

ATTACHMENT II-G

SURFACE WATER HYDROLOGY

(880-X-8E-.06(1))

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

### **General Description of Surface Water Hydrology**

The proposed Thunder Oaks surface mine permit site is located in the Town Creek Basin and is drained by Wolf Branch, Bengis Creek and unnamed tributaries of Bengis Creek along the south, southwest side of the proposed permit. Surface runoff drains into Wolf Branch to the north, northeast and into Bengis Creek to the south and to an unnamed tributary of Bengis Creek to the south, southwest. Browder Spring Branch flows south and into Wolf Branch due north of the proposed permit area. Stream flows vary with season and rainfall with low flows generally occurring during the summer and fall months and high flows occurring in winter and early spring. As describe on page 34 of "Hydrology of Area 21, Eastern Coal Province, normal precipitation for the area ranges from 52 to 56 inches and averages about 55 inches. With yearly seasonal variations, precipitation can range from a low of about 35 inches to a high of 70 inches. The predominate land uses at the proposed mine site are cropland, pasture and undeveloped with geologic conditions that maintain high shallow perched water tables immediately above the relatively impervious Upper Conglomerate Structure of Sand Mountain. This has resulted in the formation of numerous natural and manmade ponds which are used as livestock watering areas. Croplands, pasture lands and ponds with relatively minimal forest canopy have resulted higher evaporation losses from pond areas and evapotranspiration losses from the presence of both crops and agricultural cultivation activities and pasture lands. The USGS Hydrologic Unit Code and SCS Sub-watershed Number for the immediate drainage area of this proposed mine is 06030001-250 as defined by the USDA Soil Conservation Service.

Surface water flowing from the proposed permit area disturbed by mining operations will initially be routed through two (2) main sediment basins prior to discharge into the state waters of Wolf Branch and Bengis Creek. As mining progresses an additional ten (10) basins will be constructed as disturbance dictates by the mining plan for this permit. A total of twelve (12) sediment control structures are proposed to control exit flows from this facility (See [NPDES Permit Map](#) for basins identification and location.) Prior to any mining disturbance, sediment basins will be constructed in the corresponding sub-watersheds to contain and treat all surface water flows before being discharged into state waters.

There are no perennial streams or springs located within the proposed permit boundary. The Alabama Department of Environmental Management has designated all streams within the area surrounding the proposed mining operations as "Fish and Wildlife". Baseline surface water data (quality and quantity) will be generated from five (5) designated surface water monitoring sites. SW-1 (upstream sample station) represents drainage from 327 acres on Wolf Branch, SW-2 (upstream sample station) represents drainage from 380 acres on Browder Spring Branch, SW-3 (downstream sample station) represents drainage from 1261 acres on Wolf Branch and is downstream of both SW-1 and SW-2. SW-5 (upstream sample station) represents drainage from 12,972 acres on Bengis Creek and SW-4 (downstream sample station) is downstream of SW-1, SW-2, SW-3 and SW-5 and represents drainage from 16,013 acres on Bengis Creek. Performance monitoring will be taken from SW-4 with all 599 disturbed acres from this proposed mine draining to this sample station. For locations of the surface monitoring stations see the attached [Hydrologic Monitoring Map](#).

NOTE: SW-5 monitoring station was established upstream on Bengis Creek at the recommendation of the Alabama Surface Mining Commission during the November 8, 2011 Interagency Coordination meeting. Sampling was commenced on November 18, 2011 during the next scheduled sample permit for this site.

### **Surface-Water Bodies**

Other than the previously described intermittent and wet weather streams as previously described there are no other naturally formed surface-water bodies. The proposed sediment basins on this site will be temporary and will be removed in the reclamation process. Twelve (12) sediment control structures will be used for this mining operation. For location of surface water monitoring stations see the [Hydrologic Monitoring Map](#) and for the location and NPDES numbers of proposed sediment basins see [Hydro-Geo Map](#) in Part II-E.

In addition to what appears to be an abandoned sediment basin (P-4) from past mining operations, there are eleven (11) other ponds/impoundments to make a total of twelve (12) ponds that have been constructed by landowners for irrigation and watering of farm stock. The geology of the area of the proposed mine is conducive to pond construction. The "caprock" of the Upper Conglomerate usually occurs within a maximum of ten (10) feet below the surface and is a natural barrier to water flow, so any sink and/or depression whether natural or man-made has a tendency to collect water making pond construction relatively easy.

To document the base line water quality of the existing water impoundments, samples have been taken and analyzed for Ponds P-1, P-4, P-6, P-8, P-9, P-10 and P-12. Due to several ponds being

in series, only the downstream pond has been sampled and is considered to be the most representative of the composite water quality of these ponds.

**POND SAMPLE DATA**  
 Sample Date: March 30, 2012

| SAMPLE ID | POND | pH s.u. | SpC u-mhos/cm | TSS Mg/l | Fe Mg/l | Mn Mg/l | SO4 Mg/l | ACID Mg/l | ALKA Mg/l |
|-----------|------|---------|---------------|----------|---------|---------|----------|-----------|-----------|
| IMPS #1   | P-1  | 6.55    | 143           | 9        | 0.61    | 1.40    | 17       | 10        | 22        |
| IMPS #2   | P-4  | 6.42    | 137           | 5        | 0.56    | 1.30    | 19       | 11        | 19        |
| IMPS #3   | P-6  | 6.67    | 126           | 2        | 0.29    | 1.09    | 56       | 9         | 17        |
| IMPS #4   | P-8  | 6.59    | 239           | 2        | 0.33    | 1.05    | 155      | 13        | 22        |
| IMPS #5   | P-7  | 6.07    | 312           | 11       | 0.65    | 1.21    | 195      | 19        | 27        |
| IMPS #6   | P-9  | 7.05    | 290           | 4        | 0.58    | 0.98    | 27       | 10        | 21        |
| IMPS #7   | P-10 | 6.52    | 154           | 3        | 0.62    | 1.44    | 20       | 12        | 23        |
| IMPS #8   | P-12 | 6.49    | 139           | 3        | 0.67    | 1.49    | 19       | 15        | 20        |

**Surface Water Uses**

The known uses of surface water on Wolf Branch, Browder Spring Branch, Bengis Creek and/or any unnamed tributaries and wet-weather streams at this site are considered fish and wildlife.

**Surface Water Quality**

See attached Surface Water Baseline Analyses. Samples taken from surface water monitoring stations SW-1, SW-2, SW-3, SW-4 and SW-5 indicate the water is of good quality. As shown in the following "Surface Water Baseline Analyses" all analyzed parameters are within expected ADEM/EPA limits. Samples have been taken over adequate monthly intervals to identify seasonal flow characteristics.

## **Surface Water Quantity**

Stream Flow (overland flow) water quantity in cubic feet per second (cfs) is determined at each sampling interval of baseline data. Flow rate measurement of surface water samples were performed in accordance with ASTM D3858-95 (Reapproved 2008) pages 1-9, "Standard Test Method for Open-Channel Flow Measurement of Water by Velocity-Area Method" and utilizing a "FP211 Flow Probe" digital water velocity meter.

## **Surface Water Sampling and Analytical Methods**

All surface water samples were collected by the grab method and analyzed by TASK Engineering Management Inc. Flow rates were determined as outline in the previous "Surface Water Quantity" section. Flow velocity, pH and Specific Conductivity of all samples were measured in the field at the time said samples were taken. Samples are immediately stored in new, clean plastic sample bottles. After all field measurements are completed, the time, date, mine identification and surface monitoring site identification are recorded on the sample bottle and on a chain of custody form to maintain documentation and sample integrity. Samples are then deposited in a field cooler with ice to refrigerate to near 4°C for delivery to the TASK Engineering Management Inc. offices for further chemical testing.

See following for description and documentation of methodology of analyses:

- 1) Analysis of pH was a direct reading and performed in accordance with the standard operating procedures of the Hach Company's sensION1 Portable pH meter.

- 2) Analysis of Conductivity, SpC, was a direct reading and performed in accordance with the standard operating procedures of the Hach Company's DR3 Spectrophotometer which is equipped with a conductivity meter.
- 3) Analysis of Total Iron, Fe, was utilizing a Hach DR/890 Colorimeter and performed in accordance with the Hach DR/820-DR/850-DR/890 Datalogging Colorimeter Handbook, "FerroVer Method", pp.227 through 233 (USEPA approved).
- 4) Analysis of Total Manganese, Mn, was performed in accordance with the Hach DR/820-DR/850-DR/890 Datalogging Colorimeter Handbook, "Periodate Oxidation Method", pp.253 through 261 (USEPA approved).
- 5) Analysis of Sulfate, SO<sub>4</sub>, was performed in accordance with the Hach DR/820-DR/850-DR/890 Datalogging Colorimeter Handbook, "SulfaVer 4 Method", pp.539 through 545 (USEPA approved).
- 6) Analysis of Acidity was performed by digital titration in accordance with the Hach Water Analysis Handbook , "Methyl Orange Method" pp.2-3 through 2-5.
- 7) Analysis of Alkalinity was performed by digital titration in accordance with the Hach Water Analysis Handbook, "Titration Method" pp.2-9 through 2-12.

- 8) Analysis of Suspended solids was performed by gravimetric methods and/or  
Photometric methods as required.

NOTE: Any chemical analyses parameters outside the ability of TASK Engineering Management Inc. will be sent to ESC Lab Sciences for processing. Samples not analyzed by TASK Engineering Management Inc. will be so noted by correspondence to the Regulatory Authority.

### **Precipitation Modeling**

No modeling and/or simulation methods are employed at this time.

### **Surface Water Monitoring Station Location(s)**

For locations of surface water monitoring stations, see [Hydro-Geo Map](#) and [Hydrologic Monitoring Map](#).

### **Results of Surface Water Sampling for Heavy Metals**

At the request of the Regulatory Agency, testing of Heavy Metals for high and low flow conditions were performed at the surface water monitoring stations and the existing Pond #1 (see [Hydro-Geo Map](#)). High flow conditions were sampled on March 30, 2012 and low flow conditions were sampled on November 21, 2013 with the following results.

Heavy metal analyses for high flow conditions were performed by ESC Lab Sciences on samples collected on March 30, 2012 at sites SW-1, SW-2, SW-3, SW-4, SW-5 and IMPS#1 (Pond #1) to provide high flow baseline data for the following parameters: Cyanide, Total Phenol, Mercury, Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Thallium and Zinc. (Note: Zinc was omitted during the first sample data on March 30, 2012 but analysis for zinc was performed on refrigerated samples on June 17, 2012.) Zinc was present in low quantities on all samples and SW-3 noted the presence of lead in low quantity. All other parameters were below the laboratory detection limit.

Heavy metal analyses for low flow conditions were performed by ESC Lab Sciences on samples collected on November 21, 2013 at sites SW-1, SW-2, SW-3, SW-4, SW-5 and IMPS#1 (Pond #1) to provide high flow baseline data for the following parameters: Cyanide, Total Phenol, Mercury, Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Thallium and Zinc. Arsenic was present in low quantities at SW-1 and SW-3 showed the presence of low quantities of Nickel and Zinc and IMPS#1 at Pond #1 showed a moderate amount of Nickel.

[See Heavy Metal Report of Analyses](#) for lab results on heavy metals.

**Results of Surface Water Sampling and Analytical Data for Each Sample**

See attached Surface Water Baseline Tables. All surface water samples were analyzed for Quantity of Flow, pH, Conductivity, Total Suspended Solids, Total Iron, Total Manganese, Sulfates, Acidity, and Alkalinity.

**SURFACE WATER BASELINE ANALYSIS**

SAMPLE I.D.: SW-1  
 MONITORING SOURCE: WOLF BRANCH  
 DRAINAGE AREA: 0.51 SQ. MI.  
 LOCATION FROM MINE: UPSTREAM

| DATE     | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|----------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| 06/20/11 | 0.60         | 7.27       | 115              | 11          | 0.90       | 0.22       | 3           | 7            | 17           |
| 07/20/11 | 0.26         | 6.24       | 69               | 27          | 1.33       | 0.74       | 2           | 5            | 14           |
| 08/23/11 | 0.35         | 6.84       | 87               | 15          | 0.85       | 0.13       | 2           | 11           | 25           |
| 09/13/11 | 0.18         | 7.07       | 127              | 8           | 0.72       | 0.19       | 3           | 9            | 21           |
| 10/17/11 | 0.14         | 7.48       | 6                | 5           | 1.44       | 0.67       | 2           | 13           | 30           |
| 11/18/11 | 0.30         | 6.26       | 136              | 23          | 0.98       | 0.78       | 2           | 8            | 17           |
| 12/09/11 | 0.88         | 6.43       | 90               | 35          | 0.82       | 0.54       | 3           | 10           | 22           |
| 01/16/12 | 2.39         | 6.77       | 88               | 30          | 0.80       | 0.19       | 2           | 6            | 18           |
| 02/09/12 | 0.96         | 6.98       | 145              | 24          | 0.87       | 0.52       | 3           | 7            | 23           |
| 03/30/12 | 1.47         | 6.22       | 70               | 12          | 0.40       | 0.46       | 4           | 11           | 29           |
| 04/19/12 | 0.23         | 7.11       | 89               | 20          | 0.50       | 0.32       | 3           | 12           | 29           |
| 05/16/12 | 0.33         | 7.31       | 120              | 7           | 1.06       | 0.11       | 4           | 14           | 35           |
| 06/12/12 | 0.58         | 6.98       | 105              | 9           | 0.33       | 0.42       | 3           | 10           | 19           |
| 07/26/12 | 0.78         | 6.21       | 60               | 12          | 1.20       | 0.29       | 2           | 7            | 15           |
| 08/23/12 | 0.16         | 6.19       | 80               | 11          | 0.37       | 0.74       | 3           | 5            | 16           |

### SURFACE WATER BASELINE ANALYSIS

SAMPLE I.D.: SW-2

MONITORING SOURCE: BROWDER SPRING BRANCH

DRAINAGE AREA: 0.59 SQ. MI.

LOCATION FROM MINE: UPSTREAM

| DATE     | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|----------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| 06/20/11 | 0.75         | 6.90       | 121              | 6           | 0.54       | 0.19       | 6           | 12           | 34           |
| 07/20/11 | 0.15         | 7.20       | 98               | 12          | 0.29       | 0.20       | 8           | 9            | 25           |
| 08/23/11 | 0.38         | 7.15       | 136              | 10          | 0.25       | 0.18       | 6           | 7            | 19           |
| 09/13/11 | 0.30         | 7.01       | 78               | 7           | 0.65       | 0.27       | 6           | 10           | 23           |
| 10/17/11 | 0.18         | 7.00       | 150              | 4           | 1.07       | 0.45       | 5           | 11           | 19           |
| 11/18/11 | 0.40         | 6.69       | 69               | 5           | 0.55       | 0.24       | 5           | 9            | 23           |
| 12/09/11 | 1.06         | 7.05       | 90               | 7           | 0.46       | 0.27       | 7           | 8            | 17           |
| 01/16/12 | 2.64         | 7.03       | 85               | 6           | 0.24       | 0.26       | 6           | 6            | 17           |
| 02/09/12 | 1.05         | 6.92       | 76               | 6           | 0.25       | 0.25       | 5           | 6            | 19           |
| 03/30/12 | 1.97         | 6.69       | 73               | 11          | 0.22       | 0.30       | 7           | 8            | 20           |
| 04/19/12 | 0.28         | 6.88       | 105              | 10          | 0.37       | 0.28       | 6           | 5            | 19           |
| 05/16/12 | 0.60         | 6.95       | 110              | 13          | 0.45       | 0.27       | 8           | 7            | 18           |
| 06/12/12 | 0.63         | 6.89       | 82               | 12          | 1.07       | 0.25       | 7           | 11           | 21           |
| 07/26/12 | 1.00         | 6.97       | 77               | 10          | 0.88       | 0.23       | 6           | 10           | 22           |
| 08/23/12 | 0.22         | 6.26       | 76               | 5           | 0.70       | 0.30       | 5           | 7            | 16           |

**SURFACE WATER BASELINE ANALYSIS**

SAMPLE I.D.: SW-3

MONITORING SOURCE: BENGIS CREEK

DRAINAGE AREA: 1.97 SQ. MI.

LOCATION FROM MINE: DOWNSTREAM

| DATE     | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|----------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| 06/20/11 | 2.02         | 6.60       | 90               | 5           | 0.84       | 0.20       | 13          | 15           | 30           |
| 07/20/11 | 0.88         | 6.73       | 169              | 10          | 0.98       | 0.10       | 3           | 12           | 24           |
| 08/23/11 | 1.25         | 6.68       | 50               | 10          | 1.15       | 0.18       | 2           | 7            | 20           |
| 09/13/11 | 0.93         | 7.14       | 160              | 9           | 0.55       | 0.36       | 5           | 6            | 14           |
| 10/17/11 | 0.62         | 6.50       | 75               | 8           | 1.07       | 0.20       | 36          | 10           | 11           |
| 11/18/11 | 1.12         | 7.22       | 63               | 7           | 0.49       | 0.28       | 2           | 9            | 23           |
| 12/09/11 | 3.02         | 6.90       | 170              | 10          | 0.55       | 0.36       | 25          | 11           | 19           |
| 01/16/12 | 8.26         | 6.84       | 196              | 8           | 0.45       | 0.30       | 3           | 11           | 24           |
| 02/09/12 | 3.30         | 6.36       | 232              | 6           | 0.41       | 0.40       | 5           | 13           | 26           |
| 03/30/12 | 4.89         | 6.39       | 167              | 15          | 0.78       | 0.90       | 12          | 10           | 25           |
| 04/19/12 | 0.95         | 6.95       | 90               | 8           | 0.66       | 0.45       | 6           | 8            | 19           |
| 05/16/12 | 1.26         | 7.19       | 144              | 11          | 0.72       | 0.49       | 6           | 12           | 30           |
| 06/12/12 | 1.79         | 6.95       | 87               | 10          | 1.22       | 0.58       | 5           | 12           | 29           |
| 07/26/12 | 2.79         | 6.91       | 160              | 11          | 0.71       | 0.44       | 5           | 14           | 33           |
| 08/23/12 | 0.71         | 6.56       | 226              | 7           | 0.51       | 1.10       | 30          | 10           | 19           |

**SURFACE WATER BASELINE DATA**

SAMPLE I.D.: SW-4

MONITORING SOURCE: BENGIS CREEK

DRAINAGE AREA: 25.02 SQ. MI.

LOCATION FROM MINE: DOWNSTREAM

| DATE     | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|----------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| 06/20/11 | 22.40        | 6.55       | 85               | 6           | 0.20       | 0.26       | 7           | 12           | 24           |
| 07/20/11 | 10.19        | 6.40       | 113              | 5           | 0.18       | 0.28       | 15          | 9            | 17           |
| 08/23/11 | 15.40        | 6.39       | 75               | 9           | 0.77       | 0.28       | 5           | 13           | 19           |
| 09/13/11 | 12.16        | 6.25       | 127              | 4           | 0.15       | 0.29       | 3           | 10           | 24           |
| 10/17/11 | 2.40         | 6.26       | 72               | 5           | 0.21       | 0.30       | 7           | 8            | 18           |
| 11/18/11 | 7.10         | 6.40       | 135              | 5           | 0.16       | 0.31       | 5           | 5            | 16           |
| 12/09/11 | 25.16        | 6.60       | 82               | 11          | 0.35       | 0.35       | 10          | 9            | 24           |
| 01/16/12 | 75.10        | 7.04       | 74               | 9           | 0.17       | 0.32       | 6           | 11           | 33           |
| 02/09/12 | 40.15        | 6.95       | 147              | 10          | 0.67       | 0.33       | 11          | 10           | 26           |
| 03/30/12 | 43.91        | 6.68       | 90               | 8           | 0.29       | 0.40       | 9           | 10           | 20           |
| 04/19/12 | 6.95         | 6.38       | 80               | 11          | 0.20       | 0.32       | 14          | 6            | 19           |
| 05/16/12 | 8.14         | 6.55       | 155              | 7           | 0.25       | 0.38       | 23          | 7            | 21           |
| 06/12/12 | 10.12        | 6.50       | 103              | 6           | 0.29       | 0.30       | 6           | 11           | 26           |
| 07/26/12 | 30.06        | 6.90       | 54               | 5           | 0.18       | 0.29       | 5           | 10           | 19           |
| 08/23/12 | 6.86         | 6.95       | 143              | 3           | 0.19       | 0.20       | 19          | 11           | 29           |

**SURFACE WATER BASELINE DATA**

SAMPLE I.D.: SW-5

MONITORING SOURCE: BENGIS CREEK

DRAINAGE AREA: 20.27 SQ. MI.

LOCATION FROM MINE: UPSTREAM

| DATE      | DISH. | pH   | SpC       | TSS  | Fe   | Mn   | SO4  | ACID | ALKA |
|-----------|-------|------|-----------|------|------|------|------|------|------|
|           | cfs   | s.u. | u-mhos/cm | Mg/l | Mg/l | Mg/l | Mg/l | Mg/l | Mg/l |
| *11/18/11 | 6.40  | 6.45 | 60        | 9    | 0.22 | 0.22 | 12   | 11   | 21   |
| 12/09/11  | 23.15 | 6.80 | 121       | 6    | 0.25 | 0.45 | 6    | 9    | 19   |
| 01/16/12  | 66.83 | 7.05 | 107       | 11   | 0.34 | 0.65 | 9    | 6    | 17   |
| 02/09/12  | 36.20 | 6.60 | 86        | 5    | 0.24 | 0.68 | 20   | 12   | 25   |
| 03/30/12  | 42.12 | 6.82 | 75        | 6    | 0.32 | 1.00 | 7    | 10   | 20   |
| 04/19/12  | 6.12  | 6.61 | 92        | 7    | 0.28 | 0.80 | 5    | 9    | 20   |
| 05/16/12  | 7.41  | 6.78 | 106       | 9    | 0.40 | 0.33 | 22   | 9    | 24   |
| 06/12/12  | 9.01  | 6.85 | 97        | 5    | 0.37 | 0.82 | 5    | 8    | 19   |
| 07/26/12  | 26.12 | 6.55 | 111       | 4    | 0.22 | 0.70 | 33   | 11   | 22   |
| 08/23/12  | 6.17  | 6.99 | 122       | 1    | 0.39 | 0.30 | 11   | 9    | 23   |

\*ASMC Requested this Monitoring Source on 11/08/11 during Army Corps Interagency Meeting

**SEASONAL BASELINE DATA**

SAMPLE I.D.: SW-1  
MONITORING SOURCE: WOLF BRANCH  
DRAINAGE AREA: 0.51 SQ. MI.  
LOCATION FROM MINE: UPSTREAM

| SEASON  | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|---------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| SUMMER  | 0.35         | 6.38       | 84.60            | 14.60       | 0.89       | 0.42       | 2.40        | 7.40         | 18.20        |
| FALL    | 0.44         | 6.50       | 95.67            | 21.00       | 1.08       | 0.66       | 2.33        | 10.33        | 23.00        |
| WINTER  | 1.61         | 6.53       | 101.00           | 22.00       | 0.69       | 0.39       | 3.00        | 7.33         | 20.33        |
| SPRING  | 0.44         | 7.11       | 104.67           | 12.00       | 0.63       | 0.28       | 3.33        | 12.00        | 27.67        |
| AVERAGE | 0.71         | 6.56       | 96.48            | 17.40       | 0.82       | 0.44       | 2.77        | 9.27         | 22.30        |

SAMPLE I.D.: SW-2  
MONITORING SOURCE: BROWDER SPRING BRANCH  
DRAINAGE AREA: 0.59 SQ. MI.  
LOCATION FROM MINE: UPSTREAM

| SEASON  | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|---------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| SUMMER  | 0.56         | 6.75       | 117.20           | 10.00       | 0.66       | 0.27       | 7.40        | 11.00        | 27.80        |
| FALL    | 0.53         | 6.88       | 103.00           | 5.33        | 0.69       | 0.32       | 5.67        | 9.33         | 19.67        |
| WINTER  | 1.89         | 6.86       | 78.00            | 7.67        | 0.24       | 0.27       | 6.00        | 6.67         | 18.67        |
| SPRING  | 0.57         | 6.91       | 99.00            | 11.67       | 0.63       | 0.27       | 7.00        | 7.67         | 19.33        |
| AVERAGE | 0.88         | 6.84       | 99.30            | 8.67        | 0.56       | 0.28       | 6.52        | 8.67         | 21.37        |

**SEASONAL BASELINE DATA**

SAMPLE I.D.: SW-3  
MONITORING SOURCE: BENGIS CREEK  
DRAINAGE AREA: 1.97 SQ. MI.  
LOCATION FROM MINE: DOWNSTREAM

| SEASON  | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|---------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| SUMMER  | 1.31         | 6.76       | 153.00           | 9.40        | 0.78       | 0.44       | 9.00        | 9.80         | 22.00        |
| FALL    | 1.59         | 6.78       | 102.67           | 8.33        | 0.70       | 0.28       | 21.00       | 10.00        | 21.33        |
| WINTER  | 5.48         | 6.48       | 198.33           | 9.67        | 0.55       | 0.53       | 6.67        | 11.33        | 24.67        |
| SPRING  | 1.51         | 7.02       | 107.00           | 9.67        | 0.87       | 0.51       | 5.67        | 10.67        | 26.00        |
| AVERAGE | 2.47         | 6.72       | 140.25           | 9.27        | 0.72       | 0.44       | 10.58       | 10.45        | 23.50        |

SAMPLE I.D.: SW-4  
MONITORING SOURCE: BENGIS CREEK  
DRAINAGE AREA: 25.02 SQ. MI.  
LOCATION FROM MINE: DOWNSTREAM

| SEASON  | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|---------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| SUMMER  | 14.93        | 6.49       | 102.40           | 5.20        | 0.29       | 0.27       | 9.40        | 10.60        | 21.60        |
| FALL    | 11.55        | 6.40       | 96.33            | 7.00        | 0.24       | 0.32       | 7.33        | 7.33         | 19.33        |
| WINTER  | 53.05        | 6.86       | 103.67           | 9.00        | 0.38       | 0.35       | 8.67        | 10.33        | 26.33        |
| SPRING  | 11.90        | 6.47       | 112.67           | 8.00        | 0.25       | 0.33       | 14.33       | 8.00         | 22.00        |
| AVERAGE | 22.86        | 6.52       | 103.77           | 7.30        | 0.29       | 0.32       | 9.93        | 9.07         | 22.32        |

**SEASONAL BASELINE DATA**

SAMPLE I.D.: SW-5

MONITORING SOURCE: BENGIS CREEK

DRAINAGE AREA: 20.27 SQ. MI.

LOCATION FROM MINE: UPSTREAM

| SEASON  | DISH.<br>cfs | pH<br>s.u. | SpC<br>u-mhos/cm | TSS<br>Mg/l | Fe<br>Mg/l | Mn<br>Mg/l | SO4<br>Mg/l | ACID<br>Mg/l | ALKA<br>Mg/l |
|---------|--------------|------------|------------------|-------------|------------|------------|-------------|--------------|--------------|
| SUMMER  | 16.15        | 6.72       | 116.50           | 2.50        | 0.31       | 0.50       | 22.00       | 10.00        | 22.50        |
| FALL    | 14.78        | 6.59       | 90.50            | 7.50        | 0.24       | 0.34       | 9.00        | 10.00        | 20.00        |
| WINTER  | 48.38        | 6.79       | 89.33            | 7.33        | 0.30       | 0.78       | 12.00       | 9.33         | 20.67        |
| SPRING  | 7.51         | 6.73       | 98.33            | 7.00        | 0.35       | 0.65       | 10.67       | 8.67         | 21.00        |
| AVERAGE | 21.70        | 6.70       | 98.67            | 6.08        | 0.30       | 0.57       | 13.42       | 9.50         | 21.04        |