APPENDIX 2
Impacts to Water Quality and Wildlife

SEP 24 2010

Abstract

Additional mining would be likely to degrade instream water chemistry and biology in the Coal River sub-basin. Many streams occurring in the Spruce Fork sub-watershed are already listed by West Virginia Department of Environmental Protection (WVDEP) as impaired. Results from existing mines show that additional mining would be likely to increase adverse impacts to water quality and wildlife, especially from salts (e.g. magnesium, bicarbonate, and sulfate) and selenium. It is notable that several stream reaches in and around the Spruce No. 1 site (e.g., Oldhouse Branch, Pigeonroost Branch, and White Oak Branch) are still judged to have high quality, based on biological and water quality monitoring results. Valley fills and mining impacting these streams will not only destroy some of the few remaining high quality streams in these watersheds, they will reduce the input of freshwater that is currently mitigating the impacts of mine effluent from elsewhere in the watershed to the Spruce Fork mainstem.

A2.1 Current Water Quality Impairments based on the 303(d) listings

Using the WVDEP 2008 West Virginia Impaired by Pollutant GIS data, percent and total stream impairments were calculated for the Coal River Sub-basin (HUC 8) and sub-watersheds (HUC 12) that comprise the sub-basin. These stream impairments represent segments that are on the 303(d) list, have a TMDL or need a TMDL, or are a Category 4(c) type and include all years for which data are available. In Table 1, approximately 33% of the streams in the Coal River Sub-basin are considered impaired. The percentage of streams that is impaired among sub-watersheds in the Coal River Sub-basin ranges from 21% to 45%. Specifically, in the Headwaters Spruce Fork sub-watershed, where Spruce No. 1 is located, approximately 34% of the stream miles are impaired.

The streams in the headwaters of the Spruce Fork sub-watershed are listed as impaired for biology, fecal, iron, and selenium (see Table 2). It should be noted that historically, WVDEP has not consistently listed waters as impaired for ionic toxicity, even though conductivity and associated salts are elevated in many streams (see further discussion below). Please note that some sections of stream are listed for more than one type of impairment. Furthermore, the 2008 West Virginia Integrated Water Quality Monitoring and Assessment Report lists the causes for the most recent 303(d) listings as mining or unknown and Category 4(c) as coal mining. For more details, see http://www.dep.wv.gov/WWE/WATERSHED/IR/Pages/default.aspx

Table 1. Impaired Waters in the Coal River Sub-basin (HUC 12 Scale)

Subwatershed Name	HUC_12	Impaired Miles	Stream Miles (NHD 1:24k)	Percent Impaired
Headwaters Clear Fork	050500090101	30.51	107.68	28.33
Outlet Clear Fork	050500090102	27.27	73.05	37.33
Stephens Lake	050500090201	25.19	63.17	39.88
Upper Marsh Fork	050500090202	61.61	186.41	33.05
Middle Marsh Fork	050500090203	41.31	116.53	35.45
Lower Marsh Fork	050500090204	29.60	87.59	33.79
Spruce Laurel Fork	050500090301	24.51	77.03	31.82
Headwaters Spruce Fork	***050500090302***	***39.55***	***116.19***	***34.04***
Outlet Spruce Fork	050500090303	47.61	92.53	51.45
Upper Pond Fork	050500090401	17.83	63.25	28.20
West Fork	050500090402	33.32	99.87	33.36
Middle Pond Fork	050500090403	19.39	57.30	33.84
Lower Pond Fork	050500090404	25.49	85.94	29.66
Big Horse Creek	050500090501	21.76	88.02	24.72
Upper Little Coal River	050500090502	53.99	173.17	31.18
Lower Little Coal River	050500090503	22.63	64.32	35.19
White Oak Creek	050500090601	13.00	52.54	24.75
Laurel Creek	050500090602	42.20	128.04	32.96
Joes Creek-Big Coal River	050500090603	46.18	133.71	34.54
Drawdy Creek-Big Coal River	050500090604	36.99	103.23	35.83
Brier Creek	050500090605	8.96	36.31	24.67
Fork Creek-Big Coal River	050500090606	18.90	88.84	21.28
Smith Creek-Coal River	050500090607	38.97	85.04	45.82
Browns Creek-Coal River	050500090608	16.44	52.51	31.30
Subbasin Name	**HUC_8**			
Coal	***05050009***	***743.21***	***2232.27***	***33.29***

Table 2. Impairment type for waters in the Coal River sub-basin (HUC 12 Scale)

		Impairments (miles of streams)*								
Subwatershed	**HUC12**	**Al**	**Bio**	**Fecal**	**Fe**	**LowFlow**	**Mn**	**pH**	**Se**	**Total**
Headwaters Clear Fork	050500090101		16.4	15.7	30.5					62.6
Outlet Clear Fork	050500090102	11.7	10.1	17.9	22.8			2.4	3.3	68.1
Stephens Lake	050500090201		10.2	9.2	23.9					43.3
Upper Marsh Fork	050500090202	1.1	20.6	47.1	44.0			1.1		113.8
Middle Marsh Fork	050500090203	2.7	5.7	24.8	34.7			2.7		70.6
Lower Marsh Fork	050500090204		1.8	11.3	29.6		4.9			47.7
Spruce Laurel Fork	050500090301		6.3		8.2	16.1				30.5
Headwaters Spruce Fork	**050500090302**		**5.3**	**14.6**	**39.5**				**6.7**	**66.2**
Outlet Spruce Fork	050500090303	2.7	5.9	44.9	28.4			2.7		84.5
Upper Pond Fork	050500090401		15.9	2.7	13.2					31.8
West Fork	050500090402	1.8	15.2	3.8	24.4	17.5			0.2	63.0
Middle Pond Fork	050500090403		5.5	11.9	18.6				6.7	42.6
Lower Pond Fork	050500090404			6.1	25.5					31.6
Big Horse Creek	050500090501		12.0	20.7	21.8					54.5
Upper Little Coal River	050500090502		29.1	49.0	5.7			2.2		86.0
Lower Little Coal River	050500090503		4.0	16.6	2.1					22.6
White Oak Creek	050500090601				13.0			1.8	11.2	26.0
Laurel Creek	050500090602	2.4	16.1	20.6	42.1			2.4		83.7
Joes Creek-Big Coal River	050500090603	5.0	5.6	29.6	26.7			5.0	5.6	77.6
Drawdy Creek-Big Coal River	050500090604		11.4	34.2	19.3					64.9
Brier Creek	050500090605		9.0	9.0						17.9
Fork Creek-Big Coal River	050500090606		0.0	11.5	7.4					18.9
Smith Creek-Coal River	050500090607		11.7	39.0						50.6
Browns Creek-Coal River	050500090608		5.7	16.4						22.2
Totals		27.4	223.4	456.5	481.3	33.6	4.9	20.3	33.7	1,281.1

**streams may have more than one impairment resulting in higher total calculations*

A2.2. TDS/Conductivity Data and Projections

2.2.1 Historical WVDEP data describing water quality in the vicinity of the proposed project area:

Table 3 lists average conductivity and sulfate values for selected WVDEP sampling sites on Spruce Fork, Pond Fork and the Little Coal River, including data for the streams located at the proposed project area. These data indicate that levels of conductivity on the mainstem of Spruce Fork, Pond Fork and the Little Coal River exceeded 500 µS/cm almost every time WVDEP sampled these sites in 1997, 2002-2003, 2005 and 2008. A recent study found that elevated conductivity greater than 500 µS/cm caused by alkaline mine effluents was strongly associated with high probability of impairment to native biota (Pond et al. 2008).

The US Army Corps of Engineers Huntington District (USACE) also reported conductivity values as part of the baseline water quality for Spruce Fork upstream and downstream of the proposed project area in the EIS for the proposed project (U.S. Army Corps of Engineers Huntington District 2006, DEIS Spruce No. 1 Mine). The DEIS reported that the minimum, average and maximum conductivity levels for Spruce Fork upstream of the propose project area were 112, 656 and 1130 µS/cm at that time, indicating that on average the conductivity in Spruce Fork was already elevated to > 500 µS/cm, and maximum conductivity levels exceeded twice that level.

Because mining has continued in these watersheds since sampling, the extent of mined areas and the related pollutant inputs have probably continued to increase. Therefore, these data, although somewhat dated, are likely representative of water quality in the unmined tributaries. However, they may underestimate levels of pollutants on the mainstems of Spruce Fork, Pond Fork and the Little Coal River, because more mining has occurred in other tributaries since these data were collected.

The data also indicate that conductivity and sulfate levels of the streams draining the proposed project area (i.e., Pigeonroost, Oldhouse Branch and White Oak Branch) represent good to excellent water quality, and that pollutant levels of the streams draining the nearby Dal-tex mine (i.e., Rockhouse Creek, Beech Creek, Left Fork Beech Creek, Trace Branch) represent severely degraded water quality. The proposed project will degrade the streams draining the project area, as well as contribute additional pollutants to Spruce Fork, causing unacceptable adverse impacts to water quality and wildlife habitat.

Table 3. Conductivity and sulfate values for selected sites on Spruce Fork, Pond Fork and the Little Coal River (WVDEP data 1997-2003).

Stream Name (mile point)	Period of Record	n Cond/ n Sulfate	Avg. Conductivity (µS/cm)	Avg. Sulfate (mg/l)
Tribs where WVDEP identified ionic toxicity as primary stressor				
James Branch (at mouth)	Jul-02-May-03	12/0	720	NA
Ellis Creek (at mouth)	Jul 02-May-03	12/11	1068	427
Rockhouse Creek (mile 0.8)	Jul-02-Jun-03	12/11	1012	407
Toney Fork (at mouth)	Jun-02-May-03	12/11	1050	466
Buffalo Fork (at mouth)	Jun-02-May-03	11/11	1226	580
Left Fork Beech Creek (at mouth)	Jul-02-Jun-03	12/11	2426	1019
Seng Creek (at mouth)	Jul-02-May-03	11/14	794	328
Average			**1185**	**538**
Tribs to Spruce Fork draining Spruce No. 1				
Seng Camp Creek (at mouth)	Jul-02-May-03	10/9	189	61
Pigeonroost Branch (mile 0.8)	Jul-02-May-03	12/6	199	99
Oldhouse Branch (at mouth)	Jul-02-May-03	11/11	90	28
White Oak Branch (mile 0.5)	Jul-00, Dec-00	2/2	118	24
Tribs to Spruce Fork draining nearby mined areas				
Rockhouse Creek (mile 0.8 – same site as above)	Jul-02-Jun-03	12/11	1012	407
Beech Creek (at mouth)	Jul-02-Jun-03	12/11	1432	557
Left Fork Beech Creek (at mouth – same site as above)	Jul-02-Jun-03	12/11	2426	1019
Trace Branch (at mouth)	Jul-02-May-03	11/6	971	569
Adkins Fork (at mouth)	Sep-97, Jul-02-May-03	13/11	834	148
Spruce Fork mainstem sites				
Spruce Fork (mile 0.3)	Sep-97, Jul-02-May-03	12/12	641	187
Spruce Fork (mile 0.5)	May-05	1/1	608	234
Spruce Fork (mile 4.6)	Sep-97, Jul-02-Jun-03	12/13	667	175
Spruce Fork (mile 6)	Jun-02	1/0	846	NA
Spruce Fork (mile 9.6)	May-08	1/1	665	164

Spruce Fork (mile 11.4)	Jul-02-Jun-03	12/12	685	196
Spruce Fork (mile 14.4)	Jul-02-Jun-03	12/11	815	260
Spruce Fork (mile 17.2)	Sep-97	1/1	883	170
Spruce Fork (mile 18.1)	Aug-02-May-03	11/10	503	121
Spruce Fork (mile 18.5)	Sep-97	1/1	913	170
Spruce Fork (mile 18.6)	Jul-02	1/1	824	168
Spruce Fork (mile 23.7)	Jul-02-May-03	12/11	393	117
Pond Fork mainstem sites				
Pond Fork (mile 0.3)	Jul-02-May-03	11/11	813	187
Pond Fork (mile 0.4)	Sep-97	1/0	1016	NA
Pond Fork (mile 4.9)	Sep-97	1/1	1028	260
Pond Fork (mile 6.3)	Jul-02-May-03	11/11	915	205
Pond Fork (mile 9.0)	Sep-97	1/1	1037	240
Pond Fork (mile 12.6)	Jul-02-May-03	11/0	827	NA
Pond Fork (mile 15.8)	Jul-02-May-03	12/11	858	220
Pond Fork (mile 21.6)	Jul-02-May-03	12/11	785	202
Pond Fork (mile 24.4)	Sep-97	1/1	1114	860
Pond Fork (mile 26.6)	Jul-02-May-03	12/11	816	256
Pond Fork (mile 32.3)	Jul-02-May-03	12/11	806	321
Little Coal mainstem sites				
Little Coal River (mile 0.2)	Jul-02-Apr-03	11/0	660	NA
Little Coal River (mile 3.6)	Sep-97	1/1	1030	280
Little Coal River (mile 4.7)	Jul-02-Apr-03	11/0	676	NA
Little Coal River (mile 10.2)	Jul-02-May-03	11/0	679	NA
Little Coal River (mile 16.5)	Jul-02-Apr-03	11/0	756	NA
Little Coal River (mile 17)	Sep-97	1/1	1111	280
Little Coal River (mile 17.2)	Aug-02	1/0	1165	NA
Little Coal River (mile 17.8)	Jul-02-Apr-03	11/0	685	NA
Little Coal River (mile 21.7)	Jul-02-Apr-03	12/0	725	NA
Little Coal River (mile 25.2)	Jul-02-Apr-03	11/0	767	NA

n Cond/n Sulfate: indicates the number of samples used to calculate the average values for conductivity and sulfate
NA - no WVDEP data available for that site
Seng Camp Branch is approx. at Spruce Fork RM 17.5
Pigeonroost Branch is approx. at Spruce Fork RM 20.8
Oldhouse Branch is approx. at Spruce Fork RM 21.5
White Oak Branch is approx. at Spruce Fork RM 24.6

A2.2.2 Predictions of conductivity changes in Spruce Fork due to proposed project

The USACE reported baseline surface water quality sampling results for several mining related water quality parameters, including conductivity and sulfate, on the main stem of Spruce Fork upstream and downstream of the project area, and in the tributaries on the proposed project area in the EIS for the proposed project (USACE 2006). Johnson et al. (2010, in press) described a model to predict conductivity downstream of the confluence of two tributaries using watershed area as a tributary weighting factor and conductivity data from the two tributaries and validated this model using conductivity data from mined watersheds in southern WV.

The weighted model incorporates watershed area and conductivity values from two confluent tributaries such that:

$$y_{ij} = d_i * x_i /(d_i + d_j) + d_j * x_j /(d_i + d_j)$$

Where: y = downstream water chemistry value, i and j = contributing tributaries, x_i = water chemistry measurement on tributary i, d_i = drainage area of tributary i, x_j = water chemistry measurement on tributary j, d_j = drainage area of tributary j.

This model was used to predict pre-mining average and maximum conductivity levels in Spruce Fork, downstream of the three tributaries on the project area, using measured average and maximum pre-mining conductivity values for Spruce Fork upstream of the project area, Oldhouse Branch, Pigeonroost Branch and Seng Camp Creek. These values were obtained from the project baseline water quality data provided in the EIS, with the exception of Oldhouse Branch (see Table 4). The pre-mining maximum conductivity value reported for Oldhouse Branch (649 μS/cm) in the EIS seemed high based on the premining values reported for Pigeonroost (318 μS/cm) and EPA and WVDEP historical data for Oldhouse Branch. In order to prevent over estimation of the post-mining conductivity level, we used a lesser value 159 μS/cm for the pre-mining maximum conductivity level in Oldhouse Branch. This value is the maximum value for conductivity at the mouth of Oldhouse of the 2002-2003 WVDEP data. The modeled pre-mining average and maximum conductivity levels in Spruce Fork, downstream of Seng Camp Creek, were compared to the actual measured average and maximum values at that location to determine how well the model predicted pre-mining conductivity. The relative percent difference (RPD) was calculated to quantify the difference between the measured and predicted average and maximum values. RPD is calculated as the absolute difference between the measured and predicted value divided by the average of the two values, multiplied by 100:

$$RPD = (ABS(X1 - X2))/((X1 + X2)/2))*100$$

Where ABS = absolute value, X1 is the measured value, and X2 is the predicted value.

Post-mining conductivity was predicted using the measured pre-mining value for Spruce

Fork, upstream of Oldhouse Branch, and then estimating likely post-mining conductivity values for the mined streams. We used 500 and 1000 μS/cm as post-mining average values and 1000 and 1500 μS/cm for post-mining maximum values for the filled tributaries as a conservative estimate of post-mining conductivity levels. These values are conservative and likely underestimate the post-mining conductivity values. For example, when compared to Left Fork Beech Creek, which is completely mined and filled, the average and maximum conductivity values are 2426 and 3000 μS/cm. In Beech Creek, which is partially mined and filled, the average and maximum conductivity values are 1432 and 1776 μS/cm (average and maximum values based on 2002-2003 WVDEP data).

We estimated watershed areas for the proposed project area for this model using GIS techniques. Watersheds were delineated using the 1:24,000 scale National Hydrography Dataset (NHD) flowline stream segments between stream confluences and elevation data depicted in a digital elevation model (DEM) for the National Elevation Dataset (NED), following established practices and mapped segment level watersheds through various hydrological modeling tools available in ArcGIS. The NHD segment-based tabular stream flow data were used to develop a network of the watershed's flow connectivity, to assign attributes to the watersheds based on the stream's NHD reach code, and to construct a watershed-based flow table to approximate the flow network between watersheds. These datasets allow for the analysis of many watershed network-based analyses, including identification of watersheds upstream or downstream from a given location. This information is packaged in an ArcGIS toolbox which was used to calculate the upstream contributing areas of the points of interest (Strager et al. 2009).

Johnson et al. (2010, in press) noted that model error for conductivity showed a general increase with increasing conductivity and error tended to be greater for mined confluences where conductivity values were greater than 1000 μS/cm. USEPA observed (Green et al. 2000) and hydrologic studies by the U.S. Geological Survey confirmed that valley-filled streams have higher flows when compared to unmined streams in West Virginia (Messinger and Paybins, 2003; Wiley et al., 2001). This increase in baseflow may introduce error in these post mining conductivity estimates since we assume the watershed areas (a surrogate for stream flows) remain constant pre and post mining. If flows increase post mining, the total loading of pollutants could also increase out of the mined watersheds, and the modeled downstream conductivity predictions may actually underestimate the true post mining conductivity levels. Accordingly, the model prediction is conservative.

The modeled and measured pre-mining average (555 μS/cm modeled, 570 μS/cm measured) and maximum (961 μS/cm modeled, 1080 μS/cm measured) conductivity values in Spruce Fork, downstream of Seng Camp Creek, were similar. The RPD for the average values was 2.7% and the RPD for the maximum values was 11.7%. The modeled values underestimated the measured values, and the RPD was larger for the maximum values compared to the average values.

Post-mining conductivity levels in Spruce Fork downstream of the project area were modeled using two post-mining average (500 and 1000 μS/cm) and maximum (1000 and 1500 μS/cm) conductivity values for Oldhouse Branch, Pigeonroost Branch and Seng Camp Creek post mining. Based on the in-stream conductivity levels in Left Fork Beech Creek and Beech Creek these values are conservative (see above). In every case, since the measured conductivity levels in Spruce Fork are already greater than 500 μS/cm pre-mining, the modeled post-mining conductivity values are also greater than 500 μS/cm (see Table 4 and Figure 1).

Construction of valley fills, sediment ponds, and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will likely further degrade the water quality of the mainstem of Spruce Fork. Even if the post-mining conductivity is managed to be 500 μS/cm in the three tributaries located on the project area, which is the scenario with lowest conductivity levels presented here, the conductivity levels in the mainstem of Spruce Fork downstream of the project area will increase from 555 μS/cm on average pre-mining to 615 μS/cm on average post-mining.

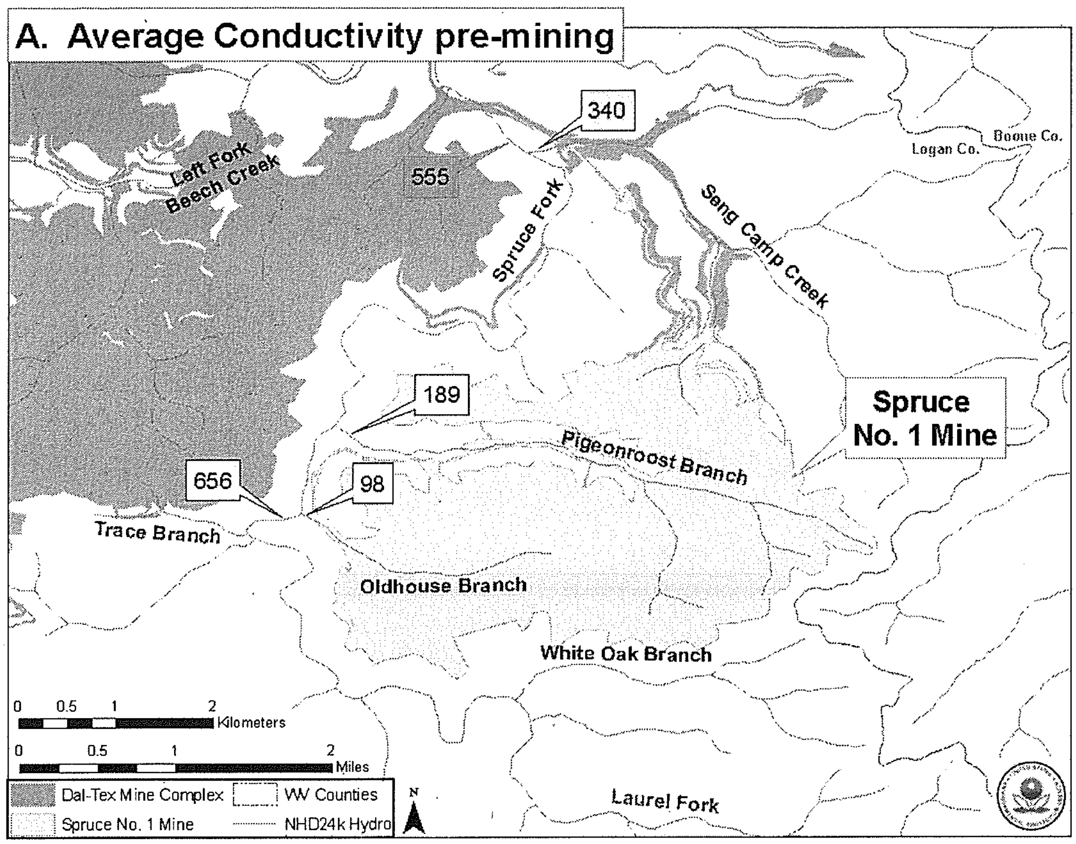
Table 4. Modeled conductivity downstream of proposed project area pre & post mining

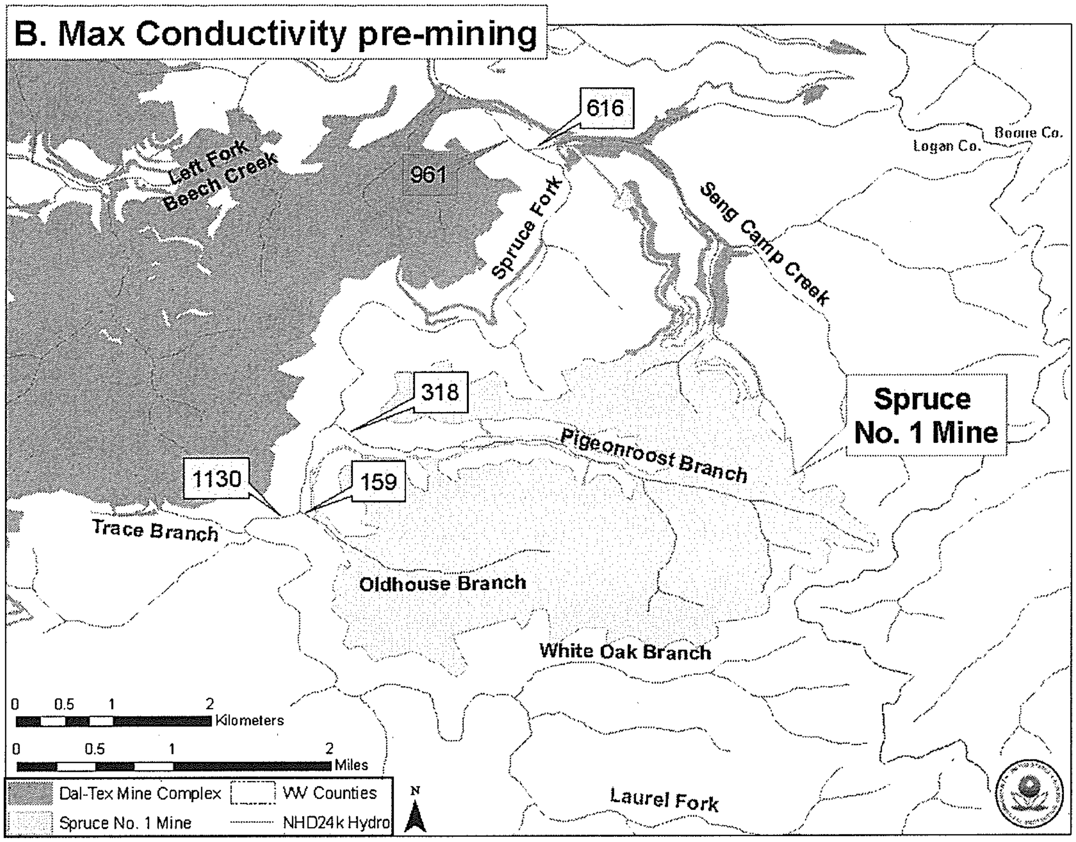
	Pre Mining	Pre Mining	Post Mining	Post mining
	Conductivity*	Conductivity*	Conductivity	Conductivity
	Modeled	Measured	Modeled	Modeled
	Avg μS/cm		Avg μS/cm	Avg μS/cm
Spruce Fork upstream of Oldhouse Branch	656		656	656
Oldhouse Branch	98		500	1000
Pigeonroost Branch	189		500	1000
Seng Camp Branch	340		500	1000
Spruce Fork downstream of Seng Camp Branch	555	570	615	745
	Max μS/cm		Max μS/cm	Max μS/cm
Spruce Fork upstream of Oldhouse Branch	1130		1130	1130
Oldhouse Branch	**159		1000	1500
Pigeonroost Branch	318		1000	1500
Seng Camp Branch	616		1000	1500
Spruce Fork downstream of Seng Camp Branch	961	1080	1096	1226

* Measured values taken from Spruce No. 1 EIS baseline water quality monitoring data.
** This maximum value was taken from 2002-2003 WVDEP data for Oldhouse Branch
Input value - measured except where noted**

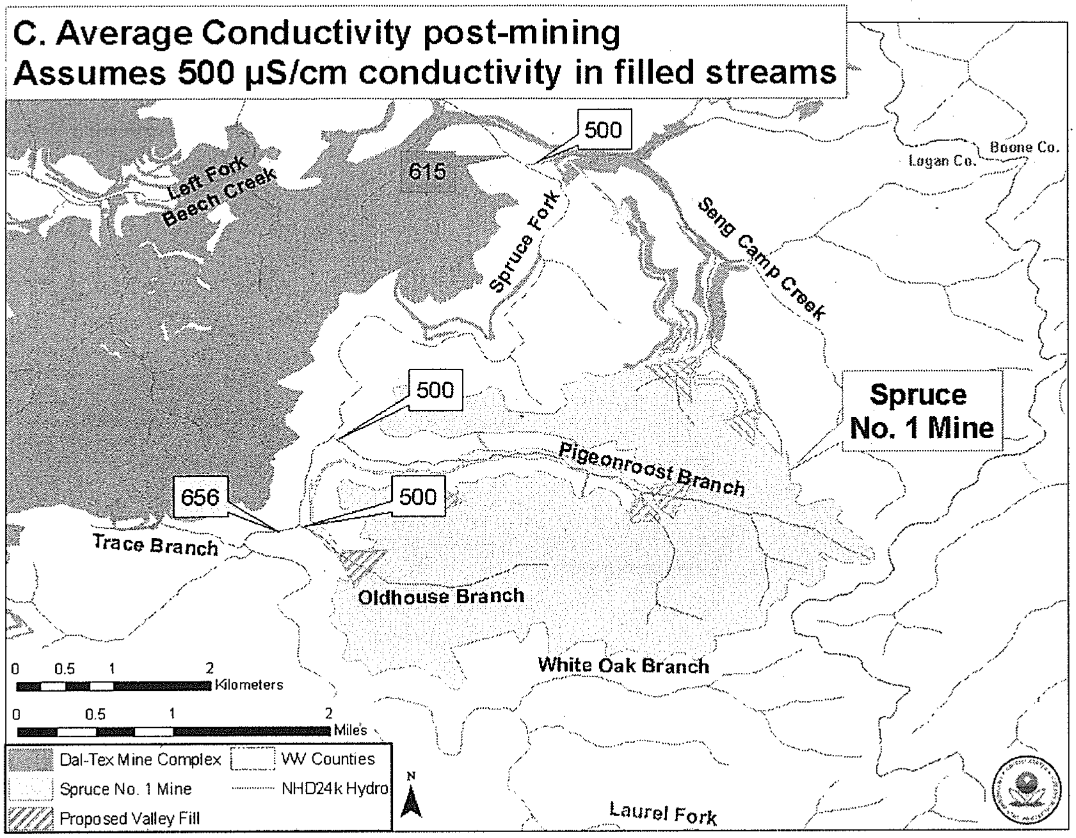
Input value - predicted post mining
Modeled value

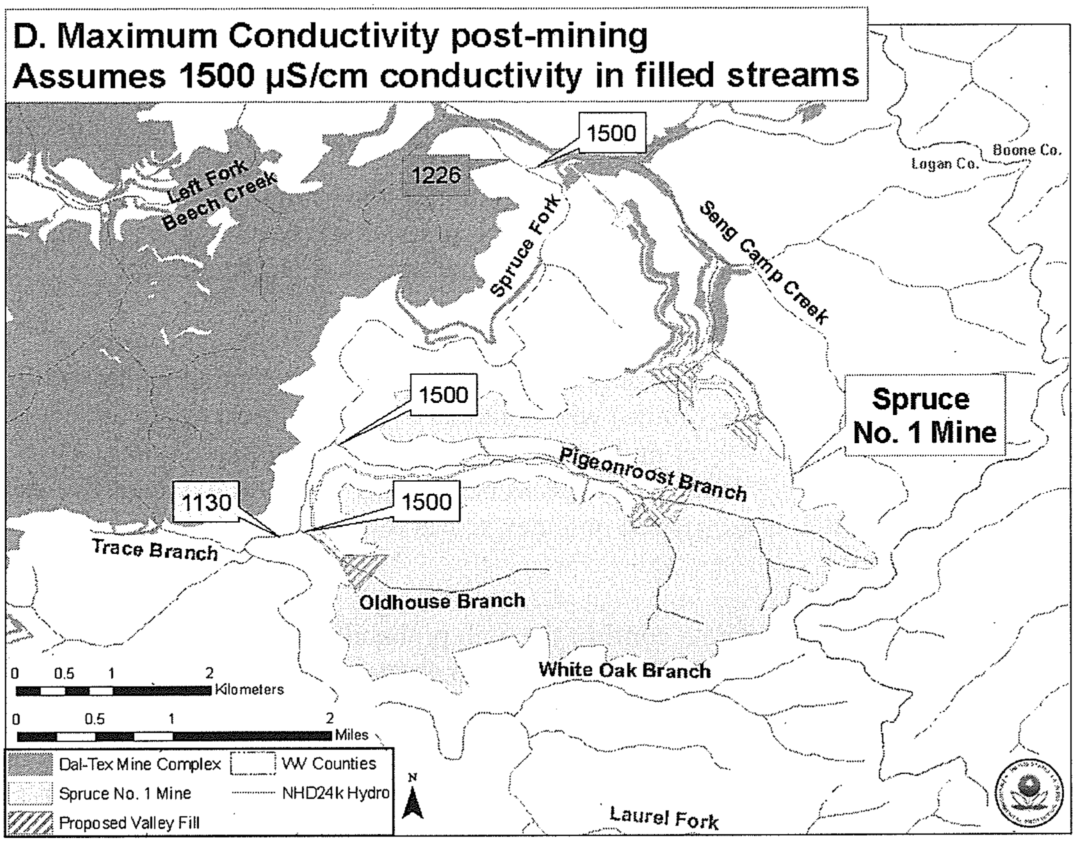
Figure 1. Maps indicating modeled average and maximum pre and post-mining conductivity in Spruce Fork, downstream of Seng Camp Creek. Blue values were measured values taken from the Spruce EIS. Green values were modeled values. Yellow values were inputs to the model to estimate post-mining conductivity in the tributaries. A. shows average conductivity pre-mining. B. shows maximum conductivity pre-mining. C. shows average conductivity post mining assuming 500 μS/cm average in the filled tributaries. D. shows maximum conductivity post mining assuming 1500 μS/cm maximum in the filled tributaries.





B. Max Conductivity pre-mining
616
961
1130
318
159
Left Fork Beech Creek
Spruce Fork
Seng Camp Creek
Logan Co.
Boone Co.
Spruce No. 1 Mine
Pigeonroost Branch
Trace Branch
Oldhouse Branch
White Oak Branch
Laurel Fork
0 0.5 1 2 Kilometers
0 0.5 1 2 Miles
Dal-Tex Mine Complex
Spruce No. 1 Mine
WV Counties
NHD24k Hydro
N


C. Average Conductivity post-mining
Assumes 500 µS/cm conductivity in filled streams
500
615
Left Fork Beech Creek
Spruce Fork
Seng Camp Creek
Logan Co.
Boone Co.
500
Spruce No. 1 Mine
Pigeonroost Branch
656
500
Trace Branch
Oldhouse Branch
White Oak Branch
Laurel Fork
0 0.5 1 2 Kilometers
0 0.5 1 2 Miles
Dal-Tex Mine Complex
WV Counties
Spruce No. 1 Mine
NHD24k Hydro
Proposed Valley Fill
N


D. Maximum Conductivity post-mining
Assumes 1500 µS/cm conductivity in filled streams
1500
1226
Left Fork
Beech Creek
Spruce Fork
Seng Camp Creek
Logan Co.
Boone Co.
1500
Spruce
No. 1 Mine
Pigeonroost Branch
1130
1500
Trace Branch
Oldhouse Branch
White Oak Branch
Laurel Fork
0 0.5 1 2 Kilometers
0 0.5 1 2 Miles
Dal-Tex Mine Complex
WV Counties
Spruce No. 1 Mine
NHD24k Hydro
Proposed Valley Fill
N

A2.3. Analyses Linking Impacts on Water Quality and Wildlife

A2.3.1 Conductivity
A2.3.1.1 WVDEP biological and conductivity data

Analyses of data from the WVDEP show degradation of the naturally occurring aquatic life would be likely when conductivity levels exceed 500 µS/cm even when accounting for the possible confounding effects of acidic pH and habitat degradation

A recent study found that conductivity levels greater than 500µS/cm were strongly associated with a high probability of degradation of native biota (Pond et al. 2008). In that study, 20 of 20 mined sites (100%) with conductivity levels greater than 500µS/cm were degraded using a genus-level multi-metric index, and 17 of those 20 sites (85%) scored below levels that WVDEP recognizes as below fully supporting aquatic life using the family-level WVSCI index ((based on index scores lower than the original 68 threshold).

WVDEP ambient monitoring data confirm the high probability of degradation of the aquatic life when conductivity levels are elevated to greater than 500µS/cm. WVDEP macroinvertebrate data from subecoregion 69d (the Cumberland Mountains of the Central Appalachians, the specific subecoregion where the Spruce No. 1 mine is located) were analyzed to determine the percentage of WVDEP sites that were degraded when the instream conductivity levels were greater than 500µS/cm. Two thresholds were used to indicate degradation to the macroinvertebrate assemblage. The first threshold was a WVSCI score less than 68, corresponding to the original statewide WVSCI threshold (Gerritsen et al. 2000), representing the 5th percentile of the scores at the 107 statewide reference sites that were available at that time. The second threshold was a WVSCI score < 72, which represents the 5th percentile of 51 reference sites that are located within subecoregion 69d.[1]

This analysis indicates that a large majority of the sites are degraded when conductivity levels are elevated to greater than 500µS/cm, even when accounting for the possible confounding effects of acidic pH and habitat degradation (see Table 5 and Figure 2). For example, only 54 sites out of 417 exceed a score of 72 when conductivity levels were greater than 500 µS/cm. The large majority of the sites (87%) scored below 72. One-hundred of 417 sites achieved scores of at least 68, and 76% of the sites were below 68. When the potential effect of habitat degradation was completely removed (subset includes only sites with RBP habitat scores greater than 140, indicating reference quality habitat), 79% of the sites scored below the 72 threshold and 62% of the sites scored below the 68 threshold.

The analysis of WVDEP data also confirms that there is a lower probability of adverse effect if conductivity levels are maintained at below 300 µS/cm. Table 6 indicates that

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[1] A more recent analysis by Region III indicates that the 5th percentile of 394 WVDEP statewide reference site WVSCI scores (through 2009) is also 72.

many fewer sites are degraded when conductivity levels are maintained below 300µS/cm, after accounting for possible confounding effects of acidic pH and habitat degradation. When the potential effect of habitat degradation was completely removed (subset includes only sites where RBP habitat scores were greater than 140, indicating reference quality habitat), only 26% of the sites scored below the 72 threshold and 15 % of the sites scored below the 68 threshold. The degradation at these sites is caused by a stressor other than conductivity or habitat.

Table 5. Percentage of WVDEP sites degraded when conductivity > 500 µS/cm. Table includes sites in subecoregion 69d with pH 6-9 in order to exclude effects of acidification.

Filters applied	% of sites degraded	# sites attaining use out of total number of sites in that category
>500 µS/cm and WVSCI < 72	87	54 out of 417 attain use
>500 µS/cm and WVSCI < 68	76	100 out of 417 attain use
Habitat Influence		
>500 µS/cm and RBP >140 and WVSCI < 72	79	27 out of 128 attain use
>500 µS/cm and RBP <120 and WVSCI < 72	92	9 out of 116 attain use
>500 µS/cm and RBP >140 and WVSCI < 68	62	49 out of 128 attain use
>500 µS/cm and RBP <120 and WVSCI < 68	89	13 out of 116 attain use

Table 6. Percentage of WVDEP sites degraded when conductivity < 300 µS/cm. Table includes sites in subecoregion 69d with pH 6-9 in order to exclude effects of acidification.

Filters applied	% of sites degraded	**# sites attaining use out of total number of sites in that category**
<300 µS/cm and WVSCI < 72	47	254 out of 475 attain
<300 µS/cm and WVSCI < 68	35	167 out of 475 attain
Habitat Influence		
<300 µS/cm and RBP >140 and WVSCI < 72	26	151 out of 204 attain
<300 µS/cm and RBP <120 and WVSCI < 72	77	22 out of 95 attain
<300 µS/cm and RBP >140 and WVSCI < 68	15	173 out of 204 attain
<300 µS/cm and RBP <120 and WVSCI < 68	77	22 out of 95 attain

The effect of elevated conductivity on the degradation of macroinvertebrates can also be summarized in a two-way table that partitions the effect of habitat (Table 7). When habitat is good at sites (RBP total score greater than 140, or reference quality habiat), 62% sites were degraded when conductivity levels were elevated to greater than 500 µS/cm compared to only 15% degraded when conductivity was below 300 µS/cm. When habitat is good, 47% more sites are degraded when conductivity levels increase to greater than 500 µS/cm. This indicates that water quality degradation and not habitat degradation is primarily causing or contributing to the degradation of macroinvertebrates at those sites.

Table 7. Effect of elevated conductivity on degradation of macroinvertebrates

	Poor habitat (RBP <120)	**Good habitat (RBP >140)**
<300 µS/cm and WVSCI < 68	73/95 (77%)	31/204 (15%)
>500 µS/cm and WVSCI < 68	103/116 (89%)	79/128 (62%)
Inference	When habitat is poor, 12% more sites are degraded when conductivity levels are elevated to >500.	When habitat is good, 47% more sites are degraded when conductivity levels are elevated to > 500.

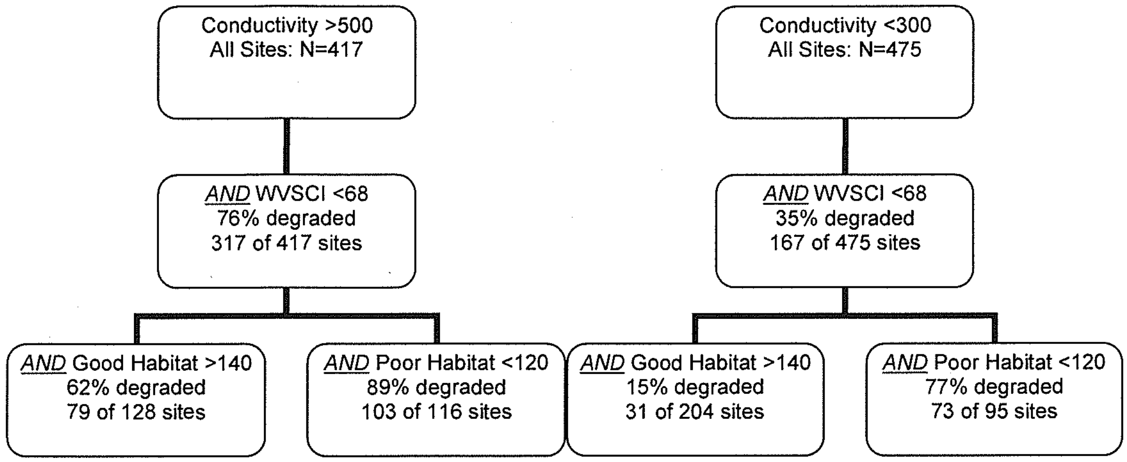

Figure 2. Flowchart indicating the percentage of WVDEP sites with degraded aquatic life (WVSCI index less than 68 only shown) when conductivity levels are greater than 500 µS/cm or less than 300 µS/cm., with good or poor habitat. When conductivity is less than 300 µS/cm, there is less degradation associated with good habitat and much higher degradation associated with poor habitat, suggesting habitat quality is causing or contributing to the degradation. However, when conductivity is greater than 500 µS/cm biological degradation is high regardless of habitat quality. There is only a slightly more degradation at sites with poor habitat compared to those sites with good habitat, suggesting water quality degradation is causing or contributing to biological degradation.

A2.3.1.2 EPA's Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams

EPA's draft report, *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams* (USEPA 2010a), also recognizes stream impacts associated with conductivity. This study is publicly available and is undergoing external peer review by the SAB, with final review expected by January 2011. It applies EPA's standard method for deriving water quality criteria to field measurements and concludes that extirpation of 5% of the macroinvertebrate community occurs at a conductivity levels of 300 µS/cm (USEPA 2010a). This analysis was based on WVDEP data and verified using Kentucky Department of Water data. This data analysis can be used to estimate the percentage of native genera that would likely be extirpated if conductivity levels were elevated to various levels (see Table 8). For example, if conductivity levels were elevated to 461 µS/cm, 15% of the native genera that would be expected could be extirpated. Water quality criteria are normally derived to protect 95% of species. Following this policy, the loss of native genera associated with conductivity levels > 500 µS/cm is significant and clearly represents degradation to aquatic wildlife.

Maximum conductivity levels already exceed 1000 µS/cm at several locations on the mainstem of Spruce Fork and we predict conductivity will exceed 1000 µS/cm in the mainstem of Spruce Fork downstream of the proposed project area if the project proceeds. This level of conductivity has the potential to extirpate or prevent colonization of ~30% of the native aquatic macroinvertebrate genera that would normally be part of the regional reference taxa pool, or approximately 44 genera. Most of these genera (33) are members of the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) orders, which are an important component of the aquatic wildlife that inhabit headwater streams in Appalachia. The proposed project will further contribute to elevated conductivity and other pollutants in Spruce Fork and will further degrade the aquatic community and wildlife habitat.

Table 8. Conductivity levels associated with % native invertebrate genera extirpation

% genera extirpated	Conductivity estimate (uS/cm)	95% confidence interval
2	224	137-253
5	297	225-305
10	335	295-400
15	461	375-521
20	601	474-670
30	912	750-1140

A2.3.1.3 EPA and WVDEP Stressor Identification Study in Clear Fork

EPA and most state agencies do not have numeric water quality criteria to protect aquatic life from excessive amounts of total dissolved solids or ion mixtures. A few states have numeric criteria for single component ions such as sulfate. WVDEP does not have any numeric water quality criteria for conductivity or the component ions in alkaline mine drainage, but WVDEP has developed guidelines for some water quality parameters for use in the TMDL stressor identification program. For example, in the Coal River TMDL WVDEP eliminated conductivity as a potential stressor if the maximum measurement in a waterbody was less than 300 µS/cm. In more recent TMDLs, WVDEP indicates that sulfate levels greater than 202 mg/l or conductivity levels greater than 767 µS/cm indicate that these parameters are likely stressors causing or contributing to biological degradation. The afore-mentioned USEPA studies (Pond et al. 2010, USEPA) and WVDEP's own ambient monitoring data indicate these levels may not be fully protective of aquatic life and wildlife habitat.

In 2006, WVDEP participated in a causal assessment of the Clear Fork watershed using the USEPA stressor identification process (USEPA 2010b). Clear Fork is a tributary to the Big Coal River and is located approximately 20 miles west of the Spruce No. 1 mine area, and in the same ecoregion. In this case study, the USEPA's Stressor Identification Guidance (USEPA 2000) was used to identify and rank stressors that impaired the aquatic community and stressor response threshold values were based on several statistical analyses of WVDEP statewide data. Stressor values below the reference site 95^{th} percentile (less than 185 µS/cm) were considered to estimate the range of the stressor with almost no adverse effect on biological response. Stressor values above the "plausible threshold" greater than 185 µS/cm) were not associated with the best biological conditions, indicating slight to moderate degradation. Stressor values greater than the "substantial effects threshold" (greater than 300 µS/cm) were almost always associated with substantial biological degradation, and these stressor levels were considered strong evidence of a candidate cause of biological impairment (see Table 9).

The "substantial effects threshold" (greater than 300 µS/cm) is close to the level of conductivity where EPA estimated 5% of the native taxa would be extirpated (297 µS/cm), even though the "substantial effects threshold" was derived with different endpoints and different statistical techniques. This finding provides weight of evidence that these conductivity thresholds are associated with biological degradation. These analyses represent EPA's most current and most thorough statistical analyses of stressor thresholds using the WVDEP dataset to date.

It is also important to note that WVDEP has not been consistent in applying their stressor thresholds to identify ionic toxicity as a stressor in impaired water bodies. WVDEP does not consistently identify all waters with elevated conductivity and sulfate as impaired for ionic toxicity in their stressor identification process even if levels of conductivity indicate that conductivity is a likely stressor causing or contributing to biological impairment. For example, for certain waters in the Coal River watershed (James Branch, Ellis Creek, Rockhouse Creek, Toney Fork, Buffalo Fork, Left Fork/Beech Creek, and Seng Creek), WVDEP concluded that ionic toxicity was a primary stressor (Rockhouse Creek and the Left Fork of Beech Creek drain the Mingo Logan Dal-Tex operation). Other waters in the vicinity of the proposed project had comparable elevated levels of conductivity and sulfate, but WVDEP did not identify ionic toxicity as a primary stressor. See Table 3 above for examples. .

The proposed project is likely to cause levels of conductivity and sulfate higher than these substantial effects thresholds in both the tributaries to Spruce Fork and in the mainstem of Spruce Fork and is therefore likely to cause further biological degradation in downstream waters.

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Table 9. Thresholds for evaluating stressor-response information in ecoregion 69 (Central Appalachia). Source USEPA 2010, Inferring Causes of Biological Impairment in the Clear Fork Watershed, WV.

Stressor	Reference Threshold	Plausible Threshold	Substantial Effects Threshold
Conductivity (µS/cm)	max < 180	> 180	> 300
Sulfate (mg/l)	max < 43	> 43	> 43

In summary, it is clear that the proposed project will elevate conductivity and other pollutants in Oldhouse Branch, Pigeonroost Branch, Seng Camp Branch and Spruce Fork to levels that will cause or contribute to the significant degradation of water quality and wildlife habitat.

A2.4 Trends in Water Quality

A2.4.1 Trends Since 2002: WVDEP EQUIS Trends stations on Spruce Fork and Pond Fork

WVDEP maintains some water quality trend data for several sites statewide on its online GIS web server (http://gisonline.wvdep.org/equis/equis.html). These data span the period of 2003 to 2008 and provide some limited information on trends. Unfortunately, these data do not represent the period prior to large-scale surface mining in the watersheds.

Two sites are located on Spruce Fork; one near the mouth of Spruce Fork (TS078) and one just upstream of Beech Creek (and hence upstream of most of the drainage from Dal-Tex Mine) near Sharples, WV (TS058). The upstream site on Spruce Fork (TS058) is downstream of the Spruce No.1 project area. Two other sites are located on Pond Fork, one near the mouth (TS079) and one farther upstream in Barrett, WV (TS057). Pond Fork and Spruce Fork join at Madison, WV to form the Little Coal River. The sites on Pond Fork are discussed to describe a broader context of water quality for the Little Coal River subwatershed.

The following figures (Figures 3-10) represent trends in conductivity using all the available data points and trends in flow-weighted annual means for conductivity. The conductivity measurements represent the concentrations that biota would be exposed to, and hence are the values that would be compared to any thresholds or aquatic life advisory levels. The flow-weighted annual means for conductivity are an attempt to factor in differences in flow from year to year at each site. A red line indicating a threshold of 500 μS/cm conductivity has been added to each graph for reference. EPA has found that conductivity values greater than 500 μS/cm are associated with a high probability of degradation of aquatic life.

Individual conductivity values are variable within individual years and over the period of record. Despite this seasonal variability, the data indicate increasing trends in both conductivity and flow-weighted conductivity at all four monitoring sites.

These data support the general trends seen in the WVDEP Watershed Assessment Program data. Levels are elevated in both Spruce Fork and in Pond Fork and the levels are higher in Pond Fork than in Spruce Fork.

At the downstream Spruce Fork site (TS078), 59% of the samples (40 of 68) had conductivity greater than 500 μS/cm over the period of record (Table 10). At the upstream Spruce Fork site (TS058), 38% of the samples (26 of 68) had conductivity greater than 500 μS/cm. These data support the finding that the water quality in the headwaters of Spruce Fork is of better quality and is providing a source of cleaner water to downstream reaches of Spruce Fork and farther downstream to the Little Coal River. At the downstream Spruce Fork site, the flow-weighted annual averages were greater than 500 μS/cm from 2004 to 2008. At the upstream Spruce Fork site, only one flow-weighted annual average was greater than 500 μS/cm (2007), but the trend is increasing.

At the downstream Pond Fork site (TS079), 86% of the samples (57 of 66) had a conductivity > 500 µS/cm over the period of record. At the upstream Pond Fork site (TS057), 85% of the samples (58 of 68) had conductivity > 500 µS/cm. At both the downstream and upstream Pond Fork sites, every flow-weighted annual average was > 500 µS/cm from 2003 to 2008.

Table 10. Conductivity Concentrations and Trends for the period 2003-2008

Stream	Location	Site #	% samples > 500 µS/cm	Trend in conductivity
Spruce Fork	near mouth	TS078	59	Increasing
Spruce Fork	upstream of Beech Creek	TS058	38	Increasing
Pond Fork	near mouth	TS079	86	Increasing
Pond Fork	in Barrett, WV	TS057	85	Increasing

Figure 3.

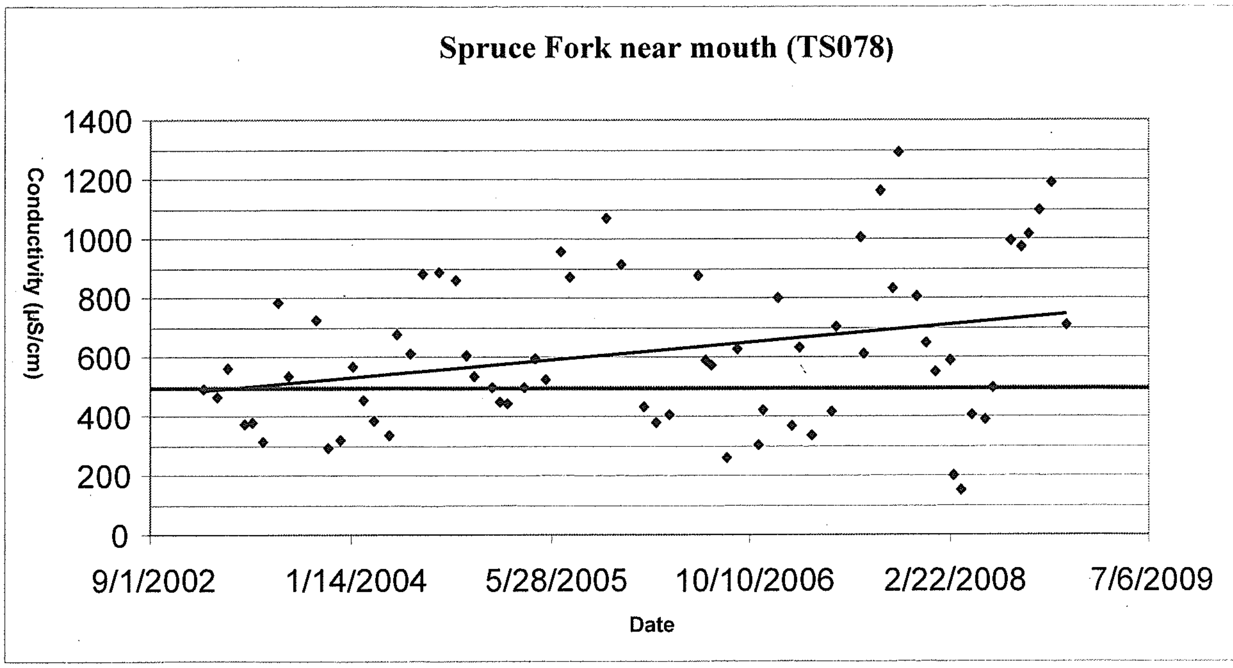


Figure 4.

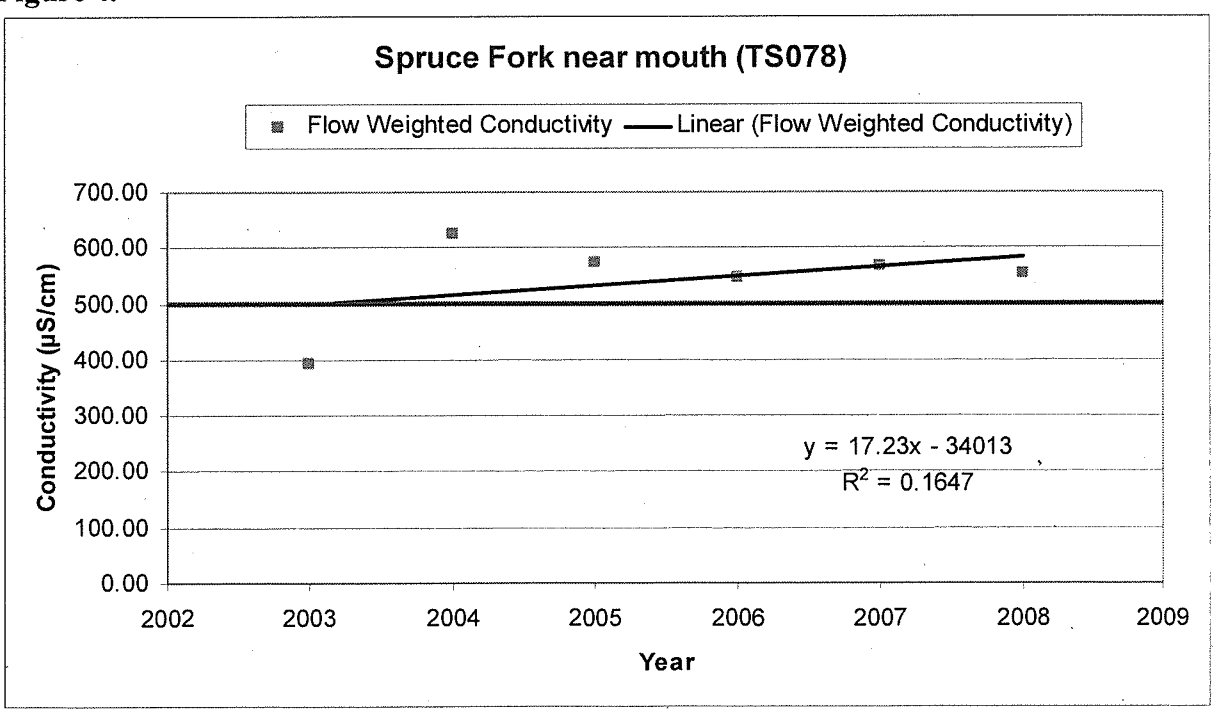


Figure 5.

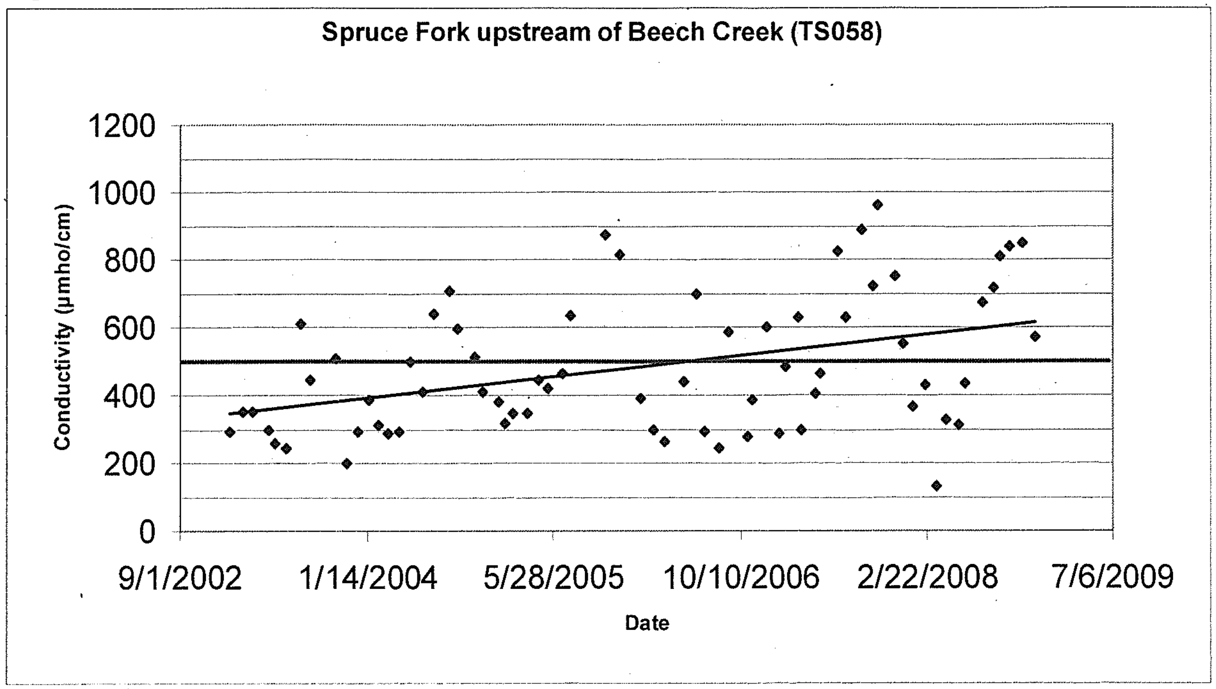


Figure 6.

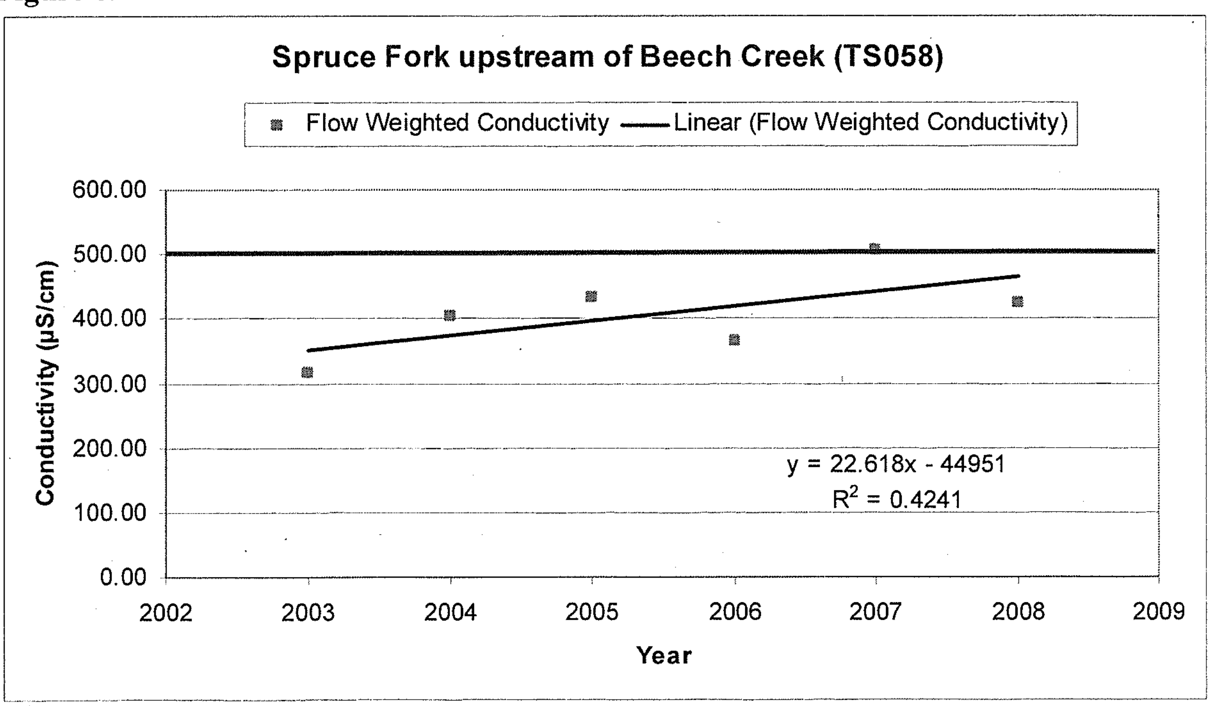


Figure 7.

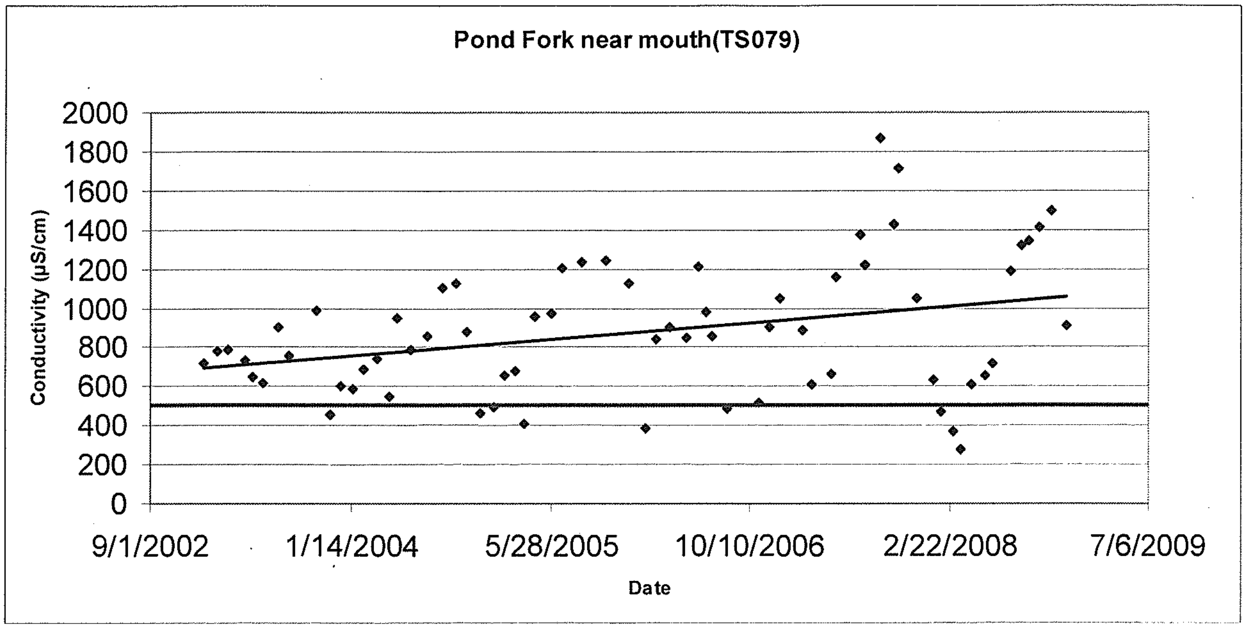


Figure 8.

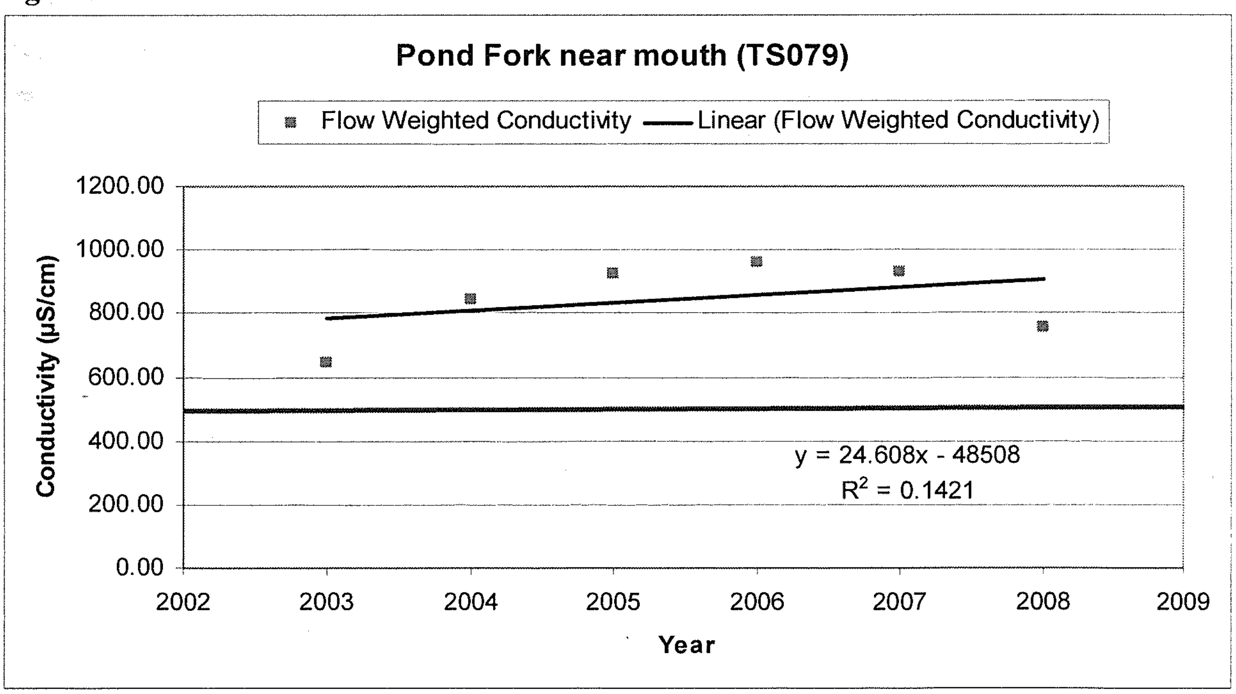


Figure 9.

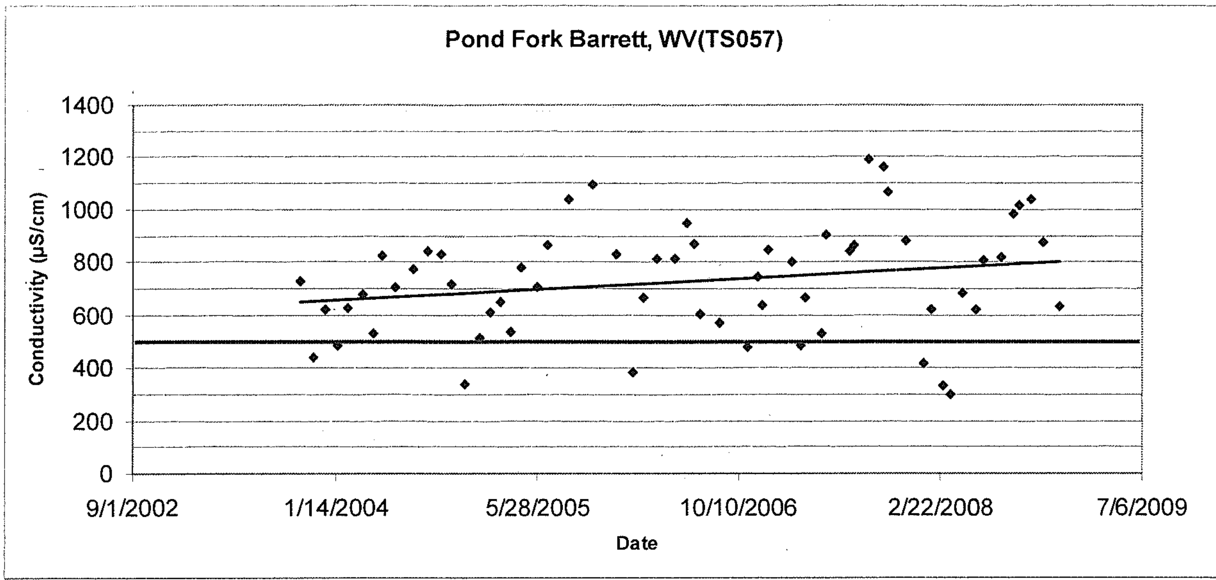
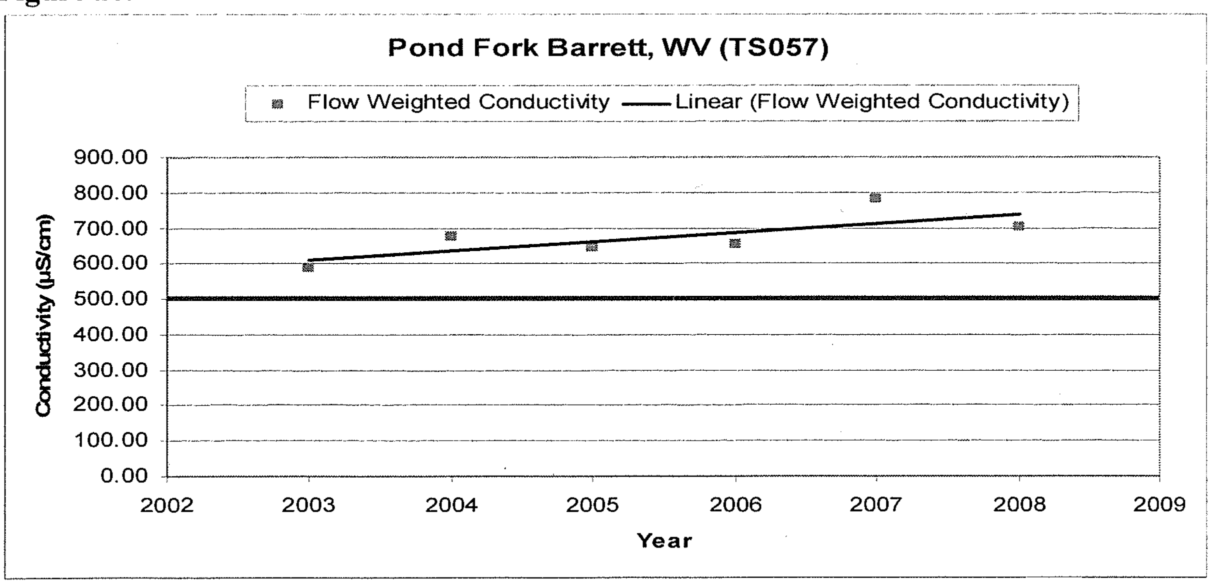


Figure 10.



A2.4.2 Longer Term Trends: WVDEP Ambient Monitoring Site on Coal River

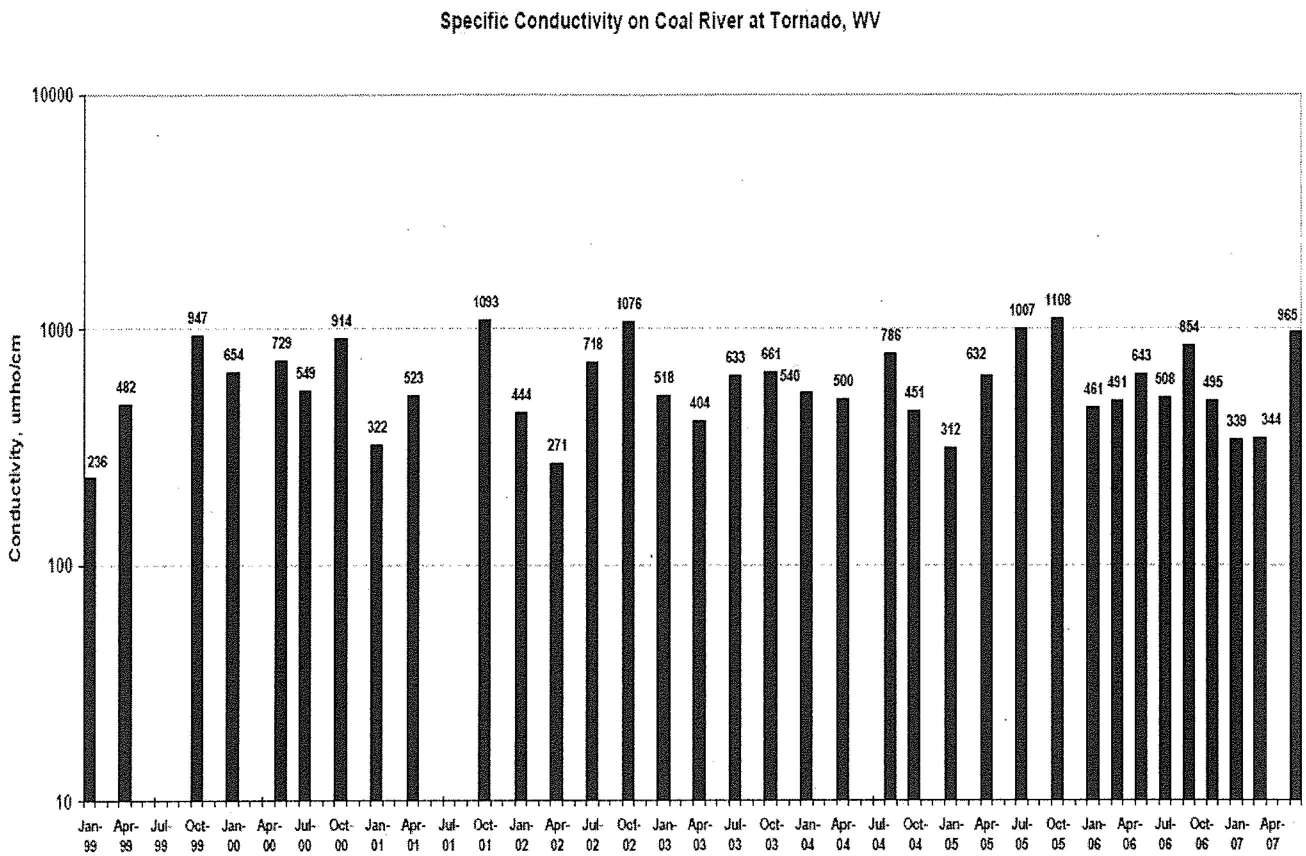
The WVDEP maintains a set of ambient monitoring sites around the state with a longer period of record in order to monitor water quality of West Virginia's streams over time. The Ambient Water Quality Network consists primarily of single sites on the main stem streams of 32 major watersheds, near the mouths of the watersheds. The sites in the network are visited every three months, usually in January, April, July, and October.

The site closest to the Spruce No.1 project area is located on the Coal River at Tornado, WV, approximately 31 miles north of the proposed project area. This is the closest long term trend site downstream of the proposed project area and has limited direct relevance to the headwaters of Spruce Fork, where the proposed project is located. This site does, however, reflect water quality changes in the entire Coal River basin. Graphs are available from the WVDEP website, but not the raw data. These graphs display data from 1999 to 2007. The following graphs were downloaded from the WVDEP website: http://www.wvdep.org/Item.cfm?ssid=11&SS1ID=713 .) (Figures 11-13).

The site on the Coal River was sampled 35 times between January 1999 and April 2007. The conductivity was > 500 μS/cm during 22 of the 35 sampling events (63% of the time). The conductivity follows a strong seasonal pattern with the highest values recorded during the low flow months (July and October). Sulfate concentrations follow a similar seasonal pattern. Sulfate concentrations were > 202 mg/l during 13 of the 37 monitoring events (35% of the time). There is no obvious trend in either conductivity or sulfate over the period of record available.

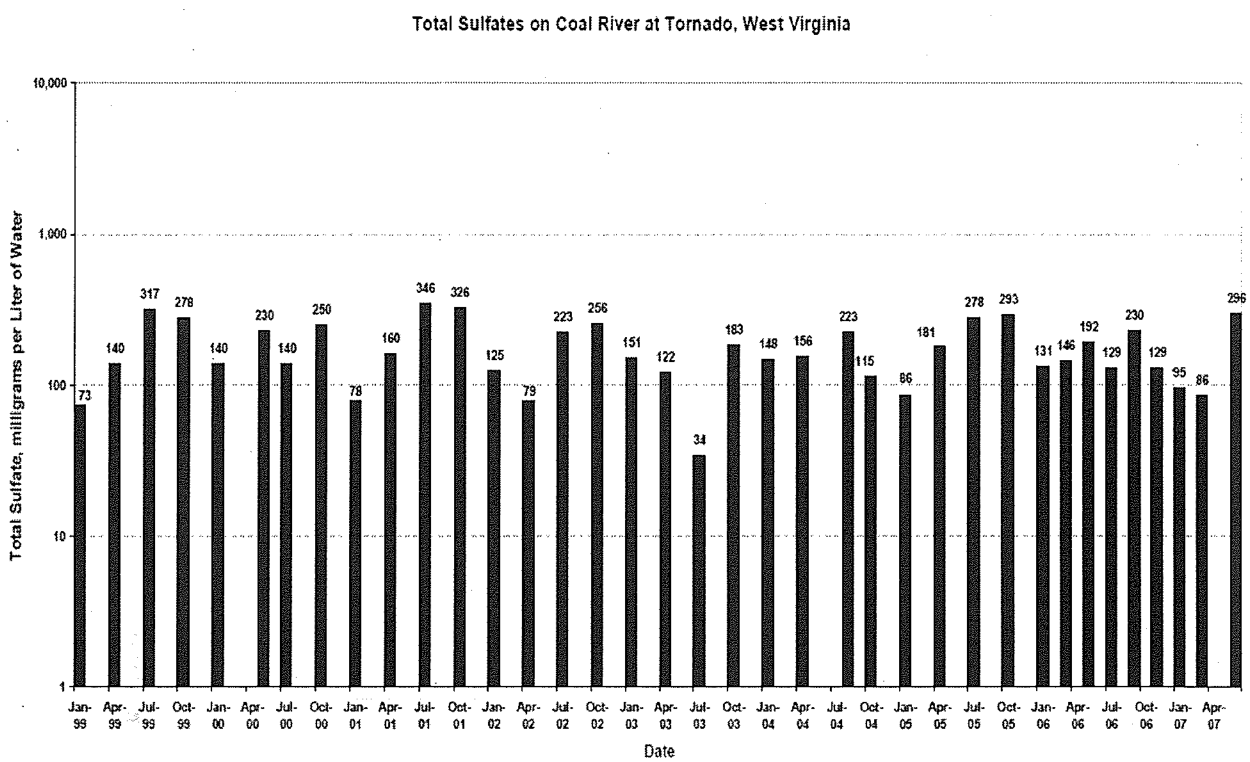
WVDEP has some trend data for selenium at the Coal River ambient water quality site. The detection limit for selenium has changed over time, so it is difficult to evaluate trends with this dataset. Selenium was detected during the last 10 sampling events (October 2005 to June 2007), but has never exceeded the 5 μg/l criterion. The highest value (4 μg/l) was observed during the most recent sampling event.

Figure 11.



Equipment not functioning or unavailable for readings on July 1999, and July 2001.

Figure 12.


Total Sulfates on Coal River at Tornado, West Virginia
Total Sulfate, milligrams per Liter of Water
Date
10,000
1,000
100
10
1
73
140
317
278
140
230
140
250
78
160
346
326
125
79
223
256
151
122
34
183
148
156
223
115
86
181
278
293
131
146
192
129
230
129
95
86
296
Jan-99
Apr-99
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
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Jul-01
Oct-01
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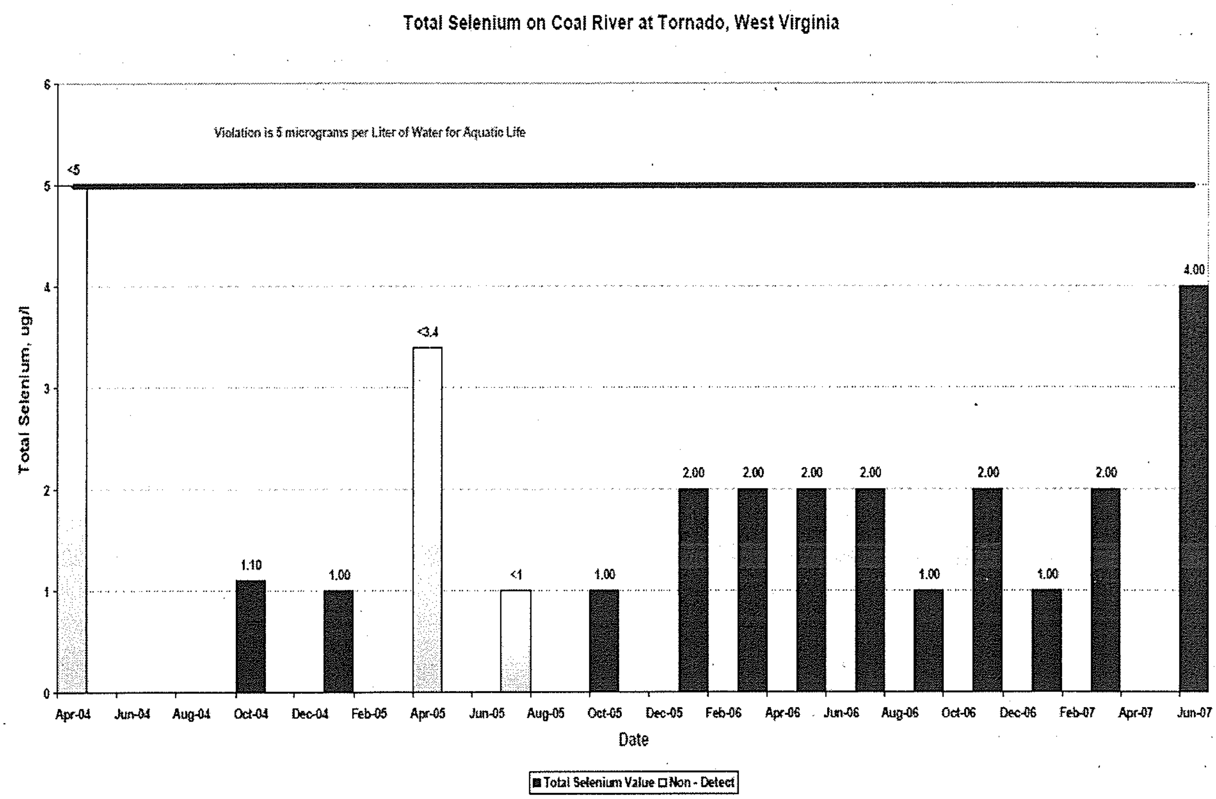
Jan-07
Apr-07

Figure 13.



Total Selenium on Coal River at Tornado, West Virginia
Violation is 5 micrograms per Liter of Water for Aquatic Life
Total Selenium, ug/l
0
1
2
3
4
5
6
<5
<3.4
<1
1.10
1.00
1.00
2.00
2.00
2.00
2.00
1.00
2.00
1.00
2.00
4.00
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06
Feb-07
Apr-07
Jun-07
Date
Total Selenium Value
Non - Detect

A2.5 Selenium

Construction of valley fills, sediment ponds, and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) would be likely to increase selenium loading to the immediate receiving streams and downstream waters. Surrounding mined streams and Spruce Fork already have elevated selenium concentrations exceeding the chronic water quality criterion of 5 μg/l (see Tables 11, 12, and 14). The sedimentation ponds used to treat drainage from mining operations are not effective in removing selenium from the discharge. The materials handling plan being implemented effect on the active portion of the Spruce No. 1 project has not prevented elevated selenium concentrations in the active discharges.

Selenium is a naturally occurring chemical element that is an essential micronutrient, but excessive amounts of selenium have toxic effects. For aquatic animals, the concentration range between essential and toxic is very narrow, being only a few micrograms per liter in water. Selenium toxicity is primarily manifested as reproductive impairment and birth defects due to maternal transfer, resulting in embryotoxicity and teratogenicity in egglaying vertebrates (e.g., fish and birds). The most sensitive toxicity endpoints in fish larvae are teratogenic deformities such as skeletal, craniofacial, and fin deformities, and various forms of edema. Embryo mortality and severe development abnormalities can result in impaired recruitment of individuals into populations (Chapman et al. 2010). The State of West Virginia has established a numeric chronic water quality criterion for selenium (5 μg/L) to protect instream aquatic life.

In West Virginia, coals that contain the highest selenium concentrations are found in a region of south central West Virginia where the Allegheny and Upper Kanawha Formations of the Middle Pennsylvanian are mined (WVGES 2002). WVDEP reports that some of the highest coal selenium concentrations are found in the central portion of the Coal River watershed where significant active mining and selenium impaired streams are located and in the immediate vicinity of the Spruce No. 1 project.

A WV draft study indicates that elevated selenium concentrations in fish eggs, increased larval deformity rates, and increased deformity rates in mature fish are occurring in the Mud River Reservoir, Boone County, WV due to mining activities (WVWRI 2010). These adverse conditions were all associated with elevated water column selenium concentrations (WVDEP, 2009, draft).

WVDEP and EPA have sampled selenium in streams in the vicinity of the Spruce No. 1 project. Table 11 provides a summary of selenium averages and ranges for streams draining the nearby Dal-Tex operation and for those draining the Spruce No. 1 project area. Left Fork Beech Creek, Beech Creek, and Trace Branch are in whole or in part impacted by the Dal-Tex Mine Complex which is located near the proposed Spruce No. 1 Mine Complex. Streams draining the nearby Dal-Tex operation have selenium concentrations exceeding the 5 μg/l selenium criterion.

The data from the Dal-Tex mine complex do not indicate any decrease in Se concentrations over the period of record (from 2000-2007, see Table 11). These data strongly suggest that since the coal seams mined at the Spruce No. 1 mine are similar to those mined at Dal-Tex, the authorized project would likely have similar impacts.

Table 11. Selenium Concentrations (ug/l) Near Spruce No. 1 Project Area

Stream Name	Subbasin	Source and time period of data					
		PEIS (2000-2001)		WVDEP (2002-2003)		WVDEP (2005-	
		Se (avg)	Se (range)	Se (avg)	Se (range)	Se (avg)	Se
Average and Range of Se in Tribs to Spruce Fork that drain Spruce No. 1 project area							
White Oak Branch	Spruce Fork	<3 ND		<5 ND		NS	
Oldhouse Branch	Spruce Fork	<3 ND		<5 ND		NS	
Pigeonroost Branch	Spruce Fork	<3 ND		<5 ND		NS	
Seng Camp Creek	Spruce Fork	NS		<5 ND		NS	
Average and Range of Se in Tribs to Spruce Fork draining Dal-Tex Operation							
Beech Creek[2]	Spruce Fork	7.5	5.6-9.5	6	5.0-9.0	12.3	
Left Fork of Beech Creek	Spruce Fork	22.7	15.3-31.1	22	5.0-53.0	NS	
Trace Branch	Spruce Fork	NS	NS	7	5.0-10.0	NS	
Rockhouse Branch	Spruce Fork	5.3	3.8-8.0	< 5 ND	< 5 ND	NS	

ND: Se not detected. Detection limit shown.
NS: Not sampled. Stream was not sampled for the study shown.

Beech Creek was sampled for selenium five times in 2000-2001 for the programmatic EIS on mountaintop mining. During this time period, selenium values ranged from 5.6 – 9.2 µg/L with an average of 7.5 µg/L. The 2002-2003 WVDEP sampling data (n=11) indicate that selenium in Beech Creek at the mouth ranged from less than 5 µg/L to 9 µg/L with an average of 6 µg/L and a median of less than 5 ug/l.

WVDEP sampled Beech Creek again for selenium between 2005 and 2007 as part of a research project to develop fish bioaccumulation factors for selenium (WVDEP 2009a). Water column selenium was monitored approximately monthly for a period of a year between November 2005 and April 2007. The average concentration in Beech Creek was 12.3 µg/L with a range of 6 µg/L to 22 µg/L(n=14).

These three datasets document that selenium water column concentrations are not decreasing over the period of record (1998-2006) within this adjacent mined watershed.

[2] In the WVDEP study on selenium bioconcentration factors, selenium was also found in fish tissue in Beech Creek (average 7.55 mg/kg).

In the WVDEP study on selenium bioconcentration factors, selenium was also found in fish tissue in Beech Creek (average 7.55 mg/kg).

Graphical trends of selenium concentrations from Division of Mining and Reclamation records for January 2007 to June 2010 from three outfalls from the Dal-Tex Mine outfall locations in Dal-tex and Spruce No. 1 Mine are shown in Figure 14. Operations are shown in Figure 15 through 17. The data indicate that the Dal-Tex Gut Fork Mine Outlet 012 (Figure 15) has been exceeding the WV water quality standard for selenium every month from August 2008 to June 2010 except for March 2009 and January 2010. This represents an 89% exceedance rate of the WV WQS for selenium for both the maximum and average endpoints. Prior to June 2008, the outfall exceeded the selenium WQS on 2 occasions (April 2007 and July 2007).

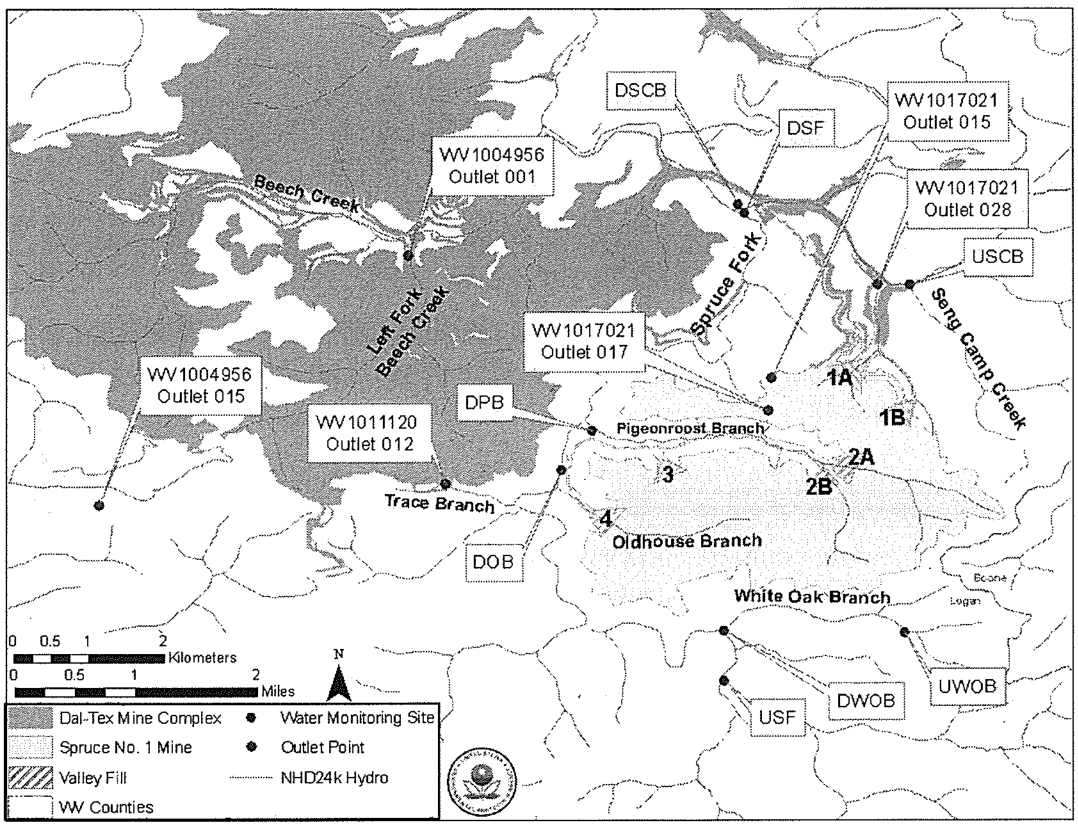


Figure 14: Outfall locations in Dal-tex and Spruce No. 1 Mine

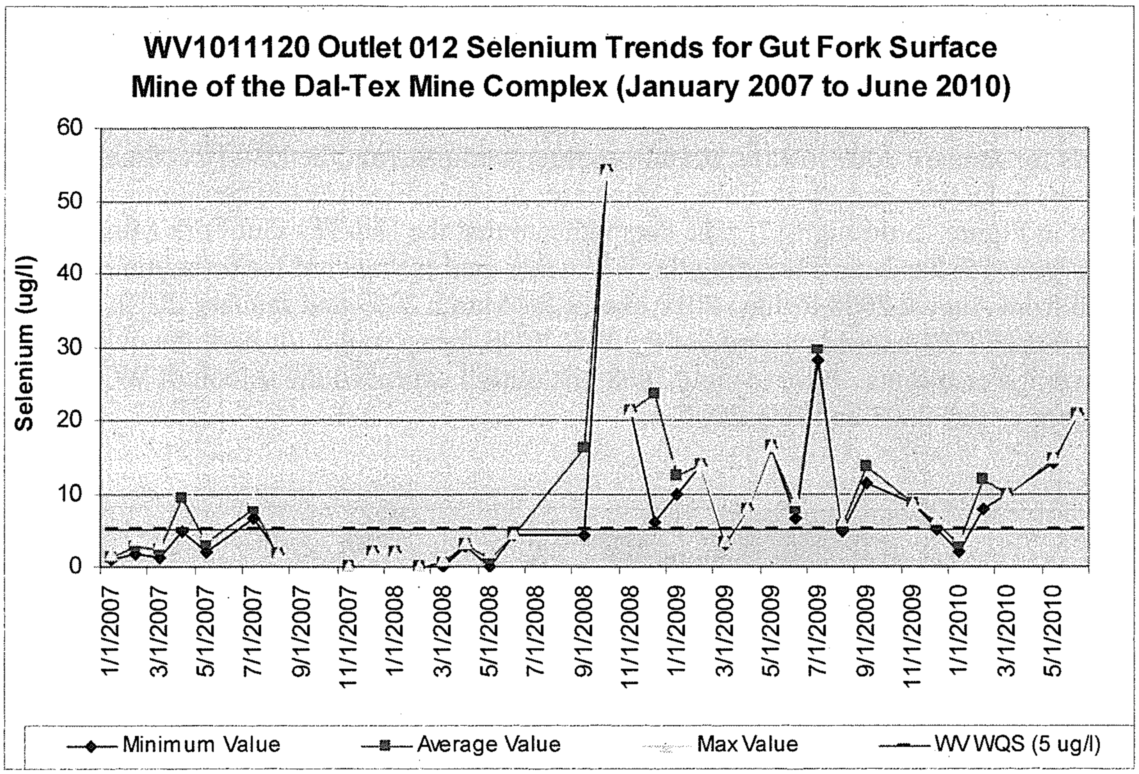


Figure 15. Selenium Trends from January 2007 to June 2010 for NPDES Permit WV1011120 – Outlet 012 (Mingo Logan Coal Company's Gut Fork Surface Mine of the Dal-Tex Mine Complex)

The data indicate that the Dal-Tex Left Fork No. 2 Mine Outlet 015 (Figure 16) has been exceeding the WV WQS for selenium every month from August 2008 to June 2010 for the maximum selenium endpoint and every month except for August and September 2009 for the average selenium endpoint. This represents a 100% and an 89% exceedance rate of the WV WQS for selenium for the maximum and average endpoints, respectively, between August 2008 to June 2010. Prior to June 2008, the outfall exceeded the selenium WQS only on 2 occasions (November 2007 and February 2008). The Division of Mining and Reclamation records indicate an upward trend since July/August 2008 of the water quality selenium values for this outlet. The trend indicates that water quality has deteriorated and exceeded the WV WQS for selenium since that time.

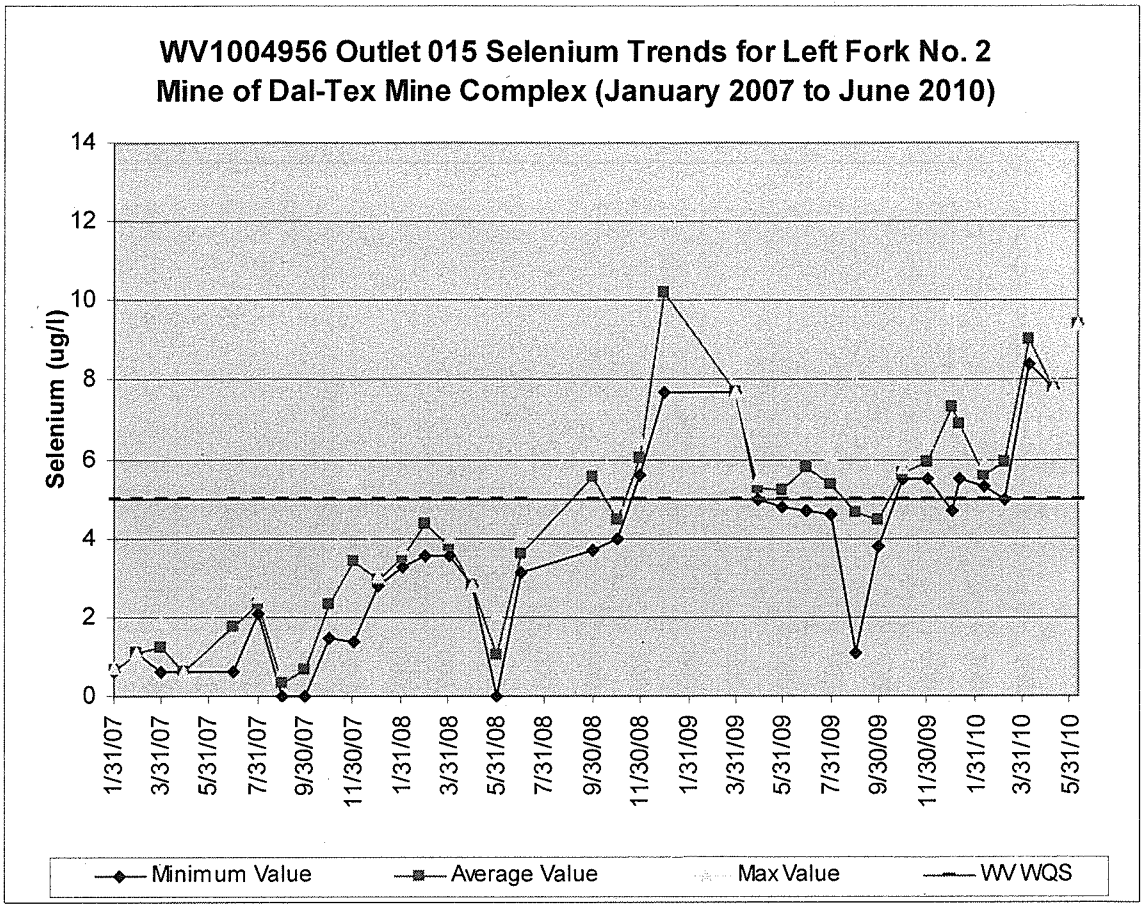


Figure 16. Selenium Trends (January 2007 to June 2010) for NPDES Permit WV1004956 – Outlet 015 (Mingo Logan Coal Company's Left Fork No. 2 Mine of the Dal-Tex Mine Complex)

The data indicate that the Dal-Tex Left Fork No. 2 Mine Outlet 001 (Figure 17) has been exceeding the WV WQS for selenium every monthly from August 2008 to June 2010 for the maximum and average selenium endpoints except for September 2009 and November 2009. This represents an 89% exceedance rate of the WV WQS for selenium for both the maximum and average endpoints for the August 2008 to June 2010 time period. Prior to June 2008, the outfall exceeded the selenium WQS (maximum and average value) on numerous monthly occasions with some values reaching 45 ug/L concentrations. The Division of Mining and Reclamation records indicate an upward trend since January 2007.

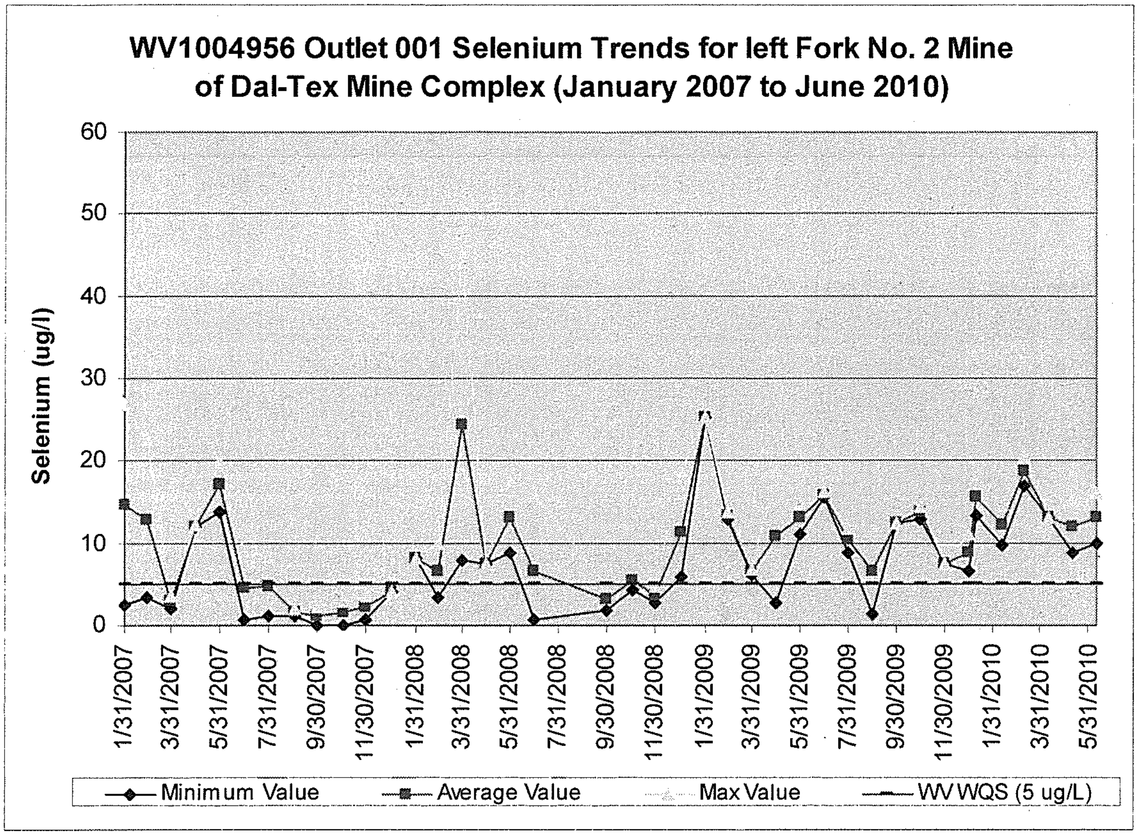


Figure 17. Selenium Trends (January 2007 to June 2010) for NPDES Permit WV1004956 – Outlet 001 (Mingo Logan Coal Company's Left Fork No. 2 Mine of the Dal-Tex Mine Complex)

Selenium concentrations in exceedance of the 5 μg/l Se criterion have been detected in several other mined streams throughout the Coal River Sub-basin (Table 12). For most of these streams, WVDEP data indicate only one (1) sample exceeding the selenium criterion. Selenium concentrations have exceeded the Se criterion at least three times in six (6) other mined streams in the Coal River Sub-basin. These streams are farther from the project area than those listed in Table 11 above. These include White Oak Creek (a tributary to the Coal River), the left Fork of White Oak Creek, Seng Creek (another tributary to the Coal River); and Casey Creek, James Creek, and Beaver Pond Branch, all tributaries to Pond Fork. These exceedances of the numeric water quality criterion for selenium demonstrate that the geology in the area of the Spruce No. 1 mine is likely to release selenium during mining activities.

Table 12. Other streams in the Coal River sub-basin where selenium concentrations have exceeded the 5 ug/l criterion. Data Source: WVDEP monitoring data from 2002-2003.

Stream Name	Next Higher Watershed	Avg of Values > 5ug/l	Range of Values > 5 ug/l
White Oak Branch	Spruce Laurel Fork	7	1 sample
Spruce Lick	Big Horse Creek	7	1 sample
Bragg Fork	Big Horse Creek	6	1 sample
Whites Trace Branch	Spruce Fork	10	1 sample
Robinson Creek	Pond Fork	15	1 sample
Bull Creek	Pond Fork	6	1 sample
West Fork/Pond Fork	Pond Fork	6	1 sample
James Creek	**West Fork/Pond Fork**	**8**	**6.0-11.0**
Casey Creek	**Pond Fork**	**6**	**6.0-6.0**
Beaver Pond Branch	**Pond Fork**	**10**	**7.0-22.0**
Jarrell Branch	Pond Fork	6	1 sample
Left Fork/Joes Creek	Joes Creek	6	1 sample
White Oak Creek (mile 3.9)	**Coal River**	**9**	**6.0-20.0**
Left Fork/White Oak Creek	**Coal River**	**9**	**6.0-20.0**
Little Elk Creek	Coal River	6	1 sample
Seng Creek (mile 3.9)	**Coal River**	**14**	**8.0-45.0**
Brushy Fork	Marsh Fork	6	1 sample
Sandlick Creek	Marsh Fork	10	1 sample
Right Fork/Sandlick Creek	Sandlick Creek	10	10.0-10.0
Harper Branch	Sandlick Creek	10	1 sample
Dingess Branch	Marsh Fork	10	1 sample
Clear Fork	Coal River	6	1 sample
Rockhouse Creek	Clear Fork	7	6.0-8.0
Toney Fork	Clear Fork	10	1 sample
Buffalo Fork/Toney Fork	Clear Fork	8	6.0-10.0
Streams in Bold text are those streams where WVDEP has confirmed exceedances with more than two samples.			

The Spruce No. 1 project has active mining in the Right Fork of the Seng Camp Creek sub-watershed. Mingo-Logan indicated that their mining activities on the proposed project would not result in exceedances of the selenium criterion. However, there is evidence that the active mining has already resulted in elevated selenium in the few discharge outfalls.

The NPDES permit issued for the Spruce No. 1 project imposes effluent limitations for selenium in only three (3) of 28 outfalls and requires only monitoring (no limitations) for selenium at the remaining outfalls. Outfall locations in Dal-tex and Spruce No. 1 Mine are shown in Figure 14 above. Recent NPDES discharge monitoring reports (DMR) for a 16 month period (December 2008 to March 2010 – Figure 18) show that the constructed portion of the Spruce No. 1 project (Outfall 028) is discharging selenium at concentrations that exceed West Virginia's numeric water quality standard (Table 13). Please note that the July 2009 DMR was not provided for review. A technical review of the submitted 16 monthly DMR records for the Spruce No. 1 Outfall 028 (December 2008 to March 2010) document the maximum values exceeded the selenium water quality criteria of 5 µg/L on six occasions (December 2008, January 2009, August 2009, September 2009, February 2010, and March 2010) representing a 37.5% exceedance rate. In addition, the average monthly measurements during this same time frame (December 2008 to March 2010) for Outfall 028 exceeded the water quality criterion on 4 of the 16 monthly DMR reports (December 2008, January 2009, September 2009, and March 2010) representing a 25% exceedance rate of the WV WQC for selenium. Selenium concentrations in excess of the criterion were also reported from outfall 017.

Table 13. Total Recoverable Selenium (µg/L) for Outfalls 015, 017 and 028 for NPDES Permit WV1017021, Mingo Logan Coal Company Spruce No. 1 Mine. Note: Shaded areas indicate exceedances of the selenium standard (5 µg/L).

Site Code	Site Location	Sample Date	Min Value	Ave. value	Max value
015	Outlet 015	12/31/2008	0.00	0.00	0.00
017	Outlet 017	12/31/2008	0.00	0.00	0.00
017	Outlet 017	9/30/2009	19.20	19.20	19.20
028	Outlet 028	12/31/2008	5.70	5.70	5.70
028	Outlet 028	1/31/2009	9.80	9.80	9.80
028	Outlet 028	2/28/2009	3.90	3.90	3.90
028	Outlet 028	3/31/2009	0.60	1.00	1.40
028	Outlet 028	4/30/2009	1.70	1.70	1.70
028	Outlet 028	5/31/2009	2.50	2.50	2.50
028	Outlet 028	6/30/2009	3.20	3.30	3.40
028	Outlet 028	8/31/2009	1.25	3.48	5.70
028	Outlet 028	9/30/2009	4.60	6.05	7.50
028	Outlet 028	10/31/2009	3.00	3.00	3.00
028	Outlet 028	11/30/2009	1.40	1.85	2.30
028	Outlet 028	12/31/2009	1.80	1.85	1.90
028	Outlet 028	1/31/2010	3.40	3.80	4.20
028	Outlet 028	2/28/2010	3.80	4.50	5.20
028	Outlet 028	3/31/2010	4.70	6.10	7.50

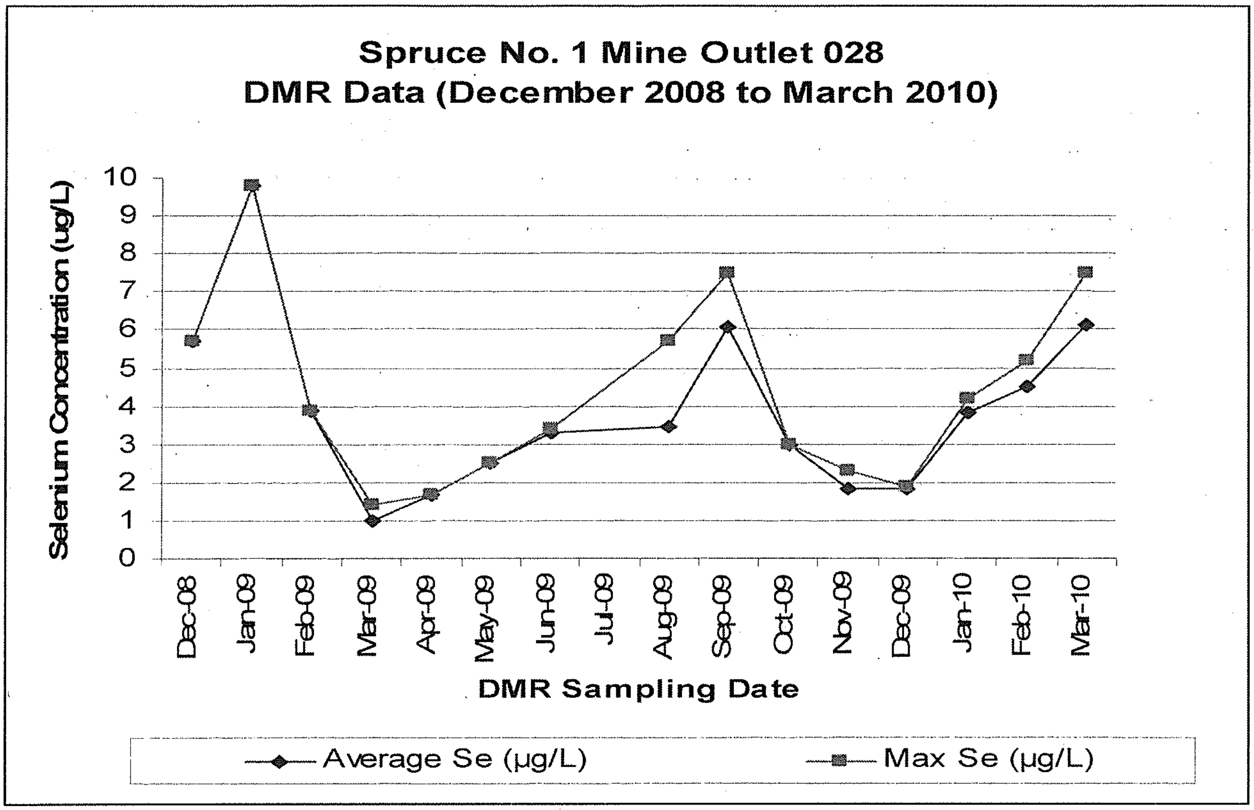


Figure 18. Selenium concentrations in discharge from outlet 028 on Spruce No. 1 Mine on Seng Camp Creek

The USEPA also evaluated the instream DMR monitoring data from December 2008 to March 2010 from several ambient monitoring stations associated with the proposed Spruce No. 1 mine project: Stations DSCB (Downstream Seng Camp Creek, located at the mouth of Seng Camp Creek), USCB (Upstream Seng Camp Creek), USF (Upstream Spruce Fork) DSF (Downstream Spruce Fork), DPB (downstream Pigeonroost Branch) and DOB (Downstream Oldhouse Branch). Locations for Dal-tex and Spruce No. 1 Mine are shown in Figure 14 above. Selenium concentrations at Station DSCB during this 16 month period did not violate the selenium numeric water quality criterion (5 µg/L); however, the values ranged from <0.60 to 2.5 µg/L with 12 of the 15 values being greater than the detection limit of 0.6 µg/L. The summarized data for the upstream monitoring station USCB (Upstream Seng Camp Creek) for the same time period, documented that 13 of the 15 samples were below or at the detection limit of 0.6 µg/L and that the two DMR records that were above the detection limit were 0.70 and 0.80 µg/L. This documents that the current mining activity on the Spruce No. 1 mine in the Seng Camp Creek watershed is contributing selenium into the receiving streams.

The upstream in-stream monitoring station on Spruce Fork (USF) had maximum selenium values that exceeded the water quality criterion (5 µg/L) on 8 of the 16 months (50% exceedance rate). The downstream in-stream monitoring station on Spruce Fork

(DSF) had maximum selenium values that did not exceed the selenium water quality criterion (5 µg/L). During the same December 2008 to March 2010 time frame, when Outfall 028 was discharging, the DMR reports indicate 15 of the 16 selenium measurements at both Pigeonroost Branch and Oldhouse Branch were below the detection limit of 0.6 µg/L. The single detection of selenium on Oldhouse Branch was 0.9 µg/L during July 2009. The single detection of selenium on Pigeonroost Branch was 1.9 µg/L during August 2009.

The Spruce Fork watershed upstream of Pigeonroost Branch and Oldhouse Branch has selenium concentrations elevated above the water quality standard based on the instream DMR data (Table 14). The downstream Spruce Fork (DSF) site does not have selenium concentrations above the water quality standard. This suggests that Pigeonroost Branch and Oldhouse Branch provide clean dilution water to the mainstem of Spruce Fork (Table 15). The proposed valley fills for Pigeonroost Branch and Oldhouse Branch will eliminate the freshwater dilution contributions from both of these tributaries. Based on the current during- and post-mining water quality conditions observed in Seng Camp Creek downstream of the Spruce Fork No. 1 project, selenium values will likely also increase at both outlet points on Oldhouse and Pigeonroost Branch during and post-mining. The increased selenium concentrations combined with the elimination of the dilution from these two tributaries will likely cause the selenium concentrations in Spruce Fork to increase.

Mingo-Logan has commented that"the first location where USEPA has noted the presence of a significant fish population – Spruce Fork – the contributions of selenium from operations in Seng Camp Creek are negligible. The data above, however, indicate that Outlet 028 is contributing selenium to the stream at values greater than the water quality criterion and this selenium is contributing to the existing selenium loading in Spruce Fork and that the additional valley fills proposed for Pigeonroost and Oldhouse would be likely to cause additional loading of selenium on Spruce Fork and impacts to its aquatic life.

Table 14. Monthly Total Recoverable Selenium (μg/L) for ambient water quality monitoring station: USF (Spruce Fork Upstream) within the Spruce Watershed for the Mingo-Logan Coal Company. Note: shaded areas indicate exceedances of the selenium standard (5 μg/L).

Site Code	Site Location	Sample Date	Min Value	Ave. value	Max value
USF	Spruce Fork Upstream	12/31/2008	0.00	0.90	1.80
USF	Spruce Fork Upstream	1/31/2009	3.10	3.85	4.60
USF	Spruce Fork Upstream	2/28/2009	6.10	8.80	11.50
USF	Spruce Fork Upstream	3/31/2009	2.20	2.40	2.60
USF	Spruce Fork Upstream	4/30/2009	2.80	2.85	2.90
USF	Spruce Fork Upstream	5/31/2009	4.90	4.90	4.90
USF	Spruce Fork Upstream	6/30/2009	4.00	4.00	4.00
USF	Spruce Fork Upstream	7/31/2009	4.10	4.75	5.40
USF	Spruce Fork Upstream	8/31/2009	4.10	5.05	6.00
USF	Spruce Fork Upstream	9/30/2009	5.40	6.80	8.20
USF	Spruce Fork Upstream	10/31/2009	0.60	3.10	6.20
USF	Spruce Fork Upstream	11/30/2009	3.00	4.75	6.50
USF	Spruce Fork Upstream	12/31/2009	2.60	3.20	3.80
USF	Spruce Fork Upstream	1/31/2010	2.20	4.45	6.70
USF	Spruce Fork Upstream	2/28/2010	3.60	4.20	4.80
USF	Spruce Fork Upstream	3/31/2010	0.60	3.10	6.20

Table 15. Monthly Total Recoverable Selenium (μg/L) for ambient water quality monitoring station: DSF (Spruce Fork Downstream) within the Spruce Watershed for the Mingo-Logan Coal Company.

Site Code	Site Location	Sample Date	Min Value	Ave. value	Max value
DSF	Spruce Fork Downstream	12/31/2008	0.00	1.25	2.50
DSF	Spruce Fork Downstream	1/31/2009	2.00	2.45	2.90
DSF	Spruce Fork Downstream	2/28/2009	1.00	1.70	2.40
DSF	Spruce Fork Downstream	3/31/2009	0.60	0.60	<0.60
DSF	Spruce Fork Downstream	4/30/2009	0.90	1.15	1.40
DSF	Spruce Fork Downstream	5/31/2009	0.60	1.05	1.80
DSF	Spruce Fork Downstream	6/30/2009	0.60	1.10	1.90
DSF	Spruce Fork Downstream	7/31/2009	0.60	0.70	1.10
DSF	Spruce Fork Downstream	8/31/2009	1.60	2.05	2.50
DSF	Spruce Fork Downstream	9/30/2009	1.10	1.25	1.40
DSF	Spruce Fork Downstream	10/31/2009	1.00	1.05	1.10
DSF	Spruce Fork Downstream	11/30/2009	0.60	0.30	0.60
DSF	Spruce Fork Downstream	12/31/2009	0.60	0.60	<0.60
DSF	Spruce Fork Downstream	1/31/2010	1.10	1.10	1.10

Site Code	Site Location	Sample Date	Min Value	Ave. value	Max value
DSF	Spruce Fork Downstream	2/28/2010	1.00	1.10	1.20
DSF	Spruce Fork Downstream	3/31/2010	1.00	1.40	1.80

In summary, water quality data from both the Dal-Tex Mine Complex and the current operational portions of the Spruce No. 1 Mine Complex confirm Region III's concern that the construction of Spruce No. 1 project as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) would be likely to contribute to increased levels of selenium exceeding the WV WQS for selenium (greater than 5 ug/l) downstream of the filled streams and in Spruce Fork. High levels of Se have been known to bioaccumulate to four times the toxic level which can cause teratogenic deformities in larval fish and leave fish with Se concentrations above the threshold for reproductive failure (4 ppm). It can also place birds at risk for reproductive failure through ingestion of fish with selenium concentrations greater than 7 ppm (Lemley 2006). An important adverse impact of selenium residues in aquatic food chains is not just the direct toxicity to the invertebrates and fish themselves, but rather the dietary source of selenium they provide to predatory fish and wildlife species in the upper food web that feed on them.

Region III has reason to believe, based on existing and adjacent mine data that the construction of the Spruce No. 1 mine as currently authorized has the potential to cause or contribute to discharges of selenium that could result in significant degradation of water quality.