| Scanned By | Date | DOC ID | Permit |
|---|---|---|---|
| Backus | 10/15/2014 | 21984 | 4112-MSWLF-1997 |

**APPROVED**

**DIVISION OF WASTE MANAGEMENT**

**SOLID WASTE SECTION**

**Date** 06/11/2015 **By** Patricia N. Backus

**DIN 21984**

**Attachment** 1 **Part** II **Document** 18
**Permit** 4112-MSWLF-1997 **Permit DIN** 24424

**Permit Amendment**

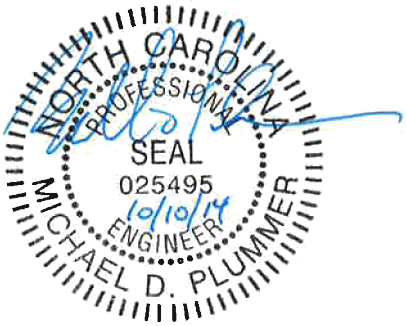
# White Street Sanitary Landfill - Phase III

Project No. 06770-137686-018

Permit 41-12

*Greensboro, North Carolina*

**October 2014**



October 10, 2014

Ms. Patricia Backus, P.E.
North Carolina Department of Environment and Natural Resources
1646 Mail Service Center
Raleigh, NC 27699-1646

RE: Application for Continued Operation
City of Greensboro, White Street Landfill – Phase III
Guilford County, Permit No. 41-12

Dear Ms. Backus,

HDR Engineering, Inc. of the Carolinas (HDR) is pleased to submit the enclosed permit amendment application for the continued operation of the White Street Landfill – Phase III on behalf of the City of Greensboro (City).

The White Street Landfill – Phase III is being operated under North Carolina Department of Environment and Natural Resources (NCDENR) Solid Waste Permit No. 41-12. In accordance with NCDENR Rules 15A NCAC 13B .1603(a)(2) and .1617(b) this application requests the renewal of the 5-year Permit to Operate (PTO).

The originally permitted Phase III area of the landfill has not reached final design grades and, therefore, this application addresses the extension request for the permitted operational life to allow full development of Phase III. The total operating capacity for Phase III, as amended through the approved 2000 Permit Modification, is 5,058,000 cubic yards which includes airspace for waste, daily and intermediate cover. Based on a May 3, 2014 aerial topography Phase III has an estimated 1,624,100 cubic yards of operating capacity remaining.

As required by the General Facility Conditions specified in the PTO, the City is required to submit a permit amendment to NCDENR. Based on Rule 15A NCAC 13B .1617(b), NCDENR requires the following updated documents to be submitted with the continued operation request.

- Engineering Plan
- Construction Quality Assurance Plan
- Operation Plan
- Closure and Post-Closure Plans
- Water Quality Monitoring Plan

With the exception of the Water Quality Monitoring Plan, all the plans were updated from what was originally submitted in the 2011 Permit Amendment. A copy of each revised document is included in the enclosed permit amendment for your review and approval. In addition, a revised copy of each

document is provided with tracked changes for your ease in reviewing the specific revisions that have been made.

There were no changes to the Water Quality Monitoring plan; however, a copy of the most recent approved plan is included for reference.

If you have any questions regarding this permit amendment request, please do not hesitate to call me at (704) 338-6843.

Sincerely,
HDR Engineering Inc., of the Carolinas

Michael D. Plummer, P.E.
*Project Manager*

MDP/spf/apb

Enclosure

cc: Dale Wyrick, P.E., City of Greensboro (w/o enclosure)
Gail Hay, P.E., City of Greensboro (with enclosure)
Jason Jernigan, City of Greensboro (with enclosure)
Joe Readling, P.E., HDR Engineering (w/o enclosure)

**Engineering Plan**

# White Street Sanitary Landfill - Phase III

Project No. 06770-137686-018

Permit 41-12

*Greensboro, North Carolina*

**October 2014**

# 3.0 ENGINEERING PLAN

## 3.1. Facility Design

The facility has been designed in general accordance with Section .1620(d) of the Rules. The design includes a composite base-liner system of low permeability clay and synthetic liner.

The proposed horizontal expansion will allow the continued use of existing facilities such as the scalehouse facility, truck scales, paved access road, and the maintenance building. The proposed site development will include excavation of borrow areas, construction of the lined area, perimeter roadway, storm water conveyance, environmental control systems, leachate collection system, and gas management systems.

The facility is currently surrounded on all sides by natural barriers or fencing, to control vehicular access and prevent illegal disposal. All access is limited by gates, and such gates are securable and equipped with locks.

Internal roads will be maintained to be passable in all weather by all vehicles. All operation areas and units will be accessible. Roads will be finished with either gravel or asphalt. Internal roads will be a minimum of 20 feet wide and will not have slopes of more than 8 percent.

### 3.1.1. General

The Phase III area, with 52 acres of liner, contains approximately 5,058,000 cubic yards of operating capacity for waste. Phase III is a discrete unit and is not expected to be expanded with additional "cells."

Phase III has been constructed in three separate cells (cells 1, 2, and 3). Cell 1 was constructed with a 2-foot thick $10^{-7}$ cm/sec clay barrier while Cells 2 and 3 were constructed with the approved alternative base liner system of a 1.5-foot thick $10^{-5}$ cm/sec clay layer overlain by a geosynthetic clay layer (GCL).

Cell 1 was constructed and approved for operation in December 1997 with a gravity drain sump. Cell 2 was constructed and approved for operation in June 2001 Cell 3 was constructed and approved for operation in April 2005. Cell 2 drains to a leachate sump with pumps that direct leachate to the onsite storage tanks. Cell 3’s leachate system gravity drains into the Cell 1 and 2 leachate systems.

Phase III has a gas collection system to collect and direct landfill gas to either an onsite flare or to a transmission line for offsite use. The gas system is regulated through the facilities’ Title V permit.

### 3.1.2. Foundation

The foundation of the landfill consists of the naturally occurring soils and some structural fill material. Based on the geologic exploration of the subsurface (see Design Hydrogeological Report) no areas of gross instabilities are expected. After excavation of the site to the design subgrade, the areas were proofrolled (minimum 20-ton pneumatic tired vehicle) for confirmation

and any areas noted to exhibit signs of instability were excavated and backfilled with structural fill.

The subgrades were constructed to obtain regulatory minimum separation for groundwater and bedrock.

### 3.1.3. Base Liner System

The base liner system was designed to be constructed upon a stable subgrade. A 2-foot layer of low permeability ($<1 \times 10^{-7}$) clay covers the Cell 1 area and a 1.5 foot layer of $<1x10^{-5}$ permeability material with a geosynthetic clay layer (GCL) was constructed for the Cell 2 and 3 areas. The clay or GCL is overlain by a 60 mil HDPE geomembrane. The geomembrane was checked for failure due to self weight, slipping of operational cover and waste subsidence and failure of the anchor trench and the design is adequate. Calculations were attached in the original construction permit applications.

The leachate collection layer consists of a geonet on the exterior berm sideslopes and a collection layer of 12 inches of high permeability soil on the bottom of the unit with perforated leachate collection pipes surrounded by stone, and a protective geosynthetic filter fabric. The stone was constructed like a chimney to the surface of the operational cover, to speed in the removal of leachate from the cells. The LCR system has been designed to allow no more than 1 foot of head on the liner system.

The design as submitted utilizes a drainage media of 12 inches of sand ($1 \times 10^{-1}$ cm/sec) with a 12-inch operational cover of native soil ($2 \times 10^{-5}$ cm/sec).

An operational cover soil provides protection to the LCR system and geomembrane liner from construction and landfill equipment. The operational cover will be a minimum of 24 inches thick on sideslopes and 12 inches elsewhere. Select loads of MSW form the initial lift to further protect the base liner system. The original permit calculations demonstrate stability of the operational cover on sideslopes and the ability of SDR 11 leachate pipes to withstand loading without crushing.

### 3.1.4. Cap System Design

The final cap system design is placed over the 12 inches of intermediate soil cover. The cap consists of a minimum of 18 inches of low permeability soil ($<1 \times 10^{-5}$ cm/sec) overlain by a geomembrane, a geonet for infiltration collection, 18 inches of cover soil, and 6 inches of top soil. The maximum design slope is 25 percent; vegetation will be established after completion of the cap to control erosion of the soil cover.

### 3.1.5. Gas Management System

A gas collection system is included as part of the final cap design. At this time, active wells or collection trenches have been installed in each cell. The gas is directed to the onsite blower/flare skid. The gas management system either flares the gas or directs it into a transmission line for offsite use.

## 3.1.6. Leachate Handling and Storage Facilities

#### 3.1.6.1. GENERAL

The disposal alternative is to pump the leachate from the proposed landfill to the local POTW for initial treatment and discharge.

Due to the variability of leachate generation and water quality, there is no immediate need for extensive wastewater pretreatment facilities. At this time, two storage tanks have been constructed for equalization of flow prior to discharge to the City wastewater treatment plant. A process and instrumentation diagram (P&ID) is included for reference.

The proposed leachate equalization tanks are located on the eastern side of the landfill expansion area (see Drawing PID-1). The equalization tanks and associated pumps are installed on a concrete foundation. A gravel access road was constructed for access to the facilities by transport trucks, maintenance vehicles, and operations personnel.

The equalization tanks, pumps, and associated above-ground piping are provided with secondary containment. The lined secondary containment area is constructed around the tanks and is sized for containment of 110 percent of the largest tank volume. The type of secondary containment is concrete floor with concrete walls. This containment area is piped for drainage of storm water into the adjacent storm water basin. However, the pipe has a manual valve that is to remain closed during normal operations. This arrangement is to ensure that any tank failures or accidental spills are identified by the operations staff and properly handled.

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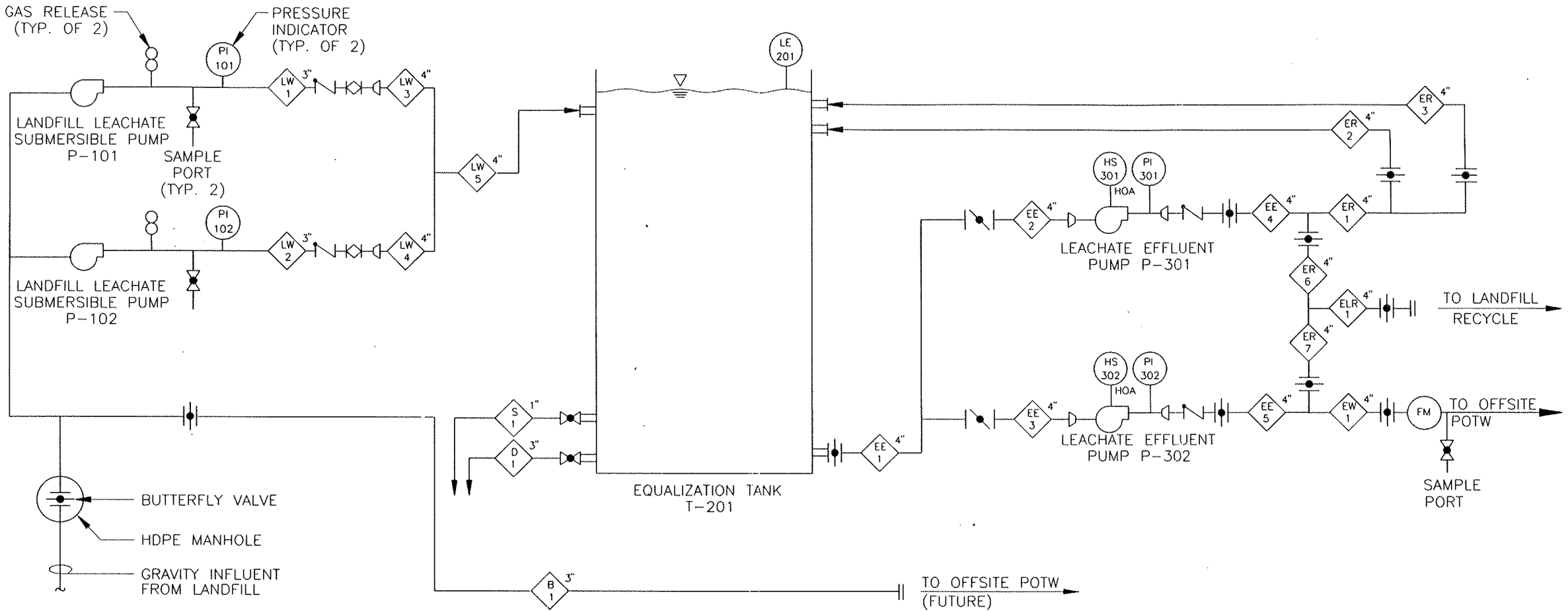
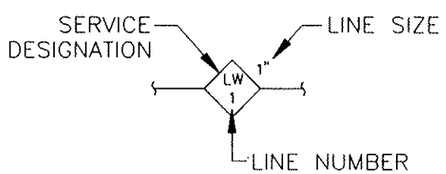



## TYPICAL INSTRUMENTATION ABBREVIATION

| | |
|---|---|
| LE | LEVEL ELEMENT |
| PI | PRESSURE INDICATOR |
| HS | HAND SWITCH |
| HOA | HAND-OFF-AUTO SELECTOR SWITCH |

## TYPICAL PIPING CALL-OUT




## VALVE LEGEND

| | |
|---|---|
| | BALL VALVE |
| | BUTTERFLY VALVE |
| | CHECK VALVE |
| | PLUG VALVE |
| \|\| | CAPPED/FLANGED STUB-OUT |

## PIPING LINE DESIGNATIONS

| | | | |
|---|---|---|---|
| LW | LEACHATE WASTEWATER | EE | EQUALIZED EFFLUENT |
| D | DRAIN | EW | EQUALIZED WASTEWATER |
| R | RECIRCULATION | ER | EQUALIZED RECIRCULATION |
| S | SAMPLE LINE | ELR | EQUALIZED LANDFILL RECYCLE |

HDR

HDR Engineering, Inc.

# CITY OF GREENSBORO
# WHITE STREET SANITARY LANDFILL
# PHASE III EXPANSION

## LEACHATE TREATMENT SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM

Date 2/15/96

Figure PID-1

P:\GBOF -1A.DWG

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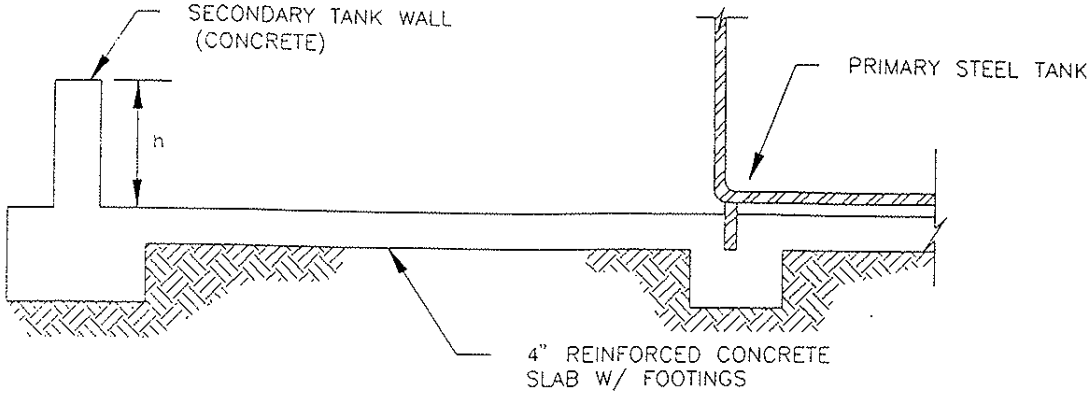
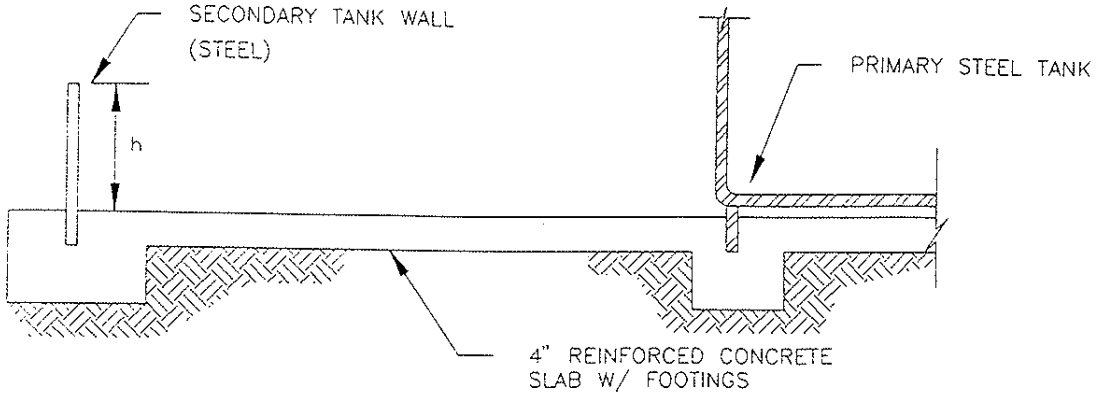
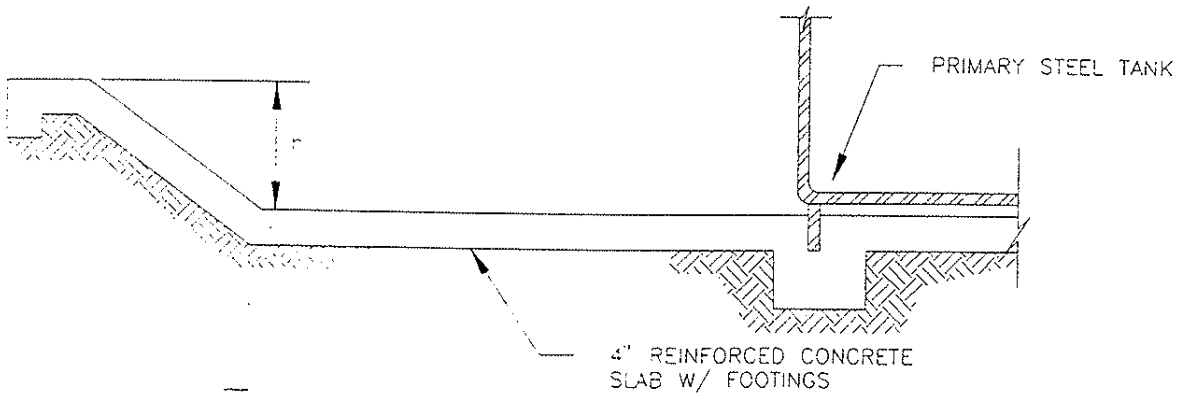



NOTES:

1. "h" IS EXPECTED TO BE BETWEEN 3' AND 6'. FINAL HEIGHT WILL DEPEND ON AREA ENCLOSED

# ALTERNATE
# SECONDARY LEACHATE CONTAINMENT CROSS SECTIONS

NO SCALE

#### 3.1.6.2. FINAL DISPOSAL PLANS AND DISCHARGE LIMITS

The Phase III leachate collection system includes two submersible pumps located inside an HDPE manhole outside of the landfill. A series of float switches mounted inside the manhole signal the pumps to operate and transfer leachate to the on-site equalization tanks. The float switches can be set to turn the pump on and off as well as to signal a high level alarm. Similarly, the leachate storage tanks are equipped with a high level float switch to prevent the pump from over topping the tanks. An electronic flow meter is installed to record the amount of leachate discharged.

In the event of a power failure, a portable generator may be utilized to pump leachate. Under normal operations, the liquid level is maintained at less than 1 foot above the membrane liner.

The HDPE manhole allows easy removal for operation and maintenance. The two pumps transfer leachate via a combination of PVC and HDPE piping (force mains) to the equalization tanks. All leachate piping systems are equipped for periodic flushing to remove any settled debris or other pipe restrictions.

#### 3.1.6.3. LEACHATE EQUALIZATION

Depending on the time of year, age of landfill, operation of the landfill, and range of storm events, leachate generation will vary. The purpose of equalization of the process wastewater flow is twofold. A large volume is necessary to equalize water quality variation which may result from various landfill operations. Secondly, equalization is required to control hydraulic fluctuations. By dampening both the hydraulic and water quality fluctuations, a more steady and consistent flow can be transferred for treatment.

#### 3.1.6.4. CONTINGENCY MEASURES

The leachate collection and treatment system is driven primarily by electric power. As a result, any major power failure of the supply to the facility would eliminate treatment and disposal capabilities. In the event of such conditions, the site would be forced to store leachate within the lined landfill. However, excess storage capacity is available within the landfill. Under certain conditions a liquid level greater than 1 foot may be imposed on the membrane liner for periods up to one week.

For extended periods of downtime, the pumps may run from power provided by portable generators. In addition, tanker trucks may be utilized to remove leachate from the tank for eventual disposal at the City wastewater treatment plant.

## 3.2. Construction Practices

Test pads were constructed of the soils proposed for use as the clay liner to determine the construction methods necessary to achieve the design criteria as outlined in .1624.(8)(B). The leachate collection system was constructed in general accordance with rule .1624(10)(B). The geomembrane liner was constructed in general accordance with rule .1624(9)(B).

## 3.3. Special Engineering Features

The proposed landfill design was evaluated for seismic and static slope stability. The EPA guidelines for minimum factors of safety against slope failure are 1.5 statically and 1.0 dynamically. These minimum factors of safety are met by this design assuming a conservative cohesion value for waste of 300 pounds per square foot. The complete analysis was included in the original permit application calculation section.

## 3.4. Design Hydrogeologic Report

A copy of the complete report was contained within the original permit application.

**Construction Quality Assurance Plan**

# White Street Sanitary Landfill - Phase III

Project No. 06770-137686-018

Permit 41-12

*Greensboro, North Carolina*

**October 2014**

# TABLE OF CONTENTS

# SECTION 1.0 GENERAL

## 1.1. INTRODUCTION

This Construction Quality Assurance (CQA) Plan has been prepared to provide the Owner, Engineer, and CQA Consultant the means to govern the construction quality and to satisfy landfill certification requirements under current solid waste management regulations.

More specifically, this CQA Plan addresses the soils and geosynthetics components of the liner and leachate collection/removal (LCR) systems. The liner system, as referenced herein, generally consists of a soil subgrade and a composite liner (consisting of a compacted soil liner, a geosynthetic clay liner and an overlying HDPE geomembrane liner). The LCR system consists of a granular drainage material with perforated collection piping, manholes, and fittings. General references in this Plan to the various components as the "liner or LCR system(s)" are intended to be as described herein.

The CQA Plan is divided into the following sections:

| | |
|---|---|
| Section 1.0 | General |
| Section 2.0 | Soil Liner Construction Quality Assurance |
| Section 3.0 | Geomembrane Liner Construction Quality Assurance |
| Section 4.0 | LCR Construction Quality Assurance |
| Section 5.0 | Geotextile Construction Quality Assurance |
| Section 6.0 | High Density Polyethylene Pipe, Manholes, and Fittings Construction Quality Assurance |
| Section 7.0 | Geonet Construction Quality Assurance |
| Section 8.0 | GCL Construction Quality Assurance |
| Section 9.0 | Surveying Construction Quality Control |
| Section 10.0 | Construction Quality Assurance Documentation |

## 1.2. DEFINITIONS RELATING TO CONSTRUCTION QUALITY

### 1.2.1. Construction Quality Assurance (CQA)

In the context of this Plan, construction quality assurance is defined as a planned and systematic program employed by the Owner to assure conformity of the liner systems, LCR systems, and protective cover system installation with Contract Drawings, and the project specifications. CQA is provided by the CQA Consultant as a representative of the Owner and is independent from the Contractor and all manufacturers. The CQA program is designed to

provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

### 1.2.2. Construction Quality Control (CQC)

Construction Quality Control refers to actions taken by manufacturers, fabricators, installers, or the Contractor to ensure that the materials and the workmanship meet the requirements of this CQA Plan and the project specifications. In the case of the liner and LCR systems, CQC is provided by the Contractor's CQC Consultant. In the case of geosynthetic components, material quality control (QC) is provided by the manufacturer's certification and the CQC for the installation of the various geosynthetics is provided by the Contractor's CQC Consultant. The manufacturer's specifications and quality control (QC) requirements are included in this CQA Plan by reference only. A complete updated version of each geosynthetic component manufacturer's QC Plan will be incorporated as part of the Contractor's CQC Plan.

### 1.2.3. CQC/CQA Certification Document

At the completion of construction and prior to placement of waste in the landfill, a certification document will be prepared by the CQA Consultant and be submitted to State Solid Waste Regulators. The certification report will include all QC testing performed by the Geosynthetics Manufacturers, all CQC testing performed by the CQC Consultant, or Geosynthetic Installers, and all CQA conformance testing performed by the CQA Consultant.

### 1.2.4. Discrepancies Between Documents

The CQA Plan is intended to be a supporting document to improve the overall documentation of the Work. The CQA Plan is less specific from the project specifications, and conflicts may exist between the documents. The Contractor is instructed to bring discrepancies to the attention of the Engineer or CQA Consultant for resolution. The Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents. Unless otherwise determined by the Engineer, the more stringent requirement shall be the controlling resolution. Reference is made to the project specifications, Section 00700 - General Conditions.

## 1.3. PARTIES TO CONSTRUCTION QUALITY ASSURANCE

### 1.3.1. Description of the Parties

The parties to Construction Quality Assurance and Quality Control include the Owner, Project Manager, Engineer, Contractor, Geosynthetics Manufacturer, Geosynthetics Installer, CQA Consultant, Geosynthetics CQA Laboratory, Soils CQA Laboratory, CQC Consultant, Geosynthetics CQC Laboratory, and Soils CQC Laboratory. The lines of authority and communications between each of the parties involved in the CQA and CQC are illustrated in Figure 1 (Page 4).

#### 1.3.1.1. OWNER

The Owner is the City of Greensboro, who owns and/or is responsible for the facility.

#### 1.3.1.2. PROJECT MANAGER

The Project Manager is the official representative of the Owner. The Project Manager serves as communications coordinator for the project, initiating the resolution, preconstruction, and

construction meetings outlined in Section 1.7. The Project Manager shall also be responsible for proper resolution of all quality issues that arise during construction. The Project Manager is HDR Engineering, Inc. of the Carolinas, of Charlotte, NC.

#### 1.3.1.3. ENGINEER

The Engineer is responsible for the engineering design, drawings, plans and project specifications for the liner system and protective cover system. The Engineer is HDR Engineering, Inc. of the Carolinas, of Charlotte, NC.

#### 1.3.1.4. CONTRACTOR

The Contractor is responsible for the construction of the subgrade, construction of the subbase (as applicable), soil liner berms, soil and geosynthetic liners, anchor trench excavation and backfill, and for placement of the LCR system. The Contractor is responsible for submittal coordination and the overall CQC on the project.

#### 1.3.1.5. GEOSYNTHETICS MANUFACTURER

The Geosynthetics Manufacturer(s) is(are) responsible for the production of geomembranes, geosynthetic clay liners, geonets, and geotextiles. The manufacturers are responsible for Quality Control (QC) during manufacture of the geosynthetic components, certification of the properties of the geosynthetic components, and field installation criteria.

#### 1.3.1.6. GEOSYNTHETICS INSTALLER

The Geosynthetics Installer(s) is(are) a subcontractor of the Contractor and is(are) responsible for field handling, storing, placing, seaming, protection of (against wind, etc.), and other aspects of the geosynthetics installations, including the geomembranes, geosynthetic clay liners and geotextiles. The Installer may also be responsible for transportation of these materials to the site, and for the preparation and completion of anchor trenches.

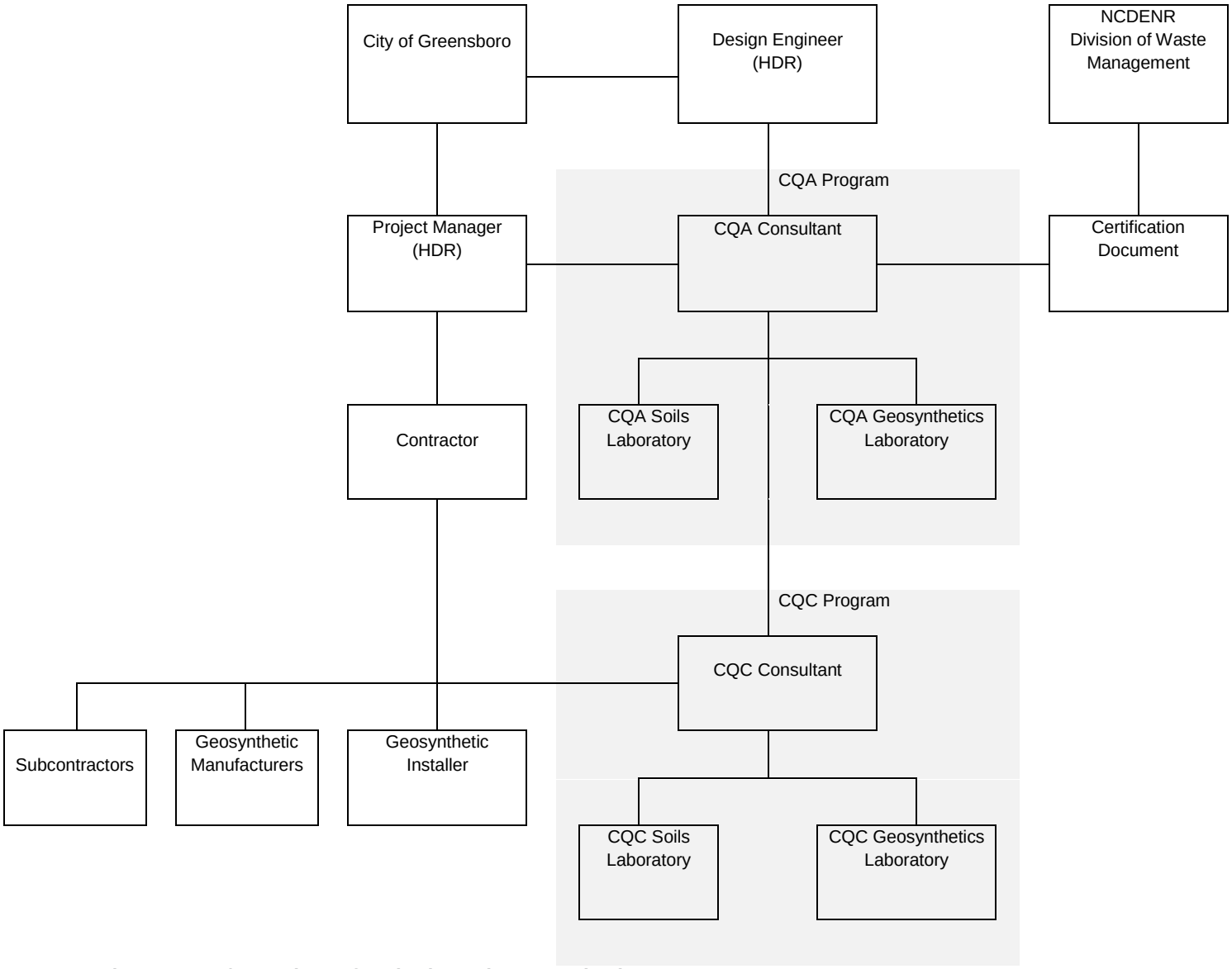



**Figure 1 CQA/CQC Lines of Authority and Communication**

#### 1.3.1.7. CONSTRUCTION QUALITY ASSURANCE CONSULTANT

The CQA Consultant is a representative of the Owner and is responsible for observing, testing, and documenting activities related to the CQC/CQA of the earthworks at the site, and the installation of the geosynthetic components of the liner and leachate collection/removal systems. The CQA Consultant is also responsible for issuing a facility certification report, sealed by a Professional Engineer registered in North Carolina.

#### 1.3.1.8. GEOSYNTHETICS CONSTRUCTION QUALITY ASSURANCE LABORATORY

The Geosynthetics CQA Laboratory is a party, independent from the Owner, that is responsible for conducting tests on conformance samples of geosynthetics used in the liner and LCR systems. The Geosynthetics CQA Laboratory service cannot be provided by any party involved with the manufacture, fabrication, or installation of any of the geosynthetic components.

#### 1.3.1.9. SOILS CONSTRUCTION QUALITY ASSURANCE LABORATORY

The Soils Construction Quality Assurance Laboratory is a party, independent from the Owner, that is responsible for conducting geotechnical tests on conformance samples of soils used in the liner system. The Soils CQA Laboratory service cannot be provided by any party involved with the Contractor.

#### 1.3.1.10. CONSTRUCTION QUALITY CONTROL CONSULTANT

The CQC Consultant is a representative of the Contractor and is responsible for the earthwork and soil liner quality control sampling and testing. The term CQC Consultant shall be used to designate the Engineer in charge of the quality control work. The personnel of the CQC Consultant also includes Quality Control Monitors who are also located at the site for construction observation and monitoring. The CQC Consultant is responsible for the timely conveyance of CQC testing results to the CQA Consultant.

#### 1.3.1.11. GEOSYNTHETICS CONSTRUCTION QUALITY CONTROL LABORATORY

The Geosynthetics CQC Laboratory is a party, independent from the Contractor, that is responsible for conducting tests on conformance samples of geosynthetics used in the liner and LCR systems.

#### 1.3.1.12. SOILS CONSTRUCTION QUALITY CONTROL LABORATORY

The Soils Construction Quality Control Laboratory is a party, independent from the Contractor, that is responsible for conducting geotechnical tests on conformance samples of soils used in the liner system.

### 1.3.2. Qualifications of the Parties

The following qualifications are required of all parties involved with the manufacture, fabrication, installation, transportation, and CQC/CQA of all materials for the liner and LCR systems. Where applicable, these qualifications must be submitted by the Contractor to the Project Manager for review and approval.

#### 1.3.2.1. CONTRACTOR

Qualifications of the Contractor are specific to the construction contract and independent of this CQA Plan.

#### 1.3.2.2. GEOSYNTHETICS MANUFACTURERS

Each Geosynthetics Manufacturer must satisfy the qualifications presented in the project specifications and must be prequalified and approved by the Project Manager.

The physical properties of each geosynthetic product must be certified by the geosynthetics manufacturer. The properties certified must include, at a minimum, those identified in the project specifications. Manufacturer's certification must be approved by the CQA Consultant before the product is used.

#### 1.3.2.3. GEOSYNTHETIC INSTALLER(S)

The Geosynthetic Installer(s) will be trained and qualified to install the geosynthetics components of the liner system. Each Geosynthetics Installer must meet the requirements of the project specifications and be approved by the Project Manager. The Geomembrane Installer must be approved by the Geomembrane Manufacturer.

#### 1.3.2.4. CONSTRUCTION QUALITY ASSURANCE CONSULTANT

The CQA Consultant will act as the Owner's CQA Representative and will report to the Project Manager. The CQA Consultant will perform conformance testing to satisfy the requirements of this CQA Plan, will observe the CQC work performed by the CQC Consultant, and will prepare the certification document incorporating both CQA and CQC test data. The CQA Consultant will have experience in the CQC/CQA aspects of landfill liner system construction and soils testing, and be familiar with ASTM and other related industry standards. The activities of the CQA Consultant will be performed under the supervision of a Registered Professional Engineer.

#### 1.3.2.5. CONSTRUCTION QUALITY CONTROL CONSULTANT

The CQC Consultant will be a party, independent from the Contractor. The CQC Consultant will be experienced with soils, including soil liners, and geosynthetics, including geomembranes, geosynthetic clay liners geonets, and geotextiles. The CQC Consultant will satisfy the requirements of the project specifications and be approved by the Project Manager. The activities of the CQC Consultant will be performed under the supervision of a Registered Professional Engineer.

#### 1.3.2.6. GEOSYNTHETICS CONSTRUCTION QUALITY CONTROL LABORATORY

The Geosynthetics CQC Laboratory is a subcontractor of the CQC Consultant and will have experience in testing geosynthetics and be familiar with ASTM, NSF, and other applicable test standards. The Geosynthetics CQC Laboratory will be capable of providing test results within 24 hours or a reasonable time after, as agreed to at the outset of the project, receipt of samples, and will maintain that standard throughout the installation.

## 1.4. SCOPE OF CONSTRUCTION QUALITY ASSURANCE PLAN

The scope of this CQA Plan includes the CQA of the soils and geosynthetic components of the liner and LCR systems for the subject facility. The CQA for the selection, evaluation, and placement of the soils is included in the scope. This document is intended to be used in concert with the CQC requirements presented in the project specifications.

## 1.5. UNITS

In this CQA Plan, all properties and dimensions are expressed in U.S. units.

## 1.6. REFERENCES

The CQA Plan includes references to the most recent version of the test procedures of the American Society of Testing and Materials (ASTM), the Federal Test Method Standards (FTMS), the "Standards for Flexible Membrane Liners" of the National Sanitation Foundation (NSF), and the "Geosynthetic Research Institute" (GRI).

## 1.7. SITE AND PROJECT CONTROL

To guarantee a high degree of quality during installation, clear, open channels of communication are essential. To that end, meetings are critical.

### 1.7.1. CQA/CQC Resolution Meeting

Prior to field mobilization by the Contractor, a Resolution Meeting will be held. This meeting will include all parties then involved, including the Project Manager, the CQA Consultant, the Engineer, the Contractor, and the CQC Consultant.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems which might cause difficulties and delays in construction, and, above all, review the CQA and CQC Plans to all of the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all.

This meeting should include all of the following activities:

- communicate to all parties any relevant documents;
- review critical design details of the project;
- review the seam layout drawing provided by the Geomembrane/Geosynthetic Installer.
- review the site-specific CQA and CQC Plans;
- make any appropriate modifications to the CQA and CQC Plans to ensure that they specify all testing activities that are necessary;
- reach a consensus on the CQA/CQC quality control procedures, especially on methods for determining acceptability of the soils and geosynthetics;
- review the proposed liner system and protective cover system;
- decide the number of spare seaming units for geomembranes to be maintained on site by the Geomembrane/Geosynthetic Installer (this number depends on the number of seaming crews and on the type of seaming equipment);
- select testing equipment and review protocols for testing and placement of general earthwork materials;
- confirm methods for the soil liner material selection testing, acceptable zone determinations, and test strip installation;
- confirm the methods for documenting and reporting, and for distributing documents and reports; and
- confirm the lines of authority and communication.

The meeting will be documented by the Project Manager and minutes will be transmitted to all parties.

### 1.7.2. CQA/CQC Preconstruction Meeting

A Preconstruction Meeting will be held at the site prior to placement of the geosynthetic liner system. At a minimum, the meeting will be attended by the Project Manager, Engineer, the CQA Consultant, the Contractor, the CQC Consultant, and the Geosynthetic/Geomembrane Installation Superintendent.

Specific topics considered for this meeting include:

- make any appropriate modifications to the CQA and CQC Plans;
- review the responsibilities of each party;
- review lines of authority and communication;

- review methods for documenting and reporting, and for distributing documents and reports;
- establish protocols for testing;
- establish protocols for handling deficiencies, repairs, and retesting;
- review the time schedule for all operations;
- establish rules for writing on the geomembrane, i.e., who is authorized to write, what can be written, and in which color;
- outline procedures for packaging and storing archive samples;
- review panel layout and numbering systems for panels and seams;
- establish procedures for use of the extrusion seaming apparatus, if applicable;
- establish procedures for use of the fusion seaming apparatus, if applicable;
- finalize field cutout sample sizes;
- review seam testing procedures;
- review repair procedures; and
- establish soil stockpiling locations (if any).

The meeting will be documented by the Project Manager and minutes will be transmitted to all parties. The Resolution Meeting and the Preconstruction Meeting may be held as one meeting or separate meetings, depending on the direction of the Project Manager.

### 1.7.3. Daily and Weekly CQA/CQC Progress Meetings

A weekly progress meeting will be held between the Project Manager, the CQA Consultant, the Contractor, the CQC Consultant, the Geosynthetic/Geomembrane Installation Superintendent, and representatives from any other involved parties. This meeting will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Consultant will log any problems, decisions, or questions arising at this meeting in his daily report. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties.

A daily meeting will be held between the CQA Consultant, the CQC Consultant, the Geosynthetic/ Geomembrane Installation Superintendent, and representatives from any other involved parties. This meeting will discuss current progress, planned activities for the next shift, and any new business or revisions to the work. The CQA Consultant will log any problems, decisions, or questions arising at this meeting in his daily report. Any matter requiring action which is raised in this meeting will be reported to the appropriated parties.

Meeting frequency will depend on the schedule of the project and the mutual agreement of all parties involved.

### 1.7.4. Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by all interested parties, the Contractor, the Project Manager, and the CQA Consultant. If the problem requires a design modification, the Engineer should also be present. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the Project Manager and minutes will be transmitted to affected parties.

# SECTION 2.0 SOIL LINER CONSTRUCTION QUALITY ASSURANCE

## 2.1. INTRODUCTION

This section of the CQA Plan addresses the soil components of the liner system, and outlines the soils CQA program to be implemented with regard to materials confirmation, laboratory and field confirmation test requirements, overview and interfacing with the Contractor's CQC Program, and resolution of problems.

## 2.2. EARTHWORK CONSTRUCTION

### 2.2.1. Subgrade

The subgrade material below the controlled fill will be prepared by the Contractor prior to the placement of fill. The CQC Consultant will provide density testing of the pre-fill subgrade at the frequency specified in the project specifications. The CQA Consultant will observe the proofroll by the Contractor, review the density test data provided by the CQC Consultant, and provide verification that the pre-fill subgrade is acceptable. The CQA Consultant may conduct confirmation density testing as deemed appropriate.

### 2.2.2. Structural/Controlled Fill

The Contractor shall place fill in accordance with the project specifications. The CQC Consultant shall provide testing of the controlled fill material in accordance with the project specifications. The CQA Consultant will provide confirmation testing of the controlled fill as deemed appropriate.

## 2.3. SOIL LINER SYSTEM

### 2.3.1. Soil Liner Subgrade

Testing will be conducted by the CQC Consultant as observed by the CQA Consultant. The subgrade material below the subbase is composed of controlled fill and in situ soils. The surface of the subgrade will be prepared prior to the construction of the subbase. The CQA Consultant will visually examine the surface of the subgrade to verify that any potentially deleterious materials have been removed.

### 2.3.2. Soil Liner Material

The soil liner material shall be placed and compacted in accordance with the project specifications. The CQC Consultant shall conduct field density and moisture tests at the frequency presented in the project specifications. The CQA Consultant shall provide conformance tests at a frequency of approximately 10 percent of the required CQC tests. Additional CQA conformance testing may be performed at the discretion of the CQA Consultant.

Hydraulic Conductivity, Atterberg Limits, and Percent Fines testing of the soil liner material shall be performed by the CQC Consultant in accordance with the project specifications. Additional CQA conformance testing may be performed at the discretion of the CQA Consultant.

Thickness measurement shall be conducted in accordance with the project specifications by the CQC Consultant and observed by the CQA Consultant.

## 2.4. SOILS TESTING

### 2.4.1. Test Methods

All testing used to evaluate the suitability or conformance of soils materials will be carried out in accordance with the project specifications.

### 2.4.2. Soils Testing Requirements

The soil CQC testing must comply with the minimum frequencies presented in the project specifications. The frequency of CQA testing required will be determined by the CQA Consultant in light of the potential variability of materials and the acceptance/failure rate of the CQC testing.

## 2.5. SOILS CONSTRUCTION QUALITY ASSURANCE

CQA will be performed on all soil components of the liner construction. CQA evaluation will consist of: (1) monitoring the work and observing the CQC testing; and (2) performing laboratory and field conformance tests. Laboratory CQA conformance tests will be conducted on samples taken at the borrow source, stockpile, and during the course of the work prior to construction. Field CQA conformance tests will be conducted during the course of the work.

### 2.5.1. Monitoring

The CQA Consultant shall monitor and document the construction of all soil components. Monitoring the construction work for the subbase soil, and the soil component of the liner system, includes the following:

- observing CQC testing to determine the water content and other physical properties of the subbase and soil component of the liner system during compaction and compilation of the data;
- monitoring the loose thickness of lifts as placed;
- monitoring the action of the compaction and/or heavy hauling equipment on the construction surface (i.e., penetration, pumping, cracking. etc.); and
- monitoring the number of passes used to compact each lift.

### 2.5.2. Construction Quality Assurance Judgmental Testing

During construction, the frequency of conformance testing may be increased at the discretion of the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;

- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

### 2.5.3. Perforations in Soil Liner

Perforations that must be filled will include, but not be limited to, the following:

- nuclear density test probe locations;
- permeability sampling locations; and/or
- thickness checks.

Unless otherwise noted, or as directed by the Project Manager, all perforations of the subbase by probes or sample tubes will be backfilled in accordance with project specifications. The CQA Consultant will observe and confirm that adequate procedures are being employed.

### 2.5.4. Deficiencies

If a defect is discovered in the earthwork product, the CQC Consultant will immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQC Consultant will determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQC Consultant will define the limits and nature of the defect.

#### 2.5.4.1. NOTIFICATION

After determining the extent and nature of a defect, the CQC Consultant will notify the Project Manager, the CQA Consultant, and Contractor and schedule appropriate retests when the work deficiency is corrected. The CQA Consultant shall observe all retests on defects.

#### 2.5.4.2. REPAIRS AND RETESTING

The Contractor will correct the deficiency to the satisfaction of the CQA Consultant. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQC Consultant will develop and present to the Project Manager and CQA Consultant suggested solutions for approval.

All retests recommended by the CQC Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The CQA Consultant will verify that all installation requirements are met and that all submittals are provided.

# SECTION 3.0 GEOMEMBRANE LINER CONSTRUCTION QUALITY ASSURANCE

## 3.1. GEOMEMBRANE MANUFACTURER'S CERTIFICATION, AND CQA CONFORMANCE TESTING

### 3.1.1. Geomembrane Manufacturer's Certification

Compliance testing will be performed by the Geomembrane Manufacturer to demonstrate that the product meets the manufacturers' quality control and conformance test minimum standards for geomembrane specifications and exceeds the project specifications. Additional testing will be performed by the CQA Consultant for purposes of conformance evaluation. If the results of the Geomembrane Manufacturer's and the CQA Consultant's testing differ, the testing will be repeated by the CQA Consultant's laboratory, and the Geomembrane Manufacturer will be allowed to monitor this testing. The results of this latter series of tests will prevail, provided that the applicable test methods have been followed.

#### 3.1.1.1. RAW MATERIAL

Prior to the installation of any geomembrane material, the Geomembrane Manufacturer will provide the CQA Consultant and the CQC Consultant with the following information as a bound document with the individual sections clearly identified:

- the origin (Resin Supplier's name and resin production plant), identification (brand name, number), and production date of the resin;
- a copy of the quality control certificates issued by the Resin Supplier;
- reports on the tests conducted by the Geomembrane Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the project; and
- a statement that the percentage of reclaimed polymer added to the resin is in accordance with the project specifications.

The CQA Consultant will review these documents and report any discrepancies with the above requirements to the Project Manager.

#### 3.1.1.2. GEOMEMBRANE MANUFACTURING

Prior to the installation, the Geomembrane Manufacturer will provide the Contractor and the CQA Consultant with the following:

- a properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the project technical specifications, or equivalent;
- the sampling procedure and results of testing; and
- a certification that property values given in the properties sheet are minimum average roll values and are guaranteed by the Geomembrane Manufacturer.

The CQA Consultant will review these documents and verify that:

- the reported property values certified by the Geomembrane Manufacturer meet all of the project technical specifications;
- the measurements of properties by the Geomembrane Manufacturer are properly documented and that the test methods used are acceptable; and
- Report any discrepancies with the above requirements to the Project Manager.

#### 3.1.1.3. ROLLS AND SHEETS

Prior to shipment, the Geomembrane Manufacturer will provide the CQA Consultant and the CQC Consultant with a quality control certificate for each roll (HDPE geomembrane) or sheet (non-HDPE geomembrane) of geomembrane provided. The quality control certificate will be signed by a responsible party employed by the Geomembrane Manufacturer, such as the Production Manager. The quality control certificate will include:

- roll numbers and identification; and
- sampling procedures and results of quality control tests -- as a minimum, results will be given for thickness, tensile characteristics and tear resistance, evaluated in accordance with the methods indicated in the project specifications or equivalent methods approved by the Engineer.

The quality control certificate will be bound and included as part of the report required in Section 3.1.1.1.

The CQA Consultant will:

- verify that the quality control certificates have been provided at the specified frequency and that each certificate identified the rolls or sheets related to it;
- review the quality control certificates and verify that the certified roll or sheet properties meet the project technical specifications; and
- report any discrepancies with the above requirements to the Project Manager.

## 3.2. GEOMEMBRANE INSTALLATION

### 3.2.1. Transportation, Handling, and Storage

#### 3.2.1.1. TRANSPORTATION AND HANDLING

The CQA Consultant will verify that:

- handling equipment used on the site is adequate, meets manufacturer’s recommendations, and does not pose any risk of damage to the geomembrane; and
- the Geomembrane Installer's personnel handle the geomembranes with care.

Upon delivery at the site, the CQA Consultant will conduct a surface observation of all rolls and sheets for defects and damage. This examination will be conducted without unrolling rolls or unfolding sheets unless defects or damages are found or suspected. The CQA Consultant will indicate to the Project Manager:

- any rolls or sheets, or portions thereof, that should be rejected and removed from the site because they have severe flaws; and
- any rolls or sheets that have minor repairable flaws.

Refer to ASTM D4873 for detailed methods.

#### 3.2.1.2. STORAGE

The CQA Consultant will document that the Contractor's storage of the geomembrane provides adequate protection against moisture, dirt, shock, and other sources of damage or contamination.

### 3.2.2. Earthwork

#### 3.2.2.1. SURFACE PREPARATION

The CQC Consultant and the Geomembrane Installer will certify in writing that the surface on which the geomembrane will be installed meets line and grade, and the surface preparation requirements of the project specifications. The certificate of acceptance will be given by the CQC Consultant to the CQA Consultant prior to commencement of geomembrane installation in the area under consideration. The CQA Consultant will give a copy of this certificate to the Project Manager.

To ensure a timely covering of the soil liner surface, the Project Manager may allow subgrade acceptance in areas as small as one acre. After the supporting soil has been accepted by the Geomembrane Installer, it will be the Geomembrane Installer's responsibility to indicate to the Project Manager of any change in the supporting soil condition that may require repair work. If the CQA Consultant concurs with the Geomembrane Installer, then the Project Manager will ensure that the supporting soil is repaired.

#### 3.2.2.2. ANCHORAGE SYSTEM

The CQA Consultant will verify that anchor trenches have been constructed and backfilled according to project specifications and design drawings.

### 3.2.3. Geomembrane Placement

#### 3.2.3.1. FIELD PANEL IDENTIFICATION

The CQA Consultant will document that the Geomembrane Installer labels each field panel with an "identification code" (number or letter-number consistent with the layout plan) agreed upon by the CQC Consultant, Geomembrane Installer, and CQA Consultant at the CQA/CQC Preconstruction Meeting, Section 1.7.2.

The Geomembrane Installer will establish a table or chart showing correspondence between roll numbers and field panel identification codes. This documentation shall be submitted to the CQC Consultant and CQA Consultant weekly for review and verification. The field panel identification code will be used for all quality control and quality assurance records.

#### 3.2.3.2. FIELD PANEL PLACEMENT

##### 3.2.3.2.1. Location

The CQA Consultant will verify that field panels are installed at the location indicated in the Geomembrane Installer's layout plan, as approved or modified in Section 3.2.3.1.

#### 3.2.3.2.2. Installation Schedule

The CQA Consultant will evaluate every change in the schedule proposed by the Geomembrane Installer and advise the Project Manger on the acceptability of that change. The CQA Consultant will verify that the condition of the supporting soil has not changed detrimentally during installation.

The CQA Consultant will record the identification code, location, and date of installation of each field panel.

#### 3.2.3.2.3. Placement of Geomembrane

The CQA Consultant will verify that project specification related restrictions on placement of geomembrane are fulfilled. Additionally, the CQA Consultant will verify that the supporting soil has not been damaged by weather conditions.

The CQA Consultant will inform the Project Manager if the above conditions are not fulfilled.

#### 3.2.3.2.4. Damage

The CQA Consultant will visually observe each panel, after placement and prior to seaming, for damage. The CQA Consultant will advise the Project Manager which panels or portion of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected will be marked and their removal from the work area recorded by the CQA Consultant. Repairs will be made according to procedures described in the project specifications.

As a minimum, the CQA Consultant will document that:

- the panel is placed in such a manner that it is unlikely to be damaged; and
- any tears, punctures, holes, thin spots, etc., are either marked by the Geomembrane Installer for repair or the panel is rejected.

## 3.2.4. Field Seaming

#### 3.2.4.1. SEAM LAYOUT

The Geomembrane Installer will provide the CQA Consultant with a seam layout drawing, i.e., a drawing of the facility to be lined showing all expected seams. The CQA Consultant and Engineer will review the seam layout drawing and verify that it is consistent with the accepted state of practice and this CQA Plan. In addition, no panels not specifically shown on the seam layout drawing may be used without the Project Manager's prior approval.

A seam numbering system compatible with the panel numbering system will be agreed upon at the Resolution and/or Preconstruction Meeting, Section 1.7. An on-going written record of the seams and repair areas shall be maintained by the Geomembrane Installer with weekly review by the CQA Consultant.

#### 3.2.4.2. REQUIREMENTS OF PERSONNEL

The Geomembrane Installer will provide the CQA Consultant with a list of proposed seaming personnel and their experience records. This document will be reviewed by the Project Manager and the CQA Consultant for compliance with project specifications.

#### 3.2.4.3. SEAMING EQUIPMENT AND PRODUCTS

Field seaming processes must comply with project specifications. Proposed alternate processes will be documented and submitted to the CQA Consultant for his approval. Only seaming apparatus which have been specifically approved by make and model will be used. The CQA Consultant will submit all documentation to the Engineer for his concurrence.

#### 3.2.4.4. NONDESTRUCTIVE SEAM CONTINUITY TESTING

The Geomembrane Installer will nondestructively test all field seams over their full length using test methods approved by the project specifications. The CQA Consultant shall periodically observe the nondestructive testing to ensure conformance with this CQA Plan and the project specifications.

For approximately 10% of the noncomplying tests, the CQA Consultant will:

- observe continuity testing of the repaired areas performed by the Geomembrane Installer;
- confirm the record location, date, test unit number, name of tester, and compile the record of testing provided by the Geomembrane Installer;
- provide a walkthrough inspection of all impacted seam areas and verify that the areas have been tested in accordance with the CQA Plan and project specifications; and
- verify that the Geomembrane Installer has marked repair areas with the appropriate color-coded marking pencil.

#### 3.2.4.5. DESTRUCTIVE SEAM TESTING

Destructive seam tests will be performed by the CQC consultant at locations and a frequency in accordance with the project specifications. The CQA Consultant will perform conformance tests on a minimum of 10% of the CQC destructive seam test samples obtained. Additional destructive seam tests may be required at the CQA Consultant's discretion. Selection of such locations may be prompted by suspicion of contamination, excessive grinding, off-center and/or offset seams, or any other potential cause of imperfect seaming.

##### 3.2.4.5.1. Geosynthetics Construction Quality Assurance Laboratory Testing

Destructive test samples will be packaged and shipped by the CQA Consultant in a manner that will not damage the test sample. The Project Manager will be responsible for storing the archive samples. These procedures will be fully outlined at the Resolution Meeting, Section 1.7. Test samples will be tested by the Geosynthetics CQA Laboratory.

Conformance testing will include "Seam Strength" and “Peel Adhesion" (ASTM D638 using one-inch strips and a strain rate of two inches per minute) in accordance with ASTM D4437 and project specifications. All geomembrane destructive test samples that fail to meet project specifications shall be saved and sent to the CQA Consultant for observation.

The Geosynthetics CQA Laboratory will provide preliminary test results no more than 24 hours after they receive the samples. The CQA Consultant will review laboratory test results as soon as they become available.

#### 3.2.4.5.2. Defining Extent of Destructive Seam Test Failure

All defective seam test failures must be bounded by seam tests from which destructive samples passing laboratory tests have been taken. The CQA Consultant will document repair actions taken in conjunction with all destructive seam test failures.

### 3.2.5. Defects and Repairs

All seams and nonseam areas of the geomembrane will be examined by the CQC Consultant for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Each suspected location, both in seam and nonseam areas, will be nondestructively tested using methods in accordance with the project specifications. Each location which fails the nondestructive testing will be marked by the CQC Consultant and repaired by the Geomembrane Installer. Repair procedures will be in accordance with project specifications or procedures agreed to by the Project Manager in the preconstruction meeting. The CQA Consultant will observe all repair procedures and advise the Project Manager of any problems.

### 3.2.6. Backfilling of Anchor Trench

Anchor trenches will be will be backfilled and compacted as outlined in the project specifications. The CQA Consultant will review the backfilling operation and advise the Project Manager of any problems.

### 3.2.7. Liner System Acceptance

The Geomembrane Installer and the Geosynthetic Manufacturers will retain all ownership and responsibility for the geosynthetics in the landfill cell until acceptance by the Owner.

The geomembrane component of the liner system will be accepted by the Owner when:

- the installation is finished;
- verification of the adequacy of all seams and repairs, including associated testing, is complete;
- CQC Consultant provides the CQA Consultant and Project Manager with a final copy of the nondestructive test documentation, repair information, and as-built drawings.
- CQA Consultant furnishes the Project Manager with certification that the geomembrane was installed in accordance with the Geosynthetic Manufacturer's recommendations as well as the Plans and project specifications;
- all documentation of installation is completed including the CQA Consultant's final report; and
- certification by the CQA Consultant, including Record Drawing(s), sealed by a Professional Engineer registered in the state in which the project is located, has been received by the Project Manger.

The CQA Consultant will certify that the installation has proceeded in accordance with this CQA Plan and the project specifications for the project except as noted to the Project Manager.

### 3.2.8. Materials in Contact with Geomembranes

The quality assurance procedures indicated in this Subsection are only intended to assure that the installation of these materials does not damage the geomembrane. Although protective geosynthetics and geotextiles have been incorporated into the liner system, all reasonable measures to protect the geomembrane and provide additional quality assurance procedures are necessary to assure that systems built with these materials will be constructed to ensure proper performance.

#### 3.2.8.1. SOILS

Prior to placement, the CQA Consultant will visually confirm that all soil materials to be placed against the geomembrane comply with project specifications. The Geomembrane Installer will provide the CQA Consultant a written surface acceptance certificate in accordance with Section 3.2.1. All soil materials shall be placed and compacted in accordance with project specifications.

#### 3.2.8.2. SUMPS AND APPURTENANCES

The CQA Consultant will verify that:

- installation of the geomembrane in appurtenance areas, and connection of the geomembrane to appurtenances have been made according to the project specifications;
- extreme care is taken while seaming around appurtenances since neither nondestructive nor destructive testing may be feasible in these areas;
- the geomembrane has not been visibly damaged while making connections to appurtenances;
- The installation of the geomembrane shall be exercised so as not to damage sumps; and
- the CQA Consultant will inform the Project Manager if the above conditions are not fulfilled.

# SECTION 4.0 LCR CONSTRUCTION QUALITY ASSURANCE

## 4.1. INTRODUCTION

This section of the CQA plan addresses the sand and gravel drains, and the soil buffer layer of the LCR system. By reference to Sections 5.0 and 6.0 of this CQA Plan, this section also addresses the perforated plastic pipes and geotextile filters and cushions that are included in the LCR system. This section outlines the CQA program to be implemented with regard to materials confirmation, laboratory and field test requirements, overview and interfacing with the Contractor's CQC Program, and resolution of problems.

## 4.2. GRANULAR LEACHATE COLLECTION SYSTEM

### 4.2.1. Protective Cover (Leachate Collection Layer) Material

The LCR layer shall be placed and compacted in accordance with the project specifications. The CQC Consultant will provide gradation and density testing of the granular material at the frequency specified in the project specifications. The CQA Consultant will observe that placement of the granular material is done in a manner to protect the geomembrane, and review the gradation and density test data provided by the CQC Consultant. The CQA Consultant may conduct confirmation gradation and density testing as deemed appropriate.

### 4.2.2. Sump and LCR Pipe Drain Material

The drain material placed in the sumps and surrounding the LCR drainage pipe shall be placed in accordance with the project specifications. The CQC Consultant will provide gradation and mineralogical testing of the gravel material at the frequency specified in the project specifications. The CQA Consultant will observe that placement of the gravel is done in a manner to protect the geomembrane and plastic pipe and review the gradation and density test data provided by the CQC Consultant. The CQA Consultant may conduct confirmation gradation and additional testing as deemed appropriate.

## 4.3. RELATED MATERIALS

### 4.3.1. Geotextile Cushion and Filter Material

The geotextile cushion placed beneath the sand drainage layer, and the geotextile filter placed between the sand drainage layer and the soil buffer layer shall be placed in accordance with project specifications. The CQA program for these materials is presented in Section 5.0 of this CQA Plan.

### 4.3.2. High Density Polyethylene (HDPE) Pipe Material

The perforated HDPE pipe placed within the gravel drain material shall be placed in accordance with project specifications. The CQA program for this material is presented in Section 6.0 of this CQA Plan.

### 4.3.3. Soil Buffer Layer Material

The soil buffer layer material shall be placed and compacted in accordance with project specifications. The CQC Consultant will provide classification testing of the material at the frequency specified in the project specifications. The CQA Consultant will observe that the placement of the soil buffer is done in a manner to protect the filter geotextile and review the classification data provided by the CQC Consultant. The CQA Consultant may conduct confirmation classification testing as deemed appropriate.

## 4.4. MATERIALS TESTING

### 4.4.1. Test Methods

All testing used to evaluate the suitability or conformance of LCR materials will be carried out in accordance with the project specifications.

### 4.4.2. Material Testing Requirements

The material CQC testing must comply with the minimum frequencies presented in the project specifications. The frequency of CQA testing will be determined by the CQA Consultant in light of the potential variability of the materials and the acceptance/failure rate of the CQC testing.

## 4.5. LCR CONSTRUCTION QUALITY ASSURANCE

CQA will be performed on all components of the LCR system construction. CQA evaluation will consist of: (1) monitoring the work and observing the CQC testing, and (2) performing laboratory and field conformance tests. Laboratory CQA conformance tests will be conducted on samples taken at the borrow source, stockpile, and during the course of work prior to construction. Field conformance tests will be conducted during the course of the work.

### 4.5.1. Monitoring

The CQA Consultant shall monitor and document the construction of all LCR components. Monitoring the construction work for the natural materials of the LCR system includes the following:

- reviewing CQC testing for gradation and other physical properties of the natural materials and compilation of the data;
- monitoring the minimum vertical buffer maintained between field equipment and the geomembrane; and

- monitoring the placement of the natural materials does not fold or damage the geomembrane in any way.

### 4.5.2. Deficiencies

If a defect is discovered in the earthwork product, the CQC Consultant will immediately determine the extent and nature of the defect and report it to the CQA Consultant. If the defect is indicated by an unsatisfactory test result, the CQC Consultant will determine the extent of the

deficient area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate.

#### 4.5.2.1. NOTIFICATION

After determining the extent and nature of a defect, the CQC Consultant will notify the Project Manager and Contractor and schedule appropriate retests when the work deficiency is corrected. The CQA Consultant shall observe all retests on defects.

#### 4.5.2.2. REPAIRS AND RETESTING

The Contractor will correct the deficiency to the satisfaction of the CQA Consultant. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQC Consultant will develop and present to the Project Manager suggested solutions for his approval.

All retests recommended by the CQC Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The CQA Consultant will verify that all installation requirements are met and that all submittals are provided.

# SECTION 5.0 GEOTEXTILE MATERIAL AND INSTALLATION QUALITY ASSURANCE

## 5.1. MANUFACTURING

The Contractor will provide the CQA Consultant with a list of guaranteed “minimum average roll value" properties (as defined by the Federal Highway Administration), for the type of geotextile to be delivered. The Contractor will also provide the CQA Consultant with a written certification from the Geotextile Manufacturer that the materials actually delivered have "minimum average roll value" properties which meet or exceed all property values guaranteed for that type of geotextile.

The CQA Consultant will examine all manufacturer certifications to ensure that the property values listed on the certifications meet or exceed those specified for the particular type of geotextile. Any deviations will be reported to the Project Manager.

The inspection methods, handling techniques, and property values identified in this section for the filter geotextile shall also apply to geotextile portion of the geocomposite drain which will be heat bonded to the geonet (see Section 7.0 for more detail).

## 5.2. LABELING

The Geotextile Manufacturer will identify all rolls of geotextile in conformance with the project specifications. The CQA Consultant will examine rolls upon delivery and any deviation from the above requirements will be reported to the Project Manager.

## 5.3. SHIPMENT AND STORAGE

During shipment and storage, the geotextile will be protected as required by manufacturer’s recommendations and the project specifications. The CQA Consultant will observe rolls upon delivery at the site and any deviation from the above requirements will be reported to the Project Manager.

## 5.4. HANDLING AND PLACEMENT

The Geosynthetic Installer will handle all geotextiles in such a manner as required by the project specifications. Any noncompliance will be noted by the CQA Consultant and reported to the Project Manager.

## 5.5. SEAMS AND OVERLAPS

All geotextiles will be seamed or overlapped in accordance with project specifications or as approved by the CQA Consultant and Engineer.

## 5.6. REPAIR

Any holes or tears in the geotextile will be repaired in accordance with the project specifications. The CQA Consultant will observe any repair and note any noncompliance with the above requirements and report them to the Project Manager.

## 5.7. PLACEMENT AND MATERIALS

All soil materials located on top of a geotextile shall be placed in accordance with the project specifications. Any noncompliance will be noted by the CQA Consultant and reported to the Project Manager.

# SECTION 6.0 HIGH DENSITY POLYETHYLENE MANHOLES, PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

## 6.1. MATERIAL REQUIREMENTS

All HDPE manholes, pipe, and fittings shall be produced in accordance with the project specifications.

## 6.2. MANUFACTURER

Prior to the installation of HDPE manholes or pipes, the Manufacturer will provide to the Contractor and the CQA Consultant the following:

- a properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the project technical specifications;
- a list of quantities and descriptions of materials other than the base resin which comprise the pipe;
- the sampling procedure and results of testing; and
- a certification by the HDPE Pipe Manufacturer that values given in the properties sheet are minimum values and are guaranteed by the HDPE Pipe Manufacturer.

The CQA Consultant will review these documents and verify that:

- the property values certified by the HDPE Pipe Manufacturer meet all of the project technical specifications; and
- the measurements of properties by the HDPE Pipe Manufacturer are properly documented and that the test methods used are acceptable.
- Report any discrepancies with the above requirements to the Project Manager.

### 6.2.1. Verification and Identification

Prior to shipment, the Contractor will provide the Project Manager and the CQA Consultant with a quality control certification for each lot/batch of HDPE pipe provided. The quality control certificate will be signed by a responsible party employed by the HDPE Pipe Manufacturer, such as the Production Manger. The quality control certificate will include:

- lot/batch number and identification; and
- sampling procedures and results of quality control tests.

The CQA Consultant will:

- verify that the quality control certificates have been provided at the specified frequency for all lots/batches of pipe, and that each certificate identifies the pipe lot/batch related to it; and

- review the quality control certificates and verify that the certified properties meet the project technical specifications.

## 6.3. NONDESTRUCTIVE TESTING

### 6.3.1. Nondestructive Testing of Joints

All nonperforated HDPE joints must be nondestructively tested. These pipe joints will be tested using the pressure test as provided in the project technical specifications. Other nondestructive test methods may be used only when:

- the Geosynthetic Installer can prove its effectiveness;
- the method is approved by the Pipe Manufacturer; and
- the method is approved by the Engineer.

The Project Manager and the CQA Consultant will verify the effectiveness and validity of the alternative test method,

The CQA Consultant will report any nonconformance of testing methods to the Project Manager.

# SECTION 7.0 HDPE GEONET CONSTRUCTION QUALITY ASSURANCE

## 7.1. MATERIAL REQUIREMENTS

All HDPE geonet shall be produced in accordance with the project specifications.

## 7.2. MANUFACTURING

The Geonet Manufacturer will provide the Contractor and the CQC Consultant with a written certification, signed by a responsible party, that the geonets actually delivered have properties which meet or exceed the guaranteed properties.

The CQA Consultant will examine all manufacturers' certifications to ensure that the property values listed on the certifications meet or exceed the project specifications. Any deviations will be reported to the Project Manager.

## 7.3. LABELING

The Geonet Manufacturer will identify all rolls of geonet in accordance with project specifications. The CQA Consultant will examine rolls upon delivery and any deviation from the above requirements will be reported to the Project Manager.

## 7.4. SHIPMENT AND STORAGE

Geonet cleanliness is essential to its performance; therefore, the shipping and storage of geonet must be in accordance with the project specifications. The CQA Consultant will examine rolls upon delivery and any deviation from the above requirements will be reported to the Project Manager.

The CQA Consultant will verify that geonets are free of dirt and dust just before installation. The CQA Consultant will report the outcome of this verification to the Project Manager; and, if the geonets are judged dirty or dusty, they will be washed by the Geonet Installer prior to installation.

Washing operations will be observed by the CQA Consultant and improper washing operations will be reported to the Project Manager.

## 7.5. HANDLING AND PLACEMENT

The Geonet Installer will handle all geonets in a manner in accordance with the project specifications. The CQA Consultant will note any noncompliance and report it to the Project Manager.

## 7.6. STACKING AND JOINING

When several layers of geonets are stacked, care should be taken to ensure that stacked geonets are placed in the same direction. A stacked geonet will never be laid in perpendicular directions to the underlying geonet (unless otherwise specified by the Engineer). The CQA

Consultant will observe the stacking of geonets and will note any noncompliance and report it to the Project Manager.

Adjacent geonets will be joined according to construction drawings and project specifications. The CQA Consultant will note any noncompliance and report it to the Project Manager.

## 7.7. REPAIR

Any holes or tears in the geonet will be repaired in accordance with project specifications. The CQA Consultant will observe any repair, note any noncompliance with the above requirements, and report them to the Project Manager.

## 7.8. PLACEMENT OF SOIL MATERIALS

All soil materials placed over the geonet should be placed in accordance with project specifications so as to ensure:

- the geonet and underlying geomembrane are not damaged;
- minimal slippage of the geonet on the underlying geomembrane occurs; and
- no excess tensile stresses occur in the geonet.

Any noncompliance will be noted by the CQA Consultant and reported to the Project Manager.

# SECTION 8.0 GEOSYNTHETIC CLAY LINER (GCL) MATERIAL AND INSTALLATION QUALITY ASSURANCE

## 8.1. MANUFACTURING

The Contractor will provide the CQA Consultant with a list of guaranteed “minimum average roll value” properties (as defined by the Federal Highway Administration) for the GCL to be delivered. The Contractor will also provide the CQA Consultant with a written certification from the GCL Manufacturer that the materials actually delivered have “minimum average roll value” properties which meet or exceed all property values guaranteed for the GCL.

The CQA Consultant will examine all manufacturer certifications to determine if the property values listed on the certifications meet or exceed those specified for the GCL. Any deviations will be reported to the Engineer.

## 8.2. LABELING

The GCL Manufacturer will identify all rolls of GCL in conformance with the project specifications. The CQA Consultant will examine rolls upon delivery and any deviation from the above requirements will be reported to the Engineer.

## 8.3. SHIPMENT AND STORAGE

During shipment and storage, the GCL will be protected as required by the project specifications. The CQA Consultant will observe rolls upon delivery at the site and any deviation from the above requirements will be reported to the Engineer.

## 8.4. HANDLING AND PLACEMENT

The Geosynthetic Installer will handle the GCL in such a manner as required by the project specifications. Any noncompliance will be noted by the CQA Consultant and reported to the Engineer.

## 8.5. SEAMS AND OVERLAPS

The GCL will be seamed or overlapped in accordance with project specifications or as approved by the CQA Consultant and Engineer.

## 8.6. REPAIR

Any holes or tears in the GCL will be repaired in accordance with the project specifications. The CQA Consultant will observe any repair and note any noncompliance with the above requirements and report them to the Engineer.

## 8.7. PLACEMENT AND MATERIALS

All soil materials located on top of the GCL shall be placed in accordance with the project specifications. Any noncompliance will be noted by the CQA Consultant and reported to the Engineer.

# SECTION 9.0 SURVEYING CONSTRUCTION QUALITY CONTROL

## 9.1. INTRODUCTION

Surveying of lines and grades is conducted on an ongoing basis during construction of the component liner and leachate collection systems. Close CQC of the surveying is absolutely essential to ensure that slopes are properly constructed. The surveying conducted at the site shall be performed by the Contractor.

## 9.2. SURVEY CONTROL

Permanent benchmarks and baseline control points are to be established for the site at locations convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards.

## 9.3. SURVEYING PERSONNEL

The Contractor's survey crew will consist of a Senior Surveyor, and as many Surveying CQC Monitors as are required to satisfactorily undertake the requirements for the work. All Surveying CQC personnel will be experienced in the provision of these services, including detailed, accurate documentation.

All surveying will be performed under the direct supervision of a Registered Professional Engineer (PE) or Licensed Land Surveyor (PLS) licensed in the state in which the project is located. The Licensed Land Surveyor may be the Senior Surveyor.

## 9.4. PRECISION AND ACCURACY

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01 foot and with a setting accuracy of 20 seconds. ($5.6 \times 10^{-3}$ degrees).

## 9.5. LINES AND GRADES

The following surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include (as deemed appropriate by the Engineer and CQA Consultant):

- one or more construction baselines;
- a working grid with a sufficient number of benchmarks;
- surface of the subgrade;
- all existing structures;
- surface of the soil liner component;

invert elevation of and location of leachate collection/header and force main piping at each lateral intersection and endpoint, and every 50 feet between the intersections and endpoints;

- inverts of sumps and manholes;
- surface of the leachate collection layer (protective cover);
- elevations of and locations of temporary berms;
- top/toe of all perimeter berms, roads, and channels;

location of edge of liner, tie-in seam to adjacent existing liner system (as applicable);

- corners/intersections of all geosynthetic rolls or panels; and
- location of anchor trenches.

Laser planes are highly recommended for achieving the correct lines and grades during construction of each surface.

## 9.6. FREQUENCY AND SPACING

All surveying will be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks, as determined by the Senior Surveyor, CQA Consultant, or Project Manager, during construction may be necessary to assist the Contractor in complying with the required grades.

The following spacings and locations will be provided by the CQC Surveyor, as a minimum, for survey points:

- surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than 100 feet;
- on slopes greater than 10 percent, a square grid not wider than 100 feet will be used, but, in any case, a line of survey points at the crest, midpoint, and toe of the slope will be taken;
- a line of survey points no farther than 100 feet apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope);
- a line of survey points not farther than 50 feet apart will be taken for all piping used for leachate collection/detection lines, in particular, at the lateral intersection and line end points;
- at a minimum, a line of survey points no farther than 50 feet apart will be taken for all cleanout risers;
- at a minimum, every 100 feet along the perimeter of the primary and secondary liner system; and
- at a minimum, a line of survey points no farther than 50 feet apart will be taken for all piping used for the leachate collection/detection lines.

## 9.7. THICKNESS MEASUREMENTS

The CQC surveyor as a representative of the Contractor shall obtain top and bottom elevations of the soil liner at a maximum 100-foot grid points and at all grade break lines prior to placement of the geomembrane liner system. The procedure for obtaining top and bottom elevations of the soil liner shall be agreed to by the CQA Consultant and Engineer prior to construction. The CQC Surveyor shall review the survey information with the Contractor to ensure that the survey

demonstrates compliance with the project technical specifications. The Contractor is responsible for identifying and reporting to the CQA Consultant any areas of non-compliance evidenced by the survey, and for repairing such areas. The CQA Consultant and Contractor shall review the thickness measurements of the soil liner component prior to placement of the geomembrane liner.

## 9.8. TOLERANCES

Except for liner components where no minus tolerances are acceptable, the following are maximum tolerances for survey points:

- on surfaces, the maximum tolerances shall be 0.2 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation;
- on piping for leachate collection/detection lines, the maximum tolerance shall be 0.02 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation; and
- on cleanout risers, the tolerance shall be 0.2 foot  This tolerance must be set to the record elevation of the surface below it and not the design elevation.

## 9.9. DOCUMENTATION

All field survey notes will be retained by the Senior Surveyor. The results from the field surveys will be documented on a set of Survey Record (As-Built) Drawings by the Contractor for submittal to the CQA Consultant. The Contractor shall certify to the CQA Consultant and Engineer that the results of the survey demonstrates compliance with the Contract Documents. These drawings shall, at a minimum, show the final elevations and locations of all surfaces and appurtenances surveyed in Subsection 2.5 of this CQA/CQC Plan. Record drawings shall be signed and sealed by a registered land surveyor in the State of North Carolina. Additionally, an electronic file (i.e., Autocad) shall be submitted to the Engineer.

# SECTION 10.0 CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

## 10.1. DOCUMENTATION

An effective CQA plan depends largely on recognition of all construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality

assurance activities. The CQA Consultant will document that all quality assurance

requirements have been addressed and satisfied.

This CQA plan integrates the testing and inspection performed by the CQC Consultant in accordance with the project specifications with the CQA overview and conformance testing performed by the CQA Consultant, in accordance with this CQA Plan.

The CQA Consultant will provide the Project Manager with the CQC Consultant's daily and weekly reports including signed descriptive remarks, data sheets, and logs to verify that all CQC monitoring activities have been carried out. The CQA Consultant will also provide the Project manager with a weekly report summarizing CQA activities and identifying potential quality assurance problems. The CQA Consultant will also maintain at the job site a complete file of Plans, Reports, project specifications, a CQA Plan, checklists, test procedures, daily logs, and other pertinent documents.

## 10.2. RECORDKEEPING

The CQC Consultant's reporting procedures will include preparation of a daily report which, at a minimum, will consist of: a) field notes, including memoranda of meetings and/or discussions with the Contractor; b) observation logs and testing data sheets; and c) construction problem and solution data sheets. The daily report must be completed at the end of each CQC Consultant's shift, prior to leaving the site. This information will be submitted weekly to and reviewed by the CQA Consultant.

The CQC Consultant's weekly reports must summarize the major events that occurred during that week. Critical problems that occur shall be communicated verbally to the Project Manager or CQA Consultant immediately as well as being included in the weekly reports. The CQC Consultant's weekly report must be submitted to the CQA Consultant no later than the Monday following the week reported.

The CQA Consultant's weekly report must summarize the CQC Consultant's weekly and daily reports, CQA conformance testing activities, construction problems that occurred, and the resolution of construction problems. The CQA Consultant's weekly report should identify all potential or actual compliance problems outstanding. The CQA Consultant's weekly report must be submitted to the Project Manager on the Wednesday following the week reported.

### 10.2.1. Memorandum of Discussion with CQC Consultant or Geosynthetic Installer

A report will be prepared summarizing each discussion between the CQA Consultant and the CQC Consultant or Geosynthetic Installer. At a minimum, the report will include the following information:

- date, project name, location, and other identification;
- name of parties to discussion at the time;
- relevant subject matter or issues;
- activities planned and schedule; and
- signature of the CQA Consultant.

### 10.2.2. CQA Observation Logs and Testing Data Sheets

CQA observation logs and conformance testing data sheets will be prepared by the CQA Consultant on a weekly basis. At a minimum, these logs and data sheets will include the following information:

- an identifying sheet number for cross referencing and document control;
- date, project name, location, and other identification;
- data on weather conditions;
- a reduced-scale Site Plan showing all proposed work areas and test locations;
- descriptions and locations of ongoing construction;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- off-site materials received, including quality verification documentation;
- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality; and the CQA Consultant's signature.

### 10.2.3. CQA Construction Problem and Solution Data Sheets

CQA sheets describing special construction situations will be cross-referenced with specific CQA observation logs and testing data sheets, and must include the following information, where available:

- an identifying sheet number for cross referencing and document control;
- a detailed description of the situation or deficiency;
- the location and probable cause of the situation or deficiency;
- how and when the situation or deficiency was found or located;
- documentation of the response to the situation or deficiency;
- final results of any responses;
- any measures taken to prevent a similar situation from occurring in the future; and
- the signature of the CQA Consultant, and signature of the Project Manager indicating concurrence if required by this CQA Plan.

The Project Manager will be made aware of any significant recurring nonconformance with the project specifications. The Project Manager will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specification. When this type of evaluation is made, the results will be documented, and any revision to procedures or project specifications will be approved by the Owner and Engineer.

## 10.3. CQA PHOTOGRAPHIC REPORTING DATA SHEETS

Photographic reporting data sheets, where used, will be cross-referenced with CQA observation logs and testing data sheets and/or CQA construction problem and solution data sheets. Photographs shall be taken at regular intervals during the construction process and in all areas deemed critical.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain color prints in chronological order. These records will be presented to the Project Manager upon completion of the project.

In lieu of photographic documentation, videotaping may be used to record work progress, problems, and mitigation activities. The Project Manager may require that a portion of the documentation be recorded by photographic means in conjunction with video taping.

## 10.4. DESIGN AND/OR PROJECT TECHNICAL SPECIFICATION CHANGES

Design and/or project specification changes may be required during construction. In such cases, the CQA Consultant will notify the Project Manager and the Engineer. The Project Manager will then notify the appropriate agency, if necessary.

Design and/or project specification changes will be made only with the written agreement of the Project Manager and the Engineer, and will take the form of an addendum to the project specifications. All design changes shall include a detail (if necessary) and state which detail it replaces in the plans.

## 10.5. CQA PROGRESS REPORTS

The CQA Consultant will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information;

- a unique identifying sheet number for cross-referencing and document control;
- the date, project name, location, and other information;
- a summary of work activities during progress reporting period;
- a summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period;
- summary of all test results, failures and retests, and signature of the CQA Consultant.

## 10.6. SIGNATURE AND FINAL REPORT

At the completion of each major construction activity at the landfill unit, the CQA Consultant will certify all required forms, observation logs, field and laboratory testing data sheets including sample location plans, construction problems and solution data sheets. The CQA Consultant will also provide a final report which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information.

The CQA Consultant will also provide summaries of all the data listed above with the report. The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the Record Drawings will be done by the Construction Surveyor. These documents will be certified by the Contractor and CQC Consultant and delivered to the CQA Consultant and included as part of the CQA documentation (Certification) report.

It may be necessary to prepare interim certifications, as allowed by the regulatory agency to expedite completion and review.

## 10.7. STORAGE OF RECORDS

All handwritten data sheet originals, especially those containing signatures, will be stored by the Project Manager in a safe repository on site. Other reports may be stored by any standard method which will allow for easy access. All written documents will become property of the Owner.

**Operation Plan**

# White Street Sanitary Landfill - Phase III

Project No. 06770-137686-018

Permit 41-12

*Greensboro, North Carolina*

**October 2014**

# 5.0 OPERATION PLAN

## 5.1. Introduction

The purpose of this section is to identify protocols for the overall operation and maintenance of the White Street Sanitary Landfill – Phase III, which is owned and operated by the City of Greensboro under North Carolina Department of Environment and Natural Resources (NCDENR) Permit 41-12. The landfill, which is located at the east end of White Street and is currently permitted to accept municipal solid waste generated within the City of Greensboro and Guilford County. This plan has been prepared in accordance with Rule .1625 and provides details of the procedures and policies which currently are, or shall be, implemented throughout the life of the City of Greensboro's White Street Sanitary Landfill – Phase III. Detailed drawings for each phase of the landfill's development are provided in the approved Construction Permit Application. Figures 5-2 and 5-3, illustrating the existing conditions, fill plan, and final build out for Phase III, are provided at the end of this Operation Plan.

## 5.2. Standard Operating Procedures

### 5.2.1. Hours and Days of Operation

The landfill is at present, and is anticipated to be, open for operation between the hours of 7:50 AM and 4:50 PM, Monday through Friday, and from 7:00 AM and 1:00 PM on Saturday. The landfill is normally closed on Sundays except where prior permission has been given to receive waste for special instances such as a natural disaster. The observed holidays are New Year's Day, Martin Luther King Jr. Day, Good Friday, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, and Christmas Day.

Special notices are posted at the scalehouse advising users of observed holidays. Such notices are posted at least one week in advance of the holiday.

### 5.2.2. Traffic Routing

An entrance sign is posted stating the facility name, permit number, and operating hours. Additional signs are posted for allowable speed limit and directional signs indicating the location of the disposal area.

All trucks entering the landfill to dispose of solid waste are weighed at one of two (2) 70' x 10' inbound scales at the scalehouse. Regular users may not be weighed upon leaving if vehicle tare weights are known.

Automobiles and low-sided pickup trucks are required to weigh in; however, the Scale Attendant(s) controls access to the landfill to prevent abuse and misuse. A designated area at the working face is set aside for these small vehicles to dispose of solid waste. This area is separated from the area being used by the City and private haulers.

Internal roads are hard surface or gravel and are maintained to be passable in all weather by all vehicles so that operation areas and units are accessible.

The total length of roadway from the entrance to the scales and from the scales to the disposal area is approximately 1,400 feet. This provides sufficient queuing distance for trucks during the peak traffic periods.

Perimeter roads and operational access roads have been built to allow for two-way truck traffic. The operational access road on the fill has been developed with branch roads extending from the exterior to the interior. A level area for truck turning will be maintained ahead of the active disposal area. The trucks come in via the access road, dump their load, turn around, and exit via the access road.

The approach to the working face is maintained such that two or more vehicles may safely unload side-by-side. A vehicle turn-around area large enough to enable vehicles to arrive and turn around safely with reasonable speed is provided adjacent to the unloading area. The vehicles back to a vacant area near the working face to unload. Upon completion of the unloading operation, the transportation vehicles immediately leave the working face area. Personnel direct traffic as necessary to expedite safe movement of vehicles.

### 5.2.3. Litter Control

Litter control is a prime requisite in the proper operation of the landfill. In order to control litter and windblown debris, the working face is kept as small as possible and waste is compacted soon after it is unloaded. Cover material is applied daily. If required, portable litter fences will be utilized downwind of and in close proximity to the working areas to catch blowing litter. The area around the working face and the property in general is routinely checked and the litter removed on a regular basis.

### 5.2.4. Odor, Dust, and Noise Control

Odors which emanate from solid waste as it is placed and compacted are generally limited to within a short distance of the working face. The covering of waste on a daily basis prevents odors from becoming a nuisance.

The access road from the scalehouse to the landfill unit is paved; all other service roads on the operating landfill are graded as necessary to maintain smooth, well-drained surfaces. During extended dry periods, operating roads may be sprayed with water to reduce dust problems. Regular maintenance of soil stockpiles, including frequent wetting or temporary seeding, serves to limit the generation of wind blown dust. Similarly, frequent wetting of on-site roads prevents truck traffic from creating dust.

Noise resulting from landfill equipment is limited to the period of time during operating hours. To reduce the nuisance of noise to neighbors or the administrative function of the landfill, a buffer of trees and other vegetation is maintained between the operating areas and other areas not designated for landfill operations. All on-site equipment is equipped with mufflers or similar noise-dampening devices. Equipment operators, drivers, and other operating personnel will be trained in the use of equipment in an effort to minimize noise generation. These efforts help to ensure that noise does not become a nuisance problem to neighbors or to the administrative function of the landfill.

### 5.2.5. Inclement Weather Operations

During periods of heavy rainfall, the working face is kept as close to the landfill service roads as practical.

### 5.2.6. Personnel Structure

Responsibility for overall facility management and operation rests with the Solid Waste Disposal Manager. This individual is designated as the contact person for matters related to regulatory compliance, and is responsible for providing adequate personnel and equipment in order to operate the facility in accordance with the approved permit documents and the North Carolina Solid Waste Management Rules and Solid Waste Management Law.

Landfill supervisory staff includes the Landfill Supervisor, and the Scalehouse Supervisor. In addition to the supervisory staff, the City has twelve other permanent staff available for operations at the landfill. These staff positions include a two person environmental staff that oversees waste screenings, load inspections, groundwater wells maintenance, and methane gas monitoring.

The Scale Attendant(s), stationed at the scalehouse at the site entrance, is responsible for maintaining complete and accurate records of vehicles and visitors entering and leaving the facility. The Scale Attendant(s) also visually inspects incoming vehicles to the extent that the loads are covered properly and determines if the load is acceptable.

An equipment operator doubles as a truck spotter directs incoming vehicles to the proper location to unload refuse at the working face. The primary function of the spotter is to prevent unloading in areas that are not designated for disposal and to visually inspect all loads as they are dumped to assure compliance with posted operating rules. A traffic controller is located at the working face to direct vehicles to the location where the waste is to be unloaded.

Equipment operators are responsible for the safe operation of site equipment. As the personnel most closely involved with the actual landfill operation, these employees are responsible for identifying any potentially dangerous conditions, monitoring waste for unauthorized or hazardous materials, as well as careless or improper actions on the part of other persons while on the premises, and reporting such observations immediately to the Landfill Supervisor and the environmental specialist. Other services such as sediment basin maintenance, construction, site clean-up, etc. may be contracted to outside firms on a temporary basis.

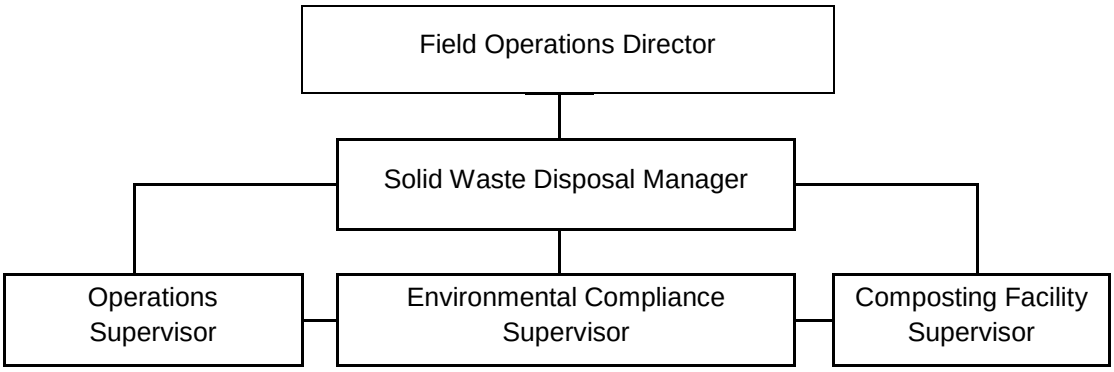
### 5.2.7. Personnel Training

The Landfill Manager shall be a certified Manager of Landfill Operations (MOLO) by the Solid Waste Association of North America (SWANA) as required by GS 130A-309.25. In addition, the landfill will maintain SWANA Landfill Operations certification as required. As part of this training, personnel learn to recognize loads which may contain regulated hazardous waste or wastes containing PCB's. Landfill personnel are all trained in safety procedures for fire fighting, first aid, CPR, and the handling of hazardous materials.

### 5.2.8. Management Authority

The management authority, or chain of command, for decisions regarding landfill operation is depicted in Figure 5-1.

**Figure 5-1 White Street Sanitary Landfill Organization Chart**




### 5.2.9. Equipment Requirements

Equipment requirements may vary in accordance with the method or scope of landfill operations at any given time. Additional or different types of equipment may be provided as necessary to enhance operational efficiency. The types and sizes of equipment currently in use at the White Street Sanitary Landfill are presented in Table 5-1.

**Table 5-1 Current Equipment Inventory**

| Description | Make/Model | No. | Comment |
|---|---|---|---|
| Landfill Compactor | 836C Cat | 3 | |
| Bulldozer | D8N Cat | 2 | |
| Grader | 140G Cat | 1 | |
| Loader | WA250-1 Komatsu<br>FR20B Fiat Allis | 1<br>1 | |
| Off-road haul trucks | Cat D-400 | 3 | |
| Excavator | Samsung 100,000 lb class | 1 | |
| Water Truck | International | 1 | 3500 gallon capacity w/external fire hose |
| Dump Truck | Sterling | 1 | On Road |
| Other Trucks | F350D HD Ford 1994<br>C3400 Chevrolet<br>S-10 Four wheel drive Chev. | 1<br>1<br>1 | Dump bed maintenance truck<br>Fuel Truck<br>Maintenance |

| Description | Make/Model | No. | Comment |
|---|---|---|---|
| Other (specify): | New Holland | 1 | Farm Tractor |
| | John Deere 2355 | 1 | Farm Tractor |
| | 7’ bush hog | 1 | Mower |
| | 16’ bat wing bush hog | 1 | Mower |
| | Polaris 700 | 1 | ATV |
| | Bobcat | 1 | ATV |
| | Polaris | 1 | ATV |

## 5.3. Waste Screening Programs

In order to assure that prohibited wastes are not entering the landfill facility, screening programs have been implemented at the White Street Sanitary Landfill. Waste received at both the scalehouse entrance and waste taken to the working face is inspected by trained personnel. These individuals have been trained to spot indications of suspicious wastes, including: hazardous placarding or markings; liquids; powders or dusts; sludges; bright or unusual colors; drums or commercial size containers; and chemical odors. Screening programs for visual and olfactory characteristics of prohibited wastes are an ongoing part of the landfill operation. These programs are implemented in accordance with Rule .1626 Part (1) (f).

### 5.3.1. Waste Receiving and Inspection

All vehicles must stop at the scalehouse located at the entrance of the landfill facility and visitors are required to sign-in. All refuse transportation vehicles are weighed and the content of the load assessed. Any materials which pose health hazards, cause fire, or which could impact negatively on the environment are deemed unacceptable. The Scale Attendant(s) requests from the driver of the vehicle entering the landfill a description of the waste it is carrying to ensure that unacceptable waste is not allowed into the landfill. The Attendant(s) then visually checks the vehicle as it crosses the scale. Signs are conspicuously posted informing users of the acceptable and unacceptable types of waste.

Each day trucks hauling commercial and industrial loads of waste are selected for screening at random. A minimum of one percent of the waste stream (by weight) will be inspected for liquid waste, hazardous waste, PCB waste, and other banned items. Selected vehicles are directed to a lined area separate from the working face where the vehicle will be unloaded. Waste is carefully spread using suitable equipment. An attendant trained to identify wastes that are unacceptable at the landfill inspects the waste discharged at the screening site.

If waste is detected which is suspected to be unauthorized liquid waste (liquids in containers or non-bulk/non-containerized liquids other than household wastes), the attendant will perform a paint filter test on a sample of the suspect waste. The paint filter test will be performed as follows:

- a 100 milligram sample of waste will be placed in a conical, 400 micron paint filter;
- if liquid passes through the paint filter in five minutes, the conclusion that the waste contains free liquid will be made.

If unacceptable waste is found, including wastes generated from outside of Guilford County, the load will be isolated and secured by berming off the area. The Solid Waste Disposal Manager or the Landfill Supervisor will then notify the following official of the NCDENR Division of Waste Management (DWM) within 24 hours of attempted disposal of any waste the landfill is not permitted to receive in order to determine the proper course of action (it should be noted that the hauler is responsible for removing unacceptable waste from the landfill property):

Mr. Hugh Jernigan
Waste Management Specialist
585 Waughtown Street
Winston-Salem, NC 27107
(336) 771-5000

The following records are kept on-site to document all inspections:

- The date and times wastes were received for inspection
- Source and type of wastes
- Vehicle and driver identification
- All observations made by the inspector
- Final disposition of waste after inspection

### 5.3.2. Prohibited Waste Types

The following wastes are prohibited from disposal within a municipal solid waste landfill (MSWLF) unit:

- Whole Scrap Tires
- Used Oil
- White Goods
- Antifreeze (ethylene glycol)
- Lead Acid Batteries
- Yard Trash
- Regulated Asbestos Waste (friable)
- Wooden Pallets
- Aluminum Cans
- Certain Rigid Plastic Containers
- Plastic Bottles
- Motor Vehicle Oil Filters
- Discarded Computer Equipment
- Televisions
- Beverage Containers that are required to be recycled
- Oyster Shells

In addition, operating criteria prohibit other materials from disposal at the MSWLF unit. These criteria address the following types of waste:

- Hazardous waste as defined within 15A NCAC 13A, including hazardous waste from conditionally exempt small quantity generators.
- Polychlorinated biphenyls (PCB) wastes as defined in 40 CFR 761.
- Bulk or non-containerized liquid wastes unless the waste is household waste other than septic waste and waste oil; or the waste is leachate or gas condensate derived from the MSWLF unit, whether it is a new or existing MSWLF unit or lateral expansion, is designed with a composite liner and leachate collection system.
- Containers holding liquid wastes unless the container is a small container similar in size to that normally found in household waste; the container is designed to hold liquids for use other than storage; or the waste is household waste.
- Wastewater treatment sludges unless they are used as a soil conditioner and incorporated or applied to the vegetative growth layer (at a depth no greater than six inches).

### 5.3.3. Hazardous Waste Contingency Plan

This plan is developed to meet the requirements of the North Carolina Administrative Code 13B.1626 (1) (f) (iv). The White Street Sanitary Landfill does not accept any liquid or hazardous waste. Active measures are taken to insure that hazardous materials do not enter the landfill. These include signage, customer screening, radiation scanning and load inspections.

This plan establishes procedures that must be taken to minimize hazards to human health and the environment caused by sudden, non-sudden, or unplanned explosion, fire, discovery, or release of an unknown or hazardous material to the air, soil, surface water, or ground water.

#### 5.3.3.1. FACILITY IDENTIFICATIONS AND GENERAL INFORMATION

**Name:** The City of Greensboro
Field Operations Department
Division of Solid Waste Disposal
White Street Landfill

**Location:** 2503 White Street
Greensboro, North Carolina 27405

**Mailing Address**: PO Box 3136
Greensboro, NC 27402-3136

**Telephone:** (336) 373-7770 (Administration Office)
(336) 412-3959 (Landfill Operations)
(336) 587-3445 (Landfill Operations Cell Phone)

#### 5.3.3.2. FACILITY TYPE

A municipal solid waste landfill with the following operations on-site: (a) MSWLF disposal sites (active and closed), (b) construction and demolition debris landfill, (c) yard waste composting facility, (d) heavy equipment maintenance garage, (e) fuel dispensing station (automated), (f) administrative offices and scale facility, (g) storage facility, (h) two phase landfill gas system.

The White Street Sanitary Landfill is not a RCRA Hazardous Waste generator or disposer. Used oil generated in the maintenance garage is pumped out of the aboveground storage tank and sent for recycling. Any hazardous materials encounter on this site will be as a result of an attempt to improperly dispose of materials banned from this site or materials exempt from regulation.

#### 5.3.3.3. PERSONAL TRAINING

Facility personnel are properly instructed in the operation and maintenance of all equipment used to prevent discharges from the site. Personnel receive training upon employment and annual refreshers. The Contingency Plan is reviewed and updated annually.

#### 5.3.3.4. EMERGENCY COORDINATORS

| Primary Emergency Coordinator | | Business Phone | Cellular |
|---|---|---|---|
| Solid Waste Disposal Manager<br>711 N. Church Street<br>Greensboro, NC 27401 | | (336) 412-3959 | (336) 587-3445 |

| Secondary Emergency Coordinators | | Business Phone | Cellular |
|---|---|---|---|
| Operations Supervisor<br>760 Boone Station Dr. Apt C<br>Burlington, NC 27215 | | (336) 373-7616 | (336) 337-0571 |
| Environmental Compliance Supervisor<br>3605 A Lynhaven Dr<br>Greensboro, NC 27406 | | (336) 373-7662 | (336) 254-8096 |
| Composting Facility Supervisor<br>3379 Rebecca Dr.<br>Summerfield, NC 27358 | | (336) 373-7659 | (336) 430-2359 |

#### 5.3.3.5. EMERGENCY PHONE NUMBERS

| | |
|---|---|
| Fire and/or Hazmat | 911 or 373-2222 |
| Police | 911 or 373-2222 |
| Emergency Medical Service | 911 |
| Emergency Management (Greensboro/Guilford Co.) | 336-641-2278 or 336-574-4082 |
| Emergency Response (NCDENR) | 1-800-858-0368 |
| NCDENR DWM (Winston-Salem Regional Office) | 336-771-5000 |
| NC Department of Labor – OSHA | (919) 779-8560 or 1-800-625-2267 |
| CHEMTREC | (800) 262-8200 or<br>(800) 424-9300 (Emergency Number) |
| National Response Center | 1-800-424-8802 or 202-267-2675 |
| Medical Services (City of Greensboro) | 336-373-2412 |
| Moses Cone Hospital (Emergency Department) | 336-832-8040 |

#### 5.3.3.6. EMERGENCY RESPONSE PROCEDURES

In the event that hazardous or suspicious materials are detected at the landfill, the following steps will be taken:

NOTIFICATION:

The individual discovering the situation will immediately notify the Administrative Building. The operator receiving the call will immediately notify the Emergency Coordinator.

The Emergency Coordinator shall assess the situation and take action as necessary. In the event of an actual emergency situation, the Emergency Coordinator must immediately:

1. Notify all landfill personnel
2. Evacuate personnel and customers to a safe location, as appropriate
3. Require transporter to remain at facility, as appropriate
4. Implement the appropriate Action Plan (see appendix)
5. Notify Greensboro Fire Department Hazmat Team if appropriate
6. Notify NCDENR DWM, Solid Waste Section
7. If the Emergency Coordinator has determined that the facility has had a release, fire or explosion that could threaten human health, or the environment, outside the facility, then the NCDENR Emergency Management Center (1-800-858-0368) and the National Response Center (1-800-424-8802) must be notified as follows:

   Report should include the following information:

   a. Name and telephone number of reporter
   b. Name and address of facility
   c. Time and type of incident (release, fire, etc.)

d. Name and quantity of material involved
e. The extent of injuries, if any
f. Possible hazards to human health, or the environment, outside the facility
g. Corrective actions taken or planned

#### 5.3.3.7. FOLLOW-UP

The Emergency Coordinator will ensure that, after a hazardous materials emergency has occurred, all recovered waste, contaminated soil and water will be disposed of in accordance with EPA guidelines.

The Emergency Coordinator will see that all materials used in the containment or cleanup are replaced in a timely manner.

The Emergency Coordinator will also ensure that an investigation be conducted to determine the cause of the incident and the steps will be taken to prevent its reoccurrence.

The Emergency Coordinator shall notify NCDENR within 24 hours of an attempted disposal of any waste the landfill is not permitted to receive, including waste from outside the area the landfill is permitted to serve. Within five days of the incident, the Emergency Coordinator must submit a written report to the NCDENR, DWM, Solid Waste Section. The report must include the following:

a. The name, address, and telephone umber of the facility
b. The name, address and telephone number of the transporter
c. The name address and telephone number of the waste generator
d. When the incident took place
e. Who was responsible for responding the incident (Hazmat Team, Environmental Clean-up contractor, etc.)
f. The response actions taken
g. The extent of human injuries caused by the incident
h. An assessment of harm to both human health and environment
i. The amount of materials recovered and disposed of the incident
j. Additionally, the report should contain documentation of calls of notification to the state or EPA as appropriate.
k. Note preventative measures, if any, and historical incidents at the site.

#### 5.3.3.8. APPENDIX

Hazardous or Suspect Materials Action Plan

1. The employee who discovers hazardous or suspected waste shall see that all personnel, customers and visitors are evacuated a safe distance upwind from the waste. Then;
2. Notify the Emergency Coordinator. The Emergency Coordinator will notify the Emergency Team.
3. The Emergency Coordinator shall assess the situation and determine if an emergency exists and the appropriate action.
4. The transporter of the material will be instructed to remain on the landfill.

5. If the Emergency Coordinator determines an emergency exists, the Greensboro Police/Fire communications shall be notified and request a response from the Hazmat Team.
6. Lead operators will be responsible for a “roll call” in their area, as well as accounting for customers and visitors. The lead operators will report personnel status to the Landfill Supervisor immediately. If anyone is injured and unable to evacuate him or herself from the hazard area, this shall be reported immediately. In order to prevent additional causalities, rescue will be the responsibility of Fire and/or EMS personnel and will not be attempted by landfill personnel.
7. Due to the landfill waste disposal activities being considered an essential and critical function of the City of Greensboro, should a spill or release of material occur, interrupting the normal operation of the landfill or transfer station, a secondary disposal area will be opened as soon as possible to allow disposal operations to continue. Selection of an alternative disposal area will be based on distance from spill area, wind direction and any other factors that will affect safety.
8. Containment and clean up of hazardous materials shall be the responsibility of GFD Hazmat and the owner of the material. Landfill personnel are not trained to attempt containment or cleanup of hazardous materials.

Radiation Emergency Action Plan

1. If the radiation detectors located on either Scale 1 or Scale 2 goes to alarm mode (>1000 cpm) the scale operator will instruct the driver to turn off all unnecessary electrical components on his vehicle. If the detector continues to alarm, the driver will be instructed to move his vehicle to the paved road leading to the Operations Building. Once the driver has moved his vehicle to the road and parked it halfway between the scalehouse and the Operations Building, he/she will secure the vehicle, abandon the vehicle, and report to the scalehouse.
2. The scale operator shall notify the Emergency Coordinator.
3. All personnel will be kept a safe distance from the vehicle.
4. The Emergency Coordinator will notify GFD Hazmat (373-2222), Greensboro/Guilford County Emergency Management (641-2278) and NCDENR Emergency Management (1-800-858-0368).
5. Containment, cleanup and removal of material shall be the responsibility of GFD Hazmat and the owner of the material.

## 5.4. Waste Disposal

Solid waste transportation vehicles arrive at the working face at random intervals. There may be a number of vehicles unloading waste at the same time, while other vehicles are waiting. In order to maintain control over the off loading of waste, a certain number of vehicles are allowed on the working face at a time. The actual number is determined by the truck spotter. This procedure is used in order to minimize the potential of off loading non-acceptable waste and to control disposal activity. Operations at the working face are conducted in a manner which will encourage the efficient movement of transportation vehicles to and from the working face and expedite the unloading of solid waste.

Solid waste unloading at the landfill is controlled to prevent disposal in locations other than those specified by site management. Such control is also used to confine the working face to a minimum width, yet allow safe and efficient operations. The width of the working face is maintained as small as practical in order to maintain the appearance of the site, control windblown waste, and minimize the amount of cover soil required each day. Normally, only one working face is active on any given day, with all deposited waste in other areas covered by either daily, intermediate cover or final cover, as appropriate.

Other services such as sediment basin maintenance, construction, site clean-up, etc. may be contracted to outside firms on a temporary basis.

The sequence of fill will proceed uphill from the low end, subcell by subcell. Using multiple lifts allows filling to occur uniformly across the subcells, eliminates depressed areas and facilitates movement of storm water off site. Less extreme elevation differences occur during construction when using multiple lifts. Waste disposal activities are expected to start on the western side of the landfill and progress east across the landfill.

All putrescible solid waste delivered to the working face, such as spoiled foods, animal carcasses, abattoir waste, hatchery waste, and other animal waste, is covered immediately. Asbestos waste is not accepted at the landfill.

Use of portable signs with directional arrows and portable traffic barricades facilitates the unloading of wastes to the designated disposal locations. These signs and barricades are placed along the access route to the working face of the landfill or other designated disposal areas which may be established.

## 5.5. Spreading and Compacting

The procedures for the placement of waste in the landfill include the unloading of trucks, checking of waste for fire, the even spreading of waste, and compaction using the landfill compactor equipment in layers not to exceed eighteen inches in depth. These layers are applied to construct a lift of approximately ten (10) feet in depth after compaction. Cover material will be placed over the compacted waste at the end of each day. The size of the working face, where unloading, spreading, and compacting takes place, will be limited to allow for the most efficient use of cover material.

## 5.6. Cover Requirements

A significant volume of soil is required to provide for the cover requirements of the White Street Sanitary Landfill. In order to provide for these requirements, on-site borrow areas are excavated in stages to keep pace with the demand for soil. The borrow areas are located south of the entrance road. During normal operations material is excavated, loaded, hauled and then placed over the waste. The development of large stockpiles which result in double handling of materials is avoided. However, stockpiling of material may be necessary prior to the winter when excavating materials is more difficult due to colder, wetter weather. Off-site soil or alternative cover may be used to reduce the on-site requirements for soil cover.

### 5.6.1. Daily Cover

In accordance with Rule .1626 (2)(a) disposed solid waste is covered with six inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging.

On weekends and holidays the lift face will be covered with six inches of compacted soil.

The White Street Sanitary Landfill has an adequate quantity of acceptable earth cover for routine operations.

### 5.6.2. Intermediate Cover

Intermediate cover consisting of a total thickness of twelve inches is applied to all areas which will not have wastes placed on them for 12 months or more, but where final termination of disposal operation has not occurred. The areas which have received intermediate cover are graded to prevent ponding and temporary grass cover is planted. Any erosion or other damage which has occurred to the intermediate cover is repaired on a routine basis. Litter fences are installed to reduce blowing litter.

## 5.7. Disease Vector Control

The need for extensive disease vector control (control of rodents, flies, mosquitoes, or other animals, including insects, capable of transmitting disease to humans) is minimized through proper site operation, including on-going compaction and application of daily and final cover. If vector problems develop that require control beyond the measures indicated above, appropriate measures will be taken.

## 5.8. Explosive Gases Control

Landfill gases are the product of solid waste decomposition under anaerobic conditions. The quantity and types of gas generated depend on the type of waste disposed of. The largest amount of gas generated is generally from waste containing a high percentage of readily degradable organic matter. The rate of generation depends mainly on the moisture content, temperature, and particle size of the waste and the age of the fill. High temperature and moisture content, along with small particle size, tend to result in higher gas production. Gas production from a landfill can last from two to 100 years, but generally peaks after approximately five years, if the moisture content is not limited. Landfill gases predominately consist of methane and carbon dioxide. Initially, the gas is mostly carbon dioxide with methane production beginning later; however, the gas eventually reaches approximately 50% methane by volume.

A gas monitoring system has been constructed along the perimeter of the landfill. All buildings and enclosed structures on the landfill are monitored as part of a routine methane monitoring program.

The LFG collection system was designed in accordance with the Environmental Protection Agency (EPA) NSPS criteria and the NSPS GCCS Design Plan for the facility dated November 2006 and was expanded in the first half of 2010. The GCCS meets the following NSPS design objectives (§60.752(b)(2)(ii)).

- The collection system is sized to handle the maximum expected LFG flowrate for the landfill area that warrants control over the lifetime of the LFG collection system.
- The system collects LFG from each cell in the landfill in which solid waste has been placed for a period of two years or more in a closed area, or five years or more in an active area.
- The system collects LFG at a sufficient extraction rate while not causing air infiltration, which has the potential promote a subsurface fire.
- The system is designed to minimize off-site migration of subsurface LFG.
- Surface methane emissions are maintained below 500 ppm above the background concentration.
- LFG wellheads have sampling ports to allow for monitoring required by NSPS.

The LFG collection system in Phase III supplies LFG to a 12-inch diameter LFG+E flare with a design capacity of 1,500 scfm. Vacuum is provided to the LFG collection system through the use of two positive displacement blowers manufactured by Tuthill; each with 150-hp motors. Each blower has a maximum flow rating of 1,500 scfm.

The utility flares are equipped with an autodialer, wind shroud, a propane pilot flame system, and a thermocouple. Operation of the flares is monitored at a control panel located adjacent to the flare pad. The control station is capable of start-up and shutdown activities as well as recording the flow rates and temperature of gas to the flare.

The blower/flare skids are also equipped with manual and automatic isolation valves. If the flares shut down, programmable logic controllers close the valve that feeds the flares. The automatic valves are integrated with the system controls to help prevent the free venting of uncombusted LFG at the control device for the safety of on-site personnel, the public and the environment.

The LFG can also be transported via underground piping to Cone Denim, Inc. (Cone) for use in their operations. The flare stations are used to combust excess LFG not utilized in the boiler systems at Cone.

### 5.8.1. Methane Monitoring Program

The City of Greensboro will continue to conduct routine methane monitoring events to ensure that methane concentrations do not exceed 25% of the lower explosive limit (LEL) in facility structures or 100% of the LEL at property boundaries, as required in Rule 1626 (4). Methane wells and locations along North Buffalo Creek will continue to be monitored quarterly as part of the program.

If concentrations are measured at greater than 25 percent of the LEL for methane in facility structures then the City will immediately take all necessary steps to ensure protection of human

health and shall notify the Division of Waste Management. Within seven days of detection, the methane gas levels detected and a description of the steps taken to protect human health shall be placed in the operating record. Within sixty days of detection, a remediation plan describing the nature and extent of the problem and the proposed remedy for methane gas releases shall be placed in the operating record, the remediation plan shall be implemented, and the Division of Waste Management shall be notified that the remediation plan has been implemented.

### 5.8.2. Sampling Procedures

The monitoring device that will be used during each quarterly monitoring event will be a portable combustible gas indicator. This is equipped with a flexible hose and rigid probe. Calibration of the instrument will be performed in accordance with the manufacturer's specifications.

Personnel designated to perform the monitoring program will be trained in the operation, maintenance, and calibration of the monitoring equipment. The following operating procedures and safety precautions will be adhered to by all personnel when monitoring for methane gas.

1. At least two people should be present at all times when monitoring for explosive gases.
2. At a minimum, safety glasses, gloves, work boots, will be worn. Other appropriate personal protective equipment will be worn as needed.
3. Smoking and open flames are strictly prohibited at all times during the monitoring event.
4. Fire extinguishers will be readily available when performing the monitoring event.
5. Personnel performing the monitoring event will have the City radio readily available as it has direct access to emergency personnel.

### 5.8.3. Emergency Response Plan

In the event gas levels are detected that exceed allowable limits, the emergency response plan will be as follows.

1) For 100% LEL at landfill boundaries less than 250 feet from structures:
   a) Greensboro Fire Department and Hazardous Material Team will be notified.
   b) Implement procedures as outlined in Rule 1626 (4).
2) For 100% LEL at landfill boundaries where the distance is greater than 250 feet from structures:
   a) Notify the Division.
3) For structures detection levels greater than 25% LEL:
   a) Evacuate the structure immediately.
   b) Notify Greensboro Fire Department and Hazardous Material Team.

## 5.9. Air Criteria

In accordance with the State Implementation Plan developed under the Clean Air Act Section 110, open burning is prohibited at the site, unless approved by the Division for the infrequent burning of land clearing debris generated on site or debris from emergency clean-up operations. In order to control accidental fires from occurring at the site, the following preventative measures have been taken:

- The Scale Attendant(s) and equipment operators screen incoming waste loads for signs of hot loads, such as smoke, steam or heat being released from the waste, in order to prevent such loads from being off-loaded in the active area of the landfill.
- Smoking is confined to designated areas only, away form active areas of the landfill, fuel stations, methane collection and treatment equipment and other fire-sensitive areas.
- Motorized equipment is not parked near fuel stations longer than necessary for refueling.
- Fuel spills are contained by berming and cleaned up immediately using some type of absorbent material.
- Landfill equipment does not remain in the active area of the site overnight.
- Dead trees, brush, or vegetation adjacent to the landfill are removed immediately, and grass and weeds mowed so that brush fires cannot spread to the landfill. A mower/shredder is available to control grass and brush.

Fire fighting equipment is available on-site to control fires should they occur. In addition, all equipment is equipped with automatic fire extinguisher systems. In the event that additional fire protection be needed, the City of Greensboro Fire Department will be contacted immediately by dialing 911 to provide fire-fighting services. The Division of Waste Management will be notified verbally within 24 hours of any fire occurrence at the landfill, and written notification shall be submitted to the Division within 15 days of the fire incident.

## 5.10. Access and Safety Requirements

Entry to the site is limited to landfill personnel, approved waste haulers and properly identified persons whose entry is authorized by the site management. The City reserves the right to restrict access to the site. Visitors may be allowed near the active area only when accompanied by a site representative.

An entrance sign is posted stating the facility name, permit number and operating hours. Additional signage regulates traffic flow, provides information on dumping procedures, the type of waste the facility is permitted to receive as well as those wastes banned from disposal at the facility, and indicates the location of the disposal area.

Facility roads are maintained to be passable to ensure that all operation areas and units are accessible in all weather conditions. Dust control measures, including wetting or temporary seeding of soil stockpiles and wetting of on-site roads, are implemented when necessary.

All facilities are surrounded on all sides by natural barriers, fencing, or an equivalent means of controlling vehicular access and preventing illegal disposal. All access is limited by gates, and such gates are securable and equipped with locks.

Scavenging is not permitted at the landfill. If the volume of salvageable goods is sufficient, those items are set aside for salvage disposal by the City of Greensboro; however, under no circumstances are goods to be salvaged from the working face. Items stockpiled for possible salvage are maintained in a neat and orderly fashion.

Barrels and drums are not be disposed of unless they are empty and perforated sufficiently to ensure that no liquid or hazardous waste is contained therein.

## 5.11. Sedimentation and Erosion Control

The landfill is constructed with maximum 4:1 side slopes and minimum 12.5:1 top slopes to promote runoff and prevent ponding over or in the waste. Perimeter drainage channels at the toe of the slope provide runoff, erosion, and sediment control. The drainage channel allows for the movement of surface water from landfilling activities and provides a settling zone for sediments carried from the site. The channel is constructed to allow drainage via sediment basins through natural outfalls to North Buffalo Creek. In addition to the drainage channel, sediment basins, silt fences, slope drains, and sediment traps, temporary and permanent seeding will be used to mitigate sedimentation and erosion control problems. All measures will be constructed or installed in accordance with standards specified in the North Carolina Erosion and Sediment Control Planning and Design Manual.

Sediment basins will also prevent the discharge of pollutants that violate requirements of the Clean Water Act, including, but not limited to, NPDES requirements, into the waters and wetlands of the United States.

The landfill has a comprehensive surface and groundwater monitoring program to provide early detection of any leachate migration problems (refer to the Water Quality Monitoring Plan). In the event any constituents are detected above allowable limits, measures will be taken to begin assessing the extent of contamination. If necessary, corrective actions will be taken to prevent the pollution of waters and wetlands of the United States and to avoid violating any requirements of an area-wide or state-wide water quality management plan that have been approved under Section 208 or 319 of the Clean Water Act, as amended.

## 5.12. Leachate Management

A description of the leachate collection system can be found in the Facility Report Section 2.4.1 of the approved Construction Permit Application. The leachate collection system shall be inspected by remote camera and cleaned as outlined in NCGS §130A-295.6(h)(3). Any unusual fluctuation in leachate quantity or incident affecting the collection system shall trigger a complete inspection of the system. Records shall be kept indicating any maintenance performed on the system and all associated test results. Leachate samples shall be obtained semi-annually from the pump station for quality analysis. These results shall be forwarded to the treatment plant operator and maintained on-site for regulatory review. Provisions will be made for hauling leachate by truck should that become necessary. The leachate storage tank's final sizing shall be determined by the allowable discharge rate into a POTW pipeline and a minimum of one week emergency capacity. The emergency capacity is to account for repairs to system

pumps of discharge lines. The plan may be revised after any unexpected condition to reflect the appropriate action in the event of a recurrence.

The Division of Waste Management, Solid Waste Section will be notified verbally within 24 hours of any release occurrence at the landfill.

## 5.13. Record Keeping

The City of Greensboro maintains detailed records of all activities relating to the landfill. These records are either kept on site or at the office of the City's Public Works Department and include: types and quantities of waste received; source of waste received; revenue generated from waste received; applications for industrial waste disposal and related analyses; well water usage; results from surface and groundwater monitoring, landfill gas monitoring; leachate quantity and quality results; correspondence from regulatory agencies; accident reports; and reports of site and random load inspections. Table 5-2 provides a summary of the records kept, their frequency of completion, and the locations where the records are maintained.

**Table 5-2 Landfill Record Keeping**

| Type of Record | Frequency of Completion | Location Maintained |
|---|---|---|
| Waste quantities received | Daily | Landfill |
| Source of waste received | Daily | Landfill |
| Revenue from waste received | Daily | Landfill |
| Industrial waste applications and analyses | Before initial waste disposal and annually thereafter | Landfill |
| Employee Training and Certifications | As performed | Landfill |
| Surface and groundwater monitoring data | Semi-annually | Landfill |
| Related correspondence | As received | Landfill |
| Accident reports | After each occurrence | Landfill |
| Site inspections | Daily, quarterly, annually | Landfill |
| Results of random waste load inspections | After each inspection | Landfill |
| Gas monitoring results | Quarterly | Landfill |
| Leachate quality | Semi-annually | Landfill |
| Leachate quantity | Monthly | Landfill |
| Closure/ Post Closure estimate | Annually | Landfill |


N

GENERAL NOTES:

1. MAY 3, 2014 AERIAL SURVEY OBTAINED FROM BRADY SURVEYING CO., P.A.
2. ACCORDING TO PREVIOUS 2011 PERMIT AMENDMENT, COMPOSITE ASBUILT TOP OF OPERATIONAL COVER CONTOURS FOR CELL 1, 2, AND 3 RESPECTIVELY OBTAINED FROM:
   - 2.1. "WHITE STREET LANDFILL PHASE III EXPANSION CELL 1 CONSTRUCTION PLANS, TOP OF OPERATIONAL COVER RECORD DRAWING"
   - 2.2. ASBUILT SURVEY OF CELL 2 OF THE WHITE STREET LANDFILL 2/12/01.
   - 2.3. "ASBUILT WHITE STREET LANDFILL PHASE III EXPANSION CELL 3 NOVEMBER 2, 2004.
3. ACCORDING TO PREVIOUS 2011 PERMIT AMENDMENT, DESIGN TOP OF FINAL COVER GRADES OBTAINED FROM SEDIMENT AND CONTROL PLAN FOR THE WHITE STREET LANDFILL PHASE III EXPANSION CONSTRUCTION PERMIT APPLICATION, FINAL CONTOURS AND DRAINAGE PLAN, C-7A ISSUE A2.

PHASE III REMAINING CAPACITY

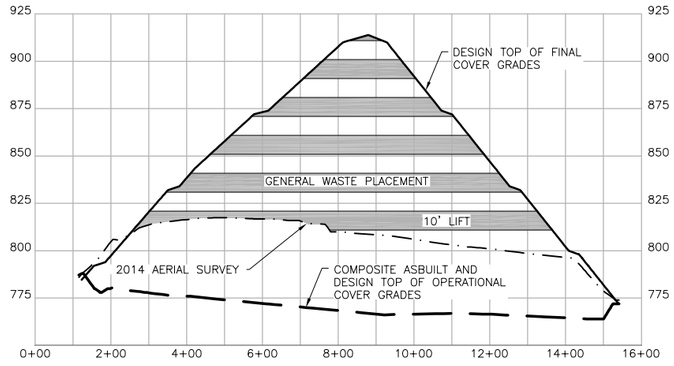
TOTAL OPERATING CAPACITY = 5,058,000 CY*
AIRSPACE CONSUMED TO DATE = 3,433,900 CY**
OPERATING AIRSPACE REMAINING = 1,624,100 CY**

* VOLUME EXCLUDES BASE LINER AND CAP LINER.

** AS OF MAY 3, 2014 SURVEY.

LEGEND

- EXISTING CONTOURS (MAY 3, 2014 AERIAL SURVEY)
- LINER LIMITS
- CELL BOUNDARY
- TREELINE
- FENCE




FILLING PLAN CROSS-SECTION AA' 00C-01

VERTICAL SCALE 1"=40' HORIZONTAL SCALE 1"=200'

FILLING PLAN NOTES:
10 FOOT LIFTS WILL BEGIN ON THE WESTERN SIDE OF THE LANDFILL AND PROGRESS TO THE EAST.

HDR Engineering, Inc. of the Carolinas
440 S Church Street, Suite 1000
Charlotte, NC 28202
704.338.6700
N.C.B.E.L.S. License Number F-0116

| ISSUE | DATE | DESCRIPTION |
|---|---|---|
| 0 | 10/2014 | FINAL DRAWING – FOR REVIEW PURPOSES ONLY |

| | |
|---|---|
| PROJECT MANAGER | M.D. PLUMMER, P.E. |
| | L. MCCAUL |
| | S. FUTRELL, P.E. |
| PROJECT NUMBER | 06770-137686-018 |

**WHITE STREET LANDFILL**
**PERMIT 41-12**
**PHASE III**
**PERMIT AMENDMENT**

**CITY OF GREENSBORO** **NORTH CAROLINA**

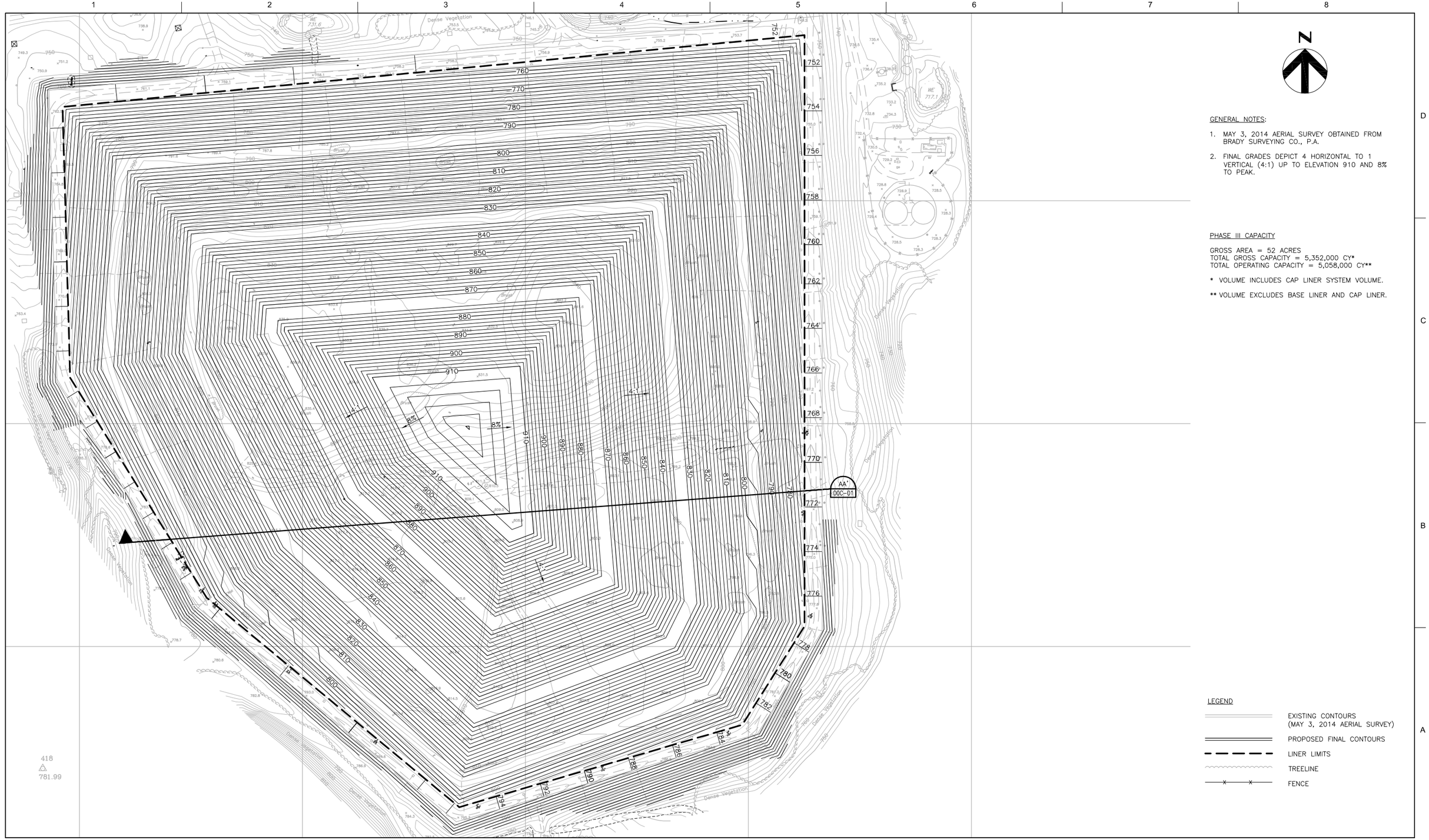
**EXISTING CONDITIONS & FILL PLAN**

0 1" 2"

FILENAME FIGURE 5-2.dwg
SCALE 1" = 100'

SHEET
**FIGURE 5-2**

C:\pwworking\tpa\d0618883\FIGURE 5-2.dwg, Plot, 10/10/2014 3:51:13 PM, jgaul




C:\pwworking\tpa\d0618883\FIGURE 5-3.dwg, Plot, 10/10/2014 3:52:35 PM, jgaul

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# WHITE STREET LANDFILL
## PERMIT 41-12
## PHASE III
## PERMIT AMENDMENT

CITY OF GREENSBORO NORTH CAROLINA

## CELLS 1, 2, AND 3 DEVELOPMENT PLAN (4H:1V TO 8% AT 910')

0 1" 2"

FILENAME FIGURE 5-3.dwg
SCALE 1" = 100'

SHEET
**FIGURE 5-3**

**Closure Plan**

# White Street Sanitary Landfill - Phase III

Project No. 06770-137686-018

Permit 41-12

*Greensboro, North Carolina*

**October 2014**

# 6.0 CLOSURE PLAN

## 6.1. Cap System Background

In compliance with the Solid Waste Management Rules, the landfill will place a final cap system over all waste placed in the Phase III expansion. The cap system will be designed and constructed in accordance with Rule .1624 (b) (8), (9), and (15), to minimize infiltration and erosion. It is estimated that the total landfill operating volume at completion will be 5,058,000 cubic yards. The maximum area requiring a cap at any one time is approximately 52 acres.

## 6.2. Cap System Design

The cap system designed will be checked prior to closure and revised and updated as appropriate. Compacted clay liners will be incorporated in the cap system design to provide protection throughout the 30-year post-closure period and beyond. The system will consist of, from bottom up; an 18-inch compacted clay liner ($1 \times 10^{-5}$ cm/sec); a geomembrane; a drainage layer (geonet); an 18-inch vegetative support layer; and, a 6-inch erosion layer.

The landfill may use on-site or off-site borrow material for the low permeability layer. The low-permeability layer will consist of no less than 18 inches of clay material having permeability no greater than $1 \times 10^{-5}$ cm/sec. In order to assure that the material meets the established criteria, the material will be tested prior to use and after placement. Testing requirements will be outlined in the final closure plan. Construction methods for the compacted clay liner shall be based upon the type and quality of the borrow source and shall be verified in the field by constructing test pad(s). A Professional Engineer shall certify that the compacted clay liner installation conforms with the plans approved by the NCDENR Division of Waste Management.

The soil above the geonet shall consist of 24 inches of cover soil of which no less than six inches of earthen material that is capable of sustaining native plant growth. The landfill anticipates use of on-site borrow material suitable for the erosion layer.

The material of the erosion layer will be selected considering: soil type, nutrient levels, pH, erodibility, and other factors. The vegetation should be selected based upon:

- Species of grasses which are locally adapted and resistant to drought or temperature extremes;
- Having roots which will not disrupt the low permeability layer;
- Ability to thrive in low nutrient soil and develop a good stand to resist erosion;
- Survive and function with little or no maintenance.

All cover material will be free of putresible material, solid waste, vegetation, rocks, construction debris, frozen soil, and other deleterious materials.

## 6.3. Final Contour Requirements

The final contour requirements for closure are shown on the drawings. These contours have been established to reflect all municipal solid waste expected to be received, intermediate cover

material (representing a total of 12 inches), and the final cover system (representing a total of three and one-half feet).

## 6.4. Cap System Material Requirements

Based on 18 inches of clay placed over the 52 acres that require final closure, 126,000 cubic yards of low-permeability clay are required for the first layer of the cap system. Additionally, 126,000 cubic yards is required for the vegetative support soil. An estimated 42,000 cubic yards of earthen material is required for the 6 inches of top soil layer. An estimated 2,270,000 square feet of geomembrane will be used in final cover of this phase.

## 6.5. Drainage Control Measures

The landfill is designed to have top slopes of 8 percent and side slopes of 25 percent. Final contours have been established to allow the landfill to drain while limiting erosion potential and maintaining post settlement slopes greater than 5 percent. Surface water will sheet flow down each of the sideslopes, and into terrace perimeter drainage ditches which will direct flow via down chutes to sedimentation basins located around the unit.

## 6.6. Permanent Erosion Control Measures

The landfill is situated near North Buffalo Creek at the northern side of the property, which is a tributary to the Haw River. As shown in the Drawings, a system of drainage channels and sedimentation basins will be used to protect the North Buffalo Creek from sediment laden runoff. The sedimentation basins are designed to control the 24-hour/25-year storm event and achieve a minimum of 70 percent efficiency in settling a sediment particle with a diameter of 40 microns. The sedimentation basin design calculations may be found at the end of this application.

## 6.7. Settlement Subsidence and Displacement

Landfill compaction methods which include the use of steel-wheeled compaction equipment to spread and compact in layers not to exceed two feet in thickness, combined with an adequate number of passes over each layer of waste, will be utilized to reduce voids and minimize differential settlement. Proper placement of daily, intermediate, and final cover will reduce the moisture content of the waste prior to site closure and further reduce settlement. Final slopes of the landfill have been developed to allow for this anticipated subsidence so that positive drainage of the fill will not be hindered.

## 6.8. Leachate Control

The installation of the final cap system over the fill area will greatly reduce infiltration of surface water and lessen the potential for leachate generation. The landfill has a comprehensive surface and groundwater monitoring program to detect any potential leachate migration problems. This program will be continued throughout the post-closure care period.

## 6.9. Gas Collection/Venting System

An active gas extraction system will be installed under the cap to allow movement of gas generated from the completed fill area to the gas management area.

## 6.10. Schedule for Closure

The closure will begin after completion of a portion of the final grades but no later than 30 days after the final receipt of waste. The design of the landfill in combination with the maintenance plan should assure a fairly uncomplicated closure period. The closure of the entire unit, or portions thereof, will be completed within 180 days unless an extension has been requested and received due to changes in the anticipated schedule.

## 6.11. Notice of Closure and Date of Final Waste Acceptance

A sign indicating the anticipated date of closure and the date of final waste acceptance will be conspicuously posted at the facility at least 30 days in advance of closure. The landfill may take other steps to notify the public of the planned closure. Prior to beginning closure of the unit or portions thereof, the NCDENR Division of Waste Management will be notified that a notice of intent to close has been placed in the operating record.

## 6.12. Implementation of Closure Plan

The closure plan will be implemented no more than 30 days from the date of final waste acceptance and completed in accordance with State regulations.

## 6.13. Closure Verification

The following procedures will be implemented following closure.

- A Construction Quality Assurance (CQA) report shall be submitted to the NCDENR Division of Waste Management. This report shall describe the observations and tests used before, during, and upon completion of construction to ensure that the construction materials meet the cap design specifications and the construction and certification requirements. The CQA report shall contain as-built drawings.
- A signed certification from an independent registered professional engineer verifying that closure has been completed in accordance with the closure plan will be submitted to the NCDENR Division of Waste Management.
- At least one sign notifying all persons of the closing of the phase and that wastes are no longer accepted will be posted. Suitable barriers will be installed as necessary at former accesses to prevent new waste from being deposited.
- Within 90 days, a survey plat, prepared by a professional land surveyor registered by the State, indicating the location and dimensions of landfill disposal areas, will be submitted to the circuit court clerk of the City of Greensboro.
- A notation shall be recorded on the deed notifying any potential purchaser of the property that the land has been used as a solid waste management unit and that future use is restricted under Paragraph (8) of Rule .1627. A copy of the deed notation as recorded shall be filed with the operating record.

**Post-Closure Plan**

# White Street Sanitary Landfill - Phase III

Project No. 06770-137686-018

Permit 41-12

*Greensboro, North Carolina*

**October 2014**

# 7.0 POST-CLOSURE PLAN

## 7.1. Introduction

This Post-Closure Plan has been developed to outline steps to be taken to ensure the environmental soundness of the landfill during its post-closure care period. The post-closure care period will last at least 30 years after closure completion and at a minimum will consist of the following:

- Maintaining integrity and effectiveness of final cover system
- Performing groundwater and surface water monitoring
- Maintaining and operating a gas monitoring system
- Maintaining run-on/run-off controls

No wastes will remain exposed after closure of the unit. Access to the closed site by the public or domestic livestock will not pose a health hazard.

## 7.2. Post-Closure Contact

All correspondence and questions concerning the post-closure care of the unit should be directed to:

Field Operations Director
City of Greensboro
401 Patton Ave
Greensboro, NC 27406
(336) 373-2443

## 7.3. Description of Use

After filling operations cease at Phase III of the White Street Sanitary Landfill and the unit is officially closed in accordance with the Plan described in Section 7.0, the area will be allowed to return to its natural vegetative state.

## 7.4. Maintenance

### 7.4.1. Repair of Security Control Devices

All security control devices will be inspected and maintained as necessary to ensure access to the site is controlled. Locks, vehicular gates and fencing will be replaced if functioning improperly. Warning signs will be kept legible at all times and will be replaced if damaged by inclement weather or vandalism.

### 7.4.2. Erosion Damage Repair

If erosion of the final cover occurs during post-closure, the affected area will be repaired and reseeded as necessary. Excessive slopes will be flattened if possible by adding clean fill material. If necessary, erosion control fabrics will be used to expedite rapid re-vegetation of slopes and to secure topsoil in place. Rough surfaces which cause isolated erosion areas will be smooth and reseeded as necessary.

### 7.4.3. Correction of Settlement, Subsidence and Displacement

Minimum slopes of five percent will be maintained after settlement in order to prevent ponding and allow for proper drainage without infiltration. If vertical or horizontal displacement occurs due to differential settlement, cracks will be filled with appropriate material and final cover will be reestablished. Excessive vertical displacement is not anticipated.

### 7.4.4. Repair of Run-On/Run-Off Control Structures

All terraces, ditches, and perimeter channels will be repaired, cleaned, or realigned in order to maintain original condition. Any culverts that are damaged will be replaced.

### 7.4.5. Gas Collection System

The landfill gas collection system is anticipated to be maintained by the City or a third party. Proper operation of the systems will be verified through testing at the landfill gas monitoring wells and probes.

If methane gas recovery wells do not function as a result of irregular settlement, accumulation of liquids (condensate, leachate, water), binding or corrosion, replacement wells can be installed if necessary.

### 7.4.6. Groundwater Monitoring System

All groundwater monitoring wells have been installed with concrete pads and protective casings to prevent accidental damage by vehicles and equipment. The wells are also equipped with a locking cap to discourage vandalism. Groundwater wells will be inspected regularly (at the time of sampling) to ensure integrity. Persons inspecting a well should look for signs of well tampering, cracking or degradation, and determine whether the well needs to be replaced. If the decision is made to replace and abandon a well, the replacement well should be installed 5-10 feet from the abandoned well in accordance with previous well specifications. Well abandonment should be accomplished by pulling the casing out and grouting the hole.

### 7.4.7. Leachate Collection System

The leachate collection system will be monitored. The leachate production rates are expected to be reduced significantly following capping. After six months of minimal flows the storage tank system may be evaluated for decommissioning and leachate will be pumped directly into the discharge line from the pump station. The tanks and pipe system will be annually inspected and repaired as necessary.

After closure of the landfill areas has been achieved, the generation of leachate will eventually curtail. The flow rate immediately after closure should decrease to 20 gallons/acre/day (gpad) which for all disposal areas yield approximately 800 gallons/day. Toward the end of the 30-year post-closure period, the flow should approach zero, at which time the storage tank will not be required. The following procedures will be followed to properly close the storage tank.

- Completely drain and remove all liquids, sludges, sediments, etc., from the storage tank.
- Disassemble the tank, piping, and appurtenances and dispose of the contents in a manner approved by NCDENR.

- Sample and analyze the soil for appropriate constituents inherent to leachate. Assess the results for evidence of contaminant migration.
- If contamination of underlying soil is exhibited, perform an assessment as to the degree of contamination and develop remedial actions.
- Obtain approval from NCDENR for the assessment and associated remedial measures.
- Perform the remedial actions as necessary to limit any threats to public health and the environment.
- Restore the area to closely match pre-existing conditions in the vicinity of the impoundment. Activities may include: filling, grading, topsoiling, and seeding.

## 7.5. Monitoring Plan

The closed unit shall be monitored for a minimum of 30 years. A series of inspections shall be scheduled to ensure the integrity and effectiveness of the cap system, storm water control system, groundwater monitoring system, gas collection system, leachate collection system, and to protect human health and the environment.

### 7.5.1. Inspection Frequencies

Inspections to be conducted during the post-closure care period will occur regularly as follows:

| Inspection | Frequency |
|---|---|
| Security Control Devices | Quarterly |
| Cover drainage system functioning | Semi-annually |
| Gas collection system | Monthly |
| Groundwater monitoring system | Semi-annually |
| Erosion damage | Semi-annually |
| Cover settlement, subsidence and displacement | Quarterly |
| Vegetative cover condition | Semi-annually |
| Stormwater control system | Quarterly |
| Benchmark Integrity | Quarterly |
| Leachate Collection System | Quarterly |

A copy of the Post-Closure Inspection Checklist is provided as Figure 7-1.

### 7.5.2. Quarterly Inspections

Quarterly inspections of the closed site will include examining the security control devices for signs of deterioration or vandalism to ensure access to the site is limited to authorized persons. The previous disposal area will be checked to ensure that the integrity of the final cover system is maintained, erosion damage is repaired, vegetative cover persists, and that cover settlement, subsidence and displacement are minimal. Drainage ditches will be cleared of litter and debris and benchmark integrity will be noted and maintained.

### 7.5.3. Semi-Annual Inspections

Semi-annual inspections of the site during the post-closure period will be conducted by the City of Greensboro's consultant engineer with detail attention paid to integrity and drainage of the final cover system and proper functioning of the groundwater and gas monitoring systems.

Groundwater monitoring will continue on a regular basis throughout the post-closure care period. The parameters chosen for analysis will be no less than the requirements of regulatory agencies. Groundwater monitoring wells will be inspected in accordance with the Water Quality Monitoring Plan. A report of the findings will be sent to City of Greensboro representative via the Post-Closure Inspection Checklist including any recommendations for actions necessary to ensure the site continues to meet the closure performance standard. The engineer will also receive copies of the quarterly inspections reports and respond to any comments that demand immediate attention.

Gas migration will be monitored using an explosimeter around the perimeter of the fill area and between the fill and adjacent buildings and property lines. Monitoring will take place at least quarterly for safety purposes. If it is determined that an active gas venting system is required to control migration, a system including final gas treatment and disposal will be incorporated.

## 7.6. Engineering Certification

Based on the City's monitoring reports and an engineer's quarterly site visits, annual certifications by the engineer will be placed in the operating record. They will certify that the closure plan has been followed, noting discrepancies along with the corrective actions undertaken. At the end of the post closure period, the individual certifications will be compiled into a final document and forwarded to the Division.

**Figure 7-1 Post-Closure Inspection Checklist**

Date: _____ Time: _____

Weather: _____ Completed by: _____

| | | Yes | No |
|---|---|---|---|
| I. | Security Control Devices: | | |
| | Are security control devices in place and functioning? | ☐ | ☐ |
| | Are all warning signs prominent and legible? | ☐ | ☐ |
| | Are there any signs of unauthorized entry on the site? | ☐ | ☐ |
| | Are there signs of illegal dumping on site? | ☐ | ☐ |
| II. | Final Cover System: | | |
| | Is the final cover free of erosion and depressions? | ☐ | ☐ |
| | Is there leachate seeping from the final cover? (If yes, make note of location on comment section below.) | ☐ | ☐ |
| | Is the vegetative cover continuous and in good condition, free of bare spots? | ☐ | ☐ |
| | Does the site require mowing? (If yes, mow grass and note in comment section below.) | ☐ | ☐ |
| | Is there ponding of water on final cover system? | ☐ | ☐ |
| III. | Gas Collection System: | | |
| | Are the casings in good repair and secure? | ☐ | ☐ |
| IV. | Groundwater Monitoring Wells: | | |
| | Is the casing upright and unobstructed? | ☐ | ☐ |
| | Is the outer casing secure and locked? | ☐ | ☐ |
| | Is the ID tag present and legible? | ☐ | ☐ |
| V. | Leachate Collection System: | | |
| | Are the cleanouts accessible and secured? | ☐ | ☐ |
| | Are the valves operational? | ☐ | ☐ |
| | Are the tanks and pipelines free of signs of leakage? | ☐ | ☐ |
| VI. | Miscellaneous: | | |
| | Are all benchmarks visible and intact? | ☐ | ☐ |
| | Are all ditches free of debris and litter? | ☐ | ☐ |
| | Are any odors present which may indicate landfill gas migration? | ☐ | ☐ |

## Comments

Please use the section below to comment on any area not covered above, and also note any areas of concern or needing immediate attention.

**Closure / Post-Closure Cost Estimate**

# White Street Sanitary Landfill - Phase III

Project No. 06770-137686-018

Permit 41-12

*Greensboro, North Carolina*

**October 2014**

# 8.0 CLOSURE / POST-CLOSURE COST ANALYSIS AND SUMMARY

## 8.1. Introduction

The purpose of this section is to provide a written estimate in current dollars of all activities and costs associated with all activities specified in the written closure and post-closure plans which have been developed for the City of Greensboro's White Street Sanitary Landfill Phase III (see Sections 6.0 and 7.0 of the approved Construction Permit Application). This cost estimate for closure and post-closure care is submitted in compliance with Rule .1628.

## 8.2. Estimated Closure Costs

Table 8-1 summarizes the estimated costs for the largest area requiring a final cover. This cost estimate is based on a third party providing the necessary services and includes labor in the unit prices given. The estimated closure costs will be reviewed annually or updated as required to reflect adjustments for inflation, rising costs of anticipated closure care, increased costs in construction or materials, or any other adjustments to the Closure Plan described in Section 6.0 of the approved Construction Permit Application.

## 8.3. Estimated Post-Closure Costs

Table 8-2 summarizes the estimated costs for the White Street Sanitary Landfill Phase III post-closure care maintenance activities. This cost estimate is based on a third party providing the necessary services and includes labor in the unit prices given. The estimated post-closure costs will be reviewed annually or updated as required to reflect adjustments for inflation, rising costs of anticipated post-closure care, or any other adjustments to the Post-Closure Plan described in Section 7.0 of the approved Construction Permit Application.

**Table 8-1 Cost Estimate for Closure of the Unit (Based on 52 Acres)**

| ITEM | QUANTITY | UNIT | UNIT COST | TOTAL |
|---|---|---|---|---|
| Construction: | 52 | AC | | |
| Geomembrane (40 mil LLDPE) | 2,265,120 | SF | $0.50 | $1,132,600 |
| Geonet Drainage Layer | 2,265,120 | SF | $0.73 | $1,653,500 |
| 1 x $10^{-5}$ Infiltration Layer (18 inches): | | | | |
| Transportation (20 miles @ $3.00/mile/load) | 12,590 | Load | $60 | $755,400 |
| Material | 125,900 | CY | $6.00 | $755,400 |
| Placing/Grading/Compaction | 125,900 | CY | $6.00 | $755,400 |
| Vegetative Support Layer (24 inches): | | | | |
| Transportation (20 miles @ $3.00/mile/load) | 16,780 | Load | $60 | $1,006,800 |
| Material | 167,800 | CY | $3.50 | $587,300 |
| Placing/Grading/Compaction | 167,800 | CY | $3.50 | $587,300 |
| Seeding and Mulching | 52 | AC | $1,700 | $88,400 |
| Backfill/Grading/Drainage | 1 | LS | $700,000 | $700,000 |
| Methane Gas Control (active extraction) | 20 | AC | $2,500 | $50,000 |
| Subtotal | | | | $8,072,100 |
| Contingency (20%) | | | | $1,614,400 |
| Engineering Planning/Design | | | | $400,000 |
| Construction Quality Assurance (CQA) | 5 | % | $403,605 | $403,600 |
| **2009 TOTAL CONSTRUCTION** | | | | **$10,490,000** |
| 2010 Inflation Factor per NCDENR | | | | 1.2% |
| 2011 Inflation Factor per NCDENR | | | | 1.0% |
| 2012 Inflation Factor per NCDENR | | | | 2.1% |
| 2013 Inflation Factor per NCDENR | | | | 1.8% |
| 2014 Inflation Factor per NCDENR | | | | 1.5% |
| **2014 TOTAL CONSTRUCTION** | | | | **$11,311,000** |

Note:

1. The majority of the methane gas extraction system in the Phase III closure area has been completed. This item is to finalize the gas collection system.
2. These estimates are based on average costs bid for similar work at a nearby landfill.
3. This estimate assumes soil material will come from offsite sources.
4. CQA includes construction monitoring, documentation and certification services as required under NCDENR Rules 15A NCAC 13B .1621 and .1624.
5. The quantities, unit costs, etc. have not been reviewed or updated since 2009. The average annual cost has been inflated to get the 2014 costs, as shown.

**Table 8-2 Estimated Average Annual Post-Closure Cost (Based on 52 Acres of Permitted Area)**

| ITEM | QUANTITY | UNIT | UNIT COST | TOTAL |
|---|---|---|---|---|
| Engineering Certificate | 1 | LS | $17,400 | $17,400 |
| Site Inspection and Recordkeeping: | 80 | HR | $100 | $8,000 |
| Cap Maintenance: | | | | |
| Mowing | 52 | AC | $100 | $5,200 |
| Gates/Fences and Access Control | 1 | LS | $2,300 | $2,300 |
| Erosion Control | 1 | LS | $5,800 | $5,800 |
| Surface Water Control | 1 | LS | $3,500 | $3,500 |
| Seeding | 4 | AC | $1,400 | $5,600 |
| Monitoring: | | | | |
| Methane Gas Monitoring and Report (quarterly) | 4 | 3 mo. | $5,800 | $23,200 |
| Groundwater Sampling/Lab and Report (semiannual) | 1 | LS | $35,200 | $35,200 |
| Monitor well Maintenance | 1 | LS | $1,500 | $1,500 |
| Methane Gas System Repairs | 1 | LS | $12,000 | $12,000 |
| Subtotal | | | | $119,700 |
| Contingency (20%) | | | | $23,940 |
| | | | **2009 AVERAGE ANNUAL COST** | **$143,640** |
| | | | 2010 Inflation Factor per NCDENR | 1.2% |
| | | | 2011 Inflation Factor per NCDENR | 1.0% |
| | | | 2012 Inflation Factor per NCDENR | 2.1% |
| | | | 2013 Inflation Factor per NCDENR | 1.8% |
| | | | 2014 Inflation Factor per NCDENR | 1.5% |
| | | | **2014 TOTAL CONSTRUCTION** | **$155,000** |

Note:

1. These estimates are for a third party and include labor.

2. The quantities, unit costs, etc. have not been reviewed or updated since 2009. The average annual cost has been inflated to get the 2014 costs, as shown.

# City of Greensboro

Department of Environmental Services
Solid Waste Management Division
White Street Waste Disposal Facility



GREENSBORO

# WATER QUALITY MONITORING PLAN

P.O. BOX 3136, GREENSBORO, NC 27402-3136

# WATER QUALITY MONITORING PLAN
# WHITE STREET LANDFILL
# PHASE III AREA

**WHITE STREET**
**GREENSBORO, NORTH CAROLINA**
**S&ME PROJECT NO. 1584-98-081**

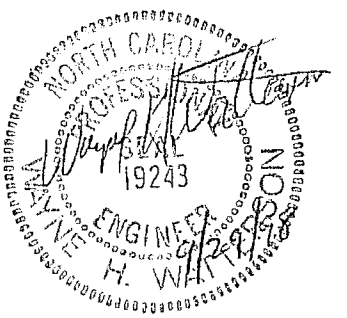
**Prepared For:**

THE CITY OF GREENSBORO

**Prepared By:**

S&ME, Inc.
3718 Old Battleground Road
Greensboro, North Carolina 27401

September 1998



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TABLES



APPENDIX

# 1.0 WATER QUALITY MONITORING PLAN

## 1.1 PURPOSE AND INTENT

The purpose of this plan is to provide a program which describes the collection and evaluation of ground-water monitoring samples collected from compliance wells installed within the uppermost aquifer adjacent to the proposed expansion area and surface water quality samples from the same vicinity. The intent of this plan is to provide detection monitoring throughout the active life and post closure care period at the White Street Sanitary Landfill Subtitle D MSWLF expansion.

This plan was prepared in accordance with the rules codified under North Carolina Solid Waste Management Rules 15A NCAC 13B, Sections .1630 through .1637 under the guidance of a North Carolina Professional Engineer, and it is certified that this water quality monitoring plan for the White Street Sanitary Landfill Subtitle D MSWLF expansion is effective in providing early detection of any release of hazardous constituents (from any point in this expansion) to the uppermost aquifer, so as to be protective of public health and the environment.

The plan presented herein is a revision of the Water Quality Monitoring Plan prepared for the facility by HDR Engineering, Inc. of North Carolina dated January 1, 1997. The plan is revised to include procedures to sample ground water monitor wells with dedicated pneumatic sampling pumps. No other parts of the January 1, 1997 plan prepared by HDR have been modified.

## 1.2 DESCRIPTION OF PLAN COMPONENTS

The following is a brief description of the main components of this water quality monitoring plan.

### 1.2.1 Water Quality Sampling Locations

The following sections discuss the general ratioale used to select the upgradient (background) compliance well and the downgradient (detection) compliance wells based on the geologic and hydrogeologic data obtained during the development of the Hydrogeologic Design Report. All well locations were selected on their basis to provide water quality data from the uppermost aquifer beneath the facility. The rationale for selection of surface water monitoring points is also discussed.

Using the historical water-table elevation data collected during multiple ground-water monitoring events at the facility, and the geology of the site, two background compliance wells were selected on the basis of hydraulic position in relation to the solid waste management unit. Background well MW-15 is hydraulically "upgradient" of the unit and was completed in the gneissic material. Background well MW-16 is hydraulically sidegradient of the unit and was completed in the granitic material. Table 1-1 summarizes the proposed background monitoring wells for this plan and their approximate distance from the edge of the proposed solid waste cell.

1.2.1.2 Downgradient (Detection) Wells

The hydrogeologic and geologic characteristics of the facility and surrounding land, the quantity, quality, and direction of ground-water flow were evaluated to determine the appropriate selection of downgradient (detection) wells. In addition to the criteria above, the distance of each proposed well relative to the waste unit (100 to 150 feet) and the boundary of the property (50 feet or greater) were also considered. Table 1-1 summarizes the proposed downgradient (detection) monitoring wells for this plan and their estimated distance from the subject compliance boundary.

Each downgradient well was installed with a screened interval of Schedule 40 PVC well screen with a 0.010-inch slotted opening.

**TABLE 1-1**
**SUMMARY OF PROPOSED DETECTION MONITORING SAMPLE LOCATIONS**
**White Street Sanitary Landfill**
**Phase III**
Greensboro, North Carolina

| SAMPLE ID | SAMPLE TYPE | INTERVAL MONITORED | SAMPLE LOCATION AND POSITION | | DETECTION MONITORING FUNCTION |
|---|---|---|---|---|---|
| | | | Distance and Direction From Waste Cell Boundary | Hydrogeologic Position | |
| MW-15 | Ground Water | Uppermost Aquifer Gneissic Material | 225 Feet Southwest | Upgradient | Provide Background Water Quality Data |
| MW-16 | Ground Water | Uppermost Aquifer Granitic Material | 450 Feet Southeast | Sidegradient | Provide Background Water Quality Data |
| MW-17 | Ground Water | Uppermost Aquifer | 125 Feet East | Downgradient | Provide Release Detection Data |
| MW-18 | Ground Water | Uppermost Aquifer | 135 Feet East | Downgradient | Provide Release Detection Data |
| MW-19 | Ground Water | Uppermost Aquifer | 110 Feet Northeast | Downgradient | Provide Release Detection Data |
| MW-20 | Ground Water | Uppermost Aquifer | 125 Feet North | Downgradient | Provide Release Detection Data |
| MW-21 | Ground Water | Uppermost Aquifer | 125 Feet West | Downgradient | Provide Release Detection Data |
| MW-22 | Ground Water | Uppermost Aquifer | 150 Feet North-Northwest | Downgradient | Provide Release Detection Data |
| MW-23 | Ground Water | Uppermost Aquifer | 150 Feet West-Northwest | Downgradient | Provide Release Detection Data |
| MW-24 | Ground Water | Uppermost Aquifer | 150 Feet West | Downgradient | Provide Release Detection Data |
| MW-25 | Ground Water | Uppermost Aquifer | 135 Feet North | Downgradient | Provide Release Detection Data |
| MW-25D | Ground Water | Deeper Portions of Uppermost Aquifer | 125 Feet North | Downgradient | Provide Release Detection Data |
| SU-1 | Surface Water | Tributary/Stream | See Drawing G-1 | Upstream | Provide Background Water Quality Data |
| SU-2 | Surface Water | Tributary/Stream | See Drawing G-1 | Downstream | Provide Surface Water Quality Data |
| SU-3 | Surface Water | Tributary/Stream | See Drawing G-1 | Downstream | Provide Surface Water Quality Data |
| SU-4 | Surface Water | Tributary/Stream | See Drawing G-1 | Downstream | Provide Surface Water Quality Data |

Shallow wells have 15-foot screens and deep wells will have 10-foot screens. The construction of the final ground water monitoring wells will be in general accordance with the North Carolina Well Construction Standards. A schematic showing general well construction details is shown on Construction Permit Application Drawing C-12 (see January 1997 plan).

The number and location of the proposed monitoring wells have been selected based on several considerations. First, knowledge of ground water flow at the proposed expansion area, as described in the accompanying "Design Hydrogeologic Report," indicates that these wells encompass the downgradient area of the expansion. Second, each shallow well will be completed in the uppermost aquifer, with well screens that span the water table. Third, the lateral spacing of these wells was chosen because it is more than adequately close together considering the fine-grained nature of the saprolite aquifer in which dispersion is high. Finally, a well was located downgradient of the leachate collection sump, an area that the State considers particularly vulnerable. Well MW-25 will monitor the northeastern sump, as well as provide monitoring for that general portion of the lined facility.

In addition, a deep well, MW-25D, was installed as a nest at MW-25. Note also that this well pair is located along the axis of the prominent bedrock surface valley that trends through that area.

#### 1.2.1.3 Surface Water Sample Locations

Four surface water sample locations have been proposed to monitor the quality of surface water near the solid waste unit. A surface water sample representing background water quality will be collected from the upstream portion of the creek that flows to the east of the disposal area. The downstream surface water samples will be collected from streams that will receive run-off from the landfill area. The location of these proposed surface water sampling locations can be seen on Drawing G-1.

### 1.2.2 Monitoring Well Data Collection

The following data will be collected and reported during the period of performance for this water quality plan. A brief discussion on the collection of and analysis of these data is provided in the sections to follow.

1.2.2.1 Ground Water Level Data Measurements

Static ground-water levels (and total well depth) will be obtained from the proposed ground-water compliance monitoring wells immediately prior to purging during each required water quality sampling event. An electronic water level meter capable of measuring differences in water levels of 0.01 feet will be used to obtain these measurements.

All measurements will be obtained from a reference point at the top of each PVC well casing which has an elevation established by a North Carolina registered land surveyor. The horizontal position of each well will be established using North Carolina Plane Coordinates. These data will be used to calculate the volume of standing water in each well and will provide information concerning well integrity (e.g., identify the presence of excessive siltation or casing breaches). All measuring equipment will be decontaminated between use at each well by washing in a non-phosphate detergent solution and rinsing in distilled or deionized water.

1.2.2.2 Ground Water Direction and Flow Measurements

Water table elevations will be calculated for each monitoring well using surveyed top-of-casing elevations prepared by a North Carolina registered land surveyor. Calculated potentiometric surface elevations, for each sampling event, will be placed on a scaled base map of the facility beside each respective monitoring point and contoured to produce a water table potentiometric surface map depicting potential ground-water flow direction(s) across the expansion area. In addition, estimated ground-water flow velocities for each compliance monitoring point will be calculated for each water quality sampling event. Using the static water table potentiometric data, effective porosities for each well, hydraulic conductivities determined from slug tests of each well, and the calculated hydraulic gradients at each monitoring well for the respective sample event, an estimated seepage (pore water) velocity at each monitoring well will be calculated to evaluate potential contaminant migration.

1.2.2.3 Ground Water Sampling With Dedicated Pneumatic Pumps

The City of Greensboro has elected to use dedicated sampling pumps to collect groundwater samples from monitor wells at the landfill. With proper techniques for low-flow purging and sampling, the pumps offer the potential of obtaining groundwater samples with lower turbidity than

would be obtainable with bailers. The following text provides specifications and procedures applicable to groundwater sampling with dedicated pneumatic pumps.

Dedicated sampling pumps shall be all pneumatic, bladder pumps driven by a portable cycling air controller supplied with compressed air from a portable oil-less air compressor or compressed air bottle. Pump effluent will pass through a portable flow-through cell and water analyzer, which will monitor temperature, pH, conductivity, oxidation-reduction potential (ORP), and dissolved oxygen to indicate when stabilization has occurred.

The sampling pump shall be a positive gas displacement pin construction bladder pump. The pump shall be constructed such that no gas or liquid is introduced into the well during the pump operation. The pump shall be constructed of 316 stainless steel with a Teflon bladder. Bladders shall be field-replaceable and warranted for a period of 10 years. Bladder clamps shall also be constructed of 316 stainless steel. Pumps will be equipped with a screen having an opening not exceeding 0.012 inches. Sample pumps shall employ self-polishing hard seat internal check valves.

The manufacturer shall warrant all pumps to be new construction and shall certify all pumps to be free of all EPA Method 601,602, base neutral, and acid extractable contaminants. Certification and copies of the analytical reports with test batch numbers will be provided with each pump.

Pump airline and discharge tubing shall be of new material, sized to match the fittings supplied with each pump. The tubing bundle will consist of polyethylene air supply line heat bonded to a Teflon-lined polyethylene water supply line. The sample discharge tube shall provide a separate flow path without exposure to pump drive air and shall assure that discharge from the pump contacts only the Teflon inner tubing. The manufacture shall certify that only virgin PTFE (Teflon) has been used in the manufacture of the inner tubing.

The pump air supply line and discharge tubing shall be attached to a well head assembly that will allow attachment of the air supply line to the well head with the use of a quick-connect fitting. The well head assembly shall have an opening to allow measurement of water level with an electric water level probe. The discharge piping shall allow attachment of a Teflon elbow (QED part number 34485 or equivalent) to facilitate collection of the sample.

The air compressor shall be portable, gasoline-powered, of an oil-less design to prevent potential cross-contamination to the sample in the event of malfunction and capable of supplying air to the controller at a minimum rate of 4.3 SCFM at 100 psi. The compressor shall be supplied with a

minimum of 40 feet of air-line to allow for operation of the gasoline engine downwind of the well during sampling.

The controller shall be capable of regulating both pressure and duration of bladder inflation and deflation cycles to allow optimum pump performance. A pause feature shall be provided to allow manual discharging and filling of sample during sample collection.

Purging should be performed by removing water from the well at a flow rate of less than 500 ml per minute. Purging rates should be less than the well recovery rate. The purge rate should be low enough that recharge water does not become excessively agitated or that colloids are drawn into the well bore. Purging should be continued until field measurements of turbidity, oxidation-reduction potential (ORP), and dissolved oxygen in-line analyses of groundwater have stabilized to within 10 percent over at least two measurements made 3 minutes apart.

Following stabilization of the field parameters, the well head should be fitted with the Teflon elbow and the discharge regulated to allow the filling of sample containers. Flow rates should be low enough to prevent aeration of the samples. For the volatile organic compound ( VOCs) containers, the vials should be filled so that there are no air bubbles or "headspace".

A complete set of pre-cleaned and pre-labeled sample bottles will be removed from the cooler, prior to turning on the pump, to collect the sample. Once collected, a portion of the sample from the pump (for each well) will be transferred into a fresh container. Preservatives will be added as necessary (in accordance with EPA Methods SW-846) to the sample bottles, either by the laboratory or in the field immediately prior to sampling. A duplicate water quality sample will be collected, at least once a year, from a selected monitoring well in order to verify laboratory accuracy and QA/QC. One trip blank prepared by the laboratory will be analyzed for each sampling event. Equipment blanks are not recommended since the equipment is dedicated.

The sample collection sequence will proceed as follows: volatile organics (VOCs) and/or total organic halogens (TOX) will be collected first in 40 ml glass vials with Teflon-lined caps. The vials will be filled completely with no headspace. Samples to be analyzed for inorganic compounds (metals) will be collected next. The containers are most often plastic cubes or bottles that have acid placed inside as a preservative. These containers should not be rinsed prior to filling. Semi-volatiles will be collected following the inorganics. Generally, the semi-volatiles are collected in 1-liter amber glass bottles. Water samples to be analyzed for radiological parameters will be collected next, followed by the bacteriological parameters, if necessary. The radiological

parameters will be collected in 1-liter bottles, and the bacteriological parameters will be collected in 120 ml plastic bottles containing sodium thiosulfate as a preservative.

After transferring the samples to the appropriate containers, they will be sealed and placed in a chilled cooler, or transpack, pending the completion of the sampling event. Upon completion of sampling at each well location, the well will be capped and secured.

All samples will be transferred directly to the appropriate sample containers in a manner which minimizes the sample agitation, and the potential for cross-contamination. A Chain of Custody Record will accompany the samples to document changes in the custody of the samples in the period between sampling and receipt of the sealed sample containers by the laboratory. The samples will be analyzed for the designated list of parameters by a North Carolina certified laboratory.

### 1.2.3 Sample Parameters and Frequency

#### 1.2.3.1 Analytical Methods

All water quality samples will be analyzed for the constituents listed in Appendix I of 40 CFR Part 258 entitled "Constituents for Detection Monitoring." Table 1-2 lists the Appendix I constituents as well as the preferred analytical method and Practical Quantitation Limit (PQL) for each constituent.

During the purging process, field measurements (i.e., pH, temperature, and specific conductance) will be collected at each sample location in order to evaluate the effectiveness of purging procedures. These measurements will be obtained from a field-calibrated instrument in accordance with the manufacturers' specifications and industry standards (SW-846). If these field indicators do not appear to have stabilized after 5 well volumes, then well purging efforts will continue until "stabilized" conditions occur.

## TABLE 1-2
## SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS

White Street Sanitary Landfill
Greensboro, North Carolina

**Metals:**

| PARAMETER | CERTIFICATION | METHOD | PQL |
|---|---|---|---|
| Antimony | Low level | 7041 | 30 |
| Arsenic | Low level | 7060,7061 | 10 |
| Barium | (20) | 7080,6010 | 500 |
| Beryllium | Low level | 7091 | 2 |
| Cadmium | Low level | 7131 | 1 |
| Chromium | Low level | 7191 | 10 |
| Cobalt | Low level | 7201 | 10 |
| Copper | Regular level | 7210,6010 | 200 |
| Lead | Low level | 7421 | 10 |
| Nickel | Regular level | 7520,6010 | 50 |
| Selenium | Low level | 7740,7741 | 20 |
| Silver | Low level | 7761 | 10 |
| Thallium | Low level | 7841 | 10 |
| Vanadium | Low level | 7911 | 40 |
| Zinc | Regular level | 7950,6010 | 50 |

PQL - Practical Quantitation Limit in parts per billion (ppb).

**TABLE 1-2 (continuation)**
**SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS**

White Street Sanitary Landfill
Greensboro, North Carolina

**Volatile Organics:**

| ORGANIC CONSTITUENT | METHOD | PQL |
|---|---|---|
| Acetone | 8240/8260 | 100 |
| Acrylonitrile | 8240/8260 | 200 |
| Benzene | 8240/8260 | 5 |
| Bromochloromethane | 8240/8260 | 5 |
| Bromodichloromethane | 8240/8260 | 5 |
| Bromoform | 8240/8260 | 5 |
| Carbon Disulfide | 8240/8260 | 100 |
| Carbon Tetrachloride | 8240/8260 | 10 |
| Chlorobenzene | 8240/8260 | 5 |
| Chloroethane | 8240/8260 | 10 |
| Chloroform | 8240/8260 | 5 |
| Chlorodibromomethane | 8240/8260 | 5 |
| 1,2-Dibromo-3-Chloropropane | 8240/8260 | 25 |
| Ethylene Dibromide | 8240/8260 | 5 |
| O-Dichlorobenzene | 8240/8260 | 5 |
| P-Dichlorobenzene | 8240/8260 | 5 |
| T-1,4-Dichloro-2-Butene | 8240/8260 | 100 |
| 1,1-Dichloroethane | 8240/8260 | 5 |
| Ethylene Dichloride | 8240/8260 | 5 |
| Vinylidene Chloride | 8240/8260 | 5 |
| Cis-1,2-Dichloroethene | 8240/8260 | 5 |
| T-1,2-Dichloroethene | 8240/8260 | 5 |
| Propylene Dichloride | 8240/8260 | 5 |
| Cis-1,3-Dichloropropene | 8240/8260 | 10 |

PQL - Practical Quantitation Limit in micrograms per liter (µg /l).

**TABLE 1-2 (continuation)**
**SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS**

White Street Sanitary Landfill
Greensboro, North Carolina

**Volatile Organics:**

| ORGANIC CONSTITUENT | METHOD | PQL |
|---|---|---|
| T-1,3-Dichloropropene | 8240/8260 | 10 |
| Ethylbenzene | 8240/8260 | 5 |
| Methyl Butyl Ketone | 8240/8260 | 50 |
| Methyl Bromide | 8240/8260 | 10 |
| Methyl Chloride | 8240/8260 | 10 |
| Methylene Bromide | 8240/8260 | 10 |
| Methylene Chloride | 8240/8260 | 10 |
| MEK; 2-Butanone | 8240/8260 | 100 |
| Methyl Iodide | 8240/8260 | 10 |
| Methyl Isobutyl Ketone | 8240/8260 | 100 |
| Styrene | 8240/8260 | 10 |
| 1,1,1,2-Tetrachloroethane | 8240/8260 | 5 |
| 1,1,2,2-Tetrachloroethane | 8240/8260 | 5 |
| Tetrachloroethylene | 8240/8260 | 5 |
| Toluene | 8240/8260 | 5 |
| 1,1,1-Trichloroethane | 8240/8260 | 5 |
| 1,1,2-Trichloroethane | 8240/8260 | 5 |
| Trichloroethylene | 8240/8260 | 5 |
| Trichlorofluoromethane | 8240/8260 | 5 |
| 1,2,3-Trichloropropane | 8240/8260 | 15 |
| Vinyl Acetate | 8240/8260 | 50 |
| Vinyl Chloride | 8240/8260 | 10 |
| Xylenes | 8240/8260 | 5 |

PQL - Practical Quantitation Limit in micrograms per liter (µg /l)

Trip blanks will be analyzed for volatile organics only, while equipment blanks will be analyzed for volatile organics and metals. Duplicate samples will be analyzed for the entire parameter list.

1.2.3.2 Sampling Frequency

Ground-water samples will be obtained during four independent events during the first 6 months of baseline sampling in order to provide enough data to adequately determine background/natural ground-water conditions or trends. For the remainder of the required monitoring period, water quality samples from all sample points will be collected on a semiannual basis.

## 1.3 STATISTICAL EVALUATION OF MONITORING DATA

Five methods have been deemed acceptable by the NCDEHNR for the statistical evaluation of ground-water quality data from MSWLF facilities (as referenced in Section .1632 of the Ground-Water Sampling and Analysis Requirements, 15A NCAC 13B). Each of these tests have inherent advantages and disadvantages which render them more or less useful, depending on site and data set characteristics. Each method is briefly described below. In addition to the statistical analysis of the data, all sampling analytical data will be compared to the North Carolina Ground-Water Standards, 15A NCAC 2L, .0202.

### 1.3.1 ANOVA (Parametric)

A parametric analysis of variance (ANOVA) followed by multiple comparison procedures to identify specific sources of difference is the preferred method for a facility in the early stages of monitoring. The procedures include estimation and testing of the contrasts between the mean concentrations at each compliance well and those at the background well for each constituent.

Analysis-of-variance models are used to analyze the effects of an independent variable on a dependent variable. For ground-water monitoring data, a well or group of wells is the independent variable, and the aqueous concentration of certain constituents or of a specified contaminant or contaminants is the dependent variable. An analysis-of-variance can determine whether observed variations (differences) in aqueous concentrations between compliance and background wells are

statistically significant. Use of analysis-of-variance models is appropriate in situations where background concentrations of specific constituents can be determined and the data are normally or log normally distributed. The constituents which are most appropriately evaluated using ANOVA approaches are naturally occurring metals and other geochemical parameters such as chloride, nitrate-N, and specific conductivity.

### 1.3.2 ANOVA (Non-parametric)

A non-parametric analysis of variance (ANOVA) based on ranks followed by multiple comparison procedures to identify specific sources of difference can be used when the data are not normally distributed and cannot be transformed into a log-normal distribution. The procedure includes estimation and testing of the contrasts between the median of each compliance well and the background well for each constituent. This is a non-parametric procedure, which means that the laboratory values are not used; only the relative ranks are used.

### 1.3.3 Tolerance/Prediction Intervals

A tolerance interval or a prediction interval for each constituent is established from the background data. The concentration of each constituent in each compliance well is compared to set upper (or lower) tolerance or prediction limits.

Tolerance intervals define, with a specified probability, a range of values that are expected to contain a discrete percentage of the sample population (95%). Tolerance intervals are most appropriate for facilities which do not have high degrees of spatial variability between background and compliance well (e.g., areas underlain by homogeneous geologic materials such as granitic saprolite). With ground-water monitoring data, tolerance intervals can be constructed from concentrations found in the background well(s); these intervals are most often expressed as limits defined by the mean background well concentration plus a population size determined multiple of the standard deviation of the mean. Possible ground-water contamination is indicated when concentrations of the specified constituent(s) at the compliance well(s) plot above the calculated tolerance interval limits.

Prediction intervals are intervals in which the user is confident at a specified percentage (95%) that the next observation will lie within the interval, and are based on the number of previous

observations, the number of new measurements to be made, and the level of confidence that the user wishes to obtain. This method of statistical analysis can be used in both detection and compliance monitoring programs. The mean concentration and standard deviation are estimated from the background wells. In a compliance monitoring program, prediction intervals are constructed from compliance well concentrations beginning at the time the facility entered the compliance monitoring program. Each compliance well observation is tested to determine if it lies within the prediction interval. If it is greater (or lower) than the historical prediction limits, water quality has deteriorated to such a point that further action may be warranted.

### 1.3.4 Control Charts

A control chart approach provides control limits for each constituent which can be used to evaluate data produced by repeated sampling and analysis for each well in the monitoring network. This is an intrawell approach which does not involve a comparison between background and compliance wells. If any compliance well has a value or a sequence of values that lie outside of the control limits for that constituent, this may constitute statistically significant evidence of contamination.

Control charts are based on repeated independent sampling events conducted over time and may be developed for each constituent of interest. Different statistical measurements, such as the means, standard deviation and mean of replicate values at a point in time, are computed and plotted graphically together with upper predetermined limits on a chart in which the x-axis represents time. When a data point plots above these boundaries, the process is "out of control," and when it plots below the boundaries the process is "in control." Control charts can be used to analyze the inherent statistical variation of ground-water monitoring data, to note aberrations and to detect trends in the data. Further investigation of "out of control" points is necessary before taking any direct action. A control chart can be constructed for each constituent in each well to monitor the concentration of that constituent over time. New samples can be compared to the historical data from the well to determine if the well is "in or out of control." Control charts can also be used to evaluate ground-water monitoring data when these data have been adjusted and/or transformed as appropriate.

### 1.3.5 Other Statistical Methods

Other statistical methods submitted by the facility owner or operator and approved by the NCDEHNR may also be used. This could include development of confidence intervals in which data are compared to Federal or State established maximum contaminant limits (MCLs) or alternate contaminant limits (ACLs).

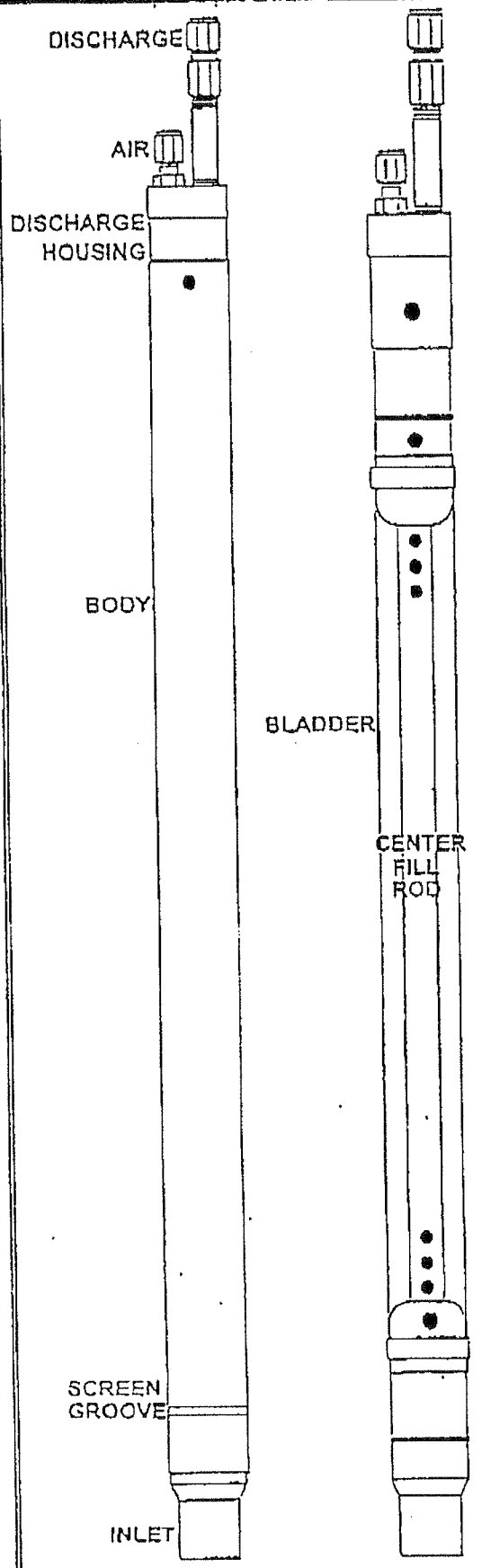
## 1.4 DETECTION MONITORING REPORTING

The reporting of detection monitoring data will occur within 14 days from the completion of the statistical analysis of the ground-water quality analytical data. A report will be prepared which summarizes the sampling event; including field observations relating to the condition of the monitoring wells, field data, laboratory data, statistical analysis, sampling methodologies, quality assurance and quality control data, information on ground-water flow direction, and calculations of ground-water flow rate.

# Appendix

# TECHNICAL DATA/SPECIFICATION SHEET

**WELL WIZARD® PUMP MODEL T1200(M)**




**PUMP TYPE:** POSITIVE DISPLACEMENT BLADDER PUMP

**MATERIALS:**

BODY - 316 STAINLESS STEEL
BLADDER - TEFLON®
INLET & DISCHARGE HOUSINGS - 316 STAINLESS STEEL
O-RINGS - VITON

**DIMENSIONS:**

DIAMETER - 1.5"
LENGTH - 42.25"
LENGTH WITH SCREEN - 47.75"
WEIGHT - 4.05 LBS.
SCREEN MESH - 50 (.010)

**FITTINGS:**

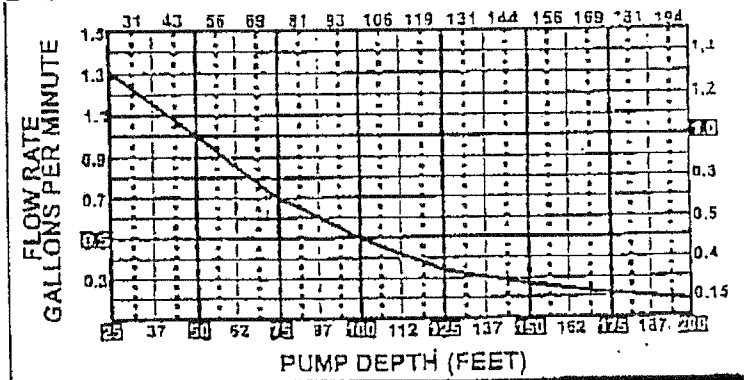
STAINLESS STEEL COMPRESSION-TYPE
AIR - ¼" O.D., 3/16" I.D.
DISCHARGE - 1/2" O.D., 3/8" I.D.
(M) DISCHARGE - 3/8" O.D., 1/4" I.D.

**PUMP VOLUME:**

| LITERS | MILILITERS | GALLONS | OUNCES |
|---|---|---|---|
| .495 | 495 | .13 | 16.6 |

**MAXIMUM LIFT:** 300 FEET

**T1200 FLOW RATES**



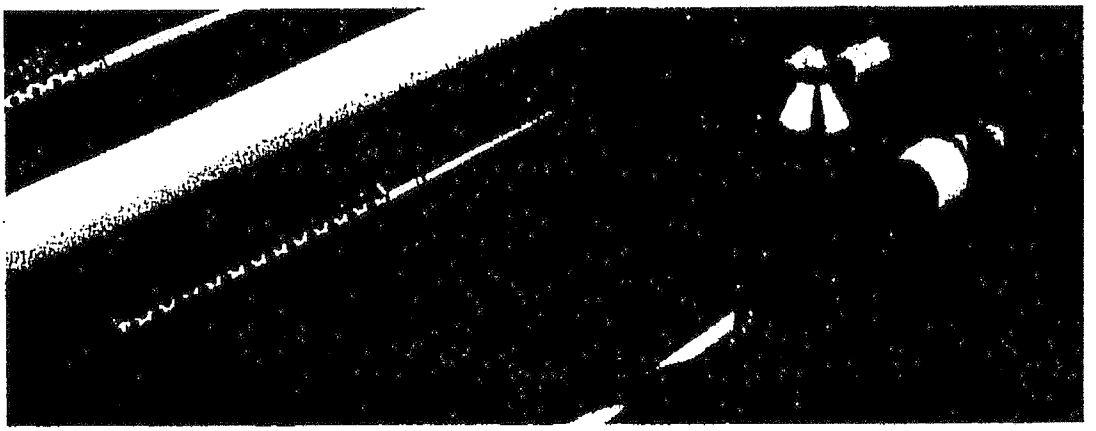

**NOTE:** Flow rates are based on a pump submergence of 25 feet, 1/2" discharge tubing and an operating gas pressure of 100 P.S.I. from an 3111HR air source/controller

**ACCESSORIES:**

INLET SCREEN 6" STAINLESS STEEL P/N 35200
BLADDER KIT P/N 35313
CLAMP HAND TOOL/PUNCH KIT P/N 35314

MICROPURGE

# Well Wizard® Bladder Pumps: The Low-Flow Sampling Standard



*The leaders since 1982 in dedicated pump technology, performance, and support.*

The heart of every MicroPurge low-flow ground water monitoring program is the sampling device. For the system to do its job properly, the sampler must:

- run reliably and at low rates (100 ml/min or less) over a wide range of conditions;
- operate gently without increasing turbidity or altering samples;
- deliver reliable performance for many years without needing frequent repairs.

For nearly 15 years, Well Wizard pumps from QED have been doing all this...at more sites...for more users... then any other system.

## The most complete low-flow pump selection

MicroPurge system pumps come in an unsurpassed range of sizes, materials, and capabilities, including models for deep wells, narrow or obstructed casings, and small-volume pumps for low-recovery wells. Together with MicroPurge controllers, flow cells, and accessories, they create the most reliable, cost-effective low-flow system available.

Field proven pump materials and exclusive, high performance bladder polymers offer the reliability critical to long-term monitoring. QED was first in the industry with a standard 10-year sampling pump warranty.

## Unmatched regulatory and user acceptance

Bladder pumps, EPA-accepted for low-flow sampling, have been shown to deliver superior sample accuracy in dozens of independent studies. Almost 40,000 Well Wizard bladder pumps are in use — more than all other brands and types of dedicated ground water samplers combined.

### Well Wizard Advantages

- EPA-accepted low-flow sampling accuracy.
- Models for every well — pump volumes as low as 100ml, well depths to 1,000 feet, casing I.D. from 1.25".
- Proven reliability since 1982, with the industry's first standard 10-year warranty.
- Exclusive bladder polymer rated 200,000 cycles for years more flex life.

ESHELMAN CAROLINAS, INC.
1127 Commercial Avenue
CHARLOTTE, NORTH CAROLINA 28205
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## HOW THEY WORK

# *Well Wizard Bladder Pumps*

### Designed for superior low-flow sampling performance

Pneumatic bladder pumps operate with a unique, gentle action ideal for low-flow sampling. Timed on/off pulses of compressed air alternately squeeze the flexible bladder to displace water out of the pump, and release it to allow the pump to refill under the natural in-situ hydrostatic pressure of the aquifer. Bladder pumps run easily at low rates for extended times, without the problems of other samplers.

- No overheating of high-speed electric pump motors, which can alter samples and even ruin the pumps.
- No churning action, like that of bailers or foot-valve samplers, which increases turbidity.
- No suction to cause degassing of dissolved volatile contaminants.

The bladder prevents contact between the pump drive air and the sample, and the downwell equipment is permanently dedicated to each well, so both samples and the well are protected from disturbance or the threat of cross-well contamination.

### The easiest system to order and use

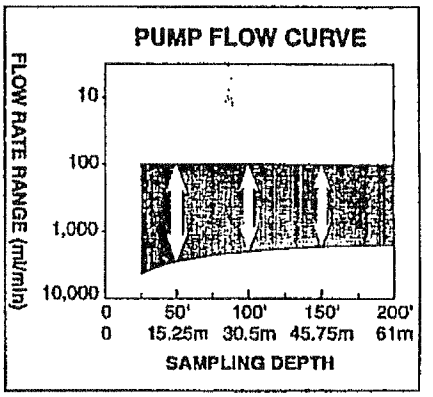
Well Wizard Bladder Pumps are part of the complete low-flow MicroPurge sampling system engineered for easy installation and use. QED application specialists will help specify the most effective, economical pumps and accessories for your site.

Each pump is cleaned and laboratory-certified to be free of all EPA 601, 602, base neutral and acid extractable contaminants. Your system is preassembled, with tubing cut to length, ready to install.

If desired, installation by OSHA-certified field engineers can be provided. QED customer support — with trained local representatives, 24-hour toll-free hotline, and next-day loaners or service turnaround — backs you with unmatched expertise and service.

More MicroPurge dedicated sampling systems and pumps have been chosen since 1982 than all other manufacturers' equipment combined.

To find out why, call QED today for a Low-Flow Data Sheet and site-specific cost analysis.




***This graph shows the range of precisely controlled flow rates available from Well Wizard Bladder Pumps and the MicroPurge Model 400 controller. Consult QED for flow rates at greater depths or other special applications.***

## MICROPURGE PUMP SPECIFICATIONS

| Model No. | Pump Materials | Length | O.D. | Fitting Material | *Tubing Size | Volume (ml) | Max. Lift |
|---|---|---|---|---|---|---|---|
| T1100 | Teflon | 3.3' (1.0 m) | 1.66" (4.2 cm) | Teflon | 1/4 x 1/2" (6 x 13 mm) | 395 | 250' (75m) |
| P1101 | PVC | 3.4' (1.04 m) | 1.66" (4.2 cm) | Polypropylene | 1/4 x 1/2" (6 x 13 mm) | 395 | 300' (90m) |
| P1101H | PVC | 3.3' (1.0 m) | 1.66" (4.2 cm) | Stainless Steel | 1/4 x 1/2" (6 x 13 mm) | 395 | 600' (180m) |
| ST1101P | 316 Stainless Steel | 3.4' (1.04 m) | 1.66" (4.2 cm) | Stainless Steel | 1/4 x 1/2" (6 x 13 mm) | 395 | 1,000' (305m) |
| T1200 | 316 S.S. and Teflon | 3.4' (1.04 m) | 1.50" (3.8 cm) | Stainless Steel | 1/4 x 1/2" (6 x 13 mm) | 495 | 300' (90m) |
| T1250 | 316 Stainless Steel | 1.25' (0.38 m) | 1.50" (3.8 cm) | Stainless Steel | 1/4 x 3/16" (6 x 5 mm) | 100 | 300' (90m) |
| P1150 | PVC, Teflon | 1.63' (0.5 m) | 1.66" (4.2 cm) | Polypropylene | 1/4 x 3/16" (6 x 5 mm) | 130 | 300' (90m) |
| T1300 | 316 S.S. and Teflon | 3.8' (1.16 m) | 1.00" (2.5 cm) | Stainless Steel | 1/4 x 3/8" (6 x 9 mm) | 220 | 300' (90m) |

* To choose 3/8" (9 mm) rather than 1/2" (13 mm) discharge tube option, add suffix M to pump model number.

**Intake Screen Specifications**

| Model No. | Material | Screen Size | Fits Pump Model(s) |
|---|---|---|---|
| 35200 | Stainless Steel | 0.01" (0.25 mm) mesh | T1200, T1250 |
| 37347 | PVC | .010" (0.25 mm) slot | P1101, P1101H |
| 37727 | PVC | .010" (0.25 mm) slot | P1250 (also P1101, P1101H) |
| 37733 | Teflon | .010" (0.25 mm) slot | T1100 |

Note: Pump models ST1101P, T1300 include intake screens. Screens are optional on other pump models, but are required for full 10-year warranty coverage.

**Materials Specifications**

| | |
|---|---|
| Stainless Steel: | Type 316 electropolished |
| PVC: | NSF-grade, extruded specifically for QED with no markings or lubricants. |
| Teflon (pumps): | duPont Teflon® and other premium PTFE resins |
| Teflon (bladders): | Q-flex exclusive 200,000 cycle rated PTFE. |

Teflon is a registered duPont trademark.

# *Dedicated Groundwater Monitoring Pumping System Specifications*

## 1.0 Manufacturer

The manufacturer shall have a minimum of 13 years experience providing pneumatic bladder pumps in groundwater monitoring applications. The manufacturer shall warranty all components for a minimum of one year. Bladder pumps with inlet screens shall be warranted for a period of 10 years. The manufacturer shall have a local, factory trained agent, and shall have OSHA certified technicians available for installation or start-up assistance. The manufacturer shall maintain a toll-free, 24-hour service line, 365 days a year, provide 24-hour service turnaround, have a minimum of eleven (11) years experience with a pump certification program as described in 1.21. Manufacturer's facility shall include a 300' test well for flow rate verification. Manufacturer must be capable of shipping all standard equipment within ten working days of receipt of order. The manufacturer shall provide an instructional video tape with the system.

## 1.1 Overview of Operation

An all pneumatic, bladder pump will pump water from a groundwater monitoring well. The pump will be driven by a portable cycle controller, with air supplied by a portable air compressor. Pump effluent will pass through a portable flow-through cell and water analyzer which will monitor temperature, pH, conductivity, ORP, and dissolved oxygen to indicate when stabilization has occurred.

## 1.2 System Components

**1.21 Pump.** Sampling pumps shall be positive gas displacement, pin construction bladder pumps, constructed such that no gas or liquid is introduced into the well or sample during the pumping operation. The pumps shall be fabricated of electro-polished 316 stainless steel with a Q-flex Teflon bladder. Bladders shall be field replaceable by replacement of the bladder only, and be warranted for a period of ten (10) years (if a pump inlet screen is used). Bladder life shall be rated for a minimum of 200,000 cycles. Bladder clamps shall be electro-polished 316 stainless steel Oetiker low profile earless type. Each pump shall be fitted with an electropolished inlet screen, having a screen opening size not to exceed 0.012 inches. The screen shall attach directly by means of three Allen set screws, to the stainless steel pump body for maximum strength. The

screens shall be fabricated of Type 316 stainless steel, and shall have a total surface area of 36 square inches. The screen length shall be eight (8) inches to provide stand off in wells with silt. These pumps shall be designed to pump water which may contain small amounts of fine silt and sand without accumulation of such materials in the pump or bladder. Each pump shall be provided with stainless steel, non-lubricated, replaceable nut compression (not barbed) fittings and hardware needed to connect sample discharge and air supply tubing. Sample pumps shall employ self-polishing, hard seat, internal check valves to eliminate wear prone elastomeric seals and avoid mineral deposit build up. The pump inlets shall be capable of easily adapting to optional flow reducers to reduce the pump refill rate when micropurging/ low flow purging. The pump inlets shall be threaded with 1/2" FNPT threads so as to be easily adapted to dip tubes for specific well applications. Pumps shall be capable of pumping dry without damage. All pumps and screens shall be laboratory-certified to be free of all EPA 601, 602, base neutral, and acid extractable contaminants. This shall be verified by soaking the pumps in lab-grade water for a minimum of 18 hours and analyzing the soak water. The analysis shall be performed by an independent certified laboratory. Copies of the analytical results with test batch numbers must be provided in writing with each pump.

**1.22 Sample Pump Tubing.** Tubing shall be sized to match the appropriate bladder pump fittings. The tubing bundles shall consist of an air supply line and water sample line that are continuously heat bonded to each other (no adhesives or mechanical fastener) for ease of handling, yet be manually separable and sealable via standard compression fittings. The tubing bundles shall be fabricated of polyethylene with the discharge tube lined with Teflon. All materials are to be 100% virgin grade with no regrind, additives or mold release agents used. The sample discharge tube shall provide a separate flow path without exposure to pump drive air, and be fully and continuously visible and accessible for inspection. Each tubing bundle shall be provided with a Type 316 stainless steel insert for maximum holding strength connection to the pump discharge fitting. The system shall be available with the tubing cut to exact length (to nearest foot) as specified by the customer, pre-assembled to pump and well cap and factory tested for leakage.

**1.23 Wellhead Assemblies.** Each wellhead assembly shall have a quick-connect fitting for attachment of the air supply line from the air source to the air supply line of the bladder pump. Each wellhead assembly shall have a flexible, corrugated Teflon discharge tubing of appropriate size for ease of sample collection. The corrugated discharge tubing shall be attached to the pump discharge tubing with an Oetiker 316 stainless steel ear clamp, and using a 316 stainless steel insert. Sample discharge line shall be compatible for use with in-line filter attachments.

**QED Environmental Systems, Inc.**
**MicroPurge™ System**
**Sole Source Justification**

QED Environmental Systems, Inc. is the sole vendor able to supply a complete MicroPurge system of its own manufacture to be used for low impact sampling. Only the Well Wizard® MicroPurge system components and accessories are designed to work as a totally integrated system and to achieve **all** the technical and commercial benefits that are associated with the low impact approach to groundwater sampling: **sample quality, method control, labor savings, flow control accuracy, reliability,** and where applicable **disposal costs.** Additionally, the Well Wizard MicroPurge System leads in the field of low flow sampling; proven both by numbers sold and years of use. It is the combination of these factors and the following criteria listed that make QED the sole source for a MicroPurge system.

The **Well Wizard Programmable Pump Controller/Model 400** was specifically designed to facilitate low flow sampling, making it an integral component of the MicroPurge System from QED. The 400 Digital Controller is capable of storing both site and well identification and timer settings for up to 10 sites and 50 wells per site. This feature insures consistency for subsequent sampling events even with changes in personnel. For micropurging, it is essential the controller be capable of accurately minimizing flow to 100 ml/min. or less. The 400 also has repeatable digital timer settings with 1/10th of a second intervals which allow for accurate adjustment, simplified flow rate control, which insures achievement low flow minimal draw down sampling efforts. The unique drive air regulator allows adjustment of the exact pump discharge pressure without cycling the controller, preventing the unnecessary loss of sample volume. The repeatability and accuracy of QED's Model 400 make it the desired controller for use with low-flow sampling.

NOW FC4000

The **Model FC2000 Water Analyzer** from QED allows for quick, easy monitoring of indicator parameters as requried when micropurging. The flow cell simultaneously measures, compensates, displays and records temperature, dissolved oxygen (DO), conductivity, pH, and oxygen/reduction (ORP) with a single probe and meter. The FC2000, unique in the instrumentation market, is the only flow cell with the capability of simultaneously reading pH and conductivity without drift. The probe may also be used downwell in 2" or larger wells or for surface water sampling. Characteristic only to the FC2000 unit are the specially engineered domed top design and flow distribution plates that eliminate dead space and turbulent flow. The resulting even flow insures accurate readings with quick response time to changes. The cell is designed to be used in its own case, and does not require a level surface at the well site to operate. The meter is capable of storing up to *199* sets of readings and may be downloaded via the RS-232 port.

**Well Wizard MicroPurge Pumps** are unequaled in terms of the reliability and durability they provide. This can be directly attributed to the most essential part of the pump, the bladder. Well Wizard bladders are made from an *exclusive* proprietary TFE formulation to provide the longest "flex life" in the industry, averaging over 200,000+ cycles. PFA and TEP formulations used by other manufacturers tend to average only a few thousand cycles. A certification program, a *standard* procedure exclusive to QED since 1986, insures that all Well Wizard pumps are **certified clean** for the absence of EPA 601, 602 acid extractables, and base neutral parameters. The analysis is performed by an independent qualified testing laboratory, and the resulting data is logged and stored. This certification is provided in writing with each pump. A comprehensive list of various pump accessories including tubing, caps and discharge adapters is available to complete pump portion of the Well Wizard Micro Purge System from QED.

# WELL WIZARD PUMP CERTIFICATION PROCEDURE

After cleaning of all components prior to assembly, all Well Wizard sampling pumps are passed through a rigorous certification procedure before they are shipped. Each batch of pumps to be tested is immersed in a sealed, high purity water bath for 24 hours, with samples taken of the water before and after the soak period. During the soak period the water is recirculated through all of the pumps, to ensure exposure of the internal and external surfaces of the pumps.

No pumps are released for shipment until the test results are received. Each pump is then tagged and shipped with the certification batch number. All results are kept on file, tying pump serial numbers to the specific analytical test results from the pump batch.

In addition to the certification of the sampling pumps, QED keeps a file of vendor affidavits verifying that suppiled materials meet QED's purity and handling requirements. Tubing, packaging materials and raw materials are batch certified at regular intervals.

## EVALUATING PUMP CERTIFICATION RESULTS

Enclosed you will find the analytical results of the Well Wizard pump certification batch which included pumps shipped to you. The procedure employed in pump certification is detailed on the attached sheet labeled Well Wizard Pump Certification Procedure.

Note that QED has employed a 20 ppb cut-off limit for any parameter in the total group being analyzed for; pumps with any parameter above 20 ppb are not certified. The level of any parameter that does show up between the detection limit for the parameter and the 20 ppb cut-off is not related to levels detected in actual monitoring use for the following reasons:

1. Certification tests both internal and external surfaces.

2. The ratio of pump surface area(s) to water volume is much higher than that found in monitoring wells.

3. Most importantly, the certification allows pumps to soak for 24 hours in contrast to the 10 second exposure to the internal pump surface a sample normally experiences in actual use.

The results of the certification procedure are carefully monitored by our production and engineering staff. Testing has confirmed that limits of detection for the certification procedure we employ are two or more orders of magnitude better that what would be detected in a normally pumped sample taken with a Well Wizard Teflon bladder pump. What this means is that the 20 ppb cut-off limit employed in the certification procedure translates to a 0.2 ppb cut-off limit for actual pump use.

## WELL WIZARD CLEANING PROCEDURES

The following outlines QED's Well Wizard sampling pump cleaning procedures.

1. All pump parts are batch cleaned in an alkaline, non-organic industrial cleaning solution (Alconox type) maintained at 130 degrees Fahrenheit.
2. The parts are rinsed with 130 degree F tap water.
3. The parts are double washed with water which has been treated as follows:
    a. Tap water is filtered to remove particulates.
    b. The filtered water is passed through an activated carbon column to remove organic compounds.
    c. The water is passed through a series of ion-exchange columns to remove inorganic compounds.
4. Assembly and pump testing is done using the treated water.