep. David McKinley press statement, January 13, 2011, <http://mckinley.house.gov/press-release/mckinley-%E2%80%9C-epa-has-gone-too-far-%E2%80%93-war-coal-must-stop%E2%80%9D>.
- ¹² J.D. Charles, “Adkins: Spruce permit vital to area,” *The Logan Banner*, January 30, 2011, http://www.loganbanner.com/view/full_story/11163981/article-Adkins--Spruce-permit-vital-to-area?
- ¹³ Michael Browning, “Coalition for Coal,” *The Logan Banner*, January 27, 2011, http://www.loganbanner.com/view/full_story/11122500/article-Coalition-for-Coal?
- ¹⁴ William Yeatman, “Pests over People?” *The Washington Times*, May 24, 2011, <http://www.washingtontimes.com/news/2010/may/24/obamas-choice-pests-over-people/>.
- ¹⁵ EPA, *Final Determination*, p. 17.
- ¹⁶ EPA Science Advisory Board, Draft Panel Report, “Advisory on EPA’s Draft Report on Aquatic Ecosystem Effects of Mountaintop Mining and Valley Fills,” November 18, 2010, pp. 18-19, [http://yosemite.epa.gov/sab/sabproduct.nsf/c91996cd39a82f648525742400690127/24B50F8B609F610D852578070062D45B/\\$File/MTM-VF+Aquatic+Effects+letter-11-8-10+Quality+Review+draft.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/c91996cd39a82f648525742400690127/24B50F8B609F610D852578070062D45B/$File/MTM-VF+Aquatic+Effects+letter-11-8-10+Quality+Review+draft.pdf).
- ¹⁷ EPA, *Final Determination*, Appendix III, http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/upload/Appendix_3_Mitigation_011311.pdf.
- ¹⁸ U.S. Army Corps of Engineers Huntington District, Spruce No. 1 Mine Final Environmental Impact Statement, September 2006. Huntington, WV, 2006, 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.
- ¹⁹ *Ibid*, p. 1379.
- ²⁰ U.S. Army Corps of Engineers Huntington District, 2006, Spruce No. 1 Draft Environmental Impact Statement, pp. 3-156, http://www.lrh.usace.army.mil/_permits/Spruce%20No%201%20Mine%20Draft%20and%20Final%20EIS/Spruce%20Mine%20No%201%20Draft%20EIS%20-%20March%202006/Spruce%20No%201%20Mine%20Draft%20EIS/Chapter_6.pdf.
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- ²² EPA Science Advisory Board, Draft Panel Report, “Advisory on EPA’s Draft Report on Aquatic Ecosystem Effects of Mountaintop Mining and Valley Fills,” November 18, 2010, p. 21.
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- ²⁴ EPA, *Final Determination*, p. 17.
- ²⁵ EPA, *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. 11 Surface Mine, Logan County, West Virginia*, March 26 2010, p. 25, <http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/upload/spruceproptdeterm.pdf>.
- ²⁶ U.S. Army Corps of Engineers Huntington District, Spruce No. 1 Draft Environmental Impact Statement, March 2006. Huntington, WV, pp. 3-162.
- ²⁷ *Ibid*, pp. 3-158.
- ²⁸ EPA, *Final Determination*, Appendix 6, p. 128.
- ²⁹ EPA, *Final Determination*, p. 17.

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- ³⁰ U.S. Army Corps of Engineers Huntington District, 2006, Spruce No. 1 Draft Environmental Impact Statement, pp. 3-154.
- ³¹ Ibid., pp. 3-162.
- ³² R.S. Mulvihill et al, Effects of acidification on the breeding ecology of a streamdependent songbird, the Louisiana Waterthrush (*Seiurus motacilla*), *Freshwater Biology*, Vol. 53, No. 11 (2008), pp. 2158-2169.
- ³³ B. J. Mattsson & R.J. Cooper, "Louisiana Waterthrushes (*Seiurus motacilla*) and habitat assessments as costeffective indicators of instream biotic integrity," *Freshwater Biology*, Vol. 51, No. 10 (2006), pp. 1941-1958.
- ³⁴ U.S. Army Corps of Engineers Huntington District, Spruce No. 1 Draft Environmental Impact Statement, pp. 3-163.
- ³⁵ EPA, *Proposed Determination*, pp. 27-29.
- ³⁶ EPA, Final Determination, Appendix 6, p. 125.
- ³⁷ Surface Mining Control and Reclamation Act, 1977, "Statement of Purpose," Sec 102 (f).
- ³⁸ EPA, Final Determination, Appendix 6, p. 20.
- ³⁹ Preliminary Comments to "The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields," for July 20-22, 2010 meeting EPA Science Advisory Board, p. 32 (hard copy provided at meeting).
- ⁴⁰ EPA, Final Determination, Appendix 6, pp. 8-11.
- ⁴¹ Friends of Coal.
- ⁴² EPA, Final Determination, Appendix 6, p. 26.
- ⁴³ Ibid, pp. 23-24.
- ⁴⁴ A. DeBruyn et al, "Selenium toxicity to invertebrates: will proposed thresholds for toxicity to fish and birds also protect their prey?" *Environmental Science & Technology*, Vol. 41 (2007), pp. 1766-1770.
- ⁴⁵ T.C. Merricks et al, Coal mine hollow fill and settling pond influences on headwater streams in southern West Virginia, USA, *Environmental Monitoring and Assessment* 129 (2007), pp. 359-378.
- ⁴⁶ K.J. Hartman, M.D. Kaller, J.W. Howell & J.A. Sweka, "How much do valley fills influence headwater streams?" *Hydrobiologia*, Vol. 532 (2005), pp. 91-102.
- ⁴⁷ G. A. Gingerich, Quantifying changes in ecological function of headwater catchments following large-scale surface mining in southern West Virginia. M.S. Thesis, 2009, West Virginia University, Morgantown, WV.
- ⁴⁸ K.M. Fritz et al, "Structural and functional characteristics of natural and constructed channels draining a reclaimed mountaintop removal and valley fill coal mine," *Journal of the North American Benthological Society*, Vol. 29, No. 2, (2010) pp. 673-689.
- ⁴⁹ K. Patnode et al, Salamander assemblage survey of mercury and selenium contaminated headwater sites in the Appalachian Mountains of Pennsylvania, Virginia, and West Virginia. USFWS Region 5 Environmental Contaminants Program Final Report, 2005, p. 21.
- ⁵⁰ F. Fulk et al, Ecological assessment of streams in the coal mining region of West Virginia using data collected by the U.S. EPA and environmental consulting firms. National Exposure Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. Appendix in Mountaintop mining/valley fills in Appalachia, Final programmatic environmental impact statement, 2003, Environmental Protection Agency, Philadelphia.
- ⁵¹ EPA, Proposed Determination, p. 34.
- ⁵² EPA, , Appendix 6, p 120
- ⁵³ Roelke, D. L., et al, 2011, "A Decade of fish-killing *Prymnesium parvum* blooms in Texas: roles of inflow and salinite, *Journal of Plankton Research* 33(2), 243-253
- ⁵⁴ Hambright, K. D., et. al., 2010, Temporal and spatial variability of an invasive toxigenic protest in a North American subtropical reservoir, *Harmful Algae* 9, 568-577