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**ATTACHMENT II-F**

**GROUNDWATER HYDROLOGY**

The following descriptions of regional groundwater and aquifer characteristics are based on information contained in the 'Hydrology Reports' for Areas 21, 22, 23, & 24 by the U.S. Geological Survey and also information contained in various hydrogeological evaluations submitted to, and approved by, the Alabama Surface Mining Commission.

Groundwater occurring within and adjacent to the proposed Carter Mine exists in both Coker and Pottsville Formation strata. According to 'Ground-water Availability in Tuscaloosa County, Alabama', sand and gravel beds in the Coker Formation constitute the most extensive and probably the most productive aquifers in Tuscaloosa County. It also states that the most productive aquifer zone lies within the basal beds of sand and gravel (present within the proposed permit area) and that properly constructed wells in some parts of Tuscaloosa County that intersect the Coker Formation may produce as much as 1,000 gallons per minute. The high yield rates of Coker Formation wells are no doubt due to the unconsolidated nature of this Formation and its corresponding high hydraulic conductivity. Pottsville formation strata is more consolidated and, in general, has much lower hydraulic conductivities therefore the primary source of groundwater within Pottsville Formation strata in the Warrior Basin occurs chiefly in water-bearing openings such as faults, fractures, and also occurs along bedding planes. The most productive water-bearing openings generally occur in sandstone beds within 250 to 350 ft. of the surface. Well yields in the Pottsville depend on the number and size of water-bearing openings present.

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The number and size of the openings normally varies from one point to another depending upon the degree of fracturing present in the rocks.

In areas where they are exposed to the surface, the primary source of recharge to groundwater in both Pottsville and Coker Formation strata is rainfall. In areas where the Coker overlies the Pottsville, (which occurs throughout a majority of the permit area) the primary source of recharge to the Pottsville strata is from groundwater which has infiltrated through the overlying soils, past the root zone of plants, and through unconsolidated Coker Formation strata. Due to the fact that Pottsville strata typically has much lower hydraulic conductivities than Coker strata, groundwater in the Coker strata 'sits' upon Pottsville strata at the Cretaceous-Pottsville contact, therefore groundwater within the Coker in this area exists under perched water-table conditions. Groundwater in the Coker strata will both travel laterally in the direction of the dip of the Cretaceous-Pottsville contact and act as a source of recharge to the Pottsville by infiltrating into Pottsville strata at a rate which is based upon the hydraulic conductivity of the Pottsville strata, or at a higher rate into faults and/or fracture zones. Once within the Pottsville, groundwater will infiltrate into strata such as sandstone where it will sit (perch) upon an interval, such as shale, which has a very low hydraulic conductivity perpendicular to its bedding planes and therefore limits the downward progress of the groundwater. Groundwater may also encounter fault and fracture zones, which will transmit the groundwater past the bedding planes of shale, or other aquitards, and into to deeper aquifers. The upper most aquifer in the Pottsville Formation strata at this site is also a water table aquifer (where it exists in sandstone strata) because there is no confining layer.

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Groundwater movement in the Warrior Basin is generally from areas of higher elevation (called recharge areas), along bedding planes in Pottsville Formation strata or along the Cretaceous-Pottsville contact in Coker Formation strata, and toward stream channels (discharge areas). Where the static groundwater level intersects the surface, usually where the Cretaceous-Pottsville Contact intersects the surface, seeps or springs may occur. Where this occurs, groundwater discharges into the stream and contributes to surface runoff as baseflow.

Groundwater monitoring sites utilized for describing the quality, quantity, and seasonal variation of groundwater within and adjacent to the proposed Carter Mine include Groundwater Monitoring Sites CRCMMW-1, CRCMMW-2, CRCMMW-3, and CRCMMW-4 which were specifically drilled and cased for baseline information for the proposed Carter Mine. These sites were drilled by personnel of Cahaba Resources and cased by qualified personnel of PERC Engineering Co., Inc.. Data from these wells (with the exception of CRCMMW-1) will be utilized to determine the chemical characteristics and water levels of groundwater located within the Coker Formation and in the Pottsville Formation both above and below the Carter Coal Seam at this site. Groundwater Monitoring Site CRCMMW-1 caved in to a depth of 15 feet from the surface so was not monitored.

As shown on the attached 'Casing Specifications', Groundwater Monitoring Site CRCMMW-2 monitors the characteristics of groundwater associated with the cretaceous sediments of the Coker Formation, Groundwater Monitoring Site CRCMMW-3 monitors the characteristics of groundwater within Pottsville Formation strata located above the

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Carter Coal Seam and Groundwater Monitoring Site CRCMMW-4 monitors the characteristics of groundwater within Pottsville Formation strata located below the Carter Coal Seam.

Groundwater levels recorded at monitoring well installed to monitor the cretaceous aquifer at the proposed Carter Mine reveal that the surface of the groundwater in this aquifer exists at an average of 20.60 ft. below the land surface (or 21.4 ft. above the Cretaceous-Pottsville contact) at CRCMMW-2. As stated previously, the dominant lithology in this aquifer is unconsolidated sands, silts, clays, and pebbles. A comparison of groundwater levels shown above with the lithology of the above mentioned monitoring well shows that this groundwater exists under perched or water table conditions and the aquifer 'sits' or perches upon the more consolidated, and as such less permeable, Pottsville sandstones and shales. As stated previously, due to the unconsolidated nature of the cretaceous strata and its corresponding high hydraulic conductivity, wells penetrating this formation have high yield rates depending upon the thickness and aerial extent of this strata at, and adjacent to the well. Also, groundwater levels within this aquifer at any one point will fluctuate based on factors such as rainfall amount and frequency, thickness of the aquifer, the hydraulic conductivity of the Pottsville strata beneath the aquifer, the number and extent of fault and fracture zones in Pottsville strata beneath the aquifer, and water usage from the aquifer. A well penetrating this strata in the immediate vicinity of the proposed permit area would be sufficient from a quantity standpoint to supply a domestic well (assuming the strata was at least 30-40 feet thick).

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Groundwater within Pottsville Formation strata lying above the Carter Coal Seam within and adjacent to the proposed permit area is found primarily in shale strata. As stated previously, some sandstone overlies the shale interval on the western portion of the proposed permit area, but that interval is only 5 feet thick. As stated above, this interval is hydraulically connected to the overlying Cretaceous aquifer and it gets most of its recharge from it, although the rate at which groundwater from the overlying aquifer enters this interval is dictated by the composition of this interval. In areas where the majority of this interval is composed of sandstone, migration of groundwater from the overlying Cretaceous sediments into this interval is more rapid than at the proposed mine site where the majority of this interval is composed of shale. Groundwater levels recorded at Groundwater Monitoring Site CRCMMW-3 reveals that the surface of the groundwater in this well exists at an average of 41.5 ft. below the land surface or 7.50 ft. above the top of the Carter Coal Seam. As stated above, the source of water for Pottsville aquifers above the Carter Coal Seam is either from direct infiltration resulting from rainfall where these intervals outcrop or from infiltration from the overlying Cretaceous aquifer. In any event, a well penetrating just this interval (as shown in Groundwater Monitoring Site CRCMMW-3) would not develop enough groundwater to be utilized for a domestic source unless it happened to penetrate a water bearing fracture or fault.

Groundwater associated with the Carter Coal Seam within and adjacent to the proposed permit area is limited in capacity due to the thinness of the intervals, and these intervals are of limited aerial extent due to the complex local topography. The Carter Coal Seam interval in this area would not be considered a reliable source of domestic groundwater

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from a quantity standpoint and the elimination of this interval during mining would not measurably affect the quantity of local groundwater resources.

Groundwater below the Carter Coal Seam within and adjacent to the proposed permit area is also found in sandstone strata. Groundwater levels recorded at Groundwater Monitoring Site CRCMMW-4 reveals that the surface of the groundwater in this aquifer exists at an average of 12.48 ft. below the land surface or 12.52 ft. above the top of the sandstone interval monitored by this well. This information indicates that this interval is confined. The average elevation of the groundwater in this well is approximately 7.48 ft. below the Pottsville-Coker contact at CRCMMW-4 therefore the elevated water level observed at this monitoring site is most likely a result of a pressure head from up-dip groundwater in this sandstone interval. Because of the local topography, and average elevations within and adjacent to the proposed permit in the nearby area, this interval does not have a regional, but rather a localized outcrop area in this vicinity. The majority of the recharge into this interval is from either: 1- outcrop areas located up-dip from the monitoring site, 2- down slope areas from the monitoring site where the overlying shale interval is eroded and the sandstone interval outcrops, or 3- infiltration from the overlying cretaceous aquifer IF there are areas where the overlying Pottsville strata does not exist and the cretaceous strata rests upon this sandstone interval. In any event, this interval contains enough groundwater to be utilized for a domestic source from a quantity standpoint, however most wells in the area probably would not be drilled into this interval because of the additional cost of drilling a well so deep when abundant supplies of groundwater are available from the overlying cretaceous aquifer.

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All groundwater monitoring sites mentioned above were sampled by the PERC Engineering Laboratory strictly as baseline information for this proposed permit. Groundwater Monitoring Sites CRCMMW-1, CRCMMW-2, CRCMMW-3, and CRCMMW-4 were sampled on 7 occasions between the dates 08-14-14 and 02-27-15. Samples collected by PERC Engineering were taken with either a hand bailer or a submersible pump after development. Water level is measured prior to development. Practices employed by PERC Engineering concerning the volume of groundwater extracted at groundwater monitoring sites prior to sampling is outlined as follows: Where recharge of groundwater is sufficient, three well volumes of groundwater (measured from the static depth) are pumped prior to sampling so the sample obtained is from recharge. Where recharge is slow, and three well volumes cannot be obtained within the monitoring cycle (usually monthly), only one well volume will be pumped. The well will then be allowed to recharge and a sample will be obtained after a volume equal to the volume of the pump line has been discharged. In infrequent instances where recharge is very limited, and the volume of water in the well is too small to be pumped to the surface, a 'bottom sampler' is employed to bail as much water as possible from the well. The well will then be allowed to recharge and the bottom sampler will again be used to obtain a sample when ample groundwater is present to be collected.

Depth to water, and pH are measured in the field, and the sample is split into two separate containers: a 473 ml plastic bottle is acidified and utilized for metals analysis, and a one quart plastic bottle is utilized for all other analysis. Both are stored in an ice chest for transport to the PERC Engineering Laboratory. All samples taken to the PERC Engineering

Laboratory are analyzed according to ASTM specifications. Parameters tested include pH, iron, manganese, conductivity, sulfates, acidity, and alkalinity. See attached results of analysis.

Averages for selected parameters from groundwater samples taken at wells measuring chemical quality in groundwater both above and below the target coal seam at this site are as follows:

<u>Well No. and Interval Measured:</u>	<u>pH* (S.U.):</u>	<u>FeT (mg/l):</u>	<u>SpC (umhos):</u>	<u>SO4 (mg/l):</u>
CRCMMW-2 (Cretaceous Aquifer)	6.12	0.35**	174	<1
CRCMMW-3 (Above Carter Seam)	6.29	26.20	138	4.64
CRCMMW-4 (Below Carter Seam)	6.41	18.44	182	29.14

\* - median

\*\* - FeT value for 8/14/15 was thrown out of average.

Groundwater quality in the Coker Formation was described by Thomas J. Hill in "Hydrologic Assessment, Eastern Coal Province Area 23, Alabama" on page 59. The following is an excerpt from this study characterizing Coker Formation groundwater:

<u>Parameter:</u>	<u>Max:</u>	<u>Min:</u>	<u>Ave:</u>
FeT (mg/l)	21.0	0.01	0.28
pH (s.u.)	7.80	3.60	6.60*
SpC (umhos)	359	16	83
SO4 (mg/l)	12.0	0.00	2.9

\*median

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A comparison between averages for groundwater within the Cretaceous aquifer at the proposed mine site vs. the above stated Coker Formation averages show that the groundwater within the Cretaceous aquifer has a little lower pH, a little higher mineralization, a higher specific conductivity, and a lower sulfate value. This says that local groundwater is of similar quality to Coker Formation averages and as such is probably suitable for a domestic source from a quality standpoint.

Groundwater quality in the Pottsville Formation was described by Thomas J. Hill in "Hydrologic Assessment, Eastern Coal Province Area 23, Alabama" on page 59. The following is an excerpt from this study characterizing Pottsville Formation groundwater:

<u>Parameter:</u>	<u>Max:</u>	<u>Min:</u>	<u>Ave:</u>
FeT (mg/l)	7.40	0.10	0.89
pH (s.u.)	9.40	6.40	8.40*
SpC (umhos)	760	37	504
SO4 (mg/l)	37.0	0.20	11.0

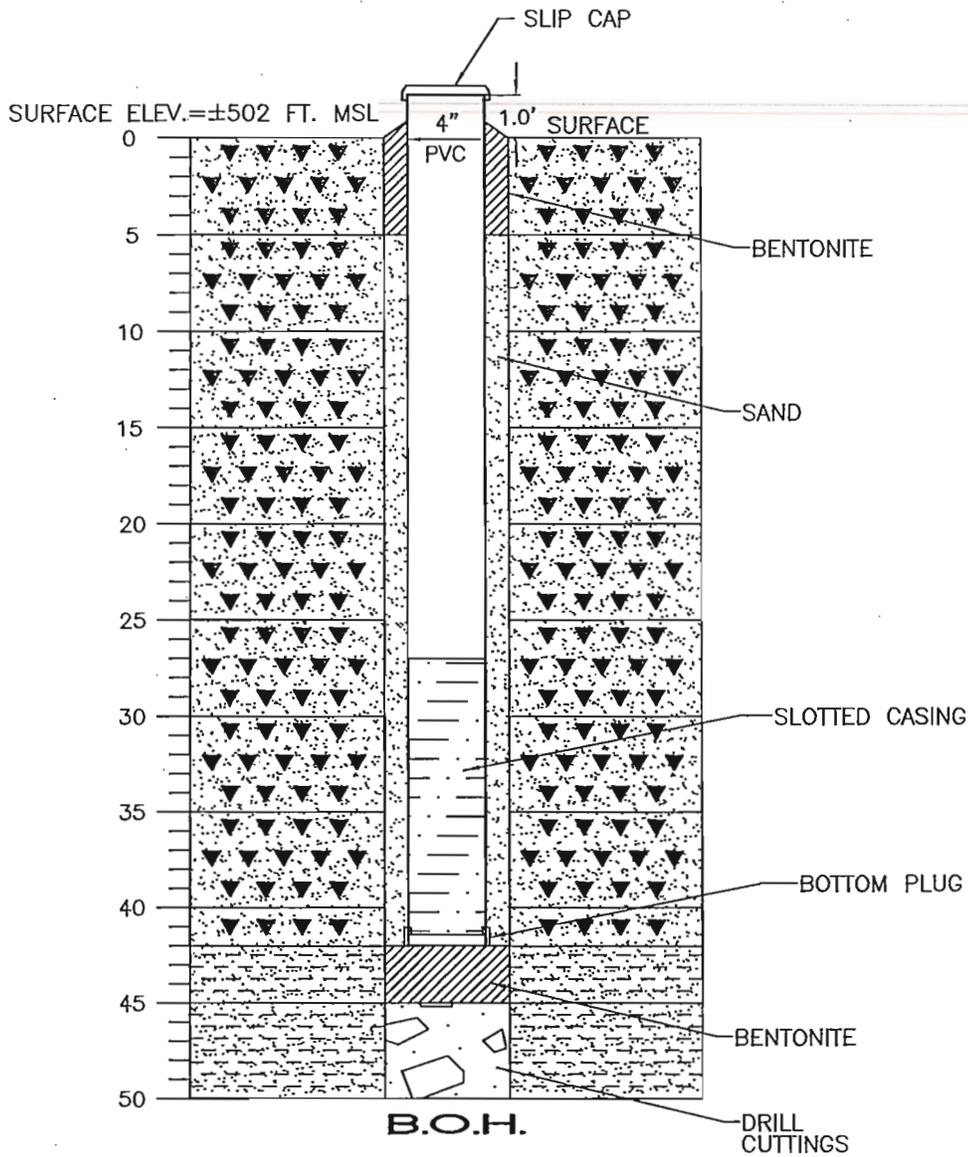
\*median

A comparison between averages for Pottsville aquifers at the proposed mine site vs. Pottsville Formation averages show that the local groundwater has a lower pH, much higher mineralization, lower specific conductivity, and higher or lower sulfate values than the Pottsville averages shown above. This says that local Pottsville aquifers are of lower quality than Pottsville averages and as such is probably not suitable for a domestic source from a quality standpoint. The groundwater quality shown for Groundwater Monitoring Site CRCMMW-4 is indicative of being affected by previous coal related disturbance.

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A well inventory conducted by PERC Engineering Co., Inc. in November of 2014 through April of 2015 reveals that there are 58 residences within a ½ mile radius of the proposed Carter Mine. Of the 58, 48 residences utilize municipal water from Citizens' Water Authority as their only domestic source, 18 residents were not at home, and four residences were vacant. The discrepancy between the total number of residences and the breakdown of those numbers is explained by the fact that information on several residences was given by either neighbors, relatives, or the owners of mobile home parks. No domestic wells have been identified during the well inventory. Pertinent information of the well inventory is attached. Impact to surrounding groundwater users, if any, as a result of this operation will be addressed in the Probable Hydrologic Consequences (PHC).

Groundwater movement for the Cretaceous aquifer in the vicinity of the Carter Mine is dominated by the dip direction and magnitude of the top of the Pottsville Formation as shown on the attached Pottsville-Cretaceous Contact Map and, as stated earlier, is toward the southwest. Groundwater movement for the Pottsville aquifers in the vicinity of the Carter Mine should be down dip as shown on the attached Structure-Contour Map for the Carter Coal Seam, which, as stated earlier, is toward both the southwest and the northeast. In addition, groundwater movement in this area is influenced by on-site and adjacent streams, on-site and adjacent previously mined areas, and by local surface topography.



B.O.H. - BOTTOM OF HOLE



**CAHABA RESOURCES  
CARTER MINE  
Casing Specifications for Groundwater  
Monitoring Site CRCMMW-2**

DRAWN BY: S.W.L.  
DWG. NAME: CRCMLTH

DATE: 1-20-15

APPROVED BY: T.S.T.

SCALE: NO SCALE

PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 170675  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-2  
 Code : w  
 Date Taken : 08/14/2014  
 Sampled By : jdc  
 Time Taken : 1605  
 Depth or Flow : 17.20'  
 Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	26	mg/l	Heath Brown	08/19/2014	1000	305.1 (1)
Alkalinity	22	mg/l	Heath Brown	08/19/2014	1030	310.1 (1)
Conductivity	62	us/cm	Heath Brown	08/15/2014	1000	120.1 (1)
Iron	27.35	mg/l	Danny C. Mays	08/26/2014	1455	236.1 (1)
Manganese	1.36	mg/l	Danny C. Mays	08/26/2014	1545	243.1 (1)
pH	6.69	s.u.	Johnny Collier	08/14/2014	1605	150.1 (1)
Report			Sherri Fields	08/28/2014		
Sulfate	<1	mg/l	Heath Brown	08/19/2014	1500	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
- 2) Standard Methods for the Examination Water and Wastes Water
- 3) HACH Water Analysis Handbook, 2nd Edition
- 4) EPA-600/4-88/039 Revised July 1991
- 5) EPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition
- 6) Code of Federal Regulations, Title 40, Part 136, Appendix A

APPROVED BY: \_\_\_\_\_

PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 171298  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-2  
Code : w  
Date Taken : 09/26/2014  
Sampled By : jdc  
Time Taken : 1140  
Depth or Flow : 18.10'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	22	mg/l	Michael Roell	09/30/2014	1545	305.1 (1)
Alkalinity	16	mg/l	Michael Roell	09/30/2014	1400	310.1 (1)
Conductivity	49	us/cm	Heath Brown	10/03/2014	1530	120.1 (1)
Iron	0.34	mg/l	Danny C. Mays	09/30/2014	0955	236.1 (1)
Manganese	0.86	mg/l	Danny C. Mays	09/30/2014	1040	243.1 (1)
pH	6.83	s.u.	Johnny Collier	09/26/2014	1140	150.1 (1)
Report			Sherri Fields	10/13/2014		
Sulfate	<1	mg/l	Heath Brown	10/10/2014	1445	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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- 6) Code of Federal Regulations, Title 40, Part 136, Appendix A

APPROVED BY: \_\_\_\_\_

PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 171801  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin,Stream,Well ID: CRCMMW-2  
Code : w  
Date Taken : 10/27/2014  
Sampled By : jdc  
Time Taken : 1220  
Depth or Flow : 18.40'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	34	mg/l	Michael Roell	10/31/2014	1100	305.1 (1)
Alkalinity	16	mg/l	Michael Roell	10/31/2014	1015	310.1 (1)
Conductivity	85	us/cm	Heath Brown	10/31/2014	1430	120.1 (1)
Iron	0.39	mg/l	Danny C. Mays	10/30/2014	1105	236.1 (1)
Manganese	0.83	mg/l	Danny C. Mays	10/30/2014	1155	243.1 (1)
pH	5.51	s.u.	Johnny Collier	10/27/2014	1220	150.1 (1)
Report			Sherri Fields	11/05/2014		
Sulfate	<1	mg/l	Heath Brown	11/04/2014	0900	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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APPROVED BY: \_\_\_\_\_

PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 172246  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-2  
Code : w  
Date Taken : 11/24/2014  
Sampled By : jdc  
Time Taken : 1310  
Depth or Flow : 23.1'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	40	mg/l	Heath Brown	12/02/2014	0815	305.1 (1)
Alkalinity	12	mg/l	Heath Brown	12/02/2014	0930	310.1 (1)
Conductivity	39	us/cm	Heath Brown	12/02/2014	1330	120.1 (1)
Iron	0.24	mg/l	Danny C. Mays	12/04/2014	1500	236.1 (1)
Manganese	0.89	mg/l	Danny C. Mays	12/04/2014	1600	243.1 (1)
pH	5.05	s.u.	Johnny Collier	11/24/2014	1310	150.1 (1)
Report			Sherri Fields	12/05/2014		
Sulfate	<1	mg/l	Heath Brown	12/02/2014	1350	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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APPROVED BY: \_\_\_\_\_

PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 172748  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-2  
Code : w  
Date Taken : 12/26/2014  
Sampled By : jdc  
Time Taken : 1300  
Depth or Flow : 22.0'  
Tests to be done : pH, Cond, SO4, Fe, Mn, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	18	mg/l	Michael Roell	12/30/2014	1435	305.1 (1)
Alkalinity	18	mg/l	Heath Brown	12/30/2014	1315	310.1 (1)
Conductivity	430	us/cm	Johnny Collier	12/26/2014	1300	120.1 (1)
Iron	0.35	mg/l	Danny C. Mays	01/02/2015	1345	236.1 (1)
Manganese	0.94	mg/l	Danny C. Mays	01/02/2015	1325	243.1 (1)
pH	6.42	s.u.	Johnny Collier	12/26/2014	1300	150.1 (1)
Report			Sherri Fields	01/07/2015		
Sulfate	<1	mg/l	Heath Brown	01/02/2015	1530	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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APPROVED BY: \_\_\_\_\_

PERC ENGINEERING CO., INC.  
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Sample Number : 173001  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-2  
Code : w  
Date Taken : 01/13/2015  
Sampled By : jdc  
Time Taken : 1630  
Depth or Flow : 22.15'  
Tests to be done : pH, Cond, SO4, Acid, Alk, Fe, Mn,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	14	mg/l	Heath Brown	01/16/2015	0805	305.1 (1)
Alkalinity	24	mg/l	Heath Brown	01/16/2015	0910	310.1 (1)
Conductivity	495	us/cm	Johnny Collier	01/13/2015	1630	120.1 (1)
Iron	0.29	mg/l	Danny C. Mays	01/19/2015	1430	236.1 (1)
Manganese	1.14	mg/l	Danny C. Mays	01/19/2015	1500	243.1 (1)
pH	7.19	s.u.	Johnny Collier	01/13/2015	1630	150.1 (1)
Report			Sherri Fields	01/21/2015		
Sulfate	<1	mg/l	Heath Brown	01/16/2015	1350	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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- 6) Code of Federal Regulations, Title 40, Part 136, Appendix A

APPROVED BY: \_\_\_\_\_

PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

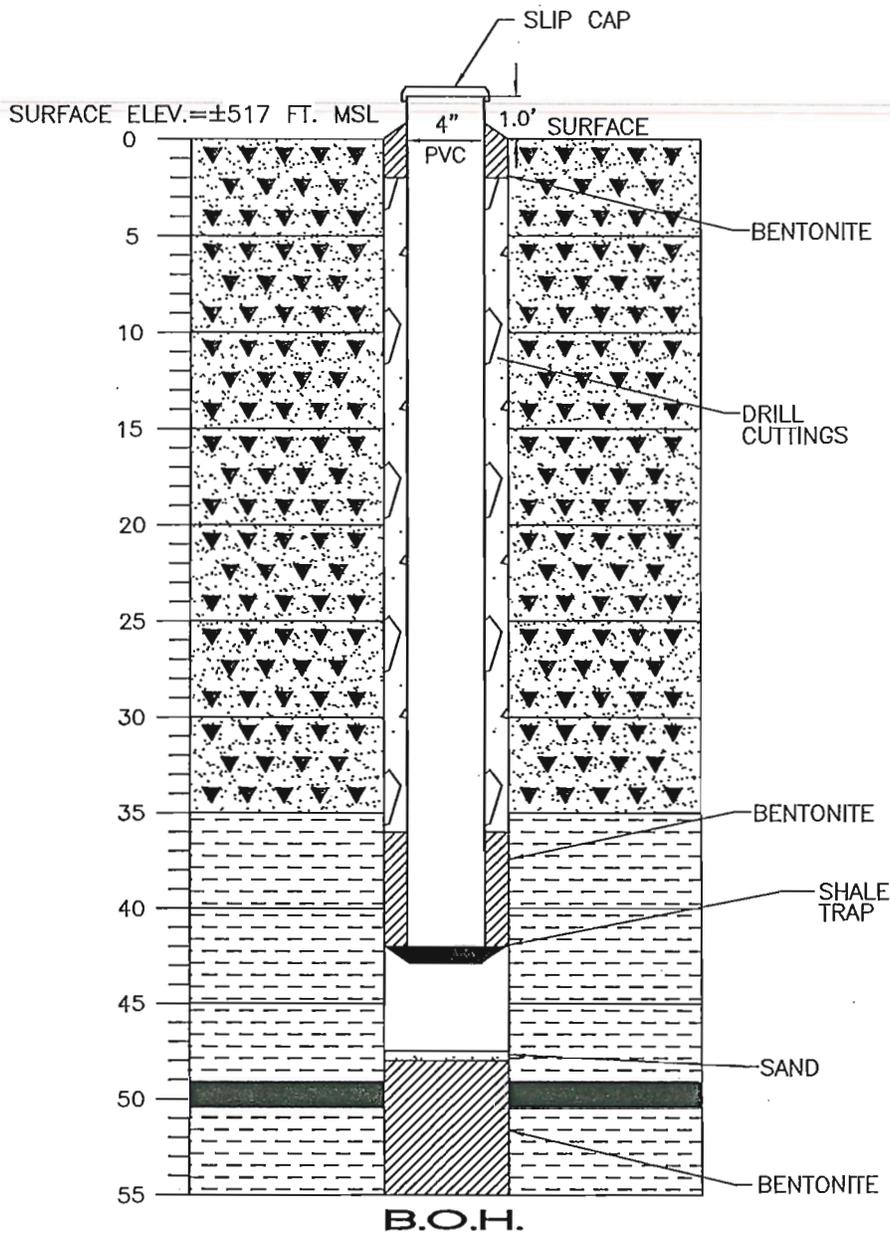
(205) 384-5553

Sample Number : 173629  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-2  
 Code : w  
 Date Taken : 02/27/2015  
 Sampled By : jdc  
 Time Taken : 1225  
 Depth or Flow : 23.25'  
 Tests to be done : pH, Cond, SO4, Acid, Alk, Fe, Mn,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	22	mg/l	Heath Brown	03/09/2015	1045	305.1 (1)
Alkalinity	16	mg/l	Heath Brown	03/09/2015	1450	310.1 (1)
Conductivity	58	us/cm	Heath Brown	03/02/2015	1500	120.1 (1)
Iron	0.47	mg/l	Danny C. Mays	03/03/2015	1430	236.1 (1)
Manganese	1.86	mg/l	Danny C. Mays	03/03/2015	1530	243.1 (1)
pH	5.15	s.u.	Johnny Collier	02/27/2015	1225	150.1 (1)
Report			Sherri Fields	03/10/2015		
Sulfate	<1	mg/l	Heath Brown	03/09/2015	0830	8051 (3)

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- 4) EPA-600/4-88/039 Revised July 1991
- 5) EPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition
- 6) Code of Federal Regulations, Title 40, Part 136, Appendix A

APPROVED BY: \_\_\_\_\_



B.O.H. - BOTTOM OF HOLE



**CAHABA RESOURCES  
CARTER MINE  
Casing Specifications for Groundwater  
Monitoring Site CRCMMW-3**

DRAWN BY: S.W.L.  
DWG. NAME: CRCMLITH

DATE: 1-20-15

APPROVED BY: T.S.T.

SCALE: NO SCALE

PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 170673  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-3  
Code : w  
Date Taken : 08/14/2014  
Sampled By : jdc  
Time Taken : 1150  
Depth or Flow : 38.0'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	52	mg/l	Heath Brown	08/19/2014	1000	305.1 (1)
Alkalinity	80	mg/l	Heath Brown	08/19/2014	1030	310.1 (1)
Conductivity	228	us/cm	Heath Brown	08/15/2014	1000	120.1 (1)
Iron	6.18	mg/l	Danny C. Mays	08/26/2014	1455	236.1 (1)
Manganese	0.66	mg/l	Danny C. Mays	08/26/2014	1545	243.1 (1)
pH	6.64	s.u.	Johnny Collier	08/14/2014	1150	150.1 (1)
Report			Sherri Fields	08/28/2014		
Sulfate	29	mg/l	Heath Brown	08/19/2014	1500	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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- 6) Code of Federal Regulations, Title 40, Part 136, Appendix A

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PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 171296  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-3  
Code : w  
Date Taken : 09/26/2014  
Sampled By : jdc  
Time Taken : 0840  
Depth or Flow : 38.75'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	18	mg/l	Michael Roell	09/30/2014	1545	305.1 (1)
Alkalinity	10	mg/l	Michael Roell	09/30/2014	1400	310.1 (1)
Conductivity	73	us/cm	Heath Brown	10/03/2014	1530	120.1 (1)
Iron	51.30	mg/l	Danny C. Mays	09/30/2014	0955	236.1 (1)
Manganese	0.92	mg/l	Danny C. Mays	09/30/2014	1040	243.1 (1)
pH	6.72	s.u.	Johnny Collier	09/26/2014	0840	150.1 (1)
Report			Sherri Fields	10/13/2014		
Sulfate	<1	mg/l	Heath Brown	10/10/2014	1445	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 171799  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-3  
Code : w  
Date Taken : 10/27/2014  
Sampled By : jdc  
Time Taken : 0905  
Depth or Flow : 38.55'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	32	mg/l	Michael Roell	10/31/2014	1100	305.1 (1)
Alkalinity	18	mg/l	Michael Roell	10/31/2014	1015	310.1 (1)
Conductivity	97	us/cm	Heath Brown	10/31/2014	1430	120.1 (1)
Iron	37.0	mg/l	Danny C. Mays	10/30/2014	1105	236.1 (1)
Manganese	2.71	mg/l	Danny C. Mays	10/30/2014	1155	243.1 (1)
pH	5.48	s.u.	Johnny Collier	10/27/2014	0905	150.1 (1)
Report			Sherri Fields	11/05/2014		
Sulfate	<1	mg/l	Heath Brown	11/04/2014	0900	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 172244  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-3  
 Code : w  
 Date Taken : 11/24/2014  
 Sampled By : jdc  
 Time Taken : 0920  
 Depth or Flow : 45.20'  
 Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	30	mg/l	Heath Brown	12/02/2014	0815	305.1 (1)
Alkalinity	22	mg/l	Heath Brown	12/02/2014	0930	310.1 (1)
Conductivity	99	us/cm	Heath Brown	12/02/2014	1330	120.1 (1)
Iron	11.18	mg/l	Danny C. Mays	12/04/2014	1500	236.1 (1)
Manganese	0.85	mg/l	Danny C. Mays	12/04/2014	1600	243.1 (1)
pH	5.52	s.u.	Johnny Collier	11/24/2014	0920	150.1 (1)
Report			Sherri Fields	12/05/2014		
Sulfate	<1	mg/l	Heath Brown	12/02/2014	1350	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 172746  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-3  
 Code : w  
 Date Taken : 12/26/2014  
 Sampled By : jdc  
 Time Taken : 0905  
 Depth or Flow : 43.6'  
 Tests to be done : pH, Cond, SO4, Fe, Mn, Acid, Alk,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	26	mg/l	Michael Roell	12/30/2014	1435	305.1 (1)
Alkalinity	30	mg/l	Heath Brown	12/30/2014	1315	310.1 (1)
Conductivity	137	us/cm	Johnny Collier	12/26/2014	0905	120.1 (1)
Iron	28.80	mg/l	Danny C. Mays	01/02/2015	1345	236.1 (1)
Manganese	1.15	mg/l	Danny C. Mays	01/02/2015	1325	243.1 (1)
pH	6.52	s.u.	Johnny Collier	12/26/2014	0905	150.1 (1)
Report			Sherri Fields	01/07/2015		
Sulfate	<1	mg/l	Heath Brown	01/02/2015	1530	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 172999  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-3  
 Code : w  
 Date Taken : 01/13/2015  
 Sampled By : jdc  
 Time Taken : 1225  
 Depth or Flow : 43.50'  
 Tests to be done : pH, Cond, SO4, Acid, Alk, Fe, Mn,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	20	mg/l	Heath Brown	01/16/2015	0805	305.1 (1)
Alkalinity	36	mg/l	Heath Brown	01/16/2015	0910	310.1 (1)
Conductivity	132	us/cm	Johnny Collier	01/13/2015	1225	120.1 (1)
Iron	13.12	mg/l	Danny C. Mays	01/19/2015	1430	236.1 (1)
Manganese	1.05	mg/l	Danny C. Mays	01/19/2015	1500	243.1 (1)
pH	6.75	s.u.	Johnny Collier	01/13/2015	1225	150.1 (1)
Report			Sherri Fields	01/21/2015		
Sulfate	<1	mg/l	Heath Brown	01/16/2015	1350	8051 (3)

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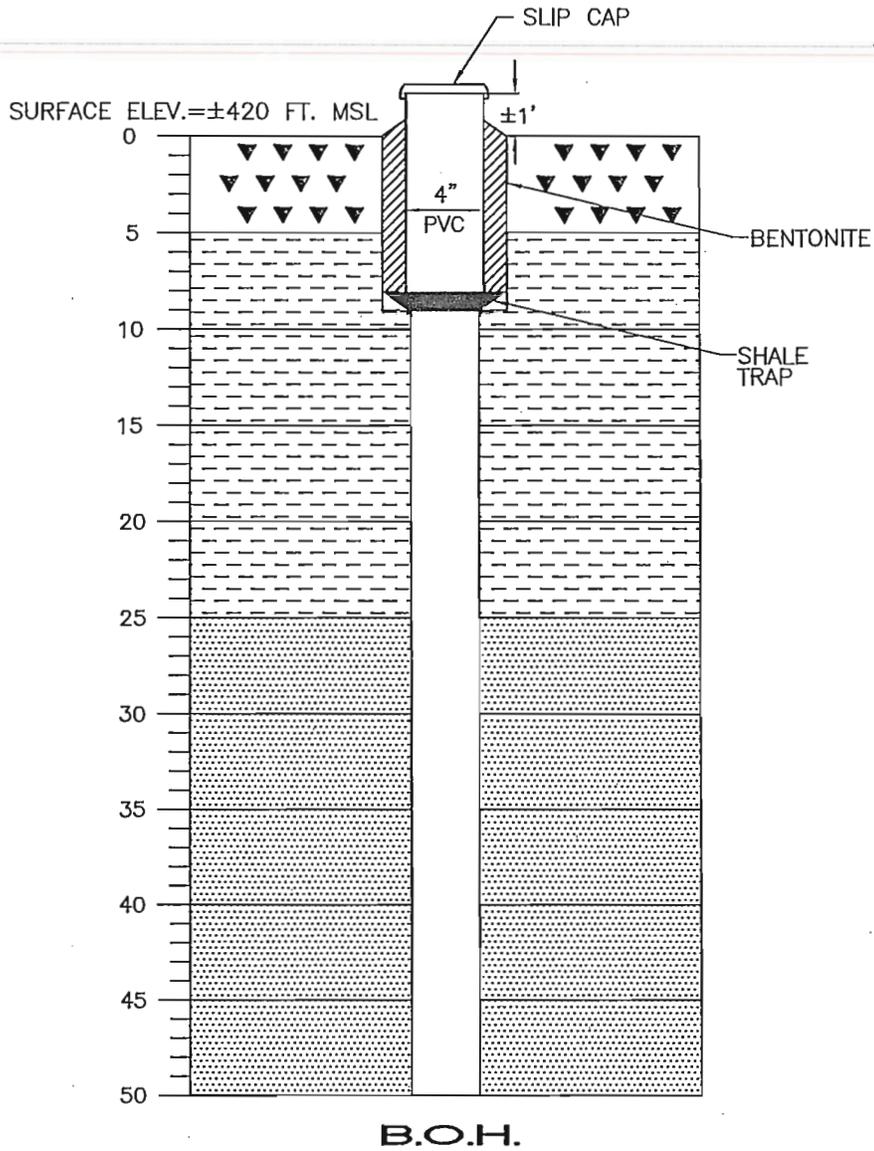
PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 173627  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-3  
Code : w  
Date Taken : 02/27/2015  
Sampled By : jdc  
Time Taken : 0910  
Depth or Flow : 42.90'  
Tests to be done : pH, Cond, SO4, Acid, Alk, Fe, Mn,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	26	mg/l	Heath Brown	03/09/2015	1045	305.1 (1)
Alkalinity	32	mg/l	Heath Brown	03/09/2015	1450	310.1 (1)
Conductivity	200	us/cm	Heath Brown	03/02/2015	1500	120.1 (1)
Iron	35.85	mg/l	Danny C. Mays	03/03/2015	1430	236.1 (1)
Manganese	0.79	mg/l	Danny C. Mays	03/03/2015	1530	243.1 (1)
pH	6.40	s.u.	Johnny Collier	02/27/2015	0910	150.1 (1)
Report			Sherri Fields	03/10/2015		
Sulfate	1	mg/l	Heath Brown	03/09/2015	0830	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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APPROVED BY: \_\_\_\_\_



B.O.H. - BOTTOM OF HOLE



**CAHABA RESOURCES  
CARTER MINE  
Casing Specifications for Groundwater  
Monitoring Site CRCMMW-4**

DRAWN BY: S.W.L.	DATE: 12-15-14
DWG. NAME: CRCMLITH	
APPROVED BY: T.S.T.	SCALE: NO SCALE

PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 170674  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-4  
Code : w  
Date Taken : 08/14/2014  
Sampled By : jdc  
Time Taken : 1400  
Depth or Flow : 15.25'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	24	mg/l	Heath Brown	08/19/2014	1000	305.1 (1)
Alkalinity	10	mg/l	Heath Brown	08/19/2014	1030	310.1 (1)
Conductivity	64	us/cm	Heath Brown	08/15/2014	1000	120.1 (1)
Iron	21.25	mg/l	Danny C. Mays	08/26/2014	1455	236.1 (1)
Manganese	0.41	mg/l	Danny C. Mays	08/26/2014	1545	243.1 (1)
pH	6.70	s.u.	Johnny Collier	08/14/2014	1400	150.1 (1)
Report			Sherri Fields	08/28/2014		
Sulfate	1	mg/l	Heath Brown	08/19/2014	1500	8051 (3)

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PERC ENGINEERING CO., INC.  
P.O. Box 1712  
Jasper, Alabama 35502  
(205) 384-5553

Sample Number : 171297  
Client : Cahaba Resources, LLC  
Facility : Carter Mine  
Job Number :  
NPDES Permit # :  
Basin, Stream, Well ID: CRCMMW-4  
Code : w  
Date Taken : 09/26/2014  
Sampled By : jdc  
Time Taken : 1105  
Depth or Flow : 15.20'  
Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	30	mg/l	Michael Roell	09/30/2014	1545	305.1 (1)
Alkalinity	94	mg/l	Michael Roell	09/30/2014	1400	310.1 (1)
Conductivity	213	us/cm	Heath Brown	10/03/2014	1530	120.1 (1)
Iron	13.56	mg/l	Danny C. Mays	09/30/2014	0955	236.1 (1)
Manganese	0.84	mg/l	Danny C. Mays	09/30/2014	1040	243.1 (1)
pH	6.60	s.u.	Johnny Collier	09/26/2014	1105	150.1 (1)
Report			Sherri Fields	10/13/2014		
Sulfate	29	mg/l	Heath Brown	10/10/2014	1445	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 171800  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-4  
 Code : w  
 Date Taken : 10/27/2014  
 Sampled By : jdc  
 Time Taken : 1135  
 Depth or Flow : 15.22'  
 Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	42	mg/l	Michael Roell	10/31/2014	1100	305.1 (1)
Alkalinity	62	mg/l	Michael Roell	10/31/2014	1015	310.1 (1)
Conductivity	210	us/cm	Heath Brown	10/31/2014	1430	120.1 (1)
Iron	15.63	mg/l	Danny C. Mays	10/30/2014	1105	236.1 (1)
Manganese	1.01	mg/l	Danny C. Mays	10/30/2014	1155	243.1 (1)
pH	5.30	s.u.	Johnny Collier	10/27/2014	1135	150.1 (1)
Report			Sherri Fields	11/05/2014		
Sulfate	38	mg/l	Heath Brown	11/04/2014	0900	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 172245  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-4  
 Code : w  
 Date Taken : 11/24/2014  
 Sampled By : jdc  
 Time Taken : 1150  
 Depth or Flow : 17.25'  
 Tests to be done : pH, Cond, Fe, Mn, SO4, Acid, Alk,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	38	mg/l	Heath Brown	12/02/2014	0815	305.1 (1)
Alkalinity	66	mg/l	Heath Brown	12/02/2014	0930	310.1 (1)
Conductivity	206	us/cm	Heath Brown	12/02/2014	1330	120.1 (1)
Iron	5.56	mg/l	Danny C. Mays	12/04/2014	1500	236.1 (1)
Manganese	1.04	mg/l	Danny C. Mays	12/04/2014	1600	243.1 (1)
pH	5.63	s.u.	Johnny Collier	11/24/2014	1150	150.1 (1)
Report			Sherri Fields	12/05/2014		
Sulfate	35	mg/l	Heath Brown	12/02/2014	1350	8051 (3)

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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 172747  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-4  
 Code : w  
 Date Taken : 12/26/2014  
 Sampled By : jdc  
 Time Taken : 1135  
 Depth or Flow : 7.07'  
 Tests to be done : pH, Cond, SO4, Fe, Mn, Acid, Alk,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	28	mg/l	Michael Roell	12/30/2014	1435	305.1 (1)
Alkalinity	66	mg/l	Heath Brown	12/30/2014	1315	310.1 (1)
Conductivity	211	us/cm	Johnny Collier	12/26/2014	1135	120.1 (1)
Iron	28.45	mg/l	Danny C. Mays	01/02/2015	1345	236.1 (1)
Manganese	0.77	mg/l	Danny C. Mays	01/02/2015	1325	243.1 (1)
pH	6.67	s.u.	Johnny Collier	12/26/2014	1135	150.1 (1)
Report			Sherri Fields	01/07/2015		
Sulfate	33	mg/l	Heath Brown	01/02/2015	1530	8051 (3)

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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 173000  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-4  
 Code : w  
 Date Taken : 01/13/2015  
 Sampled By : jdc  
 Time Taken : 1445  
 Depth or Flow : 8.15'  
 Tests to be done : pH, Cond, SO4, Acid, Alk, Fe, Mn,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	22	mg/l	Heath Brown	01/16/2015	0805	305.1 (1)
Alkalinity	74	mg/l	Heath Brown	01/16/2015	0910	310.1 (1)
Conductivity	222	us/cm	Johnny Collier	01/13/2015	1445	120.1 (1)
Iron	25.84	mg/l	Danny C. Mays	01/19/2015	1430	236.1 (1)
Manganese	0.74	mg/l	Danny C. Mays	01/19/2015	1500	243.1 (1)
pH	7.05	s.u.	Johnny Collier	01/13/2015	1445	150.1 (1)
Report			Sherri Fields	01/21/2015		-
Sulfate	35	mg/l	Heath Brown	01/16/2015	1350	8051 (3)

- 1) EPA-600/4-79-020 Revised March 1983
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PERC ENGINEERING CO., INC.

P.O. Box 1712

Jasper, Alabama 35502

(205) 384-5553

Sample Number : 173628  
 Client : Cahaba Resources, LLC  
 Facility : Carter Mine  
 Job Number :  
 NPDES Permit # :  
 Basin, Stream, Well ID: CRCMMW-4  
 Code : w  
 Date Taken : 02/27/2015  
 Sampled By : jdc  
 Time Taken : 1000  
 Depth or Flow : 9.20'  
 Tests to be done : pH, Cond, SO4, Acid, Alk, Fe, Mn,  
 Report,

Parameter	Result	Units	Analyst	Date	Time	Method
Acidity	24	mg/l	Heath Brown	03/09/2015	1045	305.1 (1)
Alkalinity	70	mg/l	Heath Brown	03/09/2015	1450	310.1 (1)
Conductivity	148	us/cm	Heath Brown	03/02/2015	1500	120.1 (1)
Iron	12.36	mg/l	Danny C. Mays	03/03/2015	1430	236.1 (1)
Manganese	1.11	mg/l	Danny C. Mays	03/03/2015	1530	243.1 (1)
pH	6.92	s.u.	Johnny Collier	02/27/2015	1000	150.1 (1)
Report			Sherri Fields	03/10/2015		
Sulfate	33	mg/l	Heath Brown	03/09/2015	0830	8051 (3)

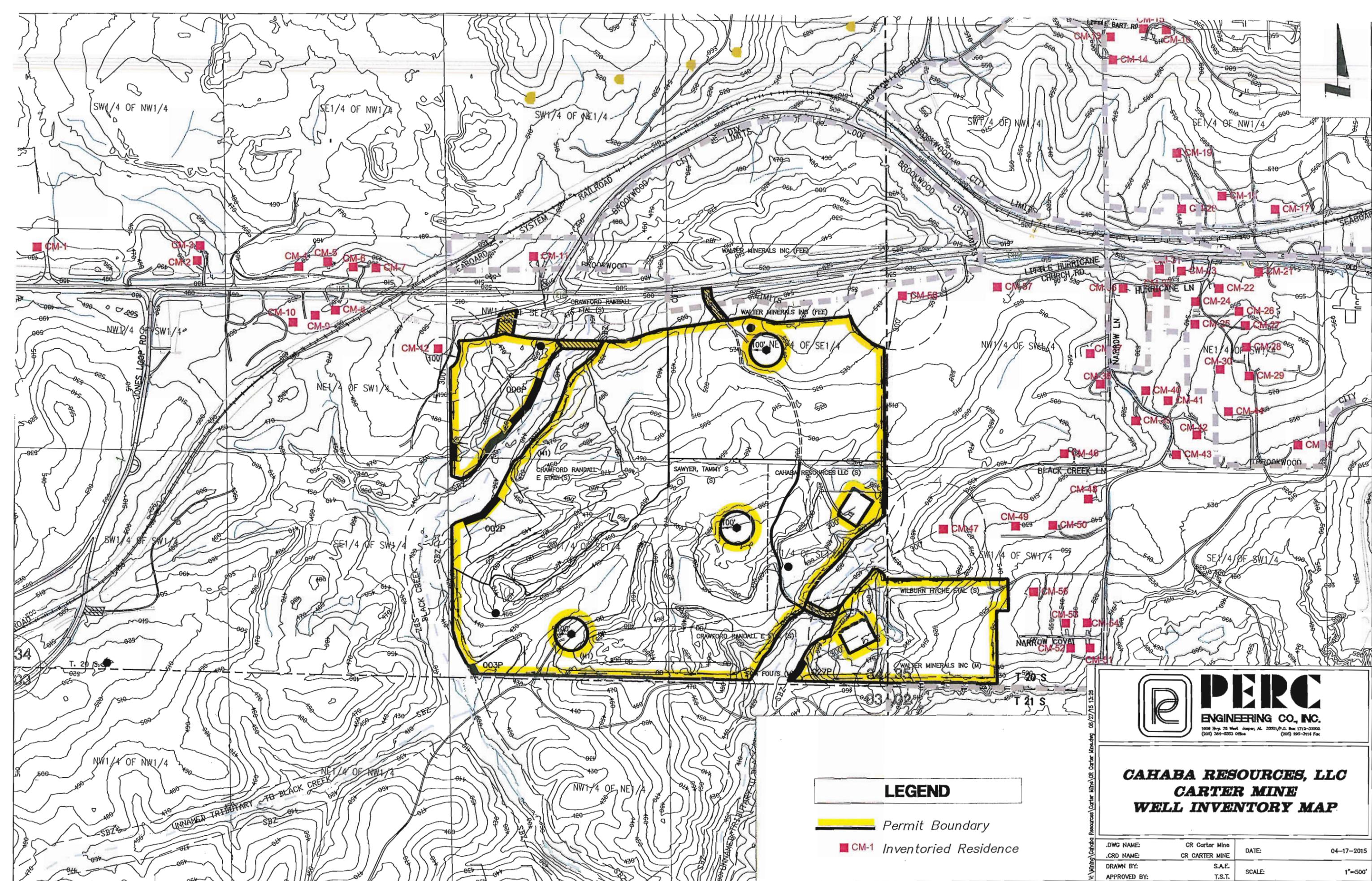
- 1) EPA-600/4-79-020 Revised March 1983
- 2) Standard Methods for the Examination Water and Wastes Water
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**Cahaba Resources, LLC  
Carter Mine  
Well Inventory Summary**

RESIDENCE NUMBER	MUNICIPAL WATER	WATER AUTHORITY	WELL	TOTAL DEPTH	NUMBER OF RESIDENTS	WELL USAGE
CM-1	Yes	Citizen's Waterworks	No		1	
CM-2	Yes	Citizen's Waterworks	No		2	
CM-3	Yes	Citizen's Waterworks	No		2	
CM-4	Yes	Citizen's Waterworks	No		2	
CM-5	Yes	Citizen's Waterworks	No			
CM-6	Yes	Citizen's Waterworks	No		3	
CM-7	Yes	Citizen's Waterworks	No		Not at home	
CM-8	Yes	Citizen's Waterworks	No		Vacant	
CM-9	Yes	Citizen's Waterworks	No		1	
CM-10	Yes	Citizen's Waterworks	No		Vacant	
CM-11	Yes	Citizen's Waterworks	No		Not at home	
CM-12					Not at home	
CM-13	Yes	Citizen's Waterworks	No		2	
CM-14	Yes	Citizen's Waterworks	No		2	
CM-15	Yes	Citizen's Waterworks	No		1	
CM-16	Yes	Citizen's Waterworks	No		1	
CM-17	Yes	Citizen's Waterworks	No		1	
CM-18	Yes	Citizen's Waterworks	No		2	
CM-19					Not at home	
CM-20					Not at home	
CM-21	Yes	Citizen's Waterworks	No		Not at home	
CM-22	Yes	Citizen's Waterworks	No			
CM-23	Yes	Citizen's Waterworks	No		Not at home	
CM-24	Yes	Citizen's Waterworks	No			
CM-25	Yes	Citizen's Waterworks	No			
CM-26	Yes	Citizen's Waterworks	No			
CM-27	Yes	Citizen's Waterworks	No			
CM-28	Yes	Citizen's Waterworks	No			
CM-29	Yes	Citizen's Waterworks	No			
CM-30	Yes	Citizen's Waterworks	No			
CM-31	Yes	Citizen's Waterworks	No			
CM-32	Yes	Citizen's Waterworks	No			
CM-33	Yes	Citizen's Waterworks	No			
CM-34	Yes	Citizen's Waterworks	No			
CM-35	Yes	Citizen's Waterworks	No			
CM-36	Yes	Citizen's Waterworks	No			
CM-37	Yes	Citizen's Waterworks	No		Church	
CM-38	Yes	Citizen's Waterworks	No		1	
CM-39	Yes	Citizen's Waterworks	No		Vacant	
CM-40	Yes	Citizen's Waterworks	No		2	
CM-41	Yes	Citizen's Waterworks	No			
CM-42	Yes	Citizen's Waterworks	No			
CM-43	Yes	Citizen's Waterworks	No		4	
CM-44					Not at home	
CM-45					Not at home	
CM-46					Not at home	

RESIDENCE NUMBER	MUNICIPAL WATER	WATER AUTHORITY	WELL	TOTAL DEPTH	NUMBER OF RESIDENTS	WELL USAGE
CM-47					Not at home	
CM-48					Not at home	
CM-49	Yes	Citizen's Waterworks	No		Not at home	
CM-50	Yes	Citizen's Waterworks	No		4	
CM-51	Yes	Citizen's Waterworks	No		Not at home	
CM-52	Yes	Citizen's Waterworks	No		Not at home	
CM-53	Yes	Citizen's Waterworks	No		Not at home	
CM-54	Yes	Citizen's Waterworks	No		Vacant	
CM-55	Yes	Citizen's Waterworks	No		2	
CM-56	Yes	Citizen's Waterworks	No			
CM-57					Not at home	
CM-58					Not at home	



**CAHABA RESOURCES, LLC  
CARTER MINE  
WELL INVENTORY MAP**

- LEGEND**
- Permit Boundary
  - CM-1 Inventoried Residence

.DWG NAME:	CR Carter Mine	DATE:	04-17-2015
.CRD NAME:	CR CARTER MINE	DRAWN BY:	S.A.E.
APPROVED BY:	T.S.T.	SCALE:	1"=500'

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