

Permit No.	Date	Document ID No.
18-04	November 3, 2008	6066

RECEIVED

October 28, 2008

Solid Waste Section

Asheville Regional Office

APPROVED DOCUMENT

Division of Waste Management

Solid Waste Section

Date **December 6, 2013** By **LY Frost**

CLOSURE AND POST-CLOSURE PLAN
MARSHALL STEAM STATION ASBESTOS LANDFILL
CATAWBA COUNTY, NORTH CAROLINA
S&ME Project No. 1356-08-107



Prepared for:
Duke Energy
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Charlotte, North Carolina, 28202

Prepared by:



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Charlotte, North Carolina 28273

September 3, 2008

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FIGURES

Figure 1 Marshall Steam Station Asbestos Landfill

APPENDICES

Appendix I	Permit Drawings (Cover System Plans and Details)
Appendix II	Asbestos Landfill Permit
Appendix III	Technical Specifications
Appendix IV	Cover System Design Analyses
Appendix V	Borrow Area Information
Appendix VI	Post-Closure Observation Form
Appendix VII	Contact Information

1. INTRODUCTION

1.1 Introduction

The following Closure and Post-Closure Plan was prepared for the Marshall Steam Station Asbestos Landfill to establish criteria for closure and requirements for post-closure compliance. This Closure and Post-Closure Plan was prepared in general accordance with Title 15A Subchapter 13B of the North Carolina Administrative Code (NCAC) Rules .0501 through .0510. Duke Energy will use this Closure and Post-Closure Plan to close the Asbestos Landfill and provide post-closure maintenance and monitoring during the post-closure care period.

1.2 Project Information

Marshall Steam Station is located on 8320 East Highway 150 in Terrell, North Carolina. The Asbestos landfill is located on Duke Energy property to the north of a previously closed ash landfill. The Asbestos landfill is bordered to the north by an existing borrow area, to the east and south by an access road, and to the west by an existing ash basin. The landfill site and surrounding vicinity are illustrated on Figure 1. A more detailed illustration of the site conditions is provided in Drawing 1 (Existing Conditions) provided in Appendix I.

The Asbestos landfill on Duke Energy property is a part of the North Carolina Department of Environment and Natural Resources (NCDENR) landfill permit No. 18-04, issued in 1983. Landfill permit No. 18-04 encompasses 3 areas. Area 1 consists of a 58-acre flyash landfill, located to the south of the Asbestos landfill, which was closed in 2001. Area 2 consists of an asbestos landfill located to the northwest of the ash landfill with an original permitted area of 38.1 acres. Area 3 consists of the C&D landfill which has an original permitted area of 2.9 acres. Surface drainage from the Asbestos landfill flows to an existing ash basin (NPDES Permit No. NC0004987).

The NCDENR Solid Waste Section issued revised regulations for the closure of existing C&D landfills in January 2007 in North Carolina Administrative Code Title 15A Chapter 13B Section .0532 through .0547. These rules contain more extensive closure requirements than the previous rules for closure found in Section .0510. The revised rules state that C&D landfills that receive no waste after June 30, 2008 can be closed under the requirements of Section .0510 and the conditions of the existing permit. The existing Asbestos landfill was permitted as a modification to landfill permit No. 18-04. The permit medication, including cover system requirements is provided in Appendix II. The Marshall Asbestos Landfill operations stopped on or before June 30, 2008 and the landfill is being closed in accordance with Section .0510 and the conditions of the existing permit.

2. CLOSURE PLAN

2.1 Cover System

The cover system has been developed to resist erosion and to isolate the underlying waste from exposure and contact. Construction drawings and technical specifications were prepared for cover system construction. Construction drawings are provided in Appendix I. Technical specifications are provided in Appendix III.

Consistent with the existing permit conditions, the proposed cover system consists of a 36-inch thick soil layer including a 30-inch thick structural fill overlain by a 6-inch thick vegetative soil layer. **The existing landfill cover and slope will not be regraded.** Limited structural fill will be placed to establish cover system subgrade with adequate slopes to promote stormwater drainage. The cover system will be constructed over the subgrade to provide a minimum three percent and a maximum of 3 horizontal to 1 vertical (33 percent) side slopes.

2.1.1 Structural Fill

Structural fill will make up at least 30 inches of the proposed soil cover system. Structural fill soils will be obtained from an on-site borrow source. The bottom 12 inches of the structural fill (placed directly on top of proposed subgrade) may consist of fly ash or bottom ash. The top 18 inches of structural fill must be comprised of natural soil materials.

2.1.2 Vegetative Soil

Vegetative soil shall make up at least 6 inches of the proposed cover system. Vegetative soil will be obtained from on-site sources and amended as necessary to provide the organic content, nutrients, and characteristics to establish grass cover.

2.1.3 Borrow Area

S&ME conducted a limited borrow area study to evaluate the quantity and suitability of on-site soil sources for cover system construction. The proposed borrow area is located immediately north of the Asbestos Landfill. The borrow area evaluation consisted of advancing hand-auger borings and observing/documenting soil conditions. The hand auger boring logs are presented in Appendix V. The borrow area evaluation results indicate the quantity and quality of soil required for landfill closure is available on-site.

2.2 Landfill Gas

Based on the typically inert nature of Asbestos waste, (i.e. low if any organic content and potential for organic decomposition and landfill gas formation) the potential for landfill gas generation is anticipated to be low. Considering the low gas generation potential and that the Asbestos landfill is relatively small a landfill gas venting system is not proposed. In the event that landfill gas effects are observed after cover construction, such as distressed and dying vegetation and landfill gas odors, the conditions will be evaluated and addressed at that time.

2.3 Storm Water Management Systems

The cover system has been designed with a network of storm water controls and conveyances to manage storm water upon final closure. Storm water will be collected and conveyed through a network of drainage ditches and down-drain pipes to the down-gradient perimeter of the landfill. Plans and details illustrating the storm water management system are provided in Appendix I. Engineering analyses supporting the storm water management system design are provided in Appendix IV.

2.4 Closure Schedule

Duke Energy will begin closure activities as soon as reasonably practical after the date on which the area receives the known final receipt of wastes. Duke Energy will complete closure activities in accordance with the Closure Plan. Following closure of the Asbestos landfill, Duke Energy will notify the NCDENR that a certification, signed by the Engineer verifying that closure has been completed in accordance with the Closure Plan, has been placed in the operating record.

Following closure of the Asbestos landfill, Duke Energy will record a notation on the deed to the facility property, or some other instrument that is normally examined during title search, and notify the Division that the notation has been recorded, and a copy has been placed in the operating record. The notation on the deed shall in perpetuity notify any potential purchaser of the property that:

- The land has been used as a landfill facility; and
- Its use is restricted under the Closure Plan approved by NCDENR.

2.5 Security

Landfill area security is provided by restricting site access. Site access is restricted by fences, gates, and terrain around the Duke Energy property. Access is controlled at the entrance gate by security guards where sign in/out is required.

3. POST-CLOSURE PLAN

3.1 General

The Post-Closure Plan outlines the monitoring and maintenance activities intended to maintain cover system integrity during the post-closure period. The proposed post-closure period is 5 years. During the post-closure period the landfill cover system and related facilities will be monitored and maintained.

3.2 Maintenance Activities

Maintenance required for the final cover is anticipated to be minimal. The vegetative cover shall be mowed at least once a year. The vegetative cover shall be amended and fertilized as needed to maintain healthy vegetation. Depressions in the cover that pond water or otherwise impair the function of the final cover will be filled and/or regraded. Areas subject to regrading will be revegetated. Animal burrows and eroded areas should be filled in and reseeded. If vegetative cover is not adequate in a particular area, fertilizer should be applied and the area re-seeded in order to re-establish vegetation. Insecticides may be used to eliminate insect populations that are detrimental to the vegetation. Deep-rooted or woody vegetation that may have established itself on the cover soil will be removed.

3.3 Monitoring Activities

Post-closure monitoring will be conducted quarterly for the first two years and semi-annually thereafter for the remainder of the post-closure period. The following cover system and landfill components will be monitored:

- surface water management systems for signs of erosion, sedimentation, and condition;
- cover system for signs of erosion;
- cover system for evidence of settlement or subsidence; and
- condition and/or presence of vegetation (for distressed or dying vegetation, woody vegetation).

Post-closure monitoring will be documented on post-closure monitoring forms. Post-Closure Observation forms are provided in Appendix VI. Completed post-closure monitoring forms will be maintained in the facilities operating record.

3.3.1 Groundwater Monitoring

We note that the Asbestos Landfill was permitted within a portion of the old ash landfill footprint (permit No 18-04) for which groundwater monitoring is conducted. However, there is currently no groundwater monitoring conducted specifically for the Asbestos Landfill. Asbestos landfill groundwater monitoring is not proposed.

3.3.2 *Surface Water Monitoring*

Surface water monitoring specific to the Asbestos Landfill is not proposed. We note that the Asbestos Landfill is tributary to the existing active ash basin (NPDES Permit No. NC0004987) for which surface water monitoring is conducted.

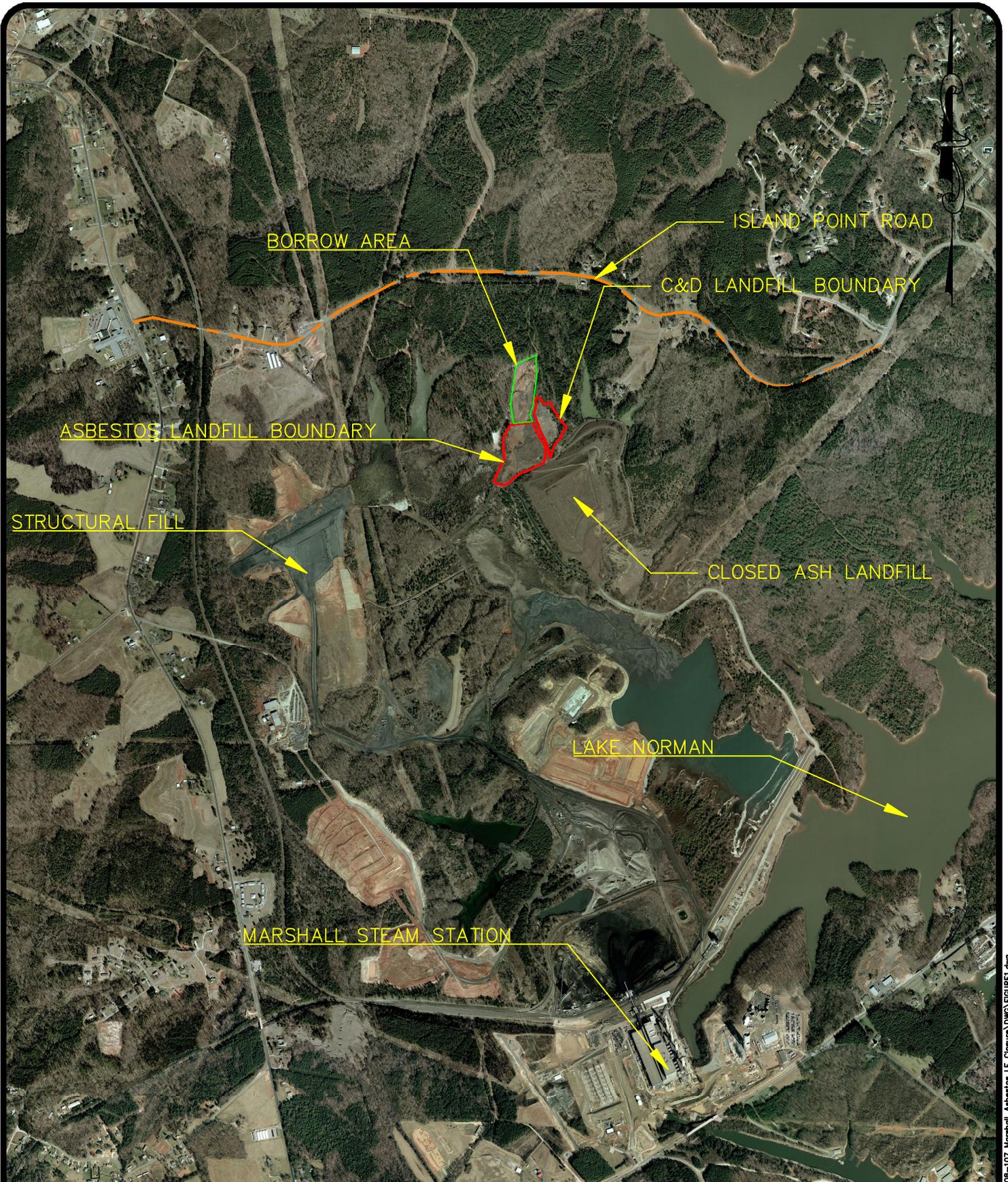
3.4 Facility Contact

The post-closure maintenance of the landfill will be the responsibility of Duke Energy. Relevant contact information is provided in Appendix VII.

3.5 Post-Closure Planned Use

Following closure operations, the landfill will be closed and grass will be planted and maintained. Duke Energy will maintain control of, and limit access to the facility. No post-closure use is proposed at this time. In the event the post-closure planned use is changed, Duke Energy shall obtain prior approval from NCDENR.

FIGURES



SCALE: 1-IN:1600-FT
 DATE: 8-15-2008
 DRAWN BY: WMH
 PROJECT NO: 1356-08-107



SITE VACINITY MAP
 ASBESTOS LANDFILL CLOSURE
 DUKE ENERGY-MARSHALL STEAM STATION
 CATAWBA COUNTY, NC

FIGURE NO.
 1

G:\1356\DUKE ENERGY\08-107 Marshall Asbestos LF Closure\DWG\FIGURE1.dwg

APPENDIX I – COVER SYSTEM PLANS AND DETAILS

FINAL CLOSURE PLAN

ASBESTOS LANDFILL CLOSURE

ISSUED FOR CONSTRUCTION

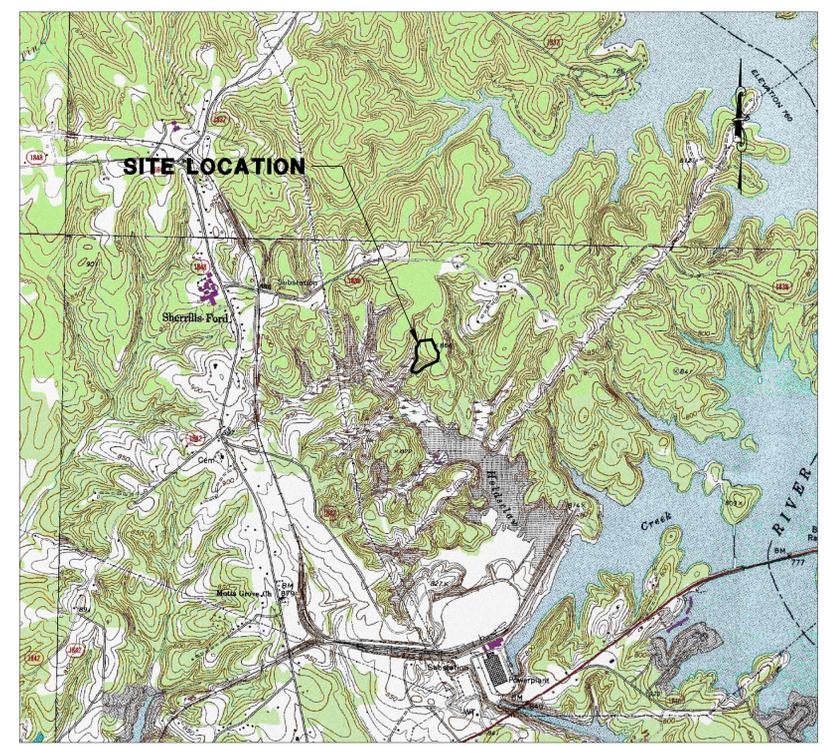
DUKE ENERGY - MARSHALL STEAM STATION

CATAWBA COUNTY, NORTH CAROLINA

OCTOBER 2008



LOCATION / S&ME OFFICE MAP
NOT TO SCALE



SITE VICINITY MAP
NOT TO SCALE

INDEX OF DRAWINGS

DRAWING	TITLE
1	EXISTING CONDITIONS MAP
2	PROPOSED SUBGRADE PLAN
3	PROPOSED FINAL COVER PLAN
4	BORROW AREA AND TOPSOIL BORROW AREA PLAN
5	DETAILS I
6	DETAILS II



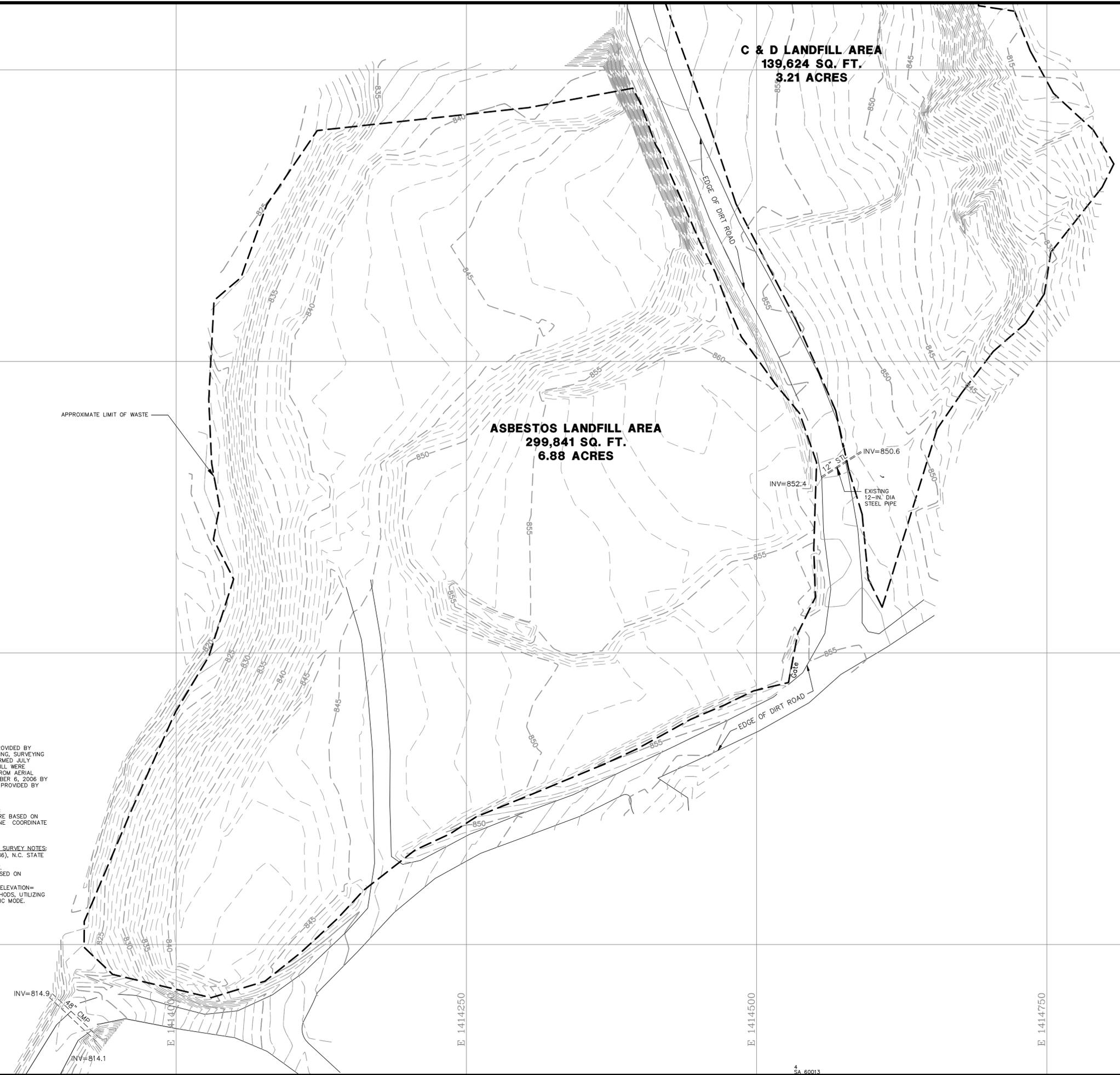
9751 SOUTHERN PINE BLVD.
CHARLOTTE, NC 28273
(704) 523-4726
(704) 525-3953 Fax
WWW.SMEINC.COM

N 686000

N 685750

N 685500

N 685250



C & D LANDFILL AREA
139,624 SQ. FT.
3.21 ACRES

ASBESTOS LANDFILL AREA
299,841 SQ. FT.
6.88 ACRES

APPROXIMATE LIMIT OF WASTE

EDGE OF DIRT ROAD

EDGE OF DIRT ROAD

EXISTING 12-IN. DIA STEEL PIPE

INV=852.4

INV=850.6

INV=814.9

INV=814.1

REFERENCE:
 LANDFILL TOPOGRAPHIC CONTOURS PROVIDED BY CHAS. H. SELLS, INC., CIVIL ENGINEERING, SURVEYING AND PLANNING, FROM SURVEY PERFORMED JULY 2008. CONTOURS OUTSIDE OF LANDFILL WERE OBTAINED FROM TOPOGRAPHIC MAP FROM AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 6, 2006 BY NOVA SURVEYING AND MAPPING, INC. PROVIDED BY DUKE ENERGY.

CHAS. H. SELLS, INC., SURVEY NOTES:
 1. BASIS OF BEARINGS: BEARINGS ARE BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NAD 83/86.
 2. ELEVATIONS BASED ON NAVD 88.

NOVA SURVEYING AND MAPPING, INC., SURVEY NOTES:
 1. HORIZONTAL DATUM: NAD 83 (1986), N.C. STATE PLANE COORDINATES, FEET.
 2. VERTICAL DATUM: NAVD 88 FEET.
 3. HORIZONTAL CONTROL DATA BASED ON MARSHALL MONUMENT "MCP-5" (N=678,732.56, E=1,414,680.01, ELEVATION=807.55 (F.)); TIED BY GPS METHODS, UTILIZING TRIMBLE 4400 RECEIVERS IN STATIC MODE.

LEGEND
 --- EXISTING MAJOR CONTOUR (5')
 --- EXISTING MINOR CONTOUR (1')
 --- APPROXIMATE LIMIT OF WASTE (NOTE 1)

NOTES:
 1. LIMIT OF WASTE WAS FIELD DELINEATED BY DUKE PERSONNEL AND LOCATED BY FIELD SURVEY.

(IN FEET)
 1 inch = 40 ft.



NO.	DATE	DESCRIPTION	BY
1	10-10-08	ISSUED FOR CONSTRUCTION	

EXISTING CONDITIONS MAP
ASBESTOS LANDFILL CLOSURE
DUKE ENERGY - MARSHALL STEAM STATION
CATAWBA COUNTY, NORTH CAROLINA

DRAWN BY:	CHECKED BY:
CLD	KRD
DESIGNED BY:	APPROVED BY:
CLD	KRD
PROJECT NUMBER:	DATE:
1356-08-107	10-10-08
SCALE:	AS SHOWN
1	6

N 686000

N 685750

N 685500

N 685250

APPROXIMATE LIMIT OF WASTE
SEE NOTE 3.

REFERENCE:
LANDFILL TOPOGRAPHIC CONTOURS PROVIDED BY CHAS. H. SELLS, INC., CIVIL ENGINEERING, SURVEYING AND PLANNING, FROM SURVEY PERFORMED JULY 2008. CONTOURS OUTSIDE OF LANDFILL WERE OBTAINED FROM TOPOGRAPHIC MAP FROM AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 6, 2006 BY NOVA SURVEYING AND MAPPING, INC. PROVIDED BY DUKE ENERGY.

CHAS. H. SELLS, INC., SURVEY NOTES:
1. BASIS OF BEARINGS: BEARINGS ARE BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NAD 83/96.
2. ELEVATIONS BASED ON NAVD 88.

NOVA SURVEYING AND MAPPING, INC., SURVEY NOTES:
1. HORIZONTAL DATUM: NAD 83 (1986), N.C. STATE PLANE COORDINATES, FEET.
2. VERTICAL DATUM: NAVD 88 FEET.
3. HORIZONTAL CONTROL DATA BASED ON MARSHALL MONUMENT "MCP-5" (N=678,732.56, E=1,414,680.01, ELEVATION=807.55 (F.)); TIED BY GPS METHODS, UTILIZING TRIMBLE 4400 RECEIVERS IN STATIC MODE.

C & D LANDFILL AREA
139,624 SQ. FT.
3.21 ACRES

ASBESTOS LANDFILL AREA
299,841 SQ. FT.
6.88 ACRES

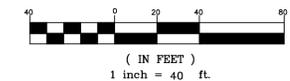


LEGEND

- EXISTING MAJOR CONTOUR (5')
- EXISTING MINOR CONTOUR (1')
- PROPOSED SUBGRADE MAJOR CONTOUR (5')
- PROPOSED SUBGRADE MINOR CONTOUR (1')
- - - - - APPROXIMATE LIMIT OF WASTE (NOTE 1)
- ■ ■ SILT FENCE

NOTES:

1. LIMIT OF WASTE WAS FIELD DELINEATED BY DUKE PERSONNEL AND LOCATED BY FIELD SURVEY.
2. PROPOSED SUBGRADE SHALL BE ACHIEVED BY PLACING STRUCTURAL FILL PER SPECIFICATION REQUIREMENTS FOR TYPE S1 FILL.
3. LIMIT OF WASTE SHALL BE FIELD VERIFIED BY DUKE ENERGY PERSONNEL AFTER CLEARING. LIMIT OF WASTE AND RESULTING GRADING MAY BE ADJUSTED BY DUKE ENERGY PERSONNEL TO ACCOMMODATE REVISED LIMITS OF WASTE.



NO.	DATE	DESCRIPTION	BY
10-10-08	10-10-08	ISSUED FOR CONSTRUCTION	

SUBGRADE GRADING PLAN	
ASBESTOS LANDFILL CLOSURE	
DUKE ENERGY - MARSHALL STEAM STATION	
CATAWBA COUNTY, NORTH CAROLINA	
DRAWN BY: CLD	CHECKED BY: KRD
DESIGNED BY: ELH	APPROVED BY: KRD
PROJECT NUMBER 1356-08-107	
SCALE: AS SHOWN	DATE: 10-10-08
DRAWING: 2	OF: 6

DRAWING PATH: \OUTSIDE\DUKE ENERGY\807-PERSONNEL\ASBESTOS LP CLOSURE\ASBESTOS LP CLOSURE.DWG

N 686000

N 685750

N 685500

N 685250

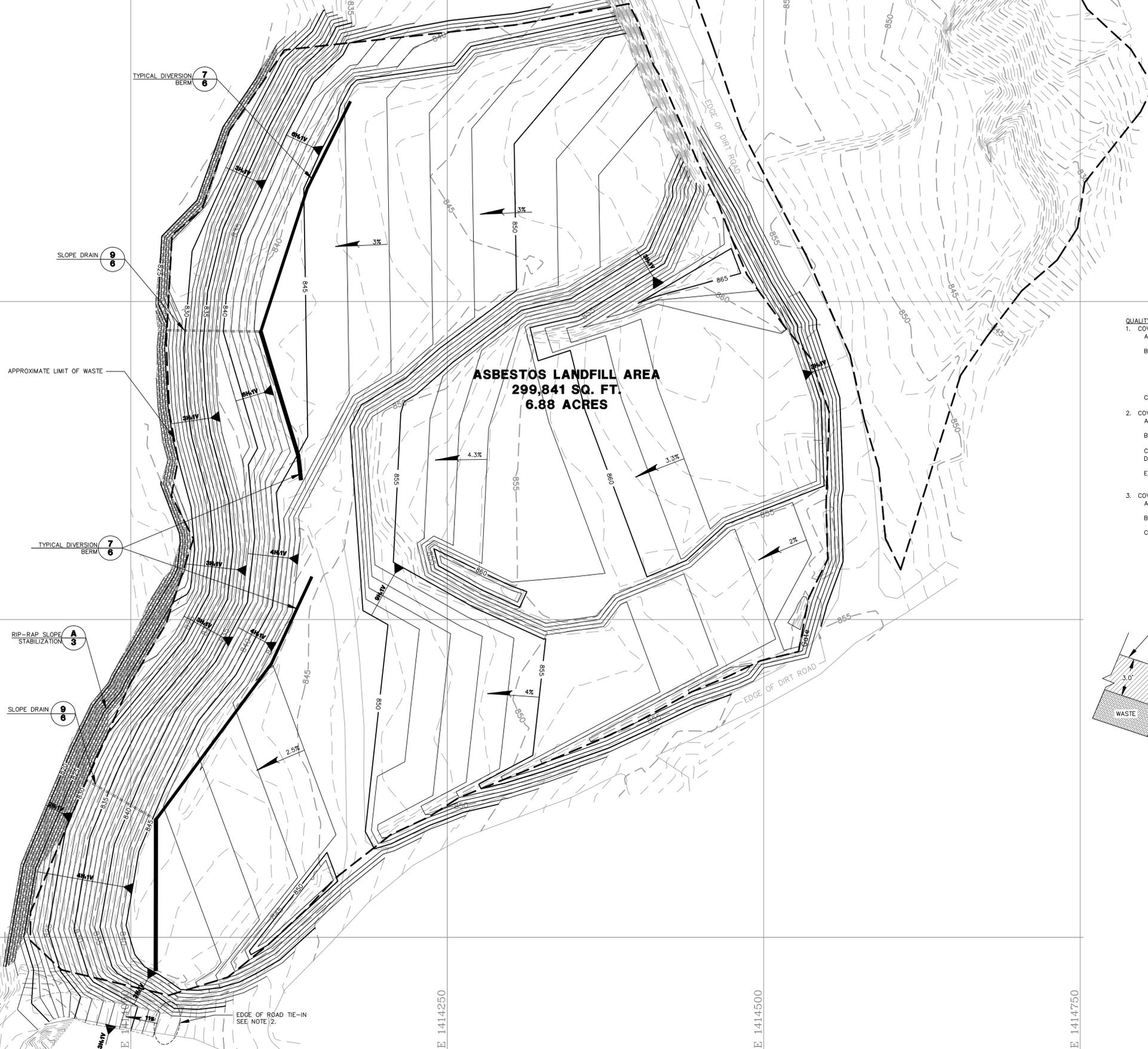
E 1414250

E 1414500

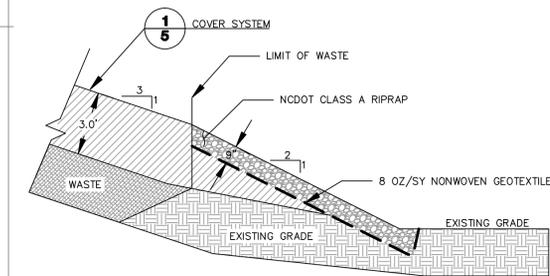
E 1414750

C & D LANDFILL AREA
139,624 SQ. FT.
3.21 ACRES

ASBESTOS LANDFILL AREA
299,841 SQ. FT.
6.88 ACRES



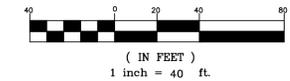
- QUALITY CONTROL REQUIREMENTS:**
- COVER SOIL LABORATORY TESTING
 - PERFORM LABORATORY MATERIAL TESTS IN ACCORDANCE WITH ASTM D422, ASTM D698, ASTM D2216, AND ASTM D4318.
 - TEST AT A FREQUENCY OF: 10,000 CUBIC YARDS OF STRUCTURAL FILL MATERIAL PLACED; OR A MINIMUM OF THREE SUITES OF TESTS, WHICHEVER RESULTS IN THE GREATER NUMBER OF TESTS FOR A CONSISTENT MATERIAL TYPE, WHEN MATERIALS USING FOR STRUCTURAL FILL CHANGE; AND/OR AS WELL AS WHEN DIRECTED BY THE ENGINEER.
 - SAMPLE SIZE SHALL BE 50-LB.
 - COVER SOIL IN PLACE COMPACTION AND MOISTURE CONTENT TESTS
 - PERFORM IN PLACE COMPACTION TESTS IN ACCORDANCE WITH ASTM D1556, ASTM D2922, OR ASTM D2937.
 - PERFORM IN PLACE MOISTURE CONTENT TEST IN ACCORDANCE WITH ASTM D2216.
 - FREQUENCY OF COMPACTION/NATURAL MOISTURE CONTENT TESTS: D. LANDFILL: EACH LIFT AT A MINIMUM FREQUENCY OF 1 PER ACRE PER LIFT. E. EMBANKMENTS: EACH LIFT AT A MINIMUM FREQUENCY OF 1 PER 5000 SQ. FT.
 - COVER SYSTEM THICKNESS VERIFICATION
 - THE FINAL COVER SYSTEM THICKNESS SHALL BE FIELD VERIFIED BY HAND AUGURING OR OTHER METHODS PERFORMED BY THE ENGINEER.
 - THICKNESS VERIFICATION SHALL BE CONDUCTED ON AN APPROXIMATE 100-FT GRID PATTERN.
 - THICKNESS MEASUREMENTS SHALL NOT EXTEND INTO WASTE AND MAY BE TERMINATED AT A DEPTH OF 3.0 FEET



A/3 RIP-RAP SLOPE STABILIZATION

- LEGEND**
- EXISTING MAJOR CONTOUR (5')
 - EXISTING MINOR CONTOUR (1')
 - PROPOSED CLOSURE MAJOR CONTOUR (5')
 - PROPOSED CLOSURE MINOR CONTOUR (1')
 - APPROXIMATE LIMIT OF WASTE (NOTE 1)

- NOTES:**
- LIMIT OF WASTE WAS FIELD DELINEATED BY DUKE PERSONNEL AND LOCATED BY FIELD SURVEY.
 - GRADE EDGE OF ROAD AT 3H:1V TO MEET EXISTING GRADE.
 - FINAL COVER SYSTEM SHALL TIE INTO EXISTING GRADE FROM THE LIMIT OF WASTE AT A 2H:1V SLOPE, WHERE TOE OF SLOPE EXTENDS BEYOND TOPOGRAPHIC SURVEY LIMITS SHOWN, EXTEND SLOPE TO MEET EXISTING GRADE.



REFERENCE:
LANDFILL TOPOGRAPHIC CONTOURS PROVIDED BY CHAS. H. SELLS, INC., CIVIL ENGINEERING, SURVEYING AND PLANNING, FROM SURVEY PERFORMED JULY 2008. CONTOURS OUTSIDE OF LANDFILL WERE OBTAINED FROM TOPOGRAPHIC MAP FROM AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 6, 2006 BY NOVA SURVEYING AND MAPPING, INC. PROVIDED BY DUKE ENERGY.

CHAS. H. SELLS, INC., SURVEY NOTES:

1. BASIS OF BEARINGS: BEARINGS ARE BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NAD 83/86.
2. ELEVATIONS BASED ON NAVD 88.

NOVA SURVEYING AND MAPPING, INC., SURVEY NOTES:

1. HORIZONTAL DATUM: NAD 83 (1986), N.C. STATE PLANE COORDINATES, FEET.
2. VERTICAL DATUM: NAVD 88 FEET.
3. HORIZONTAL CONTROL: DATA BASED ON MARSHALL MONUMENT "MCP-5" (N=678,732.56, E=1,414,680.01, ELEVATION=807.55 (F.)); TIED BY GPS METHODS, UTILIZING TRIMBLE 4400 RECEIVERS IN STATIC MODE.

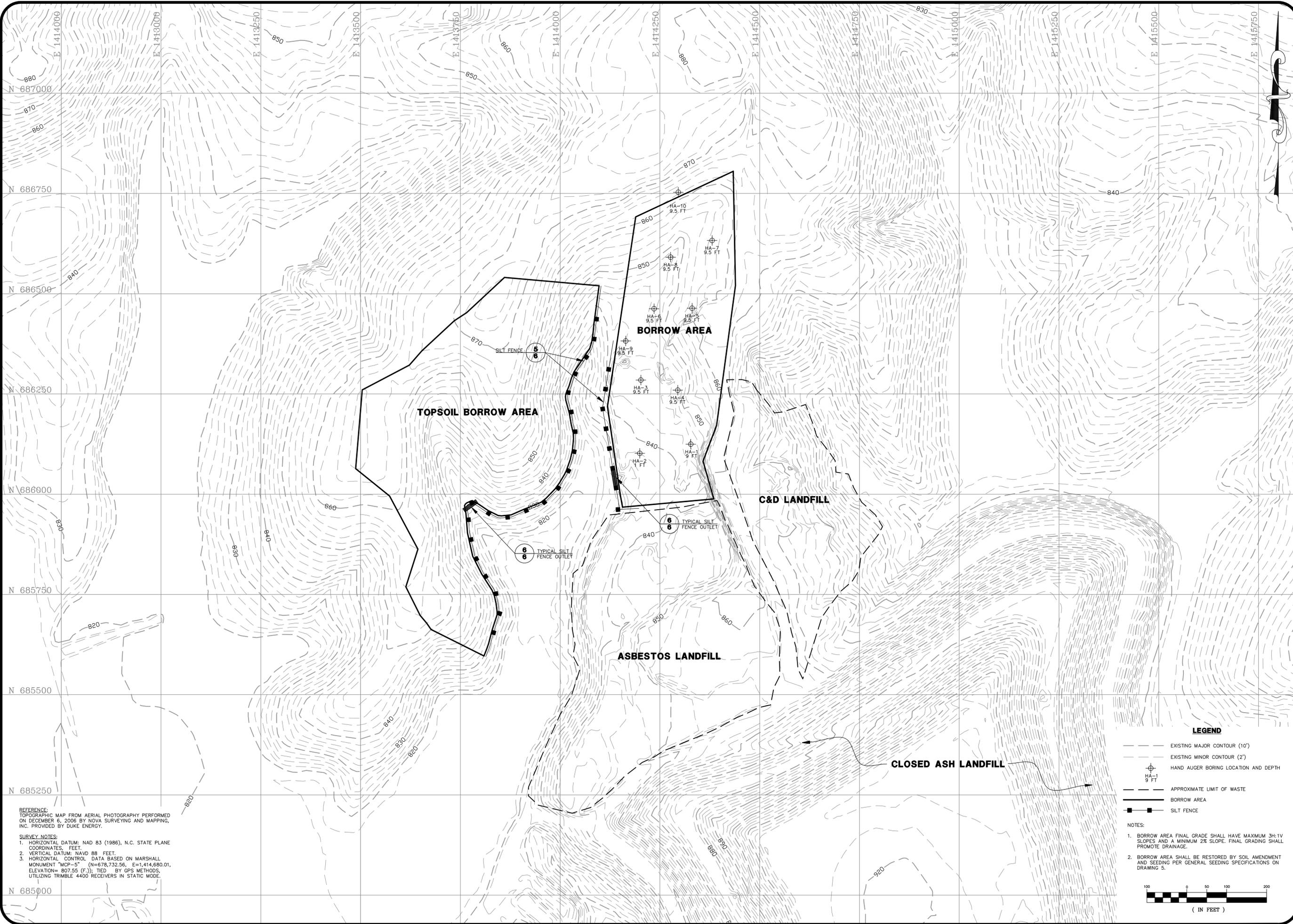


NO.	DATE	ISSUED FOR CONSTRUCTION	DESCRIPTION	BY
1	10-10-08			

PROPOSED FINAL COVER PLAN
ASBESTOS LANDFILL CLOSURE
DUKE ENERGY - MARSHALL STEAM STATION
CATAWBA COUNTY, NORTH CAROLINA

DRAWN BY:	CLD	CHECKED BY:	KRD
DESIGNED BY:	CLD	APPROVED BY:	KRD
PROJECT NUMBER:	1356-08-107		
SCALE:	AS SHOWN	DATE:	10-10-08
DRAWING:	3	OF:	6

DRAWING PATH: \\NTS05\DUKE ENERGY\08-107\PERSONNEL\ASBESTOS\1356-08-107\FINAL\DESIGN\DWG



REFERENCE:
 TOPOGRAPHIC MAP FROM AERIAL PHOTOGRAPHY PERFORMED
 ON DECEMBER 6, 2006 BY NOVA SURVEYING AND MAPPING,
 INC. PROVIDED BY DUKE ENERGY.

SURVEY NOTES:
 1. HORIZONTAL DATUM: NAD 83 (1986), N.C. STATE PLANE
 COORDINATES, FEET.
 2. VERTICAL DATUM: NAVD 88 FEET.
 3. HORIZONTAL CONTROL DATA BASED ON MARSHALL
 MONUMENT "MCP-5" (N=678,732.56, E=1,414,680.01,
 ELEVATION= 807.55 (F)); TIED BY GPS METHODS,
 UTILIZING TRIMBLE 4400 RECEIVERS IN STATIC MODE.

LEGEND

- EXISTING MAJOR CONTOUR (10')
- - - EXISTING MINOR CONTOUR (2')
- ⊕ HA-1 9 FT HAND AUGER BORING LOCATION AND DEPTH
- - - APPROXIMATE LIMIT OF WASTE
- ▬ BORROW AREA
- ▬ SILT FENCE

NOTES:
 1. BORROW AREA FINAL GRADE SHALL HAVE MAXIMUM 3H:1V SLOPES AND A MINIMUM 2% SLOPE. FINAL GRADING SHALL PROMOTE DRAINAGE.
 2. BORROW AREA SHALL BE RESTORED BY SOIL AMENDMENT AND SEEDING PER GENERAL SEEDING SPECIFICATIONS ON DRAWING 5.

100 0 50 100 200
 (IN FEET)

Duke Energy

S&ME
 WWW.SMEINC.COM

ISSUED FOR CONSTRUCTION	BY
10-10-08	DATE
NO.	NO.
DESCRIPTION	DESCRIPTION

BORROW AREA PLAN AND TOPSOIL BORROW AREA PLAN	ASBESTOS LANDFILL CLOSURE DUKE ENERGY - MARSHALL STEAM STATION CATAWBA COUNTY, NORTH CAROLINA
DRAWN BY: CLD	CHECKED BY: KRD
DESIGNED BY: WMH	APPROVED BY: KRD
PROJECT NUMBER 1356-08-107	DATE: 10-10-08
SCALE: AS SHOWN	OF: 6
4	6

DRAWING PATH: Q:\1356\DUKE ENERGY\08-107\MARSHALL ASBESTOS LP CLOSURE\WV\WV\WV\ASB BORROW AREAS

DEFINITION
Controlling runoff and erosion on disturbed areas by establishing perennial vegetative cover with seed.

PURPOSE
To reduce erosion and decrease sediment yield from disturbed areas, and to permanently stabilize such areas in a manner that is economical, adapts to site conditions, and allows selection of the most appropriate plant materials.

SPECIFICATIONS

SEEDBED REQUIREMENTS
Establishment of vegetation should not be attempted on sites that are unsuitable due to excessive soil compaction, inappropriate soil texture, poor drainage, concentrated overland flow, or steepness of slope until measures have been taken to correct these problems.

To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. The existing soil should have these criteria:

- Enough fine-grained (silt and clay) material to maintain adequate moisture and nutrient supply (available water capacity of at least .05 inches water to 1 inch of soil).
- Sufficient pore space to permit root penetration.
- Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans should be 12 inches or more, except on slopes steeper than 2:1 where the addition of soil is not feasible.
- A favorable pH range for plant growth, usually 6.0 – 6.5.
- Free from large roots, branches, stones, large clods of earth, or trash of any kind. Clods and stones may be left on slopes steeper than 3:1 if they are to be hydro seeded.

If any of the above criteria are not met – i.e., if existing soil is too coarse, dense, shallow or acidic to foster vegetation – special amendments are required. The soil conditioners described below may be beneficial or, preferably, topsoil may be applied.

SEEDBED PREPARATION
Install necessary mechanical erosion and sedimentation control practices before seeding, and complete grading according to the approved plan.

Lime and fertilizer needs should be determined by soil tests. Directions, sample cartons, and information sheets are available through county Agricultural Extension offices. Testing is also done by commercial laboratories.

When soil tests results are not available, follow rates suggested in the seeding specifications shown at right. Application rates usually fall into the following ranges:

- Ground agricultural limestone:
Light-textured, sandy soils: 1 to 1-1/2 tons/acre
Heavy-textured, clayey soils: 2-3 tons/acre
- Fertilizer:
Grasses: 800-1200 lb/acre of 10-10-10 (or the equivalent)
Grass-legume mixtures: 800-1200 lb/acre of 5-10-10 (or the equivalent)

Apply lime and fertilizer evenly and incorporate into the top 4-6 inches of soil by disking or other suitable means. Operate machinery on the contour. When using a hydro seeder, apply lime and fertilizer to a rough, loose surface.

Roughen surfaces prior to seeding.

Complete seedbed preparation by breaking up large clods and raking into a smooth, uniform surface (slopes less than 3:1). Fill in or level depressions that can collect water. Broadcast seed into a freshly loosened seedbed that has not been sealed by rainfall.

SEEDING
Seeding dates given in the seeding mixture specifications are designated as "best" or "possible". Seeding properly carried out within the "best" dates have a high probability of success. It is also possible to have satisfactory establishment when seeding outside these dates. However, as you depart from them, the probability of failure increases rapidly. Seeding on the last date shown under "possible" may reduce chances of success by 30-50%. Always take this into account in scheduling land-disturbing activities.

Use certified seed for permanent seeding whenever possible.

Labeling of non-certified seed is also required by law. Labels contain important information on seed purity, germination, and presence of weed seeds. Seeds must meet State standards for content of noxious weeds. Do not accept seed containing "prohibited" noxious weed seed.

Inoculate legume seed with the Rhizobium bacteria appropriate to the species of legume. Apply seed uniformly with a cyclone seeder, drop-type spreader, drill, cultipacker seeder, or hydro seeder on a firm, friable seedbed.

When using a drill or cultipacker seeder, plant small grains no more than 1 inch deep, grasses and legumes no more than 1/2 inch. Equipment should be calibrated in the field for the desired seeding rate.

When using broadcast-seeding methods, subdivide the area into workable sections and determine the amount of seed needed for each section. Apply one-half the seed while moving back and forth across the area, making a uniform pattern; then apply the second half in the same way, but moving at right angles to the first pass.

Mulch all plantings immediately after seeding.

HYDRO SEEDING
Surface roughening is particularly important when hydro seeding, as a roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or smooth. Fine seedbed preparation is not necessary for hydro seeding operations: large clods, stones, and irregularities provide cavities in which seeds can lodge.

Rate of wood fiber (cellulose) application should be at least 2,000 lb/acre.

Apply legume inoculants at four times the recommended rate when adding inoculant to a hydro seeder slurry.

If a machinery breakdown of 1/2 to 2 hours occurs, add 50% more seed to the tank, based on the proportion of the slurry remaining. This should compensate for damage to seed. Beyond 2 hours, a full rate of new seed may be necessary.

Lime is not normally applied with a hydraulic seeder because it is abrasive. It can be blown onto steep slopes in dry form.

MAINTENANCE
Generally, a stand of vegetation cannot be determined to be fully established until soil cover has been maintained for one full year from planting. Inspect seeded areas for failure and make necessary repairs and reseedings within the same season, if possible.

Re-seeding—If a stand has inadequate cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider seeding temporary, annual species if the time of year is not appropriate for permanent seeding.

If vegetation fails to grow, soil must be tested to determine if acidity or nutrient imbalance is responsible.

Fertilization—On the typical disturbed site, full establishment usually requires re-fertilization in the second growing season. Fine turf requires annual maintenance fertilization. Use soil tests if possible or follow the guidelines given for the specific seeding mixture.

TEMPORARY SEEDING SPECIFICATIONS

Seeding mixture (fall)	Species*	Rate (lb/acre)
	Rye Grain (<i>Secale cereale</i>)	120

Seeding Mixture (late winter early spring)	Species*	Rate (lb/acre)
	Rye Grain (<i>Secale cereale</i>)	120
	Annual (Korean) Lespedeza (<i>Kummerowia stipulacea</i>)	50

Seeding mixture (summer)	Species*	Rate (lb/acre)
	German Millet (<i>Setaria italica</i>)	40

Seeding dates (Piedmont)	Best	Possible
Fall:	Aug. 25 – Sept. 15	Aug. 20 – Oct. 25
Late winter:	Feb. 15 – Mar. 21	Feb. 1 – Apr. 15

Soil amendments	Rate (lb/acre)
Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.	

Mulch
Apply 4,000 lb/acre straw. Anchor mulch by tacking with asphalt, roving or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance
Re-fertilize if growth is not fully adequate. Reseed, re-fertilize and mulch immediately following erosion or other damage.

Pursuant to G.S. 113A-57(2), the angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion-control devices or structures. In any event, slopes left exposed will, within 21 calendar days of completion of any phase of grading, be planted or otherwise provided with temporary or permanent ground cover, devices, or structures sufficient to restrain erosion.

Pursuant to G.S. 113A-57(3), provisions for permanent groundcover sufficient to restrain erosion must be accomplished for all disturbed areas within 15 working days or 90 calendar days (whichever is shorter) following completion of construction or development.

*REF: 6.10 A,B and C, NC Erosion and Sediment Control Planning and Design Manual, 2006

PERMANENT SEEDING SPECIFICATIONS

Seeding mixture	Species*	Rate (lb/acre)
	Tall fescue (<i>Festuca arundinacea</i>) (Grass lined Channels)	200
	Tall fescue (<i>Festuca arundinacea</i>) (Other Areas)	100

Nurse plants
Between May 1 and Aug. 15, add 10 lb/acre German millet (*Setaria italica*) or 15 lb/acre Sudan grass. Prior to May 1 or after Aug. 15, add 40 lb/acre Rye Grain (*Festuca arundinacea*).

Seeding dates
Fall: Aug. 25 – Sept. 15
Late winter: Feb. 15 – Mar. 21

Fall is best for tall fescue (*Festuca arundinacea*) and late winter or summer for lespedeza. Over seeding of Kabe lespedeza (*Kummerowia striata*) over fall-seeded tall fescue is very effective.

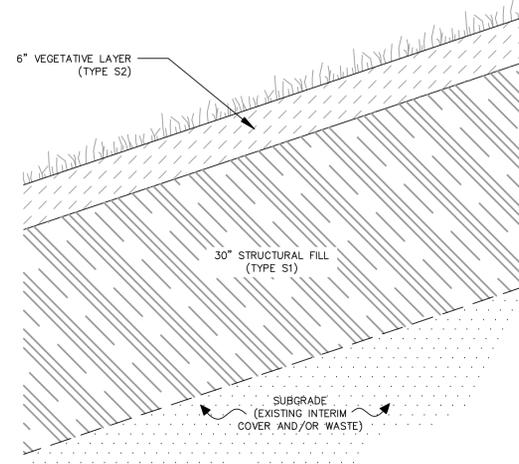
Soil amendments
Apply lime and fertilizer according to soil tests, or apply 4,000 lb/acre ground agricultural limestone and 1,000 lb/acre 10-10-10 fertilizer.

Mulch
Apply 4,000-5,000 lb/acre grain straw or equivalent cover of another suitable mulching material. Anchor mulch by tacking with asphalt, roving, or netting. Netting is the preferred anchoring method on steep slopes.

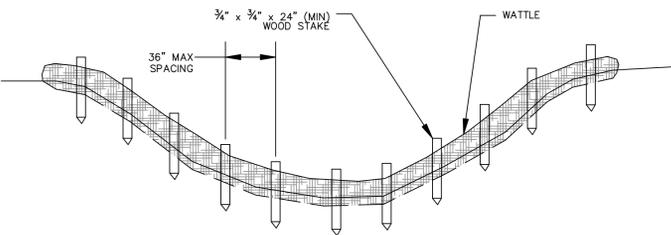
Maintenance
Re-fertilize in the second year unless growth is fully adequate. May be mowed once or twice a year, but mowing is not necessary. Reseed, fertilize, and mulch damaged areas immediately.

Pursuant to G.S. 113A-57(3), provisions for permanent groundcover sufficient to restrain erosion must be accomplished for all disturbed areas within 15 working days or 90 calendar days (whichever is shorter) following completion of construction or development.

*REF: 6.11L NC Erosion and Sediment Control Planning and Design Manual, 2006



1 COVER SYSTEM
1" = 1'



GENERAL NOTES:
1. SPACE WATTLES ACCORDING TO TABLE 1 ALONG ANY PORTION OF DITCHLINE WITH A SLOPE OF 5 PERCENT OR GREATER AND A SLOPE LENGTH OF 50 FEET OR GREATER.

TABLE 1: WATTLE SPACING

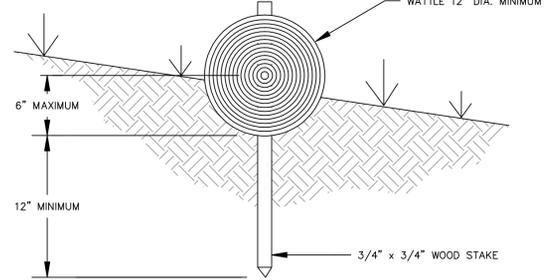
SLOPE (%)	SPACING DISTANCE (FT. O.C.)	
	12" DIA.	18" DIA.
5	20	30
6	17	25
7	14	21
8	13	19
9	11	17
10	10	15

2. PLACE FIRST WATTLE 1/2 SPACING DISTANCE FROM CREST OF QUALIFYING SLOPE.
3. SPACE WOODEN STAKES 3 FEET O.C.
4. PLACE CHECK DAMS OR WATTLES AT THE LOWER LIMITS OF EACH DAYS WORK.

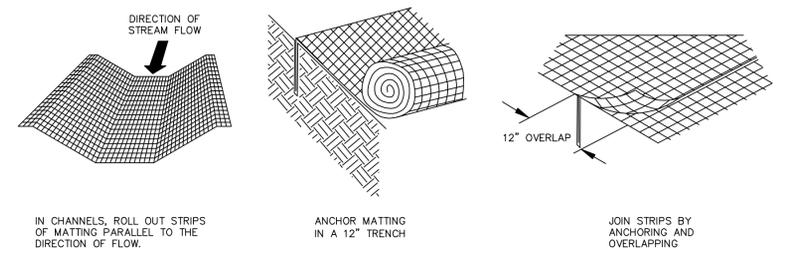
MAINTENANCE NOTES:

1. IT IS IMPERATIVE THAT WATTLES BE INSPECTED AFTER INSTALLATION AND SIGNIFICANT (0.5" OR GREATER) RAINFALL EVENTS.
2. THERE ARE TO BE NO GAPS BETWEEN ADJACENT WATTLES OR BETWEEN SOIL SURFACE AND WATTLE BOTTOM.
3. REPAIR ANY UPSLOPE OR UNDERCUTTING DEFICIENCIES FOR PROPER PERFORMANCE.
4. REMOVE ALL FILTRATION IMPEDIMENTS INCLUDING SEDIMENT DEPOSITS AND LOOSE DEBRIS WHEN SUCH CONDITIONS IMPACT WATTLE FUNCTIONALITY.
5. SEDIMENT BUILD UP SHOULD NOT BE ALLOWED TO EXCEED ONE THIRD OF WATTLE HEIGHT.
6. MONITOR CHANGING CONDITIONS TO ANTICIPATE WATTLE REMOVAL OR REPLACEMENT.

*REF: EASTCOAST EROSIONBLANKETS INSPECTION AND MAINTENANCE WWW.EROSIONBLANKETS.COM



4 TYPICAL WATTLE DETAIL
NTS



GENERAL NOTES:

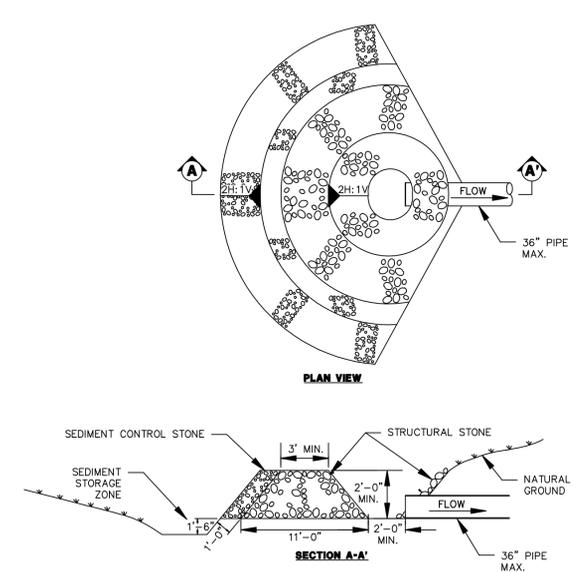
1. DITCH LINES OVER 3 PERCENT MUST BE MATTED WITH NORTH AMERICAN GREEN DS-75 MATTING OR EQUIVALENT.
2. APPLY SEED BEFORE LAYING THE NET OR MAT. IF OPEN-WEAVE NETTING IS USED, LIME MAY BE INCORPORATED BEFORE INSTALLING THE NET AND FERTILIZER AND SEED MAY BE SPRAYED ON AFTERWARD.
3. START LAYING THE NET FROM THE TOP OF THE CHANNEL OR SLOPE AND UNROLL IT DOWN THE GRADE. ALLOW NETTING TO LAY LOOSELY ON THE SOIL BUT WITHOUT WRINKLES—DO NOT STRETCH.
4. TO SECURE THE NET, BURY THE UPSLOPE END IN A SLOT OR TRENCH NO LESS THAN 12 INCHES DEEP. COVER WITH SOIL, AND TAMP FIRMLY. STAPLE THE NET EVERY 12 INCHES ACROSS THE TOP END EVERY 3 FEET AROUND THE EDGES AND BOTTOM. WHERE 2 STRIPS OF NET ARE LAID SIDE BY SIDE, THE ADJACENT EDGES SHOULD BE OVERLAPPED 3 INCHES AND STAPLED TOGETHER. EACH STRIP OF MATTING SHOULD ALSO BE STAPLED DOWN THE CENTER, EVERY 3 FEET.

MAINTENANCE NOTES:

1. INSPECT ROLLED EROSION CONTROL PRODUCTS (RECP) AT LEAST WEEKLY AND AFTER EACH SIGNIFICANT (0.5" OR GREATER) RAIN FALL EVENT.
2. GOOD CONTACT WITH THE GROUND MUST BE MAINTAINED, AND EROSION MUST NOT OCCUR BENEATH THE RECP.
3. ANY AREAS OF THE RECP THAT ARE DAMAGED OR NOT IN CLOSE CONTACT WITH THE GROUND SHALL BE REPAIRED AND STAPLED.
4. IF EROSION OCCURS DUE TO POORLY CONTROLLED DRAINAGE, THE PROBLEM SHALL BE FIXED AND THE ERODED AREA PROTECTED.
5. MONITOR AND REPAIR THE RECP AS NECESSARY UNTIL GROUND COVER IS ESTABLISHED.

*REF: 6.17.12 NC Erosion and Sediment Control Planning and Design Manual, 2006

2 TYPICAL TEMPORARY MATTING DETAIL
NTS



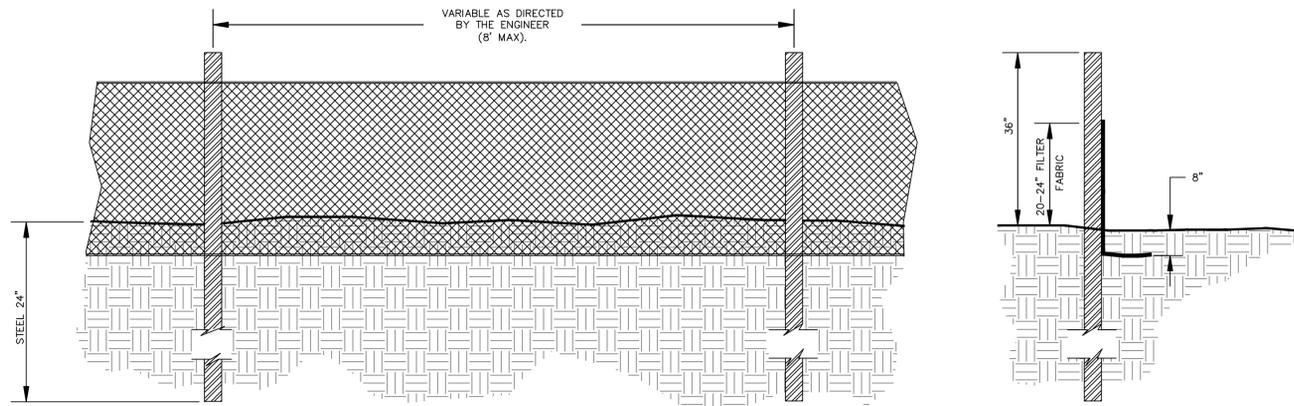
3 STANDARD ROCK PIPE INLET PROTECTION
NTS



NO.	DATE	DESCRIPTION	BY
10-10-08		ISSUED FOR CONSTRUCTION	

DETAILS I
ASBESTOS FINAL CLOSURE PLAN
DUKE ENERGY - MARSHALL STEAM STATION
CATAWBA COUNTY, NORTH CAROLINA

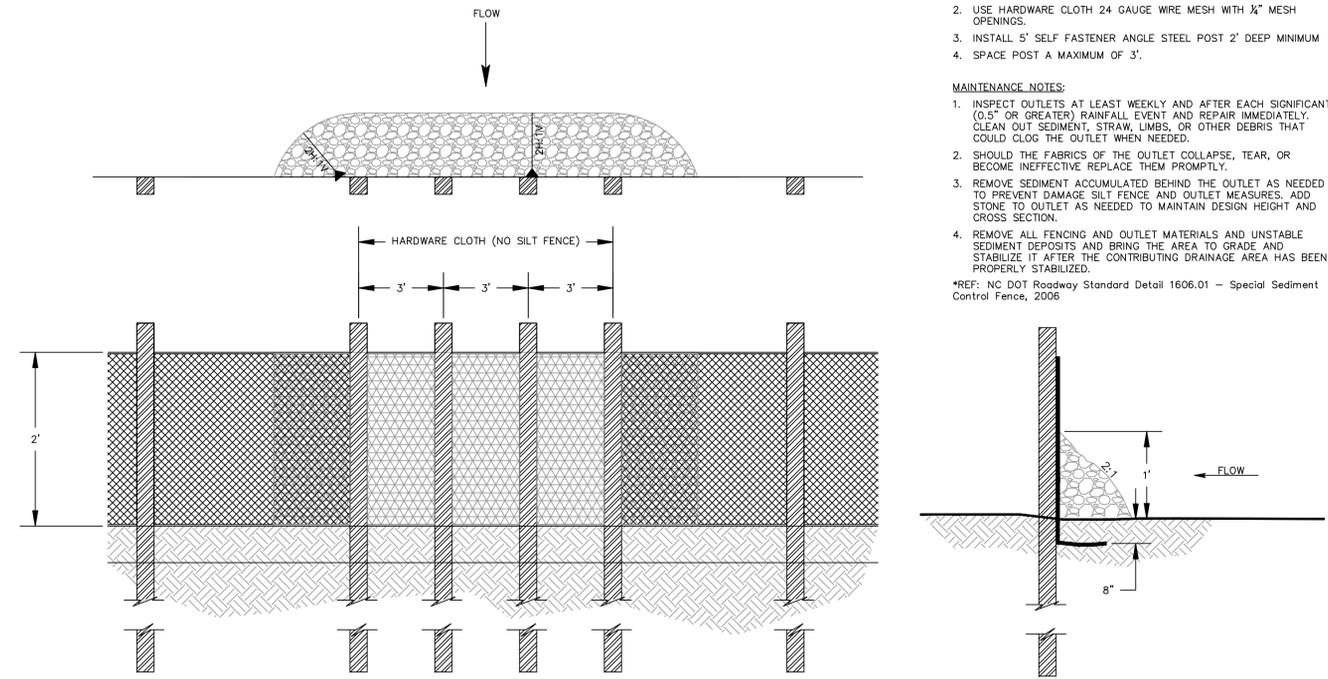
DRAWN BY:	CHECKED BY:
CLD	KRD
DESIGNED BY:	APPROVED BY:
WMH	KRD
PROJECT NUMBER	DATE:
1356-08-106	10-10-08
SCALE:	OF:
AS SHOWN	6



- GENERAL NOTES:**
1. PREFABRICATED SILT FENCE IS NOT ACCEPTABLE ON THIS PROJECT.
 2. STEEL POSTS SHALL BE USED ON THIS PROJECT INSTEAD OF WOOD POSTS.
 3. FILTER FABRIC FENCE SHALL BE A MINIMUM OF 32" IN WIDTH AND SHALL HAVE A MINIMUM OF 6 LINE WIRES WITH 12" STAY SPACING.
 4. WOVEN FILTER FABRIC SHALL BE USED WHERE SILT FENCE IS TO REMAIN FOR A PERIOD OF MORE THAN 30 DAYS.
 5. STEEL POSTS SHALL BE 5"-0" IN HEIGHT AND BE OF THE SELF-FASTENER ANGLE STEEL TYPE.
 6. TURN SILT FENCE UP SLOPE AT ENDS.
 7. SILT FENCE SHALL BE STANDARD STRENGTH FILTER FABRIC WITH WIRE MESH REINFORCEMENT OR EXTRA STRENGTH FILTER FABRIC.
 8. WHEN FABRIC IS USED WITH WIRE MESH, 8' CENTERED POSTS MAY BE USED.
 9. THE USE OF SILT FENCE IN AREAS OF CONCENTRATED FLOW IS INAPPROPRIATE.

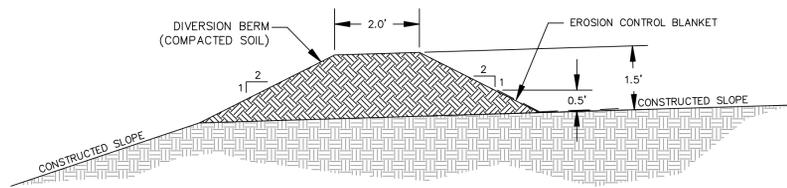
- MAINTENANCE NOTES:**
1. INSPECT SEDIMENT FENCES AT LEAST ONCE A WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATELY.
 2. SHOULD THE FABRIC OF A SEDIMENT FENCE COLLAPSE, TEAR, DECOMPOSE OR BECOME INEFFECTIVE, REPLACE IT PROMPTLY.
 3. REMOVE SEDIMENT DEPOSITS AS NECESSARY TO PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN AND TO REDUCE PRESSURE ON THE FENCE. TAKE CARE TO AVOID UNDERMINING THE FENCE DURING CLEANOUT.
 4. REMOVE ALL FENCING MATERIALS AND UNSTABLE SEDIMENT DEPOSITS AND BRING THE AREA TO GRADE AND STABILIZE IT AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.
- *REF: 6.62.7 NC Erosion and Sediment Control Planning and Design Manual, 2006

5
6 TYPICAL SILT FENCE INSTALLATION DETAIL
NTS



- GENERAL NOTES:**
1. USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL.
 2. USE HARDWARE CLOTH 24 GAUGE WIRE MESH WITH 1/4" MESH OPENINGS.
 3. INSTALL 5' SELF FASTENER ANGLE STEEL POST 2" DEEP MINIMUM.
 4. SPACE POST A MAXIMUM OF 3'.
- MAINTENANCE NOTES:**
1. INSPECT OUTLETS AT LEAST WEEKLY AND AFTER EACH SIGNIFICANT (0.5" OR GREATER) RAINFALL EVENT AND REPAIR IMMEDIATELY. CLEAN OUT SEDIMENT, STRAW, LIMBS, OR OTHER DEBRIS THAT COULD CLOG THE OUTLET WHEN NEEDED.
 2. SHOULD THE FABRICS OF THE OUTLET COLLAPSE, TEAR, OR BECOME INEFFECTIVE REPLACE THEM PROMPTLY.
 3. REMOVE SEDIMENT ACCUMULATED BEHIND THE OUTLET AS NEEDED TO PREVENT DAMAGE SILT FENCE AND OUTLET MEASURES. ADD STONE TO OUTLET AS NEEDED TO MAINTAIN DESIGN HEIGHT AND CROSS SECTION.
 4. REMOVE ALL FENCING AND OUTLET MATERIALS AND UNSTABLE SEDIMENT DEPOSITS AND BRING THE AREA TO GRADE AND STABILIZE IT AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.
- *REF: NC DOT Roadway Standard Detail 1606.01 - Special Sediment Control Fence, 2006

6
6 TYPICAL SILT FENCE OUTLET DETAIL
NTS



7
6 TYPICAL DIVERSION BERM DETAIL
NTS

DEFINITION:
A STRUCTURE DESIGNED TO CONTROL EROSION AT THE INLET OR OUTLET OF A CHANNEL OR CONDUIT.

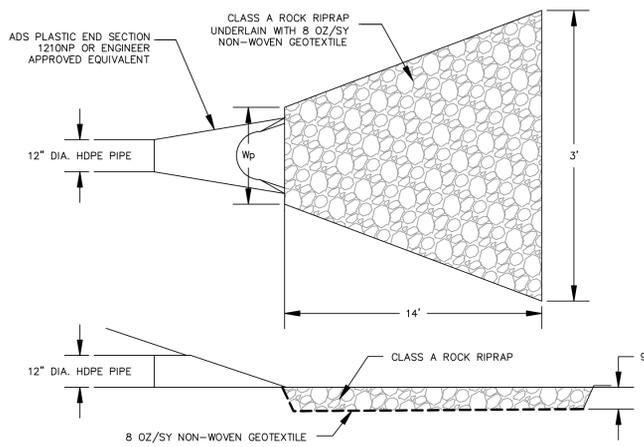
PURPOSE:
TO PREVENT EROSION AT THE OUTLET OF A CHANNEL OR CONDUIT BY REDUCING THE VELOCITY OF FLOW AND DISSIPATING THE ENERGY.

CONSTRUCTION SPECIFICATIONS:

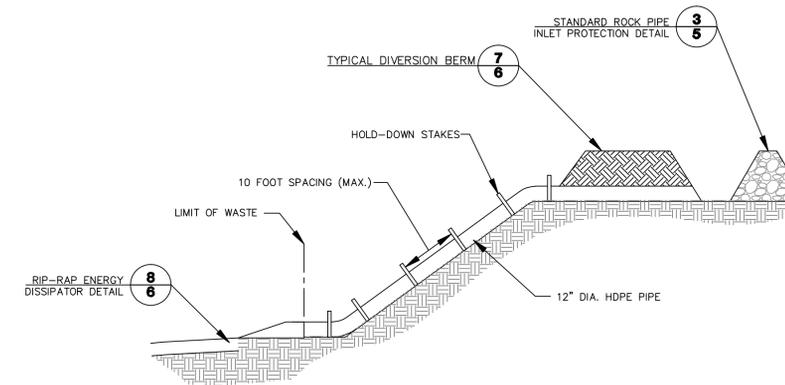
1. ENSURE THAT THE SUBGRADE FOR THE FILTER AND RIPRAP FOLLOWS THE REQUIRED LINES AND GRADES SHOWN IN THE PLAN. COMPACT ANY FILL REQUIRED IN THE SUBGRADE TO THE DENSITY OF THE SURROUNDING DISTURBED MATERIAL. LOW AREAS IN THE SUBGRADE ON UNDISTURBED SOIL MAY ALSO BE FILLED BY INCREASING THE RIPRAP THICKNESS.
2. THE RIPRAP AND GRAVEL FILTER MUST CONFORM TO THE SPECIFIED GRADING LIMITS SHOWN ON THE PLANS.
3. FILTER CLOTH, WHEN USED, MUST MEET DESIGN REQUIREMENTS AND BE PROPERLY PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION. REPAIR ANY DAMAGE BY REMOVING THE RIPRAP AND PLACING ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA. ALL CONNECTING JOINTS SHOULD OVERLAP SO THE TOP LAYER IS ABOVE THE DOWNSTREAM LAYER A MINIMUM OF 1 FT. IF THE DAMAGE IS EXTENSIVE, REPLACE THE ENTIRE FILTER CLOTH.
4. RIPRAP MAY BE PLACED BY EQUIPMENT, BUT TAKE CARE TO AVOID DAMAGING THE FILTER.
5. THE MINIMUM THICKNESS OF THE RIPRAP SHOULD BE 1.5 TIMES THE MAXIMUM STONE DIAMETER.
6. RIPRAP MAY BE FIELD STONE OR ROUGH QUARRY STONE. IT SHOULD BE HARD, ANGULAR, HIGHLY WEATHER-RESISTANT AND WELL GRADED.
7. CONSTRUCT THE APRON ON ZERO GRADE WITH NO OVERFILL AT THE END. MAKE THE TOP OF THE RIPRAP AT THE DOWNSTREAM END LEVEL WITH THE RECEIVING AREA OR SLIGHTLY BELOW IT.
8. ENSURE THAT THE APRON IS PROPERLY ALIGNED WITH THE RECEIVING STEAM AND PREFERABLY STRAIGHT THROUGHOUT ITS LENGTH. IF A CURVE IS NEEDED TO FIT SITE CONDITIONS, PLACE IN THE UPPER SECTION OF THE APRON.
9. IMMEDIATELY AFTER CONSTRUCTION, STABILIZE ALL DISTURBED AREAS WITH VEGETATION.

MAINTENANCE:
INSPECT RIPRAP OUTLET STRUCTURES WEEKLY AND AFTER SIGNIFICANT (1/2 INCH OR GREATER) RAINFALL EVENTS TO SEE IF ANY EROSION AROUND OR BELOW THE RIPRAP HAS TAKEN PLACE, OR IF STONES HAVE BEEN DISLODGED. IMMEDIATELY MAKE ALL NEEDED REPAIRS TO PREVENT FURTHER DAMAGE.

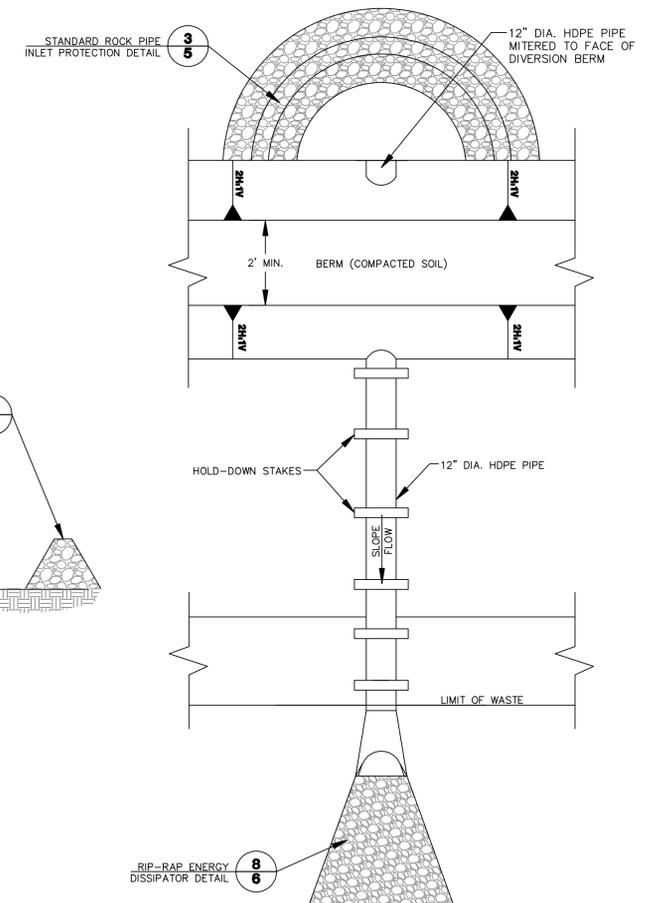
REFERENCE:
6.41.5 NC EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL, 2006



8
6 RIP-RAP ENERGY DISSIPATOR DETAIL
NTS



9
6 SLOPE DRAIN DETAIL
NTS



NO.	DATE	DESCRIPTION	BY
10-10-08	10-10-08	ISSUED FOR CONSTRUCTION	

DETAILS II	
ASBESTOS FINAL CLOSURE PLAN DUKE ENERGY - MARSHALL STEAM STATION CATAWBA COUNTY, NORTH CAROLINA	
DRAWN BY: CLD	CHECKED BY: KRD
DESIGNED BY: WMH	APPROVED BY: KRD
PROJECT NUMBER 1356-08-106	
SCALE: AS SHOWN	DATE: 10-10-08
DRAWING: 6	OF: 6

DRAWING PATH: \OUTSIDE\DUKE ENERGY\8-07\PROJECTS\ASBESTOS_FINAL_CLOSURE\ASBESTOS_FINAL_CLOSURE\DETAILS II.DWG

APPENDIX II - ASBESTOS LANDFILL PERMIT



North Carolina Department of Human Resources
Division of Health Services
P.O. Box 2091 • Raleigh, North Carolina 27602-2091

James G. Martin, Governor
David T. Flaherty, Secretary

Ronald H. Levine, M.D., M.P.H.
State Health Director

March 1, 1988



Mr. Richard Crowell
Duke Power Company
Fossil Production Department
P.O. Box 33189
Charlotte, N.C. 28242

RE: Marshall Steam Plant Sanitary Landfill, Amendment to Permit No. 18-04

Dear Mr. Crowell:

The Branch has completed its review of the proposed revisions to the construction plan for the referenced facility and has made the following decisions:

- (1) The proposed area for the disposal of asbestos is hereby approved with the following conditions:
 - (a) The area be clearly marked and designated for asbestos disposal only, apart from other wastes and in virgin soil.
 - (b) Asbestos will be packaged and transported in accordance with 40 CFR 61 and all pertinent regulations.
 - (c) Asbestos will be covered immediately with a minimum of 6" of soil in a manner that will not cause airborne conditions.
 - (d) Final cover will be a minimum of 3' of soil
 - (e) Final elevations will not exceed pre-existing contours or in any way encourage erosion.
 - (f) No future land-disturbing activities will disrupt the final cover.

- (2) The proposed expansion of the flyash area will be approved upon satisfaction of conditions previously outlined in the December 21, 1987 letter.

An amended permit will be issued, which will include conditions for both the flyash and asbestos areas when all conditions are met.

If there are any questions, please contact Jim Coffey at (919) 733-0692.

Sincerely,

A handwritten signature in black ink, appearing to read "J. Gordon Layton". The signature is written in a cursive style with a large initial "J".

J. Gordon Layton, Acting Head
Solid Waste Branch
Solid Waste Management Section

JGL/mj

cc: Rick Doby
Julian Foscue
Jim Coffey
Central Files

APPENDIX III – TECHNICAL SPECIFICATIONS

**TECHNICAL SPECIFICATIONS
MARSHALL ASBESTOS LANDFILL CLOSURE
TABLE OF CONTENTS**

DIVISION 1 - GENERAL REQUIREMENTS

01100	Summary
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01300	Administrative Requirements
01400	Quality Requirements
01500	Temporary Facilities and Controls
01600	Product Requirements
01700	Execution Requirements

DIVISION 2 - SITE CONSTRUCTION

02060	Aggregate
02230	Site Clearing
02320	Backfill - Structural
02374	Erosion Control Devices
02610	Pipe Culverts
02674	Nonwoven Geotextiles
02924	Seeding and Soil Supplements

SECTION 01100
SUMMARY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Summary.
 - 2. Definitions for reference.
 - 3. Contract description.
 - 4. Contractor and subcontractor qualifications.
 - 5. Contractor's use of site.
 - 6. Work sequence.
 - 7. Owner occupancy.

1.2 DEFINITIONS FOR REFERENCE

- A. Atterberg Limits: the liquid limit and plastic limit (ASTM D4318).
- B. Authorized Representative: shall mean the Engineer or his authorized agent of whom has the authority to approve construction quality assurance testing on behalf of the Owner.
- C. Classification System: the soil classification system shall be in accordance with the standard test method for classification of soils for engineering purposes (ASTM D2487).
- D. Compaction: the process of increasing the dry density or unit weight of soil by rolling, tamping, vibrating, or other mechanical means. Compaction tests are determined by the Sand Cone Method (ASTM D1556), Drive Cylinder Method (ASTM D2937), or Nuclear Density Gauge (ASTM D2922).
- E. Contract: Either a purchase order placed by "Owner" and accepted by "Contractor" together with these Specifications and all other documents referred to in such purchase order, or a formal contract executed by "Owner" and "Contractor", together with these Specifications and all other documents referred to in such a formal contract.
- F. Contractor: the organization that will be retained by the "Owner" for all construction activities (i.e.: site preparation, earthwork construction, etc.) in accordance with the design and construction criteria, drawings, and specifications. The "Contractor" shall submit all the shop drawings and other necessary documents for approval by the "Engineer". The "Contractor" is also responsible for cooperating with the "Engineer" to help conduct all CQA inspection and testing.
- G. CQA: Construction Quality Assurance.
- H. CQAO: Construction Quality Assurance Officer.
- I. Density: mass density of a soil is its weight per unit volume; usually reported in pounds per cubic foot. Maximum dry density as determined by Standard Proctor Test (ASTM D698) or Modified Proctor Test (ASTM D1557).
- J. Dewatering: process of lowering the groundwater level or removing surface water from the construction area to permit construction activities to proceed "in the dry".
- K. Engineer: the authorized representative or registered professional engineer who is employed by the Owner to design and/or oversee aspects of construction, installation, and testing. The Engineer is

responsible for the design and construction specifications and/or quality control and quality assurance activities as specified in these Specifications.

- L. Geotextile: a relatively porous, permeable construction or reinforcement fabric used in civil engineering for geotechnical projects. The fabric structure may be knit, woven or nonwoven. Filter geotextile is a material which provides separation of materials with different pore size openings to prevent clogging. Drainage geotextiles are materials with adequate transmissivity to provide planar flow of fluid. Reinforcing geotextile is a material with sufficient strength to support some or all of the load applied to a composite system.
- M. In-Situ: "As is", or as it exists in-place naturally.
- N. Manufacturer: the organization(s) that will manufacture and supply the geosynthetic materials for this project.
- O. Moisture Content: ratio of quantity of water in the soil (by weight) to the weight of the soil solids (dry soil), expressed in percentage; also referred to as water content (ASTM D2216).
- P. NCDOT: North Carolina Department of Transportation.
- Q. Optimum Moisture Content (OMC): moisture content corresponding to maximum dry density as determined by the Standard Proctor Test (ASTM D698) or Modified Proctor Test (ASTM D1557).
- R. Owner: the entity who possesses the landfill. The Owner has the authority to select and dismiss the Contractor, the Liner Installer and/or the Manufacturer. The Owner also has the authority to accept or reject design plans and specifications, recommendations of the Engineer, the materials supplied, and the workmanship of the "Contract(s)" and the Geosynthetics Contractor.
- S. Plasticity: ability of a soil mass to be remolded without raveling or breaking apart. The plasticity index, numerically equal to the difference between the liquid and plastic limit, is a comparative number which describes the range of moisture contents over which a soil behavior is plastic.
- T. QA/QC Technician: Quality Assurance/Quality Control Technician.
- U. Work: any and all labor, supervision, services, materials, supplies, utilities, machinery, equipment, tools, and facilities called for by the "Contract".

1.3 CONTRACT DESCRIPTION

- A. Work of the Project includes and consists of furnishing all labor, materials, supervision, equipment and services necessary to complete the construction of the Asbestos Landfill cover system as indicated in the Technical Specifications, Drawings, and Bid Worksheet. The work will include:
 - 1. providing for on-site health and safety measures;
 - 2. installation of required Erosion and Sedimentation (E&S) Control measures;
 - 3. site clearing and preparation;
 - 4. placing fill to achieve proposed subgrade;
 - 5. cover system construction including structural fill and topsoil/vegetative layer placement;
 - 6. final cover seeding and stabilization; and
 - 7. borrow area restoration and seeding.
- B. Perform Work of Contract under stipulated sum with Owner in accordance with Conditions of Contract.
- C. Work of Contract shall be constructed to the lines and elevations as shown on the Drawings and as identified in these Technical Specifications. Any deviations from the Drawings or Technical

Specifications require the prior written approval of the ENGINEER and State Solid Waste Section and must be documented by "as-built" revisions to the Drawings and/or Technical Specifications.

- D. During all phases of construction, construction will be tested, monitored, and evaluated prior to approval.

1.4 CONTRACTOR AND SUBCONTRACTOR QUALIFICATIONS

- A. General Contractor (Contractor):
 - 1. The Contractor must be qualified and experienced in landfill construction.
- B. Surveyor:
 - 1. All field layouts shall be performed by or under the supervision of a licensed Professional Land Surveyor registered in the state where the Work is to be conducted. The Contractor shall establish and maintain a minimum of two permanent benchmarks. Horizontal and vertical locations of the benchmarks shall be recorded on the As-Built Drawings.

1.5 CONTRACTOR'S USE OF SITE

- A. Limit use of site and premises to allow:
 - 1. Owner occupancy.
- B. Access to site: as established by the Owner.
- C. Construction operations limited to areas noted on Drawings.
- D. Time Restrictions for Performing Work:
 - 1. In accordance with Owner's designated schedule or as otherwise agreed upon by the Owner.

1.6 WORK SEQUENCE

- A. General Order of Construction. During and prior to construction period, coordinate construction schedule and operations with Owner, Engineer, and any other applicable parties.
 - 1. Utility location within the work area
 - 2. Installation of required Erosion and Sedimentation Control Measures/Devices
 - 3. Site Clearing
 - 4. Install stormwater management features
 - 5. Subgrade construction
 - 6. Cover system construction
 - 7. Final stabilization

1.7 OWNER OCCUPANCY

- A. Access must be maintained for other site activities.
- B. Schedule the Work to accommodate Owner occupancy.

END OF SECTION

SECTION 01200
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Summary.
 - 2. Allowances.
 - 3. Applications for payment.
 - 4. Change Procedures.
 - 5. Defect Assessment.
 - 6. Unit prices.
 - 7. Alternates.

1.2 ALLOWANCES

- A. OVERHEAD AND PROFIT
 - 1. Allowance for overhead and profit combined shall not exceed fifteen percent (15%) of the net cost except where the change involves a Subcontractor; allowances shall not exceed fifteen percent (15%) for the Subcontractor and seven and one-half percent (7-1/2%) for the Prime Contractor.
 - 2. Work covered by unit prices will have no allowance for overhead and profit.
 - 3. In the case of deductible Change Orders other than for unit prices, the Contractor shall include not less than ten percent (10%) profit but no allowance for overhead.

1.3 APPLICATIONS FOR PAYMENT

- A. The Contractor shall submit to the Engineer an original itemized Application for Payment, notarized, in accordance with EJCDC Document C-700, supported by such data substantiating the Contractor's right to payment as the Owner or the Engineer may require, and reflecting retainage amounts. This Application for Payment will be submitted on a date to be mutually agreed upon by all Prime Contractors, the Engineer, and the Owner at preconstruction conference.
- B. The Owner will retain five percent of each Application for Payment, and such retainage should be accounted for in the Contractor's Application for Payment. The Owner shall release to the Contractor all retainage on payments held by the Owner if (1) the Owner receives a certificate of substantial completion from the Engineer; or (2) the owner receives beneficial occupancy or use of the project. However, the owner may retain sufficient funds to secure completion of the project or corrections on any work. If the owner retains funds, the amount retained shall not exceed two and one-half times the estimated value of the work to be completed or corrected.
- C. The Contractor shall include in his Contract Sum and shall pay all County, State and Federal Sales or Use Taxes applicable to performance of the Work. The Contractor shall submit with each payment request, submitted on quarter months, an original notarized statement showing all taxes paid on the project. The statement shall list each Subcontractor and supplier by name and the amount of Sales Tax paid to and by each of them and the total amount of Sales Tax paid.
- D. Applications for Payment shall be accompanied by a North Carolina Local Sales or Use Tax Statement. This statement shall be submitted on the forms provided by the Owner and shall show the North Carolina, County, and/or Local Sales Tax and any other applicable Taxes paid. It shall also list any payments made directly to the North Carolina Department of Revenue. If no sales tax has been paid, "NONE" shall be entered on the statement form.

- E. When requesting payment for materials stored, the Contractor shall submit with his request a Certificate of Insurance showing proof of coverage for the materials. Payment will be made for up to ninety percent (90%) of invoice amount only for the stored materials. No payment will be made for anticipated overhead and profit. Requests for payment for materials stored shall be accompanied by the Supplier's invoices, or other indications of the value of the stored materials, satisfactory to the Owner. The Contractor shall notify the Engineer of this intention to bill for stored materials seven (7) days prior to the normal billing date and will reimburse the Owner for costs incurred upon reviewing stored materials.

1.4 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. The Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time.
- C. The Engineer may issue a Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change, and the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within three days.
- D. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01600.
- E. Work Directive Change: Engineer may issue directive instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Engineer and/or Owner, it is not practical to remove and replace the Work, the Engineer will direct appropriate remedy or adjust payment.
- C. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- D. Authority of Engineer and/or Owner to assess defects and identify payment adjustments is final.
- E. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected products.

1.6 UNIT PRICES

A. Unit Quantities

1. Measurement methods delineated in individual specification sections complement criteria of this section. In event of conflict, requirements of individual specification section govern.
2. Take measurements and compute quantities. Engineer will verify measurements and quantities.
3. Quantities and measurements indicated in Bid Form and/or Contract Documents are for contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
 - a. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit prices contracted.
 - b. When actual Work requires 30 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim for Contract Price adjustment.

B. Unit Prices

1. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.
2. Specific Item Unit Pricing is delineated in the individual specification sections.
3. Mobilization
 - a. Basis of Measurement: By lump sum.
 - b. Basis of Payment: Includes mobilization for the project.
4. Surveying
 - a. Basis of Measurement: By lump sum.
 - b. Basis of Payment: Includes surveying to the locations and grades according to the plans and specifications and providing as-built drawings, and any incidentals in completing the contract. Surveys required to complete as-built drawings shall include, at a minimum, the following:
 - 1) Existing Conditions Survey: after bush hogging and clearing, before stripping.
 - 2) Stripped Surface Survey: after stripping, before excavation or cut and fill.
 - 3) Rough Subgrade Survey: prior to beginning rough final subgrade construction
 - 4) Final Subgrade Survey: after excavation, cut, and fill to subgrade elevations, before placement of overlying materials.
 - 5) Soil Liner Survey: after compacted soil liner placement and removal of overbuild, before placement of geosynthetics.
 - 6) Protective Cover Survey: after geosynthetics placement and protective cover soil, before waste placement.
 - 7) As-Built Survey: after Work is completed.

1.7 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work.

END OF SECTION

SECTION 01300
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Summary.
 - 2. Project meetings.
 - 3. Submittal procedures.
 - 4. Construction progress schedules.
 - 5. Cash Flow Schedule.
 - 6. Health & Safety Professional.
 - 7. Administrative Submittals

1.2 PROJECT MEETINGS

- A. A pre-construction conference will be scheduled as soon as practicable after the award of the contract. The Contractor shall attend the conference along with anticipated major Subcontractors. During this conference, the Contractor shall submit a list of anticipated Subcontractors and major material suppliers, a detailed construction schedule, and a statement of anticipated monthly progress payments showing the percent of progress each month. The Contractor shall also provide at least two local telephone numbers that may be used to contact the Contractor or his authorized representative in the event of an emergency after normal business hours. The Contractor shall also have his prospective job Superintendent attend the pre-construction conference.
- B. The Contractor shall attend all weekly progress meetings for the purpose of informing the Owner and the Engineer regarding the status of the project. A person authorized to act on behalf of the Subcontractor(s) shall be present. Each representative shall be thoroughly familiar with the status of the project and shall be prepared to discuss and act upon any situations that may arise. The time, date and location of these meetings will be established during pre-construction conference. The General Contractor shall provide an updated job progress schedule at each weekly meeting, including percentage of task complete versus percentage invoiced.
- C. Pre-installation meetings may be scheduled as needed before the start of select work items to coordinate efforts and communicate expectations between the Contractor, Subcontractors, Engineer, and CQA Officer.

1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer accepted form.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor and Supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

- E. Identify variations from Contract Documents and product or system limitations, which may be detrimental to successful performance of completed Work.
- F. When revised for resubmission, identify changes made since previous submission.
- G. Submittals not requested will not be recognized or processed.

1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. The project schedule shall be developed using commercially available project scheduling software.
- B. The Contractor shall ensure schedule compatibility with Owner's integrated site schedule including but not limited to Activity Codes, Calendars, etc. Approved schedule templates are available from Owner upon request.
- C. Submit initial schedules within 10 days after date of Notice to Proceed. After review, resubmit required revised data within 10 days.
- D. Submit revised Progress Schedules with each Application for Payment.
- E. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.
- F. In addition to the schedule updates described above Contractors shall report to the Owner immediately upon becoming aware of any circumstances which might result in deviation from the approved Project Milestone Schedule. Should the project fall behind schedule to the extent that completion of Work within the Contract Time appears doubtful, Contractor shall take corrective action to get back on schedule at no change in target price. In addition to informing the Owner and taking prompt corrective action, the Contractor shall develop and submit to the Owner a schedule Recovery Plan which identifies changes in approach, schedule sequence logic, work schedule, etc. required to meet the contract Substantial Completion. A Recovery Plan shall be developed by the Contractor by the next schedule update.

1.5 CASH FLOW SCHEDULE

- A. The Contractor shall submit a cash flow schedule with the construction progress schedule. The cash flow schedule shall define on a monthly basis the estimated progress payment amount for the project duration.
- B. Submit revised cash flow schedules with each Application for Payment

1.6 HEALTH & SAFETY PROFESSIONAL

- A. The Contractor shall be responsible for providing for health & safety during construction activities.

1.7 ADMINISTRATIVE SUBMITTALS: The Contractor shall submit the following within 21 days after date of Notice to Proceed. After review, resubmit required revised data within 7 days.

- A. Material Handling Plan;
- B. Project Work Plan;
- C. List of subcontractors;

- D. Employee training matrix;
- E. List of non-English speaking personnel. Note that the contractor shall be responsible for providing interpreters and documenting legal United States working status for non-English speaking personnel;
- F. List of all chemical products that will be stored/used;
- G. MSDS sheets for all chemical products;
- H. List of fuel driven equipment and company vehicles (to be completed on forms provided by Duke Energy);
- I. Contractor and subcontractor time and materials unit rates; and
- J. Provide copies of MICCS cards for all employees.

END OF SECTION

SECTION 01400 QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Summary.
 - 2. Quality Control and Control of Installation.
 - 3. Tolerances.
 - 4. Surveying.
 - 5. References.
 - 6. Mock-Up Requirements.
 - 7. Testing and observation requirements.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Perform work activities in accordance with Owner's safety plans, procedures, and requirements.
- B. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- C. Comply with manufacturers' and/or supplier's instructions, including each step in sequence.
- D. When manufacturers' and/or supplier's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- F. Perform Work by persons qualified to produce required and specified quality.
- G. Verify field measurements are as indicated on Construction Drawings or as instructed by manufacturer.
- H. Materials stored off the site shall be stored in a bonded warehouse and shall be clearly marked as being for this project.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 SURVEYING

- A. All field layouts shall be performed by or under the supervision of a licensed Professional Land Surveyor registered in the state where the Work is to be conducted. The Contractor shall establish

and maintain a minimum of two permanent benchmarks. Horizontal and vertical locations of the benchmarks shall be recorded on the As-Built Drawings.

- B. The Engineer will be responsible for surveying necessary for Record Drawings. A 50' X 50' grid pattern of ground surface elevations in the construction area shall be surveyed. The Record Drawings shall be determined and provided by the Engineer's licensed surveyor.
- C. Record Drawings for cover system construction shall include:
 - 1. completed subgrade (for subgrade fill measurement and payment purposes)
 - 2. final cover system.
- D. Record Drawings will require the following surveys at a minimum, and any surveys required to satisfactorily provide documentation to create the record drawings:
 - 1. Final Subgrade Survey: after excavation, cut, and fill to subgrade elevations, before placement of overlying materials.
 - 2. As-Built Survey: after Work is completed.
- E. The thickness of the final cover soil layers shall be determined by non-destructive survey methods by comparison of topographic survey and spot elevations of the top of subject layer to the bottom of the subject layer. All anchor trenches, berms, toes, crests and breaks-in-slope shall be surveyed, field referenced and located on Record Drawings.

1.5 REFERENCES

- A. For products or workmanship specified by association, trades, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable code.
- B. Obtain copies of standards where required by product specifications sections.
- C. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.6 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in respective product specification sections.

1.7 TESTING AND OBSERVATION REQUIREMENTS

- A. Testing and observation services for the purpose of conducting tests shall be performed by the Contractor. All costs of testing shall be paid by the Contractor. The entity providing the CQA testing shall be referred to as the CQA agent herein.
- B. Testing, observations and source quality control may occur on or off project site. Perform off-site testing as required by Engineer or Owner.
- C. CQA Reports will be submitted by the Engineer to the NCDENR Solid Waste Section summarizing observations and results of tests.
- D. Cooperate with CQA agent; furnish samples of materials, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. The Contractor shall give ample advance notice to the CQA agent and Engineer prior to expected time for operations requiring testing services and/or before covering up items that require inspection.
 2. Make arrangements with CQA agent and pay for additional samples and tests required for Contractor's use.
- E. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- F. Re-testing or observation required because of non-conformance to specified requirements shall be performed by same CQA agent on instructions by Engineer. Payment for re-testing will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- G. CQA Agent Responsibilities:
1. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials with requirements of Contract Documents.
 4. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
 5. Perform additional tests required by Engineer.
 6. Attend preconstruction meetings and progress meetings.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Contractor shall verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Contractor shall verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Contractor shall examine and verify specific conditions described in individual specification sections.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Summary.
 - 2. Temporary Utilities:
 - a. Temporary electricity.
 - b. Telephone service.
 - c. Facsimile service.
 - d. Temporary water service.
 - e. Temporary sanitary facilities.
 - 3. Construction Facilities:
 - a. Field offices and sheds.
 - b. Vehicular access.
 - c. Parking.
 - d. Progress cleaning and waste removal.
 - 4. Temporary Controls:
 - a. Barriers.
 - b. Water control.
 - c. Dust control.
 - d. Erosion and sediment control.
 - e. Pollution control.
 - 5. Site Security.
 - 6. Removal of utilities, facilities, and controls.

1.2 TEMPORARY UTILITIES

- A. Temporary Sanitary Facilities
 - 1. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.
 - 2. Sanitary arrangements shall include water closet facilities acceptable to the local Health Department and shall be kept in a sanitary condition at all times. These facilities shall be available to all workers on the job.

1.3 CONSTRUCTION FACILITIES

- A. Field Offices and Sheds
 - 1. Temporary structures may include a temporary field office at the Contractors discretion and at no cost to the Owner.
 - 2. Do not use permanent facilities for field offices or for storage.
 - 3. Removal: At completion of Work, remove buildings, foundations, utility services, and debris. Restore areas to satisfaction of Owner.
- B. Vehicular Access
 - 1. Location as indicated on Drawings approved by Engineer and/or Owner.
 - 2. Use designated existing on-site roads for construction traffic.
- C. Parking
 - 1. Arrange for and/or provide temporary parking areas to accommodate construction personnel.

2. Locate as approved by Owner.
3. When site space is not adequate, provide additional off-site parking.
4. Tracked vehicles not allowed on existing on-site streets and driveways.
5. Do not allow vehicle parking on existing pavement without approval by Owner.
6. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
7. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified condition.
8. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

D. Progress Cleaning and Waste Removal

1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
2. Provide a dumpster and regular garbage services on-site.
3. On-site burial of waste, debris, and rubbish shall not be permitted.

1.4 TEMPORARY CONTROLS

A. Barriers

1. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Water Control

1. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
2. Provide water barriers as required to protect site from soil erosion according to project's Erosion and Sedimentation Control Plan.

C. Dust Control

1. Execute Work by methods to minimize raising dust from construction operations.
2. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

D. Erosion and Sediment Control

1. Follow project's Erosion and Sedimentation Control Plan.
2. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
3. Minimize surface area of bare soil exposed at one time.
4. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow across disturbed areas.
5. Construct fill and waste areas by selective placement to avoid erosive surface.
6. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

E. Pollution Control

1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
2. Comply with pollution and environmental control requirements.
3. Comply with Owner's pollution control program.

1.5 SITE SECURITY

- A. The Contractor is responsible for securing the work area, equipment, and materials. Owner will not be responsible for vandalism, damage, or theft of equipment and materials on the job site.

1.6 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

END OF SECTION

SECTION 01600 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Summary.
 - 2. Products.
 - 3. Product delivery requirements.
 - 4. Product storage and handling requirements.
 - 5. Product options.
 - 6. Product substitution procedures.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions and Specifications. When manufacturers' and/or suppliers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions. When manufacturers' and/or suppliers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather-tight enclosures in an environment favorable to product.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- E. Materials stored off the site shall be stored in a bonded warehouse and shall be clearly marked as being for this project. When requesting payment for the materials stored, the Contractor shall submit with his request a Certificate of Insurance showing proof of coverage for the materials. Payment will be made for up to 90% of invoice amount only for stored materials. No payment will be made for anticipated overhead and profit. Requests or payments for materials stored shall be accompanied by the Supplier's invoices, or other indications of the value of the stored materials, satisfactory to the Owner.

- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

- A. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- C. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- D. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- E. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner and/or Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.
- F. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- G. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. Engineer will notify Contractor in writing of decision to accept or reject request.

END OF SECTION

SECTION 01700
EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Summary.
 - 2. Closeout procedures.
 - 3. Final cleaning.
 - 4. Testing, adjusting and balancing.
 - 5. Protecting installed construction.
 - 6. Project record documents.

1.2 CLOSEOUT PROCEDURES

- A. Certificate of Substantial Completion will not be issued until Owner has been provided with written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Owner and Engineer's review.
- B. Final Application for Payment shall be accompanied by the following documents:
 - 1. Guarantees of all materials and workmanship.
 - 2. Contractor's Affidavit, Release and Waiver of Claims.
 - 3. Consent of Surety (if applicable).
 - 4. Final State/County Sales/Use Tax Statement (if applicable).
 - 5. Complete list of all Subcontractors and areas of work performed.
 - 6. Proof of Compliance with Building Standards.
 - 7. MWBE Documentation of Final Contract Payments (if applicable).

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean site; sweep paved areas, rake and clean landscaped surfaces.
- C. With Owner's permission, may dispose of waste and surplus materials, and rubbish on-site in Owner designated location. Otherwise remove these items from the site. In addition, remove construction facilities from site.

1.4 TESTING, ADJUSTING AND BALANCING

- A. Testing and CQA reports will be submitted by CQA agent to Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.5 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.

- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Prohibit traffic on landscaped areas.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly. For each item, include percentage of work complete versus percentage of work invoiced.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.
- G. Submit documents to Engineer.

END OF SECTION

SECTION 02060
AGGREGATE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Aggregate Type A1 – No. 57 stone for drainage aggregate and erosion and sediment control structures.
 2. Aggregate Type A2 – Class B riprap for erosion and sediment control structures.
 3. Aggregate Type A3 – Class 2 riprap for erosion and sediment control structures.
 4. Aggregate Type A4 – Class A riprap for slope stabilization.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Coarse Aggregate:
1. Basis of Measurement: A1, A2, & A3 by the **in place cubic yard** or as otherwise indicated in other Sections of these Specifications. Installation quantities shall not include quantities placed beyond the lines and grades shown on the Drawings.
 2. Basis of Payment: By the cubic yard placed times the unit price for each aggregate type, or as otherwise indicated in these Specifications.
 - a. Includes supplying aggregate materials, hauling, stockpiling, and placement.
 - b. Requested payment quantities will be submitted by the Contractor with final approval by the Owner. If a dispute exists relative to payment quantities, the Contractor at his expense will uncover any buried or covered material for re-evaluation.
- B. Riprap Slope Stabilization (Aggregate Type A4 – Class A riprap):
1. Basis of Measurement: By the square feet of installed material.
 2. Basis of Payment: Includes labor and materials for cleaning, excavating, backfilling, placing embankment, placing geotextile fabric, and placing rock as indicated on Drawings.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T11 – Standard Method of Test for Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing.
 2. AASHTO T27 – Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM International:
1. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.
 2. ASTM D421 – Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
 3. ASTM D422 – Standard Test Method for Particle Size Analysis of Soils.
 4. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 5. ASTM D4254 – Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- C. North Carolina Department of Transportation (NCDOT) Standard specifications for Roads and Structures.

1.4 SUBMITTALS

Not Used.

1.5 QUALITY ASSURANCE

- A. Furnish each aggregate material type from single source throughout the Work.
- B. Perform Work in accordance with North Carolina Department of Transportation Standard Specifications for Roads and Structures or as otherwise specified.

PART 2 PRODUCTS

2.1. COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate Type A1 – Drainage Aggregate: Subangular, subrounded, rounded, or well rounded particle shaped conforming to No. 57 Stone NCDOT Standards. Coarse Aggregate Type A1 shall be used for construction of erosion and sediment control structures, and where shown on the Drawings.
- B. Coarse Aggregate Type A2: Conforming to Class B Riprap NCDOT standards. Coarse Aggregate Type A2 shall be used for drainage feature inlet and outlet protection, for construction of erosion and sediment control structures, and where shown on the Drawings.
- C. Coarse Aggregate Type A3: Conforming to Class 2 Riprap NCDOT standards. Coarse aggregate Type A3 shall be used for drainage feature outlet protection, for erosion and sediment control structures, and where shown on the Drawings.
- D. Coarse Aggregate Type A4: Conforming to Class A Riprap NCDOT standards. Coarse Aggregate Type A4 shall be used for riprap slope stabilization at the cover system termination to existing grade along the western edge of the cover system.

2.2 SOURCE QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing and observation services.
- B. Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136, ASTM D421, ASTM D422, ASTM D4253, ASTM D4254, AASHTO T11, and/or AASHTO T27.
- C. When tests indicate materials do not meet specified requirements, change material or material source and retest.
- D. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1. STOCKPILING

- A. Stockpile materials on site at locations agreed upon by the Owner.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.

- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

3.2. STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water and restore to original site conditions.

3.3. EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.4. PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.5. AGGREGATE PLACEMENT

- A. Spread aggregate over prepared substrate to a total compacted thickness as specified on Drawings.
- B. Place aggregate in a maximum layer and compact to specified density.
- C. Level and contour surfaces to elevations and grades indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.6. RIPRAP SLOPE STABILIZATION

- A. Excavate to indicated depth of rock lining or nominal placement thickness as indicated on Drawings. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.
- B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from up slope to down slope. Overlap edges to provide a minimum overlap of 1.5 feet. Offset adjacent roll ends a minimum of 3 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than 2 weeks.
- C. Carefully place rock on geotextile fabric to produce an even distribution of pieces, with minimum of voids and tearing of geotextile. Place as indicated on Drawings.
- D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and to avoid displacement of underlying material. Arrange individual rocks for uniform distribution. Place evenly and carefully to minimize voids.

3.7. TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Scheduled Compacted Thickness: Within 1/2 inch.
- C. Variation From Design Elevation: Within 1 inch.

END OF SECTION

SECTION 02230
SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rotary Cutting / Bush Hogging.
 - 2. Site Clearing and Grubbing.
 - 3. Stripping / Topsoil Excavation.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Rotary Cutting / Bush Hogging:
 - 1. Basis of Measurement: By the acre of the original ground surface that is cut with a rotary mower. Computation of the quantities of rotary cutting will be based on surveyed surface areas (provided by the Contractor) rotary cut and will be mutually agreed to in writing by the Owner and Contractor for each particular area.
 - 2. Basis of Payment: By the 2-dimensional acre rotary-cut times unit price per acre for rotary cutting.
 - a. Includes rotary cutting, loading, hauling, and removing waste materials from site (unless permitted to dispose of on site by Owner).
- B. Site Clearing and Grubbing:
 - 1. Basis of Measurement: By the acre of the original ground surface that is cleared and grubbed. Computation of the quantities of clearing and grubbing will be based on surveyed surface areas (provided by the Contractor) cleared and grubbed and will be mutually agreed to in writing by the Owner and Contractor for each particular area.
 - 2. Basis of Payment: By the 2-dimensional acre cleared and grubbed times unit price per acre for clearing and grubbing.
 - a. Includes clearing and grubbing site, loading, hauling, and removing waste materials from site (unless permitted to dispose of on site by Owner).
- C. Stripping / Topsoil Excavation:
 - 1. Basis of Measurement: By the acre of the original ground surface that is excavated of topsoil. Computation of the quantities of topsoil excavation will be based on surveyed surface areas (provided by the Contractor) excavated of topsoil and will be mutually agreed to in writing by the Owner and Contractor for each particular area
 - 2. Basis of Payment: Made at contract price per 2-dimensional acre for topsoil excavation. Includes removal, loading, hauling, and stockpiling at the designated on-site stockpile location, of excavated material and removing waste materials from site (unless permitted to dispose of on site by Owner).

1.3 SUBMITTALS

- A. NA

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State and local standards and ordinances.
- B. Conform to applicable codes for environmental requirements, disposal of debris, and burning debris on site (if allowed by OWNER).

PART 2 PRODUCTS

2.1 MATERIALS

- A. NA

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Flag clearing limits.
- C. Identify waste area for placing removed materials and/or stockpiling topsoil. May dispose on site if permitted by Owner in Owner designated area.

3.2 PREPARATION

- A. Call Local Utility Line Information service not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

3.3 PROTECTION

- A. Locate, identify, and protect from damage utilities indicated to remain.
- B. Protect bench marks, survey control points, groundwater monitoring wells, and existing structures from damage or displacement.

3.4 SITE ROTARY CUTTING OR CLEARING AND GRUBBING

- A. No excavation shall be conducted within the Asbestos landfill limits of waste.
- B. Notify Owner prior to commencing with land disturbance activities.
- C. Flag land disturbance limits.
- D. Install erosion control devices as shown on the Drawings.
- E. Clear areas required for access to site and execution of Work.
- F. Identify areas to be rotary cut or cleared and grubbed. Remove trees and shrubs within construction area. Remove all trash or debris. Fibrous organic matter, rubbish, vegetable matter, small stones, stumps, roots, root system, or other objectionable deleterious material within the Asbestos landfill limits of waste shall be left in place.

- G. Clear undergrowth and deadwood.
- H. Allow inspection of cleared areas by Owner or his representative prior to beginning other construction activities.
- I. Haul and stockpile cutting, clearing and grubbing debris in stockpile area designated on the Drawings.

3.5 REMOVAL

- A. Remove debris, rock, and extracted vegetation from site. If permitted by Owner, may dispose of on-site in Owner specified location.
- B. Remove construction debris and other materials that can not be used in earthwork construction or final vegetation. Materials shall be disposed off-site in accordance with any applicable North Carolina laws or regulations unless permitted by Owner to dispose of on-site in Owner designated location.
- C. Do not burn or bury materials on-site unless permitted by State and local ordinances and laws and given permission by Owner to do so. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

- A. No excavation shall be conducted within the Asbestos landfill limits of waste.
- B. Excluding the areas within the Asbestos landfill limits of waste, excavate topsoil from areas to be further excavated, or re-graded without mixing with foreign materials for use in finish grading. The minimum topsoil stripping depth shall be six inches or as determined by the Owner.
- C. Stockpile material at the designated on-site stockpile location and protect from erosion.
- D. Remove excess topsoil not intended for reuse from site unless permitted by owner to dispose of on-site in Owner designated location.
- E. Obtain Owner's acceptance after stripping activities have ceased and before excavation activities commence.

END OF SECTION

SECTION 02320
BACKFILL - STRUCTURAL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Fill Type S1, structural fill, defined as compacted fill for landfill cover system, cover system subgrade, surface water control systems, roadways, and area fills.
 2. Fill Type S2, topsoil/vegetative layer, defined as soil material capable of sustaining vegetation as specified in these Specifications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Fill Type S1:
1. Basis of Measurement: By the cubic yard filled. The quantity of structural fill will be based upon the in-place volume between the excavated surface or prepared subgrade and the structurally filled surface as determined by surveys after completion of the placement of the earth structural fill. A grid pattern as approved by the Engineer of ground surface elevations in the area shall be surveyed and reference points installed by the Earthwork Contractor prior to structural backfill placement and prior to placement of any overlying material. The Engineer shall check the as-built finished grades and determine the backfilled volume of soil based on survey data.
 2. Basis of Payment: Lump sum - OR – by the cubic yard placed times the unit price for fill placement. Please refer to the Bid Sheet to determine which method applies.
 - a. Includes furnishing, borrow, hauling, scraping, stockpiling, scarifying substrate surface, placing where required, compacting, maintenance, and removing accumulated water during construction.
 - b. Payment for structural fill will be based on the in-place volume filled times the unit price for structural fill.
 - c. Requested payment quantities will be submitted by the Earthwork Contractor with final approval by the Owner. If a dispute exists relative to payment quantities, the Earthwork Contractor, at his expense, will uncover any buried or covered material for re-evaluation.
- B. Fill Type S2:
1. Basis of Measurement: By the cubic yard filled.
 2. Basis of Payment: Lump sum - OR – by the cubic yard placed times the unit price for fill placement. Please refer to the Bid Sheet to determine which method applies.
 - a. Includes furnishing, borrow, amending, scarifying fill material, placing, compacting, and maintenance of topsoil.

1.3 REFERENCES

- A. ASTM D422 - Standard test Method for Particle-Size Analysis of Soils (Grain Size with Hydrometer).
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
- C. ASTM D1556 – Standard Test Method for Density of Soil In Place by the Sand-Cone Method.
- D. ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

- E. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D2487 – Standard Practices for Classification of Soil for Engineering Purposes (Unified Soil Classification System)
- G. ASTM D2937 - Standard Test Method for Density of Soil in place by the Drive-Cylinder Method.
- H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 SUBMITTALS

- A. Section 01330 – Submittal Procedures: Submittal procedures.
- B. Samples: Submit, in air-tight containers, 50 lb sample of each type of excavated material to testing laboratory to determine suitability for use as structural fill material and compaction characteristics.
- C. The Contractor and/or CQA agent shall submit field quality control test results to the Engineer.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Standard Fill Type S1:
 - 1. Excavated and reused material from designated on-site or off-site borrow areas and/or stockpiles.
 - 2. Borrow material shall be classified as SM, SC, ML, MH, or CL soils according to the Unified Soil Classification System (ASTM D2487).
 - 3. May consist of fly ash and bottom ash from for use only as fill to achieve cover system subgrade and the bottom 12-inches of the 36-inch thick cover.
 - 4. Free of topsoil, organic material, roots, stumps, brush, rocks larger than 3 inch, subsoil, debris, vegetation, and other foreign matter.
 - 5. All material clods will be broken down with tillers and/or discs to provide a homogeneous soil that is free of clods greater than 4 inches in diameter with no more than 15% retained on the No. 4 sieve.
 - 6. Borrow area(s) shall be final graded to slopes as shown on the Drawings.

- B. Fill Type S2, Topsoil/Vegetative Layer:
 - 1. Topsoil/vegetative layer is defined as compacted fill placed to achieve final grades on the final cover system or to otherwise support vegetation establishment in areas not within the landfill cells.
 - 2. Excavated and reused materials from designated on-site or off-site borrow areas and/or stockpiles and/or approved soil from trenching operations.
 - 3. Shall be classified as SM, SC, SW-SM, SW-SC, SP-SM, ML, MH, or CL soils according to the Unified Soil Classification System (ASTM D2487).
 - 4. Free of roots, stumps, brush, rocks larger than 2 inches, debris, and other foreign matter.
 - 5. Topsoil material shall have nutrient content and pH capable of supporting vegetation.
 - 6. Shall have a minimum organic content of 2% by weight.
 - 7. All material clods will be broken down with tillers and/or discs to provide a homogeneous soil that is free of clods greater than 2 inches in diameter with no more than 15% retained on the No. 4 sieve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions
- B. The Engineer will assist the Earthwork Contractor in the determination of Structural Fill and non-select material during excavation operations (see Section 02315). The Earthwork Contractor will be responsible for excavating, transporting, stockpiling, placing and compacting all materials as needed.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. No excavation shall be conducted within the Asbestos landfill limits of waste.
- C. Do not scarify subgrade surface or otherwise disturb existing Asbestos landfill cover soils.
- D. Proof roll subgrade to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations as shown on Drawings with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Fill Type S1 and S2: Place and compact material in equal continuous layers not exceeding 6 inches compacted depth. Manually compacted fill near pipes and other structures will be compacted in loose lifts not exceeding 4 to 6 inches in thickness.
- D. Bench the existing side slopes during fill placement to promote bonding of existing and new fill materials.
- E. Employ placement method that does not disturb or damage other work.

- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Backfill against supported structures. Do not backfill against unsupported structures.
- H. Backfill simultaneously on each side of unsupported structures until supports are in place.
- I. Protect backfill from desiccation, crusting, or cracking.
- J. Make gradual grade changes. Blend slope into level areas.
- K. Remove surplus backfill materials from site unless authorized by Owner to dispose of on-site in an Owner designated location.
- L. Leave fill material stockpile areas free of excess fill materials.

3.4 TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Top Surface of General Backfilling: Plus or minus 0.1 feet from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing and observation services.
- B. The Contractor is responsible for quality control testing defined herein.
- C. Laboratory Testing
 - 1. Perform laboratory material tests in accordance with ASTM D422, ASTM D698, ASTM D2216, and ASTM D4318.
 - 2. Test at a frequency of:
 - a. 10,000 cubic yards of structural fill material placed; or
 - b. a minimum of three suites of tests, whichever results in the greater number of tests for a consistent material type;
 - c. When materials using for structural fill change; and/or
 - d. As well as when directed by the Owner.
 - 3. Sample size shall be 50-lb.
- D. In Place Compaction and Natural Moisture Content Tests
 - 1. Perform in place compaction tests in accordance with ASTM D1556, ASTM D2922, or ASTM D2937.
 - 2. Perform in place natural moisture content test in accordance with ASTM D2216.
 - 3. Frequency of compaction/natural moisture content tests:
 - a. Landfill: Each lift at a minimum frequency of 1 per acre per lift.
 - b. Embankments: Each lift at a minimum frequency of 1 per 5000 sq. ft.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- F. Cover system thickness verification:
 - 1. The final cover system thickness shall be field verified by hand augering or other methods performed by the Engineer.
 - 2. Thickness verification shall be conducted on an approximate 100-ft grid pattern.
 - 3. Thickness measurements shall not extend into waste and may be terminated at a depth of 3.0 feet (the required cover system thickness).

3.6 PROTECTION OF FINISHED WORK

- A. Section 01700 - Execution Requirements: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

3.7 SCHEDULE

- A. Landfill and Embankments:
 - 1. Fill type S1 should be compacted to 95 percent of its Standard Proctor (ASTM D 698) maximum dry density.
 - 2. Compacted moisture content shall be within 3 percent of optimum moisture content for all fill placed, or as otherwise approved by Engineer.
- B. Drop Inlets, and Culverts:
 - 1. Backfill of the drop inlets and culverts shall be placed and compacted in 6 inch thick loose lifts around the drop inlets and up to 2 feet above the culverts.
 - 2. Compaction shall be performed by hand tampers or small hand operated compactors.
 - 3. Compaction shall be at a minimum 95 percent of the Standard Proctor maximum dry density.
 - 4. Additional compaction of lifts 2 feet or greater above culverts shall conform to Landfill and Embankments Backfill schedule found in Part 3.7 A.1 of this Section.

END OF SECTION

SECTION 02374
EROSION CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grass-Lined/Diversion Channel.
 - 2. Riprap Energy Dissipater (Outlet Protection Apron).
 - 3. Wattles.
 - 4. Silt Fencing.
 - 5. Silt Fence Outlets.
 - 6. Slope Diversion Berm
 - 7. Grassing.

- B. Related Sections:
 - 1. Section 02060 – Aggregate.
 - 2. Section 02674 – Nonwoven Geotextile.
 - 3. Section 02924 - Seeding and Soil Supplements.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Grass-Lined/Diversion Channel:
 - 1. Basis of Measurement: By linear foot.
 - 2. Basis of Payment: Unit Price per linear foot or each.
 - a. Based on linear foot of channel times the unit price for the channel.
 - b. Includes excavating, windrowing, compacting, installing erosion control matting and seeding and mulching for grass-lined channels as indicated on Drawings. Refer to Section 02924 for Section on soil supplements for grassing.
 - c. Requested payment quantities will be submitted by the Contractor with final approval by the Owner. If a dispute exists relative to payment quantities, the Contractor at his expense will uncover any buried or covered material for re-evaluation

- B. Riprap Energy Dissipator (Outlet Protection Apron):
 - 1. Basis of Measurement: Each unit placed.
 - 2. Basis of Payment: Unit Price for each unit placed.
 - a. Includes labor and materials for cleaning, excavating, backfilling, placing embankment, placing geotextile fabric, placing riprap/aggregate, and required grouting as indicated on Drawings.

- C. Wattles:
 - 1. Basis of Measurement: Each unit placed.
 - 2. Basis of Payment: Unit Price for each unit placed.
 - a. Includes furnishing, installing, and maintaining the wattles as may be required to obtain the specified results.

- D. Silt Fencing:
 - 1. Basis of Measurement: By the linear foot.
 - 2. Basis of Payment: Unit Price for each linear foot placed.
 - a. Includes furnishing and maintaining the silt fencing as may be required to obtain the specified results, and maintaining a stone stockpile on site for maintenance purposes.

- E. Silt Fence Outlets:
 - 1. Basis of Measurement: By the linear foot.
 - 2. Basis of Payment: Unit Price for each linear foot placed.
 - a. Includes furnishing and maintaining the silt fence outlet as may be required to obtain the specified results and maintaining a stone stockpile on site for maintenance purposes.
- F. Slope Diversion Berm:
 - 1. Basis of Measurement: By the linear foot.
 - 2. Basis of Payment: Unit Price for each linear foot placed.
 - a. Includes furnishing and maintaining the tack on bench as may be required to obtain the specified results.
- G. Grassing:
 - 1. Basis of Measurement: By the Acre.
 - 2. Basis of Payment: Unit Price for each acre seeded.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- B. NCDOT Standard Specifications for Roads and Structures
- C. American Welding Society (AWS) D1.1 Structural Welding Code

1.4 SUBMITTALS

- A. Section 01300 – Administrative Requirements: Requirements for submittals.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Project record documents.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with requirements of these Project Specifications.
- B. Perform Work in accordance with NCDOT standards.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01300 - Administrative Requirements: Project meetings.
- B. Convene minimum one week prior to commencing work of this Section.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not place grout when air temperature is below freezing.

- C. Do not place concrete when base surface temperature is less than 40 degrees F or surface is wet or frozen.

PART 2 PRODUCTS

2.1 RIPRAP AND GEOTEXTILE MATERIALS

- A. Riprap: As specified in Section 02060. Furnish in accordance with NCDOT Standard Specifications section 1042.
- B. Geotextile Fabric: Non-biodegradable, non-woven geotextile, 8 oz/sy, UV stabilized filter fabric as specified in Section 02674.

2.2 AGGREGATE AND SOIL MATERIALS

- A. Coarse Aggregate: Type A1 and A2 as specified in Section 02060.
- B. Soil Backfill: Soil Type S1 as specified in Section 02320. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.3 SILT FENCING

- A. As specified on Drawings.

2.4 WATTLES

- A. As specified on Drawings.

2.5 PLANTING MATERIALS

- A. Seeding and Soil Supplements: As specified in Section 02924.
- B. Mulch: As specified in Section 02924.

2.6 ACCESSORIES

- A. Joint Sealers: Furnish in accordance with NCDOT standards and as indicated on Drawings.
- B. Joint Filler: Furnish in accordance with NCDOT standards and as indicated on Drawings.
- C. Grout: Furnish in accordance with NCDOT standards and as indicated on Drawings.
- D. Steel Plate Anti-Vortex Device: Furnish in accordance with NCDOT standards and as indicated on Drawings.
- E. Welding Material: Furnish in accordance with NCDOT and/or AWS D1.1 standards and as indicated on Drawings.

2.7 SOURCE QUALITY CONTROL (AND TESTS)

- A. Section 01400 - Quality Requirements: Testing and observation requirements.

- B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.
- C. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade or granular base is acceptable and ready to support devices and imposed loads.
- B. Verify grades and elevations of base or foundation for other work are correct.

3.2 GRASS LINED/DIVERSION CHANNELS

- A. Windrow excavated material on low side of channel.
- B. Compact subgrade soils to a minimum of 95 percent of the maximum dry density as determined by ASTM D698.
- C. On entire channel area, apply soil supplements and sow seed as specified in Section 02924.
- D. Mulch seeded areas with hay as specified in Section 02924 according to Drawings.
- E. Install erosion control matting as specified on Drawings.

3.3 RIPRAP ENERGY DISSIPATOR (OUTLET PROTECTION APRON)

- A. Excavate to indicated depth of rock lining or nominal placement thickness as indicated on Drawings. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire apron subgrade area to firm, even surface.
- B. Lay and overlay geotextile fabric over apron subgrade. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 2 feet. Offset adjacent roll ends a minimum of 5 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.
- C. Carefully place riprap/aggregate on geotextile fabric to produce an even distribution of pieces, with minimum of voids and without tearing geotextile. Place as indicated on Drawings.
- D. Unless indicated otherwise, place full course thickness of riprap/aggregate in one operation to prevent segregation and to avoid displacement of underlying material. Arrange individual rocks for uniform distribution. Place evenly and carefully to minimize voids.
 - 1. Saturate riprap/aggregate with water and let all standing water drain. Fill voids between pieces with grout, where shown on Drawings, for at least top 6 inches. Sweep surface with stiff broom to remove excess grout.
 - 2. Grout shall have a slump between 6 and 8 inches.

3.4 WATTLES

- A. Proper site preparation is essential to ensure complete contact of the Wattle (fiber roll) with the soil.
- B. Remove all rocks, clods, vegetation or other obstructions so that the installed wattles will have direct contact with the soil.
- C. A small trench 2-3 inches (8-10 cm) in depth should be excavated on the slope contour and perpendicular to water flow. Soil from the excavation should be placed down-slope next to the trench.
- D. Install the wattles in the trench, insuring that no gaps exist between the soil and the bottom of the wattle. The ends of adjacent wattles should be tightly abutted so that no opening exists for water or sediment to pass through. Alternately, wattles may be lapped, 6" minimum to prevent sediment passing through the field joint.
- E. Wooden stakes should be used to fasten the wattles to the soil. When conditions warrant, a straight metal bar can be used to drive a hole through the Wattle and into the soil.
- F. Wooden stakes should be placed 6" from the Wattle end angled towards the adjacent Wattle and spaced at 4 feet leaving less than 1-2 inches of stake exposed above the Wattle. Alternately, stakes may be placed on each side of the Wattle tying across with a natural fiber twine or staking in a crossing manner ensuring direct soil contact at all times.
- G. Terminal ends of wattles shall be dog legged up slope to help ensure containment and prevent channeling of sedimentation.
- H. Backfill the upslope length of the Wattle with the excavated soil and compact.
- I. Care shall be taken during installation so as to avoid damage occurring to the Wattle as a result of the installation process. Should the Wattle be damaged during installation, a wooden stake shall be placed either side of the damaged area terminating the log segment.
- J. Field monitoring shall be performed to verify that the placement does not damage the Wattle.
- K. Any Wattle damaged during placement or operations shall be replaced as recommended by the Owner or his representative, at the Contractor's expense.

3.5 SILT FENCING

- A. Install as specified on Drawings.

3.6 SILT FENCE OUTLETS

- A. Install as specified on Drawings.

3.7 SLOPE DIVERSION BERM

- A. Install as specified on Drawings.

3.8 MATTING

- A. Install in grass lined ditches and where specified on the Drawings.

3.9 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed heights indicated on the drawings. Slope stockpile sides at 2(H): 1(V) or flatter or as otherwise indicated on the Drawings.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
 - 1. During non-germinating periods, apply mulch at recommended rates.
 - 2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 02924 and as specified on Drawings for temporary seeding.
 - 3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 02924 permanent seeding specifications.
- E. Stabilize diversion channels and stockpiles immediately.

3.10 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements and Section 1700 - Execution Requirements: Testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- C. Compaction Testing: As specified in Section 02320.
- D. When tests indicate work does not meet specified requirements, remove work, replace and retest.

3.11 CLEANING

- A. Section 01700 - Execution Requirements: Final cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-half depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one half channel depth.
- F. Do not damage channel or channel lining material during cleaning operations.

3.12 PROTECTION

- A. Section 01700 - Execution Requirements: Protecting installed construction.

END OF SECTION

SECTION 02610
PIPE CULVERTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. HDPE corrugated, smooth interior stormwater pipe.
 2. Joints and accessories.

- B. Related Sections:
1. Section 02320 – Backfill – Structural.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Pipe Culvert:
1. Basis of Measurement: By the linear foot invert length of pipe and diameter for each type of pipe.
 2. Basis of Payment: By the linear foot placed times the unit price for culvert placement.
 - a. Includes excavating (trenching), hand trimming excavation, removing soft subsoil, compacting; installing pipe, fittings and accessories, and backfilling.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Society for Testing and Materials:
1. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
 2. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 3. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 4. ASTM D2216 – Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
 5. ASTM D2937 – Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
 6. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 7. ASTM F405 – Standard Specification for Corrugated Polyethylene Pipe and Fittings.
 8. ASTM F667 – Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.

1.4 SUBMITTALS

- A. Section 01300 – Administrative Requirements: Requirements for submittals.
- B. Product Data: Submit data on pipe, fittings and accessories.

- C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Closeout procedures
- B. Project Record Documents:
 - 1. Accurately record actual locations of pipe runs, connections, and invert elevations.
- C. Operation and Maintenance Data: Procedures for submittals.

1.6 PRE-INSTALLATION MEETING

- A. Section 01300 - Administrative Requirements: Pre-installation meeting.

PART 2 PRODUCTS

2.1 HDPE Corrugated Stormwater Pipe

- A. Stormwater pipe shall be HDPE corrugated, smooth interior pipe as manufactured by ADS (N-18) or engineer approved equivalent, meeting the requirements of ASTM F405 and ASTM F667 or as otherwise shown on the drawings.

PART 3 EXECUTION

LINES AND GRADES

- A. Grades:
 - 1. Lay pipes to lines and grades indicated on Drawings.
 - 2. Maintain grade alignment of pipe using string line parallel with grade line and vertically above centerline of pipe.
 - a. Establish string line on level batter boards at intervals of not more than 25 feet.
 - b. Install batter boards spanning trench, rigidly anchored to posts driven into ground on both sides of trench.
 - c. Set three adjacent batter boards before laying pipe to verify grades and line.
 - d. Determine elevation and position of string line from elevation and position of offset points or stakes located along pipe route.
 - e. Do not locate pipe using side lines for line or grade.
 - 3. As an alternative method, use laser-beam instrument with qualified operator to establish lines and grades.
- B. Location of Pipe Lines:
 - 1. Location and approximate depths of proposed pipe lines are shown on Drawings.
 - 2. Engineer or Owner reserves right to make changes in lines, grades, and depths of pipe lines and structures when changes are required for Project conditions.

3.2 PREPARATION

- A. Call Local Utility Line Information service and the Owner not less than three working days before performing Work. Coordinate with and hire a private utility location firm, as needed.
 - 1. Underground utilities must be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect bench marks and existing structures from excavating equipment and vehicular traffic.
- D. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCHING

- A. Implement temporary dewatering measures to reduce softening of exposed subgrade soils as excavation advances, until foundation construction is complete, and until fill placement is a minimum of 3-feet above the groundwater level.
- B. Do not advance open trench more than 100 feet ahead of installed pipe.
- C. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- D. Excavate bottom of trenches maximum 16 inches wider than outside diameter of pipe or structure.
- E. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- F. Do not disturb subgrade soils within a 45 degree zone of influence with depth of foundations, if applicable.
- G. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls can not be sloped, provide sheeting or shoring to protect excavation as specified in this Section.
- H. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered. Backfill according to Part 3.5 of this Section.
- I. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type S1 and compact to density equal to or greater than requirements for subsequent backfill material.
- J. Hand trim excavation. Remove loose matter.
- K. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with lean concrete as directed by Engineer.
- L. Stockpile excavated material in area designated on site and remove excess material not being used from site unless authorized by Owner to dispose of on-site in an Owner designated location.

3.4 SHEETING AND SHORING

- A. Comply with all OSHA, State, and local trench safety requirements.
- B. Sheet, shore, and/or brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- C. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- D. Design sheeting and shoring to be removed at completion of excavation work.
- E. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

- F. Repair damage to pipe bedding work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Fill Type S1 – Structural Fill: Place and compact material in equal continuous layers not exceeding 6 inches compacted depth. Refer to Section 02320.
- D. Employ placement method that does not disturb or damage utilities in trench.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Do not leave more than 50 feet of trench open at end of working day. Protect open trench to prevent danger to the public.
- G. Remove and replace trench subgrade soils softened or saturated as a result of exposure to weather or inadequate temporary dewatering measures.
- H. Remove surplus fill materials from site unless authorized by Owner to dispose of on-site in an Owner designated location.
- I. Protect open trench to prevent danger to the Owner or public.

3.6 TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances
- B. Top Surface of General Backfilling: Plus or minus 1/2 inch from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing and observation services.
- B. Perform laboratory material tests in accordance with AASHTO T180, ASTM D698, and/or ASTM D1557.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2922, ASTM D2937.
 - 2. Moisture Tests: ASTM D2216, ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
- E. Frequency of Tests: One test per compacted lift per 50 linear feet of trench.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01700 - Execution Requirements: Protecting Installed Construction.

- B. Reshape and re-compact fills subjected to vehicular traffic during construction.
- C. Vehicular traffic shall be limited to areas which have been protected by at least 24 inches of cover material above the liner. Vehicles shall be prohibited from performing tight turning radii and rapid braking on the cover material.

3.9 SCHEDULE

- A. Trenches with Piping:
 - 1. Cover pipe and bedding with Fill Type S1 in loose 8 inch lifts, compacted uniformly to a minimum of 95 percent of its Standard Proctor maximum dry density (ASTM D698).

END OF SECTION

SECTION 02674
NONWOVEN GEOTEXTILES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonwoven geotextile for:
 - a. Erosion control devices.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Geotextile
 - 1. Basis of Payment: Not applicable, included in other sections of the specifications.

1.3 REFERENCES:

- A. Construction Quality Assurance (CQA) Plan
- B. American Society for Testing and Materials (ASTM) standards
 - 1. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics— Diaphragm Bursting Strength Tester Method.
 - 2. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 - 3. ASTM D4491 – Standard Test Method for Water Permeability of Geotextiles by Permittivity.
 - 4. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 - 5. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - 6. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 7. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 - 8. ASTM D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
 - 9. ASTM D5261 – Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

1.4 SUBMITTALS

Not Used.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Product Requirements: Product delivery requirements and Product storage and handling requirements.
- B. Geotextile labeling, shipment, and storage shall follow ASTM D 4873.
- C. Each geotextile roll shall be wrapped with a material that will protect the geotextile, including the ends of the roll, from damage due to shipment, water, ultraviolet sunlight, mud, dust, puncture, and other damaging deleterious conditions. The protective wrapping shall be maintained during periods of shipment and storage.

- D. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 160°F (71°C), and any other environmental condition that may damage the property values of the geotextile.
- E. Transport and handle geotextile with equipment designed to protect it from damage. Equipment used to unload, stack or transport geotextile shall not damage protective wrap or geonet layers.
- F. Upon delivery at the job site, the contractor shall ensure that the geotextile rolls are handled and stored in accordance with the manufacturer's instructions as to prevent damage.
- G. Do not use materials damaged during storage or handling. If the geotextile is not packaged and a roll is damaged during shipment, it shall be rejected.
- H. The geotextile shall be relatively free of holes or any sign of contamination by foreign matter. The Engineer may reject all or portions of units (or rolls) of the geotextile if in his opinion significant quantities of production flaws are observed.

PART 2 PRODUCTS

2.1 GEOTEXTILE

- A. Nonwoven geotextile shall be that which is specified on the Drawings. Unless otherwise noted on the Drawings, geotextile suppliers shall furnish materials whose Minimum Average Roll Values meet or exceed the criteria specified in Table 02674-B.
- B. The geotextile shall be:
 - 1. Nonwoven, needlepunched, continuous filament polyester material; or
 - 2. Nonwoven, needlepunched, continuous filament polypropylene material; or
 - 3. Nonwoven, needlepunched, polypropylene staple or continuous fiber material.
- C. The geotextile shall be manufactured from first quality virgin polymer.
- D. In addition to the property values listed in Table 02674-B, the geotextiles shall:
 - 1. Retain its structure during handling, placement, and long-term service.
 - 2. Be capable of withstanding outdoor exposure for a minimum of 30 days with no measurable deterioration.

**TABLE 02674-A
GEOTEXTILE REQUIRED PHYSICAL PRE-SHIPING TESTING**

PROPERTY	TEST METHOD	MINIMUM FREQUENCY
Mass Per Unit Area	ASTM D5261	Every 100,000 ft ²
Grab Tensile Strength	ASTM D4632	Every 100,000 ft ²
Grab Tensile Elongation	ASTM D4632	Every 100,000 ft ²
Trapezoid Tear Strength	ASTM D4533	Every 100,000 ft ²
Mullen Burst Strength	ASTM D3786	Every 100,000 ft ²
Puncture Strength	ASTM D4833	Every 100,000 ft ²
Apparent Opening Size (AOS)	ASTM D4751	1 per production lot (filter geotextiles only)
Permeability	ASTM D4491	1 per production lot (filter geotextiles only)
UV Resistance ⁽³⁾	ASTM D4355	1 per production lot

**TABLE 02674-B
GEOTEXTILE REQUIRED PHYSICAL AND HYDRAULIC PROPERTIES**

PROPERTIES AND REQUIREMENTS ^(1,2)	UNITS	SPECIFIED VALUES	SPECIFIED VALUES	SPECIFIED VALUES	SPECIFIED VALUES	TEST METHOD
		6 oz.	8 oz.	10 oz.	12 oz.	
Type	---	Nonwoven	Nonwoven	Nonwoven	Nonwoven	---
Mass Per Unit Area	oz/yd ²	6.0	8.0	10.0	12.0	ASTM D5261
Grab Tensile Strength	lb	160	200	230	300	ASTM D4632
Grab Tensile Elongation	%	50	50	50	50	ASTM D4632
Trapezoid Tear Strength	lb	65	80	95	115	ASTM D4533
Mullen Burst Strength	lb/in ²	310	380	520	550	ASTM D3786
Puncture Strength	lb	85	110	120	140	ASTM D4833
Apparent Opening Size (AOS)	US Sieve/ mm	70/0.212	80/0.18	100/0.15	100/0.15	ASTM D4751
Permeability	cm/sec	0.25	0.3	0.3	0.3	ASTM D4491
UV Resistance ⁽³⁾	% strength retained	70	70	70	70	ASTM D4355

Notes:

- (1) All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table) except for UV resistance, which is a minimum value.
- (2) Polymer composition of 95 % polypropylene or polyester by weight
- (3) Evaluation to be on 2.0 inch strip tensile specimen after 500 hours of exposure.

2.2 ACCESSORIES

- A. Sewing materials: Types recommended by manufacturer for sewing seams in geotextile.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to implementing any geotextile work, the Contractor shall carefully inspect the subgrade and verify that all work is complete to the point where the installation of the geotextile may properly commence without adverse impact.

- B. If the Contractor has any concerns regarding the installed work, the Engineer and/or Owner shall be notified in writing within 48-hours of his site inspection. Failure to inform the Engineer and/or Owner in writing or installation of the geotextile will be construed as Contractor's acceptance of all prior related work.
- C. Any geotextile that does not comply with Table 02674-B of this Section 02674 shall be rejected and replaced with new material in accordance with the Specifications, at no additional cost to Owner.

3.2 INSTALLATION

- A. The Contractor shall handle all geotextile in such a manner as to ensure they are not damaged in any way.
- B. The Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.
- C. In the presence of wind, all geotextiles shall be weighted by sandbags or approved equivalent. Such anchors shall be installed during placement and shall remain in place until replaced with cover material.
- D. After unwrapping the geotextile from its opaque cover, the geotextile shall not be left exposed for a period in excess of 20 days unless a longer exposure period is approved by the Engineer based on a formal demonstration from the CONTRACTOR that the geotextile is stabilized against U.V. degradation for the proposed period of exposure.
- E. The CONTRACTOR shall take care not to entrap stones, excessive dust, or moisture in the geotextile during placement.
- F. Nonwoven geotextile shall be continuously sewn at their seams. Geotextiles shall be overlapped a minimum of 6 inches, or as otherwise specified in the Specifications.

3.3 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing and observation requirements.
- B. The Contractor shall be aware of the activities outlined in the CQA Plan and shall account for these CQA activities in the installation schedule.
- C. The need for conformance testing shall be determined by the Engineer.
- D. The finished geotextile shall have good appearance qualities. It shall be free from such defects that would affect the specific properties of the geotextile, or its proper functioning.
- E. Defects and Repairs:
 - 1. Any holes or tears in the geotextile shall be repaired with a patch made from the same geotextile. The patch shall be sewn in place with a minimum of 12 inches overlap in all directions.
 - 2. Care shall be taken to remove any soil or other material, which may have penetrated the torn geotextile.
- F. Before initial placement of protective cover, compacted soil cover, or other overlying materials, inspect underlying system seams and repaired areas to ensure tight, continuously seamed installation. Repair damaged system and re-inspect repaired work.

3.4 PROTECTION OF FINISHED WORK

- A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.
- B. The Contractor shall use all means necessary to protect all prior work and all materials and completed work of other Sections.
- C. In applying fill material, no equipment can drive directly across the geotextile. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.
- D. The geotextile shall be covered as soon as possible after installation and approval. The geotextile shall not be exposed to precipitation prior to being installed and shall not be exposed to direct sun light for more than 20 days after installation.
- E. Placement of Overlying Material:
 - 1. Placement of the overlying material shall proceed immediately following placement and inspection of the geotextile
 - 2. The overlying material shall be placed on the geotextile in such a manner that ensures that:
 - a. The geotextile and underlying lining materials are not damaged.
 - b. Minimal slippage occurs between the geotextile and underlying layers.
 - c. Wrinkling of geosynthetics does not occur.
- F. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary at the expense of the responsible party, to the approval of the Engineer.
- G. Protect installed geotextile according to manufacturer's instructions. Repair or replace areas of damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.
- H. The contractor shall not use heavy equipment to traffic above the geotextile without approved protection.

END OF SECTION

SECTION 02924
SEEDING AND SOIL SUPPLEMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Preparation of subsoil.
 - 2. Fertilizing.
 - 3. Seeding.
 - 4. Hydroseeding.
 - 5. Maintenance.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Seeding:
 - 1. Basis of Measurement: By the acre.
 - 2. Basis of Payment: By the acre seeded times the unit price for seeding.
 - a. Includes all labor, equipment and materials required to establish a permanent grass cover on all graded surfaces including, but not limited to preparation of subsoil, soil amendments, installation of erosion control matting, fertilizing, and seeding.
 - b. Includes maintaining grass cover until acceptance by the Owner.
 - c. Includes any maintenance and protection required to control erosion on embankment fill surfaces prior to beginning permanent grassing operations.

1.3 REFERENCES

- A. The State of North Carolina Erosion and Sediment Control Planning and Design Manual.

1.4 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.5 SUBMITTALS

- A. Section 01300 - Administrative Requirements: Submittal procedures.
- B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.
- C. Soil test results and fertilizer and soil amendment recommendations from the North Carolina Department of Agriculture and Consumer Affairs or a similar soil and nutrient testing laboratory.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Project record documents.
- B. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.7 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and

location of packaging.

- B. Perform Work in accordance with North Carolina Erosion and Sedimentation Control Planning and Design Manual.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Product storage and handling requirements.
- B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.9 MAINTENANCE SERVICE

- A. Section 01700 - Execution Requirements: Manual for materials and finishes.
- B. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for three cuttings.

PART 2 PRODUCTS

2.1 SEED MIXTURE

- A. Temporary Seed Mixture: As specified on Drawings.
- B. Permanent Seed Mixture: As specified on Drawings.
- C. Seed Mixture shall be in accordance with the latest edition of the North Carolina Erosion and Sediment Control Planning and Design Manual.

2.2 SOIL MATERIALS

- A. Topsoil/Vegetative Layer: Excavated from site and free of weeds consistent with fill type S2 requirements of Section 02320.

2.3 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry and as described in the North Carolina Erosion and Sediment Control Planning and Design Manual.
- B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil as described in the North Carolina Erosion and Sediment Control Planning and Design Manual and as indicated on Drawings.
- C. Lime: Pelletized agricultural lime is recommended for grass; of proportion necessary to adjust pH of soil to acceptable levels as described in the North Carolina Erosion and Sediment Control Planning and Design Manual and as indicated on the Drawings.
- D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

- E. Erosion Fabric: Erosion control matting, as specified on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify prepared soil base is ready to receive the Work of this Section.

3.2 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.

3.3 FERTILIZING

- A. Perform chemical soil tests to determine soil nutrient and amendment requirements to promote grass growth.
- B. Apply lime and fertilizer in accordance with Soil test results and fertilizer and soil amendment recommendations from the North Carolina Department of Agriculture and Consumer Affairs.
- C. Apply after smooth raking of topsoil.
- D. Do not apply fertilizer at same time or with same machine used to apply seed.
- E. Mix fertilizer thoroughly into upper 2 inches of soil.
- F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.4 SEEDING

- A. Apply seed at rate as indicated on Drawings evenly in two intersecting directions and in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season: As indicated on Drawings and in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual.
- D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.
- E. Immediately following seeding, apply mulch to thickness as specified on Drawings and in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual. Maintain clear of shrubs and trees.
- F. Apply water with fine spray immediately after each area has been mulched. Saturate to 2 inches of soil.

3.5 HYDROSEEDING

- A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate of 2000 lbs per acres evenly in one pass.
- B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.6 MAINTENANCE

- A. Mow grass at regular intervals to maintain at maximum height of 3 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.
- D. Water to prevent grass and soil from drying out.
- E. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- F. Immediately reseed areas showing bare spots.
- G. Repair washouts or gullies.
- H. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

APPENDIX IV – COVER SYSTEM DESIGN ANALYSES

Stormwater, Sedimentation, and Erosion Control Devices



JOB NO. 1356-08-106

SHEET NO. 1 of 2

DATE 08-15-08

JOB NAME Marshall Steam Station – Asbestos Landfill Closure

COMPUTED BY JMB

SUBJECT Storm Water and Erosion Control Devices

CHECKED BY [Signature]

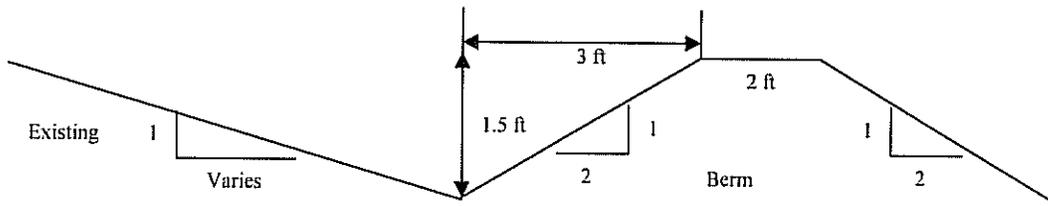
- OBJECTIVE:** Based on a 10 yr design storm:
1. Design proposed grass-lined channels for diversion berms for slope drains.
 2. Size slope drain pipes.
 3. Design the proposed outlet aprons for the slope drains.

- REFERENCE:**
1. Erosion and Sediment Control Planning and Design Manual, NCDENR, June 1, 2006.
 2. Erosion Control Materials Design Software; V4.1, North American Green.
 3. FlowMaster; V8, Bentley, 2005.
 4. CulvertMaster; V3, Bentley, 2008.

PARAMETERS:
 Drainage Areas obtained from AutoCad drawings.
 Use a 10-yr storm to obtain design flows.

Channel:

Berm Dimensions: 1.5 ft deep, 2:1 side slope (berm side), cover system side slope (varies)



DESIGN:

Calculate Flows (Q):

Use Rational Formula to determine Q

$$Q = c \times i \times A$$

c = Runoff Coefficient
 i = Rainfall Intensity Factor (in/hr)
 A = Drainage Area (acres)

$c = 0.40$ (Ref. 1, Table 8.03b, Agricultural Lands: Bare, packed soil - Rough)

Determine i

Let $i = 7.26$ in/hr (Ref. 1, Figure 8.03c, 10-yr storm, use $T_c = 5$ min to be conservative) for all areas

Table 1: Peak Discharge Summary

ID	Area (acres)	Peak Discharge (cfs)
1A	1.51	4.40
1B	1.71	4.97
2A	1.63	4.73
2B	0.36	1.04



JOB NO. 1356-08-106

SHEET NO. 2 of 2

DATE 08-15-08

JOB NAME Marshall Steam Station – Asbestos Landfill Closure

COMPUTED BY JMB

SUBJECT Storm Water and Erosion Control Devices

CHECKED BY VMA

Channel Stabilization Check:

Table 2 : Channel Velocities

[Ref. 2 and 3]

ID	Peak Discharge (cfs)	Diversion Slope	Velocity (fps)
1A	4.40	0.010	1.48
1B	4.97	0.015	1.77
2A	4.73	0.017	1.83
2B	1.04	0.008	0.94

All channels are stable in the vegetated condition, however, at peak discharge all of the channels are unstable in the unvegetated form. North American Green DS75 Temporary Matting should be used on all channels to increase stability during the establishment period.

Design of Slope Drain and Riprap Energy Dissipater:

Calculate slope drain size assuming ADS N-12 HDPE pipe.

Table 3 : Slope Drain Sizing

[Ref. 3]

ID	Peak Discharge (cfs)	Slope	Size (inches)	Velocity (fps)	Normal Depth (ft)
1	9.36	0.33	12	27.1	0.45
2	5.77	0.33	12	23.7	0.35

Use 12 inch diameter ADS N-12 HDPE pipe for slope drain.

Calculate Riprap Energy Dissipater dimensions (where culvert inlet control limits maximum discharge to 10 cfs).

From Figure 8.06a:

[Ref. 1]

$$W = 3 D_o = 3 \times 1 \text{ foot} = 3 \text{ feet}$$

$$L_a = 14 \text{ feet}$$

$$D_{50} = 0.6 \text{ feet THEREFORE Use Class B Riprap}$$

Table 8.03b
Value of Runoff Coefficient
(C) for Rational Formula

Land Use	C	Land Use	C
Business:		Lawns:	
Downtown areas	0.70-0.95	Sandy soil, flat, 2%	0.05-0.10
Neighborhood areas	0.50-0.70	Sandy soil, ave., 2-7%	0.10-0.15
Residential:		Sandy soil, steep, 7%	0.15-0.20
Single-family areas	0.30-0.50	Heavy soil, flat, 2%	0.13-0.17
Multi units, detached	0.40-0.60	Heavy soil, ave., 2-7%	0.18-0.22
Multi units, Attached	0.60-0.75	Heavy soil, steep, 7%	0.25-0.35
Suburban	0.25-0.40		
Industrial:			
Light areas	0.50-0.80		0.30-0.60
Heavy areas	0.60-0.90		0.20-0.50
		Agricultural land:	
Parks, cemeteries	0.10-0.25	Bare packed soil	0.30-0.60
		Smooth	0.20-0.50
Playgrounds	0.20-0.35	Rough	0.20-0.40
		Cultivated rows	0.10-0.25
Railroad yard areas	0.20-0.40	Heavy soil no crop	
		Heavy soil with crop	0.15-0.45
Unimproved areas	0.10-0.30	Sandy soil no crop	0.05-0.25
Streets:		Sandy soil with crop	0.05-0.25
Asphalt	0.70-0.95		
Concrete	0.80-0.95	Pasture	
Brick	0.70-0.85	Heavy soil	0.15-0.45
Drives and walks	0.75-0.85	Sandy soil	0.05-0.25
Roofs	0.75-0.85	Woodlands	0.05-0.25

NOTE: The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

Table 8.03c Intensity Duration Frequency

For use with Rational Method**

Murphy, North Carolina 35.0961N, 84.0239W										
ARI* (years)	5 min.	10 min.	15 min.	30 min.	60 min.	120 min.	3 hr.	6 hr.	12 hr.	24 hr.
2	4.93	3.94	3.30	2.28	1.43	0.89	0.62	0.38	0.24	0.15
10	6.78	5.42	4.57	3.31	2.16	1.29	0.92	0.55	0.34	0.21
25	7.90	6.29	5.31	3.94	2.62	1.57	1.13	0.68	0.41	0.25
100	9.62	7.64	6.44	4.93	3.40	2.06	1.50	0.90	0.53	0.33

Asheville, North Carolina 35.4358N, 82.5392W										
ARI* (years)	5 min.	10 min.	15 min.	30 min.	60 min.	120 min.	3 hr.	6 hr.	12 hr.	24 hr.
2	5.21	4.16	3.46	2.41	1.51	0.89	0.63	0.38	0.24	0.14
10	7.06	5.65	4.76	3.45	2.25	1.30	0.91	0.55	0.34	0.20
25	8.09	6.44	5.45	4.03	2.69	1.56	1.10	0.66	0.40	0.24
100	9.68	7.69	6.48	4.96	3.42	2.00	1.43	0.86	0.50	0.30

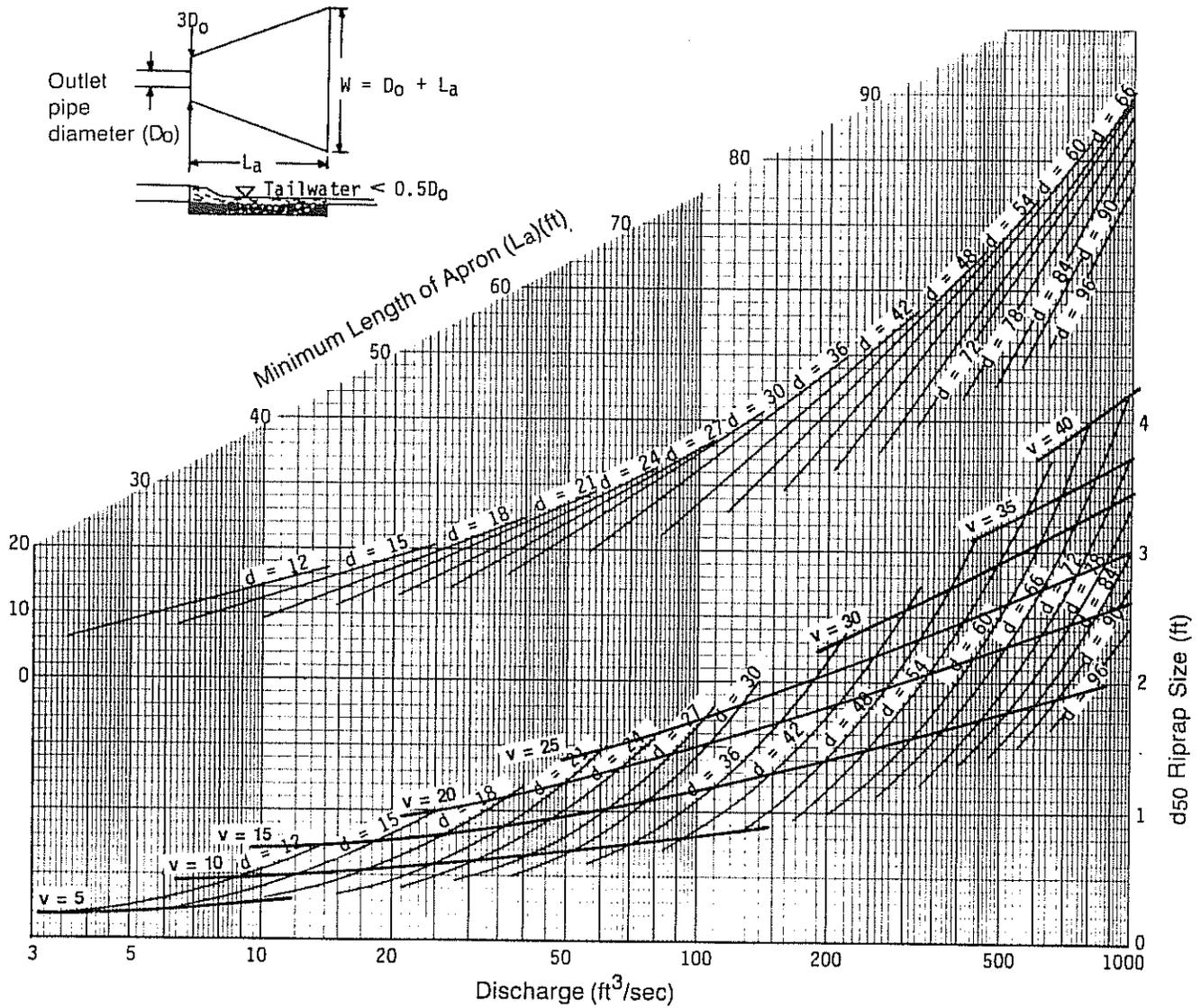
Boone, North Carolina 36.2167N, 81.6667W										
ARI* (years)	5 min.	10 min.	15 min.	30 min.	60 min.	120 min.	3 hr.	6 hr.	12 hr.	24 hr.
2	5.71	4.57	3.83	2.64	1.66	1.00	0.72	0.48	0.31	0.18
10	7.50	6.00	5.06	3.67	2.39	1.46	1.06	0.69	0.44	0.28
25	8.59	6.85	5.78	4.28	2.85	1.77	1.29	0.83	0.52	0.34
100	10.38	8.25	6.95	5.32	3.67	2.35	1.72	1.08	0.65	0.44

Charlotte, North Carolina 35.2333N, 80.85W										
ARI* (years)	5 min.	10 min.	15 min.	30 min.	60 min.	120 min.	3 hr.	6 hr.	12 hr.	24 hr.
2	5.68	4.54	3.80	2.63	1.65	0.96	0.68	0.41	0.24	0.14
10	7.26	5.80	4.89	3.55	2.31	1.36	0.98	0.59	0.35	0.20
25	8.02	6.38	5.40	4.00	2.66	1.59	1.15	0.70	0.42	0.24
100	9.00	7.15	6.03	4.62	3.18	1.93	1.43	0.87	0.53	0.30

Greensboro, North Carolina 36.975N, 79.9436W										
ARI* (years)	5 min.	10 min.	15 min.	30 min.	60 min.	120 min.	3 hr.	6 hr.	12 hr.	24 hr.
2	5.46	4.36	3.66	2.52	1.58	0.93	0.66	0.40	0.23	0.14
10	6.85	5.48	4.62	3.35	2.18	1.30	0.92	0.56	0.33	0.20
25	7.39	5.89	4.98	3.69	2.46	1.49	1.06	0.65	0.39	0.23
100	7.93	6.30	5.31	4.07	2.80	1.75	1.24	0.78	0.48	0.29

* ARI is the Average Return Interval.

** Intensity Duration Frequency table is measured in inches per hour.



Curves may not be extrapolated.

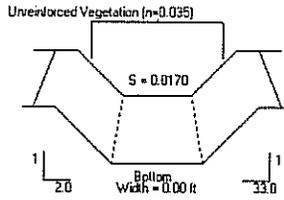
Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition ($T_w < 0.5$ diameter).

[REF. 2]

North American Green - ECMS Version 4.3 6/15/2008 06:16 PM COMPUTED BY: jmb
 PROJECT NAME: Marshall Steem Station - Asbestos Cover PROJECT NO.: 1366-06-107
 FROM STATION/REACH: TO STATION/REACH: DRAINAGE AREA: DESIGN FREQUENCY:

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius (ft)	Normal Depth (ft)
4.8	24.0	1.84	2.61	0.19	0.39



LINER RESULTS

Not to Scale

Reach	Matting Type	Stability Analysis	Vegetation Characteristics				Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
			Phase	Class	Type	Density				
Straight	Unreinforced	Vegetation		D	Bunch	50-75%	3.33	0.41	8.13	STABLE
			Soil		Silt Loam		0.035	0.049	0.72	UNSTABLE

ASBESTOS 1A

Project Description

Friction Method Manning Formula
 Solve For Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	33.00	ft/ft (H:V)
Discharge	4.40	ft ³ /s

Results

Normal Depth	0.41	ft
Flow Area	2.98	ft ²
Wetted Perimeter	14.55	ft
Top Width	14.45	ft
Critical Depth	0.33	ft
Critical Slope	0.03285	ft/ft
Velocity	1.48	ft/s
Velocity Head	0.03	ft
Specific Energy	0.45	ft
Froude Number	0.57	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.41	ft
Critical Depth	0.33	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.03285	ft/ft

ASBESTOS 1B

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	33.00	ft/ft (H:V)
Discharge	4.97	ft ³ /s

Results

Normal Depth	0.40	ft
Flow Area	2.81	ft ²
Wetted Perimeter	14.12	ft
Top Width	14.02	ft
Critical Depth	0.35	ft
Critical Slope	0.03232	ft/ft
Velocity	1.77	ft/s
Velocity Head	0.05	ft
Specific Energy	0.45	ft
Froude Number	0.70	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.40	ft
Critical Depth	0.35	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.03232	ft/ft

ASBESTOS 2A

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01700	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	33.00	ft/ft (H:V)
Discharge	4.73	ft ³ /s

Results

Normal Depth	0.38	ft
Flow Area	2.58	ft ²
Wetted Perimeter	13.54	ft
Top Width	13.44	ft
Critical Depth	0.34	ft
Critical Slope	0.03253	ft/ft
Velocity	1.83	ft/s
Velocity Head	0.05	ft
Specific Energy	0.44	ft
Froude Number	0.74	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.38	ft
Critical Depth	0.34	ft
Channel Slope	0.01700	ft/ft
Critical Slope	0.03253	ft/ft

ASBESTOS 2B

Project Description

Friction Method Manning Formula
 Solve For Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00780	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	33.00	ft/ft (H:V)
Discharge	1.04	ft ³ /s

Results

Normal Depth	0.25	ft
Flow Area	1.11	ft ²
Wetted Perimeter	8.88	ft
Top Width	8.82	ft
Critical Depth	0.19	ft
Critical Slope	0.03981	ft/ft
Velocity	0.94	ft/s
Velocity Head	0.01	ft
Specific Energy	0.27	ft
Froude Number	0.46	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.19	ft
Channel Slope	0.00780	ft/ft
Critical Slope	0.03981	ft/ft

ASBESTOS PIPE 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.012
Channel Slope	0.33000 ft/ft
Diameter	1.00 ft
Discharge	9.36 ft ³ /s

Results

Normal Depth	0.45 ft
Flow Area	0.35 ft ²
Wetted Perimeter	1.48 ft
Top Width	1.00 ft
Critical Depth	0.99 ft
Percent Full	45.3 %
Critical Slope	0.05467 ft/ft
Velocity	27.05 ft/s
Velocity Head	11.37 ft
Specific Energy	11.83 ft
Froude Number	8.09
Maximum Discharge	23.85 ft ³ /s
Discharge Full	22.17 ft ³ /s
Slope Full	0.05882 ft/ft
Flow Type	SuperCritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	45.32 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s

ASBESTOS PIPE 1

GVF Output Data

Normal Depth	0.45	ft
Critical Depth	0.99	ft
Channel Slope	0.33000	ft/ft
Critical Slope	0.05467	ft/ft

ASBESTOS PIPE 2

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.33000	ft/ft
Diameter	1.00	ft
Discharge	5.77	ft ³ /s

Results

Normal Depth	0.35	ft
Flow Area	0.24	ft ²
Wetted Perimeter	1.26	ft
Top Width	0.95	ft
Critical Depth	0.95	ft
Percent Full	34.8	%
Critical Slope	0.01935	ft/ft
Velocity	23.73	ft/s
Velocity Head	8.75	ft
Specific Energy	9.10	ft
Froude Number	8.28	
Maximum Discharge	23.85	ft ³ /s
Discharge Full	22.17	ft ³ /s
Slope Full	0.02235	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	34.81	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

ASBESTOS PIPE 2

GVF Output Data

Normal Depth	0.35	ft
Critical Depth	0.95	ft
Channel Slope	0.33000	ft/ft
Critical Slope	0.01935	ft/ft

APPENDIX V – BORROW AREA INFORMATION

SUMMARY OF HAND AUGER BORINGS
Marshall C&D and Asbestos LF Closure
Terrell, North Carolina
S&ME, Inc. Project No. 1356-08-106/107

Date	Test Location*	Depth (Feet)**	Soil Description
7-23-08	HA-1	EG – 1.0 1.0 – 3.0 3.0 – 9.0	RESIDUAL: Orange Brown Fine Sandy Silt Brown Fine Sandy Silt Brown White Black Silty Sand
7-23-08	HA-2	EG – 1.0	RESIDUAL: Orange, Brown Silty Sand *refusal met at 1'; offset approximately 5' from HA-2 and encountered refusal at 1' for offsets
7-23-08	HA-3	EG – 7.0 7.0 – 9.5	RESIDUAL: Red Brown Fine Sandy Clayey Silt Tan Brown Fine Sandy Clayey Silt
7-23-08	HA-4	EG – 2.0 2.0 – 9.5	RESIDUAL: Red Brown Fine Sandy Silt Gray Brown Silty Sand *location is within a current excavated area
7-23-08	HA-5	EG – 2.0 2.0 – 9.5	RESIDUAL: Tan Brown Silty Medium to Fine Sand Gray Fine Sandy Silt *location was adjacent to approximate 6 ft. drop off
7-23-08	HA-6	EG – 4.0 4.0 – 9.5	RESIDUAL: Orange Brown Fine Sandy Silt Brown Fine Sandy Silt
7-23-08	HA-7	EG – 4.0 4.0 – 9.5	RESIDUAL: Red Brown Clayey Sandy Silt Brown White Fine Sandy Silt

* Hand Auger Locations can be seen in Figure 1.

**EG denotes Existing Grade.

SUMMARY OF HAND AUGER BORINGS

Marshall C&D and Asbestos LF Closure

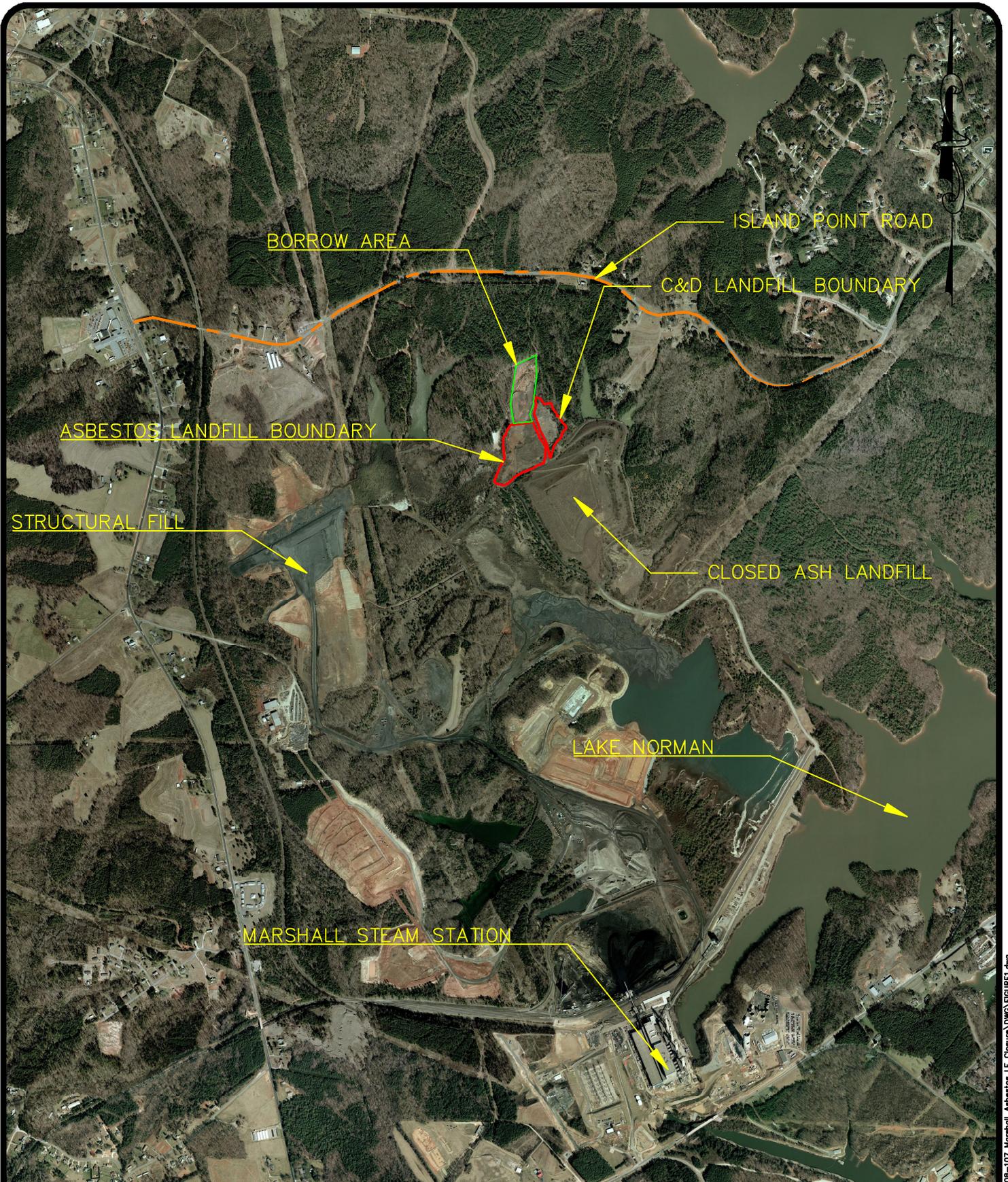
Terrell, North Carolina

S&ME, Inc. Project No. 1356-08-106/107

Date	Test Location*	Depth (Feet)**	Soil Description
7-23-08	HA-9	EG – 2.0 2.0 – 9.5	RESIDUAL: Red Brown Fine Sandy Clayey Silt Brown White Sandy Silt
7-23-08	HA-10	EG – 4.0 4.0 – 9.5	RESIDUAL: Red Brown Fine Sandy Clayey Silt Tan Brown Fine Sandy Silt

* Hand Auger Locations can be seen in Figure 1.

**EG denotes Existing Grade.



SCALE: 1-IN:1600-FT
 DATE: 8-15-2008
 DRAWN BY: WMH
 PROJECT NO: 1356-08-107



SITE VACINITY MAP
 ASBESTOS LANDFILL CLOSURE
 DUKE ENERGY-MARSHALL STEAM STATION
 CATAWBA COUNTY, NC

FIGURE NO.
 1

APPENDIX VI – POST-CLOSURE OBSERVATION FORM



**MARSHALL ASBESTOS LANDFILL
POST-CLOSURE MONITORING FORM**

Date: _____ Observation Personnel: _____

Time: _____

Observed Weather Conditions: _____

<i>COVER SYSTEM</i>
Evidence of erosion, settlement, rutting, potholes:
Evidence of cover system intrusion (ruts, burrows, excavation):
Evidence of stressed vegetation or bare spots. Evidence of woody vegetation (small trees and/or shrubs):
Condition of storm water channels, drainage swales, down drain pipes – signs of erosion or sedimentation?:
Additional Comments:



**MARSHALL ASBESTOS LANDFILL
POST-CLOSURE MONITORING FORM**

Date _____

<i>SITE SECURITY</i>
Evidence of penetrations (poles, posts, stakes):
Evidence of human encroachment (trash, fire pits, tire/footprints):
General site condition:
Additional Comments:

<i>OTHER</i>



**MARSHALL ASBESTOS LANDFILL
POST-CLOSURE MONITORING FORM**

Date _____

PHOTOGRAPHIC LOG

Photograph No.	Description
1:	_____
2:	_____
3:	_____
4:	_____
5:	_____
6:	_____
7:	_____
8:	_____
9:	_____
10:	_____
11:	_____
12:	_____
13:	_____
14:	_____
15:	_____
16:	_____
17:	_____
18:	_____
19:	_____
20:	_____

APPENDIX VII – CONTACT INFORMATION

Duke Energy Contacts:

Duke Energy – Environmental Health and Safety

Mr. Chris Hallman, P.E.
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Charlotte, NC 28202
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cdhallma@duke-energy.com

Duke Energy – Marshall Steam Station

Mr. Brian K. Chambers
Marshall Steam Station
8320 East NC Hwy 150
Terrell, NC 28682
(828) 478-7501
bkchambe@duke-energy.com

North Carolina Regulatory Contacts:

North Carolina Department of Environment and Natural Resources

Division of Waste Management, Solid Waste Section
Asheville Regional Office
2090 US Highway 70
Swannanoa, NC 28778
(828) 296-4704

Regional Engineer: Larry Frost, P.E.

larry.frost@ncmail.net