

Permit No.	Date	Document ID No.
44-07	September 12, 2008	5808



BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

ENVIRONMENTAL MONITORING PLAN PROPOSED PHASE 3 & 4 MSW CELL AREAS

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

Prepared For:

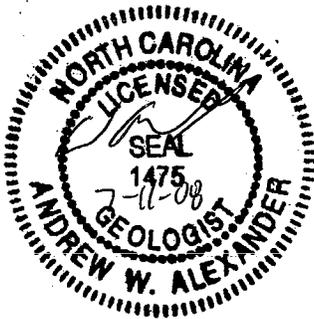
**MCGILL ASSOCIATES, P.A.
55 BROAD STREET
ASHEVILLE, NORTH CAROLINA 28801**

Prepared By:

**BUNNELL-LAMMONS ENGINEERING, INC.
6004 Ponders Court
Greenville, South Carolina 29615**

July 11, 2008

BLE Project Number J07-1957-02





BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

Fac/Perm/Co ID #	Date	Doc ID#
44-07	9/12/08	5808

July 11, 2008

McGill Associates, P.A.
55 Broad Street
Asheville, North Carolina 28801

Attention: Mr. Jeff R. Bishop, P.E.

Subject: **Environmental Monitoring Plan**
Proposed Phase 3 & 4 MSWLF Cell Areas
White Oak Landfill
Haywood County, North Carolina
BLE Project Number J07-1957-02

Dear Mr. Bishop:

As authorized by your acceptance of Bunnell-Lammons Engineering, Inc. (BLE) proposal number P07-0129 dated February 27, 2007, we have completed the Environmental Monitoring Plan for the subject site. This plan addresses the relevant environmental monitoring requirements as outlined in the North Carolina Rules for Solid Waste Management, T15A NCAC 13B .1623(b)(3).

We appreciate the opportunity to serve as your geological, hydrogeological, and geotechnical consultant on this project and look forward to continue working with you at the White Oak Landfill. If you have any questions, please contact us at (864) 288-1265.

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

Andrew W. Alexander, P.G.
Senior Hydrogeologist
Registered, North Carolina No. 1475

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

c:\law\active projects\mcgill\haywood county lf\wolf phase 3 & 4 emp\haywood co unit 3 & 4 1957-02 env mon plan.doc

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 a Subtitle D municipal solid waste (MSW) landfill and a 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 cells designated Phase 1 and Phase 2. The county plans to construct two new MSW cells designated Phase 3 and Phase 4, which will cover approximately 15.3 acres (Figures 2 & 3).

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, Rule T15A NCAC 13B .1623(b), which pertain to the geologic and hydrogeologic conditions of the proposed landfill expansion area.

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. The DHR (prepared by BLE in 2008) 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 (Figure 2).

As part of the expansion project, we have prepared this Environmental Monitoring Plan (EMP) as required for the Phase 3 & 4 expansion areas. This plan for Phase 3 & 4 supplements but does not replace the existing plan for the entire site. Groundwater and surface water sampling procedures and methodologies for the Phase 3 & 4 cells should be performed as currently conducted for the existing cells.

-oOo-

2.0 EXISTING WATER QUALITY MONITORING SYSTEM

The Subtitle D lined MSW landfill has fifteen groundwater monitoring wells consisting of two upgradient (MW-11S and MW-11D) and thirteen downgradient wells (MW-1A, MW-2, MW-2D, MW-3, MW-3D, MW-4A, MW-5A, MW-5D, MW-8, MW-9, MW-12, MW-13S, and MW-13D). Additionally, there are four surface water sampling points (SW-1, SW-2, SW-3, and SW-5), a leachate lagoon sampling point, and a settling pond sampling point (Figure 2). The C&D landfill, which is located on the same property, is monitored by one upgradient (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.

There are no existing compliance wells located downgradient from the proposed Phase 3 or 4 waste boundaries. The closest compliance well is MW-4A which is located approximately 175 feet sidegradient from the proposed waste boundary. Therefore, the installation of five additional compliance wells (MW-16 through MW-20) is required to target areas of convergent groundwater flow. Five existing groundwater monitoring wells (MW-5A, MW-5D, MW-12, MW-13S, and MW-13D) are present within the Phase 3 cell limits and must be abandoned prior to Phase 3 development.

Existing background monitoring wells MW-11S and MW-11D are located approximately 1,000 feet from the proposed Phase 3 & 4 waste boundaries in a location sufficient for background monitoring of the proposed waste areas.

The existing surface water sampling location SW-5 is downstream of proposed Phase 3 expansion area. There are no existing surface water monitoring locations present downgradient of the southwestern side of the proposed Phase 4 expansion area. Therefore, one additional surface water monitoring point (SW-8) will be required for Phase 4.

The revised water quality monitoring system is shown on Figure 3.

3.0 GROUNDWATER MONITORING PLAN

These revisions to the existing monitoring system are needed to better address 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.

Groundwater elevations were measured in the piezometers on site at the time of boring and after 24 hours. Additionally, water level measurements were collected from selected piezometers and wells on site during the period from September 2007 to February 2008. The water level data was

presented in the DHR. A groundwater elevation contour map was prepared for the February 14, 2008 data and those contours are displayed on Figure 3.

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 cell. 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 (SW-6, SW-7, and proposed SW-8). The residual soils and bedrock comprise the unsaturated and saturated zones of the uppermost water table aquifer.

On February 14, 2008, the depth to groundwater varied locally from about 3.77 feet above ground surface (BLE-5) in low elevation areas to about 91.40 feet below ground surface (BLE-11) in high elevation areas.

3.2 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 expansion areas, we propose the installation of five additional downgradient groundwater monitoring wells for the Phase 3 and Phase 4 cell areas (Figure 3). The wells will be designated as MW-16, MW-17, MW-18, MW-19, and MW-20. Proposed monitoring well MW-16 is located to intercept groundwater flow from almost the entire Phase 3 cell except for a small northwestern section which borders the Phase 3/Phase 4 boundary. 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 remaining 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 proposed well depths will be determined 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 the DHR and from proposed grades provided by McGill we anticipate the following depths to water and depths to rock at the proposed monitoring well locations:

Proposed Well	Depth to Water (feet bgs)	Depth to Rock (feet bgs)
MW-16	44	60
MW-17	61	61
MW-18	53	79
MW-19	59	84
MW-20	52	70

3.5 Proposed Monitoring Well Construction and Laboratory Analysis

The anticipated lithology at the new proposed well locations has been estimated based on the closest available boring/coring data, geologic cross-sections, and plan view geologic maps from the DHR supplemented, along with proposed design grade elevation data from McGill.

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 the procedures in the existing WQMP.

4.0 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 3). 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 3). Sampling and laboratory analyses should continue as performed in the past and should follow the procedures in the existing WQMP.

5.0 REVISED WATER QUALITY MONITORING SYSTEM

The revised water quality monitoring system for the existing landfill is shown on Figure 3. Once constructed, the monitoring system will include seventeen groundwater monitoring wells, eight 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);
- fourteen downgradient monitoring wells (MW-1A, MW-2, MW-2D, MW-3, MW-3D, MW-4A, MW-8, MW-9, MW-15, MW-16, MW-17, MW-18, MW-19, and MW-20);
- one upgradient surface-water location (SW-6);
- seven downgradient surface-water locations (SW-1, SW-2, SW-3, SW-5, SW-7, SW-8, and Settlement Pond); and
- one leachate sampling location (Leachate Lagoon).

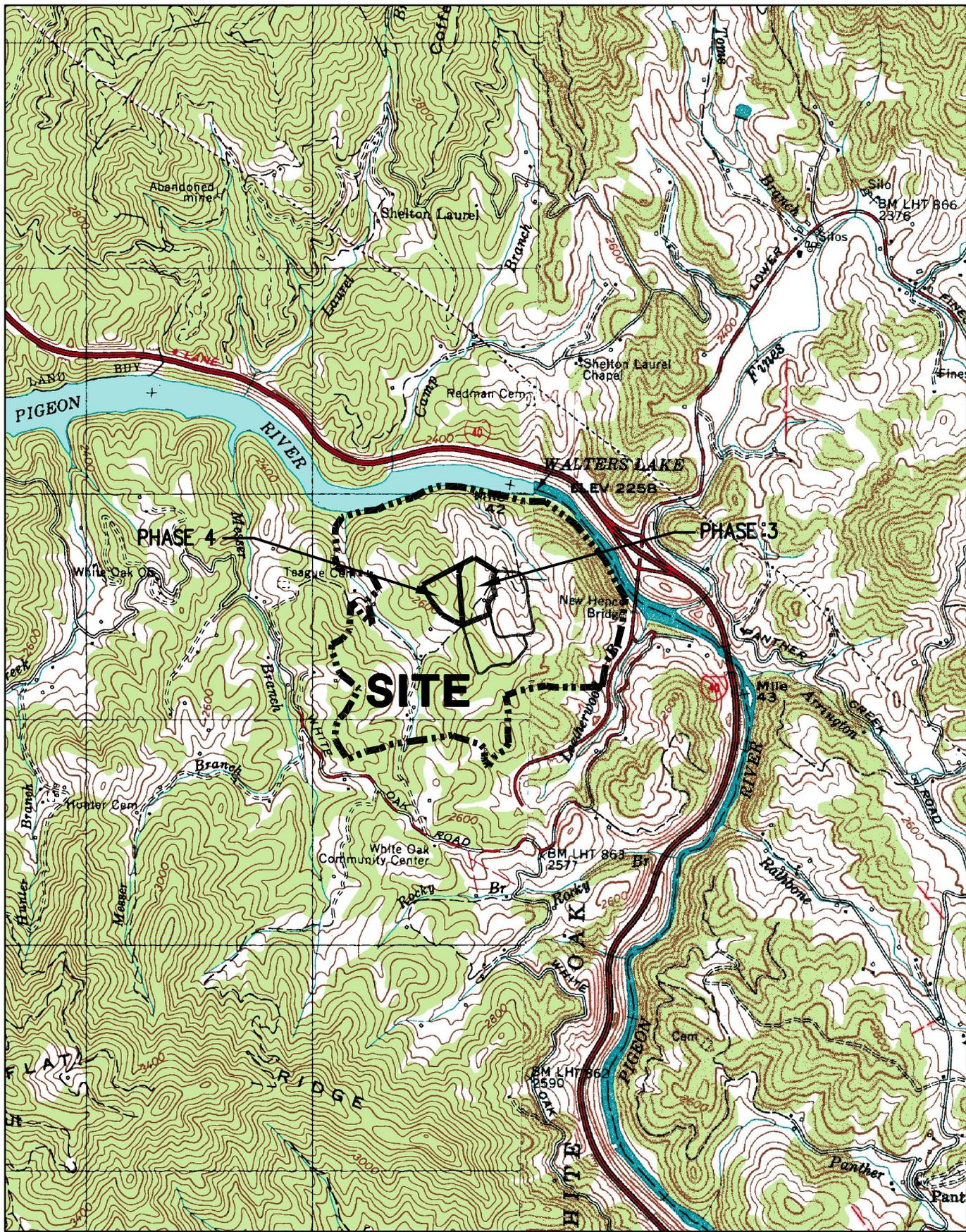
Please note that groundwater compliance monitoring for the Phase 3 area will only require sampling of the upgradient wells (MW-11S and MW-11D) and of the proposed compliance wells (MW-16 and MW-17). Surface-water compliance monitoring for the Phase 3 area will require sampling of the downgradient (SW-5) compliance point.

Groundwater compliance monitoring for the Phase 4 area will only require sampling of the upgradient wells (MW-11S and MW-11D) and of the 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-5 and SW-8) compliance points.

Please note that five groundwater monitoring wells (MW-5A, MW-5D, MW-12, MW-13S, and MW-13D) are present within the Phase 3 cell limits and must be abandoned.

-oOo-

FIGURES



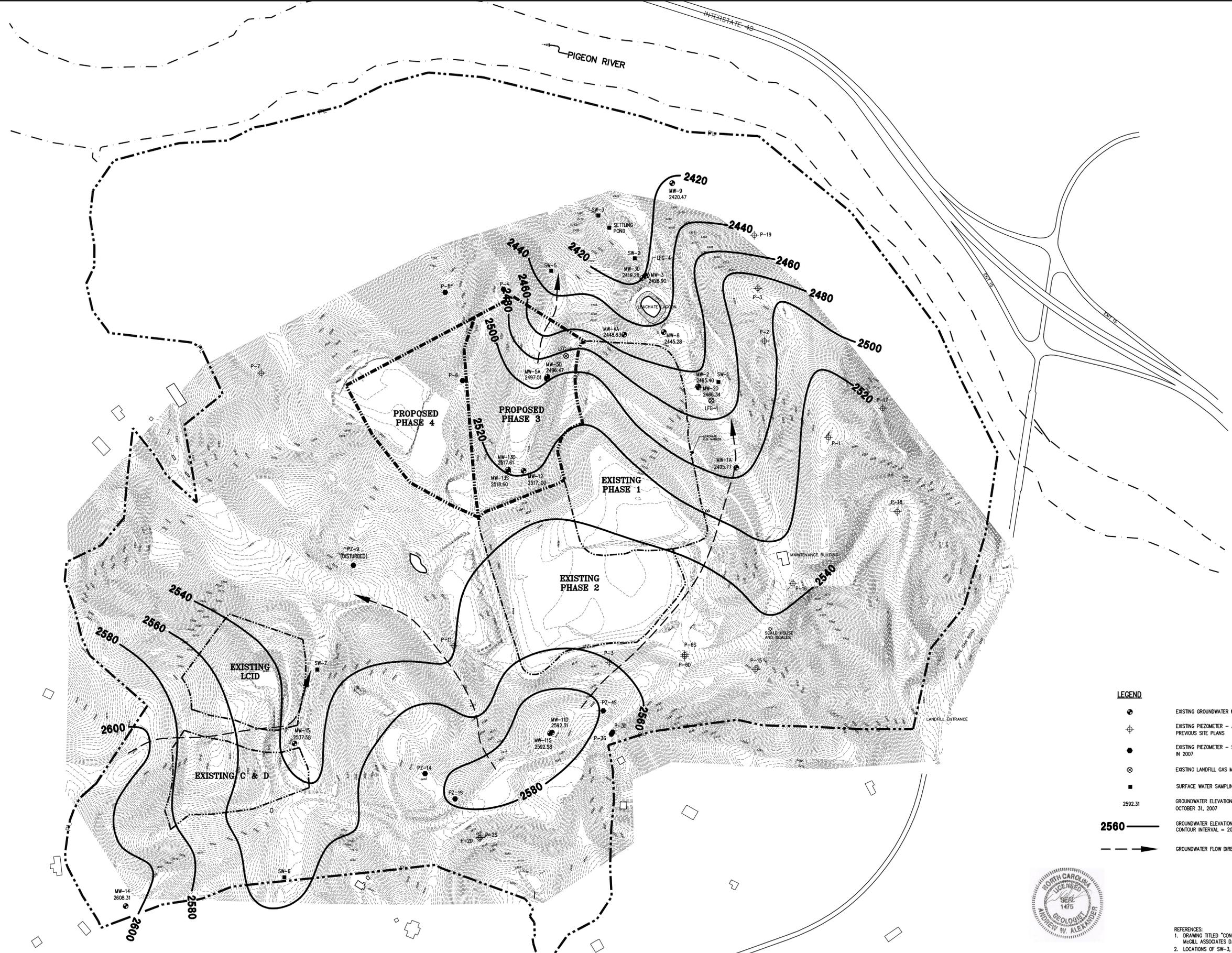
REFERENCE:
 USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES,
 COVE CREEK GAP AND FINES CREEK, N.C. QUADRANGLES, 1967.

DRAWN:	AEH	DATE:	07-11-08
CHECKED:	MSP	CAD:	HCWOLF-02 SLM
APPROVED:		JOB NO:	J07-1957-02

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



- LEGEND**
- EXISTING GROUNDWATER MONITORING WELL
 - EXISTING PIEZOMETER - APPROXIMATE LOCATIONS FROM PREVIOUS SITE PLANS
 - EXISTING PIEZOMETER - SURVEYED BY MCGILL ASSOCIATES IN 2007
 - EXISTING LANDFILL GAS MONITORING PROBE
 - SURFACE WATER SAMPLING LOCATION
 - 2592.31 GROUNDWATER ELEVATION (IN FEET) OCTOBER 31, 2007
 - 2560 GROUNDWATER ELEVATION CONTOUR CONTOUR INTERVAL = 20 FEET
 - GROUNDWATER FLOW DIRECTION



REFERENCES:
 1. DRAWING TITLED "CONCEPTUAL SITE PLAN, OPTION 1 & 2" BY MCGILL ASSOCIATES DATED JUNE 2007.
 2. LOCATIONS OF SW-3, SW-6, SW-7 AND SETTLING POND PROVIDED BY PACE LABS.

REVISIONS		BY
No.	DESCRIPTION	

DRAWN: AEH	DATE: 07-11-08
CHECKED: TJB	CAD FILE: HCWOLF-EMP2007
APPROVED:	JOB NO: J07-1957-02



BUNNELL-LAMMONS ENGINEERING, INC.
 6004 POWERS COURT
 GREENVILLE, SOUTH CAROLINA 29615
 PHONE: (864)286-1266 FAX: (864)286-4480

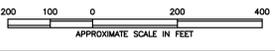
GROUNDWATER ELEVATION CONTOUR MAP - 10/31/07
 WHITE OAK MSW LANDFILL
 HAYWOOD COUNTY, NORTH CAROLINA



- LEGEND**
- EXISTING GROUNDWATER MONITORING WELL
 - ⊕ EXISTING PIEZOMETER - APPROXIMATE LOCATIONS FROM PREVIOUS SITE PLANS
 - ⊙ EXISTING PIEZOMETER - SURVEYED BY MCGILL ASSOCIATES IN 2007
 - ⊗ EXISTING LANDFILL GAS MONITORING PROBE
 - ⊖ EXISTING PIEZOMETER AND/OR BORING INSTALLED BY BUNNELL-LAMMONS ENGINEERING IN 2007
 - SURFACE WATER SAMPLING LOCATION
 - PROPOSED SURFACE WATER SAMPLING LOCATION
 - 2466.10 GROUNDWATER ELEVATION (IN FEET) FEBRUARY 14, 2008
 - 2560 GROUNDWATER ELEVATION CONTOUR CONTOUR INTERVAL = 10 FEET
 - ▲ F.G. ELEV: 2594 PROPOSED GROUNDWATER MONITORING WELL WITH FUTURE GROUND SURFACE ELEVATION



- REFERENCES:**
1. DRAWING TITLED "CONCEPTUAL SITE PLAN, OPTION 1 & 2" BY MCGILL ASSOCIATES DATED JUNE 2007.
 2. LOCATIONS OF SW-3, SW-6, SW-7 AND SETTLING POND PROVIDED BY PACE LABS.



REVISIONS		
No.	DESCRIPTION	BY

DRAWN: AEH	DATE: 07-11-08
CHECKED: TJB	CAD FILE: HCWOLF-EMP2008
APPROVED:	JOB NO: J07-1957-02



BUNNELL-LAMMONS ENGINEERING, INC.
 6004 POWERS COURT
 GREENVILLE, SOUTH CAROLINA 29615
 PHONE: (864)286-1265 FAX: (864)282-4480

ENVIRONMENTAL MONITORING PLAN - PHASES 3 AND 4
 GROUNDWATER ELEVATION CONTOUR MAP - 2/14/08
 WHITE OAK MSW LANDFILL
 HAYWOOD COUNTY, NORTH CAROLINA