



June 25, 2008

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Caermen J.	8/6/08	DIN 5464

Mr. Ed Mussler, PE
North Carolina Division of Solid Waste Management
Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Re: City of Winston-Salem Solid Waste Permit No. 34-12
Old Salisbury C&D Landfill Closure/Post-Closure Plans
HDR Project No. 00162-13625-018

Dear Mr. Mussler:

HDR Engineering Inc. of the Carolinas is submitting, on behalf of the City of Winston-Salem (City), a Closure and Post-Closure Plan for the Old Salisbury Road Construction and Demolition Debris Landfill as required under the North Carolina Department of Environment and Natural Resources (NCDENR) Solid Waste Management Rule 15A NCAC 13B Section .0547 (2). Three copies have been included for your review. Financial Assurance documentation has been submitted by the City under separate cover.

If you have any questions regarding this certification, please contact me at (704) 338-6843.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Michael D. Plummer, PE
Project Engineer

MDP/apb

cc: Mrs. Jan McHargue, PE – City of Winston-Salem
Mr. Edward Gibson, PE – City of Winston-Salem



CLOSURE & POST-CLOSURE PLANS

OLD SALISBURY ROAD C&D LANDFILL WINSTON-SALEM, NORTH CAROLINA

JUNE 2008



Prepared for

City/County Utility Commission
City of Winston-Salem
P.O. Box 2511
Winston-Salem, NC 27102

Prepared by

HDR

HDR Engineering, Inc. of the Carolinas
128 S. Tryon St., Suite 1400
Charlotte, NC 28202

HDR Project No. 00162-13625-018

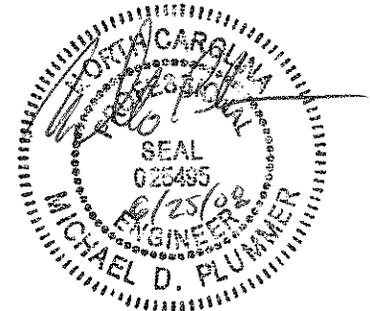


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SECTION 1.0 CLOSURE PLAN

1.1 Cap System Background

In compliance with the State Solid Waste Management Rule 0.543, the Old Salisbury Road (OSR) Landfill will place a final cap system over all waste placed in the approximately 26 acre footprint of Phases IV, V, and VI of the landfill. The layers of the cap system will be designed and constructed with a low permeable layer under an erosion layer. It is estimated that the total landfill volume for Phases IV, V, and VI at completion will be **2,251,000 CY** (gross capacity) or **2,236,000 CY** (C&D waste, weekly cover and intermediate cover). The maximum area requiring a cap at any one time shall be **26.4** acres.

1.2 Cap System Design

Compacted soil liners will be incorporated in the cap system design to provide protection throughout the 30-year post-closure period. The system will consist of two layers (bottom up): the compacted soil liner and the erosion layer. The compacted soil liner forms a composite barrier designed to reduce infiltration into the Landfill, thus minimizing leachate and the potential for groundwater contamination. The erosion layer is designed to provide vegetation and minimize erosion.

The Landfill may use on- or off-site borrow material for the compacted soil layer and erosion layer. The compacted soil liner will consist of no less than **18 inches** of soil having permeability equal to or less than **1 x 10⁻⁵ cm/sec**. In order to assure that the material meets the permeability criteria, the soil will be tested prior to use and during placement. It is anticipated that the upper **12 inches** of the intermediate cover will be suitable for compaction and incorporation into the compacted soil layer. Construction methods for the compacted soil 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 soil liner installation conforms with the plans approved by the NCDENR Division of Solid Waste Management.

The erosion layer will consist of no less than **18 inches** of earthen material capable of sustaining native plant growth. It is anticipated that this layer will consist of 18 inches of suitable on-site or off-site borrow material.

The materials of the erosion layer will be selected considering soil type, nutrient levels, pH, erodibility, sideslope drainage, and other factors. The vegetation will be selected based upon the following characteristics.

- 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 putrescible material, solid waste, vegetation, rocks, construction debris, frozen soil, and other deleterious materials.

1.3 Final Contour Requirements

The final contour requirements for closure are shown on the **Drawing C-01**. These contours represent the top of the erosion layer and have been established to reflect all C&D waste expected to be received, intermediate cover material, and the final cover system (representing a total of 3 feet).

The Landfill is designed to have top slopes of eight percent and side slopes of 3H:1V. Final contours have been established to allow the Landfill's surface water to drain off the final cover while limiting erosion potential and maintaining post settlement slopes greater than five percent. A system of sideslope diversion channels, slope drains, and perimeter channels are designed to convey the runoff to one of seven adjacent sedimentation basins.

1.4 Cap System Material Requirements

Based on **18 inches** of compacted soil placed over the areas that require final closure of the unit, **63,888 CY** of compacted soil are required for the first layer of the cap system. A minimum of **63,888 CY** is required for the erosion layer.

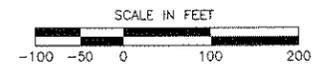
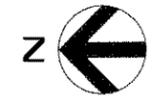
The following table summarizes the cap system requirements for OSR C&D Landfill.

Cap System Requirements	
18 inch Compacted Soil Liner	63,888 CY
18 inch Erosion Layer	63,888 CY

1.5 Erosion Control Measures

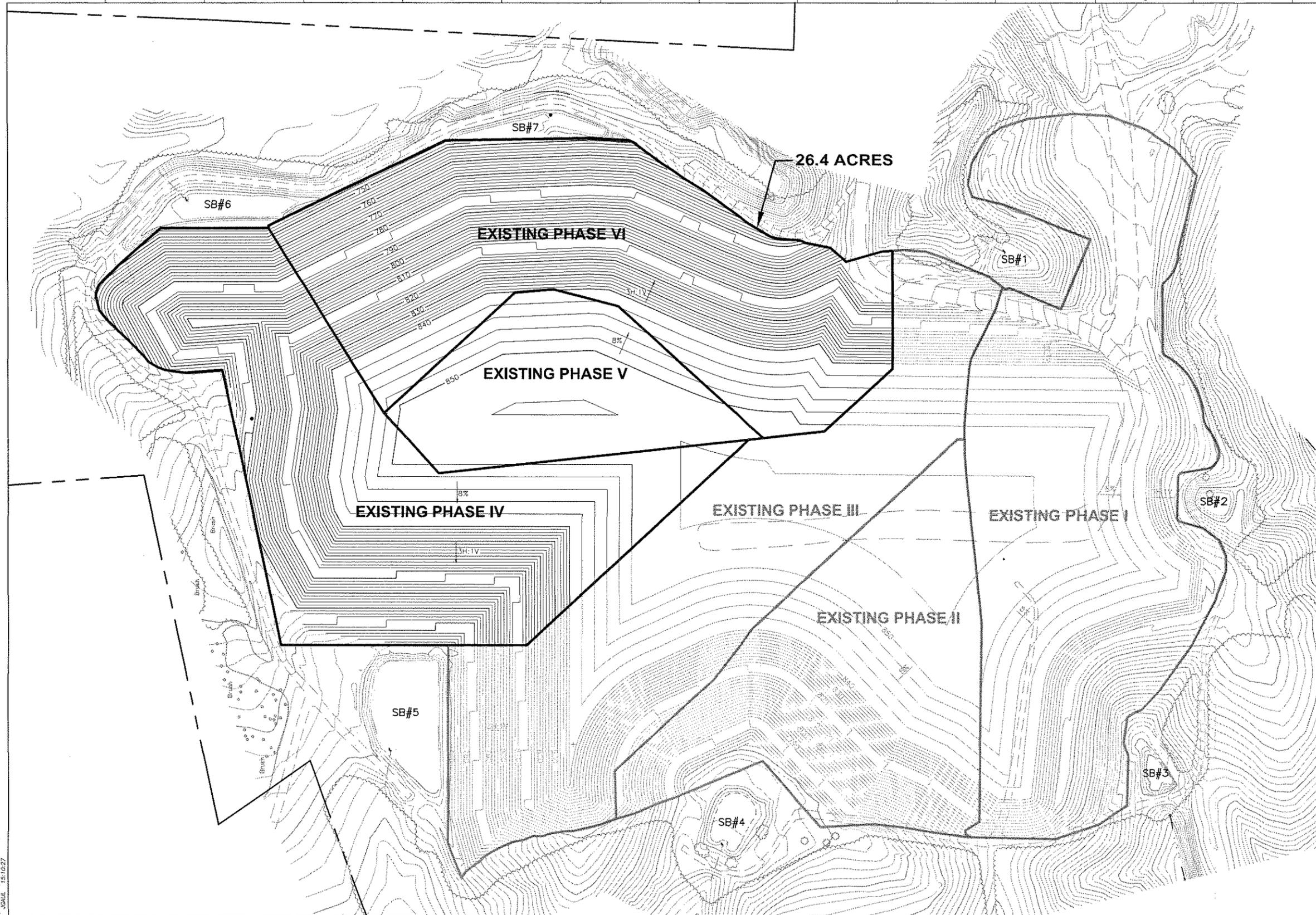
The sedimentation basins were designed to control the 24-hour 25-year storm event. The sedimentation basin design calculations may be found in the calculations section of the OSR Phases IV, V, and VI Construction Permit Application.

A B C D E F G H I J K L M N O P



NOTES

1. PHASE I-IV TOPOGRAPHIC INFORMATION INDICATES PERMITTED CONTOURS.
2. TOPOGRAPHIC INFORMATION OUTSIDE OF PHASES I-VI PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED JAN 3, 2008.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. PROPOSED FINAL CAP CONTOURS ARE SHOWN AT THREE HORIZONTAL TO ONE VERTICAL SLOPE WITH A FIFTEEN FOOT WIDE BENCH EVERY THIRTY VERTICAL FEET.
5. THE OVERALL HEIGHT OF THE LANDFILL IS NOT CHANGED FROM THE ORIGINAL PERMITTED CAP.
6. LOCAL GOVERNMENT APPROVAL WAS GRANTED ON NOVEMBER 15, 2002 TO CHANGE THE EXTERIOR SLOPES FROM A FOUR HORIZONTAL: ONE VERTICAL TO A THREE HORIZONTAL: ONE VERTICAL.



LEGEND

- 770 EXISTING CONTOUR
- PHASING LIMITS
- 770 PROPOSED CONTOUR
- PROPERTY LINE

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 06/12/2008 2:11:03 PM
 /CLTSMAN/DWG_P/70016555.018/52502-C06.DWG
 P2-13-02 -JGAL
 75.10.27

Issue No.	Description	Date	Drawn	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL					

HDR
 HDR Engineering, Inc.
 of the Carolinas
 Suite 1400
 128 S. Tryon Street
 Charlotte, NC 28202-5009
 (704) 338-6700

Project Manager	J.C. READLING, P.E.
Designed	M.D. PLUMMER, P.E.
Checked	
Drawn	J. GAUL

**OSR C&D LANDFILL
 PHASE IV, V, AND VI**

WINSTON-SALEM NORTH CAROLINA

Date	JUNE 2008	Project No.	00162-13625-018	Drawing No.	C-01	Issue	A
Scale	AS SHOWN	File Name					

1.6 Settlement Subsidence and Displacement

Landfill compaction methods, which include the use of steel-wheeled compaction equipment to spread and compact in layers, 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 long-term positive drainage of the fill will not be hindered.

1.7 Gas Collection/Venting System

It is anticipated that passive gas venting system will be installed to allow movement of gas generated from the completed fill area. The gas collection system will be designed prior to closure.

1.8 Schedule for Closure

Currently the Old Salisbury Road C&D landfill holds a Permit to Construct Phases IV, V, and VI dated October 7, 2005. The next Permit to Construct is a vertical expansion over Phase IV, V, and VI and therefore the City of Winston-Salem will request the closure timeline extension in accordance with Rule .0543(c)(5). The closure activities will begin no later than 30 days after the known final receipt of waste.

Areas at final design grade will be closed within 180 days unless an extension has been requested and received which identified the need for an increase schedule in accordance with Rule .0543(c)(6).

1.9 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. Prior to beginning closure of the unit or portions thereof, the NCDENR Department of Solid Waste Management will be notified that a notice of intent to close has been placed in the operating record.

1.10 Closure Verification

The following procedures will be implemented following closure.

- A CQA report shall be submitted to the NCDENR Division of Solid Waste Management. This CQA 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 Solid Waste Management and a copy will be placed in the operating record.
- 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 recorded in the RMC office.
- 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 .0543(c). A copy of the deed notation as recorded shall be filed with the operating record.

1.11 Cost Estimate of Closure Activities

The following table gives a cost estimate for closure construction at the OSR Landfill, Phases IV, V, and VI.

**CITY/COUNTY UTILITY COMMISSION OSR LANDFILL
OSR LANDFILL CLOSURE CONSTRUCTION COST
26.4 ACRES (Phases IV through VI) ¹**

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
MOBILIZATION, CQC, PROJECT ADMIN., BONDS	1	LS	4.00%	\$128,800
NUMBER OF ACRES TO CONSTRUCT:	26.4 ²			
SURVEYING AND CONTROL	26.4	ACRE	\$3,000	\$79,200
EROSION AND SEDIMENT CONTROL AND MAINTENANCE	26.4	ACRE	\$5,000	\$132,000
GRADING PREPARATION	26.4	AC	\$5,900	\$155,800
MISCELLANEOUS STRUCTURAL FILL	35,000	CY	\$5.00	\$175,000
CONSTRUCT COMPACTED SOIL LINER (18" THICK)	63,888	CY	\$18.00	\$1,150,000
CONSTRUCT EROSION LAYER (18" THICK)	63,888	CY	\$5.00	\$319,400
CONSTRUCT GAS COLLECTION SYSTEM	26.4	ACRE	\$35,000.00	\$924,000
TOE DRAIN	2,100	LF	\$12.00	\$25,200
CONSTRUCT DRAINAGE BERMS	2,400	LF	\$12.00	\$28,800
PERIMETER RIP-RAP CHANNEL	3,200	TONS	\$45.00	\$144,000
CONSTRUCT DOWNCHUTES	2,000	LF	\$25.00	\$50,000
FURNISH AND INSTALL SEEDING AND MULCHING	26.4	ACRE	\$1,400	\$37,000
Sub Total	-	-	-	\$3,349,200
CONTINGENCY	5%			\$170,800
ENGINEERING	26.4	ACRE	\$2,000	\$52,800
CONSTRUCTION MANAGEMENT	2%	PERCENT	\$3,349,200	\$67,000
CQA	26.4	ACRE	\$5,000	\$132,000
TOTAL COSTS	-	-	-	\$3,828,400
Cost per Acre	-	-	-	\$145,000

Notes:

1. Phases IV, V, and VI are estimated based on the new regulatory cap system.
2. Covers Phases IV, V, and VI (25 Ac) plus a slope factor.
3. Unit prices are estimated in 2007 dollars.
4. Soil Liner is 1 X 10-5 cm/sec material from off site location within 10 miles.
5. All other soils are from onsite.
6. Gas Collection System has not been fully designed and therefore the estimated is subject to change.

SECTION 2.0 POST-CLOSURE PLAN

2.1 Introduction

This Post-Closure Plan has been developed to outline steps to be taken to ensure the environmental soundness of the Landfill Phases IV, V, and VI 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 will be restricted. Any proposed use will be evaluated to determine its potential for posing a significant health hazard.

2.2 Post-Closure Contact

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

Solid Waste Administrator
City/County Utility Commission
City of Winston-Salem
PO Box 2511
Winston – Salem, NC 27102
(336) 747-7310

2.3 Description of Use

After the unit is officially closed in accordance with the Closure Plan, the area will be allowed to return to a natural vegetative state. The City will maintain control of the property and prevent public access to it during the post-closure period.

There will be an access road on the cap to allow proper maintenance during post-closure. Final location of the access will be determined as a part of operations and Closure Plan.

2.4 Maintenance

2.4.1 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.

2.4.2 Erosion Damage Repair

If erosion of the final cover occurs during post-closure, the affected area will be repaired and re-seeded 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 revegetation of slopes and to secure topsoil in place. Rough surfaces, which cause isolated erosion areas will be smooth and re-seeded as necessary.

2.4.3 Correction of Settlement, Subsidence, and Displacement

Minimum slopes of five percent will be maintained 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.

2.4.4 Repair of Run-On/Run-Off Control Structures

All side slope 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.

2.4.5 Gas Collection/Venting System

The landfill gas collection and venting system will be inspected and maintained. Proper operation of the systems is verified through testing at the landfill gas monitoring wells and probes.

2.4.6 Groundwater Monitoring System

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 to 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.

2.5 Monitoring Plan

The closed unit shall be monitored for 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, and to protect human health and the environment.

2.5.1 Inspection Frequencies

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

Inspection Activity	Years 1-3	Years 4-30
Security Control Devices	Quarterly	Quarterly
Cover Drainage System Functioning	Quarterly	Semiannually
Gas Collection/Venting System	Quarterly	Semiannually
Groundwater Monitoring System	Semiannually	Semiannually
Erosion Damage	Quarterly	Semiannually
Cover Settlement, Subsidence, and Displacement	Quarterly	Semiannually
Vegetative Cover Condition	Quarterly	Semiannually
Stormwater Control System	Quarterly	Semiannually
Benchmark Integrity	Annually	Annually

A copy of the Post-Closure Inspection Checklist is included as Figure 2-1 on the following page.

**FIGURE 2-1
POST-CLOSURE INSPECTION CHECKLIST**

Location: _____

Date: _____

Time: _____

Weather: _____

Completed By: _____

	<u>Yes</u>	<u>No</u>
I. Security Control Devices		
Are security control devices in place and functioning?	<input type="checkbox"/>	<input type="checkbox"/>
Are all warning signs prominent and legible?	<input type="checkbox"/>	<input type="checkbox"/>
Are there any signs of unauthorized entry on the site?	<input type="checkbox"/>	<input type="checkbox"/>
Are there signs of illegal dumping on site?	<input type="checkbox"/>	<input type="checkbox"/>
II. Final Cover System		
Is the final cover free of erosion and depressions?	<input type="checkbox"/>	<input type="checkbox"/>
Is there leachate seeping from the final cover? (If yes, make note of location in comment section below).	<input type="checkbox"/>	<input type="checkbox"/>
Is the vegetative cover continuous and in good condition, free of bare spots?	<input type="checkbox"/>	<input type="checkbox"/>
Does the site require mowing? (If yes, mow grass and note in comment section below).	<input type="checkbox"/>	<input type="checkbox"/>
Is there ponding of water on final cover system?	<input type="checkbox"/>	<input type="checkbox"/>
III. Groundwater Monitoring Wells		
Is the casing upright and unobstructed?	<input type="checkbox"/>	<input type="checkbox"/>
Is the outer casing secure and locked?	<input type="checkbox"/>	<input type="checkbox"/>
Is the ID tag present and legible?	<input type="checkbox"/>	<input type="checkbox"/>
IV. Miscellaneous		
Are all benchmarks visible and intact?	<input type="checkbox"/>	<input type="checkbox"/>
Are all ditches free of debris and litter?	<input type="checkbox"/>	<input type="checkbox"/>
Are any odors present which may indicate landfill gas migration?	<input type="checkbox"/>	<input type="checkbox"/>

2.5.2 Quarterly Inspections

Quarterly inspections of the closed site will include examination of the security control devices for signs of deterioration or vandalism to ensure access to the site is limited to authorized persons.

2.5.3 Semiannual Inspections

Semiannual inspections of the site during the post-closure period will be conducted by the Owner or Owner's representative with attention paid to the integrity of the final cover system. This includes inspection for erosion damage, a good stand of vegetative cover, and cover settlement, subsidence, and displacement. Drainage ditches will be cleared of litter and debris, benchmark integrity will be noted and maintained as well as the integrity 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 post-closure inspection protocol. A report of findings will be made to the responsible party 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 inspection reports and respond to any comments that demand immediate attention.

2.6 Engineering Certification

Based on the monitoring reports and semiannual site visits, annual certifications by the owner or owner's representative will be placed in the operating record. They will certify that the post closure plan is being 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 NCDENR.

2.7 Cost Estimate of Post Closure Care Activities

Table 2.7-2 gives a cost estimate of the Post Closure Care activities.

**Table 2.7-2
CITY/COUNTY UTILITY COMMISSION OSR LANDFILL
ENGINEERING OPINION OF PROBABLE POST-CLOSURE COST
56 ACRES, 30-YEAR TERM**

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
SECURITY FENCE REPAIR	30	YEAR	\$2,000	\$60,000
EROSION, SETTLEMENT REPAIR & REVEGETATION				
YEARS 0-5	5	YEAR	\$40,000	\$200,000
YEARS 6-10	5	YEAR	\$20,000	\$100,000
YEARS 11-30	20	YEAR	\$5,000	\$100,000
SEDIMENT BASIN CLEANOUT (20 hours/basin, 9 basins, cleaned once/5 years)	900	HOURS	\$100	\$90,000
SEEDING (2 acres/year for 30 years)	60	ACRE	\$2,000	\$120,000
MOWING (2 times/year over 56 acres for 30 years)	3,360	ACRE	\$40	\$134,400
GAS MONITORING	60	Semiannually	\$5,000	\$300,000
GROUNDWATER & SURFACE WATER MONITORING	60	Semiannually	\$15,000	\$900,000
SITE INSPECTIONS				
YEARS 0-5	20	Quarterly	\$2,000	\$40,000
YEARS 6-30	50	Semiannually	\$2,000	\$100,000
ELECTRICITY/LIGHTING	30	YEAR	\$4,000	\$120,000
POST CLOSURE CERTIFICATION (at year 30)	1	EACH	\$25,000	\$25,000
Sub Total	-	-	-	\$2,323,800
			30-YEAR TOTAL COST :	\$2,323,800
			AVERAGE ANNUAL COST	\$77,500
			Phase 1,2,3 PC Cost:	\$1,285,757
			Phase 4,5,6 PC Cost:	\$1,038,043