

**GROUND WATER HYDROLOGY (880-X-8E-.06 (1))**

- 1. Groundwater Hydrology Description**      *No change from original permit.*
- 2. Lithologic Description of Water Bearing Zone(s):**      *No change from original permit.*
- 3. Aquifer Test(s):**      Aquifer tests have not been required at this time.

**4. Well Inventory:**

A well inventory was conducted by McGehee Engineering Corp. in July of 2010 on the original permit application. Door to door interviews were conducted on occupied dwelling within one half mile of the permit boundary to determine if domestic wells were present. This inventory was updated in February of 2014. The updated inventory revealed that there are 16 new residences within the half-mile radius of the proposed Revision R-5 permit boundary of Mine No. 1 that were not surveyed with the original permit.

There was one new well located on Residence ID# 113 (previously ID# 97). The well is owned by Cecil F. & Janie C. Hatcher (1260 Crossfield Ln, Gardendale, AL, 35071) and is used to water a garden. The owner declined to have the well sampled. The other three wells were identified in the original survey. These wells are located on ID# 68, #71 and # 119. None of the three previously identified wells are currently in use.

The primary water source for all residents within the half- mile radius of Mine No. 1 is obtained from the Birmingham Waterworks. See [Well Inventory](#) and [Hydro-Geo Map](#).

**5. Groundwater Baseline Quality:**

A total of 8 monthly samples were taken prior to the permit being issued to determine the baseline groundwater quality. The pre-mine quality of the groundwater in the monitored wells is summarized in Pre-Mine Groundwater Baseline Analysis Table.

**6. Geologic Structures that Influence Groundwater Movement:** *No change from original permit.*

**7. Groundwater Description Support Data:** *No change from original permit.*

**8. Groundwater Sampling and Analytical Methods:** *No change from original permit.*

**9. Groundwater Sampling and Analytical Information:**

A total of twelve (12) quarterly samples have been taken in each monitoring well since mining has been active. The active mining quality of the groundwater in the monitored wells is summarized in Active Mining Groundwater Analysis Table.

**Black Warrior Minerals, Inc.**  
**Mine No. 1, P-3950, R-5**  
**Addendum to Attachment II-F**

**PRE-MINE GROUNDWATER BASELINE ANALYSIS**

SAMPLE I.D.: MW-1

MONITORING SOURCE: WELL

MONITORING ELEV. = 336.70'

DATE	pH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
01/11/10	6.95	2.85	0.42	420	48	21	154	7.50'	329.20'
02/08/10	6.57	14.06	0.59	429	67	34	150	6.00'	330.70'
03/22/10	6.70	1.59	0.56	431	70	49	151	7.00'	329.70'
04/12/10	6.73	4.36	0.52	421	55	27	34	7.00'	329.70'
05/10/10	6.57	7.90	0.46	431	51	18	151	7.00'	329.70'
06/14/10	7.04	2.01	0.54	434	51	19	152	7.50'	329.20'
08/23/10	7.39	0.58	0.40	457	36	19	159	8.17'	328.53'
10/04/10	7.68	0.68	0.43	435	33	31	148	9.0'	327.7'

**ACTIVE MINING GROUNDWATER ANALYSIS**

SAMPLE I.D.: MW-1

MONITORING SOURCE: WELL

MONITORING ELEV. = 336.70'

DATE	pH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
01/13/11	8.02	0.68	0.43	463	72	56	145	7.5'	329.2'
04/14/11	6.69	1.25	0.41	419	66			7.0'	329.7'
08/01/11	7.23	1.53	0.04	430	2			8.0'	328.7'
11/18/11	7.63	0.31	0.36	442	68			8.0'	328.7'
02/06/12	7.2	1.11	0.52	462	52			7.0'	329.7'
05/21/12	6.92	0.54	0.21	445	13			7.33'	329.37'
08/27/12	6.83	0.64	0.41	397	33			7.0'	329.7'
11/14/12	8.15	0.72	0.37	406	36			7.0'	329.7'
02/07/13	6.69	1.85	0.48	461	102			6.0'	330.7'
04/10/13	7.76	1.50	0.51	517	94			5.5'	331.2'
07/30/13	7.38	10.22	0.28	492	122			6.0'	330.7'
11/7/13	7.28	0.45	0.04	516	75			7.0'	329.7'

**Black Warrior Minerals, Inc.**  
**Mine No. 1, P-3950, R-5**  
**Addendum to Attachment II-F**

**PRE-MINE GROUNDWATER BASELINE ANALYSIS**

SAMPLE I.D.: MW-2

MONITORING SOURCE: WELL

MONITORING ELEV. = 404.90'

DATE	pH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
01/11/10	6.95	8.37	0.51	154	2	23	75	16.00'	388.90'
02/08/10	6.13	16.76	0.5	140	7	15	59	15.00'	389.90'
03/22/10	6.68	1.53	0.25	172	7	29	71	16.00'	388.90'
04/12/10	6.63	3.84	0.23	174	10	21	39	15.00'	389.90'
05/10/10	6.42	9.24	0.24	178	9	15	73	16.00'	388.90'
06/14/10	7.20	5.45	0.29	182	9	16	80	16.50'	388.40'
08/23/10	7.67	3.07	0.36	115.1	2	18	51	17.58'	387.32'
10/04/10	8.24	0.61	0.11	58.5	2	32	23	19.0'	385.9'

**ACTIVE MINING GROUNDWATER ANALYSIS**

SAMPLE I.D.: MW-2

MONITORING SOURCE: WELL

MONITORING ELEV. = 404.90'

DATE	pH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
01/13/11	8.15	0.87	0.19	135.4	5			16	388.9'
04/14/11	7.78	2.10	0.07	56	2			18	286.9'
08/01/11	6.37	7.26	0.09	54.8	77			19	385.9'
11/18/11	6.05	0.33	0.03	59.8	30			23	381.9'
02/06/12	6.56	0.77	0.07	67.6	2			20	384.9'
05/21/12	6.57	2.91	0.04	41.4	9			23	381.9'
08/27/12	5.55	0.57	0.64	49.7	2			22	382.9'
11/14/12	7.74	0.81	0.15	67.8	2			24	380.9'
02/07/13	6.64	2.46	0.05	56.1	8			21.5	383.4'
04/10/13	7.64	1.31	0.05	57.9	5			22	382.9'
07/30/13	7.08	2.22	0.07	101.5	41			24	380.9'
11/7/13	7.61	0.45	0.04	160.1	39			26	378.9'

**Black Warrior Minerals, Inc.**  
**Mine No. 1, P-3950, R-5**  
**Addendum to Attachment II-F**

**PRE-MINE SEASONAL DATA**

**MW-1**

SEASON	pH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
SPRING	6.66	4.62	0.5	428	59	31	112	7.00'	329.70'
SUMMER	7.04	2.01	0.54	434	51	19	152	7.50'	329.20'
FALL	7.68	0.68	0.43	435	33	31	148	9.0'	327.7'
WINTER	6.72	8.46	0.5	425	58	28	152	6.75'	329.95'
AVERAGE	7.03'	3.94'	0.49	429	50.2	22.5	141	7.56'	329.14'

**ACTIVE MINING SEASONAL DATA**

**MW-1**

SEASON	pH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
SPRING	7.12	1.10	0.37	460	57.7			6.61'	330.09'
SUMMER	7.15	4.13	0.24	440	52.3			7.0'	329.70'
FALL	7.69	0.49	0.26	455	59.7			7.33'	329.37'
WINTER	7.30	1.21	0.48	462	75			6.83'	329.87'
AVERAGE	7.32'	1.73	0.34	454	61.2			6.94'	329.76'

**PRE-MINE SEASONAL DATA**

**MW-2**

SEASON	PH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
SPRING	6.56	4.87	0.2	175	9	22	61	15.67'	389.23'
SUMMER	7.20	5.45	0.29	182	9	16	80	16.50'	388.40'
FALL	8.24	0.61	0.11	58.5	2	32	23	19.0'	385.9'
WINTER	6.37	12.57	0.51	147	5	19	67	15.50	389.40'
AVERAGE	7.09	5.87	0.28	141	6.25	22.25	57.75	16.67'	388.23'

**ACTIVE MINING SEASONAL DATA**

**MW-2**

SEASON	PH s.u.	Fe MG/L	Mn MG/L	COND. U- MHOS	SO <sub>4</sub> MG/L	ACIDITY MG/L	ALKA MG/L	WATER DEPTH	WATER ELEV.
SPRING	7.33	2.11	0.05	52	5.3			21.0'	383.9'
SUMMER	6.33	3.35	0.27	69	40			21.7'	383.2'
FALL	7.13	0.53	0.07	96	23.6			24.33'	380.57'
WINTER	7.12	1.36	0.10	86	5			19.17'	385.73'
AVERAGE	6.98	1.84	0.12	76	18			21.55'	383.35'