

Cost Analysis



Costs are based on average conditions calculated from research plot applications. Costs can vary considerably depending on specific site conditions. These examples are intended for comparison purposes and should not be used as bid prices.

Figure 21. Estimated Unit Costs for Installation and Maintenance Procedures (2004)

Material, Installation Procedure or Maintenance Procedure	Estimated Price
Drill seeding/sq. ft.	\$ 0.06
Hydroseeding/sq. ft.	\$ 0.04
Seed cost, low fescue, approximate cost/1000 sq. ft.	\$ 2.25
Seed cost, warm-season grass mixture, approximate cost/1000 sq. ft.	\$ 4.50–18.00
Seed cost, warm-season grass/perennial forb mix/1000 sq. ft.	\$ 11.50-45.00
Plugging with herbaceous plants/plant	\$ 0.46
Plant cost (average), herbaceous plugs,	\$ 1.00
Planting herbaceous plants in one quart containers/plant	\$ 1.00
Plant cost (average), herbaceous quart	\$ 2.25
Planting herbaceous plants in one gallon containers/plant	\$ 1.75
Plant cost (average), herbaceous gallon	\$ 4.00
Planting shrubs in one gallon container/plant	\$ 7.00
Plant cost (average), one gallon shrub	\$ 7.50
Planting shrubs in B & B form/plant	\$ 20.00
Plant cost (average), B & B shrub	\$ 20.00
Planting trees in three gallon container/plant	\$ 20.00
Plant cost (average), three gallon tree	\$ 20.00
Planting trees in 2" caliper B & B form/plant	\$ 75.00
Plant cost (average), 2" caliper B & B tree	\$ 150.00
Glyphosate treatment of low herbaceous layer/1000 sq. ft.	\$ 20.00
Glyphosate treatment of low herbaceous layer/acre	\$ 400.00
Glyphosate treatment of brush/1000 sq. ft.	\$ 80.00
Glyphosate treatment of brush/acre	\$ 700.00
Glyphosate spot treatment/1000 sq. ft.	\$ 30.00
Glyphosate spot treatment/acre	\$ 160.00
Mowing/1000 sq. ft.	\$ 10.00
Cutback/1000 sq. ft.	\$ 50.00
Brush removal/1000 sq. ft.	\$ 125.00

Note: Estimated costs do not include bark mulch applied as a continuous bed. If that is the desired treatment, an additional mulch materials and application cost would apply. Estimated costs do not include plant or installation warranties.

Figure 21. Estimated Costs for Installation and Maintenance, for comparison (2004)

Installation or Maintenance Procedure	Estimated Price
Drill seeding with low fescue/1000 sq. ft.	\$ 62.25
Drill seeding with warm-season grass mixture/1000 sq. ft.	\$ 64.50 – 78.00
Drill seeding with warm-season grass/perennial forb mix/1000 sq. ft.	\$ 71.50 – 105.00
Hydroseeding with low fescue/1000 sq. ft.	\$ 42.25
Hydroseeding with warm-season grass mixture/1000 sq. ft.	\$ 44.50 – 58.00
Hydroseeding with warm-season grass/perennial forb mix/1000 sq. ft.	\$ 51.50 – 85.00
Plugging with herbaceous plants/1000 sq. ft. on 18" centers	\$ 650
Plugging with herbaceous plants/1000 sq. ft. on 30" centers	\$ 235
Planting herbaceous plants in one quart containers/1000 sq. ft on 18" centers	\$ 1,445
Planting herbaceous plants in one gallon containers/1000 sq. ft. on 18" centers	\$ 2,556
Planting herbaceous plants in one quart containers/1000 sq. ft. on 30" centers	\$ 520
Planting herbaceous plants in one gallon containers/1000 sq. ft. on 30" centers	\$ 920
Planting shrubs in one gallon container/1000 sq. ft. on 5' centers	\$ 580
Planting shrubs in B & B form/plant/1000 sq. ft. on 5' centers	\$ 1,600
Planting trees in three gallon container/1000 sq. ft. on 15' centers	\$ 2,667
Planting trees in 2" caliper B & B form/plant/1000 sq. ft. on 15' centers	\$ 15,000
Glyphosate treatment of low herbaceous layer/1000 sq. ft.	\$ 43.00
Glyphosate treatment of low herbaceous layer/acre	\$ 400.00
Glyphosate treatment of brush/1000 sq. ft.	\$ 80.00
Glyphosate treatment of brush/acre	\$ 700.00
Glyphosate spot treatment/1000 sq. ft.	\$ 80.00
Glyphosate spot treatment/acre	\$ 160.00
Routine mowing (8x/year)/1000 sq. ft.	\$ 80.00
Routine mowing (8x/year)/acre	\$ 3,480
Periodic mowing (1x/year)/1000 sq. ft.	\$ 10.00
Periodic mowing (1x/year)/acre	\$ 435.00
Cutback/1000 sq. ft.	\$ 50.00
Brush removal/1000 sq. ft.	\$ 125.00

Note: Estimated costs do not include bark mulch applied as a continuous bed. If that is the desired treatment, an additional mulch materials and application cost would apply. Estimated costs do not include plant or installation warranties.



Drilling holes prior to planting quart containers.

Appendix A:

Checklists—Inventory of Site Conditions

1. Climate and Growth Conditions Checklist

Check the appropriate cold hardiness zone:

Zone 6 or Zone 7

Project is located in the following county:

New Castle Kent Sussex

Project is located in the following physiographic region:

Piedmont Coastal Plain

Conduct a soil test to determine the following soil characteristics:

Soil texture: Sand Sandy loam Loam Clay loam Clay

Organic matter content: _____% **pH:** _____

Soil moisture content: Dry Moist Very wet (drainage < 1"/hr)

Check the light exposure:

Full sunlight Partial sunlight Shade

List existing thriving plant species:

Desirable	Undesirable
_____	_____
_____	_____
_____	_____
_____	_____

Indicators of stress on existing species:

Interveinal chlorosis Chlorosis Leaf wilting
 Marginal leaf scorch Premature fall coloration

List species affected by stress:

_____	_____
_____	_____

2. Roadway Limitations Checklist

Check the roadside zone(s) included in the location to be landscaped:

Back slope or cut slope Swale or ditch zone
 Approach or shoulder zone Edge or border zone Front or fill slope

Check the appropriate clear zone requirement:

Standard 30 feet Other (_____feet)

Presence of guard rail and/or barrier curb:

Guard rail Yes No Partial (_____feet)
 Barrier curb Yes No Partial (_____feet)

Potential design exceptions to clear zone requirements (For new projects only):

Exceptional trees (note size, species or historic value on separate sheet)
 Adverse character change
 Significant functional and/or aesthetic value
 Scenic or low speed road
 Rare/endangered/threatened species (plant or animal)
 Wetland
 Reduction of water quality or serious erosion/sedimentation effects

Is the drainage ditch designed with sufficient width to accommodate plantings?

Yes No

Note the presence of all utilities:

Above ground high voltage electric wires Buried utilities
 Control boxes requiring access

Note required line of sight setback: _____feet required

Note locations requiring erosion control:

_____square feet at _____% slope
 _____square feet at _____% slope

Note functions plants are required to perform at this site:

Indicate change in direction
 Increase effectiveness of traffic signs
 Attenuate impact
 Screen headlight glare
 Block undesirable views
 Emphasize desirable views
 Combat highway hypnosis
 Buffer noise
 Reduce mowing time
 Increase maintenance safety
 Integrate the roadside landscape into the surroundings
 Contribute to the health and diversity of the regional environment
 Introduce travelers to Delaware's regional vegetation
 Control drifting snow
 Discourage graffiti
 Provide a buffer for pedestrians

3. Cultural and Historical Characteristics (CHC) Matrix

Use the following chart to determine cultural and historical characteristic values.

Characteristic	Assigned Value			Yes	No
	High	Medium	Low		
Traffic exposure	2	1	0		
Gateway component				4	0
Tourism value	2	1	0		
Intersection component				3	0
Visibility				1	0
Community involvement	2	1	0		
Size	0	2	4		
Existing DE nat. veg. adjacent to site	0	1	2		
Existing DE native vegetation on site	0	1	2		
Historic value				2	0
Available budget	4	2	0		

Fill in appropriate numbers for each site using the blank matrix below. Carry the number assigned for each row to the value column and total the values to arrive at a matrix score for the site.

Characteristic	Assigned Value			Yes	No	Value
	High	Medium	Low			
Traffic exposure						
Gateway component						
Tourism value						
Intersection component						
Visibility						
Community involvement						
Size						
Existing DE nat. veg. adjacent to site						
Existing DE native vegetation on site						
Historic value						
Available budget						
						Total
CHC Matrix Score						

Trees

Common Name	Scientific Name
Allegheny serviceberry	<i>Amelanchier laevis</i>
American holly	<i>Ilex opaca</i>
American beech	<i>Fagus grandifolia</i>
American linden	<i>Tilia americana</i>
Sycamore	<i>Platanus occidentalis</i>
Apple serviceberry	<i>Amelanchier x grandiflora</i>
Bald cypress	<i>Taxodium distichum</i>
Black tupelo	<i>Nyssa sylvatica</i>
Bur oak	<i>Quercus macrocarpa</i>
Carolina silverbell	<i>Halesia tetraptera</i>
Chestnut oak	<i>Quercus prinus</i>
Common pawpaw	<i>Asimina triloba</i>
Common sassafras	<i>Sassafras albidum</i>
Cucumber magnolia	<i>Magnolia acuminata</i>
Donald Wyman crabapple	<i>Malus 'Donald Wyman'</i>
Downy serviceberry	<i>Amelanchier arborea</i>
Eastern flowering dogwood	<i>Cornus florida</i>
Eastern red cedar	<i>Juniperus virginiana</i>
Eastern redbud	<i>Cercis canadensis</i>
Emerald sentinell cedar	<i>Juniperus virginiana 'Emerald Sentinell'</i>
Flowering cherry	<i>Prunus x yedoensis</i>
Galaxy magnolia	<i>Magnolia 'Galaxy'</i>
Giant arborvitae	<i>Thuja plicata 'Green Giant'</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Green hawthorn	<i>Crataegus viridis 'Winter King'</i>
Hackberry	<i>Celtis occidentalis</i>
Hophornbeam	<i>Ostrya virginiana</i>
Ironwood	<i>Carpinus caroliniana</i>
Japanese tree lilac	<i>Syringa reticulata</i>
Kentucky coffeetree	<i>Gymnocladus dioicus</i>
Loblolly pine	<i>Pinus taeda</i>
London plane	<i>Platanus x acerifolia</i>
Maidenhair tree	<i>Ginkgo biloba</i>
Merrill magnolia	<i>Magnolia 'Merrill'</i>
Pagoda dogwood	<i>Cornus alternifolia</i>
Persimmon	<i>Diospyros virginiana</i>

Trees

Common Name	Scientific Name
Red maple	<i>Acer rubrum</i>
Red oak	<i>Quercus rubra</i>
River birch	<i>Betula nigra</i>
Scarlet oak	<i>Quercus coccinea</i>
Serviceberry	<i>Amelanchier canadensis</i>
Shingle oak	<i>Quercus imbricaria</i>
Shumard oak	<i>Quercus shumardii</i>
Sourwood	<i>Oxydendrum arboreum</i>
Southern magnolia	<i>Magnolia grandiflora</i>
Star magnolia	<i>Magnolia stellata</i>
Sugar maple	<i>Acer saccharum</i>
Swamp chestnut oak	<i>Quercus michauxii</i>
Swamp white oak	<i>Quercus bicolor</i>
Sweetbay magnolia	<i>Magnolia virginiana</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Tulip tree	<i>Liriodendron tulipifera</i>
Two-winged silverbell	<i>Halesia diptera</i> var. <i>magniflora</i>
Virginia pine	<i>Pinus virginiana</i>
White ash	<i>Fraxinus americana</i>
White fringetree	<i>Chionanthus virginicus</i>
White oak	<i>Quercus alba</i>
White pine	<i>Pinus strobus</i>
Willow oak	<i>Quercus phellos</i>
Yellow bird magnolia	<i>Magnolia</i> 'Yellow Bird'
Yellowwood	<i>Cladrastis kentukea</i>
Yoshino cryptomeria	<i>Cryptomeria japonica</i> 'Yoshino'

Shrubs

Common Name	Scientific Name
American bladdernut	<i>Staphylea trifolia</i>
Arrowwood viburnum	<i>Viburnum dentatum</i>
Beach plum	<i>Prunus maritima</i>
Black chokeberry	<i>Aronia melanocarpa</i>
Blackhaw viburnum	<i>Viburnum prunifolium</i>
Blue holly	<i>Ilex x meserveae</i>
Border forsythia	<i>Forsythia x intermedia</i>
Bracted viburnum	<i>Viburnum bracteatum</i>
Bumald spirea	<i>Spiraea x bumalda</i>
Buttonbush	<i>Cephalanthus occidentalis</i>
Chokeberry	<i>Aronia arbutifolia</i>
Coast azalea	<i>Rhododendron atlanticum</i>
Common witchhazel	<i>Hamamelis virginiana</i>
Cranberrybush viburnum	<i>Viburnum trilobum</i>
Dwarf fothergilla	<i>Fothergilla gardenii</i>
False indigo-bush	<i>Amorpha fruticosa</i>
Fragrant sumac	<i>Rhus aromatica</i>
Glossy abelia	<i>Abelia x grandiflora</i>
Gray dogwood	<i>Cornus racemosa</i>
Gro-low fragrant sumac	<i>Rhus aromatica</i> 'Gro-low'
Groundselbush	<i>Baccharis halimifolia</i>
Highbush blueberry	<i>Vaccinium corymbosum</i>
Hoary azalea	<i>Rhododendron canescens</i>
Inkberry	<i>Ilex glabra</i>
Japanese spirea	<i>Spiraea japonica</i> 'Nana'
Judd viburnum	<i>Viburnum x juddii</i>
Koreanspice viburnum	<i>Viburnum carlesii</i>
Large fothergilla	<i>Fothergilla major</i>
Lowbush blueberry	<i>Vaccinium angustifolium</i>
Manchurian lilac	<i>Syringa patula</i> 'Miss Kim'
Mapleleaf viburnum	<i>Viburnum acerifolium</i>
Marsh elder	<i>Iva frutescens</i>
Meyer lilac	<i>Syringa meyeri</i>
Mountain fetterbush	<i>Leucothoe axillaris</i>
Nannyberry viburnum	<i>Viburnum lentago</i>
Northern bayberry	<i>Myrica pensylvanica</i>

Shrubs

Common Name	Scientific Name
Oakleaf hydrangea	<i>Hydrangea quercifolia</i>
Pinxterbloom azalea	<i>Rhododendron periclymenoides</i>
Possum-haw viburnum	<i>Viburnum nudum</i>
Redosier dogwood	<i>Cornus sericea (C. stolonifera)</i>
Shore juniper	<i>Juniperus conferta</i>
Shrubby St. Johnswort	<i>Hypericum prolificum</i>
Silky dogwood	<i>Cornus amomum</i>
Smooth alder	<i>Alnus serrulata</i>
Smooth sumac	<i>Rhus glabra</i>
Snowmound spirea	<i>Spiraea nipponica 'Snowmound'</i>
Spicebush	<i>Lindera benzoin</i>
Staghorn sumac	<i>Rhus typhina</i>
Swamp azalea	<i>Rhododendron viscosum</i>
Swamphaw viburnum	<i>Viburnum nudum</i>
Sweet pepperbush	<i>Clethra alnifolia</i>
Sweetbells leucothoe	<i>Leucothoe racemosa</i>
Sweetshrub	<i>Calycanthus floridus</i>
Trumpet vine	<i>Campsis radicans</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
Virginia sweetspire	<i>Itea virginica</i>
Winged sumac	<i>Rhus copallina</i>
Winterberry	<i>Ilex verticillata</i>
Witherod viburnum	<i>Viburnum cassinoides</i>

Herbaceous Plants

Common Name	Scientific Name
Aromatic aster	<i>Aster oblongifolius 'October Skies'</i>
Aromatic aster	<i>Aster oblongifolius 'Raydon's Favorite'</i>
Basil bee-balm	<i>Monarda clinopodia</i>
Black bugbane	<i>Cimicifuga racemosa</i>
Black-eyed Susan	<i>Rudbeckia hirta</i>
Blazing star	<i>Liatris spicata</i>
Blue ice blue star	<i>Amsonia 'Blue Ice'</i>
Blue phlox	<i>Phlox divaricata</i>
Blue vervain	<i>Verbena hastata</i>
Bluestem goldenrod	<i>Solidago caesia</i>
Bowman's root	<i>Porteranthus trifoliatum</i>
Bristly aster	<i>Aster puniceus</i>
Broadleaf cattail	<i>Typha latifolia</i>
Broadleaf ironweed	<i>Vernonia glauca</i>
Brown-eyed Susan	<i>Rudbeckia triloba</i>
Butterfly milkweed	<i>Asclepias tuberosa</i>
Cardinal flower	<i>Lobelia cardinalis</i>
Common boneset	<i>Eupatorium perfoliatum</i>
Common milkweed	<i>Asclepias syriaca</i>
Creeping phlox	<i>Phlox stolonifera</i>
Culver's root	<i>Veronicastrum virginicum</i>
Cutleaf coneflower	<i>Rudbeckia laciniata</i>
Downy blue star	<i>Amsonia ciliata</i>
Downy goldenrod	<i>Solidago puberula</i>
Downy phlox	<i>Phlox pilosus</i>
Early goldenrod	<i>Solidago juncea</i>
Eastern silvery aster	<i>Aster concolor</i>
False blue indigo	<i>Baptisia australis</i>
Four-angled sundrop	<i>Oenothera tetragona</i>
Fragrant cudweed	<i>Gnaphalium obtusifolium</i>
Garden phlox	<i>Phlox paniculata</i>
Goat's beard	<i>Aruncus dioicus</i>
Goat's rue	<i>Tephrosia virginiana</i>
Goblet aster	<i>Aster lateriflorus</i>
Golden ragwort	<i>Senecio aureus</i>
Goldenrod	<i>Solidago rugosa 'Fireworks'</i>

Herbaceous Plants

Common Name	Scientific Name
Grassleaf gayfeather	<i>Liatris graminifolia</i>
Grassleaf goldenrod	<i>Euthamia graminifolia</i>
Gray-stem goldenrod	<i>Solidago nemoralis</i>
Great blue lobelia	<i>Lobelia siphilitica</i>
Hardy ageratum	<i>Eupatorium coelestinum</i>
Heart-leaf aster	<i>Aster cordifolius</i>
Hollow Joe-pye weed	<i>Eupatorium fistulosum</i>
Hyssop-leaved thoroughwort	<i>Eupatorium hyssopifolium</i>
Joe-pye thoroughwort	<i>Eupatorium dubium</i>
Lanceleaf coreopsis	<i>Coreopsis lanceolata</i>
Late purple aster	<i>Aster patens</i>
Late-flowering thoroughwort	<i>Eupatorium serotinum</i>
Lizard's tail	<i>Saururus cernuus</i>
Maryland golden aster	<i>Chrysopsis mariana</i>
Maryland senna	<i>Senna marilandica</i>
Narrow-leaf cattail	<i>Typha angustifolia</i>
New England aster	<i>Aster nova-angliae</i>
New York aster	<i>Aster novi-belgii</i>
New York ironweed	<i>Vernonia noveboracensis</i>
Orange coneflower	<i>Rudbeckia fulgida</i>
Oswego-tea bee-balm	<i>Monarda didyma</i>
Ox-eye	<i>Heliopsis helianthoides</i>
Pale coneflower	<i>Echinacea pallida</i>
Phlox	<i>Phlox carolina</i>
Purple cone flower	<i>Echinacea purpurea</i>
Purple lupine	<i>Lupinus perennis</i>
Rough-leaf goldenrod	<i>Solidago rugosa</i>
Roundleaf thoroughwort	<i>Eupatorium rotundifolium</i>
Seaside goldenrod	<i>Solidago sempervirens</i>
Showy aster	<i>Aster spectabilis</i>
Showy evening primrose	<i>Oenothera speciosa</i>
Shrubby sundrops	<i>Oenothera fruticosa</i>
Small dog-fennel thoroughwort	<i>Eupatorium capillifolium</i>
Smooth blue aster	<i>Aster laevis</i>
Smooth heath aster	<i>Aster pilosus</i>
Stiff aster	<i>Aster linariifolius</i>

Herbaceous Plants

Common Name	Scientific Name
Stonecrop	<i>Sedum x 'Autumn Joy'</i>
Stonecrop	<i>Sedum x 'Matrona'</i>
Swamp milkweed	<i>Asclepias incarnata</i>
Swamp rosemallow	<i>Hibiscus moscheutos</i>
Swamp sunflower	<i>Helianthus angustifolius</i>
Sweet Joe-pye weed	<i>Eupatorium purpureum</i>
Tall white beard-tongue	<i>Penstemon digitalis</i>
Thin-leaved sunflower	<i>Helianthus decapetalus</i>
Threadleaf blue star	<i>Amsonia hubrichtii</i>
Tiny headed goldenrod	<i>Euthamia tenuifolia</i>
Virginia bluebells	<i>Mertensia virginica</i>
Virginia mountain-mint	<i>Pycnanthemum virginianum</i>
Virginia spiderwort	<i>Tradescantia virginiana</i>
White heath aster	<i>Aster ericoides</i>
White thoroughwort	<i>Eupatorium album</i>
White wood aster	<i>Aster divaricatus</i>
Whorled milkweed	<i>Asclepias verticillata</i>
Wild bergamot	<i>Monarda fistulosa</i>
Wild senna	<i>Senna hebecarpa</i>
Willow leaf Blue Star	<i>Amsonia tabernaemontana</i>
Woodland sunflower	<i>Helianthus divaricatus</i>

Herbaceous Plants—Grasses, Sedges, and Rushes

Common Name	Scientific Name
Beardgrass	<i>Andropogon gyrans</i>
Bent-awn plume grass	<i>Saccharum brevibarbe</i>
Big bluestem	<i>Andropogon gerardii</i>
Blue moor grass	<i>Sesleria caerulea</i>
Blue wood sedge	<i>Carex flaccosperma</i>
Blunt mannagrass	<i>Glyceria obtusa</i>
Bottle-brush grass	<i>Hystrix patula</i>
Broomsedge	<i>Andropogon virginicus</i>
Bunched plume grass	<i>Saccharum coarctatum</i>
Bushy beardgrass	<i>Andropogon glomeratus</i>
Canada wild rye	<i>Elymus canadensis</i>
Woolgrass	<i>Scirpus cyperinus</i>
Crinkled hairgrass	<i>Deschampsia flexuosa</i>
Fresh water cordgrass	<i>Spartina pectinata</i>
Giant plume grass	<i>Saccharum giganteum</i>
Wild oat	<i>Chasmanthium latifolium</i>
Indiangrass	<i>Sorghastrum nutans</i>
Indiangrass	<i>Sorghastrum nutans</i> 'Sioux Blue'
Keeled little bluestem	<i>Schizachyrium littorale</i>
Little bluestem	<i>Schizachyrium scoparium</i>
Little bluestem	<i>Schizachyrium scoparium</i> 'The Blues'
Purple muhly grass	<i>Muhlenbergia capillaris</i>
Coastal switchgrass	<i>Panicum amarum</i>
Pennsylvania sedge	<i>Carex pensylvanica</i>
Perennial ryegrass	<i>Lolium perenne</i>
Prairie dropseed	<i>Sporobolus heterolepis</i>
Purple love-grass	<i>Eragrostis spectabilis</i>
Red fescue	<i>Festuca rubra</i>
Red switchgrass	<i>Panicum virgatum</i> 'Haense Herms'
Riverbank brome	<i>Bromus latiglumus</i>
Sheep fescue	<i>Festuca ovina</i>
Silver bluestem	<i>Andropogon ternarius</i>
Smooth rush	<i>Juncus effusus</i>
Smooth saltmarsh cordgrass	<i>Spartina alterniflora</i>
Coastal switchgrass	<i>Panicum amarum</i> 'Dewey Blue'
Switchgrass	<i>Panicum virgatum</i>

Herbaceous Plants—Grasses, Sedges, and Rushes

Common Name	Scientific Name
Switchgrass	<i>Panicum virgatum</i> 'Cloud Nine'
Switchgrass	<i>Panicum virgatum</i> 'Dallas Blues'
Switchgrass	<i>Panicum virgatum</i> 'Northwind'
Switchgrass	<i>Panicum virgatum</i> 'Rehbraun'
Switchgrass	<i>Panicum virgatum</i> 'Shenandoah'
Switchgrass	<i>Panicum virgatum</i> 'Squaw'
Purple-top	<i>Tridens flavus</i>
Tussock sedge	<i>Carex stricta</i>

Herbaceous Plants—Ferns

Common Name	Scientific Name
Christmas fern	<i>Polystichum acrostichoides</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>
Eastern hay-scented fern	<i>Dennstaedtia punctilobula</i>
Evergreen wood fern	<i>Dryopteris intermedia</i>
Goldie's wood fern	<i>Dryopteris goldiana</i>
Interrupted fern	<i>Osmunda claytoniana</i>
Lady fern	<i>Athyrium filix-femina</i>
Marginal Wood fern	<i>Dryopteris marginalis</i>
Marsh fern	<i>Thelypteris palustris</i>
New York fern	<i>Thelypteris noveboracensis</i>
Royal fern	<i>Osmunda regalis</i>

Appendix C: Illustrated Plant Palette: Selected Examples



1



2



3



4



5



6

1 *Acer rubrum* (red maple) flowers

2 *Acer rubrum* (red maple) fall color

3 *Amelanchier x grandiflora* (serviceberry) backed by *Juniperus virginiana* (eastern red cedar)

4 *Amsonia hubrichtii* (threadleaf bluestar) in front of *Amsonia tabernaemontana* (common bluestar) blooming in spring with *Panicum virgatum* (switchgrass) emerging alongside

5 *Amsonia hubrichtii* (threadleaf bluestar), *Amsonia tabernaemontana* (common bluestar), *Cornus sericea* (redosier dogwood), *Panicum virgatum* (switchgrass), and *Cercis canadensis* (Eastern redbud) planted on highway median berm

6 *Amsonia hubrichtii* (threadleaf bluestar) turning yellow and *Amsonia tabernaemontana* (common bluestar) in its tan winter color

7 *Andropogon glomeratus* (bushy beard grass) backed by a woods edge containing *Clethra alnifolia* (sweet pepperbush), *Magnolia virginiana* (sweetbay magnolia), and *Quercus phellos* (willow oak)

8 *Andropogon glomeratus* (bushy beard grass) close up

9 *Andropogon ternarius* (silver bluestem)

10 *Aronia arbutifolia* (red chokeberry) spring flower with *Cercis canadensis* (redbud)

11 *Aronia arbutifolia* (red chokeberry) fall color

12 *Asclepias incarnata* (swamp milkweed) flowers

13 *Asclepias tuberosa* (butterfly milkweed) seeded with naturally occurring *Asclepias syriaca* (common milkweed)

14 *Aster laevis* 'Bluebird' (smooth aster) blooming



7



8



9



10



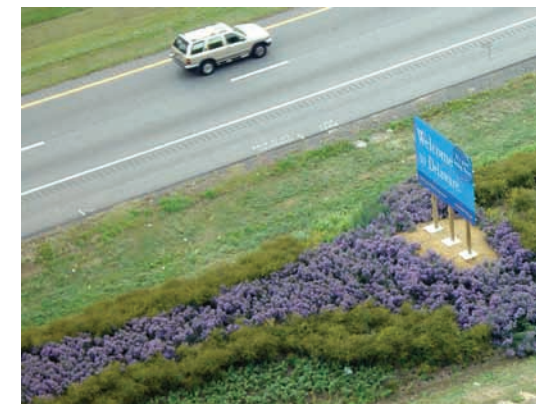
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16

15 *Aster novae-angliae* (New England aster) and *Solidago rugosa* (rough-stemmed goldenrod) naturally occurring in open field



17



18

16 *Aster novae-angliae* (New England aster), *Solidago rugosa* (rough-stemmed goldenrod) and *Eupatorium hyssopifolium* (hyssop-leaved thoroughwort) seeded in a wet swale

17 *Aster novae-angliae* (New England aster) and *Panicum virgatum* (switchgrass)

18 *Aster oblongifolius* 'October Skies' (aromatic aster) with *Amsonia hubrichtii* (threadleaf blue star)



19



20

19 *Baccharis halimifolia* (groundsel bush) in a mass of *Panicum virgatum* (switchgrass) backed by *Juniperus virginiana* (eastern red cedar)

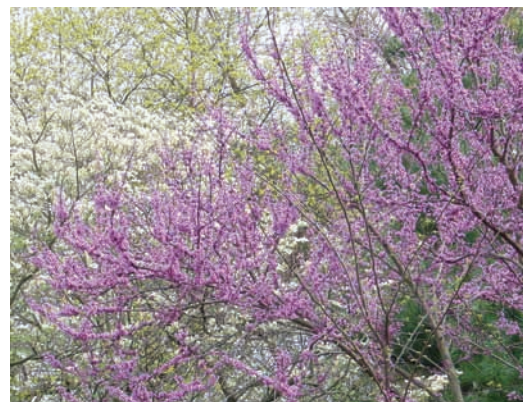
20 *Baccharis halimifolia* (groundsel bush) flowers

21 *Cephalanthus occidentalis* (button bush) flower

22 *Cercis canadensis* (redbud) flowering



21



22

23 *Chionanthus virginicus* (fringetree) flowering



23

24 *Clethra alnifolia* (sweet pepperbush) in fall color planted with *Betula nigra* (river birch) in wet swale



24

25 *Clethra alnifolia* (sweet pepperbush) in flower naturally occurring with *Nyssa sylvatica* (black gum) along a moist wood edge



25

26 *Clethra alnifolia* (sweet pepperbush) flowers



26

27 *Cornus sericea baileyi* (red twig dogwood) winter color



27

28 *Diospyros virginiana* (persimmon) and *Myrica pensylvanicum* (northern bayberry) naturally occurring in a sandy roadside



28

29 *Diospyros virginiana* (persimmon) fruit



29

30 *Eupatorium capillifolium* (dog fennel) naturally occurring in a sandy roadside



30



31



32

31 *Eupatorium dubium* (hollow joe-pye weed) and *Typha latifolia* (broadleaf cattail) naturally occurring on the slope of a roadside ditch.

32 *Eupatorium hyssopifolium* (hyssop-leaved thoroughwort) flowers



33



34

33 *Eupatorium hyssopifolium* (hyssop-leaved thoroughwort) and *Schizachyrium scoparium* (little bluestem) planted from plugs in a seeded highway infield

34 *Eupatorium serotinum* (late-flowering thoroughwort) and *Solidago canadensis* (Canada goldenrod) naturally occurring



35



36

35 *Euthamia graminifolia* (grass-leaf goldenrod), *Baccharis halimifolia* (groundselbush) naturally occurring in a sandy ditch

36 *Hamamelis virginiana* (witchhazel) flowers

37 *Hibiscus moscheutos* (marsh mallow) flowers

38 *Ilex verticillata* (winterberry holly) and *Juniperus virginiana* (eastern red cedar) planted on dry highway median slope



37



38

39 *Juncus effusus* (common rush) at pond edge

40 *Liquidambar styraciflua* (sweet gum) fall color

41 *Lobelia cardinalis* (cardinal flower) with *Hibiscus moscheutos*, (marsh mallow) seeded in a wet roadside

42 *Magnolia 'Butterflies'* (butterflies magnolia) flowers

43 *Magnolia virginiana* (sweetbay magnolia), *Rhus copallina* (winged sumac) and *Baccharis halimifolia* (groundselbush) naturally occurring in a sandy roadside

44 *Magnolia virginiana* (sweetbay magnolia) flowers

45 *Malus 'Donald Wyman'* (Donald Wyman crabapple) in fruit

46 *Malus 'Donald Wyman'* (Donald Wyman crabapple) flower and fruit closeup



39



40



41



42



43



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48

47 *Myrica pensylvanica* (northern bayberry), *Baccharis halimifolia* (groundselbush), and *Rhus copallina* (winged sumac) naturally occurring on a sandy roadside dune



49

48 *Myrica pensylvanica*, (northern bayberry) and *Euthamia tenuifolia* (tiny-headed goldenrod) naturally occurring in a sandy roadside



50

49 *Narcissus* sp. (daffodil) blooming

50 *Nyssa sylvatica* (black gum) fall color



51

51 *Panicum amarum* (Coastal switchgrass) on sandy dune



52

52 *Panicum amarum* 'Dewey Blue' with *Aster oblongifolius* 'October Skies' (October Skies aster)

53 *Panicum virgatum* 'Cloud Nine' (Cloud Nine switchgrass) and *Aster oblongifolius* 'Raydon's Favorite' (Raydon's Favorite aster) flowering

54 *Panicum virgatum* 'Dallas Blues' (Dallas Blues switchgrass) flowering



53



54

55 *Panicum virgatum* 'Northwind' (Northwind switchgrass) in early June edged with *Amsonia* 'Blue Ice' (Blue Ice blue star)

56 *Panicum virgatum* 'Northwind' (Northwind switchgrass) flowering with upright form

57 *Rhexia mariana* (Maryland meadow beauty) flowers

58 *Rhododendron atlanticum* (coast azalea) flowering

59 *Rhododendron atlanticum* (coast azalea) flower close up

60 *Rhododendron periclymenoides* (pinxterbloom azalea) flowering

61 *Rhus copallina* (winged sumac) fall color

62 *Rhus glabra* (smooth sumac) fruit and fall color



55



56



57



58



59



60



61



62



63



64

63 *Rhus glabra* (smooth sumac) and *Eupatorium hyssopifolium* (hyssop-leaved thoroughwort) on a dry roadside

64 *Rhus typhina* (staghorn sumac) fall color



65



66

65 *Rhus typhina* (staghorn sumac) fruit

66 *Rudbeckia hirta*, (black-eyed susan) seeded with *Schizachyrium scoparium* (little bluestem) on a dry infield slope

67 *Rudbeckia hirta* (black-eyed susan) and *Silphium laciniatum* (compass plant) in dry infield

68 *Sambucus canadensis* (elderberry) flowering

69 *Sassafras albidum* (common sassafras)

70 *Schoenoplectus tabernaemontani* (great bulrush) in wet swale



67



68



69



70

71 *Schoenoplectus tabernaemontani* (great bulrush) flowers close up

72 *Scirpus cyperinus* (woolgrass) and *Liquidambar styraciflua* (sweetgum) naturally occurring in wet roadside swale.

73 *Scirpus cyperinus* (woolgrass) and *Solidago rugosa* (rough leaf goldenrod) in masses with *Liquidambar styraciflua* (sweetgum) and *Baccharis halimifolia* (groundsel bush)

74 *Schizachyrium scoparium* (little bluestem) winter color

75 *Senna hebecarpa* (northern wild senna) flowering

76 *Solidago* 'Fireworks' (Fireworks goldenrod) with *Aster oblongifolius* 'October Skies' (October Skies aster) and *Panicum virgatum* 'Northwind' (Northwind switchgrass)

77 *Solidago* 'Fireworks' (Fireworks goldenrod) with *Aster laevis* 'Bluebird' (Bluebird aster) flowers

78 *Solidago rugosa*, (rough leaf goldenrod) and *Eupatorium hyssopifolium* (hyssop-leaved thoroughwort) naturally occurring on dry roadside



71



72



73



74



75



76



77



78



79



80

79 *Solidago sempervirens* (seaside goldenrod) and *Panicum amarum* (panic beachgrass) naturally occurring in sandy median



81



82

81 *Sorghastrum nutans* (indiangrass) and *Rudbeckia hirta* (black-eyed susan) seeded on a dry infield slope

82 *Sorghastrum nutans* (indiangrass) flowering

83 *Typha latifolia* (broad-leaved cattail) in a wet swale with seeded *Rudbeckia hirta* (black-eyed susan)



83



84

84 *Typha angustifolia* (narrow-leaved cattail) in seed

85 *Verbena hastata* (blue vervain) seeded with *Hibiscus moscheutos* (marsh mallow) planted in a routinely wet roadside

86 *Vernonia noveboracensis* (New York ironweed) flowering



85



86

87 *Viburnum dentatum* (arrowwood viburnum) variations in fall color

88 *Viburnum nudum* 'Winterthur' (Winterthur swamphaw viburnum) fall color and fruit



87



88

Appendix D: Recommended References

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Glossary

Annual – a plant that completes its life cycle in one growing season.

Backslope – the slope extending upward and outward from side ditches to intersect the natural ground.

Balled and burlapped (B & B) plants – field grown plants harvested with a root mass and surrounding soil, contained by burlap. This is a common production method for woody shrubs and trees and is less commonly used for large herbaceous plants.

Bare root plants – field grown woody plants harvested with a root mass that is devoid of soil, typically used only for plants in a dormant state.

Berm – mounded and shaped soil.

Biennial – a plant that completes its life cycle in two growing seasons; usually undergoing vegetative growth only during the first season and reproductive growth during the second season.

Biological diversity (Biodiversity) – the variety of life forms, including genetic types, species and natural communities, present. Species diversity, or the number of species present, is the predominant measure of biodiversity used by most ecologists.

Broadcast seeding – the simple dry distribution of seed often mixed with a carrier such as sawdust to improve dispersal.

Brush removal – cut and remove designated woody plants by manual hand or mechanical means; leave stump height not to exceed 10 inches; remove cut material from site to acceptable disposal area; and treat stump with appropriate chemical herbicide to prevent regrowth.

Canopy trees – trees with heights of 100 feet or more making up the top layer of the forest.

Channelization – the separation or regulation of conflicting traffic movements into definite paths of travel by traffic islands or pavement marking to facilitate the safe and orderly movements of both vehicles and pedestrians.

Clear zone (lateral clearance) – the distance between the outside edge of the traveled way to a roadside obstruction, a clear area allowing drivers the opportunity to recover control if their vehicle accidentally leaves the pavement surface. The desired width of this clear zone varies with operating speeds, volume of traffic, steepness of slopes, degree of curvature and accident history (see chapter 4, DelDOT Road Design Manual.)

Clump-forming shrubs – shrubs that spread in width from a central stem or clusters of stems.

Coherence – sense of order and direction of a viewed scene.

Colonizing shrubs – shrubs that spread by woody rhizomes and have the capacity to fill in relatively large areas.

Community – (a) group of species of plants and/or animals living and interacting at a particular time and place. (b) group of people residing in the same place and under the same government; spatially defined places such as towns or neighborhoods.

Community involvement – a neighboring community's interest in landscape enhancement at a particular roadside location and its willingness to accept some ongoing responsibility for its planting and maintenance.

Complexity – characteristics of scenes that warrant exploration.

Container-grown plants – grown in artificial media within a container. This production method is increasingly used for woody plants and herbaceous perennials.

Context sensitive – aesthetic, scenic, historic and cultural resources and the physical characteristics of an area giving a community its identity and sense of place and source of local pride.

Cool-season grass – grass species that grow best when temperatures are 60° – 75° F and usually undergo summer dormancy; include most of the mowed turfgrasses.

Cultural and historical characteristics (CHC) matrix – a tool designed to provide an objective basis for the selection of one of the three design approaches.

Cutback (Cutting back) – periodic cutting of woody vegetation to maintain dense and healthy growth within desired height and spread parameters.

Deliberate planting – plants may be deliberately introduced in one of two general ways—by sowing seed or by the installation of plants.

Design exception – a special circumstance where the departure from minimum design standards can be allowed as justified by supporting rationale. The designer must provide thorough documentation for review and approval by the Chief Engineer for each request in format as established in Chapter 3 of the DeIDOT Road Design Manual.

Discontinued mowing – cessation of any routine mowing practice releasing the desirable regional vegetation to develop through natural growth or seeding. Undesirable plants will be controlled by spot treatment. A released site may require occasional intervention such as periodic mowing, editing or cutting back.

Drill seeding – the placement of seed in a shallow trench created by a disc.

Ecology – the study of interactions between organisms and the environment.

Ecological landscape design – an approach to landscape design intended to consciously create a meaningful order or balance based on the composition, structure and processes of ecosystems (whole communities that work in the self-sustaining and self-limiting ways of nature.) The design seeks to optimize the positive ecological impacts based on a thorough observation and analysis of the (physical and experiential) qualities of a place; i.e., the site and the surrounding context; balancing cultural or human needs and natural processes.

Ecotype – locally adapted variant of a plant species.

Editing – evaluate existing vegetation and identify opportunities to introduce aesthetic order by highlighting individual specimens or plant groups through the process of removing other vegetation.

Editing and adding – after editing, supplement the existing landscape with desirable species to enhance the groupings.

Erosion (control) – removal of soil particles through the action of water and wind.

Fascination – facet of a setting resulting in effortless attention.

Fauna – the whole of the animal world, as opposed to the flora or plant life; also the animals of a particular area.

Fertility – quantity of nutrients present in soil system.

Flora – the whole of the plant world, as opposed to the fauna or animal life; also the plants of a particular area.

Forbs – broadleaved flowering herbaceous plants.

Frontslope – the slope extending outward and downward from the finished shoulder to the side ditch.

Gateway component – a measure of the site's relative importance as a gateway or prominent entrance to a community, town or city.

Glyphosate – an herbicide used for non-selective herbicide control of vegetation (selection can be achieved with spot application).

Ground layer – the lowest layer usually ranging from a few inches to perhaps six feet.

Habitat – the natural environment of an organism; the place where it is usually found.

Hardiness zones – regions outlined by the USDA to indicate where a plant can live year round with out protection; both cold and warm hardiness zones are outlined.

Herbaceous – a term referring to any non-woody plant; a plant that dies back to the ground seasonally.

Herbicide – chemical used to kill plants either selectively or non-selectively.

Horticultural – referring to cultivation of plants using a higher intensity than agronomic crops.

Human scale – an installation is of a human scale if its size, position and details relate to passers-by in a way that makes them feel comfortable rather than intimidated.

Hydroseeding – distributing seed with fiber mulch through a stream of high-pressure water.

Impact attenuation – a means to prevent vehicles from impacting fixed objects head-on by stopping the vehicle at a rate of deceleration that is tolerable to the vehicle occupants.

Intersection component – a measure of the site's positioning at a regulated intersection, since drivers who stop are more likely to notice conditions at such sites.

Invasive plants (nonnative invasive species) – plants that reproduce rapidly, spread over large areas of the landscape and have few, if any, natural controls, such as herbivores and diseases to keep them in check.

Landscape character – the appearance of land, including its shape, form, colors and elements; the way these (including those of roads) components combine in a way that is distinctive to particular localities; the way they are perceived; and an area's cultural and historical associations.

Legibility – visible characteristics of scenes that result in ease of understanding and ability of the viewer to remember the scene.

Line of sight (sight distance) – minimum safe unobstructed vision distances as measured from the vehicle operator's position in the lane of travel. Sight distances must be sufficiently designed to allow reasonably competent and alert drivers to make safe decisions under ordinary circumstances for vehicle operations such as passing, turning or stopping.

Low-impact design – a shift from the philosophy of rapid removal and collection of water to the slowing and infiltration of water; a reversal of the traditional approach to site drainage design to more closely mimic the natural drainage functions.

Macroclimate – characteristic conditions such as temperature extremes, soil type, rainfall and patterns of seasonal variation that dictate the vegetation.

Median – center space set aside on divided multi-lane highways to provide a separation of opposing traffic lanes.

Microclimate – localized conditions that dictate whether vegetation is sustainable in a specific site.

Mystery – characteristic of scenes that provide a pleasant challenge to the imagination.

Native plant – a plant that records indicate to be naturally occurring prior to European settlement. Unless otherwise specified in this manual, "native plants" are native to Delaware.

Naturalization – the process of allowing existing soil-banks to germinate and/or encroaching adjacent seed sources to take over. Proximity to natural plant communities and a diligence to remove invasive plants are required for success (Harper-Lore, 1998).

Noxious weed – a plant that is regulated by a state; property owners can not allow these plants to go to seed on their properties.

Ornamental – serving to embellish or adorn; decorative.

Passing sight distance – sufficient sight distance to enable drivers to occupy the opposing traffic lane for passing other vehicles on certain two-lane highways without risk of a crash.

Perennial – a plant that lives for two or more growing seasons.

Perennial forb – broadleaved herbaceous flowering plant (as opposed to the narrow-leaved grasses, sedges and rushes).

Periodic mowing – mowing annually or as necessary to discourage establishment of woody species and maintain an herbaceous composition (defined for Costs Section as 1x).

pH – relative alkalinity or acidity of a soil.

Physiographic region – Region characterized by climate, topography and soil type.

Plant community – all the plants inhabiting a common environment and interacting with one another.

Plugs – very small herbaceous plants grown in small containers.

Population dynamics – change in the composition of species within a plant community.

Preservation – preserving and managing existing remnants of ecosystems wherever possible (Harper-Lore, 1998).

Provenance – the geographical area or place of origin of a collection of genetic material (generally in the form of seed, pollen or cuttings) for which the process of natural selection has resulted in some common or shared population characteristics.

Ramp infield – the enclosed area between the travel lanes of divided multi-lane highways and the exit or entrance ramps.

Re-creation – the process of returning an ecosystem type to the vicinity, but not exact site, of that ecosystem type (Harper-Lore, 1998).

Reclamation – the process of revegetating severely disturbed lands where plants and soil no longer resemble the original. The primary objective is to cover the soils and limit erosion, with a goal of increased usable land (Harper-Lore, 1998). In other words, any deliberate attempt to return a damaged ecosystem to some kind of productive use or socially acceptable condition (Jordan et. al., 1998).

Regeneration – the process of allowing existing soil-banks to germinate and/or encroaching adjacent seed sources to take over. Proximity to natural plant communities and a diligence to remove invasive plants are required for success (Harper-Lore, 1998).

Regional – as it pertains to design and management strategies, a regional approach considers the local character and ecology of the place and allows for input of local citizens. To be truly regional, an application must be fitted to the local biological processes and systems, and must conform to the local knowledge of cultural and historical traditions that result from extended residence in a place.

Rehabilitation – the process of improving the ecosystem health of disturbed land. When soils are not disturbed, the site will revegetate without aid, but disturbed soils are subject to weed invasion, compromising the original ecosystem. The primary focus of rehabilitation may be weed control (Harper-Lore, 1998).

Restoration – defined as “the process of establishing the original site characteristics (ecosystem) that existed prior to land disturbance” (Gerling, 1996) or “the recreation of entire communities of organisms, closely modeled on those occurring naturally” (Jordan et. al., 1998).

Revegetation – the process of returning plant cover to exposed soils. Revegetation can be accomplished through planting, allowing existing seed to germinate or allowing seed from surrounding vegetation to encroach (Harper-Lore, 1998).

Rhizomes – an underground stem distinguishable from a root by presence of nodes, buds or scale-like leaves.

Right-of-way – legal limits of use or boundaries of a transportation corridor as defined on property deeds.

Routine mowing – frequent mowing (defined for Costs Section as 8x) of the site to maintain a specified height of vegetation.

Sedimentation – pertaining to drainage ditches and basins, an accumulation of soil particles as carried by surface stormwater runoff.

Seeding – this planting method can be economical for establishing herbaceous plants (grasses and forbs). Since seeding results in random or informal distribution it is most appropriate for larger areas where the precise location of individual plants is not of primary importance.

Sense of place – the meaning, values and feelings that people associate with physical locations because of their experiences there. The aesthetic, nostalgic or spiritual effects of physical locations on humans based on personal, use-oriented or attachment-oriented relationships between individuals and those locations. [National Trust for Historic Preservations: Those things that add up to a feeling that a community is a special place, distinct from anywhere else. J. B. Jackson: It is place, permanent position in both the social and topographical sense, that gives us our identity. Forman: Goals of good designs include: relink people with genius of their places, revivify image and identity with places, and maintain identity of places.]

Shrub layer – middle layer, typically ranging from two to fifteen feet in height; comprised of woody, semi-permanent components of the landscape.

Spatial organization – how space is organized in a viewed scene. Can range from open to densely packed with objects. Ground texture and depth can be defined.

Stopping sight distance – minimum safe unobstructed vision distance such that drivers can control the operation of their vehicles to avoid striking an unexpected object in the traveled way. Distances to be used in the design of roadside and road profiles may be calculated as per criteria described in Chapter 5 of the DelDOT Road Design Manual.

Succession – an ecologically predictable process of changes in structure and composition of plant and animal communities over time.

Sustainability –the ability of a society, ecosystem, or any such ongoing system to continue functioning into the indefinite future. Sustainable development involves meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Tourism value – a measure of the prominence of the site with regard to tourist traffic.

Traffic exposure – a measure of the relative number of cars that pass a site.

Traffic island – a roadway median space separating traffic lanes, typically at intersections or on lower-speed urban arterials, potentially providing opportunities for community-supported landscape enhancement.

Transportation corridor – the long, narrow portion of land dedicated to movement of humans and human commodities usually delineated by rights-of-way boundaries.

Tree layer – the uppermost layer continuing from the upper reaches of the shrub layer to the sky; including an understory layer of smaller trees and a canopy layer of larger trees.

Understory trees – trees ranging in height from 20 feet to 40 feet.

Visibility – a measure of how clear the lines of sight are from the roadway.

Vista – a view, particularly a long narrow view, as opposed to a panorama, which is a wide sweep.

Visual priority – an integrated priority level determined by visibility and contribution to corporate image or tourism potential.

Warm-season grass – grass species that grows best when temperatures are 80°– 90° F; include the majority of our native prairie and meadow species.

Wildflower – a term used to describe a plant wild or native to a place, but often misused as a generically desirable plant for a specific landscape application.

Wetland Mitigation – the use of wetland restoration to “offset” an unavoidable wetland disturbance (Harper-Lore, 1998).

Woody plant – plant that contains secondary xylem (wood); it has a permanent above ground structure whereas herbaceous plants die back to the ground seasonally.

Zone – component of the roadside.

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