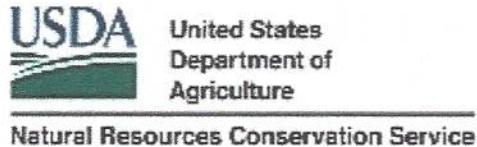


PROJECT PLANS & SPECIFICATIONS

100% COMPLETE FINAL PLAN- FOR CONSTRUCTION

Prepared For:



**EMERGENCY WATERSHED PROTECTION PROGRAM
EWP EVENT NO.37-03-18-5038-00**

**REPAIR/STABILIZATION OF TWO STREAM BANK SITES-
DSR NO.494-HOLLY SHELTER WILDLIFE COMMISSION DEPOT
AND
DSR NO.489-LAKE ROAD/HORSE BRANCH CREEK
PENDER COUNTY, NC**

MARCH 14, 2022

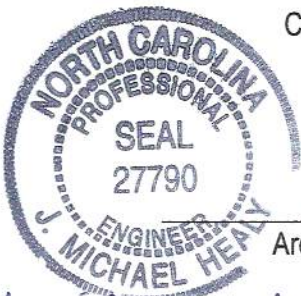
**NATURAL RESOURCES CONSERVATION SERVICE
AND
U.S. DEPARTMENT OF AGRICULTURE
AND
PENDER COUNTY PLANNING & COMMUNITY DEVELOPMENT DEPARTMENT**

Prepared By:

Ardurra



CONSTRUCTION SPECIFICATIONS PREPARED AND SEALED BY:



Ardurra Project Engineer

3/14/22
Date

J. Michael Healy

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BID SCHEDULE

Pender County-Emergency Watershed Project
USDA/NRCS Stabilization Projects
March 14, 2022

DSR-494/ Site 4-Holly Shelter Wildlife Depot-NE Cape Fear River

SCOPE OF WORK: Stabilize Slope w/ Flexamat™PLUS Armor Between STA 130+00 and STA 70+00

Item No.	Description of Work	Quantity	Units	Unit Price(\$)	Extended Amount (\$)
1	Mobilization/Demobilization (paid 50% each)	1	NA		
2	Clearing & Grubbing-Veg. Debris (by volume)	100	CYS		
2-A	Alternate-Clearing & Grubbing-Veg. Debris (by weight)	25	TONS		
3	General Grading/Shaping/Filling and Earthwork Operations (Includes All Scope per Plans)	1	LS		
4	Flexamat PIUS-RTCB Mat® or Equivalent RTCB (+4-Layer underlayment mat); 60ftW X 60ftL)	3600	SF		
5	Flexamat 18" U-Anchors # 3 rebar® for Seams	189	EACH		
6	Gripple 9 ft.Percussion Anchors® TL6CRS-TLA4-9ft-6MM per Anchor Plan-Sheet 8 and 9	72	EACH		
7	Earthfill (Imported Suitable Fill)	100	CYS		
8	Undercut/Disposal of Unsuitable Soils/Material	100	CYS		
9	Class I-NCDOT Rip- Rap	350	TONS		
10	Non-woven Geotextile Underlayment	2000	SF		
11	Seeding/Mulching-Disturbed Areas/Slopes	4200	SF		
12	Pre-Construction/Post-Construction Survey (sealed by PE)	2	EACH		
13	Geotechnical Testing (specify no. of tests/cost)	1	LS		

SF-Square Ft.; LS=Lump Sum; NA=Not Applicable

Total=

Submitted By: _____

Company: _____

Date: _____



BID SCHEDULE

Pender County-Emergency Watershed Project
USDA/NRCS Stabilization Projects
March 14, 2022

DSR-489/Lake Road-Horse Branch Creek

SCOPE OF WORK: Stabilize Slope w/ Class I Rip-Rap Armor Between STA 20+00 and STA 120+00

Item No.	Description of Work	Quantity	Units	Unit Price(\$)	Extended Amount (\$)
1	Mobilization/Demobilization (paid 50% each)	1	NA		
2	Clearing & Grubbing Vegetation Debris (by volume)	200	CYS		
2-A	Alternate-Clearing & Grubbing Vegetation Debris (by weight)	50	TONS		
3	General Grading/Shaping/Filling and Earthwork Operations (All Scope per Plans)	1	LS		
4	Earthfill (Imported Suitable Fill)	100	CYS		
5	Undercut/Disposal of Unsuitable Soils/Material	50	CYS		
6	Class I Rip-Rap-Slope (100'X20'X1.5')	250	TONS		
7	Coffer Dam (25'X1.5'X1.5')	10	TONS		
8	Rip-Rap Swale-STA 15+00 (5'WX20'L)	20	TONS		
9	Non-woven Geotextile Underlayment	2100	SF		
10	Tri-Axial Geogrid	2100	SF		
11	Seeding/Mulching-All Disturbed Areas/Slopes	1000	SF		
12	Pre-Construction/Post-Construction Survey (sealed by PE)	2	EACH		
13	Geotechnical Testing (specify no. of tests/cost)	1	LS		

SF-Square Ft.; LS=Lump Sum; NA=Not Applicable

Total=

Submitted By: _____

Company: _____

Date: _____

100% COMPLETE FINAL PLAN-FOR CONSTRUCTION

**USDA/NRCS Emergency Watershed Protection Program
Contract: 37-03-18-5038-001
EWP Event: 5038**



Date:
March 14, 2022

Scope:
**Plans & Specifications for
Repair of Eroded Channel Banks and Slopes
for
Sites Adjacent to the NE Cape Fear River and Horse Branch Creek
Pender County, North Carolina**

Prepared For:
**Natural Resources and Conservation Service
And
U.S. Department of Agriculture
And
Pender County, NC- Inspections & Planning Department**

Prepared By:
Ardurra of NC



100% COMPLETE DRAFT PLAN-FOR CONSTRUCTION

Project Introduction

The United States Department of Agriculture (USDA)-Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) program provides recovery assistance for undertaking restoration and repairs of damaged waterways and drainage structures resulting from declared events. Emergency measures may include emergency repairs, rehabilitation, and temporary stabilization of eligible damaged waterways and properties. Eligible recovery measures include practices that conform to all applicable statutes, regulations, and Executive Orders (EOs). The EWP Program helps project sponsors implement emergency recovery measures to relieve imminent hazard or threat to life or property created by a natural disaster or man-made disaster. Such hazards often cause sudden impairment of a watershed which often results in large-scale flooding. EWP technical (TA) and financial assistance (FA) may be available to financial assist sponsors when:

- 1.The President declares an emergency under the Robert T. Stafford Disaster Relief and Emergency Assistance Act.
- 2.The Secretary of Agriculture declares a drought emergency.
3. An appropriation of funding via other Federal or State Programs.

Recovery from flooding and watershed disaster events can potentially be addressed by other federal programs administrated by the Federal Emergency Management Agency (FEMA) Public Assistance (PA) grant program. The Sponsors for the EWP Program administering this contract include: Pender County, USDA, and the NRCS. The term “Sponsor” will be used throughout this document and refers primarily to the Pender County, NC-Inspections & Planning Department who is the sponsor/recipient and administrator of the USDA/NRCS EWP grant. The Sponsor gives notice that funding under this USDA/NRCS EWP contract does not duplicate funding received from the FEMA Public Assistance (PA) Grant reimbursement program used to perform other unrelated repairs and recovery actions to County infrastructure.

There are two projects included in the following workscope requiring repairs under this Request for Proposal (RFP) and existing EWP contract. The extent of the damages to these two sites are described in NRCS Disaster Survey Reports DSR-494 and DSR-489 and further detailed in the attached project Plans & Specifications including Appendix I. Proposed emergency work will be administered under funding provided via USDA/NRCS Contract 37-03-18-5038-001. Each of the project sites are located in northern Pender County, North Carolina. DSR-494/Holly Shelter Wildlife Depot is located along a segment of the east bank of the North East Cape Fear River at 7471 Shaw Highway, Rocky, Point, NC. The other site, DSR-489/Horse Branch Creek outlet structure is located at 269 Lake Road, Willard, NC along the south bank of Horse Branch Creek. These sites are located north westerly of the Town of Burgaw, NC. The NE Cape Fear River is primarily a fresh water river system and major drainage conveyance for stormwater in Pender County, NC. The river is oriented northerly to southeast. The river is sinusoidal and flows from northerly to southerly and eventually into the Cape Fear River. The NE Cape Fear River is an expansive

river system with narrow fetches typically less than a quarter-mile throughout many parts of the project area. The river does not experience significant wave propagation because of low fetches but does experience high water elevations, regional flooding, and high velocity flow patterns particularly in periods of unseasonably high rainfall. Heavy rainfall throughout the Coastal Plains during Hurricane Florence (areas > 60”), resulted in regional damages including extensive streambank erosion, streambank slope failures, and severe flooding in low lying areas of the County.

Detailed field investigations were conducted by USDA/NRCS, in conjunction with Pender County NRCS/Soil & Water personnel. The team identified over 100 storm damaged streams and properties throughout the County resulting from Hurricane Florence. NRCS engineers and inspectors used a standardized damage reporting system to capture and document storm related damages to property parcels. Disaster Survey Reports for each site to quantify and prioritize impacts to the sites. Damages for emergency repairs to qualifying sites will be funded under the Robert T. Stafford Disaster Relief and Emergency Assistance Act administered by the USDA/NRCS EWP program. The work scope contained in the following Plans & Specifications (prepared by Ardurra of NC) will address the proposed emergency repair measures planned for repairing the two damaged sites listed below. The table below show the two sites, the associated DSR Number, and approximate coordinates for each site addressed by these project Plans & Specifications:

**Location EWP Project Sites
Emergency Watershed Protection Program
Pender County, NC**

DSR No.	Site Name.	Owner/Address	Apprx.Latitude/Longitude
5038-494	Holly Shelter NC Wildlife Resource Depot	NC Wildlife Resource Commission 7471 Shaw Highway Rocky Point, NC	34.551694/-77.811841
5038-489	Lake Rd Outlet Structure	R. Dayhuff 269 Lake Rd. Willard, NC	34.62620/-77.993220

Contract Objective

The objective of performing this work is to complete repairs to storm damaged streambank side slopes and channels at designated properties located in Pender County, NC in accordance with these project Plans & Specifications dated 3/14/2022 including Appendix I. The general design for the stabilization repair work specifies using suitable earthfill to backfill and restore scoured banks and slopes. Suitable earthfill material will be used for general fill purposes for: backfilling and compacted in-place; shaping to a finished slope angle that can be re-vegetated or otherwise stabilized using measures such as Tied Re-enforced Concrete Block Mat (TRCBM) such as Flexamat™ PLUS or by NCDOT Class I -Rip Rap Armor. Graded finished slopes that will not receive rigid matting or rock armor will be provided with a woven jute mat erosion control blanket (ECB) while establishing a vegetative groundcover. The vegetative groundcover will consist of a designed seed/mulch specification suitable for the geographic area of the repairs. The stabilization repairs specified in these plans are not designed to provide long-term or permanent solutions for stabilizing eroded channel banks or to prevent damages from future catastrophic storm events such as a 100-year storm event. Innovative approaches have been incorporated in these plans for using Tied Re-enforced Concrete Block Matting using in the repair designs for one severely eroded site. The TRCBM armor layer will retard

severe bluff/scarp erosion along the NE Cape Fear River at DSR-494. The performance of the TRCBM will be bolstered by grading the steep scoured stream bank to a reduced slope angle and planting a permanent vegetation groundcover beneath the TRCBM surface. The vegetation grows up through the mesh and tied block matrix to provide additional support and stability to the slope. This Bio-engineered method couples a semi-rigid composite geotextile underlayment with a rigid TRCBM mat and a planted vegetation cover beneath the system. The vegetation emerges through the mat and becomes the new visible surface of the slope. The slope can be mowed and maintained just like any normal vegetated slope. Repair measures identified in these plans are not long-term remedies which can permanently cease persistent high velocity streamflow and subsequent channel bank degradation. High velocity stream flow and channel bank erosion will continue to be experienced in future catastrophic storm events to most riparian properties located in Pender County.

Published literature and source references were utilized for guidance in the preparation and development of these Plans & Specifications. The key reference used is Title 210, USDA/NRCS National Engineering Manual, Part 642, *Specifications for Construction Contracts*, Rev January 2009. This document was relied upon to detail the work scopes anticipated for performing the emergency stabilization repair work to each properties shown in the above table. Following are the construction specifications and repair details for each of the two EWP project sites addressed by these Plans & Specifications:

Construction Specification 2—Clearing and Grubbing

1. Scope

The work consists of clearing and grubbing of designated trees and vegetation within the defined Construction Limits and includes vegetative storm debris. Disposal of vegetation will include trees, logs, limbs, debris, brush, stumps, undergrowth, and vegetative storm debris to be removed from each EWP project. This vegetative debris **must** be properly disposed in a permitted landfill or an approved alternate site identified by the Sponsor. Existing rip-rap, blocks, or concrete fragments may be present in places and will need to be relocated for future use, or disposed of offsite as determine by the Sponsor. Areas designated to be cleared and grubbed are identified by the Sponsor in the Plans & Specifications and will be delineated in the field during a site-walk with the Sponsor and contractor present. This scope also includes light clearing and removal of limbs, branches, and brush that may be needed for gaining ingress/egress to each EWP site. The cost for this should be included in the attached Bid Schedules for these two projects in the Clearing & Grubbing Bid Item.

2. Protection of Existing Vegetation

Trees, established landscaping, and other vegetation adjacent to the Construction Limits shall remain undisturbed shall be protected from damage throughout the duration of the construction period. Any damages resulting from the contractor's operations or neglect shall be repaired by the contractor to like-kind conditions. The Construction Limits or each project site shall be visibly marked in the field and approved by the Sponsor prior to commencement of Clearing & Grubbing operations.

Earthfill, stockpiling of materials, vehicular parking, and excessive foot or vehicular traffic shall not be allowed within the drip line of vegetation designated to remain in place. Vegetation damaged by any of these or similar actions shall be replaced with viable vegetation of the same species, similar condition, and like size unless otherwise approved by the Sponsor.

Any cuts, skins, scrapes, or bruises to the bark of the vegetation shall be carefully trimmed according to local arborist/nursery accepted practice procedures and methods used to seal damaged bark.

Any limbs or branches 0.5 inches or larger in diameter that are broken, severed, or otherwise seriously damaged during construction shall be cut off at the base of the damaged limb or branch flush with the adjacent limb or tree trunk. All roots 1.0 inch or larger in diameter that are cut, broken, or otherwise severed during construction operations shall have the end smoothly cut perpendicular to the root. Roots exposed during excavation or other operations shall be covered with moist earth or backfilled as soon as possible to prevent the roots from drying out.

3. Marking

The limits of all areas proposed for Clearing & Grubbing shall be marked by the contractor using stakes, high visibility flagging, tree paint, obvious markings, or by other suitable methods approved by the Sponsor. Trees to be left standing and uninjured will be designated by special markings placed on the trunk approximately 6 feet above the ground surface. The Sponsor will assist the contractor in making field determinations at each site to define the limits for clearing and grubbing.

4. Clearing and Grubbing

Except for all trees marked for preservation, trees within the Construction Limits, logs, brush, stumps, shrubs, rubbish, and similar waste material shall be cleared from within the limits of the designated work zone. Unless otherwise specified, all stumps, roots, and root clusters that have a diameter of 1 inch or larger shall be grubbed out to a depth of at least 12.0 ft. below subgrade for construction of concrete or structures, and 1.0 ft. below the ground surface when constructing embankment sites, earthfill sections, earthfill cuts, earth, berms or other areas designated by the Sponsor. The Sponsor will assist the contractor in making field determinations at each site to define the limits for clearing and grubbing. Light clearing and removal of limbs, branches, and brush that may be needed for gaining clear ingress/egress is included in this work scope and should be included Bid Item No. 2.

5. Disposal

All vegetative materials cleared and grubbed from the designated areas located on the EWP sites shall be disposed of at an approved landfill location permitted by the North Carolina Division of Waste Management. Permitted disposal locations are referenced in the project specifications in Section 7 below, of the Plans & Specifications. The contractor is responsible for complying with all state and local rules and regulations regarding removal and disposition of vegetative and storm debris. The contractor shall be responsible for payment of tipping fees or any other fees that may result from disposal of wastes at approved permitted landfill facilities. Approved disposal facilities are identified in Section 7, Work Scope and Construction Details, shown below.

6. Measurement and Payment

For payment of items of work covered in this scope, the contractor shall be paid on a per ton basis if scales are available, or by volume, if scales are not available. Payment shall include compensation for all labor, equipment, tools, landfill, tipping fees, surcharges, fuel, supplies, transportation, rentals, and all other items necessary and/or incidental to the completion of Clearing & Grubbing, and disposal of debris described for this task. Certified and dated, time-stamped weigh tickets or other written forms of documentation acceptable to the Sponsor from the debris facility, will be the instrument used for determining the amount of waste/debris removed from Clearing & Grubbing operations and debris removal/disposal. The CFR must verify and sign-off on the estimated volume of debris for every load of vegetative debris that is transported from each project site, before the contractor removes any debris/waste from each site.

7. Work Scope and Construction Details

The following Scope of Work includes items of work to be performed in conformance with these specifications and the construction details. These include but are not limited to the following:

- a. Bid Item #2: Clearing and Grubbing (including access ways to the site)
 - (1) Section 1: This item shall consist of site preparation work consisting of clearing and light grubbing of vegetation located on the earthfill footprint, adjacent locations shown on the drawings or otherwise conveyed to the contractor by the Sponsor, and ingress/egress to the site. Stripping or Clearing and Grubbing shall not be performed until any such area is needed for access or placement of earthfill in the construction operations. Areas proposed for clearing and grubbing shall be marked by the contractor using high visibility paint or flagging and approved by the Sponsor before clearing operations commence.
 - (2) Section 5: Woody brush, limbs, trees, storm debris and other storm debris shall be removed from the site and disposed of at a NCDSWM permitted disposal site. Grass and earth shall be stockpiled in areas designated by the Sponsor's site representative and may be re-used for spreading over designated areas of the site when construction activities cease.
 - (3) Section 6: Measurement and payment for this item will be weight based and paid by the ton (or in cases by volume if no scales are available) inclusive of all labor, materials, equipment, transportation and disposal costs. All debris must be delivered to a NCDSWM permitted landfill disposal site (see Note (4) below). The Contractor is responsible for any and all tipping and disposal fees, waste characterization fees, waste profile fees, or other fees charged by the disposal facility receiving the vegetative waste.
 - (4) Section 5 and 7: All wastes and debris removed from each EWP site resulting from clearing and grubbing or other purposes, must be disposed of at a designated permitted facility approved by the Sponsor.

All waste disposed at this facility by the contractor shall be documented and quantified by certified weigh tickets/manifest issued by the disposal facility and shall show: the facility name, time, truck ID, load details, and tare weight of waste. Payment for waste disposal will be based on the weight of waste material (tons) or volume determined by the disposal facility weigh scales. If payment by volume, the Sponsor's CFR shall verify and confirm the volume of every waste load transported offsite in order to receive payment. The CFR will sign-off by entering each load into a Waste Load Verification Form completed and totaled on a daily. This will be the method the only method for determining payment if scales are not available to the project. If by weight, time/date stamped weigh tickets issued by the facility will be used to verify the weight of waste material generated by the work scope defined in Construction Specification 2—Clearing & Grubbing.

The contractor must request approval of any debris disposal site considered, to be submitted to the Sponsor in writing at least 10 days **prior** to the proposed delivery date of any waste to a disposal facility. Debris disposed at any unapproved alternative site or location will result in non-payment for this work scope and will result in the contractor being required to remove all material from the unapproved site and transferring that material to the approved waste disposal site. Any corrective measures will be performed at the contractor's expense.

- (5) Section 7: Method of Payment will be made in accordance with Method 5 for all vegetative wastes and debris.

Construction Specification 5—Pollution Control (Sedimentation and Other)

1. Scope

The work performed under this specification consists of installing measures and performing work in such a manner that controls and contains erosion and sedimentation from occurring onto adjacent sites or waters. Sedimentation and any other pollutants generated during the repair operations must be contained onsite at all times, and prevented from entering adjacent waters, lands, or properties. Pollutants covered under this specification includes the following: (1) Sedimentation (2) Chemical, and (3) Air.

For reduction, minimization, and elimination of sedimentation pollutants from occurring, there are a number of USDA Bio-Preferred products recommended for use. The following USDA Bio-Preferred product categories are applicable to this specification: (1) Mulch and compost materials, (2) Erosion control materials/mechanical barriers, (3) Fertilizers, (4) Dust suppressants, and (5) Agricultural spray adjuvants.

2. Materials

Silt fence shall be the primary form of sedimentation pollution control and shall conform to the requirements of Construction Material Specification 592-Geotextile. Silt fence shall also meet the requirements of the material specifications listed in Sediment Filters (Silt Fence) shown below. All sedimentation and erosion control measures must be of sufficient size, length, and type to meet site runoff generated by a 10-year/24 hr. peak storm event. Synthetic filter fabric should contain ultraviolet inhibitors and be durable enough to restrain decay/breakdown for at least 6 months. Additional details for silt fences are provided in the below sections.

3. Erosion and Sediment Control Measures and Works

Erosion and sediment control measures and works shall include, but are not limited to, the following:

Staging of Earthwork Activities—Excavation and moving of soil materials shall be scheduled to minimize the size of areas disturbed and unprotected from erosion for the shortest reasonable time.

Seeding—Seeding to protect disturbed areas shall occur as soon as reasonably possible following completion of that earthwork activity and in no case greater than 10 days of Final grading of any area.

Mulching—Mulching to provide temporary protection of the soil surface and seed from eroding shall be used in conjunction with establishing a Final groundcover sufficient to restrain accelerated erosion. Mulch shall applied at a rate that provides a minimum of 85-100 % coverage to all denuded or graded slopes or areas.

Diversions—Diversions and swales shall be used to re-route water from work areas and on slopes in the work area to reduce erosion and increase the probability for germination and establishment of seed. These measures are temporary in nature and shall be removed; these areas shall be restored to their original condition when the diversions are no longer required or when a permanent groundcover is established.

Stream Crossings—Culverts or bridges where equipment cross streams must be necessary. These are temporary in nature and shall be removed, and the area restored to its near original condition, when the crossings are no longer required or when permanent erosion control measures are installed. No sediment or earthfill may be placed or allowed to enter any stream or channel. The contractor must obtain permits and/or authorization from the US Army Corps of Engineers prior to performing any stream crossing, placing any culvert, or constructing any bridge during the construction of any EWP project.

Sediment Basins—Sediment basins collect, settle, and eliminate sediment from eroding areas from impacting properties and streams below the construction site(s). These basins are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

Sediment Filters (Silt Fences)—Geotextile silt fences shall be properly installed along the perimeter of the active Construction Limits and upland of the USACE/CAMA High Water Mark (HWM) prior to commencing grading activities on any site. The silt fence geotextile material shall comply with the requirements of ASTM D 6461. The silt fence must prohibit sediment from migrating off site to sensitive adjacent environmental areas including surface waters, wetlands, marshes, waterways, or adjacent properties. The silt fence shall be constructed to limit runoff and maintain all construction generated sediment or fill material onsite at all times. Silt fences shall be properly trenched into the ground and anchored to prevent erosion from occurring under or around the fence. Silt fences shall be installed and maintained in accordance with ASTM D6462 and the NC Division of Energy, Minerals, and Land Resources/Land Quality Section specifications and requirements for use and maintenance of sedimentation and erosion control measures cited in the NC Erosion and Sediment Control, Planning and Design Manual, May 2013 (see Section 6, Practice Standards and Specifications, *Sediment Traps and Barriers*, 6.62 *Sediment Fence (Silt Fence)*). Silt fences are temporary and shall be maintained at all times during the construction period. Silt fences may be removed when a permanent vegetative groundcover has been established on all grades areas and is sufficient to restrain erosion. The location of all proposed silt fencing for each EWP site must be illustrated in the Pollution Control Plan developed by the contractor for each EWP site.

Temporary Slope Drains—Temporary slope drains may be deemed necessary for the contractor to control surface runoff during active construction and to establish a final permanent vegetative groundcover on the 1.5H:1V finished-grade slope. An erosion control blanket made of jute mat will also be utilized in establishing the permanent vegetative groundcover on all slopes and banks that are not covered by Flexamat or Class I Rip Rap. For any temporary slope drains installed, they shall be operated, and maintained in accordance with the NC Erosion and Sediment Control, Planning and Design Manual, May 2013 (see Section 6, Practice Standards and Specifications, *Runoff Conveyance Measures*, 6.32 *Temporary Slope Drains*).

Waterways—Waterways include those installed for the diversion and safe disposal of runoff from graded areas, diversion channels, and other temporary structures or measures. These works are temporary and shall be removed and the area restored to its original condition when they are no longer required to restrain erosion or when a permanent groundcover has been established.

Other—Additional protection measures as specified in Section 8 of this specification or required by Federal, State, or local government.

4. Chemical Pollution

In addition to the contractor providing adequate measures to ensure that offsite sediment pollution does not occur, the contractor shall provide adequate containment, watertight tanks, barrels, liners, barriers, or sumps sealed with plastic sheeting and/or synthetic liners to collect and temporarily contain any chemical pollutants generated during the construction process. This includes containment and management of ANY hazardous or deleterious materials used onsite to ensure that such materials are prevented from entering onto the site or adjacent grounds, or adjacent watercourses during construction. This includes but is not limited to collecting and containing fuels for refueling equipment, drained/leaking lubricants, motor oils, degreasers, transmission fluids, brake fluids, grease/oils, surfactants/soaps, cleaning agents, fertilizers, concrete mixer wash-water, or asphalt or liquid-tack, or any other deleterious material produced as a by-product of any of the construction activities performed. Pollutants shall be disposed of in accordance with governing Local, State, and Federal regulations. At the completion of the construction work, tanks, barrels, and sumps shall be removed and the area restored to its original condition as specified in Section 8 of this specification. Sump removal shall be conducted without causing pollution. Any spill of any hazardous or deleterious material as a result of the contractor's operations must be reported immediately to the Sponsor or in no case later than 24 hours, or as required by State or Federal reporting requirements in North Carolina.

Sanitary facilities, such as chemical toilets, or septic tanks shall not be located near or next to live streams, water wells, or springs. They shall be located at a distance at least 150 ft. away from such area to prevent potential contamination of any water source. At the completion of construction activities, chemicals, fuels, wastewaters, etc. shall be properly disposed offsite without causing pollution or contamination as specified in Section 8 of this specification.

5. Air Pollution

The burning of brush, vegetation, slash, trees, limbs, stumps, wood, wood-waste or wood products, trash, debris, petroleum, or flammable chemicals of any kind shall not be performed onsite or offsite so as not to create air quality impacts during construction. Disposal of any other materials that create the potential for air quality degradation or pollution shall be performed in such a manner that adheres to all Local, State and Federal regulations.

Fire prevention measures and precautions shall be taken by the contractor to prevent the start, ignition, or spreading of wildfires that may result from project activities. Firebreaks or guards shall be constructed and maintained at locations shown on the drawings or otherwise deemed necessary by the Sponsor.

Errant dust and particulates shall be controlled by the contractor at all times during construction. Any public or private access or haul road used by the contractor during the project, shall be sprinkled or otherwise treated with water to fully suppress dust. Dust control methods and measures shall ensure the protection of air quality and safe construction operations at all times. If chemical dust suppressants are applied, the material shall be a commercially available product specifically designed for dust suppression and the application shall follow manufacturer's requirements and recommendations. A copy of the product data sheet and manufacturer's recommended application procedures shall be provided to by the Sponsor at least 5 working days before the first proposed application.

6. Maintenance, Removal, and Restoration

All pollution control measures and temporary works for sediments, chemicals, and airborne pollutants shall be adequately maintained in a functional condition for the duration of the construction period. All temporary measures and materials used for these purposes shall be removed from the work site and materials storage areas, and the site restored to its original pre-existing condition prior to the contractor receiving payment of retainage addressed in Construction Specification 00.

7. **Measurement and Payment Method**—The following provision applies to measurement and payment of Construction Specification 5- Pollution Control. Compensation for any item of work described in the contract, but not listed in specifically in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Payment for Construction Specification 5- Pollution Control will be made subsidiary to Construction Specification-8 Mobilization and Demobilization. Such items, and the items to which they are made subsidiary, are identified in Section 8 of this specification.

8. **Work Scope and Construction Details**

The following Scope of Work shall be performed in conformance with the specifications and construction details below:

a. **Subsidiary Item, Pollution Control**

- (1) Section 1: A written Pollution Control Plan is required and shall be prepared by the contractor and submitted to the Sponsor at least 10 days prior to commencement of work. The Contractor's written Pollution Control Plan shall be approved by the Sponsor prior to the start of any construction activity. The written plan shall include the proposed measures for controlling, eliminating, and preventing each of the above described pollution sources (sediments, chemicals, and airborne) from adversely impacting the project site, adjacent sites, or adjacent waters including those governed by the NC Division of Coastal Management, NC Division of Water Quality, or the US Army Corps of Engineers. Project sequencing should also be considered to minimize the duration and size of disturbed areas in order to prevent offsite sedimentation from occurring. The construction site shall be maintained in a clean and safe condition at all times during construction operations.
- (2) Section 2: The sediment filter material (silt fence) used for erecting a barrier around the active Construction Limits shall meet the requirements of ASTM D6461. Solid hay bales shall only be used for temporary water diversion or impoundment, and not for sediment control. The Pollution Control Plan shall be prepared by the contractor to include a drawing illustrating the proposed active Construction Limits and the type, and location of all silt fence sections proposed for each EWP repair site. The details for installation and maintenance of the silt fence shall also be included in the Pollution Control Plan.
- (3) Section 3: Sediment filters shall be installed according to the requirements in ASTM D6462. BEST MANAGEMENT PRACTICES FOR EROSION CONTROL: The finished grade of all disturbed areas not covered with armored ECB mat (jute) shall be protected from runoff by establishing a temporary vegetative groundcover. These areas should be provided with a 3.0 to 4.0 inch thick layer of topsoil and seeded, after excavation, grading, and associated slope repair operations are complete. Topsoil will be placed and spread over the entire disturbed areas to promote vegetative growth. The Soil & Water District Conservationist will assist the Sponsor in developing the seeding specification for restoring vegetative groundcovers to each project site. The contractor will be provided with these seeding specifications prior to construction commencement including temporary and permanent groundcovers. Existing vegetation located downstream of all construction activities will be maintained and utilized to the

greatest extent practicable as buffer strips to prevent sediment transport. Sediment that accumulates on grass buffer strips will be removed and placed upgradient of silt fences constructed to delimit the Construction Limits, or Sponsor designated fill/waste areas. , Silt fences shall be maintained as soon as practicable after rainfall events, and in no case, greater than 24 hours from the time of rainfall occurrence.

- (4) Section 4: All chemical pollutants used or generated by the contractor, and other any other non-hazardous pollutants shall be disposed at an offsite at an approved permitted NCDSWM landfill, or other State, or EPA permitted disposal facility that is duly permitted to receive such wastes. Containment and management of chemical pollutants must be identified in the contractor's Pollution Control Plan.
- (5) Section 5: Air pollution, generation of dust and particulates, and burning of any type of combustible material shall not be permitted on the work site. Watering or dust fences shall be utilized to restrain and control dust from leaving the construction site and travel ways. Containment and management of dust or airborne pollutants must be identified in the contractor's Pollution Control Plan.
- (6) Section 7: Measurement and payment for this item will be made. All subsidiary to BID ITEM #1, MOBILIZATION AND DEMOBILIZATION

Construction Specification 6—Seeding, Sprigging, and Mulching

1. Scope

The work consists of preparing the area for treatment; furnishing and placing seed, sprigs, mulch, fertilizer, inoculant, lime, and other soil amendments; and anchoring mulch in designated areas as specified.

The following USDA BioPreferred product categories are applicable to this specification:

- Mulch and compost materials
- Erosion control materials
- Fertilizers
- Agricultural spray adjuvants

2. Material

Seed—All grass seed must conform to the current rules and regulations of the State of North Carolina Department of Agriculture and must be from the latest crop available. Seed must meet or exceed the standard for purity and germination listed in Section 7.

Seed must be labeled in accordance with NC State laws and U.S. Department of Agriculture rules and regulations under the Federal Seed Act in effect on the date of invitations for bids. Bag tag figures are evidence of purity and germination. No seed may be accepted with a test date of more than 9 months before the date of delivery to the site.

Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be accepted. The percent of noxious weed seed allowable must be as defined in the current State laws relating to agricultural seeds. Each type of seed must be delivered in separate sealed containers and fully tagged unless an exception is granted in writing by the contracting officer.

Fertilizer—Unless otherwise specified, the fertilizer must be a commercial-grade fertilizer. It must meet the standard for grade and quality specified by State law. Where fertilizer is furnished from bulk storage,

the contractor must furnish a supplier's certification of analysis and weight. When required by the contract, a representative sample of the fertilizer must be furnished to the contracting officer for chemical analysis.

Inoculants—The inoculant for treating legume seeds must be a pure culture of nitrogen-fixing bacteria prepared specifically for the species and must not be used later than the date indicated on the container or as otherwise specified. A mixing medium, as recommended by the manufacturer, must be used to bond the inoculant to the seed. Two times the amount of the inoculant recommended by the manufacturer must be used, except that four times the amount must be used when seed is applied using a hydraulic seeder. Seed must be sown within 24 hours of treatment and must not remain in the hydraulic seeder longer than 4 hours.

Lime and other soil amendments—Lime must consist of standard ground agriculture limestone, or approved equivalent. Standard ground agriculture limestone is defined as ground limestone meeting current requirements of the State department of agriculture. Other soil amendments must meet quality criteria and application requirements specified in Section 7.

Mulch Tackifiers—Asphalt emulsion tackifiers must conform to the requirements of ASTM D977, Specification for Emulsified Asphalt. The emulsified asphalt may be rapid setting, medium setting, or slow setting. Non-asphaltic tackifiers required because of environmental considerations must be in accordance with those specified in Section 7, if any are anticipated.

Straw Mulch Material—Straw mulch must consist of wheat, barley, oat or rye straw, hay, grass cut from native grasses, or other plants as specified in Section 7. The mulch material must be air-dry, reasonably light in color, and must not be musty, moldy, caked, or otherwise of low quality. The use of mulch that contains noxious weeds is not permitted. The contractor must provide a method satisfactory to the Sponsor for determining weight of mulch furnished.

Other Mulch Materials—Mulching materials, such as wood cellulose fiber mulch, mulch tackifiers, synthetic fiber mulch, netting, and mesh may be required for specialized locations and conditions. These materials, when specified, must be accompanied by the manufacturer's recommendations for methods of application.

3. Seeding Mixtures, Sod, Sprigs, and Dates of Planting

The application rate per acre for seed mixtures, sprigs, or sod and date of seeding or planting must be in accordance with these plans or as specified in Section 7. The Sponsor reserves the right to change the seeding specifications identified in these plans based on current or local climatic conditions.

4. Seedbed Preparation and Treatment

Areas to be treated must be dressed to a smooth, firm surface. On sites where equipment can operate on slopes safely, the seedbed must be adequately loosened (4 to 6 inches deep) and smoothed. Depending on soil and moisture conditions, disking or culti-packing, or both, may be necessary to properly prepare a seedbed. Where equipment cannot operate safely, the seedbed must be prepared by hand methods by scarifying to provide a roughened soil surface so that broadcast seed will remain in place.

If seeding is to be accomplished immediately following construction operations, seedbed preparation may not be required except on a compacted, polished, or freshly cut soil surface.

Rock fragments larger than 2.0- inches in diameter, trash, weeds, and other vegetative debris that will interfere with seeding or maintenance operations must be removed or disposed of as specified in Section 7.

Seedbed preparation must be discontinued when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed as determined by the Sponsor or their local representative.

5. Seeding, Sprigging, Fertilization, Mulching, and Slope Stabilizing

All seeding or sprigging operations must be performed in such a manner that enables application in the specified quantities to occur uniformly in areas designated for establishment of a vegetative groundcover. The method and rate of seed application must be performed as specified in Section 7. Unless otherwise specified, seeding or sprigging must be accomplished within 2 days after final grading of repaired slope is completed and approved by the Sponsor or its local representative.

Fertilizer, lime, and other soil amendments must be applied as specified in Section 7. Fertilizer and soil amendments must be thoroughly incorporated into the soil immediately following surface application.

For areas where mulch will be used, the rate, amount, and kind of mulching must be as specified in Section 7. Mulches must be applied uniformly to the designated areas and shall provide at least 85% coverage of the ground surface where applied. Mulch must be applied to areas seeded not later than 1 working day after seeding has been performed. Straw mulch material must be stabilized within 24 hours of application using a mulch crimper or an equivalent anchoring tool or by a suitable tackifier. When the mulch crimper or equivalent anchoring tool is used, it must have straight blades and be the type manufactured expressly for and capable of firmly punching the mulch into the soil. Where the equipment can be safely operated, it must be operated on the contour. Hand methods must be used in areas where equipment cannot safely operate to perform the work required.

Tackifier must be applied uniformly over the mulch material at the specified rate, or it must be injected into the mulch material as it is being applied. Mesh, jute, or netting stabilizing materials must be applied smoothly but loosely on the designated areas. The edges of these materials must be buried or securely anchored using spikes or staples as specified in Section 7.

The contractor must maintain mesh, jute, or netting in all areas applied until all work under the contract has been completed and accepted by the Sponsor. Maintenance must consist of the repair of areas damaged by water erosion, rainfall, wind, fire, lack of proper seed germination, improper soil conditions, or other causes that prohibit a permanent groundcover to be established on all grades or cut/fill areas of the project site. Such areas must be repaired to reestablish the intended condition and to the design lines and grades required by the contract. The areas displaying inadequate germination or insufficient groundcover for any reason, must be re-limed, re-fertilized, re-seeded, and re-mulched as necessary to establish a groundcover before the application of a new mesh, jute, or netting is applied. Until a groundcover has been established and deemed sufficient to restrain erosion as determined by the Sponsor and the NC Division of Energy, Minerals, and Land Resources-Land Quality Section, the contractor will not be eligible to request payment for completion of this work scope.

5.1 Temporary Slope Protection/ Slope Stabilization

Some project sites may experience periods of rainfall causing concentrated surface water flow from adjacent areas over the completed 1.5H:1V earthfill constructed or graded slope. The contractor shall be responsible for providing temporary flexible slope drains, wattles, diversions, hay barriers, or other temporary measures necessary to control or divert flow, while establishing a permanent vegetative groundcover. The contractor shall identify sites that are anticipated to need the types of temporary erosion control measures such as those stated above. The contractor shall provide a written Temporary Slope Protection Plan to the Sponsor identifying the type, details, and locations of slope protection measures proposed. The Plan shall propose measures to control concentrated surface water flow and diverting runoff off earthfill slope faces. The Plan shall include the timing for installing the temporary slope protection measures and the anticipated maintenance for the slope protection measures. The costs for installing

temporary erosion control measures should be incorporated into the contractor's bid within Items 1 through 5, and is not required to be delineated as an independent line item. These measures proposed for surface water flow control shall be in accordance with the NC Erosion and Sediment Control, Planning and Design Manual, May 2013, Temporary Slope Drains Practice No. 632.

6. Measurement and Payment

Method —For items of work for which specific unit rate prices are established in the contract (cost/SF), each area treated is measured and adjusted as specified in Section 7, to the nearest 0.1 acre. Payment for treatment is made at the contract unit price for the designated treatment, which will constitute full compensation for completion of the work. Payment will be adjusted to actual area seeded and mulched rather than the quantity estimated in the Bid Item 4. Payment will be based on the contract unit rate specified x the square footage actually seeded/mulched and measured to the nearest 0.1 acre.

Jute, mesh, or netting is also measured to the nearest square foot of surface area covered and provided. Payment is made at the contract unit price and will constitute full compensation for completion of the work.

7. Scope of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details are shown below:

Bid Item #4: Seeding, Sprigging, and Mulching

- (1) Section 1: Scope of work shall include seeding on all disturbed areas including site ingress and egress locations.
- (2) Section 2: Seed shall be common rye grass. Other mulch material shall be erosion control blanket (ECB) as specified in construction notes.
- (3) Section 3: Seeding type and rate shall be as specified by the Soil & Water Conservationist or specified in the construction notes. Fertilizer and lime rates shall be based on recommendations of the Soil & Water Conservationist or by soil test results from the North Carolina State University agronomy/soils laboratory.
- (4) Section 4: Incorporate lime and fertilizer to a depth of at least 3" into the soil during preparation of seedbed. All gullies and rills shall be filled and smoothed prior to application of fertilizer. The seedbed will be prepared with common farm tools such as disks, harrows, and cultipackers. Areas not accessible to field machinery shall be prepared by hand.
- (5) Section 5: Apply seed uniformly at a depth of $\frac{1}{8}$ to $\frac{1}{4}$ inch with drill or cultipacker type seeder or broadcast seed uniformly and cover $\frac{1}{8}$ to $\frac{1}{4}$ inch deep with a cultipacker, harrow, or similar tool. Seeding operation shall be performed immediately after seedbed preparation, if seeding dates permit. Stabilizing shall be accomplished with ECB as specified in construction notes.
- (6) Section 6: Measurement and payment for this item will be made using the Method specified above and in accordance with unit rates described from Bid Item No. 4 of the Bid Schedule. Payment will be adjusted for the actual square footage of surface area provided with seeding/mulching/jute measured to the nearest 0.1 acre.

Construction Specification 7—Construction Surveys

1. Scope

Emergency repair work for the two EWP sites will include contractor performed surveys on each site for grade control during construction and to demonstrate final finished slope elevations are met. Earthfill operations at all sites will be completed with a final grade of 1.5H:1V finished slope. Construction drawings included in this set of Plans & Specifications illustrate the existing grades of each site as well as the proposed finished grade.

Surveying will include the contractor identifying and marking the Constructing Limits shown in the Plans & Specifications for each site. In addition, surveying will include location of the HWM, property boundaries, setting grade stakes, performing elevation measurements, and performing computations as required by this specification. Temporary benchmarks are not provided by the Sponsor on these EWP sites for use by the contractor.

2. Equipment and Material

Equipment for construction surveys shall be of a quality and condition to provide the required accuracy. The equipment shall be maintained in good working order and in proper adjustment at all times. Records of repairs, calibration tests, accuracy checks, and adjustments shall be maintained and be available for inspection by the engineer. Equipment shall be checked, tested, and adjusted as necessary in conformance with manufacturer's recommendations.

Materials include field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and all other items necessary to perform the surveying work specified.

3. Quality of Work

All work shall follow recognized professional practice and the standards of the civil construction industry unless otherwise specified in Section 9 of this specification. The work shall be performed to the accuracy and detail appropriate for the type of job. Notes, sketches, and other data shall be complete, recorded neatly, legible, reproducible and organized to facilitate ease in review and allow reproduction of copies for job documentation. Survey equipment that requires little or no manual recording of field data shall have survey information documented as outlined in Section 9 of this specification.

All computations shall be mathematically correct and shall include information to identify the survey location, purpose, date, and who performed, checked, and approved the computations. Computations shall be legible, complete, and clearly document the source of all information used including assumptions and measurements collected.

If software or common industry computer programs are used to perform the computations, the contractor shall provide the Sponsor with the software identification, vendor's name, version number, and other pertinent data before beginning survey activities. Computer generated computations shall show all input data including values assigned and assumptions made.

The elevations of permanent and temporary benchmarks shall be determined and recorded to the nearest 0.01 foot. Differential leveling and transit traverses shall be of such precision that the error of vertical closure in feet shall not exceed plus or minus 0.1 times the square root of the traverse distance in miles. Linear measurements shall be accurate to within 1 foot in 5,000 feet, unless otherwise specified in Section 9 of this specification. The angular error of closure for transit traverses shall not exceed 1-minute times the square root of the number of angles turned.

The minimum requirements for placing slope stakes shall be at 100-foot stations for tangents, as little as 25 feet for sharp curves, breaks in the original ground surface and at any other intermediate stations necessary to ensure accurate location for construction layout and measurement. Slope stakes and cross- sections shall be perpendicular to the centerline. Significant breaks in grade shall be determined for cross- sections.

Distances shall be measured horizontally and recorded to the nearest 0.1 foot. Side shots for interim construction stakes may be taken with a hand level.

Unless otherwise specified in Section 9 of this specification, measurements for stationing and establishing the location of structures shall be made to the nearest 0.1 foot.

Elevations for concrete work, pipes, and mechanical equipment shall be determined and recorded to the nearest 0.01 foot. Elevations for earth work shall be determined and recorded to the nearest 0.1 foot.

4. Primary Control

Temporary benchmarks (TBM) for primary control, necessary to establish lines and grades may be needed for construction. Station lines set by the Sponsor's CFR may exist on EWP sites and should be used when possible for performing construction layout. TBMs have not been established on each site by the Sponsor and shall be the Contractor's responsibility.

The baselines (Station Locations) should be used as the origin of all surveys, layouts, and measurements when possible, to establish construction lines and grades. It is the contractor's responsibility to undertake all necessary measures and precautions to prevent the loss or damage of any primary control point or TBM monument. Any TBM provided by the Sponsor, Sponsor performed construction staking, or control points lost or damaged by the contractor's construction activity or for any reason, will be reestablished by the contractor and at their own expense. TBMs and control points shall be protected by the contractor throughout the construction process.

5. Construction Surveys

Plan sheet drawings for each EWP site have been performed by the Sponsor and are contained in these Plans & Specifications for the Contractor to use in layout and construction. The drawing files are not available in digital format and are only provided for general use to initiate site stake-out and subsequent construction. Plan Sheets for each site are identified as Sheet 1 through X and include Cross Sections for each site. The Cross Sections illustrate station locations, cross section transects, and existing grade. The contractor may utilize these plan sheet drawings at their discretion for estimating quantities of cut and/or fill necessary at each site, but are advised to perform their own pre-construction survey for the purpose of estimating quantities. The accuracy of any field survey included in the attached Plans & Specifications is insufficient for use to accurately measure materials and quantities. Surveys provided in these Plans are for bidding purposes only; estimates of earthfill/cut for each site have been provided and should not be relied upon for construction purposes. Quantities shown in these Plans are subject to change more or less. The field surveys and Bid Schedules may represent some of the materials and quantities needed to perform the requested work scope, but not all. Materials and quantities shown in the Bid Schedules may contain more or less quantities and materials than will actually be used by the contractor to complete the specified work scope, however the contractor will be paid based on actual quantities used for such items shown in the Bid Schedules.

Before any sitework is undertaken that requires the contractor to perform surveys, the contractor shall submit a request to the Sponsor in writing for approval of their proposed surveyor, or qualified person who will be performing their site surveys. The following information must be submitted to the Sponsor including: the surveyors name, qualifications, licensure (if any), and experience of the individual(s) to be assigned to the survey tasks.

Contractor performed surveys shall consist of all work necessary for the following:

- establishing line and grade for all work
- setting slope stakes for all work
- checking and any supplemental or interim staking

- establishing final grade stakes
- performing quantity surveys, measurements, and computations for reporting earthfill progress
- performing original (initial) and final surveys for determination of final quantities to be back-checked with earth fill volumes delivered from the borrow pit (when applicable)
- other surveys as described in Section 9 of this specification
- establishing adjacent property boundaries only to the degree necessary to prevent encroach on adjacent private or public property

6. Staking

The construction staking required for the item shall be completed before work on any item starts. Construction staking shall be completed as follows or as otherwise specified in Section 9 of this specification:

Clearing & Grubbing—The boundary of the area(s) to be cleared and grubbed shall be staked or flagged at a maximum interval of 100 feet, or closer if needed, to clearly mark the limits of the active work zone. When contractor staking is the basis for determining the area for final payment, all boundary stakes will be reviewed by the Sponsor before start of this work item.

Excavation, Cut and/or Fill—Slope stakes shall be placed at the intersection of the specified station locations, slopes, and ground lines. Slope and fill stakes shall be marked with the stationing, required cut or fill, slope ratio, and horizontal distance from the centerline or other control line. The minimum requirements for placing slope stakes is outlined in Section 3, Quality of Work.

Structures—Centerline and offset reference line stakes for location, alignment, and elevation shall be placed for all structures.

7. Records

All survey data shall be recorded in fully identified standard hard-bound engineering survey field notebooks with consecutively numbered pages. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, weather data, sketches, and the personnel who performed and checked the work. Electronically generated survey data and computations shall be bound, page numbered, and cross referenced in a bound field notebook containing the index for all survey activities. All work shall follow recognized professional practice.

The construction survey records shall be available at all times during the progress of the work for examination and use by the engineer and when requested, copies shall be made available. The original field notebooks and other records shall be provided to and become the property of the owner before final payment and acceptance of all work.

Complete documentation of computations and supporting data for progress payments shall be submitted to the Project Engineer with each invoice for payment as specified in Section 9 of the specification. When the contractor is required to conduct initial and final surveys as outlined in Section 7, Construction Surveys, notes shall be provided as soon as possible after completion to the Sponsor for the purpose of determining final payment quantities.

8. Payment

Method—Payment will be provided specific to this item for the labor and materials required to perform the work in accordance with the line item in the Bid Schedule included in the Plans & Specifications. Compensation/payment for this item is listed in the Bid Schedule and will be paid upon completion to the satisfaction of the Sponsor.

9. Scope of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details are below:

a. Subsidiary Item, Construction Surveys

(1) Section 1: Field Surveys, Staking, and Final As-Built Survey to be performed by the contractor shall include:

i. The contractor shall make an initial survey of each site (as deemed necessary) to determine the degree of work to be performed. This includes estimating the volume of earthfill material needed. The earthfill quantity estimate shown in the Bid Schedule is for bidding purposes and should not be relied upon as the actual volume that may be required to complete repairs as specified in these Plans. Actual earthfill quantities may vary from those shown in the Bid Schedule.

ii. The contractor shall observe the established Construction Limits and mark these limits on each site in the field prior to performing earthfill operations. This also includes using high visibility methods of marking slope widths, property lines, and toe of bank for placement of required earthfill.

iii. The contractor will observe and mark the clearing and grubbing limits described in the plans and specifications, or as marked or otherwise indicated by the Sponsor. This includes identifying the locations of displaced rip rap for relocating to designated areas along the toe of fill. The Sponsor will assist the contractor in field verifying rip rap needing relocation to approved areas.

iv. The Sponsor will perform periodic grade checks, lift thickness checks, density checks, and other verifications as noted in the construction inspection plan. It is the contractor's responsibility to perform their own verifications for lift thickness, grade, compaction, elevation, slope angle, borrow material compliance with specifications, and other construction quality control checks.

v. The contractor should coordinate construction stake-out and grading control with the Sponsor for project layouts at each site. Any Sponsor staking shall be performed once; damaged survey stakes, TBMs, or control points will be replaced by the contractor at their expense. All surveys shall proceed from temporary benchmarks, reference points, and/or stakes set or established by the Sponsor, and identified in the attached plan sheets.

vi. The Contractor shall perform an As-Built Final Survey of the completed 1.5H:1V finished slope. The survey must be performed and sealed by a qualified Professional Engineer (PE) registered in the State of North Carolina. The Sponsor reserves the right to approve the proposed survey firm, the RLS performing the survey, and to conduct their own QA survey to verify that the finished 1.5H:1V finished slope was built according to the Plans & Specifications.

(2) Section 3, Quality of Work, Measurements for establishing the location of completed fill-sections or structures shall be made to the nearest 0.1 foot, or as determined in the field by the Sponsor or its engineering representative.

- (3) Section 4: Additional Primary Control, will not be established by the Sponsor to supplement Primary Control identified on the drawings.
- (4) Section 5: Construction Surveys, the Method of Payment described above in No. 8-Payment, shall apply.
- (5) Section 8: Measurement and Payment for this item will not be made. All construction surveys are subsidiary to BID ITEM #3, EARTHFILL

Construction Specification 8—Mobilization and Demobilization

1. Scope

This task consists of mobilization and demobilization of the contractor's forces and equipment necessary for performing the work required under the contract. It does not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract. Mobilization will not be considered as work in fulfilling the contract requirements for commencement of work.

2. Equipment and Material

Mobilization shall include all activities and associated costs for transportation of contractor's personnel, equipment, and operating supplies to the site; establishment of offices, buildings, staging areas, and other necessary general facilities for the contractor's operations at the site; premiums paid for performance and payment bonds including coinsurance and reinsurance agreements as applicable; and other items specified in Section 4 of this specification.

Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not required or included in the contract from the site; including the disassembly, removal, repairs, and site cleanup of offices, buildings, staging areas, grounds, and other facilities assembled on the site used specifically for this contract.

The work scope performed under this contract includes **one mobilization and demobilization** per DSR. There are a total of two DSRs covered under this EWP contract. If the Sponsor should change, delete, alter, or add additional scopes of work that are not specified in this contract, then an adjustment in the contract price for such cost additions or reductions will be considered for work that was added or deducted from the scope identified in these Plans & Specifications.

3. Payment

Payment may be requested by the Contractor for 50% of mobilization/demobilization costs upon **completion** of the mobilization phase. The Sponsor shall determine when the Mobilization phase is complete and supported by evidence provided by the contractor that materials, supplies, equipment, and resources necessary to being the specified work scope are in-place and onsite and in "start-ready" condition. Payment requests shall be supported by such documentation to show direct costs for specific mobilization/demobilization expenses. This may include documentation such as charges from suppliers, subcontractors, and equipment vendors, etc., and other costs. Payment will be made in the amount of 50% of the total cost for mobilization/demobilization upon the contractor's arrival and staging of all equipment and personnel necessary to complete the work required for each DSR. When the work scope for each DSR is completed in full and to the Sponsor's satisfaction, the remaining 50% balance for Item 1-Mobilization/Demobilization in the Bid Schedule will be released for final payment including subsidiary cost included in this Bid Item.

4. Scope of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item #1: Mobilization and Demobilization

- (1) Section 1: the following items are subsidiaries to Bid Item 1-Mobilization and Demobilization: Pollution Control (005), and Contractor Quality Control Plan (094).

The demobilization operation shall include but not be limited to the following items of work:

- (a) Removal of all debris, trash, tires, equipment, equipment parts, chains, cables, soil, mud, rock, and other such items resulting from the construction operation shall be collected and removed from the work site. These materials must be disposed in a NC-DSWM permitted landfill that is approved by the Sponsor.
- (b) All access routes whether paved or unpaved, to and from the site off of public/private roadways shall be maintained or restored by the contractor to a like-kind condition that pre-existed prior to construction activities.
- (c) All disturbed areas including the site, adjacent affected areas, staging/lay down areas, or any other temporary area used during construction shall be bladed or smoothed to blend the area with the surrounding land surfaces. The bladed or smoothed surface shall be free of abrupt mounds, windrows, depressions or other irregularities that would prevent the safe operation of ordinary farm equipment thereon. The finished surface shall prevent diversion of surface runoff and shall prevent standing or ponding water. Disturbed areas that were formerly lawn or grassed shall be seeded and mulched as noted in Construction Specification 6 except for graveled travel lanes and ramps used for site access which may remain if authorized by the property owner.
 - (1) All earthwork activities for site ingress/egress (e.g. ramps, travel-ways, matting) shall be included as part of Mobilization/Demobilization and must be protected as described below:
 - a.) Construction matting shall have a minimum weight loading of 400 psi, or
 - b.) Clean gravel minimum 2" to 3" thickness over equipment compacted soil subbase. Minimum width for all travel ways shall be widest equipment track/tread width + 2.0 ft. Graveled access routes may be left in place once construction is completed with written permission from the Sponsor and the property owner.
 - c.) All temporary matting and ramps shall be removed from the site. Disturbed areas that were formerly lawn or grassed shall be restored to pre-existing condition by sodding or seeding and mulching as noted in Construction Specification 6 and drawing notes.

Construction Specification 23—Earthfill

1. Scope

The work scope may include placement of earthfill and constructing earthen embankments which may include earthen slopes, berms, backfills, and other earthfill sections as required by the project drawings and specifications.

Earthfill is composed of natural granular earth materials using the specified soil types defined in the specifications to facilitate placement and compaction using construction equipment and operated in a conventional manner.

Earth backfill is composed of the same type and classification of natural granular earth material placed and compacted in confined spaces or adjacent to structures (including pipe trenches) by hand tamping, manually directed mechanical power tampers, or vibrating plates, or their equivalent.

2. Borrow Material

For all borrow material proposed for use to perform earthfill construction shall be obtained from permitted and legally authorized borrow areas permitted by the NC Division of Energy, Minerals, and Land Resources (NCDEMLR). Any proposed borrow pit must be permitted and in good standing with the NCDEMLR. A copy of the borrow pit permit shall be included in the submittal of the Borrow Material Plan. The contractor shall prepare and submit a Borrow Material Plan at least 10 days prior to commencement of construction. The Borrow Material Plan shall also identify the geotechnical testing regime proposed to qualify the material as an acceptable fill source, and the location of any proposed borrow pit location.

Geotechnical laboratory testing of any proposed earthfill material source shall be performed by the contractor to pre-qualify the material for use on EWP projects. The geotechnical tests results shall be submitted to the Sponsor at least 10 days prior to commencement of earthfill placement on any site. The selection, blending, augmentation, and use of any earthfill material that deviates from those materials specified as acceptable fill sources in these Plans & Specifications, will not be permitted without the written consent by the Sponsor. Geotechnical testing and construction of test strips for the purpose of evaluating the field performance of any proposed materials, will be required at the discretion of the Sponsor.

Prior to commencement of construction, and prior to placement of earthfill on any project site, the contractor shall collect bulk samples of each proposed borrow material, from each proposed borrow pit, and submit to a certified and licensed geotechnical testing laboratory. The contractor shall perform a series of geotechnical tests on each soil type proposed including maximum dry density (Standard Proctor), gradation analysis, optimum moisture content, Wash No. 200, and Atterberg Limits, (see details below). These tests will assure that proposed borrow sources conform with the contract specifications for acceptable earthfill soil types.

The contractor shall submit a Borrow Material Plan identifying the testing regime proposed to qualify the material as an acceptable fill source. The Borrow Material Plan shall include each proposed borrow pit location, owner's name, GPS coordinates for the pit, and a copy of the NCDEMLR permit. Unless all borrow material located at the proposed borrow pit is homogenous, geotechnical soil samples should be collected for **each different soil type** and tested as shown below. The below geotechnical tests shall be specified in the Borrow Material Plan in order to qualify each proposed material type for use under this contract. At a minimum, at least one test specified by each below test method will be required for each proposed material type, and shall be performed as follows:

- Gradation by ASTM D-422
- Standard Proctor by ASTM D-698
- Moisture Content by ASTM D-2216
- Liquid Limits/PL/PI by ASTM D-4318
- Soil Classification by ASTM D- 2488/2487

As stated in the Plans & Specifications, the only soil types approved for earthfill are those soil types listed and described in the specifications and include: clean SC-SM, SC, SM, CL, and CL-ML soils (per the Unified Soil Classification System). The Sponsor reserves the right to require more soil tests than one per soil type if it is determined to be

warranted. The Sponsor also reserves the right dis-allow the contractor's use of any proposed borrow material or borrow source, if justified.

Earthfill material used for slope building and construction purposes shall not contain organic or fat clay soils, organic matter, debris, wood, vegetation, sod, clay clods, brush, roots, refuse, metal, rock, gravel, or perishable materials. Rock particles larger than 1/8" diameter size in the matrix of each type of specified fill for use shall be screened or otherwise removed prior to compaction of the fill. The contractor's Borrow Material Plan shall identify the testing regime used to qualify the material as an acceptable fill source, the proposed laboratory for performing the test, the laboratory's certifications, and the proposed borrow pit locations.

The types of material for use in the various earthfills shall be those soil types listed and described in the specifications and drawings including: clean SC-SM, SM, SC, CL, and CL-ML, soils (per the Unified Soil Classification System). The contractor shall also identify the geotechnical testing firm proposed for performing onsite testing of moisture, density, and soil classification of in-bound borrow material. The test measures proposed for onsite soil moisture and density must be identified in the Borrow Material Plan. The field personnel performing the Quality Control testing must demonstrate at least 3 years of expertise performing soil density, soil moisture, and soil classification.

3. Foundation Preparation

The foundation sub-base for earthfill shall be stripped, raked, or excavated to remove organic materials, vegetation, roots, root mat, rubble, debris, unsuitable soils, fat clay, and other unsuitable or any foreign materials to a depth of 1.0 ft. below existing grade.

Except as otherwise specified, each earthfill lift surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored, scarified, or loosened to a minimum depth of 0.5 ft. below existing. The moisture content of the loosened soil-material shall be controlled in the same manner specified for earthfill and to the same moisture specification. The surface material of the foundation shall be compacted and bonded with the first layer of earthfill as specified, and for all subsequent layers of earthfill.

Test pits, borings, or exploratory excavations shall be filled with compacted earthfill conforming to the specifications for the earthfill to be placed upon the foundation.

3.1 Geogrid Underlayment

Each EWP project site where there is an adjacent waterbody or channel, particularly those portions in close proximity to the US Army Corps or CAMA High Water Mark (HWM), may be comprised of inferior sub-base soils or hydraulic conditions that inhibit achieving the specified density requirement. This may include wet, saturated, or poor soil quality that is not conducive for achieving specified soil densification. To improve these conditions, a triaxial geogrid is required for underlaying the first earthfill lift of imported suitable fill, or on cut slopes or fills that **will not** be provided with other specified underlayments that are a component of a composite mat system such as Flexamat, or other RTCBM equivalent system.

Once the foundation sub-base has been removed of organics, root mats, and other materials stated in Section 3. Foundation Preparation above, the first earthfill lift placed on top of native sub-base soils is required to be underlain by a single-ply layer of high tensile strength triaxial geogrid on top of the sub-base soils. This measure is necessary to provide stability of sub-base soils in order to achieve proper compaction of the initial earthfill lift. The width of the triaxial grid placed horizontally across the top of the sub-base soil foundation and shall be the full width of the first placed/compacted lift running approximately from the Toe-of-Fill to the face-cut of the eroded slope. All exposed upper surface of the sub-base soil foundation, shall be covered with a single layer of triaxial geogrid comprised of a manufactured punched polypropylene grid oriented in multiple equilateral directions, forming triangular apertures. The triaxial geogrid is designed to provide enhanced in-plane high radial stiffness and creates a "snowshoe effect" by spreading the surface load over a wider area of the subgrade. The triaxial geogrid will produce an improved foundation and will enable subsequent lifts of earthfill to attain specified compaction standards. There are a variety of acceptable geogrid products available such as the TENSAR®TRI-AX®TX130S Geogrid. Approved equivalents, are also acceptable for use as an underlayment for slope repair/rehabilitation projects. The contractor should submit a cut-sheet and product specification for approval by the Sponsor for any geogrid material proposed for use on sub-base soils.

Geogrid such as TENSAR®TRI-AX®TX130S Geogrid will not be required on cut or filled earth foundations when other underlayments have been specified as part of a component to a RTCBM system.

4. Placement of Earthfill

Earthfill operations shall not commence until the required sub-base and foundation soils have been properly prepared, compacted/densified, and tested to receive overlying lifts of earthfill. When the sub-base and foundation soils are ready for receiving earthfill, the Sponsor must be contacted to inspect and approve the foundation sub-base. Earthfill shall not be placed upon organic soils, or soils incorporated with vegetation, wood, roots, limbs, debris, sticks, or stumps, rock, or rubble in the sub-base matrix.

Earthfill sections shall be placed in uniform horizontal layers using only approved specified soils. The thickness of each lift before compaction shall not exceed the 9.0 inch maximum thickness specification. Earthfill placed by dumping in piles or windrows shall be spread uniformly across the horizontal fill-section to no more than the 9.0 inch specified thickness before compaction operations commence.

Areas requiring hand compacted earthfill shall be placed in layers not to exceed the specified thickness before compaction. The maximum thickness of 9.0 inches is also specified for layers of earthfill compacted by manual mechanical machinery such as power, vibratory, and plate tampers. If field observation and/or geotechnical testing determines that the specified lift thickness is too thick to enable the compaction specification to be achieved, then the contractor will be required to reduce the thickness in order to attain acceptable compaction.

Earth backfill shall be placed in a manner that prevents damage to any structures, including houses, out buildings, bulkheads, seawalls, walkways, driveways and any other harden structure located on the project sites. The earthfill shall be placed in a manner that allows such structures to assume the load and pressures exerted from the earthfill in a gradual and uniform manner. The height of the earth backfill adjacent to a structure shall be increased at an equal incremental rate on all sides of the structure.

5. Control of Moisture Content

During placement and compaction of earthfill, or on graded earthen surfaces receiving an overlay of a RTCBM system, the moisture content of the material being placed shall be maintained and continuously tested to assure the material is within the specified moisture content range.

The application of water to the earthfill material shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the material after placement on the earthfill, if necessary. Uniform moisture distribution shall be obtained by disking in cases where moisture content is too high.

Stockpiled and surplus soil material should remain covered at all times until need for placement to minimize rapid changes in moisture content. Whether located at the borrow pit or the project site, material that is too wet (>1.5% over Optimum Moisture) shall not be placed onsite, or used in any active lift section, or used for any purpose in the slope repairs process until the material is altered to reduce the moisture content within the acceptable range. Any material that is determined by the Sponsors inspector to exceed 1.5% of the Optimum Moisture Content or by field testing methods will either be rejected upon delivery to the site or if already placed into a lift, removed from the lift and discarded, until the material is dried to the specified moisture content. Stockpiled earthfill material, whether onsite or at the borrow pit, shall be covered nightly to prevent rainfall from impacting the natural moisture content of the earthfill. Earthfill excavated at the borrow pit, should be not transported directly to the project site for placement, without some degree of drying using stockpiles, tilling, or windrowing. Wet/saturated earthfill material delivered to the project site without proper drying will be rejected by the Sponsor's construction inspectors.

In the event that earthfill soils placed on the top surface of the sub-base foundation, or a compacted earthfill lift, or graded/cut earth surface that will receive a RTCBM system becomes too dry to permit a suitable bond or achieve the compaction specification, it shall be removed, or scarified/moistened by sprinkling to achieve an acceptable moisture content before placement of the next overlying lift of earthfill. Stockpiled soils proposed for use on any EWP project site, whether onsite or offsite, should be covered each night to prevent excessive moisture infiltration.

6. Compaction

Earthfill surfaces whether placed in lifts, or caused by cutting or grading of onsite soil surfaces shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction—Each layer of earthfill (or a cut surface comprised of existing suitable onsite soils) shall be compacted as necessary to provide the density of the earthfill matrix not less than the minimum of 91% Maximum Dry Density (MDD) for all approved earthfill material, or cut/graded surfaces, used in the slope re-building process. Any density determined to exceed this standard by acceptable specified testing methods will be allowed, but in no case, less than 91% MDD. The earthfill matrix is defined as the portion of the earthfill material finer than the maximum particle size allowed in the reference compaction test method specified (ASTM D-698 or ASTM D-1557). Deviations to lift thickness, soil material types, moisture, or the compaction density specification cited in these Plans will not be accepted by the Sponsor.

Earth backfill—Earth backfill adjacent to structures shall be compacted to a density equivalent to that of the surrounding in-place earth material or adjacent required earthfill or earth backfill. Compaction shall be accomplished by hand tamping or manually directed power tampers, plate vibrators, walk-behind, miniature, or self-propelled rollers. Unless otherwise specified heavy equipment including backhoe mounted power tampers or vibrating compactors and manually directed vibrating rollers shall not be operated within 3 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist is not permitted.

7. Failures, Reworking, Removal, and Replacement of Defective Earthfill

Any earthfill section whether graded, cut, or filled, or area placed, either too wet, too dry, too loose, or over-compacted or using soil types that are not approved and specified in these construction specifications will be deemed “non-suitable” and will be required to be remedied. Only earthfill types that have been approved by the Sponsor for use, and specified in these Plans & Specifications are acceptable. Soil that is placed in lifts, or graded earth surfaces serving as foundation soils that result in densities lower than the specified minimum density or at moisture contents deviating from the specified acceptable range, or not conforming to other project specifications, shall be reworked to meet the minimum requirements OR shall be removed and replaced by acceptable fill as determined by the Sponsor or the CFR. Replacement earthfill for foundation soils, and other earthfill surfaces shall conform to all requirements of this specification including preparation, placement, moisture control, compaction, thickness, and grade.

8. Testing

During the course of the earthfill work, the contractor shall perform daily geotechnical testing and record the results in a Daily Log. The Daily Log shall identify types of earthfill and volume of earthfill materials used; the maximum dry density, and optimum moisture content in multiple locations for each completed earthfill lift; and document that each lift conforms to the thickness, testing requirements, and construction specifications stated in this document. All areas tested must be identified on a scaled Site Map showing the lift number, test location, the moisture/density result, and whether the test location passed or failed the project specifications. The Sponsor’s representative must be notified immediately of any failures and the contractor must identify the immediate proposed measures for remedy. A project log (Failure Log) listing the running tally of each failure shall be recorded and maintained by the contractor on a separate sheet for each EWP project site. Failures will be denoted by lift number, failure number, and location including GPS coordinates, and elevation and shall be sufficient to locate each failure. Each failure must be recorded and described with the locations of the failure such as: (ex. Lift 1-F1, 34.7864/77.5638; Lift-2-F4, 34.7854/77.5772, etc).

Determining Reference Maximum Dry Density and Optimum Moisture Content—For Class A compaction, the reference maximum density and optimum moisture content shall be determined in accordance with the compaction test and method specified below.

Documenting Specification Conformance—In-place densities of earthfill and earth backfill requiring Class A compaction shall be measured in accordance with ASTM D1556, D2167, D2937, or D6938. Moisture contents of earthfill and earth backfill at the time of compaction shall be measured in accordance with ASTM D2216, D4643, or D6938. Values of moisture content determined by ASTM D2216 are considered the true value of the soil moisture.

Values of moisture content determined by ASTM D4643 or D6938 shall be verified by comparison to values obtained by ASTM D2216.

For field testing purposes to determine compaction and soil moisture content, the use of nuclear density gauges such as a Troxler or Humbolt are acceptable for this project. The instrument and operator must be properly licensed and certified in Nuclear Density Testing. The instrument must be calibrated daily, and a Daily Calibration Log maintained. All nuclear density test results submitted to the Sponsor shall be supported with calibration logs for the period the gauge was in use.

Values of in-place density and moisture content determined by the above tests shall be compared to the minimum density and moisture content range specified in these Plans & Specifications or on the construction drawings.

A Standard Proctor laboratory test must be performed for **every** earthfill soil type that is proposed for use. In the event that a change occurs in the inbound soils coming from the Borrow Pit, and/or density failures occur, the contractor must discontinue use of that particular soil type for earthfill purposes until a Standard Proctor test can be performed on that soil type to qualify the “new” soil as a suitable fill source. It is the contractor’s responsibility to assure the inbound soils arriving at the construction site meets the geotechnical specifications for: soil type; moisture, and quality of soil (free from organics/debris). Any material rejected by the Sponsor shall be immediately removed from the project site, transported, and disposed at a permitted facility offsite. The location of any soil disposed must be documented by the contractor and reported/communicated to the Sponsor daily in written form or memorandum.

Correction for Oversize Particles—If the materials to be used for earthfill or earth backfill contain more than 5 percent by dry weight of oversize rock particles (particles larger than those allowed in the specified compaction test and method), corrections for oversize particles shall be made using the appropriate procedures explained in ASTM D4718.

The frequency of testing compaction and soil moisture as each earthfill lift is being constructed will be determined by the Sponsor prior to construction. At a minimum, two moisture and compaction tests each will be performed by the contractor for each lift, or each new soil surface every 500 square feet (Area=10ft. X 50ft.). If the testing frequency is modified by the Sponsor, the contractor will be notified prior to construction. The frequency and number of tests may change during the construction process. The Sponsor will observe construction and determine if the frequency and number of tests specified in this section should be modified based on field conditions.

9. Groundwater

Groundwater control or dewatering is not anticipated during placement of earthfill operations, or during excavation/cut of site soils on these projects. No sub-grade excavation is proposed at elevations lower than the normal water levels of the adjacent watercourses shown in the Plan Sheet drawings for each project. However, any groundwater that the contractor deems necessary for removal or control, shall be the responsibility of the contractor, and shall be performed by the methods selected by the contractor, and approved by the Sponsor. Any costs for groundwater control shall be the contractor’s responsibility and incorporated into the Bid Schedule in the Bid Item that includes earthfill, excavation, and earthwork operations.

10. Measurement and Payment

For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill and earth backfill within the specified zone boundaries and pay limits is measured and computed to the nearest cubic yard upon the entry of haul trucks into the construction sites, where Sponsor inspectors will perform volume estimates of the material entering in each delivered truck. Each truck load of earthfill material delivered to the sites will be provided with an inspectors certification that is signed and dated. Claims for payment of earthfill by the contractor without these Sponsor signed inspection-ticket certifications will not be granted.

The pay limits shall be further defined below, with the provision that earthfill required to fill voids resulting from over-excavation of the foundation, outside the specified lines and grades, or limits will be included in the measurement for payment **ONLY** when both of the following two conditions are met:

- (1) Where such over-excavation is directed by the Sponsor or NRCS engineer to remove unsuitable material, and

(2) the unsuitable condition in # 1 above is not a result of the contractor's improper construction or excavation operations as determined by the Sponsor or onsite engineering representative.

Payment for earthfill will be performed in accordance with the following method:

Method 1—The pay limits shall be based on the measured volume of delivered earthfill material in cubic yards (CYS), as verified by the Sponsors site inspectors upon delivery to the site. All earthfill delivered must be verified by the Sponsors inspectors and supported with signed certification tickets documenting the material type, truck number, time/date of delivery, driver name, and measurement/estimated volume of earthfill delivered to the site. All the required information referenced above will be necessary to assure payment for earthfill material.

11. Scope of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

Bid Item #3: Earthfill

- (1) Section 2: Material suitable for earthfill shall be those noted in these construction specifications.
- (2) Section 3: Abutment surfaces may be steeper than 1 horizontal to 1 vertical and as determined by site conditions or noted in construction drawings.
- (3) Section 4: The maximum thickness of each uncompacted granular soil lift shall not exceed 9.0 inches. The finished or completed surface (top) of the compacted berm or slope shall be 1.5H horizontal to 1V vertical as noted in construction drawings.
- (4) Section 5: Soil moisture content shall be monitored throughout the earthfill and construction process in the field by contractor using a properly calibrated Nuclear Density gauge, Sand Cone Test by ASTM D 1556, or by other methods approved by the Sponsor or its representative prior to commencement of construction: moisture content for all lifts placed and for all stockpiled soils proposed for earthfill use shall be maintained at the Optimum Moisture Content (plus or minus 1.5%).
- (4) Section 6: Class A compaction—Each layer of earthfill shall be compacted as necessary to provide the density of the earthfill matrix not less than the density specified in these Plans which is 91% MDD. The earthfill matrix is defined as the portion of the earthfill material finer than the maximum particle size allowed in the reference compaction test method specified (ASTM D-698 or ASTM D-1557). This includes graded/cut sub-base soils beneath the RTCBM.
- (5) Section 8: Testing: The frequency of testing soil compaction and soil moisture for each earthfill lift, or any cut/graded surface or sub-base specified to receive a RTCBM system, will be determined by the Sponsor prior to construction. At a minimum, two soil moisture and compaction tests each will be performed by the contractor for each lift, or graded/cut sub-base soil layer beneath a RTCBM every 500 square feet (Area=50' X 10'). If the specified testing frequency is modified, the contractor will be notified by the Sponsor. The frequency and number of tests may change during the construction process, more or less. The Sponsor will observe construction and determine if the frequency and number of tests specified in this section should be modified based on observed field conditions once construction has commenced.
- (6) Section 9: Measurement and payment for earthfill will be made using Method 1 (cited above) and shall be at the contract unit rate prices based on the number of certified cubic yards (CYS) of approved earthfill placed and compacted.

12. Relocation of Existing Rip Rap

Existing rip rap materials may present on the EWP project areas from previous failed repair attempts. Existing rip rap is comprised of a variety of ranges that grade from cobble size to as great as boulder size. Existing rip rap shall be removed from existing earthfill that will be recovered and re-used from grading operations. Recoverable rip-rap shall be

moved by the contractor to elevations on the site greater than the US Army Corps of Engineers mean high water mark (HWM) prior to performing any clearing or grubbing activity. Rip rap **shall not** be removed from any CAMA Area of Environmental Concern (AEC) or any US Army Corps Section 404/401 State/Federal jurisdictional waters or lands, from below the HWM, or any area governed by any other State, Federal or Local regulation. Any jurisdictional wetland governed by State or Federal regulations shall not be entered or altered by the contractor for any reason, or for the purpose of recovering displaced rip rap or while placing proposed rip-rap aprons adjacent to waterways. No activities that constitute dredging and/or filling as defined the US Army Corps of Engineers shall be undertaken by the contractor in any waters, or upon any lands, governed by the State of North Carolina or US Army Corps of Engineers. No contractor owned or rented equipment shall enter upon or operate from or within the waters of the Northeast Cape Fear River, Horse Creek Branch, or any other State or Federal waters encountered, or at an elevation waterward of the HWM denoted in the attached Plan Sheets. Existing re-covered rip-rap material may be temporarily relocated on a Sponsor approved upland lay-down area until the finished 1.5H:1V slope repair is completed. Rip-rap may then be re-positioned to its final location at the toe of the finished 1.5H:1V repaired slope, or on adjacent slopes approved by the Project Engineer, but at no time may be placed below the US Army Corps or CAMA mean HWM.

13. Installation of Tied Re-enforced Concrete Block Mat (TRCBM) aka-Flexamat™ or Equivalent Mats

Items of work to be performed in this section shall be in conformance with this specification and other construction details shown in the Plan drawings identified as generally as Sheets 1 through 10, but may vary. These details cover the locations and details for installing the Flexamat™ PLUS slope protection erosion control blanket (ECB), or an approved equivalent TRCBM. The type, alignment, length, width, beginning and end points, and proximity of the Flexamat™ PLUS, or approved equivalent in relation to existing eroded slope faces are also shown on the attached referenced plan sheets. No deviations to the proposed construction method including: the alignment, width, elevation, material type, proximity to existing cut slope, and length of system should occur from the details shown in these plans without written consent from the Sponsor. The Flexamat™ PLUS, or approved equivalent will be incorporated in the repair, regrading, and re-construction of channel slopes graded to 1.5H:1V on each repair site identified in these plans.

Details and specifications for constructing the Flexamat™ PLUS, or an approved equivalent TRCBM follows:

13.1 Design Rationale for Flexamat™ TRCBM

The design rationale for incorporating Flexamat™ PLUS into the repair of Site DSR-494 was multi-dimensional. There are many factors that contributed to the design outcome indicating Flexamat™ PLUS as the most viable option for slope repairs planned to occur at DSR-494. Some of the factors considered in the design process included:

- USDA/NRCS project goals for EWP projects funded under the Stafford Act
- Pender County Planning Department derived goals
- Regulatory requirements
- Safety
- Construction challenges/impediments
- Cost efficiency of the repair method
- Vulnerability of the repair site
- Urgency for completing repair work
- Access/ingress/egress into the repair site
- Immediate threat to property and/or life
- Long term threat to property and/or life

The DSR-494 Holly Shelter NC Wildlife Depot was evaluated with consideration given to the above criteria. The DSR field assessments characterized the type and degree of damages that occurred to each candidate site. Of the sites evaluated in Pender County, the sites covered by the plans were among those deemed to be the most vulnerable in terms of imminent threat to property, structures, or loss of life. The principle repair remedy considered for all repair sites damaged by Hurricane Florence has consisted of backfilling eroded streambanks with suitable compacted earthfill material to re-establish pre-storm slope and elevation. In cases it is necessary to provide an additional armor measure such rip-rap, ECBs, and/or rigid matting systems. Due to the vulnerability of the slope section between STA 130+00

and STA 70+0 at the DSR-494 site, the Flexamat™ PLUS alternative was considered the best alternative for enhancing streambank protection on this exceptionally vulnerable site.

Flexamat™ PLUS and other types of ECB's were among several alternatives considered for augmenting earthfill replacement of the eroded slope section at this site. This alternative is an environmentally compatible (Bio-engineered) and cost effective solution that is adaptable for incorporating into the principle repair method. The Flexamat™ PLUS system conforms to site conditions readily and can be configured to meet the array of site variables and unique site conditions inherent to the site. The Flexamat™ PLUS system provides enhanced slope protection and will supplement the function of the compacted underlying compacted earth sub-base used to repair the damaged slope. The Flexamat™ PLUS system alternative is considered a "soft armor system" rather than a harden structure such as sheet piling, wooden bulkhead, rock rip-rap revetment, concrete, or vinyl retaining wall. This design approach not only achieves the Sponsor's goals and objectives, but also meets applicable State/Federal regulatory requirements. The site was selected for use of Flexamat™ PLUS because it is considered to be a highly vulnerable site with the great propensity for loss of property, structures, and/or life.

13.2 Flexamat™ PLUS Mat Size/Dimensions (or Equivalent)

Refer to project plans, details, and specifications found in the Plans & Specifications and Appendix I.

13.3 Flexamat™ PLUS General Specifications (or Equivalent)

Refer to project plans, details, and specifications found in the Plans & Specifications and Appendix I.

13.4 Flexamat™ PLUS Orientation (or Equivalent)

Refer to project plans, details, and specifications found in the Plans & Specifications and Appendix I.

13.5 Placement of Flexamat™ PLUS (or Equivalent)

Refer to project plans, details, and specifications found in the Plans & Specifications and Appendix I.

13.6 Location/Alignment of Flexamat™ PLUS or Class I Rip-Rap Armor Systems

Refer to project plans, details, and specifications found in the Plans & Specifications and Appendix I.

The location and alignment of the Flexamat™ PLUS sections identified in the plan set drawings for DSR-494 show the approximate location of the Flexamat™ PLUS alignments and associated station (STA) locations. Cross-section (XS) drawings are also provided for site locations and depict approximate corresponding elevations. The contractor will be responsible for field stake-out of the Flexamat™ PLUS locations and alignment. The site shall be clearly staked and marked by the contractor. The contractor must take all precautions to prevent the Flexamat™ PLUS alignments and the construction process, from encroaching on or upon the CAMA HWM, or adjacent properties. The stake-out alignment and elevations established by the contractor must be inspected and approved by Sponsor prior to contractor proceeding with installation. Note that some site conditions may have changed since the time of site surveying and preparation of these Plans & Specification. The Sponsor will assist the contractor in making field determinations for each Flexamat™ PLUS panel alignment location. Field adjustments may be necessary to establish the final proposed Flexamat™ PLUS locations, length, and configuration for the site prior to construction. Approximately 60 LF of Flexamat™ PLUS will be installed from the crest of the slope to the toe of the slope at STA 130+00 to STA 70+00. The general width of the Flexamat™ PLUS RTCBM across the face of the slope is approximately 50 LF. See the below table for the general location of placement of Flexamat™ PLUS RTCBM or NCDOT Class I Rip Rap on each of the two applicable sites that will be repaired.

Location/Details for Flexamat™ PLUS ECB or Class I Rip-Rap Armor Systems (1)

DSR Number	Site Name	Owner	Proposed Armor Type	Station Locations For Repair (2)	Approx. Flexamat or RipRap Length	Approx. Elevation of Armor Alignment
5038-494-	Holly Shelter	NC Wildlife Commission	Flexamat™ ECB	STA 130+00 to STA 70+00	60 LF	0.00 to 31.75
5038-489	Lake Road	R. Dayhuff	Class I Rip-Rap	STA 20+00 to STA 120+00	100 LF	0.00 to 13.0 ft.

1. The qty of material for each site listed above is an estimate only. The Sponsor may modify the length, width, alignment, or configuration of armor due to current onsite field conditions at each site.

2. The contractor must perform a stake-out of the proposed locations for armor types specified at each site listed above. The contractor must obtain Sponsor written approval of the proposed staked-out or armor systems prior to construction.

13.7 Foundation Preparation for Flexamat™ PLUS ECB or Class I Rip-Rap Armor

Refer to project plans, details, and specifications found in the Plans & Specifications and Appendix I.

The sub-base foundation soils shall be prepared in the same manner specified in Section 3. Foundation Preparation, Section 3.1 Geogrid Underlayment, and Section 6. Compaction. Triaxial Geogrid will underlie the width of the proposed armor system on sites where specified (DSR-489 only). The footprint occupied by the Class I Rip- Rap is approximately 21.0 LF Wide X 100.0 LF Long. A single ply layer of Tri-axial Geogrid will be placed beneath the Rip-Rap such that it exceeds the base footprint by a minimum of 2.0 ft. on each side of the sandbags long axis. The proposed coffer dam that will constructed at the toe of slope at DSR-489 will not be required to be underlain by Geogrid, however a layer of non-woven geotextile will be required.

13.7.1 Anchor Trenches

For installation of armor matting on sites where Flexamat™ PLUS is used, an anchor trench shall be excavated in the site foundation soils to accommodate burial and placement of the RTCBM's leading and tailing edge into an 18" deep shallow trench. The anchor trench should extend the horizontal length (width) of the RTCBM crest and toe alignment from the beginning point to the end point of each designated station location shown in the following table. The trench shall be at least the 12" wide and a depth of 18" below existing grade. The 4-Layer underlayment mat should encompass the entire footprint of the Flexamat™ PLUS mat footprint and extend at least 1.0 ft. greater than the footprint of the mat base in all directions.

On the DSR-489 site where Class I Rip-Rap will be used to armor damaged slopes, anchor trenches will be needed only to accommodate installation of non-woven geotextile fabric beneath the rip-rap armor. Trenching will be conducted in the same manner as described above. Refer to Plans & specifications for each DSR showing details for the trench installations.

13.7.2 Underdrains

Underdrains are not anticipated or required for earthworks and repairs on either DSR 494 or DSR-489.

13.8 9 ft. Cross Plate Percussion Anchors and 18" U-Anchors for Securing Flexamat™ PLUS TRCBM

For proposed repairs using anchors that will be performed at DSR-494/Wildlife Resource Commission Depot, refer to project plans, details, and specifications found in the Plans & Specifications and Appendix I. Two different types of anchors will be used to secure the Flexamat™ PLUS RTCBM to the sub-surface compacted soils.

Percussion Anchors-TL6CRS-TLA4-9FT-6MM will be used to secure the perimeter of the RTCBM, each overlapping longitudinal panel seam, and along the mid-point (mid-panel) between each longitudinal panel seam panel. These cross-plate percussion anchors will be embedded to -9 ft. below the compacted subsurface soil surface. These anchors will be spaced 8.0 ft on-center (OC) as shown in Sheets 8 and 9 of the Plans & Specifications. These cross plate percussion anchors will be installed by using Flexamat specified roto-hammer drill tooling and rods designed solely for this installation, and by the methods specified in the Flexamat Installation Guidelines in Appendix I of these Plans. Any other tooling or methods proposed by the contractor that deviate with this specification will require approval by the Ardurra Project Engineer.

18" U-Anchors comprised of No. 3 Rebar, 18" long will be used space at 2.0ft. OC along panel seams between the 9ft. percussion anchors. The 18" U-Anchors will be spaced at 2.0ft OC running in the longitudinal direct such that three U-Anchors will be installed between each set of 9ft. percussion anchor to pin the TRCBM to underlying soils. See Appendix I for anchor specifications and Plan Sheets 7, 8, and 9 for anchor installation details .

13.9 Final Cover Over Flexamat™ PLUS

No final cover will be applied over the Flexamat™ PLUS matting. A vegetative groundcover per the Seeding/Mulching specifications twill be installed on the graded/cut compacted slope surface prior to deployment of the Flexamat™ PLUS TRCBM system and on each adjacent slope on each side of the TRBCM system A standing vegetative groundcover must be established in this manner by providing the specified seed/mulch application rates beneath the Flexamat™ PLUS layer; this will enable germination to take place below the mat surface. Vegetation will grow upward through the re-enforced tied-concrete blocks and biaxial geogrid matting overlying the prepared/compacted earthen surface below the TRCBM. The vegetation root mat growing up through the rigid biaxial matting will provide additional support to secure the TRBCM system in place. Mowing can then be performed across the vegetated surface of the RTCBM once the groundcovers is fully established.

13.10 General Pre-Construction Notes for Installing Flexamat™ PLUS or Class I Rip-Rap Armor

The proposed alignment and locations of any site or area receiving Flexamat™ PLUS or Class I Rip-Rap Armor shall be staked in the field by the contractor prior to construction. The proposed staked locations will be inspected and approved by the Sponsor of the CFR prior to the contractor commencing installation of armor on any sites. Sites designated to receive Flexamat™ PLUS ECB or Class I Rip-Rap armor may require field adjustments for alignment, length, and elevation to be approved by the Sponsor of CFR. Field adjustments to any mat or armor alignment by the contractor, regardless of how small, must be coordinated with the Sponsor's field inspector (CFR) and approved prior to making any such adjustment. For any discrepancy of field conditions found by the contractor to be in deviation with these Plans & Specifications, the contractor must notify the Sponsor immediately before proceeding with any further repair work related to earthfill conditions, installing grade, elevation, or location/position of the TRCBM.

13.11 Changes in Site Conditions

Recent site visits by the Sponsor indicate that some changes in site conditions with respect to slope angle and degree of erosion, may have occurred at each of the two project locations since the time the DSRs were prepared by NRCS. During preparation of these Plans & Specifications and after Ardurra performed initial site reconnaissance, some site conditions appear to have changed. For both sites, DSR No. 494 and DSR. No. 489 bank erosion may have increased.

Adjustments in the field may be necessary with respect to the alignment, length, width, or configuration of the Flexamat™ PLUS RTCBM or to rip-rap alignments for projects shown in Cross Sections. Prior to the contractor commencing construction, the Sponsor and their CFR will conduct a site walk for each DSR project site and provide

direction concerning site changes noted which may potentially affect the proposed construction methods. The Contractor shall perform pre-and post elevation surveys to memorialize site conditions immediately prior to, and after completed construction, and for use to determine quantities in Measure and Payment. The surveys must be sealed by a North Carolina Professional Engineer (PE).

Construction Specification 94—Contractor Quality Control

1. Scope

The work consists of developing, implementing, and maintaining a quality control system to ensure that the specified quality standards are achieved in a safe and effective manner that conforms with the materials and work scope identified in these Plans & Specifications performed.

2. Equipment and Materials

Equipment and material used for quality control shall be of the quality and condition required to meet the test specifications cited in the contract. Testing equipment shall be properly adjusted and calibrated at the start of operations and the calibration maintained at the frequency specified. Records of equipment calibration tests shall be available to the Sponsor at all times. Equipment shall be operated and maintained by qualified operators as prescribed in the manufacturer's operating instructions, the references specified, and as specified in Section 12 of this specification. All equipment and materials used in performing quality control testing shall be as prescribed by the test standards referenced in the contract in Construction Specification 23-Earthfill.

All equipment and materials shall be handled and operated in a safe and proper manner and shall comply with all applicable regulations pertaining to their use, operation, handling, storage, and transportation.

3. Quality Control System

Method—The contractor shall develop, implement, and maintain a system adequate to achieve the specified quality of all work performed, material incorporated, and equipment furnished before use. The system established shall be documented in a written Quality Control Plan developed by the contractor and approved by the contracting officer. The system activities shall include the material testing and inspection needed to verify the adequacy of completed work and procedures to be followed when corrective action is required. Daily records to substantiate the conduct of the system shall be maintained by the contractor. The Quality Control Plan shall cover all aspects of quality control and shall address, as a minimum, all specified testing and inspection requirements. The plan provided shall be consistent with the planned performance in the contractor's approved construction schedule. The plan shall identify the contractor's onsite Quality Control Manager and provide an organizational listing of all quality control personnel and their specific duties. The written plan shall be submitted to the Sponsor within 10 calendar days after notice of award. The contractor shall not proceed with any construction activity that requires inspection until the written plan is approved by the Sponsor.

The quality control system shall include, but not be limited to, a rigorous examination of construction material, processes, and operation, including testing of material and examination of manufacturer's certifications as required, to verify that work meets contract requirements and is performed in a competent manner.

4. Quality Control Personnel

Method—Quality control activities shall be performed by competent personnel employed by the contractor. A competent person is: One who is experienced and capable of identifying, evaluating, and documenting that materials and processes being used will result in work that complies with the contract, and holds relevant certifications and training for their respective types of testing; and, who has authority to take prompt action to remove, replace, or correct such work or products not in compliance. Off-site geotechnical testing laboratories shall be certified or inspected by a State and/or nationally recognized certifying entity. The Contractor shall submit to the Sponsor, for approval, laboratory certification or inspection documentation to demonstrate that the proposed testing laboratory is duly certified to perform materials testing services. The Contractor shall submit to the Sponsor, for approval, the names, qualifications, statement of authority, certifications, training results, and availability of the competent personnel who will perform the quality control activities.

5. Health & Safety/OSHA

5.1 Health & Safety

The contractor shall prepare a Health & Safety Plan (HASP) describing all measures that will be implemented on EWP projects to ensure worker health and safety. The HASP shall describe the minimum needed protective clothing, gear, and wares (i.e. hand protection, hearing protection, head protection, clothing, eye protection, etc.) and other protective outfitting needed by workers while undertaking specific tasks onsite. The HASP shall identify each critical work task that is anticipated by the contractor to be conducted on each work site, the equipment to be used, and the safety/risk management measures that will be implemented by the contractor to prevent accident or injury to workers.

The HASP shall be reviewed and acknowledged by signatures from all employees of the contractor, subcontractors, vendors, and any other entity or person that will work or enter onto these construction sites on behalf of the contractor. Any person entering upon the work site **must** review the HASP and sign off with their acknowledgement and understanding of its content. The proposed HASP must be submitted to the Sponsor for review and approval, at least 10 days prior to mobilization or commencement of work on any site. The contractor shall include provisions in the HASP for conducting mandatory daily tailgate safety meetings prior to beginning work each day. The safety meetings shall be conducted by a qualified contractor designated Health & Safety Officer (HSO). The contractor shall identify their designated HSO who will be onsite and in responsible-charge of Health & Safety each day of work. All employees, subcontractors, vendors, or any other party present onsite on behalf of the contractor shall attend the H&S safety meeting each day, or received a safety briefing before entering the site. The daily safety meetings shall be documented by written record with a signature by every person attending including meeting start and stop time, and topic/points discussed. A Sponsor representative shall also be in attendance at each daily safety tailgate meeting. A copy of the meeting attendees list shall be provided to the Sponsor daily. The contractor shall keep a copy of the HASP onsite for review for the duration of each project. The contractor shall make the plan available for review (and written acknowledgment) for anyone entering the site.

5.2 OSHA Compliance

The contractor is required to perform all work activities in compliance with all OSHA standards and provisions in order to provide and maintain safe working conditions for all workers at all times on each EWP site. Contractors shall perform their work in accordance with OSHA regulations, and the Contract Work Hours and Safety Standards Act (40USC 327-330) as supplemented by Department of Labor Regulations cited in Title 29 CFR Part 5. Any work to be conducted on any site that is governed under Title 29 CFR 1926, Subpart P, Appendix A pertaining to Selection of Protective Systems; Sloping; Shoring; and Benching rules and regulations including OSHA 1926.652, Subpart P, Excavations (a) through 1926.652(g) shall be identified in writing to the Sponsor prior to commencement. The proposed measures to comply with these requirements shall be included in the notice to the Sponsor for review. Notice to the Sponsor shall include a description of the anticipated tasks to be undertaken to comply with these OSHA requirements, the measures, timeframe, and duration that the tasks taken to comply will be ongoing during the project.

6. Post-Award Conference

The contractor shall meet with the contracting officer before any work begins and discuss the contractor's quality control system. The contracting officer and the contractor shall develop a mutual understanding regarding the quality control system, including procedures for correcting quality control issues.

7. Records

The contractor's quality control records shall document both acceptable and deficient features of the work and corrective actions taken. All records shall be on forms approved by the contracting officer, be legible, and be dated and signed by the competent person creating the record.

Unless otherwise specified in Section 12 of this specification, records shall include:

(210-VI-NEH, January 2009)

- a. Documentation of shop drawings including date submitted to and date approved by the contracting officer, results of examinations, any need for changes or modifications, manufacturer's recommendations and certifications, if any, and signature of the authorized examiner.
- b. Documentation of material delivered including quantity, storage location, and results of quality control examinations and tests.
- c. Type, number, date, time, and name of individual performing quality control activities.
- d. The material or item inspected and tested, the location and extent of such material or item, and a description of conditions observed and test results obtained during the quality control activity.
- e. The determination that the material or item met the contract provisions and documentation that the engineer was notified.
- f. For deficient work, the nature of the defects, specifications not met, corrective action taken, and results of quality control activities on the corrected material or item.

8. Reporting Results

The results of contractor quality control inspections and tests shall be communicated daily to the Sponsor or immediately upon completion of the inspection or test. Unless otherwise specified in Section 12, the original test result plus one copy of all records, inspections, tests performed, and material testing reports shall be submitted to the Sponsor within one working day of completion. For deficient work product, the test results for failing material shall be delivered to the Project Engineer before any additional fill is placed using the failing material.

9. Access

The Sponsor (including Pender County personnel, NRCS/State and local personnel, USDA contracting officer and other USDA personnel conducting construction monitoring), shall be given free access to inspect and observe the contractors performance including: construction methods and practice, equipment, test methods and procedures, calibration records, all field testing equipment, facilities, construction records, field notes, test records/results, safety meeting records, records required for measures/payment, certification of vendor and subcontractor payment, employee proof of citizenship, insurance certifications, copies of permits, and any other records deemed necessary by the Sponsor for the duration of the contract.

10. Existing Structures

Existing structures may be located at or beneath each of EWP construction sites, some of which have been identified in the project Plan Sheets. These structures may include but are not limited to the following: sheds, storage buildings, sidewalks, walkways, utilities, water/sewer lines, septic tanks, decks, over-head power line, underground electrical lines, water wells, chain link fences, power poles, guidewire, culverts, existing drainage structures, concrete headwalls, wing walls, paved or unpaved roadways, and/or other types of structures. The contractor shall take all reasonable and necessary precautions to locate, mark, and protect any structure present within or adjacent to the project Construction/Grading Limits, regardless of whether such structures have been identified on the project Plan Sheets, or not.

Engineering Plans & Specification details for Flexamat™ ECB, earthfilling, grading, or construction of rip-rap armor systems do not identify the need to alter or modify any existing structures. Also, the engineer/designer of these project Plans & Specifications does not warrant or make any claims to the conditions of such existing structures, nor accepts responsibility for the condition, performance, or structural functionality of any structure encountered while onsite before or after construction. There are no modifications proposed in this design that would alter or adversely affect the performance of the bulkheads or any other existing structure that may be present on site

11. Payment

Method—Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made

subsidiary are identified in Section 10. Payment for Quality Control Plan and HASP preparation are subsidiary to Bid Item #1 MOBILIZATION/DEMOBILIZATION.

12. Scope of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

- (a.) Subsidiary Item, Contractor Quality Control
 - (1) Section 3: Method 1 shall be utilized. Due to exigent nature of work, identification of quality control personnel shall be with 10 calendar days of award.
 - (2) Section 4: The Method described in Section 4 shall be utilized and will be paid subsidiary to BID ITEM #1, MOBILIZATION AND DEMOBILIZATION (see Section 11).
 - (3) Section 5: Measurement and payment for this item will be made subsidiary to BID ITEM #1, MOBILIZATION AND DEMOBILIZATION (see Section 11).

Construction Specification 592—Geotextile (used with Class I Rip-Rap Armor)

1. Scope

This specification covers the quality and performance of geotextile underlayment for areas to be provided with Class I- Rip Rap. Work scope to be performed on DSR-494 and DSR-489 will include the use of a non-woven geotextile underlayment for placement beneath all rip-rap sections including outlet aprons, swales, and slope faces where Class I Rip-Rap is specified. Geotextile material will also be used in the work scope for both DSR project locations as an erosion control measure to contain sediment onsite during grading and prevent offsite migration of sediment and silt onto adjacent properties and waterways. Silt fencing will be required at the perimeter of the Construction Limits as shown in the Grading Plan for each DSR project site.

2. General Requirements

Fiber (thread and yarn) used in the manufacture of geotextile must consist of synthetic polymer composed of a minimum of 85 percent by weight polypropylene, polyester, polyamide, polyethylene, polyolefin, or polyvinylchloride. The fiber must be formed into a stable network of filaments retaining dimensional stability relative to each other. The geotextile must be free of defects such as holes, tears, and abrasions. The geotextile must be free of any chemical treatment or coating that significantly reduces its porosity. Fibers must contain stabilizers, inhibitors, or both to enhance resistance to ultraviolet light. Geotextile, other than that used for temporary silt fence, must conform to the requirements in tables 592-1 or 592-2, as applicable. Geotextile used for temporary silt fence must conform to ASTM D6461.

Thread used for factory or field sewing must be of a color contrasting to the color of the fabric and made of high-strength polypropylene, polyester, or polyamide material. It must be as resistant to ultraviolet light as the geotextile being sewn.

3. Classification

There are two geotextile classifications, woven and nonwoven. Geotextile for temporary silt fence may be either woven or nonwoven. Slit film woven geotextile may not be used except for temporary silt fence.

Woven geotextiles are made from fabric that is formed by the uniform and regular interweaving of the threads or yarns in two directions. Woven fabrics must be manufactured from monofilament yarn formed into a uniform pattern with distinct and measurable openings, retaining their position relative to each other. The fabric must have a selvage edge or otherwise be finished to prevent unraveling.

Nonwoven geotextiles are made from fabric that is formed by a random placement of threads in a mat and bonded by needle punching, heat bonding, or resin bonding. Nonwoven geotextile must have distinct but variable small openings, retaining their position relative to each other when bonded. The use of heat- or resin-bonded nonwovens is restricted as specified in Note 2 of Table 592-2. Non-woven geotextile fabric is a suitable material for wrapping filter stone to form a filter blanket for facilitating drainage.

4. Sampling and Testing of Geotextile

The geotextile must conform to tables 592–1, 592–2, or ASTM D6461 as applicable for the product type shown on the label. Documentation described in either a. or b. below is required to verify the product meets the specified requirements:

- A. Product properties as listed in the latest edition of the "Specifiers Guide," Geosynthetics (Industrial Fabrics Association International, 1801 County Road B, West Roseville, MN 55113-4061 or at <http://www.geosindex.com>), and that represent average roll values, are acceptable.
- B. Test data from the geotextile production run for each of the specified tests listed in Tables 592–1, 592–2, or ASTM D6461, as applicable. Requirements for woven geotextiles are shown below in Tables 592-1 and 592-2.

5. Shipping and Storage

Each roll of geotextile must be labeled or tagged to clearly identify the brand, class, and the individual production run in accordance with ASTM D4873. The geotextile must be shipped and transported in rolls wrapped with cover for protection from moisture, dust, dirt, debris, and ultraviolet light. The cover must be maintained undisturbed to the maximum extent possible before placement. Replacement for woven geotextile materials is shown below in Table 592-1 and 592-2.

6. Scope

This specification covers the quality of geotextile, including geotextile for temporary silt fence.

7. General Requirements

Fiber (thread and yarn) used in the manufacture of geotextile must consist of synthetic polymer composed of a minimum of 85 percent by weight polypropylene, polyester, polyamide, polyethylene, polyolefin, or polyvinylchloride. The fiber must be formed into a stable network of filaments retaining dimensional stability relative to each other. The geotextile must be free of defects such as holes, tears, and abrasions. The geotextile must be free of any chemical treatment or coating that significantly reduces its porosity. Fibers must contain stabilizers, inhibitors, or both to enhance resistance to ultraviolet light. Geotextile, other than that used for temporary silt fence, must conform to the requirements in tables 592–1 or 592–2, as applicable. Geotextile used for temporary silt fence must conform to ASTM D6461.

Thread used for factory or field sewing must be of a color contrasting to the color of the fabric and made of high-strength polypropylene, polyester, or polyamide material. It must be as resistant to ultraviolet light as the geotextile being sewn.

8. Classification

There are two geotextile classifications, woven and nonwoven. Geotextile for temporary silt fence may be either woven or nonwoven. Slit film woven geotextile may not be used except for temporary silt fence.

Woven geotextiles are made from fabric that is formed by the uniform and regular interweaving of the threads or yarns in two directions. Woven fabrics must be manufactured from monofilament yarn formed into a uniform pattern with distinct and measurable openings, retaining their position relative to each other. The fabric must have a selvedge edge or otherwise be finished to prevent unraveling.

Nonwoven geotextiles are made from fabric that is formed by a random placement of threads in a mat and bonded by needle punching, heat bonding, or resin bonding. Nonwoven geotextile must have distinct but variable small openings, retaining their position relative to each other when bonded. The use of heat- or resin-bonded nonwovens is restricted as specified in Note 2 of Table 592-2. Non-woven geotextile fabric is a suitable material for wrapping filter stone to form a filter blanket for facilitating drainage.

9. Sampling and Testing of Geotextile

The geotextile must conform to tables 592–1, 592–2, or ASTM D6461 as applicable for the product type shown on the label. Documentation described in either a. or b. below is required to verify the product meets the specified requirements:

- a. Product properties as listed in the latest edition of the "Specifiers Guide," Geosynthetics (Industrial Fabrics Association International, 1801 County Road B, West Roseville, MN 55113-4061 or at <http://www.geosindex.com>), and that represent average roll values, are acceptable.
- b. Test data from the geotextile production run for each of the specified tests listed in Tables 592–1, 592–2, or ASTM D6461, as applicable. Requirements for woven geotextiles are shown below in Tables 592-1 and 592-2.

10. Shipping and Storage

Each roll of geotextile must be labeled or tagged to clearly identify the brand, class, and the individual production run in accordance with ASTM D4873 and Material Specification 592 below. The geotextile must be shipped and transported in rolls wrapped with a cover for protection from moisture, dust, dirt, debris, and ultraviolet light. The cover must be maintained undisturbed to the maximum extent possible before placement. Requirements for woven geotextile materials is shown below in Table 592-1 and 592-2.

Table 592–1 Requirements for woven geotextiles ^{1/}

Property	Test method	Class I	Class II	Class III	Class IV
Grab tensile strength (lb)	ASTM D4632	247 minimum	180 minimum	180 minimum	315
Elongation at failure (%)	ASTM D4632	<50	<50	<50	<50
Trapezoidal tear strength (lb.)	ASTM D4533	90 minimum	67 minimum	67 minimum	112 minimum
Puncture strength (lb.)	ASTM D6241	495 minimum	371 minimum	371 minimum	618 minimum
Ultraviolet stability (% retained strength)	ASTM D4355	50 minimum	50 minimum	50 minimum	70 minimum
Permittivity (sec ⁻¹)	ASTM D4491		as specified		
Apparent opening size (AOS) ^{2/}	ASTM D4751		as specified		
Percent open area (POA) (%)		USACE ^{3/} CWO-02215-86			

^{1/} All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

^{2/} Maximum average roll value.

3/ Note: CWO is a USACE reference.

Material Specification 592 Geotextile (*continued*)

Table 592–2 Requirements for nonwoven geotextiles ^{1/}

Property	Test method	Class I ^{2/}	Class II ^{2/}	Class III ^{2/}	Class IV ^{2/}
Grab tensile strength (lb.)	ASTM D4632 grab test	202 minimum	157 minimum	112 minimum	202 minimum
Elongation at failure (%)	ASTM D4632	50 minimum	50 minimum	50 minimum	50 minimum
Trapezoidal tear strength (lb.)	ASTM D4533	79 minimum	56 minimum	40 minimum	79 minimum
Puncture strength (lb.)	ASTM D6241	433 minimum	309 minimum	223 minimum	433 minimum
Ultraviolet light (retained strength) (%)	ASTM D4355	50 minimum	50 minimum	50 minimum	50 minimum
Permittivity sec ⁻¹	ASTM D4491	0.70 minimum or as specified			
Apparent opening size (AOS) (mm) ^{3/}	ASTM D4751	0.22 maximum or as specified			

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Needle punched geotextiles may be used for all classes. Heat-bonded or resin-bonded geotextiles may be used for class IV only.

3/ Maximum average roll value.

Material Specification 592 Geotextile (continued)

Table 592–2 Requirements for nonwoven geotextiles ^{1/}

Property	Test method	Class I ^{2/}	Class II ^{2/}	Class III ^{2/}	Class IV ^{2/}
Grab tensile strength (lb.)	ASTM D4632 grab test	202 minimum	157 minimum	112 minimum	202 minimum
Elongation at failure (%)	ASTM D4632	50 minimum	50 minimum	50 minimum	50 minimum
Trapezoidal tear strength (lb.)	ASTM D4533	79 minimum	56 minimum	40 minimum	79 minimum
Puncture strength (lb.)	ASTM D6241	433 minimum	309 minimum	223 minimum	433 minimum
Ultraviolet light (retained strength) (%)	ASTM D4355	50 minimum	50 minimum	50 minimum	50 minimum
Permittivitysec ⁻¹	ASTM D4491		0.70 minimum or as specified		
Apparent opening size (AOS) (mm) ^{3/}	ASTM D4751		0.22 maximum or as specified		

1. All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.
2. Needle punched geotextiles may be used for all classes. Heat-bonded or resin-bonded geotextiles may be used for class IV only.
3. Maximum average roll value.

Construction Specification 95—Construction Schedule

The contractor shall prepare a construction schedule that identifies each site by DSR number. The schedule must visually illustrate and show all tasks, scopes of work, milestones, and proposed completion dates planned for executing of each DSR. The anticipated completion date for completing all work required by each DSR shall also be shown in the chart. A Gant chart, XCEL chart, or other commercially available visual graphic type construction schedule shall be submitted at least 10 days prior to construction.

Construction Specification 00—Invoicing/Retainage of Payment

For interim work task or milestones completed prior to the time of Substantial Completion of the project, the contractor shall submit progress payment request at 30 day intervals. Invoices submitted **must** include all of the following:

- (1) Brief description of the work completed
- (2) Every invoice **must** include the following project billing code identifiers: DSR number/Group number/Site number/Property owner/address
- (3) Quantities and costs

- (4) Contract amount for the DSR payment requested/Percent that present invoice represents; and the amount remaining in the DSR budget
- (5) Contractor shall submit a monthly spreadsheet with a Summary of Project Billings. The spreadsheet shall summarize cumulative cost accrued to each DSR by Group number/Site number.

Each DSR will have a “not-to-exceed” contract amount that the contractor shall be responsible for managing cost accounting for the contract so as to not exceed the cost for any site or DSR. Costs shall not exceed the ceiling cost awarded for any single DSR. Site costs for individual sites may vary from the contractors estimate for sites within its DSR/Group, however, the DSR ceiling amount may not be exceeded for any reason. The Sponsor may determine that circumstances or reasons for the contractor exceeding the DSR award ceiling may be warranted, and will provide written authorization only in such cases when sufficient justification has been provided. No guaranty is implied or expressed that payment will be authorized for any DSR that is exceed.

For each progress payment made by the contractor prior to the time Substantial Completion of the work has been reached, the Sponsor shall retain ten percent (15%) of the contract amount for each DSR for which the contractor has provided services and goods, Retainage shall be managed in accordance with North Carolina Code and State Law. The prevailing requirements for payment of services will be defined in the contract between Pender County Government Administrative Office and each contractor awarded under this contract.

Construction Specification 01—Design Exceptions and Exclusions

Ardurra’s work scope under this EWP contract did not include precursor studies, assessments, investigations, or evaluations to determine the structural or geotechnical integrity of any property or existing structure. This includes soil conditions, subsurface conditions, foundation conditions, slope stability, terraces, or any other existing structures or features. No inference is made in these Plans & Specifications regarding the existing condition of any such features.

Ardurra specifically asserts no claim as to the condition of existing or new structures including: bulkheads, breakwaters, groins, seawalls, rip-rap armor, dwellings, buildings, garages, walkways, driveways, utilities, septic tanks, water lines, gas lines, building foundations, pavement, roadways, drainage culverts, or any other structure present on these sites. Ardurra’s design considerations has not proposed or effected any change to the purpose, size, function, dimension, or structural integrity of any structure located on the EWP sites. The design engineer has included no specifications or direction to cause contractor’s working on these sites to alter or change any structures specified above. Contractors proposing work on the EWP sites are advised to do so with extreme caution and to implement precautionary measures prior to construction, to protect any and all structures. The designer accepts no responsibility for any damages that may be claimed, or caused by the contractor’s performance during the implementation of the emergency repairs identified in these Plans & Specifications.

Construction Specification 02—Reliance on Existing Surveying Data

The NC Wildlife Resource Commission procured Bass, Nixon & Kennedy, Inc. for surveying services needed in the preparation of Plans & Specifications for “Existing Conditions and Demolition Plan“, Drawing C1.0 sealed by Kirby R. Bell, Jr, PE on April 4, 2015. The surveying services included: boundary surveys/property line identification; establishment of temporary benchmarks; preparation of plan sheets showing existing conditions and utilities; spot elevations of the site, the location of eroded Top of Bank, location of the NE Cape Fear River mean HWM, determination/location of the 100 Year Flood Elevation and 500 Year Flood Elevation; The Sponsor and Ardurra relied on the accuracy of the survey data, details, and features identified in this drawing to facilitate the preparation of these Plans & Specifications. Errors or omissions that may be discovered in the sealed Bas, Nixon, Kennedy site survey and C1.0 Plan Sheet is the sole responsibility of

Bass, Nixon, & Kennedy, Inc.. Should errors, omissions or inaccuracy be identified in the surveys or drawings that affect or impede the proposed construction methods or costs, the Sponsor or their representatives, will request Bass, Nixon, & Kennedy to remedy any deficiency.

-----END OF PLANS & SPECIFICATIONS-----

PLANS & SPECIFICATIONS

APPENDIX 1

FLEXAMAT INSTALLATION GUIDELINES

for

DSR-494

**NC Wildlife Commission Depot
7471 Shaw Highway
Rocky Point, NC**

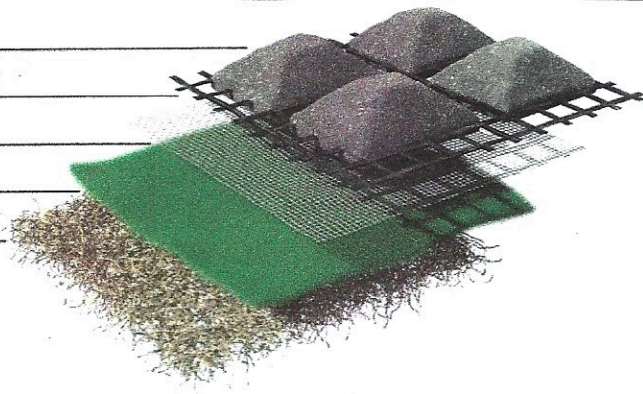
5000 PSI Concrete Blocks

High Strength Biaxial Geogrid

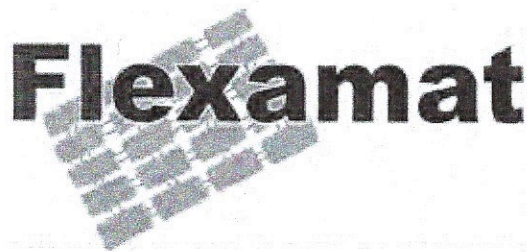
5-Pick Leno Weave

Recycllex® TRM

Curlex® II Wood Excelsior



Flexamat



INSTALLATION GUIDELINES

Flexamat® is a tied concrete block system that is manufactured with site specific underlay. First, for applications where vegetation growth is expected, we use a 12-18 month degradable excelsior blanket (Curlex® II), second, for applications where vegetation will be sparse, we use a permanent synthetic erosion control blanket (Recyclex® TRM-V), and third, for sandy, non-cohesive soils, we use a non-woven geotextile fabric

Flexamat® is available in widths of 4', 5.5', 8', 10', 12', and 16'. For applications with wider widths, mats are installed adjacent to another. The manufacturer or authorized representative will provide technical assistance during installation as needed.

SHIPPING, TRANSPORT, STORAGE & HANDLING:

Flexamat® is packaged in rolls for shipment. The rolls have a minimum weight of 10 pounds per square feet. Rolls are packaged with handling straps. For safety, it is recommended that these straps only be used for lifting below 2' as a means to place heavy duty lifting straps under rolls.

Upon delivery, rolls may be left exposed for up to 30 days. If exposure will exceed 30 days, the rolls must be tarped or otherwise covered to minimize UV exposure.

SUBGRADE PREPARATION:

The prepared subgrade shall provide a firm, unyielding foundation for the mats. The subgrade shall be prepared as detailed on the plans. Subgrade surface shall be free of any debris, protrusions, rocks, sticks, roots or other hindrances which would result in an individual block being raised more than $\frac{3}{4}$ " above the adjoining blocks. Undulations, rolls, knolls and rises in the subgrade to which the tied concrete mat is able to contour over and maintain intimate contact with the subgrade will be allowed. The Flexamat block has a height of 2.25". When grading next to hard surfaces like a road, sidewalk, or outlet pad, consider lowering the grade to allow for a smooth transition for water to flow from the hard surface onto the Flexamat. Before unrolling the Flexamat, apply seed and soil amendments directly to the prepared soil prior to installation of mats. Use seed and soil amendments or topsoil per project specifications.

UNROLLING:

Position the rolls in the direction to be unrolled, with the leading edge at the bottom of the roll with the line and grade shown on the plans and according to the manufacturer's installation guidelines. Flexamat can be unrolled down or across slopes. It is important to considering the direction of any overland or channel flow when anchoring and installing the succeeding rolls for seams or abutments in the design. All edges exposed to concentrated flows, especially the upstream leading edges must be terminated and properly anchored according to engineer drawings. If no hydraulic or overland flow is expected, a soil transition cover of 4"-6" can be graded over the edges in lieu of placement in an anchor trench. Overlapping seam should be installed like a shingle on a roof.

PANEL SEAMING:

Panel seams (Channel and Slopes) perpendicular to the hydraulic flow must be overlapped. The downstream panels will be terminated and properly anchored according to engineer drawings and placed under the upstream panel by overlapping 18". If no hydraulic or overland flow is expected, butting the seams together is acceptable along with a 4' section of erosion control matting is used with 2' being placed under each neighboring panel.

ANCHORING:

Flexamat shall have an 18" toe-in at edges perpendicular to concentrated hydraulic flow. For areas exposed to surface sheet flow, recess the mat 12". Alternately, edges not exposed to surface sheet flow do not need to be toed. Rather, a soil transition cover may be placed 4" along the edge of mat to transition to landscape.

Where permanent anchoring is required, e.g., installing mats on steep slopes, channels or stream banks engineered with live staking or native vegetation, the anchors shall exhibit an engineered downward force over the polypropylene grid between the tied concrete blocks. Standard anchors used are #3 Rebar bent into a "U" shaped 18" in length or percussion anchors with designed cross plates. Important areas for considering anchoring are the leading edges, seams and overlaps. The design and spacing layout of the anchored system shall be designed by the engineer with assistance from manufacturer.

MAINTENANCE:

Flexamat is comprised of 5,000 psi concrete blocks embedded into flexible geogrid. Our selected geogrid is comprised of polypropylene yarns that are resistant to a pH range of 2 – 13. Embedding within concrete this will not adversely affect the durability of the geogrid throughout its design life. The useful design life of Flexamat is in excess of 75 years as long as the geogrid does not stay exposed to sunlight, and the vegetative support stays maintained.

Key points for inspections and maintenance:

- Do not spray with weed or grass killers. Use a selective herbicide to control invasive plants.
- Maintain stabilization of adjacent areas. Repair any rills or gullies that can effect upstream/downstream or top of slope terminations.
- Maintain adjacent vegetation. Exposed soil above and along the sides of the Flexamat should be seeded or covered.
- Routine maintenance can include mowing on stabilized areas and weed eating around wet areas.
- Inspect Flexamat panel seams for any separation, or undermining.
- Inspect outlets that enter the Flexamat for abutment failure, or loss of stabilization.

PLANS & SPECIFICATIONS

APPENDIX 1

FLEXAMAT PRODUCT SPECIFICATIONS

for

DSR-494

**NC Wildlife Commission Depot
7471 Shaw Highway
Rocky Point, NC**

Composition of Materials – Flexamat Plus

Blocks	5000 PSI, Wet-cast Portland Cement			
Interlocking Biaxial Geogrid	Fornit 30/30 – Polypropylene Geogrid with 2,055 lb/ft biaxial strength. Carbon black UV inhibitor shall be blended into the extruded yarns at a rate no less than 0.8% by weight.			
	Property	Unit	Test	Requirement
	Mass/Unit Area	oz/yd ²	ASTM D5261	6.5 oz/yd ²
	Aperture Size	English units	Measured	1.4x 1.4 inch
	Ultimate Wide Width Tensile Strength (MD x CMD)	lb/ft	ASTM D6637	2,055 lb/ft
	Elongation at Ultimate Tensile Strength (MD x CMD)	%	ASTM D6637	6%
	Wide Width Tensile Strength @ 2% (MD x CMD)	lb/ft	ASTM D6637	822 lb/ft
	Wide Width Tensile Strength @ 5% (MD x CMD)	lb/ft	ASTM D6637	1,640 lb/ft
	Tensile Modulus @ 2% (MD x CMD)	lb/ft	ASTM D6637	41,100 lb/ft
	Tensile Modulus @ 5% (MD x CMD)	lb/ft	ASTM D6637	32,800 lb/ft
Flexamat Plus Underlayment	A four-layered system includes, in order from top to bottom, 1) Concrete block mat 2) 5-Pick Leno Weave 3) Recyclex TRM and 4) Curlex® II. The underlayment materials shall be packaged within the roll of the Flexamat Plus.			

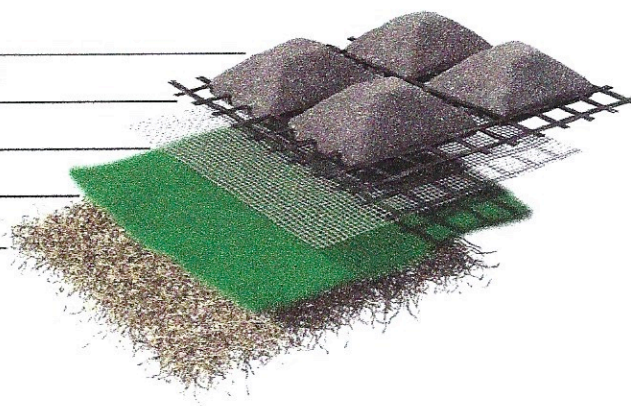
5000 PSI Concrete Blocks

High Strength Biaxial Geogrid

5-Pick Leno Weave

Recyclex[®] TRM

Curlex[®] II Wood Excelsior



Manufacturing Values

Flexamat Properties	Values
Roll Width	4', 5.5', 8', 10', 12', 15.5, & 16'
Roll Length	30', 40', 50' / custom
Material Weight	10 lbs./sf
Block Size	6.5" x 6.5" x 2.25"
Percentage Open Area (POA)	30% min.

Performance

Test	Tested Value	Bed Slope	Soil Classification	Limiting Value
ASTM 6460	Shear Stress	30%	Sandy Loam (USDA)	24 PSF
ASTM 6460	Velocity	20%	Loam (USDA)	30 ft./sec

Flexamat Plus Specification

1. DESCRIPTION

A Tied Concrete Block Mat with Triple Layered Underlayment. This work shall consist of furnishing and placing the system in accordance with this specification and conforming with the lines, grades, design, and dimensions shown on the plans.

2. MATERIALS

Flexamat Plus is manufactured from individual concrete blocks tied together with high strength knitted polypropylene bi-axial geogrid. Each block is tapered, beveled and interlocked and includes connections that prevent lateral displacement of the blocks within the mats when they are lifted for placement.

Tied Concrete Block Mats with Triple Underlayment shall be Flexamat Plus, manufactured by Motz Enterprises, Inc.

- 2.1. **Blocks.** Furnish blocks manufactured with concrete conforming to the cement requirements of ASTM C150 and to the aggregate requirements of ASTM C33. Blocks shall have a minimum weight of 3 lb. per block and placed no further than 2 in. apart. Material weight per square foot shall not exceed 10 lbs. Blocks shall have a 2.25" profile, a flat-top pyramid shape, and a coarse finish without protrusions. Concrete shall have a minimum compressive strength requirement of Table 1 and certified by a third party.

Table 1
Concrete Compressive Strength Requirements

Age	Required Compressive Strength psi
7 - Day	5000 psi
14 - Day	6000 psi
28 - Day	6900 psi

- 2.2. **Polypropylene Bi-Axial Geogrid.** The interlocking geogrid shall be an open knitted fabric composed of high tenacity, multifilament polypropylene yarns knitted and coated in tension with an acrylic based coating which is designed to resist degradation in environments with exposure to water and low pH (4 pH) and high pH (>9 pH). When combined with the revetment mat, this will yield a high tenacity, low elongating, and continuous filament polypropylene geogrid that is embedded within the base of the concrete blocks. Ensure the geogrid meets the requirements of Table 2.

Table 2
Polypropylene Bi-Axial Geogrid

Property	Unit	Test	Requirement
Mass/Unit Area	oz/yd ²	ASTM D5261	6.5 oz/yd ²
Aperture Size	English units	Measured	1.4x 1.4 inch
Ultimate Wide Width Tensile Strength (MD x CMD)	lb/ft	ASTM D6637	2,055 lb/ft
Elongation at Ultimate Tensile Strength (MD x CMD)	%	ASTM D6637	6%
Wide Width Tensile Strength @ 2% (MD x CMD)	lb/ft	ASTM D6637	822 lb/ft
Wide Width Tensile Strength @ 5% (MD x CMD)	lb/ft	ASTM D6637	1,640 lb/ft
Tensile Modulus @ 2% (MD x CMD)	lb/ft	ASTM D6637	41,100 lb/ft
Tensile Modulus @ 5% (MD x CMD)	lb/ft	ASTM D6637	32,800 lb/ft

2.3.

Underlayment Materials. A four-layered system includes, in order from top to bottom, 1) Concrete block mat 2) 5-Pick Leno Weave 3) Recyclex TRM-V and 4) Curlex® II. The underlayment materials shall be packaged within the roll of the Flexamat Plus.

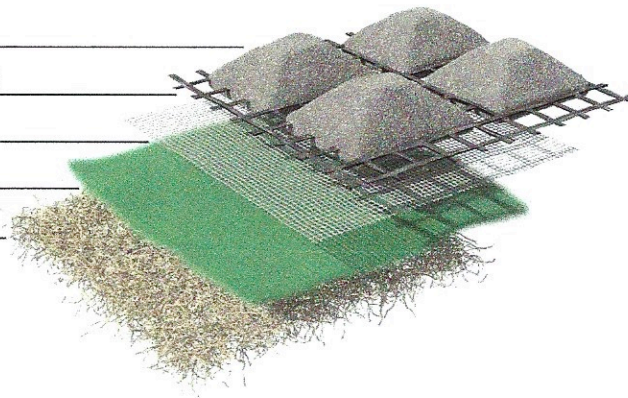
5000 PSI Concrete Blocks

High Strength Biaxial Geogrid

5-Pick Leno Weave

Recyclex® TRM

Curlex® II Wood Excelsior



Five-Pick Leno Weave:

This Five-Pick Weave provides added strength and support to the underlayments.

<u>Index Property</u>	<u>Units</u>	<u>Value</u>
GSM	g/m ²	118 (-3 ~ +3)
Density	Picks/10cm	62 x 24 (+/- 2)
Warp Strength	N/5cm	≥ 350
Warp Elongation	%	20 - 50
Weft Strength	N/5cm	≥ 280
Weft Elongation	%	20 - 50
Warp Shrinkage	%	≤ 7
Weft Shrinkage	%	≤ 9

Recyclex® TRM:

Recyclex TRM – V is a permanent non-degradable Turf Reinforcement Mat (TRM), consists of 100% post-consumer recycled polyester (green or brown bottles) with 80% five-inch fibers or greater fiber length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the TRM. The top and bottom of each TRM is covered with heavy duty polypropylene net. Fibers are tightly crimped and curled to allow fiber interlock, and to

retain 95% memory of the original shape after loading by hydraulic events. Fibers have a specific gravity greater than 1.0; therefore, the blanket will not float during hydraulic events. Recyclex TRM – V meets Federal Government Executive Order initiatives for use of products made from, or incorporating, recycled materials. Recyclex TRM – V shall be manufactured in the U.S.A. and the fibers shall be made from 100% recycled post-consumer goods.

Index Property	Test Method	Value
Thickness	ASTM D 6525	0.294 in (7.47 mm)
Light Penetration	ASTM D 6567	57%
Resiliency	ASTM D 6524	86%
Mass per Unit Area	ASTM D 6566	0.50 lb/yd ² (271 g/m ²)
MD-Tensile Strength Max.	ASTM D 6818	295.2 lb/ft (4.32 kN/m)
TD-Tensile Strength Max.	ASTM D 6818	194.4 lb/ft (2.85 kN/m)
MD-Elongation	ASTM D 6818	32.2%
TD-Elongation	ASTM D 6818	40.8%
Swell	ECTC Procedure	8%
Water Absorption	ASTM D 1117/ECTC	33.8%
Specific Gravity	ASTM D 792	1.21
UV Stability	ASTM D 4355 (1,000 hr)	80% minimum
Porosity	Calculated	97.5%
Bench-Scale Rain Splash	ECTC Method 2	SLR = 5.86 @ 2 in/hr ^{1,2}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 5.00 @ 4 in/hr ^{1,2}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 6.33 @ 6 in/hr ^{1,2}
Bench-Scale Shear	ECTC Method 3	2.41 lb/ft ² @ 0.5 in soil loss ²
Germination Improvement	ECTC Method 4	432%

¹ SLR is the Soil Loss Ratio, as reported by NTPEP/AASHTO. ² Bench-scale index values should not be used for design purposes

Curlex® II:

Curlex II erosion control blanket (ECB) consists of a specific cut of naturally seed free Great Lakes Aspen curled wood excelsior with 80% six-inch fibers or greater fiber length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the blanket. The top and bottom of each blanket is covered with degradable polypropylene netting.

Index Property	Test Method	Value
Thickness	ASTM D 6525	0.418 in (10.62 mm)
Light Penetration	ASTM D 6567	34.6%
Resiliency	ASTM D 6524	64%
Mass per Unit Area	ASTM D 6475	0.57 lb/yd ² (309 g/m ²)
MD-Tensile Strength Max.	ASTM D 6818	127.0 lb/ft (1.9 kN/m)
TD-Tensile Strength Max.	ASTM D 6818	50.9 lb/ft (0.7 kN/m)
MD-Elongation	ASTM D 6818	28.64%
TD-Elongation	ASTM D 6818	29.84%
Swell	ECTC Procedure	89%
Water Absorption	ASTM D 1117/ECTC	199%
Bench-Scale Rain Splash	ECTC Method 2	SLR = 6.84 @ 2 in/hr ^{2,3}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 7.19 @ 4 in/hr ^{2,3}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 7.56 @ 6 in/hr ^{2,3}
Bench-Scale Shear	ECTC Method 3	2.6 lb/ft ² @ 0.5 in soil loss ³
Germination Improvement	ECTC Method 4	645%

¹ Weight is based on a dry fiber weight basis at time of manufacture. Baseline moisture content of Great Lakes Aspen excelsior is 22%.

² SLR is the Soil Loss Ratio, as reported by NTPEP/AASHTO. ³ Bench-scale index values should not be used for design purposes.

- 2.4. Mats will be rolled for shipment. Upon delivery, rolls may be left exposed for up to 30 days. If exposure will exceed 30 days, cover or tarp the rolls to minimize UV exposure.

Chipping or missing concrete resulting in a weight loss exceeding 15% of the average weight of a concrete unit is grounds for rejection by the engineer. Replace, repair or patch the damaged areas per the manufacturer's recommendations.

3. PERFORMANCE

Full-Scale laboratory testing performed by an independent 3rd party testing facility with associated engineered calculations certifying the hydraulic capacity of the proposed Tied-Concrete Block Erosion Control Mat meets the following requirements:

Test	Tested Value	Bed Slope	Soil Classification	Limiting Value
ASTM 6460	Shear Stress	30%	Sandy Loam (USDA)	24lb./ft ²
ASTM 6460	Velocity	20%	Loam (USDA)	30 ft./sec

4. ALTERNATIVE PRODUCTS

Such products must be pre-approved in writing by the Engineer prior to bid date. Alternative product packages must be submitted to the Engineer a minimum of fifteen (45) days prior to bid date. Submittal packages for alternate products must include, as a minimum, the following:

- 4.1. Alternative Product Properties – Product must be comprised of materials as detailed in Section 2, including both in composition, underlayment layers and performance requirements.
- 4.2. Full-Scale laboratory testing performed by an independent 3rd party testing facility with associated engineered calculations certifying the hydraulic capacity of the proposed Tied-Concrete Block Erosion Control Mat meets the performance requirements listed in Section 3 of this specification.
- 4.3. A list of 15 comparable projects in terms of project size, application and material dimensions in the United States, where the results of the specific alternative material's use can be verified and reviewed for system integrity and sustained after a minimum of 10 years of service life.

5. EQUIPMENT

Provide the proper equipment to place the mat that will not damage the mat material or disturb the topsoil subgrade and seed bed.

6. CONSTRUCTION

Prior to installing Flexamat Plus, prepare the subgrade as detailed in the plans. All subgrade surfaces to be smooth and free of all rocks, stones, sticks, roots, and other protrusions or debris of any kind that would result in an individual block being raised more than 3/4 in. above the adjoining blocks. When seeding is shown on the plans, provide subgrade material that can sustain growth.

Ensure the prepared subgrade provides a smooth, firm, and unyielding foundation for the mats. The subgrade shall be graded into a parabolic or trapezoidal shape to concentrate flow to middle of mat or mats.

When vegetation is required, distribute seed on the prepared topsoil subgrade before installation of the concrete mats in accordance with the specifications.

Install mats to the line and grade shown on the plans and per the manufacturer's guidelines. The manufacturer or authorized representative will provide technical assistance during preparation and installation of the concrete block mats as needed.

Provide a minimum 18 in. deep concrete mat embedment toe trench at all edges exposed to concentrated flows. Recess exterior edges subject to sheet flow a minimum of 6 in.

Provide fastening or anchoring as recommended by the manufacturer or engineer for the site conditions.

7. MEASUREMENT

This Item will be measured by the square foot as shown on the plans, complete in place.

8. PAYMENT

The work performed, and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Flexamat Plus". This price is full compensation for loading and transporting, placing concrete block mats; excavation and disposal; furnishing topsoil and bedding; and equipment, labor, materials, tools, and incidentals.

PLANS & SPECIFICATIONS

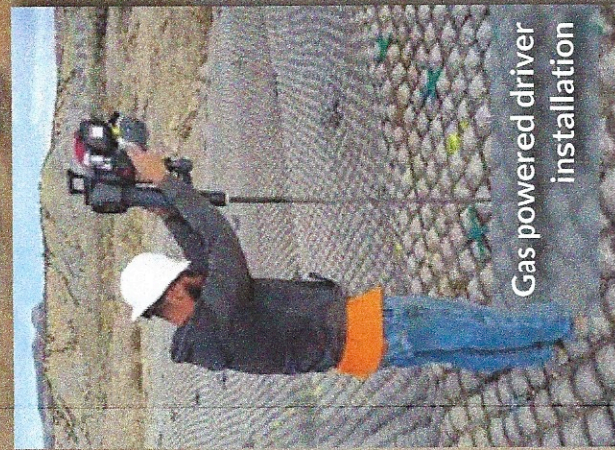
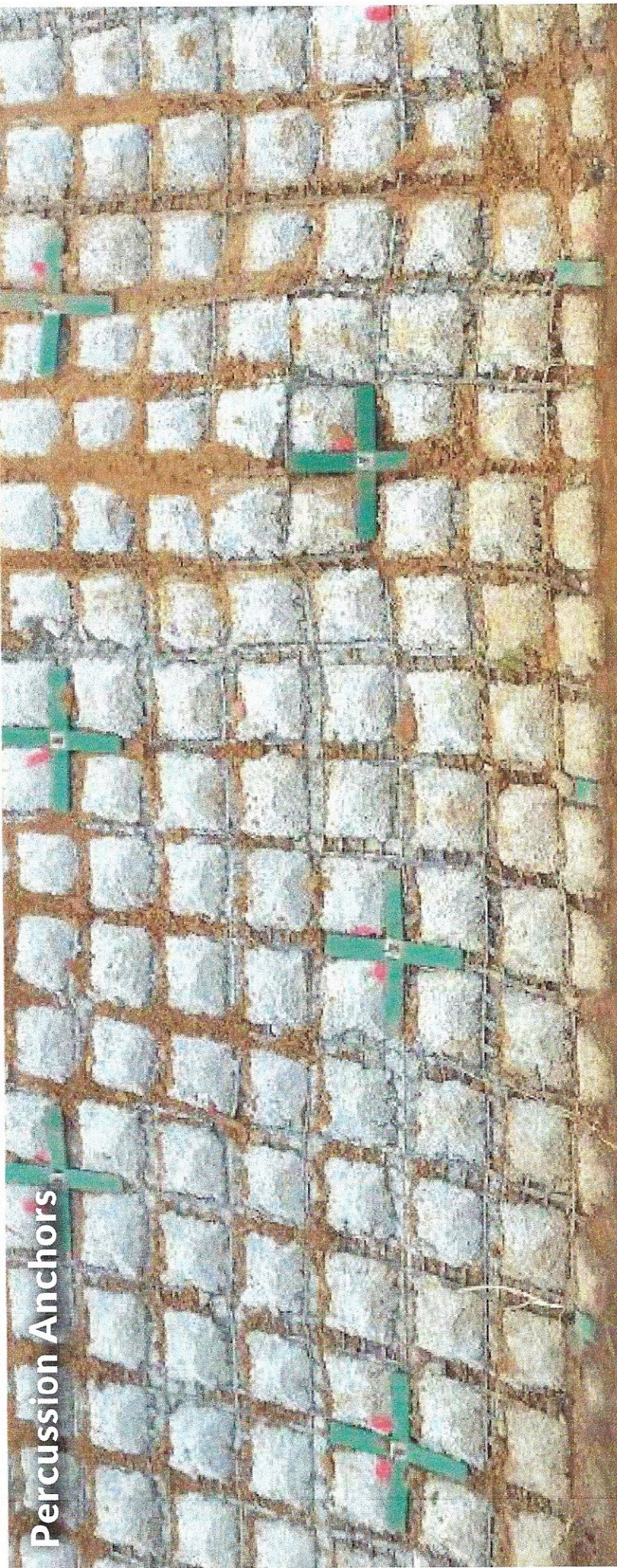
APPENDIX 1

FLEXAMAT ANCHOR DETAILS AND SPECIFICATIONS FOR 9-FT CROSS PLATE ANCHORS (TL-6CRS-TLA4-6MM-S) AND 18"U-ANCHORS (#3 REBAR)

for

**DSR-494
NC Wildlife Commission Depot
7471 Shaw Highway
Rocky Point, NC**

Percussion Anchors



Gas powered driver installation



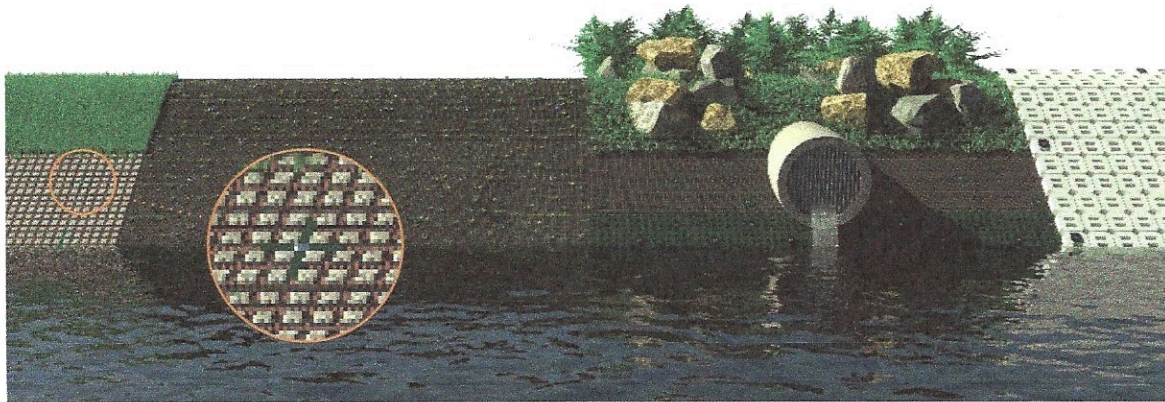
Loading anchor with Jack Jaw®



Installed anchors



TL-6CRS-TLA4-6MM-S



TL-6CRS



TL-A4

Terra-Lock® Earth Percussion Anchors are designed to provide drive efficiency and maximize load capacity across a wide range of applications. The Terra-Lock 6CRS is a unique design for securing Flexamat. Terra-Lock anchor assemblies are all pre-assembled with specific anchor heads, wire rope tendon, and bearing plates. Patented Gripple technology allows for re-tensioning and negates the need for time consuming crimping.

Performance

Typical Anchor Load Range ⁽¹⁾	SEE GRAPH ON THE REVERSE PAGE
Safe Working Load ⁽¹⁾	2500 lbs
Maximum Breaking Load	2850 lbs

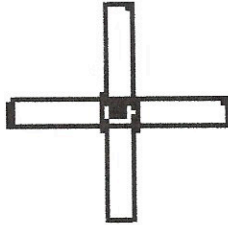
Component	Type	Material	Specifications
Top Bearing Plate	TL-CRS	Mild Steel Plastisol Coated ⁽²⁾	Head Size: 300 mm Diameter
Top Termination	TL-600	Zinc-Aluminium Alloy - ZA 2 & Ceramic ⁽³⁾	(H) 48 mm x (W) 33 mm 5 mm Head Thickness
Anchor Head	TL-A4	Zinc-Aluminum Alloy - ZA 2 ⁽⁴⁾	Surface Area: 7,740 mm ²
Cable Tendon	6MM-S	Stainless Steel Type 316	Diameter: 6 mm 7x19 Strand 1,770 N / mm ² Tensile Strength to DIN 3053
Lower Termination	Ferrule	Stainless Steel	Length: 26 mm Wall Thickness: 2.7 mm

- (1) Values are soil dependent; See graph on the reverse page. (2) Corrosion resistant with UV inhibitors. (3) Corrosion resistant pressure die cast zinc alloy & ceramic roller.
(4) Corrosion resistant pressure die cast zinc alloy. The longevity depends on location factors and soil, water & climate conditions as well as the local risk of erosion on site. PP materials are UV protected, designed for a long life.

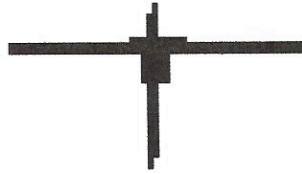
www.gripple.com

Gripple Inc. | 1611 Emily Lane | Aurora, IL 60502 USA

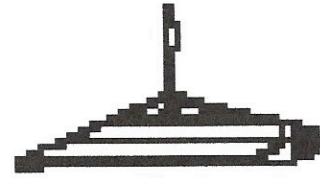
TL-6CRS-TLA4-6MM-S



TL-6CRS - Top



TL-6CRS - Side



TL-A4 - Side

SPT Count & Gripple Anchor Performance

General information

The standard penetration test (SPT) is widely used to determine the strength and deformation properties of the course soil. Approximate correlation of properties of drained granular soil are:

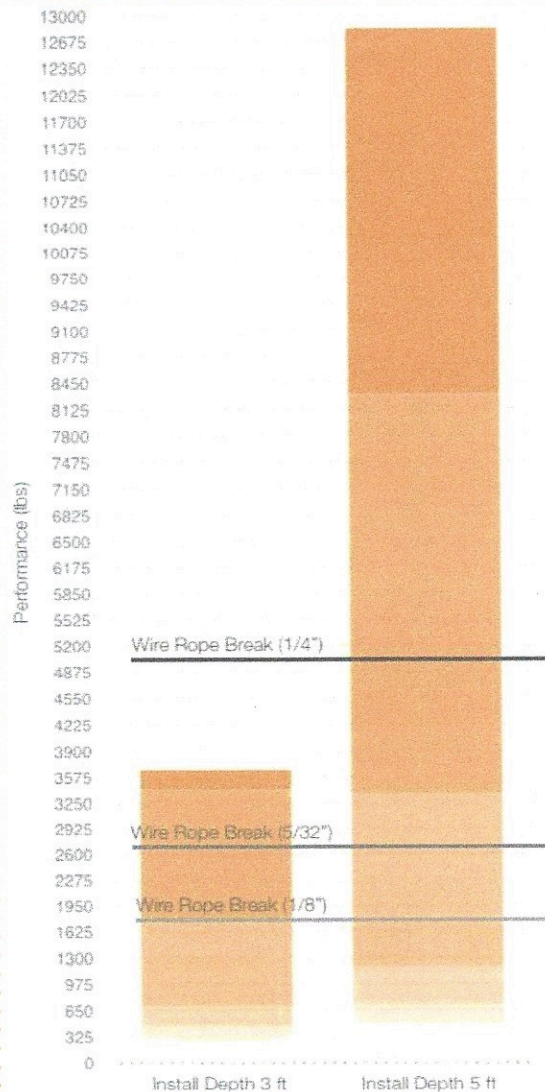
Very Loose	SPT 0-4
Loose	SPT 4-10
Medium Dense	SPT 10-30
Dense	SPT 30-50
Very Dense	> 50

These figures can then be used to obtain typical shear strength and bulk unit weight for each soil.

This information is then used to predict Gripple Anchor Performance in relation to the conditions described.

The following graphs are derived from idealised theoretical calculations and should be used as a guide only. The variability of soil types should always be taken into account and on-site testing should always be carried out in order to obtain more accurate results.

Soil Density	Anchor Performance (kg)			
	Install Depth 3 ft		Install Depth 5 ft	
Very Loose	292.6	433.4	468.6	710.6
Loose	443.4	693.0	710.6	534
Medium Dense	693.0	1751.2	1174.8	1525
Dense	1751.2	3405.6	3355.0	8283.0
Very Dense	3405.6	3658.6	8283.0	12826.0
Wire Rope Break	(1/8") - 1793 lbs			
	(3/16") - 2640 lbs			
	(1/4") - 4994 lbs			



www.gripple.com

Gripple Inc. | 1611 Emily Lane | Aurora, IL 60502 USA

Short Description

Gripple anchor assembly for fixing geosynthetics, geotextiles, matting, turf reinforcement mats or TRM, jute and other ground coverings. Terra-Lock Earth Percussion Anchors are designed to provide drive efficiency and maximise load capacity across a wide range of applications.

Description

The Gripple Terra Lock Earth Percussion Anchors are designed to provide drive efficiency and maximise load capacity across a wide range of applications. The Terra-Lock™ 100 load bearing plate has an open face allowing for vegetation establishment. Terra-Lock anchors assemblies are all preassembled with specific anchor heads, wire rope tendon, and bearing plates. Patented Gripple technology allows for re-tensioning and negates the need for time consuming crimping. Removes 20mm drive rods after install. Load lock anchor with ease.

Applications:

1. Designed for securing HPTRM and TRM
2. Open face allows vegetation to grow through
3. 100 mm (4") head size
4. Accepts 3 mm (1/8") wire
5. Zinc die-cast, one-piece housing

System Performance:

6. Maximum Working Load(1) 450kg
7. Ultimate Assembly Strength 500kg
8. Ultimate Wire Rope Strength 815kg

Benefits of the Terra Lock Gripple Anchors:

Gripple anchor systems provide a labour saving method of geotechnical engineering for erosion control, soil retention & slope reinforcement.

9. **Slows Flows** - The use of vegetation in the Terra-Lock® System can help control hydraulic flows, minimising scour and damage to other parts of the system
10. **Resilient** - Reinforcing elements of the solution alongside the promotion of vegetation means the Terra-Lock® System is essentially 'self-healing', delivering longevity to the install
11. **Sediment Control** - Intimate contact with substrates retains soil particles, minimising erosion and downstream sedimentation
12. **Durable** - Manufactured using corrosion resistant materials to ensure longevity
13. **Steepened Slopes** - Allows slopes and embankments to be sharply angled, reducing groundworks and maximising use of space
14. **Lightweight** - Easy to handle on site and adds minimal excess loads to the structure; minimises settlement and subsidence, especially in poor soils
15. **Increased factor of safety** - The installation depth of anchors is calculated based on engineering principles to guarantee the System locks into structurally sound soil
16. **Failure Prevention** - The system actively holds the surface, locking it deep into the structures while catching and retaining surface failures

Terra-Lock™ System



Installation Guidelines & Procedures

STEP 1

Insert appropriate drive steel into Terra-Lock™ Anchor and place perpendicular to the slope.

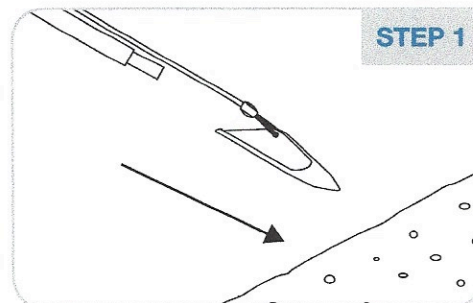
- Determine where anchor will be positioned, insert Drive Rod into anchor and swiftly puncture the Drive Rod and anchor through the mat in desired location. Entry point should be perpendicular to the slope

STEP 2

Drive the Terra-Lock™ Anchor to the desired depth.

- Appropriate means of driving anchors include:
 - Gas powered driver*
 - Hammer drill*
 - Sledge hammer

*Appropriate sized reducer sleeve required for efficient install



STEP 1

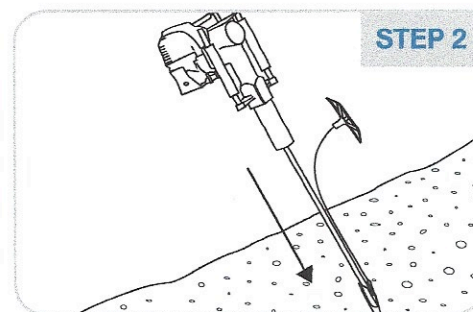
STEP 3

Remove Drive Rod and load-lock the anchor.

- In soft soils, Drive Rod can be removed by hand
- In tougher, compacted soils, Drive Rod may need to be extracted with the JackJaw®
 - Insert JackJaw® baseplate notch around Drive Rod, handle must be in up position to open jaws for insertion
 - Move lever handle of JackJaw® in full down/up motion until Drive Rod is extracted

STEP 4

- Once Drive Rod is removed, slide Terra-Lock™ termination to be flush with the ground
- Place JackJaw® baseplate directly over the center of the Terra-Lock™ termination, ensure cable is in line with the JackJaw® jaws. Handle must be in up position to open jaws
- Move lever handle of JackJaw® in full down/up motion. Pump until resistance is felt. Minimum of 2 complete pumps are necessary. The Terra-Lock™ termination will appear recessed in the mat once the anchor is load-locked



STEP 2

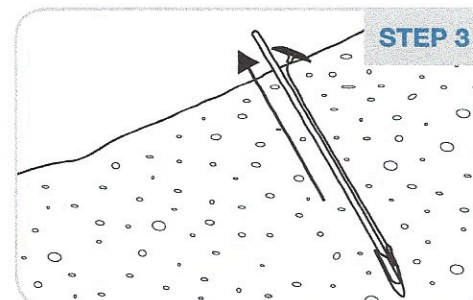
STEP 5

Cut the cable below the grade.

- Using cable cutters snip the wire below grade on the Terra-Lock™ Termination

PPE EQUIPMENT:

- Hard hat
- Safety glasses
- Gloves
- Ear defenders/plugs
- Vest and trousers
- Hi-vis clothing
- Safety boots



STEP 3

SPECIFIC HAZARDS

The key hazard in this procedure is the use of installation tools. The GPD is a petrol powered vibration driver; this vibration is considered to be low category, however, the necessary guidelines should be followed.

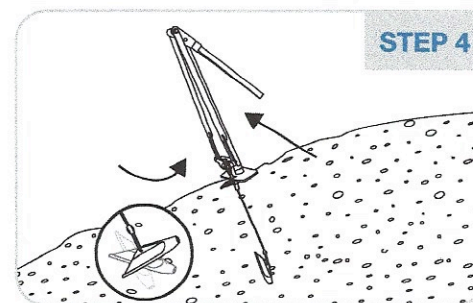
GPD safety warnings:

- Safety equipment PPE – ears, eyes, gloves and boots.
- Do not start the GPD whilst it is lying on the ground
- When using the GPD – stand firmly, hold with both hands and ensure that handles are clean from grease/oil.
- Ensure the engine is facing away from you during use.

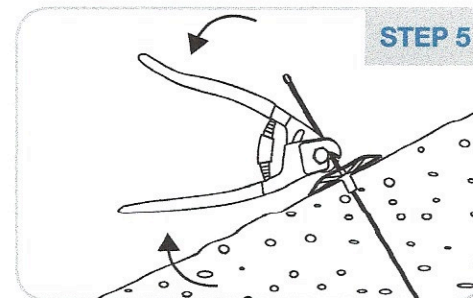
Normal use exposes the operator to vibration; this vibration is dampened to allow longer working times. It is recommended that daily use does not exceed 4 hours 'trigger time' per individual and regular breaks should be taken. If vibrations become more severe, the machine should be stopped immediately.

JackJaw® safety warnings:

- The JackJaw® uses moving parts in order to grip drive rods and wire rope. Gloves should always be worn and hands/body parts should be kept away from the moving parts, especially when it is in use.



STEP 4



STEP 5

U-Anchor Properties

Material	#3 Rebar
Leg length	18"
Leg spacing	3"

Picture of U-Anchor



Proudly Manufactured in the USA



RESULTS OF SLOPE STABILITY ANALYSES

Project:

**DSR-494
NC Wildlife Resource Commission Depot
7471 Shaw Highway
Rocky Point, NC**

Prepared By:

**Ardurra Group of NC
And
Gripple, Inc**

Date:

3/8/2022



**Slope Stability Analysis for Proposed Slope Armor/Repairs
Infinite Slope; Culmann's Wedge; and Method of Slices**

Slope Stability Analysis for DSR-494
NC Wildlife Resource Commission Depot
7471 Shaw Highway
Rocky, Point NC

Prepared By:
Ardurra Group of NC
Rudy Smithwick, PG
Mike Healy, PE

Prepared For:
Ardurra Group of NC

Date:
3/8/2022

Spreadsheet Slope Stability Calculator

Copyright © 2019 Ben Leshchinsky, Oregon State University

This calculator may be distributed freely for use. Under no circumstances may it be sold or may any charge be made for it. The author assumes no liability for its correctness or for any consequences or damages arising from its use. It is intended for educational purposes only.

CONTENTS:

This calculator provides three simple slope stability calculations. Notably:

- (1) **The Infinite Slope Method.** This slope stability analysis is often used to assess "shallow" failures, defined as failures that are translational in nature and often occur along a weak seam or interface with bedrock. This analysis is appropriate for scenarios where landslide geometry is expected to be wide and long in extents and where the general depth of soil does not change significantly along landslide extents. This analysis can account for seismicity, root reinforcement, surcharge and water.
- (2) **The Culmann Wedge Method.** This analysis assumes translational geometry and is often used for cut and fill slopes. It looks at many trial wedge geometries and determines the wedge that yields the lowest factor of safety. It is versatile in that it can account for external loads and finite slope geometry. This analysis can account for a surcharge, seismicity, and water.
- (3) **Ordinary Method of Slices.** This slope stability analysis accounts for circular failure geometry, appropriate for deep-seated slope failures that exhibit rotational kinematics. One must assume a trial failure geometry as an input. Once a user selects a critical failure geometry (perhaps from a back-analysis), a trial buttress geometry may be considered to reach a target factor of safety. This analysis can account for water and buttress drainage and stabilization.

DEFINITIONS:

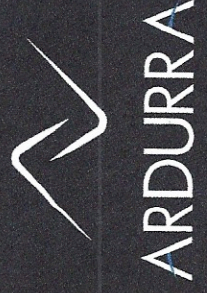
Internal angle of friction, ϕ' : A shear strength parameter that represents strength attained from effective normal stress.

Cohesion, c' : A shear strength parameter that is independent of effective normal stress. When considering undrained conditions, this may be treated as undrained shear strength (c_u) and ϕ should be set to 0.

Soil Unit Weight, γ : This represents the bulk density of soil.

Horizontal acceleration, k_h : This represents the horizontal inertial load stemming from seismicity. This is measured in units of gravity (g's).

Vertical acceleration, k_v : This represents the vertical inertial load stemming from seismicity. This is measured in units of gravity (g's).

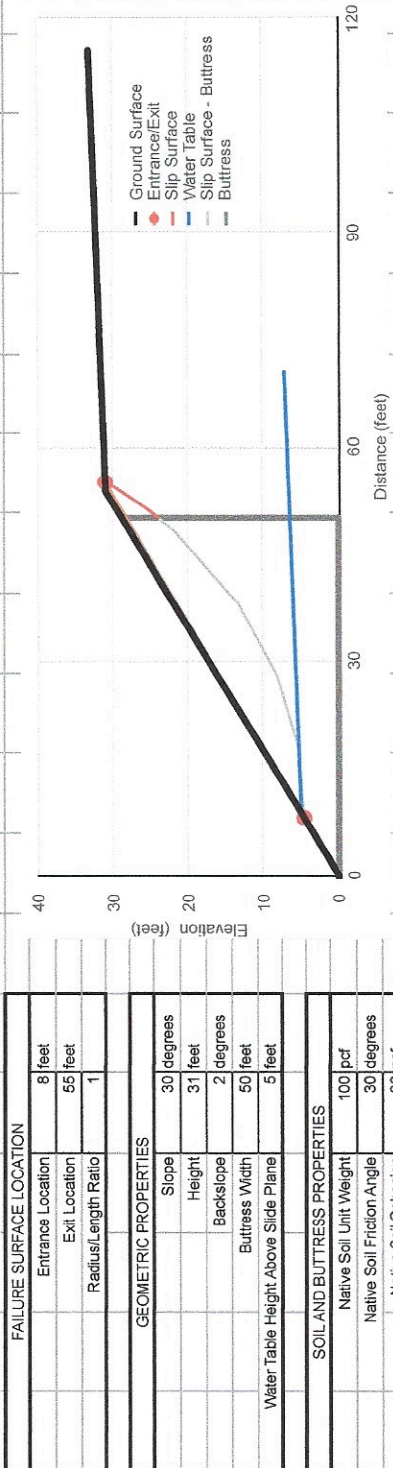


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Method of Slices-DSR 494/NCWRC/Rocky Point, NC



Slope Stability Analysis for DSR-494

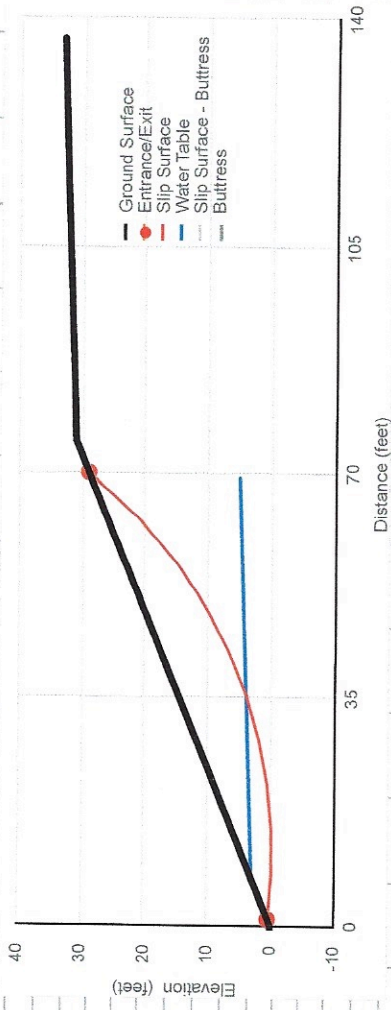
FAILURE SURFACE LOCATION		
Entrance Location	1	feet
Exit Location	70	feet
Radius/Length Ratio	1	

GEOMETRIC PROPERTIES		
Slope	22.5	degrees
Height	31	feet
Backslope	2	degrees
Buttress Width	1	feet
Water Table Height Above Slide Plane	3	feet

SOIL AND BUTTRESS PROPERTIES		
Native Soil Unit Weight	110	pcf
Native Soil Friction Angle	30	degrees
Native Soil Cohesion	50	psf
Rockfill Unit Weight	130	pcf
Rockfill Friction Angle	67	degrees
Rockfill Cohesion	100	psf

FACTOR OF SAFETY	1.57
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ROCKFILL VOLUME PER FOOT	0	CUBIC YARDS
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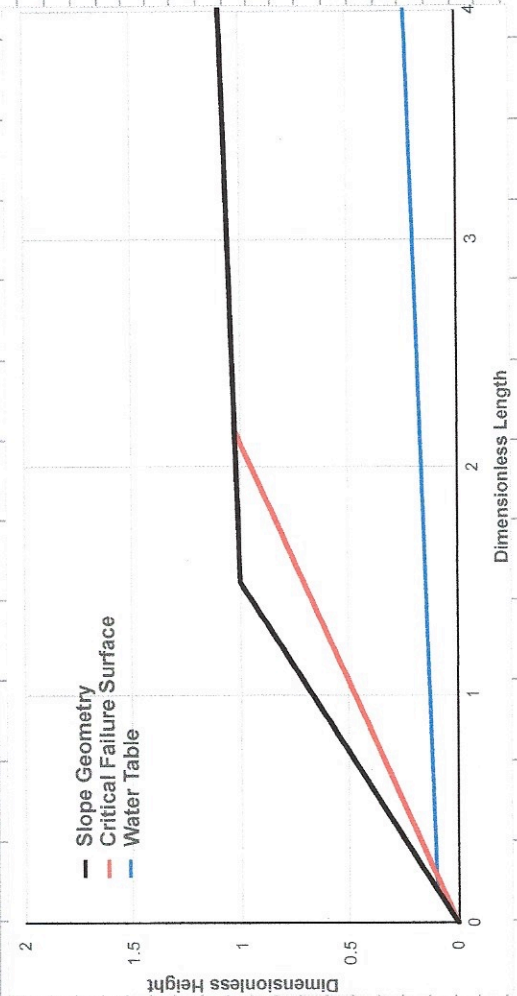


GEOMETRIC PROPERTIES	
Out or Fill Slope Angle	33.75 degrees
Backslope Angle	2 degrees
Height of Cut or Fill Slope	31 feet
Water Table Elevation	3 feet

SOIL PROPERTIES	
Unit Weight	100 pcf
Friction Angle	25 degrees
Cohesion	100 psf

OTHER PROPERTIES	
Horizontal Seismic Acceleration	0 g
Vertical Seismic Acceleration	0 g
Surcharge Clearance from Crest	0 ft
Surcharge Load on Crest	0 lbs

FACTOR OF SAFETY	1.55
CRITICAL FAILURE ANGLE	25.31



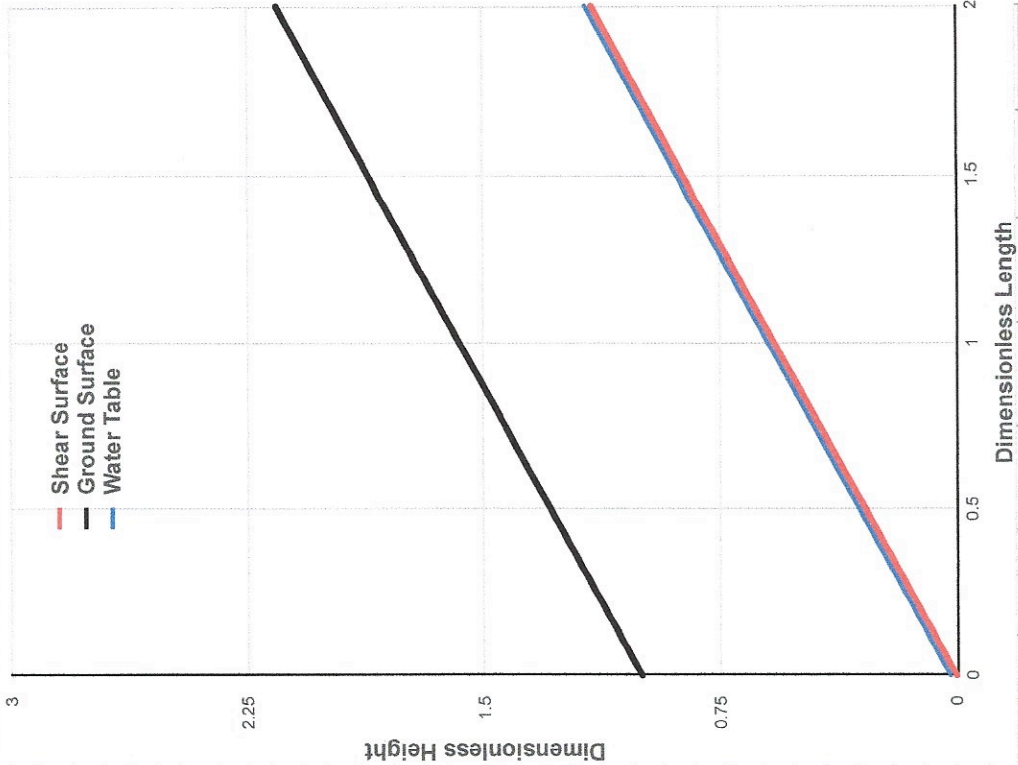
Infinite Slope-Using Slope Angle of 30.0

GEOMETRIC PROPERTIES		
Slope	30	degrees
Depth of Slide Plane	25	feet
Water Table Height Above Slide Plane	0.5	feet

SOIL PROPERTIES		
Unit Weight	100	pcf
Friction Angle	35	degrees
Cohesion	100	psf

OTHER PROPERTIES		
Horizontal Seismic Acceleration	0	g
Vertical Seismic Acceleration	0	g
Root Reinforcement at Slide Plane	0	psf
Tree Surcharge Pressure	0	psf

FACTOR OF SAFETY	1.29
------------------	------



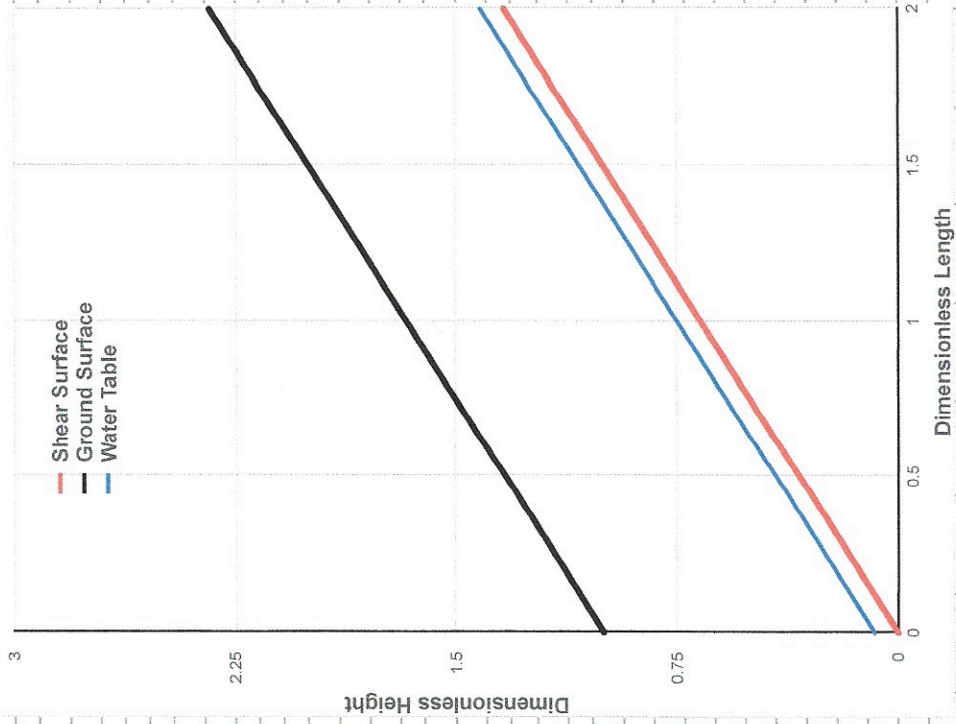
Infinite Slope Method -Using Slope Angle of 33.7

GEOMETRIC PROPERTIES		
Slope	33.75	degrees
Depth of Slide Plane	25	feet
Water Table Height Above Slide Plane	2	feet

SOIL PROPERTIES		
Unit Weight	100	pcf
Friction Angle	35	degrees
Cohesion	100	psf

OTHER PROPERTIES		
Horizontal Seismic Acceleration	0	g
Vertical Seismic Acceleration	0	g
Root Reinforcement at Slide Plane	0	psf
Trees Surcharge Pressure	0	psf

FACTOR OF SAFETY	1.07
------------------	------



From: Nicholas Paz <NPaz@gripple.com>
Sent: Monday, March 7, 2022 4:05 PM
To: Will Sullivan <will.sullivan@hanescompanies.com>; Rudy Smithwick
<RSmithwick@Ardurragroup.com>
Subject: RE: NC Wildlife Resources Flexamat Slope Stability

Will,

Thank you for coordinating things with Rudy.

Rudy,

I was able to make some adjustments to the model to increase the factor of safety to 1.15. I changed the anchor spacing to 8' and the anchors embedment depth to 9', however to poor soils are a limiting factor. With nothing but the friction angle increased from 28° to 32° the F.S. increases to > 1.34. If there is any way to confirm the soil properties, id be happy to run it again, otherwise I can continue to make adjustments to see if we can get any more performance with 28° and 101 lb/ft³.

Thank you,

Nicholas Paz

Business Development & Engineering Manager

Mobile: 813-460-9761 Email: NPaz@gripple.com



Gripple Inc.

1611 Emily Lane, Aurora, IL 60502 USA

Office: 630-406-0600 Fax: 630-406-0664

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RE: NC Wildlife Resources Flexamat Slope Stability

Nicholas Paz <NPaz@gripple.com>

Tue 3/8/2022 11:13 AM

To: Rudy Smithwick <RSmithwick@Ardurragroup.com>; Will Sullivan <will.sullivan@hanescompanies.com>
Cc: Mike Healy <MHealy@ardurragroup.com>; Mendle Floyd <mendlewayne.floyd@gmail.com>; Matt Motz <matt@flexamat.com>

Rudy,

Thank you for sharing your results. I don't see anything that is jumping out at me. Like I originally said, my values were conservative guesses so if you are comfortable with the slightly higher shear angle, and the higher FS then I am happy with that.

I would be happy to work with you on future projects as early as possible to simplify the design process and assist in any way I can.

As far as the 18" U-anchors are concerned; I spoke with Matt Motz about them. He said that Gripple percussion anchors can replace the U-anchors along the seam, however they do need to be placed at 2' spacing (same as the U-anchors). I have also looped Matt in on this email.

I am free all day, and would be happy to jump on a call to discuss anchor spacing / placement. Let me know how you all would like to proceed.

Thank you,

Nicholas Paz

Business Development & Engineering Manager

Mobile: 813-460-9761 Email: NPaz@gripple.com



Gripple Inc.

1611 Emily Lane, Aurora, IL 60502 USA

Office: 630-406-0600 Fax: 630-406-0664

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Slope Stability Analysis for Proposed Slope Armor/Repairs
LimitStateGEO3.5 Method

Slope Stability Analysis for DSR-494
NC Wildlife Resource Commission Depot
7471 Shaw Highway
Rocky, Point NC

Prepared By:
Nicholas Paz/Engineering Manager
Gripple, Inc.

Prepared For:
Ardurra Group of NC

Date:
3/8/2022

About this Report

This report has been generated using LimitState:GEO, a software application capable of directly identifying the critical collapse mechanism for a wide variety of geotechnical stability problems, including those involving slopes, retaining walls, footings etc.

The software utilizes the Discontinuity Layout Optimization (DLO) procedure to obtain a solution (Smith and Gilbert 2007). The main steps involved are: (i) distribution of nodes across the problem domain; (ii) connection of every node to every other node with potential discontinuities (e.g. slip-lines); (iii) application of rigorous optimization techniques to identify the critical subset of potential discontinuities, and hence also the critical failure mechanism and margin of safety.

The accuracy of the DLO solution is controlled by the specified nodal density. Within the set of all possible discontinuities linking pairs of nodes, all potential translational failure mechanisms are considered, whether anticipated or not by the engineer. Failure mechanisms involving rotations along the edges of solid bodies in the problem can also be identified. Thus in this case the solution identified by the DLO procedure is guaranteed to be the most critical solution for the problem posed. This means that there is no need to prescribe any aspect of the collapse mechanism prior to an analysis, or to separately consider different failure modes. The critical mechanism and collapse load factor are determined according to the well established upper bound theorem of plasticity.

LimitState:GEO reports the solution to a problem both visually as a collapse mechanism and numerically in terms of an Adequacy Factor, which is defined as the factor by which specified loads must be increased, or material strengths decreased, in order for the system under consideration to reach a collapse state.

REFERENCE

Smith, C.C. and Gilbert, M. (2007) Application of discontinuity layout optimization to plane plasticity problems, Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, Vol. 463, 2086, pp 2461-2484.

Summary

Name	Date of Analysis	Name of Engineer	Organization
Rocky Point	Mon Mar 7 2022	Nicholas Paz	Gripple Inc.

Reference #	Location	Map Reference	Tags
	Rocky Point, NC		

Comments
9ft deep anchors @ 8ft O.C. *** PRELIMINARY ***

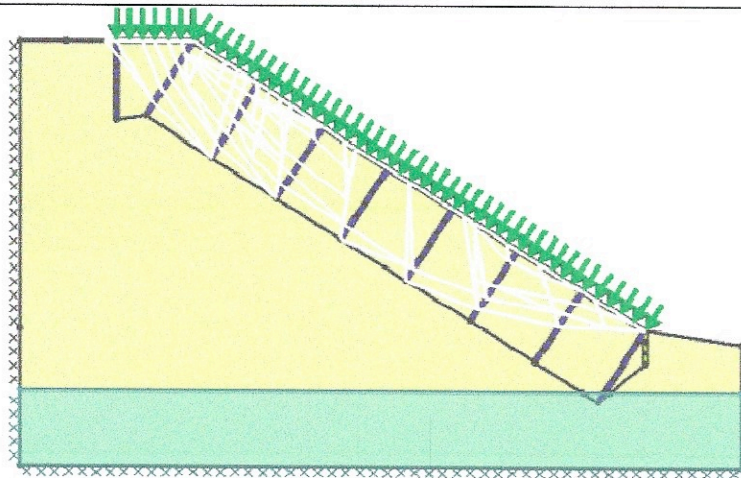
Target Nodal Density	Nodal Spacing Scale Factor	Water	Model Translational Failures?	Model Rotational Failures?	Seismic Accelerations: Horiz. / Vert. (g)
Medium (500 nodes)	1.05227	Enabled	True	Along edges	None

Scenario	Partial Factor Set	Short / Long Term?*	Analysis Type	Adequacy Factor
1*	Unity	Short / Long Term	Factor Strength(s)	1.146

*This report provides details of this scenario, which has been identified as the most critical.

**For Mohr Coulomb materials with Drainage Behaviour specified as 'drained/undrained', undrained properties are used in a short term analysis, and drained properties are used in a long term analysis.

Failure Mechanism (Scenario 1)



Analysis Options

Factor Strength(s)

Solution Tolerance (%)	Automatic Adequacy on Load(s)	Factor on Load(s)	Artificial Cohesion (kN/m ² (kPa))
1	True	1	0.1

Geometry

(all distances in ft)

All Geometrical Objects

No. of Vertices (V)	No. of Boundaries (B)	No. of Solids (S)
116	129	10

Solid Objects

ID	Vertex IDs (x, y)	Boundary IDs	Baseline Nodal Spacing (x / y)	Material(s)/Water Regime(s)
S1*	V1 (10.8268,1.24672) V659 (10.8268,-0.082021) V658 (10.8268,-1.41076) V657 (10.8268,-2.75591) V656 (10.8268,-3.93701) V655 (10.8268,-5.57743) V2 (10.8268,-6.88976) V3 (13.7795,-6.2336) V664 (14.7638,-4.92126) V663 (15.4199,-3.93701) V662 (16.4042,-2.52625) V661 (17.0604,-1.27953) V660 (18.0446,-0.00787402) V4 (18.7008,1.24672) V665 (17.3885,1.24672) V666 (16.0761,1.24672) V667 (14.7638,1.24672) V668 (13.4514,1.24672) V669 (12.1391,1.24672)	B1 B692 B691 B690 B689 B688 B2 B3 B697 B696 B695 B694 B693 B698 B699 B700 B701 B702 B4	3.28084 / 3.28084	Clean Fine Grained SAND (SP)
S4*	V3 (13.7795,-6.2336) V17 (20.6693,-10.4987) V681 (21.6535,-9.18635) V680 (22.3097,-8.2021) V679 (22.9659,-6.88976) V678 (23.9501,-5.57743) V677 (24.6063,-4.26509) V21 (25.5906,-3.05118) V686 (24.6063,-2.3294) V685 (23.294,-1.60761) V684 (22.3097,-0.885827) V683 (20.9974,-0.183727) V682 (20.0131,0.524934) V4 (18.7008,1.24672) V660 (18.0446,-0.00787402) V661 (17.0604,-1.27953) V662 (16.4042,-2.52625) V663 (15.4199,-3.93701) V664 (14.7638,-4.92126)	B17 B23 B714 B713 B712 B711 B710 B24 B719 B718 B717 B716 B715 B693 B694 B695 B696 B697 B3	3.28084 / 3.28084	Clean Fine Grained SAND (SP)
S5*	V17 (20.6693,-10.4987) V16 (27.5591,-14.7638) V691 (28.2152,-13.7795) V690 (29.1995,-12.4672) V689 (29.8556,-11.1549) V688 (30.8399,-9.84252) V687 (31.4961,-8.53018) V22 (32.4803,-7.21785) V696 (31.168,-6.56168) V695 (30.1837,-5.90551) V694 (28.8714,-5.24934) V693 (27.8871,-4.59318) V692 (26.5748,-3.60892) V21 (25.5906,-3.05118) V677 (24.6063,-4.26509) V678 (23.9501,-5.57743) V679 (22.9659,-6.88976) V680 (22.3097,-8.2021) V681 (21.6535,-9.18635)	B16 B25 B724 B723 B722 B721 B720 B26 B729 B728 B727 B726 B725 B710 B711 B712 B713 B714 B23	3.28084 / 3.28084	Clean Fine Grained SAND (SP)
S6*	V16 (27.5591,-14.7638) V15 (32.8084,-19.357) V701 (36.0892,-18.0446) V700 (36.0892,-16.7323) V699 (36.0892,-15.4199)	B15 B27 B734 B733 B732	3.28084 / 3.28084	Clean Fine Grained SAND (SP)

	V698 (36.0892,-14.1076) V697 (39.3701,-12.7953) V23 (39.3701,-11.811) V706 (39.3701,-10.8268) V705 (36.0892,-10.1706) V704 (36.0892,-9.51444) V703 (36.0892,-8.85827) V702 (32.8084,-8.2021) V22 (32.4803,-7.21785) V687 (31.4961,-8.53018) V688 (30.8399,-9.84252) V689 (29.8556,-11.1549) V690 (29.1995,-12.4672) V691 (28.2152,-13.7795)	B731 B730 B28 B739 B738 B737 B736 B735 B720 B721 B722 B723 B724 B25		
S7*	V15 (32.8084,-19.357) V14 (39.3701,-23.622) V711 (42.6509,-22.3097) V710 (42.6509,-20.9974) V709 (42.6509,-19.685) V708 (42.6509,-18.3727) V707 (45.9318,-17.3885) V24 (45.9318,-16.0761) V716 (45.9318,-15.0919) V715 (42.6509,-14.4357) V714 (42.6509,-13.7795) V713 (42.6509,-13.1234) V712 (39.3701,-12.4672) V23 (39.3701,-11.811) V697 (39.3701,-12.7953) V698 (36.0892,-14.1076) V699 (36.0892,-15.4199) V700 (36.0892,-16.7323) V701 (36.0892,-18.0446)	B14 B29 B744 B743 B742 B741 B740 B30 B749 B748 B747 B746 B745 B730 B731 B732 B733 B734 B27	3.28084 / 3.28084	Clean Fine Grained SAND (SP)
S8*	V14 (39.3701,-23.622) V13 (49.2126,-27.8871) V721 (49.2126,-26.5748) V720 (49.2126,-25.2625) V719 (49.2126,-23.9501) V718 (52.4934,-22.6378) V717 (52.4934,-21.6535) V25 (52.4934,-20.3412) V726 (52.4934,-19.685) V725 (49.2126,-18.7008) V724 (49.2126,-18.0446) V723 (49.2126,-17.3885) V722 (45.9318,-16.7323) V24 (45.9318,-16.0761) V707 (45.9318,-17.3885) V708 (42.6509,-18.3727) V709 (42.6509,-19.685) V710 (42.6509,-20.9974) V711 (42.6509,-22.3097)	B13 B31 B754 B753 B752 B751 B750 B32 B759 B758 B757 B756 B755 B740 B741 B742 B743 B744 B29	3.28084 / 3.28084	Clean Fine Grained SAND (SP)
S9*	V13 (49.2126,-27.8871) V12 (55.7743,-32.1522) V731 (55.7743,-30.8399) V730 (55.7743,-29.5276) V729 (55.7743,-28.2152) V728 (59.0551,-27.231) V727 (59.0551,-25.9186) V26 (59.0551,-24.6063) V736 (59.0551,-23.9501) V735 (55.7743,-23.294) V734 (55.7743,-22.3097) V733 (55.7743,-21.6535) V732 (52.4934,-20.9974) V25 (52.4934,-20.3412)	B12 B33 B764 B763 B762 B761 B760 B34 B769 B768 B767 B766 B765 B750	3.28084 / 3.28084	Clean Fine Grained SAND (SP)

	V717 (52.4934,-21.6535) V718 (52.4934,-22.6378) V719 (49.2126,-23.9501) V720 (49.2126,-25.2625) V721 (49.2126,-26.5748)	B751 B752 B753 B754 B31		
S2	V5 (0.82021,-42.6509) V6 (75.4593,-42.6509) V7 (75.4593,-36.0892) V8 (75.4593,-30.1837) V9 (65.6168,-28.8714) V671 (65.6168,-29.8556) V670 (65.6168,-31.168) V10 (65.6168,-32.1522) V741 (62.336,-36.0892) V11 (62.336,-36.0892) V742 (59.0551,-36.0892) V12 (55.7743,-32.1522) V13 (49.2126,-27.8871) V14 (39.3701,-23.622) V15 (32.8084,-19.357) V16 (27.5591,-14.7638) V17 (20.6693,-10.4987) V3 (13.7795,-6.2336) V2 (10.8268,-6.88976) V655 (10.8268,-5.57743) V656 (10.8268,-3.93701) V657 (10.8268,-2.75591) V658 (10.8268,-1.41076) V659 (10.8268,-0.082021) V1 (10.8268,1.24672) V205 (5.57743,1.24672) V18 (0.82021,1.24672) V19 (0.82021,-28.8714) V20 (0.82021,-36.0892)	B5 B6 B7 B8 B9 B704 B703 B10 B774 B11 B775 B12 B13 B14 B15 B16 B17 B2 B688 B689 B690 B691 B692 B1 B18 B222 B19 B20 B21	3.28084 / 3.28084	Clean Fine Grained SAND (SP)
S3	V11 (62.336,-36.0892) V741 (62.336,-36.0892) V10 (65.6168,-32.1522) V670 (65.6168,-31.168) V671 (65.6168,-29.8556) V9 (65.6168,-28.8714) V672 (65.6168,-29.8556) V673 (65.6168,-31.168) V674 (62.336,-32.4803) V675 (62.336,-32.8084) V676 (62.336,-36.0892) V743 (62.336,-36.0892)	B774 B10 B703 B704 B9 B705 B706 B707 B708 B709 B778 B22	3.28084 / 3.28084	Clean Fine Grained SAND (SP)
S10	V12 (55.7743,-32.1522) V742 (59.0551,-36.0892) V11 (62.336,-36.0892) V743 (62.336,-36.0892) V676 (62.336,-36.0892) V675 (62.336,-32.8084) V674 (62.336,-32.4803) V673 (65.6168,-31.168) V672 (65.6168,-29.8556) V9 (65.6168,-28.8714) V740 (65.6168,-27.8871) V739 (62.336,-27.231) V738 (62.336,-26.2467) V737 (59.0551,-25.2625) V26 (59.0551,-24.6063) V727 (59.0551,-25.9186) V728 (59.0551,-27.231) V729 (55.7743,-28.2152) V730 (55.7743,-29.5276) V731 (55.7743,-30.8399)	B775 B11 B22 B778 B709 B708 B707 B706 B705 B35 B773 B772 B771 B770 B760 B761 B762 B763 B764 B33	3.28084 / 3.28084	Clean Fine Grained SAND (SP)

* Loaded solid (self weight).

Water Table

(all distances in ft)

Water Table Status	Vertices (x, y)
Enabled	(0.833333, -35.25) (75.8333, -35.25)

Water Regimes


(potentials in ft, pressures in psf (lb/ft²))

(No water regime defined)

Materials



(unit weights (weight densities) in pcf (lb/ft³), strengths in psf (lb/ft²), angles in degrees, datum level in ft, undrained strength gradient in psf (lb/ft²)/ft)

Mohr-Coulomb Material(s)

Key	Name	Unit Weight (Saturated Unit Weight)	Drainage Behaviour	c' (φ')	c _u (datum) (gradient) (grid)
	Clean Fine Grained SAND (SP)	101 (105)	Always drained	0* (28*)	0 (0) (0) (-)

*Property used in Scenario 1 (described in this report).

Engineered Element Material(s)

Key	Name	Pullout Factors: Tc (Tq)	Lateral Factors: Nc (Nq)	Mp	Rupture Strength	Compression Strength	Subdivide at Nodes?
	TLA4	138(0)	100(0)	1e+30	1e+30	1e+30	True
	FLEAMAT	1e+30(0)	1e+30(0)	0	22637.8	0	True

Partial Factors

Factor	User*			
Unfavourable: permanent	1			
Unfavourable: variable	1			
Unfavourable: accidental	1			
Favourable: permanent	1			
Favourable: variable	1			

Favourable: accidental	1			
c'	1			
$\tan\phi'$	1			
c_u	1			

*These partial factors were used in Scenario 1 (described in this report).

Loads

(normal and shear loads in psf (lb/ft²))

Solid Objects

Loaded Object	Type	Loading Type	Adequacy?
S1	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S4	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S5	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S6	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S7	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S8	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S9	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S63	Permanent (unfactored self weight: 105 pcf (lb/ft ³))	neutral	true
S64	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S65	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S66	Permanent (unfactored self weight: 105 pcf (lb/ft ³))	neutral	true
S67	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true
S68	Permanent (unfactored self weight: 105 pcf (lb/ft ³))	neutral	true
S69	Permanent (unfactored self weight: 101 pcf (lb/ft ³))	neutral	true

PLANS & SPECIFICATIONS

APPENDIX 1

SITE PHOTOGRAPHS OF SLOPE REPAIR AREA

for

**DSR-494
NC Wildlife Commission Depot
7471 Shaw Highway
Rocky Point, NC**

NC Wildlife Depot

aerial photo w/ 80 ft. scale
Top of slope=24.0 ft by pin
Water Elevation (toe)=4.0 ft.

Legend

 Slope Erosion/NC Wildlife Depot

Northeast Cape Fear River

 Slope Erosion/NC Wildlife Depot

Google Earth



80 ft

→ Cape Fear River Depot



5/1/11