



PLAN

REVISED LANDFILL GAS REMEDICATION PLAN – METHANE EXCEEDANCES AT METHANE MONITORING WELL MP-4

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

September 2016

0839-650616.600



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September 15, 2016

0839-650616.600

Ms. Jackie Drummond
Department of Environmental Quality
Division of Waste Management - Solid Waste Section
2090 US Highway 70
Swannanoa, NC 28778
828-296-4706
jaclynne.drummond@ncdenr.gov

**RE: REVISED LANDFILL GAS REMEDIATION PLAN – METHANE EXCEEDANCES AT METHANE MONITORING WELL MP-4
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 revised Landfill (LFG) Remediation Plan in response to continued detections of methane above the lower explosive limit (LEL) in methane monitoring well MP-4 during quarterly methane monitoring events. This revised Plan replaces the original that was submitted on September 2, 2016. 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).

As there were no LEL exceedances during the third quarter methane monitoring event, the enclosed LFG Remediation Plan will be initiated within 90 days of a future exceedance of the LEL in methane monitoring well MP-4. If you have any questions regarding the LFG Remediation Plan, please contact the undersigned at (336) 852-4903.

Sincerely,
GOLDER ASSOCIATES NC, INC.

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Senior Hydrogeologist

Rachel P. Kirkman, PG
Associate and Senior Consultant

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1.0 INTRODUCTION

This Landfill Gas (LFG) Remediation Plan has been prepared by Golder Associates NC, Inc. (Golder) for the closed Henderson County Municipal Solid Waste (MSW) Landfill in Henderson County, North Carolina (NC), due to sporadic LFG exceedences in methane monitoring well MP-4. 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 NC Department of Environmental Quality (NC DEQ).

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.

The County monitors methane at six compliance methane monitoring wells (MP-1, MP-3, MP-4, MP-7, MP-8, and MP-9) and three assessment methane monitoring wells (MP-6, TR-2, and TR-3) located around the MSW landfill on a quarterly schedule. Additionally, the County monitors three compliance methane monitoring wells (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 well MP-2 was removed from the compliance network and abandoned during the construction of the new landfill entrance and scalehouse. Well MP-5 was removed from the compliance network and fitted with a turbine vent and TR-1 abandoned as specified in the LFG Remediation Plan – Phase 2, which was approved by the NC DEQ on January 21, 2015.

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 components of the system.

Methane concentrations from well MP-4 exceeded the lower explosive limit (LEL) during the June and September 2015 quarterly monitoring event. As documented in the Third Quarterly Methane Monitoring Report of 2015, a turbine vent was installed onto landfill gas vent EW-4, which is located in close proximity to MP-4, due to these exceedances. Methane concentrations from MP-4 once again exceeded the LEL during the June 2016 event, but were below the LEL during the September 2016 event.

Due to sporadic detections of methane above the LEL in MP-4 during quarterly methane monitoring events, the County is proceeding with producing this revised LFG Remediation Plan, which describes the steps to reduce LFG migration and to protect human health and the environment if methane concentrations exceed the LEL in MP-4 during future quarterly events.

3.0 METHANE MONITORING WELL MP-4 EVALUATION

Methane concentrations from well MW-4 have fluctuated since its initial LEL exceedance in July 2012, but did not exceed the LEL again until the June 2015 quarterly monitoring event. After a second exceedance from MP-4 during the September 2015 quarterly event, a turbine vent was installed onto landfill gas vent EW-4, which is located in close proximity to MP-4. Methane concentrations subsequently decreased below the LEL for the next two quarterly events, but the concentration exceeded the LEL once again during the June 2016 event. The concentration of methane from MP-4 was below the LEL during the September 2016 event. A graph showing the historical methane readings for available data from MP-4 is included as Figure 1.

Methane monitoring well MP-4 has a total depth of approximately 19.5 feet below ground surface. An installation record for this well cannot be located; therefore, the screened interval is unknown. The well is located approximately 37 feet from the edge of waste. During a field investigation of MP-4 and the surrounding area in August 2016 by Golder staff, liquid was measured in MP-4 at approximately 8 feet below ground surface. The groundwater surface contour map from the March 2016 water quality monitoring event is included as Drawing 1 for reference.

4.0 PROPOSED REMEDIATION

Proposed remediation activities for addressing the elevated methane concentrations observed in the methane monitoring well MP-4 are discussed in the following sections. They include best management

practices that include repairs to the landfill cap and the installation of a cut-off trench between the MSW waste unit and methane monitoring well MP-4.

4.1 Best Management Practices

The County has begun improvements to the landfill cap on the northwest slope of the MSW waste unit. These improvements include grading to divert runoff from the landfill cap to decrease the amount of infiltration of precipitation into the waste unit. The County has also reseeded sections of the cap to stabilize the slope. The County will continue to monitor the improvements and other sections of the cap for additional repairs.

4.2 Installation of Cut-Off Trench

Contingent upon future exceedance of the LEL from MP-4, the County proposes to install a cut-off trench between the waste unit and methane monitoring well MP-4 in order to vent LFG that may be migrating from the landfill toward MP-4. The proposed trench is to be approximately 250 feet long and 2 to 4 feet wide and will be located as shown on Drawing 2. The trench will be dug to an average depth of 20 feet below ground surface. Well MP-4 has total depth of approximately 19.5 feet below ground surface. The depth of waste in the northwest corner of the waste unit is not expected to exceed the depth of the trench, based on available information.

The back wall of the trench will be lined with an impermeable barrier and backfilled with stone. Perforated 6-inch schedule 80 polyvinyl chloride (PVC) pipe will be installed approximately 4 feet below ground surface along the length of the excavation. Non-perforated 6-inch schedule 80 PVC pipe will be attached to the perforated pipe and extend above ground to vent accumulated landfill gas. A vent located 50 feet from each end of the trench will be installed. The vents will be topped by passive wind-driven turbine vents. The upper 2 feet of the excavation will be backfilled with a relatively impermeable soil. A detail of the construction of the cut-off trench is shown on Drawing 3.

The installation of the proposed cut-off trench will be initiated within 90 days of any future LEL exceedances from methane monitoring well MP-4. Routine quarterly methane monitoring will continue on a quarterly basis. If there is no indication of a declining trend in methane concentrations at the end of one year after installation, additional remediation will be recommended.

5.0 CONCLUSIONS

This LFG Remediation Plan has been prepared in response to sporadic detections of methane above the LEL in compliance methane monitoring well MP-4 at the facility. The remedial activities consist of installing a cut-off trench between the waste unit and MP-4, contingent upon any future LEL exceedances from MP-4.

6.0 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.

Golder Associates NC, Inc., January 6, 2015. Landfill Gas Remediation Plan – Phase 2; Closed Henderson County Landfill, Permit No. 45-01; Henderson County, North Carolina.

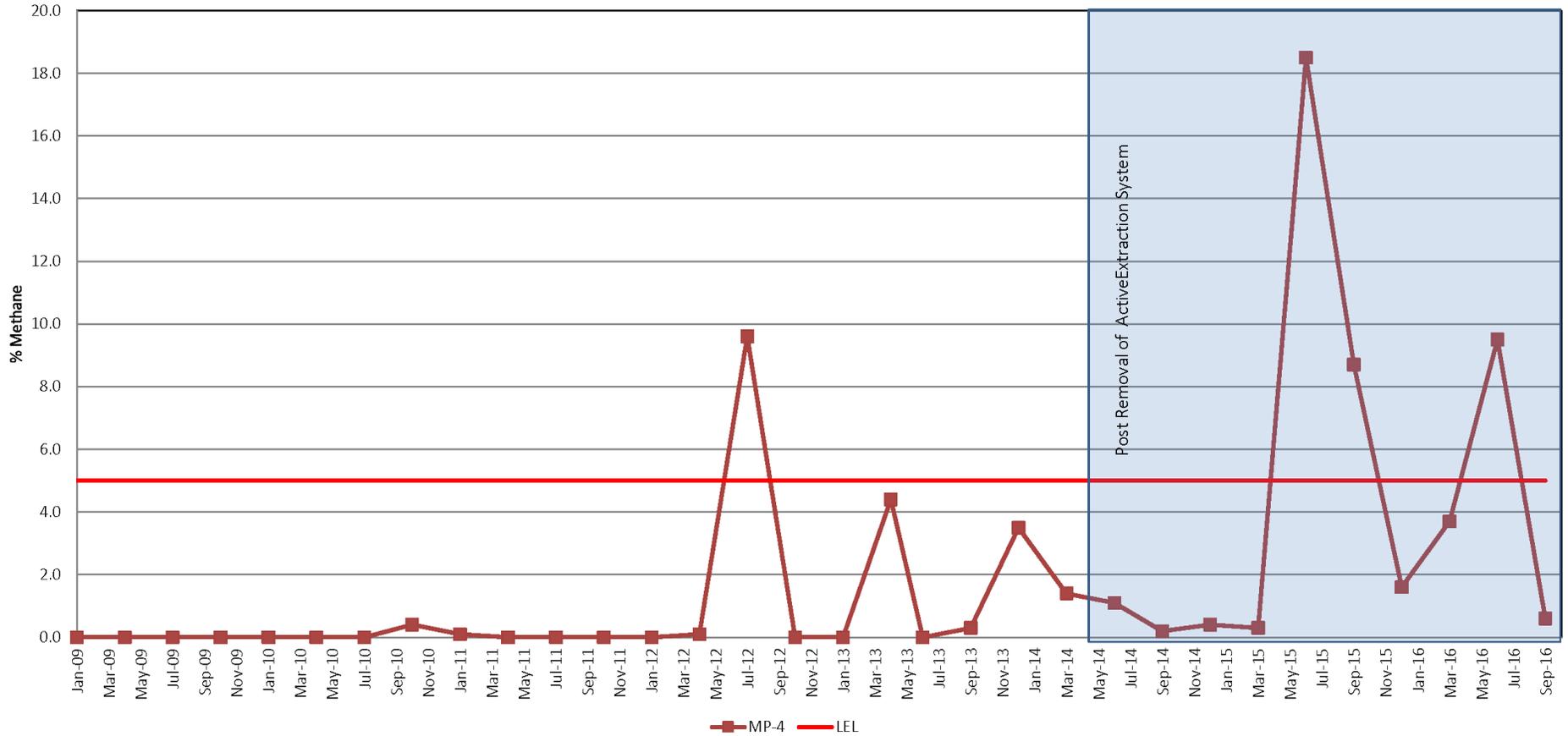
Golder Associates NC, Inc., September 30, 2015. Methane Monitoring Results – Third Quarterly Event of 2015; Closed Henderson County Landfill, Permit No. 45-01; Henderson County, North Carolina.

Golder Associates NC, Inc., June 20, 2016. Methane Monitoring Results – Second Quarterly Event of 2016; Closed Henderson County Landfill, Permit No. 45-01; Henderson County, North Carolina.

Golder Associates NC, Inc., September 13, 2016. Methane Monitoring Results – Third Quarterly Event of 2016; Closed Henderson County Landfill, Permit No. 45-01; Henderson County, North Carolina.

Golder Associates NC, Inc., July 25, 2016. Water Quality Monitoring Report, First Semi-Annual 2016 Sampling Event and Corrective Action Monitoring; Closed Henderson County Landfill, Permit No. 45-01; Henderson County, North Carolina.

FIGURE



CLIENT
HENDERSON COUNTY



PROJECT
**HENDERSON COUNTY CLOSED MSW LANDFILL
 PERMIT NO. 45-01**

CONSULTANT

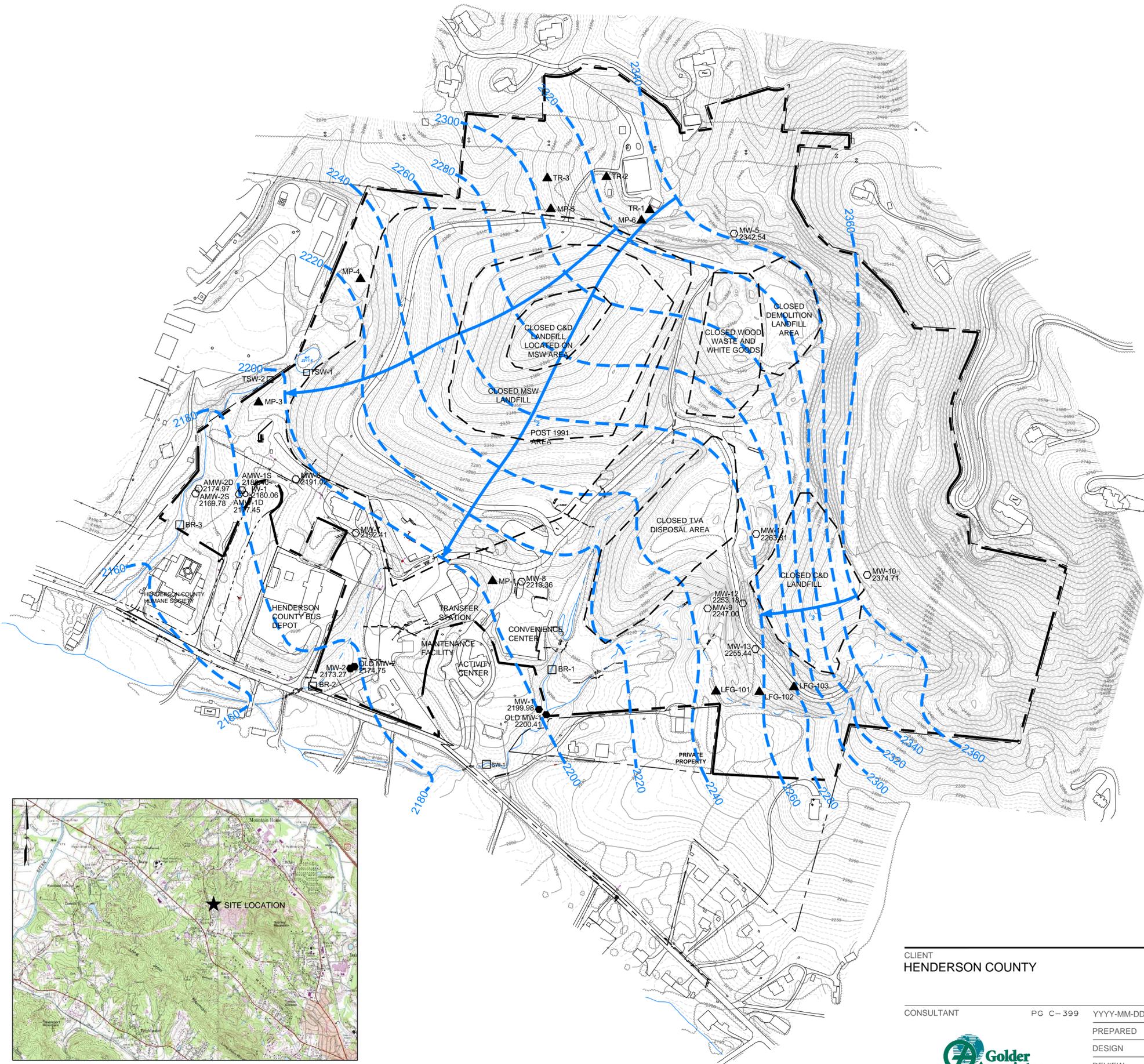


YYYY-MM-DD 2016-08-25
 PREPARED DYR
 DESIGN DYR
 REVIEW RPK
 APPROVED RPK

TITLE
**METHANE CONCENTRATION TREND GRAPH FOR METHANE
 MONITORING WELL MP-4**

PROJECT No.	PHASE	Rev	FIGURE
0839650616	600	0	FIGURE 1

DRAWINGS



LEGEND

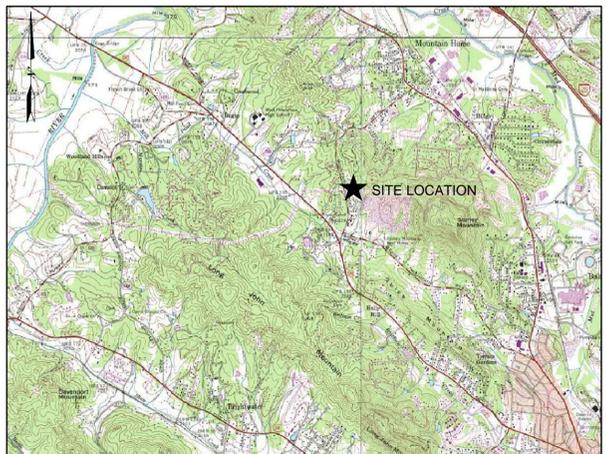
- EXISTING 10 FT. CONTOUR
- EXISTING 2 FT. CONTOUR
- PROPERTY LINE
- LIMITS OF WASTE
- STREAM
- BUFFER
- TREELINE
- EXISTING ROAD
- FENCE
- GROUNDWATER SURFACE CONTOURS
- APPROXIMATE GROUNDWATER FLOW SEGMENT USED TO CALCULATE GRADIENT
- MW-8 2213.36 COMPLIANCE MONITORING WELL AND IDENTIFICATION
- MW-1 NON COMPLIANCE MONITORING WELL AND IDENTIFICATION
- MP-6 METHANE MONITORING WELL AND IDENTIFICATION
- BR-1 SURFACE WATER MONITORING POINT AND IDENTIFICATION
- IW-1 INJECTION WELL
- NOT MEASURED

NOTES

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET
2. GROUNDWATER SURFACE CONTOUR INTERVAL = 20 FEET
3. GROUNDWATER ELEVATIONS BASED ON MARCH 15, 2016.
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.
8. LOCATION OF COMPLIANCE METHANE MONITORING WELL MP-4 IS APPROXIMATE.

REFERENCES

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



SITE LOCATION MAP
NOT TO SCALE

CLIENT
HENDERSON COUNTY

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

CONSULTANT PG C-399 YYYY-MM-DD 2016-09-01

TITLE
GROUNDWATER SURFACE CONTOUR MAP
MARCH 15, 2016

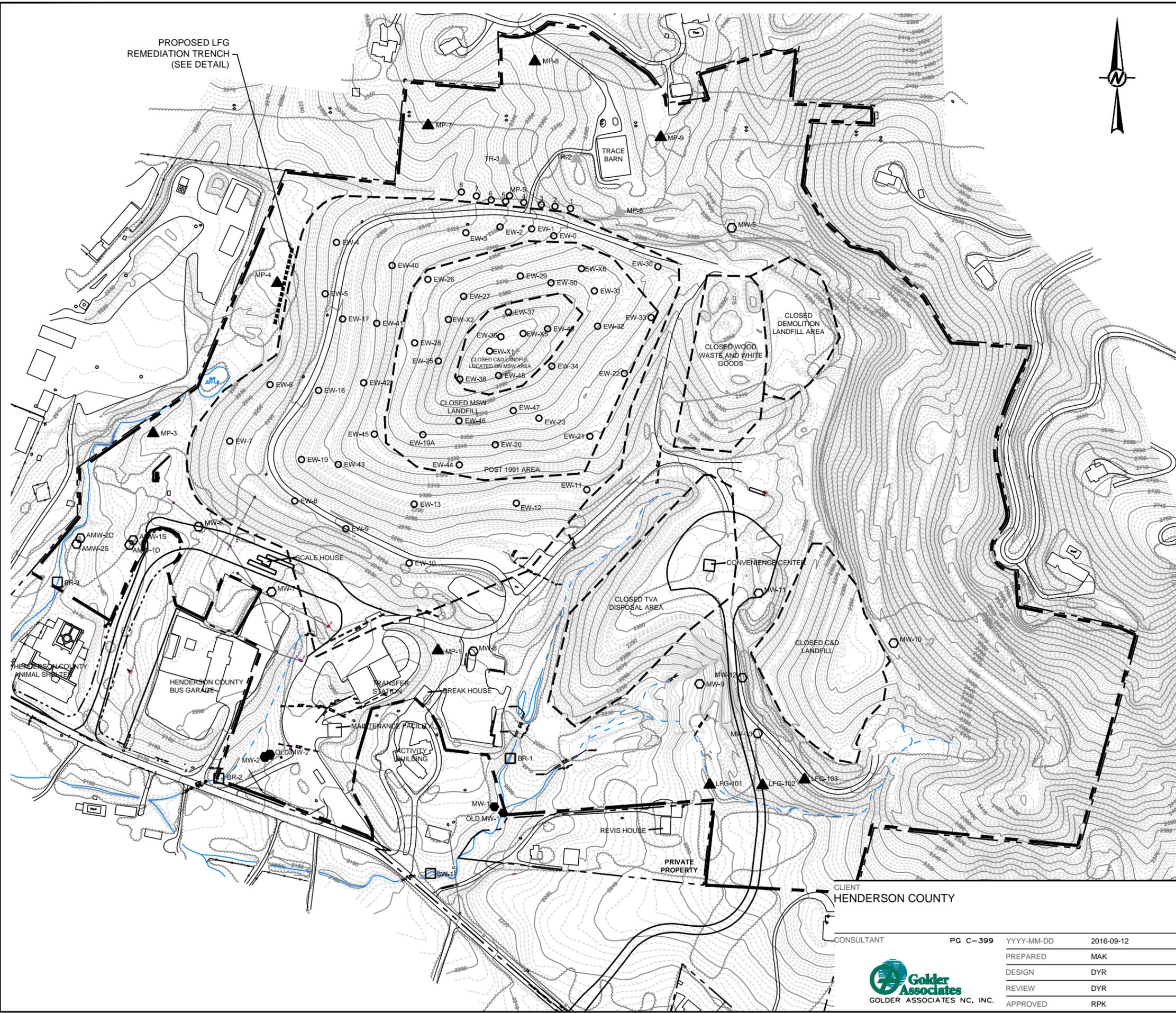


PREPARED	MAK
DESIGN	DYR
REVIEW	DYR
APPROVED	RPK

PROJECT No.	PHASE	Rev.	DRAWING
0839650616	600	0	1

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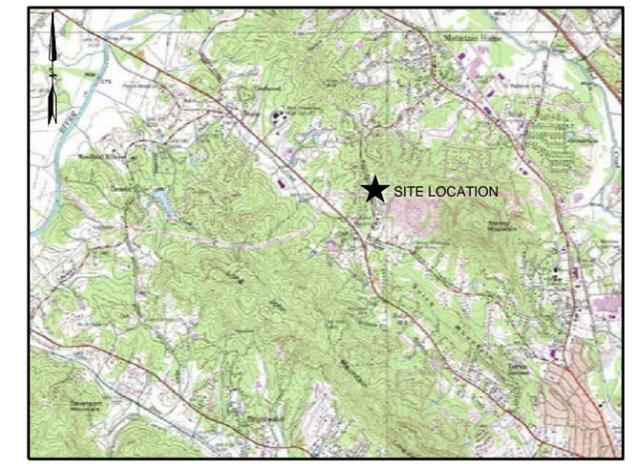


LEGEND

	EXISTING 10 FT. CONTOUR
	EXISTING 2 FT. CONTOUR
	PROPERTY LINE
	LIMITS OF WASTE
	STREAM
	BUFFER
	TREELINE
	EXISTING ROAD
	FENCE
	LFG COLLECTION PIPING
	LFG REMEDIATION TRENCH
	MW-8 COMPLIANCE MONITORING WELL
	MW-1 NON COMPLIANCE MONITORING WELLS
	MP-6 COMPLIANCE METHANE MONITORING WELLS
	MP-6 ASSESSMENT METHANE MONITORING WELLS
	BR-1 SURFACE WATER MONITORING POINT
	EW-29 LFG EXTRACTION WELL CONVERTED TO PASSIVE VENTING

- 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.
 5. LOCATION OF COMPLIANCE METHANE MONITORING WELL MP-4 IS APPROXIMATE.

- REFERENCE**
1. BASE MAP PROVIDED BY CAMP DRESSER & McKEE FROM PREVIOUS WATER QUALITY MONITORING REPORTS.
 2. WELLS MP-7, MP-8, AND MP-9 WERE SURVEYED BY REGIONAL LAND SURVEYING, INC. ON JUNE 11, 2015.



SITE LOCATION MAP
NOT TO SCALE

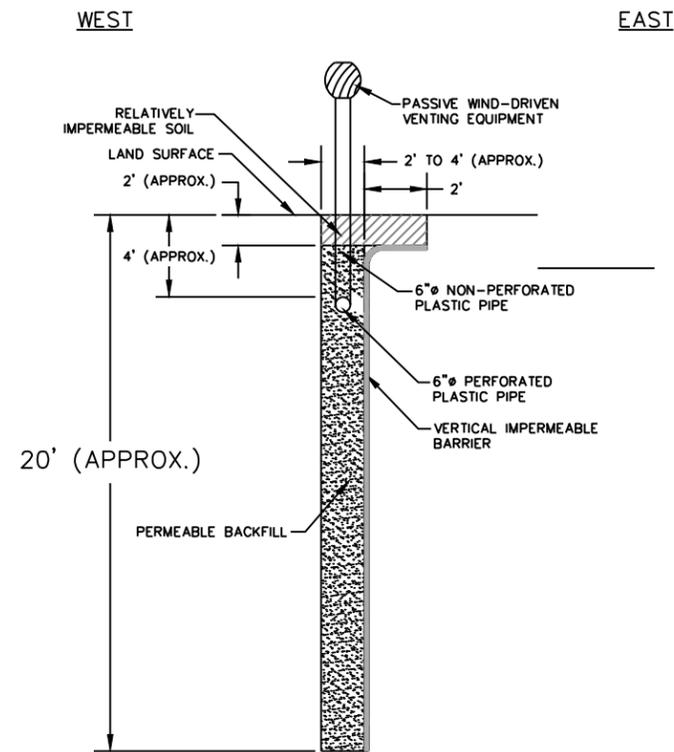
PROJECT		HENDERSON COUNTY CLOSED MSW AND C&D LANDFILL PERMIT # 45-01	
TITLE		LANDFILL GAS REMEDIATION PLAN	
PROJECT No.	PHASE	Rev.	DRAWING
0839650616	600	1	2

CLIENT	HENDERSON COUNTY
CONSULTANT	PG C-399
DATE	YYYY-MM-DD 2016-09-12
PREPARED	MAK
DESIGN	DYR
REVIEW	DYR
APPROVED	RPK



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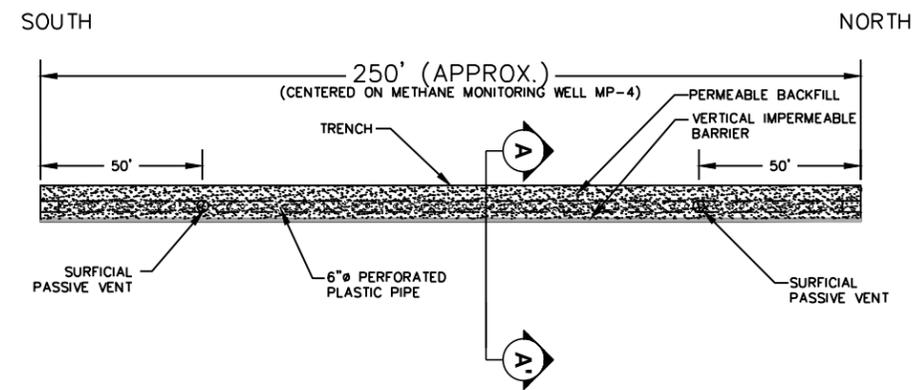


PROPOSED TRENCH AND VENT SYSTEM CROSS SECTION A-A'

NOT TO SCALE

NOTES:

1. NON-PERFORATED 6" PIPE INSTALLED ON BOTH ENDS OF PASSIVE VENT SYSTEM.



PROPOSED LANDFILL GAS REMEDIATION TRENCH DETAIL

NOT TO SCALE

NOTES:

1. NEAR-SURFACE HORIZONTAL EXTENSION OF PLASTIC BARRIER AND SURFICIAL SOIL CAP OMITTED FOR CLARITY.

CLIENT
HENDERSON COUNTY

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

CONSULTANT PG C-399 YYYY-MM-DD 2016-09-12

TITLE
LANDFILL GAS REMEDIATION PLAN DETAILS

DESIGNED DYR
PREPARED MAK
REVIEWED DYR
APPROVED RPK

PROJECT NO. 0839650616 PHASE 600 REV. 1 DRAWING 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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