



7 – LANDSCAPING

DESIGN AND ESTIMATING PRINCIPLES FOR CATEGORY 700 – LANDSCAPING

[VERSION DEVELOPED FOR ACCESS AND DISTRICT PERMIT APPLICANTS]

Cat 700 Introduction

This Manual explains landscape design and estimating principles used to develop Plans, Engineer’s Estimates, and Specifications of the Invitation for Bids (IFB). Guidance is provided for Category Code items that are associated with Sections 701 through 716 of the SHA Standard Specifications for Construction & Materials (SHA Specifications) and for some other items that are often used for landscape construction. Unless other Special Provisions are approved for a project and inserted into the IFB, the guidance of this document applies to all SHA contracts that reference SHA Specifications.

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Cat 700 Organization of This Manual

Order Cat. 700 - Landscaping. Chapters of this Manual follow Section numbers of the SHA Specifications for Cat. 700 - Landscaping. Thus, Category Code items associated with Sections of the SHA Specification follow in order by Section with relevant information about design principles and cost estimating for the pertinent items.

Landscape-Related Items. Discussion of items that are often used in landscaping, but which are not associated with a Section of the SHA Specifications, or which are not Category 700 – Landscaping Category Code items follow at the end of the Manual.

Pages, Chapter and Section Numbers. Page numbers of this Manual are prefixed “N” such as N-18. Chapters of the Landscape Design Guide are prefixed “LDG” such as LDG-7.6. References to SHA Specifications always use their assigned numbers such as Section 710 or 710.03.02.

Cat 700 SHA Landscape Design Guidance Documents

The following documents are available online or from the Office of Environmental Design (OED):

- **SHA Landscape Estimating Manual.** This Manual explains design and estimating principles for Category Code items associated with SHA Specifications and Special Provisions (SPs).
⇒ Go to: <http://www.roads.maryland.gov/index.aspx?PageId=25>
- **SHA Landscape Design Guide (LDG).** Explains organization and assistance of the SHA Office of Environmental Design (OED), as well as design principles and geometric standards for roadside landscaping.
⇒ LDG: <http://www.roads.maryland.gov/index.aspx?PageId=25>

The SHA Design Guide (LDG) explains the SHA Landscape Design Philosophy and principles to develop context sensitive, environmentally appropriate, cost-effective and sustainable landscaping. The LDG and its appendices include detailed information about the following:

- Role of Office of Environmental Design
 - Context sensitive landscape design
 - Contacts in Office of Environmental Design
 - Clear zones, offset distances to trees & shrubs
 - Required elements of landscape plans
 - Preferred uses and sizes of plant materials
 - Environmental compliance & mitigation
 - Design of roadsides, mitigation, facilities
 - Offset distances to utilities and structures
 - Forms and other reference documents
- **SHA Preferred Plant List (PPL).** A spreadsheet of acceptable and prohibited species and cultivars of trees, shrubs and other plant materials for highway installation.
⇒ PPL: <http://www.roads.maryland.gov/index.aspx?PageId=25>
 - **SHA Environmental Guide for Access and District Permit Applicants.** The “Environmental Guide” explains landscape design and plan requirements for private construction projects on SHA rights of ways and easement areas, and within areas of SHA property and lands to be conveyed to SHA as part of a permit application.
⇒ Environmental Guide: <http://www.roads.maryland.gov/index.aspx?PageId=25>
 - **Other Landscape Design Guidance Documents and Assistance.** Refer to SHA Landscape Design Guide and Environmental Guide for contact information of OED staff and documents that are available by email.
 - **Special Provisions Format Writing Guide.** Explains fonts, margins, abbreviations and other requirements for SPs developed for IFBs of SHA construction contracts. This document is available by email from OED-LOD.

Cat 700 SHA Standard Specifications for Construction & Materials

Hereafter referred to as SHA Specifications, these specifications define SHA landscape construction materials and methods and are required for all SHA Contracts unless other specifications are approved.

- All originally published Sections of Category 700 – Landscaping and Section 920 - Landscaping Materials, were revised and replaced in 2015 with Special Provisions Inserts (SPIs).
- All Cat. 700 Specifications, including all 2015 SPIs will be completely replaced when the 2017 Specifications are approved and published.
- Refer to N-3 for information about writing SPs using SHA approved format and style.
- Refer to information following below regarding changes to SHA Landscape Specifications.
 - ⇒ SHA SPIs: <http://www.roads.maryland.gov/Index.aspx?PageId=44> (all SHA SPIs)
<http://www.roads.maryland.gov/index.aspx?PageId=25> (only landscape-related SPIs)
 - ⇒ Other Special Provisions are available by email from OED-LOD.

Cat 700 Changes to SHA Landscape Specifications

2008 SHA Specifications Will Soon be Obsolete. Due to changes to Maryland laws and other adjustments to improve construction inspection and compliance, all originally published Sections of Cat. 700 - Landscaping and Section 920 of the 2008 SHA Specifications and all subsequent Special Provisions Insets (SPIs) of the 2008 SHA Specifications will soon be obsolete.

When new Standard Specifications for Construction and Materials are published in 2017, all construction under an Access Permit or a District Permit must conform to the requirements of the 2017 Specifications. This requirement will supersede any requirements of SHA Landscape Notes reproduced on plans that were previously approved as part of a Permit submittal.

New Specifications for landscape construction and landscape materials will be published at <http://www.roads.maryland.gov/index.aspx?PageId=25> as soon as feasible after the 2017 Specifications are published for use.

Staff of OED-LOD will provide assistance to explain the requirements of new 2017 Specifications during project design and construction.

Cat 700 SHA Landscape Details

Standard Details of the SHA Book of Standards for Highway and Incidental Structures apply to all SHA contracts. These details are not reproduced on plans, but references and hyperlinks to SHA Standard Details are included in the 2017 SHA Specifications.

- When project-specific non-standard details are needed, they should be reproduced on plans. OED-LAD has non-standard landscape details available for use.

- A link to SHA Standard Details and a list of all SHA Standard Details for Landscaping is provided below, and a link to OED-LAD landscape details follows afterwards:

⇒ SHA Standard Details of SHA Book of Standards:

<http://apps.roads.maryland.gov/BusinessWithSHA/bizStdsSpecs/desManualStdPub/publicationonline/ohd/bookstd/toccat7.asp>

MD-710.03-01	STAKING EVERGREEN TREES 5 AND 6 FEET HIGH
MD-710.03-02	STAKING EVERGREEN TREES 7, 8 AND 9 FEET HIGH
MD-710.03-03	GUYING EVERGREEN TREES 10 FEET HIGH AND GREATER
MD-710.03-04	STAKING FLOWERING TREES 6 FEET HIGH TO 2 INCH CALIPER
MD-710.03-05	GUYING FLOWERING TREES 3 INCH CALIPER AND GREATER
MD-710.03-06	STAKING SHADE TREES 6 FEET HIGH TO 2 INCH CALIPER
MD-710.03-07	STAKING SHADE TREES 2 INCH TO 3 INCH CALIPER
MD-710.03-08	GUYING SHADE TREES 4 INCH CALIPER AND GREATER
MD-710.03-09	FASTENERS FOR TREE SUPPORT
MD-710.03-10	PLANTING VINES ADJACENT TO WALLS FLAT AREAS AND SLOPES FLATTER THAN 4:1
MD-710.03-11	PLANT BED MULCHING AND PLANT LAYOUT ON FLAT AREAS AND SLOPES FLATTER THAN 4:1
MD-710.03-12	PLANT BED MULCHING AND PLANT LAYOUT ON SLOPES 4:1 AND STEEPER
MD-710.03-13	PRUNING PATTERNS
MD-710.03-14	PLANTING TREES ON SLOPES FROM 3:1 TO 2:1
MD-710.03-15	ROOT COLLAR HEIGHTS FOR VARYING SOIL CONDITIONS

⇒ Details of the Landscape Architecture Division (OED-LAD) are available from OED-LOD upon request.

Cat 700 SHA Price Index

The SHA Price Index includes actual prices of Category Code items as awarded in SHA Contracts for the past several years, updated in January and July. More info about the prices of landscape items is provided in Chapter 700 Unit Prices on page N-6.

⇒ Price Index: <http://www.marylandroads.com/Index.aspx?PageId=34>

Cat 700 Unit Prices of this Manual

Unit Prices of this Manual for Cat. 700 - Landscape Category Code items (also known as “pay items”) are shown in blue type. Thus, a Unit Price of **\$1.50** in this Manual would indicate a typical contract Unit Price for an item based of the OHD Price Index and recent experience.

The Designer will use the Unit Price of this Manual by default to prepare the Engineer’s Estimate, or will use a higher or lower Unit Price when a more accurate estimated price is based on the SHA Price Index or other available information. The SHA Price Index is updated each year in January and July.

Frequently, the Unit Price of a Category Code item is lower when large quantities of an item are required, and is often much higher for small quantities. The Unit Price of a Category Code item may also vary in different parts of the State because of availability, transportation costs, or other factors.

Cat 700 Landscape Category Code Items

The SHA Category Code System includes all SHA Category Code items. Table 700-A and Table 700-B include a small part of the Category Code System.

Table 700-A shows the Category Code items associated with the SHA Specifications and their SPs and SPIs, as well as the Section of the SHA Specifications in which the item is used or associated with, and the standard name and unit of measurements for the item. The same information is shown in the Schedule of Prices (SOP) of the Invitation for Bids (IFB).

Table 700-B includes certain other Category Code items that are often used in landscaping, but which are not associated with a Section of the SHA Specifications, or are not Category 700 - Landscaping Category Code items.

Table 700-A Sections 701 - 716 Category Codes Items for Landscaping		
This table shows items associated with the SHA Standard Specifications for Construction and Materials. Use these items whenever possible.		
Category Code No.	Section of SHA Specs	Item and Unit of Measure
701200	701	PLACING SALVAGED SUBSOIL CY
701205	701	PLACING FURNISHED SUBSOIL CY
701201	701	PLACING SALVAGED SUBSOIL 6 INCH DEPTH SY
701202	701	PLACING SALVAGED SUBSOIL 12 INCH DEPTH SY
701203	701	PLACING SALVAGED SUBSOIL 18 INCH DEPTH SY
701210	701	PLACING FURNISHED SUBSOIL 6 INCH DEPTH SY
701212	701	PLACING FURNISHED SUBSOIL 12 INCH DEPTH SY
701214	701	PLACING FURNISHED SUBSOIL 18 INCH DEPTH SY
701305	701	PLACING SALVAGED TOPSOIL FOR GRADING ADJUSTMENT SY
704305	701	PLACING FURNISHED TOPSOIL FOR GRADING ADJUSTMENT SY
701300	701	PLACING SALVAGED TOPSOIL FOR GRADING ADJUSTMENT CY
704300	701	PLACING FURNISHED TOPSOIL FOR GRADING ADJUSTMENT CY
701325	701	PLACING SALVAGED TOPSOIL 2 INCH DEPTH SY
701345	701	PLACING SALVAGED TOPSOIL 4 INCH DEPTH SY
701365	701	PLACING SALVAGED TOPSOIL 6 INCH DEPTH SY
704325	701	PLACING FURNISHED TOPSOIL 2 INCH DEPTH SY
704345	701	PLACING FURNISHED TOPSOIL 4 INCH DEPTH SY
704365	701	PLACING FURNISHED TOPSOIL 6 INCH DEPTH SY

705405	704	TEMPORARY SEED SY
705412	704	TEMPORARY MULCH SY
705500	705	TURFGRASS ESTABLISHMENT SY
705565	705	REFERTILIZING SY
706100	706	UPLAND SHRUB SEEDING SY
706110	706	LOWLAND SHRUB SEEDING SY
707400	707	UPLAND MEADOW ESTABLISHMENT SY
707410	707	LOWLAND MEADOW ESTABLISHMENT SY
707420	707	WET MEADOW ESTABLISHMENT SY
707415	XXX	BIORETENTION MEADOW ESTABLISHMENT SY
707425	707	SHORT MEADOW ESTABLISHMENT SY
708220	708	TURFGRASS SOD ESTABLISHMENT SY
708225	708	ZOYSIAGRASS SOD ESTABLISHMENT SY
708235	708	BERMUDAGRASS SOD ESTABLISHMENT SY
705565	705	REFERTILIZING SY
709100	709	TYPE A SOIL STABILIZATION MATTING SY
709110	709	TYPE B SOIL STABILIZATION MATTING SY
709120	709	TYPE C SOIL STABILIZATION MATTING SY
709130	709	TYPE D SOIL STABILIZATION MATTING SY
709140	709	TYPE E SOIL STABILIZATION MATTING SY
710150	710	TREE, SHRUB, AND PERENNIAL INSTALLATION AND ESTABLISHMENT LS
710170	710 711	CONSTRUCTING PLANTING BEDS SY
710185	710	EXPANDED TREE PIT EA
715015	710	SHREDDED HARDWOOD BARK MULCHING 3 IN. DEPTH SY
711100	711	ANNUALS AND BULBS INSTALLATION AND ESTABLISHMENT LS
712100	712	TREE BRANCH PRUNING LS
713015	713	BRUSH REMOVAL SY
713010	714	TREE FELLING AND STUMP REMOVAL LS
715050	715	TREE ROOT PRUNING LF
716100	716	TREE BROADCAST FERTILIZING SY
716105	716	TREE INJECTION FERTILIZING SY
716110	716	TREE DRILL FERTILIZING SY

Table 700-B		
Some Category Codes Not Associated with Cat. 700 - See More on Page N-64		
Category Code No.	Section of SHA Specs	Item and Unit of Measure
110100	101	CLEARING AND GRUBBING LS
120784	120	TEMPORARY ORANGE CONSTRUCTION FENCE LF
390660	316	BIORETENTION SOIL MIX CY
616251	609	CRUSHER RUN AGGREGATE CR-6 FOR SHOULDER EDGE DROPOFF SY

Cat 700 Required and Incidental Materials

Many Category Code items include certain defined and incidental materials as part of that “pay item”. During construction, the Contractor is required to use all required and incidental materials associated with that Category Code item.

The Office of Construction (OOC) prefers that Category Code items associated with Sections of the SHA Specifications be measured and paid for separately in conformance with their associated specifications. However, OOC recognizes that it may be appropriate to make existing Category Code items incidental to, or to be included as part of, other measured or lump sum payment items.

Some examples to illustrate the difference between Category Code items and some of their required or incidental materials:

- 705500 Turfgrass Establishment SY includes the cost of soil preparation, seed, fertilizer, straw mulch and other materials that are required per Section 705. Thus, the complete requirements for Turfgrass Establishment include much more than “seed and mulch.”
- 710150 Tree, Shrub, and Perennial Installation and Establishment LS includes the lump sum cost of all specified plants as well the water, fertilizer, mulch, stakes, berming, edging, weeding, pest control and labor required for installation and one year of establishment per Section 710. Thus, the cost of this item includes many additional materials and operations, not just the plants.
- 709100 Type A Soil Stabilization Matting SY includes the cost of the matting, fasteners, water and all the labor required to trench and bury edges of the matting. Thus, while payment is for the area actually covered by matting, it includes everything required for installation per Section 709.

Cat 700 Reducing Conflicts in Plans, Specifications & Estimates

Only Category Code items or write-in payment items that correspond exactly to a Special Provision (SP) of the IFB are appropriate items of reference in the Engineer’s Estimate. Such Category Code items and write-in items will include all relevant costs. A SP must be inserted into the IFB to define the required materials, construction, and measurement and payment of all write-in payment items.

To ensure consistency and reduce the likelihood of errors in estimates, plans and specifications for landscape construction:

- The Engineer’s Estimate shall include Category Code items associated with numbered Sections of the SHA Specifications and write-in payment items of OED-approved Cat. 700 SPs.
- The Engineer’s Estimate shall not include any materials that are constituents of Category Code items or constituents of write-in payment items of SPs.
- Only the approved names of Category Code items shall be shown in typicals, details, and plans unless it is necessary to refer to specific materials of the SHA Specifications or in SPs.
- Plan sheets shall not specify changes to materials, construction, measurements or payments that are defined in the SHA Specifications, approved SPIs, or SPs.

- Plan sheets shall not provide composition of seed mixes, installation instructions for landscape materials, or any information which should be explained in specifications.
- Plan sheets should not make reference or provide notes about required specifications or any required or incidental materials unless such reference is necessary for clarity.
- Plan sheets should minimize the use of notes, and only provide callouts as needed to clarify the installation locations of required construction and materials, consistent with their specifications.

Cat 700 Quantity Correction for Slope

Many landscape items involve areas, volumes or application rates that are affected by the slope of the area at final grade. When plan views are used to calculate these items, the effect of slope is easily overlooked, but the error is often evident during construction when quantities run short. Payments for landscape items are based on actual measurements as installed at ground level, not plan view.

Since slopes always have greater surface area than flat areas when measured in plan view, calculations of area and volume that are based on measurements calculated plan views are always the minimum quantity required. Calculations based on plan views are only accurate for flat areas.

When GIS or CAD is not available for slope calculation and automatic correction, the Designer will use Table 700-C to correct for slopes on the project.

Table 700-C Correcting Plan View Measurements for Slope Actual Area = Plan View Area x Correction Factor		
Slope %	Slope Ratio	Correction
0	-	x 1.00
5.0	20 : 1	x 1.00
10.0	10 : 1	x 1.01
20.0	5 : 1	x 1.02
25.0	4 : 1	x 1.03
33.3	3 : 1	x 1.05
50.0	2 : 1	x 1.12
66.7	1.5 : 1	x 1.20
100.0	1 : 1	x 1.41

700 Typical for Topsoil and Permanent Vegetation

Below is the text of the Typical Note that should be used for most projects that involve topsoil and Turfgrass Establishment (seeding).

This text of the following Typical may be modified as needed for the unique needs of a project.

SLOPES 2:1 AND STEEPER: PLACING FURNISHED TOPSOIL 2 IN. DEPTH, TURFGRASS ESTABLISHMENT, AND TYPE A SSM, UNLESS OTHERWISE NOTED.

SLOPES 4:1 AND FLATTER THAN 2:1: PLACING FURNISHED TOPSOIL 4 IN. DEPTH, TURFGRASS ESTABLISHMENT, AND TYPE A SSM, UNLESS OTHERWISE NOTED.

AREAS FLATTER THAN 4:1: PLACING FURNISHED TOPSOIL 4 IN. DEPTH AND TURFGRASS ESTABLISHMENT, UNLESS OTHERWISE NOTED.

The designer will ensure that typicals, details, callout notes and other references to Category Code items or materials use the approved names of the items and materials per the SHA Specifications.

The use of approved names wherever possible reduces errors and confusion during bidding and construction.

SECTION 701 SUBSOIL AND TOPSOIL

Table 700-A (part)	
Section 701 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measurement
701200	PLACING SALVAGED SUBSOIL CY
701205	PLACING FURNISHED SUBSOIL CY
701201	PLACING SALVAGED SUBSOIL 6 INCH DEPTH SY
701202	PLACING SALVAGED SUBSOIL 12 INCH DEPTH SY
701203	PLACING SALVAGED SUBSOIL 18 INCH DEPTH SY
701210	PLACING FURNISHED SUBSOIL 6 INCH DEPTH SY
701212	PLACING FURNISHED SUBSOIL 12 INCH DEPTH SY
701214	PLACING FURNISHED SUBSOIL 18 INCH DEPTH SY
701305	PLACING SALVAGED TOPSOIL FOR GRADING ADJUSTMENT SY
704305	PLACING FURNISHED TOPSOIL FOR GRADING ADJUSTMENT SY
701300	PLACING SALVAGED TOPSOIL FOR GRADING ADJUSTMENT CY
704300	PLACING FURNISHED TOPSOIL FOR GRADING ADJUSTMENT CY
701325	PLACING SALVAGED TOPSOIL 2 INCH DEPTH SY
701345	PLACING SALVAGED TOPSOIL 4 INCH DEPTH SY
701365	PLACING SALVAGED TOPSOIL 6 INCH DEPTH SY
704325	PLACING FURNISHED TOPSOIL 2 INCH DEPTH SY
704345	PLACING FURNISHED TOPSOIL 4 INCH DEPTH SY
704365	PLACING FURNISHED TOPSOIL 6 INCH DEPTH SY

701 Introduction

A close relationship exists between the soil and the landscaping it supports. Therefore, in keeping with the SHA Landscape Design Philosophy of the SHA Landscape Design Guide (LDG), the Designer will coordinate the placement of soil layers with the specified permanent vegetation and the anticipated future maintenance of the project area.

The Designer will ensure that soil testing is performed by the Office of Materials Technology (OMT) to determine the availability of salvageable subsoil and topsoil for stockpiling and reuse at the project. Furnished soils will be specified as necessary to meet the landscaping objectives of the project when salvaged soils are insufficient to meet anticipated needs. To reduce costs, the Designer will allocate limited soil resources to the priority turfgrass areas and landscape beds that are closest to the highway, and maximize the use of naturalized vegetation, such as meadow and shrub seeding, in areas where soil quality or quantity is limiting.

Table 700-A shows the Category Codes for placing subsoil and topsoil. Both subsoil and topsoil may be salvaged or furnished. Topsoil may be measured and placed per cubic yard (CY) or per square yard (SY). The Designer will select the soils and units of measurement best suited to the project. Because plan view measurements are only accurate for flat areas, the Designer will refer to Table 700-C to correct areas for slope before developing the Engineer's Estimate for soil quantities.

701 Specifications & SP 700 - Nutrient Management Program (NMP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Nutrient Management Plan (NMP). When developed by the Landscape Operations Division (OED-LOD) the NMP is a Cat. 700 SP that updates the application rates of fertilizer and soil amendments required for landscaping. Per the new SPs for Cat. 700 - Landscaping, all soil amendments specified in the SP 700 - NMP are now incidental to Category Code items for permanent vegetation establishment.

When existing topsoil will be used for landscape construction, or when salvaged topsoil is included in the Engineer's Estimate or Schedule of Prices, the Designer will include the SP 700 - NMP in the IFB before contract advertisement. Note: When furnished topsoil is included in the contract, the SP 700 - NMP is developed during construction, and is not included in the IFB.

Bioretention Soil Mix (BSM). BSM shall be installed in conformance with SPI 316, or with a project-specific SP.

701 Types of Soil

Salvaged Subsoil and Salvaged Topsoil. The Office of Materials Technology (OMT) performs soil testing and determines the quantities of available salvageable subsoil and salvageable topsoil. In response, the Landscape Operations Division (OED-LOD) develops a SP 700 - NMP for vegetation installed in salvaged topsoil.

To ensure that salvaged subsoil and salvaged topsoil may be used during construction, the Designer will request OMT to perform soil testing whenever the use of salvaged soils is anticipated and feasible. As soon as possible during the design process, preferably as part of the Preliminary Investigation, the Designer will request OMT to perform soil testing to determine the suitability and salvageable quantities of subsoil and topsoil on the project.

Note: When the Engineer's Estimate or Schedule of Prices includes salvaged topsoil, the SP 700 - NMP must be inserted into the IFB before Final Review.

Existing Topsoil. Existing topsoil is the surface soil material of the project which is available for use as topsoil, but which will not be excavated or salvaged during construction. Existing topsoil is used in place with minimal handling or manipulation, but this material is not measured or paid for.

Because existing topsoil may be high in soluble salts or other contaminants, or may not be able to support permanent plant growth for other reasons, existing topsoil must be tested to prove that it is appropriate for use, and to determine the needs for fertilizer and soil amendments.

As soon as possible during the design process, preferably as part of the Preliminary Investigation, the Designer will request OMT to perform soil testing to determine the suitability of existing topsoil whenever the use of existing topsoil is anticipated and feasible.

The testing process and standards for approving existing topsoil are the same as those for salvaged topsoil. When existing soil is approved, the Landscape Operations Division (OED-LOD) will develop the SP 700 - NMP, and the Designer will include this SP in the IFB before the Final Review.

Furnished Topsoil. Because furnished topsoil is purchased by the Contractor from a source of supply approved by OMT during construction, the IFB does not include a SP 700 - NMP for furnished topsoil. The SP 700 - NMP for furnished topsoil is developed by the Landscape Operations Division (OED-LOD) during construction, and is not included in the IFB.

Furnished Subsoil. A SP 700 - NMP is not developed for furnished subsoil.

701 Matching Soil Placement with Vegetation

Refer to 700 Typical for Topsoil and Permanent Vegetation on N-10. The use of 4 in. topsoil is strongly preferred for most landscaped areas with slope < 2:1.

A soil profile that includes layers of topsoil and subsoil placed over a suitable base (subgrade) is required for landscaped areas. The depth of these layers ultimately determines vegetation survival and future maintenance. Table 701-A shows the relationship of subsoil and topsoil thickness to the adapted vegetation and its future maintenance in typical roadside locations.

Whether salvaged or furnished soils are specified, the Designer will consider the plant material and future mowing and maintenance requirements of the site, as well as the landscape context and availability of soils. Areas with more frequent mowing and higher expectations require thicker subsoil and topsoil layers. The Designer will consider all these factors to optimize costs and sustainability.

Table 701-A Vegetation for Various Depths of Subsoil and Topsoil						
	Subsoil	Topsoil	Plant Material	Annual Mowing	Annual Maint.	Typical Location
F A I R	6 in. Subsoil or Common Borrow	2 in. Topsoil	Meadow Establishment	0	None	Non-maintained areas and slopes This option is only appropriate for areas where soil resources and future maintenance are severely limiting
			Shrub Seeding Establishment	0	None	
			Reforestation	0	None	
G O O D	12 in. Subsoil	2 in. Topsoil	Turfgrass Establishment	0 - 1	Low	Non-maintained areas and slopes more than 10 feet from pavement edge For most areas with slope < 2:1 the use of 4 in. topsoil is strongly preferred
			Meadow Establishment	0 - 1	Low	
			Shrub Seeding Establishment	0	None	
			Reforestation	0	None	
			Tree & Shrub Planting Pits	0	Low	

Table 701-A, continued...

Vegetation for Various Depths of Subsoil and Topsoil

	Subsoil	Topsoil	Plant Material	Annual Mowing	Annual Maint.	Typical Location
B E T T E R	12 in. Subsoil	4 in. Topsoil	Turfgrass Establishment	1 - 3	Medium	Rural, suburban and urban areas Most areas less than 10 feet from pavement edge Most pavement removal areas High foot traffic or high vehicle traffic areas Curbed medians
			Short Meadow Establishment	1 - 3	Medium	
			Turfgrass Sod Establishment	1 - 3	Medium	
			Tree & Shrub Planting Pits	0	Medium	
			Planting Beds	0	Medium	
B E S T	18 in. Subsoil	6 in. Topsoil	Turfgrass Sod Establishment	3+	High	Urban streetscapes & medians High expectation landscape areas Facilities
			Tree & Shrub Planting Pits	0	High	
			Planting Beds	0	High	

701 Soil Placement Considerations

Accurate representation of soil placement in typical drawings and other plan sheets improves the accuracy of Engineer’s Estimates, reduces the likelihood of errors during construction, and improves the ability of SHA to install context sensitive and sustainable landscaping.

All permanently landscaped areas require soil, including those areas where pavement is removed in preparation for landscaping. Although some projects will be able to provide salvaged soils to meet all landscaping needs, other projects may require furnished soils. The Designer will include soils in the Engineer’s Estimate as needed to balance the landscape objectives with soil availability and costs.

The following design principles affect the placement of subsoil and topsoil layers. The Designer will consider these factors when delineating the placement of topsoil and subsoil layers in plans. To the greatest extent feasible, the Designer will provide soils that meet long-term landscaping objectives without unduly complicating installation during construction.

701 Soil Stockpiles

The reuse of soils is an important part of SHA’s commitment to use recycled materials. In order for salvaged subsoil and topsoil to be reused during construction, suitable stockpile areas must be identified for the storage of these soils. The Designer will consider proximity, cost, and construction scheduling when determining the locations of soil stockpiles.

When insufficient space is available on the project, the Designer will consider off-site locations for soil stockpiles, so that these materials may be used to the greatest extent feasible. Note: If there is no area available for stockpiles, there is no need to perform soil testing.

701 Subsoil Design Guide

Although subsoil is often similar to Common Borrow, and many samples of Common Borrow will also meet SHA specifications for Salvaged Subsoil, Common Borrow is not the same as subsoil.

Common Borrow is a highly variable material that is used to construct roadbeds and embankments; the ability of Common Borrow to support the growth of permanent vegetation is not tested and cannot be guaranteed.

Therefore, the use of Common Borrow as the base for topsoil placement is not recommended for most landscaped areas, and the Designer will specify both subsoil and topsoil for permanent vegetation whenever feasible. Refer to Table 701-A.

Although Salvaged Subsoil is often available at a project, the quality and quantity of Salvaged Subsoil cannot be assumed without testing performed by the Office of Materials Technology (OMT). Subsoil testing and approval should be a routine part of the design process, and begin during the Preliminary Investigation (PI) stage of project development, so that the available quantities of salvageable topsoil and subsoil are known as soon as possible.

For many reconstruction projects, the suitability of existing soil for use as subsoil can generally be assumed as long as turfgrass and other plants are growing on the site. Soil testing is always recommended, but testing is essential when there is reason to suspect that the soil may not be able to support permanent vegetation.

The Designer will specify Salvaged Subsoil of the project to the extent that it is available, and specify Furnished Subsoil as needed to meet landscaping objectives.

701 Subsoil Measurement

Subsoil may be measured and placed per square yard (SY) of a specified depth, or placed by volume per cubic yard (CY). Regardless of the units of measurement, the Designer will ensure that a soil profile is constructed to meet the needs of permanent vegetation at the project:

Subsoil Placement by SY of Specified Depth. The placement of subsoil in layers of specified depth is preferred, because it ensures adequate rooting depth for permanent vegetation. Category Code items currently exist for 6 in., 12 in., and 18 in. subsoil depth.

701201	PLACING SALVAGED SUBSOIL 6 INCH DEPTH SY	Salvaged Subsoil SY
701202	PLACING SALVAGED SUBSOIL 12 INCH DEPTH SY	
701203	PLACING SALVAGED SUBSOIL 18 INCH DEPTH SY	
701210	PLACING FURNISHED SUBSOIL 6 INCH DEPTH SY	Furnished Subsoil SY
701212	PLACING FURNISHED SUBSOIL 12 INCH DEPTH SY	
701214	PLACING FURNISHED SUBSOIL 18 INCH DEPTH SY	

The Designer will determine the locations where subsoil will be placed at 6 in., 12 in., or 18 in. depth, and calculate the respective areas and costs of those layers to develop the Engineer's Estimate. The Designer will develop a Special Provision if another subsoil depth is specified, or when additional guidance is needed to explain subsoil placement.

When site conditions make subsoil placement by specified depth cumbersome for the Project Engineer during construction, and particularly where the depth of placement may be variable, the Designer will specify subsoil placement by volume rather than by specified depth.

Subsoil Placement by CY Volume. Subsoil may be measured and placed per CY where the depth of placement is variable. This method is often appropriate for filling gullies, restoring soil areas after sidewalk or pavement removal and for similar restoration projects where topsoil and permanent landscaping will be established.

Table 701-C Subsoil for Grading Adjustment		
701200	PLACING SALVAGED SUBSOIL CY	Salvaged Subsoil CY
701205	PLACING FURNISHED SUBSOIL CY	Furnished Subsoil CY

The Designer will estimate the required quantity of subsoil, and the Project Engineer will place subsoil as needed during construction in conformance with this Guide and the Contract documents. Notes to guide soil placement should be included in typicals or plan sheets whenever possible.

701 Subsoil Estimating Guide

Table 701-D shows the Unit Prices for placing subsoil per SY and CY. It does not include any costs for topsoil that may be required to construct the complete soil profile.

Table 701-D Subsoil Measurement & Unit Price		
Specified Depth	Salvaged Subsoil Unit Price	Furnished Subsoil Unit Price
6 in.	\$9.00 per SY	\$21.00 per SY
12 in.	\$12.00 per SY	\$23.00 per SY
18 in.	\$15.00 per SY	\$26.00 per SY
Volume	Salvaged Subsoil Unit Price	Furnished Subsoil Unit Price
Varies	\$24.00 per CY	\$45.00 per CY
Note: Refer to Table 701-G for topsoil costs		

701 Topsoil Design Guide

Refer to 700 Typical for Topsoil and Permanent Vegetation on N-10. The use of 4 in. topsoil is strongly preferred for most landscaped areas with slope < 2:1. Topsoil placed in conjunction with subsoil is essential for the long-term success of most routinely maintained landscape areas.

The installation of vegetation in subsoil is not recommended. The total quantity of topsoil required for a project will depend upon the cost and availability of topsoil as well as the landscaping objectives, vegetation types, and future maintenance regime.

Although salvaged topsoil is often available at a project, the quality and quantity of salvaged topsoil cannot be assumed without testing performed by the Office of Materials Technology (OMT). Soil testing and approval of salvaged topsoil is required as part of the design process coordinated by OMT and the Landscape Operations Division (OED-LOD).

Furnished topsoil is generally more expensive than salvaged topsoil, but is often required because a sufficient quantity of salvaged topsoil is not available at the project, or there is no place to stockpile salvaged soil during construction. Therefore, the Designer will specify salvaged topsoil to the extent that is available and feasible to use, and specify furnished topsoil as needed to ensure the success of the plant material and meet landscaping objectives of the project. As with subsoil, methods of topsoil placement vary with the nature of the project. The Designer will determine the areas and depth of topsoil, and show these areas on plans.

701 Topsoil Measurement

Topsoil may be measured and placed per square yard (SY) of a specified depth, or placed by volume per cubic yard (CY).

Topsoil Placement by SY of Specified Depth. The placement of topsoil in layers of specified depth is usually preferred since this method is readily shown on plans and accurately estimated.

Table 701-E Topsoil by Specified Depth		
701325	PLACING SALVAGED TOPSOIL 2 INCH DEPTH SY	Salvaged Topsoil SY
701345	PLACING SALVAGED TOPSOIL 4 INCH DEPTH SY	
701365	PLACING SALVAGED TOPSOIL 6 INCH DEPTH SY	
704325	PLACING FURNISHED TOPSOIL 2 INCH DEPTH SY	Furnished Topsoil SY
704345	PLACING FURNISHED TOPSOIL 4 INCH DEPTH SY	
704365	PLACING FURNISHED TOPSOIL 6 INCH DEPTH SY	

The Designer will determine the area where 2 in., 4. in., and 6 in. topsoil layers will be placed, and calculate the respective costs of those layers to develop the Engineer's Estimate. The Designer will develop a Special Provision if another topsoil depth is specified.

When site conditions are likely to make placement by specified depth cumbersome for the Project Engineer during construction, such as sidewalk projects and areas with variable grades or where measurement of area is difficult, the Designer will specify topsoil placement for grading adjustment by SY or CY.

Topsoil Placement for Grading Adjustment by SY or CY. Topsoil may be measured and placed for grading adjustment per SY or CY when the placement depth is variable. Placing topsoil for grading adjustment is often appropriate for finishing the grade for guardrail installation, shoulder edge drop-off, sidewalk retrofit projects, as backfill behind curbs, minor gully and rut repair, and similar projects.

Table 701-F Topsoil for Grading Adjustment		
701305	PLACING SALVAGED TOPSOIL FOR GRADING ADJUSTMENT SY	Square Yards SY
704305	PLACING FURNISHED TOPSOIL FOR GRADING ADJUSTMENT SY	
701300	PLACING SALVAGED TOPSOIL FOR GRADING ADJUSTMENT CY	Cubic Yards CY
704300	PLACING FURNISHED TOPSOIL FOR GRADING ADJUSTMENT CY	

The Designer will estimate the total quantity of topsoil required, and the Project Engineer will determine the areas and placement of topsoil during construction in conformance with this Guide and the Contract documents. Notes and delineations in plan sheets are the preferred way to specify the installation locations, but a Special Provision may be appropriate for projects without plans.

It is impractical to measure areas of soil placement less than ½ inch depth, and when more than 8 inch depth is placed there may be unacceptable settling. Therefore, topsoil placed for grading adjustment is installed in depths of 1/2 inch to 8 inches. In areas where more than 8 inches of soil fill is needed, the Designer will specify a suitable thickness of subsoil in preparation for the topsoil layer.

When topsoil for grading adjustment is specified, the Designer will ensure that the existing soil of the area below the topsoil is suitable for use. When there is doubt about the suitability of existing soil to sustain permanent landscaping, the Designer will request the Office of Materials Technology (OMT) to test the existing soil. The existing soil must meet the standards of salvaged subsoil. If the soil is not suitable, it must be excavated and replaced with a suitable thickness of furnished subsoil.

701 Topsoil Estimating Guide

Table 701-G shows the Unit Prices for placing topsoil per SY and CY. The table does not include any costs for subsoil or other borrow materials that may be required to construct the complete soil profile.

Table 701-G Topsoil Measurement & Unit Price		
Specified Depth	Salvaged Topsoil Unit Price	Furnished Topsoil Unit Price
2 in.	\$3.00 per SY	\$5.00 per SY
4 in.	\$4.00 per SY	\$8.00 per SY
6 in.	\$6.00 per SY	\$10.00 per SY
Depth Varies for Grading Adjustment	\$10.00 per SY	\$15.00 per SY
Volume	Salvaged Topsoil Unit Price	Furnished Topsoil Unit Price
For Grading Adjustment	\$40.00 per CY	\$70.00 per CY
Note: Refer to Table 701-F for subsoil costs		

SECTION 704

TEMPORARY MULCH AND TEMPORARY SEED

Table 700-A (part) Section 704 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
705412	TEMPORARY MULCH SY
705405	TEMPORARY SEED SY

704 Introduction

Temporary Mulch and Temporary Seed are different Category Code items that are used for short-term and long-term temporary soil stabilization, respectively. The Designer will evaluate the need for Temporary Mulch and Temporary Seed for erosion and sediment control requirements during construction, and include one or both of these items in the Engineer's Estimate.

Note: Because Temporary Mulch and Temporary Seed will eventually be replaced with permanent vegetation, installation details or other information about these Category Code items should not be shown on Landscape Plans. When instructions about Temporary Mulch and Temporary Seed are appropriate, the pertinent information will be included in the Erosion and Sediment Control Plans.

704 Specifications

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

Alternatively, the Designer will insert SP 704 to specify other construction materials or methods, or to make the cost of Temporary Mulch or Temporary Seed incidental to other Contract items such as 5 in. Concrete Sidewalk. Refer to N-8 regarding incidental items. Staff of the Landscape Architecture Division (OED-LAD) or Landscape Operations Division (OED-LOD) will provide assistance to develop appropriate specifications.

SP 700 - Nutrient Management Plan (NMP). A SP 700 - NMP is never developed for Temporary Mulch. However, a SP 700 - NMP may be developed when Temporary Seed will be installed in soils that could impair the growth of seedlings.

704 Temporary Mulch Design & Estimating Guide

705400 Temporary Mulch is used to prevent erosion in areas that will be redisturbed in less than 2 months. Because the maximum lifespan of Temporary Mulch is 2 months, Temporary Mulch may be reapplied during construction. Thus, the total square yards of Temporary Mulch used during construction may substantially exceed the total area of soil disturbance on the project.

- The pay item for Temporary Mulch is per square yard (SY), and is estimated on the basis of total site disturbance within the LOD as a function of the project type per table 704-A.
- The Designer will include Temporary Mulch in the Engineer’s Estimate for all projects that involve soil disturbance, unless payment for Temporary Mulch is incidental to another item.
- Modification of the new SP 704 to make payment for Temporary Mulch incidental to another Contract item is recommended for small projects.
- When the Designer anticipates that some areas will be redisturbed in 2 to 6 months, Temporary Seed should be specified to stabilize those areas, and indicated on the plans.
- When the Designer anticipates that some areas will be redisturbed after 6 months, Turfgrass Establishment should be specified to stabilize those areas, and indicated on the plans.

Table 704-A Temporary Mulch Quantity & Unit Price ~ When payment is not incidental to another Contract item per SP 704 ~		
TEMPORARY MULCH SY	SY of Temporary Mulch	Unit Price
Project Type		
Simple sidewalk retrofits, resurfacing, guardrails, etc.	1.10 x SY of total project soil disturbance	\$0.75 per SY
Complex most new construction and reconstruction.	1.25 x SY of total project soil disturbance	
Major projects with construction longer than 1 year. Note: Temporary Seed may also be required.	1.40 x SY of total project soil disturbance	

704 Temporary Seed Design & Estimating Guide

705412 Temporary Seed SY Temporary Seed is used to prevent erosion on soil stockpiles, temporary soil earthworks, and other areas that will be disturbed again in 2 to 6 months. Because the maximum lifespan of Temporary Seed is 6 months after application, the areas stabilized with Temporary Seed must be permanently vegetated with Turfgrass Establishment, Meadow Establishment or other approved vegetation before construction is completed.

The measurement and payment for Temporary Seed is per square yard (SY), which is a change from previous design guidance (formerly per LB of seed).

The designer will include SY of Temporary Seed, as described in Table 704-B.

Table 704-A Temporary Seed Quantity & Unit Price	
TEMPORARY SEED SY	Unit Price
Soil Stockpiles and other Temporary Earthworks, as Delineated or Described on Plan Sheets or in Special Provisions.	\$0.90 per SY

SECTION 705 TURFGRASS ESTABLISHMENT

Table 700-A (part) Section 705 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
705500	TURFGRASS ESTABLISHMENT SY
705565	REFERTILIZING SY

705 Introduction

Turfgrass Establishment is an essential element of roadside safety and landscaping aesthetics and has often been considered the default “permanent seeding” for roadside groundcover vegetation. With the advent of Meadow Establishment, Shrub Seeding Establishment and other options, the role of turfgrass has become more specialized and somewhat more limited.

In keeping with the SHA Landscape Design Philosophy and principles of the SHA Landscape Design Guide (LDG), the Designer will install turfgrass in most locations less than 10 feet from the pavement edge, and in all areas where it is the best adapted and most sustainable groundcover alternative.

705 Specifications and SP 700 - Nutrient Management Plan (NMP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI’s of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Nutrient Management Plan (NMP). Refer to N-12.

705 Turfgrass Establishment Design Guide

Turfgrass provides a durable groundcover with many environmental benefits. However, turfgrass is not appropriate for all situations, and the Designer will consider the areas where turfgrass will perform best in view of all available options. Table 701-A shows soil profiles and maintenance required for successful Turfgrass Establishment.

705 Flowchart for Permanent Vegetation, Mulch, and SSM

Table 705-A shows a flowchart for selecting permanent groundcover vegetation and soil stabilization matting combinations based on slope steepness, channel flow velocity and other factors.

**Table 705-A
Flowchart for Permanent Groundcover Vegetation and Mulch**

Read flowchart from top to bottom, i.e. from sites with typically low erosion risk to higher erosion risk, and from left to right to select the preferred options for vegetation and soil stabilization matting.

Note: This flowchart considers most common conditions but not all possibilities. Options that are not anticipated by this flowchart may require Special Provisions or notes in the plans.

Site	Land Use	Erosion Risk	Routine Mowing	Vegetation	SSM
Areas Flatter than 4:1	Large roadside areas, open medians, most areas where turfgrass is OK	→ Low or Moderate	→ Yes	→ Turfgrass Establishment	None or Type E
	Large roadside areas, open medians, most areas where turfgrass is OK	→ Low or Moderate	→ Yes	→ Short Meadow Establishment	None or Type E
	Curbed medians, streetscapes, facilities, adjacent to sidewalks, etc.	→ Low or Moderate	→ Yes	→ Turfgrass Sod Establishment	None
	Roadside areas, open medians more than 10 ft. from pavement edge	→ Low or Moderate	→ No	→ Upland, Lowland, Wet Meadow Establishment	None or Type E
	Areas more than 10 ft from pavement edge, adjacent to natural areas	→ Low or Moderate	→ No	→ Shrub Seeding Establishment	None or Type E
	To provide turfgrass reinforcement in areas with high vehicle traffic	→ Low to Severe	→ Yes	→ Turfgrass Establishment	Type B or Type C
Natural Areas	Areas of naturalized vegetation where straw mulch is not OK:	→ Low or Moderate	→ No	→ Upland, Lowland, Wet Meadow Establishment	Type E or Type D
	Stormwater management facilities ponds, basins, infiltration facilities, BSM, swales, channels, or adjacent to wetlands, streams, etc.	→ Low	→ No	→ Perennial or Grass Plugs	Hardwood Bark Mulch, Type E or Type D
		→ Low	→ No	→ Reforestation Trees & Shrubs in approved areas	Hardwood Bark Mulch
Channels and Ditches	Channel bottoms and sideslopes	→ Low or Moderate	→ Yes	→ Turfgrass Sod Establishment	None
		→ Low or Moderate	→ No	→ Turfgrass Establishment	Type A or Type D
		→ Low or Moderate	→ No	→ Upland, Lowland Meadow Establishment	Type D
		→ Significant	→ No	→ Turfgrass Establishment	Type B
		→ Severe	→ No	→ Turfgrass Sod Establishment	Type C
		→ Severe	→ No	→ Turfgrass Establishment	Type C
		→ Very Severe	→ No	→ No Vegetation	Rip Rap
		→ Flow Velocity > 8.5 ft/sec Shear Stress > 5.0 lb/ft ²	→ No	→ Consult Highway Hydraulics Division (OHD-HHD)	
Slopes 4:1 and Steeper	Slopes 4:1 to 3:1	→ Low or Moderate	→ Yes	→ Turfgrass Sod Establishment	None
		→ Low or Moderate	→ No	→ Turfgrass Establishment	Type A is Typical per N-10. Type E or other SSM as specified

		Slopes 4:1 to 3:1 continued	→	Low or Moderate	→	No	→	Upland Meadow Establishment	Type E or Type D
			→	Low or Moderate	→	No	→	Shrub Seeding Establishment	Type E or Type D
	→	Slopes 3:1 to 2:1	→	Moderate to Severe	→	No	→	Turfgrass Establishment	Type A, Type D Type B, Type C
	→	Slopes steeper than 2:1	→	Moderate to Severe	→	No	→	Consult Engineering Geology Division (OMT-EGD)	

705 Turfgrass Establishment Best Uses and Other Choices

Per the Typical on N-10, Turfgrass Establishment is the permanent groundcover vegetation for most sites. However, the SHA Specifications include other options for Turfgrass Sod Establishment as well as Meadow Establishment and Shrub Seeding Establishment. These different types of groundcover vegetation have specific roles in the highway landscape. The LDG emphasizes the use of native species and naturalized vegetation, and the current SHA Business Plan tracks the use of naturalized vegetation among its environmental stewardship and landscape restoration objectives.

To aid accurate estimation and reduce conflicts during construction, the Designer will delineate Turfgrass Establishment (TE) areas on plans in conformance with the Typical on N-10. Thus, Turfgrass Establishment will be performed in all disturbed areas for permanent groundcover vegetation except as noted in or delineated for other groundcover vegetation, tree pits, planting beds, etc.

For flat areas and mild slopes that are flatter than 4:1 slope, Turfgrass Establishment is specified by itself, without SSM. However, Turfgrass Establishment is specified in with Soil Stabilization Matting (SSM) as a separate pay item in channels and on steeper slopes. Refer to Table 705-A.

When used with SSM, at least 1.0 SY of Turfgrass Establishment is required for each SY of SSM. Refer to 709 of this Guide for more info about SSM selection and quantity estimation. The following highlights some appropriate uses for Turfgrass Establishment, and suggests alternatives when Turfgrass Establishment is not the best option.

Best Uses for Turfgrass Establishment

- Large areas that will be routinely mowed within 10 feet of the pavement edge, and larger areas such as exit gores where sightlines must be preserved.
- Roadsides, medians and large areas at facilities where routine mowing will be performed, and where the turf will be subjected to occasional impacts of pedestrian and vehicle traffic.
- Shoulders and crossovers where vehicles are likely to travel off the pavement into turf areas.
- Within roadside stormwater channels and swales.

Other Choices

- Short Meadow Establishment is a suitable alternative for full sun or partial shade in suburban and rural areas where flowering plants and associated pollinator insects are acceptable.

- Turfgrass Sod Establishment is preferred where more rapid turfgrass cover is desired to improve pedestrian safety and aesthetics in curbed medians and near sidewalks, streetscapes, and facilities, or to reduce the potential for soil erosion on mild slopes, at stormwater inlets, in channels, and near commercial and residential areas.
- Type A Soil Stabilization Matting + Turfgrass Establishment is preferred in areas where additional erosion protection is required during establishment. Refer to Typical on page N-10 and Type A SSM on page N-37.
- Type E Soil Stabilization Matting + Turfgrass Establishment is preferred in areas where hydroseeding and straw mulch are impractical such as narrow medians, soil trenching disturbances, and other areas of limited soil disturbance.
- Meadow Establishment is preferred in low-maintenance naturalized areas that are more than 10 ft. from the pavement edge and where tall vegetation will not interfere with sightlines.

705 Turfgrass Establishment Design Considerations

The accessibility, steepness and contours of turfgrass areas are important factors to future maintenance by mowing equipment. The Designer will adjust design features and consider the feasibility of other groundcover vegetation or hardscape materials to improve future maintainability of turfgrass areas. Table 705-B shows conditions where turf should be avoided, and some alternatives.

Problem	Condition to Avoid	Solution or Alternative
Small Quantity	Turfgrass Establishment < 500 SY	Turfgrass Establishment requires a hydroseeder to secure straw mulch, which often makes small quantities costly <ul style="list-style-type: none"> ● Specify Turfgrass Sod Establishment ● Specify Turfgrass Establishment + Type E SSM, which does not require a hydroseeder for installation
Tight Areas	Small, narrow, or complex patterns of Turfgrass Establishment	Small or awkward areas are often difficult to hydroseed, and straw is difficult to install and secure in small or odd areas <ul style="list-style-type: none"> ● Specify Turfgrass Sod Establishment ● Specify Turfgrass Establishment + Type E SSM ● Expand adjacent areas of meadow, planting beds or other vegetation ● Connect beds to forested edges or structures
Excessive Turf Area	Areas > 10 ft. from pavement edge Areas that mowing staff may neglect	Per SHA Mowing Policy, most areas more than 10 feet from pavement edge will not be mowed more than once per year <ul style="list-style-type: none"> ● Specify Meadow Establishment ● Specify Shrub Seeding Establishment ● Specify trees as reforestation / afforestation
Narrow Medians	Turf medians < 5 ft. wide	Narrow medians are difficult and costly to maintain. Specify hardscape such as stamped concrete or decorative pavers.
Narrow Area Between Curb & Sidewalk	Turf areas < 3 ft. wide	Narrow areas are difficult to establish by seed, and may not be reliably sustainable <ul style="list-style-type: none"> ● Redesign sidewalk to eliminate narrow or difficult to maintain areas

		<ul style="list-style-type: none"> ● Install walkable hardscape in narrow areas ● Install raised beds to reduce foot traffic and improve survival of plants ● Specify Turfgrass Sod Establishment if turf is necessary
Short Distance Between Beds	< 30 ft. of turf between beds	Eliminate or consolidate beds
Short Distance Between Pits	< 15 ft. of turf between trees or shrub planting pits	Eliminate individual plants, or consolidate trees and shrubs in planting beds to reduce mowing conflicts
Sharp Curves Difficult to Mow	Tight turns and directions difficult for mowers at normal speeds	Maximize straight lines, ensure smooth and gentle curves, minimize need for mowing except in the direction of travel
High Traffic Areas	Frequent all-year foot or vehicular traffic	Realign sidewalks or install other walkable or driveable hardscape materials. Consider barriers to direct traffic along preferred paths
Excessive Shade	Areas under structures, bridges, ramps, etc.	Specify hardscape material over subsoil or common borrow in lieu of turfgrass

705 Turfgrass Establishment Estimating Guide

705500 Turfgrass Establishment SY

Turfgrass Establishment is measured and paid for per SY. The Designer will include Turfgrass Establishment in the Engineer's Estimate as needed to provide permanent groundcover vegetation. Because plan view measurements are only accurate for flat areas, the Designer will refer to N-9 and correct areas for slope before developing the Engineer's Estimate. Table 705-C shows the methods of calculation with Unit Price per SY of Turfgrass Establishment.

705565 Refertilizing SY

The Designer shall include 1 SY of Refertilizing for each SY of Turfgrass Establishment.

Note: Any required quantity of Refertilizing must be combined with the quantity of Refertilizing required for Turfgrass Sod Establishment, so that the total SY of Refertilizing is equal to the total area of turfgrass on the project.

Table 705-C Turfgrass Establishment Quantity & Unit Price		
Category Code Item	Estimated Quantity	Unit Price
705500 TURFGRASS ESTABLISHMENT SY	1.0 SY of Turfgrass Establishment (TE)	\$1.50 per SY
705565 REFERTILIZING SY	1.0 SY Refertilizing per 1.0 SY of Turfgrass	\$0.80 per SY

SECTION 706 SHRUB SEEDING ESTABLISHMENT

Table 700-A (part)	
Section 706 - Category Codes for Landscaping	
706100	UPLAND SHRUB SEEDING SY
706110	LOWLAND SHRUB SEEDING SY

706 Introduction

Shrub Seeding Establishment involves the installation of native shrub and meadow species in roadside areas that will not receive any significant maintenance after establishment. The Designer will identify locations appropriate for Shrub Seeding Establishment to the extent feasible, since the increased use of this naturalized vegetation is a key component of the SHA Landscape Design Philosophy.

Shrub Seeding Establishment includes a group of species for well drained areas (Upland) and a group for moist to wet areas (Lowland). The Designer will review Section 706 as well as 920.06.01 (Names and Naming), and 920.06.06 (Standards for Seed Species) for information about seeding operations and mixtures.

As specified in Section 706, the Contractor and not the Designer will select species for Shrub Seeding Establishment. However, the Designer may specify a fixed set of species and seeding rates, or alter the species and/or seeding rates of the shrub or meadow seed mixes to suit the needs of the project. Significant alteration may be appropriate in certain environments or regions of the state, but any change to the SHA Specifications will require the Designer to develop a Special Provision (SP).

Although seed mixes and other information about Shrub Seeding Establishment may be shown on landscape plan sheets, the Designer will indicate project-specific seed mixes and installation instructions in a SP for this work, and show that information on landscape plan sheets.

The Designer will delineate the areas of Upland Shrub Seeding Establishment (USE) and Lowland Shrub Seeding Establishment (LSE) when plans are developed.

706 Specifications and SP 700 - Nutrient Management Plan (NMP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Nutrient Management Plan (NMP). Refer to N-12.

706 Shrub Seeding Establishment Design Guide

Table 701-A shows soil profiles and maintenance required for Shrub Seeding Establishment. Table 705-A shows a flowchart for selecting permanent groundcover vegetation and soil stabilization matting combinations based on slope steepness, channel flow velocity and other factors.

The following information highlights some appropriate uses for Shrub Seeding Establishment, and proposes some alternatives when Shrub Seeding Establishment is not the best option:

Best Uses for Shrub Seeding Establishment

- Slopes and areas at least 10 ft. from the pavement edge, consistent with the design speed of the highway, signage, and maintenance.
- Slopes and areas within or adjacent to forest edges, meadows, streams and wetlands and other natural areas.
- Wide medians and roadside areas where tall, woody growth will not interfere with sightlines, safety and roadside maintenance operations.

Other Choices

- Turfgrass Establishment, with or without Soil Stabilization Matting, is most appropriate where erosion, traffic and maintenance concerns are paramount.
- Meadow Establishment is lower growing and more adaptable to periodic maintenance.

706 Shrub Seeding Establishment Design Considerations. Table 706-A conditions where Shrub Seeding Establishment should be avoided, and some alternatives.

Problem	Condition to Avoid	Solution or Alternative
Small Quantity	< 2,000 SY total quantity of USE or LSE	Small quantities are costly and may pose problems during construction. Expand adjacent area of turfgrass, meadow, etc.
Small Areas	< 500 SY individual areas of USE or LSE	Small areas are difficult to install. Expand adjacent area of turfgrass, meadow, shrubs in planting pits, etc.
Awkward Areas	Areas of Shrub Seeding Establishment in complex patterns	Define Shrub Seeding Establishment areas with simple, compact shapes, and minimal "edge effect"
Narrow Areas	Areas < 15 ft. wide	Expand adjacent area of turfgrass or meadow
Bridge Abutments	Areas < 30 ft. from bridge abutments	Specify Turfgrass Establishment, Turfgrass Sod Establishment, or Constructing Planting Beds with perennials and low shrubs
Stormwater Management Areas	Woody plants on embankments	Specify Meadow Establishment, turfgrass, or other non-woody vegetation
Poor Placement	Vegetation that will block sidewalks or paths. and obstruct views to planting beds, etc.	Specify turfgrass near paths. Specify meadow for transition to naturalized area

Unsafe Vegetation	Tall vegetation in areas where driver and pedestrian sightlines must be preserved	Specify turfgrass or Constructing Planting Beds with perennials and low shrubs
Wrong Context	Urban areas and other areas where tall, naturalized vegetation is not appropriate	Specify turfgrass or Constructing Planting Beds with perennials and low shrubs

Shrub Seed Selection. There are two Shrub Seeding Establishment options. The Designer will select Upland Shrub Establishment or Lowland Shrub Seeding Establishment, and delineate the locations separately on the plans.

Upland Shrub Seeding Establishment is specified on mild slopes and other well-drained areas that are occasionally dry during the growing season, in full sun to partial shaded conditions.

Lowland Shrub Seeding Establishment is specified on mild slopes and nearly level areas that are rarely subject to severe drought during the growing season, in full sun to moderately shaded conditions.

Straw Mulch and Soil Stabilization Matting (SSM). Straw mulch covered with wood cellulose fiber mulch binder is the mulch used for Meadow Establishment per Section 706.

Type E and Type D SSM may be specified for installation with Shrub Seeding Establishment in lieu of straw mulch in areas or low to moderate soil erosion risk.

Types A, B and C SSM are not appropriate for Shrub Seeding, and will not be specified.

706 Shrub Seeding Establishment Estimating Guide

Table 706-B shows the methods of calculation with Unit Price per SY of the Category Code Items associated with Shrub Seeding Establishment.

706100 and 706110 Shrub Seeding SY

The two Category Code items for Upland Shrub Seeding (USE) and Lowland Shrub Seeding (LSE) are measured and paid for per SY area of each type. The Designer will include quantities of USE and LSE with the necessary related Category Code items when Shrub Seeding Establishment is specified.

Because plan view measurements are only accurate for flat areas, the Designer will refer to N-9 and correct for slopes before developing the Engineer's Estimate for Shrub Seeding Establishment.

Table 706-B Shrub Seeding Establishment Quantity & Unit Price		
Category Code Item	Quantity	Unit Price
706100 UPLAND SHRUB SEEDING SY	1.0 SY of Upland Shrub Seeding (USE)	\$2.00 per SY
706110 LOWLAND SHRUB SEEDING SY	1.0 SY of Lowland Shrub Seeding (LSE)	\$2.00 per SY

SECTION 707 MEADOW ESTABLISHMENT

Table 700-A (part) Section 707 - Category Codes for Landscaping	
707400	UPLAND MEADOW ESTABLISHMENT SY
707410	LOWLAND MEADOW ESTABLISHMENT SY
707420	WET MEADOW ESTABLISHMENT SY
707415	BIORETENTION MEADOW ESTABLISHMENT SY
707425	SHORT MEADOW ESTABLISHMENT SY

707 Introduction

Meadow Establishment involves three landscape groundcover options that are preferable to Turfgrass Establishment and planting beds in many locations. Areas designated for meadow improve roadside diversity and aesthetics, and provide valuable habitat for plants and animals. Meadow vegetation significantly reduces annual maintenance costs.

The increased use of naturalized vegetation such as meadow is a key component of the SHA Landscape Design Philosophy and principles of the SHA Landscape Design Guide (LDG). Therefore, the Designer will identify locations suitable for meadow to the greatest extent feasible.

Meadow Establishment involves the installation of native grass and forb (broadleaf) species in roadside areas that will receive minimal maintenance inputs after establishment.

Meadow Establishment includes a group of species for well drained areas (Upland Meadow), a group for moist areas (Lowland Meadow), and a group for poorly drained areas (Wet Meadow). The Designer will review Section 707 as well as 920.06.01 (Names and Naming), and 920.06.06 (Standards for Seed Species) for information about seeding operations and mixtures.

Per Section 707, the Contractor (not the Designer) will select species from the appropriate lists of Section 707 for Meadow Establishment. Alternatively, the Designer may specify a fixed set of species and seeding rates, or alter the species and seeding rates to suit the needs of the project.

Significant alteration of species may be appropriate in certain environments or regions of the state. However, any change to the SHA Specifications will require the Designer to develop a Special Provision (SP) for Meadow Establishment.

Although seed mixes and other information about Meadow Establishment may be shown on landscape plan sheets, the Designer will indicate project-specific seed mixes and installation instructions in a SP for this work, and show that information on landscape plan sheets.

The Designer will delineate the areas of Upland Meadow (UM), Lowland Meadow (LM), and Wet Meadow (WM) when plans are developed.

707 Specifications

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Bioretention Meadow Establishment must be inserted into the IFB to use this item.

SP 700 - Nutrient Management Plan (NMP). Refer to N-12.

707 Meadow Establishment Design Guide

Table 701-A shows soil profiles and maintenance required for successful Meadow Establishment.

Table 705-A shows a flowchart for selecting permanent groundcover vegetation and soil stabilization matting combinations based on slope steepness, channel flow velocity and other factors.

The Designer will consider the areas where Meadow Establishment may be appropriate, and where it will perform best in view of all the available groundcover and maintenance options.

The following information highlights some appropriate uses for Meadow Establishment and proposes some alternatives when meadow is not the best option:

Best Use for Meadow Establishment

- Roadside areas where flowers and pollinator insects are acceptable alternatives to turfgrass in suburban and rural areas with occasional mowing: Short Meadow Establishment.
- Areas > 10 ft. from the pavement edge, consistent with the design speed of the highway, signage and maintenance: Upland, Lowland, Wet, and Bioretention Meadow Establishment.
- Areas where mowing is not desirable and will not be performed: Upland, Lowland, Wet and Bioretention Meadow Establishment.
- Areas where mowing will typically be performed once per year in conformance with SHA Mowing Policy: Upland, Lowland, and Bioretention Meadow Establishment.
- Areas within or adjacent to forest edges, meadows, streams, wetlands and other naturalized areas: Upland, Lowland and Wet Meadow Establishment.
- Areas of Bioretention Soil Mix (BS): Bioretention Meadow Establishment.

Other Choices

- Shrub Seeding Establishment is often appropriate in areas farther from the pavement edge, or where any maintenance will be difficult to provide.

- Turfgrass Establishment, with or without Soil Stabilization Matting, is most appropriate where erosion, traffic, visibility and maintenance concerns are paramount.

707 Meadow Establishment Design Considerations

Table 707-A Meadow Establishment Design Considerations		
Problem	Condition to Avoid	Solution or Alternative
Small Quantity	< 2,000 SY Quantity of UME, LME, or WME	Small quantities are costly and may pose problems during construction. Expand area of turf, etc.
Undersize Areas	< 500 SY Areas of UME, LME, or WME	Small areas are difficult to install. Expand adjacent area of turfgrass, etc.
Awkward Areas	Areas < 15 ft. wide; narrow, complex, or awkward shapes	Define areas with simple, compact shapes with minimal "edge effect"
Poor Placement	Vegetation that will block sidewalks or paths	Specify turfgrass
Unsafe Vegetation	Tall vegetation in areas where driver and pedestrian sightlines must be preserved	Specify turfgrass
Wrong Context	Urban areas and other areas where tall, naturalized vegetation is not appropriate	Specify turfgrass or Constructing Planting Beds with perennials and low shrubs

Meadow Establishment Mixes Meadow Establishment includes a set of species approved for three different soil and moisture conditions. The Designer will select the appropriate type of Meadow Establishment for the site conditions and delineate each type of Meadow Establishment on Plans using the Landscape Keys:

Upland Meadow Establishment (UME) is appropriate for exposed, well-drained flat areas and slopes in full sun or partial shade.

Lowland Meadow Establishment (LME) is appropriate for areas with consistently moist soils in full sun or partial shade. These areas may be flat or mild slopes, floodplains and in stormwater management areas.

Wet Meadow Establishment (WME) is appropriate for areas with full sun or partial shade exposure where standing water is frequent but not constant, in areas adjoining streams and wetlands, and in the lower portions of stormwater management areas. Wet meadow is not intended for tidal, brackish or frequently flooded areas.

Bioretention Meadow Establishment (BME) is appropriate for areas installed with Bioretention Soil Mix (BSM) with full sun or partial shade exposure, and where standing water is frequent but not prolonged.

Short Meadow Establishment (SME) is appropriate for areas of low erosion risk with full sun or partial shade exposure on suburban or rural roadsides where turfgrass would ordinarily be installed. This item requires 1 SY of Refertilizing for each SY of Short Meadow, which is measured and paid for separately.

Options for Straw Mulch and Soil Stabilization Matting. Straw mulch covered with wood cellulose fiber mulch binder is the mulch of the SHA Specifications used for Meadow Establishment.

Type D and Type E Soil Stabilization Matting (SSM) may be specified for installation with Meadow Establishment in lieu of straw mulch.

Type A, Type B, and Type C SSM are not appropriate for Meadow Establishment.

707 Meadow Establishment Estimating Guide

Table 707-B shows the methods of calculation with Unit Price per SY of Meadow Establishment.

707400 Upland Meadow Establishment SY The five Category Code items for Upland Meadow (UME), Lowland Meadow (LME), Wet Meadow (WME), Bioretention Meadow (BME), and Short Meadow (SME) are measured and paid for per SY area of each meadow type.

The Designer will include quantities of UME, LME, WME, BME and SME with the necessary related Category Code items when Meadow Establishment is specified. Because plan view measurements are only accurate for flat areas, the Designer will refer to N-9 and correct for slopes before developing the Engineer's Estimate for Meadow Establishment.

707410 Lowland Meadow Establishment SY See Upland Meadow Establishment SY, above.

707420 Wet Meadow Establishment SY See Upland Meadow Establishment SY, above.

707415 Bioretention Meadow Establishment SY See Upland Meadow Establishment SY, above. This Category Code item requires SP 700 - Bioretention Meadow Establishment.

707425 Short Meadow Establishment SY See Upland Meadow Establishment SY, above.

Table 707-B Meadow Establishment Quantity & Unit Price		
Category Code Item	Quantity	Unit Price
707400 UPLAND MEADOW ESTABLISHMENT SY	1.00 SY of Upland Meadow Establishment (UME)	\$ 2.00 per SY
707410 LOWLAND MEADOW ESTABLISHMENT SY	1.00 SY of Lowland Meadow Establishment (LME)	\$ 2.00 per SY
707420 WET MEADOW ESTABLISHMENT SY	1.00 SY of Wet Meadow Establishment (WME)	\$ 2.00 per SY
707415 BIORETENTION MEADOW ESTABLISHMENT SY	1.00 SY of Bioretention Meadow Establishment (BME)	\$ 2.00 per SY
707425 SHORT MEADOW ESTABLISHMENT SY	1.00 SY of Short Meadow Establishment (SME)	\$ 2.00 per SY
705565 REFERTILIZING SY	and 1.0 SY Refertilizing per SY of Short Meadow	\$0.80 per SY

SECTION 708 TURFGRASS SOD ESTABLISHMENT

Table 700-A (part) Section 708 - Category Codes for Landscaping	
708220	TURFGRASS SOD ESTABLISHMENT SY
708225	ZOYSIAGRASS SOD SY
708235	BERMUDAGRASS SOD SY
705565	REFERTILIZING SY

708 Introduction

Although Turfgrass Establishment (seeding) is the most utilized permanent groundcover vegetation, there are many situations where Turfgrass Sod Establishment is preferred. In keeping with the SHA Landscape Design Philosophy and the principles of the SHA Landscape Design Guide (LDG), the Designer will refer to Section Table 705-A and the discussion in Section 705 for guidance about groundcover alternatives.

In general, sod is installed in preference to seeding where more rapid development of turfgrass groundcover is desired. When grown from seed, turfgrass requires 2 to 3 months to develop a groundcover able to resist erosion and traffic whereas sod can usually provide immediate erosion protection with firm footing and an attractive “finished surface” in less than two weeks.

The Designer will specify Turfgrass Sod Establishment in where soil and future management are appropriate for sod growth per Table 701-A and delineate the areas of Turfgrass Sod Establishment (TSE) when plans are developed.

708 Specifications

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI’s of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Nutrient Management Plan (NMP). Refer to N-12.

708 Turfgrass Sod Establishment Design Guide

Table 701-A shows soil profiles and maintenance required for Turfgrass Sod Establishment.

Table 705-A shows a flowchart for selecting permanent groundcover vegetation and soil stabilization matting combinations based on slope steepness, channel flow velocity, and other factors.

The Designer will consider the areas where Turfgrass Sod Establishment may be an appropriate alternative to Turfgrass Establishment (seeding), appropriate, and where it will perform best in view of all the available groundcover and maintenance options.

The following information highlights some appropriate uses for Turfgrass Sod Establishment and proposes some alternatives when Turfgrass Sod is not the best option:

☑ Best Uses for Turfgrass Sod Establishment.

- Streetscapes, facilities, sidewalk and ADA rehabilitation projects.
- Areas within curbed medians or adjacent to landscaped beds.
- Areas within 10 ft of pavement edge in high traffic locations.
- Areas within 30 ft of commercial and residential buildings.
- In channels and stormwater inlets with water flow ≤ 5 fps.
- Turfgrass areas less than 500 SY.
- Turfgrass Sod (TSE) is always Tall Fescue Sod in Region 1, 2, and 3 per 705.03.01 unless the designer specifies and delineates areas of Zoysiagrass Sod or Bermudagrass Sod.
- Zoysiagrass Sod may be specified in full sun areas in Region 2 or 3. Zoysiagrass Sod should be installed between curb and sidewalk, within curbed medians, within curbed splitter islands, within curbed roundabouts, or within similar areas. Zoysiagrass Sod may be installed adjacent to planting beds within curbed or constrained areas.
- Bermudagrass Sod may be specified in full sun area in Region 3. Bermudagrass Sod may be installed in curbed or uncurbed areas. Bermudagrass Sod should not be installed adjacent to planting beds, or adjacent to sensitive neighboring properties.

☑ Other Choices

- Turfgrass Establishment is preferred in large roadside areas and where rapid vegetation establishment is not required.
- Turfgrass Establishment + SSM is preferred in steep slopes and channels that will not be routinely mowed.
- Meadow Establishment is preferred in areas where meadow is adapted and appropriate.

708 Turfgrass Sod Establishment Design Considerations

Turfgrass Sod Establishment is appropriate in many locations where Turfgrass Establishment is feasible. Refer to Table 705-B.

Table 708-A shows conditions where turfgrass sod should be avoided, and some alternatives.

Table 708-A Turfgrass Sod Establishment Design Considerations		
Problem	Condition to Avoid	Solution or Alternative
Excess Cost	Areas > 2,000 SY	Specify Turfgrass Establishment in large areas where “instant grass” cannot be justified
Excessive Turf Area	Areas > 10 ft from the pavement edge that will not be mowed per SHA Mowing Policy Areas that mowing staff may neglect	Specify Meadow Establishment Specify Shrub Seeding Establishment
High Traffic Areas	Frequent all-year foot or vehicular traffic	Realign sidewalks or install other walkable or driveable hardscape materials Consider barriers to direct traffic along preferred paths
Excessive Shade Areas	Areas under structures, bridges, ramps, etc.	Specify hardscape material over subsoil in lieu of Turfgrass Establishment

708 Turfgrass Sod Establishment Estimating Guide

708220 Turfgrass Sod Establishment SY Turfgrass Sod Establishment (TSE, which is always Tall Fescue sod) as well as Zoysiagrass Sod Establishment (ZSE) and Bermudagrass Sod Establishment (BSE) are measured and paid for per SY of area established. The Designer will include quantities of the pertinent type of sod establishment when any of these items are specified in the Engineer’s Estimate.

708225 Zoysiagrass Sod Establishment SY Refer to Turfgrass Sod Establishment, above.

708235 Bermudagrass Sod Establishment SY Refer to Turfgrass Sod Establishment, above.

705565 Refertilizing SY The Designer shall include 1 SY of Refertilizing for each SY of Turfgrass Sod Establishment. Any required quantity of Refertilizing for sod must be combined with the quantity of Refertilizing required for Turfgrass Establishment (seeding) so that the total SY of Refertilizing is equal to the total area of turfgrass on the project.

Table 708-A Turfgrass Sod Establishment Quantity & Unit Price		
CATEGORY CODE ITEM	Quantity	Unit Price
708220 TURFGRASS SOD ESTABLISHMENT SY	1.00 x SY of Turfgrass Sod Establishment (TSE)	\$5.00 per SY
708225 ZOYSIAGRASS SOD ESTABLISHMENT SY	1.00 x SY of Zoysiagrass Sod Establishment (ZSE)	\$5.00 per SY
708235 BERMUDAGRASS SOD ESTABLISHMENT SY	1.00 x SY of Bermudagrass Sod Establishment (BSE)	\$5.00 per SY
705565 REFERTILIZING SY	1.0 SY Refertilizing per SY of Turfgrass Sod	\$0.80 per SY

SECTION 709 SOIL STABILIZATION MATTING

Table 700-A (part) Section 709 - Category Codes for Landscaping	
709100	TYPE A SOIL STABILIZATION MATTING SY
709110	TYPE B SOIL STABILIZATION MATTING SY
709120	TYPE C SOIL STABILIZATION MATTING SY
709130	TYPE D SOIL STABILIZATION MATTING SY
709140	TYPE E SOIL STABILIZATION MATTING SY

709 Introduction

Soil Stabilization Matting (SSM) is used as a mulch to enhance seed germination of turfgrass or other groundcover vegetation, to reduce raindrop impact and soil erosion, and to reinforce the root zone of turfgrass during and after establishment. Different types of SSM are used in natural areas, flat areas, on slopes, and in channels/ditches.

The SHA Landscape Design Philosophy recognizes that soil stabilization matting is often required for vegetation establishment and sustainability. To the extent possible, however, the Designer will limit the area of SSM, and particularly the area of nondegradable SSM, to the minimum needed to accomplish the design objectives. SSM materials can significantly increase the cost of landscape construction, and the unnecessary use of synthetic materials has been associated with poor vegetation establishment, maintenance complications, and harm to wildlife such as snakes and birds.

The Designer will specify the type of SSM selected for use in the Contract documents, indicate the quantity and costs in the Engineer's Estimate, and show the location of each SSM installation on the plans. The Designer will also develop any Special Provisions that may be required for the SSM, and include those Special Provisions in the Contract documents.

Table 705-A shows a flowchart for selecting permanent groundcover vegetation and soil stabilization matting combinations based on slope steepness, channel flow velocity, and other factors.

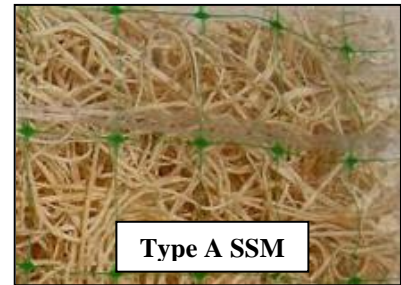
709 Specifications

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

709 Types of Soil Stabilization Matting

The different types of SSM are described below. Also refer to Table 705-A regarding the selection of groundcover and mulches, including SSM.

Type A SSM is a degradable matting composed of excelsior (non-woven shaved wood) or non-woven coconut fiber (coir) that is installed directly over soil prepared and seeded as specified in Section 704 or 705.



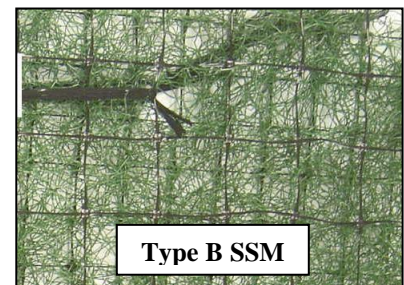
Best Use of Type A SSM. Type A SSM has a lifespan of 12 to 24 months, and is best used in the following areas:

- Slopes where straw mulch + wood cellulose fiber mulch binder as specified Turfgrass Establishment are not able to protect the seedbed from erosion when water velocity exceeds 2.0 fps, or sheer stress exceeds 1.0 fps.
- Channels where Turfgrass Establishment is required and flow velocity is less than 5.0 fps or shear stress is 2.0 fps.
- Retention basins and other stormwater management facilities where straw mulch may float, wash or block inlets.
- Areas where Turfgrass Sod Establishment is not practical or feasible in areas of difficult access, poor soils, or limited irrigation water availability.

When Type A SSM is Not Appropriate.

- Turfgrass Sod Establishment is preferred to Type A SSM + Turfgrass Establishment near sidewalks, streetscapes, facilities, inlets and other areas where more rapid establishment of turfgrass groundcover is desirable, and to reduce tripping hazards.
- Type A SSM is not appropriate for use as outfall protection, or for sites where baseflow, stony soils, heavy shade, prolonged inundation, or other conditions will prevent the establishment or survival of turfgrass groundcover.

Type B SSM is a non-degradable matting composed of non-woven synthetic polymer fibers that is installed directly over soil that has been prepared and seeded as specified in Section 705. Type B SSM is also used per Section 709 to cover Type C SSM that has been infilled and seeded as specified.



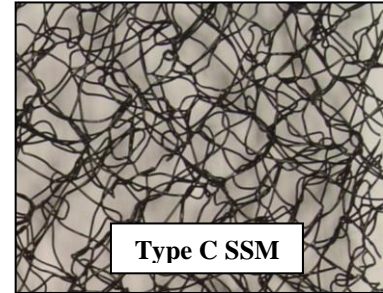
Best Use of Type B SSM. Type B SSM is permanent matting that is best used in channel bottoms and the lower sides of channels where established turfgrass will not be able to resist the force of water runoff without permanent reinforcement.

☒ When Type B SSM is Not Appropriate.

- Type A SSM + Turfgrass Establishment, or Turfgrass Sod Establishment, are preferred in channels and slopes with low to moderate risk of erosion. Type C SSM is preferred in channels with severe risk of erosion. Type D SSM is preferred in naturalized areas.
- Type B is not appropriate for use as outfall protection, or for areas with heavy shade, base flow, or prolonged inundation that will prevent the establishment or survival of turfgrass groundcover.

Type C SSM is a non-degradable matting composed of a lattice of synthetic fibers. The installation methods allow infilling with topsoil followed by Turfgrass Sod Establishment, or installation of Turfgrass Establishment + Type B SSM.

Additional materials are required to cover and establish permanent vegetation groundcover on Type C SSM and the surrounding areas, as shown in Table 709-A. The Designer will specify the appropriate materials when Type C SSM is specified.



☒ Best Use of Type C SSM.

- Type C is best installed where established turfgrass is not able to resist the erosive force of runoff without substantial additional reinforcement. These are areas where flow velocity or shear stress exceeds the ability of Type B to resist erosion. In this role, Type C is used in channels as an alternative to riprap.
- Type C is also installed in roadside areas that are subject to heavy traffic (rootzone reinforcement); where the matting helps to resist rutting and improve turfgrass survival.

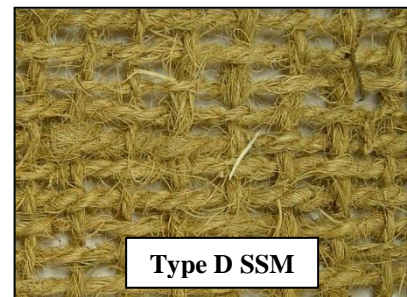
☒ When Type C SSM is Not Appropriate.

- Type B SSM is preferred in channels with significant, but not severe risk of erosion.
- The Designer will consult the Highway Hydraulics Division (OHD-HHD) when flow velocity and shear stress exceed the limits shown in Table 705-A. The Designer will consult the Engineering Geology Division (OMT-EGD) for slopes steeper than 2:1.
- Type C SSM is not appropriate for use in areas with heavy shade, base flow, or prolonged inundation that will prevent the establishment or survival of turfgrass groundcover.

Table 709-A Covering Options for Type C SSM	
1.0 SY Type C SSM with Soil Infilling per Section 709	Uses
Requires 1.0 SY of Turfgrass Sod Establishment installed over soil-infilled Type C SSM <i>or</i> Requires 1.0 SY of Turfgrass Establishment <u>and</u> 1.0 SY of Type B SSM installed over soil-infilled Type C SSM	Install in channel bottoms and lower channel sidewalls where flow velocity up to 9.0 fps is expected <i>or</i> Install in areas where turf reinforcement is required to improve vehicle bearing strength, reduce rutting, and to improve turfgrass survival under traffic
1.0 SY of Type C SSM with Different Seeding or No Soil Infilling	
Requires 1.0 SY of Turfgrass Establishment or other seed in bonded fiber matrix (BFM) or flexible growth medium (FGM) hydromulch applied directly over Type C SSM without soil infilling. These uses requires a Special Provision	

Type D SSM is a degradable matting composed of woven coconut fibers (coir), installed directly over soil that has been prepared in conjunction with Section 705, 706, 707, or other specified vegetation.

A combination of seed, plugs, live stakes, or other vegetation is appropriate for installation in conjunction with Type D. Native vegetation types are preferred for Type D SSM, since this matting is used within or adjacent to natural areas.



Best Use of Type D SSM. Type D SSM has a lifespan of 24-36 months, and is best used where the specified vegetation is able to resist the erosive force of runoff after an extended establishment period. These locations include areas of native and naturalized vegetation within stormwater management facilities such as ponds, basins, infiltration facilities, swales, and channels, as well as areas within or adjacent to wetlands and streambanks.

- Type D SSM is used in conjunction with Meadow Establishment, Shrub Seeding Establishment, Tree, Shrub and Perennials Establishment, and Live Stake Installation
- Type D SSM may be installed with Turfgrass Establishment, but this use is not cost effective for large areas; use Type A SSM with Turfgrass Establishment, if possible.

When Type D SSM is Not Appropriate.

- Straw + wood cellulose fiber mulch binder is the typical option for Meadow Establishment in non-erodible areas, and where straw will not wash or float away.
- Where significant risk of erosion exists, no other SSM is a suitable alternative for Type D SSM. Consult staff of the Landscape Architecture Division (OED-LAD) or the Landscape Operations Division (OED-LOD) for options that may be feasible in natural areas with Special Provisions.
- Type D SSM is not appropriate for sites with heavy shade or conditions that prevent the establishment or survival of the specified permanent vegetation.

Type E SSM is a degradable matting composed of straw, or a blend of straw and coconut fibers, or lightweight excelsior similar to Type A SSM, but less thick.

Type E SSM is installed directly over soil that has been prepared and seeded as specified in Section 704, 705, 706, 707, or other specified vegetation seeding.



Best Use of Type E SSM. Type E SSM is a light duty material, has an effective lifespan of 6 to 12 months, and is best used in the following areas:

- Areas flatter than 4:1 with low erosion risk and no significant runoff inflow where Turfgrass (seed with straw mulch and mulch binder) would be expected to grow quickly.
- Areas of small size or unusual shape where hydroseeding equipment is not practical or desirable (e.g., soil disturbance caused by utility trenching, guardrail installation, etc.).
- Areas where straw mulch is objectionable, or where Type A SSM or Turfgrass Sod Establishment are not feasible alternatives.

When Type E SSM is Not Appropriate.

- Turfgrass Establishment that involves a covering of straw mulch per the SHA Specifications is typically used for permanent seeding.
- Type E SSM is not appropriate for use in erodible channels or slopes, or in any areas where permanent vegetation groundcover is not appropriate or sustainable.
- Turfgrass Sod Establishment, or Type A SSM + Turfgrass Establishment, provide more rapid turfgrass groundcover (sod) or improved erosion protection in the months after installation, but at higher cost.

709 Selection of Soil Stabilization Matting

Turfgrass Establishment as specified in Section 705 is the expected groundcover seeding for flat areas and slopes. Where additional short-term or permanent protection against soil erosion is required, SSM is installed in lieu of straw as specified in Section 709.

Degradable SSM provides short-term erosion protection, and is preferred to synthetic SSM under conditions of low to moderate flow velocity or shear stress. Synthetic SSM is only installed where non-degradable materials are needed to prevent erosion in the event of failure or loss of turfgrass groundcover.

SSM in Channels and Ditches. Some form of channel lining is required for channels/ditches. One or more SSM will be specified by the Designer for installation in channels, unless another material such as riprap is required. The Designer will calculate channel velocities and shear stress using the procedures in Table 709-B or 709-C to determine the most appropriate SSM. The Designer will use

Type B or C SSM only where turfgrass can be established, and the use of riprap or other hard channel linings are not desirable.

Channels and ditches that are subject to substantial flows during Turfgrass Establishment should be protected by diversions or the use of Turfgrass Sod Establishment. For additional information, the Designer will also refer to FHWA HEC-15 and the SHA Highway Drainage Manual.

Table 709-B
Calculation of Shear Stress

Shear Stress (τ) is a measure of the force of moving water against the substrate and is calculated as:

$$\tau = \gamma \cdot R \cdot S_w \quad \text{where:}$$

τ = Shear Stress (lb/ft²) γ = Weight Density of Water (lb/ft)
 R = Average water depth (Hydraulic Radius) (ft)
 S_w = Water Surface slope (ft/ft)

Table 709-C
Calculation of Flow Velocity

Flow Velocity (V) is a measure of water flow through a defined area, usually a channel and is calculated as:

$$V = 1.486/n \cdot R^{2/3} \cdot S^{1/2} \quad \text{where:}$$

V = Flow Velocity (ft/sec) n = Manning's Roughness Coefficient
 R = Hydraulic Radius (ft) S = Channel Slope (ft/ft)

Table 709-D
SSM Use in Channels

Flow Velocity (ft/sec)	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9+	
Shear Stress (lb/ft ²)	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9+	
Type A	Effective	Effective	Effective	Effective	Effective	Effective	Effective	Effective	Effective	Effective	Effective	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Type B	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Type C	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Type D	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Type E	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Rip Rap or SP	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

	Effective Range
	Applicable, but maybe not preferable or cost effective
	Not Applicable

SSM on Slopes. Some SSM may be required for slopes where straw and wood cellulose fiber cannot be applied, or the slopes/soils have high erosion potentials. Use Table 709-D as a guide. The Engineering Geology Division (OMT-EGD) may be contacted for assistance on geotechnical analyses.

Table 709-E SSM Use on Slopes																
Slope	6:1 or Flatter			4:1			3:1			2.5:1			2:1			Steeper than 2:1^a
Length of Slope (ft)	0-30	30-60	60-120	0-30	30-60	60-120	0-30	30-60	60-120	0-30	30-60	60-120	0-30	30-60	60-120	
Type A	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range
Type B	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range
Type C	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range
Type D	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range
Type E	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range	Effective Range
Note: ^a Slopes steeper than 2:1 must be engineered, and Reinforced Soil Slope may be appropriate. Contact Engineering Geology Division (OMT-EGD) for assistance for all slopes steeper than 2:1.										Effective Range Applicable, but maybe not preferable or cost effective Not Applicable.						

709 Vegetation with Soil Stabilization Matting

Refer to Table 705-A. In locations where SSM will be installed in conjunction with permanent vegetation groundcover such as Turfgrass Establishment, Shrub Seeding Establishment, Meadow Establishment, or other specified vegetation, the Designer will include 1.0 Square Yard (SY) of vegetation for each SY of SSM in the Engineer’s Estimate. Refer to Table 709-A for vegetation options and quantities with Type C SSM.

Factors that may affect Turfgrass Establishment or other vegetation such as baseflow, groundwater, presence of rock or shade will be considered in the selection of SSM. The Designer will also consider diversions and other methods to allow sufficient time for vegetation establishment before the SSM is subjected to concentrated flow.

709 Soil Stabilization Matting Plan Review

For slopes, the Engineering Geology Division (OMT-EGD) will provide recommendations regarding the use of SSM based on geotechnical analyses. If SSM is not appropriate, a Special Provision of Section 204 for fill embankments, or Section 200 for cut slopes will be prepared.

For channels/ditches, the Highway Hydraulics Division (OHD-HHD) will review the intended uses, areas and cost estimates of SSM. The Landscape Operations Division (OED-LOD) will review the intended uses, areas, cost estimates and draft Special Provisions of SSM. These Divisions will also review the Special Provision and suggest revisions to ensure that the planned uses and Engineer’s Estimates are consistent with this Guide.

709 Soil Stabilization Matting Estimating Guide

The area of matting for the Engineer's Estimate is computed by determining the area covered by SSM on the plans. The Designer will not rely on plan view alone to calculate the area of coverage, but use the actual surface area as corrected for topography. Refer to N-9.

709100 Type A SSM SY The area of matting is reported in the Engineer's Estimate. The Designer will also include an equal quantity of Turfgrass Establishment for installation with the matting.

709110 Type B SSM SY The area of matting is reported in the Engineer's Estimate. The Designer will also include an equal quantity of Turfgrass Establishment for installation with the matting.

709120 Type C SSM SY The area covered with Type C matting is reported in the Engineer's Estimate. The area covered by Turfgrass Sod Establishment, Type B matting + Turfgrass Establishment or other materials and vegetation is measured and paid for separately. These additional materials are not incidental to the price of Type C SSM.

709130 Type D SSM SY The area of matting is reported in the Engineer's Estimate. The Designer will also include an equal quantity of Meadow Establishment, Shrub Seeding Establishment, Turfgrass Establishment or other vegetation specified for installation with the matting.

709140 Type E SSM SY The area of matting is reported in the Engineer's Estimate. The Designer will also include an equal quantity of Turfgrass Establishment, Meadow Establishment, Shrub Seeding Establishment or other vegetation specified for installation with the matting.

Table 709-F		
Soil Stabilization Matting Items Quantity & Unit Price		
Category Code Item	Quantity	Unit Price
709100 TYPE A SOIL STABILIZATION MATTING SY	1.00 SY of Type A SSM	\$ 2.50 per SY
	1.00 SY of Turfgrass Establishment	\$ 1.50 per SY
709110 TYPE B SOIL STABILIZATION MATTING SY	1.00 SY of Type B SSM	\$ 8.00 per SY
	1.00 SY of Turfgrass Establishment	\$ 1.50 per SY
709120 TYPE C SOIL STABILIZATION MATTING SY	1.00 SY of Type C SSM	\$ 20.00 per SY
	1.00 SY of Turfgrass Sod Establishment (option 1)	\$ 5.00 per SY
	1.00 SY of Type B SSM (part of option 2)	\$ 8.00 per SY
	1.00 SY of Turfgrass Establishment (part of option 2)	\$ 1.50 per SY
709130 TYPE D SOIL STABILIZATION MATTING SY	1.00 SY of Type D SSM	\$ 5.00 per SY
	1.00 SY of Meadow Establishment (typical)	\$ 2.00 per SY
709140 TYPE E SOIL STABILIZATION MATTING SY	1.00 SY of Type E SSM	\$ 2.00 per SY
	1.00 SY of Turfgrass Establishment (typical)	\$ 1.50 per SY

SECTION 710

TREE, SHRUB AND PERENNIALS

INSTALLATION AND ESTABLISHMENT

Table 700-A (part) Section 710 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
710150	TREE, SHRUB, AND PERENNIAL INSTALLATION AND ESTABLISHMENT LS
710170	CONSTRUCTING PLANTING BEDS SY
710185	EXPANDED TREE PIT EA
715015	SHREDEDDED HARDWOOD BARK MULCHING 3 IN. DEPTH SY

710 Introduction

Trees, shrubs and planting beds are important elements of landscape design, particularly in urban and suburban areas. Small trees and other plants are also installed in naturalized areas, and to mitigate tree and forest losses in accordance with federal and state laws.

Very often, the installation of ornamental trees, shrubs and planting beds adds substantially to the cost of landscape construction and to future landscape maintenance. The materials also have important impacts on the safe operation of the highway system.

In keeping with the SHA Landscape Design Philosophy and principles of the SHA Landscape Design Guide (LDG), the Designer will prioritize the installation of ornamental trees, shrubs and perennials to those areas where aesthetic enhancement is most needed, and where maintenance can be consistently and efficiently provided.

710 Specifications

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

Other project-specific Special Provisions for Beaver Tree Protection Shelters, Deer Protection Shelters, Live Stakes, Stone Mulch, and other operations or materials for the installation of trees, shrubs, perennials and planting beds are available from the Landscape Architecture Division (OED-LAD) and Landscape Operations Division (OED-LOD).

SP 700 - Nutrient Management Plan (NMP). Refer to N-12.

SP 700 - Tree Preservation Program (TPP). Refer to N-41.

710 SHA Details for Landscaping

Standard Details. Refer to page N-4 for a hyperlink and list of all SHA Standard Details for Landscaping. Standard Details are not reproduced on plan sheets.

Project-Specific Details. Refer to page N-4 for a hyperlink to project-specific non-standard details maintained by OED-LAD. Non-standard details are reproduced on plan sheets.

710 Design Guide for Trees, Shrubs and Perennials

This Guide provides design information the Category Code items of Section 710. The Designer will refer to the LDG for detailed information about the item “Tree, Shrub and Perennials Installation and Establishment” and the following topics:

- Context sensitive and sustainable landscape design principles
- Project planning, scope development and bidding processes
- Permits, mitigation, critical areas and related requirements
- Site visits, field checks, plan preparation and plan reviews
- Designing for utilities, sight-lines and safety set-backs
- Specifying preferred plant species, cultivars and sizes
- Preparing Engineer’s Estimate and Landscape Plans
- Many related landscape planning topics

Specialists of the Landscape Architecture Division (OED-LAD) will provide assistance with project development, plan and estimating review for contracts that involve Category Code items of Section 710.

Table 705-A shows a simplified decision-making flowchart that includes Turfgrass Sod Establishment, other groundcover vegetation, and Soil Stabilization Matting (SSM). The Designer will consider the areas where Trees, Shrubs and Perennials are desired, and where these plant materials will perform best in view of all the available groundcover options.

Table 701-A shows soil profiles and future maintenance regimes adapted for Tree, Shrubs and Perennials. The Designer will ensure that the soil is able to support the growth and expected future maintenance of the specified plant materials.

710 Estimating Guide for Trees, Shrubs, and Perennials

Table 710-B provides a Unit Price for all Category Code items associated with Section 710 except “Tree, Shrub and Perennials Installation and Establishment” which is a lump sum item.

An example calculation showing estimating methods is included at the end of this section with an example Engineer’s Estimate.

710150 Tree, Shrub, and Perennial Installation and Establishment LS This item is a single lump sum cost for all trees, shrubs, vines, ornamental grasses, and perennial plants of the project. It also includes the costs of mulch, fertilizer, water, etc. needed to install the plants.

Although the Designer will report the number and kinds of plant materials in the Contract documents, usually in plans but occasionally in the IFB, the quantity for this item in the Engineer's Estimate is always "1.000" since it is a lump sum.

710185 Expanded Tree Pit EA. Planting pits for trees that are excavated to dimensions larger than required per Table 3 of SP 710 are sometimes appropriate for installation in urban sites or other locations where poor growing conditions may be offset by improved rootzone preparation.

When this item is added to the Estimate, the detail available from the Landscape Architecture Division (OED-LAD) should be reproduced on plan sheets. Refer to N-4 regarding details. Modification of a detail may be appropriate to accommodate unique project needs.

Note: Expanded Tree Pit will be measured and paid for at the Contract unit price per each. The price shall include the cost of excavation to the specified dimensions, furnished subsoil, disposal of excavated soil and all operations related to construction of the expanded tree pit.

710170 Constructing Planting Beds SY This item is specified when plant materials are installed together in beds, rather than in separate planting pits. It includes all operations to construct and cover the bed with 3 in. of SHB mulch. It does not include the cost of plant materials.

The Designer will report the total SY area of planting beds after correcting for slope per N-9. The area of each planting bed is calculated from the perimeter of the bed as delineated on plans or described in the Contract documents.

Because this item is also used in Section 711, the Designer will combine the SY of Constructing Planting Beds in Section 710 and 711 to develop a single estimate for this item.

715015 Shredded Hardwood Bark Mulching 3 in. Depth SY. This mulching item is often used for constructing the surface finish of bioretention and microbioretention facilities.

Measurement and payment for this Category Code item is specified in Section 710. However, SPI 316 Stormwater Filtration Facilities and other SPs may also include references to this payment item, which is associated with Section 710.

The installation of Shredded Hardwood Bark Mulching 3 in. Depth SY does not require the usual tilling and other operations associated with 710170 Constructing Planting Beds.

Shrubs, ornamental grasses and perennials may be installed with this item, but those plant materials are separately measured and paid for as part of the lump sum of 710150 Tree, Shrub and Perennial Installation and Establishment LS.

Table 710-A Tree, Shrub, and Perennials Related Items Quantity & Unit Price		
Category Code Item	Quantity	Unit Price
710150 TREE, SHRUB AND PERENNIAL INSTALLATION AND ESTABLISHMENT LS	Guidance of Landscape Architect based upon prevailing prices	Lump Sum
710185 EXPANDED TREE PIT EA	Guidance of Landscape Architect for each tree with larger pits	\$15.00 per EA
710170 CONSTRUCTING PLANTING BEDS SY	1.00 SY of Planting Bed	\$10.00 per SY
715015 SHREDDED HARDWOOD BARK MULCHING 3 IN. DEPTH	1.00 SY of Surface of Bottom of Bioretention Facility	\$5.00 per SY

SECTION 711 ANNUALS AND BULBS INSTALLATION AND ESTABLISHMENT

Table 700-A (part) Section 711 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
711100	ANNUALS AND BULBS INSTALLATION AND ESTABLISHMENT LS
710170	CONSTRUCTING PLANTING BEDS SY

711 Introduction

Because annuals die at the end of their growing season, these plants are usually specified for installation and replacement in ongoing maintenance contracts. For these areas, a yearly commitment to planting bed maintenance and replanting is usually expected. Annuals are not often installed in new construction.

Bulbs, principally daffodils and crocus, are often specified in construction and rehabilitation projects. The bulbs may be installed in maintained beds, or in “naturalized” areas that will not be mowed during their bloom period and active growing season (February through May for daffodils and crocus).

Although the cost of annuals and bulbs is relatively low, the annual cost to maintain the beds can be significant. In keeping with the SHA Landscape Design Philosophy and the principles of the SHA Landscape Design Guide (LDG) the Designer will specify the installation of annuals and bulbs in those areas where aesthetic enhancement is most needed, and where maintenance can be consistently and efficiently provided.

711 Specifications

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Nutrient Management Plan (NMP). Refer to N-12.

711 Design Guide for Annuals & Bulbs

This Guide provides design information for the Category Code items of Section 711. The Designer will refer to the Landscape Design Guide for additional information about the item “Constructing Planting Beds” and “Annuals and Bulbs Installation and Establishment.”

Specialists of the Landscape Architecture Division (OED-LAD) will provide assistance with project development, plan review and estimating for contracts that involve Category Code items of Section 711.

The Designer will consider the areas where Planting Beds are desired, and where annuals will perform best in view of all the available groundcover options.

Table 701-A shows soil profiles and future maintenance regimes adapted for Planting Beds. The Designer will ensure that the soil is able to support the growth and expected future maintenance of the specified plant materials.

711 Estimating Guide for Annuals & Bulbs

Table 711-A provides the Unit Price for all Category Code items associated with Section 711, except the item “Annuals and Bulbs Installation and Establishment” which is discussed in the LDG. An example calculation showing estimating methods is included at the end of this chapter with a sample Engineer’s Estimate.

Table 711-A Annuals and Bulbs and Related Items Quantity & Unit Price		
Category Code Item	Quantity	Unit Price
711100 ANNUALS AND BULBS INSTALLATION AND ESTABLISHMENT LS	Guidance of Landscape Architect	Lump Sum
710170 CONSTRUCTING PLANTING BEDS SY	1.00 SY of Planting Bed	\$ 10.00 per SY

711100 Annuals and Bulbs Installation and Establishment LS This item is a single lump sum cost for all annuals and bulbs of the project. It also includes the costs of mulch, fertilizer, water, etc. needed to install the plants. The Designer will refer to the LDG to develop the Engineer’s Estimate for this item. Although the Designer will report the number and kinds of plant materials in Contract documents, the quantity for this item in the Engineer’s Estimate is always “1.000” since it is a lump sum.

710170 Constructing Planting Beds This item is specified when plant materials are installed together in beds, rather than in separate planting pits. It includes all operations to construct and cover the bed with 3 in. of SHB mulch. It does not include the cost of plant materials.

The Designer will report the total SY area of planting beds after correcting for slope per N-9. The area of each planting bed is calculated from the perimeter of the bed as delineated on plans or described in the Contract documents. Because this item is also used in Section 710, the Designer will combine the SY of Constructing Planting Beds in Section 710 and 711 to develop a single estimate for this item.

SECTION 712 TREE BRANCH PRUNING

Table 700-A (part) Section 712 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
712100	TREE BRANCH PRUNING LS
716100	TREE BROADCAST FERTILIZING SY

712 Introduction

Tree Branch Pruning involves the selective removal of tree limbs. The Designer will refer to Section 712 and ANSI A300 Standards for Tree Care Operations for additional information about this work.

- Tree Branch Pruning may be specified on the plans, or in a SP 700 - Tree Preservation Program (TPP). SP 700 - TPP is the preferred method of specifying the Operations, and is required for projects without plans, because the payment is lump sum.
- Tree Branch Pruning may be appropriate within a delineated Tree Preservation Area to remove damaged branches, to improve clearance in adjacent areas, or to improve aesthetics.

712 Roadside Tree Permit (RTP) and Other Permits

A Roadside Tree Permit (RTP) issued by the Maryland Dept. of Natural Resources Forest Service is required for Tree Branch Pruning in the right of way. A RTP is not required for Tree Branch Pruning at facilities and other locations outside the right of way.

The Designer will obtain the RTP when it is required, and insert a copy of the RTP into the IFB before Final Review, in conformance with the policy of the Office of Environmental Design (OED).

Staff of the Landscape Architecture Division (OED-LAD) or the Landscape Operations Division (OED-LOD) will provide assistance to determine the need for a RTP, or assist with the application. They will also provide technical assistance to determine the goals of Tree Branch Pruning and the costs. Refer to LDG Chapter 4 for information about other environmental permits.

712 Specifications & SP 700 - Tree Preservation Program (TPP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Tree Preservation Program (TPP). SP 700 - TPP is a Special Provision (SP) of the Contract developed by the Designer in cooperation with the Landscape Architect and the Statewide Forest Mitigation Coordinator.

SP 700 - TPP specifies the landscaping objectives, trees and areas of Tree Branch Pruning (712), Tree Root Pruning (715), and Tree Fertilizing (716). SP 700 - TPP will also include Tree Felling (714) and Brush Removal (713) when these operations are also included in the Contract.

The Designer will include SP 700 - TPP for Tree Branch Pruning in the IFB when a project does not include plans. SP 700 - TPP is also recommended whenever a TPA is delineated on plans, or when Tree Felling, Brush Removal, Tree Root Pruning, or Tree Fertilizing are included in the Contract.

When landscape plans are developed, SP 700 - TPP is encouraged to improve the accuracy of the Engineer's Estimate and bids on advertised contracts, and to reduce the likelihood of confusion during construction. However, SP 700 - TPP may not be required if the plans adequately describe the locations and work to be done.

The Designer will develop SP 700 - TPP in preparation for Final Review. When SP 700 - TPP is developed, no other SPs for work associated with Sections 712 through 716 are usually appropriate or required.

SP 700 - Nutrient Management Plan (NMP). SP 700 - TPP will provide fertilizer application rates when Tree Fertilizing per Section 716 will be performed in conjunction with Tree Branch Pruning. A separate SP 700 - NMP will not be prepared by the Landscape Operations Division (OED-LOD) for Tree Fertilizing.

712 Tree Branch Pruning Design Guide

Tree Branch Pruning is specified to meet different landscaping objectives. The Landscape Architect, the Statewide Forest Mitigation Coordinator and other staff of the Landscape Operations Division (OED-LOD) may also be able to provide assistance to determine the need for Tree Branch Pruning, to define the Operations, or to assist with estimating the costs.

Operations. The SHA Specifications include the following Tree Branch Pruning Operations. All of these Operations are explained in the plans or SP 700 - TPP, as appropriate. Tree Branch Pruning should be considered for all projects that involve Clearing and Grubbing operations where the new forest edges are created.

- a. **Cleaning.** To remove dead, diseased and broken branches. This operation is often appropriate at forest edges, at the edges of Clearing and Grubbing operations, within islands of isolated forest such as Tree Preservation Areas, and whenever branches are hazardous and must be removed.
- b. **Thinning.** To reduce the density of live branches. This operation may be appropriate to reduce crown area when roots are pruned. Thinning should be considered when Tree Root Pruning or Clearing and Grubbing operations will damage existing roots, and may be appropriate to reduce the likelihood of wind throw when tall or dense interior forest trees are left exposed at the edges of cleared areas.
- c. **Raising.** To provide clearance to a height of 16 ft over roadways, or to a height of 8 ft over sidewalks, or as otherwise specified in the Contract Documents. This operation is often necessary following Clearing and Grubbing operations.
- d. **Reducing.** To decrease the height or spread. This operation may be used to reduce interference with vehicles along the roadway, to eliminate conflicts with overhead utilities, or to restore visibility for signs, etc. This operation may be appropriate after Clearing and Grubbing operations.
- e. **Specialty Pruning.** To meet the needs of young trees, at planting, once established, pollarding, for restoration, to maintain vistas, or to accommodate utilities. SP 700 - TPP or plans must provide adequate details regarding the branches to be removed and/or the goals of the pruning.

The need for Tree Branch Pruning at facilities, streetscape projects, sidewalk retrofits and many other projects is easily overlooked or underestimated. To reduce the likelihood of neglecting issues that are best addressed during construction, the Designer will:

- **Arrange site visits** with the Landscape Architect, Statewide Forest Mitigation Coordinator or other staff of the Landscape Operations Division (OED-LOD) as soon as possible during project development to assess the Operations and determine the costs.
- **Develop SP 700 - TPP** for Tree Branch Pruning for all projects without plans, or when the branch pruning will be performed within a delineated TPA, or when plan notes will not adequately define the Tree Pruning Operations. SP 700 - TPP for Brush Removal will include information regarding the species and location of trees, clearly define the Operations, and specify the disposal methods of debris and chips.

712 Tree Branch Pruning Estimating Guide

712100 Tree Branch Pruning LS The Designer will develop the Engineer’s Estimate for Tree Branch Pruning as a lump sum item to include all the costs associated with branch pruning on the project. Projects that involve Clearing and Grubbing or delineated Tree Preservation Areas (TPA) per Section 120, or which involve the use of Temporary Orange Construction Fence to protect trees should be reviewed to determine the need for Tree Branch Pruning to eliminate hazardous branches, improve aesthetics or provide clearance for roadways and sidewalks.

The estimate is based upon site visits, plan reviews and measurements of pruning requirements by the Designer, the Landscape Architect, or the Landscape Operations Division (OED-LOD). This method involves on-site appraisal of work and costs.

716100 Tree Broadcast Fertilizing SY When a project includes Tree Root Pruning, the Designer should consider the need for Tree Broadcast Fertilizing to offset any loss of vigor caused by the pruning.

The amount of Tree Broadcast Fertilizing is usually based upon the SY area of fertilizing within the critical root zone, generally the soil area within the delineated area of root pruning under the drip line of the tree, per Table 715-A. Note: Other fertilizing options may be selected.

Table 712-A Tree Branch Pruning to Develop Lump Sum Price	
Category Code Item	Assessment Method
712100 TREE BRANCH PRUNING LS	Lump Sum Based on Site Visits
716100 TREE BROADCAST FERTILIZING SY	Optional: Other Fertilizing Operations May Be Appropriate

SECTION 713 BRUSH REMOVAL

Table 700-A (part) Section 713 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
713015	BRUSH REMOVAL SY

713 Introduction

Brush Removal involves the cutting of shrubs and other brushy vegetation in selected areas, as well as herbicide application and debris removal. The purpose of the Brush Removal may be to restore sightlines, improve aesthetics, remove invasive species, or to create space for meadows, trees, or other landscaping.

- Brush Removal is not specified in the same areas where Clearing and Grubbing is specified.
- Brush Removal may be appropriate within a delineated Tree Preservation Area, particularly when such areas include invasive species.
- Brush Removal may be specified on the plans or in SP 700 - Tree Preservation Program (TPP).
- SP 700 - TPP is the preferred method of specifying the Operations of Brush Removal, and is required for projects without plans.
- Areas of Brush Removal may require restoration of groundcover as separate pay items.

713 Permits

Because the removal of brush is not regulated under the Maryland Roadside Tree Law or the Maryland Forest Conservation Act, no permits are required for Brush Removal. In case of doubt, the Designer will consult the Landscape Architect, the Statewide Forest Mitigation Coordinator, or other staff of the Landscape Operations Division (OED-LOD) regarding permit requirements.

713 Specifications and SP 700 - Tree Preservation Program (TPP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Tree Preservation Program (TPP). Refer to N-41 and the bullets above. SP 700 - TPP is appropriate for most projects for Brush Removal, with or without plans.

713 Brush Removal Design Guide

Brush Removal is specified to meet different landscaping objectives. The Landscape Architect and staff of the Landscape Operations Division (OED-LOD) may also be able to provide assistance to determine the need for Brush Removal, to define the Operations and any methods needed to restore groundcover vegetation, or to assist with estimating the costs.

Operations. Section 713 provides two Operations for Brush Removal, described below. For both Operations, the Project Engineer will decide whether the debris is chipped during construction, and how the chips are to be dispersed or disposed during construction unless the Designer provides instructions in SP 700 - TPP or plans.

Operation 1 – Brush Removal The unwanted vegetation is cut to a height of no more than 1 in. above the soil surface. This method is most appropriate where landscape seeding and mowing will be able to suppress the regrowth of brush, or where the brush is dead unlikely to regrow after cutting.

Operation 2 – Brush Removal with Stump Treatment The unwanted vegetation is cut as in Operation 1, and a herbicide is applied to the stumps to prevent regrowth. This method is appropriate for vigorously growing brush, and particularly on steep slopes and other areas where mowing cannot be performed to suppress regrowth.

Because of the prevalence of brushy species that regrow vigorously (Tree of Heaven, Multiflora Rose, Russian Olive, Black Locust, others), Operation 2 is generally preferred in locations where mowing will not be routinely performed after the brush is removed.

Groundcover Restoration. The need to restore erosion-resistant groundcover vegetation after Brush Removal is easily overlooked. However, it is often the case that densely brushy areas have little turfgrass or other permanent groundcover vegetation. When the brush is removed from these areas, the soil is vulnerable to erosion as well as “rebound” weed growth. When Brush Removal is contemplated, the Designer will assess the need for additional landscape groundcover seeding. To reduce the likelihood of neglecting issues that are best addressed during construction, the Designer will:

- **Arrange site visits** with the Landscape Architect, Statewide Forest Mitigation Coordinator, or other staff of the Landscape Operations Division (OED-LOD) as soon as possible during project development to assess the Operations and determine the costs. A site visit is also required to assess site conditions and the need for additional groundcover seeding or other provisions that may be required when brush is removed.
- **Develop SP 700 - TPP** for Brush Removal for all projects without plans, or when Brush Removal will be performed within a delineated TPA, or when plan notes will not adequately define the Brush Removal Operations. SP 700 - TPP for Brush Removal will usually include information regarding the location of the brush, as well as information about the Operations and disposal of debris and chips.

713 Brush Removal Estimating Guide

713015 Brush Removal SY The Designer will develop the Engineer’s Estimate for Brush Removal as a weighted average of all Brush Removal Operations per SY. Refer to Table 713-A.

The estimate is based upon site visits, plan reviews, and measurements of areas by the Designer, the Landscape Architect, or the Landscape Operations Division (OED-LOD). This method involves on-site appraisal of work and costs.

To assess the costs, the Designer will determine the need for Operation 1, Operation 2, or a combination of these Operations. The terrain, caliper and density of brush, need for herbicide application and method of debris removal, all affect the estimated Unit Price.

Brush Removal may be specified with SP 700 - TPP, or by delineating the areas and describing the Operations to be performed on the plans. In all cases, Designer will indicate the method of debris disposal.

Table 713-A Brush Removal Operation and Average SY Price	
713015 BRUSH REMOVAL SY	Unit Price per SY
Operation 1, most brush less than 1 in. diameter, debris dispersed on site	\$ 8.00
Operation 1, most brush less than 2 in. diameter, debris dispersed on site	\$ 10.00
Operation 1, most brush larger than 2 in. diameter, debris dispersed on site	\$ 12.00
Operation 2, most brush less than 1 in. diameter, debris removed from site	\$ 14.50
Operation 2, most brush less than 2 in. diameter, debris removed from site	\$ 16.00
Operation 2, most brush larger than 2 in. diameter, debris removed from site	\$ 18.50
Note: * Unit Price per Square Yard of Brush Removal. When more than one Operation or method of debris disposal is specified, the Designer will calculate the average Unit Price for this item, and show this average in the Engineer's Estimate	

SECTION 714 TREE FELLING AND STUMP REMOVAL

Table 700-A (part) Section 714 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
713010	TREE FELLING LS

714 Introduction

Tree Felling and Stump Removal involves the selective cutting and trees and/or grinding of stumps, and all associated debris removal.

- Tree Felling and Stump Removal is not specified in the same areas where Clearing and Grubbing is specified.
- Tree Felling may be appropriate within a delineated Tree Preservation Area to remove hazardous trees or invasive tree species.
- Tree Felling and Brush Removal may be specified on the plans or in SP 700 - Tree Preservation Program (TPP).
- SP 700 - TPP is the preferred method of specifying the Operations of Tree felling and Brush Removal, and is required for projects without plans.

714 Roadside Tree Permit (RTP)

A Roadside Tree Permit (RTP) issued by the Maryland Dept. of Natural Resources Forest Service is required for the felling of live trees in the right of way. A RTP is not required for felling of dead trees, for stump removal of dead trees, or for tree felling at facilities and other sites outside the right of way.

The Designer will obtain the RTP when it is required, and insert a copy of the RTP into the IFB before the time of Final Review, in conformance with the policy of the Office of Environmental Design (OED).

The Designer will obtain the RTP when it is required, and insert a copy of the RTP into the IFB before Final Review, in conformance with the policy of OED. Staff of the Landscape Architecture Division (OED-LAD) or the Landscape Operations Division (OED-LOD) will provide assistance to determine the need for a RTP, and will either submit the application to MD-DNR or assist the designer with the application. These staff will also provide technical assistance to determine the cost of Tree Felling, or assist with the determination of unsafe trees, the identification of invasive species of trees, and the need for felling to remove these trees.

714 Specifications and SP 700 - Tree Preservation Program (TPP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Tree Preservation Program (TPP). Refer to N-41. The Designer will indicate the species, sizes, and locations of trees to be felled in SP 700 - TPP (preferred), or include this information in the plans. Care is needed to provide adequate information, because the removal of live trees in the right of way is legally regulated, and payment for Tree Felling is a lump sum item.

714 Tree Felling Design Guide

Tree Felling is performed to reduce safety and visibility problems, to remove unhealthy trees, hazardous trees and invasive tree species. Tree Felling is occasionally specified to facilitate the installation of other more desirable landscape vegetation.

Operations. Section 714 provides five operations, described below. For Operations 1, 2 and 3 the Designer will decide whether the debris is chipped and how the chips are dispersed or disposed during construction. This information is shown on the plans or in SP 700 - TPP or other Special Provisions of the Contract.

Operation 1 - Felling and Stump Removal Trees are felled, the stumps are removed or ground down, wood debris is removed, holes are filled with soil and seeded to turfgrass. This Operation is the preferred method at facilities, in streetscapes, and most locations where a large stump or void is objectionable or hazardous.

Operation 2 - Felling and Stump Treatment Trees are felled, stumps are cut to a height less than 4 in. above the soil surface, wood debris is removed, and a herbicide is applied to stumps to prevent regrowth. This Operation is preferred for species that sprout vigorously after being cut (Black Locust, Tree of Heaven, others), or where a moderate to large stump is not objectionable, or where mowing will not normally be performed (forest edges, steep slopes, etc.). This Operation is most often used to remove live trees in roadside areas, and where different tree species are removed at the same time.

Operation 3 - Felling and Removal Trees are felled, stumps are cut to a height less than 4 in. above the soil surface, and wood debris is removed. This Operation is most appropriate for the removal of dead or dying trees, or species that rarely sprout after cutting, in roadside areas and locations where a moderate to large stump is not objectionable.

Operation 4 - Felling and Delimiting Trees are felled, stumps are cut to less than 12 in. height, branches are cut so none extend higher than 3 ft above the soil surface, and no debris is removed. This Operation is most appropriate in wooded areas, areas within a TPA, and other locations where tree debris can be tolerated without safety or maintenance concerns.

Operation 5 - Stump Removal. Existing stumps removed or ground to a depth at least 8 in. below the soil surface. Wood debris and stump grindings are removed, and within 24 hours after removal or grinding, the stump holes are backfilled with topsoil to the surrounding soil level, and Turfgrass Establishment is performed as specified in Section 705.

The need for Tree Felling to remove invasive species, or to eliminate hazards, trees in poor health, or undesirable trees within Tree Preservation Areas is easily overlooked or underestimated. To reduce the likelihood of neglecting issues that are best addressed during construction, the Designer will:

- **Arrange site visits** with the Landscape Architect, Statewide Forest Mitigation Coordinator, or other staff of the Landscape Operations Division (OED-LOD) as soon as possible during project development to assess the Operations and determine the costs.
- **Develop SP 700 - TPP** for Tree Felling for all projects without plans, or when Tree Felling will be performed within a delineated TPA, or when plan notes will not adequately define the Tree Felling Operations. SP 700 - TPP for Tree Felling will include information regarding the location, species, and size of the tree, and information about Operations and disposal of debris.

714 Tree Felling Estimating Guide

713010 Tree Felling LS The Designer will develop the Engineer's Estimate for Tree Felling as a lump sum item to include all the costs associated with all Tree Felling on the project. The estimate is based upon site visits, plan reviews and measurements of tree diameter at breast height (DBH) by the Designer, the Landscape Architect, the Statewide Forest Mitigation Coordinator, or other staff of the Landscape Operations Division (OED-LOD). This method involves on-site appraisal of work and costs using Table 714-A.

Table 714-A Tree Felling Sizes and Costs to Develop Lump Sum Price					
713010 TREE FELLING LS	Assessment Method				
	Per Tree of Tree Felling Size Class & Operation				
Tree Felling Size Class ^aIn. DBH	Operation 1 Felling and Stump Removal	Operation 2 Felling and Stump Treatment	Operation 3 Felling and Removal	Operation 4 Felling & Delimiting	Operation 5 Stump Removal
Under 10+	\$ 700	\$ 650	\$ 600	\$ 200	\$ 200
10 to 15+	\$ 800	\$ 750	\$ 700	\$ 250	\$ 200
16 to 20+	\$ 900	\$ 850	\$ 800	\$ 300	\$ 250
21 to 25+	\$ 1,200	\$ 1,050	\$ 1,000	\$ 350	\$ 250
26 to 30+	\$ 1,400	\$ 1,250	\$ 1,200	\$ 400	\$ 300
31 to 35+	\$ 1,800	\$ 1,550	\$ 1,500	\$ 450	\$ 300
36 to 39+	\$ 2,100	\$ 1,850	\$ 1,800	\$ 500	\$ 350
40 to 45+	\$ 2,500	\$ 2,250	\$ 2,200	\$ 600	\$ 350
46 to 50+	\$ 3,100	\$ 2,650	\$ 2,600	\$ 700	\$ 400
Over 51	\$ 3,600	\$ 3,150	\$ 3,100	\$ 800	\$ 400
Note: ^a In. DBH = Diameter of Tree at Breast Height; the standard measurement of tree diameter					

SECTION 715 TREE ROOT PRUNING

Table 700-A (part) Section 715 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
715050	TREE ROOT PRUNING LF
716100	TREE BROADCAST FERTILIZING SY

715 Introduction

Tree Root Pruning is a specialized trenching and root cutting method used to intentionally reduce the growing area of tree roots. Tree Root Pruning is usually performed at the beginning of construction, and preferably before other construction activities that could impact trees. When Tree Root Pruning is performed several months before other construction activities begin, trees within root pruned areas often exhibit less construction-related stress, damage, and loss.

- Tree Root Pruning may be appropriate at the edge of a Tree Preservation Area, at the Limits of Disturbance (LOD), or at the edge of areas where Clearing and Grubbing is performed.

- Tree Root Pruning may be specified in SP 700 - Tree Preservation Program (TPP) or by delineating the area of root pruning on the E&S sheets.
- SP 700 - TPP is required for projects without plans.
- Tree Root Pruning is often specified in conjunction with Tree Branch Pruning or Tree Fertilizing to reduce construction impacts on trees to be preserved.

715 Roadside Tree Permit (RTP)

A Roadside Tree Permit (RTP) issued by the Maryland Dept. of Natural Resources Forest Service is required for Tree Root Pruning operations that cut roots of trees in the right of way over 1 in. diameter. A RTP is not required for Tree Root Pruning at facilities and other locations outside the right of way. The Designer will obtain the RTP when it is required, and insert a copy of the RTP into the IFB before the time of Final Review, in conformance with the policy of the Office of Environmental Design. Staff of the Landscape Architecture Division (OED-LAD) or the Landscape Operations Division (OED-LOD) will provide assistance to determine the need for a RTP, or assist with the application. These staff will also provide technical assistance to determine the need for Tree Root Pruning and the costs.

715 Specifications and SP 700 - Tree Preservation Program (TPP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications. After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Tree Preservation Program (TPP). Refer to N-41. The Designer will indicate locations of Tree Root Pruning in SP 700 - TPP, or include this information on the E&S sheets so this work will be performed early during construction. Care is needed to provide clear instructions, because Tree Root Pruning in the right of way is legally regulated, and sensitive trees may be involved.

SP 700 - Nutrient Management Plan (NMP). Because SP 700 - TPP will provide fertilizer application rates when Tree Fertilizing per Section 716 is performed in conjunction with Tree Root Pruning a separate SP 700 - NMP will not be prepared by the Landscape Operations Division (OED-LOD) for Tree Fertilizing.

715 Tree Root Pruning Design Guide

The time between root pruning and construction impacts can vary, but an interval of 9 to 18 months is adequate for large, vulnerable, or valuable individual trees. For perimeter root pruning of TPA, an interval of 6 months is adequate, if root pruning will not be performed from May through August.

The delineation of Tree Root Pruning for individual trees is usually based upon a technical field examination. For most TPA the delineation is the outer dripline the trees within the TPA.

The need for Tree Branch Pruning at the edge of Clearing and Grubbing areas, in streetscape and sidewalk retrofit projects, and many other projects is easily overlooked or underestimated. To reduce the likelihood of neglecting issues that are best addressed during construction, the Designer will:

- **Arrange site visits** with the Landscape Architect, Statewide Forest Mitigation Coordinator, or other staff of the Landscape Operations Division (OED-LOD) as soon as possible during project development to assess the need for root pruning, and to determine the costs.
- **Develop SP 700 - TPP** for Tree Root Pruning at the edge of a delineated TPA, or when plans will not adequately define the root pruning area. SP 700 - TPP for Tree Root Pruning will usually include information about the location, species, and size of the tree, as well as information about timing of the root pruning.

Any associated Tree Branch Pruning or Tree Fertilization will also be included in SP 700 - TPP. The plans should show delineated areas of Tree Root Pruning.

715 Tree Root Pruning Estimating Guide

715050 Tree Root Pruning LF The Landscape Architect will estimate Tree Root Pruning per linear foot (LF) along the delineated path for the root pruning.

Table 715-A Tree Root Pruning Quantity & Unit Prices	
Category Code Item	Unit Price
715050 TREE ROOT PRUNING LF	\$ 10.00 per LF
716100 TREE BROADCAST FERTILIZING SY	Optional: Tree Broadcast Fertilizing or other Tree Fertilizing Operations may be appropriate.

716100 Tree Broadcast Fertilizing SY When a project includes Tree Root Pruning the Designer should consider the need for Tree Broadcast Fertilizing to offset any loss of vigor caused by the pruning.

The amount of Tree Broadcast Fertilizing is usually based upon the SY area of fertilizing within the critical root zone, which is generally the soil area within the delineated area of root pruning under the drip line of the tree, per Table 715-A. Note: Other fertilizing options may be selected depending upon site needs and the value of trees to be preserved.

SECTION 716 TREE FERTILIZING

Table 700-A (part) Section 715 - Category Codes for Landscaping	
Category Code No.	Item and Unit of Measure
716100	TREE BROADCAST FERTILIZING SY
716105	TREE INJECTION FERTILIZING SY
716110	TREE DRILL FERTILIZING SY

716 Introduction

Tree Fertilizing is used to increase the vitality of trees, or to improve the resistance of trees to construction-related damage in their rootzone.

- Tree Fertilizing may be specified by SP 700 - Tree Preservation Program (TPP) or by including notes in the landscape plans.
- SP 700 - TPP is the preferred method of specifying the Operations of Tree Fertilizing, and is required for projects without plans.
- Tree Fertilizing may be appropriate within a delineated Tree Preservation Area.
- Tree Fertilizing is often specified in conjunction with Tree Branch Pruning or Tree Root Pruning to reduce construction impacts on trees to be preserved.

716 Roadside Tree Permit (RTP)

A Roadside Tree Permit (RTP) issued by the Maryland Dept. of Natural Resources Forest Service is required for Tree Fertilizing in the right of way. A RTP is not required for Tree Fertilizing at facilities and other locations outside the right of way. The Designer will obtain the RTP when it is required, and insert a copy of the RTP into the IFB before the time of Final Review, in conformance with the policy of the Office of Environmental Design (OED).

The Landscape Architect of the Landscape Architecture Division (OED-LAD) may provide assistance to determine the need for a RTP. The Landscape Architect or the Statewide Forest Mitigation Coordinator may also be able to provide assistance with the application, if needed. Any of these staff may also assist with the determination of fertilizing operations, materials and application rates.

716 Specifications and SP 700 - Tree Preservation Program (TPP)

SHA Specifications. Refer to Cat 700 Changes to Landscape Specifications on page N-4. Until the 2017 Specifications are published, all construction under an Access Permit or a District Permit shall use the most recent SPI's of 2008 SHA Standard Specifications.

After the 2017 Specifications are published, only the 2017 Standard Specifications for Construction and Materials shall be used for construction under an Access Permit or a District Permit unless other specifications are approved.

SP 700 - Tree Preservation Program (TPP). Refer to N-41. The Designer will indicate the species, sizes and locations of trees to be fertilized in SP 700 - TPP (preferred), or include this information in the landscape plans. Care is needed to provide clear instructions because fertilizer application is legally regulated.

SP 700 - Nutrient Management Plan (NMP). Because SP 700 - TPP will provide fertilizer application rates when Tree Fertilizing per Section 716 will be performed in conjunction with Tree Root Pruning, a separate SP 700 - NMP will not be prepared by the Landscape Operations Division (OED-LOD) for Tree Fertilizing.

716 Tree Fertilizing Design Guide

The need for Tree Fertilizing is easily overlooked or underestimated. To reduce the likelihood of neglecting issues that are best addressed during construction, the Designer will:

- **Arrange site visits** with the Landscape Architect, Statewide Forest Mitigation Coordinator or other staff of the Landscape Operations Division (OED-LOD) as soon as possible during project development to assess the need for Tree Fertilizing, and to determine the costs.
- **Develop SP 700 - TPP** for Tree Fertilizing within a delineated TPA, or when plans will not adequately define the area of Tree Fertilizing.

SP 700 - TPP for Tree Fertilizing will usually include information about the location, species and size of the tree, information about the fertilizer and application rate, and any other information about the timing of the fertilizer application. Any associated Tree Branch Pruning or Tree Root Pruning will also be included in SP 700 - TPP.

716 Tree Fertilizing Operations

Each Operation of Tree Fertilizing has its own Category Code.

Operation 1 - Tree Injection Fertilizing This method involves pressurized injection of liquid fertilizer into the soil to a depth of 8 to 10 inches. Since this method requires specialized equipment, it should be reserved for limited areas, specimen trees, or soils with moderate compaction. Tree Injection Fertilizing will not be specified by the Designer without on-site consultation with the Landscape Operations Division (OED-LOD).

Operation 2 - Tree Drill Fertilizing SY This method allows both fertilization and relief of moderate to severe soil compaction. Since this method is very laborious, it should be reserved for the most valuable or important trees, or in soils with the most severe compaction problems. The Designer will not specify Tree Drill Fertilizing without on-site consultation with the Landscape Operations Division (OED-LOD).

Operation 3 - Tree Broadcast Fertilizing This method involves spreading 200 lbs per acre of 20-16-12 fertilizer on the soil surface around trees or within TPA. It is the most commonly used method, and is the least costly per square yard.

Although Tree Broadcast Fertilizing is appropriate for most routine fertilizer applications to trees impacted by construction activities such as Tree Root Pruning or heavy branch loss caused by Tree Branch Pruning, this method is the least efficient for delivering fertilizer to tree roots. When trees are debilitated because of soil compaction or other factors which reduce their vitality, then Tree Injection Fertilizing or Tree Drill Fertilizing should be considered.

716 Tree Fertilizing Estimating Guide

The Designer will use one or more of the Operations below to develop the Engineer’s Estimate for Tree Fertilizing. The estimate is based upon the plan reviews, site visits, and measurements of areas and fertilizing requirements.

The Landscape Architect is usually responsible for defining these Operations in SP 700 - Tree Preservation Program (TPP) and ensuring that they are included in the Estimate. However, the Statewide Forest Mitigation coordinator or other staff of the Landscape Operations Division (OED-LOD) may perform these responsibilities.

716100 Tree Broadcast Fertilizing SY The Landscape Architect will estimate the square yards (SY) and amount when the use of this item is recommended.

716105 Tree Injection Fertilizing SY The Landscape Architect will estimate the square yards (SY) and amount when the use of this item is recommended.

716110 Tree Drill Fertilizing SY The Landscape Architect will estimate the square yards (SY) and amount when the use of this item is recommended.

Table 716-A Tree Fertilizing Quantity & Unit Price	
Category Code Item	Unit Price
716100 TREE BROADCAST FERTILIZING SY	\$2.00
716105 TREE INJECTION FERTILIZING SY	\$6.00
716110 TREE DRILL FERTILIZING SY	\$8.00

OTHER CAT. 700 & NON-CAT. 700 LANDSCAPE-RELATED ITEMS

The preceding sections explain the Category Code items that are associated with Category 700 - Landscaping of the SHA Specifications. However, many Category Code items that are not associated with any Section of Category 700 are often used in landscape construction, and this chapter provides information about some of those items.

Table 700-B Other Landscape-Related Items			
Category Code No.	Section of SHA Specs*	Item and Unit of Measure	Additional Information
110100	101	CLEARING AND GRUBBING LS	See comments on N-65
120784	120	TEMPORARY ORANGE CONSTRUCTION FENCE LF	See comments on N-65
390660	316	BIORETENTION SOIL MIX CY	See comments on N-65
524525	XXX	CRUSHER RUN AGGREGATE CR-6 TON	Under traffic barriers where turf is not sustainable. See comments on N-65
616251	609	CRUSHER RUN AGGREGATE CR-6 FOR SHOULDER EDGE DROPOFF TON	Where turf is not sustainable. See comments on N-65
616251	609	CRUSHER RUN AGGREGATE CR-6 FOR SHOULDER EDGE DROPOFF SY	Where turf is not sustainable. See comments on N-65
	XXX	BEAVER TREE PROTECTION SHELTER EA	Contact OED-LAD for SP.
	XXX	BIKE RACK EA	Contact OED-LAD for SP.
	XXX	BIODEGRADABLE TREE SHELTER EA	Contact OED-LAD for SP.
707415	XXX	BIORETENTION MEADOW ESTABLISHMENT SY	See comments on N-32
	XXX	BLACK ALUMINUM RAILING LF	Contact OED-LAD for SP.
	XXX	INFILTRATION FACILITY STABILIZATION AND VEGETATION	Contact OED-LAD for SP.
	XXX	INVASIVE SPECIES CONTROL	Contact OED-LAD for SP.
	XXX	LIVE STAKE INSTALLATION AND ESTABLISHMENT	Contact OED-LAD for SP.
	XXX	PLUG AND SEED ESTABLISHMENT ON REINFORCED SLOPE	Contact OED-LAD for SP.
	XXX	RIGID BRICK PAVER SY	Contact OED-LAD for SP.
	XXX	SALVAGING AND PLACING WETLAND SOIL	Contact OED-LAD for SP.
	XXX	SOIL DECOMPACTION AND AMENDMENT	Contact OED-LAD for SP.
	XXX	STONE MULCH SY	Contact OED-LAD for SP.
	XXX	WOOD PRIVACY FENCE EA	Contact OED-LAD for SP.
	XXX	VEGETATION MANAGEMENT WORK CREW HR	Contact OED-LAD for SP.
Note: * XXX items are not associated with any Section of the SHA Specification; these items <u>always</u> require a Special Provision for use.			

110100 Clearing and Grubbing LS This item is used to remove all objects within a delineated Limits of Disturbance (LOD). As such, any trees or vegetation within the LOD may be destroyed and removed by the Contractor, unless specified otherwise by the Project Engineer.

It is for this reason that Tree Felling and Brush Removal are not used within the LOD when there is a Clearing and Grubbing item; all this vegetation will be removed during construction. To prevent damage to sensitive areas and trees, the designer will delineate Tree Preservation Areas (TPA) per Section 120 within or adjacent to the LOD.

To protect the TPA, the Designer will specify the installation of Temporary Orange Construction Fence (TOCF) at the perimeter of the TPA, and describe any necessary protection measures in SP 700 - Tree Preservation Program (TPP) for the project. Refer to N-41 regarding SP 700 - TPP, and below regarding TOCF.

120784 Temporary Orange Construction Fence LF (TOCF) is a durable plastic mesh fence that is installed around Tree Protection Areas per Section 120 to prevent damage to trees and other sensitive structures or areas. To ensure conformance with the provisions of Section 120, TOCF should be delineated and noted on the plans. For projects that do not involve plans, the installation locations of TOCF may be specified in SP 700 - Tree Preservation Program (TPP) developed for the project. Refer to N-41 regarding SP 700 - TPP. TOCF is measured and paid for by the linear foot, and usually costs **\$3.00** per LF.

390660 Bioretention Soil Mix CY is a sand-based soil mix that is used to construct bioretention and infiltration areas. The placement of BSM is usually specified by the Highway Hydraulics Division (OHD-HHD). Turfgrass Sod Establishment, Turfgrass Establishment with Type A Soil Stabilization Matting, and Meadow Establishment (including special seed mixes developed for lower growth or pollinator habitat) with Type D Soil Stabilization Matting are used to stabilize and permanently vegetate the surface of BSM.

In addition to turfgrass sod and seed options, a variety of perennial grasses and broadleaf plants can also be installed in BSM as quart or gallon containerized stock along with seeded vegetation, or when 715015 Shredded Hardwood Bark Mulching 3 in. Depth is installed over the surface of the BSM. For this application, container stock such as switchgrass is installed on check dams, and a mix of other plants are installed on \pm 3 foot centers in BSM and side slopes. BSM usually costs **\$100.00** per CY.

616250 Crusher Run Aggregate CR-6 for Shoulder Edge Dropoff TON. CR-6 is a stone mix used to create a stable area at the edge of pavement and under guardrails. CR-6 is used in heavy traffic areas, shaded areas, or other areas where topsoil and turfgrass may not be sufficiently stable, durable, or sustainable. Although topsoil + turfgrass is the preferred groundcover in most roadside areas, CR-6 is the preferred aggregate option when turfgrass is not appropriate. When CR-6 is specified for Shoulder Edge Dropoff, it is usually installed in a depth varying from 6 in. at the pavement edge to 1 in. at the edge of installation.

The installation of CR-6 should be explained in plan notes or typicals so that no confusion exists during construction. CR-6 usually costs **\$35.00** per TON. Note: One ton of CR-6 with nominal 130 lb/CF density will yield 6.8 SY per ton when applied at an average depth of 3 in.

616251 Crusher Run Aggregate CR-6 for Shoulder Edge Dropoff SY. Refer to 616250, above. CR-6 may also be specified per SY at the usual cost of **\$16.00** per SY.