APPENDIX 1
Impacts to Water Quality and Wildlife

Abstract
Many streams occurring in the Headwaters Spruce Fork sub-watershed are already listed by the West Virginia Department of Environmental Protection (WVDEP) as impaired. While the Final Determination and this Appendix refer to some of West Virginia's numeric and narrative water quality criteria, the Final Determination is based upon a finding of unacceptable adverse effects to wildlife. This determination is qualitatively different than, and is not dependent upon, a measure of compliance with water quality standards. Rather, EPA has evaluated the expected impacts of the discharges on water quality, and the related impacts on wildlife. Discussions of the specific standards provide information and context, but do not form the basis of the Final Determination.

Additional mining from the Spruce No. 1 Mine will further degrade in-stream water chemistry and biology in the Coal River sub-basin. Results from existing mines show that additional mining will increase adverse impacts to water quality and wildlife, especially from total dissolved solids (e.g. magnesium, bicarbonate, and sulfate) and selenium. 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 be of 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, but will also reduce the input of freshwater that is currently mitigating the impacts of mine effluent from elsewhere in the watershed to the Spruce Fork main stem.

A1.1. Current Water Quality Impairments based on the 303(d) listings
Using the WVDEP 2008 West Virginia Streams 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 Total Maximum Daily Load (TMDL) or need a TMDL, or are a Category 4(c) type and include all years for which data are available. In Table A1.1., approximately 33% of the streams in the Coal River Sub-basin are considered impaired. The percentage of streams that are impaired among sub-watersheds in the Coal River Sub-basin range from 21% to 45%. Specifically, in the Headwaters Spruce Fork sub-watershed, where the Spruce No. 1 Mine 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 Tables A1.1. and A1.2.). 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). 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/303d_305b.aspx.

Table A1.1. 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 A1.2. 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*

A1.2. Total Dissolved Solids/Conductivity Data and Projections

A1.2.1. Historical WVDEP data describing water quality in the vicinity of the project area

Table A1.3. 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 in the project area. These data indicate that levels of conductivity on the main stem 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 project area in the EIS for the 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 proposed project area were 112, 656 and 1130 µS/cm respectively, indicating that on average the conductivity in Spruce Fork was already elevated greater than 500 µS/cm, and maximum conductivity levels exceeded twice that level. Furthermore, because mining has continued since 2006, these values have most likely remained stable or have increased over the past four years.

The data also indicate that low conductivity and sulfate levels of the streams draining the proposed project area (i.e., Pigeonroost Branch, 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 project will degrade the streams draining the project area, as well as contribute additional pollutants to Spruce Fork, contributing to adverse water quality and impacting wildlife habitat on-site and downstream.

Table A1.3. Conductivity and sulfate values for selected sites on Spruce Fork, Pond Fork and the Little Coal River (source: WVDEP data 1997-2003).

Stream Name (mile point)	Period of Record	n Conductivity/ n Sulfate	Avg. Conductivity (µS/cm)	Avg. Sulfate (mg/L)
Tributaries 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**
Tributaries 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
Tributaries 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 main stem 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	11/11	718	206
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

Stream Name (mile point)	Period of Record	n Conductivity/ n Sulfate	Avg. Conductivity (µS/cm)	Avg. Sulfate (mg/L)
Pond Fork main stem 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 main stem 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 Conductivity/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 Creek is approximately at Spruce Fork RM 17.5
Pigeonroost Branch is approximately at Spruce Fork RM 20.8
Oldhouse Branch is approximately at Spruce Fork RM 21.5
White Oak Branch is approximately at Spruce Fork RM 24.6

A1.2.2. Predictions of conductivity changes in Spruce Fork due to project

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

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 in 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 A1.4.). The pre-mining maximum conductivity value reported for Oldhouse Branch (649 µS/cm) in the EIS seemed high based on the pre-mining values reported for Pigeonroost Branch (318 µS/cm) and EPA and WVDEP historical data for Oldhouse Branch. We used a value of 300 µS/cm for the pre-mining maximum conductivity level in Oldhouse Branch, an estimate based on maximum conductivity values for Pigeonroost Branch and farther upstream on Oldhouse as reported in the Spruce No. 1 DEIS. 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 an estimate of post-mining conductivity levels. However, these values likely underestimate the post-mining conductivity values. For example, Left Fork Beech Creek, which is completely mined and filled, the average and maximum conductivity values are 2426 and 3000 µS/cm. And Beech Creek, which is partially mined and filled, has average and maximum conductivity values of 1432 and 1776 µS/cm respectively (WVDEP 2003).

EPA estimated watershed areas for the project area for this model using standard GIS techniques for flow analysis. We delineated watersheds using the 1:24,000 scale National Hydrography Dataset (NHD) flowline stream segments between stream confluences along with digital elevation models (DEMs) from the National Elevation

Dataset (NED). Using ArcGIS software, we mapped the catchments for each stream segment through various hydrological modeling tools. We then developed the flow connectivity network of each watershed using NHD segment-based tabular stream-flow data. From this information, the catchment areas upstream of points of interest could then be delineated and calculated (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. EPA has observed (Green et al. 2000) and hydrologic studies by the U.S. Geological Survey have 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 base flow 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 are more likely to underestimate than overestimate the true post-mining conductivity levels. Accordingly, the model prediction is conservative.

The modeled and measured pre-mining average (552 µS/cm modeled, 570 µS/cm measured) and maximum (960 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 3.2% and the RPD for the maximum values was 11.8%. 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 A1.4. and Figures A1.1.-A1.4.).

Construction of valley fills, sediment ponds, and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will further degrade the water quality of the main stem 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 main stem of Spruce Fork downstream of the project area will increase from 552 µS/cm on average pre-mining to 614 µS/cm on average post-mining. Figures A1.1.-A1.4. indicate 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.

Table A1.4. Modeled conductivity downstream of project area pre & post-mining.

	Pre-Mining Conductivity* Modeled	Pre-Mining Conductivity* Measured	Post-Mining Conductivity Modeled	Post-mining Conductivity 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 Creek	340		500	1000
Spruce Fork downstream of Seng Camp Creek	552	570	614	748
	Max µS/cm		Max µS/cm	Max µS/cm
Spruce Fork upstream of Oldhouse Branch	1130		1130	1130
Oldhouse Branch	**300		1000	1500
Pigeonroost Branch	318		1000	1500
Seng Camp Creek	616		1000	1500
Spruce Fork downstream of Seng Camp Creek	960	1080	1095	1228

* Measured values taken from Spruce No. 1 EIS baseline water quality monitoring data.
** This value was estimated from other pre-mining measured values in Oldhouse Branch and Pigeonroost Branch

Input value - measured except where noted**
Input value - predicted post mining
Modeled value

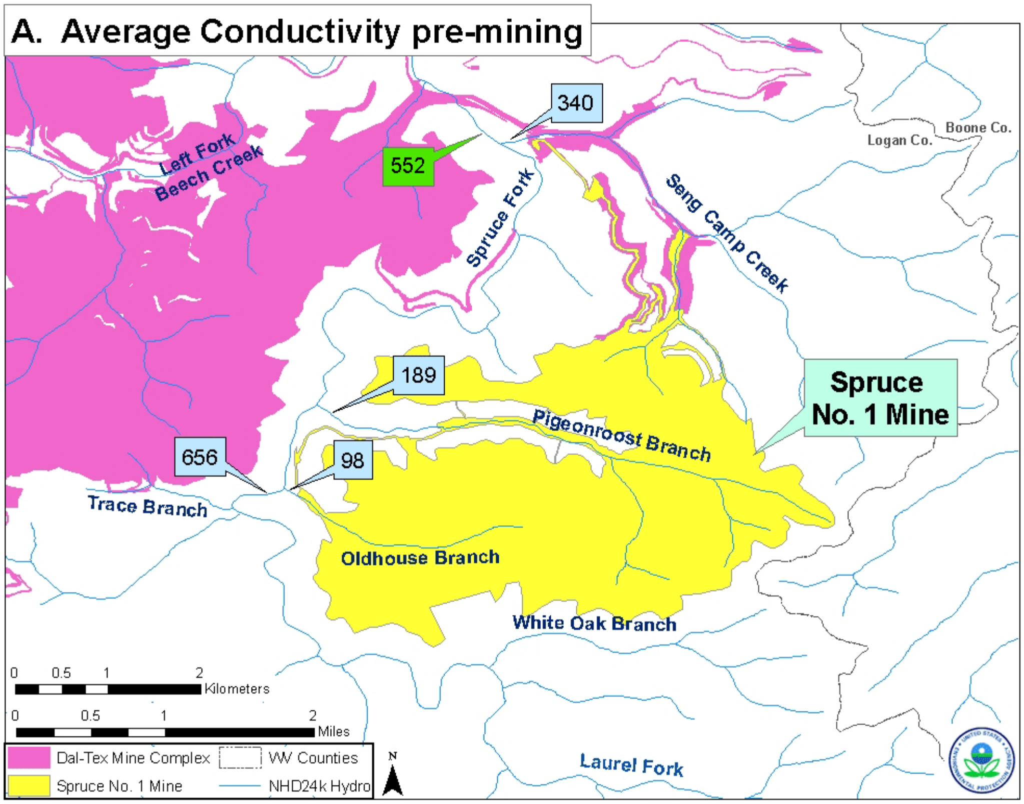

Figure A1.1. Average conductivity pre-mining.

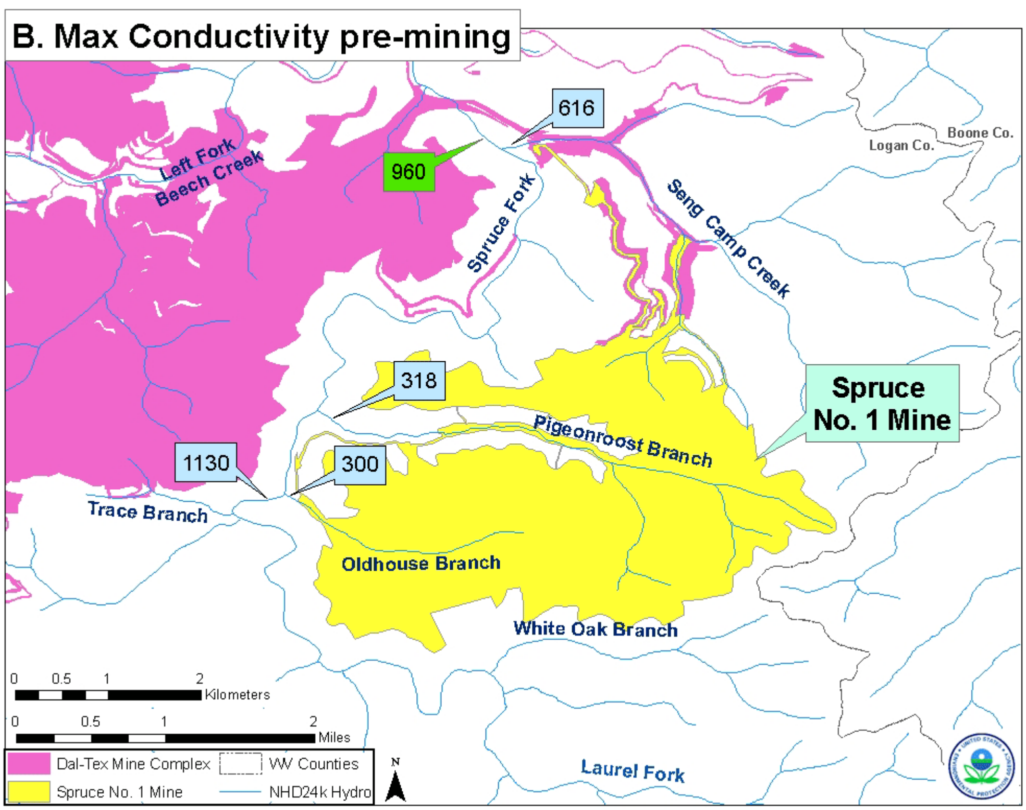

Figure A1.2. Maximum conductivity pre-mining.

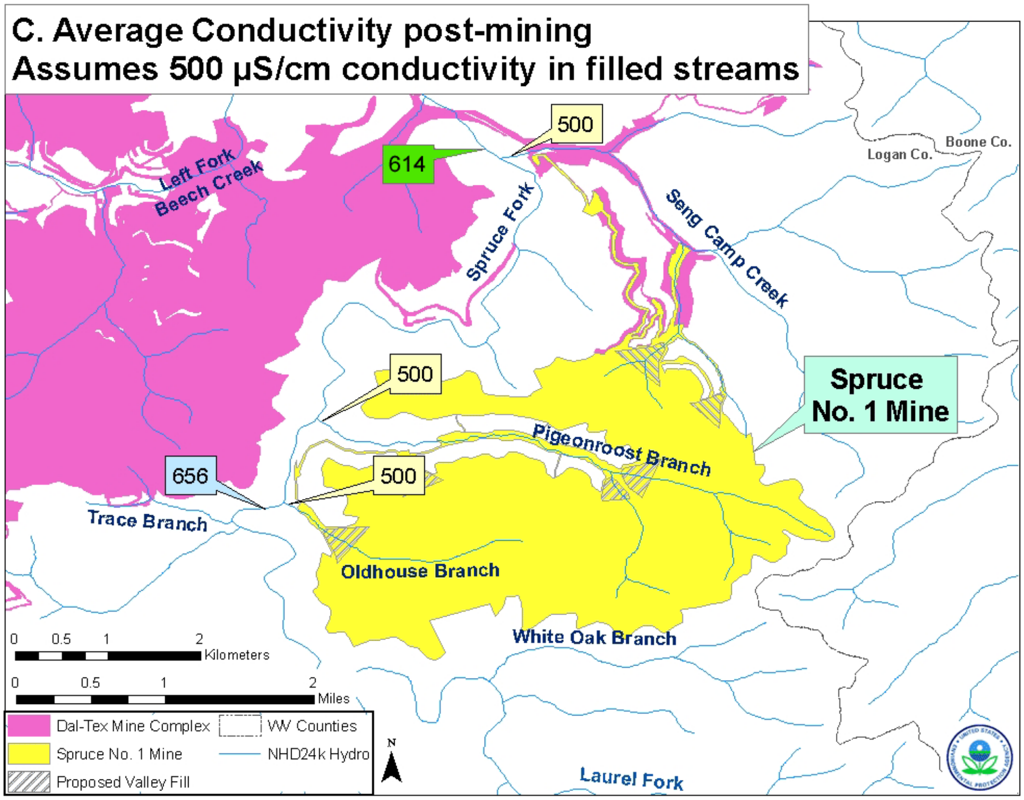

Figure A1.3. Average conductivity post-mining assuming 500 µS/cm average in the filled tributaries.

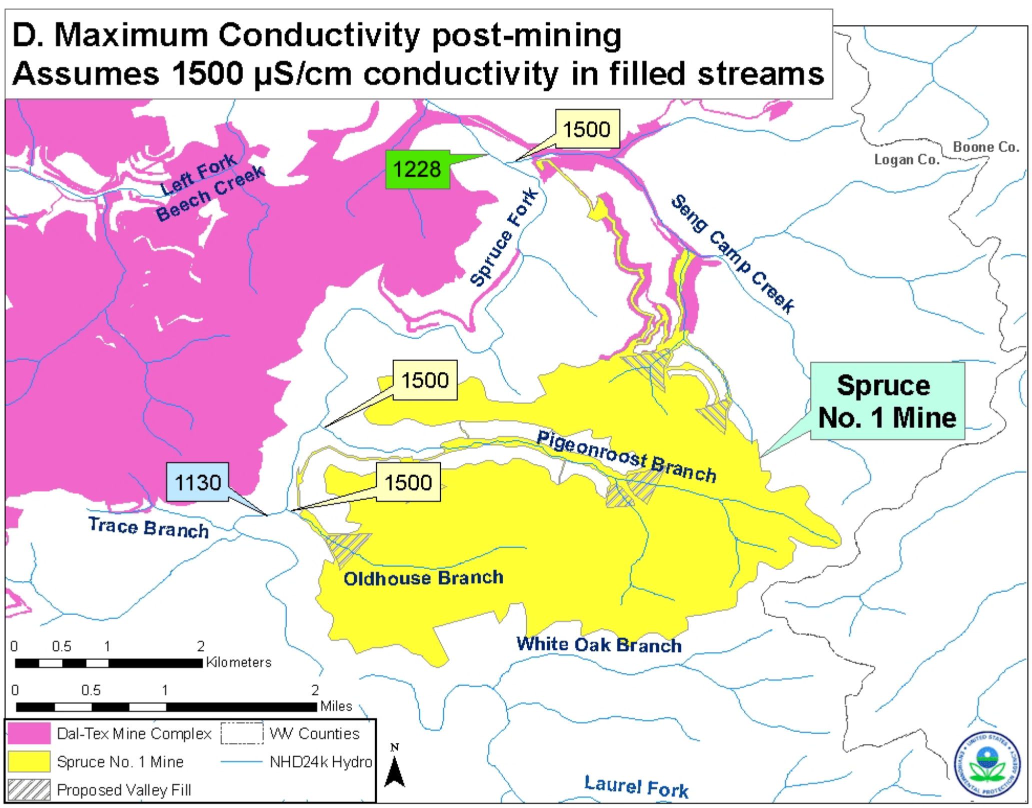

Figure A1.4. Maximum conductivity post-mining assuming 1500 µS/cm max. in the filled tributaries.

A1.3. Analyses Linking Impacts on Water Quality and Wildlife

A1.3.1. Conductivity

A1.3.1. WVDEP biological and conductivity data

Analyses of WVDEP data show that degradation of aquatic life occurs 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 500 µS/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 500 µS/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 their aquatic life use using the family-level WVSCI index (based on index scores lower than the threshold score of 68).

WVDEP ambient monitoring data confirm the high probability of degradation of aquatic life when conductivity levels are elevated to greater than 500 µS/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 in-stream conductivity levels exceeded 500 µS/cm. Two values were used to indicate degradation to the macroinvertebrate assemblage. The first value 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. Currently, WVDEP uses WVSCI index scores greater than 68 to indicate full support of the aquatic life use. The second value was a WVSCI score less than 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 is elevated to levels greater than 500 µS/cm, even when accounting for the possible confounding effects of acidic pH and habitat degradation (see Table A1.5.). For example, 100 of 417 sites achieved scores of at least 68, and 76% of the sites were below 68 when conductivity levels were greater than 500 µS/cm. In addition, only 54 sites out of 417 exceed a score of 72. The large majority of the sites (87%) scored below 72. 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), 62% of sites scored below 68 and 79% of the sites scored below 72.

[1] As noted in Appendix 2, a more recent analysis by EPA indicates that the 5th percentile of 394 WVDEP statewide reference site WVSCI scores (through 2009) is also 72.

Table A1.5. Percentage of WVDEP sites degraded when conductivity is greater than 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	Number of sites consistent with 5th percentile reference sites out of total number of sites in that category
>500 µS/cm and WVSCI < 72	87	54 out of 417
>500 µS/cm and WVSCI < 68	76	100 out of 417
>500 µS/cm and RBP >140 and WVSCI < 72	79	27 out of 128
>500 µS/cm and RBP <120 and WVSCI < 72	92	9 out of 116
>500 µS/cm and RBP >140 and WVSCI < 68	62	49 out of 128
>500 µS/cm and RBP <120 and WVSCI < 68	89	13 out of 116

The analysis of WVDEP data also confirms that there is a lower probability of adverse effect if conductivity is maintained at levels below 300 µS/cm. Table A1.6. indicates that many fewer sites are degraded when conductivity levels are maintained below 300 µS/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 15% of the sites scored below 68 and 26% of the sites scored below 72. As these results suggest, the degradation at these sites is likely being caused by a stressor other than conductivity or habitat, as reinforced by the analyses conducted in Appendix 2.

Table A1.6. 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	Number of sites consistent with 5th percentile reference sites out of total number of sites in that category
<300 µS/cm and WVSCI < 72	47	254 out of 475
<300 µS/cm and WVSCI < 68	35	308 out of 475
<300 µS/cm and RBP >140 and WVSCI < 72	26	151 out of 204
<300 µS/cm and RBP <120 and WVSCI < 72	77	22 out of 95
<300 µS/cm and RBP >140 and WVSCI < 68	15	173 out of 204
<300 µS/cm and RBP <120 and WVSCI < 68	65	33 out of 95

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 A1.7.). When habitat is good at sites (RBP total score greater than 140, or reference quality habitat), 62% of 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 increases to levels greater than 500 µS/cm. This result indicates that water quality degradation and not habitat degradation is primarily causing or contributing to the degradation of macroinvertebrate communities at those sites.

Table A1.7. Effect of elevated conductivity on degradation of macroinvertebrate communities.

	Poor habitat (RBP <120)	Good habitat (RBP >140)
<300 µS/cm and WVSCI < 68	62/95 (65%)	31/204 (15%)
>500 µS/cm and WVSCI < 68	103/116 (89%)	79/128 (62%)
Inference	When habitat is poor, 24% more sites are degraded when conductivity levels are elevated to greater than 500 µS/cm.	When habitat is good, 47% more sites are degraded when conductivity levels are elevated to greater than 500 µS/cm.

A1.3.2. EPA's Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams[2]

EPA's draft report, *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams*, also recognizes stream impacts associated with conductivity. This study is publicly available and is undergoing external peer review by EPA's Science Advisory Board (SAB), with final review expected in 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 level of 300 µS/cm (USEPA 2010a). Water quality criteria are normally established to protect 95% of species. 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 will be extirpated if conductivity levels were elevated to various levels (see Table A1.8.). For example, if conductivity levels were elevated to 461 µS/cm, 15% of native genera that would be expected to occur at that site would be extirpated. Following this method, the loss of native genera associated with conductivity levels greater than 500 µS/cm is significant and represents degradation of aquatic wildlife.

Maximum conductivity levels already exceed 1000 µS/cm at several locations on the main stem of Spruce Fork, and EPA predicts conductivity will exceed 1000 µS/cm in the main stem of Spruce Fork downstream of the project area following construction of the Spruce No. 1 Mine (see Appendix 5). As shown in Table A1.8. below, this level of conductivity has the potential to extirpate or prevent colonization of approximately 44 genera (30%) of the native aquatic macroinvertebrate genera that would normally be part of the regional reference taxa pool. Most of these genera (33) are members of the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) orders, which are important aquatic wildlife that inhabit headwater streams in Appalachia. Even more significant is the trend of continually increased extirpation associated with increased conductivity levels. Because the project will further contribute to elevated conductivity and other pollutants in Spruce Fork, it will therefore further degrade the aquatic community and wildlife habitat.

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[2] EPA's § 404(c) Final Determination and its discussion of conductivity are not based on this report or its conductivity benchmark value. Rather, EPA's Final Determination and its discussion of conductivity and its impacts on wildlife are based on a dose-response threshold of 500 µS/cm that corresponds to adverse effects on the integrity of the benthic macroinvertebrate wildlife community.

Table A1.8. Conductivity levels associated with % native invertebrate genera extirpation.

% genera extirpated	Conductivity estimate (µS/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

A1.3.3. EPA and WVDEP Stressor Identification Study in Clear Fork

WVDEP has developed guidelines for using some water quality parameters 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 probable stressors causing or contributing to biological degradation. The aforementioned USEPA studies (Pond et al. 2008, USEPA 2010a) and WVDEP's own ambient monitoring data indicate these levels are not 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). Located in the same ecoregion, Clear Fork is a tributary to the Big Coal River and is located approximately 20 miles west of the Spruce No. 1 Mine site. In this case study, EPA's Stressor Identification Guidance (USEPA 2000) was used to identify and rank stressors that impaired the aquatic community. Stressor response threshold values were based on several statistical analyses of WVDEP statewide data. Stressor values below the reference site 95th percentile of 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" of 185 µS/cm were associated with slight to moderate degradation. Stressor values greater than the "substantial effects threshold" of 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 (Table A1.9.).

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 its stressor thresholds to identify ionic toxicity as a stressor in impaired water bodies, and thus there are likely more streams that are impaired by this stressor than indicated by WVDEP. For example, WVDEP concluded that ionic toxicity was a primary stressor for certain waters in the Coal River watershed, such as James Branch, Ellis Creek, Rockhouse Creek, Toney Fork, Buffalo Fork, Left Fork/Beech Creek, and Seng Camp Creek. Of these, Rockhouse Creek and the Left Fork of Beech Creek drain the nearby Mingo Logan Dal-Tex operation. Other waters in the vicinity of the project had comparable elevated levels of conductivity and sulfate, but WVDEP did not identify ionic toxicity as a primary stressor (Table A1.3.).

EPA believes the project will cause levels of conductivity and sulfate higher than these substantial effects thresholds in both the tributaries to Spruce Fork and in the main stem of Spruce Fork and will therefore cause further biological degradation in downstream waters.

Table A1.9. 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

A1.4. Selenium

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 egg laying 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. 2009). The State of West Virginia has established a numeric chronic water quality criterion for selenium (5 µg/L) to protect in-stream aquatic life.

Construction of valley fills, sediment ponds, and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will increase selenium loading to the immediate receiving streams and downstream waters. In fact, surrounding mined streams and Spruce Fork already have elevated selenium concentrations exceeding 5 µg/L (see Tables A1.10. and A1.11.). The sedimentation ponds used to treat drainage from mining operations are typically not effective in removing selenium from the discharge.

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) (see Appendix 4). 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

Mine. The effects of these selenium levels have already been documented. For example, a WVDEP 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, West Virginia due to mining activities (Ziemkiewicz 2009). These adverse conditions were all associated with elevated water column selenium concentrations (WVDEP 2009a).

WVDEP and EPA have sampled selenium in streams in the vicinity of the Spruce No. 1 Mine. Table A1.10. provides a summary of selenium averages and ranges for streams draining the nearby Dal-Tex operation and for those draining the Spruce No. 1 Mine 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 Spruce No. 1 Mine. Streams draining the nearby Dal-Tex operation have selenium concentrations exceeding 5 μg/L. 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 A1.10.). 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 will have similarly elevated levels of selenium. As noted in Appendix 4, EPA does not find Mingo Logan's argument that its materials handling plan will prevent these impacts to be compelling.

Table A1.10. Selenium Concentrations (μg/L) Near Spruce No. 1 Mine.

Stream Name	Source and time period of data						
	Subbasin	PEIS (2000-2001)		WVDEP (2002-2003)		WVDEP (2005-2007)	
		Se (avg)	Se (range)	Se (avg)	Se (range)	Se (avg)	Se (range)
Average and Range of Se in Tribs to Spruce Fork that drain Spruce No. 1 Mine							
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 Operations							
Beech Creek[3]	Spruce Fork	7.5	5.6-9.5	6	5.0-9.0	12.3	6.0-22.0
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 μg/L.

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

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

EPA scientists completed a review of rock cores and corresponding cross sections for the Dal-Tex mines including the Gut Fork mine compared to the Spruce No. 1 Mine. For the most part, the formations are repeated from the Dal-Tex mine complex to the Spruce No. 1 Mine location. Table A1.10. provides a summary of selenium averages and ranges for Pigeonroost Branch and Oldhouse Branch and streams draining the nearby Dal-Tex operation (Left Fork Beech Creek, Beech Creek, and Trace Branch). The table also contains data for White Oak Branch (upstream of Spruce No. 1 Mine) and Seng Camp Creek (prior to 2007, when the DA permit was issued and filling associated with Spruce No. 1 commenced in that watershed).

Table A1.11. Other streams in the Coal River sub-basin where selenium concentrations have exceeded 5 µg/L. Source: WVDEP monitoring data from 2002-2003.

Stream Name	Next Higher Watershed	Avg of Values > 5µg/L	Range of Values > 5 µg/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.			

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.[4] In addition, EPA has reviewed data from discharge monitoring reports from mining outlets that drain a portion of the Spruce No. 1 Mine that has been constructed in the Seng Camp Creek watershed (Figure A1.5.).

Graphical trends of selenium concentrations from the West Virginia Division of Mining and Reclamation records for January 2007 to June 2010 from three outfalls from the Dal-Tex Mine and Spruce No. 1 Mine are shown in Figures A1.6.-A1.8-8. The data indicate that the Dal-Tex Gut Fork Mine Outlet 012 (Figure A1.6.) has been exceeding 5 μg/L every month from August 2008 to June 2010 except for March 2009 and January 2010. This represents a rate of 89% exceeding selenium concentrations of 5 μg/L. Prior to June 2008, the outfall exceeded 5 μg/L on two occasions (April 2007 and July 2007).

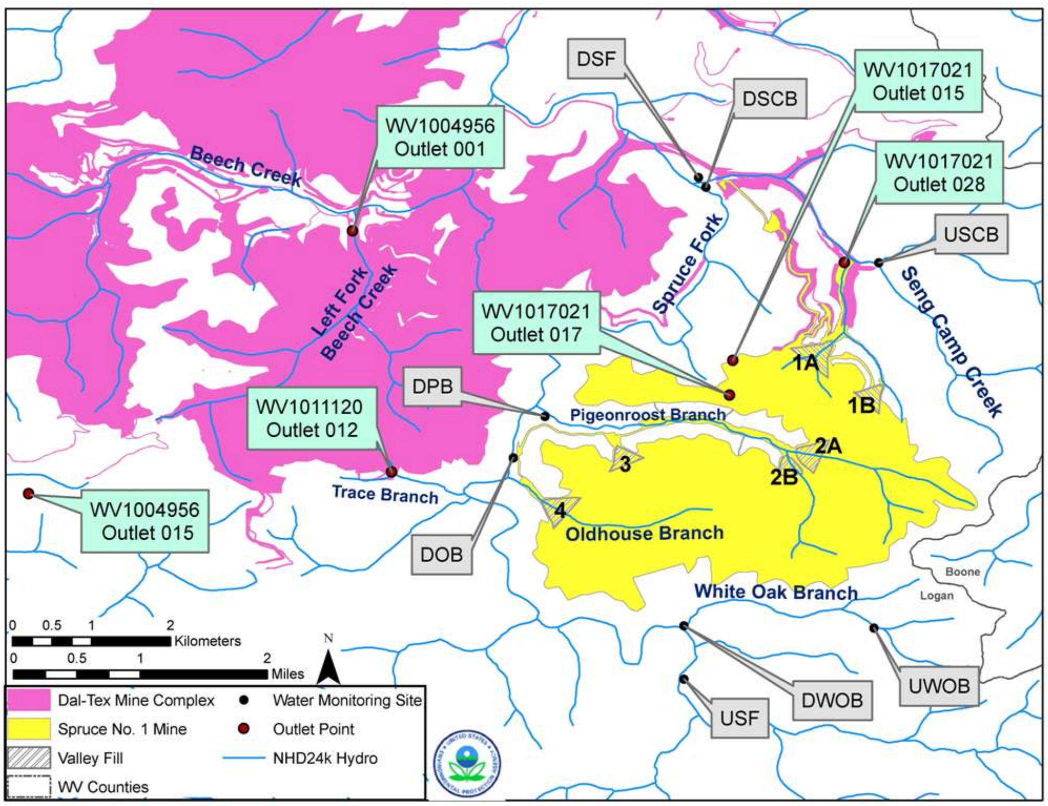

Figure A1.5: Outfall locations in Dal-tex and Spruce No. 1 Mine.

[4] Levels of selenium in other nearby waters that have been impacted by surface coal mining activity and generally have similar geology also support a prediction that construction of the Spruce No. 1 Mine as currently authorized will result in elevated levels of selenium in downstream waters.

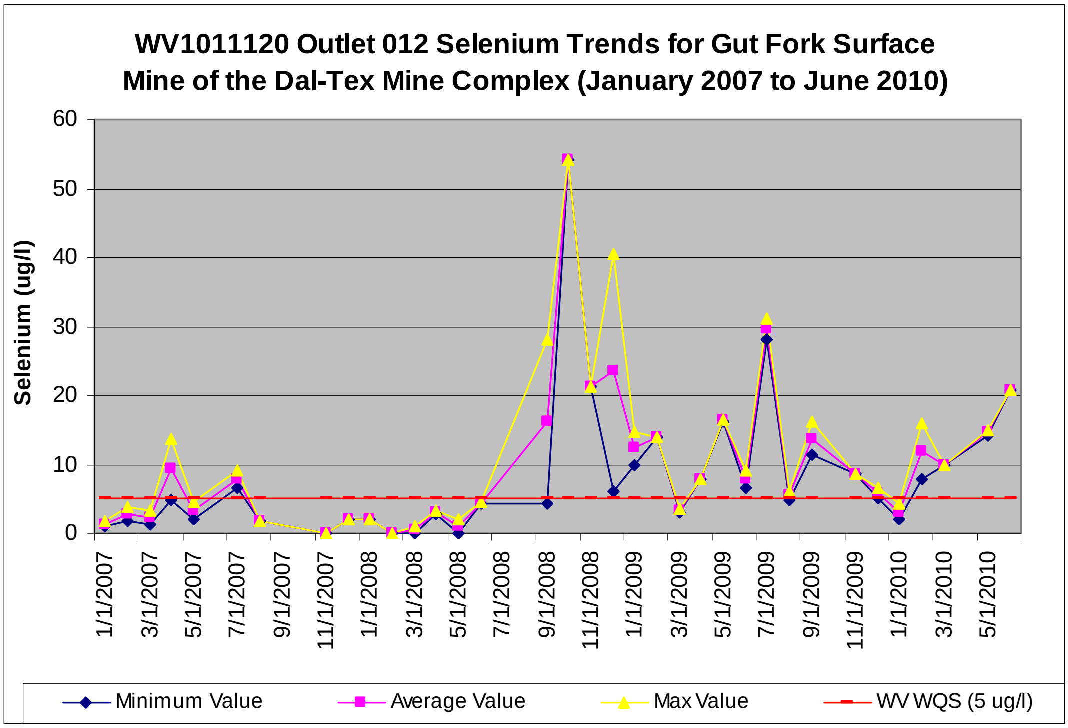

Figure A1.6. Selenium Trends from January 2007 to June 2010 for NPDES Permit WV1011120 – Outlet 012 (Mingo Logan Coal Company's Gut Fork Surface Mine of the Dal-Tex Mine Complex).

The data indicate that the Dal-Tex Left Fork No. 2 Mine Outlet 015 (Figure A1.7.) has been exceeding 5 μg/L every month except for August and September 2009 since August 2008. Prior to June 2008, the outfall exceeded 5 μg/L 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 selenium values for this outlet. The trend indicates that water quality has deteriorated since that time.

The data indicate that the Dal-Tex Left Fork No. 2 Mine Outlet 001 (Figure A1.8.) has also been exceeding 5 μg/L every month from August 2008 to June 2010 except for September 2009 and November 2009. Prior to June 2008, the outfall exceeded 5 μg/L on numerous monthly occasions with one value reaching 45 μg/L.

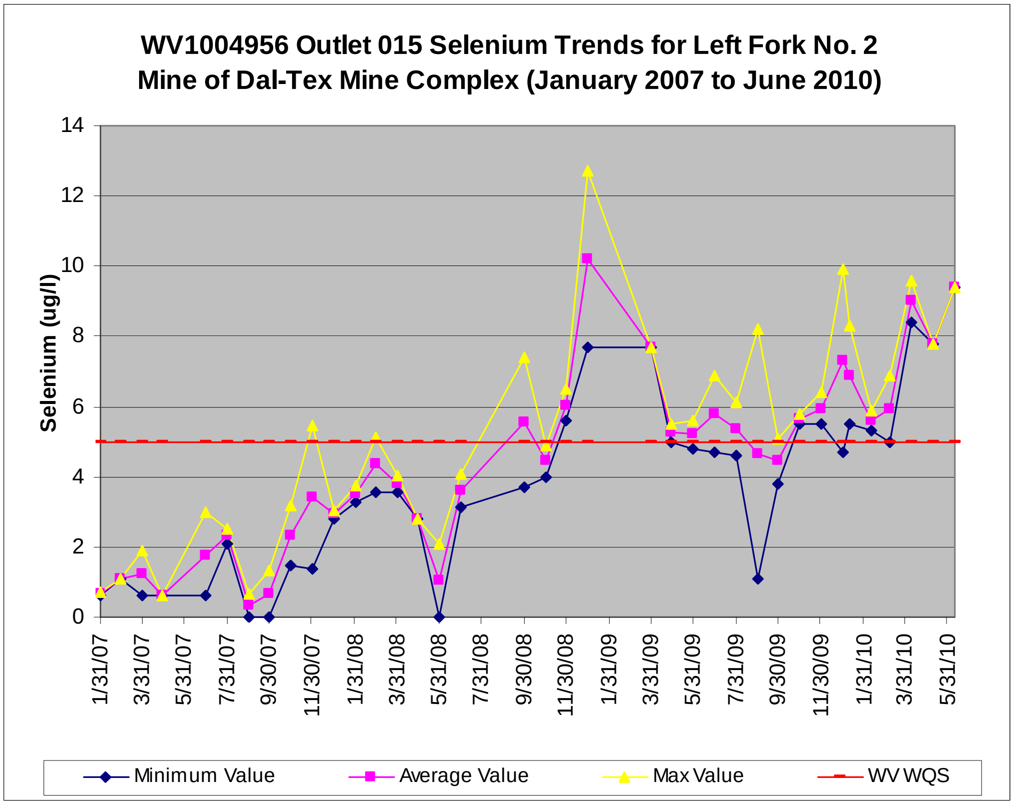

Figure A1.7. Selenium Trends (January 2007 to June 2010) for NPDES Permit WV1004956 – Outlet 015 (Mingo Logan Coal Company's Left Fork No. 2 Mine of the Dal-Tex Mine Complex).

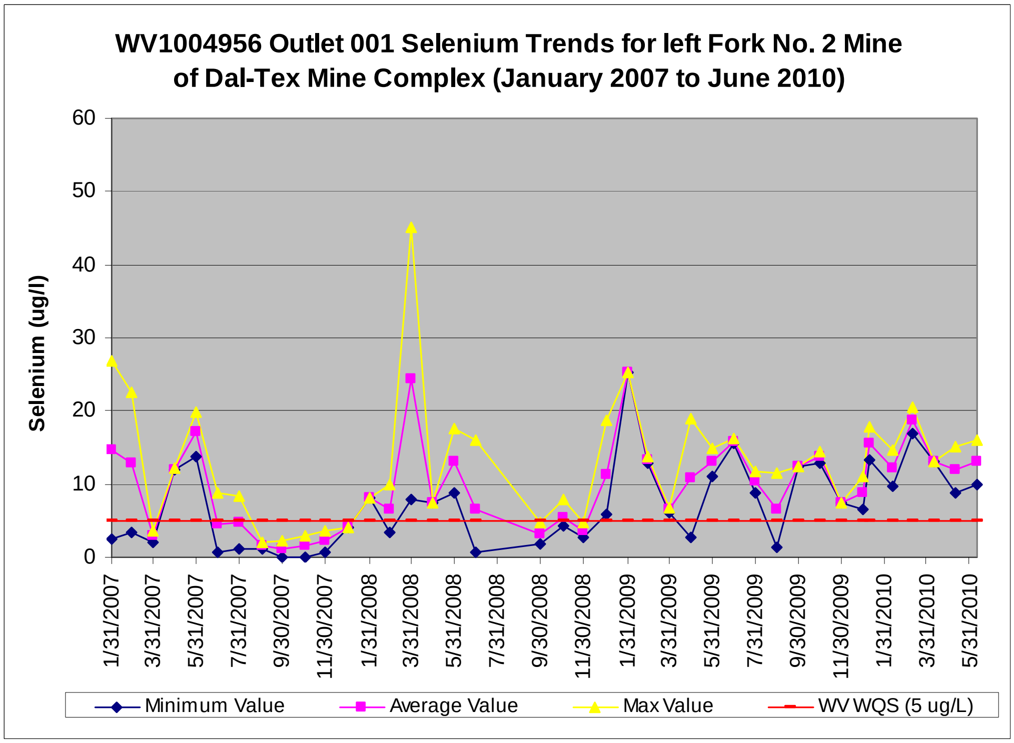

Figure A1.8. Selenium Trends (January 2007 to June 2010) for NPDES Permit WV1004956 – Outlet 001 (Mingo Logan Coal Company's Left Fork No. 2 Mine of the Dal-Tex Mine Complex).

Total Maximum Daily Loads to address impairment from elevated concentrations of selenium have been developed for six other streams affected by mining in the Coal River sub-basin. These include nearby White Oak Creek, a tributary to the Coal River, the left Fork of White Oak Creek, Seng Creek, also a tributary to the Coal River; and Casey Creek, James Creek, and Beaver Pond Branch, all tributaries to Pond Fork. These elevated levels of selenium demonstrate that the geology in the vicinity of the Spruce No. 1 Mine will release selenium during mining activities, as further described in Appendix 4.

EPA also reviewed data from the portion of the Spruce No. 1 Mine that is already operational in Seng Camp Creek (Figure A1.9.), including active mining activities in the Right Fork of the Seng Camp Creek sub-watershed. Mingo-Logan has indicated that its mining activities on the project site affecting Pigeonroost and Oldhouse Branches would not result in elevated levels of selenium. However, there is evidence that the active mining has already resulted in elevated selenium in the few outfalls that currently exist, which discharge to Seng Camp Creek. Recent NPDES discharge monitoring reports (DMRs), submitted by the permittee, over a 16-month period (December 2008 to September 2010) show that Outfall 028, which handles, among other things, discharges from Valley Fill 1A, is discharging selenium at average monthly concentrations above 5 µg/L (Table A1.12., Figure A1.9.).[5] It is also noted that the September 2009 value from Outfall 017 also is elevated. These data support EPA's prediction that construction of valley fills in Pigeonroost Branch and Oldhouse Branch will result in discharges of elevated levels of selenium.

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. EPA evaluated the in-stream DMR monitoring data from December 2008 to March 2010 from several ambient monitoring stations associated with the Spruce No. 1 mine as authorized 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, located downstream of Seng Camp Branch), DPB (downstream Pigeonroost Branch, at mouth of Pigeonroost Branch) and DOB (Downstream Oldhouse Branch, at mouth of Oldhouse Branch). As explained below, this analysis shows that Pigeonroost Branch and Oldhouse Branch are providing dilution that is helping to maintain reduced selenium concentrations in Spruce Fork.

[5] While Outfall 028 receives discharges from other portions of the site, it handles the discharges from valley fill 1A. EPA notes that WVDEP sampling from 2002-2003 (prior to construction of Spruce No. 1 Mine in Seng Camp Creek) found selenium levels in Seng Camp Creek to be below detection levels.

Table A1.12. 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 selenium concentrations exceeding 5 µg/L.

Site Code	Site Location	Report Date	Min Value	Avg. 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
028	Outlet 028	4/30/2010	3.8	4.40	5.00
028	Outlet 028	5/31/2010	4.70	7.60	10.50
028	Outlet 028	6/30/2010	11.40	11.50	11.60
028	Outlet 028	7/31/2010	6.40	8.50	10.40
028	Outlet 028	8/31/2010	4.80	10.65	14.80
028	Outlet 028	9/30/2010	4.80	9.40	11.00

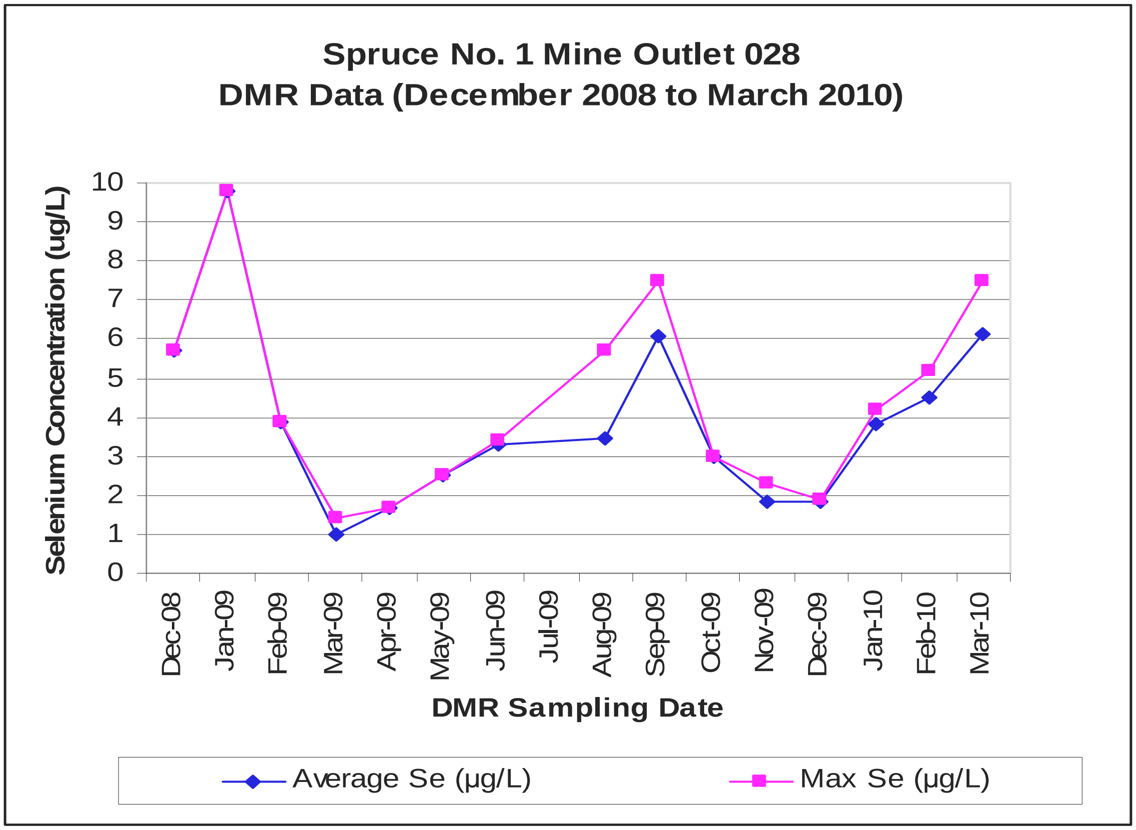

Figure A1.9. Selenium concentrations in discharge from outlet 028 on Spruce No. 1 Mine on Seng Camp Creek.

The Spruce Fork watershed upstream of Pigeonroost Branch and Oldhouse Branch (Station USF) has average monthly selenium concentrations ranging from 0.9 µg/L to 10.90 µg/L (August 2010), with nine monthly average concentrations greater than 5 µg/L based on the in-stream DMR data for the December 2008 to September 2010 time period. It should be noted that the last 6 months of available DMR data (April 2010 to September 2010) for USF had monthly selenium concentrations above the 5 µg/L potentially indicating new selenium contamination sources. The downstream Spruce Fork (DSF) site has concentrations that are significantly lower, and does not have any average monthly selenium concentrations above 5 µg/L, with the highest monthly average selenium concentration during the time period (December 2008 to September 2010) being 2.50 µg/L (May 2010). This suggests that Pigeonroost Branch and Oldhouse Branch (along with other tributaries that enter Spruce Fork between the monitoring stations) provide clean dilution water to the main stem of Spruce Fork. This conclusion is supported by the very low levels of selenium in Pigeonroost Branch and Oldhouse Branch. During the same December 2008 to September 2010 time frame, the DMR reports indicate almost all of the average monthly selenium measurements at both Pigeonroost Branch and Oldhouse Branch were below the detection limit of 0.6 µg/L. The single detection of selenium during the time period in Oldhouse Branch was 0.9 µg/L during July 2009 (a maximum value). All monthly average selenium concentrations in Pigeonroost Branch were below the detection limit from December 2008 through June 2010 except the monthly average in August 2009 which had a value of 1.3 µg/L (maximum value was 1.9 µg/L). However, the monthly average selenium concentrations for the July 2010 to September 2010 time period documented a developing selenium problem in Pigeonroost Branch. The monthly average selenium concentration in July 2010 was 2.7 µg/L, August 2010 was 2.6 µg/L and September 2010 was 1.4 µg/L.

By way of example, the average monthly selenium concentration at the USF monitoring location for the month of April 2010 is reported on the DMR as 10.60 µg/L. The average monthly concentration at the DSF location for April 2010 is reported on the DMR as 0.90 µg/L. For April 2010, the DMR reports average monthly selenium concentrations at Pigeonroost Branch and Oldhouse Branch as below the detection level of 0.60 µg/L. While Pigeonroost Branch and Oldhouse Branch are not the only contributing tributaries between the USF and DSF stations, this data strongly suggests that they are contributing dilution.

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 5 µg/L. These data indicate that this selenium from existing portions of the Spruce No. 1 mine is contributing to the existing selenium loading in Spruce Fork. Moreover, based on watershed flow characteristics, these data also suggest that if the additional valley fills in Pigeonroost Branch and Oldhouse Branch cause selenium loading consistent with that observed in Seng Camp Creek, additional impacts to Spruce Fork and its aquatic life are expected. As noted in Appendix 4, the permittee's arguments suggesting that materials handling approaches will not yield similar selenium concentrations from outfalls draining (buried) Pigeonroost and Oldhouse Branches are not compelling.

In the absence of direct water column-fish tissue correlations measured in Spruce Fork, EPA's concerns with bioaccumulation are justified by WVDEP studies documenting fish health problems as a result of high selenium levels in West Virginia streams and lakes. As recently as January 2010, WVDEP concluded: "Larval deformity rates were variable throughout the study duration but were nonetheless associated with waterborne selenium exposure." (WVDEP 2010a). A second WVDEP study (February 2009) documents that numerous streams and lakes in West Virginia have elevated selenium in receiving streams and that fish are accumulating the selenium in their tissues (WVDEP 2009a). While samples were not collected from the main stem of Spruce Fork, this study did sample in adjacent watersheds, such as Beech Creek, which drains part of the Dal-Tex complex. Levels of selenium are sufficiently high that a TMDL for selenium was developed for Beech Creek.

Several nearby streams in the Coal River sub-basin have available data 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. 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 chub 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.

In summary, water quality data from both the Dal-Tex Mine Complex confirm EPA's concern that the construction of Spruce No. 1 Mine as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will contribute to increased levels of selenium downstream of the filled streams and in Spruce Fork. High levels of Se have been known to bioaccumulate to four times the toxic level that can cause teratogenic deformities in larval fish and leave fish with Se concentrations above the threshold for reproductive failure. It can also place birds at risk for reproductive failure through ingestion of fish with elevated selenium tissue concentrations (Lemly 2007). 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. EPA has reason to believe, based on existing data, that the construction of the Spruce No. 1 Mine as currently authorized will cause or contribute to discharges of selenium that will result in significant degradation of water quality and unacceptable adverse effects to wildlife.