

West, Tommi

From: Sadler, Bill
Sent: Monday, February 10, 2014 4:29 PM
To: West, Tommi
Subject: FW: Calhoun County Class 4 Landfill
Attachments: Hydrogeological-Geotechnical Report-Cond

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AFIN: 07-00024

PMT#: 0070-S

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Tommi – please put in the file - Thanks

From: Lance Powell [<mailto:lpowell@ce-associates.biz>]
Sent: Monday, February 10, 2014 4:12 PM
To: Sadler, Bill
Cc: 'Patricia Gurnsey'; 'Dan McCullough'
Subject: Calhoun County Class 4 Landfill

Bill,

On behalf of Calhoun County, Civil Engineering Associates, LLC is submitting the attached Hydrogeologic and Geotechnical Investigation Report for review. Please contact me if you have questions or need additional information.

Thanks,

Lance Powell, P.E.
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HYDROGEOLOGIC AND GEOTECHNICAL INVESTIGATION REPORT

**LATERAL EXPANSION AREA
CALHOUN COUNTY LANDFILL**

**ADEQ PERMIT NO. 0070-S
AFIN: 07-00024**

PREPARED FOR:

**Calhoun County
309 West Main Street
Hampton, Calhoun County, Arkansas 71744
(870)-798-4818**

PREPARED BY:




August 2013

**CALHOUN COUNTY CLASS 4 LANDFILL
HYDROGEOLOGIC AND GEOTECHNICAL INVESTIGATION REPORT
PROPOSED CLASS 4 LANDFILL EXPANSION**

Professional Geologist Certification

"I certify to the best of my professional judgment that this document and all attachments properly adhere to established, sound practices. This certification is contingent on the fact that all information supplied to the signatory authority, up to the date of this certification, is accurate and was provided in good faith."



Dan McCullough, P.G. Date 11/15/13
Senior Hydrogeologist #1802




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1.0 Introduction

Calhoun County currently owns, operates, and maintains a Class 4 Municipal Solid Waste landfill (Landfill) under Arkansas Department of Environmental Quality (ADEQ) Solid Waste Permit 0070-S. The Landfill is located in the west half of the southwest quarter of Section 2, Township 13 South, Range 13 West, Calhoun County, Arkansas. A site location map is presented as **FIGURE 1**. The property has historically been used and operated as a solid waste disposal site with a Class 4 disposal area.

1.1 BACKGROUND

Calhoun County submitted a workplan (doc. 63918) and an addendum to the workplan (doc. 64060) to ADEQ on April 6, 2013 and March 13, 2013 respectively. The workplan along with the Addendum was approved by ADEQ in a letter (doc. 64065) dated March 14, 2013. The workplan along with the Addendum included a request to conduct a hydrogeologic characterization associated with a proposed expansion that consists of a 20 acre tract that is owned by Calhoun County. A site layout map showing the proposed expansion tract is included as **FIGURE 2**. The Workplan, Addendum, and ADEQ approval are all included in **APPENDIX A** of this report.

Civil Engineering Associates (CEA) on behalf of Calhoun County submitted an administratively complete permit pre-application for a 20-acre expansion that included submittals on October 12, 2012 (doc. 61725) and November 2, 2012 (doc. 63326). A public meeting was held on January 8, 2013.

2.0 REGIONAL CHARACTERIZATION

This section discusses the regional soils, geology, and hydrogeology of the area surrounding the Calhoun County Landfill. The information contained in these sections was compiled from a published literature review that was conducted as part of this investigation.

2.1 REGIONAL CLIMATE

Calhoun County is located in the humid subtropical zone that defines the Gulf Coastal Plain of the southeastern United States. Using the Koppen climate classification, Calhoun County is in a “Cfa” or “humid subtropical” region. Specifically, a “Cfa” area experiences temperature during its warmest month reaches 22 degrees Celsius or greater, while temperatures in its coldest month reach between 18 and -3 degrees Celsius. Rainfall is rather evenly distributed throughout the year in this region and averages between 40 to 60 inches annually (Britannica Online).

2.2 REGIONAL SOILS

A review of information provided by the Web Soil Survey website (April 10, 2013), indicated that the soils in the vicinity of the Calhoun County Landfill can be classified as seven distinct soil units:

1. Pikeville fine sandy loam lykz - (approximately 40%)
2. Pikeville fine sandy loam – ly10 (approximately 20%)
3. Ruston fine sandy loam – ly13 (approximately 20%)
4. Sacul fine sandy loam – ly15 (trace)
5. Smithton fine sandy loam - ly1p (trace)
6. Guyton soils - ly1t (Approximately 20%)
7. Pheba silt loam – ly1w (trace)

The local soils on and around landfill property are primarily loams and clays with marine and fluvial origins. **FIGURE 3** shows the distribution of soil types around the landfill property. Below is a description of each soil type as it occurs in the map legend (see **FIGURE 3**).

Pikeville fine sandy loam (lykz) - A loam of marine origin this soil is commonly found forming interfluvial areas between drainages and has a convex-down slope/linear-across slope profile. This unit drains wells and has a high saturated hydraulic conductivity ($K_{sat} = 0.57$ to 1.98 in/hr). In profile, this unit typically demonstrates a fining upward sequence as follows from bottom to top: Very gravelly sandy clay loam, Gravelly loam, Loam, and fine sandy loam. This unit is about eighty (80) inches thick on average and has three (3) to eight (8) percent slopes.

Pikeville fine sandy loam (lyl0) - Nearly identical to the (lykz) Pikeville loam, this unit is differentiated by its linear-down slope profile, convex-across slope profile, and steeper slope character (8 to 12 percent).

Ruston fine sandy loam (lyl3) - This soil is a loamy marine deposit with a linear down slope, convex across slope shape that is commonly found at interfluves. The Ruston has a high Ksat value (0.57 to 1.98 in/hr), does not flood or pond, and usually has a one (1) to three (3) percent slope. A typical sequence soil is as follows from bottom to top: Sandy clay loam, Sandy loam, to Fine sandy loam.

Sacul fine sandy loam (lyl5) – Originating from clayey marine deposits, the Sacul soil unit generally has a three (3) to eight (8) percent slope, is moderately well-drained, and has a high water capacity (about 9.5 inches). A typical sequence for this unit is as follows from bottom to top: Clay loam, Clay, to Fine sandy loam.

Smithton fine sandy loam (lylp) – is a Loamy marine deposit with little surface expression on site. It commonly forms stream terraces, has a down slope – concave/across slope - linear shape, and is poorly drained due to its low slope nature (0 to 1 percent). A typical profile fines upward from a loam to a fine sandy loam.

Guyton soils (lylt) - A loamy alluvial deposit found in flood plains, this unit is linear in both down slope and across slope profile and has a 0 to 1 percent slope. This unit typically has a coarsening upward sequence from a silty clay loam to a silt loam.

Pheba silt loam (lylw) - Another silt loam, this marine deposit is a true silt loam soil. It is concave in down-slope shape and linear across-slope. Commonly found along interfluves, this soil is flat (0 to 2 percent slope) and somewhat poorly drained yet has low potential for flooding.

2.3 REGIONAL GEOLOGY

The Calhoun County Class 4 Landfill is located in the Gulf Coastal Plain physiographic province of southern Arkansas. Spanning from southern Texas to southern Florida, this region is characterized by alluvial and marine sedimentary deposits that vary in age from the Cretaceous Period to the present day. In Arkansas, these deposits dip gently to the south into the Gulf of Mexico and are important resources to the state.

The Calhoun Landfill resides within the Tertiary Claiborne Formation with some Quaternary Terrace deposits near the west and east boundaries of the site. The Claiborne is chiefly non-marine in origin, but does contain some marine intervals. “The unit is composed of medium- to very fine-grained sands, silts, and silty clays. The sands tend to be light- to dark-gray, white, brown, or red, depending on the

degree of weathering. The silts and clays are light- to dark-gray and sometimes variegated. Intervals enriched in carbonaceous material are dark-brown to black. The silts are usually clayey and the clays are normally silty or sandy. Lignite beds are present in this interval. Lignite deposition was controlled by the geologic environment. In the subsurface, the Claiborne Group has been divided into the Carrizo Sand, Cane River Formation, Sparta Sand, Cook Mountain Formation, and Cockfield Formation. Fossils include fish and reptile bones and teeth, leaf impressions, lignitic wood, and trace fossils. The lower contact of the Claiborne Group is poorly known, but considered unconformable to the Wilcox Group. The thickness of the Claiborne ranges from a thin edge to 1,500 feet (Conrad, 1847).” The Claiborne Group is a very important hydrogeologic unit in some parts of the state where it lies in the subsurface as it has intervals of extensive porous unconsolidated sands (Sparta Sand and Cockfield) and confining units (Cane River and Cook Mountain) that form local and regional aquifers.

2.3.1 Geomorphology

The Calhoun County Class 4 landfill rests between 250 and 300 feet mean sea level (fmsl) on the west side of a topographic high dividing the south flowing Champagnolle Creek and Hurricane Creek drainages. Ridges in the region are commonly parallel to prominent waterways as the ridges themselves are created by the incision of streams and rivers. Landfill property quickly drains to the west into the mature Champagnolle Creek. Drainage patterns are dendritic to deranged with the primary waterways being mature with well developed floodplains. Common landforms include stream terraces and meandering stream deposits and forms, such as oxbow lakes.

In a regional geomorphic sense, Calhoun County is near the intersection of the Mississippi Embayment physiographic province and the Gulf Coastal Plain. When the Gulf of Mexico began to rift a structural triple junction formed with two arms spreading into what is now the Gulf and a third rift arm, now known as the Reelfoot Rift, failing to fully develop leaving a topographically low north-south feature on the continent. This feature was followed by the Mississippi River during its development at the end of the last glacial maximum. When sea level was higher, the Gulf of Mexico extended into southern Arkansas and even into southeastern Missouri along the embayment depositing the Cretaceous and Tertiary marine sediments.

2.4 REGIONAL HYDROGEOLOGY

The hydrogeology of the Calhoun County landfill is controlled by alluvial deposits of sand, silt, and clays described in **Section 2.1**. The landfill is located near the contact between the Tertiary Claiborne hydrogeologic unit and the Quaternary terrace deposits see **FIGURE 4**. Regionally the porous, unconsolidated sand intervals of the Claiborne are very important sources for municipal and agricultural water supply. Major recharge for both of these aquifers comes from precipitation, while

Calhoun County Landfill
Project Number 13-031
August, 2013

both the Claiborne and the terrace deposits discharge primarily to streams and rivers in this area. Champagnolle Creek and its tributaries are the primary discharge point for the Calhoun County landfill. The portion of the Claiborne formation in contact with the landfill is of the interbedded clays and silts of the upper Claiborne. Gravel deposits exist within the alluvium and lower terrace deposits, though their depth and extent is variable around the area.

Local groundwater flow generally follows topography to the bottom of valleys containing perennial streams or springs; on site, water flow is from the east to west. Hydraulic conductivity and permeability within the upper silts and clays underneath the landfill property will be determined during the geotechnical portion of this hydrogeologic investigation. Permeability

3.0 SITE CHARACTERIZATION

3.1 SUBSURFACE EXPLORATION PROGRAM

In accordance with APC&EC Reg. §22.1104(e)(1), the current borings were a minimum of one boring every five acres associated with the site. The proposed lateral expansion area covers approximately 20 acres resulting in a requirement of at least four (4) exploratory borings to satisfy the Regulation 22 spacing requirement. The locations for the 4 borings are shown on **FIGURE 5**. Borings were executed in compliance with the ADEQ approved Workplan and Addendum and in order to collect geological and hydrogeological data within and near the proposed 20-acre expansion area. In addition to the four soil borings one test pit was dug and samples were obtained and analyzed for geotechnical parameters in accordance with Reg. §22.1104(e).

On March 19, 2013 four soil borings were advanced within the proposed 20-acre lateral expansion area. Three of the borings (EB-2, EB-3, and EB-4) were advanced to a depth of 30 feet below ground surface (bgs) and the remaining boring was advanced to a depth of 50 ft bgs. The locations of the borings were chosen to ensure adequate spacing to satisfy regulation 22.1104(e)(1) requirements (see **FIGURE 5**).

On June 20, 2013 one test pit was advanced within the proposed 20-acre lateral expansion area near the location of EB-2 (See **FIGURE 5**). The test pit was advanced to eight (8) ft bgs. Two Shelby tubes and two bucket samples were obtained from the test pit and analyzed for geotechnical parameters. The results of the geotechnical analysis are discussed in further detail in **Section 4.0** of this report.

The drilling contractor for the drilling activities was Anderson Engineering of Little Rock, Arkansas. A buggy mounted CME-55 drill rig was utilized to advance the borings. The soil borings were advanced utilizing 8.25 hollow stem augers with continuous sampling methods. A CRC Geologist logged the borings and directed temporary well installation. A detailed field boring log for each soil boring is presented in **Appendix B**.

3.1.1 Site Geology

During the advancement of exploratory boring EB-1, topsoil was encountered from ground surface to six inches bgs. Underlying topsoil was orange silty to sandy clay with gravel and gray mottling from six inches to five and a half (5.5) feet bgs. From five and a half (5.5) to 11 ft bgs was a tan plastic clay. Silty to sandy clay that varied from tan to brown with red to reddish orange mottling was then encountered from 11 to 50 ft bgs, becoming saturated near the 39 ft bgs mark. Once 50 ft bgs was reached, PVC pipe was installed and the borehole was allowed to stay open for 24 hours. The stabilized water level after 24hrs was measured at 9.76 ft below ground surface. See **Figure 2** for the

location of exploratory boring EB-1. Field boring logs (**Appendix B**) have been included as appendices to this report.

During the advancement of the exploratory boring for EB-2, reddish orange silty to sandy clay was encountered from ground surface to a depth of 6 feet bgs. Underlying the silty clay was tan clay with orange mottling to 11 ft bgs. Gray silty to sandy clay with orange mottling extended to a depth of 16 ft bgs followed by gray fat clay that transition in color to brown to a depth of 22 ft bgs. Underlying the clay was gray silty to sandy clay that transition in color to tan with orange mottling that extended to the bottom of the borehole. During drilling EB-2 groundwater was encountered at 25 ft bgs. The total depth of the boring for EB-2 was 30 ft bgs. PVC pipe was then installed and the borehole was allowed to set open for 24 hours. However, it should be noted that water appeared to be infiltrating the boring from near the surface. In addition, a test pit was advanced to a depth of 8 ft bgs in the vicinity of EB-2 (approximately 3 months after EB-2 was advanced) and no water was observed. The stabilized groundwater level was measured at 1.87 ft bgs after 24hrs. See **Figure 2** for the location of monitoring well MW-2. Field boring logs and construction diagrams (**Appendix B**) have been included as appendices to this report.

During the advancement of exploratory boring EB-3, gray silty to sandy clay that transitioned in color to orange and then tan with some gravel was encountered from ground surface to 9 feet bgs. Underlying the silty sandy clay was tan fat clay that transitioned in color to orange with black organics from 9 feet to 17 feet bgs. From 17 to 25 ft bgs was a orange silty to sandy clay that transitioned in color to tan with orange and gray mottling. Tan silty sand was observed from 25 ft to 29 ft below ground surface. Brown fat clay with black organics was present to the bottom of the borehole. The total depth for EB-3 was 30 ft bgs. Groundwater was observed at 23.5 ft bgs during drilling. PVC pipe was installed and the borehole was allowed to stay open for 24 hours. The stabilized water level after 24hrs was measured at 13.76 ft below ground surface. See **Figure 2** for the location of exploratory boring EB-1. Field boring logs (**Appendix B**) have been included as appendices to this report.

During the advancement of exploratory boring EB-4, topsoil was encountered from ground surface to six inches bgs. Underlying topsoil was reddish-orange silty to sandy clay with gravel and gray mottling that transitioned in color to gray from six inches to 12 feet bgs. From 12 to 19 ft bgs was a tan fat clay with gray mottling. Tan silty to sandy clay with orange and gray mottling was then encountered from 19 to 22 ft bgs. Below the silty sandy clay was a tan fat clay to 24 ft bgs. Silty sandy clay that varied in color from dark brown to tan with orange mottling was encountered from 24 to 28.5 ft bgs. Below the silty sandy clay was a fat brown clay that extended to the bottom of the borehole. The total depth for EB-4 was 30 ft bgs. Groundwater was observed at 25.5 ft below ground surface. PVC pipe was installed and the borehole was allowed to stay open for 24 hours. The stabilized water level after 24hrs was measured at 18.53 ft below ground surface. See **Figure 2** for the location of exploratory boring EB-1. Field boring logs (**Appendix B**) have been included as appendices to this report.

Test pit TP-1 was approximately 8 ft bgs. The test pit contained reddish-orange silty to sandy clay. Below the silty to sandy clay was a reddish brown fat clay with orange and tan mottling. No water was observed during the advancement of TP-1.

3.2 GROUNDWATER ELEVATIONS (APC&EC Reg. §22.1104(c))

As per ADEQ request (doc. 63933) and to demonstrate seasonal high water table surface per Reg. 22.1104(b), the exploratory borings were drilled in the spring. This was to ensure that the seasonal high water table was able to be evaluated. As shown in **TABLE 1** below and in **FIGURE 6**, groundwater is higher in the east and flows to the west along the same general direction as the topographic gradient.

TABLE 1
Groundwater Elevations

Boring	Approximate Surface Elevation (fmsl)	Approximate Groundwater Elevation (fmsl)	Approximate Stabilized Groundwater (after 24hrs) (fmsl)
EB-1	278	239	268.24
EB-2	280	255	278.13*
EB-3	278	254.5	264.24
EB-4	266	240.5	247.47

*Note: groundwater stabilized at 1.87ft below ground surface and appeared to be infiltrating from near ground surface.

4.0 GEOTECHNICAL TESTING (APC&EC Reg. §22.1104(e)(2&3))

In order to characterize the proposed expansion area in terms of geotechnical properties, samples were collected from test pits during this investigation. A total of 4 samples were collected from one (1) test pit. These four samples were taken at various depths and submitted to Anderson Engineering, Inc. for geotechnical analysis. The purpose of these analyses was to gain information on the geotechnical properties of the samples and to properly characterize each individual soil type found on site.

The appropriate geotechnical lab tests outlined below were conducted for characterization purposes, and compliance with APC&EC Reg. §22.1104(e)(2&3):

- Atterberg Limits (ASTM D4318)
- Sieve Analysis (ASTM D1140 & D422)
- Hydraulic Conductivity (undisturbed soils)

APPENDIX C contains all geotechnical laboratory test results associated with the current proposed permit modification. The following sections summarize the results of the geotechnical testing conducted during this investigation.

4.1 SIEVE ANALYSIS SUMMARY

Particle size analyses were conducted on the samples collected during this investigation for the purpose of analyzing grain size distribution and classification associated with soils native to the proposed expansion area.

In the sieve analysis, a series of sieves (screens) differing in slot size are stacked with the larger sizes over the smaller. The soil sample being tested is dried, clumps are broken, and the sample is passed through the series of sieves by shaking. Larger particles are caught on the upper sieves, and the smaller particles filter through to be caught on one of the smaller underlying sieves. The weight of material retained on each sieve is conventionally presented as a grain or particle size distribution on tables presented in the results.

The samples were analyzed in the laboratory for grain size distribution in accordance with ASTM D422 and ASTM C 117.

4.2 ATTERBERG LIMITS/MOISTURE CONTENT SUMMARY

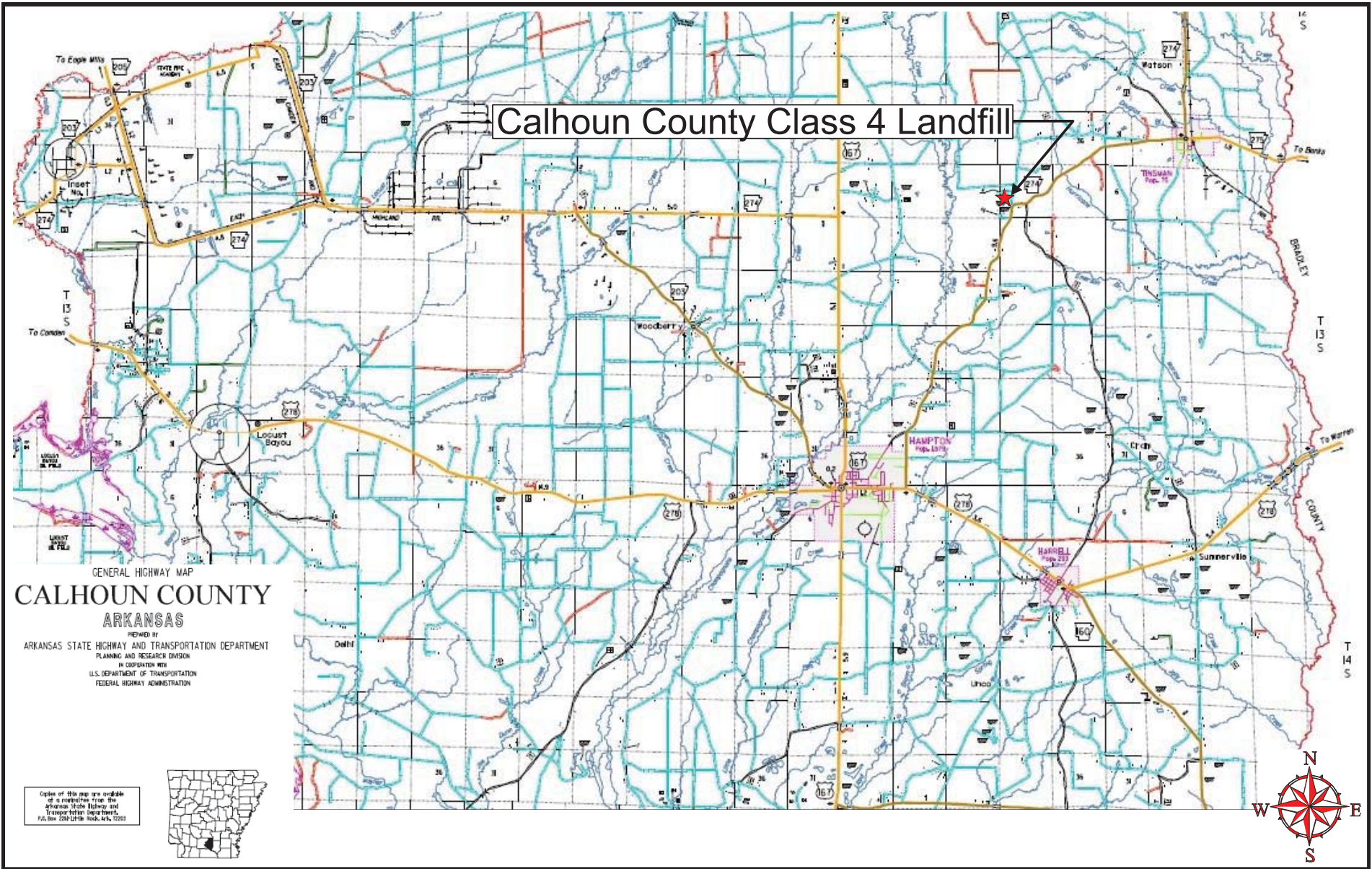
In the remolded state, the consistency of clay soil varies in proportion to the water content. At higher water content, the soil-water mixture possesses the properties of a liquid. At lesser water contents a soil-water mixture possesses properties that resemble a plastic. At still lesser water contents, soil-water mixtures approach a solid or semi-solid state. The water content indicating the division between the liquid and plastic state has been designated as the Liquid Limit. The division between the plastic and semi-solid state is referred to as the Plastic Limit. The numerical difference between the Liquid Limit and the Plastic Limit is identified as the Plasticity Index. These values are often referred to as Atterberg Limits. The Atterberg Limits test is used to obtain basic index information on soils and is used to estimate strength, settlement, and workability characteristics. It is the primary form of classification for cohesive soils properties for soils commonly used in the construction of landfill liner systems.

In general, on-site clays determined to have Plasticity Indices greater than 10 can be considered for used in the construction of any clay liner system. It should be noted that on-site clays contain a plastic limit of 29 and could potentially be utilized in a compacted clay liner system. The Atterberg Limits results are presented in **APPENDIX C**.

4.3 HYDRAULIC CONDUCTIVITY SUMMARY

Soil samples were obtained for the purpose of characterizing the permeability characteristics of area clays. Results of these samples are presented in **APPENDIX C**. All tests were completed on remolded specimens in accordance with ASTM D-5084. The values from the two tests ranged from 8.95×10^{-9} to 1.07×10^{-5} cm/sec with an average result of 5.35×10^{-6} cm/sec.

FIGURES

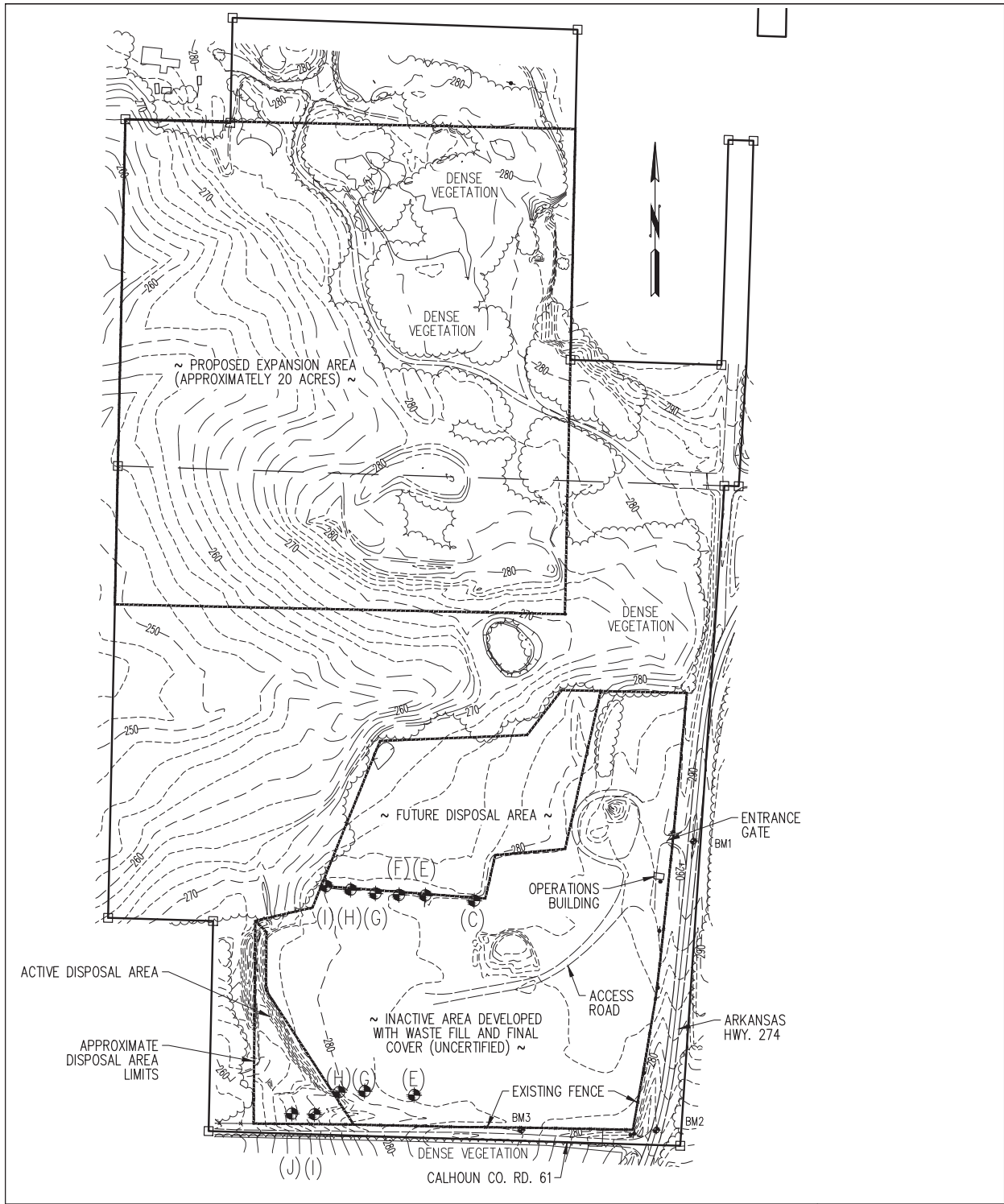



7529 Counts Massie Road, North Little Rock, AR 72113
501-812-4551
Quality Groundwater & Environmental Consulting

Site Location Map
Calhoun County Class 4 Landfill
Calhoun County, AR

**FIGURE
1**

Date: 1/17/13
By: RWF



NOTE: TOPOGRAPHIC SURVEY
 PERFORMED BY
 AMI ENGINEERING, INC.
 ON MARCH 20, 2011.



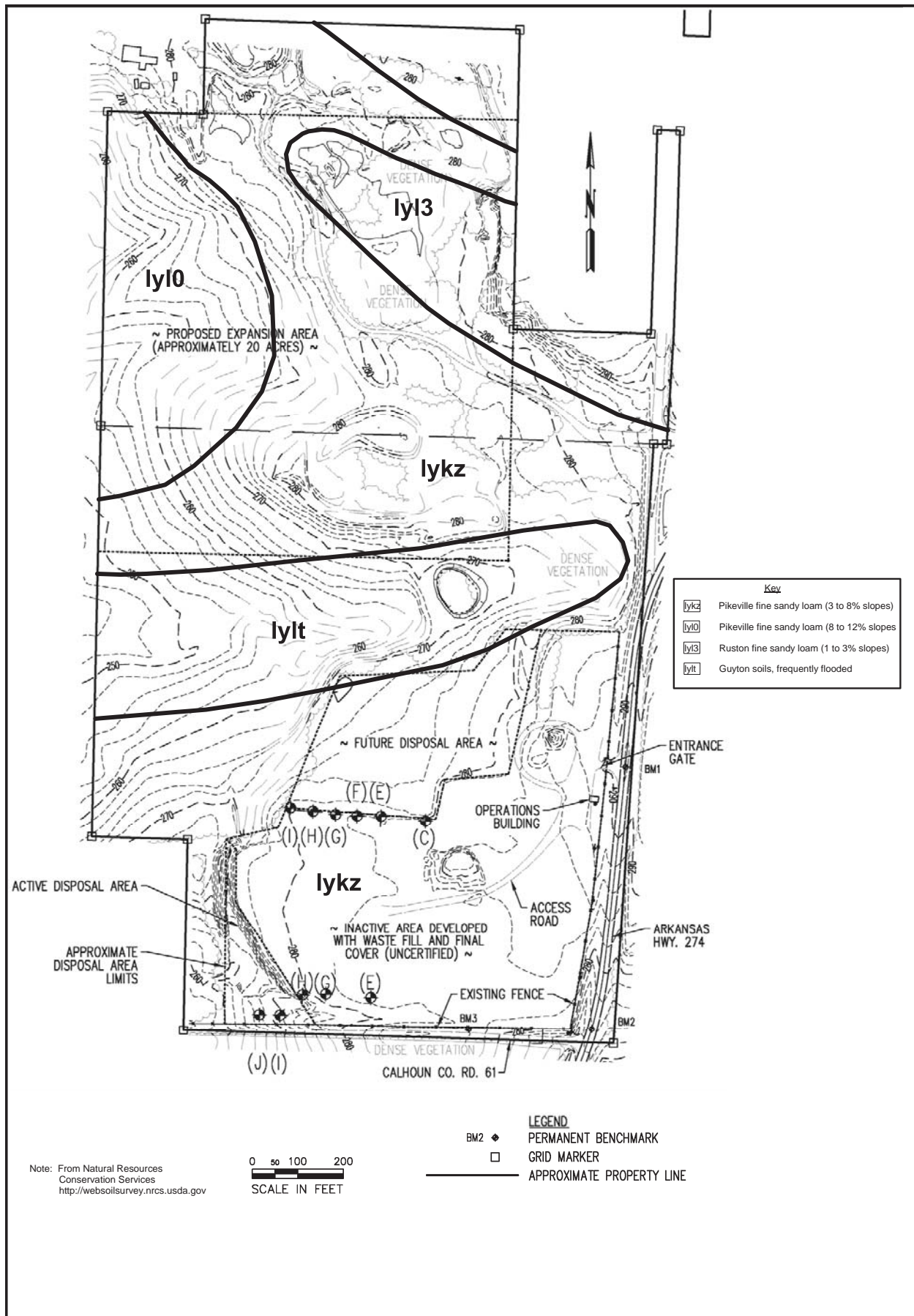
LEGEND
 BM2 ◆ PERMANENT BENCHMARK
 □ GRID MARKER
 ——— APPROXIMATE PROPERTY LINE

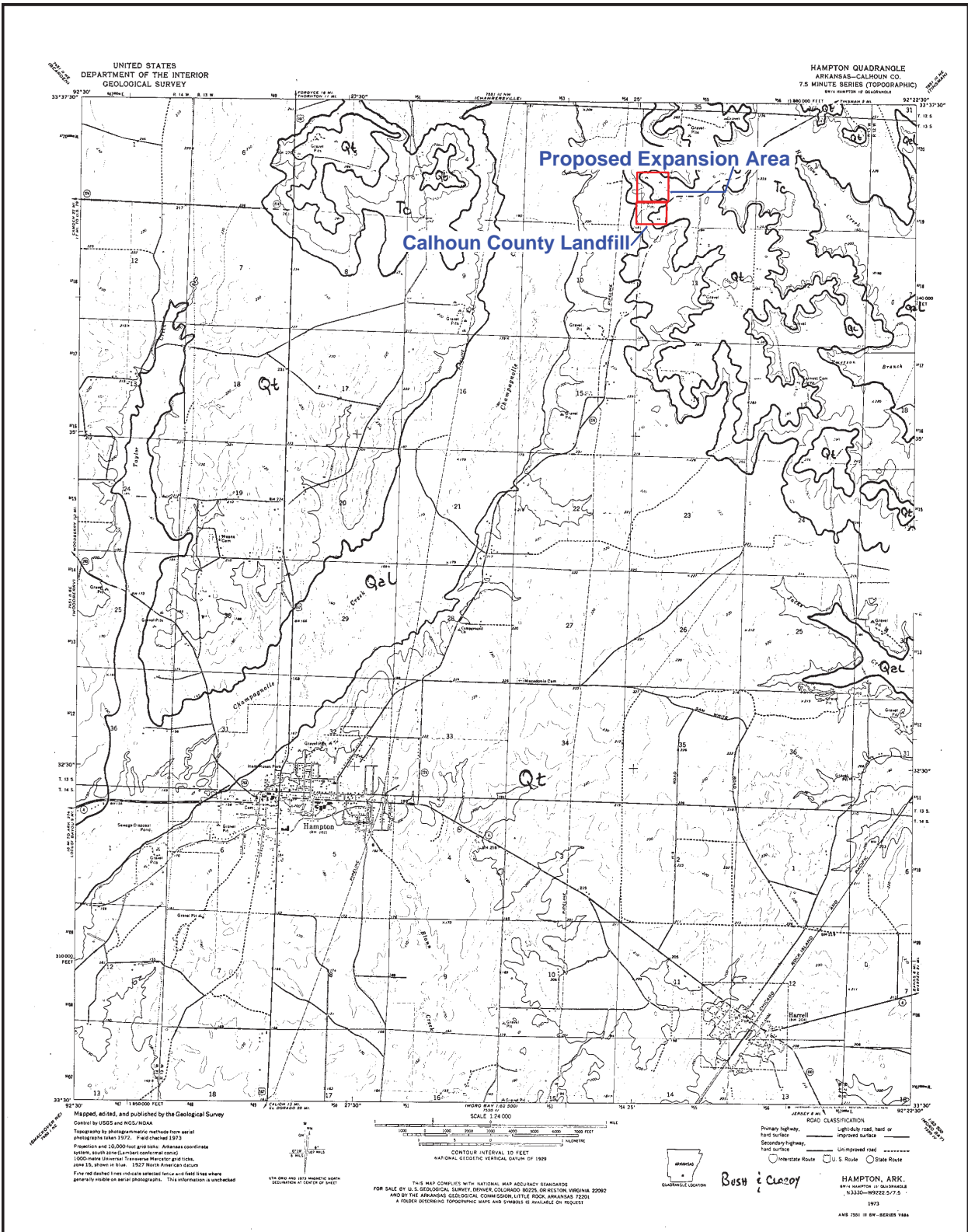
REVISED: 5/21/13
 JOB NO: 7-4005-1201
 ACAD NO: 002
 DWN. JKP 5/13
 SCALE: 1" = 200'
 DATE: MAY 2013



7529 Counts Massie Rd. N. Little Rock, AR 72113 Ph.: (501) 812-4551

FIGURE 2
 SITE LAYOUT
 CALHOUN COUNTY CLASS 4 LANDFILL
 CALHOUN COUNTY
 ARKANSAS





Legend

Note: Modified USGS Geologic Worksheet, Hampton Quad. Bush and Clardy

Qt	Quaternary Terrace Deposits - Alluvium
Tc	Tertiary - Claiborne Group
Qal	Quaternary Alluvium

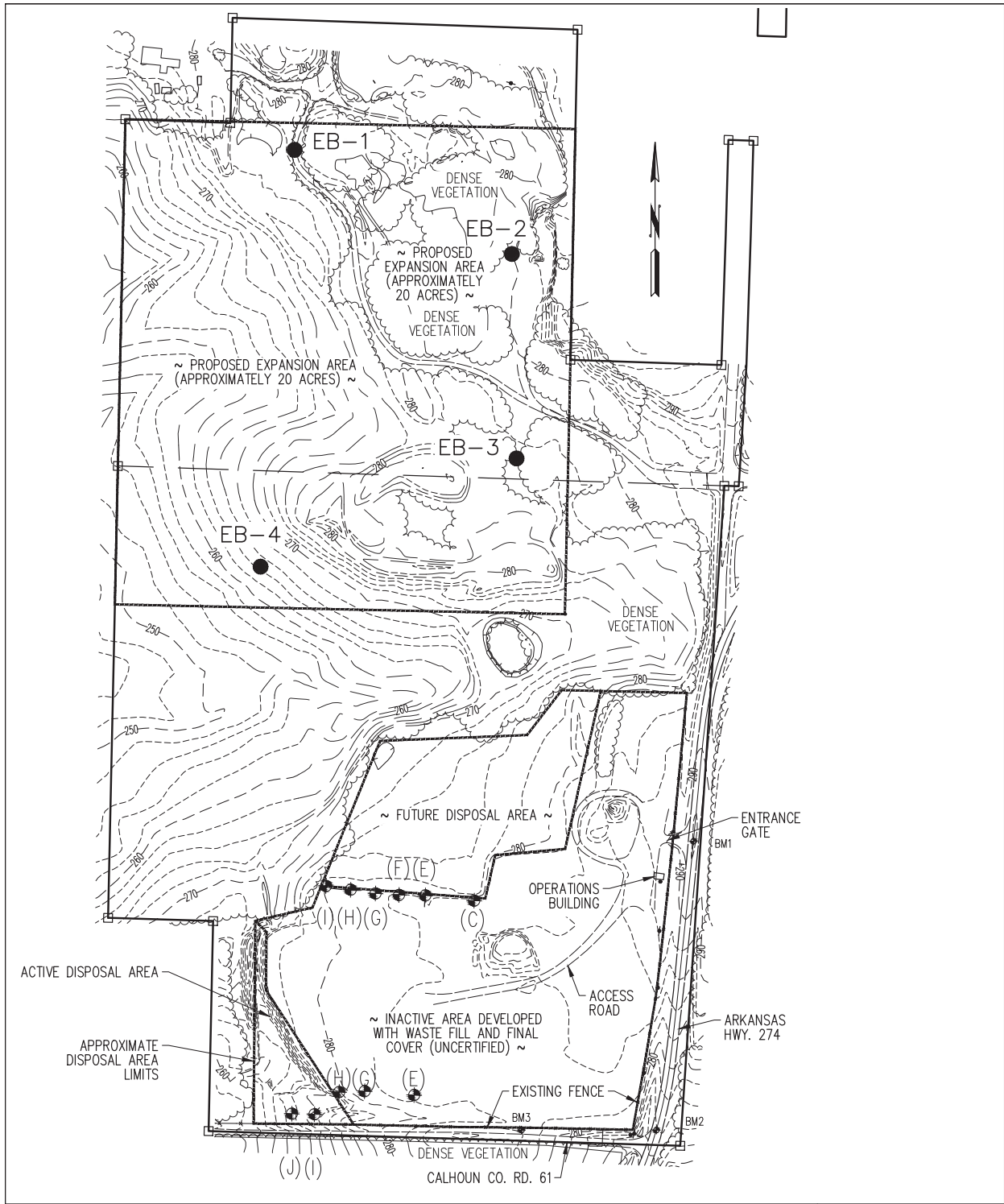
CRC CHIMNEY ROCK CONSULTING

7529 Counts Massie Road, North Little Rock, AR 72113
501-812-4551
Quality Groundwater & Environmental Consulting

Site Geologic Map
Calhoun County Class 4 Landfill
Calhoun County, AR

FIGURE
4

Date: 5/22/13
By: RWF



NOTE: TOPOGRAPHIC SURVEY
 PERFORMED BY
 AMI ENGINEERING, INC.
 ON MARCH 20, 2011.



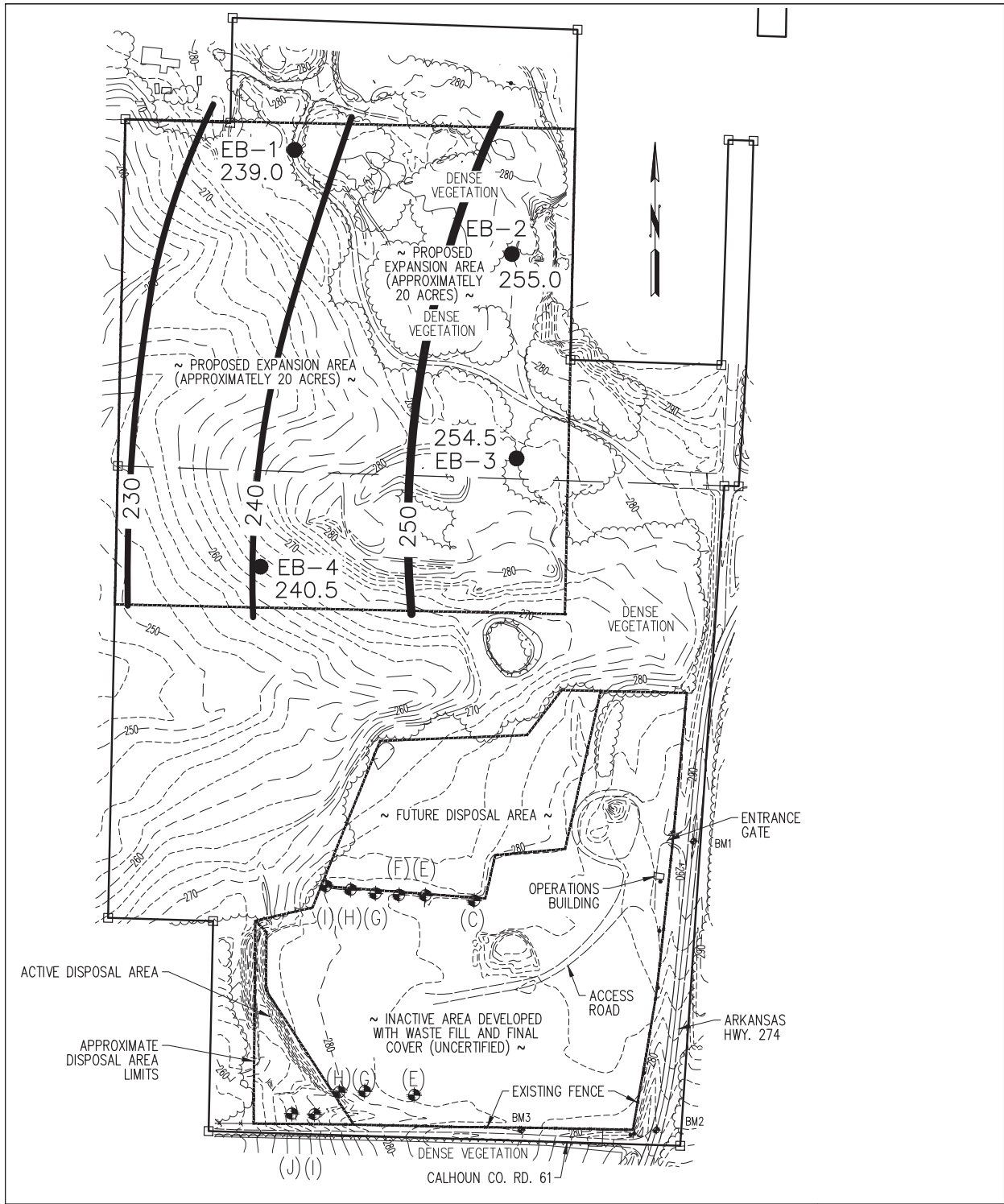
LEGEND
 BM2 ◆ PERMANENT BENCHMARK
 □ GRID MARKER
 EB-3 ● EXPLORATORY BORING LOCATION
 ——— APPROXIMATE PROPERTY LINE

REVISED: 5/21/13
 JOB NO: 7-4005-1201
 ACAD NO: 002
 DWN. JKP 5/13
 SCALE: 1" = 200'
 DATE: MAY 2013



7529 Counts Massie Rd. N. Little Rock, AR 72113 Ph.: (501) 812-4551

FIGURE 5
 EXPLORATORY BORING LOCATION
 CALHOUN COUNTY CLASS 4 LANDFILL
 CALHOUN COUNTY
 ARKANSAS



NOTE: TOPOGRAPHIC SURVEY
 PERFORMED BY
 AMI ENGINEERING, INC.
 ON MARCH 20, 2011.



- LEGEND**
- BM2 ◆ PERMANENT BENCHMARK
 - GRID MARKER
 - EB-3 ● EXPLORATORY BORING LOCATION
 - APPROXIMATE PROPERTY LINE
 - GROUNDWATER CONTOUR

REVISED: 8/07/13		
JOB NO: 7-4005-1201		
ACAD NO: 003		
DWN.	JKP	8/13
SCALE: 1" = 200'		
DATE: AUGUST 2013		



7529 Counts Massie Rd. N. Little Rock, AR 72113 Ph.: (501) 812-4551

FIGURE 6
 POTENTIOMETRIC SURFACE
 CALHOUN COUNTY CLASS 4 LANDFILL
 CALHOUN COUNTY
 ARKANSAS

APPENDIX A
Workplans and Approvals

**Calhoun County Class 4 Landfill
Hydrogeologic Investigation Workplan
Proposed Class 4 Landfill Expansion
Permit Number 0070-S AFIN: 07-00024**

**Project No. 13-031
February 2013**

Prepared for:

**Calhoun County
309 West Main Street
Hampton, Calhoun County, Arkansas 71744
(870)-798-4818**

Prepared by:



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APPENDICES

APPENDIX A FIGURES


FIGURE 1 Site Location Map

FIGURE 2 Site Layout Map with Proposed Boring Locations

**CALHOUN COUNTY CLASS 4 LANDFILL
HYDROGEOLOGIC INVESTIGATION WORKPLAN
PROPOSED CLASS 4 LANDFILL EXPANSION**

Professional Geologist Certification

"I certify to the best of my professional judgment that this document and all attachments properly adhere to established, sound practices. This certification is contingent on the fact that all information supplied to the signatory authority, up to the date of this certification, is accurate and was provided in good faith."


Dan McCullough

Dan McCullough, P.E. Date *6/6/2013*
Senior Hydrogeologist #1802

1.0 INTRODUCTION

Calhoun County currently owns, operates, and maintains a Class 4 Municipal Solid Waste landfill (Landfill) under Arkansas Department of Environmental Quality (ADEQ) Solid Waste Permit 0070-S. The Landfill is located in the west half of the southwest quarter of Section 2, Township 13 South, Range 13 West, Calhoun County, Arkansas. A site location map is presented as **FIGURE 1**. The property has historically been used and operated as a solid waste disposal site with a Class 4 disposal area.

1.1 BACKGROUND

Calhoun County is submitting this workplan for a hydrogeologic characterization associated with a proposed expansion that consists of a 20 acre tract that is owned by Calhoun County. A site layout map showing the proposed expansion tract is included as **FIGURE 2**.

Civil Engineering Associates (CEA) on behalf of Calhoun County submitted an administratively complete permit pre-application for a 20 acre expansion that included submittals on October 12, 2012 (doc. 61725) and November 2, 2012 (doc. 63326). A public meeting was held on January 8, 2013.

This workplan is intended to address the requirements of Arkansas Pollution Control & Ecology Commission (APC&EC) Regulation 22, Chapter 11, “Geotechnical and Hydrogeological Investigations,” Section 22.1104 pertaining to Class 4 landfills.

The following list of tasks that are outlined in this work plan are required to address the hydrogeologic investigation:

- Groundwater separation,
- Bedrock separation,
- Site Characterization;
 - Subsurface borings
 - Geotechnical soil samples
- Soil hydraulic conductivity testing.

1.2 GEOLOGIC BACKGROUND

The Calhoun County Class 4 Landfill is located in the Gulf Coastal Plain physiographic province of southern Arkansas. Spanning from southern Texas to southern Florida, this region is characterized by alluvial and marine sedimentary deposits that vary in age from the Cretaceous Period to the present day. In Arkansas, these deposits dip gently to the south into the Gulf of Mexico and are important resources to the state.

The Calhoun Landfill resides within the Tertiary Claiborne Formation with some Quaternary Terrace deposits near the west and east boundaries of the site. The Claiborne is chiefly non-marine in origin, but does contain some marine intervals. “The unit is composed of medium- to very fine-grained sands, silts, and silty clays. The sands tend to be light- to dark-gray, white, brown, or red, depending on the degree of weathering. The silts and clays are light- to dark-gray and sometimes variegated. Intervals enriched in carbonaceous material are dark-brown to black. The silts are usually clayey and the clays are normally silty or sandy. Lignite beds are present in this interval. Lignite deposition was controlled by the geologic environment. In the subsurface, the Claiborne Group has been divided into the Carrizo Sand, Cane River Formation, Sparta Sand, Cook Mountain Formation, and Cockfield Formation. Fossils include fish and reptile bones and teeth, leaf impressions, lignitic wood, and trace fossils. The lower contact of the Claiborne Group is poorly known, but considered unconformable to the Wilcox Group. The thickness of the Claiborne ranges from a thin edge to 1,500 feet (Conrad, 1847).” The Claiborne Group is a very important hydrogeologic unit in some parts of the state where it lies in the subsurface as it has intervals of extensive porous unconsolidated sands (Sparta Sand and Cockfield) and confining units (Cane River and Cook Mountain) that form local and regional aquifers.

1.2.1 Geomorphology

The Calhoun County Class 4 landfill rests between 250 and 300 fmsl on the west side of a topographic high dividing the south flowing Champagnolle Creek and Hurricane Creek drainages. Ridges in the region are commonly parallel to prominent waterways as the ridges themselves are created by the incision of streams and rivers. Landfill property quickly drains to the west into the mature Champagnolle Creek. Drainage patterns are dendritic to deranged with the primary waterways being mature with well developed floodplains. Common landforms include stream terraces and meandering stream deposits and forms, such as oxbow lakes.

In a regional geomorphic sense, Calhoun County is near the intersection of the Mississippi Embayment physiographic province and the Gulf Coastal Plain. When the Gulf of Mexico began to rift a structural triple junction formed with two arms spreading into what is now the Gulf and a third rift arm, now known as the Reelfoot Rift, failing to fully develop leaving a topographically low north-south feature on the continent. This feature was followed by the Mississippi River during its development at the end of the last glacial maximum. When sea level was higher, the Gulf of Mexico extended into southern Arkansas and even into southeastern Missouri along the embayment depositing the Cretaceous and Tertiary marine sediments.

2.0 SITE CHARACTERIZATION

2.1 SUBSURFACE EXPLORATION PROGRAM

The intrusive portion of the site characterization will be performed by utilizing borings. During the drilling of the borings proposed in this workplan, the following information will be obtained:

1. Thickness and extent of each distinct soil texture unit or petrologic unit;
2. Depth to bedrock and/or;
3. Depth to groundwater during drilling and water levels after 24 hours.

Geotechnical samples will be collected from select borings. In accordance with Regulation 22, Section 22.1104 (e)(2), each textural horizon will be classified using the following physical tests:

1. Atterberg limits (ASTM D-4318);
2. Sieve analysis and grain size distribution curves (ASTM D-1140 & D-422);
3. Soil hydraulic conductivity tests using undisturbed soil samples.

2.1.1 Borehole Drilling Program

Section 22.1104 (e)(1) of APC&EC Regulation 22 requires a minimum spacing of one (1) boring per five (5) acres of expansion for Class 4 landfills. The proposed lateral expansion area covers approximately 20 acres resulting in a requirement of at least four (4) exploratory borings to satisfy the Regulation 22 spacing requirement. The proposed locations for the 4 borings are shown on **FIGURE 2**.

Each of the borings drilled during this investigation will be advanced through the overburden (residuum) until either groundwater or bedrock has been encountered. Continuous soil sampling will be performed in each boring. The on-site project geologist will record the lithology from the surface to the total depth of the boring and depth to water during and 24 hours after drilling on the boring logs.

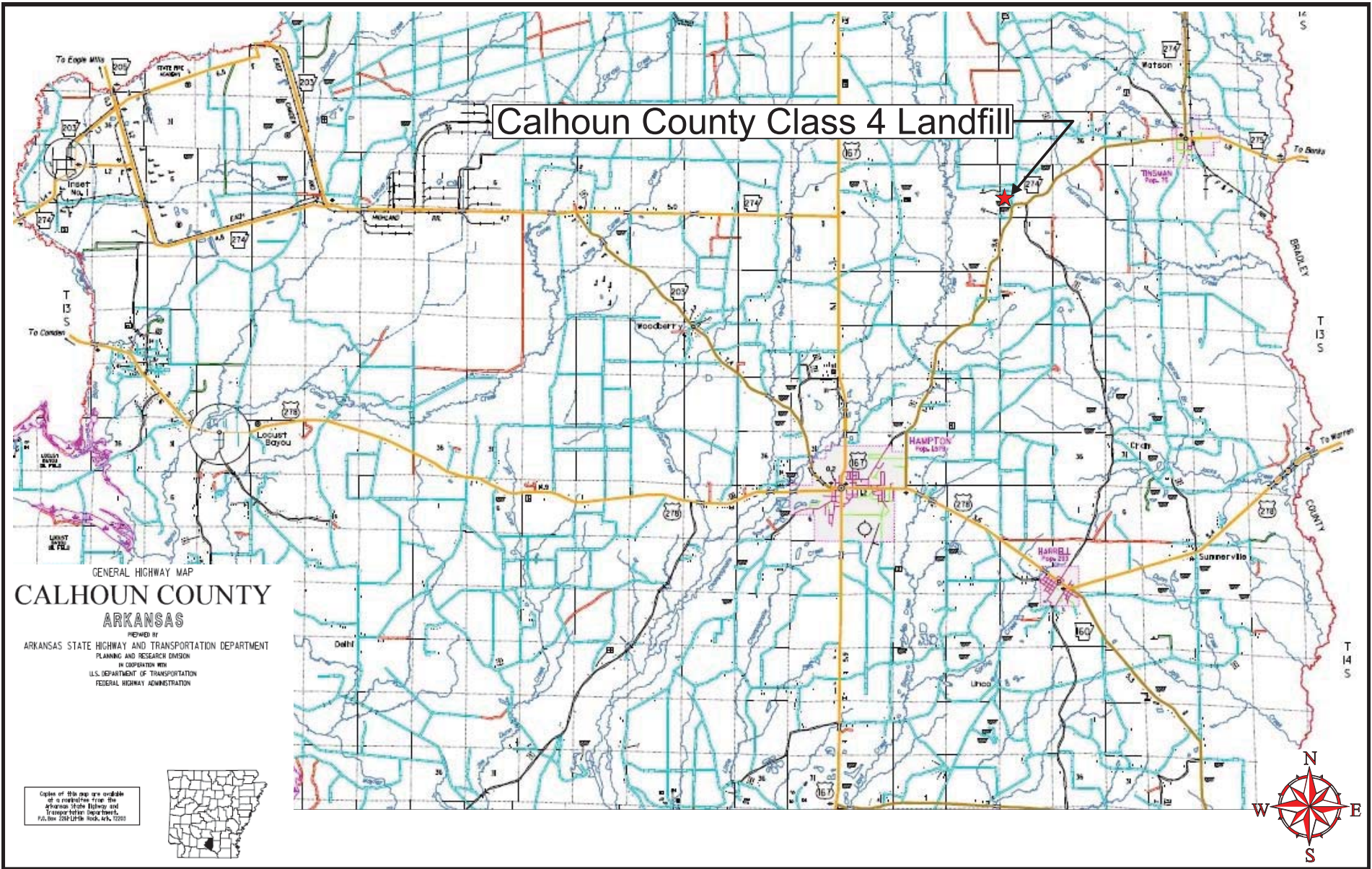
Upon obtaining 24 hour water level data, each boring will be decommissioned. Decommissioning will be performed in accordance with the “EPA Handbook of Suggested Practices for Design and Installation of Groundwater Monitoring Wells”. The decommissioning will be accomplished by grouting to the surface utilizing bentonite chips. CRC will record the amount of bentonite chips utilized during decommissioning.

3.0 REPORT PREPARATION

A Hydrogeologic and Geotechnical Report will be prepared documenting work performed during this investigation as required by Regulation 22. The report will include information required by APC&EC Regulation 22 Section 22.1104 and will contain a detailed description of all field activities conducted during this investigation. The report will be certified by an Arkansas Registered Professional Geologist.

APPENDIX A

FIGURES

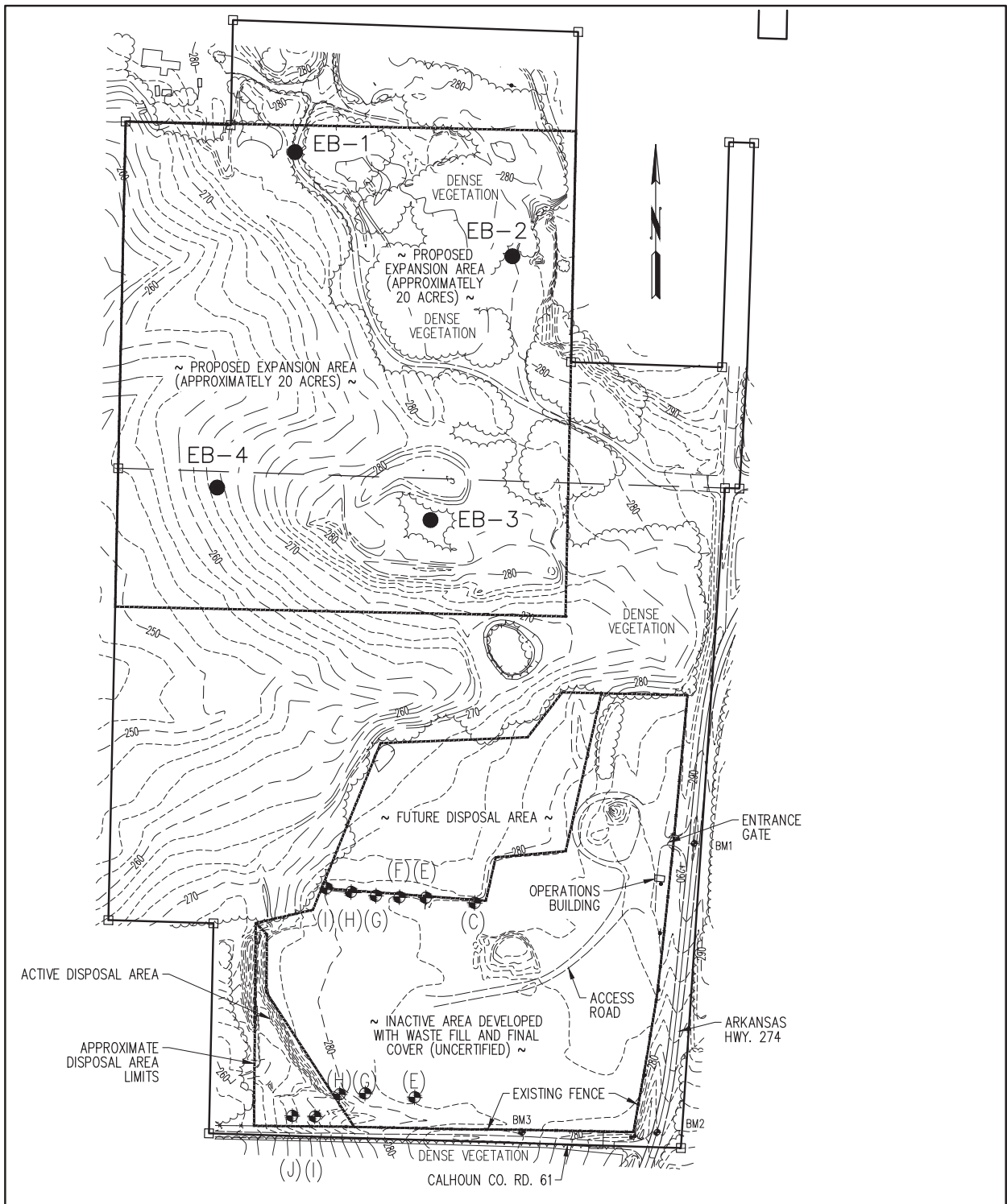


CRC CHIMNEY
 ROCK
 CONSULTING

7529 Counts Massie Road, North Little Rock, AR 72113
 501-812-4551
 Quality Groundwater & Environmental Consulting

Site Location Map
 Calhoun County Class 4 Landfill
 Calhoun County, AR

FIGURE
1
 Date: 1/17/13
 By: RWF



NOTE: TOPOGRAPHIC SURVEY
 PERFORMED BY
 AMI ENGINEERING, INC.
 ON MARCH 20, 2011.



LEGEND
 BM2 ◆ PERMANENT BENCHMARK
 □ GRID MARKER
 EB-3 ● PROPOSED BORING LOCATION
 ——— APPROXIMATE PROPERTY LINE

REVISED: 2/01/13
 JOB NO: 7-4005-1201
 ACAD NO: 001
 DWN. JKP 1/13
 SCALE: 1" = 200'
 DATE: JANUARY, 2013



7529 Counts Massie Rd. N. Little Rock, AR 72113 Ph.: (501) 812-4551

FIGURE 2
 SITE LAYOUT WITH PROPOSED BORINGS
 CALHOUN COUNTY CLASS 4 LANDFILL
 CALHOUN COUNTY
 ARKANSAS

ADEQ

ARKANSAS
Department of Environmental Quality

March 4, 2013

The Honorable Floyd Nutt
Calhoun County
P.O. Box 566
Hampton, Arkansas 71744

RE: Comments Regarding the Hydrogeologic Investigation Workplan Proposed Class 4 Landfill Expansion dated February 2013 by Chimney Rock Consulting

AFIN: 07-00024

Document Number: 63993

Permit No: 0070-S

Cross Reference: 63918

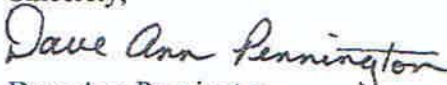
Dear Judge Nutt:

The ADEQ-Solid Waste Management Division reviewed the document submitted on your behalf on February 12, 2013 titled "Hydrogeologic Investigation Workplan Proposed Class 4 Landfill Expansion" dated February 2013 by Chimney Rock Consulting. The following comments should be addressed in an addendum to the submitted work plan.

1. Specify the drilling method for the site borings.
2. State how the boring will remain open for 24 hours after drilling to obtain water levels.
3. Regulation 22.1104 (e)(1) states "Test pits and/or borings must be used to demonstrate the depth and site stratigraphy to a depth of no less than ten feet below the bottom of the containment structure." The work plan states "Each of the borings drilled during this investigation will be advanced through the overburden (residuum) until either groundwater or bedrock has been encountered." The work plan should also address compliance with Regulation 22.1104(e)(1) regarding an estimated target depth.
4. The drill activities should occur when the seasonal high water table can be evaluated – so not in summer or fall.

If you have any questions or comments contact me or Bill Sadler at 501-682-0590 or 501-682-0606 or by electronic mail at pennington@adeq.state.ar.us or sadler@adeq.state.ar.us.

Sincerely,



Dave Ann Pennington
Senior Geologist



Bill Sadler, P.G.
Geologist Supervisor

cc: Lance Powell, P.E., CEA
Dan McCullough, P.G., Chimney Rock Consulting
Heidi Love, Inspector Supervisor, SWMD
Gerry Eddy, District Inspector, SWMD



2114 East Matthews Avenue
Jonesboro, Arkansas 72401
870-972-5316
Fax 870-932-0432

March 13, 2013

Arkansas Department of Environmental Quality
Solid Waste Management Division
Attn: Ms. Dave Ann Pennington
5301 Northshore Drive
North Little Rock, AR 72218

**SUBJECT: Addendum to Hydrogeologic Investigation Workplan
Proposed Class 4 Landfill Expansion
Calhoun County Class 4 Landfill
Solid Waste Permit Number 0070-S, AFIN 07-00024**

Dear Ms. Pennington,

On behalf of Calhoun County, Civil Engineering Associates, LLC (CEA) is submitting this Addendum to the Hydrogeologic Investigation Workplan (Document Number 63918) for the proposed expansion of the Calhoun County Class 4 Landfill. This Addendum was prepared to address the comments issued by the Arkansas Department of Environmental Quality (ADEQ) in a letter dated March 4, 2013 (Document Number 63933). The comments noted in the referenced letter are shown below in bold italics for reference, followed by the response from CEA.

1. Specify the drilling method for the site borings.

Each boring will be advanced by a truck or buggy mounted CME-55 utilizing 8.25 hollow stem augers with continuous sampling methods.

2. State how the boring will remain open for 24 hours after drilling to obtain water levels.

As stated in the Hydrogeologic Investigation Workplan, the on-site project geologist will record the lithology from the surface to the total depth of the boring and the depth to water during and 24 hours after drilling on the boring logs. Therefore, in order to obtain a 24 hour water level, each boring will remain open for 24 hours. To insure that a water level can be recorded 24 hours after drilling, a temporary PVC screen and riser pipe will be installed. This temporary pipe will be removed after 24 hours and the borehole will be backfilled with bentonite chips.

3. Regulation 22.1104(e)(1) states "Test pits and/or borings must be used to demonstrate the depth and site stratigraphy to a depth of no less than ten feet below the bottom of the containment structure". The work plan states "Each of the borings drilled during this investigation will be advanced through the overburden

HOT SPRINGS ■ JONESBORO ■ POPLAR BLUFF

(residuum) until either groundwater or bedrock has been encountered.” The work plan should also address compliance with Regulation 22.1104(e)(1) regarding an estimated target depth.

All borings will be used to demonstrate the depth and site stratigraphy to a depth of no less than ten feet below the bottom of the containment structure as outlined in Regulation 22.1104(e)(1). As stated in the Hydrogeologic Investigation Workplan, the borings will be advanced through the overburden until either groundwater or bedrock has been encountered and the design of the landfill will be based on information gathered from the borings. As such, the containment structure will be designed to be five feet above the seasonal high water table surface and/or at a minimum of two feet above the bedrock surface as outlined in Regulation 22.1104. Therefore, the borings will be advanced to either a depth of five feet into groundwater or eight feet into bedrock, whichever comes first.

4. The drill activities should occur when the seasonal high water table can be evaluated – not in summer or fall.

Drilling activities will initiate once approval of the Hydrogeologic Investigation Workplan from the ADEQ is granted, therefore, drilling is anticipated to be completed during the spring of 2013.

If you have any questions, or if you need additional information, please do not hesitate to contact Dan McCullough or me.

Sincerely,
CIVIL ENGINEERING ASSOCIATES, LLC



Lance Powell, P.E.
Project Manager

cc: The Honorable Floyd Nutt, Calhoun County
Dan McCullough, P.G., Chimney Rock Consulting

ADEQ

ARKANSAS
Department of Environmental Quality

March 14, 2013

The Honorable Floyd Nutt
Calhoun County
P.O. Box 566
Hampton, Arkansas 71744

**RE: Approval of the Hydrogeologic Investigation Workplan Proposed Class 4 Landfill
Expansion including the Addendum to the Workplan**

AFIN: 07-00024

Permit No.: 0070-S

Document No.: 64065

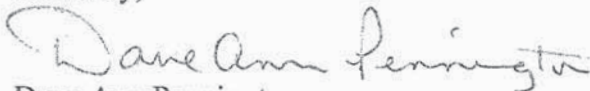
Cross Reference: 64060 and 63918

Dear Judge Nutt:

The ADEQ-Solid Waste Management Division (SWMD) Technical Branch staff reviewed the March 13, 2013 "Addendum to Hydrogeologic Investigation Workplan" by CEA. The "Hydrogeologic Investigation Workplan" (Doc. 63918) including the "Addendum" (64060) for the proposed expansion of the Calhoun County Class 4 Landfill is approved by the SWMD.

If you have any questions or comments, contact me or Bill Sadler at 501-682-0590 or 501-682-0606 or by electronic mail at pennington@adeq.state.ar.us or sadler@adeq.state.ar.us.

Sincerely,




Dave Ann Pennington
Senior Geologist

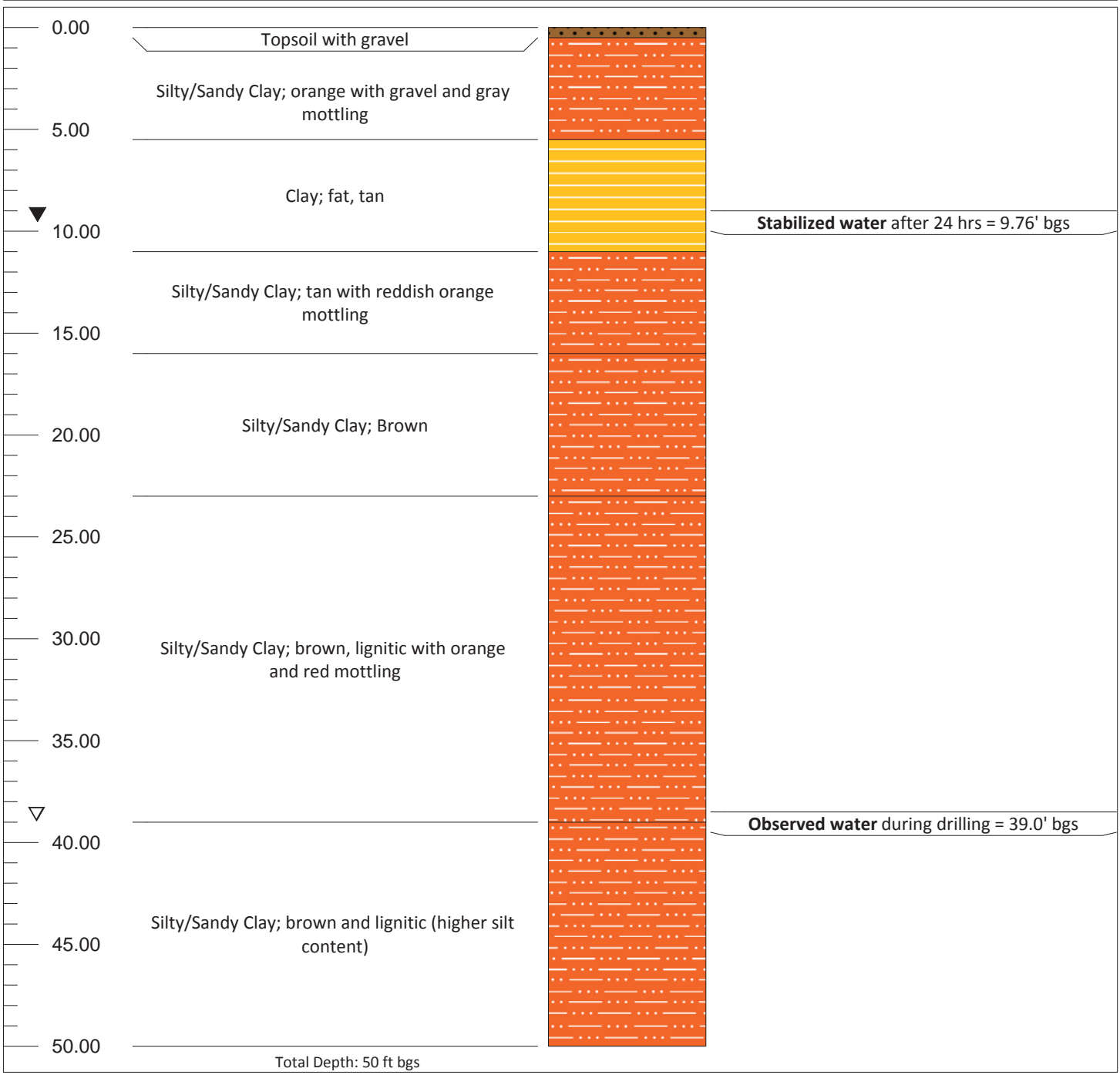



Bill Sadler, P.G.
Geologist Supervisor

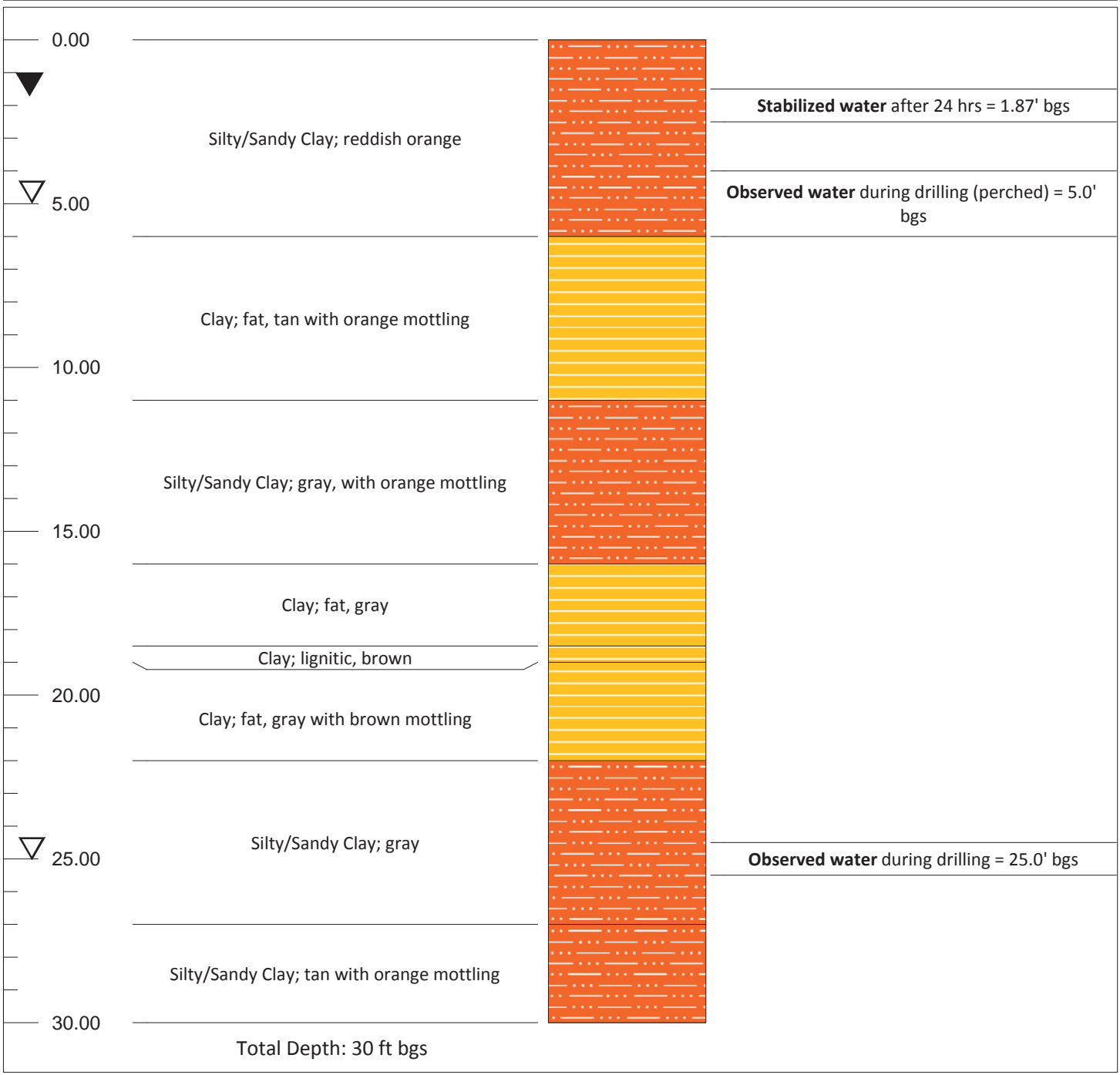
cc: Lance Powell, P.E., CEA
Dan McCullough, P.G., Chimney Rock Consulting
Heidi Love, Inspector Supervisor, SWMD
Gerry Eddy, District Inspector, SWMD


APPENDIX B
Boring Logs

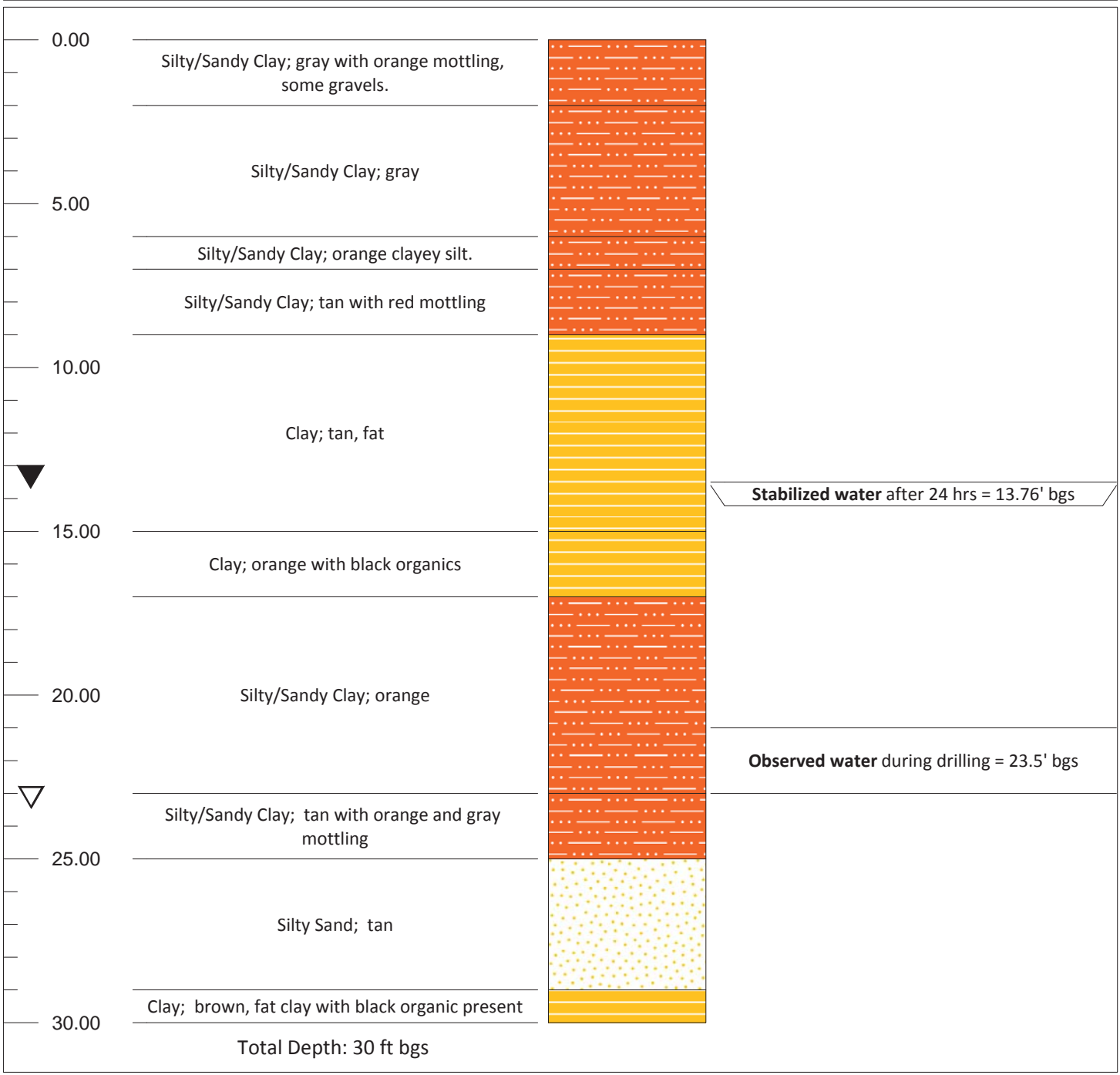
Field Boring Log	Boring No. : EB-1		 <p>7529 Counts Massie Road " North Little Rock, Arkansas 72113 Phone (501) 812-4551 " www.chimrockconsulting.com</p>
	Date Drilled: 3/19/2013		
Client: Calhoun County Class IV Landfill	Proj. No.: 13-031		
Logged By: Robert Fowler			
Total Depth: 50.0 ft below ground surface (bgs)			
Drilling Method: 8.25"Hollowstem augers		Drilling Co. : Anderson Engineering	
Sampling Method: Continuous		Driller: Gary Moyers	
Location: Hampton, AR		Rig Type: ATV Mounted CME 55	
Northing:	Easting:	Elevation:	Page:
Depth bgs	Lithologic Description	Litho. Symbol	COMMENTS




Field Boring Log	Boring No. : EB-2		 <p>7529 Counts Massie Road " North Little Rock, Arkansas 72113 Phone (501) 812-4551 " www.chimrockconsulting.com</p>
	Date Drilled: 3/19/2013		
Client: Calhoun County Class IV Landfill	Proj. No.: 13-031		
Logged By: Robert Fowler			
Total Depth: 30.0 ft below ground surface (bgs)			
Drilling Method: 8.25" Hollowstem augers		Drilling Co. : Anderson Engineering	
Sampling Method: Continuous		Driller: Gary Moyers	
Location: Hampton, AR		Rig Type: ATV Mounted CME 55	
Northing:	Easting:	Elevation:	Page:
Depth bgs	Lithologic Description	Litho. Symbol	COMMENTS




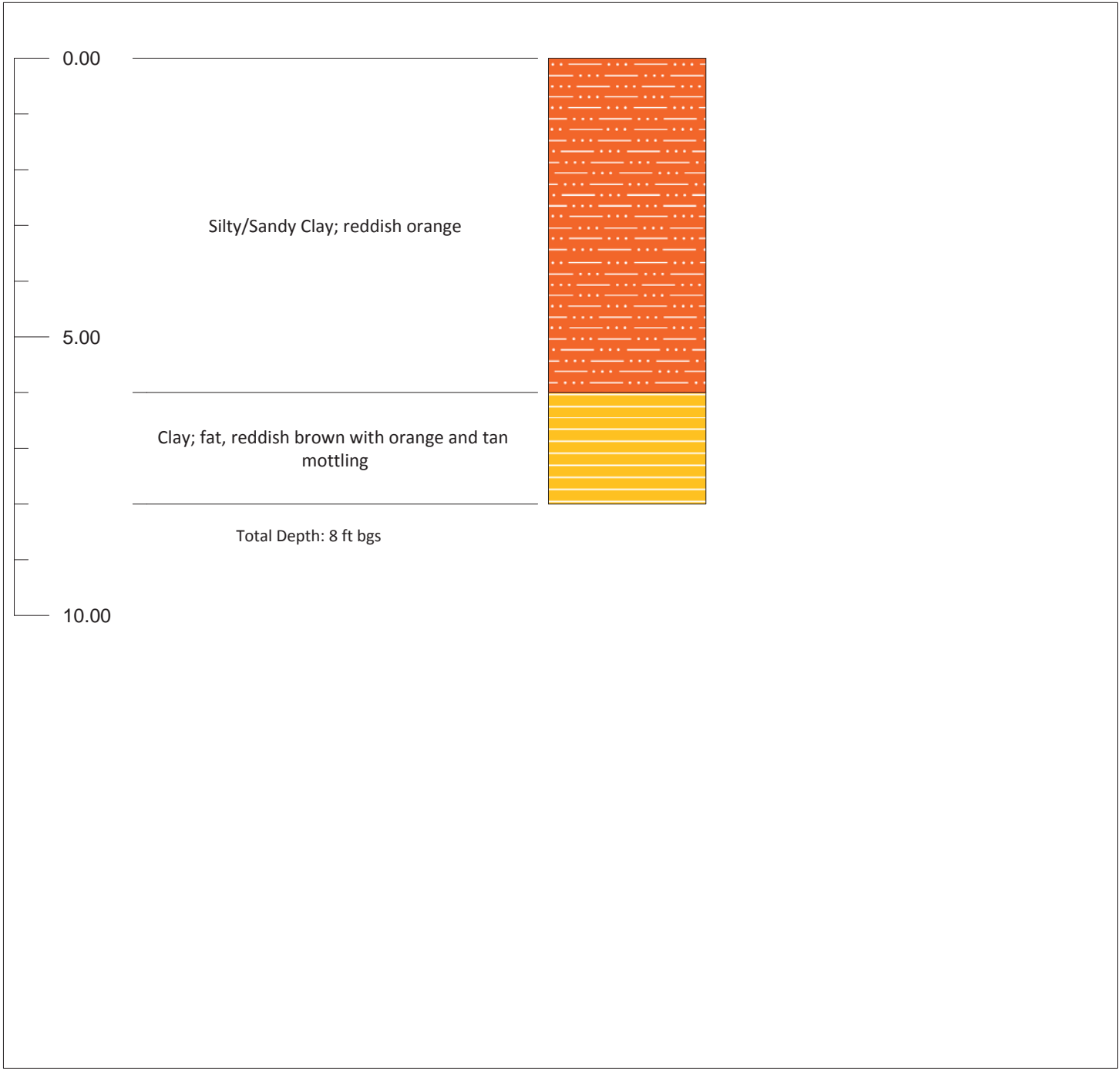
Field Boring Log	Boring No. : EB-3		 <p>7529 Counts Massie Road " North Little Rock, Arkansas 72113 Phone (501) 812-4551 " www.chimrockconsulting.com</p>
	Date Drilled: 3/19/2013		
Client: Calhoun County Class IV Landfill	Proj. No.: 13-031		
Logged By: Robert Fowler			
Total Depth: 30.0 ft below ground surface (bgs)			
Drilling Method: 8.25" Hollowstem augers		Drilling Co. : Anderson Engineering	
Sampling Method: Continuous		Driller: Gary Moyers	
Location: Hampton, AR		Rig Type: ATV Mounted CME 55	
Northing:	Easting:	Elevation:	Page:
Depth bgs	Lithologic Description	Litho. Symbol	COMMENTS



Field Boring Log	Boring No. : EB-4		 <p>7529 Counts Massie Road " North Little Rock, Arkansas 72113 Phone (501) 812-4551 " www.chimrockconsulting.com</p>
	Date Drilled: 3/19/2013		
Client: Calhoun County Class IV Landfill	Proj. No.: 13-031		
Logged By: Robert Fowler			
Total Depth: 30.0 ft below ground surface (bgs)			
Drilling Method: 8.25" Hollowstem augers		Drilling Co. : Anderson Engineering	
Sampling Method: Continuous		Driller: Gary Moyers	
Location: Hampton, AR		Rig Type: ATV Mounted CME 55	
Northing:	Easting:	Elevation:	Page:
Depth bgs	Lithologic Description	Litho. Symbol	COMMENTS



Field Boring Log	Boring No. : TP-1		 <p>7529 Counts Massie Road " North Little Rock, Arkansas 72113 Phone (501) 812-4551 " www.chimrockconsulting.com</p>
	Date Drilled: 6/20/2013		
Client: Calhoun County Class IV Landfill	Proj. No.: 13-031		
Logged By: Robert Fowler			
Total Depth: 8.0 ft below ground surface (bgs)			
Drilling Method: Trac Hoe		Drilling Co. : Calhoun County	
Sampling Method:		Driller: Rodney Gorman	
Location: Hampton, AR		Rig Type: trac hoe	
Northing:	Easting:	Elevation:	Page:
Depth bgs	Lithologic Description	Litho. Symbol	COMMENTS



APPENDIX C
Geotechnical Laboratory Test Results



ANDERSON ENGINEERING CONSULTANTS, INC.

10205 ROCKWOOD ROAD – LITTLE ROCK, ARKANSAS 72204

PHONE (501) 455-4545 FAX (501) 455-4552

July 16, 2013
Job No. 13714B

Mr. Robert Fowler
Chimney Rock Consulting
7529 Counts Massie road
North Little Rock, Arkansas 72113

Re: Calhoun County Landfill - Labwork
Hampton, Arkansas

Dear Mr. Fowler:

This letter is in response to your request for our services to perform soil classification and permeability tests.

SCOPE

Two (2) Shelby Tube samples and two (2) bucket samples were delivered to our laboratory for testing. (Sample Nos. TP-1 @ 2'-4', TP-1 @ 6'-8', TP-1 @ 3' and TP-1 @ 6').

TEST PROCEDURES

ASTM C 117	Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.
ASTM D 422	Particle-Size Analysis of Soils (+No. 200).
ASTM D 2216	Laboratory Determination of Water (Moisture) Content of Soil and Rock.
ASTM D 2487	Classification of Soils for Engineering Purposes.
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 5084	Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter.

TEST RESULTS

For detailed test results, see the attached Plates 1 through 4.

It has been our pleasure to provide these services to you and are always available should you require further services.

Very Truly Yours,
ANDERSON ENGINEERING CONSULTANTS, INC.

Myles D. Graham, SET
Laboratory Manager

MDG/mdg
Attachment: Test Results – Plates 1 through 4
13714B-ltr.1

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM D 2487
(UNIFIED SOIL CLASSIFICATION SYSTEM)

PROJECT: CALHOUN COUNTY LANDFILL - LABWORK

JOB NO.: 13714B

LOCATION: HAMPTON, COUNTY, ARKANSAS

REPORT DATE: 07/11/13

SAMPLE NO.: TP-1

DEPTH: 3'

SOURCE: NR

MATERIAL DESCRIPTION: REDDISH BROWN SAND WITH SILT AND GRAVEL

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

<u>LIQUID LIMIT DETERMINATION</u>			<u>PLASTIC LIMIT DETERMINATION</u>	
TARE NO.		NON-PLASTIC	TARE NO.	
NUMBER OF BLOWS			TARE + WET SOIL (g)	
TARE + WET SOIL (g)			TARE + DRY SOIL (g)	
TARE + DRY SOIL (g)			TARE (g)	
WATER (g)			DRY SOIL (g)	
TARE (g)			WATER (g)	
DRY SOIL (g)			WATER CONTENT (%)	
WATER CONTENT (%)			PLASTIC LIMIT	
LIQUID LIMIT				
			NON-PLASTIC	

LIQUID LIMIT: NP

PLASTIC LIMIT: NP

PLASTICITY INDEX: NP (NON-PLASTIC)

PARTICLE SIZE ANALYSIS OF SOILS
ASTM D 422

Sieve or Screen	Weight Retained (Grams)	Cummulative Weight Retained (Grams)	Percent Retained	Percent Finer	Specification
1.5"	0.0	0.0	0	100	N/A
3/4"	0.0	0.0	0	100	N/A
#4	122.6	122.6	17	83	N/A
#10	46.5	169.1	24	76	N/A
#40	74.9	244.0	34	66	N/A
#200	417.1	661.1	92.0	8.0	N/A
Original Sample Weight:		718.3			

Percent Gravel: 17.1

Percent Sand: 75.0

Percent Silt/Clay: 8.0

UNIFIED SOIL CLASSIFICATION (USCS): SP-SM

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM D 2487
(UNIFIED SOIL CLASSIFICATION SYSTEM)

PROJECT: CALHOUN COUNTY LANDFILL - LABWORK

JOB NO.: 13714B

LOCATION: HAMPTON, COUNTY, ARKANSAS

REPORT DATE: 07/11/13

SAMPLE NO.: TP-1

DEPTH: 6'

SOURCE: NR

MATERIAL DESCRIPTION: REDDISH BROWN & LIGHT BROWN FAT CLAY

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

<u>LIQUID LIMIT DETERMINATION</u>			<u>PLASTIC LIMIT DETERMINATION</u>	
TARE NO.	KH		TARE NO.	68
NUMBER OF BLOWS	24		TARE + WET SOIL (g)	15.75
TARE + WET SOIL (g)	14.84		TARE + DRY SOIL (g)	14.02
TARE + DRY SOIL (g)	11.05		TARE (g)	8.09
WATER (g)	3.79		DRY SOIL (g)	5.93
TARE (g)	6.85		WATER (g)	1.73
DRY SOIL (g)	4.20		WATER CONTENT (%)	29.17
WATER CONTENT (%)	90.2		PLASTIC LIMIT	29
LIQUID LIMIT	90			

LIQUID LIMIT: 90

PLASTIC LIMIT: 29

PLASTICITY INDEX: 61

PARTICLE SIZE ANALYSIS OF SOILS
ASTM D 422

Sieve or Screen	Weight Retained (Grams)	Cummulative Weight Retained (Grams)	Percent Retained	Percent Finer	Specification
1.5"	0.0	0.0	0	100	N/A
3/4"	0.0	0.0	0	100	N/A
#4	0.5	0.5	0	100	N/A
#10	0.0	0.5	0	100	N/A
#40	0.3	0.8	0	100	N/A
#200	2.8	3.6	1.2	98.8	N/A
Original Sample Weight:		311.2			

Percent Gravel: 0.2

Percent Sand: 1.0

Percent Silt/Clay: 98.8

UNIFIED SOIL CLASSIFICATION (USCS): CH

**COEFFICIENT OF PERMEABILITY
 (CONSTANT HEAD)
 ASTM D 5084 - FLEXIBLE WALL**

Project:	CALHOUN COUNTY LANDFILL - LABWORK	Project No.:	13714B
Location:	HAMPTON, ARKANSAS	Date:	07/12/13
Sample No.:	TP-1	Sample Depth:	2.0' - 4.0'
Soil Description:	RED/BROWN SAND WITH SILT AND GRAVEL	Station No.:	NA
Source:	NR	Lift No.:	NA

PHYSICAL PROPERTIES

Diameter, Inch.....	2.800	Diameter, Cm.....	7.11
Height, Inch.....	2.800	Height, Cm.....	7.11
Area, Square Inch.....	6.16	Area Sq. Cm.....	39.73
Volume, Cubic Inch.....	17.24	Volume, Cubic Cm.....	282.58
Initial Wt., Gram.....	541.9	Est. SP. GR.....	2.67
Water Content.....	15.9	Void Ratio.....	0.6120
Wet Unit Wt., PCF.....	119.7	Water Head:	
Dry Unit Wt., PCF.....	103.4	Cm.....	140.68
		Ft.....	4.62

TIME, MIN (T)	WATER DEG.,C	TEMP. ++ (RT)	HEAD PRESS psi (h)	FLOW ML (Q)	K20 CM./SEC
40	20.0	1.000	2.0	20.00	1.07E-05

**COEFFICIENT OF PERMEABILITY
(CONSTANT HEAD)
ASTM D 5084 - FLEXIBLE WALL**

Project:	CALHOUN COUNTY LANDFILL - LABWORK	Project No.:	13714B
Location:	HAMPTON, ARKANSAS	Date:	07/12/13
Sample No.:	TP-1	Sample Depth:	6.0' - 8.0'
Soil Description:	LIGHT BROWN FAT CLAY	Station No.:	NA
Source:	NR	Lift No.:	NA

PHYSICAL PROPERTIES

Diameter, Inch.....	2.800	Diameter, Cm.....	7.11
Height, Inch.....	2.800	Height, Cm.....	7.11
Area, Square Inch.....	6.16	Area Sq. Cm.....	39.73
Volume, Cubic Inch.....	17.24	Volume, Cubic Cm.....	282.58
Initial Wt., Gram.....	508.2	Est. SP. GR.....	2.67
Water Content.....	36.5	Void Ratio.....	1.0255
Wet Unit Wt., PCF.....	112.3	Water Head:	
Dry Unit Wt., PCF.....	82.3	Cm.....	140.68
		Ft.....	4.62

TIME, MIN (T)	WATER DEG.,C	TEMP. ++ (RT)	HEAD PRESS psi (h)	FLOW ML (Q)	K20 CM./SEC
240	20.0	1.000	2.0	0.10	8.95E-09