



September 13, 2010

Ms. Elizabeth S. Werner
Solid Waste Section – Permitting Branch Hydrogeologist
North Carolina Department of Environment and Natural Resources
Raleigh Regional Office
1601 Mail Service Center
Raleigh, North Carolina 27699-1601

RE: Landfill Gas Monitoring Plan and
Landfill Gas Assessment and Remediation
Plan
Francis Farm Landfill, Permit Number 44-03
Haywood County, North Carolina

Dear Ms. Werner:

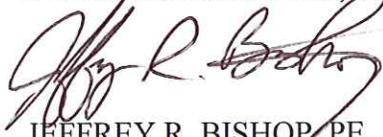
On behalf of Haywood County, please find enclosed the Landfill Gas Monitoring Plan and the Landfill Gas Assessment and Remediation Plan for the closed Francis Farm Landfill. The plans have been completed in response to the Facility Compliance Audit Report conducted on July 21, 2010.

The Landfill Gas Monitoring Plan is a stand alone document that includes standard operating procedures for sampling the landfill gas probes, a site map locating the existing and proposed monitoring probes, calibration procedures, a standardized data collection sheet, and a contingency plan for managing landfill gas exceedences. Additionally, a Landfill Gas Assessment and Remediation Plan has been prepared to describe steps that have been taken to remediate landfill gas exceedences and to outline steps that will be taken to further assess the landfill gas exceedences. A detailed schedule of implementation has also been included in the plan.

Haywood County has already taken several steps to address the issues outlined in the audit report and is committed to completing the outlined assessment. We look forward to working with you to address the concerns outlined in the audit report regarding landfill gas exceedences at the Francis Farm Landfill. Please let us know if you have additional questions or if you require additional information.

Ms. Elizabeth Werner
September 13, 2010
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Sincerely,
McGILL ASSOCIATES, P.A.

A handwritten signature in black ink, appearing to read "Jeffrey R. Bishop". The signature is fluid and cursive, with the first name "Jeffrey" being the most prominent.

JEFFREY R. BISHOP, PE
Director of Solid Waste Services

Enclosures

cc: David Cotton, Haywood County Manager, w/encl.
Marty Stamey, Haywood County Assistant County Manager, w/ encl.
Stephen King, Haywood County Solid Waste Director, w/encl.
Andrea Keller, NCDENR Solid Waste Section, w/encl.

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**LANDFILL GAS ASSESSMENT AND
REMEDATION PLAN**

**FRANCIS FARM LANDFILL
PERMIT NO. 44-03
HAYWOOD COUNTY, NORTH CAROLINA**

JEFFREY R. BISHOP, PE

 **McGill**
ASSOCIATES
Engineering • Planning • Finance
Asheville, North Carolina



September 2010

10.00726

Landfill Gas Assessment and Remediation Plan
Francis Farm Landfill
Permit No. 44-03

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1.0 Introduction

The Francis Farm Landfill, Permit No. 44-03, is located in Haywood County, North Carolina on Francis Farm Road, (S.R. 1802), Waynesville, North Carolina. The Francis Farm Landfill began operation in the early 1970's and was operated as Haywood County's primary MSW landfill through 1994. The facility was officially closed per a Closure Certification prepared by RCF, Inc. Hazclwood, North Carolina dated September 14, 1994 and submitted to the North Carolina Department of Environment and Natural Resources (NCDENR). The original Permit for Closure was issued on December 13, 1995. The facility encompasses approximately 33.1 acres as shown on the Landfill Gas Assessment and Remediation Plan Drawing (Figure 1), included as Appendix 1. Within the Facility Boundary, in addition to the closed landfill, Haywood County Schools operates a maintenance/ bus garage facility. The Maintenance/ Bus Garage Facility includes a maintenance/ bus garage building, equipment storage building, and maintenance storage building. The Maintenance Building consists of offices, carpentry shop and bus maintenance facility.

The Maintenance/ Bus Garage Building is equipped with a methane gas monitoring system and a gas ventilation system constructed below the concrete building slab. The methane gas monitoring system continuously monitors for methane gas at three (3) strategic locations within the building, including the base of the mezzanine stairs, the hallway of the office area, and the Carpentry Shop. The system is operated and maintained by the Haywood County School System staff. The system is calibrated once a month. The monitoring system sounds an alert horn if the methane gas readings are detected above 25 percent of the lower explosive limit of methane gas. The below-slab ventilation system was installed as part of the original construction of the building. Based on our discussions with staff, the system consists of a network of pipes tied to the gravel foundation of the building within the bus maintenance portion of the building, which is connected to an exhaust blower. The exhaust blower exhausts air to the outside of the building on the west side.

The facility property is bounded by private property utilized for residential and agricultural uses. The closest residential structure is located on the Stephens property, approximately 340 feet to the south of the facility property line.

2.0 Regulatory Compliance

The Francis Farm Landfill operates under the Permit for Closure with a most recent revision dated May 23, 2006. The Landfill Gas Monitoring Plan was developed to comply with the following Methane Gas Remediation Conditions section of the Permit for Closure. This section has been included below.

- (8) The owner or operator shall maintain and operate the gas monitoring system to ensure that:
 - (a) The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit for methane in facility structures (excluding gas control or recovery system components); and
 - (b) The concentration of methane gas does not exceed 100 percent of the lower explosive limit for methane at the facility property boundary.

- (9) If methane gas levels exceeding these limits are detected, the owner or operator must take all steps necessary to meet the standards established in condition 8. Methane gas remediation plans approved by the Division are described in the List of Approved Documents, Attachment 1, Part C of the Permit for Closure.

"Lower Explosive Limit" (LEL) is defined as the lowest percent by volume of a mixture of explosive gases which will propagate a flame in air at 25° C and atmospheric pressure.

The North Carolina Department of Environment and Natural Resources (NCDENR), Solid Waste Section (SWS) performed a Facility Compliance Audit Report on July 21, 2010. The report was mailed to Haywood County on July 26, 2010. In the audit report, the SWS required that a Landfill Gas Assessment Plan be prepared and submitted to the SWS. Haywood County has enlisted the services of McGill Associates, P.A. to prepare and carry out the Assessment Plan. In addition, since there have been exceedences of methane gas in the monitoring probes, a Landfill Gas Remediation Plan has also been prepared and included in this document.

3.0 Landfill Gas Assessment Plan

The proposed Landfill Gas Assessment Plan outlines a detailed approach to evaluate the methane gas migration at the Francis Farm Landfill. An informed evaluation is difficult at this time because of the lack of available data. Part of the Assessment Plan will be to further investigate existing conditions at the landfill. This investigation will include an in-depth review of available record data, field surveys and potential field excavations to verify locations and construction details. The plan also includes installation of additional methane monitoring probes and an increase in the gas monitoring frequency during the assessment period.

The Landfill Gas Assessment Plan will comprise of the following components:

3.1 Assessment Monitoring Plan

The compliance monitoring locations were developed based on the relationship of solid waste disposal areas to property lines and adjacent landfill structures. The spacing of the monitoring probes is between 300 and 600 feet. The Francis Farm Landfill was not constructed with an impermeable base liner system and cap system. There may be a chance for landfill gas migration through the permeable *in situ* soils. The migration of landfill gas is induced by pressure gradients. The landfill gas will move from areas of high pressure to those of low pressure following the path of least resistance. The landfill gas generally migrates vertically until it reaches the landfill cap, where it may begin to flow horizontally. This occurs until it finds a pathway out through the permeable *in situ* soils. As the landfill gas migrates it will fill the void created by the monitoring point's gravel backfill whereupon a landfill gas detection device will detect and read the level of gas concentration.

The existing gas monitoring system includes six (6) methane monitoring probes spaced along the northern, eastern, and southern reaches of the waste area. The probes consist of 1-inch PVC capped pipe enclosed by a metal enclosure with locking metal cap. The PVC pipe is equipped with a quick coupler for use with the landfill gas analyzer. The actual construction details for these original probes are not available.

In addition, the County monitors five (5) specific points within the three (3) existing on-site buildings. The five (5) points are identified with a small plastic sign at each location within the buildings. There are three (3) locations within the Maintenance Building, one location in the Equipment Storage Building, and one location in the Maintenance Storage. These eleven monitoring locations define the existing compliance monitoring points for the landfill and are shown on the Landfill Gas Assessment and Remediation Plan Drawing (Figure 1), included as Appendix 1.

As part of the Assessment Plan, Haywood County proposes to install six (6) new landfill gas monitoring probes along the northern, southern and western reaches of the waste area. Currently, there are no landfill gas monitoring probes on the west side of the landfill. These proposed probes are also shown on Figure 1. A detail of the typical proposed landfill gas monitoring probe is shown in Appendix 2. The new probes will be installed by on or about November 15, 2010. Following the installation, these probes will be utilized for the Landfill Gas Assessment Monitoring Plan and also included into compliance points in the Landfill Gas Monitoring Plan. In addition, one of the original methane probes, MM-8, will be re-established at the time of installation of the new probes.

Table 1 lists the existing and proposed landfill gas compliance monitoring locations for the Francis Farm Landfill.

Table 1 –Landfill Gas Compliance Monitoring Locations

Compliance Point	Description
MM-1	Monitoring Probe along northern property line
MM-2	Monitoring Probe along northern property line
MM-3	Monitoring Probe along northern property line
MM-4	Monitoring Probe along northern property line
MM-5	Monitoring Probe along northern property line
MM-6	Monitoring Probe along eastern property line
MM-7	Monitoring Probe along eastern property line
MM-8	Monitoring Probe along eastern property line
MM-9	Monitoring Probe along southern property line
MM-10	Proposed Monitoring Probe along southern property line
MM-11	Proposed Monitoring Probe along western property line
MM-12	Proposed Monitoring Probe along western property line
MM-13	Proposed Monitoring Probe along western property line
SM-1a	Monitoring Point in Maintenance/ Bus Garage Building – Bus Garage (base of mezzanine stairs)
SM-1b	Monitoring Point in Maintenance/ Bus Garage Building – Office Area (main hallway)

SM-1c	Monitoring Point in Maintenance/ Bus Garage Building - Carpentry Shop
SM-2	Equipment Storage Building (doorway between garage and storage area)
SM-3	Maintenance Storage Building (middle storage bay at floor drain)

In addition to the compliance monitoring locations, Haywood County proposes to monitor four (4) additional landfill gas monitoring points. Table 2 lists the proposed additional locations. These additional locations will be monitored during the proposed assessment monitoring period.

Table 2 – Additional Landfill Gas Monitoring Locations

Monitoring Point	Description
VB-1	Water Valve Box just outside Maintenance/ Bus Garage
MW-4	Existing Groundwater Monitoring Well
MW-5	Existing Groundwater Monitoring Well
SM-4	Private Residence (crawl space)

Haywood County will perform Assessment Landfill Gas Monitoring on a monthly basis for one year (12 months) from the approval date of the Landfill Gas Assessment and Remediation Plan at all of the compliance and additional monitoring locations listed in Table 1 and Table 2. As described in the remediation section below, Haywood County has installed 21 gas extraction wells within the waste footprint. It will take some time before the construction of gas extraction wells has an impact on landfill gas at the sampling probes; therefore the assessment sampling period is proposed for a 12 month period. Sampling will be completed in accordance with the approved Landfill Gas Monitoring Plan. All collected data will be documented on the Landfill Gas Measurement Field Worksheet, included as Appendix 3. Prior to the sampling event, the person performing sampling will review the approved Landfill Gas Monitoring Plan to become familiar with the locations of the compliance points and the requirements of the plan.

3.2 Determination of Existing Landfill Gas Probes Construction Detail

Currently, there is no construction data available for the existing landfill gas probes. As part of the Landfill Gas Assessment Plan, Haywood County proposes to investigate to determine how the probes were constructed and if the probes are located within waste limits. This information will be used to evaluate the effectiveness of the probes as future monitoring points.

3.3 Evaluate the Gas Venting System and Gas Monitoring System at the Maintenance/ Bus Garage Building

As discussed above, the existing Maintenance/ Bus Garage Building has a gas venting system and continuous gas monitoring system. These systems are operated by Haywood County Schools (HCS) staff. Based on discussions with the HCS staff, both systems are operational. The gas monitoring system is calibrated on a monthly basis. To verify the effectiveness of the venting system, a review of the actual as-built drawings is required. Further investigation is also required to verify that monitoring system equipment is calibrated to meet regulatory requirements of the Solid Waste Section.

As part of the evaluation of the Maintenance/ Bus Garage Building, an analysis will be completed as to the appropriate equipment to install in the other two on-site buildings to provide continuous gas monitoring. Haywood County will make a recommendation to HCS to install the appropriate monitoring equipment in each of the buildings and will insure that the proper monitoring equipment is installed in concurrence with the proposed improvements and field evaluation occurring as part of the Landfill Gas Assessment and Remediation Plan.

3.4 Waste Limits Survey

The Francis Farm Landfill began operation in the early 1970's. There is limited documentation available to accurately depict the actual limits of waste along the northern and eastern sides of the waste mass. As part of the Assessment Plan, Haywood County will perform limited excavation to attempt to define the limits of waste along the northern and eastern portions of the landfill. Once the limit of waste is determined, the points will be surveyed and placed on a revised Overall Site Plan of the facility.

3.5 Final Report

At the end of the proposed assessment monitoring period (12 months), a final report will be prepared and submitted to the SWS. The report will compile all of the collected data and provide recommended improvements to the Landfill Gas Compliance Monitoring Plan and identify additional remediation measures, if needed. During the assessment monitoring period, if methane gas exceedences continue to occur, additional remediation methods may be implemented during the assessment period. However, any proposed modifications will be submitted to the Solid Waste Section for approval prior to implementation.

4.0 Landfill Gas Remediation Plan

4.1 Preparation of Landfill Gas Monitoring Plan

Haywood County has prepared a complete Landfill Gas Monitoring Plan for the Francis Farm Landfill. The plan was submitted to the Solid Waste Section on September 13, 2010. The monitoring establishes naming conventions for monitoring probes, establishes sampling protocols, and provides a site plan of the existing and proposed monitoring probes. The monitoring plan provides the basis for performing and recording gas sampling in a consistent manner going forward.

4.2 Installation of Landfill Gas Extraction Wells

Haywood County has already taken a major step in addressing the methane gas migration by installing 21 new passive landfill gas extraction wells within the waste mass. During the September 29, 2009 gas sampling event, Haywood County personnel detected gas readings at MM-3, MM-4, and MM-6 that exceeded the lower explosive limit for methane gas. As a result, the County enlisted the services of McGill Associates to prepare a gas extraction system design and permit through SWS. The plans were submitted on November 6, 2009 and approved by the SWS on March 17, 2010. The approved drawings included the construction of 21 passive gas extraction wells (Phase 1) and a proposed future installation of an active gas extraction system with a blower/ flare system (Phase 2). As result of the current economic situation, the County elected to construct only the gas extraction events at this time. The contract for the installation for the passive gas extraction wells was issued on August 10, 2010. The installation of the new extraction wells was completed on August 23, 2010. The locations of the wells are shown on the Landfill Gas Assessment and Remediation Plan Drawing, included as Appendix 1.

4.3 Existing Landfill Gas Monitoring Probes

As outlined in the Facility Compliance Audit Report, the existing monitoring probes were deficient of metal well tops, labeling, and concrete pads. The County has completed the repairs to the existing landfill gas monitoring probes and also to the groundwater monitoring wells.

4.4 Install Clay Seal along Existing Water Line

The additional landfill gas monitoring point, VB-1 has historically yielded a high methane gas reading. VB-1 is a water valve box located on the west side of the Maintenance/ Bus Garage Building. Preliminary evaluation indicates that landfill gas may be migrating along the water line in the gravel backfilled trench. As part of the Remediation Plan, Haywood County will excavate down to the water line and install a bentonite clay seal around the water line to hopefully eliminate the migration of landfill gas towards the building. The VB-1 monitoring point will continue to be monitored during the assessment period to determine the effectiveness of the clay seal and the results will be submitted with the Final Assessment Report.

5.0 Proposed Implementation Schedule

The proposed implementation schedule for the above Assessment and Remediation Plan is outlined below. The dates shown are projected. The proposed actions will be completed on or about these dates.

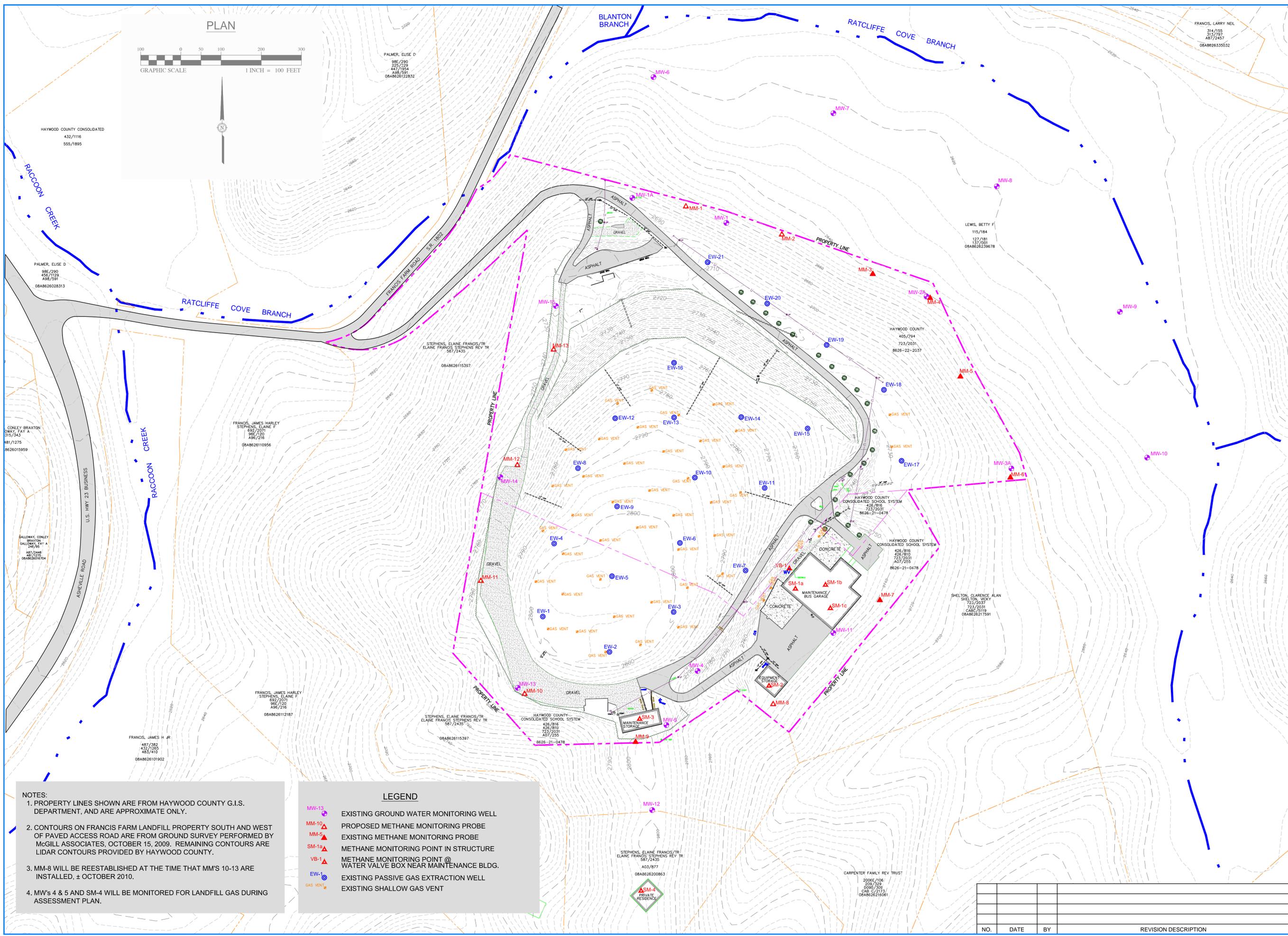
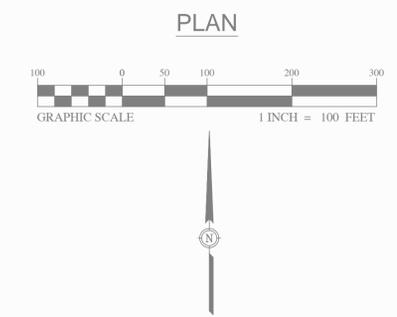
Installation of Methane Gas Extraction Wells	Completed
Repairs to Existing Gas Monitoring Probes	Completed
Preparation of Landfill Gas Monitoring Plan	Completed
Installation of Additional Landfill Gas Probes	November 15, 2010
Survey of Existing Landfill Gas Probes	November 15, 2010

Installation of clay seal along Water Line	November 15, 2010
Determination of Waste Limits	November 15, 2010
Evaluation of System at Maintenance/ Bus Garage	December 1, 2010
Sampling during the Assessment Monitoring Period	November 15, 2010 to November 15, 2011
Prepare Final Assessment Report/ Submit to SWS	December 15, 2011

APPENDICES

APPENDIX 1

Landfill Gas Assessment and Remediation Plan Drawing



- NOTES:**
1. PROPERTY LINES SHOWN ARE FROM HAYWOOD COUNTY G.I.S. DEPARTMENT, AND ARE APPROXIMATE ONLY.
 2. CONTOURS ON FRANCIS FARM LANDFILL PROPERTY SOUTH AND WEST OF PAVED ACCESS ROAD ARE FROM GROUND SURVEY PERFORMED BY MCGILL ASSOCIATES, OCTOBER 15, 2009. REMAINING CONTOURS ARE LIDAR CONTOURS PROVIDED BY HAYWOOD COUNTY.
 3. MM-8 WILL BE REESTABLISHED AT THE TIME THAT MM'S 10-13 ARE INSTALLED, ± OCTOBER 2010.
 4. MW'S 4 & 5 AND SM-4 WILL BE MONITORED FOR LANDFILL GAS DURING ASSESSMENT PLAN.

LEGEND

MW-13	EXISTING GROUND WATER MONITORING WELL
MM-10	PROPOSED METHANE MONITORING PROBE
MM-5	EXISTING METHANE MONITORING PROBE
SM-1a	METHANE MONITORING POINT IN STRUCTURE
VB-1	METHANE MONITORING POINT @ WATER VALVE BOX NEAR MAINTENANCE BLDG.
EW-1	EXISTING PASSIVE GAS EXTRACTION WELL
GAS VENT	EXISTING SHALLOW GAS VENT

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FRANCIS FARM LANDFILL
LFG ASSESSMENT & REMEDIATION PLAN
HAYWOOD COUNTY
HAYWOOD COUNTY, NORTH CAROLINA

JOB NO.: 10.00726
DATE: SEPTEMBER 10, 2010
DESIGNED BY: DP
CADD BY: DP
DESIGN REVIEW: _____
CONST. REVIEW: _____
FILE NAME: Remediation Plan 9-10-10.dwg

LANDFILL GAS
ASSESSMENT AND
REMEDATION PLAN

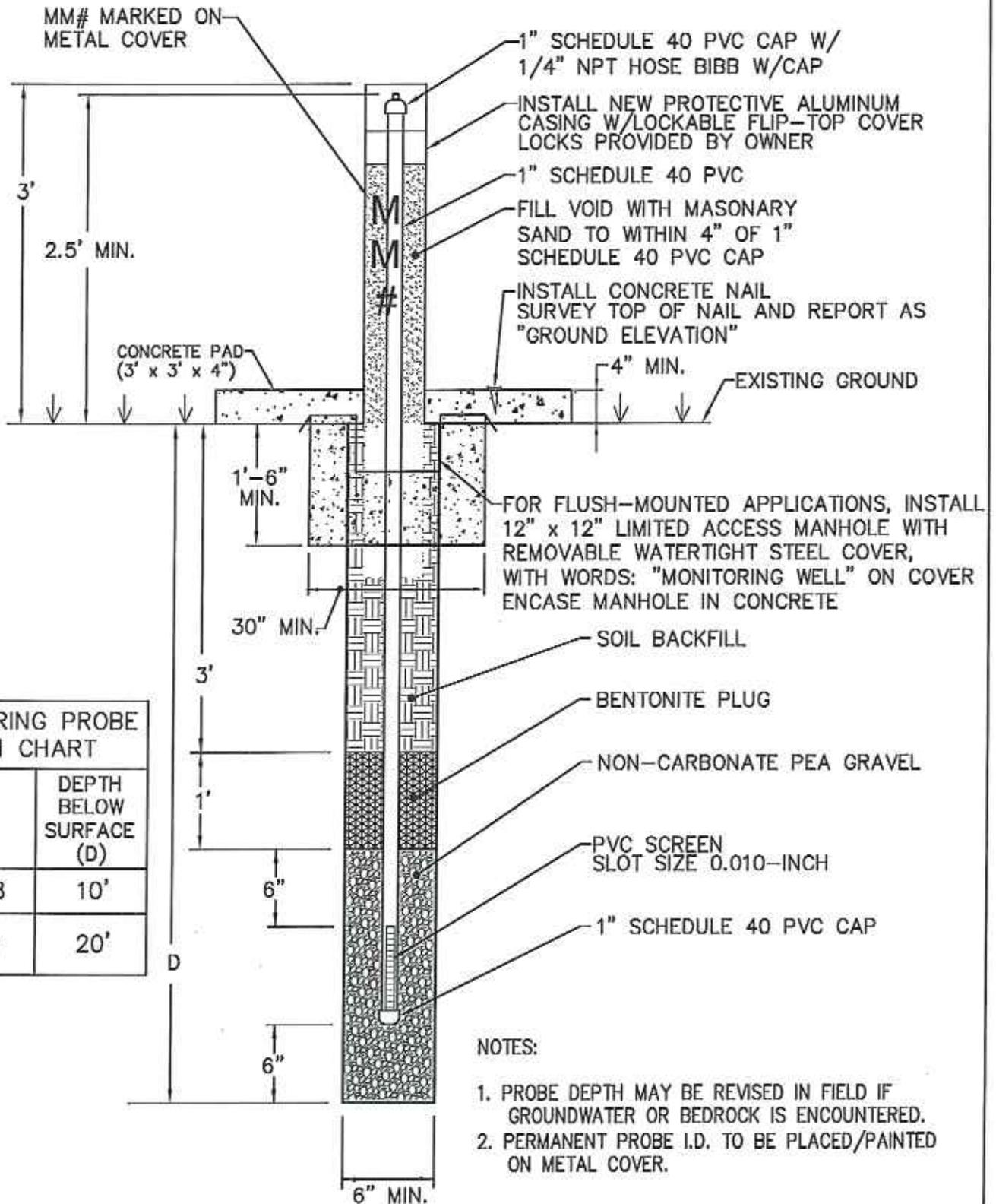
FIGURE
1

NO.	DATE	BY	REVISION DESCRIPTION

APPENDIX 2

Landfill Gas Monitoring Probe Detail

NOTE: USE ABOVE GROUND PROTECTIVE METAL COVER UNLESS A FLUSH-MOUNTED APPLICATION IS REQUIRED, TO BE DETERMINED IN FIELD. BOTH COVERS SHOWN HERE.



MONITORING PROBE DEPTH CHART	
MM #	DEPTH BELOW SURFACE (D)
1, 2, 8	10'
10, 11, 12, 13	20'

LANDFILL GAS MONITORING PROBE

NOT TO SCALE

APPENDIX 2

APPENDIX 3

**Landfill Gas Measurement Field Worksheet
(Assessment Period)**

Landfill Gas Measurements Field Worksheet
Francis Farm Landfill - Permit #44-03
Haywood County, North Carolina

Name of Person Taking Readings: _____ Date: _____

Weather Conditions: _____ Ambient Temp: _____

Atmospheric Pressure: _____

Gas Monitoring Equipment: Land-Tec GEM 2000 Serial #: GM05480

Factory Calibration Date: _____ Field Calibration Date : _____

Well or Probe ID	Stable Readings	Time	%LEL	%CH ₄	%CO ₂	%O ₂	Notes:
MM-1							
MM-2							
MM-3							
MM-4							
MM-5							
MM-6							
MM-7							
MM-8							
MM-9							
MM-10							
MM-11							
MM-12							
MM-13							
SM-1a							
SM-1b							
SM-1c							
SM-2							
SM-3							
SM-4*							
VB-1*							
MW-4*							
MW-5*							

Notes:

1. If methane gas readings exceed 25% of LEL in structures or 100% of LEL in probes, contact Haywood County Solid Waste Director immediately.
2. *To be monitored from 11/15/10 to 11/15/11. May be dropped from monitoring after assessment period is complete.

Field Observation Notes: