

Specifications

Vegetated Retaining Wall System

1. **Vegetated Retaining Wall and Steepened Slope System, Item SPV.**

A Description

This special provision describes furnishing and installing all materials required to construct and establish a Vegetated Retaining Wall and Steepened Slope System. The work includes furnishing and installing soil bags, soil bag locking pins, geogrid soil bag stabilizer strips, geotextile fabric, erosion mat, foundation material, soil, live plants, and hydroseeding mix. The work also includes submitting retaining wall design calculations, soil testing reports, plant and seed lists and proof of install qualifications, ongoing maintenance schedule and warranty commitments to the engineer for approval.

B Materials

B1 Soil Bags

(1) Furnish soil bags consisting of a staple fiber, needle-punched, non-woven polypropylene geotextile meeting the following specifications:

- Grab Tensile Strength – 115 pounds - *ASTM Test Method D4632*
- Fabric Weight - 3.5 ounces per square yard - *ASTM Test Method D5261*
- Mullen Burst Strength - 210 pounds per square inch - *ASTM Test Method D3786*
- UV resistance @ 500 hours - greater than 70% - *ASTM Test Method D4355*
- Water Flow – 140 gallons per minute per square foot

Unfilled bags shall be nominally 18 inches x 36 inches, including seams. Stitch all seams with polyester thread. Bags (including bag fill) shall have a nominal weight of 80 pounds each. Bags shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the structure.

(2) Bag fill shall consist of 80% (by volume) clean sandy and granular material and 20% (by volume) fine Grade compost that conforms to the criteria below.

Characteristic	Range	Desirable
pH	5.0-8.5	6.0-7.5
Soluble salts	1-10 dS/m	5 dS/m or less
Carbon: Nitrogen	20:1	12:1 to 30:1
Water Holding Capacity <i>dry weight basis</i>	75-200%	100% or better
Bulk Density	700-1200 lbs/yd ³	800-1000 lbs/yd ³
Moisture Content	30-60%	40-50%
Organic Matter Content	30-70%	50-60%
Particle Size		3/4-3/8" screening
Trace Elem. Heavy Metals		Pass EPA Part 503
Growth Screenings		Pass germ. growth assays
Stability		Stable to highly stable
Meets or exceeds WDNR S100 specifications		

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(3) Soil bag fill shall be free of sharp material that could damage or puncture the geotextile fabric. Soil from the project site may be used if quality is equivalent to WDNR S100 compost. Soil must be free of chemical contaminants. Link to S100 compost specification:
<http://www.dnr.state.wi.us/org/water/wm/nps/pdf/stormwater/techstds/post/SpecificationS100Compost.pdf>

B2 Soil Bag Locking Pins

(1) Furnish locking pins made of polypropylene. The locking pin shall be a 4-inch diameter disc with 1/2-inch diameter spikes protruding 90 degrees from the center of each side of the disc, 2 inches in length. Pins must be capable of allowing root growth while retaining structural shear strength.

B3 Geogrid Soil Bag Strips

(1) Furnish geogrid strips consisting of a 4-inch wide uniaxial network of integrally connected tensile elements with aperture geometry sufficient to permit significant mechanical interlock with surrounding soil, aggregate or other material. Geogrid shall be high density polyethylene (HDPE) with a nominal tensile strength of 3,000 pounds per square foot. Furnish geosynthetics currently approved for use such as Miragrid 3XT, Stratagrid 200, and Tensar UX1400SB.

B4 Foundation & Backfill Material

(1) Furnish material for the soil bag wall foundation consisting of compacted sand, gravel, or combination thereof (USCS soil types GP, GW, SP, and SW). Aggregate shall be pea gravel, clean stone or granular type fill (no sharp angled stones that puncture bags) meets the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch	100
3/4-inch	75-100
No. 4	0-60
No. 40	0-50
No. 200	0-5

(2) Furnish clean soil conforming to Section 625 of the standard WisDOT specification for backfilling behind the wall system as required.

<http://roadwaystandards.dot.wi.gov/standards/stndspec/toc.pdf>

B5 Geotextile Fabric

(1) Furnish fabric consisting of a staple fiber, needle-punched, non-woven polyethylene geotextile meeting the following specifications:

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- Grab Tensile Strength – 15 pounds - *ASTM Test Method D4632*
- Fabric Weight - 3.5 ounces per square yard - *ASTM Test Method D5261*
- Mullen Burst Strength - 210 pounds per square inch - *ASTM Test Method D3786*
- UV resistance @ 500 hours - greater than 70%- *ASTM Test Method D4355*
- Water Flow – 100 gallons per minute per square foot

B6 Erosion Mat

(1) Furnish a minimum of Class II Type C Erosion Mat conforming to section 628 of the Standard WisDOT Specifications above the bag system. Link to Product Acceptability List (PAL): <http://www.dot.wisconsin.gov/business/engrserv/docs/pal.pdf>

B7 Live Plant Installation

(1) Furnish live plants for installation per the plans, details, and this special provision.

(2) Submit a complete list of all live herbaceous plants, tubers, bulbs, and dormant root stocks to the owner’s representative prior to delivery of any materials to the site. Include complete data on source, quantity, and quality. This submittal will in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved by the owner’s representative. Submit “as-built” plans including a listing of all species installed, locations, and quantities installed to the owner’s representative after the work is complete. Mark on the original planting plan any field changes or deviations from the original plans.

(3) All material shall be true to genus and species. Cultivars and hybrids are not recommended. Species substitutions must be approved by the owner’s Representative. Plant plugs shall be 2.5” x 2.5” square with a depth of 3.5”, deep 38’s or equivalent. Plugs shall have well developed root systems filling the soil. Plant tops shall be well developed, healthy, viable, and adequately hardened off for outdoor planting. Deliver plugs to the planting site with adequate soil moisture, free of disease, mold, insect infestation, or other defects. Plants used shall be grown from seed origins within the project eco-region.

(4) Provide the sources of plant material (include name if nursery, address, telephone number and name of contact person for each source). Plants shall be selected from nurseries that have been inspected and certified by the State Department of Agriculture in the state where the plant was obtained.

Emergent Zone: Furnish live plants in equal amounts from the following list.

Grasses	
Latin Name	Common Name
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco	Appropriate for site conditions in your Eco-Region

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Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Sedges	
Latin Name	Common Name
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Wildflowers	
Latin Name	Common Name
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region

Wetland Zone: Furnish live plants in equal amounts from the following list.

Grasses	
Latin Name	Common Name
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region

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Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
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Riparian Buffer Zone: Furnish live plants in equal amounts from the following list.

Grasses	
Latin Name	Common Name
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Sedges	
Latin Name	Common Name
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Wildflowers	
Latin Name	Common Name
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region
Appropriate for site conditions in your Eco-Region	Appropriate for site conditions in your Eco-Region

- 5) Woody species may be installed from live plants, bare roots and cuttings. If cuttings are used increase numbers 33% per bag.
- 6) Contact Native growers from the projects Eco-Region for recommendations. Vegetation must cover the wall and also help lock system to the parent material on site.

B8 Hydroseeding

(1) Furnish seed mix for application per the plans, details and this special provision.

(2) Provide a copy of the seed mix listing the following information to the engineer prior to the delivery of the seed.

- Pure Live Seed (PLS) oz per Species
- PLS seeds per total area
- PLS seeds per square foot
- Total PLS seeds per square foot

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- Seeds per square foot per species
- Total seeds per acre
- Total seeds per square foot

Furnish hydroseeding native mix in accordance with the following table:

Common Name	Latin Name	Wetland Indicator	Coefficient of Conservatism	Seeds/oz	PLS %	Total PLS Oz	% of Mix
Grasses							
Appropriate for site conditions in your Eco-Region							
Sedges							
Appropriate for site conditions in your Eco-Region							
Wildflowers							
Appropriate for site conditions in your Eco-Region							

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(1) Provide the following submittals to the engineer prior to start of wall system:

1. Retaining wall design submittal – Submit two sets of detailed design calculations and final construction plans for approval two weeks prior to start wall system. All calculations and drawings shall be prepared and sealed by a Professional Engineer (P.E.) licensed in the State of the project.
2. Bag fill soil test reports to confirm no contamination present in any soil to be used as part of the system.
3. Live plant list as described in section B7 paragraph (2) of this special provision.
4. Seed mix list as described in section B8 paragraph (2) of this special provision.
5. Proof of contractor qualifications as described in section C12 of this special provision.

C Construction

C1 Soil Bags

(1) Fill soil bags with a homogenous mix of sand and compost as described in section B of this special provision. Seal each bag with a plastic zip tie. Install soil bags at locations as per the details and as shown in the plans. Follow manufacturer's recommended installation guidelines for detailed construction or as directed by the engineer.

(2) Place bags in a staggered fashion, overlapping half of the bag below. Tamp each bag firmly in place, with seams exposed to wall face.

C2 Soil Bag Locking Pins

(1) Insert two locking pins per bag, between each course of bags, so each bag is pinned to adjacent bags above and below.

C3 Geogrid Soil Bag Stabilizer Strips

(1) Install geogrid strips in an over-under weaving fashion along each course of soil bags. Splice geogrid strips with a minimum overlap of 2 soil bags or tie together using a square knot. Install geogrid parallel to the soil bag wall ensuring that the fabric's strength axis is aligned in the same manner.

C4 Foundation and Backfill

(1) Foundation material: Place fill in 6-inch lifts and compact.

(2) Backfill: Backfill in a manner that prevents damage or misalignment of facing wall unit.

C5 Geotextile Fabric

(1) Install fabric per Section 645 of the standard specifications.

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C6 Erosion Mat

(1) Install erosion mat per Section 628 of the standard WisDOT specifications.

C7 Live Plant Installation

(1) Install plants in the correct zone as shown on the detail, per manufactures guidelines and as follows:

Emergent Zone Plantings: Install one to three plants per bag in a random assortment, between layers of bags during wall construction. Do not puncture the bags during installation.

Wetland Zone Plantings: Install one to three plants per bag in a random assortment, between layers of bags during wall construction. Do not puncture the bags during installation.

Riparian Buffer Zone Plantings: Install plants in a random assortment, with a minimum of one plant per square foot.

C8 Hydroseeding

(1) Hydrate bags to saturation.

(2) Sow or spread native seed upon the installed bags using a stream or spray of water under pressure and operated from an engineer-approved machine designed for that purpose. Place the selected seed mixture and water into a tank provided within the machine, in sufficient quantities that when spraying the seed on a given area it is uniformly spread at the required application rate. During this process, keep the contents stirred or agitated to provide uniform distribution. Spread the tank contents within 1 hour after adding the seed to the tank. The engineer will reject seed that remains mixed with the water for longer than one hour.

(3) Apply fiber mulch and bonding agent to installed bags using a stream or spray of water under pressure and operated from an engineer-approved machine designed for that purpose. Place the material and water into a tank provided within the machine, in sufficient quantities that when spraying the material on a given area it is uniformly spread at the required application rate. During this process, keep the contents stirred or agitated to provide uniform distribution.

(4) Sequencing

Seeding:

Time seeding appropriate for the project Eco-Region. Consult a Local Eco-Region native nursery for appropriate seeding dates.

C9 Plant Establishment Period

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(1) Ensure the plants are growing for two (2) months following live plant installation and seed germination. Replace all dead plants with live plants of same species, if required during this period.

C10 Plant Maintenance

(1) Maintain plants by watering, weeding, hand pulling and/or herbicide applications, and resetting plants, as required to establish healthy, viable plantings for three (3) years following live plant installation and seed germination.

(2) Remove noxious and invasive plants of your eco-region from the project area.

Latin Name	Common Name
<i>Noxious and Invasive plants for the projects Eco-Region</i>	<i>Noxious and Invasive plants for the projects Eco-Region</i>
<i>Noxious and Invasive plants for the projects Eco-Region</i>	<i>Noxious and Invasive plants for the projects Eco-Region</i>
<i>Noxious and Invasive plants for the projects Eco</i>	<i>Noxious and Invasive plants for the projects Eco</i>
<i>Noxious and Invasive plants for the projects Eco</i>	<i>Noxious and Invasive plants for the projects Eco</i>
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<i>Noxious and Invasive plants for the projects Eco</i>	<i>Noxious and Invasive plants for the projects Eco</i>
<i>Noxious and Invasive plants for the projects Eco</i>	<i>Noxious and Invasive plants for the projects Eco</i>

(3) Herbicide treatments shall be performed by licensed applicators who are experienced with native and non-native plant identification. Used herbicides in full conformance with label requirements and application techniques and approved by local ordinances. Take care to limit overspray and damage to off-target species. Manage pests to maintain plants in a healthy and aesthetically pleasing condition for the long term. Maintain all plants through the establishment period.

(4) Establish a semi-monthly maintenance cycle and provide written documentation of tasks performed to the owner after each cycle.

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C11 Contractor Qualification

(1) Contractor must be able to fulfill the following qualifications:

1. Ability to reach the project site within 48 hours following a notice of emergency repairs needed.
2. Obtain seeds and plants native to your Eco-Region.
3. Provide Certified Contactor Installation Certificate from Vegetated Retaining Wall and Steepened Slope System manufacturer or employ a manufacturer certified site superintendent during the installation of the project.

D Measurement

(1) The Owner or Owners Representative will measure Vegetated Retaining Wall and Steepened Slope System in area by the square foot (SF). Calculate the area by multiplying the distance between the bottom of the toe bag and the upper bag of the wall (measured along the grade) by the length. Measure each wall individually.

E Payment

(1) The Owner or Owners Representative will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV	Vegetated Retaining Wall and Steepened Slope System	SF

(2) Payment is full compensation for providing all necessary submittals prior to construction; preparing the site; including excavation and disposal of surplus materials; furnishing and installing soil bags, soil bag locking pins, geogrid soil bag stabilizer strips, geotextile fabric, erosion mat, foundation material, live plants, and hydroseeding mix; backfilling; establishing and maintaining vegetation; and for furnishing all tools, labor, equipment, and incidentals necessary to complete the contract work.