Permit No.	Date	DIN
97-04	January 7, 2016	25438

JOYCE ENGINEERING
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Charlotte, NC 28273
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RECEIVED
January 7, 2016
Solid Waste Section
Asheville Regional Office

December 21, 2015

Mr. Allen Gaither
Environmental Engineer II
NC Department of Environmental Quality (NC DEQ)
Division of Waste Management
2090 US HWY 70
Swannanoa, NC 28778

RE: Permit to Operate Renewal Application
Roaring River Landfill
Wilkes County, North Carolina
Permit #97-04

Dear Mr. Gaither:

On behalf of Wilkes County, Joyce Engineering, Inc. (JOYCE) is pleased to submit this application for continued operation of the Roaring River Landfill. In accordance with 15A NCAC 13B .1617(b), please find enclosed the revised Facility Plan, Operations Plan, and Financial Assurance cost estimates to reflect existing conditions. The Landfill Gas Monitoring Plan (LFGMP) and Water Quality Monitoring Plan (WQMP) were also revised and sumitted to DEQ separately.

The Engineering Plan, Closure and Post-Closure Plan, CQA Plan and Technical Specifications were not included in this submittal due to the fact that no revisions have been made to the landfill design since they were last permitted, and no expansions are proposed with this submittal.

Please do not hesitate to contact us during the review process with any questions or comments you may have. We look forward to working with you to get this permit renewed for continued operation of the landfill.

Sincerely,
JOYCE ENGINEERING, INC.

Amy Davis

Amy Davis, P.E.
Sr. Project Consultant

Attachments
Revised Facility Plan & Drawings
Revised Operations Plan & Drawings
Financial Assurance Cost Estimates

C: Kent Brandon, Roaring River Landfill

PREPARED FOR:
WILKES COUNTY DEPARTMENT OF SOLID WASTE
9219 ELKIN HIGHWAY
ROARING RIVER, NORTH CAROLINA 28669

ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA
PERMIT NO. 97-04

PERMIT RENEWAL

FACILITY PLAN

JANUARY 2011
REV. MAY 2011
REV. DECEMBER 2015

PREPARED BY:

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CHARLOTTE, NC 28273
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VOLUME 1, SECTION II
FACILITY PLAN

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1.0 INTRODUCTION AND OVERVIEW

The facility plan describes the comprehensive development of the Wilkes County Roaring River Landfill as required by Subsection .1619 of the North Carolina Solid Waste Management Rules. The plan includes drawings and a report that present the long-term conceptual design for the landfill facility.

The Wilkes County Roaring River Landfill is owned and operated by Wilkes County under Permit No. 97-04. The landfill property is located near the town of Roaring River, North Carolina. The site is located on a group of knolls rising over 150 feet above the floodplain of the Yadkin River. The property boundary and disposal area are indicated on an enlarged portion of the USGS 7 ½ minute topographic map for Ronda, North Carolina (Figure No. FP-T). The landfill facility boundary includes most of the area between the disposal cells and the Yadkin River.

The existing MSW landfill (Permit No. 97-04) was designed with a liner and leachate collection system. The landfill is presently in Phase 4 (a vertical expansion over Phases 1, 2 and 3). Based on the current waste stream and a capacity analysis performed in 2015, the life of Phase 4 is projected to extend into FY 2020.

2.0 FACILITY DRAWINGS

2.1. Existing Conditions

Existing conditions at the project site is presented on Drawing No. FP-01. Drawing No. FP-01 shows the property boundaries, limits of the existing waste disposal areas, the existing environmental monitoring system, the landfill entrance road, landfill access and perimeter roads, scalehouse and office, and the convenience center. Current topography for the property is shown, as well as the 300-foot buffer from the property line and other site features.

2.2. Site Development

The Site Development Plan is presented on Drawing No. FP-02. In addition to showing many of the site features on Drawing No. FP-01, Drawing FP-02 shows the phase limits of the previous Phases 1, 2, and 3; active Phase 4; and proposed disposal areas (Phases 5 and 6), as well as, the location of the existing leachate line and collection pond.

Site suitability has previously been established, and therefore information regarding site suitability is not provided in this application for permit renewal. A previously permitted C&D unit was planned west of the Phase 6, but never constructed; therefore the unit is no longer shown as a viable disposal area.

2.3. Landfill Construction

Landfill construction is proposed to occur in two phases (5 and 6) beyond the current phase, with a projected operating life of approximately 19 years. Base grades were designed to be a minimum of four feet above groundwater and bedrock. Additional information and drawings related to groundwater and bedrock can be found in the *Design Hydrogeologic Report and Groundwater Monitoring Plan for the Wilkes County Roaring River Landfill Phase 3 & 4 Expansion*, dated April 2004. Drawing No. FP-04 shows final grades which were developed for fill slopes of 3 horizontal to 1 vertical (3H:1V).

2.4 Landfill Operation

Phasing for the facility is included on Drawing No. FP-05. The phasing plans include transitional contours for each phase of development. Stormwater control features are included in the Erosion and Sediment Control plans found in the *Design Hydrogeologic Report and Groundwater Monitoring Plan for the Wilkes County Roaring River Landfill Phase 3 & 4 Expansion*, dated April 2004, and *Erosion and Sediment Control Plan Revision to Phase 3 Expansion*, dated May 2008; and Engineering Plan, dated January 2011.

3.0 FACILITY REPORT

3.1 Waste Stream

Types of Waste Specified for Disposal: The facility will accept residential, commercial, and industrial waste, wastewater treatment sludges, and construction and demolition (C&D) debris for disposal. Hazardous waste as defined within 15A NCAC 13A, polychlorinated biphenyls (PCBs) wastes as defined in 40 CFR 761, and liquid waste will be prohibited from disposal in the landfill. Liquid waste is defined as any waste material that is determined to contain "free liquids" as defined by Method 9095 Paint Filter Liquids Test (SW-846), unless the waste is household waste other than septic waste, waste oil, leachate, or gas condensate derived from the landfill. Waste acceptance is further discussed in the Operations Plan.

Disposal Rates and Estimated Variances: Table 1 presents the Roaring River Landfill's annual waste disposal quantities for FY1994 through FY2015. As indicated in the table, MSW quantities fluctuated from a low of 32,925 tons (108 Tons per Day assuming a 6 day workweek and 7 holidays (TPD_6)) in FY1994 to a high of 233 TPD_6 in FY2000. The high and low disposal quantities are within twenty eight percent of the average annual disposal quantity of 55,624 tons (182 TPD_6), except for FY 1994. The amount of MSW disposed over this period has fluctuated from year-to-year. The annual increase in the amount of total waste disposed from FY 1996 through FY 2015 averaged 1% over the 20 year period.

Data from Table 1 and information on demographic and waste generation trends in Wilkes County have been used to estimate the growth rate for the amount of waste disposed at the facility. For planning purposes, the base annual waste stream is assumed equal to 54,058 tons, the quantity

received in FY2015. A steady growth rate of 1% per year has been assumed to represent the change in the waste stream over the future life of the facility. Using this growth rate, the projected disposal rate per year and cumulative totals, Phase 4 will reach capacity in FY 2020.

Facility Service Area: The facility receives waste generated within the boundaries of Wilkes County. At this time, Wilkes County has no plans to request a larger service area. The present population of Wilkes County specified herein is estimated to be about 67,300 people.

Waste Management Procedures: The following procedures are in use at the existing MSWLF unit and are proposed to continue. During operating hours, traffic is routed from the entrance gate to the scalehouse along a paved road. From the scalehouse, traffic is routed to a gravel road leading to the disposal area. Employees at the landfill are trained in the safety procedures for handling and detection of unapproved waste. The screening of unacceptable waste is done through the random checking of incoming loads by a landfill employee at the scalehouse and at the active tipping area. When unacceptable waste is detected at the scalehouse, the load is rejected and not permitted into the landfill. If unapproved waste is found at the tipping area, identification of the truck or persons is made (if possible) and documented. The waste is then identified and placed into an appropriate container and taken to a facility specifically approved to accept that type of waste for proper disposal. When this occurs, the event is reported to the appropriate authorities.

A convenience center and facility for the collection of hazardous household waste are provided near the scalehouse. These facilities enable residential users to dispose waste without having to drive to the working face of the landfill. White goods are collected in a separate area west of the landfill, and are removed by landfill staff and hauled to a local recycling facility. Tires are disposed of by customers and stacked into trailers in the designated tire disposal area as shown on Drawing No. FP-01. Wilkes County contracts with a private hauler to transport the tires to Concord and Pilot Mountain, North Carolina. The following materials are collected for recycling at the landfill: cardboard, mixed paper, old newsprint, aluminum, steel cans, used motor oil, glass, plastic, electronics, batteries, fluorescent bulbs, and mercury thermostats. The approximate locations of these features are indicated on Drawing No. FP-01.

Equipment Requirements: The Roaring River landfill personnel will maintain on-site equipment required to perform the necessary landfill activities. Periodic maintenance of all landfilling equipment will either be performed on-site or at designated maintenance facilities outside of the landfill. During the operational life of the facility, equipment needs will be reviewed annually, and additional equipment purchased or leased as needed. New equipment will be phased in as older equipment is retired.

A detailed list of equipment is included in the Operations Plan for the facility submitted with this Permit to Operate Renewal Application.

3.2 Landfill Capacity

Landfill capacity, by phase, was calculated using airspace volumes obtained using AutoDesk Civil3D/Survey software. The data and assumptions used are consistent with the disposal rates discussed in the preceding section, and are representative of the operational requirements and conditions anticipated for the new facility.

Operating Capacity: The operating gross capacities, by phase and total, are shown in Table 2 and listed below. The estimated operating life of the facility is approximately 19 years.

Phase	Area (Acres)	Gross Capacity (cubic yards)	Status
1	11.7	1,534,786	inactive
2	7.0		inactive
3	6.7	664,167	inactive
4	vertical	888,804	active fill area
5	5.6	798,379	not constructed
6	12	970,911	not constructed
Total	**43**	**4,857,047**	

Soil Resources: The in-place ratio of waste to soil used to calculate the operating life and operating soil requirements for each phase was assumed to be 7 to 1 which is generally consistent with results observed from air space utilization studies. This assumes an operating plan designed to minimize soil usage, and use of an alternate daily cover. The on-site soil resources, usage, and balances are shown by phase in Table 3. The deficit of soil during the operation of Phase 4 (and future Phases 5 and 6) can be satisfied by borrowing soil from other locations within the limits of the facility property or from off-site sources. Based on the conceptual design volumes, the total soil requirement over the life of the facility (Phases 3, 4 and 5) is approximately 128,774 cubic yards.

3.3 Containment and Environmental Control Systems

Base Liner Systems:

Phase 4 is a vertical expansion in nature. The current liner system consists of the following components from top to bottom:

- 12-inch granular protective and/or drainage layer with 12-inch tire chip layer;
- Non-woven geosynthetic cushion;
- 60 mil high density polyethylene (HDPE) textured geomembrane;
- Geosynthetic clay liner (GCL); and
- 18-inch compacted soil layer having a permeability no greater than $1x10^{-5}$cm/sec.

Leachate Management System:

The leachate collection and removal system (LCRS) was designed to meet the requirements of the North Carolina Solid Waste Management Regulations. The LCRS will include the following components:

- Drainage layer;
- Leachate collector and header pipes; and
- Leachate holding pond.

Leachate is conveyed through the drainage layer consisting of at least 24 inches of free-draining granular material. Within the drainage layer, a network of perforated collector pipes intercepts the leachate, conveying the leachate by gravity to the leachate header pipe. The header pipe discharges to a sump at the downgradient end of the landfill cell. Cleanouts are provided for all leachate collector lines and the leachate header pipe to provide access for video inspection and to clean out the pipes. Leachate is pumped from the sump to a holding pond outside of the cell. Leachate from the storage pond is periodically transported by tanker truck to the local wastewater treatment plant. More details on the leachate collection system are included in the Engineering Plan and in the application for permit to construct for Phase 3.

Cap System:

The cap system is described from bottom to top in the following paragraphs.

Subgrade: Additional soil will be placed as needed over the 12 inches of intermediate cover to provide a uniform base for construction of the final cap.

Gas Collection Layer: A geonet composite (geonet with geotextile fabric heat-bonded to both sides) will be placed directly on the intermediate cover. The geonet composite will serve as a migration zone for the lateral movement of landfill gas. The geotextile component will prevent the migration of soil into the geonet so that gas migration will not be impeded.

Infiltration Barrier: A composite infiltration barrier will consist of a textured 40 mil flexible membrane cap (FMC) placed on top of a geosynthetic clay layer (GCL), as discussed in the Engineering Plan of this report. The low-permeability soil layer, or the GCL, will lie directly above the gas collection layer. The FMC will consist of a linear low-density polyethylene (LLDPE) or PVC membrane.

Drainage Layer: A geonet composite will be placed directly on top of the flexible membrane cap. The geonet will promote drainage away from the infiltration barrier and towards the perimeter ditches. It will also help to protect the FMC from puncture.

Erosion Control Components (Protective Layer and Erosion Layer): A protective layer consisting of at least 18 inches of local soil will be placed on top of the drainage layer. A layer of topsoil material

or organically amended local soil at least 6 inches in thickness will be placed on top of the protective layer. The erosion and protective layers will not be heavily compacted so that vegetative growth will be promoted. Soil tests will be conducted prior to seeding to determine if amendments to the soil are needed to establish a healthy stand of vegetation.

Vegetative Cover: After placement of the erosion layer, the area that has been closed will be seeded with a grass mixture. Mulch and erosion control matting will be used as needed to further minimize erosion.

Gas Management System:

To protect public health and safety in the vicinity of the landfill, landfill gas produced by the decomposition of refuse will be controlled and monitored during the operational, closure, and post-closure periods. A gas management plan and gas monitoring program will be implemented for the purpose of maintaining the concentration of methane gas below the following regulatory levels:

- The concentration of methane gas generated is not to exceed 25 percent of the lower explosive limit (LEL) for methane in on-site structures (excluding gas control or recovery system components); and

- The concentration of methane gas is not to exceed the LEL for methane at the facility property boundary.

Landfill gas is a by-product from the decomposition of organic waste in a sanitary landfill. The major components of landfill gas are methane and carbon dioxide. Other gases, such as volatile organic compounds, are present in trace quantities. The landfill gas is proposed to be managed by a passive gas collection system. The gas may be recovered in the future with an active system if generation rates are sufficient to justify the additional costs.

Gas monitoring will be conducted during the active life of the landfill and throughout the closure and post-closure periods. At a minimum, quarterly monitoring of explosive gases will be conducted at all gas detection probes and in structures at the landfill. If additional structures are built, the monitoring program will be expanded to include the new structures. Gas detection probes will be installed around the boundary of the waste disposal unit. Probes should not be needed where site topography permits gas to be released to the atmosphere before it migrates to the property boundaries, or where the site is bounded by water. The Operation Plan contains more detailed information regarding landfill gas management.

(End)

TABLES

Table 1:
Roaring River Landfill Yearly Disposal Rate

Fiscal Year	Tons/year
FY 1994	32,925
FY 1995	53,892
FY 1996	41,372
FY 1997	57,827
FY 1998	58,196
FY 1999	63,217
FY 2000	71,136
FY 2001	59,143
FY 2002	60,635
FY 2003	60,114
FY 2004	61,686
FY 2005	61,649
FY 2006	57,391
FY 2007	58,121
FY 2008	58,220
FY 2009	57,484
FY 2010	50,984
FY 2011	48,031
FY 2012	51,474
FY 2013	52,801
FY 2014	53,362
FY 2015	54,058

Total	1,223,718	**Tons**
Annual Average	55,624	**Tons/year**
Daily Average	182	**Tons/day**

Notes:
1. Information on yearly tonnages and totals was obtained from NC DEQ Division of Solid Waste disposal reports for 1994 to 2008. Information obtain from Wilkes County Landfill scalehouse records for 2009 to 2015.
2. Daily average is based on a six day per work week and 7 holidays.

Table 2
Projected Yearly Disposal Rates

FY YEAR [1,2,4]	ANNUAL		CUMULATIVE		Required Disposal Capacity (CY)	Designed Waste Capacity from Table 3 (CY)
	Tons	CY [5]	Tons	CY	CY	CY
1994	32,925	62,064	32,925	62,064	2,004,707	Phase 1-3 (1,995,571 CY)
1995	53,892	101,587	86,817	163,651		
1996	41,372	77,987	128,189	241,638		
1997	57,827	109,005	186,016	350,643		
1998	58,196	109,700	244,212	460,343		
1999	63,217	119,165	307,429	579,508		
2000	71,136	134,092	378,565	713,600		
2001	59,143	111,485	437,708	825,086		
2002	60,635	114,298	498,343	939,384		
2003	60,114	113,316	558,457	1,052,699		
2004	61,686	116,279	620,143	1,168,978		
2005	61,649	116,209	681,792	1,285,188		
2006	57,391	108,183	739,183	1,393,370		
2007	58,121	109,559	797,304	1,502,929		
2008	58,220	109,746	855,524	1,612,675		
2009	57,484	108,358	913,008	1,721,033		
2010	50,984	96,106	963,992	1,817,139		
2011	48,031	90,539	1,012,023	1,907,678		
2012	51,474	97,029	1,063,497	2,004,707		
2013	52,801	99,531	1,116,298	2,104,238	827,010	Phase 4 (867,226 CY)
2014	53,362	100,588	1,169,660	2,204,826		
2015	54,058	101,900	1,223,718	2,306,726		
2016	54,599	102,919	1,278,317	2,409,645		
2017	55,145	103,948	1,333,461	2,513,593		
2018	55,696	104,988	1,389,157	2,618,581		
2019	56,253	106,038	1,445,410	2,724,619		
2020	56,816	107,098	1,502,226	2,831,717		
2021	57,384	108,169	1,559,609	2,939,886	780,281	Phase 5 (748,782 CY)
2022	57,957	109,251	1,617,567	3,049,136		
2023	58,537	110,343	1,676,104	3,159,479		
2024	59,122	111,447	1,735,226	3,270,926		
2025	59,714	112,561	1,794,940	3,383,487		
2026	60,311	113,687	1,855,251	3,497,174		
2027	60,914	114,824	1,916,165	3,611,997		
2028	61,523	115,972	1,977,688	3,727,969	836,567	Phase 6 (864,631 CY)
2029	62,138	117,132	2,039,826	3,845,101		
2030	62,760	118,303	2,102,586	3,963,404		
2031	63,387	119,486	2,165,973	4,082,890		
2032	64,021	120,681	2,229,994	4,203,570		
2033	64,661	121,888	2,294,655	4,325,458		
2034	65,308	123,106	2,359,963	4,448,564		

TOTAL in Place:	**1,223,718**	**2,306,726**
YEARLY AVERAGE (tons):	**55,624**	
AVERAGE (TPD[3]):	**182**	
PERCENTAGE ANNUAL INCREASE	**1%**	

NOTES:

1. Information on yearly tonnage and totals were obtained from the NC DEQ website "Data, Statistics, Reports, and Maps"
2. Tonnage data for FY 2011 to FY 2015 was obtained from scalehouse records
3. Averages are based on a six day per work week and 7 holidays.
4. Projected tonnage are based on a 1% increase from FY 2015
5. Projected volume based on an in-place density of: 1061 lb/cy

Table 3
Soil Balance

LANDFILL PHASING - SOIL BALANCE

MSW PHASE	AREA (acres)	NET GRADING (cy)	AIRSPACE (Gross Capacity) (cy)	SOIL LINER (cy)	LEACHATE DRAINGAGE (cy)	CAP (cy)	WASTE CAPACITY (cy)	DAILY COVER (-) (cy)	BALANCE (cy)
Phase 1	11.7		895,734	-28,261	-37,681	-37,681	792,111	-113,159	-179,101
Phase 2	7	43,016	639,052	-16,908	-22,544	-22,544	577,055	-82,436	-78,873
Phase 3	6.7	-99,741	664,167	-16,184	-21,578	0	626,405	-89,486	-205,411
Phase 4	0	0	888,804	0	0	-21,578	867,226	-123,889	-145,468
Phase 5	5.6	27,070	798,379	-13,527	-18,035	-18,035	748,782	-106,969	-111,461
Phase 6	12	319,306	970,911	-28,986	-38,647	-38,647	864,631	-123,519	128,154
Total	**43**	**289,651**	**4,857,047**	**-103,865**	**-138,486**	**-138,486**	**4,476,210**	**-639,459**	**-592,159**

Total soil requirement over the life of the facility (Phases 3, 4 and 5) -128,774

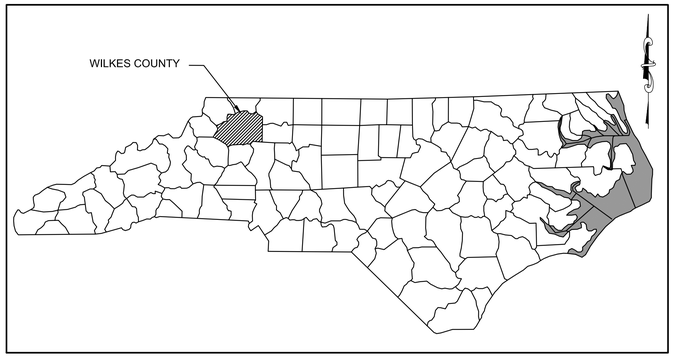
DESIGN VALUES (MSW)

MSW LINER SYSTEM SOIL THICKNESS (ft):	**1.5**
LEACHATE DRAINAGE LAYER - GRANULAR MATERIAL (ft):	**2.0**
MSW CAP SYSTEM SOIL THICKNESS (ft):	**2.0**
MSW: SOIL COVER RATIO	**7:1**

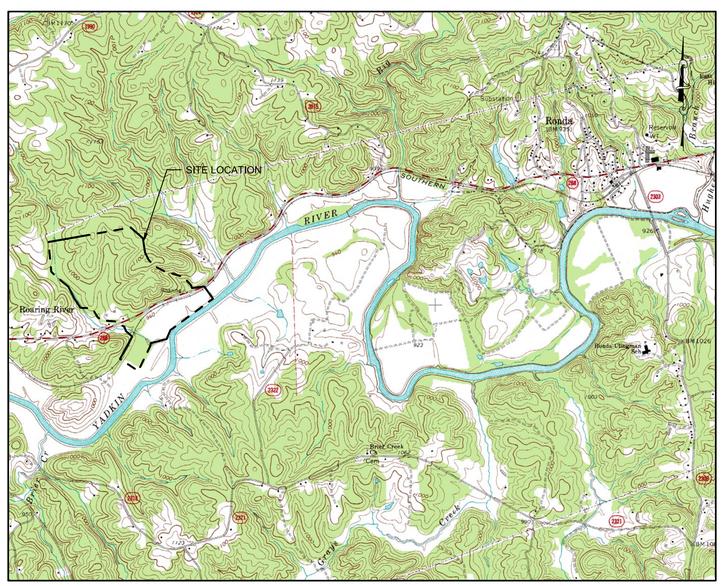
DRAWINGS

ROARING RIVER LANDFILL
PERMIT RENEWAL

WILKES COUNTY, NORTH CAROLINA



NORTH CAROLINA
COUNTY LOCATION MAP



VICINITY MAP

OWNER INFORMATION

PREPARED FOR:	WILKES COUNTY DEPARTMENT OF SOLID WASTE
ADDRESS:	9219 ELKIN HIGHWAY ROARING RIVER, NORTH CAROLINA, 28669
CONTACT:	KENT BRANDON (336) 696-5806 (336) 927-4117

PROPERTY INFORMATION

ADDRESS:	9219 ELKIN HIGHWAY ROARING RIVER, NORTH CAROLINA, 28669
NCDENR PERMIT:	97-04
ACREAGE:	145 ACRES

DRAWING INDEX

SHEET	DESCRIPTION
FP-T	TITLE SHEET
FP-L	LEGEND AND GENERAL NOTES
FP-01	EXISTING CONDITIONS
FP-02	SITE DEVELOPMENT PLAN
FP-03	SITE DEVELOPMENT PLAN: BASE GRADING PLAN
FP-04	SITE DEVELOPMENT PLAN: FINAL GRADE
FP-05	SITE DEVELOPMENT PLAN: PHASING PLAN

FACILITY PLAN
DECEMBER 2015

DATE		NO	BY	CK	APP
12/21/15	2015 PERMIT RENEWAL SUBMITTED TO DEQ		RH	LB	MM
	REVISIONS AND RECORD OF ISSUE				

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. DAVIS

DESIGNED	MM
DRAWN	RWH
CHECKED	LB
APPROVED	MM
DATE	12/21/15

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CHARLOTTE, NC 28273
PHONE: (704) 617-2037
NC CORP LIC: C-0782

ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

TITLE SHEET

PROJECT NO.
356

SCALE
N.T.S.

DRAWING NO.
FP-T

L:\Wilkes\dwg\2015 renewal\facility plan\FP-T TITLE SHEET.dwg Layout=Layout1

CONVENTIONAL SYMBOLS AND GENERAL NOTES

ENVIRONMENTAL MONITORING FEATURES

MW-X	EXISTING GROUNDWATER MONITORING WELL
MW-#	PROPOSED GROUNDWATER MONITORING WELL
MW-OW-#	EXISTING OBSERVATION WELL
MW-OW-X	PROPOSED OBSERVATION WELL
NES-OW-X	EXISTING NES WELL
NES-OW-#	PROPOSED NES WELL
MW-PW-X	EXISTING PERFORMANCE WELL
MW-PW-#	PROPOSED PERFORMANCE WELL
MW-X	EXISTING SENTINEL WELL
MW-#	PROPOSED SENTINEL WELL
EW-X	EXISTING EXTRACTION WELL
EW-#	PROPOSED EXTRACTION WELL
PZ-#	WETLANDS PIEZOMETER
PZ-X	PIEZOMETER
GP-X	GAS PROBE
GV-X	EXISTING GAS VENT
GV-#	PROPOSED GAS VENT
GW-X	EXISTING GAS WELL
GW-#	PROPOSED GAS WELL
SMP-X	SURFACE WATER MONITORING POINT
LMP-1	LEACHATE MONITORING POINT
B-X	BORE HOLE LOCATION
C-X	CORING LOCATION
SS-X	SOIL SAMPLING LOCATION
TP-X	TEST PIT LOCATION
W	WELL LOCATION
S-X	SPRINGHEAD LOCATION

SURVEY FEATURES

BM	BENCHMARK
CP	CONTROL POINT
	PROPERTY LINE
	EASEMENT
R/W	RIGHT OF WAY
x	FENCE LINE
	RAILROAD
	GUARDRAIL
	RESOURCE PROTECTION AREA

UTILITIES

	UTILITY POLE
	HYDRANT
	LIGHT POLE
	TANK (SIZE VARIES)
	TRANSFORMER
M	MANHOLE
	CLEANOUT
	VALVE
OHE	OVERHEAD ELECTRIC
UGE	UNDERGROUND ELECTRIC
OHT	OVERHEAD TELEPHONE
UGT	UNDERGROUND TELEPHONE
FM	LEACHATE FORCE MAIN
DCFM	DUAL CONTAINED LEACHATE FORCE MAIN
SS	SANITARY SEWER
PS	PROCESS SEWER
G	LANDFILL GAS LINE
UGG	NATURAL GAS LINE
W	POTABLE WATER
	SOLID PIPE (TYPE NOTED)
	PERFORATED PIPE (TYPE NOTED)
	CULVERT (SIZE NOTED)

LANDFILL AND ROAD FEATURES

	PAVED ROAD
	GRAVEL/DIRT ROAD
	EDGE OF PAVEMENT
	LIMIT OF WASTE/EDGE OF LINER
	FACILITY BOUNDARY/CELL LIMITS/PHASE LIMITS

BUILDINGS AND STRUCTURES

	BUILDING
	DAM
	FOUNDATION

HYDROLOGY

	APPROXIMATE 100 YEAR FLOOD PLAIN
	DITCH FLOW
	STREAM OR RIVER

VEGETATION

	SINGLE TREE
	TREE LINE
	SHRUB

EROSION AND SEDIMENT CONTROL FEATURES

SF SF	SILT FENCE
IP	INLET PROTECTION
	OUTLET PROTECTION (SIZE VARIES)
	DIVERSION BERM

TOPOGRAPHICAL FEATURES

100	EXISTING 10' TOPO CONTOUR
	EXISTING 2' TOPO CONTOUR
100	PROPOSED 10' TOPO CONTOUR
	PROPOSED 2' TOPO CONTOUR
100	GROUNDWATER SURFACE CONTOUR (FT ABOVE MEAN SEA LEVEL)
100	BEDROCK SURFACE CONTOUR (FT ABOVE MEAN SEA LEVEL)
100.00	SPOT ELEVATION

HATCHING

	WETLANDS
	RIPRAP
	WASHED STONE
	BUFFER AREA
	PROPOSED ROAD
	COMPACTED BACKFILL

SURVEY NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET, UNLESS INDICATED OTHERWISE.
3. ON-SITE TOPOGRAPHY PROVIDED BY SPATIAL DATA CONSULTANTS, INC. , 1008 HUTTON LANE, HIGH POINT, NORTH CAROLINA 27262, DATED FEBRUARY 26, 2011 AND MERGED WITH APRIL 2015 GROUND SURVEY PROVIDED BY COUNTY IN ACTIVE LANDFILL AREAS.
4. FEDERAL INSURANCE ADMINISTRATION, FLOOD INSURANCE RATE MAP, WILKES COUNTY, NC, INDICATES NO 100 YEAR FLOOD PLAINS ON SITE.
5. PROPERTY BOUNDARY BEARING AND DISTANCES PROVIDED BY TOM FRAZIER, R.L.S 1286 NC. ON MAY 8, 1989.
6. SITE CONTROL INFORMATION UPDATED BY SPATIAL DATA CONSULTANTS, INC. , 1008 HUTTON LANE, HIGH POINT, NORTH CAROLINA 27262, DATED MARCH 19, 2010.
5. THE SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE SEARCH AND ALL EASEMENTS AND ENCUMBRANCES MAY NOT BE SHOWN.

GENERAL NOTES:

1. SITE LIGHTING IS NOT PROPOSED FOR THIS PROJECT.
2. LANDSCAPING IS NOT PROPOSED FOR THIS PROJECT. HOWEVER THE BUFFER AREA SHOWN ON DRAWINGS WILL REMAIN UNDISTURBED EXCEPT FOR THE INSTALLATION OF UTILITIES, STORMWATER DRAINAGE FEATURES AND ACCESS TO THE SITE. WHEN POSSIBLE CLEARING WITHIN THE BUFFER WILL BE ALIGNED TO MINIMIZE VISUAL IMPACTS.
3. SOIL STOCKPILE AREAS WILL BE ESTABLISHED TO FACILITATE PHASED CONSTRUCTION. STOCKPILE LOCATIONS AND SIZE MAY VARY AND MAY NOT BE LIMITED TO THE AREAS SHOWN . SILT FENCE WILL BE INSTALLED AROUND THE BASE OF THE STOCKPILE.

DATE	REVISIONS AND RECORD OF ISSUE	NO	BY	CK	APP
12/21/15	2015 PERMIT RENEWAL SUBMITTED TO DEQ		RH	LB	MM

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. DAVIS

DESIGNED MM
DRAWN RWH
CHECKED LBB
APPROVED MM
DATE 12/21/15

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JOYCE ENGINEERING
9731-F SOUTHERN PINE BLVD
CHARLOTTE, NC 28273
PHONE: (704) 817-2037
NC CORP LIC: C-0782

ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

LEGEND AND GENERAL NOTES

PROJECT NO. 356

SCALE N.T.S.

DRAWING NO. FP-L

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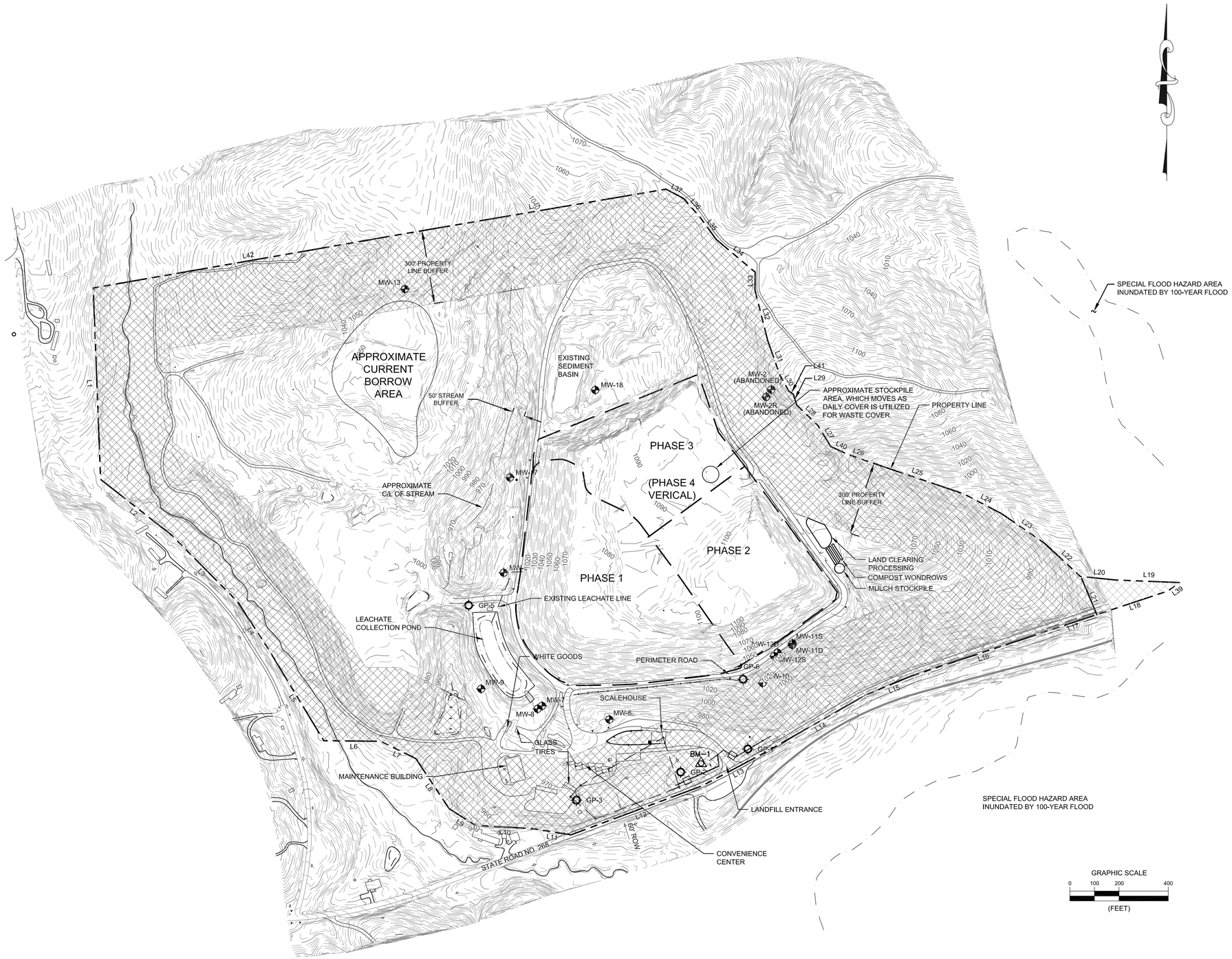

DESIGNATION	NORTHING	EASTING	ELEVATION
BM-1	900380.982	1413671.867	966.22

PROPERTY BOUNDARY INFORMATION

LINE	LENGTH	BEARING
L1	783.33	S02°16'26"E
L2	364.97	S51°59'07"E
L3	384.09	S44°50'19"E
L4	232.98	S32°55'19"E
L5	430.34	S31°16'36"E
L6	232.44	S89°26'08"E
L7	158.45	S63°41'08"E
L8	243.85	S33°41'13"E
L9	127.53	S57°38'18"E
L10	228.75	S86°57'01"E
L11	160.00	S80°57'35"E
L12	569.61	N69°25'34"E
L13	289.95	N61°59'14"E
L14	470.66	N60°09'52"E
L15	209.89	N67°26'41"E
L16	567.86	N71°38'28"E
L17	217.04	N71°34'34"E
L18	303.05	N71°34'34"E
L19	261.04	N87°49'27"W
L20	143.96	N85°27'28"W
L21	164.71	N22°59'38"W
L22	196.05	N46°54'20"W
L23	214.23	N55°22'15"W
L24	171.39	N62°08'46"W
L25	424.41	N71°23'03"W
L26	80.17	N70°36'24"W
L27	100.32	N30°42'05"W
L28	130.02	N46°07'41"W
L29	42.10	N13°44'33"W
L30	73.52	N29°57'55"W
L31	149.15	N19°39'34"W
L32	211.05	N14°35'19"W
L33	77.45	N00°52'23"E
L34	207.16	N50°04'05"W
L35	107.11	N36°07'58"W
L36	105.58	N41°00'08"W
L37	81.60	N62°17'08"W
L38	1075.15	S80°14'35"W
L39	62.84	N56°39'59"E
L40	71.45	N67°44'08"W
L41	18.87	N61°24'41"W
L42	1285.43	S80°14'35"W

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	RH	LB	MM

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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

EXISTING CONDITIONS

PROJECT NO.
356

SCALE
AS SHOWN

DRAWING NO.
FP-01

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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

SITE DEVELOPMENT PLAN

PROJECT NO.
356

SCALE
AS SHOWN

DRAWING NO.
FP-02

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APPROVED	MM
DATE	12/21/15

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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

SITE DEVELOPMENT: BASE GRADING PLAN

PROJECT NO. 356

SCALE AS SHOWN

DRAWING NO. FP-03

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FUTURE
PHASE 5
5.6 ACRES

PHASE 3 & 4
6.7 AC
(CURRENT DISPOSAL AREA)

FUTURE
PHASE 6
12.0 ACRES

500'-0" RADIUS FROM OBSERVED PRIVATE RESIDENTS

50'-0" STREAM BUFFER

APPROXIMATE C/L OF STREAM

EXISTING LEACHATE LINE

LEACHATE COLLECTION POND

WHITE GOODS

GLASS

TIRES

MAINTENANCE BUILDING

SCALEHOUSE CONVENIENCE CENTER

PHASE 1

PHASE 2

PERIMETER ROAD

LANDFILL ENTRANCE

LAND CLEARING PROCESSING

COMPOST WINDROWS

MULCH STOCKPILE

PROPERTY LINE

300'-0" PROPERTY BUFFER

MW-17 MW-5 MW-8 MW-7 MW-6 MW-11S MW-2 (ABANDONED) MW-2S (ABANDONED) GP-5 GP-6 GP-7 GP-8 GP-9

GRAPHIC SCALE
0 50 100 200
(FEET)

NO	BY	CK	APP
	RH	LB	MM

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APPROVED	MM
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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

SITE DEVELOPMENT:
FINAL GRADE

PROJECT NO.
356

SCALE
AS SHOWN

DRAWING NO.
FP-04

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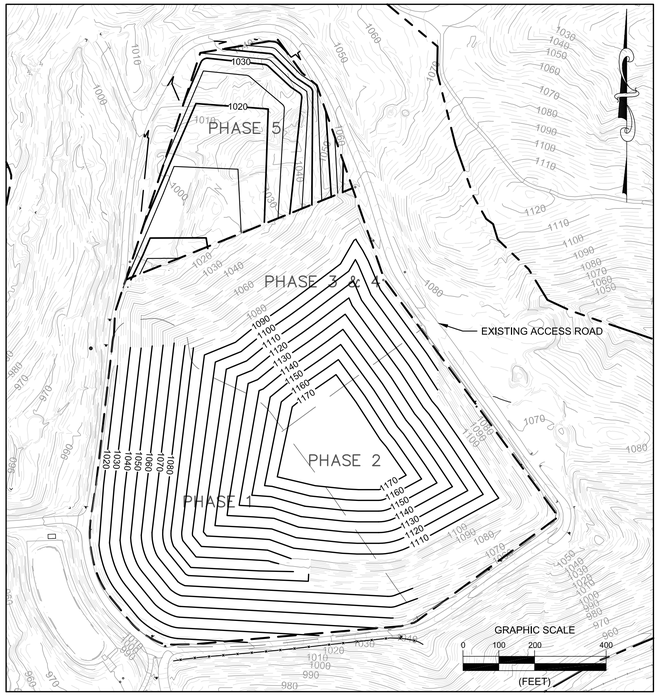
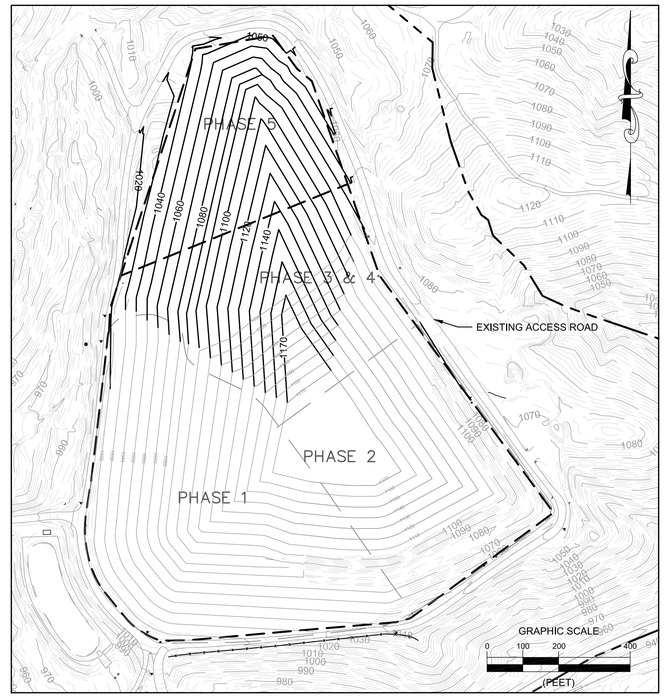
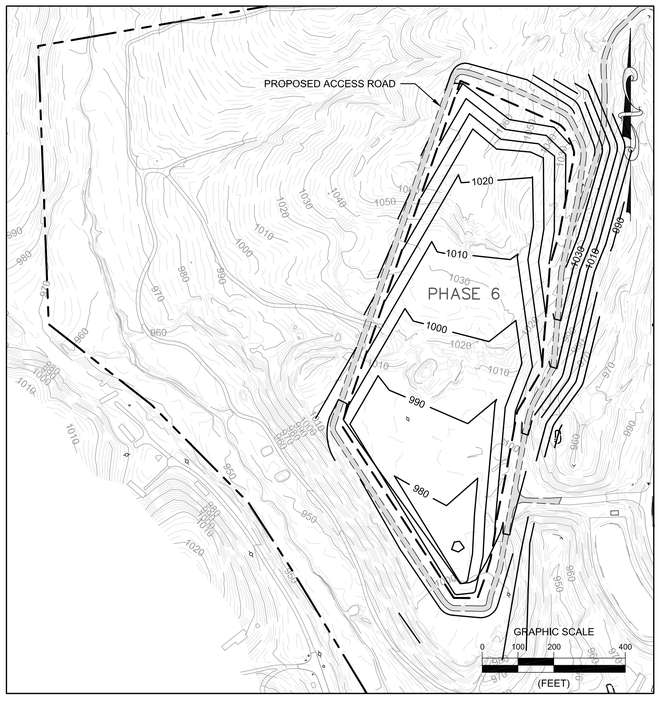


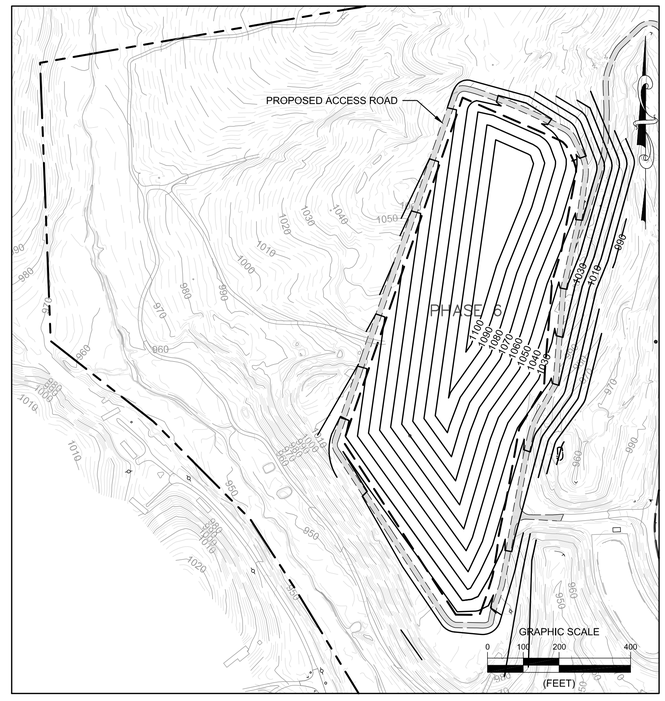
PHASE 4 FINAL GRADE - PHASE 5 BASE GRADE



PHASE 5 FINAL GRADE



PHASE 6 BASE GRADES



PHASE 6 FINAL GRADES

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APPROVED MM
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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

SITE DEVELOPMENT:
PHASING PLAN

PROJECT NO.
356

SCALE
AS SHOWN

DRAWING NO.
FP-05

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PREPARED FOR:
WILKES COUNTY DEPARTMENT OF SOLID WASTE
9219 ELKIN HIGHWAY
ROARING RIVER, NORTH CAROLINA 28669

ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA
PERMIT NO. 97-04

OPERATIONS PLAN

JANUARY 2011
REVISED AUGUST 2011
REVISED OCTOBER 2014
REVISED DECEMBER 2015

PREPARED BY:

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JOYCE PROJECT NO. 356
NORTH CAROLINA CORPORATE LIC: C-0782

VOLUME 2, SECTION V
OPERATION PLAN

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APPENDICES

Appendix V-1 Random Waste Screening Program Forms
- Form A - Waste Inspection Forms
- US EPA Hazardous Waste Inspection Decision Tree

Appendix V-2 Tarp Data Sheet

Appendix V-3 Temperature Log Data Sheet

Appendix V-4 Compost End User Brochure

Appendix V-5 Landfill Gas Monitoring Guidance Document

DRAWINGS

Drawing No. OP-T Title Sheet
Drawing No. OP-L Legend and General Notes
Drawing No. OP-01 Existing Conditions
Drawing No. OP-02 Site Development Plan
Drawing No. OP-03 Phasing Plan: Phase 4 / Years 1-5

1.0 GENERAL

This operation plan describes how the design and construction plans will be implemented during the life of the facility. The plan consists of drawings and accompanying text which illustrate existing conditions, cell progression, waste placement and daily operations, leachate management, special waste management, buffer zones and soil borrow procedures.

The Wilkes County Landfill is owned and operated by Wilkes County. Approximately 180 tons of municipal solid waste is managed daily at the site which is located off Highway 268 in Roaring River. The facility began accepting waste in October 1993 when lined Phase 1 began operating. Wastes are currently placed in Phase 4, which is a vertical expansion over Phases 1, 2 and 3. Leachate collected from Phases 1, 2, and 3 is stored in a lined surface impoundment, and then transported to the Wilkesboro Wastewater Treatment Plant for disposal.

Other on-site development consists of a scale house and office, maintenance building, recycling area, wood disposal area, and a soil borrow area. Much of the remainder of the site is wooded. See Drawing OP-1 for an illustration of the existing conditions at the site.

2.0 OPERATIONS DRAWINGS

2.1 Existing Conditions

The site existing conditions is presented on Drawing No. OP-01 and currently includes the following components:

- Active MSW landfill
- Convenience center (drop-off area for recyclables and waste)
- Office and maintenance building
- Weighing scales
- Tire collection area
- White goods collection area
- Land clearing debris collection area
- Yard trash collection and compost area

The drawing also shows the limits of the existing waste disposal area, the environmental monitoring system, the landfill entrance road, landfill access and perimeter roads, scale house, and office. Current topography for the property is shown, as well as the neighboring residence and wells, the 300-foot buffer from the property line, and other site features.

2.2 Proposed Site Development

Development of Phase 4 is presented on Drawing No. OP-02. The construction of the Phase 4 disposal area described in the Engineering Plan consists of 6.7 acres.

The components listed in the existing conditions section above are included in this drawing in addition to the leachate holding pond, force main line, and overhead electrical.

The on-site soil resources, usage, and balances are shown in Table 3 of the Facility Plan. The deficit of soil during the operation of Phase 4 can be satisfied by excavating from the large stockpile on the northern end of Phase 6.

2.3 Operations

The progression of operations for Phase 4 is presented on Drawing No. OP-03. This drawing includes the progression of initial waste placement, transition contours, and final contours.

3.0 GENERAL OPERATING CONDITIONS

3.1 Hours of Operation

The landfill is open to private waste haulers and the public from 7:00 a.m. to 5:00 p.m. and the convenience center hours are 7:00 a.m. to 6:00 p.m. Monday through Saturday. The following holidays are observed: New Year's Day, Martin Luther King Day, Easter, Memorial Day, July 4, Labor Day, Veterans Day, Thanksgiving, Christmas Eve and Christmas Day.

3.2 Site Access and Safety

Access to the landfill is controlled through a single access road with a secure gate to prevent access when the landfill is not open. A sign containing information required in Rule .1626(6)(e), (i.e., dumping procedures, hours, permit number, etc.) is posted at the landfill entrance. During the hours of operation, traffic is routed from the entrance gate and scale house to a gravel road leading to the disposal area. Directional signs and speed limit signs are posted to provide traffic control. The road is maintained so that it is passable during all weather conditions. An attendant is on duty at the scale house at all times during operating hours.

3.3 Waste Acceptance

The landfill will accept only those solid wastes included in the current permit, including household, commercial and industrial solid wastes. These are defined in Rule .1602 as follows:

- Household waste means any solid waste derived from households including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas.

- Commercial solid waste means all types of solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities, excluding residential and industrial wastes.

- Industrial solid waste means solid waste generated by manufacturing or industrial processes that is not a hazardous waste regulated under Subtitle C of RCRA. Such waste may include, but is not limited to, waste resulting from the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and related products/by-products; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/ foundries; organic chemicals; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay, and

concrete products; textile manufacturing; transportation equipment; and water treatment. This term does not include mining waste or oil and gas waste.

Neither spoiled food, hatchery waste, nor other animal waste has been received historically in quantities large enough to be problematic for operations. In the event that such wastes are received, they will be immediately buried and covered with a thick layer of soil followed by nonputrescible municipal solid waste. If asbestos waste is received, it shall be managed in accordance with 40 CFR 61. The waste will be disposed of at the bottom of the working face and covered immediately with soil in a manner that will not cause asbestos particles to become airborne. Asbestos disposal locations will be documented using a GPS device and kept on record.

On or before August 1 of each year, Wilkes County will report to the Solid Waste Section the amount of waste received in tons at this facility and disposed of in the landfill units. Data will be transmitted on forms prescribed by the Section. The report will include the following:

- The reporting period shall be for the previous year beginning July 1 and ending on June 30.
- The amount of waste received and landfilled in tons, compiled on a monthly basis by county or transfer station of origin and by specific waste type if diverted to a specific unit within the permitted facility; and
- The completed report shall be forwarded to the Regional Waste Management Specialist for the facility. A copy of the completed report shall be forwarded to the County Manager of each county from which waste was received.

3.4 Prohibited Waste

A sign is posted at the landfill gate (see Section 2.B above) that reads "No hazardous or liquid waste accepted without written permission from the Division of Solid Waste Management". The landfill will not accept:

- Hazardous waste as defined within 15A NCAC 13A, including hazardous waste from conditionally exempt small quantity generators;

- Polychlorinated biphenyl (PCB) wastes as defined in 40 CFR 761;liquid wastes (i.e., any waste material that is determined to contain "free liquids" as defined by SW-846 Method 9095 (Paint Filter Liquids Test), unless the waste is household waste other than septic waste or waste oil, or leachate or gas condensate derived from the landfill (however, leachate and gas condensate may only be recirculated in cells with liner constructed as described in Rule .1624(b)(1)(A)(i).); and

- Barrels and drums unless they are empty and sufficiently perforated, except fiber drums containing asbestos;

- Other wastes specifically banned from landfill disposal by rule or statute, such as lead acid batteries, whole tires, used oil, aluminum cans, wooden pallets, oil filters, plastic bottles, discarded computer equipment and televisions, fluorescent bulbs, mercury thermostats or oyster shells.

Wilkes County will notify the Division within 24 hours of attempted disposal of any waste the landfill is not permitted to receive, including waste from outside the area the landfill is permitted to serve. The waste screening program is described later in this Operation Plan.

3.5 Special Wastes

The landfill accepts "special waste" such as tires, white goods, wood waste, and yard waste. These special wastes are separated from the general disposal area.

The tire collection shall be managed in accordance with Solid Waste Management Regulations Section .1100. Section .1107 provides detailed scrap tire collection site operational requirements.

1) Scrap tires stored indoors shall meet conditions for the Standard for Storage of Rubber Tires, NFPA 231-D1986 by the National Fire Protection Association.
2) All scrap tire collection sites processing tires outdoors must comply with technical and operational standards (2)(a) through (2)(l) of the Section .1107.
3) Processed tires shall be stored in accordance with the requirements of indoor/outdoor storage rules (a) temperature rules, and (b) residuals from the scrap tire disposal.
4) The Division may approve exceptions to the technical and operational standards (a) at least once during 30-day period all scrap tires are removed from the site for disposal; and (b) the site owner has sufficient fire suppression equipment or materials on-site to extinguish potential fire.

Tires are collected at the designated tire collection area and placed in a trailer for transportation to disposal. The County contracts with a private hauler to transport the tires to an approved facility for recycling and/or disposal.

White goods are separated from the general waste and stored. The Landfill staff removes and hauls the collected white goods to a local recycling facility. The landfill's recycling area handles cardboard, mixed paper, old newsprint, aluminum, steel cans, used motor oil, glass and plastic.

Clean, untreated wood waste (largely pallets) is separated and stored on-site until it can be recycled, boiler fuel, or ground for mulch. C&D waste that is not appropriate for recycling or mulching is currently disposed in the lined landfill.

Wilkes County receives yard waste from Wilkes County. This waste consists of yard and garden waste, silvicultural waste, untreated and unpainted wood waste. The facility may contract with a third party to grind the waste on site and compost it in their permitted Type 1 Composting Facility, or it will be hauled to another location for processing.

3.6 Litter Control

The public judges a landfill site by the things that they see. While there is no way to catch every piece of paper, scattered and blowing litter can be minimized by keeping the size of the working face small and by covering parts of the cell as it is constructed. Some measures that may be taken to minimize litter are:

a. Unload vehicles at the base of the working slopes to use the working face itself as a wind screen.

b. Unloading against the wind can help to keep the load compact until the loader can push the waste onto the working face.

c. Add a thin layer of cover material to the compacted working face periodically throughout windy days to help

d. Heavier waste materials can be used on the surface to help keep lighter waste materials from dislodging or becoming airborne.

e. Temporary litter fences strategically located on the working face help intercept and trap blowing litter. Any litter recovered from such fences, as well as litter blown into adjacent areas shall be collected and landfilled at the conclusion of each day of operation. Multiple defenses of temporary fences and/or berms help to contain windblown material during operations. In addition, landfill personnel will pick up windblown litter along the access road and in locations around the active disposal area.

3.7 Equipment

The following list of equipment is currently in use at the landfill for current operations averaging approximately 180 tons of waste disposed per day (TPD_6):

Type	Model	Quantity
Trucks	Rolloff Truck	1
	Road Tractor with Dump Trailer	1
	Articulated Truck	1
Compactors	CAT 826G or Equivalent	1
	Back-up	1
Bulldozer	Cat D6 or Equivalent	1
Excavator	Cat 320BL or Equivalent	1
Loader	Cat 963C Trackloader or Equivalent	1
	Bobcat Skidsteer Loader	1
Other	Motorgrader	1
	General Purpose Tractor	1
	Hydroseeder	1

As the waste stream changes during the operational life of the facility, equipment needs will be periodically reviewed and additional equipment purchased or leased as needed. New equipment will be phased in as older equipment is retired.

3.8 Air Quality

Open burning of solid waste including yard waste and brush is prohibited at the landfill. Burning of brush and/or stumps would only be requested on an infrequent basis in conjunction with construction events and approved by the Section in accordance with Rule .1626(5)(b) prior to burning activities taking place.

3.9 Dust, Odor, Fire and Vector Control

Dusty road surfaces will be sprayed with water from a water truck during windy, dry weather. Odors and disease vectors will be controlled by promptly covering the waste at the working face, and by the use of daily cover. Daily cover is described in more detail in a subsequent section.

Incoming waste loads shall be observed by site operators for evidence of fire such as flames, smoke, or the odor of burning material. Burning loads will be extinguished before dumping if possible. If there is evidence of fire in the landfill itself, the Wilkes County Solid Waste Director will be notified immediately. If possible, the waste will be removed or segregated from other waste in the disposal area. The landfill operator will evaluate the situation to determine whether the fire can be extinguished using fire extinguishers or equipment present at the site, or if off-site equipment will be needed. If necessary, the local fire department (Roaring River Volunteer Fire Department) will be called to render assistance in extinguishing the fire. Fires that occur at the landfill will be reported verbally to the Division within 24 hours and in writing within 15 days.

Fire extinguishers shall be located on each piece of equipment on site. Equipment operators shall be trained in the use of these extinguishers. Fire extinguishers will be used for small, localized fires. A stockpile of soil shall be maintained near the working face to be used for extinguishing small surface fires that may be too large to control with the fire extinguishers carried on the landfill equipment.

Emergency equipment will be called in the case of fires too large to be extinguished with fire extinguishers or soil as described above. Water contained in sedimentation ponds and the Yadkin River can serve as emergency reservoirs to aid local firefighters in the extinguishing of larger fires.

3.10 Scavenging/Salvaging

The unauthorized removal of waste and scavenging at the landfill is prohibited. Removal of recyclable or reusable items is sometimes authorized when recovery of such items can be accomplished with no risk to landfill staff or the general public, for instance, prior to disposal on the working face. Landfill personnel may remove salvageable materials and place them at the recycling center for removal by others. The general public is not allowed to scavenge items from the working face, and landfill staff attempts to prevent them from coming in contact with waste. The placement of additional roll-off containers near the scalehouse should help keep residential users from coming in contact with the waste.

3.11 Type 1 Composting Facility

3.11.1 Waste Quantities

Wilkes County receives yard waste from Wilkes County. This waste consists of yard and garden waste, silvicultural waste, untreated and unpainted wood waste. The facility may receive up to 175 tons of this type of waste per month.

Accurate records of incoming waste should be kept at the scale house. These records should differentiate between loads of brush (including all land clearing debris), clean wood and loads of leaves or grass clippings.

3.11.2 Design Considerations

Design Capacities and Product Quality

The facility currently receives an average of 100 tons per month of compostable waste. This waste is stockpiled until sufficient material is available to produce a windrow.

The following table summarizes the design criteria used to verify adequate space at the facility for the composting operation. As a factor of safety, it was assumed that the density of the product remains the same as the incoming waste stream.

Total waste stream (by weight)	1,000 tons (annual)
Total waste stream for composting (95%)	950 tons
Density (assumed average)	500 lb/cubic yard
Composting waste stream (by volume)	3,800 cubic yards (102,600 ft^3)
Cross-section windrow 2' (top) x 15' (base) x 5' (ht)	42 square feet
Total length windrow required	2,500 feet
At 100' length	25 windrows needed annually
With 15' base and 10' aisle, total acreage required	0.25 acres maximum (running 3 windrows at a time)

The site is designed with a working area for the Type 1 facility of approximately 0.25 acres as illustrated on Drawing No. OP-01. Sufficient room is available for the operations.

Site Plan

The composting facility is located southeast of the active cell. The location is shown on Drawing No. OP-01.

The grinding and composting area, shown on Drawing No. OP-01, has an approved Erosion and Sediment Control Plan that diverts stormwater. The area will continue to operate under the guidelines of the approved plan.

3.11.3 Operations

General Description

Incoming yard waste and land clearing and inert debris (LCID) is weighed and directed to the mulching operational area. The LCID will be temporarily stockpiled until processing or removal by a third party. The LCID material will be turned over periodically to prevent the material from heating and to reduce the potential of combustion. The facility may contract with a third party to grind the wood waste at the site or haul it to another location for processing.

If the facility conducts active composting, the wood waste will be processed by a grinder and placed in windrows and turned over several times to mix the materials. If necessary, water will be added during the stabilization process. The pile will be sprayed as it is turned on an as needed basis. For optimum composting the moisture should be maintained between 45% and 60%. Dryer than 45% and the microbial action is slowed; higher than 60% and the material becomes difficult to handle and difficult to aerate.

The temperatures are taken at a minimum of each third (3 separate places) of the windrow. It is suggested that the temperature be controlled by turning (aerating) to assure that the compostable material is maintained at an optimum range for decomposition (between 104°F and 113°F) and then allowed to elevate to 131°F where it must be maintained for a period of 3 consecutive days as required by Rule .1406(10). When the temperature within the windrow falls below 120 ^{o}F – 130°F during the final stages of composting, the windrow is turned. Windrow construction and turning frequency will be sufficient to maintain aerobic conditions to produce a compost product in the desired time frame. Separate records are kept for each windrow. Once a windrow is constructed, it is assigned an I.D. number and folder which are used over the lifespan of the windrow. Every time windrow data is taken, it is documented and logged in the folder.

A nitrogen source may be added to the yard waste as needed to promote the compost process. The County uses calcium nitrate when necessary. The calcium nitrate is spread by hand and mechanically mixed.

The process from grinding though stabilization is expected to take 4 weeks. The final time frame is a function of material density, material type, moisture and operational controls.

Once the windrow begins to cool indicating stabilization, the County removes the larger particles are reuses them in the process or used as woodchips or mulch. By keeping the coarser materials in the compost, it enables more oxygen to get into the windrows and produces more compost in the finished product. The compost is now stockpiled. Depending on the end use requirements, the compost may be screened again prior to stockpiling if a finer screen is available. The larger particles would be either reused in the process or used as a coarser product.

If the material is free of sharp particles, has no offensive odor, and has minimal pathogens, it may be used in an unrestricted way.

Once the compost meets the regulatory requirements for distribution to the public, it can be released for use. As the public obtains the material they must be given the information indicated in Section 3.11.8.

3.11.4 Waste Acceptance Rule .1406 (6)

The Type 1 compost facility shall accept only yard and garden waste, silvicultural waste, untreated and unpainted wood waste. No municipal solid waste (MSW), hazardous waste, asbestos containing waste, or medical waste shall be accepted at the facility. The County accepts yard waste in a non-bagged state or in approved biodegradable bags. Deliveries are monitored at the site. The County anticipates little contamination of the material.

3.11.5 Monitoring Requirements Rule .1406 (9)

The windrows are monitored for temperature daily. A log will be kept of all temperature readings, which includes the location of the probes. A copy of the temperature log is contained in Appendix V-4.

Moisture should be kept in the range of 45% - 60%. Water should be added as required to stay within this range. Temperature will be monitored daily until readings of 131°F are achieved for three (3) consecutive days. To monitor temperature, the probe should be inserted 12"- 24" every 50' along the windrow at a 45° - 90° angle.

3.11.6 Temperature Parameters Rule .1406 (10)

For Type I facilities, the compost process must be maintained at or above 55°C (131°F) for 3 consecutive days and aerated to maintain elevated temperatures.

3.11.7 Addition of Nitrogen Bearing Materials Rule .1406 (13)

Nitrogen compounds may be added as necessary to adjust the nutrient balance for optimum product development. Only approved waste materials (i.e. grass clippings, leaves) or chemical compounds may be added. Nitrogen rich materials can decompose rapidly and cause odor problems. Materials such as grass clippings must be incorporated into the process as soon as possible.

To determine if nitrogen is necessary, the carbon to nitrogen ratio should be calculated. For proper composting, this ratio should be greater than 25:1, but less than 40:1 at the start of composting. Incoming materials have the following estimated ratios:

- Grass clippings 12 - 15:1
- Dry leaves 40:1
- Paper and wood 200:1
- Sawdust 200 - 500:1

Thus, adjustment may be necessary after grinding, screening and blending the feedstock materials.

3.11.8 Classification/Distribution of MSW Compost Products Rule .1407

Requirements

For unrestricted use, the finished Type I compost must meet the following criteria:

- Minimal pathogenic organisms
- Free from offensive odors
- Containing no sharp particles
- Man made inerts do not exceed 1 inch in size

If these criteria are met then the finished compost material will be marketed to residents of the County and surrounding areas with directions provided.

Labeling

When the Type 1 compost material is to be marketed to the public, sufficient information should be provided to the public to:

- Inform users of the benefits of using compost
- Advise users on suggested uses of product
- Inform users of cautions in using product
- Inform users of composition of the material including nutrients and contaminants
- Inform users of source of feedstock

Appendix VI-5 includes samples of informative brochures that may be provided to the end user.

4.0 RANDOM WASTE SCREENING PROGRAM

4.1 Authority

The Wilkes County Solid Waste Department has developed this "Random Waste Screening Program" in accordance with North Carolina's Solid Waste Management Regulations, Rule .1626(1)(f). Key elements of Rule .1626(1)(f) addressing waste screening are as follows:

No hazardous or liquid wastes as defined in 15A NCAC 13A or materials shall be accepted at the landfill except as specifically authorized by the facility permit or by the Division. The owner or operator shall implement an inspection program to detect and prevent disposal of hazardous and liquid wastes and polychlorinated biphenyls (PCB). This program shall include, at a minimum:

- Random inspections of incoming loads unless the owner or operator takes other steps to ensure that incoming loads do not contain regulated hazardous or liquid wastes or PCB wastes;
- Records of any inspections;
- Training of facility personnel to recognize regulated hazardous waste, liquid waste, and PCB wastes; and
- Development of a contingency plan to properly manage any identified hazardous and/or liquid wastes.

4.2 Random Selection

Random selection of vehicles to be inspected will be conducted on a regular basis, depending on personnel available. At least one vehicle per week, but not less than one percent by weight of the waste stream (based on the previous week's total), will be randomly selected at the working face by the personnel conducting the inspection. A random truck number and time will be selected (e.g., the tenth load after 10:00 a.m.) on the day of inspections.

4.3 Record Keeping

Report forms for record-keeping purposes are included in Appendix V-1. These forms are completed at each inspection. All reports and resulting correspondence are maintained at the Wilkes County Landfill office for the life of the landfill and during the post-closure period.

4.4 Training

Inspections will be carried out and supervised by landfill staff trained to identify and manage hazardous and liquid waste. Landfill operators responsible for screening waste are trained by attending the Waste Screening training course offered by the Solid Waste Association of North America.

4.5 Inspection Site Location

Inspections will be conducted in a designated area near the working face of the landfill.

4.6 Action Plan

The following action plan details the procedure for conducting random waste inspections.

1) Dump single load in prepared area. Detain truck and driver until inspection is completed.

2) Spread waste with compactor and/or hand tools as appropriate. Hand rake loads that include items such as large closed containers to avoid possible rupturing of the containers. Have appropriate safety equipment present. Minimum safety equipment will include:

- Rubber gloves;
- Rubber boots;
- Safety glasses; and
- Long handled hoe.

3) Examine waste for excluded waste and/or safety hazards:

- Containers labeled hazardous;
- Excessive or unusual moisture;
- Regulated biomedical (red bag) waste;
- Powders, dusts, smoke, vapors, or chemical odors;
- Sludges, pastes, slurries, or bright colors (such as dyes); and
- Unauthorized out-of-County waste.

4) Take appropriate action(s) as follows:
- Incorporate acceptable waste into working face.
- Hold suspect waste for identification by on-site personnel and, if necessary, confirmation by others such as a contract laboratory, hazardous waste management firm, or state and/or federal regulator.
- Interview driver and hauler to identify the source of suspect waste in the load.
- Hold rejected hazardous or liquid waste for generator.
- Arrange for hazardous or liquid waste collection by licensed collector.

5) Document Actions:
- Record Inspection.
- Retain Reports.
- Report hazardous, liquid or PCB wastes to Solid Waste Section – NC DEQ.

5.0. SUBCELL PROGRESSION AND WASTE PLACEMENT

5.1. Subcell Progression

Phase 4, as well as successive phases, will be constructed with multiple subcells and stormwater segregation features to limit the amount of stormwater runoff that becomes leachate. Inactive subcells will be separated from the active area by the use of temporary berms to segregate the uncontaminated runoff. As subsequent subcells are opened in the planned sequence, uncontaminated stormwater can be diverted around the active subcells for collection and removal at the northwest corner of the cell. Stormwater will be drained from the collection area into the existing drainage channel leading to the sediment basin north of Phase 3.

Drawing OP-03 shows annual phases of development for Phase 4 of the landfill. The grades are projected based on the waste stream increasing at a rate of 1% as discussed in the Facility Plan.

5.2. Waste Placement and Compaction

The waste will be tipped in the active subcell as closely as possible to the working face then pushed, if necessary, to the desired area. The length of the daily working face will be maintained at approximately 100 feet in order to provide adequate space for several trucks to dump at the same time. The width of the working face will vary somewhat depending on the rate of waste acceptance on a given day, weather conditions and other factors, but will be maintained as small as possible. The waste will be compacted as described below with one of two steel-wheeled compactors the County owns (see equipment list earlier in this section).

To minimize the chance of damage to the liner in any new subcell, the initial lift of waste will be at least 5 feet thick, and will consist of only residential, non-bulky waste. Compaction will be minimal because later lifts will surcharge the initial lift so that there is no net loss of density. Typical compaction procedures on lifts above the initial one will involve placement of waste in thin layers (1-2 feet thick) as flat as is practical. The compactor will roll across and slightly past the waste (to prevent wind-blown material leaving from the edge of the lift) a minimum of three times. Previous calculations have determined that the approximate in-place density of waste and soil combined is around 1,200 pounds per cubic yard. The waste density calculation will be reviewed periodically and operational procedures may be revised to improve the efficiency of the site.

5.3. Filling Operations

The method of filling shall be in accordance with the filling sequence shown on Drawing No. OP-03. The waste will be compacted according to the procedures described above. Each lift of waste shall be approximately 10 feet thick, including an allowance for weekly cover. The proposed waste to total soil volume ratio is approximately 7:1. The size of the working face will be maintained as small as possible. The width of the working face will vary, depending on the rate of waste acceptance on a given day and weather conditions.

5.4. Daily Cover

At the end of each day's operation, compacted waste in the subcell shall be covered with either a minimum six inches of soil, or an approved alternative cover material approved by the Solid Waste Section (SWS). When soil is used for daily cover, at least two passes of heavy equipment will be made over the area to provide adequate soil compaction. Waste may be covered more frequently than once per day if necessary to control fires, odors, or blowing litter.

5.5. Intermediate Cover

In areas where another lift of waste will not be placed for at least 12 months, an additional 6 inches of soil shall be placed over the daily cover for a total of 12 inches of intermediate cover. Organic soil amendment in ratio 50/50 is allowed with the cover soil to promote healthy vegetative growth. Provisions for a vegetative ground cover sufficient to restrain erosion shall be accomplished within 120 calendar days following completion of each phase of development.

5.6 Alternate Cover Material

One alternate cover material (ACM) method is described in this section; tarps. The ACM shall provide control for disease vectors, fires, odor, blowing litter, and scavenging. An ACM in addition to soil may be used daily. Through a NC Department of Environmental Quality (NC DEQ) Solid Waste Section demonstration period October 29, 2008 through February 20, 2009, the ACM has been determined to provide an equal or better element control as soil.

For precautionary measures regarding fire in the waste, ACM shall not be used more than 5 consecutive days. Soil will be used on the 6th day of covering.

5.6.1 Tarps

Tarps are proposed as an ACM. The tarps will be placed either manually or by using equipment. Tarps will not be used on any waste area that will not receive additional waste over a 24 hour period.

5.6.1.1 Properties of Tarps

Tarps shall be Fabrene TGPN3N3M or equal (manufacturer data sheet is included in Appendix V-2) and have properties as follows:

Unit Weight	9oz/yd^2
Warp Construction	23.9 Tapes/in (Warp)
	16.0 Tapes/in (Weft)
Tensile Grab Strength	495 lbf (Warp)
	326 lbf (Weft)
Tear Strength (tongue)	135 lbf (Warp)
	152 lbf (Weft)
Tear Strength (trapezoid)	162 lbf (Warp)
	107 lbf (Weft)
Coating Thickness	1.5 mil
Mullen Burst Strength	609 psi
Nominal Thickness	20 mil
Dimensions	48’-0” x 50’-0” (approximate)

Tarps shall be coated on two sides with low density polyethylene and will contain ultraviolet inhibitors.

5.6.1.2 Tarp Cover System Application Procedures

Procedure for Inspecting Tarps

The tarps are inspected for tears each morning and afternoon. Should a tear be found in the tarp, an attempt will be made to repair the area by stitching. If repair is inadequate or cannot be made, the tarp will not be used on the working face.

Application Procedure for Placement of Tarps

Application of the tarp will employ the following minimum procedures:

- Visually inspect working face to ensure that no sharp objects are protruding from the compacted waste which may tear the tarp;
- If necessary, run compacter or tracked machine over any protruding objections;
- Deploy tarp onto the landfill face by attaching the tarp to the spreader bar via integrated D-rings. Final placement is completed by hand to ensure proper coverage;
- Place additional tarps as needed to adequately cover working face;
- Tarps are self-anchored with perimeter chains;
- The tarps will be visually inspected following placement to ensure that uplift will not occur; and,

- Soil will be placed over any areas of exposed waste and/or inadequate coverage.

Maximum Daily Area Coverage
Based on the 2015 Airspace Analysis Report:

- Annual waste disposal rate (MSW only) = approximately 55,700 tons
- Operating days per year = 305 days;
- Approximate daily waste disposal rate = 183 tons
- In-place density = 1,012 lbs/cy of MSW per cubic yard;
- Daily cubic yards disposed = daily waste disposal rate / in-place density = 362 cy or 9,770 cf
- The working face will be restricted to the smallest area feasible; and
- The working lift is typically 2-3 feet high. Based on a working lift thickness of 2 feet, the working face area averages 5,000 square feet (daily cubic yards disposed / working lift thickness), which is equal to the daily coverage area.

Any additional areas of uncovered waste will be covered each day with 6 inches of soil.

Daily Depth and Quantity to be Applied
N/A

Average Monthly Volume of Daily Cover
N/A

List of Equipment
Equipment utilized for Tarps consists of:

Dozer, Loader, or other equipment available on-site will be the equipment used for the tarp installation.

Material and Equipment Storage
Tarps will be stored adjacent to the working face in a County designated area that will not conflict with daily haul and disposal operations.
The equipment will be stored in a County designated area that will not conflict with daily haul and disposal operations.

Wet Weather Operation
The tarping wet weather operation will be similar to operations the County currently follows when using soil as daily cover during wet weather.

Contingency Plans
If, for any reason the County cannot use tarps as ACM material; soil will be used.

Screening Criteria
N/A

6.0. ENVIRONMENTAL MONITORING PROGRAMS

6.1 Water Quality

The water quality monitoring program for groundwater and surface water is described in the Water Quality Monitoring Plan. Refer to that plan in Section VII of this Permit Renewal Application for a detailed discussion of the program.

6.2 Landfill Gas

Landfill gas is a by-product from the decomposition of organic waste in a sanitary landfill. The major components of landfill gas are methane and carbon dioxide. Other gases, such as volatile organic compounds, are present in trace quantities. To protect public health and safety in the vicinity of the landfill, landfill gas produced by the decomposition of refuse will be controlled and monitored during the operational, closure, and post- closure periods. A landfill gas monitoring program has been implemented for the purpose of maintaining the concentration of methane gas below the following regulatory levels:

- The concentration of methane gas generated is not to exceed 25 percent of the lower explosive limit (LEL) for methane in on-site structures (excluding gas control or recovery system components); and

- The concentration of methane gas is not to exceed the LEL for methane at the facility property boundary.

The landfill gas monitoring plan (signed by a professional engineer or licensed geologist) has been implemented to include monitoring of landfill gas boundary probes and facility structures. Remedial measures will be implemented as needed to mitigate a potential gas migration problem. The gas may be actively recovered in the future if generation rates are sufficient to justify the additional costs of an active system.

Regarding compliance with air quality (New Source Performance Standards), based on NC DEQ Administrative Code .1703 Emission Standards, the Roaring River landfill does not exceed the permitting threshold requirements for design capacity or NMOC emission rates. There is approximately 1,223,718 tons of waste material currently in place within the inactive and active phases (refer to Table 1 of the Facility Plan). This equates to approximately 1,110,138 Mg. It is projected that the remaining portion of Phase 4 will add an additional capacity of 278,508 tons (524,991 cy), refer to Table 2 of the Facility Plan. Therefore, the projected total capacity for Phase 1, 2, 3 and 4 is approximately 1,502,226 tons or 1,362,796 Mg, which is below the 2.5 million Mg threshold required for NSPS Title V permitting.

6.2.1 General

Gas monitoring at the Wilkes County Landfill will be performed during the active life of the landfill and throughout the post-closure care period. At a minimum, quarterly monitoring will be conducted at all subsurface gas detection probes and in all structures located on the landfill property. Wilkes County has five subsurface gas detection probes: GP-1, GP-2, GP-3, and GP-5. GP-4 was accidently destroyed by facility equipment. Upon meeting with Ervin Lane of the

Solid Waste Section on February 29, 2008, it was determined that the destroyed gas probe GP-4 did not need to be replaced unless methane detections in boundary probes exceed the lower explosive limit. GP-6 was removed from the monitoring network after it was determined to be too shallow to effectively monitor for landfill gas migration while located between the waste boundary and GP-1 at the property boundary. The probes are made of 1-inch schedule-40 PVC pipe with PVC caps fitted with "quick-connect" fittings, a concrete well pad, and a 4-inch x 4-inch lockable steel casing affixed with an identification plate. The structures being monitored for landfill gas are the scalehouse and the maintenance building. The location of each gas detection probe and structure are presented on Drawing OP-01.

Additional gas detection probes will be installed on the site as additional phases are constructed. They will be designed to extend to a depth at least equal to the maximum depth of waste within 1,000 feet of the monitoring point or to either bedrock or the water table, whichever is encountered first. Proposed probe locations will likely be field engineered due to rough topography adjacent to expansion areas which may limit access with a drill rig. Sufficient numbers of gas wells will be installed to adequately monitor the unit. At least three probes will be installed within each borehole to monitor shallow, intermediate, and deep zones within the subsurface profile. The actual spacing of the probes within the borehole will be established after review of the drilling log to identify potential preferential pathways. Construction records for the gas probes will be submitted to the Division upon completion. Currently, the area east of Phase 3 is being used for borrow material. Once the area is no longer being used for borrow, a landfill gas monitoring probe (GP-7) is proposed for installation. If necessary, based on geologic and hydrologic conditions, GP-7 will be installed as a shallow and deep nested pair.

Passive landfill gas vents will be installed along with the final cover system to allow release of gas to the atmosphere. These vents will be installed at a density of approximately one per acre of cap surface area.

6.2.2 Monitoring Procedure

Record Keeping: The operator will record the date, time, location, sampling personnel, atmospheric temperature, reported barometric pressure, equipment calibration information, and general weather conditions at the time of sampling, in addition to the concentration of combustible gases according to the SWS's Landfill Gas Monitoring Guidance document included as Appendix V- 5. The records will be maintained in the landfill operating record.

On-site Structures: Gas monitoring in on-site structures will attempt to identify the "worst case" concentrations. Monitoring will be conducted at the earliest possible time after the structure has been unused (e.g., a morning after a weekend or holiday). The monitoring locations will be in corners along floors and ceilings, at cracks in the floor, and at other areas likely to accumulate gas. Gas monitoring will also be conducted in any confined space requiring the entry of personnel for maintenance or inspection. The monitoring will take place prior to entry by personnel in accordance with OSHA regulations.

Gas Detection Probes: Gas monitoring in detection probes will consist of attaching the portable combustible gas monitor to each probe, and recording both the initial concentration and steady

state concentration of combustible gases. SWANA guidelines for purging wells and other monitoring procedures will be followed.

Equipment: A portable combustible gas monitor, measuring the concentration of combustible gases in units of percent of lower explosive limit, shall be used to conduct gas monitoring. Lower explosive limit (LEL) means the lowest percent by volume of a mixture of combustible gas in air that will propagate a flame at 25 degrees Celsius and atmospheric pressure. The gas monitor shall be calibrated to methane using the manufacturer's calibration kit and procedure before the monitoring activities begin. Calibration information must be recorded on the Landfill Gas Monitoring Data Form.

6.2.3 Response to Detected Combustible Gases

The regulatory action levels for combustible gas monitoring in gas detection probes are 100% LEL at the facility boundary and 25% LEL in on-site structures. Readings exceeding the regulatory action levels shall be reported to Wilkes County immediately. The County will notify the North Carolina Department of Environment, Health, and Natural Resources, Solid Waste Section in writing and will take immediate steps to ensure safety and protection of human health.

At a minimum, the following actions will be taken if the methane concentration exceeds 25% in any structure:

- Put out all smoking materials and turn off all ignition sources;
- Evacuate all personnel;
- Vent the structure;
- Do not allow personnel to reenter the building except to perform gas monitoring until the results of additional monitoring indicate that methane concentrations are sustained or stabilized below 25% LEL;
- Begin continuous monitoring within the structure; and
- Undertake an assessment to determine the origin and pathways of the gas migration.

Within seven days of detection, the monitoring results will be placed in the Operating Record and the County will indicate actions taken and actions proposed to resolve the problem. Within 60 days of detection, the County will develop and implement a landfill gas remediation plan for the combustible gas releases and notify the Division that the plan has been implemented. The plan will describe the nature and extent of the problem and the proposed remedy.

The County will also use monitoring action levels of 75% LEL in the gas detection probes at the property boundary, if installed in the future, and 15% LEL in structures. If gas readings exceed the monitoring action levels, the monitoring frequency will be increased to monthly until three consecutive readings below those levels are recorded. If the monitoring action level is exceeded in structures, options will be evaluated to permanently reduce the current levels and to prevent a further increase in gas levels in the structures.

7.0 EROSION AND SEDIMENT CONTROL REQUIREMENTS

The operator shall not cause a discharge of pollutants into waters of the United States, including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to Section 402, or cause the discharge of a nonpoint source of pollution to waters of the United States, including wetlands, that violates any requirement of an area-wide or State-wide water quality management plan that has been approved under Section 208 or 319 of the Clean Water Act, as amended. Surface water shall be diverted from the operational area and shall not be impounded over or in waste.

All vegetative and structural erosion and sediment control practices have been designed and shall be constructed and maintained according to the North Carolina Erosion and Sediment Control Planning and Design Manual (NCESCPDM). An *Erosion and Sediment Control Plan for the Wilkes County Landfill* was prepared and previously approved by the Land Quality Section. A copy of The Letter of Approval with Modifications and Certificate of Plan Approval with Modifications can be found in Appendix III-5 of the Engineering Plan submitted in the Permit to Construct Application for Phase 4, dated January 2011.

8.0 RECORD KEEPING REQUIREMENTS

The following records will be maintained in the Operating Record at the landfill office:

- The operating permit and pertinent correspondence;
- Operation Plan;
- Emergency Response Plan;
- Inspection records, waste determination records, and training procedures for waste screening programs;
- Amounts by weight of solid waste received at the facility, including the source of generation;
- Gas monitoring plan, monitoring results and any remediation plans developed in accordance with Division requirements if required as a response to elevated gas concentrations;
- Water Quality Monitoring Plan and any demonstration, certification, finding, monitoring, testing, or analytical data required by the water quality monitoring program at the site;
- Closure and Post-Closure Plans and any required monitoring, testing or analytical data performed during the closure and post-closure periods;
- Required cost estimates and financial assurance documentation;
- Leachate management records; and
- Safety training records.

9.0 LEACHATE MANAGEMENT PLAN

9.1 Maintenance of the Leachate Collection System

Leachate control and migration begins with proper operational safeguards. Proper facility operation by maintaining design grades, placement of daily cover, intermediate and final covers, maintaining good vegetative cover, and applying run-on and run-off controls will help to reduce leachate production. The operator will conduct weekly inspections of the leachate collection and storage system. Leachate levels in the storage lagoon will be monitored weekly and after storm events to assess the need for leachate removal and hauling. Cleanouts are provided to allow access to the leachate collection system. Water under pressure has been and will continue to be introduced through these cleanouts periodically as preventive maintenance of the piping system. Mechanical equipment or chemical cleaning agents may also be used to mitigate clogging. Maintenance needs will be re-evaluated if there is an unexpected decrease or increase in leachate production rates.

9.2 Leachate Generation Records

Wilkes County maintains records of leachate hauled from the leachate pond at the landfill to the wastewater treatment plant. The County is currently considering the installation of a flowmeter in the manhole upgradient of the pond so that leachate flow quantities from the landfill can be measured. The volume of leachate in the lagoon is checked on regular basis and after every significant storm event. Records will be maintained at the landfill throughout the operating life and during the post-closure care period. In addition to leachate generation quantities, Wilkes County will maintain analytical data from leachate sampling events. See Appendix III-4 of the Engineering Plan submitted in the Permit to Construct Application for Phase 4, dated January 2011, for additional information on leachate generation rates.

9.3 Leachate Monitoring

The chemical composition of untreated leachate generated will be analyzed semi-annually concurrent with water quality sampling. The leachate will be analyzed for the Detection Monitoring constituents (EPA Appendix I list from Subtitle D) required by Rule.1633, and pH, specific conductance, BOD, COD, phosphate, nitrate and sulfate. Test results will be submitted to the Solid Waste Section. Monitoring parameters include the following:

PARAMETER	Sample Type	FREQUENCY
PH	Grab	Semi-annually
Oil and Grease	Grab	Semi-annually
BOD	Grab	Semi-annually
TSS	Grab	Semi-annually
Cd-Cadmium	Grab	Semi-annually
Cr-Chromiun (Total)	Grab	Semi-annually
Cu-Copper	Grab	Semi-annually
Ni-Nickel	Grab	Semi-annually
Cyanide	Grab	Semi-annually
Zn-Zinc	Grab	Semi-annually
Pb-Lead	Grab	Semi-annually
Mercury	Grab	Semi-annually
Temperature	Grab	Semi-annually

9.4 Leachate Disposal and Recirculation

Leachate will be collected and stored in the existing on-site leachate pond. The leachate is periodically removed by pumping into a tanker truck for transport to the Wilkesboro Wastewater Treatment Plant for treatment and disposal. This practice is expected to continue with the opening of subsequent phases at the landfill. An agreement with the Town of Wilkesboro is in place for the discharge of wastewater from the landfill to the plant. Leachate will be tested in accordance with pretreatment conditions as described above. Although no pretreatment has been required to date, aerators are being installed in the pond to reduce BOD levels in the wastewater.

As previously approved in the Wilkes County Transition Plan and other correspondence, Wilkes County intends to continue leachate recirculation in the existing Phase 1 area. The current practice consists of the introduction of minimal amounts of leachate back into the lined cell by applying it with a water truck or by using a pump and sprinkler system to control dust.

9.5 Contingency Plan for Extreme Conditions

Wilkes County Landfill staff hauls leachate from the pond to the wastewater treatment plant using a leased vehicle. If required due to extreme conditions, additional hauling capacity will be obtained from subcontract haulers or by the rental of additional tanker trucks. If the receiving facility no longer accepts the leachate, it will be pre-treated to facilitate acceptance, or hauled to another POTW or commercial pretreatment facility.

[End]

APPENDIX V-1

RANDOM WASTE SCREENING PROGRAM FORMS

- FORM A – WASTE INSPECTION FORMS
- USEPA HAZARDOUS WASTE INSPECTION DECISION TREE

ROARING RIVER LANDFILL
WASTE INSPECTION FORM **FORM A**

DATE: _____ TIME WEIGHED IN. _____
TRUCK OWNER: _____ DRIVER NAME: _____
TRUCK TYPE: _____ VEHICLE ID/TAG: _____
WEIGHT: _____ TARE: _____
WASTE SOURCE: _____

Reason Load Inspected: Random Inspection _____ Staff Initials _____
Detained at Scales _____ Staff Initials _____
Detained by Operating Staff _____ Staff Initials _____

Inspection Location: _____

Description of Load: _____

Waste: Accepted [ ] Rejected [ ] Held [ ]

Notified: Supervisor [ ] County EMS [ ] Generator [ ]
Hauler [ ] NCDENR [ ] Federal [ ]

Loader Operator: _____

Personnel Conducting the Inspection: _____

Load Accepted (signature) _____ Date _____

Load Not Accepted (signature) _____ Date _____

REASON LOAD NOT ACCEPTED (Complete the following section if load not accepted)

Description of Suspicious Contents:

Color _____ Texture _____ Smell _____

Drums Present _____ Haz Waste Markings _____

Estimated CY present in load: _____ Estimated tons present in load: _____

Emergency Management Contacted? _____

Hazardous Materials Present: _____

_____

Hauler notified (if waste not accepted) Phone: _____ Time Contacted: _____

Other Observations: _____

_____

Final Disposition Signature: _____ Date: _____ Time: _____

Waste Screening Inspector or Landfill Manager

ADDITIONAL COMMENTS: on the back

Attach related correspondence to this form
File completed form in Operating Record

WASTE INSPECTION FORM **FORM A**

FACILITY: _____ PERMIT NO. _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

Waste Name(s) & Address (es)

1. _____
2. _____
3. _____
4. _____
5. _____

Waste Hauler _____

Address _____

Driver's Name _____

Waste Accepted [ ] Rejected [ ] Held [ ]

NOTIFIED: Waste Source [ ] Hauling Management [ ] Site Management [ ]

State [ ] Federal [ ]

Loader Operator: _____

Personnel Conducting the Inspection: _____

_____

1. Supervisor Conducting the Inspection: _____

SIGNATURE: _____

2. Witness: _____

SIGNATURE: _____

3. Driver: _____

SIGNATURE: _____

4. Other: _____

Company: _____ Title: _____

SIGNATURE: _____

DATE: _____ TIME _____ AM [ ] PM [ ]

ADDITIONAL COMMENTS: on the back

CONTAINER INVENTORY **FORM A**

FACILITY: _____ PERMIT NO. _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

Container:

Drum [ ] Metal [ ] Cardboard [ ] Plastic [ ] Other [ ]

Other: _____

Contents:

1. Full [ ] Partially Full [ ] Empty [ ]
2. Crushed [ ] Punctured [ ]
3. Labeled [ ] Hazardous [ ]

Identified: _____

Additional Information:

Container:

Drum [ ] Metal [ ] Cardboard [ ] Plastic [ ] Other [ ]

Other: _____

Contents:

1. Full [ ] Partially Full [ ] Empty [ ]
2. Crushed [ ] Punctured [ ]
3. Labeled [ ] Hazardous [ ]

Identified: _____

Additional Information:

INSPECTION CHECK LIST: (Check all that apply) **FORM A**

(If "YES" Please explain in the space provided below)

FACILITY: _____ PERMIT NO. _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

	YES	NO
1. Powders/Dusts	____	____
Identified: _____		
Unknown	____	____
2. Unacceptable Saturation	____	____
3. Odor/Fumes	____	____
Strong	____	____
Faint	____	____
Describe: _____		
4. Heat	____	____
Item: _____		
5. Battery	____	____
6. Oil	____	____
7. Biomedical	____	____
8. Radioactivity	____	____
9. Ashes/Residue	____	____
10. Sod/Soil	____	____
11. Asbestos (not properly contained)	____	____
12. PCB	____	____
13. Out of County Waste	____	____

Explanation:

REFUSE/UNIDENTIFIED WASTE INSPECTION **FORM - B**

FACILITY: _____ PERMIT NO. _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

REJECTABLE WASTE DESCRIPTION: _____

_____

_____

_____

WASTE: Rejected [ ] Accepted [ ]

NOTIFIED: [ ] Waste Source [ ] Hauling Management [ ] Federal
[ ] Site Management [ ] State

REFUSED WASTE TRANSPORTED BY:

Hauler Address: _____

_____

Destination: _____

_____

ACCEPTED WASTE:

Contained area: _____

Secured by: _____

Lab to complete testing: _____

ADDITIONAL COMMENTS: _____

_____

_____

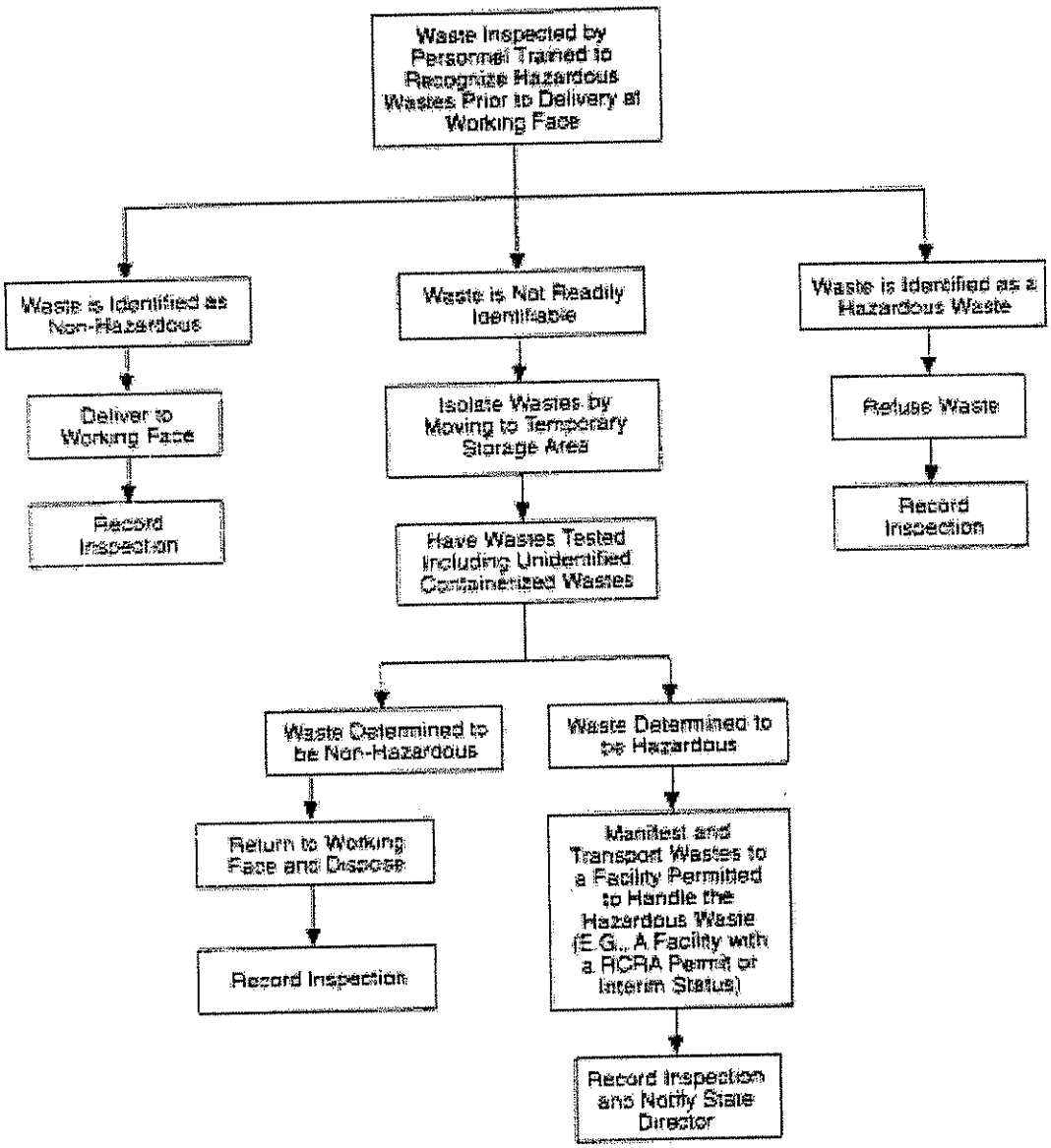

Figure 3-1
Hazardous Waste Inspection Decision Tree
Inspection Prior to Working Face

EPA Landfill Criteria Technical Manual, Subpart C, November 1993

APPENDIX V-2

TARP DATA SHEET

FABRENE®

INDUSTRIAL SYNTHETIC FABRICS

TYPE TGPN3N3M

Made from high density polyethylene tapes, coated on two sides with low density polyethylene.

PROPERTY	UNIT		VALUES	TEST METHOD
Unit Weight	g/m2		305	ASTM D3776
Warp Construction	Tapes/10cm	Warp	94	ASTM D3775
		Weft	63	
Tensile Grab Strength	Newtons	Warp	2200	ASTM D751
		Weft	1450	
Tear Strength * (tongue)	Newtons	Warp	600	ASTM D2261
		Weft	675	
Tear Strength (trapezoid)	Newtons	Warp	720	ASTM D4533
		Weft	475	
Coating	µm		38	ASTM D1777 MOD
Mullen Burst Strength	kPa		4200	ASTM D751
Nominal Thickness	µm		513	ASTM D1777 MOD

* Includes force to shift tapes - Tear may be crosswise to direction of force.

Fabrene® TGPN3N3M contains ultraviolet inhibitors and is suitable for outdoor applications.
For further information, contact your FABRENE Inc. representative.

Suggested Applications: Heavy tarpaulins, Geomembranes

SALES INQUIRIES

abrene Inc.
l: (888) 322-7363 ext 234
el: (705) 476-7057 ext 234
Fax: (705) 476-7787

ORDER DESK

North Bay, ON, Canada
Tel: (888) FABRENE
(888) 322-7363
ext. 222 or 226
Fax: (705) 476-0665

MAILING ADDRESS

Fabrene Inc.
240 Dupont Rd.
P.O. Box 4040
North Bay, ON, Canada
P1B 9B4

Date: 00/10/23

ISO 9001:2000
CSA Registered
Certificate: 92540

APPENDIX V-3

TEMPERATURE LOG DATA SHEET

WILKES COUNTY
LANDFILL
TEMPERATURE LOG

(Complete one (1) per windrow)

Windrow ID Number: _____

Date Windrow Started: _____

General windrow location and length: _____

Date & Initials	(x) if turned and number of times turned	Temp. at Location #1	Temp. at Location #2	Temp. at Location #3	Temp. at Location #4	Weather: Temp/ Condition

APPENDIX V-4

COMPOST END USER BROCHURE

US Composting Council

USCC Factsheet: Compost and Its Benefits[1]

What is Compost?

Compost is the product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth. Compost bears little physical resemblance to the raw material from which it originated.

Photo: Larry Strong

Compost is an organic matter resource that has the unique ability to improve the chemical, physical, and biological characteristics of soils or growing media. It contains plant nutrients but is typically not characterized as a fertilizer.

How is Compost Produced?

Compost is produced through the activity of aerobic (oxygen-requiring) microorganisms. These microbes require oxygen, moisture, and food in order to grow and multiply. When these factors are maintained at optimal levels, the natural decomposition process is greatly accelerated. The microbes generate heat, water vapor, and carbon dioxide as they transform raw materials into a stable soil conditioner. Active composting is typically characterized by a high-temperature phase that sanitizes the product and allows a high rate of decomposition, followed by a lower-temperature phase that allows the product to stabilize while still decomposing at a lower rate. Compost can be produced from many "feedstocks" (the raw organic materials, such as leaves, manures or food scraps). State and federal regulations exist to ensure that only safe and environmentally beneficial composts are marketed.

Benefits of Compost and its Effects on Soils and Plants

Thanks to its many attributes, compost is extremely versatile and beneficial in many applications. Compost has the unique ability to improve the properties of soils and growing media physically (structurally), chemically (nutritionally), and biologically. Although some equate the benefit of compost use to lush green growth, caused by plant-available nitrogen, the real benefits of using compost are long-term and related to its organic matter content.

Benefits of Using Compost

- Improves the soil structure, porosity, and density, thus creating a better plant root environment.
- Increases infiltration and permeability of heavy soils, thus reducing erosion and runoff.
- Improves water holding capacity, thus reducing water loss and leaching in sandy soils.
- Supplies a variety of macro and micronutrients.
- May control or suppress certain soil-borne plant pathogens.
- Supplies significant quantities of organic matter.
- Improves cation exchange capacity (CEC) of soils and growing media, thus improving their ability to hold nutrients for plant use.
- Supplies beneficial microorganisms to soils and growing media.
- Improves and stabilizes soil pH.
- Can bind and degrade specific pollutants.

Physical Benefits

Improved Structure

Compost can greatly enhance the physical structure of soil. In fine-textured (clay, clay loam) soils, the addition of compost will reduce bulk density, improve friability (workability) and porosity, and increase its gas and water permeability, thus reducing erosion. When used in sufficient quantities, the addition of compost has both an immediate and long-term positive impact on soil structure. It resists compaction in fine-textured soils and increases water holding capacity and improves soil aggregation in coarse-textured (sandy) soils. The soil-binding properties of compost are due to its humus content. Humus is a stable residue resulting from a high degree of organic matter decomposition. The constituents of the humus act as a soil 'glue,' holding soil particles together, making them more resistant to erosion and improving the soil's ability to hold moisture.

Moisture Management

The addition of compost may provide greater drought resistance and more efficient water utilization. Therefore, the frequency and intensity of irrigation may be reduced. Recent research also suggests that the addition of compost in sandy soils can facilitate moisture dispersion by allowing water to more readily move laterally from its point of application.

Chemical Benefits

Modifies and Stabilizes pH

The addition of compost to soil may modify the pH of the final mix. Depending on the pH of the compost and of the native soil, compost addition may raise or lower the soil/compost blend's pH. Therefore, the addition of a neutral to slightly alkaline compost to an acidic soil will increase soil pH if added in appropriate quantities. In specific conditions, compost has been found to affect soil pH even when applied at quantities as low as 10-20 tons per acre. The incorporation of compost also has the ability to buffer or stabilize soil pH, whereby it will more effectively resist pH change.

[1] Excerpted from the Field Guide to Compost Use, ©2001 The United States Composting Council

Increases Cation Exchange Capacity

Compost will also improve the cation exchange capacity of soils, enabling them to retain nutrients longer. It will also allow crops to more effectively utilize nutrients, while reducing nutrient loss by leaching. For this reason, the fertility of soils is often tied to their organic matter content. Improving the cation exchange capacity of sandy soils by adding compost can greatly improve the retention of plant nutrients in the root zone.

Provides Nutrients

Compost products contain a considerable variety of macro and micronutrients. Although often seen as a good source of nitrogen, phosphorous, and potassium, compost also contains micronutrients essential for plant growth. Since compost contains relatively stable sources of organic matter, these nutrients are supplied in a slow-release form. On a pound-by-pound basis, large quantities of nutrients are not typically found in compost in comparison to most commercial fertilizers. However, compost is usually applied at much greater rates; therefore, it can have a significant cumulative effect on nutrient availability. The addition of compost can affect both fertilizer and pH adjustment (lime/sulfur addition). Compost not only provides some nutrition, but often makes current fertilizer programs more effective.

Biological Benefits

Provides Soil Biota

The activity of soil organisms is essential in productive soils and for healthy plants. Their activity is largely based on the presence of organic matter. Soil microorganisms include bacteria, protozoa, actinomycetes, and fungi. They are not only found within compost, but proliferate within soil media. Microorganisms play an important role in organic matter decomposition which, in turn, leads to humus formation and nutrient availability. Microorganisms can also promote root activity as specific fungi work symbiotically with plant roots, assisting them in the extraction of nutrients from soils. Sufficient levels of organic matter also encourage the growth of earthworms, which through tunneling, increase water infiltration and aeration.

Suppresses Plant Diseases

Disease incidence on many plants may be influenced by the level and type of organic matter and microorganisms present in soils. Research has shown that increased population of certain microorganisms may suppress specific plant diseases such as pythium and fusarium as well as nematodes. Efforts are being made to optimize the composting process in order to increase the population of these beneficial microbes.

Additional Benefits of Compost

Some additional benefits of compost have been identified, and has led to new uses for it. These benefits and uses are described below.

Binds Contaminants

Compost has the ability to bind heavy metals and other contaminants, reducing both their leachability and absorption by plants. Therefore, sites contaminated with various pollutants may often be improved by amending the native soil with compost. The same binding affect allows compost to be used as a filter media for storm water treatment and has been shown to minimize leaching of pesticides in soil systems.

Degrades Compounds

The microbes found in compost are also able to degrade some toxic organic compounds, including petroleum (hydrocarbons). This is one of the reasons why compost is being used in bioremediation of petroleum contaminated soils.

Wetland Restoration

Compost has also been used for the restoration of native wetlands. Rich in organic matter and microbial population, compost and soil/compost blends can closely simulate the characteristics of wetland soils, thereby encouraging the re-establishment of native plant species.

Erosion Control

Coarser composts have been used with great success as a mulch for erosion control and have been successfully used on sites where conventional erosion control methods have not performed well. In Europe, fine compost has been mixed with water and sprayed onto slopes to control erosion.

Weed Control

Immature composts or ones which possess substances detrimental to plant growth (phytotoxins), are also being tested as an alternative to plastic mulches for vegetable and fruit production. While aiding in moisture conservation and moderating soil temperatures, immature composts also can act as mild herbicides.

A Bright Future

With these many benefits and its myriad of applications, from the traditional growing of plants to novel uses in stormwater management and climate change mitigation, the production and use of compost has a bright future indeed!

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About the USCC: The United States Composting Council (USCC) is a national not-for-profit organization dedicated to the development, expansion and promotion of the composting industry. For more information visit www.compostingcouncil.org

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*How much compost to use when planting?**

- **Trees and Shrubs** – Backfill plantings with a 50:50 mix of compost and native soil. Mulch a 2 to 3 inch layer of compost around plants extending 6 inches beyond the drip line. Do not mound compost or mulch around stems and tree trunks because this invites insects and diseases.
- **Flowers and Vegetable Gardens** – Work 2 to 3 inches of compost into the top 6 inches of soil before planting.
- **Turf Grass** – Work 2 to 3 inches of compost into the top 6 inches of soil prior to sod placement or seeding.
- **Containers and Raised Beds.** Add transplants to containers and beds filled with a 30 percent blend of compost and potting soil.
- **Foundations** – Replace compacted and contaminated fill along building foundations with a blend of compost, sand and topsoil.
- **Mulch** – Spread a 2 to 3 inch layer around plants to prevent erosion, act as a weed barrier and conserve water.

MIX CALCULATOR: Creating a landscape bed? Use this formula: **square feet to be covered X depth to be filled (in inches) X 0.0031 = cubic yards of mix needed.** Use compost instead of peat moss.

Depth of Compost Layer	Cubic Yards Needed Per 1,000 Square Feet
1/2 inch	1.5
1 inch	3.0
2 inches	6.0
3 inches	9.0

* Provided by Gardening and Recycling Organics Wisely (GROW), a program sponsored by S.C. DHEC's Office of Solid Waste Reduction and Recycling.

Artwork provided by the Seattle Washington Saving Water Partnership's "The Natural Lawn & Garden" series. Reprinted with permission.

Layout and design provided by the S.C. Department of Health and Environmental Control's (S.C. DHEC) Office of Solid Waste Reduction and Recycling.

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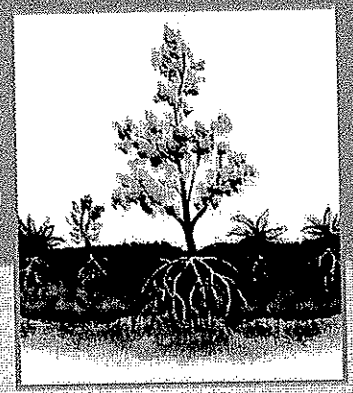


Landscape with Compost

10 Tips for Healthier Soil & Plants

Carolinas
COMPOSTING COUNCIL
www.carolinascompostingcouncil.org
(919) 545-9050

Landscape with compost!

1. **It's alive! It's alive!** Like every other living organism, soil needs food, water and oxygen. Feed your soil to grow healthier plants. Keep it aerated. Don't let it dry out or become water logged.

2. **Break it up.** Soil preparation is an important first step. Don't skip it. Break up large areas of high compaction by tilling and amending with compost before planting. Dig planting beds to a depth of 6 to 12 inches and add compost.

3. **Boost resistance.** Compost is microbiologically active like yogurt and yeast. This helps plants with nutrient uptake as well as builds resistance to pests and diseases. Do not use fumigants and harsh chemicals that will kill hard-working microbes and cancel one of compost's most desirable benefits.

4. **Control run-off.** Compost is one of the best products you can use to encourage rainwater to stay on your property. It will reduce erosion and minimize run-off of soils and nutrients to rivers and streams. Sediment and excess nutrients negatively impact water quality and aquatic life.

5. **Waterhogs unite!** Consider water resources when placing plants in the landscape. Plants that need more water should be located where water naturally collects – near downspouts, roof drip lines and similar locations. Use compost to improve both moisture retention and drainage.

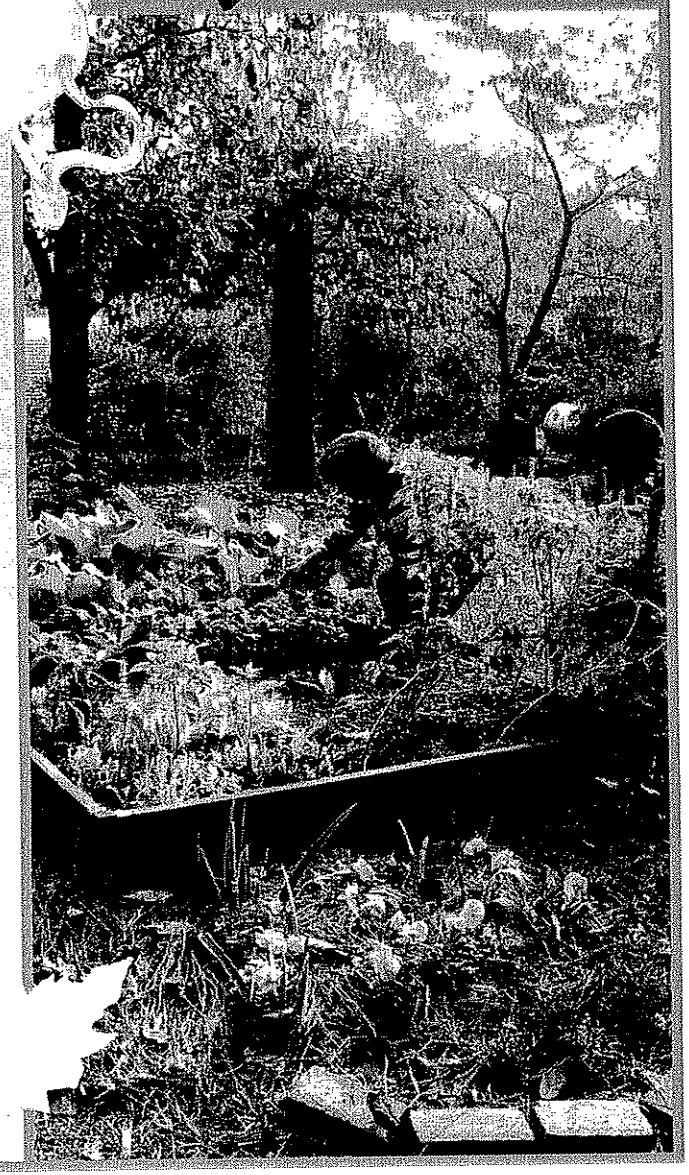
6. **It looks like soil.** Look for compost that is dark in color and smells like soil. Immature compost is light in color and/or smells like ammonia. Immature compost may burn sensitive plants and compete for nutrients.

7. **A little bit does a lot.** As little as 1/4 inch of compost as a top dressing can give lawns a boost. Bare spot? Add a layer of compost and rake into the soil before seeding.

8. **Quality counts.** The U.S. Composting Council has developed a marketing label to identify tested compost. Look for the Seal of Testing Assurance when comparing products.

9. **Don't concentrate!** Add no more than 30 percent compost in a blend with bark, topsoil, sand, clay and other ingredients. Use in raised beds or in potting and planting mixes for trees, shrubs and garden plants. As mulch, add 2 to 3 inches to the surface.

10. **Dress it up.** Top dress with 1/4 to 1/2 inch of compost to replenish nutrients and keep root zones cool and moist. Surface applications should always be well incorporated with a rake or tilling equipment.



Pictured (right): This garden shows many places to use compost – around trees as mulch, in flower and vegetable beds, in raised beds and containers as well as around shrubs.

APPENDIX V-5

LANDFILL GAS MONITORING GUIDANCE DOCUMENT

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF WASTE MANAGEMENT

SOLID WASTE SECTION

LANDFILL GAS MONITORING GUIDANCE

NOVEMBER 2010

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SECTION 1 - Introduction

North Carolina Solid Waste Management Rules 15A NCAC 13B require quarterly monitoring of methane gas (at MSW landfills) and quarterly monitoring of methane and other explosive landfill gases (LFG) (at C&D and other landfills) to ensure that landfill gas does not exceed the lower explosive limit (LEL) at the facility property boundary or 25 percent of the lower explosive limit in facility structures. If the concentration exceeds the specified limits, steps must be taken to ensure the protection of public health and a remediation plan must be implemented immediately. A landfill gas monitoring plan is necessary to ensure that these performance standards are met and this guidance document was developed to assist in establishing a standardized procedure for the monitoring of landfill gas.

Background

Organic matter in landfills begins to decompose almost immediately after being placed in a disposal site. Putrescible wastes such as food products and sewage sludges begin to break down by biological processes very rapidly whereas paper, cardboard or cellulose based materials are slower to decompose. However, when conditions become favorable, most organic matter will decompose. The decomposition process typically goes through several stages that depend on conditions such as pH, temperature, and moisture content. The final stage results in the production of methane and although the rate of production may vary, most landfills produce methane.

Landfill Gas Generation

Landfill gas is a natural by-product of the anaerobic decomposition of organic waste in a landfill. The composition, quantity and rate of landfill gas generation are dependent on the types of waste that are decomposing and the level of microbial activity within the wastes. The decomposition of biodegradable waste begins with aerobic decomposition which lasts until the oxygen in the landfill is depleted. The anaerobic phase then begins, resulting in landfill gas production.

There are four stages of landfill gas composition: the first stage is characterized by elevated nitrogen levels and occurs when the landfill is new. The second stage is characterized by elevated carbon dioxide levels and occurs for a relatively short period of time after the initial stage is complete. The third and fourth stages are characterized by elevated methane concentrations and represent the active life of a landfill and the post-closure time frame.

Landfill gas is generally composed of 50-55% methane (CH4); 45-50% carbon dioxide (CO2); less than 5% nitrogen (N2); and less than 1% non-methane organic compounds. These individual gases generally remain co-mingled and do not naturally separate. The Solid Waste Section (SWS) Rules typically focus on methane (CH4) and its explosive properties due to public safety issues. Hydrogen sulfide (H2S) is also of particular concern in landfills and is typically recognized by its rotten egg odor. H2S is immediately dangerous to life and health at concentrations of 100 parts per million (ppm).

Landfill Gas Migration

The production of landfill gas creates a positive pressure within the landfill that forces the gas to migrate. Landfill gas migrates from place to place by diffusion and pressure gradient and will follow the path of least resistance. Subsurface gas typically migrates above the groundwater table and is restricted laterally by streams. Porous soils lying above the bedrock can serve as pathways to transmit large volumes of gas. Underground off-site migration is common and can be facilitated by the presence of pipelines, buried utility corridors or trenches located within or adjacent to the landfill boundaries. Movement depends on soil type and moisture, and migration distances of 1,500 feet have been observed. Barometric pressure also influences movement. Falling barometric pressure allows methane to migrate out of the landfill and into surrounding areas.

SECTION 2 - Factors Influencing Landfill Gas Generation and Migration

Factors that affect landfill gas generation and migration through the subsurface include the following:

Waste Composition
The production of landfill gas is directly related to the amount of organic matter present in waste. The bacteria that break down the waste require small amounts of specific minerals such as calcium, potassium, magnesium and other micronutrients. Bacteria are able to thrive and produce landfill gas if the minerals/micronutrients are present. If the minerals/micronutrients are not present or if substances that inhibit bacterial growth exist, landfill gas production will occur at a reduced rate. Some forms of organic matter such as cellulose break down quickly whereas matter such as lignin breaks down more slowly. The rate at which landfill gas is produced depends on the proportions of each type of organic matter present in the waste.

Moisture Content
Landfills with higher moisture content generate higher concentrations of landfill gas in earlier stages of development (such as during leachate recirculation). Moisture accelerates the methanogenic process.

Temperature
Landfill bacteria are temperature dependant. They are able to survive and function below the freezing point, but they also function well at temperatures up to 65°C. Anaerobic bacteria produce small amounts of heat and may not be able to maintain the temperature of a shallow landfill when external temperatures decrease, so LFG generation may exhibit seasonal variations. Saturated landfills may not achieve ideal temperatures because the bacteria do not generate sufficient heat to raise the temperature of the excess water. Higher temperatures promote volatilization and chemical reactions with the waste so the trace gas component of landfill gas tends to increase with higher landfill temperatures.

Age of Landfill
Typically, landfills have an increasing generation of landfill gas for a number of years until closure at which time landfill gas generation reaches a peak and begins to subside. An evaluation of the age of the landfill and use of a landfill gas generation curve can be helpful in determining the likelihood of significant landfill gas concentrations from the landfill.

Landfill Cap
The type or presence of landfill cover can influence landfill gas generation and migration. Although a low permeability cap will reduce moisture and landfill gas generation over the longer term, initially, the installation of a landfill cap could drive landfill gas migration further from the landfill in the subsurface without proper ventilation (either passive or active). This is especially true in the case of unlined (unvented) landfills.

Water Table
Landfill gas movement in unlined landfills may be influenced by groundwater table variations. A rising water table could cause displacement and force upward movement of landfill gas.

Man-made and Natural Conduits
Structures such as drains, trenches, and buried utility corridors can act as conduits for landfill gas migration. Geologic features including fractured bedrock, porous soil, and permeable strata also provide conduits for landfill gas migration

Landfill Liner Conditions
The presence of a Subtitle-D (or equivalent) landfill liner has the capability to limit the lateral migration of landfill gas in the subsurface. Unlined landfills have no barrier to prevent lateral landfill gas migration in the subsurface.

Weather Conditions
Barometric pressure and precipitation have significant effects on landfill gas migration. Increased barometric pressure yields decreased landfill gas venting from the subsurface, until the pressure within the subsurface is greater than the atmospheric (barometric) pressure. Conversely, as the barometric pressure decreases, the landfill will vent the stored gas until pressure equilibrium is reached. Capping of a landfill can influence the effect of barometric pressure on landfill gas migration. Generally, a more permeable landfill cap will allow greater influence by barometric pressure than a less permeable landfill cap.

SECTION 3 – Current Solid Waste Section Rules Pertaining to Landfill Gas Monitoring

Web link to the 15A NCAC 13B rules - http://portal.ncdenr.org/web/wm/sw/rules

15A NCAC 13B

.0101- DEFINITIONS
.0101 (14) "Explosive gas" means Methane (CH4)
.0101(25) "Lower explosive limit" (LEL) means the lowest percent by volume of a mixture of explosive gases which will propagate a flame in air at 25 degrees Celsius and atmospheric pressure.

.0503 - SITING AND DESIGN REQUIREMENTS FOR DISPOSAL FACILITIES
.0503(2) A site shall meet the following design requirements:

(a) The concentration of explosive gases generated by the site shall not exceed:

(i) twenty-five percent of the limit for the gases in site structures (excluding gas control or recovery system components); and

(ii) the lower explosive limit for the gases at the property boundary;

.0543 - CLOSURE AND POST-CLOSURE REQUIREMENTS FOR C&DLF FACILITIES
.0543(e) Post-closure criteria.

(1) Following closure of each C&DLF unit, the owner and operator must conduct post-closure care. Postclosure care must be conducted for 30 years, except as provided under Subparagraph (2) of this Paragraph, and consist of at least the following:

(C) maintaining and operating the gas monitoring system in accordance with the requirements of Rule .0544 of this Section; and

(2) The length of the post-closure care period may be:

(A) decreased by the Division if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Division; or

(B) increased by the Division if the Division determines that the lengthened period is necessary to protect human health and the environment.

.0544 - MONITORING PLANS AND REQUIREMENTS FOR C&DLF FACILITIES
.0544(d) Gas Control Plan

(1) Owners and operators of all C&DLF units must ensure that:

(A) the concentration of methane gas or other explosive gases generated by the facility does not exceed 25 percent of the lower explosive limit in on-site facility structures (excluding gas control or recovery system components);

(B) the concentration of methane gas or other explosive gases does not exceed the lower explosive limit for methane or other explosive gases at the facility property boundary; and

(C) the facility does not release methane gas or other explosive gases in any concentration that can be detected in offsite structures.

(2) Owners and operators of all C&DLF units must implement a routine methane monitoring program to ensure that the standards of this Paragraph are met.

(A) The type of monitoring must be determined based on soil conditions, the Hydrogeologic conditions under and surrounding the facility, hydraulic conditions on and surrounding the facility, the location of facility structures and property boundaries, and the location of all offsite structures adjacent to property boundaries.

(B) The frequency of monitoring shall be quarterly or as approved by the Division.

(3) If methane or explosive gas levels exceeding the limits specified in Subparagraph (d)(1) of this Rule are detected, the owner and operator must:

(A) immediately take all steps necessary to ensure protection of human health and notify the Division;

(B) within seven days of detection, place in the operating record the methane or explosive gas levels detected and a description of the steps taken to protect human health; and

(C) within 60 days of detection, implement a remediation plan for the methane or explosive gas releases, place a copy of the plan in the operating record, and notify the Division that the plan has been implemented. The plan must describe the nature and extent of the problem and the proposed remedy.

(4) Based on the need for an extension demonstrated by the operator, the Division may establish alternative schedules for demonstrating compliance with Parts (3)(B) and (3)(C) of this Paragraph.

(5) For purposes of this Item, "lower explosive limit" means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25 C and atmospheric pressure.

.0566 - OPERATIONAL REQUIREMENTS FOR LAND CLEARING/INERT DEBRIS (LCID) LANDFILLS

.0566(13) The concentration of explosive gases generated by the facility shall not exceed:

(a) Twenty-five percent of the lower explosive limit for the gases in facility structures.

(b) The lower explosive limit for the gases at the property boundary.

.1626 – OPERATIONAL REQUIREMENTS FOR MSWLF FACILITIES

.1626(4) Explosive gases control.

(a) Owners or operators of all MSWLF units must ensure that:

(i) 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

(ii) The concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary.

(b) Owners or operators of all MSWLF units must implement a routine methane monitoring program to ensure that the standards of (4)(a) are met. A permanent monitoring system shall be constructed on or before October 9, 1994. A temporary monitoring system shall be used prior to construction of the permanent system.

(i) The type and frequency of monitoring must be determined based on the following factors:

(A) Soil conditions;

(B) The hydrogeologic conditions surrounding the facility;

(C) The hydraulic conditions surrounding the facility; and

(D) The location of facility structures and property boundaries.

(ii) The minimum frequency of monitoring shall be quarterly.

(c) If methane gas levels exceeding the limits specified in (4)(a) are detected, the owner or operator must:

(i) Immediately take all necessary steps to ensure protection of human health and notify the Division;

(ii) Within seven days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health; and

(iii) Within 60 days of detection, implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify the Division that the

plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy.

(iv) Based on the need for an extension demonstrated by the operator, the Division may establish alternative schedules for demonstrating compliance with (4)(c)(ii) and (iii) of this Rule.

(d) For purposes of this Item, "lower explosive limit" means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C and atmospheric pressure.

.1626(10) Recordkeeping requirements.

(a) The owner or operator of a MSWLF unit must record and retain at the facility, or an alternative location near the facility approved by the Division, in an operating record the following information as it becomes available:

(iii) Gas monitoring results and any remediation plans required by Item (4) of this Rule;

.1627 – CLOSURE AND POST CLOSURE REQUIREMENTS FOR MSWLF ACTIVITES

.1627(d) Post-Closure Criteria

(1) Following closure of each MSWLF unit, the owner or operator shall conduct post-closure care. Post-closure care shall be conducted for 30 years, except as provided under Subparagraph (2) of this Paragraph, and consist of at least the following:

(D)-Maintaining and operating the gas monitoring system in accordance with the requirements of Rule .1626 of this Section.

(2) The length of the post-closure care period may be:

(A) Decreased by the Division if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Division; or

(B) Increased by the Division if the Division determines that the lengthened period is necessary to protect human health and the environment.

(3) Following completion of the post-closure care period for each MSWLF unit, the owner or operator shall notify the Division that a certification, signed by a registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan, has been placed in the operating record.

NOTES:

Based on the referenced rules above, the following words / phrases are presently in the Solid Waste Section rules pertaining to methane and explosive landfill gas.

Rule .0101(14) states: *"Explosive gas means Methane (CH)"*.
Rule .0503 (2)(a) refers to *"explosive gases"*.
Rule .0544(d) refers to *"Gas Control Plan"*
Rule .0544(d)(1) refers to *"methane or other explosive gases"*.
Rule .0544(d)(2) refers to "*methane monitoring program*"
Rule .0544(d)(3) refers to *"methane or explosive gas levels*"
Rule .0566 (13) refers to *"explosive gases"*.
Rule .1626 (4) refers to *"explosive gases control"*
Rule .1626(4)(a-b) refers to "*methane monitoring"* and "*methane monitoring program"*.

Monitoring Goals

Landfill design and landfill gas monitoring regulations in North Carolina require that there not be an exceedance of 100% of the Lower Explosion Limit (LEL) (equivalent to 5% methane) at the property boundary, or 25% LEL in on-site structures. These regulations were developed over time to protect the health and safety of the citizens of North Carolina and the U.S. from the asphyxiation and explosive hazards of landfill gas.

NC Rule History

A review of NC landfill guidance documents and regulations from 1972 to the present indicates that from 1972 through 1982, there was no mention of design requirements regarding the control of landfill gas, nor were there any landfill monitoring requirements for landfill gas. In 1982, the regulations were changed to require that sanitary landfill design prevent landfill gas concentrations of 100% LEL at the property boundary line and 25% inside on-site structures. Although a design requirement was added, no design requirement was established to determine if the design requirement was being met. In 1993 with the establishment of .1600 rules, requirements for designs to limit landfill gas levels to below 100% at the property boundary line and 25% in on-site structures and monitoring of landfill gas concentrations around the perimeter of the landfill and inside on-site structures were adopted.

SECTION 4 – Landfill Gas Incidents and Explosions

Hazards Involving Landfill Gas

Landfill fires may or may not be directly caused by landfill gas. The primary concern with these fires is air contamination from the resulting smoke; however they also present a variety of additional problems. In addition to concerns with containing and extinguishing landfill fires, potential reactions involving unknown chemicals in the landfill can cause uncertain hazards. Discarded consumer products in a landfill, such as pesticides, paints, solvents, cleaners, and other material can be the source of chemical releases. Heat from the fire can cause chemicals to volatilize, breakdown, and enter the environment. Also to be considered is the presence of other combustible gases in addition to methane. Whenever an environmental investigation of a landfill is prompted by odorous compounds or explosive gases, the presence of toxic substances should also be investigated. One example is hydrogen sulfide (H2S) that can cause asphyxiation and is flammable. An analysis should include alkyl benzenes, sulfur compounds, vinyl chloride, and methane, and other products associated with industrial wastes, construction and debris waste, and normal organic and inorganic waste.

Fires and explosion hazards become a concern when gases collect in confined spaces. Buildings, basements, and pits are typically regarded as confined spaces. However, landfill gases also collect in and migrate to cracks in the landfill cover, leachate “springs”, cracks in adjacent structures, paved parking areas, etc. Fires can occur on the surface and underground. Surface fires involve recently buried waste near the surface in an aerobic decomposing layer, typically 1 to 4 feet below ground. These fires can be intensified by subsurface landfill gas and spread throughout the landfill. Subsurface fires occur deeper within the landfill, involve material buried for months or years, and can burn for days and months.

The following is a brief summary of some incidents involving landfill gas migration from landfills:

2007 Four employees died as a result of exposure to high concentrations of hydrogen sulfide while attempting to repair a leachate pump at a C&D landfill in Superior, Wisconsin (Journal of Environmental Heath 2008).

1999 An 8-year old girl was burned on her arms and legs when playing in an Atlanta, Georgia playground. The area was reportedly used as an illegal dumping ground many years ago (Atlanta Journal-Constitution 1999).

1994 While playing soccer in a park built over an old landfill in Charlotte, North Carolina, a woman was seriously burned by a methane explosion (Charlotte Observer 1994).

1987 Offsite landfill gas migration is suspected to have caused a house to explode in Pittsburgh, Pennsylvania (EPA 1991).

1984 Landfill gas migrated to and destroyed one house near a landfill in Akron, Ohio. Ten houses were temporarily evacuated (EPA 1991).

1983 An explosion destroyed a residence across the street from a landfill in Cincinnati, Ohio. Minor injuries were reported (EPA 1991).

1975 In Sheridan, Colorado, landfill gas accumulated in a storm drain pipe that ran through a landfill. An explosion occurred when several children playing in the pipe lit a candle, resulting in serious injury.

1969 Methane gas migrated from an adjacent landfill into the basement of an armory in Winston-Salem, North Carolina. A lit cigarette caused the gas to explode, killing three men and seriously injuring five others (USACE 1984).

SECTION 5 - Landfill Gas Monitoring Wells

Locations

Landfill gas monitoring well locations will be site specific depending upon site geology, depth to groundwater, surface water features, on-site and off-site structures and sensitive receptors. The landfill gas monitoring wells must be spaced no more than 500 feet apart depending upon site specifics. A readily accessible, unobstructed path must be maintained so that landfill gas monitoring wells are always accessible using four-wheel drive vehicles. Regardless of site specifics, the permittee must obtain approval from the Solid Waste Section for the design and installation of any landfill gas monitoring well system.

Well Construction and Installation

Landfill gas monitoring wells are the same as groundwater monitoring wells with two exceptions. Landfill gas monitoring wells are installed just above the water table within the unsaturated zone and are equipped with a stopcock valve or a quick connect coupling on the cap, which allows for accurate landfill gas measurements. The stopcock valve must be equipped with flexible tubing and a barb connection that will fit the gas meter's inlet tube. The stopcock valve or a quick connect coupling must be closed between monitoring events. The landfill gas monitoring well must also be capped, locked, and labeled with a permanently affixed identification plate stating the well contractor name and certification number, date of well competition, total depth of well, screen length and well ID number. See detailed schematics of a landfill gas monitoring well (Figure 1).

The depth of each landfill gas monitoring well will be site specific depending upon depth to groundwater. Landfill gas monitoring wells must be constructed the same as groundwater monitoring wells as described in 15A NCAC Subchapter 2C. Typically landfill gas monitoring wells must be installed using 2" PVC piping and screen. The screen length, also site specific, must span the majority of the unsaturated zone while still allowing for proper well construction. A North Carolina Licensed/Professional Geologist must be present to supervise the installation of all landfill gas monitoring wells. The exact locations, screened intervals, and nesting of the wells must be approved by the Solid Waste Section Hydrogeologist prior to landfill gas monitoring well installation. Each landfill gas monitoring well must be surveyed for location and elevation by a North Carolina Registered Land Surveyor. Within thirty (30) days of the completed construction of each new landfill gas monitoring well, the well construction record (Division of Water Quality form GW-1b) and the boring log/well detail diagram of each well must be submitted to the Solid Waste Section. The submittal must also include a scaled topographic map showing the location and identification of new, existing and abandoned landfill gas monitoring wells.

Nested and Clustered Landfill Gas Monitoring Wells

Nested and/or clustered landfill gas monitoring wells may be required in unsaturated zones of 45 feet or more to measure specific depths of the unsaturated zone. Initially, the installation of one long screen shall be sufficient. If a monitoring event shows an exceedance of the lower explosive limit, then the Solid Waste Section may require the installation of nested and/or clustered landfill gas monitoring wells.

Abandonment of Wells

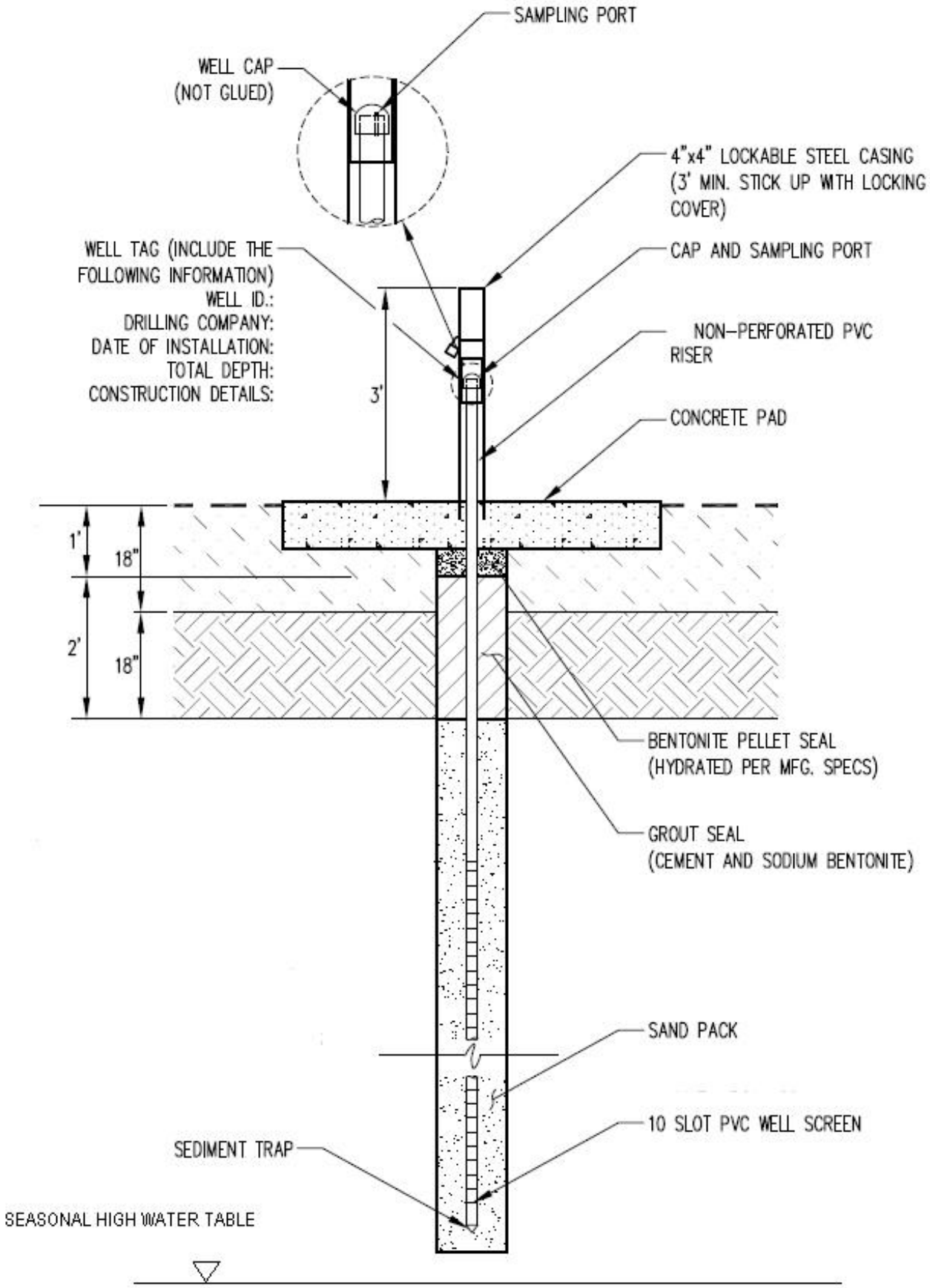
An abandonment record must be submitted to the Solid Waste Section within 30 (thirty) days of the abandonment of a landfill gas monitoring well. The landfill gas monitoring well(s) must be overdrilled and sealed with grout in accordance with 15A NCAC 2C .0113(d) and certified by a North Carolina Licensed/Professional Geologist.

Professional Certification

The certification statement below must be signed and sealed by a Professional Geologist and submitted with the Landfill Gas Monitoring Plan.

> The landfill gas monitoring plan for this facility has been prepared by a qualified geologist who is licensed to practice in the State of North Carolina. The plan has been prepared based on first-hand knowledge of site conditions and familiarity with North Carolina solid waste rules and industry standard protocol. This certification is made in accordance with North Carolina Solid Waste Regulations, indicating this Landfill Gas Monitoring Plan should provide early detection of any release of hazardous constituents to the uppermost aquifer, so as to be protective of public health and the environment. No other warranties, expressed or implied, are made.
>
> Signed _____
>
> Printed _____
>
> Date _____
>
> Not valid unless this document bears the seal of the above mentioned licensed professional.

Figure 1 – Landfill Gas Monitoring Well Detail



SECTION 6 – Landfill Gas Monitoring Instrumentation

The person using the landfill gas monitoring instrument must understand the principles of operation and follow the manufacturer's instructions. This includes calibrating the instrument according to the manufacturer's specifications. Include the following on the top portion of the landfill gas monitoring form (See example below) : facility name, permit number, type and serial number of gas monitoring instrument, calibration date of the instrument, date and time of field calibration, type of gas used for field calibration (15/15 or 35/50), expiration date of field calibration gas canister, date of landfill gas monitoring event, name and position of sample collector, pump rate of instrument being used, ambient air temperature, and general weather conditions. Verification that the equipment was calibrated in accordance with the manufacturer's specifications is also required. When determining which field calibration gas to use, take into consideration the expected levels of methane in the landfill gas monitoring wells. If the methane levels are expected to be low, use the 15/15 gas canister (15% CO2/15% CH4). If the methane levels are expected to be high, use the 35/50 gas canister (35% CO2/50% CH4).

For every landfill gas monitoring well, please include the following: verification of sample tube purge prior to each sample taken (should be one minute), the time pumped in seconds (should be at least one minute), barometric pressure, time stabilized reading collected, percent lower explosive limit, percent methane by volume, percent oxygen, percent carbon dioxide, and any observations or comments. Most modern gas monitoring instruments will measure percent oxygen and carbon dioxide in addition to the methane and display the results on the same instrument. Recording the levels of percent oxygen and carbon dioxide should require little or no extra effort.

The landfill gas monitoring data form (See example below) and results should be retained in the facility's operating record unless an exceedance has occurred and/or is requested by the Solid Waste Section.

Landfill gas monitoring readings from non-calibrated or inaccurately calibrated instruments are not reliable, and will therefore be rejected by the Solid Waste Section. Landfill gas monitoring readings collected with monitoring equipment that was not designed for landfill gas monitoring will also be rejected by the Solid Waste Section. There are several different landfill gas monitoring instruments on the market which may be used in order to obtain all of the information required by the Solid Waste Section.

Monitoring Times

Monitoring times are also important when conducting landfill gas monitoring. Proper landfill gas monitoring should include sampling during times when landfill gas is most likely to migrate. Landfill gas can migrate and accumulate not only in landfill gas monitoring wells; it can also migrate and accumulate in buildings and other structures. Because subsurface gas pressures are considered to be at a maximum during the afternoon hours, monitoring should be conducted in the afternoon or whenever the barometric pressure is low.

Scientific evidence also indicates that weather and soil conditions influence the migration of landfill gas. Barometric pressure and precipitation have significant effects on landfill gas migration. Increased barometric pressure generates decreased landfill gas venting from the subsurface, until the pressure within the subsurface is greater than the atmospheric (barometric) pressure. On the other hand, when the barometric pressure decreases, the landfill will vent the stored gas until a pressure equilibrium is reached. Capping of a landfill can influence the effect of barometric pressure on landfill gas migration. Generally, a more permeable landfill cap will allow greater influence by barometric pressure than a less permeable

landfill cap. As a result, landfill gas monitoring should be conducted when the barometric pressure is low and soils are saturated. During the winter season when snow cover is just beginning to melt or when the ground is frozen or ice covered, landfill gas monitoring should be conducted when the barometric pressure is low.

Landfill Gas Sampling Procedures

Any accumulation of landfill gas in the landfill gas monitoring wells is the result of landfill gas migration. The following procedure is a recommended example for conducting landfill gas monitoring well sampling, but always read and follow the manufacturer's instructions because each instrument will be different.

Step 1 – Calibrate the instrument according to the manufacturer's specifications. In addition, prepare the instrument for monitoring by allowing it to properly warm up as directed by the manufacturer. Make sure the static pressure shows a reading of zero on the instrument prior to taking the first sample.
Step 2 – Purge sample tube for at least one minute prior to taking reading. Connect the instrument tubing to the landfill gas monitoring well cap fitted with a stopcock valve or quick connect coupling.
Step 3 – Open the valve and record the initial reading and then the stabilized reading. A stable reading is one that does not vary more than 0.5 percent by volume on the instrument's scale.
Step 4 - Record the stabilized reading including the oxygen concentration and barometric pressure. A proper reading should have two percent oxygen by volume or less. If levels of oxygen are higher, it may indicate that air is being drawn into the system giving a false reading.
Step 5 – Turn the stopcock valve to the off position and disconnect the tubing.
Step 6 – Proceed to the next landfill gas monitoring well and repeat Steps 2 – 5.

Landfill Gas Constituent Sampling and Analysis

Sampling of landfill gas to determine volume percentages/concentrations of each constituent can be accomplished through the use of canisters which are specifically designed for landfill gas analysis. Several analytical methods are available to determine the concentrations of a variety of constituents. Typically, landfill gas analysis of this type is performed to determine the non-methane organic compounds emission rate for Tier 2 testing under the Clean Air Act (Title V Subpart WWW 60.754). Isotropic identification of landfill methane can be accomplished to identify one source of methane from another. In this case, isotopes of carbon and hydrogen in the methane are analyzed to determine the methane source.

NC Division of Waste Management - Solid Waste Section

Landfill Gas Monitoring Data Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Facility Name: _____ Permit Number: _____

Date of Sampling: _____ NC Landfill Rule (.0500 or .1600): _____

Name and Position of Sample Collector: _____

Type and Serial Number of Gas Meter: _____ Calibration Date of Gas Meter: _____

Date and Time of Field Calibration: _____

Type of Field Calibration Gas (15/15 or 35/50): _____ Expiration Date of Field Calibration Gas Canister: _____

Pump Rate of Gas Meter: _____

Ambient Air Temperature: _____ Barometric Pressure: _____ General Weather Conditions: _____

Instructions: Under "Location or LFG Well" identify the monitoring wells or describe the location for other tests (e.g., inside buildings). A drawing showing the location of test must be attached. Report methane readings in both % LEL and % methane by volume. A reading in percent methane by volume can be converted to % LEL as follows: % methane by volume = % LEL/20

Location or LFG Well ID	Sample Tube Purge	Time	Time Pumped (s)	Initial %LEL	Stabilized %LEL	%CH4 by Volume	%O2	%CO2	Notes

If your facility has more gas monitoring locations than there is room on this form, please attach additional sheets listing the same information as contained on this form.

Certification
To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

_____ _____
SIGNATURE TITLE

SECTION 7 - References

Agency for Toxic Substances & Disease Registry. "Landfill Gas Primer- An Overview for Environmental Health Professionals. 2001." http://www.atsdr.cdc.gov/HAC/landfill/html/toc.html (accessed February 24. 2010).

California Environmental Protection Agency. "Landfill Gas Monitoring Well Functionality at 20 California Landfills, 2008". http://www.calrecycle.ca.gov/Publications/Organics/2008022.pdf (accessed February 24 2010).

Florida Department of Environmental Protection. Gas Management Systems, under Rule 62-701.530. http://www.dep.state.fl.us/waste/quick_topics/rules/default.htm (accessed February 24, 2010).

Missouri Department of Natural Resources, Flood Grant Team. "An Analysis of Landfill Gas Monitoring Well Design and Construction, 2007". http://www.clu-in.org/conf/itrc/directpush/prez/Missouri_Study.pdf (accessed February 24, 2010).

Missouri Department of Natural Resources. "Design and Construction of Landfill Gas Monitoring Wells". http://www.dnr.missouri.gov/pubs/pub2054.pdf (accessed February 24. 2010).

Wisconsin Department of Natural Resources. Environmental Monitoring for Landfills, under Chapter NR 507.22. http://www.dnr.state.wi.us/org/aw/wm/information/wiacsss.htm (accessed February 24, 2010).

"Landfill Gas-an Overview" Landfill-gas.com. Web, 22, Feb. 2010 http://www.landfill-gas.com/webpage -LFG-overview.doc

SECTION 8 – Suggested Outline for a Landfill Gas Monitoring Plan

1. Introduction
   1.1. Background (project overview, site observations, NCDENR rules referenced)
   1.2. Site Geology with discussion of groundwater depth and flow (potentiometric surface map)
   1.3. Regulatory Limits
2. Landfill Gas Monitoring
   2.1. Landfill Gas Monitoring Well Locations (discussion of reasoning behind proposed locations, discussion of well construction, reference map showing proposed locations, reference table displaying well ID, well depth, screen interval and depth to groundwater)
   2.2. Structure and Ambient Sampling
   2.3. Landfill Gas Monitoring Frequency
3. Landfill Gas Sampling Procedures
   3.1. Detection Equipment Used (discussion of calibration procedures)
   3.2. Landfill Gas Sampling Procedure
4. Record Keeping and Reporting
   4.1. Landfill Gas Monitoring Data Form
   4.2. Sampling Reports
   4.3. Permanent Record Keeping
5. Contingency Plan
6. Certification of Professional Geologist
7. Certification of Registered Land Surveyor

Figures

Map displaying proposed landfill gas monitoring well locations

Potentiometric Surface Map

Diagram showing construction of stopcock valve or quick connect coupling on well cap

Diagram showing well construction of each landfill gas monitoring well

Table

Table displaying well ID, well depth, screen interval, depth to groundwater

Example of landfill gas monitoring data form

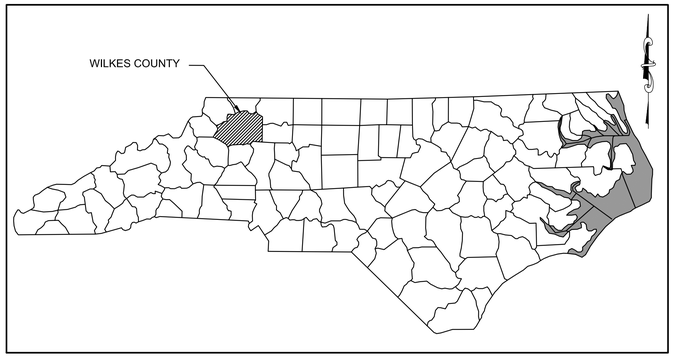
SECTION 9 – Checklist of Items to be Included in a Landfill Gas Monitoring Plan

1. Depth to groundwater discussion
2. Well locations
    a. Number of wells
    b. Well spacing
3. Instrumentation being used
    a. Calibration procedures
4. Sampling procedures as per the manufacture's instructions
5. Map of well locations
6. Table describing each well location
    a. Well ID
    b. Well depth
    c. Screen interval
    d. Depth to groundwater
    e. Subsurface lithology
7. Diagram of cap construction w/ stopcock valve or quick connect coupling
8. Diagram of well construction
9. Potentiometric surface map
10. Professional Geologist certification
11. Registered Land Surveyor certification

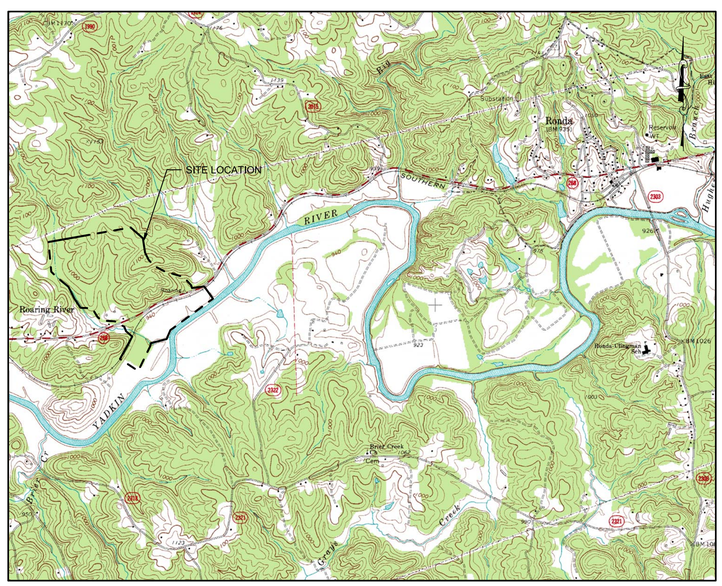
DRAWINGS

ROARING RIVER LANDFILL
PERMIT RENEWAL

WILKES COUNTY, NORTH CAROLINA



NORTH CAROLINA
COUNTY LOCATION MAP



VICINITY MAP

OWNER INFORMATION

PREPARED FOR:	WILKES COUNTY DEPARTMENT OF SOLID WASTE
ADDRESS:	9219 ELKIN HIGHWAY ROARING RIVER, NORTH CAROLINA, 28669
CONTACT:	KENT BRANDON (336) 696-5806 (336) 927-4117

PROPERTY INFORMATION

ADDRESS:	9219 ELKIN HIGHWAY ROARING RIVER, NORTH CAROLINA, 28669
NCDENR PERMIT:	97-04
ACREAGE:	145 ACRES

DRAWING INDEX

SHEET	DESCRIPTION
OP-T	TITLE SHEET
OP-L	LEGEND AND GENERAL NOTES
OP-01	EXISTING CONDITIONS
OP-02	SITE DEVELOPMENT PLAN
OP-03	PHASING PLAN: PHASE 4 / YEARS 1-5

OPERATIONS PLAN
DECEMBER 2015

DATE	REVISIONS AND RECORD OF ISSUE	NO	BY	CK	APP
12/21/15	2015 PERMIT RENEWAL SUBMITTED TO DEQ		RH	LB	MM

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. DAVIS

DESIGNED MM
DRAWN RWH
CHECKED LB
APPROVED MM
DATE 12/21/15

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NC CORP LIC: C-0782

ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

TITLE SHEET

PROJECT NO. 356

SCALE N.T.S.

DRAWING NO. OP-T

L:\Wilkes\dwg\2015 renewal\OPERATIONS PLAN\OP-T TITLE SHEET.dwg Layout=Layout1

CONVENTIONAL SYMBOLS AND GENERAL NOTES

ENVIRONMENTAL MONITORING FEATURES

MW-X	EXISTING GROUNDWATER MONITORING WELL
MW-#	PROPOSED GROUNDWATER MONITORING WELL
MW-OW-#	EXISTING OBSERVATION WELL
MW-OW-X	PROPOSED OBSERVATION WELL
NES-OW-X	EXISTING NES WELL
NES-OW-#	PROPOSED NES WELL
MW-PW-X	EXISTING PERFORMANCE WELL
MW-PW-#	PROPOSED PERFORMANCE WELL
MW-X	EXISTING SENTINEL WELL
MW-#	PROPOSED SENTINEL WELL
EW-X	EXISTING EXTRACTION WELL
EW-#	PROPOSED EXTRACTION WELL
PZ-#	WETLANDS PIEZOMETER
PZ-X	PIEZOMETER
GP-X	GAS PROBE
GV-X	EXISTING GAS VENT
GV-#	PROPOSED GAS VENT
GW-X	EXISTING GAS WELL
GW-#	PROPOSED GAS WELL
SMP-X	SURFACE WATER MONITORING POINT
LMP-1	LEACHATE MONITORING POINT
B-X	BORE HOLE LOCATION
C-X	CORING LOCATION
SS-X	SOIL SAMPLING LOCATION
TP-X	TEST PIT LOCATION
W	WELL LOCATION
S-X	SPRINGHEAD LOCATION

SURVEY FEATURES

BM	BENCHMARK
CP	CONTROL POINT
	PROPERTY LINE
	EASEMENT
R/W	RIGHT OF WAY
x	FENCE LINE
	RAILROAD
	GUARDRAIL
	RESOURCE PROTECTION AREA

UTILITIES

	UTILITY POLE
	HYDRANT
	LIGHT POLE
	TANK (SIZE VARIES)
	TRANSFORMER
M	MANHOLE
	CLEANOUT
	VALVE
OHE	OVERHEAD ELECTRIC
UGE	UNDERGROUND ELECTRIC
OHT	OVERHEAD TELEPHONE
UGT	UNDERGROUND TELEPHONE
FM	LEACHATE FORCE MAIN
DCFM	DUAL CONTAINED LEACHATE FORCE MAIN
SS	SANITARY SEWER
PS	PROCESS SEWER
G	LANDFILL GAS LINE
UGG	NATURAL GAS LINE
W	POTABLE WATER
	SOLID PIPE (TYPE NOTED)
	PERFORATED PIPE (TYPE NOTED)
	CULVERT (SIZE NOTED)

LANDFILL AND ROAD FEATURES

	PAVED ROAD
	GRAVEL/DIRT ROAD
	EDGE OF PAVEMENT
	LIMIT OF WASTE/EDGE OF LINER
	FACILITY BOUNDARY/CELL LIMITS/PHASE LIMITS

BUILDINGS AND STRUCTURES

	BUILDING
	DAM
	FOUNDATION

HYDROLOGY

	APPROXIMATE 100 YEAR FLOOD PLAIN
	DITCH FLOW
	STREAM OR RIVER

VEGETATION

	SINGLE TREE
	TREE LINE
	SHRUB

EROSION AND SEDIMENT CONTROL FEATURES

SF	SILT FENCE
IP	INLET PROTECTION
	OUTLET PROTECTION (SIZE VARIES)
	DIVERSION BERM

TOPOGRAPHICAL FEATURES

100	EXISTING 10' TOPO CONTOUR
	EXISTING 2' TOPO CONTOUR
100	PROPOSED 10' TOPO CONTOUR
	PROPOSED 2' TOPO CONTOUR
100	GROUNDWATER SURFACE CONTOUR (FT ABOVE MEAN SEA LEVEL)
100	BEDROCK SURFACE CONTOUR (FT ABOVE MEAN SEA LEVEL)
100.00	SPOT ELEVATION

HATCHING

	WETLANDS
	RIPRAP
	WASHED STONE
	BUFFER AREA
	PROPOSED ROAD
	COMPACTED BACKFILL

SURVEY NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET, UNLESS INDICATED OTHERWISE.
3. ON-SITE TOPOGRAPHY PROVIDED BY SPATIAL DATA CONSULTANTS, INC. , 1008 HUTTON LANE, HIGH POINT, NORTH CAROLINA 27262, DATED FEBRUARY 26, 2011 AND MERGED WITH APRIL 2015 GROUND SURVEY PROVIDED BY COUNTY IN ACTIVE LANDFILL AREAS.
4. FEDERAL INSURANCE ADMINISTRATION, FLOOD INSURANCE RATE MAP, WILKES COUNTY, NC, INDICATES NO 100 YEAR FLOOD PLAINS ON SITE.
5. PROPERTY BOUNDARY BEARING AND DISTANCES PROVIDED BY TOM FRAZIER, R.L.S 1286 NC. ON MAY 8, 1989.
6. SITE CONTROL INFORMATION UPDATED BY SPATIAL DATA CONSULTANTS, INC. , 1008 HUTTON LANE, HIGH POINT, NORTH CAROLINA 27262, DATED MARCH 19, 2010.
5. THE SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE SEARCH AND ALL EASEMENTS AND ENCUMBRANCES MAY NOT BE SHOWN.

GENERAL NOTES:

1. SITE LIGHTING IS NOT PROPOSED FOR THIS PROJECT.
2. LANDSCAPING IS NOT PROPOSED FOR THIS PROJECT. HOWEVER THE BUFFER AREA SHOWN ON DRAWINGS WILL REMAIN UNDISTURBED EXCEPT FOR THE INSTALLATION OF UTILITIES, STORMWATER DRAINAGE FEATURES AND ACCESS TO THE SITE. WHEN POSSIBLE CLEARING WITHIN THE BUFFER WILL BE ALIGNED TO MINIMIZE VISUAL IMPACTS.
3. SOIL STOCKPILE AREAS WILL BE ESTABLISHED TO FACILITATE PHASED CONSTRUCTION. STOCKPILE LOCATIONS AND SIZE MAY VARY AND MAY NOT BE LIMITED TO THE AREAS SHOWN. SILT FENCE WILL BE INSTALLED AROUND THE BASE OF THE STOCKPILE.

DATE	REVISIONS AND RECORD OF ISSUE	NO	BY	CK	APP
12/21/15	2015 PERMIT RENEWAL SUBMITTED TO DEQ		RH	LB	MM

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. DAVIS

DESIGNED MM
DRAWN RWH
CHECKED LBB
APPROVED MM
DATE 12/21/15

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CHARLOTTE, NC 28273
PHONE: (704) 817-2037
NC CORP LIC: C-0782

ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

LEGEND AND GENERAL NOTES

PROJECT NO. 356

SCALE N.T.S.

DRAWING NO. OP-L

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NO	BY	CK	APP
	RH	LB	MM

DATE	REVISIONS AND RECORD OF ISSUE
12/21/15	2015 PERMIT RENEWAL SUBMITTED TO DEQ

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. DAVIS

DESIGNED	MM
DRAWN	RWH
CHECKED	LBB
APPROVED	MM
DATE	12/21/15

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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

EXISTING CONDITIONS

PROJECT NO. 356

SCALE AS SHOWN

DRAWING NO. OP-01

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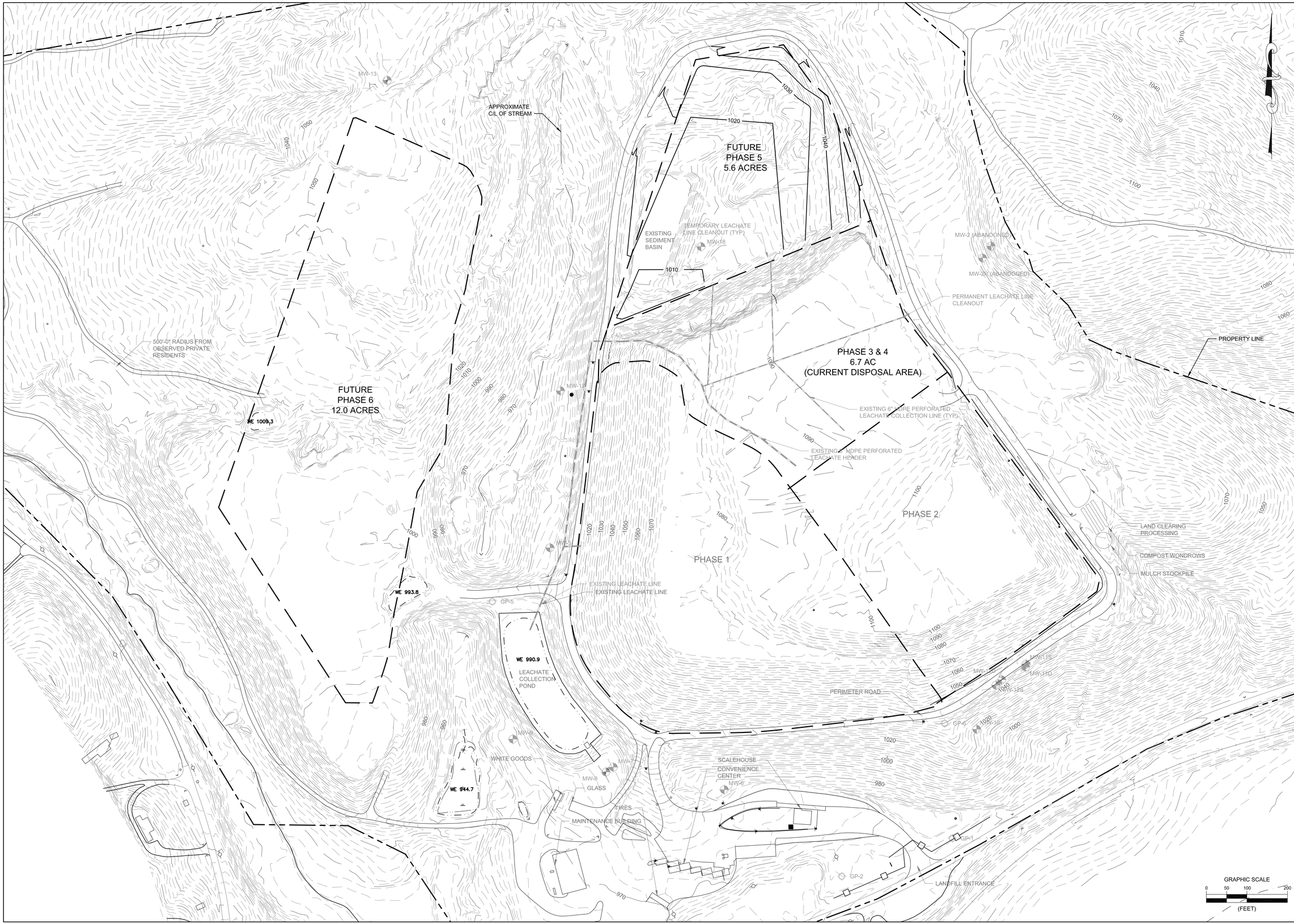

NO	BY	CK	APP
RH	LB	MM	

DATE	REVISIONS AND RECORD OF ISSUE
12/21/15	2015 PERMIT RENEWAL SUBMITTED TO DEQ

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. DAVIS

DESIGNED	MM
DRAWN	RWH
CHECKED	LBB
APPROVED	MM
DATE	12/21/15

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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

SITE DEVELOPMENT PLAN

PROJECT NO.
356

SCALE
AS SHOWN

DRAWING NO.
OP-02

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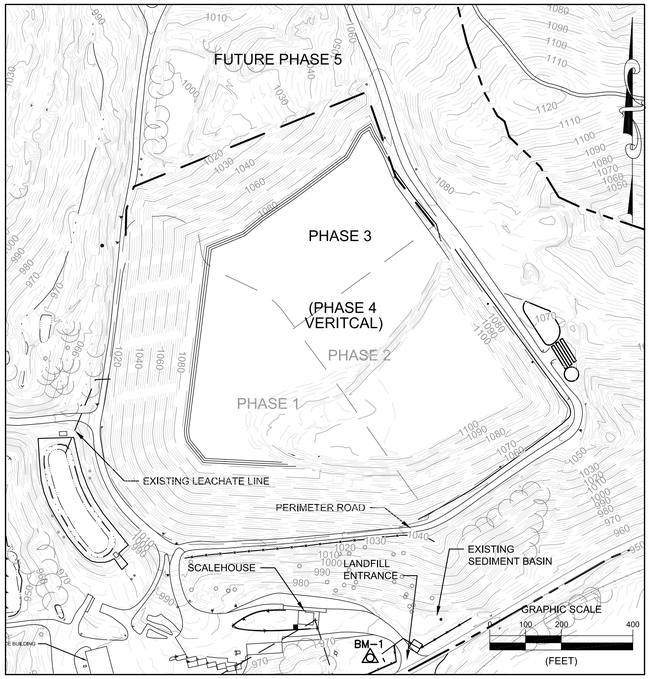
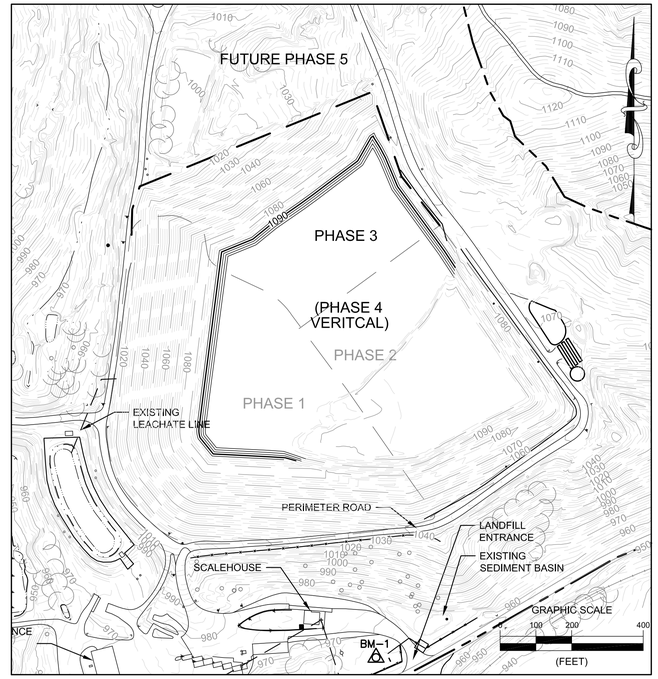
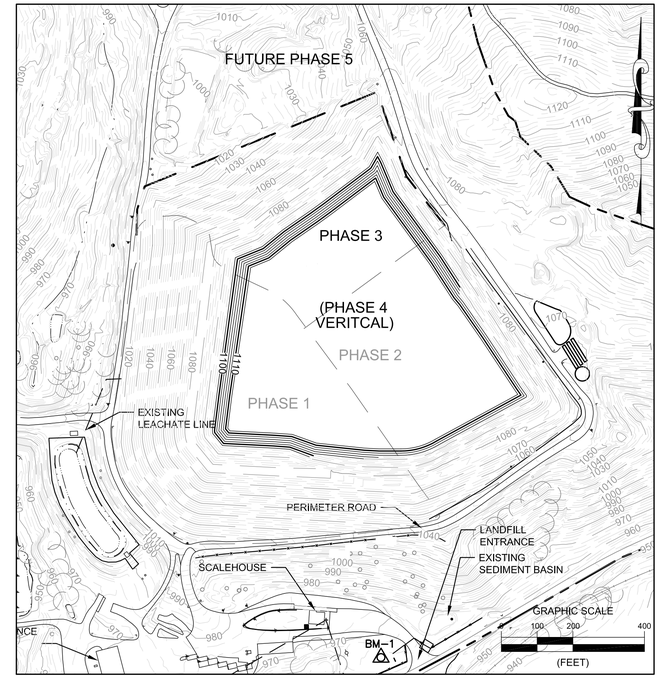


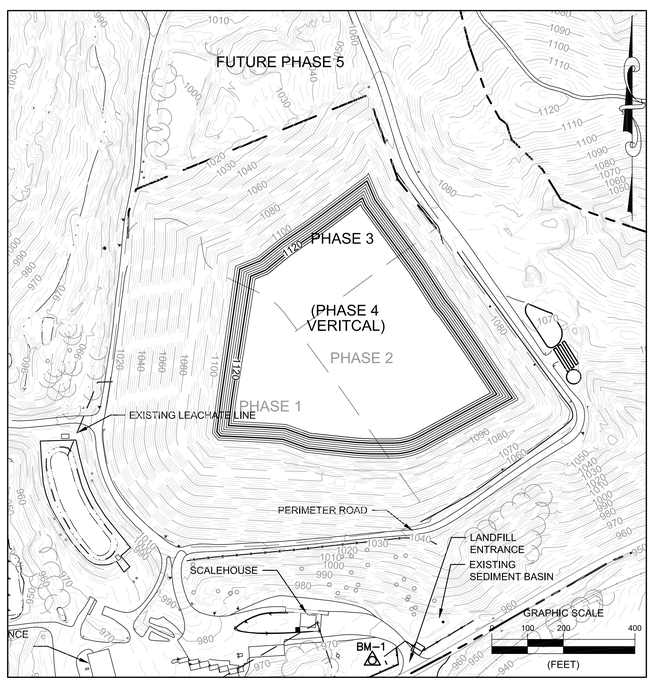
PHASE 4
YEAR 1 -103,325 CY CONSUMED AIRSPACE



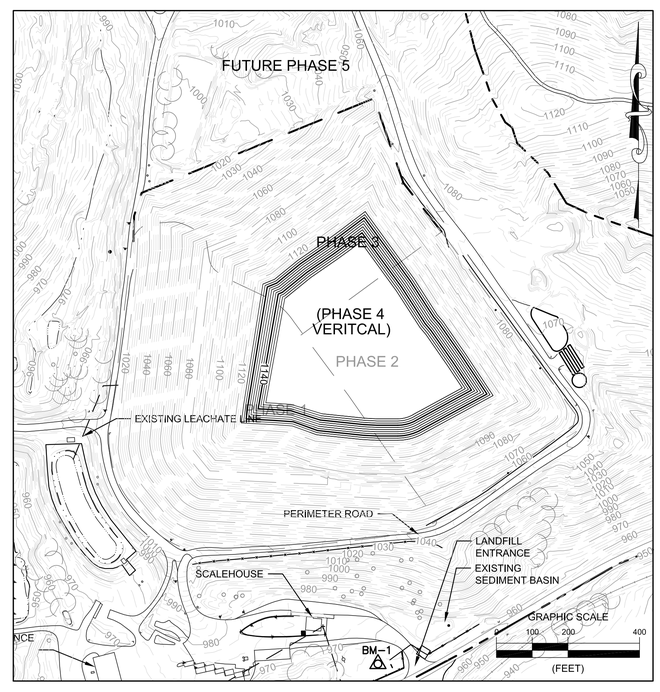
PHASE 4
YEAR 2- 106,260 CY CONSUMED AIRSPACE



PHASE 4
YEAR 3 -104,500 CY CONSUMED AIRSPACE



PHASE 4
YEAR 4 - 106,200 CY CONSUMED AIRSPACE



PHASE 5
YEAR 5 -104,200 CY CONSUMED AIRSPACE

SPECIAL WASTE AREAS

ASBESTOS (IN ACCORDANCE WITH 40CFR61) WILL BE DIPOSED OF AT THE BOTTOM OF THE CURRENT WORKING FACE, AND IMMEDIATELY COVERED WITH SOIL. ASBESTOS DISPOSAL LOCATIONS WILL BE DOCUMENTED USING A GPS DEVICE AND KEPT ON RECORD.

NO	BY	CK	APP
RH	LB	MM	

DATE	REVISIONS AND RECORD OF ISSUE
12/21/15	2015 PERMIT RENEWAL SUBMITTED TO DEQ

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. DAVIS 12/21/15

DESIGNED	MM
DRAWN	RWH
CHECKED	LBB
APPROVED	MM
DATE	12/21/15

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ROARING RIVER LANDFILL
WILKES COUNTY, NORTH CAROLINA

PHASING PLAN: PHASE 4/ YEARS 1-5

PROJECT NO.
356

SCALE
AS SHOWN

DRAWING NO.
OP-3

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Table 1
Estimate of Closure Cost:
Roaring River Landfill
Phases 1-4

ITEM	UNIT	QUANTITY	UNIT COST	COST $
FINAL CAP SYSTEM- 25.4 ACRES (PHASE 1-4)				
Intermediate Cover (6" non-specified)	cy	20,489	$4.00	$81,957
Geonet Composite (Gas Migration Layer)	sf	1,106,424	$0.50	$553,212
GCL	sf	1,106,424	$0.55	$608,533
Geomembrane (40 mil)	sf	1,106,424	$0.50	$553,212
Geonet Composite (Drainage Layer)	sf	1,106,424	$0.50	$553,212
Protective cover (18")	cy	61,469	$5.10	$313,489
Erosion Layer (6")	cy	20,490	$4.00	$81,958
			Subtotal	**$2,745,574**
SEDIMENTATION AND EROSION CONTROLS				
Diversion Berms				
Construction and lining	lf	5,770	$13.00	$75,010
Slope Drains				
HDPE Pipe and Installation	lf	1,625	$43.12	$70,070
Drainage Bench Inlet	each	14	$300.0	$4,200
Conveyance Channels				
Riprap Channels	lf	0	$57.50	$0
Grass-lined Channels	lf	385	$5.75	$2,214
Drainage Pipe (RCP)	lf	0	$40.00	$0
Miscellaneous				
Outlet Protection (RipRap)	each	3	$440.00	$1,320
Silt Fence	lf	1,000	$3.60	$3,600
			Subtotal	**$156,414**
GAS CONTROLS (Vents)	each	25	$5,000.00	**$127,000**
VEGETATIVE COVER	acre	25	$1,750.00	**$44,450**
TOTAL OF ABOVE ITEMS				**$3,073,438**
MOBILIZATION / DEMOBILIZATION	(construction only)		5%	$153,672
ENGINEERING FEE	-	-	2%	$61,469
CQA	(cap only)	-	6%	$164,734
CONTINGENCY	-	-	10%	$307,344
ADMINISTRATION	lump sum	-	-	$2,500
CLOSURE CERTIFICATION	lump sum	-	-	$2,500
SURVEY AND DEED	lump sum	-	-	$8,000
TOTAL CLOSURE COST (IN 2010 DOLLARS)				$3,773,656
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2011) - ASSUMED TO BE THE SAME AS 2012				1.021
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2012) - NC DEQ				1.021
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2013) - NC DEQ				1.018
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2014) - NC DEQ				1.015
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2015) - NC DEQ				1.014
TOTAL CLOSURE COST (IN 2015 DOLLARS)				**$4,121,598**

Notes:
1. Costs are based on conceptual design and should be considered approximate.

Table 2
Estimate of Post-Closure Care Costs:
Roaring River Landfill
Phases 1-4

ITEM	UNIT	QUANTITY	UNIT COST	ANNUAL COST
INSPECTIONS/ RECORD KEEPING	per trip	4	$500	**$2,000**
MONITORING				
Explosive gases (quarterly)	per trip	4	$1,000	$4,000
Groundwater/Surfacewater (semi-annually)				
Sampling	per trip	2	$4,000	$8,000
Analysis	per trip	2	$2,500	$5,000
Reporting	per trip	2	$2,500	$5,000
Surface Water (semi-annually)	per trip	2	$2,100	$4,200
Leachate sampling and analysis	per trip	2	$500	$1,000
Subtotal				**$27,200**
ROUTINE MAINTENANCE				
Mowing	acre	25.4	$150	$3,810
Fertilizing (once every 3 years)	acre	8.5	$255	$2,159
Reseeding (once every 3 years)	acre	8.5	$1,600	$13,547
Vector and Rodent Control	acre	25.4	$30	$762
Subtotal				**$20,278**
WELL MAINTENANCE				
Groundwater Wells	lump sum	1	$1,000	$1,000
Gas Detection Probes	lump sum	1	$500	$500
Subtotal				**$1,500**
CAP REPAIR	lump sum	1	$6,000	**$6,000**
TOTAL OF ABOVE ITEMS				**$56,978**
ENGINEERING	-	-	3%	$1,709
CONTINGENCY	-	-	5%	$2,849
TOTAL ANNUAL POST-CLOSURE COST (IN 2010 DOLLARS)				**$61,536**
TOTAL 30 YEAR POST-CLOSURE COST (IN 2010 DOLLARS)				**$1,531,963**
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2011) - ASSUMED TO BE THE SAME AS 2012				1.021
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2012) - NC DEQ				1.021
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2013) - NC DEQ				1.018
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2014) - NC DEQ				1.015
INFLATION FACTOR PRICE DEFLATOR/MULTIPLIER (2015) - NC DEQ				1.014
TOTAL 30 YEAR POST-CLOSURE COST (IN 2015 DOLLARS)				**$1,673,214**

Notes:

1. All costs include labor by a third party.
2. Water quality monitoring and leachate management costs are estimated.
3. Cost for groundwater wells assumes maintenance of each well during the period.
4. Cost for the gas probes assumes maintenance of each probe during the period.