Water Quality Monitoring Plan

Washington County C&D Landfill (Permit 94-04)

Roper, North Carolina

Prepared For:

Washington County Public Utilities
396 Millpond Road
Roper, North Carolina 27970

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

November 2009
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RSG Project No. WASH-11-1

Joan A. Smyth, P.G.
Principal, Senior Hydrogeologist

NORTH CAROLINA LICENSED SEAL 1369 GEOLOGIST JOAN A. SMYTH

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RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES
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WASHINGTON COUNTY C&D LANDFILL

WATER QUALITY MONITORING PLAN

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SECTION 1.0
INTRODUCTION

1.1 PLAN BACKGROUND

This Water Quality Monitoring Plan (WQMP) specifies the procedures and requirements to satisfy North Carolina Solid Waste Management Rule 15A NCAC 13B.0544 (b). Surface water is not addressed in this WQMP due to a lack of surface water near the landfill. Although the landfill is surrounded by wetlands, no consistently flowing surface water is located within approximately 1/4 mile. Based upon the lack of surface water in the immediate vicinity of the landfill, no surface water sampling is proposed in this document. The WQMP addresses monitoring/sampling of the groundwater monitoring system.

The WQMP is designed to comply with the following requirements:

- *Represent the quality of the background groundwater that has not been affected by leakage from the unit (.0544 (b)(1)(A)).*
- *Represent the quality of the groundwater passing the relevant point of compliance as approved by the Division (.0544 (b)(1)(B)).*
- *The groundwater monitoring programs must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and down-gradient wells (.0544 (b)(1)(C)).*
- *Detection Groundwater monitoring program (.0544 (b)(1)(D)).*
- *The sampling procedures and frequency must be protective of human health and the environment (.0544 (b)(1)(E)).*
- *Responsibility of sample collection and analysis must be defined as a part of the monitoring plan (.0544 (c)(2)).*

This WQMP also addresses the following subjects:

- Sample preservation and shipment;
- Laboratory analytical procedures;
- Sample chain-of-custody control; and
- Quality assurance/quality control programs;

The methods and procedures described in the WQMP are intended to facilitate the collection of true and representative samples and test data. Field procedures are presented in **Section 2.0** in their general order of implementation. Equipment requirements for each field task are presented

within the applicable section. Laboratory procedures, quality assurance methods, and record keeping requirements are presented in **Sections 3.0 through 7.0.**

Strict adherence to the procedures stipulated in this plan is required. Any variations from these procedures should be thoroughly documented.

1.2 SITE CONTACT INFORMATION

In case of emergencies, or if questions arise during the implementation of this program, please contact the following:

Owner:	
Mr. Carl Critcher	Ms. Joan Smyth, P.G.
Washington County	RSG
Office (252) 793-5615	Office (919) 828-0577 x122
	Cell (919) 815-1494

1.3 SITE BACKGROUND

Washington County owns and operates a construction and demolition debris (C&D) landfill under NC Solid Waste Permit No. 94-04, located at 718 Landfill Road Roper, North Carolina. The nearest water body is an unnamed tributary of the Roanoke River that drains into Swan Bay located approximately 1/4 mile to the northeast of the site. The site and monitoring network are shown in **Figure 1**. Information for existing monitoring wells can be found in **Table 1**. The County's closed MSW landfill (NC Solid Waste Permit 94-02) is located on the property to the southwest of the C&D landfill.

1.3.1 Geology

The site is located in the Coastal Plain physiographic province of North Carolina. The site is located east of the Suffolk Scarp and is underlain by undifferentiated Quaternary sediments. These sediments consist of sand, clay, gravel, and peat that were deposited in marine, fluvial, eolian, and lacustrine environments. Ground water at the site flows in the unconsolidated sediments toward discharge features.

1.3.2 Hydrogeology

The uppermost aquifer at the site flows within the unconsolidated sediments described above with discharge to the unnamed tributary of the Roanoke River. Hydraulic conductivities[1] for this aquifer range from 1×10^{-2} to 3.6×10^{-2}.

[1]Site Application Report for Proposed Construction and Demolition Waste Landfill and Tire Monofill for Washington County, Diehl & Phillips, P.A. Consulting Engineers, October 1994.

SECTION 2.0
MONITORING PROGRAM

2.1 MONITORING NETWORK AND ANALYTICAL PARAMETERS

The monitoring network for the C&D landfill currently includes four (4) compliance groundwater monitoring wells (CD-1, CD-2, CD-3, & CD-4). These wells are monitored for constituents referenced in 15A NCAC 13B 0.544(b)(1)(D) on a semi-annual basis. The monitoring network is shown on **Figure 1**. Analytical parameters for each well are outlined in **Table 2**.

Additionally, applicable local, state, and federal health and safety requirements will be followed. Requirements for the disposal of any investigation derived wastes will also be followed.

2.2 GROUNDWATER SAMPLE COLLECTION

2.2.1 Introduction

This section presents details of the procedures and equipment required to perform groundwater field measurements and sampling from monitoring wells during each monitoring event. **Where possible, phases of work will proceed from the upgradient (background) wells to downgradient (compliance) wells.**

2.2.1.1 Guidance Documents

Sampling, analysis, and submittals shall be performed in accordance with this plan and the following guidance documents:

1. Groundwater, Surface Water and Soil Sampling for Landfills - NCDENR Guidance updated April 2008.

2. October 26, 2006 Memo from NCDENR entitled: "New Guidelines for Electronic Submittal of Environmental Monitoring Data".

3. February 23, 2007 Memo from NCDENR entitled Addendum to October 27, 2006 North Carolina Solid Waste Section Memorandum Regarding New Guidelines for Electronic Submittal of Environmental Data.

4. October 16, 2007 Memo from NCDENR entitled Environmental Monitoring Data for North Carolina Solid Waste Management Facilities.

2.2.1.2 Fuel Powered Equipment

Fuel-powered equipment, such as generators for pumps, must be situated away and downwind from all site activities (ie. purging and sampling). If field conditions prevent such placement, then the fuel source must be placed as far away as possible from the

sampling activities. The conditions of sampling must be described in detail in the field notes.

If fuel must be handled, it should be done the day before sampling. Effort should be made to avoid handling fuels on the day of sampling. If fuels must be dispensed during sampling activities, dispense fuel downwind and well away from any sampling locations. Wear gloves while working with fuel and dispose of the gloves away from sampling activities. Wash hands thoroughly after handling any fuels.

2.2.1.3 Equipment Decontamination

All non-dedicated equipment that will come in contact with the well casing and water will be decontaminated between wells. The procedure for decontaminating non-dedicated equipment is as follows:

1. Don new powder-free Nitrile gloves.
2. Clean item with tap water and phosphate-free laboratory detergent (Liquinox or equivalent), using a brush if necessary to remove particulate matter and surface films.
3. Rinse thoroughly with pesticide grade isopropanol and allow to air dry.
4. Rinse with organic-free water (Milli-Q water or other ultra-pure water) and allow to air dry.
5. Wrap with commercial-grade aluminum foil, if necessary, to prevent contamination of equipment during storage or transport.

It should be noted that Liqui-Nox detergent solutions will be stored in a clearly marked HDPE or PP container. Containers for pesticide-grade isopropanol will be made of inert materials such as Teflon, stainless steel, or glass.

Sampling will be planned and conducted in such a way as to minimize the need for decontamination in the field through the use of dedicated sampling equipment, or a new disposable Teflon bailer at each well. Unclean equipment will be segregated from clean equipment during all field activities. All clean equipment will remain in the manufacturer's packaging until use, or will be wrapped in commercial-grade aluminum foil or untreated butcher paper.

2.2.2 Water Level Measurements

2.2.2.1 Static Levels

Static water level and depth to the well bottom will be measured in each well prior to any purging or sampling activities. Static water level and well depth measurements are necessary to calculate the volume of stagnant water in the well prior to purging. Additionally, these measurements provide a field check on well integrity, degree of siltation, and are used to prepare potentiometric maps, calculate aquifer flow velocities

and monitor changes in site hydrogeologic conditions.

Groundwater depths will be measured to a vertical accuracy of 0.01 feet relative to established wellhead elevations, provided in **Table 1**. Each well will have a permanent, easily identified reference point on the lip of the well riser from which all water level measurements will be taken. The elevation of the reference point will be established by a Registered Land Surveyor.

2.2.2.2 Contamination Prevention

Upon opening each well, new latex or nitrile surgical gloves will be donned. Appropriate measures will be taken during all measurement activities to prevent soils, decontamination supplies, precipitation, and other potential contaminants from entering the well or contacting clean equipment.

2.2.2.3 Equipment

An electronic water level indicator will be used to accurately measure depth to groundwater in each well and/or piezometer. The electronic water level indicator will be constructed of inert materials such as stainless steel and Teflon (example). **Between each well, the device will be thoroughly decontaminated by washing with non-phosphate (Liqui-Nox) soap and rinsing with organic-free water to prevent cross contamination from one well to another.**

The following measurements will be recorded in a dedicated field book prior to sample collection (see **Section 5.0** for detailed description of field notes to be collected):

- Depth to static water level and well bottom (to the nearest 0.01 foot)
- Height of water column in the riser (based upon measured depth of well)
- Condition of wellhead protective casing, base pad, and riser
- Changes in condition of well and surroundings.

2.2.3 Well Evacuation

2.2.3.1 Description

Water accumulated in each well may be stagnant and unrepresentative of surrounding aquifer conditions, and therefore must be removed to insure that fresh formation water is sampled. Each well will be purged of standing water in the well casing following the measurement of the static water level. Monitoring well evacuation should be performed in upgradient wells first, then moving to downgradient wells.

2.2.3.2 Contamination Prevention

New latex or nitrile surgical gloves will be donned for all well purging and sampling activities and whenever handling decontaminated field equipment. Appropriate measures will be taken during all measurement, purging, and sampling activities to prevent surface soils, decontamination supplies, precipitation, and other potential contaminants from entering the well or contacting cleaned equipment.

2.2.3.3. Calculation

The volume of standing water in the well riser and screen will be calculated immediately before well evacuation during each monitoring event. A standing water volume will be calculated for each well using the measured static water level, well depth, and well casing diameter according to the following equation:

$$\mathbf{V = (TD - SWL) \times C}$$

Where:
V = One well volume
TD = Total depth of the well (in feet)
SWL = Static water level (in feet)
C = Volume constant for given well diameter (gallons/foot)
C = 0.163 gal/ft for two-inch wells.
C = 0.653 gal/ft for four-inch wells.

2.2.3.4 Well Purging

After the volume of standing water within the casing is established, a minimum of three and a maximum of five well volumes of water will be evacuated from each well. New, disposable bailers with either double or bottom check-valves will be used to purge each well. Disposable bailers will be constructed of fluorocarbon resin (Teflon) or inert plastic suitable for the well conditions. Each bailer will be factory-clean and remain sealed in a plastic sleeve until use. A new Teflon-coated stainless steel, inert mono-filament line, or nylon cord will be used for each well to retrieve the bailers. Alternately, well pumps which are cleaned between uses or are dedicated to each well may be used.

2.2.3.5 Purge Rate

Wells will be purged at a rate that will not cause recharge water to be excessively agitated or cascade through the screen. Care will also be taken to minimize disturbance to the well sidewalls and bottom which could result in the suspension of silt and fine particulate matter. The volume of water purged from each well and the relative rate of recharge will be documented in sampling field notes. Wells which are of very low recharge rates will be purged once until dry. Damaged, dry or low yielding, and high turbidity wells will noted for reconsideration before the next sampling event.

2.2.3.6 Purge Water Disposal

Purge water will be managed to prevent possible soil and surface water contamination. Well site management options may include temporary containment and disposal as leachate or portable activated carbon filtration.

2.2.3.7 Non-Dedicated Equipment

Durable, non-dedicated equipment to be lowered into the well or which may contact the water samples will be thoroughly decontaminated before each use. Equipment shall be disassembled to the degree practical, washed with (non-phosphate) soapy potable tap water, and triple rinsed using de-ionized water. Detailed equipment decontamination procedures are detailed in **Section 2.2.1.3**.

2.2.4 Sample Collection

After purging activities are complete, groundwater samples will be collected for laboratory analysis. Samples should be collected from least contaminated location(s) first, followed by locations of increasing contamination across the site. Prior to sample collection, all sample labels should be properly filled-out with permanent ink, such as Sharpie pen. At a minimum, the label should identify the sample with the following information:

- Sample Location or Well Number;
- Sample Identification Number;
- Date and Time of Collection;
- Analysis Required;
- Sampler's Initials;
- Preservative Used (if any); and
- Other Pertinent Information As Necessary.

Upon completion of the sample label, the label should be affixed to the sample bottle prior to sampling.

Sampling will occur within 24 hours of the purging of each well and as soon after well recovery as possible. Wells which fail to recharge or produce an adequate sample volume within 24 hours of purging will not be sampled.

2.2.4.1 Field Parameters

Field measurements of temperature, pH, and specific conductivity will be made immediately prior to sampling each monitoring point. The field test specimens will be collected with the sampling bailer and placed in a clean, non-conductive glass or plastic container for observation. The calibration of the pH, temperature, conductivity, and turbidity meters will be completed according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste -Physical/Chemical Methods (SW-846). A pocket thermometer and litmus paper will be available in case of meter malfunction.

2.2.4.2 Sample Equipment

Each well will be sampled using a new, factory-cleaned, disposable Teflon bailer with bottom check-valve and sample discharge mechanism. A new segment of Teflon-coated stainless steel wire, inert mono-filament line or nylon cord will be used to lower and retrieve each bailer. The bailer will be lowered into each well to the point of groundwater contact, then allowed to fill as it sinks below the water table. Bottom contact will be avoided in order to avoid suspending sediment in the samples. The bailer will be retrieved and emptied in a manner which minimizes sample agitation.

2.2.4.3 Sample Transference

Samples will be transferred directly from the Teflon bailer into a sample container that has been specifically prepared for the preservation and storage of compatible parameters. A bottom emptying device provided will be used to transfer samples from bailer to sample container. The generation of air bubbles and sample agitation will be minimized during bailer discharge. Groundwater samples will be collected and contained in the order of volatilization sensitivity.

2.2.4.4 Order of Sample Collection

Initially, only purgeable organics and total metals samples will be collected for laboratory analysis. Subsequently, other analytical methods may be required. When collected, the following order of sampling will be observed:

- Volatile Organics and Volatile Inorganics;
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease;
- Total Metals;
- Inorganic Nonmetallics, Physical and Aggregate Properties and Biologicals;
- Microbiologicals; and
- Measurements of pH, temperature, DO, ORP, conductivity and turbidity.

Note: Where applicable, if the pump used to collect groundwater samples is not suitable to collect volatile or extractable organics then collect all other parameters and withdraw the pump and tubing. Then collect the volatile and extractable organics.

All samples will be collected and analyzed in an **unfiltered** state during sampling events. Samples for dissolved metal analysis, if subsequently required, will be prepared by field filtration using a decontaminated peristaltic pump and a disposable 0.45 micron filter cartridge specifically manufactured for this purpose.

2.2.4.5 Decontamination

All reusable sampling equipment including water level probes, pH/conductivity meters, interface probes, and filtering pumps which might contact aquifer water or samples will be thoroughly decontaminated between wells by washing with non-phosphate soapy, de-ionized water and rinsing with isopropanol and organic-free water. Detailed equipment decontamination procedures are detailed in **Section 2.2.1.3**.

2.2.4.6 Sample Preservation

Upon completion of sampling at each location, the sample bottles will be placed in a cooler with ice, that is sealed in plastic zip bags, for preservation.

2.2.4.7 Field Quality Assurance

Field and trip blanks will be prepared, handled, and analyzed as groundwater samples to ensure cross-contamination has not occurred. One set of trip blanks, as described later in this document, will be prepared before leaving the laboratory to ensure that the sample containers or handling processes have not affected the quality of the samples. One set of field (equipment) blanks will be created in the field at the time of sampling to ensure that the field conditions, equipment, and handling during sampling collection have not affected the quality of the samples. A duplicate groundwater sample may be

collected from a single well as a check of laboratory accuracy. Where applicable, blanks and duplicate containers, preservatives, handling, and transport procedures for surface water samples will be the same as those noted for groundwater samples.

2.2.4.8 Sample Containers

Sample containers will be provided by the laboratory for each sampling event. Containers must be either new and factory-certified analytically clean by the manufacturer, or cleaned by the laboratory prior to shipment for sampling. Laboratory cleaning methods will be based on the bottle type and analyte of interest. Metal containers are thoroughly washed with non-phosphate detergent and tap water, and rinsed with (1:1) nitric acid, tap water, (1:1) hydrochloric acid, tap water, and deionized water, in that order. Organic sample containers are thoroughly washed with non-phosphate detergent in hot water and rinsed with tap water, distilled water, acetone, and pesticide quality hexane, in that order. Other sample containers are thoroughly washed with non-phosphate detergent and tap water, rinsed with tap water, and rinsed with deionized water. The laboratory shall provide proper preservatives in the sample containers prior to shipment (see **Section 6.0**).

SECTION 3.0
FIELD QA/QC PROGRAM

Field Quality Assurance/Quality Control (QA/QC) requires the routine collection and analysis of trip blanks to verify that the handling process has not affected the quality of the samples. Any contaminants found in the trip blanks could be attributed to:

1. Interaction between the sample and the container;
2. Contaminated source water; or
3. A handling procedure that alters the sample.

3.1 TRIP BLANK

The laboratory will prepare a trip blank by filling each type of sample bottle with laboratory grade distilled or deionized water. Trip blanks will be placed in bottles of the specific type required for the analyzed parameters and taken from a bottle pack specifically assembled by the laboratory for each groundwater sampling event. Trip blanks will be taken prior to the sampling event and transported with the empty bottle packs. The blanks will be analyzed for volatile and purgeable organics only.

3.2 TRIP BLANK CONCENTRATIONS

The concentration levels of any contaminants found in the trip blank will be reported but will not be used to correct the groundwater data. In the event that elevated parameter concentrations are found in a blank, the analysis will be flagged for future evaluation and possible re-sampling.

3.3 FIELD INSTRUMENTS

All field instruments utilized to measure groundwater characteristics will be calibrated prior to entering the field, and recalibrated in the field as required, to insure accurate measurement for each sample. The specific conductivity and pH meter shall be recalibrated utilizing two prepared solutions of known concentration in the range of anticipated values (between 4 and 10). A laboratory grade thermometer, calibrated against a National Bureau of Standards Certified thermometer, will be used for temperature meter calibration.

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SECTION 4.0
SAMPLE PRESERVATION AND SHIPMENT

Methods of sample preservation, shipment, and chain-of-custody procedures to be observed between sampling and laboratory analysis are presented in the following sections.

4.1 SAMPLE PRESERVATION

Pre-measured chemical preservatives will be provided by the analytical laboratory. Hydrochloric acid will be used as a chemical stabilizer and preservative for volatile and purgeable organic specimens. Nitric acid will be used as the preservative for samples for metals analysis.

4.2 STORAGE/TRANSPORT CONDITIONS

Proper storage and transport conditions must be maintained in order to preserve the integrity of samples between collection and analysis. Ice and chemical cold packs will be used to cool and preserve samples, as directed by the analytical laboratory. Samples will be maintained at a temperature of 4° C. **Dry ice is not to be used**. Samples will be packed and/or wrapped in plastic bubble wrap to inhibit breakage or accidental spills.

Chain-of-custody control documents will be placed in a waterproof pouch and sealed inside the cooler with the samples for shipping. Tape and/or custody seals shall be placed on the outside of the shipping coolers, in a manner to prevent and detect tampering with the samples.

4.3 SAMPLE DELIVERY

Samples shall be delivered to the analytical laboratory within a 24-hour period in person or using an overnight delivery service to insure holding times are not exceeded. Shipment and receipt of samples will be coordinated with the laboratory. Do NOT store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same cooler or shipping container with other environmental samples.

4.4 CHAIN-OF-CUSTODY

Chain-of-custody control will be maintained from sampling through analysis to prevent tampering with analytical specimens. Chain-of-custody control procedures for all samples will consist of the following:

1. Chain-of-custody will originate at the laboratory with the shipment of prepared sample bottles and a sealed trip blank. Identical container kits will be shipped by express carrier to the sampler or site or picked up at the laboratory in sealed coolers.

2. Upon receipt of the sample kit, the sampler will inventory the container kit and

check its consistency with number and types of containers indicated in the Chain-of-custody forms and required for the sampling event.

3. Labels for individual sample containers will be completed in the field, indicating the site, time of sampling, date of sampling, sample location/well number, and preservation methods used for the sample.

4. Collected specimens will be placed in the iced coolers and will remain in the continuous possession of the field technician until shipment or transferral as provided by the Chain-of-custody form has occurred. If continuous possession can not be maintained by the field technician, the coolers will be temporarily sealed and placed in a secured area.

5. Upon delivery to the laboratory, samples will be given laboratory sample numbers and recorded into a logbook indicating client, well number, and date and time of delivery. The laboratory director or his designee will sign the Chain-of-custody control forms and formally receive the samples. The field technician, project manager and the laboratory director will work together to insure that proper refrigeration of the samples is maintained.

6. Copies of the complete Chain-of-custody forms will be placed in the laboratory's analytical project file and attached to the laboratory analysis report upon completion.

Chain-of-custody forms will be used to transfer direct deliveries from the sampler to the laboratory. A coded, express delivery shipping bill shall constitute the Chain-of custody between the sampler and laboratory for overnight courier deliveries.

SECTION 5.0
FIELD LOGBOOK

The field technician will keep an up-to-date logbook documenting important information pertaining to the technician's field activities. The field logbook will document the following:

- Site Name and Location;
- Date and Time of Sampling ;
- Climatic Conditions During Sampling Event;
- Sampling Point/Well Identification Number;
- Well Static Water Level;
- Height of Water Column in Well;
- Purged Water Volume and Well Yield (High or Low);
- Presence of Immiscible Layers and Detection Method;
- Observations on Purging and Sampling Event;
- Time of Sample Collection;
- Temperature, pH, Temperature, DO, ORP, Turbidity, and Conductivity Readings;and
- Signature of Field Technician.

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SECTION 6.0
LABORATORY ANALYSIS

The ground and surface water parameters will be analyzed for field indicators of water quality (pH, conductivity, temperature, and turbidity) and those constituents listed in **Table 2**. All analytical methods are taken from Test Methods For Evaluating Solid Waste - Physical/Chemical Methods (SW-846) or Methods For the Chemical Analysis of Water and Wastes and will be consistent with the Division of Waste Management's policies regarding analytical methods and reporting limits. Analysis will be performed by a laboratory certified by the North Carolina DENR for the analyzed parameters.

6.1 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Formal environmental laboratory Quality Assurance/Quality Control (QA/QC) procedures are to be utilized at all times. The owner/operator of the landfill is responsible for selecting a laboratory contractor and insuring that the laboratory is utilizing proper QA/QC procedures. The laboratory must have a QA/QC program based upon specific routine procedures outlined in a written laboratory Quality Assurance/Quality Control Manual. The QA/QC procedures listed in the manual shall provide the lab with the necessary assurances and documentation that accuracy and precision goals are achieved in all analytical determinations. Internal quality control checks shall be undertaken regularly by the lab to assess the precision and accuracy of analytical procedures.

6.2 LABORATORY QUALITY CONTROL CHECKS

The internal quality control checks include the use of calibration standards, standard references, duplicate samples, and spiked or fortified samples. Calibration standards shall be verified against a standard reference obtained from an outside source. Calibration curves shall be developed using at least one blank and three standards. Samples shall be diluted if necessary to insure that analytical measurements fall on the linear portion of the calibration curve. Duplicate samples shall be processed at an average frequency of 10 percent to assess the precision of testing methods, and standard references shall be processed monthly to assess accuracy of analytical procedures. Spiked or fortified samples shall be carried through all stages of sample preparation and measurement to validate the accuracy of the analysis.

6.3 DATA REVIEW

During the course of the analyses, quality control data and sample data shall be reviewed by the laboratory manager to identify questionable data and determine if the necessary QA/QC requirements are being followed. If a portion of the lab work is subcontracted, it is the responsibility of the contracted laboratory to verify that all subcontracted work is completed by certified laboratories, using identical QA/QC procedures.

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SECTION 7.0
RECORD KEEPING AND REPORTING

After each monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system remains adequate and to determine the rate and direction of groundwater flow at the site.

7.1 GROUNDWATER SYSTEM EVALUATIONS

The direction of groundwater flow will be determined by a comparison of groundwater surface elevations across the site through the construction of a potentiometric surface map. Groundwater flow rate will be determined using the following equation:

$$V=KI/n$$

Where:
V = Velocity (feet/day)
K = Hydraulic Conductivity (feet/day)
I = Hydraulic Gradient (foot/foot)
n = Effective Porosity of aquifer soils (unitless)

If these evaluations indicate the groundwater monitoring system is insufficient in meeting the requirements of the Rules, the monitoring system will be modified accordingly and a work plan will be submitted to NCDENR for review prior to modifications to enhance the monitoring system.

7.2 RESULT REPORTING

Copies of all laboratory analytical data will be forwarded to the SWS within 60 calendar days of the receipt of laboratory data. The analytical data submitted will specify the date of sample collection, the sampling point identification, and include a map of sampling locations. Should a significant concentration of contaminants be detected in groundwater, as defined in North Carolina Solid Waste Rules, Groundwater Quality Standards, the owner/operator of the landfill shall notify the SWS and will place a notice in the landfill records as to which constituents were detected.

All monitoring reports will be submitted with the following:

- An evaluation of potentiometric surface;
- Analytical laboratory reports and summary tables;
- A Solid Waste Environmental Monitoring Reporting Form (**Attachment 1**); and
- Laboratory Data submitted in accordance with the Electronic Data Deliverable Template.

Monitoring reports may be submitted electronically by e-mail or in paper copy form. Copies of all laboratory results and water quality reports for the Washington County Landfill will be kept at the Landfill office. Reports summarizing all groundwater quality results and data evaluation will be submitted to the Division of Waste Management for each sampling event. Depending upon the analytical results received, graphical analyses may be performed to evaluate plume movement and contaminant trends over time.

SECTION 8.0
MONITORING PROGRAM MODIFICATIONS

8.1 WELL ABANDONMENT/REHABILITATION

After each groundwater monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system remains adequate and to determine the rate and direction of groundwater flow at the site.

Should wells become irreversibly damaged or require rehabilitation, the SWS shall be notified. If monitoring wells and/or piezometers are damaged irreversibly they shall be abandoned under the direction of the SWS. The abandonment procedure in unconsolidated materials will consist of over-drilling and/or pulling the well casing and plugging the well with an impermeable, chemically-inert sealant such as neat cement grout and/or bentonite clay. For bedrock well completions the abandonment will consist of plugging the interior well riser and screen with an impermeable neat cement grout and/or bentonite clay sealant.

8.2 ADDITIONAL WELL INSTALLATIONS

Any additional well installations will be carried out in accordance with SWS directives. If the potentiometric maps reveal that the depths, location, or number of wells is insufficient to monitor potential releases of solid waste constituents from the solid waste management area, new well locations and depths will be submitted to the SWS for approval.

All monitoring wells shall be installed under the supervision of a geologist or engineer who is registered in North Carolina and who will certify to the SWS that the installation complies with the North Carolina Regulations. Upon installation of future wells, the documentation for the construction of each well will be submitted by the registered geologist or engineer within 30 days after well construction.

8.3 IMPLEMENTATION SCHEDULE

This monitoring program will be implemented upon approval of this Water Quality Monitoring Plan.

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Figures

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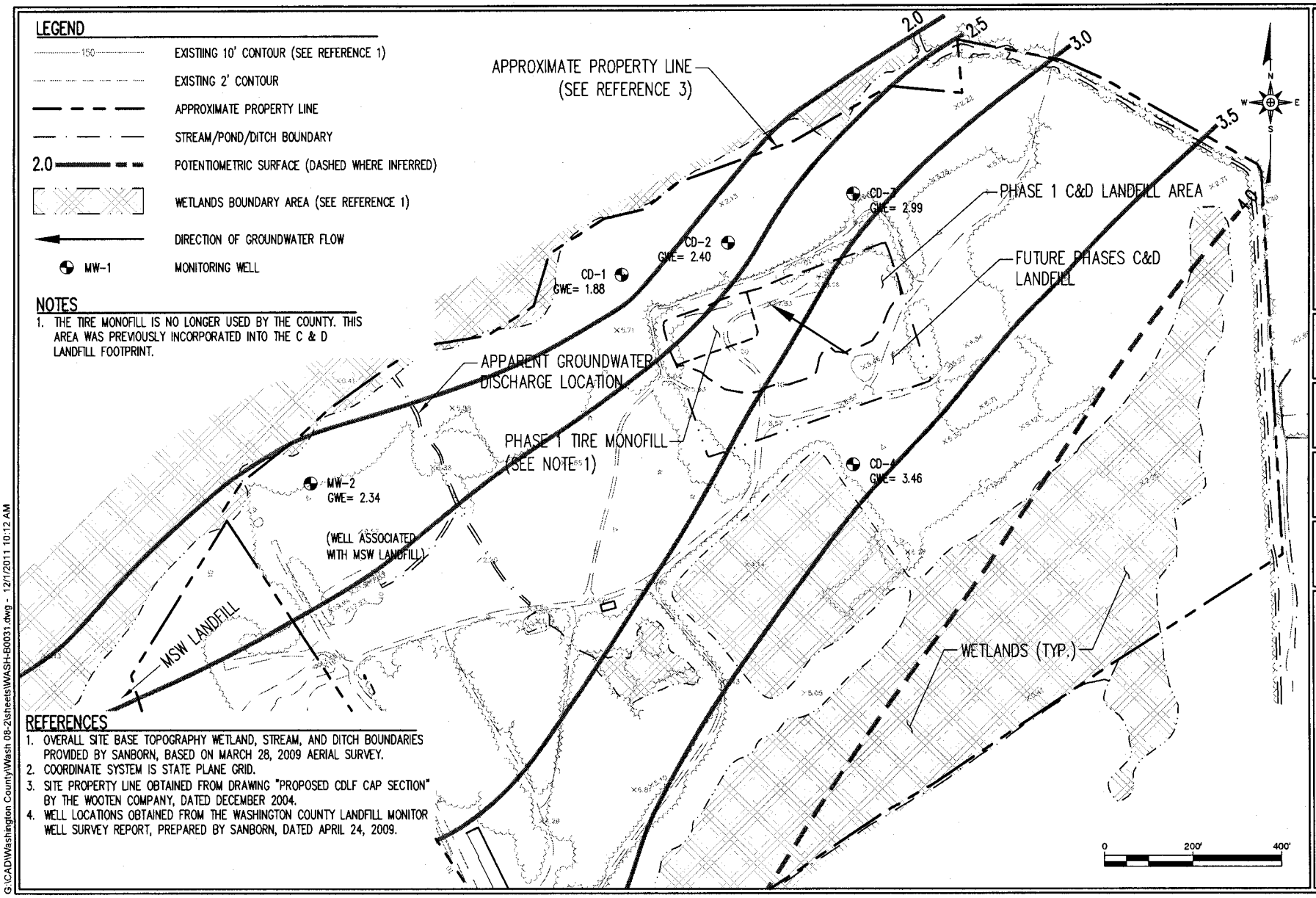

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com

DRAWN BY: C.T.J.	CHECKED BY: J.A.S.	SCALE: AS SHOWN	FIGURE NO. 1
DATE: Dec. 2011	PROJECT NO. WASH 08-2		FILE NAME WASH-B0031

TITLE: WASHINGTON COUNTY C&D LANDFILL POTENTIOMETRIC SURFACE MAP MARCH 2010

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Tables

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RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C0628 (ENGINEERING)

By: JAS
Date: 11/18/09

Table 1

Monitoring Well Completion Information
Washington County C&D Landfill
Roper, North Carolina

Monitoring Well	Northing	Easting	Top of Casing Elevation	Depth to Well Bottom	Depth to Water 9/09	Upgradient/ downgradient
CD-1	799028.14	2691515.73	7.81	22.90	6.49	Down
CD-2	799100.9	2691755.17	7.68	19.90	6.11	Down
CD-3	799210.55	2692038.09	7.77	21.45	5.90	Cross
CD-4	798597.78	2692406.42	9.11	20.67	6.98	Up

Notes: 1. Survey data from Sanborn Survey Report dated 4/24/09
2. Depth to Well Bottom measured from Top of Casing by Environment 1 personnel.

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES
1418 BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C0923 (ENGINEERING)

By: JAS
11/28/2011

Table 2

Appendix I Analyte List with C&D Landfill Indicator Analytes

Appendix I Constituents	EPA Method	Synonyms	2L or GWP Standard
Antimony	7041		1.4
Arsenic	7060/7061		50
Barium	7080/6010		2000
Beryllium	7091		4
Cadmium	7131		1.75
Chloride	SM4500 CLB		250000
Chromium	7191		50
Cobalt	7201		70
Copper	7210/6010		1000
Iron	7300		300
Lead	7421		15
Manganese	200.7		50
Mercury	245.1		1.05
Nickel	7520/6010		100
Selenium	7740/7741		50
Silver	7761		17.5
Sulfate	SM4500		250000
Thallium	7841		0.28
Vanadium	7911		3.5
Zinc	7950/6010		1050
Temperature	Field		na
pH	Field		6 - 8
Specific Conductance	Field		na
Alkalinity	SM2320B		na
Total Dissolved Solids	SM2540C		na
Acetone	8260	2-Propanone	700
Acrylonitrile	8260	2-Propenenitrile	na
Benzene	8260		1
Bromochloromethane	8260	Chlorobromomethane	0.6
Bromodichloromethane	8260	Dibromochloromethane	0.56
Bromoform	8260	Tribromomethane	4.43
Carbon Disulfide	8260		700
Carbon Tetrachloride	8260	Tetrachloromethane	0.269
Chlorobenzene	8260		50
Chloroethane	8260	Ethyl chloride	2800
Chloroform	8260	Trichloromethane	70
Dibromochloromethane	8260	Chlorodibromomethane	0.41
1,2-Dibromo-3-chloropropane	8260	DBCP	0.025
1,2-Dibromoethane	8260	Ethylene dibromide, EDB	0.0004
1,2-Dichlorobenzene	8260	o-Dichlorobenzene	24
1,4-Dichlorobenzene	8260	p-Dichlorobenzene	1.4
trans-1,4-Dichloro-2-butene	8260		na
1,1-Dichloroethane	8260	Ethyldidene chloride	70
1,2-Dichloroethane	8260	Ethylene dichloride	0.38
1,1-Dichloroethylene	8260	Vinylidene chloride	7
cis-1,2-Dichloroethylene	8260		70
trans-1,2-Dichloroethylene	8260		100
1,2-Dichloropropane	8260	Propylene dichloride	0.51
cis-1,3-Dichloropropene	8260		0.19
trans-1,3-Dichloropropene	8260		0.19
Ethylbenzene	8260		550
2-Hexanone	8260	Methyl butyl ketone	280
Methyl bromide	8260	Bromomethane	na
Methyl chloride	8260	Chloromethane	2.6
Methyl ethyl ketone	8260	2-Butanone	4200
Methyl iodide	8260	Iodomethane	na
4-Methyl-2-pentanone	8260	Methyl isobutyl ketone	560
Methylene bromide	8260	Dibromomethane	na
Methylene chloride	8260	Dichloromethane	4.6
Styrene	8260	Ethenylbenzene	100
1,1,1,2-Tetrachloroethane	8260		1.3
1,1,2,2-Tetrachloroethane	8260		0.18
Tetrachloroethylene	8260	Perchloroethylene	0.7
Tetrahydrofuran	8260		na
Toluene	8260	Methyl benzene	1000
1,1,1-Trichloroethane	8260	Methyl chloroform	200
1,1,2-Trichloroethane	8260		0.6
Trichloroethylene	8260		2.8
Trichloroflouromethane	8260	CFC-11	2100
1,2,3-Trichloropropane	8260		0.005
Vinyl acetate	8260	Acetic acid, ethenyl ester	7000
Vinyl chloride	8260	Choroethene	0.015
Xylenes	8260	Dimethyl benzene	530

All concentrations in ug/l
NC 2L is the ground water standard for each constituent.GWP is Groundwater Protection Standard.
Detection abovve these concentrations are considered to require source determination, and possible .
assessment and remediation.
na = no standard available

Attachment 1

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DENR USE ONLY: ☐ Paper Report ☐ Electronic Data - Email CD (data loaded: Yes / No) Doc/Event #:

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting 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).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.).
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: _____ Phone: _____

E-mail: _____

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☐ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Type of data submitted: (Check all that apply)

☐ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☐ Surface water monitoring data
☐ Methane gas monitoring data
☐ Corrective action data (specify) _____
☐ Other(specify) _____

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.
☐ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of **my knowledge, the information reported** and statements made on this data submittal and attachments **are** true and correct. **Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.**

Facility Representative Name (Print) Title (Area Code) Telephone Number

Affix NC Licensed/ Professional Geologist Seal

Signature Date

Facility Representative Address

NC PE Firm License Number (if applicable effective May 1, 2009)

Revised 6/2009

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Landfill Gas Monitoring Plan

Washington County C&D Landfill (Permit 94-04)

Roper, North Carolina

Prepared For:

Washington County Public Utilities
396 Millpond Road
Roper, North Carolina 27970

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

November 2011

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LANDFILL GAS MONITORING PLAN

Washington County C&D Landfill
Roper, North Carolina

Prepared for:
Washington County Public Utilities
Roper, North Carolina

RSG Project No. WASH-11-1

Joan A. Smyth, P.G.
Principal, Senior Hydrogeologist

NORTH CAROLINA LICENSED SEAL 1369 GEOLOGIST JOAN A. SMYTH

November 2011

RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

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WASHINGTON COUNTY C&D LANDFILL
LANDFILL GAS MONITORING PLAN

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Figures

Figure 1 – Site Location Map
Figure 2 – Site Map with 2000' Property Radius

Appendices

Appendix A – Landfill Gas Monitoring Reporting Form

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1.0 INTRODUCTION

1.1 Project Description

This Landfill Gas Monitoring Plan (Plan) has been prepared by Richardson Smith Gardner & Associates, Inc. (RSG) to present a comprehensive landfill gas (LFG) monitoring program at the Washington County C&D Landfill (NCDENR Solid Waste Permit 94-04). The site is located at 718 Landfill Road, Roper, NC 27970 as shown in **Figure 1**. The proposed plan presents the rationale for the monitoring program as well as necessary actions required by the Owner to protect and safeguard the area surrounding the landfill and to satisfy NCDENR Solid Waste Management Rules [15A NCAC 13B.0544(d)] for monitoring and controlling LFG.

At a minimum, these regulations require owners of landfills to ensure that the facility does not exceed:

- *25% of the lower explosive limit (LEL) or 1.25% methane (CH_4) by volume in structures; and*
- *100% of the LEL or 5% CH_4 by volume at the facility property boundary.*

The Engineer has utilized the best available site data, practices, experience, and judgment to develop this plan. However, the program may require modifications and updates over time to accommodate changing landfill conditions, changing receptors in areas adjacent to and around the landfill, or other conditions that cannot be fully anticipated. Suggestions are also included in this plan to assist in the identification of secondary conditions that may require updates to this Plan.

Uncontrolled migration of LFG can result in loss of property, loss of life, injury, vegetative damage, and intolerable odors. The monitoring of landfills includes exposure to explosive gases. All operational and/or monitoring staff should be specifically trained in the management and response for situations such as fire or explosion, confined space, and overhead hazards, and possess an awareness of changing conditions around these sites.

1.2 Contact Information

In case of emergencies, if questions arise during the implementation of this program, or to meet notification requirements outlined in **Section 2.3.4**, please contact the following:

1.2.1 Owner

Washington County Dept. of Public Utilities
396 Millpond Road
Roper, NC 27970

Mr. Lou Manring, Director
Phone: (252) 793-7345

Mr. Carl Critcher, Operations Manager
Phone: (252) 793-5615

1.2.2 Engineer

Richardson Smith Gardner & Associates, Inc.
14 N. Boylan Avenue
Raleigh, North Carolina 27603
Phone: (919) 828-0577

Mr. Pieter K. Scheer, P.E., Project Manager
email: pieter@rsgengineers.com

Ms. Joan A. Smyth, P.G., Senior Hydrogeologist
email: joan@rsgengineers.com

1.2.3 Solid Waste Regulatory Agency

NCDENR- Division of Waste Management
1646 Mail Service Center
Raleigh, NC 27633-1646
Phone (919) 508-8400

Mr. Ming-Tai Chao, P.E., Environmental Engineer II
email: ming.chao@ncdenr.gov

NCDENR – Field Operations Branch – Washington Regional Office
943 Washington Square Mall
Washington, North Carolina 27889
Phone (252) 946-6481

Mr. Ray Williams, Waste Management Specialist
Email: ray.williams@ncdenr.gov

1.3 Existing Site Conditions

The Washington County. C&D Landfill is located at 718 Landfill Rd. in Roper, NC, as shown in **Figure 1**. The facility property is approximately 71 acres with approximately 2.34 acres currently used for C&D waste placement, as shown in **Figure 2**.

1.3.1 Topography

The landfill site is located adjacent to Swan Bay as shown in **Figure 1**. Existing ground surface elevations vary from approximately two (2) feet above mean sea level to approximately 24 feet (msl) at the top of the closed MSW landfill (located southwest of the C&D landfill). Currently, the surrounding area (2,000 feet from the property line) is undeveloped and generally either wooded or consists of wetlands/swamp.

1.3.2 Adjacent Areas

To the south and east of the C&D landfill, at a distance greater than 2,000 ft., some houses are located. The closed MSW landfill is located to the southwest of the C&D landfill on an adjacent property also owned by Washington County.

There are three (3) structures located on the site, the scalehouse/office, the maintenance building and the animal shelter. These structures are located in the southwest corner of the property at the entrance to the site.

The nearest structures located off-site are located approximately 2,635 feet to the east (although unconfirmed, this building is believed to be a private recreational facility, which includes a basketball court for the owner), and 2,675 feet to the south of the C&D landfill (this building is a residence). These structures are shown on **Figure 2**.

1.3.3 Site Soils Information

The native soil types at, and around the landfill are classified as Conetoe loamy fine sand, Altavista fine sandy loam, August fine sandy loam, Dorovan muck, with minor amounts of Muckalee loam. The predominant soil type across the site is the Conetoe loamy fine sand. This soil is classified as "well drained" and is found on 0% to 3% slopes. The second most predominant soil types on the site are the Altavista fine sandy loam and Augusta fine sandy loam both of which are found on slopes of 0% to 2%. These soils are classified as moderately well drained (Altavista) to somewhat poorly drained (Augusta). The soils located between the property line and Swan Bay consist of the Dorovan muck. This soil type is found at an elevation of 0 feet mean sea level. This soil type is very poorly drained and is found on floodplains. The Muckalee loam is found in a small portion of the site and surrounding area. This soil is poorly drained and is found on floodplains.

Geologic investigations at the site indicate the upper 20 to 30 feet of soils primarily consist of relatively clean sand with interbedded silty clay.

2.0 MONITORING PROGRAM

2.1 Monitoring Network

Previous investigations of the site indicate groundwater is typically found at a depth of approximately 3 to 6 feet below grade around the C&D landfill. The shallow nature of groundwater at this site prohibits the movement of landfill gas in the subsurface. Additionally, constructing a monitoring well in accordance with drilling requirements (15A NCAC 2C.0108(5) & (6)) would necessitate the screened interval of each well to be a minimum of five (5) feet below grade (allowing for a 1 foot sand pack above the screened interval, 1 foot thick bentonite plug, and three feet of grout to the ground surface). This will put the screened interval below the water table and make any well ineffective for monitoring landfill gas in the uppermost soils at the site.

Further, the area located to the north of the site is at elevation 0 ft, or mean sea level. The swampy soils in this area will prevent any potential landfill gas migration in this area. Wetland areas have historically been mapped to the south and east of the C&D landfill as well. The property to the west contains the closed MSW landfill.

Additionally, On October 26th 2011, RSG personnel performed a soil gas survey at the C&D landfill. The soil gas survey consisted of advancing a hand-auger boring to a depth of approximately 5 to 7 feet below grade to reach the approximate depth of groundwater. A slotted section of PVC well screen and solid PVC pipe was inserted into the boring and capped. The piping was allowed to stabilize prior to the collection of readings. Landfill gas readings with a GEM 2000 meter indicated no detectable concentrations of methane in the four locations evaluated. These locations are shown on **Figure 1**.

Based upon the shallow nature of groundwater at the site, well installation requirements, the location of wetlands around the C&D landfill, the lack of detected methane in the area of the C&D landfill and the large distances to any off-site receptors, we recommend that no landfill gas monitoring probes be installed. Instead we recommend that only building monitoring be conducted. Proposed monitoring locations are summarized below.

Table 1 – Gas Monitoring Locations

Building	Monitoring Locations (inside each building)
Scalehouse/office	4 corners of scalehouse/office near floor
Animal Shelter	4 corners of animal shelter building near floor
Maintenance Building	4 corners of maintenance building near floor

2.1.1 Surrounding Conditions/Potential Receptors

The monitoring probe locations have been evaluated based on the surrounding area conditions, soil types, location of waste on property, and nearby bodies of water. The following is a summary of local conditions within 2,000 feet of the facility property line:

- There are no residences located on nearby properties within 2,000 feet.;
- Swan Bay of the Albemarle Sound is adjacent to the property line to the north;
- The property immediately to the west is the location of the closed MSW landfill; and
- The land surrounding the site to the north, south, and east within 2,000 feet of the property line is primarily undeveloped woodland.

The landfill property with the 2,000-foot buffer shown is included on **Figure 2**. As stated in **Section 1.3.2**, the nearest buildings located off-site are over 2,300 feet from the C&D landfill. No sensitive receptors are located to the west of the C&D landfill. The closed MSW landfill is located on the adjacent property in this direction.

Swan Bay and associated swamp located to the north of the property is a natural barrier to landfill gas migration and should effectively prevent the migration of landfill gas off-property in this direction. Wetlands located south and east of the C&D landfill will also act as a natural barrier to landfill gas migration in these directions.

Due to the location of Swan Bay to the north, and wetlands to the south and east of the site, and the significant distance of homes from the waste toward the south and east, it is unlikely that any potential LFG migration would impact a sensitive receptor.

2.3 Monitoring and Reporting

Monitoring of buildings at the site and reporting of LFG gas concentrations will be performed in accordance with NCDENR rules and as outlined below. The buildings will be monitored according to the requirements of this section.

2.3.1 Frequency

LFG monitoring will be completed on a quarterly frequency. Monthly or more frequent monitoring will be necessary if concentrations are close to or above the regulatory levels or demonstrate a pattern which indicates that it may be approaching this limit. In the future, the County may opt to install permanent monitoring devices in these buildings. If that is the case, the form included in **Attachment A**, should be filled out with readings from each permanent monitoring device on a quarterly basis.

2.3.2 Personnel

LFG monitoring will be performed by trained personnel knowledgeable of the LFG hazard and the use of explosive gas meters. A designated landfill technician will be assigned to regular LFG monitoring duty. Training will be performed to refresh personnel on any site changes or updates to this Plan.

2.3.3 Equipment

A Landtec ™ GEM-2000 infrared portable gas analyzer (or equivalent) will be used to monitor buildings at the site. This analyzer operates using the infrared spectral property of methane (CH_4) to measure concentrations in air below the LEL. This meter is calibrated to methane. Measurements of O_2 and CO_2 will also be made with this meter. This meter may be used in oxygen (O_2) deficient areas (less than 10% O_2) since oxygen is not required for a chemical combustion of flammable gases within the meter. Measurements of the concentrations of CH_4, O_2, and CO_2 can be collected from this meter. On the day of monitoring, prior to monitoring activities, this meter must be field calibrated. Additionally, all monitoring equipment should be regularly calibrated in accordance with manufacturer's specifications and operated only as instructed.

Should permanent monitoring devices be chosen in the future, NCDENR will be notified with specifications of the equipment chosen.

2.3.4 Procedures

Each monitoring event should begin by calibrating the gas meter with a known calibration standard in accordance with manufacturer's recommendations and operated only as instructed. The form included in **Attachment A** will be used to record landfill gas monitoring data.

Procedures for the LFG monitoring probes should include the following:

- Check calibration date on the meter;
- Perform "bump test" against known gas concentration;
- Record date, time, general weather conditions, ambient temperature;
- Barometric Pressure, name of technician and equipment used;
- Record maximum steady state methane reading[1], as well as steady state
- CO_2, and O_2 percentages; and
- If less than 1.25% CH_4, move to next building location.

If methane gas concentrations are **equal to or greater than 1.25% in any structure**, follow the Contingency Plan presented in **Section 3.0**.

[1] In accordance with NCDENR LFG Monitoring Guidance (2010).

IF EXPLOSIVE GAS CONCENTRATIONS EQUAL TO OR GREATER THAN 1.25% METHANE AT ANY OF THE LFG MONITORING LOCATIONS THE FOLLOWING ACTIONS SHALL BE TAKEN BY PERSONNEL:

1. **Immediately** contact the Washington County Operations Manager and Engineer.
2. Recalibrate monitoring equipment and confirm results.
3. If concentrations still exceed 1.25% methane, Washington County and the Engineer will implement the Compliance Action Plan located in **Section 3.2**.

2.3.5 Record Keeping

All readings will be documented with field notes and a monitoring form. A copy of the results will be given to Washington County for their operating record. Should concentrations in excess of compliance levels be detected, these results will be verbally reported to NCDENR within 24-hours and the results will be submitted to NCDENR on the form included in **Attachment A**. The completed forms will be reviewed by the Operations Manager following each monitoring event and placed in the landfill operating records. The monitoring logs will remain on file with other landfill records at the Washington County landfill offices located at 718 Landfill Rd. Roper, NC. These readings should be available for review by NCDENR personnel upon request.

2.4 Maintenance

In addition to the monitoring program, periodic maintenance and site observations will be conducted to the program components as follows (at a minimum):

- Factory calibration of the gas meter (to be performed in accordance with manufacturer's instructions/recommendations); and
- Observing landfill cover conditions, potential erosion areas, landfill seeps, odors, etc.

Any deficiencies shall be noted on the monitoring forms and reported to the Operations Manager for resolution.

3.0 CONTINGENCY PLAN

3.1 Introduction

In the event explosive gas concentrations exceed safe levels ($\geq$1.25% CH_4), a contingency plan is recommended and warranted. The contingency plan includes the specific step by step actions that should be implemented to protect human health and the environment.

3.2 Compliance Action Plan

If explosive gas concentrations **equal to or greater than 1.25% methane** in any of the LFG monitoring locations, the following actions shall be taken by personnel:

3.2.1 Immediate Action Plan

Washington County will take immediate action to ensure the protection of human health and safety as follows:

1. Evacuate any building where a high concentration was detected;
2. Employ engineering controls (fans, open windows, etc.) to reduce methane concentrations in the building;
3. Determine potential receptors surrounding the site;
4. If warranted by the location of the impact, and degree of intensity of the LFG concentration, measure LFG concentrations in structures or receptors surrounding the site;
5. Notify verbally NCDENR representatives;
6. Investigate and identify the source(s) and potential conduit(s) for LFG migration that have caused the excessive readings (i.e. the path that the LFG is taking to the monitoring location);
7. Evaluate the need to identify the extent of the LFG problem through additional probes or bar hole punch sampling methodology; and
8. As appropriate, begin to take corrective action to control the LFG levels in building(s) surrounding the landfill site.

3.2.2 Reporting and Documentation

Following the **Immediate Action Plan**, Washington County will take the following actions within five (5) days:

1. Place documentation of the **Immediate Action Plan** in the operating record for the landfill;

2. Provide documentation of the **Immediate Action Plan,** a description of the steps taken to protect human health, and the data collected in writing to the NCDENR within 5 days; and
3. Evaluate the monitoring schedule to determine if more frequent monitoring is needed.

It is also suggested that at this time, a plan be developed which:

- Describes the nature and extent of the problem; and
- Proposes future actions to assess/remediate the problem.

3.2.3 Remediation Plan

In the event the prolonged explosive gas concentrations exist and as identified during the **Immediate Action Plan** and in follow-up monitoring, Washington County will prepare and implement a Remediation Plan to mitigate the migration of landfill gas.

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Figures

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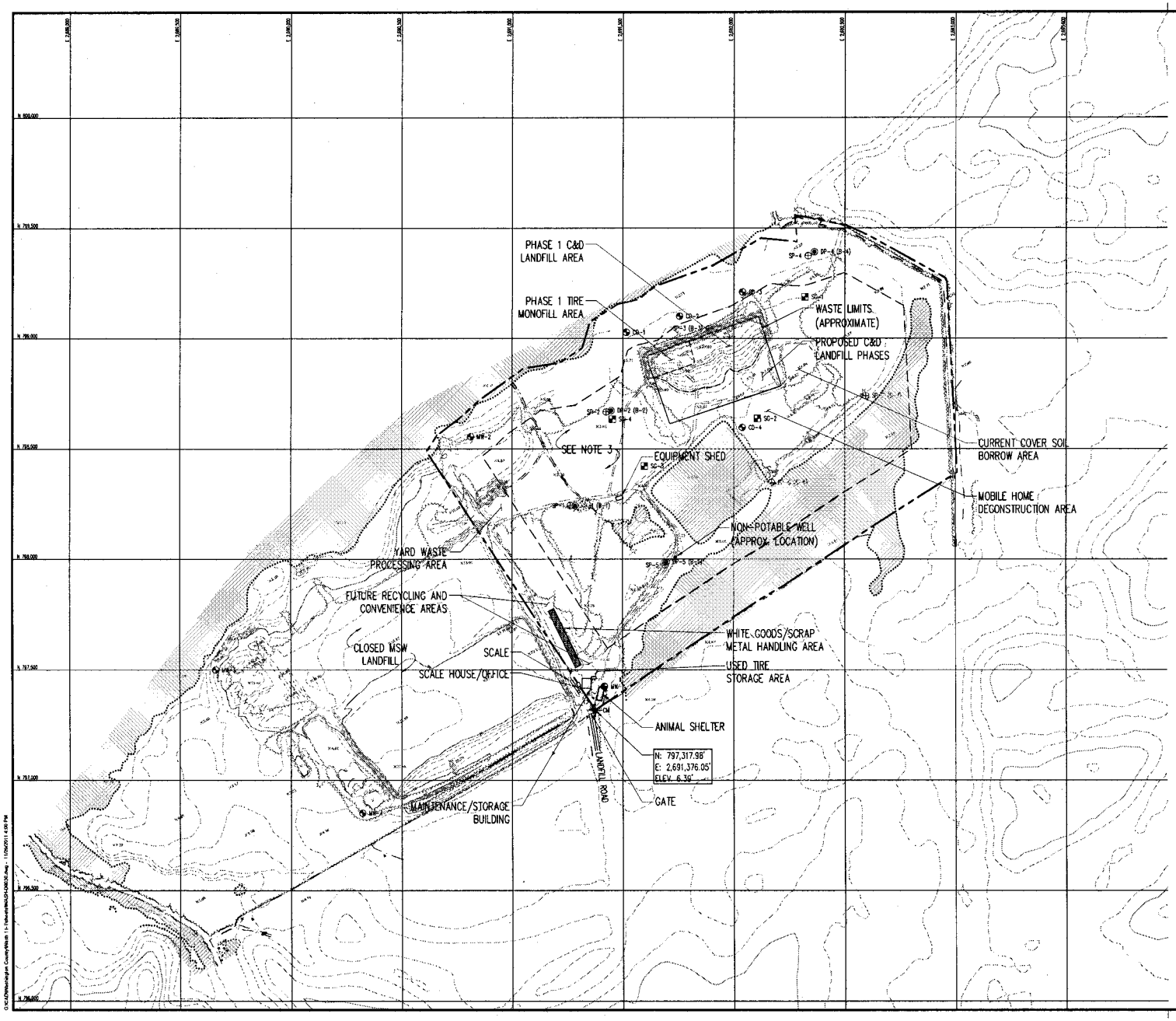


LEGEND

	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	APPROXIMATE PROPERTY LINE
	200 FOOT BUFFER FROM PROPERTY LINE
	APPROXIMATE EXISTING WASTE LIMITS
	STREAM/POND/DITCH BOUNDARY
	PROPOSED LANDFILL AREA
	WETLANDS (APPROXIMATE)
MW-1	MONITORING WELL (CLOSED MSWLF)
CD-1	MONITORING WELL (C&DLF)
CM	EXISTING CONCRETE MONUMENT
SG-1	SOIL GAS SURVEY LOCATIONS
B-6	ABANDONED SOIL BORING (SAME, 1994)
B-1	ABANDONED PIEZOMETER (SAME 1994)

NOTES

1. THE TIRE MONOFILL IS NO LONGER USED BY THE COUNTY. THIS AREA WAS PREVIOUSLY INCORPORATED INTO THE C&D LANDFILL FOOTPRINT.
2. 100-YEAR FLOODPLAIN IS AT ELEVATION 7.0.
3. THIS AREA IS DESIGNATED AS A DISASTER DEBRIS HANDLING AREA.

REFERENCES

1. OVERALL SITE BASE TOPOGRAPHY WETLAND, STREAM, AND DITCH BOUNDARIES PROVIDED BY SANBORN, BASED ON MARCH 26, 2009 AERIAL SURVEY. ADDITIONAL WETLAND AREAS OBTAINED FROM DRAWING "PROPOSED CDLF CAP SECTION" BY THE WOOTEN COMPANY, DATED DECEMBER 2004.
2. COORDINATE SYSTEM IS STATE PLANE GRID.
3. SITE PROPERTY LINE (NORTHEASTERN HALF) OBTAINED FROM DRAWING "PROPOSED CDLF CAP SECTION" BY THE WOOTEN COMPANY, DATED DECEMBER 2004. SITE PROPERTY LINE (SOUTHEASTERN HALF) FROM DRAWING "MAP OF WASHINGTON COUNTY SANITARY LAND" SURVEYED AND PREPARED BY DOWNEAST LAND SURVEYS.
4. WELL LOCATIONS OBTAINED FROM FROM THE WASHINGTON COUNTY LANDFILL MONITOR WELL SURVEY REPORT DATED APRIL 24, 2009.
5. FLOODPLAIN INFORMATION FROM NC FIRM MAP NO. 3720676800G.

0 200' 400' 600'

DATE	NO.	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES

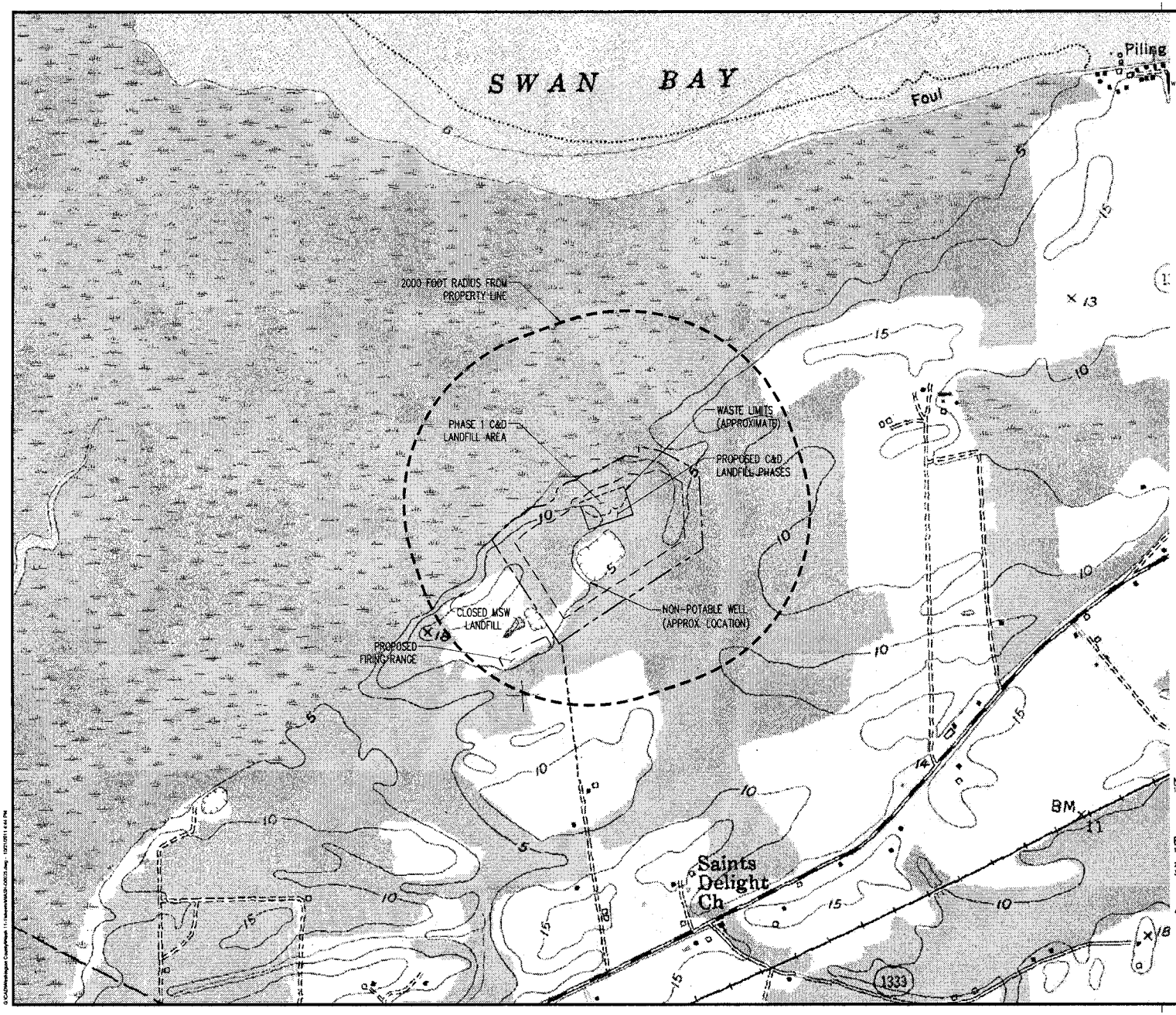
SEAL

SEAL

PROJECT TITLE: WASHINGTON COUNTY C&D LANDFILL PHASE 2 PERMIT AMENDMENT DRAWINGS

DRAWING TITLE: EXISTING CONDITIONS

DESIGNED BY: J.A.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: WASH 09-1
SCALE: AS SHOWN	DATE: OCT. 2011
FILE NAME: WASH-D0080	
SHEET NO.: FIG. 1	DRAWING NO.



NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
3104 Beryle Rd.
Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-0580
www.rsgengineering.com

SEAL

SEAL

PROJECT TITLE:
WASHINGTON COUNTY
C&D LANDFILL PHASE 2
PERMIT AMENDMENT DRAWINGS
DESIGN HYDROGEOLOGIC REPORT

DRAWING TITLE:
SITE CHARACTERIZATION AREA

DESIGNED BY: J.A.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: WASH 09-1
SCALE: AS SHOWN	DATE: OCT. 2011
FILE NAME: WASH-LD0026	
SHEET NO.: FIG. 2	DRAWING NO.:

Appendix A

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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

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