Attachment L

Water Quality Monitoring Plan

Permit to Construct Application
Wake Reclamation, LLC - Brownfield Road C&D Landfill – Phase 2B
Raleigh, North Carolina

This page intentionally left blank.

Water Quality Monitoring Plan

Brownfield Road C&D Landfill
SWS Permit No. 92-31

Prepared for:

Wake Reclamation, LLC
Raleigh, North Carolina
(A Subsidiary of Waste Industries, USA, Inc.)

October 2015

Prepared by:

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

PRINTED ON 100% RECYCLED PAPER

This page intentionally left blank

Water Quality Monitoring Plan

Brownfield Road C&D Landfill
Wake County (SWS Permit No. 92-31)

Prepared For:
Waste Reclamation, LLC
Raleigh, North Carolina
(A Subsidiary of Waste Industries USA, Inc.)

S+G Project No. BROWNFIELD-15-1

NORTH CAROLINA LICENSED SEAL 2275 GEOLOGIST MADELINE GERMAN

Madeline M. German, P.G.
Project Geologist

Joan A. Smyth, P.G.
Senior Hydrogeologist

October 2015

NC LIC NO. C-0826 (ENGINEERING)
SMITH+GARDNER
14 N. Boylan Avenue, Raleigh NC 27603 | [illegible]

This page intentionally left blank.

Wake Reclamation, LLC
Brownfield Road C&D Landfill

Water Quality Monitoring Plan

Table of Contents

Figure

Table

Appendices

1.0 INTRODUCTION

This Water Quality Monitoring Plan (WQMP) is written for the Wake Reclamation, LLC[1] Brownfield Road C&D Landfill Facility (Permit 92-31 and specifies the procedures and requirements to satisfy North Carolina Solid Waste Management Rule 15A NCAC 13B .0544 (b) and (c). The WQMP addresses the following two (2) major elements; monitoring/sampling of the groundwater system and monitoring/sampling of the surface water.

The WQMP will meet the following requirements:

- *Establish division approved background groundwater data that has not been affected by leakage from the unit (.0544 (b)(1)(A)).*
- *Represent the groundwater quality 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 procedures that will be implemented to ensure the sampling event integrity:

- 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 2.2 in their general order of implementation. Equipment requirements for each field task are presented within the applicable section. Laboratory

[1] Wake Reclamation, LLC is a subsidiary of Waste Industries, USA, Inc.

procedures, quality assurance methods and record keeping requirements are presented in **Sections 3.0 through 8.0.**

Strict adherence to the procedures stipulated in this plan is required. Any variations from these procedures should be thoroughly documented and may require prior DWM approval.

1.1 Site Contact Information

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

1.1.1 Wake Reclamation, LLC

2600 Brownfield Road
Raleigh, North Carolina 27610
Phone: (919) 779-3339
Fax: (919) 779-3970
Mr. Don Plessinger - Landfill Manager
Email: Donald.plessinger@wasteindustries.com

Mr. Richard Call - Operation Manager
Email: richard.call@wasteindustries.com

1.1.2 Engineer

Smith Gardner, Inc.
14 N. Boylan Avenue
Raleigh, North Carolina 27603
Phone: (919) 828-0577
Fax: (919) 828-3899

Ms. Joan A. Smyth, P.G., Senior Hydrogeologist
Email: joan@smithgardnerinc.com
Mr. Stacey A. Smith, P.E., Senior Engineer
Email: stacey@smithgardnerinc.com

1.1.3 NC Division of Waste Management (DWM) – Solid Waste Section

North Carolina DEQ – Raleigh Central Office (RCO)
1646 Mail Service Center
Raleigh, NC 27699
Phone: (919) 707-8200

Ms. Elizabeth Werner, Hydrogeologist
Email: Elizabeth.werner@ncdenr.gov
Phone: (919) 707-8253

Ms. Liz Patterson, Environmental Specialist
Email: elizabeth.patterson@ncdenr.gov

1.2 Site Background

The Brownfield Road C&D Landfill facility (Permit 92-31), located at 2600 Brownfield Rd, Raleigh, NC has been in operation since 2003. The surrounding area is primarily rural with industrial, agriculture and rural residential. The Wake County law enforcement center and City of Raleigh waste water treatment plant are located north of the facility. Rural residential development is primarily to the southwest. The monitoring locations are shown on **Figure 1**.

1.2.1 Geology

The Brownfield Road C&D Landfill facility is located in the eastern portion of the North Carolina Piedmont Physiographic Province. Regionally the Eastern Piedmont encompasses crystalline rock, Cretaceous and Tertiary sediments, various metamorphic belts and multiple intrusions. Locally, the site is located in the Raleigh belt of the Eastern Piedmont; typically layered hornblend geniss, amphibolite and biotite granitoid gneiss. Many medium to high grade gneiss and schist have been intruded by granitoid plutons. The Rolesville Batholith is one of the largest plutons in the Eastern United States; it is located the southern core of the Raleigh Belt, roughly along the Wake-Warren Anticlinorium[2]. The Rolesville Batholith is present at the Brownfield Road site.

1.2.2 Hydrogeology

The hydrogeology at this site has been investigated through numerous piezometers, groundwater monitoring wells, aquifer slug tests, and aquifer pumping tests. Groundwater generally flows to the northwest toward an unnamed tributary of the Neuse River. In the Phase 2B area, the uppermost, unconfined aquifer is located at an approximate elevation of 200 feet to 215 feet amsl[3]. The primary aquifer at the site is generally found in the highly weathered granite PWR or in the secondary porosity joints and fractures.

The average hydraulic gradient across the site is approximately 0.022 ft/ft in the uppermost aquifer. Average velocity for the shallow saprolite aquifer in Phase 2 is approximately 0.31 ft/day. Hydraulic conductivity, effective porosity and groundwater velocity data were recycled from the Phase 2 Design Report by David Garrett and Associates (2010).

[2] Stoddard, E. F., Farrar, S. S., Horton, J. W., Butler, J. R. and Druhan, R. M., 1991, The Eastern Piedmont in North Carolina, *in* Horton, J. W. and Zullo, V. A., eds., *The Geology of the Carolinas*, Carolina Geological Society Fiftieth Anniversary Volume, Knoxville, University of Tennessee Press, pp. 79-92.
[3] amsl = above mean sea level

This Water Quality Monitoring Plan (WQMP) has been prepared to meet the field sampling and laboratory analysis requirements of ongoing monitoring at the site. The WQMP details field and laboratory protocols that must be followed to meet the data objectives of semi-annual groundwater monitoring.

2.0 MONITORING PROGRAM

This Water Quality Monitoring Plan section addresses individual monitoring program components. At a minimum, Wake Reclamation, LLC will monitor the groundwater quality on a semi-annual basis.

2.1 Monitoring Network and Analytical Parameters

Historical water level data indicates that groundwater is flowing to the west toward the Neuse River and its tributaries. The current groundwater monitoring network includes 9 locations: 6 monitoring wells and 3 surface water locations[4]; it was revised in September 2014 to eliminate locations that were hydraulically inconsistent with the groundwater regime at the site. Existing wells MW-6AD, MW-7AS and MW-7AD will remain in place. Although these wells are not included in the monitoring network, they will remain in place in case future monitoring results indicate bedrock monitoring may be beneficial.

The proposed monitoring network is summarized in the table below.

Monitoring Network

Well	Location	Analytical Parameters
MW-1	Upgradient	Appendix I + Field + C&D
MW-2	Cross-gradient	Appendix I + Field + C&D
MW-3	Downgradient	Appendix I + Field + C&D
MW-4	Downgradient	Appendix I + Field + C&D
MW-5	Downgradient	Appendix I + Field + C&D
MW-6AS	Downgradient	Appendix I + Field + C&D
MW-6AD	Downgradient	Water Level Only
MW-7AS	Cross-gradient	Water Level Only
MW-7AD	Cross-gradient	Water Level Only
SW-1	Upgradient	Appendix I + Field
SW-2	Downgradient	Appendix I + Field
SW-3	Downgradient	Appendix I + Field

Note: Appendix I and C&D parameters are listed in Table 1.

The aforementioned wells are installed to monitor groundwater in the uppermost aquifer. This monitoring system is shown on Figure 1 and is adequate to detect any releases from the landfill unit. Well logs for the monitoring network are presented in the Design Hydrogeologic Report, Appendix A.

2.2 Groundwater Sample Collection

Details regarding the procedures and equipment required to perform groundwater field measurements and sampling from monitoring wells during each monitoring event are presented in this section. Where possible, work will

[4] Groundwater Monitoring Network Adjustment Approval, DIN 21795, September 16, 2014.

proceed from the upgradient (background) wells to downgradient (compliance) wells.

2.2.1 Guidance Documents

Sampling, analysis, and submittals will 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 27, 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.

2.2.2 Fuel Powered Equipment

Monitoring wells at Brownfield Road Landfill have dedicated bladder pumps; therefore fuel-powered equipment is not required for routine groundwater sampling. In the event, fuel-powered equipment, such as generators for additional pumps is needed, it must be situated away and downwind from site activities (i.e. 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 sampling conditions 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.

2.2.3 Equipment Decontamination

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 surgical gloves.

2. Clean item with tap water and phosphate-free laboratory detergent (Liqui-Nox 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 High Density Polyethylene (HDPE) or Polypropylene (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 by using dedicated sampling equipment, or a new disposable Teflon bailer at each well. Unclean equipment will be segregated from clean equipment during field activities. Clean equipment will remain in the manufacturer's packaging until use, or will be wrapped in commercial-grade aluminum foil or untreated butcher paper.

2.2.4 Water Level Measurements

2.2.4.1 Static Water 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 stagnant water volume 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. Each well will have a permanent, easily identified reference point on the well riser lip from which water level measurements will be measured. The reference point elevation will be established by a Registered Land Surveyor.

2.2.4.2 Contamination Prevention

After opening each well, new powder-free surgical gloves will be donned. Appropriate measures will be performed during measurement activities to minimize the potential for soils, decontamination supplies, precipitation, and/or other potential contaminants from entering the well or contacting clean equipment.

2.2.4.3 Equipment

An electronic water level indicator will be used to 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. **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);
- Water column height in the riser (based on measured well depth);
- Wellhead protective casing, base pad and riser condition; and
- Changes in well and surrounding conditions.

2.2.5 Well Monitor Evaluations

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 recording the static water level measurement. Monitoring well evacuation should be performed in upgradient wells first, and by systematically moving to downgradient well locations.

2.2.5.1 Contamination Prevention

New powder-free, surgical gloves will be donned for well purging and sampling activities and whenever handling decontaminated

field equipment. Appropriate measures will be executed during measurement, purging, and sampling activities to minimize the potential for surface soils, decontaminated supplies, precipitation, and/or other potential contaminants from entering the well or contacting cleaned equipment.

2.2.5.2 Calculations

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 measured static water level, well depth and well casing diameter according to the following equation:

$$V = (TD - SWL) \times C$$

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

2.2.5.3 Well Purging

Several options for well purging are used at this site including:

- Bailers;
- Low Flow Pumps; and
- Grundfos Redi-flo Pumps.

Bailers – Where bailers are used, new, disposable bailers with either double or bottom check-valves will be used to purge each well. Disposable purge bailers will be constructed of fluorocarbon resin (Teflon) or inert plastic suitable for the well and ground 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. Where bailers are used, a minimum of three well volumes will be purged unless the well runs dry.

Low Flow Pumps – Monitoring wells may be purged and sampled using the low-flow sampling method in accordance with the *Solid Waste Section Guidelines for Groundwater, Soil, and Surface Water Sampling* (NCDENR, 2008).

Depth-to-water measurements will be obtained using an electronic water level indicator capable of recording the depth to

an accuracy of 0.01 foot. A determination of whether or not the water table is located within the screened interval of the well will be made. If the water table is not within the screened interval, the drawdown amount that can be achieved before the screen is intersected will be calculated. If the water table is within the screened interval, total drawdown should not exceed 1 foot to minimize the amount of aeration and turbidity. If the water table is above the top of the screened interval, the drawdown amount should be minimized to keep the screen from being exposed.

If the purging equipment is non-dedicated, the equipment will be lowered into the well, using care to minimize the disturbance to the water column. If conditions (i.e., water column height and well yield) allow, the pump will be placed in the uppermost portion of the water column (minimum of 18 inches of pump submergence is recommended).

The minimum volume/time period for obtaining independent Water Quality Parameter Measurements (WQPM) will be determined. The minimum volume/time period is determined based on the stabilized flow rate and the amount of volume in the pump and the discharge tubing (alternatively, the volume of a direct read flow-cell can be used, provided it is greater than the calculated volume of the pump and discharge tubing). The bladder pump volume should be obtained from the manufacturer. Volume from the discharge tubing is as follows:

3/8-inch inside diameter tubing:	20 milliliters per foot
1/4-inch inside diameter tubing:	10 milliliters per foot
3/16-inch inside diameter tubing:	5 milliliters per foot

Once the flow-cell or the pump and discharge tubing volume has been calculated, the well purge will begin. The flow rate should be based on historical data for that well (if available) and should not exceed 500 milliliters per minute. The initial WQPM should be recorded and the flow rate adjusted until drawdown in the well stabilizes. Water levels should be measured periodically to ensure a stabilized water level is maintained. The water level should not fall within 1 foot of the top of the well screen. If the purge rate has been reduced to 100 milliliters or less and the head level in the well continues to decline, the required water samples should be collected following stabilization of the WQPM, based on the criteria presented below.

If neither the head level nor the WQPM stabilize, a passive sample should be collected. Passive sampling is defined as sampling before WQMP have stabilized if the well yield is low enough that

the well will purge dry at the lowest possible purge rate (generally 100 milliliters per minute or less).

WQPM stabilization is defined as follows: pH (+/- 0.2 S.U.), conductance (+/- 5% of reading), temperature (+/- 10% of reading or 0.2°C), and dissolved oxygen (DO) [+/- 20% of reading or 0.2 mg/L (whichever is greater)]. Oxidation reduction potential (ORP) will be measured and ideally should also fall within +/- 10mV of reading; however, this is not a required parameter. At a minimum, turbidity measurements should also be recorded at the beginning of purging, following the stabilization of the WQPM, and following samplecollection. The optimal turbidity range for micropurging is 25 Nephelometric Turbidity Units (NTU) or less. Turbidity measurements above 25 NTU are generally indicative of an excessive purge rate or natural conditions related to excessive fines in the aquifer matrix.

WQPM stabilization should occur in most wells within five to six rounds of measurements. If stabilization does not occur following the removal of a purge volume equal to three well volumes, a passive sample will be collected.

The direct-reading equipment used at each well will be calibrated in the field according to the manufacturer's specifications prior to each day's use and checked at a minimum at the end of each sampling day. Calibration information should be documented in the instrument's calibration logbook and the field book.

Each well is to be sampled immediately following stabilization of the WQPM. The sampling flow rate must be maintained at a rate that is less than or equal to the purging rate. For volatile organic compounds, lower sampling rates (100 - 200 milliliters/minute) should be used. Final field parameter readings should be recorded prior to and after sampling.

Grundfos Redi-Flo Pumps – Where Redi-Flo pumps are used, the same low flow techniques for sampling will be used. Please see above for detailed summary of purging/sampling techniques.

2.2.5.4 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 to minimize disturbance to the well sidewalls and bottom, which could result in silt and fine particulate matter suspension. The water volume purged from each well, and the relative recharge rate will be documented in sampling field notes. Wells which have

very low recharge rates will be purged once until dry. Damaged, dry, or low yielding and high turbidity wells will be documented for reconsideration before the next sampling event.

2.2.5.5 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 if warranted by field characteristics.

2.2.5.6 Non-Dedicated Equipment

Durable, non-dedicated equipment that is lowered into the well or which may come in contact with the water samples will be thoroughly decontaminated before each use. Equipment will 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 2.2.3**.

2.2.6 Sample Collection

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

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

Affix a label with the written information 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.

2.2.6.1 Field Parameters

Field measurements for temperature, pH, and specific conductance will be made immediately prior to sampling each monitoring point. For low-flow sampling, dissolved oxygen (DO) and oxidation reduction potential (ORP) shall also be collected. Additionally, turbidity measurements should be collected for detected metals evaluation. The field test specimens will be collected with the sampling bailer and placed in a clean, non-conductive glass or plastic container for observation. Temperature, pH, conductivity and turbidity meter calibration will be performed according to the manufacturers' specifications and will be 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.

2.2.6.2 Sample Equipment

Several options for sample collection are used at this site including:

- Teflon Bailers;
- Low Flow Pumps; and
- Grundfos Redi-flo Pumps.

Teflon Bailers – Where bailers are used, 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 and then allowed to fill as it sinks below the water table. Bottom contact will be avoided, preventing suspended sediment in the samples. The bailer will be retrieved and emptied in a manner which minimizes sample agitation.

Low Flow Pumps – Following purging with the low flow pump systems, samples may be collected immediately from the pumping system. Samples are to be collected in the order outlined in **Section 2.2.6.4**.

Redi-Flo Pumps - Following purging three well volumes of water, samples may be collected from the Redi-Flo pumps. Samples will be collected in the order outlined in **Section 2.2.6.4**.

2.2.6.3 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 the bailer to sample container. The generation air bubbles and sample agitation will be minimized during bailer discharge.

2.2.6.4 Sample Collection Order

Groundwater samples will be collected and contained in the order of volatilization sensitivity. When collected, the following sampling order 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;
- Wet Chemistry; and
- Measurements of pH, Temperature, DO, ORP, Conductivity, and Turbidity Measurements.

Note: 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.

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 disposable 0.45 micron filter cartridge specifically manufactured for this purpose.

2.2.6.5 Decontamination

Reusable sampling equipment including water level probes, water quality 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 (MilliQ or equivalent). Equipment decontamination procedures are detailed in Section 2.2.3.

2.2.6.6 Sample Preservation

Following sampling at each location, the sample bottles will be placed in Ziploc bags inside a cooler with ice for preservation.

2.2.6.7 Field Quality Assurance

Equipment and trip blanks will be prepared, handled, and analyzed as groundwater samples to ensure cross-contamination has not occurred. One set of trip blanks, 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 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 sample quality. This sample will be collected using the same equipment utilized for well sampling. A duplicate groundwater sample may be collected from a single well to check laboratory accuracy. Blanks and duplicate containers, preservatives, handling, and transport procedures for surface water samples will be identical to those noted for groundwater samples. Blank samples are discussed in detail in Section 3.1.

2.2.6.8 Sample Containers

Sample containers will be provided by the laboratory for each sampling event. Containers must be either new, 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 non-organic 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 non-organic water. The laboratory will provide proper preservatives in the sample containers prior to shipment (see **Section 4.0**).

2.3 Surface Water Sample Collection

This section presents the procedures and equipment required to perform surface water field measurements and sampling from springs, streams, and ponds during each monitoring event.

2.3.1 Surface Water Level Observations

Surface water quality analyses are particularly sensitive to site hydrologic conditions and recent precipitation events. Water levels may fluctuate significantly in comparison the groundwater table and may result in either diluting or increasing contaminant loadings. Recent weather and sampling station conditions should be considered when scheduling the sampling event and interpreting the surface water data.

2.3.1.1 Monitoring Conditions

Surface water level and sampling station conditions should be observed and recorded during each sampling event if warranted by site conditions. Surface water observations will include the flood stage in streams, seasonal base flow conditions, and confirm location and timing for meaningful surface water quality sampling. The following objective observations will be recorded in a dedicated field book prior to sample collection:

- Relative stream water level;
- Surface water clarity; and
- Changes in surface monitoring station conditions and surroundings.

2.3.1.2 Sampling Station Modifications

Modifications to surface water sampling station conditions may be required prior to each sampling event. These modifications may include surface and submerged debris removal, slightly deepening the station to allow sample container immersion, or channeling/piping to consolidate local discharge. When modifications are required, sufficient time will be allowed for settlement of suspended solids between the disturbance and sample collection. A minimum a settling period of four hours prior to sampling will be observed.

2.3.2 Sample Collection

2.3.2.1 Collection Procedure

Surface water samples will be obtained from areas with minimal turbulence and aeration. Samples will only be collected if flowing water is observed during the sampling event. New non-powdered, surgical gloves will be donned prior to sample collection. The following procedure will be implemented regarding surface water sampling:

1. Put on new non-powdered, surgical gloves.

2. Hold the bottle by the bottom with one hand, and with the other, remove the cap.

3. Push the sample container slowly into the water and tilt up toward the current to fill. A water depth of six inches is generally satisfactory. Breaching the surface or losing sample preservatives while filling the container will be avoided.

4. If there is little current movement, the container should be moved slowly, in a lateral, side to side direction, with the container mouth pointing upstream.

2.3.2.2 Field Parameters

Temperature, pH, specific conductivity, and turbidity will be measured at the start of sampling as a record of field conditions and check on the water sample stability over time. Temperature, pH, specific conductivity and turbidity measurements will be recorded for surface water samples. Temperature, pH, conductivity, and turbidity meter calibration will be completed at the beginning of each sampling event, according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846).

2.3.2.3 Sample Collection Order

Surface water samples will be collected in the order of volatilization sensitivity. When collected, the following sampling order will be observed:

- Volatile Organics and Volatile Inorganics;
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease;
- Total Metals;

- Inorganic Nonmetallics, Physical /Aggregate Properties, Biologicals;
- Wet Chemistry; and
- Measurements of pH, Temperature, DO, ORP, Conductivity, and Turbidity.

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.

2.3.2.4 Decontamination

Field meters which might contact surface water samples will be thoroughly decontaminated between stations by washing with non-phosphate soapy, de-ionized water and rinsed with isopropanol and organic-free water (MilliQ or equivalent). Detailed equipment decontamination procedures are detailed in **Section 2.2.3**.

2.3.2.5 Sample Preservation

Following sampling at each location, the sample bottles will be placed in Ziploc bags inside a cooler with ice for preservation.

2.3.2.6 Field Quality Assurance

Equipment and trip blanks will be prepared, handled, and analyzed as groundwater samples to ensure cross-contamination has not occurred. One set of trip blanks, 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 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 sample quality. This sample will be collected using the same equipment utilized for well sampling. **Duplicate samples will not be collected for surface water samples.** Blanks and duplicate containers, preservatives, handling, and transport procedures for surface water samples will be identical to those noted for groundwater samples. Blank samples are discussed in detail in **Section 3.1**.

2.3.2.7 Sample Containers

Sample containers will be prepared and provided by the laboratory for each surface water sampling event. Each container's

preparation and preservatives will be the same as those utilized for groundwater sampling and addressed previously in **Section 2.2.6.8**.

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; and/or
3. A handling procedure that alters the sample.

3.1 Blank Samples

3.1.1 Trip Blanks

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

3.1.2 Equipment Blanks

Where wells are sampled with non-dedicated equipment, equipment blank samples shall be collected at a rate of one sample per day. To collect an equipment blank, a bailer shall be filled with non-organic water (Milli-Q or equivalent). Handling the bailer in a manner identical to well sampling, the water is to be transferred into the sample collection jars for the equipment blanks. These samples are packed in the field and sent to the laboratory with the other samples.

3.1.3 Field Blanks

To collect a field blank, deionized water from the lab or non-organic (Milli-Q or equivalent) water will be poured at the sampling location into laboratory provided sample collection jars. These samples are packed and sent to the laboratory with the other samples.

3.2 Blank Concentrations

The contaminant concentration levels found in any blank samples 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

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 sample measurements. The specific conductivity and pH meter will be recalibrated utilizing two prepared solutions of known pH concentration in the range of anticipated values (between 4 and 10). A permanent thermometer, calibrated against a National Bureau of Standards Certified thermometer, will be used for temperature meter calibration. Other field equipment should be calibrated at least daily using the manufacturer's recommended specifications.

4.0 SAMPLE PRESERVATION AND SHIPMENT

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 inorganic metals analysis.

4.2 Storage/Transport Conditions

Proper storage and transport conditions must be maintained to preserve the sample integrity 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 maximum 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 will be placed on the outside of the shipping coolers, in a manner to prevent and detect sample tampering.

4.3 Sample Delivery

Samples shall be delivered to the analytical laboratory within a reasonable period of time in person or using an overnight delivery service to insure hold times are not exceeded. If samples are not shipped the same day, the ice used to keep the samples cool will be replenished to maintain the required maximum temperature of 4° C. Shipment and sample receipt 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 contaminant concentrations 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 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(s) in sealed coolers. Container kits will be shipped by express carrier to the sampler or site or picked up at the laboratory.

2. Following sample kit receipt, the sampler will inventory the container kit, and check its consistency with number and type 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 name, sampling time and date, sample location/well number, analysis required, sampler's initials, 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 transferal as provided by the Chain-of-Custody form has occurred. If continuous possession cannot be maintained by the field technician, the coolers will be temporarily sealed and placed in a secured area.

5. Following laboratory delivery, samples will be issued a laboratory sample number and recorded into a logbook indicating client, sample location/well number, and delivery date and time. The laboratory director or his designee will sign the Chain-of-Custody control forms and formally receive the samples.

6. Filled-in Chain-of-Custody form copies will be placed in the laboratory's analytical project file and attached to the laboratory analysis report following analysis.

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.

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;
- Sampling Date and Time;
- Climatic Conditions During Sampling Event;
- Sampling Location/Well Identification Number;
- Sample Collection Time;
- Field Technician Signature;

<u>Groundwater Sample Collection</u>

- Well Static Water Level;
- Water Column Height in Well;
- Purged Water Volume and Well Yield (High or Low);
- Observations on Purging and Sampling Event;
- Temperature, pH, Temperature, DO, ORP, Turbidity, and Conductivity Readings;

<u>Surface Water Sample Collection</u>

- Relative stream water level;
- Surface water clarity; and
- Changes in surface monitoring station conditions and surroundings.

6.0 LABORATORY ANALYSIS

The ground and surface water parameters will be analyzed for field water quality indicators (pH, conductivity, temperature and turbidity) and those constituents listed in **Table 2**. Analytical methods will follow 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 DWM's policies regarding analytical methods and reporting limits. Analysis will be performed by a laboratory certified by the North Carolina DWM 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 on 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 analytical determinations. Internal quality control checks shall be undertaken regularly by the lab to assess the precision and accuracy of analytical procedures.

6.2 Data Review

During 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 contracted laboratory's responsibility to verify that subcontracted work is completed by certified laboratories, using approved QA/QC procedures.

7.0 RECORD KEEPING AND REPORTING

This section addresses the documentation and reporting requirements associated with the WQMP implementation.

7.1 Groundwater System Evaluations

After each monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system is adequate to provide early detection of a release from the landfill unit and to determine the rate and direction of groundwater flow at the site. The groundwater flow direction will be determined by comparing groundwater surface elevations across the site through the using 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 (unit less)

If these evaluations indicate the groundwater monitoring system requires modification to meet rule requirements, a work plan and revised WMQP will be submitted to NCDWM for review prior to modifications to enhance the monitoring system.

7.2 Reporting

A report summarizing the monitoring event and the analytical data from the event will be submitted to the DWM within 120 days of completion of the event.

Monitoring reports will include the following:

1. An discussion of site geology and hydrogeology;
2. A discussion of the monitoring event procedures and results;
3. An potentiometric surface map;
4. Analytical laboratory reports and summary tables;
5. Graphical analysis of analytical data may be reported but is not required;
6. Solid Waste Environmental Monitoring Reporting Form (**Appendix A**); and
7. Laboratory Data (in Electronic Data Deliverable Format – see **Section 2.2.1**).

Monitoring reports may be submitted electronically by e-mail or in paper copy form. Copies of the reports will be kept at the landfill office.

8.0 MONITORING PROGRAM MODIFICATIONS

8.1 Overview

This section addresses the procedures that should be followed with respect to any water quality program modifications.

8.2 Well Abandonment/Rehabilitation

After each water quality monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system is still effective at detecting an early release from the landfill, and to determine the groundwater flow rate and direction at the site. If the potentiometric maps reveal the depths, locations, or well number is insufficient to monitor for a potential releases of solid waste constituents from the solid waste management area, new well locations and depths will be submitted to the DWM for approval.

Should wells become irreversibly damaged or require rehabilitation, the DWM will be notified. If monitoring wells and/or piezometers are damaged irreversibly they will be abandoned under DWM direction following 15A NCAC 02C .0113. The abandonment procedure in unconsolidated materials involves over-drilling and/or pulling the well casing and plugging the well with a sealant such as neat cement grout and/or bentonite clay. For bedrock well completions the abandonment encompasses plugging the interior well riser and screen with a sealant such as neat cement grout and/or bentonite clay sealant.

8.3 Additional Well Installations

Additional well installations will be carried out in accordance with DWM directives. Monitoring wells will be installed under the supervision of a geologist or engineer who is registered in North Carolina and who will certify to the DWM that the installation complies with the North Carolina Regulations. For future well installation, the documentation for well construction will be submitted by the registered geologist or engineer to the DWM within sixty (60) days after well construction.

8.4 Implementation Schedule

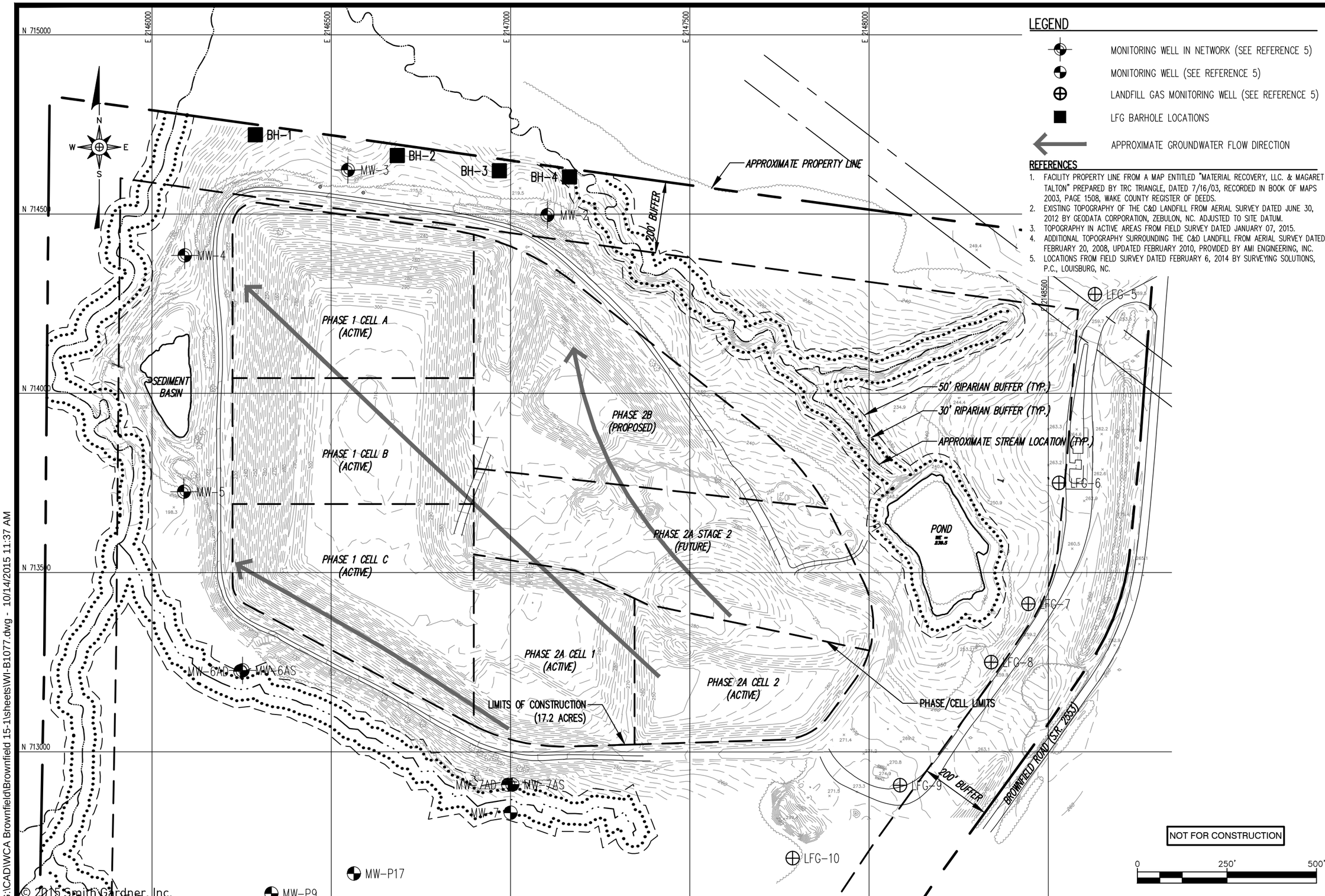
The Monitoring Program proposed herein will be implemented following approval of this Water Quality Monitoring Plan by the DWM.

This page intentionally left blank.

Figure

Water Quality Monitoring Plan
Wake Reclamation, LLC
Brownfield Road C&D Landfill
Raleigh, North Carolina

This page intentionally left blank.



G:\CAD\WCA Brownfield\Brownfield 15-1\sheets\WI-B1077.dwg - 10/14/2015 11:37 AM

PREPARED BY:
NC LIC. NO. C-0828 [ENGINEERING]
SMITH+GARDNER
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

PREPARED FOR:
WAKE RECLAMATION, LLC
BROWNFIELD ROAD C&D LANDFILL
PHASE 2B
WATER QUALITY MONITORING LOCATION MAP

DRAWN:	APPROVED:	SCALE:	FIGURE NO.
T.R.S.	J.L.M.	AS SHOWN	1
DATE:	PROJECT NO:	FILENAME:	
Oct 2015	BROWNFIELD 15-1	WI-B1077	

This page intentionally left blank.

Table

Water Quality Monitoring Plan
Wake Reclamation, LLC
Brownfield Road C&D Landfill
Raleigh, North Carolina

This page intentionally left blank.

SMITH+GARDNER

Table 1
Analytical Parameters
Brownfield Road Landfill

By: JAS/MMG
Date: 5/8/2014

Constituents	Synonyms
Antimony	
Arsenic	
Barium	
Beryllium	
Cadmium	
Chromium	
Cobalt	
Copper	
Lead	
Nickel	
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	
Temperature	
pH	
Turbidity	
Specific Conductance	
Acetone	2-Propanone
Acrylonitrile	2-Propenenitrile
Benzene	
Bromochloromethane	Chlorobromomethane
Bromodichloromethane	Dibromochloromethane
Bromoform	Tribromomethane
Carbon Disulfide	
Carbon Tetrachloride	Tetrachloromethane
Chlorobenzene	
Chloroethane	Ethyl chloride
Chloroform	Trichloromethane
Dibromochloromethane	Chlorodibromomethane
1,2-Dibromo-3-chloropropane	DBCP
1,2-Dibromoethane	Ethylene dibromide, EDB
1,2-Dichlorobenzene	o-Dichlorobenzene
1,4-Dichlorobenzene	p-Dichlorobenzene
trans-1,4-Dichloro-2-butene	
1,1-Dichloroethane	Ethyldidene chloride
1,2-Dichloroethane	Ethylene dichloride
1,1-Dichloroethylene	Vinylidene chloride
cis-1,2-Dichloroethylene	
trans-1,2-Dichloroethylene	
1,2-Dichloropropane	Propylene dichloride
cis-1,3-Dichloropropene	
trans-1,3-Dichloropropene	
Ethylbenzene	
2-Hexanone	Methyl butyl ketone

SMITH+GARDNER

Table 1
Analytical Parameters
Brownfield Road Landfill

By: JAS/MMG
Date: 5/8/2014

Constituents	Synonyms
Methyl bromide	Bromomethane
Methyl chloride	Chloromethane
Methyl ethyl ketone	2-Butanone
Methyl iodide	Iodomethane
4-Methyl-2-pentanone	Methyl isobutyl ketone
Methylene bromide	Dibromomethane
Methylene chloride	Dichloromethane
Styrene	Ethenylbenzene
1,1,1,2-Tetrachloroethane	
1,1,2,2-Tetrachloroethane	
Tetrachloroethylene	Perchloroethylene
Toluene	Methyl benzene
1,1,1-Trichloroethane	Methyl chloroform
1,1,2-Trichloroethane	
Trichloroethylene	
Trichloroflouromethane	CFC-11
1,2,3-Trichloropropane	
Vinyl acetate	Acetic acid, ethenyl ester
Vinyl chloride	Choroethene
Xylenes	Dimethyl benzene
C&D Landfill Additional Parameters:	
Mercury	
Chloride	
Manganese	
Sulfate	
Iron	
Alkalinity	
Total Dissolved Solids	
Tetrahydrofuran	

Appendix A

Environmental Monitoring Report Form

Water Quality Monitoring Report
Wake Reclamation, LLC
Brownfield Road C&D Landfill
Raleigh, North Carolina

This page intentionally left blank.

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

This page intentionally left blank.