



THE BIRMINGHAM  
WATER WORKS BOARD

July 06, 2010

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Alabama Surface Mining Commission (ASMC)  
P.O. Box 2390  
Jasper, AL 35502-2390

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RE: Shepherd Bend Mine  
ASMC Permit Application P3945

Dear Dr. Johnson:

The Water Works Board of the City of Birmingham (Board) would like to provide the following comments regarding the permit application for the Shepherd Bend Mine (ASMC P3945) located in Walker County. Water discharged from this mining operation would enter the Mulberry Fork, upstream and across from one of our surface water intakes, the Mulberry Intake. The Mulberry Intake has been in operation since 1989 and, as one of the Board's water sources, serves approximately 200,000 people in the Birmingham area. The Board submitted comments to the Alabama Department of Environmental Management (ADEM) regarding the Shepherd Bend Mine NPDES permit. We are concerned that this proposed mine has the potential to adversely impact the Birmingham area drinking water.

Our comments and requests for the permit application are summarized below:

- *Part II. Section E.2. - Geology* states that "Chemical analyses conducted to identify acid-forming or toxic-forming zones shall be made on a representative number of samples of the overburden within the permit area." It appears that only Acid Base Accounting (ABA) analyses were run on lithologic samples. ABA does not evaluate potential for "toxic-forming" compounds such as enhanced leaching of metals of exposed overburden materials. Evaluation of toxic-forming compounds should be conducted for each lithologic zone sampled.
- *Part II. Section F - Groundwater Hydrology* indicates that the baseline groundwater quality investigation is not sufficient. In addition to pH, Iron, Manganese, Acidity, Alkalinity, and Sulfate, a number of constituents should be added to the Groundwater Monitoring Parameters in Section V of the Hydrologic Monitoring Plan including: Aluminum, Arsenic, Copper, Mercury, Antimony, Zinc, Chromium, and Lead.
- *Part II. Section H - Probable Hydrologic Consequences Determination.* The proximity of the proposed mining operation to such a major municipal water supply intake is unprecedented to our knowledge, and represents an incompatible use. This operation could result in the discharge of mining related pollutants directly to the intake. The NPDES permit and this permit application do not appear to have adequately considered the drinking water use, and are wholly inadequate to protect the Board and its customers from many pollutants commonly associated with mining activities. The following comments concern the impact of the mining operation on the water supply:



- The proximity of the mining operation to Board's intake poses a potential hazard to drinking water uses. The Board's drinking water intake is within approximately 800 feet of the mining operation outfalls. Because the intake is so close to the proposed outfalls, the mining discharges may not evenly mix with the full stream flow prior to reaching the intake. The proximity and configuration of the proposed operation could result in a bank-entrained plume of mining-related pollutants traveling directly to the intake and into the Board's treatment facilities.
- The iron and manganese limits are not protective of drinking water uses. The NPDES permit limitations include daily average total iron concentrations of 3.0 mg/L (with daily maximum of 6.0 mg/L), daily average total manganese concentrations of 2.0 mg/L (daily maximum of 4.0 mg/L), daily average total suspended solids (TSS) of 35.0 mg/L (with a daily maximum of 70.0 mg/L), and pH ranging from 6.0-9.0 (daily minimum and maximum, respectively). The permit also notes that the manganese limitations are not applicable if pH is 6.0 or higher and total iron is less than 10 mg/L.

The Safe Drinking Water Act includes secondary maximum contaminant levels (MCLs) for total iron concentrations of 0.3 mg/L and total manganese of 0.050 mg/L. The average concentrations allowed by the NPDES permit are ten times the secondary MCL for iron and forty times the secondary MCL for manganese. By comparison, the daily average raw water concentrations for iron and manganese for the Western Filter Plant in 2007 were 0.057 mg/L and 0.079 mg/L, respectively. Iron and manganese can cause significant aesthetic problems in drinking water, including consumers' perceptions of the quality of the drinking water, staining of clothes and basins, and taste of the water.

The NPDES permit specifies discharge limits for total iron and manganese concentrations, however, the speciation of the iron and manganese (i.e. whether Fe and Mn are in reduced or oxidized states) will significantly impact the ability of the Board's existing treatment facilities to remove iron and manganese. For example, if  $\text{Fe}^{2+}$  and  $\text{Mn}^{2+}$  are primarily present in the discharge waters and enter the plant in the reduced oxidation states rather than as particulate iron and manganese, the current treatment process train will not be able to remove them. Speciation of iron and manganese in the discharges is needed to assess whether additional treatment would be required to oxidize the  $\text{Fe}^{2+}$  and  $\text{Mn}^{2+}$  and then remove the precipitates. However, even if the iron and manganese is present in particulate form in the discharge waters, opportunities may exist for the particulate iron and manganese to become reduced either in the riverbed sediments or in the treatment plant. Costly operational changes to the treatment plant may be required if iron and manganese precipitation and subsequent reduction occurs in the raw water storage tanks or in the sedimentation basins.

The Board's Western Filter Plant may also be impacted by higher particle loading from TSS, iron, and manganese, which would require additional



operations and maintenance (e.g. removing solids from the raw water storage tanks, increasing coagulant dosages to remove additional turbidity, more frequent backwashing of filters due to reduced filter run times, and generation of more wastewater) and may reduce the overall treatment flow rating of the plant.

- The permit application does not address the protection of the public water supply from pollution by many other mining-related pollutants, including toxic metals. Of significant concern is the potential presence of other contaminants in the discharge waters that may impact the source water. Coal in this region of Alabama has been associated with other elements that may impact water treatment, including arsenic, (described by the USGS as “well above the average for all U.S. coal”), sulfur, salinity, mercury and others. Drainage from coal mines often has elevated concentrations of not just iron and manganese, but many other metals including lead, zinc, copper, and cadmium. **Appendix A** provides a summary of data collected for the National Coal Resources Data System (NCRDS). Based on our review of data from the NCRDS trace elements can be found in very high concentrations at sites near the Mulberry Fork intake. It is expected that these trace metals will also be found in high concentrations in stormwater runoff from exposed coal. Coal samples taken near the Shepherd Bend Mine site exhibit relatively high concentrations of aluminum, arsenic, lead, and mercury. See the attached Technical Memoranda **Coal Mine Drainage and Water Quality Study** and **Surface Water Quality Analysis** for results of water quality studies conducted at a nearby mining site.

If the NPDES permit allows discharges of iron and manganese concentrations over 10-40 times higher than maximum contaminant levels, it is reasonable to presume that other pollutants associated with coal mine drainage could also greatly exceed levels necessary to protect aquatic life and drinking water. These elements, which are not currently included in the discharge permit, could significantly impact the treatment process needs of the water supply and drastically increase costs of treatment and potentially impact public health. For example, arsenic removal would require additional processes, and demand and require increased chemical dosages. Further, the presence of ammonia would significantly complicate the disinfection strategy employed at the Western Filter Plant. Additional discharge limitations on the range of elements found in the coal that could impact the Board drinking water source should be established. Further, total dissolved solids (TDS) may be high in the coal beds and should be limited to avoid exceeding the 500 mg/L TDS secondary MCL; if high TDS levels are observed at the Western Filter Plant intake, the only (and very costly) option for reducing TDS is reverse osmosis. To better evaluate the probable impacts of these discharges on operations at the Board's Western Filter Plant, additional analysis is needed beyond what is included in the NPDES permit. The impact of the flow rates at the various outfalls should be evaluated on a seasonal basis relative to river flows to estimate the anticipated concentrations of iron, manganese, and TSS at Mulberry Fork Intake. Further study is also required to determine what



other elements/compounds may occur in the discharges and additional costs of treatment associated with those discharges.

- The maximum pH limit is not protective of designated uses. The NPDES permit includes a provision that would allow a maximum daily pH of 10.5 standard units. This is well outside the range of water quality criteria deemed protective of aquatic life uses. Additionally, this pH level would exacerbate the toxicity of other constituents. The solubility of many toxic metals (for which the permit includes no limits) would increase. At this pH, even extremely low concentrations of ammonia could be toxic to aquatic life.
- The permit application does not adequately address controls on metals in stormwater runoff from mining operations. The NPDES metals limits on stormwater runoff are even less protective than for the non-precipitation-related discharges. No limits are included for any metals except iron for small precipitation events, and these iron limits are over 20 times the MCL. Larger storm events have no metals limits at all. Of special note, runoff of acid or ferruginous drainage from coal refuse disposal piles include no metals limits at all, even for 1-year, 24-hour storm events.
- The NPDES Permit could allow large slugs of suspended solids to Mulberry Fork: The permit includes no limits for total suspended solids in stormwater runoff (only settleable solids), essentially allowing unlimited discharges of fine, non-settleable suspended solids such as clays and fine silts. Given the extreme land disturbance associated with surface mining- and high rate of erosion expected - this could allow large slugs of suspended solids in runoff from even small precipitation events. This in turn could have deleterious effects on aquatic life and greatly increase solids removals costs in the water treatment plant.

Of special concern is the potential for catastrophic movement of solids into the stream during large storm events, either as the result of impoundment failure or precipitation-induced mass wastage of mining materials on high slopes. The permit includes no limits on solids for >10-year storm events, essentially providing no protection from such events. Similarly, the permit includes no hard requirement for the permittee to develop a BMP plan to contain solids, and no such plan was available to the reviewers. Catastrophic solids loading events could not only affect the water quality at the intake, it could endanger the intake itself by burial, clogging, or other damage.

- The NPDES permit provides little protection from post-mining impacts. According to section I.A.2 of the permit, permit limits would cease to apply upon revegetation of the site and Phase II bond release. This provides no long-term protection of the drinking water intake from potential post-mining drainage problems such as failure of vegetation, acid mine seepage, or other inadequacies of post-mining reclamation.



- Since a spill from the fuel storage area at the Shepherd Bend Mine could shut down the Mulberry Fork intake, the Board contends that it is critical to have an adequate Spill Prevention, Control, and Countermeasure (SPCC) plan for this facility. The SPCC plan for the Shepherd Bend Mine does not provide adequate detail as required by 40 CFR 112. The following issues were noted with the proposed plan:
  - 40 CFR 112.4 – Facility maps and diagrams were not provided and failure analysis was not performed.
  - 40 CFR 112.7 – Countermeasures for discharge discovery, response, and cleanup were not provided. A prediction of potential discharge’s direction, rate of flow, and potential quantity of material that could be discharged was not provided. An oil spill contingency plan following 40 CFR 109 was not provided. A written commitment of manpower, equipment, and materials was not provided. Inspection procedures were not clearly defined in the plan. Personnel, training, and discharge prevention procedures were not provided.
  - 40 CFR 112.8/112.12 – Facility drainage was not provided, and procedures for inspection and discharge of rainwater from containment areas were not provided.
  
- *Sedimentation basin designs do not meet standard design criteria and are inadequate for public water supply protection:* Based on the permit application materials, the proposed sedimentation basins are inadequate to prevent very large sediment discharges to Mulberry Fork. Relevant performance standards include those of federal regulations (30 CFR Ch. VII Part 816) and the equivalent regulations of the Alabama Surface Mining Commission Administrative Code (Chapter 880-X-10C). These regulations require the following of siltation structures:

Additional contributions of suspended solids sediment to streamflow or runoff outside the permit area shall be prevented to the extent possible using the best technology currently available.

The federal and state mining regulations have few quantitative design criteria for sedimentation basins that are directly related to the removal of suspended solids; rather, most of their design criteria are related to prevention of impoundment failure during very large storm events. For these reasons, it is appropriate to consider other standard design criteria for sedimentation basins, when evaluating whether or not the ponds prevent “additional contributions of suspended solids to streamflow...using the best technology currently available”. For the purposes of this review, standard design criteria for sedimentation basins are taken from the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas*, published by the Alabama Soil and Water Conservation Commission (SWCC).

A comparison of the proposed pond designs to the Alabama SWCC criteria (see table below) demonstrates that they fall far short of standard design criteria with respect to multiple factors such as dewatering time, sediment storage volume, and baffling. Such basins still might remove a proportion of the highly settleable



solids (e.g., sand & larger silt), and the ponds appear to have been primarily designed with SEDCAD to meet effluent limits for settleable solids. However, such basins would be wholly inadequate for preventing additional contributions of suspended solids as required by state and federal regulations. By failing standard design criteria, the ponds cannot be said to represent the best technology available.

### Comparison of Proposed Sedimentation Basin Designs to Alabama SWCC Design Criteria

[shaded cells indicate that proposed design does not meet design criteria]

Basin	Dewatering Time <sup>1</sup> (hours)		Length-to-Width Ratio		Sediment Storage Capacity (ac-ft)		Number of Baffles	
	Criterion	Design	Criterion	Design	Criterion	Design	Criterion	Design
005	48-240	~17	2:1	~3:1	8.3	1.9	3	1
006		~14		~2:1	2.8	3.3		1
007		~14		~1:2	4.5	4.0		1
008		~16		~4:1	12.0	2.6		1

<sup>1</sup>Interpreted from SEDCAD results as total dewatering time when water elevation is at the invert of the emergency spillway

This conclusion is borne out by the SEDCAD results presented. SEDCAD results demonstrate extremely high effluent TSS concentrations for the storm events: including peak concentrations >30,000 mg/L and average concentrations (calculated from total sediment load and water volumes provided) of >20,000 mg/L. It is clear that, even operating as designed, the basins will be discharging plumes of extremely turbid water just upstream of a public water supply intake, and thus violating federal and state regulations.

- The permit application made reference to the possible use of chemical treatment or flocculation bricks to control TSS. However, the pond design information includes no such elements. Based on the effluent TSS concentrations discussed above, it is highly recommended to implement chemical treatment measures and to include them in the facility design, along with plans/measures to determine appropriate dosing rates. Such measures require careful planning and should not be left as afterthought only to be hurriedly implemented in the event that major sedimentation problems are discovered.
- Sedimentation control structures are the primary control for surface waters leaving the property. These generally control the sediments, when well-designed, but may not reduce dissolved or ionic constituents that may be elevated due to mining activities. Constituents not controlled may include metals, explosive residue, sulfate from sulfide oxidation, etc. In addition, many of the trace contaminants in **Appendix A** are not likely to be mitigated by settling ponds.
- *Attachment III-A-5 – Disposal of Debris, Acid-Forming and Toxic Forming Material and Materials Constituting a Fire Hazard* only addresses acid forming materials (refers to neutralization). It also indicates that materials will be placed into a burial pit, but does not expand on the design of the pit. The pit design



should ensure that the materials do not contact groundwater, over the short-term and long-term, even during wet periods.

- *Attachment III-D - Hydrologic Monitoring Plan* indicates that the groundwater monitoring program is not sufficient. The applicant is requesting a waiver to monitor only one groundwater well at the site. The applicant specifically states, “No groundwater is being used in the area for a source of potable water and data shows a general lack of supply; therefore, a waiver for the remaining monitoring wells is requested as they are removed by mining.”

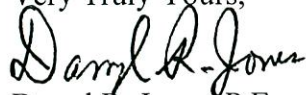
The groundwater underlying the proposed Shepherd Bend mine is in direct hydraulic communication with surface water in the Mulberry Fork, which is designated for public water supply. Due to the nature of groundwater flow at this site (see Attachment 2-3), contaminants introduced to groundwater from mining operations will discharge to the Mulberry Fork. Further, the groundwater directly underlying the site is designated as an “Underground Source of Drinking Water” (USDW) by ADEM Admin. Code r. 335 Division 6 Regulations.

Therefore, the permit and waiver for groundwater monitoring should be denied. At a minimum, The Hydrologic Monitoring Plan (Attachment III-D) should be revised to include groundwater monitoring of all wells installed at the site and replacement of all wells mined through. The Hydrologic Monitoring Plan should be revised to include a groundwater monitoring program that includes procedures to continually monitor groundwater quality in all wells versus baseline or background conditions. Additionally, the owner and ASMC’s responses and corrective actions for significant contaminant increases in groundwater over baseline or background conditions should be included in the application and Attachment III-D Hydrologic Monitoring Plan.

Our Mulberry Intake will be used to provide drinking water to the Birmingham Metropolitan Area for many years in the future and this mine would negatively impact the drinking water supply. Given what is at stake, we feel that this mining permit should not be issued. If the permit is issued, we feel that all of the areas of concern noted above must be addressed in order for us to continue to provide the regions residents with safe drinking water at a reasonable price.

Please email me at [djones@bwwsb.com](mailto:djones@bwwsb.com) or call 205-244-4404 if you have any questions or comments.

Very Truly Yours,



Darryl R. Jones, P.E.

Assistant General Manager  
Operations and Technical Services

cc: Mac Underwood, BWWB  
Patrick Flannelly, Malcolm Pirnie, Inc.



**Appendix A**

**Trace Elements in Samples Collected from Coal Fields in the Vicinity of the BWWB Public  
Water Supply Intake**



## **Trace Elements in Samples Collected from Coal Fields in the Vicinity of the BWWB Public Water Supply Intake**

### **Introduction**

A review was completed to determine concentrations of specific trace elements in coal fields in the vicinity of the BWWB public water supply intake located on the Mulberry Fork of the Black Warrior River in Walker County, Alabama (Figure 1). Trace element concentrations are provide in the *U.S. Geological Survey Open File Report 97-134*, which contains a database of analytical data, sample locations, descriptive information, analytical methods and sampling techniques, database perspective, and bibliographic references for selected coal field samples in Walker County, Alabama. All sample locations were mapped to determine the concentration of trace elements within the vicinity of the BWWB public water supply intake and local watershed. The attached table (Table 1) represents the concentrations of trace elements in samples collected from coal fields near the BWWB public water supply intake. All concentrations are provided in parts per million or milligrams per kilogram.

### **USGS Database Background**

During the energy crisis of the mid-1970s the U.S. Geological Survey (USGS), in cooperation with State Geological Surveys, initiated a project to create a comprehensive national coal information database. This database, known as the National Coal Resources Data System (NCRDS), was to contain information on the quantity and quality of domestic coal resources. A major objective was to locate, measure, and characterize all of the Nation's coal resources, without regard to bed thickness, depth, location, or quality. An initial goal of the project was to obtain and characterize at least one sample per coal bed from every geographic quadrangle (approximately 50 sq. miles) underlain by coal. During the nearly 30 years since its inception, the NCRDS's Coal Quality database has developed into the largest publicly available database of coal fields. The data are used primarily by state Geological Surveys, university researchers, and other federal and state agencies.

The EPA utilizes the USGS Coal Quality database for Clean Water Act and Clean Air Act evaluations. The 1990 Amendments to the Clean Air Act (U.S. Statutes, 1990) cite more than a dozen elements as potential hazardous air pollutants and EPA uses the USGS Coal Quality database to conduct studies of the toxic air emissions from coal burning utilities. The EPA also uses the Coal Quality database for evaluations of coal bed methane (CBM) wastewater and water quality and runoff from coal mining sites.

### **Conclusion**

Review of the database indicates that trace elements are present at significant concentrations in coal fields located near the BWWB intake (Table 1). Further, concentrations of these trace elements would be expected in stormwater runoff from mine tailings, abandoned mines, and coal piles.







Table 1. Total Trace Element Concentrations in Samples Collected from Coal Fields Near the BWB Public Water Supply Intake  
(All concentrations in mg/Kg or parts per million)

USGS Sample No.	Aluminum	Iron	Sulfur	Arsenic	Bromine	Chromium	Mercury	Manganese	Molybdenum	Lead	Antimony	Selenium	Strontium	Zinc
W191072	35,000	8,200	1,200	11	2	31	0.14	13	3.2	9.1	0.61	5.2	470	6.4
W191074	8,000	8,000	1,100	18	1	9.1	0.22	12	2.3	1.1	0.31	3	110	4
W191075	27,000	16,000	1,100	13	4	23	0.31	11	4	6.4	1.3	6	160	10
W191292	24,000	7,400	990	10	4	20	0.22	20	1.6	5.8	0.53	1	69	8.4
W191293	23,000	5,800	760	7.1	4	19	0.28	13	1.9	5.1	0.39	1.5	120	8.3
W191294	27,000	9,400	1,200	8.1	2	32	0.11	11	5.6	11	1.8	6.8	360	5
W191936	34,000	8,400	920	20	1	25	0.22	13	2.9	7.5	0.74	4.5	250	8.7
W191937	40,000	16,000	1,100	40	2	35	0.39	18	5.1	16	3	6.3	460	11
W191938	12,000	9,600	510	20	2	10	0.23	7.7	4	3.6	3.1	2	62	9.5
W191939	14,000	13,000	970	7.8	1	12	0.21	7	2.7	3.7	0.67	2.7	200	5.1
W191940	21,000	10,000	990	5.6	1	20	0.02	16	2.9	4.4	0.56	4.9	140	7
W191941	26,000	12,000	660	18	1	25	0.24	14	13	11	2	6	180	7.6
W205206	12,000	5,600	1,300	39	2.1	14	0.09	14	8.6	5.7	0.9	2.7	110	9.4
W205207	12,000	11,000	1,600	21	2.3	16	0.2	17	4.8	7	2	2.1	110	9.8
W205214	14,000	4,300	710	8	2.1	16	0.02	17	2.7	6.9	4	1	90	19
W205215	15,000	7,400	1,200	15	2.5	17	0.2	9.9	1.8	6.2	0.6	1.8	630	5.5
W220400	19,000	7,200	930	3.3	4.7	20	0.24	240	0.17	3.8	2.2	5.3	160	31
W220404	14,000	13,000	870	22	1	19	0.21	9.6	2.2	3.8	1.5	3.4	330	3.6
W220405	9,500	5,900	630	29	1.7	16	0.25	4.9	3.9	3.5	4.3	2	76	10
W220407	12,000	3,000	510	3.6	1.1	14	0.05	13	4.9	3.7	1.7	2.1	240	15
W220408	20,000	8,000	850	48	1.8	25	0.23	10	3	5.5	0.77	3.2	740	4.8
W220409	27,000	9,600	750	140	2	30	0.24	11	2.4	4.9	1.9	4.9	400	4.2
W220416	16,000	3,800	560	11	1	18	0.22	6.3	1.6	5.6	0.44	3.4	88	13
W220417	9,400	4,800	640	5.8	1.7	18	0.25	6	3	2.7	5.8	2.7	170	3.7
W220421	17,000	8,900	870	32	1.3	20	0.19	14	1.7	4.3	1.1	3.7	380	3.7
W220422	12,000	3,900	340	4.7	1.3	15	0.08	8.2	1.3	4.3	4.3	2	46	7.8
W220423	15,000	30,000	1,200	140	0.92	42	0.53	13	5.3	2.8	3.7	4.5	150	7.3



Table 1. Total Trace Element Concentrations in Samples Collected from Coal Fields Near the BWB Public Water Supply Intake  
(All concentrations in mg/Kg or parts per million)

USGS Sample No.	Aluminum	Iron	Sulfur	Arsenic	Bromine	Chromium	Mercury	Manganese	Molybdenum	Lead	Antimony	Selenium	Strontium	Zinc
W220424	9,400	11,000	240	100	1.1	12	0.39	14	1.4	4.1	5.5	2.2	48	28
W220425	18,000	12,000	820	76	1.3	18	0.21	8.9	1.8	3.8	0.72	4.8	310	3.7
W220430	12,000	2,900	420	11	1.5	15	0.08	7.2	2	4.3	6.9	1.6	67	6.3
W220432	30,000	18,000	1,500	12	1	31	0.2	26	1.5	6.2	0.34	4.7	540	6.8
W220433	11,000	3,200	420	15	1.2	14	0.12	15	4.9	3.9	3.6	2.6	61	7.3
W220434	17,000	12,000	950	15	1.3	20	0.4	12	2.6	5.4	1.3	4.3	530	4.3
W220435	8,400	9,600	560	130	1.4	13	0.19	5.8	2.8	3.1	5.3	2.2	38	7.7
W220436	23,000	9,500	1,100	20	1.7	27	0.3	14	2.4	5.6	1.5	4.4	520	4.5
W220437	10,000	4,600	720	15	1.4	16	0.17	7.4	4.6	3.6	3.3	2	120	5.4
W220438	16,000	2,900	300	13	1.6	15	0.34	11	0.37	4.1	1.4	0.7	95	6.3
W220439	9,000	2,500	360	7	2.7	13	0.08	3.9	2.1	3.3	5.5	4.1	50	6.6
W220464	3,000	11,000	690	19	1.8	6.2	0.43	7.6	0	0.3	2.2	2.1	27	8.4
W220465	13,000	13,000	390	28	5.4	15	0.34	5.9	1.6	2.7	1.1	8.4	32	8.1
W220466	16,000	7,500	640	29	0.95	20	0.25	10	2.9	3.3	1.3	3	150	4.8
W220470	22,000	4,200	620	4	6.8	21	0.05	7.8	0.91	3.6	0.6	1.6	88	8.4
W220471	4,300	17,000	310	170	1.7	8.4	0.19	6.7	12	1	5.8	1.8	17	9
W220472	5,200	4,600	290	15	2.8	8.8	0.24	3	3.3	1.3	3.2	1	14	9.4
W220473	12,000	33,000	1,100	130	1.6	14	0.2	110	11	0.89	2	1.8	31	15
W220474	22,000	6,600	3,000	26	8.7	28	0.05	11	0.48	3.2	3.9	1.3	30	17
W220783	27,000	8,700	680	19	1.2	31	0.38	7.3	6.7	5.6	2.1	7.5	280	4.7
W220786	12,000	18,000	870	86	0.78	13	0.4	11	4.7	0.84	1.4	2.7	140	5.5
W223416	18,000	16,000	530	600	5.8	19	0.41	7.8	0.43	4.3	3.4	1.4	62	4.9
W223429	9,000	14,000	400	150	2.3	20	0.35	17	5.7	4.9	4.3	2.5	25	20
W223476	22,000	3,500	320	6.9	2.2	19	0.2	7.9	1.1	3.8	0.36	1.4	160	4.9
W223477	16,000	9,200	400	61	2.2	15	0.25	13	5.8	3.1	3.5	1.5	22	26
W229173	17,000	5,800	680	4.9	4.8	15	0.05	25	1.8	5.6	1.3	1.3	140	11
W229174	16,000	9,800	240	110	3.5	15	0.13	17	0.68	3.8	1.7	1.3	92	26

Table 1. Total Trace Element Concentrations in Samples Collected from Coal Fields Near the BWB Public Water Supply Intake  
(All concentrations in mg/Kg or parts per million)

USGS Sample No.	Aluminum	Iron	Sulfur	Arsenic	Bromine	Chromium	Mercury	Manganese	Molybdenum	Lead	Antimony	Selenium	Strontium	Zinc
W229184	15,000	10,000	580	26	2.1	15	0.22	11	2.5	6.8	1.5	2.2	120	7.4
W229185	17,000	49,000	570	170	2.2	18	0.52	7.7	0	13	14	3.4	77	26
W229186	29,000	14,000	980	69	3	24	0.18	20	1.1	12	0.98	2.3	250	14
W229187	9,800	22,000	550	150	1.9	16	0.52	12	0	4.9	2.5	1.8	63	6.2
W229188	5,300	1,600	260	1.1	2.4	4.9	0.06	2.7	0.9	2.2	3.8	0.52	23	3.7
W229197	14,000	30,000	670	320	2.2	14	0.44	15	1.4	5.2	1.8	1.4	52	9.1
W229202	9,200	3,600	4,100	2.4	4.1	13	0.06	15	0.75	7.3	4.5	1.2	36	21
W229203	41,000	14,000	700	44	4	43	0.29	13	5.9	19	2.6	9.4	840	7.9
W229204	11,000	2,300	450	6.9	2.8	14	0.05	4.7	4.2	5.4	4.2	1.9	48	10
W233994	4,100	36,000	860	120	1.7	6.2	0.12	29	0	3.4	10	1.7	45	9.4
W233995	45,000	23,000	1,100	110	2.3	72	0.06	30	3.4	31	6.5	9	250	88
W233996	22,000	24,000	680	150	3	21	0.04	18	1.5	7.8	2.1	1.6	140	15
W234124	18,000	10,000	1,000	98	3.4	18	0.09	18	4	7.6	0.53	4.3	380	9.7
W234125	10,000	8,400	780	15	2.4	16	0.09	7.1	7.2	5.7	3.6	2.9	79	7.3
W234126	31,000	17,000	1,100	32	2	34	0.15	34	7.1	15	3.1	10	860	23
W234127	11,000	6,200	770	15	1.8	14	0.04	4.7	8.7	5.9	5	1.9	73	28





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**1. Executive Summary**

The Birmingham Water Works Board (Board) utilizes the Mulberry Fork as a primary water source for the Western Filter Plant (WFP). A coal mine has recently been proposed adjacent to the Board's Mulberry intake with outfalls being located approximately 800 feet upstream. The Board has raised concern regarding the impact of this mine on the raw water quality and subsequent treatment at WFP. Therefore, a sampling and analysis plan was developed to determine the possible increase in concentrations of metals and organics due to mine runoff. The mine to be evaluated is approximately 1.5 miles upstream of the Board's Mulberry intake on the east bank of Mulberry Fork.

The Board has conducted Acid Base Accounting (ABA) tests on five coal bearing samples collected from the Black Warrior River watershed in July 2009. Based on test results, this coal bearing material is expected to generate acidic conditions. As no reported natural neutralization potential exists in these samples, the acidic waters produced are likely runoff dumps during rain events. Therefore, operational processes should be considered to reduce the potential of acidic runoff. The operational processes may either be directed toward the control and treatment of the runoff or the implementation of controls to reduce the oxidation of sulfides in these materials on the dumps and waste dumps.

Should acidic conditions become pervasive, these coal bearing materials are likely to leach metals into the environment, some at concentrations above current Mulberry Fork levels and various local and federal limits. Based on the synthetic leaching tests (SPLP) the metals of greatest concern are: aluminum, arsenic, iron, manganese, and zinc.

Only one of the five samples was reported to leach BETX. Both benzene and toluene were leached at concentrations above the EPA drinking water standards for this sample.

Total organic carbon concentrations reported within the leachate from the SPLP tests ranged from 2.7 to 4.5 weight %. The impact of this additional amount of organic carbon to Mulberry Fork watershed is unknown at this time.

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**2. Study Background**

The Board utilizes the Mulberry Fork as a primary water source for the Western Filter Plant. A coal mine has recently been proposed adjacent to the Board's Mulberry intake with outfalls being located approximately 800 feet upstream. The Board has raised concern regarding the impact of this mine on the raw water quality and subsequent treatment at WFP. Therefore, a sampling and analysis plan (SAP) was developed to



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determine possible increases in concentrations of metals and organics due to mine runoff (*Sampling and Analysis Plan for the Shepherd Bend Coal Mine Waste Rock & Coal Rejects; Coal Mine Drainage and Water Quality Study dated October 2008*). The mine to be evaluated is approximately 1.5 miles upstream of the BWWB's Mulberry intake on the east bank of Mulberry Fork.

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### **3. Material Sampling**

Five (5) samples of coal bearing materials were collected in accordance with the SAP authorized by the Board. These samples were collected within the Black Warrior River watershed near an active coal mine that uses the nearby site for processing the coal bearing materials. Each of the five samples were split and placed into two Ziploc bags and sent to the two ALS laboratories for analysis.

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### **4. Sample Analysis**

Two splits from each of the five (5) samples were analyzed by two ALS laboratories: ALS Environmental Division located in Houston Texas; and, ALS Minerals Division located in Reno Nevada. The samples were analyzed in accordance with the SAP authorized by the Board. ALS Houston performed the metal/organic leaching tests and ALS Reno performed the acid base accounting (ABA) tests.

Synthetic Precipitation and Leaching Potential (SPLP) analyses (EPA Method 1312) were performed at the ALS Houston facility. The SPLP metals extraction / leachate were performed using a 1:1 ratio of sample to extraction fluid. Normally EPA Method 1312 calls for a 1:20 extraction / leachate ratio. The use of the 1:1 ratio was done to lower the methods detection limits for leached metals and organics and to increase the likelihood of observing potential impacts that might occur from the leaching of the coal bearing materials. The dissolved organic carbon (DOC) analyses were performed on the 7 day distilled water leachate from the five samples. All reported sample results passed laboratory QA/QC procedures and requirements and are considered a fair representation of the likely leachate chemistry from a rain event. Metals analyzed included: aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, titanium, and zinc. Organics and non-metals analyzed included: BETX (Benzene, Ethyl Benzene, Toluene, and Xylenes), Bromide, dissolved organic carbon, and total organic carbon.

Acid Base Accounting (ABA) tests were performed at the ALS Reno facility. The ABA tests were performed using industry standard methods based on Sobek (*Sobek, A., Schuller, Freeman, W.J. and Smith, R. (1978), Field and Laboratory Methods Applicable to Overburdens*





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and Minesoil, EPA report no. EPA-600/2-78-054 p.47-50). The results are reported in tons of calcium carbonate required to neutralize the acid for every 1000 tons of ore that may be oxidized. The pH reported is a paste pH thus reflecting the pH of small amounts of water that are in contact with this material, such as after a rain event. Additionally, the laboratory quantified the total sulfur in each sample and the amount of sulfur that was present in the form of sulfide sulfur. Sulfide sulfur is the form that may be oxidized and form sulfuric acid, initiating the condition referred to as acid mine drainage. The lowering of the pH under these types of conditions may also increase the leaching of the metals contained within the coal bearing materials, simulated by the SPLP tests described above.

## 5. Sample Results

### 5.1 Synthetic Precipitation and Leaching Potential (SPLP) – EPA Method 1312.

Metal concentrations above the method detection limits (MDL) in the SPLP leachate were observed for: aluminum, antimony, arsenic, chromium, iron, lithium, manganese, mercury, nickel, strontium, titanium, and zinc (see Table 1). Metal concentrations associated with four (4) or five (5) of the samples were reported above the MDL including: **aluminum** (average value 0.85 mg/L), **lithium** (average value 0.01 mg/L), **strontium** (average value 0.03 mg/L), and **zinc** (average value 0.07 mg/L).

- Metal concentrations in SPLP leachate that exceeded current average Mulberry Fork concentrations for one or more samples included: aluminum, iron, manganese, nickel, titanium, and zinc.
- Metal concentrations in SPLP leachate that exceeded anti-degradation limits for one or more samples included: arsenic and zinc.
- Metal concentrations in SPLP leachate that exceeded suggested mine permit limits for one or more samples included: arsenic and mercury.
- Metal concentrations in SPLP leachate that exceeded EPA Primary (or Secondary) Drinking Water Standards for one or more samples included: aluminum, antimony, arsenic (secondary), iron (secondary), manganese (secondary), and mercury.

Organics and non-metal concentrations (see Table 2) above the method detection limits in the SPLP leachate were observed for: benzene and toluene only in one of the five samples (sample number 4).

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- Organics and non-metal in SPLP leachate that exceeded EPA Primary (or Secondary) Drinking Water Standards for one or more samples included: benzene and toluene.

Dissolved organic carbon from the distilled water leach was reported in two of the five samples while total organic carbon concentration ranged from 2.7 to 4.5 weight percent for the five SPLP leachate samples.

### 5.2 Acid Base Accounting (ABA)

Maximum potential acidity (MPA) ranged from 7.8 to 84.4 tons  $\text{CaCO}_3$ /1000 tons of ore. Based on industry best practices (*Managing Sulphidic Mine Wastes and Acid Drainage, Environment Australia, 1997; Best Practice Environmental Management in Mining*) and government guidelines (*EPA/DOE Mine Waste Technology Program, various annual reports*). Materials having MPA values less than 10 are generally considered to be non-acid producing material. Materials having MPA values from 10 to 20 are considered to be non-definitive for acid generation. Materials with an MPA greater than 20 are considered likely to produce acidic conditions if no natural conditions or operational procedures are available to counter-act the acid generation and/or oxidation of sulfide sulfur (most prevalently pyrite).

The neutralization potential of a material may arise from many sources which may include: contained carbonates, silicates, and other minerals that consume acid when in contact with acidic conditions. The neutralization potential of the material is determined through titration of the material with an acid. For the five samples, the neutralization potential was reported between 0 and 2 tons  $\text{CaCO}_3$ /1000 tons of ore. These values are very low and represent material that has little buffering capacity towards acidic conditions.

If the neutralization potential of a material is greater than the potential to generate acid and the kinetics of these reactions is adequate, then the material on balance would not be considered to be acid generating. The net neutralization potential (NNP) represents this overall acidic reaction of the materials. For the five samples these are all negative numbers indicating that there is a propensity to generate acid with no buffering capacity to mediate the resultant acidic waters.

The paste pH results show that oxidization of sulfides within the coal bearing material sampled is not currently occurring ( $\text{pH} > 7$ ). However, the potential for sulfide oxidation is present based on ABA results, with the exception of Sample #2 where the paste pH suggests that oxidation is occurring and that sufficient sulfides are present to lower the





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pH of water in contact with this material to acidic conditions (pH = 4.1). It is not unusual for samples with high pyrite contents to show this type of analysis pattern.

The total sulfur and sulfide sulfur results support the MPA and paste pH results described above. Sulfide sulfur is found in all five samples and comprises most all of the sulfur found in the samples. These reported results indicate that sulfide sulfur is present in the coal bearing materials sampled and analyzed, and this sulfide sulfur may be oxidized to generate acidic conditions.

## 6. Summary Findings

Five samples of coal bearing material were sampled and sent to ALS analytical laboratories located in Houston and Reno for leaching and acid generation testing. All samples were under standard chain-of-custody procedures throughout the collection and transfer to the analytical facilities.

Based on the ABA tests, this coal bearing material is expected to generate acidic conditions. As no reported natural neutralization potential exists in these samples, the acidic waters produced are likely runoff dumps during rain events. Therefore, operational processes should be considered to reduce the potential of acidic runoff. The operational processes may either be directed toward the control and treatment of the runoff or the implementation of controls to reduce the oxidation of sulfides in these materials on the dumps and waste dumps.

Should acidic conditions become pervasive, these coal bearing materials are likely to leach metals into the environment, some at concentrations above current creek levels and various local and federal limits. Based on the SPLP tests the metals of greatest concern are: aluminum, arsenic, iron, manganese, and zinc.

Only one of the five samples was reported to leach BETX. Both benzene and toluene were leached at concentrations above the EPA drinking water standards for this sample.

Total organic carbon concentrations reported within the leachate from the SPLP tests ranged from 2.7 to 4.5 weight %. The impact of this additional amount of organic carbon to Mulberry Fork watershed is unknown at this time and not part of this study.





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**Table 1. Leachable Metal Concentrations.**  
**Results of Synthetic Precipitation and Leaching Procedure (SPLP) [USEPA Method 1312]**  
 (All concentrations are reported in mg/L)

	Aluminum	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Lithium
Sample 1	3.400	<0.005	<0.005	<0.00060	<0.00060	<0.005	0.822	<0.00040	0.0255
Sample 2	0.104	<0.005	0.00922	<0.00060	<0.00060	<0.005	18.6	<0.00040	0.0064
Sample 3	0.308	0.00793	<0.005	<0.00060	<0.00060	<0.005	<0.036	<0.00040	0.0292
Sample 4	0.163	<0.005	0.00672	<0.00060	<0.00060	<0.005	<0.036	<0.00040	<0.0050
Sample 5	0.149	<0.005	<0.005	<0.00060	0.00705	<0.005	<0.036	<0.00040	0.0063
Average Value in Mulberry Fork <sup>1</sup>	0.060	0.01	0.01	0.015	0.05	0.05	0.11	0.01	—
Antidegradation Limit <sup>2</sup>	NS	0.0104	0.009	NS	0.0505	0.0516	NS	0.0092	NS
Suggested Mine Permit Limit <sup>3</sup>		<0.1	<0.01		0.2	0.4		<0.01	
EPA Primary Drinking Water Standards <sup>4</sup>	0.05 to 0.2 <sup>5</sup>	0.006	0.01 0.0 <sup>6</sup>	0.005	0.1	1.3	0.3 <sup>5</sup>	0.015 0.0 <sup>6</sup>	NS

	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Titanium	Zinc
Sample 1	0.0141	<0.000042	<0.005	<0.005	<0.005	<0.005	0.03030	0.0246	0.095
Sample 2	0.0614	0.000262	<0.005	0.0536	<0.005	<0.005	0.08970	<0.005	0.198
Sample 3	<0.005	<0.000042	<0.005	0.0050	<0.005	<0.005	0.00691	<0.005	0.019
Sample 4	<0.005	<0.000042	<0.005	<0.005	<0.005	<0.005	0.00746	<0.005	0.011
Sample 5	<0.005	<0.000042	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.022
Average Value in Mulberry Fork <sup>1</sup>	0.06	0.0003	—	0.05	—	0.05	—	0.01	0.05
Antidegradation Limit <sup>2</sup>	NS	0.0003	NS	NS	NS	NS	NS	NS	0.0537
Suggested Mine Permit Limit <sup>3</sup>		<0.0003							0.8
EPA Primary Drinking Water Standards <sup>4</sup>	0.05 <sup>5</sup>	0.002	NS	NS	0.05	0.10 <sup>5</sup>	NS	NS	5 <sup>5</sup>





**Table 1. Leachable Metal Concentrations.**  
**Results of Synthetic Precipitation and Leaching Procedure (SPLP) [USEPA Method 1312]**  
(All concentrations are reported in mg/L)

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1) Average Value in Mulberry Fork from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
2) Antidegradation Limit from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
3) Suggested Mine Permit Limit from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
4) EPA Primary Drinking Water Standards - National Primary Drinking Water Regulations
5) EPA Secondary Drinking Water Standards - National Secondary Drinking Water Regulations
6) EPA Primary Drinking Water Standards - Public Health Goal



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**Table 2. Leachable Concentrations (Miscellaneous Constituents)  
Results of Synthetic Precipitation and Leaching Procedure (SPLP) [USEPA Method 1312]**  
(SPLP concentrations are reported in ug/kg)

	Benzene	Bromide	EthylBenzene	DOC	TOC	Toluene	Xylenes
Sample 1	<25	<0.30	<25	11.0	32,200	<25	<25
Sample 2	<25	<0.30	<25	2.67	42,500	<25	<25
Sample 3	<25	<0.30	<25	<1	45,400	<25	<25
Sample 4	37	<0.30	<25	<1	27,100	31	<25
Sample 5	<25	<0.30	<25	<1	36,900	<25	<25
Average Value in Mulberry Fork (mg/L) <sup>1</sup>	0.060						
Antidegradation Limit (mg/L) <sup>2</sup>	NS	NS	NS	NS	NS	NS	NS
Suggested Mine Permit Limit (mg/L) <sup>3</sup>		<0.05					
EPA Primary Drinking Water Standards (mg/L) <sup>4</sup>	0.005 0.0 <sup>6</sup>	NS	0.7	NS	NS	1	10

DOC = Dissolved Organic Carbon; TOC = Total Organic Carbon

- 1) Average Value in Mulberry Fork from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
- 2) Antidegradation Limit from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
- 3) Suggested Mine Permit Limit from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
- 4) EPA Primary Drinking Water Standards - National Primary Drinking Water Regulations
- 5) EPA Secondary Drinking Water Standards - National Secondary Drinking Water Regulations
- 6) EPA Primary Drinking Water Standards - Public Health Goal





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Table 3. Acid Generation Potential and Sulfide Sulfur Leachability  
Results of Synthetic Acid Base Accounting Procedure (ABA) [Industry Standard Method]

	Maximum Potential Acidity (MPA)	Neutralization Potential (NP)	Net Neutralization Potential (NNP)	NP:MPA Ratio	pH	Total Sulfur (%)	Sulfide Sulfur (%)
Sample 1	7.8	2	-6	0.26	7.1	0.25	0.25
Sample 2	84.4	0	-84	0.00	4.1	2.70	2.66
Sample 3	8.4	1	-7	0.12	7.4	0.27	0.26
Sample 4	10.9	0	-11	0.00	7.9	0.35	0.35
Sample 5	14.1	1	-13	0.07	7.1	0.45	0.45
Average Value in Mulberry Fork (mg/L) <sup>1</sup>	0.060						21
Antidegradation Limit (mg/L) <sup>2</sup>	NS	NS	NS	NS	NS	NS	NS
Suggested Mine Permit Limit <sup>3</sup>							
EPA Primary Drinking Water Standards <sup>4</sup>	NS	NS	NS	NS	6.5 - 8.5	NS	NS

MPA / NP / NNP reporting units = tCaCO<sub>3</sub>/1000t ore

- 1) Average Value in Mulberry Fork from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
- 2) Antidegradation Limit from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
- 3) Suggested Mine Permit Limit from "Shepherd Bend Mine: Potential Impacts on the Mulberry and Drinking Water Concerns" presented by Patty Barron, P.E. and Patrick Flannelly, P.E. October 2008
- 4) EPA Primary Drinking Water Standards - National Primary Drinking Water Regulations
- 5) EPA Secondary Drinking Water Standards - National Secondary Drinking Water Regulations
- 6) EPA Primary Drinking Water Standards - Public Health Goal

October 1, 2009

**Birmingham Water Works Board**  
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**1. Summary**

The Birmingham Water Works Board (Board) utilizes the Mulberry Fork as a primary water source for the Western Filter Plant (WFP). A surface water sampling plan was developed to aid in determining the potential impacts of a proposed mine near the current Mulberry intake. Since, there is an existing coal mine currently in operation upstream of the Mulberry intake, it was utilized as the focal point for our sampling locations. The mine that was evaluated is approximately 1.5 miles upstream of the Board's Mulberry intake on the east bank of Mulberry Fork. Four locations were sampled during a wet weather event and a dry weather event in July and August of 2009. Below is a list of the locations that were sampled.

- Site 1 – Mulberry Intake
- Site 2 – 800 feet downstream of mine outfall
- Site 3 - Mine Outfall
- Site 4 – 800 feet upstream of mine outfall

The sampling results confirmed the potential for several metals to be discharged from the mine outfall at elevated levels as compared to the typical water quality in this reach of the Mulberry Fork. Four of the metals found were consistent with the ones listed as potential concerns in the Coal Mine Drainage and Water Quality Study memo (Malcolm Pirnie, September 2009) with the addition of one parameter. The potential metals of concern are aluminum, iron, manganese, zinc, and strontium. All of these metals are regulated except for strontium. It is important to note that though these metals returned elevated results at the outfall location, the results at the downstream location were not greater than the typical concentrations seen from 2007-2008.

Total organic carbon (TOC) concentrations were elevated at all locations during the wet weather sampling event. The concentration discharged from the outfall was greater than that of the other three locations, however the elevated concentration at the intake can not be solely attributed to the mine outfall. During the dry weather sampling event, results from all locations were comparable to each other as well as the 2007-2008 average for concentrations of TOC.

None of the constituents sampled at the mine outfall location were beyond the limits of the current permit. However, it is important to note that aluminum, zinc, strontium, and TOC are not monitoring requirements according to the current permit but were being discharged at elevated levels.

The following section provides summary tables of the data collected during the sampling events on the Mulberry Fork.



**2. Water Quality Data**

Laboratory analysis was performed at the Board's Envirolab and the Alabama Power Laboratory as noted in the tables. Table 2.1 and 2.2 shows the data that was collected during the wet and dry weather events in July and August of 2009.

**Table 2.1**  
**Wet Weather Event Water Quality**

Parameter	Sample Location				MCL <sup>1</sup>
	Site 1 - Mulberry Intake	Site 2 - Downstream of Outfall	Site 3 - Outfall of Mine	Site 4 - Upstream of Outfall	
Samples Collected 7/22/2009 - Wet Weather Event					
Aluminum (mg/L)	<0.05	<0.05	0.206	<0.05	0.2
Antimony (mg/L) Method 200.8	<0.005	<0.005	<0.005	<0.005	0.006
Antimony (mg/L) Method 200.9	<0.005	<0.005	<0.005	<0.005	0.006
Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	0.01
Benzene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	0.005
Bromide (mg/L)	<0.1	<0.1	<0.1	<0.1	-
Chromium (mg/L)	<0.005	<0.005	<0.005	<0.005	0.1
Chromium-Hexa (Diss) (mg/L)	<0.01	<0.01	<0.01	<0.01	-
Copper (mg/L)	<0.01	<0.01	<0.01	<0.01	1
Dissolved Organic Carbon (DOC) (mg/L)	2.94	2.75	3.43	2.78	4
Ethylbenzene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	0.7
Iron (mg/L)	0.109	0.11	0.667	0.128	0.3
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	0.015
Lithium (mg/L)*	0.007	0.005	0.013	ND	-
m,p,-Xylene (mg/L)	<0.001	<0.001	<0.001	<0.001	0.01
Manganese (mg/L)	<0.01	0.059	0.188	0.09	0.1
Mercury (mg/L)	<0.001	<0.001	<0.001	<0.001	0.002
Molybdenum (mg/L)*	<0.01	<0.01	<0.01	<0.01	-
o-Xylene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	0.01
Selenium (mg/L) EPA 200.9	<0.005	<0.005	<0.005	<0.005	0.05
Strontium (mg/L)*	0.058	0.055	0.401	0.047	-
Sulfate (mg/L)	25.1	22.1	22.4	22.7	250
Toluene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	1
Total Dissolved Solids (TDS) (mg/L)	78	83	83	88	-
Total Organic Carbon (TOC) (mg/L)	3.61	3.59	4.09	3.33	4
Zinc (mg/L)	<0.01	<0.01	<0.01	<0.01	5
Soluble Aluminum (mg/L)	0.0643	0.0635	0.0811	0.0648	-
Soluble Antimony (mg/L)	<0.005	<0.005	<0.005	<0.005	-
Soluble Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	-
Soluble Copper (mg/L)	0.025	<0.01	<0.01	<0.01	-
Soluble Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	-
Soluble Lithium (mg/L)*	0.005	0.004	0.009	<0.003	-
Soluble Mercury (mg/L)	N/A	<0.001	<0.001	<0.001	-
Soluble Molybdenum (mg/L)*	<0.01	<0.01	<0.01	<0.01	-
Soluble Strontium (mg/L)*	0.043	0.039	0.307	0.036	-
Soluble Zinc (mg/L)	0.028	0.0162	0.0126	0.0469	-

\*Samples analyzed at AL Power Lab

<sup>1</sup>MCL - for drinking water

Higher than other locations but not regulated

Greater than MCL



# Technical Memorandum

## Surface Water Quality Analysis

October 1, 2009

**Birmingham Water Works Board**  
**Potential Impacts to Mulberry Fork Watershed**

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**Table 2.2**  
**Dry Weather Event Water Quality**

Parameter	Sample Location				MCL <sup>1</sup>
	Site 1 - Mulberry Intake	Site 2 - Downstream of Outfall	Site 3 - Outfall of Mine <sup>2</sup>	Site 4 - Upstream of Outfall	
	Samples Collected 8/18/2009 - Dry Weather Event				MCL
Aluminum (mg/L)	<0.05	<0.05	0.106	<0.05	0.2
Antimony (mg/L) Method 200.9	<0.005	<0.005	<0.005	<0.005	0.006
Antimony (mg/L) Method 200.8	<0.005	<0.005	<0.005	<0.005	0.006
Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	0.01
Benzene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	0.005
Bromide (mg/L)	<0.10	<0.10	<0.10	<0.10	-
Chromium (mg/L)	<0.005	<0.005	<0.005	<0.005	0.1
Chromium (VI) (mg/L)	<0.00001	<0.00001	0.01	<0.00001	-
Chromium-Hexa (Diss) (mg/L)	<0.01	<0.01	<0.01	<0.01	-
Copper (mg/L)	<0.005	<0.01	<0.01	0.0156	1
Dissolved Organic Carbon (DOC) (mg/L)	2.76	2.81	2.71	2.66	4
Ethylbenzene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	0.7
Iron (mg/L)	0.0764	0.083	0.396	0.0776	0.3
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	0.015
Lithium (mg/L) *	<0.003	<0.003	<0.003	<0.003	-
Lithium (mg/L)	<0.003	<0.003	<0.003	<0.003	-
m,p,-Xylene (mg/L)	<0.001	<0.001	<0.001	<0.001	0.01
Manganese (mg/L)	0.0241	N/A	0.242	0.0592	0.1
Mercury (mg/L)	<0.001	<0.001	<0.001	<0.001	0.002
Molybdenum (mg/L) *	<0.01	<0.01	<0.01	<0.01	-
Molybdenum (mg/L)	<0.01	<0.01	<0.01	<0.01	-
o-Xylene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	0.01
Selenium (mg/L) EPA 200.9	<0.005	<0.005	<0.005	<0.005	0.05
Strontium (mg/L) *	0.051	0.033	0.036	0.033	-
Strontium (mg/L)	0.051	0.033	0.036	0.033	-
Sulfate (mg/L)	29.1	15	15.8	18.7	250
Sulfide (mg/L)	0.06	0.06	<0.01	0.02	-
Sulfide (mg/L) *	0.06	0.06	<0.01	0.02	-
Sulfide - Dissolved (mg/L)	<0.01	0.02	<0.01	<0.01	-
Sulfide - Dissolved (mg/L) *	<0.01	0.02	<0.01	<0.01	-
Toluene (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	1
Total Dissolved Solids (TDS) (mg/L)	28	23	20	60	-
Total Organic Carbon (TOC) (mg/L)	3	2.75	2.99	2.93	4
Zinc (mg/L)	<0.01	<0.01	<0.005	<0.01	5
Soluble Aluminum (mg/L)	<0.05	<0.05	<0.05	<0.05	-
Soluble Antimony (mg/L) EPA 200.8	<0.005	<0.005	<0.005	<0.005	-
Soluble Antimony (mg/L) EPA 200.0	<0.005	<0.005	<0.005	<0.005	-
Soluble Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	-
Soluble Copper (mg/L)	<0.01	<0.01	<0.01	<0.01	-
Soluble Iron (mg/L)	<0.05	<0.05	<0.05	<0.05	-
Soluble Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	-
Soluble Molybdenum (mg/L)	<0.01	<0.01	<0.01	<0.01	-
Soluble Strontium (mg/L) *	0.047	0.032	0.033	0.032	-
Soluble Strontium (mg/L)	<0.05	<0.05	<0.05	<0.05	-
Soluble Zinc (mg/L)	0.0345	<0.01	0.212	0.0629	-

\*Samples analyzed at AL Power Lab

<sup>1</sup>MCL - for drinking water  
 Higher than other locations but not regulated  
 Greater than MCL

<sup>2</sup> Sampled in mid-river due to lack of discharge from mine outfall



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Table 2.3 shows the average water quality seen at the Mulberry intake from monthly samples collected during 2007 and 2008.

**Table 2.3**  
**Mulberry Intake Water Quality**

<b>Mulberry Fork Characteristics</b>				
<b>Parameter</b>	<b>AVG</b>	<b>Max</b>	<b>Min</b>	<b>Units</b>
<b>Metals*</b>				
Aluminum	0.065	0.270	<0.05	mg/L
Antimony	<0.005	<0.005	<0.005	mg/L
Arsenic	<0.005	<0.005	<0.005	mg/L
Chromium	<0.005	0.06	<0.005	mg/L
Copper	0.024	0.402	<0.01	mg/L
Iron	0.10	1.01	<0.05	mg/L
Lead	<0.005	0.007	<0.005	mg/L
Manganese	0.040	0.148	<0.01	mg/L
Zinc	0.064	0.230	<0.01	mg/L
Mercury	<0.001	<0.001	<0.001	mg/L
<b>IC*</b>				
Bromide	<0.25	<0.25	<0.25	mg/L
Chloride	5.11	23.30	2.08	mg/L
Fluoride	0.06	0.24	<0.05	mg/L
Nitrate as N	0.72	5.89	<0.06	mg/L
Nitrite as N	<0.08	0.36	<0.08	mg/L
Orthophosphate	<0.17	<0.17	<0.17	mg/L
Sulfate	26.2	82.7	8.3	mg/L
Conductivity	167	370	86	ms/cm
Fecal Coliform	F11	F65	0	cfu/100mL
Hardness	77	126	34	mg/L
TDS	132	280	60	mg/L
TOC	3.1	5.7	1.0	mg/L
TSS	5.0	15	1.2	mg/L

\*Data from EnviroLab Nov 2007 - 2008 Project 77

### 3. Summary Findings

While concentrations of the parameters of concern were not seen downstream at elevated levels they are still cause for potential concern if a mine outfall were to be within a close proximity of the Mulberry Intake as proposed for the Shepherd Bend Mine. Also, it is apparent from the data that there are additional contaminants that need to be considered as monitoring requirements for current and future coal mine permits. The following parameters which were seen at elevated levels in the outfall discharge consist of aluminum, iron, manganese, zinc, strontium, and TOC.