



# LANDFILL GAS REMEDIATION PLAN – PHASE 2

Closed Henderson County Municipal Solid Waste  
Landfill, Permit No. 45-01

Henderson County, North Carolina

**Submitted To:**



Henderson County Solid Waste Division  
191 Transfer Station Drive  
Hendersonville, NC 28791

**Submitted By:** Golder Associates NC, Inc.  
5B Oak Branch Drive  
Greensboro, NC 27407

January 2015

0839-650614.500

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January 6, 2015

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Ms. Jackie Drummond  
Department of Environment and Natural Resources  
Division of Waste Management - Solid Waste Section  
2090 US Highway 70  
Swannanoa, NC 28778  
828-296-4706

**RE: LANDFILL GAS REMEDIATION PLAN – PHASE 2  
CLOSED HENDERSON COUNTY MUNICIPAL SOLID WASTE LANDFILL, PERMIT NO. 45-01  
HENDERSON COUNTY, NORTH CAROLINA**

Dear Jackie:

On behalf of Henderson County, Golder Associates NC, Inc. (Golder) is submitting the enclosed Landfill (LFG) Remediation Plan – Phase 2 in response to continued detections of methane above the lower explosive limit (LEL) in compliance monitoring points during quarterly methane monitoring events. The attached LFG Remediation Plan is submitted to comply with the requirements of Title 15A of the North Carolina Administrative Code (NCAC) Subchapter 13B.1626 (4)(c).

If you have any questions regarding the LFG Remediation Plan – Phase 2, please contact the undersigned at (336) 852-4903.

Sincerely,  
**GOLDER ASSOCIATES NC, INC.**

A handwritten signature in blue ink, appearing to read "David Y. Reedy II".

David "Dusty" Y. Reedy II, P.G.  
Senior Hydrogeologist

A handwritten signature in blue ink, appearing to read "Rachel P. Kirkman".

Rachel P. Kirkman, P.G.  
Associate and Senior Consultant

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## 1.0 INTRODUCTION

This Landfill Gas (LFG) Remediation Plan – Phase 2 has been prepared by Golder Associates NC, Inc. (Golder) for the closed Henderson County Municipal Solid Waste (MSW) Landfill in Henderson County, North Carolina, due to continued LFG exceedences in one or more methane monitoring wells. The Plan has been prepared in accordance with Title 15A of the North Carolina Administrative Code (NCAC) Subchapter 13B.1626 (4)(c). The Henderson County Landfill, which consists of a closed municipal solid waste (MSW) and a closed construction and demolition (C&D) landfill, is maintained by the County under Permit No. 45-01 issued by the North Carolina Department of Environment and Natural Resources (NC DENR).

## 2.0 BACKGROUND

The location of the facility is shown on the inlay on Drawing 1. As presented, the closed Henderson County Landfill is located approximately 3 miles northwest of the city of Hendersonville, off Stoney Mountain Road. The County maintains an approximately 120-acre landfill facility that consists of a closed, unlined C&D over MSW facility; a closed, unlined C&D facility; a closed, unlined facility formerly operated by the Tennessee Valley Authority (TVA); and an active transfer station. A white goods area, a yard waste disposal area, and a beneficial reuse area are also present on the property.

The facility has been in operation since the 1940s, beginning with the TVA landfill. The MSW landfill opened in 1960. In January 1998, the MSW facility ceased accepting MSW waste and began placing C&D waste over the MSW waste. After closure of the C&D-over-MSW area in 2001, a new C&D landfill began operation on the southeastern portion of the facility property. The C&D-over-MSW area was capped with a modified clay cap. The County ceased accepting waste at the stand-alone C&D landfill on June 30, 2008, and completed closure activities on June 30, 2009.

The landfill is bounded to the north and east by residential and undeveloped wooded properties, to the south by Stoney Mountain Road and residential and wooded properties, and to the west by a tributary of Mill Pond Creek, a NC Department of Transportation maintenance yard, and a Henderson County School bus maintenance facility. Topographic relief at the landfill ranges from approximately 2170 to 2590 feet above mean sea level. Surface drainage from the facility is predominantly to the southwest toward several streams along the western and southern portions of the property. These features drain into Mill Pond Creek located southwest of the landfill.

Henderson County (The County) monitors methane at eight methane monitoring wells (MP-1, MP-3, MP-4, MP-5, MP-6, TR-1, TR-2, and TR-3) located around the MSW landfill on a quarterly schedule. Additionally, the County monitors three methane monitoring probes (LFG-1, LFG-2, and LFG-3) around the closed C&D landfill. The County currently monitors eight structures (activity building, animal shelter, break house, bus garage, convenience center building, maintenance shop, scalehouse, and the Trace barn) on County property in close proximity to the MSW or C&D landfill.

Methane monitoring probe MP-2 was removed from the compliance network during the construction of the new landfill entrance and scalehouse. Probe TR-2 has not been monitored during recent events after being damaged, but has recently been located and repaired.

An active LFG extraction system was operated by a third party (NC Municipal Gas Partners, LP/Enerdyne Power Systems) from 1998 to April 2013. NC Municipal Gas Partners, LP terminated their contract with the County on April 1, 2013, and shut down and removed the system.

Since the active extraction system was shut down, exceedences of the lower explosive limit (LEL) have occurred during quarterly methane monitoring in methane monitoring wells MP-5, TR-2, and TR-3. The concentrations in wells MP-5 and TR-3 are similar to sporadic concentrations in the wells from when the active system was in place. The concentrations in TR-2 have been over the LEL during three of the five events since being repaired.

Due to continued detections of methane above the LEL in compliance monitoring points during quarterly methane monitoring events, the LFG Remediation Plan – Phase 1 was submitted to NC DENR on September 26, 2013, and was implemented before the submittal date. Phase 1 consisted of disconnecting 14 LFG extraction wells from the active LFG extraction header pipe and installing turbine vents to each to allow each LFG extraction well to passively vent. Phase 1 also stated that a field investigation to acquire data from the LFG wells and methane monitoring wells would be performed and to create a LFG generation model. This information was proposed to be collected in order to determine the approach for future remediation measures, if needed.

Since the implementation of LFG Remediation Plan – Phase 1, consistent exceedences of the lower explosive limit (LEL) have occurred during quarterly methane monitoring from methane monitoring well MP-5 along with frequent exceedences in TR-2 and TR-3. Based on these results, the County is proceeding with producing this LFG Remediation Plan – Phase 2, which describes the next steps of a phased approach to reduce LFG migration and to protect human health and the environment.

### **3.0 LANDFILL GAS COLLECTION SYSTEM EVALUATION**

The LFG Remediation Plan – Phase 1 stated that a field investigation to acquire data from the LFG wells and methane monitoring wells would be performed and a LFG generation model would be created. The field evaluation effort took place September 16-18, 2013. This initial effort consisted of two areas of evaluation: gas generation modeling and a field investigation of in place gas collection and control system (GCCS) piping including LFG wells and methane monitoring wells.

#### **3.1 Methane Generation Modeling**

Golder completed a gas generation model for the closed MSW landfill using waste acceptance rates and actual gas collection rates for 2010, as provided by the County. The results of the model indicate that the peak gas generation would have occurred around the year 1999, with an average gas flow rate of 458

cubic feet per minute (cfm) during that year. Actual data obtained from the County for the year 2010 tracks closely with the modeled gas generation rate for that year; the model predicting 235 cfm for 2010, while the actual flow, as measured by the County, was 255 cfm. Current modeled gas generation is approximately 171 cfm for the year 2013 and is expected to continue declining until approximately year 2060. These results reinforce the decision to not replace the active gas collection components that were removed from the facility, as there would likely not be enough gas to require active collection.

### 3.2 Gas Collection and Control System

The Henderson County Landfill GCCS consists of 50 vertical extraction wells. Active collection and control components, such as flare and blowers, were taken out of operation in April 2013 and have been removed from the site.

The Golder technician monitored the gas quality at each wellhead and methane probe using a Landtec GEM2000 following standard monitoring techniques between September 16<sup>th</sup> and 18<sup>th</sup>, 2013. The technician also recorded latitude and longitude, liquid levels, well construction information, wellhead information, lateral information, notes and observations, and a photo for each well. The tabulated results can be found in Table 1. A map of the wellfield with an overlay of the well identifications can be found on Figure 1. Field photos are included as Appendix A.

The Golder technician found the site to have easy access to all areas of the GCCS. Overall, the wellhead assemblies were found to be in poor condition with the valves, flex hose connections, and boots in various stages of deterioration. Several wells were found with no identification; these are included in the tabulated data with labels GEW-X1, GEW-X2, GEW-X5, and GEW-X6. Golder located two sumps with valves east of the former flare skid area. An additional two valves (assumed to be header cut-off valves) were located on the northwest and southeast areas of the landfill, each just inside the haul road. The majority of the gas conveyance system (piping), with the exception of lateral-well connections and the connections in the area where the flare skid once stood, are buried and inaccessible.

#### 3.2.1 Wellhead Pressures

Wellhead pressures are provided as an overlay of the wellfield map in Figure 2. The majority of the wells (32 out of the 50, or 64%) had either slightly negative (7 wells) or a '0' pressure reading (25 wells). A small number (6) had a wellhead pressure between 0" and 1", while the remaining 12 wells had a positive pressure greater than 1". The wells with these slightly elevated positive pressures are fairly concentrated into groups, mainly around the top and southern slope of the landfill; most likely these are the areas containing the newest waste. The average wellhead pressure across the wellfield was 0.8" with a maximum wellhead pressure of 6.4" at GEW-46 (58.7% methane) and a minimum pressure of -1.1" at GEW-28 (0.4% methane). Considering the amount of time between the removal of the active collection system and these readings (approximately 5 months), these numbers indicate a very low gas production rate. In our experience, in active landfills that are in a more productive phase of their gas generation

curve, it is not unheard of to see wells with very large positive pressures when they have been removed from the collection system for as little as a few hours.

### **3.2.2 Wellhead Methane**

Wellhead methane concentrations are provided as an overlay of the wellfield map in Figure 3. Methane concentrations are fairly uniform and elevated across the wellfield with no obvious patterns or groupings. The average wellhead methane concentration is 46%, with minimum readings of less than 1% at 7 wells and maximum readings above 60% at 6 wells. A total of 36 wells, or 72% of the wellfield, are above 50% methane; although, as noted above, only 12 of these wells have a positive wellhead pressure of 1" or greater. These methane readings are fairly typical for an active gas collection system; however, by themselves do not indicate a need for an active system. When viewed in light of the pressure readings noted above, these methane levels are likely not sustainable and are probably due to stagnant gas accumulating in the well casings.

### **3.2.3 Well Liquid Levels**

Well water column depths are provided as an overlay of the wellfield map in Figure 4. Water column depths were calculated as the difference between depth to liquid and depth to refusal (well bottom or obstruction). The largest water columns tend to be in wells at the higher elevations and toward the center of the landfill. These data are difficult to interpret without additional information such as as-built depths, depth to screen and screen length; but based on the fact that the majority of the wells (44, or 88%) have less than 5 feet of water column it is likely that liquids are not a limiting factor on collection potential.

## **3.3 Landfill Gas Collection System Evaluation Summary**

Based on gas generation modeling and the field investigation, it appears that the landfill gas production is in decline. Historical data and wellhead measurements taken by Golder, particularly the pressure readings, indicate that the installation of a new active gas collection system at the facility may not be the most cost-effective remedy for the noted methane migration.

## **4.0 QUARTERLY METHANE MONITORING SUMMARY**

Methane levels at most methane monitoring wells have been routinely at or near zero percent before and after the removal of the active LFG extraction system (Table 2 and Figure 5). The most consistent methane readings are from well MP-5, which have ranged from 15.8% and 51.9% since the active extraction system was removed in April 2013. Methane readings had ranged from 0% to 40.5% when the LFG extraction system was operational.

Well TR-3 has had methane readings that have ranged from 0% to 13.7% since the extraction system was removed with readings exceeding the LEL on four occasions during that time span. Methane

readings have been below the LEL during the last two quarterly events. Methane readings had ranged from 0% to 8.6% when the LFG extraction system was operational.

Well TR-2 has had methane readings that have ranged from 0% to 9.8% since the well was located and repaired prior to the September 2013 event with readings exceeding the LEL on three occasions during that time span. Prior to that event the well had been broken off near ground surface and could not be located. Methane was not reported in TR-2 during the most recent event in September 2014.

Methane was reported above the LEL in well MP-6 during the December 2013 event. Methane has been present in the well at levels below the LEL during the remaining quarterly events since June 2013.

Methane was recorded above the LEL during the initial monitoring event after removing the extraction system in April 2013 in wells MP-1, MP-3, and TR-1, but have not been detected above the LEL since. Well MP-4 had a reading above the LEL during the July 2012 quarterly event, while the extraction system was in operation, but has not had any readings above the LEL since.

Based on the above information, recent LEL exceedences are confined to a small area near the northern waste boundary at MP-5, TR-2, and TR-3.

## 5.0 PHASE 2 REMEDIATION

Proposed remediation activities for addressing the elevated methane concentrations observed in the vicinity of methane monitoring wells MP-5, TR-2, and TR-3 are discussed in this section. Based on the evaluation in Section 3.0, an active LFG extraction system is not recommended due to the limited generation of methane from the aging waste unit.

### 5.1 Venting of Remaining LFG Extraction Wells

As part of Phase 1, 14 LFG extraction wells were disconnected from the extraction header pipe and turbine vents were installed to each (Drawing 1). It is proposed that the remaining 46 vents be disconnected from the extraction header pipe and either have turbine vents installed or have the LFG extraction wells topped with 'candy canes' style passive vent pipes to allow the remaining wells to passively vent and prevent the buildup of LFG in the waste unit.

### 5.2 Venting Methane Monitoring Well MP-5

As discussed in Section 4.0, methane monitoring well MP-5 has had methane readings since the removal of the LFG extraction system that have ranged from 15.8% to 51.9%. As shown on Drawing 1, MP-5 is located in closed proximity to the edge of waste or possibly in waste and therefore, is not a viable monitoring point. This well should be removed from the compliance network and a turbine vent should be installed and allowed to passively vent to help prevent migration of methane toward the property boundary.

### 5.3 Installation of Additional Methane Monitoring Wells

In addition to removing methane monitoring well MP-5 from the methane monitoring network, wells MP-6, TR-1, TR-2, and TR-3 will also be removed from the compliance network. These five methane monitoring wells will be replaced by three new wells designated as MP-7, MP-8, and MP-9. These wells will be located closer to the northern facility (compliance) boundary and further away from the waste unit as shown on Drawing 1. Wells MP-6, TR-2, and TR-3 will continue to be monitored as assessment monitoring points during the quarterly events to help determine if remediation efforts are helping reduce methane concentrations, but will not be part of the compliance monitoring network. Well TR-1 will be abandoned due to its close proximity to MP-6.

Relatively little information is known about the depth to bedrock and groundwater at the proposed locations of the landfill gas monitoring wells. Depth to bedrock at each of the locations is assumed to range between 40 and 70 feet below ground surface, based on available boring logs for groundwater monitoring wells at the facility. Depth to groundwater for each proposed location was estimated using the groundwater surface contours provided on Drawing 2. A summary of depth to bedrock and groundwater estimates along with proposed depths and screened intervals of the proposed landfill gas monitoring wells are provided on Table 3. A diagram of a typical landfill gas monitoring well is provided as Figure 6. The wells are estimated to range between 30 to 45 feet below ground surface, but actual depths will be dependent on field conditions.

The methane monitoring wells will be constructed to a depth equivalent to the top of bedrock unless groundwater is encountered above bedrock. If groundwater is encountered above bedrock, the wells will be installed approximately 5 feet above the static water level to account for seasonal high water level fluctuations. Groundwater is expected to be encountered above bedrock at each location. The wells will be constructed of 2-inch PVC with 0.010-inch slotted screen from the bottom of the well up to 5 feet below ground surface. A coarse, clean sand will be used to fill the annular space to approximately 2 feet above the screen. An approximately 2-foot thick bentonite seal will be placed above the sand. The remaining annular space will be filled with a cement mixture. The surface completion of each gas probe will consist of a 3 feet by 3 feet by 0.5 feet concrete well apron and a locking protective casing. The top of the PVC riser will be equipped a well cap with a stopcock valve or quick connect coupling.

## 6.0 CONCLUSIONS

This LFG Remediation Plan – Phase 2 has been prepared in response to continued detections of methane above the LEL in compliance methane monitoring wells in the northern portion of the facility. The Phase 2 remedial activities consist of three activities: to vent the remaining LFG extraction wells in the waste unit, vent methane monitoring well MP-5, and replace methane monitoring wells MP-5, MP-6, TR-1, TR-2, and TR-3 with wells located closer to the northern facility boundary (proposed wells MP-7, MP-8, and MP-9).

## 7.0 REFERENCES

Golder Associates NC, Inc., September 26, 2013. *Landfill Gas Remediation Plan – Phase 1; Closed Henderson County Landfill, Permit No. 45-01; Henderson County, North Carolina.*

## **TABLES**

**TABLE 1**  
**Tabulated Results of Wellfield Investigation**  
**Henderson County Closed MSW Landfill**

POINT NAME	GPS COORDINATES		DATE/TIME	GEM 2000 GAS DATA				WELL		LATERAL			WELLHEAD		LIQUID LEVELS FROM TOC			OTHER NOTES
	LAT	LOX		CH4	CO2	O2	BAL	DIAM "	TYPE	DIAM	TYPE3	OFFSET FT	SIZE / TYPE	LL	DTB	SU		
GEW00	35.3565700	-82.4954600	9/18/2013 12:32	55.7	44.2	0	0.1	4	SCH 40 PVC	4	HDPE	2.5	2" SCH 80 WITH GATE VALVE	X	-24.3	3.2	VENT INSTALLED ON WELL, NO LIQUIDS AT DTB	
GEW01	35.3566324	-82.4956646	9/18/2013 12:44	57.6	42.3	0	0.1	4	SCH 40 PVC	4	HDPE	2	2" SCH 80 WITH GATE VALVE	X	-25.8	4.2	VENT INSTALLED ON WELL, NO LIQUIDS AT DTB	
GEW02	35.3566250	-82.4960300	9/18/2013 13:04	10.3	5.7	17.3	66.7	4	SCH 40 PVC	4	X	5	2" SCH 80 WITH GATE VALVE	-17.1	-19.2	3.8	VENT INSTALLED ON WELL, LATERAL IS BURIED, A 4" FLEX LINE IS AT THE SURFACE	
GEW03	35.3565884	-82.4963843	9/18/2013 13:20	0.1	0.2	20.7	79	4	SCH 40 PVC	4	HDPE	8	2" SCH 80 WITH GATE VALVE	X	-6.0	3.0	GREY SILTY SAND ON LL PROBE, VENT INSTALLED ON WELL	
GEW04	35.3564553	-82.4976968	9/18/2013 18:02	58	41.4	0.4	0.2	4	SCH 40 PVC	4	HDPE	2	2" SCH 80 WITH GATE VALVE	-32.6	-34.6	3.5		
GEW05	35.3560274	-82.4977991	9/18/2013 17:55	0.2	1.9	19.6	78.3	4	SCH 40 PVC	4	HDPE	4	2" SCH 80 WITH GATE VALVE	-33.0	-39.0	5.7		
GEW08	35.3542700	-82.4980408	9/18/2013 17:12	57.6	42.3	0	0.1	6	HDPE	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-27.8	-41.3	3.6	GAS BLOWING FROM WELL	
GEW10	35.3537953	-82.4968394	9/18/2013 16:49	57.3	42.6	0	0.1	4	SCH 40 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	X	-13.0	3.1	GAS BLOWING FROM LATERAL, WELL IS LOOSE AT THE GROUND SURFACE, NO LIQUIDS PRESENT AT DTB	
GEW11	35.3544429	-82.4950137	9/18/2013 14:43	56.1	43.8	0	0.1	4	SCH 40 PVC	4	HDPE	6	2" SCH 80 WITH GATE VALVE	X	-37.3	3.5	GAS BLOWING FROM WELL AND LATERAL, NO LIQUIDS PRESENT AT DTB	
GEW12	35.3543286	-82.4956504	9/18/2013 14:36	0	0.9	21	78.1	4	SCH 40 PVC	4	HDPE	6.5	2" SCH 80 WITH GATE VALVE	-16.8	-37.3	3.5	INSIDE OF WELL IS BROWN AND APPEARING BURNT	
GEW13	35.3542905	-82.4967854	9/18/2013 14:23	58.5	41.4	0	0.1	4	SCH 40 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	-19.6	-19.6	3.0	GAS BLOWING FROM WELL AND LATERAL, WELL LABELED 33 ON NORTH SIDE AND 13 ON SOUTH SIDE	
GEW16	35.3552000	-82.4978300	9/18/2013 17:42	58.6	41.3	0	0.1	4	SCH 40 PVC	4	HDPE	8	2" SCH 80 WITH GATE VALVE	X	-20.7	3.0	NO LIQUID DETECTED AT MEASURED DTB	
GEW17	35.3559921	-82.4975821	9/18/2013 17:49	0.8	2.1	17.9	79.2	4	SCH 40 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	X	-18.5	3.5	NO LIQUID DETECTED AT MEASURED DTB	
GEW19	35.3546211	-82.4979823	9/18/2013 17:17	0.6	1.2	20.4	77.8	4	SCH 40 PVC	4	HDPE	7	2" SCH 80 WITH GATE VALVE	-22.1	-27.7	5.0		
GEW19A	35.3548617	-82.4967309	9/17/2013 9:38	57.4	42.5	0	0.1	4	SCH 40 PVC	4	HDPE	5	2" SCH 80 WITH GATE VALVE	X	-10.8	4.0	NO LIQUID DETECTED AT MEASURED DTB	
GEW20	35.3547921	-82.4959657	9/16/2013 16:48	56.5	43.4	0	0.1	4	SCH 40 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	-29.4	-33.0	4.7		
GEW21	35.3549059	-82.4949749	9/16/2013 16:41	62.4	37.5	0	0.1	4	SCH 40 PVC	4	HDPE	4	2" SCH 80 WITH GATE VALVE	X	-36.6	3.8	NO LIQUID DETECTED AT MEASURED DTB	
GEW22	35.3543440	-82.4946500	9/16/2013 16:35	19.1	12.7	13.9	54.3	4	SCH 40 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	X	-30.5	4.5	NO LIQUID DETECTED AT MEASURED DTB	
GEW23	35.3550391	-82.4954592	9/16/2013 15:53	58.3	41.6	0	0.1	4	SCH 40 PVC	4	HDPE	2	2" SCH 80 WITH GATE VALVE	X	-32.9	4.5	LL PROBE STOPPED, SURGING IN LATERAL, NO LIQUIDS DETECTED AT dtb	
GEW25	35.3554860	-82.4966298	9/17/2013 9:26	56.1	43.8	0	0.1	4	SCH 40 PVC	4	HDPE	4	2" SCH 80 WITH GATE VALVE	X	X	4.9	LL PROBE STOPS JUST BELOW THE SURFACE	
GEW26	35.3561608	-82.4967582	9/16/2013 17:43	57.7	42.1	0.1	0.1	4	SCH 40 PVC	4	HDPE	8	2" SCH 80 WITH GATE VALVE	-37.4	-37.4	6.0		
GEW27	35.3560537	-82.4963584	9/17/2013 8:57	42.9	29.7	4.6	22.8	4	SCH 40 PVC	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-38.7	-45.2	4.6	WELL HAS A VENT INSTALLED	
GEW28	35.3556300	-82.4968735	9/16/2013 17:34	0.4	4.5	18.9	76.2	4	SCH 40 PVC	4	HDPE	8	2" SCH 80 WITH GATE VALVE	-32.8	-49.9	4.5		
GEW29	35.3562423	-82.4957632	9/17/2013 8:34	0.7	1.1	20.9	77.3	4	SCH 40 PVC	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-34.3	-37.7	3.2		
GEW30	35.3563554	-82.4943809	9/17/2013 12:31	57.1	42.8	0	0.1	4	SCH 40 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	-27.8	-28.3	4.1	VENT INSTALLED ON WELL	
GEW31	35.3561614	-82.4950090	9/17/2013 11:49	59	40.9	0	0.1	4	SCH 40 PVC	4	HDPE	4	2" SCH 80 WITH GATE VALVE	X	-43.8	4.0	VENT INSTALLED ON WELL, ABANDONED 4" LATERAL WITH SCH 80 CAP 4' OFF WELL, NO LIQUIDS MEASURED AT DTB	
GEW32	35.3558242	-82.4949884	9/16/2013 16:12	59.6	40.3	0	0.1	4	SCH 40 PVC	4	HDPE	5	2" SCH 80 WITH GATE VALVE	X	-47.0	4.2	NO LIQUID DETECTED AT MEASURED DTB	
GEW33	35.3559173	-82.4943922	9/16/2013 16:23	58.3	41.6	0	0.1	4	SCH 40 PVC	4	HDPE	5	2" SCH 80 WITH GATE VALVE	-35.3	-38.3	3.4		
GEW34	35.3554718	-82.4954061	9/16/2013 15:42	58.5	41.4	0	0.1	4	SCH 40 PVC	4	HDPE	3.5	2" SCH 80 WITH GATE VALVE	X	-21.6	4.7	AUDIBLE SURGING IN LATERAL, ABANDONED 4" HDPE NEAR WELL, PROBE STOPS AT -21.6	
GEW36	35.3557368	-82.4959794	9/17/2013 10:06	56.2	41.5	0	2.3	6	HDPE	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-54.6	-76.6	5.0	ABANDONED 4" HDPE 8' FROM WELL, VENT INSTALLED ON WELL	
GEW37	35.3559500	-82.4958800	9/17/2013 10:33	58.8	41.1	0	0.1	4	SCH 40 PVC	4	HDPE	0.5	2" SCH 80 WITH GATE VALVE	X	-9.2	2.0	WELL AT 45DEG OUT OF GROUND, LL PROBE STOPPED JUST BELOW SURFACE, NO LIQUIDS MEASURED AT DTB	
GEW38	35.3553037	-82.4963953	9/16/2013 14:29	56.9	43	0	0.1	6	SCH 80 PVC	4	HDPE	4	2" SCH 80 WITH GATE VALVE	N/A	X	X	LL PROBE STOPPED JUST BELOW SURFACE, VENT INSTALLED ON WELL	
GEW40	35.3562703	-82.4971468	9/18/2013 13:32	64.2	35.6	0.1	0.1	6	SCH 80 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	-69.7	-70.4	4.3	GAS BLOWING FROM LAT & WELL, ABANDONED 4" HDPE 3' OFF	
GEW41	35.3557697	-82.4972536	9/18/2013 13:46	60.6	39.3	0	0.1	6	SCH 80 PVC	4	HDPE	2	2" SCH 80 WITH GATE VALVE	-44.8	-45.2	5.0		
GEW42	35.3551771	-82.4973906	9/18/2013 14:05	60.5	39.4	0	0.1	6	SCH 80 PVC	4	HDPE	2.5	2" SCH 80 WITH GATE VALVE	-36.3	-44.4	4.0	GAS BLOWING FROM WELL	
GEW43	35.3545798	-82.4975822	9/18/2013 14:13	64.6	35.3	0	0.1	6	SCH 80 PVC	4	HDPE	4	2" SCH 80 WITH GATE VALVE	-52.9	-52.9	3.8	GAS BLOWING FROM WELL AND LATERAL	
GEW44	35.3546058	-82.4963486	9/16/2013 16:59	57.8	42.1	0	0.1	6	SCH 80 PVC	4	HDPE	6.5	2" SCH 80 WITH GATE VALVE	-29.5	-29.5	4.2		
GEW45	35.3548493	-82.4972267	9/16/2013 17:20	57.8	42.1	0	0.1	6	SCH 80 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	-49.3	-54.1	4.8		
GEW46	35.3550437	-82.4963548	9/16/2013 14:43	58.7	41.2	0	0.1	6	SCH 80 PVC	4	HDPE	1.5	2" SCH 80 WITH GATE VALVE	-17.6	-43.5	4.5	LFG BLOWING FROM LATERAL	
GEW47	35.3550830	-82.4957500	9/16/2013 15:00	61.1	38.8	0	0.1	6	SCH 80 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	-26.0	-53.8	4.5		
GEW48	35.3553900	-82.4958135	9/16/2013 15:32	58.1	41.6	0.2	0.1	6	SCH 80 PVC	4	HDPE	3	2" SCH 80 WITH GATE VALVE	X	-44.6	4.8	NO LIQUID DETECTED	
GEW49	35.3557136	-82.4954486	9/17/2013 11:37	59	40.7	0.1	0.2	6	HDPE	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-44.6	-48.4	3.0	GAS BLOWING FROM LATERAL AND WELL, H2S SCALING IN WELL, GAS BLOWING FROM WELL & LAT	
GEW50	35.3561749	-82.4954377	9/17/2013 10:45	8.5	5.5	18.4	67.6	6	SCH 80 PVC	4	HDPE	3	2" SCH 40 WITH GATE VALVE	-24.8	-34.8	5.0	VENT INSTALLED ON WELL, AUDIBLE BUBBLING IN THE WELL	
GEW6	35.3551903	-82.4983953	9/18/2013 17:33	46.2	28.8	5.3	19.7	4	SCH 40 PVC	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-33.5	-33.5	3.5		
GEW7	35.3547160	-82.4987312	9/18/2013 17:26	25.7	13.9	11.8	48.6	4	SCH 40 PVC	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-26.3	-26.8	5.3		
GEW9	35.3539759	-82.4973642	9/18/2013 16:57	57.3	42.6	0	0.1	4	SCH 40 PVC	4	HDPE	4	2" SCH 80 WITH GATE VALVE	X	-11.9	3.0	GREY SILT ON LL PROBE, NO LIQUIDS PRESENT AT DTB	
GEWX1	35.3555862	-82.4960600	9/16/2013 13:45	46.8	38.7	0.2	14.3	6	HDPE	4	HDPE	4	2" SCH 80 WITH GATE VALVE	-56.0	-67.7	4.7		
GEWX2	35.3558425	-82.4964979	9/17/2013 9:14	57.9	42	0	0.1	6	HDPE	4	HDPE	6	2" SCH 80 WITH GATE VALVE	-41.0	-49.0	3.9		
GEWX5	35.3557463	-82.4957175	9/17/2013 10:19	56.9	43	0	0.1	6	HDPE	4	HDPE	3	2" SCH 80 WITH GATE VALVE	-48.0	-67.1	4.0	GAS BLOWING FROM LATERAL AND WELL	
GEWX6	35.3563159	-82.4951358	9/17/2013 12:02	58.8	41.9	0	0.1	6	HDPE	4	HDPE	5	2" SCH 80 WITH GATE VALVE	-38.0	-38.0	4.8	VENT INSTALLED ON WELL	
MP4	35.3562378	-82.4982964	9/16/2013 12:31	0	19.1	4.6	76.3	2	SCH 40 PVC	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
MP5	35.3568586	-82.4959698	9/16/2013 12:52	43.6	37.1	0.5	18.8	2	SCH 40 PVC	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
MP6	35.3566667	-82.4947013	9/16/2013 13:04	0.2	0.4	20.3	79.1	2	SCH 40 PVC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2" CAP IS LOOSE	
TR01	35.3570167	-82.4946371	9/18/2013 12:09	0	5.2	16.4	78.4	2	SCH 40 PVC	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
TR02	35.3572884	-82.4953319	9/18/2013 12:15	1	3.1	18.6	77.3	2	SCH 40 PVC	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
TR03	35.3571970	-82.4957300	9/18/2013 12:03	11.3	35.2	0	53.5	2	SCH 40 PVC	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

**TABLE 2**  
**Summary of Quarterly Methane Monitoring Data**  
**Henderson County Closed MSW Landfill**

Methane Monitoring Well Identification	During Active Extraction System Operation																	Post Removal of Active System		Post Phase 1 Implementation				
	01/20/09	04/13/09	07/21/09	10/30/09	01/21/10	04/26/10	07/27/10	10/08/10	01/26/11	04/18/11	07/29/11	10/21/11	01/19/12	04/24/12	07/31/12	10/19/12	01/14/13	04/08/13	06/25/13	09/20/13	12/18/13	03/26/14	06/26/14	09/18/14
MP-1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	5.4	0.0	0.1	0.1	0.0	0.0	0.0
MP-2	0.0	0.0	0.0	0.0	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MP-3	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	8.1	0.0	0.1	0.0	0.0	0.0	0.0
MP-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.1	9.6	0.0	0.0	4.4	0.0	0.3	3.5	1.4	1.1	0.2
MP-5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.2	0.3	0.4	36.4	40.5	0.1	0.0	15.8	35.1	47.9	35.3	22.7	51.9	48.8
MP-6	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.4	0.1	0.4	--	--	--	--	--	--	1.1	0.7	5.3	0.9	2.7	0.7
TR-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.0	0.2	0.1	0.0	1.1	5.9	0.0	0.2	0.0	0.0	0.0	0.0
TR-2	0.2	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.0	--	--	--	--	--	--	--	2.5	8.6	7.9	9.8	0.0
TR-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6	0.3	0.0	2.4	13.7	10.6	8.5	4.4	10.9	0.0	0.2

- Notes:
1. Methane results are in percent by volume.
  2. -- = measurements were not collected due to damage to the methane monitoring well or it could not be located
  3. Concentrations shown in red exceed the lower explosive limit.

**TABLE 3**

**Proposed Methane Monitoring Well Construction Table  
Henderson County Closed MSW Landfill**

<b>Well Identification</b>	<b>Ground Surface Elevation (feet AMSL)</b>	<b>Well Diameter (inches)</b>	<b>Well Depth (feet bgs)</b>	<b>Screened Interval (feet bgs)</b>	<b>Screened Interval (feet AMSL)</b>	<b>Depth To Bedrock (feet bgs)</b>	<b>Depth To Groundwater (feet bgs)</b>
MP-7	2340	2	30	5 - 30	2335 - 2310	40	35
MP-8	2360	2	35	5 - 35	2355 - 2325	50	40
MP-9	2396	2	45	5 - 45	2391 - 2351	70	50

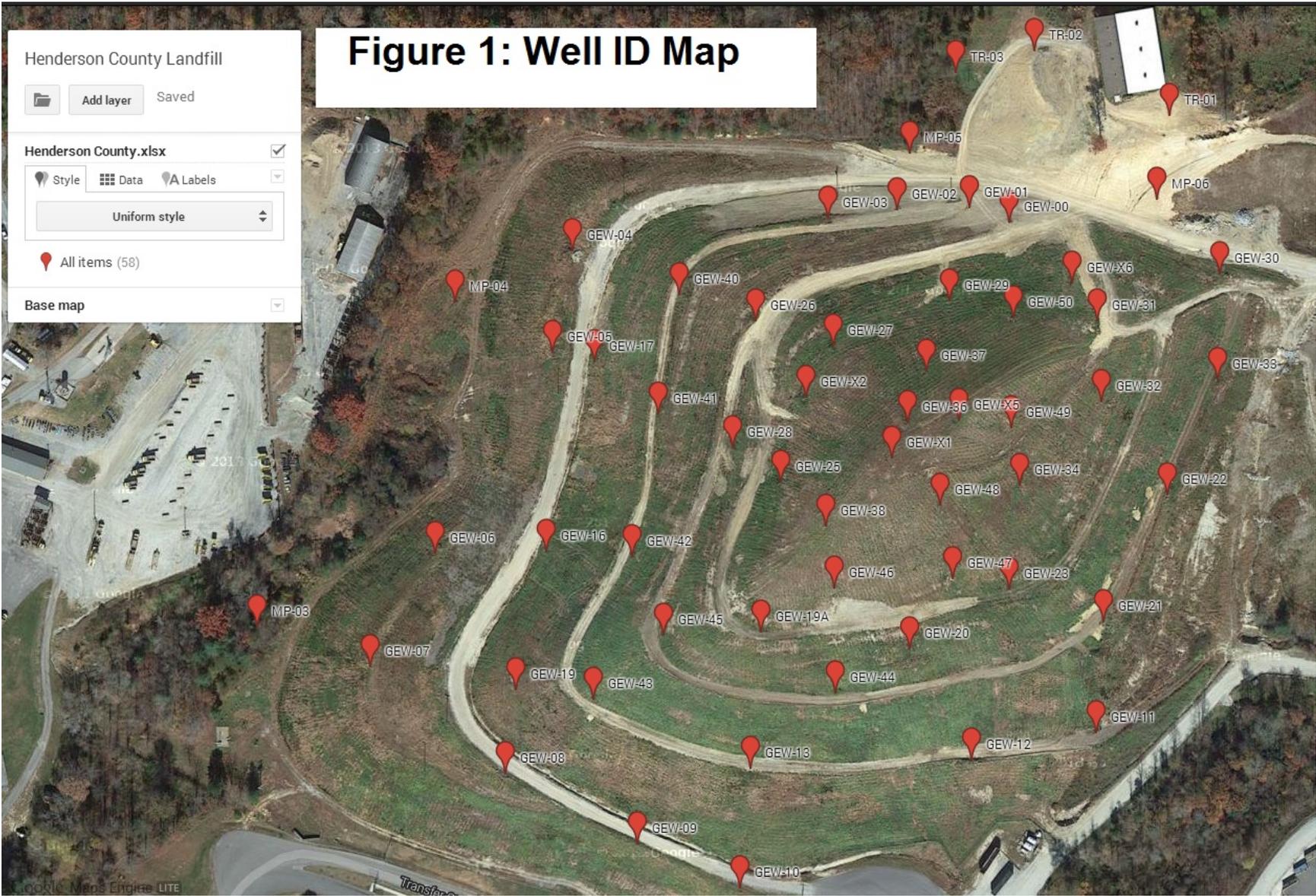
Notes:

feet AMSL = feet above mean sea level

feet bgs = feet below ground surface

## FIGURES

# Figure 1: Well ID Map



CLIENT  
HENDERSON COUNTY

PROJECT  
HENDERSON COUNTY CLOSED MSW LANDFILL

CONSULTANT

YYYY-MM-DD 2014-07-18

TITLE  
**WELL IDENTIFICATION MAP OVERVIEW**

PREPARED DYR

DESIGN DYR

REVIEW RPK

APPROVED RPK

PROJECT No.  
**0839650614**

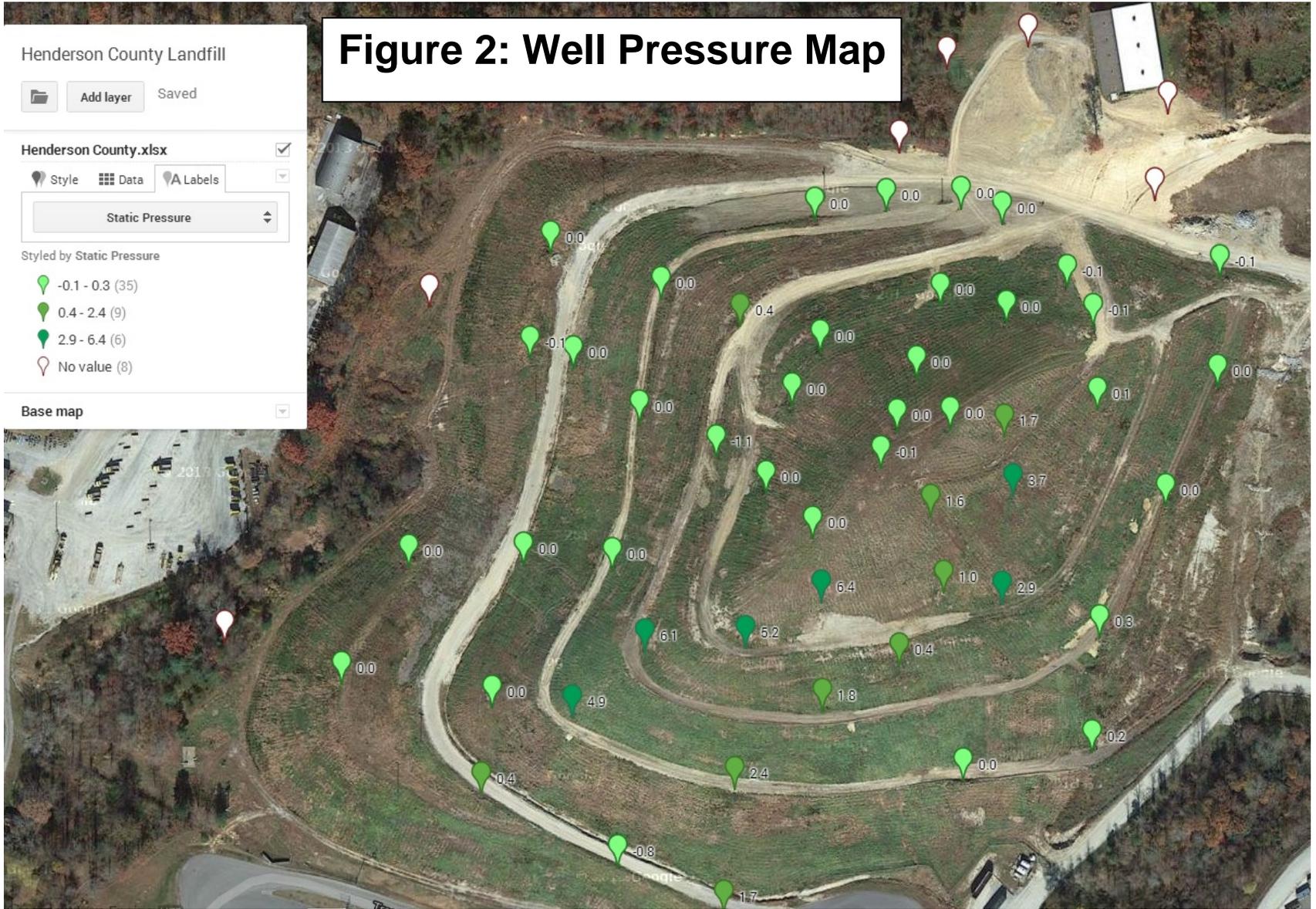
Phase  
**500**

Rev  
**0**

FIGURE  
**1**



# Figure 2: Well Pressure Map



CLIENT  
HENDERSON COUNTY

PROJECT  
HENDERSON COUNTY CLOSED MSW LANDFILL

CONSULTANT



YYYY-MM-DD 2014-07-18

PREPARED DYR

DESIGN DYR

REVIEW RPK

APPROVED RPK

TITLE

**WELL PRESSURE MAP OVERVIEW**

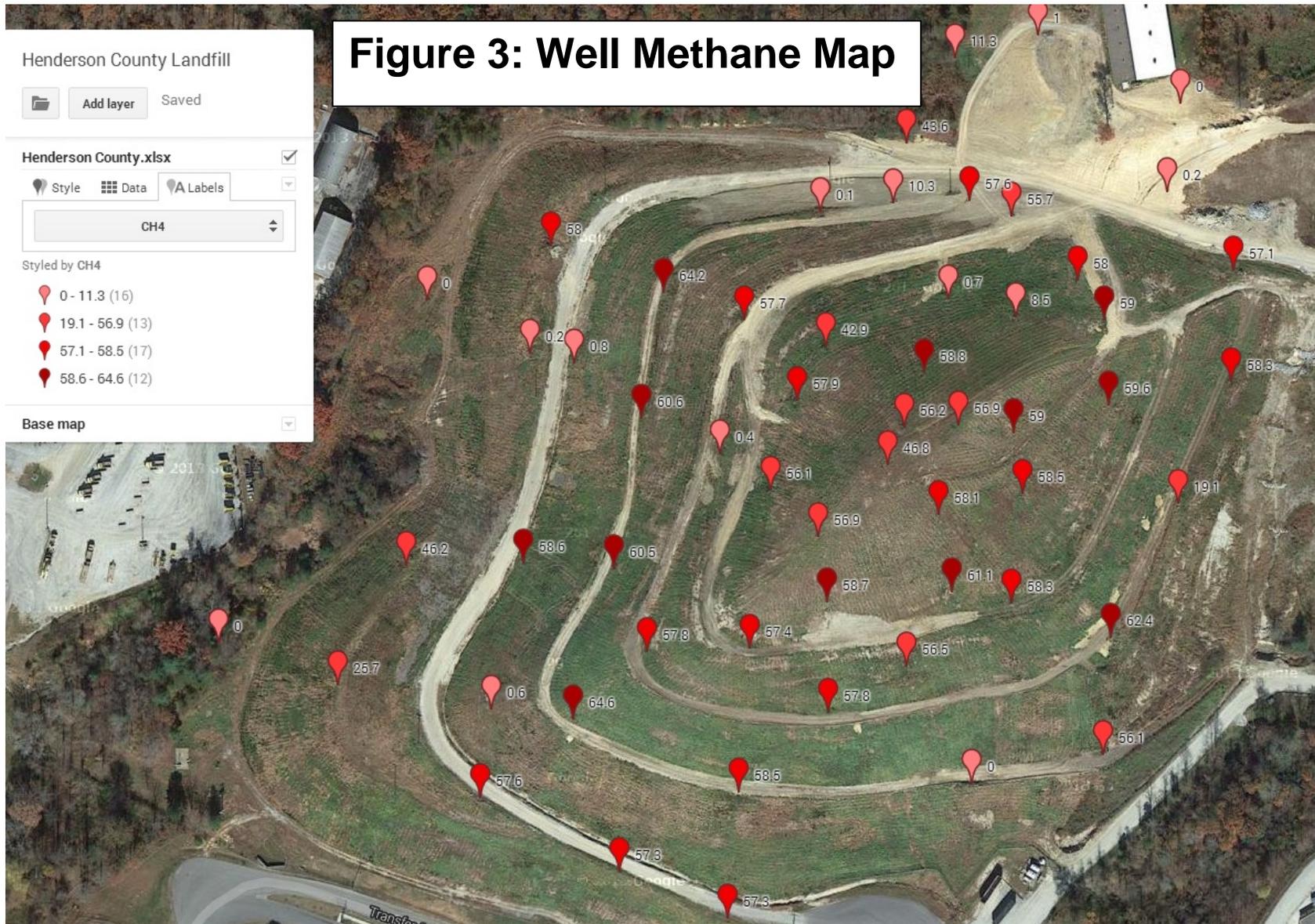
PROJECT No.  
**0839650614**

Phase  
**500**

Rev  
**0**

FIGURE  
**2**

# Figure 3: Well Methane Map



Henderson County Landfill

Add layer Saved

Henderson County.xlsx

Style Data Labels

CH4

Styled by CH4

- 0 - 11.3 (16)
- 19.1 - 56.9 (13)
- 57.1 - 58.5 (17)
- 58.6 - 64.6 (12)

Base map

CLIENT  
HENDERSON COUNTY

PROJECT  
HENDERSON COUNTY CLOSED MSW LANDFILL

CONSULTANT



YYYY-MM-DD 2014-07-18  
 PREPARED DYR  
 DESIGN DYR  
 REVIEW RPK  
 APPROVED RPK

TITLE  
**WELL METHANE MAP OVERVIEW**

PROJECT No.	Phase	Rev	FIGURE
0839650614	500	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25 mm

# Figure 4: Well Water Column Map

Henderson County Landfill

Add layer Saved

Henderson County.xlsx

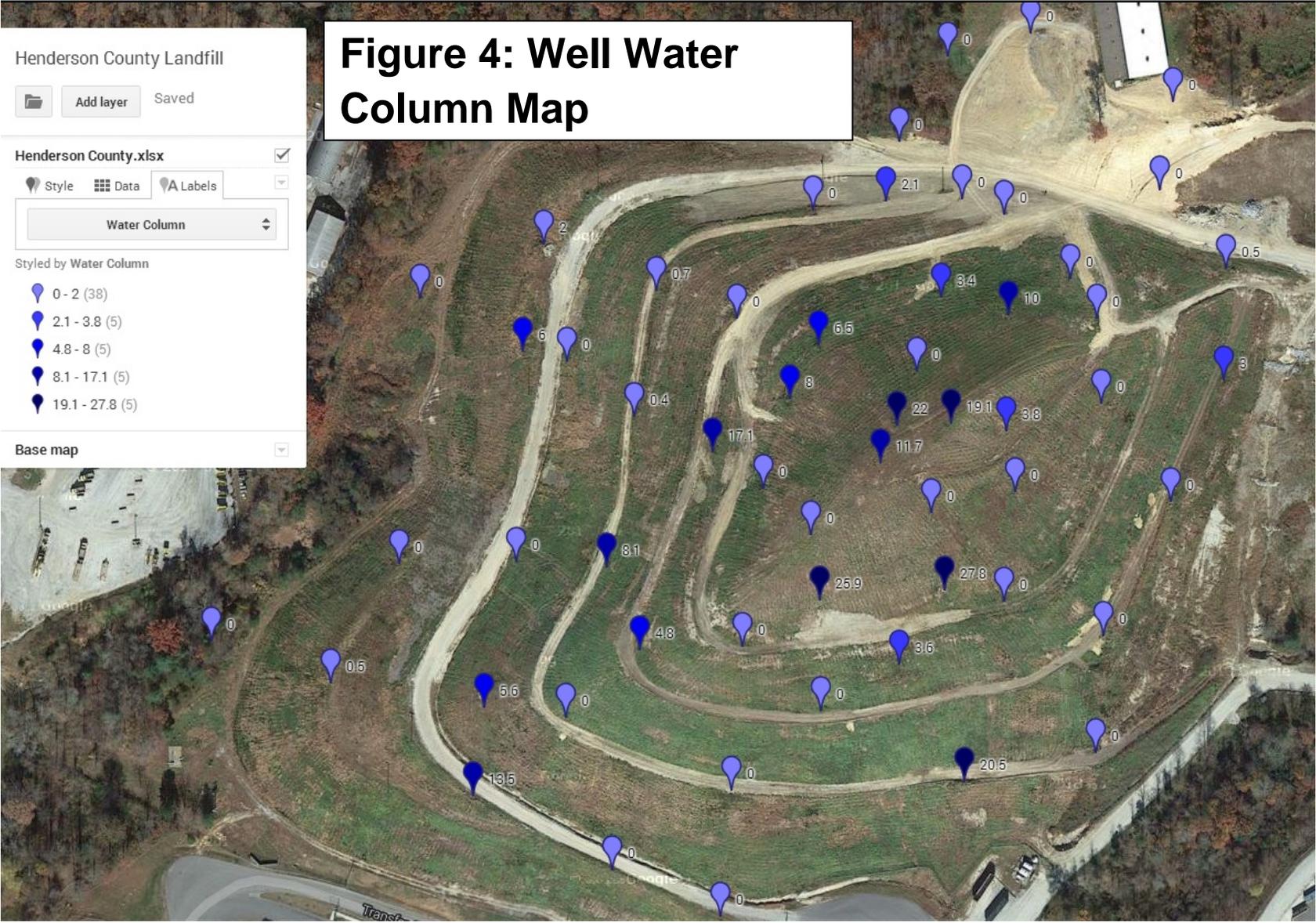
Style Data Labels

Water Column

Styled by Water Column

- 0 - 2 (38)
- 2.1 - 3.8 (5)
- 4.8 - 8 (5)
- 8.1 - 17.1 (5)
- 19.1 - 27.8 (5)

Base map



CLIENT  
HENDERSON COUNTY

PROJECT  
HENDERSON COUNTY CLOSED MSW LANDFILL

CONSULTANT

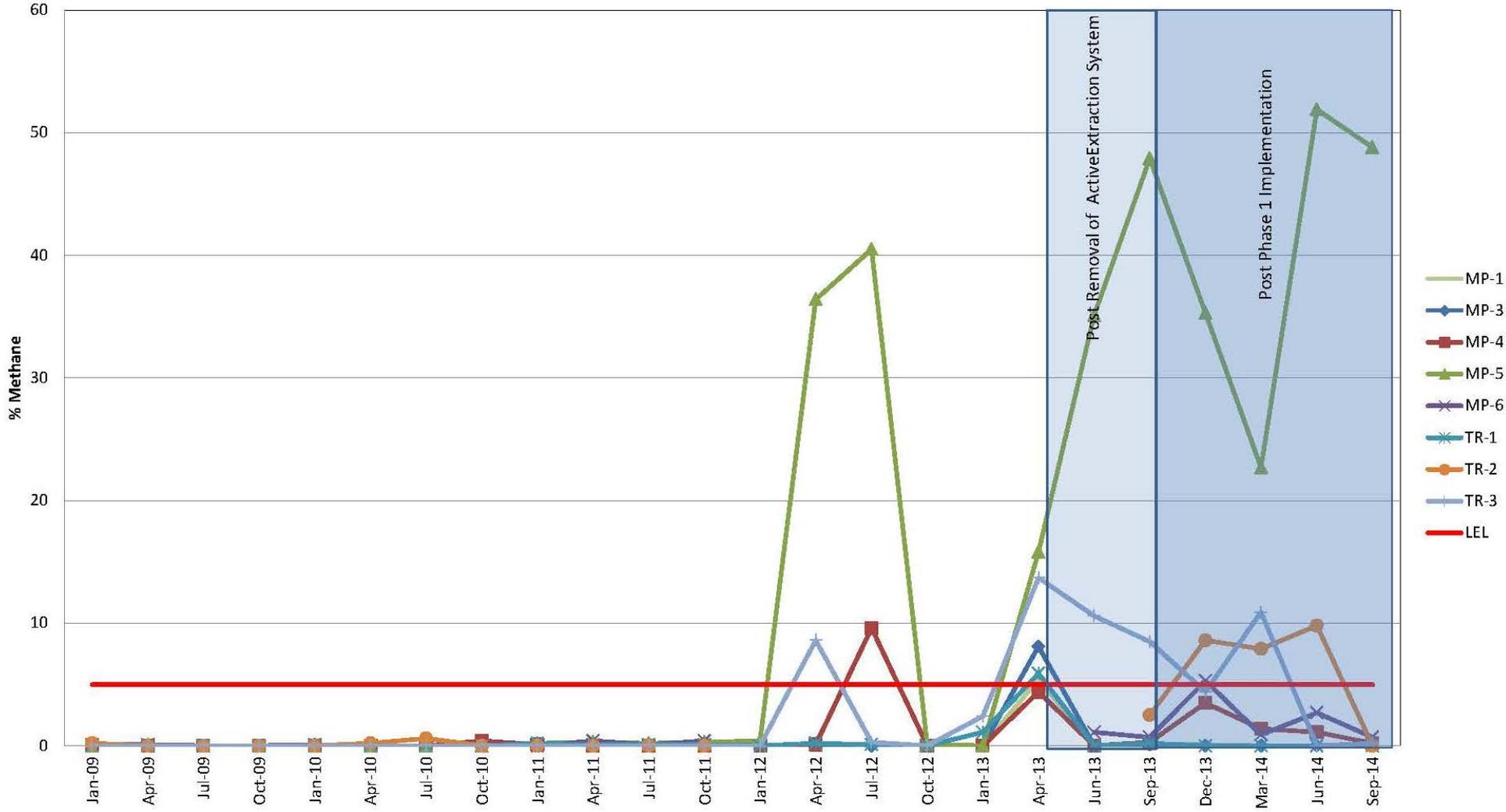


YYYY-MM-DD 2014-07-18  
 PREPARED DYR  
 DESIGN DYR  
 REVIEW RPK  
 APPROVED RPK

TITLE  
WELL WATER COLUMN MAP OVERVIEW

PROJECT No.	Phase	Rev	FIGURE
0839650614	500	0	4

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A



25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

CLIENT  
HENDERSON COUNTY

PROJECT  
HENDERSON COUNTY CLOSED MSW LANDFILL

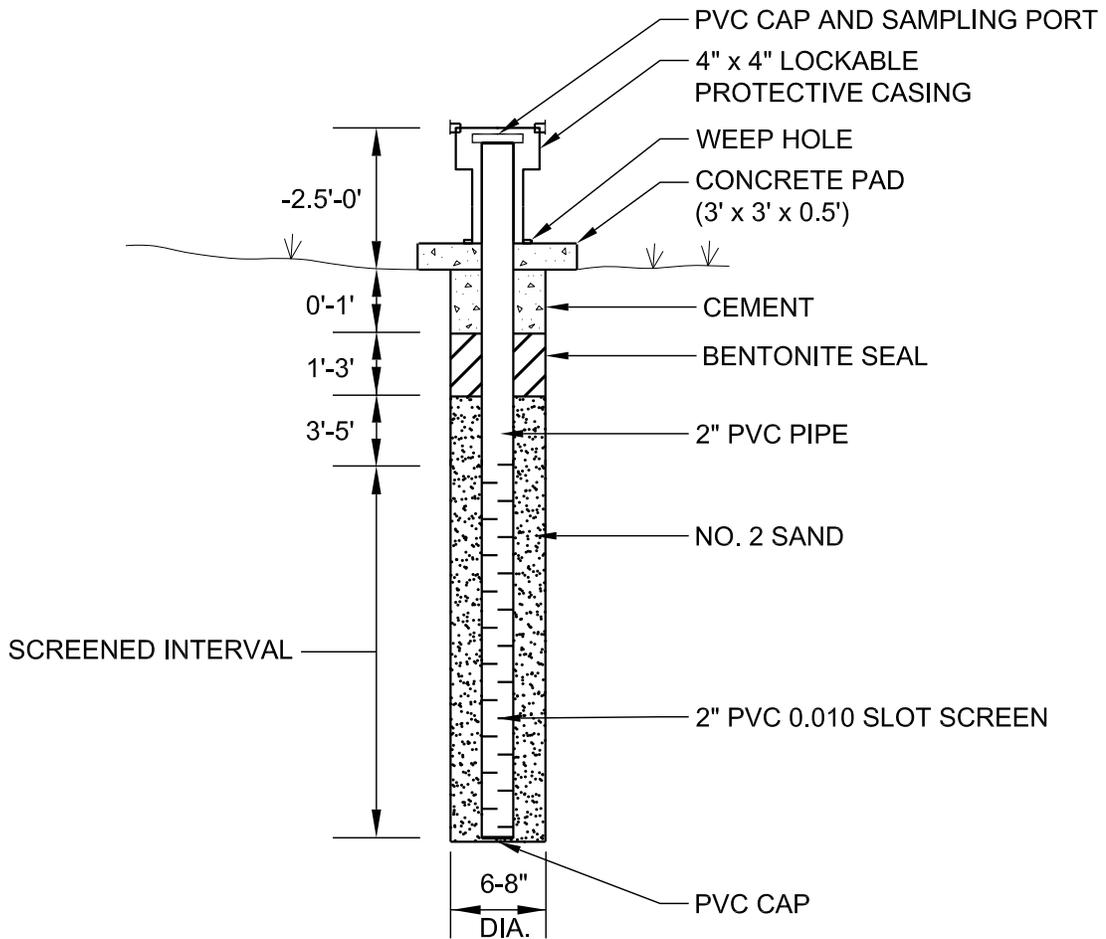
CONSULTANT



YYYY-MM-DD 2014-10-15  
 PREPARED DYR  
 DESIGN DYR  
 REVIEW RPK  
 APPROVED RPK

TITLE  
METHANE CONCENTRATION TREND GRAPH

PROJECT No.	Phase	Rev	FIGURE
0839650614	500	0	5



**NOTE**

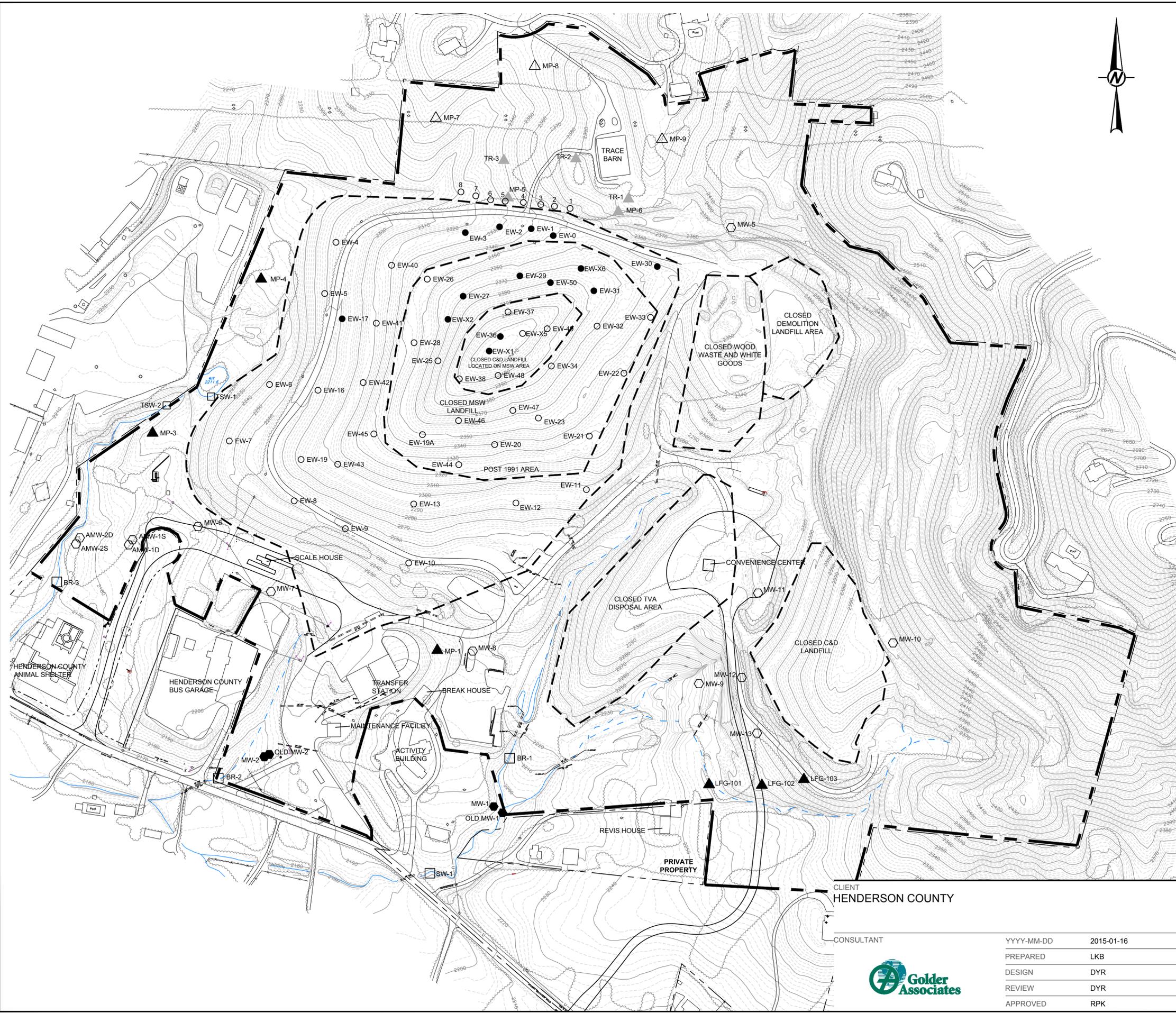
1. PLACE PEA GRAVEL IN ANNULAR SPACE BETWEEN PVC STICK UP AND PROTECTIVE CASING.
2. THE LANDFILL GAS MONITORING WELL WILL BE CONSTRUCTED AT THE TOP OF BEDROCK UNLESS GROUNDWATER IS ENCOUNTERED ABOVE BEDROCK.
3. IF GROUNDWATER IS ENCOUNTERED ABOVE BEDROCK, THE LANDFILL GAS MONITORING WELL WILL BE INSTALLED APPROXIMATELY 5 FEET ABOVE THE STATIC WATER LEVEL TO ACCOUNT FOR SEASONAL HIGH WATER LEVEL FLUCTUATIONS.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
△	-	-	-	-	-	-
PROJECT HENDERSON COUNTY C&D LANDFILL						
TITLE <b>TYPICAL LANDFILL GAS MONITORING WELL CONSTRUCTION DIAGRAM</b>						
PROJECT No.		0839-6506		FILE No. <sup>Figure 1(1-3-12)</sup>		
DESIGN	DYR	1/4/12	SCALE	N.T.S.	REV.	-
CADD	LKB	1/4/12	<b>FIGURE 6</b>			
CHECK						
REVIEW						



X:\Projects\Henderson County\GW Maps\Dusty Dwg\Figure 1(1-3-12).dwg 11/24/2014 2:35 PM

## **DRAWINGS**

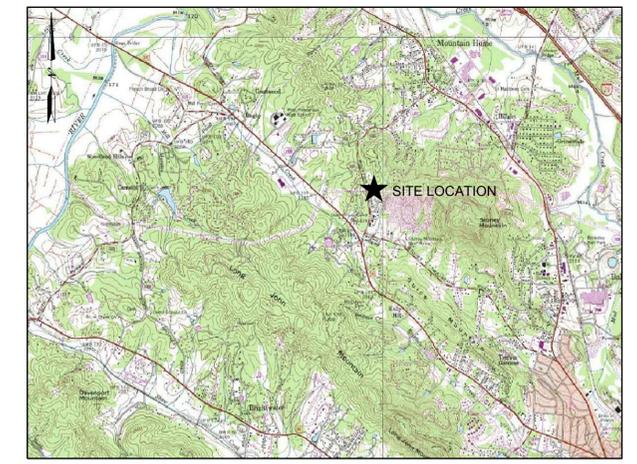


**LEGEND**

	EXISTING 10 FT. CONTOUR
	EXISTING 2 FT. CONTOUR
	PROPERTY LINE
	LIMITS OF WASTE
	STREAM
	BUFFER
	TREELINE
	EXISTING ROAD
	FENCE
	LFG COLLECTION PIPING
	COMPLIANCE MONITORING WELL
	NON COMPLIANCE MONITORING WELLS
	PROPOSED METHANE MONITORING WELLS
	METHANE MONITORING WELLS
	METHANE MONITORING WELLS PROPOSED TO BE REMOVED FROM MONITORING NETWORK
	SURFACE WATER MONITORING POINT
	LFG EXTRACTION WELL PROPOSED TO BE CONVERTED TO PASSIVE VENTING
	LFG EXTRACTION WELL CONVERTED TO PASSIVE VENTING WITH TURBINE

- NOTES**
1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET
  2. COORDINATE SYSTEM IS N.C. STATE PLANE GRID.
  3. TOPOGRAPHIC DIVIDING LINE DIVIDES THE BASE MAP TOPOGRAPHIC CONTOURS FROM LANDSAT TOPOGRAPHIC CONTOURS. LANDSAT TOPOGRAPHIC CONTOURS HAVE A 5-CONTOUR INTERVAL.
  4. RECORDS WERE UNABLE TO BE LOCATED FOR LFG EXTRACTION WELLS EW-X1 THROUGH EW-X7 AND WERE GIVEN IDENTIFICATION NAMES UNTIL SUCH TIME THAT RECORDS ARE FOUND.

- REFERENCE**
1. BASE MAP PROVIDED BY CAMP DRESSER & McKEE FROM PREVIOUS WATER QUALITY MONITORING REPORTS.



**SITE LOCATION MAP**  
NOT TO SCALE

Path: \\gremson\CAD\Projects\08396506 - Henderson\ENVIRONMENTAL\_A\_LFG Remediation Plan Phase 2\_1 File Name: 0839650613A001.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

CLIENT  
HENDERSON COUNTY

CONSULTANT

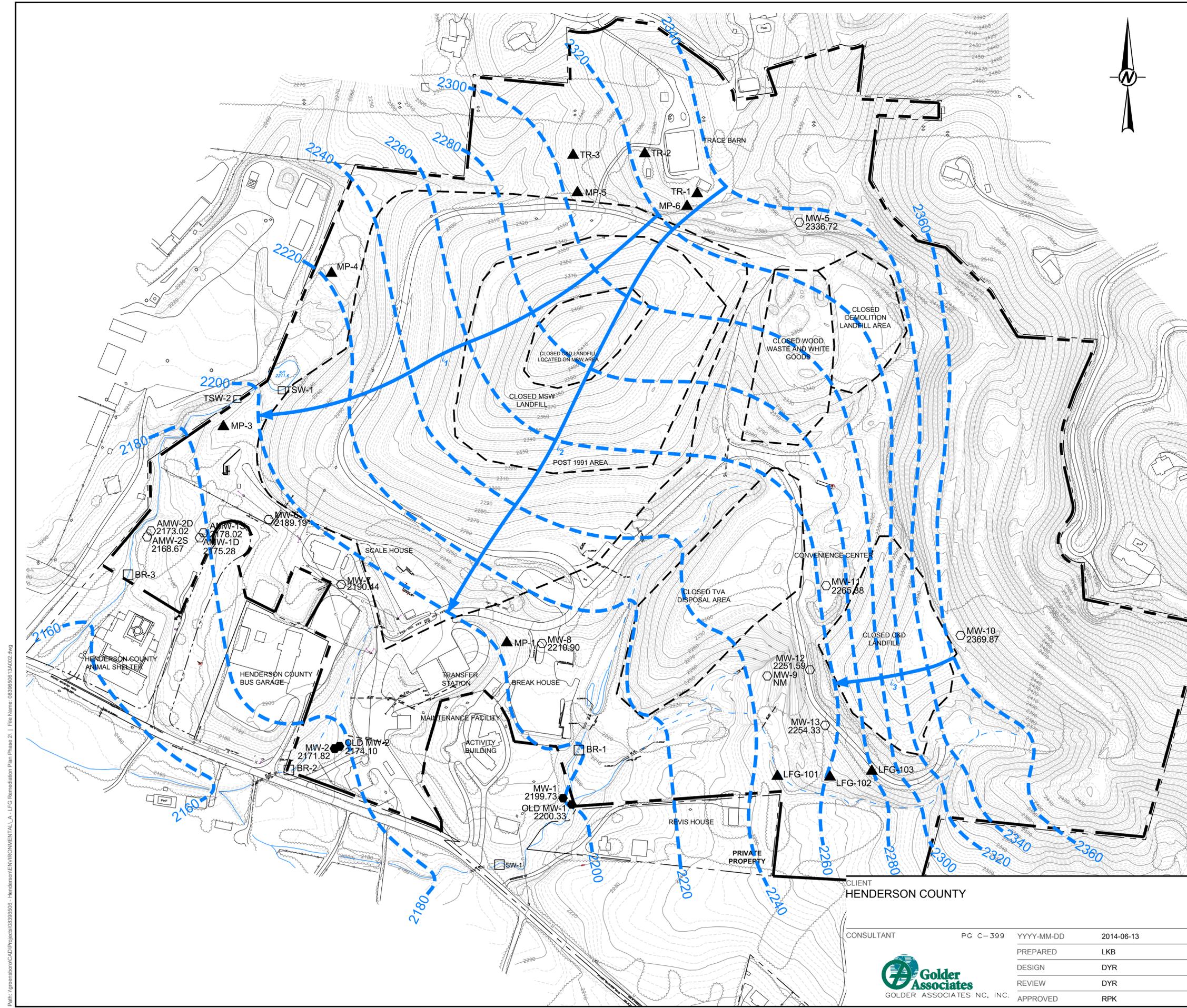


YYYY-MM-DD	2015-01-16
PREPARED	LKB
DESIGN	DYR
REVIEW	DYR
APPROVED	RPK

PROJECT  
HENDERSON COUNTY CLOSED MSW AND C&D LANDFILL  
PERMIT # 45-01

TITLE  
**LANDFILL GAS EXTRACTION SYSTEM LAYOUT AND  
PROPOSED METHANE MONITORING NETWORK**

PROJECT No.	PHASE	Rev.	DRAWING
0839650614	100	1	1

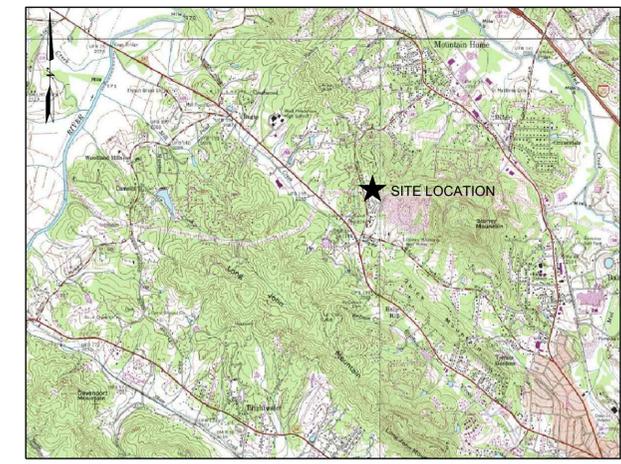


### LEGEND

- EXISTING 10 FT. CONTOUR
- EXISTING 2 FT. CONTOUR
- PROPERTY LINE
- LIMITS OF WASTE
- STREAM
- BUFFER
- TREELINE
- EXISTING ROAD
- FENCE
- GROUNDWATER SURFACE CONTOURS
- APPROXIMATE GROUNDWATER FLOW SEGMENT USED TO CALCULATE GRADIENT
- MW-8 2210.90 COMPLIANCE MONITORING WELL AND IDENTIFICATION
- MW-1 NON COMPLIANCE MONITORING WELL AND IDENTIFICATION
- MP-6 METHANE MONITORING PROBE AND IDENTIFICATION
- BR-1 SURFACE WATER MONITORING POINT AND IDENTIFICATION
- NM NOT MEASURED

- ### NOTES
1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET
  2. GROUNDWATER SURFACE CONTOUR INTERVAL = 20 FEET
  3. GROUNDWATER ELEVATIONS MEASURED ON SEPTEMBER 17, 2014.
  4. GROUNDWATER CONTOURS BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE GROUNDWATER CONTOURS MAY NOT REFLECT ACTUAL CONDITIONS.
  5. GROUNDWATER CONTOUR LINES SHOW THE WATER TABLE SHAPE AND ELEVATION. THESE CONTOURS ARE INFERRED LINES FOLLOWING THE GROUNDWATER SURFACE AT A CONSTANT ELEVATION ABOVE SEA LEVEL.
  6. COORDINATE SYSTEM IS N.C. STATE PLANE GRID.
  7. TOPOGRAPHIC DIVIDING LINE DIVIDES THE BASE MAP TOPOGRAPHIC CONTOURS FROM LANDSAT TOPOGRAPHIC CONTOURS. LANDSAT TOPOGRAPHIC CONTOURS HAVE A 5-CONTOUR INTERVAL.

- ### REFERENCES
1. BASE MAP PROVIDED BY CAMP DRESSER & McKEE FROM PREVIOUS WATER QUALITY MONITORING REPORTS.



PROJECT HENDERSON COUNTY CLOSED MSW AND C&D LANDFILL PERMIT # 45-01			
TITLE <b>GROUNDWATER SURFACE CONTOUR MAP</b> SEPTEMBER			
PROJECT No. 0839650614	PHASE 100	Rev. 0	DRAWING 2

CONSULTANT	PG C-399	YYYY-MM-DD	2014-06-13
		PREPARED	LKB
		DESIGN	DYR
		REVIEW	DYR
		APPROVED	RPK



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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANS/D 11 in

## **APPENDIX**



**Project Title: Landfill Gas Collection System Evaluation- Henderson County Closed MSW Landfill**

**PHOTO 1**

Well: GEW-00



**PHOTO 2**

Well: GEW-01





**PHOTO 3**

Well: GEW-02



**PHOTO 4**

Well: GEW-03





**PHOTO 5**

Well: GEW-04



**PHOTO 6**

Well: GEW-05





**PHOTO 7**

Well: GEW-06



**PHOTO 8**

Well: GEW-07





**PHOTO 9**

Well: GEW-08



**PHOTO 10**

Well: GEW-09





**PHOTO 11**

Well: GEW-10



**PHOTO 12**

Well: GEW-11





**PHOTO 13**

Well: GEW-12



**PHOTO 14**

Well: GEW-13





**PHOTO 15**

Well: GEW-16



**PHOTO 16**

Well: GEW-17





**PHOTO 17**

Well: GEW-19



**PHOTO 18**

Well: GEW-19A





**PHOTO 19**

Well: GEW-20



**PHOTO 20**

Well: GEW-21





**PHOTO 21**

Well: GEW-22



**PHOTO 22**

Well: GEW-23





**PHOTO 23**

Well: GEW-25



**PHOTO 24**

Well: GEW-26





**PHOTO 25**

Well: GEW-27



**PHOTO 26**

Well: GEW-28





**PHOTO 27**

Well: GEW-29



**PHOTO 28**

Well: GEW-30





**PHOTO 29**

Well: GEW-31



**PHOTO 30**

Well: GEW-32





**PHOTO 31**

Well: GEW-33



**PHOTO 32**

Well: GEW-34





**PHOTO 33**

Well: GEW-36



**PHOTO 34**

Well: GEW-37





**PHOTO 35**

Well: GEW-38



**PHOTO 36**

Well:  
GEW-40





**PHOTO  
37**

Well:  
GEW-41



**PHOTO  
38**

Well:  
GEW-42





**PHOTO  
39**

Well:  
GEW-43



**PHOTO  
40**

Well:  
GEW-44





**PHOTO  
41**

Well:  
GEW-45



**PHOTO  
42**

Well:  
GEW-46





**PHOTO  
43**

Well:  
GEW-47



**PHOTO  
44**

Well:  
GEW-48





**PHOTO  
45**

Well:  
GEW-49



**PHOTO  
46**

Well:  
GEW-50





**PHOTO  
47**

Well:  
GEW-X1



**PHOTO  
48**

Well:  
GEW-X2





**PHOTO  
49**

Well:  
GEW-X5



**PHOTO  
50**

Well:  
GEW-X6





**PHOTO  
51**

Knockout  
and  
Valve 1



**PHOTO  
52**

Knockout  
and  
Valve 2





**PHOTO  
53**

Probe:  
TR-01



**PHOTO  
54**

Probe:  
TR-02





**PHOTO  
55**

Probe:  
TR-03



**PHOTO  
56**

Probe:  
MP-01





**PHOTO  
57**

Probe:  
MP-03



**PHOTO  
58**

Probe:  
MP-04





**PHOTO  
59**

Probe:  
MP-05



**PHOTO  
60**

Probe:  
MP-06





**PHOTO  
61**

New  
Scalehouse



**PHOTO  
62**

Surface  
Breakout





**PHOTO  
63**

Excavati  
on for  
Surface  
Breakout



**PHOTO  
64**

SVE  
Point  
Near  
MP-05





**PHOTO  
65**

Valve



**PHOTO  
66**

Valve





**PHOTO  
67**

Valve



**PHOTO  
68**

Flare  
Skid 1





**PHOTO  
69**

Flare  
Skid 2



**PHOTO  
70**

Flare  
Skid 3



At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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