

Permit No.	Date	DIN
44-07	November 24, 2010	12298

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**November 24, 2010**  
Solid Waste Section  
Asheville Regional Office



## REVISED ENVIRONMENTAL MONITORING PLAN

**WHITE OAK LANDFILL**  
HAYWOOD COUNTY, NORTH CAROLINA

PERMIT NUMBER 44-07

PREPARED FOR:



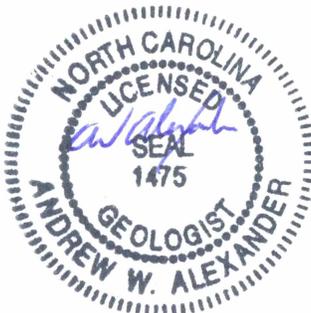
**HAYWOOD COUNTY SOLID WASTE MANAGEMENT DEPARTMENT**  
CLYDE, NORTH CAROLINA

PREPARED BY:

**BUNNELL-LAMMONS ENGINEERING, INC.**  
GREENVILLE, SOUTH CAROLINA  
ASHEVILLE, NORTH CAROLINA

NOVEMBER 18, 2010

BLE PROJECT NUMBER J10-1957-17



November 18, 2010

Haywood County Solid Waste Management  
278 Recycle Road  
Clyde, NC 28721

Attention: Mr. Stephen King  
Director of Solid Waste

Subject: **Revised Environmental Monitoring Plan**  
Phase 3 MSWLF Expansion  
White Oak Landfill  
Haywood County, North Carolina  
BLE Project Number J10-1957-17  
Permit Number 44-07

Dear Mr. King:

As authorized by your acceptance of Bunnell-Lammons Engineering, Inc. (BLE) contract number P09-0334R4a dated August 2, 2010, we have completed the Revised Environmental Monitoring Plan (EMP) for the subject site. This plan addresses the relevant environmental monitoring requirements for groundwater and surface water as outlined in the North Carolina Rules for Solid Waste Management, T15A NCAC 13B .1623(b)(3).

### **1.0 PROJECT INFORMATION**

The subject landfill site is located in Haywood County, North Carolina, approximately twelve miles north of the city of Waynesville on White Oak Road at exit 15 of Interstate 40 (Figure 1). The county owns and operates an active Subtitle D municipal solid waste (MSW) landfill and a closed construction and demolition (C&D) landfill on the subject site. An existing land clearing inert debris (LCID) disposal area is also present on the site. The operational MSW landfill consists of two waste areas designated Phase 1 and Phase 2. The county has constructed one new MSW area designated Phase 3 and plans to construct one new MSW area designated Phase 4 in the future. The combined area of both phases will cover approximately 15.3 acres (Figures 1 & 2).

A geologic study was performed for the landfill property in 1999, and was reported in a document titled *Site Hydrogeologic Report [SHR] White Oak Subtitle D Landfill*, Municipal Engineering Project Number G98010.5, dated February 8, 2000. As part of the permitting process for the expansion area, a Design Hydrogeologic Report (DHR) dated July 11, 2008 was prepared by BLE. The DHR addressed the relevant solid waste regulations under the North Carolina Department of Environment and Natural Resources, Division of Waste Management (DWM), Rule T15A NCAC 13B .1623(b), which pertain to the geologic and hydrogeologic conditions of the proposed landfill expansion area.

The DHR specifically addressed the geologic and hydrogeologic conditions of the proposed 15.3-acre Phase 3 and 4 expansion area of the MSW landfill. The expansion area of the DHR falls within the boundaries of the SHR (Figures 1 & 2).

As part of the proposed expansion project, we prepared an Environmental Monitoring Plan (EMP) as required for the Phase 3 & 4 expansion areas (*Site Environmental Monitoring Plan -- Proposed Phase 3 & 4 MSWLF Cell Areas*, BLE Project Number J07-1957-02, dated July 11, 2008). We understand that the plan was subsequently approved by the DWM (Doc ID 7276 dated April 15, 2009) and a permit to construct (PTC) was issued by the DWM for Phase 3.

Haywood County has opted not to apply for a permit to construct Phase 4 as this time. The Phase 3 area was constructed in 2009-2010 and BLE installed the required Phase 3 groundwater monitoring wells in 2010 (reported under separate cover).

As the result of changes to the site during construction of Phase 3, Haywood County has requested that BLE prepare this revised plan. Groundwater and surface water sampling procedures and methodologies for the site should be performed as currently conducted for the existing waste units.

## **2.0 EXISTING WATER QUALITY MONITORING SYSTEM**

As part of the Phase 3 expansion, BLE installed four new groundwater monitoring wells. Those wells included MW-3r (which replaced MW-3), MW-3Dr (which replaced MW-3D), and MW-16 and MW-17 as specified in the approved EMP. A report of the well installations is documented in *Report of Well Installation for the Phase 3 Expansion*, BLE Project Number J10-1957-17, dated November 12, 2010. A summary of groundwater monitoring well construction and water level data is included on Table 1.

The water quality monitoring system for the Subtitle D lined MSW landfill currently consists of eleven groundwater monitoring wells consisting of two upgradient (MW-11S and MW-11D) and nine downgradient wells (MW-1A, MW-2, MW-2D, MW-3r, MW-3Dr, MW-4A, MW-8, MW-16, and MW-17). Existing background monitoring wells MW-11S and MW-11D are located approximately 1,000 feet from the existing Phase 3 and proposed Phase 4 waste boundaries in a location sufficient for background monitoring. Additionally, there are four surface water monitoring points (SW-1, SW-2, SW-3, and SW-5), and a leachate lagoon sampling point (Figure 2).

The C&D landfill, which is located on the same property, is monitored by one upgradient well (MW-14), one downgradient well (MW-15), and two locations for surface water monitoring (SW-6 and SW-7).

The facility's existing water quality monitoring system is shown on Figure 2 and a Sampling Matrix is shown on Table 2. Water quality monitoring should continue as specified in the sampling matrix. Additional groundwater and surface water monitoring points will be required in the future as part of the construction of Phase 4. Future monitoring requirements for the Phase 4 expansion are discussed in Sections 3 through 5 below.

### **3.0 FUTURE GROUNDWATER MONITORING PLAN**

The revisions to the existing monitoring system for the future Phase 4 expansion (specified below) are needed for compliance with the requirements in Rule T15A NCAC 13B .1623(b).

#### **3.1 Subsurface Considerations, Groundwater Flow Direction and Depth**

Site specific factors were considered in redesigning this groundwater detection monitoring system, including the locations and construction details of each proposed monitoring well. In addition, environmental factors were considered, such as seasonal variations of the water table, the horizontal and vertical flow regimes, and lithology characteristics (presented in the DHR).

Groundwater elevations were measured in existing groundwater monitoring wells by Pace Analytical Services (Pace) on October 27, 2010. The water level data is summarized on Table 1. Additionally, water level measurements were collected from selected piezometers and wells on site during the period from September 2007 to February 2008 and those data were presented in the DHR. A groundwater elevation contour map was prepared for the October 27, 2010 data and those contours are displayed on Figure 2.

Groundwater beneath the Phase 3 area flows from south to north-northeast. Groundwater beneath the Phase 4 area flows in all compass directions from the approximate center of the proposed waste area. Recharge to the unconfined aquifer occurs at the higher elevations. Shallow groundwater discharge occurs to the on-site creek north of the proposed Phase 3 area (SW-5) and to the southwest of the proposed Phase 4 area (proposed SW-8). The residual soils and bedrock comprise the unsaturated and saturated zones of the uppermost water table aquifer.

On October 27, 2010, the depth to groundwater in the wells across the site varied locally from about 18.29 feet below ground surface (MW-2A) in low elevation areas to about 80.26 feet below ground surface (MW-11D) in high elevation areas.

#### **3.2 Compliance Boundary**

The groundwater monitoring wells are the compliance boundary. The compliance boundary is less than 250 feet from existing waste boundary and 50 feet or greater from the facility property boundary.

#### **3.3 Proposed Monitoring Well Locations**

Based on the groundwater flow direction in the Phase 4 expansion area, we propose the installation of three additional downgradient groundwater monitoring wells for the Phase 4 area designated MW-18, MW-19, and MW-20 (Figure 2). Existing monitoring well MW-17 is located to intercept groundwater flow from across the extreme northwestern corner of Phase 3 and the northern section of Phase 4. The proposed wells, MW-18, MW-19, and MW-20 are located to intercept groundwater flow from the northwest, west, and southern sections of Phase 4, respectively.

### 3.4 Monitoring Well Depths and Screened Intervals

The depth of the proposed monitoring wells will be designed to monitor the uppermost aquifer present at the site. The wells will be constructed with 15-foot long screened intervals. The **actual well depths will be determined in the field** by either:

- the depth to groundwater in the soil and partially weathered rock units, if a sufficient saturated thickness of the aquifer exists above the depth of auger refusal. The screened interval will be set to bracket the water table surface; or
- by the depth of water-bearing fractures in the bedrock unit. The screened interval will be set to intersect the water-bearing fractures.

Based on data from October 2010 groundwater elevation map and from existing topography provided by McGill (Figure 2) we anticipate the following depths to water and total depths at the proposed monitoring well locations:

<u>Proposed Well</u>	<u>Depth to Water (feet bgs)</u>	<u>Total Well Depth (feet bgs)</u>
MW-18	116	126
MW-19	62	72
MW-20	52	62

### 3.5 Proposed Monitoring Well Construction and Laboratory Analysis

It is proposed that the new wells be constructed of 2-inch diameter PVC casing and 15-foot long screened interval, with a sand pack, bentonite seal and grout column in the annular space between the borehole and PVC casing. A lockable standup steel cover should be secured over the well along with a concrete pad at the cover's base.

Drilling techniques, well installation, well development, sampling, and laboratory analyses should follow currently permitted procedures.

## 4.0 FUTURE SURFACE WATER MONITORING PLAN

There are four existing surface-water sampling locations (SW-1, SW-2, SW-3, and SW-5) associated with the existing MSW landfill and two existing surface-water sampling locations (SW-6 and SW-7) associated with the existing C&D landfill (Figure 2). The SW-5 location is downstream of the proposed Phase 3 cell and is sufficient for monitoring of the Phase 3 expansion area. Surface water sampling locations SW-6 and SW-7 are upstream of the Phase 4 expansion area and a new surface water sampling location (SW-8) is proposed for Phase 4 (Figure 2). Sampling and laboratory analyses should continue as performed in the past and as currently permitted.

### 5.0 FUTURE WATER QUALITY MONITORING SYSTEM SUMMARY

The existing and proposed water quality monitoring system for the existing landfill is shown on Figure 2. After the construction of the Phase 4 waste area the monitoring system will include sixteen groundwater monitoring wells, seven surface-water sampling locations, and one leachate sampling location. The water quality monitoring system for the site will include:

- three upgradient monitoring wells (MW-11S, MW-11D, and MW-14);
- thirteen downgradient monitoring wells (MW-1A, MW-2, MW-2D, MW-3r, MW-3Dr, MW-4A, MW-8, MW-15, MW-16, MW-17, MW-18, MW-19, and MW-20);
- one upgradient surface-water location (SW-6);
- six downgradient surface-water locations (SW-1, SW-2, SW-3, SW-5, SW-7, and SW-8);  
and
- one leachate sampling location (Leachate Lagoon).

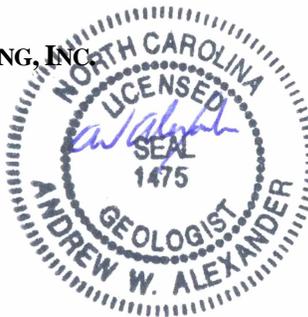
Please note that groundwater compliance monitoring for the Phase 4 area will only require sampling of the upgradient wells (MW-11S and MW-11D) and of the existing and proposed compliance wells (MW-17, MW-18, MW-19, and MW-20). Surface-water compliance monitoring for the Phase 4 area will require sampling of the downgradient (SW-8) compliance point.

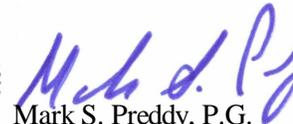
### 6.0 CLOSING

We appreciate the opportunity to work with Haywood County, McGill, and the NCDENR on this project. Please contact us at (864) 288-1265 to discuss this project or if you have any questions or comments regarding this plan.

Sincerely,  
**BUNNELL-LAMMONS ENGINEERING, INC**

  
 Andrew W. Alexander, P.G., RSM  
 Senior Hydrogeologist  
 Registered, NC No. 1475



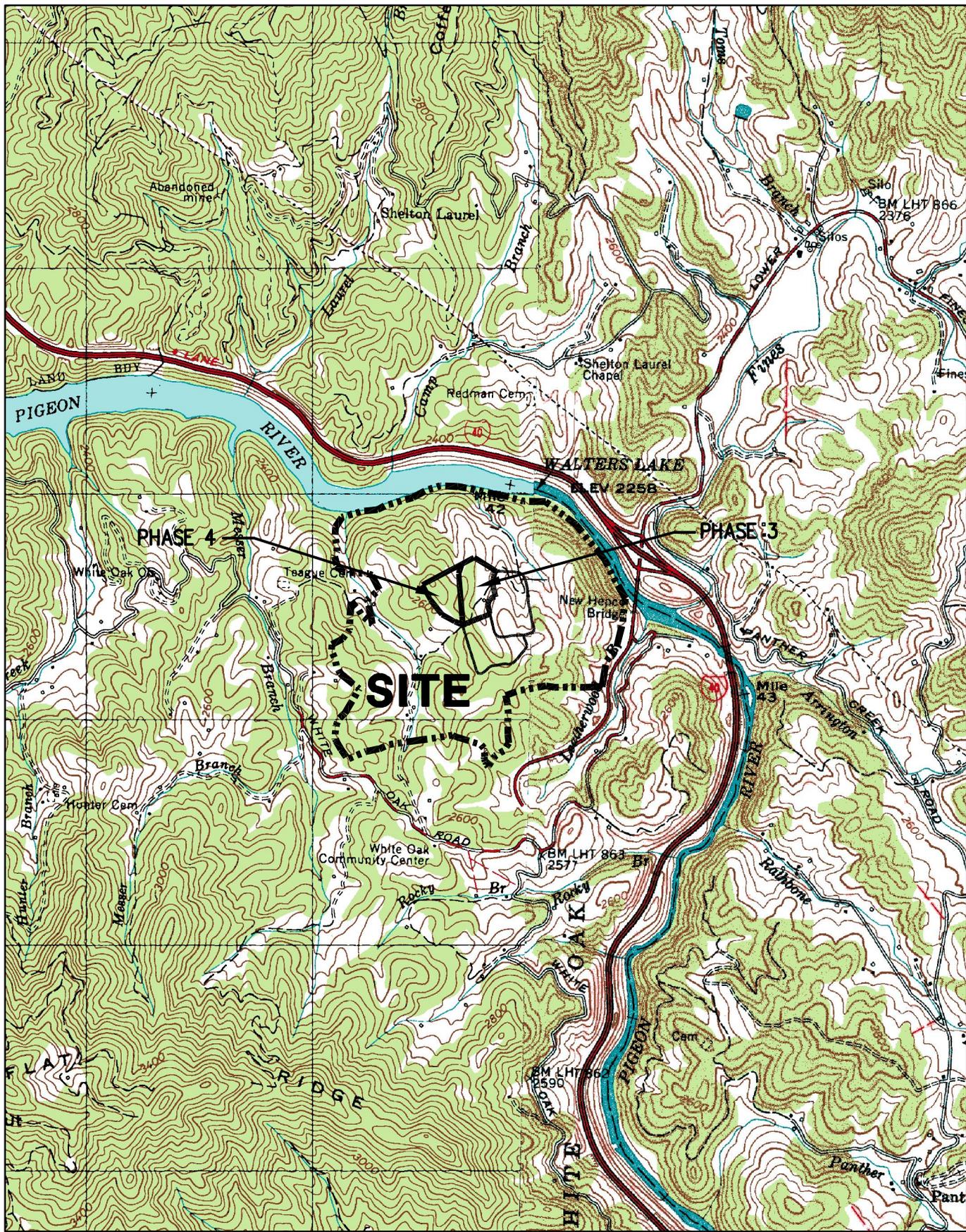
  
 Mark S. Preddy, P.G.  
 Senior Hydrogeologist  
 Registered, NC No. 1043



cc: Mr. Jeff Bishop, P.E. – McGill Associates  
Ms. Andrea Keller – NCDENR Asheville

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## **FIGURES**



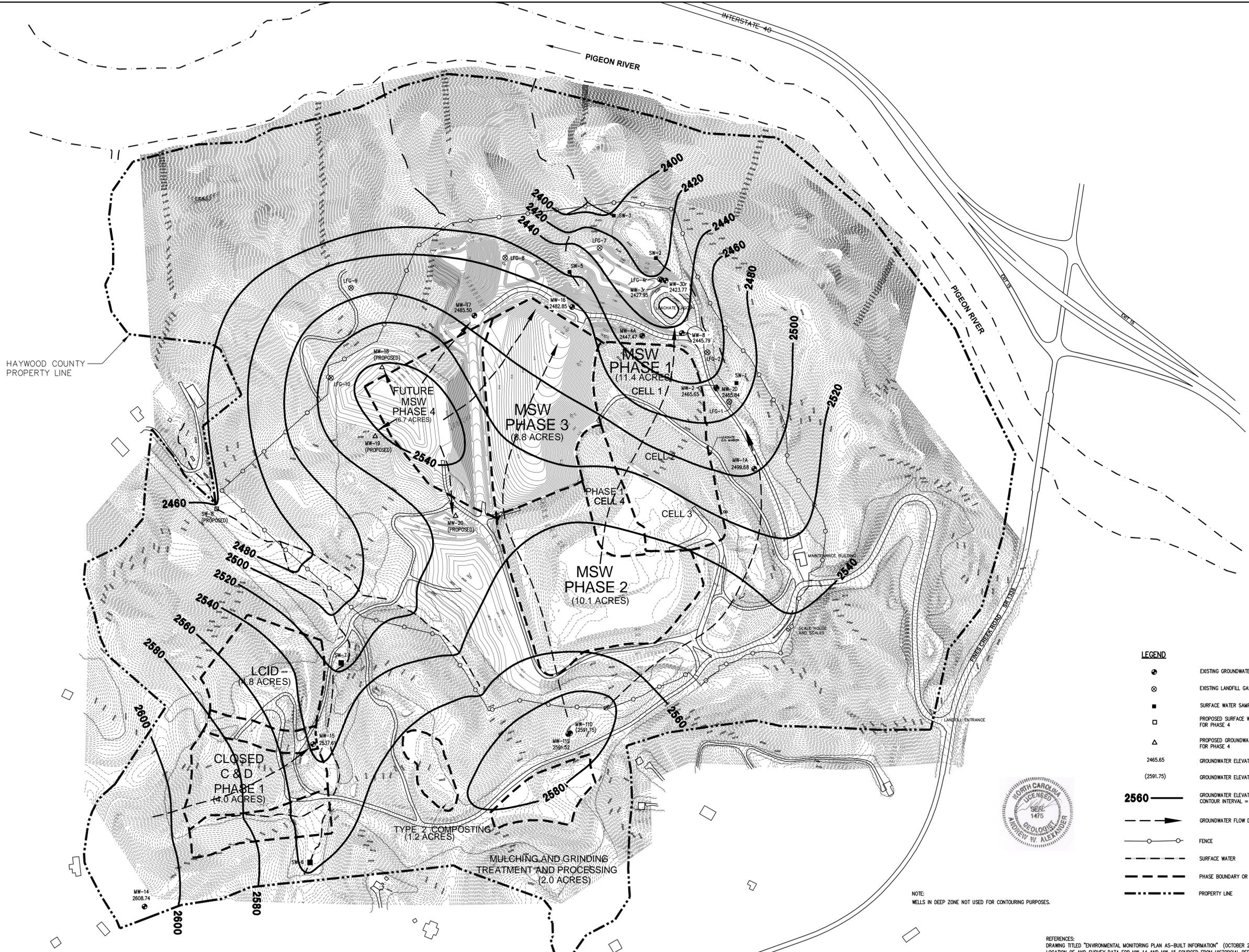
REFERENCE:  
 USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES,  
 COVE CREEK GAP AND FINES CREEK, N.C. QUADRANGLES, 1967.

DRAWN:	ACE	DATE:	06-20-10
CHECKED:	TJB	CAD:	WHITEOAK17-SLM
APPROVED:		JOB NO:	J10-1957-17

**IBLE** INC.  
**BUNNELL-LAMMONS ENGINEERING, INC.**  
 6004 PONDERS COURT  
 GREENVILLE, SOUTH CAROLINA 29615  
 PHONE: (864)288-1265 FAX: (864)288-4430

SITE LOCATION MAP  
 WHITE OAK LANDFILL  
 HAYWOOD COUNTY, NORTH CAROLINA

FIGURE  
**1**



HAYWOOD COUNTY  
PROPERTY LINE

**LEGEND**

- EXISTING GROUNDWATER MONITORING WELL
- ⊗ EXISTING LANDFILL GAS MONITORING WELL
- SURFACE WATER SAMPLING LOCATION
- PROPOSED SURFACE WATER SAMPLING LOCATION FOR PHASE 4
- △ PROPOSED GROUNDWATER MONITORING WELL LOCATION FOR PHASE 4
- 2465.65 GROUNDWATER ELEVATION (IN FEET)
- (2591.75) GROUNDWATER ELEVATION IN A DEEP ZONE (IN FEET)
- 2560 ——— GROUNDWATER ELEVATION CONTOUR  
CONTOUR INTERVAL = 20 FEET
- GROUNDWATER FLOW DIRECTION
- FENCE
- - - SURFACE WATER
- - - PHASE BOUNDARY OR WASTE UNITS
- - - - - PROPERTY LINE



NOTE:  
WELLS IN DEEP ZONE NOT USED FOR CONTOURING PURPOSES.

REFERENCES:  
DRAWING TITLED "ENVIRONMENTAL MONITORING PLAN AS-BUILT INFORMATION" (OCTOBER 2010) PROVIDED BY MCGILL ASSOCIATES.  
LOCATION OF AND SURVEY DATA FOR MW-14 AND MW-15 SOURCED FROM HISTORICAL REPORTS BY MUNICIPAL ENGINEERING.



REVISIONS		BY
No.	DESCRIPTION	

DRAWN: ACE	DATE: 10-19-10
CHECKED: AWA	CAD FILE: HCWOLF17-WM102710
APPROVED: MSP	JOB NO: J10-1957-17



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GROUNDWATER ELEVATION CONTOUR MAP - OCTOBER 27, 2010  
WHITE OAK LANDFILL  
HAYWOOD COUNTY, NORTH CAROLINA

## **TABLES**

**Table 1**  
**Groundwater Monitoring Well Construction and Groundwater Elevation Data**  
**White Oak Landfill**  
**Haywood County, North Carolina**  
**Permit Number 44-07**  
**BLE Project No. J10-1957-17**

October 27, 2010														
Well	Northing (feet)	Easting (feet)	Meas. Pt. Elevation	Gnd. Surface Elevation	*Depth to Water (bgs)	Depth to Water (bmp)	Water Elevation	Total Borehole Depth (bgs)	Screen Depth (bgs)	Screen Elevation	Well Type	Well Monitors	Top of Rock Depth (bgs)	Top of Rock Elev.
MW-1A	721,096.30	812,481.47	2,520.02	2,517.97	18.29	20.34	2499.68	UK	10.4 - 25.4	2507.6 - 2492.6	UK	Deep Residuum	UK	UK
MW-2	721,460.76	812,309.44	2,496.71	2,494.43	28.78	31.06	2465.65	UK	19.9 - 34.9	2474.5 - 2459.5	UK	Deep Residuum/PWR	UK	UK
MW-2D	721,456.01	812,311.87	2,496.89	2,494.69	28.85	31.05	2465.84	UK	44.6 - 54.6	2450.1 - 2440.1	UK	Bedrock	36.9	2457.8
MW-3r	721,943.38	812,063.70	2,462.61	2,459.53	31.58	34.66	2427.95	41.5	26.3 - 41.3	2433.2 - 2418.2	II	Deep Residuum	NE	NE
MW-3Dr	721,940.67	812,082.82	2,461.89	2,458.42	34.65	38.12	2423.77	65.0	49.8 - 64.8	2408.6 - 2393.6	IIIs	Bedrock	44.0	2414.4
MW-4A	721,693.04	811,976.64	2,493.85	2,491.60	44.13	46.38	2447.47	UK	80.6 - 95.6	2411.0 - 2396.0	UK	Bedrock	23.3	2468.3
MW-8	721,704.50	812,155.03	2,477.33	2,474.84	29.05	31.54	2445.79	UK	31.0 - 41.0	2443.8 - 2433.8	UK	Deep Residuum	UK	UK
MW-11S	719,905.88	811,642.89	2,674.58	UK	UK	83.06	2591.52	UK	UK - UK	UK - UK	UK	UK	UK	UK
MW-11D	719,909.34	811,651.55	2,674.89	2,672.01	80.26	83.14	2591.75	UK	118.0 - 127.6	2554.0 - 2544.4	UK	Bedrock	97.0	2575.0
MW-14	UK	UK	2,711.69	UK	UK	102.95	2608.74	UK	UK - UK	UK - UK	UK	UK	UK	UK
MW-15	UK	UK	2,547.41	UK	UK	9.80	2537.61	UK	UK - UK	UK - UK	UK	UK	UK	UK
MW-16	721,821.98	811,660.70	2,519.35	2,516.07	33.22	36.50	2482.85	41.0	25.8 - 40.8	2490.3 - 2475.3	II	Fill / Residuum	40.0	2476.1
MW-17	721,783.47	811,219.93	2,542.55	2,539.13	53.63	57.05	2485.50	63.0	43.0 - 58.0	2496.1 - 2481.1	II	Bedrock	40.0	2499.1

Notes:

All survey data provided by McGill Associates, all units in feet. Data for MW-14 & MW-15 sourced from historical Municipal Engineering reports.

\*DTW from bgs values have been calculated from survey data provided by McGill Associates.

All values shown to the nearest 0.1-ft have been rounded.

Water levels were measured on 10/27/10 by Pace Analytical.

MW-4A was lowered 4.59 feet by Haywood County. All bgs referenced depths for MW-4A have been adjusted accordingly on this table.

Measuring Point Elevation is top of casing.

II = Type II well

IIIs = Type III screened well

NE = Not encountered

UK = Unknown, information is not available

**Table 2**  
**Sampling Matrix**  
**White Oak Landfill**  
**Haywood County, North Carolina**  
**Permit Number 44-07**  
**BLE Project No. J10-1957-17**

			April	October
		Waste Areas	Station ID	Full Appendix I List
<b>Background Wells</b>	Phases 1-3	MW-11s	X	X
		MW-11D	X	X
	C&D	MW-14	X	X
<b>Compliance Wells</b>	Phases 1-3	MW-1A	X	X
		MW-2	X	X
		MW-2D	X	X
		MW-3r	X	X
		MW-3Dr	X	X
		MW-4A	X	X
		MW-8	X	X
	C&D	MW-15	X	X
	Phases 1-3	MW-16	X	X
		MW-17	X	X
<b>Surface Water</b>	Phases 1-3	SW-1	X	X
		SW-2	X	X
		SW-3	X	X
		SW-5	X	X
	C&D	SW-6	X	X
		SW-7	X	X
<b>Leachate</b>	Phases 1-3	Leachate	X*	X*

Notes:

\* = Plus NCDENR SWS Leachate Parameters

Leachate sample is collected from the Leachate Lagoon