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July 28, 2009

Mr. Zinith Barbee  
Solid Waste Section  
North Carolina Department of Environment  
and Natural Resources  
401 Oberlin Road  
Suite 150  
Raleigh, North Carolina 27605-1350

Scanned 7/3/13 (cf)

Subject: Substantial Amendment and Phase 5  
Permit to Construct Application  
Buncombe County C&D Landfill Facility  
Site Hydrogeologic Report, Design Hydrogeologic Report, and Water Quality  
Monitoring Plan  
Response to Review Comments  
Permit No. 11-07

Dear Mr. Barbee:

CDM is submitting this letter in response to the comments received in your letter dated July 8, 2009 regarding the above referenced subject. The comments are addressed individually with discussions and references within this letter and the attachments. Solid Waste Section comments are provided in italics with CDM response directly following. Please include all revised pages, Tables, Sheets, Figures and comments in the appropriate document. A Gas Monitoring Plan for the C&D facility, pursuant to rule .0544(d) is provided in Attachment 1.

### Site Report

*2.2.2 Correct the sentence where it is stated that "no springs were observed within the ...expansion footprint". Contrary to the report, two springs and streams are shown within the proposed landfill footprint depicted on Sheet 2-1. One is near where cross sections C-C and D-D intersect; the other, along cross section A-A.*

The statement that no springs were observed within the proposed landfill expansion footprint is correct. In September 2008 CDM performed a stream identification survey for the drainage features within the proposed landfill footprint. The US Army Corps of Engineers (USACE) was then contacted to verify the CDM observations. Based on the CDM observations and the USACE verification, the jurisdictional stream heads were revised. Sheet 2-1 has been corrected to show the revised streams. In addition to Sheet 2-1, all Sheets within the Site Hydrogeologic Report have





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been revised, where applicable, to account for the jurisdictional stream revisions. All revised Sheets (2-1 through 2-5) are provided in Attachment 2.

2.2.3 See comment in Section 2.2.2.

See above.

2.3.2 Match what is reported as the "current" study with what is proposed. Phase 5 is listed in the application and cover letter. However, in the report Phase VII is listed as the current investigation for the proposed landfill expansion.

2.3.2.2 See Comment 2.3.2.

The Phases described in Sections 2.3.1 and 2.3.2 refer to investigation phases, not landfill development. The Phase 5 listed in the application refers to the Phase of C&D landfill development. Because numerous phases of drilling have been completed at the site for both the C&D facility and the Subtitle D facility, the investigation Phases do not correspond to the phases of respective landfill development. In order to avoid confusion for this report, the "Phase VII" investigation referred to in Sections 2.3.2 and 2.3.2.2 have been changed to "current." Revised page 2-10 is provided in Attachment 3.

2.4 Under the subheading "Drilling Operations", specify alluvium as the fourth lithologic unit, since discussion of it is presented in subsequent sections of the report. Three lithologic units are listed; whereas, four reportedly exist at the site.

Section 2.4 "Drilling Observations" has been revised accordingly. Revised Page 2-17 is provided in Attachment 3.

2.7 Provide the groundwater flow nets for stratigraphic sections shown in Figures 2-1 to Figures 2-5 as indicated in the report. Depicted in the sections are lithologic units but not the groundwater flow nets referenced in the site report.

Figures 2-1 through 2-5 have been revised to show groundwater flow nets. Revised Figures are provided in Attachment 4.

2.14.1.2 Correct the first statement containing "no groundwater discharge points...in the proposed expansion". Depicted on Sheets 2-1 and 2-2 are two springs and streams within the expansion areas proposed for Phase 5.

2.14.3 See comment for Section 2.14.1.2.



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The statement that no springs were observed within the proposed landfill expansion footprint is correct. In September 2008 CDM performed a stream identification survey for the drainage features within the proposed landfill footprint. The US Army Corps of Engineers (USACE) was then contacted to verify the CDM observations. Based on the CDM observations and the USACE verification, the jurisdictional stream heads were revised on the Sheets.

#### *Figures*

*2-1 to Figure 2-5 Show the groundwater flow net mentioned in Section 2.7.*

Figures 2-1 through 2-5 have been revised to show groundwater flow nets mentioned in Section 2.7. The revised figures are provided in Attachment 4.

### **Design Report**

*1.0 In this section or elsewhere in the design report, specify acreage of the footprint.*

Section 1.0 has been revised to specify the Phase 5 acreage. The proposed Phase 5 footprint is approximately 17.2 acres, of which 2.3 acres is expansion and 14.9 is existing C&D. A revised page 1 is provided in Attachment 5.

*1.3 Clarify what is the "current" investigation. Phase VII is identified as the current investigation; whereas, Phase 5 is specified in the application.*

The Phases described in Sections 1.2 and 1.3 refer to investigation phases, not landfill development. The Phase 5 listed in the application refers to the Phase of C&D landfill development. Because numerous phases of drilling have been completed at the site for both the C&D facility and the Subtitle D facility, the investigation Phases do not correspond to the phases of respective landfill development. In order to avoid confusion for this report, the "Phase VII" investigation referred to in Sections 1.2 and 1.3 have been changed to "current." Revised page 7 is provided in Attachment 5.

*2.2 Correct the statement that 9 piezometers are used. Only 5 piezometers are shown on sheets depicting proposed Phase 5.*

Following the current investigation, due to slope requirements and wetland buffers, the Phase 5 footprint was revised such that only 5 borings installed during the current investigation (B-614, B-615, B-616, B-619s and B-619d) were within or directly adjacent to the proposed footprint. Existing piezometers B-615 and B-616 and previous investigation borings CD-6 and B-8 are within the proposed footprint expansion. A revised page 10 is provided in Attachment 5.



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*4.1 Show compliance with vertical separation requirements pursuant to Regulation 15A 13B .0540(2)(a).*

In order to maintain a 3:1 slope and tie-in to the existing C&D landfill grades, there is no excavation planned for the Phase 5 landfill. Basegrades will essentially be at existing land surface. Any topsoil and rootmat or unsuitable soils will be removed during construction; however the depth of the topsoil/rootmat was less than 18-inches when it was encountered in the borings. As shown on Sheet 2 (Bedrock Contour Map) and Sheet 4 (Seasonal High Groundwater Contour Map), there is at least 5 feet separation between the existing land surface and the top of bedrock or seasonal high groundwater throughout the Phase 5 area. Separation will be verified during the subgrade inspection per Rule .0540(5)(a).

Similar to the Site Hydrogeologic Report, the Sheets associated with the Design Hydrogeologic Report (Sheets 1 through 5) have been revised to show the new jurisdictional stream-head designation in the Phase 5 area. The revised Sheets 1 through 5 are provided in Attachment 6.

*Figures*

*Figure 3 Show the proposed landfill grades for Phase 5.*

Figure 3 (cross section A-A') has been revised to show the basegrades for Phase 5. As mentioned above, with the exception of topsoil and rootmat and unsuitable soils, there is no planned excavation for the Phase 5 landfill. In addition, Figure 3 has been revised to include groundwater flow nets. Revised Figures are provided in Attachment 7.

*Figure 5 Extend cross section C-C' across the full width of proposed Phase 5 and show proposed landfill grades for Phase 5.*

Figure 5 (cross section C-C') has been revised accordingly. In addition, groundwater flow nets have been added to the revised Figure 5. Revised Figures are provided in Attachment 7.

**Plan**

*3.1 Account for groundwater monitoring wells MW-9 and MW-9D listed on Table 1 but not shown on Sheet 1.*

As referenced on Table 1, monitoring wells MW-9 and MW-9d were abandoned during the Phase 4 expansion of the C&D landfill. Table 1 has been revised to show wells MW-9 and MW-9d as "Abandoned Wells for C&D Landfill." Revised Table 1 is provided in Attachment 8.



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*Sheets*

*Sheet 1 Show location of MW-9 and MW-9D, which are listed in Table 1.*

The location of abandoned monitoring wells MW-9 and MW-9d have been added to Sheet 1. Revised Sheet 1 is provided in Attachment 8.

***Additional Revisions***

In addition to the information and changes requested in your letter, additional revisions have also been completed as follows:

*Design Report*

Section 3.1 "Drilling Observations" has been revised to reference alluvium as the fourth lithologic unit at the site. A revised page 18 is provided in Attachment 5.

*Groundwater Monitoring Plan*

Pages 10, 12, and 13 have been revised to accommodate the possible future addition of dedicated pumps at the facility. In addition, the surface water sampling techniques have been modified to ensure that preservative is not lost during sample collection. Revised pages are provided in Attachment 8.

We hope that you find that the additional information and revisions provided in this letter sufficient to answer your questions and address your comments. If you have any questions, please do not hesitate to contact me at (919) 787-5620 or by email at colonemf@cdm.com.

Very truly yours,

Mathew F. Colone, P.G.  
Camp Dresser & McKee

cc: Ed Mussler, SWS

Allen Gaither, SWS Asheville Regional Office  
Andrea Keller, SWS Asheville Regional Office  
Jerry Mears, Buncombe County  
Kenton Yang, CDM  
File



Attachment 1  
Landfill Gas Control Plan

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## Gas Control Plan - C&D Landfill

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# Section 1

## Introduction

Landfill gas (LFG) is a natural by-product of the anaerobic decomposition of landfilled bio-degradable waste. LFG can present a danger to human health and the environment and therefore must be monitored. For these reasons, LFG is regulated by Federal and North Carolina state legislation. This Plan describes the systems and programs needed to fulfill federal and state regulations concerning LFG. Since this plan is for the C&D landfill, it is noted that LFG generation is expected to be minimal based on the lack of organic matter in the waste stream.

This Plan is intended for the C&D Landfill only. An explosive gas control plan is already in-place for the Subtitle D Landfill. The Plan for the C&D facility includes LFG monitoring at or near the facility boundary through monitoring wells. There are no structures associated with the C&D facility. All structures at the Site are monitored under the plan already in place for the Subtitle D landfill.

### 1.1 Purpose

This Plan fulfills the requirements set forth in Rule .0544(d) for monitoring LFG. This Plan:

- is intended for the C&D Facility only,
- describes the necessary LFG monitoring systems,
- sets forth the monitoring procedures and programs, and
- identifies the actions needed if levels of methane exceed regulatory limits.

### 1.2 General Characteristics of LFG and Methane Generation

LFG is composed of approximately 50 percent methane in contrast to natural gas which consists of approximately 95 percent methane. What makes LFG a source of environmental pollution is its odor, its potentially explosive properties, and its contribution to global warming. LFG programs which focus on the environmental hazards of landfill gas include systems to monitor the migration of gas and control or neutralize its environmental impacts.

LFG is composed of 50 to 55 percent methane (CH<sub>4</sub>); 45 to 50 percent carbon dioxide (CO<sub>2</sub>); and, less than one percent non-methane organic compounds. These individual gases remain co-mingled and do not naturally separate.

## Section 2

# Regulatory Background

Because of the real and potential dangers from LFG and the methane in landfill gas to the public health and safety and to the environment, existing state regulations require owners of C&D landfills to monitor and control it.

### 2.1 C&D Landfills and North Carolina Regulations

Methane gas is explosive when present within the range of 5 to 15 percent by volume in air. When present in concentrations greater than 15 percent, the mixture will not explode. The 5 percentage mixture is referred to as the Lower Explosive Limit (LEL) while the 15 percentage concentration is referred to as the Upper Explosive Limit (UEL). The State of North Carolina, through its 15A NCAC 13B .0544(d)(1), requires owners or operators of all C&D landfills to ensure that the facility:

- A) Does not exceed 25 percent of the LEL for methane in facility structures;
- B) Does not exceed the LEL at the facility property boundary; and
- C) Does not release methane gas or other explosive gases in any concentration that can be detected in offsite structures.

The LEL means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25 C and atmospheric pressure per Rule .0544(d)(5).

Rule .0544(d)(2) requires that a routine methane monitoring program be implemented to insure that these standards are met. The type of monitoring will be determined based on soil conditions, hydrogeologic conditions under and surrounding the facility, hydraulic conditions on and surrounding the facility, the location of facility structures and property boundaries, and the location of all off-site structures adjacent to property boundaries. Additionally, frequency of monitoring shall be quarterly.

Rule .0544(d)(3) requires that if methane or explosive gas levels exceed the specified limits, the owner or operator must:

- A) Immediately take all necessary steps to ensure the protection of human health and notify the Division;
- B) Within seven days of detection, place in the operating record the methane or explosive gas levels detected and a description of the steps taken to protect human health;
- C) Within 60 days of detection, implement a remediation plan for the methane or explosive gas releases, place a copy of the plan in the operating record, and notify the Division that the plan has been implemented. The plan must describe the nature and extend of the problem and the proposed remedy.

## **Section 3**

### **Gas Control Plan**

The gas control plan includes a schedule for reading or monitoring LFG emission levels at designated locations quarterly and a system for reporting the concentration levels.

The requirements for quarterly reading of the emission levels, and the plan for actions if readings exceed safe levels should, at a minimum, be based on compliance with state regulations.

#### **3.1 Frequency of Routine Monitoring**

Rule .0544(d)(2) states that a quarterly methane monitoring program be implemented.

#### **3.2 Staffing**

Monitoring should consist of having a trained technician use calibrated equipment designed to monitor methane in methane monitoring wells approved for the C&D landfill.

The job of monitoring the methane levels will require a trained staff person. Available options include training an existing staff person, hiring a special contractor, or hiring part-time staff to perform this task.

#### **3.3 Monitoring Procedures**

Each quarterly monitoring procedure shall begin by verifying that the instrument has been calibrated. Monitoring shall be completed with a GEM-2000 or equivalent. Monitoring wells around the C&D landfill shall be checked. All structures at the facility are currently monitored under the existing Subtitle D plan. There are no structures associated with the C&D facility. Currently there are no methane monitoring wells at the C&D facility. Planned well locations for the C&D facility are provided on Sheet 1.

##### **3.3.1 Monitoring Well Installation and Construction**

Proposed wells M-10 through M-12 will be used to monitor the C&D landfill facility for LFG migration. The methane monitoring wells will be constructed with 2-inch diameter schedule 40 PVC with a minimum of 10 feet of 0.010-inch slotted screen with a #2 sand filter pack extending 1 foot above the top of the screen. A 1 to 2-foot thick bentonite seal will be placed on top of the sand filter pack and hydrated. The remainder of the borehole annulus will be completed with a Portland cement/bentonite grout. Screen length will vary depending upon groundwater elevations observed in adjacent groundwater monitoring wells and observations made during well installation. Methane monitoring wells M-10 and M-11 will be installed during the Phase 5 construction. Methane monitoring well M-III will be installed during the Phase 6 construction.

Similar to the groundwater monitoring wells at the C&D facility, the methane monitoring wells will be installed within the dominant drainage features associated with each Phase of C&D landfill development. All methane monitoring wells will be constructed in accordance with the North Carolina Well Construction Standards described in 15A NCAC 2C and will be completed with locking above grade protective covers and 2-foot by 2-foot concrete pads. Following installation, the wells will be surveyed to State Plane coordinates. Figure 1 includes a typical methane monitoring well detail.

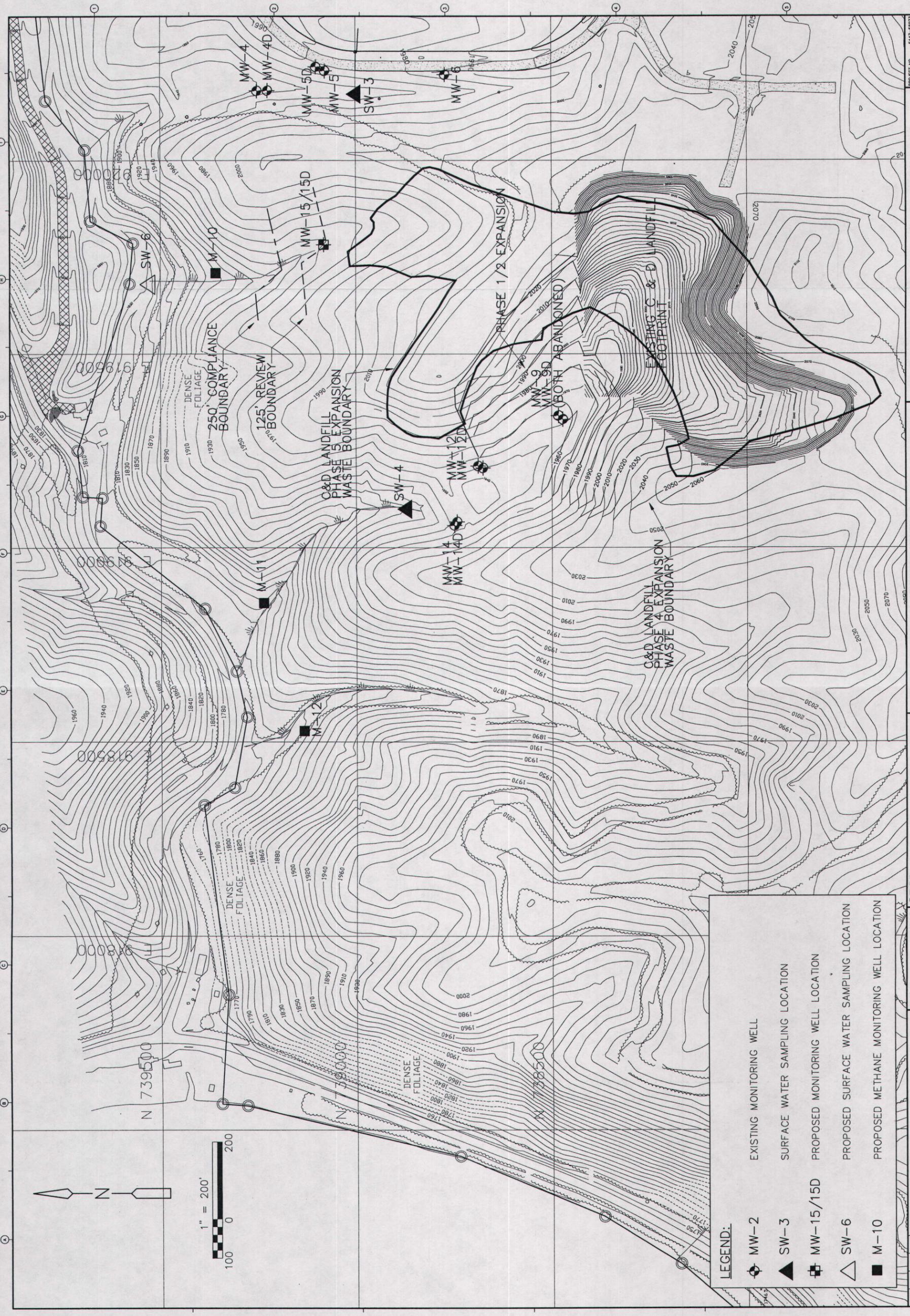
### 3.3.2 LFG Monitoring

An initial landfill gas reading will be collected from each of the newly installed methane monitoring wells with a GEM-2000 landfill gas monitoring meter or similar 24-hours after installation. Following the initial reading, readings will be collected from each well on a quarterly basis. Each well will be monitored for % methane and % lower explosive limits (LEL) for methane. If methane levels detected at the monitoring wells exceeds the LEL, the technician shall immediately follow the action plan presented in Section 4.1.

### 3.4 Record Keeping

All readings will be recorded on a standard methane monitoring log form. A sample methane monitoring log is provided at the end of this section. This form or similar will be used. These forms will be reviewed by the landfill supervisor or the County's environmental consultant and placed on file at the landfill with other landfill records. These readings should be available for review by the State upon request.

Notes:  
Stick-up will extend between 2.5 and 3 feet above finished grade.  
Silica sand filter pack will extend at least 1 foot above top of screen elevation.  
Well depth and screen length will vary upon depth to groundwater or bedrock.  
Anticipated construction depth to 20 feet below land surface with 15 feet of screen.



**LEGEND:**

	MW-2	EXISTING MONITORING WELL
	SW-3	SURFACE WATER SAMPLING LOCATION
	MW-15/15D	PROPOSED MONITORING WELL LOCATION
	SW-6	PROPOSED SURFACE WATER SAMPLING LOCATION
	M-10	PROPOSED METHANE MONITORING WELL LOCATION

PROJECT NO. 6447-0973 FILE NAME: LCC-2011-049 SHEET NO. 1	<b>GAS CONTROL PLAN - C&amp;D LANDFILL</b>	<b>BUNCOMBE COUNTY          NORTH CAROLINA</b>
<b>CONSTRUCTION AND DEMOLITION LANDFILL          PHASE 5 EXPANSION</b>		
DESIGNED BY: M. COLONE DRAWN BY: J. KILGUS CHECKED BY: J. KILGUS APPROVED BY: J. KILGUS DATE: JULY 2009	<b>CDM</b> Camp Dresser & McKee 10000 Old York Road Columbia, South Carolina 29203 Tel: (803) 791-5000 Fax: (803) 791-5700	REMARKS DATE: _____ DRAWN: _____ DATE: _____ CHECKED: _____

## **Section 4**

### **Detection Plan**

The North Carolina Solid Waste Management Rules, .0544(d)(3), require a detection plan for action if methane levels exceed the regulatory concentration limits. The plan for action includes the specific step by step actions needed should regulatory limits be detected.

#### **4.1 Actions if Regulatory Limits Detected at Monitoring Wells**

If any of the methane monitoring wells measure a level equal to or more than the LEL as defined by in the Rules, the technician should:

- immediately contact the landfill supervisor; and
- recheck the methane levels at each well.

The equipment used to take the readings should be tested to verify it is giving accurate readings.

This information, the current readings, and the levels for the previous three quarters should be provided to the Buncombe County landfill supervisor who will make the decision to: return to business as usual; temporarily evacuate the site; or, follow the plan proposed in Section 4.2.

#### **4.2 C&D Compliance Action Plan**

If upon verification as described in Sections 4.1, the methane monitoring levels are equal to or exceed the regulatory limits as defined by state regulations, the following actions are proposed to comply with state regulations as well as protect the health and safety of the individuals at or near the C&D landfill.

##### **4.2.1 Immediate Action**

If methane levels exceed the specified limits, the landfill operator or the landfill supervisor will take immediate action to ensure the protection of human health and safety. This will include:

- monitor all structures at the facility;
- if methane levels are detected in the onsite structures, open all doors and windows in buildings on the landfill site;
- if warranted by the degree of intensity of the methane concentration in the onsite structures, evacuate all buildings on the site;
- notify the Buncombe County Manager Office's about the concentration levels;

- if warranted by the degree of intensity of the methane concentration in the wells, check the methane levels in structures on adjacent properties to the facility boundary;
- if warranted by the degree of intensity of the methane concentration, evacuate the landfill area or evacuate the area adjacent to the landfill;
- notify the Division about the reading;
- begin to identify or narrow down the source of the methane causing the readings exceeding the regulatory limits (i.e. the path that the methane is taking to the monitoring location);
- begin to identify the extent of the methane problem; and
- as appropriate, begin to take corrective action to control the methane levels in building at the landfill site, at the boundaries to the landfill, and at the landfill site.

#### **4.2.2 Actions Within Seven Days**

If methane levels exceed the regulatory limits, the County must, within seven days, place in the operating record the gas levels detected and a description of the steps taken to protect human health.

It is also suggested that at this time, the operator begin to develop a plan which:

- describes the nature and extent of the problem and
- proposes a remedy for the problem.

#### **4.2.3 Actions Within Sixty Days**

If methane levels exceed the specified limits, the County must take the following actions within 60 days:

- implement a remediation plan for the methane gas release;
- place a copy of the plan in the operating record of the landfill; and
- notify the Division that the plan has been implemented.

### **4.3 Public Relations and Information**

As with any potentially dangerous situation, it is important to keep the public, public service agencies, and the media informed. False information, inaccurate information, or the lack of information concerning potential explosions at a public facility could create panic.

If it is determined that a potentially dangerous situation exists, it is recommended that a one page explanation of the situation be written and distributed to all homes and businesses within a one-half mile radius of the landfill. This should be done within the first two to four hours of making the determination that a potential danger to human health and safety exists.

It is recommended that the County Manager appoint one individual to provide information to: the media; the police authorities with jurisdiction in the area; and area medical facilities. Area hospitals and police departments may receive calls once the local media releases the story. Centralizing the flow of information will avoid conflicting information and inaccurate information. Providing detailed and honest facts about the situation being under control is critical.

## **Section 5**

# **Options for Controlling LFG**

This section presents several options which may be implemented by Buncombe County should methane readings exceed regulatory levels. It is presented in this Plan to insure that the information is readily available to the County if needed.

If regular LFG monitoring demonstrates levels that exceed the regulatory limits, the state requires actions by the owner to eliminate the problem. Remedial options to eliminate the problem include controlling the migration path or controlling the release of the LFG into the environment.

### **5.1 Migration Control Techniques**

Two techniques which can be used for controlling the migration of LFG include:

- impermeable physical barriers
- passive removal system

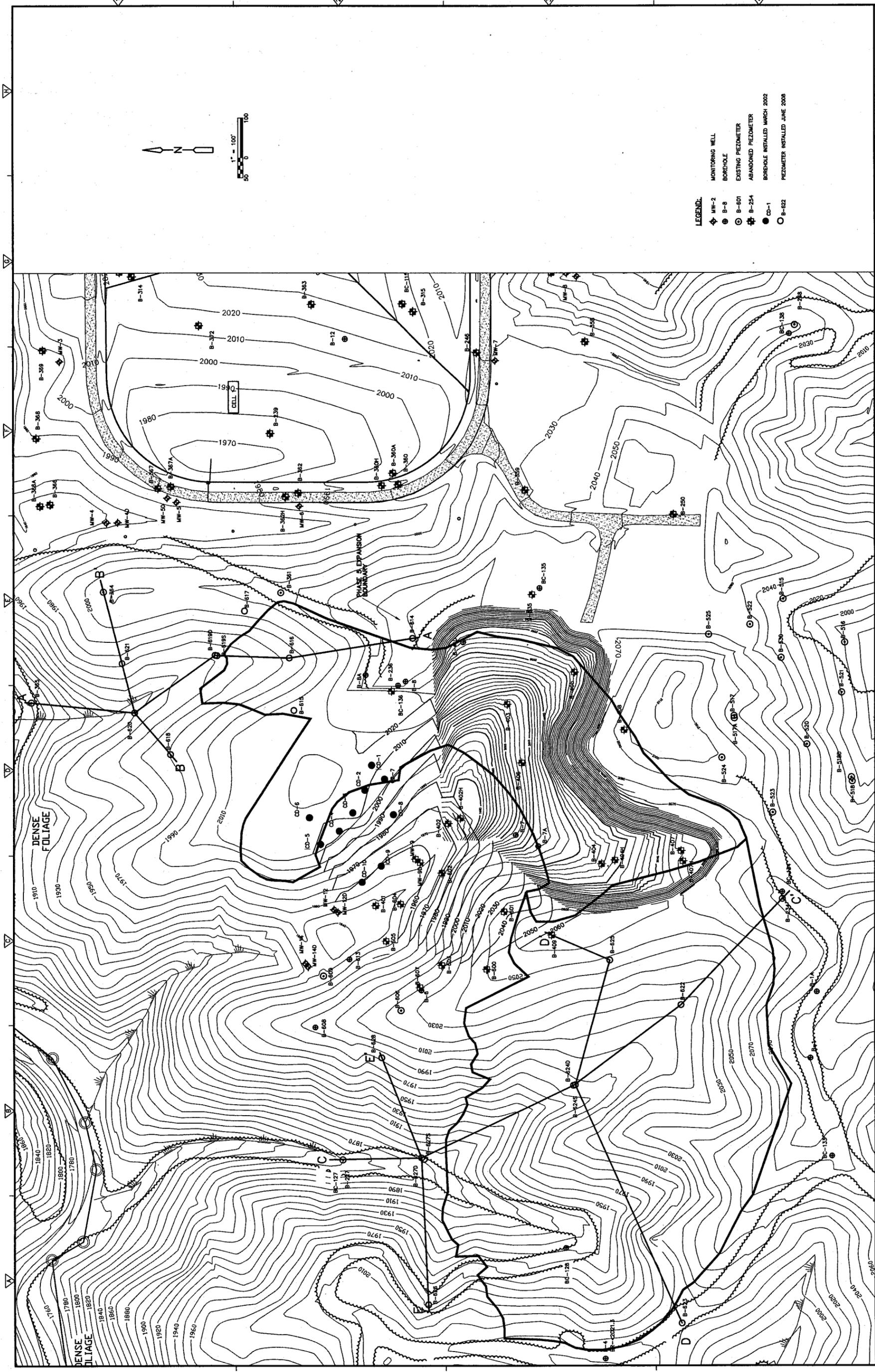
#### **5.1.1 Impermeable Physical Barriers**

An impermeable physical barrier, such as a landfill liner or a vertical impermeable barrier, can be installed to impede and ultimately stop the migration of LFG. This type of a barrier also helps to contain the gas thereby facilitating its collection.

#### **5.1.2 Passive Removal System**

A passive removal system generally provides a safe path of least resistance for migrating LFG to exit the landfill. Passive removal systems include open air ditches or passive venting wells installed in porous gravel trenches. These systems are designed to rely on the difference between the internal landfill pressure and the atmospheric pressure to control the migration path that the LFG takes.

Attachment 2  
Site Hydrogeologic Report  
Revised Sheets



PROJECT NO. 6447-89973  
 FILE NAME: SH1\_2-1.dwg  
 SHEET NO. 2-1

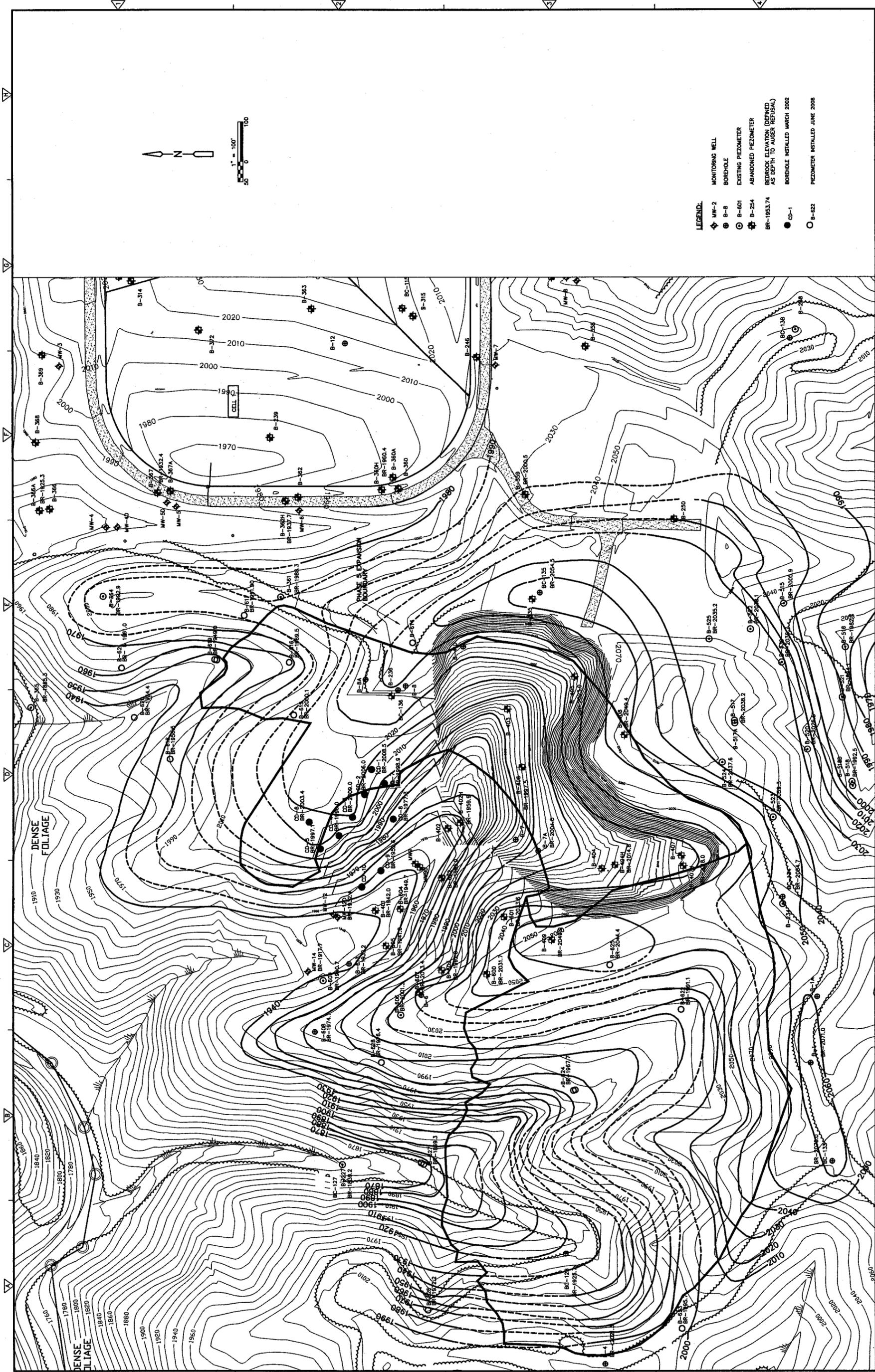
SITE MAP

BUNCOMBE COUNTY  
 NORTH CAROLINA  
 C&D LANDFILL SUBSTANTIAL AMENDMENT  
 SITE HYDROGEOLOGIC INVESTIGATION

DESIGNED BY: D. FORBES  
 DRAWN BY: J. KILLINGSWORTH  
 CHECKED BY: [blank]  
 APPROVED BY: [blank]  
 DATE: FEBRUARY, 2009

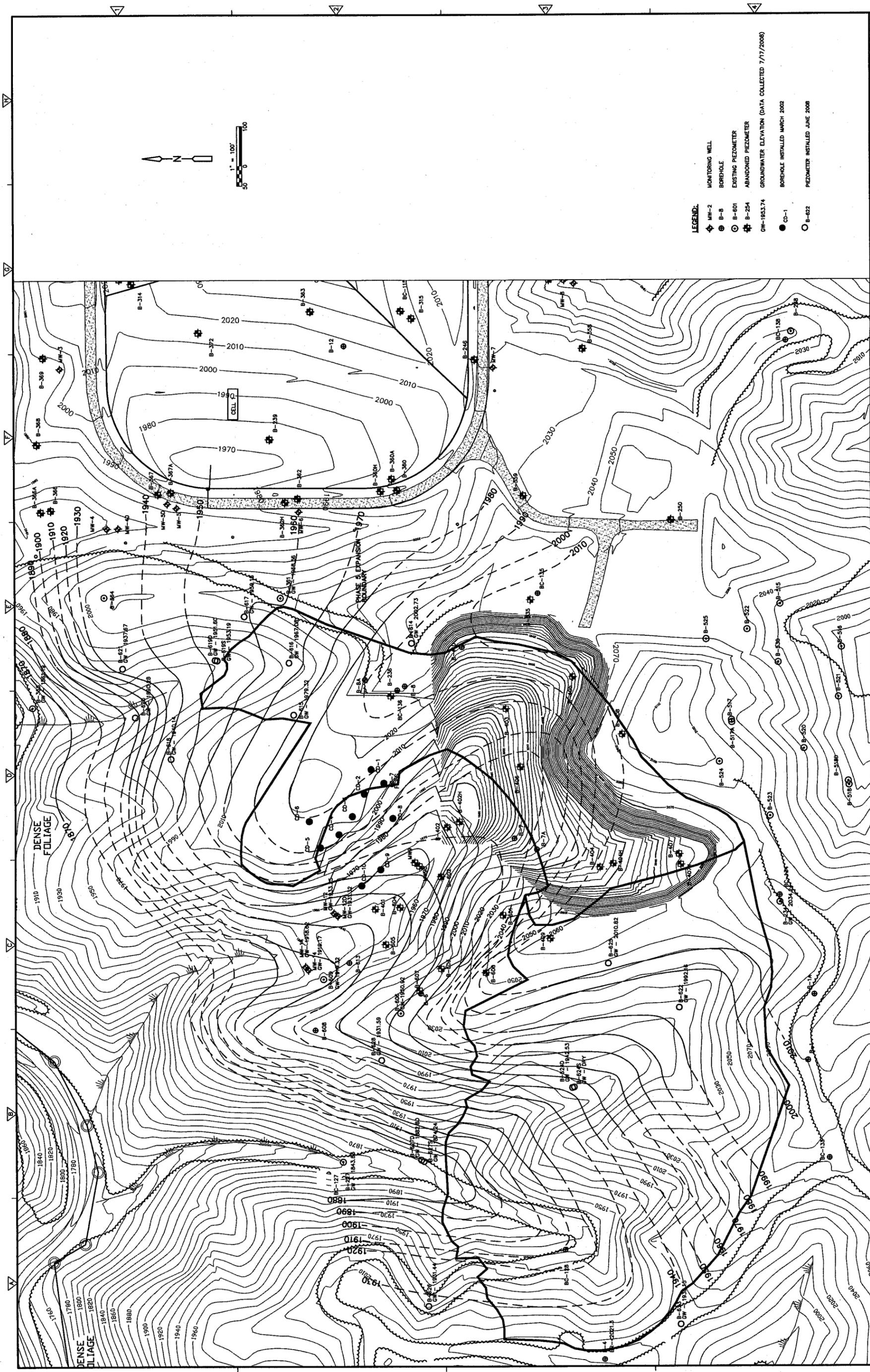
REV. NO.	DATE	DRWN	CHKD	REMARKS

**CDM**  
 CDM GROUP, INC.  
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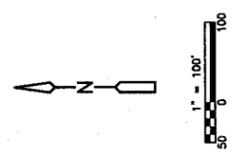


PROJECT NO. 6447-65973 FILE NAME SHT_2-2.dwg SHEET NO. 2-2	
<b>BEDROCK CONTOUR MAP</b>	
<b>C&amp;D LANDFILL SUBSTANTIAL AMENDMENT          SITE HYDROGEOLOGIC INVESTIGATION</b>	
BUNCOMBE COUNTY NORTH CAROLINA	
DESIGNED BY: D. FORBES DRAWN BY: J. KILLINGSWORTH SHEET CHECK'D BY: _____ CROSS CHECK'D BY: _____ APPROVED BY: _____ DATE: FEBRUARY 2008	
REMARKS	
REV. NO.	DATE

**CDM**  
 Camp Dresser & McKee  
 10000 Research Triangle Park, 300  
 Raleigh, North Carolina 27615  
 Tel: (919) 897-8500  
 consulting • engineering • construction • operations



- LEGEND:**
- MW-2 MONITORING WELL
  - B-369 BOREHOLE
  - B-601 EXISTING PIEZOMETER
  - B-254 ABANDONED PIEZOMETER
  - OW-1953.74 GROUNDWATER ELEVATION DATA COLLECTED 7/17/2008
  - CD-1 BOREHOLE INSTALLED MARCH 2002
  - B-622 PIEZOMETER INSTALLED JUNE 2008



PROJECT NO. 6447-6973  
 FILE NAME: SHT\_2-3.dwg  
 SHEET NO. 2-3

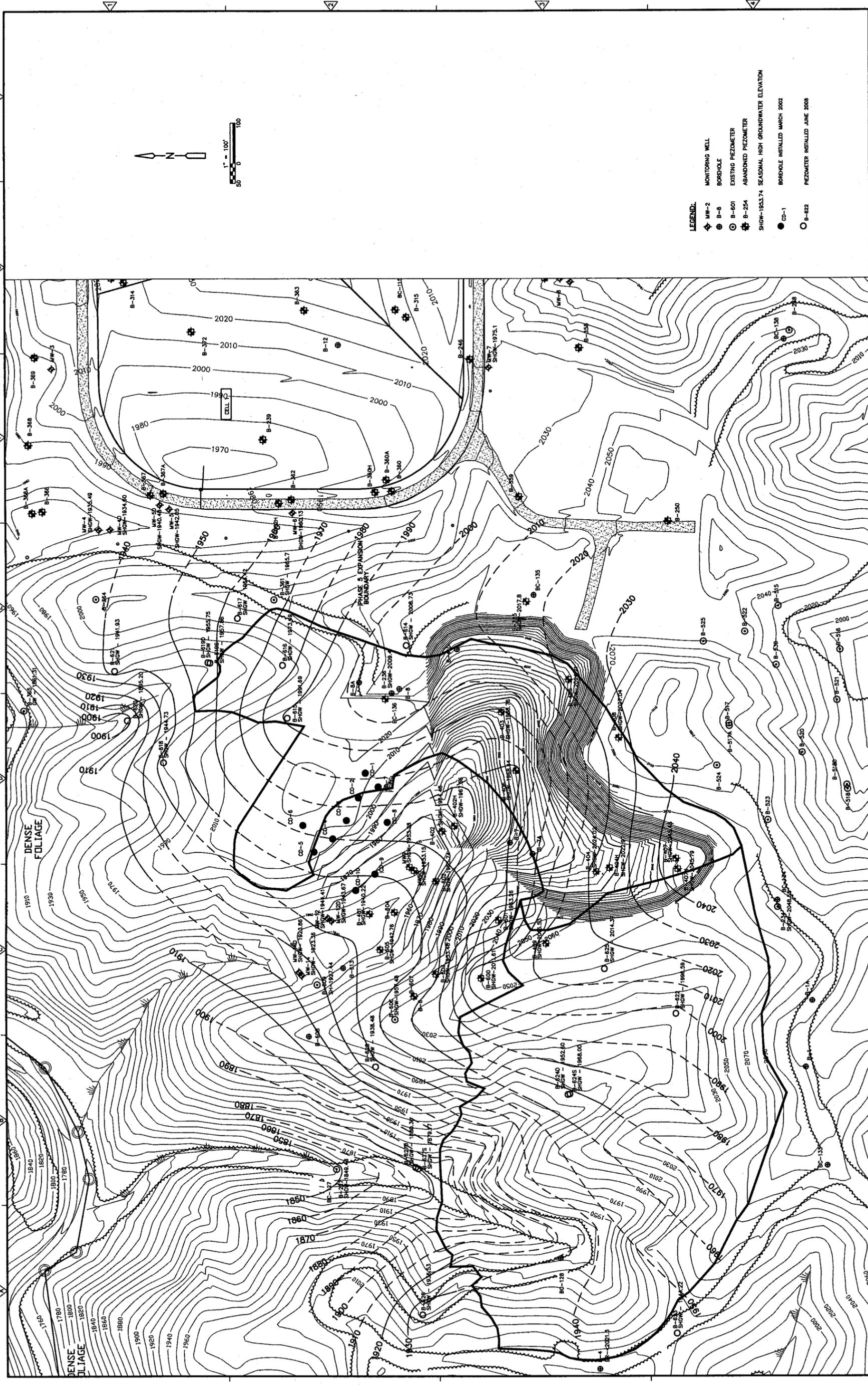
POTENTIOMETRIC CONTOUR MAP

BUNCOMBE COUNTY  
 NORTH CAROLINA  
 C&D LANDFILL SUBSTANTIAL AMENDMENT  
 SITE HYDROGEOLOGIC INVESTIGATION

DESIGNED BY: D. FORBES  
 DRAWN BY: J. MULLINS/ROB  
 SHEET CHECKED BY:  
 CROSS CHECKED BY:  
 APPROVED BY:  
 DATE: FEBRUARY 2009

REV. NO.	DATE	DOWN	CHKD	REMARKS

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 Fax: (919) 750-5201  
 Consulting - engineering - construction - operations



- LEGEND:**
- ◆ MW-2 MONITORING WELL
  - B-8 BOREHOLE
  - ⊙ B-601 EXISTING PIEZOMETER
  - ⊙ B-254 ABANDONED PIEZOMETER
  - ⊙ SHGW-1953.74 SEASONAL HIGH GROUNDWATER ELEVATION
  - CD-1 BOREHOLE INSTALLED MARCH 2002
  - B-822 PIEZOMETER INSTALLED JUNE 2008

SEASONAL HIGH GROUNDWATER CONTOUR MAP

C&D LANDFILL SUBSTANTIAL AMENDMENT  
SITE HYDROGEOLOGIC INVESTIGATION

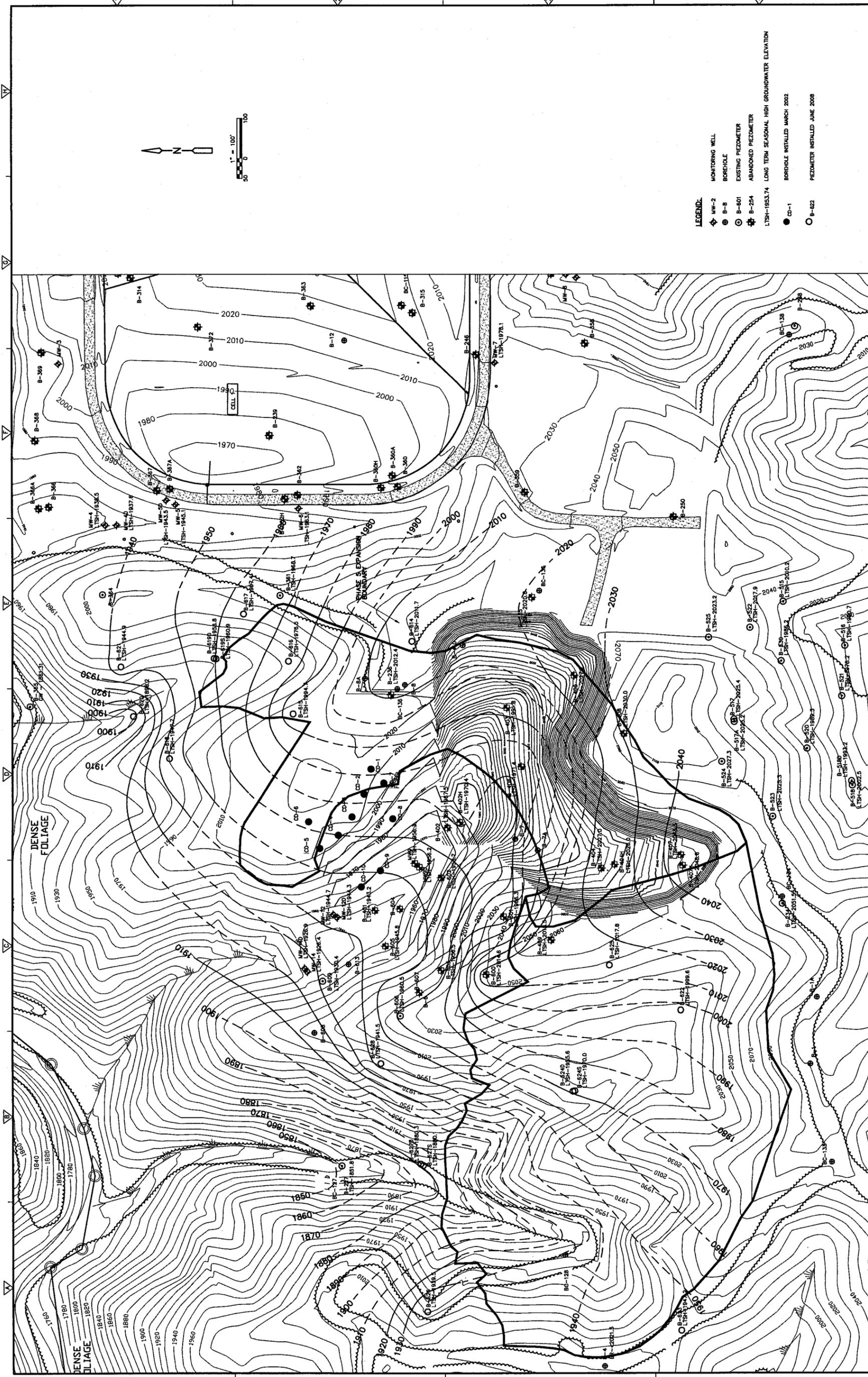
BUNCOMBE COUNTY  
NORTH CAROLINA

DESIGNED BY: D. FORBES  
DRAWN BY: J. KILGUSHDORF  
SHEET CHECK'D BY:  
CROSS CHECK'D BY:  
APPROVED BY:  
DATE: FEBRUARY, 2008

REV. NO.	DATE	DRWN	CHKD	REMARKS

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PROJECT NO. 6447-65973  
FILE NAME: SHT\_2-4.dwg  
SHEET NO. 2-4



- LEGEND:**
- MW-2 MONITORING WELL
  - B-368 BOREHOLE
  - B-601 EXISTING PIEZOMETER
  - B-254 ABANDONED PIEZOMETER
  - L7SH-1953.74 LONG TERM SEASONAL HIGH GROUNDWATER ELEVATION
  - CD-1 BOREHOLE INSTALLED MARCH 2002
  - B-622 PIEZOMETER INSTALLED JUNE 2008

PROJECT NO. 8447-65973  
 FILE NAME: SHT\_2-5.dwg  
 SHEET NO. 2-5

**LONG TERM SEASONAL HIGH  
 GROUNDWATER CONTOUR MAP**

**BUNCOMBE COUNTY  
 NORTH CAROLINA  
 C&D LANDFILL SUBSTANTIAL AMENDMENT  
 SITE HYDROGEOLOGIC INVESTIGATION**

DESIGNED BY: A. WELSPENNING  
 DRAWN BY: J. HILLINGBROOK  
 SHEET CHECKED BY: M. COLOME  
 CROSS CHECKED BY:  
 APPROVED BY: FEBRUARY 2009  
 DATE:

REV.	DATE	DRWN	CHKD	REMARKS



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Attachment 3  
Site Hydrogeologic Report  
Revised Report Pages

investigation. Seven borings were converted to temporary piezometers for groundwater elevation measurements while the remaining borings were used to collect lithologic and geotechnical data only. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for lithologic and geotechnical data collection at all borings. Rock coring was performed at one location (B-601). Standard penetration tests (blow counts) were taken at all locations.

Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

Following SWS approval and permit issuance, two monitoring wells (MW-14/14d) were installed downgradient of the Phase IV landfill.

### 2.3.2 Current Investigation

The current investigation focused on the proposed expansion facility plan area adjacent to the existing Phases of the active C&D landfill. The proposed facility plan boundaries include two individual drainage basins on either side of the existing active C&D landfill. The investigation focused on the area within the two drainages.

Eighteen boreholes were drilled at 15 locations during the current investigation. All borings were converted to temporary piezometers for groundwater elevation measurements and lithologic and geotechnical data was collected at each location. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for lithologic and geotechnical data collection at all borings. Rock coring was performed at three locations (B-619d, B-623, and B-627d). Standard penetration tests (blow counts) were taken at all locations.

Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

#### 2.3.2.1 Borehole Drilling

Borehole drilling methods included air rotary, hollow-stem auger, and conventional rock coring. An onsite hydrogeologist or geotechnical engineer observed the drilling operations and logged the borings. Boring logs from this investigation are provided in Appendix A.

##### *Air Rotary Drilling*

Air rotary drilling, utilizing a Schram truck-mounted rig, was conducted at 18 locations within the proposed landfill expansion facility boundary. The air rotary boreholes were drilled solely for the purpose of piezometer installation in bedrock. Lithologic samples were collected continuously using a shovel to observe the cuttings blown from the bottom of the hole. Grain size of the cuttings was observed to be a

A very low frequency (VLF) electromagnetic geophysical survey was also conducted at the Site (CDM 1993) for the purpose of identifying anomalous conductive features, which could represent zones of preferential groundwater occurrence and/or movement. Specifically, many of the photolineaments described above were evaluated by the survey. The survey identified nine features of potential interest at depths of 30 to 50 meters (98 to 164 feet). Many of these features as well as the photolineaments were targeted by exploratory borings drilled during the subsequent investigations.

#### ***Drilling Observations***

Four lithologic distinctions have been made at the C&D Landfill expansion area based on observations from the subsurface investigations. These are **alluvium**, **saprolite**, **partially weathered rock (PWR)**, and **bedrock**. **Alluvium or colluvium was encountered in small localized areas near the drainage features.** Descriptions of each material encountered at specific boring locations are provided in the boring logs contained in Appendix A. Each of these units is discussed in the following sections of the report. Table 2-2 lists all of the borings drilled at the C&D Landfill, and the depths at which the above geologic units were encountered.

#### **2.4.1 Alluvium**

Alluvium was present in small localized areas within or adjacent to the drainage features. Where present, the alluvium was found to be of limited thickness and overlaid PWR or bedrock. The alluvium ranged in grain size from clayey silt to poorly sorted sands.

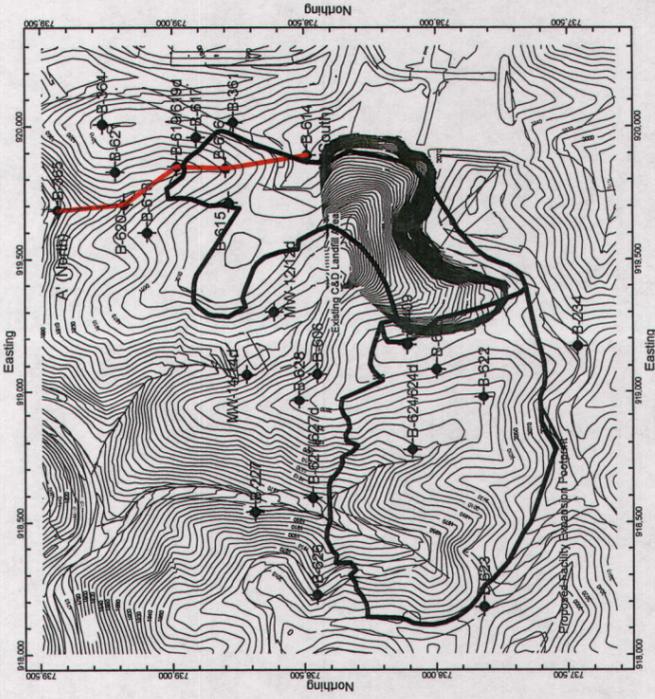
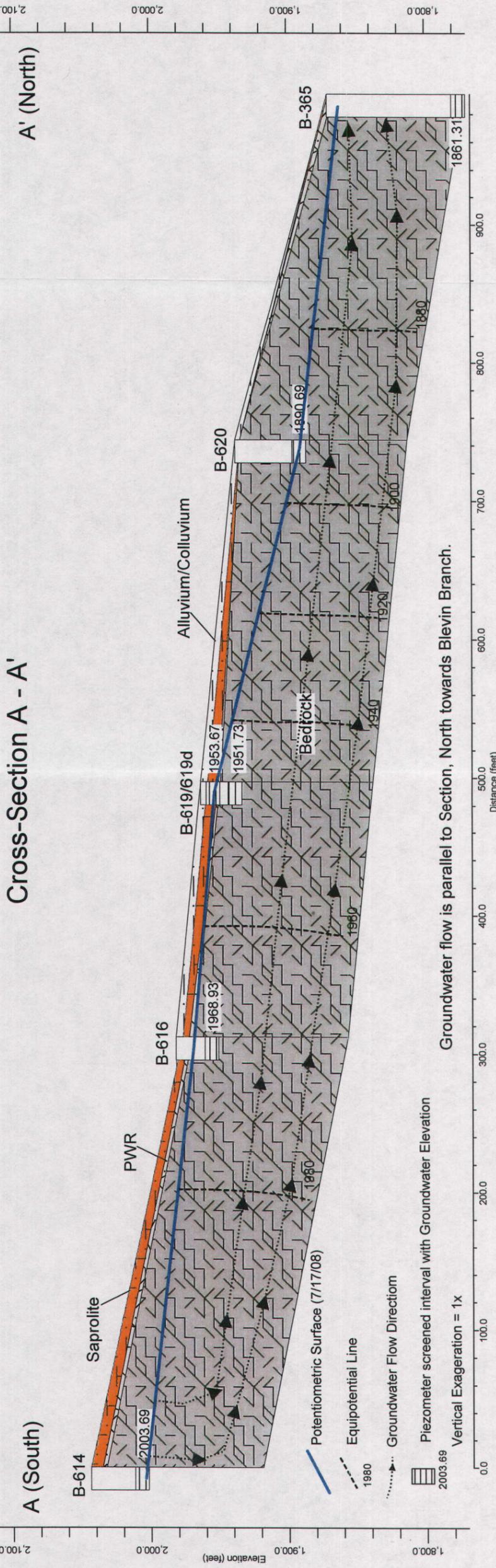
#### **2.4.2 Saprolite**

Saprolite (saprolitic soils) is the uppermost unit present at the site and is present at most locations except small areas where bedrock outcrops at the ground surface or depth to bedrock is shallow, and within most surface drainage features. These soils are derived from the in-place chemical weathering of bedrock materials, and are characterized by the presence of relict mineral fabric from the original rock mass.

These soils are typically finer near the surface where weathering is more advanced, and become more dense and coarser in texture as weathering decreases with depth.

Near the surface, they are generally comprised of fine sandy silt, or sandy silt with clay, with silty clay or silty sand present at some locations. They grade to silty sand or very sandy silt with depth. Hard rock fragments are commonly present in this lower portion of the saprolite, which become larger and more frequent with depth. The contact with the underlying partially weathered rock (PWR) or bedrock is typically gradational. These soils are typically red/brown or light to dark brown in color and usually micaceous with some areas being very micaceous. Locally grey, dark grey or green/grey colors are present, and appear to correlate with an abundance of mafic minerals in the rock mass from which they were derived. Thin zones of light brown or orange/tan lean clay are also present locally. As noted in Section 2.3.2.1, for the

Attachment 4  
Site Hydrogeologic Report  
Revised Figures

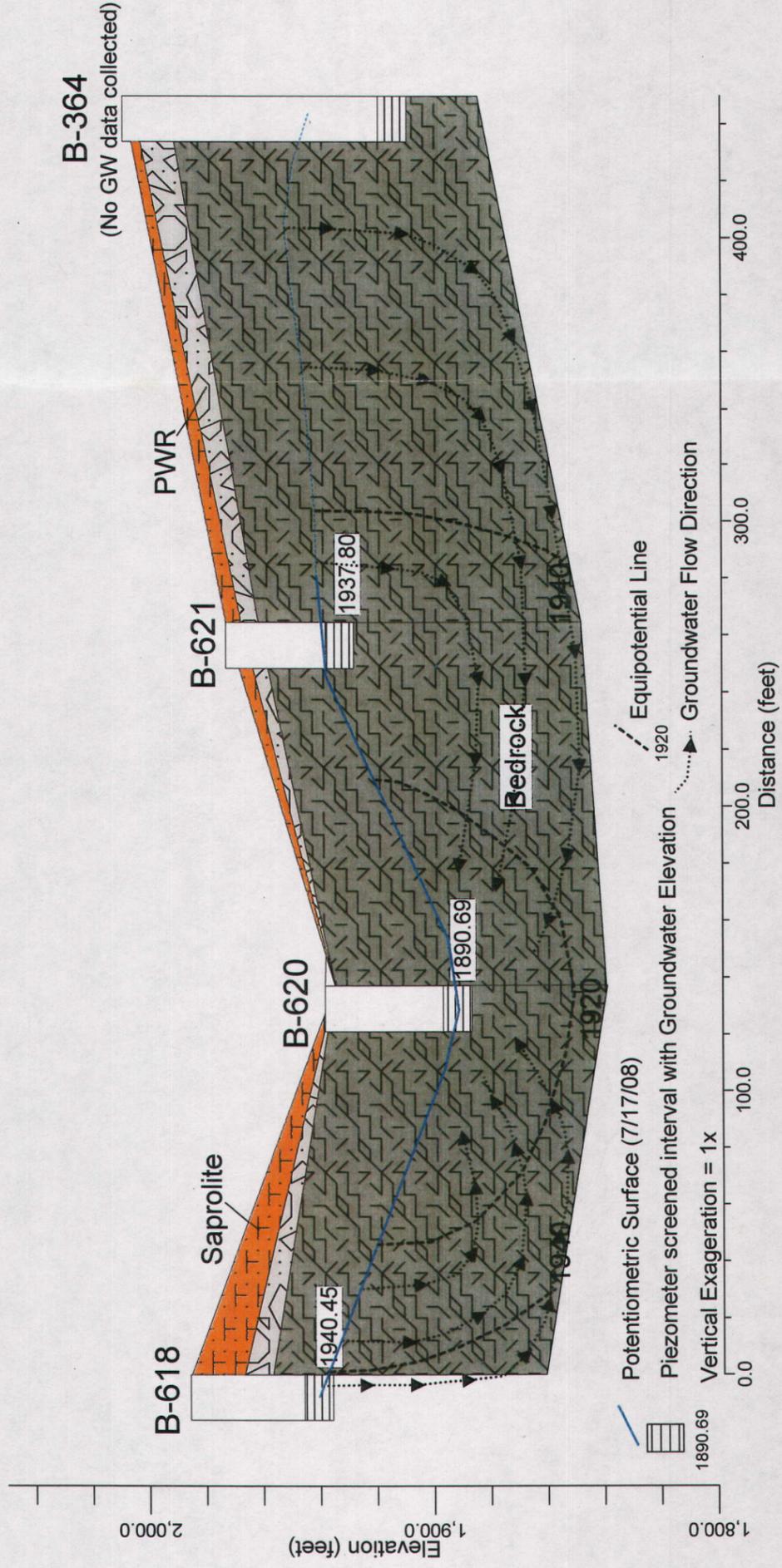


**Figure 2-1**  
**Hydrogeologic Cross-Section A - A' with Groundwater Flow Nets**  
**Buncombe County C&D Landfill Facility Expansion**  
**Site Hydrogeologic Investigation**

# Cross-Section B - B'

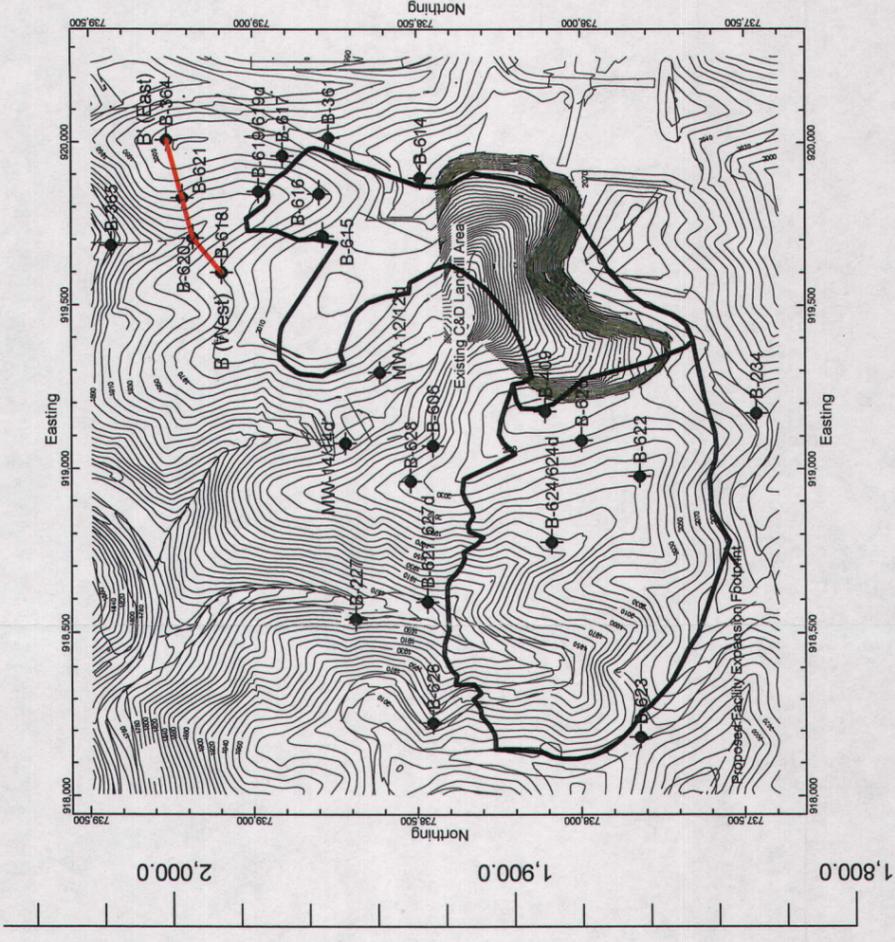
B (West)

B' (East)

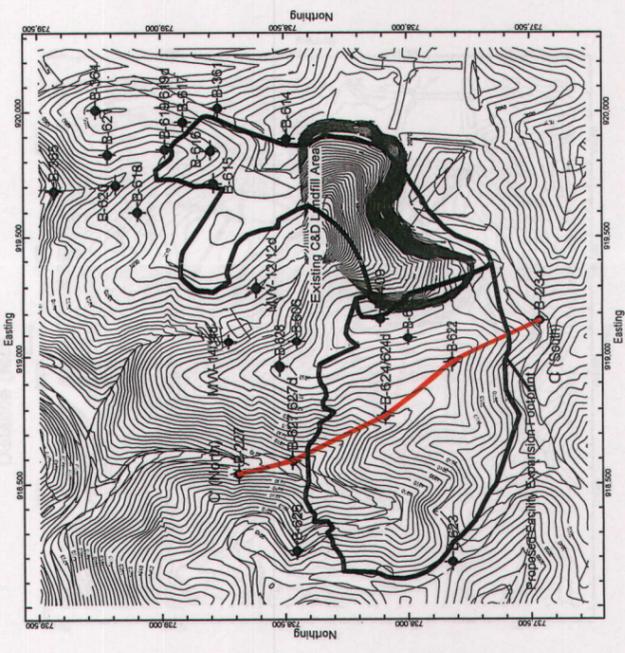
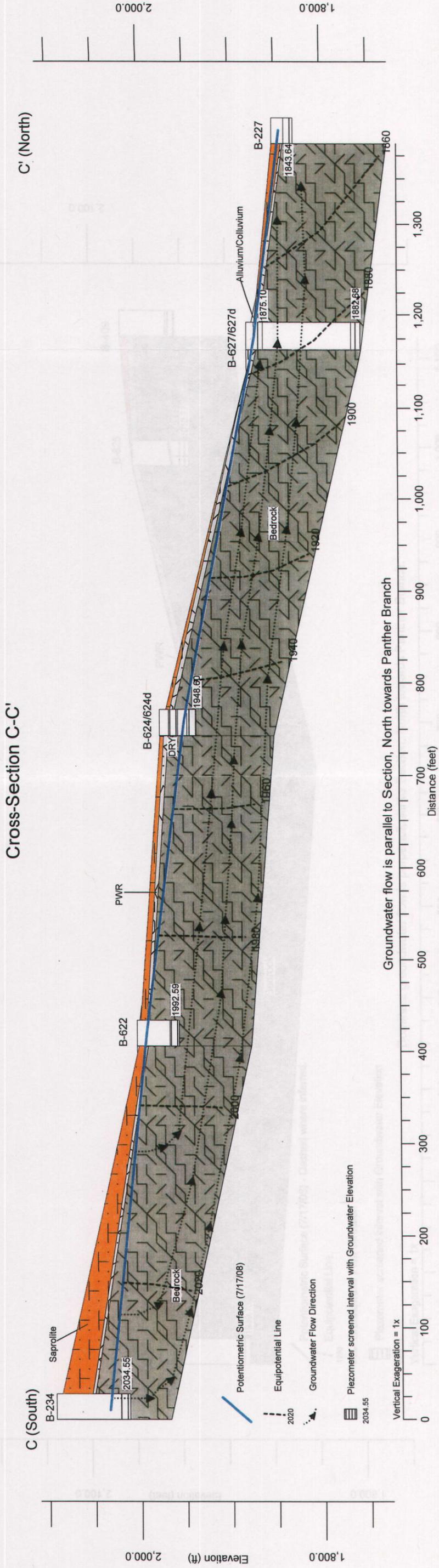


Dominant groundwater flow is perpendicular to Section, North towards Blevin Branch.

Potentiometric surface data from B-364 estimated from previous investigations.



**Figure 2-2**  
**Hydrogeologic Cross-Section B - B' with Groundwater Flow Nets**  
**Buncombe County C&D Landfill Facility Expansion**  
**Site Hydrogeologic Investigation**

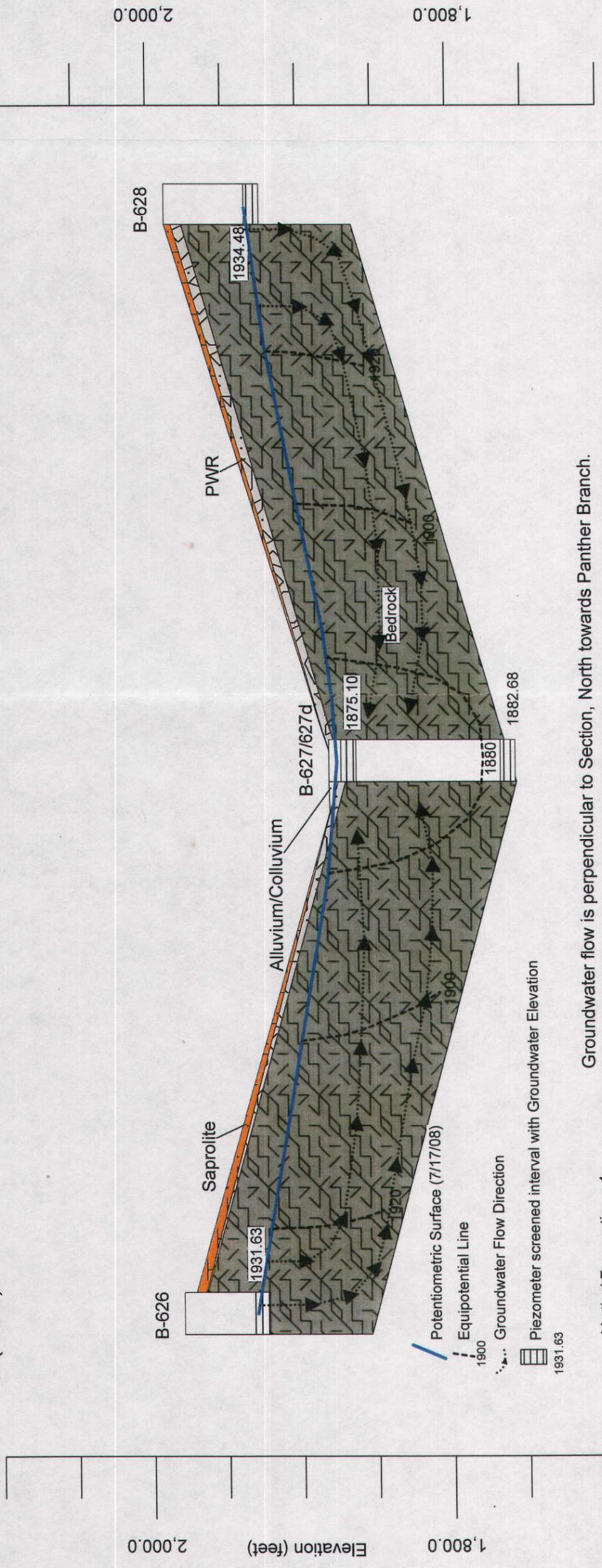


**Figure 2-3**  
**Hydrogeologic Cross-Section C - C' with Groundwater Flow Nets**  
**Buncombe County C&D Landfill Facility Expansion**  
**Site Hydrogeologic Investigation**

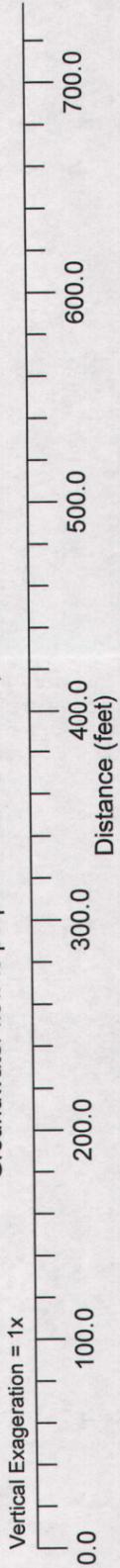
# Cross-Section E-E'

E (West)

E' (East)



Groundwater flow is perpendicular to Section, North towards Panther Branch.



**Figure 2-5**  
**Hydrogeologic Cross-Section E - E' with Groundwater Flow Nets**  
**Buncombe County C&D Landfill Facility Expansion**  
**Site Hydrogeologic Investigation**

Attachment 5  
Design Hydrogeologic Report  
Revised Report Pages

# Appendix C

## Design Hydrogeologic Investigation

Rule .0539(d)(3) of the North Carolina Solid Waste Management Rules requires that a Design Hydrogeologic Report be prepared in accordance with the requirements set forth in Rule .0538(b). This document is intended to fulfill all of the specified criteria delineated in this rule.

### 1 Purpose and Scope

The Design Hydrogeologic Report presented herein is designed to address the applicable Solid Waste Management Rules for the Permit to Construct for Phase 5 of the Buncombe County Solid Waste Management C&D Landfill Facility. **The proposed Phase 5 footprint is approximately 17 acres, of which 2.3 acres is expansion and 14.9 is existing C&D.**

The report compiles information from all field activities that have been conducted to date, summarizing data from previously-submitted documents, as well as subsequent investigation activities, to provide a comprehensive characterization of the geology and hydrogeology at the landfill site. The goal of this investigation is to provide sufficient technical information to design a Water Quality Monitoring Plan for Phase 5 as specified in Rule .0538(b)(2).

#### 1.1 Report Contents

Section 1 of the Design Hydrogeologic Report discusses the purpose and scope of the report, summarizes previous and current investigation activities, and provides a cross-reference between each applicable regulatory requirement set forth in Rule .1623(b) and corresponding sections of this report. Section 2 presents a summary of the methodologies used in this field investigation, as well as data collection and evaluation activities. Section 3 presents the results of this field investigation and data analysis activities. Conclusions derived from this and previous investigations are presented in Section 4, along with a discussion of hydrogeologic factors affecting the landfill design and development of the Water Quality Monitoring Plan.

#### 1.2 Previous Investigations

Law Environmental, Inc. initially investigated the site in 1990 (Law 1991). The investigation consisted of seventeen exploratory soil test borings using hollow-stem augers at twelve locations. Split spoon soil samples were collected at regular intervals using standard penetration test methods (ASTM D-1586). Groundwater was not encountered in any of the borings during drilling. Two borings that were left open overnight also did not accumulate groundwater. No permanent piezometers or monitoring wells were constructed. The report cited an absence of perennial surface water features and a small drainage area entering the site as advantages for landfill development, but identified limited excavation depth, lack of low permeability soils, and soil workability problems as potential constraints.

## 1.3 Current Investigation

The **current** investigation focused on the proposed expansion facility plan area adjacent to the existing Phases of the active C&D landfill. The proposed facility plan boundary included two individual drainage basins to the west and north side of the existing active C&D landfill. The investigation focused on the area within the two drainages.

Eighteen boreholes were drilled at 15 locations during the **current** investigation. All borings were converted to temporary piezometers for groundwater elevation measurements and lithologic and geotechnical data was collected at each location. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for lithologic and geotechnical data collection at all borings. Rock coring was performed at three locations (B-619d, B-623, and B-627d). Standard penetration tests (blow counts) were taken at all locations.

The site to the west will be used for future expansions. This report is intended to address the permit requirements for the area to the north (Phase 5 Expansion) of the existing landfill. Within the Phase 5 area, 9 boreholes were drilled at 8 locations during the **current** investigation. All borings were converted to temporary piezometers for groundwater elevation measurements and lithologic and geotechnical data was collected at each location. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for lithologic and geotechnical data collection at all borings. Rock coring was performed at location B-619d. Standard penetration tests (blow counts) were taken at all locations.

Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

## 2 Methodology

This section presents the methodology and data reduction used during the Phase 5 C&D Landfill hydrogeologic field investigation. As described in Section 1.3, the current investigation included borehole drilling, piezometer installation, water level measurements, and well surveying.

### 2.1 Drilling Methods

The following section details the drilling methods used to install borings and piezometers and collect geologic and hydrogeologic data for the Phase 5 C&D landfill expansion.

#### 2.1.1 Borehole Drilling

Borehole drilling methods included air rotary, hollow-stem auger, and rock coring. During the field investigation, two drill rigs (one air rotary and one hollow-stem)

from the borehole. The core sample was then extruded and placed into a box labeled with the core ID and depth intervals.

The rock core was described in the field and the percent recovery, rock quality designation (RQD), orientation and frequency of fractures, observed fracture infilling or coatings, gross mineralogy, and other notable characteristics were recorded. The RQD was determined by dividing the total length of rock fragment longer than four inches over the total length cored. Logs of the core borings are contained in Appendix A and described in Section 3.1.4.

## 2.2 Piezometer Installations

As discussed in Section 1.3, 9 piezometers were installed at 8 locations during the current investigation in the Phase 5 Area. **Following the current investigation, due to slope requirements and wetland buffers, the Phase 5 footprint was revised such that only 5 current investigation borings (B-614, B-615, B-616, B-619s and B-619d) are within or adjacent to the proposed Phase 5 footprint.** The piezometer locations are shown on Sheet 1 along with those installed in and around the Phase 5 area during previous investigations. Table 1 provides a summary of piezometer completion data for the recently installed piezometers and piezometers installed during previous investigations that were relevant to the Phase 5 investigation.

All piezometers installed during this investigation were screened in bedrock, with the exception of B-619, which was installed across the bedrock/PWR boundary. Completion diagrams are provided along with the borehole logs in Appendix A. Piezometers installed in bedrock targeted the first significant water-bearing zone for completion, as indicated by the air-lift testing during air rotary drilling.

The piezometers were constructed of 2-inch diameter PVC casing, with a 10-foot, 0.010-inch slot PVC screen and bottom cap. A filter pack consisting of #2 silica sand was placed around the well screen to a minimum of 2 feet above the top of screen. The piezometer annulus above the filter pack was then sealed with a minimum of 2 feet of 3/8-inch hydrated bentonite pellets. The bentonite was allowed to set-up for at least several hours prior to grouting. The remainder of the annulus was then filled with a Portland cement/bentonite grout poured from the surface. Locking steel protective covers with a 3-foot by 3-foot concrete pad were installed over all piezometers.

## 2.3 Water Level Measurements

Water level measurements were taken using an electronic water level meter with an accuracy of 0.01 feet. Water level measurements were taken relative to the north side of the top of each PVC well casing (TOC = top of casing). Water levels were monitored both during and after the piezometer completion. Water levels were collected after piezometer completion, when possible, 24 hours after completion, and at least seven days after completion. Measurement of water levels at precise time periods after completion was not always possible due to conflicts with other drilling

### *Drilling Observations*

Four lithologic distinctions have been made at the C&D Landfill expansion area based on observations from the subsurface investigations. These are **alluvium**, saprolite, partially weathered rock (PWR), and bedrock. **Alluvium or colluvium was encountered in small localized areas near the drainage features.** Descriptions of each material encountered at specific boring locations are provided in the boring logs contained in Appendix A. Each of these units is discussed in the following sections of the report. Table 2 lists all of the borings drilled at the C&D Landfill and the depths at which the above geologic units were encountered.

#### **3.1.1 Alluvium**

Alluvium was present in small localized areas within or adjacent to the drainage features. Where present, the alluvium was found to be of limited thickness and overlaid PWR or bedrock. The alluvium ranged in grain size from clayey silt to poorly sorted sands.

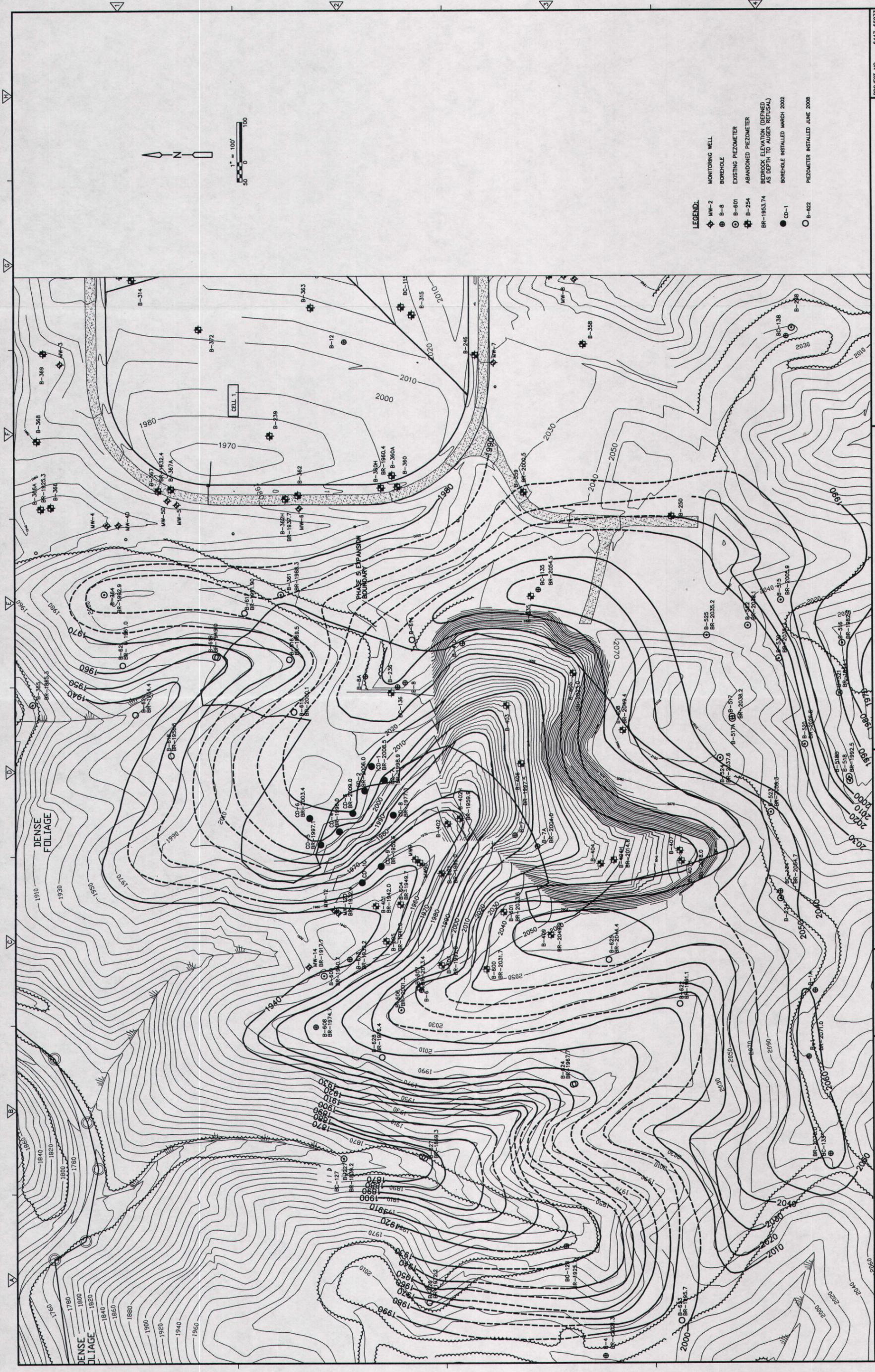
#### **3.1.2 Saprolite**

Saprolite (saprolitic soils) is the uppermost unit present at the site and is present at most locations except small areas where bedrock outcrops at the ground surface or depth to bedrock is shallow and within most surface drainage features where the PWR or alluvium is the uppermost unit. These soils are derived from the in-place chemical weathering of bedrock materials, and are characterized by the presence of relict mineral fabric from the original rock mass. These soils are typically finer near the surface where weathering is more advanced, and become more dense and coarser in texture as weathering decreases with depth.

Near the surface, they are generally comprised of fine sandy silt, or sandy silt with clay, with silty clay or silty sand present at some locations. They grade to silty sand or very sandy silt with depth. Hard rock fragments are commonly present in this lower portion of the saprolite, which become larger and more frequent with depth. The contact with the underlying partially weathered rock (PWR) or bedrock is typically gradational. These soils are typically red/brown or light to dark brown in color and usually micaceous with some areas being very micaceous. Locally grey, dark grey or green/grey colors are present, and appear to correlate with an abundance of mafic minerals in the rock mass from which they were derived. Thin zones of light brown or orange/tan lean clay are also present locally. For the purposes of this investigation, the base of the saprolite unit has been defined as the depth at which soil penetration using a split spoon sampler is greater than 50 blows per 6 inches. This definition is used to permit consistent identification of the saprolite/PWR contact.

Attachment 6  
Design Hydrogeologic Report  
Revised Sheets





- LEGEND:**
- MW-2 MONITORING WELL
  - B-368 BOREHOLE
  - B-601 EXISTING PIEZOMETER
  - B-254 ABANDONED PIEZOMETER
  - BR-1953.74 BEDROCK ELEVATION (DEFINED AS DEPTH TO AUGER REFUSAL)
  - CD-1 BOREHOLE INSTALLED MARCH 2002
  - B-422 PIEZOMETER INSTALLED JUNE 2008

BEDROCK CONTOUR MAP

BUNCOMBE COUNTY  
NORTH CAROLINA

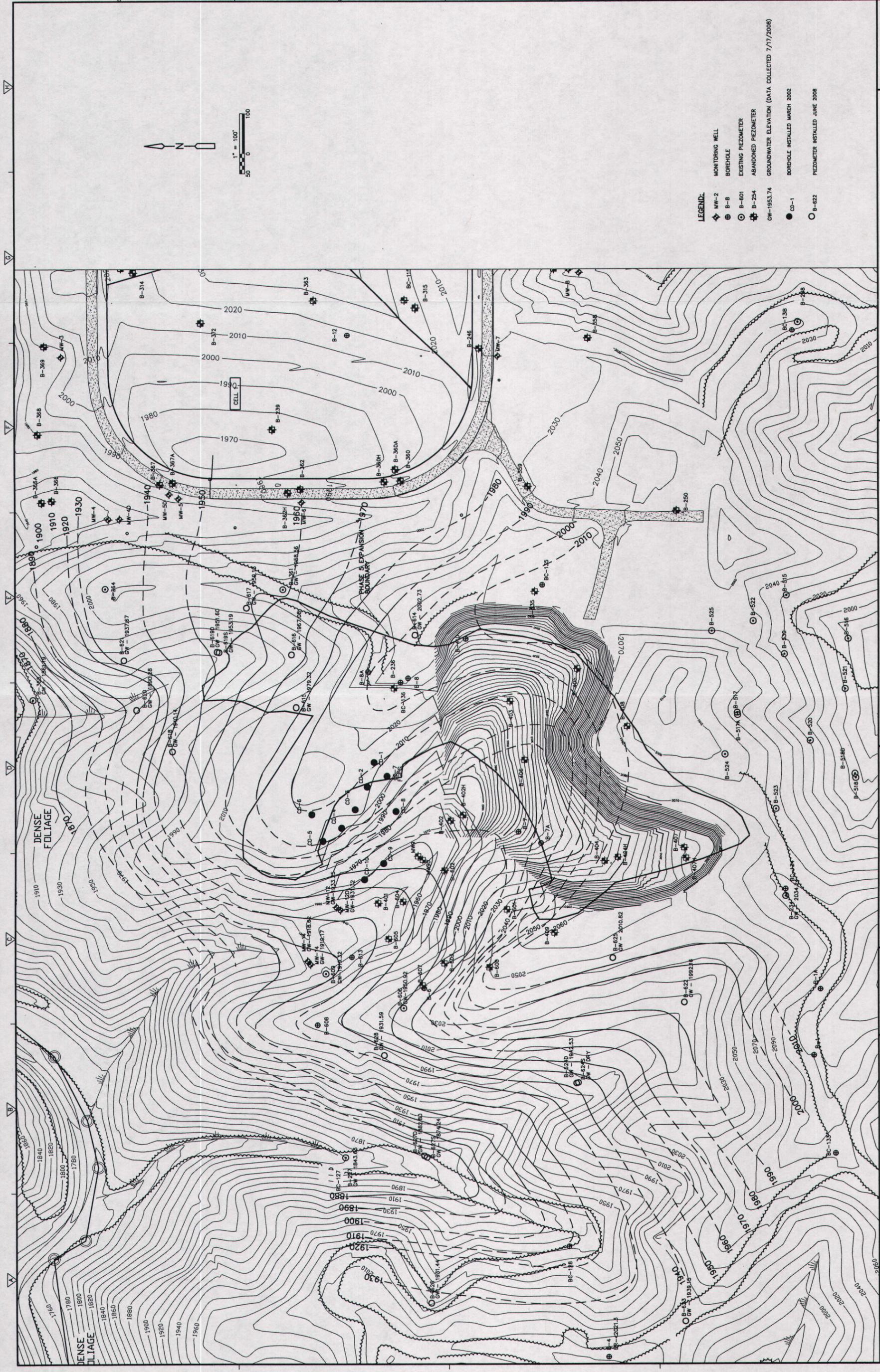
C&D LANDFILL SUBSTANTIAL AMENDMENT  
DESIGN HYDROGEOLOGIC INVESTIGATION

PROJECT NO. 6447-65973  
FILE NAME: Sheet 2.dwg  
SHEET NO. 2

DESIGNED BY: D. FORBES  
DRAWN BY: J. KLINGSOROTH  
SHEET CHECKED BY:  
CROSS CHECKED BY:  
APPROVED BY: FEBRUARY 2009  
DATE:

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- LEGEND:**
- MW-2 MONITORING WELL
  - B-8 BOREHOLE
  - B-601 EXISTING PIEZOMETER
  - B-254 ABANDONED PIEZOMETER
  - GW-1953.74 GROUNDWATER ELEVATION (DATA COLLECTED 7/17/2008)
  - CD-1 BOREHOLE INSTALLED MARCH 2002
  - B-622 PIEZOMETER INSTALLED JUNE 2008

PROJECT NO. 6447-65973  
 FILE NAME: Sheet\_3.dwg  
 SHEET NO. 3

POTENTIOMETRIC CONTOUR MAP

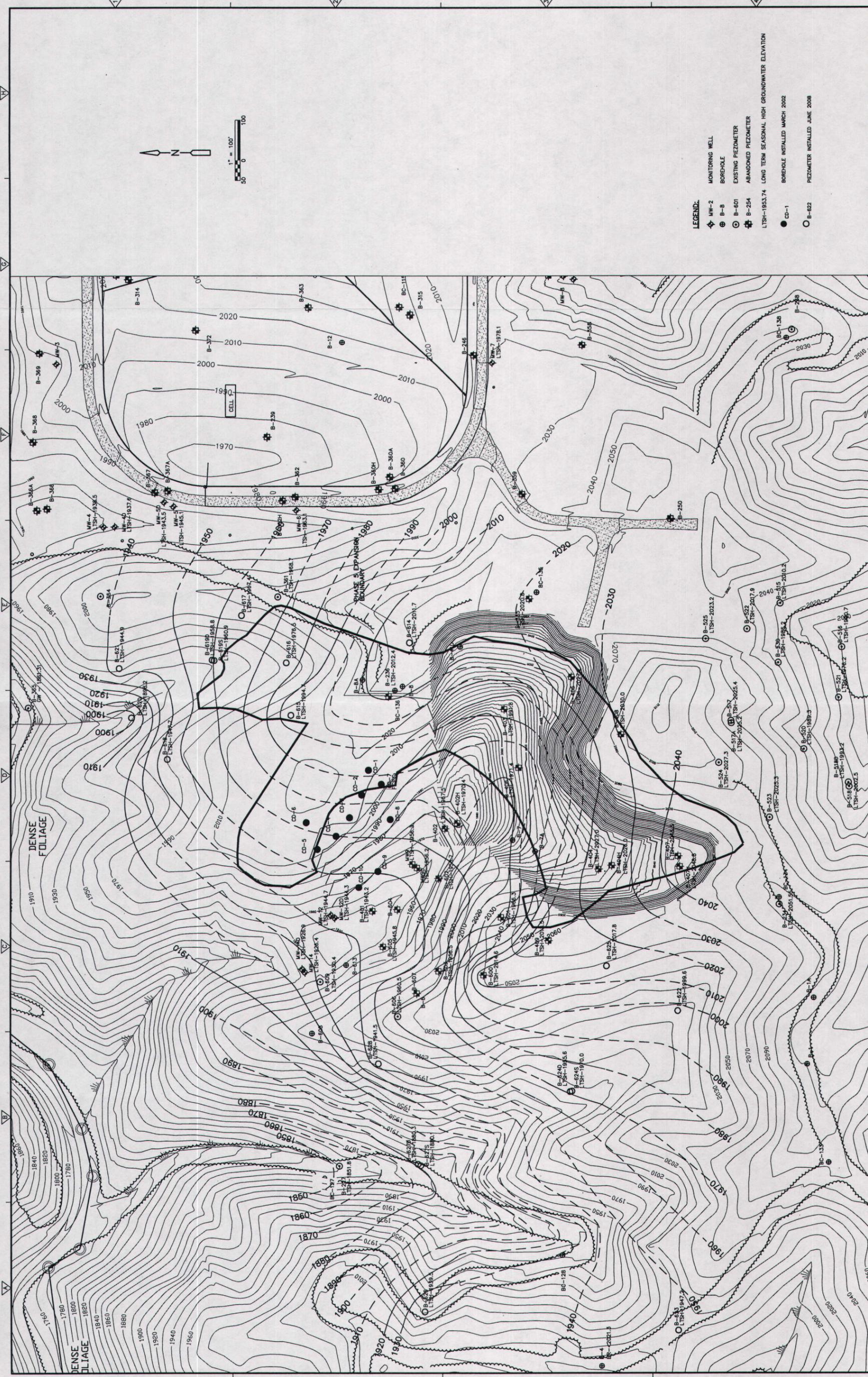
BUNCOMBE COUNTY  
 NORTH CAROLINA  
 C&D LANDFILL SUBSTANTIAL AMENDMENT  
 DESIGN HYDROGEOLOGIC INVESTIGATION

DESIGNED BY: D. FORBES  
 DRAWN BY: J. KILLINGSWORTH  
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 DATE: FEBRUARY 2008

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 Raleigh, North Carolina 27612  
 Tel: (919) 797-6600





- LEGEND:**
- MW-2 MONITORING WELL
  - B-368 BOREHOLE
  - B-601 EXISTING PIEZOMETER
  - B-254 ABANDONED PIEZOMETER
  - LTSH-1953.74 LONG TERM SEASONAL HIGH GROUNDWATER ELEVATION
  - CD-1 BOREHOLE INSTALLED MARCH 2002
  - B-422 PIEZOMETER INSTALLED JUNE 2008

LONG TERM SEASONAL HIGH  
GROUNDWATER CONTOUR MAP

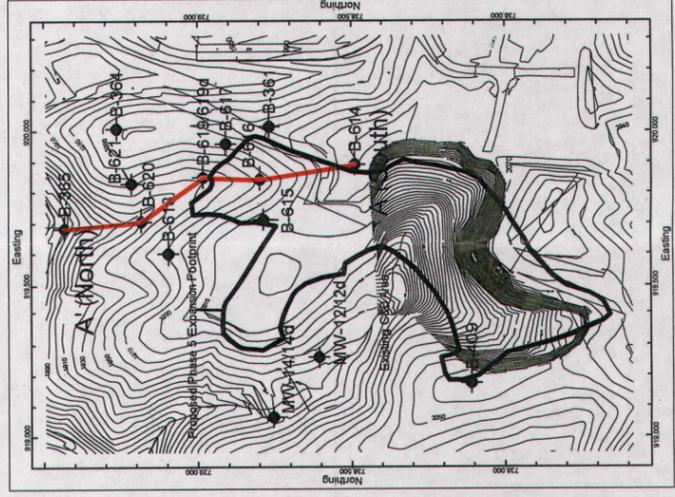
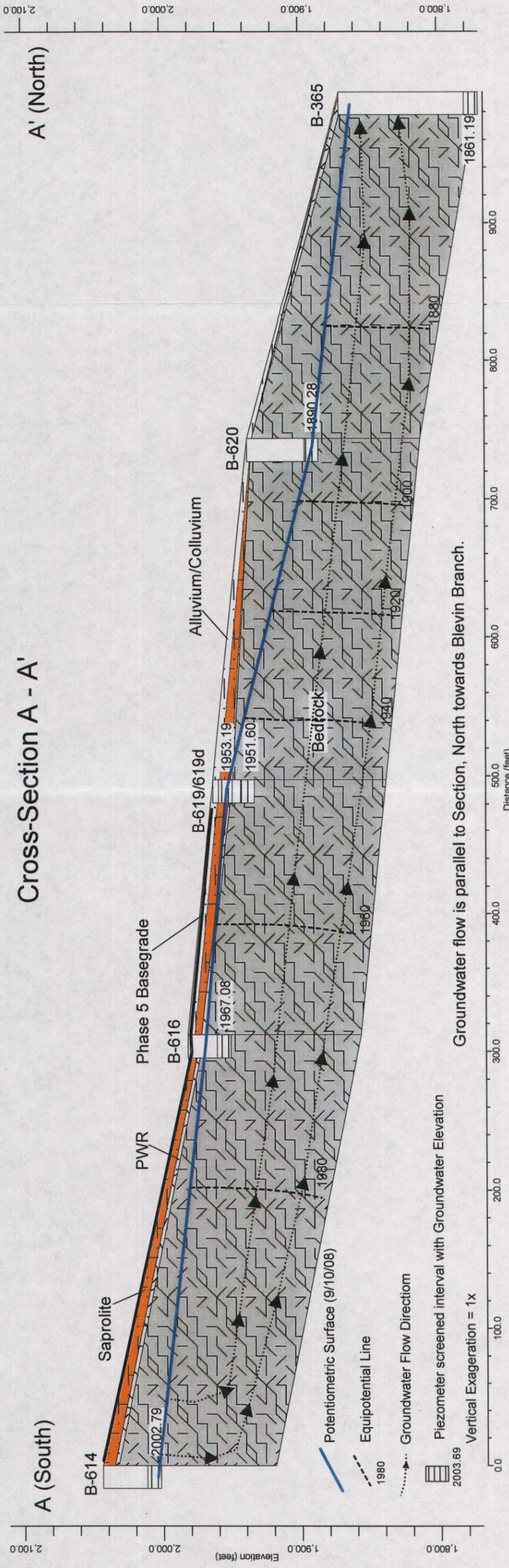
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FILE NAME: Sheet 5.dwg  
SHEET NO. 5

BUNCOMBE COUNTY  
NORTH CAROLINA  
C&D LANDFILL SUBSTANTIAL AMENDMENT  
DESIGN HYDROGEOLOGIC INVESTIGATION

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REV. NO.	DATE	DRWN	CHKD	REMARKS

Attachment 7  
Design Hydrogeologic Report  
Revised Figures



**Figure 3**  
**Hydrogeologic Cross-Section A - A' with Groundwater Flow Nets**  
**Buncombe County C&D Landfill Phase 5 Expansion**  
**Design Hydrogeologic Investigation**



Attachment 8  
Water Quality Monitoring Plan Revisions

**Table 1  
Groundwater Monitoring System Details  
Buncombe County Solid Waste Management Facility**

**EXISTING WELLS FOR SUBTITLE D LANDFILL**

Monitoring Well ID	TOC Elevation (feet AMSL)	Ground Elevation (feet AMSL)	Borehole Depth (feet)	Screened Interval (feet bgs)	Sand Pack (feet bgs)	Bentonite Seal Interval (feet bgs)	Surface Casing Depth (feet bgs)	Surface Casing Borehole Diameter (inches)	Surface Casing Diameter (inches)	Well Borehole Diameter (inches)	Well Casing Diameter (inches)
MW-1	2021.22	2019.28	76.00	76.00-81.00	76.00-59.00	59.00-57.00	NA	NA	NA	8.00	2.00
MW-1D	2021.57	2019.97	200.00	95.00-85.00	97.00-81.00	81.00-78.00	80.00	10.00	6.00	8.00	2.00
MW-2	1920.86	1918.54	20.00	20.00-5.00	20.00-3.00	3.00-1.00	NA	NA	NA	8.00	2.00
MW-2D	1920.51	1918.63	55.00	55.00-45.00	42.00-39.00	42.00-39.00	NA	NA	NA	8.00	2.00
MW-3	1987.66	1985.48	38.00	38.00-23.00	38.00-21.00	21.00-18.5	NA	NA	NA	8.00	2.00
MW-4	1944.35	1942.48	25.00	24.00-9.00	24.00-7.00	7.00-5.00	NA	NA	NA	8.00	2.00
MW-4D	1944.64	1942.79	55.00	55.00-45.00	55.00-43.00	43.00-40.00	NA	NA	NA	8.00	2.00
MW-5	1977.12	1975.39	50.00	50.00-35.00	50.00-33.00	33.00-31.00	NA	NA	NA	8.00	2.00
MW-5D	1976.92	1975.31	81.00	81.00-71.00	81.00-68.50	68.50-66.50	50.00	10.00	6.00	8.00	2.00
MW-6	1987.34	1985.39	50.00	50.00-35.00	50.00-27.00	27.00-24.5	NA	NA	NA	8.00	2.00
MW-7	2022.83	2020.72	61.00	57.00-42.00	61.00-40.00	40.00-38.00	NA	NA	NA	8.00	2.00
MW-8	1962.06	1959.85	70.00	70.00-55.00	70.00-53.00	53.00-51.00	NA	NA	NA	8.00	2.00
MW-8D	1962.47	1960.57	95.00	95.00-85.00	95.00-82.50	82.50-79.00	NA	NA	NA	8.00	2.00
MW-10	2010.54	2007.5	73.00	73.00-58.00	73.00-56.00	56.00-54.00	NA	NA	NA	6.00	2.00
MW-10D	2010.56	2007.5	117.00	117.00-102.00	117.00-100.00	100.00-98.00	NA	NA	NA	6.00	2.00
MW-11	1966.71	1963.7	50.00	50.00-35.00	50.00-33.00	33.00-31.00	NA	NA	NA	6.00	2.00
MW-11D	1966.15	1963.2	70.00	70.00-60.00	70.00-58.00	58.00-56.00	NA	NA	NA	6.00	2.00
MW-13	1953.92	1951.3	17.00	17.00-7.00	17.00-5.00	5.00-3.00	NA	NA	NA	6.00	2.00
MW-13D	1953.82	1951.4	37.00	37.00-27.00	37.00-25.00	25.00-23.00	NA	NA	NA	6.00	2.00

**EXISTING WELLS FOR C&D LANDFILL**

MW-12	1947.39	1944.71	17.00	17.00-7.00	17.00-5.00	5.00-3.00	NA	NA	NA	6.00	2.00
MW-12D	1947.10	1944.28	37.00	37.00-27.00	37.00-25.00	25.00-23.00	NA	NA	NA	6.00	2.00
MW-14	1952.78	1949.8	49.00	49.00-39.00	49.00-35.50	35.50-33.00	35.00	10.00	6.00	6.00	2.00
MW-14D	1953.77	1950.5	88.00	88.00-78.00	78.00-74.50	74.50-71.50	53.00	10.00	6.00	6.00	2.00

**ABANDONED WELLS FOR C&D LANDFILL**

MW-9	1966.54	1963.70	25.80	25.80-10.80	10.80-8.80	8.80-6.80	NA	NA	NA	6.00	2.00
MW-9D	1966.34	1963.60	39.50	39.50-34.50	34.50-31.50	31.50-29.50	NA	NA	NA	6.00	2.00

*-MW-9&9d were abandoned during Phase IV Expansion of C&D Landfill.*

**PROPOSED WELLS FOR PHASE 5 C&D EXPANSION**

Nest	Well	Drilling Method	Screen Interval Depth (feet) **	Rationale
MW-15	Air Rotary	Air Rotary	25-15	Downgradient of expansion within drainage feature, screened in PWR/bedrock contact.
MW-15D	Air Rotary	Air Rotary	55-45	Downgradient of expansion within drainage feature, screened interval in conductive fracture zone of bedrock.

**Notes:**

\* Well will be installed using hollow stem augers only if a sufficient thickness of saturated saprolite/PWR is found. If not, then boring will be advanced into bedrock using air rotary drilling and the well will be screened across the saprolite and bedrock contact.

\*\* The screen interval depths are estimated. Actual depths will depend on subsurface conditions.

AMSL - Above Mean Sea Level

TOC - Top of Casing

NA - Not Applicable

\* Top of Pad Elevation.

SW-4 is located within the drainage feature downgradient of MW-14/14d at the existing C&D landfill. Surface water sampling station SW-6 is proposed for Blevin Branch, north of the Phase 5 area. The existing and proposed sampling locations are shown on Sheet 1.

## 4 Sampling and Analysis Plan

### 4.1 Introduction

Rule .0544 specifies that the owner/operator must provide, as part of the groundwater monitoring program, a groundwater and surface water sampling and analysis (S&A) plan. The S&A plan should be designed to provide accurate results of groundwater quality at the upgradient and downgradient sampling locations. The S&A plan will address the following subjects:

- Groundwater and surface water sample collection
- Sample preservation and shipment
- Analytical procedures
- Chain-of-custody
- Quality assurance/quality control (QA/QC)

### 4.2 Groundwater and Surface Water Sample Collection

Groundwater samples will be collected from each monitoring well and surface water sampling location. Samples from each monitoring well and surface water sampling location will be sampled on a semi-annual basis. One sample from the new monitoring wells (MW-15/15d) and surface water sampling location (SW-6) will be collected prior to the Phase 5 expansion receiving waste.

#### 4.2.1 Static Water Level Measurements

Static water level elevations will be measured at each monitoring well prior to any purging or sampling activities. Static water level data will be used to monitor changes in site hydrogeologic conditions. The following measurements will be recorded in a dedicated field book or field sampling form prior to sample collection:

- Height of the well measuring point above ground surface,
- Depth of water in the well from the TOC measuring point (to the nearest 0.01 foot),
- Total depth of the well,
- Height of the water column in the well casing.

#### 4.2.3 Monitoring Well Evacuation

Following measurement of the static water level in all of the wells, individual wells will be purged of all stagnant water. The stagnant water, which is not representative of true aquifer conditions, will be removed to ensure that fresh formation water can be sampled. A minimum of three well casing volumes will be removed prior to sampling the well. The well volume for 2-inch diameter wells will be calculated using the following equation: One well volume in gallons equals the height of the water column (in feet) times 0.1632 (slightly less than 0.5 gallons per foot water for 3 casing volumes). Because aquifer formations onsite are relatively low-yield, the well will be purged in such a way that water is removed from the bottom of the screened interval.

During the well purging process, field measurements (pH, temperature, specific conductance, dissolved oxygen, oxidation/reduction potential and turbidity) will be collected at regular intervals, and reported in a tabular format. The well will be purged until field measurements stabilize within approximately 10 percent between subsequent readings or until the well is dry. Stabilization of these measurements will indicate that fresh formation water is present in the well. Field measurements of pH, temperature, conductivity, dissolved oxygen, and ORP will be obtained by using a YSI-600 series multi-parameter meter or equivalent and turbidity readings will be collected with Lamont turbidity meter or equivalent. Field measurements collected during purging activities will be recorded in the field logbook or field form. If the well is purged to dryness, the samples will be collected after a sufficient volume of water has entered the well to allow collection of the sample.

Wells will be purged using a decontaminated Teflon bailer with new nylon rope or an acceptable pumping device approved by the SWS. Teflon bailers will be pre-decontaminated by the manufacturer. No field decontamination of bailers will be performed.

#### 4.2.4 Sample Collection

After purging activities are complete, groundwater samples will be collected for laboratory analysis. The wells will be sampled using disposable laboratory decontaminated Teflon bailers equipped with new nylon rope or **dedicated well pumps**. Bailers will be used for one well only. Field decontamination of bailers will not be permitted. **If sampling is completed with bailers, the bailers will be lowered slowly into the well to minimize sample agitation.** Sample water will be placed directly into sample bottles provided by the analytical laboratory, using the following method:

1. Retrieve bailer and slowly transfer sample water to the appropriate sample container. The bailer or pump tubing should not be allowed to touch the sample container.
2. The sample container for the volatile organic compounds should be filled first, leaving no headspace or air bubbles. The container should then be tightly

sealed. The sample containers will be pre-preserved. No field preservation will be performed.

3. The sample container for the metals should then be filled. This container should be filled to the bottle shoulder.

Surface water samples will be obtained from areas of minimal turbulence and aeration. The following procedure will be implemented regarding sampling of surface waters:

1. Hold the bottle near the bottom with one hand, and with the other, remove the cap.
2. Push the sample container slowly into the water and tilt up towards the current to fill. **Do not fully submerge the sample container. Care should be taken to ensure that preservative is not flushed from the sample container during sample collection.**
3. The container should be moved slowly, in a lateral direction, if there is little current movement.
4. If the stream depths are too shallow to allow filling of the sample container, a pool may be scooped out of the channel bottom and allowed to clear prior to sampling. **Use the uncontaminated sample cap to complete filling the volatile organic sample container.**
5. Lift the container from the water and place the uncontaminated cap on the container.

The wells and surface water stations will be sampled in the order of potential for increasing contamination levels beginning with the upgradient (background) sampling locations. The individual water samples for C&D landfill wells (MW-12/12d, MW-14/14d, and proposed MW-15/15d) will be collected in the order of parameter volatility. The collection order for the samples will be as follows:

- Volatile organic compounds (VOCs),
- Chloride,
- Sulfate,
- Alkalinity,
- Total Dissolved Solids (TDS),
- Total metals (including manganese, mercury and iron).



PROJECT NO. 642-6873 FILE NAME: SWC-WQ-10-049	SHEET NO. 1			
WATER QUALITY MONITORING PLAN				
BUNCOMBE COUNTY NORTH CAROLINA				
CONSTRUCTION AND DEMOLITION LANDFILL PHASE 5 EXPANSION				
DESIGNED BY: M. COLUCCI DRAWN BY: J. HULLSPOURT CHECKED BY: J. HULLSPOURT APPROVED BY: J. HULLSPOURT DATE: MARCH 2009	CDM Camp Dresser & McKee 2000 Research Center, Suite 300 Raleigh, North Carolina 27603 Tel: (919) 791-2200 Fax: (919) 791-4700			
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